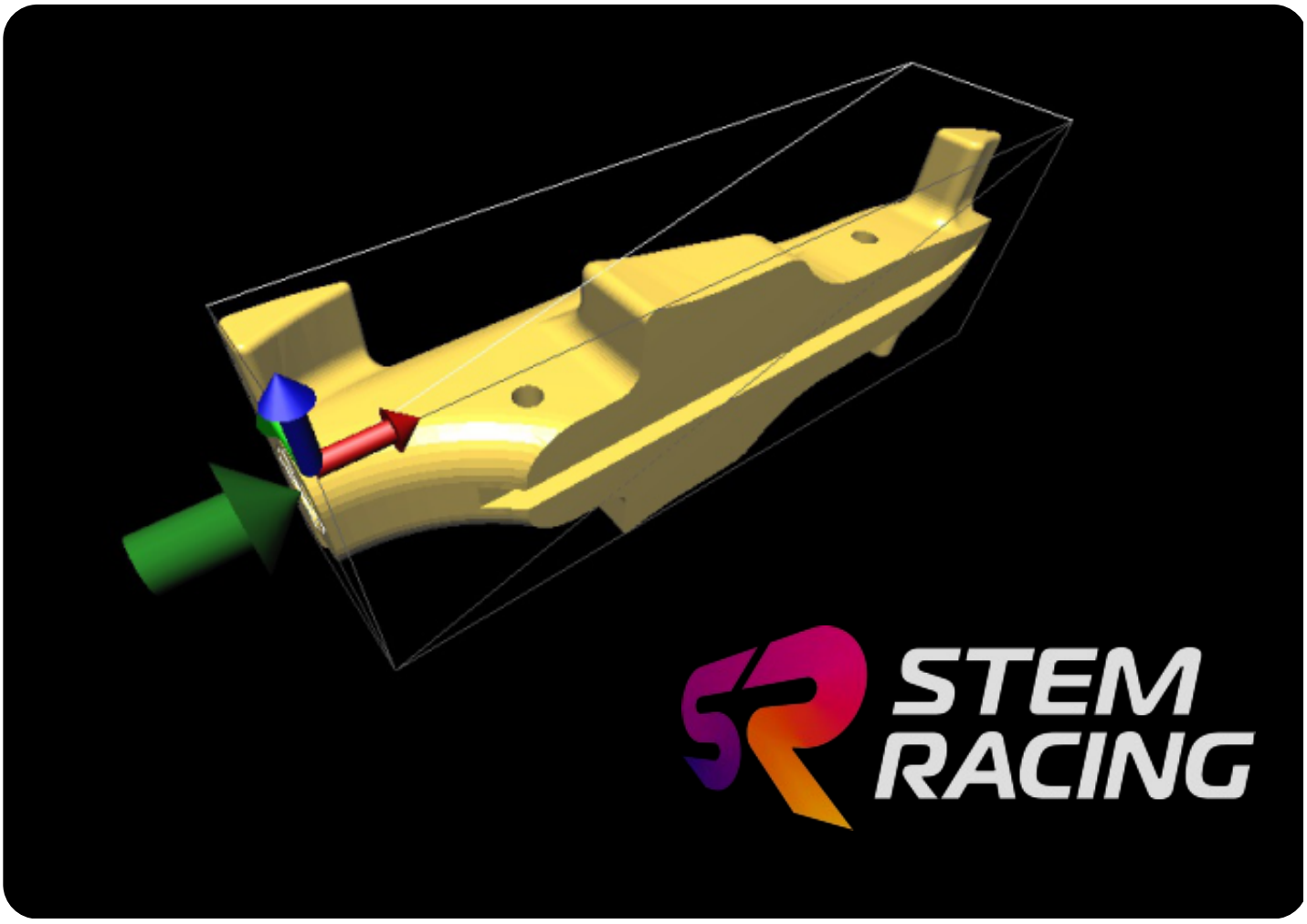
DENFORD

CAD/CAM Solutions & Projects for Education

QuickCAM Pro

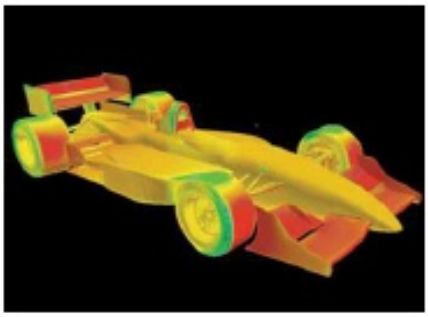
Advanced Milling CAM Software

Car Wizard Training Guide



RACE EQUIPMENT

STEM RACING Race System
POWERED BY DENFORD



ANALYSE

Virtual Wind Tunnel Software
VWT Analysis Software Mk8

Single Seat	BI01841
5 User Licence	BI01841A
Site Licence	BI01841C

MAKE

CNC Machine Options for F1 Car Manufacture:

MCR 100	F1R001000
Compact 1000	MRC002000A
Compact 1000 Pro (Metal Cutting)	MRC003000
Router 2600	MRP002000
Router 2600 Pro (Metal Cutting)	MRP003000
Router 6600	MRF002000
Router 6600 Pro (Metal Cutting)	MRF003000

Car Manufacturing Fixture NR1/D400UA
To enable the manufacture of Formula 1 Class cars. The fixture clamps directly to the T-slotted table on the Compact 1000/Pro, Router 2600/Pro and Router 6600/Pro and is also suitable for use on the VMC 1300 Pro (it is necessary to remove the tool changer to fit the fixture).

F1 Entry / Development Class Starter Kits

SOLO
1 x F1 Model Block Car Kit
1 x IsoSketch 3D Drawing Tool - single blister pack F1DKIT01

TEAM
5 x F1 Model Block Car Kit
5 x IsoSketch 3D Drawing Tool - single blister pack F1DKIT05

GROUP
10 x F1 Model Block Car Kit
1 x IsoSketch 3D Drawing Tool - class pack of 30 F1DKIT30

F1 Model Block (pack of 10) F1223/10
This official F1 Model Block measures 223mm x 65mm x 50mm, with a consistent weight and density, and contains a pre-drilled hole for the Power Pack.

Equipment available to purchase from the Denford Webshop (UK Customers only)

DENFORD WEBSHOP | denfordwebshop.com

Contents

About QuickCAM Pro

QuickCAM Pro is an advanced, yet simple to use, wizard-based CAM package, which is used to create tool paths for machining 3D parts on a milling machine or router. Both STL files and image files can be imported into QuickCAM PRO, and a comprehensive set of machining plans can be used individually or in combination to produce complex 3D surfaces and lithophanes.

Introduction

The aim of this training guide is to show you how to navigate your way around QuickCAM Pro and instruct you how to operate this software and specifically how to manufacture an STEM Racing car using Car Wizard.
This guide will explain the steps taken by the Wizard to create the CNC programs for the Right hand side and Left hand side of the car.

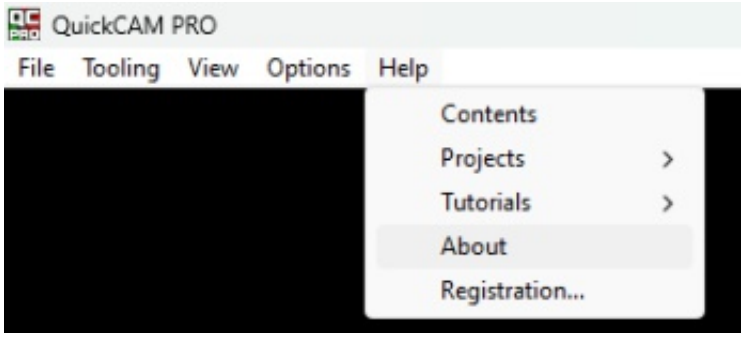
This guide makes use of screen shots where possible and will use the following conventions:

Instructions will be in this format

Text to be typed will be in this format

Any software buttons to be pressed, a picture of the button will follow the instruction.

This guide assumes that your software has already been installed and your machine has been commissioned.
If any of the features described in this guide are not operating as described please check that the version number you are using is the same as that shown on the front cover.
The software version can be found under Help -> About.



Denford provide machine training and it is recommended that you undertake the training and use this guide as a revision guide after completion of the machine training.

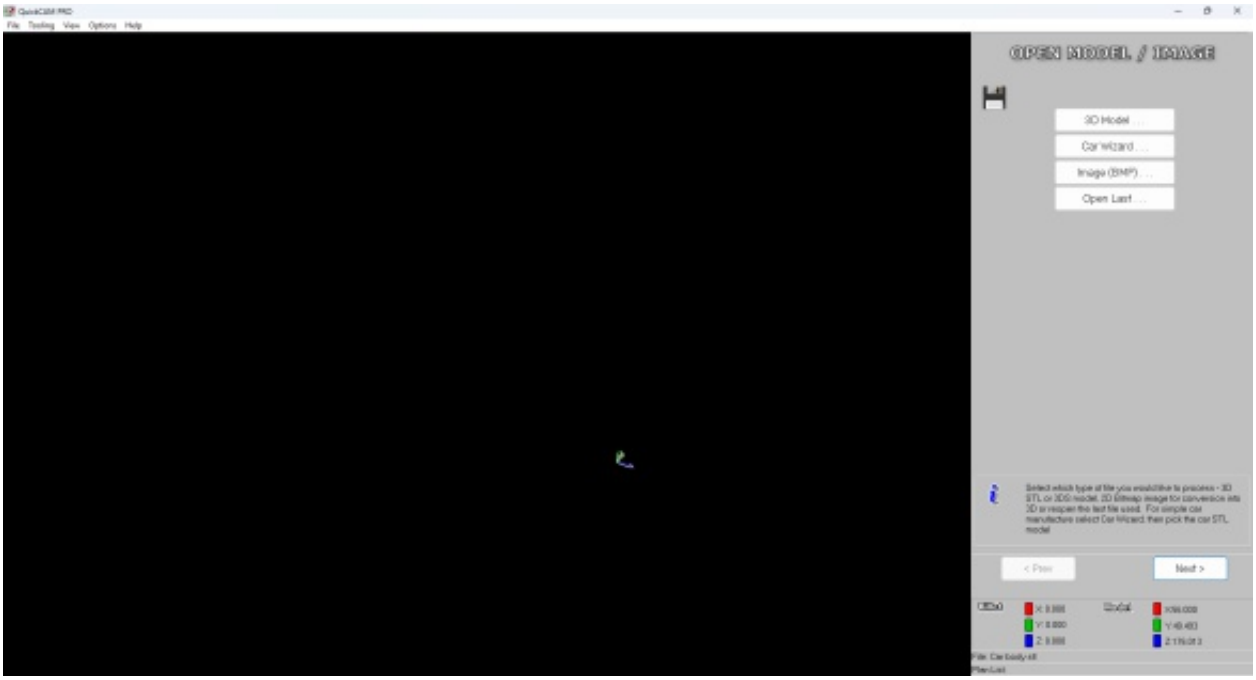
Launching QuickCAM Pro

Open the "Denford Applications" folder.
"Double click" on the QuickCAM Pro icon.

The screen shown on the right will be displayed and the software will take a minute or 2 to open. You can force the software to open quicker by following the next instruction.

"Double click" on the area circled below.

The software will open and you will be greeted with the screen below.



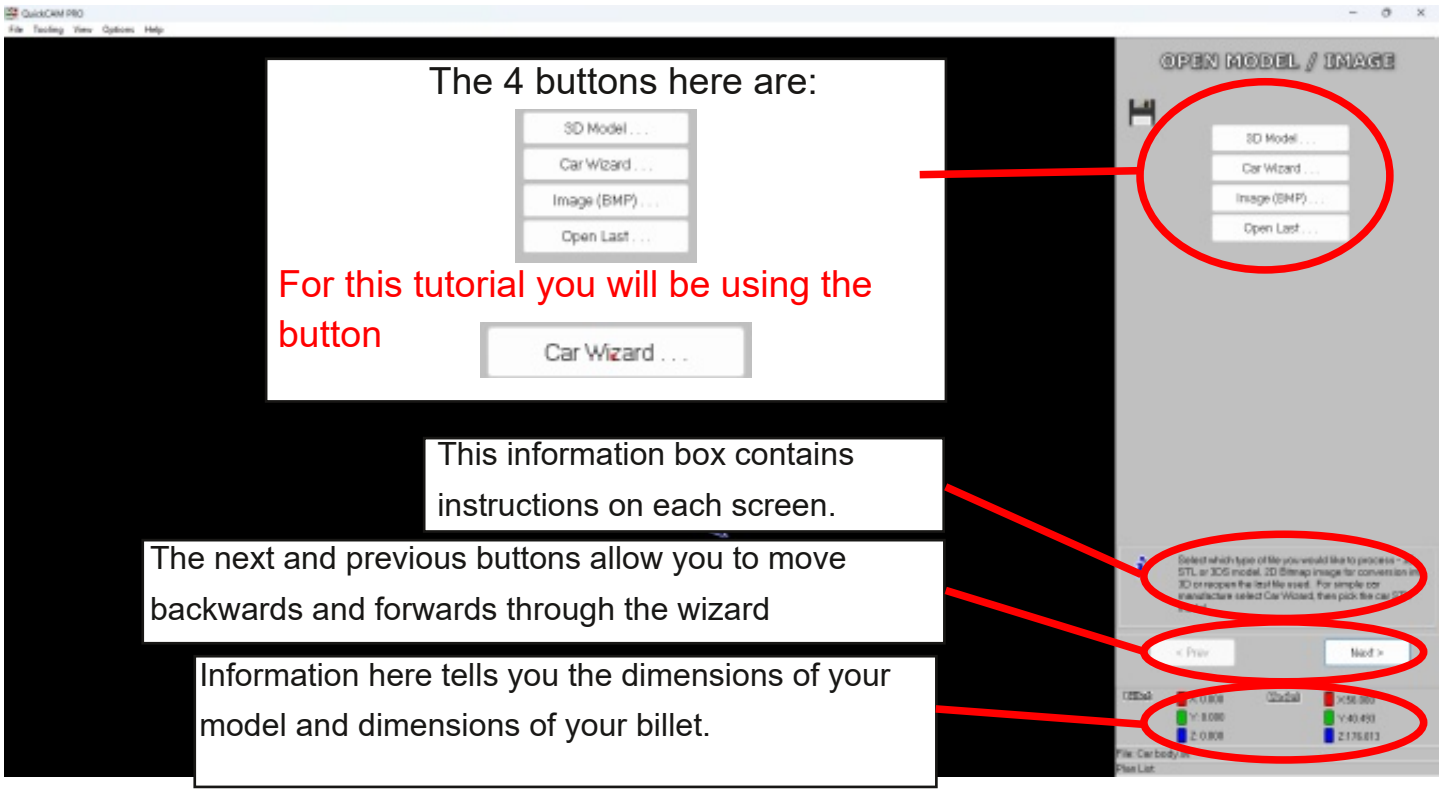
Navigating QuickCAM Pro

QuickCAM Pro is very easy to use, the main screen displays the model or image and the navigation panel on the right is how you select options and move around this wizard based program.

The Menu options at the top of the screen allow you to open the tool library and View the tools available.
The Car Wizard requires that tool 1 is a 1/4" Ball Nose cutter. If VR Milling is installed on the computer then that is the tool library that is used. To change the QuickCAM PRO tool library you must edit the tools in VR Milling. When you restart QuickCAM PRO the new tools will be available.

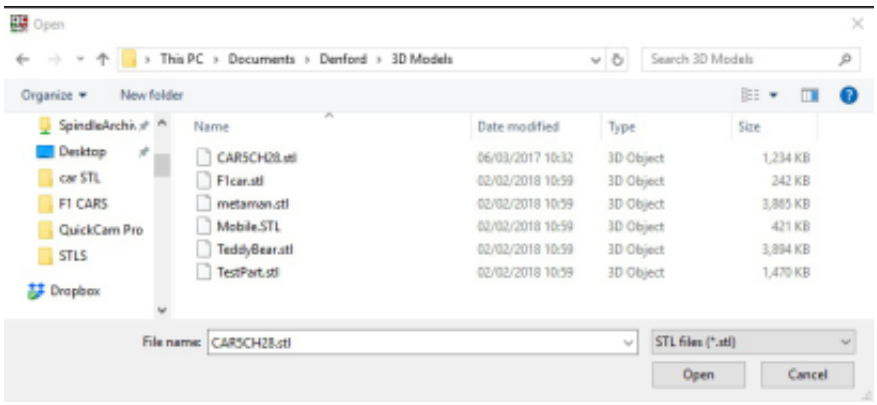
The view Menu allows you to reset the View which is useful if you have zoomed out too far or cannot see your model.

The options menu allows you to change various view settings.

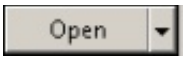


Opening your Model

Select the 3D Model button



Select the .STL file you wish to machine and click the open

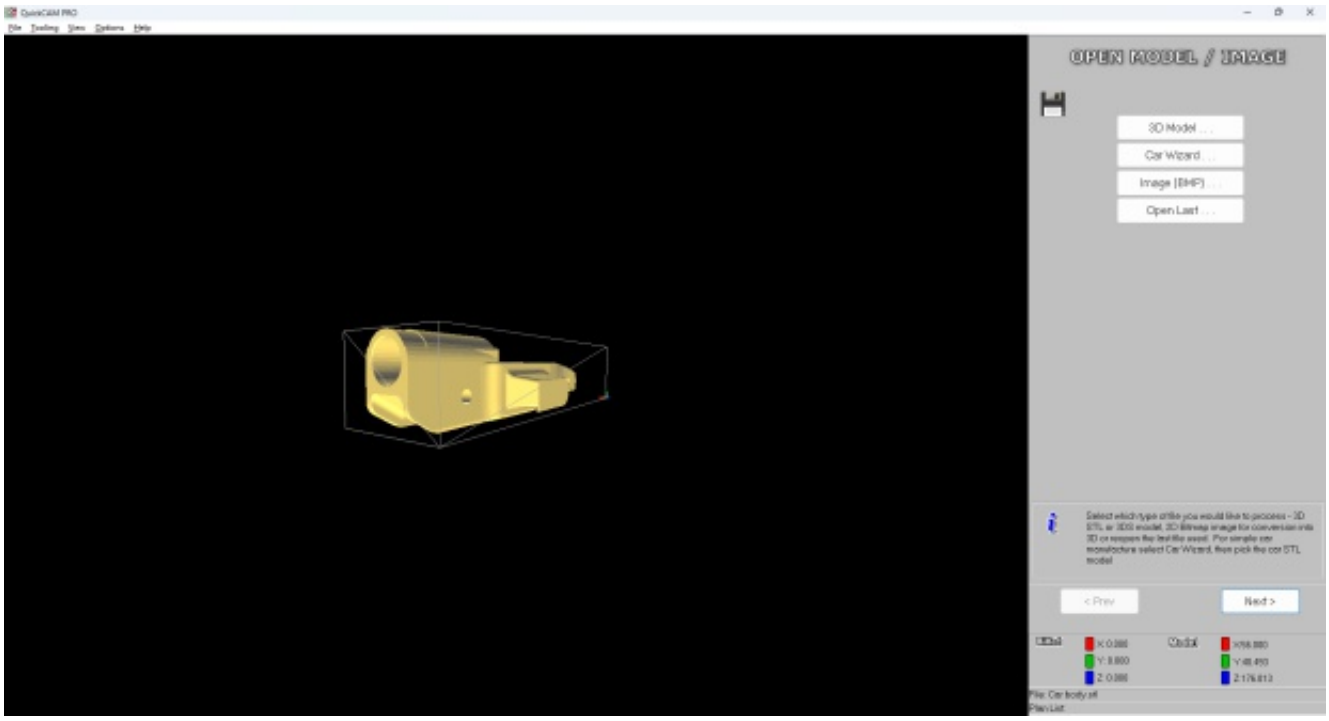


The Car Wizard will now check that Tool 1 in your tool library is a 1/4" Ball end cutter.

If this is not the case then you have to edit your tool library in VR Milling or you will not be able to use the Wizard

Provided the correct tool is selected as tool 1 your model will now be displayed in the main screen.

You can hold the left mouse button to rotate your model, holding the right mouse button zooms in and out. Holding both buttons down allows you to Pan the view.



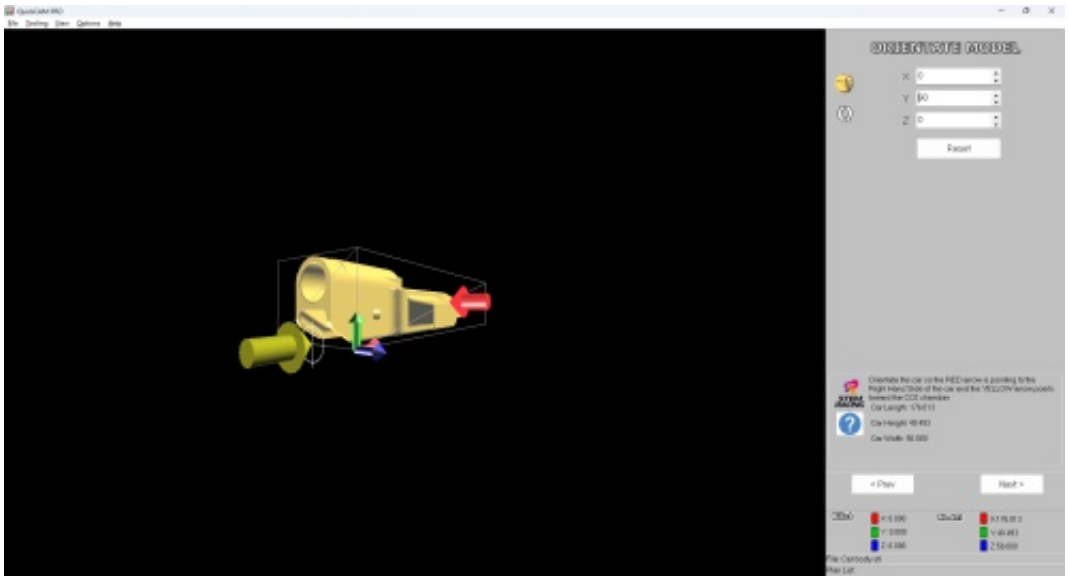
Once the Model is imported

Click the next button

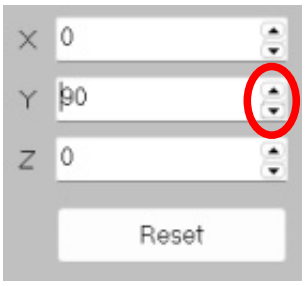
Orientate Model

Following the instructions within the Navigation panel orientate the model so that the RED arrow is pointing to the right hand side of the car and the YELLOW arrow points towards the CO2 chamber.

The large red arrow represents the tool, whilst the yellow arrow represents the centreline of the fixture.



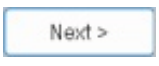
If the model requires rotation click on any of the axes buttons and these will rotate the model in increments of 90 degrees.



Whether or not the model will need rotating will depend on which planes you used when creating the model.

The car width, height and length are checked and recorded at this point, these values will be used to correctly position the block in the next pages of the Wizard.

If the car exceeds the machinable area of the Model Block then the wizard will not highlight the Next button and an error will be displayed in Red. If the car is the wrong size then it will have to be edited in CAD before you can proceed.

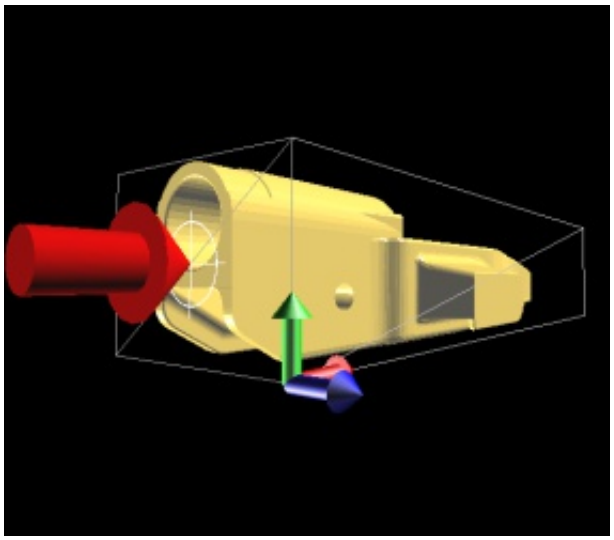
If all the dimensions are correct then click the Next button 

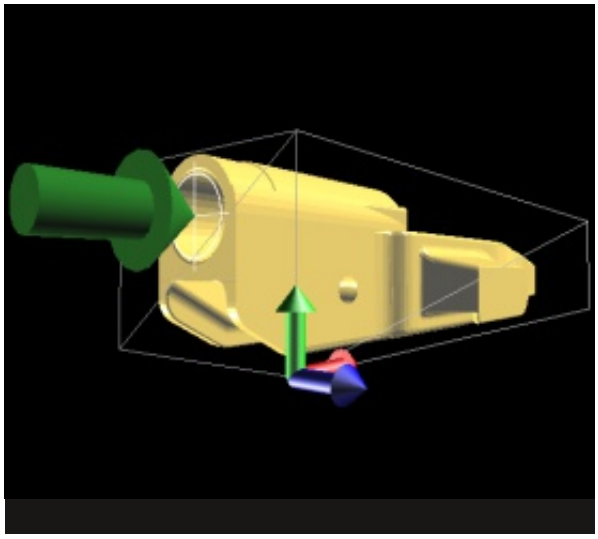
C02 Cartridge Centre Height

This screen requires you to enter the height of the CO2 Cartridge chamber from the base of the car.

The model will be positioned around a datum position set in the middle of the CO2 Cartridge chamber. The height of this must be recorded when the car is being designed in CAD and to ensure the car can be manufactured in an F1 Model block the value must be between 21mm and 29mm.

The cross hairs will help locate the centre of the bore. The arrow pointing at the bore will be Red if the value is invalid and turn green when a valid value appears.

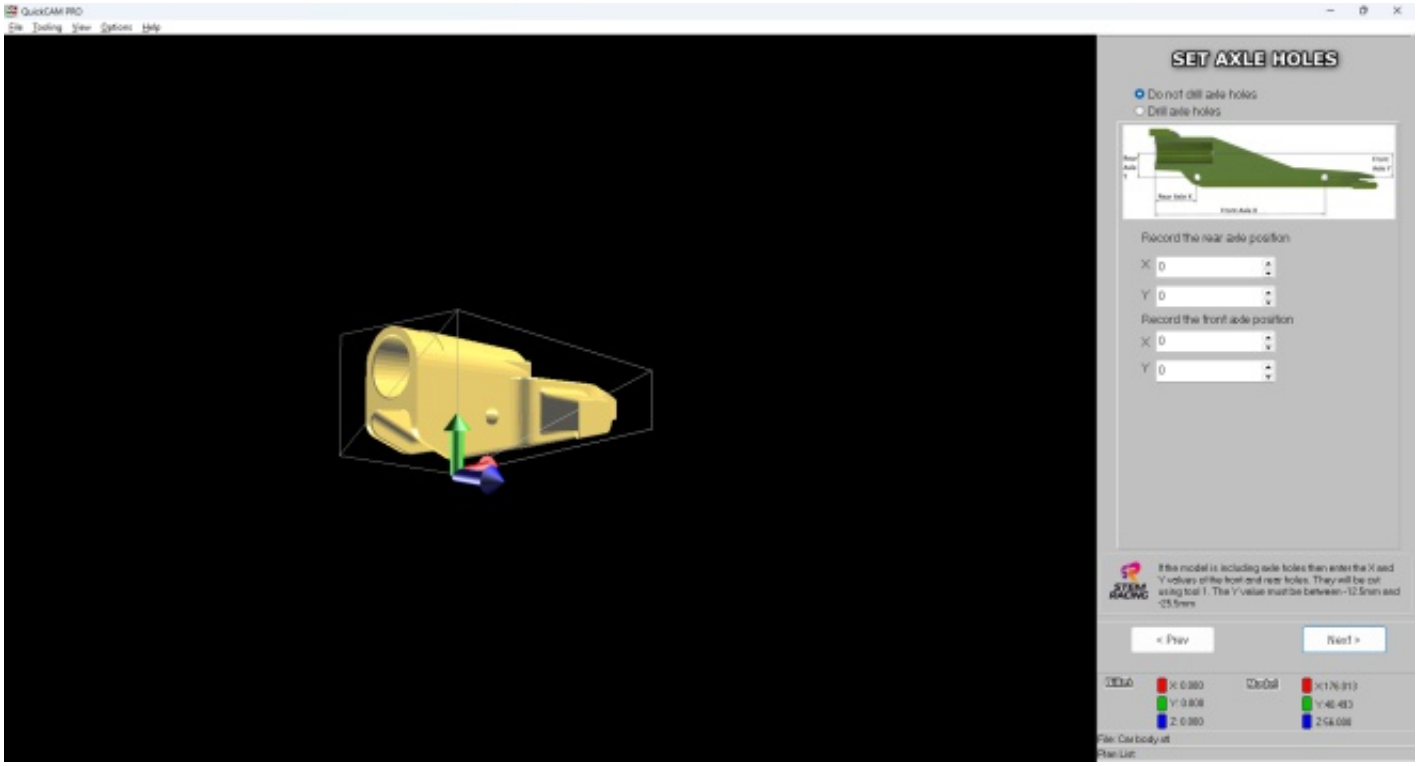




Once the centre height is correctly entered and the green arrow is correctly positioned in relation to the bore the Next button will be enabled. ***This value will be recorded for later use.*** Click the Next button 

Set Axle Holes

The Car Wizard automatically sets the Cut Depth



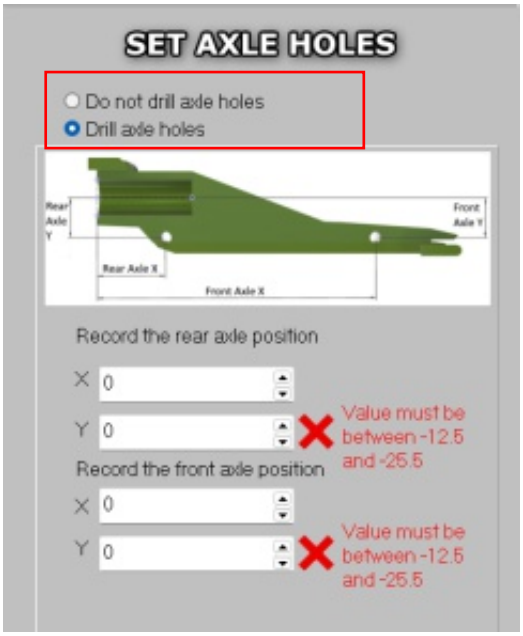
The first option you have is whether you would like to drill your axle holes or not. This will be done with Tool 1 - 1/4" Ball Nose Cutter (6.35mm). If you do not wish to drill axle holes just click Next.

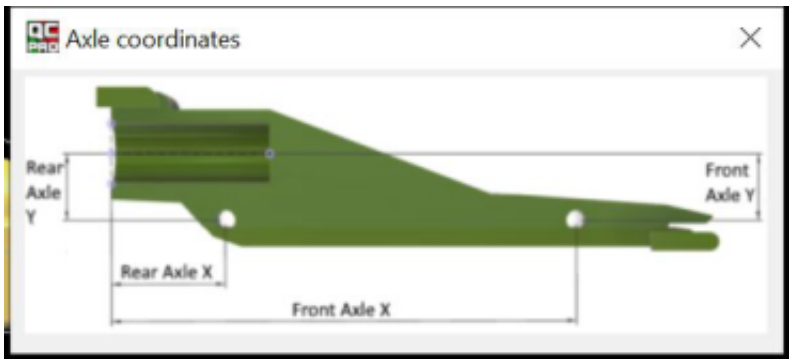
However, if you do wish to drill, you axle holes select 'Drill Axle Holes' option.

Once selected you will need to input the values.

If you don't know the values you can press this button.

The Help button will load up the image below.

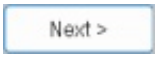




As you can see you need to input an X and a Y value for both the front and rear axle positions.
The X axis values will be a positive number and the Y axis values will to negative between -12.5 and -25.5.

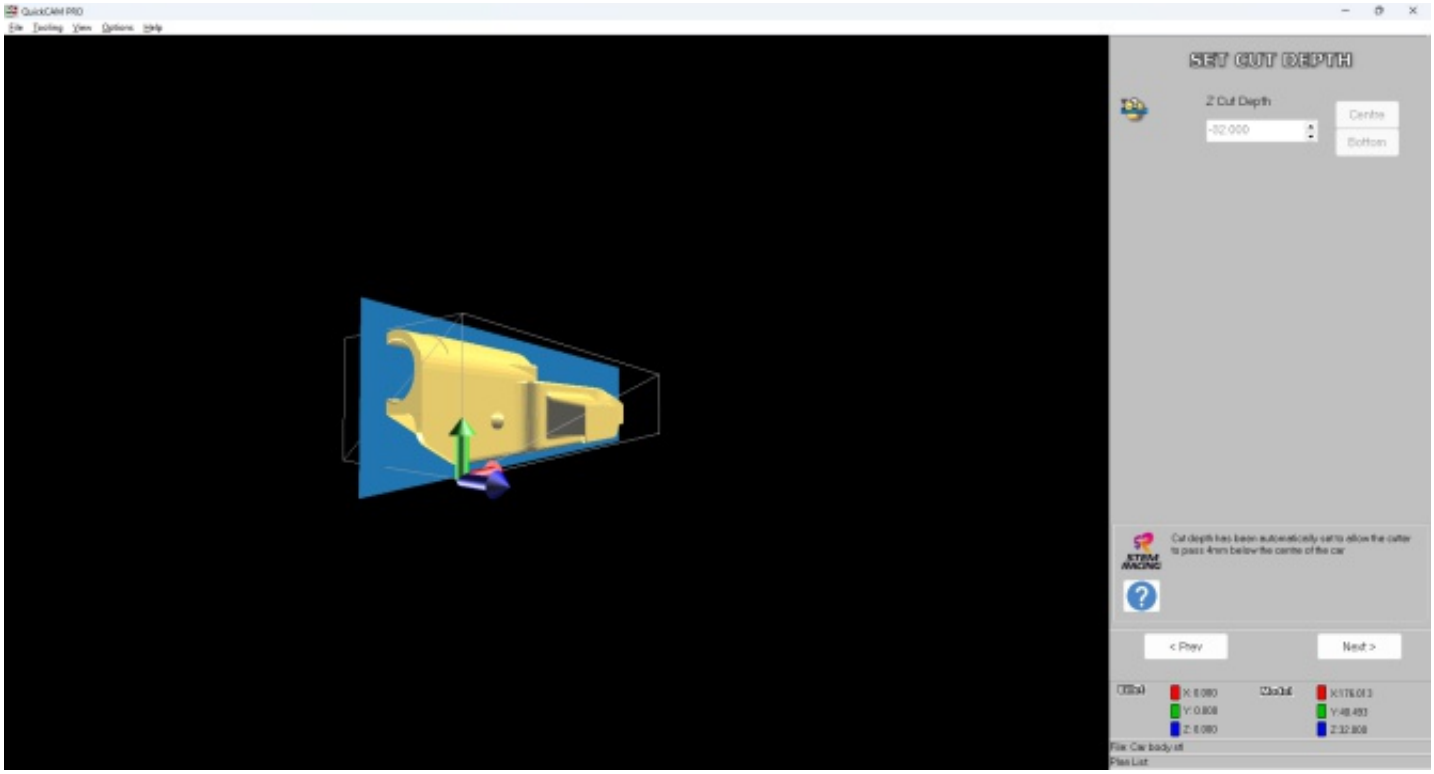
Ideally these values will be recorderd using the CAD model or drawing.

Click the Next button



Set Cut Depth

The Car Wizard automatically sets the Cut Depth



The Car Wizard recorded the width of the car when it was imported on the Orientate Model page of the wizard.

The depth of cut needs to go beyond the centre line of the car by a minimum of the cutter radius.
The cut plane will automatically be set at half the width of the car plus 4mm to take the cutter below centerline when the machining plan is calculated.

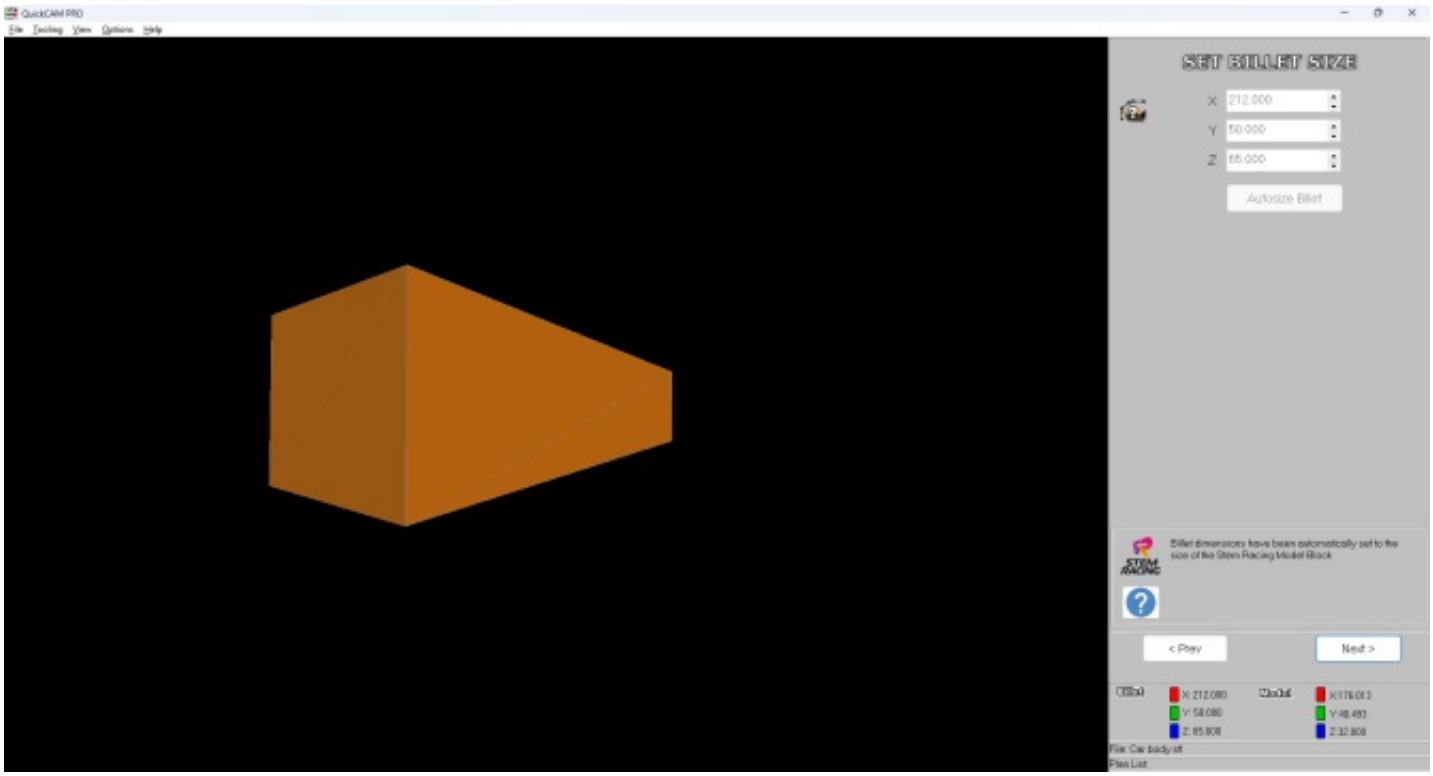
In this case the Car Width is 56mm so the Cut plane is set to half the car width 28mm + 4mm so the cut depth is set to Z-32mm

The only options available on this page is to move to the previous page or click Next.

Click the Next button

Set Billet Size

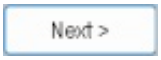
The Car Wizard automatically sets the Billet Size



The Car Wizard preloads a Billet size equal to the machinable area of the official STEM Racing Model Block.
X = 210mm, Y = 50, Z = 65

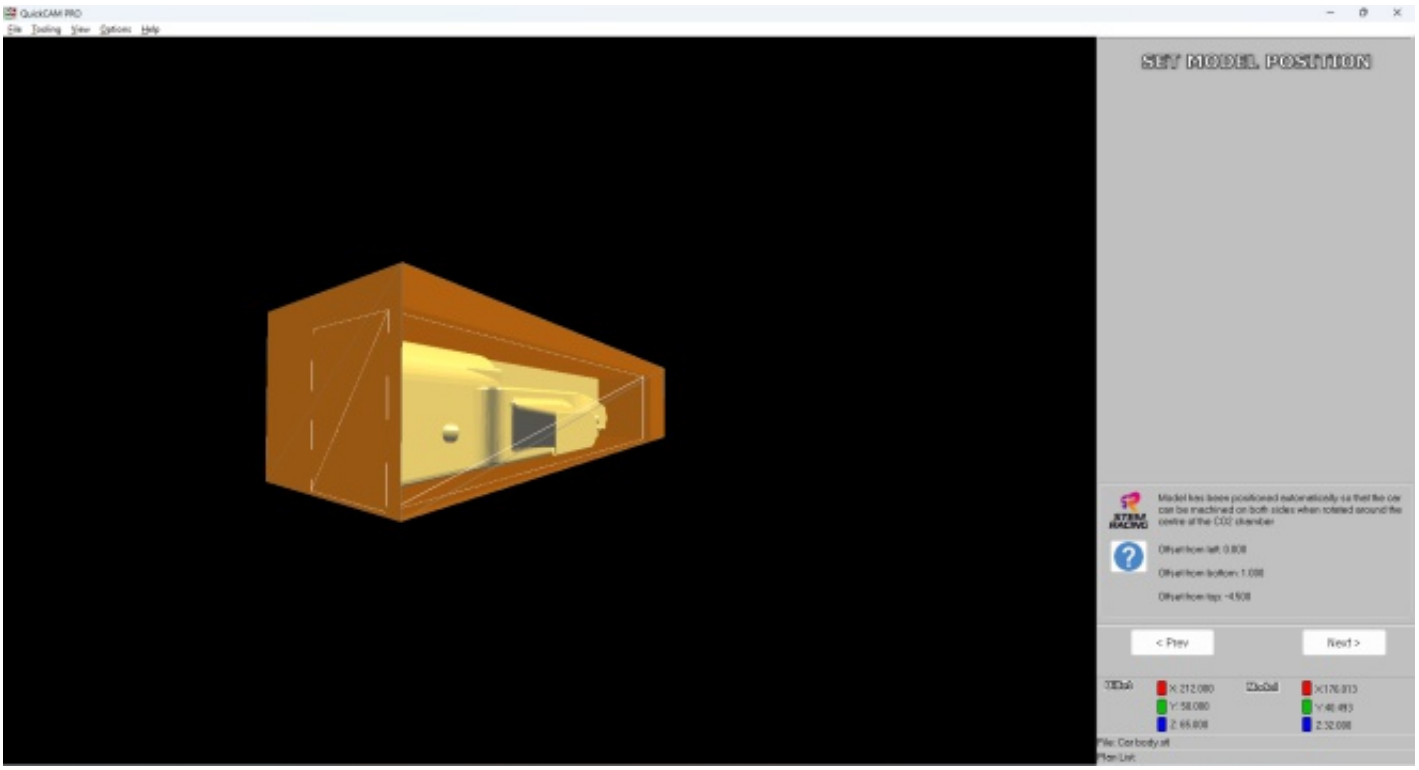
While a Model Block is 223mm long there is 13mm at the end of the block used as a clearance zone. This is to allow it to be held in the fixture and avoid the cutter causing damage.

Click the Next button



Set Model Position

The Car Wizard automatically sets the Model Position within the Billet



The Car Wizard recorded the width, height and length of the car on the Orientate Model page. The height of the CO2 Cartridge chamber from the base of car was also recorded.

As a result the Model is automatically positioned in the Billet.

The X is always given an offset of 0 and aligned to the left of the billet.

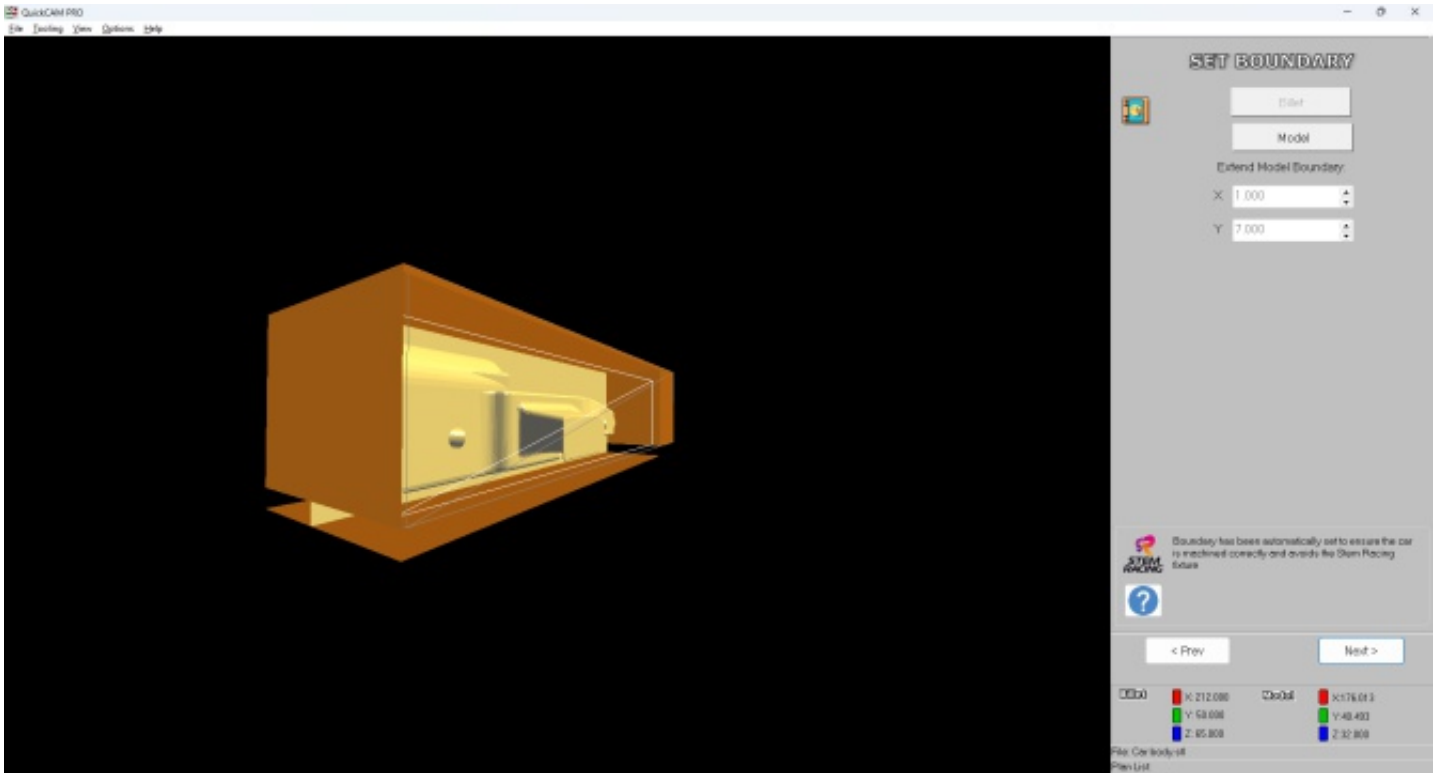
The Y axis has to be set to get the CO2 Cartridge Chamber aligned with the hole in the billet.
The Centre Height of the chamber in the Model Block is always 29mm. Subtract the height of the CO2 Cartridge chamber from the base of the car that was recorded earlier, in this case is 28mm therefore the Y offset is 1mm from the bottom.

In this case the model is 56mm wide and the billet is 65mm so there is 9mm difference split equally above and below the model
The Z offset is set to -4.5mm from the top of the billet

Click the Next button 

Set Boundary

The Car Wizard automatically sets the Machining Boundary.



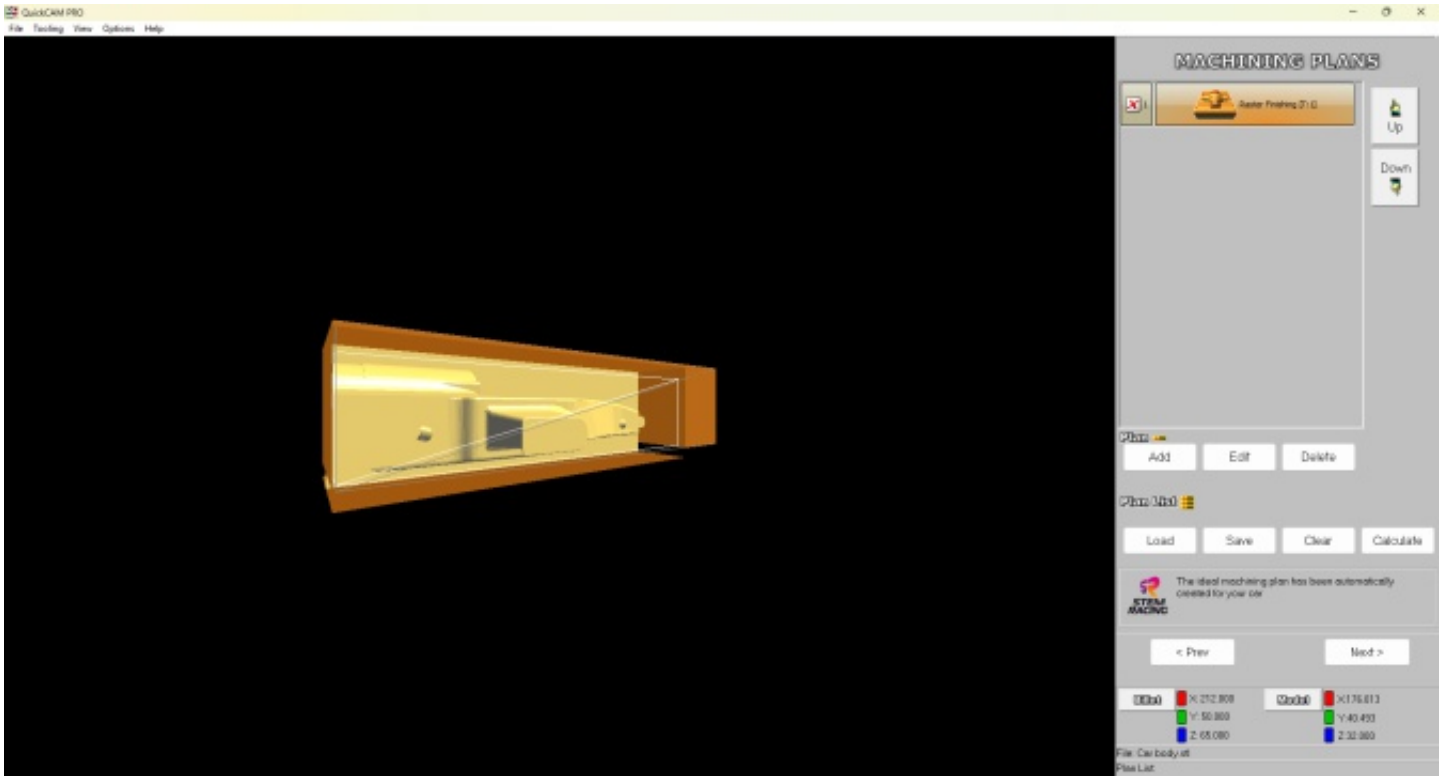
The Boundary is pre-set to allow the tool to travel 7mm outside the block in the Y axis. This is so that the tool has room to be allowed to machine the floor and top of the car.

The Boundary is also extended by 1mm in the X Axis which will clean up the edge of the model but prevent the tool chopping off the nose of the car and hitting the shaft used to secure the billet in the fixture.

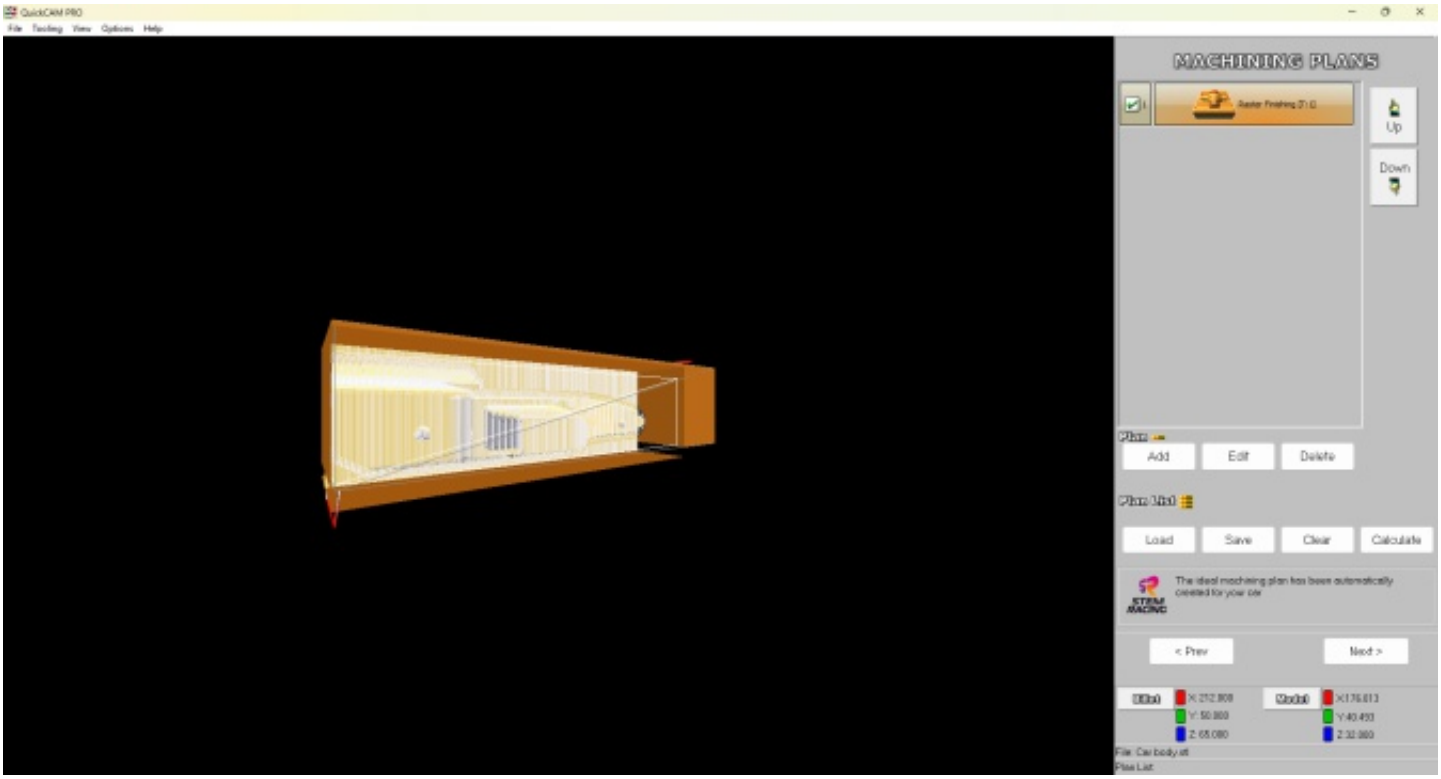
Click the Next button

Machining Plans

The Car Wizard automatically opens and calculates the Cutter Plan.



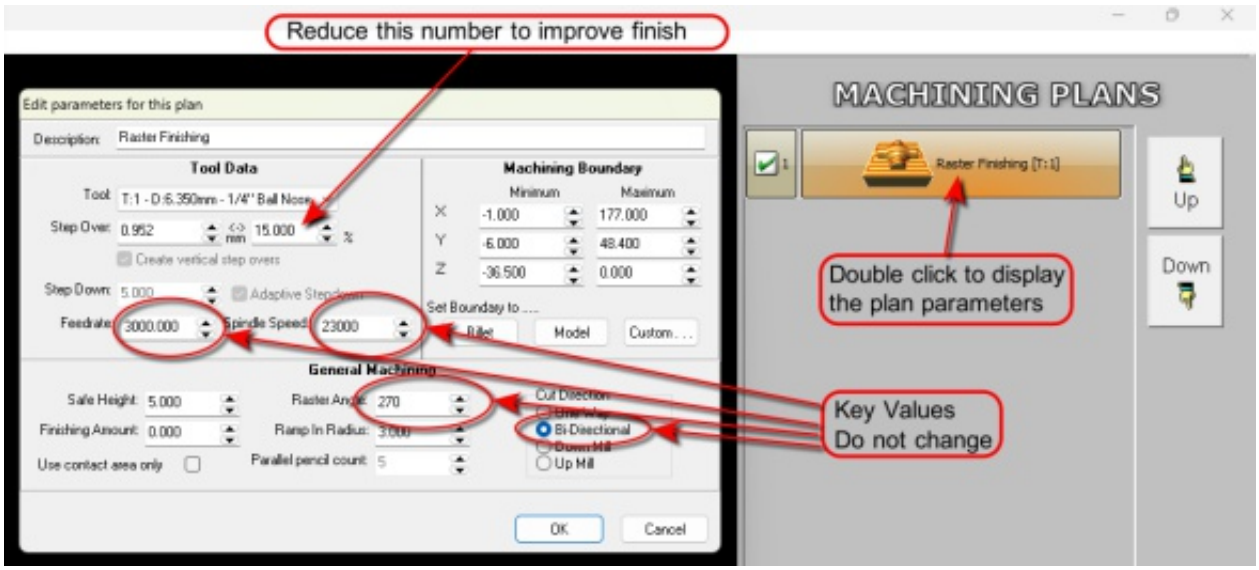
The Car Wizard loads the SRCarPlan.qpp and then automatically generates the cutter path.



Once the cutter plan is generated the cutter path is displayed. While the Raster finishing plan generated will create a good quality model additional cutter paths can be generated if required.

Editing Machining Plans

The Machining Plan can be viewed and Edited.



By double clicking on the machining plan the plan Parameters can be displayed.

The plan settings should be perfect for cutting cars out of the STEM Racing Model Block but if Balsa is used they may need to be modified.

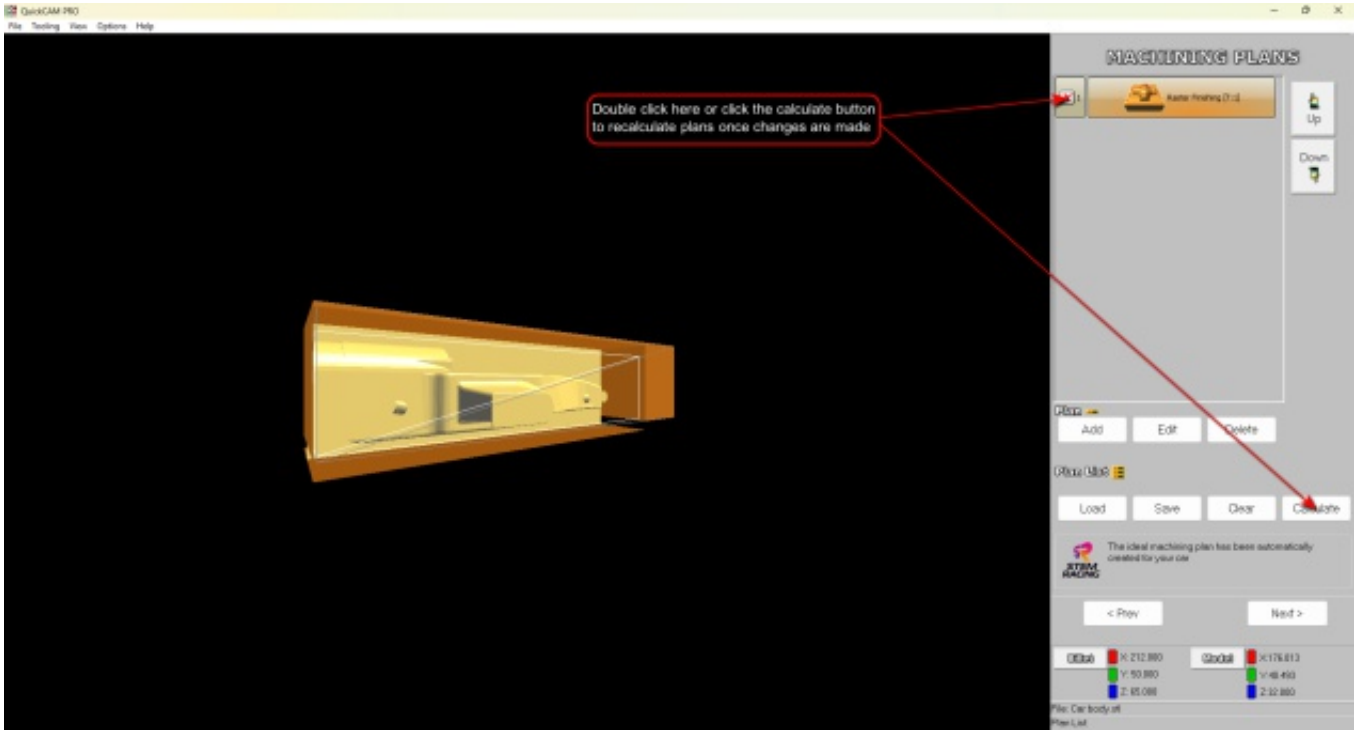
The step over of 12% will create a smooth finish. Reducing this will improve the finish but also increase the time taken to manufacture the car.

The other key values set are listed below:

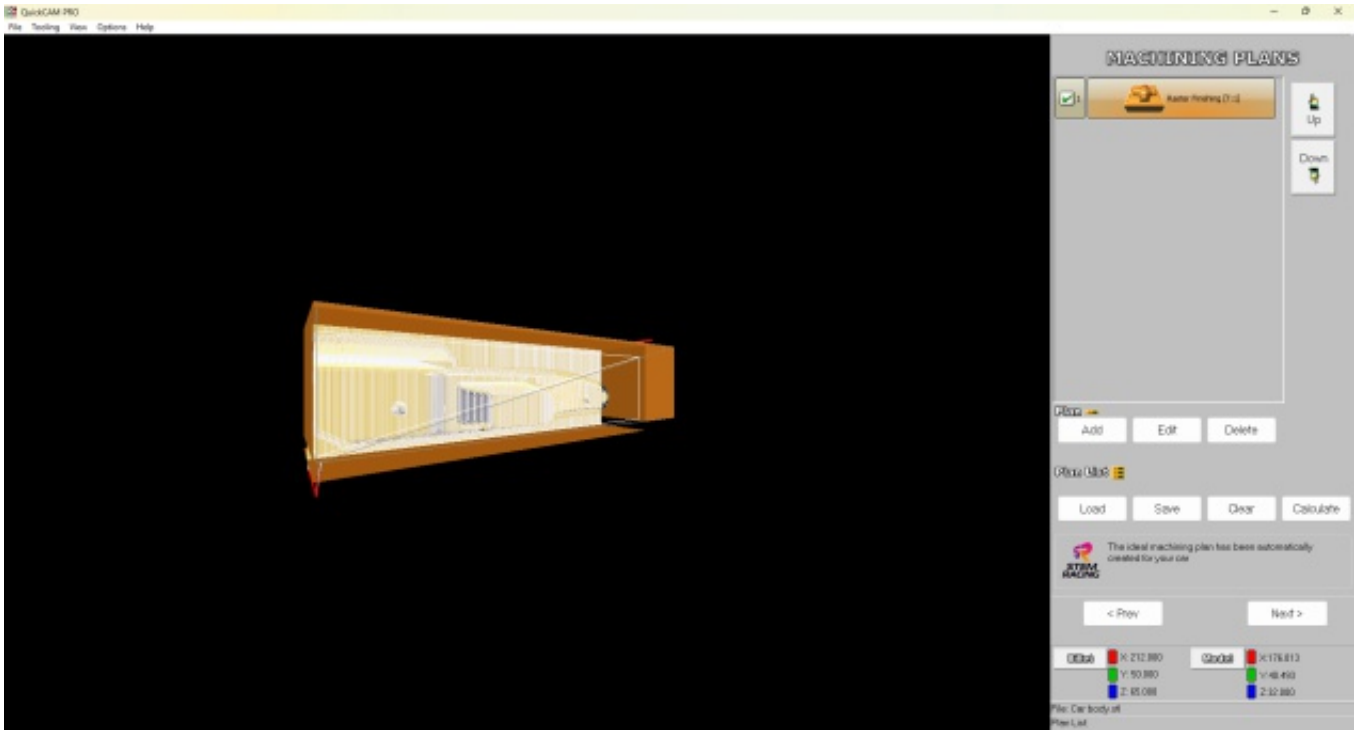
Feed	3000mm / Minute
Speed	23000RPM
Raster Angle	270 degrees
Cut Direction	Bi-Directional

Recalculating Machining Plans

The Machining Plan can be Recalculated



To recalculate a plan double clicking on the question mark icon or click on calculate.

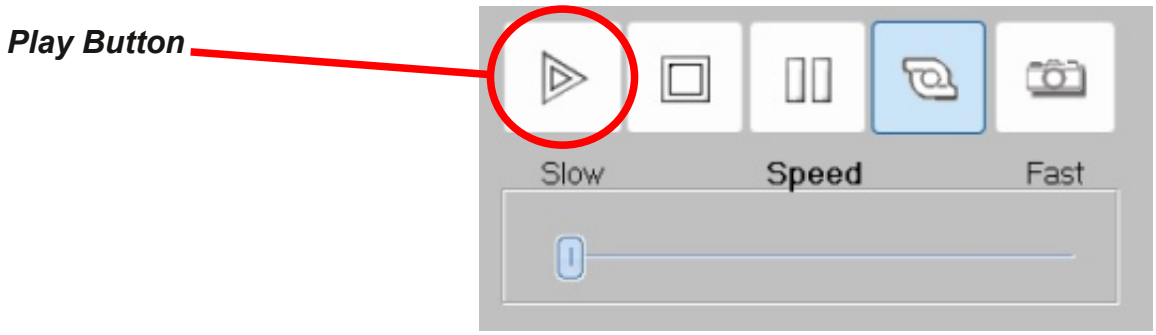


Click the Next button Next >

Tool path Simulation

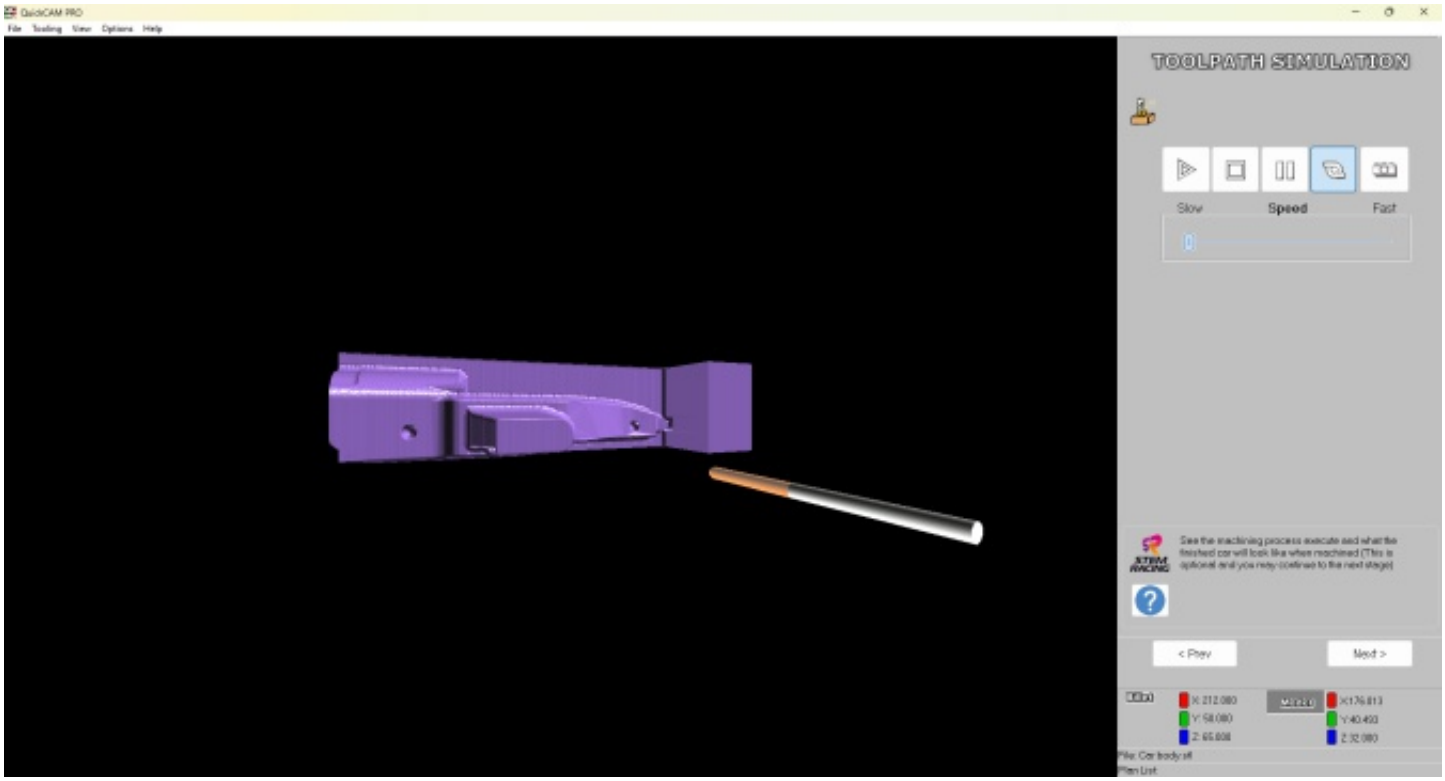
The generated cutter path can be simulated.

The Navigation panel on the right of your screen now has the video control buttons shown below

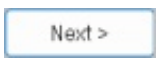


Click the Play button to run a simulation of your tool path

It should look something like the one image below.

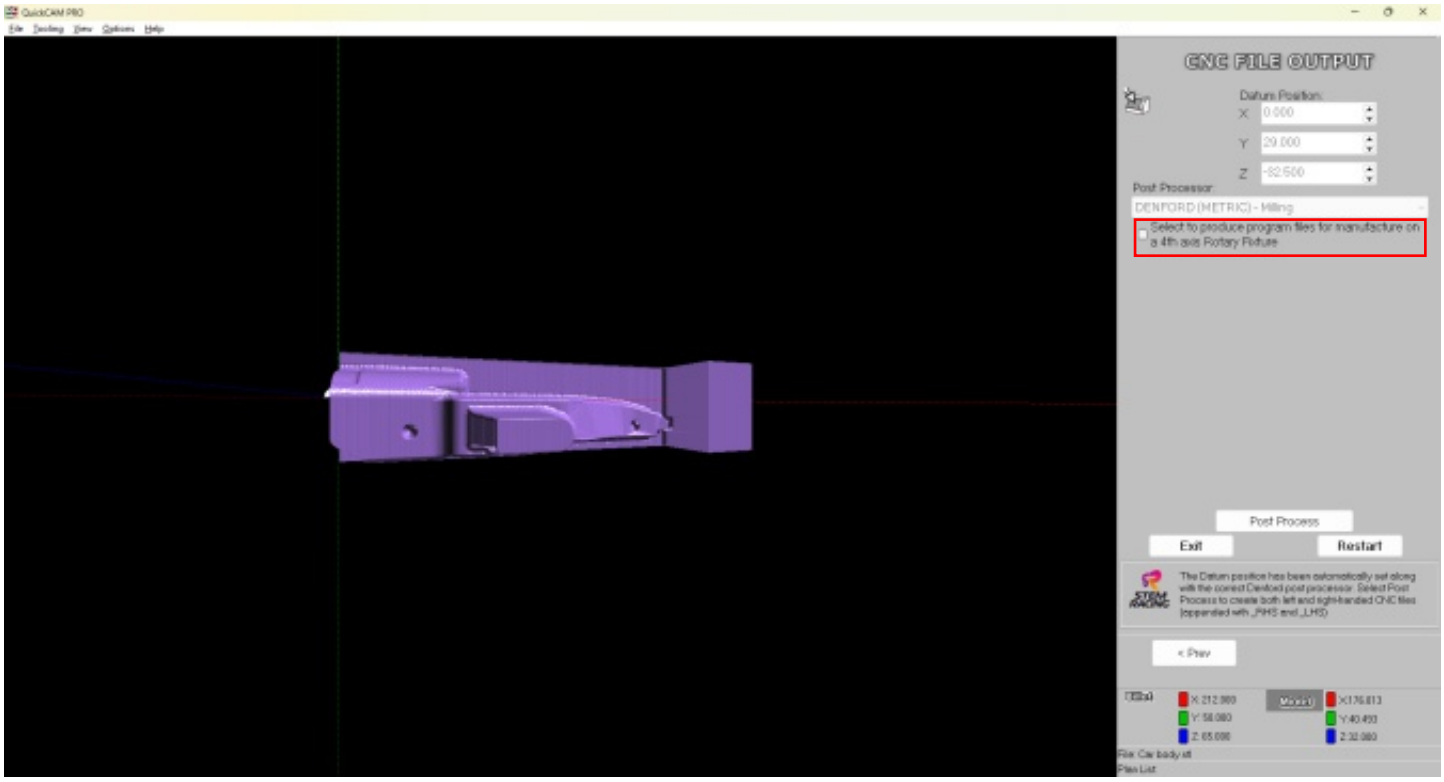


Click the Next button



CNC File Output

The Car Wizard automatically sets the Datum position and select the Post Processor.



The Car Wizard will automatically set the Datum position at the centre of the CO2 Cartridge chamber

The Datum position Values are:

X = 0	(the left hand edge of the block)
Y = 29mm	(The distance from the base to the center of the CO2 chamber)
Z = -32.5mm	(Half the height of the model block)

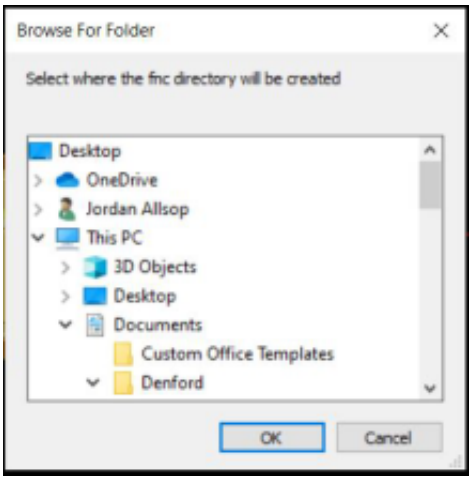
It then Selects the Denford Metric Milling Post Processor

You now have the option to choose if you want to create a program that will utilise a 4th axis.
If the box is selected then it will create programs compatible with the 4th axis rotary fixture, If the box is not selected it will create programs compatible with a standard F1 Fixture

Click the Post Process button to create the programs

Saving using the 4th Axis Option

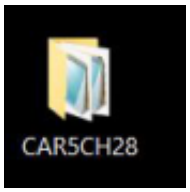
The Car Wizard automatically creates a subcall (same name as the STL File) with both sides of the car either with or without Axle Holes.



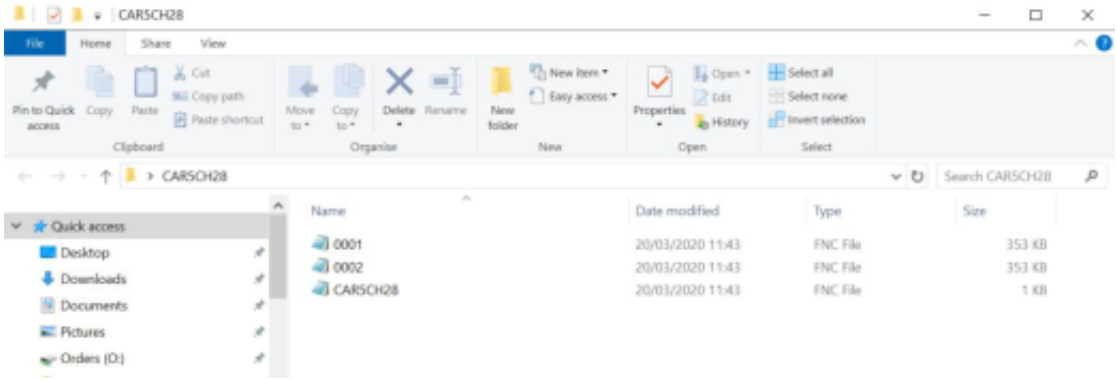
Once you have selected the 4th Axis Output it will ask you to select where to save the fnc file.

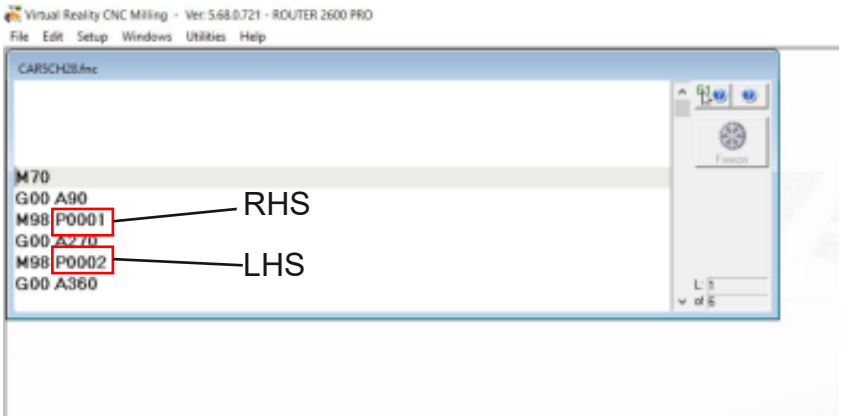
It will default to: C:\Programfiles(x86)\Documents\Denford\CNC Files

You can however select somewhere else to save this. Click OK to save the file



The Folder will be created in the directory you selected and there are 3 programs inside the folder



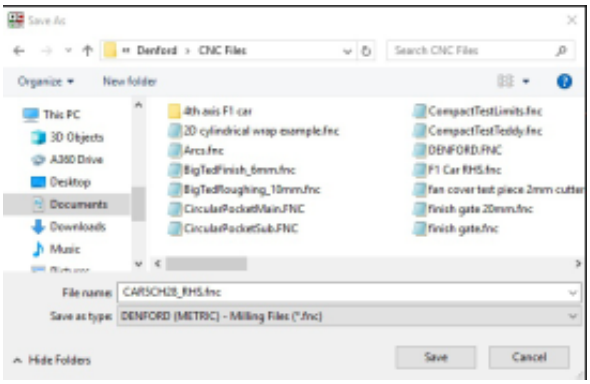


The program with the car name is the Subcall program. This is the one that will be run to cut the car.

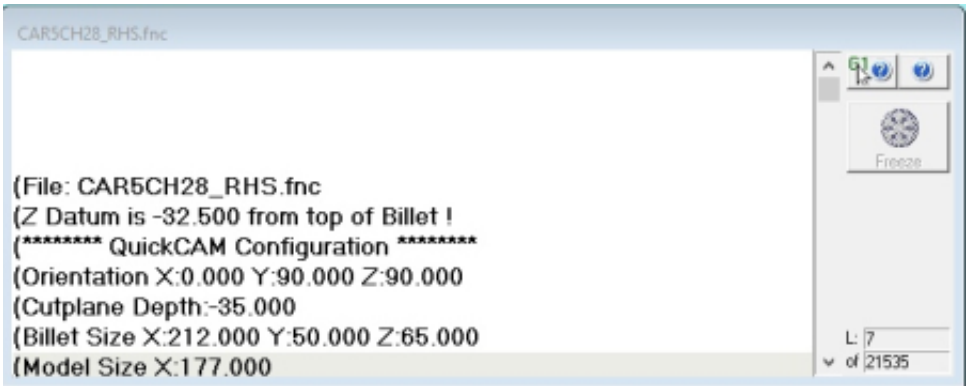
This program calls up the two sub programs for the sides of the car
P0001 is the RHS
P0002 is the LHS

Saving the CNC File for the STEM Racing Fixture

The Car Wizard automatically names the file adding RHS to the end of the file name.

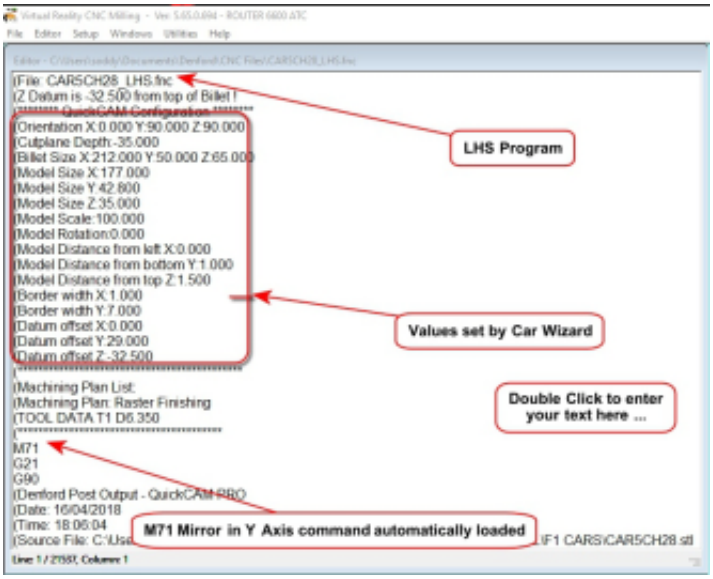


When you click Save the Car Wizard produces two files, one for the RHS and the another named LHS with the M71 mirror command code written into it.
Depending on the settings in QuickCAM PRO the VR Milling Software may open and load the RHS file when save is selected.



VR Milling Shown with the RHS program Loaded.
In the same locacation as the file was saved the program for the LHS will also be stored.

Click file open and select the LHS program



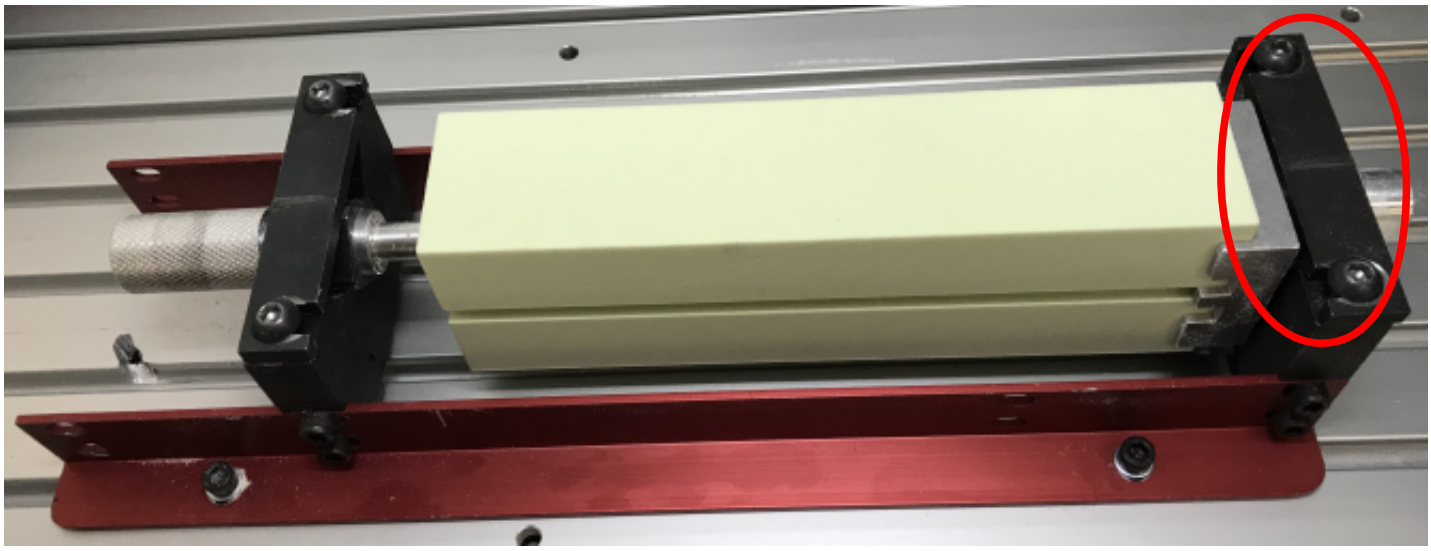
VR Milling Shown with the LHS program Loaded showing the M71 command.

Machining the STEM Racing Billet

If using the 4th Axis go to page 27.

STEM Racing Car Manufacturing Fixture

The billet should be positioned in the machine as shown in the image below.
Note that the tether line guide slot is facing you, this is set up for the right hand side to be machined.
When mounting the model block in the fixture always push the block as far to the right as possible before tightening the screws. Always tighten the screws shown in the circle first as this then pulls the block square. Only then should the screws securing the shaft at the left hand side be tightened as the split block will then allow the shaft to rotate and find its own centre.



Always ensure the Billet is pushed as far to the right in the fixture and the front of the car is clamped into position before clamping the shaft at the rear.

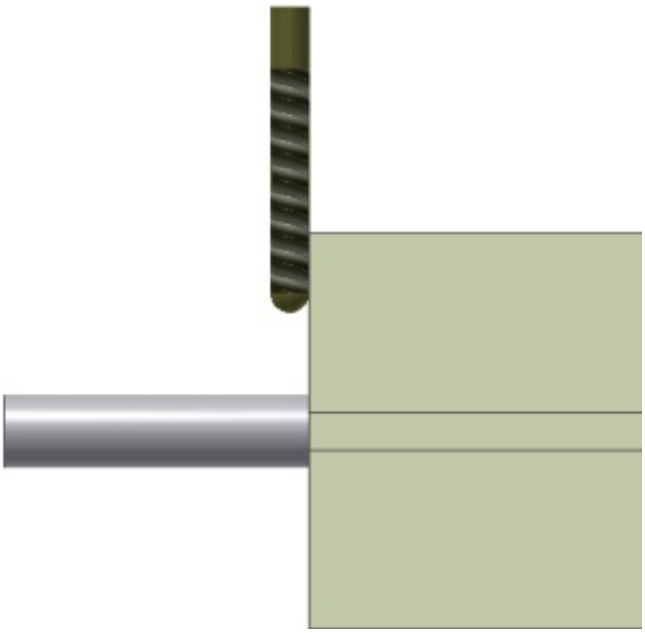
Ensure that this cut out is at the front of the V Block to allow it to compress onto the aluminium shaft.

As the screws are tightened onto the clamp plate the block with the slot in it will compress and clamp the aluminium bar that into the cartridge hole.

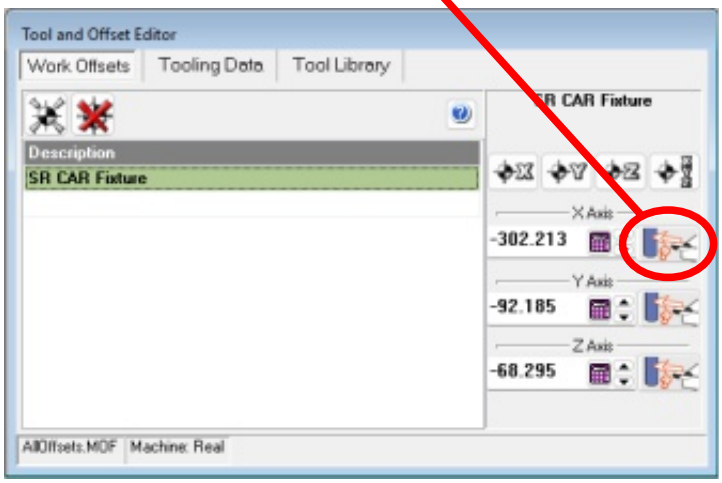
Ensure the slot is positioned to the front of the V block to allow it to clamp onto the shaft.
Set the datum to the left hand side of the billet with Y and Z on the centreline of the aluminium bar as shown on the next page.

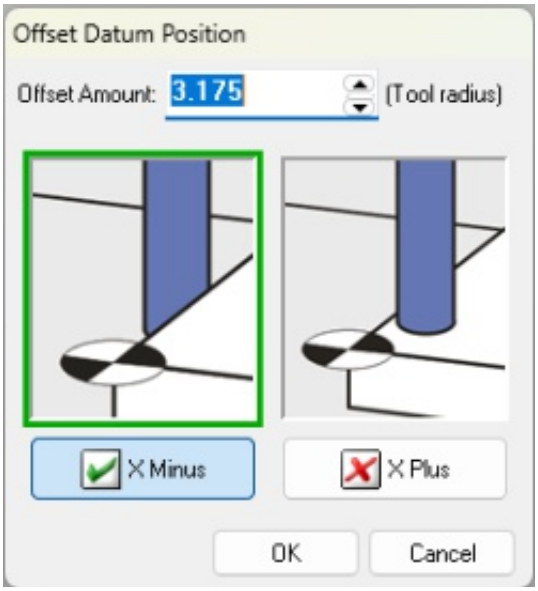
Setting the DATUM
X Axis

Touch the tool onto the left hand side of the billet as shown in the image below



In the Tool and Offset Editor window select the X axis datum offset button





The tool Radius is 3.175 so the centre line of the tool is outside the billet by this amount.This option automatically adds the radius of the tool to set the offset If the offset is not automatically loaded.

Type the value shown below into the offset amount
3.175

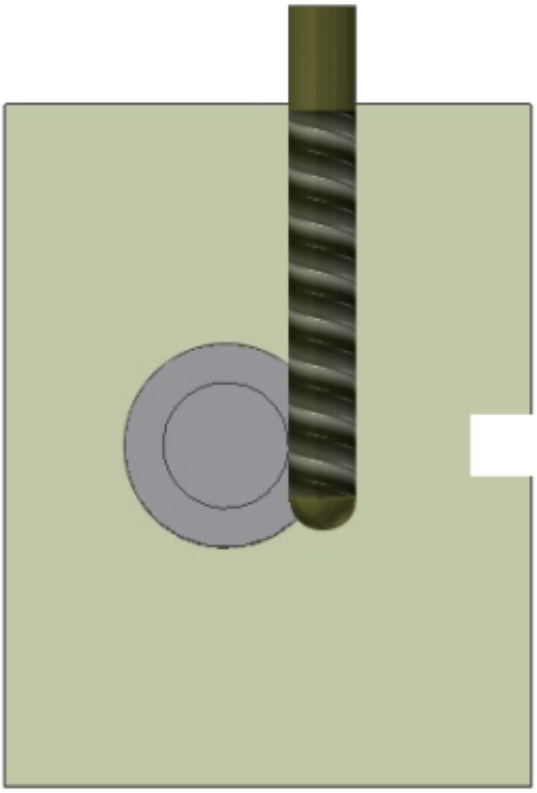
Click the X Minus button 

Click the OK button 

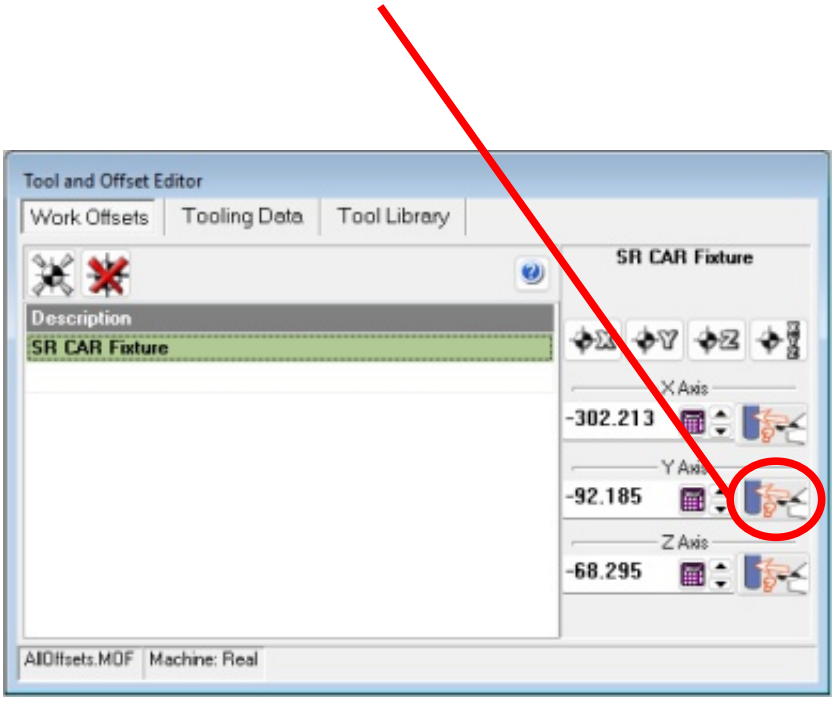
You have now set the X axis

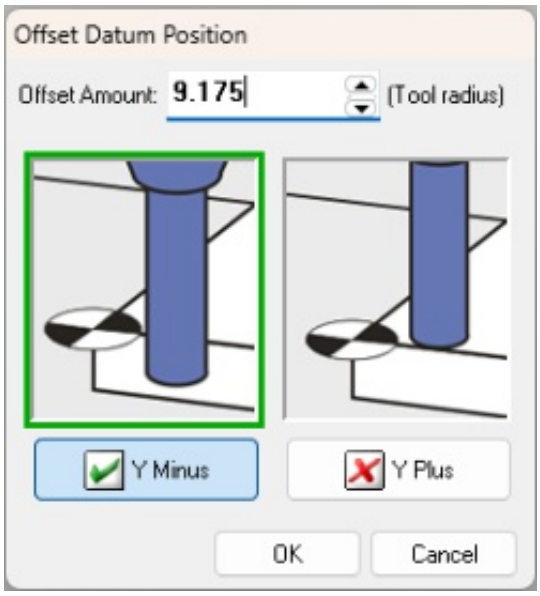
Y Axis

Touch the tool onto the front of the aluminium shaft as shown in the image below



In the Tool and Offset Editor window select the Y axis datum offset button





The aluminium shaft is 12mm Diameter so 6mm Radius.

The tool is 6.35mm Diameter so 3.175mm Radius. When the tool touches the shaft the centers are 6mm + 3.175mm away from each other = 9.175mm

Type the value shown below into the offset amount.
9.175
This is the radius of the tool and the radius of the bar

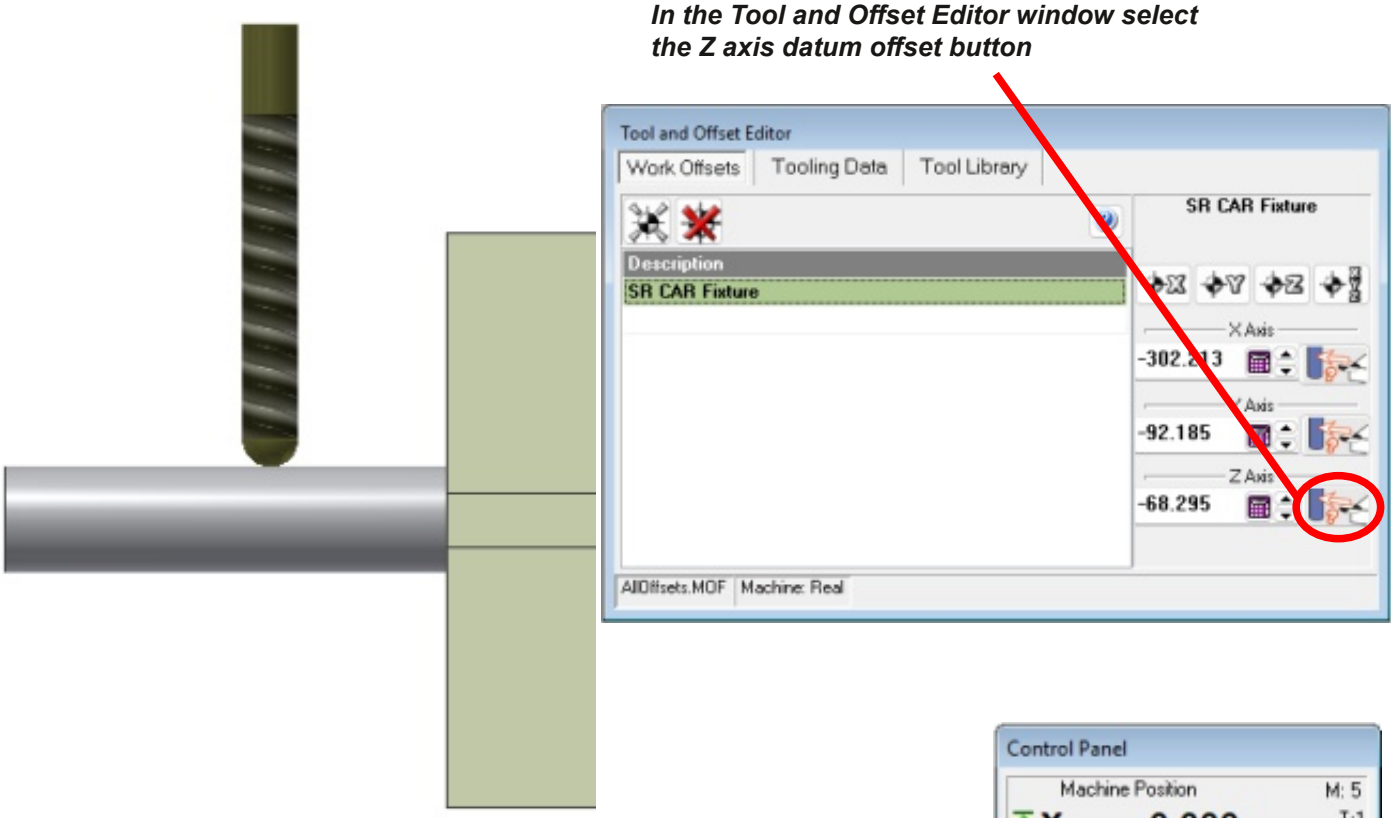
Click the Y Minus button 

Click the OK button 

You have now set the Y axis

Z Axis

Touch the tool onto the top of the aluminium shaft as shown in the image below.

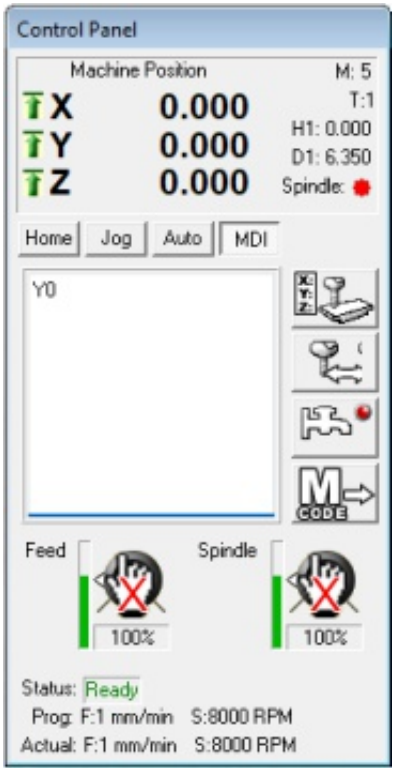


To do this the Y axis must be at 0

Go to the MDI tab in the Control Panel

Type "Y0"

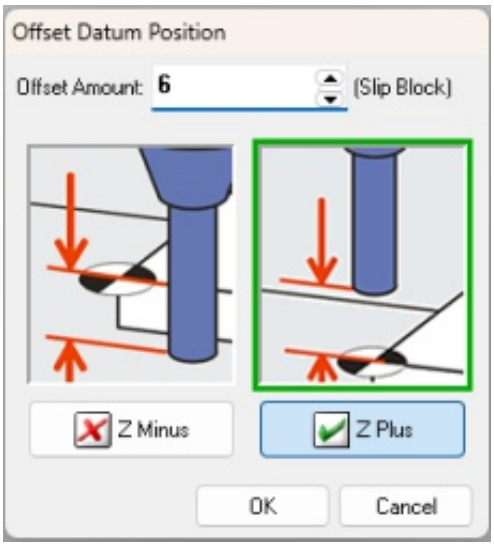
Press the Start button 

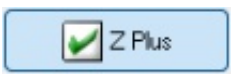


Go to the jog tab and lower the tool onto the top of the bar

The aluminium shaft is 12mm Diameter so 6mm Radius.

Enter 6mm as the offset amount



Click the Z Plus button 

Click the OK button 

You have now set the Z axis offset

4th Axis STEM Racing Car Manufacturing

The Car Wizard Produces:-

0001.fnc which is RHS

0002.fnc which is LHS

The Car Wizard Produces the SubCall Program Automatically as long as the option is selected on the CNC File Output Page refer to pg 19 for details.

The subcall routine will automatically rotate the 4th axis and call the programs 001.fnc and 0002.fnc

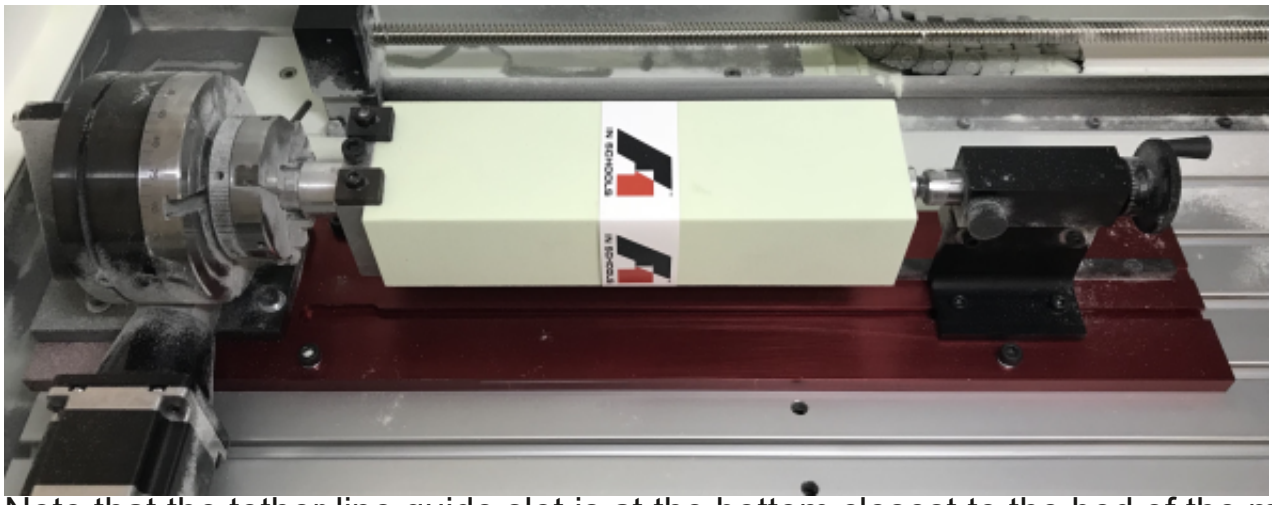
M70
G00 A90
M98 P0001
G00 A270
M98 P0002
G00 A360

M70 is another miscellaneous function, it mirrors the X axis. This is required as on the 4th axis the cartridge hole is on the right hand side.
G00 A90 instructs the 4th axis to turn 90 degrees
M98 P0001 calls program 0001.fnc and executes it
G00 A270 instructs the 4th axis to turn a further 180 degrees
M98 P0002 calls program 0002.fnc and executes it
G00 A360 returns the 4th axis to the start position

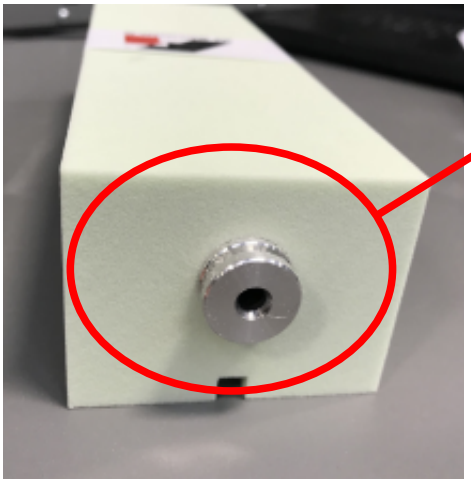
It is the SubCall file which you run when using the 4th axis to machine an F1 in Schools billet.

4th Axis STEM Racing Conversion Kit

The billet should be positioned in the machine as shown in the image below.

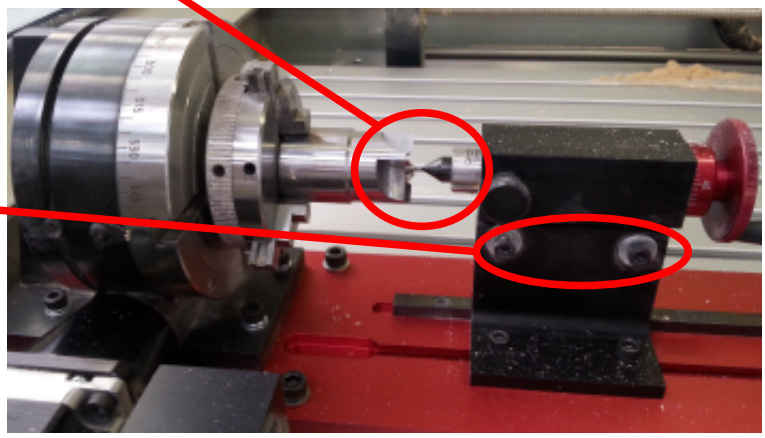


Note that the tether line guide slot is at the bottom closest to the bed of the machine and the cartridge hole is on the right, the cartridge hole should have the aluminium cartridge fitted into it and this mates up to the tail-stock of the 4th axis.

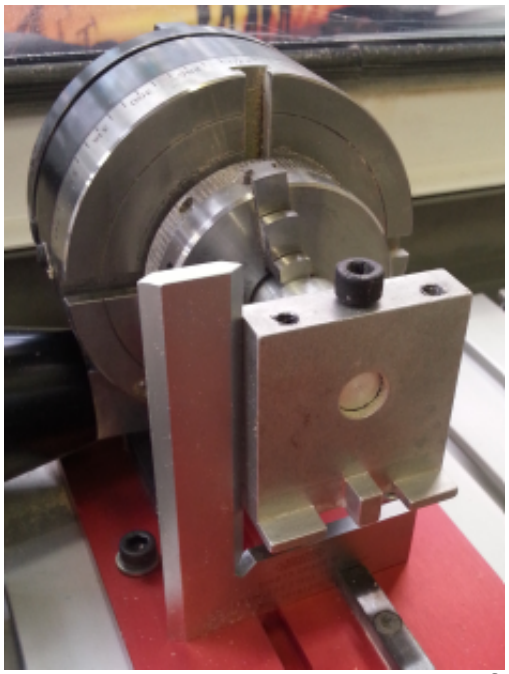


Aluminium cartridge inserted into the cartridge hole in the billet. Note the hole in the centre, this locates onto the 4th axis tail-stock.

The tail-stock must be aligned with the chuck of the 4th axis. To do this fit the spiked drive into the 4th axis and slide the tail-stock up to it, adjust the 4th axis so that the centre point of the drive and the point from the tail-stock align with each other.



Use these bolts to loosen the tail-stock in order to align it with the chuck.



The aluminium block which holds the billet fixes into the chuck of the 4th axis.

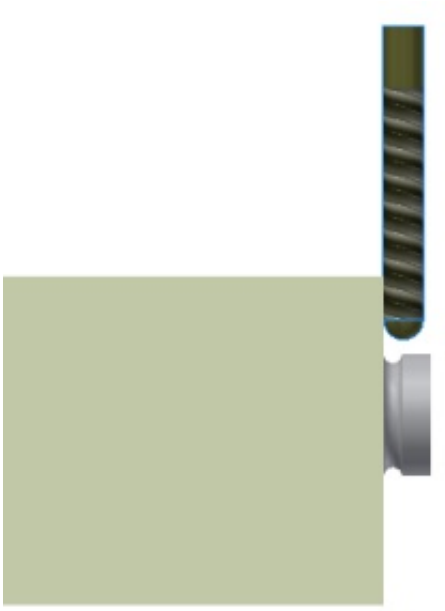
The 4th axis does not have a datum switch, this means that whatever position it is in when you connect to the router is taken as 0 degrees.

Use an engineers square to set the aluminium block so that it is parallel to the bed of the machine and then tighten the chuck on the 4th axis.

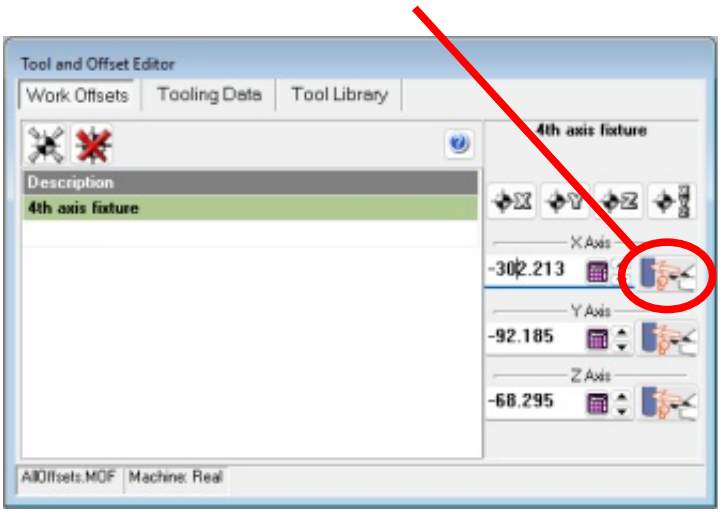
Setting the DATUM

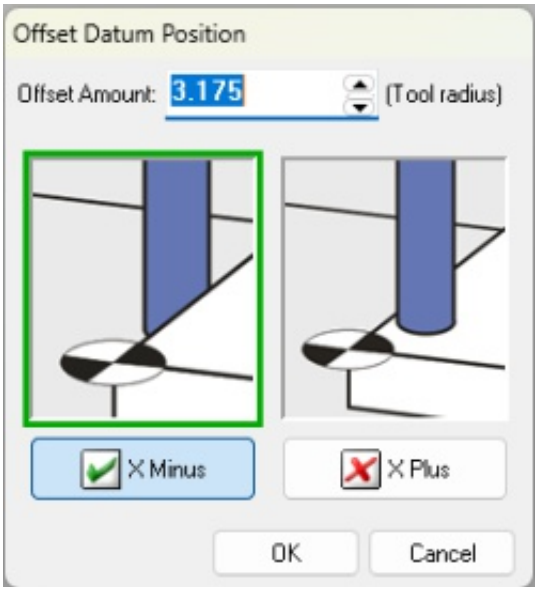
X Axis

Touch the tool onto the right hand side of the billet as shown in the image below



In the Tool and Offset Editor window select the X axis datum





offset button

Type the value shown below into the offset amount

3.175

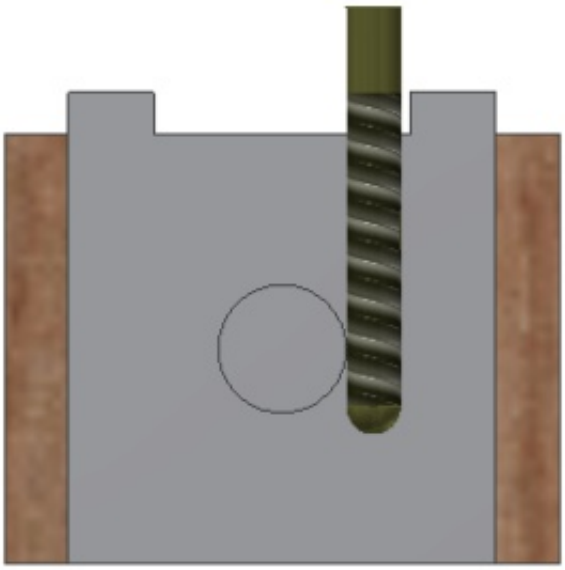
Click the X Plus button 

Click the OK button 

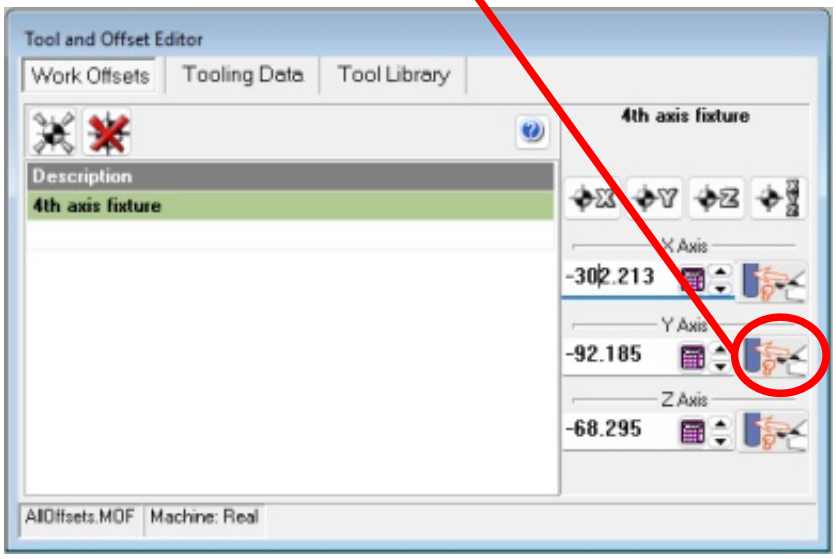
You have now set the X axis

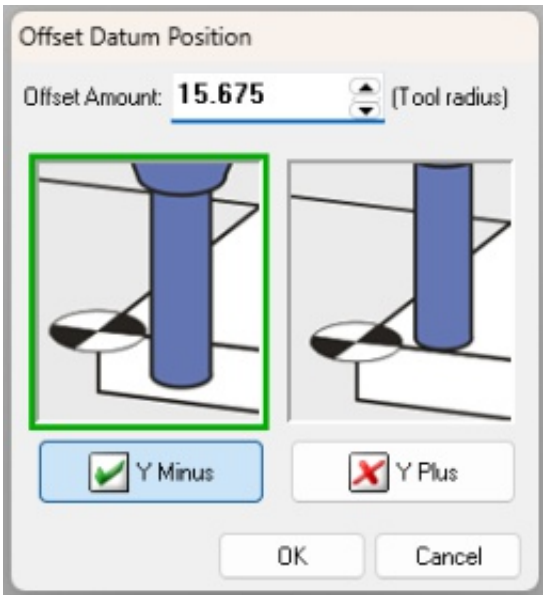
Y Axis

Touch the tool onto the front of the aluminium bar as shown in the image below



In the Tool and Offset Editor window select the Y axis datum offset button





Type the value shown below into the offset amount.

15.675

This is the radius of the tool and the radius of the bar behind the aluminium block which holds the left hand side of the billet

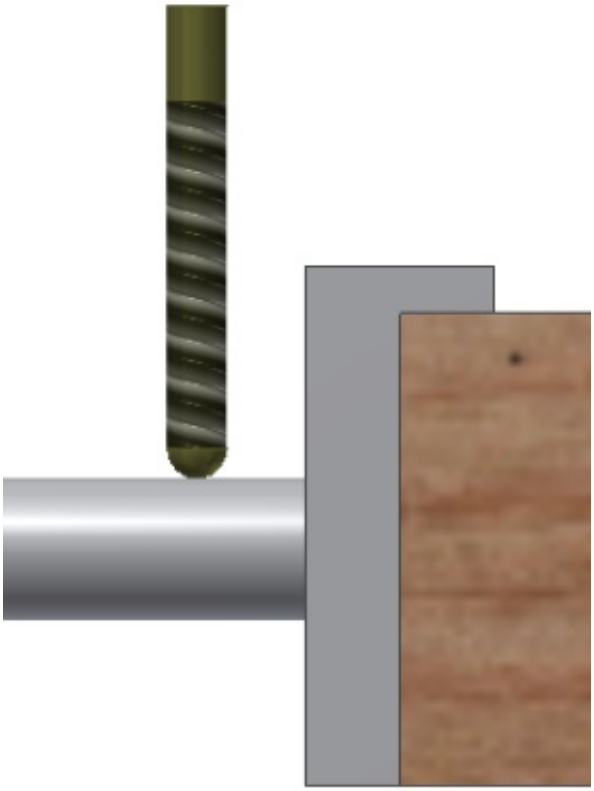
Click the Y Minus button 

Click the OK button 

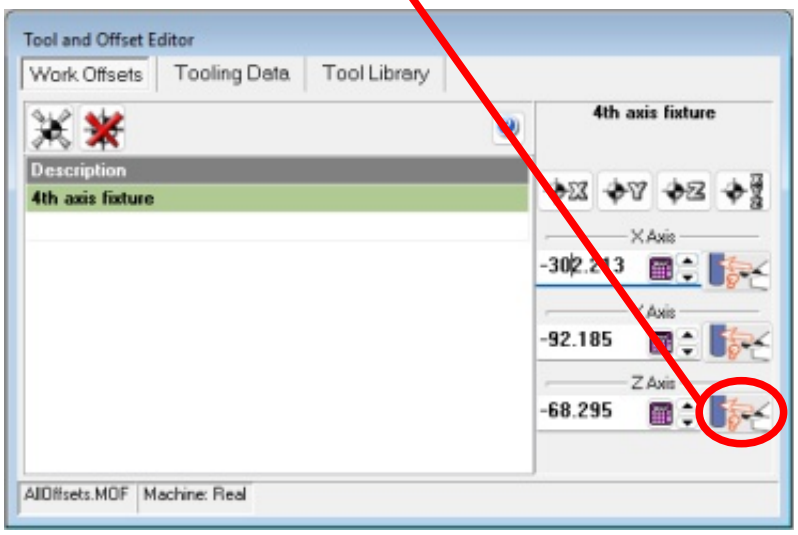
You have now set the Y axis

Z Axis

Touch the tool onto the top of the aluminium bar as shown in the image below.



In the Tool and Offset Editor window select the Z axis datum offset button

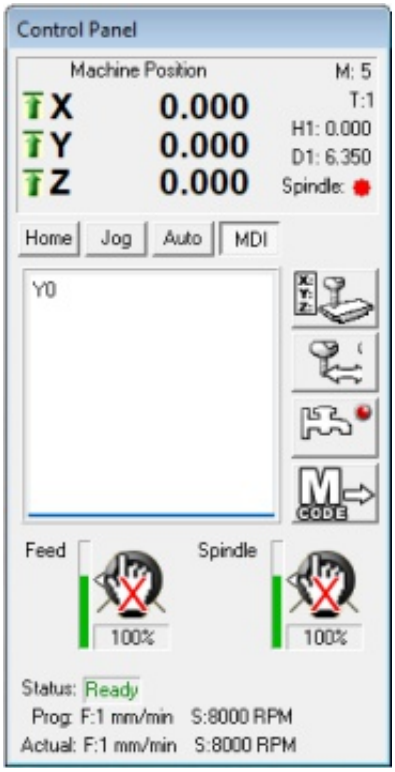


To do this the Y axis must be at 0

Go to the MDI tab in the Control Panel

Type "Y0"

Press the Start button 

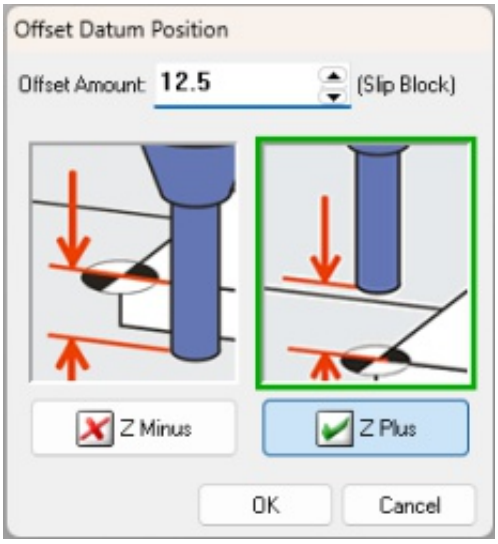


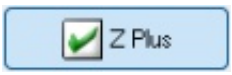
Go to the jog tab and lower the tool onto the top of the bar

Type the value shown below into the offset amount.

12.5

This is the radius of the bar



Click the Z Plus button 

Click the OK button 

You have now set the Z axis and can run the program Subcall.fnc which will automatically rotate the 4th axis and execute program 0001.fnc and 0002.fnc

Running the Program

STEM Racing Car Manufacturing Fixture

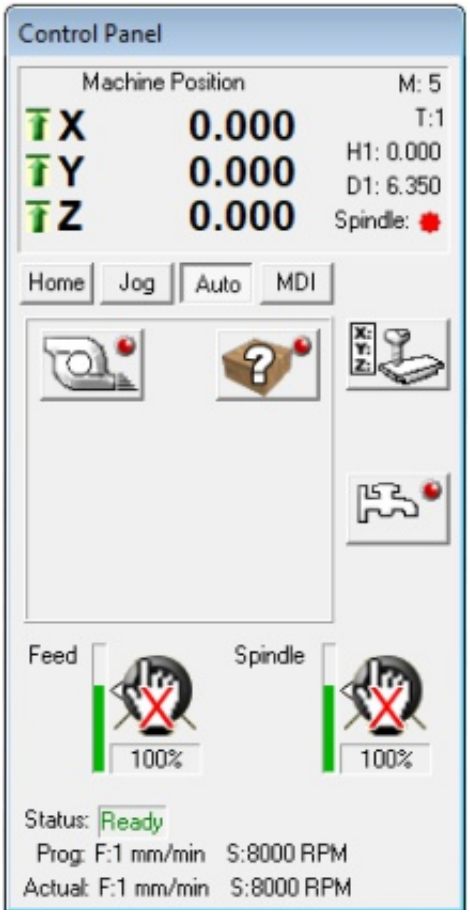
Open the "RHS.fnc" file that you created on page 19 of this guide.

STEM Racing Conversion Kit

Open the "Subcall.fnc" file that you created on page 20 of this guide.

Running the Program

On the Control Panel, ensure that you are in Auto mode
Be sure that Turbo Mode is turned on
Make sure that Material Override is turned off
Check that the Feed Rate Override on the front of the router is set to 100%



With the file control buttons select Stop, Rewind, then Start

Whilst you could just press Start, the above method is safer as it will ensure that you do not start a program part way through which could cause damage to the fixture and the tool.

STEM Racing Car Manufacturing Fixture

When the first side has finished turn the billet over, instructions for fixing the billet are on page 27

4th Axis STEM Racing Conversion Kit

When the program has finished remove the finished design

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