McGill | Faculty of Engineering

USER GUIDE

LASER CUTTERS
VLS6.60 / PLS6.75

TABLE OF CONTENTS

WORKSHOP BASICS

ACCESS:

The laser cutters are available for use during regular architecture workshop hours. During rush periods, individuals are limited to 3 hours per week, and must reserve a spot on the calendar. Check with the technicians regarding availability.

LOCATION:

Macdonald- Harrington Building.
Room B14.

HOURS OF OPERATION:

Monday to Friday.
9:00 am - 12:30 pm
2:00 pm - 5:00 pm

RESERVATIONS:

During off peak periods the laser room is available on a first-come first-serve basis. To reserve a spot during peak times, check with the workshop technician regarding availability and reserving a place.

PRICING:

Access to the laser cutters and any use of course specific software programs are incorporated into your undergraduate tuition fees. Access to these services are available using your EMF lab account log-in credentials. Alternately, students can also download the printer driver software on their personal laptops. Click the link above and download the *UCP Installer.* *S*elect drivers for VLS 6.06 and/or PLS4.75.

MATERIALS

The architecture workshop sells various precut materials to fit the laser table bed. Precut plywood, mdf and acrylic sheets are available for purchase. All other materials can be found at your local art supply store or hardware store.

OUR LASER CUTTERS

UNIVERSAL LAYER SYSTEMS (ULS)

ULS machines are designed to operate like a printer. It allows you to print from any windows based graphic software program.

There are two modes: *raster mode* or *vector mode*. *Raster mode* is generally used for engraving images. Vector mode is used to cut or mark into the material. Our laser cutters can print in either raster, vector or combined modes.

VLS 6.06 (RED / GREEN CUTTERS)

TABLE BED LAYOUT SIZE:

32" X 18"

812 mm x 457 mm

PLS 4.75 (BLUE)

TABLE BED LAYOUT SIZE:

24"X 18"

609 mm x 457 mm

SETTING UP YOUR CAD FILE (RHINO)

RHINO

The geometry you create in rhino will ultimately control the motion of the laser that will cut or engrave through the material to make your part. You can directly control the laser through the *universal control panel software (UCP)* using rhino's *print functions.*

FILE PREPARATION:

All geometry must be drawn on the ground plane (rhino's XY plane), nothing floating in space. You will be working in the TOP viewport. Select your geometry and use *'Project-ToCPlane' (this command will not work with any geometry that is on a slope.*) Make sure there are *no duplicate lines* that are stacked on top of each other, click command 'SelDup' then delete.

OPENING YOUR FILE ON OUR COMPUTER STATIONS

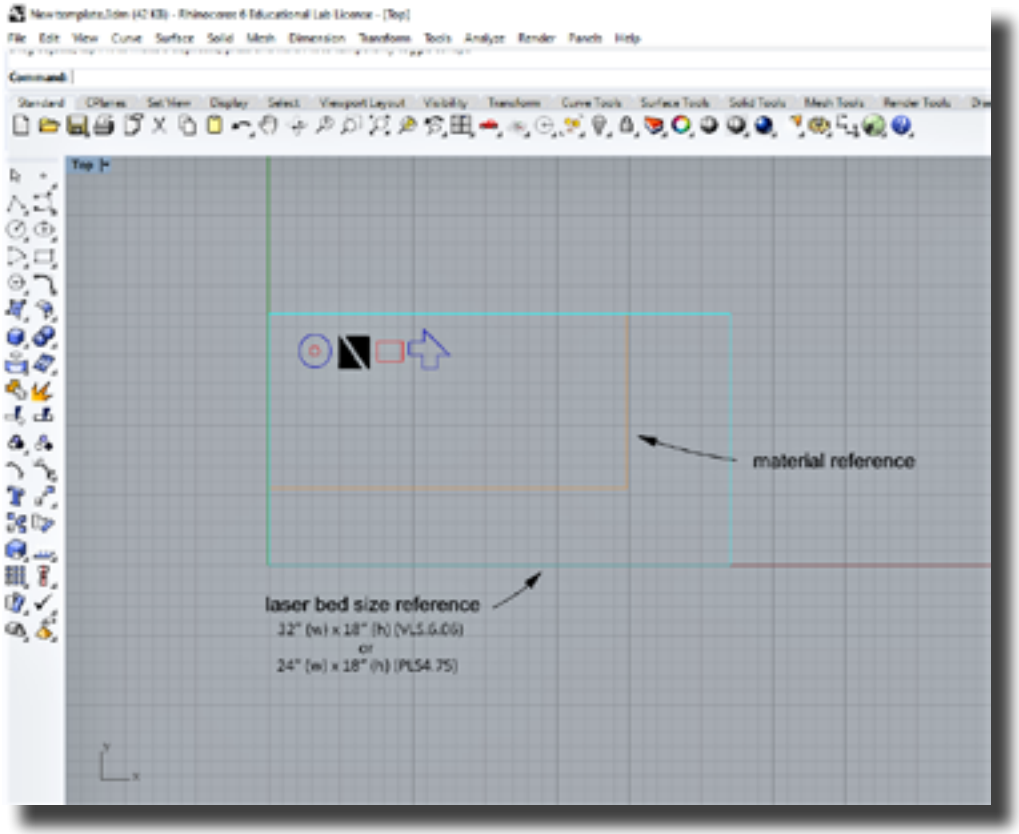
Login using your EMF account credentials.
If you're using the latest Rhino7 version, you must save your file in a Rhino 6 format. Under the *'save-as'* tab click *version 6* and save as a *3dm file.*

STANDARD LAYOUT AREA:

All files must be setup with a standard layout based on the size of the laser work table. Once your geometry is ready, create a boundary box the size of laser cutter bed.

Bed sizes:
VLS 6.06 32" x 18" (812 mm x 457 mm)
PLS 4.75 24" x 18" (609.6 mm x 457 mm)

Note: If using a full sheet, the affected working area will be smaller. The laser cutter margins are approximately 1/4" (6 mm) on every side. You can also create a material reference box based on dimensions of your material, this will allow you to reuse the rest of your material and reduce waste.



SETUP LAYERS

Placing your geometry on different layers will allow you to easily configure separate processing settings for each form. The laser operates by recognizing assigned *RGB* colours, that will then allow you to control various: POWER, SPEED and PPI (pulses per inch) % settings.
(More on this here)

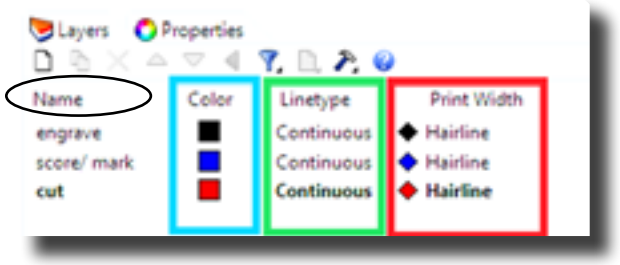
You can create up to 8 layers with different colour settings but generally, you will only use a few layers: *'cutting', scoring/marking' and 'engraving'*

Engrave (Black): For engraving a solid fill, use the *'hatch'* command in rhino.

Score/mark (Blue): Does not cut all the way through but lightly scores/ marks the surface.

Cut (Red): Cuts through the material

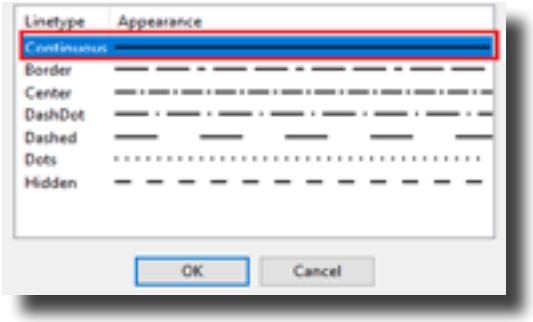
The **colour, linetype** and **print width** must be set up as below**.**



SET LAYER LINETYPE

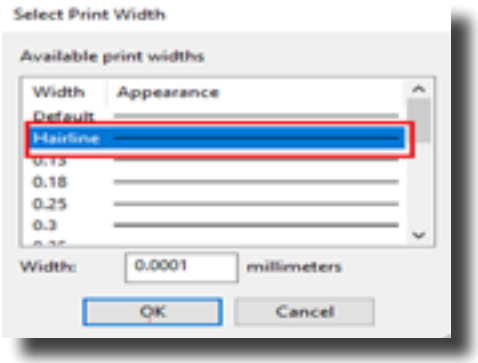
All lines and curve thickness must be set to .001 (.0254 mm) or less, or it will be treated as a raster file.

Double-click on the '*linetype'* and set to '*continuous'*.



SET LAYER PRINT WIDTH

Double-click on print width and set to '*hairline'.*



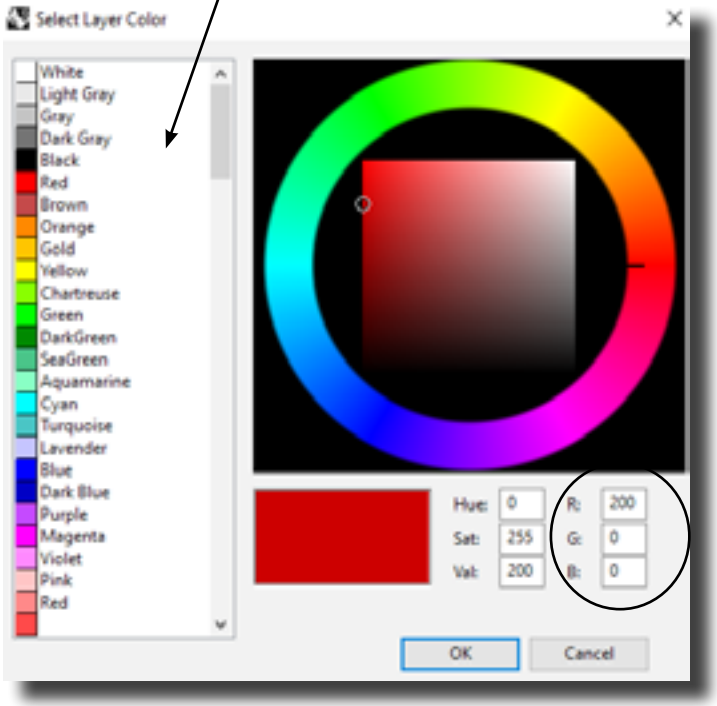
SET LAYER COLOUR

The cutter cuts in order of;
Black (0,0,0) Red (255,0,0),
Green (0,255,0), Yellow (255,255,0),
Blue (0,0,255), Magenta (255,0,255),
Cyan (0,255,255), Orange (255,127,0).

You can enable 'skip' command if the colour doesn't apply to your project

(more on navigating the laser software found here).

Make sure you are selecting from the colour panel on the left of the colour box.



SENDING YOUR FILE TO THE LASER CUTTER

PRINTING FROM RHINO

From the TOP viewport in Rhino, enter the '*print'* command, or click on file print *(CTRL + P)*. You will find the Print Setup Dialog appear.

Select *VLS6.60/75 (or PLS4.75)*

The *'properties'* tab will take you to the laser setting software, the printer driver interface.

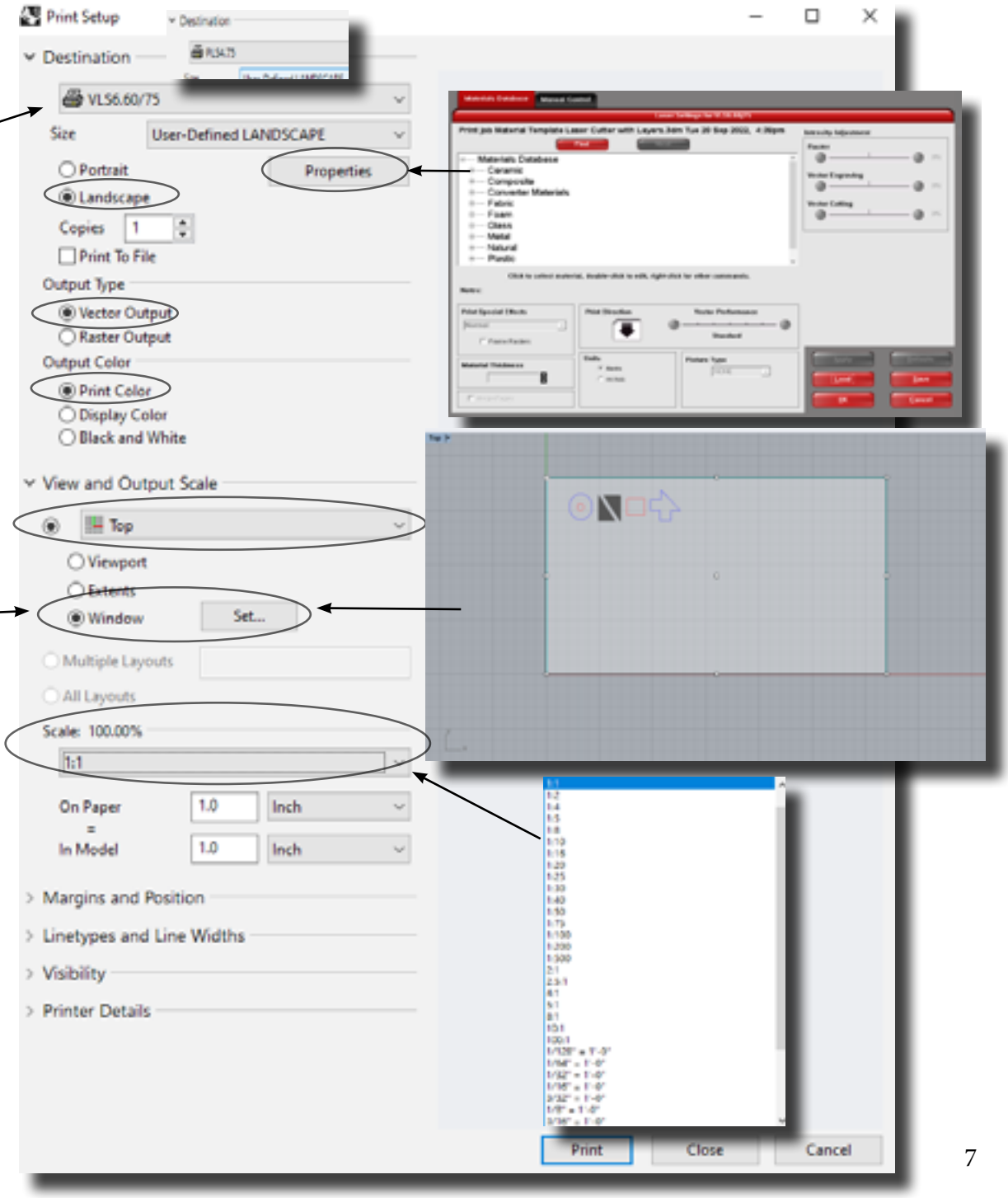
Make sure your print settings match the tabs circled in the image.

SET WINDOW

Rhino will allow you to set a window (boundary box) to the size of your work. Simply click on the *'window'* and *'set'* tab, and a rectangular boundary box will appear. This will allow you to create a print reference box that can be placed over your geometry and the laser bed reference outline, allowing you to easily setup your print dimensions.

SET SCALE

Scale option will allow you to choose various scale drawing representations.



FINISHING

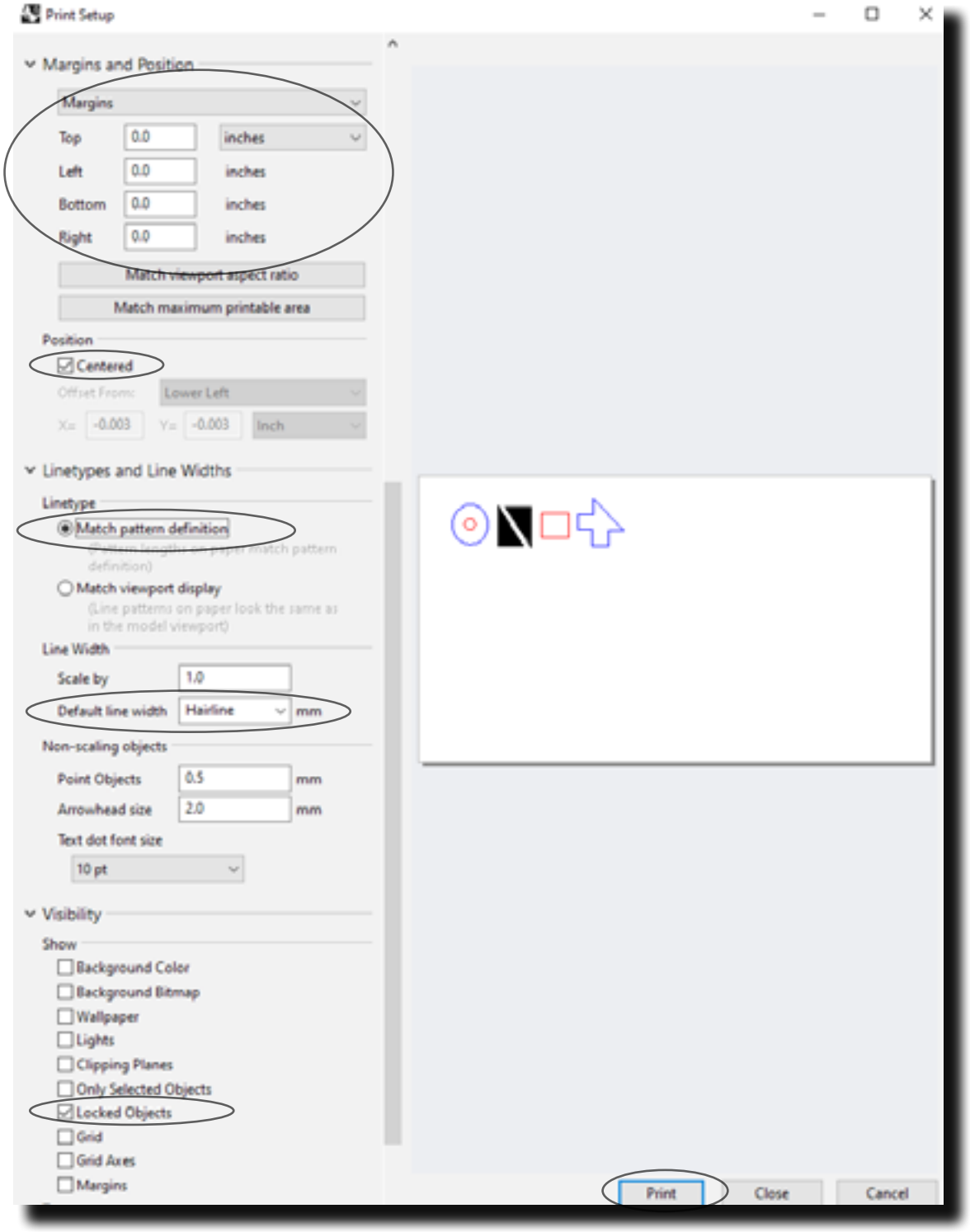
Once all your settings are calibrated in the print setup dialogue box you will need to return to the top section, and click on the *'properties' tab.*

The universal control panel (UPC) will open, this is where you will be able to adjust the laser cutter settings.

Follow the instructions in section:
'How to Set the Printer Driver Settings'

PRINT

Once all your settings are calibrated in the printer driver software, click *'print'* and the job will be sent to the printer job queue.



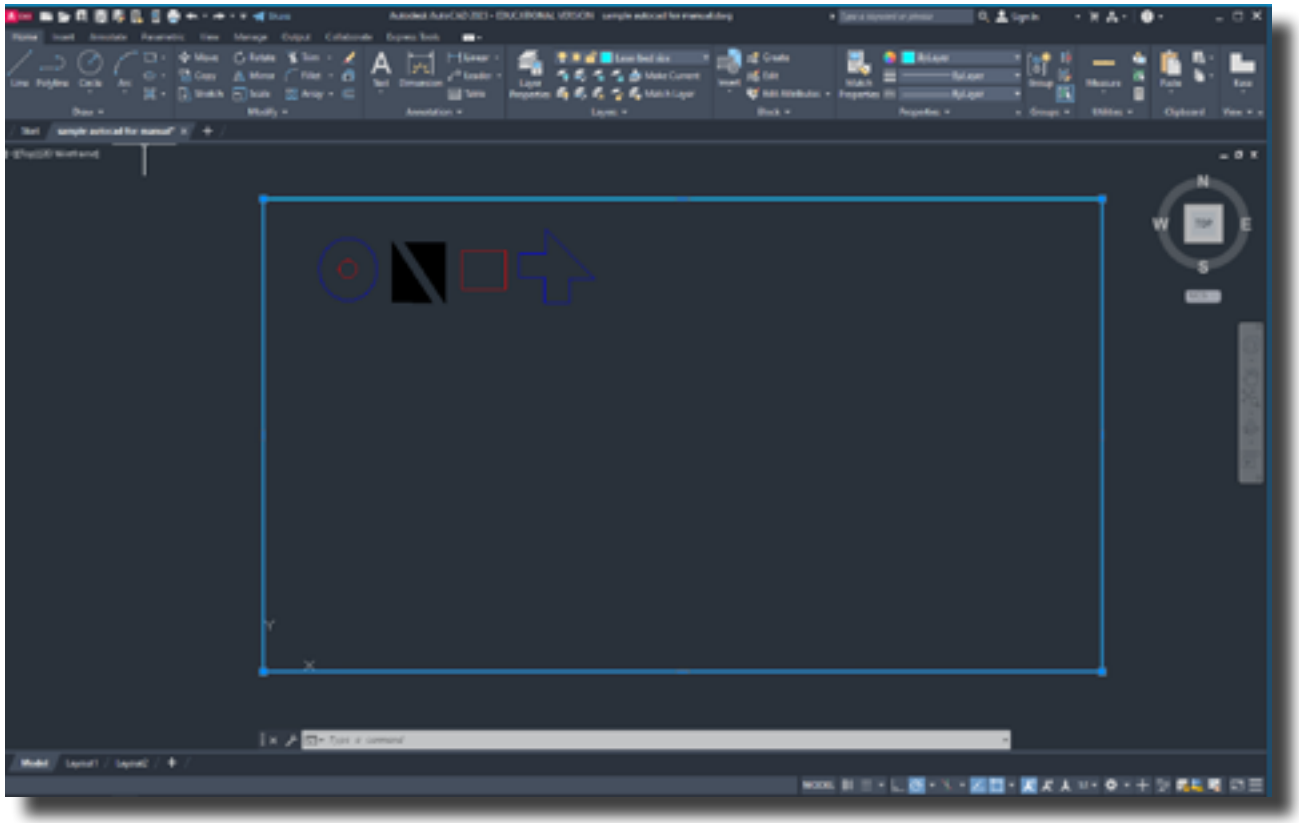
SETTING UP YOUR CAD FILE (AUTOCAD)

OPEN THE FILE

Open your AutoCAD file (.dwg or .dxf).

FILE PREPARATION:

All geometry must be flat. Select your geometry and type *'flatten'* and press *'enter'*. This will eliminate all elevation information from your drawing. Make sure there are no duplicate or overlapping lines stacked on top of each other. Type command *'overkill'* to help cleanup your linework in your drawing.



STANDARD LAYOUT AREA:

All files must be setup with a standard layout based on the size of the laser work table. Once your geometry is ready, create a boundary box the size of the laser cutter bed. This will depend on the laser cutter that you will be using.

Bed sizes:

VLS 6.06 32" x 18" (812 mm x 457 mm)

PLS 4.75 24" x 18" (609.6 mm x 457 mm)

Note: If using a full sheet, the affected working area will be smaller. The laser cutter margins are approximately 1/4"(6 mm) on every side. You can also create a material reference box based on dimensions of your material, this will allow you to reuse the rest of your material and reduce waste.

SETUP LAYERS

Placing your geometry on different layers will allow you to easily configure separate processing settings for each form. The laser operates by recognizing assigned *RGB* colours, that will then allow you to control various: POWER, SPEED and PPI (pulses per inch) % settings.

(More on this here)

You can create up to 8 layers with different colour settings but generally, you will only use a few layers: *'cutting', scoring/ marking' and 'engraving'*

Engrave (**Black**): For engraving a solid fill, use the *'hatch creation tabs'* in autocad.

Score/mark (Blue): Does not cut all the way through but lightly scores/ marks the surface.

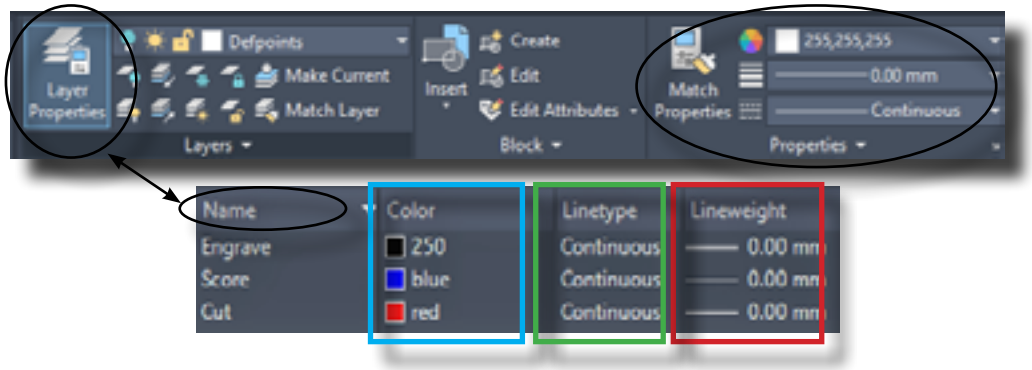
Cut (Red): Cuts through the material

SET LAYER PROPERTIES

These settings can be changed from the *'layer properties'* or from *'match properties'*. It's best to name and organize your layer in order of the sequence you would like the laser cutter to perform leaving the 'cut' layer for last.

LINETYPE & LINEWEIGHT

All lines and curve thickness must be set to 0.00 mm. Double-click on the *'linetype'* and set to '*continuous'*.



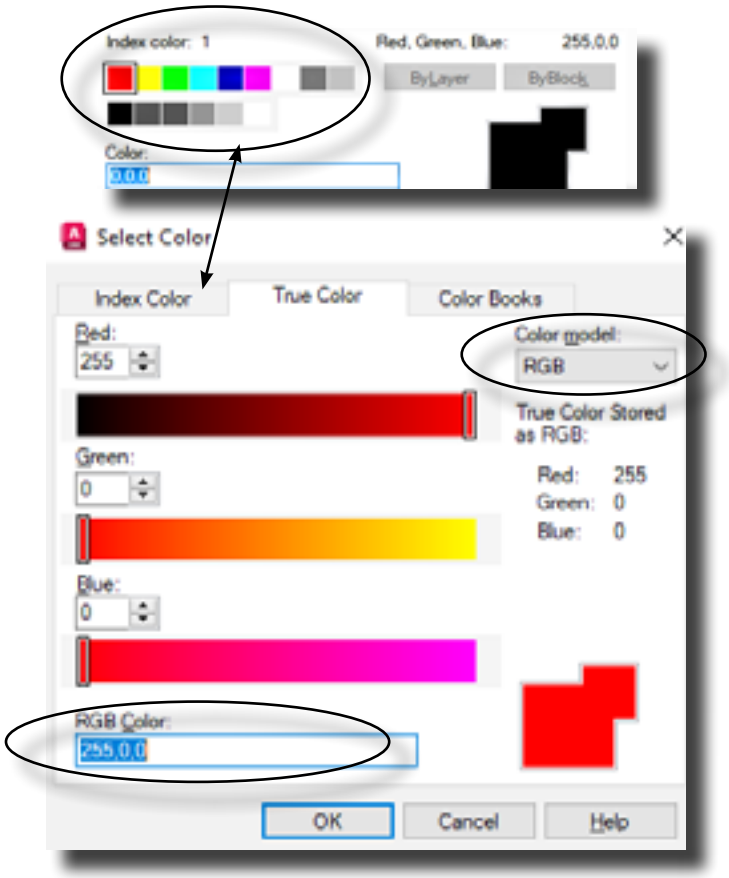
SET LAYER COLOUR

The cutter cuts in order of;
Black (0,0,0) Red (255,0,0),
Green (0,255,0), Yellow (255,255,0),
Blue (0,0,255), Magenta (255,0,255),
Cyan (0,255,255), Orange (255,127,0).

You can enable *'skip'* command if the colour doesn't apply to your project.

(More on navigating the laser software found here).

Double-click on the *'select color'* tab and use the colour settings found in *'True Color'*, select '*Color model' -'RGB'*, alternatively use the *'Index Color'* tab and select from the RGB color swatches.



SENDING YOUR FILE TO THE LASER CUTTER (AUTOCAD)

PRINTING FROM AUTOCAD

Under *'file'*, click on *'print'* then *'plot'*, or in the command search bar type *'plot'*. A *'batch plot'* screen will appear, click on *'continue'* to plot a single sheet".

From the page setup click on the *'name'* drop-down menu and choose *'VLS 6.06'* or *'PLS4.75'*, depending on the laser cutter you will be using.

The default printer settings will match the printer dimensions.

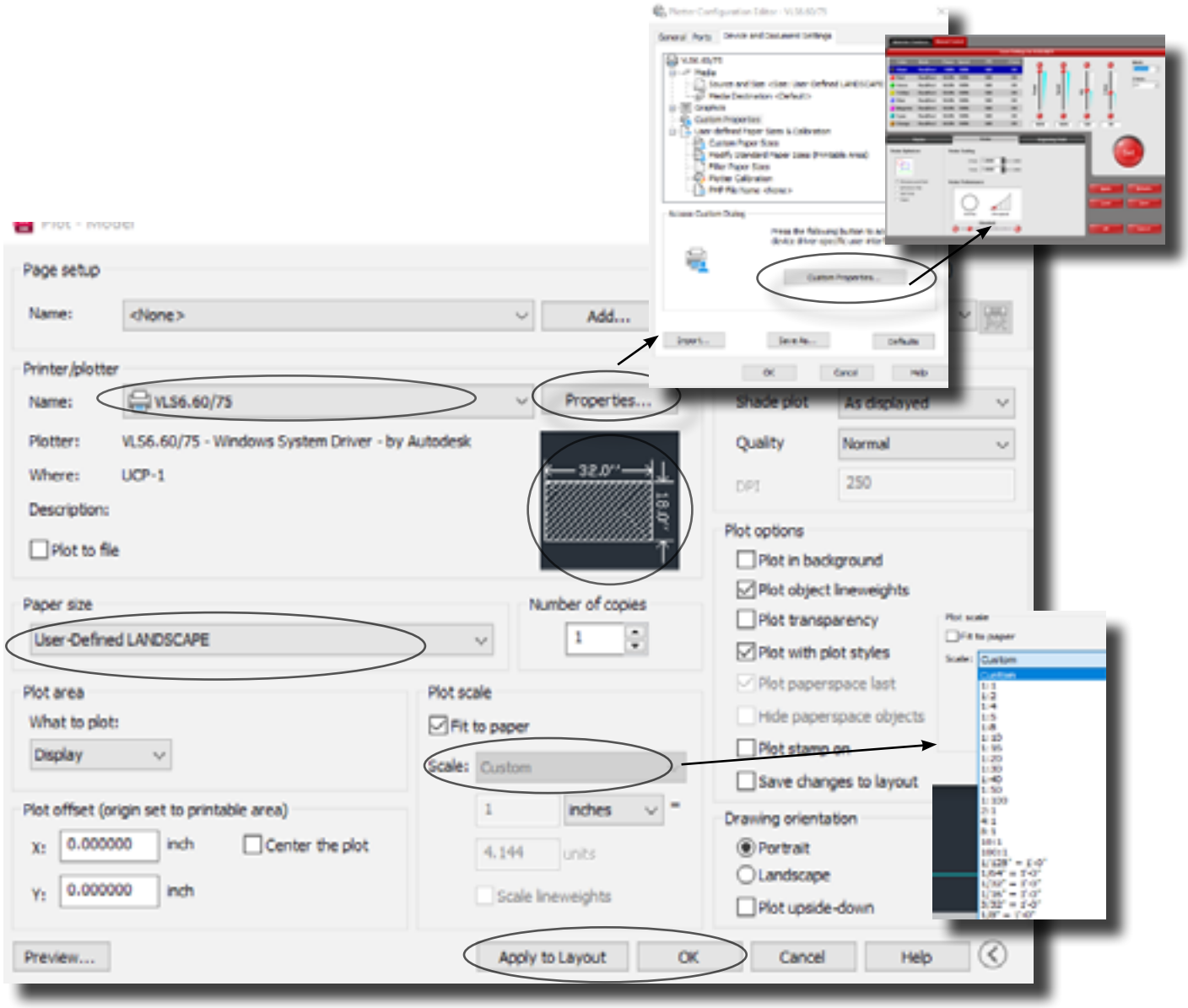
SELECT PROPERTIES

Click on the '*properties' tab* and a *'configuration editor'* will appear. Select '*custom properties*', this will take you to the laser setting software, the printer driver Interface.

Make sure your print settings match the tabs circled in the image.

SET SCALE

Scale option will allow you to choose various scale drawing representations. De-select *'fit to scale'* and choose your scale from the pop-up menu.



PRINT

Once all your settings are calibrated in both the page setup and print driver software, click *'ok'* or *'apply to layout'*.
The job will be sent to the printer job queue.

HOW TO SET THE LASER SETTINGS

COLOR TABLE/ JOB SETTINGS

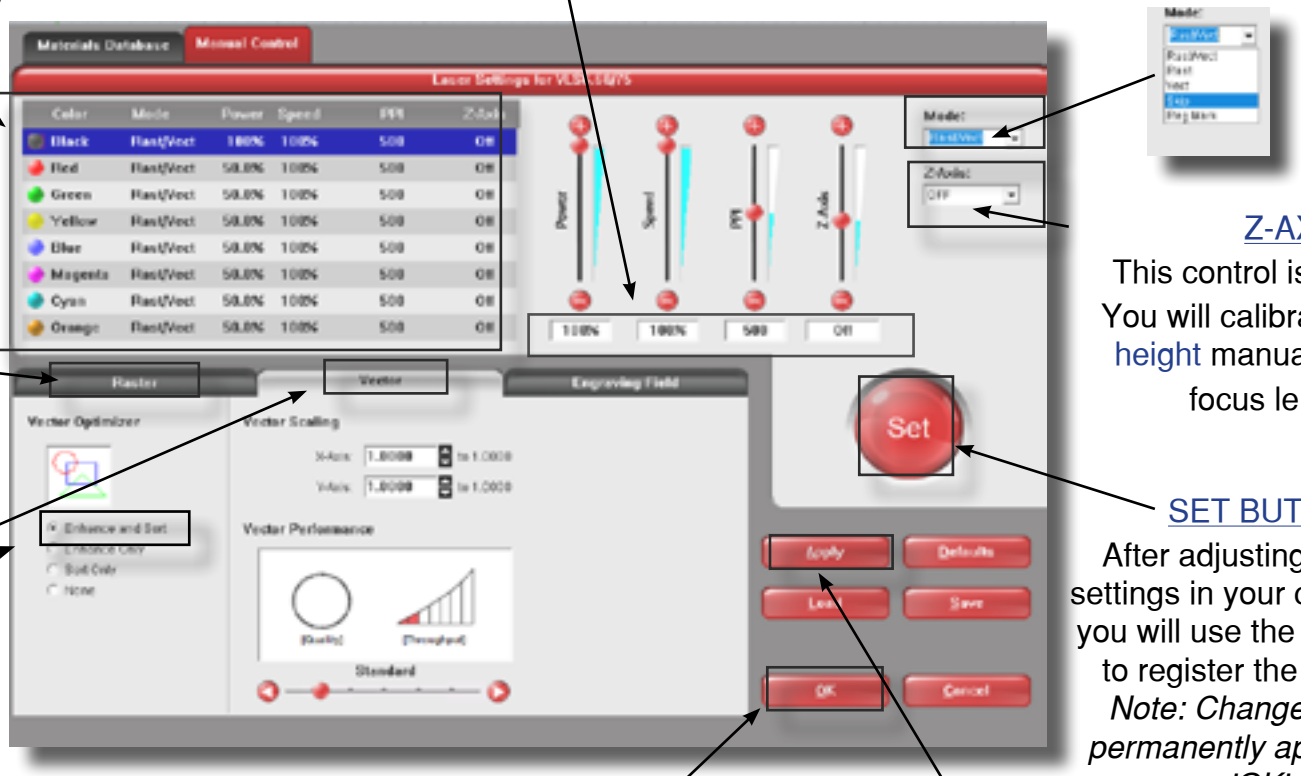
This tab contains a list of the job settings for each assigned colour. Select the colour so that it's highlighted, then use the controls on the right of the table to set the desired settings. You can also change the order layer by highlighting and moving the colour line above or below.

SET POWER,SPEED & PPI %

These settings allow your to select the laser power level, the processing speed and the laser pulse frequency per inch (PPI).

MODE (DROP DOWN MENU)

Mode menu allows you to pick a specific setting: *'Rast/ Vect'*, *'Vector'*, *'Raster'* and *'Skip'*. *'Rast/Vect'* is the default setting. *'Skip'* is used to ignore a specific color element.



RASTER SUB-TAB

The *'raster'* sub-tab displays group of settings which affect how raster images are processed.

Z-AXIS

This control is set to OFF. You will calibrate the Z-axis height manually using the focus lens tool.

VECTOR SUB-TAB

The '*vector'* sub-tab displays group of settings which affect how vector objects are processed. You will generally use this tab unless you are working with raster files. Select the enhance and sort tab.

SET BUTTON

After adjusting all of the settings in your colour table, you will use the *'Set'* button to register the changes. *Note: Changes are not permanently applied untill you press 'OK' or 'APPLY'.*

OK BUTTON

'Ok' allow you to save all changes and will closes the printer driver interface. It will take you back to the previous print dialogue window.

APPLY BUTTON

Allows you to permanently apply changes and saves your recent settings.

POWER, SPEED & PPI

POWER % SETTING

The power setting is set by a percentage between 0% (min) and 100 %(max). It describes the output power of the laser. *Power and speed work together to determine how deep or shallow the cut or engraving will be.* This will be dependent on the material you use and what you want to do. A good tip is *the higher the power % the deeper the cut or engravin*g, and vice versa. *The lower power % the more shallower the cut or engraving.* Too much or little power will affect the detail and has no influence with the job run time.

SPEED % SETTING

The speed laser settings describes the movement of the laser head. Fast speeds lead to short exposure times, and slow speeds lead to long exposure times. This setting is dependent on the size, intricacy and placement of your work. *Power and speed work together to determine how deep or shallow the cut or engraving will be*. *The higher power % combine with the lower speed % will produce deeper results.* The same is true for *lower power % and higher speeds %, this will produce shallow results*.

PPI SETTING

The PPI setting (pulses per inch) determines how many laser pulses per inch are used. This setting allows you to select the pulse frequency of the laser being applied to the material. *Low PPI setting means the pulses are not as frequent. A higher PPI means the pulses are more frequent.* This setting affects different materials in different ways.

Higher PPI settings may cause more melting, burning or charring on the edges when cutting regardless of the speed settings. It will produces finer details if speed is not too fast, and has no effect on job run time.

Lower PPI may reduce this effect melting, burning or charring but may also leave a serrated edge. Lower speed reduces image detail if set too low, it has no effect on the job run time. Both high and low setting has very little effect on depth. A PPI setting of 300-500 is a good value range for most material (1000 for plastics) but experimentation is need.

POWER, SPEED & PPI CHART

THESE SETTINGS ARE GUIDELINES ONLY.
ALWAYS TEST THE POWER AND SPEED SETTINGS EVERY TIME YOU LASER CUT.

	1 mm (3/64")		1.5 mm (1/16")		2.38 mm (3 /32")		3 mm (1/8")		4.5 mm (11/64")		6.4 mm (1/4")	
	Cut	Score	Cut	Score	Cut	Score	Cut	Score	Cut	Score	Cut	Score
Acrylic / Plexi	—	—	Power 100% Speed 3% PPI 1000	Power 2% Speed 4% PPI 1000	—	—	Power 100% Speed 2.5% PPI 1000	Power 2% Speed 4% PPI 1000	Power 100% Speed 1.5% PPI 1000	Power 2% Speed 4% PPI 1000	Power 2% Speed 4% PPI 1000	Power 2% Speed 4% PPI 1000
MDF		—	—	—	—	—	Power 80% Speed 2.5% PPI 250	Power 10% Speed 10% PPI 500	—	—	—	—
PLYWOOD	—	—	—	—	—	—	Power 80% Speed 2.5% PPI 250	Power 10% Speed 10% PPI 500	—	—	—	—
PETG	Power 70% Speed 5% PPI 1000	Power 2% Speed 4% PPI 1000	—	—	—	—	—	—	—	—	—	—
MATBOARD	—	—	Power 80% Speed 2% PPI 250	Power 11% Speed 4% PPI 250	—	—	—	—	—	—	—	—
CHIPBOARD	Power 60% Speed 4% PPI 250	Power 11% Speed 4% PPI 250	Power 70% Speed 3% PPI 250	Power 11% Speed 4% PPI 250	Power 80% Speed 2% PPI 250	Power 11% Speed 4% PPI 250	—	—	—	—	—	—
VANEER	Power 40% Speed 5% PPI 250	Power 5% Speed 10% PPI 500	—	—	—	—	—	—	—	—	—	—

KNOW YOUR MATERIALS!

HAZARDOUS MATERIALS

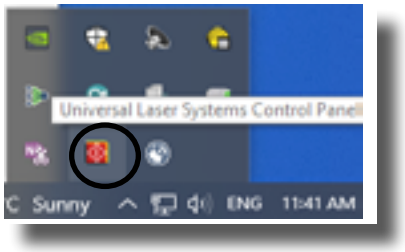
The laser cutter can cut, etch, and engrave through many materials, but there are some that are dangerous to our health and safety. Material knowledge is key to being safe! The chart below lists materials that are forbidden to use. If you have any doubt, ask!

MATERIAL	DANGER	CAUSES / CONSEQUENCES
PVC (Poly Vinyl Chloride) vinyl, pleather, artificial leather	Releases toxic hydrogen chloride which is very corrosive.	Emits harmful that will damage destroy the laser machine and is harmful to our health. **DO NOT USE.**
ABS	Emits cyanide gas and tends to melt.	ABS does not cut well in a laser cutter. It tends to melt rather than vaporize, and has a higher chance of catching on fire and leaving behind melted gooey deposits on the vector cutting grid. It also does not engrave well (tends to melt). Cutting ABS plastic emits hydrogen cyanide, which is unsafe at any concentration.
HDPE (High-density polyethylene)	Highly Flammable.	Highly Flammable. **DO NOT USE.**
Polystyrene Foam	Emits styrene gas and mix of toxicants that are hazards.	It catches fire quickly, burns rapidly, it melts, and only thin pieces cut. This is the #1 material that causes laser fires! **DO NOT USE.**
Polypropylene Foam	Highly Flammable.	Like polystyrene, it melts, catches fire, and the melted drops continue to burn and turn into rock-hard drips and pebbles.
Fiberglass	Emits fumes that are very harmful.	It's a mix of two materials that cant' be cut. Glass (etch, no cut) and epoxy resin (fumes)
Coated Carbon Fiber	Emits noxious fumes	A mix of two materials. Thin carbon fiber mat can be cut, with some fraying - but not when coated.
Epoxy	Burn / smoke	Epoxy is an aliphatic resin. A CO2 laser can't cut it and it creates toxic fumes. Items coated in Epoxy, or cast Epoxy resins must not be used in the laser cutter.
Polycarbonate / Lexan (ENGRAVE ONLY)	Cuts very poorly, discolors, catches fire	Polycarbonate (Lexan) is often found as flat, sheet material. Polycarbonate strongly absorbs infrared radiation it is very ineffective at cutting.

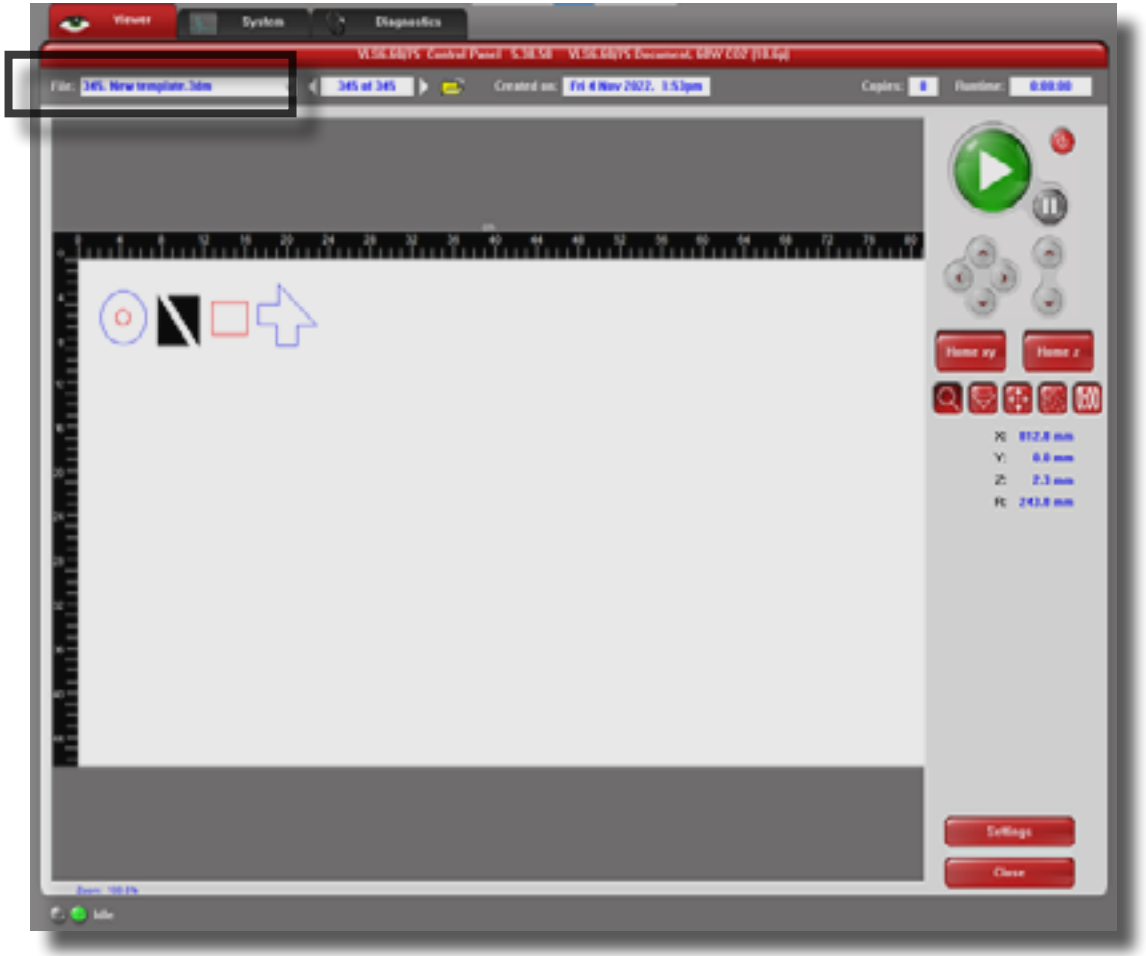
NAVIGATING THE LASER CONTROL PANEL (UCP)

SELECT PRINT & OPEN THE LASER CONTROLLER PANEL

After adjusting the print job settings in both the CAD program and on the printer driver interface, you will click *'print'* and open the UPC software icon found on your desktop.



The UPC interface will open and your file will appear in the viewer tab. You can also select a *'file'* from the '*file menu' drop-down* bar. Selecting from the viewer tab will allow you to select any jobs waiting in the print queue.



NAVIGATING THE INTERFACE

POWER BUTTON

Turns on the laser.

GREEN START BUTTON

Starts job.

PAUSE BUTTON

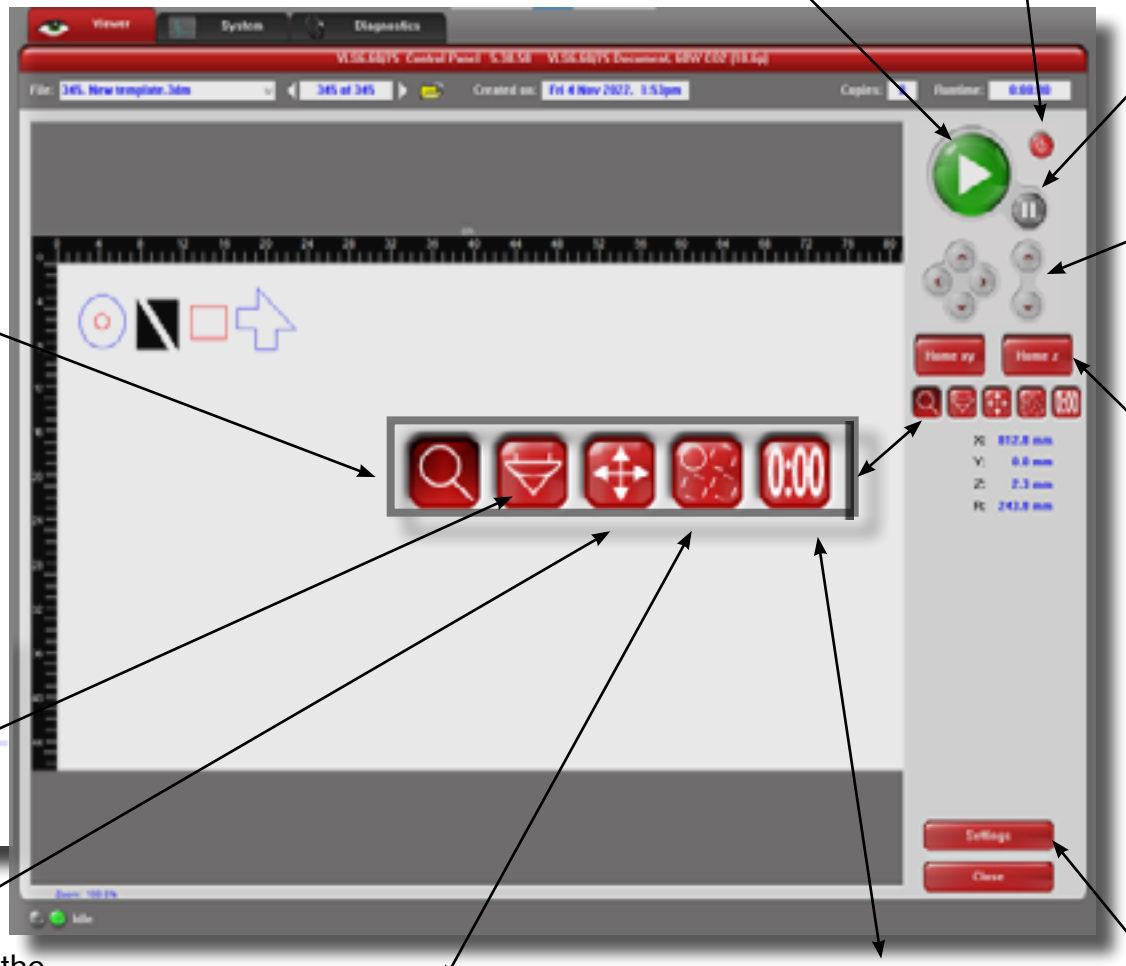
Stops/ pause the job.

ZOOM BUTTON

Magnify by zoom-in using the left-click and zoom-out using the right click.

NAVIGATION BUTTONS

The four arrows on the left allow you to manually move the laser carriage in the X & Y direction. The up & down arrows allow you to manually move in the Z direction.



FOCUS VIEW

Manually move the laser focus carriage to any desired location on the laser bed.

HOME X Y BUTTON

Allows you to re-home the laser focus carriage in the X & Y position (upper right hand corner).

HOME Z BUTTON

Allows you to re-home in the z axis position.

MOVE BUTTON

Move your image anywhere on the processing table. Select 1 of the 9 anchor points and drag/release to your desired location.

DUPLICATE BUTTON

Create duplicates by increasing the quantity in the x and y tab.

TIME ESTIMATION BUTTON

Click 'start' to determine the amount of time it will take to complete the job.

SETTINGS

Allows you to adjust the driver settings.

STARTING THE LASER (OPERATOR CHECKLIST)

Before pressing the *'START/PLAY'* button on the control panel, it is important to follow the steps below. The exhaust system (air blower) must be turned on while any activities is taking place in the room.

STEP 1:

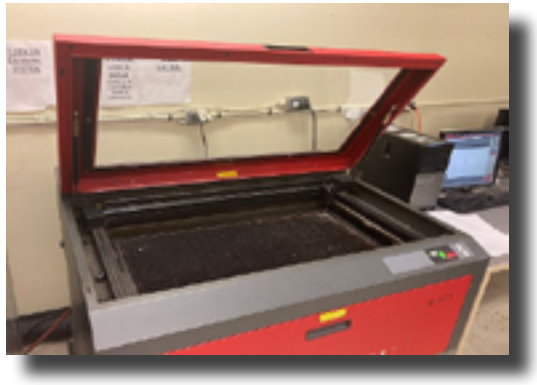
Turn 'ON' the fume extractor system. Each laser cutter has fume extractor attached to each machine. Simply press the power button located on the left side of the control panel, and a green light will indicate that the extractor is on.

STEP 2:

Turn 'ON' the air compressor that is located on the wall adjacent to the fume extractor. The handle should be parallel to the pipeline.

STEP 3:

Open the top door and position your material on the table bed. Ideally you are aligned at the top hand corner (either left or right). Press the 'ON' button on the laser keypad, or power on from the software. You must log-in from a computer and have the USB cable plugged in the laser and computer in order to operate the laser.



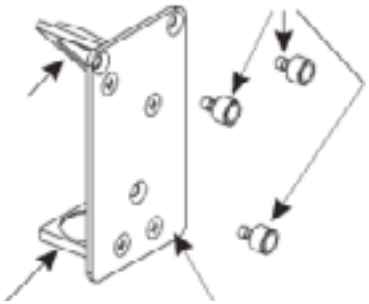
CLEANING THE LENS

It's important to check the lens prior to starting your job. Accumulation of dirt and debris will cause uneven, rough results, or position failure. Keep the lens clean.

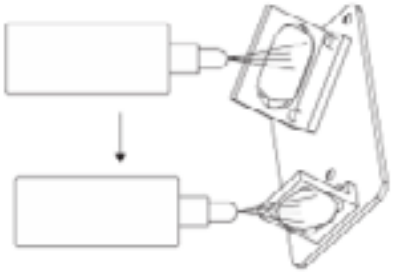
CAUTION: *Do not handle any surfaces with your fingers it can damage the optics, handle all housing by the edges.*

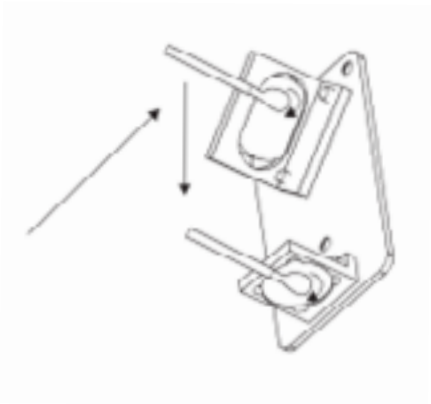
STEP 1: Turn 'OFF' the laser system and unplug it before performing any cleaning procedures.

STEP 2: On the front carriage, unscrew the 3 thumbscrews (no tool required) and put them in a safe place.



STEP 3: Clean both the mirror and lens. Be gentle! Solution and cotton swabs can be found beside the laser cutters. Tilt the front cover enough for you to apply the lens cleaning solution directly to the mirror and to the focus lens. If there is a lot of debris on the lens let the solution sit for a minute. Roll a fresh cotton swab across the mirror in one direction. Use a fresh swab for each pass. Be gentle and avoid scratching the surface. Repeat this procedure for the focus lens. Make sure you clean both sides of the lens.





STEP 4: Place the lens holder back into the carriage and fasten the 3 thumbscrews back into place.

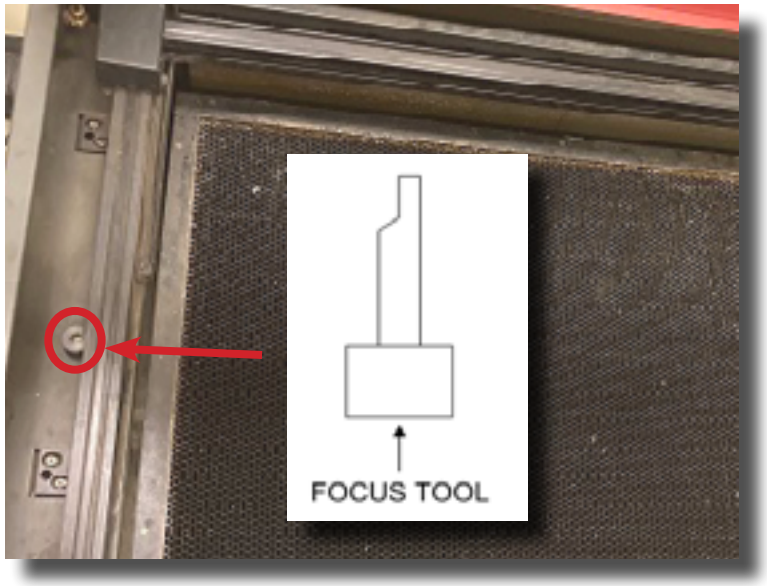
FOCUSING & SETTING THE Z-HEIGHT

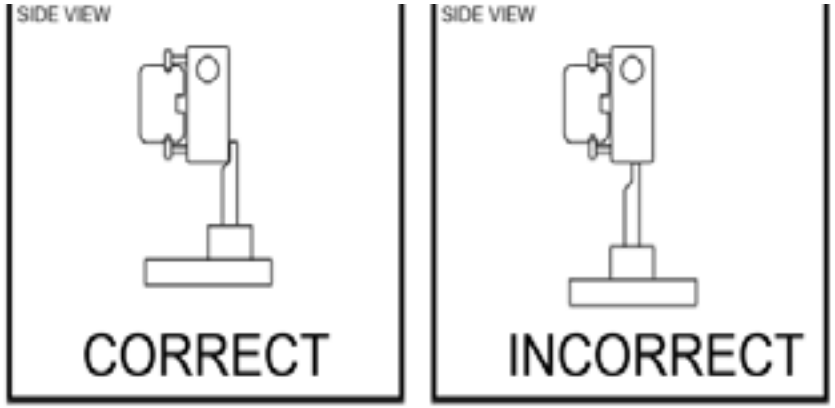
SETTING THE Z-HEIGHT

A properly adjusted z-height is key to having good results.

An incorrect z-height could cause a fire, not cut through your material and will give you overall all poor results. Make sure that you are properly focused.

Open the top door and take out the focus tool located in the slot on the left side of worktable. The wedge shaped notch on the focus tool will fit directly under the front face edge of the carriage (not on the sides).





Place the focus tool on your material and adjust the table bed by moving the z axis to the correct height. You will use the Z up & down buttons located on the laser keypad.

Once the focus is adjusted to the correct height you are ready to begin! Close the door and press *'START/PLAY'* on the UCP software.

FINISHING UP

Remove your material and clean up any debris around your workstation.
A good tip for removing cuts is to use masking tap over the cut pieces (especially small cuts) so they do not fall out as you are lifting out your sheet material.

Use the appropriate waste/recycling bins for to disposing your excess material.

Turn *'OFF'* the laser cutter and the fume extractor.
Log-out of the workstation and don't forget to take your USB key.

ASSISTANCE / TROUBLESHOOTING

If you have any questions or concerns contact the workshop technicians. Below you will find commonly asked issues and how to troubleshoot.

Problem	Possible Cause	Possible Solution
Laser not turning on.	Laser connection cables are not plugged in.	Check all plug connections and be sure the USB cable is plugged into the computer.
Job not sent to laser	Printer or paused spooling issues.	Try unplugging the USB cable from the computer, wait for 5 seconds and plug it back in. If problem persists delete and re-send the print job.
Print preview layout is incorrect.	Incorrect graphic design set-up.	Check your design file. Check the scale, page orientation, x/y offset, color and linewidth settings.
Image doesn't show up.	Incorrect graphic design set-up.	Check linewidth settings.
Not cutting through or burning.	Lens focus not set up properly, or incorrect power & speed settings.	Check the lens focus by making sure the z-height is set correctly to your material. Check the power and speed settings in the UCP software.
Laser repeatedly going back over the same lines & shapes.	Incorrect graphic design set-up.	Check duplicate lines. If no duplicates found zoom-in to verify.
Fuzzy looking engraving image or double image.	Dirty laser, or lens not properly focused.	Clean lens and re-focus the z-height. If problem still persists ask a technician for support.

END OF MANUAL.