

Laser Cutting

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Introductory Medical Device Prototyping

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Safety Notice

- ▶ You must complete safety instruction before using tools and equipment in the Medical Devices Center, ME Student Machine Shop and CSE Anderson Student Innovation Labs.
- ▶ All machinery can be dangerous. You must have a trained individual instruct you first when using unfamiliar equipment.
- ▶ Only authorized and trained individuals may operate CNC equipment – including the laser cutter.
- ▶ Always abide by shop safety instructions and never engage in horseplay.
- ▶ Remember to wear OSHA approved eye and ear protection in the shop, short sleeves, leather or steel toed shoes, and secure long hair, avoid loose clothing, and take off rings, watches and bracelets when using power equipment.
- ▶ These slides are part of the “Introductory Medical Device Prototyping” course at the University of Minnesota, and are not meant for any other purpose.

Eye Protection & First Aid



- Always wear OSHA approved eye protection in the shop.
- Familiarize yourself with the shop first aid kit, location of telephone, and emergency phone numbers.

Laser Cutting

- ▶ Laser Cutting
 - Equipment
 - Material Selection
 - Inserting Workpiece
 - Using CorelDraw and .DXF Files
 - Cutting, Raster Etching & Vector Etching
 - Focusing the Laser
 - Setting Preferences
 - Printing
 - Purchasing Stock Materials
- ▶ Further Instructional Links in Summary

Laser Cutters in Anderson Labs



Laser Cutter in the MDC



Suitable Materials to Cut

Material	Max thickness	Notes	WARNINGS!
Many woods	1/4"	Avoid oily/resinous woods	Be very careful about cutting oily woods, or very resinous woods as they also may catch fire.
Plywood/Composite woods	1/4"	These contain glue, and may not laser cut as well as solid wood.	
MDF/Engineered woods	1/4"	These are okay to use but may experience a higher amount of charring when cut.	
Paper, card stock	thin	Cuts very well on the laser cutter, and also very quickly.	
Cardboard, carton	thicker	Cuts well but may catch fire.	Watch for fire.
Cork	1/4"	Cuts nicely, but the quality of the cut depends on the thickness and quality of the cork. Engineered cork has a lot of glue in it, and may not cut as well.	Avoid thicker cork.
Acrylic/Lucite/Plexiglas/PMMA	1/2"	Cuts extremely well leaving a beautifully polished edge.	
Thin Polycarbonate Sheeting (<1mm)	<1mm	Very thin polycarbonate can be cut, but tends to discolor badly. Extremely thin sheets (0.5mm and less) may cut with yellowed/discolored edges. Polycarbonate absorbs IR strongly, and is a poor material to use in the laser cutter.	Watch for smoking/burning
Delrin (POM)	thin	Delrin comes in a number of shore strengths (hardness) and the harder Delrin tends to work better. Great for gears!	
Kapton tape (Polyimide)	1/16"	Works well, in thin sheets and strips like tape.	
Mylar	1/16"	Works well if it's thin. Thick mylar has a tendency to warp, bubble, and curl	Gold coated mylar will not work.

Always consult with the shop supervisor when using materials that you are unaccustomed to cutting.

Suitable Materials to Cut...

Solid Styrene	1/16"	Smokes a lot when cut, but can be cut.	Keep it thin.
Depron foam	1/4"	Used a lot for hobby, RC aircraft, architectural models, and toys. 1/4" cuts nicely, with a smooth edge.	Must be constantly monitored.
Gator foam		Foam core gets burned and eaten away compared to the top and bottom hard paper shell.	Not a fantastic thing to cut, but it can be cut if watched.
Cloth/felt/hemp/cotton		They all cut well. Our lasers can be used in lace-making.	Not plastic coated or impregnated cloth!
Leather/Suede	1/8"	Leather is very hard to cut, but can be if it's thinner than a belt (call it 1/8"). Our "Advanced" laser training class covers this.	Real leather only! Not 'pleather' or other imitations!
Magnetic Sheet		Cuts beautifully	
NON-CHLORINE-containing rubber		Fine for cutting.	Beware chlorine-containing rubber!
Teflon (PTFE)	thin	Cuts OK in thin sheets. See https://www.ulsinc.com/materials/teflon ; the issues listed in https://en.wikipedia.org/wiki/Polymer_fume_fever should not matter because our lasers are fully vented and exhausted.	
Carbon fiber mats/weave that has not had epoxy applied		Can be cut, very slowly.	You must not cut carbon fiber that has been coated!!
Coroplast ('corrugated plastic')	1/4"	Difficult because of the vertical strips. Three passes at 80% power, 7% speed, and it will be slightly connected still at the bottom from the vertical strips.	

Always consult with the shop supervisor when using materials that you are unaccustomed to cutting.

Suitable Materials to Etch

Etching

All the above "cuttable" materials can be etched, in some cases very deeply.

In addition, you can etch:

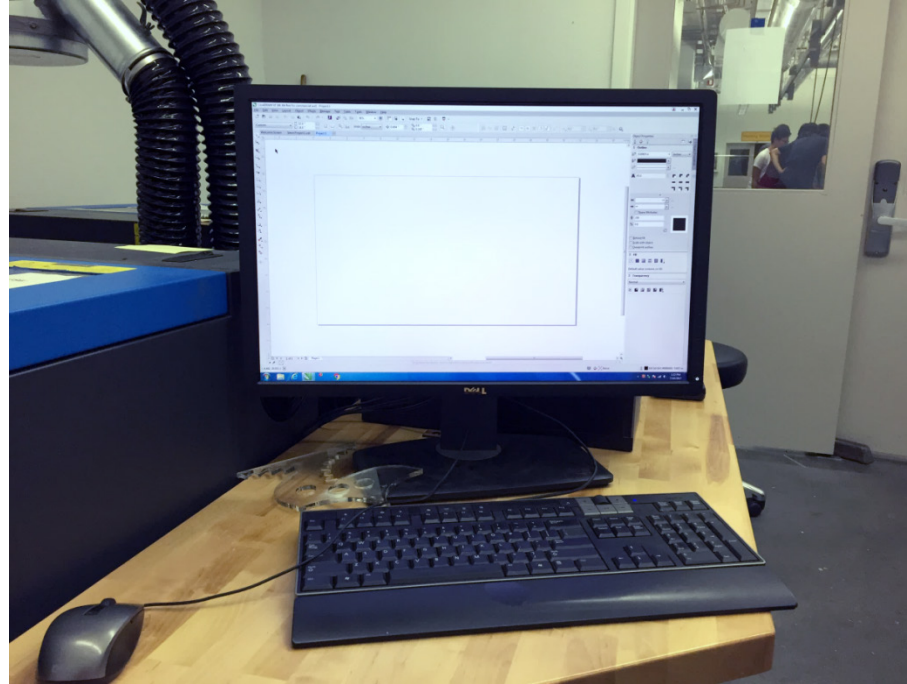
Material	Notes	WARNINGS!
Glass	Green seems to work best...looks sandblasted.	Only FLAT GLASS can be engraved in our cutter. No round or cylindrical items.
Ceramic tile		
Anodized aluminum	Vaporizes the anodization away.	
Painted/coated metals	Vaporizes the paint away.	
Stone, Marble, Granite, Soapstone, Onyx.	Gets a white "textured" look when etched.	100% power, 50% speed or less works well for etching.

Always consult with the shop supervisor when using materials that you are unaccustomed to etching.

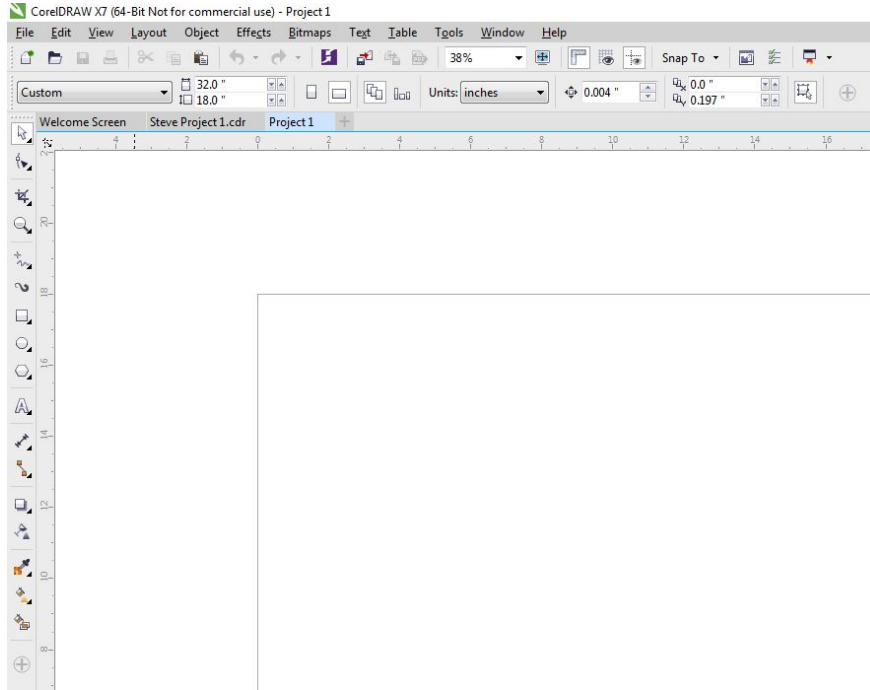
Turn on Vent



CorelDRAW

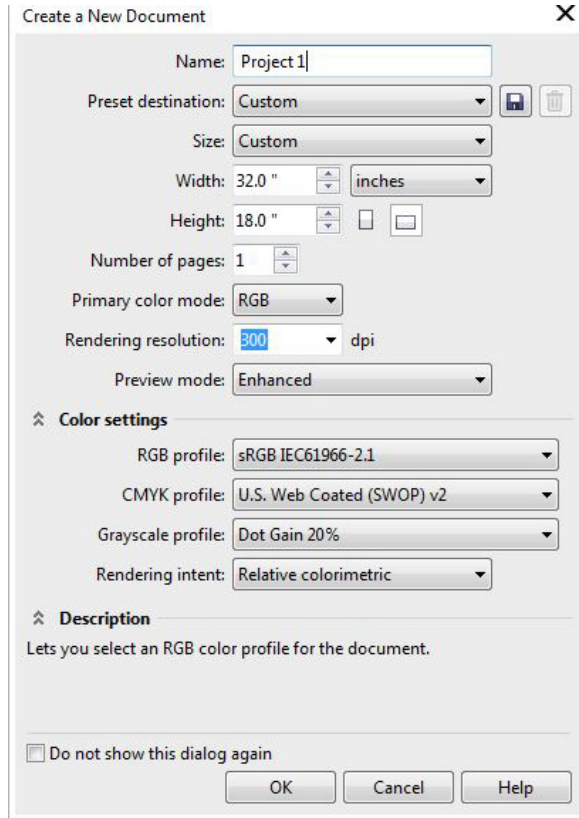


CorelDraw Workspace



You can import .DXF drawings from SolidWorks and other programs. Use unformatted, top views without extraneous elements (dimensions, comments, centerlines, crosshairs, axis, etc.)

New Document



Create a New Document

Name: Project 1

Preset destination: Custom

Size: Custom

Width: 32.0 " inches

Height: 18.0 "

Number of pages: 1

Primary color mode: RGB

Rendering resolution: 300 dpi

Preview mode: Enhanced

Color settings

RGB profile: sRGB IEC61966-2.1

CMYK profile: U.S. Web Coated (SWOP) v2

Grayscale profile: Dot Gain 20%

Rendering intent: Relative colorimetric

Description

Lets you select an RGB color profile for the document.

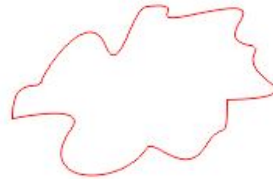
Do not show this dialog again

OK Cancel Help

- Title your project.
- It is best to keep the 32" x 18" laser cutter bed dimensions and other default settings.

Proceed with Drawing

BMEN 2151 Introductory Medical Device Prototyping



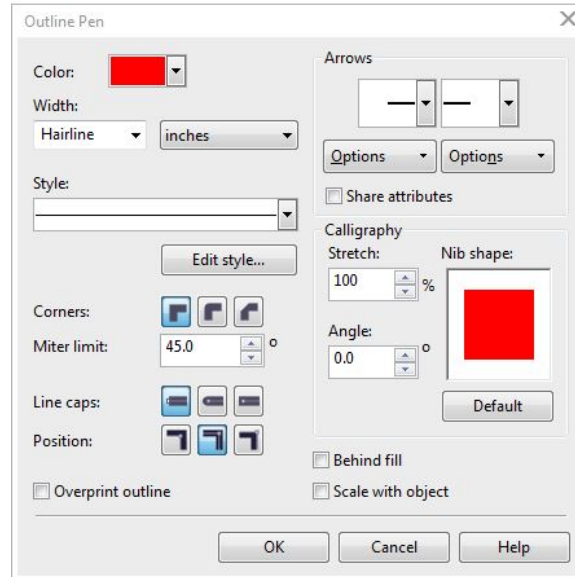
Raster
Engraving

Vector Engraving
No Fill

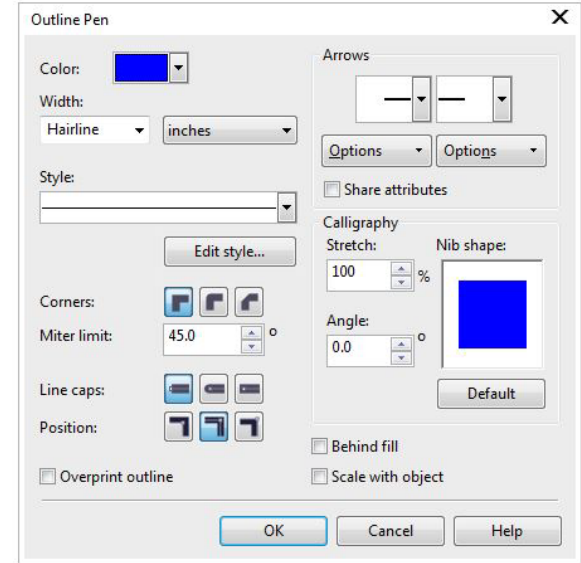
Prof. Steven S. Saliterman

- Using the tools in CorelDRAW you can create many shapes or use various fonts for cutting and etching.
- The color (pen) you select determines what operation is performed. **Red** is a thru-cut, **black** is a raster-scan engraving and **blue** is vector engraving.

Choose the Pen Color



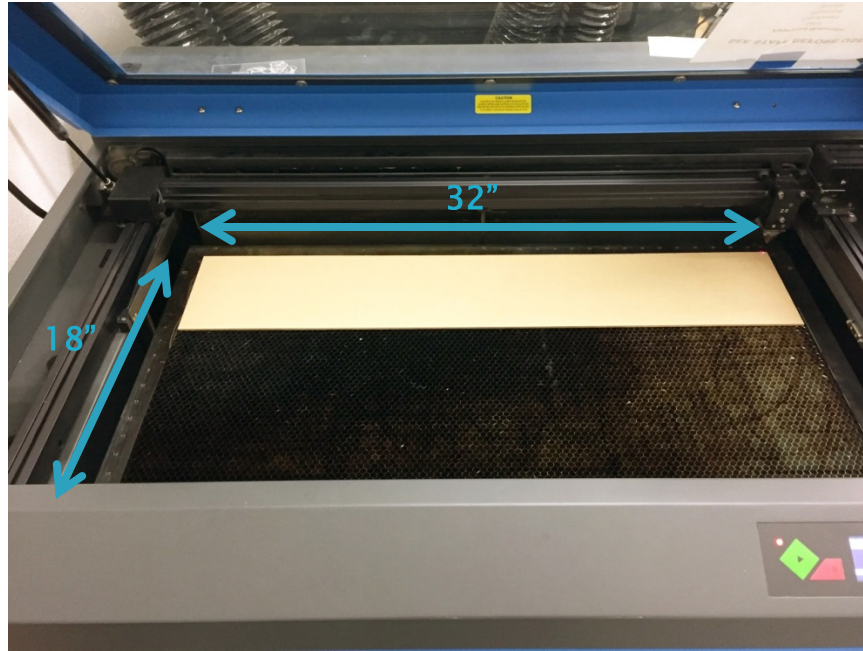
Cutting Operation



Vector Engraving Operation

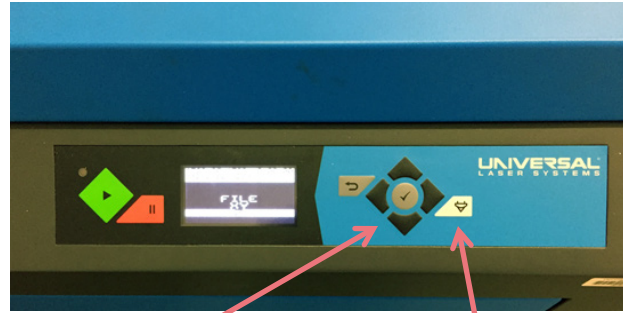
- Double click the pen icon in the lower right corner.
- The pen color determines the operation.
- Select “Hairline” for a thru-cut or Vector Engrave.

Place Your Material



- Place your material in the upper left corner.
- Note on the ruler the area you will be cutting.
- You can locate where to cut/engrave in the software.

Focusing Laser (Adjust Gap)



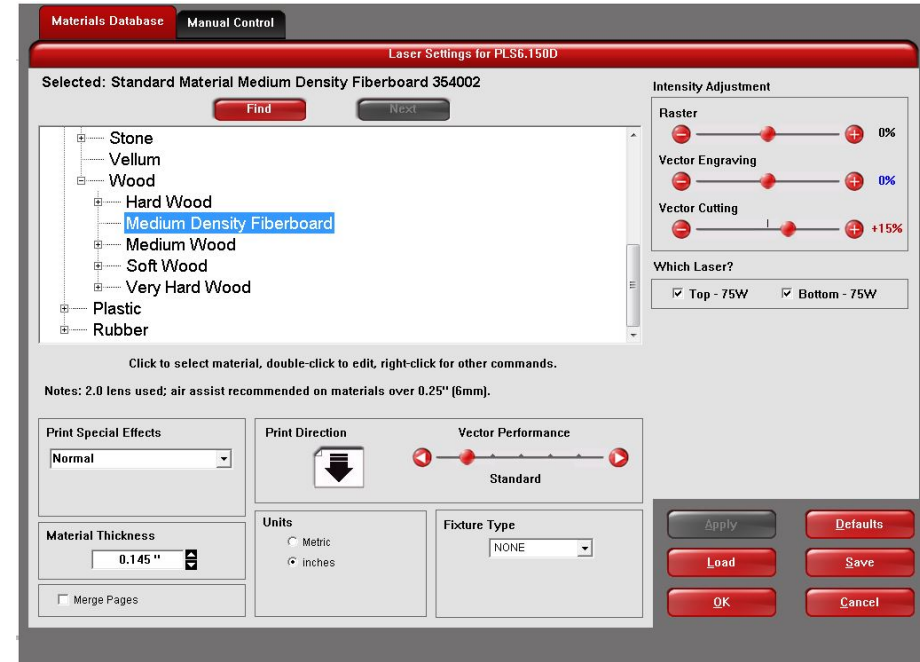
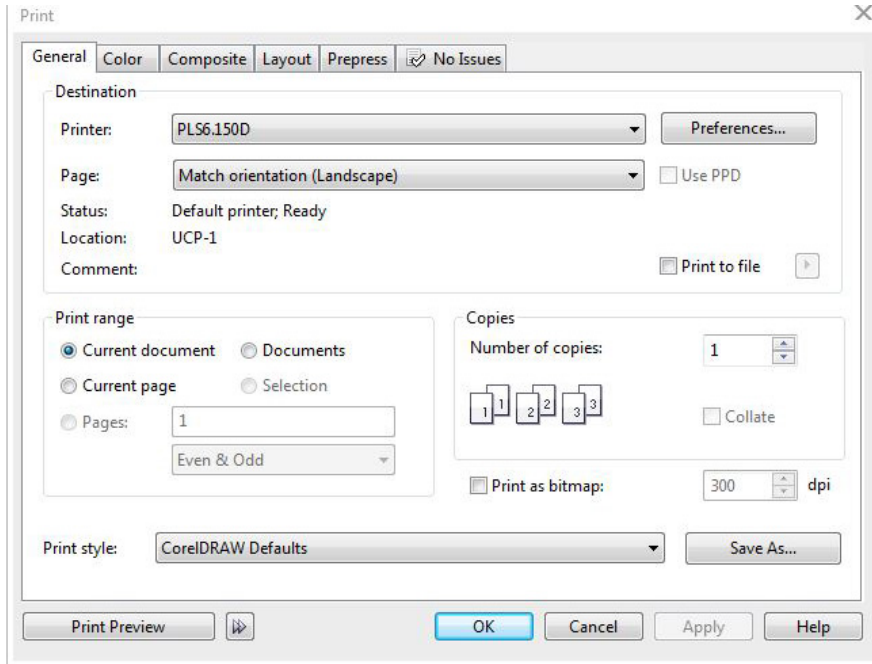
Z-jog control

Focus



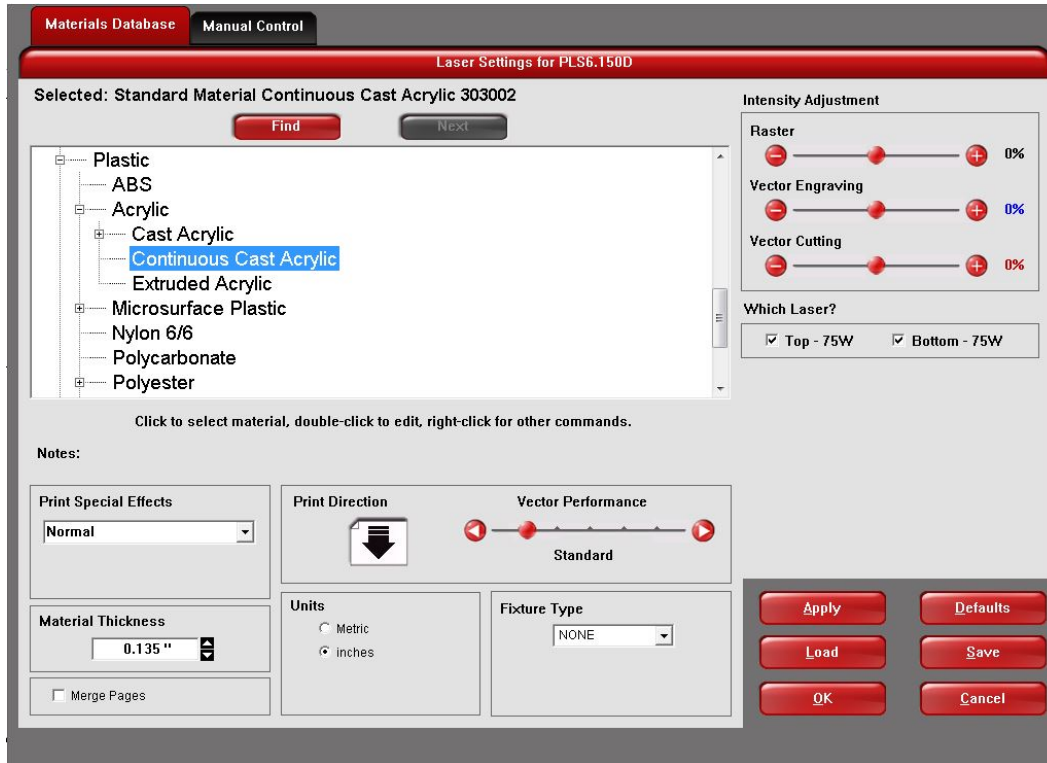
1. Jog the Z-axis so as to lower the bed, increasing the gap between the laser and bed.
2. Remove the gage from the left hand side, and align its small shelf with the bottom edge of the laser head. This defines the required gap.
3. Jog the Z-axis so that the gap narrows to a close fit. Gentle lifting the gage up and down with your thumb confirms close proximity of the shelf with the bottom of the laser head.
4. Once focused return the gage to the side holder.

Printing & Preferences

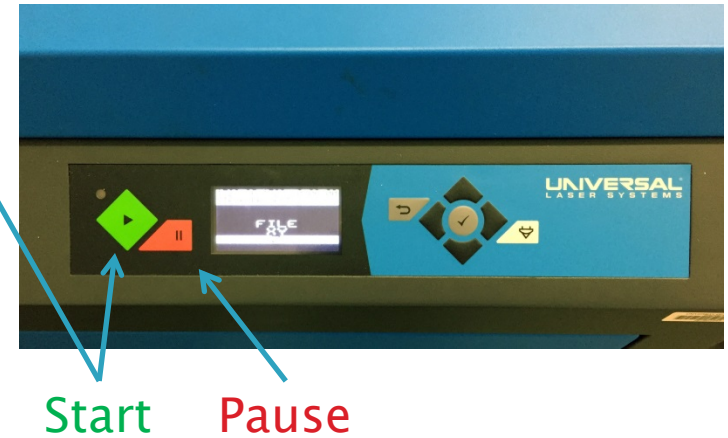
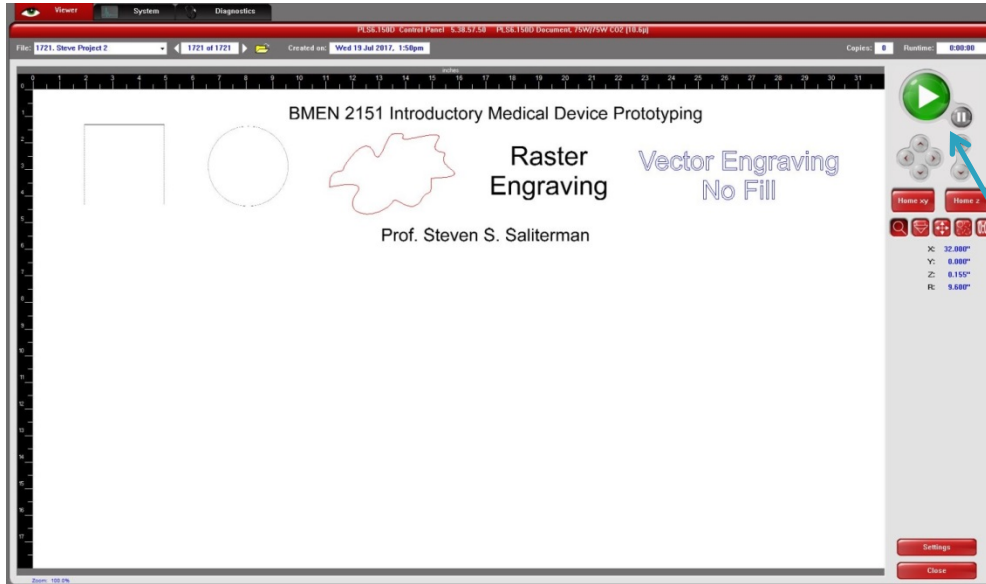


Save your work. Select “Print” from within CorelDRAW and confirm the printer above is selected (Anderson Labs). Select “Preferences” and choose the appropriate material, intensity and material thickness. Increasing thickness by .01 to .02 may be necessary to insure a thru-cut.

Settings for Acrylic (Plexiglass)

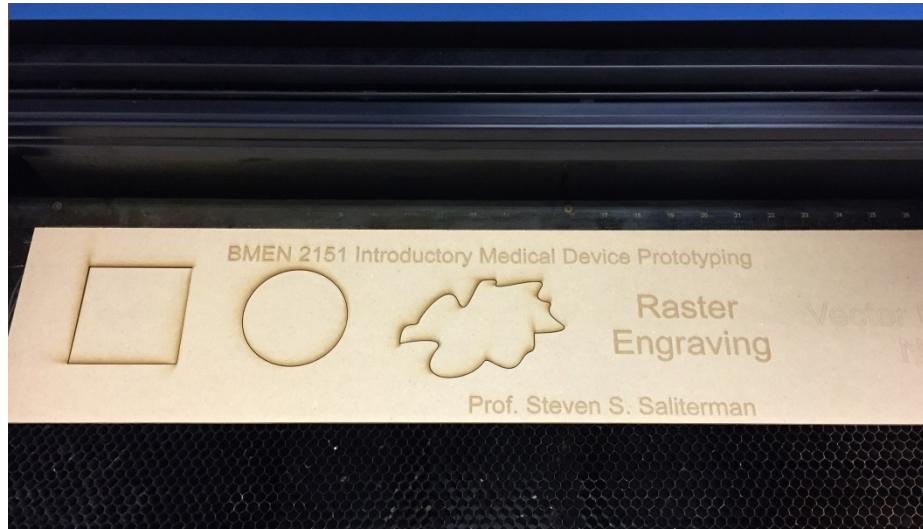


Start Printing



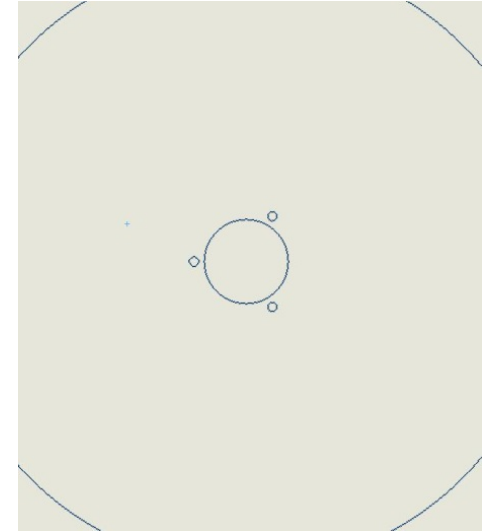
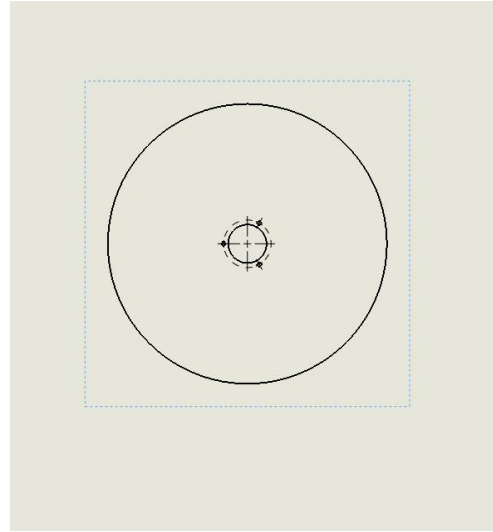
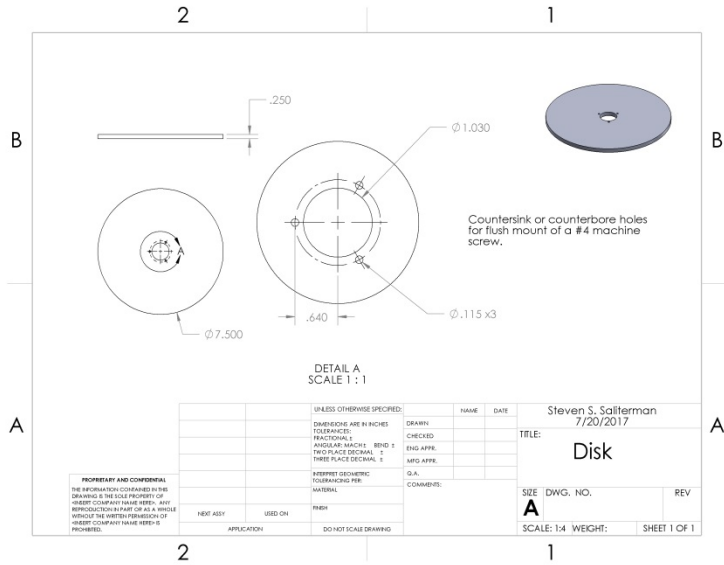
- The laser cutter door must be closed to print.
- Pressing either **Start** button will be start the machine.
- Opening the door or pushing the **Pause** button will stop the machine.

Check for Complete Cut



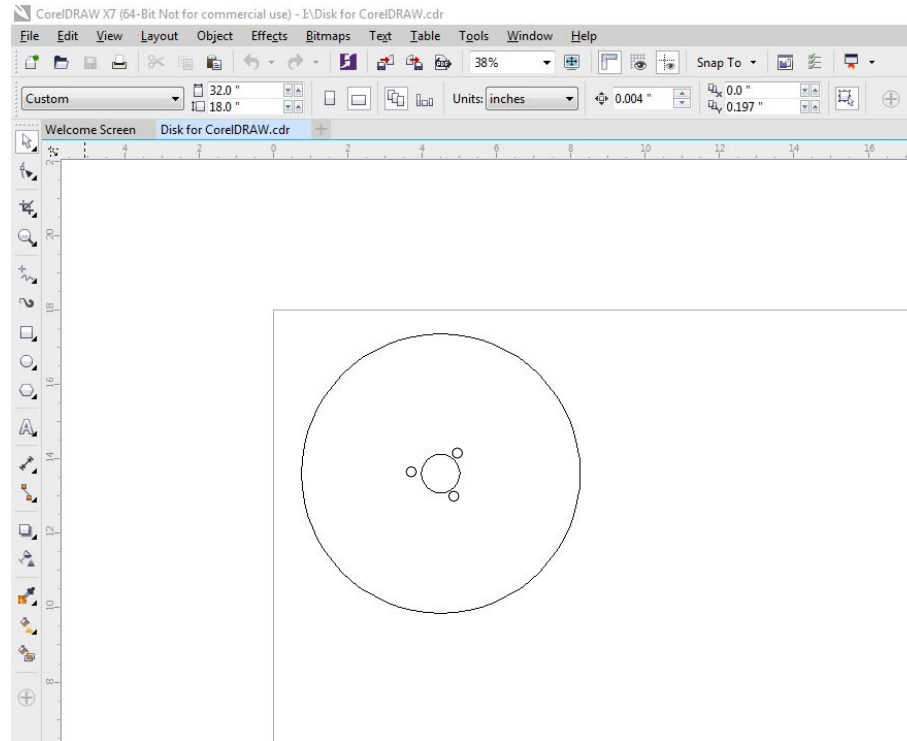
Before moving you workpiece, gentle press on one of the cutouts to be sure the cut went thru (left). Once you move the workpiece (right) you can not repeat the operation – alignment will be lost.

Working from SolidWorks

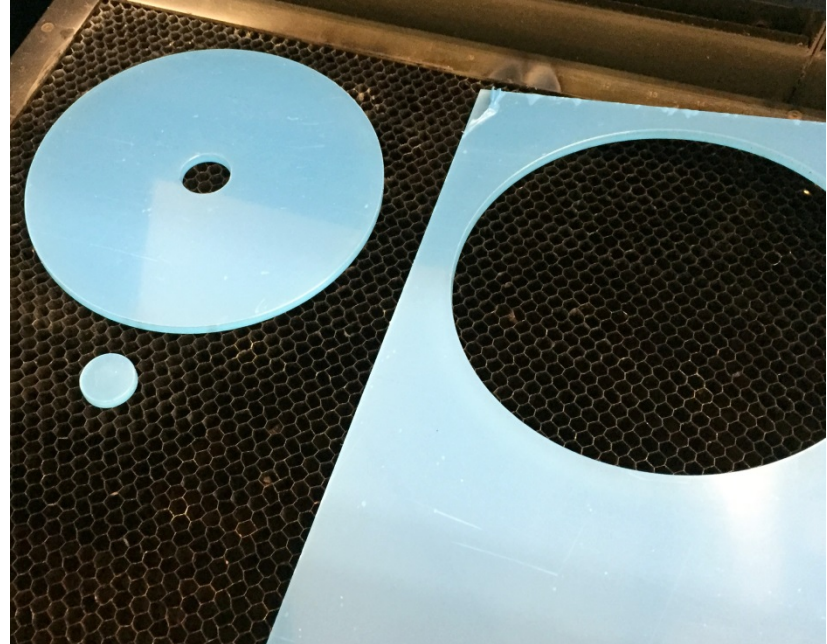
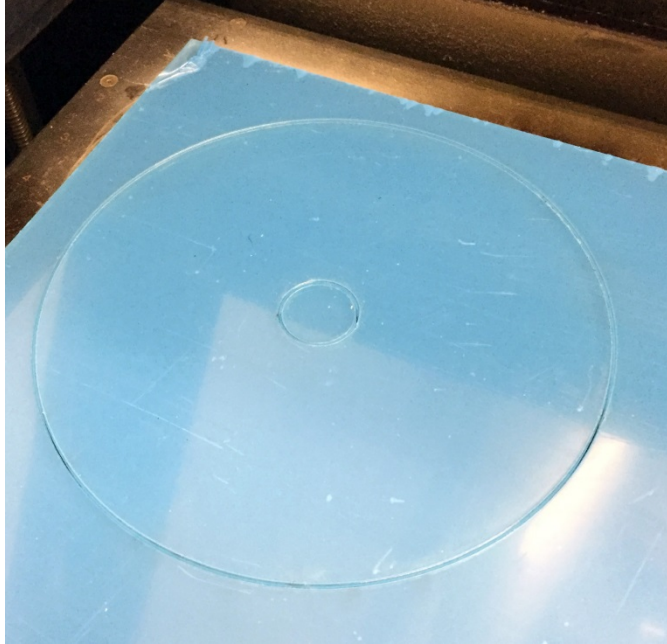


- Create a new drawing, no formatting, with only a top view.
- Remove centerlines, crosshairs and any other extraneous elements.
- Save as “[title.DXF](#)” file.

Open .DXF file with CorelDRAW



Acrylic Example



Purchasing Material



Stock material can be purchased from the College of Design store located on the ground floor of the architectural building – Rapson Hall (northeast corner of the exhibit hall). You will need either an account number or a Gopher Gold Card.

Raw Material & Supplies



Never Cut these Materials

Material	DANGER!	Cause/Consequence
PVC (Poly Vinyl Chloride)/vinyl/pleather/artificial leather	Emits chlorine gas when cut!	Don't ever cut this material as it will ruin the optics, cause the metal of the machine to corrode, and ruin the motion control system.
Thick (>1mm) Polycarbonate/Lexan	Cuts very poorly, discolors, catches fire	Polycarbonate is often found as flat, sheet material. The window of the laser cutter is made of Polycarbonate because <i>polycarbonate strongly absorbs infrared radiation!</i> This is the frequency of light the laser cutter uses to cut materials, so it is very ineffective at cutting polycarbonate. Polycarbonate is a poor choice for laser cutting.
ABS	Melts	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 (again, tends to melt).
HDPE/milk bottle plastic	Catches fire and melts	It melts. It gets gooey. Don't use it.
PolyStyrene Foam	Catches fire	It catches fire, it melts, and only thin pieces cut. This is the #1 material that causes laser fires!!!
PolyPropylene Foam	Catches fire	Like PolyStyrene, it melts, catches fire, and the melted drops continue to burn and turn into rock-hard drips and pebbles.
Fiberglass	Emits fumes	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.

Summary

- ▶ Receive instruction before using the laser cutter.
- ▶ Pick the right material.
- ▶ Use CorelDraw to create your design. If using other software, save as a top view **.DXF** file.
- ▶ Save your project on a thumb drive.
- ▶ Remove material when done and close the door.
- ▶ Leave equipment/room ready for the next user!
- ▶ Short Video: [Laser Cutter Overview](#)