LaserCAMM

We do not require users to make a LaserCAMM license before using the machine. However, a test piece must be cut from all pieces of material to confirm the material type and quality of cut on that material. Each user must give their test piece a serial number, add it to the chain of test pieces, and fill out the Cut Log. You should make sure you are familiar with how the LaserCAMM works before using it. Follow the steps listed in this document to create a part on the LaserCAMM.

Overview of the Machine

The LaserCAMM is a very cool machine that sees a great deal of student use. It can cut geometry from a two-dimensional CAD file into sheets of various wood and thermoplastic materials (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 components.

Its 100-watt laser can cut through materials up to 1/2" thick, and it can also score the surface of the material without cutting through.

The maximum size the LaserCAMM can cut is 48" (122 cm) by 24" (61 cm).

The maximum speed at which it can cut is over 200 inches per minute (508 cm/min), but this varies with material and thickness.

The LaserCAMM is connected to a PC that has the LaserCAMM software on it; this program takes a DXF file and translates it into a DMC file that the LaserCAMM can read and then cut. The list of materials the LaserCAMM can cut appears under "material" in the LaserCAMM software. **If a material is not on this materials list, you may not cut it on the LaserCAMM**. The LaserCAMM is very expensive and some materials can damage its optics.

You must cut a test piece of your material every time you use the LaserCAMM. Aside from the test pieces, there is no LaserCAMM license per-se that users must make.

**Follow the steps in this document to create a part on the LaserCAMM.**

Making the DXF File

Make Your Parts in SolidWorks Part Mode

SolidWorks is a powerful operating environment. The LaserCAMM requires DXF files as an input. SolidWorks can "save as" into DXF in Draft Mode (2D drawing mode).

Strictly speaking, parts intended for cutting on the LaserCAMM may be drawn line-by-line in SolidWorks Draft Mode. However, it is highly recommended to create the parts in SolidWorks Part Mode, and then project views of those parts in SolidWorks Draft Mode. Part Mode is parametric, where sketches and eventually solid bodies are defined by relationships that are highly modifiable. Draft Mode is not parametric.

Instruction on creating parts in SolidWorks Part Mode is beyond the scope of this tutorial. We will take the part below as a given, and proceed with making 1:1 projections of the part in Draft Mode.


part mode

draft mode
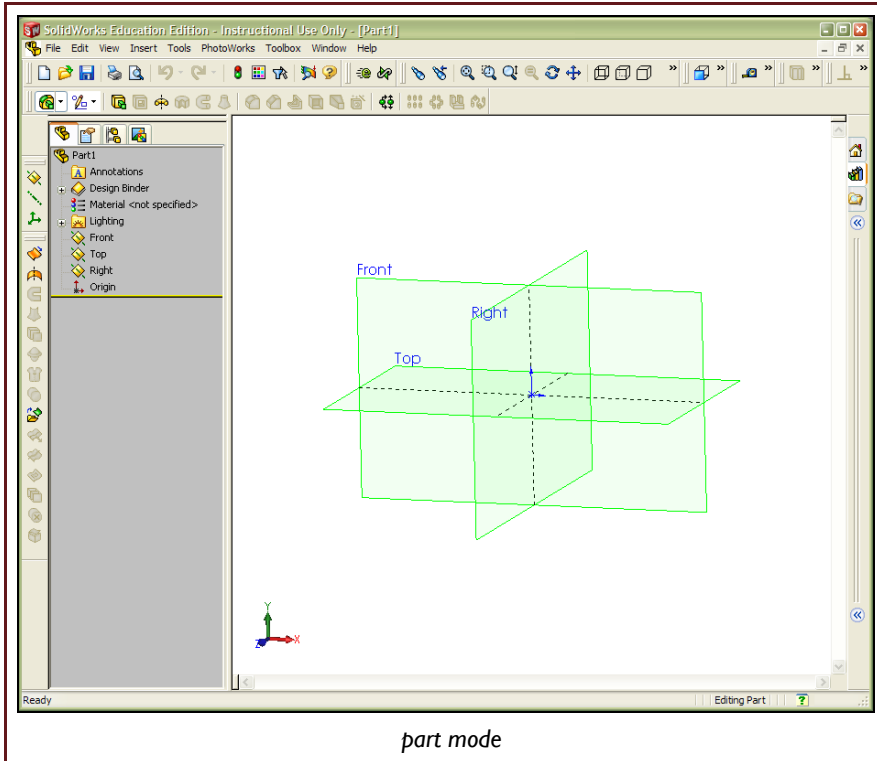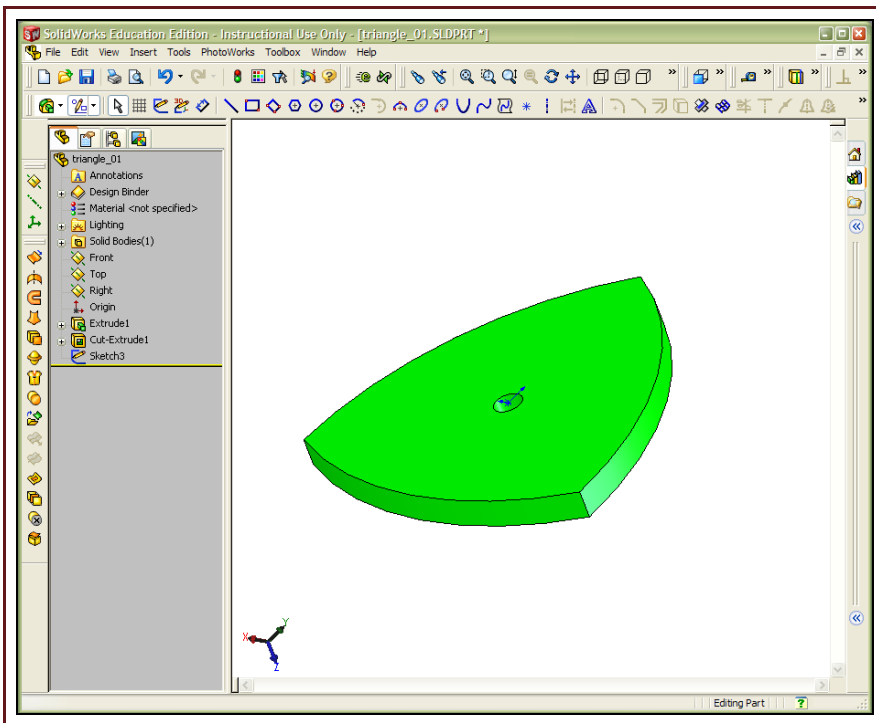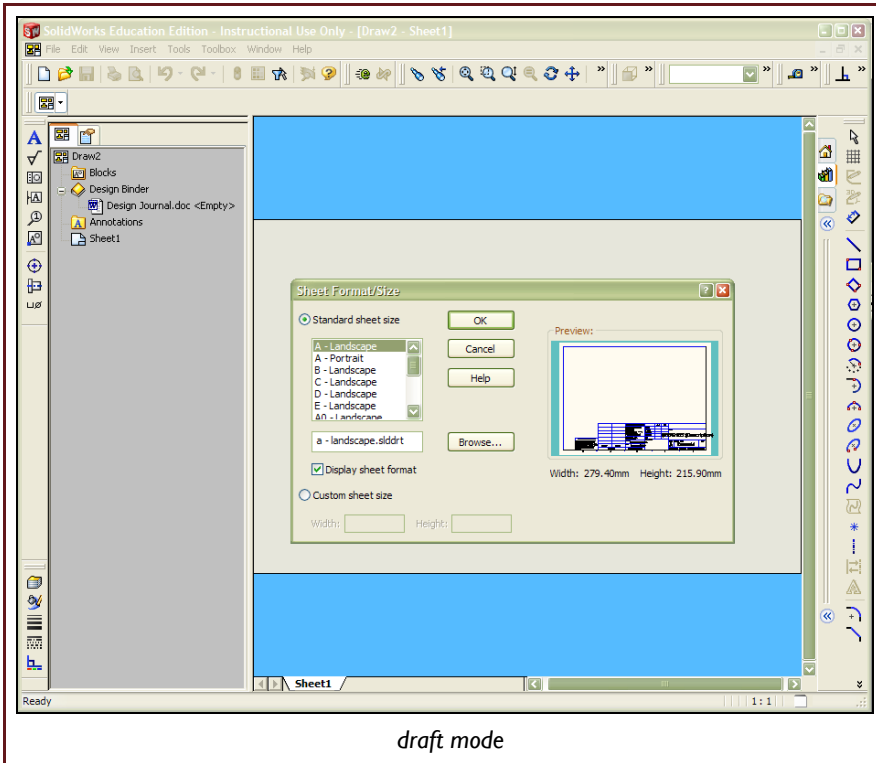
Open a Drawing with English Units and 1:1 Sheet Scaling

Open a new English-Unit Drawing in SolidWorks. **It is critical that the drawing, and the eventual DXF, be in English units, or else your parts will come out 25.4 times too big**.

The sheet size is not important – you could make the sheet A, B, C, or D. What is important is that you turn Display Sheet Format off, or else the LaserCAMM will cut every line in the sheet format.

make sure the sheet format is turned off
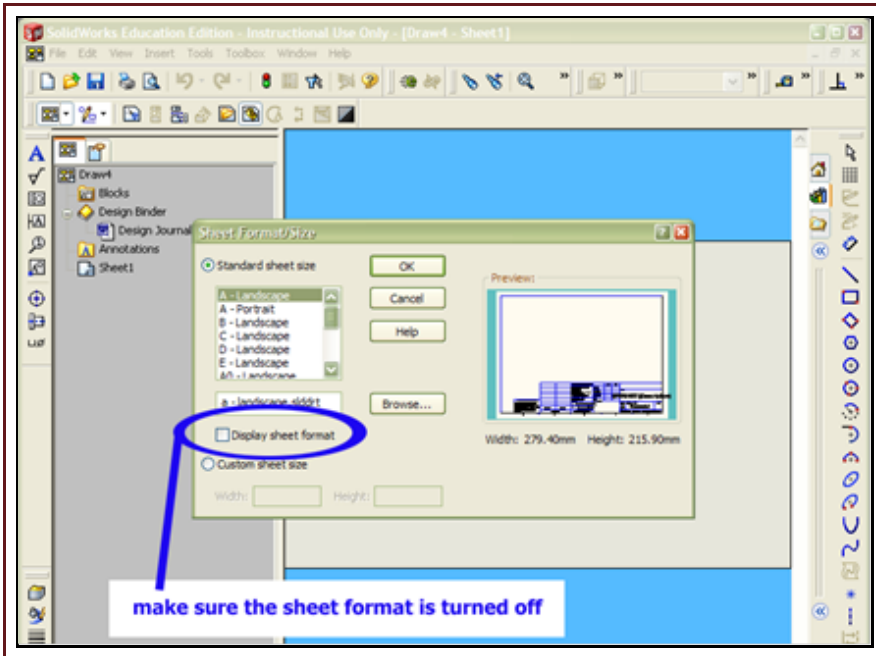
Once the Display Sheet Format is turned off, click OK on the Sheet Format Size window. In the left-hand pane, SolidWorks prompts you to select a model view. Click the "X" button.

click the "X", we'll add model views a bit later
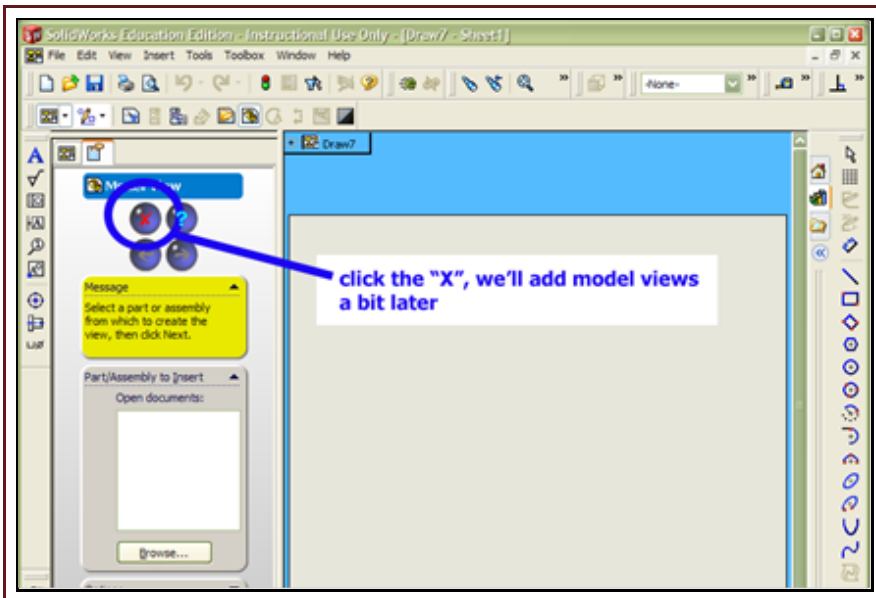
We'll add model views soon, but first we're going to confirm our **units are English** and our sheet scale is **1:1**. Right-click on the gray sheet and select Properties.
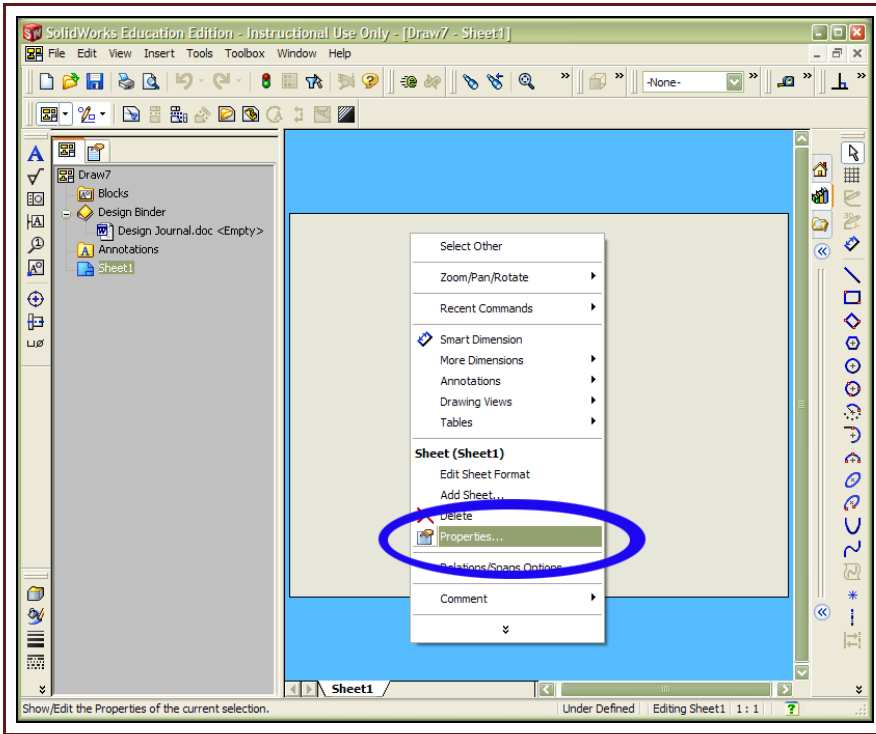
In the properties window, confirm the scaling is 1:1. If your scaling is not 1:1 here, then all the parts on the sheet will come out scaled incorrectly.
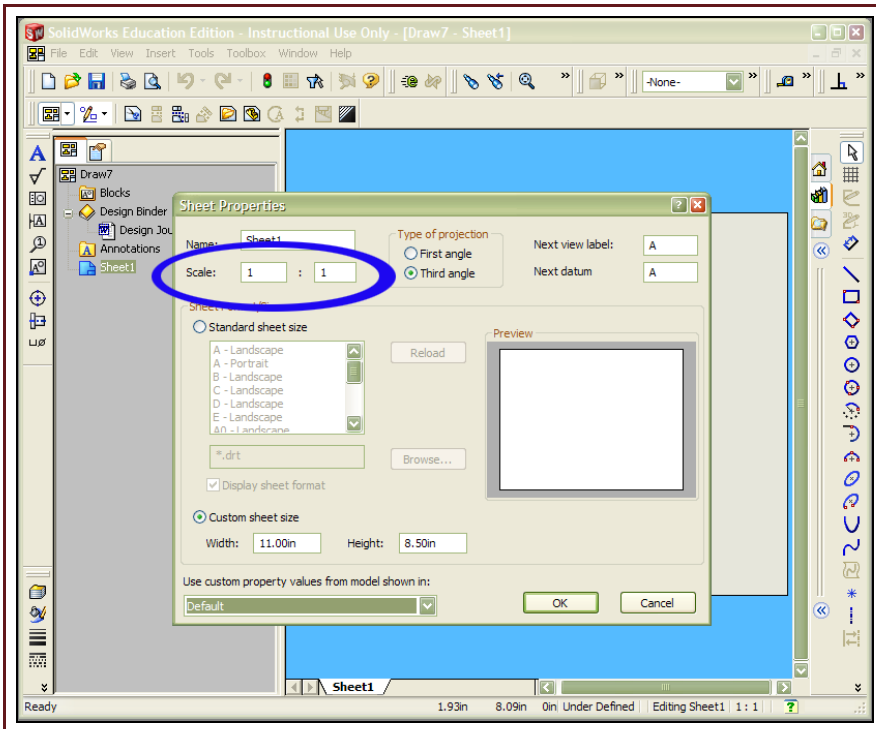

Once the sheet scale is assured to be 1:1, click OK.

If the Sheet Properties window (the window in the last screen shot) displays the sheet size in metric, then we need to correct it to English units. You can change the sheet's units by going to the Tools menu, then Options..., then in the Document Properties tab, selecting Units, and in the right-
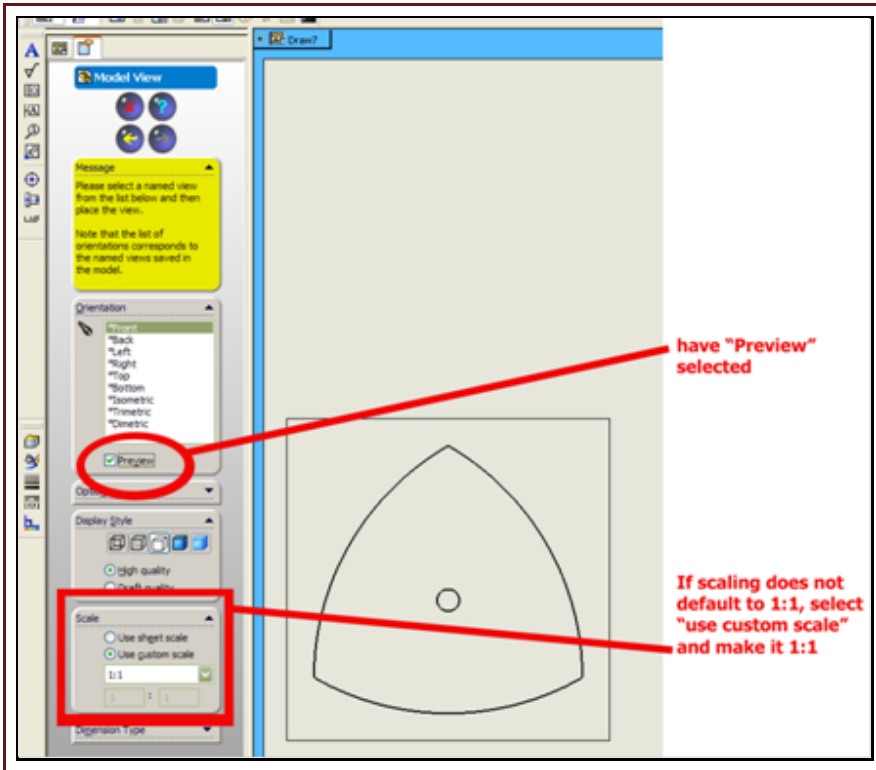
hand Unit System pane, selecting IPS (inch, pound, second).

Add Views of Your Part To The Drawing

To add your part to the blank sheet, go to the Insert menu, then Drawing View, then Model.... In the left-hand pane, browse to your part file.
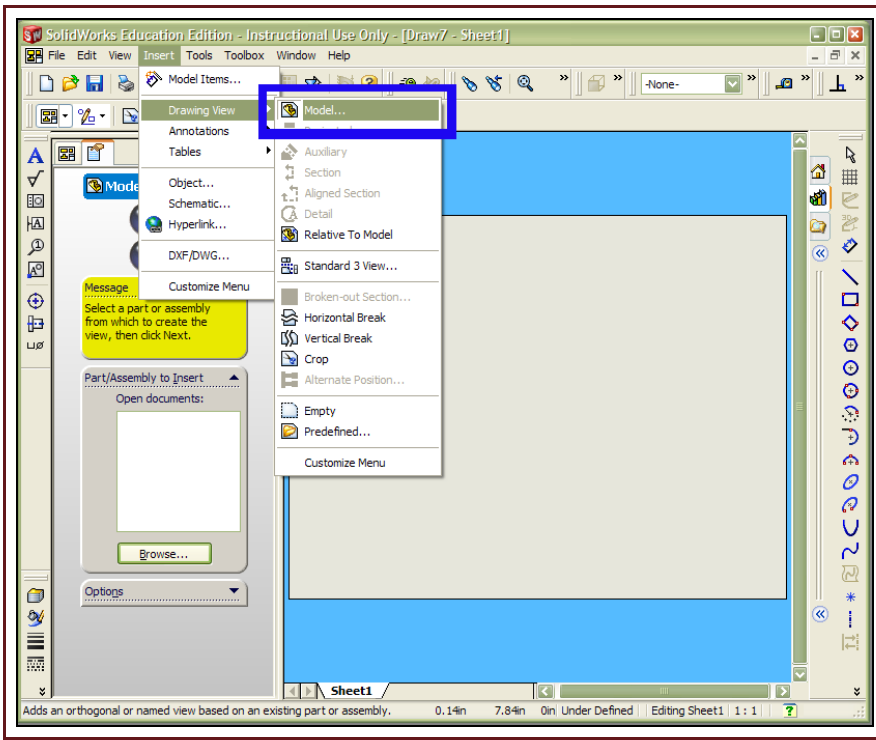
Once you've browsed to your part file, you need to select the Orientation that you want to part to appear on the sheet. It's very helpful to click the Preview button so you can see the part dragging around the sheet. Make sure the view's scale is **1:1** as well:

have "Preview" selected

If scaling does not default to 1:1, select "use custom scale" and make it 1:1

Notice how this drawing view has cross-hatches at the hole's center. Any line on the drawing will be cut by the LaserCAMM, so **delete all cross-hatches, sketching lines, and centerlines if you don't want them cut**:


delete unwanted center marks
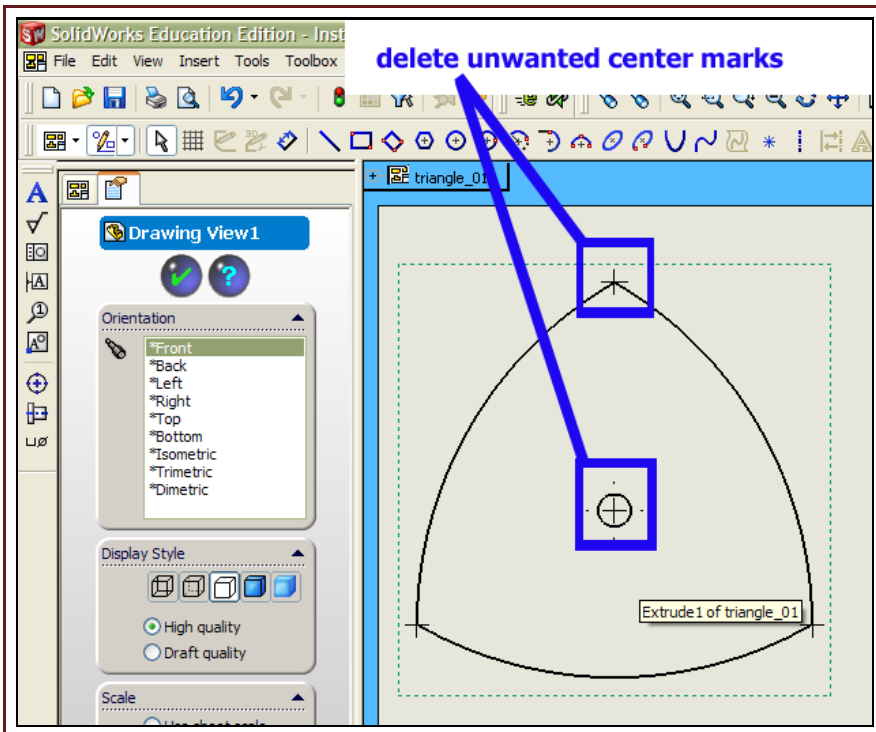
The LaserCAMM requires all lines be in positive coordinates, i.e. the upper-right quadrant relative to

the sheet's origin. A drawing sheet's origin is the bottom left-hand corner. **So all lines must be to the upper-right of the sheet's bottom-left corner**:
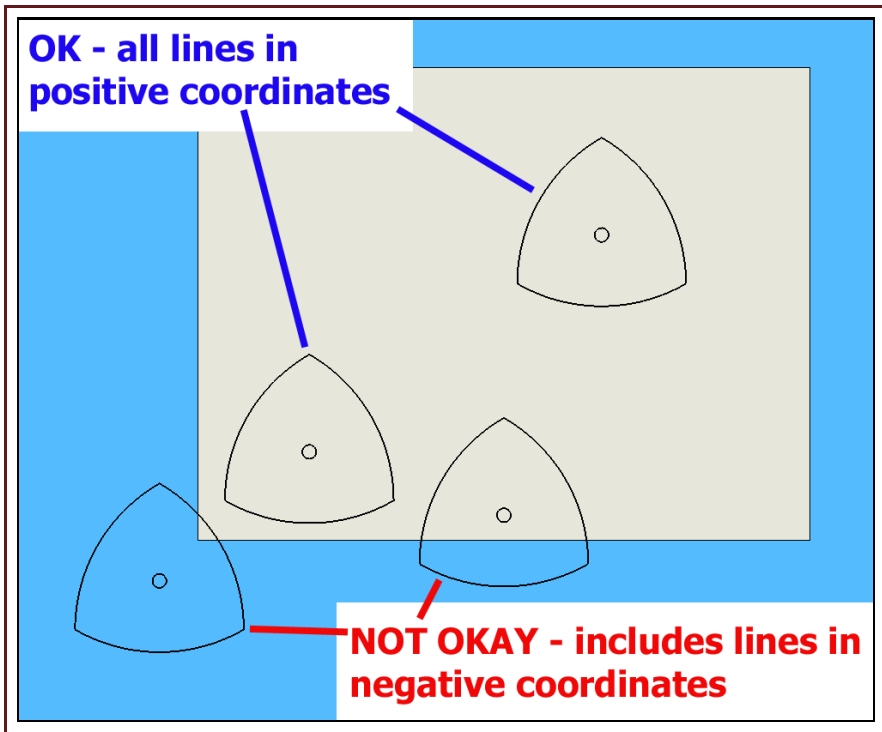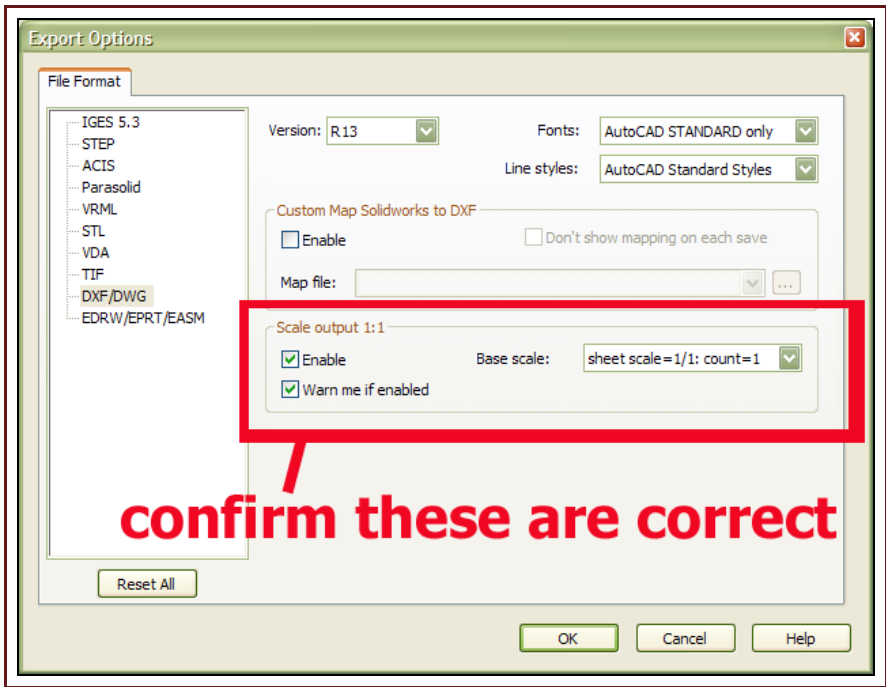

Output A DXF File From SolidWorks Drawing Mode

Once you have all the parts you want onto the sheet, you can Save As into DXF. In the Save As window, select DXF as the file type and click the Options... button:
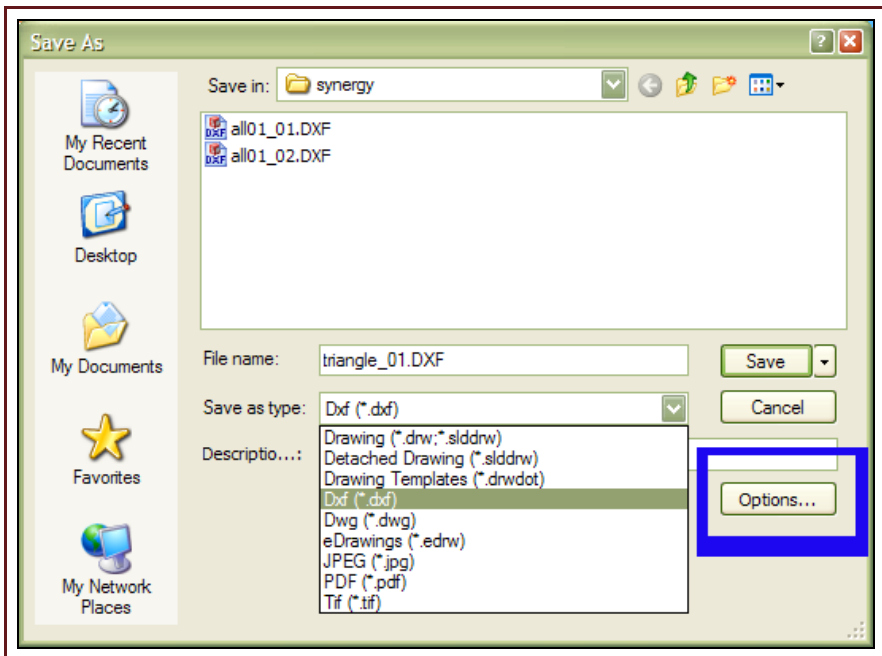
In the options window, make sure you have Scale Output 1:1 enabled, and that the Base Scale is 1:1:

Your DXF file is now ready to get uploaded to the LaserCAMM's computer.

Get Your File onto the LaserCAMM

To transfer your file to the LaserCAMM, you can use any of the following methods:

- **USB / Camera-Type Flash Memory Stick** – The reader works with USB, CF, SD and more.
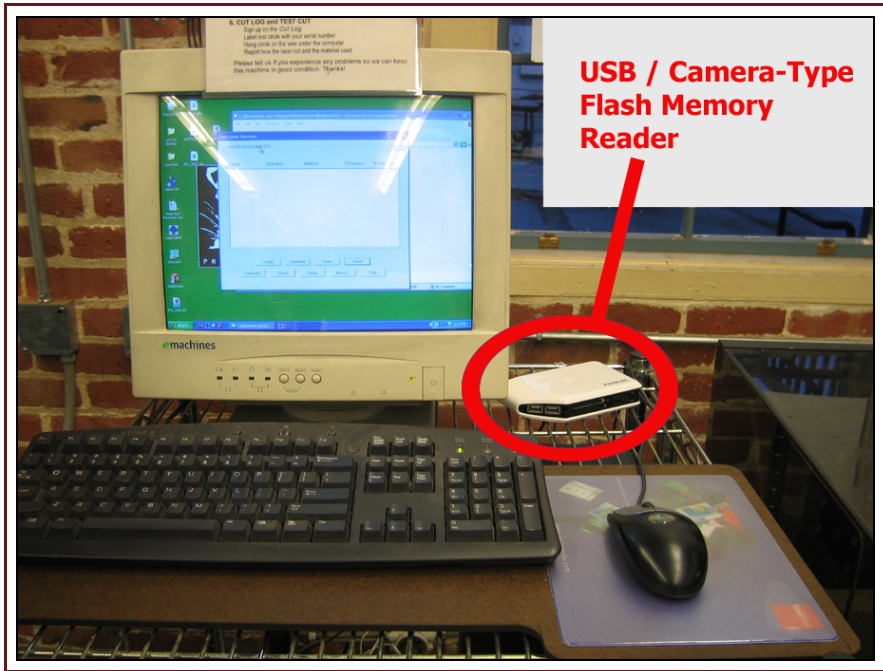
- **AFS home directory** – You can mount your AFS network drive by right-clicking on the PC-Leland icon in the Windows System Tray, and choosing Mount, then Home. You'll be prompted to log-in to PC-Leland. Your home directory will come up as the Z drive.
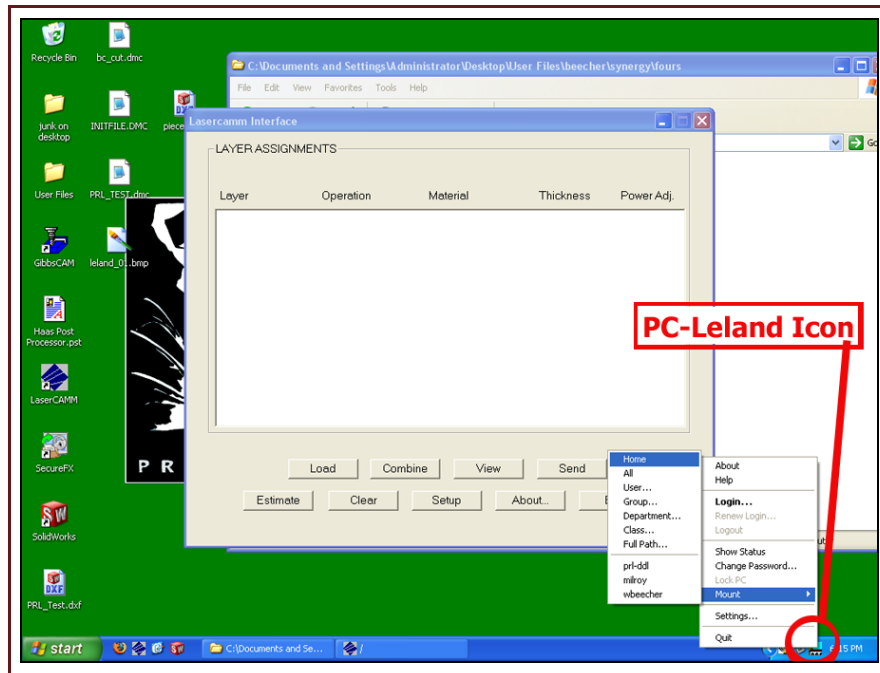
- E-mail it to yourself. The computer has both Internet Explorer and Firefox.

- FTP it to yourself. The computer has SecureFX for FTP'ing.

Working from a DXF file on a removable disk can cause problems. Copy your file onto the LaserCAMM computer. Put it either on the desktop, or make a sub-folder for yourself in the desktop folder named User Files.

NOTABLE: IF YOU HAVE A LONG FILENAME, your file may not transfer to the LaserCAMM. We don't know why this happens, but to be safe, you should always save your file to the desktop with a short name consisting of letters and numbers, such as "myfile1".

Process and Cut the Test Piece

The next step to creating a part on the LaserCAMM is to cut a test piece from your material. We will return to the DXF you just made later, but for now we'll be using PRL_Test.dxf, which is on the desktop of the LaserCAMM's computer.

Launch LaserCAMM Program

Launch the LaserCAMM software by clicking on the LaserCAMM icon on the desktop. The program will look like this:
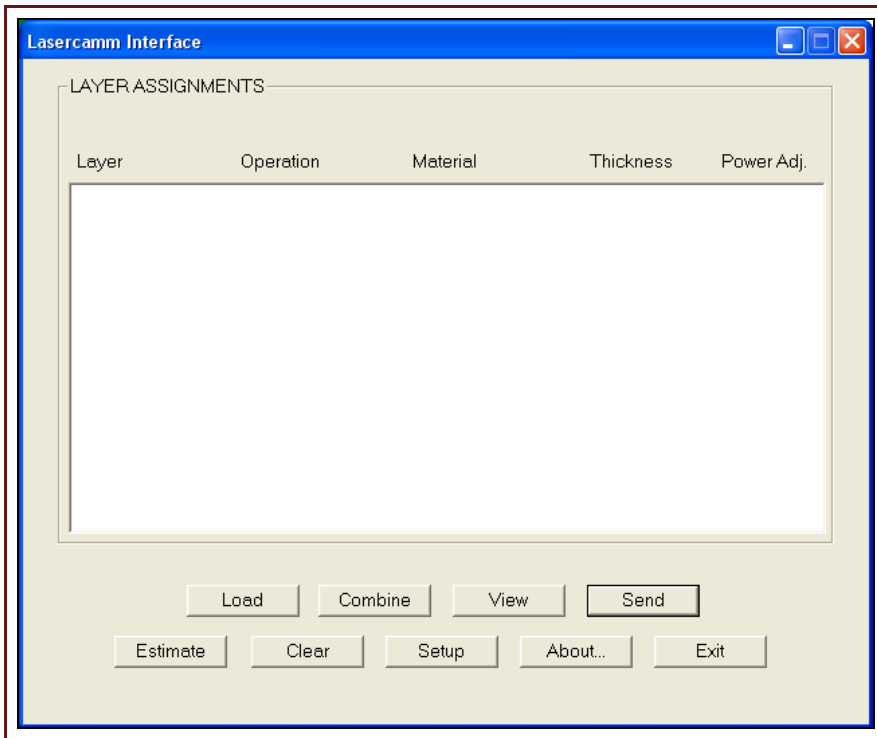
Load DXF file
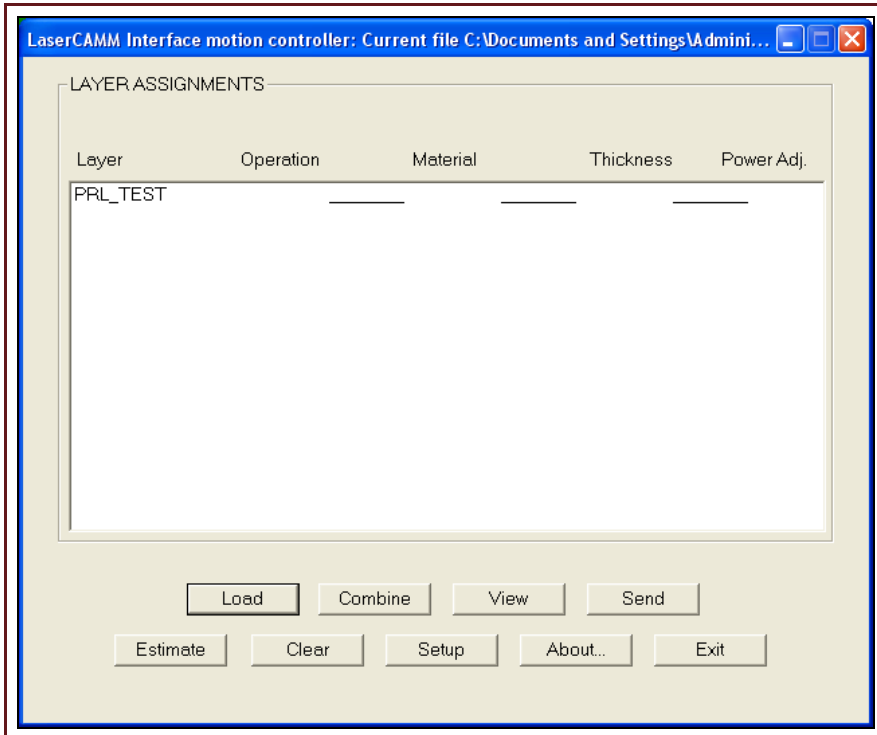
Load PRL_Test.dxf (located in the PRL Test folder) into the LaserCAMM software by clicking on the "Load" button and navigating to the desktop. The program will then display the layers of the drawing as separate text lines in the central white box of its window. In PRL_Test.dxf's case, there is only one layer, named PRL_TEST, as shown in the example below:


Process the PRL_TEST Layer for Paper

The next step in creating a LaserCAMM part is to pick the layer of the loaded drawing you want to work with and specify the operation, material, and thickness for that process. You should always cut your geometry in

paper before you cut it in your final material.

Begin by double clicking on the layer you want to cut. If you did not name your layers, your geometry is probably on Layer 0 or Layer Default. But on the PRL test piece, an advanced user named the one-and-only layer PRL_TEST. Double click PRL_TEST to start. This action will bring up the "Layer Settings" window.
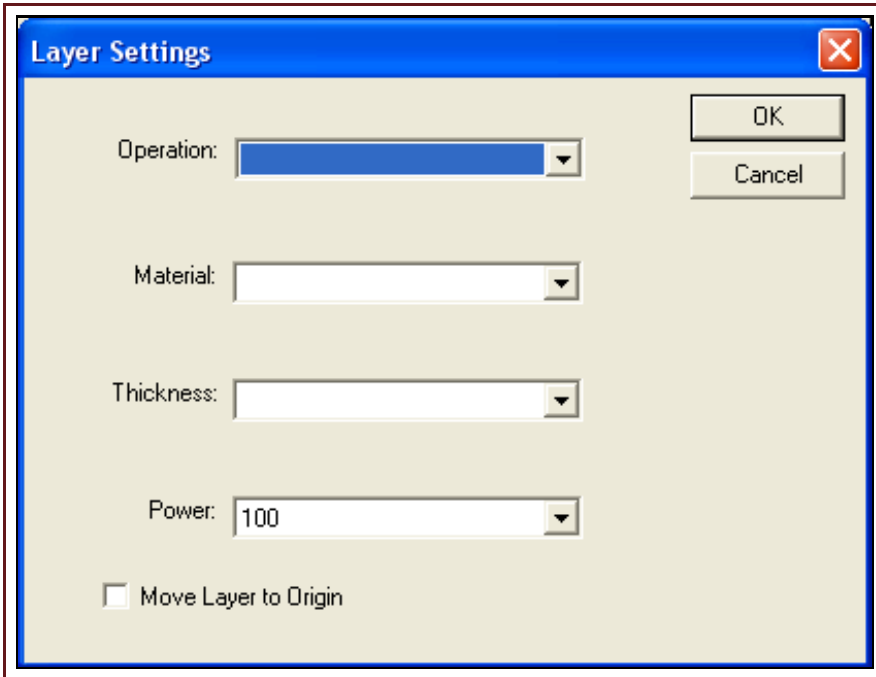
The "Operation" options are Cut, Score-1, Score-2, Score-3, Score-4, Score-5, and Custom. A Cut will fully pierce the material, and Scores only penetrate partway. Score-1 is the lightest score available, and Score-5 is the heaviest. "Custom" allows you to control the laser beam directly, but you shouldn't choose this setting unless you've discussed it with Craig.

The "Material" field includes aircraft plywood, acrylic, butcher paper, PETG, polystyrene, and many others. **If a material is not on this materials list, you may not cut it on the LaserCAMM**. The LaserCAMM is very expensive and some materials can damage its optics.

The "Thickness" options are dependent on the selected material and are displayed in inches. If you have not yet selected a material, no thickness options will be displayed.

The "Power" options adjust the strength of the laser from 90% to 110% in increments of 5%. We have found that leaving this at 100% produces the most consistent results.

Choose the Layer Settings for Cutting Paper

You should always cut your part in paper before you cut in your intended material in order to make sure everything is setup correctly. Cutting in paper will also show you exactly where you need to put your stock. Thus, you should set this layer up to "Cut" on "BUTCHER_PAPER". Choose the thinnest thickness available, 0.005", and leave the power at 100%.

When you have set the layer up to cut paper, press the "OK" button. The program will then process the layer, create the DMC file that will run the LaserCAMM, and save that file in the directory where the DXF resides.
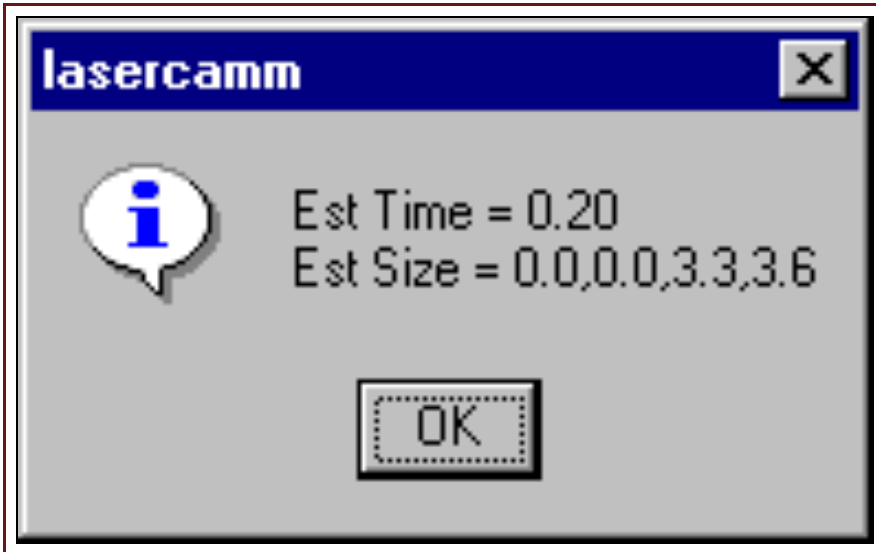
It will also display a small window named "LaserCAMM" that will show you the estimated cut time (in minutes) and estimated size (in inches) from the origin to the farthest points in the geometry.

Take note of the estimated time and make sure you have enough time left in the shop session to cut your part. You should finish before clean-up time begins, which is twenty-five minutes to the hour.

Check the DMC

Now that you've created your DMC file, you should verify that it contains the geometry you intend to cut. Press the "View" button and navigate to your file. It will be named LAYERNAME.dmc and will be located in the same directory as the DXF you originally opened. Click on it, and hit "Open".

The software will then display the path that the LaserCAMM will take to cut your geometry. Dashed lines are rapid moves and solid lines are cuts. Make sure this is the file and layer you want to cut, and then press "Esc" to exit. If nothing appears in the diagram, then there is no geometry on the layer you selected. Go back to the beginning of this step and try another layer or check your DXF.

Note that if you want to cut more than one layer at once, perhaps a cut profile and a score detail or two drawing views that happen to be on different layers, you can process both layers separately and then combine them into one DMC by clicking the "Combine" button. This is an advanced, useful feature.

Cut Test Piece in Paper

Now that you have finished processing your file to cut in paper, you are ready to set up the LaserCAMM machine. Leave the program open on the computer and approach the LaserCAMM.

Turn the Machine On

If the LaserCAMM is off, obtain the LaserCAMM key from the TA (if it's not already in the machine) and insert it into the keyhole switch on the LaserCAMM's front control panel. Rotate the big red emergency stop button clockwise to pull it out and turn the key to "ON".

When the LaserCAMM first turns on, it goes through an initialization sequence and warms up its various components. Wait until the initialization completes (check status on the four-line LCD screen on the upper surface) before you start working with the machine.

Cover the Bed With Paper

The bed of the LaserCAMM needs to be completely covered with the white paper before you run a part. Covering the bed helps the LaserCAMM's fan achieve a strong suction where the laser cuts through. This suction pulls all the smoke down and away from the optics, which keeps them clean and functional.

Covering the bed with paper will also show you exactly where you need to put your material when you do your actual part. Having a couple of small cuts in the paper beforehand is ok, but it should not have any large holes. Ask the TA where the special LaserCAMM paper is kept if you cannot find it.

Send Your DMC File

Next you need to send your DMC file over to the LaserCAMM machine. Back at the LaserCAMM computer, click on the "Send" button in the LaserCAMM program. Navigate to your file, which will be named LAYERNAME.dmc and will be located in the same directory as the DXF you originally opened, click on it, and hit "Open".

The computer will then begin sending your file to the LaserCAMM machine. You can watch the progress of the download by looking at the four-line LCD screen on the machine.

Once your file arrives, the LaserCAMM screen will display information about it:
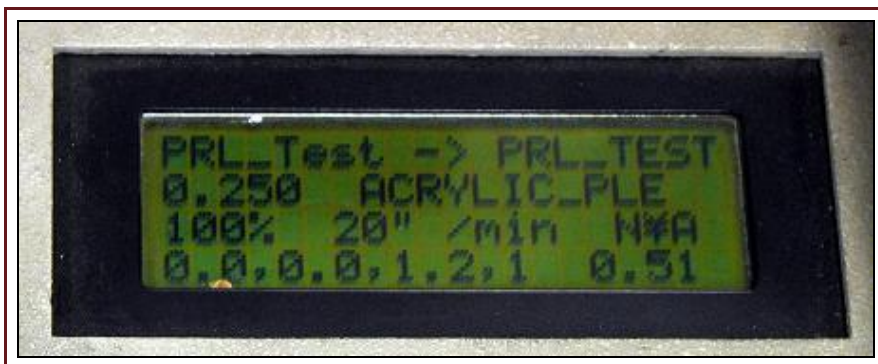
The data on the LCD screen are laid out like so:

filename	->	layer name
thickness	material	
% full power	speed [in./min]	

size		cut time [min.]

Check to make sure all the settings are correct before proceeding to the next step.

Set Laser Focus

The laser needs to be manually focused for the thickness of material that you are cutting. This setting is independent of material type. Locate the head of the LaserCAMM and find the measurement gauge above the laser tip. This gauge reads out part thickness in inches, and you should set it to the thickness of your part. Rotate the top knob, driving the brass cylinder up or down. Move the brass cylinder so that its top edge is aligned with the correct tick mark. For paper, set the thickness to just above zero
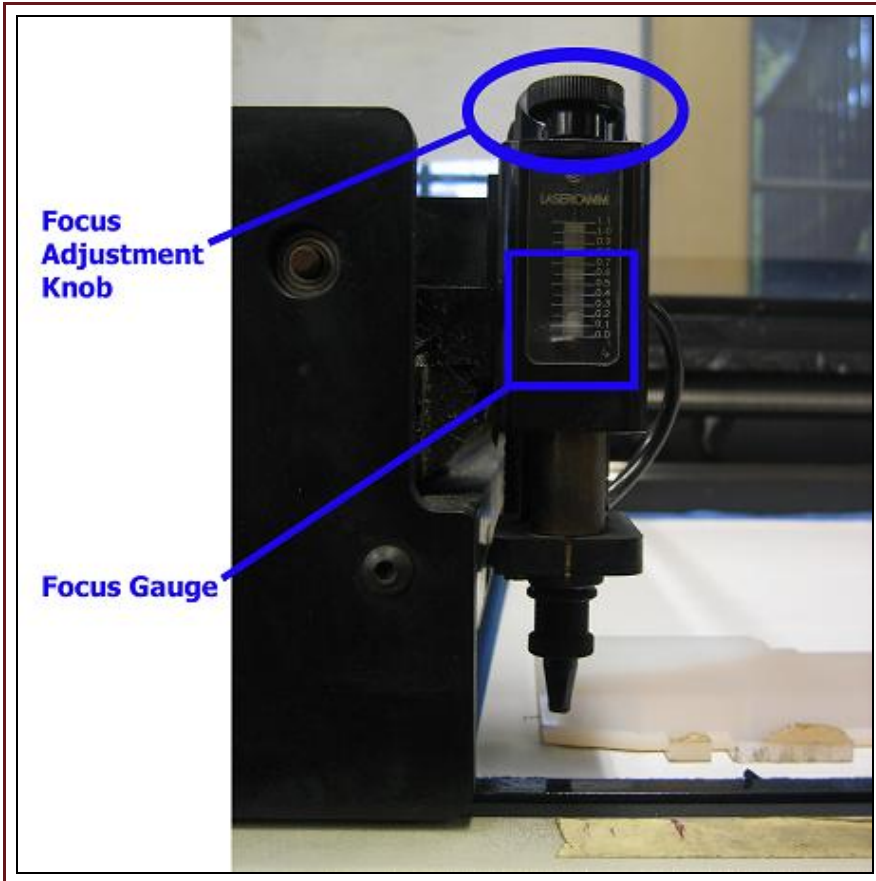
.

Improper focus can prevent the part from being cut all the way through and can leave a crummy surface finish. Drastically improper focus (e.g. set to 0" for 0.5" material) can also cause the laser to crash laterally into your part. Remember to do this step, and do it properly.

Set Origin

If you want the origin of your part to be somewhere other than the default lower-left corner of the LaserCAMM bed, switch the machine into jog mode by pressing the **Jog** rocker switch on the front control panel so its green light comes on. Then use the four arrow keys to position the head in the location where you want your origin. When you are satisfied, turn off the jog mode. This stopped position is the (0,0) coordinate of your drawing. There is no provision for more accurate positioning of the head, but often you won't even need to move it from its default position.

Double-Check Settings

Check the display on the top of the LaserCAMM. Make sure the proper filename, layer, material, and thickness

are listed. Then double-check the laser focus to make sure it is set correctly and make sure the entire bed is covered with paper.

Cut the Test Piece in Paper

Before you actually cut your file, it is important to know what you should do if something was to go wrong while the LaserCAMM was running. The biggest hazard when LaserCAMMing is that the material inside the LaserCAMM can catch fire if the settings are incorrect. Such a fire can do serious damage to the machine and could endanger shop users as well.

The first thing you can do to prevent such a scenario is **to make sure you understand how the LaserCAMM works**, check to make sure your settings are all correct, only cut approved materials, and ask a TA if you have any questions or concerns whatsoever.

The second thing you can do is to **pay full attention to the machine while it is cutting**. Once you do turn it on, you should always be within arm's reach of the machine, and you should be watching it continuously to make sure nothing is going wrong.

The third thing you can do is to **act quickly if you see a fire starting. Press the Square Red Stop Button as soon as possible**. Pressing this button will stop the LaserCAMM and return it to its home position, away from the fire. Pressing the emergency stop is not as good of an option because it kills all power to the machine, leaving the laser right above the fire, which is very bad for its optics and electronics. After you press the **Stop** button, yell for the TA, open up the cover, and remove the fire from the LaserCAMM. If you do everything correctly, the material should never catch fire.

Now that you know what to do if something goes wrong, you're ready to cut your part in paper. Press the **Green Square Start Button** to run your file. The LaserCAMM will sit still for a few seconds and then go cut your part. It will cut the geometry in a somewhat random order. Watch it throughout the cut time and make sure everything is going correctly.

If you want to pause the machine in the middle of the work, you can press the **Pause** button (top rocker switch) and cutting will stop at the end of the current command. Lifting the LaserCAMM cover will also stop the laser from cutting. Be sure to wait at least 1 minute before pressing the **Start** button again. Failure to do so can send the cutting head crashing into the stops and ruin the alignment of the laser beam. It has been found that stopping in the middle of a program can cause the machine to restart improperly. If this happens, press in the big red button, wait one minute and then rotate the big red button out. Wait for the machine to initialize. Your file should still be there ready to cut. If this does not remedy this situation, report the problem to a TA.

Reprocess Layer for Your Material

Once you have cut your test piece in paper, you are ready to cut the test piece in your material. To do so, you have to reprocess the DXF's layer and re-send the .dmc file.

Reprocess the same drawing layer to specify the operation, material, and thickness for your final part. Below,

we are configuring the "Layer Settings" window to cut the PRL_TEST layer in .250" acrylic plexiglass:
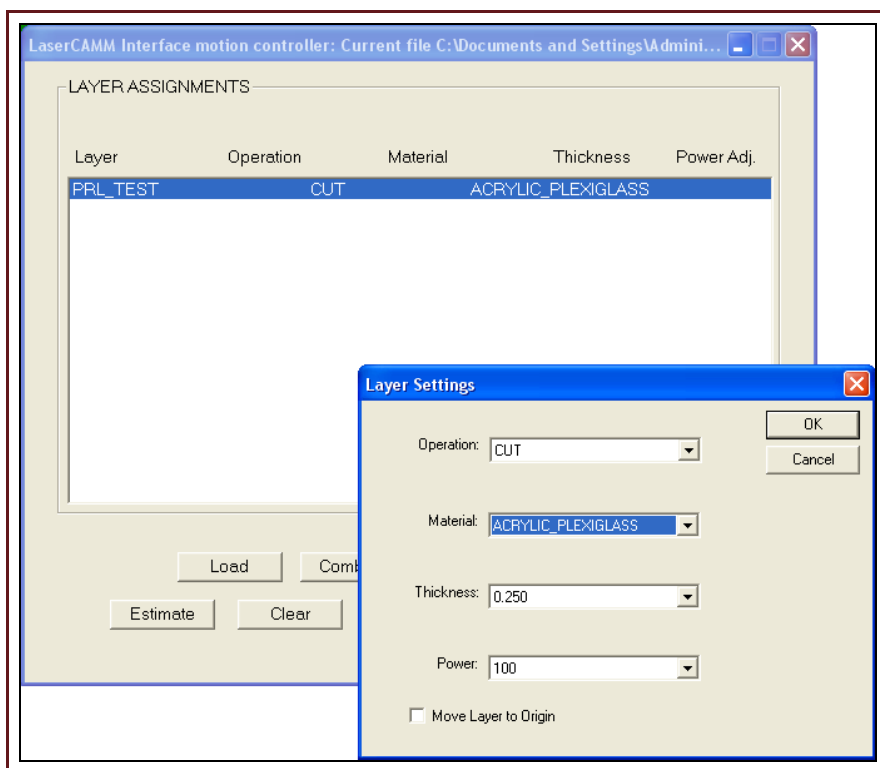
When we click "OK" in the Layer Settings window, the program will again display a small window named "LaserCAMM" that shows the estimated cut time (in minutes) and estimated size (in inches) from the origin to the farthest points in the geometry.

Take note of the estimated time (which will be longer than it took to run in paper) and make sure you have enough time left in the shop session to cut your part. You should finish before clean-up time begins at twenty-five minutes to the hour.

Cut Test Piece In Your Material

Now that you have finished processing your file to cut in your material, you are ready to setup the LaserCAMM machine to cut your part.

Prepare Your Material

Remove any paper or plastic covering that may be on your stock. This applies to acrylic plexiglass's paper or thin-plastic covering. Coverings can interfere with the laser's ability to penetrate the material and can compromise the quality of the cut. It's also famous for catching fire.

A large roll of 24"-wide masking tape is available at the PRL. **Applying this masking tape to the front and back of material will prevent scorch marks from appearing on the material**. This masking tape is a valuable resource for aesthetic pieces, but we ask you not use the masking tape unless a beautiful finished cut is required (e.g. do not use the masking tape for robot parts).

Remove Paper Parts From The LaserCAMM Bed

The cut paper acts as a good guide to show you where to put your material, but it should not stay underneath your part while it is cutting. Leaving the paper there causes it to burn and smoke and can damage the surface finish on your material.

Hold the outer edges of the paper still and carefully remove the paper cutouts of your parts.

Position your material

Place it where the LaserCAMM is going to cut your parts. Make sure every cut will be contained by your stock so that the high-power laser beam will never hit the paper.

Send Your DMC File

Back at the LaserCAMM computer, click on the "Send" button in the LaserCAMM program. Navigate to your newly processed file, which will be named LAYERNAME.dmc and will be located in the same directory as the DXF you originally opened, click on it, and hit "Open".

The computer will then begin sending your file to the LaserCAMM machine. You can watch the progress of the download by looking at the four-line LCD screen on the machine.

Once your file arrives, the LaserCAMM screen will display information about it. For our .250" acrylic plexiglass test piece, the LCD screen looks like:
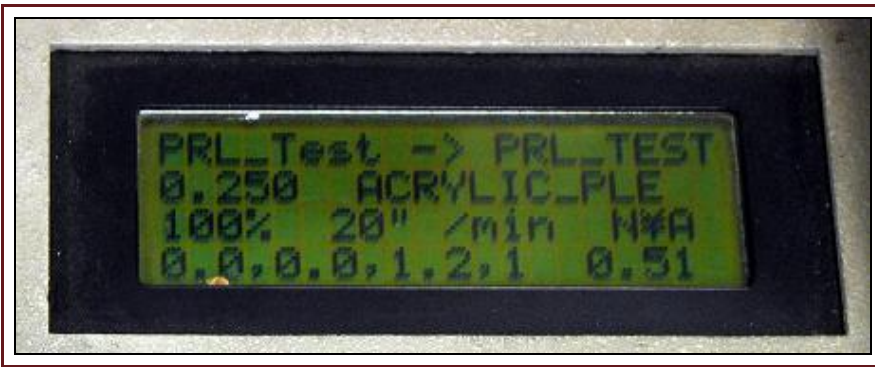
Check to make sure all the settings are right, especially material and thickness, before proceeding to the next step.

Set Laser Focus

The laser needs to be manually re-focused for the thickness of material that you are cutting. This setting is independent of material type. Locate the measurement gauge above the laser tip, and set it to the thickness of your part in inches. Rotate the top knob, driving the brass cylinder up or down. Move the brass cylinder so that its top edge is aligned with the correct tick mark.

Improper focus can prevent the part from being cut all the way through and can leave a crummy surface finish. Drastically improper focus (e.g. set to 0" for 0.5" material) can also cause the laser to crash laterally into your part. Remember to do this step, and do it properly.

Double-Check Settings

Check the display on the top of the LaserCAMM. Make sure the proper filename, layer, material, and thickness are listed. Then double-check the laser focus to make sure it is set correctly. Make sure your material is positioned in the right spot and the rest of the bed is covered with paper. Also make sure there is enough time left in the session to cut your part.

Cut Your Test Piece

Press the Green Square Start Button to run your file. The LaserCAMM will sit still for a few seconds and then go cut your part. It will cut the geometry in a somewhat random order. Watch it throughout the cut time and make sure everything is going correctly.

Press the **Red Square Stop Button** if anything goes wrong.

Press the red square "Stop" button if you see a fire starting.

Press the green square "Start" button to cut a file.

Add Your Test Piece to the Chain and Fill-Out Cut Log

Show the TA on duty your test piece. The TA will evaluate whether the cut is sufficient to continue cutting the given material on the given settings.

Look at the Cut Log taped to the LaserCAMM lid (see below image for location). You will enter your test piece's information on this log. Use a sharpie to label your test piece with your serial number. Hang your test piece on the chain of test pieces. Fill out the Cut Log with your information.

Cut Log

Chain of Test Pieces
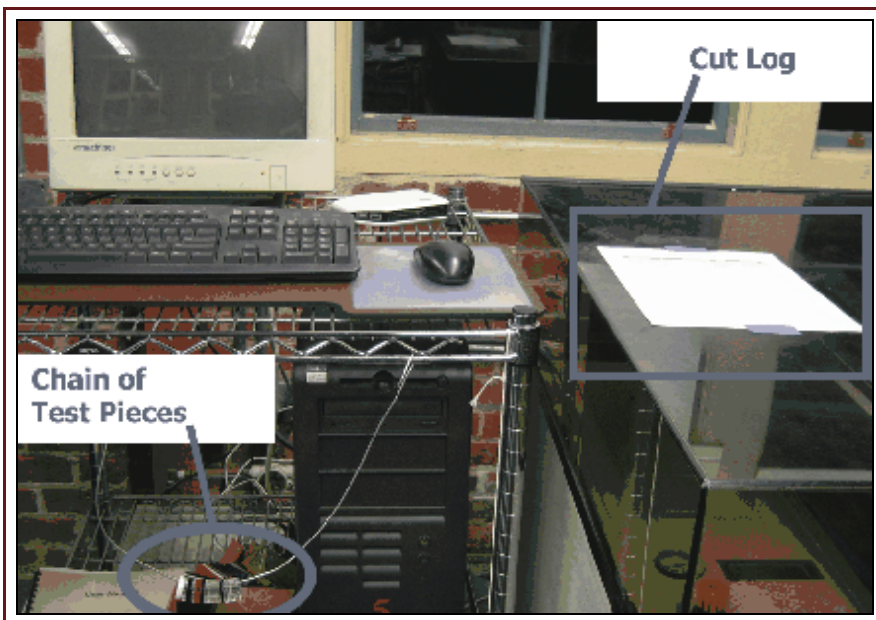
Process And Cut Your DXF

The procedure for cutting your part is the same as for the test piece:

- launch LaserCAMM program
- load DXF file
- process the desired layer for paper
- cut your part in paper
- process the desired layer for your material
- cut your part in your material

See the previous section for details on each step.

Clean Up

When your part is done, go through the following steps to clean up the area and prepare the machine for the next user:

- Remove your part from the bed of the LaserCAMM.

- If you have excess material that you don't want, please donate it to the shop's LaserCAMM scrap pile. Someone else will be very happy to use it. If your scraps are very small, make sure you throw them out.

- Replace the cut-up paper on the bed of the LaserCAMM with nice new paper.

- Delete your DXF and DMC files from the desktop of the LaserCAMM computer.

- Straighten up the surrounding area and sweep the floor.

- Ask the TA on duty to give you a 5-minute shop job if you're done for the session.

Appendix A: Creating and Cutting Text and Fonts

Method 1: Creating text from Solidworks

1. Create text in a Solidworks sketch:
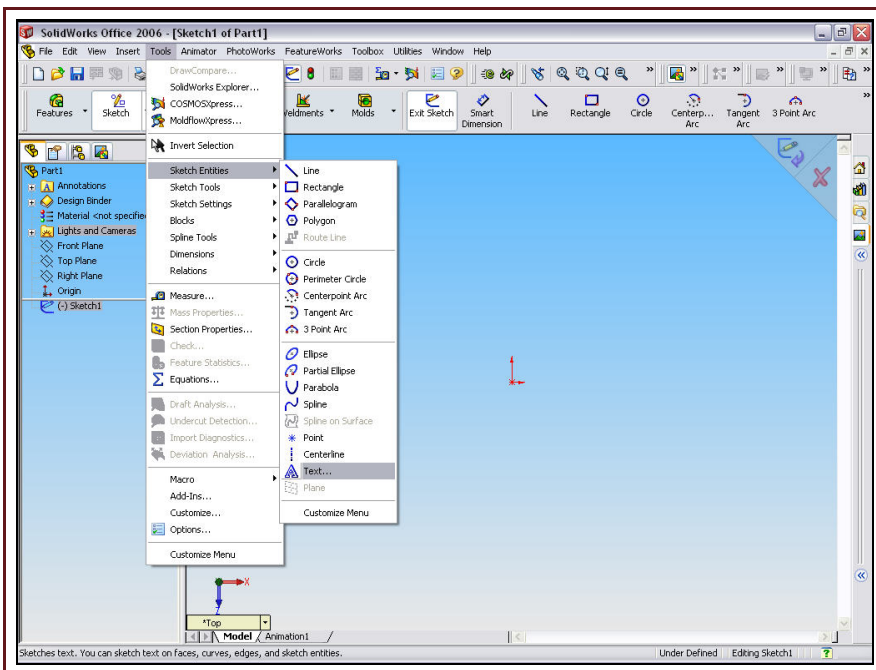
2. In Sketch Text dialog Box uncheck **Use Document Font** and then click **Font...** button.
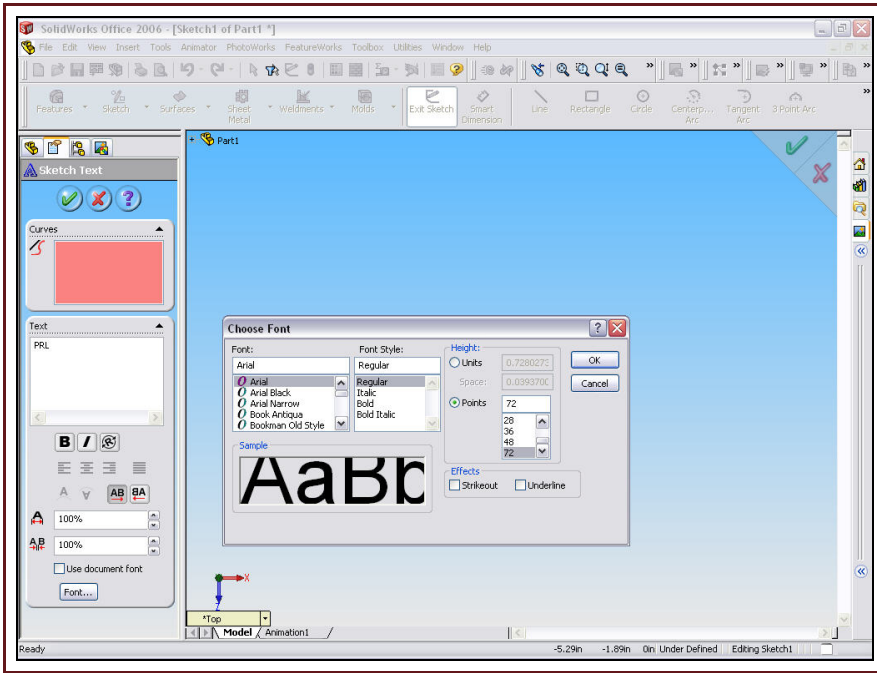
3. Close the sketch and extrude the text. Keep the extrusion depth small.
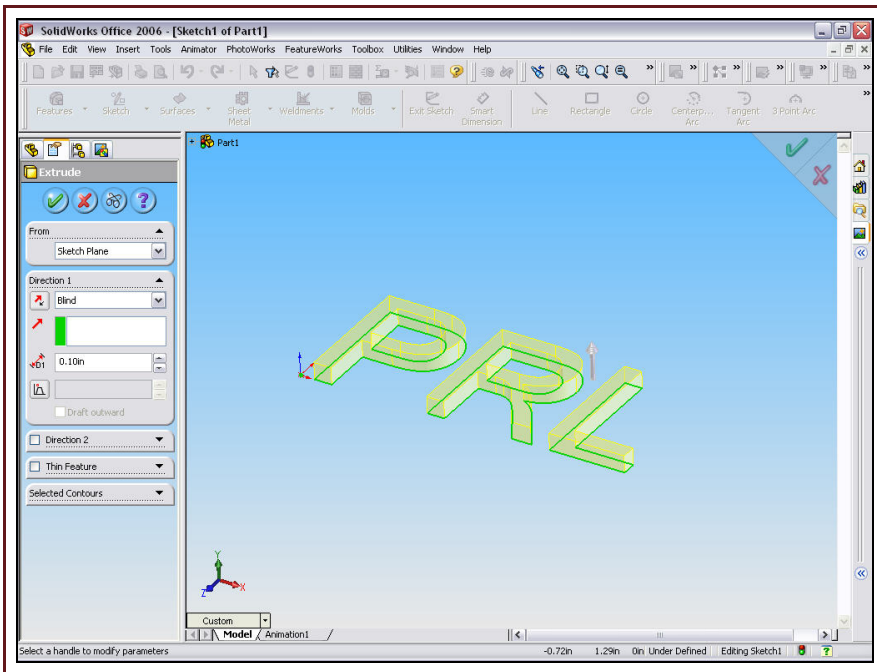
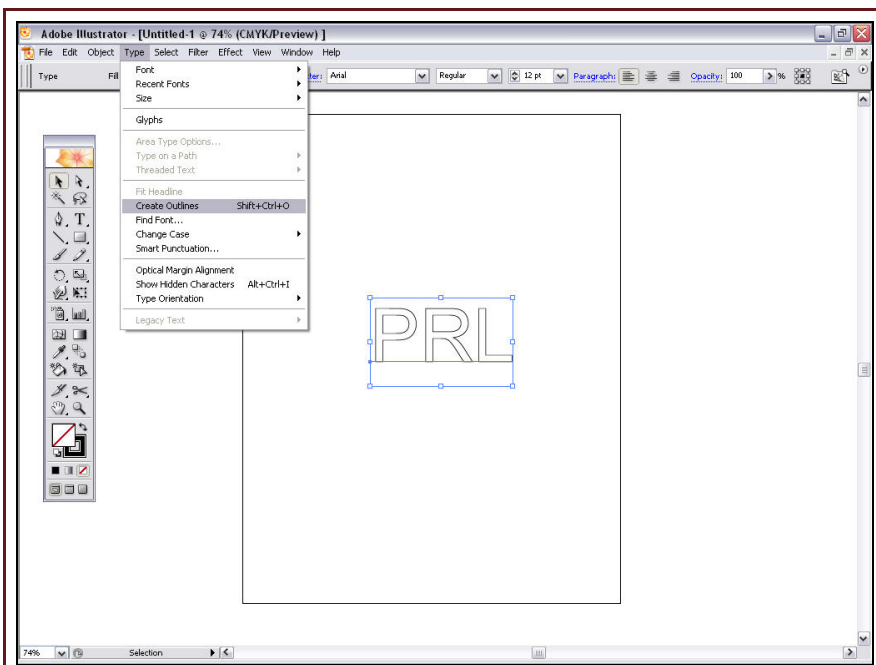4. Return the sketch model to its Top plane view.
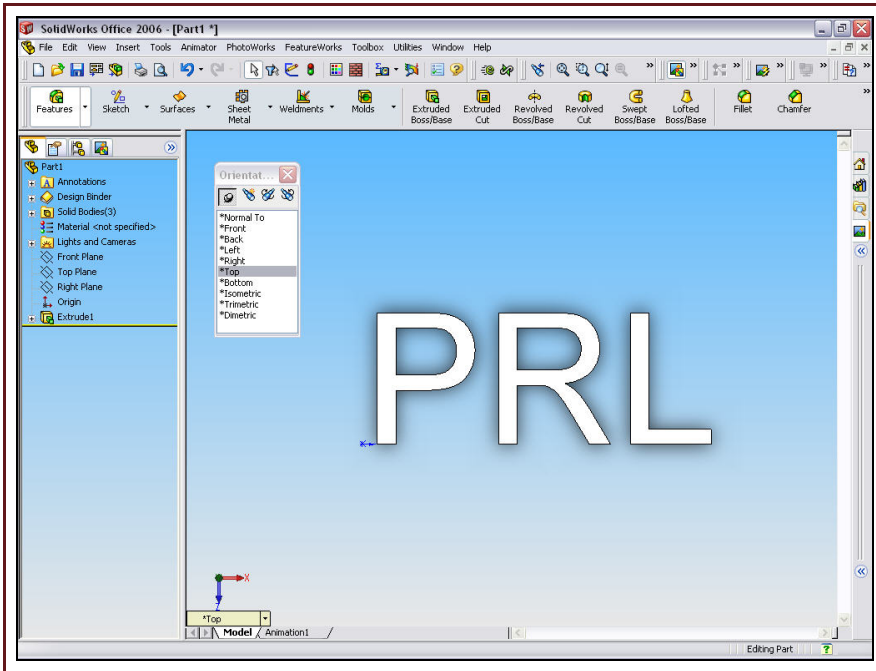
5. Make Drawing from Part as you would normally do when preparing Solidworks part files for the LaserCAMM. See Page 5 of this manual for step-by-step instructions.

Method 2: Creating Text from Adobe Illustrator CS2

This method isn't quite as dependable as the Solidworks method but can be useful if you have a design that is easier to create in Illustrator. Unfortunately, Illustrator usually exports the .dxf file into an exceptionally large scale. **You must check the scale in Solidworks before cutting otherwise you will get an 'outofbounds' error in the LaserCAMM software.** This brief tutorial shows the entire setup step-by-step.

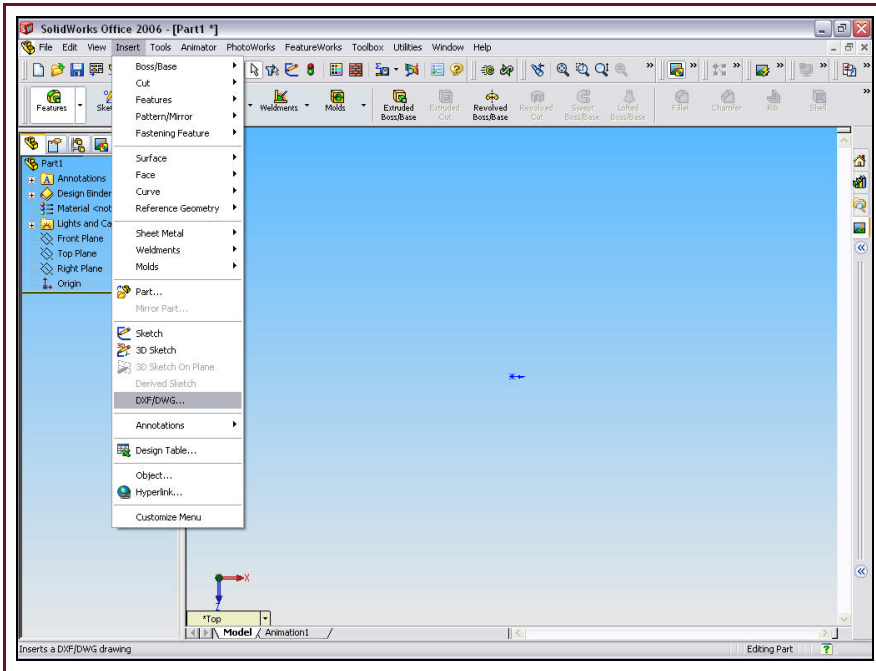1. Select Text and Use Create Outlines Tool:

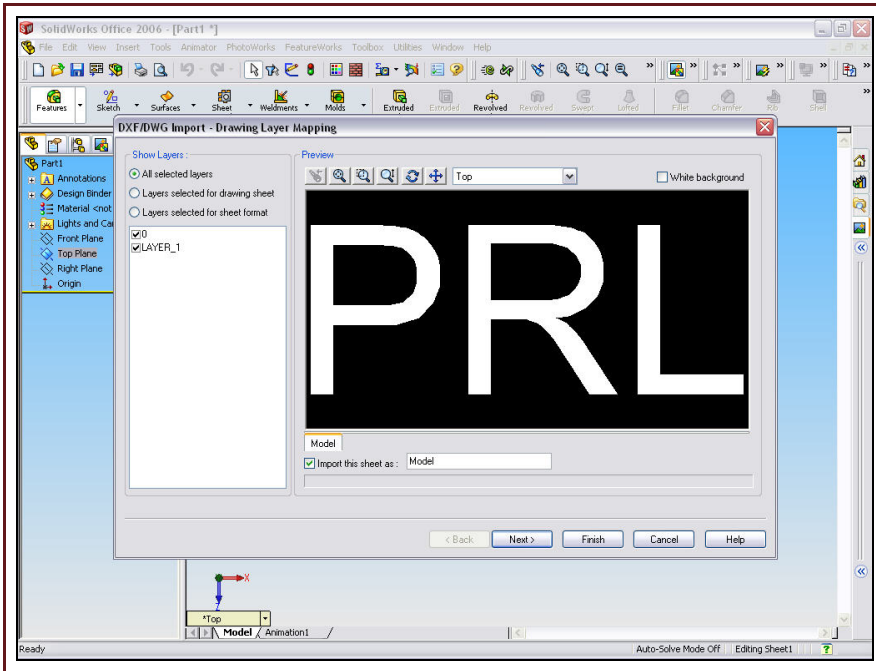2. Export text from Adobe Illustrator into .dxf format
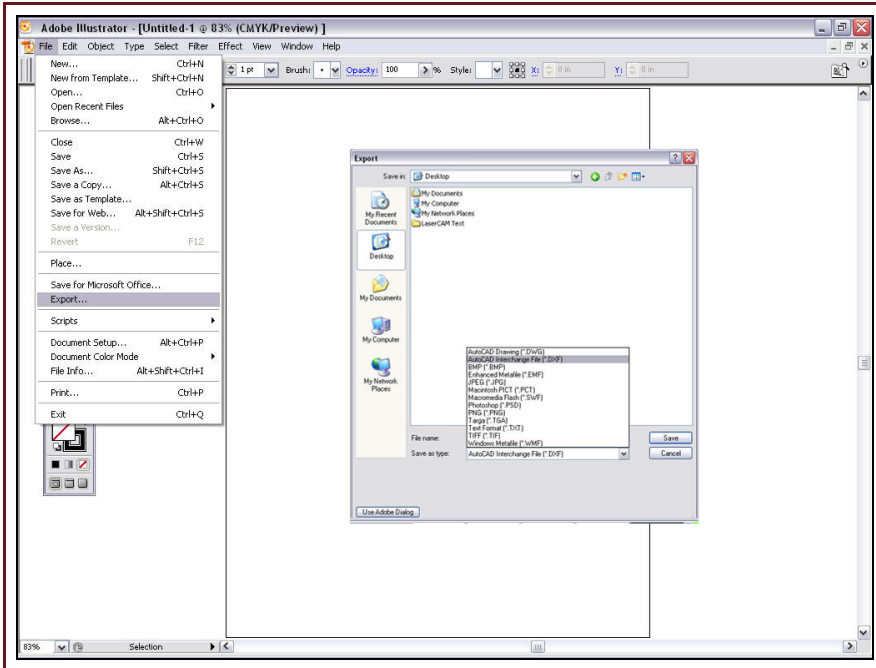
3. Leave all default options except check **JPEG** rather
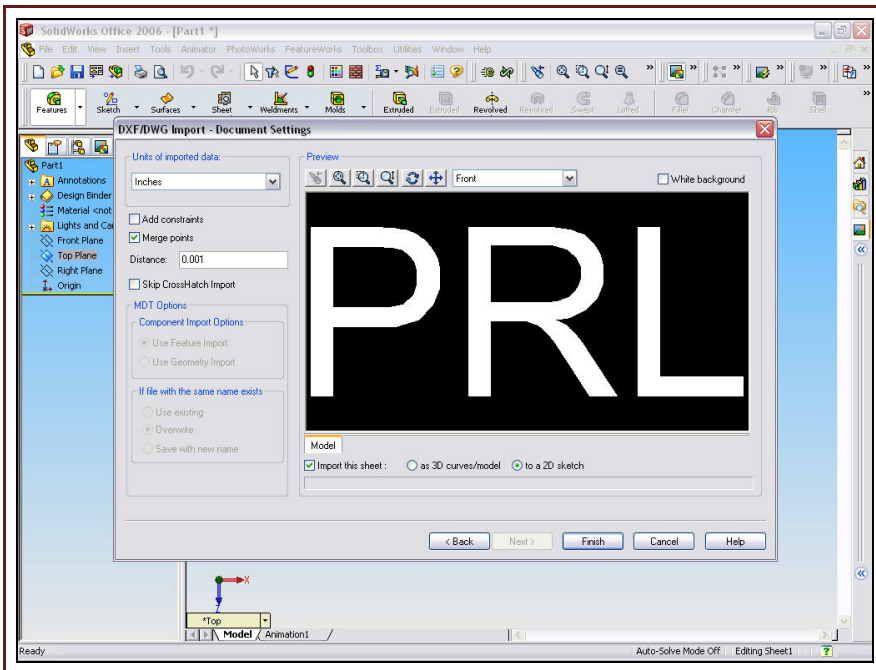then **BMP**. Click **OK.**
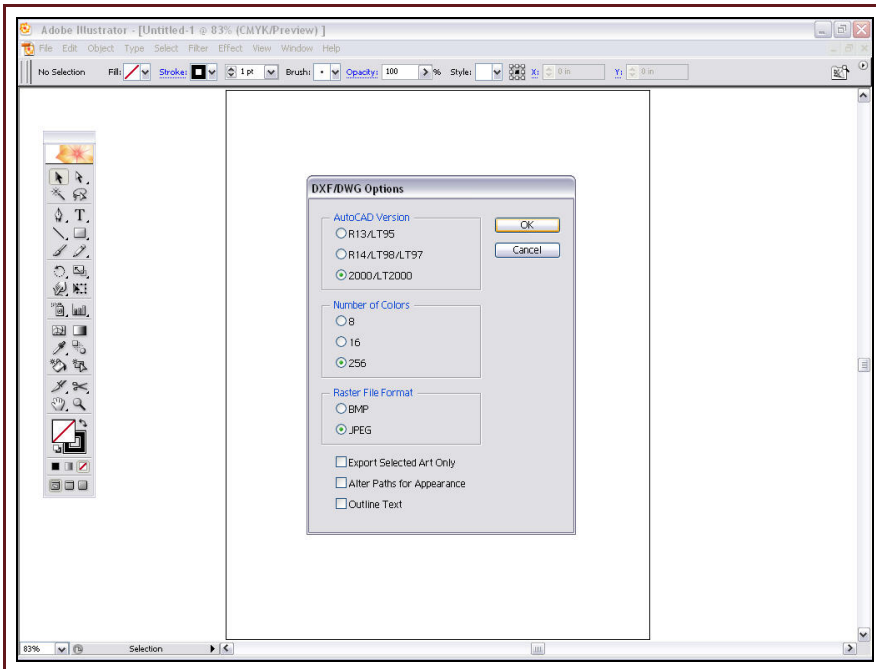
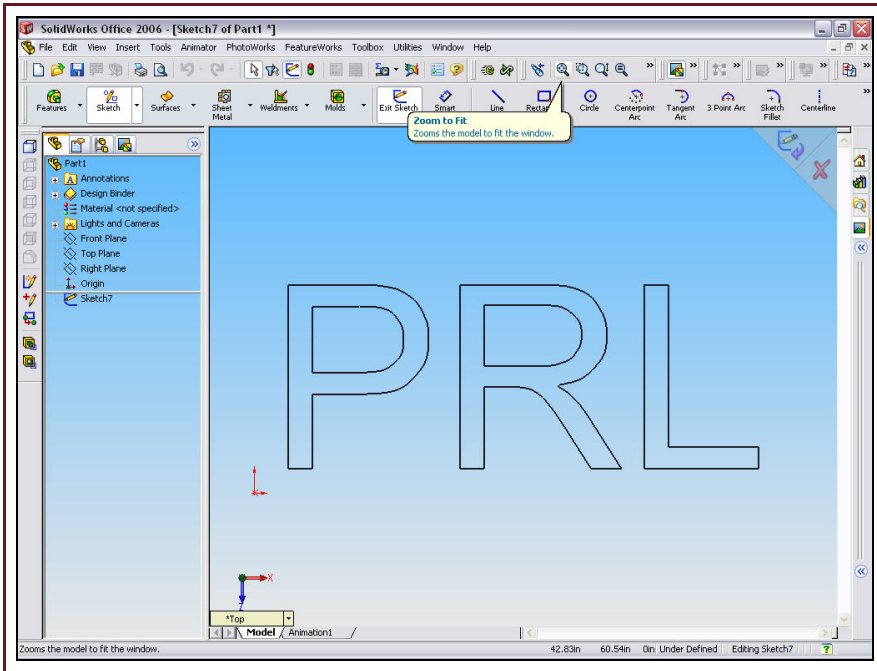4. Import your .dxf file into a new Solidworks Part.
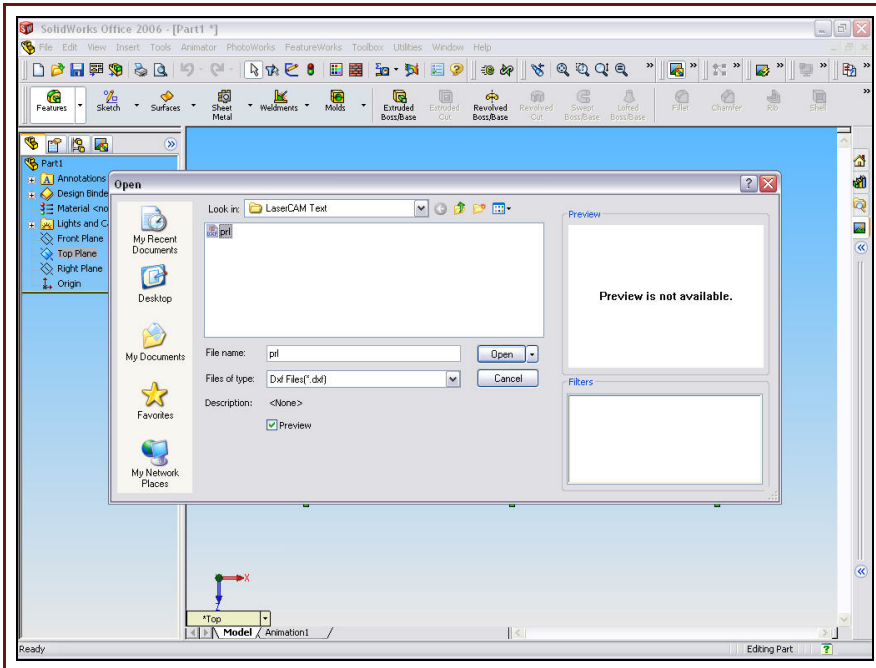
5. In DXF/DWG Import dialog box leave all default options checked. Click **Next.**
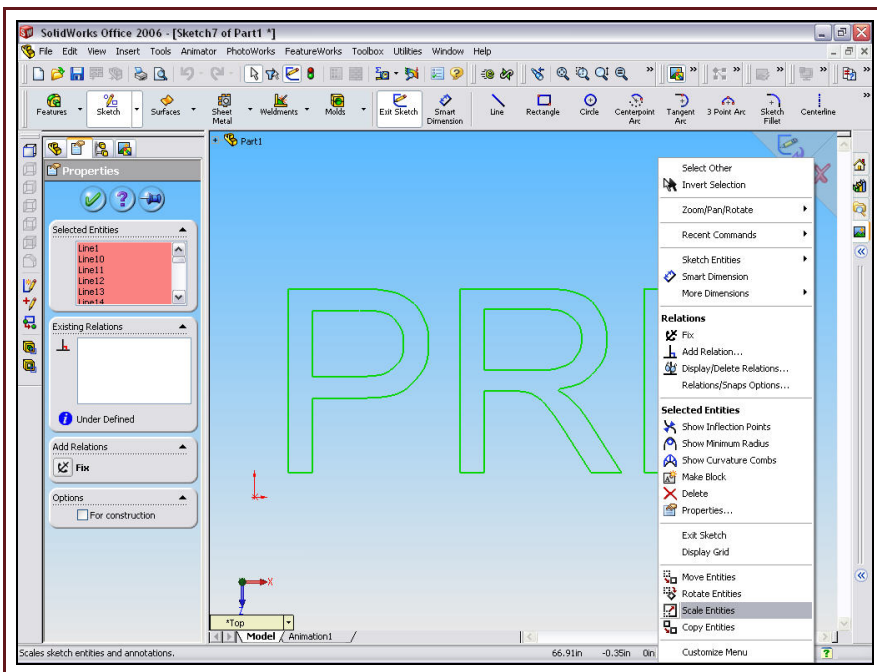
6. Select **Import this sheet: ---- to a 2d sketch.**
Click **Finish.**

7. The text will most likely be imported in a much
larger scale. Click**Zoom to Fit** to see it.

8. While still in sketch mode, select the text and scale it to the appropriate size. Save sketch.

6. Make Drawing from Part as you would normally do when preparing Solidworks part files for the LaserCAMM. See Page 5 of this manual for step-by-step instructions.