

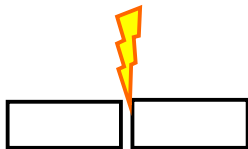
The purpose of this document is to document the use of the Universal Laser Cutters in Room 36 of the Product Realization Lab. These notes are based on our experience with operating these laser cutters in our environment in a manner that is both safe for our students and will ensure the longevity of the machines. We understand that laser cutters elsewhere may be operated under different rules.

Room 36 has two Universal VersaLaser VLS4.60 machines with 24" x 18" beds. Both machines are CO₂ lasers. The blue machine has a 30-watt laser, and the green machine has a 60-watt laser. These machines do NOT have compressed air assist, which prevents us from cutting some materials that require this feature for safe cutting.

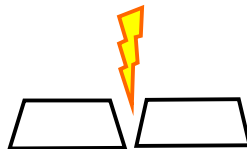
Properties of all cuts on a laser cutter

- laser kerf (material loss) is variable and depends on material and thickness—do a series of test cuts if feature size is critical.
- Cut wall is slightly angled away from the beam on the top surface of your material:

IDEAL cut:



REAL cut:



Ensuring best cut quality:

- Follow all instructions in this manual for setting up cutting files and preparing to cut in the laser cutter software.
- Remove all plastic or paper sheeting that comes stuck on your acrylic material. Replace it with transfer tape if necessary.
- Transfer tape is a low-tack masking tape typically used for transferring vinyl decals. It is also used to protect the BOTTOM surface of clear acrylic material to ensure that it remains clear. On wood materials where a clean top surface is required, transfer tape may be used on the TOP surface of the material as well.
- Check your material with a TA if you have any questions.
- Measure all materials with calipers, and enter in the value that you measure.
- Do a small test cut with your material to ensure that your settings and setup are good.
- If you are cutting thin material like paper, cover the balance of the honeycomb cutting bed with more paper—this will allow the downdraft to be effective and hold your material down flat.
- Notify Room 36 staff if cutting results are not as expected

Preventing fire:

- ***NEVER leave the laser cutter running unattended.*** Keeping an eye on the machine as your cut progresses allows you to anticipate problems.
- Hold down thin materials like paper with tape or a thin weight to prevent fluttering. These fluttering edges can burn quickly.
- Space parts approximately 1/8" away from each other and the edges of your material. Avoid double-cutting lines.
- Verify with a TA that your material is ok if you are unsure.
- Choose the correct material and thickness settings in the ULS software.

In case of fire:

- If you notice a small flame on your material, press PAUSE on the machine, allow the head to clear the flame, open the lid and put the flame out.
- If you see flames and/or excessive smoke, immediately notify the nearest Room 36 TA. They may remove the material and take it outside.
- There is a fire extinguisher located near the door by the laser cutters. This should be used when the material cannot be safely removed from the machine.

- Below are details of the materials that are commonly cut in Room 36:

Materials that can be cut and engraved/etched			
Material Category	Material	Maximum cut thickness	Notes
Plastic	Acrylic	1/4"	Remove any protective paper or plastic layers that came on the material. Apply transfer tape to the BACK of the material to protect from smoke residue when vector cutting. Transfer tape on the front surface provides additional protection to the top surface when raster engraving. Dampening the transfer tape with water before cutting is useful (particularly for thicker materials) to prevent it from burning.
	Acrylic (mirrored)	1/4"	Cut with the mirror facing UP. Apply transfer tape to BOTH sides of the material. Dampening the transfer tape with water before cutting is useful (particularly for thicker materials) to prevent it from burning.
	Mylar film	0.010"	Cuts well, usually needs a little frame to prevent it from curling up and floating away.
	PHBV	1/4"	Bio-polymer material only used by students in Sarah Billington's research lab. Composite of bio-polymer in burlap. Smells weird.
	PTFE film	0.010"	Cuts well, some smoke residue on the back surface.
	Styrene	1/16"	Smokes and results slightly raised edge when cut. Apply transfer tape to both sides of the material to prevent smoke from sticking to the surface.
Wood	Basswood	1/4"	Cuts nicely with light brown edges. Engraves/etches beautifully with a lot of color contrast. Apply transfer tape to both sides of the material to protect from smoke residue when vector cutting, but only to the back side when also raster engraving (tape residue melts into the wood a bit).
	Birch ply (high density)	1/4"	Cuts nicely, cut edge will be dark brown. Apply transfer tape to both sides of the material to protect from smoke residue when vector cutting, but only to the back side when also raster engraving (tape residue melts into the wood a bit).

	Duron/ Masonite	1/4"	Use the Duron available at Room 36 and the PRL--Home Depot MDF chars significantly and has more outgassing. Duron cuts and etches well though the cut edge will be a bit charcoal-y. The material is sometimes supplied in dark brown, sometimes it is a lighter tan.
	Hardwood (walnut, maple, etc)	1/8"	Cut very nicely. Apply transfer tape to both sides of the material to prevent smoke from sticking to the surface.
	Meranti/ Luana plywood (lower density plywoods)	1/4"	Avoid exterior grade plywood. The adhesives used in these materials are dangerous when burned. Meranti cuts fine, cut edge will be dark brown. Apply transfer tape to both sides of the material to protect from smoke residue when vector cutting, but only to the back side when also raster engraving/etching (tape residue melts into the wood a bit).
Paper and Cardboard	Chipboard	1/8"	Cuts very nicely and quickly. Vector engraved marks tend to be more visible than rastered markings.
	Corrugated Cardboard	1/4"	Cuts nicely, but is flammable—watch carefully.
	Foam core	3/16"	Very flammable material—watch carefully. Space parts from the material edges and each other by approx. 1/4" in your file. Inner foam layer melts away from cut edge of paper.
	Mat board	1/16"	Cuts nicely with slight browning of edges. Apply transfer tape to both sides of the material to prevent smoke from sticking to the surface if finish is important.
	Paper	~0.015" (then use Mat Board setting)	Cuts very quickly and cleanly with minimal smoke residue on the back surface. Some art papers will turn a lighter color when engraved for an interesting effect. Can be vector engraved to create a fold line.
Fabric	Cotton	~0.030"	Cuts quickly and cleanly with some minor smoke residue that shows on the back of lighter materials.
	Ballistic Nylon	0.020"	Cuts with a clean sealed edge.

Materials that can be engraved/etched but NOT cut (Material thickness up to 4" can be engraved on the top surface)		
Material Category	Material	Notes
Metal	Anodized/painted aluminum	The laser vaporizes the coated layer to show the bare metal.
Glass	Glass	The laser doesn't actually etch the surface, but creates tiny fractures that create a frosted appearance. DAMPENED TAPE??? Consider using the vinyl cutter to create a sticker mask and using the sand blaster at the PRL to create beautifully frosted glass.
Stone	Marble, granite, etc.	Turns white when lightly raster etched. Typically filled with paint to highlight the etched area.

Materials that CANNOT be cut OR engraved/etched		
Material Category	Material	Notes
Plastic	PVC/Vinyl	Releases poisonous chlorine gas, which is dangerous and very bad for the machine
	Delrin/Acetal	Releases poisonous formaldehyde gas, flammable without air assist
	Polycarbonate	Releases dangerous fumes and cuts very poorly
	High- and low-density polyethylene	Melts into a gooey mess and cuts very poorly
	ABS	Melts/burns and does not cut well
	Polystyrene foam (pink foam)	VERY flammable, melts a lot
Composites	Fiberglass	Releases fumes, doesn't cut
	Carbon fiber	Releases fumes, doesn't cut
	FR4 (circuit boards)	Releases fumes, doesn't cut

Preventive Maintenance:

As needed: Clean lenses and mirrors per equipment manuals.
Clean mechanical components from dust and residue.

Quarterly: Verify engraving table alignment at 4 corners. Adjust if necessary to ensure proper height setting.