USING THE LASER CUTTER

BACKGROUND

We have as a resource for the Autonomous Systems Lab a 30 Watt LaserPro Explorer II Laser Cutter/Etcher. This is a very cool machine that allows you to cut geometry from a two-dimensional CAD file into sheets of various wood and thermoplastic based materials (but NOT metal). It is an ideal tool for cutting intricate shapes with sharp internal corners. It is also excellent for creating quick prototypes and for building things that can be assembled from 2D (and essentially flat) components.

Its 30-watt laser can cut through materials up to ½" thick (very dependent on the speed and type of material), and it can also score or etch the surface of the material without cutting through. The maximum size that the Laser Cutter can cut is 20" x 32" (the table is larger, but on our specific machine, the leftmost 3 inches are not accessible to the laser). The maximum speed at which the head can move is over 100 inches/minute, but again, it varies depending on the material and thickness you are cutting.

The Laser Cutter is connected to a PC that has the Laser Cutter software drivers on it. As far as the PC is concerned, the Laser Cutter looks exactly like a USB plotter. The large difference is that the Laser Cutter uses a CO_2 laser rather than pens in order etch/cut the material. There are a few tricks to the driver that will be outlined in this document in order to produce the best cuts.

The Laser Cutter is a very expensive and delicate machine, please treat it as such. There are only a few materials that we have tested in the Laser Cutter, and appear in the list of "Approved Materials" that is found in this document. Please DO NOT cut anything that does not appear on that list: certain materials will damage the optics by depositing on the lenses and mirrors, and these are very expensive (and take a long time) to replace. Please DO NOT violate this rule—it will ruin the resource for all of us who use it.

APPROVED MATERIALS:

(1) ACRYLIC—Thicknesses up to ½" (this might require 2 passes)
(2) MASONITE—Thicknesses up to ¼"
(3) MDF—Medium Density Fiberboard, Thicknesses up to ¼"

Remember that dimensional materials are NOT accurate, though they tend to be very consistent. That is, ¼" MDF is not ¼" thick (it will be thinner). This is done to save material in the manufacturing process, and is true for all materials that you will buy. The best may to know the material thickness is to measure it. (I left some samples in the lab that were cut with the Laser Cutter).

DO NOT cut or etch any other materials in the Laser Cutter. Certain materials will release poisonous when cut with the laser. We would rather not explore these materials, and the ones that are known to be BAD are: Polycarbonate, Teflon, Plywood, FR4. Be careful with your source materials for Acrylic, Polycarbonate looks just like it, and you can only tell once you start to burn it. Polycarbonate will start to bubble and blister rather than cut. Stop the cut IMMEDIATELY if you see this happening. Teflon releases a poisonous gas, plywood gums up the works from the glue. If you have any doubt about your material, do NOT put it in the laser cutter.

PREPARING A DRAWING:

The Laser Cutter has been used successfully with CorelDraw, and that is the program we recommend for running the actual Laser Cutter. CorelDraw is a strictly 2D program (though it is a fairly nice one). Use SolidWorks for your 3-D modeling and your virtual prototyping, but once you have finished and are ready to make your parts, export each of the parts to CorelDraw in order to prepare it for cutting (both SolidWorks and CorelDraw are available on the BE-115 computers).

Setting up CorelDraw: though this should have been done for you already, if it has not been done, you will need to complete the following steps:

(1) Set the paper size to 20 x 32 inches, with the origin at the upper left corner of the page.
(2) Set the color management to OFF.
(3) Set the default pen color to red, with a line width of 0.001 inches.
(4) Set the default units to inches.

You may use whatever colors and how ever much complexity in your drawings as you like, however, the things that you want to cut should be in red, and the things you want to etch should be in green or black. All other colors are going to be ignored by the Laser Cutter.

The way the Laser Cutter works is fairly simple in theory: lines that are 0.001 inches or narrower are cut, lines that are thicker than 0.01 inches are etched. This is done at the driver level (this is where the colors come in, as well). The beam width of the cutting laser is 4.5 thousandth of an inch, and distributes evenly to both side of the cut, that is, a circle that you cut out will be 0.9955 inches in diameter (4.5 thousands less than 1"), and the hole will be 1.0045 inches in diameter (4.5 thousands larger). Thus, there will be a 0.009 inch gap between the two of them if you put it together. Remember this kerf width when you design slots and tabs to fit parts together (also, see the comment above about the dimensions of stock that you buy).

Once you have your drawing set up and ready to cut, save it (preferably on a USB stick) and bring it up to the Laser Cutter (currently in JBE-226). Get the TA's or the instructor (John, Gabriel, Erik, Ian, or Alana) to watch you do this—as we gain more trust with the class, we may relax these restrictions, but for now we are only allowing you to use the machine with supervision.

PRINTER DRIVER:

The details of how the laser cuts are all contained within the printer driver. This is accessed from the PRINT dialog box, which should have the printer set as: EXPLORER. Click in on the properties button, which will bring up the Laser Cutter printer driver.
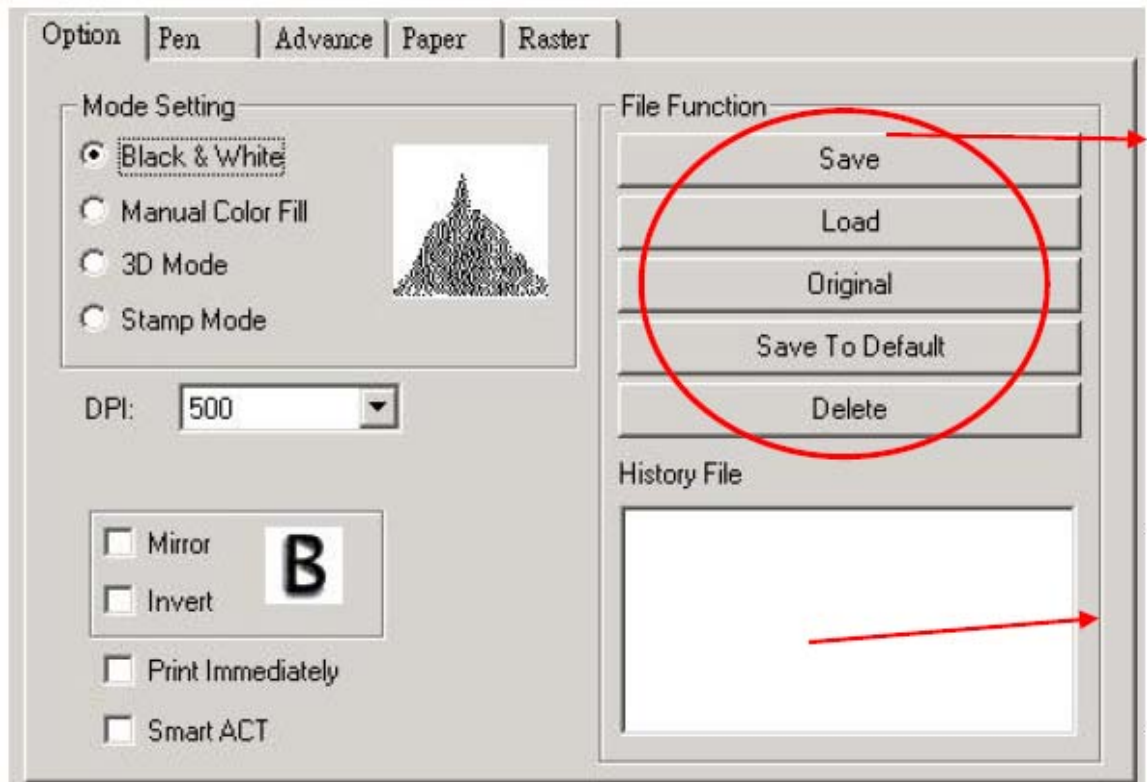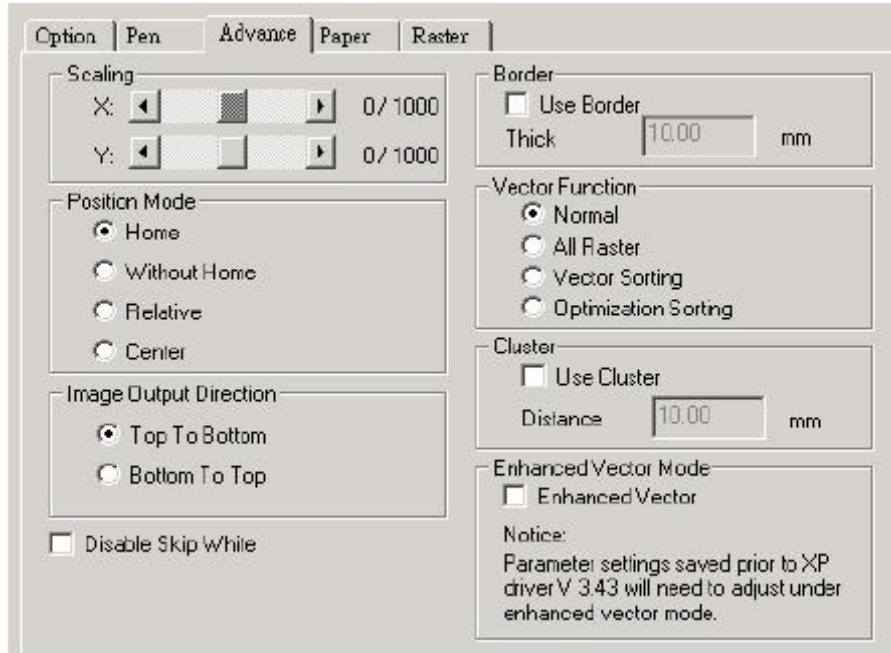
In the MODE SETTING, you should be in Black & White. Nothing else should be checked. Next, choose the PEN tab and open that up:

Fig. 6-17 Laser Parameter Settings
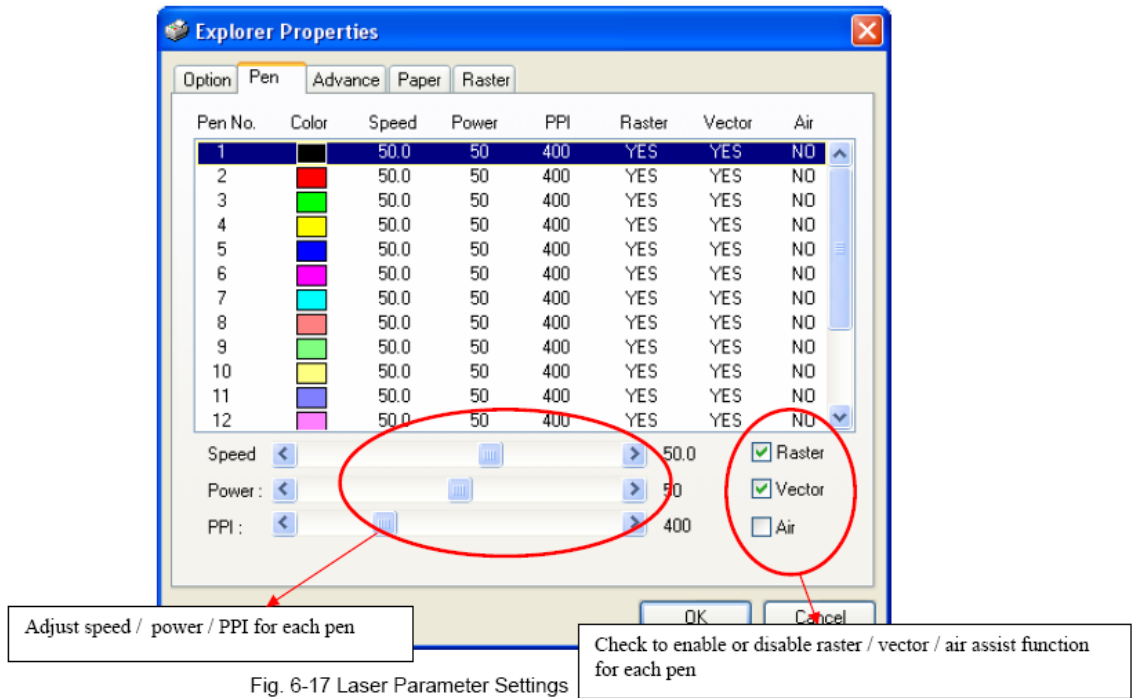
- For the BLACK color, set the pen on RASTER and AIR, set the speed at 50% and the power at 50%. This is the setting for etching.
- For the RED color, set the pen to VECTOR and AIR, set the speed to 0.7% (for ¼" MDF), set the power to 100%, and the PPI to maximum (it will change to X).
- For the GREEN pen, set the pen to RASTER and AIR, set the speed to 30%, and the power to 100%. This is for darker etching.
- Set ALL OTHER colors to OFF (neither RASTER nor VECTOR).

Next choose the ADVANCE tab, and select it. In this panel you want to choose the following settings (note that these should all have already been set, but just in case).

Option | Pen | Advance | Paper | Raster

Scaling
X: ◄ ▣ ► 0 / 1000
Y: ◄ ▢ ► 0 / 1000

Position Mode
● Home
○ Without Home
○ Relative
○ Center

Image Output Direction
● Top To Bottom
○ Bottom To Top

☐ Disable Skip White

Border
☐ Use Border
Thick [10.00] mm

Vector Function
● Normal
○ All Raster
○ Vector Sorting
○ Optimization Sorting

Cluster
☐ Use Cluster
Distance [10.00] mm

Enhanced Vector Mode
☐ Enhanced Vector

Notice:
Parameter settings saved prior to XP driver V 3.43 will need to adjust under enhanced vector mode.

In this panel, you want to leave the scaling off, POSITION MODE should be home (this tells the Laser Cutter to start at 0,0 and cut as you have it drawn on the page). Make sure the BORDER is unchecked, and the VECTOR FUNCTION is set to VECTOR SORTING (this will cut the inside parts out first, which is good because the part will drop otherwise). Keep everything else unchecked.

Click OK, and click print. The file will be transferred to the Laser Cutter, and will show up on the Green LCD screen at the front right corner of the machine.

CUTTING THE SHAPES OUT

At this point, you have set up you file, turned on the Laser Cutter, and printed your file to it. The next step is set up the material and cut the part. This consists of a few necessary steps. The first thing required is to position the material, then do an auto-focus (adjusting for material thickness), and finally to cut the material. First, a few caveats:

(1) ALWAYS cut your shape out of paper first. This will save you countless hours, and also show you where to position your material, as well as how long it is going to take to cut it. Note that the laser takes a bit of time to power up, and might only start actually cutting the material towards the end of the run.
(2) Position paper on the cutting table (remember that 0,0 starts 3 inches from the left border on the table).
(3) Move the cutting head over the center of your part (roughly), and push the AUTO-FOCUS button. The bed will rise until the plunger is hit, and then go back down to its correct height.
(4) Close the lid (and the front door), and push the START button. The laser will turn on and start to cut your part out of paper.
(5) Turn on the blower attached to the Laser Cutter (it is the red switch on the stand with the motor and the bags attached to it).

(6) You may lift the door at any time to stop the laser from cutting (there are magnetic switches that cut off the power to the laser). You can use this to get paper parts that are still attached.

Once you have cut you part out of paper, and are satisfied with you shape, you are ready to cut the part out of real materials (MDF, Masonite, or Acrylic). This requires a few additional steps:

(1) Remove the paper! It will catch on fire, and while it is not dangerous, it does stink up the place and burns the back side of your material.
(2) Place the material on stands (there are several acrylic moon-like shapes for this). If you are using the MDF with the white board backing, you should place it MDF side up. Make sure that the stands are in places that the beam will not cut through, if at all possible. You will know where the beam will cut as you will have already cut your shape out of paper.
(3) Lower the bed using the Z menu option on the LCD so that you can position the cutting head over your material without running into the plunger.
(4) Center the cutting head over the center of your part (approximately), and push the AUTO-FOCUS button.
(5) Use the Z-button to move the bed UP by half of the thickness of the material (so for ¼" MDF, you would move the bed up 0.125"). This will keep the cut as clean as possible, and give you the most perpendicular edges.
(6) Close the lid, and push the START button.
(7) If you have not already, turn on the blower.
(8) Watch and marvel at the technology.

Once you are finished cutting your part out. Open the lid and use the small shop vacuum cleaner to vacuum out any parts and paper fragments from the Laser Cutter. Please try to keep it clean.

PARTING THOUGHTS

Please be careful with this, and DO NOT PANIC. Unless you start a real fire in the Laser Cutter, don't even think of using the fire extinguisher. You will ruin the machine. In other words, the vast majority of the time, everything is going to be fine, and be patient if something is happening that you don't expect.

With the lid closed, this machine is a class IIIA laser (it won't harm your eyes). You can stop the laser firing at any time by opening the top lid. If that does not do it, there are a pair of safety goggles near the laser cutter, put those on and then open the lid again. If the beam does not stop firing, turn off the power. If it still doesn't stop, unplug it.

There is a PAUSE button on the cutter. Use it if you have to. Once you guys get through the class, you will be able to use the Laser Cutter for your 123A/B projects, so try not to break it.

VERY IMPORTANT

The Laser Cutter is housed in Claire Gu's lab, as a courtesy. We are guests in her lab, and we would like to remain there. Be courteous, be conscientious, clean up after yourselves, and always defer to any of her students.