# EasySCAN 3D User Guide

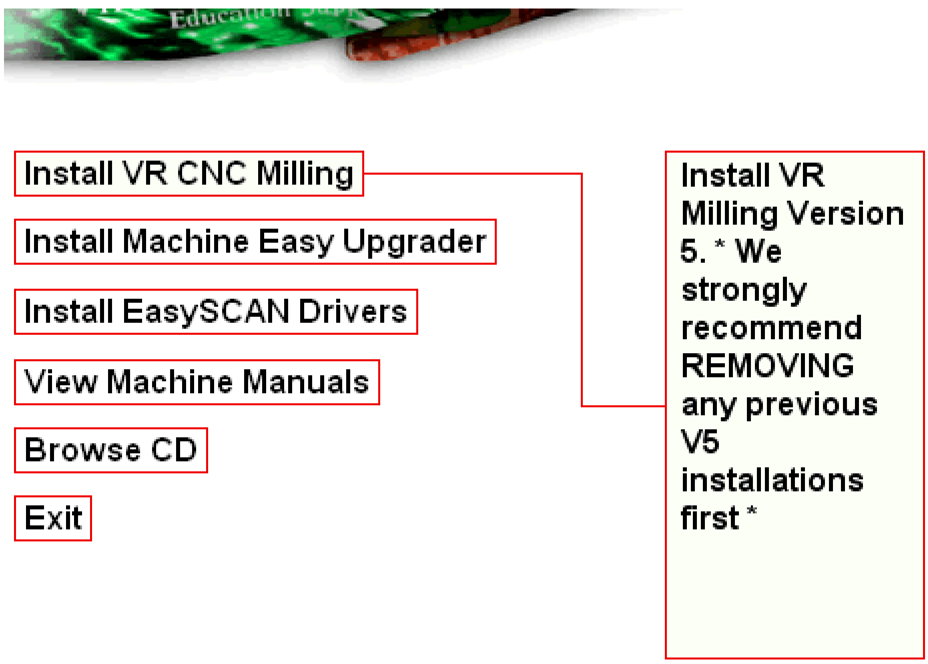
## Installation

*** Important Information ***
- Please read and understand this guide before attempting to run the EasySCAN software and machine.
- This guide assumes you know how to use the Denford machine and software.
- You **must** be able to configure offsets and run your machine normally before attempting to scan.

**1. Before connecting the Denford machine to your PC, insert the VR Milling V5 CD (version 5.13 and above) into the PC.**
If the machine and USB connections are already made, then disconnect and turn off the machine.

If your CD does not automatically run, then browse the CD, and run the file start

start.exe




**2. Install VR Milling (Option 1)**

**3. Once VR Milling has installed, return to the above setup screen and choose "Install EasySCAN Drivers"**
NB, This next installation screen may differ from shown, as the software is updated and changed.

Install Drivers for EasySCAN Mk1

Back

Exit

Install Drivers for EasySCAN Mk1

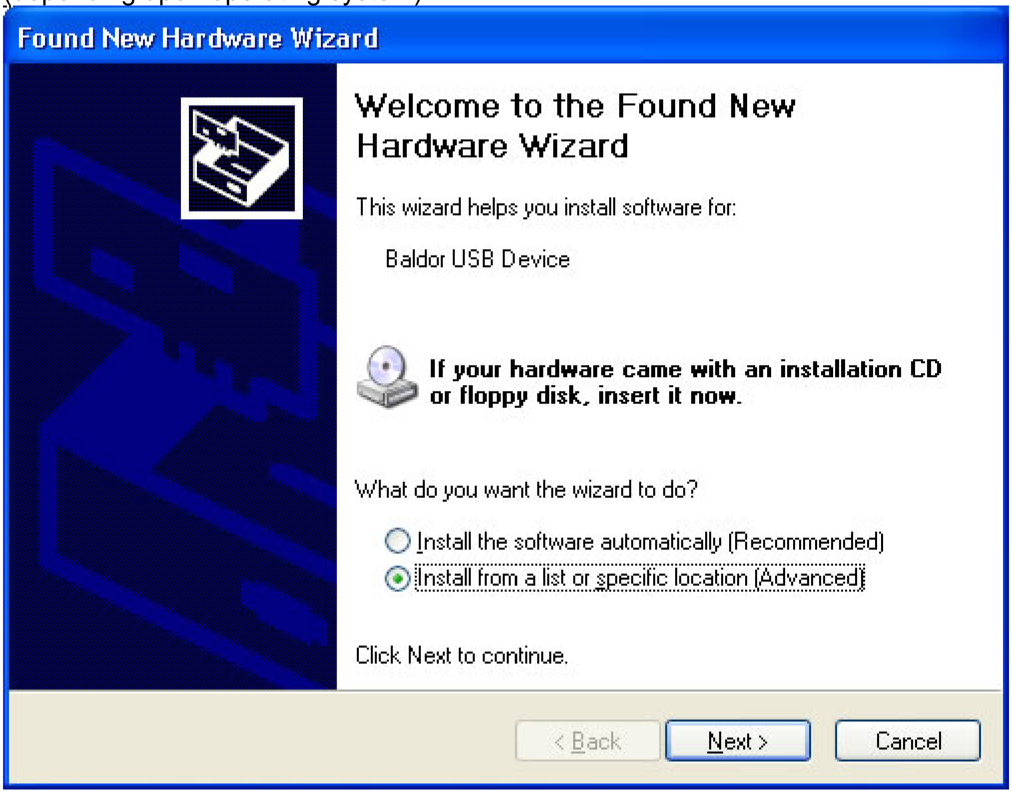
Let the installation process complete.

**4. Now connect the USB cables to the machine, and the laser scanner inputs. Turn on the Denford Machine.**

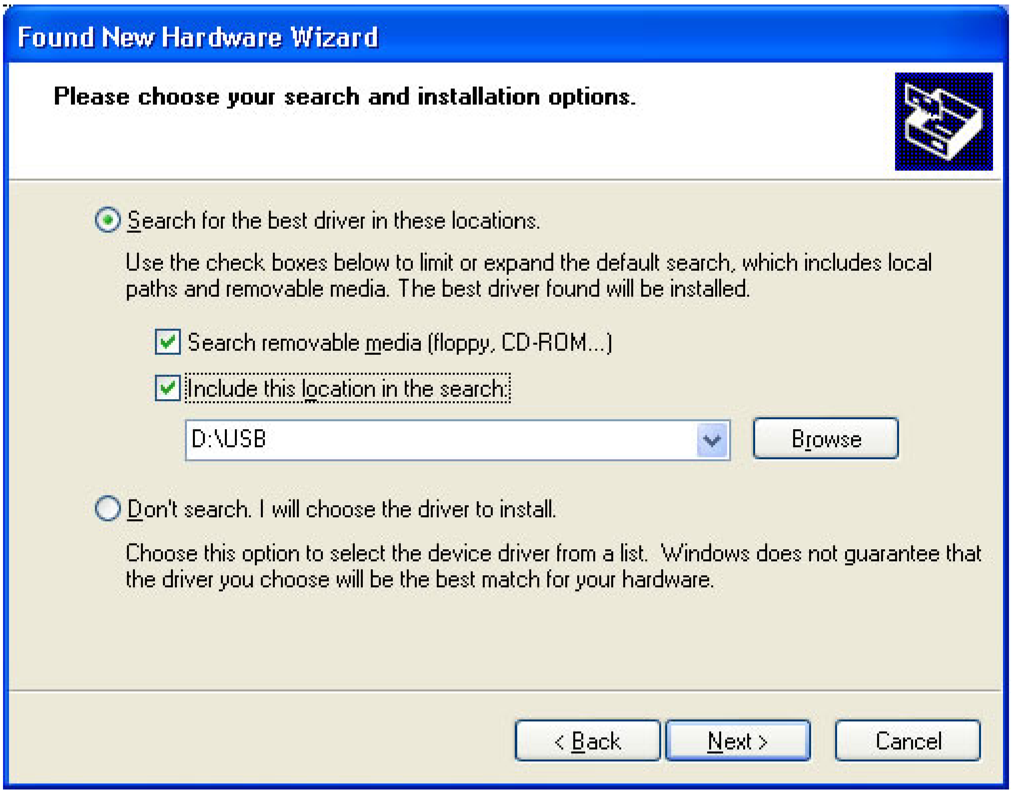

**5. You may now be asked to provide drivers for the Baldor USB device - this is the machine connection**

The very first time you connect the USB cable and power up your Denford Machine, Windows will automatically "detect new hardware" and request the correct driver. Only the supplied Denford USB driver will work. The driver consist of two files: baldorusb.inf and baldorusb.sys. These files can be found on any of the Denford VR machine installation CD's, typically in the **D:\USB** folder.

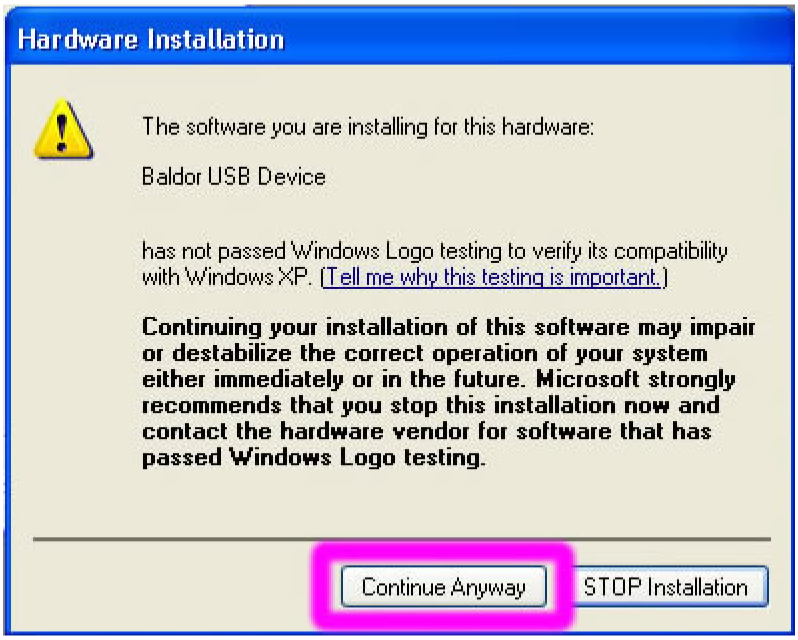
You will be asked to install the driver by the Hardware Wizard, which will look something like this (depending upon operating system):




Select the option "Install from a list or specific location (Advanced)" then click "Next >"




On this next screen, select "Include this location in the search" and enter "D:\USB" in the search path field. Click "Next >"




During the next stages, you will be warned that the driver you are installing has not been verified by Microsoft. Ignore this warning and click "Continue Anyway".

The driver installation will now complete and a new Baldor controller device will be listed in the Universal Serial Bus controllers section of Windows Device Manager.

**6. Installation complete**
The drivers for the laser scan connection should have been installed previously and will not be asked for. If you do have problems with this device, check these files have been installed correctly:
*c:\MCC\CB.CFG*
*c:\MCC\cbercode.txt*
*c:\MCC\cbw32.dll*
*c:\MCC\ULPROPS.TXT*
*c:\windows\system32\drivers\CBUL32.sys*
*c:\windows\system32\drivers\CBULWDM.sys*
*c:\windows\INF\CBI95.INF*

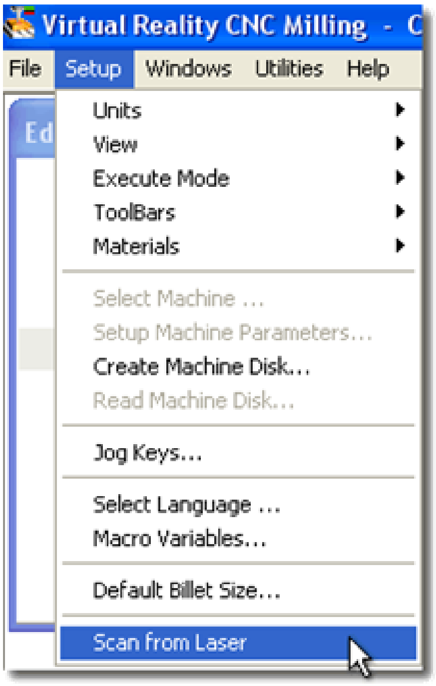
Your machine and EasySCAN installation should now be complete.
Continue with the next sections to learn how to configure and use your EasySCAN attachment

# Configuring and using the scanner

**Starting the scanning wizard**
For the EasySCAN laser to start taking readings, the following conditions must be met:

> The machine is powered on and the guard closed
> VR Milling v5 is installed and running
> The VR Milling software is connected to the machine
> The axes have been homed

Once the axes have been homed, the scanning wizard can be started, select main menu option **Setup** -> **Scan from Laser**



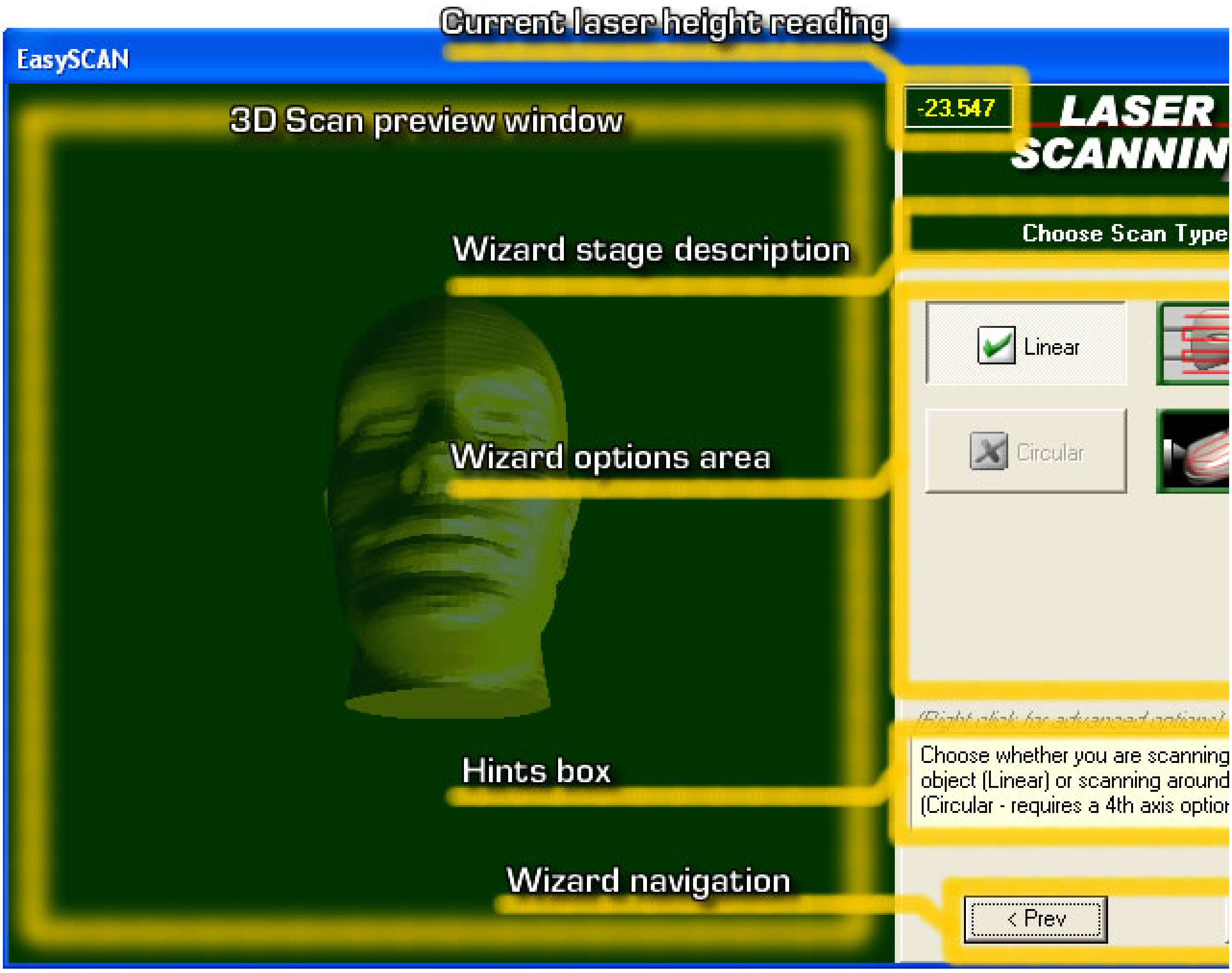

**To close the wizard, simply click on the same menu option.**

**BEFORE YOU START**

The model you wish to scan must be a matt, none reflective surface
Shiny or reflective surfaces will give poor results
You may need to prepare the model by painting it with something like a matt grey primer:

# Setting up for Linear 2.5D scanning

Here is the breakdown of the scanning wizard screen. Its is very simple to follow through the steps to scan your model

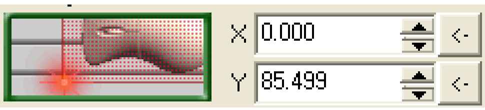



**You can zoom and rotate the 3D scan by clicking the left or right mouse buttons and dragging inside the preview window**

Choose linear scanning mode and click **[Next >]**

Place the model inside the machine and close the guard

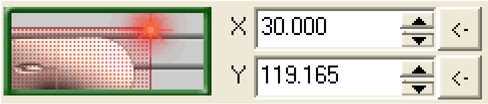
From the machine control panel, select jog mode and move the X and Y axis so that the laser is pointing to the front left corner of the model to be scanned (see next picture):




The wizard screen shows where the laser spot should be in relation to the example mouse model
Once this postion is reached, you may either:
Set the work piece offsets to 0 (datum position), and then enter X 0 Y 0 into the wizard positions
or,
Ignore the work offsets and simply click the read position buttons **[<-]** to enter the current axes positions.

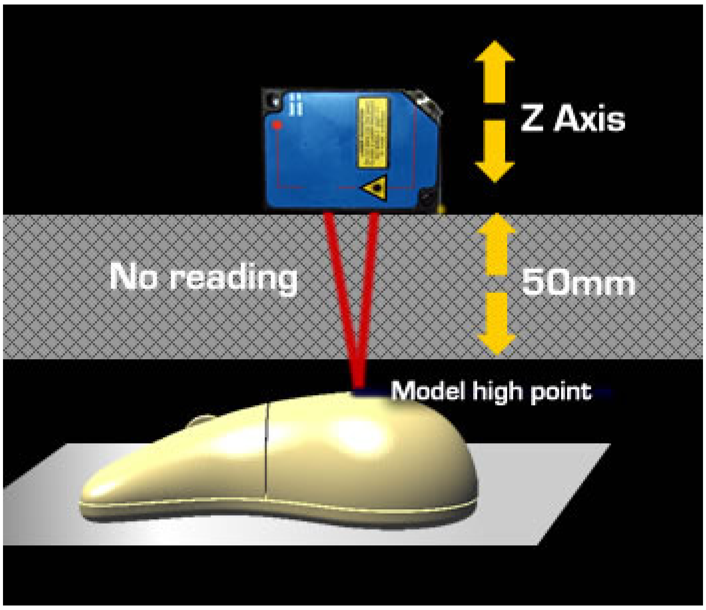
**Using work offsets will allow you to enter scanning dimensions that make sense, rather than random axis position values**

Now activate the machine control panel, and jog the axes to the far right corner of the model to be scanned:



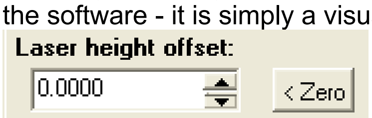

As shown by the mouse icon.
Once X or Y are in position, click the read position buttons **[<-]** for each axis
If you set your work offsets previously, the values entered in these boxes will be the length (X) and width (Y) of the scanning area.

You now need to set the laser and Z axis positions
For best results, you should place the Z position of the scan head about 55mm above the highest part of the model:




The scanner will not read in the area 50mm below the lense so make sure that the heighest part of the model is just **over** 50mm away from the lense.
You should now set your workpiece offset so that the Z axis reads zero in this position.

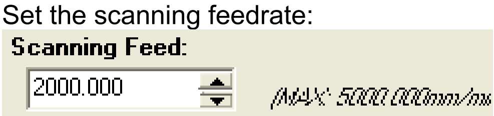
The laser depth reading can be set to zero by clicking the **[< Zero]** button.
Normally, move the laser spot so it is pointing on the machine table, and set this reading to zero.
The height reading is not important to the scanning process as the scanned model will be centralised by the software - it is simply a visual indication of the height reading for the user.




**If the laser reading freezes it means that the object is out of range - either too close or too far away from the scanner**

Once you have setup the linear scanning area, click **[Next >]**

Set the scanning feedrate:




Although the system can scan at the maximum rate shown, the results will vary according to resolution and the size of the scan area, better results can be obtained by lowering the feedrate
eg:
For a scan area of say 50mm x 50mm then choose a feedrate of around 1000mm/min
For 150mm square, choose around 2500mm/min
Anything bigger, with a coarse resolution, choose the maximum (5000mm/min)

Now set the stepover distance in none scanning axis (normally Y):

In effect, this is defining the resolution of the scanned model.
Set a lower stepover for small, high resolution models (eg 0.25mm)
and higher values for large, low resolution models (eg 1mm)

Next, set the resolution of the scanning axis (normally X):

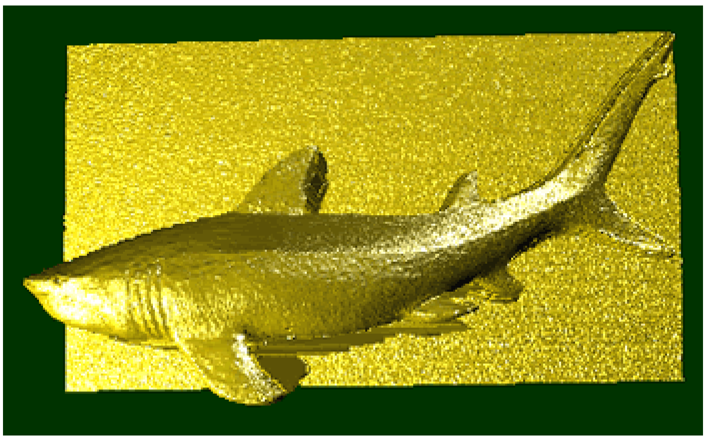

The maximum resolution of the scan is limited by the number of stepper motor *steps per mm*.
If the machine has a steps per mm value of 40, then the maximum resolution you could set would be 1/40 = 0.025mm

**Remember that the higher the resolution of the scan, the more time and memory will be required to process it !**

Guidlines for setting scan area, resolution and stepover:
Scanning anything higher than 1,000,000 (1 Million) points will cause issues with graphics card memory, and probably slow the PC down to a halt.
Use these calculations to estimate how many points will be scanned and alter resolution or step over if it works out to be too high:
For a **linear** scan, to calculate number of points that will be scanned:
(X scan distance DIVIDE by Scan axis resolution) MULTIPLY by (Y scan distance DIVIDE by step over)
eg: Scanning X100 Y50 area with scan resolution of 0.1 and stepover of 0.2:
(100 / 0.1) x (50 / 0.2) = 1000 x 250 = 250,000 points

For a **rotary** scan, to calculate number of points that will be scanned:
(X scan distance DIVIDE be scan resolution) MULTIPLY by (Total angle / Angle Stepover)
eg: Scanning X120 length at 0.25 resolution for 90 degrees at a 0.2 degree stepover:
(120 / 0.25) x (90 / 0.2) = 480 x 450 = 216,000 points

Once the scan area as been setup, press the **Scan Now** button
The axes will move to the start point and scanning will begin. You will be able to see the results appearing in the Scan Preview window after a couple of passes.
Note that the computer will not respond while performing each scan pass - this is because the system needs to capture the scan points very quickly.
If you want to cancel the scan, then press and hold the **ESC** button on the PC keyboard. Once the scan has been aborted, it is advisable to re-home the axes.
It is occasionally possible to hang-up the software if you abort during a reading, if this happens then:
*E.Stop the machine*
*Close the VR Milling software (CTRL-ALT-DEL)*
*Turn the machine power off*
*Disconnect and reconnect the Laser USB cable*
*Power on and restart the VR Milling software*


A typical 2.5D Linear Scan

Once the scan has finished you will be prompted to save the scanned point cloud. Doing this is recommended, especially for large scans.
When a 3D mesh is created, a great deal more memory is consumed which can lead to memory errors. If

you save the scanned points immediately after scanning and something goes wrong later, then you will still have the raw data available to load into another piece of software. For example, free software like MeshLab is able to load and manipulate raw point data files (.ASC)

Once point cloud data is saved, click **[Create]** then **[Save]** to build a 3-D mesh made up of triangles and save it as an .STL format file.

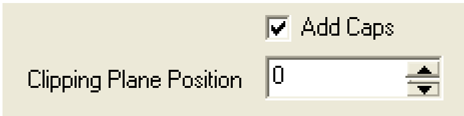
Typical linear scans will need cropping to remove the flat bottom surface...
Click **[Next >]**

# Editing the scanned model

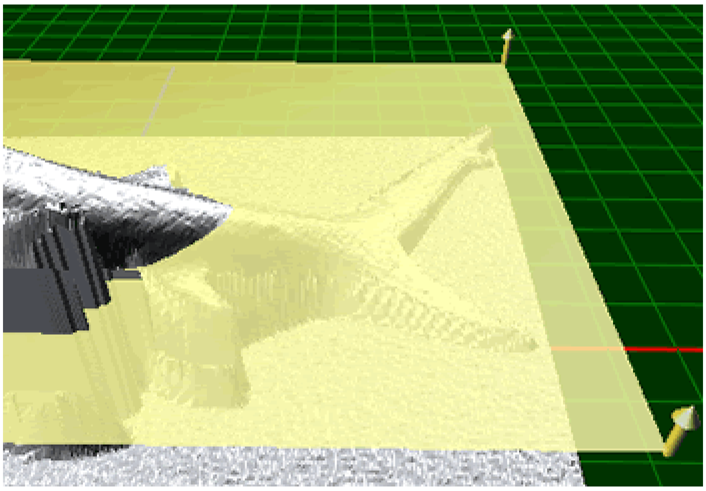
The final section of the wizard allows you to Rotate, Invert, Crop and Mirror the model
These functions are fairly self explanatory and you can experiment with them, without losing the original model - to go back to the original scan after editing, click **[< Prev]** then **[Next >]**

We will concentrate on cropping the model as the other functions work in a similar way:

Select Crop mode 


You will now see the clipping plane value box 


*If this is not visible, try expanding the size of the scanning wizard window*

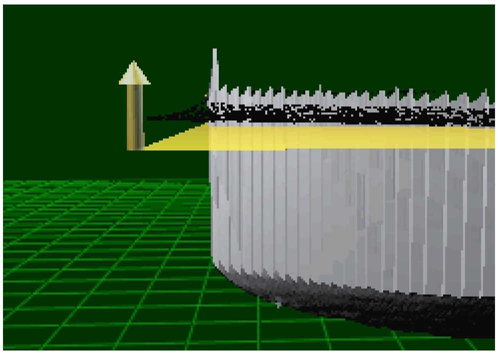


If you adjust the value of the clipping plane, you will see a transparent rectangle "cutting through" the model. The arrows at each corner of the rectangle indicate which side of the model will be cropped.
In the case of the shark, we will need to rotate the model 180 deg in order to clip off the bottom:

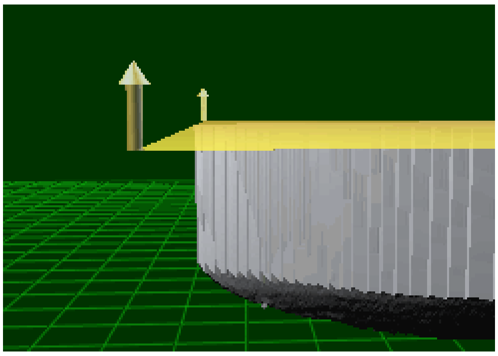
Click the rotate X button 

until the model has turned 180 degrees

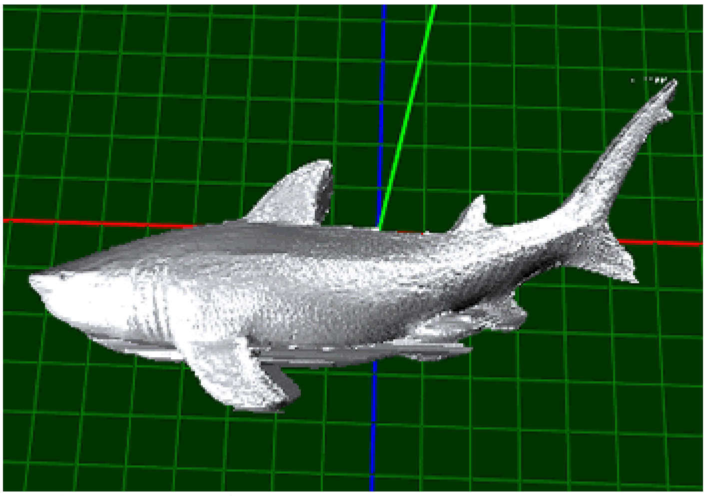
Whenever the model has been rotated, click the **[Apply]** button 



Now adjust the clipping plane value so that it is just below the part we want to remove and click **[Crop]**



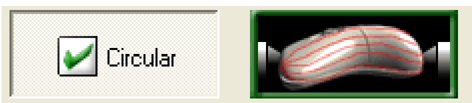
Rotate the model back 180 in X and click **[Apply]**



The flat bottom surface has now been cropped away

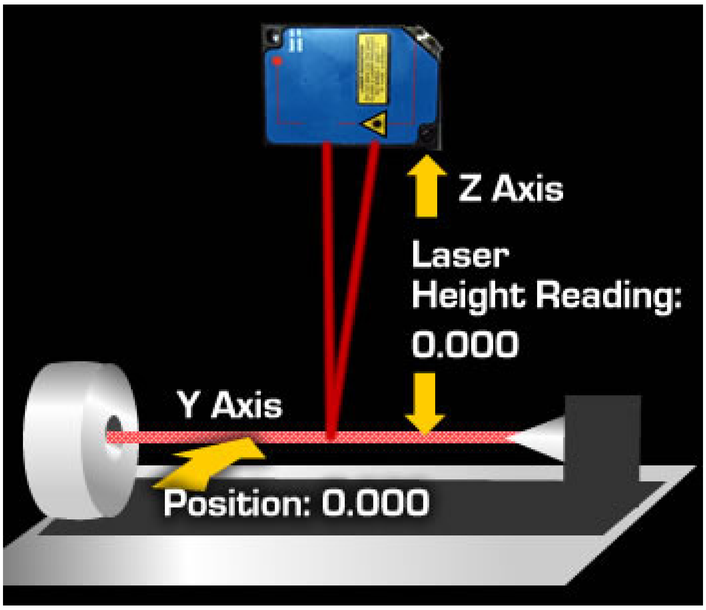
# Setting up for Rotary 3D Scanning

If you're machine has a 4th axis rotary attachement, then you are able to scan around objects in 3D.

The Circular scanning mode 

will only be enabled when the 4th axis attachment is turned on in the VR Milling parameters.

Setting up for circular scanning is more involved, as the centre of rotation of the axis must be found so that models can be scanned accurately.
However, the procedure for finding the centre of rotation should only need doing once. If the rotary fixture is removed from the machine then it may be necessary to re-set the centre of rotation values.

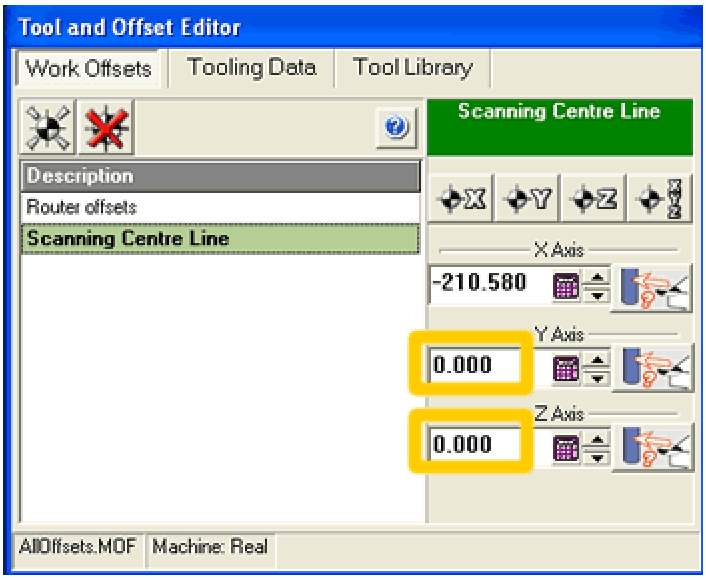



Here you can see that the Laser Height reading must read zero on the centre line, and the Y axis program position must read zero when the laser is over the centre line.

**How do you find these positions ?**

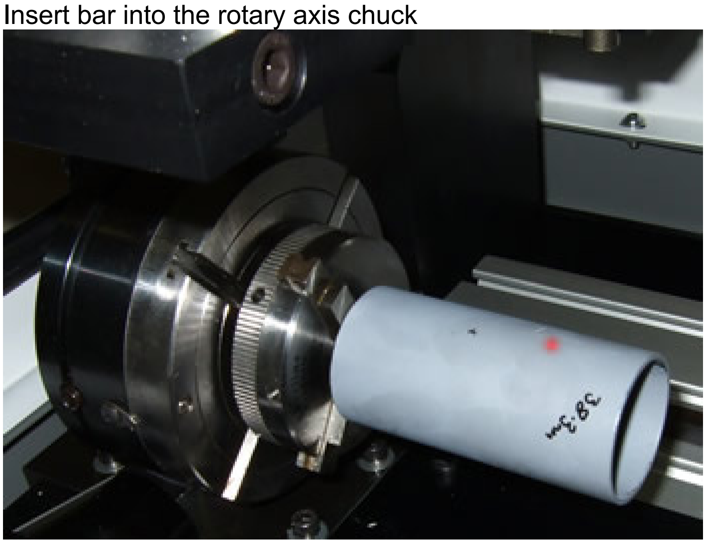
Home the machine

Clear the Z and Y work offset datums - enter 0.0 in each axis:



Find a suitable round bar (which is not reflective)
Measure its diameter

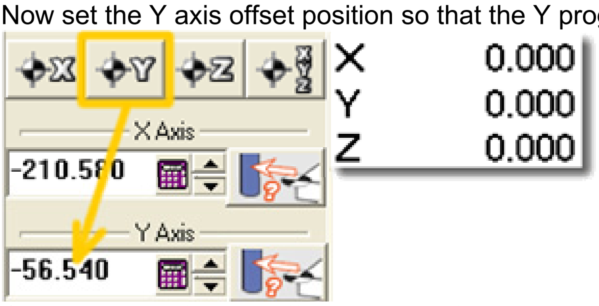
Insert bar into the rotary axis chuck



Select the **[Next >]** button to go to the second wizard screen (for circular scanning)

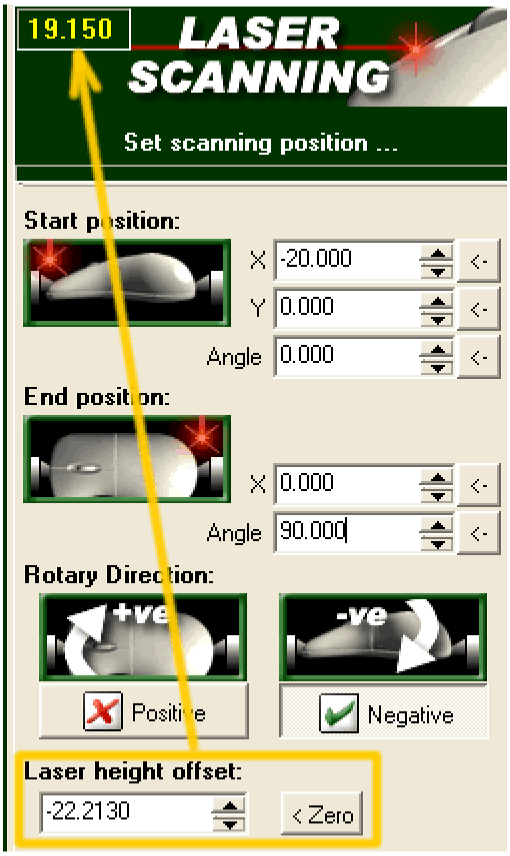
With the Z axis still at home position, jog the X and Y axes until the laser spot is on the bar.
Now run the Y axis backwards and forwards, watching the laser height reading in on the wizard screen.
When you reach the highest point, stop jogging the Y axis.
This Y position should now be the centre of the bar.

Now set the Y axis offset position so that the Y program position reads 0.000




*(Make a note of this Y offset value for future reference)*

Now you need to set the laser height offset so that the laser reading is the radius of the bar. In this example, the bar is 38.3mm Diameter, so the laser height reading needs to be 19.15mm when it is over the centre of the bar




The circular and linear wizard screens, each remember their own settings, so in theory this laser height value should be remembered next time you do circular scanning. However, it is still worth writing this number down somewhere safe (or create a text file on the PC) !

To get the best scan results, you should have the laser as close as possible to the model (see linear scanning notes above).
When circular scanning, the laser height reading **must** read 0.000 on the centre of rotation, so moving the Z axis will cause the setting to be lost. If you wish to scan closer to the model, then move the Z axis down by a fixed, known amount, then all you need to do is adjust the Laser Height Offset value by this same amount.

Now that the centre line has been determined, the rest of the wizard works in the same way as the linear wizard.
The difference being that the start and end angles are provided, and you need to decide which way round the scan will go
Positive +ve rotation means the top part of the model will move **away** from you
Negative -ve rotation means the top part of the model will move **toward** you

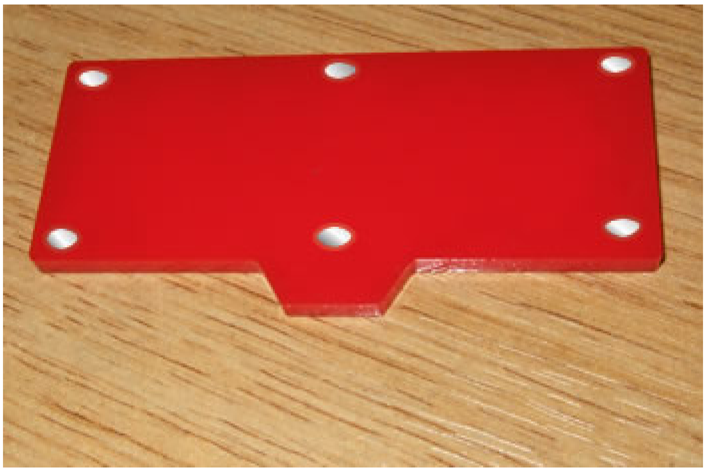
Rotary scanning move sequence:
The axes move to the X,Y and specified start angle
The scanning axis (normally X) will take a scan reading along the centre axis.
The model will then rotate by the step over value (degrees), and the scanning axis return to its start position.
This sequence will continue until the rotary angle matches the end angle specified.

**When you have determined the centre line of rotation write these values down !**

*A typical rotary scanned model*

# Looking after your EasySCAN laser scan head

The EasySCAN laser head is a precision optical device. As such, care must be taken to keep the lense clean.
We have provided a magnetic cover, which will keep the device protected from dust and swarf when you are using the machine for cutting purpose. You may keep the cover stuck to the inside of the machine for safe keeping, when scanning.



**Always keep the cover over the laser when not using the machine for scanning !**

If the red lense of the laser becomes dirty or dusty, then it must only be cleaned with a lint-free cloth and a high percentage alcohol solution. Glass lense cleaning solution and clothes from the optician would be ideal.