QuickCAM 3D - F1 Car Tutorial
Overview

This tutorial is designed primarily for students participating the "Jaguar F1 Team in Schools CAD/CAM Design Challenge". Student teams design and manufacture scale models of F1 cars, which are then raced in a National Competition. To find out more, log onto the F1 in Schools website by clicking the link below...
http://www.f1inschools.co.uk

The tutorial leads you through the process of converting a 3D model file describing the shape of an F1 car into the CNC file used to machine the solid 3D car body.

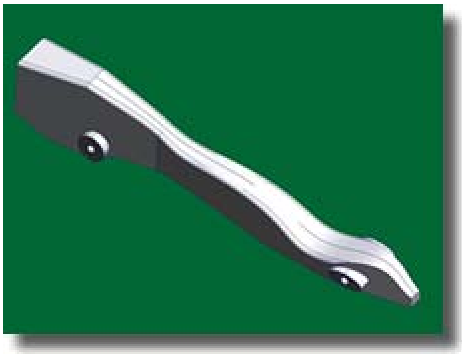
Click here to begin the tutorial...

Back to top of page
Next >

QuickCAM 3D - F1 Car Tutorial
Introduction

(c) Denford Ltd 2003
Next >

This tutorial leads you through the process of converting a 3D model, describing the shape of an F1 car body, into the CNC files needed to manufacture the design.



3D model, such as an STL file.

to

Machined 3D model.

In order to machine the tutorial example, you must create two separate CNC files. The first CNC file will be used to machine one complete side of the car body. The balsa blank can then be rotated 180° in the jig and the second CNC file used to machine the opposite side.

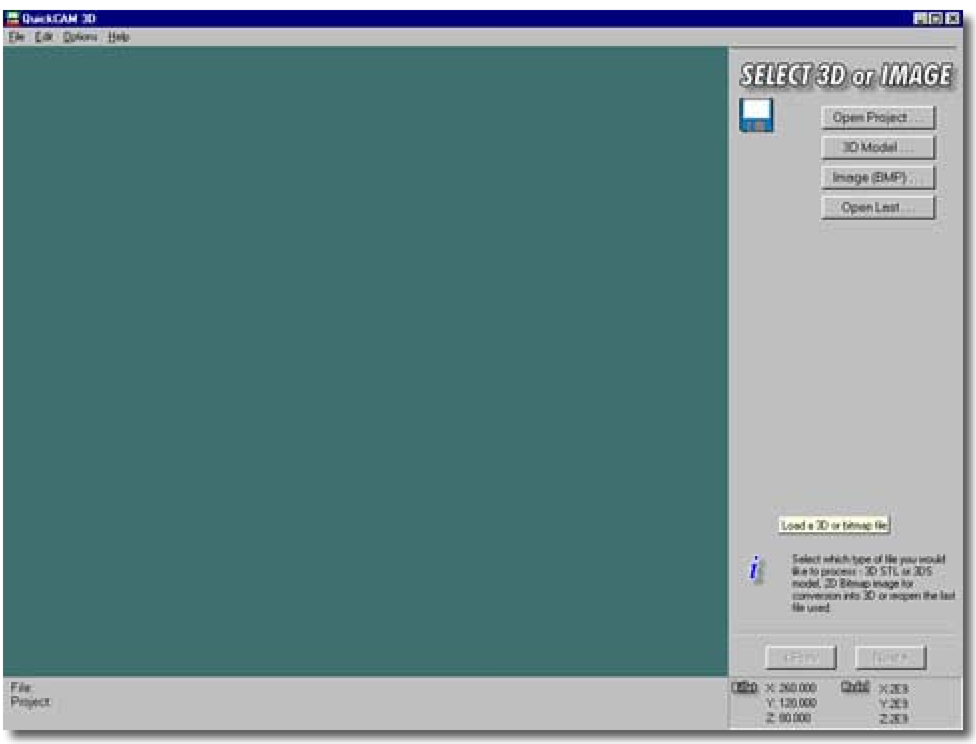
Back to top of page
Next >

QuickCAM 3D - F1 Car Tutorial

Before beginning the tutorial

< Previous - Next >

General layout of QuickCAM 3D

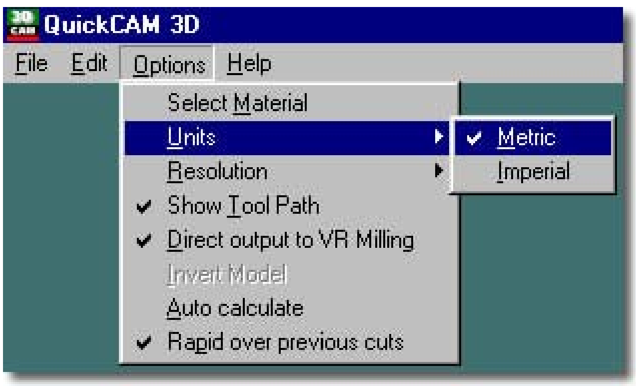


QuickCAM 3D opens at the "Select 3D or Image" screen - the first of nine separate stages. On each of these stages, the main QuickCAM 3D is always split into the same two areas:

1. A viewing pane, located on the left side and taking up the remaining two thirds of the main QuickCAM 3D window. This area is used for displaying graphic representations of the 3D model and billet. Currently this area will be blank, since no file is loaded.
2. An information pane, located on the right side and taking up around a third of the main QuickCAM 3D window. This area is used for entering and displaying any data relating to the stage being completed.

Setting the units of measurement

Before beginning the tutorial, set the QuickCAM 3D software to run using metric (millimetre) units. Click the "Options" menu, select "Units", then click the "Metric" text, if necessary, so a tickmark is displayed, as shown below.



Back to top of page
< Previous - Next >

QuickCAM 3D - F1 Car Tutorial
Stage 1 - Select 3D Model

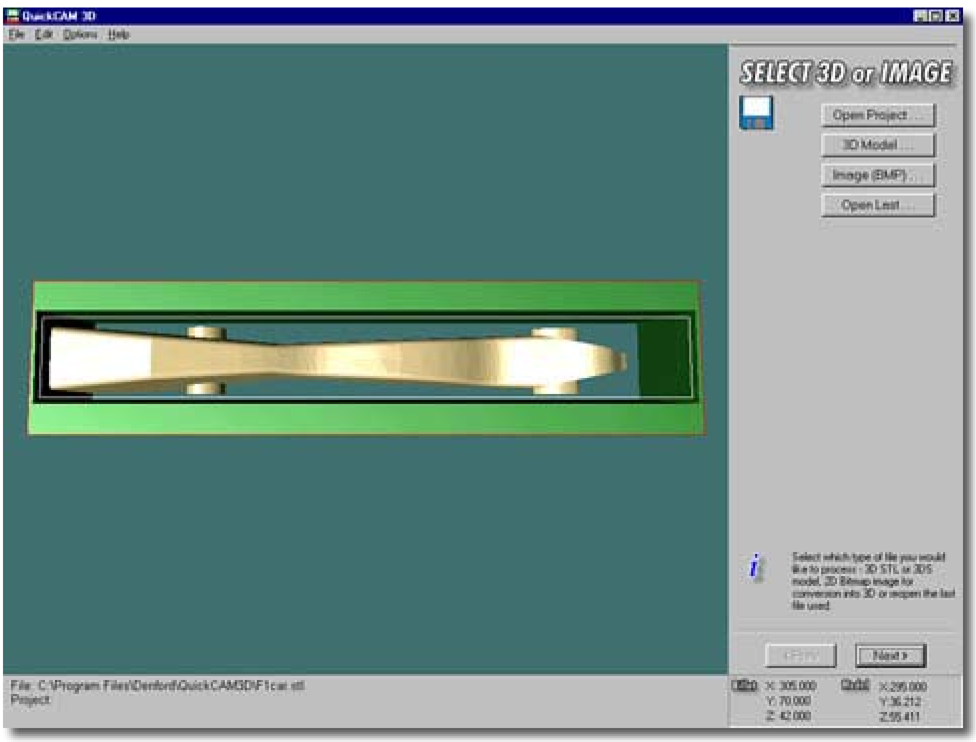
< Previous - Next >

The "Select 3D or Image" stage allows you to load the 3D file you want to convert.

Locate and load the 3D model file

Click the [3D model...] button. The "Open" window is displayed, as shown below.

Locate and select the file named "F1car.STL". If QuickCAM 3D was originally installed using the default folders, this can be found at location...
C:\Program Files\Denford\QuickCAM3D
Click the [Open] button. The 3D model is loaded into the viewing pane of the main QuickCAM 3D window. Your QuickCAM 3D window should look something like the example shown below.



Back to top of page
< Previous - Next >

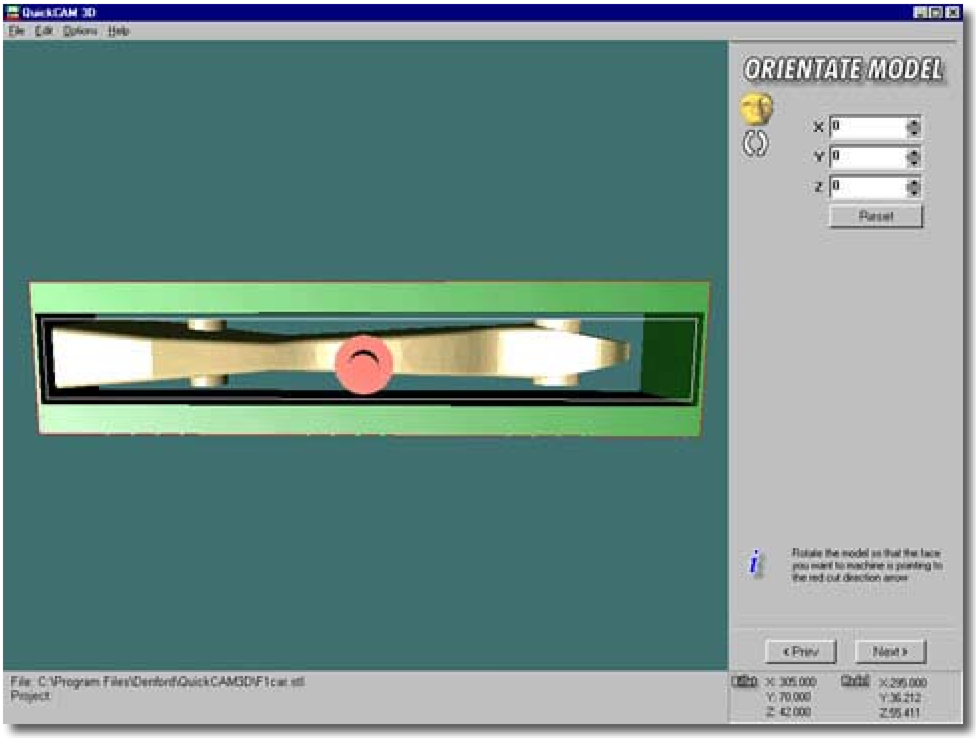
QuickCAM 3D - F1 Car Tutorial
Stage Two - Orientate Model

< Previous - Next >

The "Orientate Model" stage allows you to set how the 3D model will be positioned relative to the working area of the CNC machine. Imagine the left pane as the view through the front window of your CNC machine.

Manipulating the view

A red arrow is included in this stage, representing the direction that the cutter will approach the billet, or in other words, the Z axis of the CNC machine. At the moment, the red arrow is displayed on your screen as a red circle, since it is pointing directly down onto the plan view of the 3D model, as shown below.

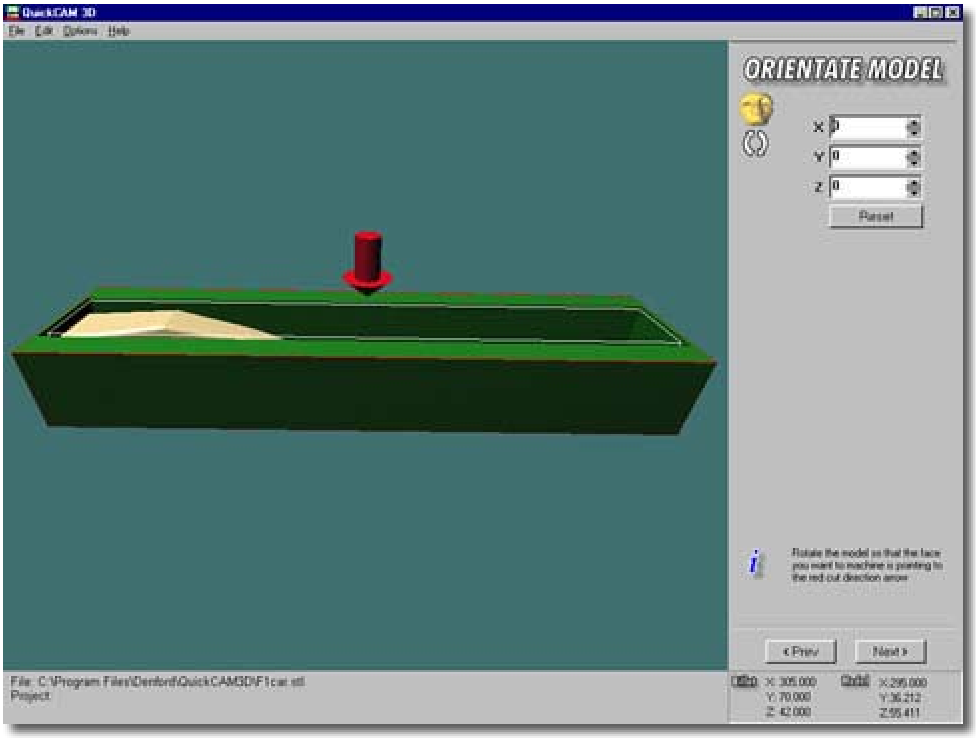


Before progressing further, you must manipulate your view of the 3D model, by zooming in and adding a bit more perspective, so you can clearly see the red arrow pointing down.

To zoom in...
Using your mouse, right click on the 3D model and continuing to hold the right mouse button down, move the cursor upwards. This enlarges the view of the 3D model. Moving the cursor down will make the 3D model smaller. Size the 3D model to fit the viewing pane.

To add perspective...
You can also tilt the 3D model front to back and left to right. Using your mouse, left click on the 3D model. Continuing to hold the left mouse button down, move the cursor upwards. This tilts the back edge of the 3D model down. Moving the cursor down will tilt the front edge of the 3D model. Moving the the cursor left or right will tilt down the left or right edges of the 3D model. Manoeuvre your view so you can see both the front and top surfaces of the 3D model, with the red arrow pointing directly down.

Your QuickCAM 3D window should look something like the example shown below.



Setting the orientation of the 3D model

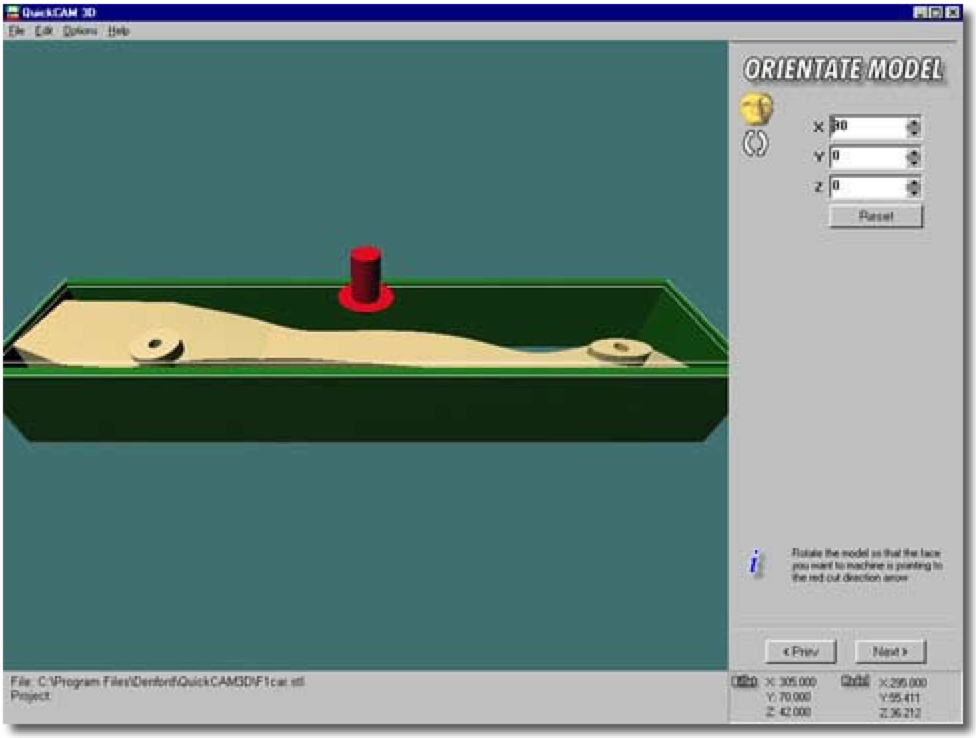
You want to create a CNC file that can manufacture one complete side of the F1 car body - in this case, we will call this side the right of the 3D model (when viewed from the back plane). This is achieved by orientating the 3D model so the red arrow (the cutter) is pointing directly down onto the face that you want to machine - this will be one of the side faces of the F1 car body. At the moment, the 3D model is positioned so the cutter is facing the top of the F1 car body.

You also want to orientate the 3D model so it makes best use of the working area in the CNC machine. At the moment, the longest side of the 3D model aligns with the X axis, which on most CNC machines will be the axis with the longest travel.

Usually, the best orientation is achieved when the following criteria are fulfilled:

- The longest side of the 3D model is parallel with the X axis (the front edge) of the CNC machine.
- The shortest side of the 3D model is parallel with the Y axis (the side edge) of the CNC machine.
- The most detailed surface of the 3D model, or the face you want to cut, points directly upwards towards the face of the cutter on the CNC machine.

To orientate your 3D model, enter a value of 90º in the "X" dialogue box, so the right side of the 3D model is facing upwards. Both the "Y" and "Z" dialogue boxes should read 0º. Note that the [Up] or [Down] buttons can be used to shift the orientation of the 3D model in 90º increments. Your QuickCAM 3D window should now look something like the example shown below.



Back to top of page
< Previous - Next >

QuickCAM 3D - F1 Car Tutorial

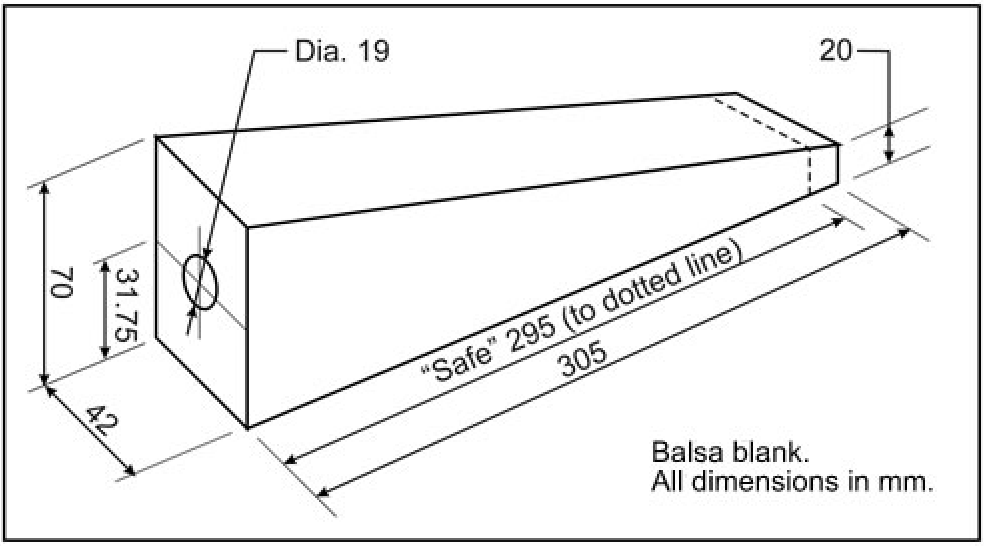
Stage Three - Billet Definition

< Previous - Next >

The "Billet Definition" stage allows you to set the size of the billet - the material used for machining the final design. It is important to understand that the values entered at this stage of the process do not necessarily have to be the exact dimensions of the actual balsa blank billet you will be using.
If you enter values less than the true size of the balsa blank billet, you can prevent the cutter from machining certain parts of the billet - for example, areas that are fragile, or contain fixture pins of screws.
If you enter values greater than the true size of the balsa blank billet, you can allow the cutter to reach extreme parts of the billet - for example, cutting completely down the sides of a model.

Entering billet sizes

The actual balsa blank used to manufacture your F1 car body is 305mm long, 42mm wide, 70mm high at the CO_2 cartridge end and 20mm high at the thin taper end, as shown below.



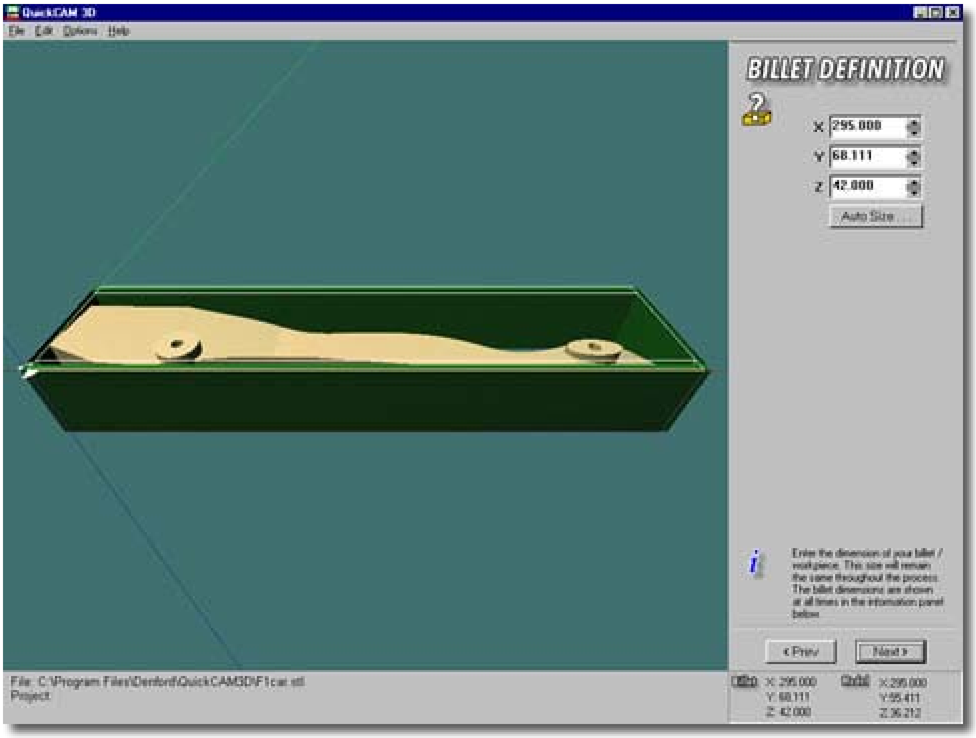
Use the "X", "Y" and "Z" dialogue boxes to enter your billet dimensions. Remember, these values do not need to be the true dimensions of the actual balsa blank billet shown above.
You can either type directly into the dialogue box, or use the [Up] and [Down] buttons to change the value.
As you enter values, notice that the billet drawing, shown using purple lines, is updated around the 3D model.

Enter the length of the 3D model into the "X" dialogue box. In this tutorial, the 3D model is 295mm long - this also happens to be the "safe" recommended length that can be machined.
The maximum dimension that should be entered in the "X" dialogue box is 295.000mm. Although the actual balsa blank has a length of 305mm, the maximum "safe" recommended length is 295mm - the extra 10mm at the taper end of the billet is required for the fixture screws that hold the billet in the CNC machine.
When entering values for your own designs, even if your 3D model is comfortably shorter than the "safe" recommended length of 295mm, we recommend that you enter the exact length of your 3D model. When combined with additional values set in the next stage of the process, this will help ensure that the CO2 fixture pin on the jig holding the balsa blank billet can never be accidently machined.

Change the "Y" dialogue box billet dimension from 55.411mm (the maximum width of the 3D model used in this tutorial) to 68.111mm. This figure is calculated as follows...
[3D model width] + [2 x the cutter diameter used]
You will be using a ¼" (6.35mm) diameter ball nose cutter to manufacture your F1 car body, so the figure is calculated as...
[55.411mm] + [2 x 6.35mm] = 68.111mm
This extra dimension is added to allow the cutter to machine fully over the profiles of the 3D model. If you do not add this cutter clearance dimension, the extreme front and back faces of the F1 car body profiles cannot be reached by the tool.

Change the "Z" dialogue box billet dimension from 36.212mm (the maximum width of the 3D model) to 42.000mm. This figure is the width of the actual balsa blank billet.

At this stage, your QuickCAM 3D window should look like the example shown below.



Back to top of page
< Previous - Next >

QuickCAM 3D - F1 Car Tutorial

Stage Four - Position & Size

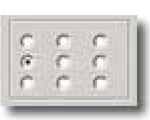
< Previous - Next >

The "Position & Size" stage allows you to scale the 3D model up or down and place the 3D model in a particular area of the billet.

Positioning the 3D model in the billet

The "XY Alignment" panel, at the top of the information pane, contains a series of nine white circles, set in a 3 x 3 grid. This represents the plan view of the billet.
Note that this panel only applies changes to the X and Y axes - the position of the 3D model in plan view only. The Z position, the depth of the 3D model within the billet, is unaffected.

Important!
Ensure that a black marker dot is placed on the second row down, in the extreme left circle, as shown below.



Why?
When you machine your design, the balsa blank billet will be held in a jig. The fixture pin on the left end of the jig will fit inside the CO2 cartridge hole on the balsa blank billet. If the XY alignment is not set as shown above, the cutter may machine through the fixture pin. Placing the black dot on the second row down

ensures that the cutter clearance, set in stage 3, is left at both the front and back of the 3D model.

Other factors must also be included to help prevent accidental machining of the jig.
The billet length entered in stage 3 should be the length of your 3D model, not the true length of the balsa blank billet. This figure must not exceed 295mm.

Using the dimensions data panel

Currently, the 3D model is positioned at the wrong depth within the billet - the side face is level with the billet top surface. You must adjust the Z depth, so equal amounts of material lie above and below the 3D model.

Look at the data panel, located in the bottom right-hand corner of the main QuickCAM 3D window. The panel lists all the billet and 3D model dimensions. The billet Z dimension is 42.000mm, whilst the 3D model Z dimension is 36.212mm. The difference in these values is the waste material that will eventually be machined from the billet.

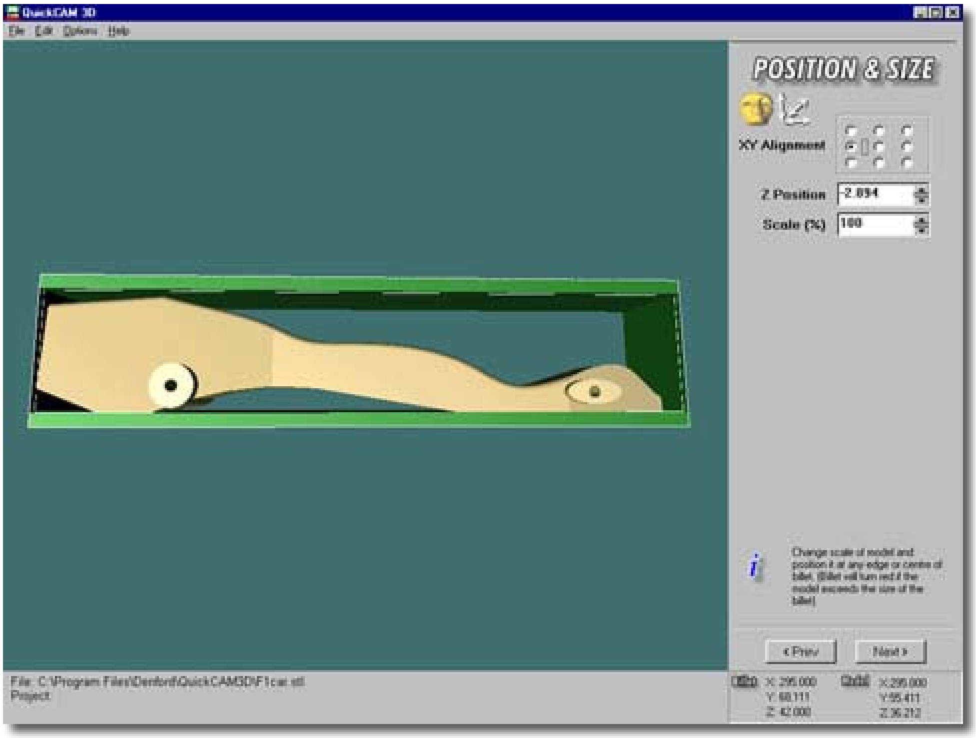
The amount the 3D model must be lowered, in order to lie exactly on the middle of the Z axis, is calculated as follows...
[Billet Z value - Model Z value] / 2
which equates to...
[42.000mm - 36.212mm] / 2 = 2.894mm

Enter a value of -2.894mm in the "Z Position" dialogue box. Notice that the sign is negative, since you are lowering the 3D model further into the billet - the top surface of the billet is taken as the zero plane.

Scaling the 3D model

The 3D model is full size, so leave the value in the "Scale (%)" panel at 100%.

At this stage, your QuickCAM 3D window should look like the example shown below.



Back to top of page
< Previous - Next >

QuickCAM 3D - F1 Car Tutorial
Stage Five - Tooling Setup

< Previous - Next >

The "Tooling Setup" stage allows you to choose the type of cutting tool and how it will be used. At this stage, you can also render the 3D model in realistic materials.

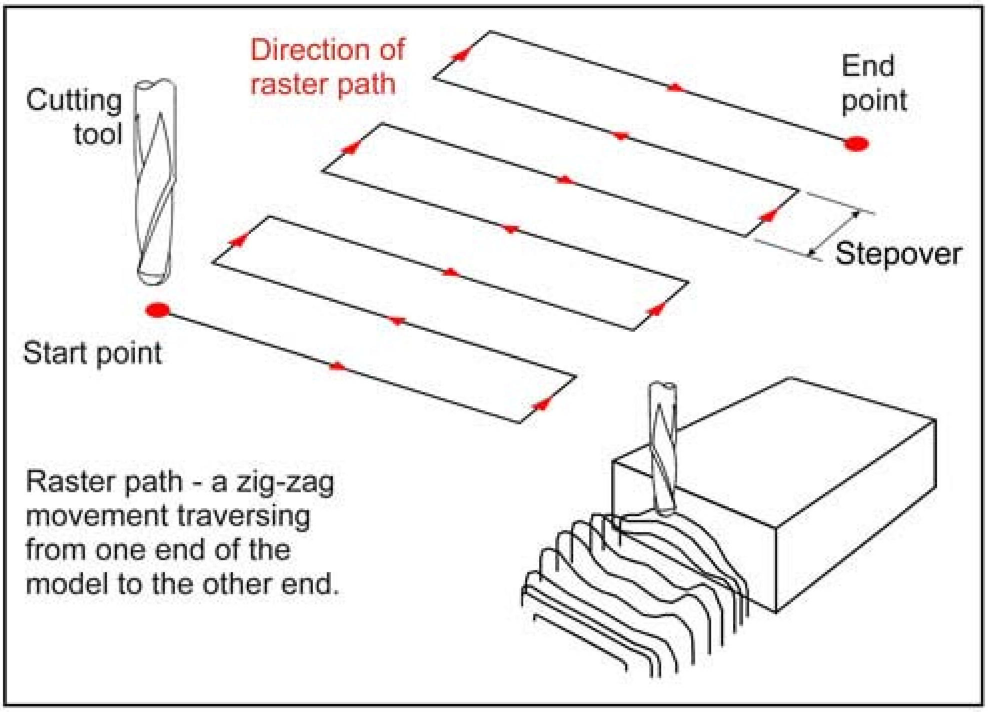
Configuring the type of cutter

For this tutorial, you will use a ¼" (6.35mm) diameter ball nose cutter. This gives a smoother edge on the changes between the profiles across the F1 car body.
Tip: For finer detail use a smaller diameter tool, although remember that your final design will take longer to machine.

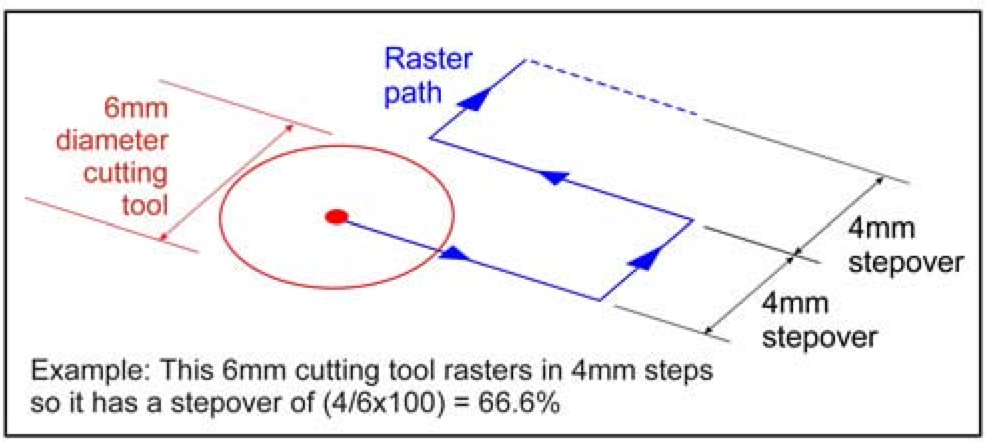
In the "Type" panel, ensure that the black marker dot is positioned in the top white circle, next to the "Ball Nose" text, then set the diameter of the tool as 6.350mm, using the "Diameter" dialogue box.

Setting a value for the stepover

The F1 car body profiles will be machined using a raster path - a series of parallel zig-zag lines followed by the tool, as shown in the diagram below.



"Stepover" determines the spacing between these lines, creating a coarse cut (such as 95%) or a fine cut (such as 5%). The stepover value is a percentage of the tool diameter value, as shown in the diagram below.



A fine cut gives excellent definition to detail but at the expense of long machining times, since there are more tool path lines. Enter a value of 20% into the "Stepover" dialogue box.

Tip: In most jobs, a stepover of 20% gives a good compromise between detail definition and machining time.

The maximum amount of material that can be removed by the cutting tool in one pass is configured using the "Max. Cut (Z)" dialogue box. Amongst many other factors, this value is determined by the type of material being machined and the flute length of the cutter. Set this value as 25.000mm. Your QuickCAM 3D window should look like the example shown below.

Back to top of page
< Previous - Next >

QuickCAM 3D - F1 Car Tutorial

Stage Six - Cutting Plane

< Previous - Next >

The "Cutting Plane" stage allows you to determine the maximum depth the cutting tool will machine into the billet.

Positioning the cutting plane

The "Cutting Plane" defines the maximum depth of cut for the 3D model, or in other words, how much of the 3D model you want to manufacture. Any parts of the 3D model below the cutting plane will not be machined. Since two separate CNC files will be cutting each half of the F1 car body, you will only need to machine down to the centreline.

Click the [Centre] button. This positions the cutting plane exactly through the middle of the 3D model. The cutting plane is shown on-screen with the blue border.

Notice that that the value in the "Z Position" dialogue box automatically changes to read -21.000mm. This value is half the billet Z dimension, 42.000mm. The value is negative to indicate that the cutting plane lies 21.000mm under the top surface of the billet (taken as the Z zero position). Remember, you can use the data panel in the bottom right-hand corner of the main QuickCAM 3D window to verify dimensions at any time during the process.

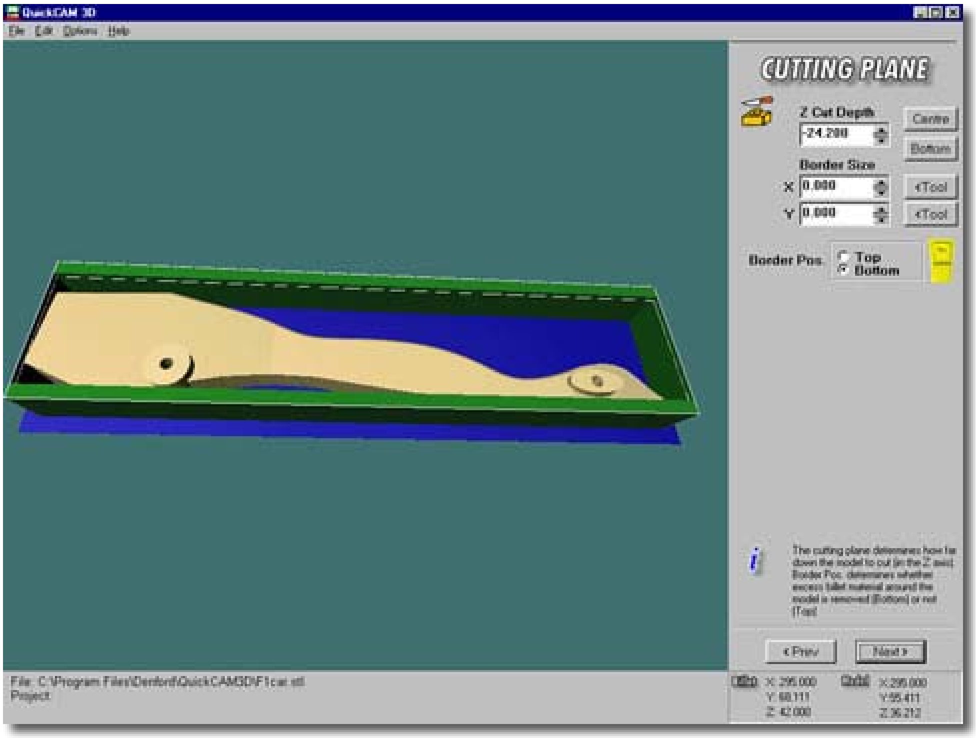
You will use a ¼" (6.35mm) ball nose cutter to machine both sides of the F1 car body. Since the tip of the cutting tool is rounded, lower the "Z Position" by an extra 3.2mm. Type a value of -24.200mm into the "Z Position" dialogue box.

Configuring a border

The "Border Pos." panel allows you to determine whether to leave the area of billet material surrounding the 3D model untouched, or machine all this remaining material down to the depth of the cutting plane. For this tutorial, you want to machine all of this surplus material away. Ensure that the black marker dot is positioned in the lower white circle, next to the "Bottom" text.

Because we are setting the border position to the bottom, there is no need to enter any values into border size, set them both to 0.0 - these values are used to create clearance around the model, within the billet.

Your QuickCAM 3D window should now look like the example shown below.



Back to top of page
< Previous - Next >

QuickCAM 3D - F1 Car Tutorial
Stage Seven - Machining Strategy

< Previous - Next >

The "Machining Strategy" stage allows you to set the feedrate and spindle speed, together with the direction of the raster tool path.

Entering feedrate and spindle speed values

Both the feedrate and the spindle speed can be influenced by a number of factors, including:

- The material being machined.
- The type, size and condition of the cutting tool.
- The type, capabilities and condition of the CNC machine.

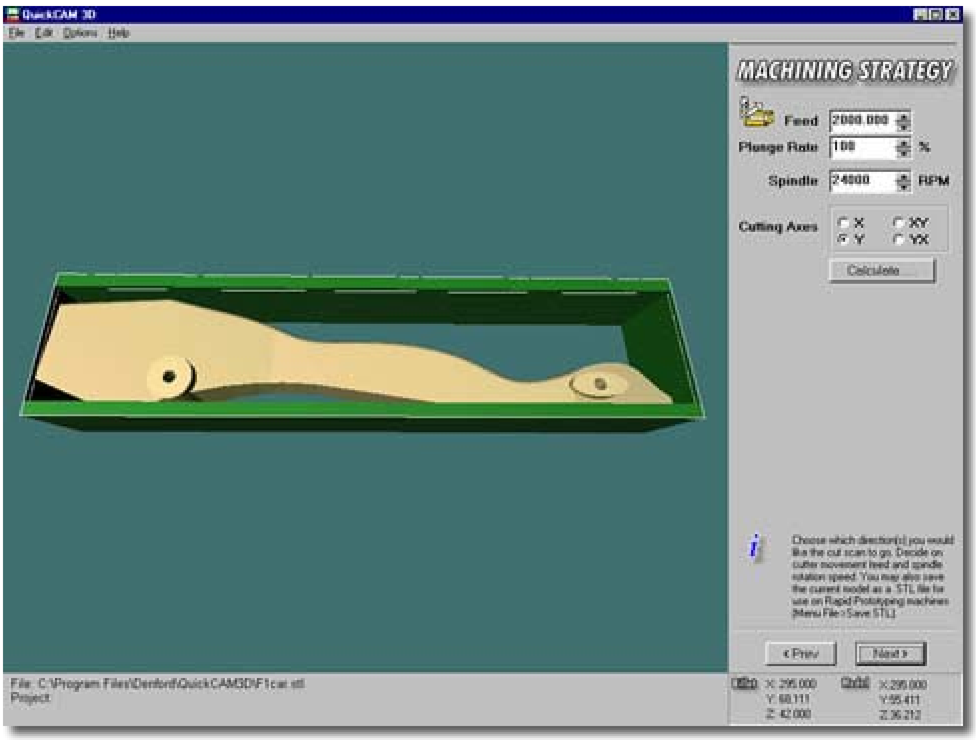
The "Feed" dialogue box is used for setting the value of the feedrate, measured in millimetres per minute (mm/min). Values entered must be suitable for machining high density urethane foam. Enter a value that matches the Denford CNC machine you intend to use or consult your CNC machine manual:

- Triac - 900
- Triton - 900
- Microrouter - 2,000

The "Spindle" dialogue box is used for setting the value of the spindle speed, measured in revolutions per minute (RPM). Values entered must be suitable for the capabilities of your CNC machine. Enter a value that matches the Denford CNC machine you intend to use or consult your CNC machine manual:

- Triac - 2,500
- Triton - 2,500
- Microrouter - 24,000

Your QuickCAM 3D window should look like the example shown below - we have entered values for a Denford CNC Microrouter in our screenshot.

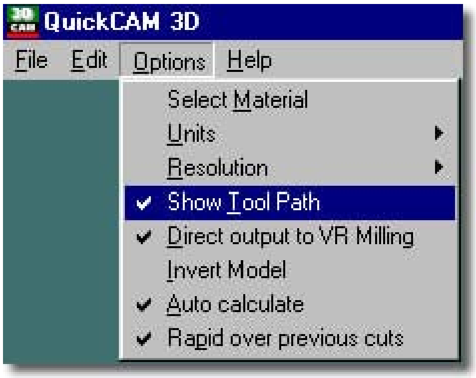


Choosing a raster tool path direction

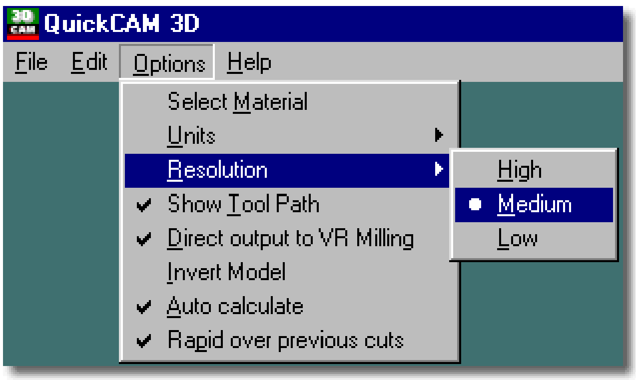
The number and direction of the raster tool paths is set using the "Cutting Axes" panel. For this tutorial, you want to machine just one raster path parallel to the ends of the billet - this will be the Y direction. Ensure that the black marker dot is positioned in the white circle next to the "Y" text.

Calculating the tool path

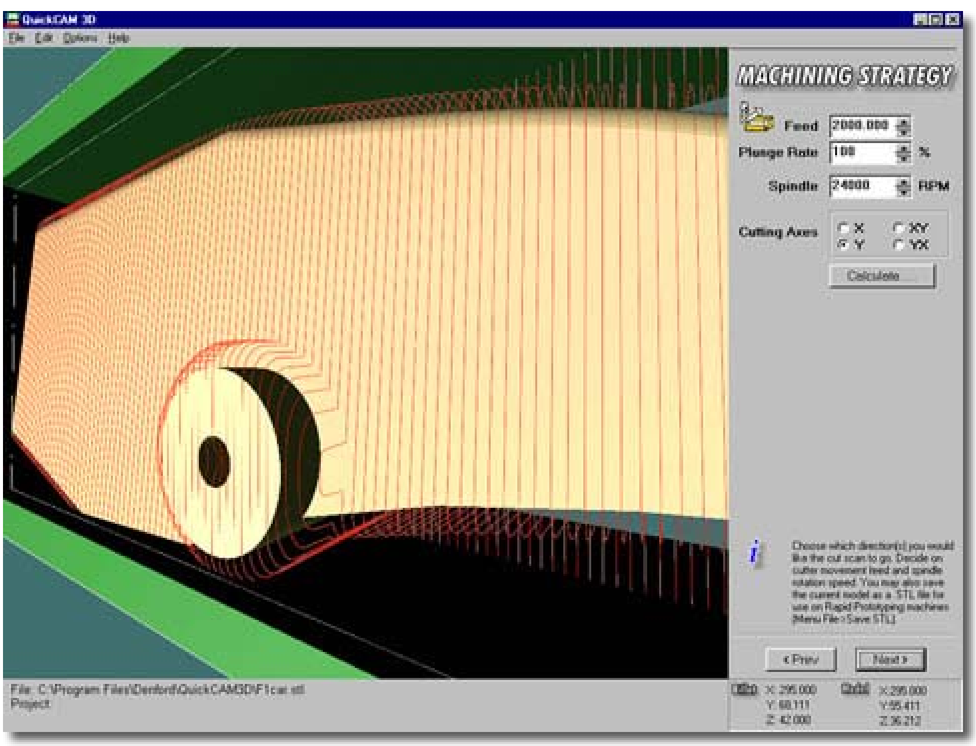
Before calculating the toolpath, switch on the show tool path feature. Click the "Options" menu, followed by the "Show Tool Path" text, if necessary, so a tickmark is displayed, as shown below.



For this type of model, it is best to select medium resolution (default) for the calculation. This option gives a good finish to the calculated toolpath, without taking too long to process:



Click the [Calculate...] button to calculate the tool path for your F1 car. The raster tool path lines are plotted on the 3D model in red at the end of the calculation sequence.



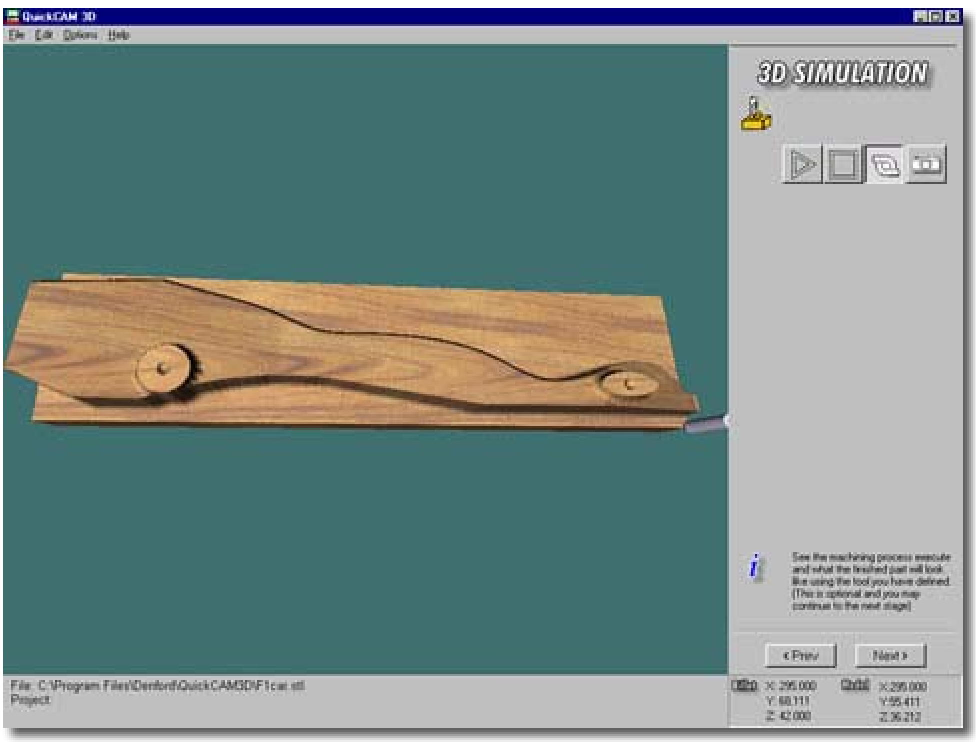
QuickCAM 3D - F1 Car Tutorial
Stage Eight - 3D Simulation

The "3D Simulation" stage allows you to simulate the machining of the 3D photograph, using the values set in all the previous stage screens. You can then examine the machined part and if not happy with the result go back to the previous stages and change values accordingly.

Running a simulation

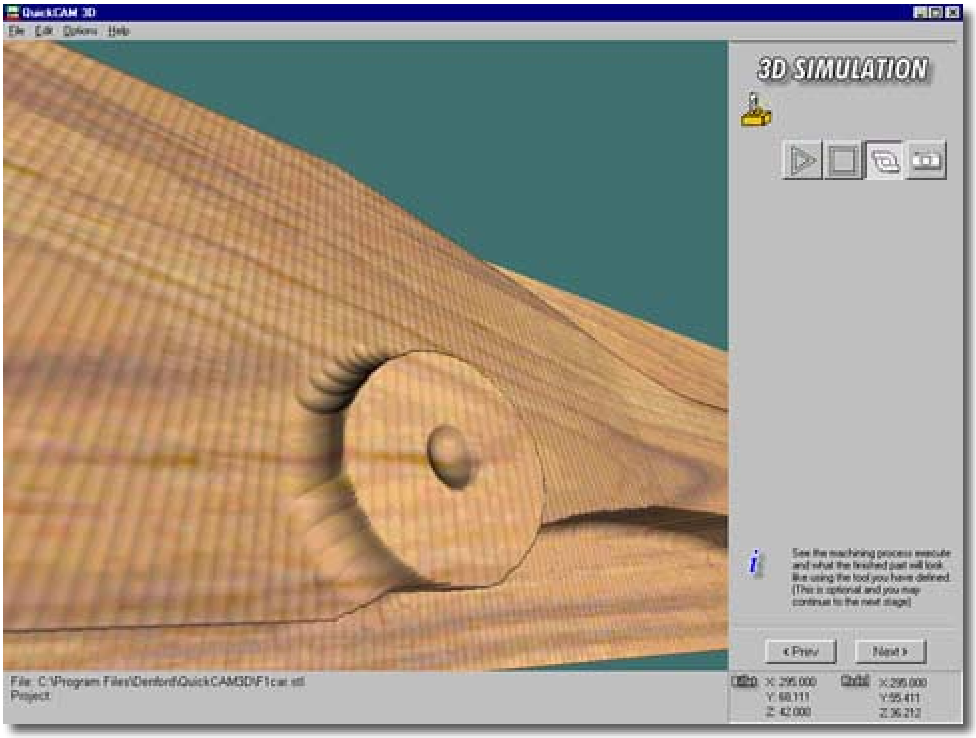
The controls for running the simulation, listed from left to right are:

- [Play] button (triangle graphic) - Click this button to begin the simulation.
- [Stop] button (square graphic) - Click this button to stop the simulation.
- [Turbo] button (turbo graphic) - Click this button to increase the speed of the simulation.
- [Snapshot] button (camera graphic) - Click this button to capture the current view of the machined part as a bitmap.



Using the simulation results

Remember, you can still zoom into the viewing window to view specific areas of the machined part in closeup. Move the mouse cursor over the graphic of the machined part, then click and holding the right mouse button down. Move the cursor upwards to zoom in or down to zoom out.



When configuring your own 3D models, this gives a good impression of what you're likely to achieve when you try to manufacture the design on the CNC machine. If you don't like the results, you can move back to the previous stages, change data accordingly, then rerun the simulation.

Rendering the 3D Model in Realistic Materials

At this stage of the process, the billet can also be rendered using realistic materials. To select the material type, click the "Options" menu, followed by "Select_Material".

.

The "Material Selector" window is displayed, as shown below.

The design will be manufactured from a balsa wood blank.
Click the [Wood] button to set the material.
Click the [Ok] button to close the window and apply the material choices.

Back to top of page   < Previous - Next >

QuickCAM 3D - F1 Car Tutorial

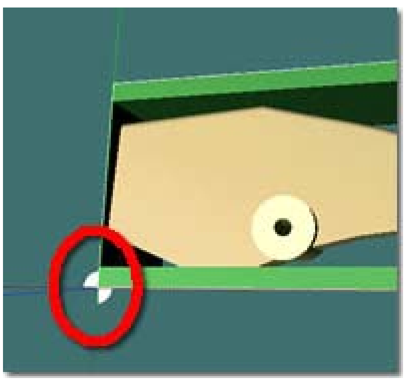
Stage Nine - CNC File Output

 < Previous - Next >

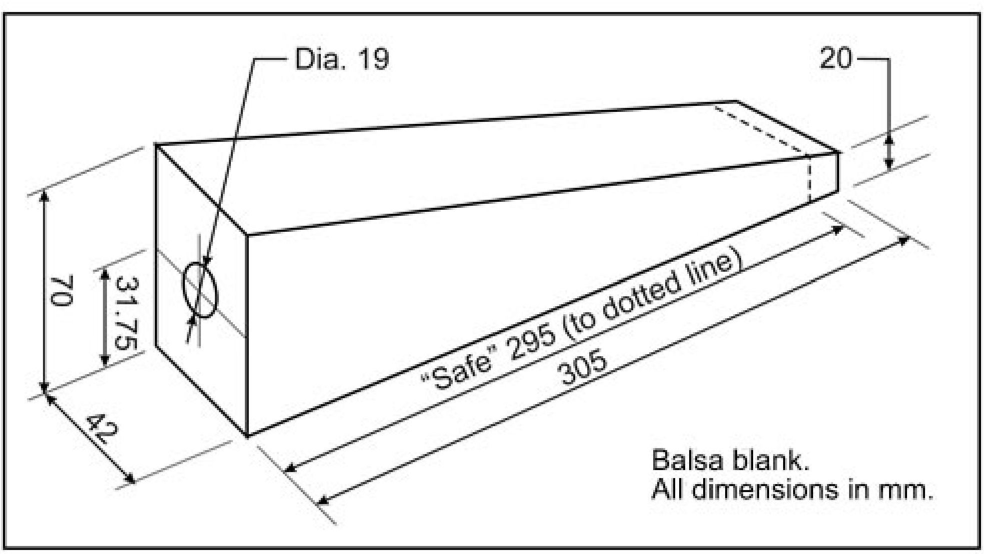
The "CNC File Output" stage allows you to set the position of the CNC program datum, then process and save the CNC file, ready to transfer to a CNC machine.

Configuring the datum position

The datum you can set in this stage refers to the zero co-ordinate position of the CNC program, indicated by the circle graphic split into four segments, shown highlighted red in the screenshot below.



In this tutorial, you will set the datum along the centreline of the CO_2 cartridge hole, intersecting with the end of the billet (the back face of the car body). You can manually locate this position, since you know the full dimensional constraints of the balsa blank...



Referring back to the QuickCAM 3D window, the "Datum Position:" panel contains three dialogue boxes, relating to the X, Y and Z co-ordinates used to define the position of the datum. Enter the following values to configure the datum position...

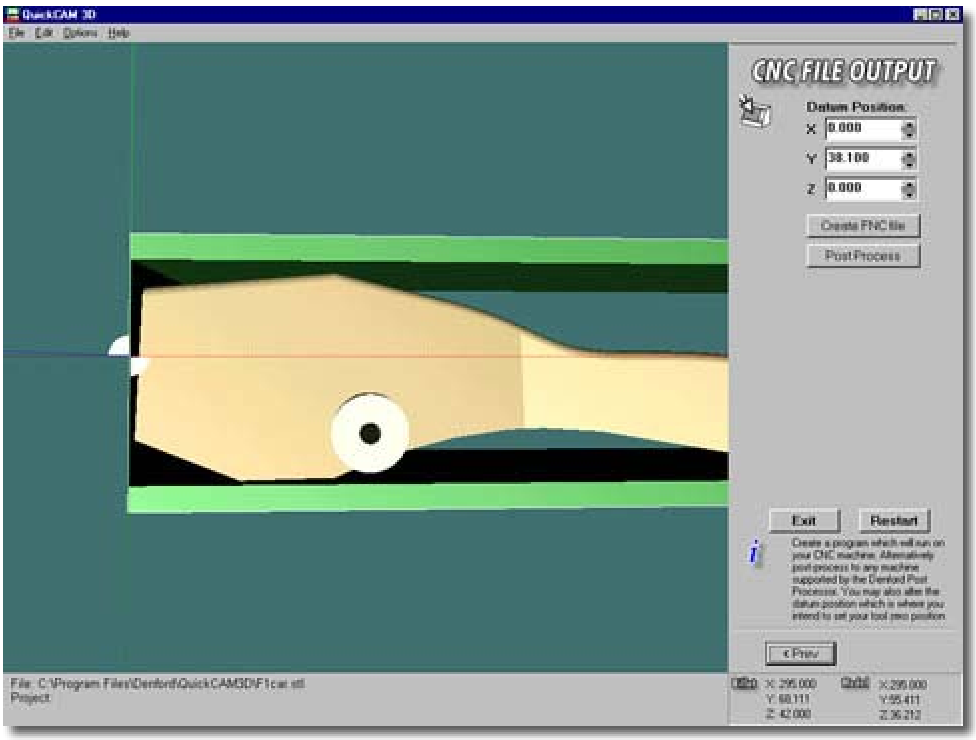
- In the "X" dialogue box, enter a value of 0mm (zero).

- In the "Y" dialogue box, enter a value of 38.100mm.
  This is calculated as follows...
  31.75mm (the distance from the centre of the CO2 cartridge hole to the base of the balsa blank) + 6.35mm (the cutter clearance that you added along this edge of the 3D model).

- In the "Z" dialogue box, enter a value of 0mm (zero).

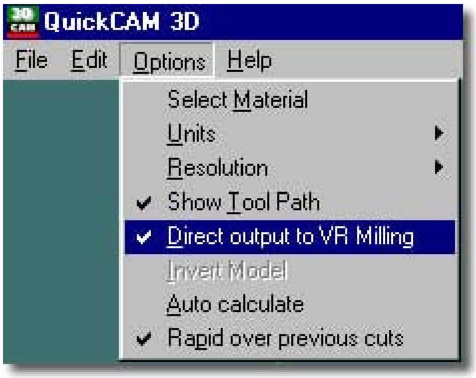
Tip: Always try to set the datum in a position you will be able to find again on the real billet. When you place the real billet in your CNC machine, you must configure the machine offsets (effectively shifting the zero datum of the CNC machine) to align with the datum position you are currently setting for your CNC program.

Your QuickCAM 3D window should now look like the example shown below. Notice that the datum symbol has moved to the new position.



Creating the CNC file

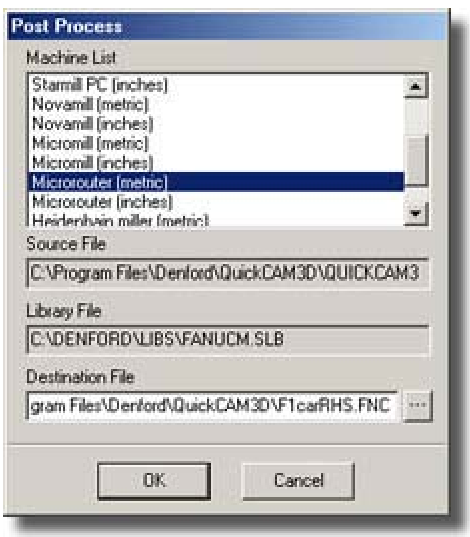
If Denford VR CNC Milling software version 2.14 or above is installed on your computer, you can configure QuickCAM 3D to automatically start VR Milling and load the newly created CNC file. Click the "Options" menu, followed by the "Direct output to VR Milling" text, if necessary, so a tickmark is displayed, as shown below.



To create the CNC file, click the [Create FNC file] button, then save the file in the appropriate hard drive folder or floppy disk with the name "F1carRHS" (denoting that the file describes the cutting operation to produce the Right-Hand Side of the model when viewed from the back plane).

Post processing the CNC file

To post process your design, click the [Post Process] button to display the "Post Process" window, as shown below.



Select the required CNC machine from the "Machine List", then post process and save the file using the name "F1carRHS" in the appropriate hard drive folder or floppy disk. In the screenshot above, we have post processed our CNC file for use on a Denford CNC Microrouter.

Back to top of page < Previous - Next >

QuickCAM 3D - F1 Car Tutorial

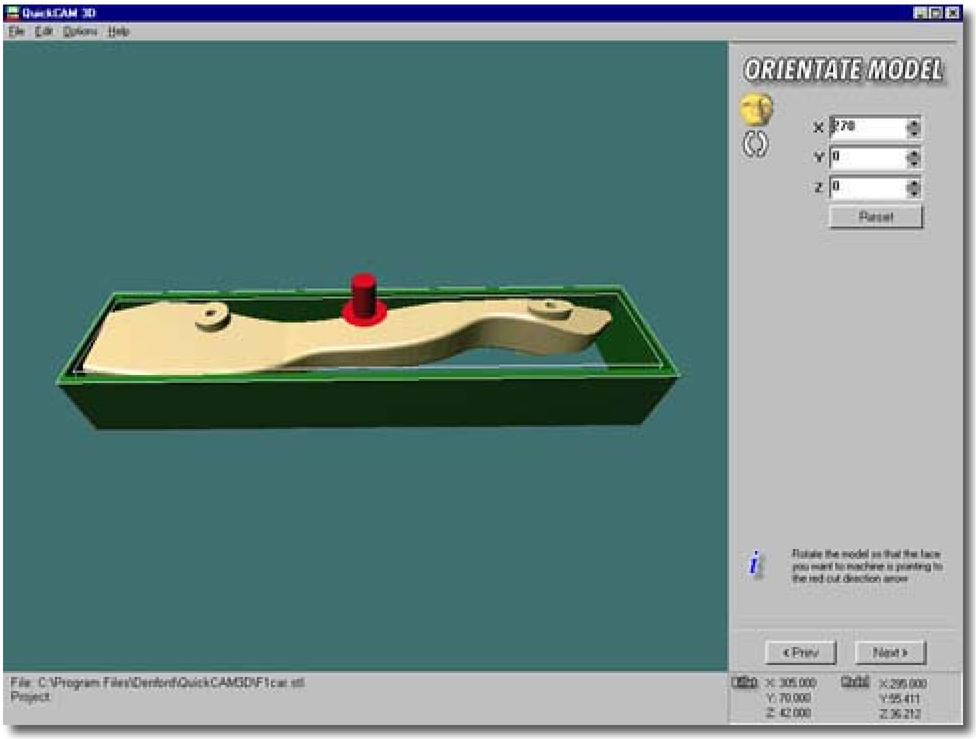
Creating a CNC file for the left car body side

 < Previous - Next >

Currently, you have one CNC file "F1carRHS.FNC", which can only be used to manufacture the right-hand side of the F1 car body when viewed from the back plane. In order to manufacture a complete F1 car body, you will need to create a second CNC file relating to the remaining left-hand side.

Creating the left car body side using QuickCAM 3D

Since the F1 car body is symmetrical, you could run the same 3D model through the QuickCAM 3D software again. This time you would orientate the model so the left side, instead of the right, faces upwards, towards the red cutting direction arrow. This could be achieved by changing the "X" orientate value from 90º to 270º, as shown in the screenshot below.



Important - Although the required side now faces upwards, towards the cutting tool, check that top of the 3D model faces towards the front. If the 3D model is orientated so the bottom faces towards you, your new CNC file will machine the left side "upside-down", compared to the right! Remember, the balsa blank will be revolving around the centreline of the CO2 cartridge hole.

The values and settings all the other stage screens would remain the same as those for the right side of the F1 car body.

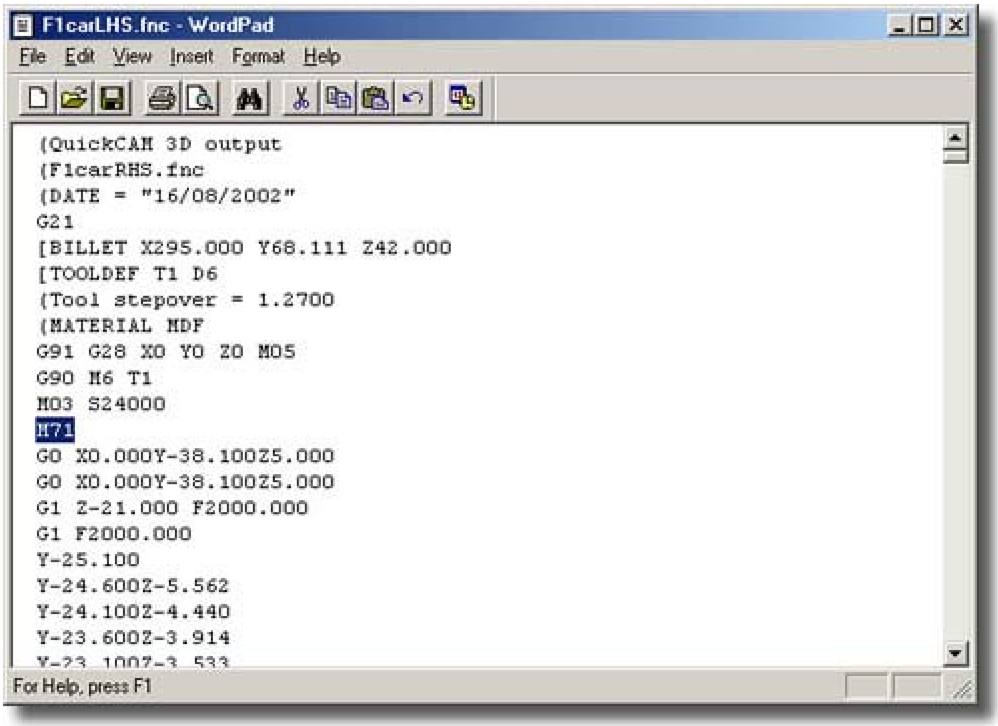
Creating the left car body side using Notepad

The quickest way to create the new CNC file for machining the left-side is by directly editing the G and M codes in your original CNC file.

Using "Windows Explorer", locate the file named "F1carRHS.FNC". Make a new copy of this file and rename it "F1carLHS.FNC" - the LHS prefix designating that this file will be used for manufacturing the Left-Hand Side of the model, when viewed from the back plane.

Open this new CNC file using a text editor package, such as "Notepad" or "WordPad".

Find the program line referring to the spindle speed. This is the line "M03 S24000" in the example screenshot below. Remember - the "S" value depends on the type of CNC machine you will be using, so it may be different in your file.



Create a new line and type in the characters below...
M71
In the example screenshot above, we have highlighted this new line. The M71 command is used to "mirror" your original CNC file so it now machines the left side of the F1 car body. Save the changes.

Back to top of page
< Previous - Next >
QuickCAM 3D - F1 Car Tutorial
Machining your 3D Model
(c) Denford Ltd 2003
< Previous

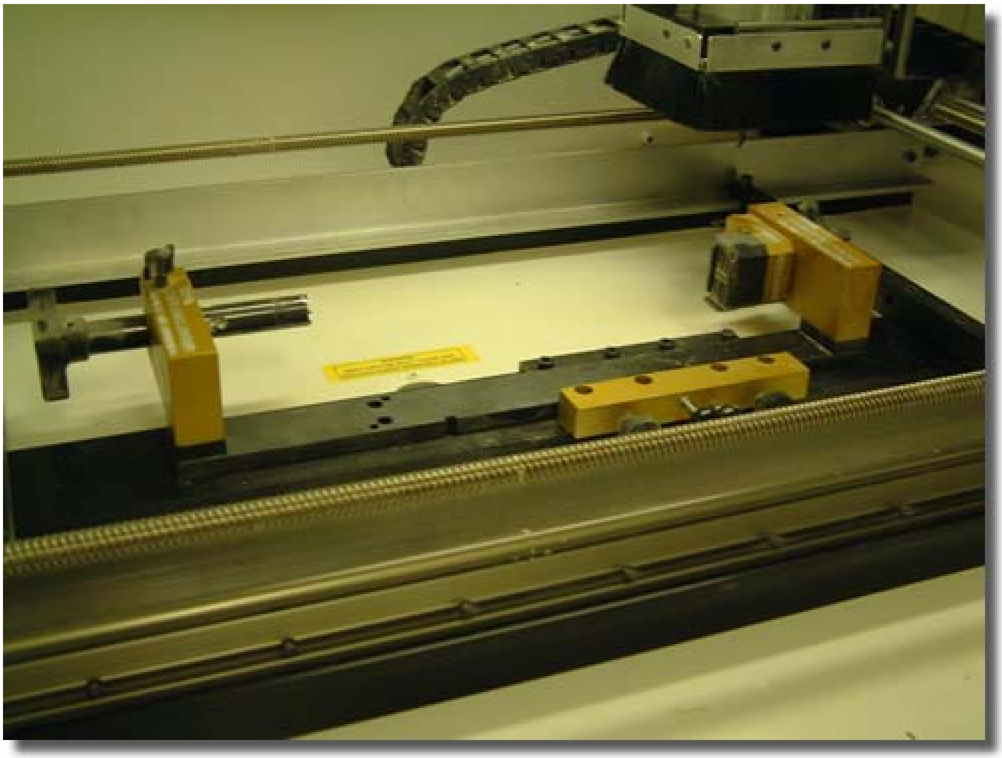
Materials and equipment required

In order to manufacture your F1 car body on a CNC machine, using the data supplied in this tutorial, you will need:

1. A ¼" (6.35mm) diameter, ball nose cutter.
   Tip: If your CNC machine is equipped with metric tooling, imperial collets are available from Denford Limited.
2. An F1 balsa wood blank, 305mm x 42mm, 70mm high at CO2 cartridge end, 22mm high at taper end.
3. Access to a CNC machine fitted with a jig capable of holding an F1 balsa wood blank.
4. Your two CNC files - one to machine the right side of the F1 car body, the other to machine the left side.

Holding the billet

The easiest, quickest and most accurate method of securing your F1 balsa wood blank in the CNC machine is by using a purpose-built jig or fixture. In the jig shown below, the circular pin on the left of the jig fits into the CO2 cartridge hole in the back face of the balsa blank. The taper end of the blank is tightened against the bracket on the right side of the jig. This end of the jig is also labeled to help when setting up. One side of the model is then machined, before revolving the blank 180º inside the jig, loading the second CNC file and machining the opposite side of the F1 car body.



Above: View of an F1 car body manufacturing jig, fitted to a Denford Microrouter.

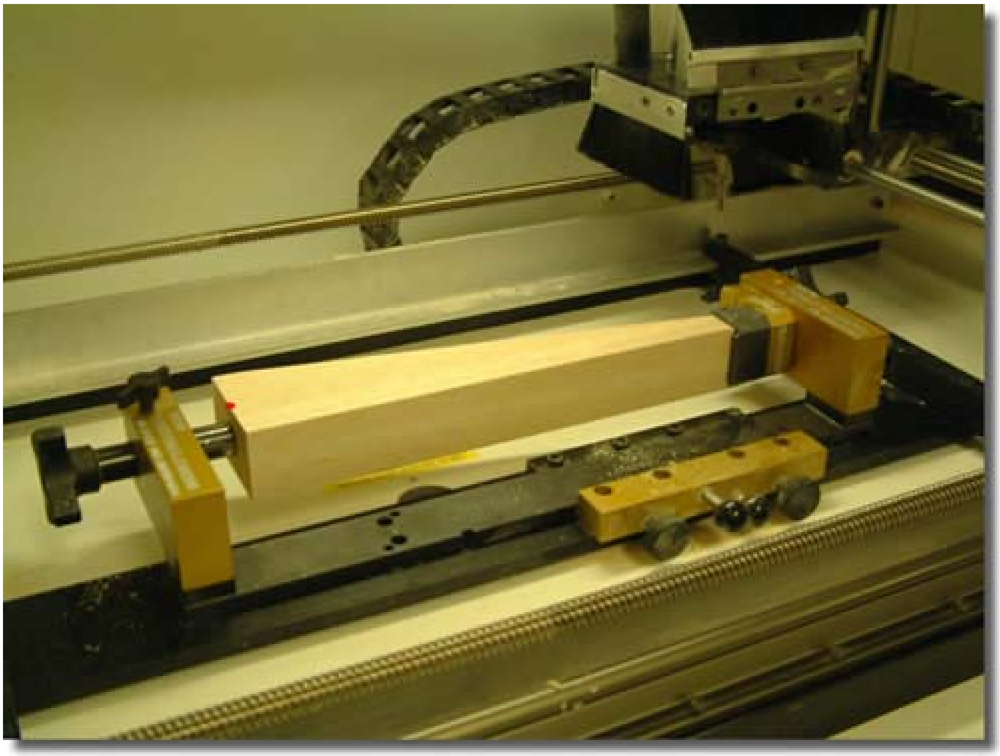
It is essential that whatever jig you decide to use is positioned and fixed "square" to the machine axes. Use an engineers square and any reference edges to help achieve this. Since the blank is revolved 180º inside the jig, any inaccuracies will be multiplied by 2.

Configuring the Offsets

To machine the first side of the F1 car body, load the file "F1carRHS.FNC". This file describes the right-hand side of the model, when viewed from the back plane.

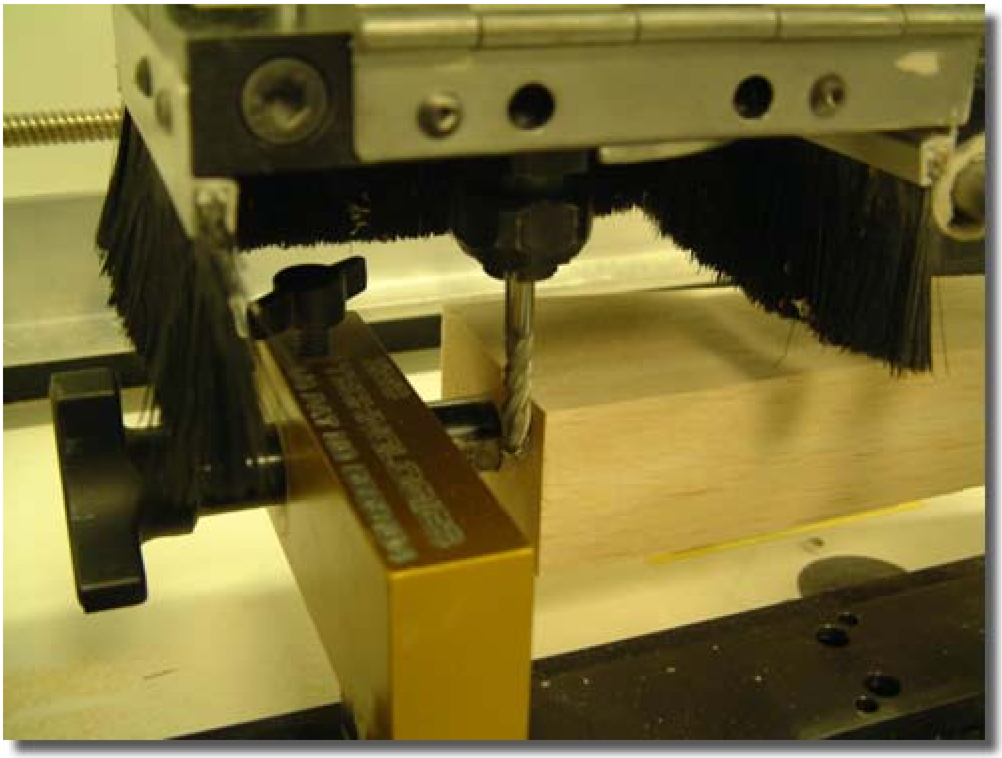
Remember that you must also orientate the balsa blank in exactly the same position as used in the QuickCAM 3D software. Since you are machining the right side first, the right side of the blank must be facing up and the base of the blank must be facing towards you.

Similarly, you must configure the offset position on the CNC machine to match the datum position set in the QuickCAM 3D software. This position was along the centreline of the CO2 cartridge hole, intersecting with the left end face of the blank and the upper surface of the blank, as shown by the red dot in the photograph below.

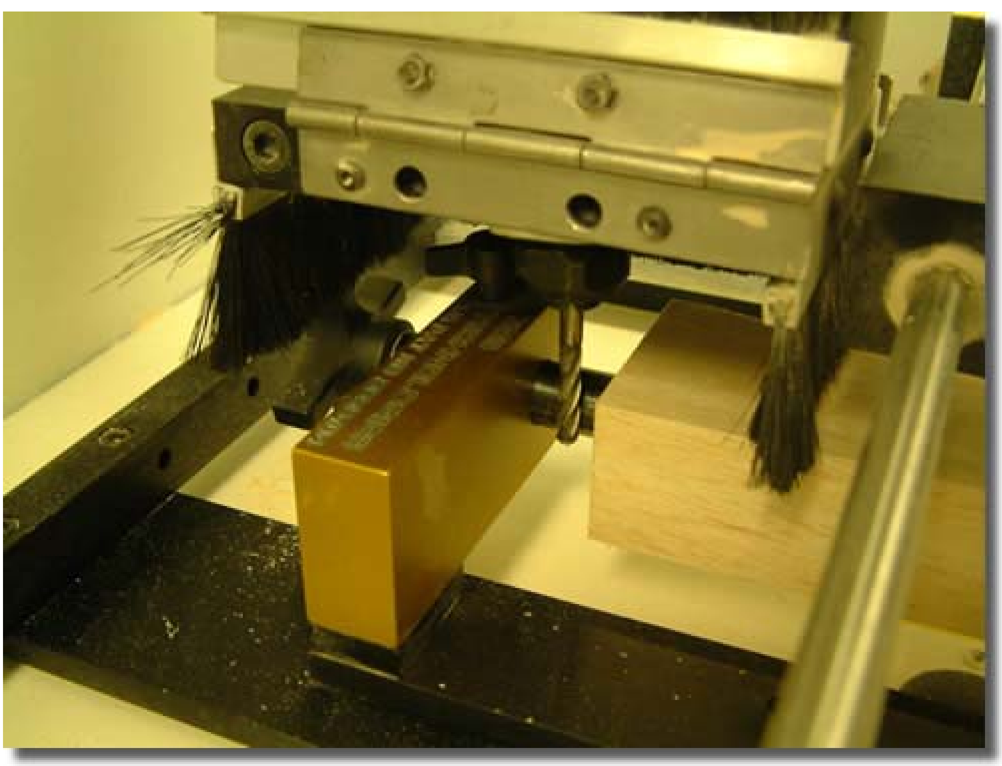


Machine Datum offset	Align with position
X	Left edge of blank (the CO_2 cartridge end)
Y	Centreline of the CO_2 cartridge (the centreline of the pin on the jig)
Z	Side face of the blank

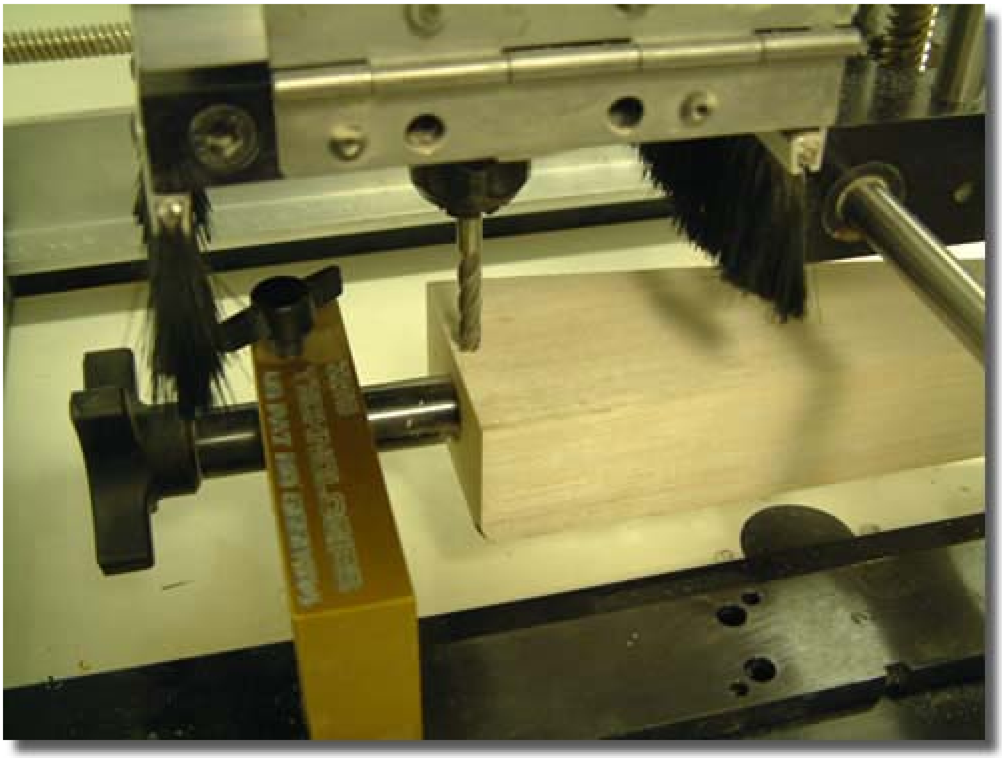
To set the X component of the machine offset, reference the side of the cutting tool against the end face of the blank, as shown in the photograph below. Do not forget to account for the radius of the cutter (3.175mm) when entering your offset value.



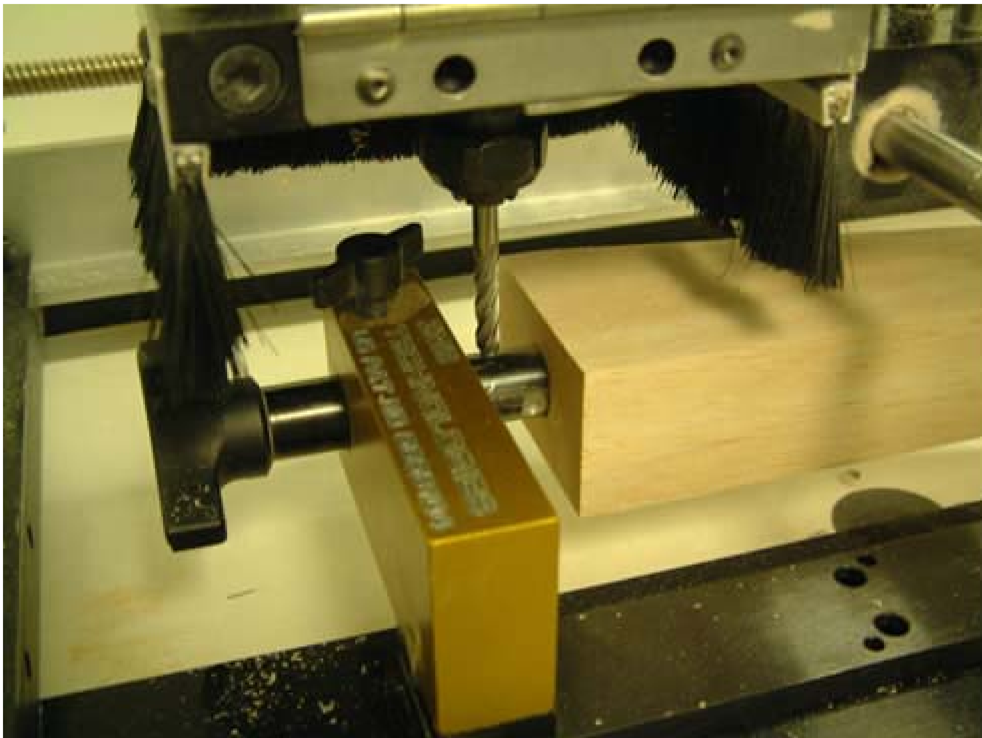
To set the Y component of the machine offset, reference the side of the cutting tool against the side of the pin, as shown in the photograph below. Do not forget to account for the radius of the cutter (3.175mm) when entering your offset value. In addition, you must also account for the radius of the pin (9.5mm), by either adding or subtracting this value - this depends on whether you referenced against the front of back surface of the pin.



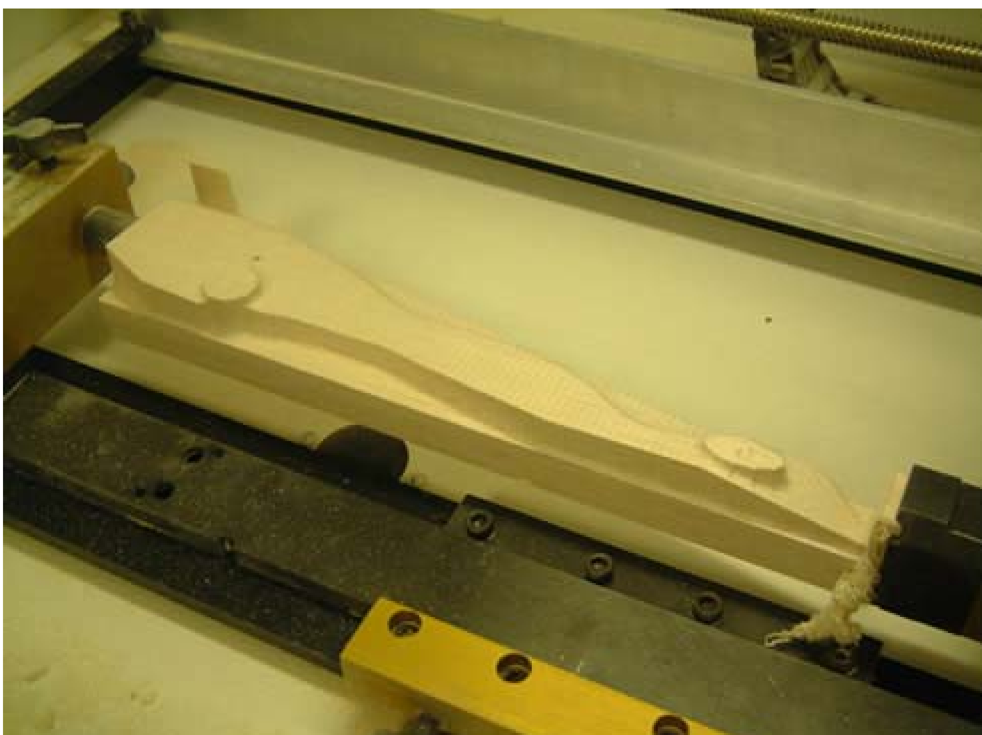
To set the Z component of the machine offset, you could reference the tip of the cutting tool against the upper face of the blank (one of the balsa blank sides), as shown in the photograph below. However, the accuracy of this value will depend upon the build quality (tolerances) of the balsa blank and the nature of its fitment to the jig.



A more accurate method of setting the Z component of the machine offset is by referencing the tip of the cutting tool against the upper surface of the pin, as shown in the photograph below. You can easily locate the centreline of the pin, since you have already set the Y component of the machine offset. Do not forget to account for the distance between the upper surface of the pin and the upper face of the blank (one of the balsa blank sides) - this is calculated as 21mm (half the width of the balsa blank) - 9.5mm (the radius of the pin) = 11.5mm.



Now machine the right side of the F1 car body, as shown below.

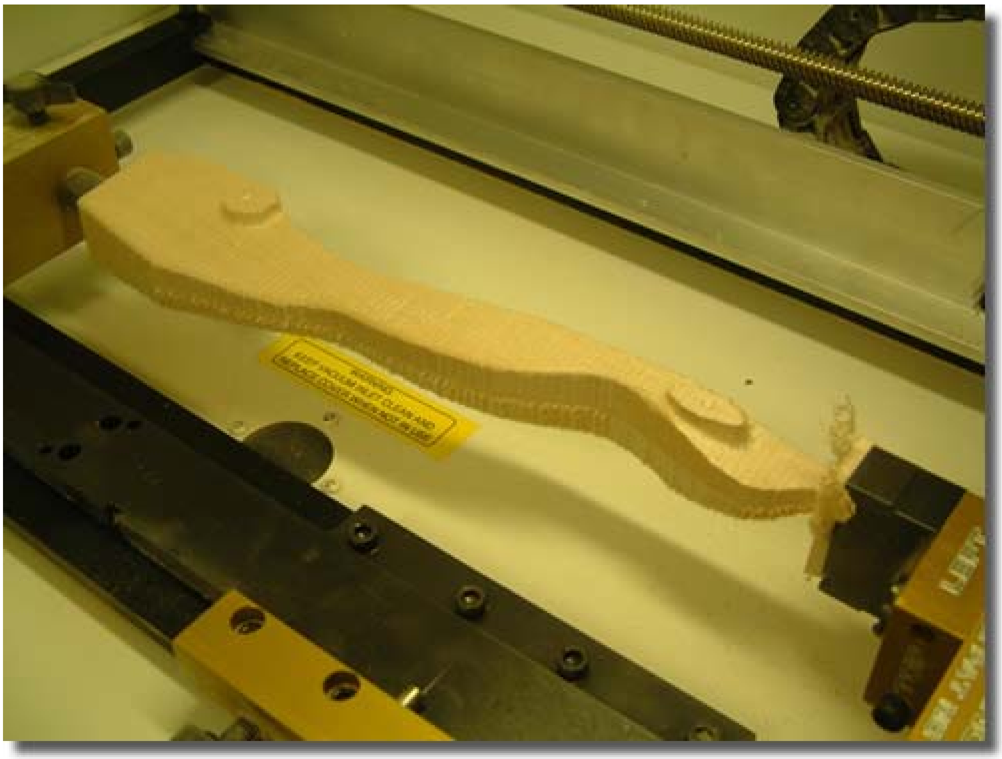


To machine the second side of the F1 car body, load the file "F1carLHS.FNC". This file describes the left-hand side of the model, when viewed from the back plane.

Remember that you must also orientate the balsa blank in exactly the same position as used in the QuickCAM 3D software. Revolve the blank in the jig 180º. Since you are machining the left side first, the left side of the blank must be facing up and the top of the blank must be facing towards you.

Notice that you can use the same machine offset with the CNC file that machines the left side of the 3D model. Since the balsa blank uses the CO_2 cartridge hole as the rotation axis, we have used this feature to help configure our datum position - it means the same datum can be used for both the right and left CNC files and therefore we need only set the machine offset once.

Now machine the left side, to complete the F1 car body, as shown below.



Ordering materials from Denford Limited

All the items required to complete this tutorial can be ordered from Denford Limited, if required. For further information, regarding current pricing, availability and ordering, please contact the Denford Sales Team.
Telephone Denford Sales: 01484 717282
Fax Denford Sales: 01484 718229
E-mail: sales@denford.co.uk
Sales Department Hours: Monday to Friday 8.30am - 5.00pm GMT
For international dialing: +44 and remove first 0 from each city code.

Back to top of page   < Previous