FlowPATH Tool-pathing Tutorial

OVERVIEW

This tutorial outlines the process of preparing a 2D digital file for tool-pathing with FlowPATH for use with the school's abrasive water-jet cutter. The water-jet is only capable of 2D cutting operations, and has extremely limited control of the depth of the cut so work should be designed with 2D lines and with the intention that the lines will be cut completely through the material – not etched. Depending on the hardness of the material it is possible to etch or score a cut instead of cutting all the way through, but this should only be done with ductile materials as it will cause shattering or breaking in more brittle materials.

2D GEOMETRY

The FlowPATH software will only accept 2D geometry, and it works best with lines and arcs, splines may cause some problems. The lines can be made in any 2D application capable of exporting DXF files; possible applications are Maya, 3dMax, Rhino, AutoCAD, Illustrator and VectorWorks. If your model is made of surfaces or polygons it is necessary to duplicate the edges of the objects to make 2D lines, you cannot use the surface geometry directly for water-jet cutting. Objects and parts should be made at full-scale on the XY plane with the Z axis up. *Rhino is the prefered application for exporting geometry.

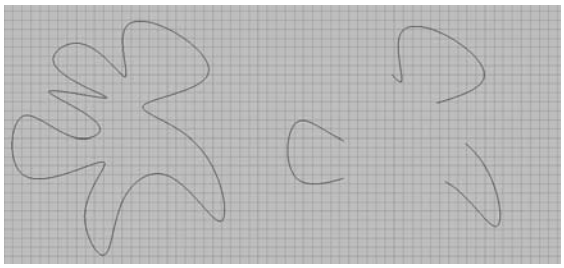
BEFORE YOU START

The waterjet can cut within an area of 18"x"32". You will need to inset all your geometry at least 1" from all four sides to ensure proper alignment of material and to allow room for weights to hold the material in place.

Pieces or parts should be arranged in a way that makes efficient use of material and pathed in a way that allows you to stop and restart with repositioned stock material if necessary:

The water jet creates a 'kerf' or thickness in its cut that varies from 1/32" to 1/16". If you manual order a path you must decide whether you want the kerf to align to the left, right, or center of your 2d geometry. Autopathing makes that decision for you.

It is important to consider the implications that the cutting instructions, or path, you create will have in terms of the amount of time it takes to cut. The waterjet cuts continous lines many times faster than broken lines. Stopping and starting the jet takes much longer and uses much more garnet than continuous cutting. If possible avoid cutting fold lines or screw holes on the waterjet.

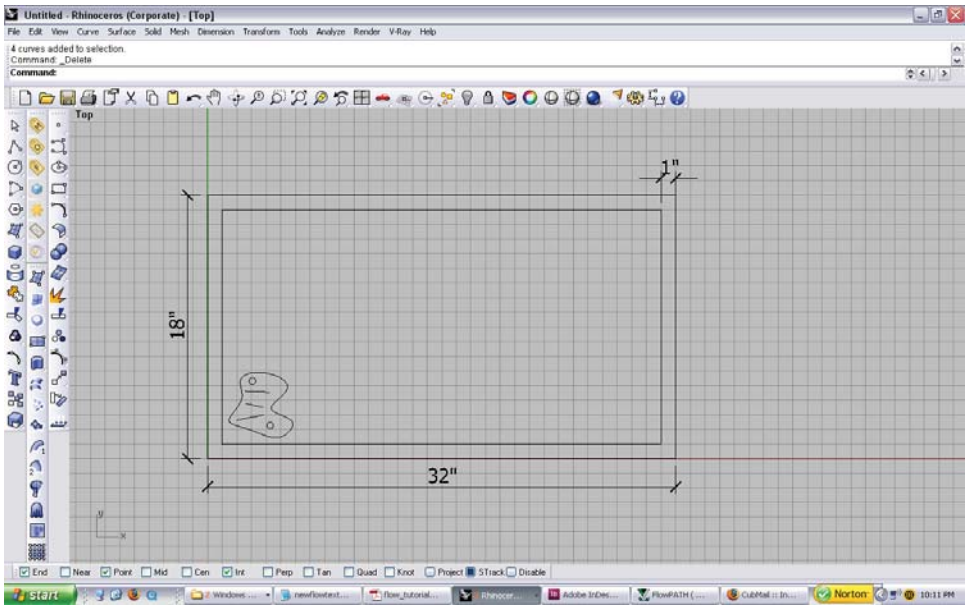


The closed shape on the left will cut in approx. half the time required to cut the open shapes on the right because of the time required to start and stop the machine at the endpoints.

RHINO

Bring the geometry you want to cut into Rhino. (Or create in Rhino)

Make sure that it is located correctly in relation to the X/Y axis, that the scale is correct, and that it fits within 18”x32” with at least a 1” border.

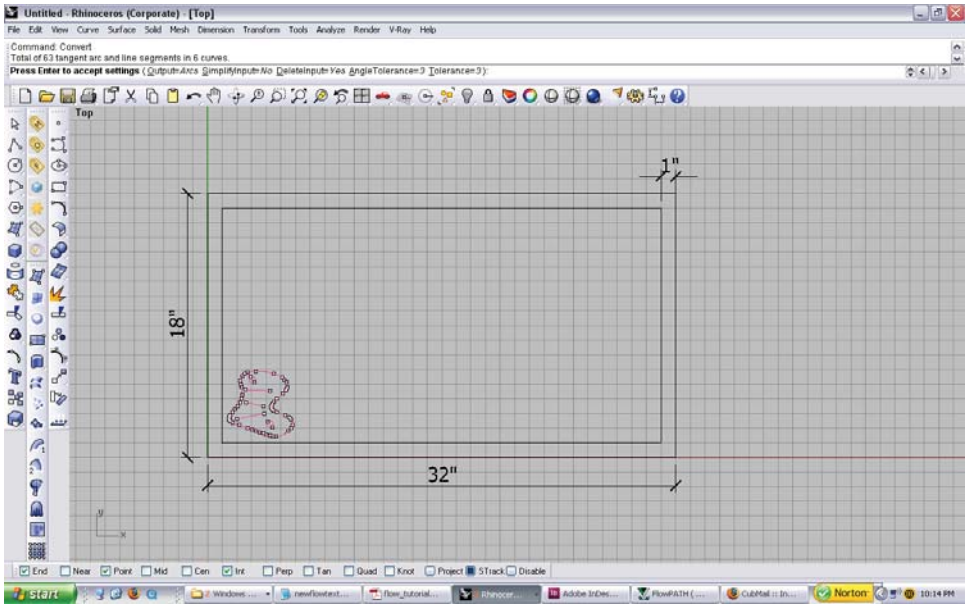


CONVERT

Select your geometry and type convert.

Toggle the options so that: ‘Output=Arcs, SimplifyInput=No, DeleteInput=Yes, AngleTolerance=3, Tolerance=3’

This process simplifies your geometry. Unsimplified geometry bogs down the CNC process. You may need to lower the tolerances if the converted geometry deviates too much from the original. Simplify as much as possible.

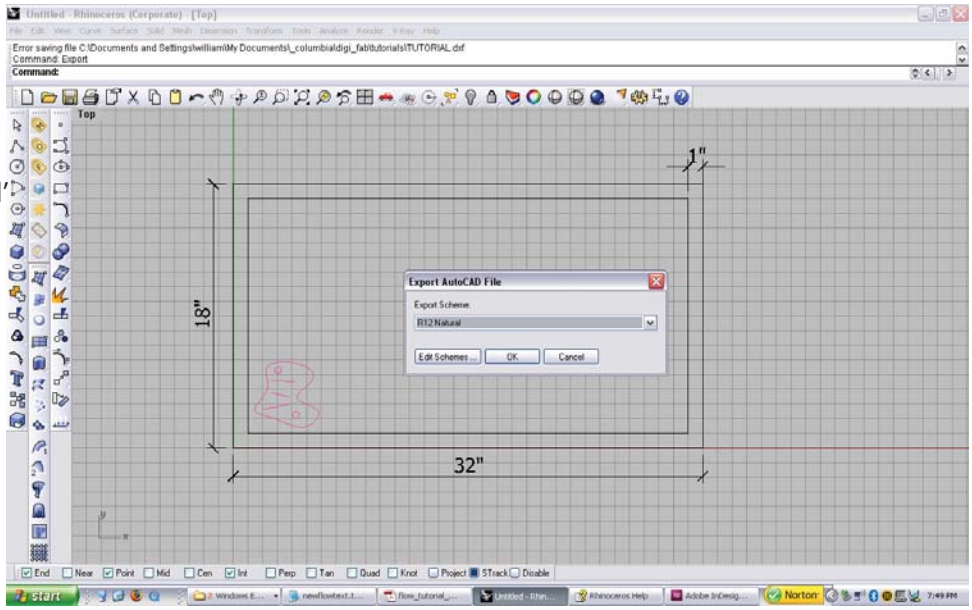


EXPORT

In Rhino, select ‘File=>Export

Selected’ and choose ‘AutocadDXF’ as the file type.

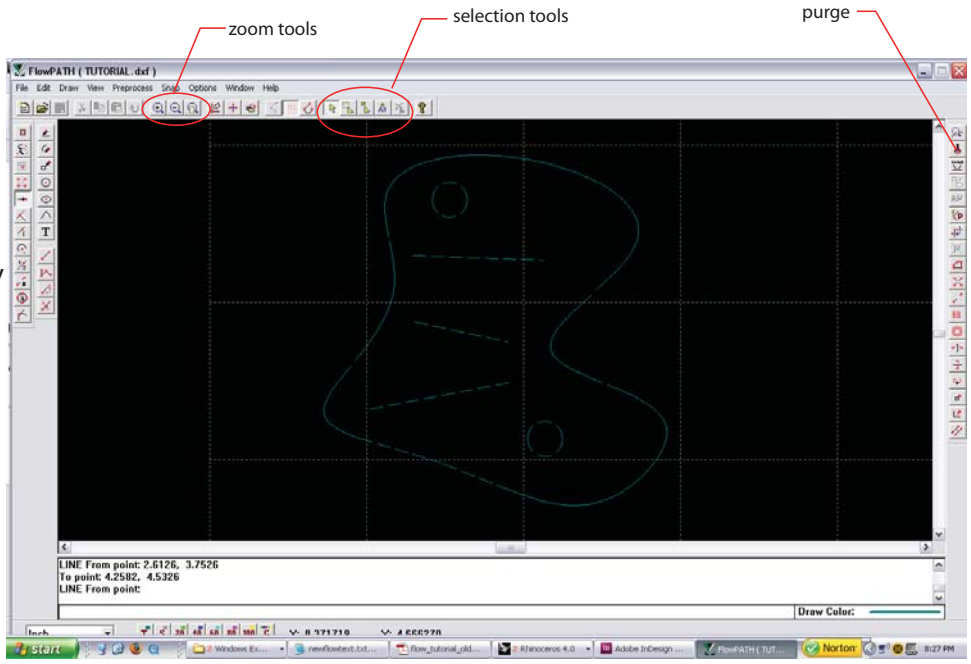
When given the option select the ‘R12 Natural’ export scheme.



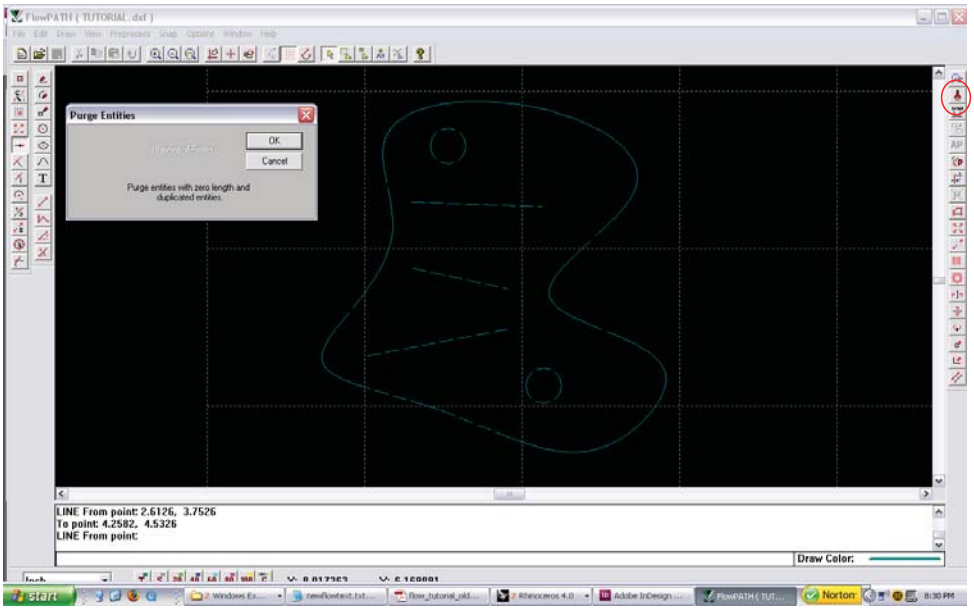
FLOWPATH
Open the program FlowPATH.

Choose 'File=>Open' and select your .dxf file

Use the zoom tools to navigate and the selection tools to choose geometry. Your geometry may appear broken at this point.

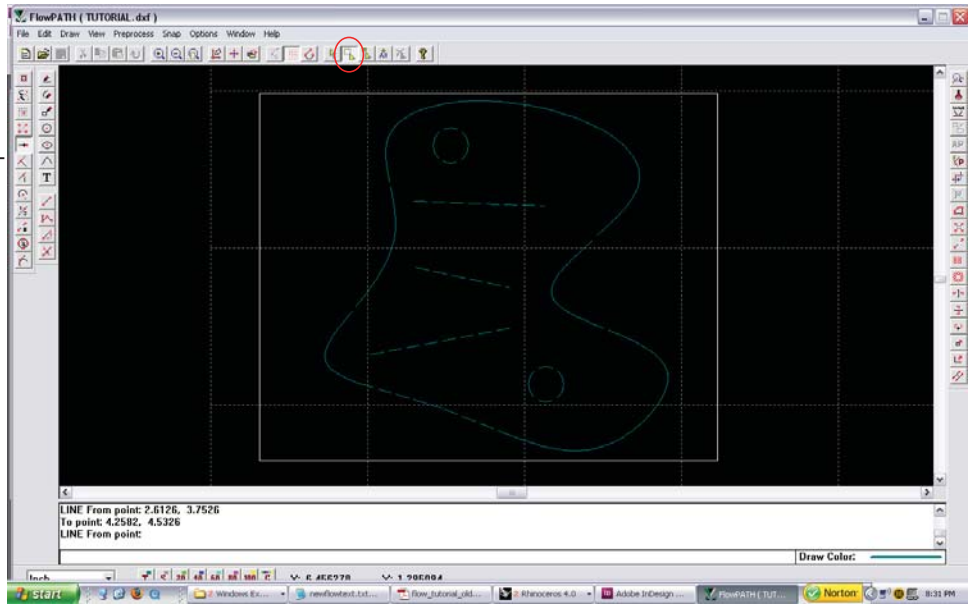


PURGE
Clicking the purge button eliminates overlapping geometry you may have mistakenly created.



ASSIGN CUT SPEEDS
Using the select window tool select all of your geometry.

You will now assign a cut speed to your geometry.

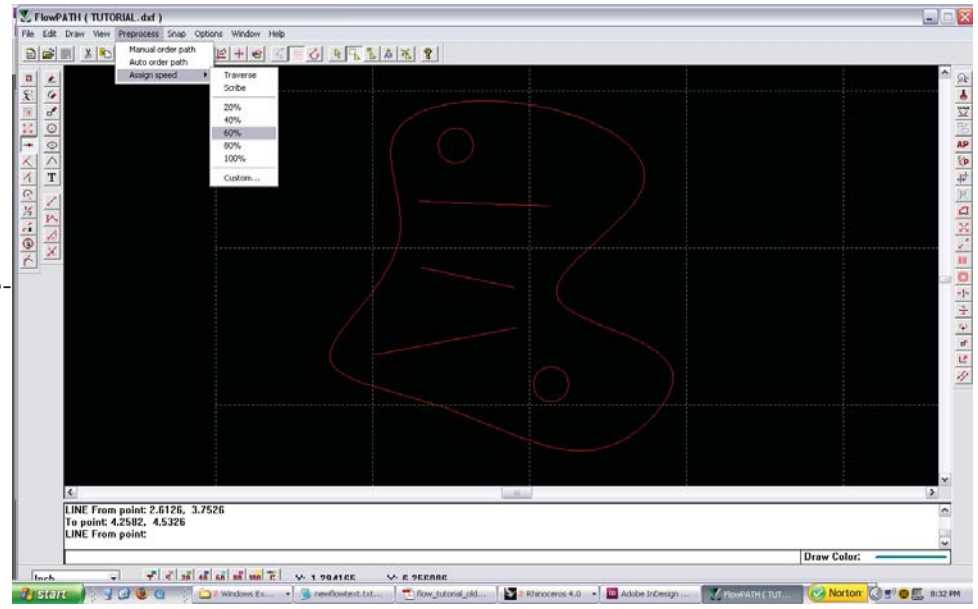


Choose 'Preprocess=>Assign Speed=>'

60% is a good default speed.
100% is slowest and prodcues the cleanest edge but the widest kerf.

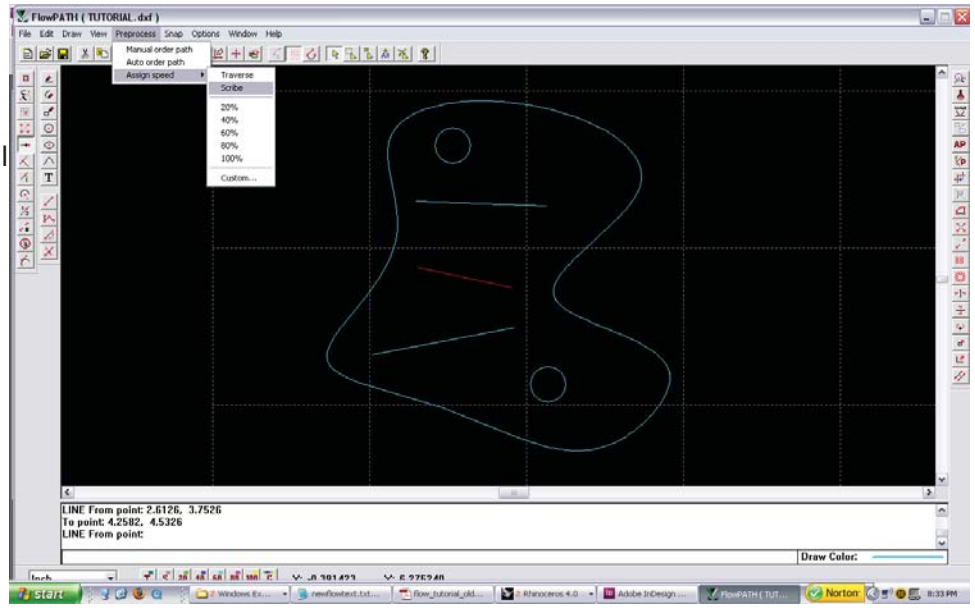
SCRIBE lines cut fastest and without abrasive and are intended to not cut through the material. Scribe lines should be used to mark fold lines and screw holes.

TRAVERSE lines indicate where the jet travels without cutting.
The final product is a single continuous line composed of variable line types .



After your geometry has been assigned a speed, your geometry should appear normal without breaks or inconsistencies

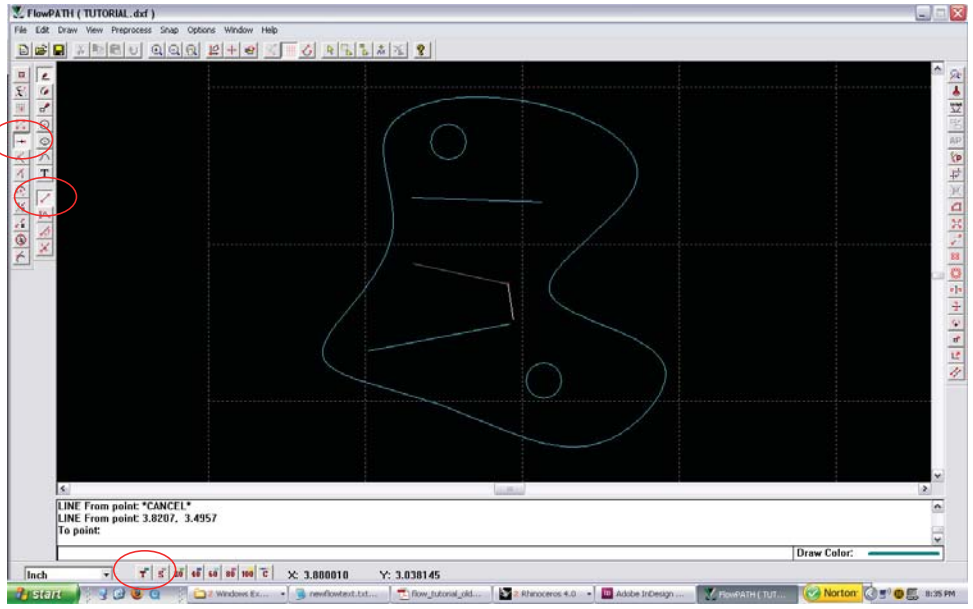
In this case the middle open straight curve will be changed to SCRIBE line. Linetypes/speeds can be changed at any time.



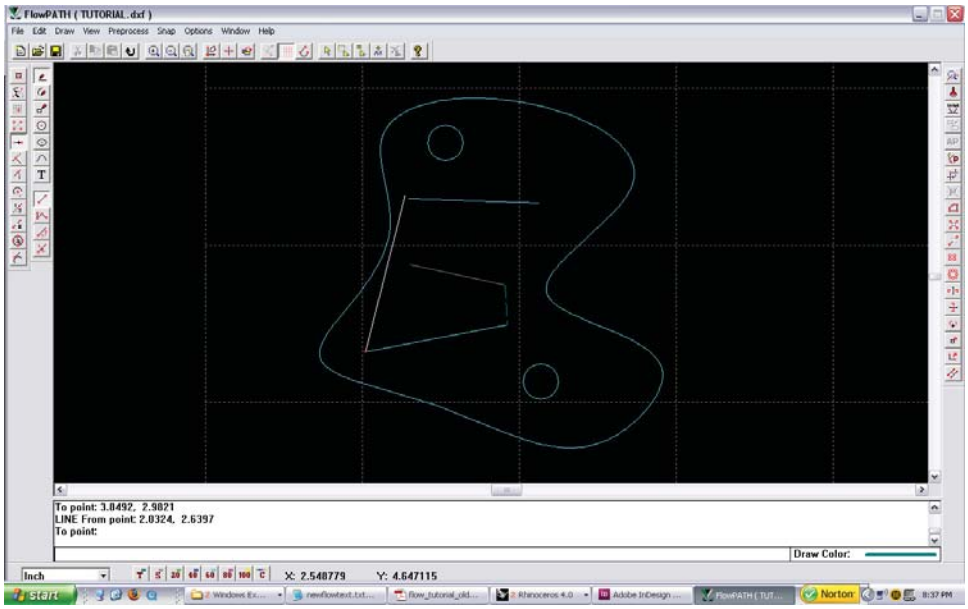
MANUAL PATHING
Open curves (in this case the straight lines) must be pathed manually. This requires the creation of TRAVERSE lines to direct the jet in between cuts.

Click the T button at the bottom of the screen to switch to TRAVERSE linetype.
Enable endoint snaps on the left.
Select the "Line" button.

In this case I want the jet to start with the scribe line and continue to the other straight lines. A travese line is drawn from the end of the scribe line to the next open curve.

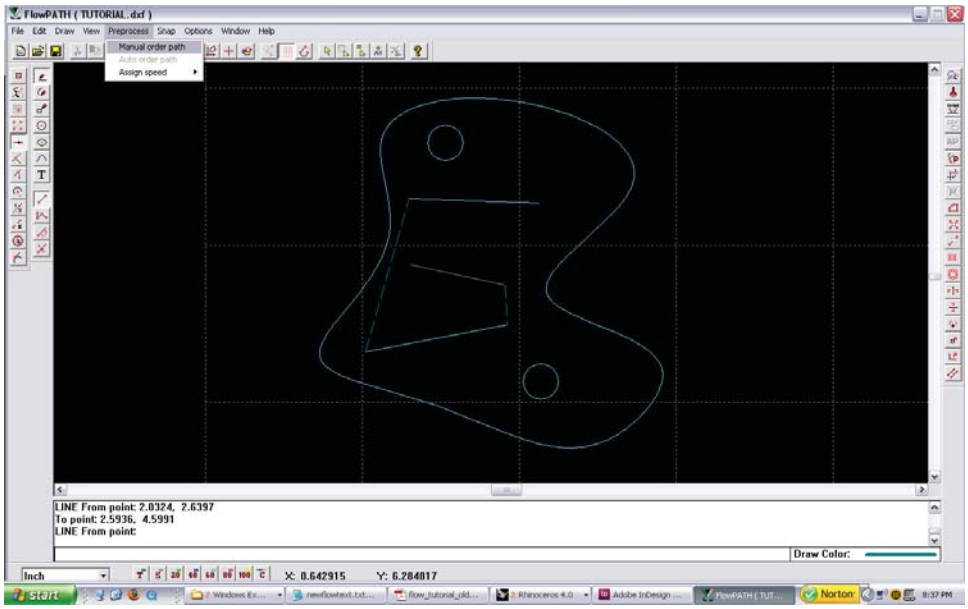


Another traverse line connects the remaining open curve.



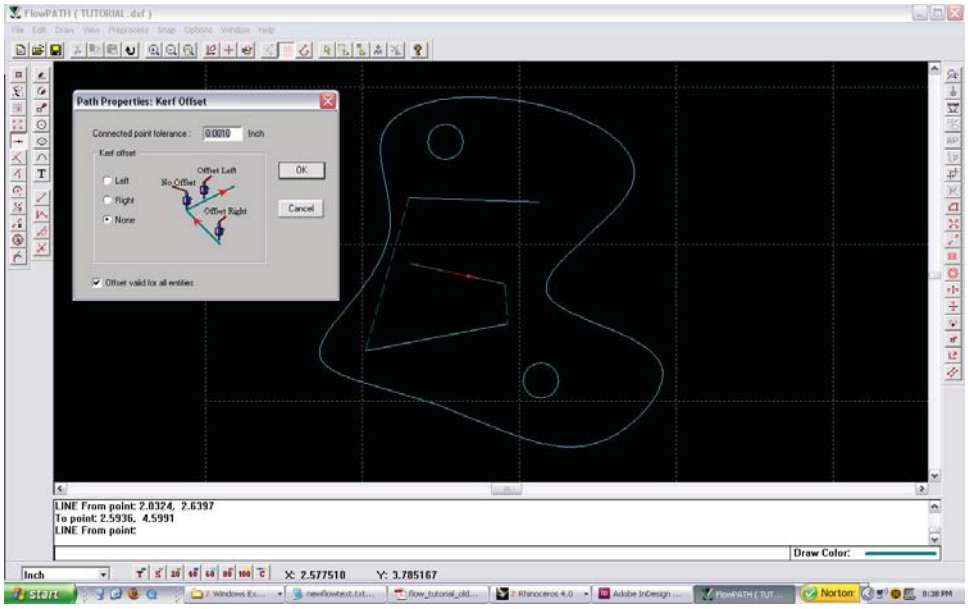
Choose 'PreProcess=>Manual Order Path'

Select the left endpoint of the scribe line as the starting point for this phase of the path.

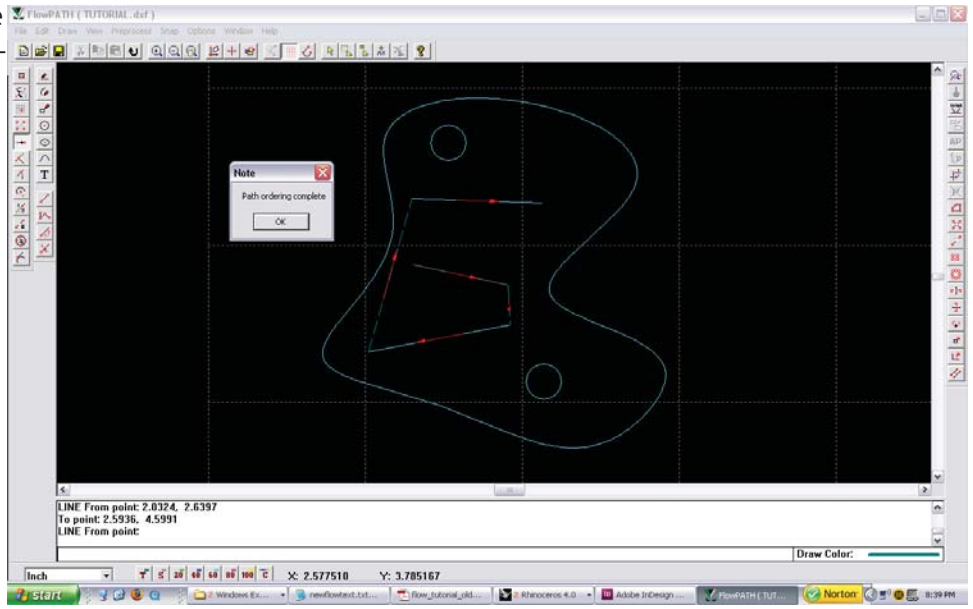


The red arrow indicates the beginning of this path.

FlowPATH prompts you for kerf directions. In general for open curves (i.e. not closed shapes) the kerf should be along the line and not offset to either side.
Select Offset: None and click OK



This creates the beginning of the path and the read arrows indicate the direction and orientation of the jet as it travels.



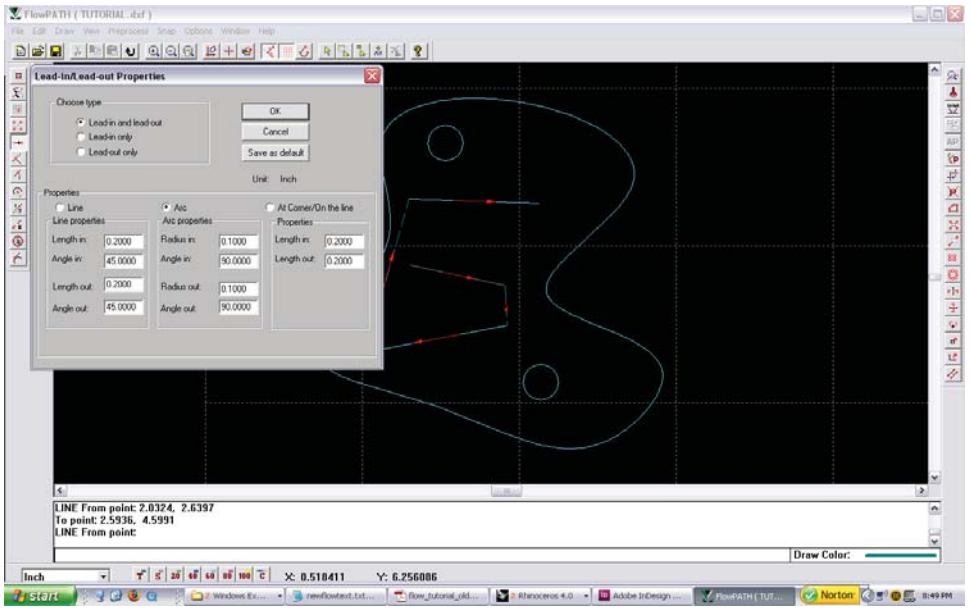
AUTOPATHING
Next you will AutoPath the closed curves.

First you will need to change the lead-in/out properties.

Choose 'Draw=>Lead-in/out Properties'

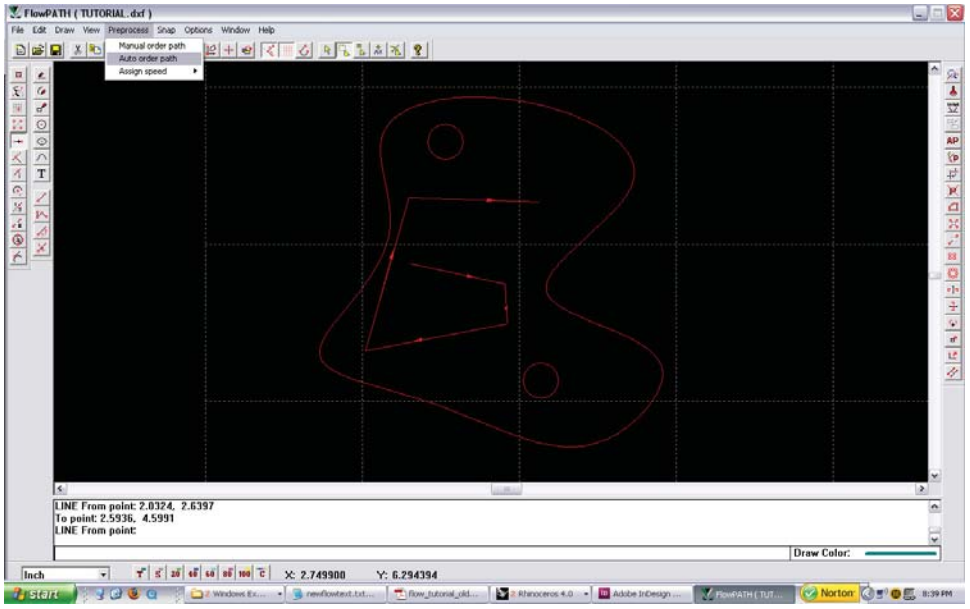
The settings should match those shown. Radius in and radius out should be less than the radius of the smallest circle you are cutting. Somewhere in the range of .05"-.2"

(if you want to manually path closed curves you will need to draw lead-ins/outs yourself)



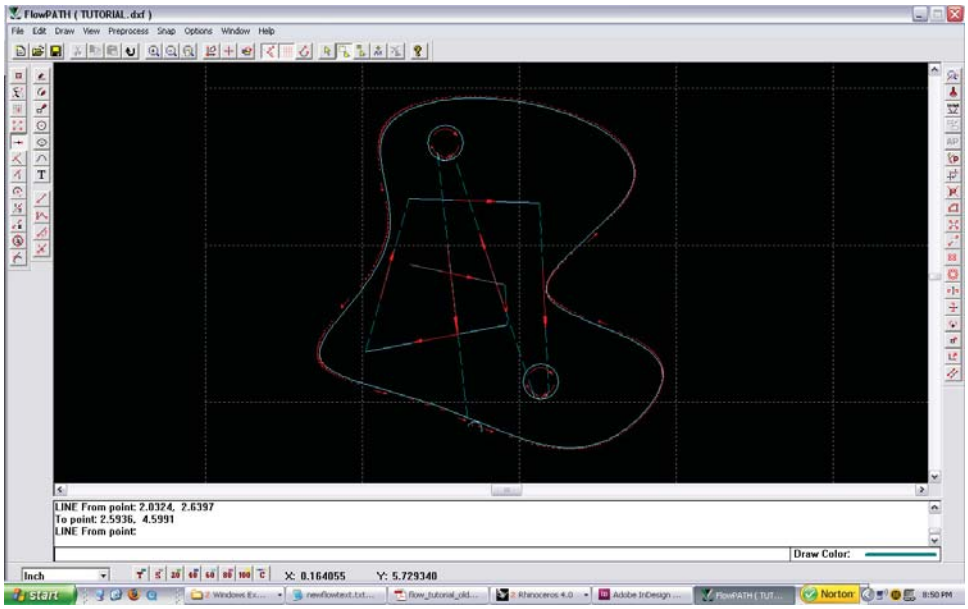
Select all of the closed curves in the part. (the open curves that were already manually pathed cannot be pathed again so its ok to select them also)

Choose 'PreProcess => Auto Order Path"



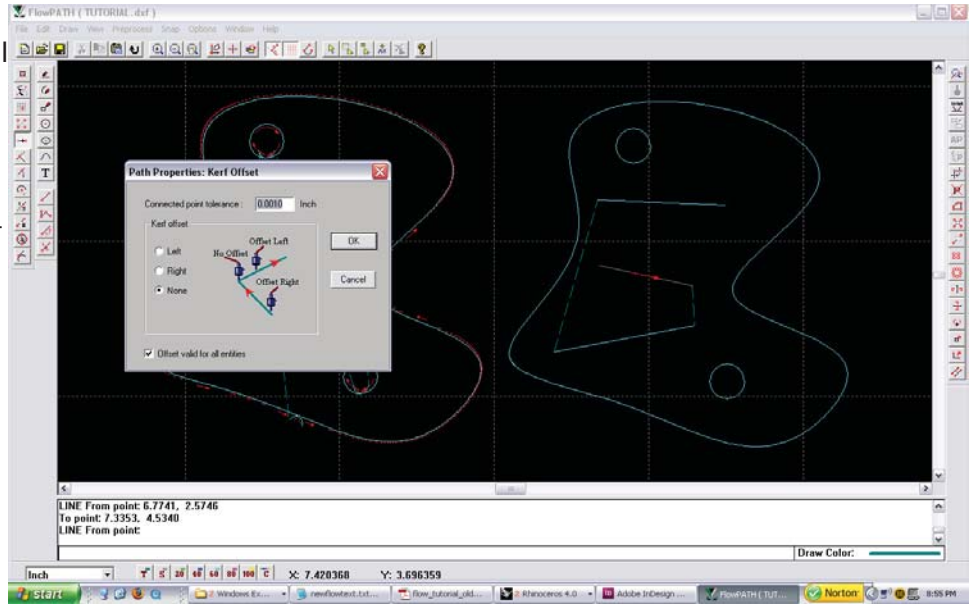
FlowPATH automatically paths the closed curves.

It offsets kerfs in such a way that the final piece will have the same dimensions as the linework (inside the inner closed curves, outsied the outer closed curveS)



If there are more parts to path you can continue this process alternating between manual and automatic pathing as necessary.

Groups of parts or pieces should be pathed in such a way that allows an individual part/ piece to be completed before starting a different part.



EXPORTING
To export a path file (a set of numeric instructions for the CNC machine) you will export an ORD (.ord) file.

To save your work in FlowPATH export a PTH (.pth) file.

Bring .ord file to the fabrication lab with a USB Flash drive (not a portable hard drive)