# Using the CNC Plasma Cutter (Torchmate)

Digital Media Lab Tutorial
Written by: John Eberhart

Create a Profile to Cut

The Plasma Cutter reads DXF profiles. Create or open your profiles in Autocad and scale them to the size you need to cut. DO NOT include the material blank dimensions in your drawing.

The max bed size for the plasma cutter is 94" long by 47" wide.

Note: profiles and openings inside the profiles all need to be closed as well, and holes cannot overlap each other.
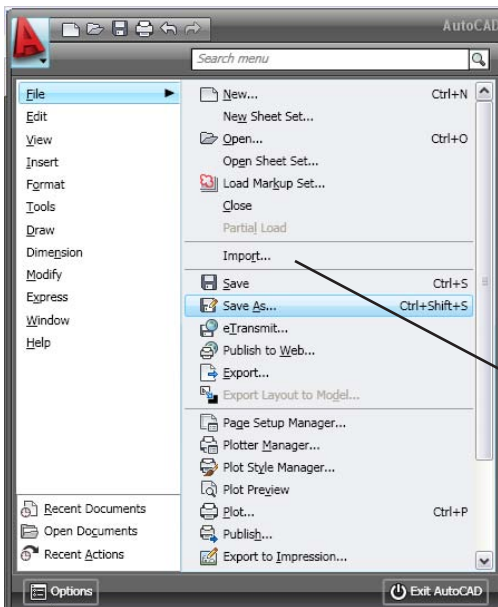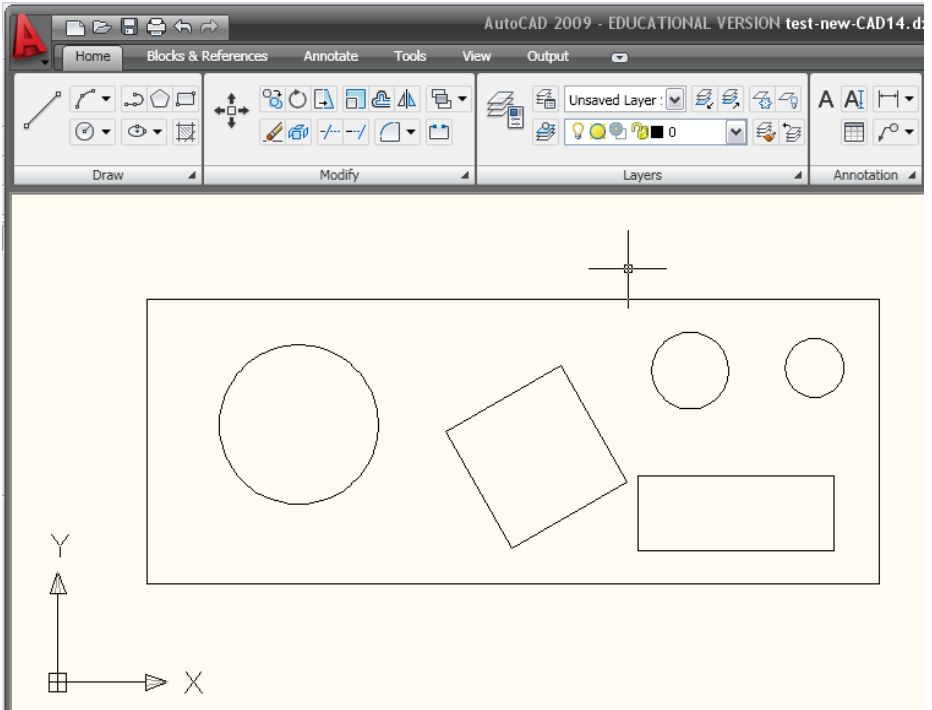
Click on **File > Save As** to save your file as a DXF File Format.

Save your file to **E:\temp** and create a folder with your initials.

For "Save as Type," select:
AutoCAD 2000/LT 2000 DXF

NOTE: When you draw shapes in programs like AutoCad, using arcs, line segments, etc., the resulting cut will be the same bunch of arcs and lines. This will cause the torch to go on and off after each segment, travel in unpredictable directions, etc.
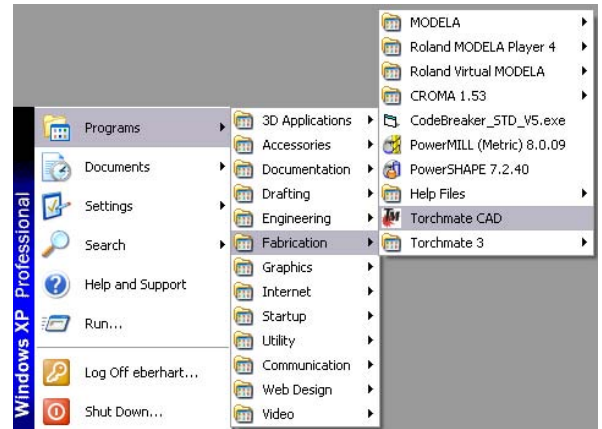
The shape must be converted into a continuous outline, without any breaks.
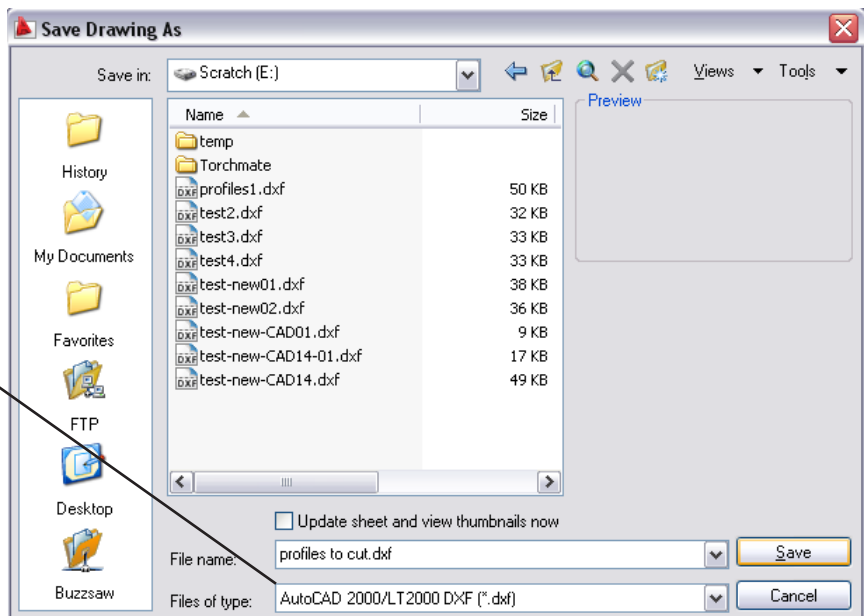
Open the Torchmate CAD Software

Torchmate CAD generates the tool paths for the plasma cutter.
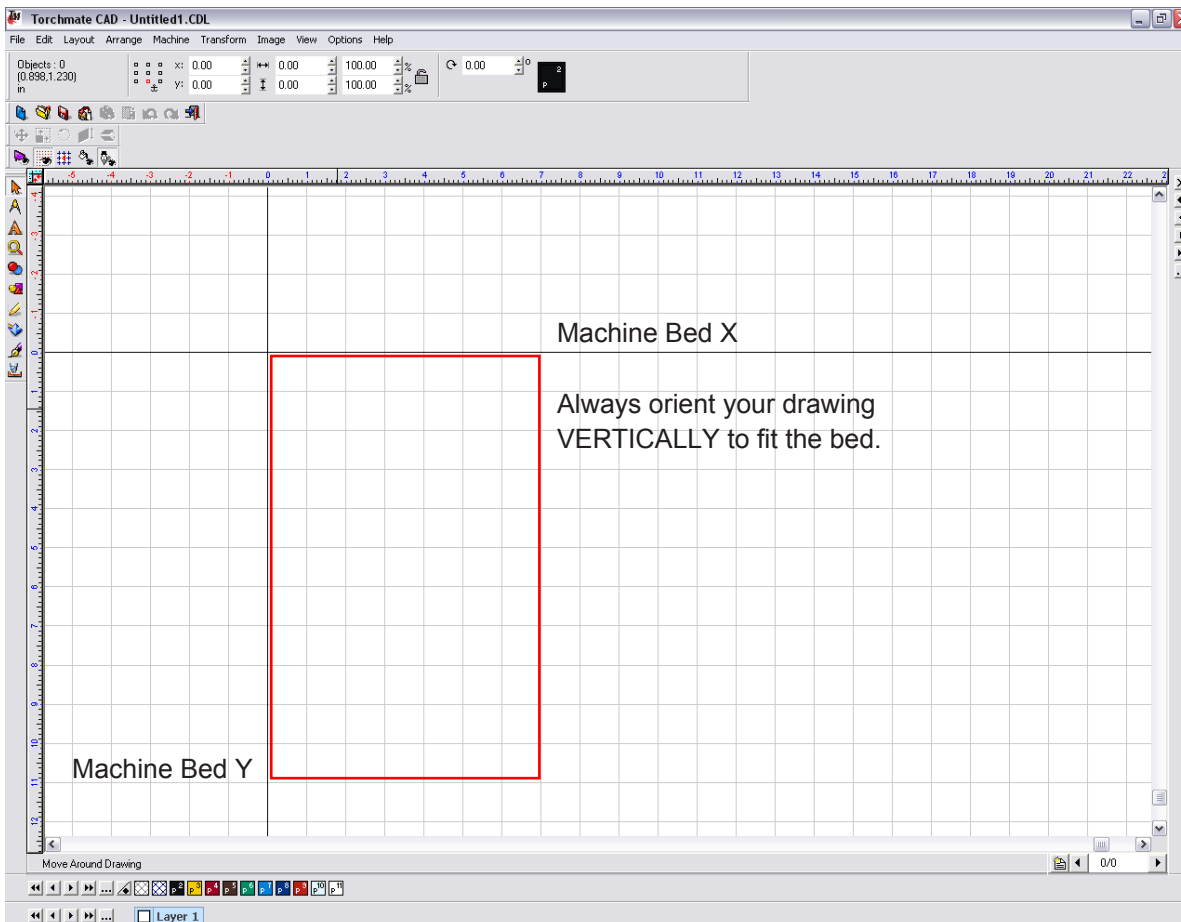
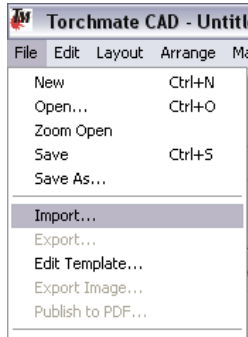Select **Start > Programs > Fabrication > Torchmate CAD** to launch the program.

If Custom Shop Palette Wizard window appears, click **Cancel** to exit the wizard, which is not used by YSoA.

Machine Bed X

Always orient your drawing VERTICALLY to fit the bed.
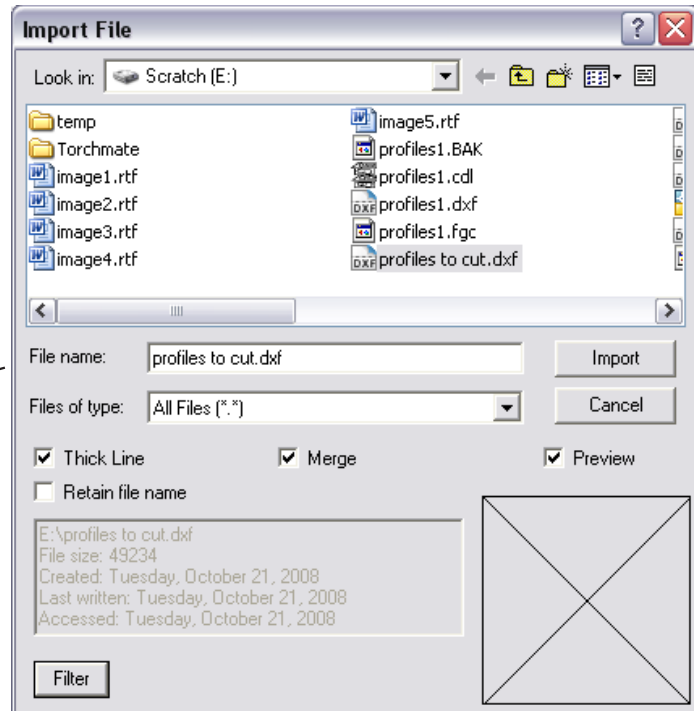
Machine Bed Y

Import the DXF file:
choose **File > Import**

In the **Import File** window, choose the DXF file to import.

Make sure **Thick Line**, **Merge**, and **Preview** options are all checked, then click **Import**.

In the **DXF Import Options** window:

Under "Import objects as," choose **Polyarcs** for files consisting mainly of curved lines, or **Polygons** for files with mainly straight lines.

Under "Scale options," select the scale of your file.

Other options can be left at defaults.

When finished, click **OK** to import the file.

NOTE: Keep in mind that polyarc profiles require more moves, making them more difficult to cut, and will therefore cause more problems than polygon profiles.

If you have an intricate design with a lot of polyarc cuts you will have better luck on the FLOW JET
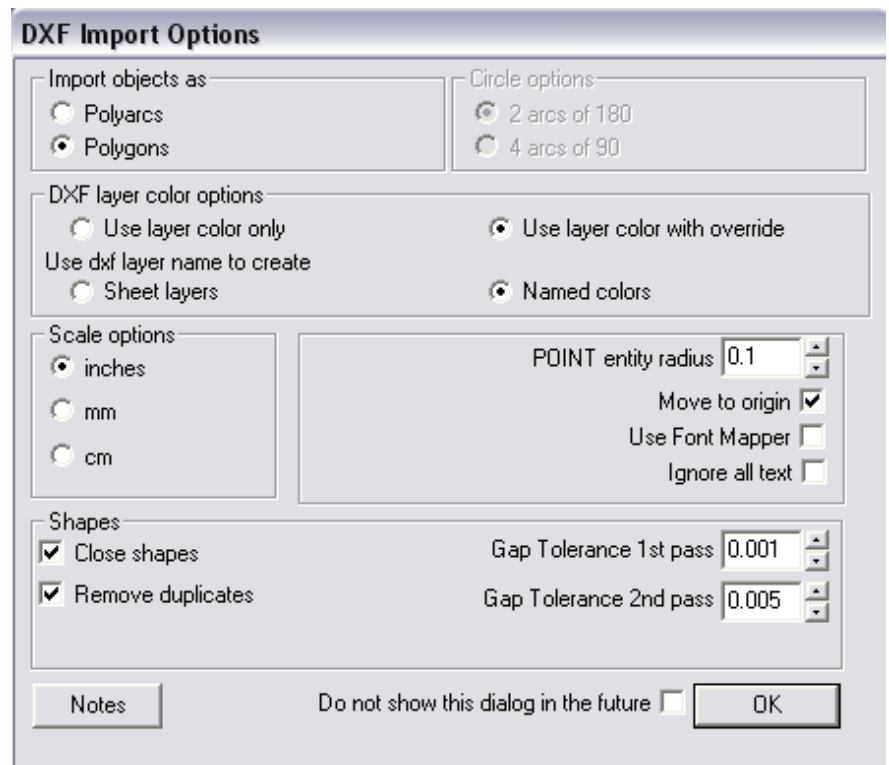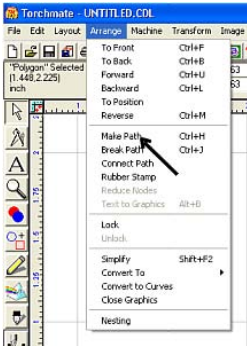
Your profiles should be loaded. Verify that there were no translation errors and everything looks correct.

Closing gaps and correcting line direction in the CAD Module.

Highlight the entire shape with your mouse by clicking on the arrow icon and dragging a box around the shape.

Next select **Arrange > Make Path**

Zoom in on one of the breaks between the lines. Next, double click on one of the lines to be joined. Small blue nodes will appear on the ends of the two lines as shown below. Disregard the small window that appears.


Move your cursor over one of the two blue nodes until your cursor becomes a small cross. Left click on it and it will become red. Now press the shift key, and left click on the other blue node. They will now both be red.

Move your cursor away a short distance and hold the right mouse button down. The small icon group shown below will appear. Move the cursor over the top center icon while the right button is down. Release the right mouse button, and the two line segments will be joined.
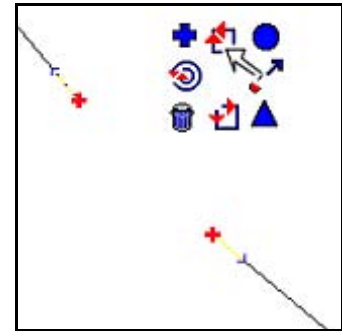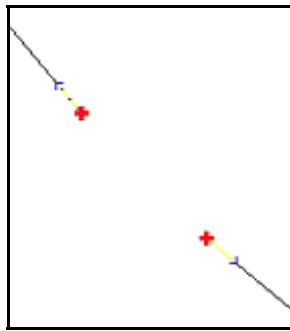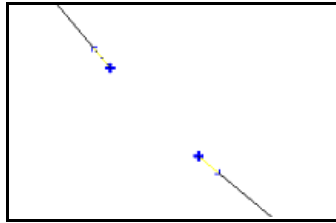
Perform the same operation with each gap in your shape. When all are closed, you will have one continuous shape.

The direction the lines were originally drawn in AutoCad will no longer matter.
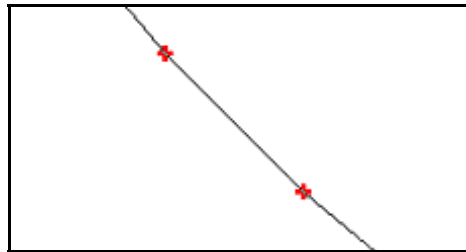
Verify you are not Grouping the profiles with the tool path.

Choose **Option > Torchmate Setup > Tool Path Preferences**
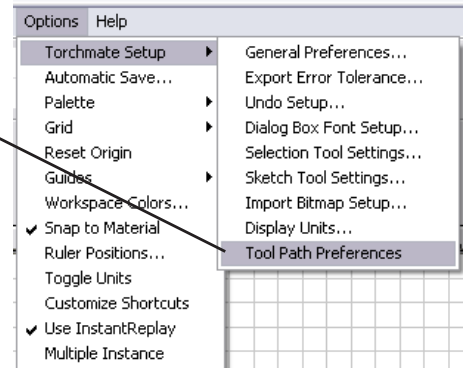
Verify that "Group tool paths with originals" is **UNCHECKED.** If this is set incorrectly the plasma cutter will cut your profiles twice.

NOTE: If your profile is positioned horizontally it will not path correctly on the machine bed, which is oriented vertically.

Select your profiles by drawing a selection box around the objects and choose:
**Arrange > Transform > Rotate**

Creating the Tool path:

Select your profiles by drawing a selection box around the objects.

Click on **Machine > Create Tool Path > Online, Male,** or **Female**

If you are cutting a piece with interior holes, choose **Female**. If cutting a single solid piece with no interior holes, choose **Male**. If you are cutting a piece drawn without considering the male/female problem and with no lead in/out then use **Online**.

NOTE: Simple **Female** tool paths will generally compensate for interior holes within a larger exterior cut and place the lead in/out correctly. When cutting more elaborate pieces it is advisable to create two seperate drawings for male and female paths. Each drawing should have a registration dot or line in the lower left corner to accurately line up the dual paths on the machine.
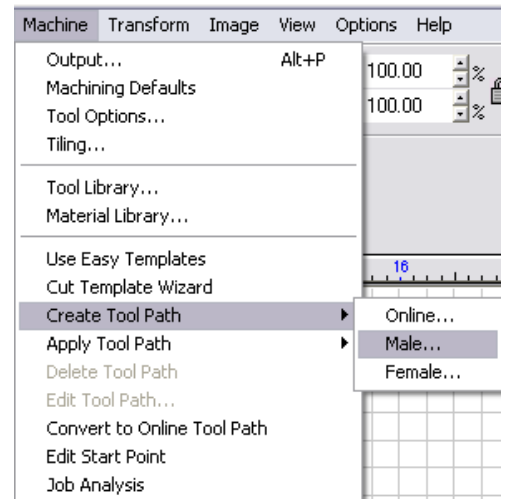
Setting the Tool path Options:

You will be using only the **Basic Cut** and **Lead in/Out** tabs to start with. The **Template** tab is used for advanced features that YSoA does not use.
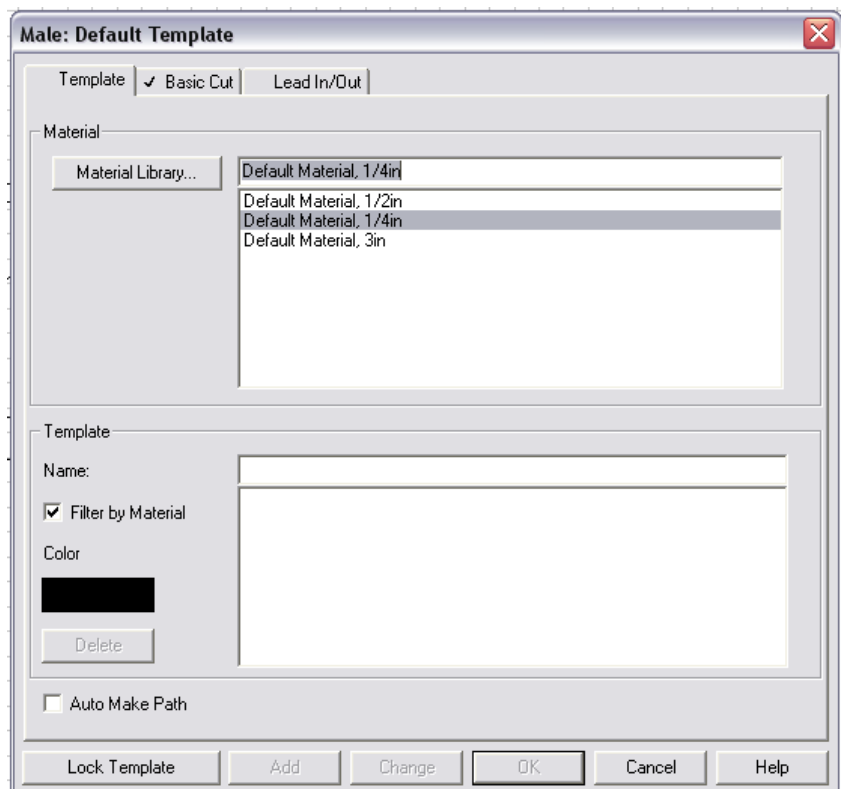
In the **Basic Cut** tab:

A dialogue box with three tabs now appears. Under the tab **Basic Cut**, select plasma as the tool.

The default kerf width for plasma is .059".

Note that if plasma is selected as the tool, the kerf allowance will be automatic. There is no need to specify an offset in this dialogue box.

Select **Climbing** as your direction for outside cuts, and for outside cuts with interior holes. The torch will automatically travel clockwise for the outside cuts, and counter-clockwise for interior cuts. Select **Conventional** when you are only making interior cuts. Ignore the four small window settings at the bottom, as they are not used in our application.
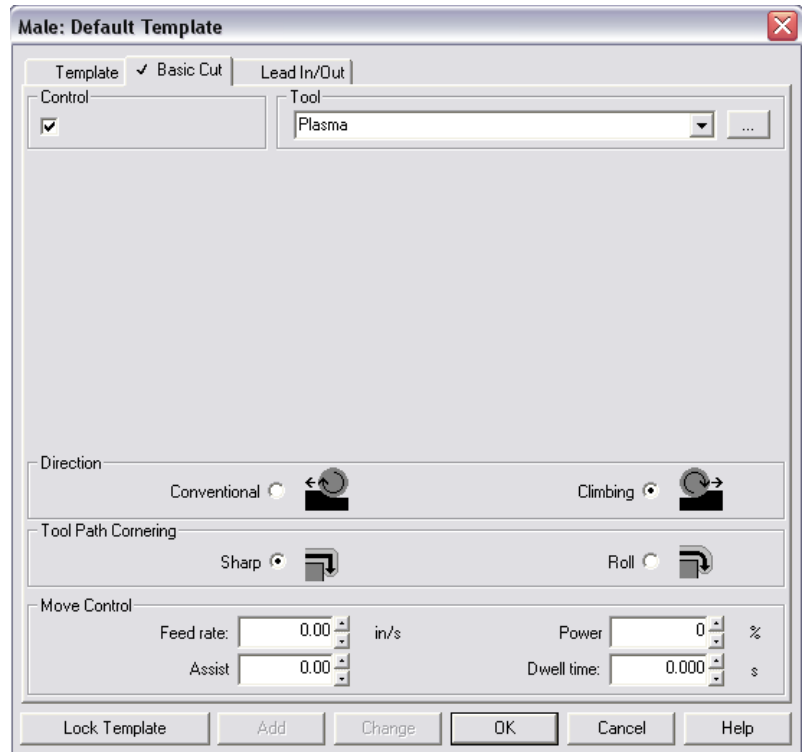
In the **Lead In/Out** tab:

Under **Control**, check **Create Lead In** and **Create Lead Out.**

You can specify whether you want these to be lines or arcs. You can set the radius for arcs, and the length and angle for lines. Arcs can provide a smoother transition from to and from the shape. Ignore the overlap setting for now.

Use any length that accounts for the default kerf width of .059".

Now click the **OK** button to generate your tool path.
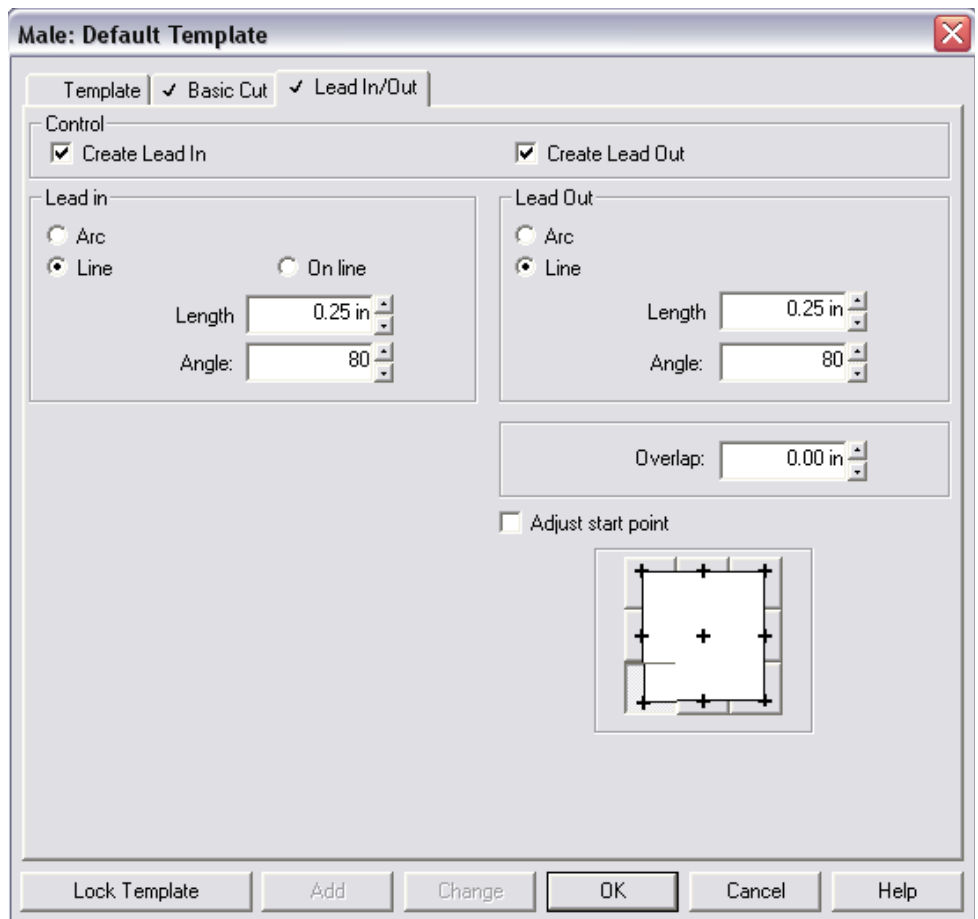
Editing Tool Paths in Torchmate CAD

Your tool path will be generated; it should look just like your part, with the addition of the lead-ins and lead-outs that the plasma cutter will use in cutting.

NOTE: that the interior cut tool path is to the inside, and the lead-in and lead-out are to the inside. The outside cut tool path is to the outside, as are the lead-in and lead-out. You must have a check in the **View** pull down menu next to **Show Tool Paths** before the tool path will be visible. You will now delete the original shape by removing the check, deleting the shape, and replacing the check, leaving only the tool path.

Check **View Tool Diameter** if you want to see the kerf width.
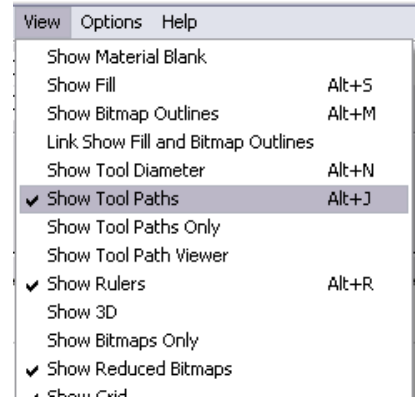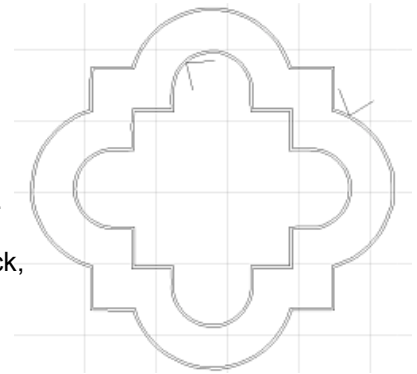
Nesting of parts:

Once a completed tool path has been created for your shape, you can duplicate it into any number of copies.
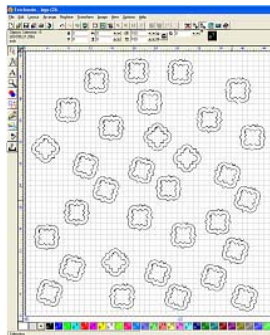
To automatically nest the parts, highlight all of them with your mouse. From the pull-down menu bar, select **Arrange/Nesting**. The nesting window, shown below, will open. There are two kinds of nesting, box nesting, and full nesting. In box nesting, an imaginary box encloses each shape, and these boxes are nested. Each part does not enter the space of another. In full nesting, the shapes are interleaved with each other. The Torchmate CAD Module does both kinds. After making your settings in the various boxes, click **OK**. It may take several minutes for the parts to be nested, depending on your computer.

The place on the material for shapes to be compressed.

The minimum degree increment for shapes to be rotated.

The minimum space to be left between parts.

The minimum border at the edge of the material.

The amount of error to be allowed.

You will generally depress only the top two buttons.
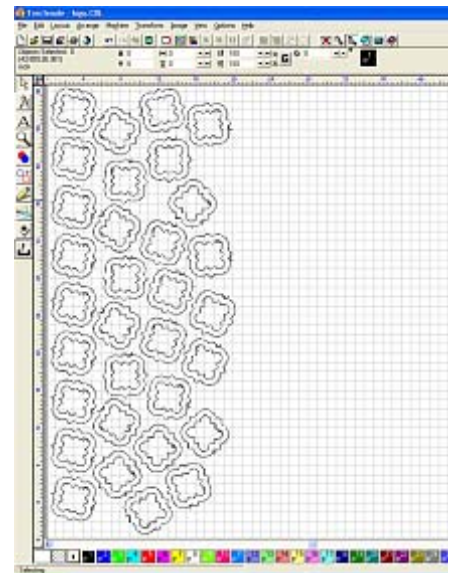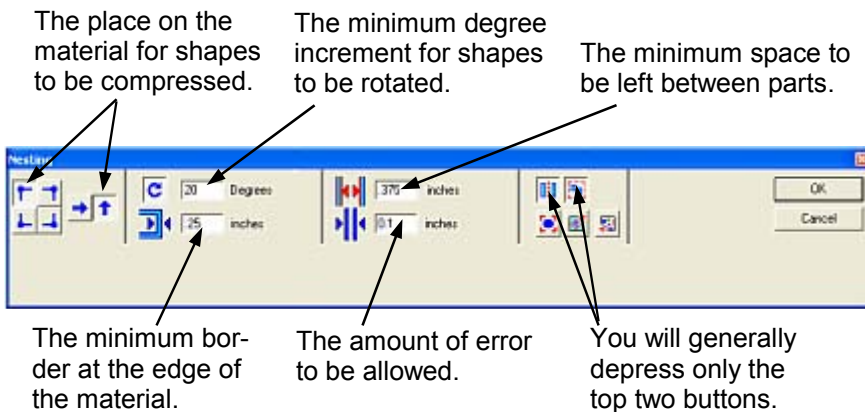
Completed nesting pattern

Sequencing of cuts:

Your last step before exporting your completed work as a DXF file, is to specify the order in which your shapes are to be cut. The program is smart, and already knows that the inside of each shape is to be cut first. You have only to set the order for all the shapes to be cut.

Move your cursor over the first shape you want cut until the cursor becomes a set of cross-hairs. Then left click your mouse to highlight it. From the pull-down menu, select Layout/Start Sequence. A blue line will then be Attached to that shape. In the order you want the shapes cut, move the cursor over each suc-cessive shape, left clicking your mouse on the shape when the cursor becomes a set of cross-hairs. You will see the blue line attach itself to each shape as you go, as shown at below.
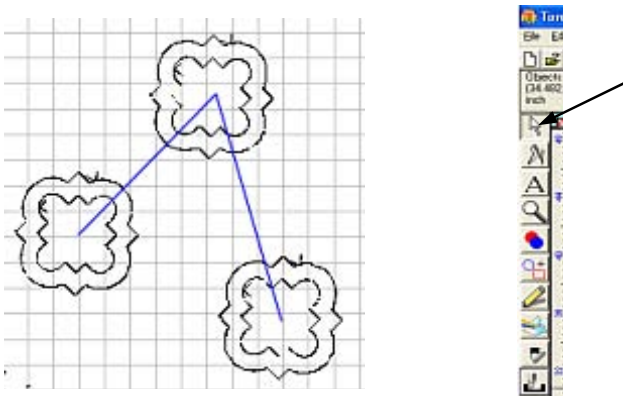
When you are finished, left click your mouse on the Arrow Select Tool, at the top of the tool bar on the left of the screen. The blue lines will disappear, and the shapes will be sequenced. Now export your shape(s) as a DXF file, and import them into the Torchmate driver software for cut-ting.

The Torchmate CAD Module has many additional features, including full drawing capability. It will take some time to master them all. However, this chart should get you started.

When you're done, select **File > Export**.

Exporting your Tool paths:

In the **Export File** window that opens, type a name for your exported tool path. For "Save as type," select **DXF (Polyline)**. Then click **Save**.
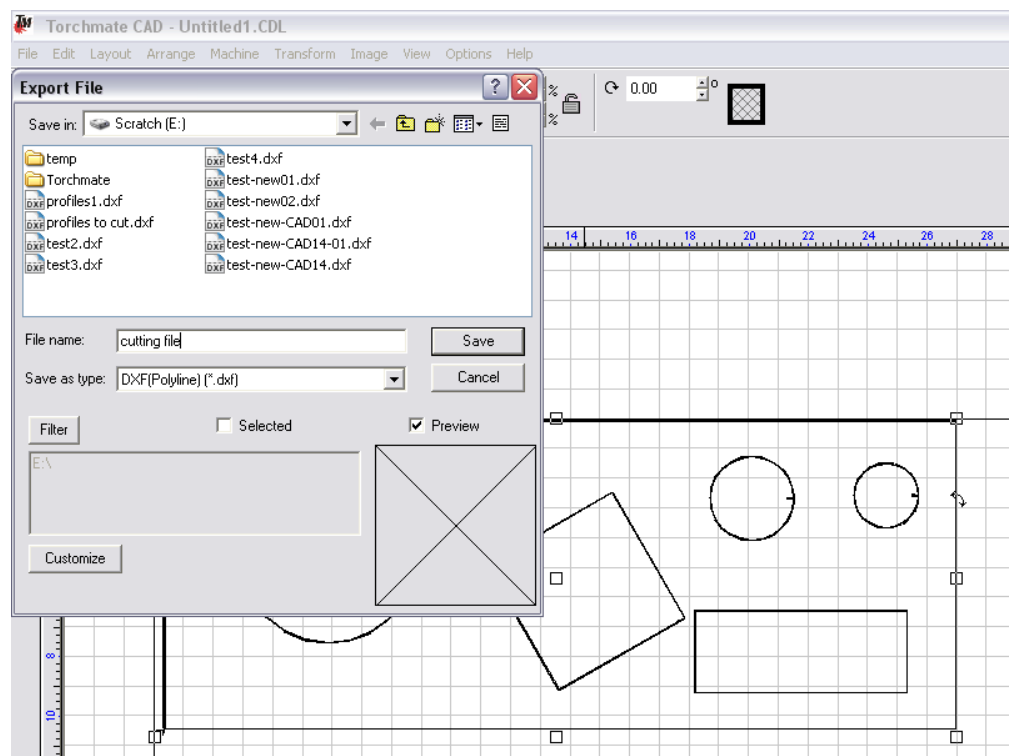
Cutting the Job: Starting the Machine, Loading a File, and Running the Machine

Place and Ground your Material

Place the material you wish to cut on the Torchmate bed.

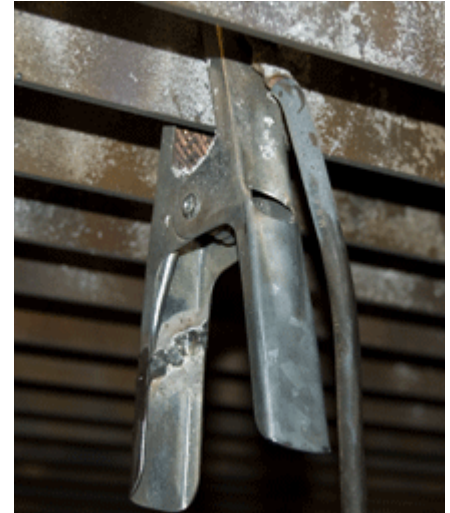Make sure the grounding clamp is attached to a slat on the cutter bed in contact with your material. If your material is not grounded, it won't cut correctly.

Power on the Torchmate

Turn on the switches on the front of the Torchmate power supply and signal generator in the computer cabinet. The system will do a check on the Torchmate computer system; lights 1-5 will light green, and if everything is working, the orange USB light on the signal generator will stay lit.

Grounding Clamp

Signal Generator & Power Supply

Turn on the plasma cutter which is at the foot of the Torchmate bed.

Plasma Cutter

Torch Height Control Module

Turn on the Torch Height Control Module using the power switch on the rear left of the box. The screen on the control module will flash a message that cutting is disabled, and the should have the following:

Current Voltage: 0
Set Voltage: Will be a number set by the previous operator
Auto
Press Ok to Change

Launch Torchmate 3

Torchmate 3 is the software used to control the plasma cutter. To launch it, click the Torchmate 3 shortcut on the workstation desktop or select **Start > Programs > Fabrication > Torchmate 3 > Torchmate 3**

If the plasma cutter was powered on correctly, you'll see the Welcome screen asking to establish a connection to the Signal Generator. Click **Yes, Start Online** to continue.

You will see a **Safety First** screen warning you that **the plasma cutter is now online, and all moves made by the Torchmate software will be executed by the tool**. Keep this in mind, and use caution when adjusting your material with the cutter online.

Click **Agree** to continue..

Load your Tool Path

First, you need to load your tool path. From the **File** menu in the Torchmate window, choose **Import DXF...**
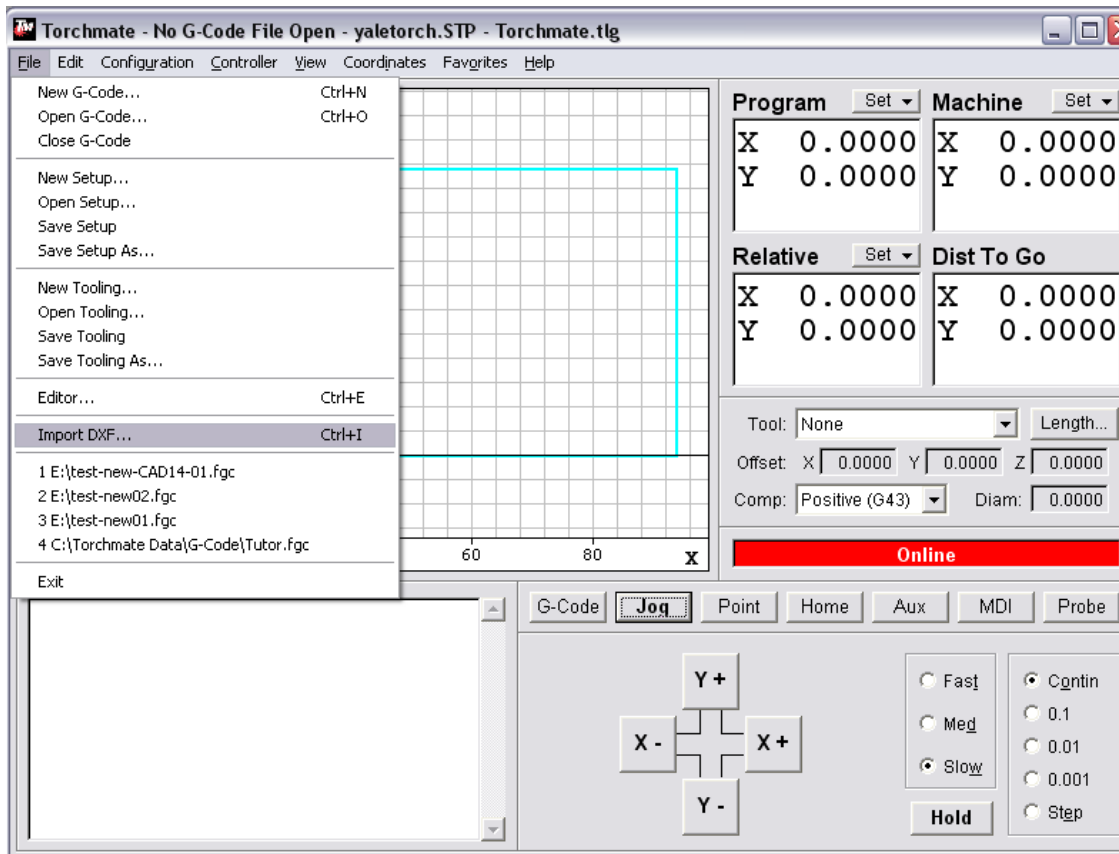
In the Open window, browse to the folder you created for your project on the Scratch Disk E: and select the dxf file you exported from the Torchmate CAD software (NOT your original dxf file that you exported from AutoCAD, unless you overwrote that file with the one from Torchmate CAD) and click **Open**

You'll then be prompted to save your machine file. Choose the folder you created for your project, give the file a name, and click **Save**.

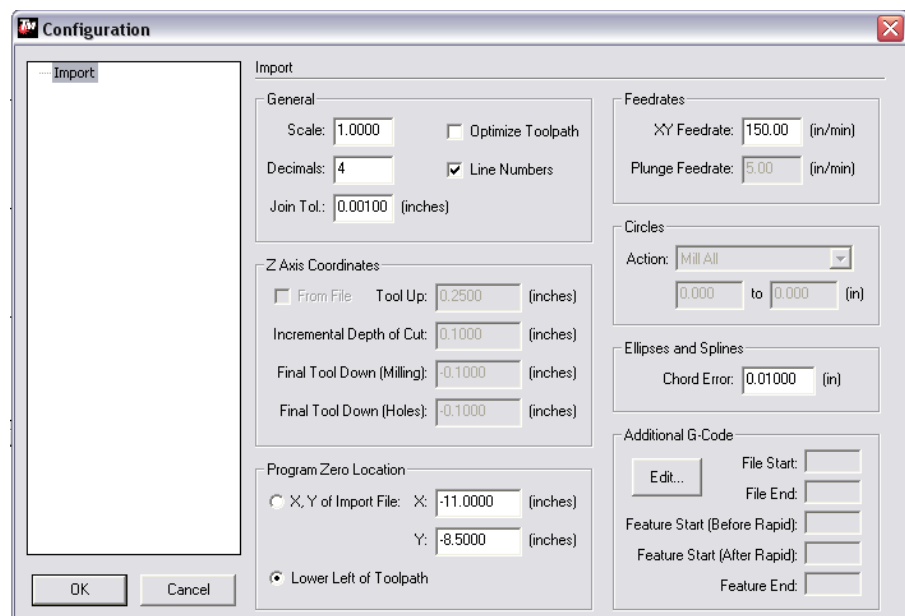In the **Configuration** window that opens, enter the following settings:

Scale: 1.0

XY Feedrate: 70.00 - 150.00

NOTE: Feedrate can be changed later, after determining optimal rates through line-speed tests.
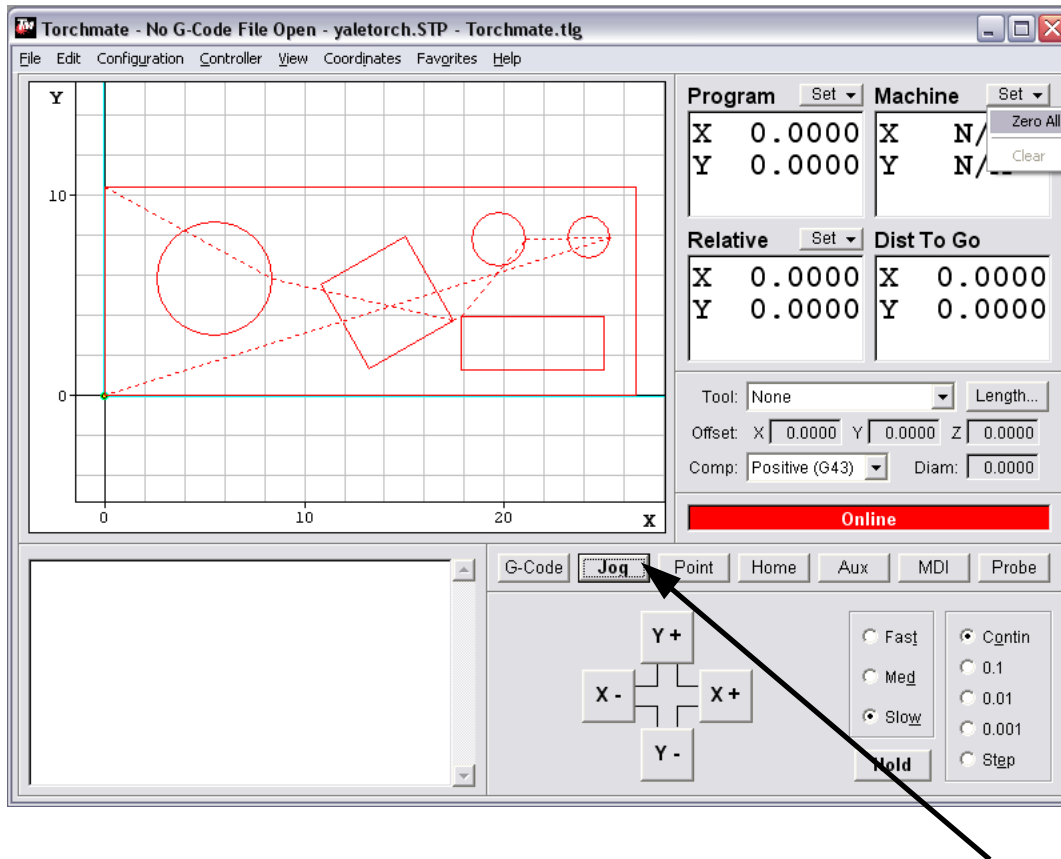
Other settings can be left at defaults.

OK to continue.

Zero the Program

Your tool path should not appear in the Torchmate window. You now need to move the plasma cutter head to the home position of your tool path, which is the lower left corner of your part.

Move the cutter head to where the home position of your tool path should be on your material by clicking on the **Jog** button (located below the bottom right corner of the tool path window) and using the X and Y buttons. You can adjust the speed of the tool head movement by clicking **Fast**, **Med**, or **Slow**. For most purposes Fast is most useful.

Once the tool head is at the home position of your tool path, click the **Set** button next to **Program** and choose **Zero All**. The coordinates in the Program and Relative windows should now all read 0.0000, which means the cutter head is at the origin of your tool path. You're now ready to cut.

NOTE: If you would like to have the ability to change program zero anytime in the middle of production, without losing the original zero, then set Relative Zero in the beginning as well.

Sending the Cutter to "Home"
With the Torchate the concept "going home" is achieved by sending the cutter to Program Zero/Relative Zero. The machine understands this as sending the cutter to a point on the bed. Click on the **Point** button, which is to the left of the **Jog** button, and select "go to program zero."

This will send the cutter to the original Program Zero position, or "Home."

Activate the Plasma Cutter

To activate the cutter, click and hold the Cut button on the Torch Height Control Module (the black box with the blue LCD screen). The "Cut Disabled" message will disappear and the red **Cut On** light will activate.*

*Put on the welding goggles.
Flash from plasma cutter could damage your vision, even if viewed peripherally.

Adjust Voltage

Voltage controls the distance between the torch and cutting material. This distance is different for each type of material blank. Once set, the voltage will allow the Torch Height Controller to automatically maintain the distance during operation. This setting is determined by running a line-speed test file. In Torchmate 3, under file, open g-code and navigate to the Scratch Disk **E: > Test Files**.

There are three different test files:
Line_Speed_190-130.fgc : For aluminum sheet and thinner gauge steels
Line_Speed_130-10.fgc : For most gauges of steel and thicker gauge aluminum
Line_Speed_70-10.fgc : For thicker gauge steels

Once the test begins cutting, the "Current Voltage" reading will fluctuate widely and settle on a median Voltage for each line. By tracking each median voltage during a line-speed test the operator can gauge an ideal Voltage for each line-speed.

Torch Height Control Module

Press Ok to Change:
This will allow you to use the "up" and "down" buttons to adjust to the voltage settings determined from the line-speed test. Once correct voltage is selected, press Ok again to set.

NOTE: If you press up/down before first pressing Ok, you will navigate to other settings menus. If this happens, just keep going until you return to the voltage setting screen.

Amperage Current Control

Adjust Amperage

Amperage controls the power to the plasma cutter.
Lower amperage for thinner gauge materials, higher amperage for thicker gauge materials. The amperage control on the Plasma Cutter can be adjusted between cuts.

Two simple ways to judge if your amperage settings are correct:
Too High = If the greater density of sparks hits the floor or beyond.
Too Low = If the material is not being cut all the way through.

Set Function

The Plasma Cutter has three function settings that we use:

SET: Used to purge air through the torch to in order to adjust gas pressure.

RUN: Used for most cutting operations

RAPID AUTO RESTART: Used for perforation type cuts

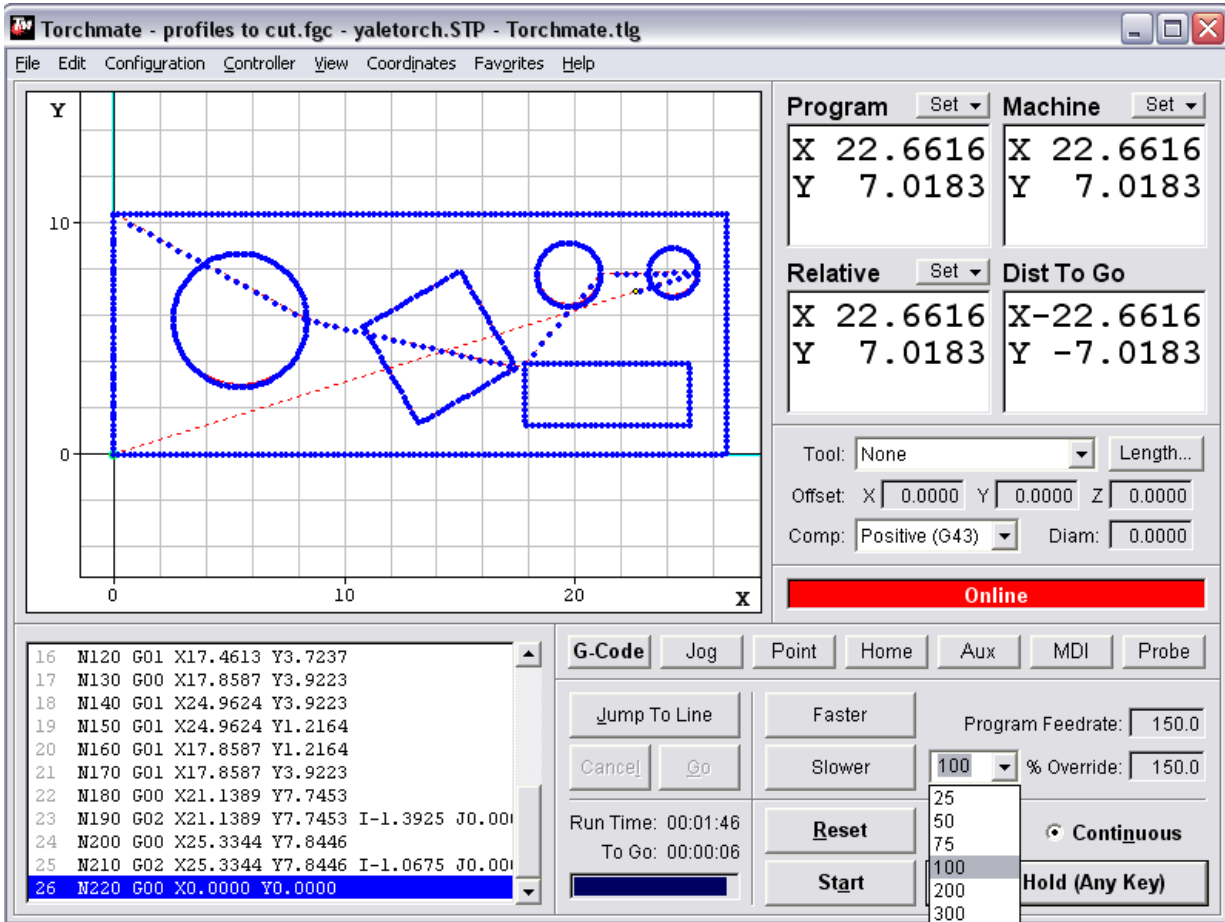**Function Control**

Plasma Cutter

Start Your Job

When you're ready, click the **Start** button in the Torchmate window to begin cutting.

The Torchmate window will show the progress of your job as it cuts. Blue lines show tool moves, including cuts, that have already been made, and red lines show the moves that have yet to be made.

Check the Cutting Amperage

As the Torchmate cuts your job, observe to see if your amperage is correct. If the amperage is too low, the cutter will not be cutting fully through your material. If your amperage is too high, you'll see a high density of sparks cascading onto the floor below the material (some sparks are normal). If you're unsure about the amperage, see one of the Fabrication Lab Faculty to help you.

Pausing Your Job

To pause your job, press any key or click **Feed Hold** to stop the machine. Do the same to resume cutting.

In Case of Misfires

Misfires can occasionally occur if the electrical connection between the cutter head and the material is broken. If a misfire occurs, you can press any key to pause the cut, then click the **Jump To Line** button in the Torchmate window to allow you to select a line of your cutting program from before the misfire occurred.

Select the line you want to go to and click **Go**. In the "Jump to Line Completed" window that opens, click **Move Now** to move the cutter head to the previous position. Then resume cutting. You will see the red and blue lines in the cut window update to reflect the current cut status.
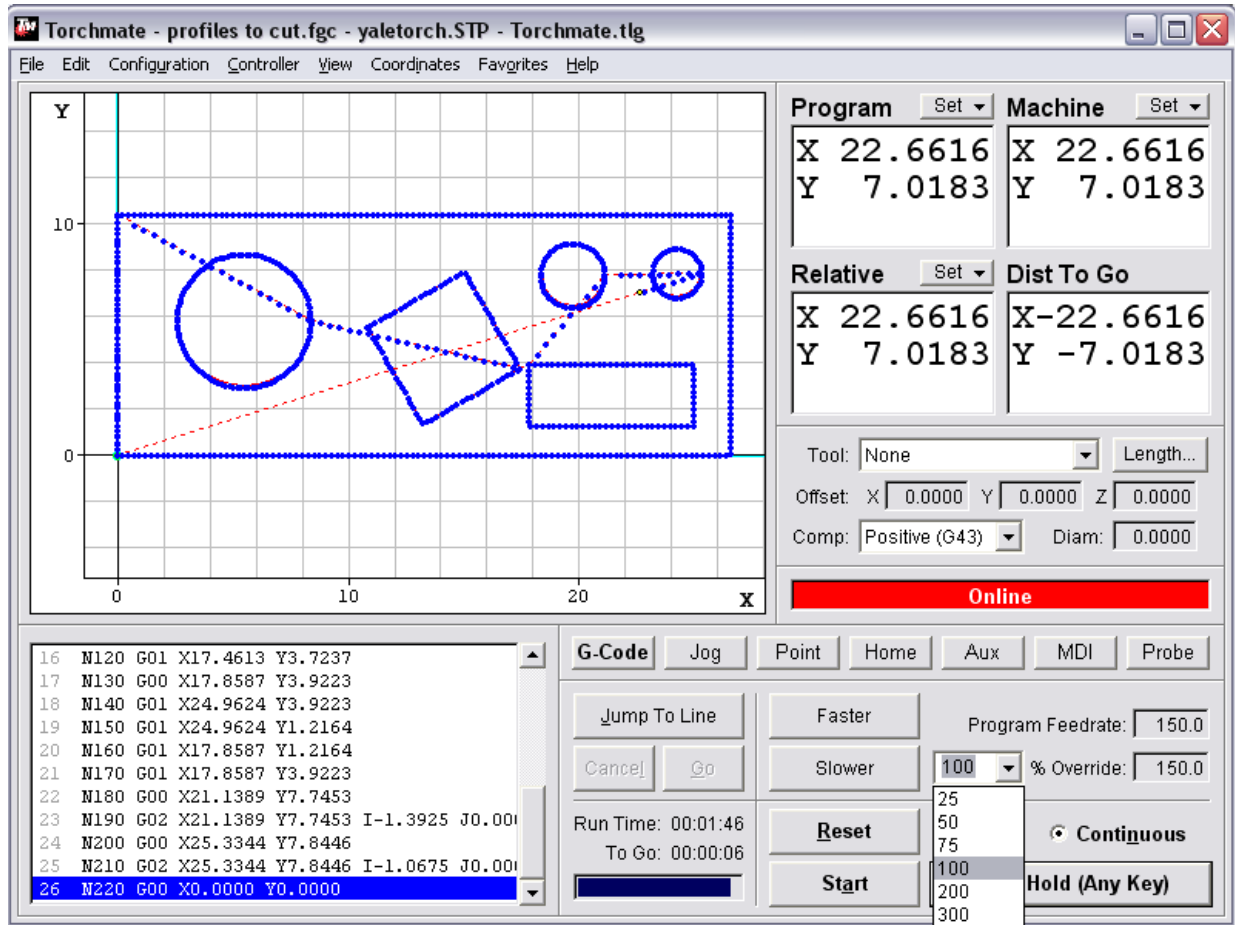
To Change the Cutting Speed

If you need to adjust the cutter speed for better cutting, hit any key to pause cutting. Under Program Feed rate, choose a % override rate to either speed up or slow down your cutting job.

REMEMBER TO USE YOUR COMMEN SENSE:
Wear welding goggles when operating the Torchmate
Consider fire hazards around the cutting bed
Never leave the Torchmate unattended during a job
Clean up the slag left over by your job
Follow the Safety First guidelines you have agreed to

Failure to follow these guidelines will result in a loss of Fabrication Labs access