Fusion Mk4 User Guide

Venture & VuMaster Series

For Version 4.20.8

Baty International

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Contents

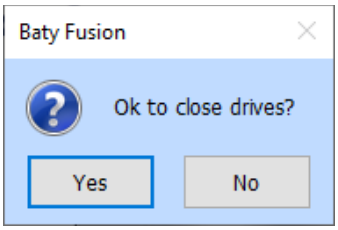
SECTION 1 – INTRODUCTION

1.0 STARTING FUSION & MACHINE ZEROING

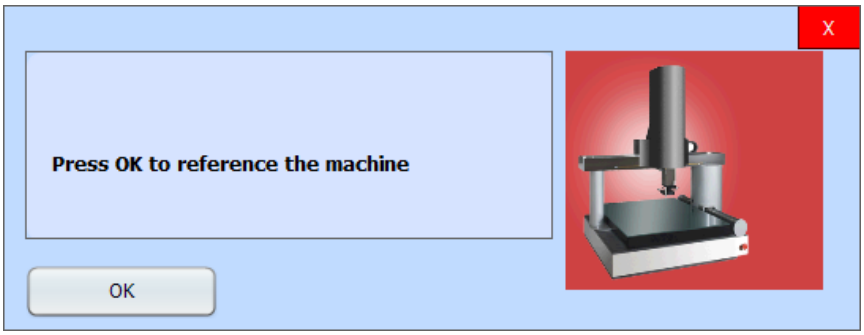
Turn on the controller by pressing the power button behind the door located at the front of the controller. This will begin the start-up process and launch Windows. On machine shutdown, it is very important that the machine is shut down from Windows. Press the windows icon and then select the shutdown option to power down the system.

From the desktop, locate shortcut icon for the Baty Fusion software and select to launch.

As the software launches, it will ask “Ok to close drives?” click Yes apply power to the motors.

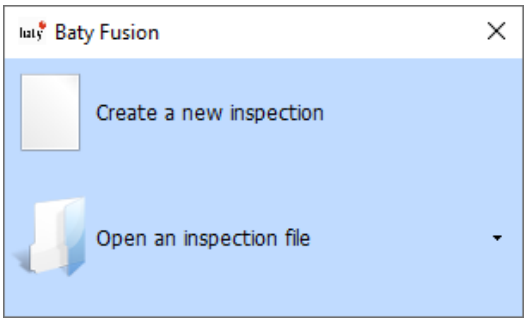


Next it will ask to begin the initial machine referencing. All Baty Vision systems running Fusion software need to be referenced at start up. Click OK to start referencing the machine. The message and picture displayed will vary depending on the machine.



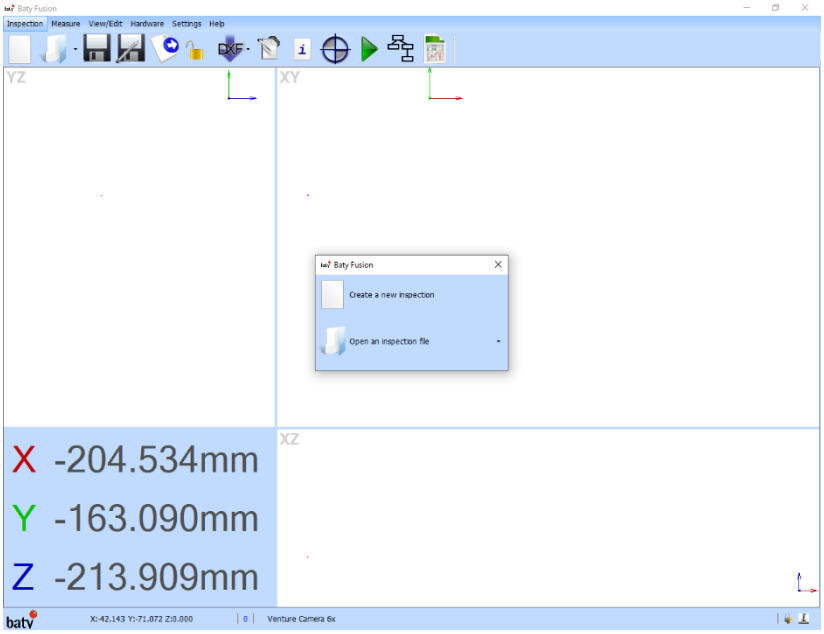
Manual machines will require each axis to be positioned at the end of its travel before clicking OK. Instructions specific to each machine type are displayed in the reference window.

Once referencing has completed, the main inspection screen will be displayed. The system is now ready to measure, by creating a new inspection or by opening an existing inspection file.

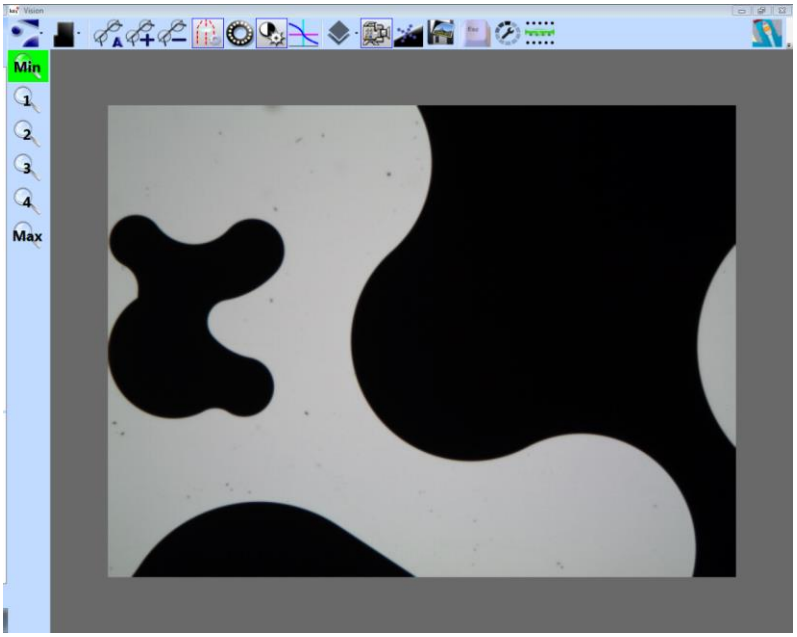


2.0 INTRODUCTION TO THE SOFTWARE

The Baty Fusion Software is based around a graphical interface that operates in Microsoft Windows. In normal use, there are 2 main windows. First is the Main Screen, shown below:



The second screen is the camera image window, which may initially have a black image if no lighting has been switched on - see Chapter 15.0 – LIGHTING, page 36.



Vision measurements are performed by using the vision measuring tools in the camera image window. Touch probe and constructed measurements are performed by using the geometric measuring tools on the main screen. All features, measured or constructed, will be drawn with a graphical representation on the Main Screen. Dimensions of size, form, and geometric qualities can also be shown in this view. These functions are covered in 35.0 – SHOWING DIMENSIONS ON THE SCREEN, page 86. If the main window is closed, using the cross in the top of the window, the full software will close, but the camera window can be closed without affecting the main window. To open the Camera Image window, click on the Camera Icon:

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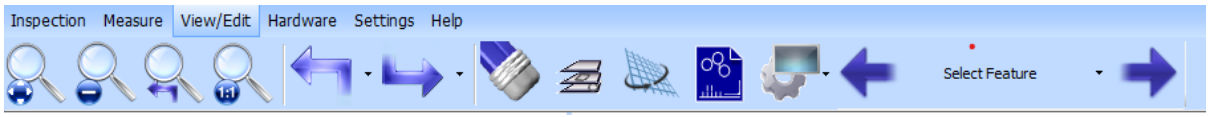

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4.0 INSPECTION TOOLBAR

4.1 New

Click on the New Inspection button to open a new, empty inspection. If the current inspection has not been saved, the user will be prompted to save it, or it will be lost. Opening a new inspection will restore settings, such as edge detection settings, to their defaults.

4.2 Open

To open a saved inspection, press the Open button. This will open a browser window to search in the controller's documents to locate where the inspections have been saved. When the desired file has been found, select it, and open the inspection file. The dropdown arrow will bring up a list of recently opened programs, select the name of the desired inspection and it will open.

4.3 Save

The Save File button should be used when the inspection has been previously saved, and the file name is correct. If the Save File button is selected but the inspection has not been previously saved, there will be a prompt to enter a file name. When the Save button is selected, any changes made to the inspection since it was last saved will now overwrite the previously saved inspection, which will be lost.

4.4 Save As

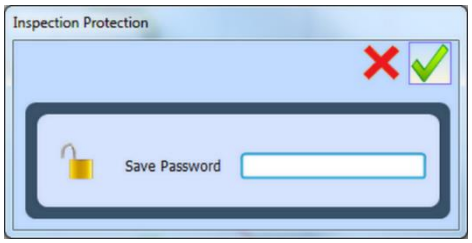
To keep the information from an old inspection and save any changes made under a new file name, select the 'Save File As' button. Clicking on the Save As button will open a window that will allow to allow the user to name and save the file. The 'Save In' box will default to the file path specified in the Results Folder in the software set up. The Save As button can also be used to save the inspection for the first time.

4.5 Export Data Points

The data points from the inspection can be exported, either in ASCI or XML format, to import into third party software. Within the inspection menu click to open a Windows browser option then enter a file name and a location. To adjust the settings for export, see Chapter 43.10 – Points Export, page 150.

4.6 Password Lock

Inspection files can be protected from changes by a password, this is done by pressing the lock icon to bring up this window:



When using a password be careful to remember the exact spelling, which will be case sensitive. If an inspection has a password, the inspection cannot be overwritten at any time in the future unless the password is again entered. Whilst the document is password protected, the padlock icon on the top toolbar will show a locked icon instead of the usual open padlock.

Password protected files can be modified; however, these changes cannot be saved using the same name. They can however be saved using a new name, using the Save File As button.

4.7 DXF Options

Fusion software can use standard DXF files to compare parts to drawings or automatically create a program to measure the part. Selection the DXF button in the Inspection toolbar will show a drop-down menu, shown and annotated below.

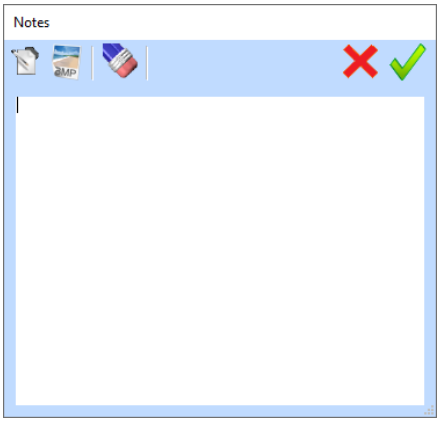
Import	Bring a DXF file into Fusion.
Export	Export measured features as a DXF.
Delete	Remove the DXF from main screen.
Best fit	Move and best fit the DXF profile to scan points.

These functions are further explained in Chapter 39.0 – DXF FILES, page 117.

4.8 Notes

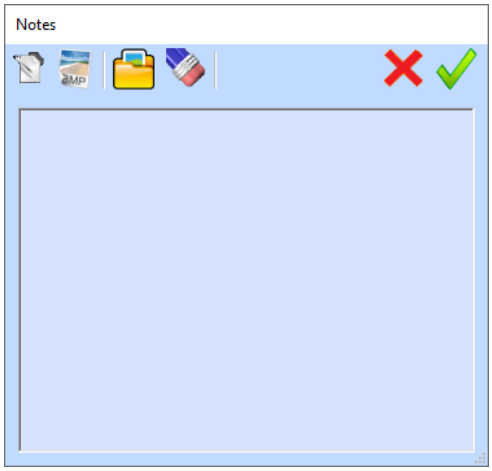
It may be necessary to add observations, instructions, and useful information to an inspection. This can be done using the Inspection Notes window, where text and images can be stored and seen by any user of the inspection.

Tapping this icon shows the Inspection Notes window:



This has three tabs Text, Image, and Erase. The text area allows inspection notes to be added, for example comments on how to manually measure references, or the type of stylus to use. To add this text, type in the white field and press the green tick to close and accept.

The Image icon allows images to be imported, for example to help identify fixtures or part positioning. Pressing this icon loads a blue field and a browser icon will appear to allow the user to select the desired image.



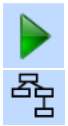
The erase tool can be used to remove any images that have been loaded and again the green tick can be sued to accept and close the window.

4.9 Inspection Details

Inspection details will give a brief overview of the current program's information. It will list the number of workpieces, features, and dimensions as well as an estimated run time and any probes used. This information cannot be edited here, it is only a summary of the inspection.

4.10 WPC

The Work Piece Co-ordinate (WPC) of a part is the X, Y reference position (0,0) of a component in terms of machine co-ordinates. This menu will bring up a series of information on the current WPC and allow multiple workpieces to be added or moved. This is thoroughly discussed in Chapter – 41.0 WORK PIECE CO-ORDINATE, page 129.



4.11 Play & Inspection Program Details

The Play button is used to play the current inspection and Inspection Program Details is used to view details about and set up the current inspection. Both are explained in detail in Chapter 40.0 – THE PLAY FUNCTION, page 124.

4.12 Run Reports

This button will open the report settings where reports can be created and customised. This is discussed in Chapter 42.0 REPORTING, page 132.

5.0 MEASURE TOOLBAR

The measure toolbar is used mainly to open feature windows to create new features.

The features available from the toolbar are:

5.1 Circle 

5.2 Line 

5.3 Point 

5.4 Plane 

5.5 Sphere 

5.6 Cylinder 

5.7 Cone 

5.8 Curve 

5.9 Surface 

5.10 Array

The array tool is used to copy features in either a circular or grid pattern. This can be used to save time while creating an inspection that contains repeating features. Use of the array tool is explained in Chapter 20.14 – Array , page 64.

5.11 Leap Frog

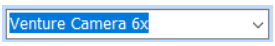
This tool allows features to be measured on components that are larger than the working volume of the machine using features that are common in every measured position. As well as being able to measure larger components, it can also be used to measure components on a rotational axis. Use of the Leap Frog tool is explained in Chapter 20.15 – Leap Frog, Page 66

5.12 Probe Manager

This will bring up the probe manager window which contains information on each of the configured probes, including their offsets to the camera. This can be used to add new probes to the system or datum existing probes. The probe manager is more thoroughly discussed in Chapter 48.1 – Probe Manager, page 162.

5.13 Put Away

This button is used as a shortcut to put away any mounted probes, this has the same effect as right clicking an item in the probe manager and selecting Put Away. If a rack is available, pressing this button will trigger the machine to move the mounted probe to the rack and return to its original position. If there is no probe mounted, there will be no action taken.



5.14 Switch Probe

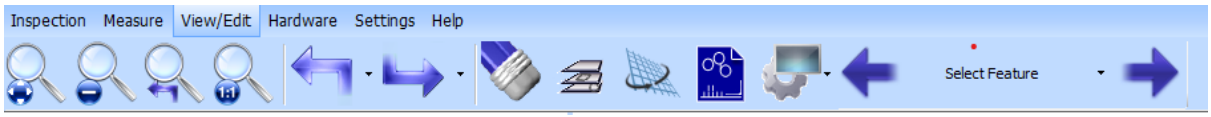
This dropdown menu allows the user to quickly switch between probes, selecting the arrow on the dropdown will display a list of the probes currently available in the probe manager. Click on one of the probe names to switch to this. Note, if switching from a probe to a camera, this will not disable the probe or put the probe away.

5.15 CAD

This icon will only be visible with the optional CAD modules installed. A separate CAD user guide can be provided for any customers requiring help with the CAD modules.

6.0 VIEW/EDIT TOOLBAR

The View/Edit toolbar is used to manipulate the graphics to adjust their size and position and make small edits to the inspection from the drawing view.



6.1 Redraw

This function will automatically zoom to 'auto fit' all the measured features and dimensions into the graphic window. If there are no features, it will zoom out to show the machine working volume. This can also be done by right clicking in the camera view and selecting redraw.

6.2 Zoom Out

This button will make the graphic window zoom out by a fixed percentage. Use by clicking the icon or scroll the mouse roller back.

6.3 Zoom Last

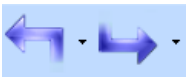
This button will make the graphic window zoom back to the previous view used.

6.4 Zoom Full

This will make the graphic window zoom out to make the machine's full measurement volume fill the screen.

6.5 Zoom In

There isn't button or icon to zoom in, instead this is done using the mouse scroller wheel or left clicking and dragging the cursor to create a box around the desired zoom area. When the left mouse button is released, the screen will zoom to the size of the box drawn. The position of the cursor will dictate the area of the screen that will retain its position and the remainder of the image will move to increase or decrease the size of the view.



6.6 Undo and Redo

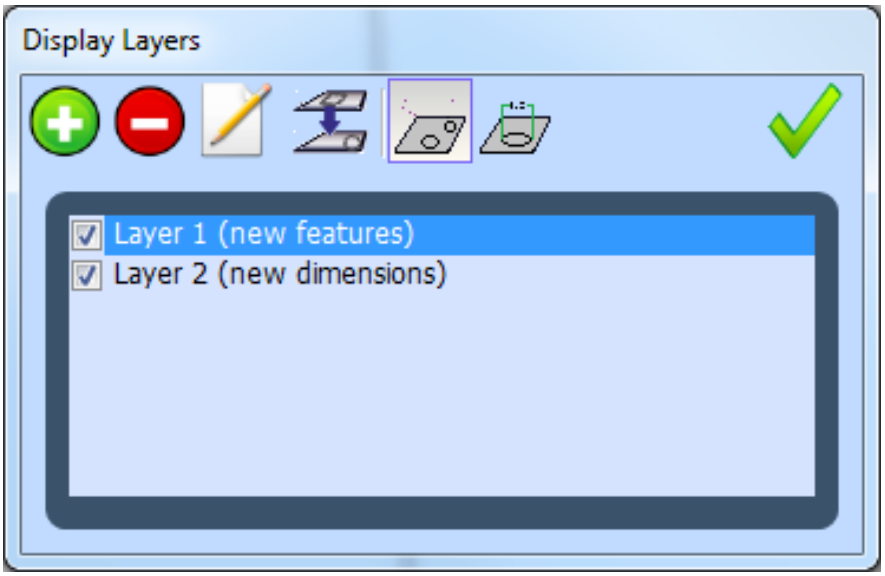
If something is done by mistake, for example erasing a feature, clicking on the 'Undo' button will undo the last action performed. In this case the last erased feature will reappear. Similarly, if a function has been undone by mistake, clicking on the 'Redo' button will redo this action.

6.7 Erase

To erase a feature or a dimension from a graphics window, press the erase button, and then touch the feature to delete. After selecting, the eraser icon will turn pink, and as this is a latching button, it will remain active until it is pressed again. It is also possible to delete large areas at once by selecting the tool and dragging to create an area to delete. If there is more than one feature in this area, a list will appear for features to delete, select All to remove all.

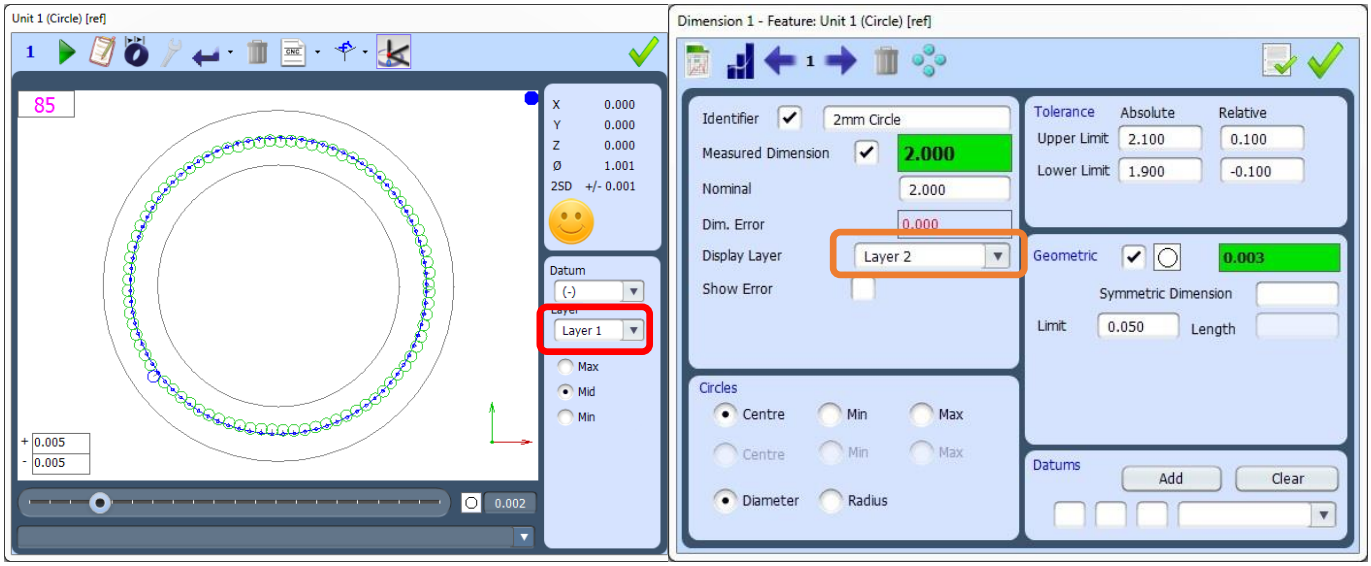
6.8 Display Layers

The main screen can occasionally become too cluttered to display information clearly. For this purpose, layers can be customised which may then be switched on and off to make the features or dimensions either visible or invisible, so that the information may be displayed more clearly. Click the tick box to determine the visibility of a layer.



From left to right these icons are: Add layer, Remove layer, Rename layer, Merge selected layers, Set default layer for new features, Set default layer for new dimensions, Save and Close.

By default, all features are placed into display layer 1 and all dimensions in layer 2. To change the layer of a feature, open the feature window and change the setting shown in red, to change the layer of a dimension, open the dimension details window and change the setting in orange.

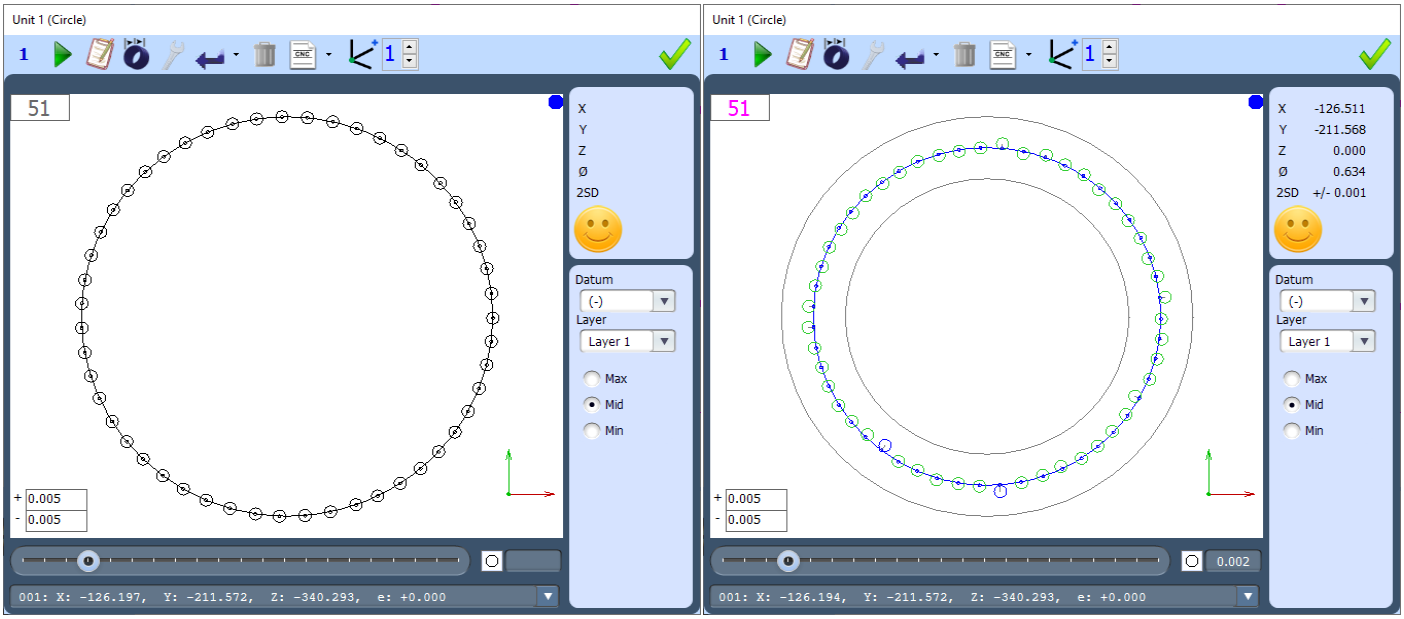


6.9 Grid Shift

This can be used to add rotations and translations to manipulate the graphics to suit a drawing, this is discussed in Chapter 34.3 – SHIFTING AND ROTATING REFERENCES, page 86.

6.10 Show Template

When Show Template is selected, all the features in the inspection will be displayed in their grey template state, rather than the most recently measured features. All dimensions will be displayed as their nominals and any feature windows opened will show the template state, shown in the right image, rather than the points measured, shown on the left.



6.11 Display Options

This icon is used to show various display options for the probe, which can now be discussed.

6.11.1 Safe Volumes

The safe volumes will show the safety zones around the part, reference sphere, rack etc. Pressing Ctrl + Alt + B will also activate this, along with the Probe Boxes.

6.11.2 Probe Boxes

This option will display the safety zones around the probe. This can also be activated using Ctrl +Alt +B.

6.11.3 Show Probe Path

Show probe path is useful in inspections that use probing, when selected, the path that the probe will follow during the inspection is shown. This includes the plunge, rise, pre-travel and measurement points can be seen graphically on the screen.

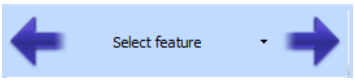
6.11.4 Recent Probe Positions

Recent probe positions will show exactly where the probe has travelled before, during and after an inspection. It will clear itself after 240mm of travel, so the inspection does not look cluttered.

6.11.5 Contact Points

A useful icon that shows exactly where the probe contacted the component.

6.12 Select Feature

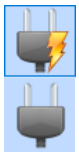


These arrows can be used to scroll through and select the features in the inspection without clicking on them. If a feature is selected, its name will appear in the box between the arrows and if this name is tapped, the feature will be selected. The features will appear in numerical order, select the right arrow to look at later features and the left arrow for earlier features.

7.0 HARDWARE TOOLBAR

7.1 Air Supply On/Off

For Venture Plus systems only – Press this icon to enable the air supply to the machine. When the air supply is enabled, it allows the drives to be enabled afterwards.



7.2 Drives On/Off

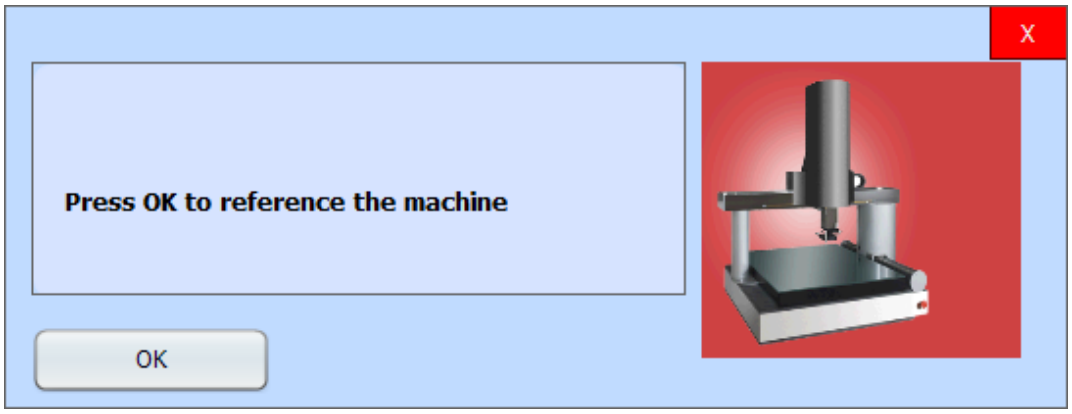
For CNC systems only – Press the plug icon to enable the XYZ drives. A lightning bolt by the plug shows when the drives are enabled. The drives must be enabled to move the machine by CNC control or the joystick.

7.3 Joystick Enabled/Disabled

For CNC systems only – Press the icon to enable the joystick. The joystick can only be enabled after the drives have been enabled, if drives are disabled, the joystick will automatically disable. Refer to Chapter 10.0 - THE JOYSTICK, Page 23 for further information on joystick controls.

7.4 Reference Machine

When switching on the machine, it needs to reference its axes by triggering their limit switches. When the software is started for the first time in a session, the reference screen will automatically appear. This will appear similarly to the example below, although this window varies for each machine type:



Now click on the OK button in the window. The Reference Machine button is also located on the Hardware menu bar and can be used at any time.

7.5 Park Machine

Pressing the park icon will make the machine move to a known safe position on the stage in XYZ (set through the settings menu) and disable drives and the joystick. The drives and joystick can be re-enabled at any time to allow use of the machine again.

7.6 Jog

Press the jog icon to move the machine via CNC without the need to use a joystick. Refer to Chapter 12.1 – M, page 32 for more details.

7.7 Settings

This can be used to access the machine settings. Refer to Chapter 43.0 – MACHINE SETTINGS, page 140 for more details.

7.8 XY Align

Used with probing measurements. Refer to Chapter 55.0 – RPS ALIGNMENT (REFERENCE POINT SYSTEM), page 185 for more details.

7.9 Probe Manager

Pressing this icon will bring up the probe manager window which contains information on each of the configured probes, including their offsets to the camera. This can be used to add new probes to the system or datum existing probes. The probe manager is more thoroughly discussed in Chapter 48.1 – Probe Manager, page 162.

7.10 Camera Button

The Camera button will open and close the Camera Image window. The Camera Image window is discussed in Chapter 11.0 – THE CAMERA IMAGE WINDOW, page 29.

7.11 Temperature

The thermometer icon accesses the temperature compensation menu. There is a standard list of common materials and their thermal coefficients to select from if required. Should any special materials be used, and the material is not available in the list, a thermal coefficient value may be entered so the machine can adjust accordingly.

8.0 SETTINGS TOOLBAR

This toolbar has useful icons to quickly change some settings, or link a to the full settings page.

8.1 Settings

This opens a window containing a wide range of settings that can be edited by the user to suit their preferences, each of these settings are discussed in Chapter 43.0 – MACHINE SETTINGS, page 140.

8.2 Store Points

The store points function allows the software to record points taken that would not otherwise be part of a feature, for example when using smart mouse points with auto select feature. When points are taken, these will be stored in the memory until deleted or a feature is opened. The number of points stored can be seen in the bottom toolbar, these are removed by right clicking on the number to clear.

Whilst points are stored, if a feature type is selected, the stored points will also be added to the feature. This button is a latching type, which when on, will display the elephant icon. To switch this function off again, press on the button for a second time and the button will return to a goldfish. This will also disable Feature Predict.

8.3 Feature Predict

The feature predict function is designed to save time while measuring with the touch probe, as the software will predict the most likely feature that can be made the points taken. With the Feature Predict function switched on, if the stored points fit either a circle, plane, or line the software will automatically open this window displaying the measured points.

This button is a latching type, which when on, will become highlighted. It will also automatically bring on the store points function, which will also become highlighted. To switch this off again, click on the button for a second time, and the button will unlatch.

8.4 Switch Units

This button performs a quick switch between Metric and Imperial units. If the DRO is currently displayed in Metric units, pressing this will change all dimensions and the DRO to Imperial and if in Imperial this will switch to Metric.

9.0 HELP TOOLBAR

The Help toolbar has some helpful information for the user or to help Baty to diagnose issues.

9.1 Show Splash Screen

This opens a screen showing the Baty logo.

9.2 Show Help File

Clicking this button will open this user guide, which should also be available on the desktop.

9.3 Version Details

This shows system information about the software, including current software version.

9.4 Create Diagnostic Report

The diagnostics report button can be used to create a zip folder containing a range of machine settings and configurations and can be sent to Baty or the local distributer to assist in diagnosing machine or inspection issues.

10.0 THE JOYSTICK

CNC systems can be controlled using a PC compatible joystick. These machines are supplied with either a Baty touchscreen joystick or a Logitech Extreme 3D pro Joystick, both joysticks can be enabled and disabled using the icon in the Hardware tool bar

10.1 Logitech Joystick

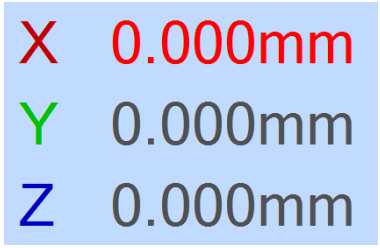
An annotated diagram of the older style of Logitech joystick can be seen below:

10.1.1 Moving the Machin in XYZ

To move the machine in the X axis direction, the joystick should be moved to the left and to the right. To move the machine in the Y axis direction, movie the joystick forwards and backwards. To move the machine in the Z axis direction, twist the joystick clockwise for down and anti-clockwise for up. The speed of these movements can be adjusted using the throttle, which is a dial on the base of the Joystick. Adjusting the throttle during playback will act as a feed override and the machine will start to move at the new speed. When the throttle is away from the joystick the speed is at a minimum and when set towards the joystick the speed will be at maximum.

10.1.2 XYZ Axis Lock

Buttons 8, 10 and 12 lock axes X, Y and Z respectively. If an axis is locked the on-screen DRO count will be displayed red. The image below shows the X axis locked and the Y and Z axis free.



10.1.3 Move Via Points

Way points can be added throughout a feature measure to avoid collision with the part or fixture between points. To create these points, move to the desired way point and press the trigger button, located at the front of the joystick.

10.1.4 Taking Probe Points

A probe point will be taken at any time that the probe touches an object or surface, as this will deflect the probe. Although, the software also allows probing points to be taken at a constant feed rate using the joystick. This means that the probe does not have to be driven into the component being inspected, increasing the repeatability of the measurement, and reducing the risk of damage to the probe.

To take a point, the probe needs to first be positioned within 5-6mm of the desired surface. Pressing button 4 will make the probe move down, negatively in the Z axis, at the default probing speed, until it contacts the surface and then move back up. If the probe does not contact a surface, it will retreat to its previous position. Button 6 will make the probe travel positively in Z, up, until it meets a surface.

The hat can also be used to take probing points, this can be pushed in the direction of the desired stage move to probe the part. For example, if the hat is moved left the stage will move left and the probe will take a point to its right. This can be used for movements in X and Y as well as diagonally in both axes.

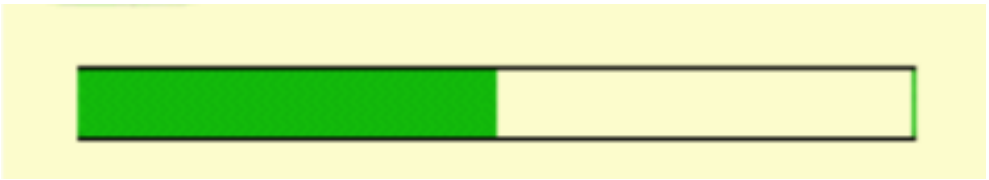
10.2 Touchscreen Joystick

There are two generations of the touchscreen joystick, the older desktop style being shown on the left, and the newer portable version on the right.

The functionality of both joysticks is almost identical, with both having the same screen pages and icons available on the touchscreen and both having a manual joystick, an e-stop, a main and auxiliary click button. The newer joystick also has a rotating wheel to control the speed bar instead of the touchscreen speed selection.

10.2.1 Moving the Machine in XYZ

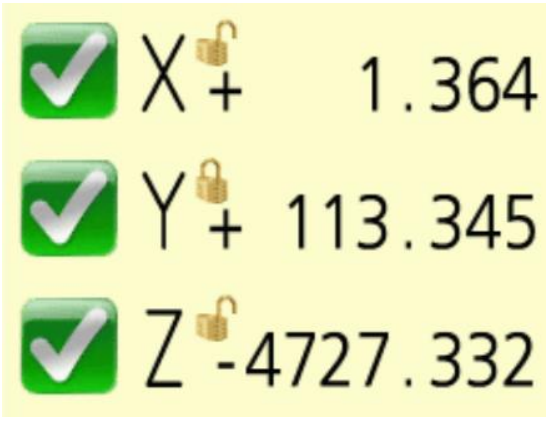
To move the machine in the X axis direction, the joystick should be moved to the left and the right. To move the machine in the Y axis direction, movie the joystick forwards and backwards. To move the machine in the Z axis direction, twist the joystick clockwise for down and anti-clockwise for up. The speed of these movements can be adjusted using the throttle bar on the touchscreen. Adjusting the throttle during playback will act as a feed override and the machine will start to move at the new speed. The full green bar demonstrates full speed, and the empty bar represents the slowest speed. This range can be adjusted in software settings.



10.2.2 XYZ Axis Lock

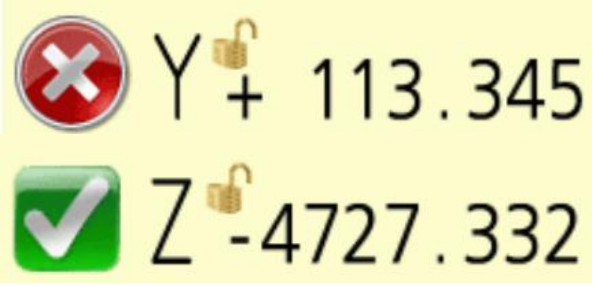
Each axis can be locked in its current position by touching the axis' letter on the touchscreen, this will cause the axis to stay in position and ignore all input from the joystick. If an axis is locked, the padlock image on the joystick will be closed and the on-screen DRO count in Fusion will be displayed RED.

The image below shows the Y axis as locked and X and Z as unlocked.



10.2.3 Disabling Axis Drives

The drives for each axis can also be controlled using the touchscreen, a green tick demonstrates an axis is enabled, and a red cross shows it is disabled. To switch between these states, touch the tick or cross. The image below shows the Y axis disabled and Z enabled.

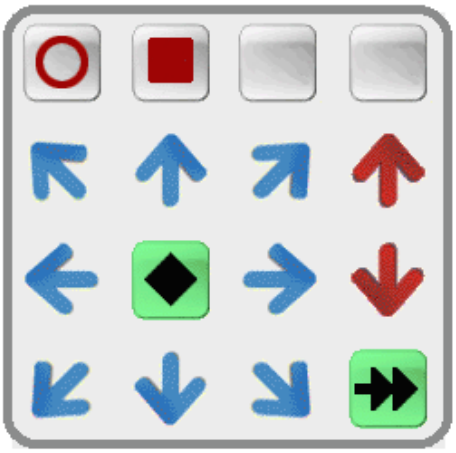


10.2.4 Taking Probe Points

A probe point can be taken at any time that the probe touches an object or surface, as this will deflect the probe. Although, much better points will be taken if this is done at a constant and repeatable rate, so the joystick can set off a probe move at a constant feed rate for a determined distance until it touches an object and then it will return to its starting position. This means that the probe does not have to be manually driven into the component being inspected, increasing the repeatability of the measurement, and reducing the risk of damage to the probe. On this joystick there are two different ways to start a probe move, one using the physical controls of the joystick and the other using icons on the touchscreen.

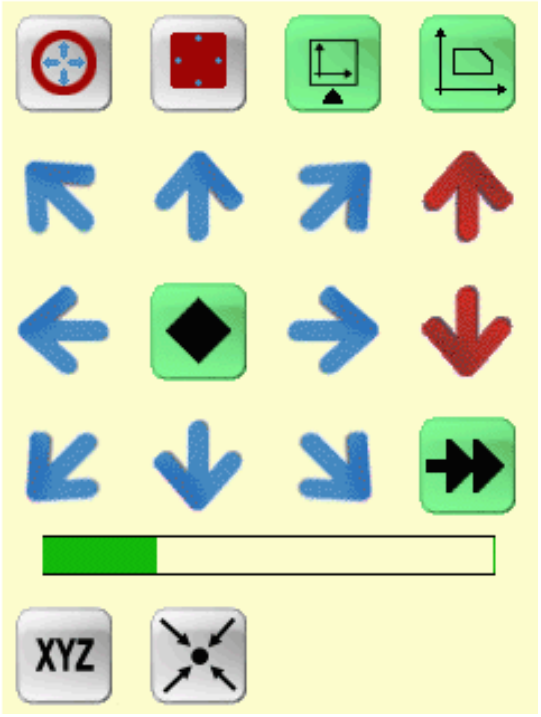
Before the point is taken, the probe needs first be positioned within around 5mm from of the desired surface. If using the first method, the main button should be pressed and held while the joystick is moved in the desired probing direction. In the image below, if the main button is pressed while the joystick is pushed right, the stage will move right at the default probing speed for the default distance. If the probe does not contact a surface within this distance, it will move back to the position it started.

Alternatively, the joystick can be driven using the touchscreen probing page, to access this press the icon for the probing page which should be on the bottom left of the screen:



If this page is not on displayed on the joystick, an update may be required to the latest joystick driver.

Pressing this icon will open the probing page, seen below:



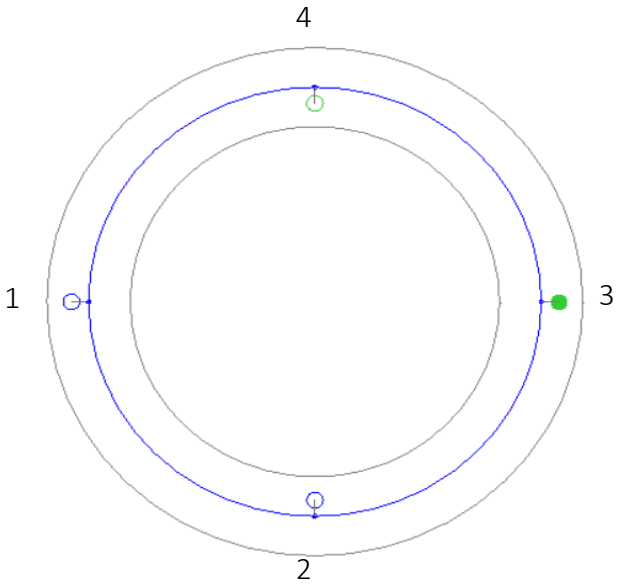
Pressing the arrow icons will start probe moves in their corresponding direction. The blue arrows represent moves in the XY plane, and the red arrows for moves in Z. For example, pressing the blue right arrow will make the stage move right. Instead of always moving the default distance and speed, the probe moves can be set to move one of three set speeds and distances. The square in the middle of the joystick controls the search distance for the probe:

The image will appear as a small, medium as show above, or large square to indicate that the moves will be the smallest, middle, or largest. Tapping this icon will cycle through the size options. By default, these distances are 5mm, 10mm and 40mm although they can be edited if needed.

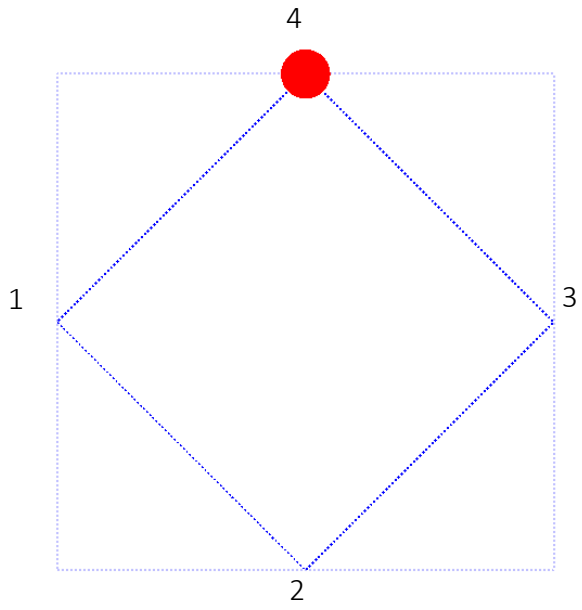
The speed is controlled by the black arrow icon to the bottom right, the options can also be cycled through by tapping the icon. The probe will move at the slowest speed when the icon shows one arrow, a medium speed when it shows two as seen above, and the fastest when the icon has 3 arrow heads. The default speeds are 1, 4 and 10 although these can also be edited.

This page also has two shortcut move sequences, triggered by tapping one of the icons below:

The circle icon will begin an XY auto circle measure, the stage will first move right at the set speed for the set distance or until it finds a feature, it then moves up in Y, left and down in Y.



The image of the square will measure a plane in XY, it will first move the stage right the set distance and will then move down in Z the same distance at the probing speed until it finds a surface. It will then move diagonally to take a point at the next corner of a square plane.



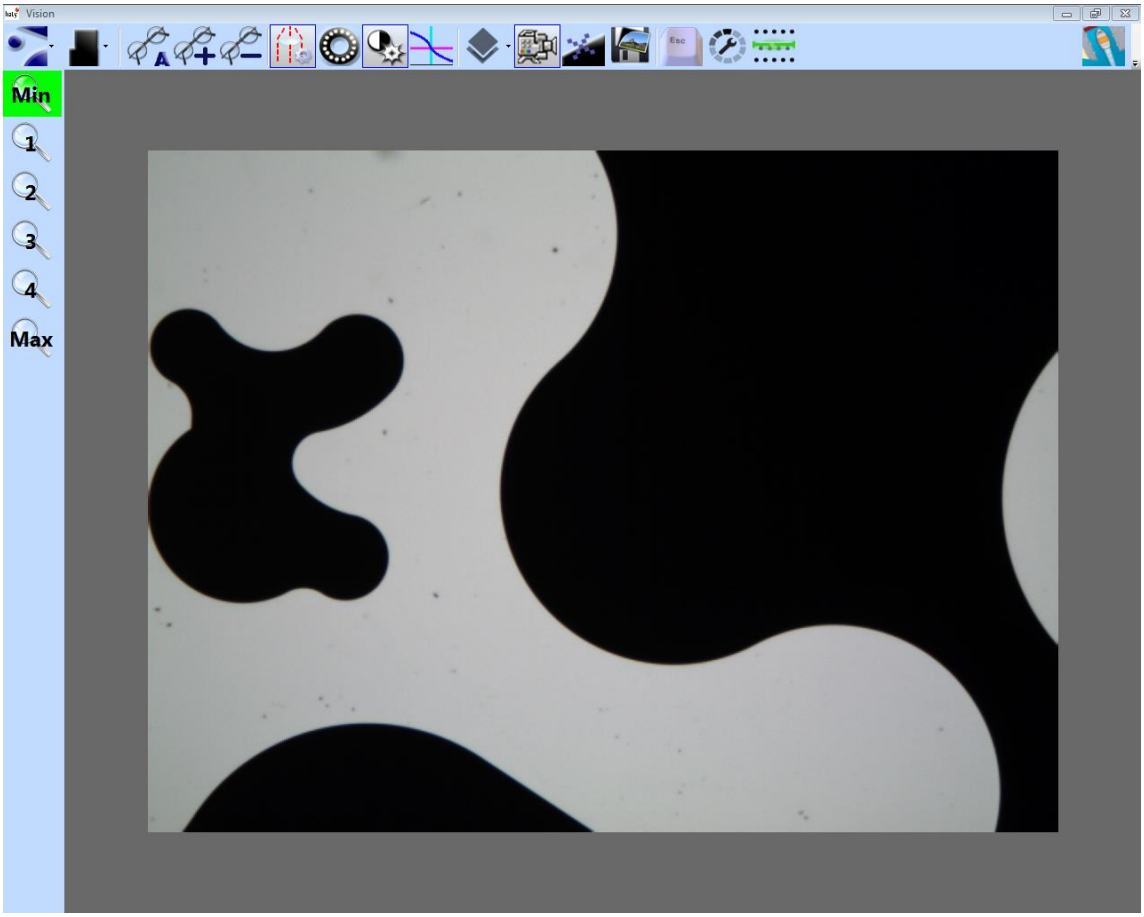
10.2.5 Move Via Points

Way points can be added throughout a feature to avoid collision with the part or fixture between points. To create these points, move to the desired way point and press the auxiliary button on the right of the joystick. On playback, the probe will move to the probe and waypoints in the order they were made. Move vias are discussed further in Chapter 52.0 – ADDING A MOVE VIA, page 179.

SECTION 2 – TAKING MEASUREMENTS USING THE CAMERA

11.0 THE CAMERA IMAGE WINDOW

The camera image window can be brought up by clicking on the camera icon. The image below shows an image of the undocked camera window, this can also be docked within the main window, using the dock control in the top right of the screen, also described below.



There are two toolbars visible on this window, the one above the camera image contains the measurement tools and setting and the toolbar to the right is used to control the camera zoom position. The first two icons in the top toolbar will by default appear as seen below.

11.1 Select Feature

This icon will show an image of the feature measurement tool currently selected; this example shows the Auto Select tool, the default option, being set. To select another, click this icon and a dropdown menu will appear with a list of the full feature types. The different feature types are discussed in Chapter 20.0 – MEASUREMENT FUNCTIONS, page 50.

11.2 Inspection Method

The inspection method is the technique used to measure the feature type selected, the one shown here is the Edge Detection which is the default. Clicking on this icon will bring up a dropdown menu to select an alternative method. As some of the methods cannot be used in combination with some feature types, these options may be grey and not selectable when some features are selected. The different inspection methods are discussed in Chapter 19.0 – MEASUREMENT TOOLS, page 48.

11.3 Auto-Focus

Clicking this icon will start an autofocus routine which moves the Z axis down and up a set distance to find an optimal focus of the part in the camera window. This is discussed further in Chapter 13.2 –Auto Focus (Pre-Focus), page 33.

11.4 Adjust Focus Z+ Direction

While this icon is pressed, the machine will move upwards in Z until released. The longer this icon is pressed, the faster the machine will move.

11.5 Adjust Focus Z- Direction

This button will move the machine downwards until it is released, it will also move faster the longer the button is selected.

11.6 Lens Set-Up

This icon will open the Lens Set-up menu, where the lens settings can be viewed, edited, and recalibrated. This menu is discussed in 46.0 – CAMERA CALIBRATION page 160.

11.7 Light Control

This icon opens the light control menu discussed in Chapter 15.0 – LIGHTING, page 36. Right clicking this icon will toggle between a top and back light if only one of them is on.

11.8 Camera Control

The button will open the camera controls, for example brightness and exposure, this is discussed further in Chapter 22.0 – CAMERA CONTROLS, page 72.

11.9 Edge Detection Settings

This will open a menu to control the settings for the edge detection measuring tools, for example the step size or maximum number of points, these settings are explained in detail in Chapter 23.0 – EDGE DETECTION CONTROLS, page 73.

11.10 Overlays

This icon opens the overlays dropdown menu which lists the overlays that can be shown on the live camera image, these are explained in Chapter 24.0 – OVERLAYS, page 69.

11.11 Camera Feed Toggle

Pressing this button will toggle between the live camera and the last captured image. When the icon has a blue selection box around it, the image is live, if the image is un-selected and there is no blue box, the image is of the last one captured by the camera.

11.12 Show Edges

This icon will display the captured image of the last measured feature, the measuring window used, and the points taken for that feature. When this icon is selected, it will have a blue box around it, to turn it off either click the button again or press escape.

11.13 Save Image

Clicking this icon will take an image of the current camera view and allow the user to save this to their controller, this is discussed further in Chapter 27.0 – SAVE IMAGE, page 81.

11.14 Escape Softkey

This icon will do the same function as pressing the escape key on the keyboard, it can be used to cancel selection of things or close some menu popups that are not wanted.

11.15 Buffer Tool

The buffer tool can be used to stack measurement tools in a queue that will all run concurrently. This is explained in detail in Chapter 29.0 – BUFFER TOOL, page 81.

11.16 Scan Area

This tool will start a scan using the camera window to create a stitched image of the area selected, this is discussed further in Chapter 30.0 – SCAN AREA page 82.

11.17 Digital Zoom

The view in the camera window can be zoomed digitally using a slider bar or the mouse scroller, for more information see Chapter 31.0 – DIGITAL ZOOM BAR, page 82.

11.18 Camera Docking

The docking icon can be used to dock the camera window in the main screen.

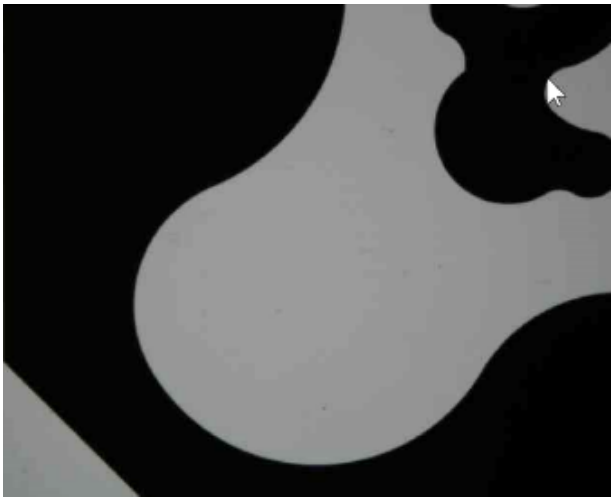
11.19 Lens Position

If this toolbar is docked, each of the zoom positions set on the machine will appear in this list as a separate icon. To move to any position, click the icon and the camera will zoom in or out to this level. On the image to the left the camera has the default number of lens position for an XT, with a position called Min, another called Max and 4 intermediate positions. Min is the lens position that is currently selected, which is indicated by it being selected in green. If none of the icons here are green, the camera is not currently in a zoom position that will allow the user to measure.

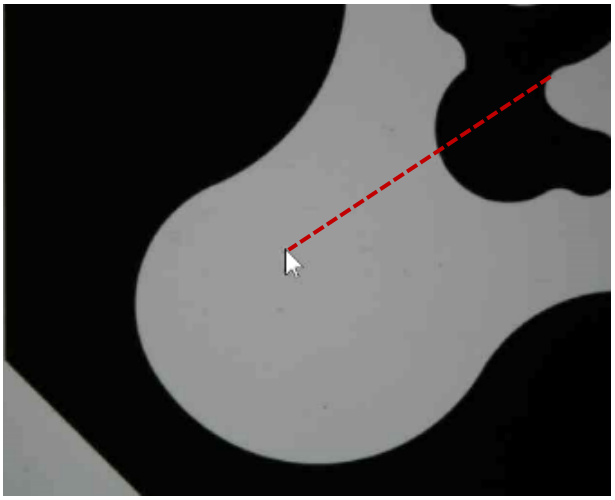
12.0 MOVING USING CAMERA WINDOW

12.1 Moving in X and Y

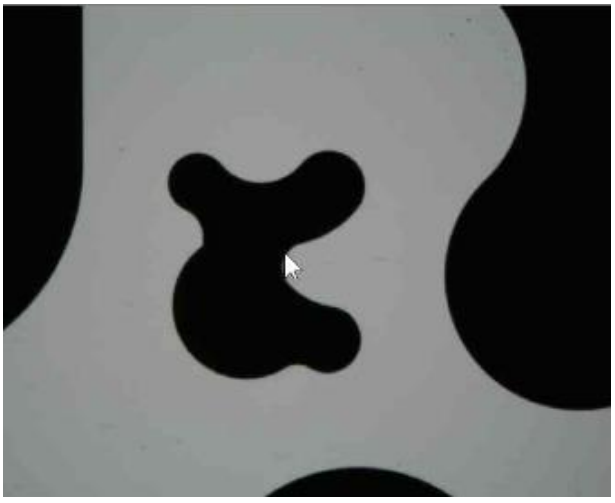
The X Y stage is either controlled using hand wheels, for manual machines, or using motors on Computer Numerical Control (CNC) systems. For CNC systems, X-Y stage moves can be made using a supplied joystick or the computer mouse. The mouse can be used to precisely make small or large movements.



Select any area in the camera window and hold down the mouse scroll wheel.



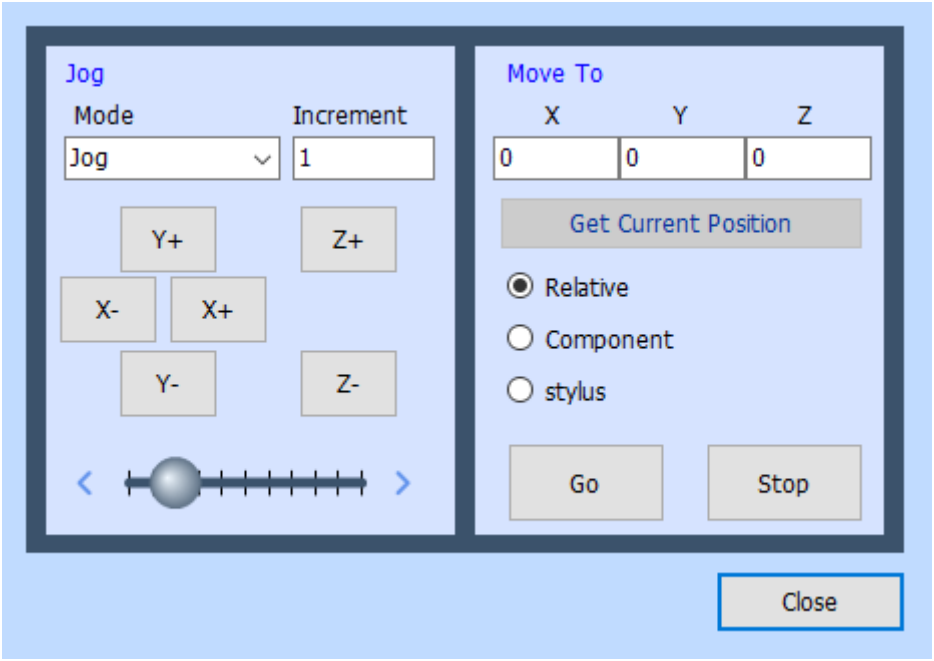
With the wheel still held down, drag this area to the desired position on screen.



When the wheel is released, the stage will move so that the area selected will move to the new mouse position.

Another method of moving a CNC stage is the jogging man function, found on the top tool bar of the main Fusion window.

Once open, CNC moves can be performed by manual individual clicks or using a relative move.



By right clicking with the mouse in either the camera or main views, a 'Jog here' option can be selected which will make the machine perform a CNC move in XY.

13.0 FOCUSING THE CAMERA

The Z axis is operated either by a handwheel, twisting the joystick or by using the Jogging man on a CNC system. For smaller Z moves or manual focusing, the focus icons can be used.

13.1 Manual Focus

To move the camera up, click and hold on the + spectacles. To move the camera down, click and hold on the - spectacles. This focusing speed control is progressive, the longer the icon is held, the faster the machine will move.

13.2 Auto Focus (Pre-Focus)

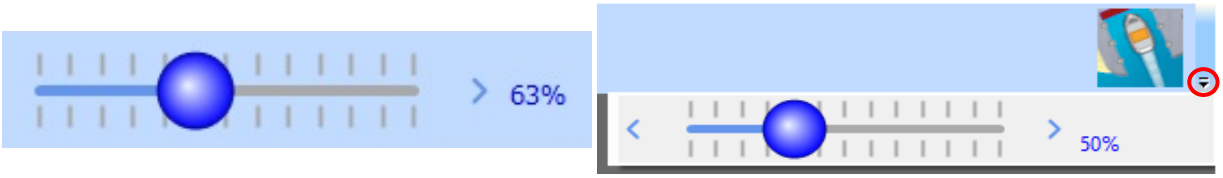
If the camera is close to a good focus on the part, an automatic routine can be used to find an optimal focus position. Move the part's edge or surface to the centre of the camera window and then press the auto focus button. The Z axis will then move down towards the part, processing the image to find a good focus position, if none is found, the camera will move up towards its original position and then an equal distance above to search instead. When a good focus is found, the machine will move to this height and the routine will stop. Auto focus can be stopped any time by pressing the red stop button. This is best used when a part is already close to being in focus and will produce better results if being used on a surface than a profile. A similar routine can be used to measure a point at an optimal focus using the Focus Point tool, discussed in Chapter 20.7 – Measuring Points using Focus Point, page 58.

14.0 CAMERA ZOOM

14.1 Digital Zoom

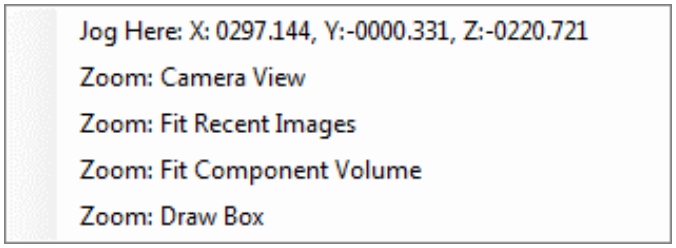
The digital zoom level can be seen on the scale at the top of the camera window. This can be controlled by moving the slider, pressing the arrows at each end or by rolling the mouse centre wheel within the camera window to move between several pre-set positions.

If working on a narrow screen, this may be hidden but can be accessed using the dropdown arrow to the right of the docking symbol, as seen in the image on the right.



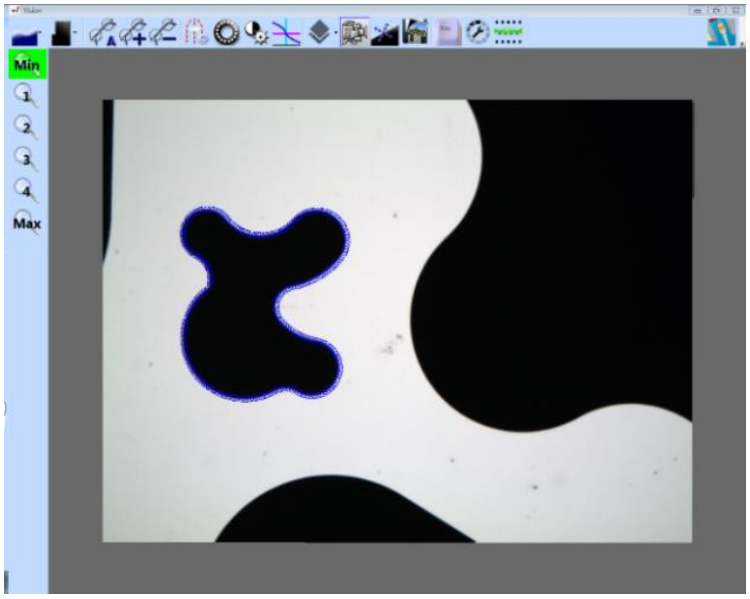
14.2 Camera Window Views

The software contains shortcuts to several convenient views that can be accessed by right clicking in the camera window to bring up the following window.



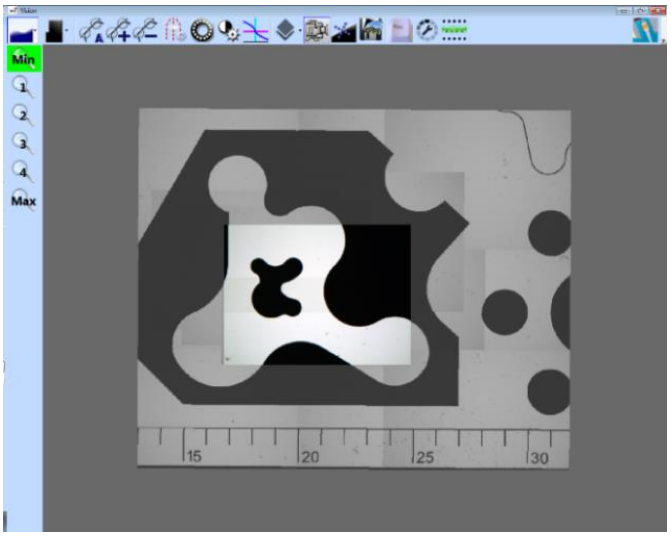
14.2.1 Zoom: Camera view

This will zoom the camera window to the field of view of the camera.



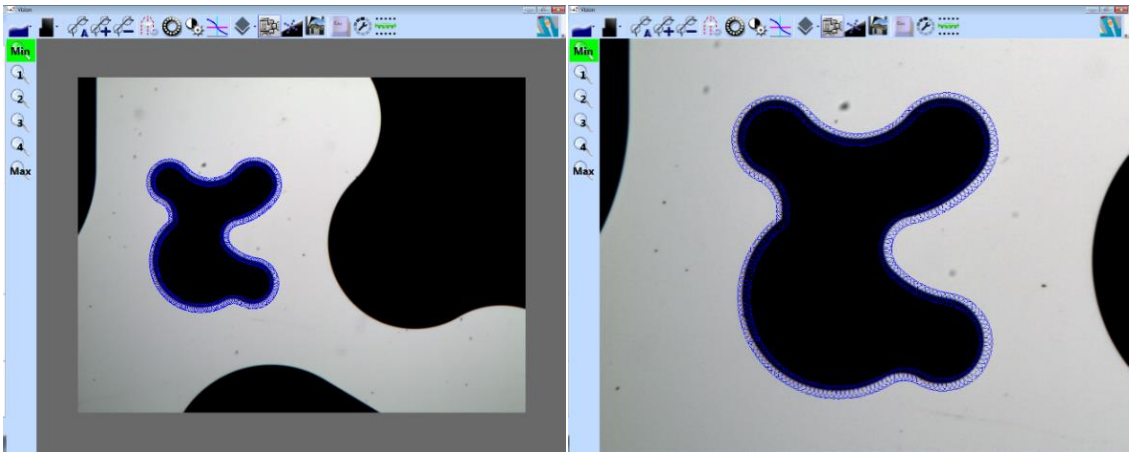
14.2.2 Zoom: Fit Recent Images

This works with the Recent Images Overlay tool, where the window view will be centred around the recently captured images. For more information see Chapter 24.0 – OVERLAYS, page 78.



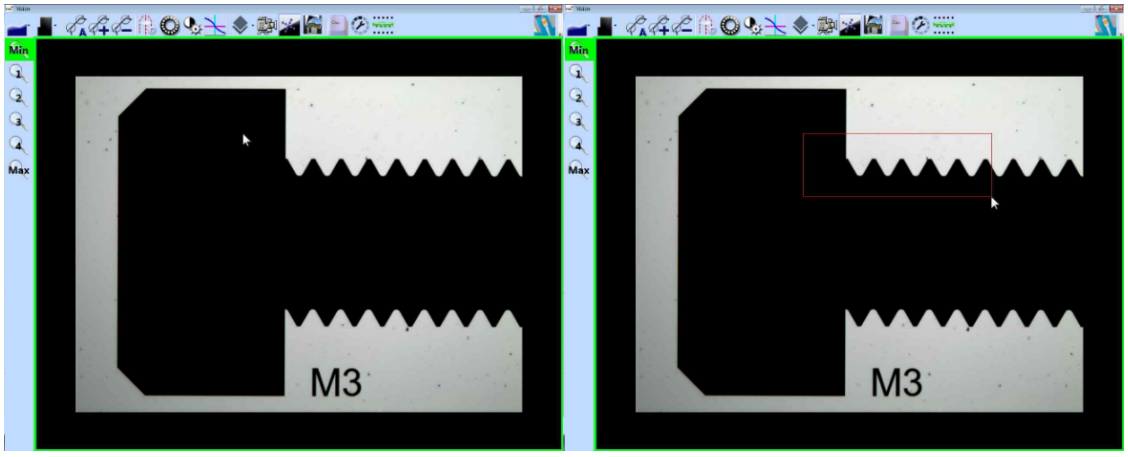
14.2.3 Zoom: Fit Component Volume

This will centralise the view around the measured component.

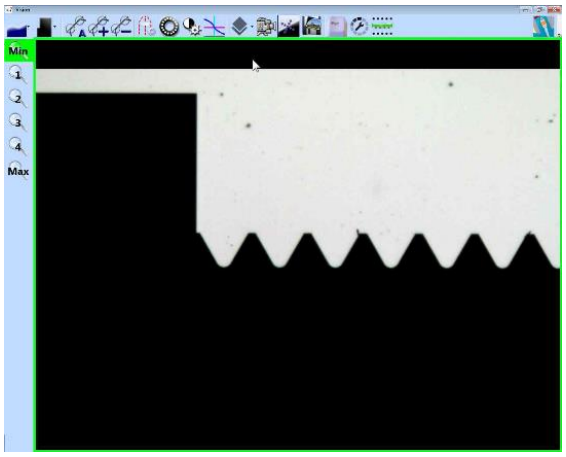


14.2.4 Zoom: Draw box

This will re-centralise about a custom drawn box. Clicking once will bring up the red zoom box which can be resized by moving the mouse.



When the box is of the desired size and position a second click will initiate the zoom.



14.3 Custom View

A custom view can be set in the camera view by holding a left click and dragging a box around the field of view and image stitching required. This will centralise the custom view in the camera screen. This is particularly useful when a graphic report is required of the camera view with the overlays applied.

15.0 LIGHTING

All Fusion machines are supplied with controllable light sources, to aid inspections for a range of components. Any light settings used during the inspection of a component will automatically be recalled if using the Play function to measure further components of the same type, for more information see Chapter 40.0 –THE PLAY FUNCTION in the software user guide or help.

15.1 Venture

The Venture has three user controlled light sources, the first is a ring light around the camera, typically used for lighting the top of a part. This consists of 64 white LEDs which can be lit individually to form a segment of varying size and user-controlled intensity. By optimising the position and intensity of the light, the clarity of any 3D edges on a component can be optimised.

Secondly, there is a backlight beneath the glass stage. This is of a fixed size and has a controllable intensity. This can be used for silhouetting the outside of a component or measuring holes or transparent features in the component.

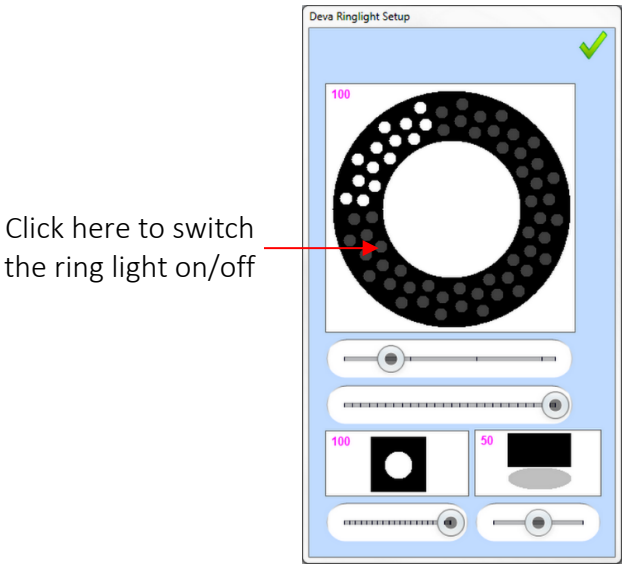
Thirdly, there is a Through the Lens (TTL) light source which is on axis with the lens and used for illuminating blind bores for example. A very low level of TTL light will be enough to completely white out an image if the surface is reflective. This lighting is used only in extreme cases where it is necessary to illuminate a small bore or cavity.

15.2 VuMaster

The VuMaster has two user controlled light sources; the ring light around the camera, consisting of 16 LEDs with variable intensity to light the top surface of measured components, and a fixed size backlight to silhouette components.

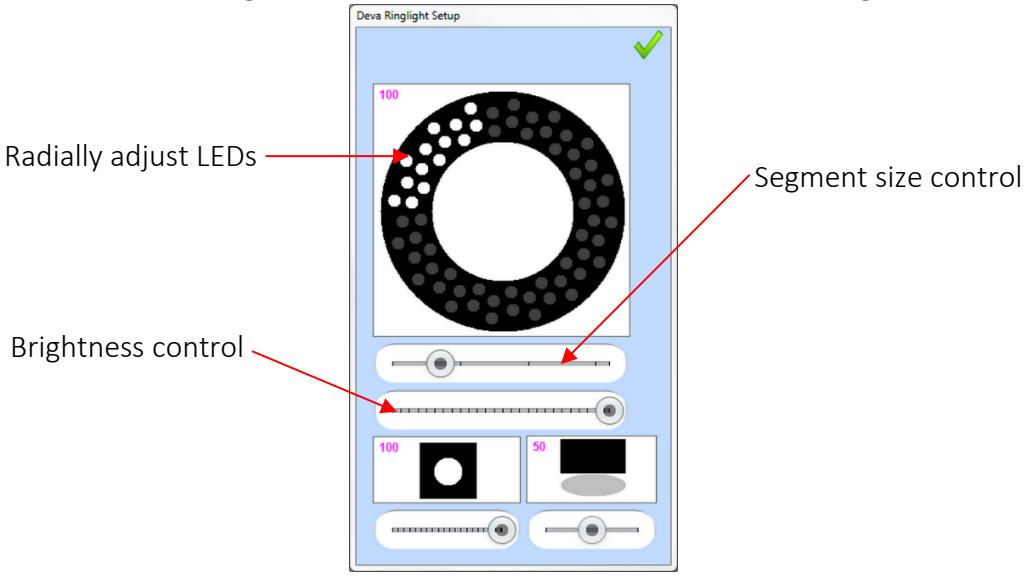
15.3 Light Control Menu

The three light sources may be switched on by clicking on the Light Control icon. This brings up the light control window, which can be positioned conveniently on the screen. To turn the ring light on, right or left click on the ring light icon at the top of the window.

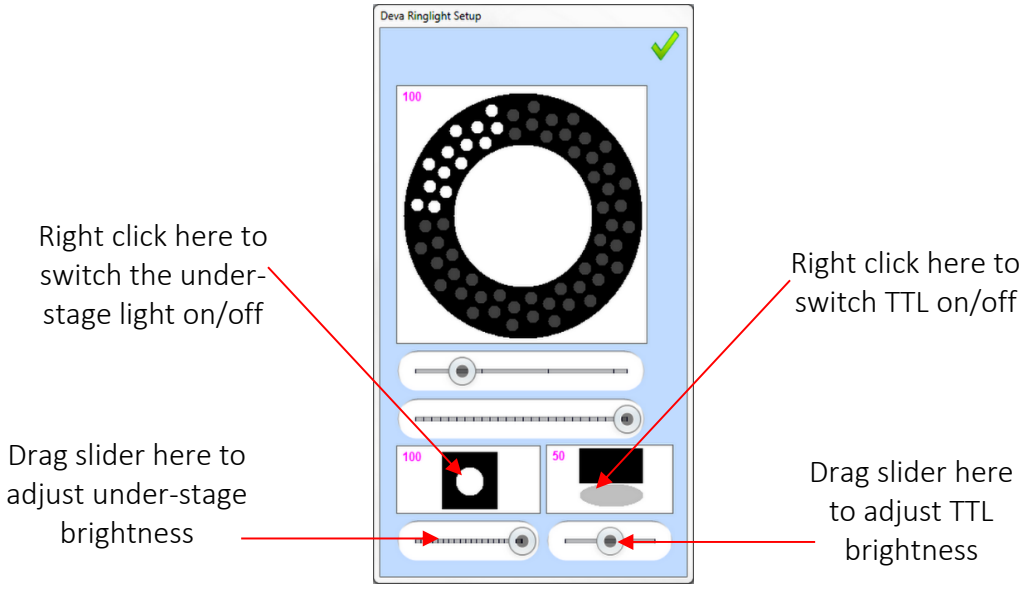


The LEDs currently lit are represented by light grey dots and unlit LEDs will be shown as dark grey. The number in the top, left hand corner of the window denotes the percentage of power being applied to the LEDs, which is proportional to their intensity (brightness). To increase or decrease the intensity of the LEDs, left click and drag the slider at the bottom of the window. As the intensity of the LEDs increases, the colour of the lit LEDs will become lighter. At 100% intensity, they will appear white. To increase the number of lit LEDs, left click and drag the slider for segment size control. Once the optimum segment size has been set using the slider, the radial position of the segment can be adjusted.

To rotate the segment, left click on the LEDs in the graphic and drag the lit segments to the desired position. This will often allow the edges of surface features to be accentuated, in order that they may be measured using the Video Edge Detection Tools. To turn the backlight on, left or right click on the backlight icon at the bottom, left hand corner of the light control window.



The pink number in the top, left hand corner of the backlight icon denotes the percentage of power being applied to the backlight, which is proportional to its intensity (brightness). To increase the intensity of the backlight, click and drag the brightness control slider as shown. The third part of the Light Control window is the TTL control.

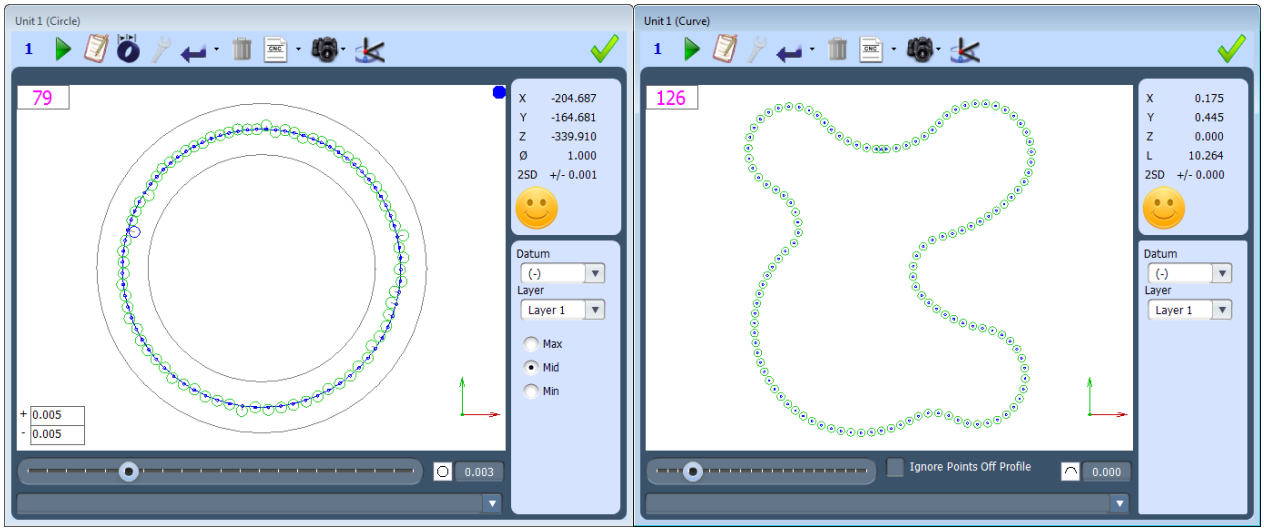


If the green tick button is clicked, the Light Control window will close, saving these settings.

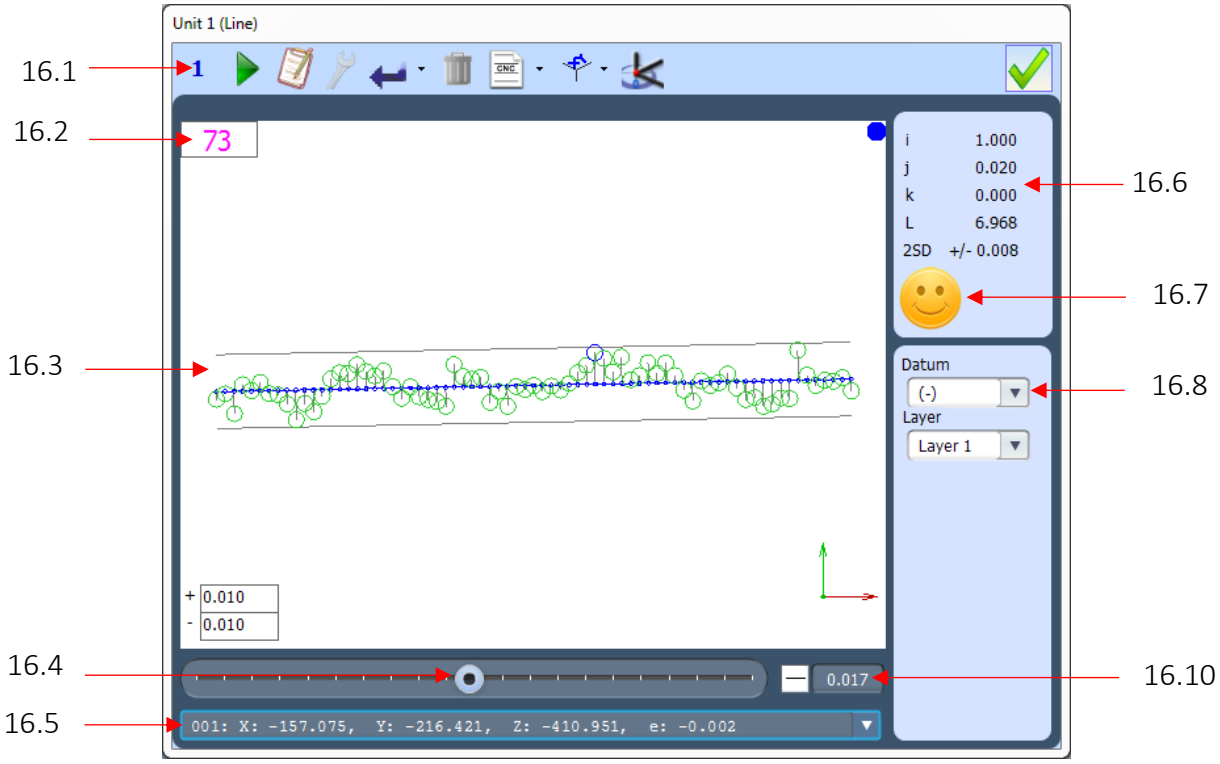
As a convenient shortcut, if either only the top light or only the backlight are on, right clicking the light controls icon in the camera toolbar will toggle between the two lights.

16.0 THE FEATURE WINDOW

When any feature is measured, a feature window will appear on screen like the images below.



The Measurement window for each feature may also be recalled from the Main Screen by right clicking on the representation of that feature. The figure below shows an annotated example of the measurement window for a line.



16.1 Feature Number

This indicates when the feature will be measured during playback, this can be manually changed by clicking and typing a new number.

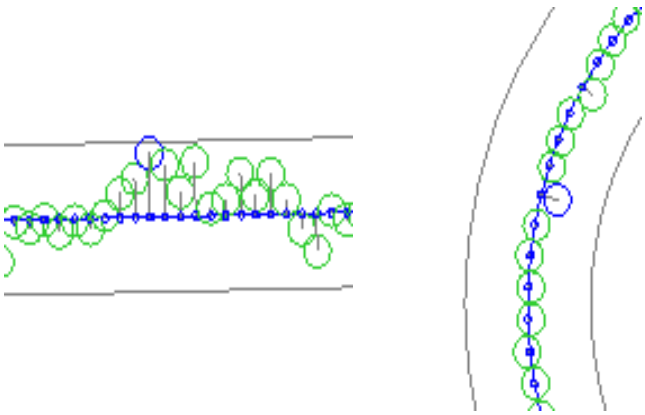
16.2 Points Taken

For all features, the number of points taken are shown in pink at the top left corner.

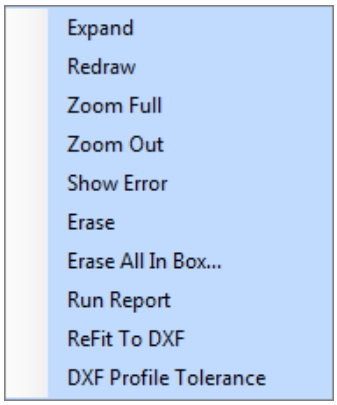
16.3 Graphic Window

The graphical depiction of the circle shows the measured points represented as small green circles and the larger blue circle is the best-fit circle through these points.

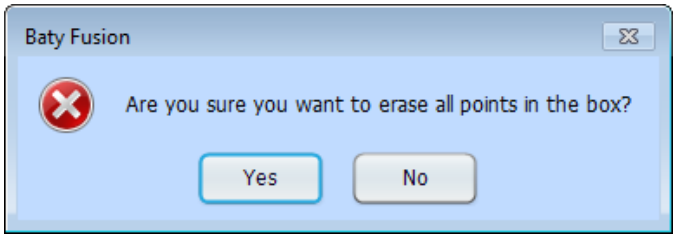
There will also be a blue circle, shown below, which displays the worst point along the form.



If there any points that have been taken in error, for instance swarf attached to the edge of the part, or if there has been accidental contact on the probe, these can be deleted. Right click on the point to remove, and the following window will appear.



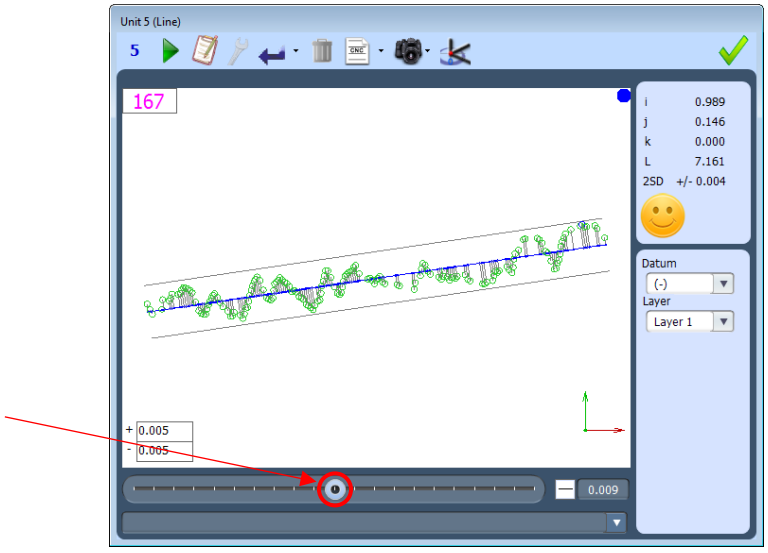
Select erase to remove the selected point, or alternatively select "Erase All In Box", after this is selected, drag to create a box to remove the contents of. The user will then receive a prompt to ensure that the points within the box should be deleted.



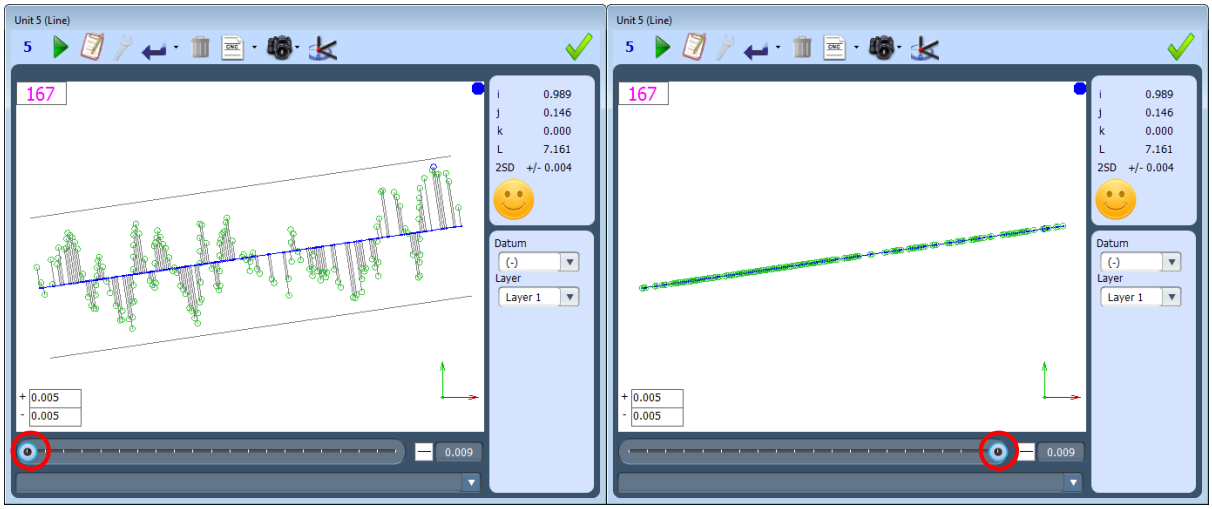
If happy with the selection, press Yes and the points will be deleted, selecting No will cancel this tool and to delete points this process must be started again.

16.4 Graphic Display Scale

Below the feature graphic is a slider bar for changing the scale at which the errors are displayed in the image, with left being the most extreme error representation and right the least.



The difference between the most and the least extreme can be seen below. For a measured curve, this scale will show the error in comparison to a DXF curve profile.

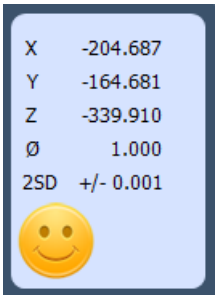


16.5 Point Details

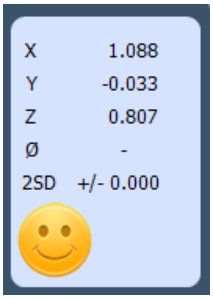
Shows the X, Y, Z coordinates and error of the points taken for the feature. The down arrow will show a drop-down list of all points and their associated error (e).

16.6 Feature Details

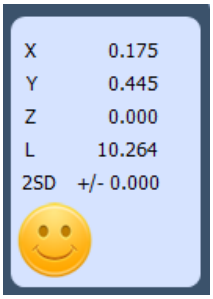
This feature details shown differ for each type of feature. For a circle or arc an X, Y and Z value are shown that relate to its centre point, and Ø its diameter, a point tool will show its X, Y, Z coordinates and a diameter of 0. A curve tool will give an X, Y, Z centre point where possible and instead of a diameter will show the length of the curve, L. For a line an i, j and k value show the direction vector for the line and its length is given as L. 2SD is the size of 2 standard deviations of the points taken, a lower value means the points are close to the mean value, a higher value shows the points taken had a wider spread from the mean.



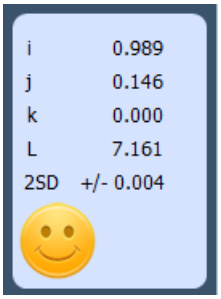
Circle



Point



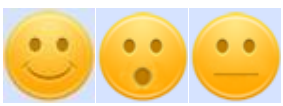
Curve



Line

16.7 Smiley Face

This shows whether the measured points fit the feature within the tolerances set in Machine Set Up, see Chapter 43.1.6 – Smile Threshold, page 140. There are three faces, the happy face to show the part is within tolerance, the open mouth showing bad form that is still within tolerance and the unhappy face to show when the form is worse than the allowable tolerance.

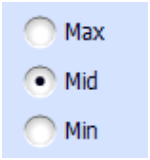


16.8 Datum

This pull-down menu allows features to be set a datum from A to Z. The layer can also be assigned from the lower drop-down menu.

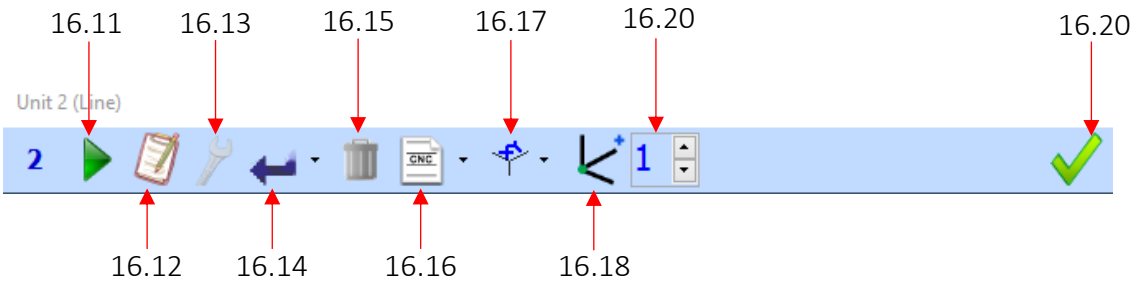
16.9 Max, Mid or Min

For a circle or arc, there is a section below the datum drop-down where one of three options can be selected for the circle made from the measured points. The default will be Mid, which is the least squares best fit of all the points taken. The Max and Min options will produce the maximum and minimum circles respectively, they will use the point furthest from or closest to the centre to create the most extreme diameters.



16.10 Geometric Tolerance

The form of the feature is shown in the box underneath the graphic window and a slider bar allows the user to change the scale used for depicting the error of the measured points.



16.11 Play Feature

Any feature can be played back individually from its feature window.

16.12 Notes

Add a note to feature.

16.13 Construct

Allows the construction of a feature relative to previously measured features. This is discussed fully in Chapter 38.0 – CONSTRUCTING FEATURES, page 101.

16.14 Retake

Erases the last measured point or the point selected from the drop-down menu.

16.15 Delete

This will erase all the measured points and close the measurement window. Note that this is a permanent function and cannot be undone.

16.16 Window View

The feature window can be made to display either the Measured Results, Inspection Program Details, Captured Images or Thread Profile Reports. Clicking the icon will scroll to the next window, or one can be selected using the dropdown menu.

16.17 Plane

Select plane of measure, for features measured with the camera this will default to the camera plane, although another plane can manually be selected using the dropdown arrow.

16.18 Set as Reference

This makes the feature selected a reference feature, for a line this means the line drawn in the Main Screen will be aligned to the closest axis, either X or Y and define X or Y = 0. For a circle, arc or point feature, the centre point will be set to X = 0 and Y = 0.

16.19 Position Set

This tool allows features to be set in a specific position in the leapfrog function. When a position is set using leapfrog, this icon can be used to easily manoeuvre the feature between the measured positions.

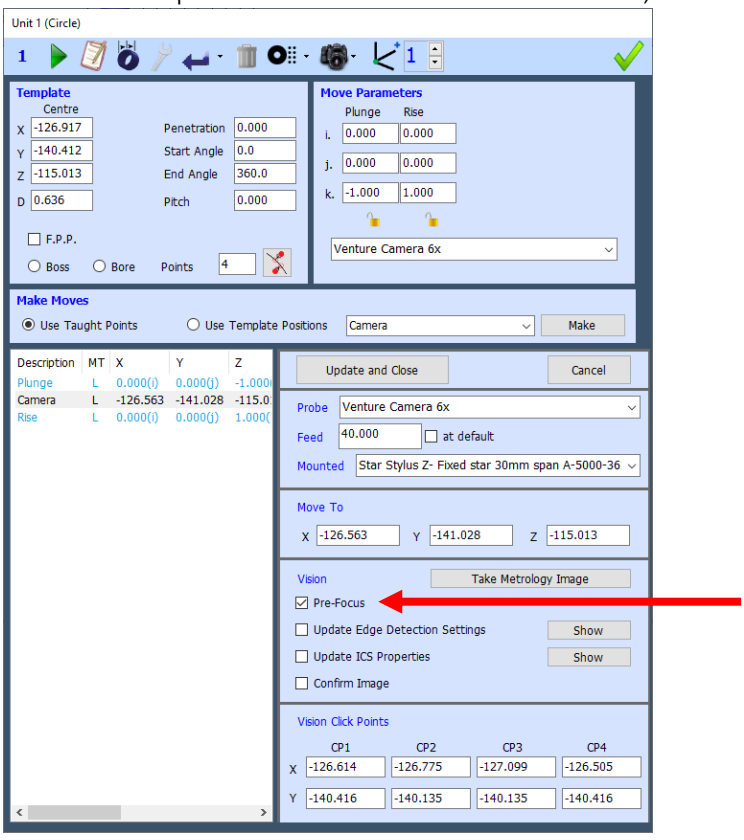
16.20 OK

Clicking will accept the measurements. The Measurement window will be closed, and a representation of the feature will be drawn within the Main Screen.

17.0 INSPECTION PROGRAM DETAILS

17.1 Pre-Focus

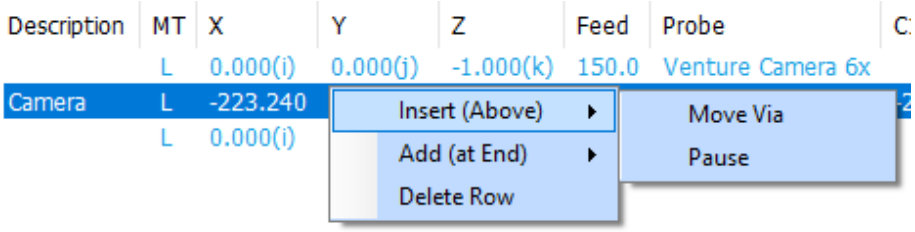
Pre-focus will perform an auto focus routine before measuring. The image below shows where in the inspection program details window this information is stored and edited. When selecting the “Camera” row, the Pre-Focus option can be selected via a checkbox, as shown below.



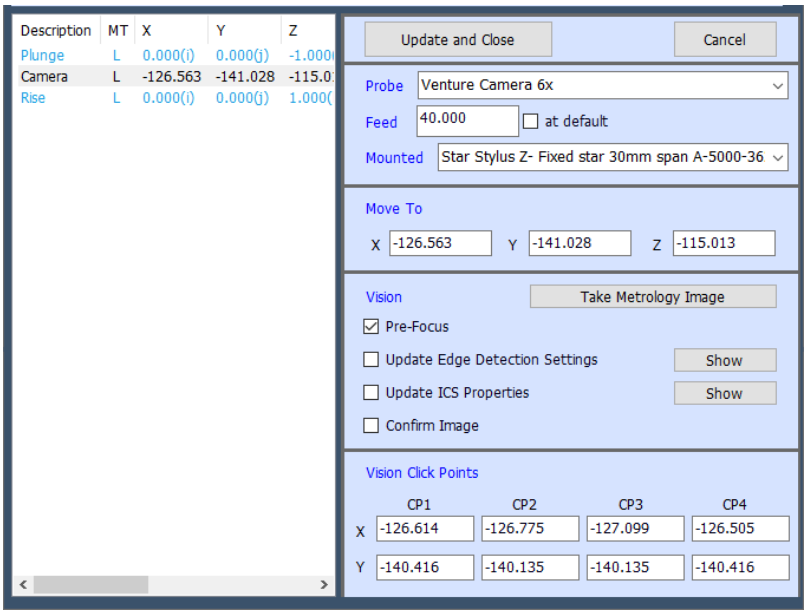
17.2 Move Via

A move via can be added using the joystick whilst a feature is first being measured, but it is also possible to add these to a feature after this has been created. Open the feature the move via is needed for and select the CNC options tab. Then select the contact or approach the move will be before or after and right click.

A menu will appear with several options, as shown below.



Select either Insert (Above) or Add (at End), depending on whether the move should be before or after this line, and select Move Via. This will add a move via using the machine's current position, but this can be edited using the menu on the right to make this any valid stage position. To remove an unwanted move via, right click on the row and select delete row.

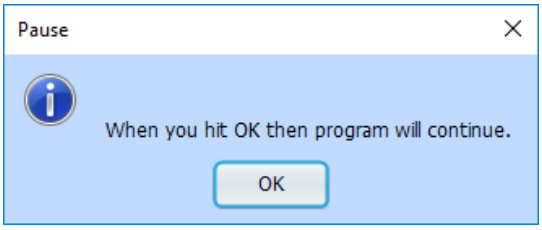


17.3 Adding a Program Pause

A program pause can be added to an inspection, to create a point where all movement is suspended until the user clears the message to resume the inspection. This can be added before or after any move in a feature, as with Move Via, by right clicking the move and selecting Pause. This will add a line in the to the moves list, labelled pause, as shown below.

Description	MT	X	Y	Z
	L	0.000(i)	0.000(j)	-1.000(k)
Camera	L	-210.751	-122.384	-331.659
	L	0.000(i)	0.000(j)	1.000(k)
Pause	P			

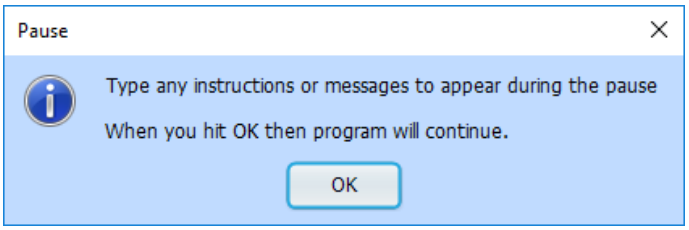
When the inspection is played back, the program will pause at the desired point and the following message will appear on screen.



The inspection will begin again when the user selects OK. This window can be modified to also show a personalised message, by entering text into the Pause Message field which appears after clicking the pause line in the CNC details window.

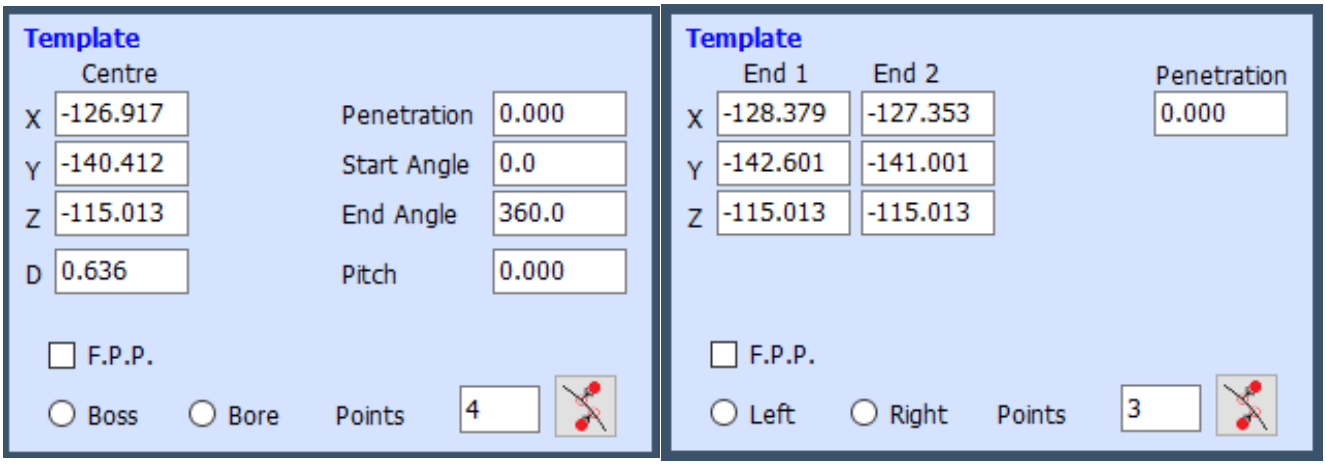
Pause P Type any instructions or messages to appear during the pause

This same message will appear during the program pause, above the usual message.



17.4 Template

The Inspection Program Details window contains a section on the part's Template, where further details about its points and position can be viewed and edited. This section will appear differently dependant on the feature measured. The image on the left shows how this will look for a circle, and on the right for a line.



17.4.1 X, Y, Z, D

This will show some positional information for the feature, in the case of a circle this is the position of the circle's centre, for a line it is the position of the beginning and end.

17.4.2 Penetration

This value used when measuring a circle using a touch probe, it is the depth from the plane that the measurement is taken. For instance, with a bore, the plane will be the top surface and the penetration how far into the hole the points are taken.

17.4.3 Start and end angle

This can be used to control the amount of the circle measured. 0° is taken from 3 o'clock, as is 360° as this signifies a full circle measurement.

17.4.4 Pitch

This is used when measuring a threaded hole using a touch probe. The probe will use the pitch of the thread to calculate the changing height of the circle to be measured.

17.4.5 F.P.P

If this box is selected, the penetration depth of the measured feature is governed from the projected plane, not the component's origin. This can be useful when measuring sheet metal parts where there may be more variation.

17.4.6 Bore/Boss

Many parts measured will either be taken from an external or internal part. The software will automatically select which of these is appropriate for the measured feature, but this can also manually be changed using these radio buttons.

17.4.7 Points

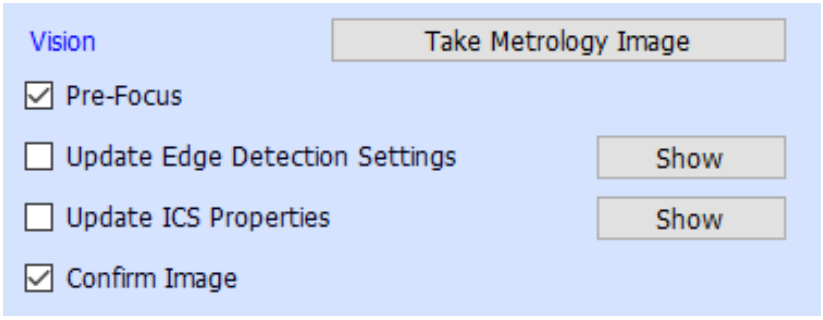
This shows the number of points taken for the measured feature in a touch probe measurement. This can be manually edited to any number, and selecting Use Template Positions and then Make, to create a template with this number of points, rather than the original number and position.

17.4.8 Regenerate Taught Points

This will regenerate taught points from the data points to recreate the template, the Make button will need to be pressed after this to update the moves.

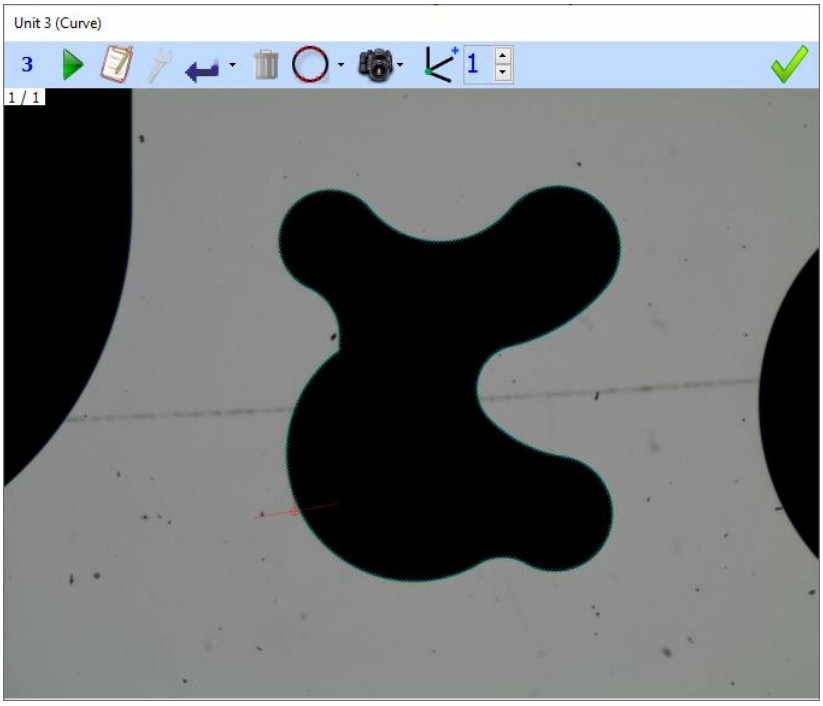
17.5 Confirm Image

This option will ask the user to confirm whether the camera view is in the correct position before measuring a feature. Found in the Vision section in the CNC setup for a feature, simply select the box.

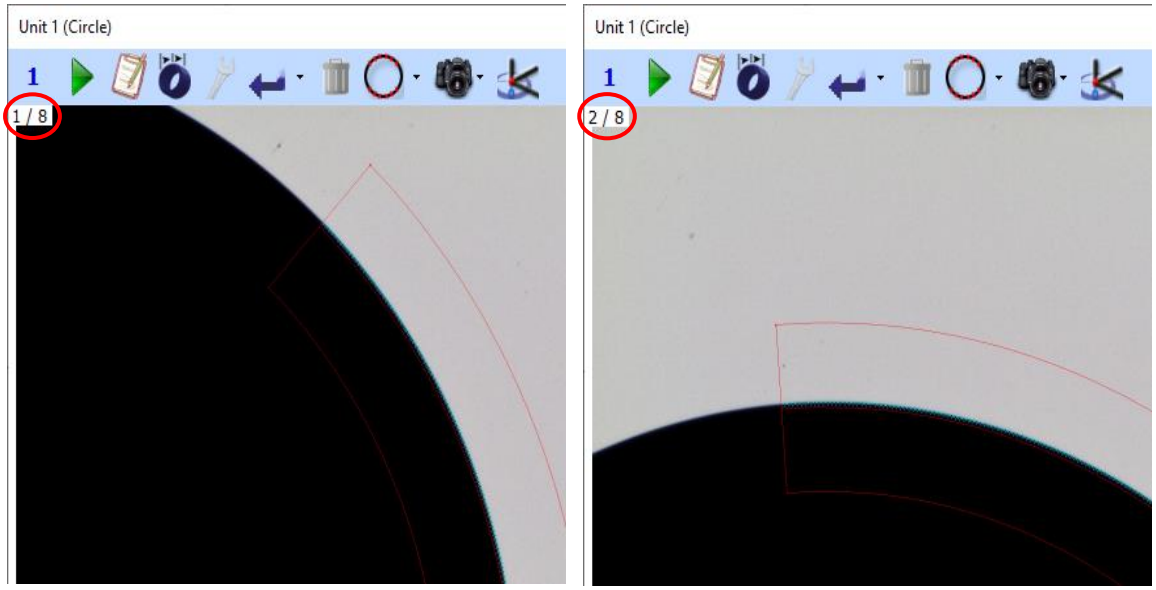


18.0 CAPTURED IMAGE

The images taken for the measurements are temporarily stored and can be viewed in this section of the feature window. This is found by selecting Captured Image from the dropdown list shown on the right, or by clicking the icon to cycle to this page. This window will show the Vision Measurements used and the points taken, demonstrated by the circle measured below.



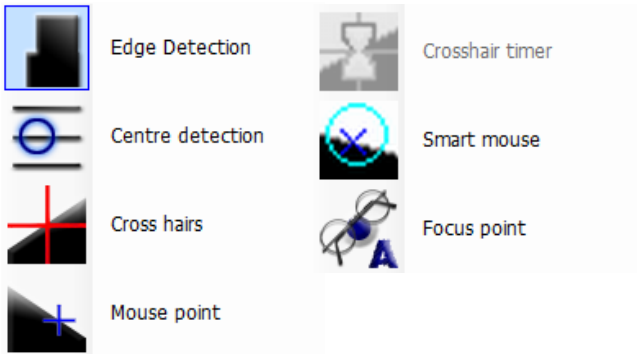
This feature fits in the camera's field of view and was measured using one position and one image. If a feature was measured using more than one image, for example on an item that did not fit into the field of view, the number of images taken can be seen in the top left-hand corner of the window.



Click on this number to move through the list of images.

19.0 MEASUREMENT TOOLS

There are several ways to measure parts in the Fusion software, ranging from fully automatic edge detection to user specific mouse clicks.



Before starting to perform measurements, select the Measurement Type required by clicking the appropriate button, as shown below.

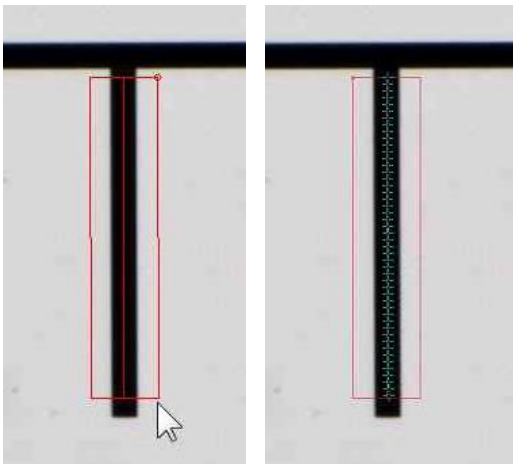
19.1 Edge Detection

When this tool is selected the software will determine which points create the edge between different colours, contrasts or focus distances on the image within the user defined by measurement selection box. This is the usual format used when measuring the edge of features on a component.

19.2 Centre Line Detection

This measurement type is used when measuring thin features, where it may be difficult to create a selection box that measures only one side of the feature, such as a thin line on a graticule. A selection box should instead be made to cover the width of both sides of the feature, and the tool will use both edges to create the centre line of the feature.

The measured points will be displayed as crosses on the image and a Measurement window will open in the same way as with any other measured feature.



19.3 Cross Hairs

It is also possible to perform measurements without using the software's automatic edge detection tools. This allows the user to have more control over the specific points taken and may be useful if the component being measured cannot be lit in such a way as to produce well-defined edges. The crosshair tool can be used to manually take a point at the intersection point of the cross hairs by clicking anywhere in the camera window.

19.4 Mouse Points

This is another manual tool, where the user is free to select a precise point on the image using a mouse click, and the chosen feature will be created from these selected points. There is no edge detection or interpretation of the point taken, it will be in the specific position of the click.

19.5 Smart Mouse

This tool combines the control of the Mouse Points tool with the benefit of the smart mouse detection tool. As with the Mouse Points tool, the user must click on the point they wish to be measured, although rather than needing to carefully select the exact position for the point, this tool will detect an edge point in the area surrounding the mouse click. This allows for faster measurement than Mouse Points, as the user only needs to select the approximate location for the point to be taken. It does, however, still require a reasonably good visible edge for the software to detect. The area over which the tool searches for the edge point can be defined in the Detection Tools window using Select Size.

19.6 Focus Point

When this tool is used the machine will run an auto focus routine on a selected area and create a point at the focus height. This tool can only be used when using the point measure feature. In the lens setup a nominated auto focus lens can be designated, when the focus point tool is selected, the lens will automatically move to this position ready to make the measurement.

20.0 MEASUREMENT FUNCTIONS

20.1 Overview

The measurement tools can be used to measure a wide variety of features, the table below summarises which tools are suitable for which of these feature functions.

Feature	Edge Detection	Centre Detection	Cross Hair	Mouse Points	Smart Mouse	Focus Point
Auto Select	✓	✓	✗	✗	✗	✗
Circle Measure	✓	✓	✓	✓	✓	✗
Line Measure	✓	✓	✓	✓	✓	✗
Arc Measure	✓	✓	✓	✓	✓	✗
Point Measure	✓	✓	✓	✓	✓	✓
Peak Point Measure	✓	✓	✗	✗	✗	✗
Thread Measure	✓	✗	✗	✗	✗	✗
Curve Measure	✓	✓	✗	✗	✗	✗
One Click Feature	✓	✗	✗	✗	✗	✗
All Edge Points	✓	✗	✗	✗	✗	✗
Ruler	✗	✗	✗	✓	✗	✗
All features in Area	✓	✗	✗	✗	✗	✗

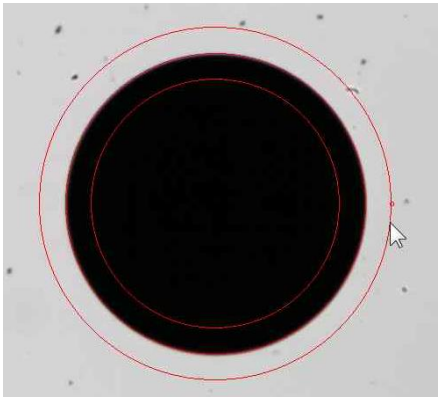
20.2 Auto Select

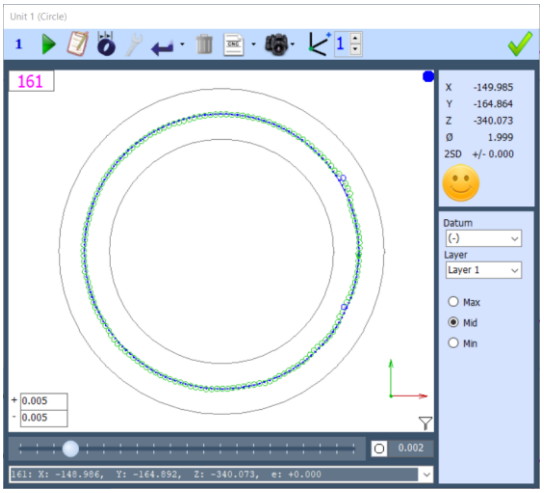
This function allows the user to measure lines, arcs or circles and the tool will adapt based on the clicks and movement of the mouse during the measurement. This allows for a range of different measured to be made without needing to select different tools. Auto select can be used with either the edge detection tool, or the centre line detection tools.

20.2.1 Measuring Circles using Edge Detection

Circles are measured in a similar way to arcs, the first click can be placed on any edge of the circle, the second click will most likely cause a line tool to appear between these points and movement along the edge will create an arc tool. The key difference between these tools is the distance covered after the first and second clicks. If this is more than 180° then the tool will snap to the form of a circle, allowing the user to click on the image a third time to define the circle to be measured. Now as the mouse is moved away from the edge, a circular selection box will be created that will move with the mouse, when the selection box of the desired size, (enclosing the entire edge, but only the edge being measured), another click will fire the tool.

This will automatically fire the circle tool and any edge within the selection box will be measured. A circle measure window will then appear, showing the measured points together with the best fit circle through the points:

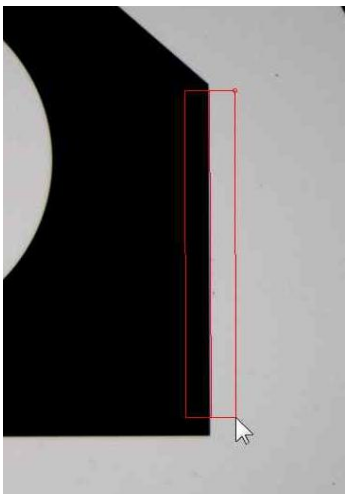


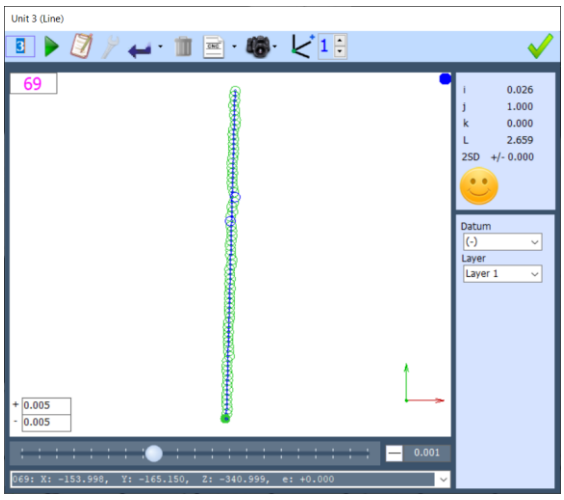


It is possible to recall the measured points shown on the grabbed image by using the Show Edge Pixels function, see Chapter 26.0 – SHOW EDGES, page 81. It is also possible to make the points appear on the image prior to firing the measurement tool, and then adjust the Edge Detection tools prior to taking the measurement, by using the Edge Detection Controls Chapter 19.0 – MEASUREMENT , page 48. For more information about the feature window, see Chapter 16.0 – THE FEATURE WINDOW, page 38.

20.2.2 Measuring Lines using Edge Detection

To measure a line, click on one end of the line and a red line tool will now become attached at the position selected. Now click on the edge at it other extreme, which will fix the other end of the line. Now as mouse is moved away from the line a selection box will be created, as shown below. When box is the desired size, (enclosing the entire edge, but only the edge being measured), click again. This will automatically fire the line tool and any edge within the selection box will be measured. A Line Measure window will then appear, showing the measured points together with the best fit line through the points:





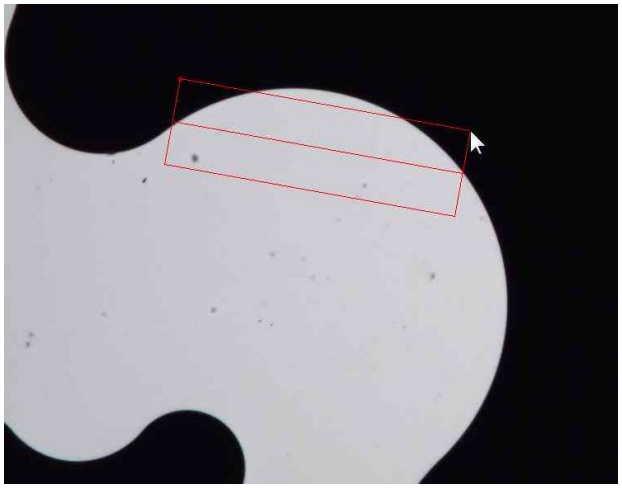
The graphical picture of the line shows the measured points represented as green circles. The blue line is the best-fit line through these points. The straightness value for the line is shown underneath the graphic view, together with a slider bar for changing the scale at which the errors are displayed in the graphical representation.

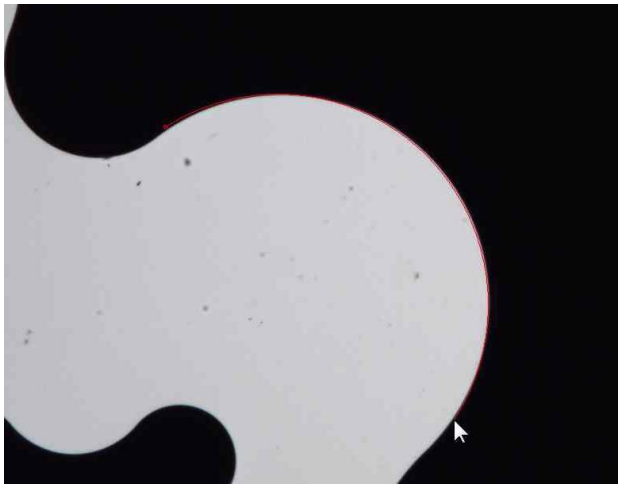
The number of points taken is shown in the top, left hand corner. The i, j and k values relate to the direction vector for the line and L is its length. The length shows distance between the two points selected on the image. It does not relate to any specific size on the component. It is possible to recall the measured points shown on the grabbed image by using the Show Edge Pixels button, see Chapter 26.0 – SHOW EDGES, page 81.

It is also possible to make the points appear on the image and adjust the Edge Detection tools prior to taking the measurement, by using the Edge Detection Controls, see Chapter 19.0 – MEASUREMENT , page 48. For more information about the measurement windows, see Chapter 33.0 – THE MAIN SCREEN, page 83.

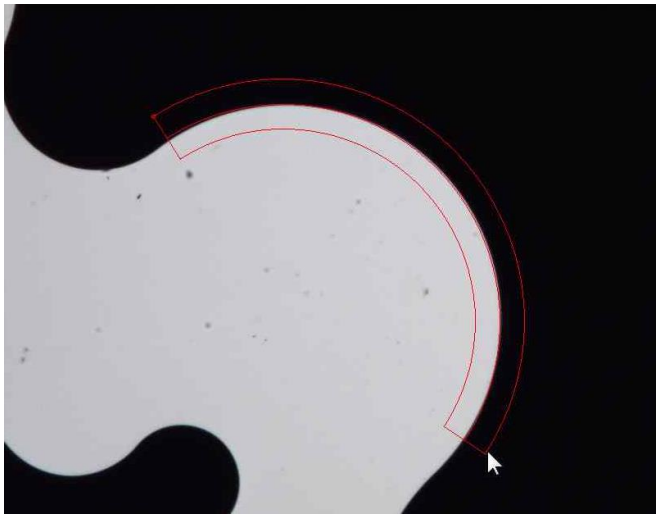
20.2.3 Measuring Arcs using Edge Detection

To measure an arc, click on the edge at one end of the feature and a line will become attached to the image at the position selected. Now click on the edge somewhere in the middle of the arc that is being measured. The line will attach itself to this point and if the mouse is moved away in a direction perpendicular to the line, a rectangular selection box will be created, in the same way as though a line were being measured. However, if the mouse is moved in a direction around the arc, the software will automatically realise that an arc is being measured and the line will now snap to the form of an arc, allowing the user to click on the image a third time at the end of where they want the arc to be measured. The images below show this transition from a line tool to an arc tool before the second click.

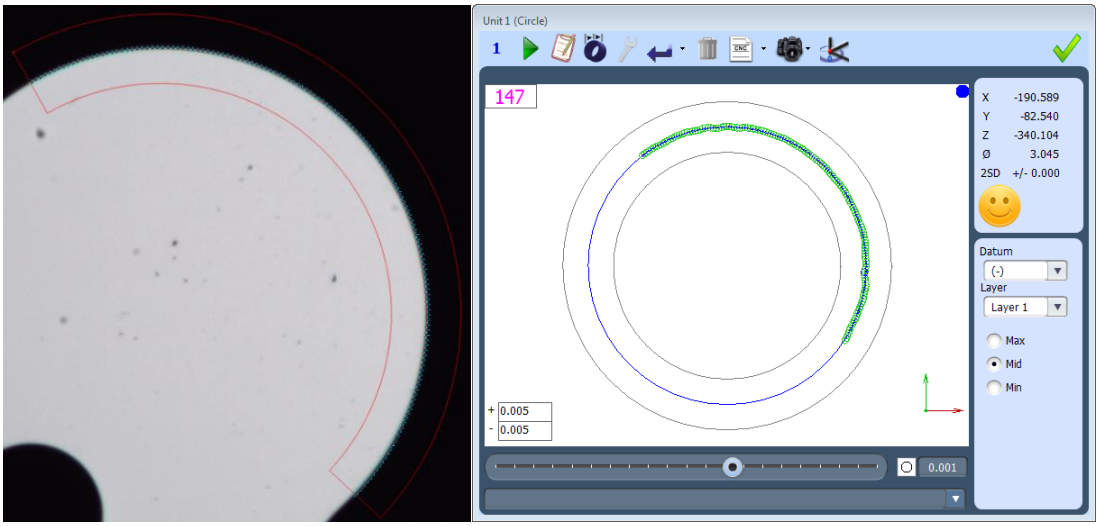




Now as the mouse is moved away from the edge, an arc shaped selection box will be created:



When the selection box is of the desired size, enclosing the whole edge but only the edge being measured, click again. This will automatically fire the tool and any edge within the selection box will be measured. The measured points will then be displayed as crosses on the image and a circle Measure window will then appear, showing the measured points together with the best fit circle through the points.



Arcs are sections of a circle and will be represented on a Circle Measure window. The number of points taken is shown in the top, left hand corner. The X, Y and Z values relate to the centre point of the circle (arc), and Ø is its diameter. The graphic of the circle shows the measured points represented as small green circles. There will also be a small blue circle amongst the green circles which is the point with the worst point in the feature. The larger blue circle is the best-fit circle through these points. The roundness value for the arc is shown underneath the graphic view, together with a slider bar for changing the scale at which the errors are displayed in the graphical representation.

The last measured points can be shown on the grabbed image by using the Show Edge Pixels function, see Chapter 26.0 – SHOW EDGES, page 81. It's also possible to make the points appear on the image and adjust the Edge Detection tools prior to taking the measurement, by using the Edge Detection Controls, see Chapter 19.0 – MEASUREMENT , page 48. For more information about the feature window, see Chapter 16.0 – THE FEATURE WINDOW, page 38.

20.3 Circles

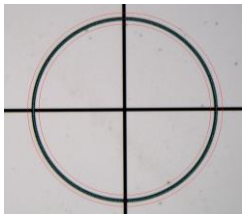
The circle tool can be used for any part that is circular for its full diameter. This can be used to show a centre position, diameter, and form.

20.3.1 Measuring Circles using Edge Detection

First, make sure the Edge Detection button is selected, then click on one point on the edge of the circle to be measured and another point opposite and a circle guide will appear. Position this circle to match the one being measured and click again. This time a selection box will appear and can be moved using the mouse to create a window for the tool to search for the circle's edge. A final click will lock the position of the box and the tool will fire, ensure that this box encloses the entire edge of the measured part, but include no other edges.

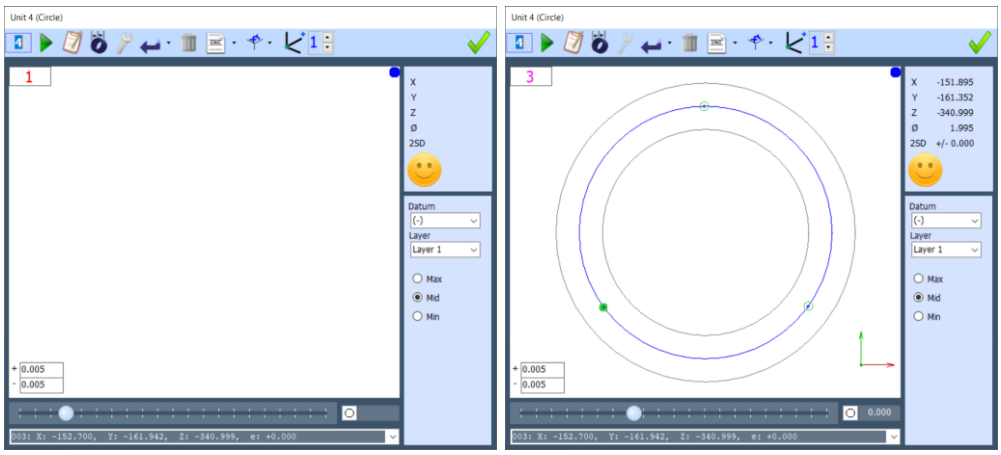
20.3.2 Measuring Circles using Centre Line Detection

This measurement type is best used when measuring thin circles, where it may be difficult to create a selection box that measures only one side of the feature. This can be used similarly to edge detection, by selecting three points around the diameter of the circle, although with this tool it is essential that the measurement selection box covers both the inner and outer edge of the circle by the fourth click that fires the tool. An example measured circle is shown below.



20.3.3 Measuring Circles using Mouse Points

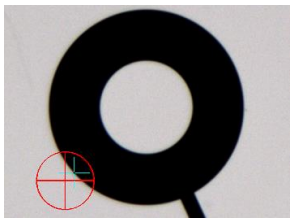
When this button is selected, automatic edge detection is no longer used. The user must click on the image in the exact position they'd like the point to be made. When the first point is taken, a circle measure window will automatically open, showing that one point has been selected, shown on the left. The tool will require a minimum of three, ideally equally spaced, point to produce a circle in the graphical window.



However, the software can always construct a perfect circle through three measurement points, and therefore at this stage the roundness value for the circle will be blank. As many points as desired can be added to the circle by clicking on the image, and as soon as there are more than three points, the roundness value of the circle will be shown underneath the graphic view.

20.3.4Measuring Circles using the Smart Mouse function

When this button is selected, the feature chosen will be measured by using discreet points selected by the user, like Mouse Points, described above. Although, when using this function, there is no need to select the exact points. Click in the approximate area of the point to be taken. The image below shows the target tools that are fired around the point selected, if the edge is within this target area, it will be taken as a point. The size of this area can be set in the Detection Tools Window, see Chapter 23.4 – Select Size, page 75.



20.4 Lines

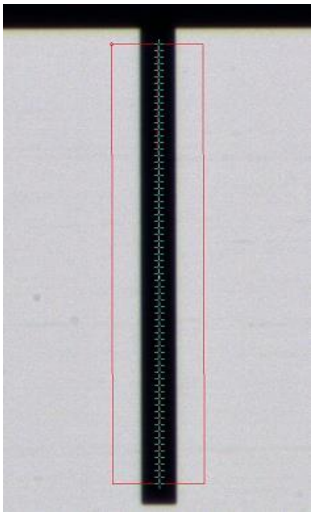
The line tool can be used to measure any straight features, the items' measurement window can then be used to view the item's length i, j, k vector and form.

20.4.1 Measuring Lines using Edge Detection

To begin, make sure the Edge Detection measurement type button is selected. Then, click on the edge of the desired line at the start and end positions of the line to be measured. This will bring up a selection box which can be adjusted by moving the mouse to an appropriate width, enclosing the full edge of the line and no other edges. Another click will lock the box width and fire the tool to measure the line.

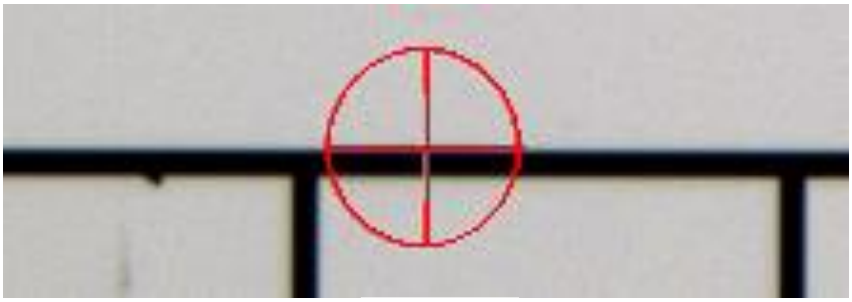
20.4.2 Measuring Lines using Centre Line Detection

This measurement type is used when measuring thin features, where it may be difficult to create a selection box for only one side of the feature, such as a line on a graticule. The measurement selection box for this feature should be made to cover both sides of the line.



20.4.3 Measuring Lines using Mouse Points

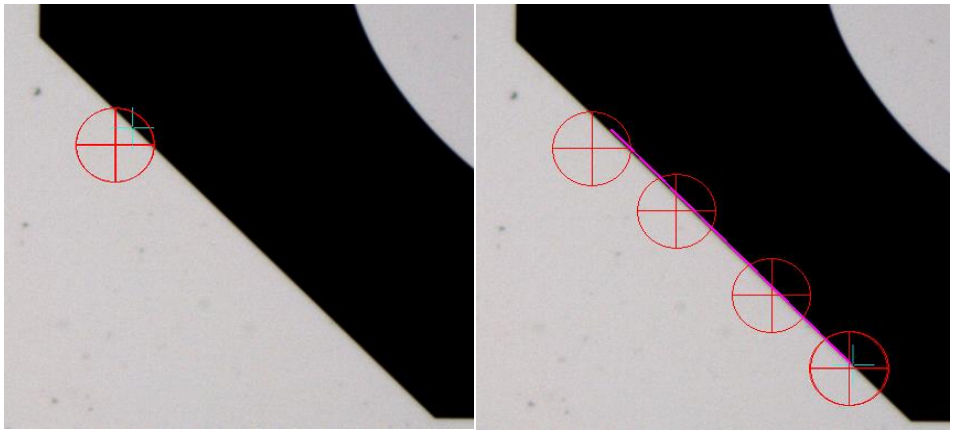
When this button is selected, automatic edge detection is no longer used. The user must click on the image at exactly the position that they wish to take a point, and this will be taken. The image below shows the point taken directly at the centre of the mouse click:



When the first point is taken, a line measure window will automatically open, showing that one point has been selected. The second point will create a line feature and after the third point has been taken, the window will begin to show the form of the line in the bottom left corner.

20.4.4 Measuring Lines using the Smart Mouse function

When this is selected, the feature chosen will be measured by using points selected by the user, like Mouse Points described above. Although, when using this function, there is no need to select the exact points. Click in the approximate area of the point to be taken and if an edge is within a target area from the click, this will be taken as a point. The size of the area scanned can be set in the Detection Tools Window, see Chapter 23.4 – Select Size, page 75.



20.5 Arcs

The arc tool is used to measure circular items less than 360°, or for measuring a large circle in sections. As with circles, this feature will show centre position, diameter, and form.

20.5.1 Measuring Arcs using Edge Detection

First, make sure the Edge Detection is selected, then click on one point on the edge of the arc and another point at the midpoint and an arc guide will appear. Move the mouse to the other end of the arc and click again. This time a selection box will appear and can be moved using the mouse to create a window for the tool to search for the circle's edge. A final click will lock the position of the box and the tool will fire, ensure that this box encloses the entire edge of the measured part, but include no other edges.

20.5.2 Measuring Arcs using Centre Line Detection

This tool is best to measure thin arcs, where it may be difficult to create a selection box that measures only one side of the feature. This can be used similarly to edge detection, by selecting three points around the diameter of the arc, although with this tool it is essential that the measurement selection box covers both the inner and outer edge of the circle.

20.5.3 Measuring Arcs using Mouse Points

When this button is selected, automatic edge detection is no longer used. The user must click on the image at exactly the position that they wish to take a point and wherever the user clicks will be taken. When the first point is taken, an arc measure window will automatically open, showing that one point has been selected. The third point will give an arc diameter and after the fourth point has been taken, the window will show the arc's form.

20.5.4 Measuring Arcs using the Smart Mouse function

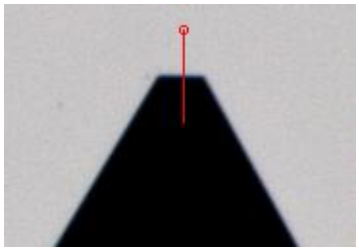
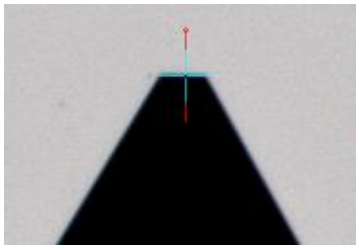
With this function, the feature chosen will be measured by using discreet points selected by the user, like mouse points, described above. Although, when using this function, there is no need to select the exact points. Click in the approximate area of the point to be taken, the tool fires a target area around the point selected, if an edge is within this target area, it will be taken as a point. The size of the area scanned can be set in the Detection Tools Window, see Chapter 23.4 – Select Size, page 75.

20.6 Points

This is used to measure specific points; it will give only position as it has no size or form.

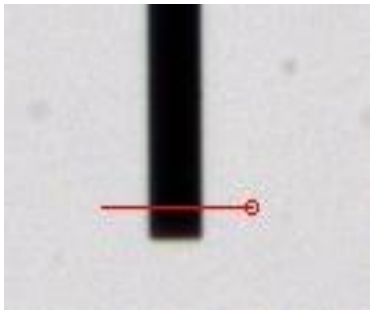
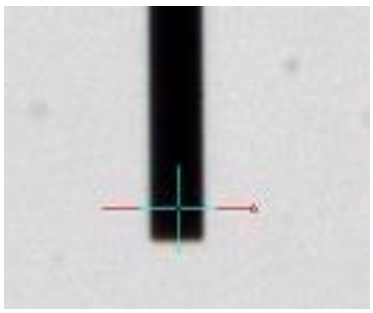
20.6.1 Measuring Points using Edge Detection

First, make sure edge detection is selected, then to measure a point click on the image at the position for the measurements to be taken. A line will now be attached to the image at the position selected that extends in both directions away as the cursor is moved. Move the cursor so the line cuts the edge at the position to take the point. Ideally this line should be approximately 90° to the edge, and it should only cut across one edge. When the line is the required size and position, (cutting the edge at the position desired), click again. This will automatically fire the Point Tool and the point where the line cuts the edge will be measured. Momentarily the measured point will be displayed as a cross on the image and a Point Measure window will then appear, showing the measured point.

20.6.2 Measuring Points using Centre Line Detection

To measure the centre point between two edges, click approximately at the centre point and pull the tool perpendicularly to, and covering, both edges. A second click will fire the tool and the centre point will be taken.

20.6.3 Measuring Points using Mouse Points

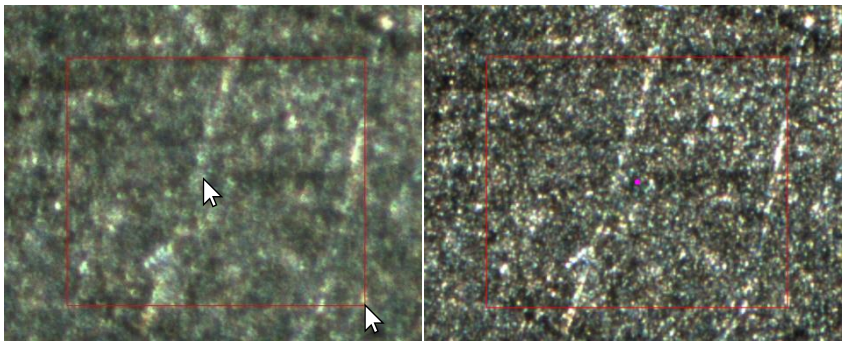
When this button is selected, automatic edge detection is no longer used. The user must click on the image at exactly the position that they wish to take a point, wherever this click is performed will be taken as a point and point measure window will open.

20.6.4 Measuring Points using the Smart Mouse function

With this function, the feature chosen will be measured by using the clicks performed by the user, like mouse points, described above. Although, when using this function, there is no need to select the exact point. Click in the approximate area of the point to be taken, the tool fires a target area around the point selected, if an edge is within this target area, it will be taken as a point. The size of the area scanned can be set in the Detection Tools Window, see Chapter 23.4 – Select Size, page 75.

20.7 Measuring Points using Focus Point

After the point tool is selected, the focus point will become available. Click once in the camera window in approximately the position to take the point and a red box will begin to form symmetrically around this area with the click as the centre point. When the area is of the desired size, click again to fire the tool and the machine will begin an auto focus routine searching in the area in the red box. If a height with a good focus is point, a point will be made at the centre point of the red box.



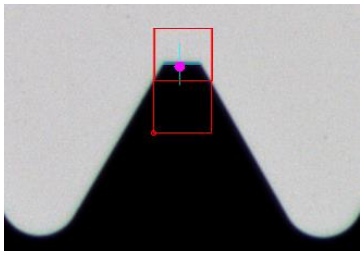
If a plane feature is opened before a focus point is taken, this point can used to create a plane at the object's surface, it is recommended there be a minimum of 4 points taken for the plane.

20.8 Peak Point

This function allows the user to define a box on the image, and the software will determine the nearest or furthest point on any edge, perpendicular to the orientation of the box. This may be useful, for instance, for determining the highest point on a gear tooth.

20.8.1 Measuring Peak Points using Edge Detection

First, make sure Edge Detection is selected, then click twice on the image to define a line perpendicular to where the peak point is. Now move the cursor so that it creates a box whose height encompasses the peak of the area and click for a third time, preferably in the area above where the peak appears to be. This will automatically fire the tool and the highest point on the edge, perpendicular to the selection box, will be measured.

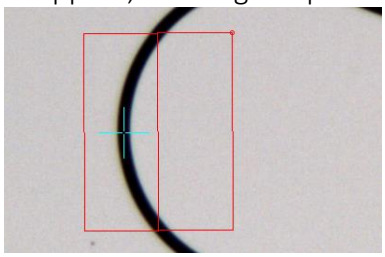


A point measure window will then appear, showing the position of the measure point.

20.8.2 Measuring Peak Points using Centre Detection

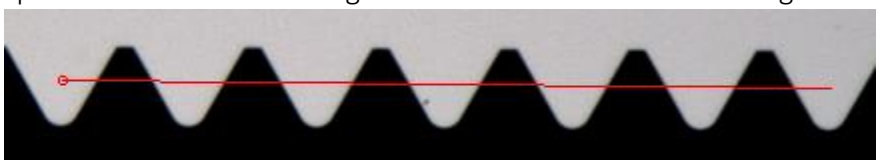
To find the centre of a peak point on a thin line, make two clicks to form a line perpendicularly to the peak and create a box that covers both edges of the peak, then make a final click near the approximate areas of the peak to fire the tool.

A point measure window will then appear, showing the position of the measure point.

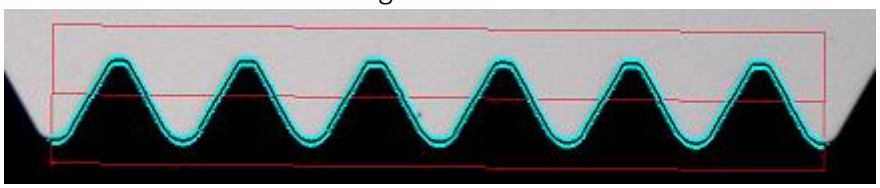


20.9 Thread Measuring

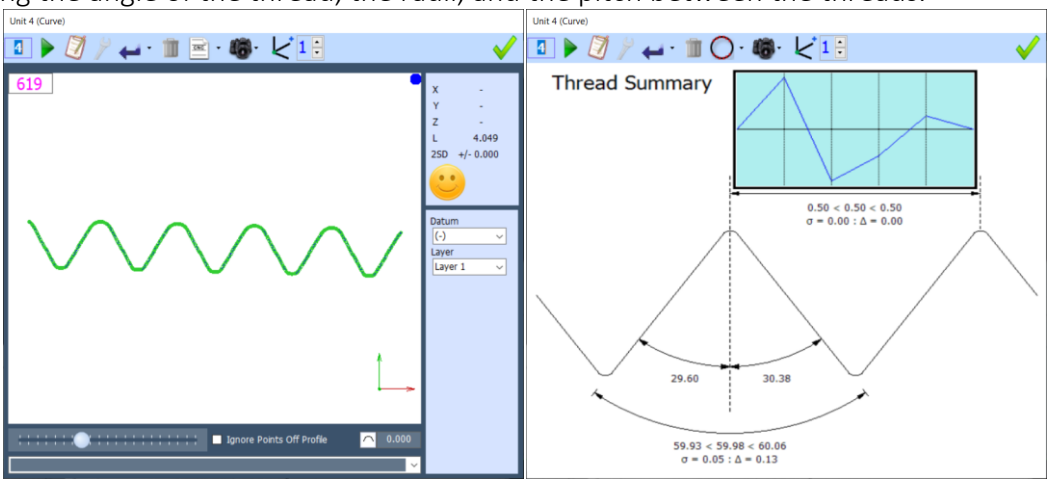
The thread tool will find and follow the edge of any thread defined within a box selected on the image, using the edge detection method. For optimum measurement, position the camera so that a minimum of three full threads are visible within the camera window. Usually, the best definition of the edge of the threads will be achieved by using the backlight to obtain a silhouette. To begin, use the tool as if doing a line measure, click once at one end of the thread at the pitch diameter and click again at the end of the thread being measured.



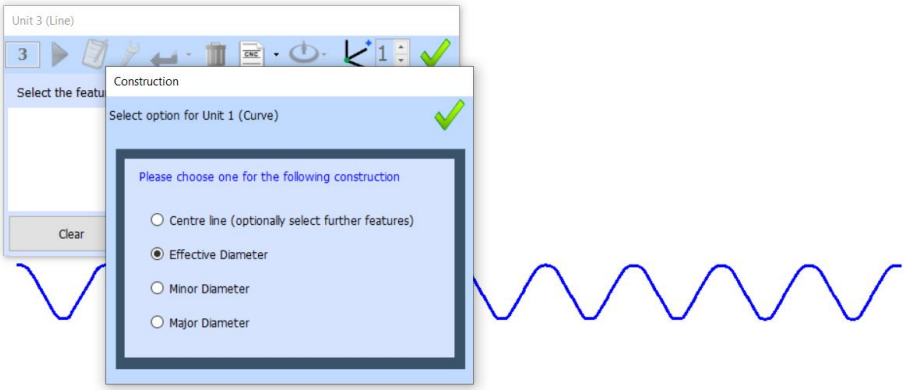
Then drag a box large enough to capture the full thread form to be measured and click another time to fire the tool and the full thread edge within the window will be followed.



A curve measure window will then appear, showing the thread's profile and length. In the window's top toolbar additional views of the measurement can be seen, for a thread there is an additional page after CNC details and captured image containing a thread summary report showing the angle of the thread, the radii, and the pitch between the threads.



The measured thread can then be used to easily add constructed lines to show the minor, major and effective diameter of the thread. To add these to the report, go to the measure tab, select a line tool, and then construct. A selection anywhere on the thread will bring up a menu for thread constructions.



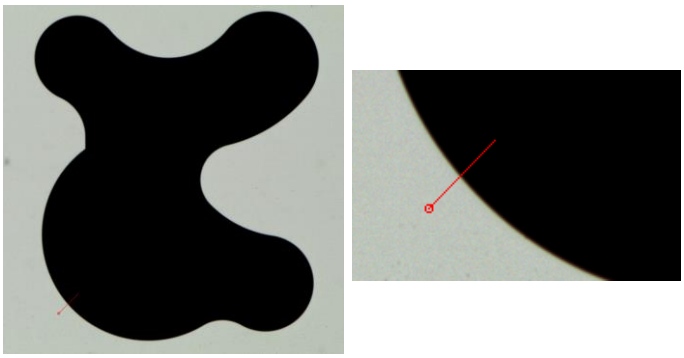
Below is an image of a measured thread with each of these constructed lines added.

20.10 The Curve Measure Function

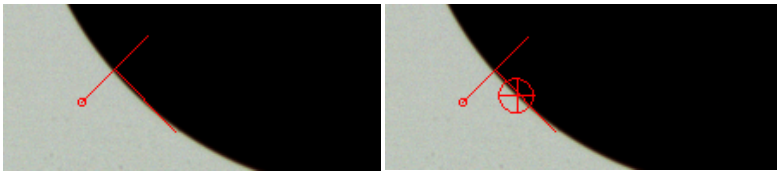
This function is used to follow an edge around a feature, allowing for easy measurement of complex shapes. The density of points taken can be defined by adjusting the Step Size in the Edge Detection Tools, for more information see Chapter 23.2 – Step Size, page 74.

20.10.1 Measuring a Curve using Edge Detection

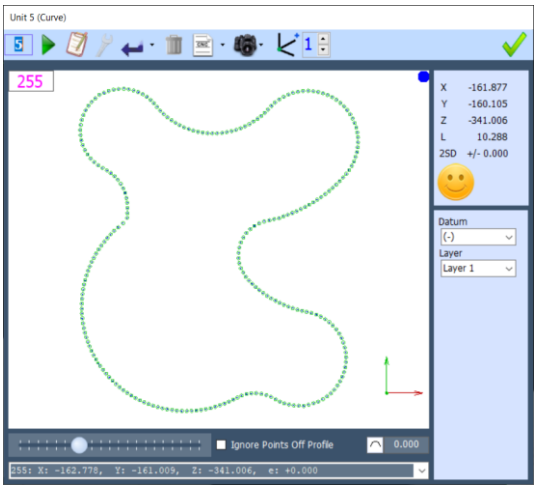
To measure a curve using edge detection, click on the edge at the position for the scan to start. A line will now become attached to the image at the position selected, this will extend in both directions away from the point as the cursor is moved. Click to lock this scanning width when the line cuts the edge at approximately 90° to the edge, cutting one edge only.



A new line will become attached to the cursor, this will be used to set the direction of the scan and should be positioned along the part's edge. The final click is used to select where the scan tool should end, this can be placed at any position along the curve, in and out of the current camera view. To measure the complete curve, the final click should be made with in between the first and third clicks, as shown below.



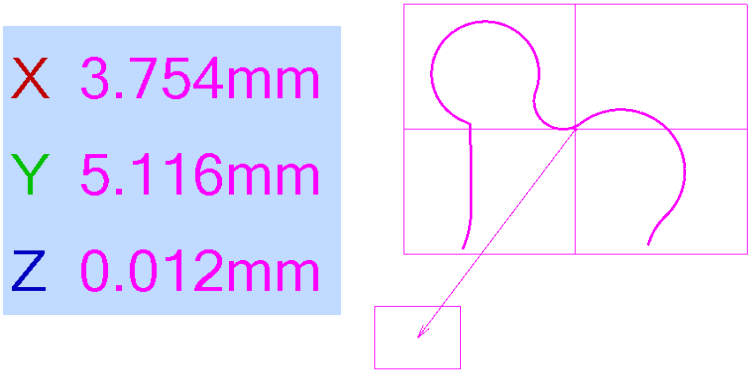
This click will fire the tool and the edge will be followed until the end point has been reached and a curve measure tool will appear showing the points taken as small green circles.



The number of points taken is shown in the top left-hand corner. The L value shows the length between the first and last scanned points. The profile value for the curve is shown underneath the graphic view if the curve is being compared to a curve profile or DXF the slider bar at the bottom of the window can be used for changing the scale at which the errors are displayed in the graphical representation. Please note that without a DXF imported, the profile value will always display a result of 0. A DXF is required to calculate the profile result of the points taken in the curve. See Chapter 39.0 – DXF FILES page 117.

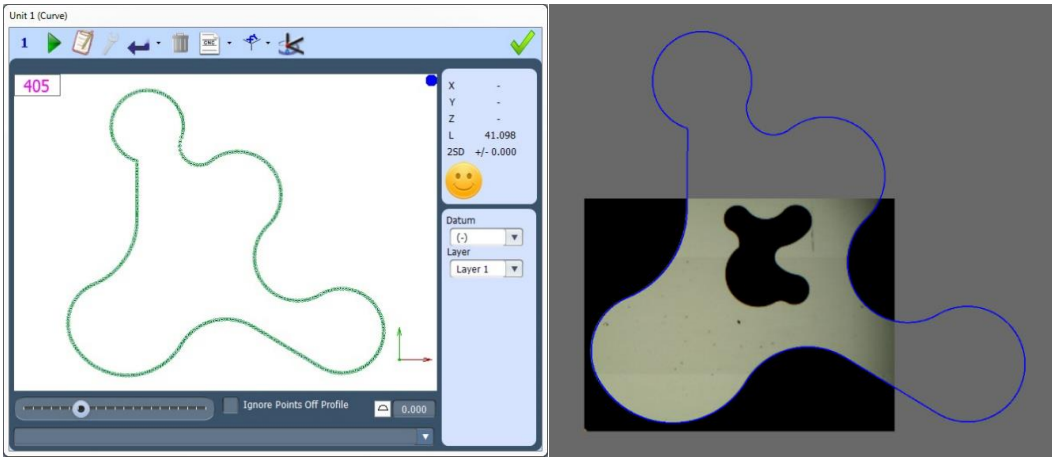
20.10.2 Measuring a Curve that is larger than the Field of View

Curves larger than the camera's field of view can be measured on both CNC and manual machines. The start point, direction and end point should be set as described above in 20.10.1, and the curve tool will follow the curve to the edge of the field of view until a move is required. CNC machines will move automatically to follow the edge until the end point, and manual machines will guide the user to move the camera as required. The Main Screen will be shown in the image below for this manual prompt, The Field of View for the camera is shown as a large pink box. A small pink square represents the target to where the camera must be moved for it to measure the first feature. The DRO also shows how far the camera must be moved in each axis to get to the centre of the target. Move the camera using the hand wheels so that the



centre of the crosshairs is within the pink target box. Typically, this needs to be within 1mm of both the X and Y coordinates displayed in the DRO. When the camera is within the target area, the rectangle representing the field of view (and the crosshairs), and the XY readouts, will temporarily turn green. The points will be taken, and the camera image window will move to the next part of the curve to be measured.

After the end point has been reached, the curve feature box will appear as with a normal curve.

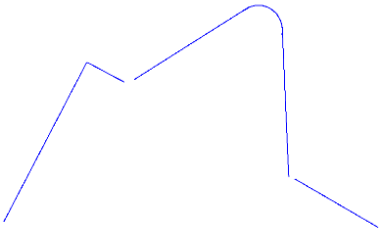


20.11 The One Click Feature

The one click feature tool can be used to quickly measure a circle, line or arc with a single click using edge detection.

20.11.1 Measuring with the One Click Feature using Edge Detection

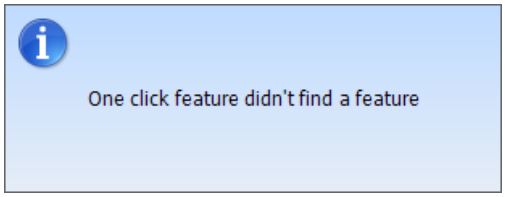
To measure any feature using this tool, click once on or close to its edge, the software will then scan for an edge around this click. If an edge is found, it will follow this feature in both directions until it reaches the edge of the camera's field of view or it transitions into another feature. When the measurement is complete, a feature window will open as usual. If another click is made for a new feature, this window will close, and the new feature's window will open. This ensures multiple features can be measured quickly with minimal interaction from the user.



The size of this area scanned is configurable in vision setup window, using the 'Select Size' slider, see Chapter 23.4 – Select Size, page 75.

20.11.2 If One Click Feature Didn't Find Feature

If an edge is poorly defined, too small, or too far from the click, a message will appear to show that a feature was not found.



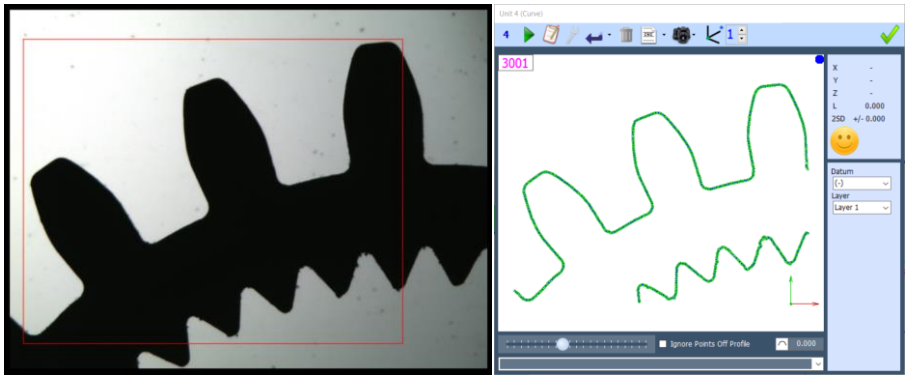
If this happens, try to ensure that the desired edge is in focus or for smaller features a greater zoom position can also help as this will increase the size of the feature on the screen. If this does not help, try changing the size of the initial area scanned by adjusting the 'Select Size' slider in the vision setup window, see Chapter 23.4 – Select Size, page 75.

20.11.3 The All-Edge Points Function

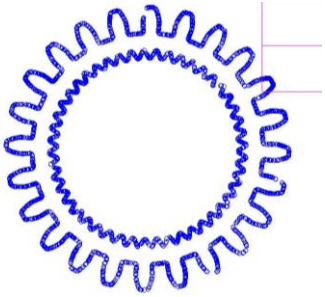
As with the curve function, described in Chapter 20.10 above, this finds edge points in non-standard features in a user defined box rather than by following an edge.

20.11.4 Measuring All Edge Points using Edge Detection

To use this tool, click on the screen twice define the opposing corners of a box to search in, this will fire the tool and a curve feature window will then open as follows:



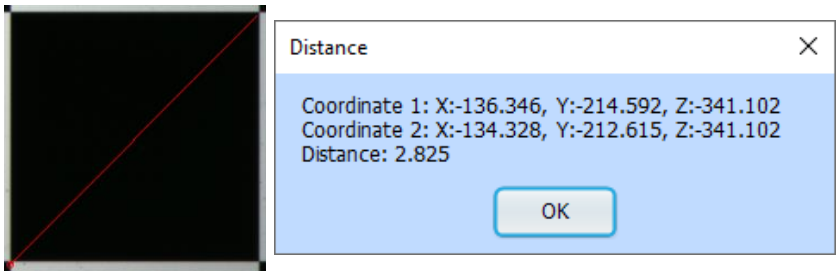
The size of this box can be as large as needed, with all measured points being put in the same curve feature. This feature will not be drawn as a polyline as the points taken are not made by following an edge, but rather by creating points on all edges at once. This curve can still be used to compare to a DXF curve, for more information, see Chapter 39.0 – DXF FILES page 117.



The density of points taken can be defined by adjusting the step size in the edge detection tools, discussed in Chapter 23.2 – Step Size, page 74.

20.12 The Screen Rule Function

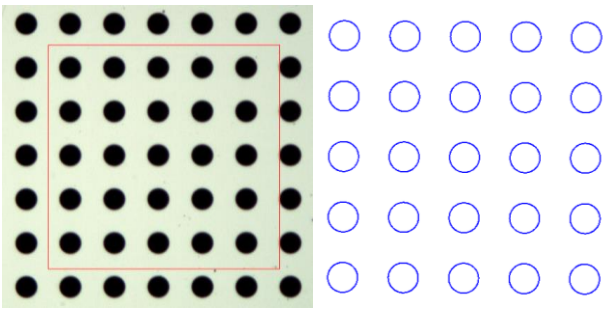
The Screen Ruler function is a tool for quickly measuring the distance between two clicks in the camera window. The image below shows this being used to measure the distance between the diagonals of a square. To start, click on one corner and a red line will attach to the cursor until a second click. Then a box will appear, reporting the coordinates of the first position, the coordinate of the second position and the distance between the two.



These results cannot be printed out in the form of an inspection report – they are for a quick check and once the box is cleared this information will be lost.

20.13 All Features Tool

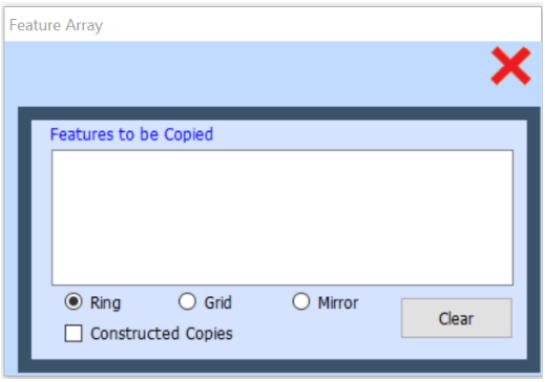
The All Features tool is designed to recognize all features within a user defined area. First, click once in the corner of the area to be measured, this will create a red box tool tied to the cursor. Move the mouse to create the desired measuring area, noting that if this is larger than a single camera grab, green boxes will appear to show the necessary camera positions for the tool. When the box is of the desired size, enclosing all the features to be measured, click to fire the tool. The camera will recognize and measure all features in the window and quickly measure all these. This is a good method to use if there are many features that need to be measured.



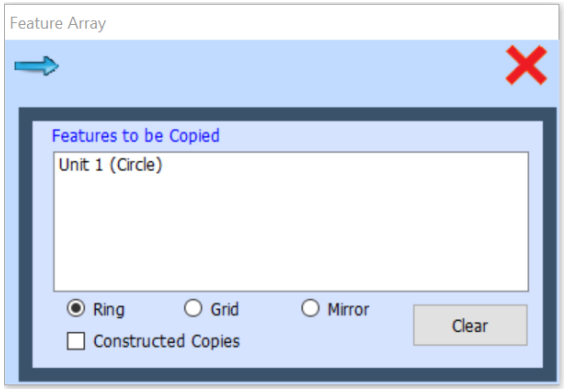
This tool can also be used outside of the field of view and is complemented by the recent images overlay, to show the position of the features to be measured.

20.14 Array Tool

The Array tool can be found in the Measure toolbar, this allows measured features to be copied in a circular or grid pattern or mirrored around another feature to measure multiple features of the same type more efficiently. When selected, the window below will appear and the main window will begin to flash, as the toolbar at the top prompts the user to select the feature or features they wish to copy.



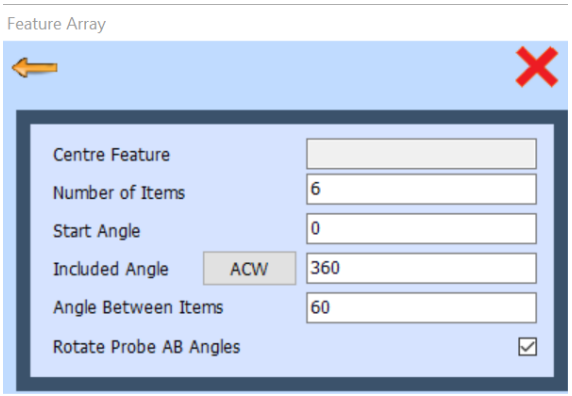
Any features that are selected now will be added to the list of features to array in the window.



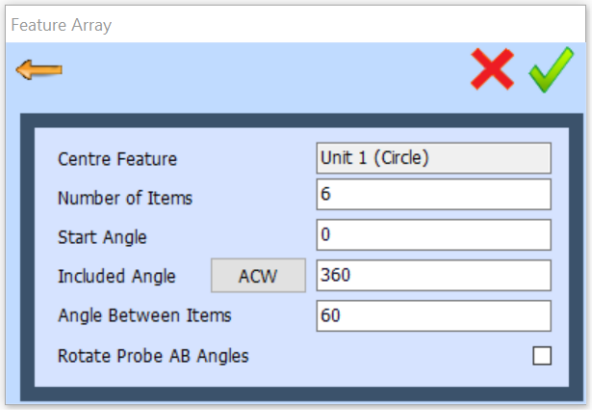
After at least one item is selected, a blue arrow will appear to proceed onto the next step.

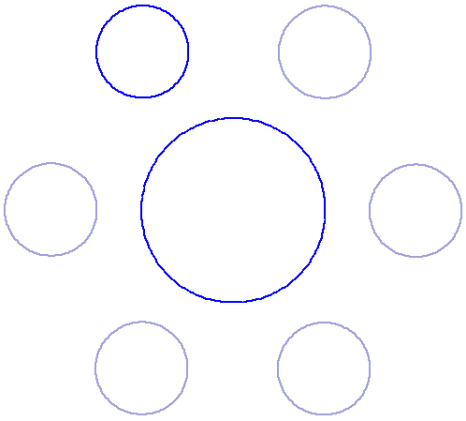
20.14.1 Ring Array

A ring array will copy features in a circular pattern, around a centre point.

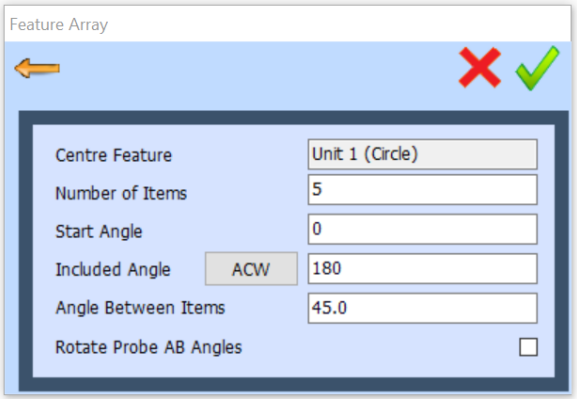


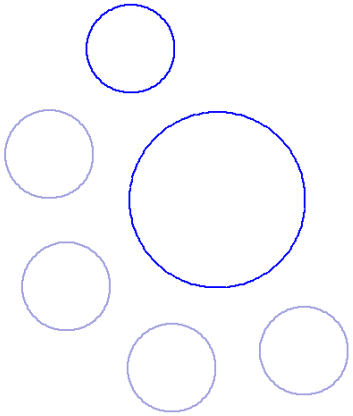
To create the array, select a circle, arc, or point centre feature to rotate around. Then choose the total number of features, for example, 6 holes about a PCD or number of teeth in a gear. The included angle is the angle from the centre of the first feature to the centre of the last feature and will be 360 degrees by default. Clockwise or anti-clockwise will determine which direction the array will be created in, this is more important if arraying around less than 360°, otherwise this will only affect the order the features are measured. Using the start angle, the ring array's starting point can be chosen. Clicking the green tick will complete the array, and the templates for the arrayed features will appear in the main window. The images below show the array function around a full circle.





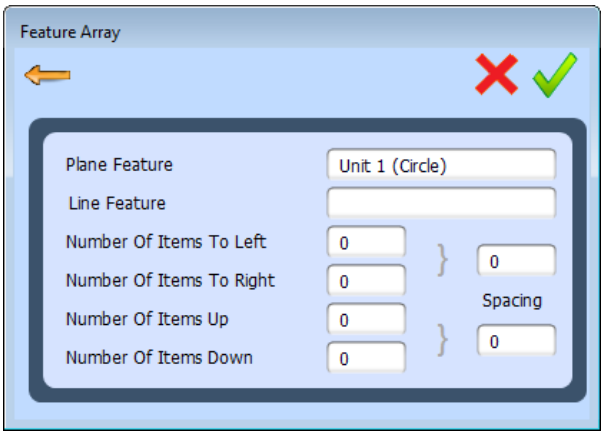
And how this differs from an array around less than 360°.



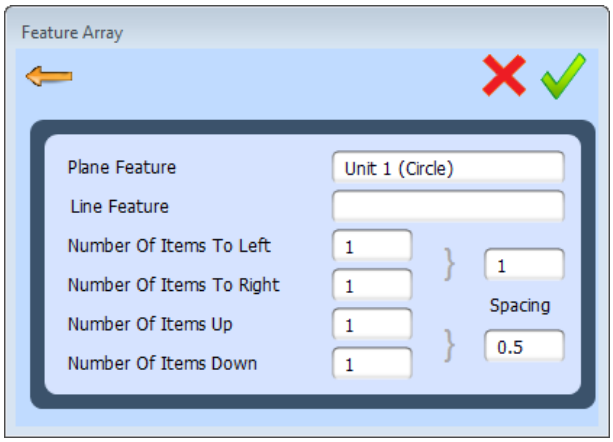


20.14.2 Grid Array

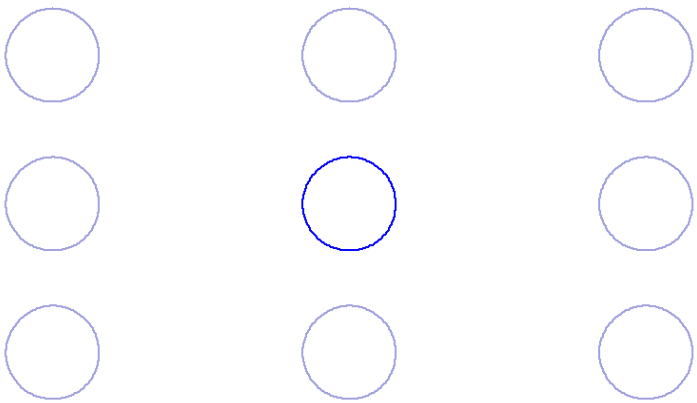
A grid array will copy features in a grid pattern, if this is selected, the following box will appear.



The grid for the features can be made left, right, up, and down from the original feature, in the plane selected and aligned to the optional line feature. The number of features in each direction can be set, or left at zero, in the column on the left and their spacing in mm can be set on the right.

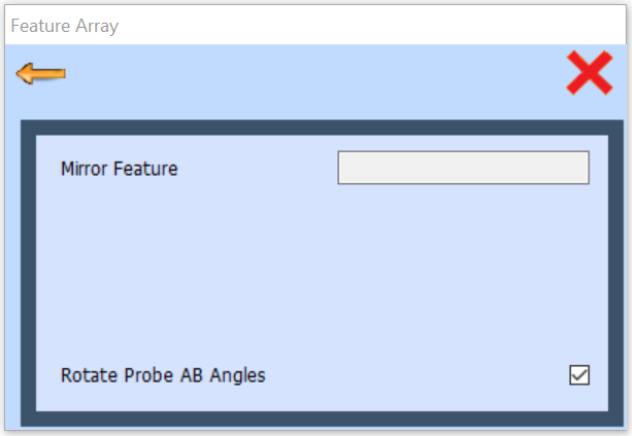


In the example above, Unit 1 is in the camera plane and is the feature being copied so has been automatically selected as the plane feature, so the directions of the arrayed items will be relative to the XY plane. There is one item each in all 4 directions and a spacing of 1 left and right and 0.5mm up and down. Clicking the green tick will apply the array and the feature templates for the grid array will appear in the measure window.



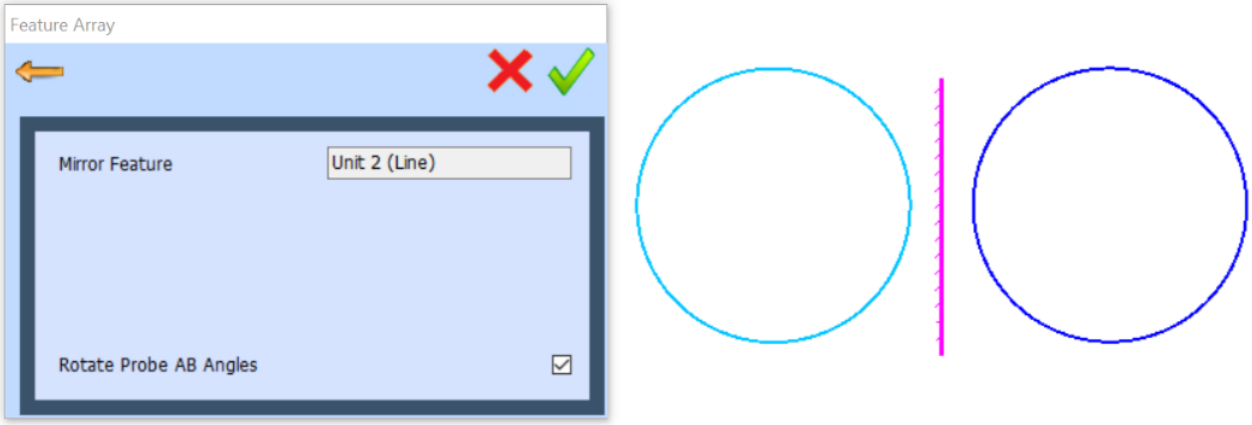
20.14.3 Mirror Array

A mirror array will mirror a feature perfectly around a selected line or plane. If the mirror option is selected, the following window will appear.



Features can only be mirrored around a line or a plane. If a line feature is used, the feature will be mirrored perfectly around that line. If a plane feature is used, the feature will be mirrored in the same place. The mirror feature box is where the line or plane used to mirror a feature is entered.

In the example, the circle is the feature being mirrored around unit 2, a line feature. The green tick will complete the mirror feature.

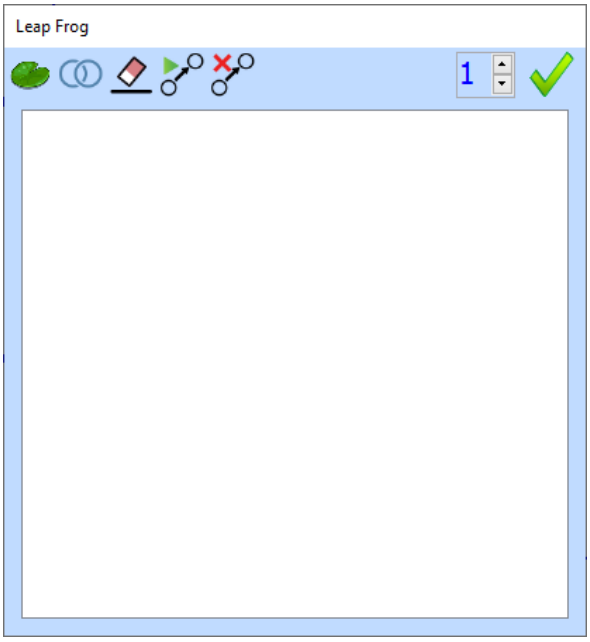


20.15 Leap Frog

The leap Frog function allows components that are larger than working volume of the machine or out of reach from the vision camera or probe to be measured. It is accomplished by realigning or moving the part to a second position using features that are common to both positions.

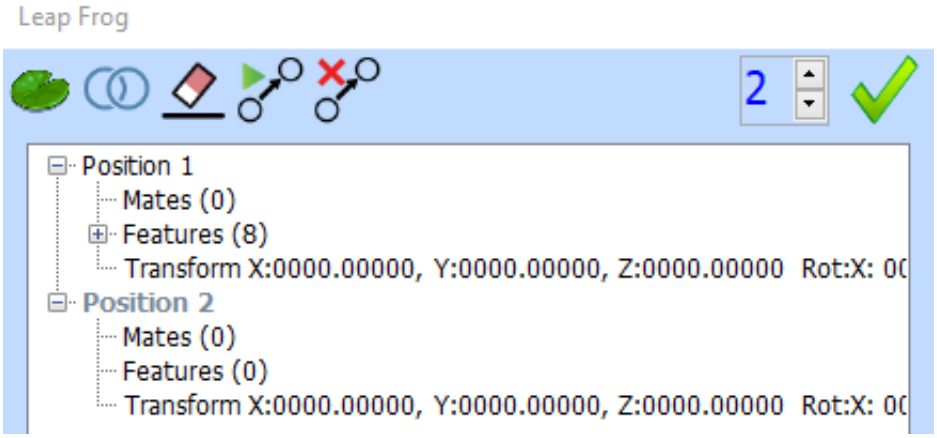
Features on the component within reach of the machine can be measured normally, including reference features used to align the component, such as a circle and a line. If a rotational leapfrog program is being run, a plane will also need to be measured. All features measured here will be measured in position 1. Mate features will need to be measured, these are features common to all positions and are used to join the whole component after the leapfrog process, these include a plane, circle, and line. To save time, Mate features can include reference features, so it is always efficient to measure these first.

After this, the Leap Frog function can be opened, this will show the following window.

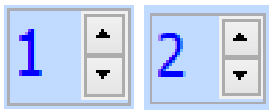


The component can be moved to the second position. The lily pad icon is used to add a new position.

The window will now look like this.

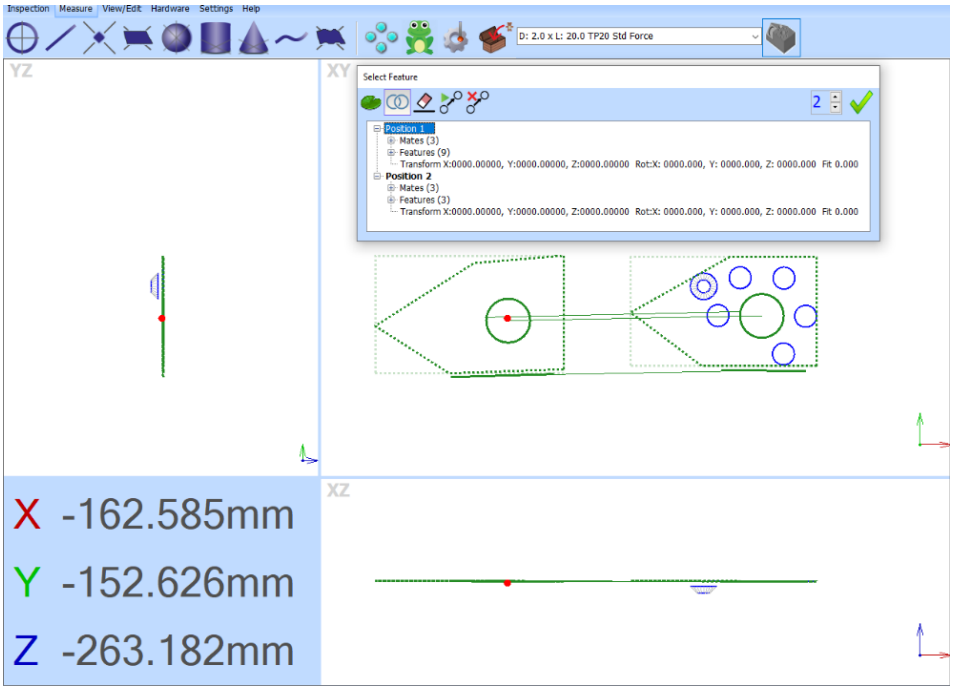


Mate features should be measured first in every new position, before measuring these features, position 2 needs to be selected. This is done by clicking on the position 2 row or using the position cycle buttons on the top right of the window.



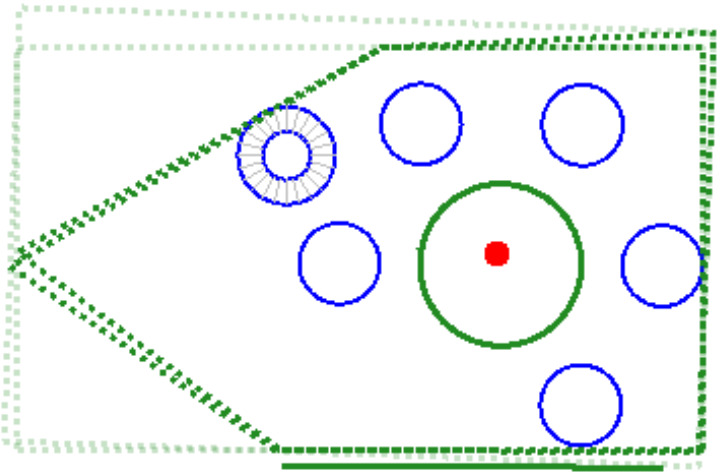
The Add Mates icon is used to link the mate features.

To mate the features together, left click on a Mate feature measured in position 1, then click on the Mate feature in position 2. A green line linking the two features will be displayed, and both features should turn green. Repeat this for all Mate features.

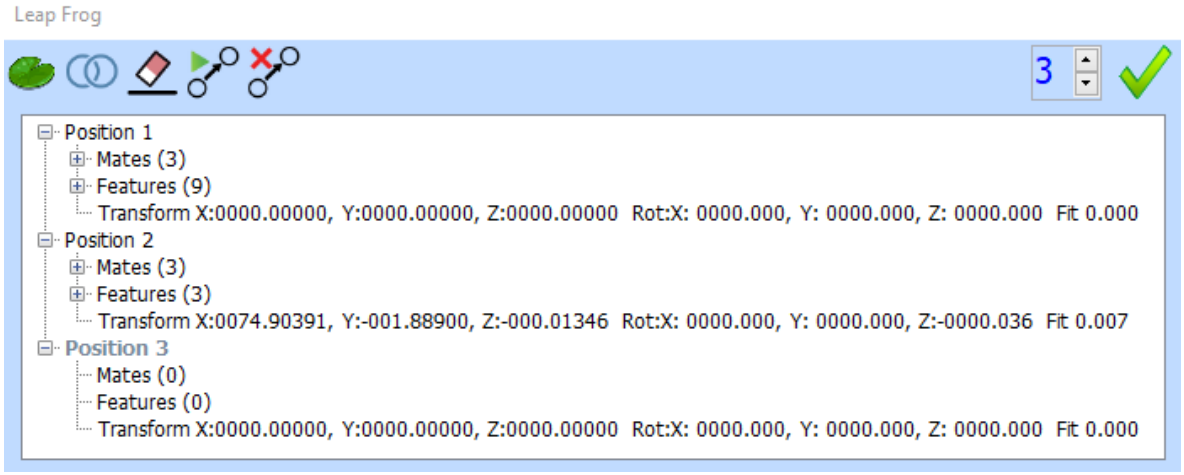


The features linked in the figure above include a plane, line, and circle. Unselecting the Add Mates icon will close the mating tool, complete the mate transform using the Calculate Transformations icon.

A successful mated component will look like the following on the Fusion screen window, with both features from position 1 and 2 in the same position.



The next section of the component can now be measured. If the component is moved again, the process needs to be repeated by adding another position.

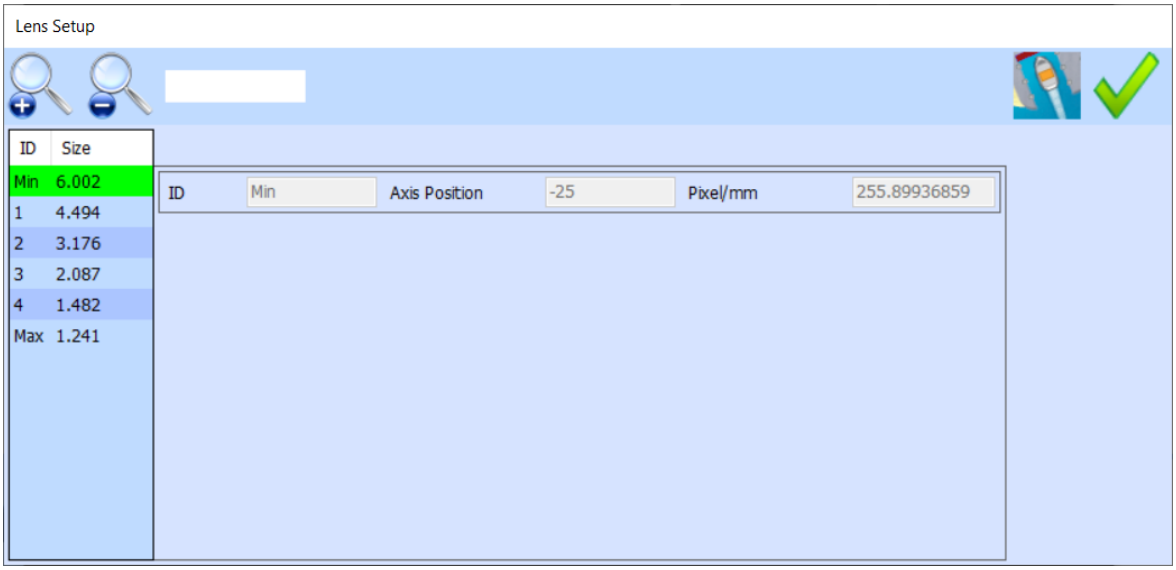


The Clear Mates and Transforms icon will clear all mates and transforms from all positions. This is used when the wrong Mate feature has been selected, or the component has been orientated incorrectly.

To separate the features but keep the mates between them, click on the Clear Transform's icon. This will separate all transforms made in the program; however, it will keep the mates between features. This is useful to check whether the correct features have been used as Mate features, without deleting the whole mates altogether.

21.0 LENS SETUP MENU

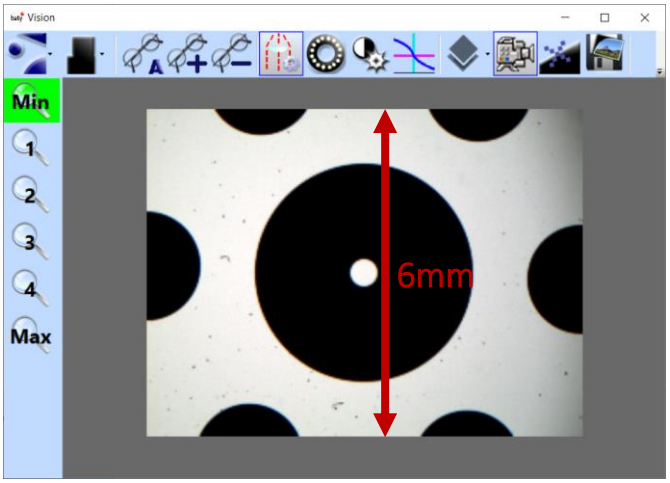
The lens setup menu, which shows information on zoom positions, can be seen below.



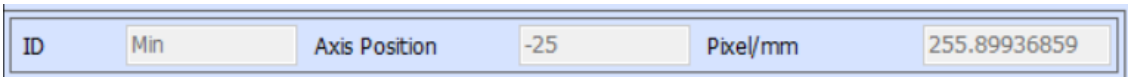
This is what the menu will look like when it is opened, and will contain sufficient information for the majority of operators, although if the lens requires calibrating, a tech code password will be required, this is further discussed in Chapter 46.1 – Full Lens Setup Menu, page 160.

On the left-hand side of the menu there is a table to show the camera's set lens positions, where the current lens position is shown in green. The table shows the ID, or name, of the position and its Size, which is the height in mm of the camera field of view at that position. For example, in the image below, the field of view is approximately 6mm tall.

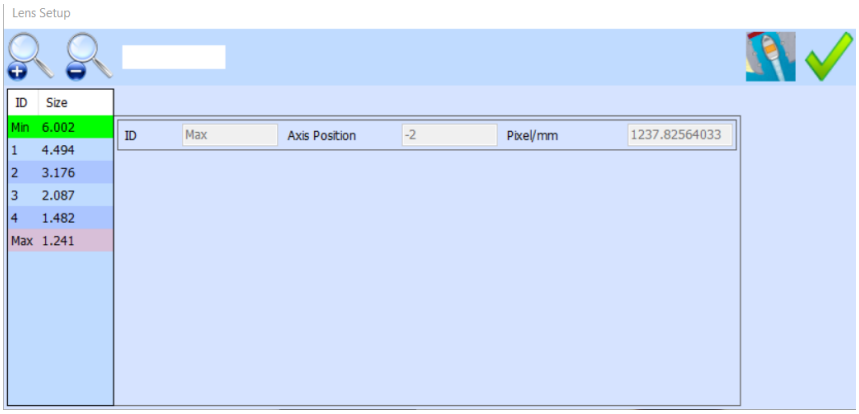
ID	Size
Min	6.002
1	4.494
2	3.176
3	2.087
4	1.482
Max	1.241



The three pieces of information on the right-hand side of the table shows the position's ID and the axis position of the lens, and the number of pixels per mm at this position.



To see the information from another position, click that row in the table once and it will turn red and display this information without moving position. The image below shows the camera is at Min, shown in green, but the information showing on the right is for Max, shown in red.



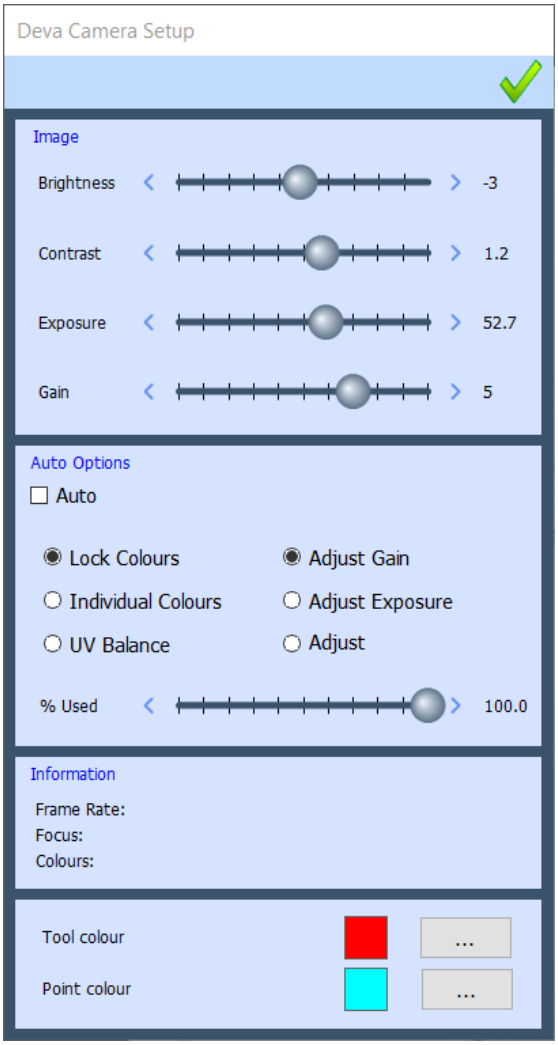
To move lens position, double click the corresponding row for in the table on the left. The menu has two magnifying glasses to zoom in and out manually between set lens positions. Lift these buttons are used, the lens will no longer be at one of the defined lens positions, so the table will no longer have a green row which usually indicates which position the lens is at.

ID	Size
Min	6.002
1	4.494
2	3.176
3	2.087
4	1.482
Max	1.241

The top right of the table has a docking icon and a tick. The docking icon will close the menu and dock the lens position information on the left of the camera view, the tick will close the menu without docking this menu.

22.0 CAMERA CONTROLS

The display settings for the camera image can be controlled using the deva camera setup menu. These settings will affect the view in the camera window and will also affect how the measuring tools work.



Brightness will adjust how bright the image is, contrast will adjust the colour contrast displayed. Exposure will adjust the refresh rate of the camera and therefore the amount of light captured, although if this is set to a large number there may be noticeable delays in the image. Gain will adjust the amplification of the image's light.

Applying auto will adjust the camera settings automatically to help to give a clearer image if manual adjustment of the settings has been difficult. It is best to turn this off after the image is clear, as when the machine moves it will automatically change the settings again dependant on the current view. It would also overwrite any settings that are manually adjusted.

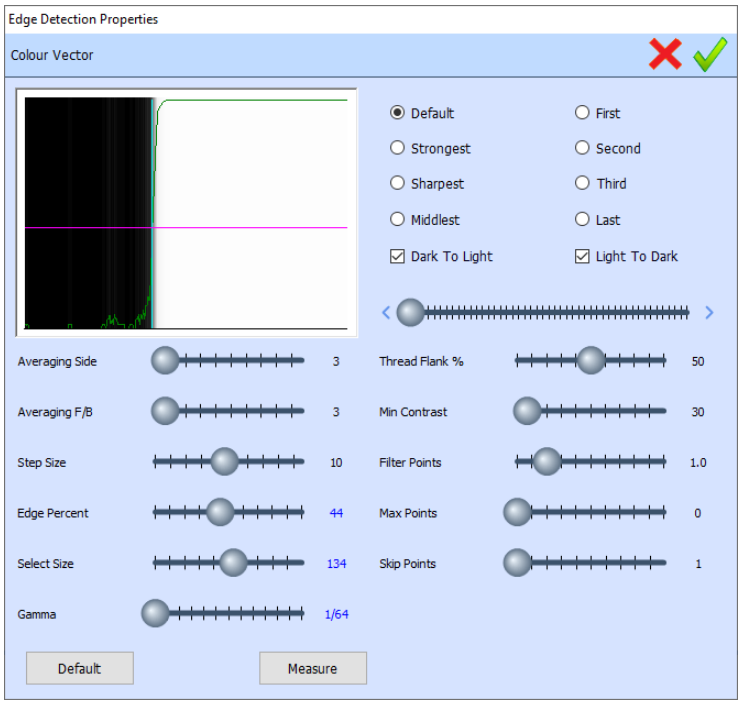
The information below this, such as frame rate and focus will only be displayed in auto mode and will update live as auto adjusts.

The tool and point colour settings change the colours seen on the image after a measurement is taken, this can be used with show edges in the vision toolbar, discussed in Chapter 26.0 – SHOW EDGES, page 81.

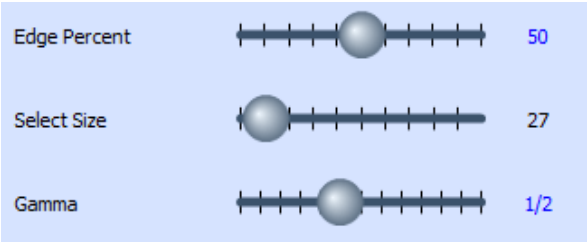
The settings used in this menu will be saved in a feature so as it is replayed, these settings will adjust for each feature if needed.

23.0 EDGE DETECTION CONTROLS

Edge detection controls allow the user to modify the values used for detecting edges. These controls are typically used for surface illumination applications where the edge might not be as clearly defined as would be seen with profile lighting. Clicking on the detection controls button will open the edge detection controls window.



Each feature measured will use the edge detection properties currently set, which for a new inspection will always have reverted to the default values. Any setting that is not currently the default value will be signified using a blue number, values at their default will be black.



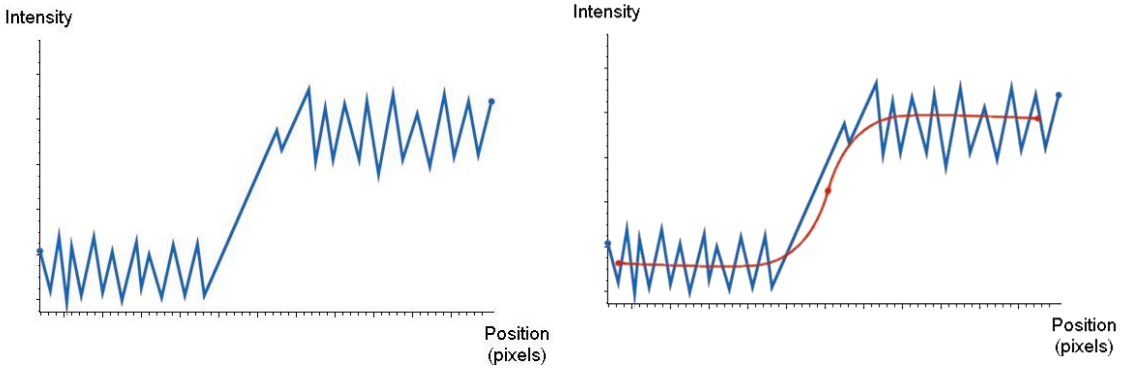
Pressing reset will restore all values to default, verified by all of the values being black. Closing the window using the tick will save the current settings, pressing the cross will put the settings back to the way they were when the window was last opened.

These settings can also be adjusted to edit a feature that has been measured. Whilst this window is open measurements can be taken as normal, however, the measurement points will remain on the screen. It is then possible to adjust the detection tools and see on the screen what effect this has on the measurement points. When happy with the measurement points shown on the screen, click on the 'Measure' button to fire the measurement tool selected.

23.1 Averaging Side and Averaging F/B

When automatically detecting an edge, the software investigates the intensity of light at each pixel within the range selected. A typical graph may look like the image on the left, although by averaging the intensity of adjacent pixels this graph could be smoothed as seen on the right.

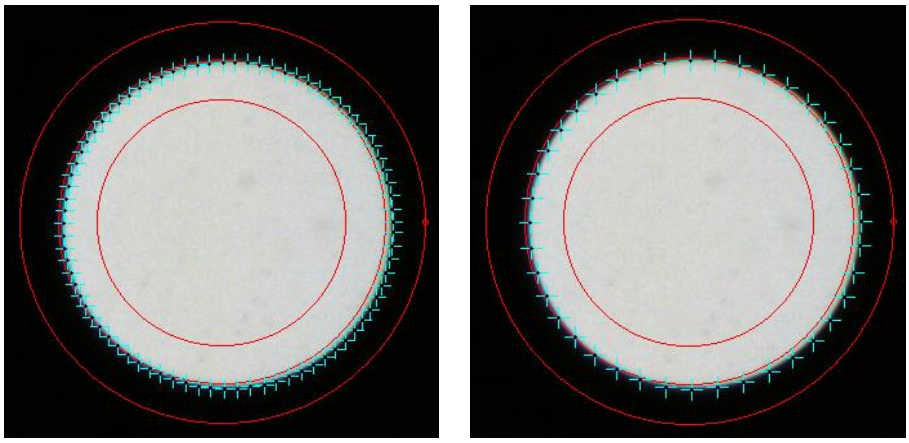
In cases where the edge of an image is not clearly defined, increasing the averaging effect may improve the ability to determine the position of the edge. In general, if there are good quality edges or tight radii, then the averaging should be kept low. For poor quality edges or if the edge is quite straight, then higher averaging may help.



The software provides two slider bars to adjust the averaging effect. Averaging Side will adjust it in a side-to-side direction (left to right across the screen), and Averaging F/B (forwards/backwards) will adjust it in a forwards and backwards direction (up and down the screen). Use a combination of both for diagonal lines through the screen.

23.2 Step Size

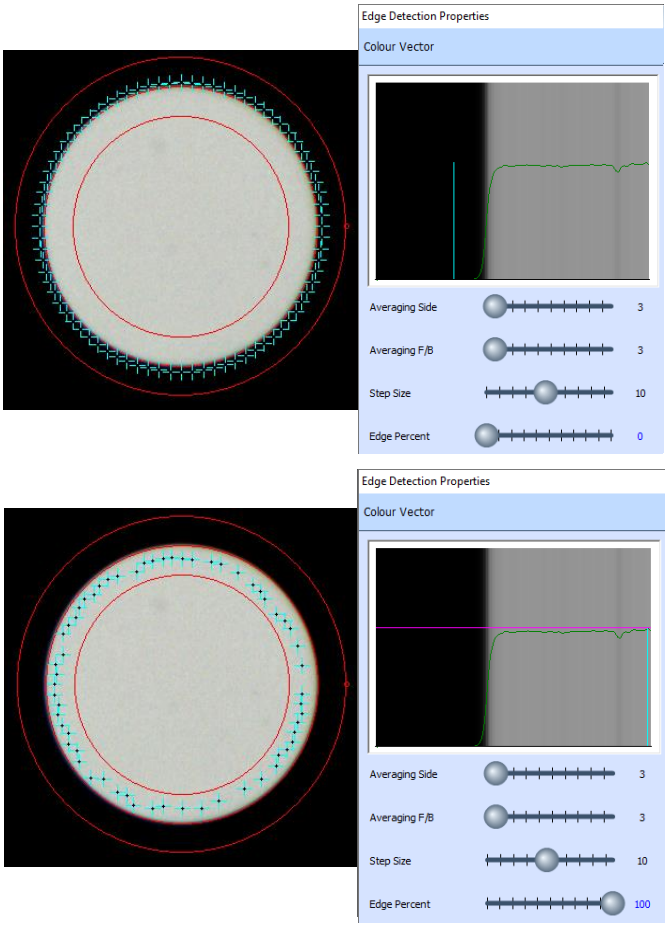
The step size will affect the number of points taken for a measurement. The number shown relates to the number of camera pixels between each point, hence the smaller the number, the more measurement points will be taken for the same distance to measure. The image on the left shows a measurement using the default step size of 10, and on the right a step size of 20.



23.3 Edge Percent

In the Intensity vs Pixel Position graphs shown above in 23.1 it can be seen that, especially when averaging is applied, the step between dark and light is represented by a sloping line. The edge percentage function determines at which percentage along this line the measurement point is taken. For Example, 50% would mean that the point is taken halfway along the line. As the edge percentage tool is adjusted, the points will move on the screen.

The difference in the points taken using 1% and 99% edge percentage can be seen below.



The default edge percent value of the machine is set at the factory. This is an optimised value when the machine is calibrated and is likely to be closer to 50%.

23.4 Select Size

The Select Size will define the area selected either when using the Smart Mouse, or the One Click functions. The larger the number selected, the larger the search area will be. When using the smart mouse measurement type, this defines how close the user must click to an edge on the image for the software to automatically take a point. The Select Size is quite an important tool when using the One Click measurement function. Using this function, the software analyses the edge being measured within the selected area, and therefore it is possible if the area is too small to mistake a large arc for a straight line. Increasing the size of the Selection Area will help the software determine which type of feature is being measured.

23.5 Gamma

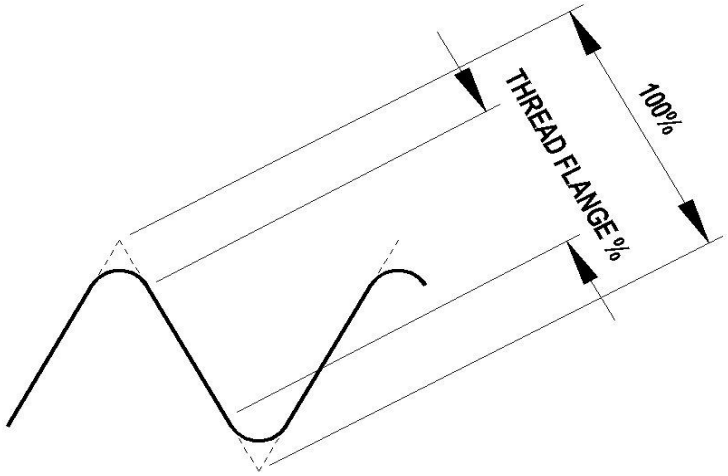
Gamma is used to adjust light levels to show greater differences between shades of light and dark. The scale below shows a linear scale from black to white, with each step increasing light level by an equal amount.

The darker steps appear to change very suddenly, but it is more difficult to perceive the differences between the brighter steps. If a non-linear scale is used, where the change to the light levels is different for each step, a more even looking scale can be made which allows better differentiation between more of the shades. The example below uses a gamma value of 2.2 as this is used as a general value to maximise shades for the human eye.

In Fusion, gamma can be used to improve the software's ability to find an edge by maximising the contrast in the tool's measuring area. This ranges from 1/64 to 64, where values larger than 1 make the darker areas darker, and values smaller than 1 make dark regions lighter.

23.6 Thread Flank %

This setting is relevant when using the Thread Measure tool. The Thread Flank percentage defines the straight part of the thread that is used to determine the flank angle:



23.7 Min Contrast

The Min Contrast setting is used when measuring a part using an existing inspection, for more information see Chapter 40.0 – THE PLAY FUNCTION, page 124. When doing repeat measurements on components, the contrast required for the software to detect an edge will be this percentage of the contrast achieved when the program was originally created.

23.8 Filter Points

Filter points is used with edge detection to remove bad points from a measure. This is controlled by a sigma calculation to filter and disqualify points that fall out of the range of the measure. This can be set from 0 (no filter) to 3 (maximum filter).

23.9 Max Points

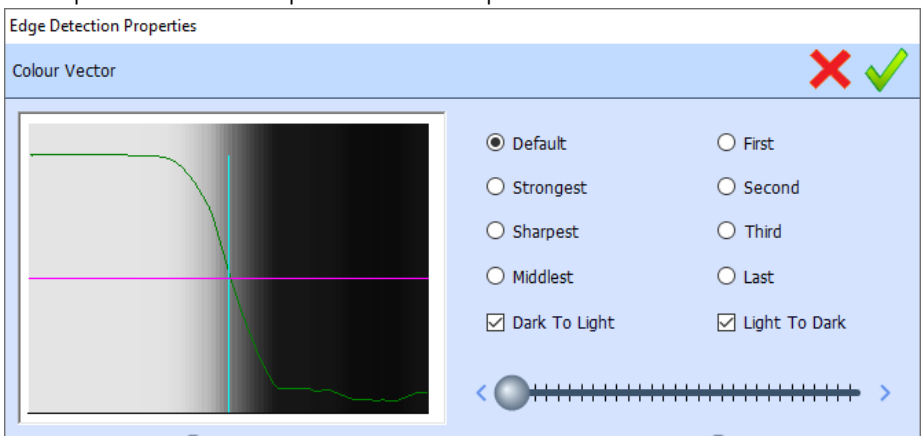
Max points is a setting for the maximum number of points taken per feature. This is most useful in scenarios where there could be excessive points in a program that could be detrimental to the memory limit.

23.10 Skip Points

Skip Points can be used with Step Size where the point density needs to follow a tight or small profile. This allows all the data points required to be taken but only every so many points taken along the profile are logged.

23.11 Optimising Edge Detection

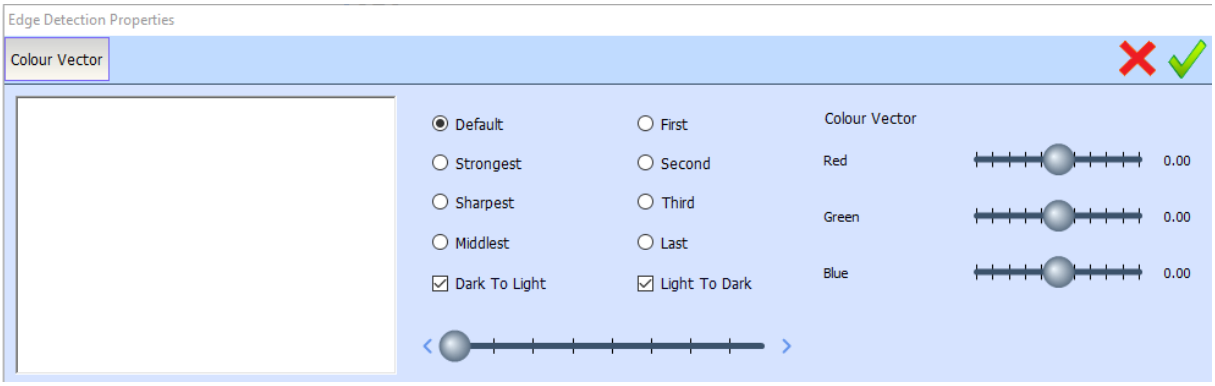
The edge detector tool allows us to optimise the edge being measured with some of the adjustment tools previously covered. When an edge is detected with the window open, options can be used to optimise how the points are interpreted.



Default uses the same algorithms as Fusion uses for profile lighting, Strongest finds the largest contrast of pixels, Sharpest selects the narrowest contrast of pixels, middlest selects the most central of the tool. The tool can also be edited to take the first, second, third or last edge detected. Changing these settings will show in real time which edge it is focusing on by moving the various coloured lines. The 'Dark to Light' and 'Light to Dark' boxes enable the user to define which direction the tool should look for an edge, both boxes ticked will allow the software to make a judgement. The graph represents the contrast of pixels within the edge detection tool.

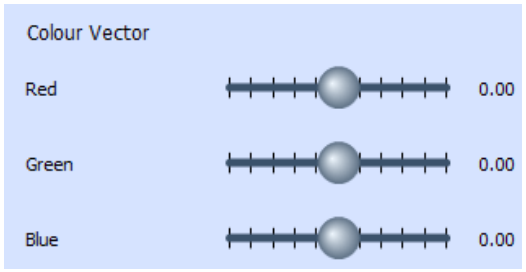
23.12 Colour Vector

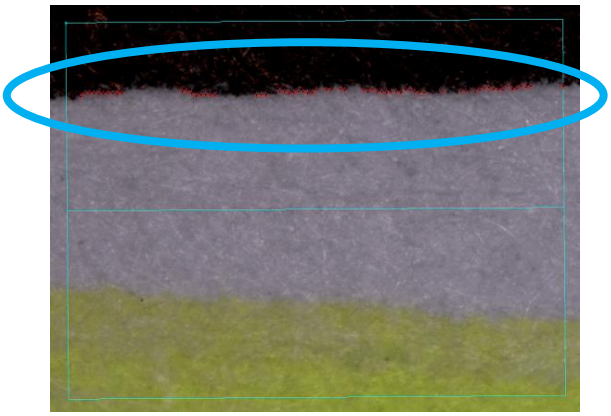
The Edge Detection Properties window is the ability to control the colour vectors of the RGB pixels on the screen to better help the program detect an edge of a coloured workpiece. The Colour Vector window can be found at the top of the Edge Detection Properties window.

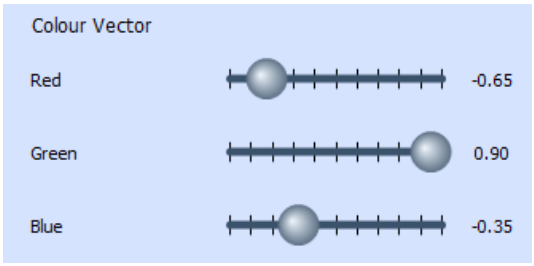


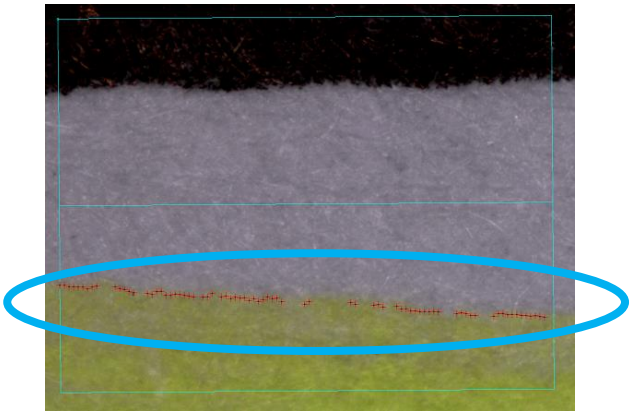
The ability to individually change the colour intensity of each of the RGB pixel group gives the user better control to find an edge of a specific colour in a component. The default setting will always choose a darker edge to measure a line. In the example below, there is a black edge and a yellow edge, with a line feature stretched between the two.

Highlighted by the blue circle, the default edge detection has chosen the darker edge to measure a line. To change where the line is measured, change the colour vector options until the program switches from the dark edge to the yellow edge, this can be seen below.



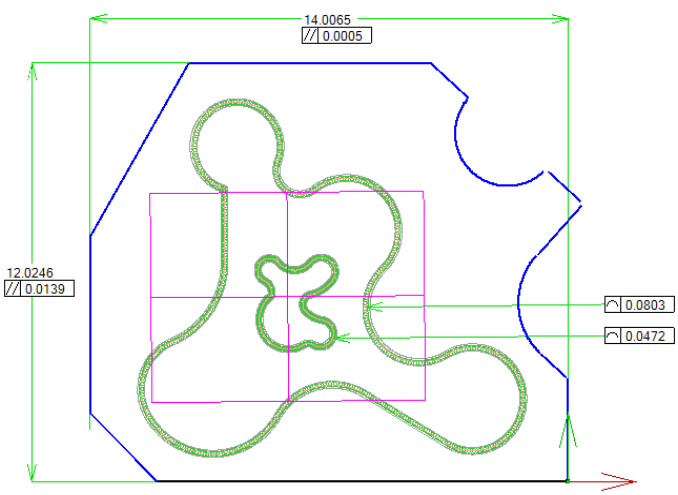


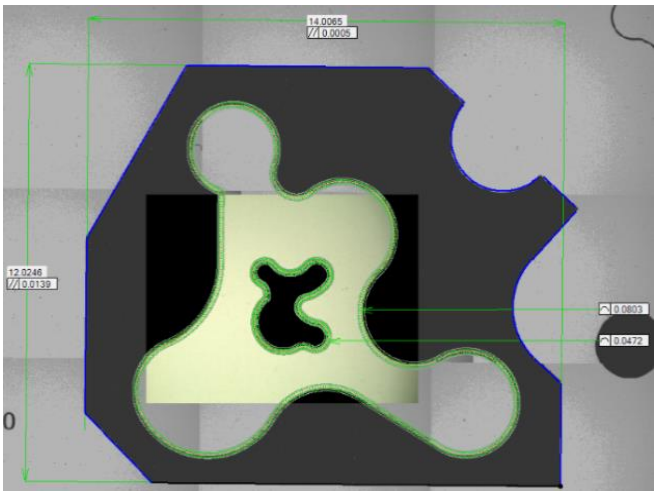




24.0 OVERLAYS

The Overlays tool is a useful feature in the Mk4 Fusion software, with multiple options available, several different layers can be applied to the camera and its image stitching to show details that have been measured and dimensioned in the main screen. These are all shown live in the camera screen and allow a direct comparison of the measures shown on the camera.

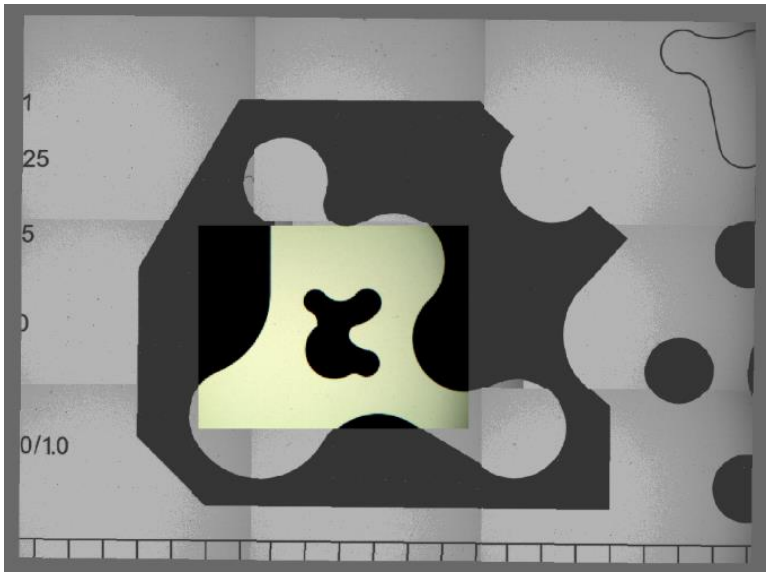




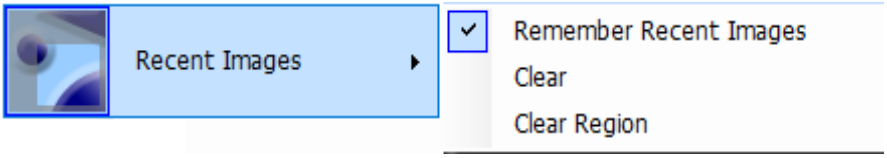
There are five overlay tools available that may be selected in any combination to suit the user, the following section contains examples of each overlay.

24.1 Recent Images

This stores images captured by camera and displays them outside the field of view. If this is not enabled, it will not be possible to see the image stitching created by the software.



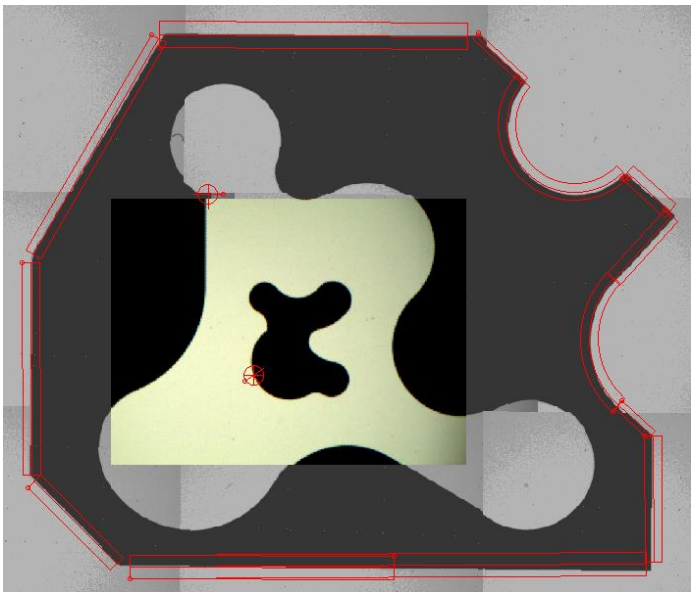
There are several additional settings for this overlay, shown below:



If the Recent Images and Remember Recent Images options are selected, all new images captured will added to the overlay. If the setting to remember images is off, no new images will be stored, but images already showing will remain as long as Recent Images are still on. Pressing clear will remove all images stored, or alternatively smaller areas can be cleared by pressing clear region and clicking to create a box within which all images will be deleted.

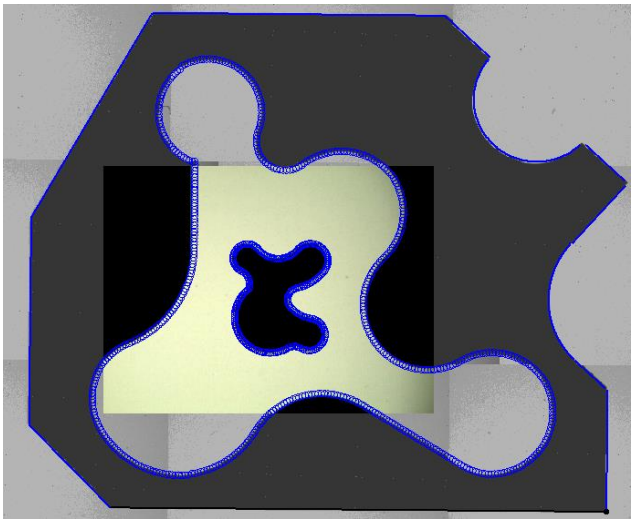
24.2 Vision Measurements

Displays the feature boxes where the camera looks for an edge.



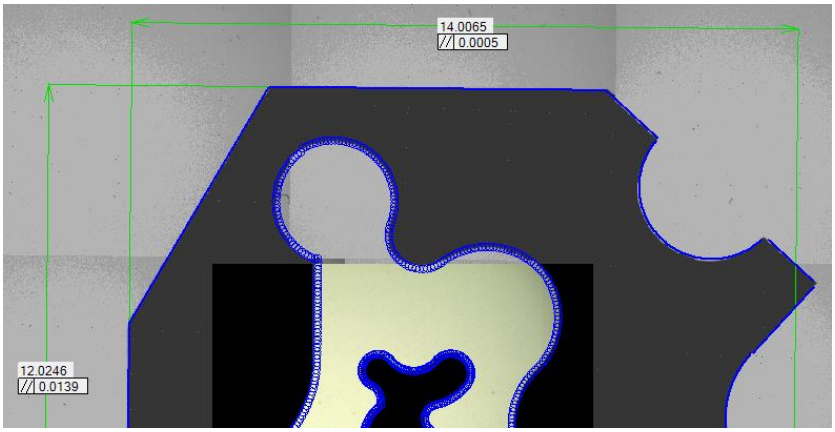
24.3 Features

Displays the current inspection's measured features on the camera screen.



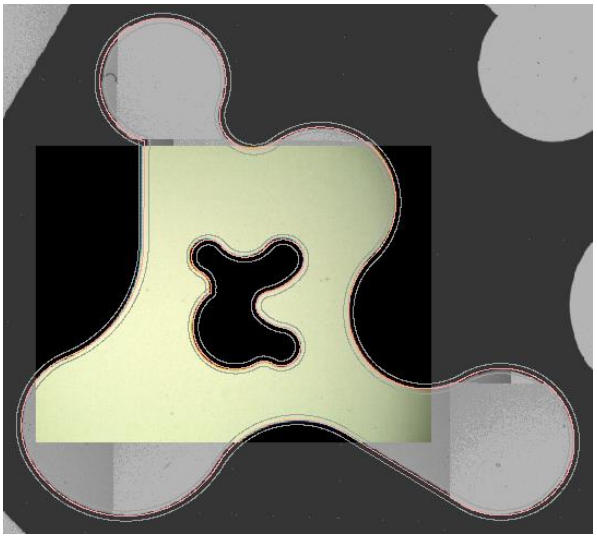
24.4 Dimensions

Displays the dimensions from the main screen in the same equivalent position.



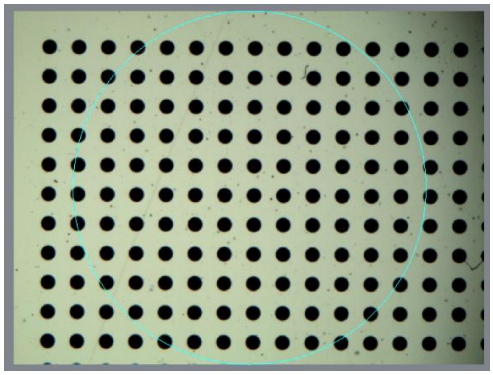
24.5 DXF

Displays an overlay of the DXF profile with profile line and the tolerance bands.



24.6 Guide

The guide overlay is a blue circle with a diameter equal to the height of the field of view, this shows the area that a feature can be rotated around and still fit in the field of view.



25.0 TOGGLE VIDEO FEED

Pressing this button will toggle between the live camera and the last captured image. When the icon has a blue selection box around it, the image is live, if the image is un-selected and there is no blue box, the image is of the last one captured by the camera.

26.0 SHOW EDGES

This icon will display the captured image of the last measured feature, the measuring window used, and the points taken for that feature. When this icon is selected, it will have a blue box around it, to turn it off either click the button again or press escape.

27.0 SAVE IMAGE

The icon here in the camera window will open a dropdown window, allowing the user to save the image as either a camera image, current view image or metrology image. Images can be saved as a bitmap (.bmp) or a JPEG (.jpeg) file by clicking on the Save Image file. It will open a Windows browser to select a name and location to save the image. Images saved as a metrology image will be saved as a separate file (.mtg).

28.0 ESCAPE SOFTKEY

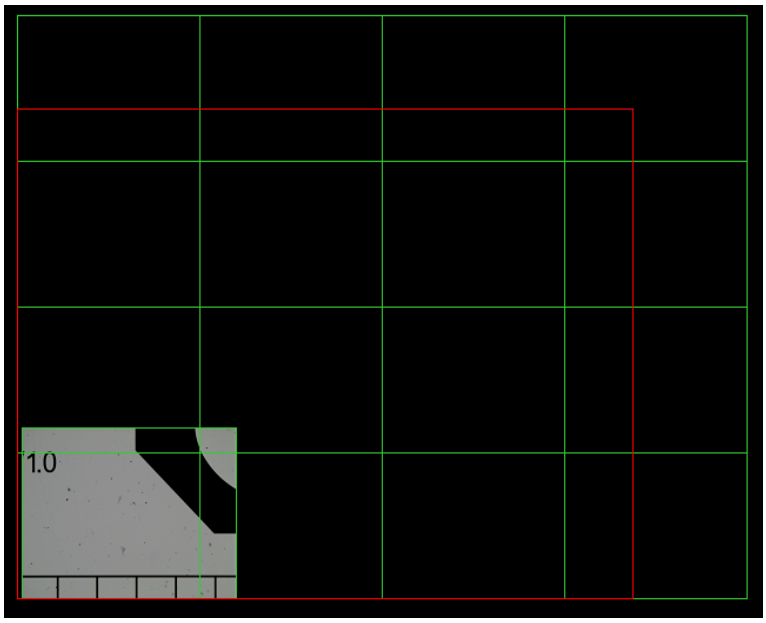
The Escape softkey works the same as the physical key on the keyboard. It can be used when a measuring tool is used in the camera window to cancel the measure, or when a windows browser is opened, and it is no longer needed. Pressing the escape key whilst using the buffer tool, will result in all the scheduled measurements being cancelled.

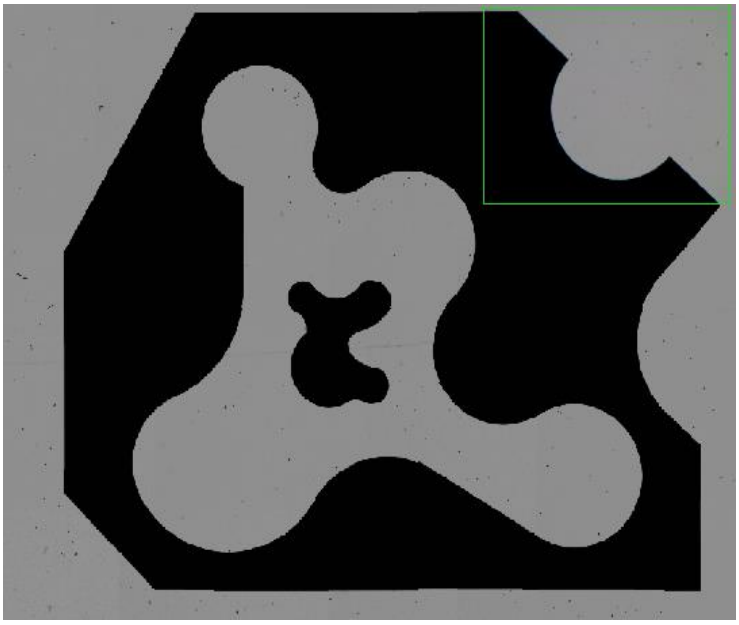
29.0 BUFFER TOOL

The Buffer tool can be used to delay measurements. Once active, any measure tool can be used as normal, but no measurement will be performed until the button is pressed again. It will then begin to measure each feature in the order given. The Buffer icon will be highlighted once toggled and will always remain selected until pressed again, to start measuring. This can be useful for a user to queue up a list of features to measure and then perform other duties elsewhere, rather than remain by the machine and waiting in-between measurements.

30.0 SCAN AREA

The image stitching tool allows the user to effectively scan the component that is to be measured. Clicking scan area will highlight the tool, then the user can click a start point for the scan area and then drag a box out to the desire finish point.

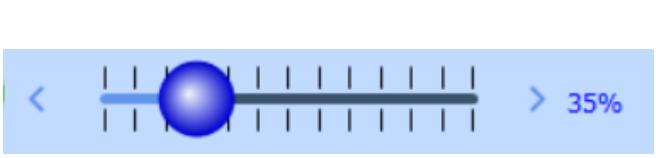


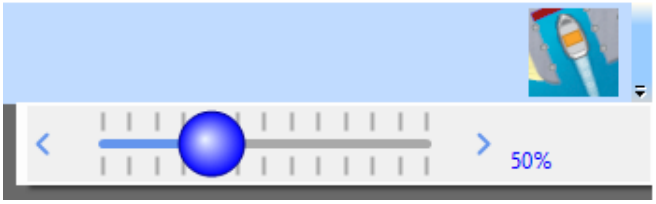


A green grid will form over the area, showing the camera grabs that will be taken for the scan. When the grid is set, the camera will grab images to show a view of the component. Note that the Overlays tool must have Recent Images and Remember Recent Images on selected to complete image stitching.

31.0 DIGITAL ZOOM BAR

The size of the image in the camera window can be adjusted via digital zoom, the current zoom level will be shown as a percentage. This can be controlled using the mouse scroller wheel or the digital zoom bar. This bar will either be in the toolbar, or on narrower screens it may appear in a dropdown to the right of the docking icon from the toolbar.





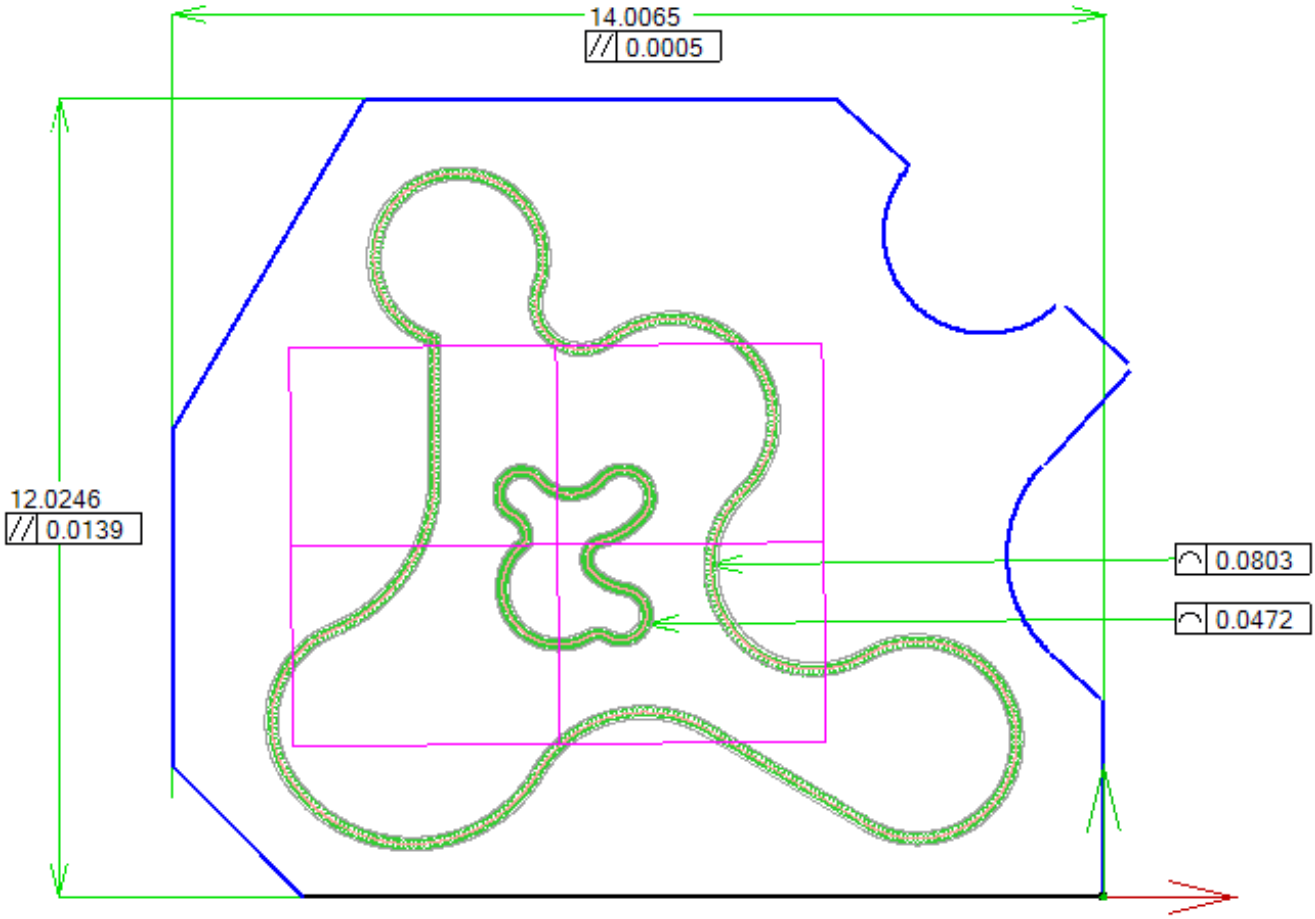
32.0 DOCKING ICON

The Docking icon is commonly used on systems with Fusion software running on single screens. This allows the camera screen to be docked into the main screen window. This moves all the vision tools also across to the main screen in the Vision tab. For machines with CAD programming or CAD compare, these windows can also be docked in the Fusion main screen.

SECTION 3 – USING THE FUSION MAIN SCREEN

33.0 THE MAIN SCREEN

Having measured the features required on a component, a graphical representation of those features will have been created in the Main Screen:



It is possible to use these features to align the component as required, call up dimensions relating to the features and their position relative to each other, construct other features relative to the measured ones, and create a variety of inspection reports.

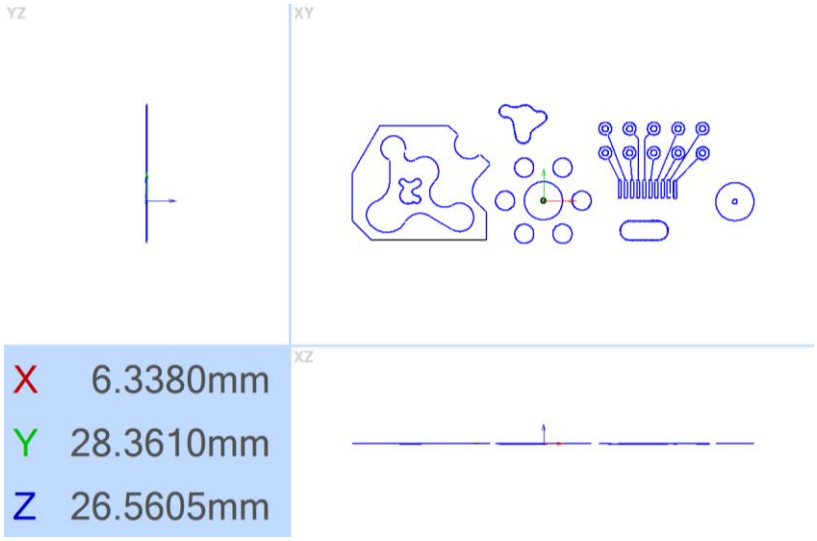
34.0 MANIPULATING THE GRAPHICS

There are several methods that can be used to adjust the size and position of the graphical representation on the screen at any time. There are several icons in the View/Edit toolbar which can be used, discussed in Chapter 6.0 – VIEW/EDIT, page 16, but the views can also be manipulated using the Tilt Table and Mini Map functions.

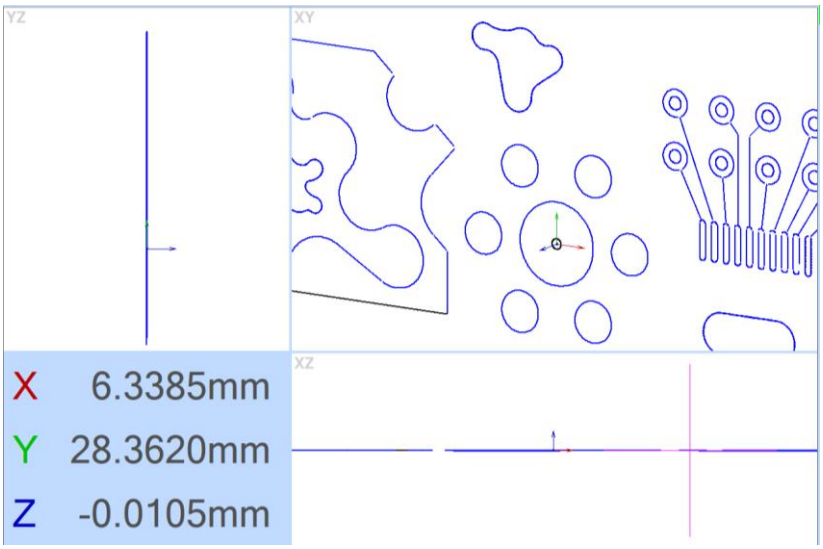
34.1 Tiltable Views

For inspections where it may be harder to view or select components that are on top of one another, the tiltable view function can be used. This will tilt the selected plane at a user directed angle to help give perspective. The example below shows this in the XY plane, but it can be done in any of the planes in the inspection.

The image below shows a standard inspection, with the view square to the planes.

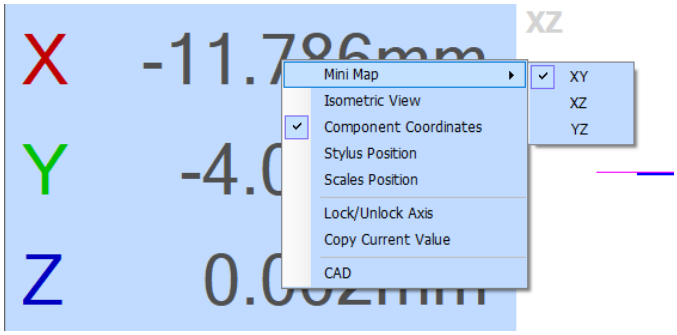


To use the tiltable view, move the mouse to the desired plane and click in the centre wheel of the mouse, then drag the mouse in any direction, the plane will then tilt in the same direction as the mouse, proportionally to the amount the mouse is dragged. The image below shows the view after the screen has been tilted towards the bottom left corner.

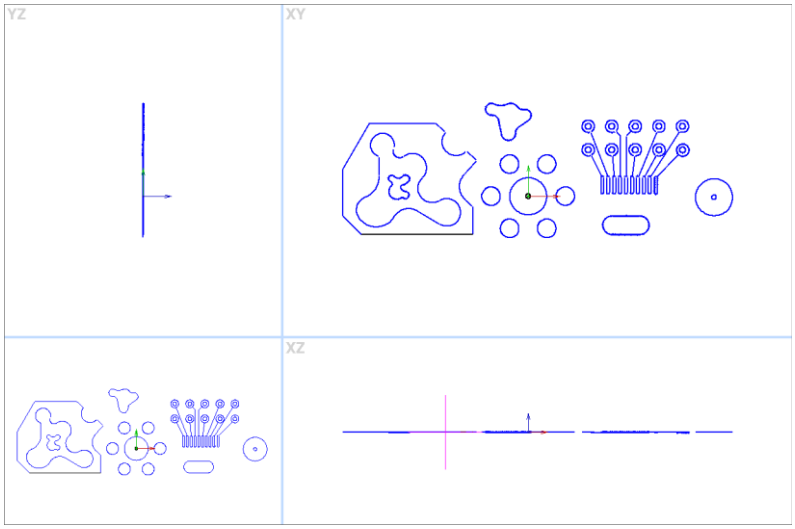


34.2 Mini Map

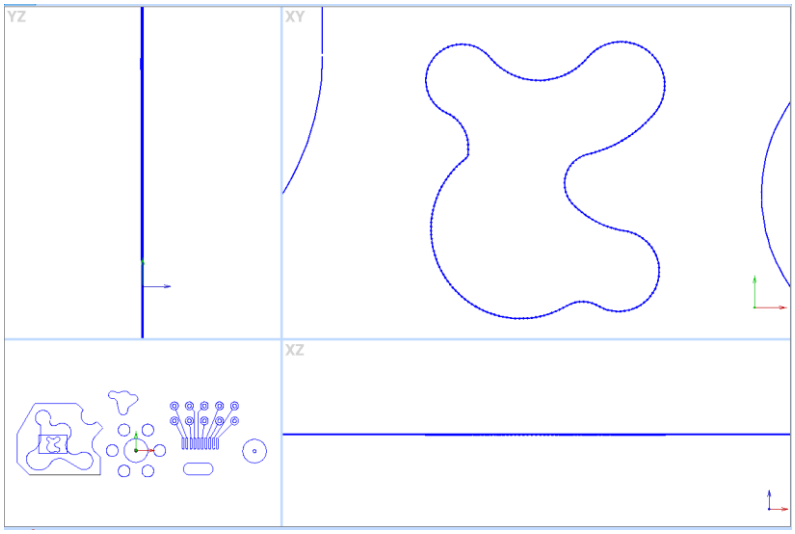
The Mini Map view can be docked in the DRO to help the user navigate around their features more efficiently. To use this, right click in the DRO and select Mini Map and the desired plane.



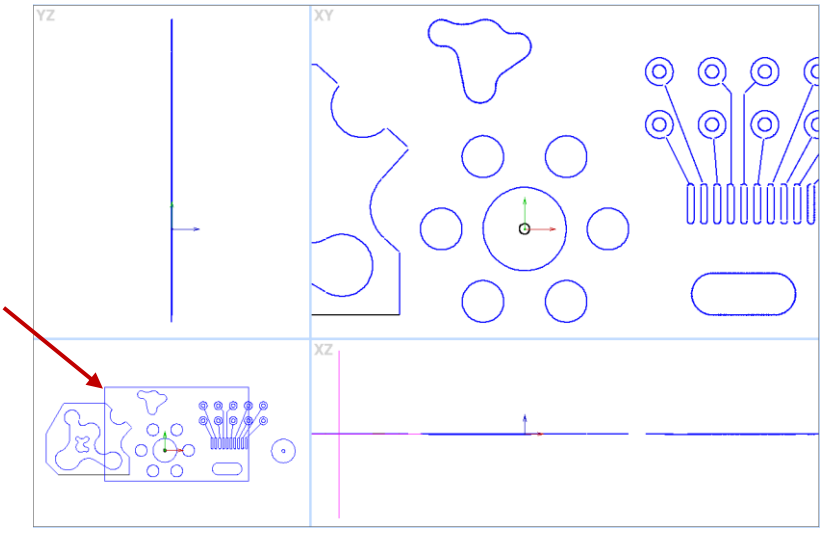
This will then bring up a map of the features measured in the inspection.



This map will always show the full inspection and when the main view is zoomed in, a blue box will be shown on the mini map to represent the area that is being shown in the main view. This blue box is indicated with a red arrow in the image below:

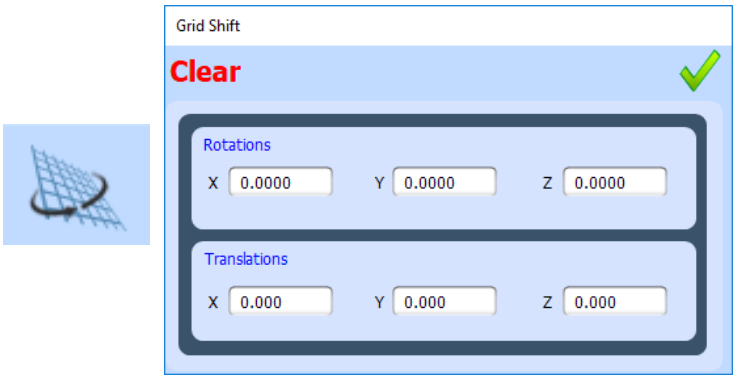


To examine a different area in the inspection, click on the Mini Map in the desired location, and the main view will move to this area. Alternatively, the box can be dragged across the mini map to move the view over this area.

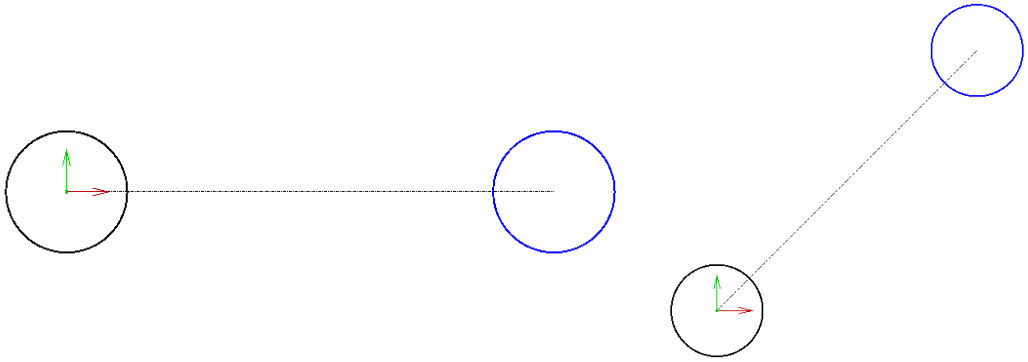


34.3 SHIFTING AND ROTATING REFERENCES

It may be necessary during an inspection to apply a rotation or shift to the inspected features. This can be achieved by using the Grid Shift button to bring up the following window:



A rotation or a translation can be applied to the measured features by typing the required angles or distances into the relevant box. For example, if a component consists of a plate with holes in its corners, and a diagonal line between these are used as a datum at 45 degrees, the best method for inspecting the plate is to measure the position of the two holes, construct a line between them and then set this line as a reference. Although by default this reference line will be displayed at 0 or 90 degrees, whichever is closer. To rotate this, click on the grid shift button, and type in 45 in the rotation about Z box. Click on the green tick to apply. The component will now be aligned at 45 degrees to the line between the holes.



When applying a rotation to an inspection, the rotation will be performed about the origin set at the time. Also, if rotations are required about more than one axis, then the order in which the rotations will be applied is Z first, Y next and then finally about X.

35.0 SHOWING DIMENSIONS ON THE SCREEN

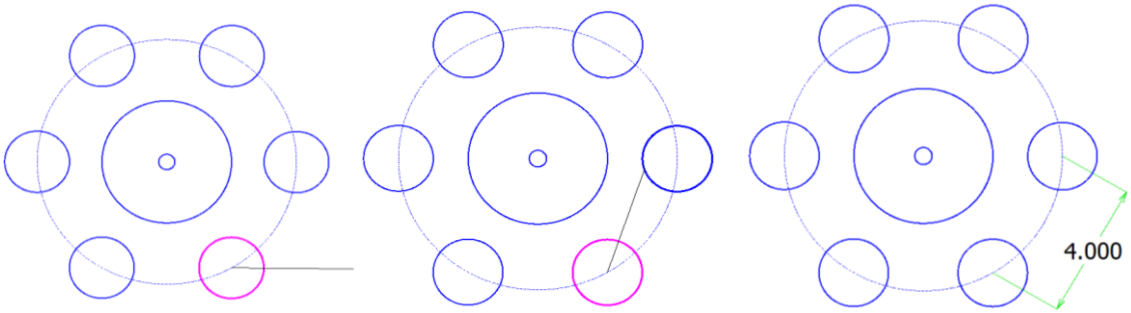
In the Baty Fusion, dimensions for the measured component can be brought up on its graphical representation, in the same way as they are shown on a component's engineering drawing.

35.1 Aligned Dimensions

An aligned dimension is the shortest distance between two points, or the perpendicular distance between a line and a point. To make an aligned dimension, left click on one of the feature's outlines to select it, if there are multiple features in the area a dropdown menu will appear, select the desired feature from the list and it will turn pink. The feature select button can be used to make this selection easier, for more information see Chapter 36.0 - USING THE FEATURE SELECT BUTTONS, Page 98. It is also possible to zoom in on the feature or change the

size of the selection box, for more information on these see Chapter 6.5 - Zoom In, Page 17 and Chapter 43.2 - Display, Page 143. If a feature was selected by accident, touch in any blank space in the drawing view to drop this selection and the feature will turn from pink back to blue or black. Click select the second feature and if correctly selected, this will also turn pink, and the outline of the dimension leader lines will appear. Moving the mouse cursor will move these leader lines any distance away from the centre and a final click will place the dimension.

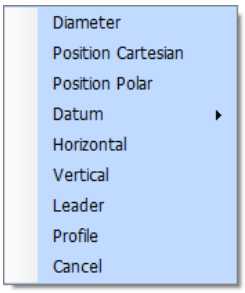
A dimension made between any pair of points, circles or lines will usually default to an aligned



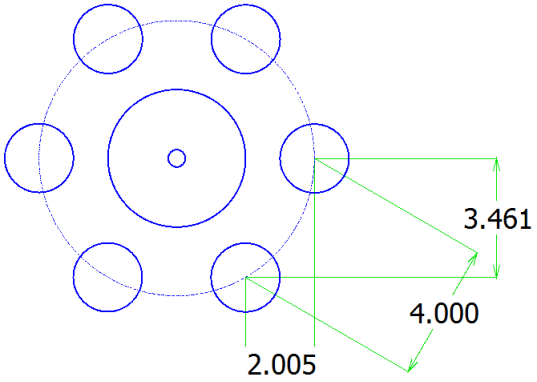
dimension. This is with some exceptions, for instance with two concentric circles, their concentricity will be reported instead as this is more likely to be the desired dimension.

35.2 Horizontal and Vertical Dimensions

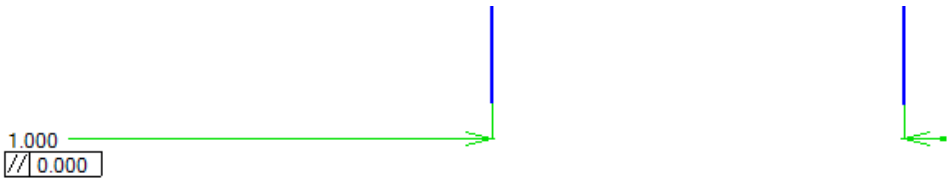
Horizontal or vertical dimensions will be made perpendicular to the alignment of the component, either defined by a line reference or the machine axes. Left click to select the features to dimension, as for aligned dimensions in Chapter 35.1 – Aligned Dimensions, page 86. The features will turn pink, and the outline of the aligned dimension leader lines will appear. Before positioning the dimension, right click to bring up the following menu:



Select the type of dimension required and the outline of the dimension leader lines will now change to match this dimension type. These leader lines can be positioned at any length on either side of the features, as for aligned dimensions, by moving the cursor on the screen. Click the mouse for a third time in the desired location and the dimension will appear on the screen.

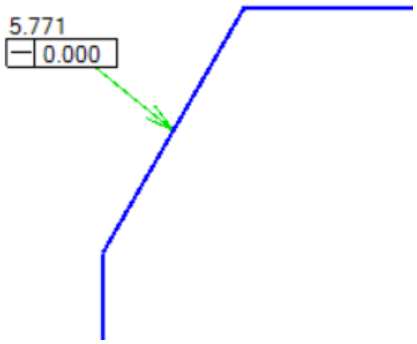


The distances shown on linear dimensions will automatically appear within the leader lines, but if the shift key is pressed while placing the dimension, these can be moved to the outside of the lines, as shown in the image below.



35.3 Line Lengths

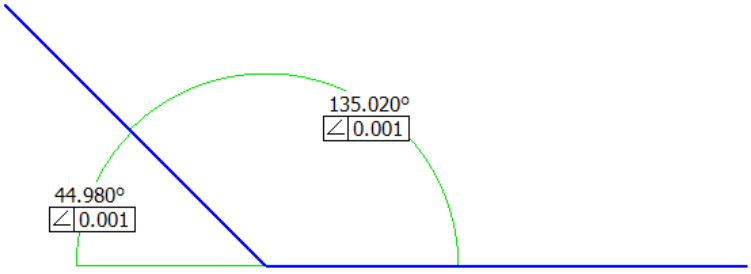
The length a of line can be reported if it extends to meet other features at both ends, and if it is a constructed line as it has a known length. This cannot be used for measured lines that do not connect to other features, as their length cannot be known.



To show line length, left click the line twice and this will be the default dimension given if this length is known. If the dimension shown is only straightness, this means that the length of the line isn't known. In this case, check that the line extends to meet features on both ends.

35.4 Angular Dimensions

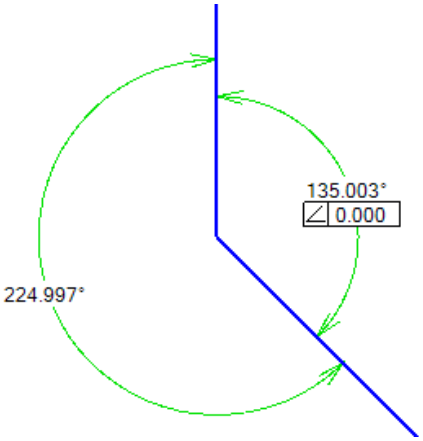
Angular dimensions may be created between any two lines. Left click to select the features to dimension, as for aligned dimensions in Chapter 35.1 – Aligned Dimensions, page 86. The features will again turn pink if correctly selected. The outline of an angular dimension will now appear on screen and can be placed at in any quadrant, by moving the cursor on the screen. When happy, click for a third time and the dimension will appear.



If the lines are almost parallel, then software may default to an aligned linear dimension. To change this, right click before positioning the dimension and select a 2D or 3D angular dimension. Similarly, when lines are almost perpendicular the geometric tolerance reported will change from angularity to squareness.

35.4.1 Reflex Angles

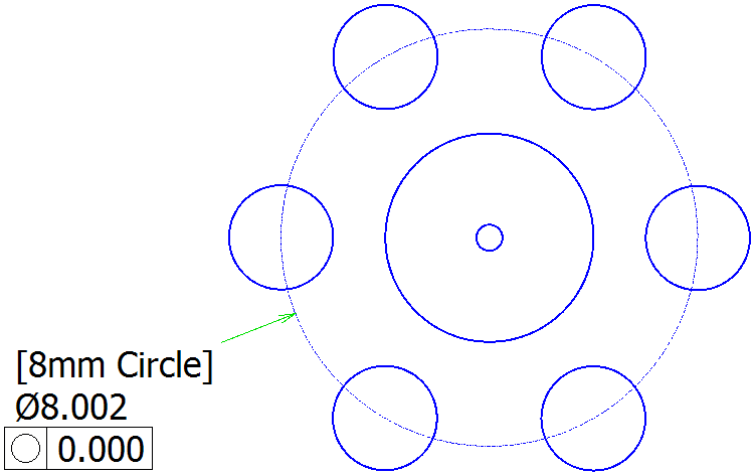
The value shown by default for an angular dimension will always be less than 180°, regardless of the quadrant it is placed in. Although the dimension can be manually edited by the user to show the reflex of this angle instead. For example, in the image below, the default angle shown between these two lines is 135° but this can be edited to display a 225° nominal instead.



Open the dimension details window and type the desired nominal for the angle, if this is a valid reflex angle, the dimension will turn green, and this will be used as the new nominal. Note that angularity cannot be displayed for a reflex angle.

35.5 Diameter and Radius Dimensions

Left click to select the circle or arc, as described in Chapter 35.1 – Aligned Dimensions, page 86. If correctly selected the feature will turn pink, now select the same feature again. The outline of a single dimension leader line will appear on the screen, and this can be positioned anywhere on the screen by moving the cursor. When it is at a convenient position, left click the mouse for a third time and the diameter or radius will now appear on the screen.

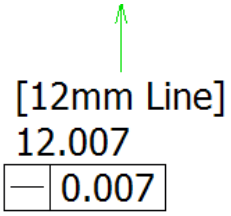


35.6 Geometric Tolerances

In the dimension details window, there are options for a measured and a geometric value. The geometric tolerance will depend on the dimensions created, for example parallelism for distance between lines. Geometric tolerances will be on or off by default as described in Chapter 43.2.8 – Geometric default ON, page 144. With this box ticked for the dimension, the geometric value will be shown below the measured value in the main view. Geometric tolerances can also be shown on their own by unticking the box for measured values.

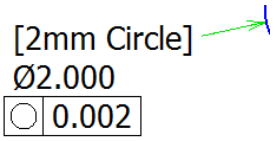
35.6.1 Displaying the Straightness of a Line

To display the straightness of a line, tap the line twice to make a dimension and tap in the drawing view to place it. If this line extends to meet features at both ends, it will display the line's length and straightness, or if it does not then only the straightness will appear. The straightness of a line is defined as the largest error of any measured point in a positive direction from the best fit line, plus the largest error of any measured point in a negative direction.



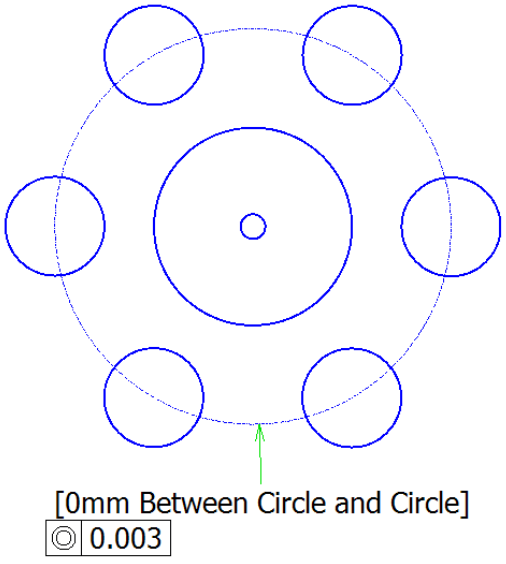
35.6.2 Displaying the Roundness of a Circle

With Geometric tolerances on, the roundness of a circle will automatically be given when measuring the diameter of a circle. To create this dimension, click to select a circle and click again to create and then click to place. The roundness will be shown underneath the diameter.



35.6.3 Displaying the Concentricity Between Two Circles

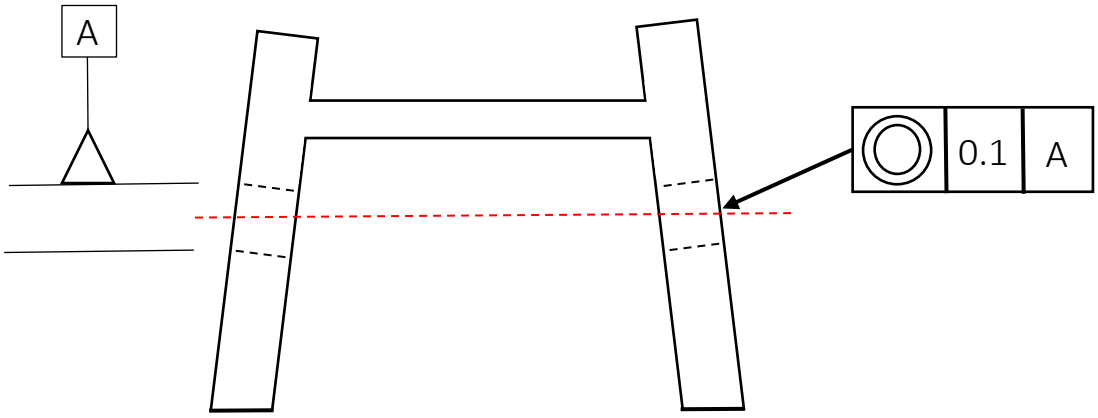
To display the concentricity between two circles, geometric tolerances must be switched on. The concentricity between circles may be brought up on the screen as follows: Select the first circle, as previously described. If correctly selected the circle will turn pink. Now select the second circle. If the circles are approximately concentric, then the outline of a single dimension leader line will appear on the screen attached to the larger circle, and this can be positioned anywhere on the screen by moving the cursor. When happy with the position, left click the mouse for a third time and the concentricity will now appear on the screen.



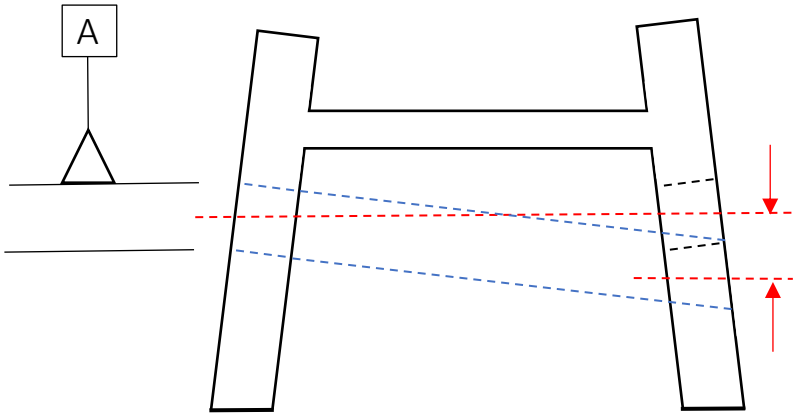
The concentricity between the circles is defined as twice the distance between their centres. If the circles are not very concentric, so that when clicking on them the software defaults to reporting the centre-to-centre distance, concentricity can still be called up by right clicking (before positioning the dimension) and selecting 'Leader' from the drop-down menu.

35.6.4 Displaying the Concentricity Between Two Circles on Different Planes

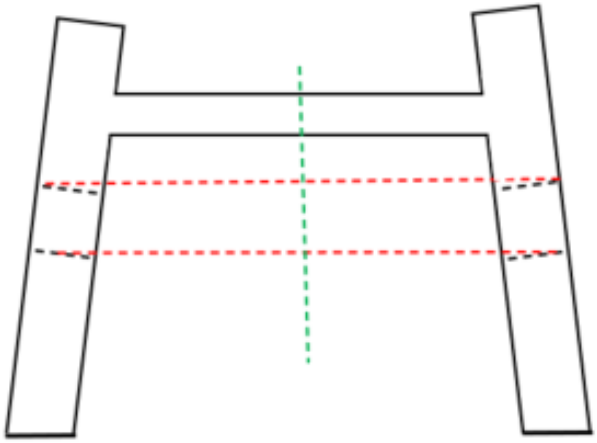
Displaying concentricity between 2 circles when those circles are on different planes is a common problem for designers. A measured circle will be projected on a plane that is respective to the angle of the section of the component it is measured on. This means that 2 circles measured opposite to each other, may not be on planes that are perfectly symmetric, leading to inaccurate concentricity values.



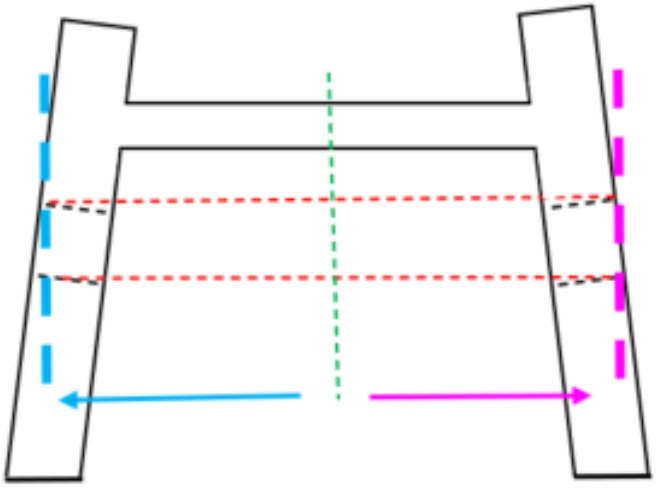
The above figure shows a cross section of a component with a hole that runs through it. This is an exaggerated example; however, it demonstrates how measuring concentricity between the 2 circles can lead to inaccurate results due to a potential unwanted taper in an imperfect component.



The figure above demonstrates this as the first circle's projection, represented in blue, sits a lot lower than the ideal line that the two circles will need to be compared against, represented in red. To accurately measure the concentricity here, both circles need to be projected on planes that are perfectly symmetrical. The plane used for both circles is crucial for achieving accurate concentricity, however the appropriate plane may not exist on the component, so a constructed plane is needed.



Measuring a cylinder between the circles, that runs through the length of the whole component, is required, demonstrated by the red lines. A plane can then be constructed from the cylinder, which should sit perfectly perpendicular in the centre of the cylinder, this is demonstrated by the green line.

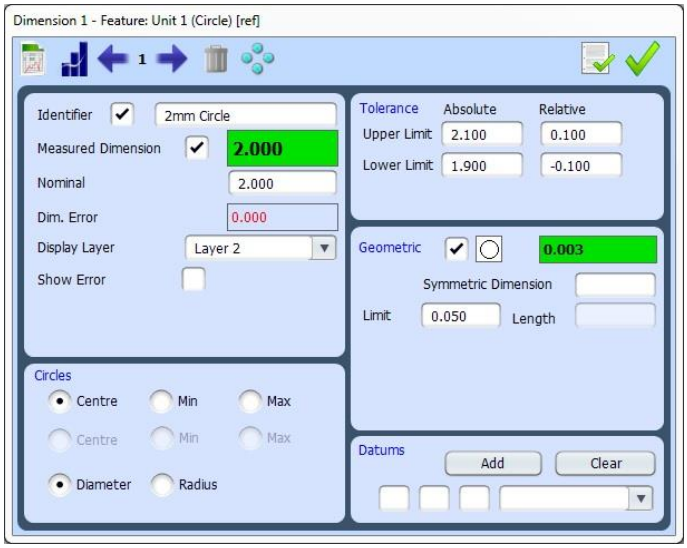


Offset planes can then be constructed from the new centre plane, that sits within the bounds of the first measured circle, represented by the blue line. Another plan needs to be constructed for the other circle on the other end of the component, represented by the pink line. The circles can be projected onto their respective offset planes so that both circles are projected onto planes that are perfectly parallel to each other. The correct concentricity can now be measured between the two circles.

35.7 Inscribed and Circumscribed Diameter Dimensions

By default, the diameter or radius displayed will be the best fit diameter or radius through the measured data points. To display the inscribed diameter, the largest diameter that fits entirely within the data points, or circumscribed diameter, the smallest diameter that fits around the outside of all the data points, then right click on the diameter or radius dimension line.

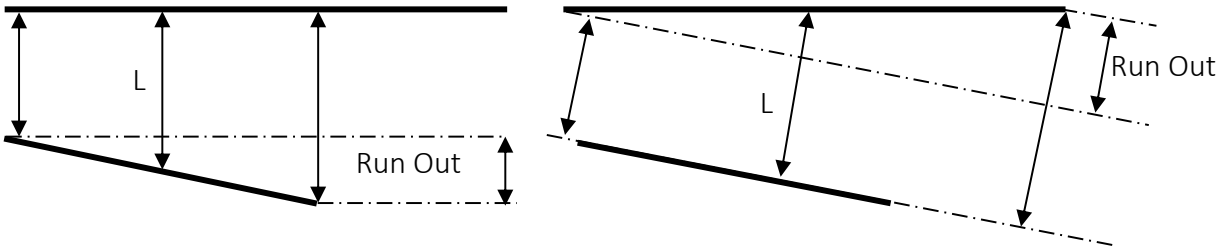
This will bring up the dimension details window:



Select min to change the diameter to inscribed and max to change it to circumscribed.

35.8 Dimensioning Between Near Parallel Lines

A linear dimension may be produced between two lines by attaching the dimension to the first line selected and extending it either perpendicularly (for an aligned dimension), or horizontally or vertically (for horizontal and vertical dimensions), until it reaches the mid-point of the second one. If the lines are not parallel, different dimensions will be achieved depending on which line or plane is selected first. Also, the geometric tolerance for run out is calculated by projecting perpendicular construction lines from the first selected line, to meet the ends of the second line. The run out (or perpendicularity) will be the difference between these two values. The diagram on the left shows the result of selecting the long line first, and on the right if the shorter line is selected first.

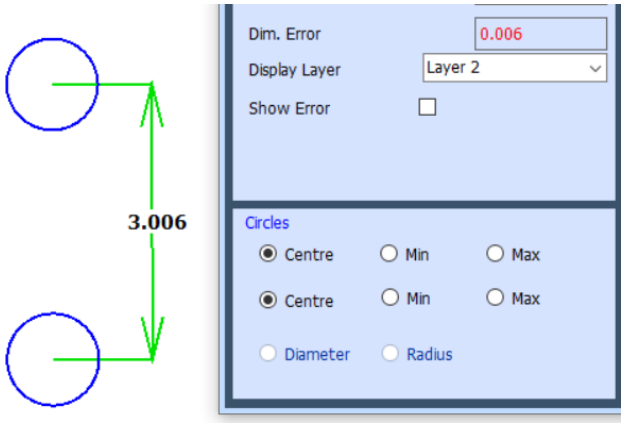


The first line selected, in effect, becomes the reference line for the measurement. If measuring the distance between a long line and a short line it will be better to select the long line first, unless the short line is specifically defined as a datum.

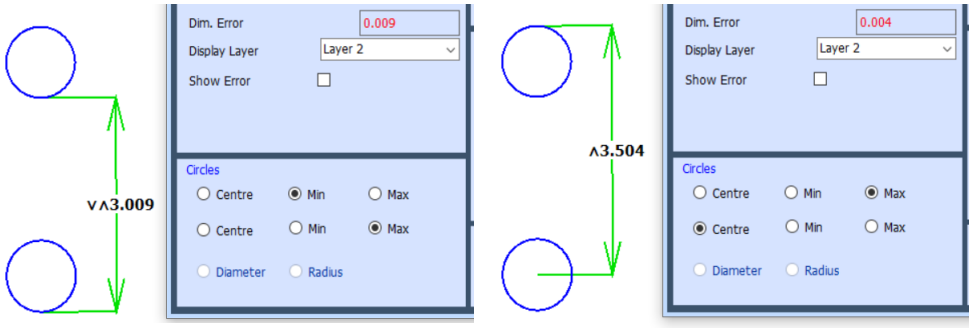
35.9 Dimensioning to the Outside of Circles or Arcs

When dimensioning to a circle or arc, this will be made from its centre point by default. The dimension can be edited to make it begin from the outer edge of the circle instead to produce a minimum or maximum distance to the other feature. This is be done by right clicking on the dimension to bring up the dimension details window.

With a dimension between two circles, the area of the circle used for the distance can be set for each individual circle, an example dimension between two circles is show below:

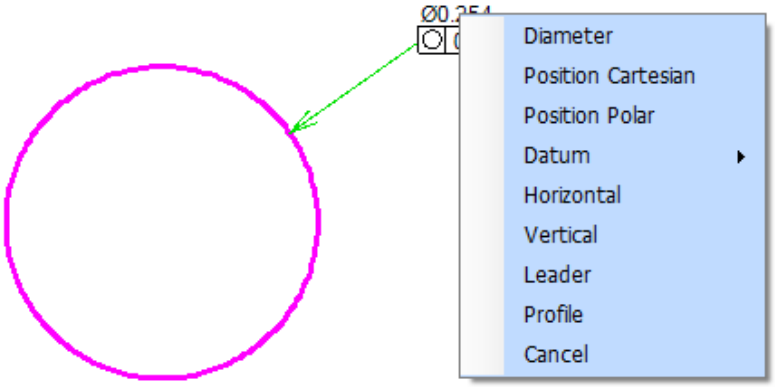


Selecting Min will make the dimension begin from the closest part of the circumference, to create the minimum distance from the circle or arc. If a Min dimension is selected, it will be symbolised by a ^ symbol to the left of the dimension value. If the maximum distance is needed instead, selecting Max will start the dimension from the opposite side of the circle. This will be signified by a ˅. Any combination of Centre Min and Max can be used for these circles, with some examples of how this will be displayed shown below.



35.10 Displaying Datums

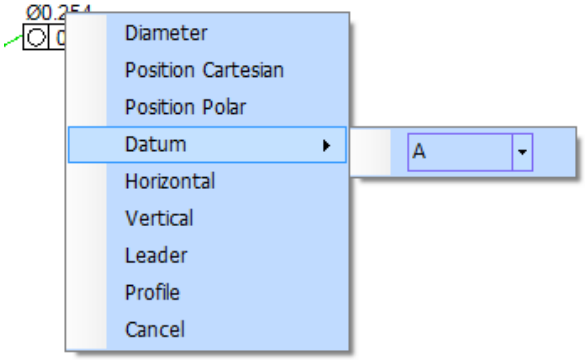
If a feature has been set as a datum, this information can be displayed in the same format as a dimension. To label the datum, double click the feature to bring up the dimension and right click to bring up the following menu:



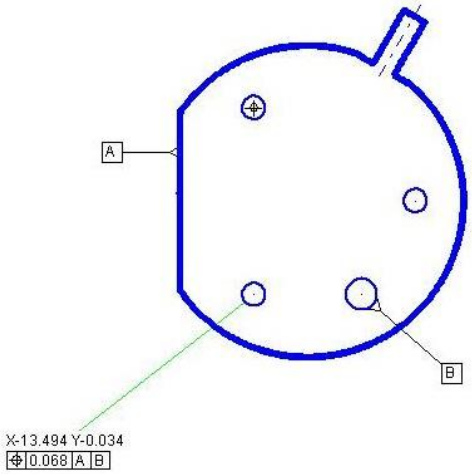
Position the mouse over the option Datum, and another tab will appear, if the part is already a datum, the first option will be the correct label. If there is no letter selected, there is currently no datum set. Selecting a letter will make the feature a datum, using the letter chosen.

35.11 Displaying the Co-ordinates and True Position of a Circle, Arc or Point

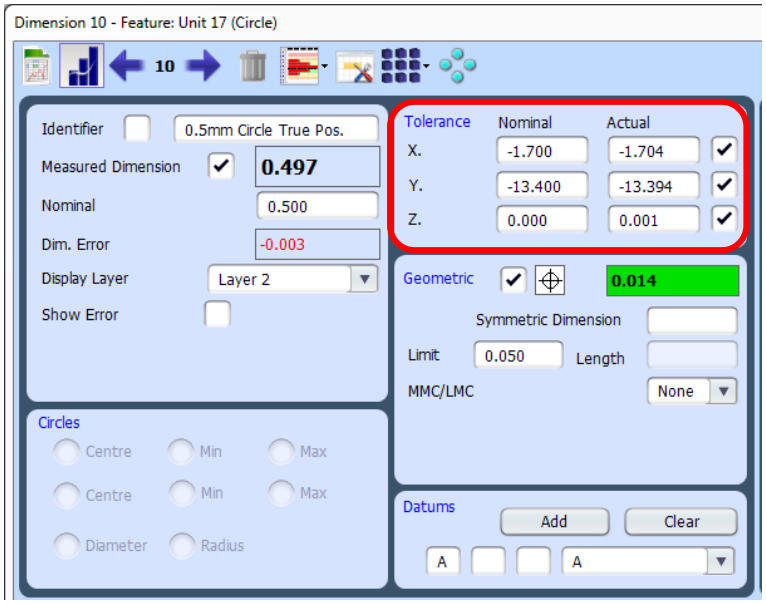
To display a true position on the main screen, geometric tolerances must be switched on. The Cartesian or Polar co-ordinates for a circle, arc or point may be displayed by selecting the feature twice and then right clicking to bring up the dimension menu.



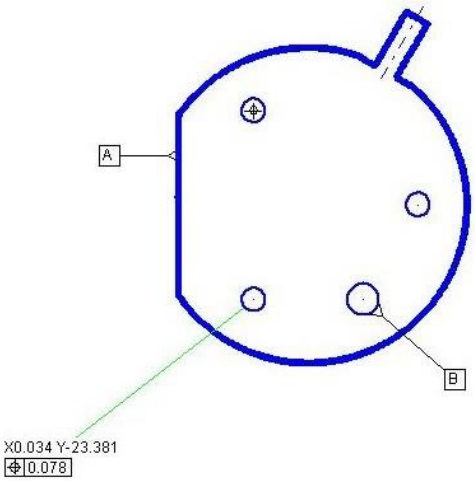
Select the desired type of co-ordinate and then position them on the graphic window and click for a third time to display them, as previously described when calling up dimensions.



To set the nominal values for the co-ordinates right click on the dimension line to bring up the dimension details window:



The software will have automatically have filled in values for the nominal position by using the measured values and rounding them to the rounding tolerance set in the Machine Set up, see Chapter 43.0 – MACHINE SETTINGS page, 140. The X and Y values can be individually switched off by un-ticking them in the dimension details window. Note that the true position will by default be taken as relative to the reference point set in the inspection. However, it can

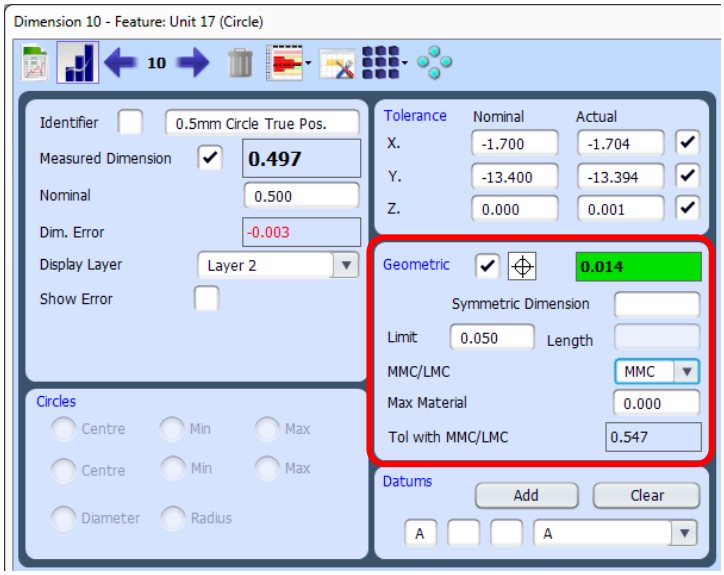


alternatively be called up relative to up to three datums. Select the datums required from the drop-down menu and click Add. This will change the reported value, as follows:

Note that this has changed the True Position displayed to be relative to the datums selected, rather than the reference position. Remember to set the Nominal position values accordingly.

35.12 Max/Min Material Condition (MMC/LMC)

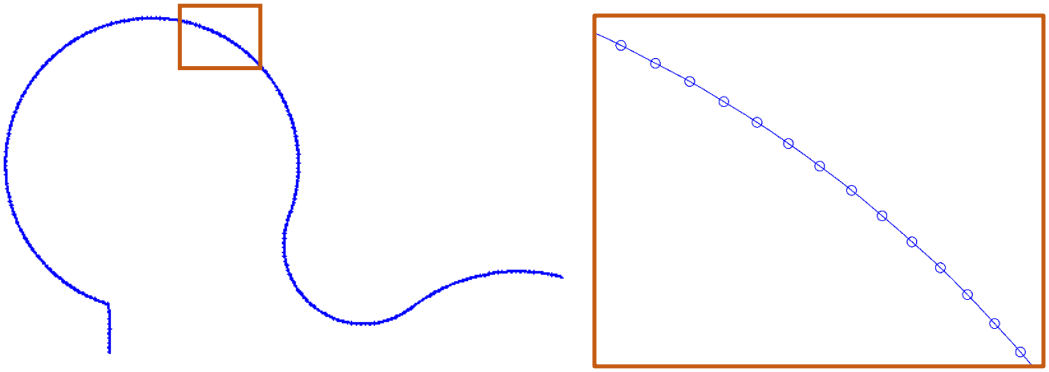
When calling up the True Position of a circle, arc, or point, as described in 35.11 above, it is also possible to allow for Maximum Material Condition. Right click on the dimension line to bring up the dimension details window. Now select the MMC drop down and two further boxes will become visible, as seen below:



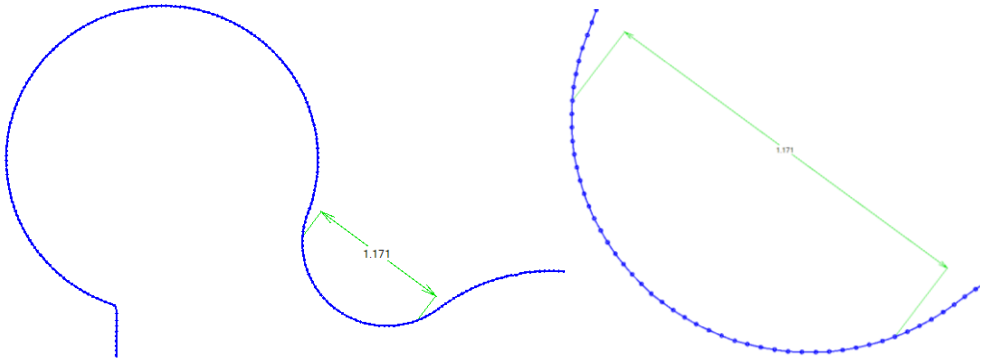
In the top box enter the minimum diameter allowable for the size of the hole (minimum limit), and in the lower box the 'bonus' mmc tolerance will be reported. This 'bonus' tolerance will alter the True Position tolerance and hence the pass/fail limit and will also be reported on a Tabulated Dimensions report.

35.13 Dimensioning a Curve

When a measurement has been taken using the Curve function, the result will be displayed as a polyline, connecting the series of points taken along the edge, shown as small blue circles.

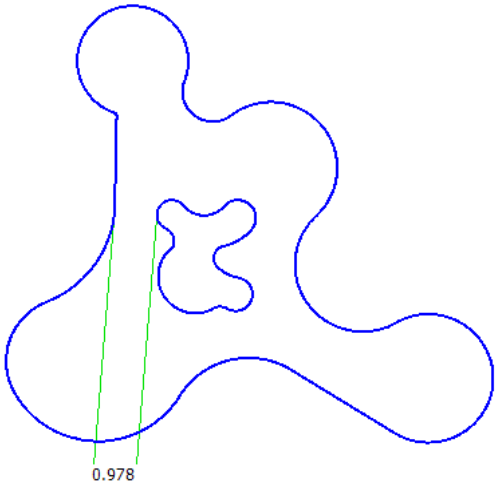


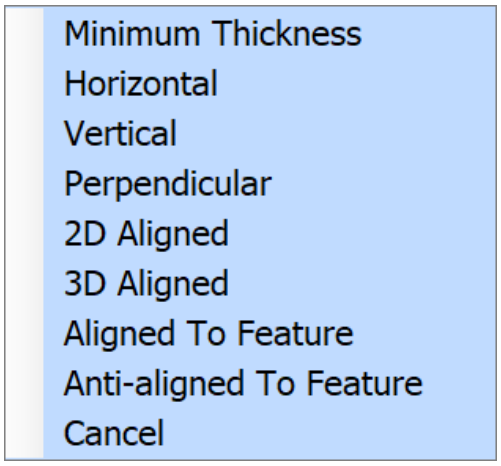
It is possible to display dimensions between any points within the same feature by left clicking on them as described above.



It is also possible to construct Lines, Circle and Arcs through any of the points selected, see Chapter 38.0 – CONSTRUCTING FEATURES, page 101. Curves can also be compared to DXF files with a tolerance band, to see the error of the measured points, double clicking in one area on the curve will create a profile dimension showing this, to get another dimension right click and select from the dropdown. DXFs are further described in Chapter 39.0 – DXF FILES page 117.

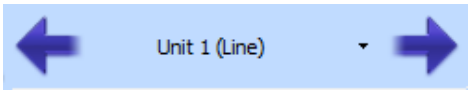
Dimensions between different curves can be attained by using the same method described above, one dimension available shows the minimum thickness between 2 curves. The two curves can be selected anywhere around the feature to get this dimension, then simply left click and select “Minimum Thickness”.





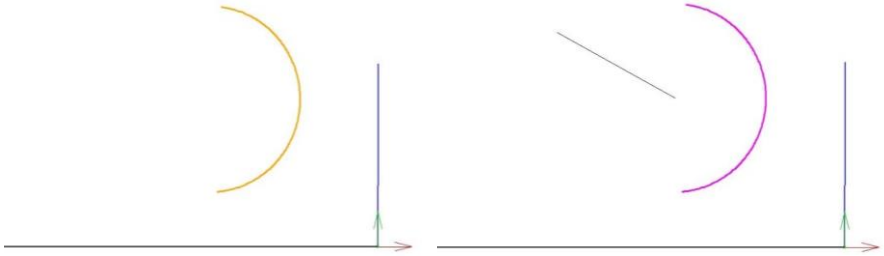
36.0 USING THE FEATURE SELECT BUTTONS

In some instances, it will be difficult to select a feature by clicking on it directly. If there is any difficulty in selecting a feature, the Feature Select buttons can be used.



Each feature is numbered, and this number is shown in the top left-hand corner of its measurement window. The ordered list of features in the program can be scrolled through by clicking the left or right arrows in the feature select toolbar. If there are many features in the program, it is possible to shortcut to the feature by clicking on the small down arrow to the right of the feature.

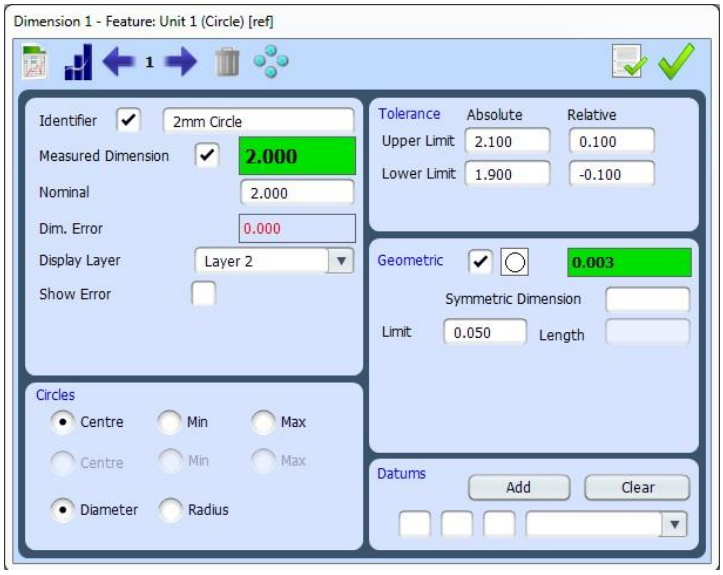
This will open a drop-down menu listing all program features, each of these are designated by a number followed by the feature type. Reference features will also be display with REF in brackets to the right of the feature type. As the feature number is selected, the graphical representation of that feature will turn orange. Now clicking anywhere within the graphical view will select the desired feature. The feature will turn purple to show it is selected for dimensioning.



The Feature Select button will only work to select a feature once. If the same feature needs to be selected twice, for instance to display the diameter of a circle, click on the feature name again to re-highlight that feature. There is no need to use the right and left arrows to move off and return to the desired feature. Clicking again in the graphical view will re-select the feature.

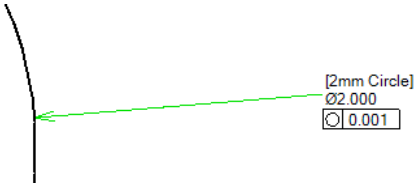
37.0 THE DIMENSION DETAILS WINDOW

For any dimension, it is possible to set the nominal value for the dimension and its tolerance by right clicking on the dimension line to bring up the Dimension Details window:



The nominal dimension and tolerances, either absolute or relative, can be set by typing over the default values. Note that the default value for the nominal is taken as the first measured value rounded to a specific value. The rounding value for the nominal and the default tolerance can be set in the Machine Set Up, see Chapter 43.0 – MACHINE SETTINGS 140. The Dim. Error is calculated as the difference between the measured value and the nominal value. If the measured dimension falls within the tolerance band set, then the colour of the measured dimension box and the dimension leader lines on the main screen will be green. If it's out of tolerance, then these will be red.

The software also assigns an identifier (or description) for the dimension, this can be changed by typing a new name into this text box. The tick box next to this, dictates whether this name will be shown above the dimension on the graphical representation.

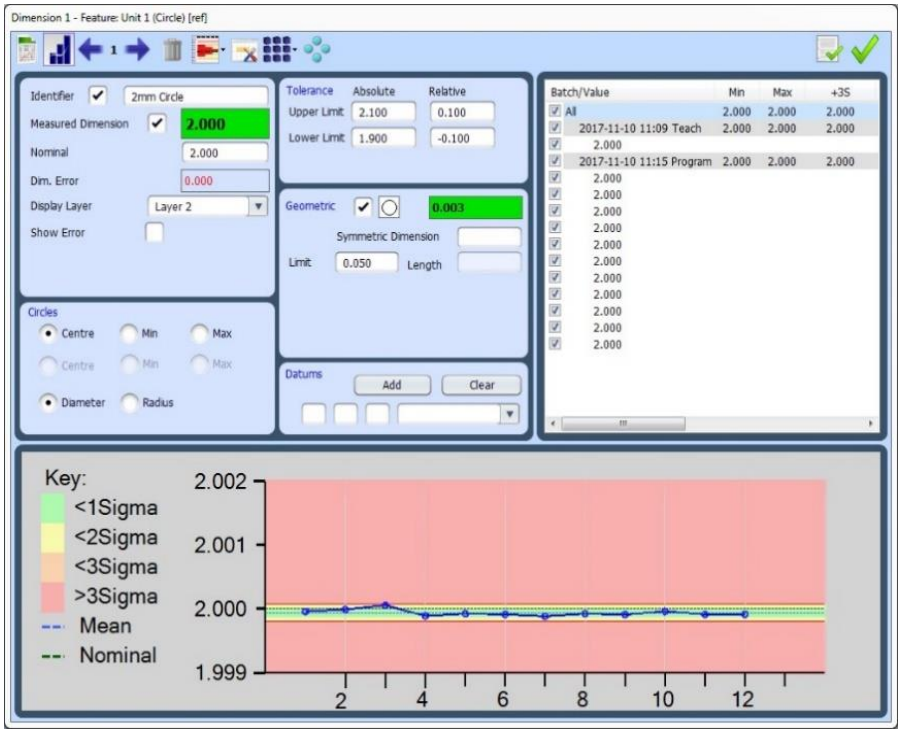


If a geometric tolerance (e.g., Roundness, Parallelism etc.) applies to the dimension called up, then the value for this will be shown in the Geometric Tolerance box. The limit for the Geometric Tolerance value is shown in the Geometric Limit box. By default, this will be equal to the value set in the Machine Set Up, Chapter 43.1.5 – Default Tolerance, page 142, but again this can be changed by typing over the value in the box.

If relevant, for instance when calling up True Positions, the Geometric Tolerance can be made to be relative to up to three previously set datums by selecting each datum from the drop-down menu and clicking 'Add'.

37.1 Showing SPC Batch Information

If a batch of components have been measured using the Play function, and the SPC data has been collected using the 'SPC all Components' option, then the batch information for each



SPC Batch Data

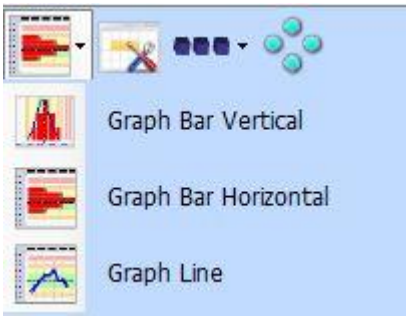
SPC Chart

dimension can be displayed by clicking on the small bar chart icon in the top left-hand corner of the Dimension Details window:

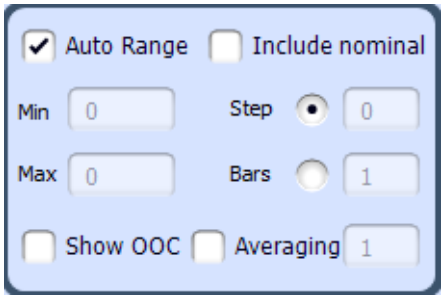
The sheet icon will shortcut to the SPC report, the feature select arrows ensures it easy move between dimensions, the rubbish bin will delete the dimension permanently, and the measured value for all the components in the batch is listed in the white field. In this field is a list of columns with the following batch information:

- Minimum
- Maximum
- Mean (value for the batch)
- Mean + 3σ (where the number of σ is configurable by the user)
- Mean - 3σ (where the number of σ is configurable by the user)
- 3 Sigma (3σ)
- CP (Process capability)
- CPK (Process capability index)
- Mean shift (difference between the mean and nominal values)

At the bottom of the window in the SPC chart area is a graphic representation of the batch data, this display can be modified by clicking the chart type button at the top of the window. Pressing this will open a drop-down menu, allowing the desired chart type to be selected.



The axes on this chart are set automatically but can be adjusted manually within Chart Options.

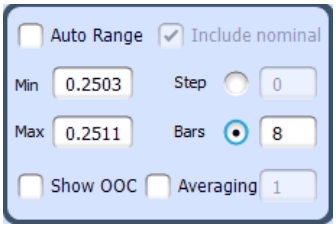


Auto range is the default setting and will choose a suitable minimum and maximum for the graph, as well as the increments on the Y axes, unticking this will open the options so that the graph can be customized. Include nominal will add a line to the graph at the nominal, this can easily be compared to the Mean shown in green.

Min and Max will set the range of the axes, Step will control the size of the increments on the Y axis, and Bars will control the number of evenly spaced increments. Averaging condenses the number of points on the graph by a factor of the value in this box, a value of 2 will halve the number of points shown and put this new number of points at an averaged location, a value of 10 here will only show 1/10th of the number original points taken.

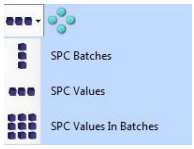
Show OOC will display information below the graph's key if there are any Out-of-Control measurements, this will state their deviation from the mean and 3 sigmas.

The following settings will produce the graph seen below:



There is coloured banding in the chart which represents the Sigma values. The green band represents the 1σ band, yellow the 2σ, orange the 3σ and red greater than 3σ.

The SPC options button is another drop-down menu, selecting one of the three options available allows the layout of the batch data to be changed.



The last icon on the Dimension window is the Array icon: 

This icon is used to copy the current dimension to similar features. For example, if there is a grid of holes of a similar size, the first hole's dimensions can be set up in the dimension window. These settings could then be applied to all other similar holes by pressing the array button so that all holes have the same dimension setup applied to them, saving setup time.

38.0 CONSTRUCTING FEATURES

Some features and dimensions cannot be measured directly but can be created by construction using previously measured features. For example, when measuring a Pitch Circle Diameter, the holes on the PCD can be measured directly, but not the diameter that the holes lie on. To find this, a further circle can be constructed through the centre of the measured holes, and this can be dimensioned to show the PCD diameter.

There is a wide range of constructions that can be made in the Fusion software, including:

1. Points:

a) A point at the intersection between two lines.

b) A point at the intersection of a line with a circle or an arc.

c) A point at the intersection between two circles or arcs.

d) A point at a user defined Cartesian or Polar position.

e) A point at the apex of a cone.

f) A point closest or furthest from another feature.

g) A point on a plane at the closest distance from another point.

2. Lines:

a) Through two or more points, circles, or arcs.

b) The Centre Line between two lines.

c) From a point, circle or arc to a user defined Cartesian or Polar position.

d) Tangentially between two circles or arcs.

e) A gauge line of defined length between two lines and perpendicular to the CL.

f) A gauge line set normal to a plane.

e) An angled gauge line from a point to a line feature

3. Circles:

a) Through three or more points, circles, or arcs (PCD).

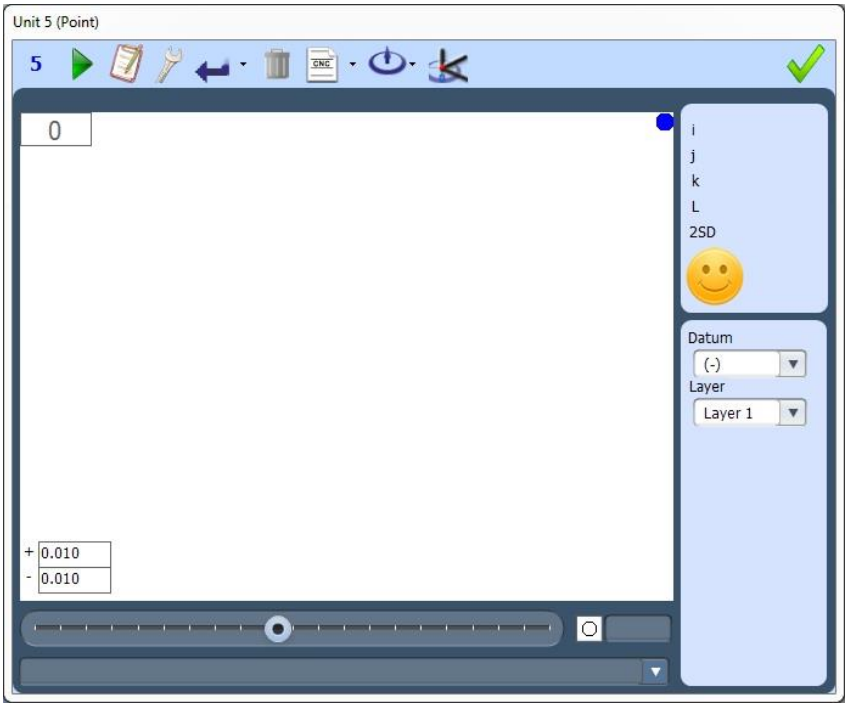
b) Of a defined diameter between two lines or two circles.

c) A gauge circle constructed using two points on a plane.

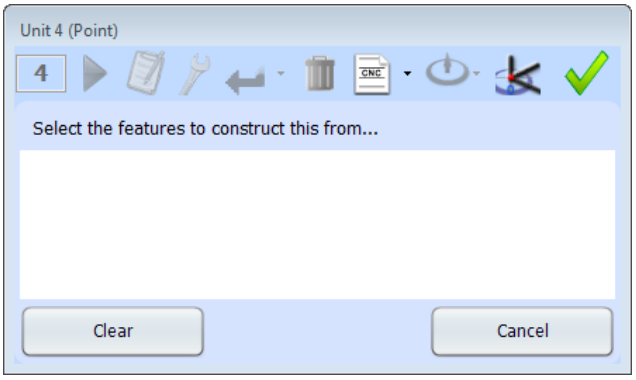
38.1 Constructing Points

38.1.1 Constructing a Point at the Intersection Between Two Lines

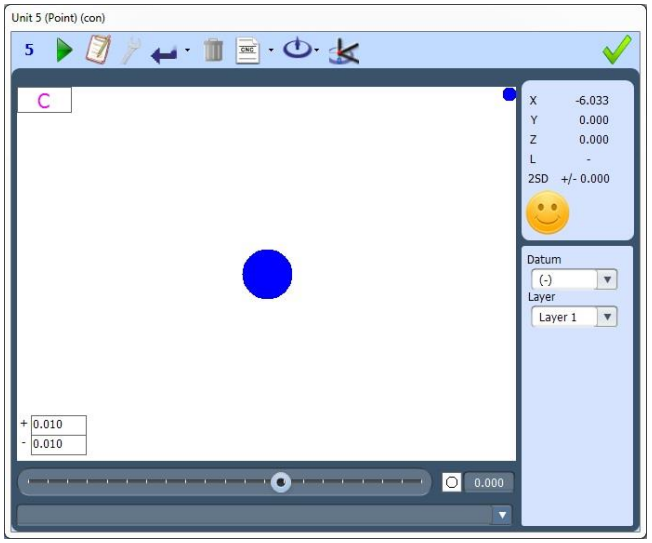
To construct a point between two lines, click on the Point Measure button, from the main screen. This will bring up the Point Measure window:



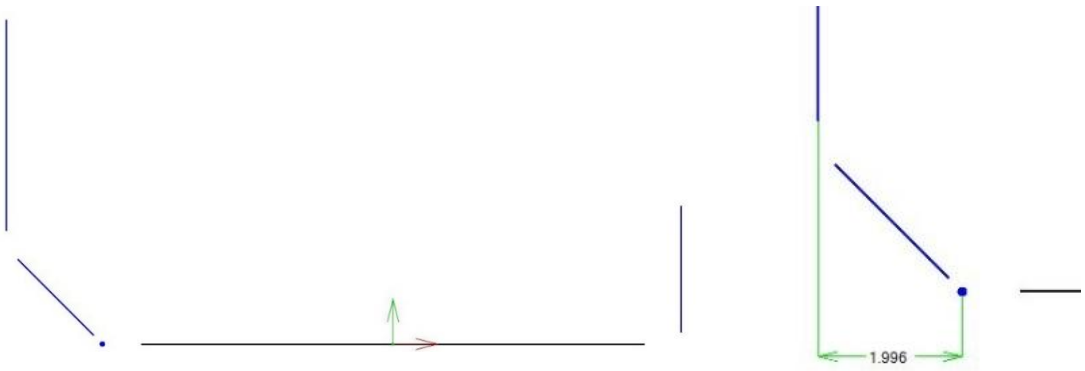
Now click on the construct (spanner) icon. The point measure window will now shrink to a new window, prompting the user to select features, which will be listed in the white box:



Next, click on the first line to construct the intersection. It will turn pink, to show that it has been selected. Then click on the second line, which will also turn pink and then the Point Measure window will automatically open showing the details of the constructed point:

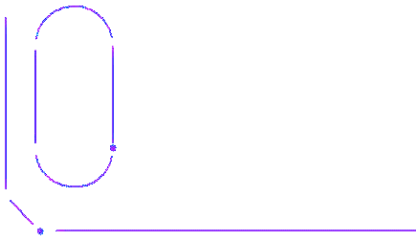


Clicking the green tick will then return to the Main Screen, drawing a representation of the point as a blue dot. Note that the size of the blue dot can be configured in “Point Size”, in the machine settings, under the display tab. Dimensions can then be called up to the constructed point as for any feature:



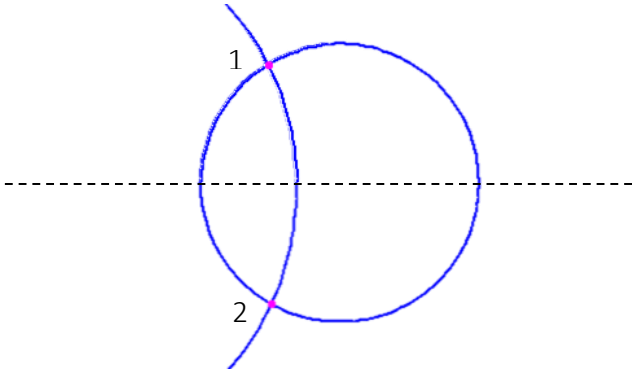
38.1.2 Constructing a Point at the Intersection of a Line with a Circle or an Arc

To construct a point between a line and a circle or an arc, follow the procedure as described in Chapter 38.1.1 above. If the line is approximately tangential to the circle or arc (as in the slot shown below) then it is possible that the features do not intersect at all. In this situation the point will be created at the minimum distance between the arc and the line.



38.1.3 Constructing a Point at the Intersection Between Two Circles or Arcs

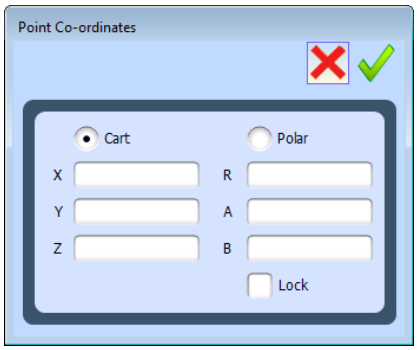
To construct a point between a line and a circle or arc, follow the procedure as described in Chapter 38.1.1. Although in this case, or for an intersection between a line and a circle or arc, there can be 2 points of intersection, as shown below:



To determine which of the 2 intersection points are constructed the software looks at the position of the user click on the ***second*** feature selected. The first feature may be selected at any position, but the point constructed will be the one closest to the second click. In the example above, if the second feature is selected above the dotted line, then point 1 will be constructed, if the second click is made below the below the line it will create point 2. If the wrong section is selected, the constructed point can be moved by selecting the spanner icon in the feature window, as discussed in Chapter 38.4 – Editing Constructions, page 116.

38.1.4 Constructing a Point at a User Defined Position

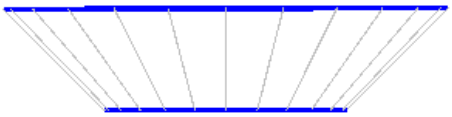
To construct a point at a defined position, click on the Point Measure button from the main screen to bring up the Point Measure window. Click on the 'Construct' button and the Point Measure window will shrink to a small box at the bottom of the screen, as previously described. Next, double click on a circle or arc and the following box will appear:



This allows the user to enter either the X, Y co-ordinates of the point, or the R and A polar values for the point, where R is the distance from the reference position and A is the polar angle in the XY plane. The Z and B boxes can be ignored on 2D systems like the VuMaster. Having entered the desired co-ordinates click the green tick and the Point Measure window will automatically reappear. Clicking OK in the Point Measure window will return the software to the Main Screen, drawing a representation of the point as a blue dot.

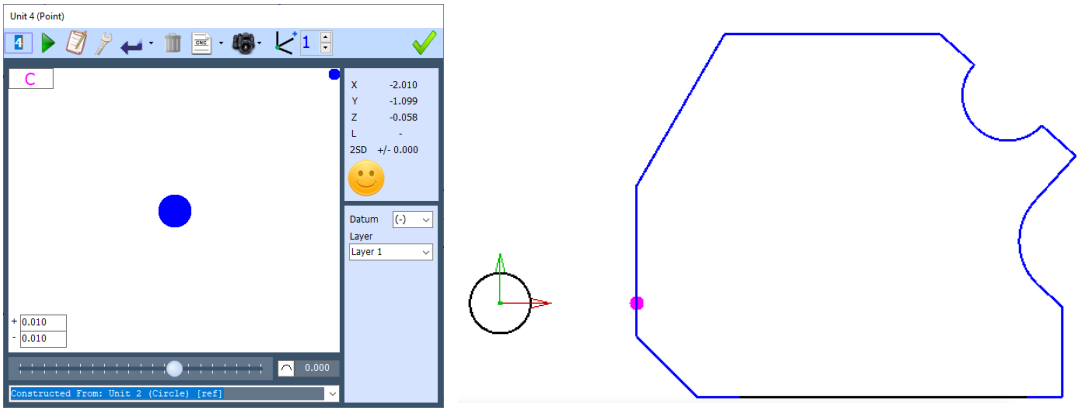
38.1.5 Constructing a Point at the Apex of a Cone

To construct a point the apex of a cone, tap on the Point Measure button from the main screen to bring up the Point Measure window. Next tap the construct button and double click on the cone feature. This will automatically place the constructed point at the tip of the cone.

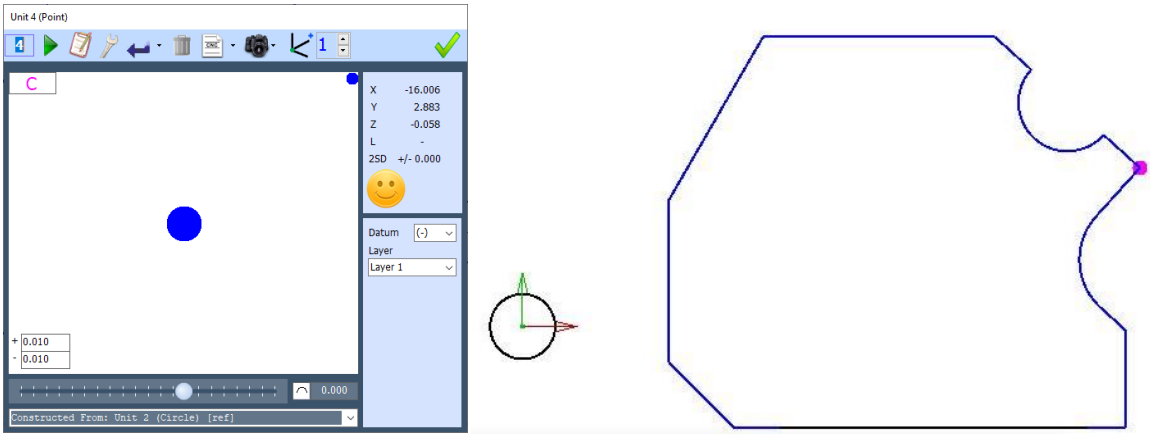


38.1.6 Constructing a Point Closest or Furthest from a Curve and a Feature

To construct a point at the closest distance between a curve and a feature, the Point Measure icon must be used from the main screen to bring up the Point Measure window. The construct icon is used next, first select the curve, then select the feature. The point will automatically be positioned at the closest distance from the feature as shown below.

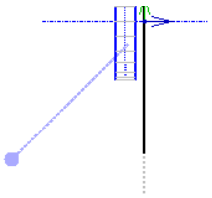


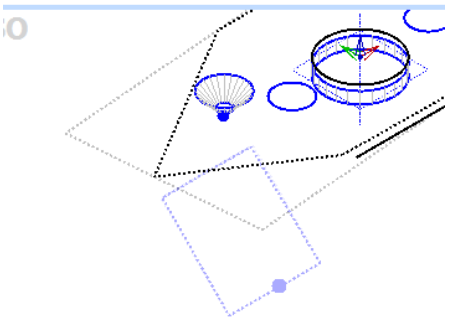
The spanner icon is used to cycle between the closest and furthest point, as shown below.



38.1.7 Constructing a Point on a Plane at the Closest Distance from Another Point.

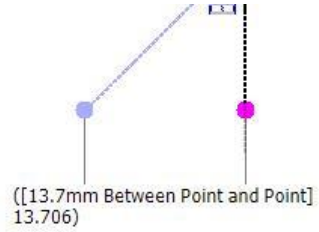
Shown below is an example of a point, depicted in blue, that is set below the reference plane, depicted in black.

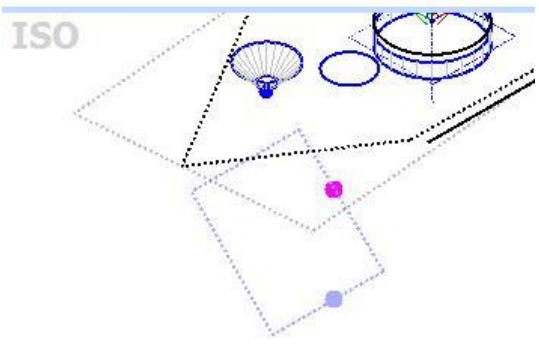




To construct a point at the closest distance between that point and a plane, a constructed point can be used. The plane the constructed point will be displayed on should be selected first, then the point on the plane that will be used to measure closest to. A point will be constructed, as shown below.

As shown by the YZ window at the top of the figure, dimensions can be added to show the distance between the two points.

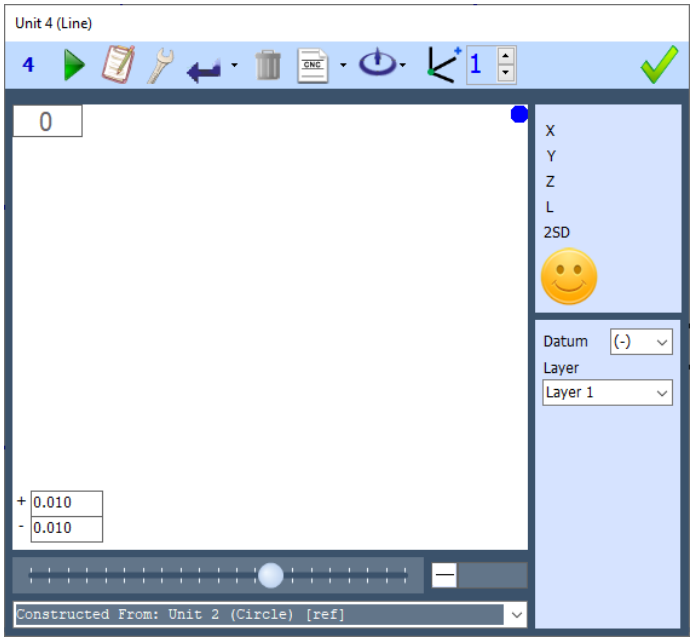




38.2 Constructing Lines

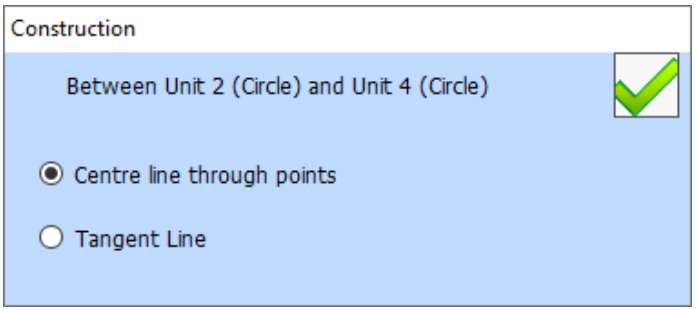
38.2.1 Constructing a Line Through Two or More Points, Circles or Arcs

To construct a line between two or more points, circles, or arcs, click on the Line Measure button, from the main screen. This will bring up the Line Measure window.

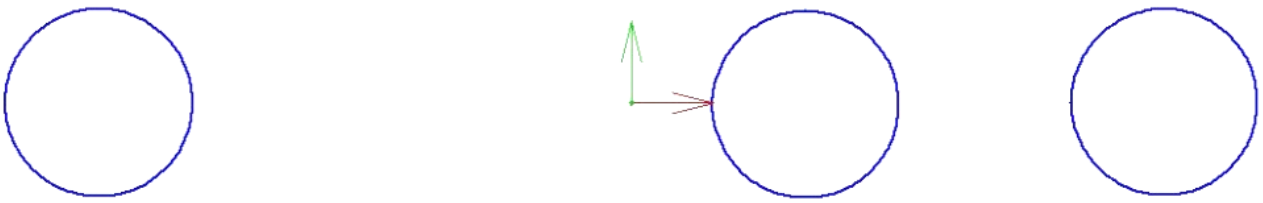


A line can be created from existing features using the construct (spanner) icon. 

Now click on the feature to construct the through. It will temporarily flash pink, to show that it has been selected. Then click on the second feature. It will also flash pink, and then the following window will appear:

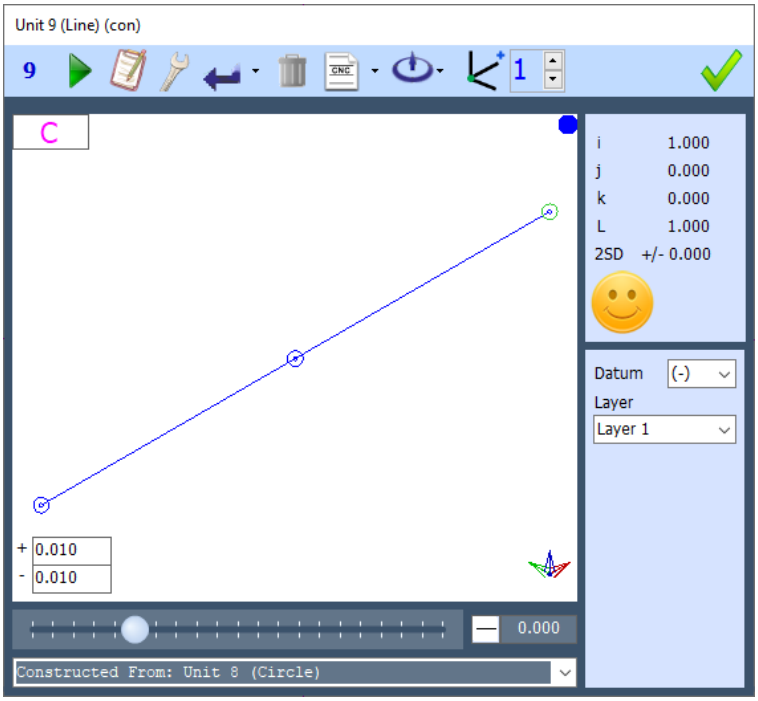


Select 'Centre line through points' and then click the green tick. The window will close and return to the Main Screen. Continue selecting any other features to construct the line through.

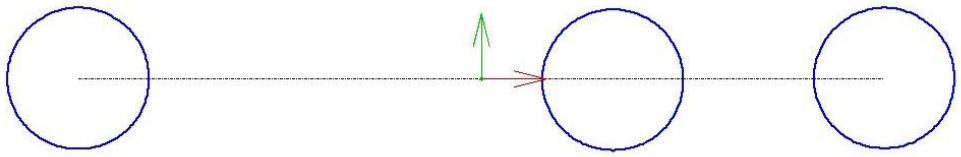


When all features are selected from the construction menu, click the green tick to accept.

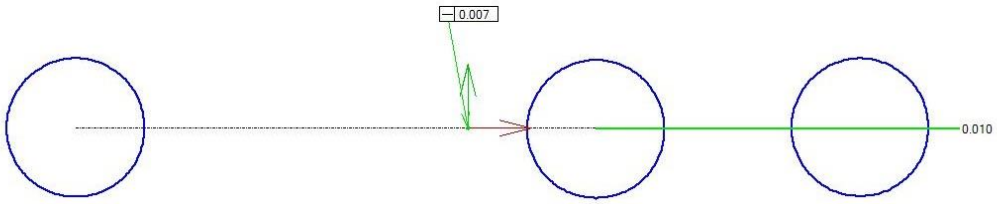
The Line Measure window will then open showing the details of the constructed line:



Clicking the green tick will accept and then return to the Main Screen, drawing a dashed, blue, best-fit line through the selected features:

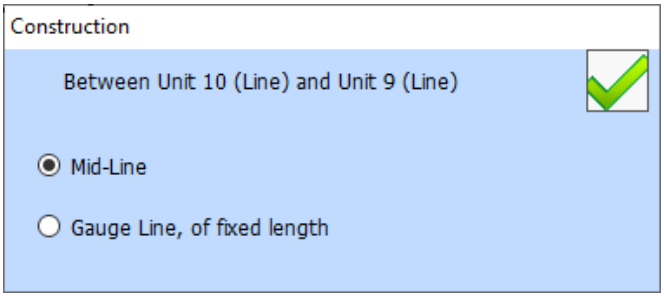


Clicking the Set Ref icon before OK will align the inspection to the nearest 90°. Dimensions can then be called up to the constructed line as for any feature:



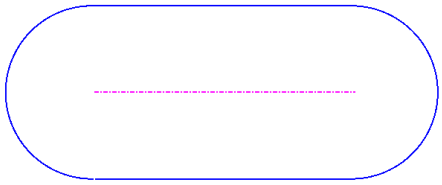
38.2.2 Constructing the Centre Line Between Two Lines

To construct a centre or mid-line between two lines, follow the procedure as described in Chapter 38.1.1. When the second line is selected, the following window will appear:

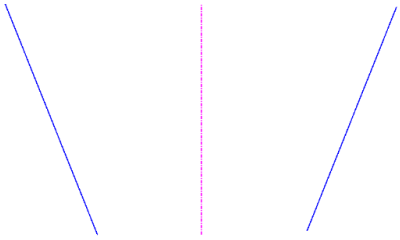


Select Mid-Line and then the green tick. The window will close, and the Line Measure window will then open showing the details of the constructed line.

Clicking the green tick will then return to the Main Screen, drawing a dashed, blue, centre line bisecting the lines selected:

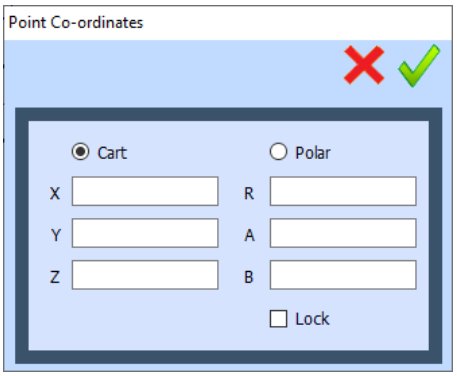


Note that the lines do not have to be parallel. The centre line constructed will always bisect the selected lines:

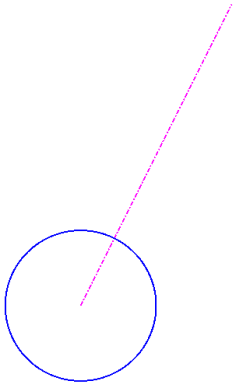


38.2.3 Constructing a Line from a Point, Circle or Arc to a User Defined Position

To construct a line from a point, circle or arc to a user defined Cartesian or Polar position, follow the procedure as described in Chapter 38.1.1. The first feature to select will define the start position of the line. Selecting the same feature again will bring up the following window:



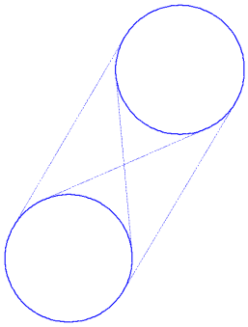
This box allows the user to enter either the X, Y co-ordinates, or the R and A polar values for the other end of the line, where R is the length of the line and A is the polar angle in the XY plane. Note that the Polar co-ordinates are extremely useful if a line needs to be constructed at a specific angle. Having entered the desired co-ordinates click the green tick and the Line



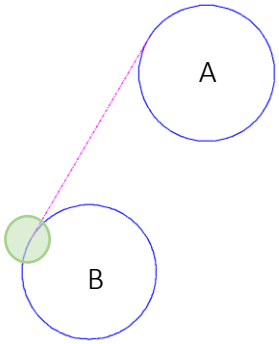
The measure window will automatically reappear. Clicking the green tick will then return to the Main Screen, drawing a dashed line.

38.2.4 Constructing a Line Tangentially Between Two Circles or Arcs

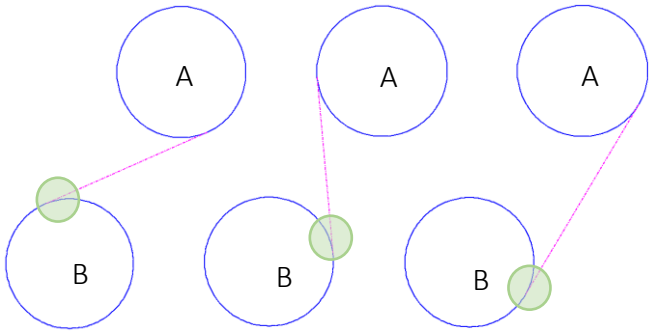
There are four tangential lines that can be constructed between two circles, as shown below.



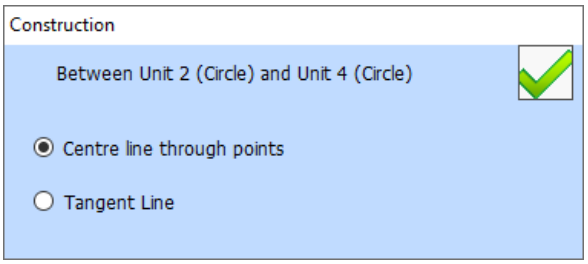
To construct these lines, select line measure, and then construct from existing features. To determine which of the 4 tangent lines is constructed the software looks at the position at where the user clicks on the ***second*** feature selected. For example, if circle A is selected first and then circle B is clicked around the area shown, this will create the following line.



The images below show how the remaining tangent lines can be created. Each begin by first selecting circle A, and then clicking in the area shown on B for the corresponding line.



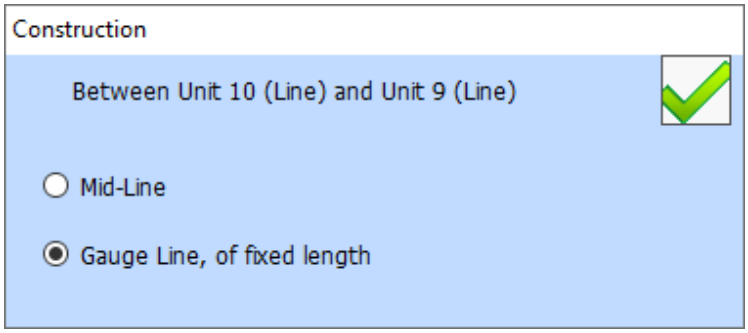
After the second feature has been selected, the following window will appear:



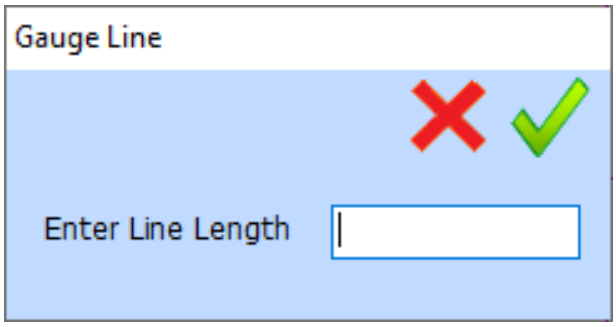
Select Tangent Line and then click the green tick. The window will close, and the Line Measure window will then open showing the details of the constructed line. Clicking the green tick will then return to the Main Screen, drawing a dashed, blue, Tangent line as defined. If the wrong section is selected, the constructed feature can be edited by selecting the spanner icon in the feature window, as discussed in Chapter 38.4 – Editing Constructions, page 116.

38.2.5 Constructing a Gauge Line Between Two Lines

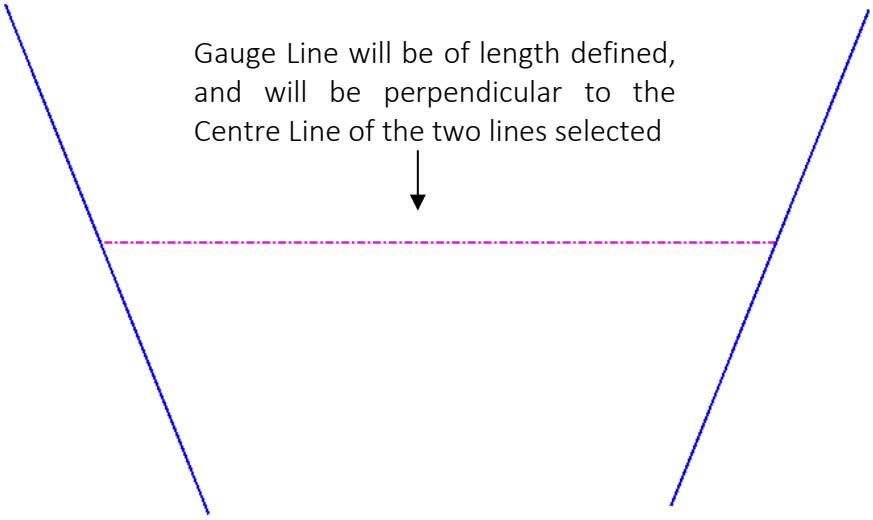
To construct a gauge line of defined length between two lines and perpendicular to the centre line, follow the procedure as described in Chapter 38.2.1. When selecting the second line, the following window will appear:



Select 'Gauge Line of fixed length' and then click the green tick. The window will close, and the following window will then open allowing the user to enter the length of Gauge Line required:



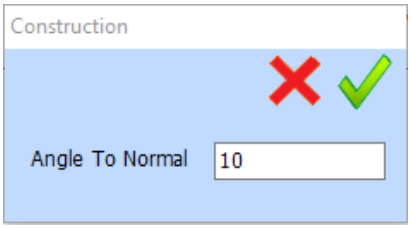
Enter the length required and then click the green tick. The window will close, and the line measure window will then open showing the details of the constructed line. Clicking the green tick will then return to the Main Screen, drawing a dashed, blue, gauge line as defined:

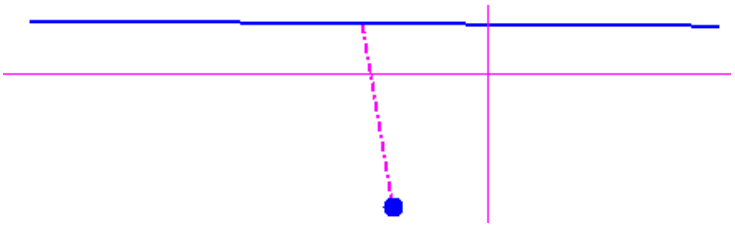


38.2.6 An angled Gauge Line from a Point to a Line Feature

Constructing a gauge line from a point to a line allows the user to specify the angle in which the gauge line sits along the feature line. This feature can be constructed by selecting the Line Measure tool in the Measure toolbar, then clicking the construct icon. The point will be selected first, and then the line, after which, the window below will appear.

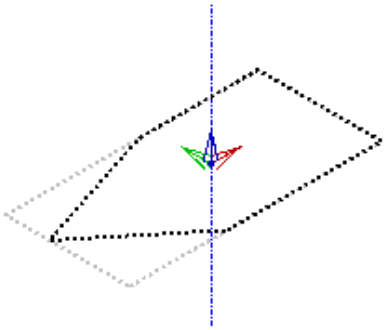
The angle in which the gauge line will sit can be chosen, using the Angle To Normal box. Selecting 0 will construct the line perfectly perpendicular to the feature line and the point. Once the angle is selected, press the green tick and the construction will be finished.



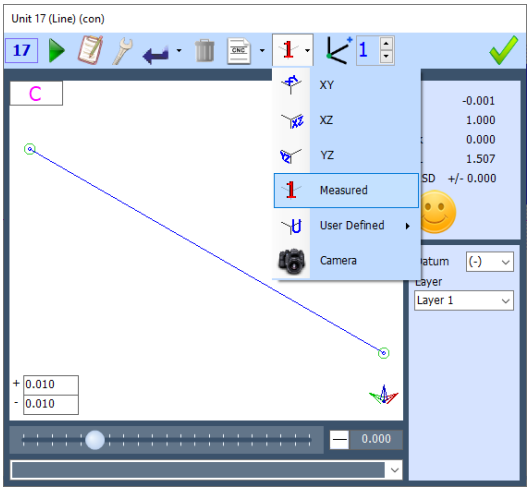


38.2.7 A Gauge Line Set Normal to a Plane

Constructing a gauge line that sits normal to a plane will set the line perpendicular to the desired plane at its centre. This feature is constructed using the Line Measure tool in the Measure toolbar, and then the construct icon. The plane the gauge line will sit perpendicular to is the only feature that needs to be selected, and the programme will automatically set the line, as shown below.



It is also possible to project this feature onto another plane. First open the gauge line feature window and select the Plane select icon at the top of the window, as shown below.

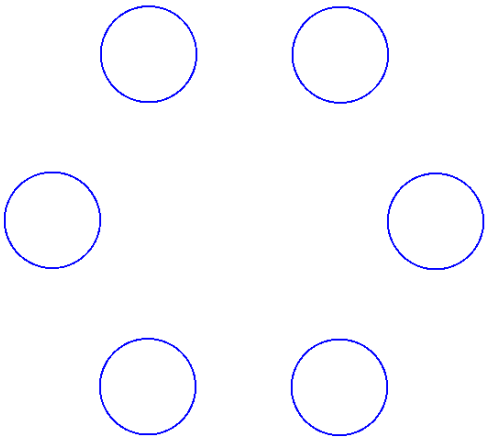


Next, click on the 'Measured' icon, a message that reads 'Click on previously measured features' should appear. Then click on the plane the line will be projected onto.

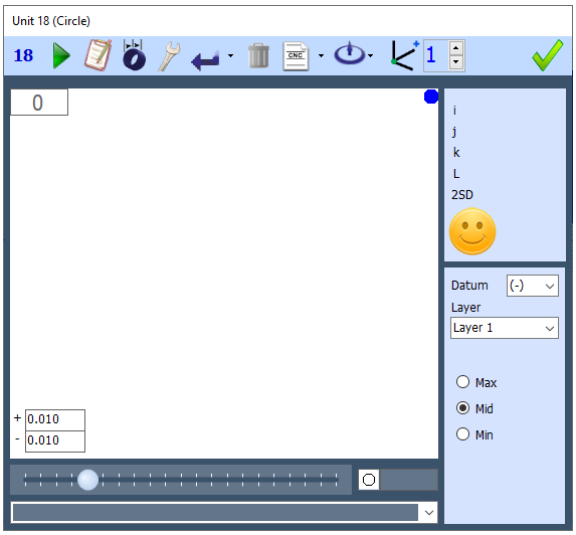
38.3 Constructing Circles

38.3.1 Constructing a Circle Through Three or More Points, Circles or Arcs

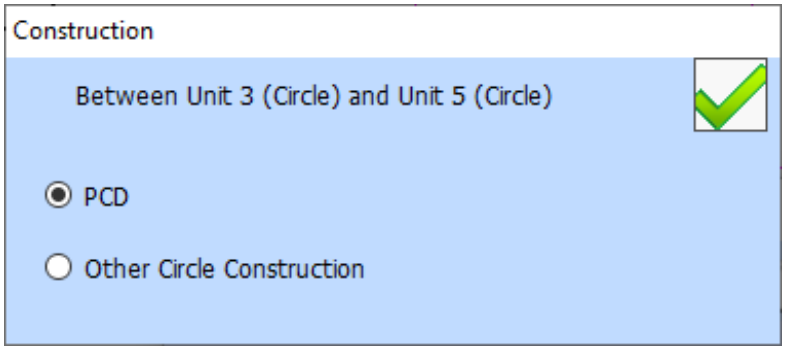
Circles can be constructed through three or more points, circles, or arcs. The image below shows circles that make a Pitch Circle Diameter- PCD.



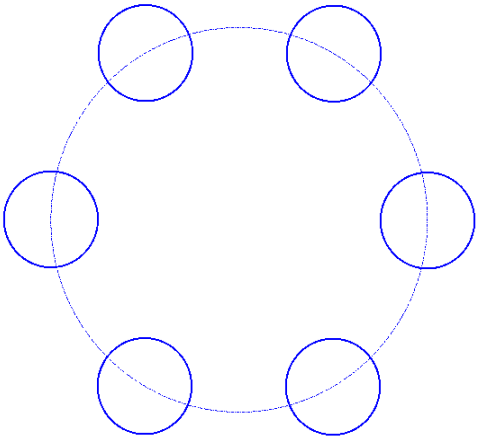
To construct this, click on the circle measure button in the main screen to bring up the circle measure window:

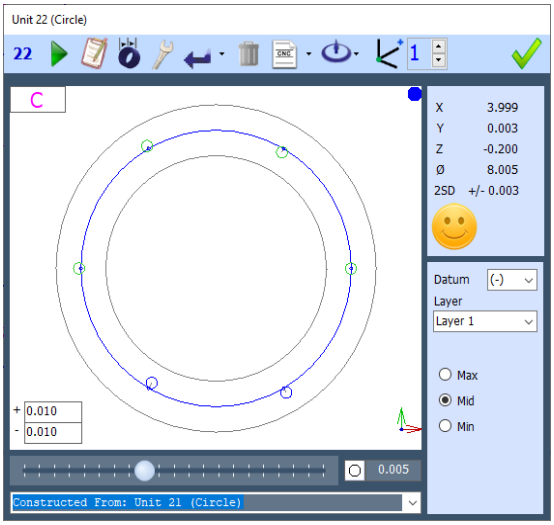


Now click on the construct (spanner) icon and click on one of the circles. It will temporarily flash pink, to show that it has been selected. Then click on the second circle. It will also flash pink, and then the following window will appear:

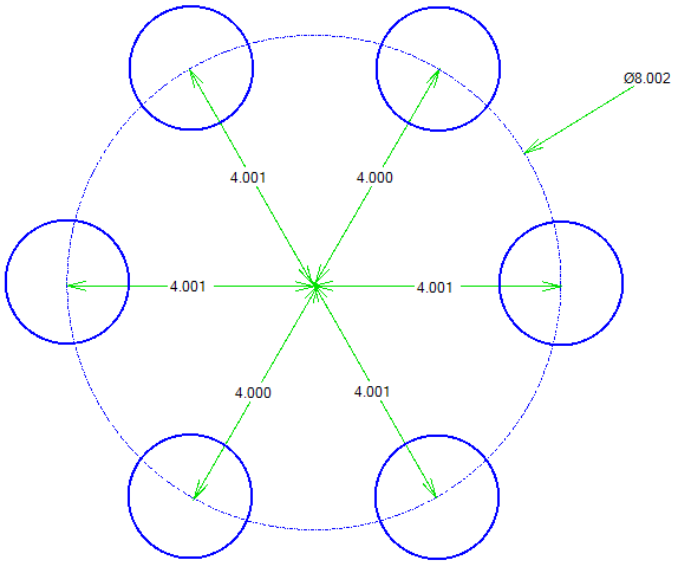


Select ‘PCD’ and then click the green tick. Continue selecting any other circles for the PCD to be constructed through, and then when finished press the green tick from the construct window. The Circle Measure window will then open showing the details of the PCD and in the Main Screen a dashed constructed line will be drawn:



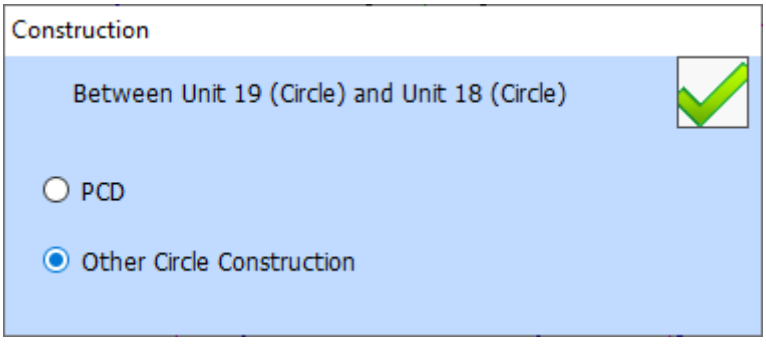


Dimensions can then be called up to the constructed line as for any feature:

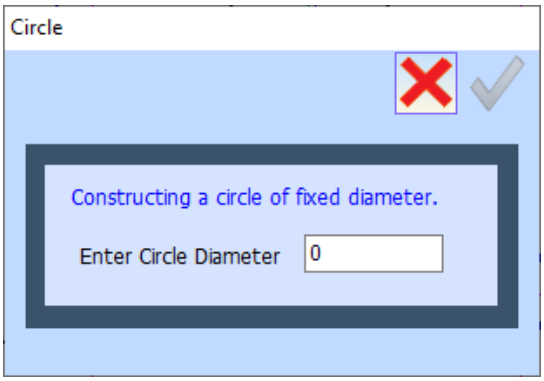


38.3.2 Constructing a Circle of Defined Diameter Between Two Lines or Two Circles

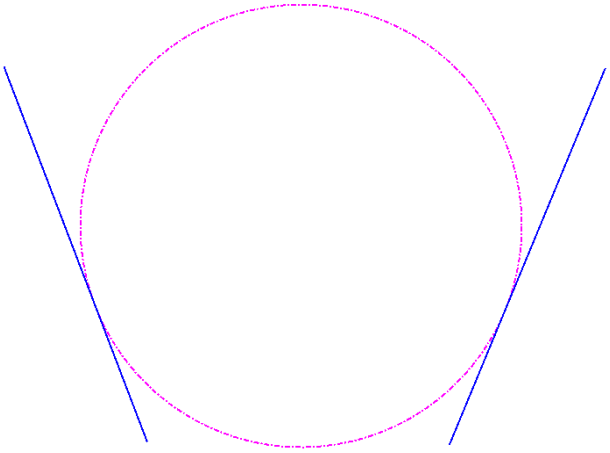
To construct a circle of a defined diameter between two lines or two circles, the procedure is similar to that in Chapter 38.3.1. Open a circle tool, click the spanner to construct and then select the two circles in turn. When both are selected, a new window will appear.



Select “Other Circle Construction”, close this window, and the following window will open allowing the user to enter the diameter of Gauge circle required:



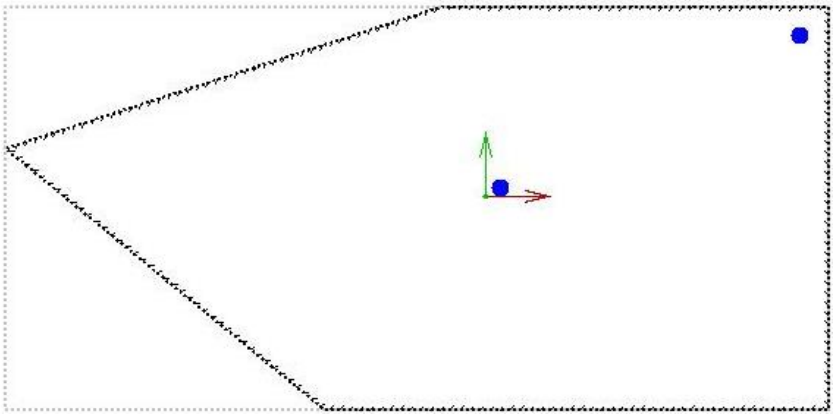
Enter the diameter required and then click the green tick. The window will close, and the Circle Measure window will then open showing the details of the constructed circle. Clicking the green tick will then return to the Main Screen, drawing a dashed, blue, gauge circle as defined:



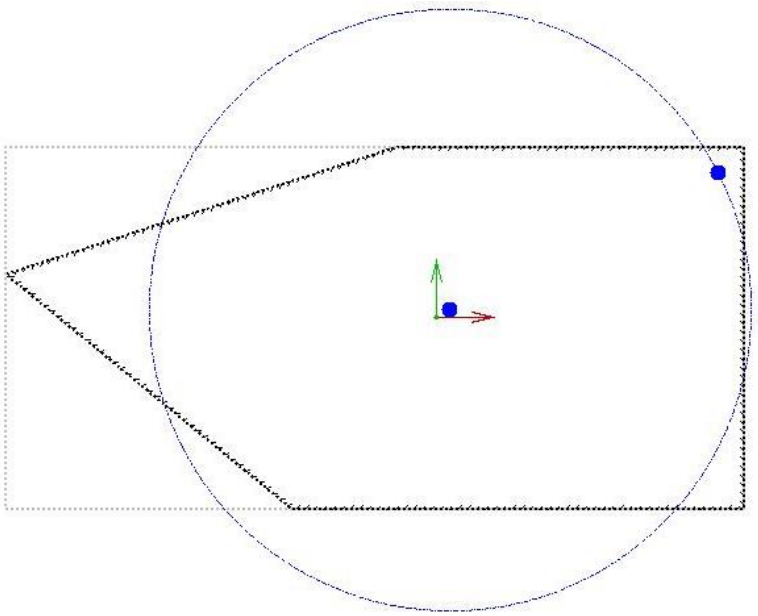
Note that when constructing a gauge circle between two circles, multiple results are available. Once again, to define which gauge circle is constructed the software looks at the position at where the user clicks on the ***second*** feature selected:

38.3.3 Constructing a Circle from 2 Points on a Plane

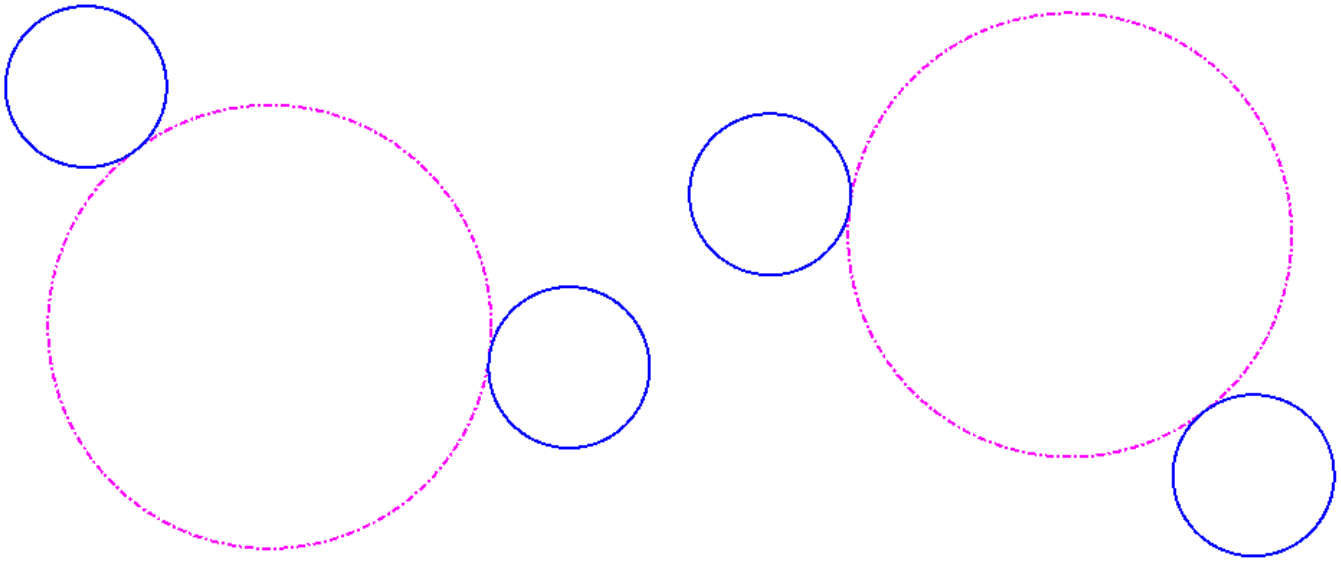
When constructing a circle from 2 points on a plane, one point will be used to define the centre of the circle, and the other point will define the radius.



Using these two points, a circle can be constructed between them. The first point selected will define the centre of the circle and the second will define the radius. After selecting the two points, the following window will ask for a PCD or other circle construction, select 'Other Circle Construction'. The constructed circle should look like the following figure.



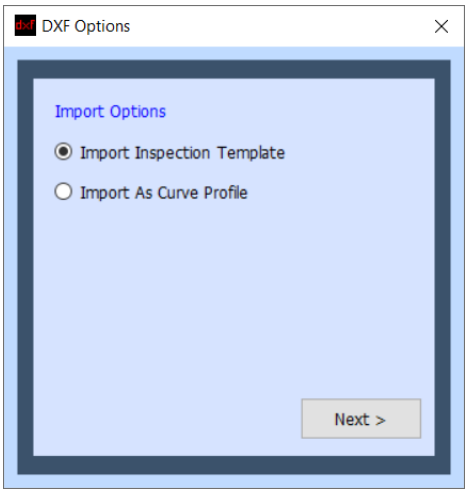
38.4 Editing Constructions



For any constructions where there are multiple options, such as tangent lines between two circles, the construction permutations can be cycled through to find the desired feature. To do this, open the feature window and select the construct spanner icon, if there is at least one other option for the feature, clicking this icon will transform the current constructed feature. Each click of the spanner icon will switch the constructed feature as it scrolls through a loop of the construction options. This can be done at any time after a construction is made, even if it has been previously changed. For any features which do not have alternative constructions, clicking this button will have no effect.

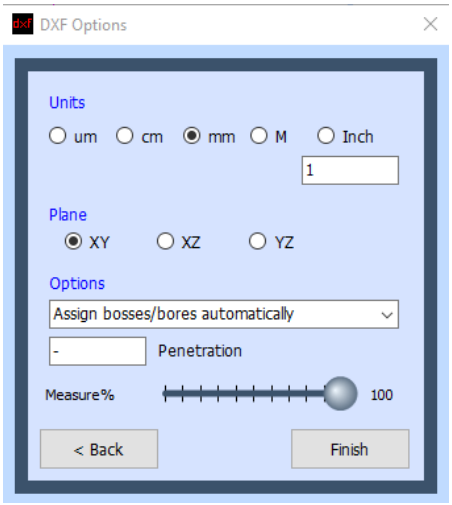
39.0 DXF FILES

DXF files can be used in two different ways, either to make an Inspection Template which imports the DXF features as features to measure, or as Curve Profile which compares the shape of a measured curve to the shape of the DXF. As DXF files are 2D and contain no dimensional information, it is necessary to specify the units used and the plane required for both methods. For either use, click the Import DXF button to select a file, double click the file or select Open and the following menu will appear:



39.1 Importing as Inspection Template

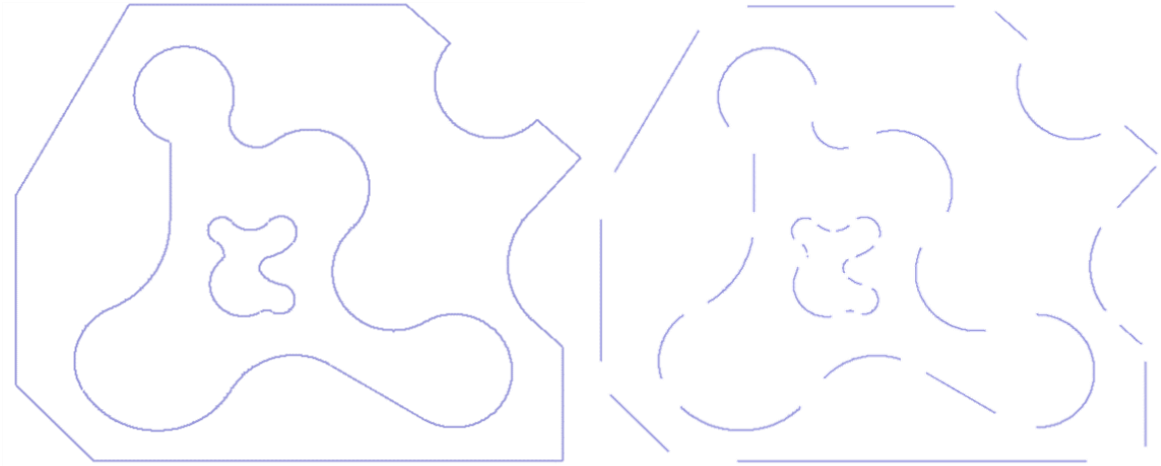
DXF files can imported to use as an inspection template, where the features of the part are used to create template features. After this method is selected, the following menu will appear:



The unit scale and measuring plane will default as above, use the unit selection to change the of scale the DXF to that measure unit. It is advised however to prepare the DXF file drawn in a scale of 1:1 and to the unit required for the inspection. Scaling can also be modified using the numerical field when a unit is selected, for instance if the DXF was drawn 1:10. The next option is for the measurement plane the DXF will appear in, for vision measurements this should be kept as XY. The next option to select is a dropdown box, which shows how the circles will be represented on the DXF. The option includes, assigning all circles to be bores, bosses or let the program assign them automatically. The penetration box below sets the distance a probe will plunge when measuring different depths on a part. The final option is for the measurement %, this controls how much of the original lines from the DXF will be used in the feature template. This will help reduce small variations in corners and edges from creating falsely poor features.

After pressing Finish, the DXF template will appear in the Main Screen. The images below show a comparison of importing 100% of the feature and 75%.

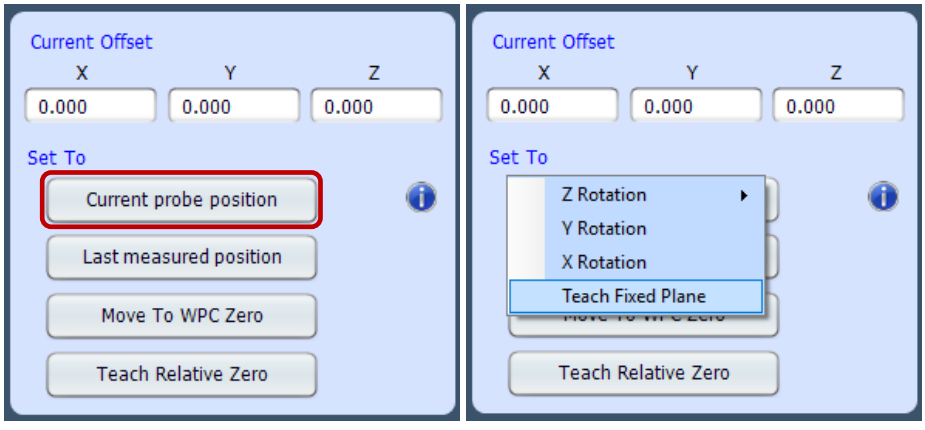
To use this as an inspection, reference features will need to be created manually measured, this is done by opening the Inspection Program Details window and ticking “Manually Measure Reference Features”, discussed in Chapter – Repositioning the Part page 126, After this is



selected, the program can be started and after the references have been measured by the user, the remainder of the part will be measured automatically.

39.1.1 Inspection Templates for VuMaster

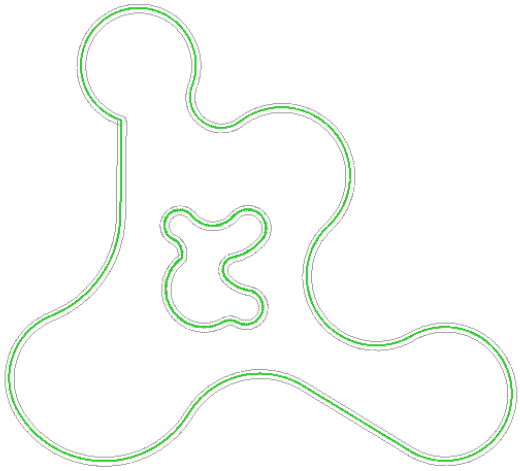
As the VuMaster is a 2D measuring system, a further step is needed to ensure the template has a fixed plane to measure so the inspection will run at the correct height. First, move the machine in Z until the part is in focus, then the DXF can be imported using the same method described above. Next, open the WPC menu and right click on Current Probe Position. Select Teach Fixed Plane and this will move the DXF to the current Z height of the machine. The inspection can be used now and can either be moved to the correct XY position using the other tools in the WPC menu or set using manual measure of reference features.



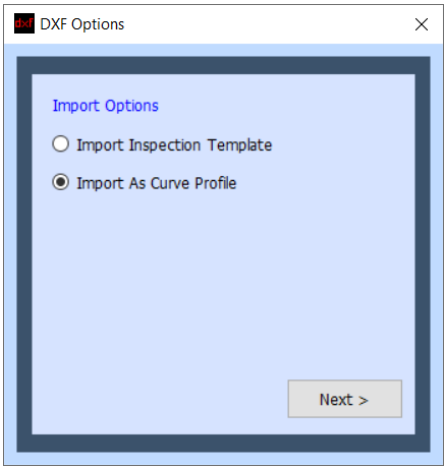
39.2 Importing as Curve Profile

The second method is to import the DXF as a curve profile, this will import a curve line with an editable tolerance band which can be compared to a measured curve, using coloured points to display if the points taken are within tolerance.

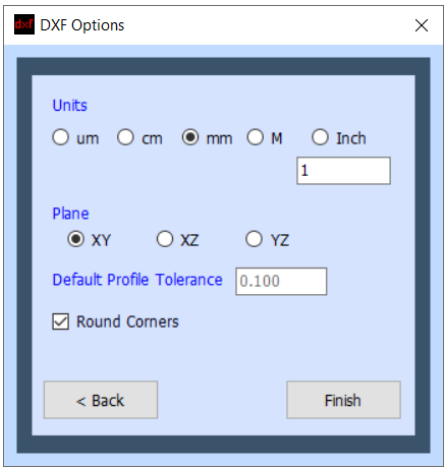
The image below shows two curves being compared to a DXF; all of the points fit within the profile tolerances so are displayed as green.



To import as a curve profile, select this option in the import DXF menu.

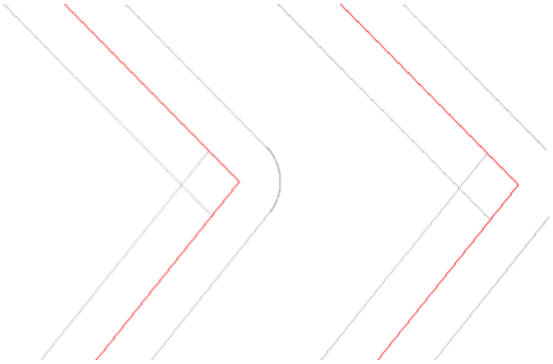


Once selected it will lead to another options menu:



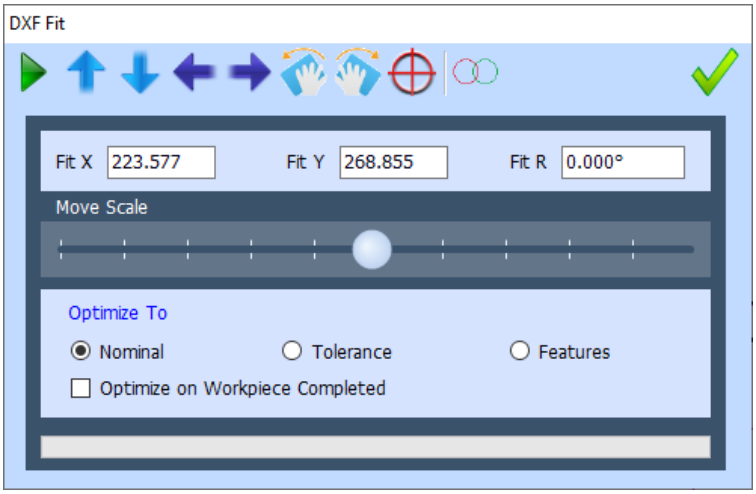
Use the unit selection to change the of scale the DXF to that measure unit. It is advised however to prepare the DXF file drawn in a scale of 1:1 and to the unit required for the inspection. Scaling can also be modified using the numerical field when a unit is selected, for instance if the DXF was drawn 1:10. The next option is for the measurement plane the DXF will appear in, for vision measurements this should be kept as XY. The final option is for “Round Corners”, this will create a small, rounded corner band between any parts that do not meet perfectly.

The image below shows the join between the same features with and without rounded corners.



39.2.1 DXF Fit Menu

The position of the DXF curve profile can be manipulated in several ways, the first of these can be done using the DXF Fit menu. Here, the DXF can be manually moved, sent to the current probe position, or best fit to the points taken.

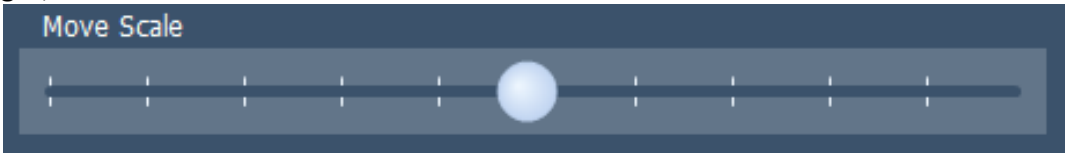


This will appear when the DXF is loaded and can be manually brought up using the target icon from the DXF dropdown menu which will be black when a DXF curve profile is present.

The toolbar at the top of the menu, annotated below, can be used to control basic movements.

The play icon, circled green, performs a best fit of the DXF to the measured curve points. This will try to find the position that reduces the maximum error from the distance of the curve points to the nominal of the DXF. This works best when near the curve it is being compared to and no more than 45 degrees different orientation.

The icons circled in red allow the user to manually move the DXF up, down, left, right and rotate clockwise and anti-clockwise. The move scale at the bottom of the menu is an exponential scale controlling the size of the move increments. The largest moves are made when the scale is at the right, and the finest at the left.



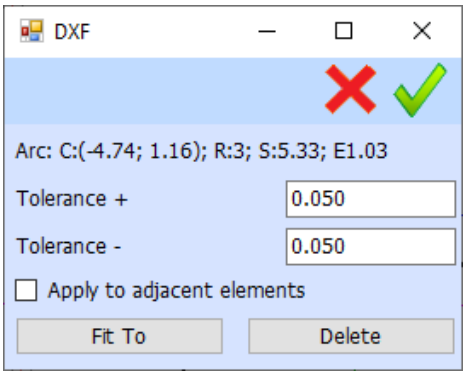
Pressing the icon highlighted yellow will snap the DXF to the current camera position.

The user can also move the DXF manually by use of X, Y & R if so desired.

Press the apply button to the left of the play icon to apply values to move the DXF. When moves are complete, press the tick icon to accept and close the window.

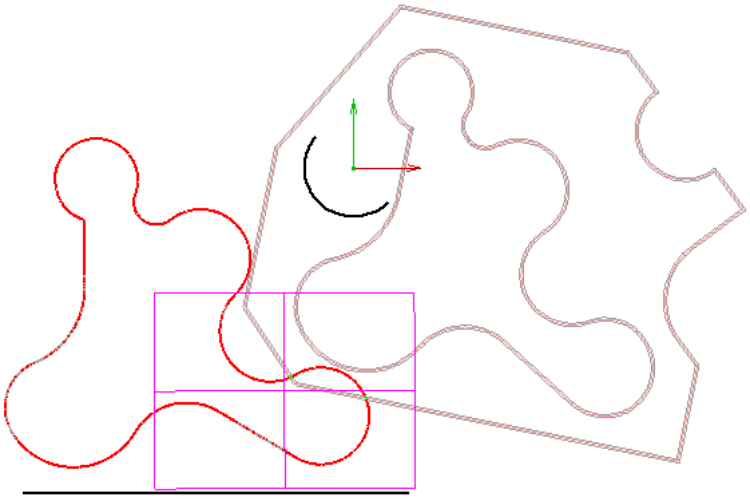
39.2.2 Fit To

Another way that the DXF can be moved to the correct position is by fitting it to a feature. This can be done with either a measured or constructed feature, preferably an arc or circle. To fit to the part, right click on the corresponding DXF feature and to bring up the settings box and select “Fit To”, the bar at the top will begin to flash as it awaits the selection.



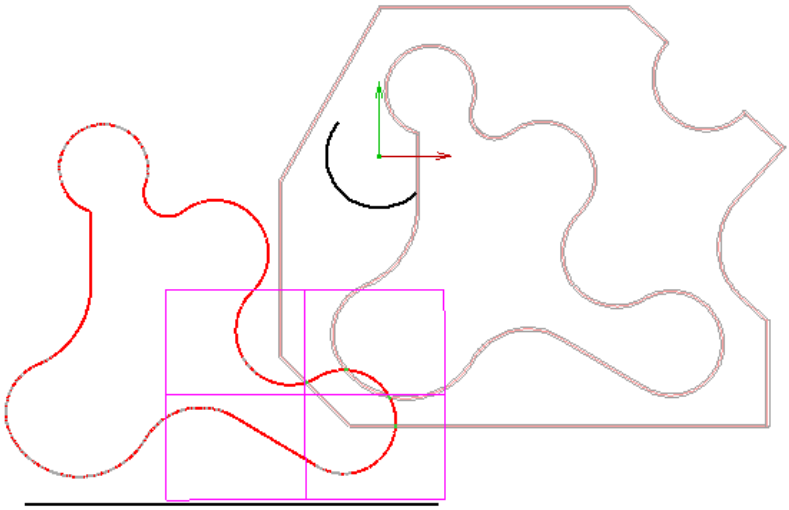
Next click on the feature to move the DXF to, and it will snap to this feature. As with referencing, there needs to be both an alignment and position given to locate the DXF correctly. This must be done in the correct order, alignment ***first*** and position ***second***, or the DXF will not position as desired.

The inspection below will be used as an example, a line and arc feature have been measured and set as a reference and a curve feature has been made to compare to the DXF. This has been imported but is at an incorrect angle and position.

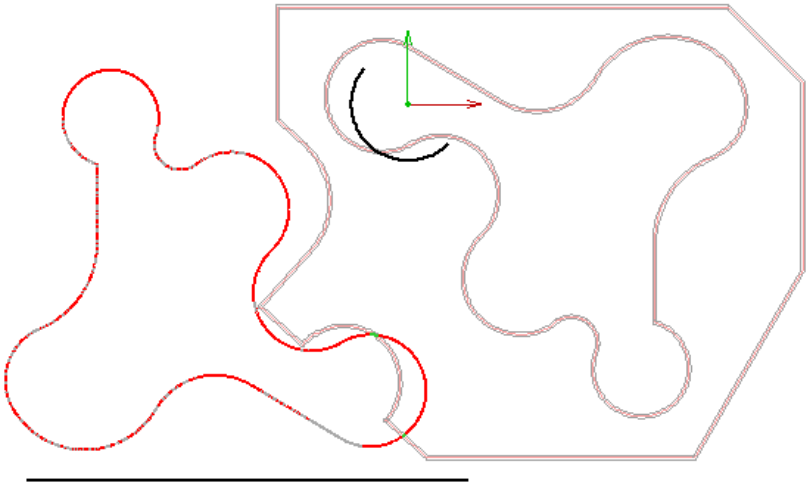


To set the alignment, a line feature must be selected to fit to the DXF. The user must right click the corresponding line on the DXF, click “Fit To” and then click the line feature.

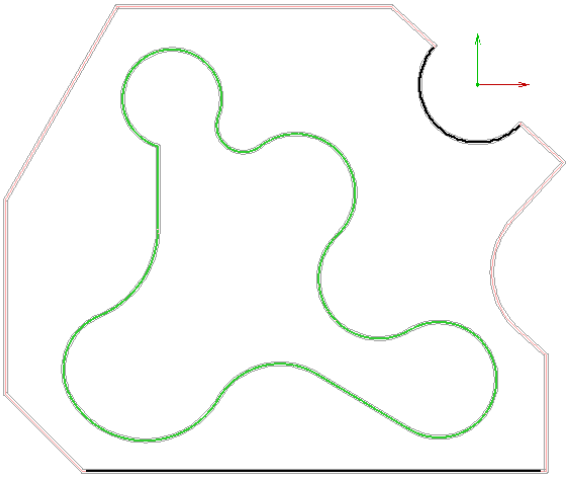
The DXF will rotate to match the orientation of the line, as shown in the example below.



This will be done to the nearest 180° so it is best to begin with a similar orientation, which may require manual adjustment, or the move may result in the DXF aligning upside-down.



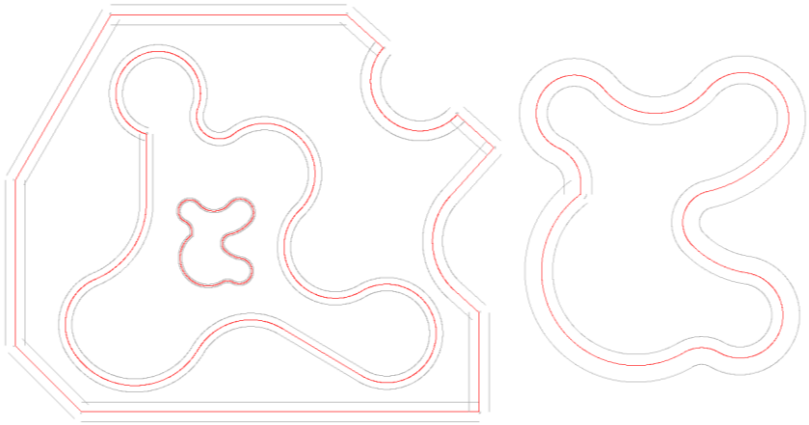
When the two are at the same alignment, select a circle or arc feature and repeat the “Fit To” procedure with the matching measured feature. The part will then move to this position and the DXF should now be in the correct position for the part. The example below shows the part fit to both reference features to demonstrate that the inner shape is fully within tolerance.



Note that the move made is not an attachment or permanent fit, any best fit or manual moves will still move the DXF freely if the position requires adjusting to fit to tolerances.

39.2.3 Setting multiple tolerance bands around a DXF

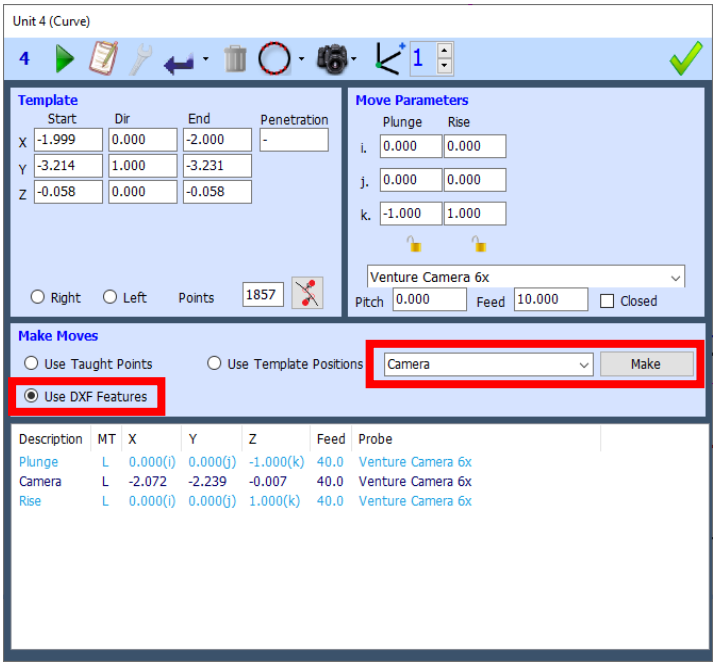
Tolerance bands can easily be edited after the initial tolerance set during import. The user can right click any feature to bring up the DXF settings box to edit these individually. These tolerances can be applied to single features, or to the selected feature and all adjacent elements, shown in the image on the left, where each section of the part requires a different tolerance. It is also possible to set different positive and negative tolerances for the same feature, shown below on the right where the inner tolerance is half the size of the outer band.



39.3 Using a DXF as a Curve Scanning tool

As an alternative to these methods, a DXF file can be used to define the boundaries to create a curve, this is designed to be used where it may be difficult to follow a profile with the standard curve tool. When using this method, data points are gathered from each tool that is fired around the profile. The tool scanning width is defined in edge detection settings which constrains the edge detection area to minimise unwanted data and prevent the tool from following scratches or debris or outside the defined profile.

To use this tool, ensure the DXF overlay is enabled, discussed in Chapter 24.0 – OVERLAYS, page 78. The DXF should then be positioned in the camera window so that it visually fits the profile to be measured, these moves can be done using the DXF fit menu or drag moves. Once positioned, select curve tool from the main screen and open the CNC details of the feature.



Start by selecting the option 'Use DXF Features'. Once selected, move to the drop-down menu, and select the Camera. Next click the 'Make' button and several vision units will be created in the fields below. These vision units are all the arc and line features that form the DXF, and each will be defined as a scanning tool with a scan width defined in edge detection settings.

The DXF is now setup ready for measure and can now be used by pressing the green play icon at the top of the feature window. This will run the curve unit, firing each of the tools and adding all the resulting data points to a single curve unit.

39.4 DXF Export

Fusion can also export DXF files, to create profiles from measured master parts. Exporting features as a DXF gives two options for file output:

39.4.1 Export Measurements as DXF

DXF files can be created using Fusion software. Any features measured such as lines, circles and arcs can be used in the creation of a profile where CAD is not readily available. Note that exporting will not give a full profile and that all features will not be connected to one another, it will match that of what the user has measured.

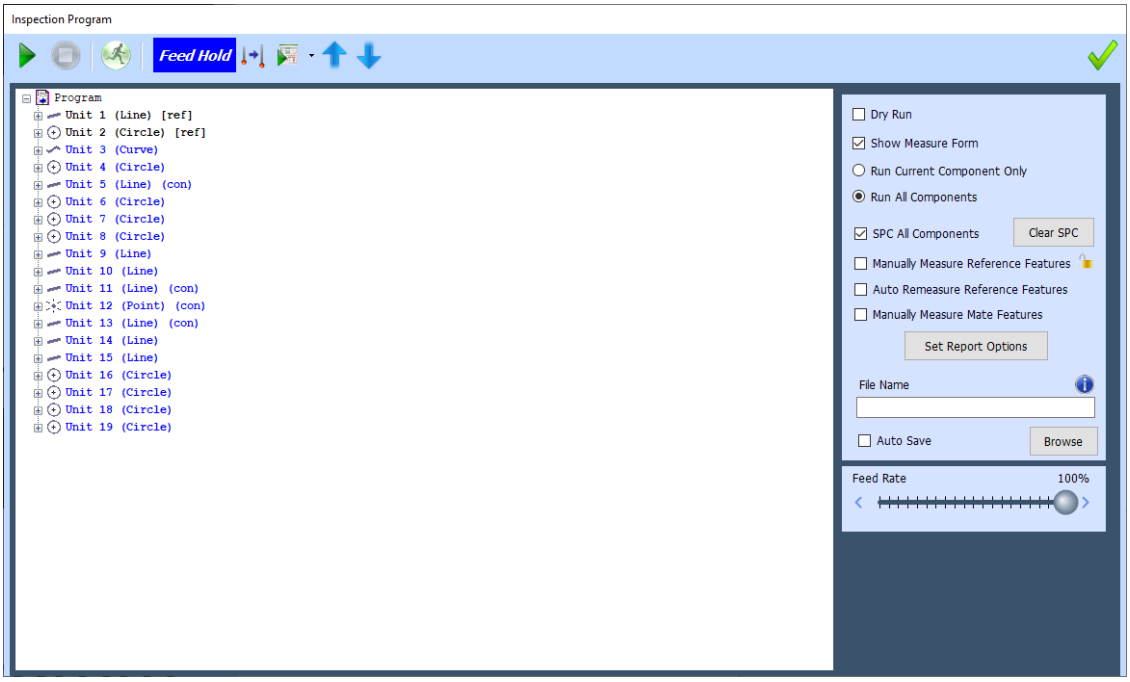
39.4.2 Export as Curve Profile

A standard DXF of a part can be imported and modified to adjust tolerances for specific features, or to remove those that don't need to be measured. To remove the need to make these changes each time the DXF is used, and save the user time, it can be exported as a curve profile to retain all modifications made. This will be saved as a CVR file type and can then be imported into inspections as a curve profile with the desired tolerances and alterations.

40.0 THE PLAY FUNCTION

The Play function is used when one component has been inspected, and subsequent components of the same type need to be measured in the same manner. After pressing play, the measurements will be taken automatically, recalling the Z axis position and lighting features used originally. Any constructed features will be reconstructed, and all dimensions will be added using the same nominal value and tolerances as originally set. The dimensions will then show as green or red if they are in or out of the original tolerance. For manual systems, the operator will be guided to move the camera to the correct position when needed, at which point the camera will automatically begin to measure.

It is important that the position and alignment of the component have been properly defined by setting features as references. This will typically be a circle or point, to set the origin as X=0, Y=0, and a line, to define alignment. Please note that when measuring components in 3D, a third reference of a plane will also be required to define Z=0 and that this needs to be set first.

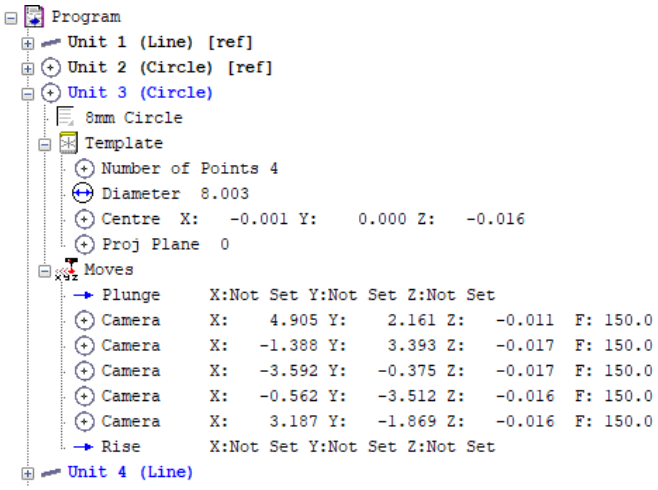


Pressing the Play details menu will bring up the following window:

The features measured in the program are listed in the tree on the left-hand side of the window, with reference features in bold. More information regarding each feature can be seen by clicking on the crosses adjacent to the features.

40.1 Automatically Running a Program

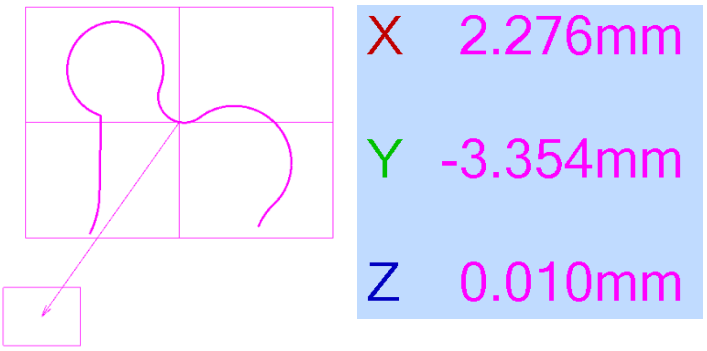
If the part has been placed on the machine in the same position as when originally measured, for instance by using a fixture, the program may be ready to run without adjustment. For this



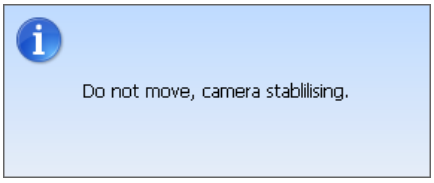
to work, the features of this part will need to fit within the original feature's selection boxes. The size of these boxes will therefore affect the precision of the positioning needed for the parts, so it is best to make these as large as possible without making them cut into other edges.

40.2 Manual Systems

On a manual system, any moves must be made by the user so in an inspection, the user will be directed to make these moves in the Main screen. The field of view for the camera is shown as a pink box with crosshairs to show its centre, the first feature to be measured is highlighted green and its measurement window will be open. A pink square will appear as the target for the centre of the camera, which it must be in to measure the feature. The DRO also shows a pink distance in each axis stating how far the camera must be moved to get to this target.



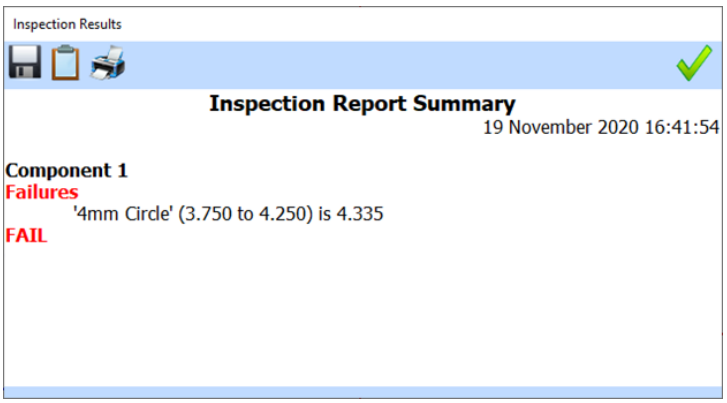
Move the machine using the handwheels so the centre of the cross is in the target area, then when the crosshairs are in the target area, the rectangle representing the Field of View and the XY readouts, will temporarily turn green and the following message will appear:



When the features are within the Field of View of the camera they will be automatically measured. When the camera needs to be moved, the Camera Image window will minimise, and the required move will be shown on the Main Screen.

40.3 Inspection Report Summary

After the inspection completes, an inspection results summary can be set to appear. This gives a summary of whether the inspection passed or failed, and it will give details for these failures.

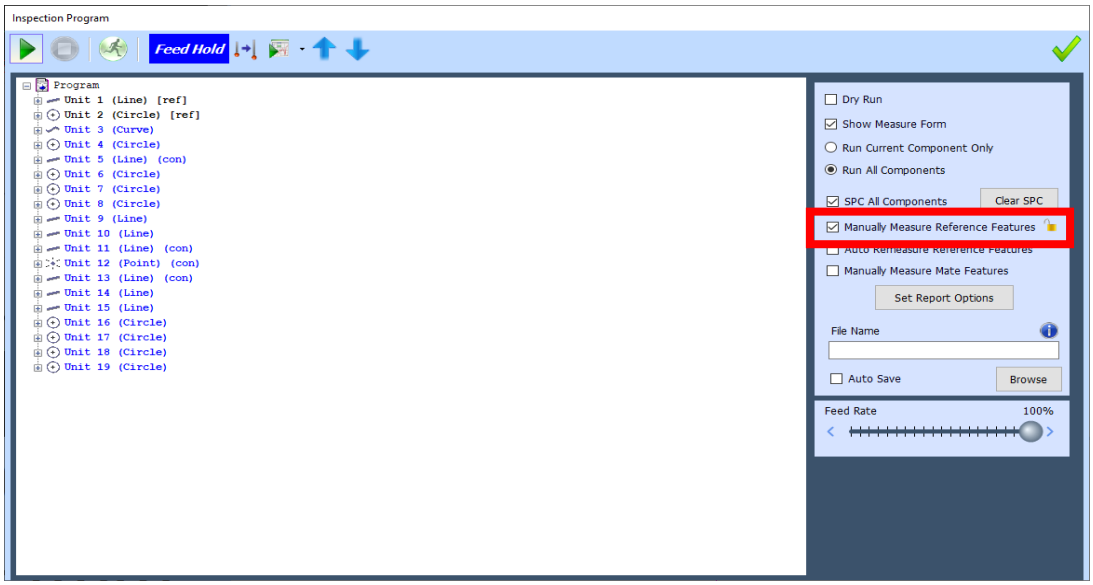


40.4 Repositioning the Part

If the part has been placed on the machine in a different position than where originally measured, the features used as references can be measured manually, so that the program knows the new position and orientation of the component. The program will play in its original order requiring manual measurement of each feature until all reference features have been measured. It is therefore best for the reference features to be at the beginning of the program.

40.4.1 Manually Measure Reference Features

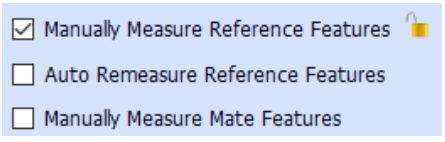
In this situation, click on the Play button to bring up the Inspection Program window, tick the 'Manually Measure Reference Features' option.



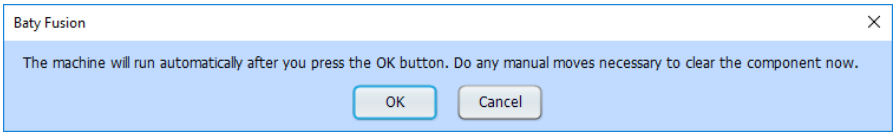
Clicking on the Play button on the Main Screen will show the first feature to be measured highlighted in green. Move to the feature prompted and measure it as usual. Note that this may also require adjustment of the Z axis, although the lighting originally used will be recalled automatically. If the feature has been measured in more than one section, the software will wait until the same number of grabs have been made as originally taken. This will teach the first feature and this measurement window will close, and the measurement window for the second feature will open. Move to this feature and measure in the same way. After all reference features have been measured, the main window will update, and all template features will snap to the taught reference positions. A prompt will then appear to say the machine is ready to move automatically and take over measurement from the operator.

40.4.2 Auto Remeasure Reference Features

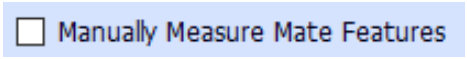
If Manually Measure Reference Features is selected, Auto Remeasure becomes available.



If this option is selected, the inspection will perform an additional measure after the manual measure, using the inspection's correct camera position and tool width to ensure better repeatability of the measure. After clicking the play button, the user will be prompted to measure the first feature, but they will only be required to set the position of this, not the tool width, as the correct width will be used for the real measure. After all the reference feature tools have been given an approximate location, the inspection will start again and measure the parts with the correct tools and settings. The manual measurements taken to set the location of the part will not be used for the inspection results and no information will be saved in the dimension SPC as only automatic measures will be record.

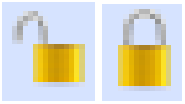


40.4.3 Manually Measure Mate Features



This function is used for Leap Frog. On inspection playback, once a position has been completed, this function gives you the option to remeasure the Mate Features to teach Fusion the new location of the next position on the component. This can be useful if the fixture being used is not secure, or if there is no fixture at all and the new position is in an unpredictable location.

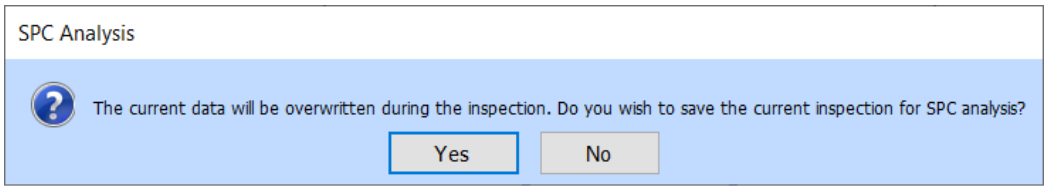
40.4.4 Locked and Unlocked



After every inspection run Manually Measure Reference Features will automatically unselect itself. The padlock locks this function so that it does not need to be reselected after every run. The padlock will also carry over for when an inspection is closed and reopened.

40.5 Collecting SPC Batch Information

Another useful option when using the Play function is the 'SPC All Components' option. Fusion will collect information for each dimension every time the program is run and store this in the dimension. It will also calculate some simple SPC information and plot both a histogram and a scatter graph for any given dimension. For more information See Chapter 37.1 –Showing SPC Batch Information, page 99. To collect this information when running a batch of components, ensure the 'SPC All Components' box on the Inspection Program is selected. Now when a program is run, the following message will appear:



To add this data to the batch information, click Yes, otherwise click No to clear the previous data and start afresh.

40.6 Probe Mapper

The probe mapper tool allows the user to quickly change probes used from a saved program or use a different styli setup in case of a probe break. Using the probe mapper allows a probe that was used to originally measure the part to be replaced with a different length or type of stylus. This allows for quick editing of a program where a probe change is required.

40.7 Run Workpiece Completed Actions

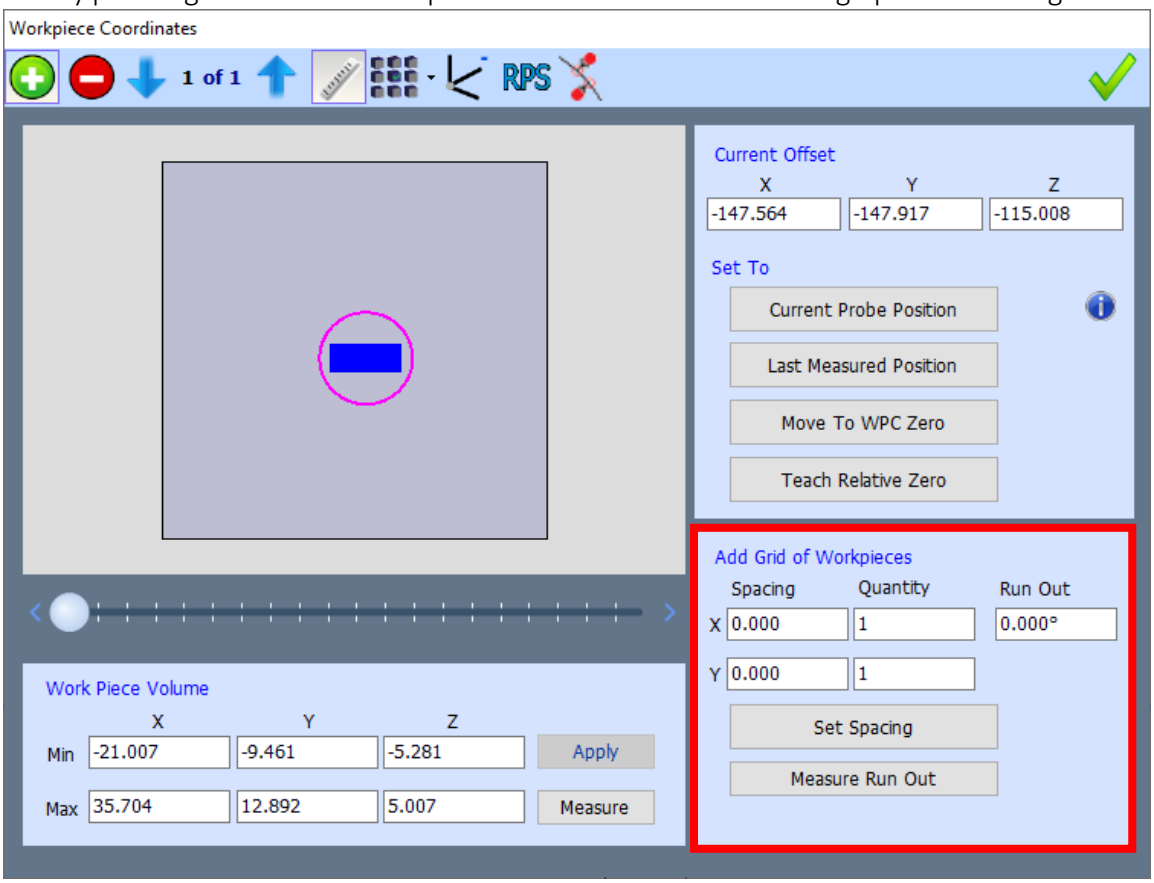
This function is used to run the already completed features in the program. This tool is only used after an inspection has been played and new features have been measured after the inspection run, it is useful to run the already measured features without measuring the new features.

40.8 Move Arrows

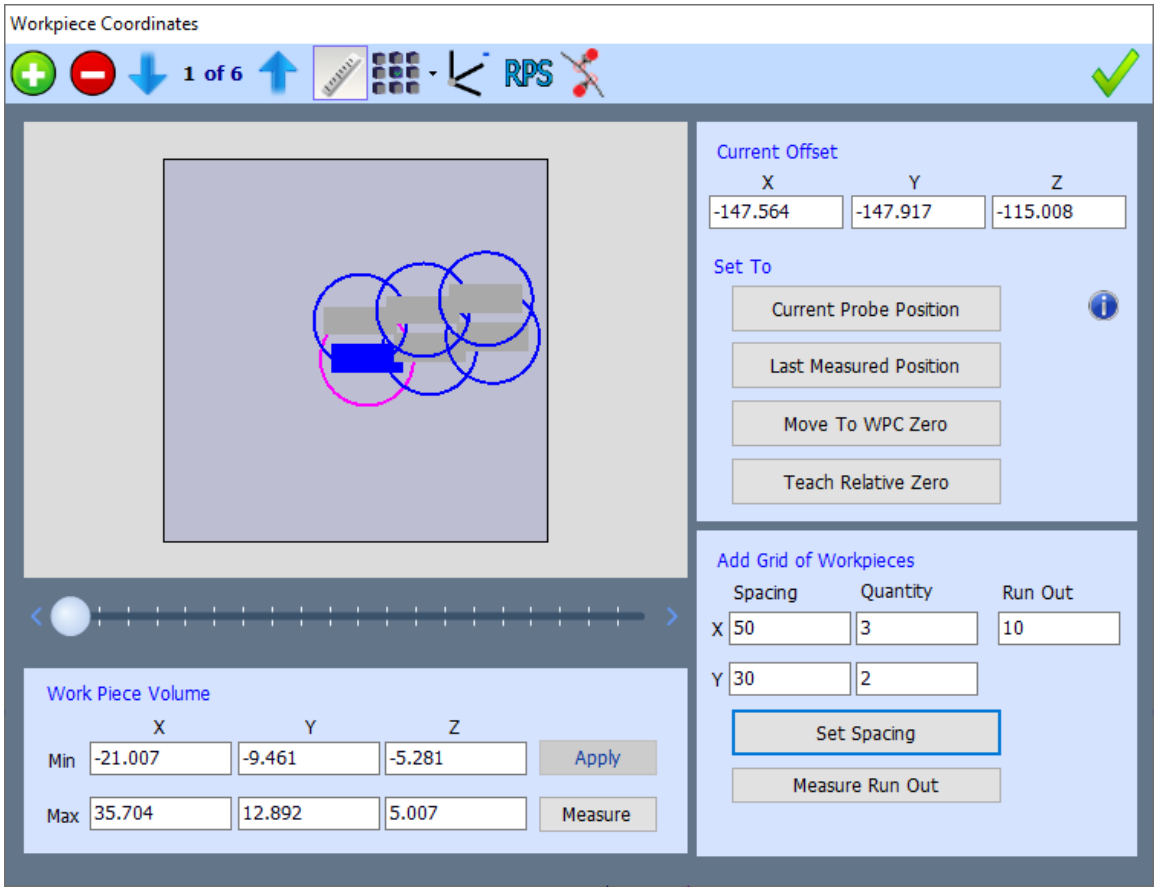
The move arrows are a useful tool that changes where a feature is in the inspection tree. This acts as an alternative to dragging and dropping the feature in the tree; however, this acts as a more accurate option.

41.0 WORK PIECE CO-ORDINATES

The Work Piece Co-ordinate (WPC) is the X, Y position of a component in terms of machine co-ordinates. The WPC function can be used to measure multiple fixtured parts without the need to create new features for each part, also known as step and repeat. To teach multiple part positions, start with a working program for a component and then open the WPC menu by pressing the icon for work piece co-ordinates. This will bring up the following window:



To teach the positions about the fixture use the menu highlighted in the bottom right of the window; add grid of workpieces. Add the spacing and quantities for both X and Y, for example a grid of 6 with X spacing of 50mm and Y spacing of 30mm in this example. Next teach run out by selecting Measure Run Out, a window will open prompting a point or circle to be taken at one end of the fixture. Measure one point or a circle and the window will then ask for a point or circle to be taken at the other end of the fixture. The alignment should be done over the longest edge of the fixture, so this may be along either the X or Y axis, subject to fixture used. When the second position is taken, a runout value will display in the Run-Out text window. Once the spacing and run out has been taught, press the Set Spacing button to apply the taught positions. The graphic should now display the number of offset positions set.



The user can scroll through the positions by clicking the blue arrows in the toolbar, the current position will be highlighted in pink. When ready, press the green tick to close the window and the play function can now be used to run the program in all the positions set using WPC.

41.1 Repositioning the Part with WPC

If the inspection is in a different position to the current part, it can be moved in a variety of ways, the first of these is shown in Chapter 40.4 – Repositioning the Part, page 126. There are also several ways that this can be done using the WPC menu.

41.1.1 Current Probe Position

A new position for the part can be set using WPC and is an alternative method to Chapter 40.4 – Repositioning the Part, page 126. To use this method, move the active probe to where the origin of the program lies (X0, Y0). When there, press the Current probe position button. If using a touch probe, the current position will be used for the origin, if using the camera, the software will ask for a point or circle to be measured. This will initially enable a point tool with mouse point mode. The centre of the next point or circle will be used to teach the origin of the program. The Current Offset values should then update to the new machine co-ordinates.

It may be necessary to also teach the alignment of the component as part of this process. To teach the alignment after the origin has been retaught, right click current probe position. This will bring up a small menu with Z rotation, Y rotation and X rotation. Hover over the Z rotation arrow and this will show four more options, X+, X-, Y+, Y-. Selecting a direction will choose the alignment. Again, this will initially enable a point tool with mouse point mode. Pick a point along the alignment edge and this will teach the program alignment.

41.1.2 Last Measured Position

This button will move the inspection to the last place it was measured, which can be useful if any of the other move methods have been used in error, or if the part in a series of multiple components needs to be remeasured.

41.1.3 Move to WPC Zero

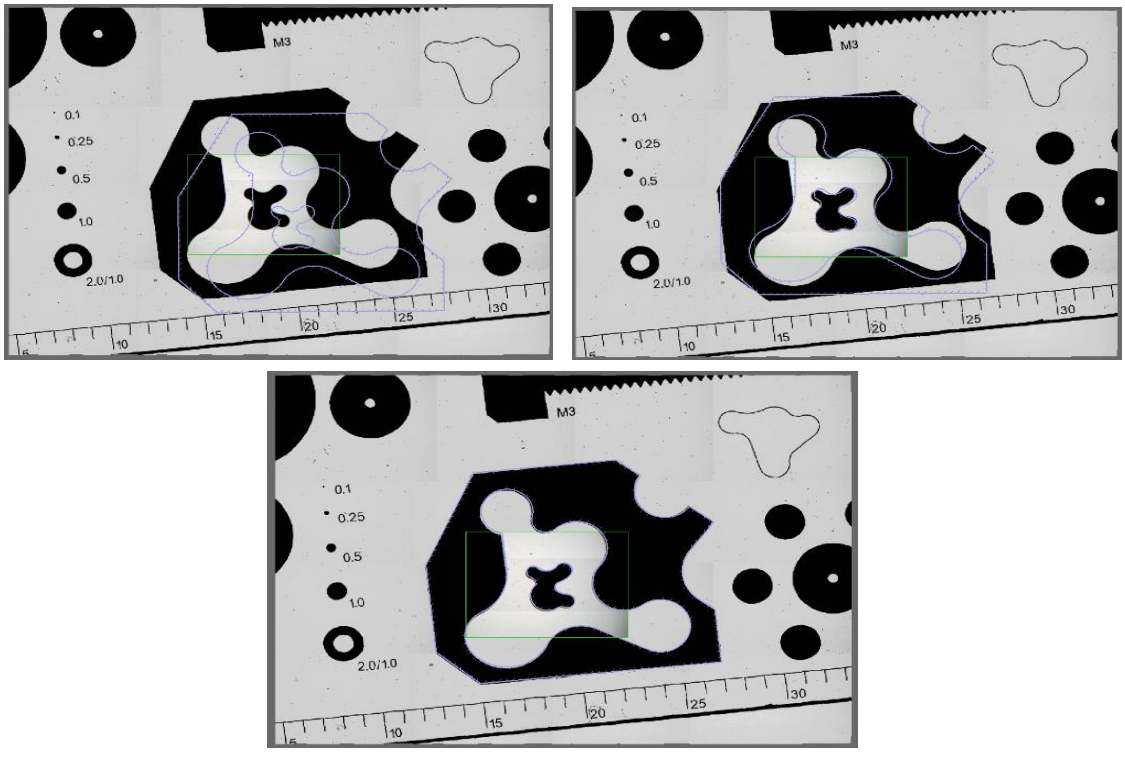
This won't move the part but will instead move the machine to the current workpiece's X, Y=0 position found using the inspection's reference features. It will also give a 2mm clearance in Z.

41.1.4 Teach Relative Zero

This can be used to teach the probe in a position different to the origin. For example, if a large diameter is the reference feature, positioning the probe by eye would be difficult. It is easier use another circle or intersection at a known offset from the origin. To do this, right click on Teach Relative Zero and enter the co-ordinate or offset being used then click on the OK. To make the program remember the relative zero offset, right click on 'Teach Relative Zero button and click on the 'OK' button. After re-opening the window, a small target icon, seen in the image below, will appear in the inspection, showing the teach position. Position the probe on the component, then click on Current probe position to teach point.

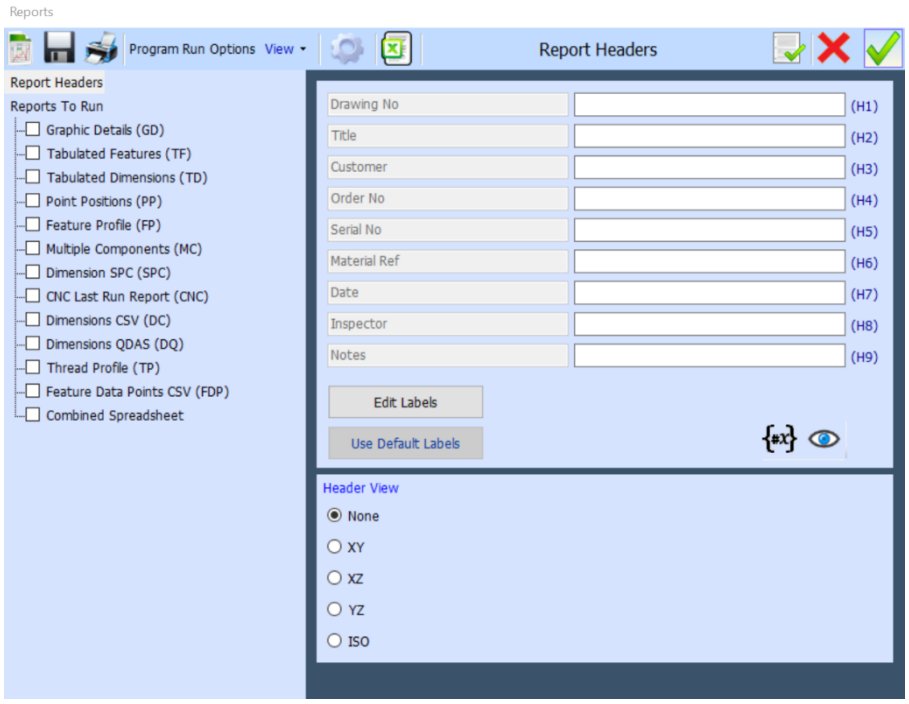
41.1.5 WPC Drag and Rotate

Vision inspections can be visually repositioned using the WPC drag and rotate function. To use this, open the WPC menu and then click in the mouse's centre wheel and drag in the camera window. This would usually trigger a machine move, but with the WPC window open, it will move the inspection instead. To rotate a program, click the mouse wheel and at the same time rotate the wheel, this rotates the inspection using the cursor as the centre point. The images below show an inspection that needed both a small move and rotation to meet the part.



42.0 REPORTING

After an inspection is complete, a range of reports can be made to display these results graphically or in a tabularly. Clicking on the reporting button will bring up the following window:



It will open to the settings for the report headers, the column on the left contains the tabs for each of the individual report types and their respective settings.

42.1 Report Headers

All inspection reports will be printed with a header containing boxes details specific to the part or batch inspected. If no information is entered, these boxes will remain blank. The titles of these headings are fully customisable, the fields can be edited by selecting the Edit Labels button, Use Default Labels will restore the defaults. Each new inspection will open with the default settings, these defaults can be edited by opening a blank inspection and then editing the headers or labels. The company name and address, as entered in the Software Set Up, see Chapter 43.8.2 – Company Details, page 147. This will also be printed on the top of each page.

42.1.1 Header View

The reports can be set to contain a thumbnail image of the inspection, this will show in the report on the right of the company logo. This can be set to one of 5 options:

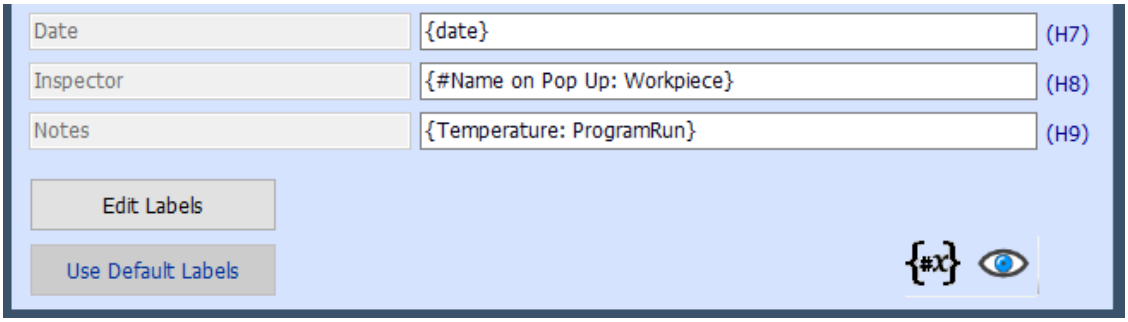
None – No thumbnail will be displayed in the report.

XY, XZ or YZ – The thumbnail shows the current view for the selected plane.

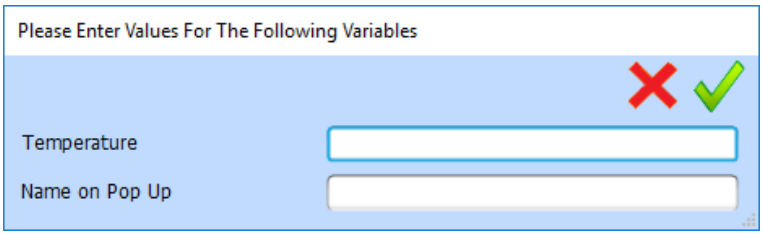
ISO – This creates a thumbnail of the part in isometric view.

42.1.2 Variables

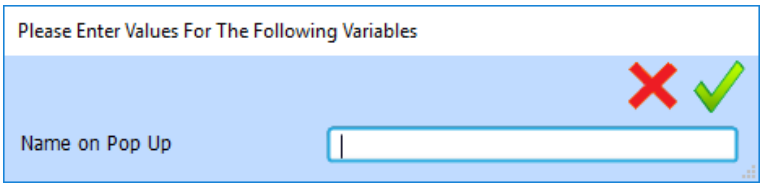
Variables can be used to automate the process of filling in and updating these headers. A pop-up box will appear to prompt the inspector to enter any relevant information when needed. The three examples below will be used to demonstrate how to use Variables



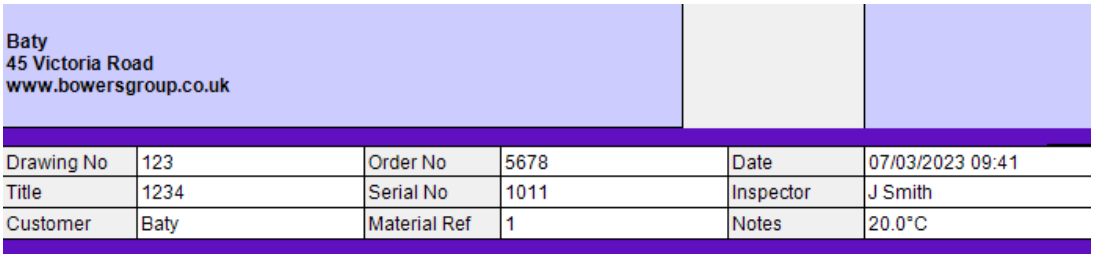
The first variable {date}, it is differentiated from normal text using curly brackets, all variables must be contained within these brackets. For user entered variables, they follow the form {#Name: Scope}, where the #Name is what will appear on the pop-up window and the Scope determines when this pop up will appear. There is a set list of these scopes: Workpiece, ProgramRun, InspectionFile and Session. Each scope name should describe when they will appear, for example Workpiece Scope Variables will appear for every new workpiece. The names that appear on the pop ups will only show in the message window, not in the report, the column on the left are the labels that will appear on the report, as with normal report headers. When an inspection is run using the examples above, the following pop up will appear:



The scope of the variables in this example is different, as the temperature is only required once per program run. If this inspection is run with more than one workpiece, at the beginning of the second workpiece the window will appear with only one of the variables.



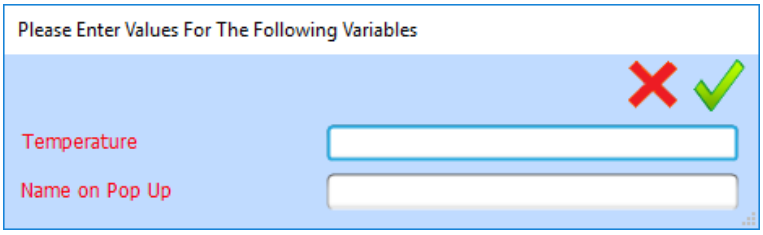
If the information is entered when prompted, this will be put into the report as seen below:



Baty
45 Victoria Road
www.bowersgroup.co.uk

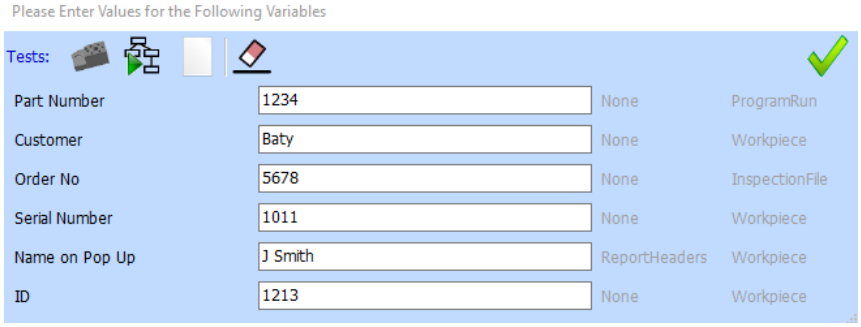
Drawing No	123	Order No	5678	Date	07/03/2023 09:41
Title	1234	Serial No	1011	Inspector	J Smith
Customer	Baty	Material Ref	1	Notes	20.0°C

This variables tool is designed to force the entry of this data, so if the boxes are left blank when the tick is pressed, the window will stay open and the text will turn red, to show the box cannot be completed yet. If the cross is tapped instead, the inspection will be aborted.



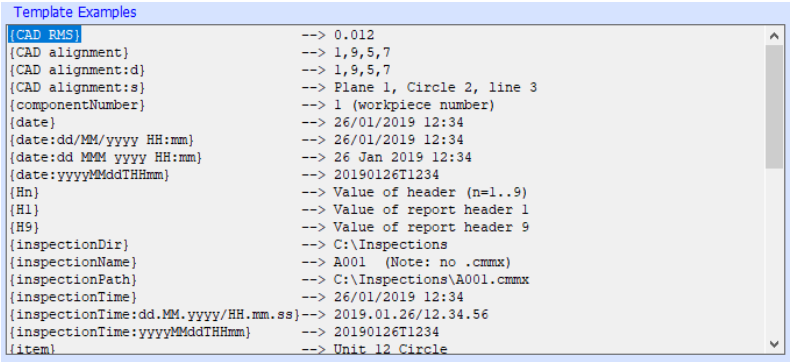
There is also a selection of variables which can be automatically entered, such as the PC username or date, these variables must also be entered into the headers box and within curly brackets, but these must be entered without the # symbol. For example {date} will enter the date the report is run in dd/mm/yyyy hh:mm, but there are other formats available, this and some of the other automatic variables can be shown by selecting the information key.

The “Show Current User Variables” icon will bring up the following window.



The icons along the top conducts certain test runs that show the user which variables change after various inspection runs to gauge whether the correct scope has been used. The first tests a single workpiece run, the second tests an entire program run and the third tests when a new inspection is loaded in. The last icon is used to clear all user variables.

The “Show or Hide Template Examples” icon will bring up the following window, showing which scopes can be used.



42.2 Reports to Run

There are twelve different reports available, each controlled by a checkbox next to the report name. Each report has a range of settings, clicking to select the report name will bring up the options for each report. A summary of the reports and their uses is detailed below.

42.2.1 Graphic Details

The Graphic Details report will print the graphical representation within the Main Screen, or the current view from the camera window. Any combination of the four views available in the main screen can be shown, these are XY, XZ, YZ or ISO. Note that only the XY view is relevant for VuMaster. The size of the area that is printed is based on the current view of the Main Screen or camera. If not all features or dimensions are on the print preview, the view in the Main Screen can be changed, the re-draw button will automatically size everything to fit the window. Also ensure that the camera window is not minimised if using the Vision option, as the camera window is temporarily seen as empty if this window is not currently displaying.

42.2.2 Tabulated Features

This is a table to report the properties of each feature measured in the inspection, with similar information as in the measure window. All the measured features are included, and they are listed in the same order as they run in the inspection. Each feature has a title column, followed by columns for each property. For example, if the first feature is a circle, the report will list its centre co-ordinates and diameter and for a line feature it will list the start and end co-ordinates and its directional vector.

42.2.3 Tabulated Dimensions

This table lists all the dimensions in the inspection, listed by the identifier shown in the dimension details window. The information shown in the report is selected by clicking the report name and using the check boxes to include options such as Dimension Number, Nominal, Pass/Fail and Geometric tolerances. This report will show the current dimension information, which will be the default values if the individual dimensions have not been edited. There is also an area called Additional Report Variables that can be used with modified reporting templates, if using standard templates this area can be left empty.

42.2.4 Point Positions

This gives a list of tables with the X, Y and Z coordinates for all circles, arcs, and points within the inspection. It can show the identifier and a nominal or actual measured position, the error and a pass or fail. For Curve and Thread features this will create a new section in the table for each of the points in the feature, this can therefore create large file sizes which may take significantly more time to open than a report without a curve profile present.

42.2.5 Feature Profile

When a feature is measured, the points taken are compared to a feature of perfect form and the fit of these points can be viewed in the feature window's graphical view. The feature profile report is a way to export the view in this window, the unit's name, tolerances, and form will be printed with the graphical result for the feature. There are no features in this report by default, so it cannot be run without any setup. To add features, select Add Feature(s) and then click on a feature in the main view and this will be added to the area called Selected Features. Any other features selected will also be added to this list until the Add Feature(s) icon is clicked again. The reports for all the features listed in the Selected Features box will be produced when the reports are made, to remove any feature, select it from this box and press Remove Features, or press clear all to features from the box. The feature profile report for any feature can be opened from in the report settings, but it can also be accessed through the feature window by right clicking on the graphic view of the feature and select Run Report.

42.2.6 Multiple Components

This is used to show the results for each dimension in a batch of components in one report. The SPC data must be collected, see Chapter 37.1 – Showing SPC Batch Information, page 99. This report names each dimension in the inspection followed by the measurement taken on each component in the order they ran. The report includes nominal, actual and error for each run as well as any geometric and tolerance information and whether the component passed.

Any measurements that were out of limits will also be shown in red. The report style can be modified so the information can be grouped and shown by Dimension or by component and this will generate additional settings for the fields to include and the numbers of cells used to report the data.

42.2.7 Dimension SPC

If a batch of components have been measured, and the SPC data collected, then the SPC results for any dimension can be reported. Dimensions can be added individually by selecting Add Dimension and then left clicking the dimension in the Measure Screen, they will then be added to the Selected Dimension box, any dimensions in this box will be added to the report. Dimensions can also be mass added by selecting Add All Dimensions or removed by selecting the name of the dimension and clicking Remove Dimension or Remove All Dimensions to clear the box.

In Dimension SPC report this information is given as a list, a line graph and a distribution bell graph to show trends and average results. These are also accompanied by details such as their standard deviation, CP, CPK, mean and sigma values.

42.2.8 CNC Last Run Report

This is a simple report which displays the Pass/Fail result of the previous run of the inspection listed by the component number. If the inspection has not been run this Fusion session, then an error will appear to say that this data is not available.

42.2.9 Dimensions CSV

This will create a comma separated value (CSV) report which can easily be opened in a range of other software, for example Microsoft Excel. It can contain all the report headers and titles followed by all the saved dimensional data and its Pass/Fail result. The separator is a comma by default, but this can also be a semi colon or tab and is selectable in the CSV report settings.

42.3 Dimension QDAS

SPC data from dimensions can now be exported in a form that is compatible with QDAS (Qualitative Data Analysis Software). This is a third-party statistical analysis tool which will need to be purchased separately.

42.4 Thread Profile

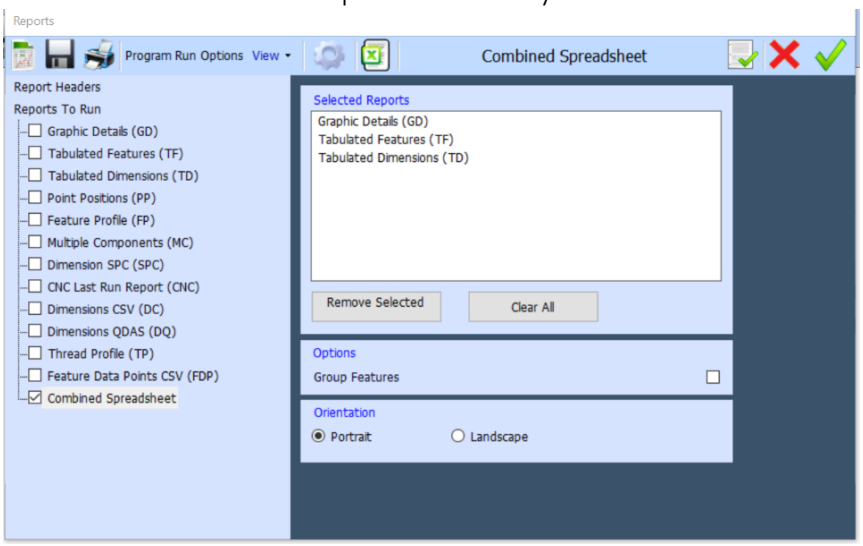
This report prints the thread summary report shown in the thread feature window. It shows the average, range, and sigma values for the angles between the thread's peaks and a line graph to show their variation along the length measured.

42.5 Feature Data Points CSV

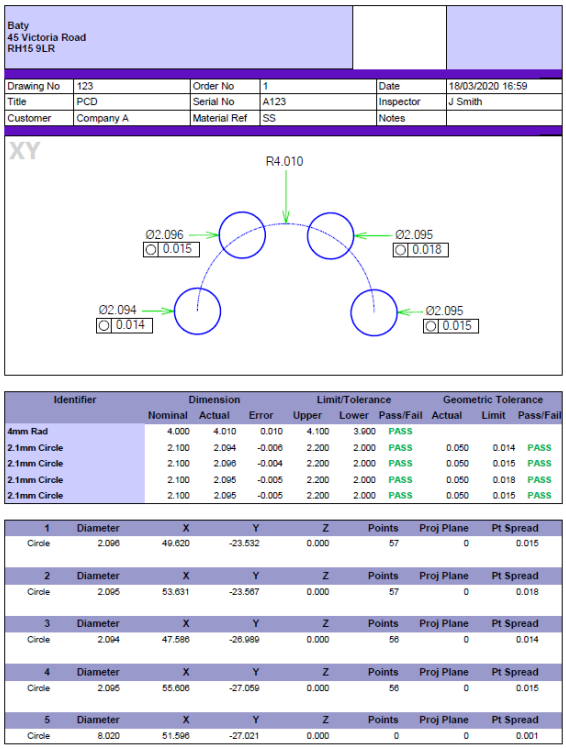
This report can have multiple features selected to show the exact XYZ position of every point on those features. It will be displayed in an excel style format that lets the user customise how they view the separations between each coordinate.

42.6 Combined Spreadsheet

The combined spreadsheet option gives the ability to print multiple reports on the same page, or in a series of pages. The image below shows a setup that will have a Graphic details report, then below this a Tabulated Features report followed by a Tabulated Dimensions report.



To add a report to this, click and drag the name on the left into the Selected Reports box. The order of the reports in the spreadsheet is determined by the order the names of the reports are in, these names can be dragged and moved in this box to reorder them. This setup will produce the report below.



Baty
45 Victoria Road
RH15 9LR

Drawing No	123	Order No	1	Date	18/03/2020 16:59
Title	PCD	Serial No	A123	Inspector	J Smith
Customer	Company A	Material Ref	SS	Notes	

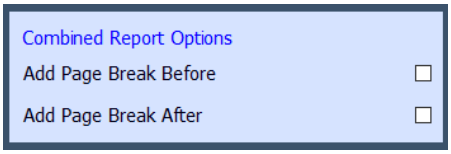
XY

R4.010
Ø2.096 ○ 0.015
Ø2.095 ○ 0.018
Ø2.094 ○ 0.014
Ø2.095 ○ 0.015

Identifier	Dimension			Limit/Tolerance			Geometric Tolerance		
	Nominal	Actual	Error	Upper	Lower	Pass/Fail	Actual	Limit	Pass/Fail
4mm Rad	4.000	4.010	0.010	4.100	3.900	PASS			
2.1mm Circle	2.100	2.094	-0.006	2.200	2.000	PASS	0.050	0.014	PASS
2.1mm Circle	2.100	2.096	-0.004	2.200	2.000	PASS	0.050	0.015	PASS
2.1mm Circle	2.100	2.095	-0.005	2.200	2.000	PASS	0.050	0.018	PASS
2.1mm Circle	2.100	2.095	-0.005	2.200	2.000	PASS	0.050	0.015	PASS

1	Diameter	X	Y	Z	Points	Proj Plane	Pt Spread
Circle	2.096	49.620	-23.532	0.000	57	0	0.015
2	Diameter	X	Y	Z	Points	Proj Plane	Pt Spread
Circle	2.095	53.631	-23.567	0.000	57	0	0.018
3	Diameter	X	Y	Z	Points	Proj Plane	Pt Spread
Circle	2.094	47.586	-26.989	0.000	56	0	0.014
4	Diameter	X	Y	Z	Points	Proj Plane	Pt Spread
Circle	2.095	55.606	-27.059	0.000	56	0	0.015
5	Diameter	X	Y	Z	Points	Proj Plane	Pt Spread
Circle	8.020	51.596	-27.021	0.000	0	0	0.001

Page breaks can be added to the spreadsheet before or after any of the selected reports, this is set up within the settings of those individual reports.



42.7 Tabulated CAD Points

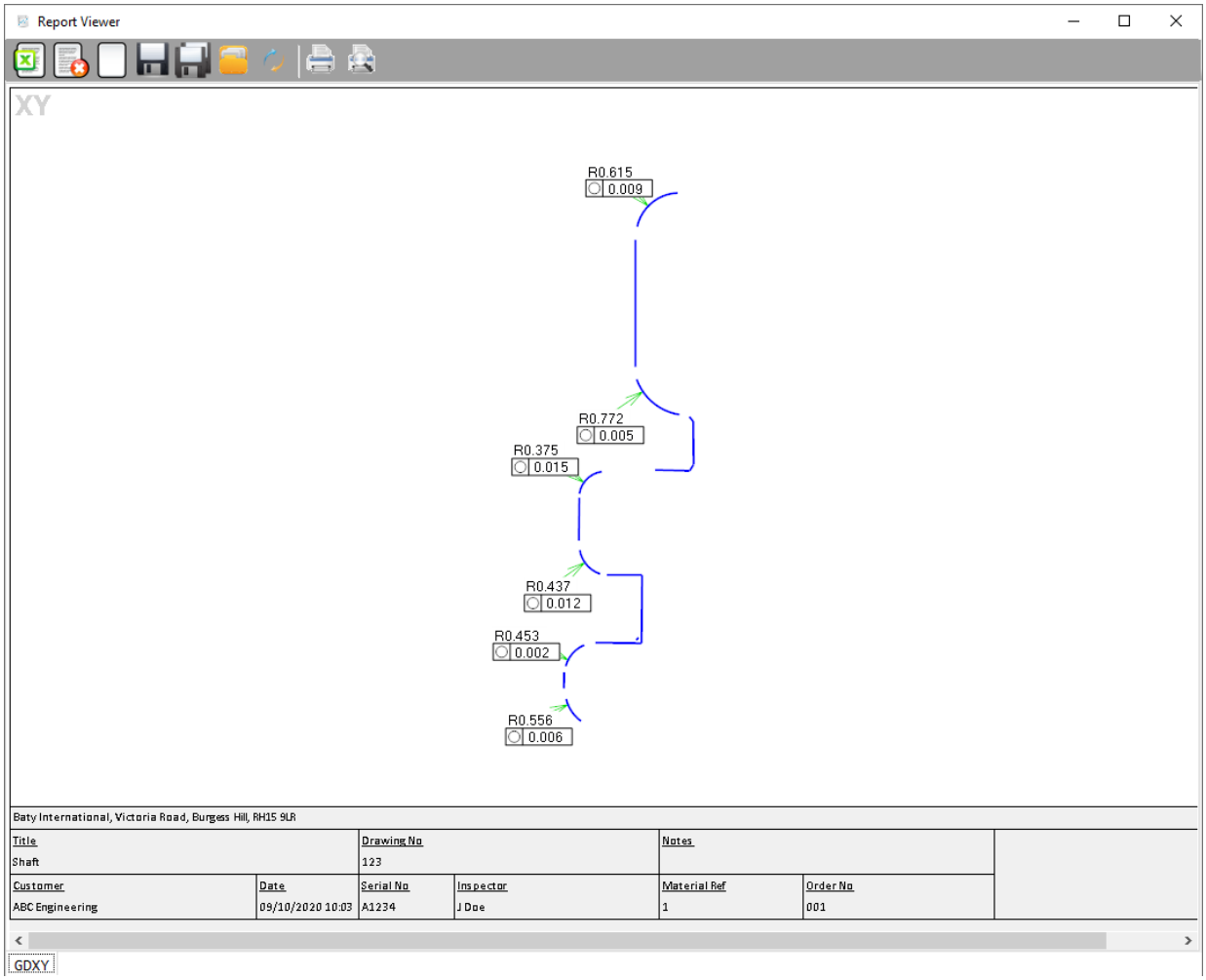
This report option will only be visible is the CAD package has been enabled, it shows a table of each of the measured points compared to the CAD model and colour codes this comparison to show whether the points taken are in or out of specification.

42.8 CAD Graphic Details

This report option will only be visible is the CAD package has been enabled, it creates a graphic details report comparing selected features to the CAD model.

42.9 The Report Viewer

When any report is opened in Fusion, it will be displayed in the report viewer. The top toolbar here will be the same for all reports but the other areas of this will change depending on the report type open. This toolbar contains many icons to control what is done with the reports. The following page shows an example report viewer with a Graphic Details report open.



The main body will show the currently selected report and there will be a bar containing headings and a section which will show to name of the currently opened report and any other reports open. The location of these two will change depending on the report type and settings.

42.10 Report Toolbar

The top toolbar will always contain the same icons, these are annotated below:

42.10.1.1 Load File

Opens a previously created report.

42.10.1.2 Close File

Closes the open report.

42.10.1.3 Close All

Closes all the open Reports.

42.10.1.4 Save

Saves current report as an XLSX file.

42.10.1.5 Save As

Saves all selected report as XLSX files.

42.10.1.6 Load Folder

Opens all reports in the selected Folder.

42.10.1.7 Refresh

Update the currently open reports.

42.10.2 Print

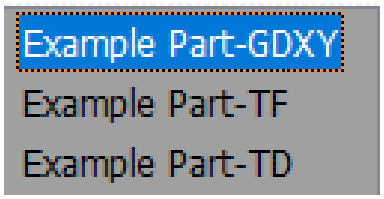
Prints the currently viewed report to PDF or a connected printer.

42.10.3 Print Preview

Previews how the report will be printed.

42.11 Open Reports

All the currently open report files will be listed on the left side of the window, select the report to view and its contents will be displayed on the right in the viewing area.



42.12 Report Viewing Area

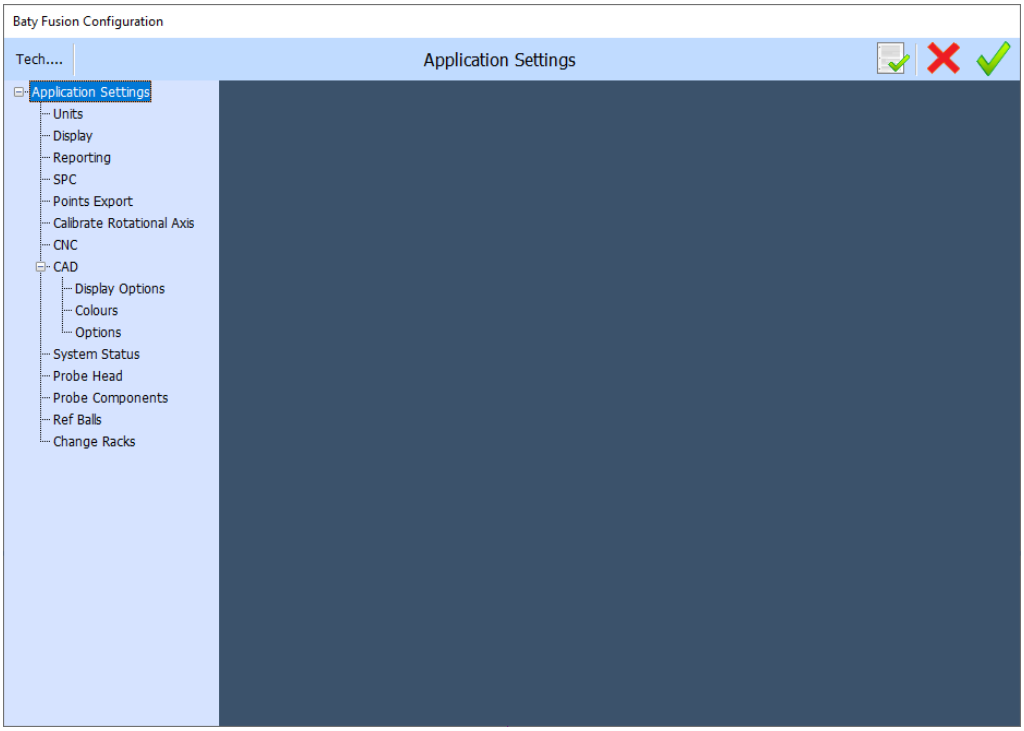
The main area in the report viewer will display the currently selected open report, by default for most of the report types this will be a large enough area to view the whole report. For larger reports, for example an SPC report with a large table of data, this will not be possible and therefor a scroller bar on either axis may appear to help view the full report.

42.13 Combined Report Tabs

Reports can be set to combine as one document, or to each be viewed and saved as separate documents, this setting is discussed in Chapter 43.8.7 – Report Options, page 149. If this is set to combine, multiple reports will be saved as one file, and they will no longer feature separately on the left of the report viewer. They will instead be listed as tabs at the bottom of the report viewer. The currently selected tab will appear white, and the other tabs will be a pale grey.

43.0 MACHINE SETTINGS

Many of the software settings may be configured by the user to suit their requirements. To change any of these, click on the Settings button, to open the window:

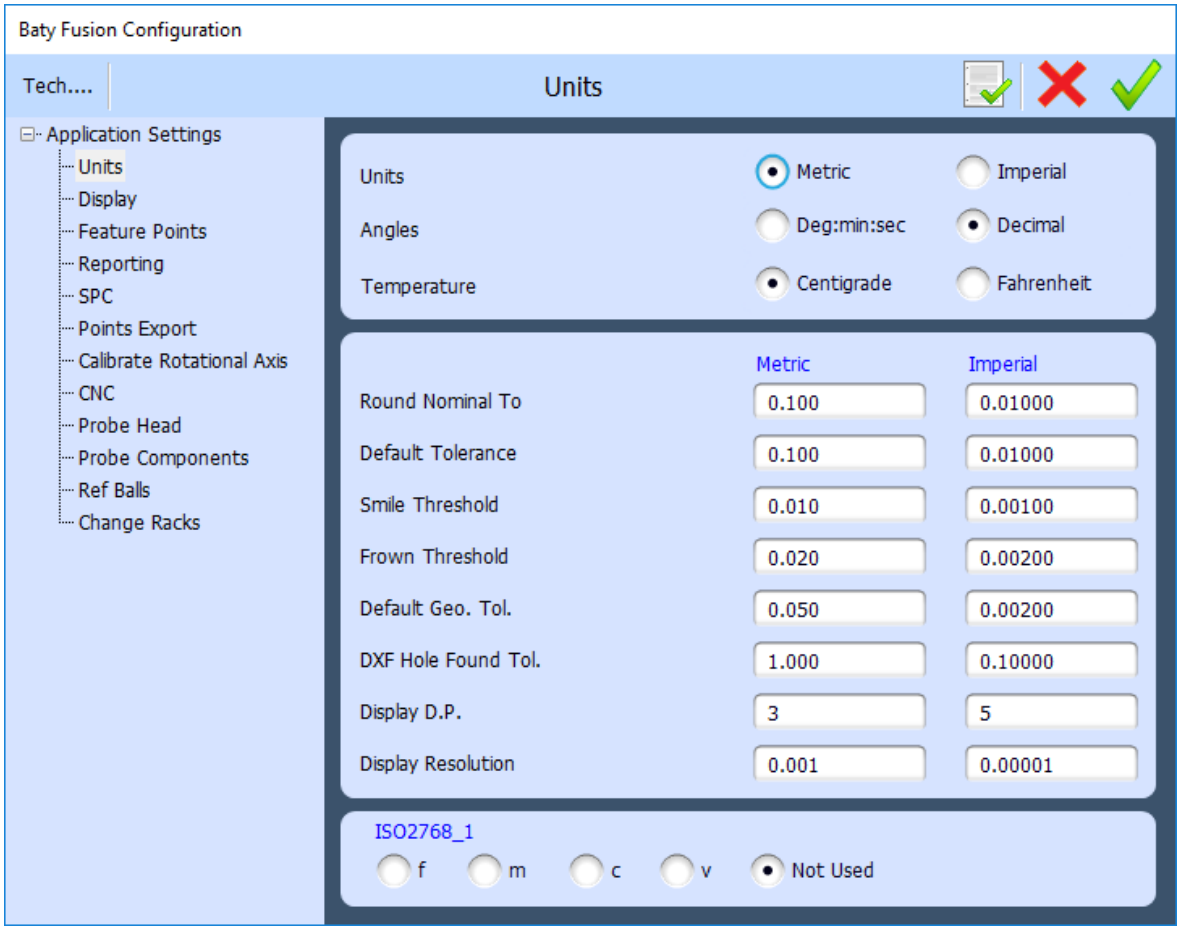


To change the default settings the user must be logged onto the controller with administrative rights. The 'Tech….' button will allow access to more technical information such as the machine's error map and other machine settings. To bring up this information a passcode must be entered. In the unlikely event that any of this information will need to be accessed, this code may be available from Baty, but this will be for servicing and problem solving only.

The green tick in the top toolbar will save and close the window, the red cross will ignore an y change made since opening and close the window. The sheet with the green tick is to apply settings without closing the window.

43.1 Units

The settings for units in the reports can be seen below:



These settings can be changed in the middle of an inspection if required, the inspection will be updated when the user selects apply or accept.

43.1.1 Units

This setting controls which units are used for measurements, this can be either Metric or Imperial. In the lower section of the window, there is a column for each system to separately control rounding, tolerances, and other thresholds.

43.1.2 Angles

Angular measurements are either show in degrees, minutes, and seconds or as a decimal value.

43.1.3 Temperature

For machines with optional temperature sensors, this can be shown in Celsius or Fahrenheit.

43.1.4 Round Nominals To

For new dimensions, an estimate nominal value is given using the measured value rounded by the value set in this box. For example, if the measured value is 0.493, the nominal could round to either 0.49 or 0.50 depending on whether the value is rounded to the nearest 0.1 or 0.01.

43.1.5 Default Tolerance

If ISO 2768-1 is not being used to define the default tolerances, then this box can be used to define a default tolerance when calling up a dimension in the Main Screen.

43.1.6 Smile Threshold

This controls the threshold used for the Smiley Face indicator in the feature window. The Face will remain smiling for all measurements where the error does not exceed the value in this box.

43.1.7 Frown Threshold

The Smiley Face indicator will frown if the measurement error exceeds this Frown Threshold. If the error is greater than the Smile Threshold value but is less than the frown threshold the face will display an open-mouthed expression.

43.1.8 Default Geo. Tol.

This defines the default limit for Geometric Tolerances when a dimension is created.

43.1.9 DXF Hole Found Tol.

Hole positions can be imported using DXF file, the software will use the tolerance set in this box to determine whether a measured hole is paired with inputted values.

43.1.10 Display D.P.

Defines the number of decimal places displayed.

43.1.11 Display Resolution

This box defines the rounding value for all measured values displayed. If all the decimal places defined in the box need to be significant, then the rounding value used in this box should be appropriate. For example, if the results are displayed to three decimal places, then the Display Resolution should be 0.001.

5.791 displayed to 3 D.P. and a resolution of 0.001 will be reported as 5.791

5.791 displayed to 3 D.P. and a resolution of 0.01 will be reported as 5.790

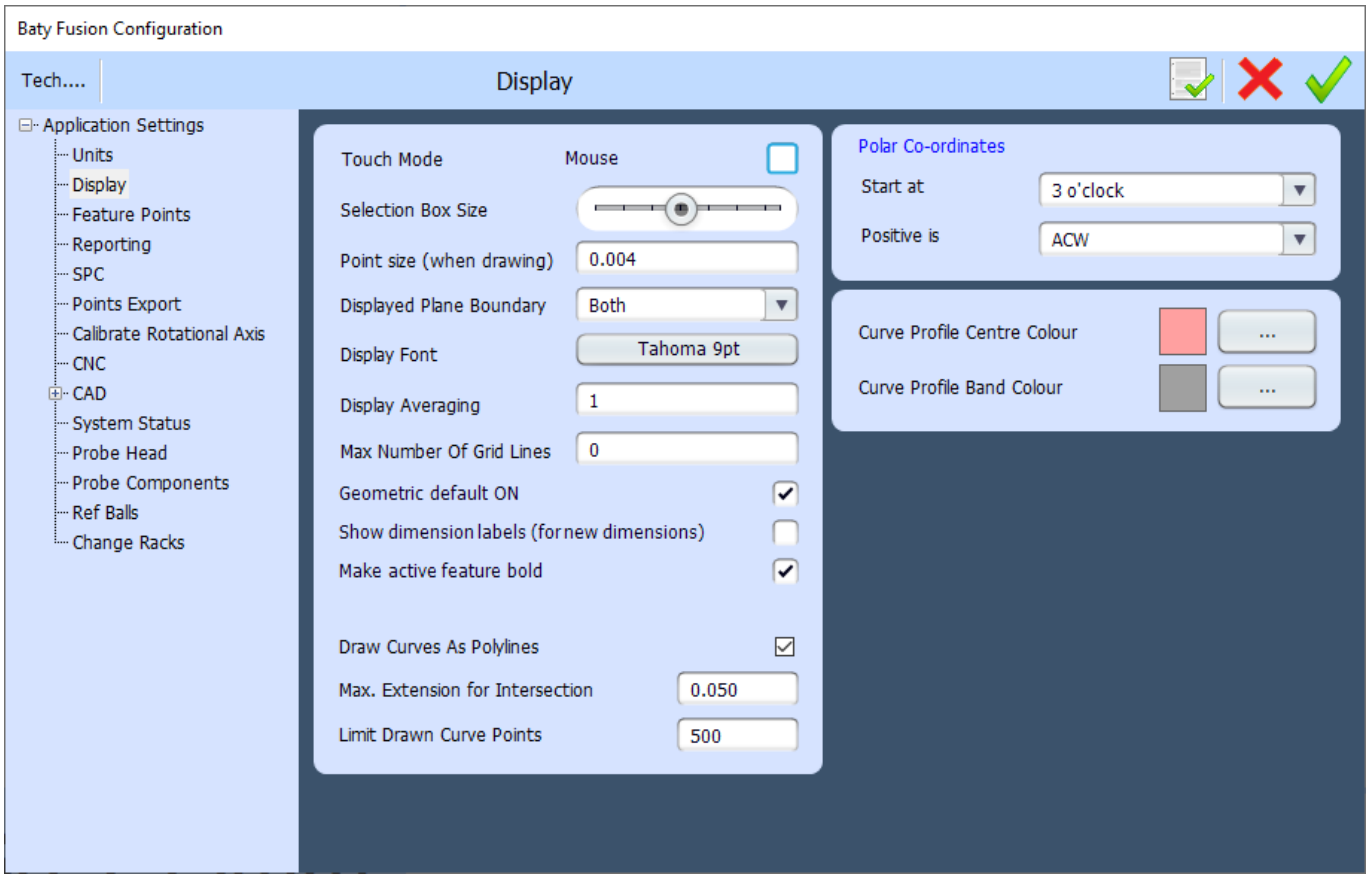
5.791 displayed to 3 D.P. and a resolution of 0.1 will be reported as 5.800

43.1.12 ISO 2768-1

Instead of the Default Tolerance defined in the box above, it is possible to use ISO 2768-1 to produce the default tolerance used when calling up a dimension in the Main Screen. The option available relate to fine, medium, coarse, and very course.

43.2 Display

The display settings for the software can be seen below:



43.2.1 Touch Mode

This controls whether the software will be controlled using a mouse or, if there is a touch enabled monitor connected, touch and mouse. Tick and untick the box to select either mode.

43.2.2 Selection Box Size

The slider bar can be used to adjust the size of the selection box that appears in the graphical areas of the Main Screen.

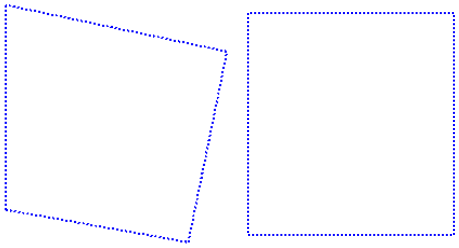
43.2.3 Point Size (when drawing)

When measuring or constructing points, they appear in the Main Screen as blue dots. Adjusting the value in this box will alter the size of these points.

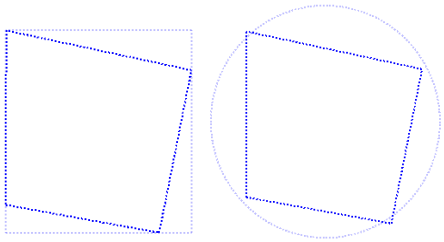
43.2.4 Displayed Plane Boundary

This controls what is displayed in the measure window after a plane has been measured. For most features, the points measured are used to create a best fit shape, and this is the outline shown. For planes, a shape can be made either from the points taken, or from the shape of the selected plane style, circular or rectangular. This setting can be used to select either of these, or both at the same time.

An example of a four-point plane displayed as a Convex Hull is shown on the left, the same plane displayed using Template Extents is shown on the right.

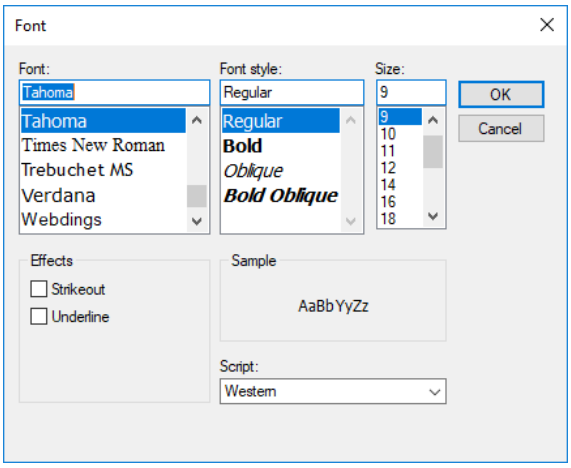


If the option Both is selected, the plane will show both boundaries, Convex in a darker blue and Template in a lighter shade. The same four-point plane is shown below for a rectangular or a circular plane using the option Both.



43.2.5 Display Font

The font, style and size of the dimensions can be selected by clicking on the grey box. This will bring up the window below to select from the standard options available within windows.



43.2.6 Display Averaging

The system will take this number of readings from the scale before displaying the average. This helps to stabilise the readouts and prevent them from flickering between two readings.

43.2.7 Max Number of Grid Lines

This relates to the grid scale used in the main drawing window. If a value of zero is set here, there will be no grid lines in the main UI, leaving just a blank sheet to work from.

43.2.8 Geometric default ON

This tick box controls whether geometric tolerances, for example parallelism or true position, are displayed by default with other dimensions. With this option turned off no geometric tolerances will be displayed as part of dimension unless manually added by the user.

43.2.9 Show Dimension Labels

This setting controls whether the dimension identifier is displayed automatically with each new dimension. The identifier will display the default measure name set by the feature and can be edited and updated in the dimension details.

43.2.10 Make Active Feature Bold

A feature or dimension will be highlighted bold if it has been selected as the active feature.

43.3 Draw Curves as Polylines

This controls whether curve features will be drawn as a polyline. A polyline approximates the shape made by the curve points, without this, points taken in the curve will be displayed as a point cloud. This will not affect how curves interact with a DXF curve comparison.

43.4 Max. Extension for Intersection

If two measured lines are close to intersecting, the lengths of the lines can be visually extended so that they meet one another to create a continuous profile of the measured part. This setting controls the maximum additional length any lines will be extended for them to intersect.

43.5 Limit Drawn Curve Points

This sets the limit of the maximum number of points which will be displayed in the drawing view. Curves with more points will retain the data for all measured points, but the point cloud drawn will show a filtered selection of points which will still represent the shape of the curve.

43.5.1 Start At

This sets the starting point for a measured circle. The options for this position are 3 o'clock, 12 o'clock, 6 o'clock, and 9 o'clock according to a standard clock face. A measurement will begin at this position and then move in the direction set as positive.

43.5.2 Positive Is

This setting control which direction is considered positive, clockwise (CW) or anti-clockwise (ACW). All automatic measuring will be done in this direction, starting at 0 degrees.

43.6 Curve Profile Centre Colour

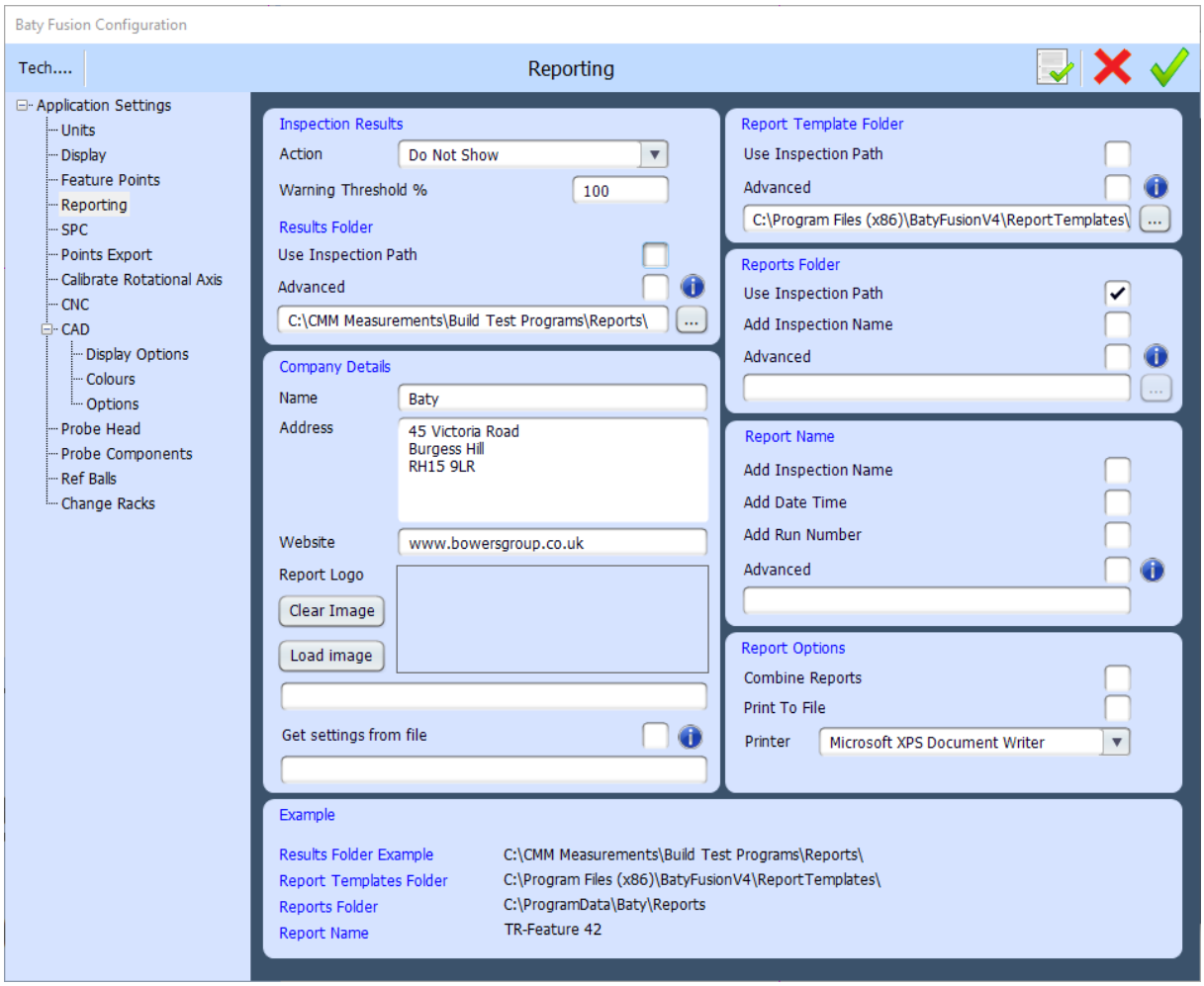
This sets the colour of the DXF curve profile's nominal centre line in both the main drawing view and the camera's DXF overlay, this may be useful to adjust to give better contrast to the part measured in a graphic details report.

43.7 Curve Profile Band Colour

This setting is for the same purpose as the one above but will adjust the colour of the upper and lower tolerance bands of the DXF curve profile.

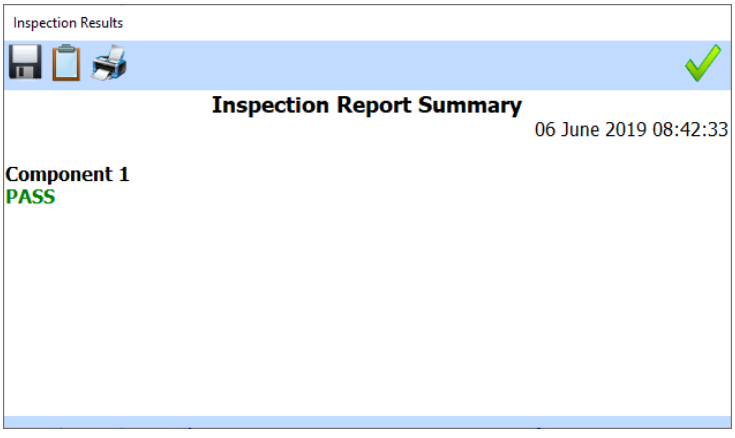
43.8 Reporting

The options for reporting can be seen in the image below.



43.8.1 Inspection Results

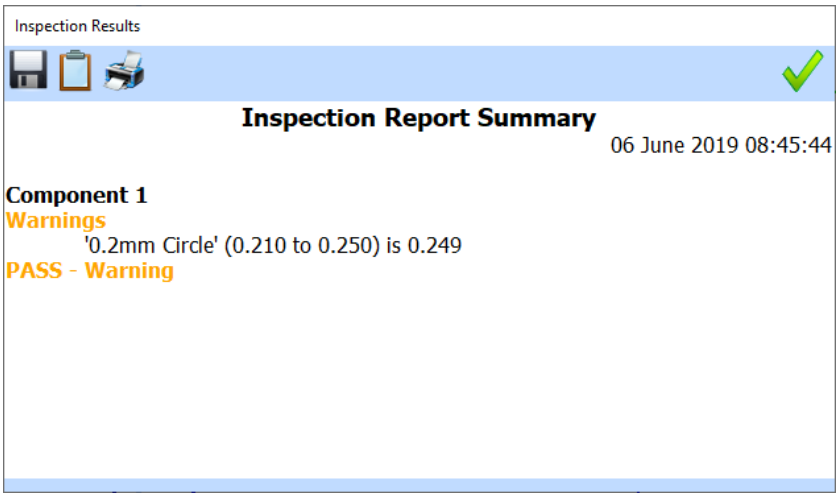
An inspection summary can be made at the end of an inspection, to give a summary of whether the inspection passed or if any features failed or were approaching failure. The Action dropdown controls what is done with the inspection summary at end of the program, this can be set to Show, Do Not Show or Save as RTF. Show will display the results in a pop up on the screen, as shown on the left, Do Not Show, which will do nothing, and Save as RTF. This will create and save a Rich Text Format file which will contain the same information as the summary that is shown.




```
Inspection Report Summary
06 June 2019 08:48:44

Component 1
PASS
```

The Warning Threshold % will add an optional warning for parts that are within the tolerance bands but are nearing these limits. A limit of 100% will never give a warning as this is when the part is out of tolerance. A tolerance of 90% will give a warning when the part is measuring to 90% of either tolerance band. For example, with a tolerance of ±0.1 this warning will be triggered on any measurements ±0.09.



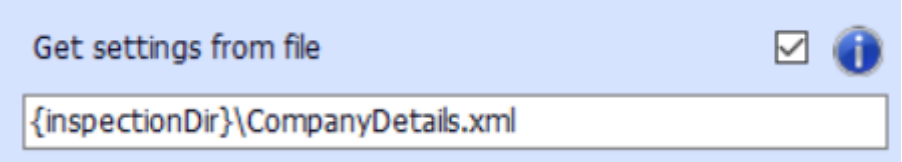
This will help to alert the user when parts are nearing their tolerances, to allow for adjustments to be made before parts are out of tolerance, reducing the need to scrap or rework parts. The Results Folder settings control where the RTF file will be saved, this can be the same folder as the inspection, or a user specified folder by selecting the '…' button and browsing for a location.

43.8.2 Company Details

The Name and Address entered here will display on all the report headers. Fields not completed will appear as blank on the report viewer.

43.8.3 Get Settings from File

Instead of being manually typed, the Company Details can be loaded from a text file, either from one set location, or a location specific to the inspection. The benefit of an inspection specific location is that these settings can be automatically applied for each part's customer without user interaction when swapping between inspections.



When ticking this setting, the default location given will be the same directory as the inspection and it will look for a file called CompanyDetails.xml.

For this to work, a file needs to be made in the format below and saved with the correct name and in the correct location. The number of strings can be customised depending on how much information is needed for each customer.

If there is no file in this location, or there is an issue with the title or formatting of this file, the reports will still run but their fields for company details will be blank.

The template for this file can be copied and customised from the text below:

```
<?xml version="1.0"?>
<CompanyDetails xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <CompanyAddress>
    <string> </string>
  </CompanyAddress>
  <CompanyLogo> </CompanyLogo>
  <CompanyName></CompanyName>
  <CompanyWebsite> </CompanyWebsite>
</CompanyDetails>
```

43.8.4 Report Templates Folder

Reports are created using template files, and the report templates folder is the location. This is the location that the templates used to create reports are found. It is recommended for normal use that this not be edited as a report will be unable to run if there are no templates in the folder it is being directed to. It is also essential to select Insert rows into spreadsheet reports in the Report Options below.

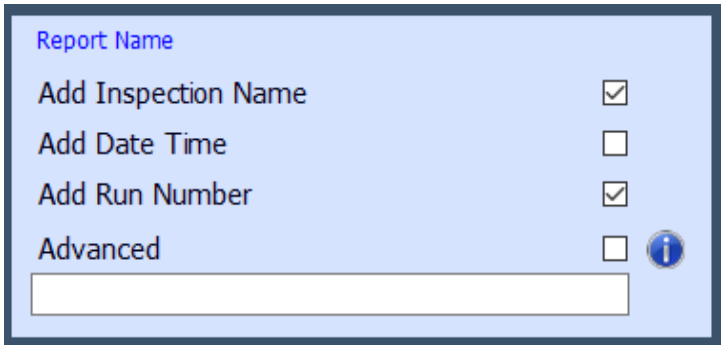
43.8.5 Reports Folder

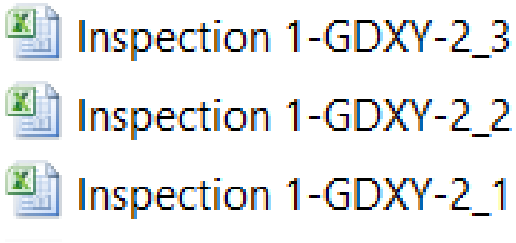
This is used to set a default location for all reports to be saved. This can be set to the same location as the inspection file by selecting Use Inspection Path, or to create a new folder with the inspection's name and save to this file instead by selecting Add Inspection Name.

43.8.6 Report Name

These options can be used to control the names of the reports generated, Add Inspection Name will add the name of the inspection to the file name of the report, Add Date Time will add a string of numbers to identify the time and date of the report. This will have 4 digits for the year, followed by 2 for the month and 2 for day, then the letter T to specify the time will follow. The time is then given in 2 digits each for hours, minutes and seconds. Run number is added to identify the number of runs and, in the case that there are multiple workpieces, which workpiece the report is for.

For an inspection that is running for the fourth time on the second workpiece in this inspection it will save as 4_2. The settings below are used on an inspection with three components which is set to save a graphic details report. On the second run of this inspection the three files below will be produced:

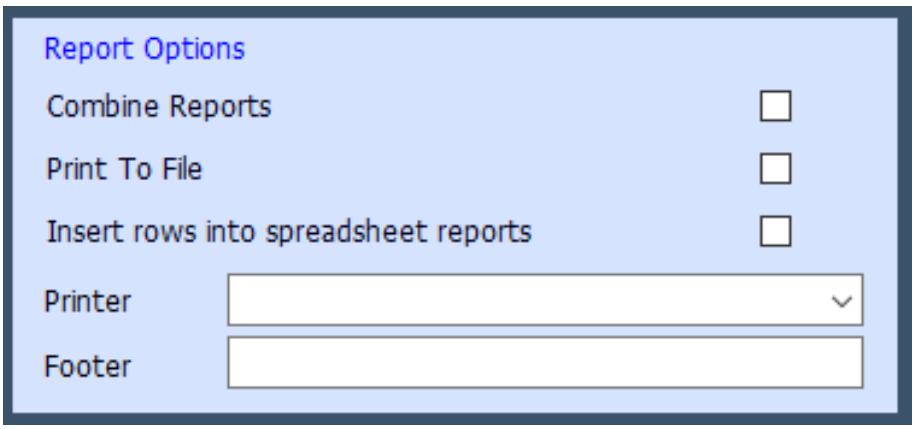




These report name details can be added in any combination desired, if no information is selected then the report will save as a two to three letter abbreviation of the report type, for example TF for a Tabulated Feature report and CGD for CAD Graphic Details report. An example of what the report name will look like is shown in the Example section at the bottom of the window, under Report Name.

43.8.7 Report Options

This contains additional reporting options; the Combine Reports option can be enabled to save multiple reports as one document, as opposed to a separate file for each report, this is discussed in Chapter 42.13 – Combined Report Tabs, page 140. Insert rows into spreadsheet will need to be ticked if using custom template reports but will not have an effect otherwise. The default printer can be selected from the dropdown or, if desired, by selecting the Print To File option can be set to print to file using a PDF or Document writer.

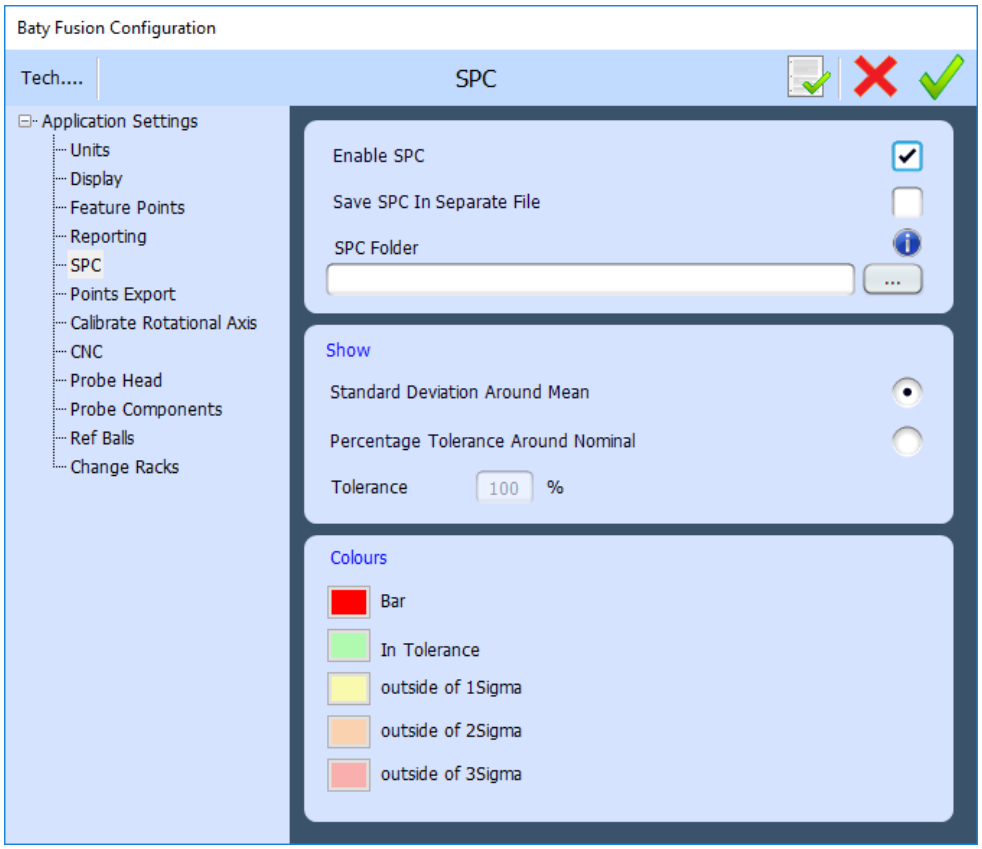


43.8.8 Example

This section is to show the user the result of the settings that they have used for the Reporting options and can be used to confirm that the reports will be named and saved as desired.

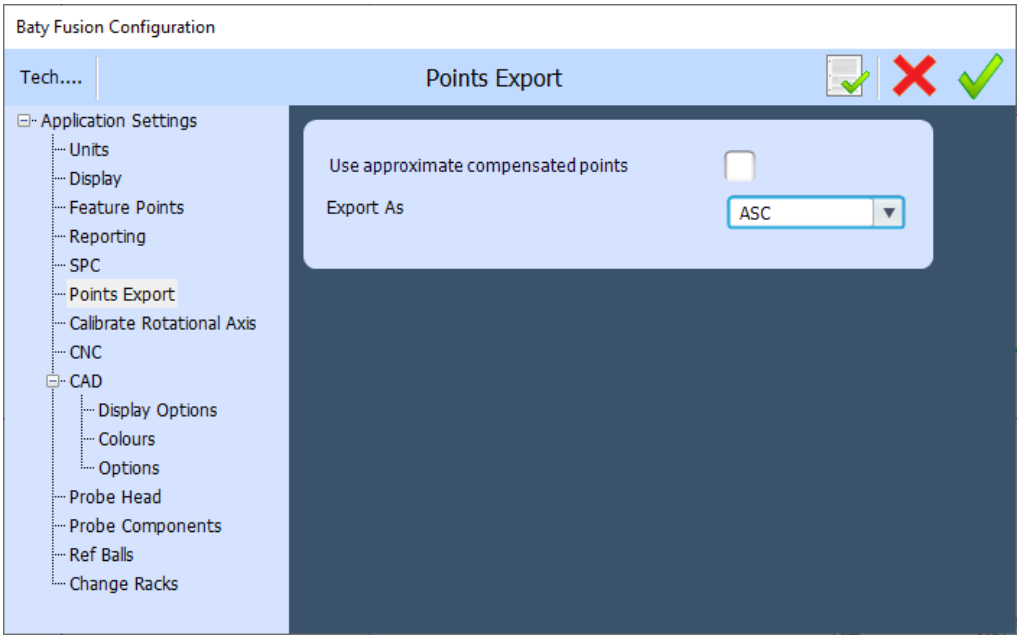
43.9 SPC

This window controls the settings for SPC, such as if it is desired to save the SPC information in its own file and the location for this. The tolerance settings may also be adjusted.



43.10 Points Export

These settings are used to control the export data points button found on inspection tab.

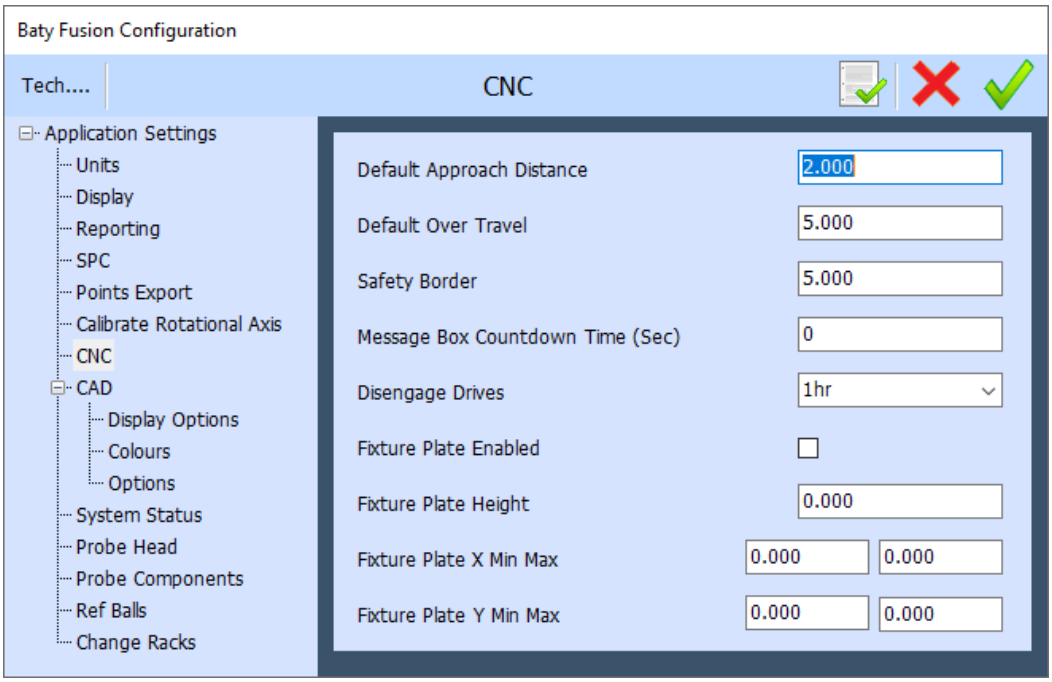


43.11 Calibrate Rotational Axis

This section is not necessary for a Venture or VuMaster as they do not have a rotational Q axis.

43.12 CNC

The options for CNC settings can be seen below.



43.12.1 Default Approach Distance

The pre-travel distance for a probe feature; the probe will start this distance from a feature's estimated position, moving at probing speed and will accept the first point taken in this search.

43.12.2 Default Over Travel

This is the distance that the probe will move whilst looking for a feature, if it doesn't contact anything in this distance it will retract to its pre-move position.

43.12.3 Safety Border

The distance a probe will pull away from a surface when a feature is completed.

43.12.4 Message Box Count Down Time

When running or stopping a program, this is the time that some timer-controlled pop-ups will take before the default option is automatically selected.

43.12.5 Disengage Drives

This specifies a time for the system to disengage drives after idling for set period.

43.12.6 Fixture Plate settings

These settings allow the addition of fixture plate safe volumes. Inputting data here will tell the program how to adjust its measurements based off the fixture plate.

43.13 Probe Head

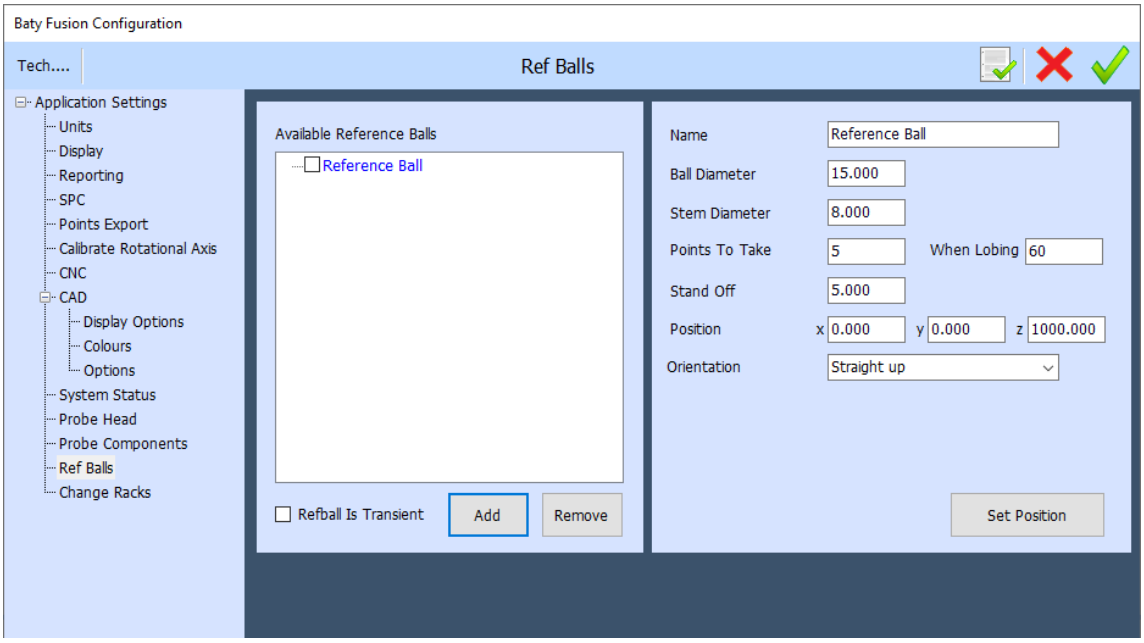
Not required for use – Only required when a new probe mounting system is being fitted.

43.14 Probe Components

Shows library of all items used when creating probes for the system. All items should be set ready for use by factory. Only required for special probe applications.

43.15 Reference Balls

For machines with one or more reference balls, these settings are used to control their name, size, and position.



43.15.1 Name

Enter a name to identify reference ball, this is most useful when there is more than one sphere.

43.15.2 Ball Diameter

This is for the size of the reference ball and can be taken from the calibration certificate.

43.15.3 Stem Diameter

This is needed to prevent star probes from crashing into the stem during referencing.

43.15.4 Points To Take

This controls the number of points that will be taken about the reference sphere for calibration, or the minimum number needed for any manual datuming.

43.15.5 Position

The XYZ co-ordinates of the reference ball when on the stage.

43.15.6 Orientation

This is the orientation of the ball with reference to the table. As supplied, this will normally be straight up. This setting can be used for reference balls orientated using i, j, k vectors.

43.15.7 Update

Any changes made in the window will need to be updated to be saved to the reference ball. This does not need to be used when setting a reference ball for the first time.

43.15.8 Add

This is used to add a reference ball to the system.

43.15.9 Set Position

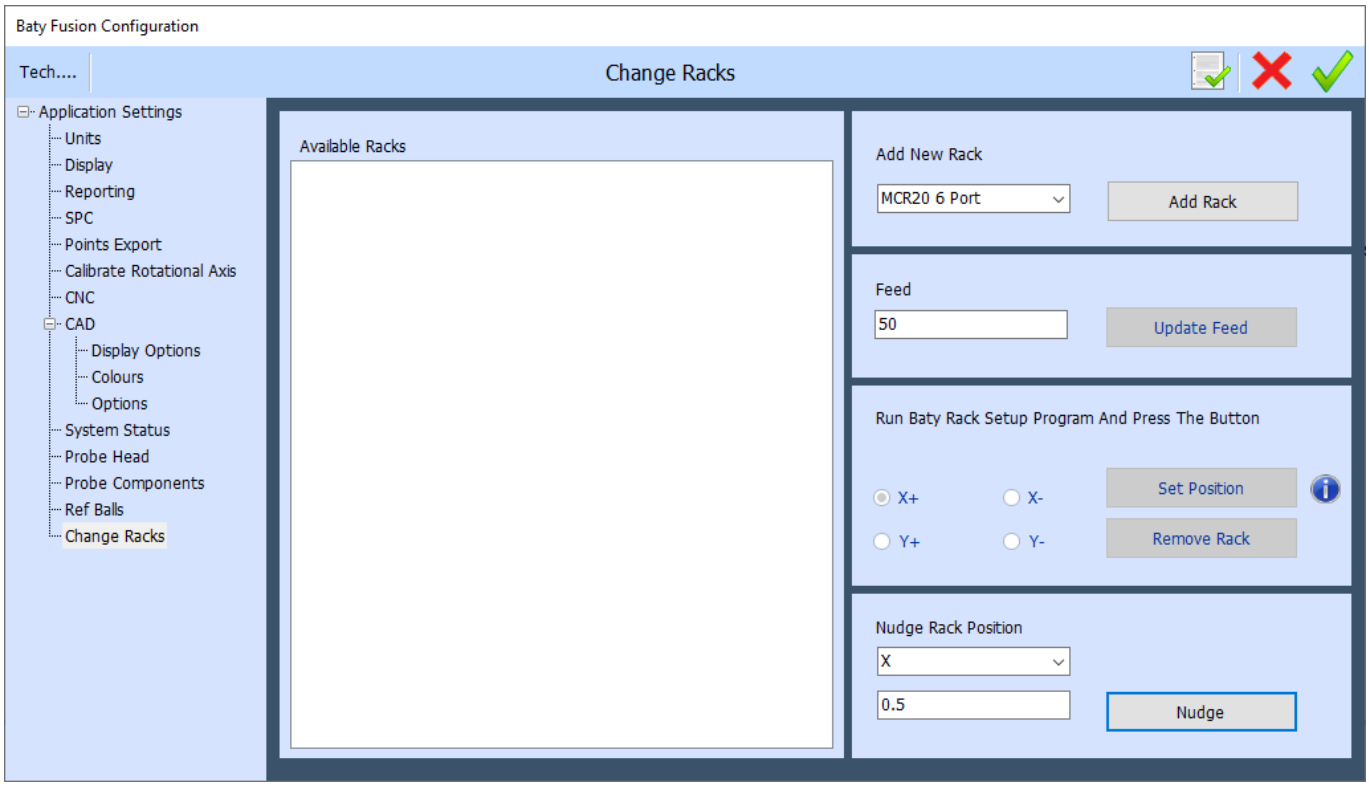
This is used to start an auto positioning routine. Ensure the master probe is active and positioned above the centre of the sphere and then press this button, this will send the probe downwards, searching for the ball. When contact is made, the machine will begin measuring the sphere. Once measured the position co-ordinates XYZ will update automatically.

43.15.10 Remove

This is used to delete a reference ball from the library, pressing this button will delete the ball.

43.16 Change Racks

This section is used to set-up and edit any change racks on the machine.



43.16.1 Add New Rack

From the drop-down menu, select the probe rack with the correct number of ports available.

43.16.2 Feed

This is used to set the speed that will be used when approaching the rack.

43.16.3 Rack Setup

Use to teach rack position, this will require the manual driving of a probe into first and last rack positions to set the rack.

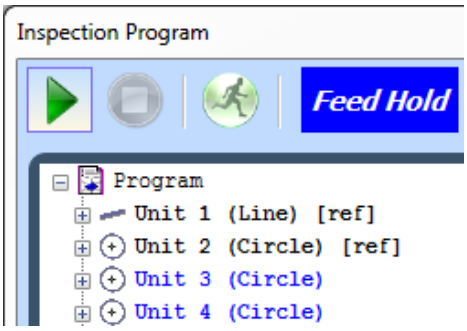
43.16.4 Nudge Rack Position

Use to adjust rack position should teach positions be slightly out on CNC change. Choose axis to adjust from drop down and set increment to 'nudge'.

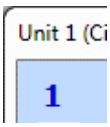
44.0 EDITING PROGRAMS

44.1 Changing the Order of Program Features

There are two ways to change the order of features, the first is done in the Inspection Program Details window. Select the feature to move, click and hold down the left mouse button, and drag to desired position. Releasing the mouse will place the feature in this position.



The second method is done in the Feature Window, in the top corner of the window is a number, this shows the feature's position in the inspection. To change this, highlight the number in this box and change it to the number of the new desired position in the queue. This should be done in ascending order if multiple features are to be re-numbered.



44.2 Adding Features to a Program

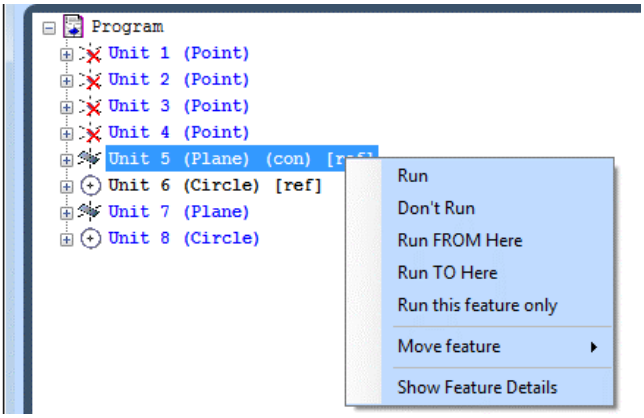
To add a feature, open the program and measure a feature as normal, then save the program to add the new features.

44.3 Delete a Feature on a Program

To delete a feature out of a program, see Chapter 16.15 – Delete, page 42, or alternatively use the erase tool, then save the program to apply the changes.

44.4 Run Selected Parts of a Program

Fusion allows the user to select which features to run in the program. Right clicking a feature in the program list brings up the following options:



Run / Don't Run – Use these options to turn features on or off in a program.

Run FROM Here – Disable all features before the feature selected.

Run TO Here – Disable all features after the feature selected.

Run This Unit Only – Disables all other features except the feature selected.

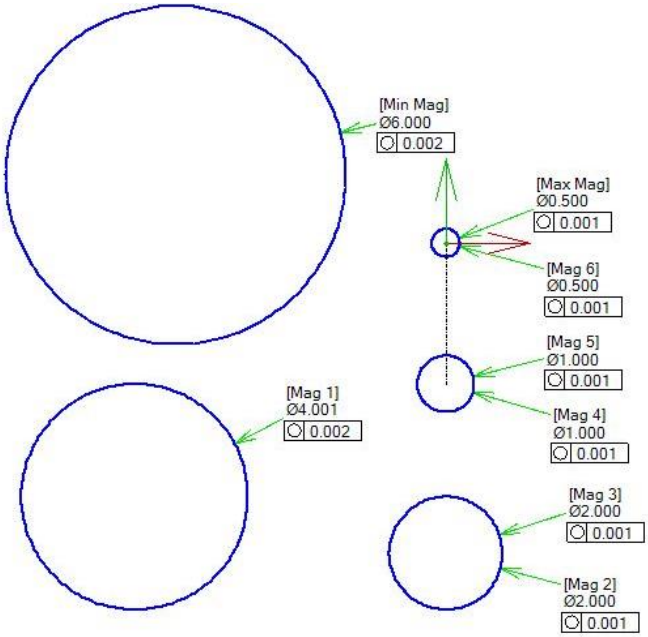
Move Feature – There are two options here, To Top and To Bottom, selecting these will move the part to the top or bottom of the features list respectively.

Show Feature Details – This option will open the Feature Window of the part selected

45.0 CAMERA VERIFICATION

45.1 Pixel Verification

Pixel verification is used to ensure the camera is measuring sizes correctly in each position.



To run the exercise, measure the recommended circle diameters on the Cal Mag from one of the two tables below. It is recommended this be done from Max mag working back to Min.

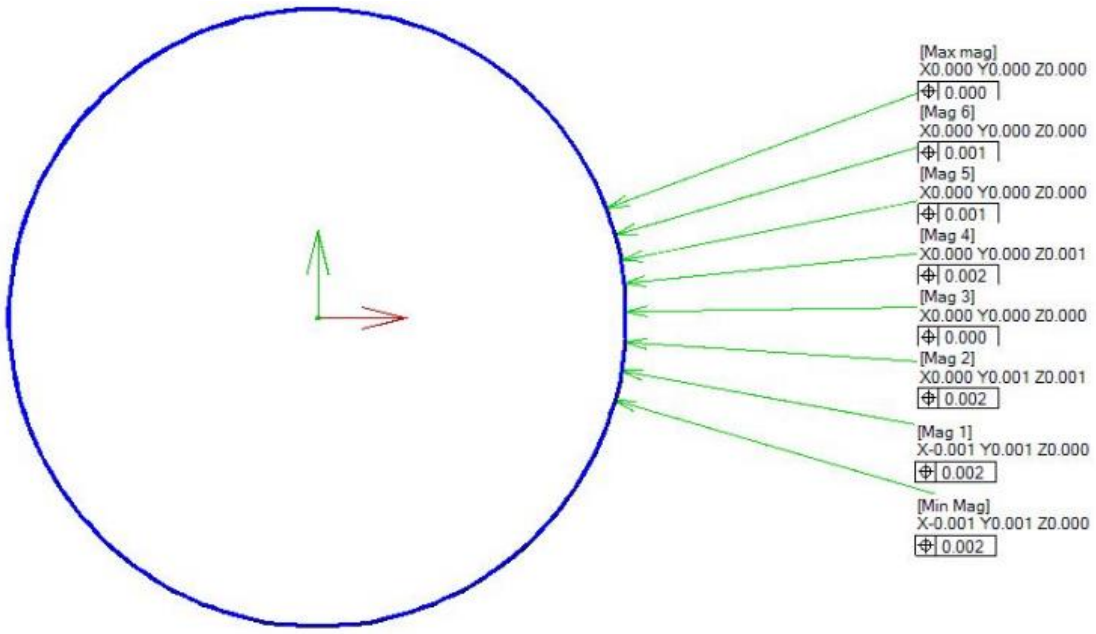
12x Lens	
Magnification	Circle Ø
Max	0.5mm
6	0.5mm
5	1.0mm
4	1.0mm
3	2.0mm
2	2.0mm
1	4.0mm
Min	6.0mm

6x Lens	
Magnification	Circle Ø
Max	0.5mm
4	1.0mm
3	1.0mm
2	2.0mm
1	2.0mm
Min	4.0mm

Once all the circles have been measured, play back the measures through the play menu. All the circles should be within ±0.002mm of the nominal value to be in specification. Any values outside this will need to be re-verified in the Lens Setup menu.

45.2 Zoom Offsets

The Zoom Offset verification is a check to ensure the various zoom positions all measure a feature in the same position so that there are no measurement discrepancies moving between zoom positions.



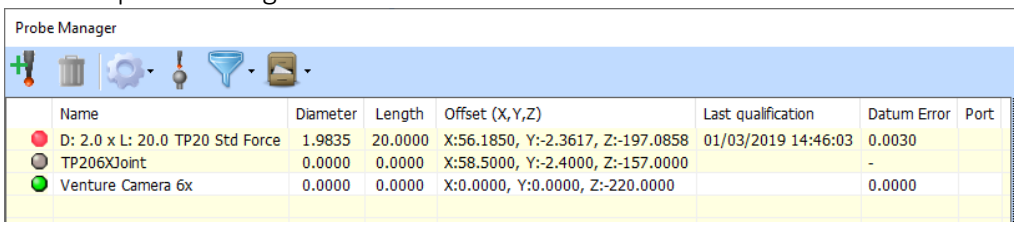
To run the exercise, measuring the 0.5mm circle from the Cal-Mag-2 in all the mag positions. Start at Max mag and set ref on the first circle to zero out the XY values. Move back through the zoom positions measuring the same 0.5mm dot and after each circle measure, place a cartesian position dimension. All the circles should be within ±0.002mm of the X & Y values to be in specification. Any values outside this will need to be re-verified in the Lens Setup menu.

45.3 Camera Z Rotation

The Camera Z-rotation verification is a check to ensure the camera lens will measure a feature in the same position wherever a feature is presented to the lens. This checks that there are no measurement discrepancies when measuring features in different places about the camera field of view. To run the exercise, measuring the 1.0mm circle from the Cal-Mag-2 in just the min mag position. Measure the 1.0mm circle 1.0mm in from each of the four corners of the camera window. Set ref on the first circle to zero out the XY values and place a cartesian position dimension. Place the cartesian dimension for all four positions. All the circles should be within ±0.002mm of the X & Y values to be in specification. Any values outside this will need to be re-verified in the Lens Setup menu.

45.4 Vision Touch Probe Offset

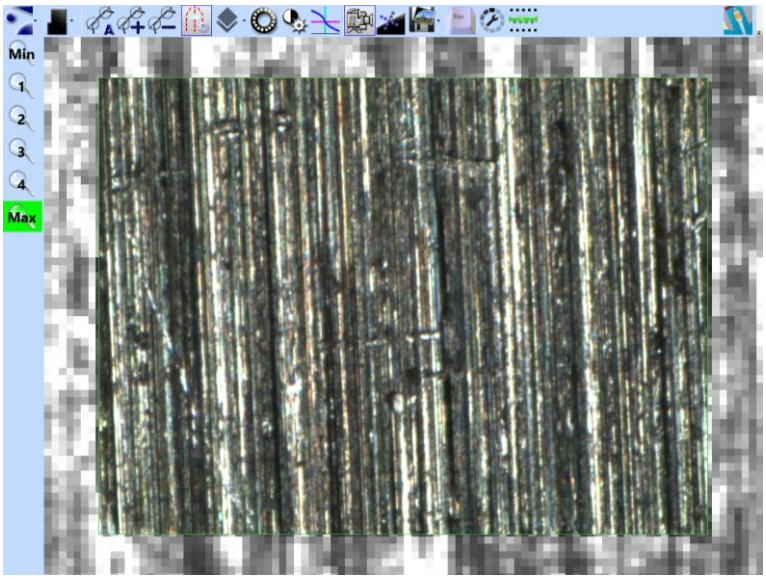
The Vision Touch probe offset is the known distance from the touch probe to the camera, which can be used in an inspection so that measurements made with both the camera and probe will appear in the right place. The camera will always appear in Fusion with an offset of X=0, Y=0 and all probes are given an offset from zero.



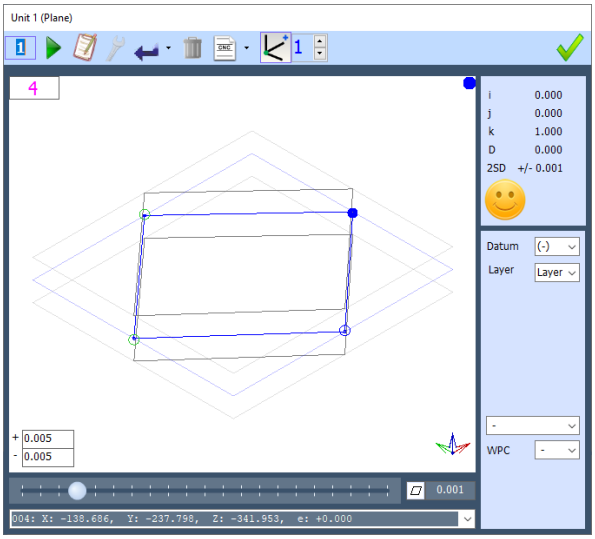
	Name	Diameter	Length	Offset (X,Y,Z)	Last qualification	Datum Error	Port
	D: 2.0 x L: 20.0 TP20 Std Force	1.9835	20.0000	X:56.1850, Y:-2.3617, Z:-197.0858	01/03/2019 14:46:03	0.0030	
	TP206XJoint	0.0000	0.0000	X:58.5000, Y:-2.4000, Z:-157.0000		-	
	Venture Camera 6x	0.0000	0.0000	X:0.0000, Y:0.0000, Z:-220.0000		0.0000	

To calculate the offset from the camera to the probe, measurements will need to be taken on the same part using both probes and the difference in the positions of the measured features can be used to calculate the distances between the probes. The part used for this is a ring gauge, as the centre point of the circle can be used for the XY positions, and a plane can be measured on top of the ring to calculate the difference in Z.

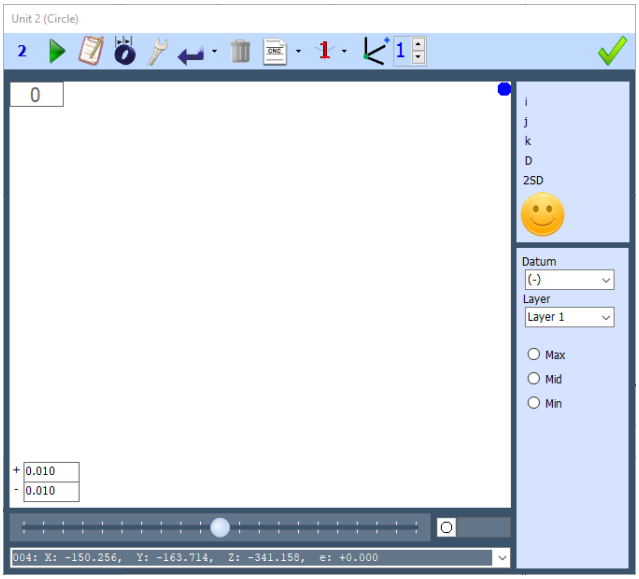
To start this procedure, select a ring gauge and ensure the inner ring and upper surface are clean and free from debris, then place it flat on the glass and secure it with blu-tack. Set the camera as the active probe and drive to a position over the top of the ring gauge, it is best to select somewhere that the surface of the ring fills the screen as much as possible. Set the lens position to Max and adjust the lighting so that the surface is well lit and easy to focus on.



Next, open the Plane tool and select Point as the Measurement Feature and Focus Point as the Inspection Method. Move to a point where the surface of the gauge fills the screen and click select an area in the centre of the camera screen to start the Auto Focus Point tool. After a point is taken, move to the opposite side of the ring gauge and take another point, repeat this process until 4 points have been taken in roughly a square on the surface of the gauge. Set the plane that these four points have created as the reference plane. Ensure the Z axis is still at its zero height and lock the axis.



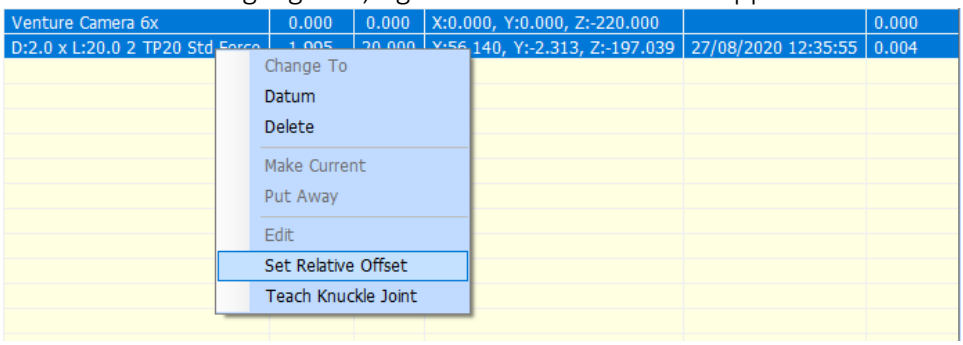
Next, move so that the centre of the gauge is within the view of the camera, and open a Circle tool and set the plane to the measured plane.



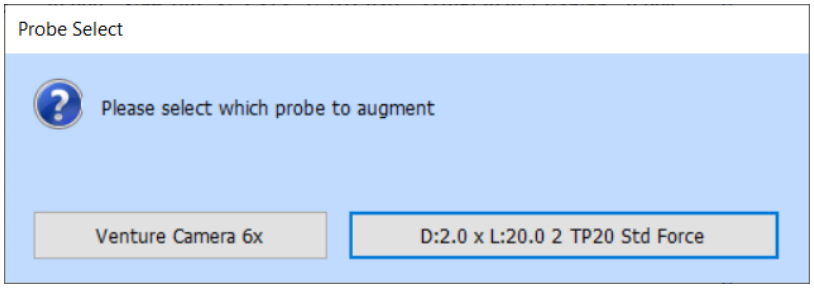
Select Edge Detection and an Arc tool and measure a section of the circle at 12 o'clock, 3 o'clock, 6 o'clock and 9 o'clock and then set this circle as a reference.

Now open the probe manager and select then change to the master probe. Next, open the plane tool and position the probe over the top of the gauge. Measure a four-point plane on the gauge in positions similar to the points taken using the camera. Press the green tick to accept this. Next, open a circle tool and set the measured plane to the probed plane, which should be feature 3. Now measure a circle using four points at 12 o'clock, 3 o'clock, 6 o'clock and 9 o'clock. After these four points have been taken, accept this feature. There will now be two planes and two circles in the inspection, dimension the X, Y and Z differences between the two circles.

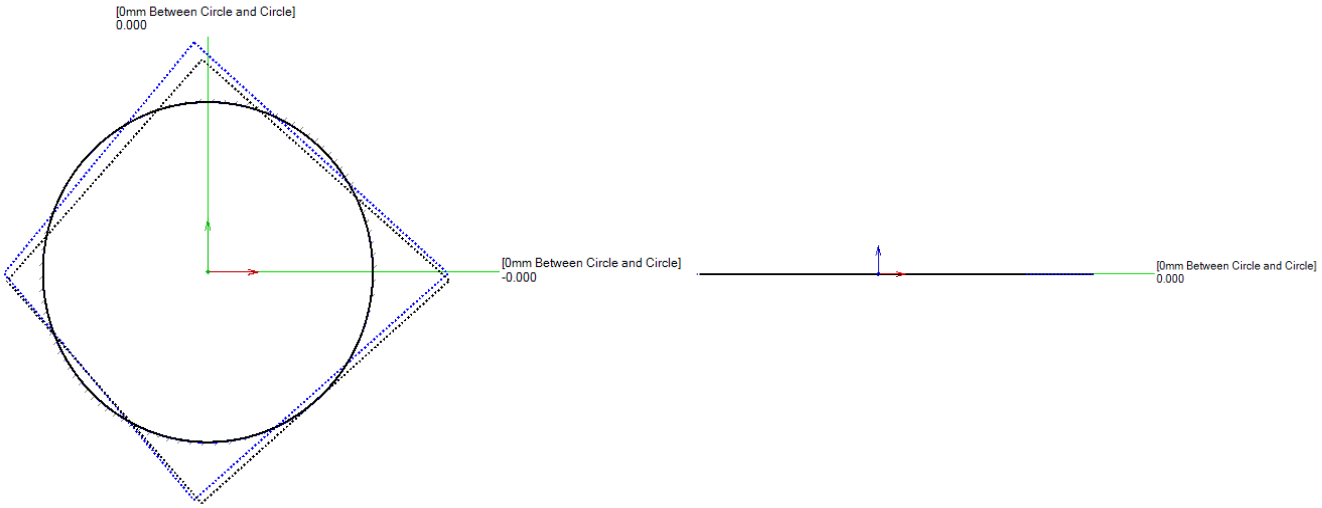
Open the probe manager and select the camera, press the Shift key, and select the probe that was used. With these two highlighted, right click and a menu will appear.



Select Set Relative Offset and a new window will appear, asking which probe should be augmented. **Always** select to augment the probe, never the camera. The camera must maintain an X, Y offset of zero.



The offset for this probe will now be put in the probe manager and should be correct, although it should be tested. This can be done by repeating these measurements and checking the dimensions between the features are now within specification. If the initial dimensions were within 0.5mm it is safe to re-run the open inspection. Although if there was a change larger than this, it is best to delete and re-measure the plane and circle measured by the probe as this position has changed. Add the dimensions between the circles and places and then run the inspection with all four features again to check that the camera and probe are both measuring the features in the same place.



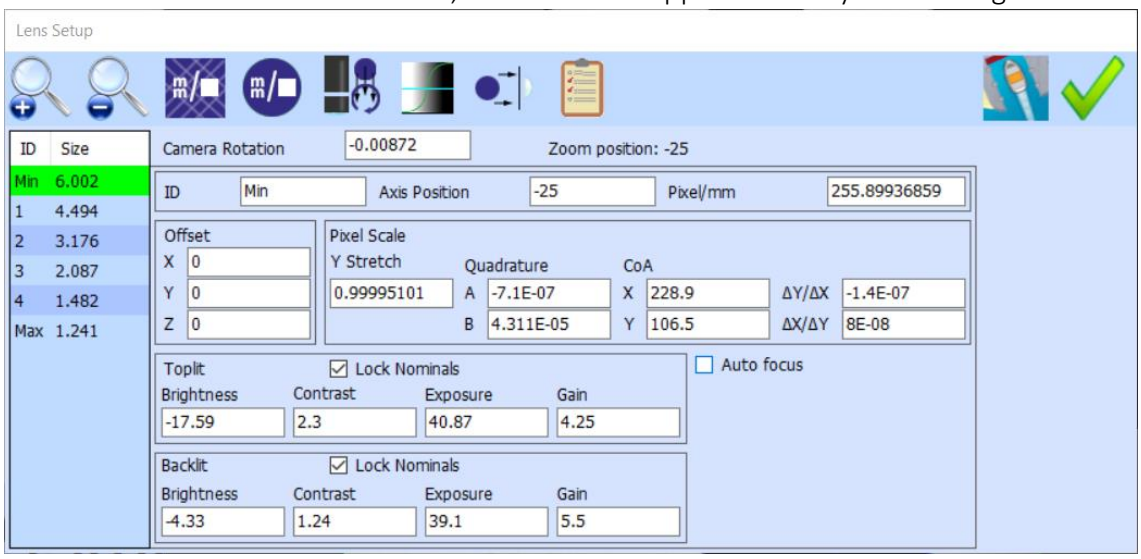
After the offset has been verified, the reference ball will now need its position updating, otherwise if the probe is datumed again, the offset for the probe will revert to the values it had when the reference ball was set.

46.0 CAMERA CALIBRATION

46.1 Full Lens Setup Menu

The Lens Setup menu will initially show some basic information about each lens position, discussed in Chapter 21.0 – LENS SETUP M, page 70. The full setup menu is locked using a tech code password which is only available from Baty. After this code is entered, more information and icons will become visible, these can be used to calibrate the camera should any of the verification exercises have failed.

After the tech code has been entered, the menu will appear similarly to the image below.



More information will become visible for each position's calibration and icons to calibrate the lenses will appear along the top bar of the window. Each of these routines is discussed below.

46.2 Calibrate all Scales from Grid:

This routine can be run either using a grid of circles, or one circle that takes up as much of the screen as possible. The grid on the Cal-Mag glass slide will be preferable when calibrating using grid. Before beginning, ensure that the circles fill the field of view when at Min and move to Max magnification and ensure that the camera is still well focussed, and there is a minimum of four measurable circles in the field of view. Pressing this icon will begin a routine which will calibrate the pixel sizes and lens distortion compensation for each of the zoom offsets. To calibrate using a circle, find a circle that takes up as much of the screen as possible, enter its known diameter and then measure the circle. Repeat this at all magnification levels.

46.3 Calibrate Lens from Circle:

This can be used to set pixel verification manually for each zoom lens as an alternative to using the grid. This routine should only be used where the option to calibrate from grid is not possible, as the grid calibration routine maps the full field of view and compensates for lens distortion as well as a size calculation. If this routine is run after a calibration from the grid, all this additional compensation will be lost.

If this routine must be run, as it is the only viable option, a prompt will ask which size circle to calibrate with. Enter the appropriate size as per 45.1 – Pixel Verification. Then measure the circle when prompted. This option requires the circle to be in the centre of the lens.

46.4 Calibrate Z Rotation from Circle:

Use this to set the Z rotation. When clicked, a prompt will ask to measure a circle in one of the four corners of the field of view. Measure the first circle and the system will automatically move the circle to the other three corners of the field of view. A prompt to remeasure the circle will appear again and this process will repeat for all four corners. The system will then calculate the Z rotation which can be checked by re-running the test in Chapter 45.3 – Camera Z Rotation, page 157.

46.5 Calibrate Edge Percent from Circle

The user will be asked to measure a circle of a known size and the default edge percent will be changed to meet this size of circle. It is recommended that this edge percent is checked using the usual method of measuring an internal and external circle of the same diameter.

46.6 Calibrate Offsets from Circle:

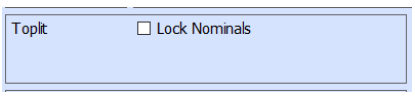
Use to set zoom offsets manually. When clicked, a prompt will ask to measure a circle with all zooms. Start on a 0.5mm dot at Max mag and then work back through the zoom positions measuring the 0.5mm dot each time. Check by re-running the exercise as in 45.2 – Zoom Offsets, page 156.

46.7 Qualify Calibration

There is a new camera calibration qualification routine. To use this, drive to the cal-mag grid and ensure that there are several rows of dots around the current field of view. The press the new icon on the right of the menu, shown above. This will take four images of the grid, with a small movement in-between and then when done a result will be shown with the error, and two pictures will appear. These will be called BareScale and FullScale, both will show scaled errors for the images taken compared to a perfect grid. BareScale shows the lens map without any compensation, and FullScale shows the error with all the compensation added. If there are a large number of red or pink arrows in the FullScale image, this signifies larger areas of error, and the camera may require re-calibrating. It is recommended to check the edge percent is correct and then re-run the grid.

46.8 Camera Nominals

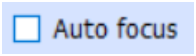
There are two sets of nominals which can be set to define the default brightness, contrast, exposure and gain for each position. These are split for use when only the back light is on, and alternative values to use at any time the top light is on. To lock these values for any condition, select the tick next to Lock Nominals and the values active at this time will be locked.



To change these values open the camera controls, (see Chapter 22.0 – CAMERA CONTROLS, page 72) and when suitable settings have been chosen, untick and re-tick to apply the new nominal values. This needs to be done for each zoom position and ideally should be set so that all positions have a similar colour and brightness. As a guide, the auto function can be used to get a starting point for each position, as it will aim for the same conditions whenever used, then small adjustments can be made after if necessary.

46.9 Auto Focus

If this setting is activated for one of the zoom positions, when the auto focus point tool is selected, the camera will automatically move to this zoom position to prepare for the measure. It is recommended this be set to Max for the best accuracy, or for Min for the fastest results if there are looser tolerances.



Ensure that only one position has this ticked, otherwise it may not move to the correct position when the autofocus point tool is selected.

SECTION 4 USING THE TOUCH PROBE

47.0 INTRODUCTION TO THE TOUCH PROBE

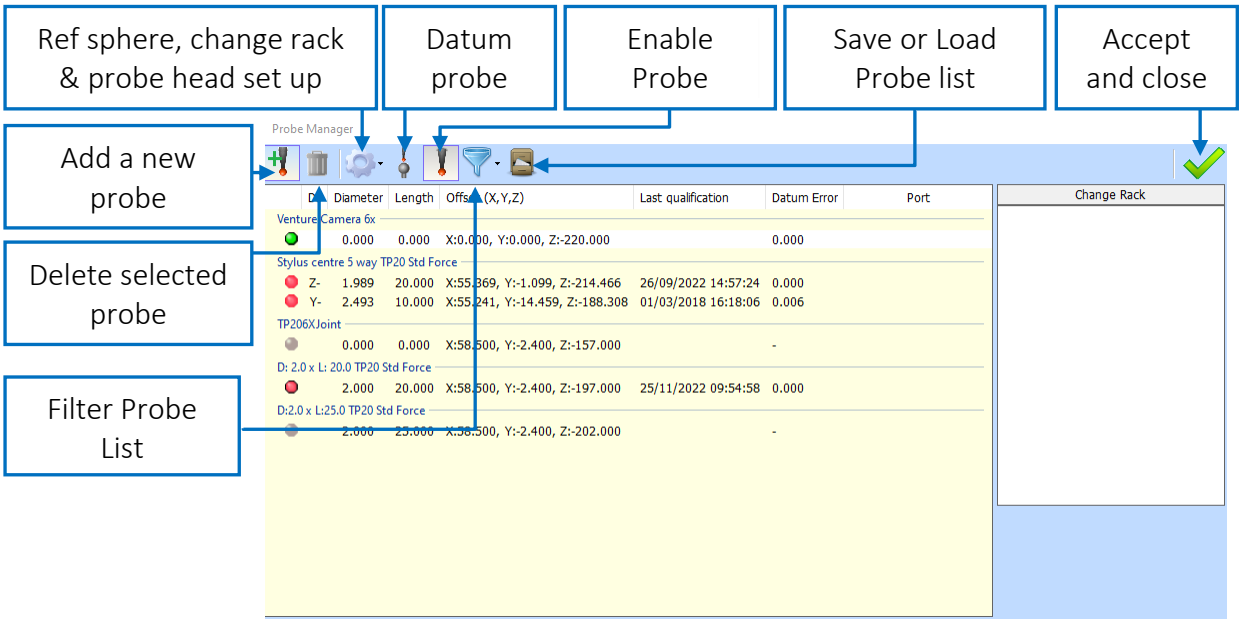
This section is designed to familiarise the user with the touch probe, with several exercises intended to demonstrate a principle of the software that should take approximately 30 minutes. This tutorial can be broken down into sections that can be performed at the convenience of the operator.

48.0 PROBE CALIBRATION

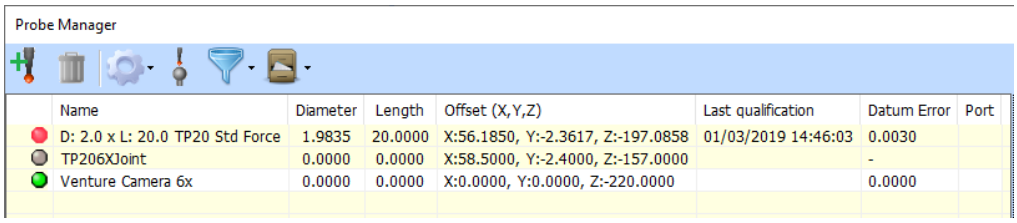
It is important to choose the correct stylus to suit the work piece, and before anything is measured, the probes that are going to be used need to be set up, calibrated and datumed. When using a touch probe to inspect a component, the software must know the length and diameter of the stylus ball being used, and its distance from the Camera probe. This can all be done using the probe manager. To open the probe manager window, click on the Hardware toolbar then click on the probe setup icon.

48.1 Probe Manager

The probe manager can be accessed using from the hardware toolbar. It shows a list of the probes set up on the machine and which of these is the currently active probe.



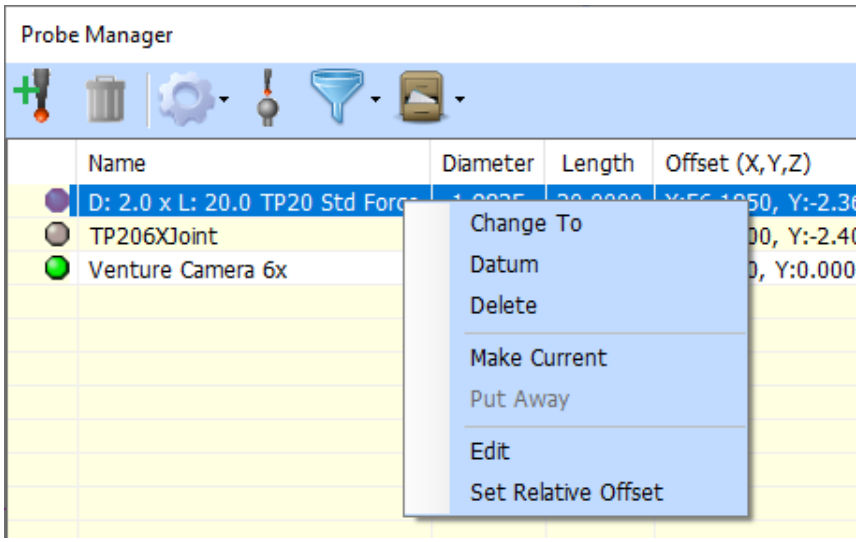
The image below shows an example of a probe manager with one touch probe and one camera probe set up. Each probe has a name, diameter, length and offset. If the probe has been datumed, this error will also be shown.



If there is a touch probe mount on the machine, the TP20XJoint must also be in the manager as this lets the software know the physical size and location of the joint even when a probe is not mounted.

48.2 Changing Probes

There are many ways to change which probe is active in the software and there are two more that can be done in the probe manager. To make a probe the current active probe, double click on its name, or alternatively right click and select Change To or Make Current. Make Current should be used if the probe is already mounted on the machine and Change To should be used if a probe is being added of it is replacing another probe. If a rack is available, change to will move the machine to the rack to pick up the desired probe.

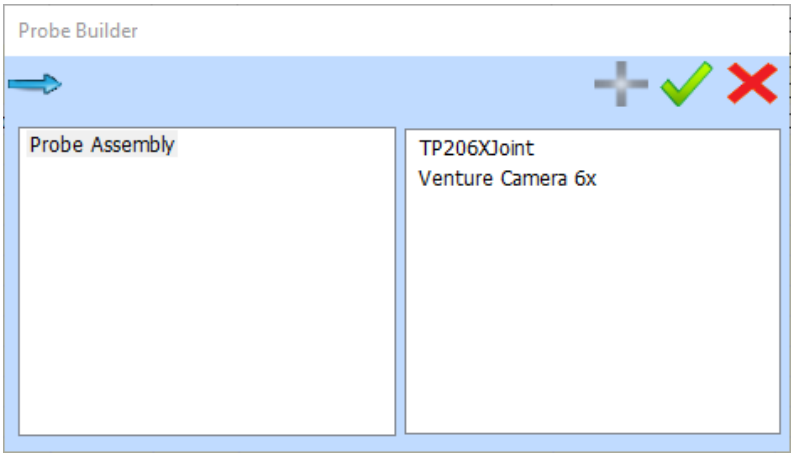


48.2.1 Building Probes

To do this click on the 'Build new probe button' this will open the probe builder window.

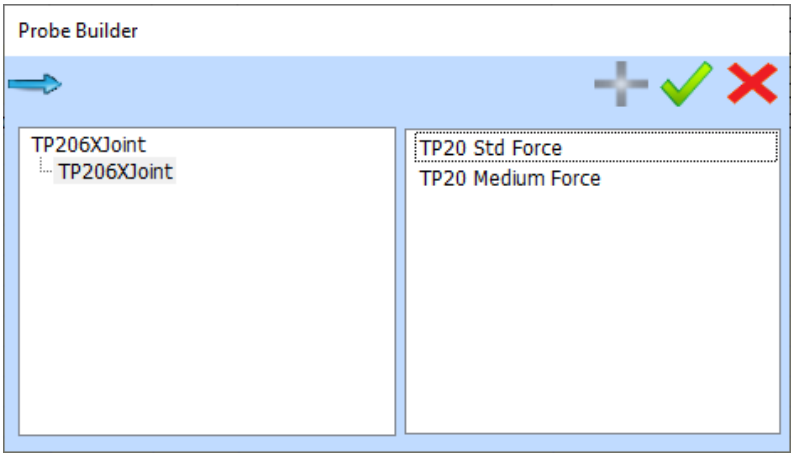
The Probe Builder window will now change to show all the available components which will fit the probe assembly. The probe head, modules and styli are predefined in the software and can be selected from a list as the probe is being built.

The image below shows the window with some of the components available. Select the joint suitable for the machine, in this example the TP20 joint.

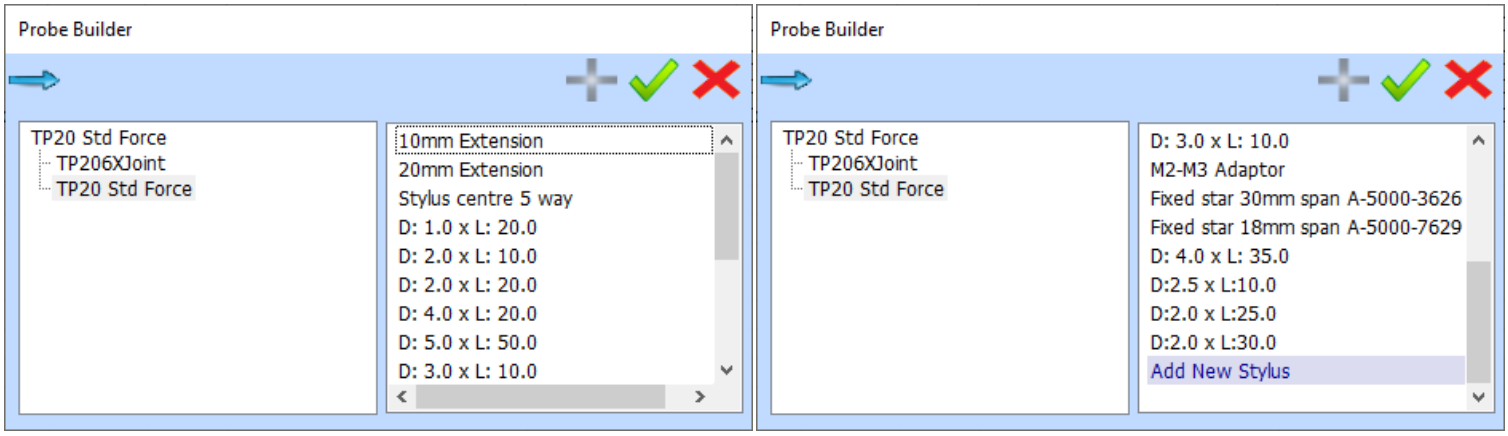


After selecting the appropriate joint, the window will change to display all available modules for this joint.

This module can then be selected and added to the probe assembly. To cancel this process at any point, press the red cross.



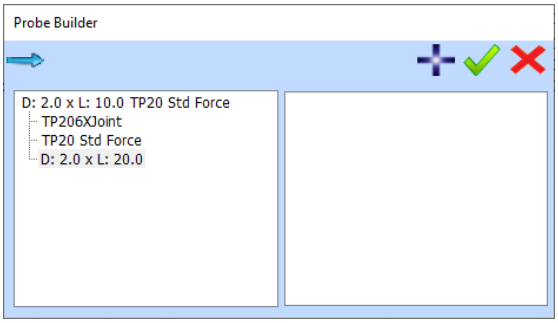
After selecting the module, the window will change to display all available styli and extensions. If there is a new stylus which is not in the list, it can be added by scrolling to the bottom of the



list and selecting 'Add new stylus' function or via the Probe components library.

To create a star probe, select the stylus 5-way centre and then add the probes in the appropriate direction. Repeat this process until all the probe angles required have been added.

After a complete probe has been made, the purple plus icon will change colour and become selectable. Clicking this will add the probe to the probe manager and keep the window open to create more probes. Pressing the green tick will add the probe to the manager and then close the window.



After the probes are created, they will be displayed in the probe manager window. All new probes will now require calibration. Calibrating probes will require a reference ball to be set up correctly, for information on how to do this see Chapter 43.15 – Reference Balls, page 152.

Click to select the probe in the list then click on the 'Probe calibrate button' or right click and choose datum. It is important to ensure that the stage is clear before selecting datum, as this will begin an automatic datum routine where the probe will be taken to the reference ball.

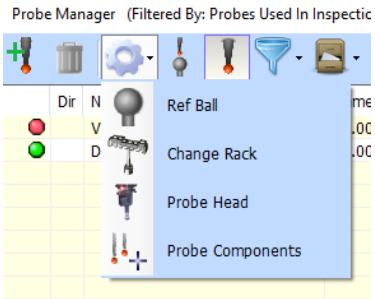
48.2.2 Deleting Probes

Any probes that are incorrectly added to the probe manager, or no longer needed can be removed by selecting them so that they are highlighted and pressing the delete icon.

If probes are deleted, or they have become lost or altered, open the Probe Status Window, and select Open, go to "C:\Program Files\Baty\Probe Settings". This is where all saved probe settings can be found. Once the probe settings are loaded, close the probe status window and re-open it to find the settings now opened. The factory settings will contain the probes the machine was shipped with, any new probes that needs to be added and calibrated.

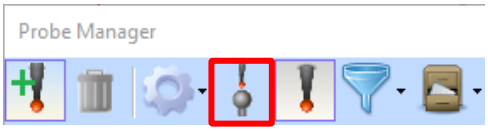
48.2.3 Setting Up Reference Balls and Probe Heads

This menu gives a short-cut to many of the settings related to probing. For more information on the Ref Ball settings, refer to Chapter 43.15 – Reference Balls, page 152. For information on Change Racks, refer to Chapter 43.16 – Change Racks, page 153. Probe head settings are not required in Fusion. The final icon is a shortcut to Probe Components, discussed in Chapter 43.14, page 152.



48.2.4 Datum Selected Probe

Probes can quickly be datumed by selecting them to highlight them and then pressing this icon.



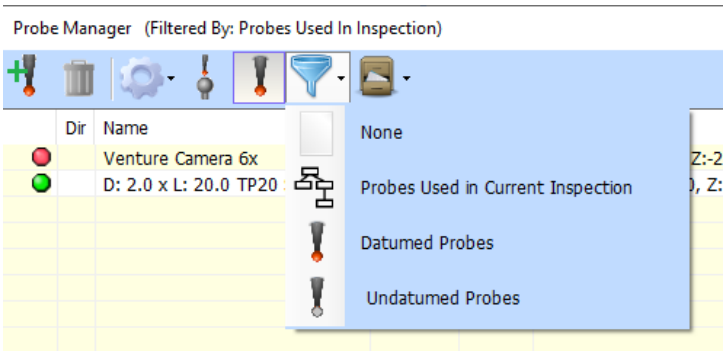
Probing the reference sphere will calibrate the probe's diameter and position offset. The probe must be calibrated every time a stylus is changed or removed and replaced.

48.3 Enable Probe

The probe enable/disable button will toggle between the probe being activated or de-activated. When a probe is disabled, it will no longer report any touch information to the machine, including unexpected contact, which may result in collisions and damage to the probe or parts on stage. This button should not be used as part of normal machine operation.

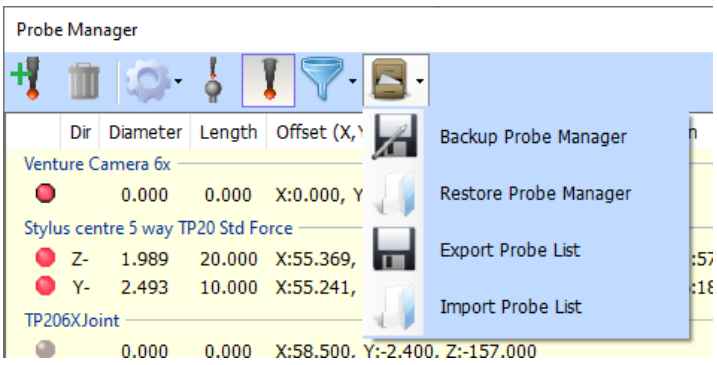
48.3.1 Filter

The filter button can be used to display just the calibrated probes or the un-calibrated probe or only the probes used in the program.



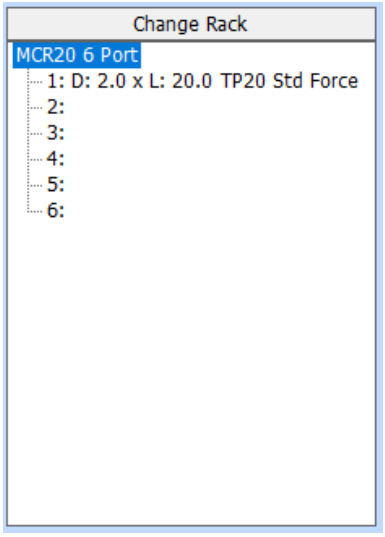
48.3.2 Saving & Loading Probe Lists

To save a probe or a probe list click on the 'backup probe manager' icon from the drop-down menu, select save or save probe list option this will open a standard file window give the file a name and save. To load a file, select the 'restore probe manager' option from the standard file window select the desired probe list and close the window. To export a probe list that has been made without saving over a current list, use the 'Export Probe List' button. To import a pre-made probe list, use the 'Import Probe List' button.



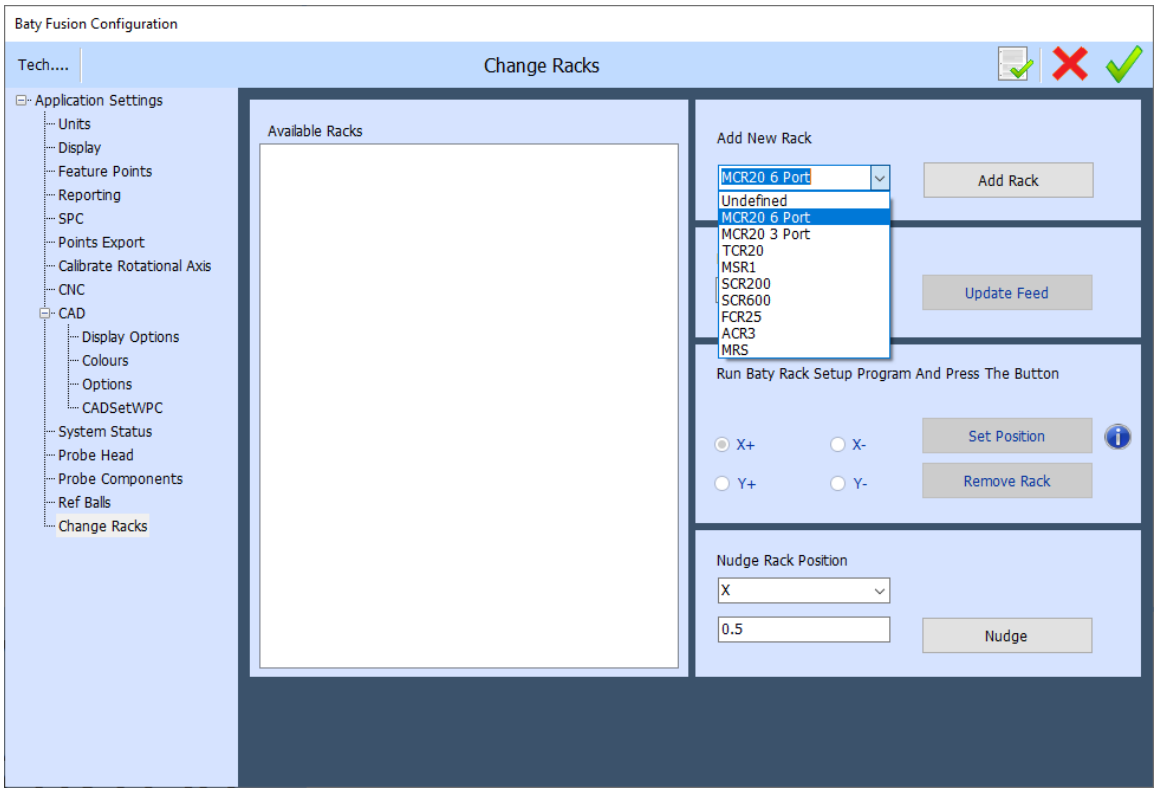
48.4 Rack Storage

Many machines will have a storage rack facility, for example the MCR20 for TP20 based modules. This enables the setup of different stylus configurations to be used within the same program. Baty Fusion does not assign probes to specific ports, instead the software will place a module to be changed into the nearest empty port and remember where it is stowed. Right click on the active probe and select put away, the machine will then put the probe module into the nearest empty port, this information is displayed on the right-hand side of the screen. Clicking on a different probe which is in the rack already and selecting 'change to' will drop off the current probe into nearest empty port and pick up the selected probe.

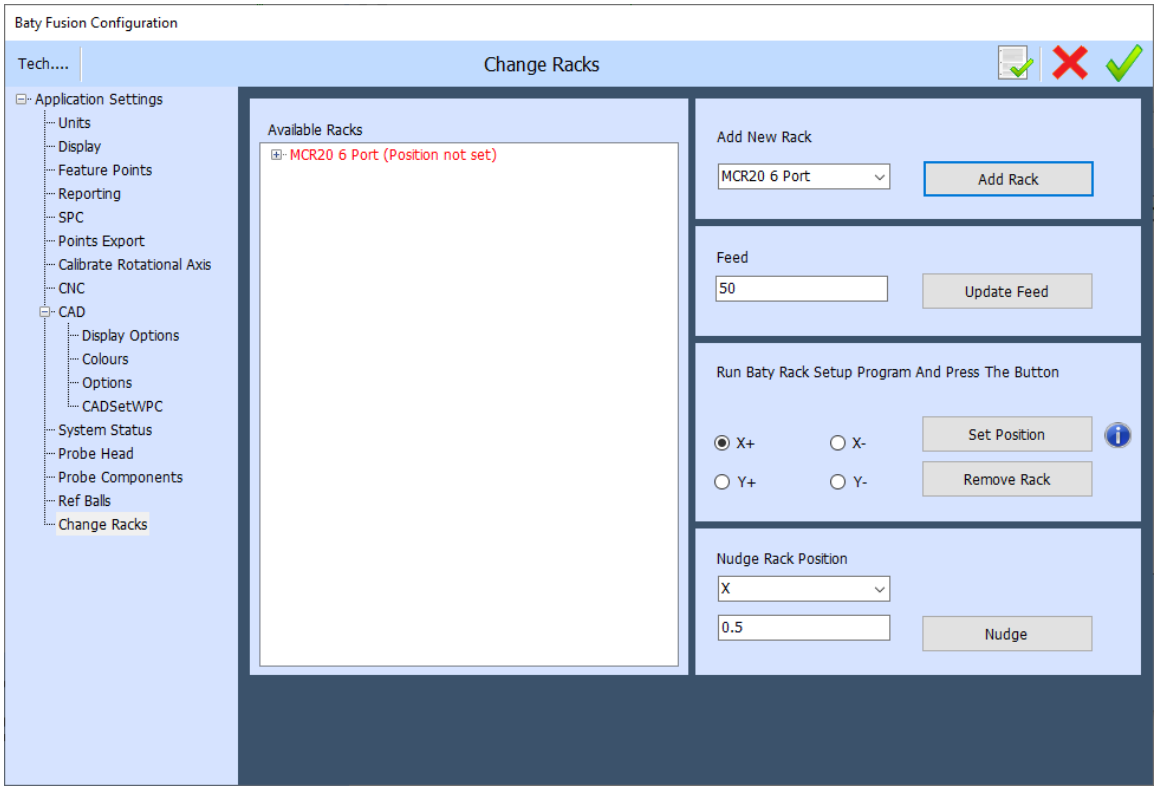


48.4.1 Adding a Rack

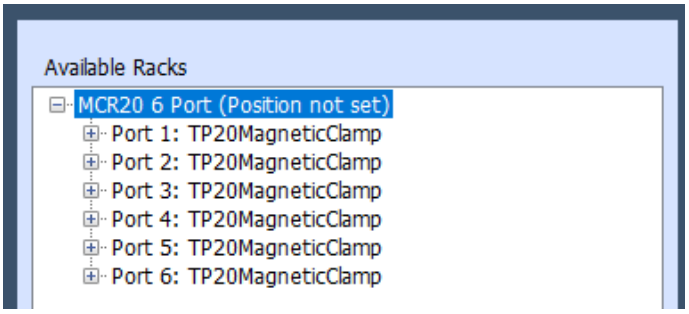
To add a change rack, a touch probe is required to be set as the active probe and this will need to be datumed. First, open the settings and find the Change Racks section. If there is no rack, the available racks section will be blank. To add a new rack, go to the Add New Rack section and select the type of rack from the dropdown list and then click Add Rack.



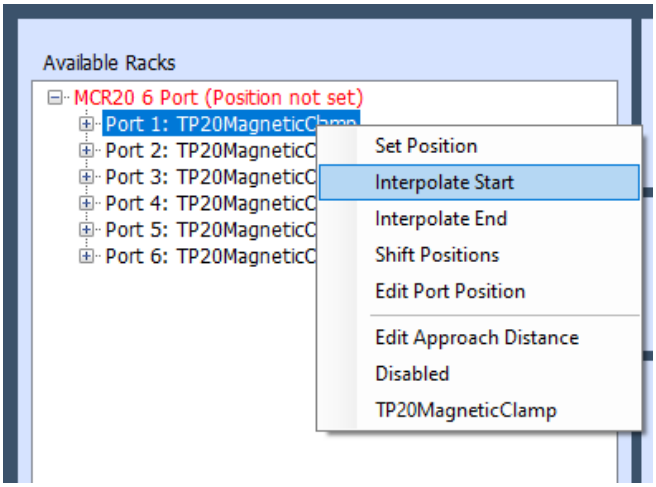
This selected rack will now appear in the Available Racks section, but it will be red and say that the position has not been set.



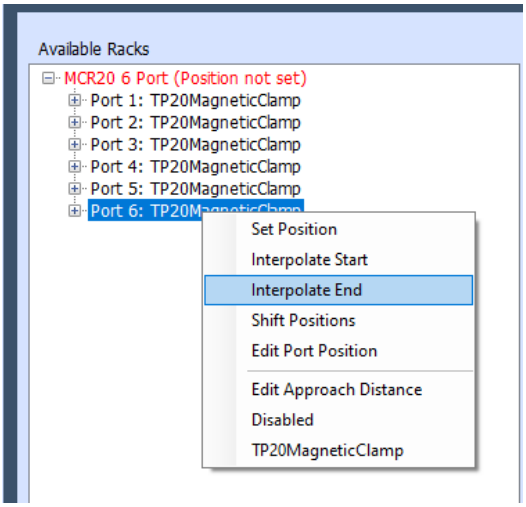
Click the plus icon on the left of the rack name and the names of the rack positions will appear.



To set the first position, drive the touch probe to the first port in the rack. The probe needs to be at the height and position it would be when the probe would be stored in the port. When the probe is in this position, in the first port in the rack, select Interpolate Start.



Next drive the probe to the last port in the rack, again at the correct height and location for storage, and then right click on Port 6 and select Interpolate End.



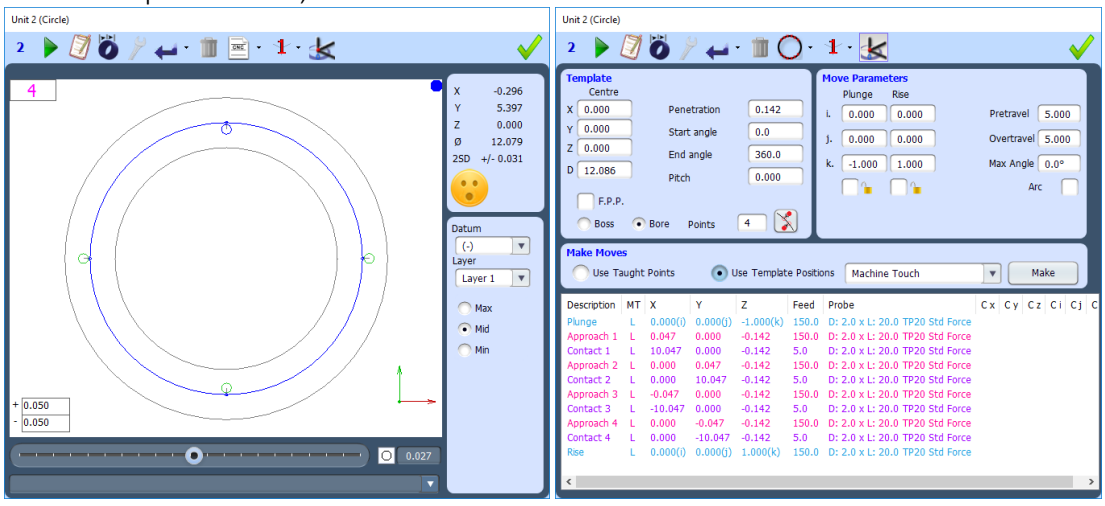
If this procedure has been followed correctly, the software will have calculated the position of the remaining positions in the probe rack. Select the Apply Changes or Accept Changes and Exit to save this rack. To test the rack, select put away on the current probe and check that the probe is successfully dropped off, then select change to this probe and see if it is also correctly collected from the rack.

49.0 MEASURING FEATURES WITH A PROBE

Both 2D and 3D features can be measured with the probes, 2D features such as lines and circles exist in only one plane and will snap to the nearest plane, XY, XZ, YZ or measured. 3D features such as Planes, Points, Spheres, Cylinders, Cones will exist in XYZ.

49.1 Circles

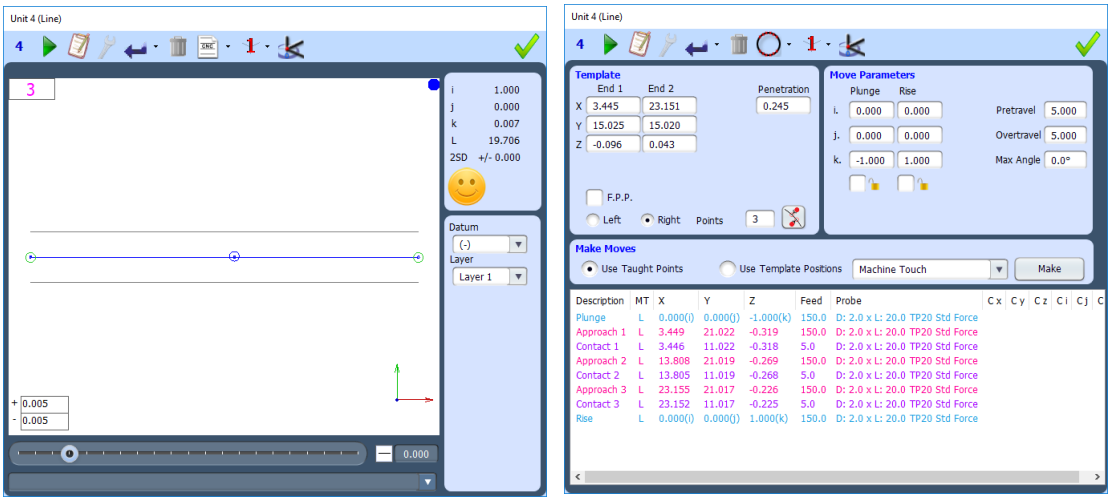
The image below shows a circle feature measured with a probe. A circle feature needs a minimum of 3 points to be created and 4 points to display form error. For this feature, an initial measurement was taken to determine the circle's position and then the points to measure were recalculated to create equally spaced points. To do this, click Use Template Positions, edit the number of points fields, then click on the Make button.



To measure a threaded hole, click on Use Template Positions and enter pitch into the Pitch field, then click on Make. To measure only a segment of the circle, click on Use Template Positions, edit the start, and end angle accordingly, and click on make, noting that the default start angle is 0 degrees at 3 'o'clock, increasing as it moves ACW.

49.2 Lines

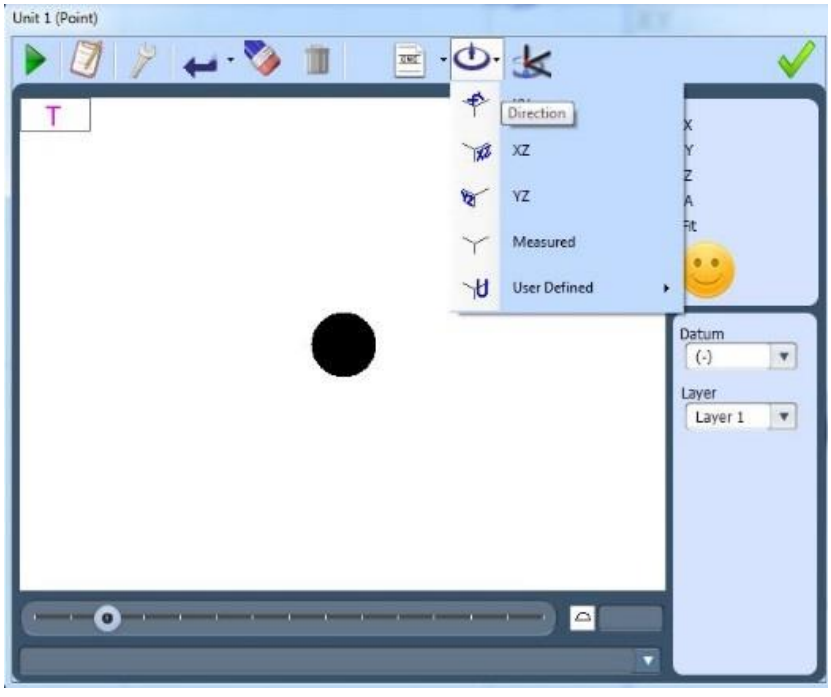
Probe line features need 2 points to be made and 3 to show form error.



To edit the depth, select Use Template Positions, edit the penetration, and select Make.

49.3 Points

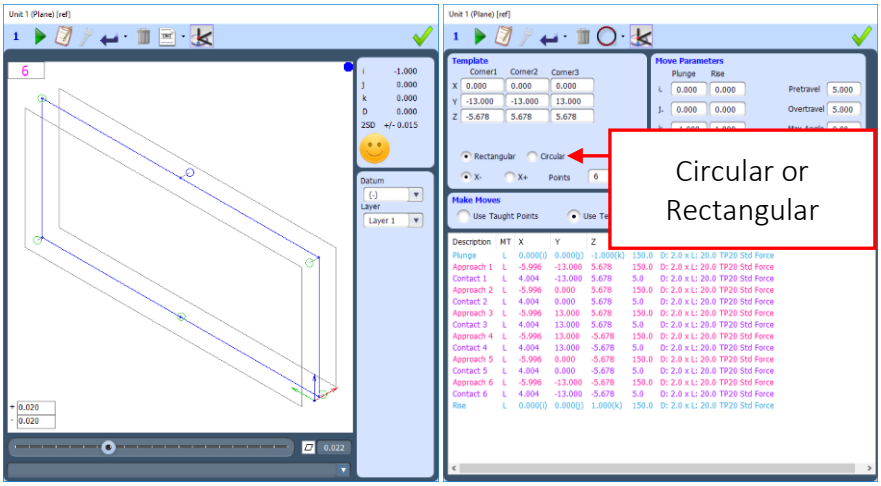
To measure points with a probe, the software needs a direction to compensate for the ball radius. This can be a machine plane, if the surface to be probed is expected to be 90 degrees relative to the alignment of the part, or by using a measured feature plane. It can also be specified as User Defined, by clicking the direction button and selecting the desired plane.



Points are only single point features and do not have form error.

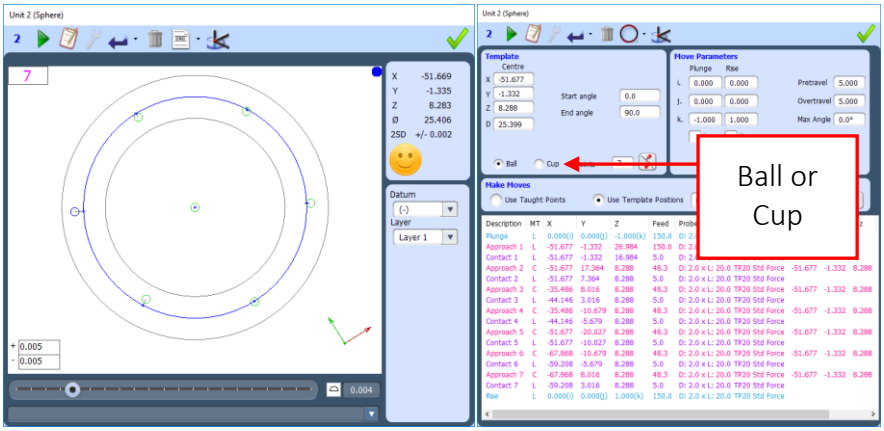
49.4 Planes

A plane feature needs a minimum of 3 points to be created and 4 points to show form error. By default, planes features are set to be a rectangular plane, to switch to a circular plane, select circular, then set to Use Template Positions and click on Make.

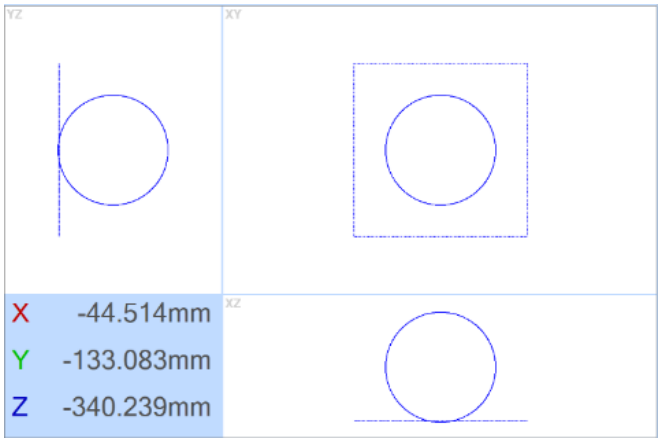


49.5 Spheres

Spheres require 4 minimum of points, but the feature can be re-measured with equally spaced points by selecting the number of points, selecting Use Template Positions, and clicking Make.

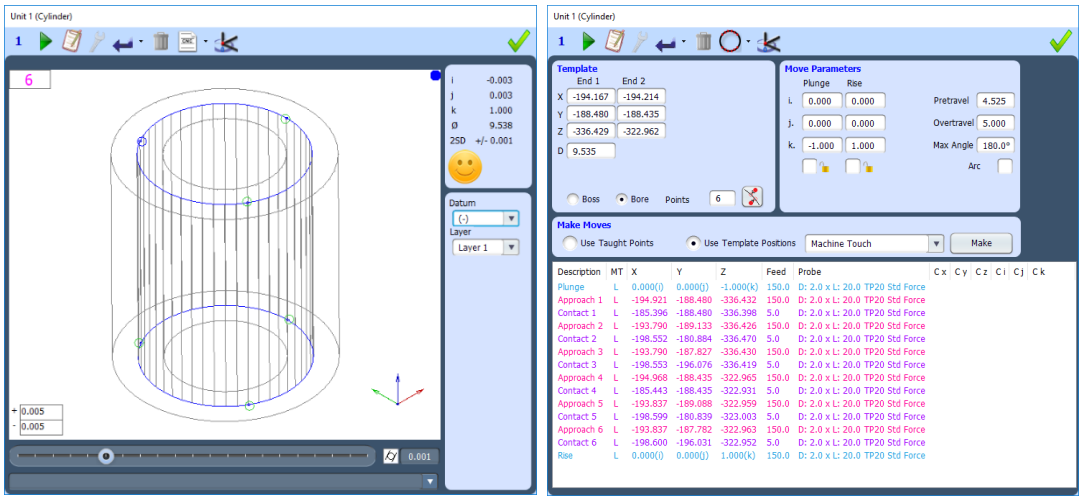


The CNC details window has a button the select whether the measured feature is a ball, with points taken on its outer surface, or a cup which is probed from the inside. The software will make an assessment to whether the sphere is a ball or a cup, but this should be checked as the correct option must be selected to ensure the part can be correctly measured on playback. A sphere will appear as a circle in all axes, as shown in the image below.



49.6 Cylinders

A minimum of five points needs to be taken for a cylinder, although it is recommended that a minimum of six are taken to ensure the shape can be constructed more accurately.



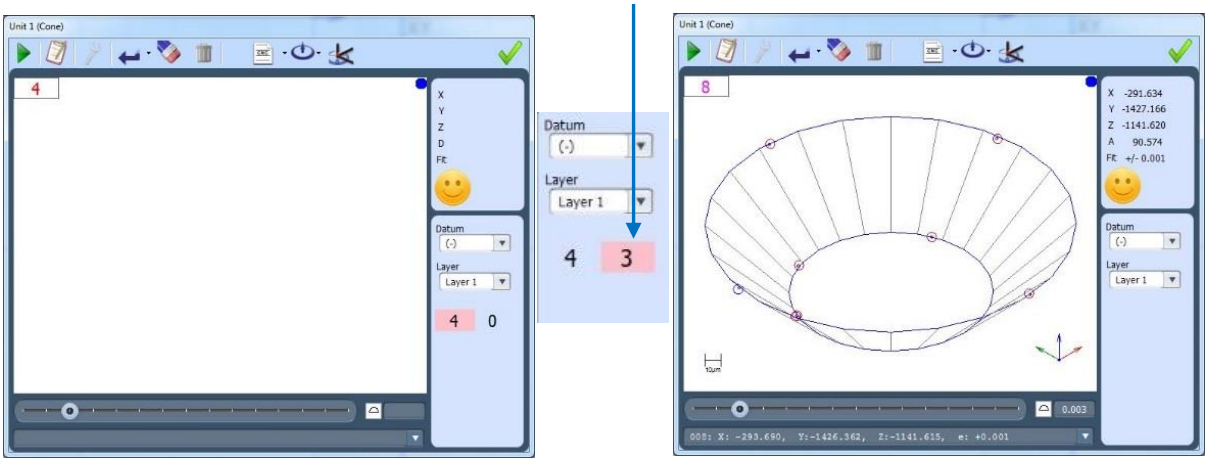
It is best to take a four-point circle at the top of the cylinder, and then another four-point circle at the base of the cylinder. For longer cylinders, where a length greater than its radius, the cylinder can be recalculated so that it is measured in 3 rings rather than the default 2. To do this, manually enter a number that is both greater than 17 and a multiple of 3, for example 18 or 21, and select recalculate. This number of points will then be evenly distributed between the top ring, bottom ring and a third ring halfway between these rings.

49.7 Cones

Cones can be measured in two ways, by defining the direction of the cone by measuring one end, followed by points at the other end. Or by defining the direction, either as a previously measured feature such as a plane or cylinder (a cone will be perpendicular to a plane, and parallel to a cylinder) or using a machine plane.

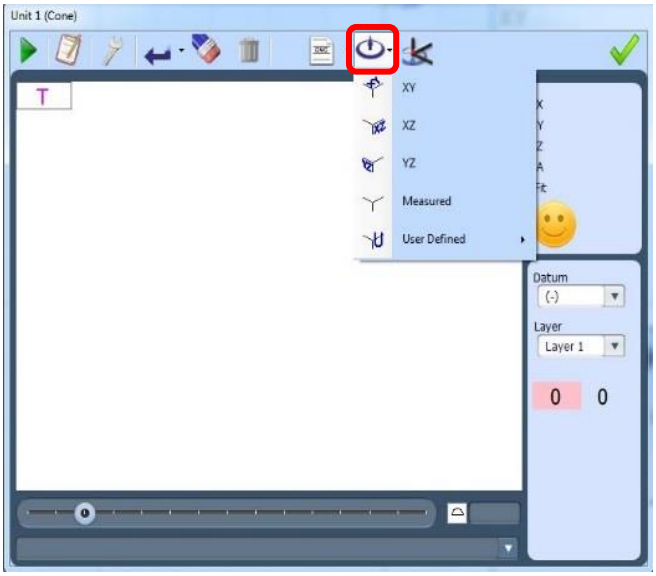
49.7.1 Method 1

Measure at least 4 points at one end, then click here, and take at least 4 more points.



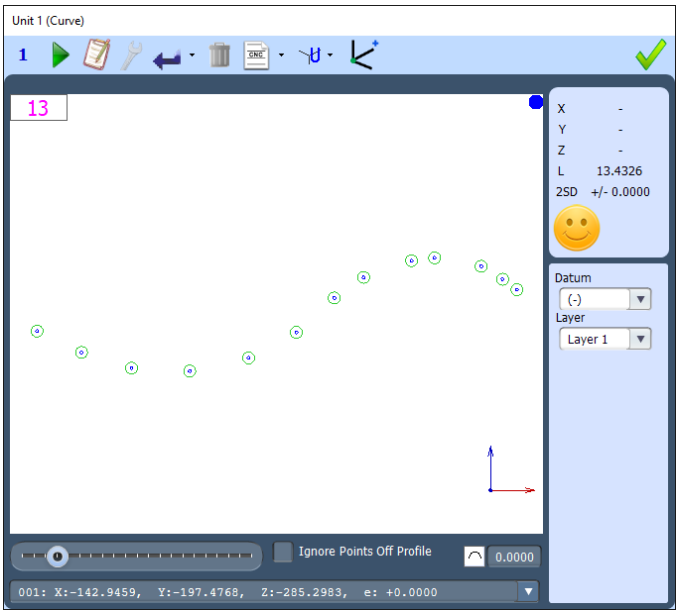
49.7.2 Method 2

Click Define Feature Axis, shown below, to show the axes available for the feature. A cone can be created from a measured surface if it is square to the feature, or from a cylinder if they share the same axis. In this method the order of the points does not matter.

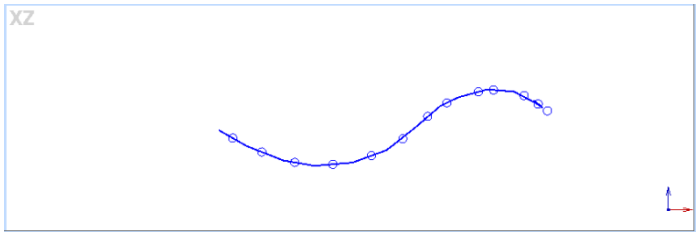


49.8 Curves

Curves can be used to measure non-geometric features and can be useful to construct other features or compare then to CAD files, if this module is active.



If these points are taken in sequence, they will be displayed as a polyline in the drawing view.



49.8.1 Machine Touch

A machine touch scan curve is made from individual points manually taken by the user; on playback these will be taken in the same way they were originally taken.

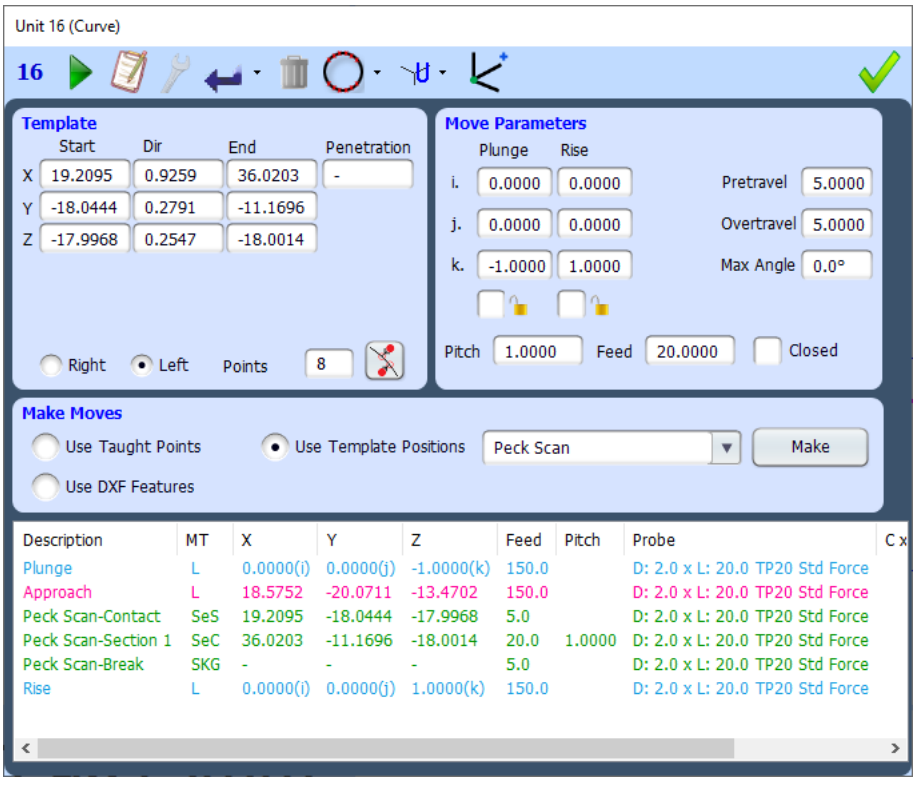
49.8.2 Peck Scan

Curves can also be measured using a Peck Scan, where the probe will take a point on the plane of the feature, retract, move by the given pitch, and take another point. This pecking is repeated and will follow the contours of the plane along the full length of the feature.

Peck scans can be used with either Taught Points or Template positions. If using Taught Points, the scan will use the points taken when creating the feature to make the scan. It will peck from the first point towards the second and when it reaches the second it will change direction and head towards the third. It will peck in lines between each of the points taken and then finish.

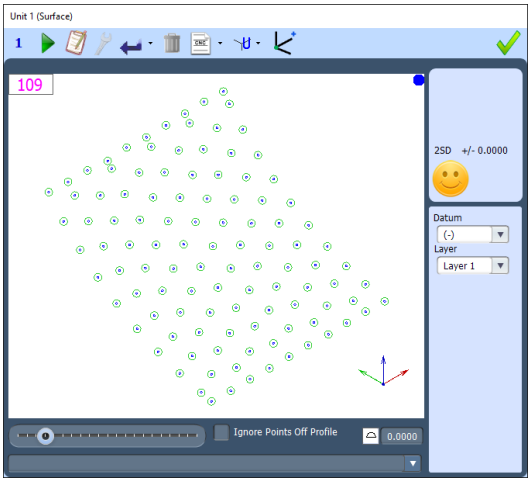
A scan made from Template Positions is an automatic searching measure that will follow the contours of the feature from a start point in a given direction to the end point. To create this feature, take a point at the start position and another a small distance away from this in the direction to scan, then take a final point at the desired end point. This end point must be reachable if the scan moves from the start point and only moves in the direction given. Select Template Positions and Make and then when the feature is played it will create its own route following the part.

The CNC moves for a Template peck scan will have an initial plunge, approach, and contact point, which will be the first point taken, and then a scan section and break. The scan section has a feed and pitch which will dictate how quickly it will peck and the distance between the points it will take. These can be adjusted in the Move parameters. For peck scans made from Taught Points, individual scan sections can be given customised pitches and feeds to suit this section, this is done by clicking on the line for the section and adjusting the Pitch and Feed in the menu that appears and then selecting Update and Close.



49.9 Surfaces

Surfaces are similar to curves but can map an area rather than a line. These can also be used to compare a part's surface to a CAD model, if CAD compare is installed.



49.9.1 Machine Touch

As with curves, surfaces can be measured using manually taken points and these will replay as they were taken.

49.9.2 Peck Scan

A peck scan for a surface can be set up similarly to that of a curve. The scan needs to be given a start point, direction and end point, although these three points should now form a triangle rather than a line. The scan will create a series of lines that create a rectangular area using the three points as corners. The scan will begin at the start point, move to the second point and then when it reaches this point, it will move perpendicularly to this line in the pitch given, and start to trace a new line parallel to the first until it is in line with the first point and then repeat this process until the end point is reached.

49.10 Editing Move Parameters

To edit the distance the probe will travel before contacting the surface, but maintain the probing co-ordinates, select the Approach before the Contact to edit and adjust the coordinates in X, Y or Z then click Update and Close.

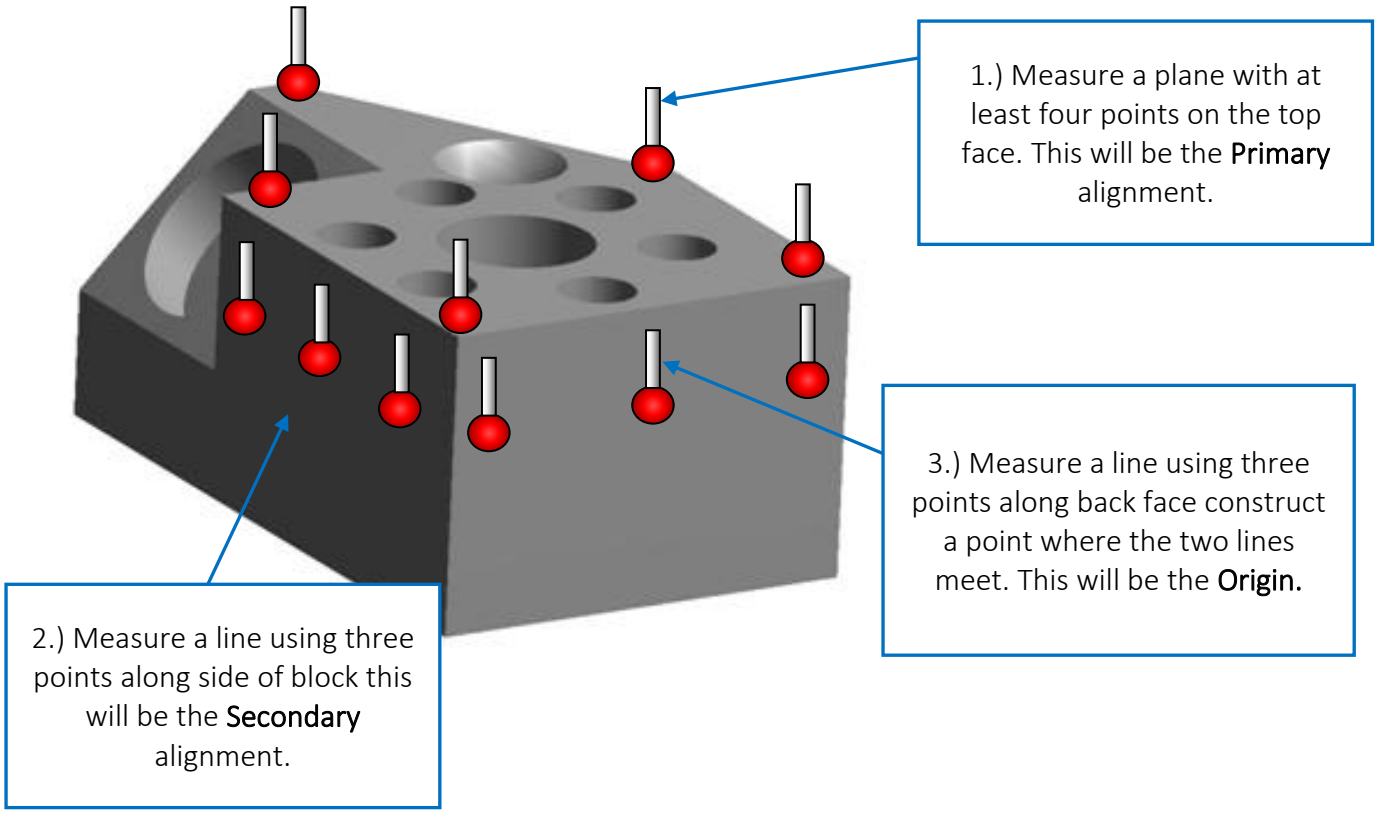
The pre-travel will adjust the distance away from the probe's expected contact point it will begin searching for the point. If the feature is in close proximity to another part where there is a risk that the Pretravel will contact this instead of the desired feature, or the part has significant variation across parts, this distance can be adjusted. The overtravel is the distance beyond the expected contact point that the probe will continue to search if no contact is made. In the example above, the probe will move a total of 10mm to search for the contact point before alerting the user that the part could not be found.

50.0 ALIGNING THE TEST PIECE

The golden rules for choosing reference features are as follows:

1. References must be selected that fully define all six degrees of freedom for a component. Usually this will be done using one plane, one line and one circle or point. If any of these features are not on the part, alternative methods including constructions can be used.
2. Measure the reference features as close to the start of the program as possible. When running a program automatically the exact position and orientation of a component will not be defined until all the reference features have been measured.
3. Choose reference features that are easy to measure e.g., large planes, edges, or holes, rather than important features that are defined as datums on the drawing. Remember, setting a feature as a datum is different to setting it as a reference – reference features are used to define the position and alignment of the component.

One method for creating references on the test block is demonstrated below:



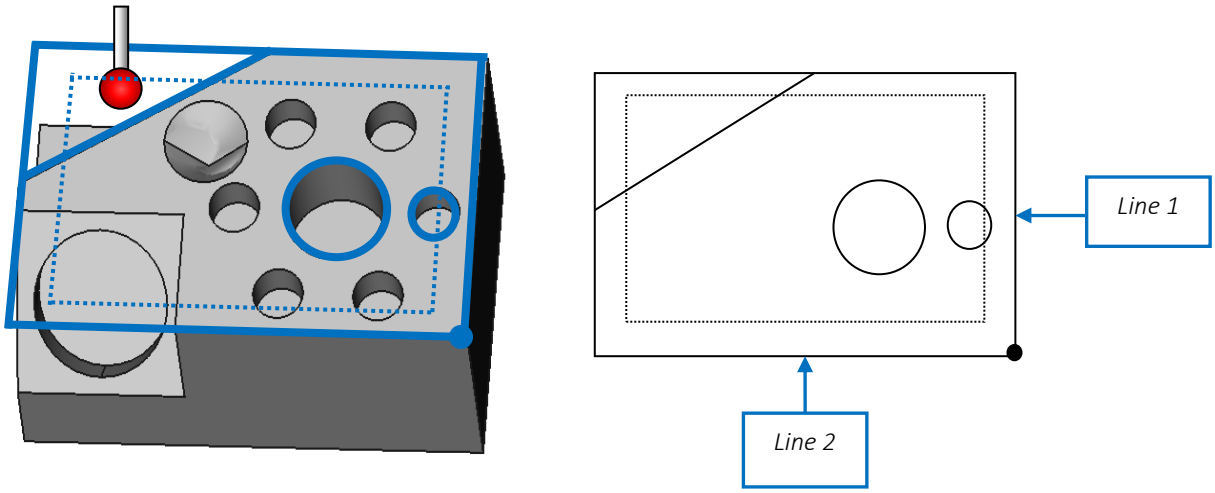
Measure a plane on the top of the block, by clicking on the Plane Measure icon in the Measure toolbar. When the measure plane window opens take four points on the top face. (Plane 1). Press the reference button to align this. This will align the Z axis 90° to the measured plane. This is our **Primary Alignment**, then click on the green tick to close the window.

Next measure a line along the side of the block by clicking on the line measure tool. Press the set ref button again to rotate the axes to align the Y axis to the side of the part. This is our ***Secondary Alignment,*** then click on the green tick to close the window. Measure a 2nd line along the back face click on the green tick to close the window. The last step is to construct a point where the two lines meet by selecting the point measure tool. When the measure point window opens click construct, left click on both of the lines and click on the green tick to close the construction window. Then press the set ref button.

This will create an **origin** (zero point) in the corner where the two lines intersect each other on the top face. Then click on the green tick to close the point window. With the part aligned, additional features can be measured.

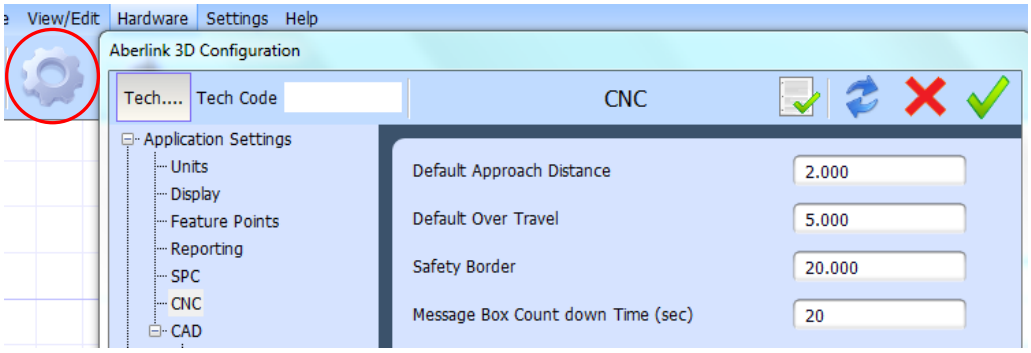
1. Measure two more lines opposite the first two in a similar fashion to the line used in the alignment. As this is done, the software will join the line up to make a rectangle.
2. Measure one more line along the angled face on the test piece.
3. Next, measure a circle to do this click on the circle measure button in the measure toolbar when the 'measure circle window' opens take four points in the large diameter bore in the centre of the test piece to close 'measure circle window' click on the green tick.
4. Repeat this for one the small bore nearest the datum end.

The XY window should appear similarly to the image on the right.



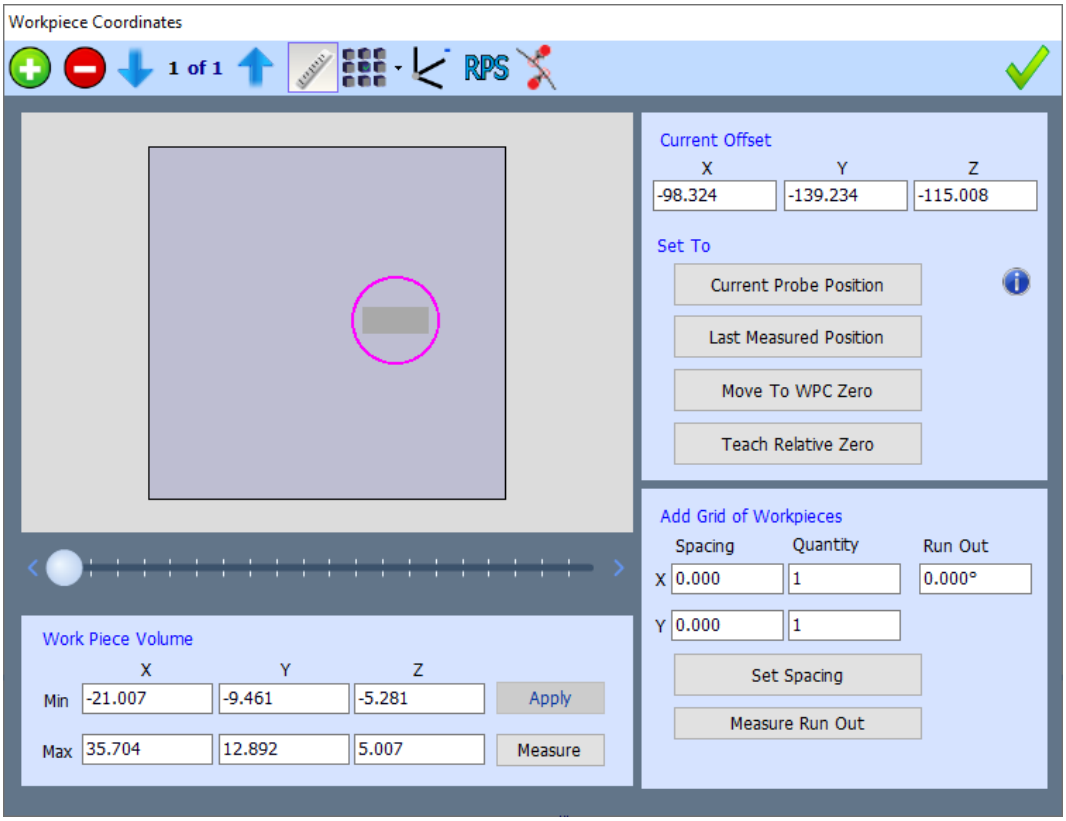
51.0 SETTING SAFE VOLUME

As the part is measured, the software will apply a cubic safe volume around the features that have been measured. The software also has safe volumes for the machine bridge, granite, ref ball, change racks, and components which make up the probe. The default safe volume is 20mm and can be set in settings as shown below.



The safe volume for a part program is shown in the work piece co-ordinate window. The safe volume normally works well, but if the volume created is larger than the machine but can still be physically measured, the volume can be edited.

When the program runs, the probe will automatically move to the edge of the safe volume between measuring features to avoid crashing into the component. Note that the safe volume can only be created around features that have been measured. If the component has protrusions that are not measured as part of the program the safe volume may need to be adjusted to account for them or add a move via point between features.



51.1 Plunge and Rise Moves from Safe Volume

Having calculated the Safe Volume as described the software calculates the Plunge and Rise values for all measurement units. The Plunge and Rise values are stored in the probe moves grid for each measurement unit. The Plunge move will be the very first line, and the Rise will be the very last. These are directions rather than co-ordinates; they show the vector that the probe will approach the workpiece from and the retract direction.

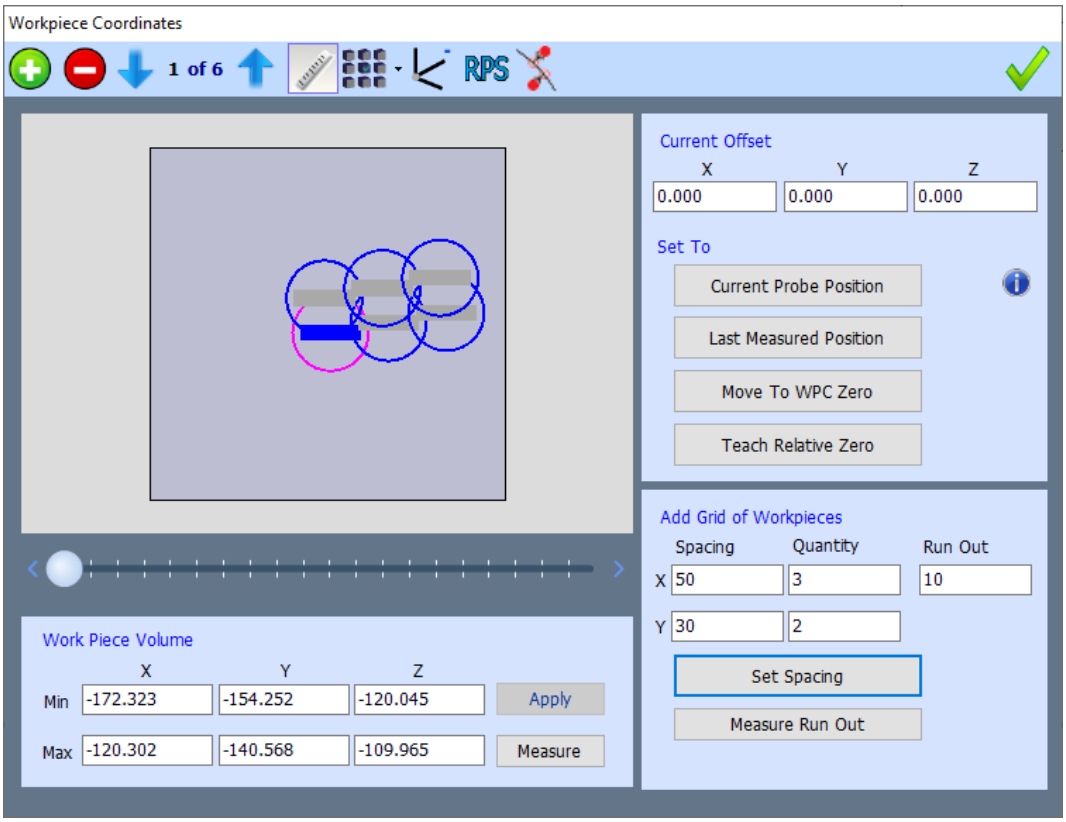
Description	MT	X	Y	Z	Feed	Probe
Plunge	L	0.000(i)	0.000(j)	-1.000(k)	150.0	D: 2.0 x L: 20.0 TP20 Std Force
Approach 1	L	3.449	21.022	-0.319	150.0	D: 2.0 x L: 20.0 TP20 Std Force
Contact 1	L	3.446	11.022	-0.318	5.0	D: 2.0 x L: 20.0 TP20 Std Force
Approach 2	L	13.808	21.019	-0.269	150.0	D: 2.0 x L: 20.0 TP20 Std Force
Contact 2	L	13.805	11.019	-0.268	5.0	D: 2.0 x L: 20.0 TP20 Std Force
Approach 3	L	23.155	21.017	-0.226	150.0	D: 2.0 x L: 20.0 TP20 Std Force
Contact 3	L	23.152	11.017	-0.225	5.0	D: 2.0 x L: 20.0 TP20 Std Force
Rise	L	0.000(i)	0.000(j)	1.000(k)	150.0	D: 2.0 x L: 20.0 TP20 Std Force

Having automatically calculated the Safe Volume and Approaches for the program, the third piece of information required to automatically run the program is the workpiece co-ordinate, sometimes called the work offset. The reference features that have been measured will have defined a X0, Y0, Z0 position on the component being measured. This will be identified by a small datum symbol on the Main Screen.

The workpiece co-ordinate defines where this position on the component is within the machine's measurement volume – i.e., where the component is on the table. If the component has not been moved since the program was created and the initial reference features measured, or it has been put back on the table in the same position, perhaps using a fixture to locate it, then these coordinates may be correct and not need to be re-measured.

51.2 Safe Volume in WPC

The workpiece safe volume will be automatically set by the software, these values are stored in the workpiece co-ordinate window shown below. The work piece safety volume can be changed by entering new values here, then apply.



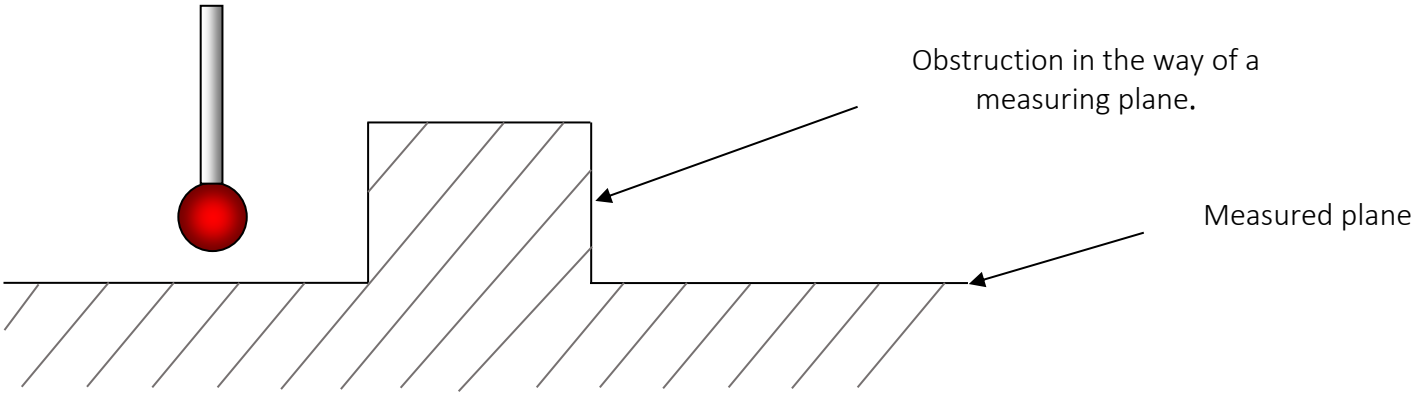
52.0 ADDING A MOVE VIA

When the Baty 3D software creates a measuring routine it will measure the points on a feature in the most efficient way. i.e., if three points are measured on a plane the machine will measure the plane as follows:

1. Rapid move to the edge of the safe volume above the first point. [plunge position]
2. Feed speed move to the pre-travel distance, usually 2mm, above point 1. [Approach 1]
3. Probe point 1 and move back up to the pre-travel distance above the plane. [Contact 1 represents the over travel distance past the point, not the expected point]
4. Move at feed speed at the pre-travel height until above point 2. [Approach 2]
5. Probe point 2 and move back up to the pre-travel distance above the plane.
6. Move at feed speed at the pre-travel height until above point 3. [Approach 3]
7. Probe point 3 and move back up to the pre-travel distance above the plane.
8. Move at feed speed to the edge of the safe volume above point 3. [Rise Position]

When measuring the points on the plane the probe never moves higher than the pre-travel distance above the plane.

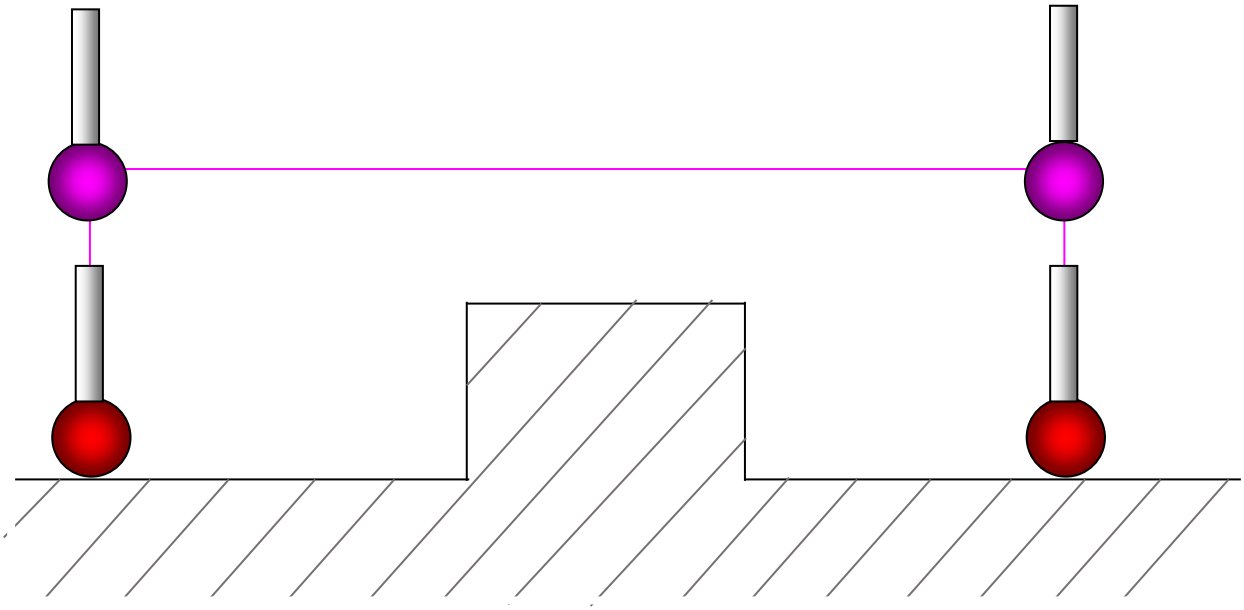
When there is an obstruction in the middle of the plane between the points, without intervention the probe would crash into this this obstruction. A 'Move Via' will need to be inserted into the measurement cycle for the plane to ensure this doesn't happen.



If points 1 and 2 are on the left-hand side of the obstruction and point 3 is on the right-hand side, the software would create a program where the probe would crash into the obstruction after the second point on the way to the third. A 'Move Via' must therefore be inserted between the contact of point two and the move to point three which will take the probe up and over the obstruction. There are three methods in which this can be done:

52.1 Method One

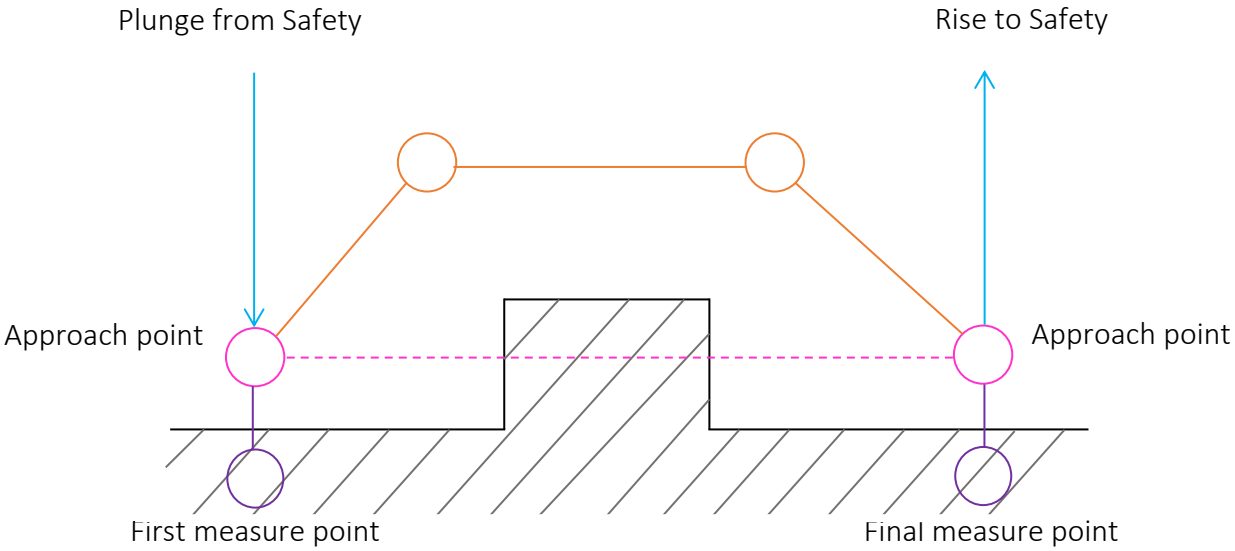
A Move Via can be added manually in between probe points whilst creating a feature.



Pressing the trigger or auxiliary button will add a 'Move Via' point at the current probe position.

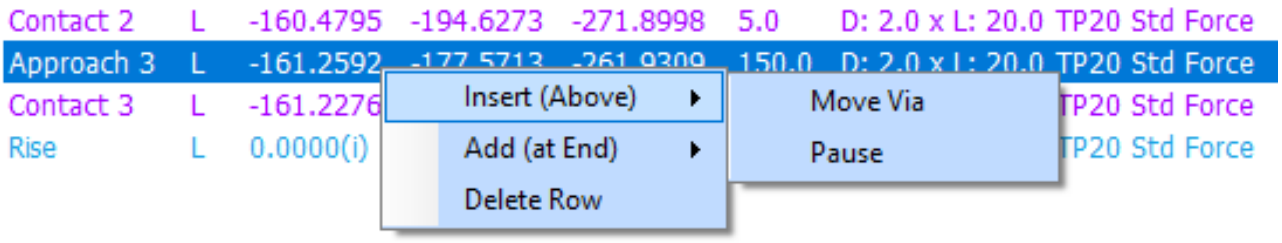
52.2 Method Two

If the show templates button is pressed, the path the probe takes, including the plunge, rise, pre-travel and measurement points can be seen graphically on the screen. These can be edited by left clicking on the connect lines between the measured points, this will add a 'Move Via', shown graphically as orange points. If the mouse button remains pressed, it is possible to move the 'Move Via' points around on the screen, clearing any obstruction. The diagram below shows an example of the probe path around an obstruction. The pink dotted line shows the original probe path which would have hit the obstruction, the orange path shows the new probe path that safely clears the obstruction.



52.3 Method Three

The XYZ information, speed and probe head position can be directly entered into the measurement grid. To enter a 'move via' between points 2 and 3, left click on the 'Approach 3' box to select that row of the grid. The row will turn dark blue. Right click on the 'Approach 3' box to bring up the following menu:

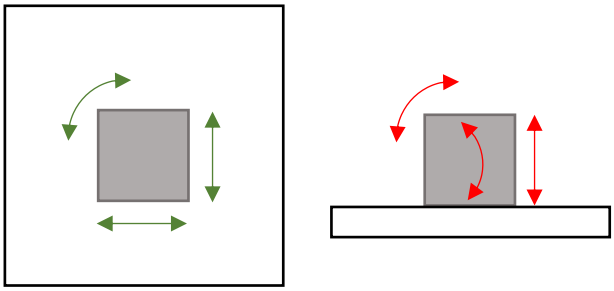


Insert (Above), Add (At end) and Delete Row, choose Insert (Above) ensure the probe tip is at the move via position. When the move via is added, it will just use the current co-ordinate of the tip. Click on Close to save and exit, the program will now move as follows: It will take points 1 and 2 staying at the pre-travel height above the plane. It will then move to the inserted position above the obstruction before moving down to the pre-travel distance above point 3, and then take point 3 before going up to the edge of the safe volume.

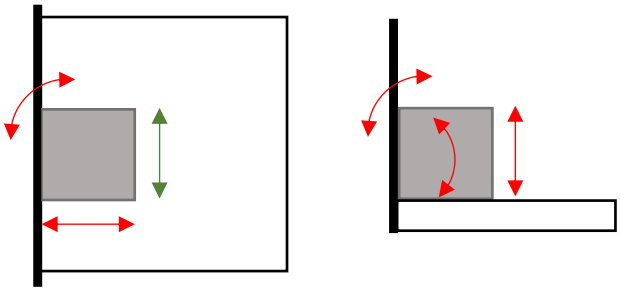
53.0 ALIGNING COMPONENTS

53.1 Physical Part Alignment

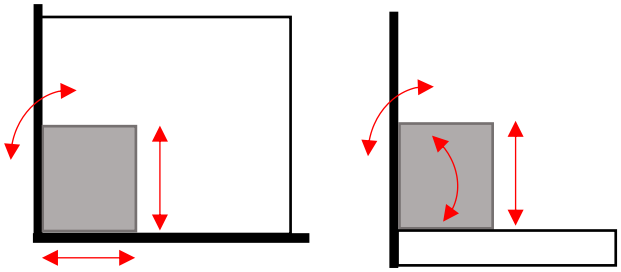
A part is properly aligned when it is constrained in all directions, this can be visualised by imagining how to constrain a square block. If the block is placed on the centre of a table, it can be pushed to move in any direction along the table's surface or rotated in place, shown in the diagram below using green arrows. As the block is sat on the table it cannot be moved down into the table and cannot be lifted, it also cannot be rotated in any direction that would separate the surface of the block from the surface of the table, as shown by the red arrows.



This is called a primary alignment. If the block were to be pushed to a wall alongside the table, this would stop rotation on the table's surface and prevent further movement towards or away from the wall. The block can now only slide across the table along the surface of the wall.



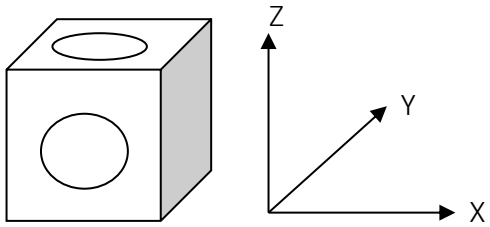
This is called a secondary alignment. If the part is now slid to meet a wall perpendicular to the first, the part is now fixed in all six degrees of freedom and is considered to be properly aligned.



53.2 Aligning Parts Using a Probe

When inspecting a component, it is necessary to virtually constrain the part using reference features. By measuring specific features on the component and setting them as references, the software will define the orientation of the axes and position of the component. It is important that when measuring 2 dimensional shapes, e.g., lines and circles, the software has a projection plane to place them. The alignment of the component must also be properly defined to produce meaningful horizontal and vertical dimensions on the screen.

An unconstrained three-dimensional object will have six degrees of freedom as each axis can be translated or rotated. Take for example a cube with a hole in the top and front faces:

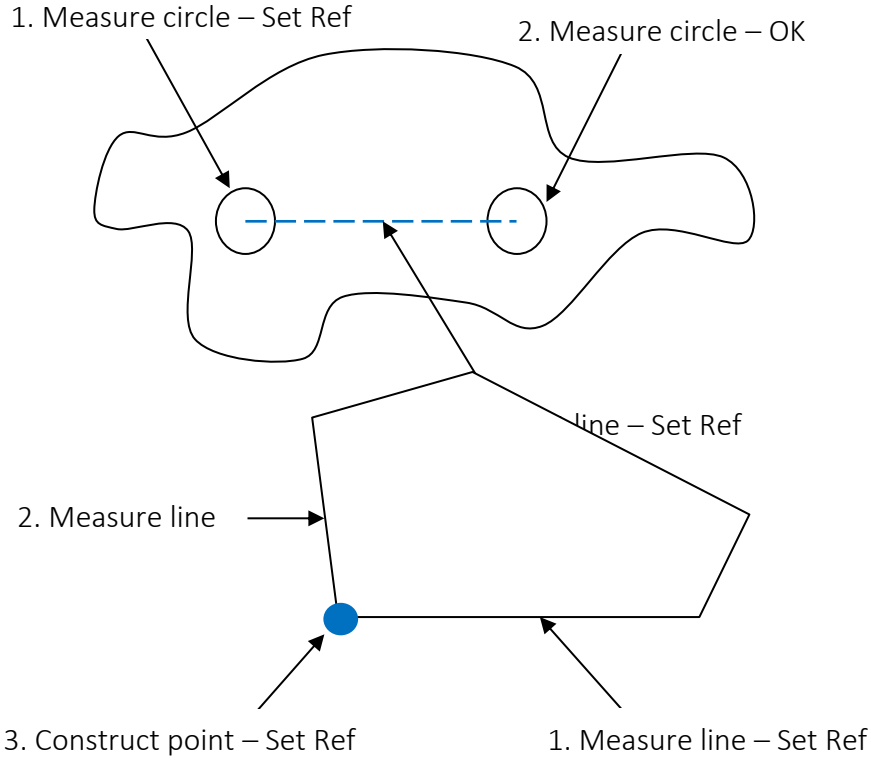


Measure a plane on the top face of the cube and set it as a reference. This defines the XY plane for the cube and sets a Z zero position. This defines three of the degrees of freedom, which are rotations about X and Y, and translation in Z.

Next measure a line along the front edge of the cube and set it as a reference. This now defines the XZ plane for the cube and a Y zero position. This line defines a further two of the degrees of freedom, which are rotation about the Z axis and translation in Y. This line can now be used to define the plane if the hole in the front face is now measured as a circle.

Measure the hole in the top face of the cube as a circle, the software will determine that this hole is in the XY plane from the direction of motion of the probe. Setting this circle as a reference will set the centre of the circle to X=0, Y=0 and define the last outstanding degree of freedom, translation in X. The position and alignment of the block will now be fully defined.

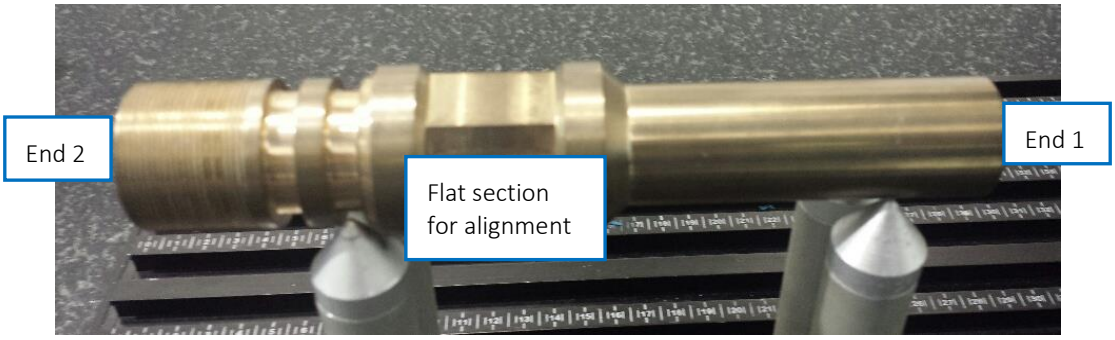
Note that a plane, a line, and a circle are the most common features used to fully define a component. Only one reference of each type can be set however, and it is recommended that when creating a program when a feature is set as a reference it is not changed halfway through. If the component being measured does not include these features other common features can be used as references. The top image shows an instance where there is no straight edge for alignment so one is constructed using the features that are available. The bottom image shows a feature with no suitable hole, so a point is constructed from the lines measured.



It is worth noting that reference cylinders and cones will define four degrees of freedom. For example, with a cylinder that has been referenced to define the X axis of the component, the axis of the cylinder defines both the rotations about, and the translations along, the Y and Z axes. This can be a useful technique for defining the orientation and position for turned components. As cylinders are viewed as line features, and it is only possible to define one line feature as a reference, it is not possible to reference a cylinder and then another line which defines a flat or keyway. In this instance its necessary to construct a plane through the cylinder, this will create a plane perpendicular to the centreline of the cylinder, hence maintaining the alignment and keeping the line element available for setting rotation.

54.0 ALIGNMENT EXAMPLES

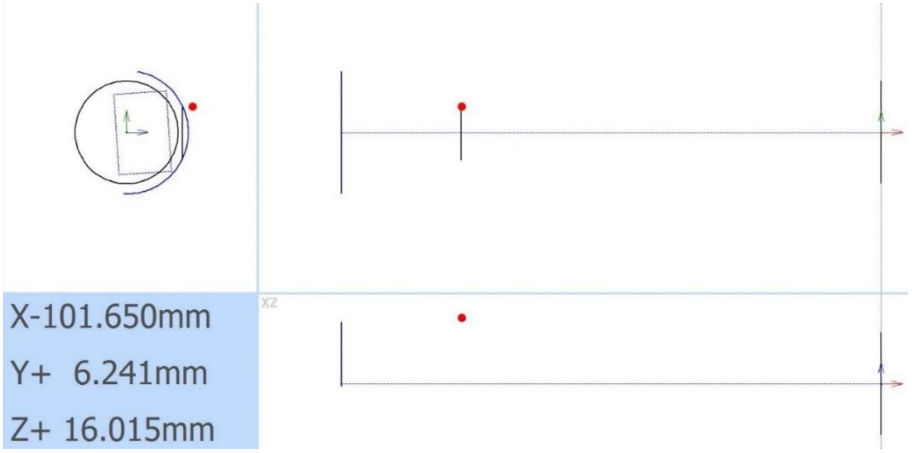
The simplest alignment is a plane for the Primary Alignment a line for the Secondary Alignment and point or circle as an Origin (Zero point). If measuring a shaft or cylinder, the centre line can be used as the Primary Alignment. To do this, measure a plane and a circle at end 1, ensuring the circle is projected into plane 1, set this circle as a reference.



Next, measure the circle at end 2 in the YZ plane and construct a line between the two circles. Open a plane tool, click the construct spanner then select the centre line and the reference circle, make this feature a reference. This will produce an aligned plane running through the referenced circle. Right click on the line and notice the I, J, K. I=1.000, j=0 and K=0, this means the feature is aligned. Right click on the reference circle, and notice X, Y and Z is 0.000

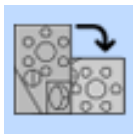
This part contains a flat section which can be used to align the part. This can be measured as a line projected into YZ view or measured as a plane with a constructed a line where this plane means the first plane. Either of these lines can be used as a third and final reference.

The part will now be aligned, this can be confirmed by right clicking on the centre line, which should show i=1.000 j=0.000 k=0.000, the reference circle will be x0.000, y0.000 z0.000 and the vector of the flat measured as a line will be i=0.000 j=1.000 z=0.000.

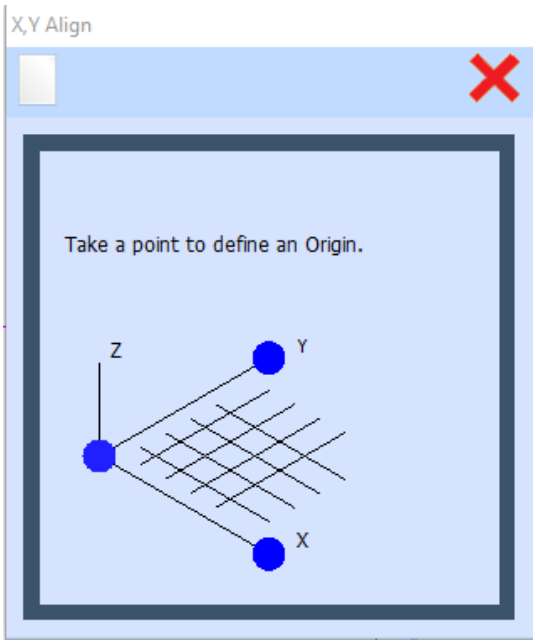


55.0 RPS ALIGNMENT (REFERENCE POINT SYSTEM) METHOD ONE

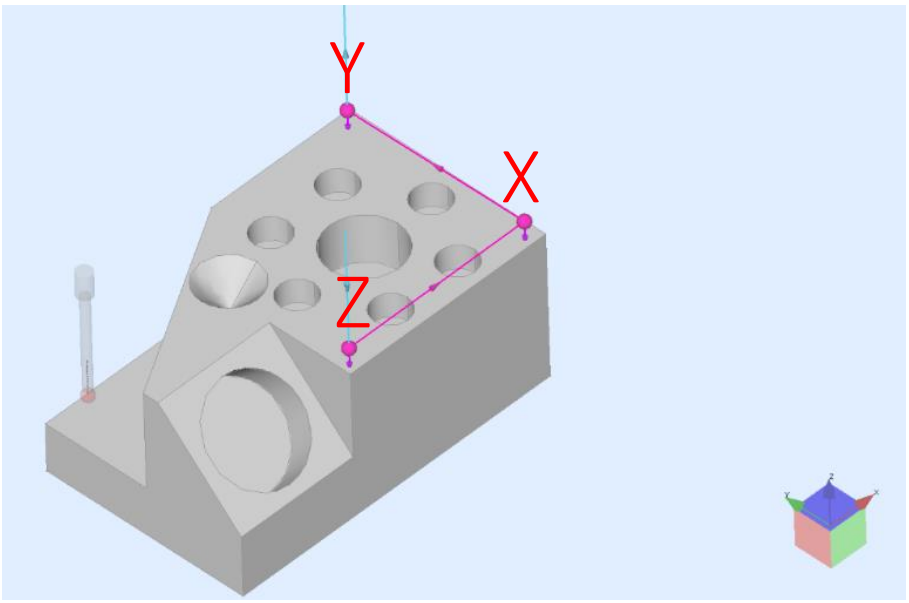
Aligning the part using RPS alignment is a simple yet effective tool that allows the component to be aligned with the measurement window. To find RPS Alignment, go to the Hardware window and find the XY Align icon.



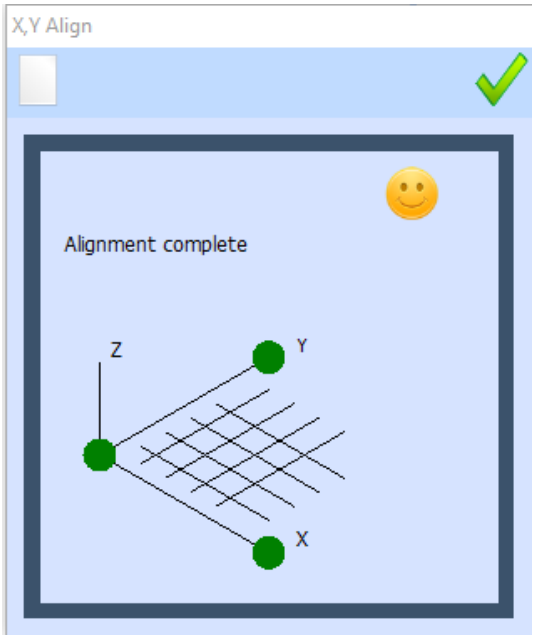
After clicking on this, the following window should appear.



To start with, the origin needs to be defined, this will be the first point taken on the physical component. The second point must be taken along the new X axis in a positive direction. The third and last point is taken in the XY plane in a positive Y direction. Shown in the figure below, A CAD model is used to represent where these points should be taken.



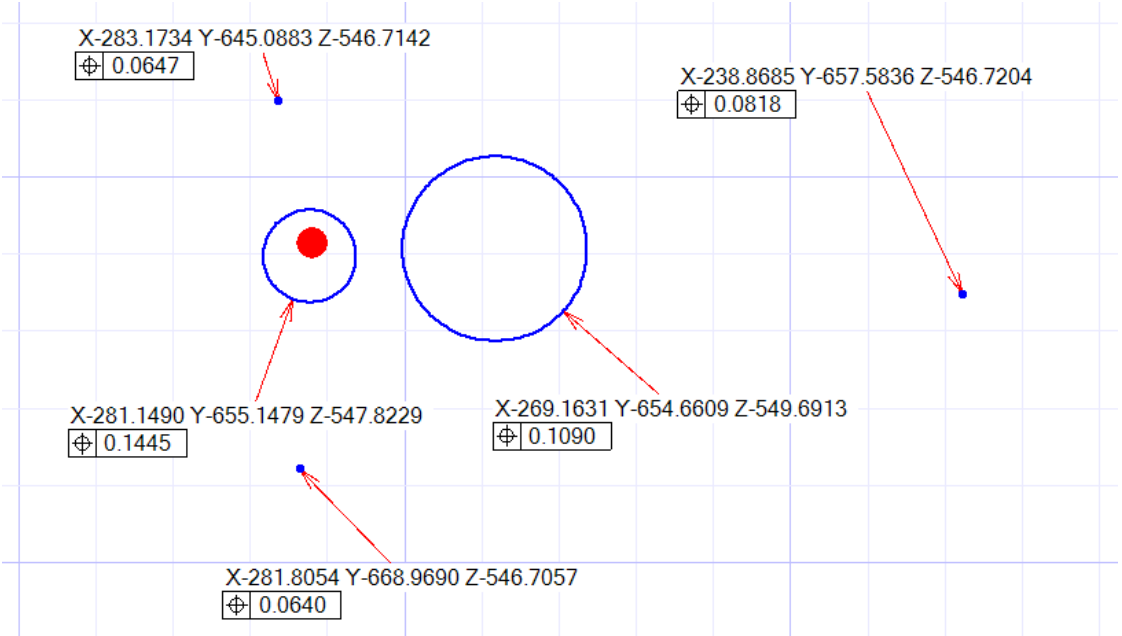
After setting the points the following window should appear and the program will be aligned to the component.



56.0 RPS ALIGNMENT (REFERENCE POINT SYSTEM) METHOD TWO

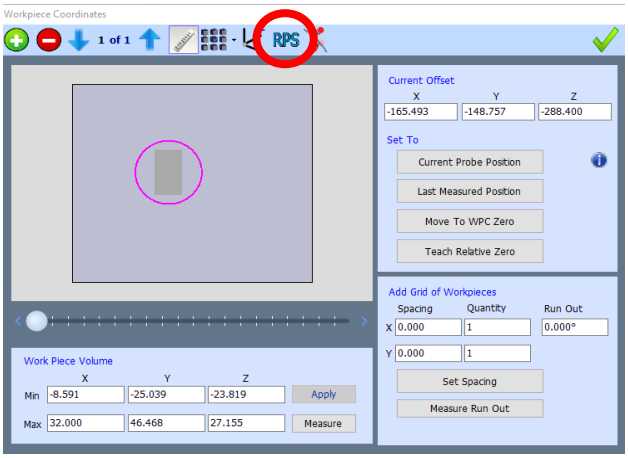
The Reference Point System can be used in cases where a traditional reference system cannot be used. RPS uses a minimum of 6 points to constrain a component and works in the same way as setting references using the 'Set Ref' feature. If more than 6 points are used and the part is over-constrained, then a best fit will be done. It is advisable to set references prior to running RPS, to aid the alignment process, as it is possible to have more than one alignment. The alignment features are measured points or circle centres. If taking a point on a surface, it will be necessary to define a direction for the point (measured, user defined or machine planes).

Below is an inspection, using 3 points in the XY plane, and 2 circles, also in the XY plane. All the points have a been given a true position dimension as an indication of a successful alignment.

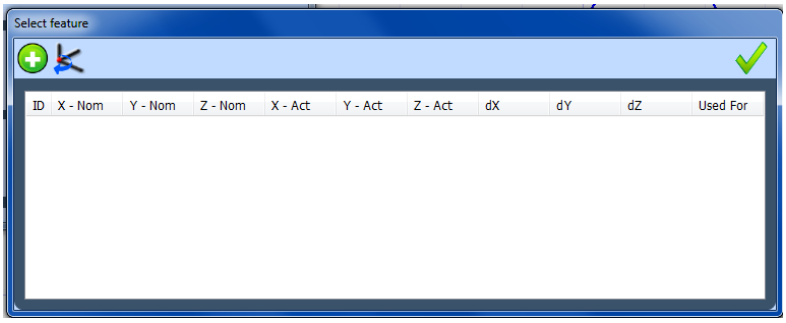


Click on the WPC icon in the Inspection menu, and the following menu will appear.

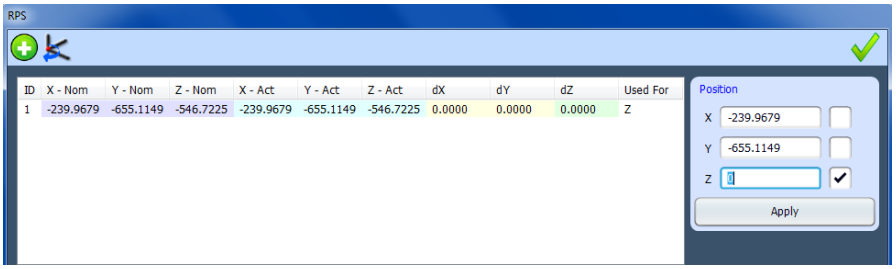
WPC



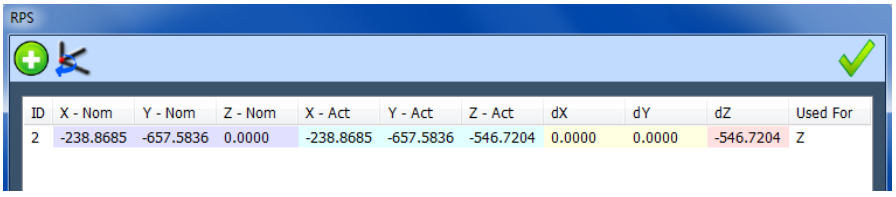
To begin alignment, click on the RPS button in the left corner and a new window will appear.



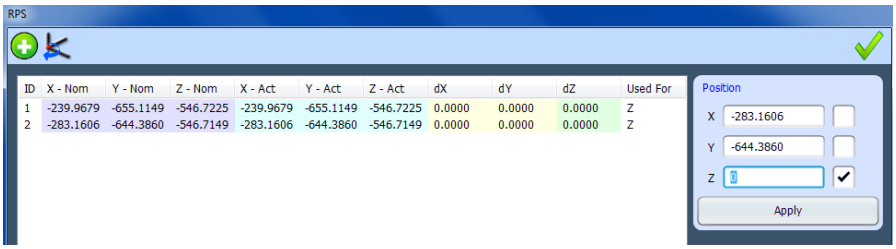
Features can be added using the green plus icon in the top of the window, click this and then on the first feature in the drawing view, here a point measured in the XY plane is selected first. Tick any axes this constrains, enter the co-ordinates, then click Apply.



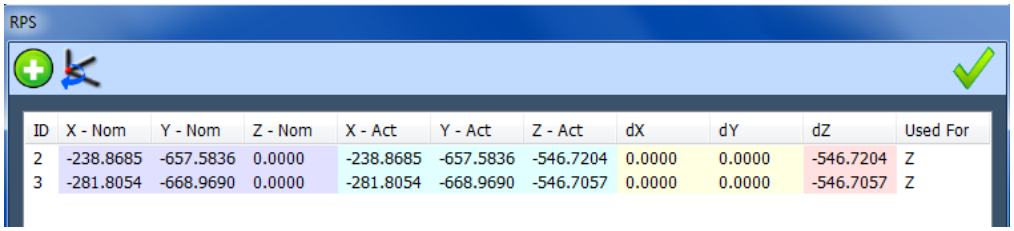
The image below shows the result after this is applied, the nominal entered above is shown for Z- Nom, the column on the far right-hand side also shows which axes the feature is used for.



Click on the green plus again and select the second feature. The point selected here was also in the Z direction, so this box is ticked, and the Z coordinate for this point is given.

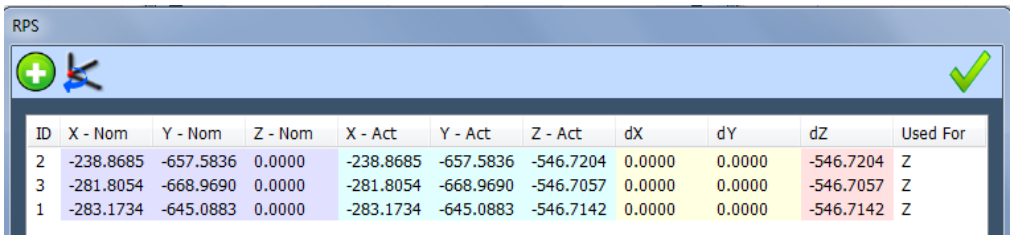


The image below shows the result after the Apply button is selected.



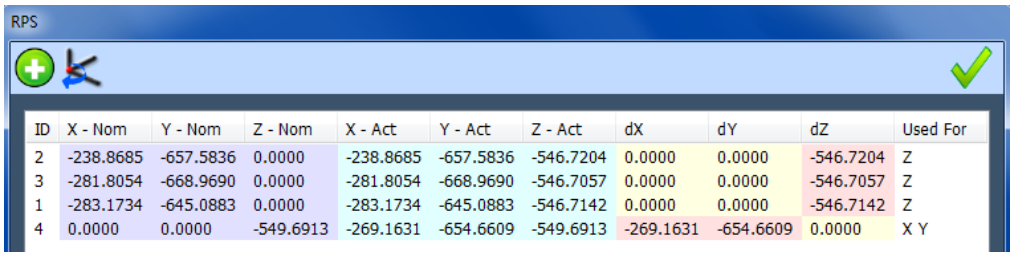
ID	X - Nom	Y - Nom	Z - Nom	X - Act	Y - Act	Z - Act	dX	dY	dZ	Used For
2	-238.8685	-657.5836	0.0000	-238.8685	-657.5836	-546.7204	0.0000	0.0000	-546.7204	Z
3	-281.8054	-668.9690	0.0000	-281.8054	-668.9690	-546.7057	0.0000	0.0000	-546.7057	Z

The window below shows the table after the third point defining Z is used.



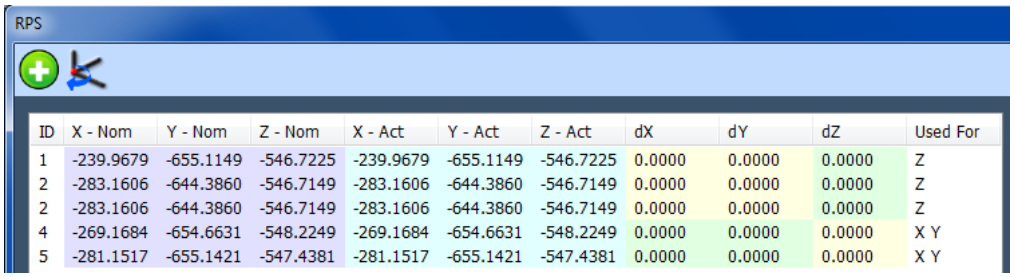
ID	X - Nom	Y - Nom	Z - Nom	X - Act	Y - Act	Z - Act	dX	dY	dZ	Used For
2	-238.8685	-657.5836	0.0000	-238.8685	-657.5836	-546.7204	0.0000	0.0000	-546.7204	Z
3	-281.8054	-668.9690	0.0000	-281.8054	-668.9690	-546.7057	0.0000	0.0000	-546.7057	Z
1	-283.1734	-645.0883	0.0000	-283.1734	-645.0883	-546.7142	0.0000	0.0000	-546.7142	Z

Click on Add again and click on the feature which defines an origin, in this case X and Y, tick X and Y and type in the co-ordinate. Then select Apply.



ID	X - Nom	Y - Nom	Z - Nom	X - Act	Y - Act	Z - Act	dX	dY	dZ	Used For
2	-238.8685	-657.5836	0.0000	-238.8685	-657.5836	-546.7204	0.0000	0.0000	-546.7204	Z
3	-281.8054	-668.9690	0.0000	-281.8054	-668.9690	-546.7057	0.0000	0.0000	-546.7057	Z
1	-283.1734	-645.0883	0.0000	-283.1734	-645.0883	-546.7142	0.0000	0.0000	-546.7142	Z
4	0.0000	0.0000	-549.6913	-269.1631	-654.6609	-549.6913	-269.1631	-654.6609	0.0000	X Y

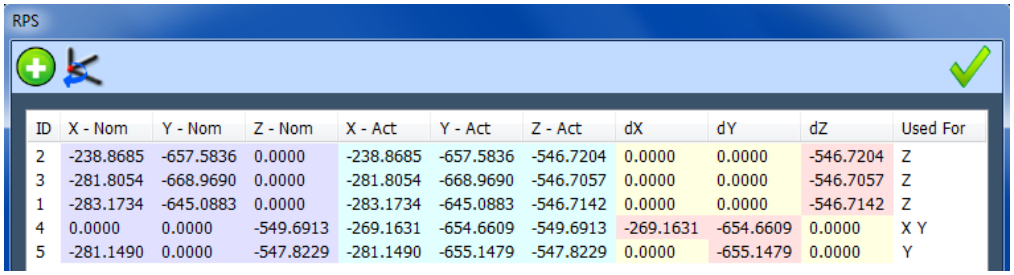
Click on Add again to select last feature, in this case it defines the rotation of the part. Choose the small circle which should be on the centre line selected Y and entered 0.000. Then Apply.



ID	X - Nom	Y - Nom	Z - Nom	X - Act	Y - Act	Z - Act	dX	dY	dZ	Used For
1	-239.9679	-655.1149	-546.7225	-239.9679	-655.1149	-546.7225	0.0000	0.0000	0.0000	Z
2	-283.1606	-644.3860	-546.7149	-283.1606	-644.3860	-546.7149	0.0000	0.0000	0.0000	Z
2	-283.1606	-644.3860	-546.7149	-283.1606	-644.3860	-546.7149	0.0000	0.0000	0.0000	Z
4	-269.1684	-654.6631	-548.2249	-269.1684	-654.6631	-548.2249	0.0000	0.0000	0.0000	X Y
5	-281.1517	-655.1421	-547.4381	-281.1517	-655.1421	-547.4381	0.0000	0.0000	0.0000	X Y

The system is now fully defined, click on the Align button in the top of RPS window.

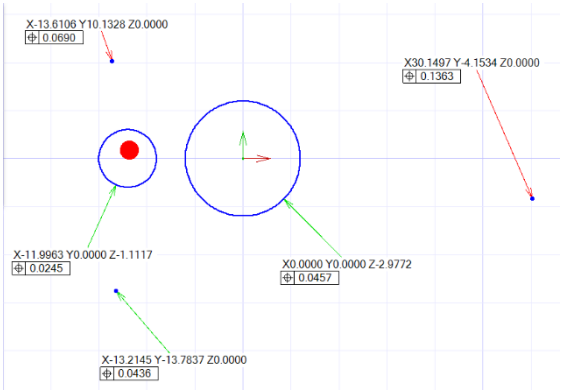
The window will then appear as it does below:



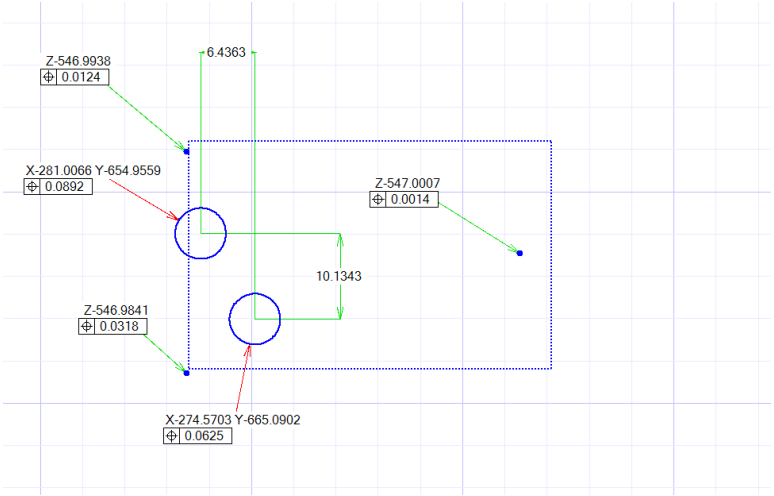
ID	X - Nom	Y - Nom	Z - Nom	X - Act	Y - Act	Z - Act	dX	dY	dZ	Used For
2	-238.8685	-657.5836	0.0000	-238.8685	-657.5836	-546.7204	0.0000	0.0000	-546.7204	Z
3	-281.8054	-668.9690	0.0000	-281.8054	-668.9690	-546.7057	0.0000	0.0000	-546.7057	Z
1	-283.1734	-645.0883	0.0000	-283.1734	-645.0883	-546.7142	0.0000	0.0000	-546.7142	Z
4	0.0000	0.0000	-549.6913	-269.1631	-654.6609	-549.6913	-269.1631	-654.6609	0.0000	X Y
5	-281.1490	0.0000	-547.8229	-281.1490	-655.1479	-547.8229	0.0000	-655.1479	0.0000	Y

If the rotation appears to be incorrect, this may mean there is more than one possible rotation. Click on the align button again to create an alternative alignment, this may take a few moments to complete.

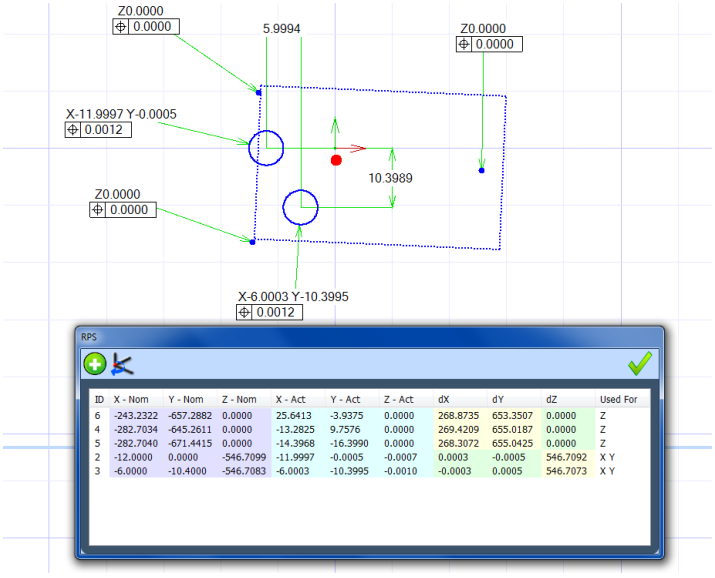
The image below shows the true position for the three points at Z0, the large circle is X0, Y0, and the small circle is X-11.996 (best fit), but Y is 0 indicating the rotation is correct.



The example below is using two circles for its alignment, using the X and Y of both, meaning it is over constrained and a best fit rotation will be applied. The distance between the circles shown should be 6.000 and 10.400. The image below shows the results when the align button was first clicked and the wrong rotation was given.



Where there is more than one alignment possible, this button can be clicked again to select another alignment. This was done with this example and the image below shows the result after the transformation where a rotation has been applied to optimise the dimensions between the circles.



SECTION 5 – ADDITIONAL TIPS AND RESOURCES

57.0 KEYBOARD SHORTCUTS

57.1 General

Keys	Action
Esc	Cancel
F5	Resize and Redraw screen
Ctrl + Z	Undo
Ctrl + Shift + Z	Redo
Shift + F5	Unset nominals
Ctrl + Alt + B	Show Safe Volumes
Ctrl + Alt + F12	Toggle simplified front end
Ctrl + Alt +T	Toggle "Display As Template"
Hols Shift	Magnifying Glass in Vision

57.2 Measure Tools

Keys	Action
Ctrl + T	Measure a Point
Ctrl + L	Measure a Line
Ctrl + C	Measure a Circle
Ctrl + Y	Measure a Cylinder
Ctrl + P	Measure a Plane
Ctrl + R	Measure a Curve
Ctrl + S	Measure a Sphere
Ctrl + N	Measure a Cone
Ctrl + U	Measure a Surface
Ctrl + K	Retake Point
Ctrl + F	Set Displayed Feature As Reference
Shift + Mouse move	Quick Measure

57.3 Changing Probes

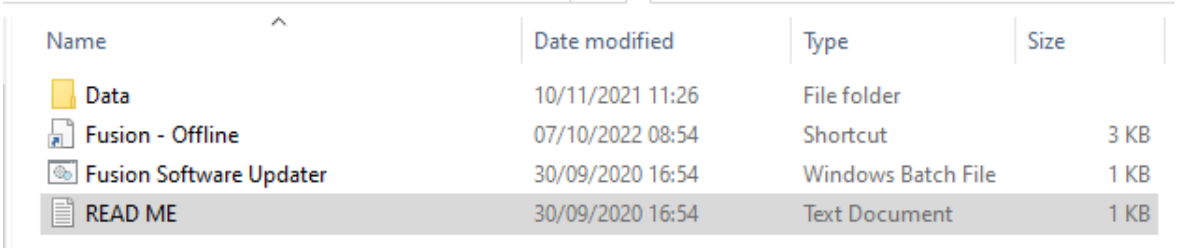
Keys	Action
Ctrl + V	Select Previous Probe
Ctrl + X	Select Next Probe

58.0 UPDATING FUSION SOFTWARE

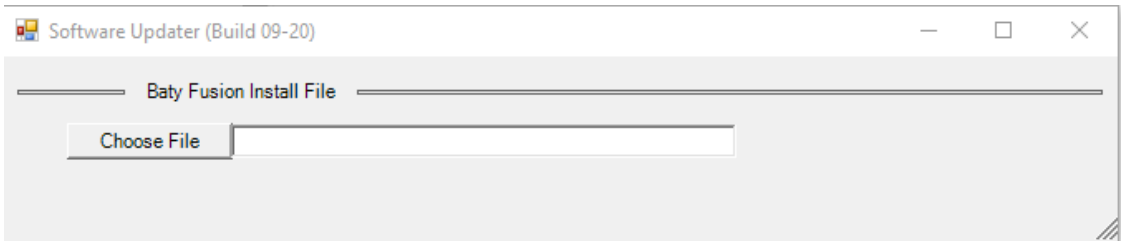
Fusion MK4 is constantly being improved and as such, updates for the software may be made available. The process for updating from one MK4 build to another is simple but should be followed precisely and a backup must be taken to ensure all data is saved. There are two methods of updating the Fusion software, the first method is recommended as it is a simpler and safer way of updating the software as an automatic backup is applied. However, if this method fails then the second method should be followed.

58.1 Method One

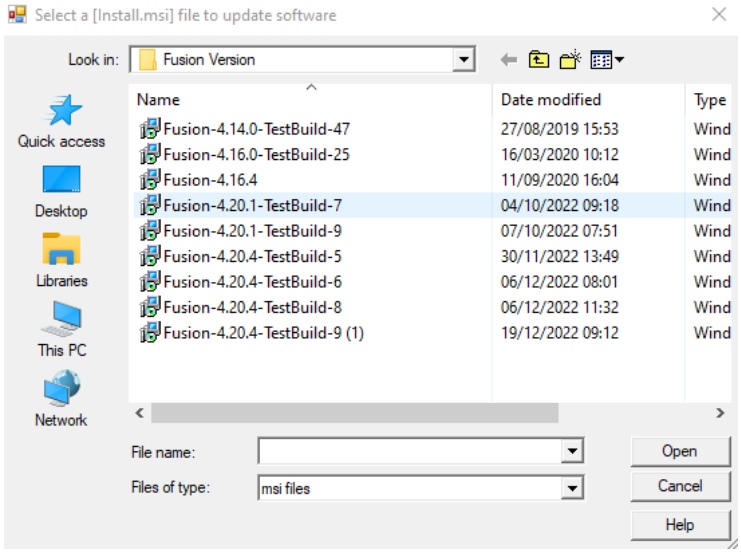
Open the Fusion Software Updater folder as shown below. This can be found on the home screen and if not, it will be located in the C: folder under Users/Baty/Desktop.



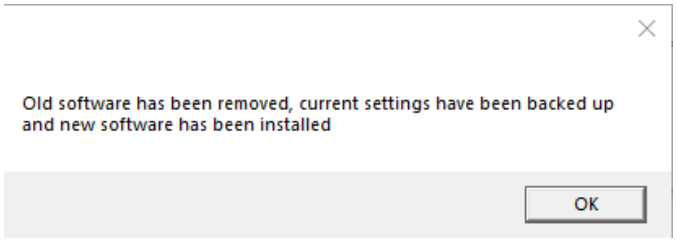
It is recommended that the READ ME note is opened first, this will open a tutorial on how to update the software if the method has been recently changed. After opening the folder, open the Fusion Software Updater tool, which should start by opening a script program, wait for this to close and the following window will appear.



Now, click on the Choose File icon, this should automatically open a folder that has all the Fusion versions downloaded into it.

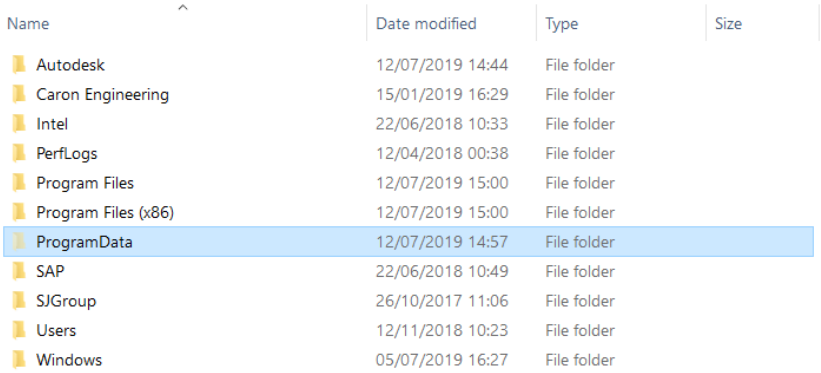


Select the latest Fusion version and the program will automatically update the software. After it has successfully completed, the following window will open.

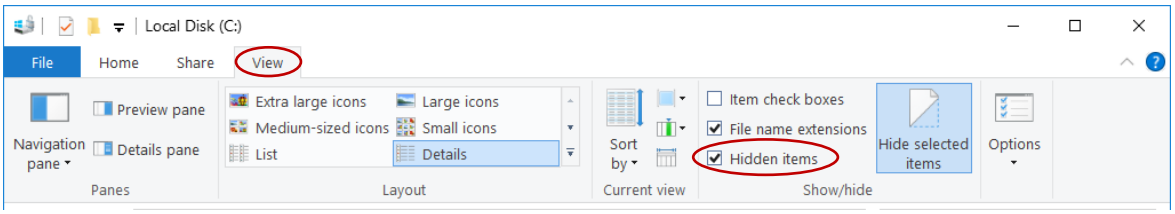


58.2 Method Two

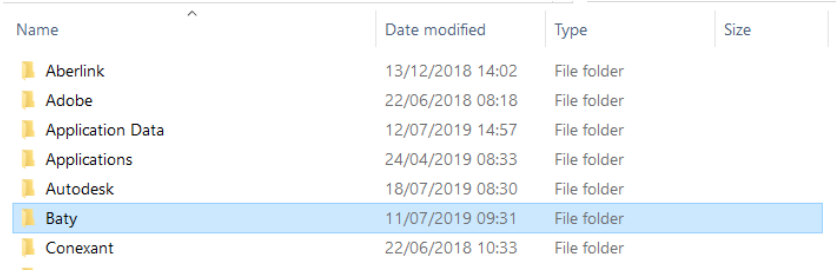
This is a more manual method to update the Fusion software. To start with, create a backup of the settings by going to the C: folder on the computer and opening ProgramData.



If this folder is not visible, go to the view tab and ensure Hidden items is ticked.

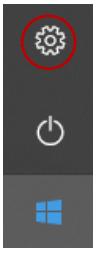


In the ProgramData folder there is a folder called Baty, this contains all the software settings for the machine.

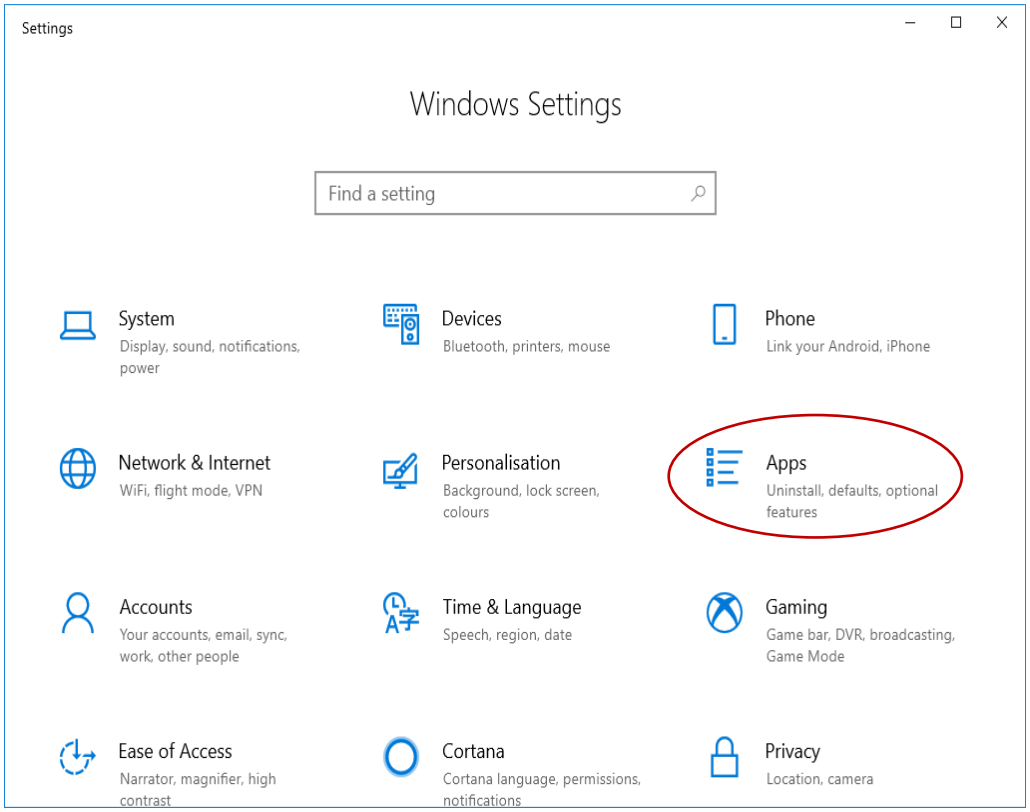


Copy this Baty folder and paste this in the same location and change the name of the copy to Baty- today's date so that it is known when this copy is from. Do not edit the name of the original Baty folder.

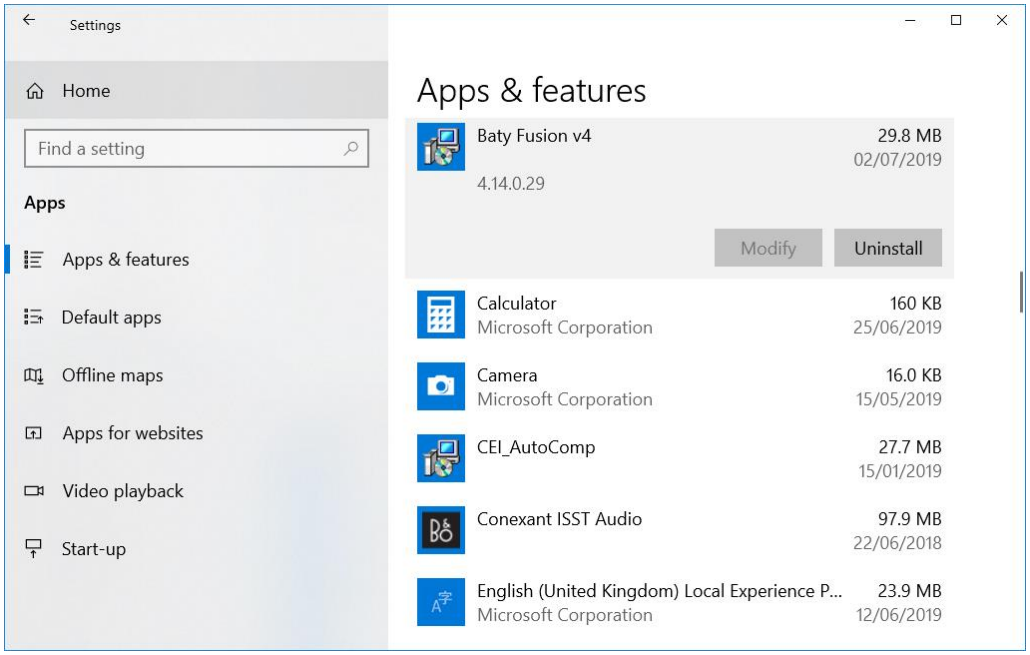
After creating the backup, go to Windows Settings, the cog symbol.



Find the Apps settings:



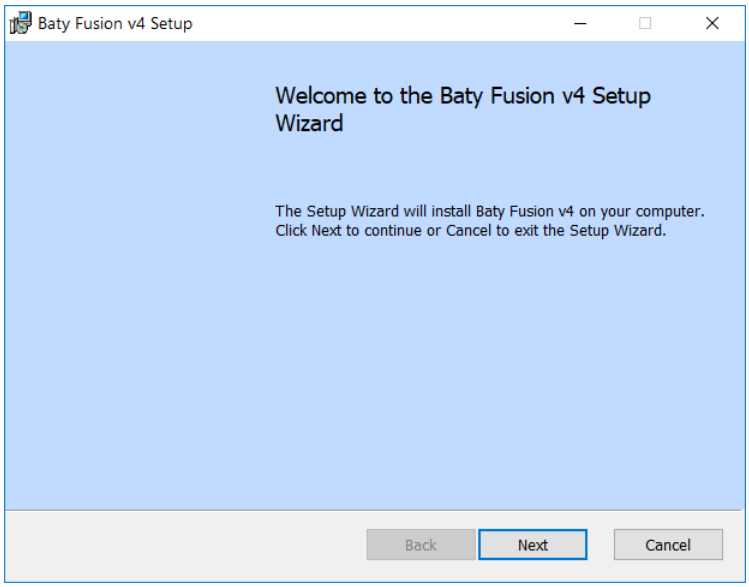
Then find Baty Fusion v4 and select this.



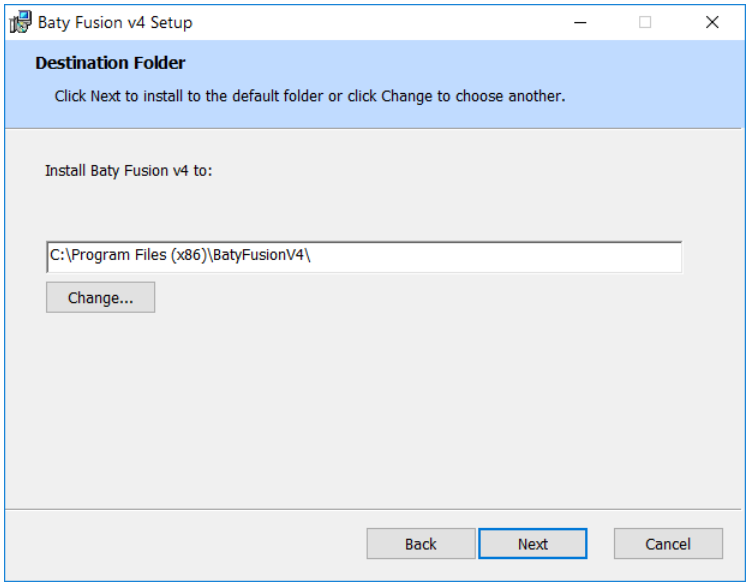
Two options will appear, select Uninstall and then Uninstall on the next prompt.

The software will now be uninstalled, and the new software can be installed. Move the installer to the desktop on the PC and then double click on the installer.

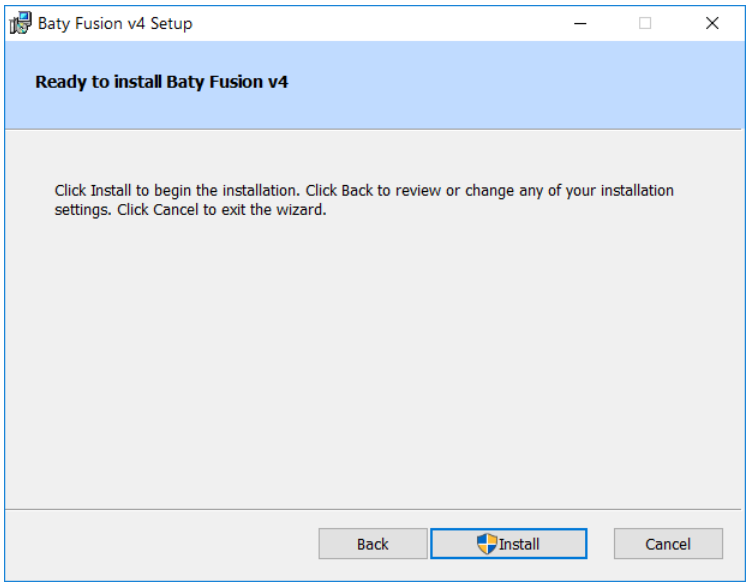
The following window will pop up, select Next.



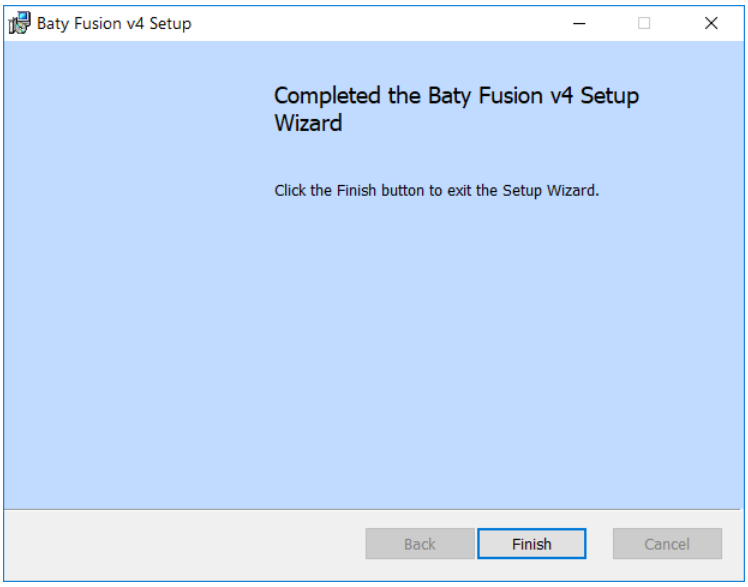
Click Next on the next window.



Then click Install on the final window



The software will then install, and the following window will appear to show this has been successful. Select Finish to close the window.



The new software should now be installed and can be opened using the Fusion shortcut on the desktop.

59.0 NETWORKING FUSION

Networking machines is not recommended as the Controllers (PCs) are designed as standalone units to control the machines and these must be configured correctly to ensure the software continues to work correctly. Many features and operations only work with Full Local Admin rights, this means that the user needs **full** read and write access to the Baty install directory and the Baty Data directory.

These are respectively:

C:/ProgramFiles(x86)/BatyFusionV4

C:/ProgramData/Baty

The rights to these locations can often be lost if joining a domain. Fusion Mk4 can read and write its inspection files to any user accessible shared directory, that it can browse to.

It is advised that any machines that are networked should also have the built in Windows Security Features enabled, for example Windows Defender, and Windows updates are run when available.

Other antivirus software packages are not recommended as many of these have been known to cause issues with the folder permissions on the controller. It is often necessary to exclude .cmmx files from aggressive virus scanning software.

60.0 CONTACT US

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