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CAD/CAM Solutions & Projects for Education

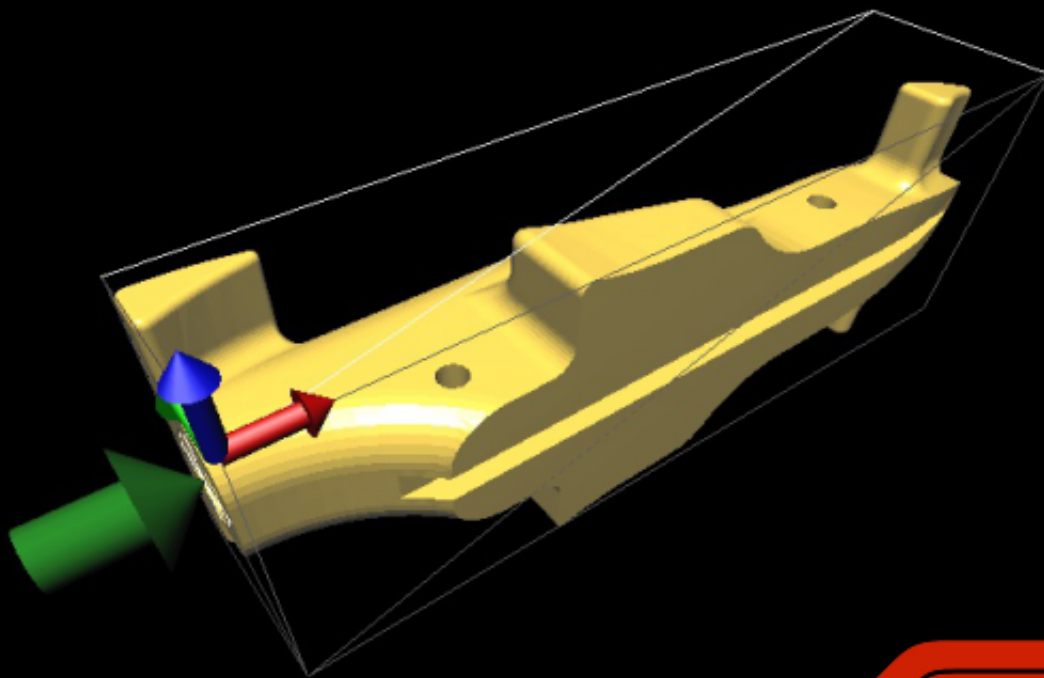
QuickCAM Pro

Advanced Milling CAM Software

Car Wizard

Training Guide

*QuickCAM Pro (V1.19)
VR Milling (V5.65)*

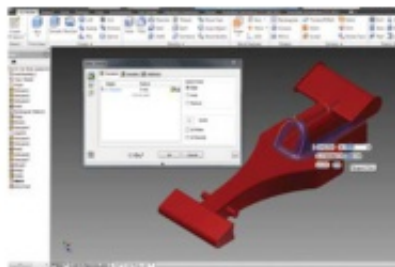



in Schools



F1 Consumables

F1 IN SCHOOLS EQUIPMENT & CONSUMABLES



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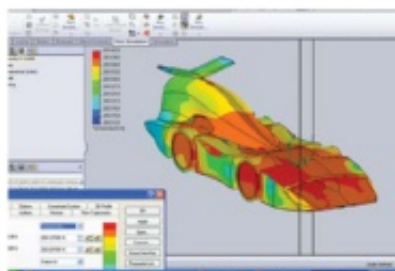


QuickCAM Pro

An advanced, yet simple to use, wizard-based CAM package, which is used to create cutter paths for machining 3D parts on a milling machine or router.

Site Licence

BID1806P



ANALYSE

Virtual Wind Tunnel

F1 VWT Analysis Software

Single Seat

5 User Licence

Site Licence

BID1841

BID1841A

BID1841C



MAKE

CNC Machine Options for F1 Car Manufacture:

MRC 40

Compact 1000 Pro (Metal Cutting)

Router 2600

Router 2600 Pro (Metal Cutting)

Router 6600

Router 6600 Pro (Metal Cutting)

MRC004000

MRC003000

MRP002000

MRP003000

MRF002000

MRF003000



F1 in Schools Car Fixture

Comes as standard with two clamping systems to enable the manufacture of Bloodhound SSC & Formula 1® Class cars. The fixture clamps directly to the T-slotted table on the MRC 40 (T-slotted table not standard equipment with MRC 40), Compact 1000 Pro and Router 2600/Pro and is also suitable for use on the VMC 1300 (it is necessary to remove the tool changer to fit the fixture)

NR1/D400UA

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About QuickCAM Pro

QuickCAM Pro is an advanced, yet simple to use, wizard-based CAM package, which is used to create cutter 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 to and specifically how to manufacture an F1 in Schools 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.

Version is written on the title bar of the main software window.

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.

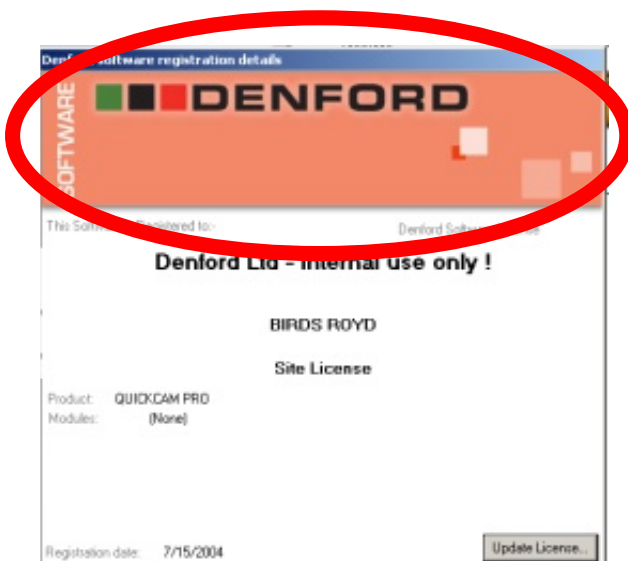
Launching QuickCAM Pro

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

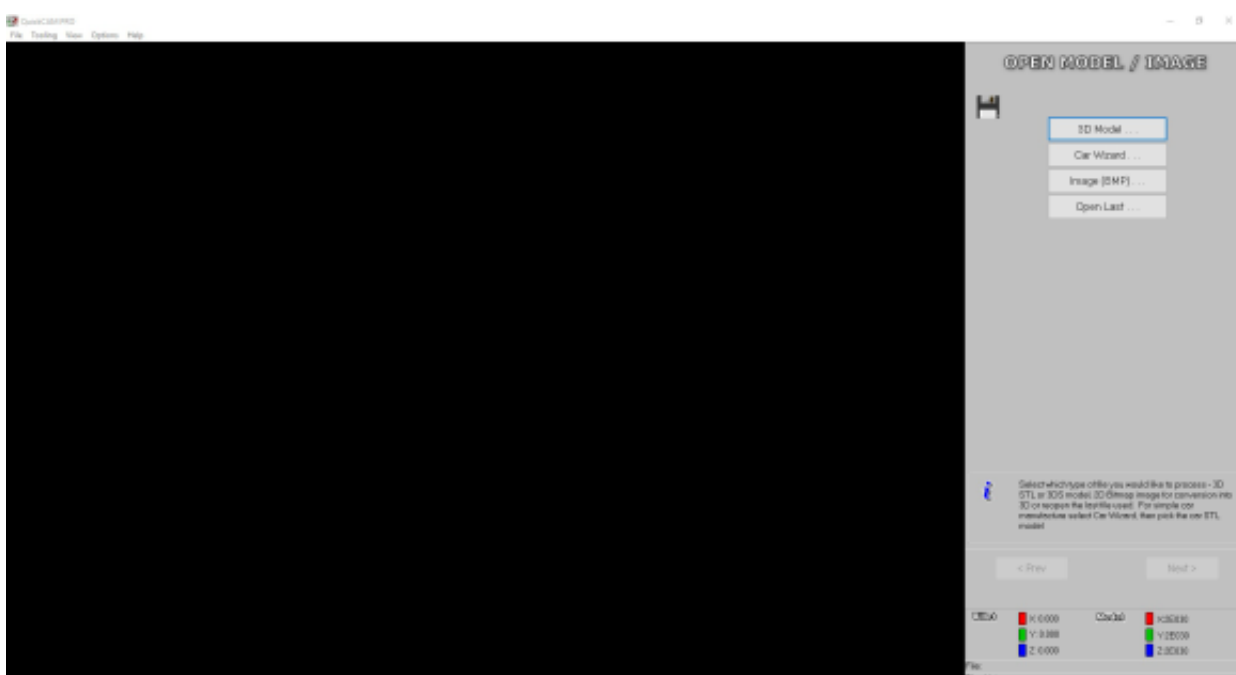


The screen shown on the right will be displayed and the software will take a minute or 2 to open.
You can force the software to open quicker by following the next instruction.

"Double click" on the area circled below.



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



Navigating QuickCAM Pro

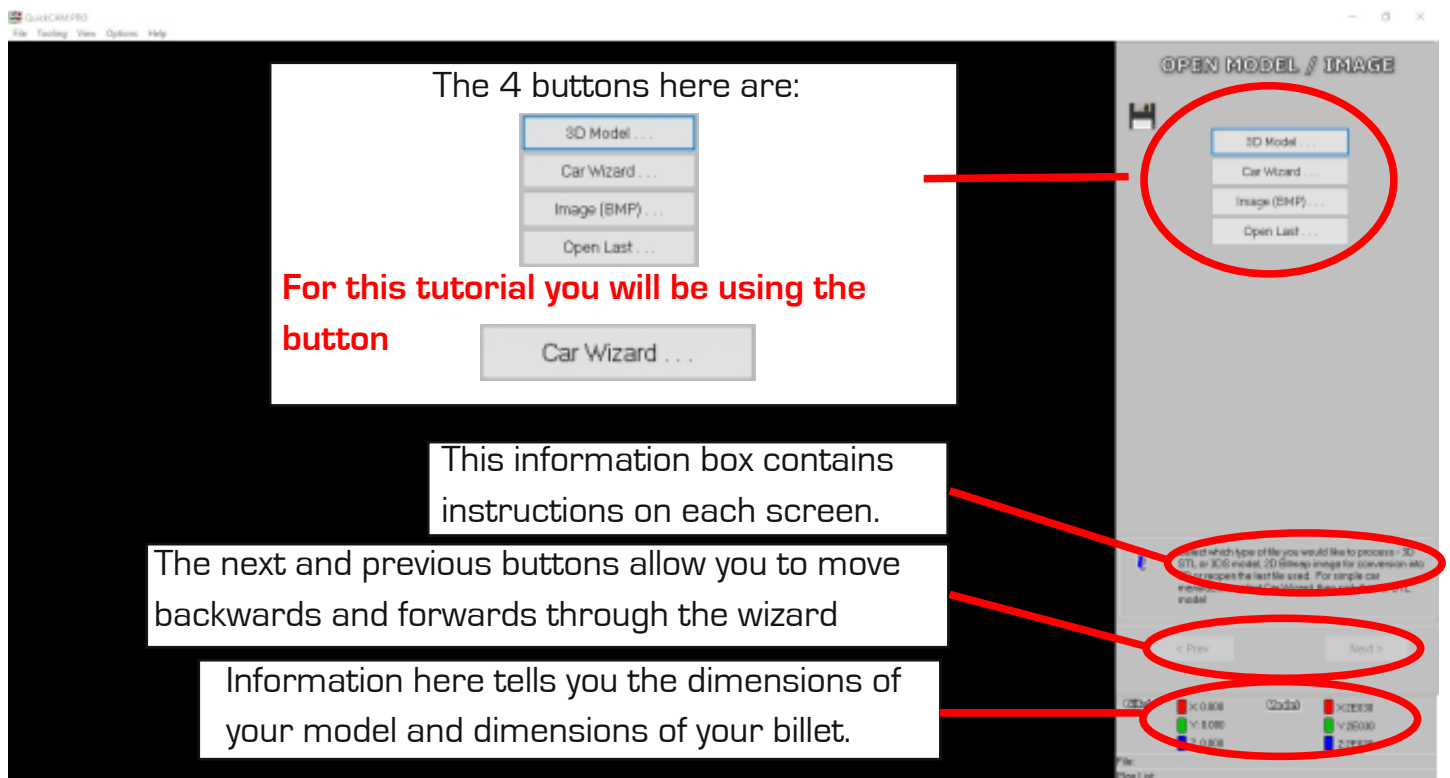
QuickCAM Pro is very easy to use, the main screen displays what is going on and the navigation panel on the right is how you select options and move around this wizard based program.

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 5. 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.

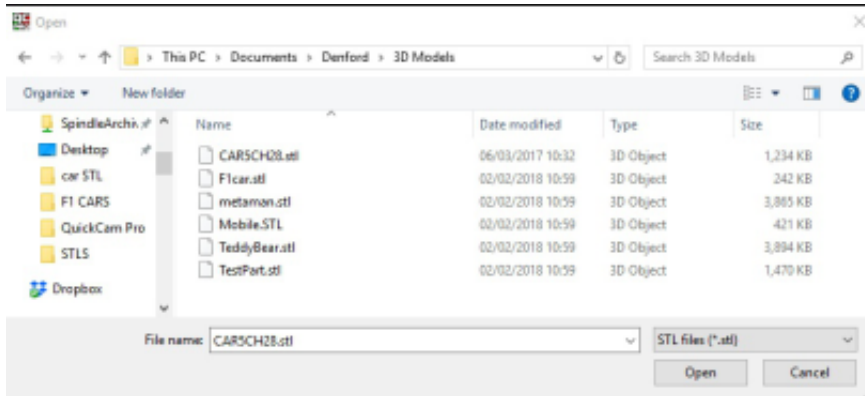
The options menu allows you to change various view settings.



Opening your Model

Select the 3D Model button

Car Wizard ...



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

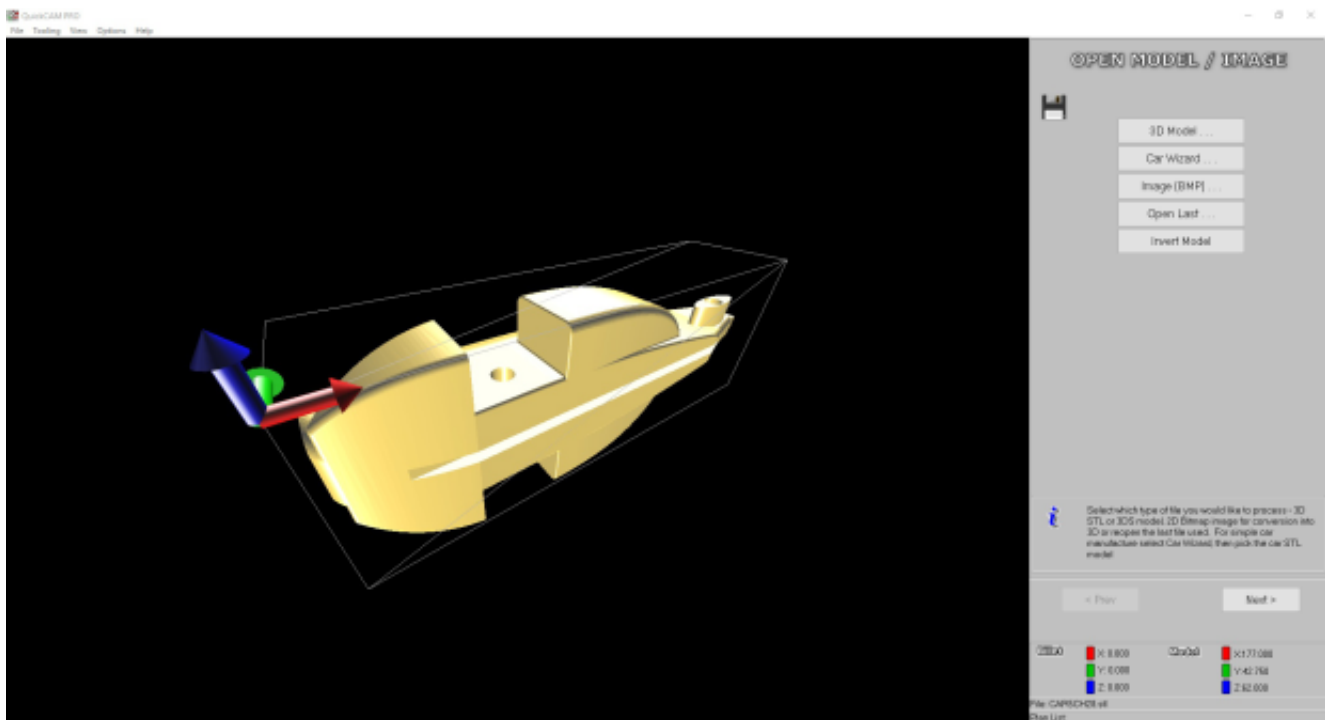
Open

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 5 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

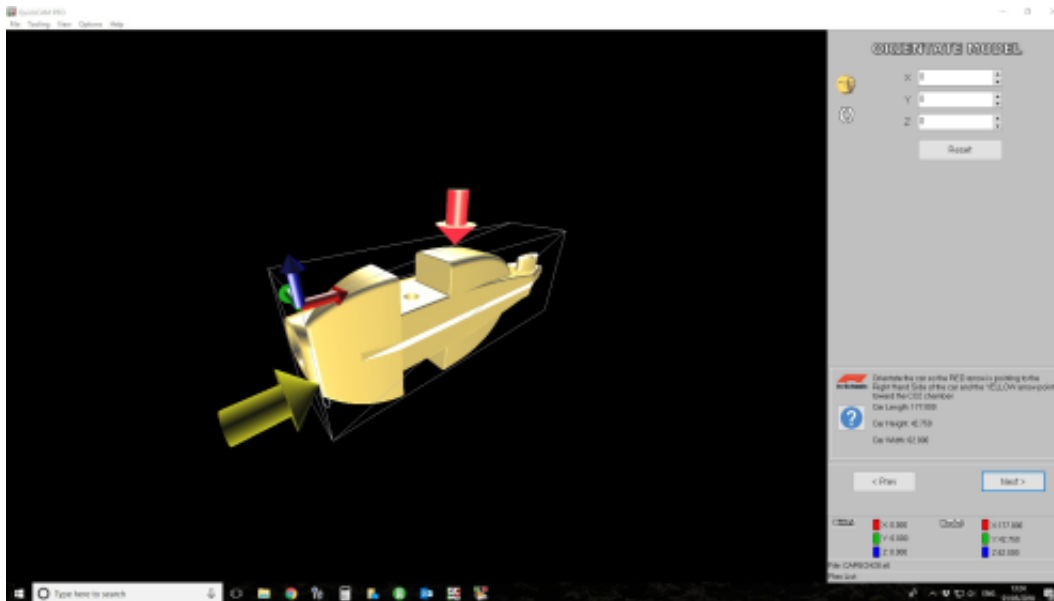
Click the next button

Next >

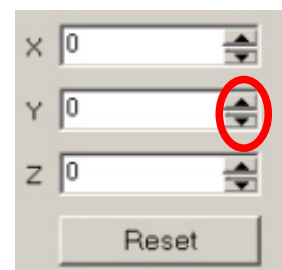
Orientate Model

There are a number of ways to orientate the model, there is no right or wrong way as long as the fixture in the machine is aligned in the same way.

We will orientate the model so that the large Red arrow points at the right hand side(RHS) of the car and the large Yellow arrow points to the face with the CO2 cartridge chamber. In the illustration below you can see a large red arrow has appeared in the main display, this represents the direction that the cutting tool will be coming from. The Yellow arrow indicates the face with the CO2 cartridge chamber in it.



If need to rotate the model you can click on any of the axes buttons and these will rotate the model in increments of 90 degrees.



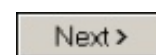
In this case the model has imported in the correct orientation.

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.

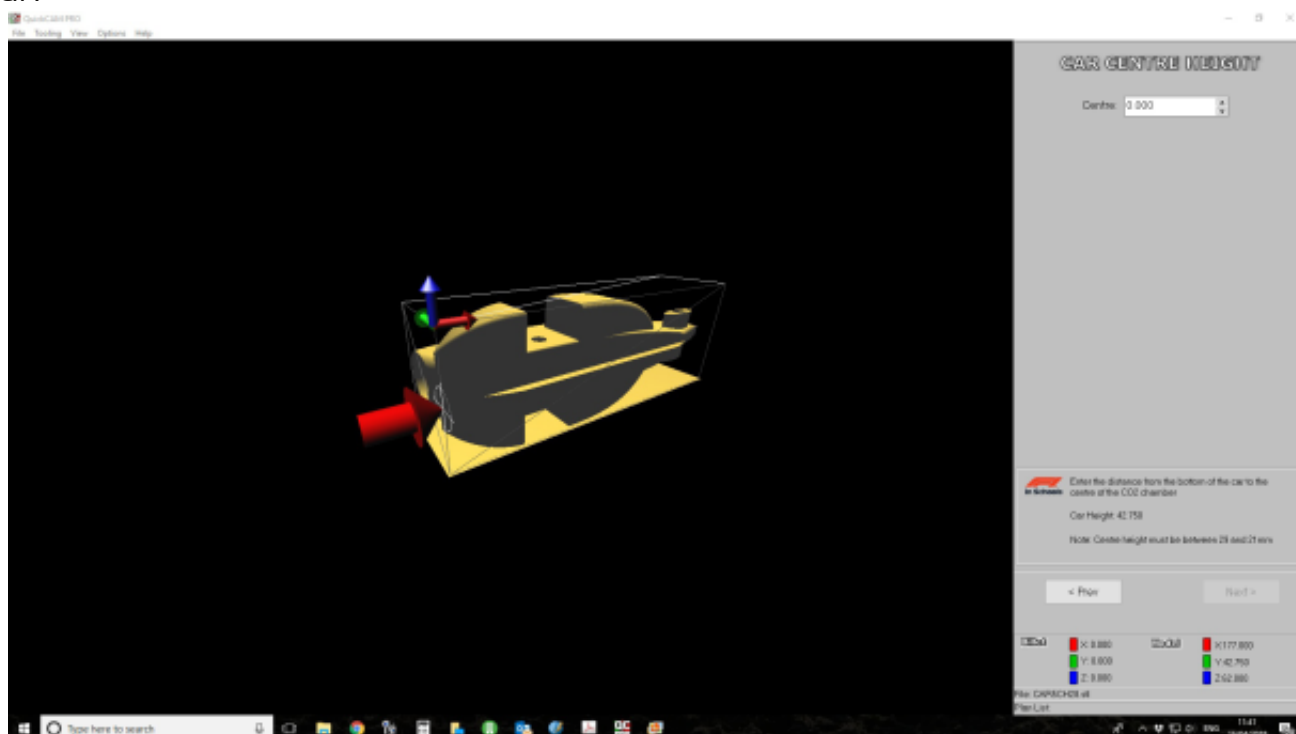
If the car exceeds the machinable area of the Model Block then the wizard will not highlight the Next button and an error will be displayed in Red. If the car is the wrong size then it will have to be edited in CAD before you can proceed.

If all the dimensions are correct then click the Next button



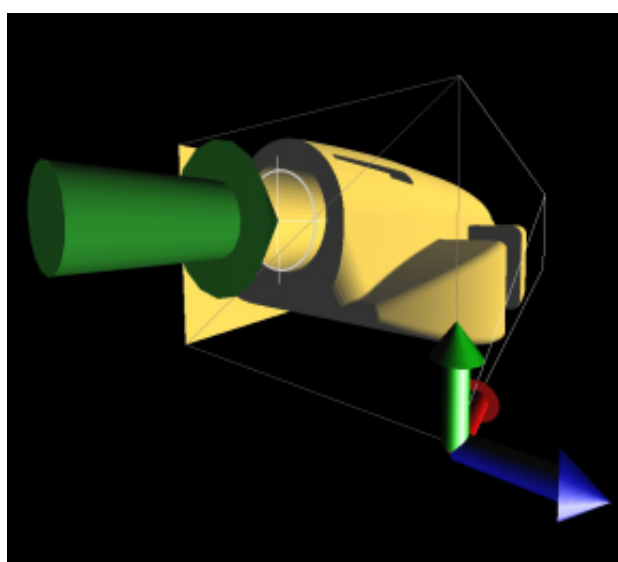
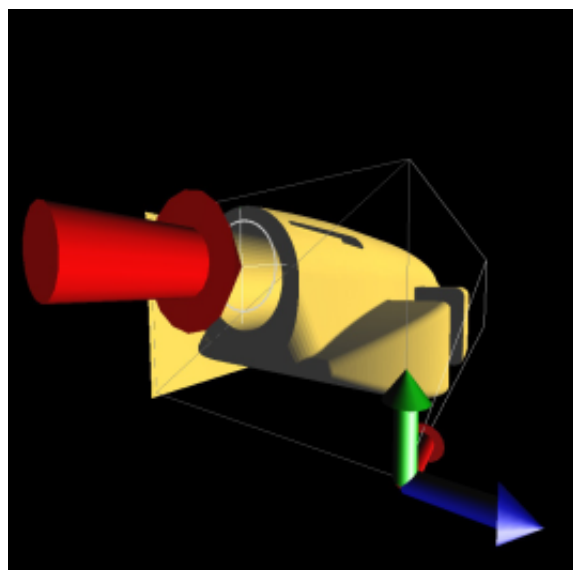
CO2 Cartridge Centre Height

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



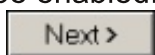
The model will be positioned around a datum position set in the middle of the CO2 Cartridge chamber. The height of this must be recorded when the car is being designed in CAD and to ensure the car can be manufactured in an F1 Model block the value must be between 21mm and 29mm.

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.



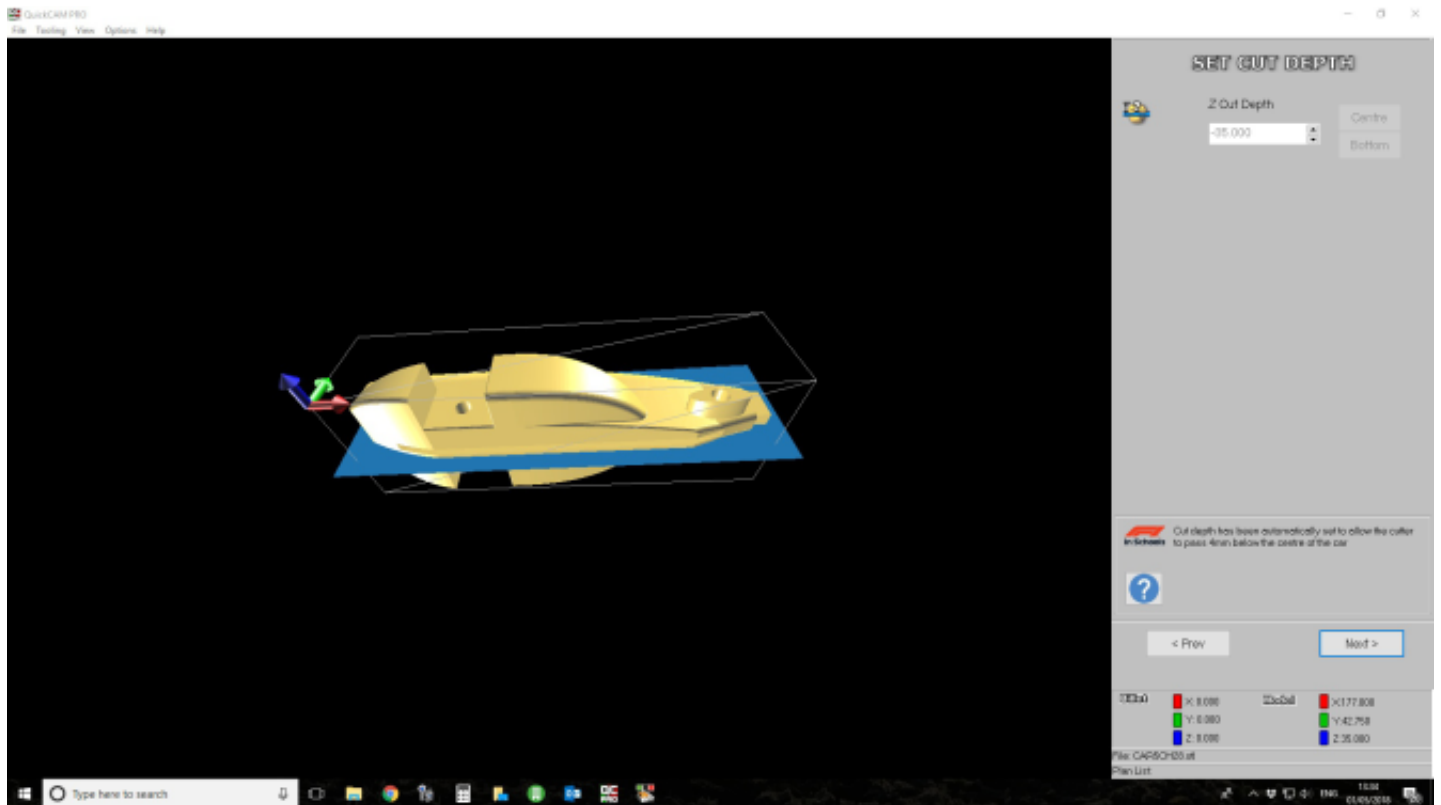
Once the centre height is correctly entered and the green arrow is correctly positioned in relation to the bore the Next button will be enabled. ***This value will be recorded for later use.***

Click the Next button



Set 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.

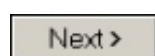
The depth of cut needs to go beyond the centre line of the car by a minimum of the cutter radius.

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 62mm so the Cut plane is set to half the car width 31mm + 4mm so the cut depth is set to Z-35mm

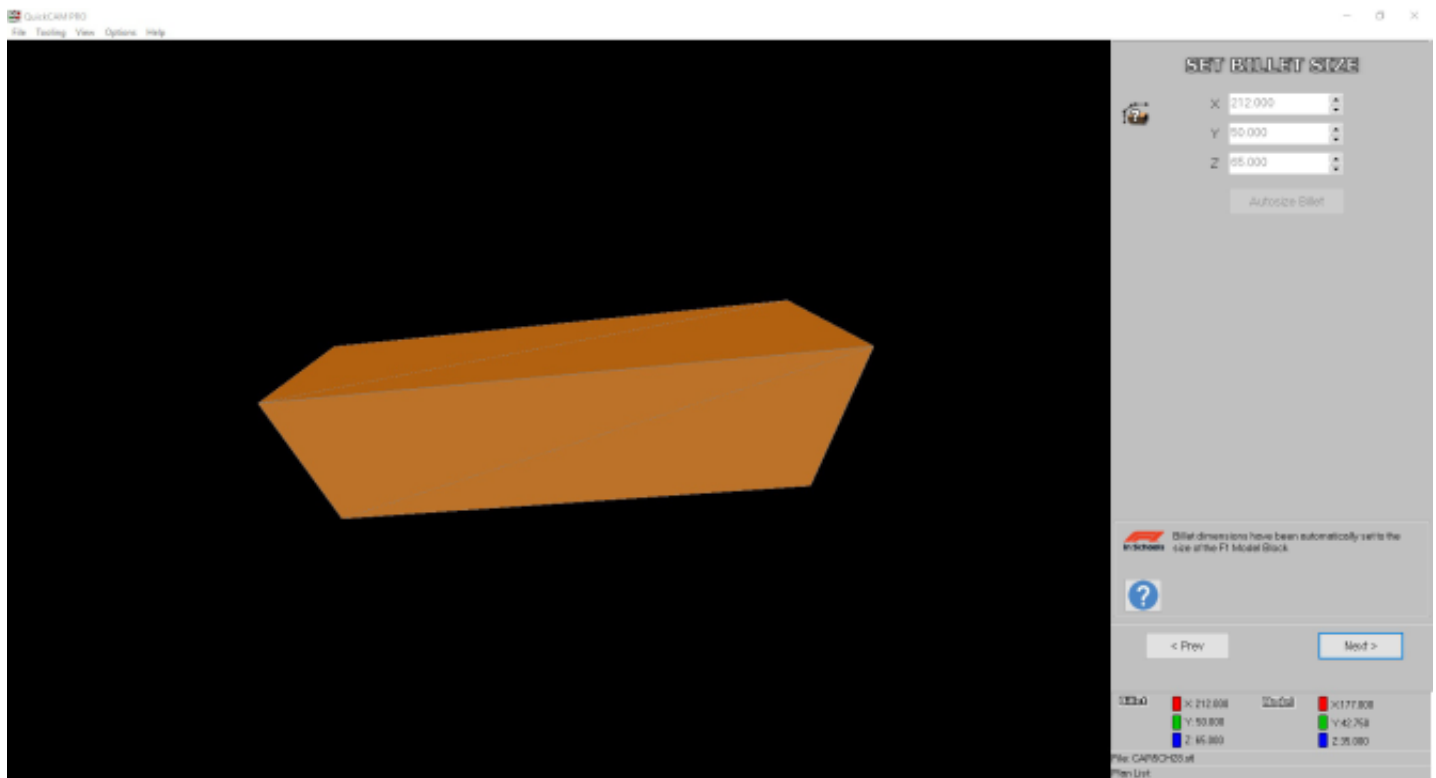
The only options available on this page is to move to the previous page or click Next.

Click the Next button



Set Billet Size

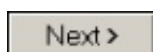
The Car Wizard automatically sets the Billet Size



The Car Wizard preloads a Billet size equal to the machinable area of the official F1 Model Block.
X = 210mm, Y = 50, Z = 65

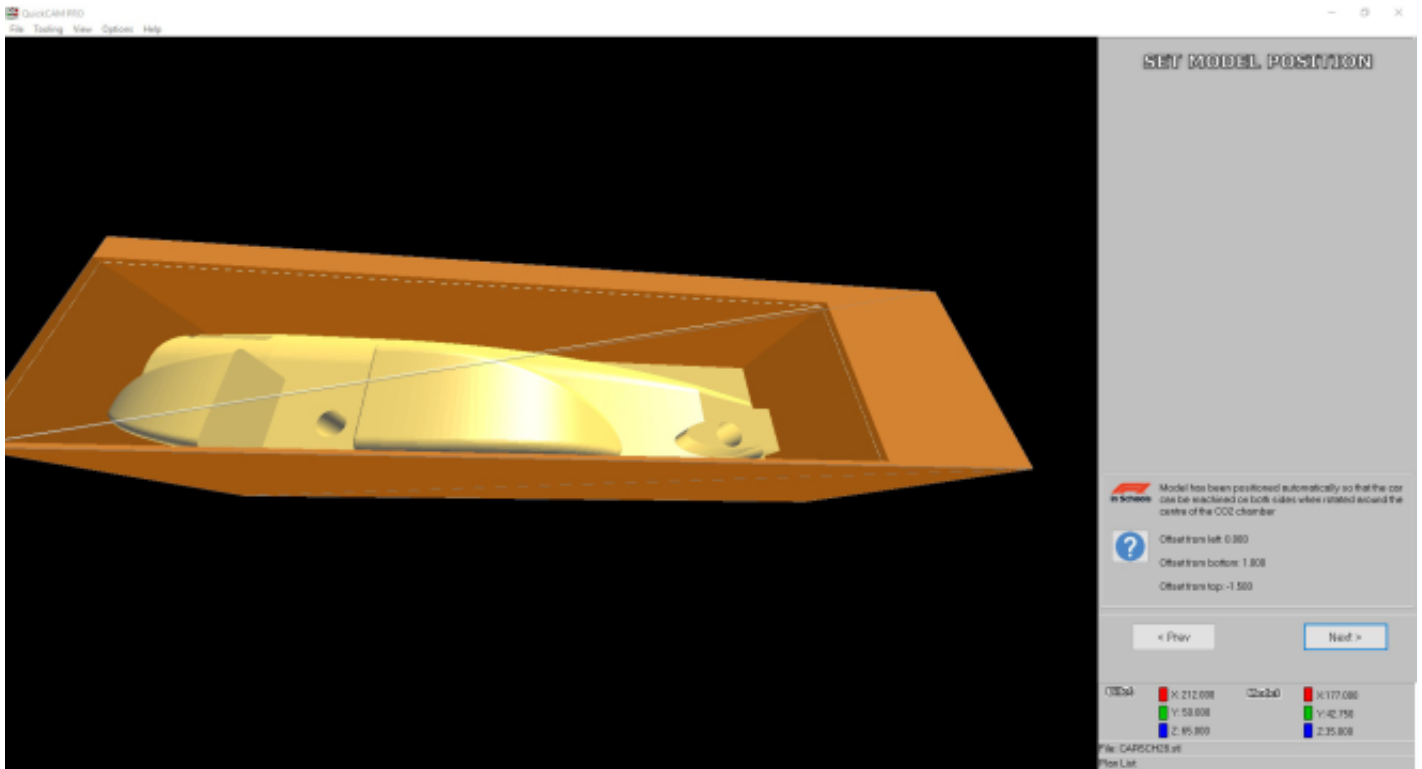
While a Model Block is 223mm long there is 13mm at the end of the block used as a clearance zone. This is to allow it to be held in the fixture and avoid the cutter causing damage.

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 camber 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 62mm wide and the billet is 65mm so there is 3mm difference split equally above and below the model

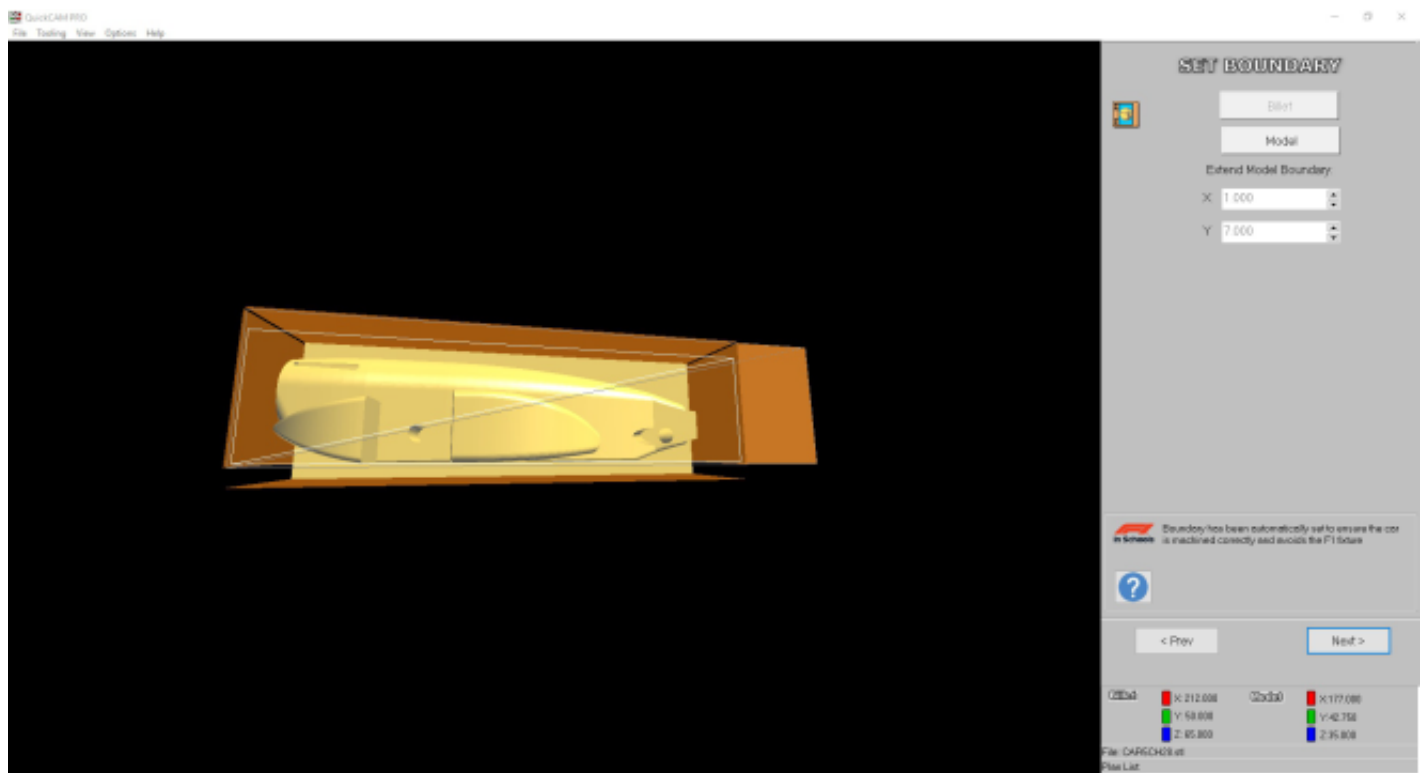
The Z offset is set to -1.5mm from the top of the billet

Next >

Click the Next button

Set Boundary

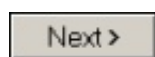
The Car Wizard automatically sets the Machining Boundary.



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.

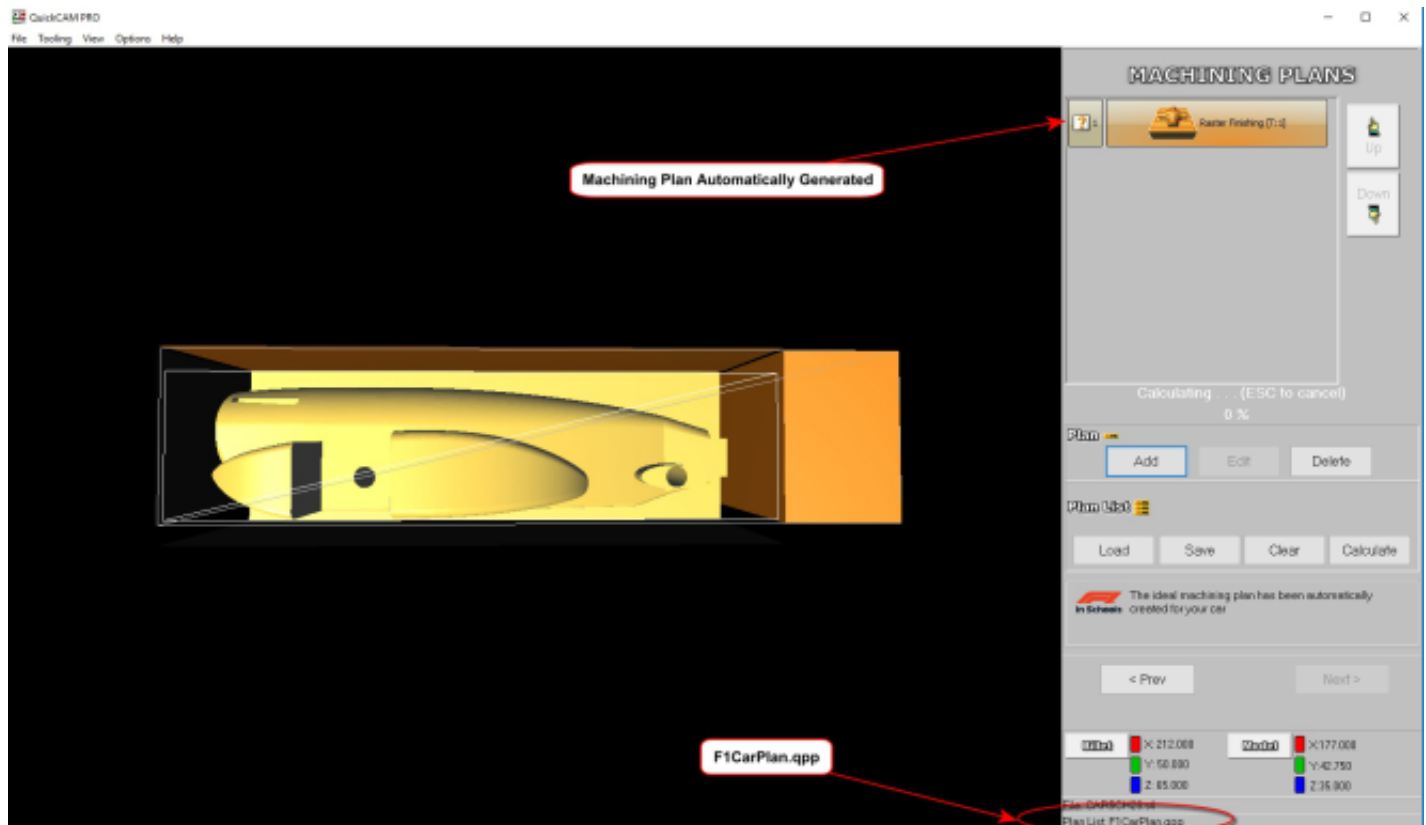
The Boundary is also extended by 1mm in the X Axis which will clean up the edge of the model but prevent the tool chopping off the nose of the car and hitting the shaft used to secure the billet in the fixture.

Click the Next button

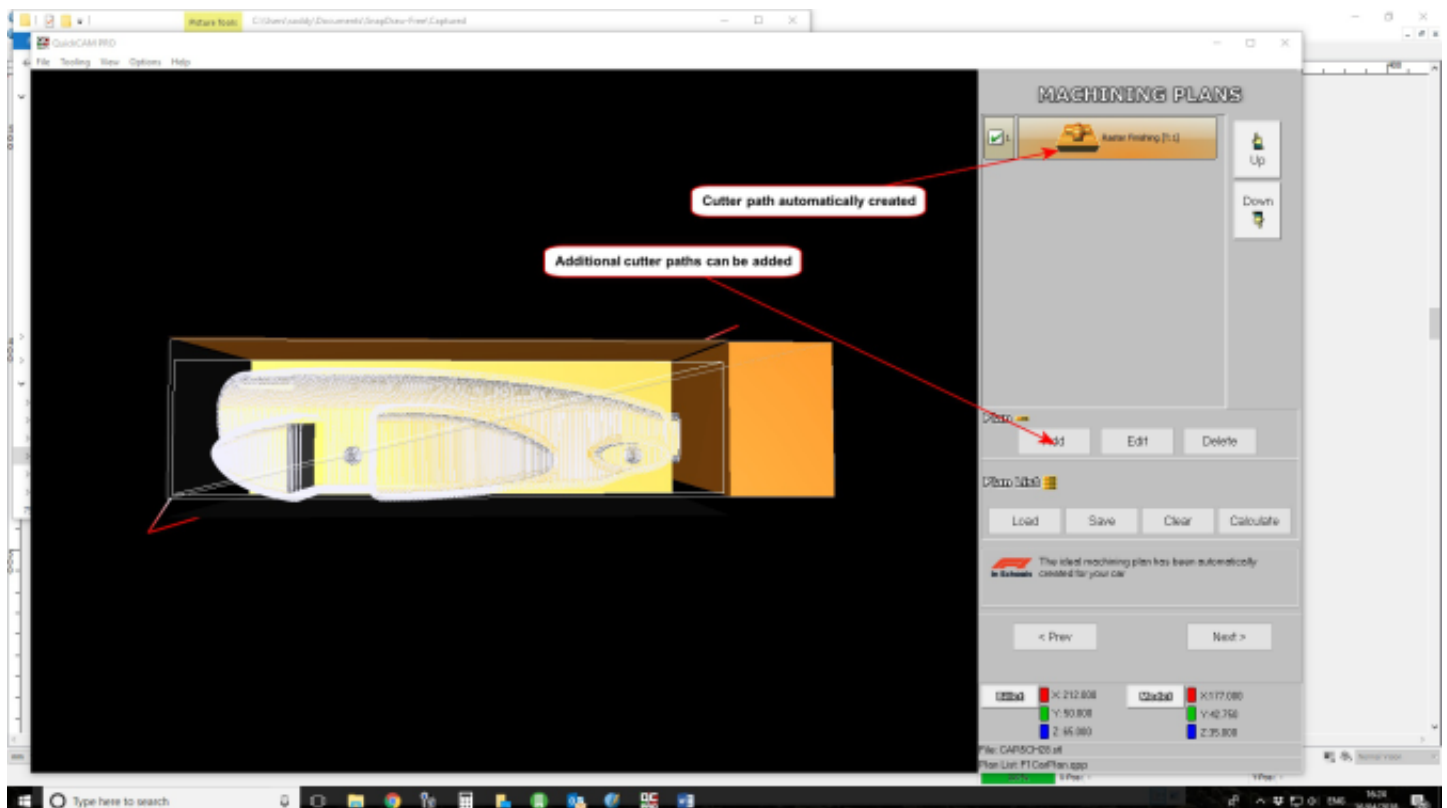


Machining Plans

The Car Wizard automatically opens and calculates the Cutter Plan.



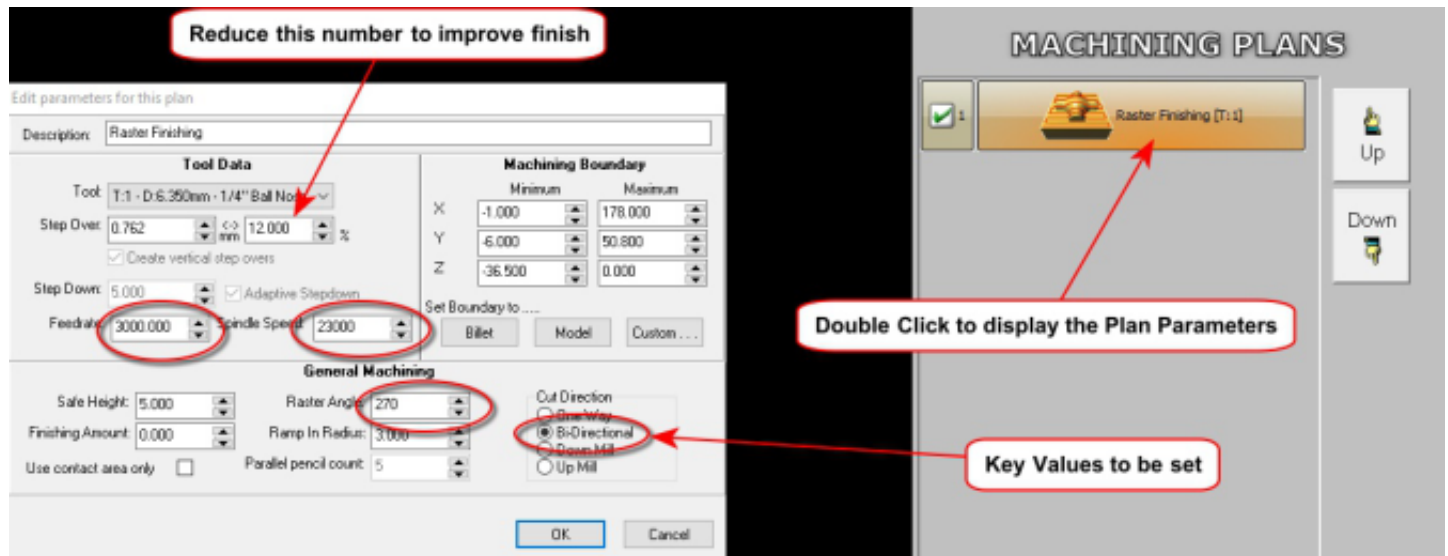
The Car Wizard loads the F1CarPlan.qpp and then automatically generates the cutter path.



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 F1 Model Block but if Balsa is used they may need to be modified.

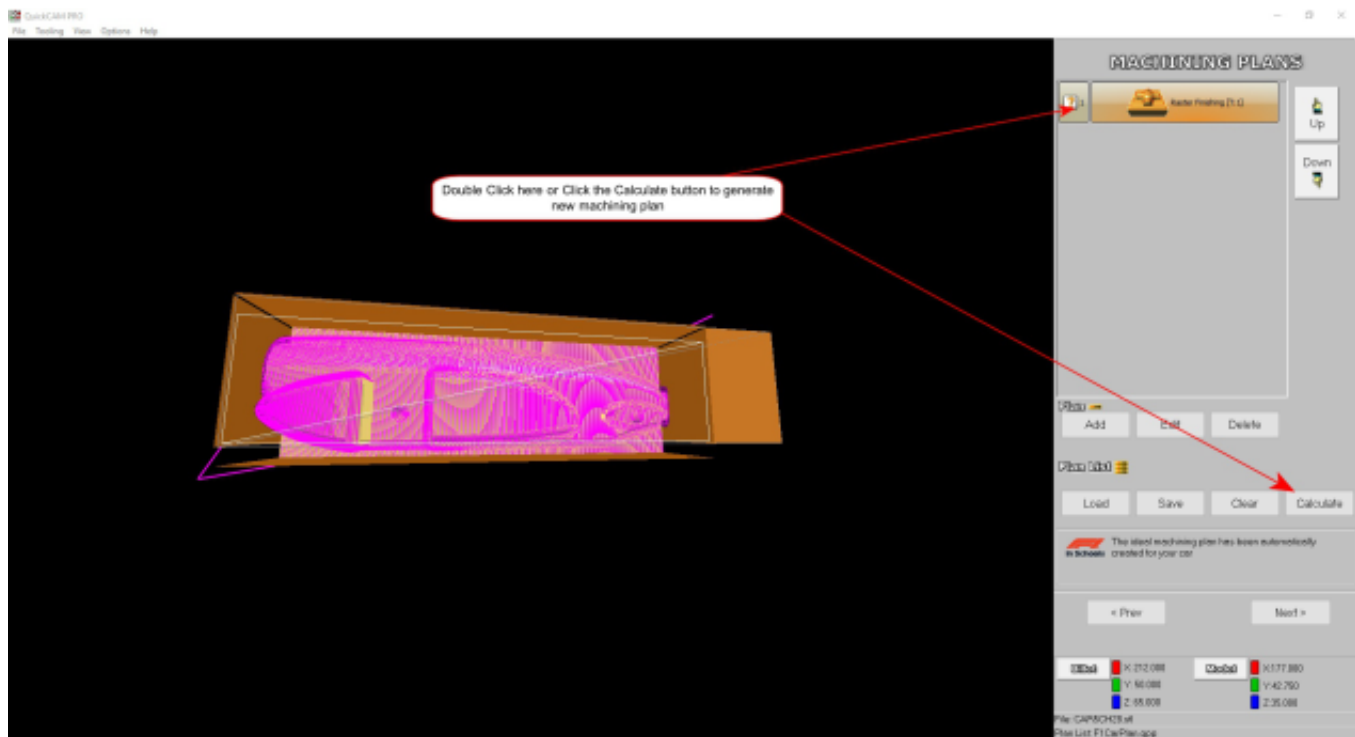
The stepover of 12% will create a smooth finish. Reducing this will improve the finish but also increase the time taken to manufacture the car.

The other key values set are listed below:

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

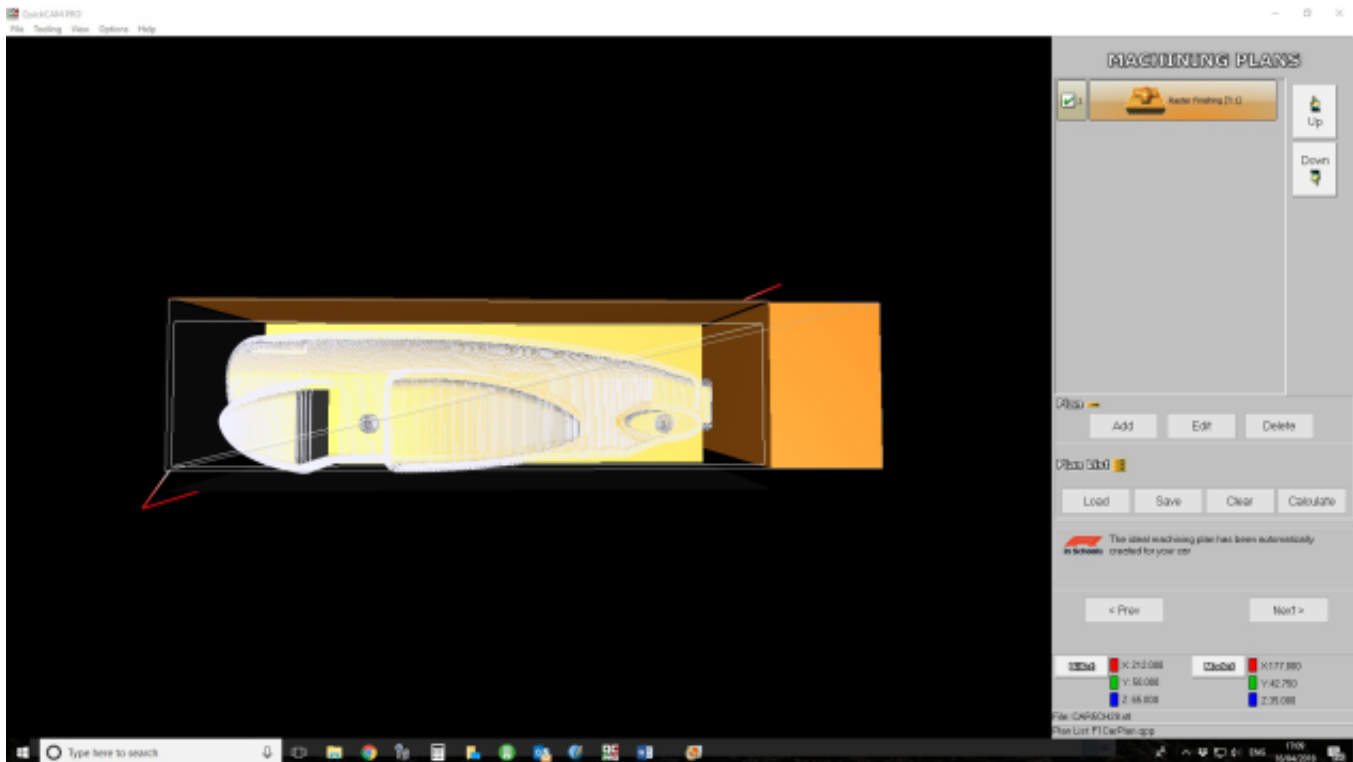
Recalculating Machining Plans

The Machining Plan can be Recalculated

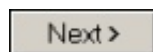


To recalculate a plan double clicking on the question mark icon or click on calculate.

The new Path will then be generated.



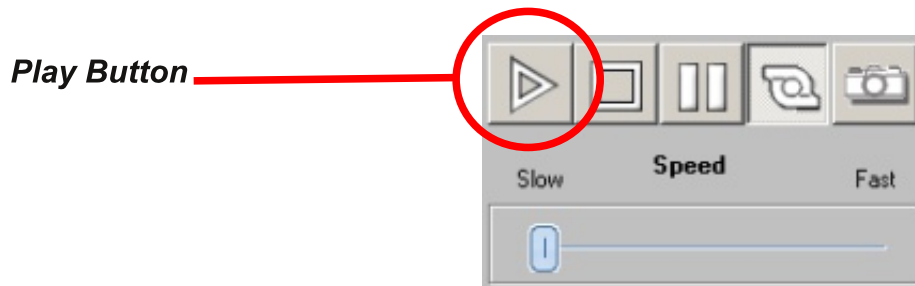
Click the Next button



Toolpath Simulation

The generated cutter path can be simulated.

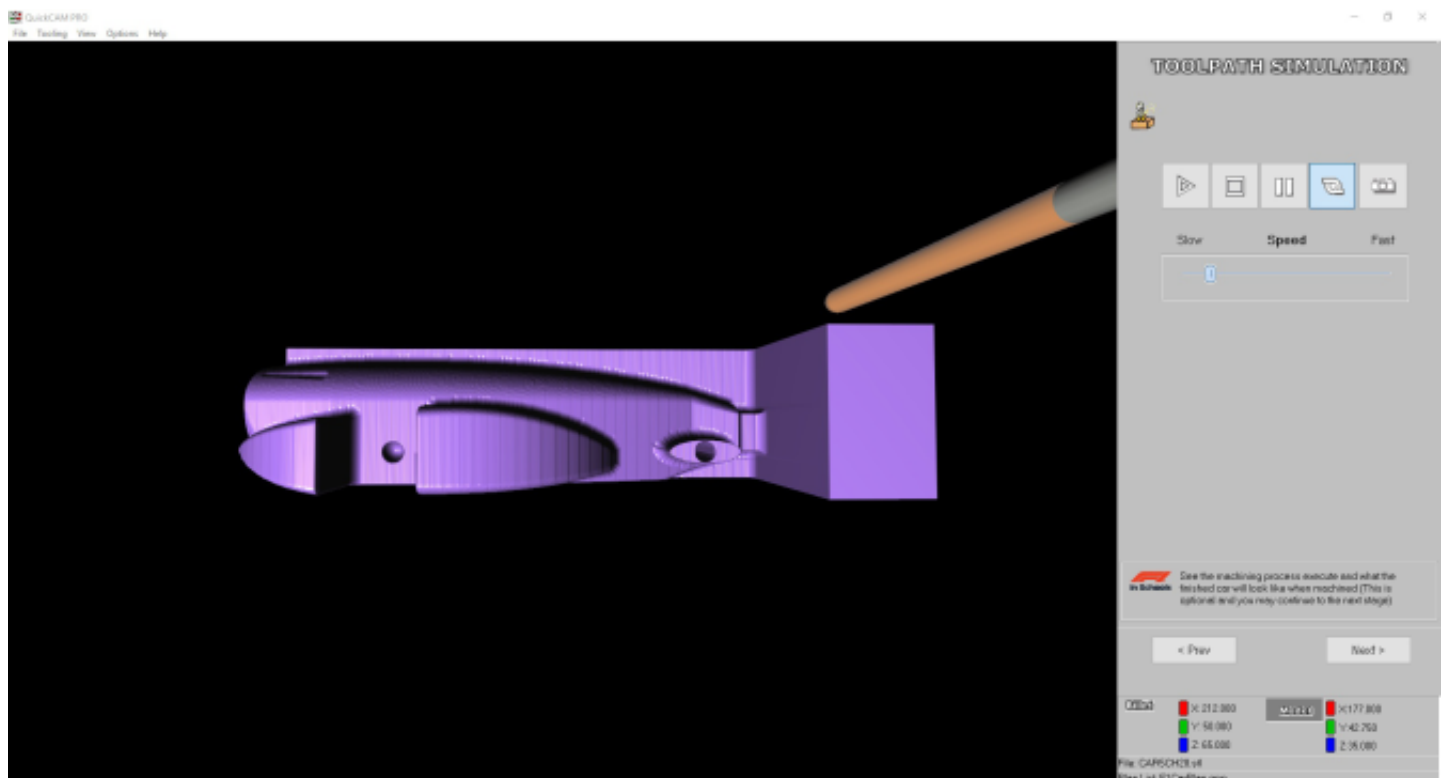
The Navigation panel on the right of your screen now has the video control buttons shown below



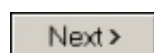
Click the Play button to run a simulation of your toolpath



It should look something like the one image below.

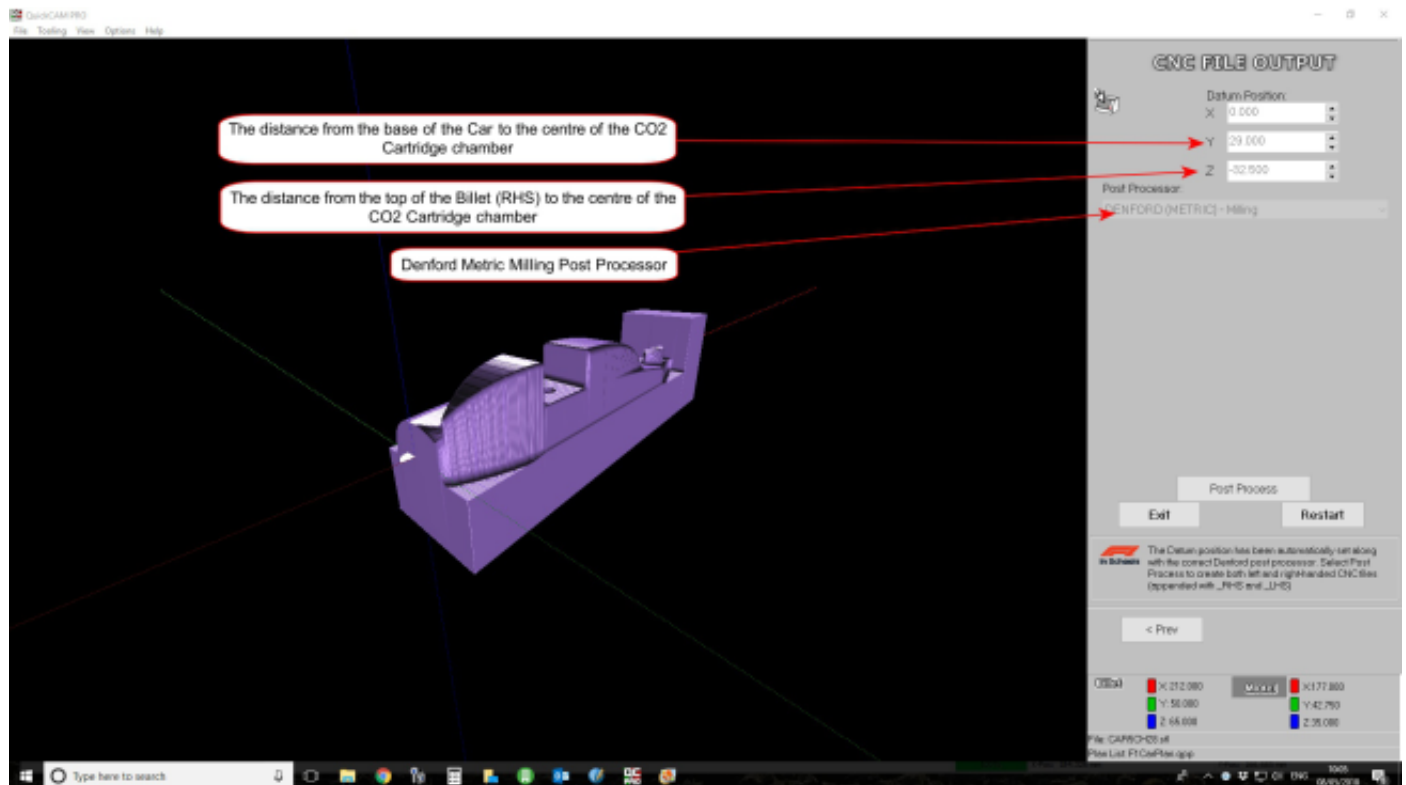


Click the Next button



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)

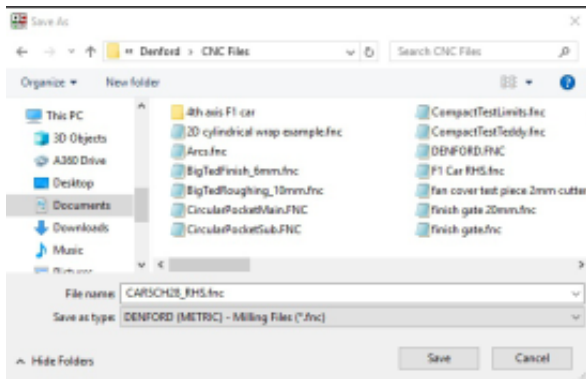
It then Selects the Denford Metric Milling Post Processor

Post Process

Click the Post Process button

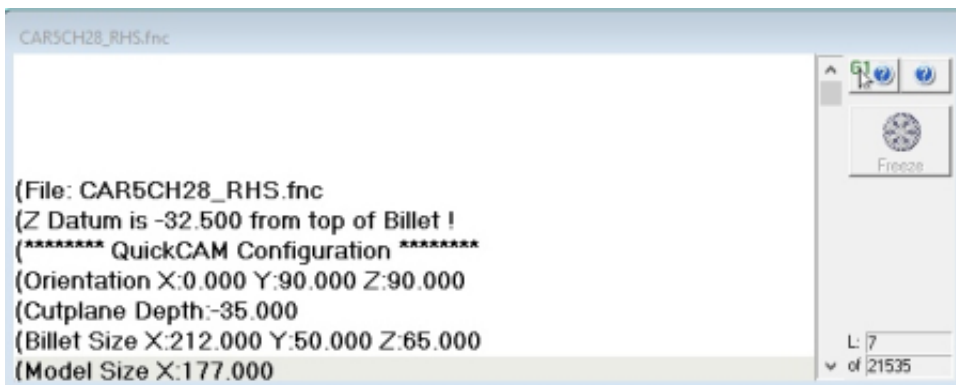
Saving the CNC File

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



When you click of 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.

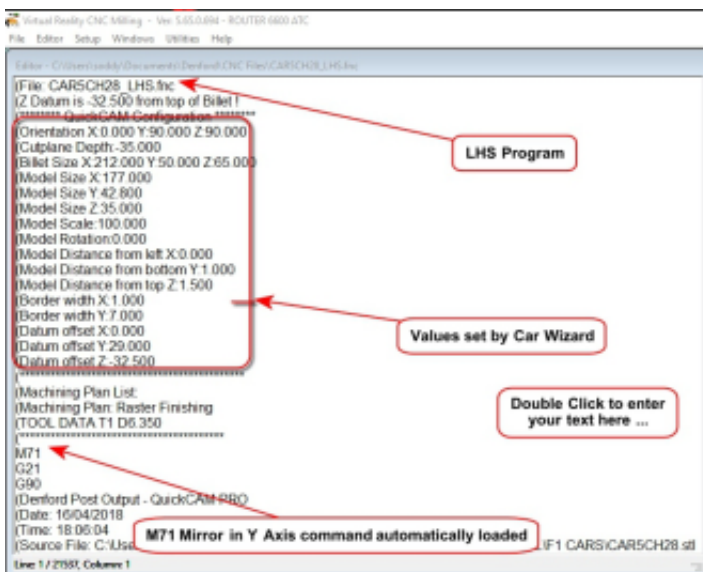
Depending on the settings in QuickCAM PRO the VR Milling Software may open and load the RHS file when save is selected.



VR Milling 5 Shown with the RHS program Loaded.

In the same location as the file was saved the program for the LHS will also be stored.

Click file open and select the LHS program



VR Milling 5 Shown with the LHS program Loaded showing the M71 command.

Machining the F1 in Schools Billet

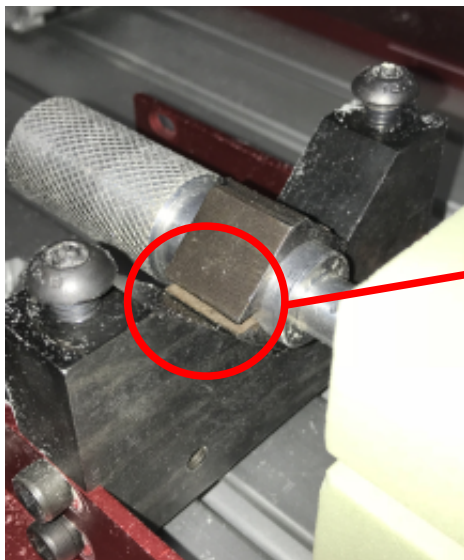
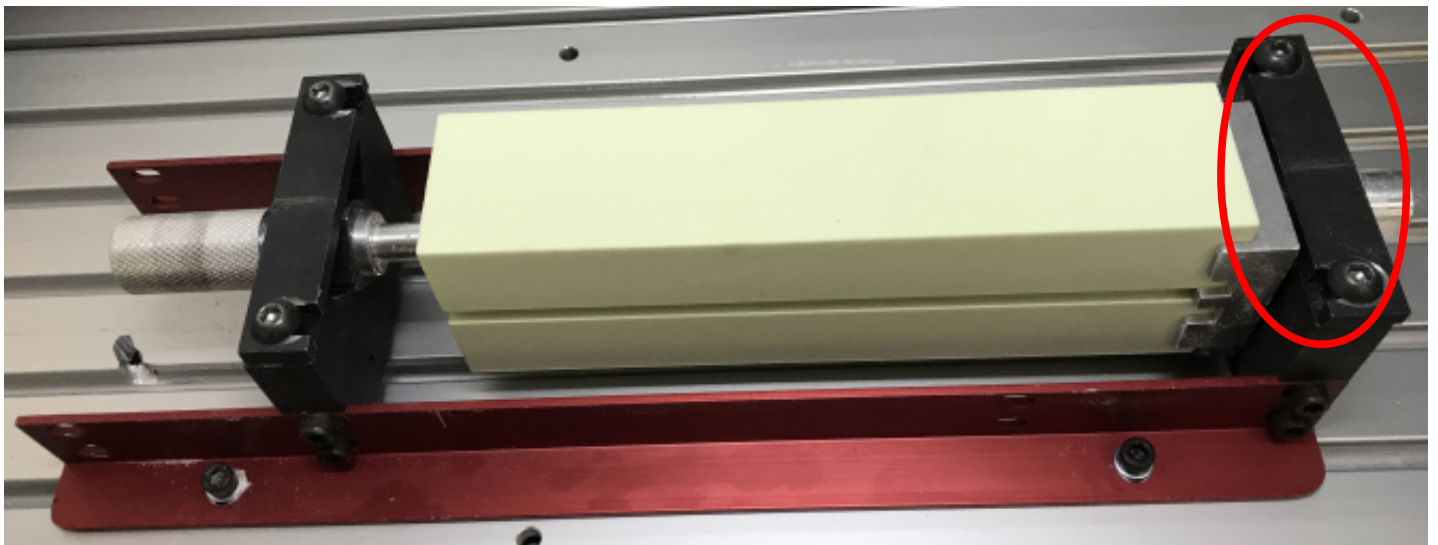
If using the 4th Axis go to page 24.

F1 in Schools 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.

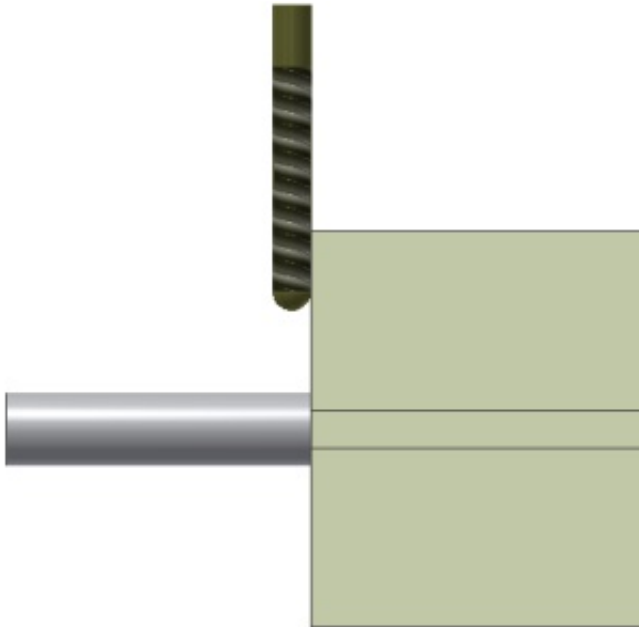
As the screws are tightened onto the clamp plate the block with the slot in it will compress and clamp the aluminium bar that into the cartridge hole.

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.

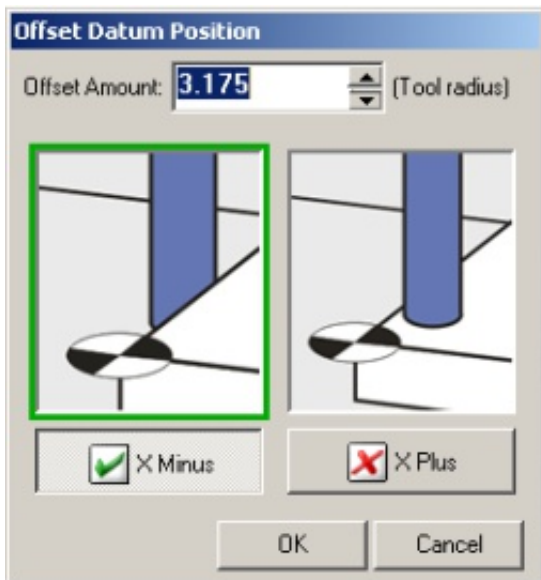
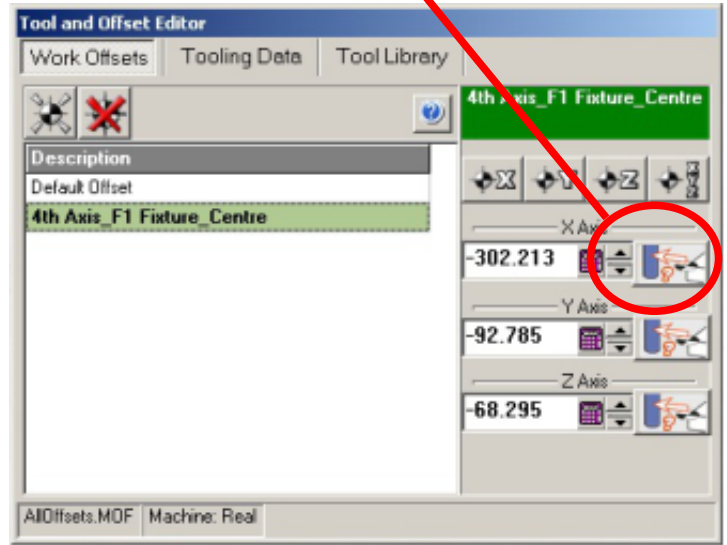
Setting the DATUM

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



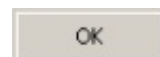
The tool Radius is 3.175 so the centre line of the tool is outside the billet by this amount. This option automatically adds the radius of the tool to set the offset. If the offset is not automatically loaded.

**Type the value shown below into the offset amount
3.175**

Click the X Minus button

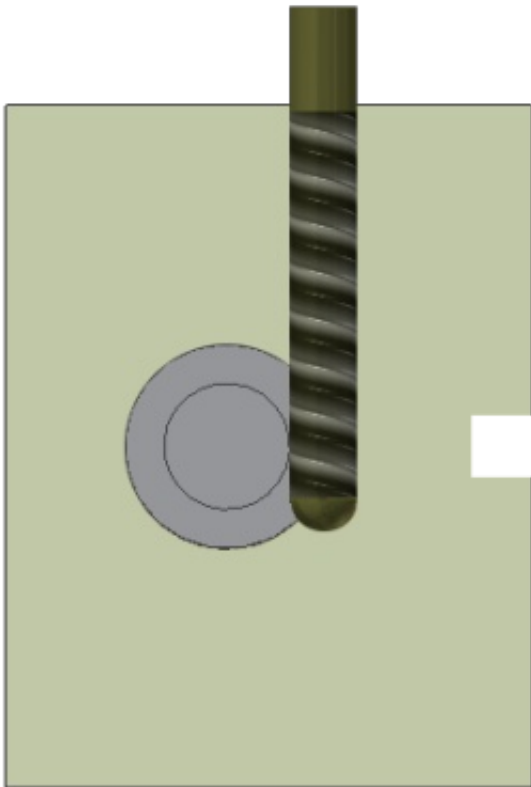


Click the OK button

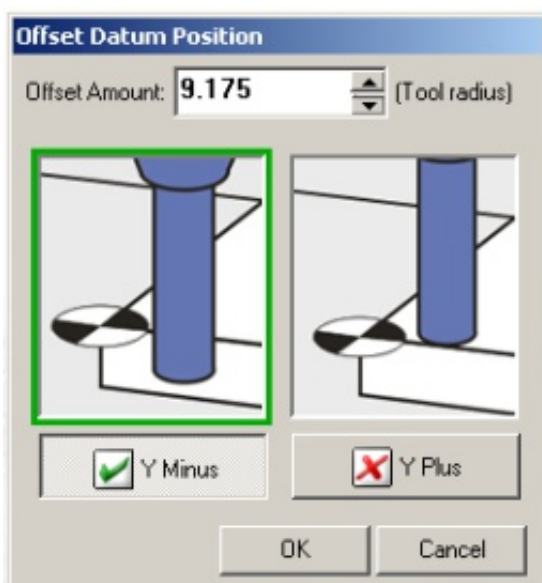
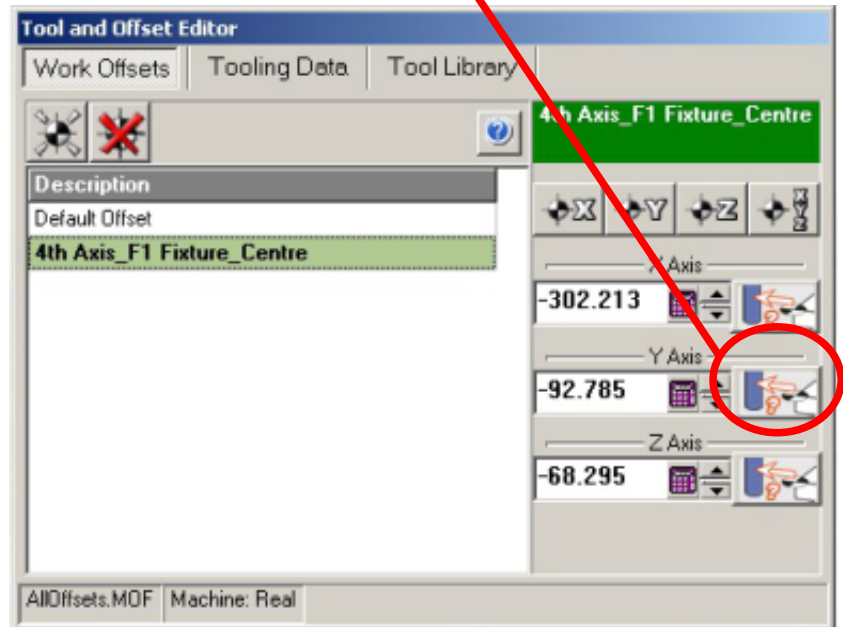


Y Axis

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



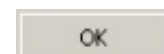
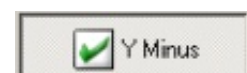
The aluminium shaft is 12mm Diameter so 6mm Radius.
The tool is 6.35mm Diameter so 3.175mm Radius.
When the tool touches the shaft the centers are 6mm + 3.175mm away from each other = 9.175mm

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

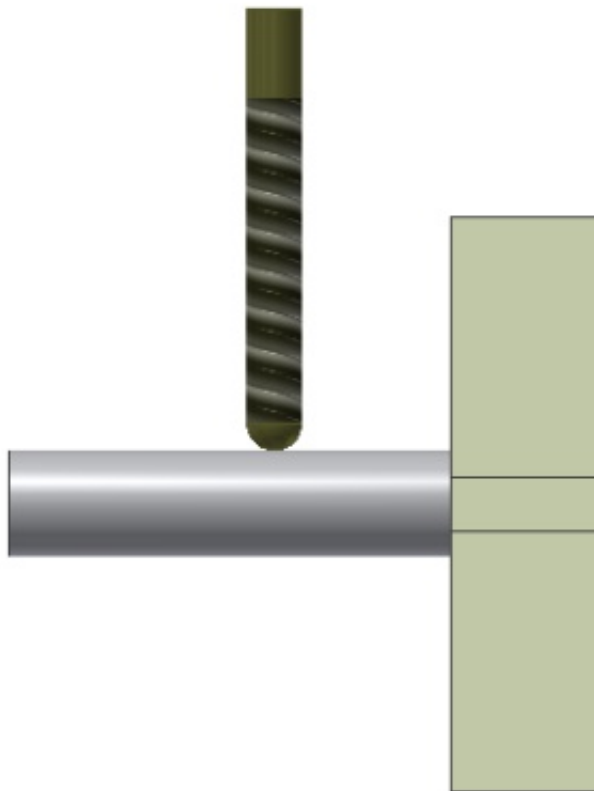
Click the OK button



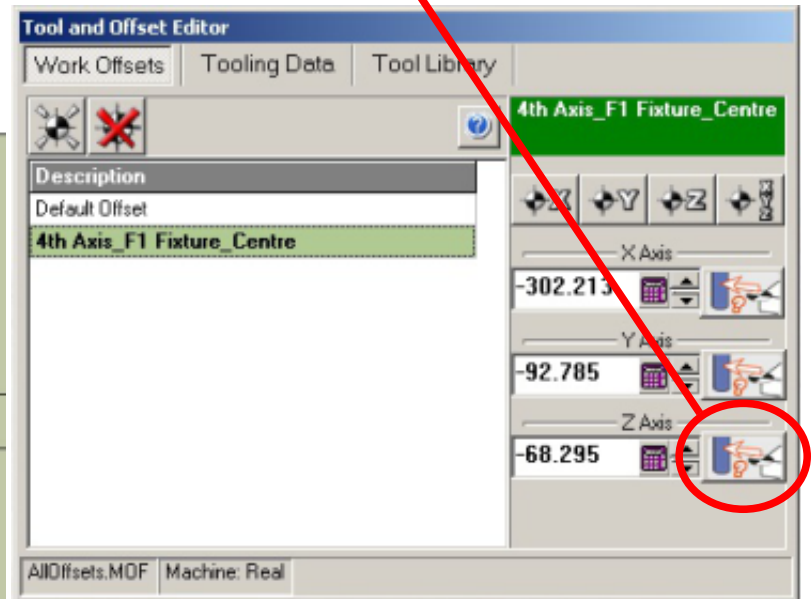
You have now set the Y axis

Z Axis

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



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

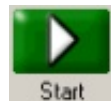


To do this the Y axis must be at 0

Go to the MDI tab in the Control Panel

Type "Y0"

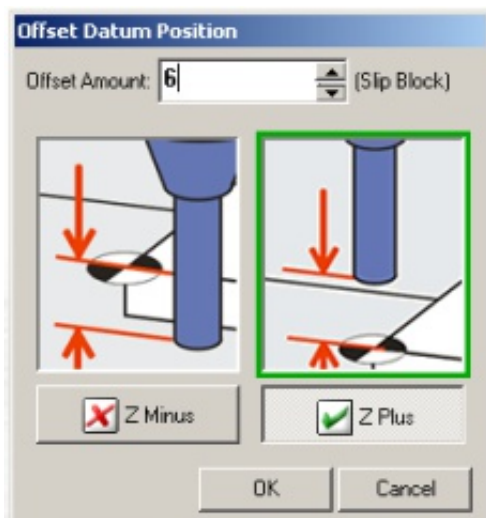
Press the Start button



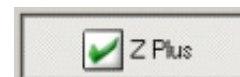
Go to the jog tab and lower the tool onto the top of the bar

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

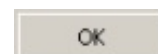
Enter 6mm as the offset amount



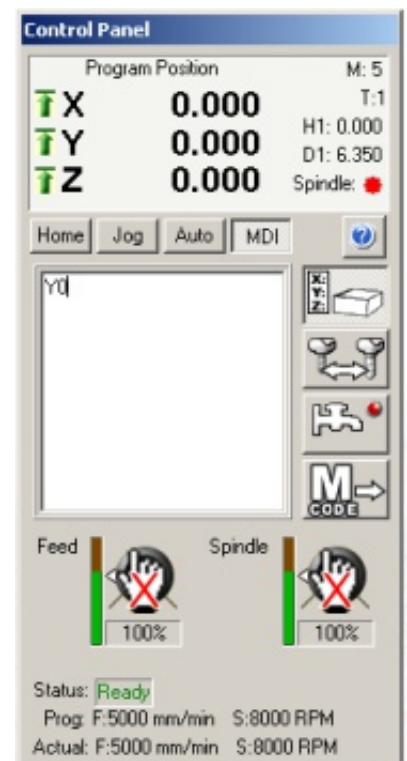
Click the Z Plus button



Click the OK button



You have now set the Z axis offset



4th Axis F1 in Schools Car Manufacturing

Follow the instructions for the F1 in Schools Car Manufacturing fixture

Open the folder which contains the files RHS.fnc and LHS.fnc

Rename RHS.fnc to 0001.fnc

Rename LHS.fnc to 0002.fnc

We now need to create a subcall routine which will automatically rotate the 4th axis and call the programs 001.fnc and 0002.fnc

In VR Milling V5 you need to create a new file

From the Toolbar select >File>New

Type the following:

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

Save this file in the same folder as program 0001.fnc and program 0002.fnc

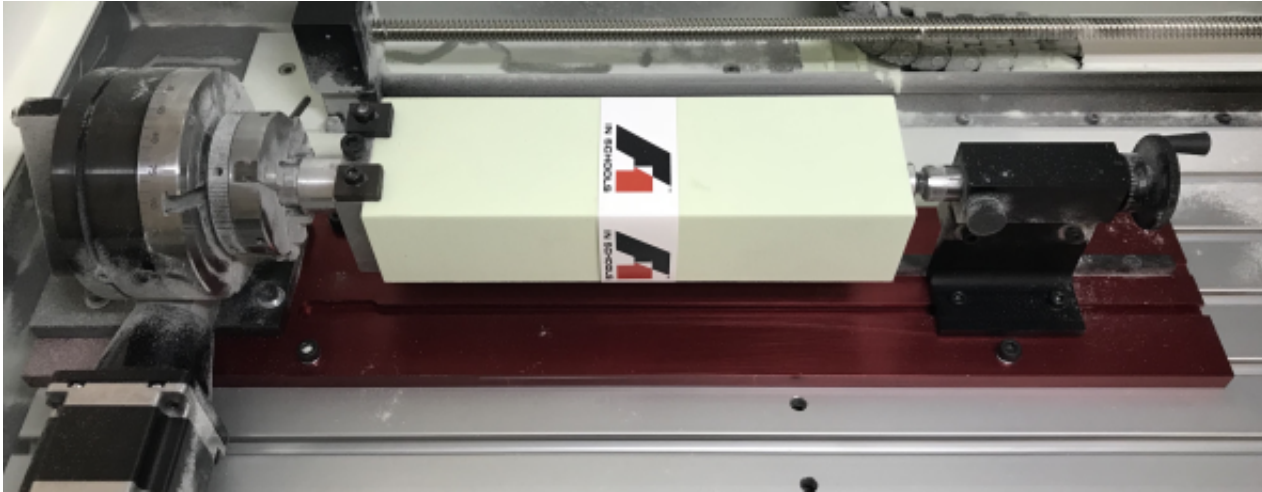
Save this file as

Subcall.fnc

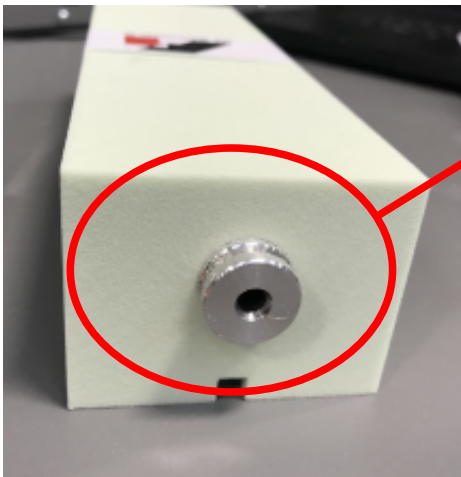
This is the file which you will run when using the 4th axis to machine an F1 in Schools billet.

4th Axis F1 in Schools Conversion Kit

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



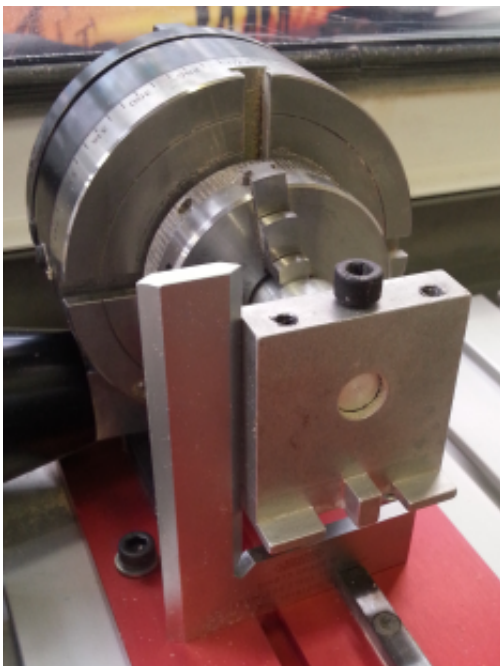
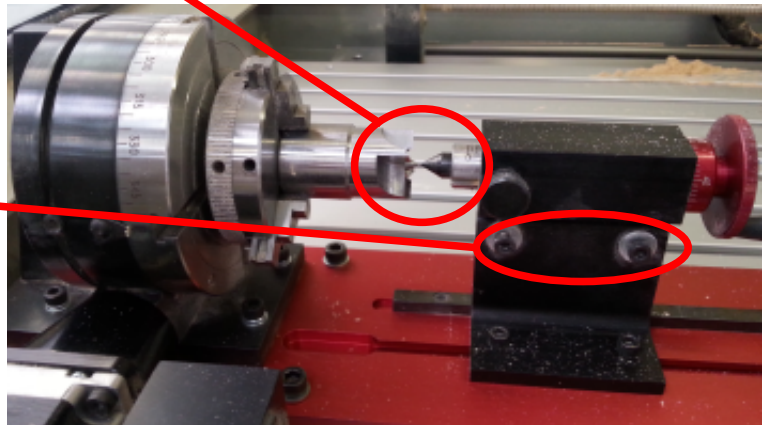
Note that the tether line guide slot is at the bottom closest to the bed of the machine and the cartridge hole is on the right, the cartridge hole should have the aluminium cartridge fitted into it and this mates up to the tail-stock of the 4th axis.



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.

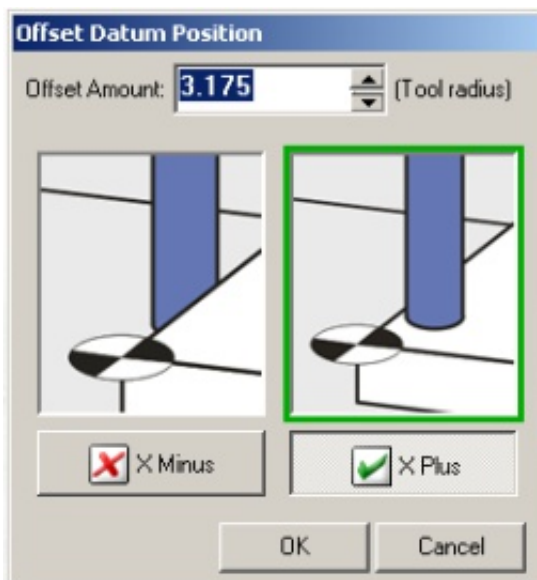
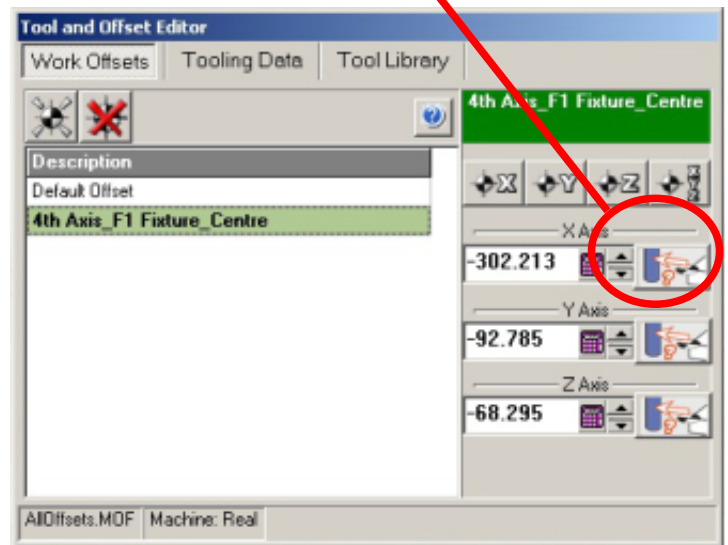
Setting the DATUM

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

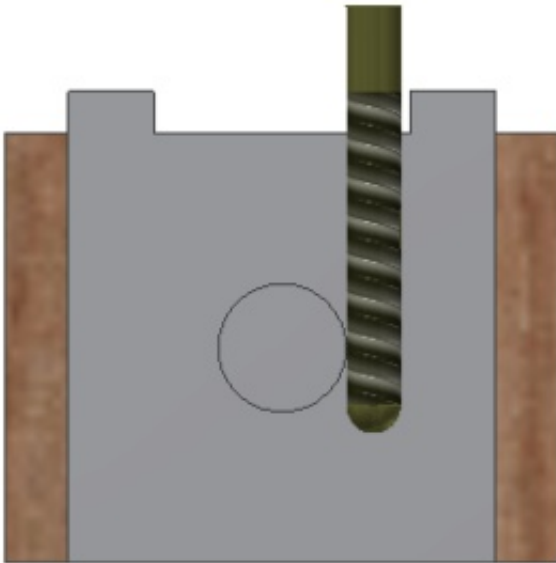
Click the X Plus button

Click the OK button

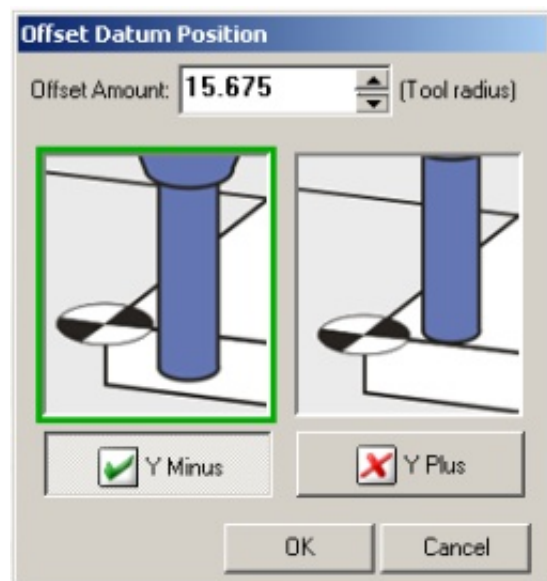
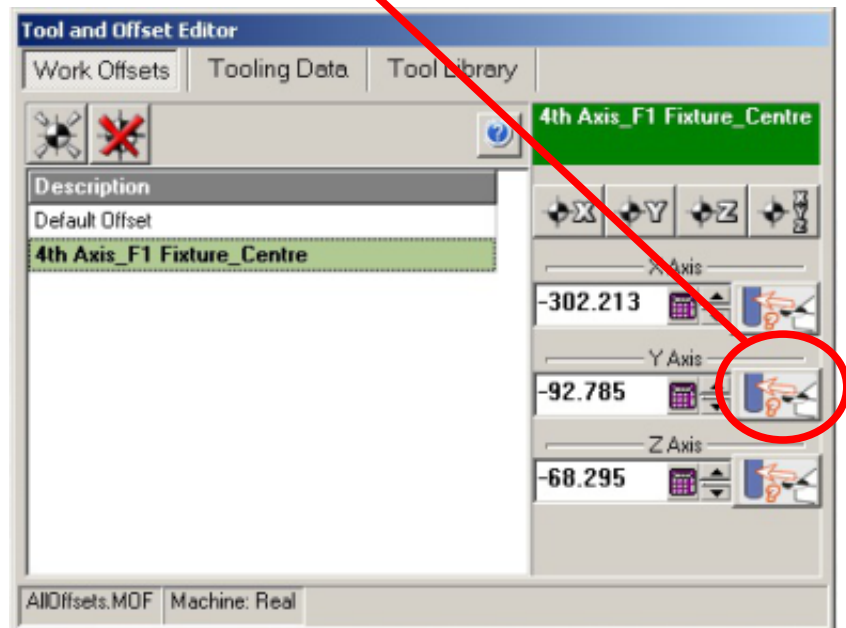
You have now set the X axis

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



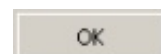
Type the value shown below into the offset amount.
15.675

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

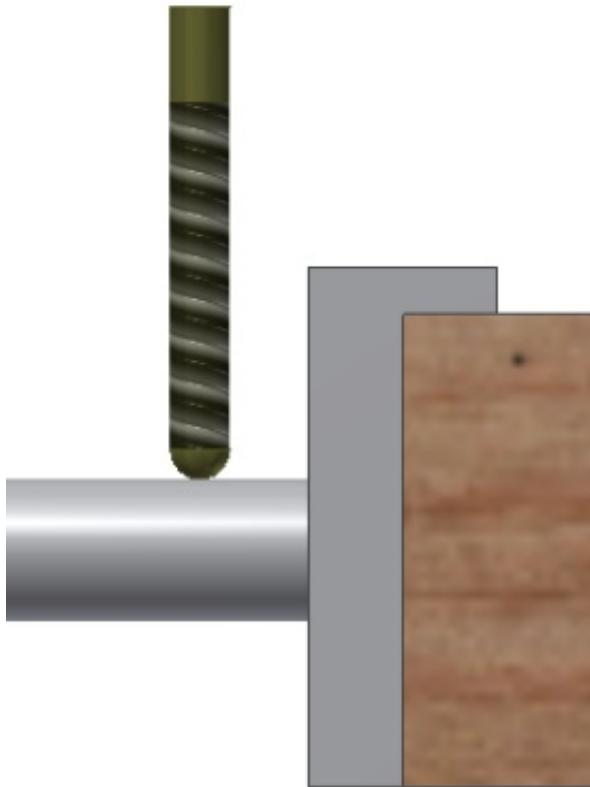


Click the OK button

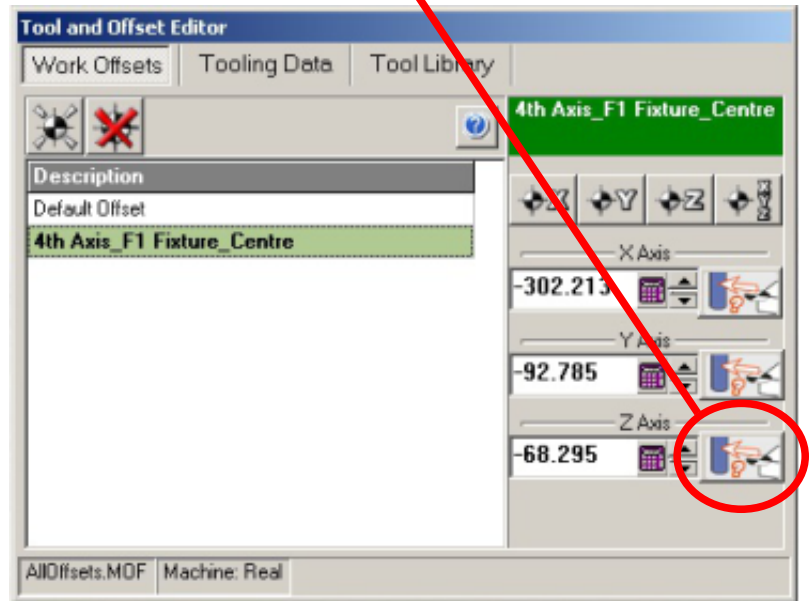


Z Axis

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

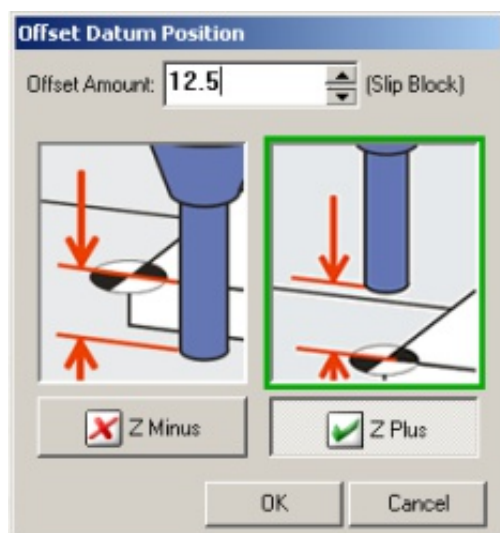


Go to the jog tab and lower the tool onto the top of the bar

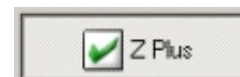
Type the value shown below into the offset amount.

12.5

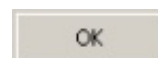
This is the radius of the bar



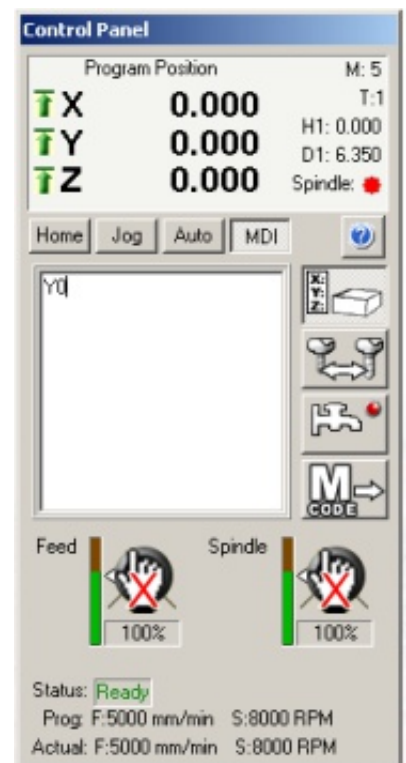
Click the Z Plus button



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

F1 in Schools Car Manufacturing Fixture

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

4th Axis F1 in Schools Conversion Kit

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

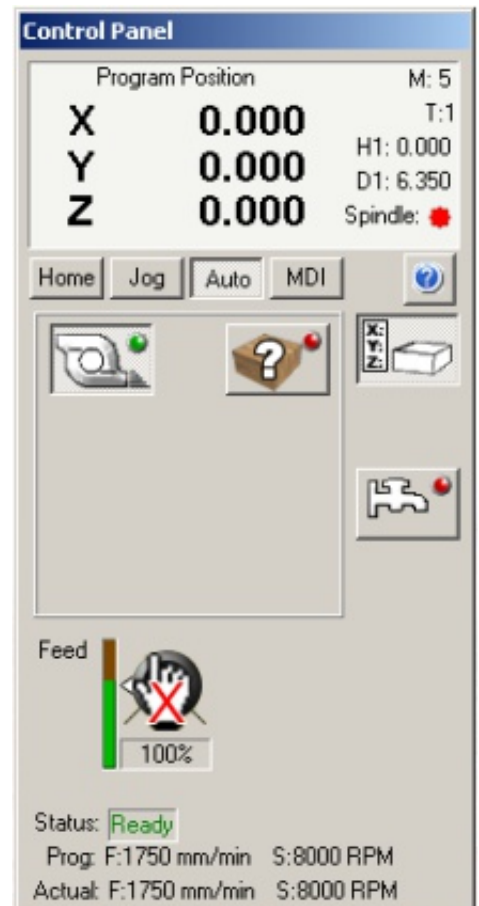
Running the Program

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.

F1 in Schools Car Manufacturing Fixture

When the first side has finished turn the billet over, instructions for fixing the billet are on page 25

4th Axis F1 in Schools Conversion Kit

When the program has finished remove the finished design



F1 in Schools Package

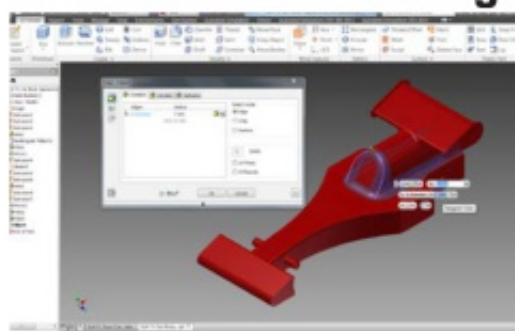
A COMPLETE PACKAGE INCORPORATING DESIGN,
ANALYSE, MAKE, TEST & RACE

The F1 in Schools Technology Challenge stimulates a student's interest in, and understanding of the entire process of design and manufacture. Through involvement in the F1 in Schools Challenge, students will gain first hand experience of teamwork and communication, whilst encouraging individual flair and confidence. The F1 in Schools Challenge provides students with the opportunity to reflect industrial working practice of developing a product from concept, to prototype to production.

Plan



Design



Analyse



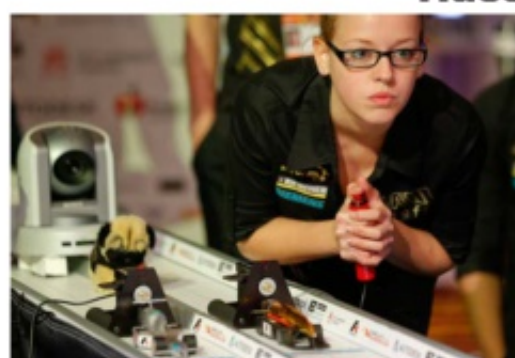
Make



Test



Race



f1inschools.com



Ideal for use in conjunction with



F1 in Schools Package

In support of the F1 in Schools Technology Challenge, Denford offer an F1® Package, which includes all of the equipment required to get you up and running for this innovative educational project - covering Design, Analyse, Make, Test & Race.

A brief overview:

1. Plan: Prepare a **business plan**, develop a budget and raise sponsorship. Teams are encouraged to collaborate with industry and create business links.

2. Design: Using 3D CAD (Computer Aided Design) software, **design** an F1® car of the future to the specifications set by the International Rules Committee just like in Formula 1®.

3. Analyse: Aerodynamics are **analysed** for drag coefficient in a virtual wind tunnel using Computational Fluid Dynamics Software (CFD).

4. Make: Using 3D CAM (Computer Aided Manufacture) software, the team evaluates the most efficient machining strategy to **make** the car.

5. Test: Aerodynamics are **tested** in wind and smoke tunnels.

6. Race: Time to test what your team has worked so hard together to achieve: **a winning car**.

The F1 in Schools Package:

DESIGN:

Autodesk® 3D Design, Drafting & Simulation Software
QuickCAM Pro Advanced Milling/Routing CAM software (site licence).

ANALYSE:

Virtual Wind Tunnel (VWT) Software (single licence).

MAKE:

CNC Machine Options

- Router 2600/Router 2600 Pro (Metal Cutting)
- Compact 1000 Pro (Metal Cutting)
- MRC 40

Car Manufacture Fixture

F1 in Schools Car Manufacturing Fixture for both Bloodhound SSC & Formula 1® Class cars.

Consumables - Bloodhound SSC & Formula 1® Class Cars

- Formula 1® Class Balsa Wood Blanks - Pack of 20.
- Fusion Wheels - Black - Pack of 100.
- Screw Eyes 1" - Pack of 100.
- Long Axles - 65mm - Pack of 100.
- Straw Wheel Spacers - Pack of 500.
- Washers - 4mm - Pack of 100.
- Decal Stickers - Pack of 25 sheets.
- Paint Stand.
- Bloodhound SSC Class Balsa Wood Blanks - Pack of 20.
- PX Wheels - Rear - Black - Pack of 100.
- LX Wheels - Front - Black - Pack of 100.
- Screw Eyes 1/4" - Pack of 100.
- Short Axles - 43mm - Pack of 100.

TEST:

Scout Wind Tunnel
Fog Maestro Smoke Generator including 1Ltr. Fog Fluid.

RACE:

Elevated Race Track - 25m track.
F1 Race System (x1 Start & Finish Gate, x2 Launch Triggers, x2 Launchers,
x1 Power Supply, x1 Control Box).
8 Gram Competition Cartridges (pack of 120).



Compact 1000 PRO



Router 2600 PRO

For the full range of F1 consumables & race equipment see pages 72 - 77.

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On-Line Technical Forum

TECHNICAL SUPPORT AVAILABLE 24 HOURS A DAY, 7 DAYS A WEEK

Denford's Technical Forum is a free of charge on-line technical support service that is available to Denford customers 24 hours a day, 7 days a week.

"The technical forum has provided a wealth of information and support for our 20-year-old Denford CNC machine, in fact just as good as the support we receive for our brand new CNC Router!"



Denford's On-Line Technical Forum is a free of charge service that can be accessed 24 hours a day, 7 days a week.

The On-Line Technical Forum is available to Denford customers, old and new, and it couldn't be easier to use. Just visit <http://www.denforddata.com/bb/> and register on line.....it's that simple.

Denford's On-Line Technical Forum opens up the traditional communication channels that can restrict customer and technical support, due to availability of staff, teaching commitments or different time zones.

A multitude of topics relating to Denford machines and software [both new and old] are covered within the forum, which is simple to search, and easy to use.

Denford's Technical Team and Denford customers from around the world regularly log on to the forum to offer support and advice and, most importantly, post a solution for all to see.

As well as offering comprehensive technical support, Denford's On-Line Technical Forum enables customers to share ideas and projects with other users. Media such as teaching material, project work, PDF's, images, drawings and text documents are easily attached to messages for all users to view and comment on.

You can also read the latest Denford news before anyone else, and keep track of machine and software upgrades, some of which can be downloaded direct from the Technical Forum web site.

The On-Line Technical Forum has proved to be hugely popular with customers. One recent user posted a note to inform us that the Technical Forum has "provided a wealth of information and support for our 20-year-old Denford CNC machine, in fact just as good as the support we receive for our brand new CNC Router!"

Of course the traditional methods of phone and email are still available, but try out this new service by simply logging on to www.denforddata.com/bb/ and register.



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