HackRVA's Laser Basics v2020.01.27

Welcome!

A few quick reminders about Laser Basics. Always be safe. If you're not sure on what a procedure is, never hesitate to ask. The info contained in this document can be found in the laser area. It is contained in the laser folder. It also has troubleshooting, material lists, and information for the laser. The most important thing we teach is safety.

Our Laser:

Thunder laser - Nova 35 from ThunderLaser.com

900mm x 600mm x 230mm (35.4" x 23.6"x 9.1" maximum thickness)
100 Watts of Power
Cuts up to 1/2" material

http://www.thunderlaser.com

What our Lasers can do:

Cut Vector files define the paths that the laser will follow. You use vectors to cut thru materials. Vector files are created with programs like Adobe Illustrator, Inkscape (open source & free), and CAD software.

Etch This can be a very light touch, even on paper. Or it can be deep for a special effect. (But a dark etch on paper or fabric will just burn through.)
Vector paths can also be used to etch. You adjust the setting for how deep you wish, and how to fill the shape, i.e. crosshatch, lines, angles of lines.

In Lightburn, a vector path on a layer will give three options: *Line* or *Fill or Offset Fill.*

- *Line* will follow the paths.
- *Fill* will fill in the path with parallel lines with the angle and spacing you specify. You can also turn on *Crosshatch* to have it go over it again at a right angle to the first pass.
- Offset Path does a spiral from the line into the center.

Raster: Pixel files, such as photos. Instead of following a line, bitmaps define an image by rows and columns of dots. This is a much slower process, but works well for pictures, fills, patterns, shadowing, solid text… These are usually pictures, created in Adobe Photoshop, GIMP (open source and free), Paint, etc.
In Lightburn, a raster file can be traced to produce a line. This will often need editing to eliminate unneeded paths.This is useful to make a cut path around a raster image.

Materials Database with Cut/Raster guidelines:

Check the book on the laser desk.

Materials to cut:

Maximum thickness of material varies. ¼" is usually easy, but ½" is possible. It may take multiple passes.
In the notebook there is a materials database with suggested settings.

- Wood
- Plywood. Differences in plywood affect cut. Some will not cut well.
- MDF
- Hardboard (Masonite) like pegboard
- Acrylic. *Plexiglas* is a brand of acrylic. (*Lexan* is polycarbonate, and does not cut well.)
    - Cast Acrylic. Frosted appearance when etched
    - Extruded Acrylic clear etching.
- Dual layer plastic (mostly for signs, name plates, etc)
- Paper Foam Core Boards.
- Paper (Hold down with magnets or weights)
- Cardboard
- EVA foam floor pads or foam box inserts. (Test for vinyl!)
- Fabrics (natural. Synthetics melt)
- Leather (stink fades, can be washed off.) go with vegi-tan, not chromium treated.
- Craft Foam/Neoprene, Playmats, EVA Foam
- Polystyrene (pink or blue foam insulation board from Home Depot/Lowes). not standard Styrofoam
- Cork, test because of different glues

- Rubber (Must not contain PVC. Look for rubber labeled as Laserable or without PVC). Do not create excessive smoke.
- Silicone, self pour.

Materials to etch/raster:

- Glass
- Mirrors (back side only! Flip your image in Lightburn.)
- Rubber Stamps (No PVC. Make sure it is laserable)
- Granite (pops the crystals with heat)
- Coated or Painted Metal (burns off the coating)
- Etch metal with an etching agent like Cermark (Molybdenum Disulfide.)
- Anodized Aluminum
- Powder Coated Metal
- Cloth

Material that will not cut or etch:

- Metal
- Carbon Fiber
- Fiberglass

Materials NOT TO USE:

Cutting unknown materials is prohibited.

These materials ARE harmful to you and/or to the laser. Think very corrosive, and chlorine gas.

- Vinyl
- PVC
- Kydex
- Sintra
- “Rubber” if it has PVC/Chlorine, unless it is marked *laserable*)

Also do not use:

- Styrofoam (Fire hazard)
- Polycarbonate (doesn’t work well, lots of fumes). Lexan is one brand.
- Front side of mirror (beam will reflect and damage things in the laser)

*If not listed, please read the Material Safety Data Sheet and check with the laser channel on Slack)

Chlorine Gas:

Cutting anything containing chlorine/phosgene is 100% prohibited no ifs, ands, or buts. Chlorine kills people and damages equipment. Anyone intentionally cutting chlorine based materials will be reprimanded.

Cutting unknown materials is prohibited.

Always watch for unexpected behavior, such as flames, smoke, gas, excessive ash.

Watch the Laser at all times!

If you need to leave, find a trained proxy. Or pause the laser.

In case of FIRE:

- Immediately stop the laser; This will more than likely extinguish the fire.
- If the fire still exists, move the head, and then try to blow it out.
- If the fire still exists, spritz it with the water bottle. Notify Laser channel on Slack.
- If All else fails, use the laser CO2 fire extinguisher. Notify Laser channel on Slack.
- CO2 Fire Extinguisher is by the laser. Use it ONLY for the laser, and use ONLY the CO2 extinguisher on the laser.
- To use an extinguisher, remember this simple word:
  P.A.S.S.- Pull the pin on the extinguisher.
  Aim at the *base* of the fire.
  Sweep from left to right.
  Squeeze the trigger slowly.
  This applies to the CO2 extinguisher, and any others.

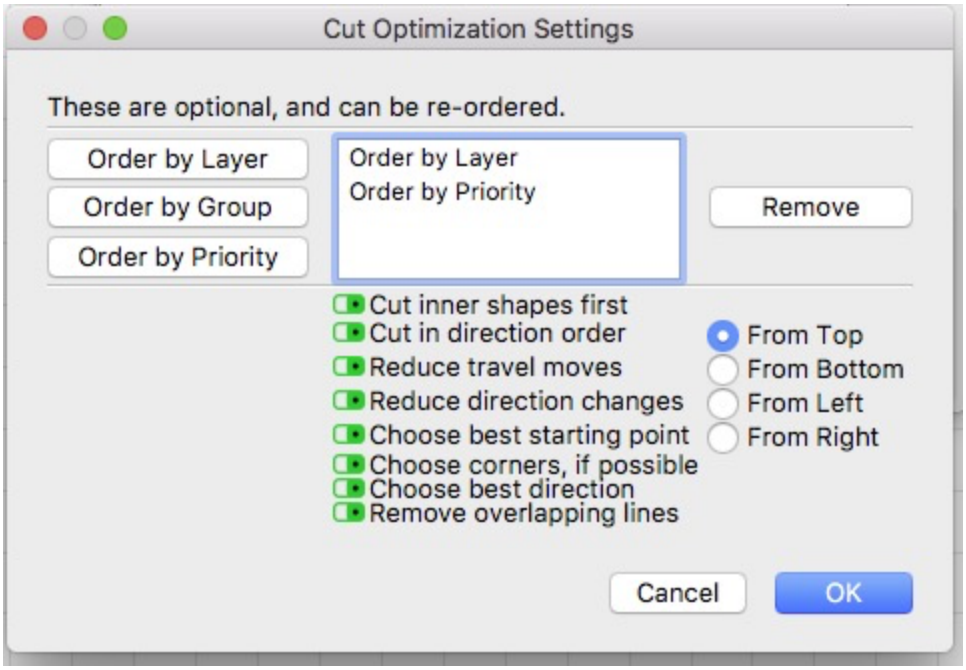
Minimize Smoke. Excessive smoke will damage the optics of the laser and workings of the bearings and motors.

Cost:

Use of the laser is included with HackRVA's monthly dues, and no additional use fees are charged. If you are using the laser for commercial use, please consider paying the space back for the laser time in some way (i.e. by teaching a class, donating supplies or money, etc.) The tube has a finite lifetime, and we will have to replace it at a cost of over $800.

Design Tips:

- Do the etching & rastering first by moving the etch layers to the top.
- Use Lightburn *Optimization Settings* on the **Laser** pallet of Lightburn to set *Cut inner shapes first.*



Laser Info

Laser		**Thunder NOVA 35 100W CO2**
Software		**Lightburn**
Bed Size		600mm X 900mm 23.6” X 35.4” (Laser area. Slightly larger materials will fit.)
Wattage		100
Max Material Thickness		up to 1/2" depending on the material, maybe with multiple passes
Manufacturer Web Site		http://www.thunderlaserusa.com
Detailed Notes		
Vector Formats		SVG (Inkscape, Illustrator, or others) (It can include raster elements)
		DXF Set Scale in Main Menu-> Config-> File Params (mm vs Inch) (Beware of possible size change.)
		AI (Adobe Illustrator) (It can include raster elements) You will get more reliable import if you *Save as* from Illustrator to SVG.
Raster Formats		BMP, PNG, GIF, JPG, Windows MetaFile They can be etched as raster or traced to vector.
		Raster and vector elements can be on the same job run, on different layers.

How the Laser works:

Laser beams & Kerfs

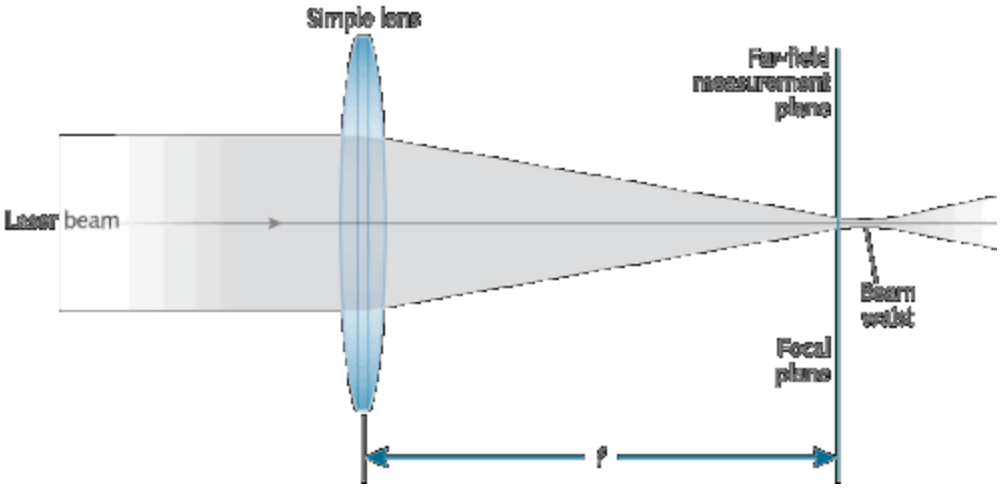
The cutting and burning beam is infrared and invisible. It will not be on if the top is open. The red dot is only a guide to where the beam will go, and it is not hot.

Kerf - the width of the laser cut. It will vary with power and material.

Kerf shape: The beam narrows at the point of focus, then expand on the other side. think of it as an hourglass shape. It is negligible on thin pieces. At ¼" , it starts to become noticeable.

Laser tube and mirrors. The tube is in the back of the machine. Mirrors bounce the beam to the flying head, then to the bed.

- Smoke causes a residue to build up on the mirrors, which makes the laser less effective and can damage the mirrors. *Air assist* is in the Lightburn settings. ***It must always be on to prevent damage to the lens.***



Focus:

- The Laser has an autofocus process. The autofocus is not reliable on thin or transparent materials, and it must be manually adjusted the first time you use it. Start by putting the lens up high in the tube, and moving the head away from the material.
- Place your material on the cutting bed between the IR limit switch, the small black devices about ⅔ up on both sides of the bed. (Do not put anything under the laser head during this process!) Press the "**Z/U**" button on the Thunder control panel and scroll down to "*auto focus*" and press *enter*. Check the focal distance by using (6mm) height gauge and if necessary raise/drop the head using the thumb screw. Do not use the head below the **LIMIT** line on the barrel.

- You can use the Z move to do a manual coarse adjustment: Press the **Z/U** button to access the menu page. Press the **>** button to move the bed down, and the **<** button to move it up.

Settings:

- **Speed-** Faster cuts - less tube time, less heat generated on the material. slower cuts, the laser will cut deeper.
- **Power-** Balance it with Speed and the number of passes
- **Passes-** One pass versus several. Thicker materials may require more passes. More passes at higher speed/lower power may reduce burning/charring of material.

General procedure:

1. Prep for fire safety:
    a. Locate Water Spritzer
    b. Locate the fire extinguisher.
    c. Ensure the cutting bed is clean and free from debris.

2. Startup procedure

    a. Turn on chiller (separate box on the left side of the laser)
    b. Make sure the big red E-stop is in the reset position.
    c. Turn on the Main switch (top) on the right side.
    d. Turn on the Laser switch (bottom) on the right side.

Auto focus procedures

1. Home the laser by pressing esc on the control pad
2. Place your material in between IR limit switch units at the side of the honeycomb. (Do not put anything under the head of the laser during this process)
3. Press the “Z/U” button to enter the menu and scroll down to “auto focus” and press enter
4. Check focus with the small focus block labeled “F=6 mm” and adjust if needed.

1. Prep Your File in Lightburn
    a. Load your file (most likely using File | Import). Source - memory stick, member drive, cloud storage (google drive, dropbox…)
    b. Review color mapping and set the appropriate operation (scan/cut), speed, and power.
    c. Review cutting order. Be sure cuts are in the correct order, usually etching first, then inside cuts, then outside cut
    d. review vectors paths (check none cross over each other unintentionally using preview)
    e. check size of document in relation to laser bed
    f. Preview the cut using the monitor icon on the toolbar.
2. Prep stock
    a. place your items on the grid/table
    b. align it
    c. secure it if necessary using hold-downs, weights, or tape.
3. Autofocus if material changed.
4. Frame job using the frame button in Lightburn to see where the laser will go during the operation.
5. Close Lid
6. Start the job via Lightburn. Changes to the file while the job is running will have no effect.
7. Watch the Laser until the job is complete.
8. Wait a few seconds for exhaust to clear.
9. Check that your cuts went through before picking up the material, just in case you need to make another pass. The hold-downs should be tight enough for you to check.

Please stand by the Laser while it is running.
Fires DO HAPPEN. Minimize Smoke. No Flames - if your material is causing a flame, stop the machine. Try a lower power or a faster speed.
Failure to do this may result in the suspension of your license to use the machines, and serious damage to the laser and MakerSpace.

Thunder Laser In Depth:

Lightburn: https://www.youtube.com/watch?v=VKZUpGUSO5k
(Laser settings are not correct for our laser.)

Problems?

- PLEASE report problems on Slack on the Laser channel so we can fix it.
- Want to fix a problem yourself? FANTASTIC. We will train you. In return, you will help build our MakerSpace, and increase the laser uptime.
- Use the red E-STOP button in case of emergency like uncontrolled movement. For fire, it is counterproductive, because you can't move the head out of the flames after it is pressed.
- If the laser seems dead, check the red E-Stop button on top. Turn it and put it in the UP position.
- Errors on the laser will show up in a small area of the LCD display.

TIPS:

1. Test your settings before committing to cut it all... settings will vary. some factors:
    a. materials.
        i. Acrylic: your acrylic cast acrylic or extruded? It is pigmented? Translucent or Transparent or Opaque?
        ii. Plywood varies a lot, even the same brand, even the same sheet.
2. Not sure of the lines? Questions about the paths?
    a. Run a dry pass (0% power or with the laser switch off). It is free. It will save you money by helping eliminate mistakes.
    b. Test on paper or cardboard.
    c. Do a sample cut (i.e. 1" square) in your material to make sure your settings are good.
3. Unexpected multiple passes
    a. Layer settings set to multiple passes
    b. Check your graphics file for an identical image on top of your image. This happens sometimes from copy and paste, or use of *Duplicate* in the graphics program
4. Before moving the material, check that the laser cut through your piece. If not, you can do another pass. Cut only the cut layer, or select the uncut shape, turn on Cut Selected Graphics, and Start. This might happen especially with plywood, as the glue and wood vary inside the layers.
    a. Smoke coming from under your material is an indicator that the cut penetrated the entire thickness.

b. Pieces will shift when cut from support material.

FAQS

Can it cut glass?

No, you can lightly etch glass, but even very slow, high power cuts will not make the glass break like a glass cutter.

Can it cut metal?

No, it will not do anything to the metal. It may burn off paint or other coatings. There are coatings you can buy that will etch metal when heated by the laser. They are expensive. Cermark is one popular brand.

Helpful Links:

Vector Graphics: https://en.wikipedia.org/wiki/Vector_graphics
Image Formats: https://en.wikipedia.org/wiki/Image_file_formats

Boxes - folding paper or cardboard: http://www.templatemaker.nl/

Gears: www.gearotic.com (For Windows only)

Box finger joints: www.MakerCase.com

Boxes.py - wonderful box designs with custom sizes and more. Website and plugin https://www.festi.info/boxes.py

Nesting (position pieces for efficient cutting) www.SVGNest.com Now built into Lightburn. (Arrange menu:Nest Selected It exports the selected shapes, then puts the file name on the clipboard, and connects to the site.)

Epiloglaser.com "**Sample Club**". Lots of practice projects.
https://www.epiloglaser.com/resources/sample-club.htm

Lasergods https://lasergods.com/

Where to Shop:

Acrylic:

Johnson Plastics Plus https://www.jpplus.com/

DIY friendly. Several different types of acrylics, like dual layer & metallic finishes. Supplier of Dye Sublimation materials as well.

Makerstock https://makerstock.com/

E & T Plastics https://www.estreetplastics.com/

Inventables.com All Cast Acrylic

Wood\Plywood:

Makerstock https://makerstock.com/

Rockler Woodworking and Hardware

WoodCraft

Laserbits.com for laserable materials and ideas. Things like rubber for stamps. (A division of Johnson Plastics)