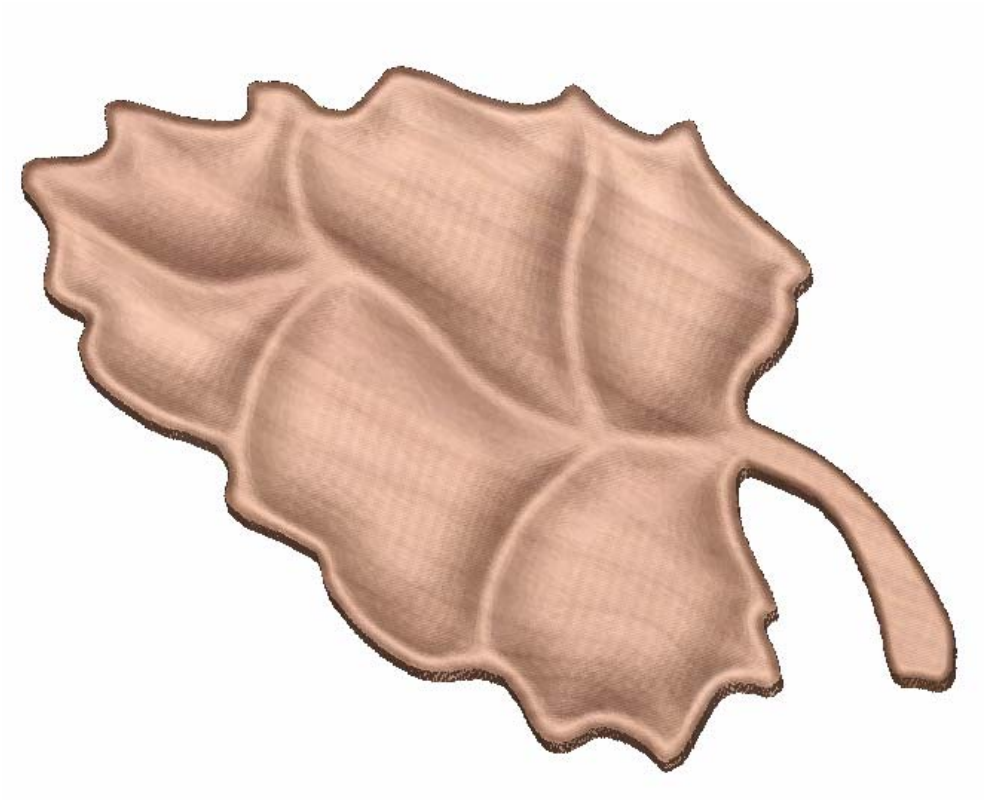
Getting Started With



Tutorial 1
Machining a 3D Bowl

Vectric

Disclaimer

All CNC machines (routing, engraving, and milling) are potentially dangerous and because Vectric Ltd has no control over how the software described in this manual might be used. Vectric Ltd or any associated Resellers cannot accept responsibility for any loss or damage to the work piece, machine or any individual, howsoever caused by misusing the software. Extreme care should always be taken and the output from the software thoroughly checked before sending it to a CNC machine.

The information in this manual may be subject to change without any prior notice. The software described in this manual is supplied under the terms and conditions of the software license agreement and may only be used in accordance with the terms of this agreement.

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Introduction

Many businesses use their CNC machine for simply cutting out flat letters and shapes from plastic sheet, or engraving standard badges and nameplates, which are all based on simple 2D machining strategies. Vectric Cut3D adds another dimension to your CNC machine, allowing it to be used for more interesting and often higher profitable projects that would normally only be possible using expensive CAD/CAM software.

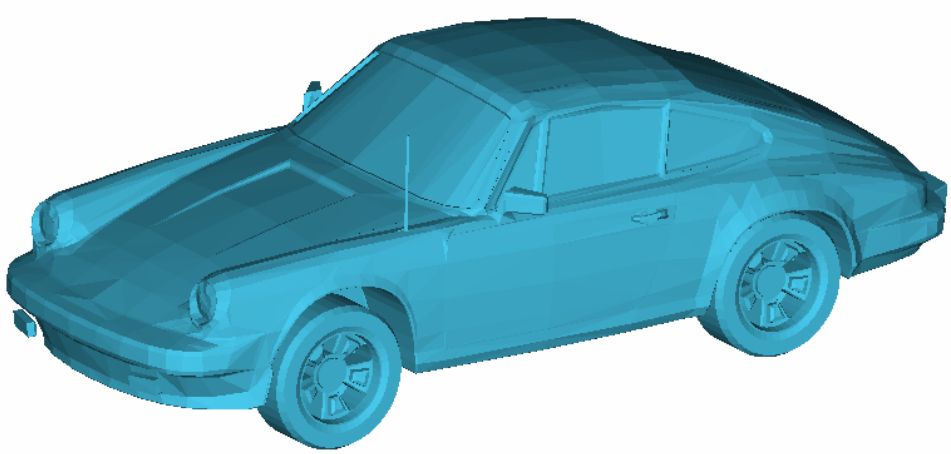
The manual takes you step-by-step through an illustrated tutorial that shows and explains exactly how to use the Software. Tips and tricks have also been included that will help you get the most from your CNC machine.

We hope you enjoy using the software.

What is Cut3D?

Cut3D has been developed specifically as a toolpath engine for machining 3D models that have previously been designed using another CAD or Graphics design product such as AutoCAD, Rhino3D etc.

The software calculates toolpaths that contain XYZ point data to move a cutter simultaneously in all 3 axes to cut the shape of a 3D model into the material being used.



Typical 3D Model designed using 3D Studio

What the software allows you to do

Cut3D can be used for the following applications,

Model making	3D models from foam, plastic, wood etc.
Rapid Prototyping	New product designs / Contract work
Sign making	Adding dimensional elements to signs
Wood Carving	Custom fireplaces, door panels
Engraving	Commemorative Brass plaques
Gifts	Personalised gifts
Stone cutting	Memorials, Commemorative engravings

What file formats can be used?

Cut3D will open 3D model files that have been saved in the following formats.

V3D	Vectric Cut3D files
STL	STL Mesh files - binary & ascii
V3M	Vector Art 3D files
3DS	3D Studio - binary & ascii
X	DirectX
DXF	AutoCAD 3D DXF
LWO	LightWave
TXT	MaxNC Digital Probe
SBP	ShopBot Digital Probe files
WRL	VRML
OBJ	Wavefront

Notes Although the design systems that are used to write the file formats all claim they output standard file formats, there are often many variations of each type. As a result Vectric cannot guarantee to read all of the file formats. There are many different file translation software products available from the internet that offers the tools needed to modify and convert 3D models into formats that are suitable for use with Cut3D.

For general file conversion and editing we recommend a product called **AccuTrans 3D** from **Micromouse Productions**. www.micromouse.ca

Getting Help

If you need assistance when using the software there are 5 primary places to look.

1. **Program Help File** - From the Main menu select Help or Press F1

2. **Video Tutorials** - These can be downloaded from the Vectric website.

3. **User Forum** - The Vectric user forum at www.vectric.com/forum is a very useful resource for information on all Vectric products along with materials, cutters etc. and also to share knowledge and experiences.

4. **E-mail Support**: - The Vectric Support Team at **support@vectric.com**

5. **Frequently Asked Questions (FAQ)** - The support area on the Vectric web site at www.vectric.com maintains a list of the most frequently asked questions along with the answers.

Watch the supporting tutorial videos

The video camera icon indicates there is a video file for that particular section of the manual.

Many of the tutorial documents have associated video footage that will make learning to use this software more interesting and enjoyable. These can be downloaded from the web site.

If you experience problems running these files or need assistance please visit the technical support area on the web site and follow the links.

Overview of the interface

The screen area is split into 6 main regions.

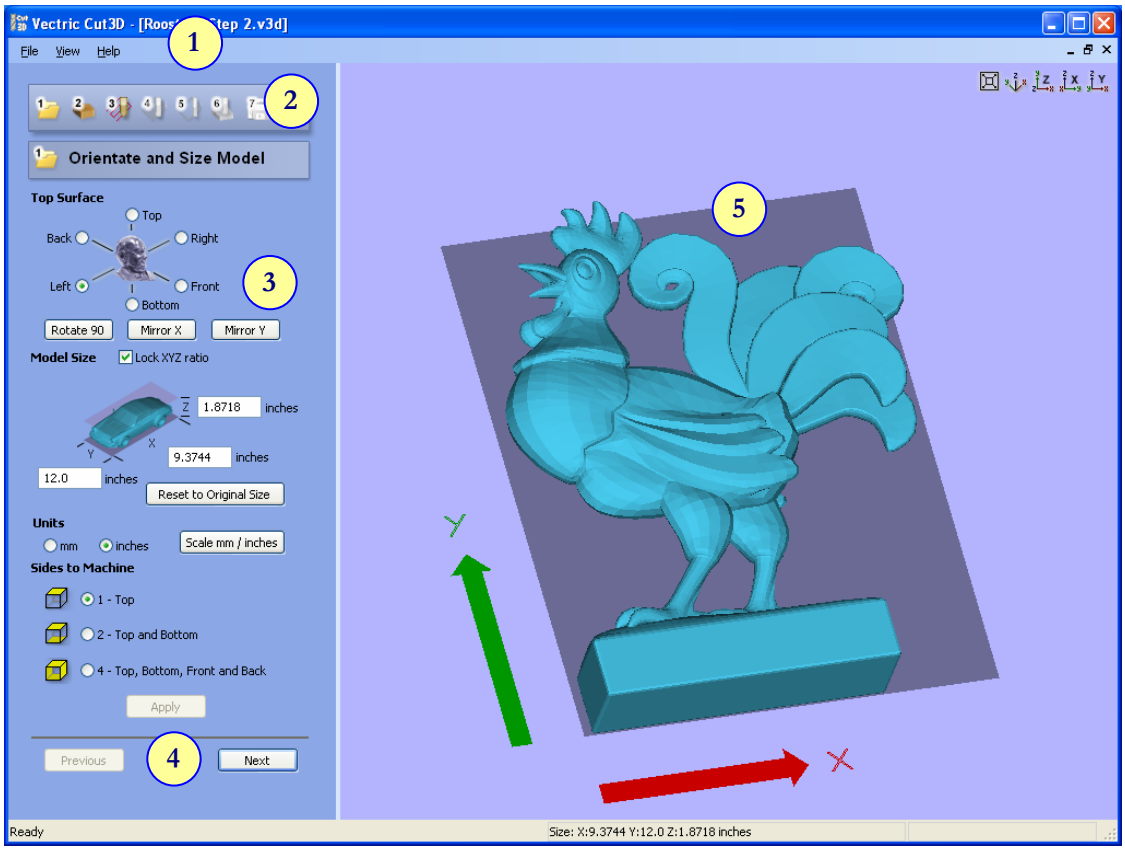
1. The **Main Menu bar** along the top of the screen provides access to the primary functionality such as File Open / Save plus the Help and License options.

2. The **Navigation Toolbar** gives easy access to each of the steps when working.

3. The **Step-by-Step Forms** on the left side of the screen lead you through each of the steps.

4. The **Navigation Buttons** are used to step forward or backwards through each of the steps.

5. The **3D Window** shows the 3D model, calculated toolpaths and the colour shaded machined preview of the model. In the top right corner of the 3D window is the **3D View Menu** for selecting pre-set views of the 3D model.



The User Interface

The Cut3D Logic

Cut3D has been developed to make machining 3D models as simple as possible. The general work flow logic to apply to most jobs is explained in the diagram below.

1
Load a 3D Mesh Model and set the size and orientation for machining

2
Specify the Material Size and Machining limits

3
Optional
Calculate a Roughing Toolpath

4
Calculate a Finishing Toolpath

5
Optional
Calculate a Cut Out Toolpath

6
Preview the job in any material

7
Save the Toolpaths ready for running on the CNC Machine

View Controls

The View Control options available when working in the 3D Windows are,

	3D Twiddle	Click and drag **Left** mouse button in the 3D window
	Zoom	**Right** mouse button – Push / Pull Mouse with Middle Wheel – Push / Pull
	Pan	Click and drag **Right** mouse button + **Ctrl** Click and drag **Right** and **Left** mouse button
	**Plan View**	Looks directly down the Z axis onto the design in 3D window
	**Isometric View**	Shows the model in a 3D isometric view in the 3D window

Mouse with Middle Wheel can be used to interactively zoom in / out.

Tutorial 1 Single Sided 3D Machining

We recommend that you watch the **5 minute Video** for this Tutorial before proceeding. The video can be found on the installation CD or downloaded from the web site at www.vectric.com

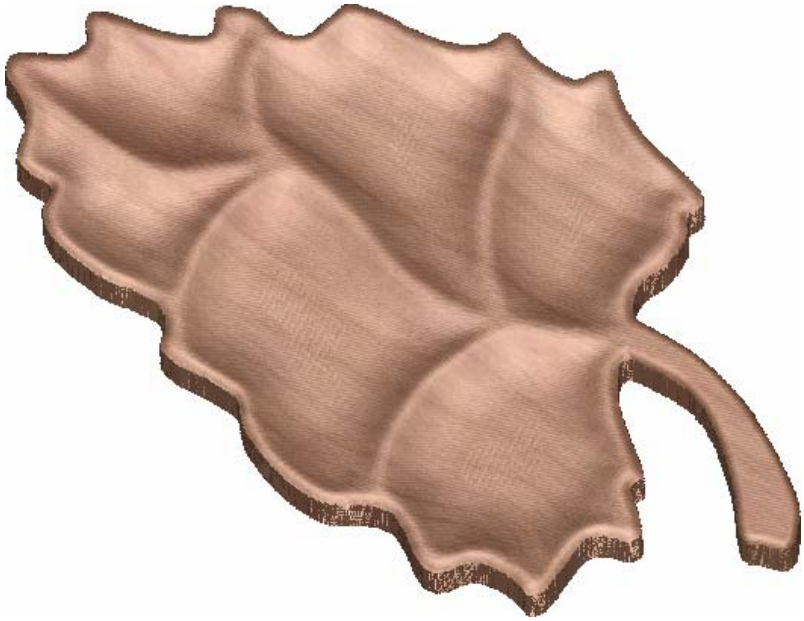
We estimate that this tutorial should take you approximately **10 minutes** to complete.

Introduction

This tutorial will show you how to Machine a 3D Decorative Carved Bowl into a piece of material that's approximately 13" x 8" x 3/4" thick using a 1/4" diameter End Mill for roughing a 1/4" Ball nose cuter for finish machining and a 1/4" diameter End Mill to cut out the bowl.

Note The 3D model can be resized to suit whatever material and cutter sizes you have available.

This 3D model has be designed using 3D Graphics packages such as Rhino, 3D Studio, Silo, Strata, ZForm etc. and then saving the design as a Mesh format that can be opened in the software.



The finished Carved Bowl

The key steps in calculating the toolpaths for this sample are,

1. Open the 3D Model and set the Size
2. Specify the Material dimensions and cutting depths
3. Calculate the Roughing toolpath - Optional
4. Calculate the Finishing toolpath
5. Calculate the Cut Out toolpath - Optional
6. Preview the completed job and Estimate the machining time
7. Save the Toolpaths ready for cutting

The file required for this tutorial are installed on your PC in the folder,

C:\Program Files\Cut3D Trial 1.0\Samples\Bowl.v3d

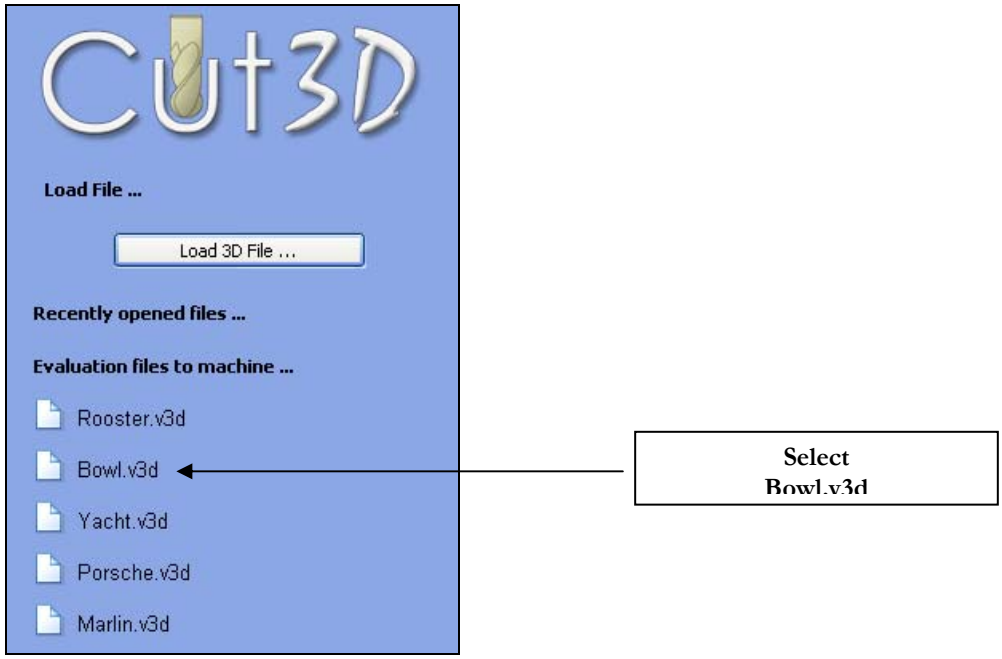
Note: If you are using the **Trial** version of Cut3D and wish to actually save the toolpaths and cut the design on your own machine. You will need to load the file **Bowl.V3D** if you want to be able to save and cut the toolpaths.

1. Opening the 3D Model

1. On the **front page click** on the **Load 3D File** 

button.
2. Navigate to the folder - **C:\Program Files\Cut3D\Samples**
3. Select the file named – **Bowl.v3d** and click the **Open** button

Alternatively, when using the **Trial version of Cut3D** select the file directly from the list of Evaluation files available



The 3D model will be drawn in the 3D view as shown below.

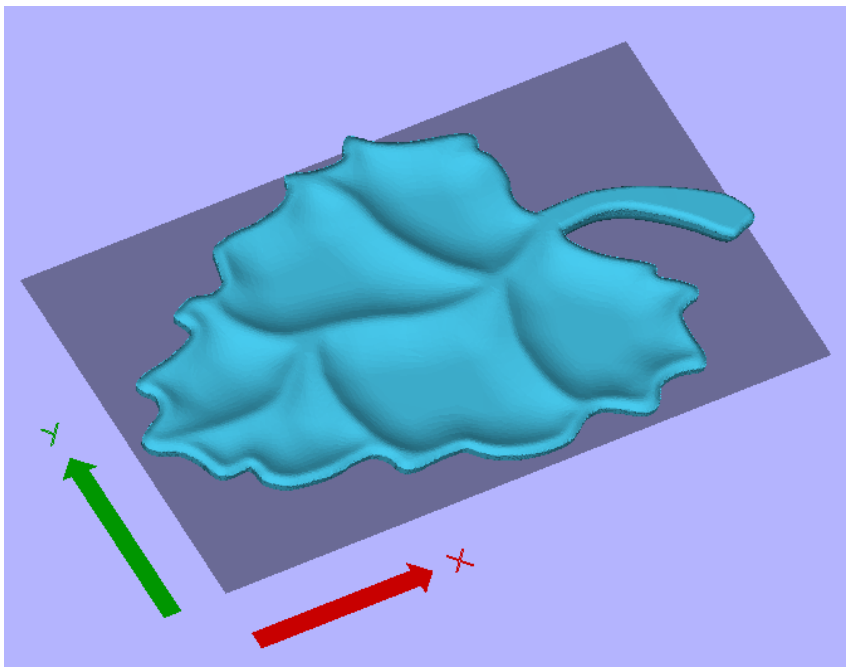
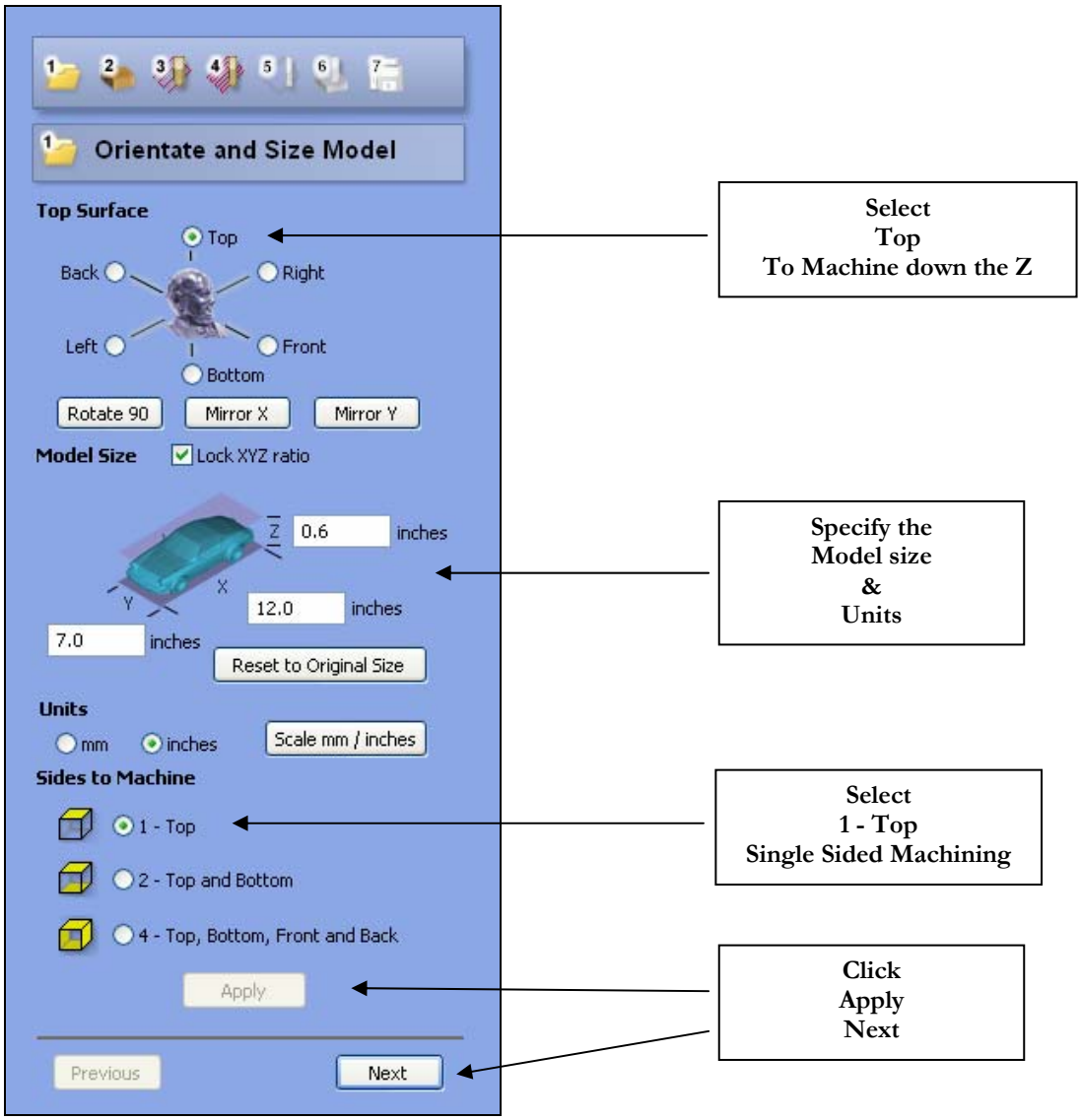


Figure 2 Original 3D Model

Note: The arrows showing the X and Y axes that relate to the coordinates on the CNC machine. .The model is automatically positoned lookin directly down the Z axis onto the XY plane.

4. Specify the required size for the model to be machined.



Click **Apply Button** to set the model size and select the Single Sided Machining option

5. Click the **Next button** to go to **Step 2** - **Material Size and Margins**

Notes The Model size should be set to fit inside the material you have available.

The Model can be scaled / squashed to fit into a specific material Thickness by,

Set the X Length and Y Height for the model
Uncheck the **Lock XYZ ratio** option
Enter the required Z thickness to fit the material

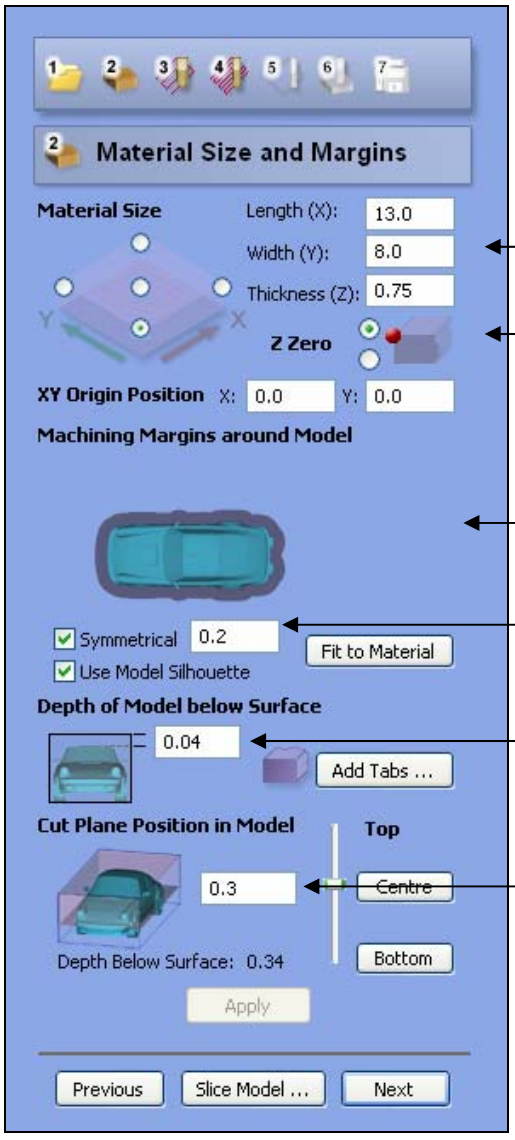
Clicking the **Reset to Original Size** button will return the model back to the original size.

2. Material Size and Margins

Step 2 is where the actual material size and cutting depths are specified. For single sided machining the material dimensions are not critical, but for multiple (2 and 4) sided machining the material must first be machined to an exact size and thickness.

6. Enter the size for the material you are going to machine the design into.

7. Complete the form as shown below



Specify the Material size

XY Origin Position
Z0 Origin

Enter the Machining boundary around the 3D Model

Machine 0.2" around the 3D model boundary

Move the 3D Model into the Material

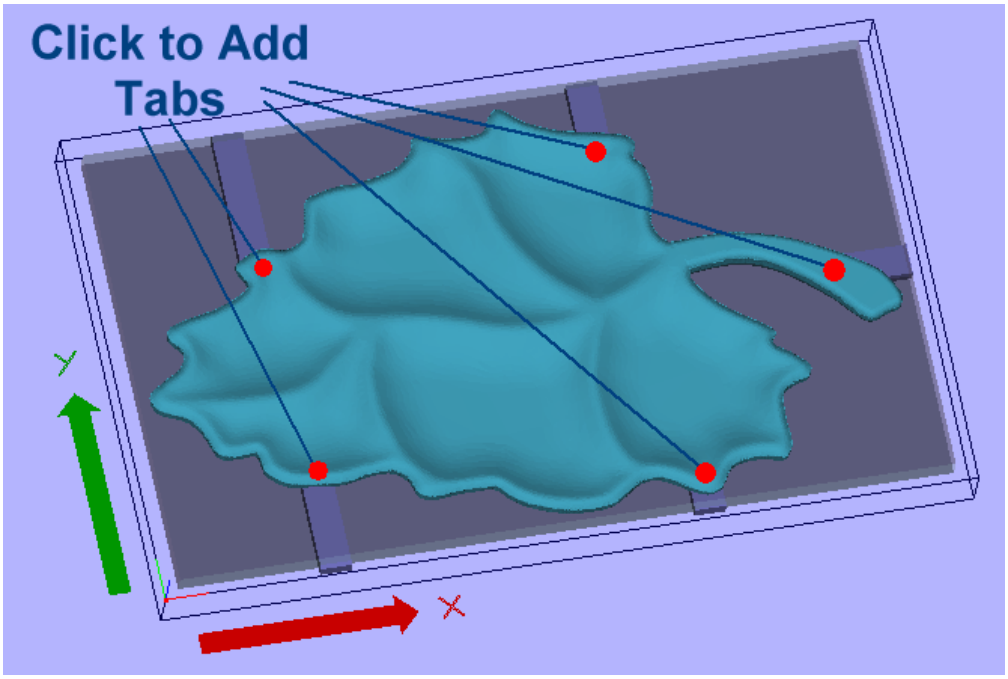
Set the Cut Plane at 0.3" into the Model

Notes: Click the **Apply button** to update the design settings in the 3D Window

8. Select a **Symmetrical** boundary of **0.2"** and **Model Silhouette** to reduce machining times.

9. Position the **Cut Plane Position** using the vertical slider or enter **0.3"**

10. Click the **Add Tabs** button and **Click On the model** to snap tabs between the model surface and the material edge as shown below. These tabs will hold the job in place during machining.



The **Black Wireframe** represents the **Material Block**

11. Click the **Apply button** to accept the settings on the form

12. Click the **Next button** to proceed to **Step 3 - Roughing Toolpath**

In this example there is no need to incorporate Tabs into the design because the Bowl is simply being machined onto a flat background. If the Bowl was being double sided machined and or cut out of the material then Tabs would be required to hold the job in place during machining

Note The large arrows indicate the axes on the CNC machine that the design will be machined a long. The model can be rotated and mirrored by pressing the **Previous** button and orientating the model as required.

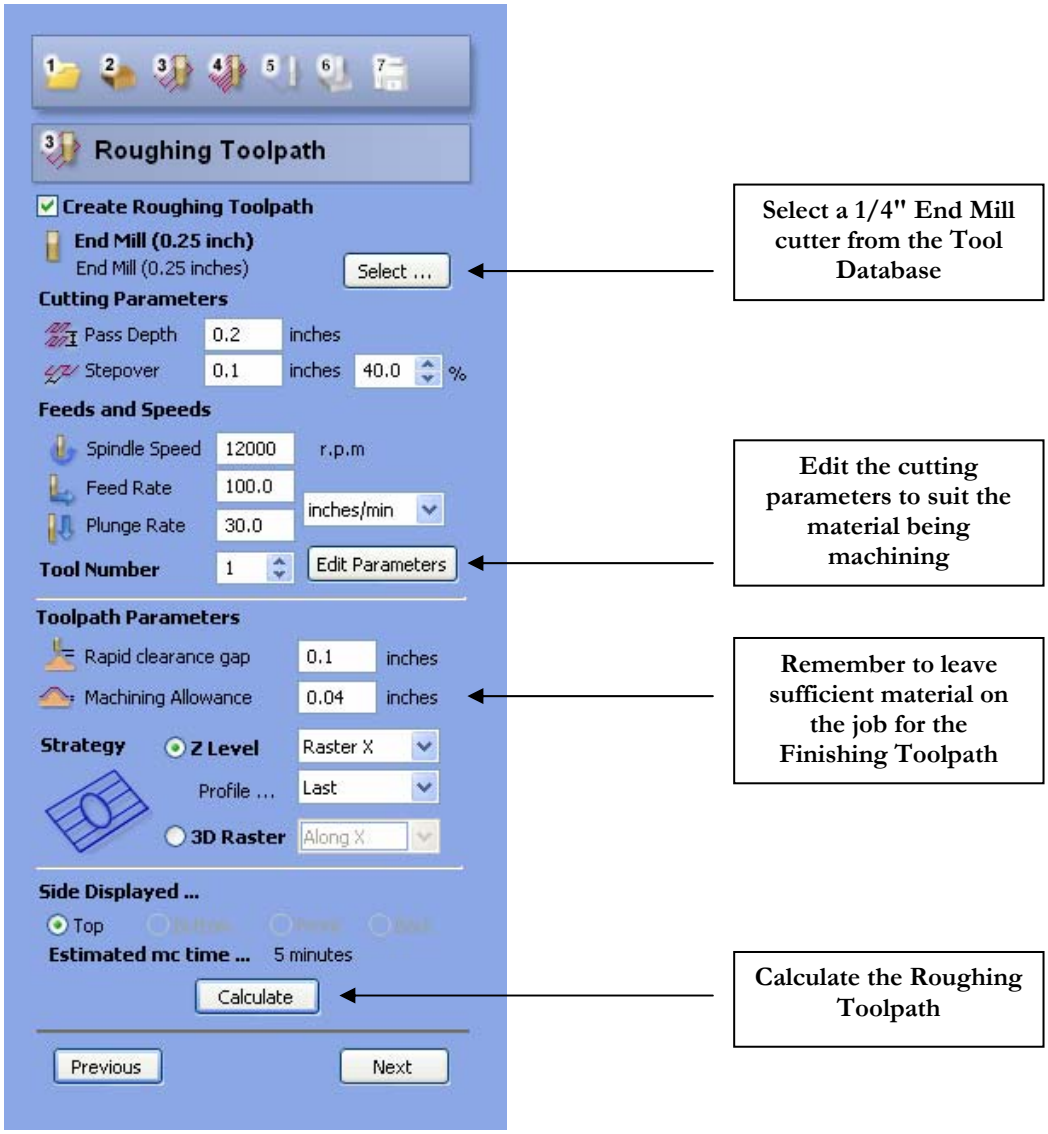
3. Roughing Toolpath

A Roughing Toolpath is optional and will only be needed when machining hard materials or the finishing cutter cannot be used to cut to full depth in a single pass. For example, the roughing toolpath is not when cutting soft materials such as foam with a cutter has sufficient flute cutting length.

13. Click the option to calculate a Roughing Toolpath

14. Click the **Select…** button and select a suitable cutter for Rough machining the bowl.

15. Complete the Roughing form as shown below,

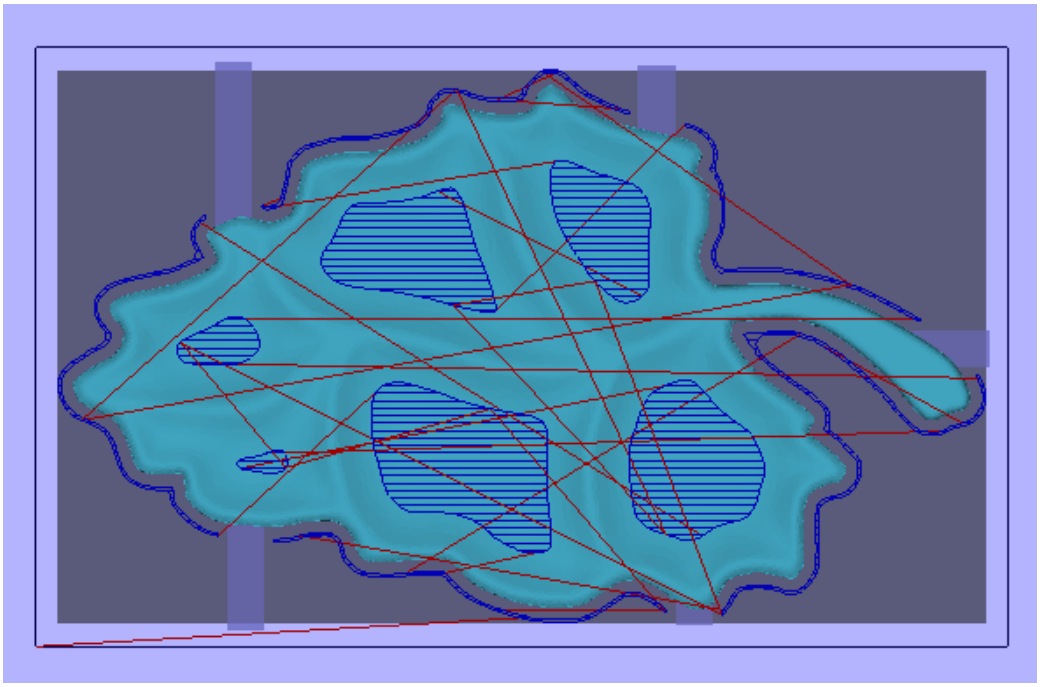


Notes This model could also be Rough and Finish machined using the same 1/4" Ball Nose

The Cutting parameters and Spindle Speed / Feed rates shown above are for general guidance only and should be set to suit the material you are cutting. Clicking the **Edit Parameters button** allows the values to be changed. Depending upon what material is being machining, you may wish to run faster or slower and with deeper cuts.

16. Click the **Calculate button** and the progress bar will run along the bottom of the screen to indicate that the toolpath is being calculated.

17. Click the **View Down Z button** in the Top Right corner of the 3D window. 



Multiple Z Level Roughing

Z Level Roughing will very quickly machine planar passes around the model to remove the unwanted stock.

Profile passes before or after each roughing pass may not always be necessary, especially when cutting soft materials.

The **Red lines** show where the cutter will retract and move at rapid feed rate.

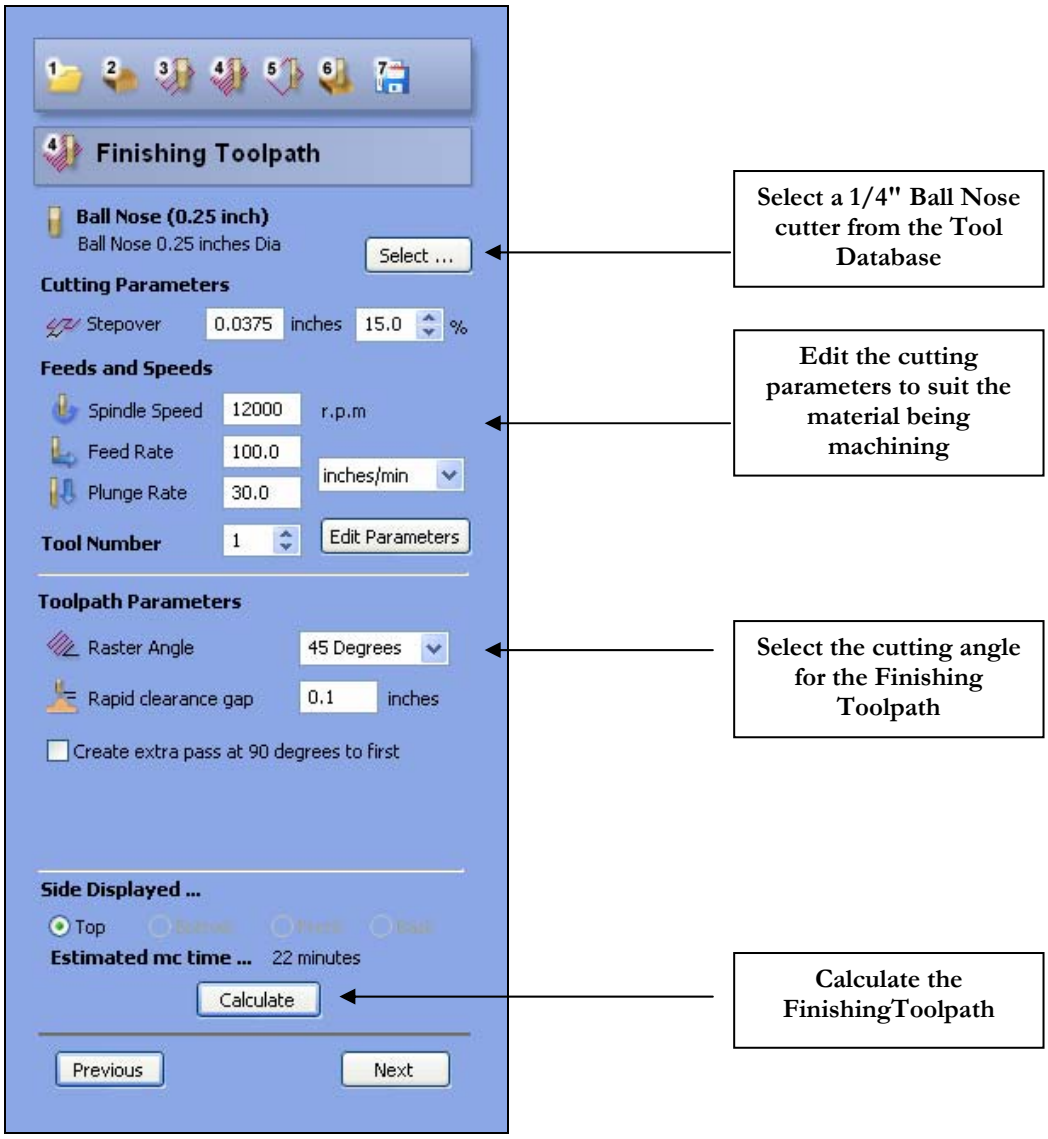
18. Click the **Next button** to proceed to **Step 4 - Finishing Toolpath**

4. Finishing Toolpath

The Finishing Toolpath machines the model to the required size using a Ball Nose cutter. A Raster toolpath will run over the specified area to be machined, along the X axis, the Y axis or at 45 degrees.

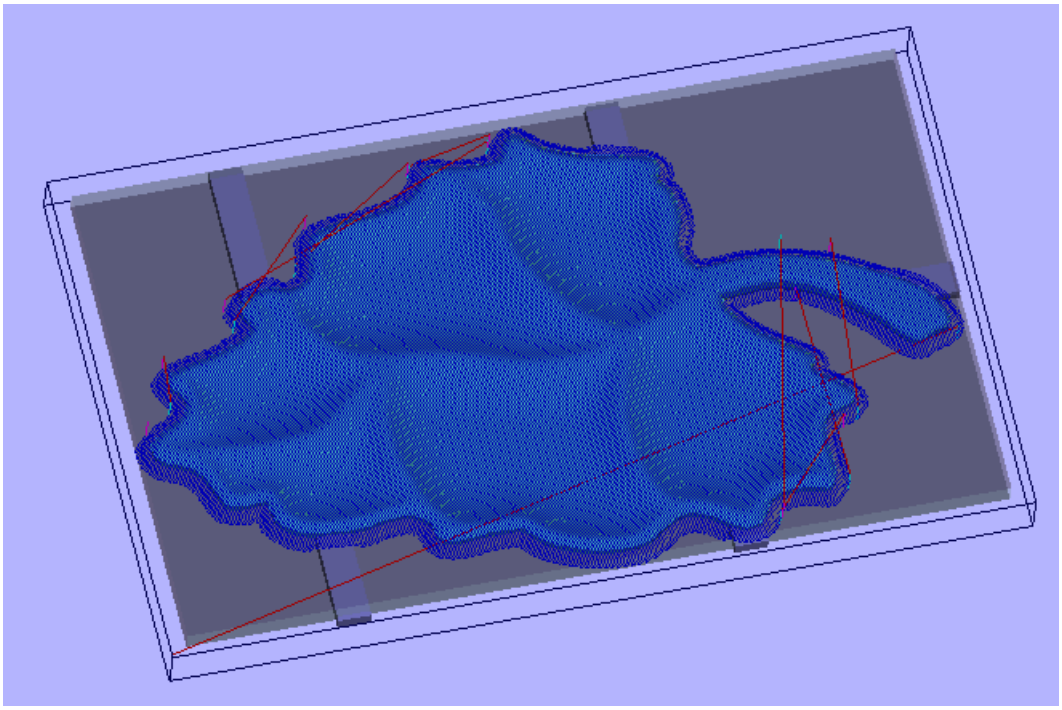
19. Click the **Select...** button and select a suitable cutter for Finish machining the design

20. Complete the Finishing Toolpath form as shown below,



Notes Cutting at 45 degrees will help produce better surface finish on the vertical walls of the base on the particular model.

21. Click the **Calculate button** and the progress bar will run along the bottom of the screen to indicate that the toolpath is being calculated.



Finishing Toolpath only machines the model and doesn't waste time cutting unwanted regions.

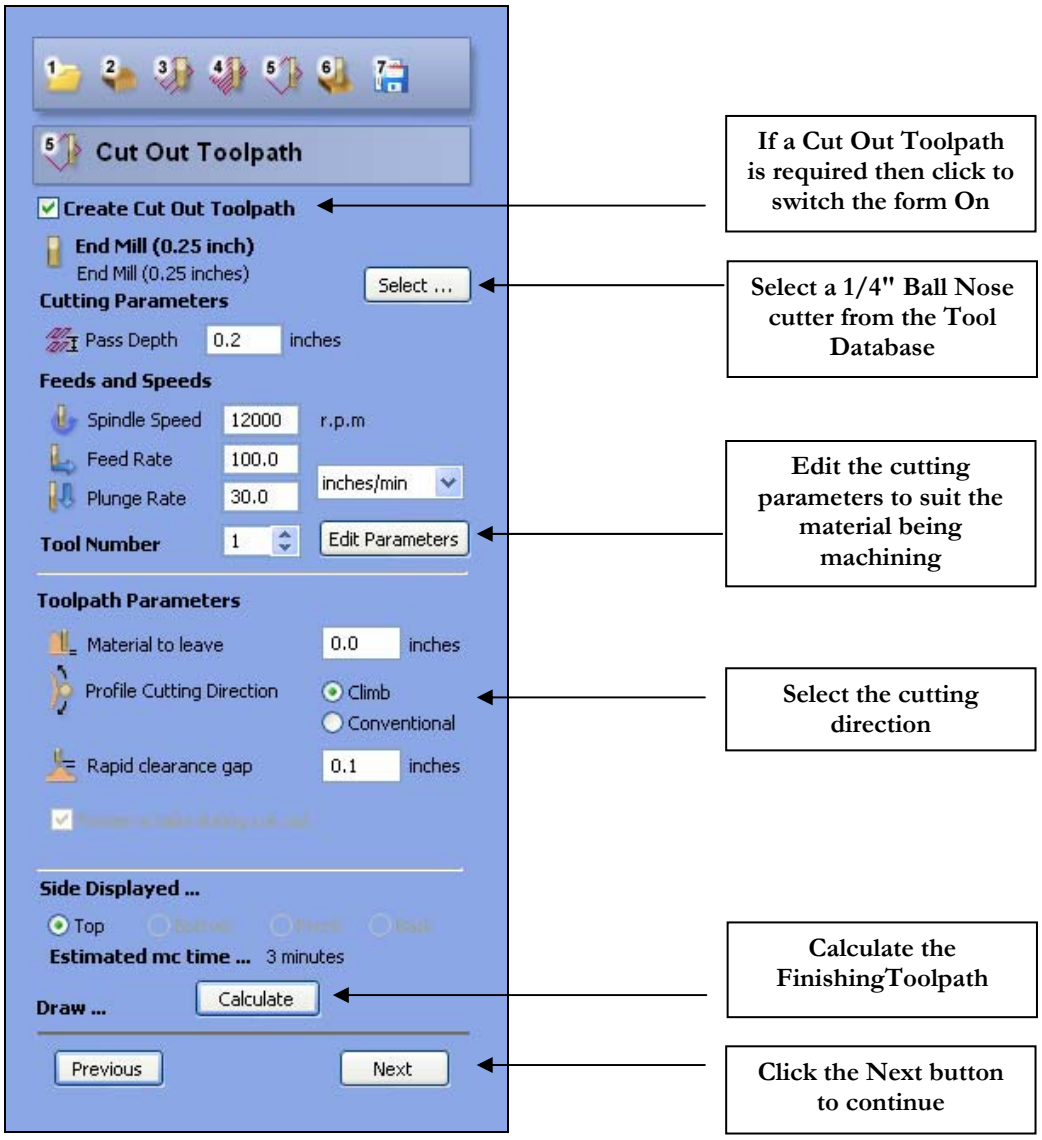
22. Click the **Next button** to proceed to **Step 5 - Cut Out Toolpath**

5. Cut Out Toolpath

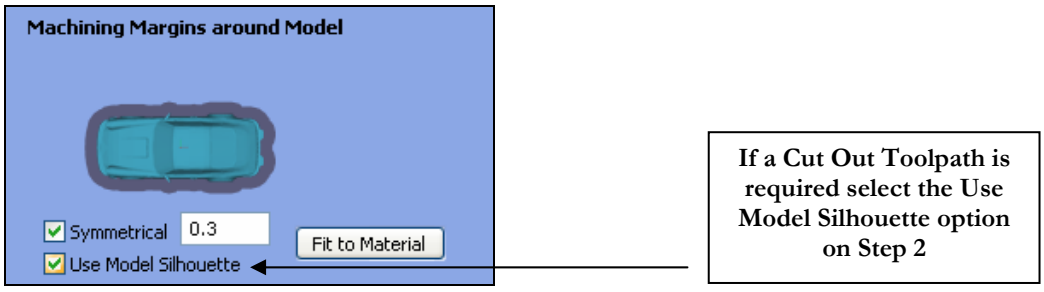
In this example the Cut Out Toolpath is not required because the design is being machined into a picture frame panel.

23. Click the option to calculate a Cut Out Toolpath and the form will become active.

24. Complete the Cut Out Toolpath form as shown below,



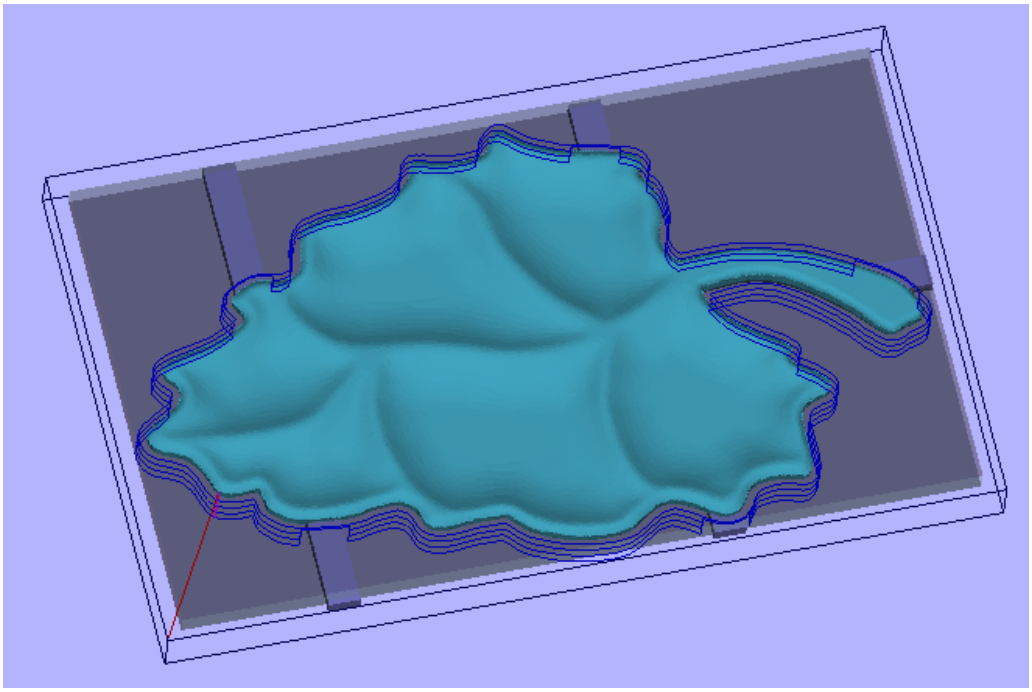
Notes To machine around the boundary silhouette of a 3D model first select the option on the Material setup form in Step 2.



The **Material to leave** option is set to 0 and by default the Cut Out Toolpath will machine to the base of the material.

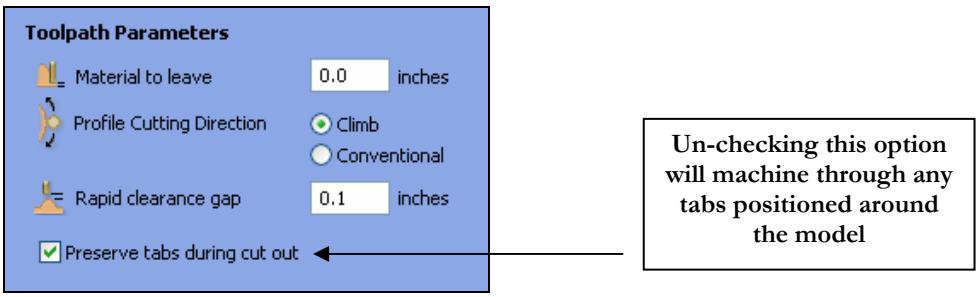
To leave a 0.020" skin on the bottom of the job — Material to leave = 0.020"

To cut 0.020" through the material — Material to leave = -0.020"



25. Click the **Next button** to proceed to **Step 6 - Preview Toolpaths**

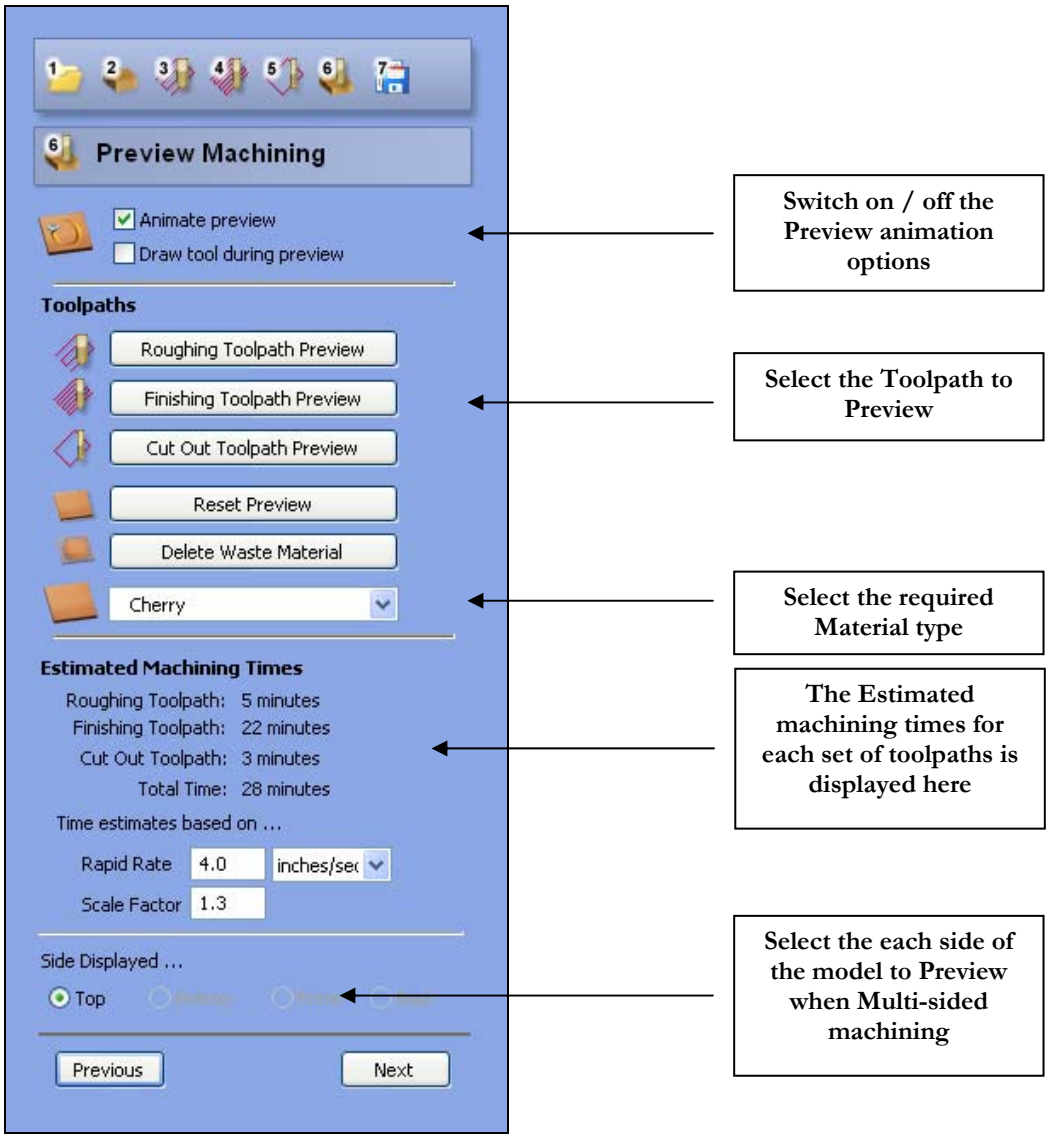
Notes The Tabs are retained when the Cut Out Toolpath is calculated. These can be removed by un-checking / switching off the option to **Preserve tabs during cut out**



6. Preview Toolpaths

After calculating the toolpaths the **Preview Machining** form can be used to simulate each of the toolpaths in turn. The material type can also be selected to create realistic screen images.

26. Click the **Roughing Toolpath Preview** button and watch the Preview in the 3D window.



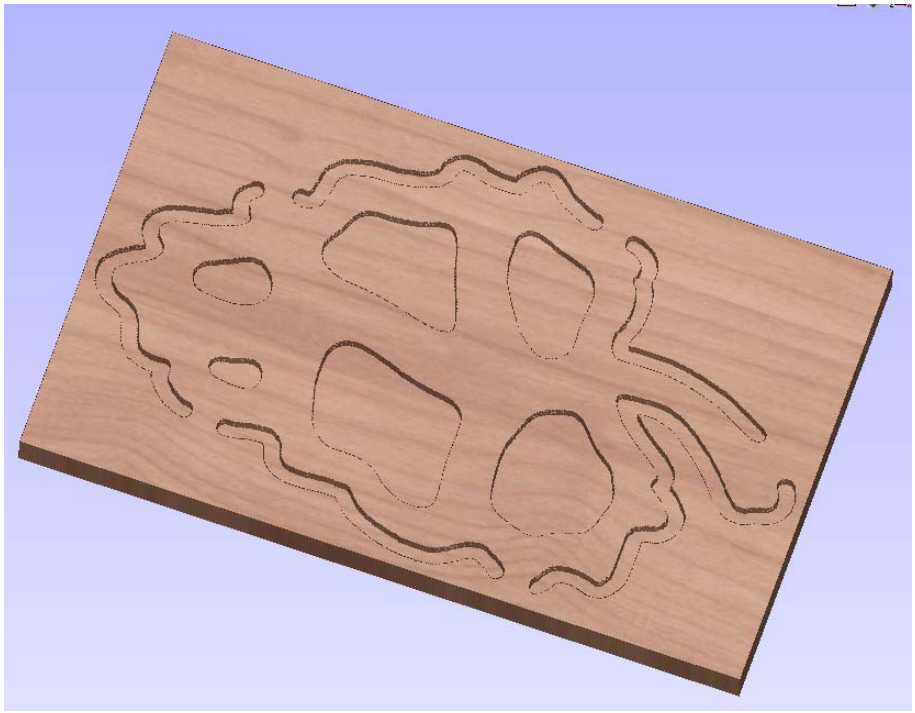
Notes

If the toolpaths cut all the way through the material the Delete Waste Material button will remove the excess material from around the remaining 3D model.

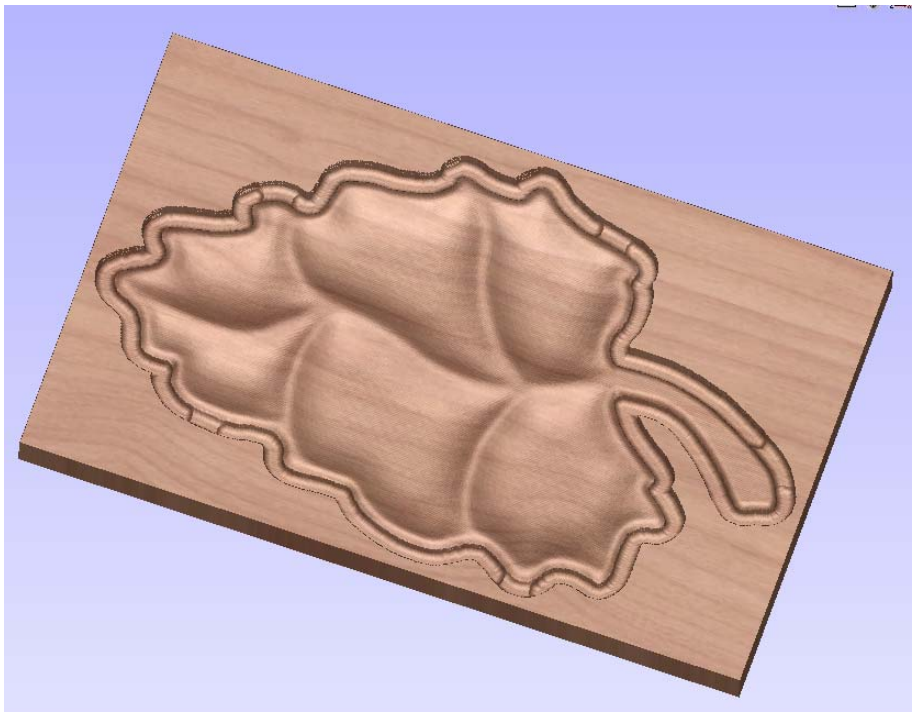
Clicking the **Reset button** returns the Preview model to a solid block.

The estimated Machining times are based on the CNC machine running at the actual programmed feed rates. This is often not possible when cutting 3D work because the control systems and hardware work more slowly when computing the 3D moves.

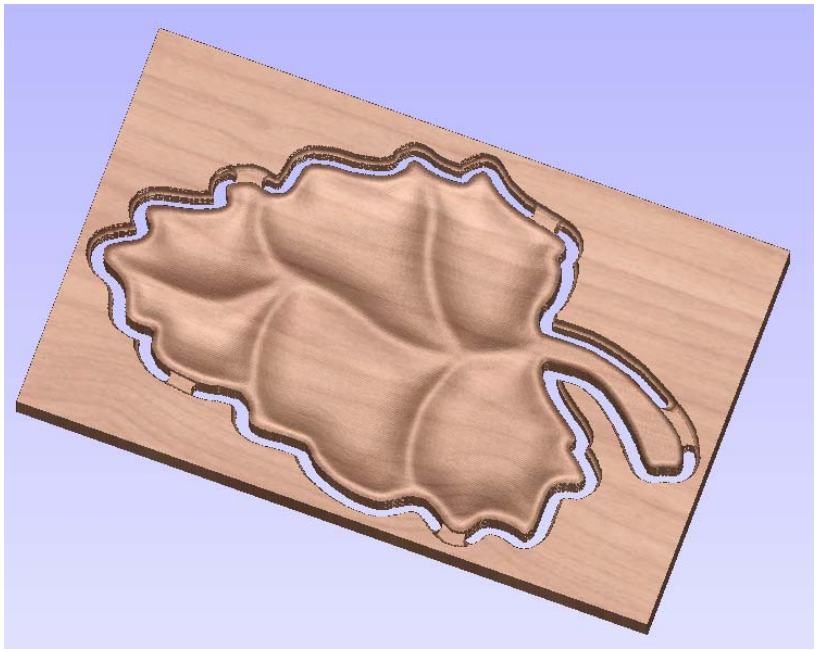
The Scale Factor allows the estimates to be more accurate and this value is remembered by the software for subsequent jobs.



Preview of the Z Level Roughing Toolpath



Preview of the Finishing Toolpath

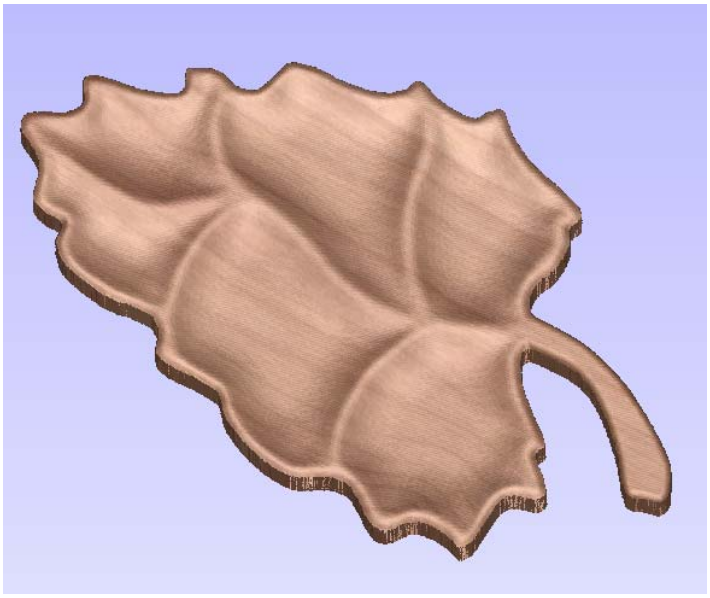


Preview of the Cut Out Toolpath after **Deleting the Waste Material**

27. Click the **Previous button** to return to the Cut Out Toolpath and calculate a toolpath with the **Preserve Tabs option** switched off.

28. Click the Next button and Preview the Cut Out Toolpath again and it will show that the piece will be machined free of the material.

29. Click the Delete Waste Material button to show the finished job.



The finish machined Carved Bowl

The content of the 3D Window can be saved as an image file at any time by selecting from the main menu,

File > Save Shaded Image

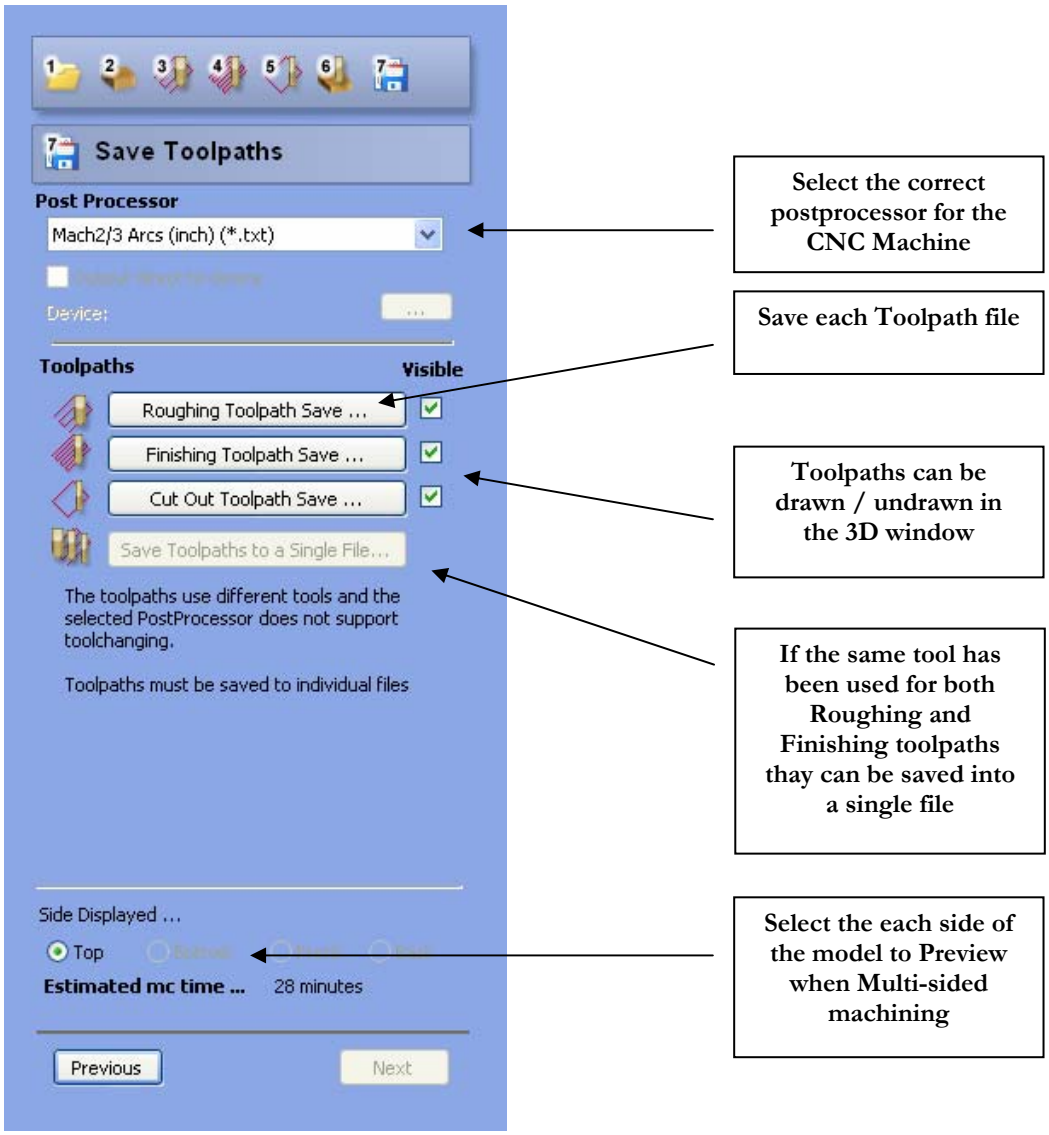
30. Click the **Next button** to proceed to **Step 7 - Save Toolpaths**

7. Save Toolpaths

The Toolptaths are now ready to be saved using the appropriate postprocessor for your CNC machine.

31. Click the pull-down list of **Postprocessors** and select the one for your machine.

32. Click the **Save Toolpath** button and enter a name to save the toolpath with.



ⓘ Take extreme care to ensure the material and cutter are setup correctly before using the toolpath.

Note: If you are using the **Trial** version of Cut3D you must load the file **Bowl.v3d** to be able to save and run the toolpaths on your own CNC machine.

8. Tool Database

The default Tool Database is preloaded with a selection of standard cutter sizes. This database can be modified to add New Tools, plus Copy or Delete existing cutters.

Important The **Cutting Parameters** should be set for the material you are cutting

Click the **Edit** button to modify the cutting parameters to match the tooling you are using