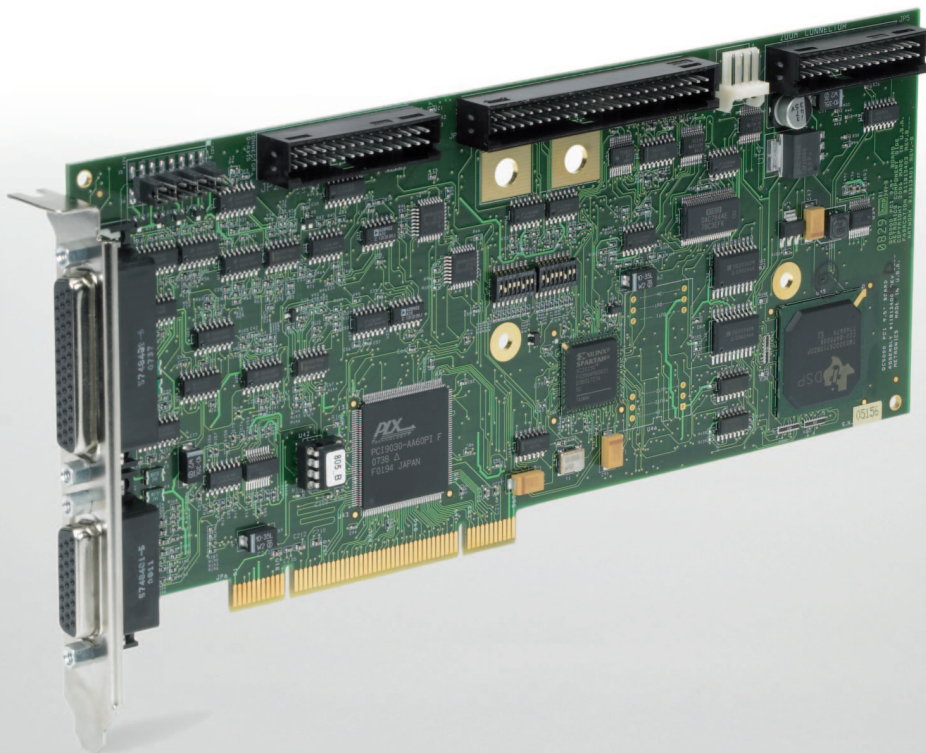




HEIDENHAIN



Operating Instructions

IK 5000 QUADRA-CHEK

(QC 5000)

Multisensor Systems

English (en)
2/2010

Quadra-Chek® 5000

User's Guide

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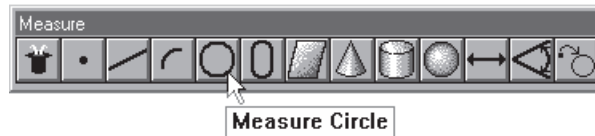
 Clicking and rotating data points A-26

Chapter 1

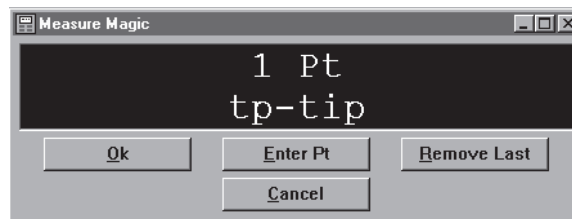
Overview

Welcome to the QC-5000

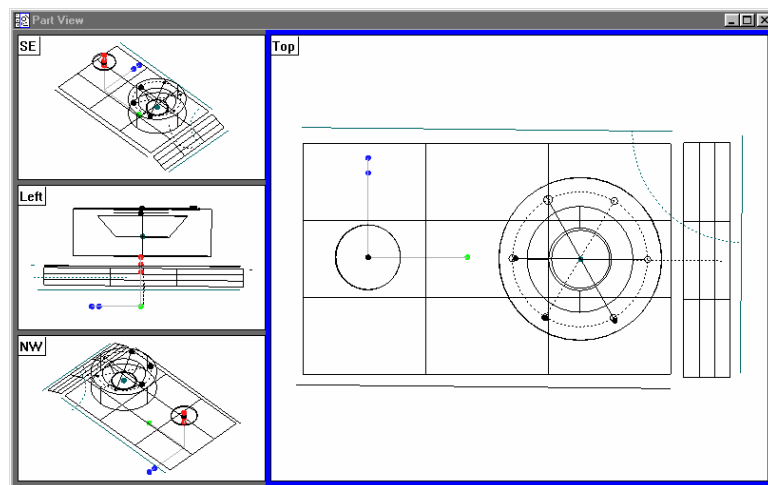
The Quadra-Chek 5000 is an advanced software application for multi-sensor measurement systems. It features a graphical user interface for simple point and click operation. Point the cursor to a feature on the measure toolbar and click.



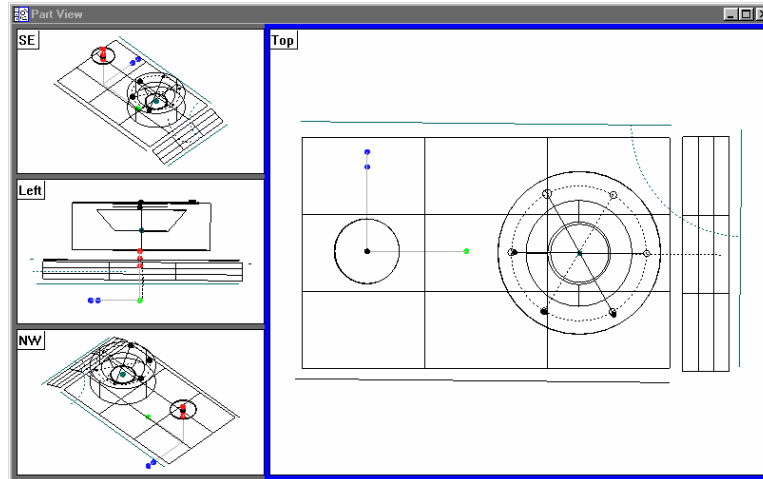
The QC-5000 measures part features using the simplest geometric components: points. Lines can be created from two points, circles from three points, and cones from six points. Simply probe the points and the QC-5000 measures the feature.



Once the required number of points are entered the QC-5000 displays the feature in the part view window.



The QC-5000 continues building the part in the part view window as features are added.



It is easy to use the QC-5000 because each measurement requires only a few points. All geometry and mathematics are handled by the software. Once the basic measuring principles are understood the QC-5000 can be programmed to handle repetitive measuring tasks. Finally, inspection and quality reports can be produced to document your results.

About This Guide

This guide is intended for end users of the QC-5000 metrology software, supervisory, and installation personnel. A basic familiarity with the Windows computing environment and operation of attached measuring systems is assumed. Material in this guide is divided into five chapters covering everything from basic operation to system configuration. Keep this guide in a convenient location for future reference.

Chapter 1: Overview

It all begins here, just point and click. There are only two things in the QC-5000 interface: windows and toolbars. This chapter tells you which is which and what to do with them. Understanding each window and toolbar helps you get the most from the QC-5000.

Chapter 2: Quick Start

This chapter gets you up and running quickly. Use this chapter to learn the most basic QC-5000 tasks. Each task in this chapter is described in greater detail elsewhere in this guide.

Chapter 3: Probes

If it's about probes, it's in this chapter. Learn to manage and calibrate VED and touch probes using probe library. All data comes into the QC-5000 through probes. Use the information in this chapter and you won't go wrong.

Chapter 4: Programming

Programming puts it all together. This chapter shows you how to create a streamlined, computer-prompted procedure to handle repetitive inspections with speed and accuracy. Use the programming feature to maximize your productivity with the QC-5000.

Chapter 5: Templates & Tolerancing

Picking up where chapter 4 leaves off this chapter covers datum magic, measure magic, layers, offset alignments, and tolerancing. The QC-5000 organizes and present data in a number of formats. For your convenience there are several data templates you can use to organize and present your results. Use this chapter to learn how to use templates more efficiently. This chapter also describes how to export QC-5000 data to other software.

Appendix A

Appendix A describes profile measurement. The appendix includes discussions of nominal profiles, profile tolerances, measurement results and the on-screen tools and windows provided to facilitate profile measurement.

Index

There's nothing worse than skimming through a user guide looking for something when you're in a hurry. To save you the hassle we indexed this guide. Simply flip to the back, find your topic, and off you go.

Icons and Type Faces

This guide uses the following icons and type faces to highlight information:



WARNING

The raised hand icon warns of situations or conditions that can lead to personal injury or death. Do not proceed until you read and thoroughly understand a warning message. Warning messages are shown in bold type.



CAUTION

The exclamation point icon indicates situations or conditions that can lead to measurement error, equipment malfunction or damage. Do not proceed until you read and fully understand a caution message. Caution messages are shown in bold type.



NOTE

The note icon indicates additional or supplementary information about an activity or concept. Notes are shown in bold type.

Warnings, cautions, and notes are shown in this typeface.

Italics

Italics indicate menu items or button icons. For example,

Step 1

Select *customize* from the tools menu.



The italics instruct the user that *customize* is an item on the tools pull-down menu.

Starting the QC-5000

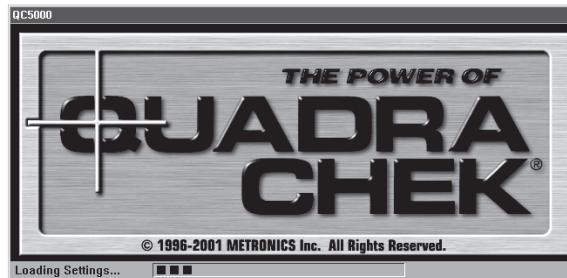
To open the QC-5000

Step 1



Double-click the QC-5000 icon on the Windows desktop.

The following screen indicates that the program is loading. It takes a couple seconds for the program to load completely.

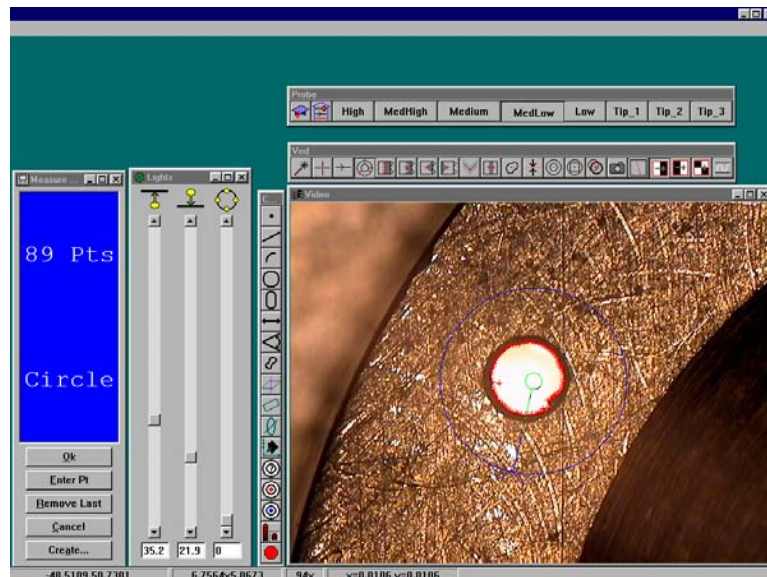
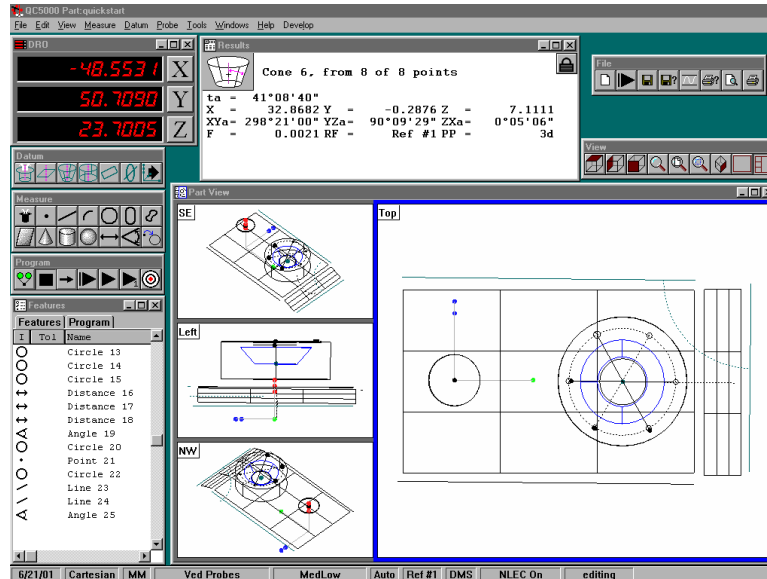


Chapter 1 Overview

Windows and Toolbars

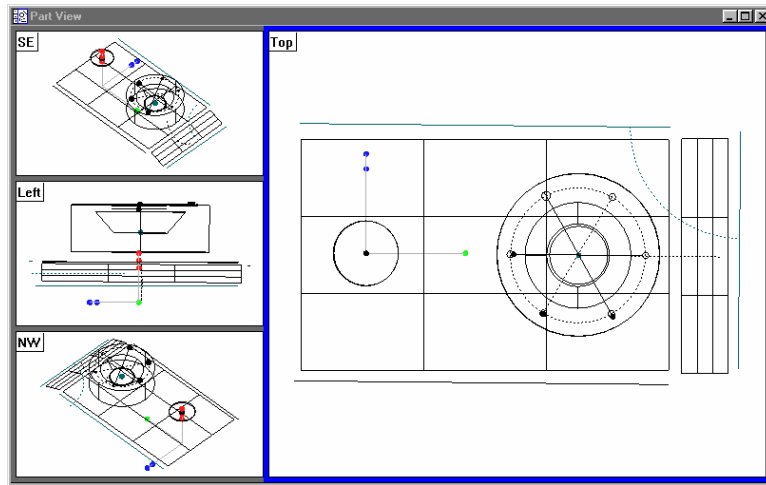
The QC-5000 uses a graphical user interface which means that instead of typing in a bunch of complicated commands you can do things by pointing and clicking the mouse.

In this manual we'll refer to the graphical user interface as the QC-5000 desktop. Although setups may vary, a typical QC-5000 desktop looks like this.



There are only two things to point and click at on the QC-5000 desktop: windows and toolbars. Here's how to tell them apart.

Windows display information. Some windows contain buttons or require input but their basic function is to display information. For example, the part view window displays a graphic of the part.



Toolbar buttons execute common tasks. For example, the *measure* toolbar contains buttons for various measurement functions. To perform a measurement, click on the desired feature button (line, circle, plane, etc.).

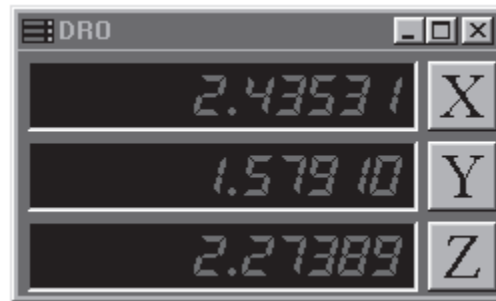


QC-5000 Windows

The QC-5000 desktop has four windows: DRO (digital readout), results, part view, and features list.

DRO

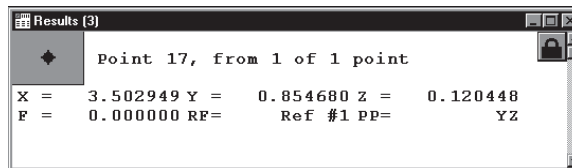
The DRO window displays the location of the X, Y, and Z axes (in mm or inches) from the datum. Click the button beside the respective axis to zero it.



The Results Window

The results window displays the results of a feature measurement. This window contains the following:

- Feature specifications
- Lock/unlock feature
- Feature type diagram / feature stamp



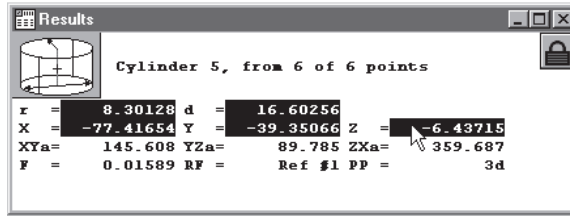
Feature Specifications

Feature information is displayed in the results window. Use the results window to add information to the features list.

To move information from the results window to the features list

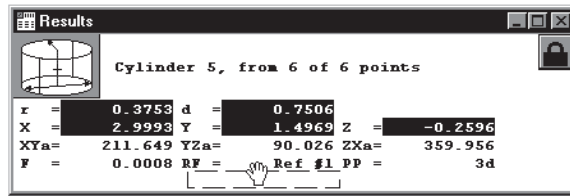
Step 1

Highlight the desired information in the results window.



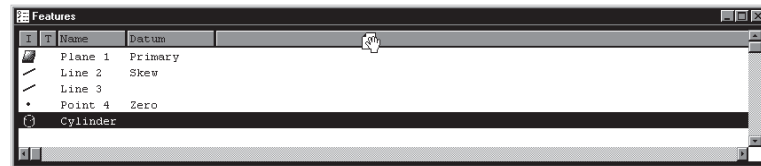
Step 2

Hold down the left mouse button and drag the information to the features list.



Step 3

Release the mouse button.

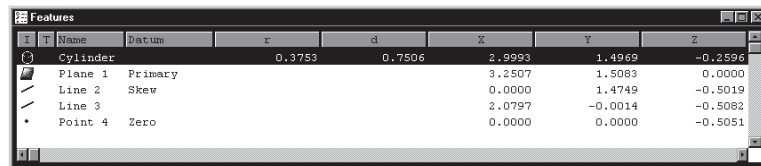


Step 4

Click the *as multiple new columns* button in the dialog box.



The feature window now displays the new parameters.



Information in this window is dependent on the type of feature. For example, the window shows radius/diameter values for spherical features but not for linear ones.

Locked/unlocked features

Some parts use more than one reference frame to measure all its features. Locked features always display results from the reference frame they are measured in the results window. Unlocked features are display results for the current reference frame.

To unlock a feature

Step 1

Click the lock icon in the results window.



To lock a feature

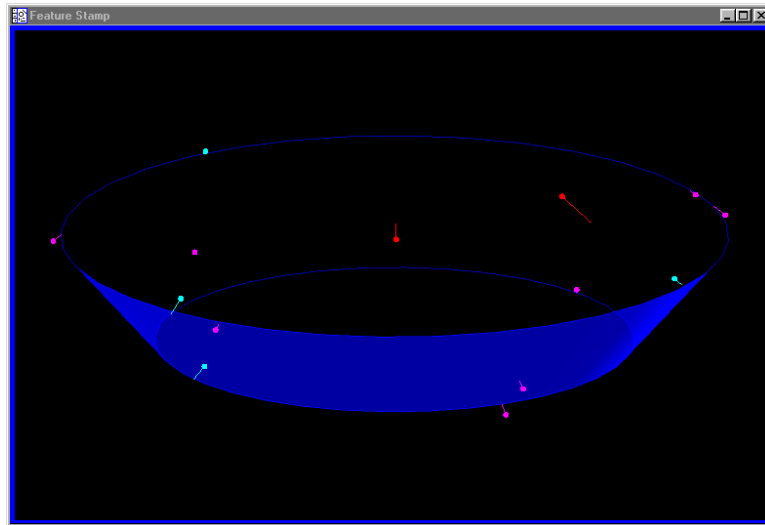
Step 1

Click the lock icon in the results window.



Feature type diagram /feature stamp

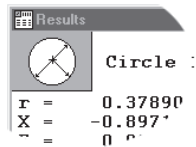
Clicking on the feature stamp icon opens the feature stamp window. The feature stamp window shows a graphic display of the feature and the distribution of the measurement points. Points discarded from the measurement are shown in red. Use the view toolbar to change the perspective in the feature stamp window.



To open the feature stamp window

Step 1

Click the *feature stamp* button in the results window.



Chapter 1 Overview

The Part View Window

The part view window displays a graphical representation of the part and its features. Use the view toolbar to change the appearance of the part view window.

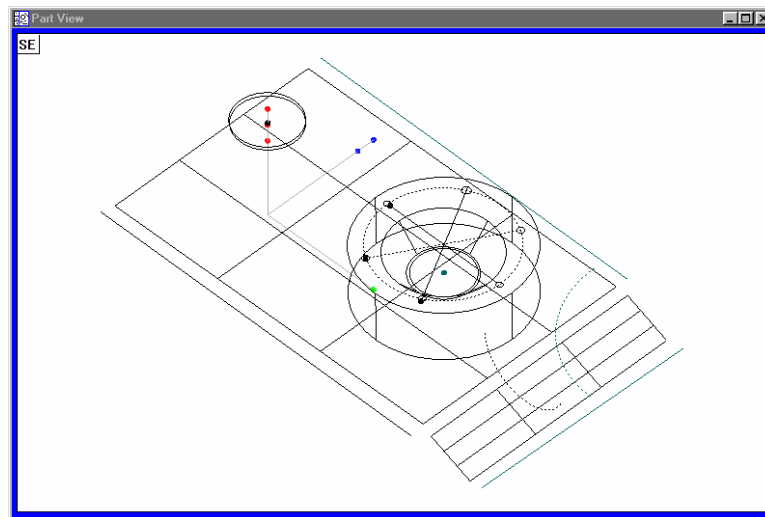


This is a typical view toolbar. Remember that QC-5000 toolbars can be customized. Toolbars pictured in this guide may vary from those on your system.

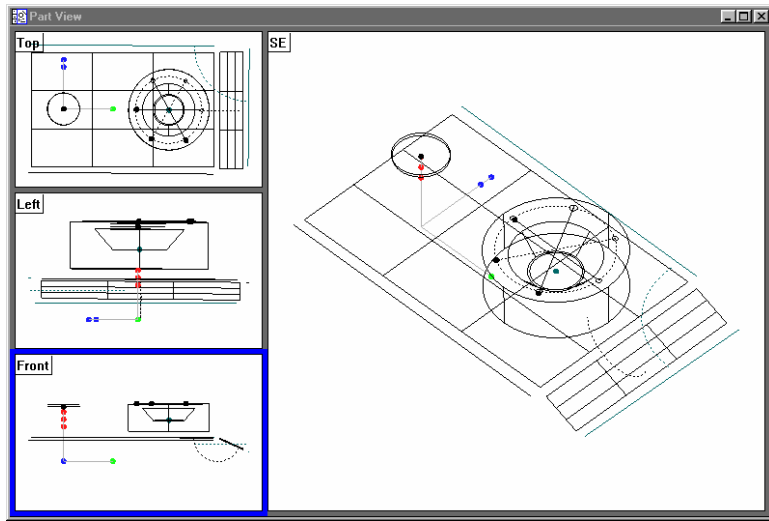
Four pane part view displays the part from four separate vantage points. Highlighted panes are outlined in blue. Place the cursor on the pane and click to highlight. Only one pane can be highlighted at a time.

The most common part view window appearances are shown here.

Single pane part view



Four pane part view



View Rotator

Change the display angle of the part view window with the view rotator.

To use the view rotator

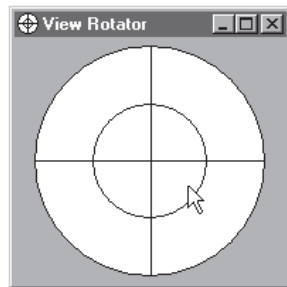
Step 1



Click the *view rotator* button on the view toolbar OR select *view rotator* from the view menu..

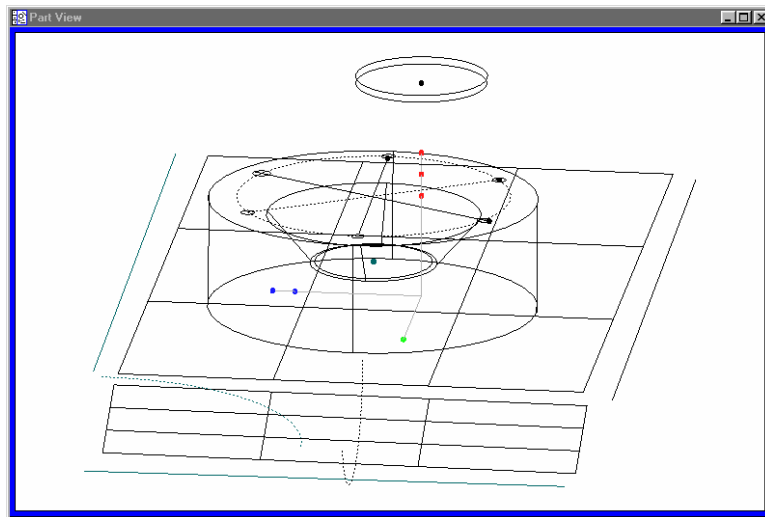
Step 2

Place the cursor over the view rotator window as shown.



Step 3

Move the cursor over the view rotator window until the part is displayed as desired.



Template Windows

Template windows display data output from QC-5000 measurements and programs. See Chapter 5: *Tolerancing & Templates* for more information on using template windows.

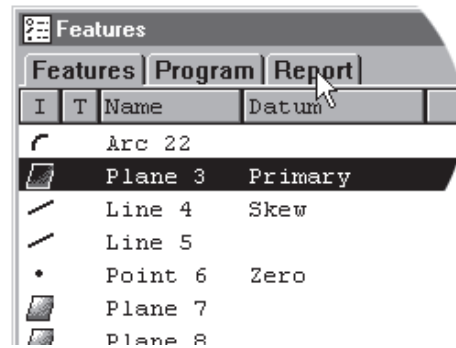
Nest template windows as shown to conserve space on the QC-5000 screen. For example, the window below contains the features, program, and report templates nested in a single window. View the desired template by selecting the proper tab. In the example below, the feature tab is selected.

I	T	Name	Datum	d	X	Y	r
✓		Arc 22		0.3746	1.9987	1.4973	0.1873
✓		Plane 3	Primary		3.2493	1.5449	
✓		Line 4	Skew		0.0000	1.4876	
✓		Line 5			2.1888	-0.0020	
•		Point 6	Zero		0.0000	0.0000	
✓		Plane 7			0.6532	1.5274	
✓		Plane 8			2.8808	0.0133	
✓		Arc 9		1.5157	4.4894	0.7543	0.7578
✓		Plane 10			5.2461	1.4748	
✓		Plane 11			4.2478	2.5456	
✓		Plane 12			2.1925	2.9965	
○		Cylinder		0.7532	2.9991	1.4966	0.3766
△		Cone 15			4.4987	0.7451	0.1758
○		Slot 16		0.3766	4.3122	1.4958	0.1883
○		Circle 17		0.3748	2.9987	0.4980	0.1874
○		Circle 18		0.3753	3.0002	2.4955	0.1877
✓		Line 19			2.1875	0.7438	
✓		Line 20			1.8106	0.7482	

To separate template windows

Step 1

Place the cursor over the desired tab as shown.



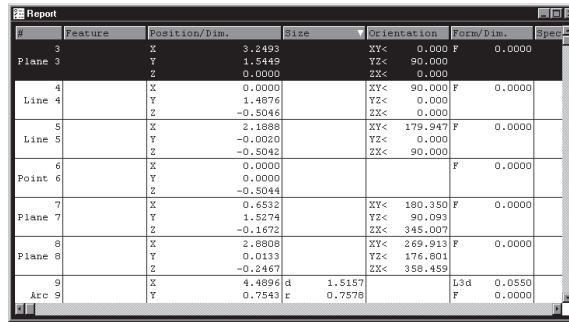
Step 2

Hold the left mouse button and drag the tab outside the current window as shown.

I	T	Name	Datum	d	X	Y	r
✓		Arc 22		0.3746	1.9987	1.4973	0.1873

Feature	Position/Dim.	Size	Orientation	Form/Dim.	Spec
Lin 3	X	3.2493	XY<	0.000 F	0.0000
Pla 3	Y	1.5449	YZ<	90.000	
Pla 3	Z	0.0000	ZZ<	0.000	
Pla 4	Y	1.4876	XY<	90.000 F	0.0000
Pla 5	Z	-0.5046	ZZ<	0.000	
Pla 5	X	2.1888	XY<	179.949 F	0.0000
Pla 5	Y	-0.0020	YZ<	0.000	
Cyl 6	Z	-0.5042	ZZ<	90.000	
Com 6	X	0.0000		F	0.0000
Slc 6	Y	0.0000			
Cir 6	Z	-0.5044			
Pla 7	X	0.6532	XY<	180.350 F	0.0000
Pla 7	Y	1.5274	YZ<	90.093	
Pla 7	Z	-0.1672	ZZ<	345.037	
Pla 8	X	2.8808	XY<	269.913 F	0.0000
Pla 8	Y	0.0133	YZ<	176.801	
Pla 8	Z	-0.2467	ZZ<	358.459	
Arc 9	X	4.4894	d	1.5157	L3d 0.0550
Arc 9	Y	0.7543	r	0.7578	F 0.0000

Step 3
Release the left mouse button.



The screenshot shows a 'Report' window with a table containing the following data:

#	Feature	Position/Dim.	Size	Orientation	Form/Dim.	Spec
3		X 3.2493		XY< 0.000	F 0.0000	
Plane 3		Y 1.5489		YZ< 90.000		
		Z 0.0000		ZX< 0.000		
4		X 0.0000		XY< 90.000	F 0.0000	
Line 4		Y 1.4876		YZ< 0.000		
		Z -0.5046		ZX< 0.000		
5		X 2.1888		XY< 179.947	F 0.0000	
Line 5		Y -0.0020		YZ< 0.000		
		Z -0.5042		ZX< 90.000		
6		X 0.0000			F 0.0000	
Point 6		Y 0.0000				
		Z -0.5044				
7		X 0.6332		XY< 180.350	F 0.0000	
Plane 7		Y 1.5274		YZ< 90.093		
		Z -0.1672		ZX< 345.007		
8		X 2.8808		XY< 269.913	F 0.0000	
Plane 8		Y 0.0133		YZ< 176.801		
		Z -0.2467		ZX< 358.459		
9		X 4.4896 d	1.5157		L3d 0.0550	
Arc 9		Y 0.7543 c	0.7578		F 0.0000	

To nest template windows

Step 1

Place the cursor over the desired template window as shown.

#	Feature	Position/Dim.
3		X 3.2493
Plane 3		Y 1.5449
		Z 0.0000
4		X 0.0000
Line 4		Y 1.4876
		Z -0.0020
5		X 2.1888
Line 5		Y -0.0020
		Z -0.5042
6		X 0.6532
		Y 1.5274
		Z -0.1572

Step 2

Hold the left mouse button and drag the template over the desired window.

#	Feature	Position/Dim.	Size	Orientation	Form/Dim.	Spec
3		X 3.2493		XY< 0.000 F	0.0000	
Plane 3		Y 1.5449		YZ< 90.000		
		Z 0.0000		ZX< 0.000		
4		X 0.0000		XY< 90.000 F	0.0000	
Line 4		Y 1.4876		YZ< 0.000		
		Z -0.5044		ZX< 0.000		
5		X 2.1888		XY< 179.947 F	0.0000	
Line 5		Y -0.0020		YZ< 0.000		
		Z -0.5042		ZX< 90.000		
6		X 0.0000			F 0.0000	
Point 6		Y 0.0000				
		Z -0.5044				
7		X 0.6532		XY< 180.350 F	0.0000	
Plane 7		Y 1.5274		YZ< 90.093		
		Z -0.1572		ZX< 345.007		
8		X 2.8808		XY< 269.913 F	0.0000	
Plane 8		Y 0.0133		YZ< 178.601		
		Z -0.2467		ZX< 358.459		
9		X 4.4896	d 1.5157		L3d 0.0550	
Arc 9		Y 0.7543	z 0.7578		F 0.0000	

Step 3

Release the mouse button.

#	Feature	Position/Dim.	Size	Orientation	Form/Dim.	Spec
Plane 3	Primary		3.2493		1.5449	
Line 4	Skew		0.0000		1.4876	
Line 5			2.1888		-0.0020	
Point 6	Zero		0.0000		0.0000	
Plane 7			0.6532		1.5274	
Plane 8			2.8808		0.0133	
Arc 9		1.5157	4.4896		0.7543	
Plane 10			5.2461		1.4748	0.7578
Plane 11			4.2478		2.5456	
Plane 12			2.1925		2.9965	
Cylinder		0.7532	2.9991		1.4966	0.3766
Cone 15			4.4987		0.7451	0.1758
Slot 16		0.3766	4.3122		1.4958	0.1883
Circle 17		0.3748	2.9987		0.4980	0.1874
Circle 18		0.3753	3.0002		2.4955	0.1877
Line 19			2.1875		0.7438	
Line 20			1.8106		0.7482	

Status Bar

The status bar runs across the bottom of the screen and displays such as:

- Date
- Type of coordinates (Polar/Cartesian)
- Selected units of measurement (in./mm)
- Active Layer
- Active probe tip
- Projection Plane
- Active Reference Frame
- Angle Display Mode
- SLEC/NLEC Status
- Recording or Editing Mode

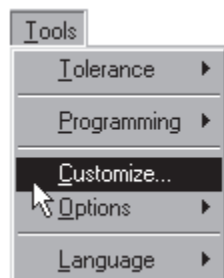


Use the status bar to toggle between settings. Place the cursor over the mm/inch section of the status bar. Click the mouse to toggle between inches and millimeters. This is a quick way to change the units of measure. Other settings in the status bar can be toggled in the same way.

To add items to the status bar

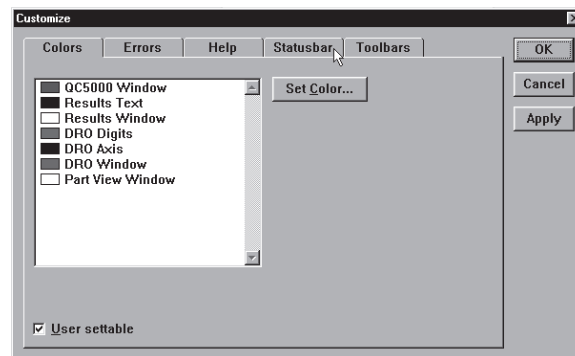
Step 1

Select *customize* from the tools menu.

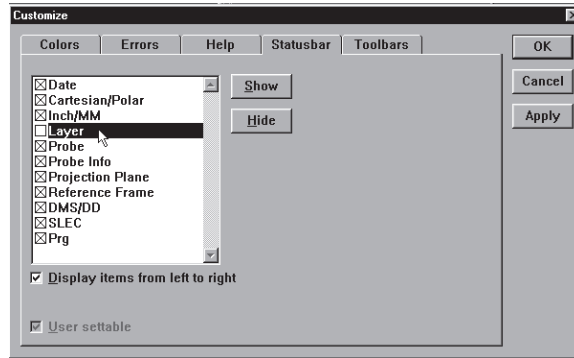


Step 2

Select the *status bar* tab as shown.

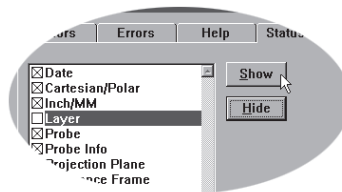


Step 3
Highlight the desired item as shown.

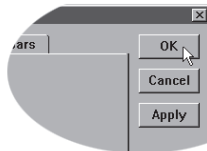


NOTE
Items currently in the status bar have an 'X' in the box next to them. An empty box indicates the item is currently not on the status bar.

Step 4
Click the *show* button.



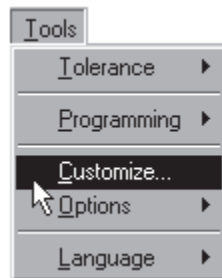
Step 5
Click OK.



To delete items from the status bar

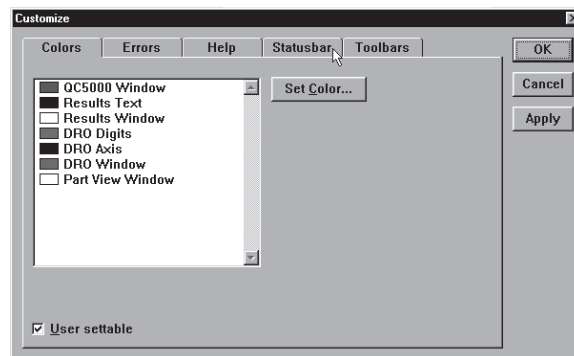
Step 1

Select *customize* from the tools menu.



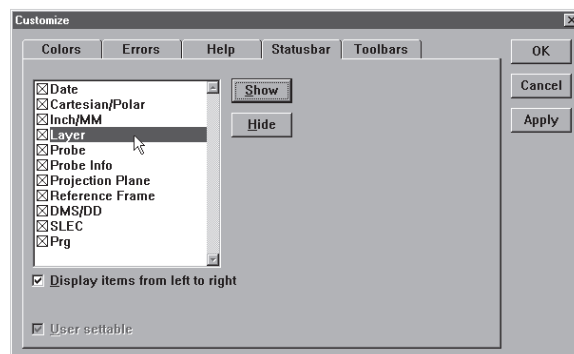
Step 2

Select the *status bar* tab as shown.



Step 3

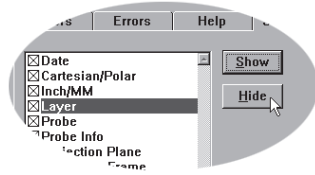
Highlight the desired item as shown.



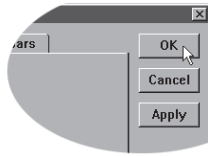
NOTE

Items currently in the status bar have an 'X' in the box next to them. An empty box indicates the item is currently not on the status bar.

Step 4
Click the *hide* button.

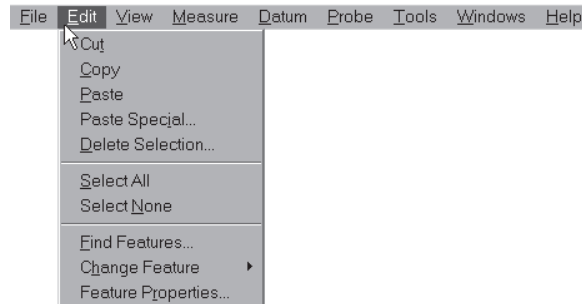


Step 5
Click OK.



Main Menu Bar

This section shows the content of the QC-5000 pull-down menus. A discussion of the various menu commands follows in later chapters. Use this section to familiarize yourself with the menus. Place the cursor over the desired menu and click to view pull-down menus.



Toolbars

Toolbars contain buttons that execute common tasks. Use toolbars instead of hunting through pull-down menus for commands. Simply click the desired button and the task is begun. Toolbars correspond to the main menu. For example, buttons in the view toolbar correspond to commands on the view menu.

Datum toolbar

Use the *datum* toolbar to establish datums and reference frames. Buttons in the *datum* toolbar correspond to items on the *datum* menu.



Measure toolbar

Use the *measure* toolbar to measure and construct features. Buttons on the *measure* toolbar correspond to items on the *measure* menu.



Probe toolbar

Use the *probe* toolbar to access probe functions and settings. Buttons on the *probe* toolbar correspond to items on the *probe* menu.



View toolbar

Use the *view* toolbar to adjust the part view window. Buttons on the *view* toolbar correspond to items on the *view* menu.



Tolerance toolbar

Use the *tolerance* toolbar to perform tolerances on selected features. Buttons on the *tolerance* toolbar correspond to items on the *tools* menu.



Program toolbar

Use the *program* toolbar to access programming functions. Buttons on the *program* toolbar correspond to items on the *tools* menu.



File toolbar

Use the *file* toolbar to access file functions. Buttons on the *file* toolbar correspond to items on the *file* menu.



VED toolbar

Use the *VED* toolbar to access VED probe tools.



Custom toolbar

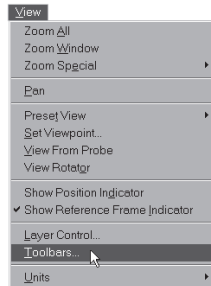
Use custom toolbars to create toolbars for specific tasks.



To place a toolbar on the QC-5000 desktop

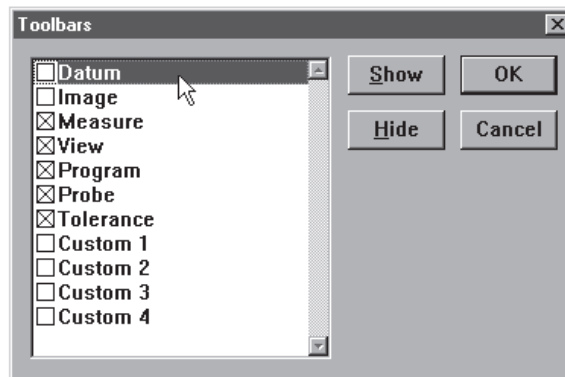
Step 1

Select *toolbars* from the view menu.



Step 2

Highlight the desired toolbar as shown.

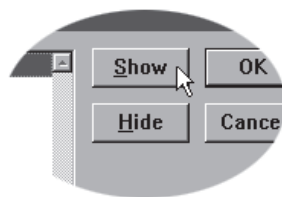


NOTE

Toolbars on the QC-5000 desktop have an 'X' in the box next to them. An empty box indicates the item is currently NOT on the desktop.

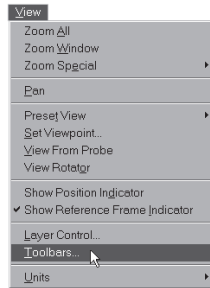
Step 3

Click the *show* button.

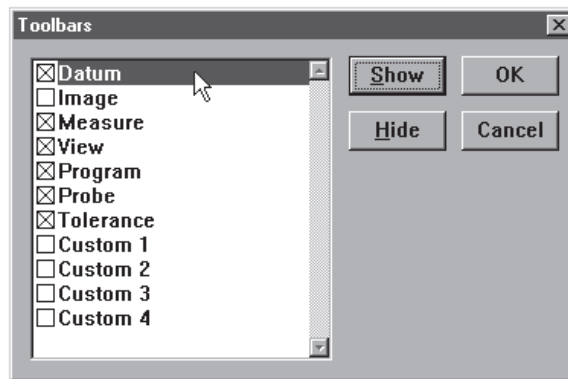


To remove a toolbar from the QC-5000 desktop

Step 1
Select *toolbars* from the view menu.

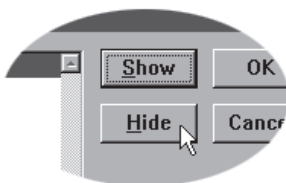


Step 2
Highlight the desired toolbar as shown.



NOTE
Toolbars on the QC-5000 desktop have an 'X' in the box next to them. An empty box indicates the item is currently NOT on the desktop.

Step 3
Click the *hide* button.

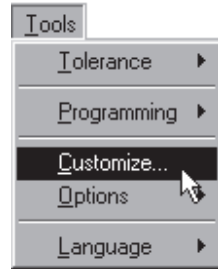


Customize your toolbars by adding or deleting buttons. Add buttons for common tasks . Delete seldom used buttons to keep toolbar size manageable.

To add buttons to a toolbar

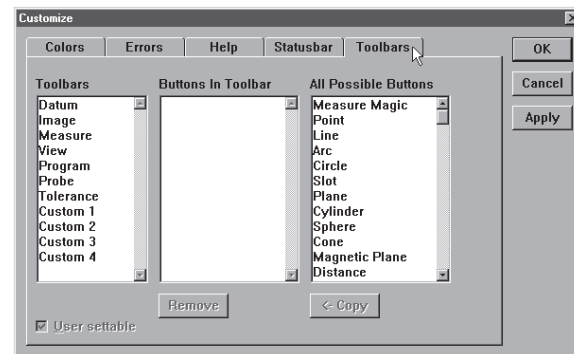
Step 1

Select *customize* from the tools menu.



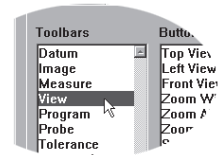
Step 2

Select the *toolbars* tab in the customize dialog box.



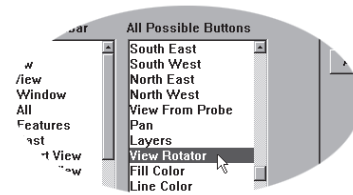
Step 3

Highlight the desired toolbar in the *toolbars* list as shown.



Step 4

Highlight the desired button in the *all possible buttons* list.

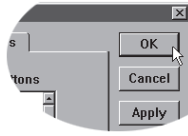


Step 5

Click the *copy* button.

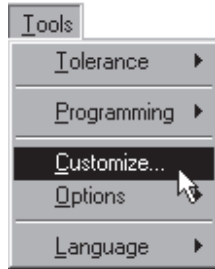


Step 6
Click OK.

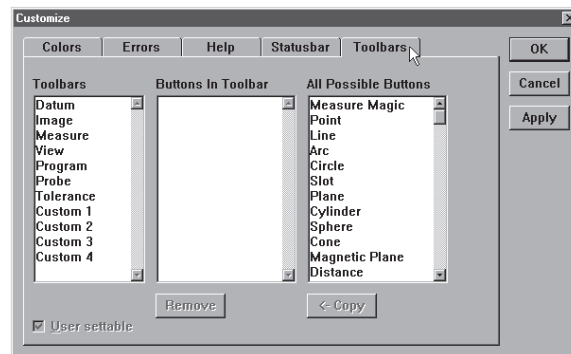


To remove buttons from a toolbar

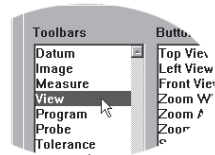
Step 1
Select *customize* from the tools menu.



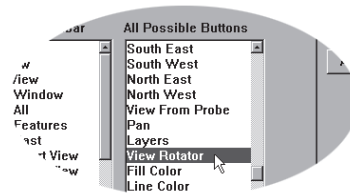
Step 2
Select the *toolbars* tab in the customize dialog box.



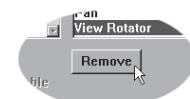
Step 3
Highlight the desired toolbar in the *toolbars* list as shown.



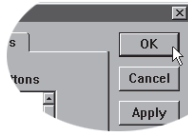
Step 4
Highlight the desired button in the *buttons in toolbar* list.



Step 5
Click the *remove* button.



Step 6
Click OK.



Chapter 2

Quick Start

Getting Started

Use this chapter to learn the basic operating principles of the QC-5000. Instructions in this chapter show the user how to create a complete inspection program. The quick start program includes:

- 2 reference frames
- VED measurements
- Touch probe measurements
- 2-D features
- 3-D features
- Constructed features
- Tolerances
- Formulas



NOTE

Systems not equipped with touch probes can substitute or omit the 3-D measurements in the quickstart program.

All tasks demonstrated are described in greater detail in other chapters. Inexperienced users should review those chapters before attempting the quick start program.

General Preparation

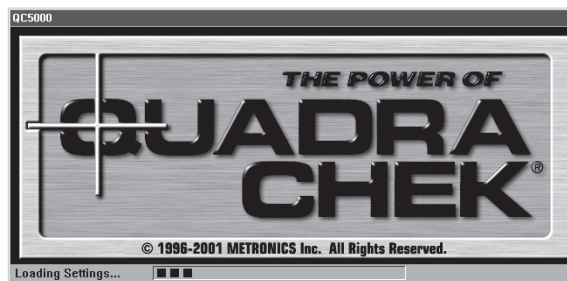
Follow the instructions in this section before beginning the quick start program.

To open the QC-5000 software

Step 1



Double-click the QC-5000 icon on the Windows desktop.



The screen above indicates that the program is loading. It takes a couple seconds for the program to load completely.

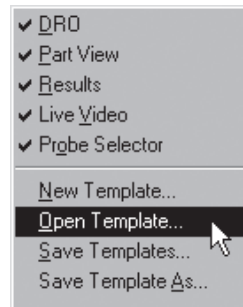
To set machine zero

Follow the machine zero procedure established by your supervisor, OEM, or distributor before beginning this section.

To display the feature list

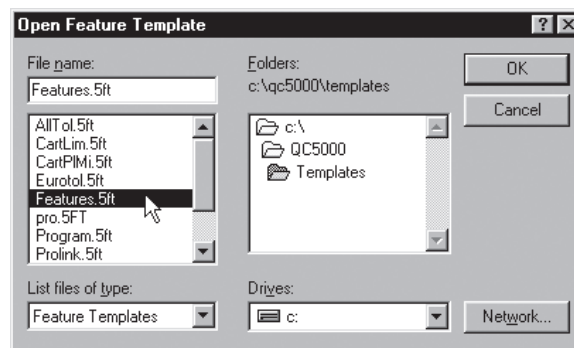
Step 1

Select *open template* from the windows menu.



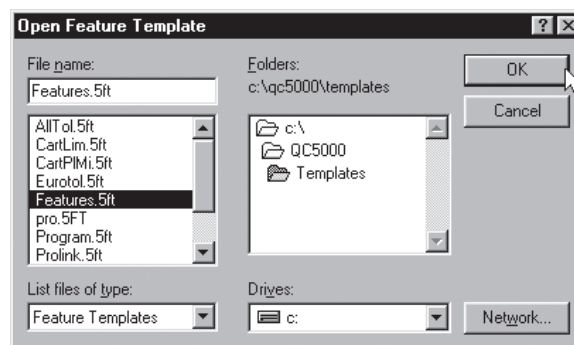
Step 2

Select *features.5ft* as shown.



Step 3

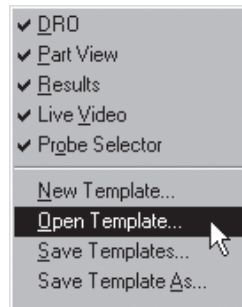
Click OK in the dialog box.



To display the program template

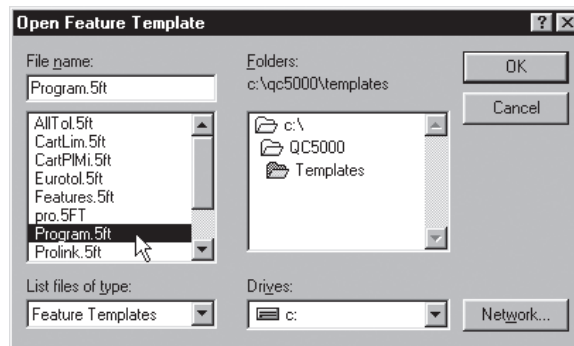
Step 1

Select *open template* from the windows menu.



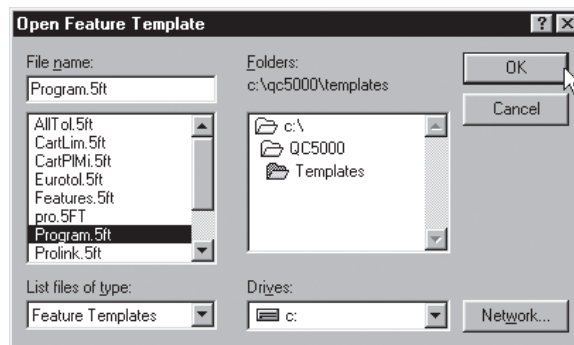
Step 2

Select *program.5ft* as shown.



Step 3

Click OK in the dialog box.

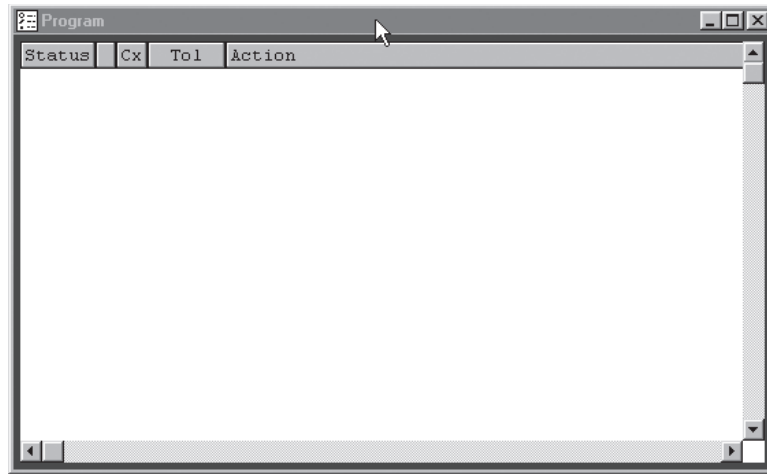


Nest template windows to keep the work space from getting too cluttered. Click on the tab to view the desired nested template.

To nest the template windows

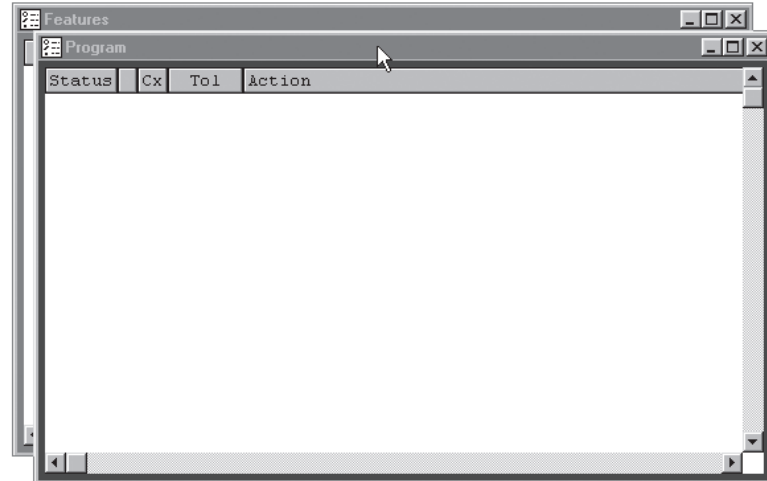
Step 1

Place the cursor on the title bar of the window as shown.

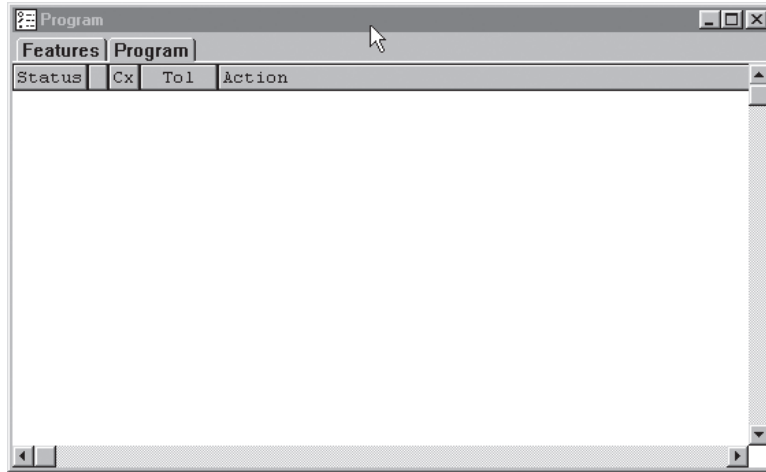


Step 2

Hold the mouse button and place the window as shown.



Step 3
Release the mouse button.

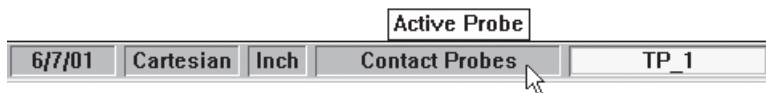


Select the Active Probe

Select the touch probe as the active probe before recording the quick start program.

To select the active probe

Step 1
Click on the status bar until *contact probes* is displayed as shown.



The contact probe group is now active.

Probing Technique

Probing technique refers to the method of moving CMM axes and entering point data with a touch probe. All features are made up of points and all points are taken with probes. In order to get good results from the QC5000 software it is important to use proper probe technique and to input proper probe settings.

Good probing techniques

- approach the feature from a 90 degree angle
- approach the feature from a distance of at least 1mm
- do not probe a feature from an angle of 45 degrees or less

Bad probing techniques

- dragging probe across a part
- dropping probe off the edge of a part

Recording the Quick Start Program

Follow the instructions in this section to record the quick start program.

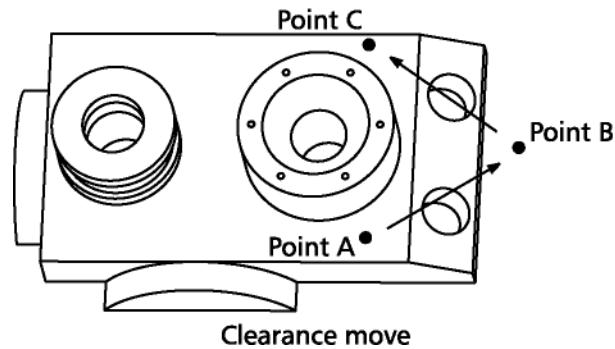
Clearance moves



CAUTION

Use clearance moves to avoid collisions between the probe and the part.

Clearance moves are necessary to create CNC paths around the part and other obstructions. For example, to safely move the probe from point A to point C, insert a clearance move at point B.

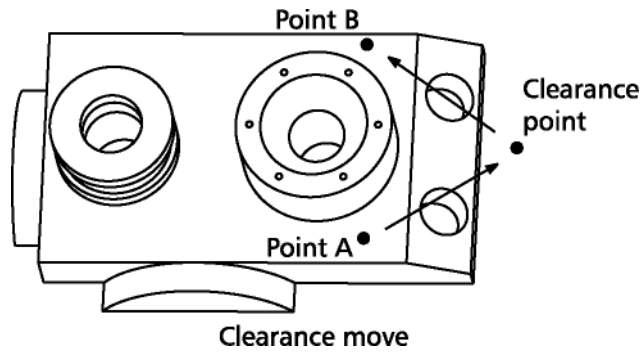


If the clearance moves are omitted, the probe will move in a straight line from point A to point C. The resulting collision could damage the probe.

To insert a clearance move

Step 1

Move the probe to the desired clearance point. Select a point that will allow the probe to travel safely away from obstacles.



Step 2

Click the *goto here button* on the program toolbar.



Use this procedure whenever directed to insert a clearance move in a program.

Creating the Start Point

It is a good practice to start the program at a point that is well clear of all part geometry. Move the probe to a clear position above the part. Make certain the probe is clear of obstructions in the XY plane. Use this position as the start and end point for the inspection in this chapter.

To record the quick start program



NOTE

Open a new part file before recording the quick start program.

Step 1

Click on the *record* button on the program toolbar.



The QC-5000 is now recording all actions as a part program. Use part programs for repetitive inspection tasks. For example, if you need to inspect 100 identical parts create a program while inspecting the first part. Run the program to inspect the remaining 99 parts.



CAUTION

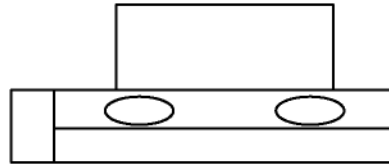
Unintentional probe collisions can result if the probe is not well clear of the part when run. Begin and end programs at points well clear of any obstruction.

To move the probe to the start point

Step 1

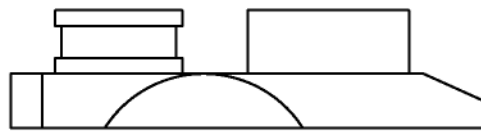
Position the touch probe at the start point as shown.

Start point ●



Right side view

Start point ●



Front view

Step 2

Click on the *goto* button on the program toolbar.



Chapter 2 Quick Start

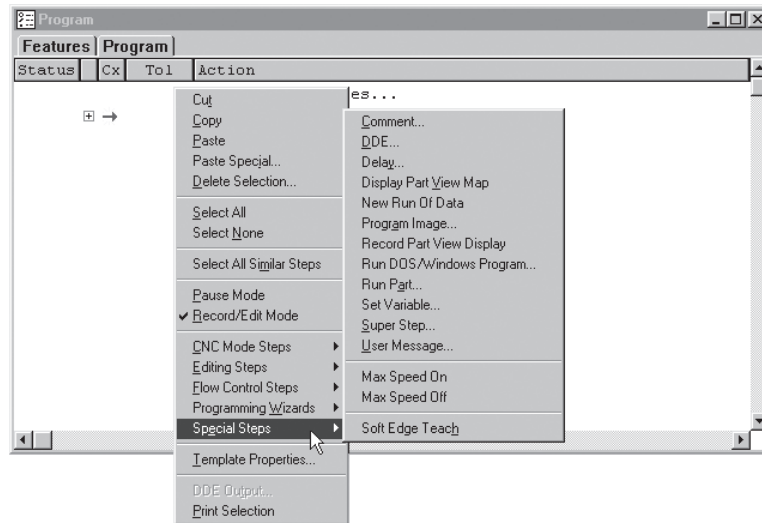
Recording the Part View Window

Follow the instructions below to record the part view display into a program. Use this procedure every time the part view window display is changed while recording a program.

To record the part view window display

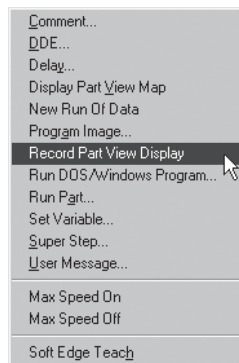
Step 1

Right-click on the program template and select special steps as shown.



Step 2

Select *record part view display*.

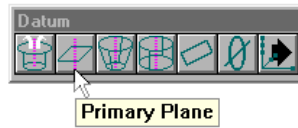


Creating the Datum

To create the primary plane

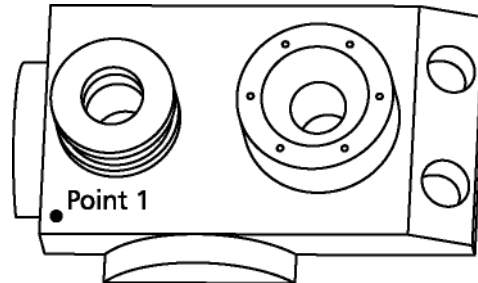
Step 1

Click the primary plane button on the datum toolbar.



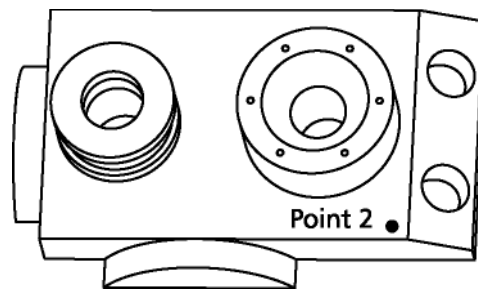
Step 2

Probe the first point as shown.



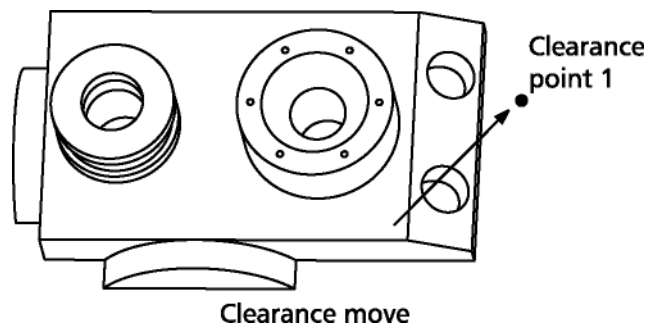
Step 3

Probe the second point as shown.



Step 4

Insert a clearance move at *clearance point 1* as shown.



Chapter 2 Quick Start

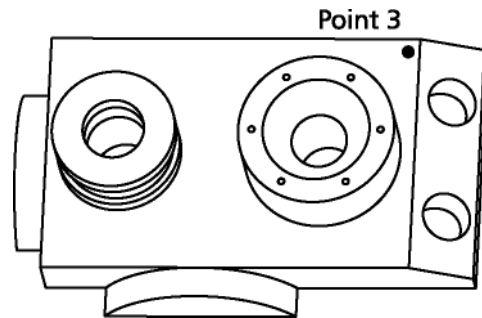
Step 5

Click on the goto button on the program toolbar.



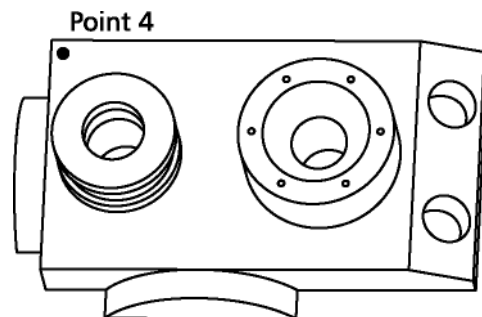
Step 6

Probe third point as shown.



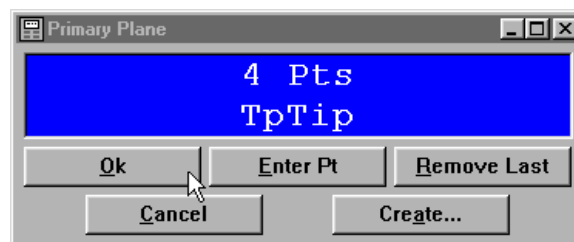
Step 7

Probe fourth point as shown.

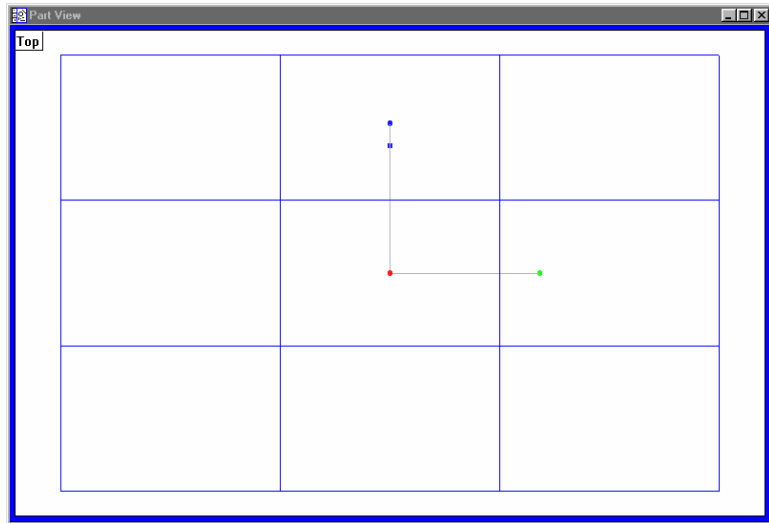


Step 8

Click OK in the dialog box.



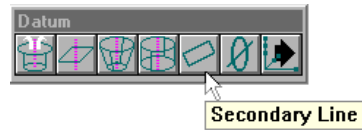
The primary plane appears in the part view window.



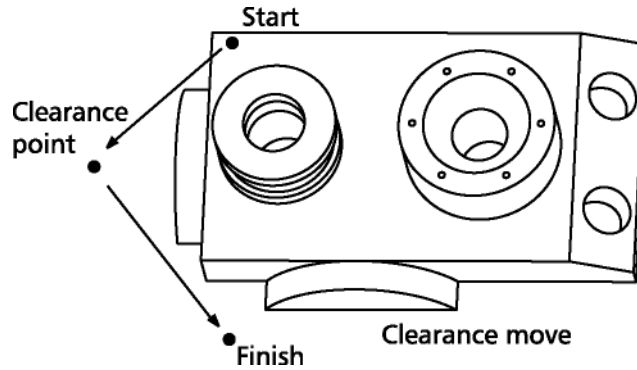
Creating the Secondary Alignment

To create a secondary alignment

Step 1
Click the secondary line button on the datum toolbar.



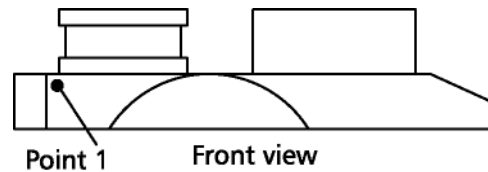
Insert a clearance move as shown.



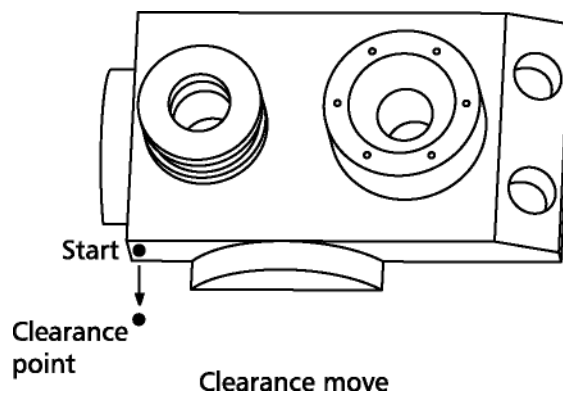
Step 2
Click the *goto* button on the program toolbar.



Step 3
Probe the first point as shown.



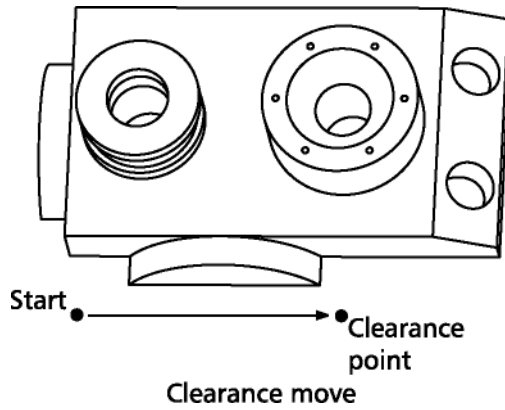
Step 4
Insert a clearance move as shown.



Step 5
Click the *goto* button on the program toolbar.



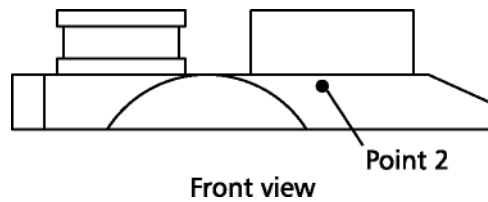
Step 6
Insert a clearance move as shown.



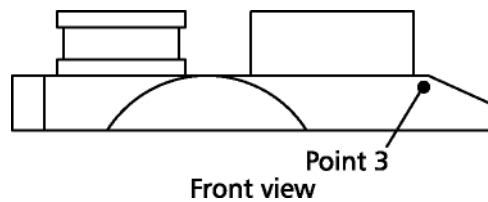
Step 7
Click the *goto* button on the program toolbar.



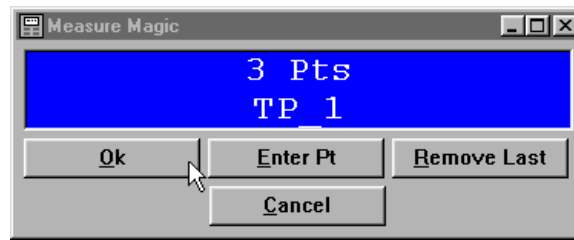
Step 8
Probe the second point as shown.



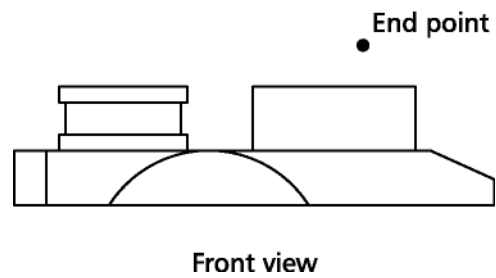
Step 9
Probe the third point as shown.



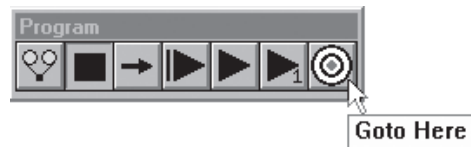
Step 10
Click OK in the dialog box.



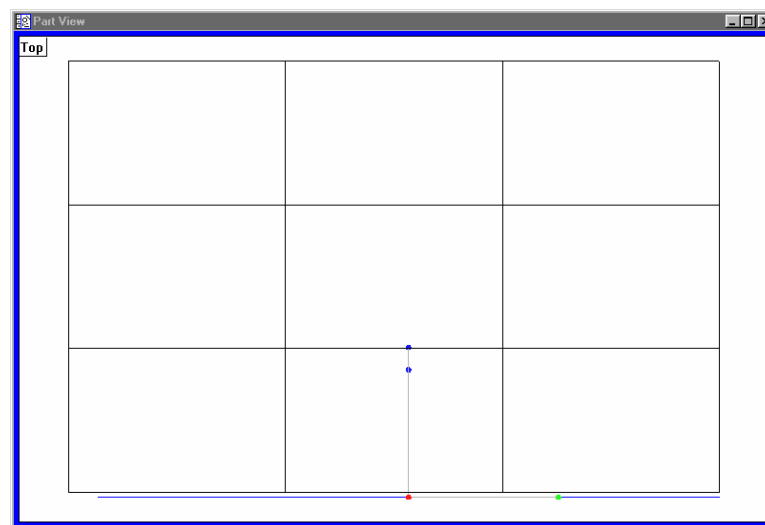
Step 11
Move the probe to the end point as shown.



Step 12
Click the *goto* button on the program toolbar.

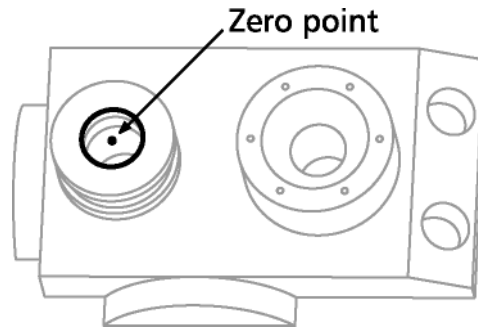


The secondary alignment appears in the part view window.



Creating the Zero Point

Measure the circle feature indicated to create the zero point.



Switch the active probe to VED for this measurement.

To activate the VED probe group

Step 1

Click on the status bar until *VED probes* is displayed as shown.



The *VED probe group* is now active. Use the following procedure to select the desired magnification.

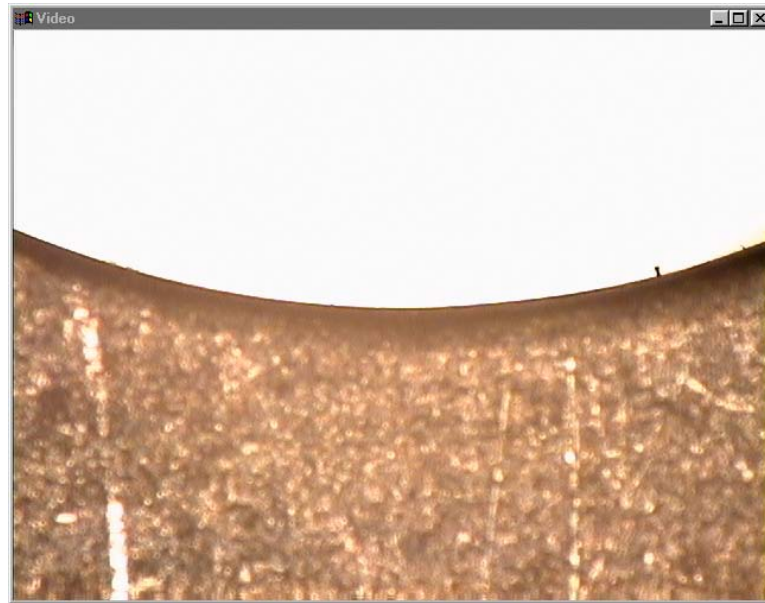
To select a magnification

Step 1

Click on the status bar until the desired magnification is displayed.



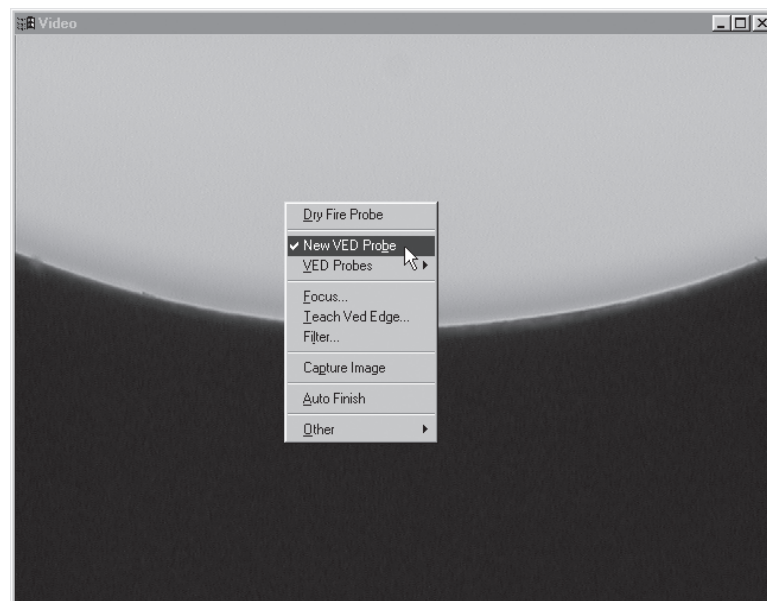
Position the circle in the video window as shown.



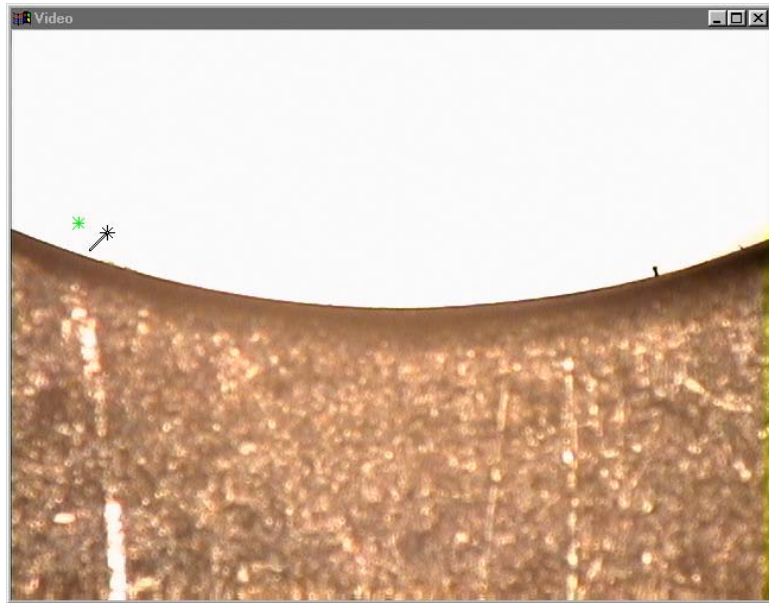
To create an arc tool

Step 1

Right click and select *new VED probe* from the list.



Step 2
Place the wand tool as shown and click.

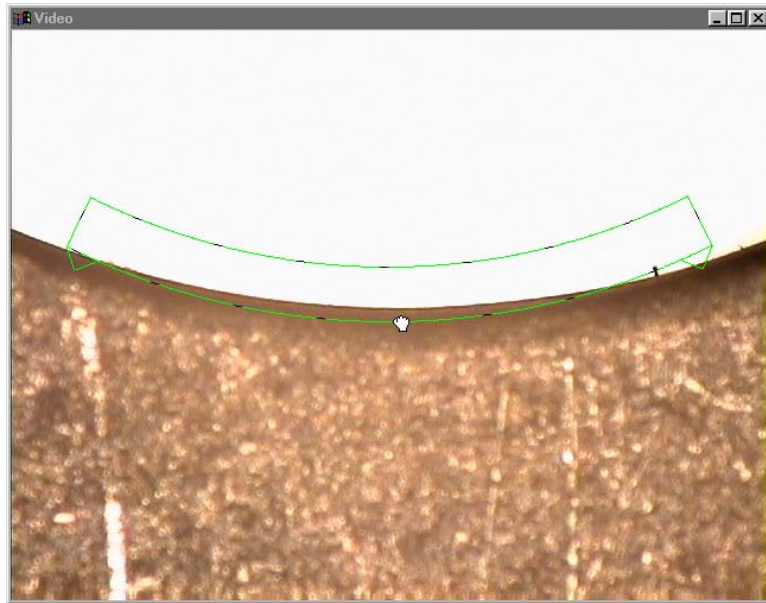


Step 2
Place the wand tool as shown and click.



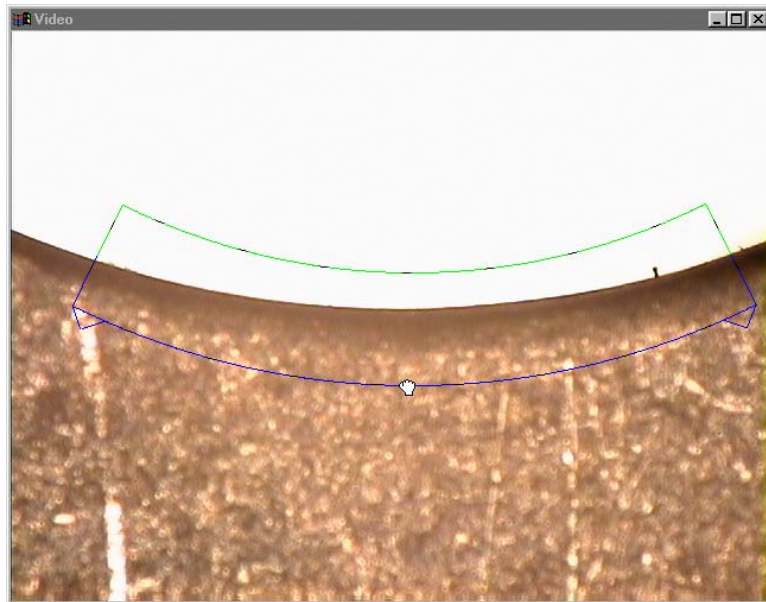
Step 3

Place the wand tool as shown and hold down the mouse button.



Step 4

Drag the wand tool in the desired scan direction.

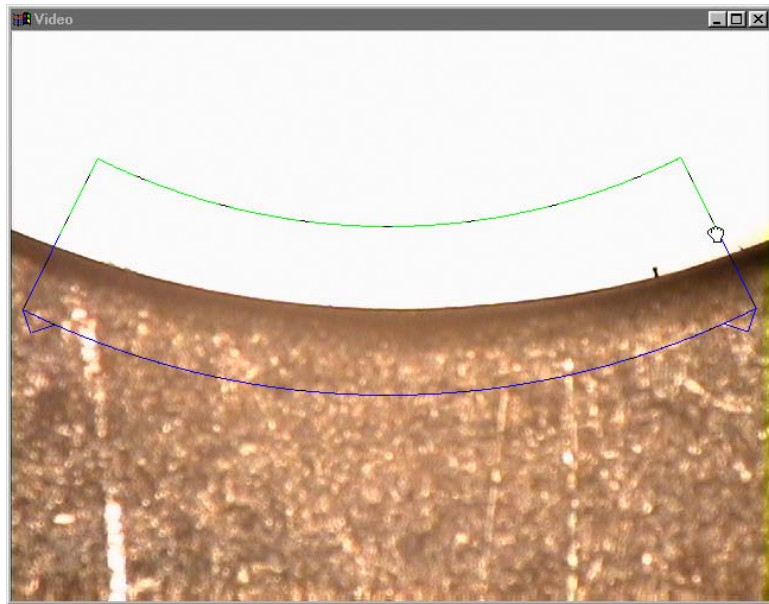


An arc tool is created with edge scan in light-to-dark direction.

To re-size a VED probe tool

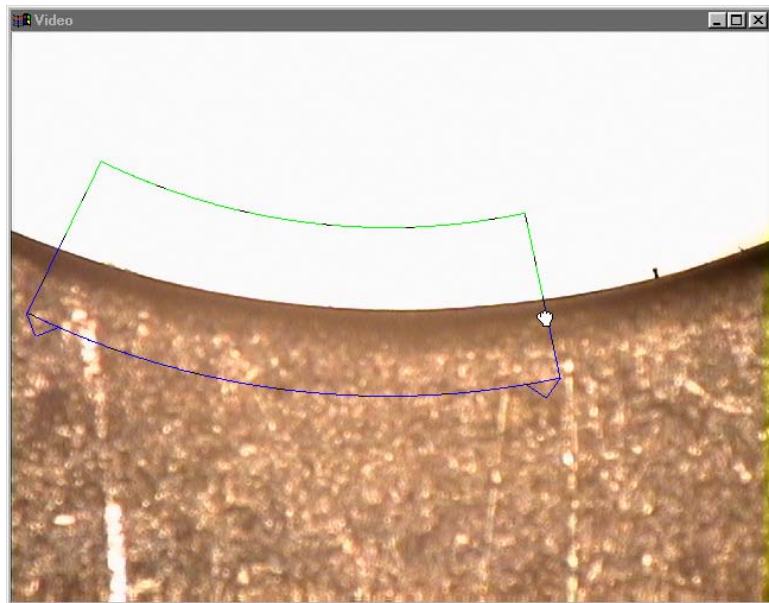
Step 1

Place the hand cursor over the over the tool as shown.



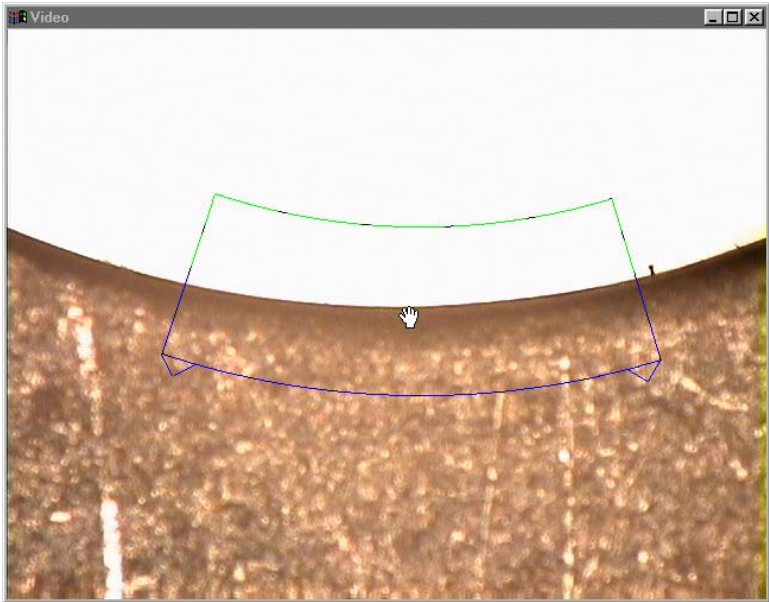
Step 2

Hold the left mouse button and move the hand cursor to the desired size.

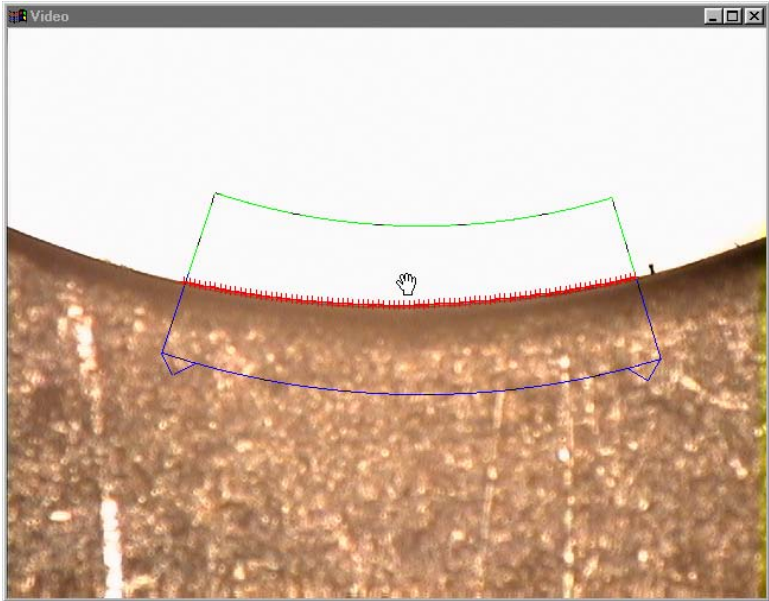


To create a zero point

Step 1
Place the probe tool as shown.

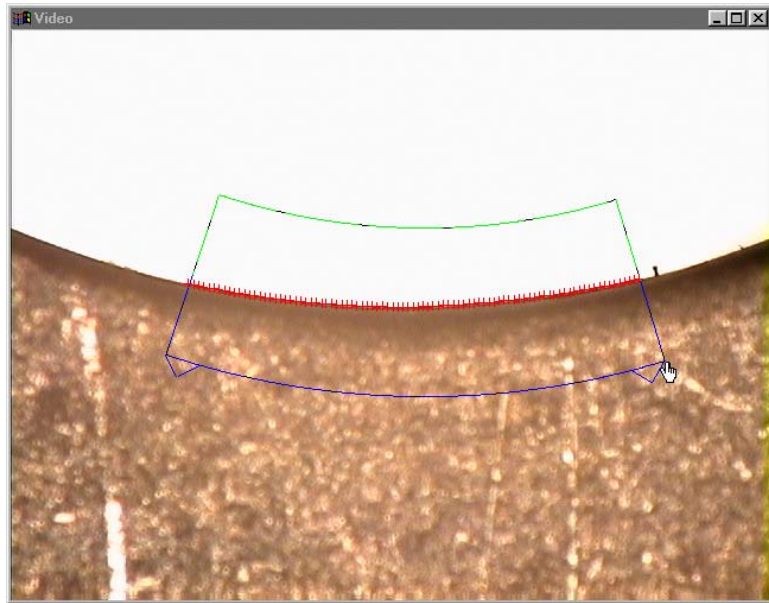


Step 2
Click the center mouse button to fire the probe tool.



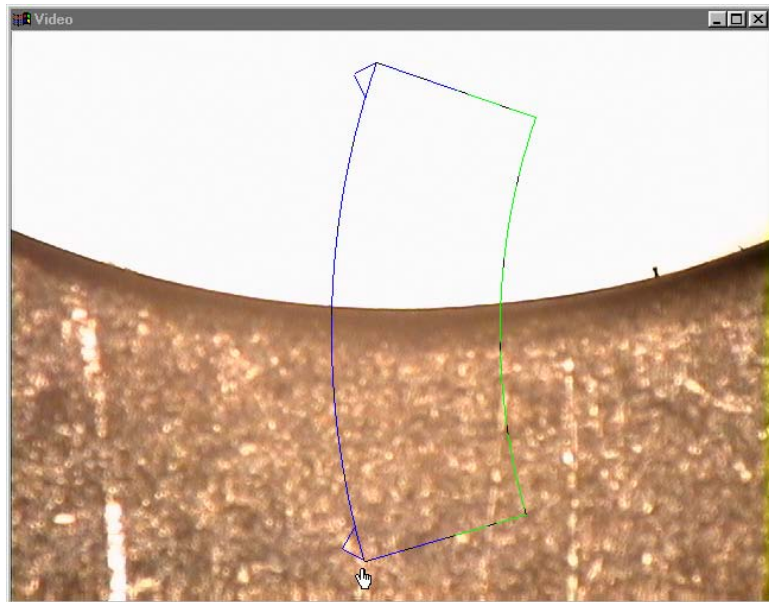
Step 3

Place the hand cursor over the corner of the probe tool as shown.

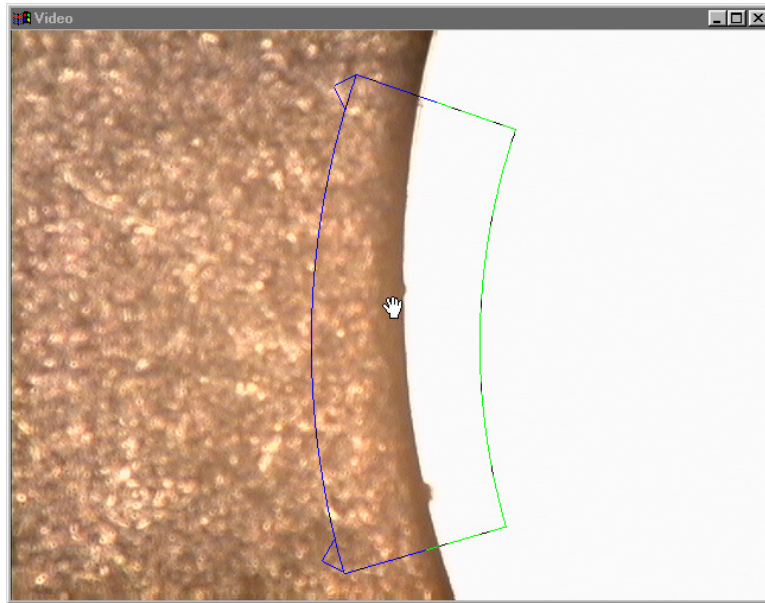


Step 4

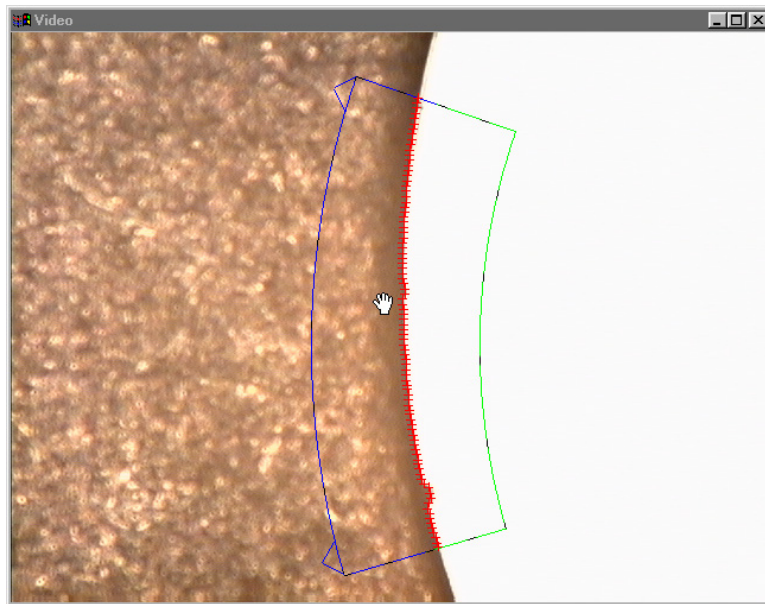
Hold the mouse button and drag the corner of the probe tool to rotate as shown.



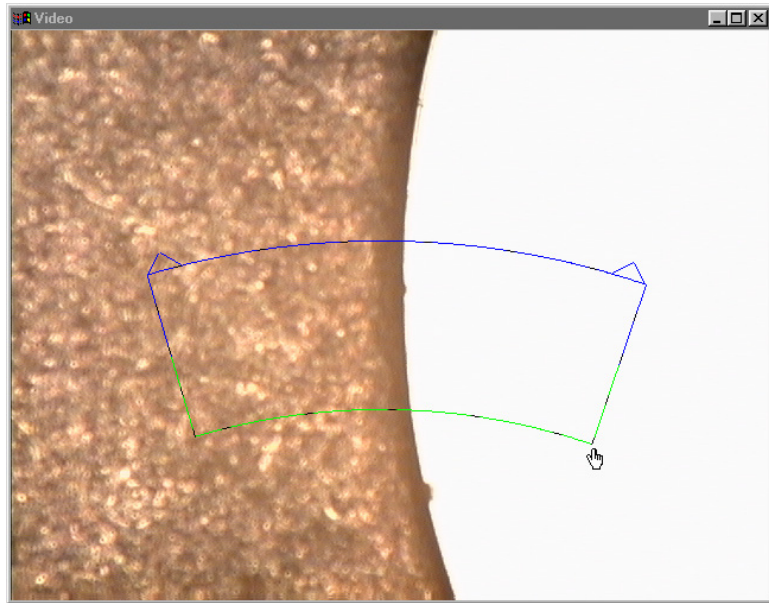
Step 5
Move the part and place the probe tool as shown.



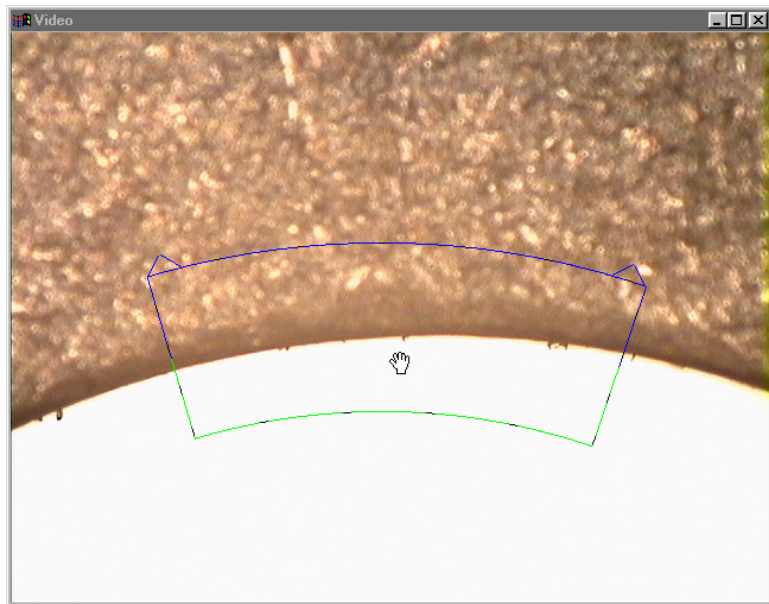
Step 6
Click the center mouse button to fire the probe tool.



Step 7
Rotate the probe tool as shown.



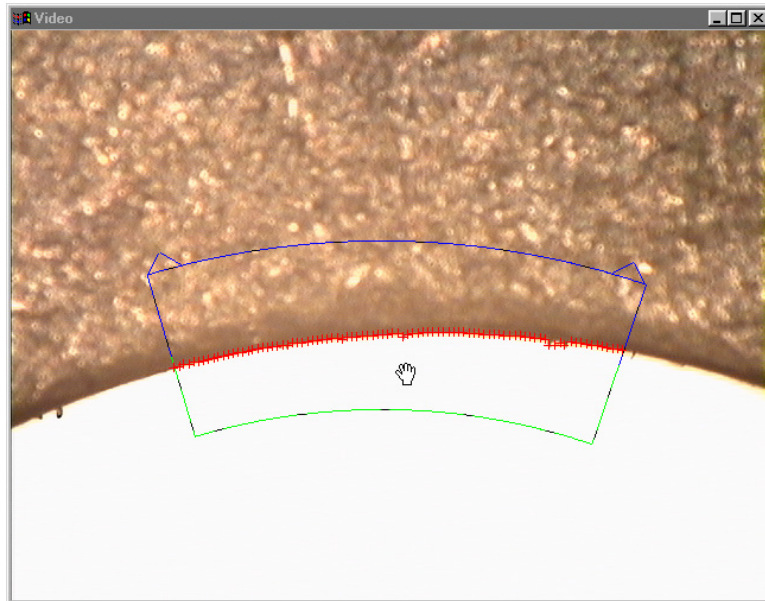
Step 8
Move the part and place the probe tool as shown.



Chapter 2 Quick Start

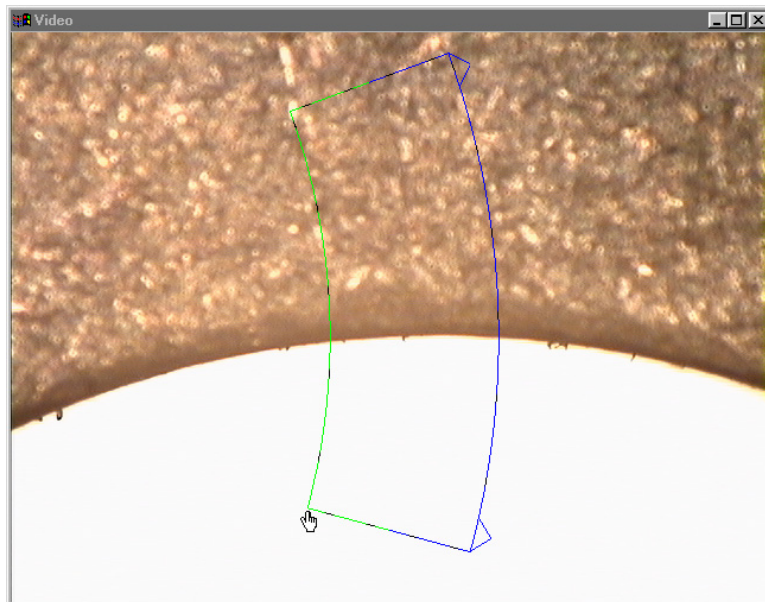
Step 9

Click the center mouse button to fire the probe tool.

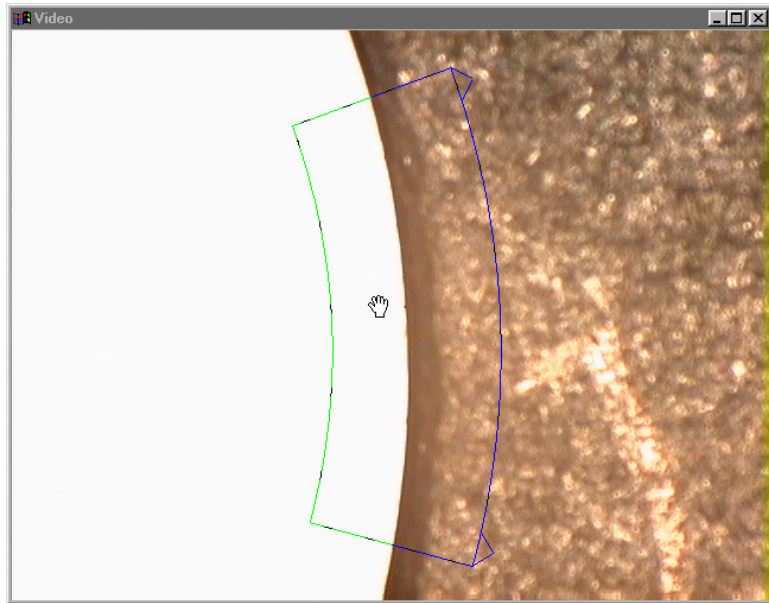


Step 10

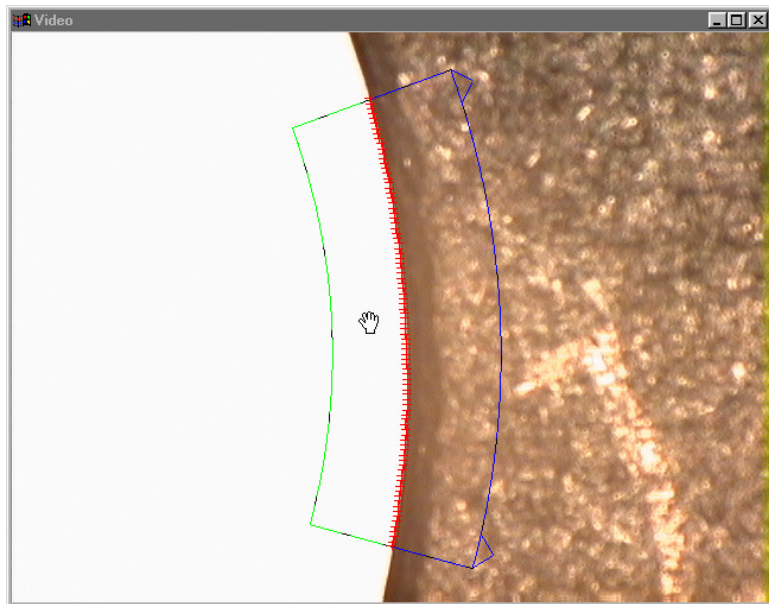
Rotate the probe tool as shown.



Step 11
Move the part and place the probe tool as shown.

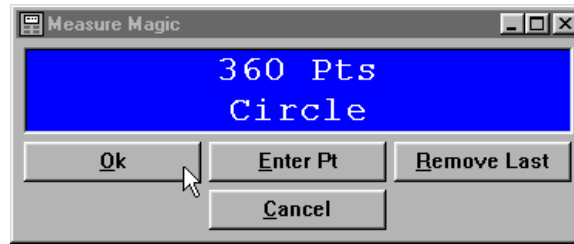


Step 12
Click the center mouse button to fire the probe tool.



Chapter 2 Quick Start

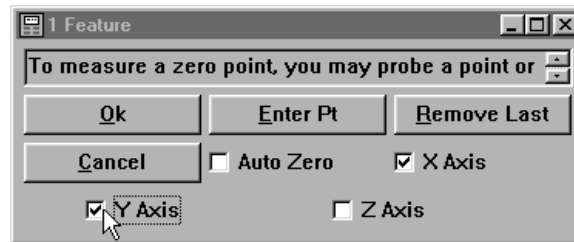
Step 13
Click OK in the dialog box.



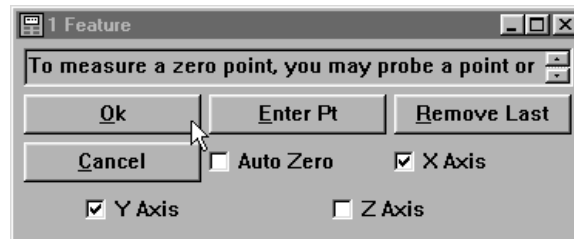
Step 14
Click the *zero button* on the datum toolbar.



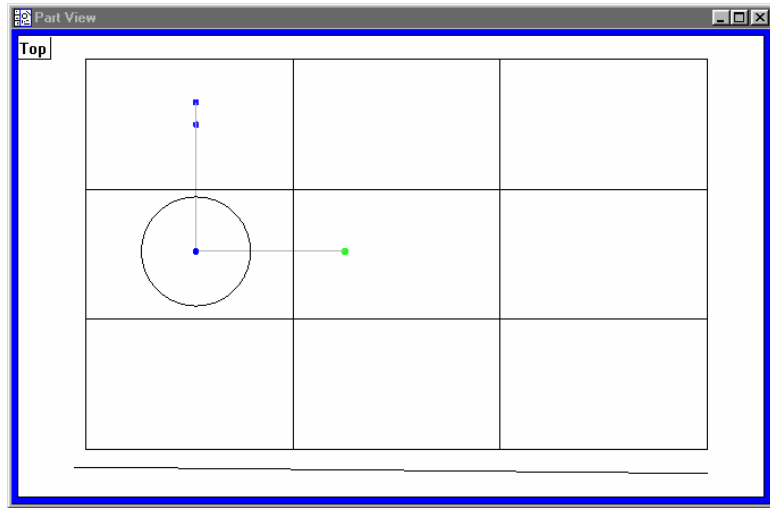
Step 15
Check X and Y axes as shown.



Step 16
Click OK in the dialog box.



The reference frame appears in the part view window.

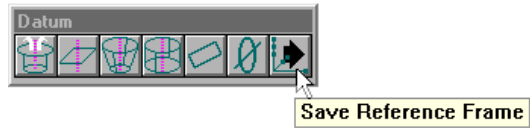


Save the Reference Frame

To save the reference frame

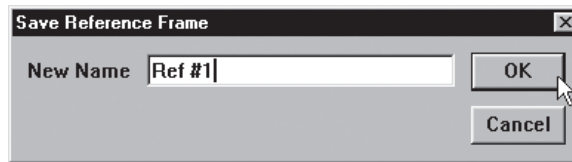
Step 1

Click the *save reference frame* button on the datum toolbar.



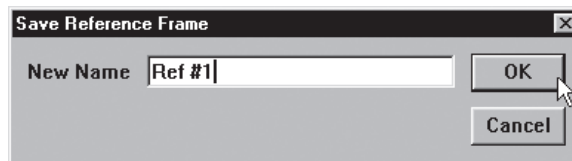
Step 2

Type a name for the reference frame.



Step 3

Click OK in the dialog box.

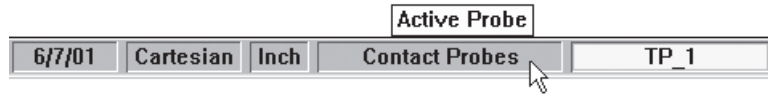


Change the active probe group to *contact probes*. Use the following procedure.

To activate the contact probe group

Step 1

Click on the status bar as shown until *contact probes* appears in the box.



The contact probes group is now the active.



NOTE

The names assigned to probes and probe groups may vary from those shown here.



NOTE

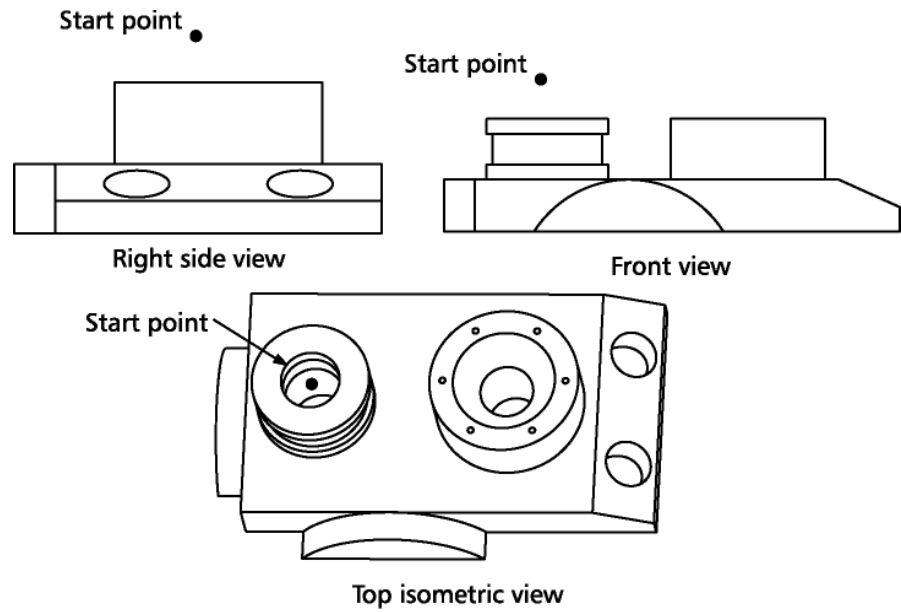
Dim the light controls to darken the live video window while using the touch probe.

Touch Probe Measurement



Use the touch probe group to complete the following measurements. Move the probe to a safe start point well clear of the part geometry as shown.

CAUTION
Insert clearance moves as necessary to safely position the probe.



To measure a circle

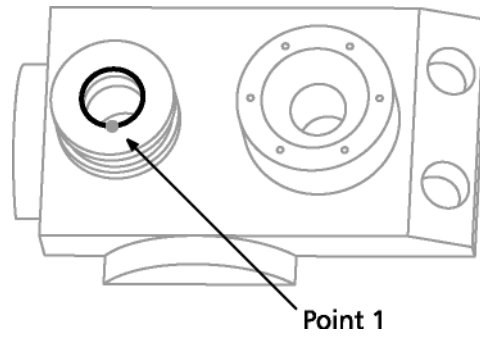


NOTE

Three points are required to measure a circle. Use more points to increase accuracy.

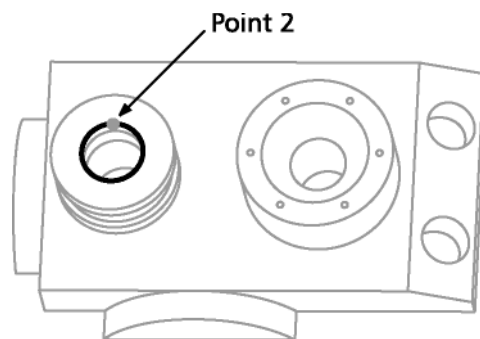
Step 1

Probe the first point as shown.



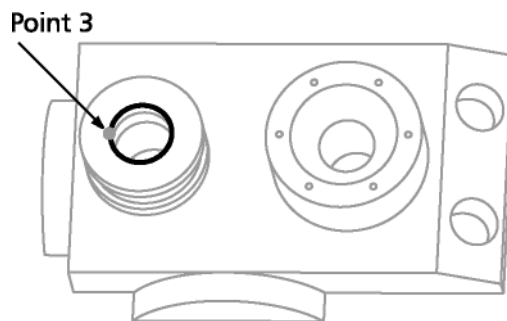
Step 2

Probe the second point as shown.

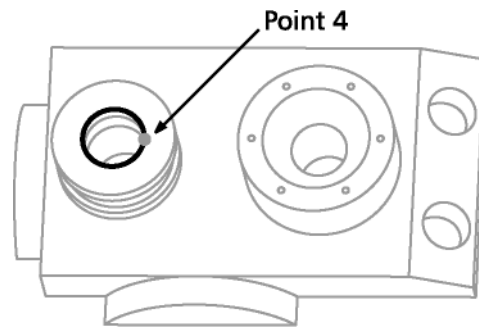


Step 3

Probe the third point as shown.



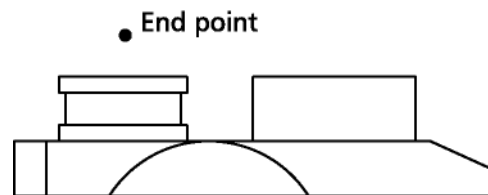
Step 4
Probe the fourth point as shown.



Step 5
Click OK in the dialog box.



Step 6
Move the probe to the end point as shown.

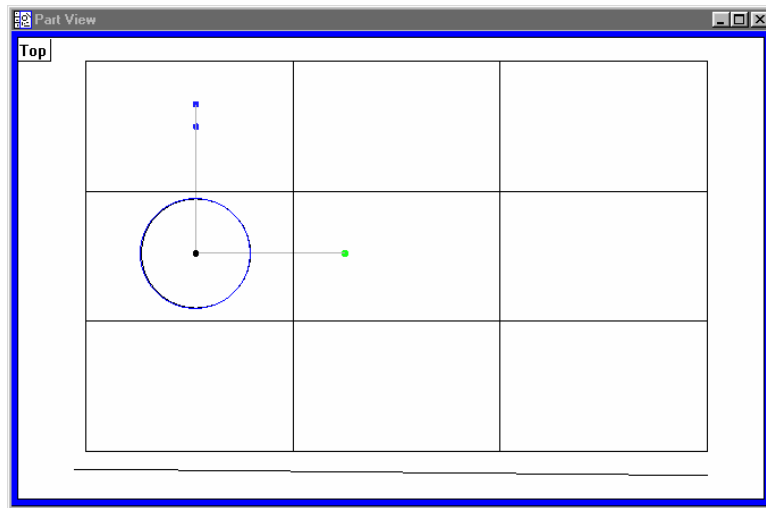


Front view

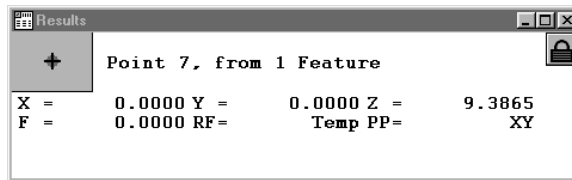
Step 7
Click the *goto* button on the program toolbar.



The circle appears in the part view window.



Measurement results are displayed in the results window.



Chapter 2 Quick Start

Measuring 3-D Features

Follow the directions in this section to measure a circle, a cone, a cylinder, and a plane.

Change the part view window perspective to *south east view* for these measurements. This will provide a better view for three-dimensional measuring.

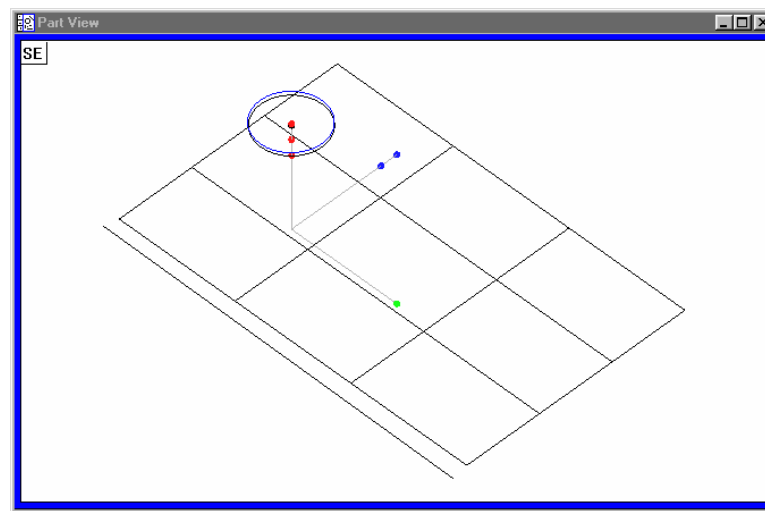
To change the part view perspective

Step 1

Click the *south east view* button on the view toolbar.

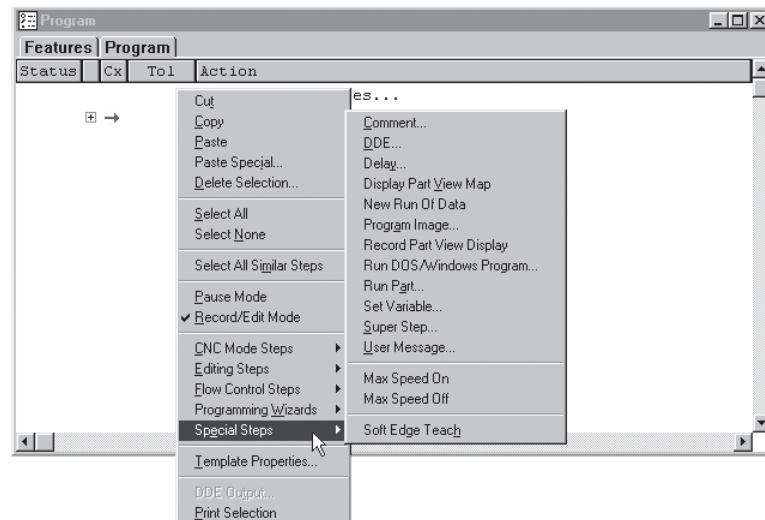


The part view window appears as shown.



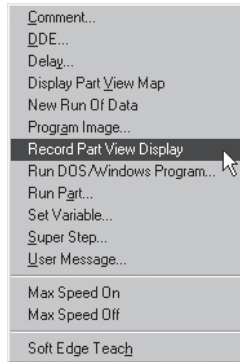
Step 2

Right-click on the program template and select special steps as shown.

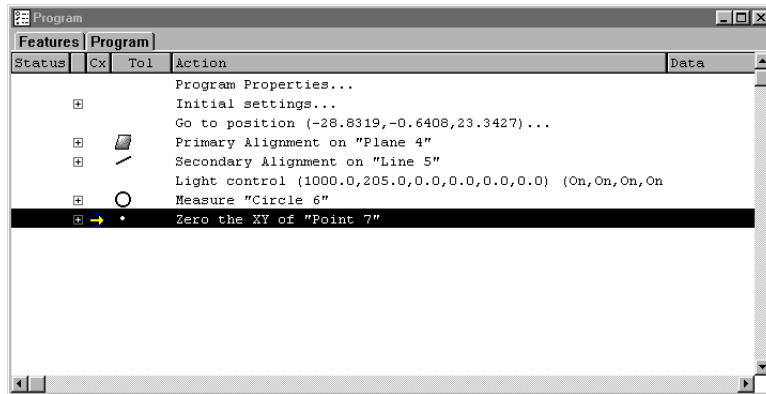


Step 3

Select *record part view display* as shown.

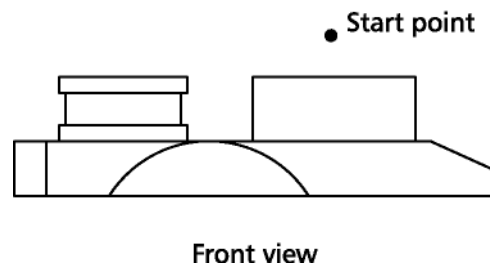


The program template displays the steps as recorded.

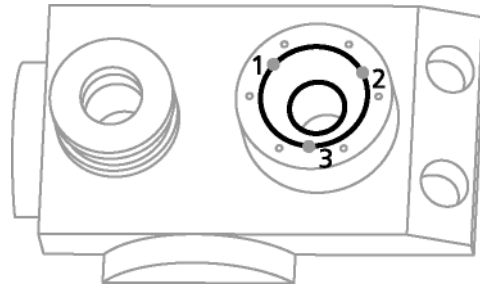


To measure a cone

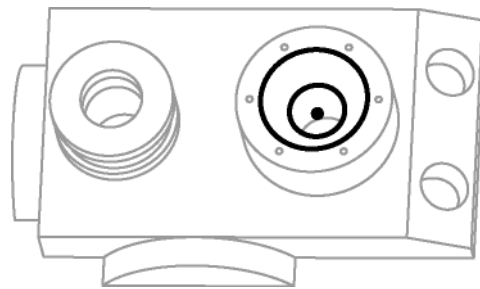
Step 1
Position the probe as shown.



Step 2
Probe 3 points around the top of the cone as shown.



Step 3
Position the probe over the center of the cone at about the same level as points 1, 2, and 3 as shown.

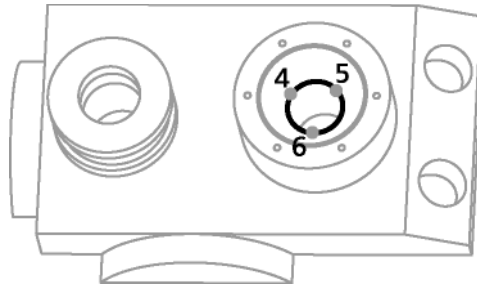


Step 4
Click the *goto* button on the program toolbar.



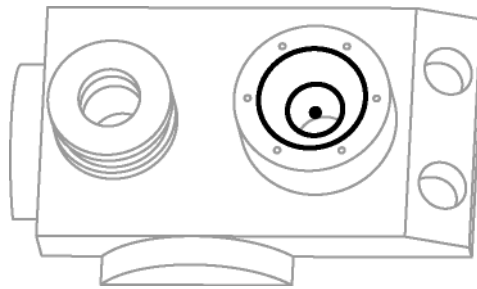
Step 5

Probe 3 points around the bottom of the cone as shown.



Step 6

Position the probe above the center of the cone and clear of the part.



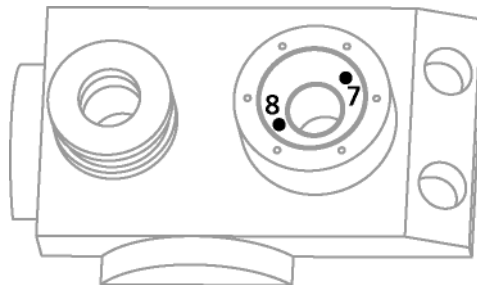
Step 7

Click the *goto here button* on the program toolbar.



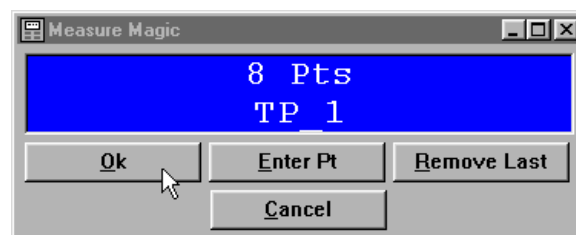
Step 8

Probe two additional points as shown.



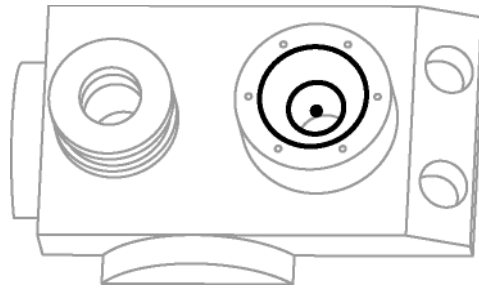
Step 9

Click OK in the dialog box.



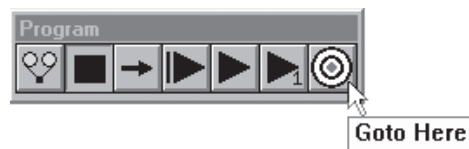
Step 10

Position the probe above the center of the cone at about the same level as points 1, 2, and 3 as shown.

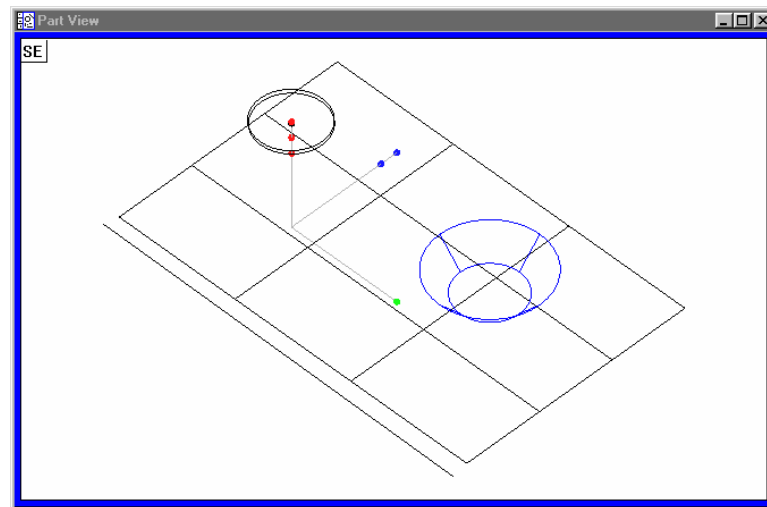


Step 11

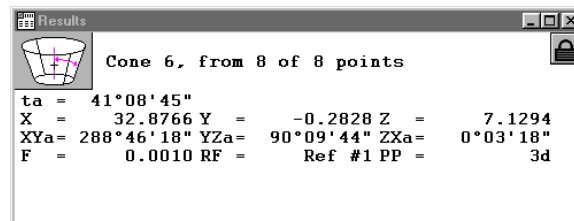
Click the *goto here button* on the program toolbar.



The cone appears in the part view window.



Measurement results are displayed in the results window.

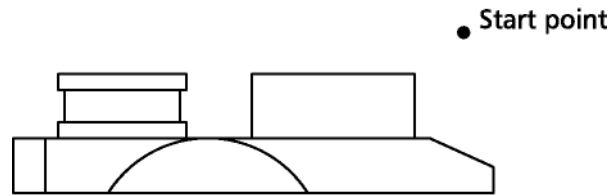


To measure a cylinder

Step 1
Position the probe as shown.



CAUTION
Insert any clearance moves necessary to avoid probe collisions.

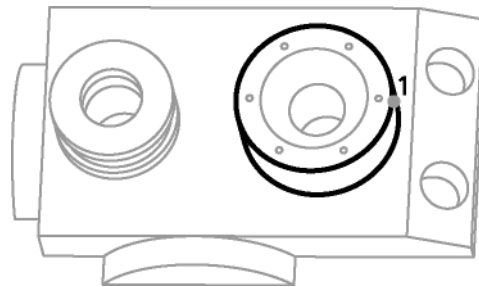


Front view

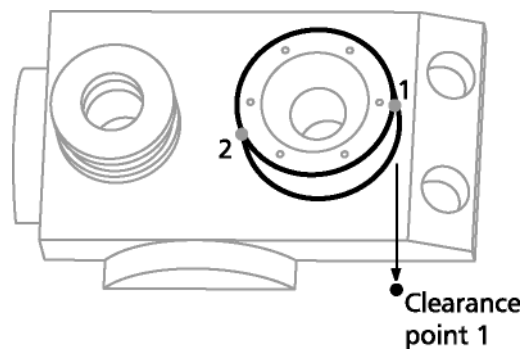


NOTE
Points 1, 2, and 3 are around the top of the cylinder.

Step 2
Probe the first point as shown.



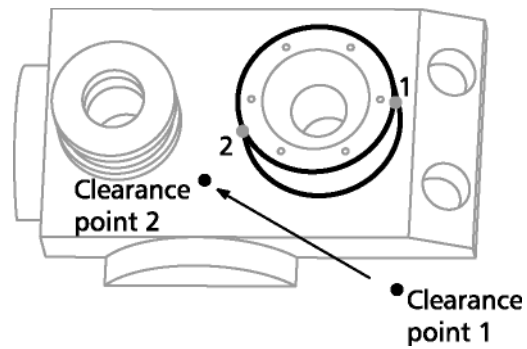
Step 4
Insert *clearance point 1* as shown.



Step 5
Click the goto button on the program toolbar.



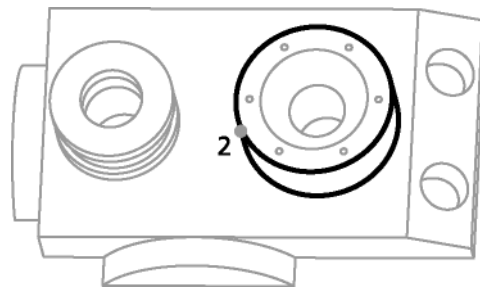
Step 6
Insert *clearance point 2* as shown.



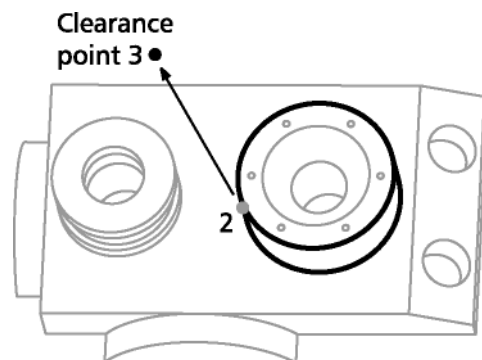
Step 7
Click the goto button on the program toolbar.



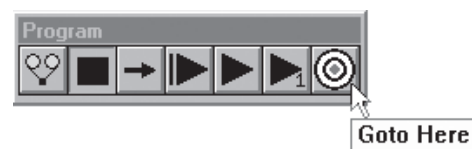
Step 8
Probe the second point as shown.



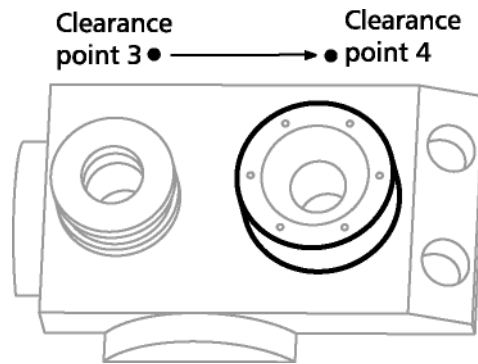
Step 9
Insert *clearance point 3* as shown.



Step 10
Click the goto button on the program toolbar.



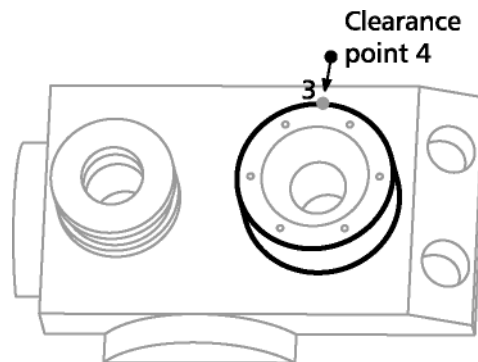
Step 11
 Insert *clearance point 4* as shown.



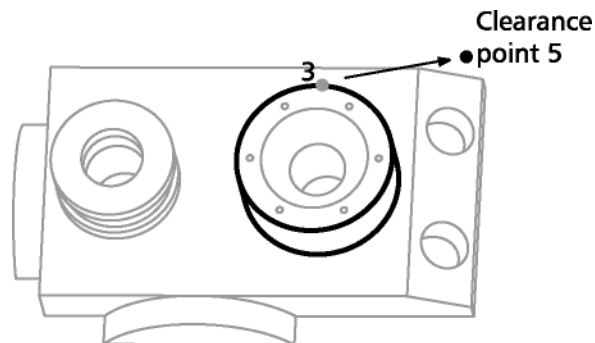
Step 12
 Click the goto button on the program toolbar.



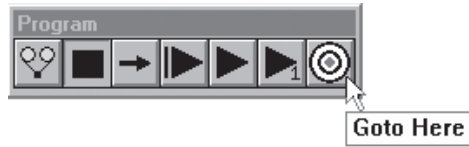
Step 13
 Probe the third point as shown.



Step 14
 Insert *clearance point 5* as shown.

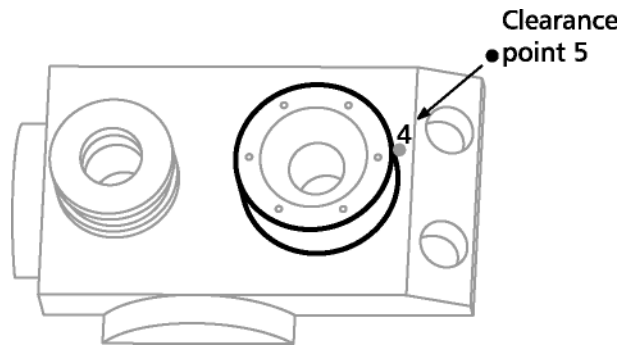


Step 15
Click the goto button on the program toolbar.

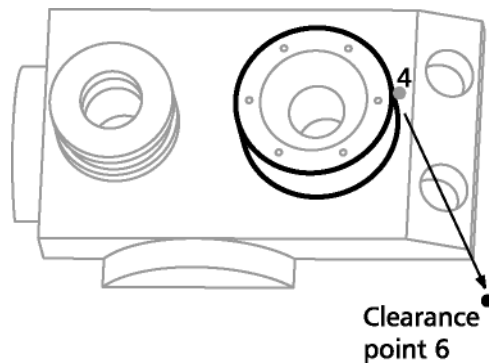


NOTE
Points 4, 5, and 6 are around the bottom of the cylinder.

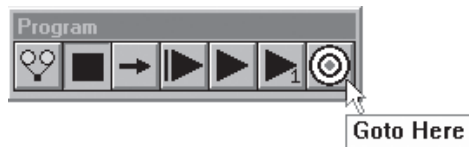
Step 16
Probe the fourth point as shown.



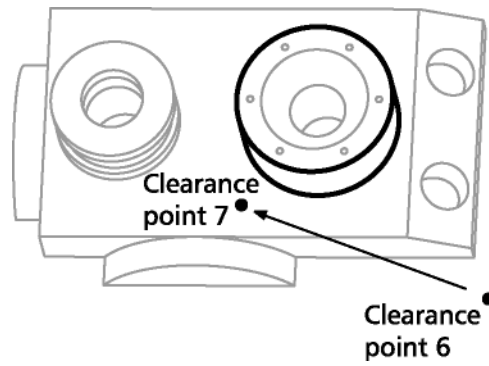
Step 17
Insert *clearance point 6* as shown.



Step 18
Click the goto button on the program toolbar.



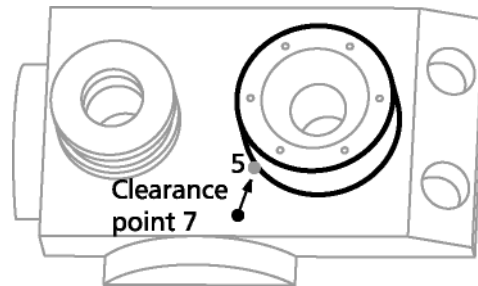
Step 19
 Insert *clearance point 7* as shown.



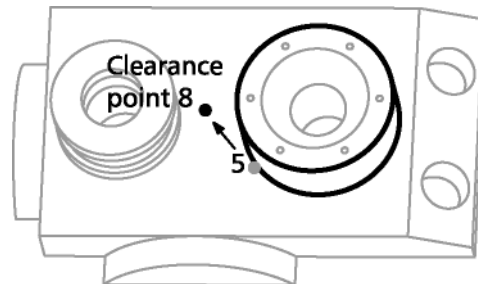
Step 20
 Click the *goto button* on the program toolbar.



Step 21
 Probe the fifth point as shown.



Step 22
 Insert *clearance point 8* as shown.

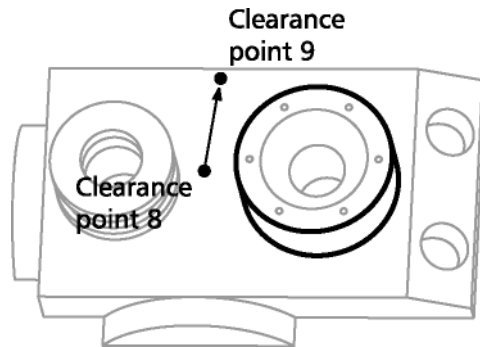


Chapter 2 Quick Start

Step 23
Click the *goto* button on the program toolbar.



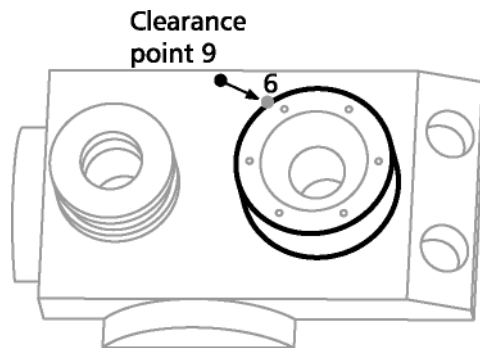
Step 24
Insert *clearance point 9* as shown.



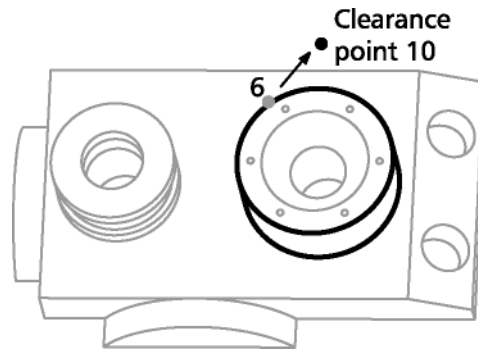
Step 25
Click the *goto* button on the program toolbar.



Step 26
Probe the sixth point as shown.



Step 27
 Insert *clearance point 10* as shown.

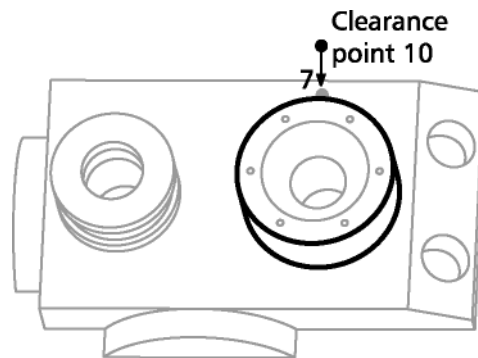


Step 28
 Click the *goto button* on the program toolbar.

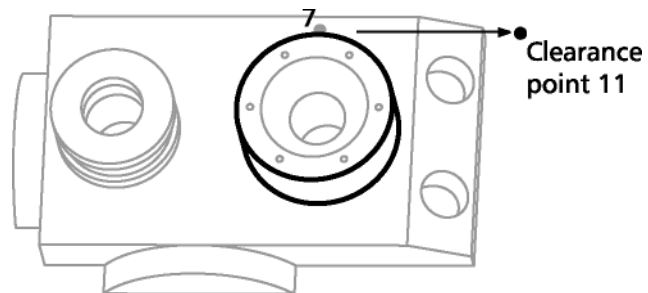


NOTE
 Points 7 and 8 are taken around the middle of the cylinder.

Step 29
 Probe the seventh point as shown.



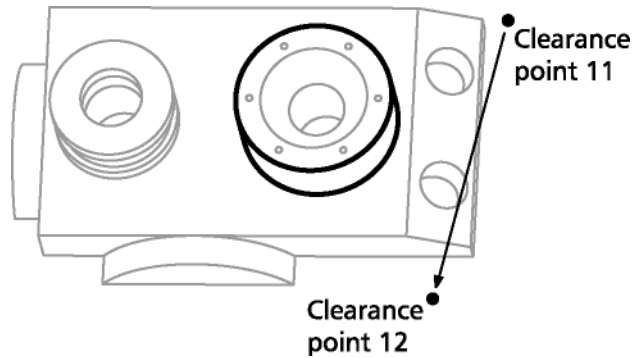
Step 30
 Insert *clearance point 11* as shown.



Step 31
Click the *goto* button on the program toolbar.



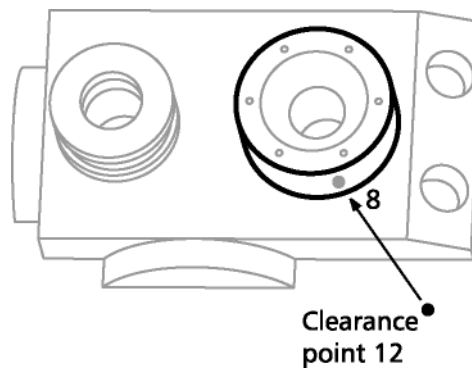
Step 32
Insert *clearance point 12* as shown.



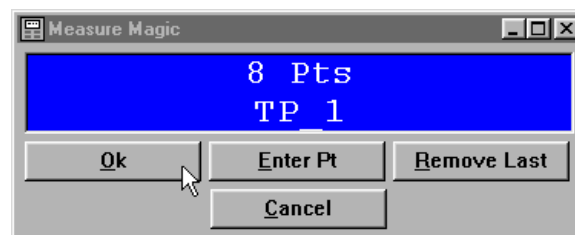
Step 33
Click the *goto* button on the program toolbar.



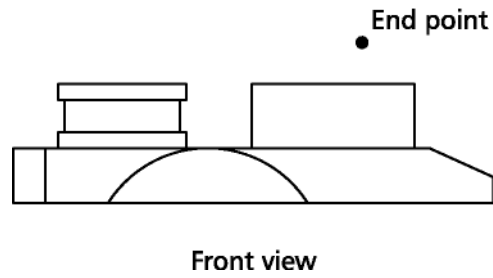
Step 34
Probe the eighth point as shown.



Step 35
Click OK in the dialog box.



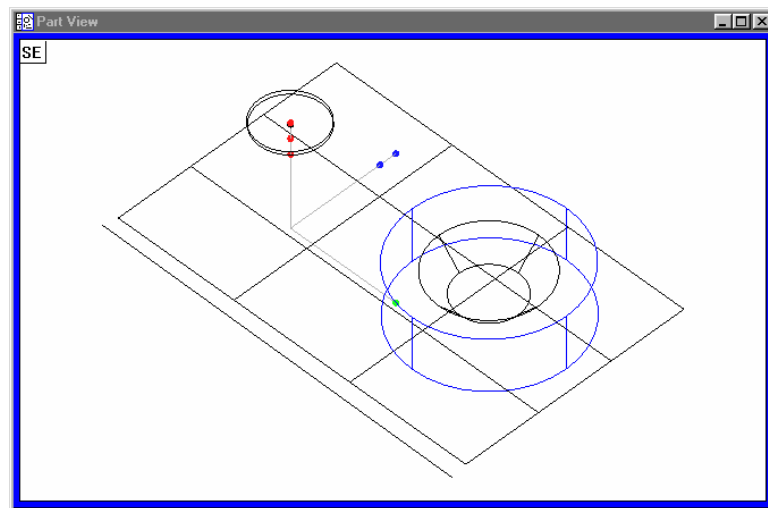
Step 36
 Move the probe to the end point as shown.



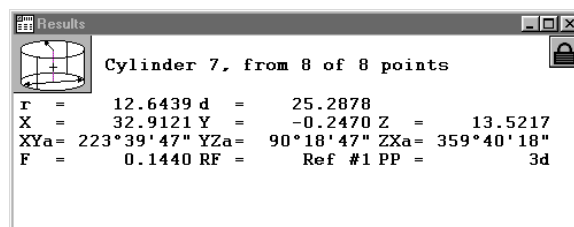
Step 37
 Click the *goto* button on the program toolbar.



The cylinder appears in the part view window.



Measurement results are displayed in the results window.

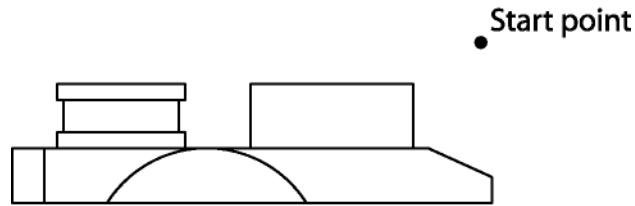


To measure a plane

Step 1
Position the probe as shown.

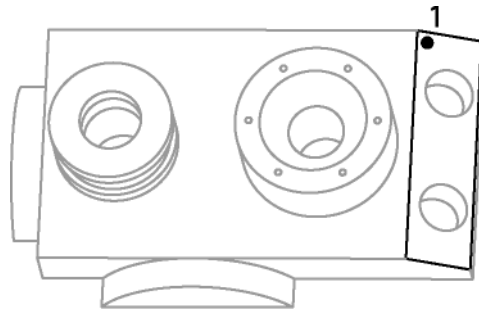


CAUTION
Insert any clearance moves necessary to avoid probe collisions.

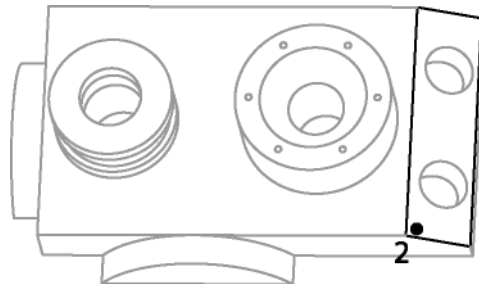


Front view

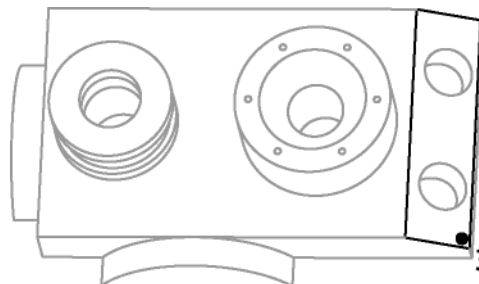
Step 2
Probe the first point as shown.



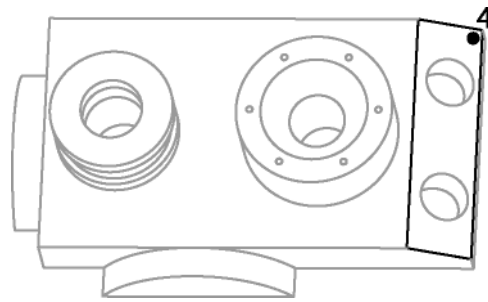
Step 3
Probe the second point as shown.



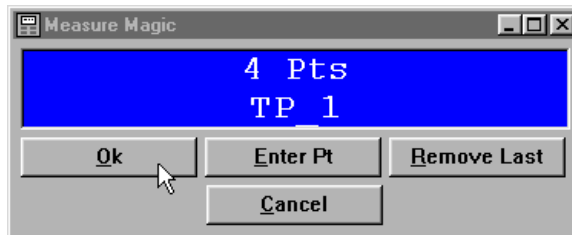
Step 4
Probe the third point as shown.



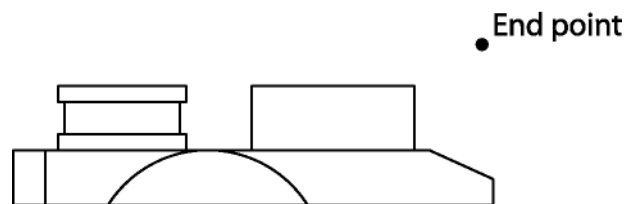
Step 5
Probe the fourth point as shown.



Step 6
Click OK in the dialog box.



Step 7
Move the probe to the end point as shown.

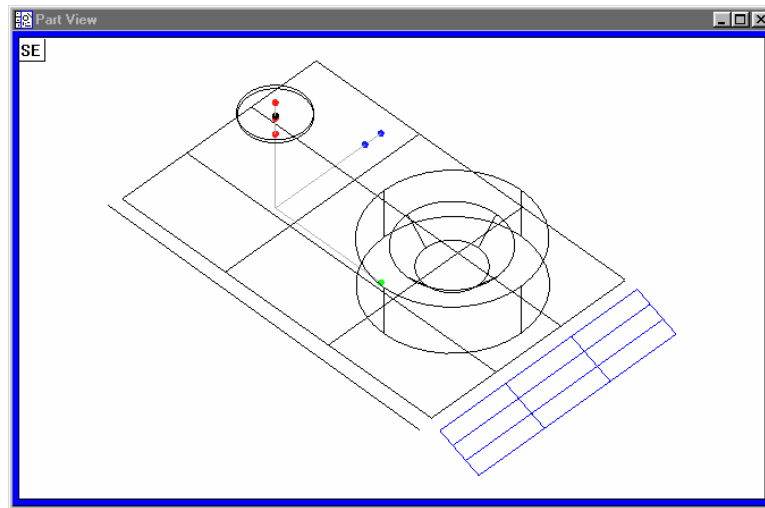


Front view

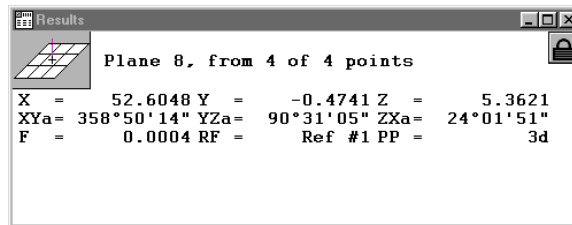
Step 8
Click the *goto* button on the program toolbar.



The plane appears in the part view window.



Measurement results are displayed in the results window.



2-D Measurement with VED

Follow the directions in this section to complete the feature measurements.

Change the part view window perspective to *top view* for these measurements. This will provide a better view for VED measuring.

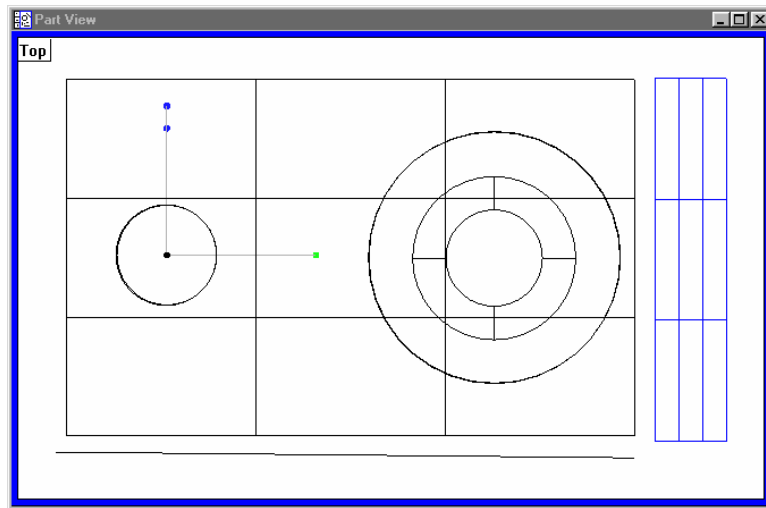
To change the part view perspective

Step 1

Click on *top view* on the view toolbar.

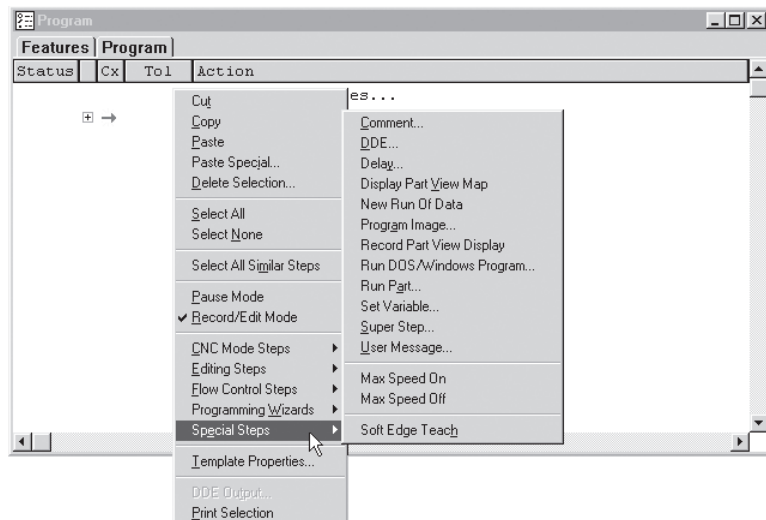


The part view window appears as shown.



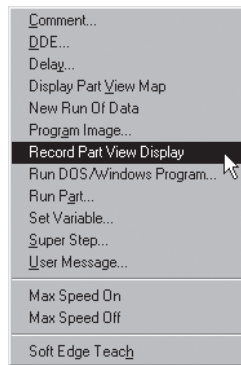
Step 2

Right-click on the program template and select special steps as shown.



Step 3

Select *record part view display* as shown.



Use the following instructions to switch to the VED probe group.

To activate the VED probe group

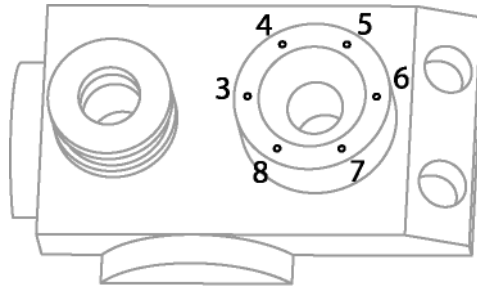
Step 1

Click on the status bar until *VED probes* is displayed as shown.



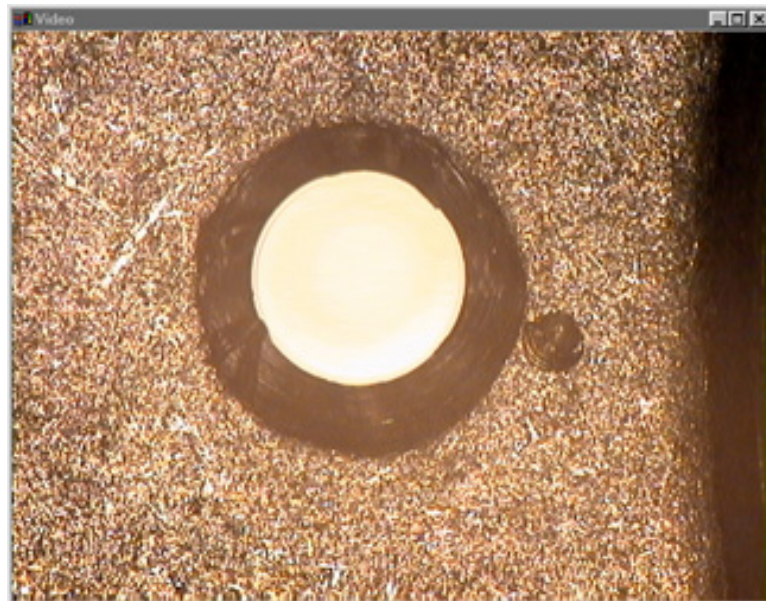
The VED probe group is now active.

Follow the instructions in the section to measure circles 3 through 8.



Circles 3 through 8

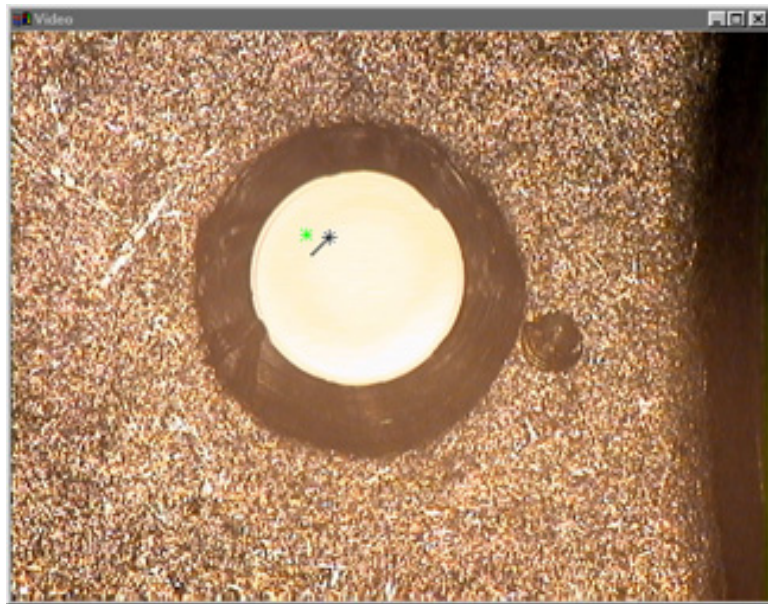
Position the circle 3 in the center of the field of view (FOV) as shown.



To create a circle probe tool

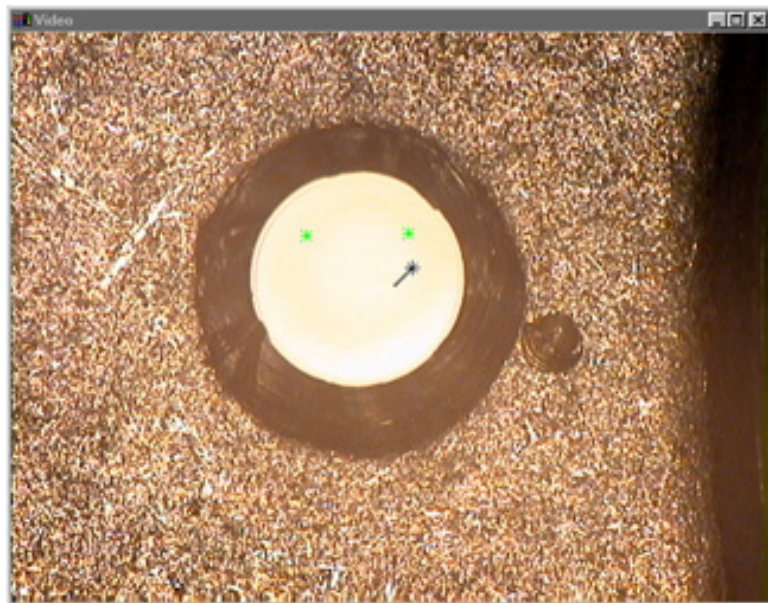
Step 1

Place the wand tool in the center of circle 3 as shown and click.



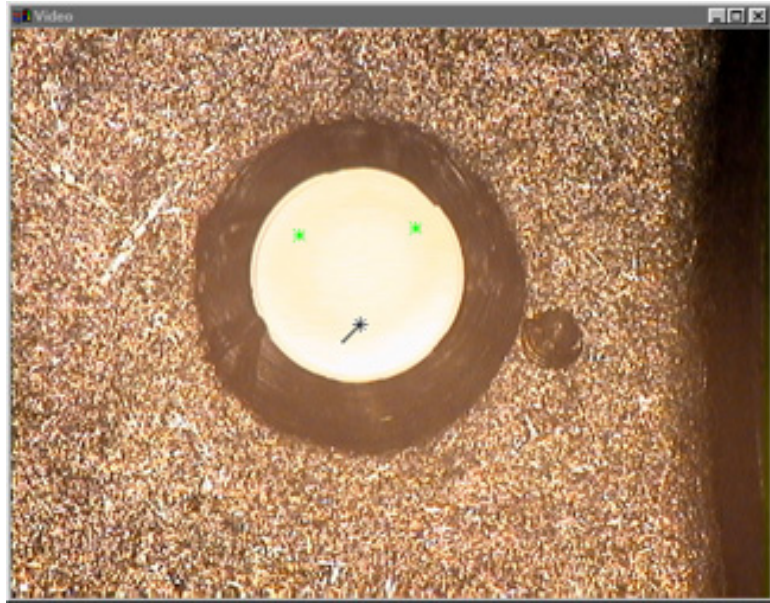
Step 2

Place the wand tool as shown and click.



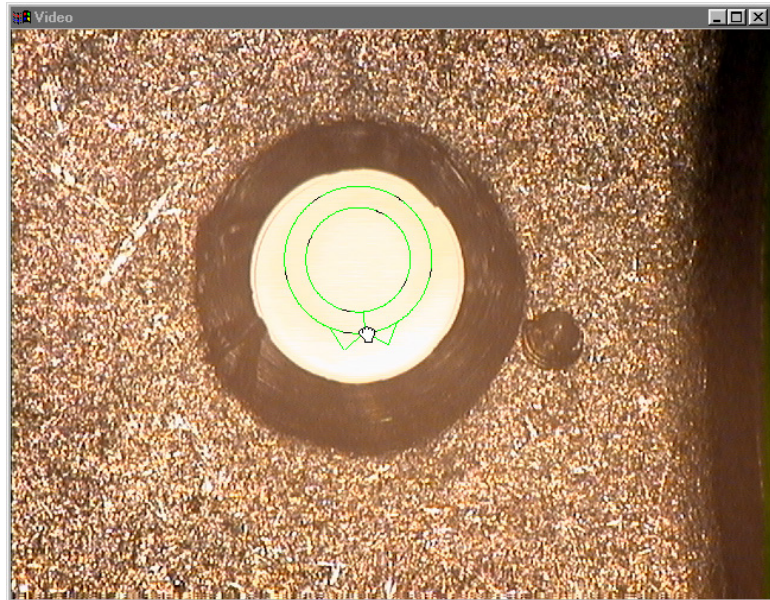
Step 3

Place the wand tool as shown hold the left-mouse button and drag out of the circle.

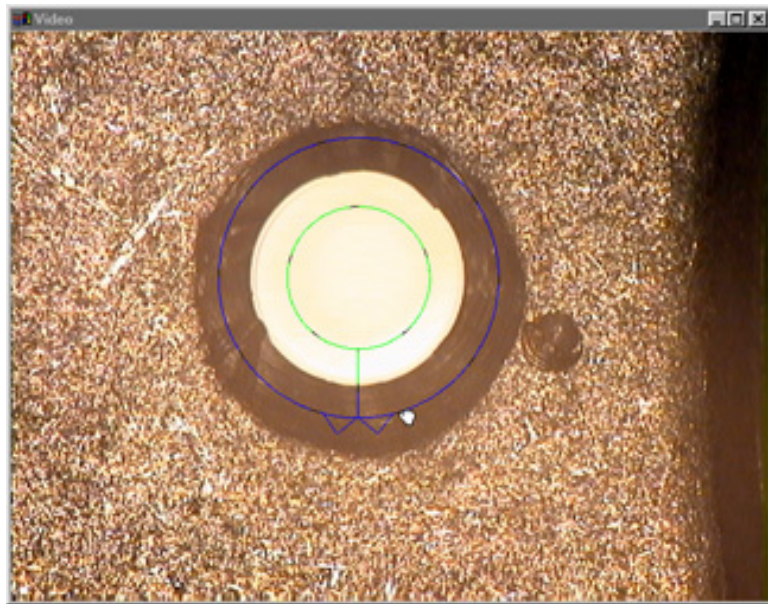


Step 4

Release the mouse button.



The circle tool is created



To measure circle 3

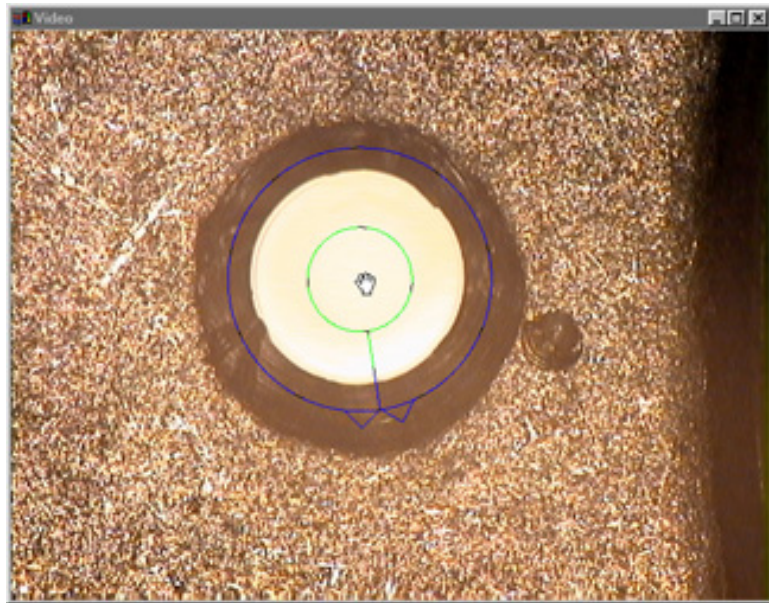
Step 1

Place the *circle tool* over circle 3 as shown.



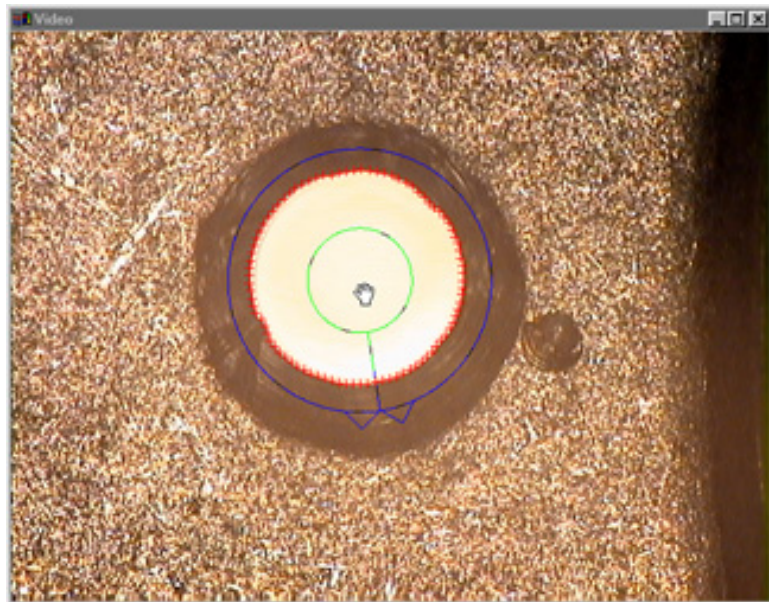
NOTE

Video measurements are most accurate in the center of the field of view (FOV). Center the probe tool by double-clicking the tool button on the VED toolbar.



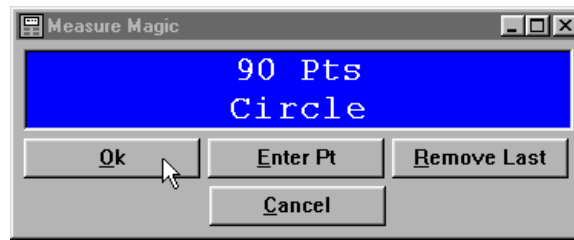
Step 2

Click the center mouse button.

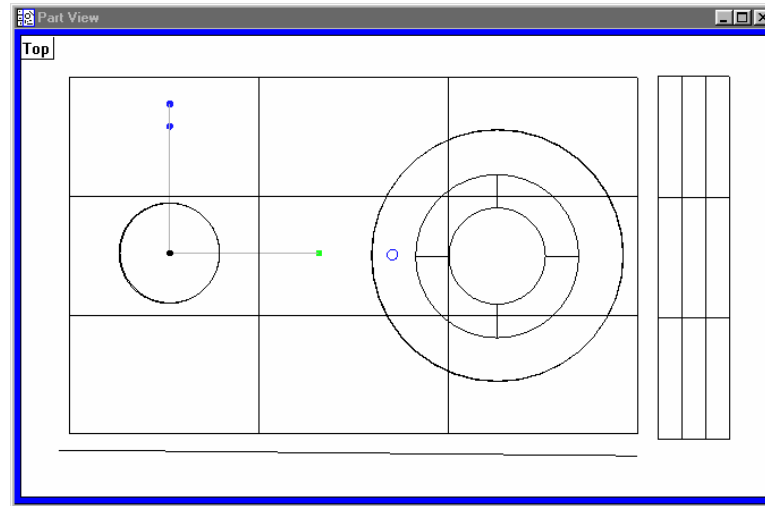


Chapter 2 Quick Start

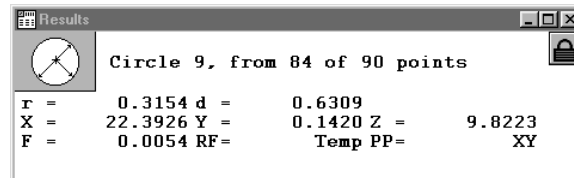
Step 3
Click OK in the dialog box.



The circle appears in the part view window.



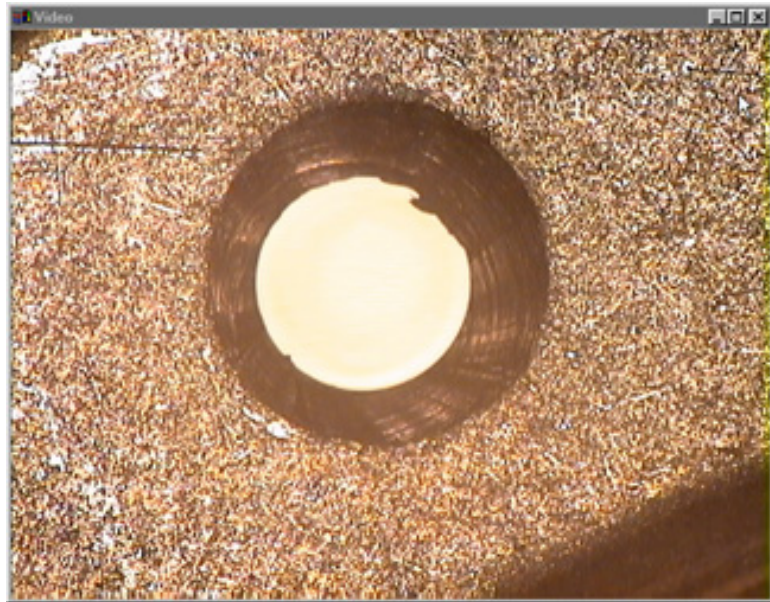
Measurement results are displayed in the results window.



To measure circle 4

Step 1

Move circle 4 into the field of view as shown.

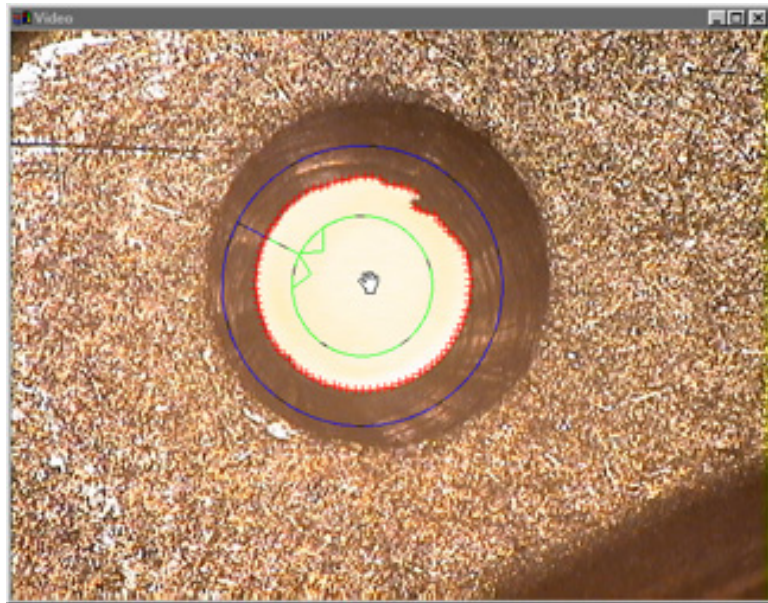


Step 2

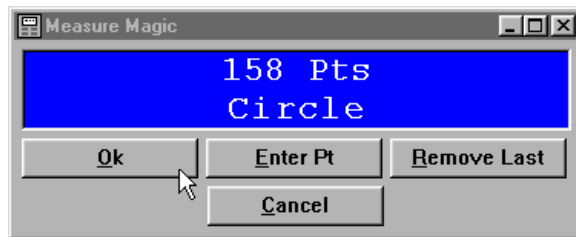
Place the *wand tool* in the center of the circle.



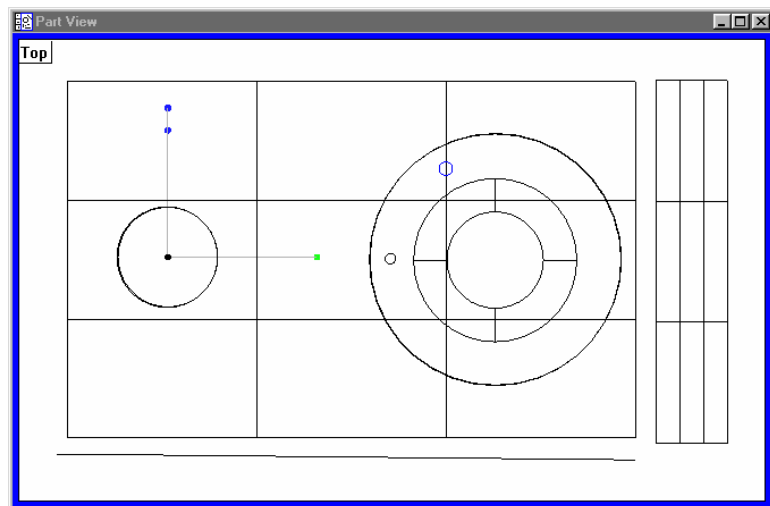
Step 3
Click the center mouse button.



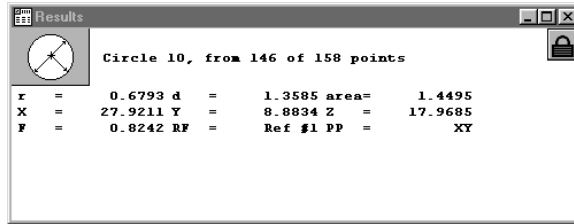
Step 4
Click OK in the dialog box.



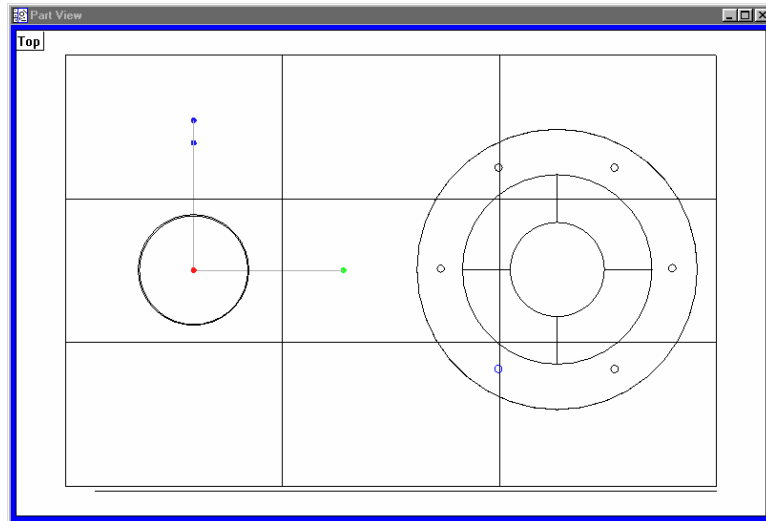
The circle appears in the part view window.



Measurement results are displayed in the results window.



Use either method to measure circles 5 through 8.



To construct a bolt hole circle

Step 1

Click the *circle button* on the measure toolbar.



Step 2

Highlight circles 3 through 8 in the features list as shown.



NOTE

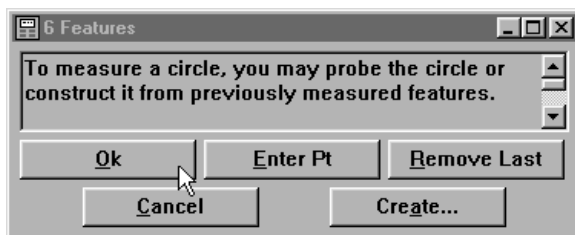
Users can also select features by clicking on them in the part view window.

The image shows a 'Features' window with a table listing various features. The 'Circle 9' through 'Circle 14' rows are highlighted in black. A mouse cursor is pointing at the 'Circle 14' row.

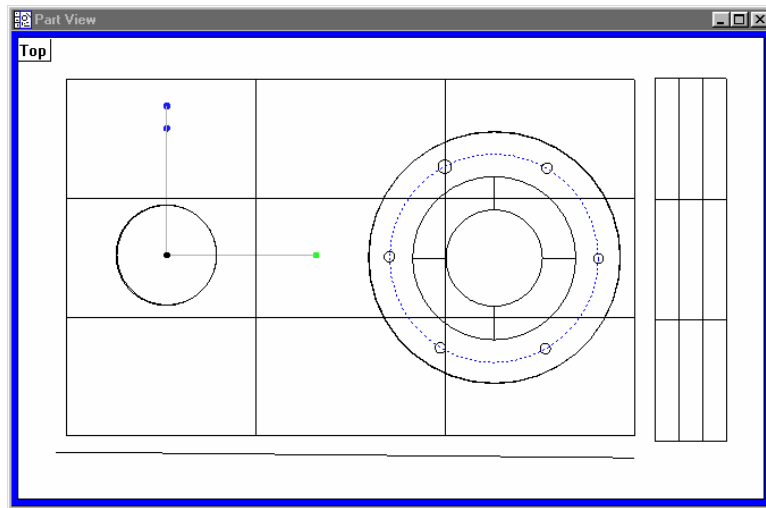
I	To1	Name	Datum	X	Y	area
		Plane 1		18.4102	-0.2483	
		Line 2		17.8677	-20.0731	
		Circle 3		0.0000	0.0000	78.8549
		Point 4	Zero	0.0000	0.0000	
		Circle 5		-0.0716	-0.0034	80.1321
		Cone 6		32.8766	-0.2828	
		Cylinder 7		32.9121	-0.2470	
		Plane 8		52.6048	-0.4741	
		Circle 9		22.3643	-0.1627	0.8561
		Circle 10		27.9211	8.8834	1.4495
		Circle 11		38.1828	8.7321	0.8534
		Circle 12		43.3709	-0.3684	0.7343
		Circle 13		38.0251	-9.3996	0.8459
		Circle 14		27.4673	-9.3237	0.8586

Step 3

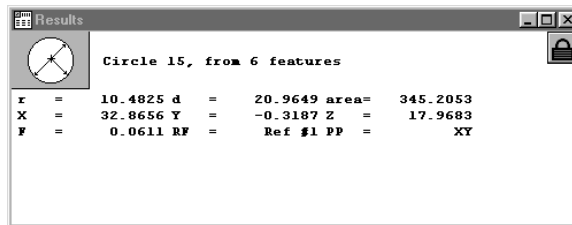
Click OK in the dialog box.



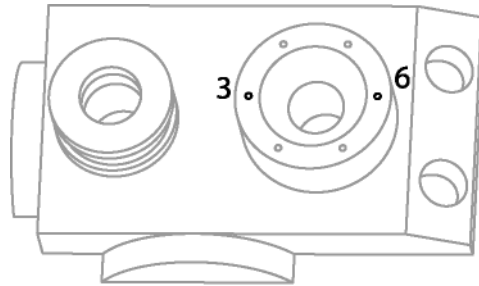
The circle appears in the part view window.



Measurement results are displayed in the results window.



To construct a nearest distance



Circles 3 and 6

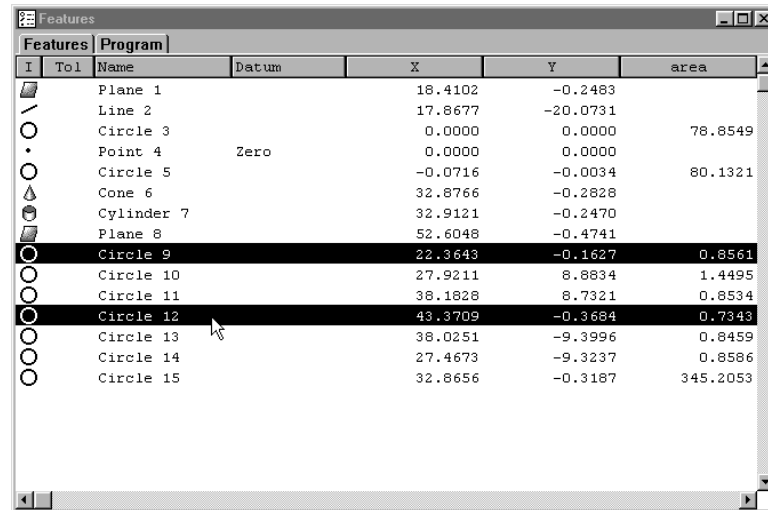
Step 1

Highlight circles 3 and 6 in the features list as shown.



NOTE

Hold down the *control (ctrl)* key to select items that are not sequential in the features list.



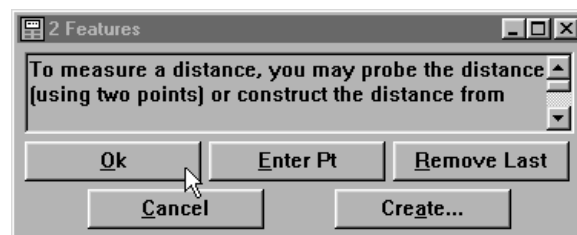
Step 2

Click the *distance button* on the measure toolbar.



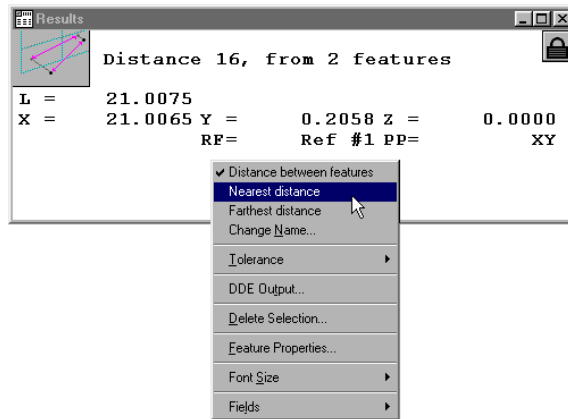
Step 3

Click OK in the dialog box.

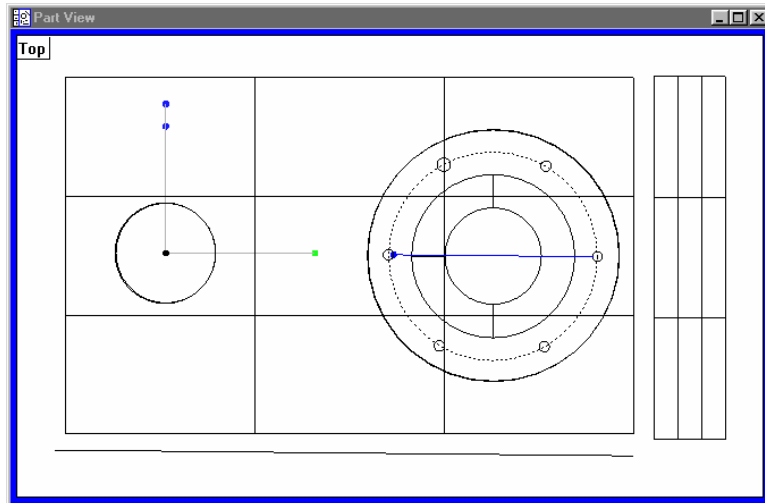


Step 4

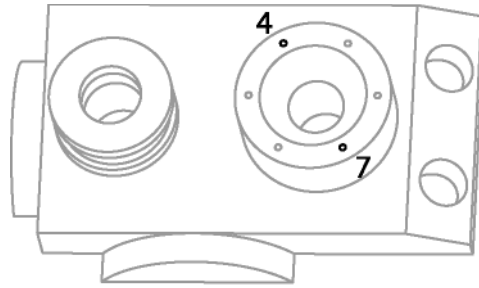
Right-click in the results window and select *nearest distance*.



The constructed nearest distance between the two circles appears in the part view window.

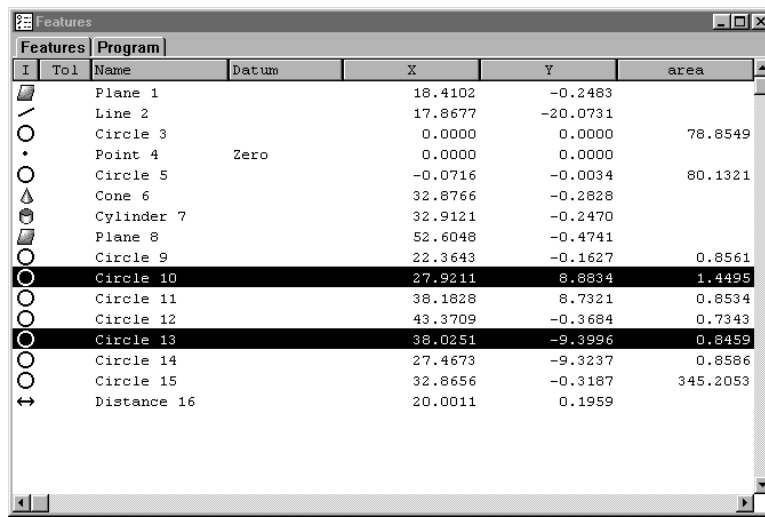


To construct a farthest distance



Circles 4 and 7

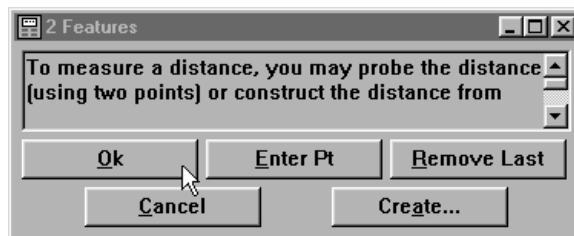
Step 1
Highlight circles 4 and 7 in the features list as shown.



Step 2
Click on the *distance button* on the measure toolbar.

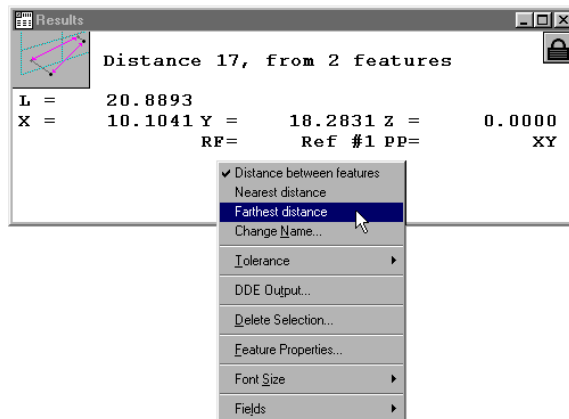


Step 3
Click OK in the dialog.

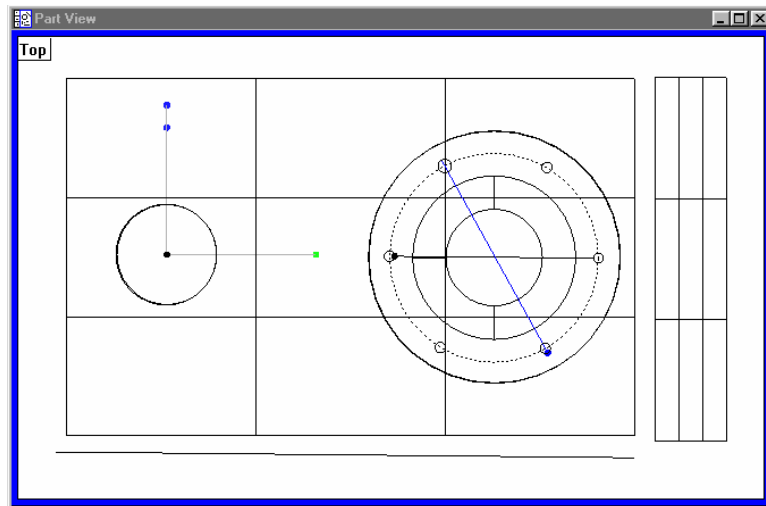


Step 4

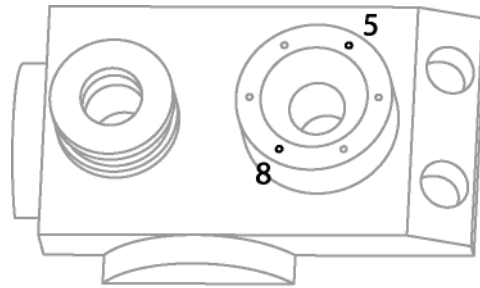
Right-click in the results window and select *farthest distance*.



The constructed farthest distance between the two circles appears in the part view window.



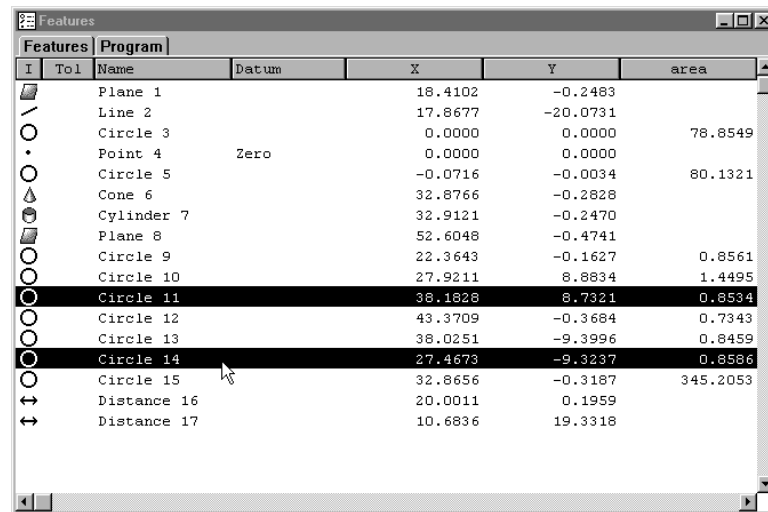
To construct a center-to-center distance



Circles 5 and 8

Step 1

Highlight circles 5 and 8 in the features list as shown.



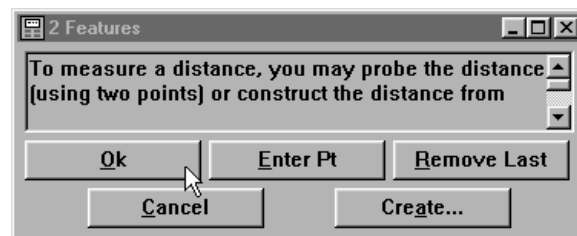
Step 2

Click the *distance button* on the measure toolbar.

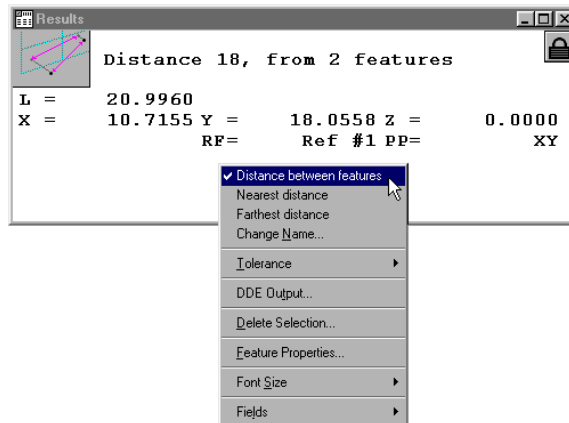


Step 3

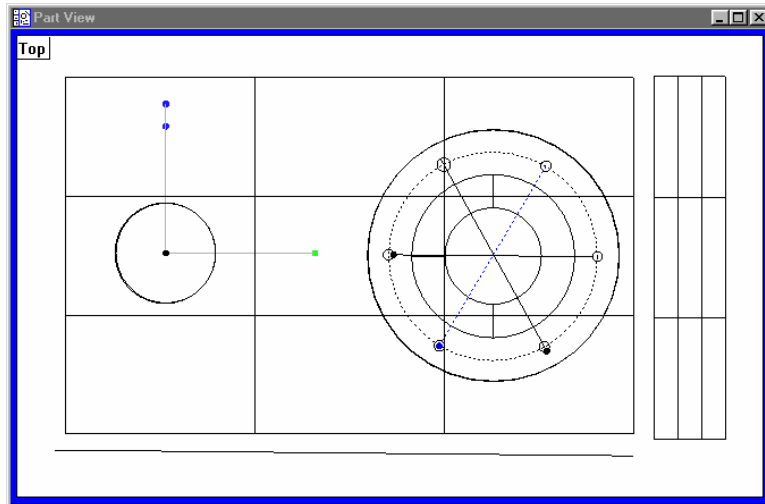
Click OK in the dialog box.



Step 4
 Right in the results window and select *distance between features*.



The constructed center-to-center distance between the two circles appears in the part view window.



Chapter 2 Quick Start

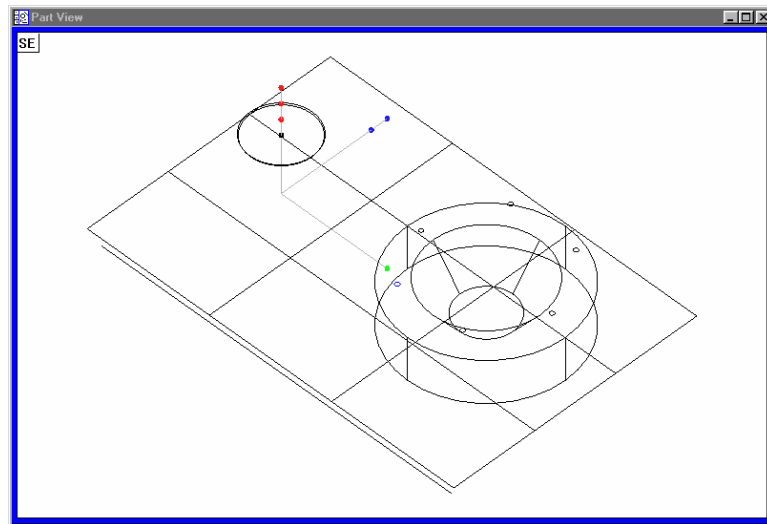
Creating the Second Reference Frame

To change the part view

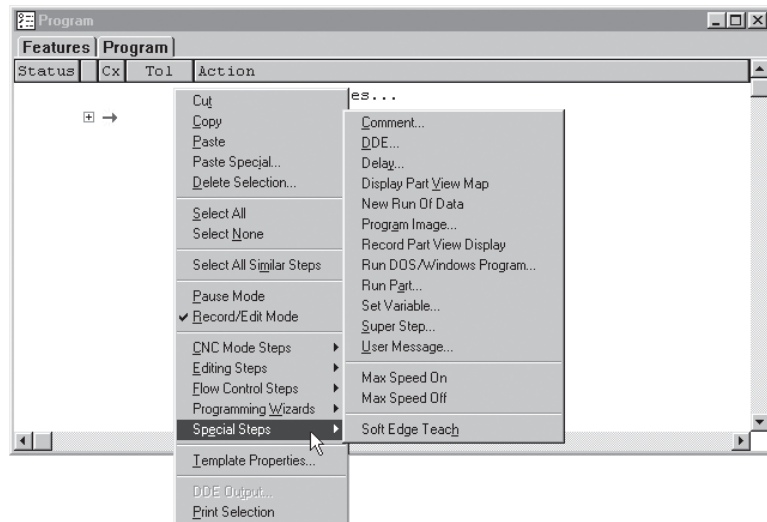
Step 1
Click the *SE view button* on the view toolbar.



The part view window appears as shown.

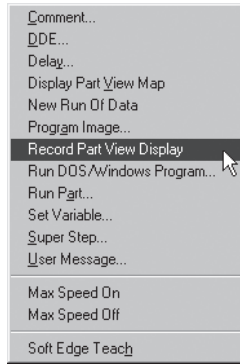


Step 2
Right-click on the program template and select special steps as shown.



Step 3

Select *record part view display*.



To measure a circle

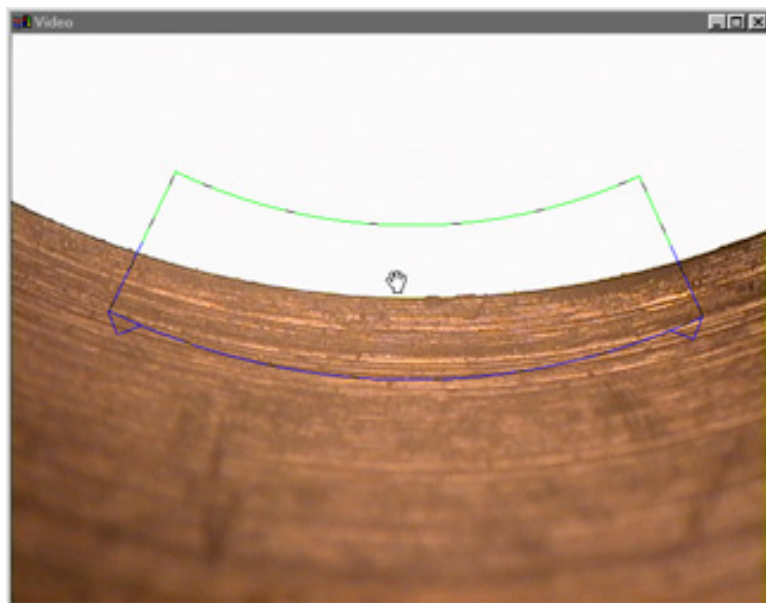
Step 1

Place the circle in the field of view (FOV) as shown.

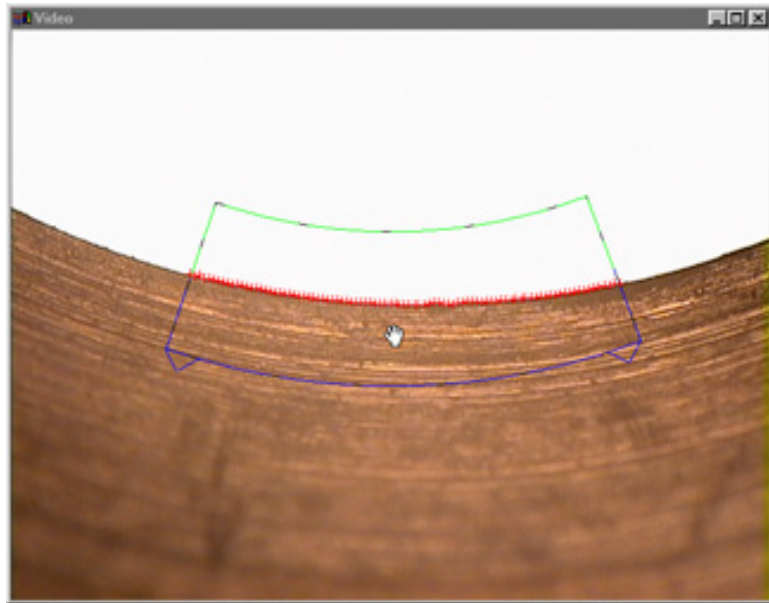


Step 2

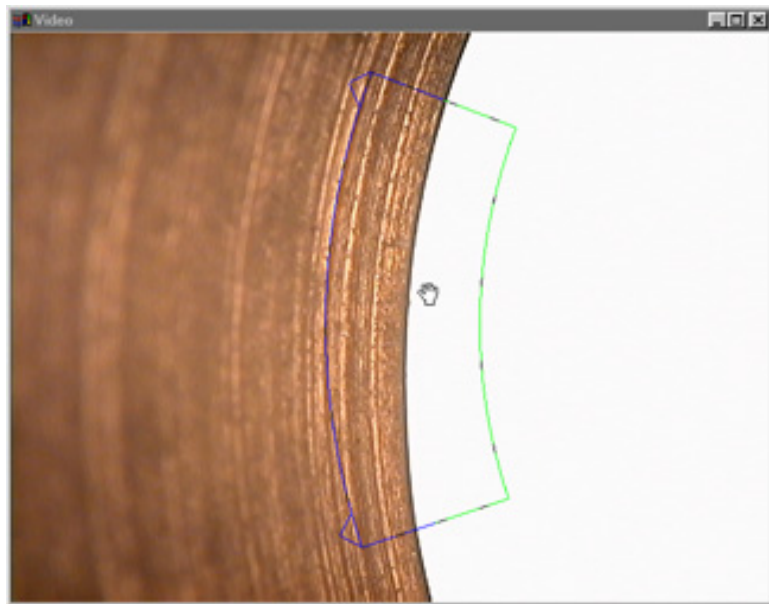
Place the probe tool as shown.



Step 3
Rotate the probe tool as shown.

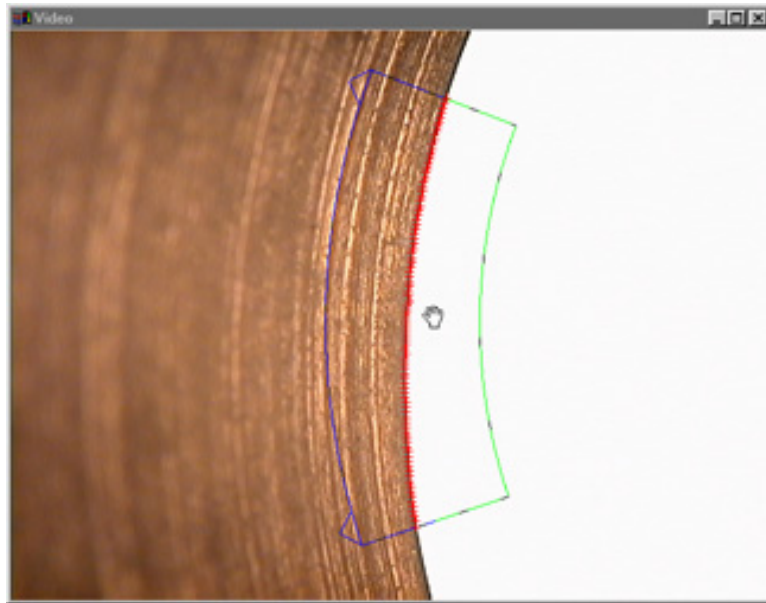


Step 4
Place the probe tool as shown.

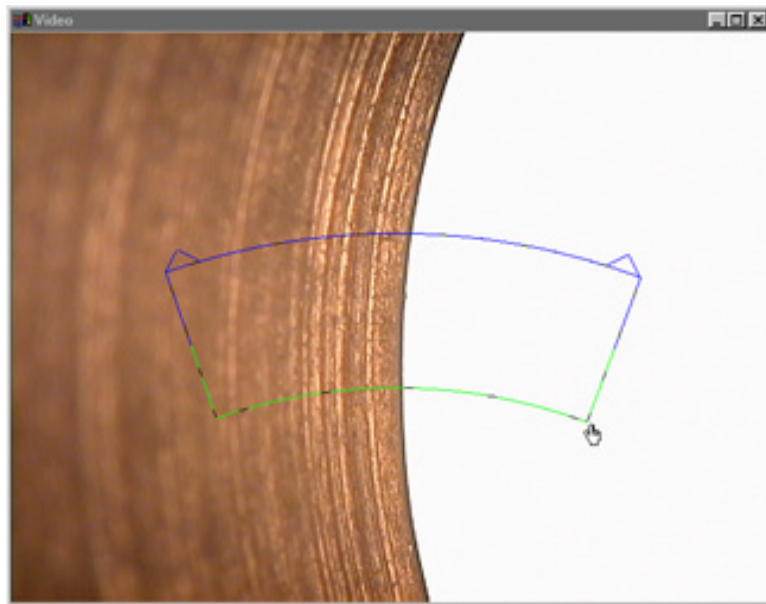


Chapter 2 Quick Start

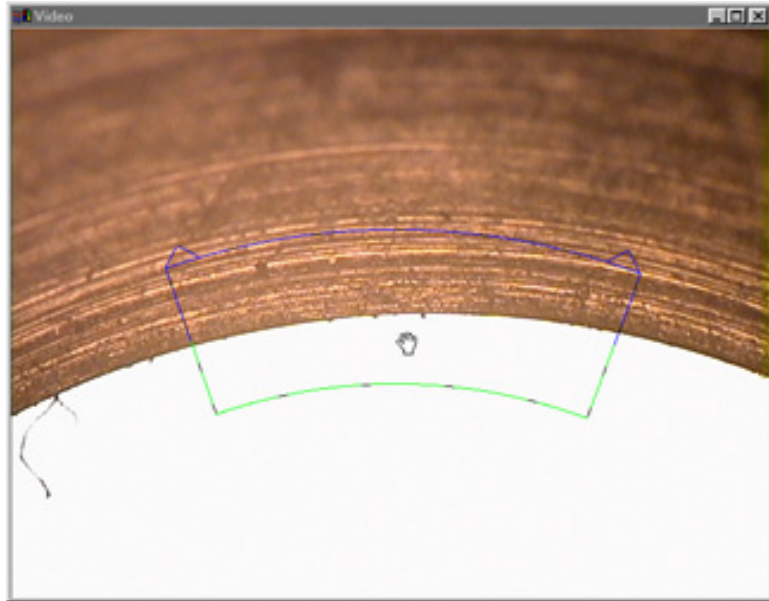
Step 5
Click the center mouse button.



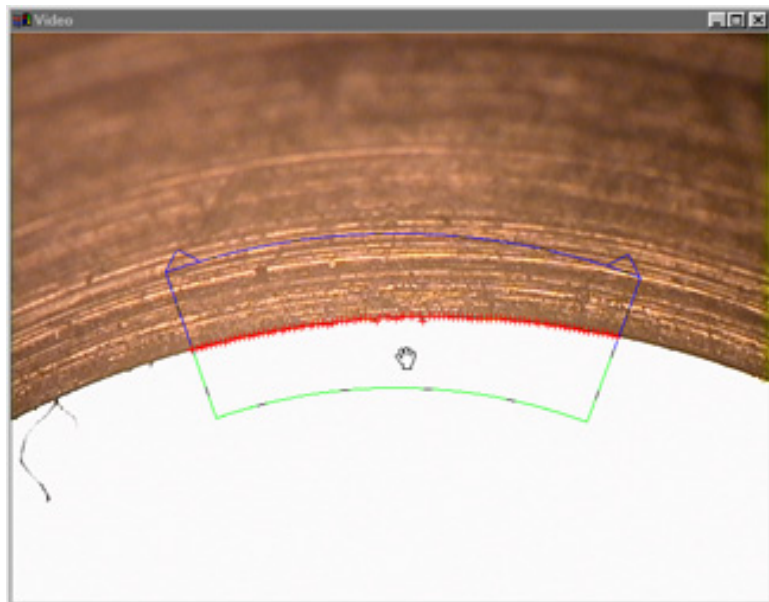
Step 6
Rotate the probe tool as shown.



Step 7
Place the probe tool as shown.

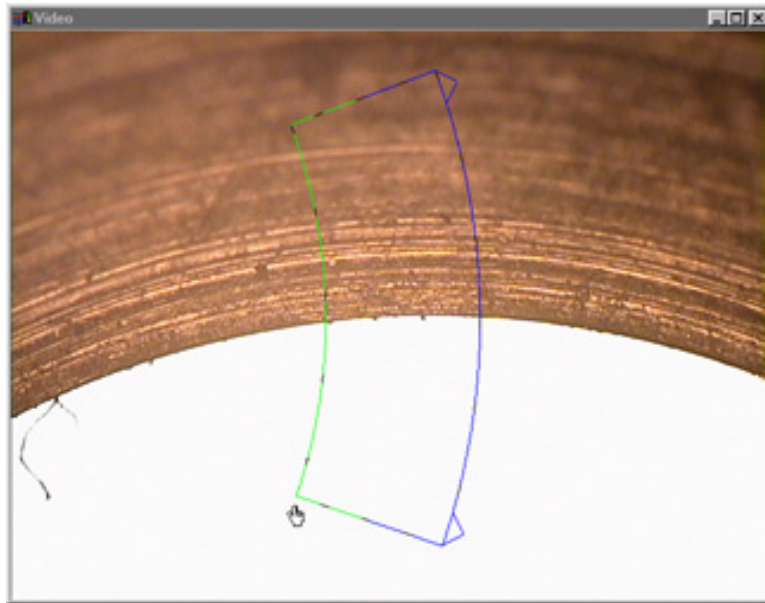


Step 8
Click the center mouse button.

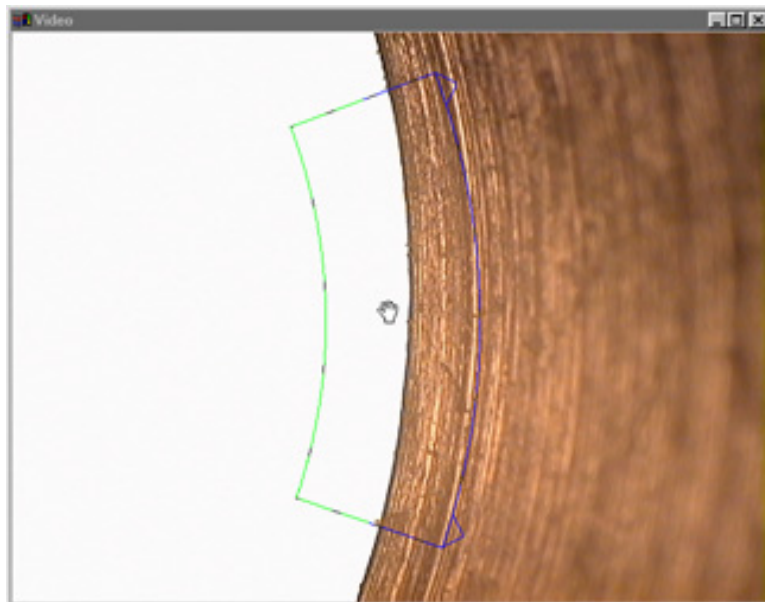


Chapter 2 Quick Start

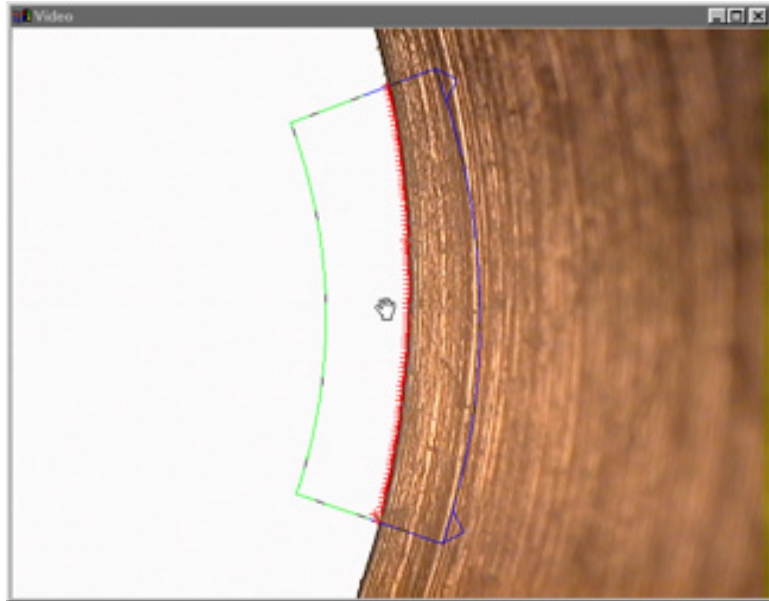
Step 9
Rotate the probe tool as shown.



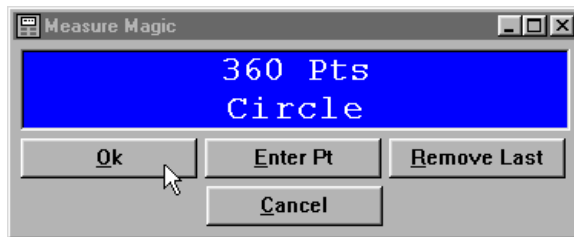
Step 10
Place the probe tool as shown.



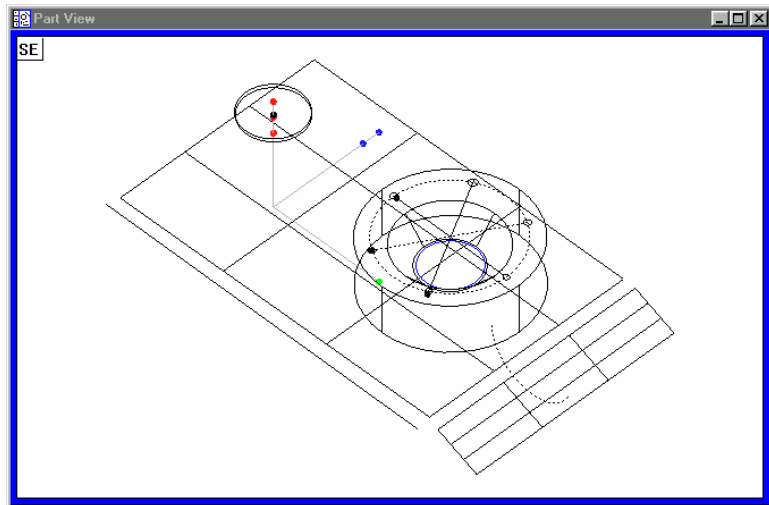
Step 11
Click the center mouse button.



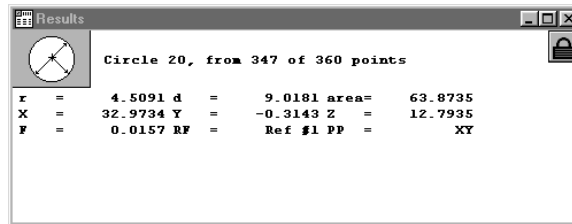
Step 12
Click OK in the dialog box.



The circle appears in the part view window as shown.



Measurement results are displayed in the results window.



To create the second reference frame

Step 1

Highlight *circle 20* in the features list as shown.

I	ToI	Name	Datum	X	Y	area
○		Circle 11		38.1828	8.7321	0.8534
○		Circle 12		43.3709	-0.3684	0.7343
○		Circle 13		38.0251	-9.3996	0.8459
○		Circle 14		27.4673	-9.3237	0.8586
○		Circle 15		32.8656	-0.3187	345.2053
↑		Distance 16		20.0011	0.1959	
↑		Distance 17		10.6836	19.3318	
↑		Distance 18		10.7155	18.0558	
△		Angle 19				
○		Circle 20		32.9734	-0.3143	63.8735

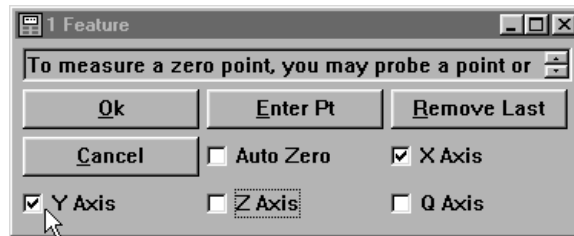
Step 2

Click the *zero button* on the datum toolbar.



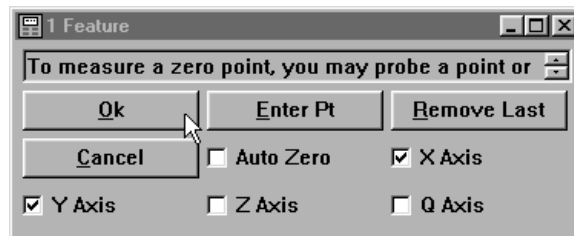
Step 3

Check X and Y axes in the dialog box.



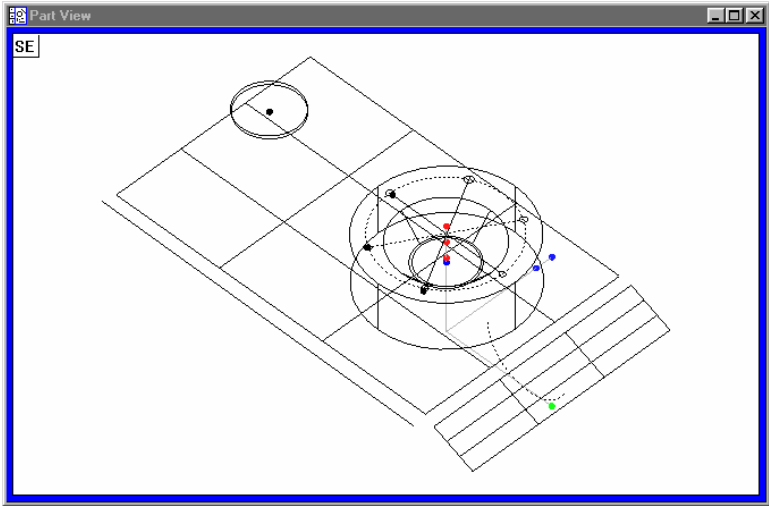
Step 4

Click OK in the dialog box.



Chapter 2 Quick Start

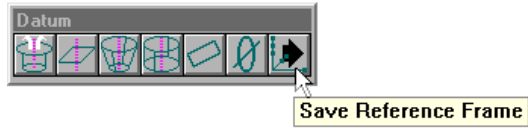
The reference frame indicator (RFI) shows the position of the second reference frame in the part view window.



To save a reference frame

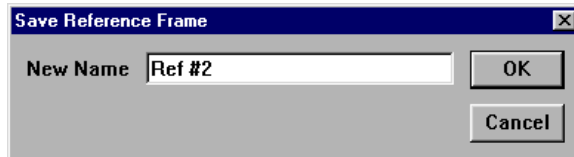
Step 1

Click the *save reference frame* button on the datum toolbar.



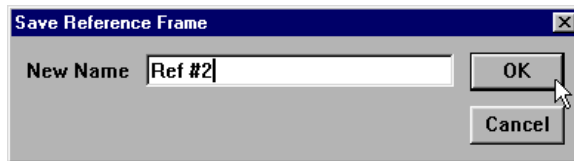
Step 2

Type a name in the text box as shown.

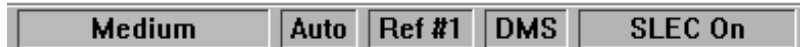


Step 3

Click OK in the dialog box.



The status bar shows the current reference frame.



To create a duplicate feature

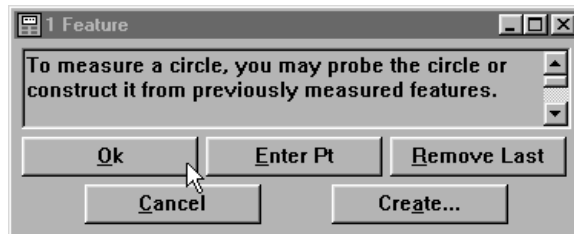
Step 1
Highlight *circle 15* as shown.

I	To1	Name	Datum	X	Y	area
/		Line 2		17.8677	-20.0731	
○		Circle 3		0.0000	0.0000	78.8549
•		Point 4		0.0000	0.0000	
○		Circle 5		-0.0716	-0.0034	80.1321
△		Cone 6		32.8766	-0.2828	
○		Cylinder 7		32.9121	-0.2470	
□		Plane 8		52.6048	-0.4741	
○		Circle 9		22.3643	-0.1627	0.8561
○		Circle 10		27.9211	8.8834	1.4495
○		Circle 11		38.1828	8.7321	0.8534
○		Circle 12		43.3709	-0.3684	0.7343
○		Circle 13		38.0251	-9.3996	0.8459
○		Circle 14		27.4673	-9.3237	0.8586
○		Circle 15		32.8656	-0.3187	345.2053
↑		Distance 16		20.0011	0.1959	
↑		Distance 17		10.6836	19.3318	
↑		Distance 18		10.7155	18.0558	
∠		Angle 19				
○		Circle 20		32.9734	-0.3143	63.8735
•		Point 21	Zero	0.0000	0.0000	

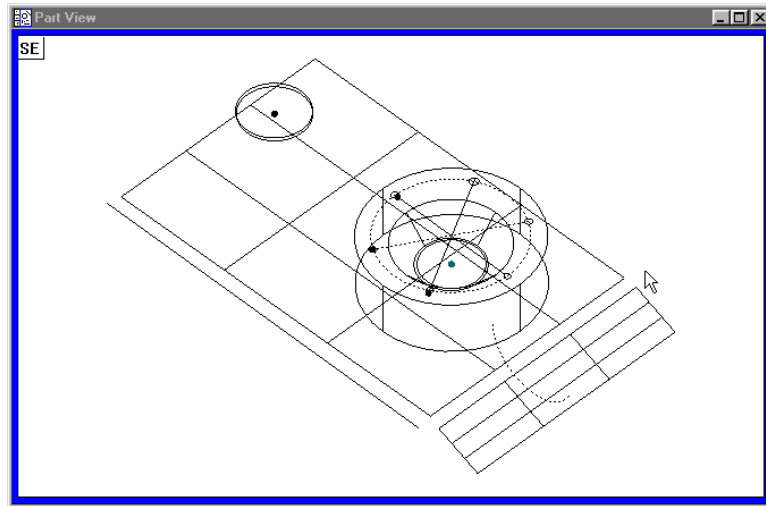
Step 2
Click the *circle button* on the measure toolbar.



Step 3
Click OK in the dialog box.

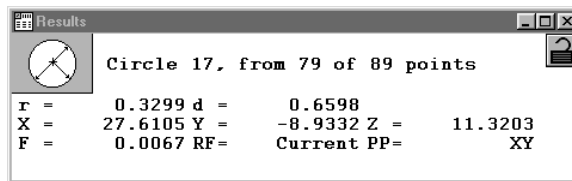


The duplicate feature of circle 22 appears in the second reference frame.



NOTE

Click the lock icon in the results window to lock/unlock features. Locked features are display results only in the reference frame measured.

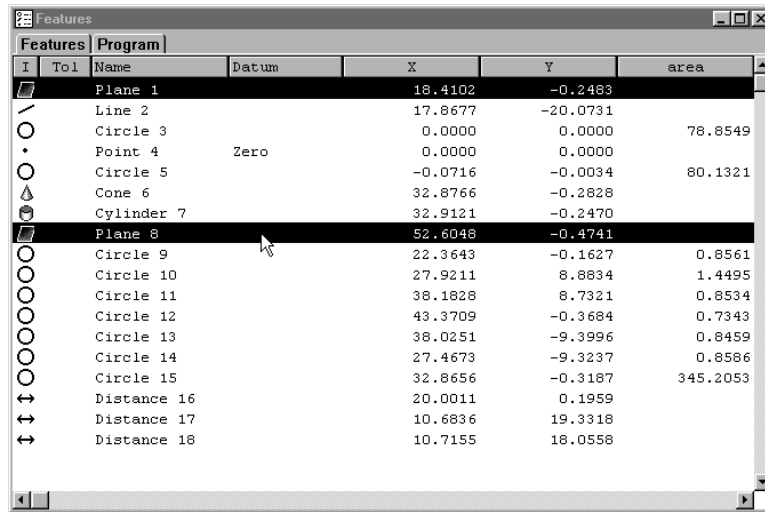


Unlocked features display results in the current reference frame even if measured in a different reference frame.

To construct an angle

Step 1

Highlight *planes 1 and 8* in the features list as shown.



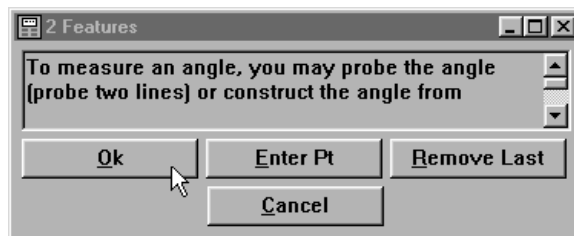
Step 2

Click the *angle button* on the measure toolbar.

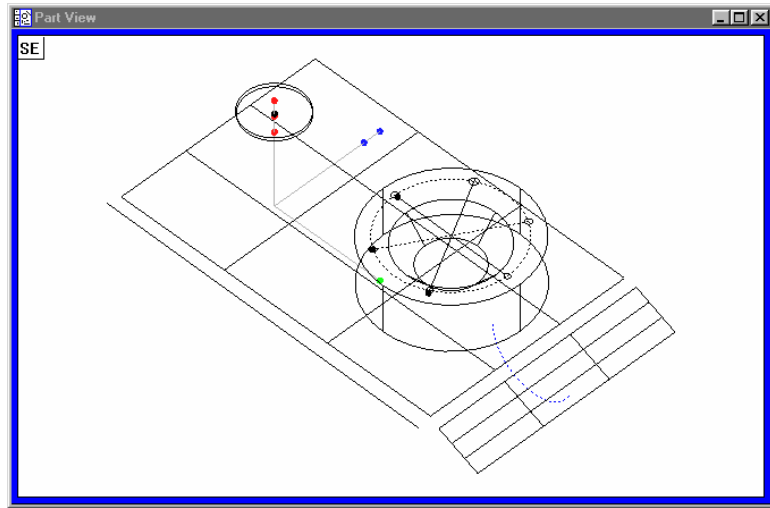


Step 3

Click OK in the dialog box.



The constructed angle appears in the part view window.



To select the active probe

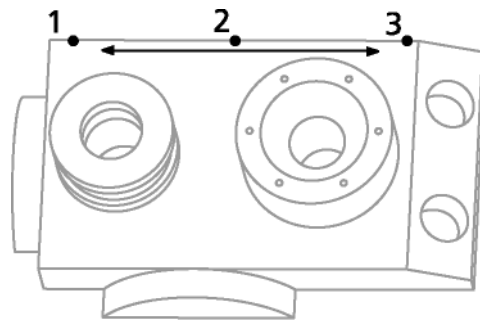
Step 1
Click on the status bar until *contact probes* is displayed as shown.



The contact probe group is now active.

To measure a line

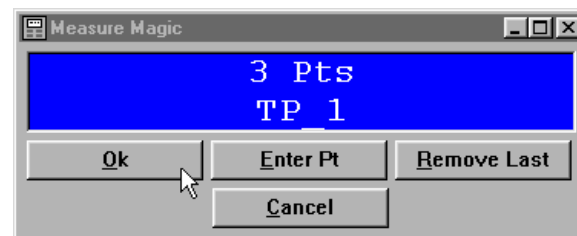
Step 1
Probe *point 1* as shown.



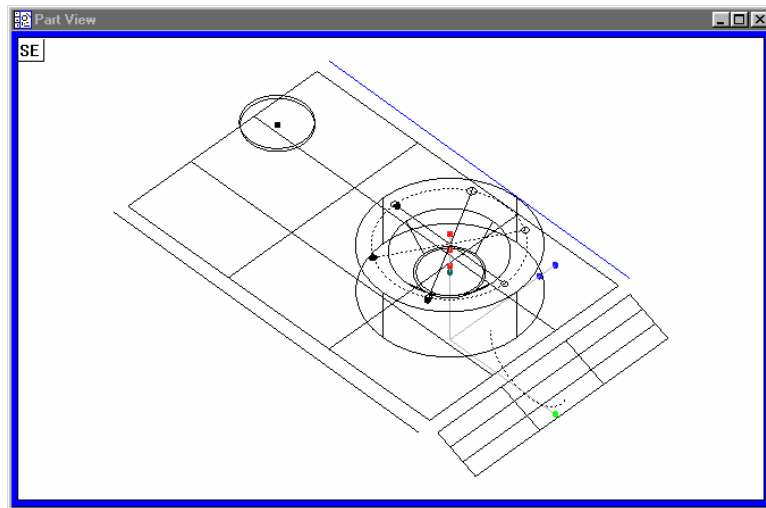
Step 2
Probe *point 2* as shown.

Step 3
Probe *point 3* as shown.

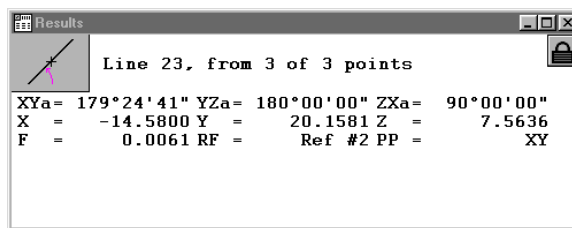
Step 4
Click OK in the dialog box.



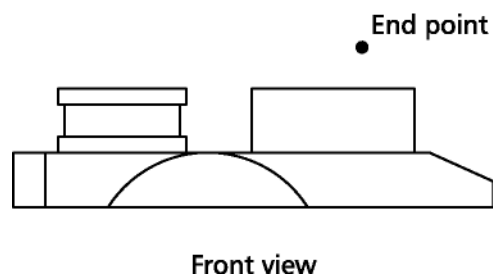
The line appears in the part view window as shown.



Measurement results are displayed in the results window.



Step 5
Move the probe to the *end point* as shown.

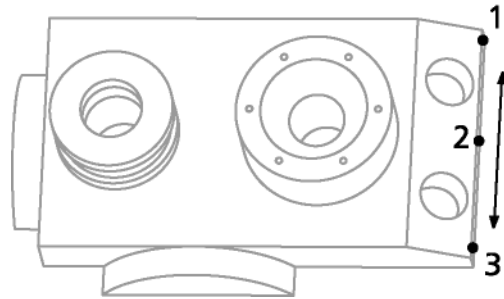


Step 6
Click the *goto button* on the program toolbar.



To measure a line

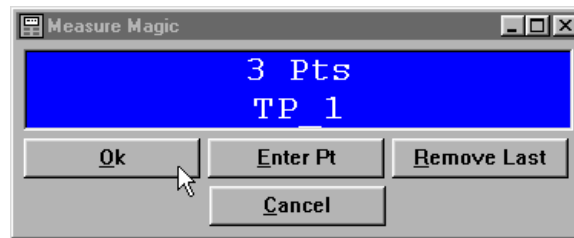
Step 1
Probe *point 1* as shown.



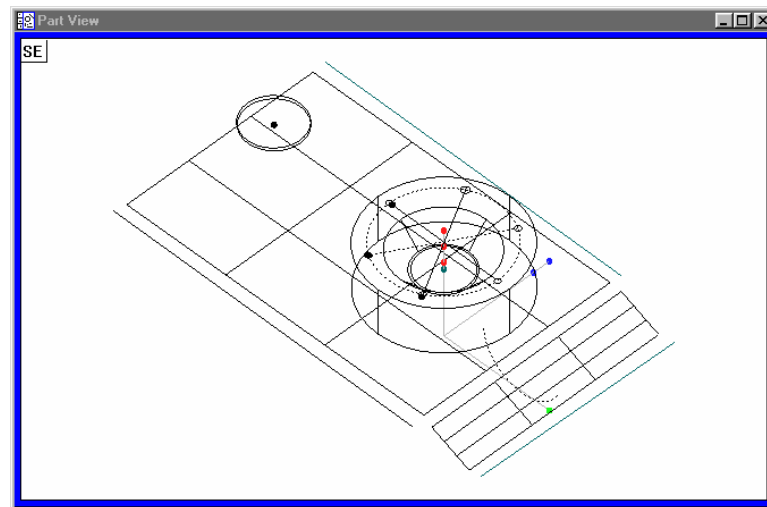
Step 2
Probe *point 2* as shown.

Step 3
Probe *point 3* as shown.

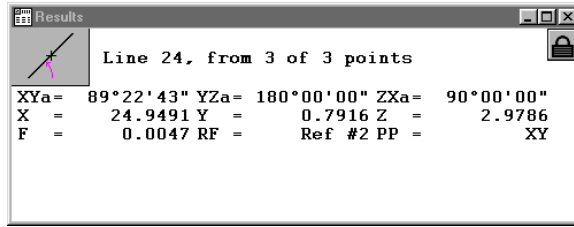
Step 4
Click OK in the dialog box.



The line appears in the part view window as shown.

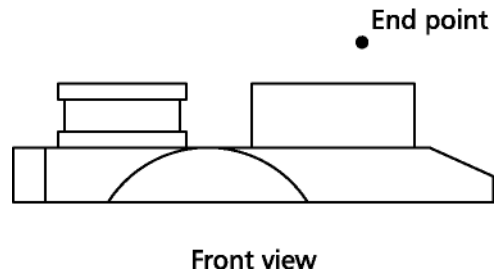


Measurement results are displayed in the results window.



Step 5

Move the probe to the *end point* as shown.



Step 6

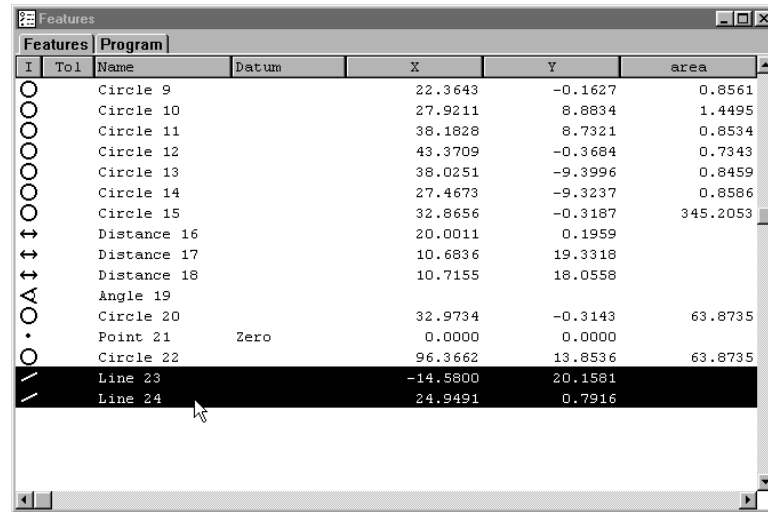
Click the *goto button* on the program toolbar.



To construct an angle

Step 1

Highlight the *lines 23* and *24* in the features list as shown.



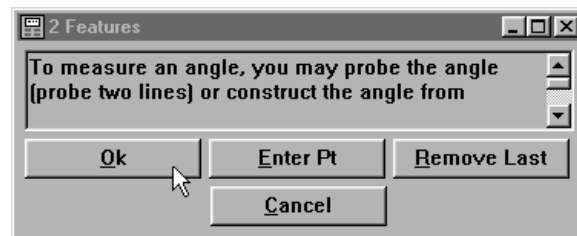
Step 2

Click the *angle button* on the measure toolbar.

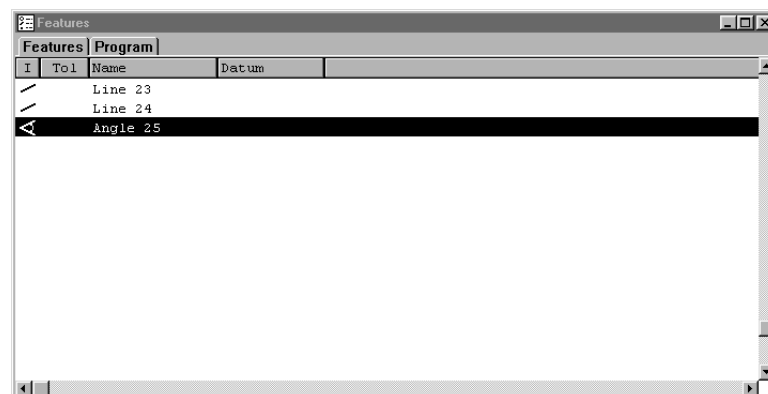


Step 3

Click OK in the dialog box.



The angle appears in the part view window.



To perform a bi-directional tolerance

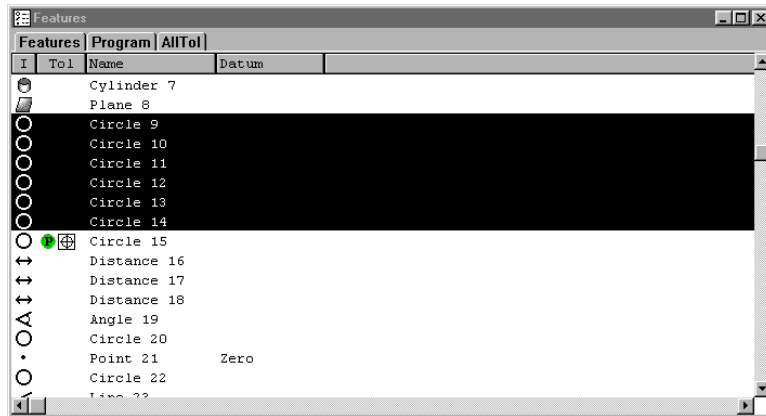


NOTE

This is an example of a group tolerance. Use group tolerances to apply one tolerance to a group of features. A bi-directional tolerance can be applied to single features or groups of features.

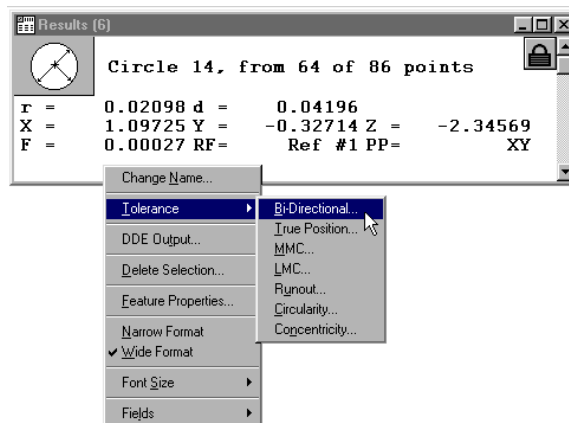
Step 1

Highlight the desired features in the features list as shown.



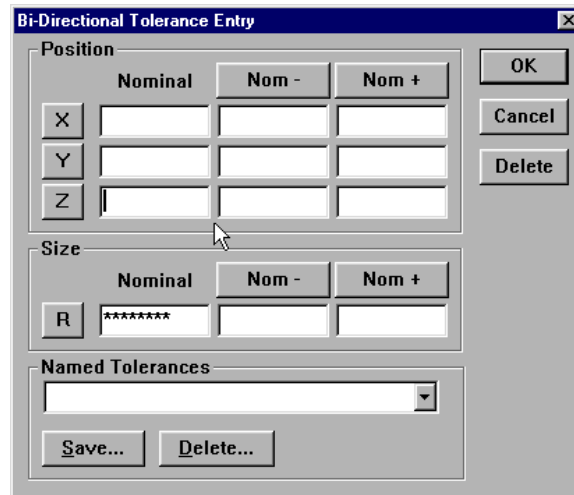
Step 2

Right-click in the results window and select *tolerance*, then select *bi-directional tolerance*.



Step 3

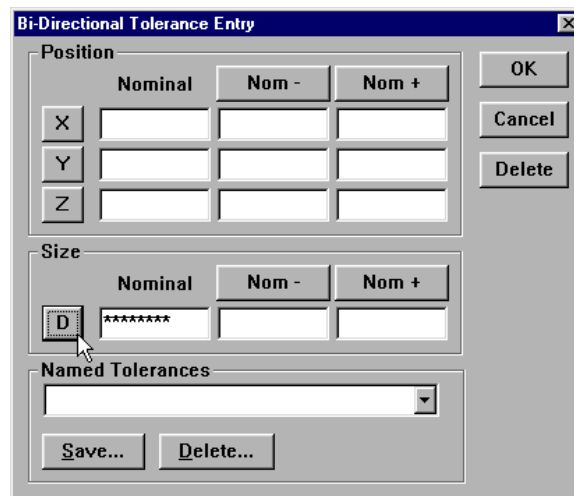
Delete the stars (*) from the X, Y, and Z boxes.



The dialog box titled "Bi-Directional Tolerance Entry" has a close button (X) in the top right corner. It is divided into three main sections: Position, Size, and Named Tolerances. The Position section contains three rows labeled X, Y, and Z. Each row has three columns: "Nominal", "Nom -", and "Nom +". In the X, Y, and Z rows, the "Nominal" column contains a text box with a star (*) inside. The Size section contains a row labeled "R" with three columns: "Nominal", "Nom -", and "Nom +". The "Nominal" column contains a text box with seven asterisks (*****). The Named Tolerances section contains a dropdown menu and two buttons: "Save..." and "Delete...". On the right side of the dialog, there are three buttons: "OK", "Cancel", and "Delete". A mouse cursor is pointing at the star in the X row's "Nominal" column.

Step 4

Click on the *radius* button as shown to change it to diameter.



The dialog box titled "Bi-Directional Tolerance Entry" is identical to the one in Step 3. However, in the Size section, the "R" button is now disabled and has a dotted border. A new button labeled "D" is now selected and highlighted with a mouse cursor. The "Nominal" column of the "D" row contains seven asterisks (*****). All other elements, including the Position section, Named Tolerances section, and right-side buttons, remain the same as in Step 3.

Step 5

Enter the nominal diameter value and the + and - tolerances.

The dialog box titled "Bi-Directional Tolerance Entry" contains the following sections:

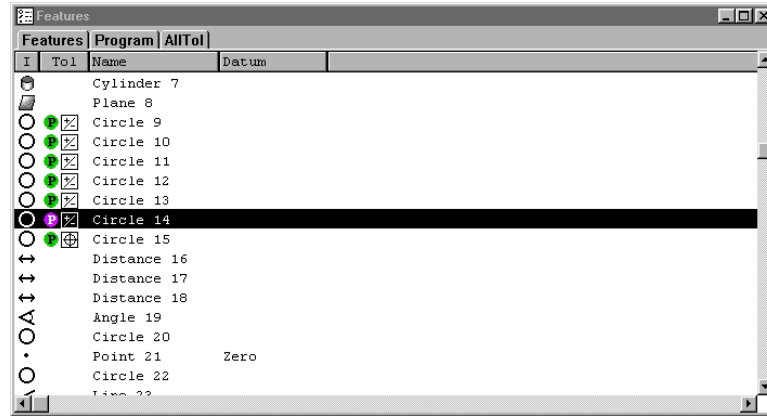
- Position:** A table with columns "Nominal", "Nom -", and "Nom +". Rows are labeled X, Y, and Z. All cells are empty.
- Size:** A table with columns "Nominal", "Nom -", and "Nom +". Row is labeled D. Values are 0.039, .005, and .005.
- Named Tolerances:** A dropdown menu with a downward arrow, currently empty.
- Buttons:** OK, Cancel, Delete, Save..., and Delete... are located on the right and bottom of the dialog.

Step 6

Click OK in the dialog box.

This image shows the same "Bi-Directional Tolerance Entry" dialog box as in Step 5. The data entered in the "Size" section (D: 0.039, .005, .005) is visible. A mouse cursor is pointing at the "OK" button on the right side of the dialog.

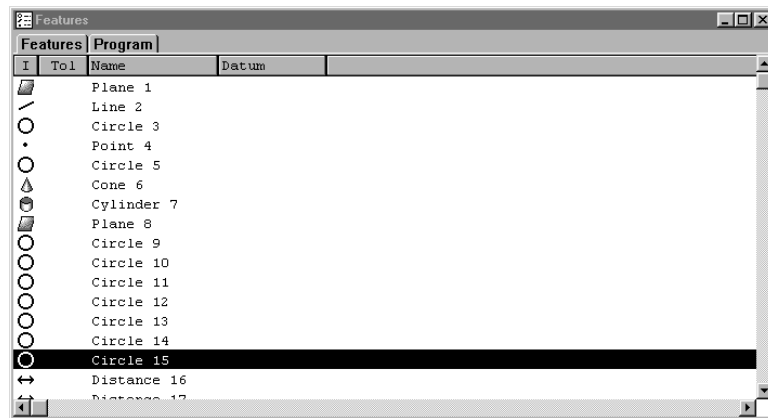
The tolerance results are displayed in the features list.



To perform a true position tolerance

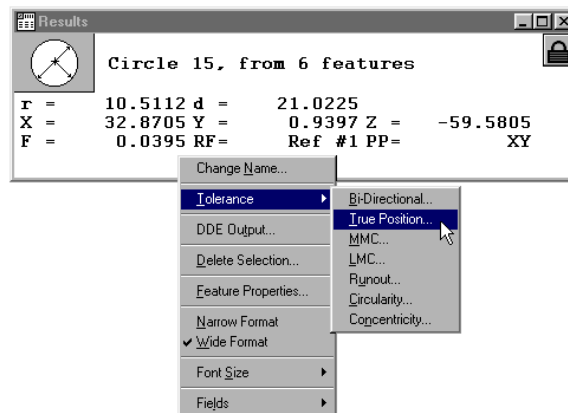
Step 1

Select the desired feature in the features list as shown.



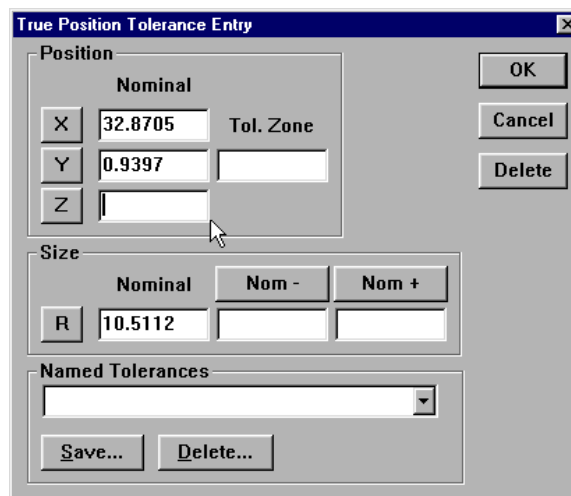
Step 2

Right-click in the results window and select *tolerance*, then select *true position*.



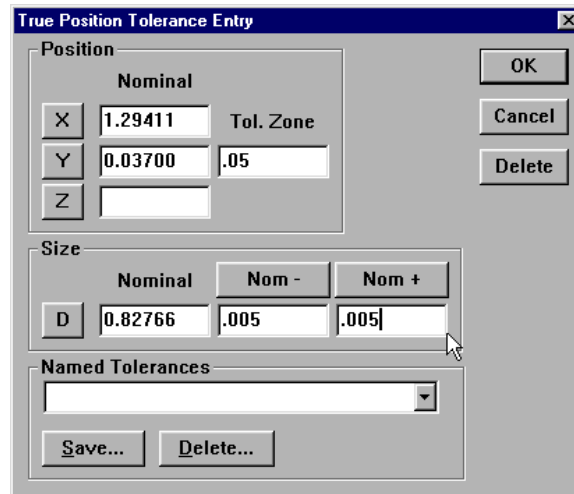
Step 3

Delete the Z tolerance value.



Step 4

Enter the desired nominal and tolerance values.



The dialog box titled "True Position Tolerance Entry" contains the following fields and controls:

- Position** section:
 - Nominal** section:
 - X: 1.29411
 - Y: 0.03700
 - Z: (empty)
 - Tol. Zone**: .05
- Size** section:
 - Nominal**: 0.82766
 - Nom -**: .005
 - Nom +**: .005
- Named Tolerances**: (empty dropdown menu)
- Buttons: OK, Cancel, Delete, Save..., Delete...

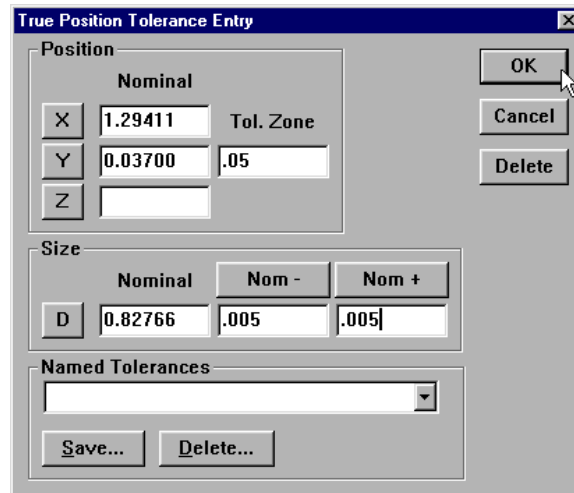


NOTE

Remove values from all fields that are not desired in the final tolerance report.

Step 5

Click OK in the dialog box.



The dialog box titled "True Position Tolerance Entry" is identical to the one in Step 4. The mouse cursor is positioned over the OK button.

The tolerance results window is displayed as shown. Click OK to accept the tolerance results.

The dialog box titled "True Position Tolerance Results" contains two main sections: "Position" and "Size".

Position Section:

	Nominal	Actual	Error Dia.	Tol. Zone	
X	1.29411	1.29411			
Y	0.03700	0.03700	0.00000	0.05000	P
Z		-2.34569			

Size Section:

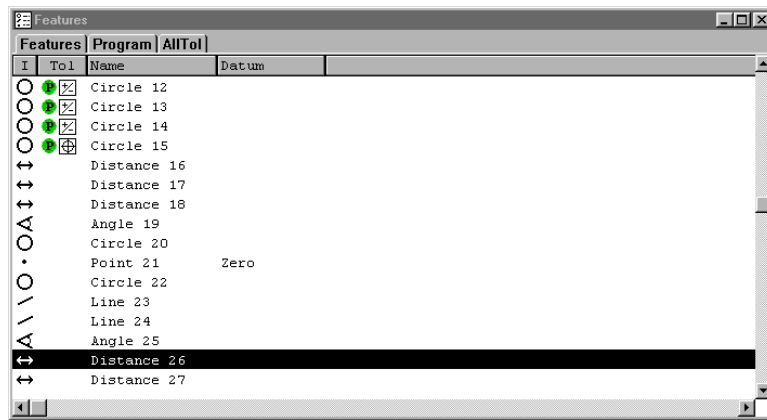
	Nominal	Actual	Deviation	Low limit	High limit	
D	0.82766	0.82766	0.00000	0.82266	0.83266	P

Buttons: OK, Edit...

To perform a width tolerance

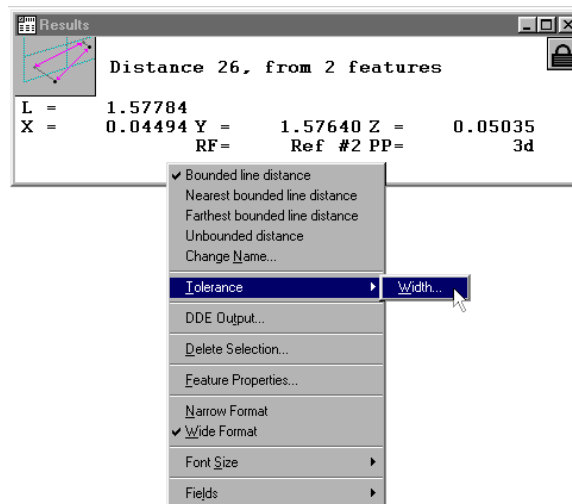
Step 1

Select the desired feature in the features list.



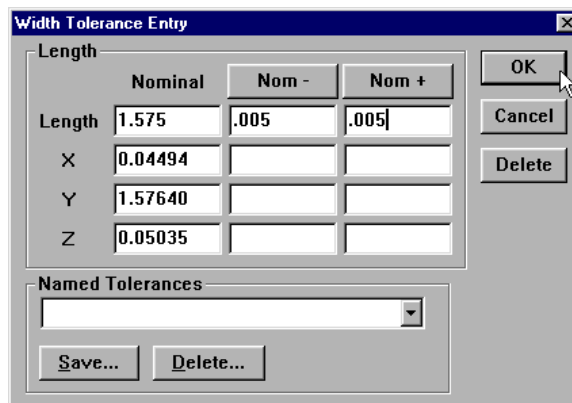
Step 2

Right-click in the results window and select *tolerance*, then select *width*.

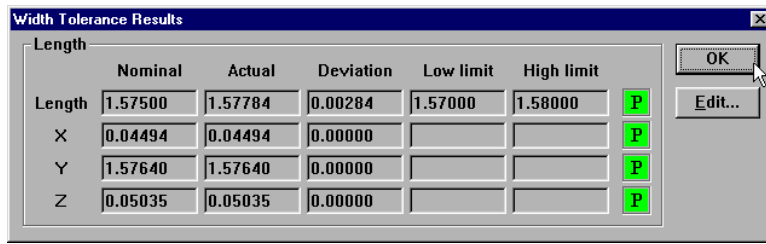


Step 3

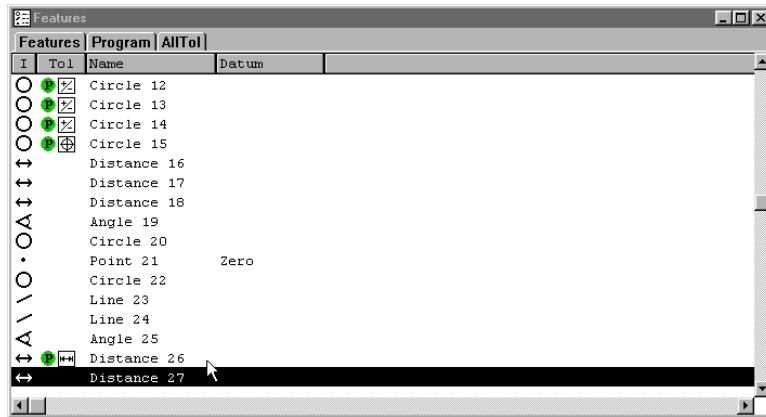
Enter values for width tolerance.



Step 4
Click OK in the dialog box.



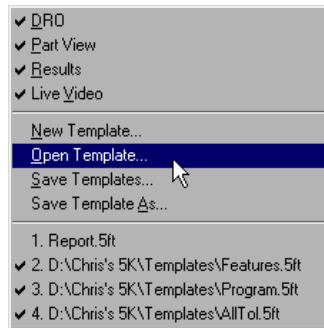
The tolerance results are displayed in the features list.



To open the *all tolerance* template

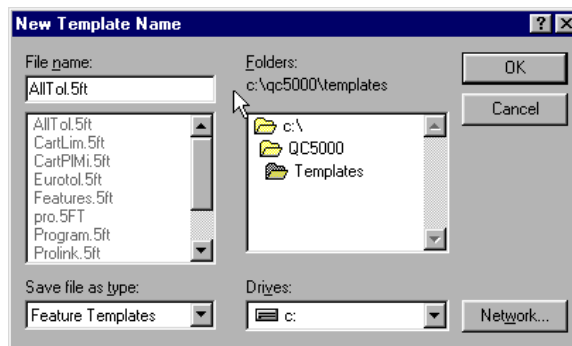
Step 1

Select *open template* from the windows menu.



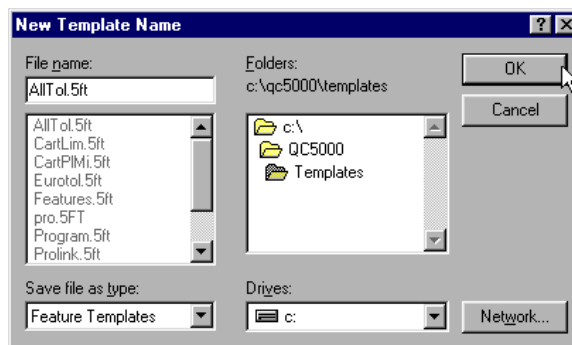
Step 2

Select the *Alltol.5ft* template as shown.



Step 3

Click OK in the dialog box.



The *all tolerance* template is displayed as shown. All tolerated and untoleranced features are displayed in this template until it is modified by the user.

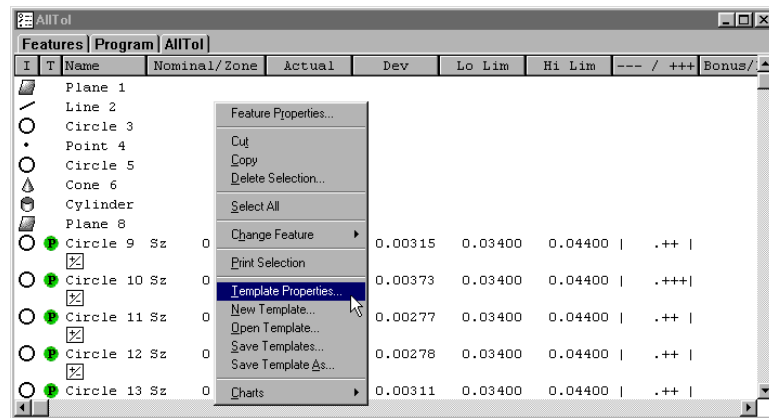
The screenshot shows a software window titled "AllTol" with a menu bar containing "Features", "Program", and "AllTol". Below the menu bar is a table with the following columns: "I", "T", "Name", "Nominal/Zone", "Actual", "Dev", "Lo Lim", "Hi Lim", "--- / +++", and "Bonus/". The table lists various features such as Plane 1, Line 2, Circle 3, Point 4, Circle 5, Cone 6, Cylinder, Plane 8, and several Circles (9-13) with their respective tolerances and bonus values.

I	T	Name	Nominal/Zone	Actual	Dev	Lo Lim	Hi Lim	--- / +++	Bonus/
		Plane 1							
		Line 2							
		Circle 3							
		Point 4							
		Circle 5							
		Cone 6							
		Cylinder							
		Plane 8							
		Circle 9 Sz	0.03900	0.04215	0.00315	0.03400	0.04400	.++	
		Circle 10 Sz	0.03900	0.04273	0.00373	0.03400	0.04400	.+++	
		Circle 11 Sz	0.03900	0.04177	0.00277	0.03400	0.04400	.++	
		Circle 12 Sz	0.03900	0.04178	0.00278	0.03400	0.04400	.++	
		Circle 13 Sz	0.03900	0.04211	0.00311	0.03400	0.04400	.++	

To modify template properties

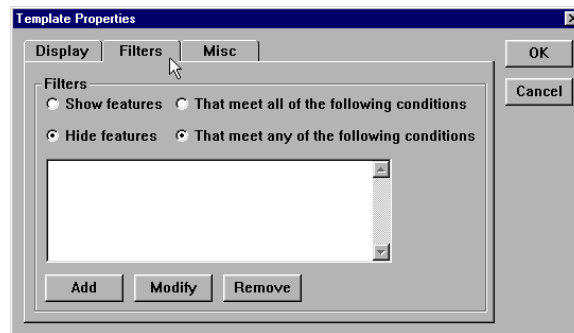
Step 1

Right-click in the all tolerances template and select *template properties*.



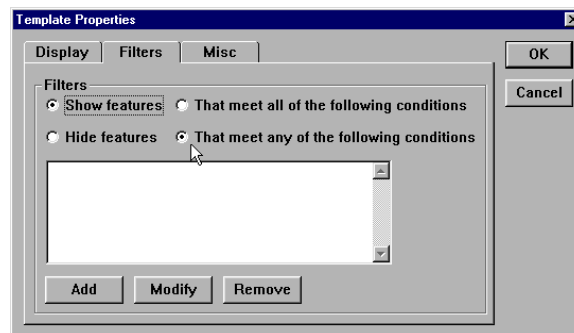
Step 2

Select *filters*.

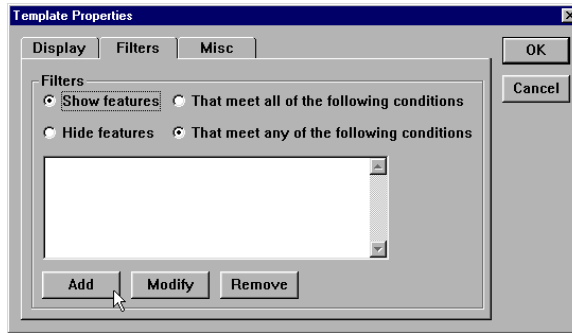


Step 3

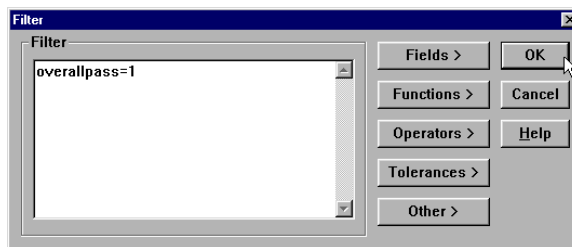
Select *show features that meet any of the following conditions*.



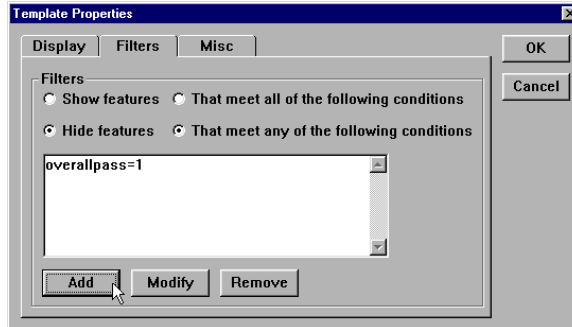
Step 4
Click the *add button*.



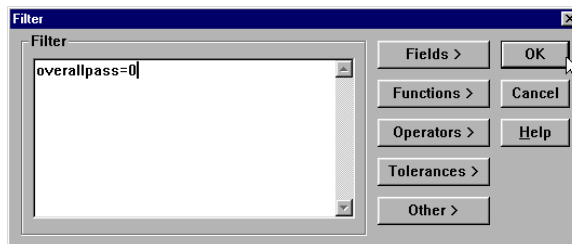
Step 5
Type *overallpass=1* and click *OK* as shown.



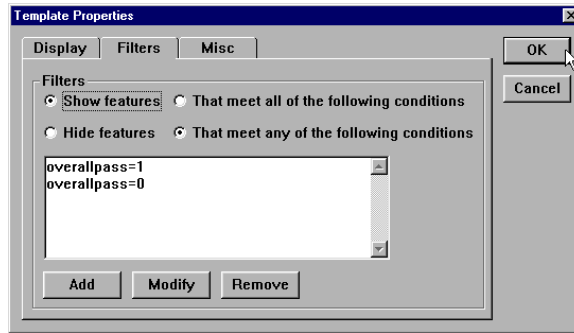
Step 6
Click the *add button*.



Step 7
Type *overallpass=0* and click *OK* as shown.



Step 8
Click OK in the dialog box.



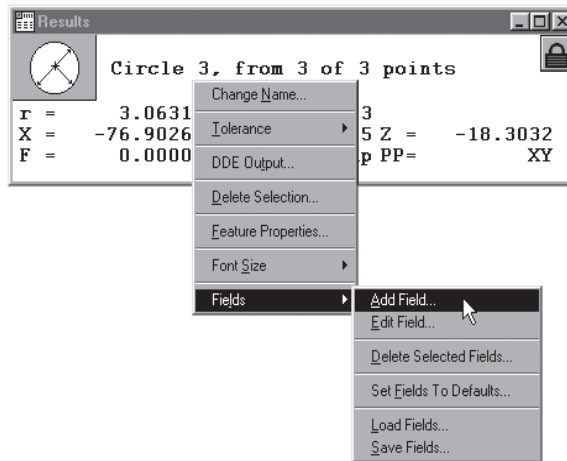
Only toleranced features are now displayed in the *all tolerances template*.

AllTol											
Features Program AllTol											
I	T	Name	Nominal/Zone	Actual	Dev	Lo Lim	Hi Lim	---	/	+++	Bonus/
○	●	Circle 9	Sz 0.03900	0.04215	0.00315	0.03400	0.04400		.++		
○	●	Circle 10	Sz 0.03900	0.04273	0.00373	0.03400	0.04400		.+++		
○	●	Circle 11	Sz 0.03900	0.04177	0.00277	0.03400	0.04400		.++		
○	●	Circle 12	Sz 0.03900	0.04178	0.00278	0.03400	0.04400		.++		
○	●	Circle 13	Sz 0.03900	0.04211	0.00311	0.03400	0.04400		.++		
○	●	Circle 14	Sz 0.03900	0.04196	0.00296	0.03400	0.04400		.++		
○	●	Circle 15	TP Sz 0.05000	0.00000	0.00000	0.00000	0.05000		.		0.00
↔	●	Distance	Dl 1.57500	1.57784	0.00284	1.57000	1.58000		.++		

To enter a formula

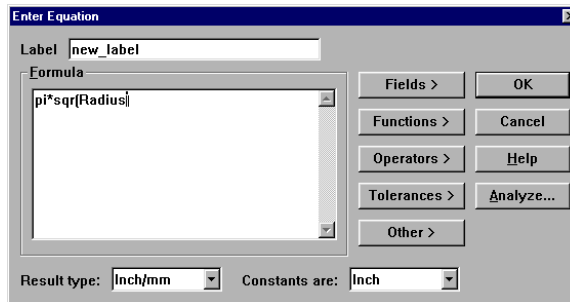
Step 1

Right-click in the results window and select *add field*.



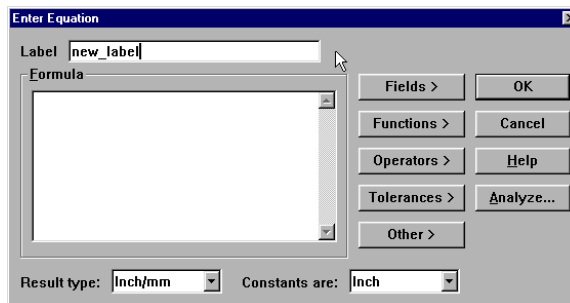
Step 2

Type $\pi * \text{sqrt}(\text{radius})$ as shown.

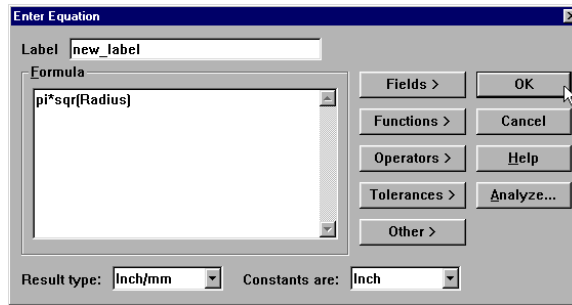


Step 3

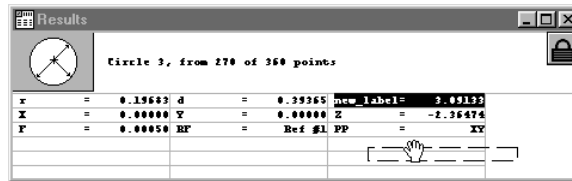
Type *label* as shown.



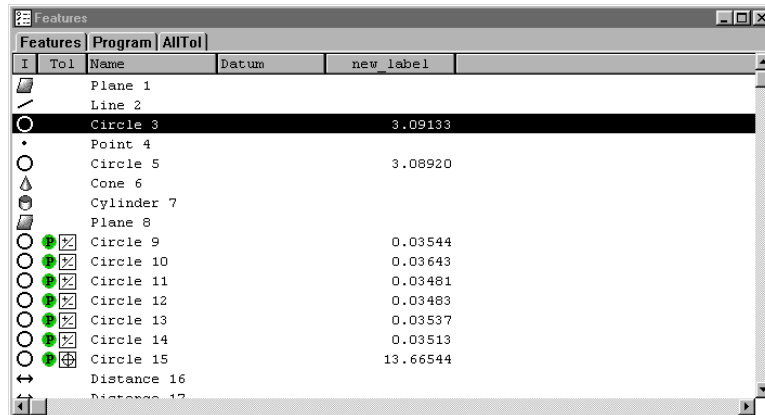
Step 4
Click OK in the dialog box.



Step 5
Drag the result into the features list as shown.



The area of all circle features is now displayed in the features list.



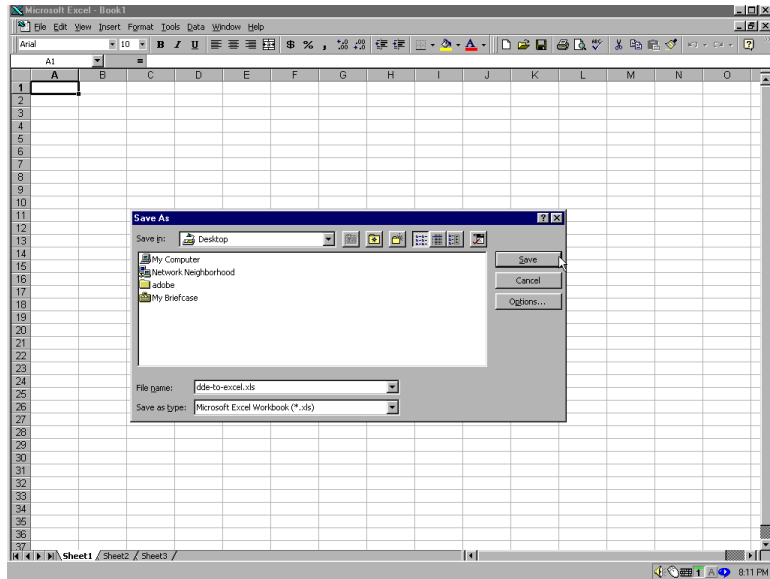
Dynamic data exchange

Use the DDE output feature to export data to a spreadsheet application in real time while the program is running. Follow the procedure below to DDE output to Microsoft Excel.

To DDE output to Excel

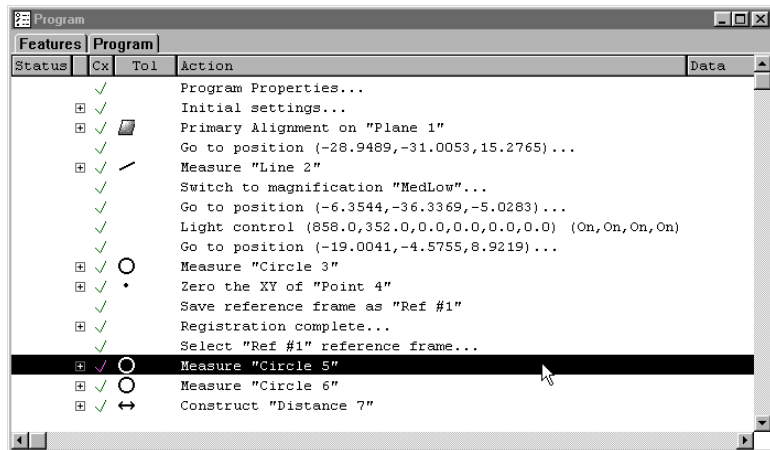
Step 1

Open Excel and create a new file to receive the DDE output.



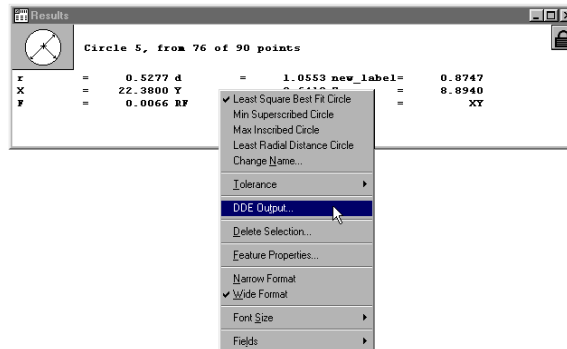
Step 2

Highlight the desired feature in the features list as shown.



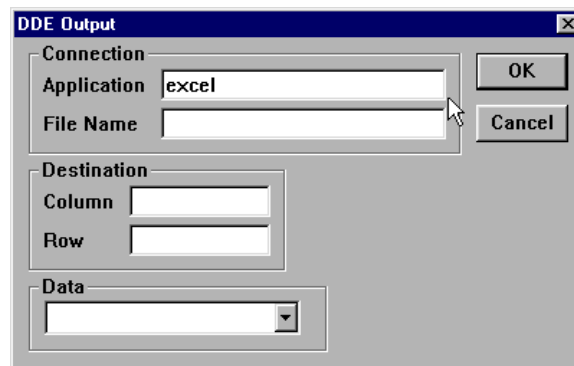
Step 3

Right-click in the results window and select DDE output as shown.



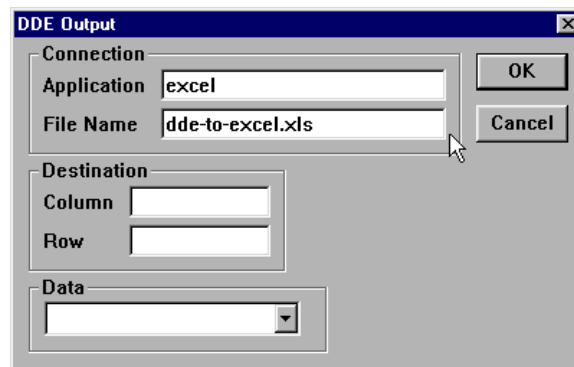
Step 4

Type Excel in the application text box as shown.



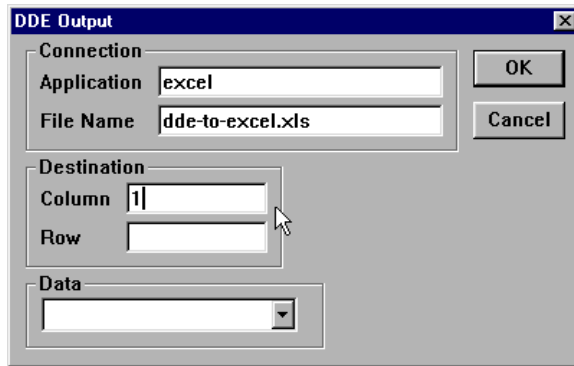
Step 5

Type the name of the file created in step 1 as shown.



Step 6

Enter the desired column or row for the data.

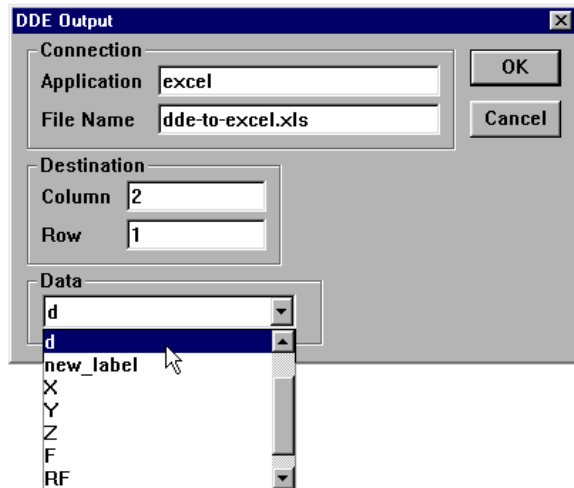


NOTE

Indicate columns by number NOT by letter. Use 1 for A, 2 for B and so forth.

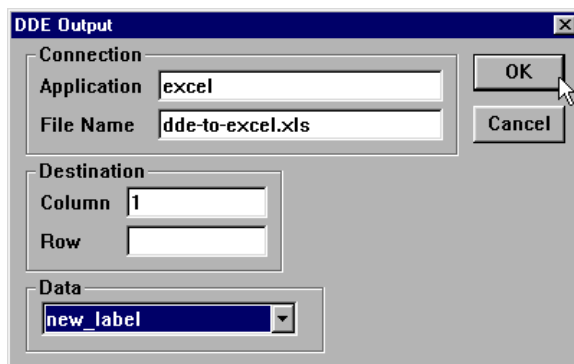
Step 7

Select the desired result coefficient as shown.

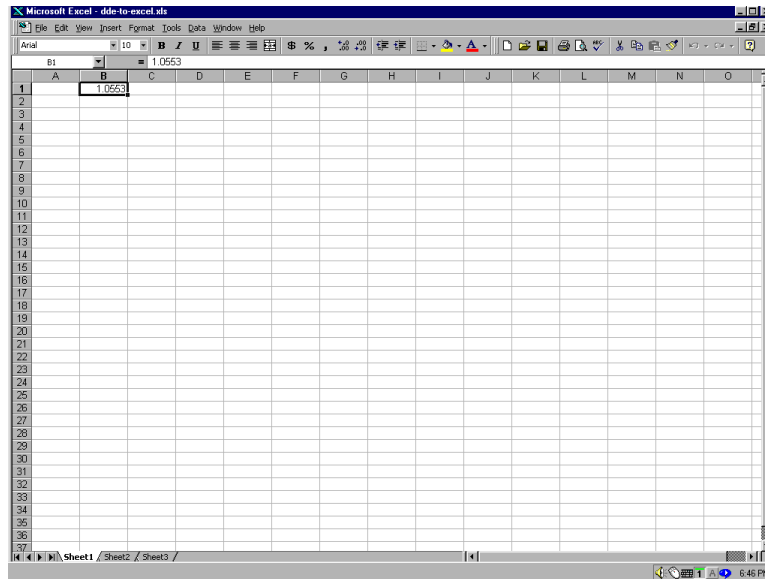


Step 8

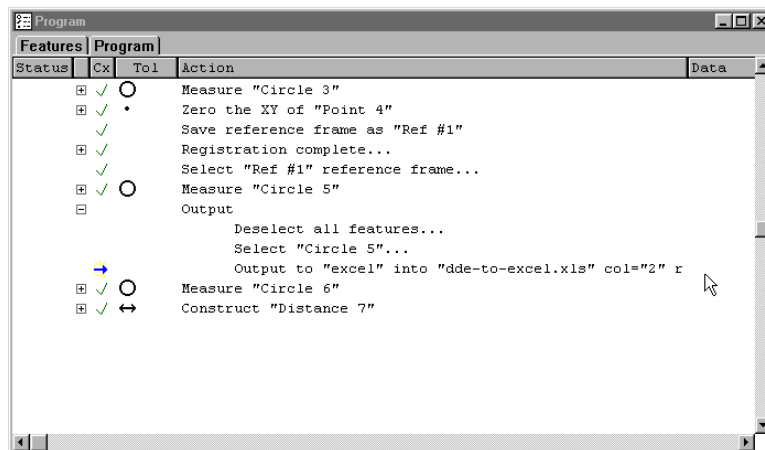
Click OK in the dialog box.



The data appears in the desired row and column of the Excel file.



The DDE step also appears in the program template.



To export a tab delimited file to a spreadsheet

Step 1

Select the features to be exported from the features list.

I	T	Name	Datum	X	Y	Z	d	r
		Plane 1	Primary	3.21868	1.62520	0.00000		
		Line 2	Skew	0.00000	1.49036	-0.39204		
		Line 3		2.17580	-0.00110	-0.39047		
		Point 4	Zero	0.00000	0.00000	-0.39125		
		Circle 5		3.00058	2.49767	-0.03507	0.37424	0.1877
		Circle 6		3.00032	1.49631	-0.02468	0.75131	0.3756
		Circle 7		2.99938	0.49964	-0.00501	0.37484	0.1874
		Circle 8		4.49935	0.74810	0.02104	1.00052	0.5002

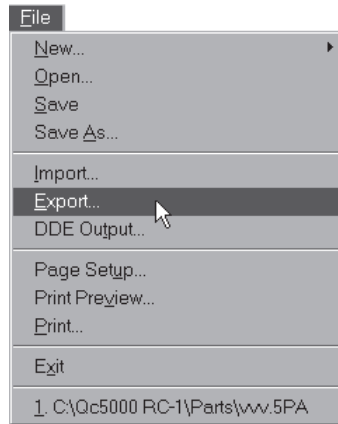


NOTE

Hold down the ctrl key to select features that are not listed sequentially in the features list.

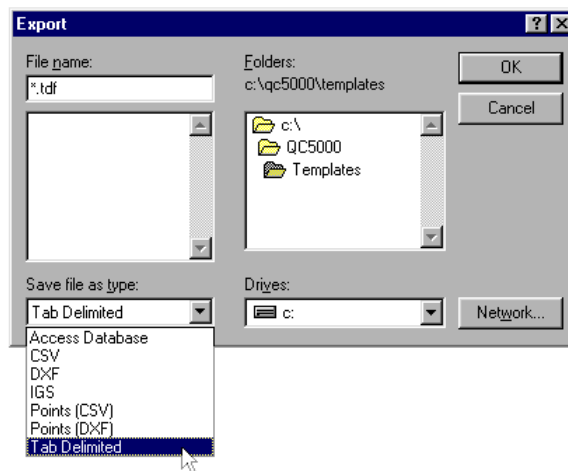
Step 2

Select *export* from the file menu.

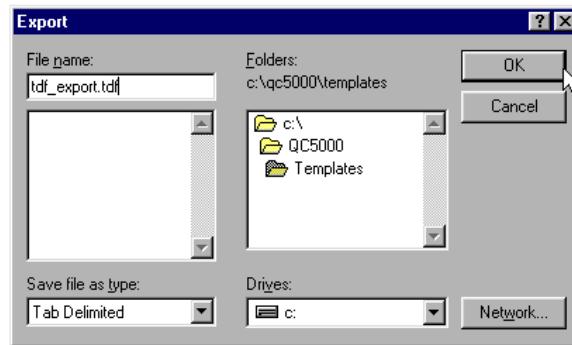


Step 3

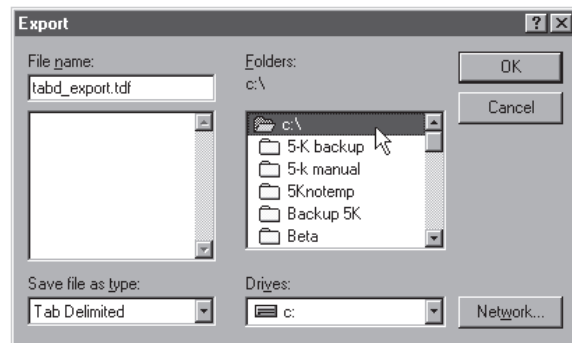
Select *tab delimited* from the *save file as type* list in the export dialog box.



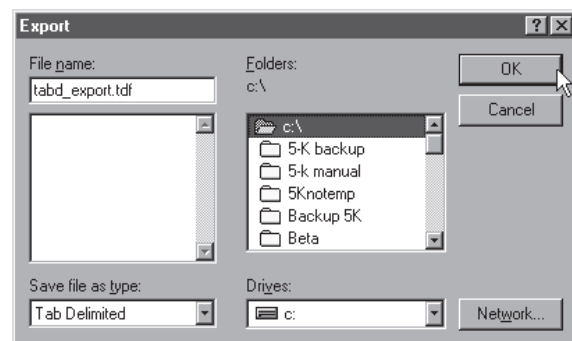
Step 4
Type the name of the file in the file name text box.



Step 5
Use the *folders* box and drives list to select the storage location for the file.



Step 6
Click OK in the export dialog box.



Step 7

Open the spreadsheet application and open the saved file.

The screenshot shows a Microsoft Excel window titled "Microsoft Excel - tabd_export.tdf". The spreadsheet contains the following data:

	A	B	C	D	E	F	G	H	I	J	K
1			Line 3		2.1758	-0.0011	-0.39047				
2			Circle 5		3.00058	2.49767	-0.03907	0.37424	0.18712		
3			Circle 7		2.99938	0.49964	-0.00901	0.37484	0.18742		
4											
5											
6											
7											
8											
9											
10											

To export to a comma separated variable file (.csv)

Step 1

Select the features to be exported from the features list.

Name	Datum	X	Y	Z	d	r
Plane 1	Primary	3.21868	1.62520	0.00000		
Line 2	Skew	0.00000	1.49036	-0.39204		
Line 3		2.17580	-0.00110	-0.39047		
Point 4	Zero	0.00000	0.00000	-0.39125		
Circle 5		3.00058	2.49767	-0.03507	0.37424	0.1877
Circle 6		3.00032	1.49831	-0.02468	0.75131	0.3756
Circle 7		2.99938	0.49964	-0.00501	0.37484	0.1874
Circle 8		4.49935	0.74810	0.02104	1.00052	0.5002

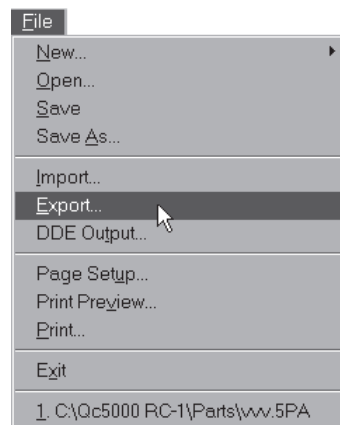


NOTE

Hold down the ctrl key to select features that are not listed sequentially in the features list.

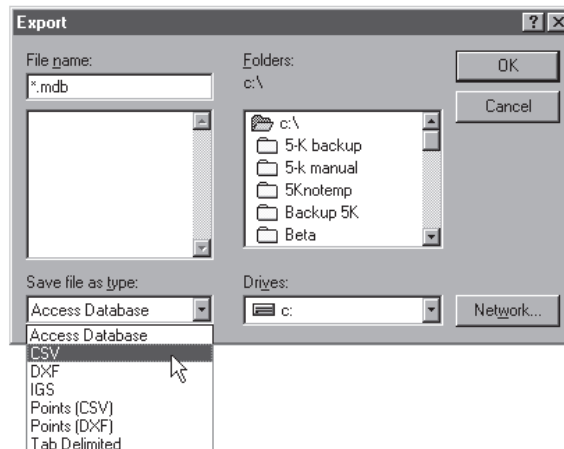
Step 2

Select *export* from the file menu.



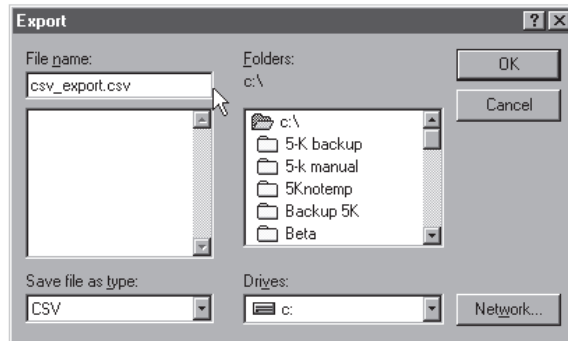
Step 3

Select *CSV* from the save file as type list in the export dialog box.



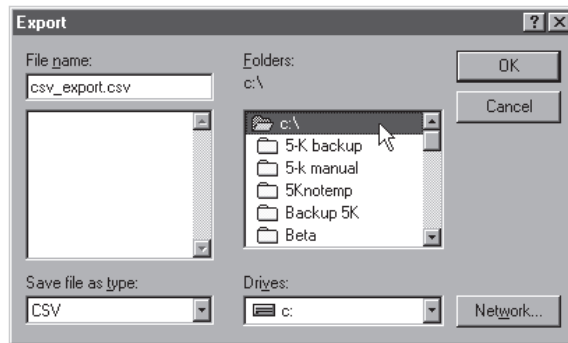
Step 4

Type the name of the file in the file name text box.



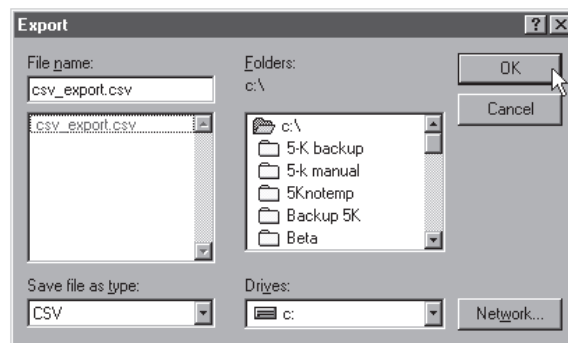
Step 5

Use the *folders* box and drives list to select the storage location for the file.



Step 6

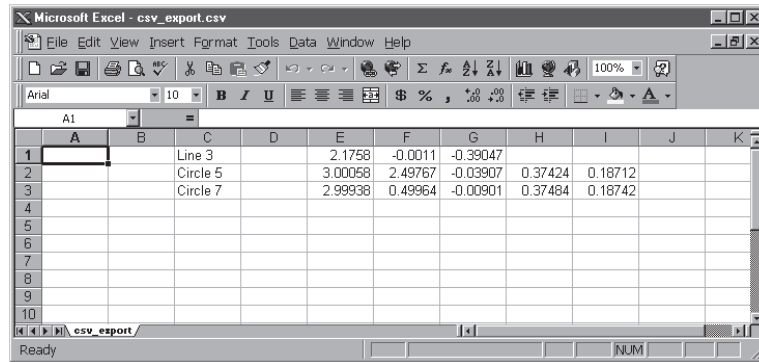
Click OK in the export dialog box.



Chapter 2 Quick Start

Step 7

Open the spreadsheet application and open the saved file.



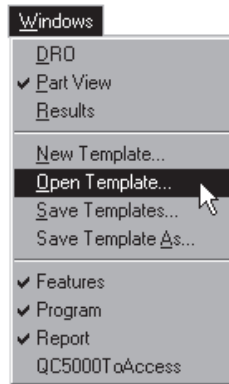
The screenshot shows the Microsoft Excel application window titled "Microsoft Excel - csv_export.csv". The menu bar includes File, Edit, View, Insert, Format, Tools, Data, Window, and Help. The toolbar contains various icons for file operations and editing. The status bar at the bottom shows "Ready" and "NUM".

	A	B	C	D	E	F	G	H	I	J	K
1			Line 3		2.1758	-0.0011	-0.39047				
2			Circle 5		3.00058	2.49767	-0.03907	0.37424	0.18712		
3			Circle 7		2.99938	0.49964	-0.00901	0.37484	0.18742		
4											
5											
6											
7											
8											
9											
10											

To export to an Access database

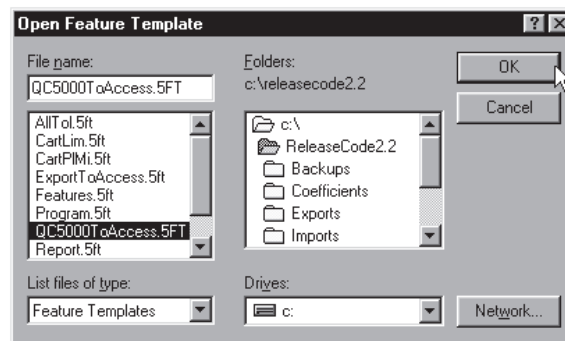
Step 1

Select *open template* from the windows menu.



Step 2

Open the *QC5000ToAccess.5ft* template as shown.



NOTE

The QC5000ToAccess.5ft template is located in the *c:\qc5000* directory.

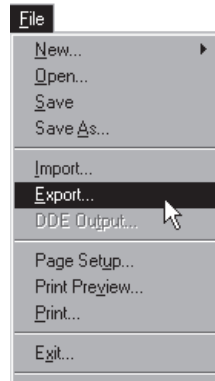
The *QC5000ToAccess.5ft* templates appears as shown.

A screenshot of a data table window titled 'QC5000ToAccess'. The table has columns for Name, r, d, X, Y, and Z. The data rows are as follows:

Name	r	d	X	Y	Z
Plane 1			3.25083	1.60275	0.00000
Line 2			2.79112	0.00000	-0.03383
Line 3			-0.00297	1.55535	-0.36903
Point 4			0.00000	0.00000	-0.20143
Cylinder 5	0.32619	0.65238	3.03047	1.53875	-0.27432
Cone 7	0.16165		4.53097	0.78854	-0.55130
Slot 10	0.13918	0.27837	4.34276	1.53850	-0.05525
Circle 13	0.15932	0.31865	3.02648	2.53612	-0.01553
Line 22			4.25858	2.64892	-0.05597
Plane 24			0.64873	1.57736	0.00000

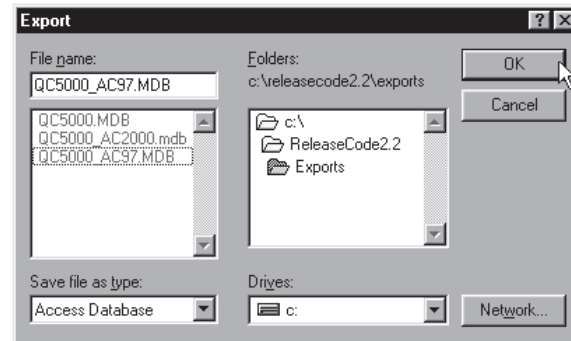
Step 3

Select *export* from the file menu.



Step 4

Select the desired database as shown and click OK.



NOTE

There are three predefined exportable databases. Use *QC5000_AC2000.mdb* and *QC5000_AC97.MDB* to export to Access2000 and Access97 respectively. Use *QC5000.mdb* to export to all other database applications.

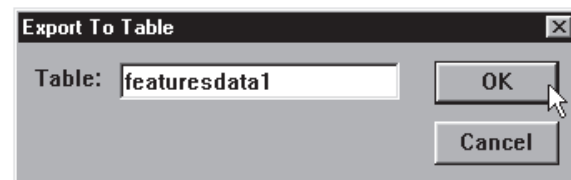


NOTE

Predefined databases are stored in the *c:\qc5000\exports* directory.

Step 5

Enter the table name as shown and click OK.



NOTE

Type the name *featuresdata1* when using the predefined

QC5000 databases.

Step 6

Start Access and open the current .mdb file and table to view the data in the table.

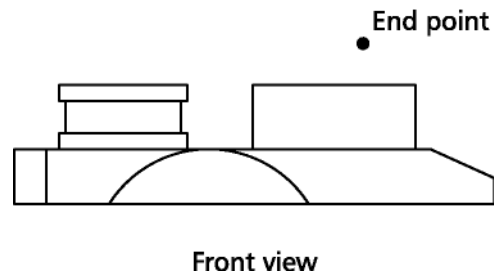
ID	Name	X	Y	Z	Q	R	D
1	Point 1	0.00000	0.00000	0.00000		0	0
2	Arc 16	4.49915	0.75079	-0.00452		0.74760	1.49519
3	Cylinder 5	2.99987	1.50005	-0.26897		0.37559	0.75117
4	Cone 9	4.49934	0.74942	-0.57706		0.19402	0
5	Circle 7	2.99767	2.49862	0.00879		0.19065	0.38130
6	Slot 10	4.31206	1.49972	-0.02523		0.18841	0.37682
7	Plane 1	3.24942	1.60329	0.00000		0	0
8	Line 2	2.25594	0.00000	-0.39735		0	0
9	Line 3	-0.00069	1.46248	-0.39766		0	0
10	Point 4	0.00000	0.00000	-0.39751		0	0
11	Cylinder 5	2.99987	1.50005	-0.26897		0.37559	0.75117
12	Circle 6	2.99943	0.50170	-0.03398		0.18747	0.37493
13	Circle 7	2.99767	2.49862	0.00879		0.19065	0.38130
14	Cone 9	4.49934	0.74942	-0.57706		0.19402	0
15	Slot 10	4.31206	1.49972	-0.02523		0.18841	0.37682

Record: 1 of 15

To complete the quick start program

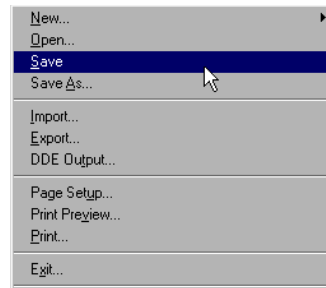
Step 1

Move the touch probe to the position as shown.



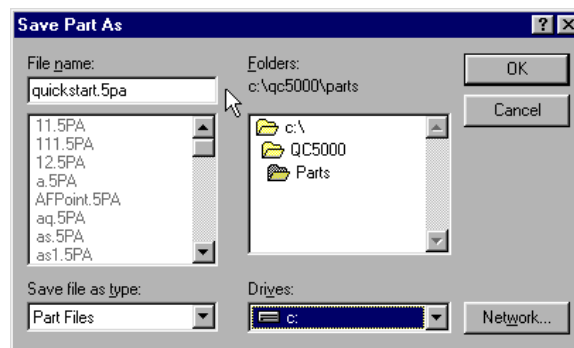
Step 2

Select *save* from the file menu.



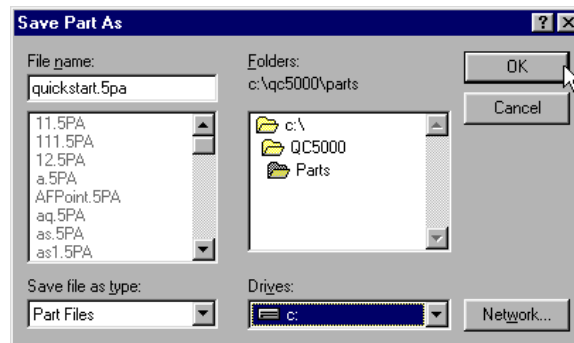
Step 3

Name the program and select the desired directory as shown.



Step 4

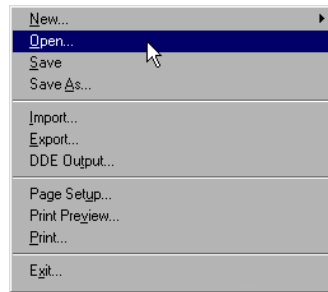
Click *OK* in the dialog box.



To run the quick start program

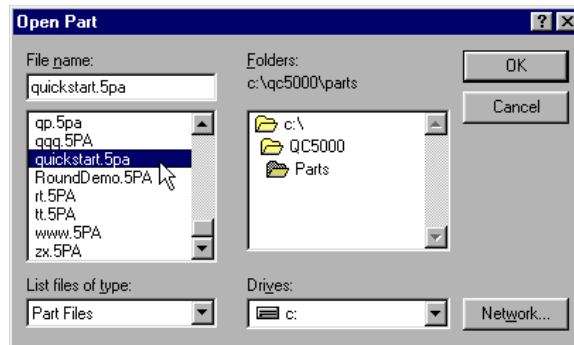
Step 1

Select open from the file menu.



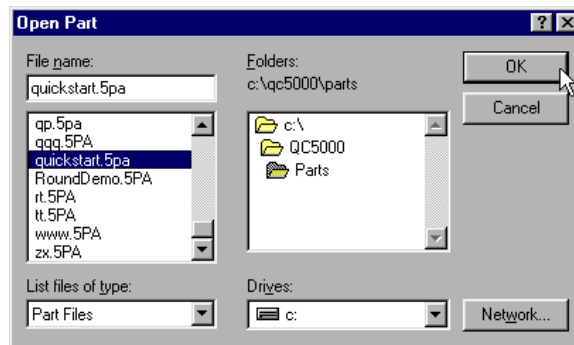
Step 2

Select the desired file as shown.



Step 3

Click *OK* in the dialog box.



Step 4

Click the *new run* button on the program toolbar.



The program executes automatically.



Chapter 3

Probes

There are 4 types of probes allowed in probe library the multi-sensor QC-5000:

- Video edge detection (VED)
- Touch probes
- Laser probes (OEM)
- Optical crosshair

Multi-sensor QC-5000 systems can support all or any combination of the above probes. VED and video probes consist of a magnification and a probe tool.

For QC-5000 multi-sensor purposes magnifications are the same as probe tips in probe library. All probe calibration data is stored and maintained in probe library.

Video probe tools determine the direction the QC-5000 scans while seeking an edge. For example, the circle probe tool directs the QC-5000 to scan from the inside of a circle feature until it finds the edge.

Think of the magnification as the probe and the probe tool as the direction the probe moves.

Video Edge Detection (VED)

VED setup requires the creation and calibration of several magnifications. Up to 10 magnifications can be stored in the VED portion of probe library.

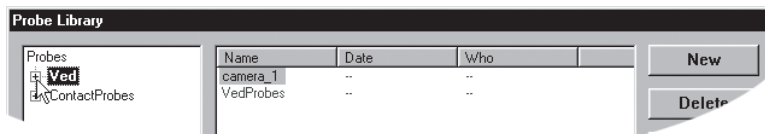
To create a new magnification

Step 1

Click the *probe library button* on the probes toolbar.

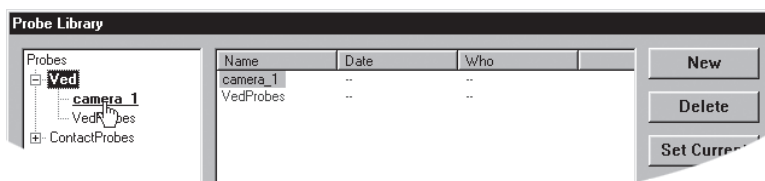


Click on the plus (+) sign next to *VED* as shown.

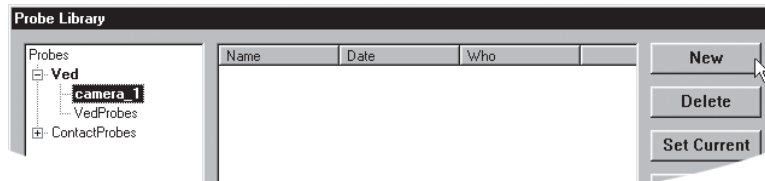


Step 2

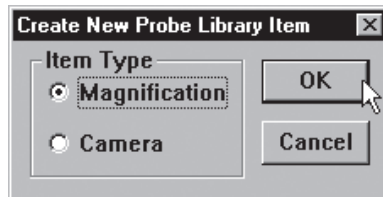
Double-click on *camera_1* as shown.



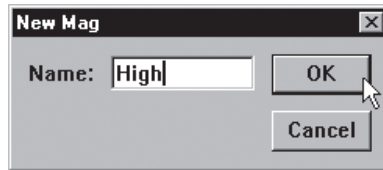
Step 3
Click the *new* button in the probe library window.



Step 4
Select the *magnification* radio button and click OK.

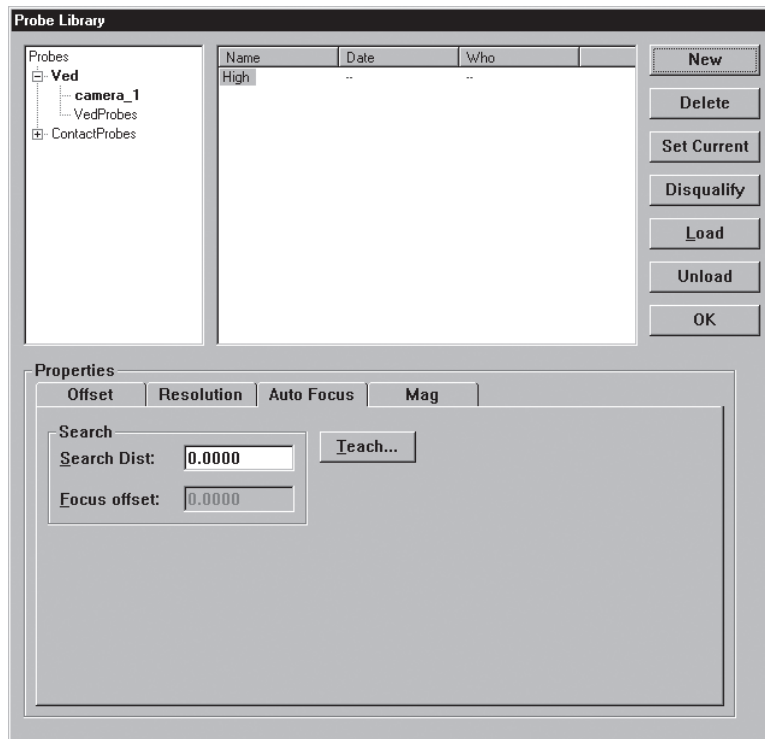


Step 5
Type the name of the magnification in the text box and click *OK*.



NOTE
Do not use spaces, dashes, or slashes in the names of probes, magnifications, probe groups.

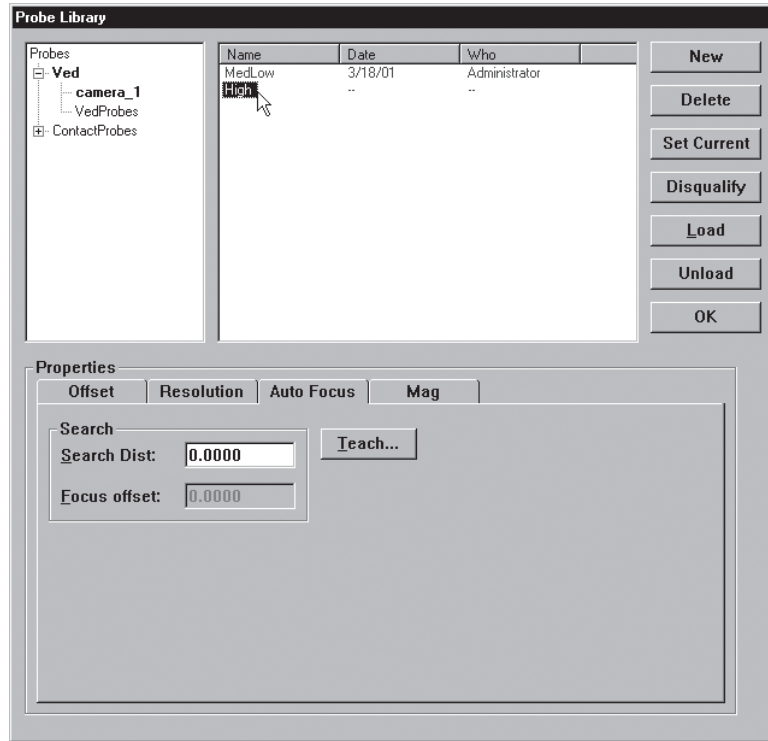
The new magnification is displayed as shown.



To delete a magnification

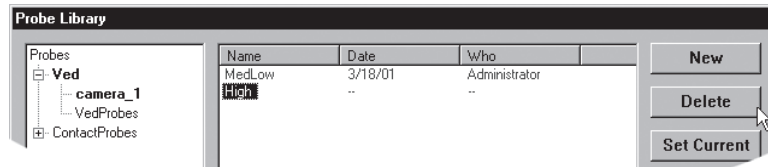
Step 1

Click on the desired magnification in the probe library window as shown.



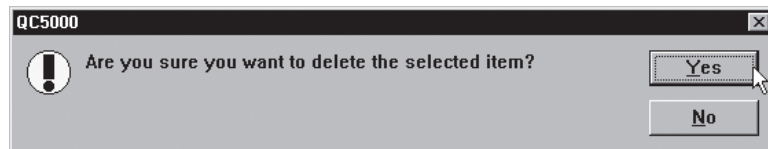
Step 2

Click the *delete* button.

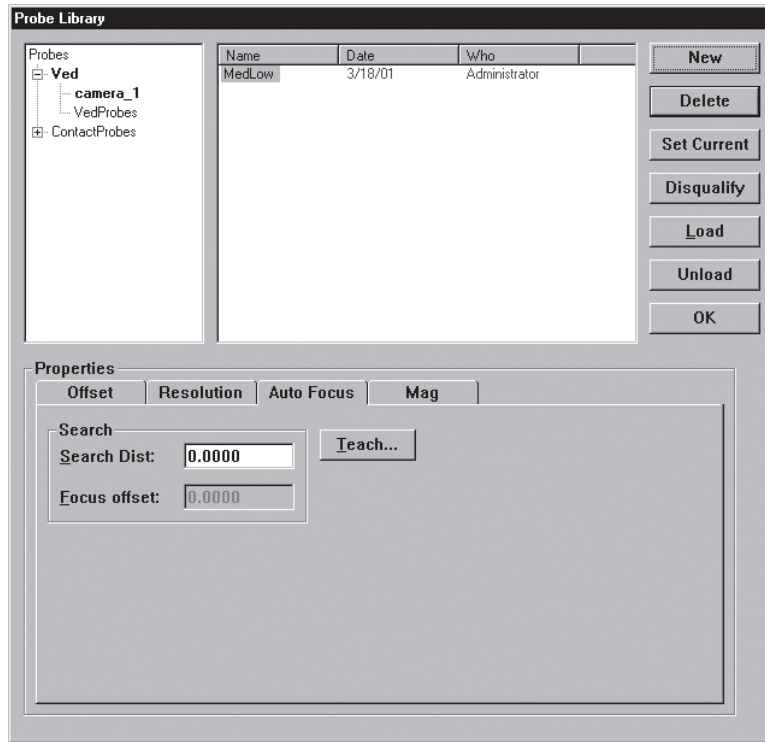


Step 3

Click *yes* in the dialog box.



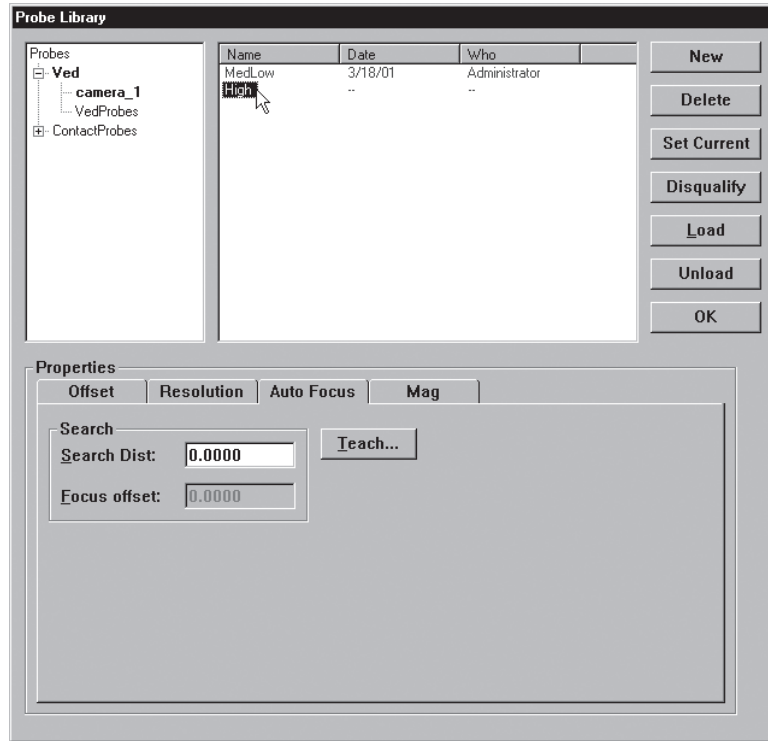
The magnification is deleted from probe library.



To assign a zoom position for a magnification

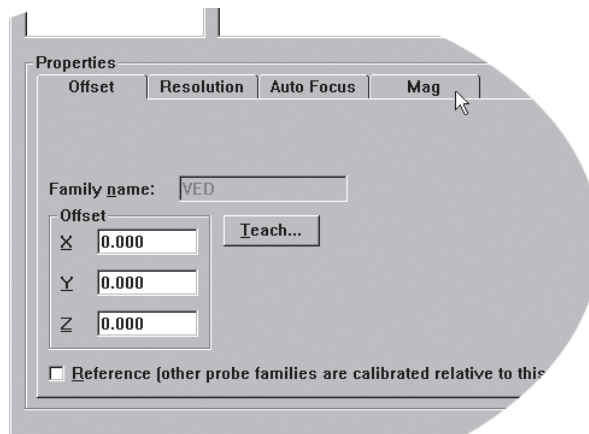
Step 1

Highlight the desired magnification as shown.

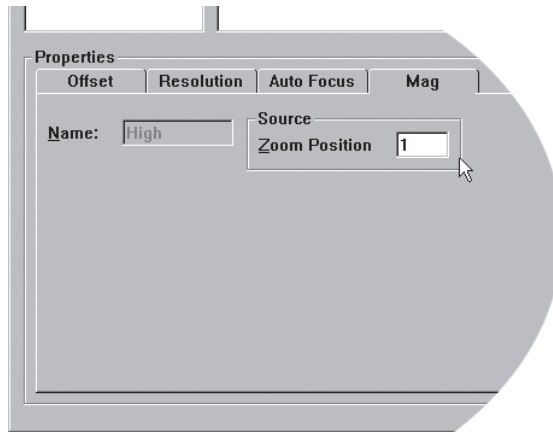


Step 2

Click on the *mag* tab.

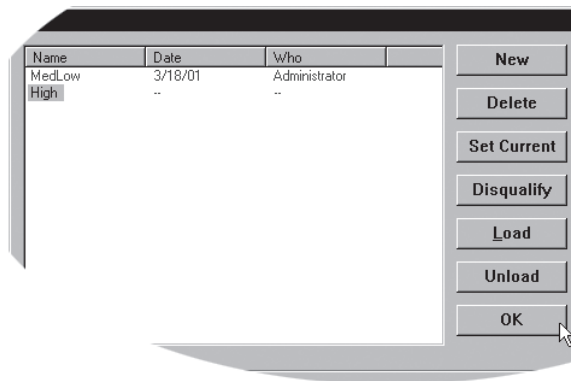


Step 3
Type the desired position as shown.



NOTE
Each magnification is assigned a different zoom position. Zoom position refers to the amount of magnification at a given lens position. The number of zoom positions is set by the OEM or distributor during initial setup.

Step 3
Click *OK*.



VED Calibrations

The following calibrations are required before using VED with the QC-5000:

- Auto focus teach (each magnification)
- Edge calibration (each VED probe tool)
- Pixel calibration (each magnification)
- Camera calibration (each camera)
- Parcentricity calibration (each magnification)

Use the glass master standard shipped with the QC-5000 to perform these calibrations.



NOTE

Perform all VED calibrations from the highest magnification to the lowest magnification. For example, if there are three magnifications (low, medium, and high) perform calibrations on high first.



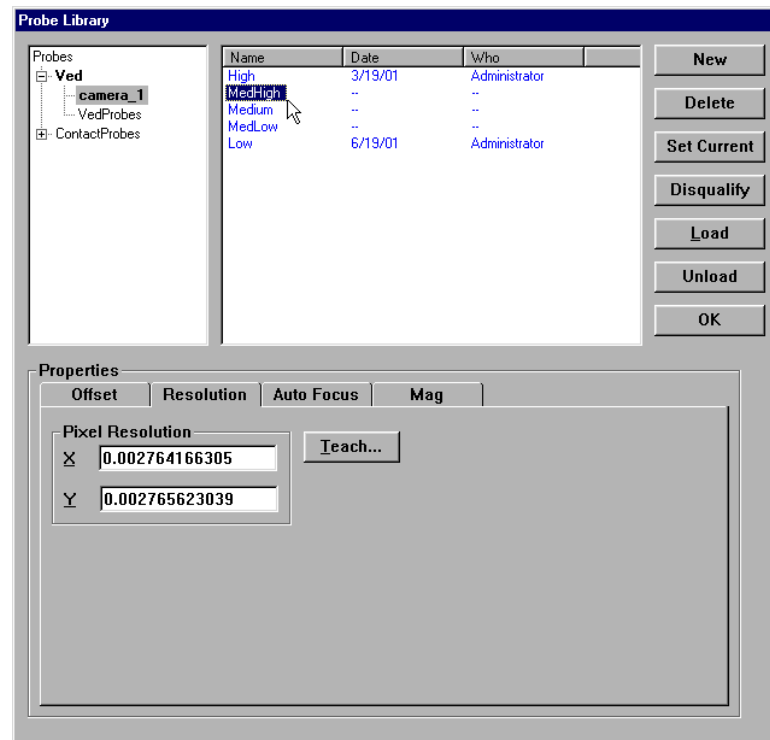
NOTE

Ignore calibration warnings as shown during the calibration process. Click the hide warning button and continue the calibration. The QC-5000 displays this message to warn users to complete calibrations before performing inspections.

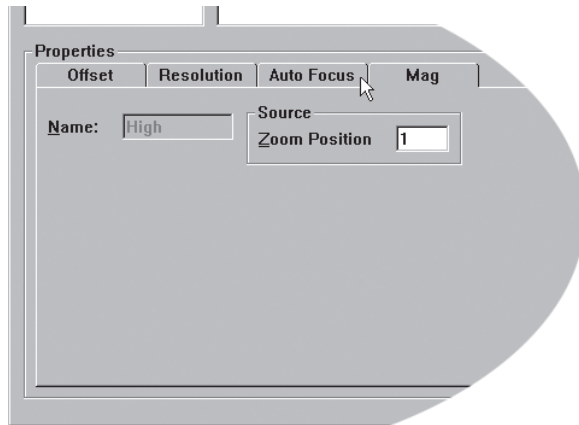
To perform an auto focus teach

Step 1

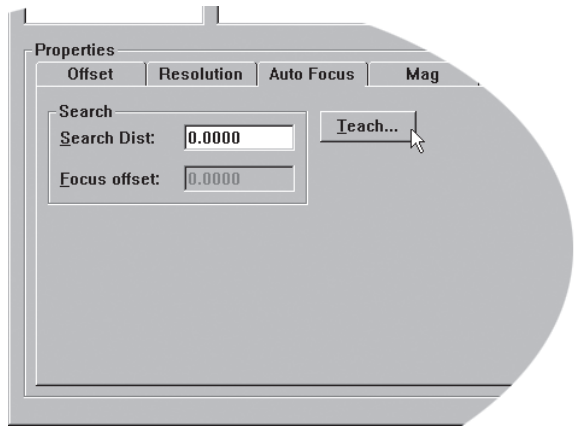
Highlight the desired magnification as shown.



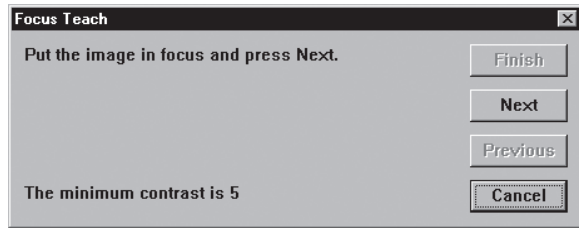
Step 2
Click on the *auto focus* tab as shown.



Step 3
Click the *teach* button.

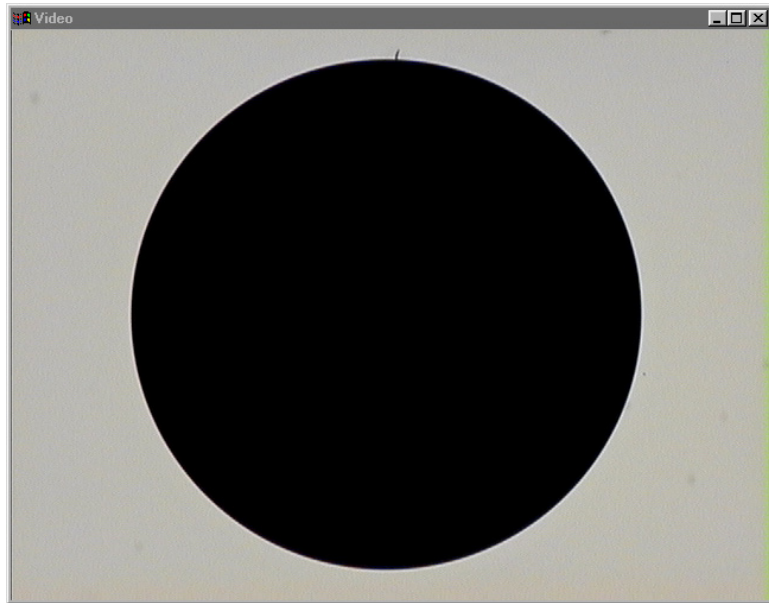


Step 4
The teach dialog box appears as shown.



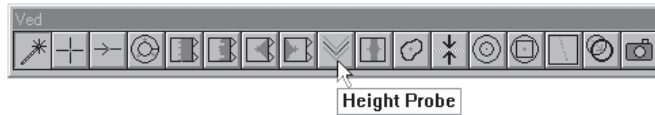
Step 5

Position the *Z axis* with a circle completely within the field of view as shown.



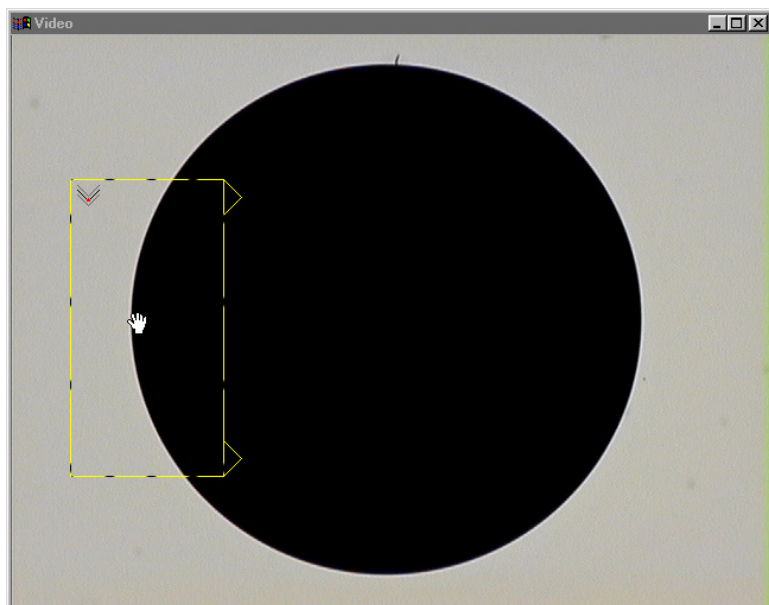
Step 6

Click on the *height probe* button on the VED toolbar.

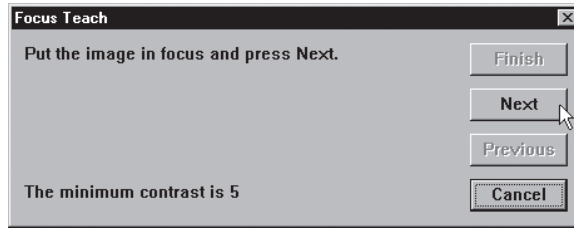


Step 7

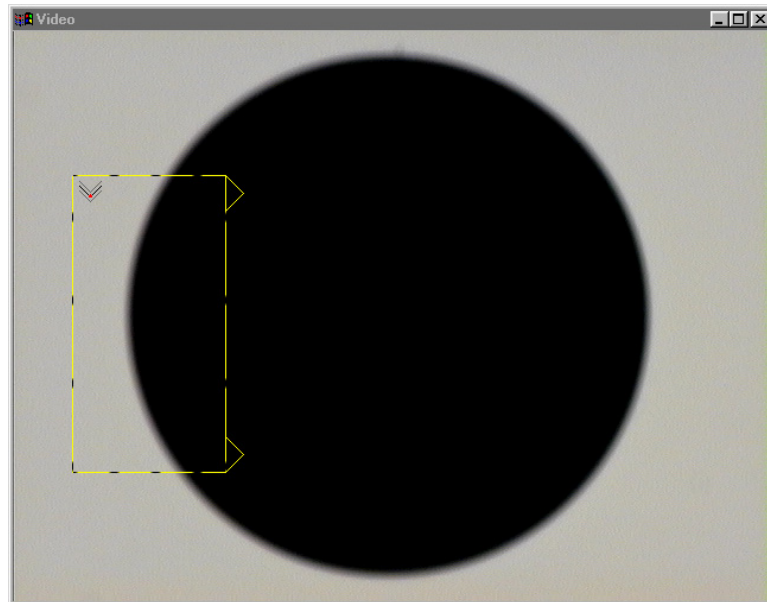
Adjust the height probe tool as shown and adjust the light so the circle is black and the background area is light grey.



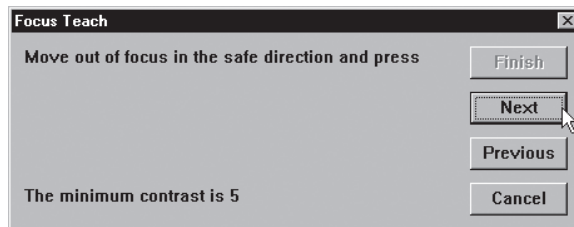
Step 8
Click *next* in the focus teach dialog box.



Step 9
Move the *Z axis* up until the image begins to lose focus as shown.

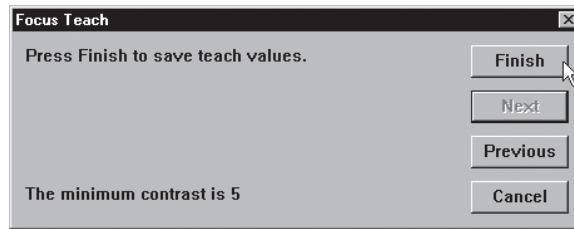


Step 10
Click *next* in the dialog box.



The system performs the auto focus teach. The *Z axis* will move up and down during this process.

Step 11
Click *finish* to save the teach values.



The auto focus teach for the magnification is complete. Perform this calibration for each magnification in probe library.

After performing the auto focus teach, perform an edge teach for each VED probe tool. This example uses the simple tool but all VED probe tools are calibrated using the same method. Use edge teach to define the light-to-dark edge characteristics for VED.

To perform an edge teach

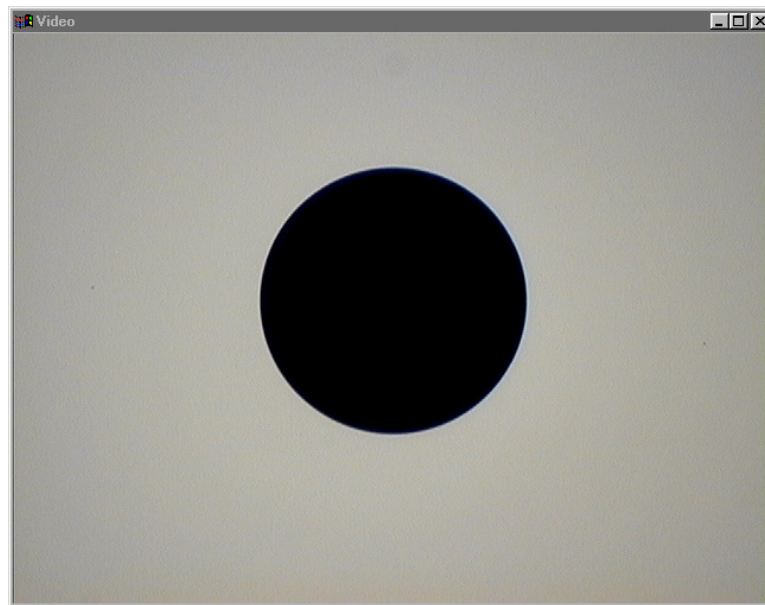
Step 1

Click the autofocus button on the VED toolbar.



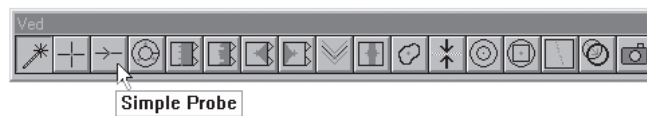
Step 2

Position the Z axis with a circle completely within the field of view and in focus as shown.

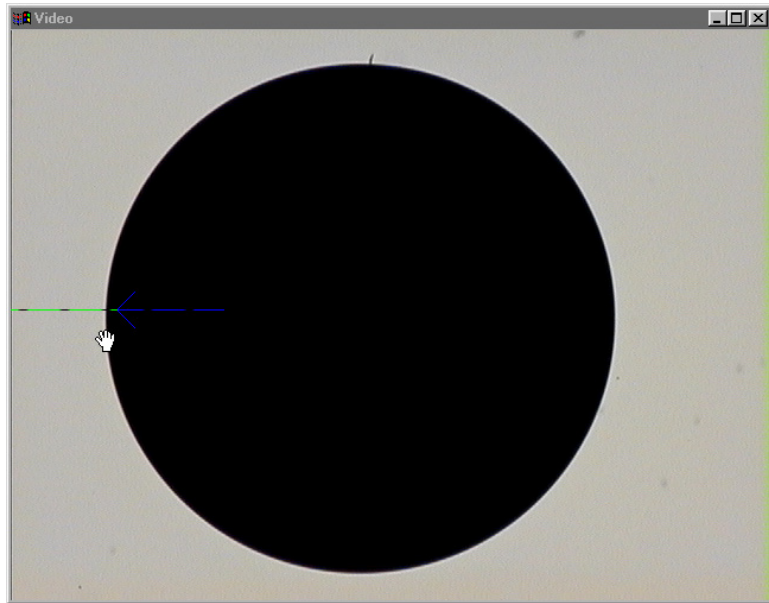


Step 2

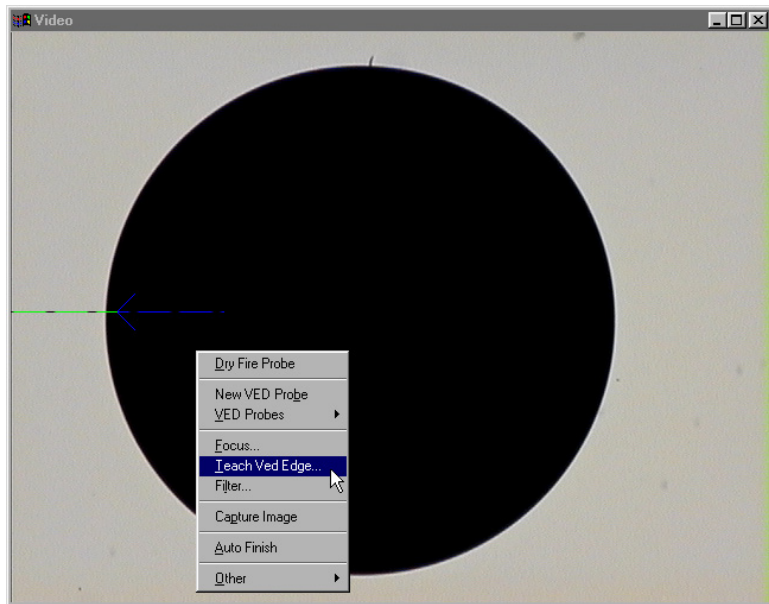
Click the *simple probe* button on the VED toolbar.



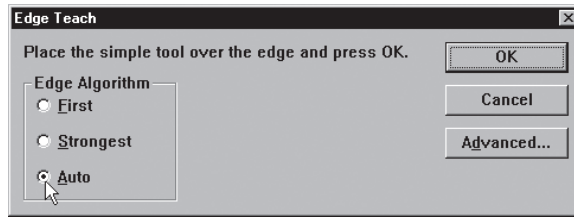
Step 3
Place the *simple probe* as shown.



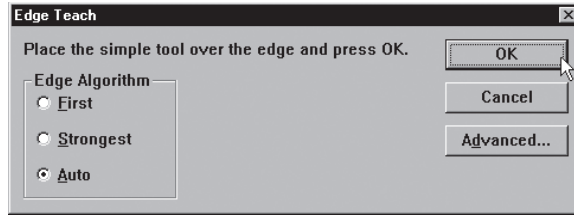
Step 4
Right click in the video window and select *teach VED edge*.



Step 5
Select *auto* as shown.



Step 6
Click *OK*.



The edge teach for the magnification is complete.

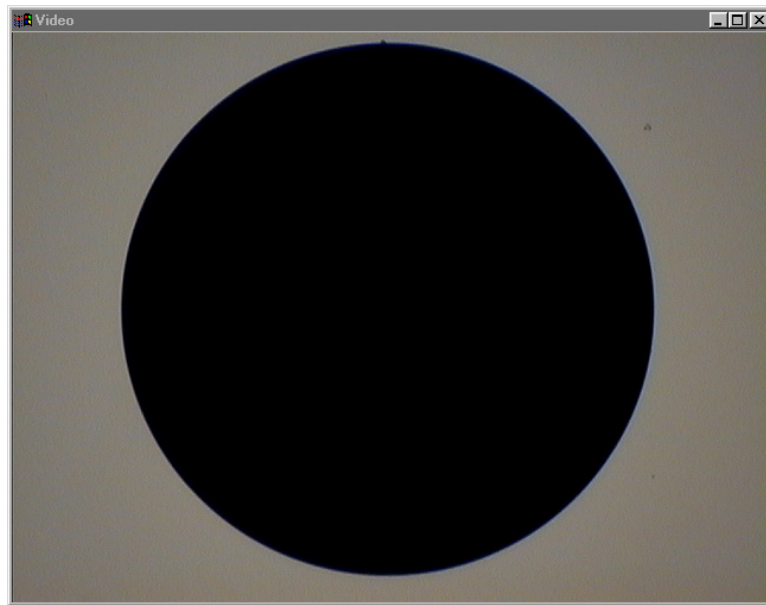
Pixel calibration

Use the pixel calibration to calibrate camera pixels to the glass master standard. Perform a pixel calibration for each magnification.

To perform a pixel calibration

Step 1

Position the largest circle on the standard in the center of the field of view as shown.



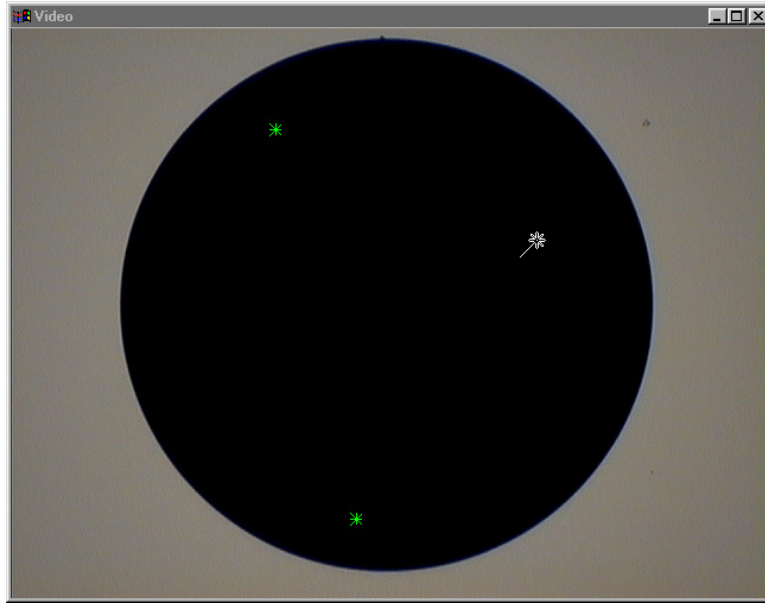
Step 2

Click on the *new probe* button on the VED toolbar.



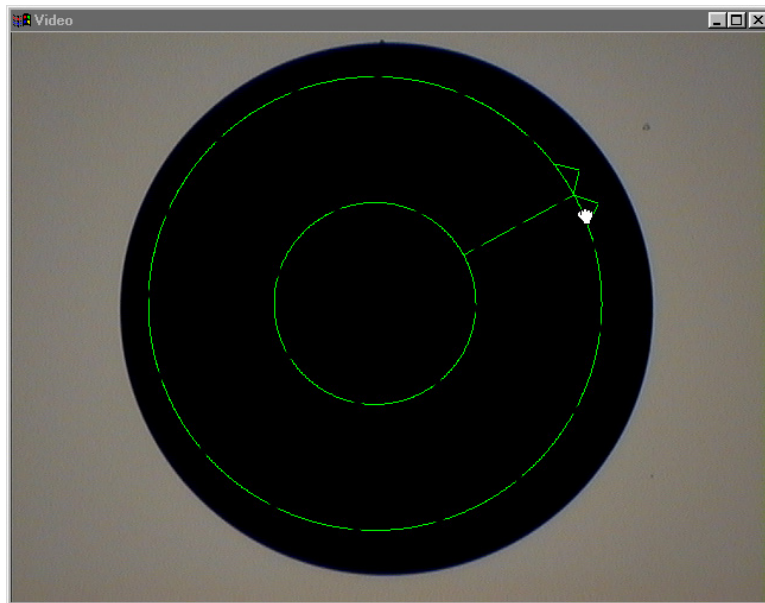
Step 3

Click in the dark area of the circle as shown. After each click an star appears in that position.



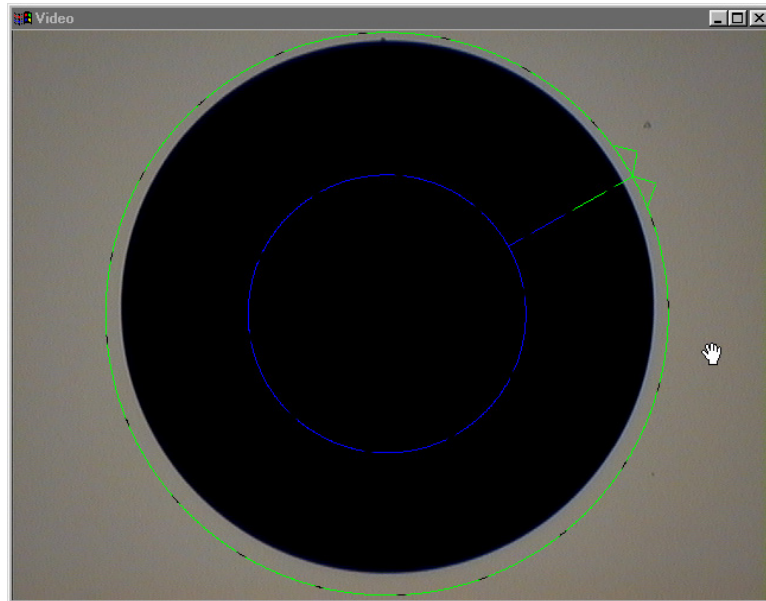
Step 4

On the third click, hold the mouse button down and drag toward the edge of the circle.



Step 5

Release the mouse button once in the light area as shown.



NOTE

Steps 1 through 5 create a custom video tool. The inside circle on the tool is black and the outside circle is green. This indicates that the QC-5000 will look for points moving from the dark area towards the light area.

Step 6

Click on the *auto focus* button on the VED toolbar.

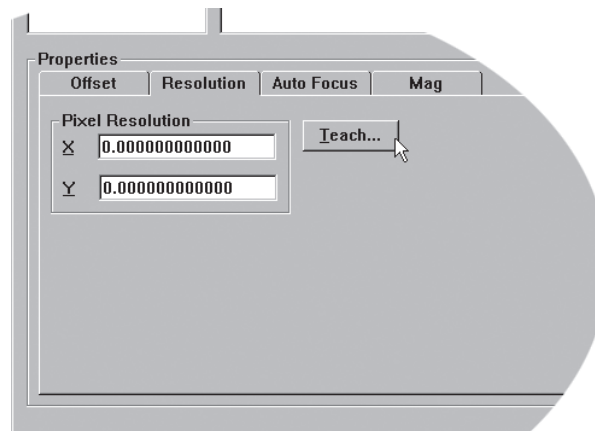


Step 7

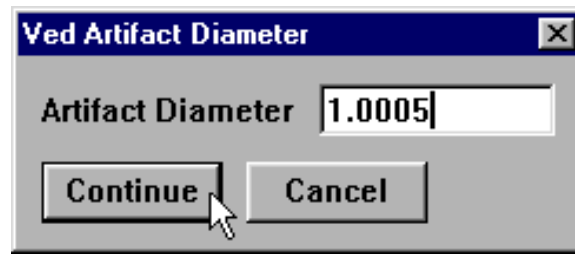
Click on the *probe library* button on the probe toolbar.



Step 8
Click on the *resolution* tab and then click on teach.

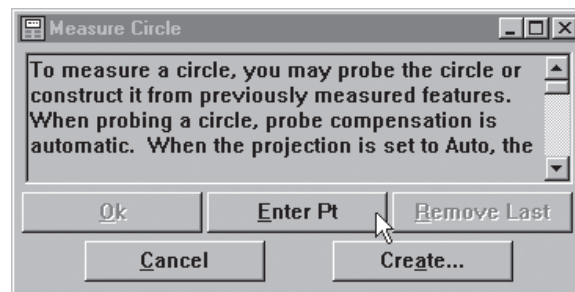


Step 9
Enter the measured diameter of the standard circle and click *continue* as shown.



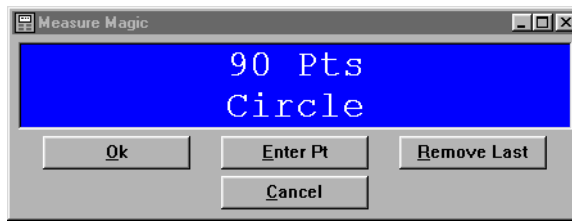
NOTE
Do not enter the diameter as measured with the QC-5000. Use the diameter found on the standard's case.

Step 10
Click *enter pt* in the dialog box as shown.

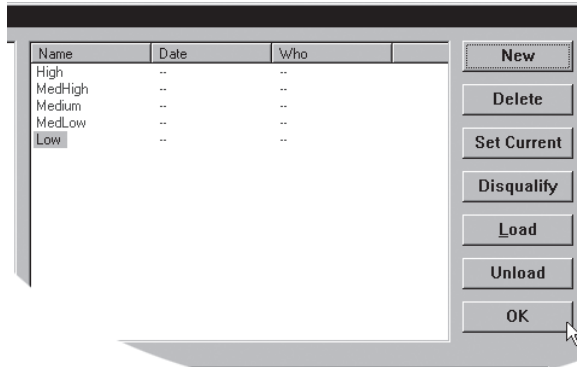


NOTE
At least 90 points are required to perform a pixel calibration.

Step 11
Click *OK*.



Step 12
Click *OK* in probe library.



The pixel calibration for this magnification is complete. Perform pixel calibrations for each magnification in probe library.

To perform a camera calibration

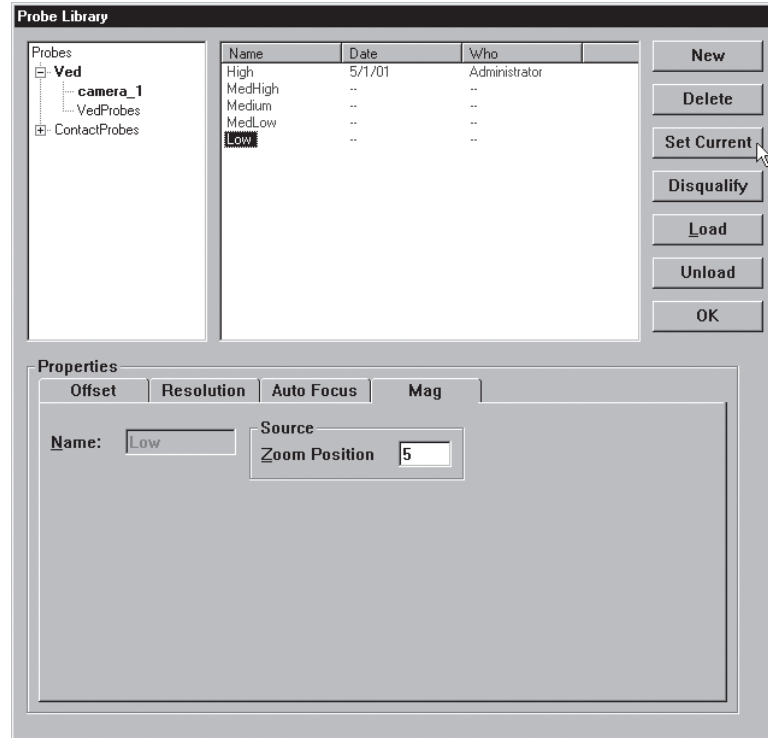


NOTE

Perform necessary mechanical alignments according to OEM instructions prior to performing a camera calibration with the QC-5000.

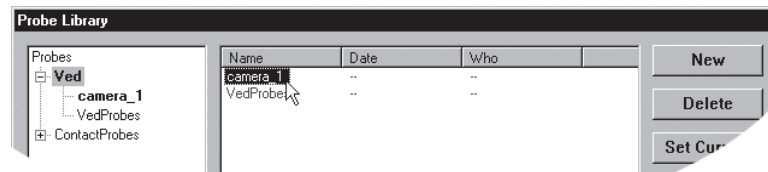
Step 1

Highlight the lowest magnification in probe library as shown and click *set current*.



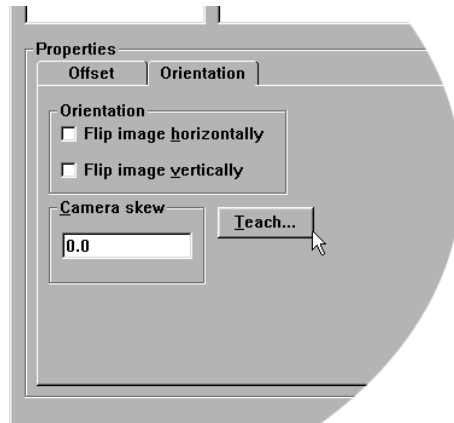
Step 2

Highlight the desired camera as shown.



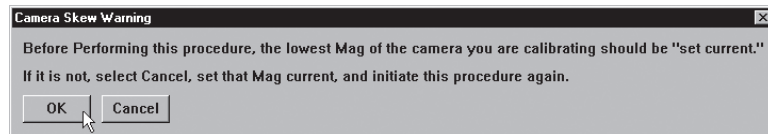
Step 3

Click on the *orientation* tab and then click the *teach* button.



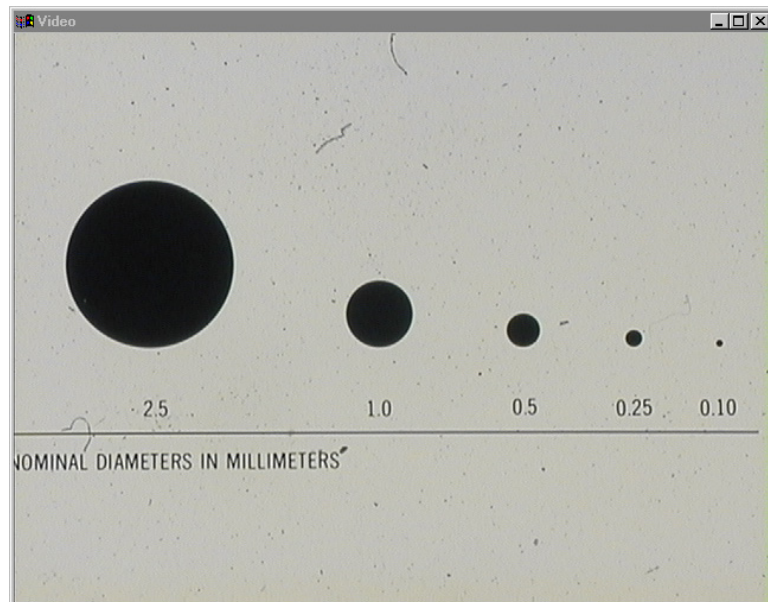
Step 4

Click *OK* in the dialog box.

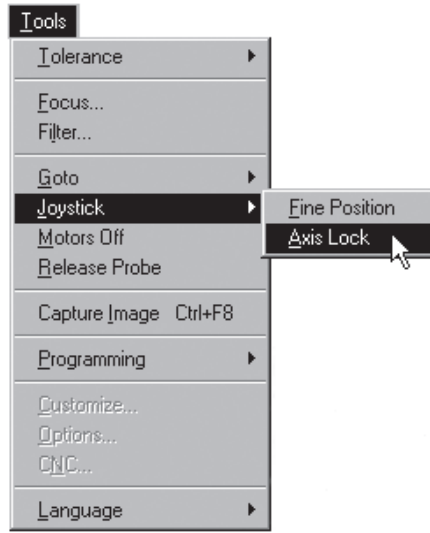


Step 5

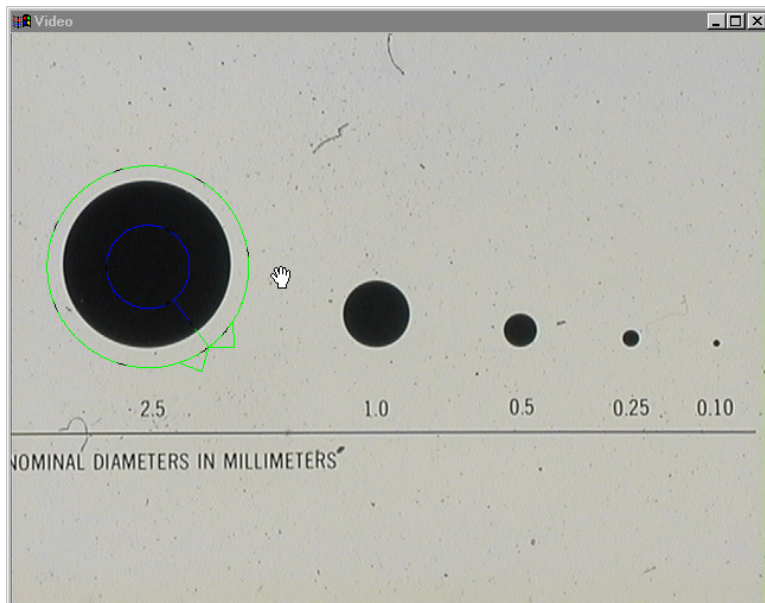
Adjust the field of view as shown.



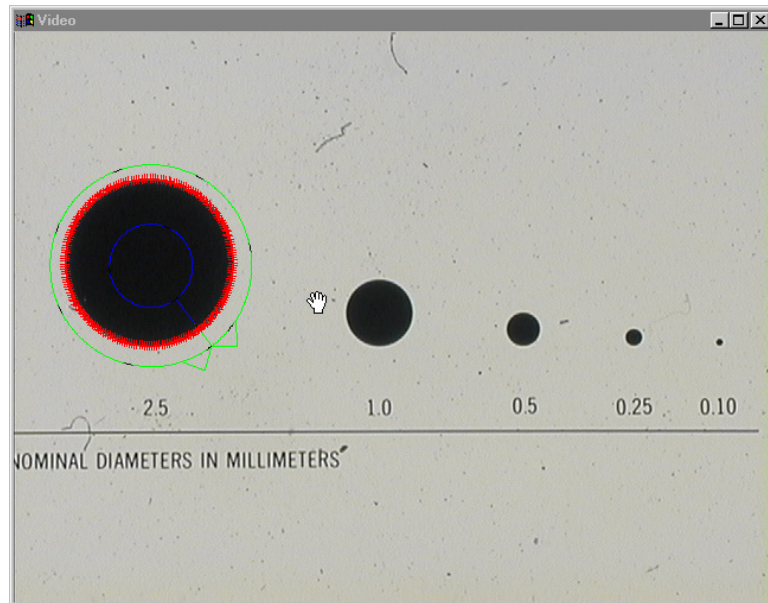
Step 6
Turn on *axis lock* as shown.



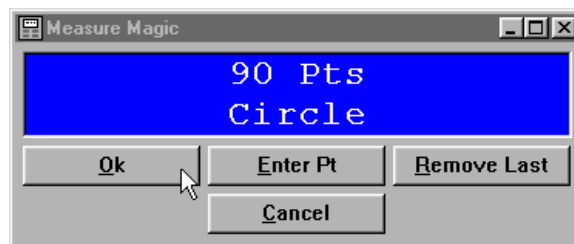
Step 7
Use the circle probe to measure the circle on the left.



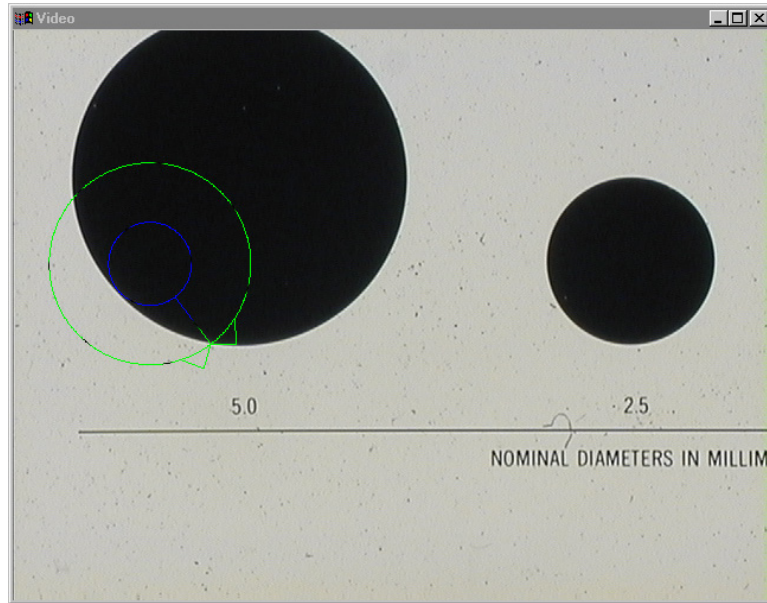
Step 8
Click the center mouse button.



Step 9
Click *OK* in the dialog box.

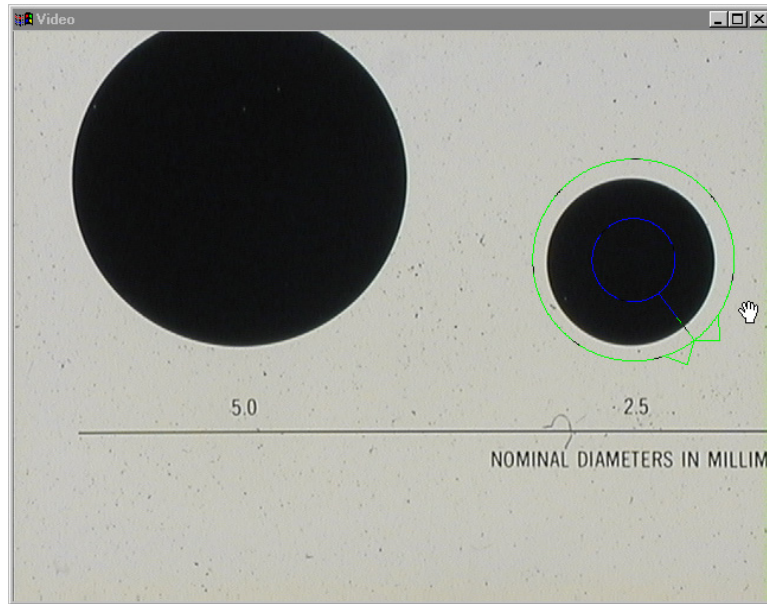


Step 10
Use the *X axis* to move the circle to the right side of the field of view as shown.

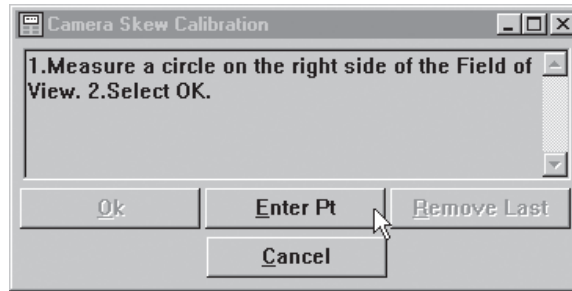


NOTE
Do not move the *Y axis*. Select *joystick* from the *tools* menu and then choose *axis lock*.

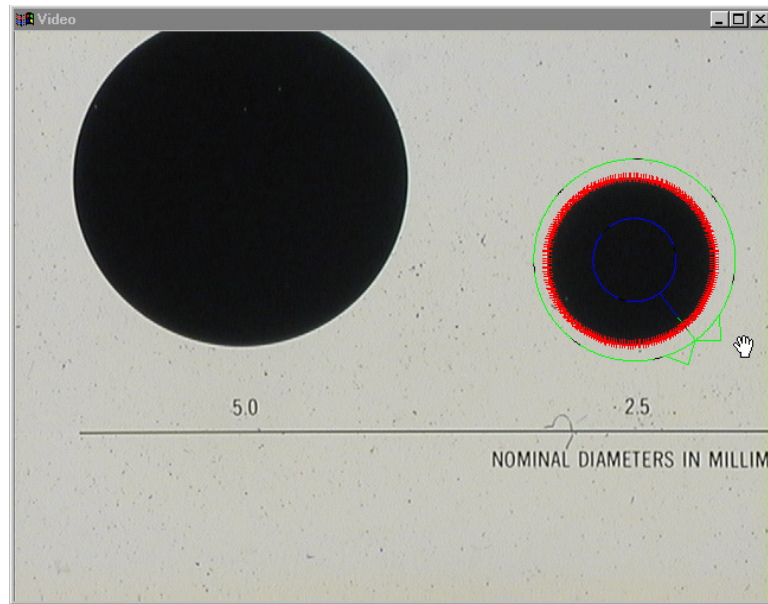
Step 11
Use the *circle probe* to measure the circle on the right.



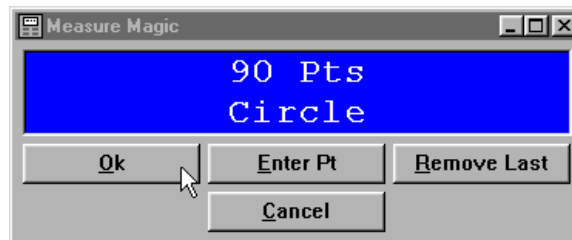
Step 12
Click *enter pt* in the dialog box.



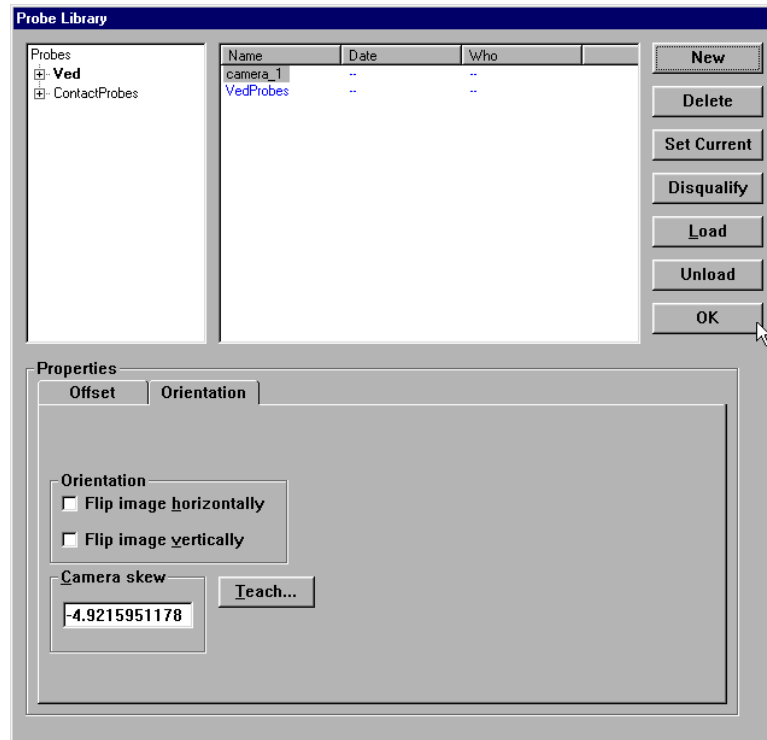
The video window appears as shown.



Step 13
Click *OK*.



Step 14
Click *OK* in probe library.



The camera calibration is now complete.



NOTE
Perform a mechanical re-alignment if the camera skew is greater than 1 degree.

Parcentricity calibration

Perform a parcentricity calibration to ensure the optics center of each lens is properly aligned. All systems with more than one magnification require parcentricity calibration. Parcentricity calibrations are performed only after all other calibrations are complete. Use a circle on the standard that will fit the field of view in all magnifications.

To perform a parcentricity calibration



NOTE

In this demonstration the following magnifications appear in probe library: High, MedHigh, Medium, MedLow, and Low. Individual users may have selected different names for the magnifications stored in probe library. To duplicate this process use the highest magnification for step 1.

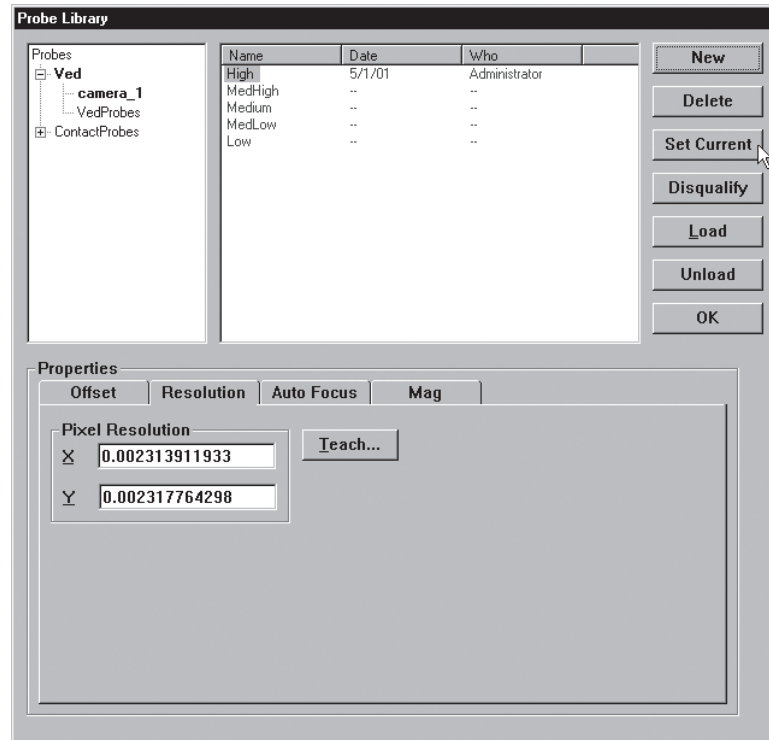


NOTE

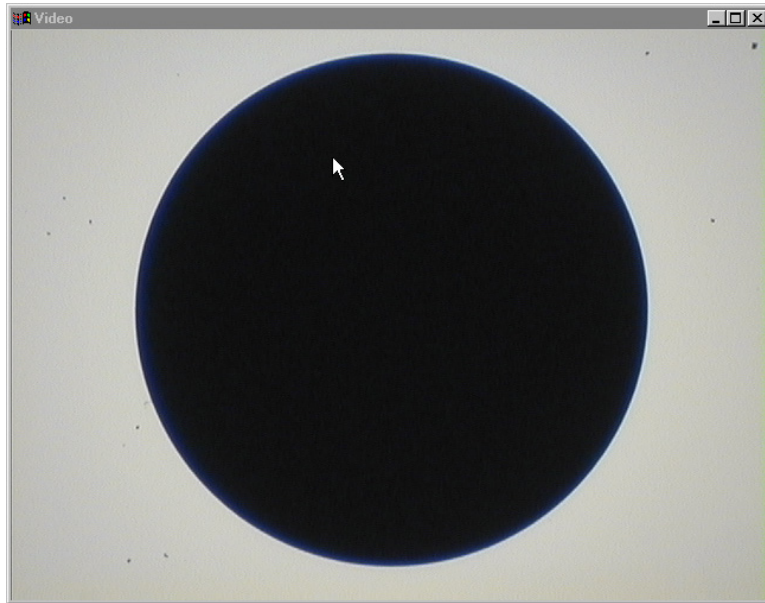
Do not move the stage between magnifications while performing the parcentricity calibration.

Step 1

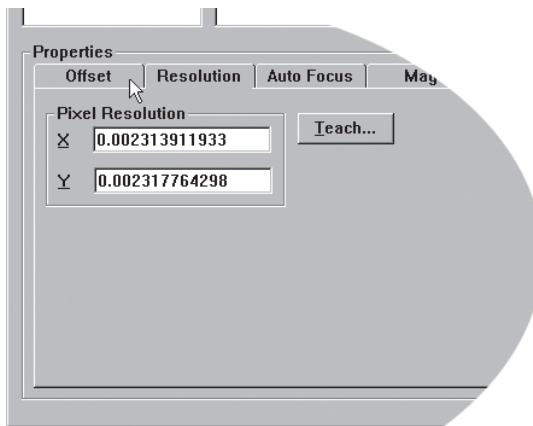
Highlight the highest magnification as shown and click *set current*.



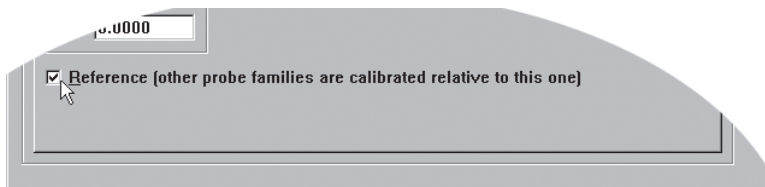
Step 2
Center the desired circle in the field of view.



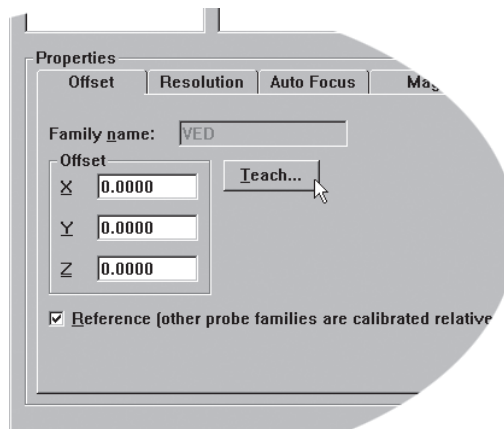
Step 3
Click the *offset* tab.



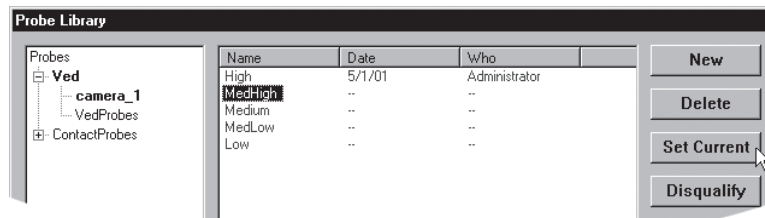
Step 4
Place a check in the *reference* checkbox as shown.



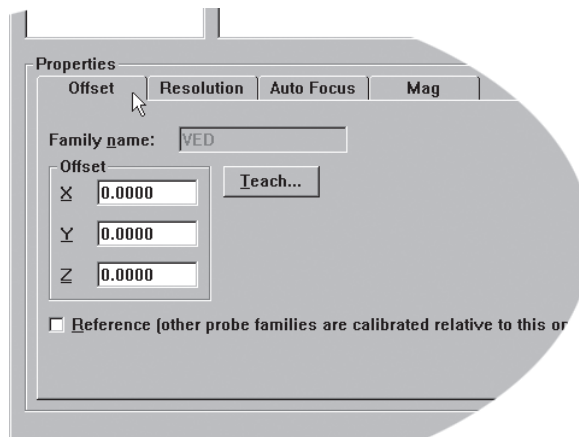
Step 5
Click the *teach* button.



Step 6
Highlight the medhigh (or next highest) magnification as shown and click *set current*.

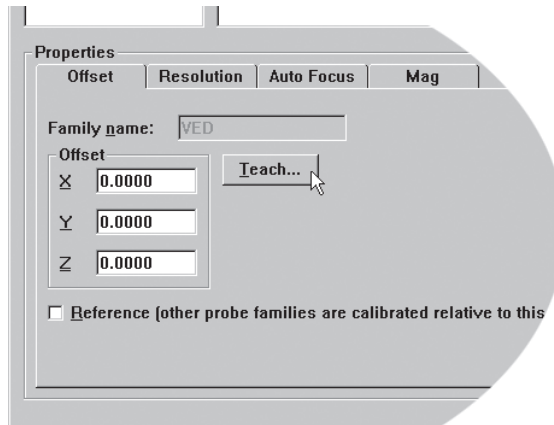


Step 7
Click the *offset* tab.

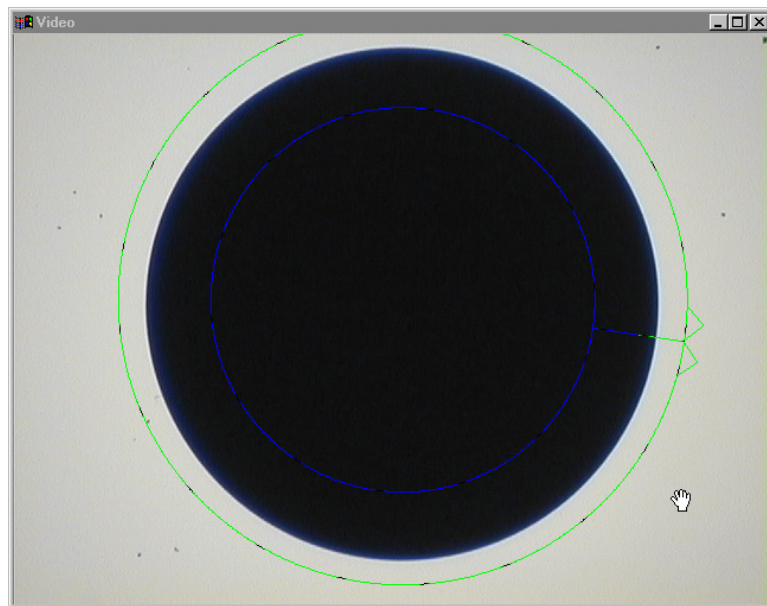


NOTE
Make certain the reference box is unchecked.

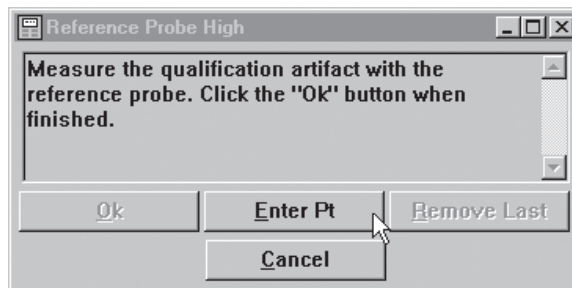
Step 8
Click the *teach* button.



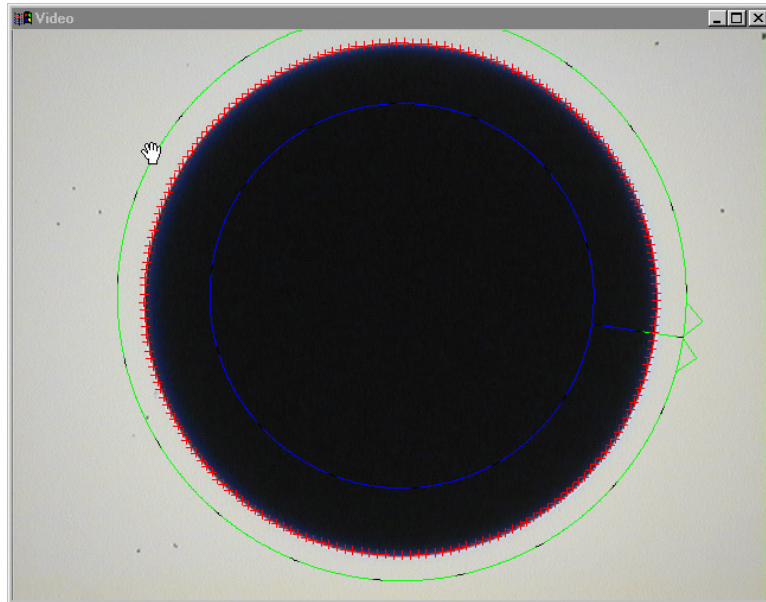
Step 9
Probe the circle as shown using the circle probe.



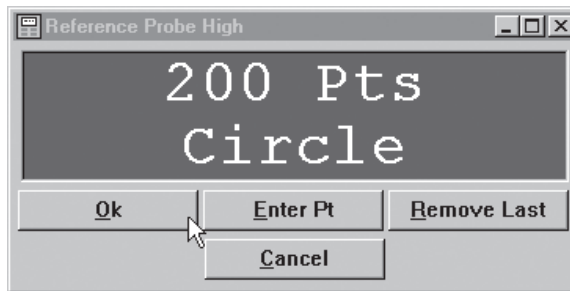
Step 10
Click the *enter pt* button.



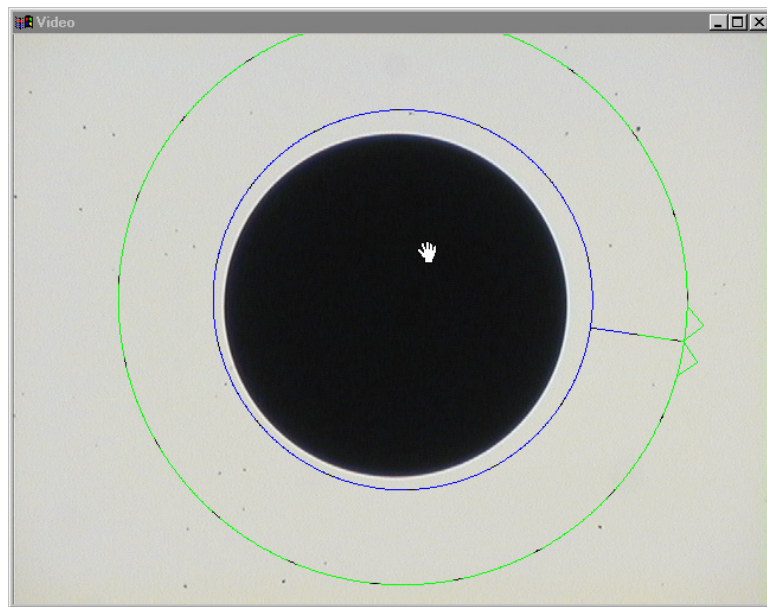
The video window appears as shown.



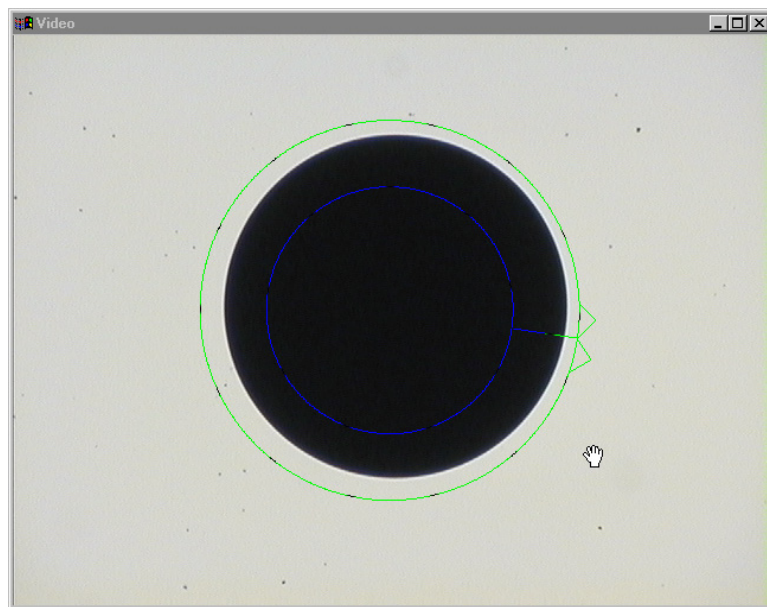
Step 11
Click *OK*.



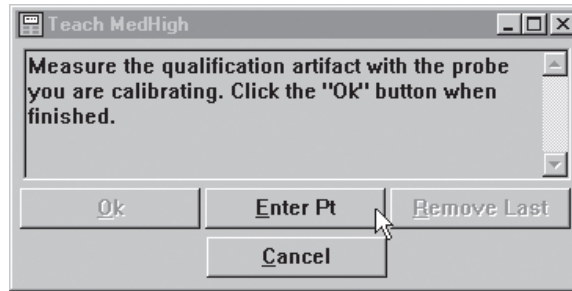
The QC-5000 automatically switches to the medhigh magnification.



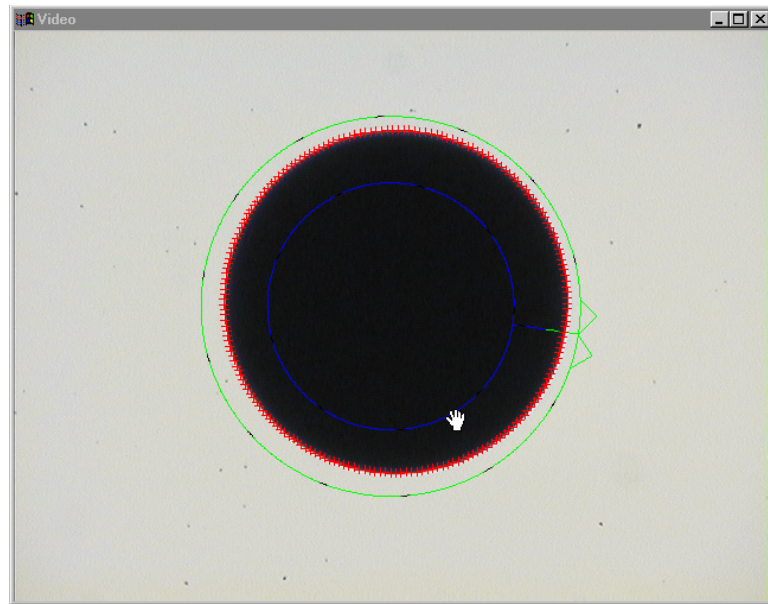
Step 12
Probe the circle as shown using the circle probe.



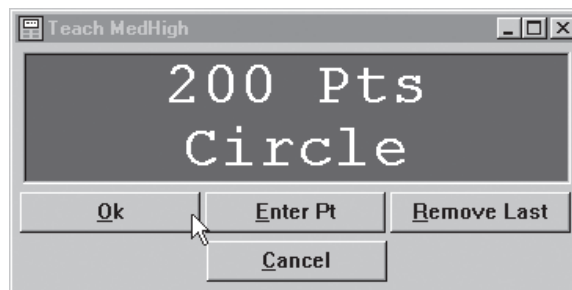
Step 13
 Click the *enter pt* button in the dialog box.



The video window appears as shown.



Step 14
 Click *OK*.



The parcentricity calibration for high and medhigh magnifications are complete. Use this process to perform parcentricity calibrations for the remaining magnifications.

VED Probes

Use VED probes to measure features with a distinct light-to-dark edge. VED probes are animated by small hash marks that move along the green probe outline. The animation shows the scan direction and the direction of edge detection.

The QC-5000 contains the following VED probes:

- New VED probe
- Simple probe
- Circle probe
- Buffer probe
- Average probe
- Nearest probe
- Farthest probe
- Height probe
- Width probe
- Blob probe
- Pattern probe
- Worm probe

New probe tool

Use the new probe tool to create simple, circle, or buffer probes.

To access the new probe tool

Step 1

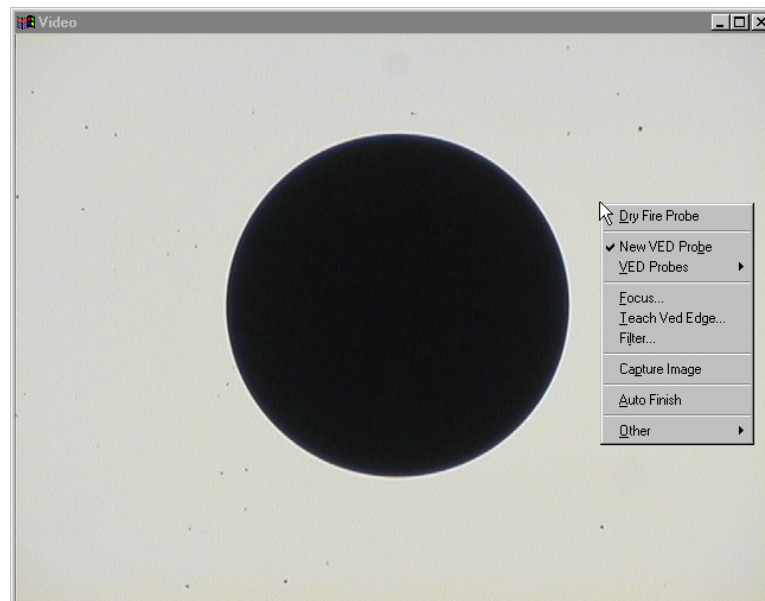
Click on the *new probe* button on the VED toolbar.



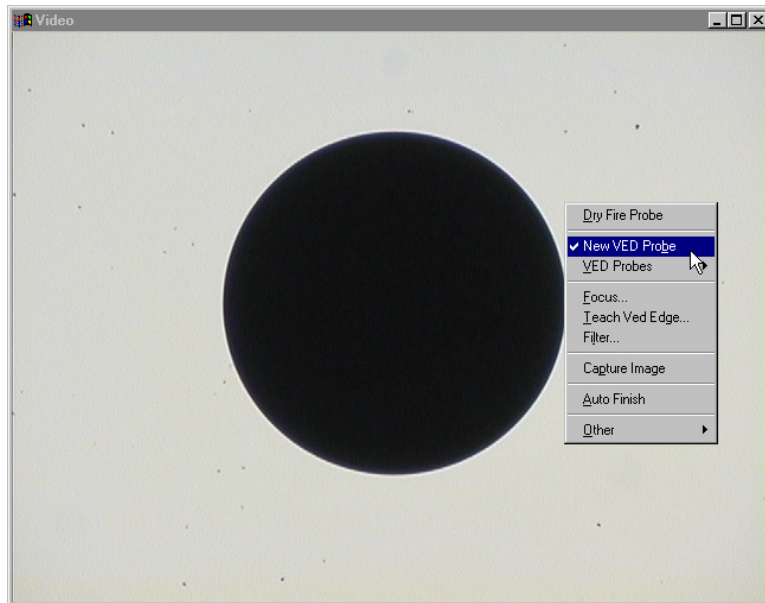
OR

Step 1

Right click in the video window as shown.

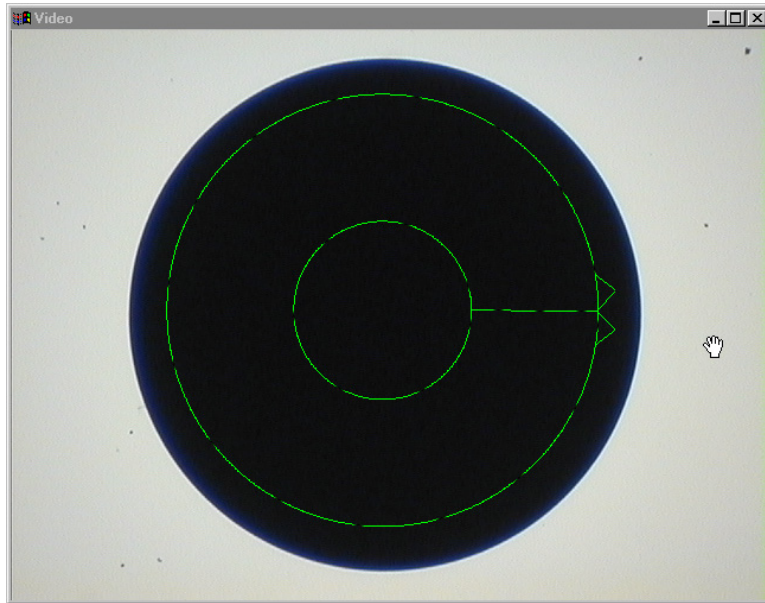


Step 2
Select *new tool* from the menu.



Hand cursors

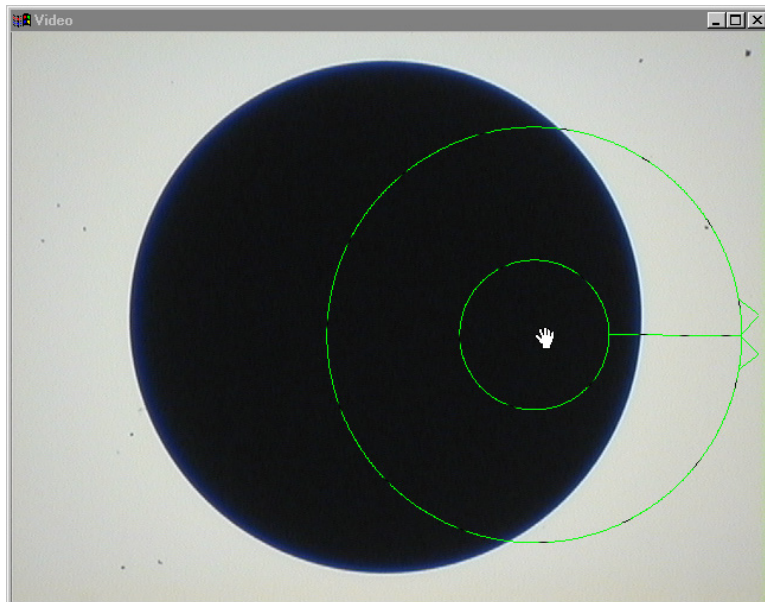
Use the hand cursors to re-size, rotate, and move probe tools in the video window. The arrow cursor becomes a hand cursor when placed next to a probe tool.



To move a probe tool

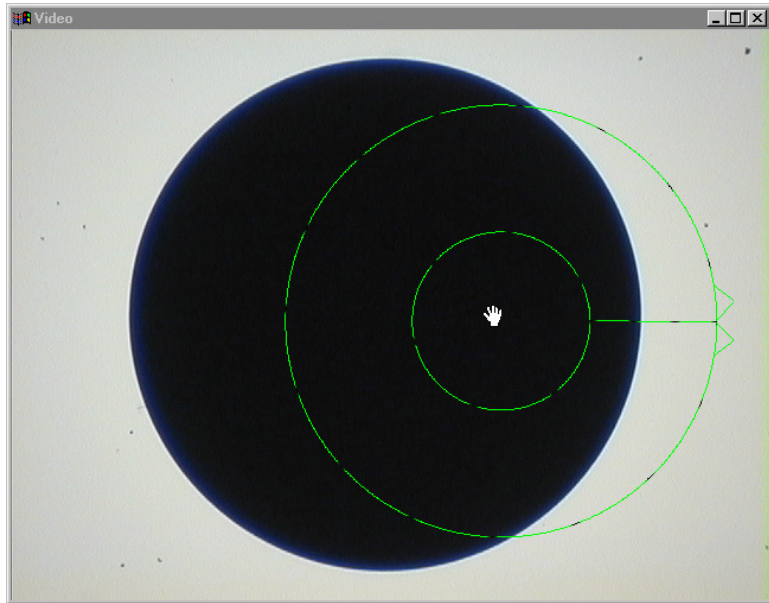
Step 1

Place the hand cursor in the center of the tool as shown.



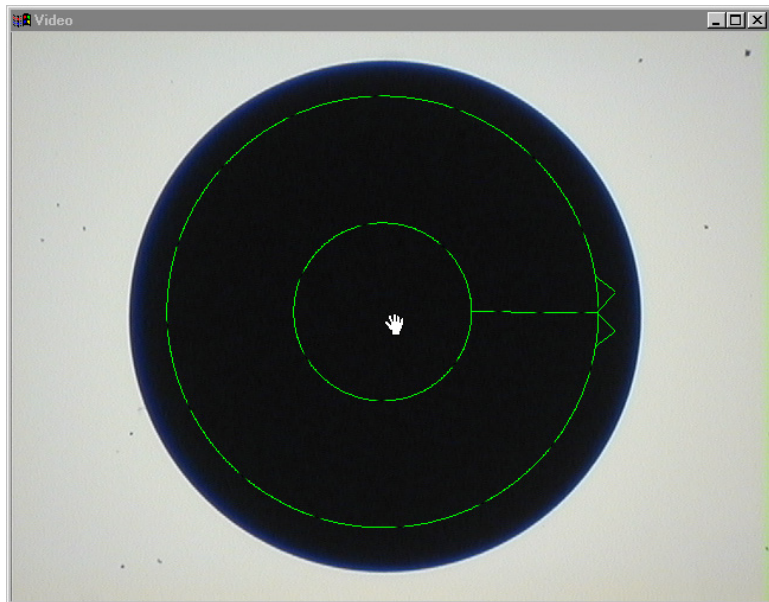
Step 2

Hold the mouse button down and drag the tool to the desired position.



Step 3

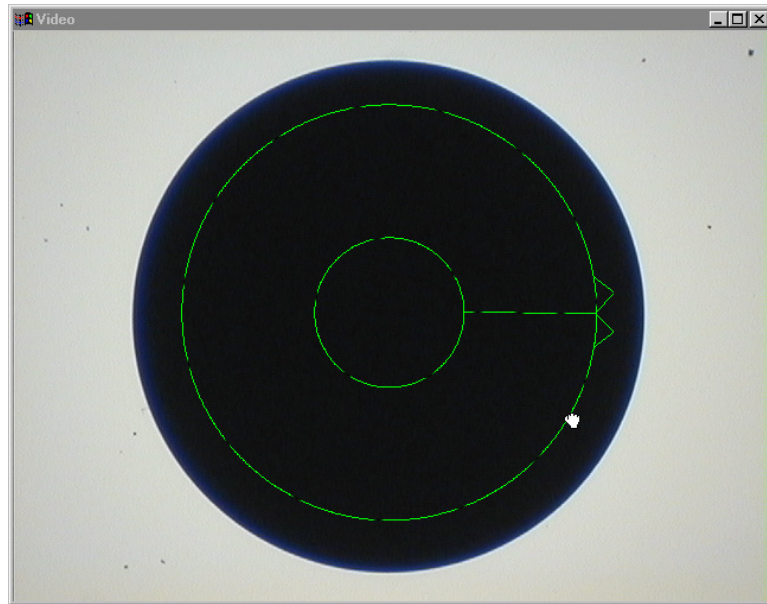
Release the mouse button.



To re-size a probe tool

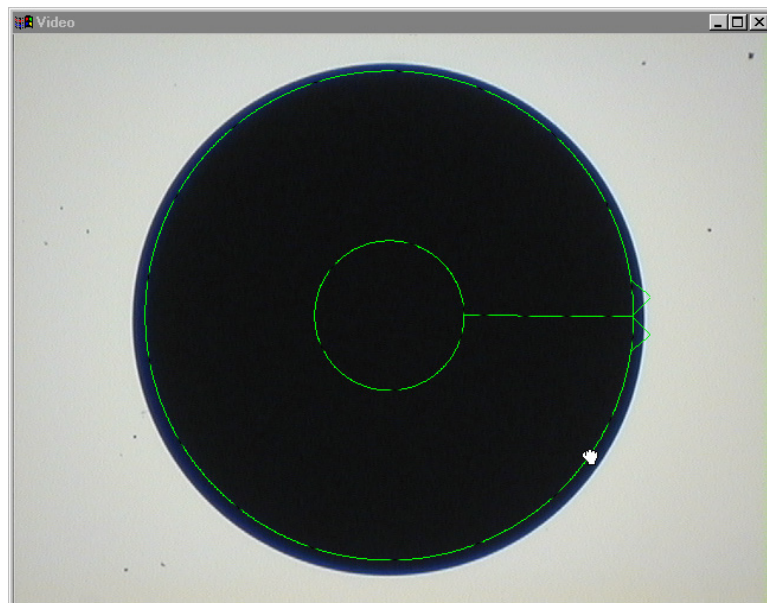
Step 1

Place the hand cursor on the portion of the tool to be re-sized.

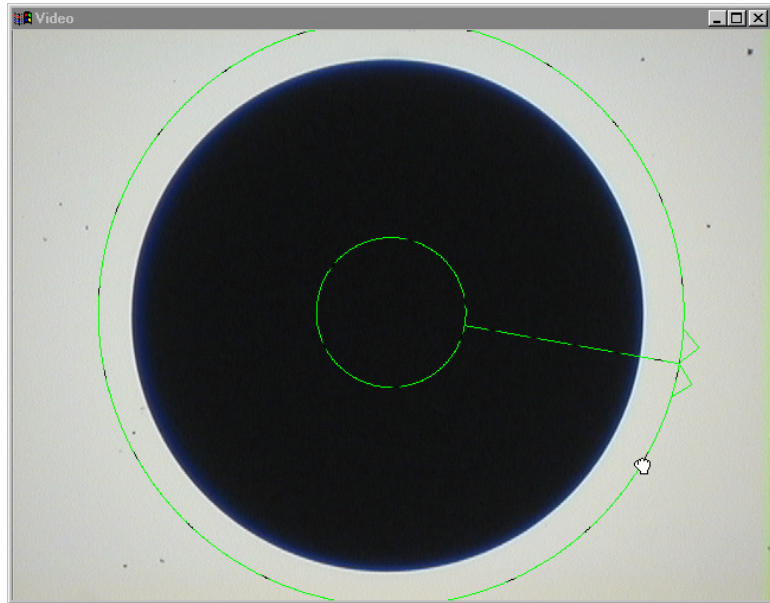


Step 2

Hold the mouse button down and drag until the tool is the desired size.



Step 3
Release the mouse button.

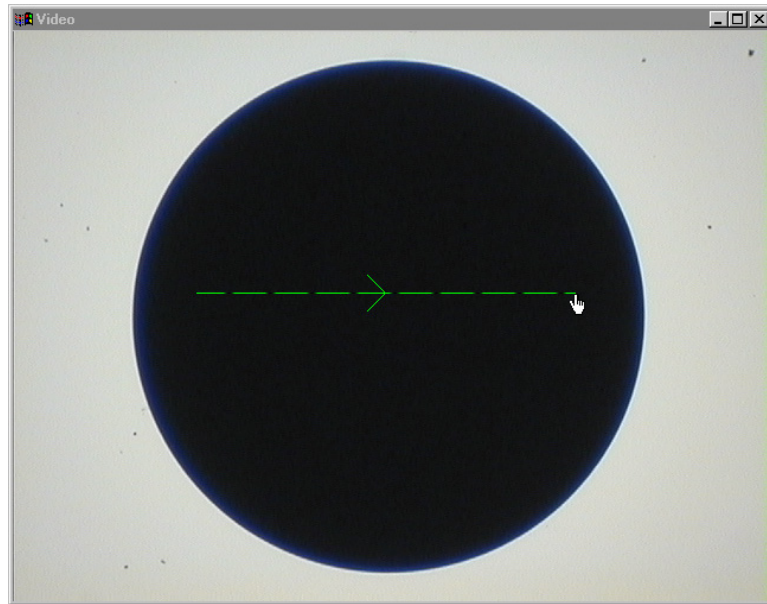


NOTE
Both the inner and outer portion of a probe tool may be resized using this procedure.

To rotate a probe tool

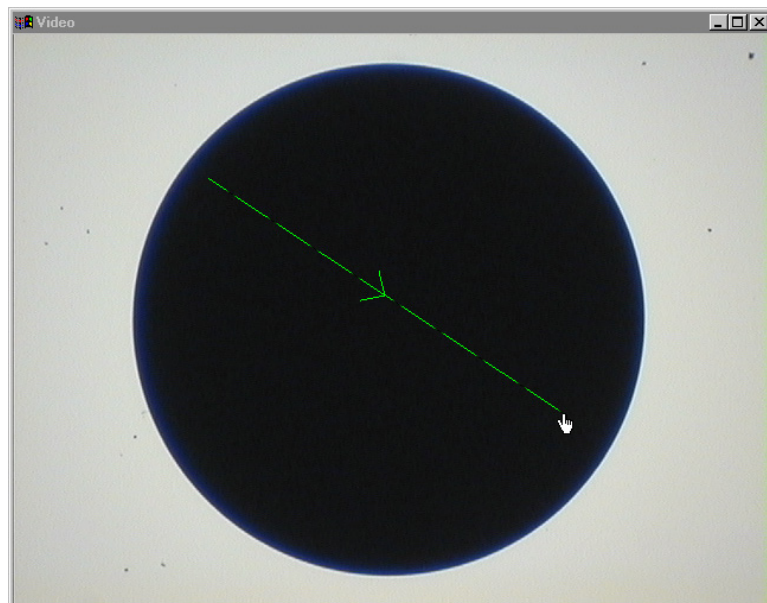
Step 1

Place the hand cursor at the end of the tool to be rotated.

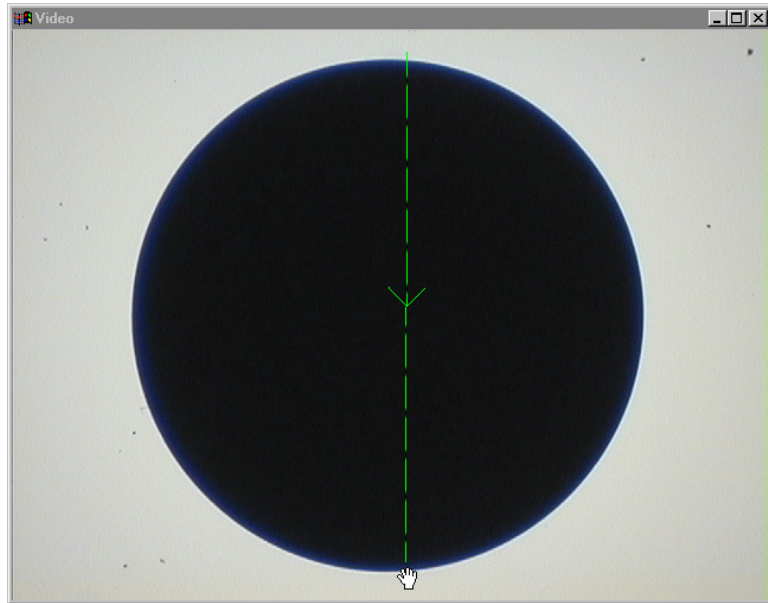


Step 2

Hold the mouse button down and drag in the direction of the desired rotation.

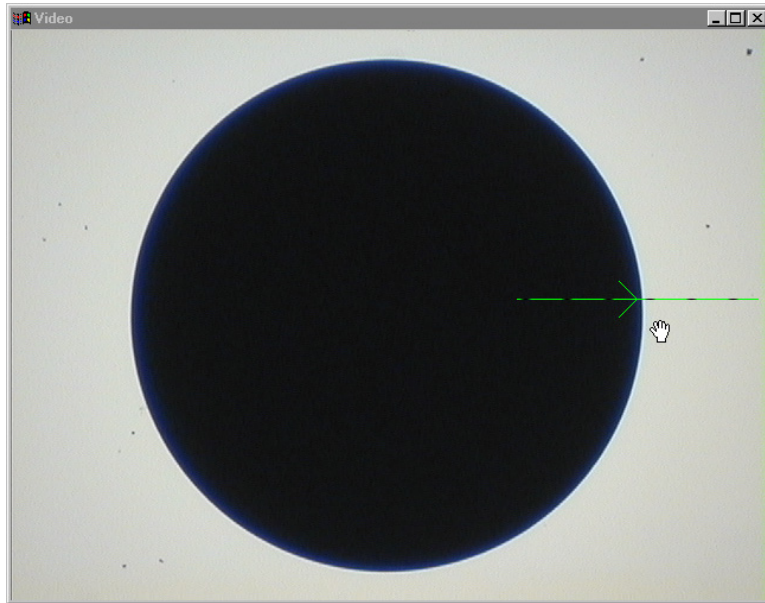


Step 3
Release the mouse button.



Simple probe

Use the *simple probe* to take a single point on an edge.



To create a simple probe

Step 1

Click on the *new probe* tool button on the VED toolbar.

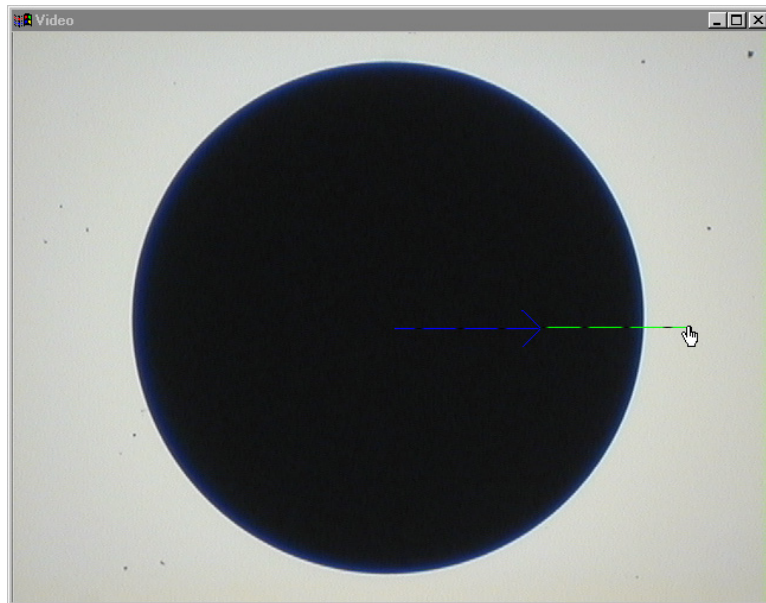


Step 2

Hold the mouse button down and drag in the desired scan direction.

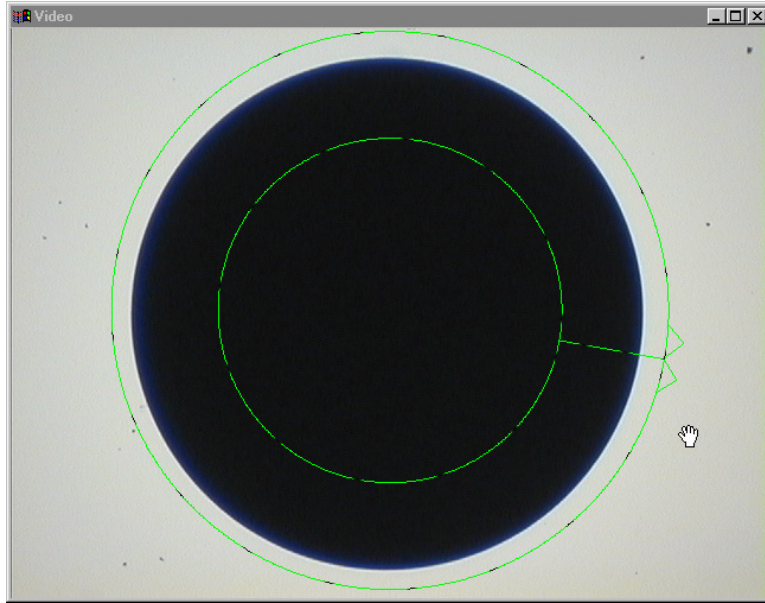


Step 3
Release the mouse button.



Circle probe

Use the *circle probe* to find the diameter and center XY coordinates of a circle or arc. The *circle probe* is also used in calibration procedures.



To create a circle probe

Step 1

Click on the *new probe* tool button on the VED toolbar.

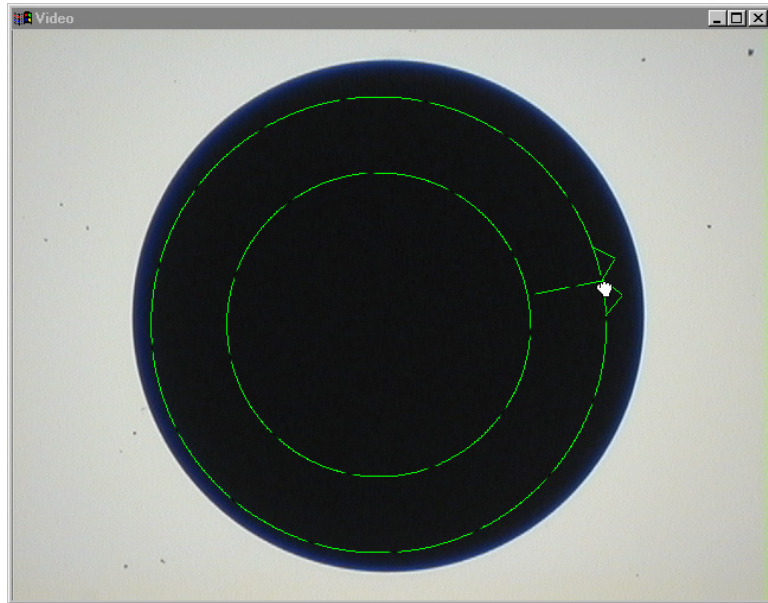


Step 2

Click at two points along the circle edge as shown.



Step 3
Hold the mouse button down on the third point and drag in the desired scan direction.

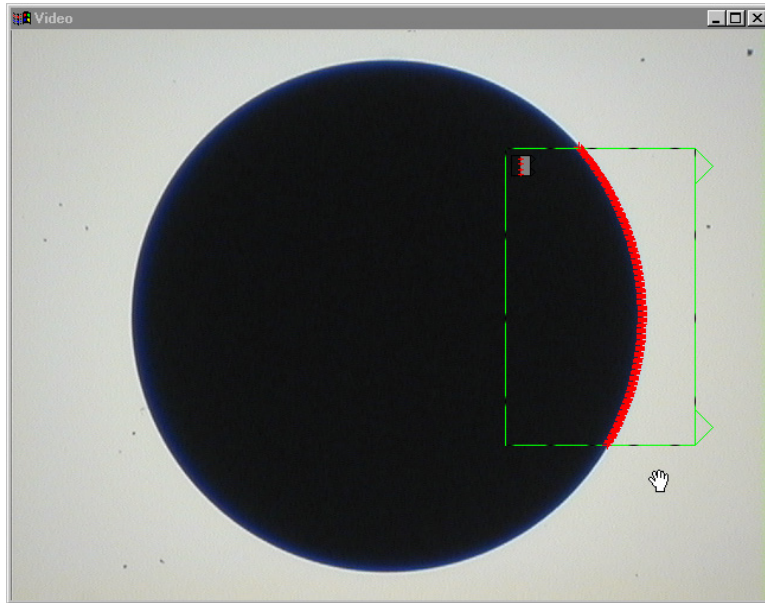


Step 4
Release the mouse button.



Buffer probe

Use the *buffer probe* to take up to 1000 points along an edge.



To create a buffer probe

Step 1

Click on the *new probe* tool on the VED toolbar.



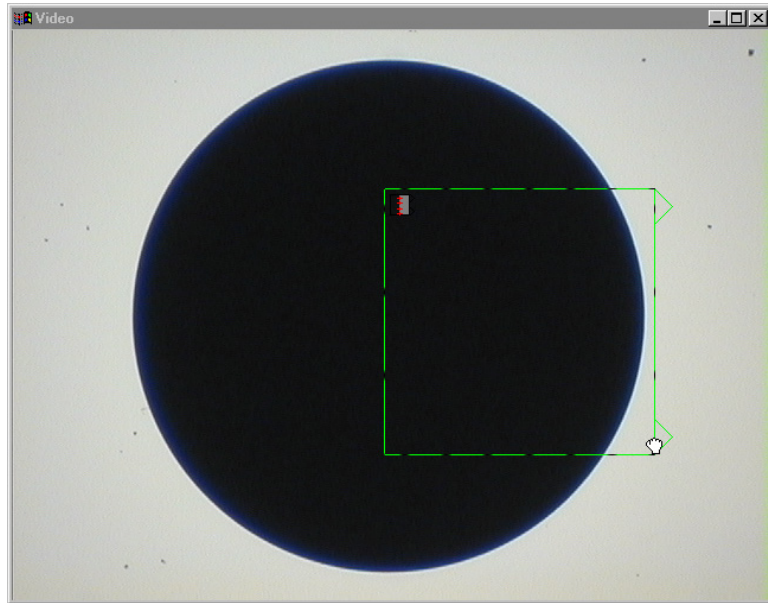
Step 2

Click at two points along the desired edge as shown.



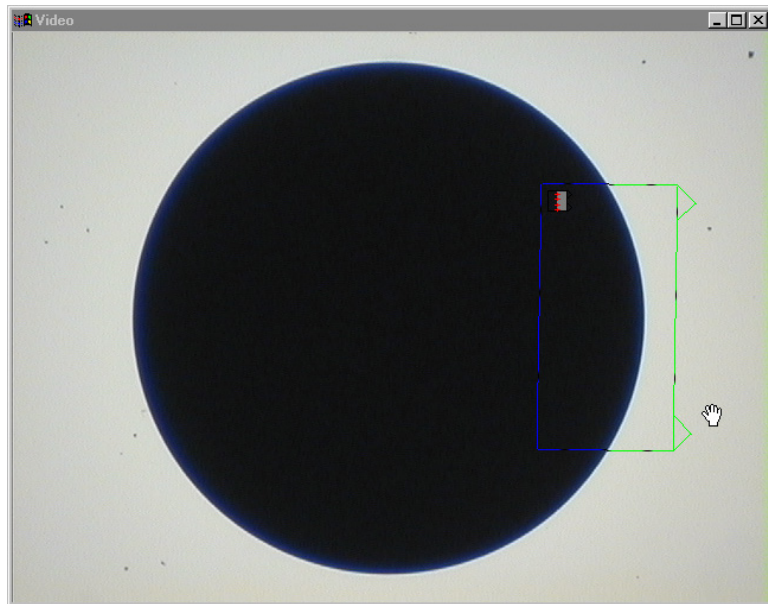
Step 3

Hold the mouse button down and drag in the desired scan direction.



Step 4

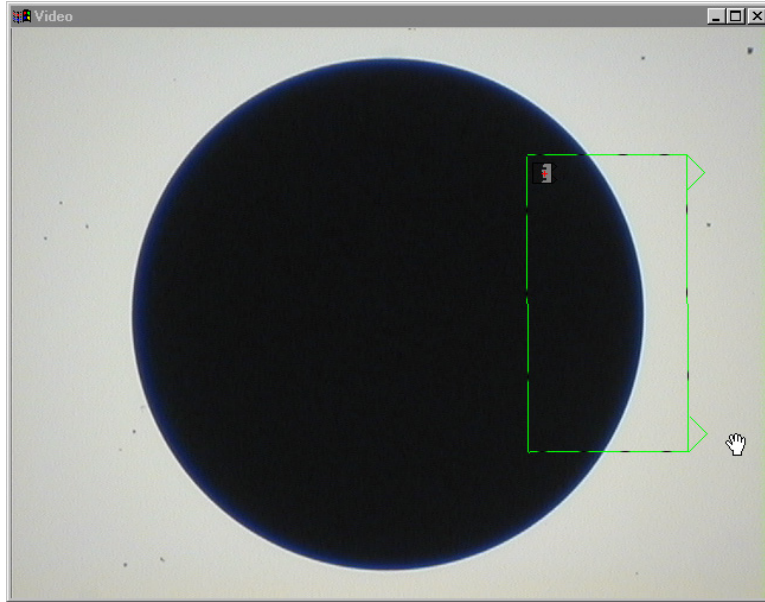
Release the mouse button.



Average probe



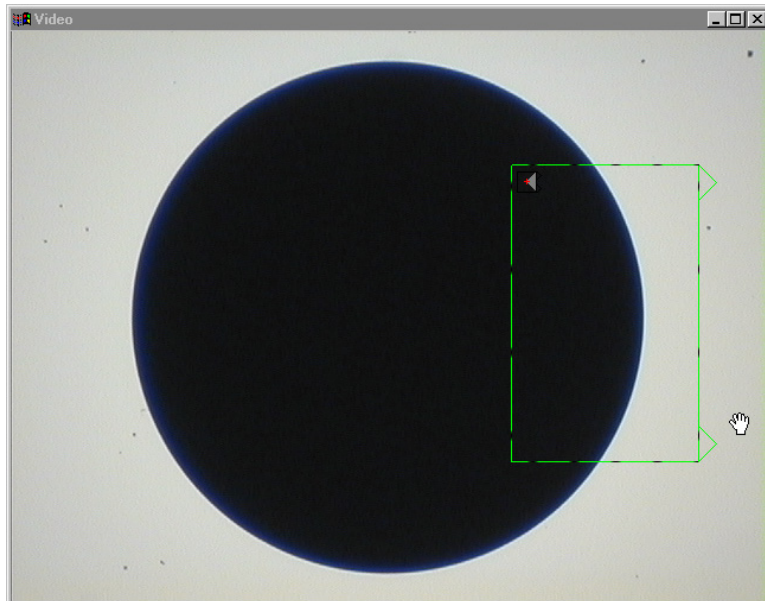
Use the *average probe* to determine the average point along an edge.



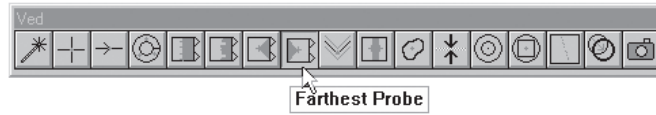
Nearest probe



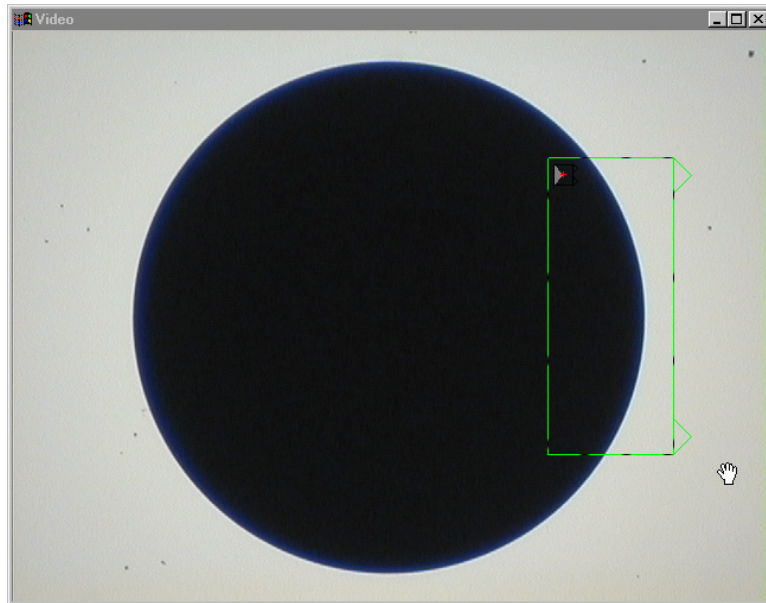
Use the *nearest probe* to find the nearest XY coordinates of an edge in the direction of the scan.



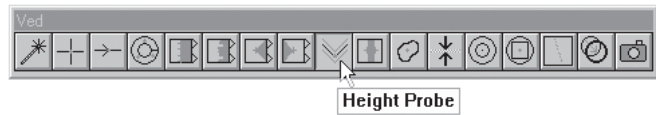
Farthest probe



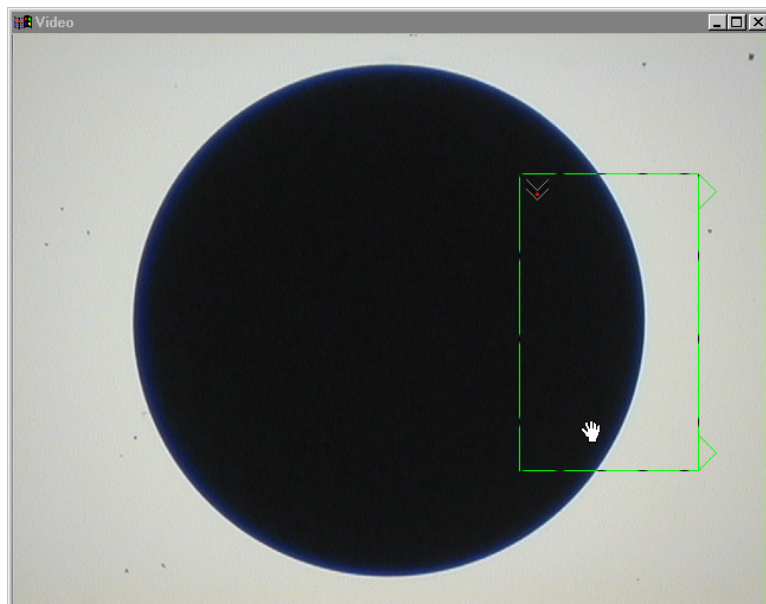
Use the *farthest probe* to find the farthest XY coordinates of an edge in the direction of the scan.



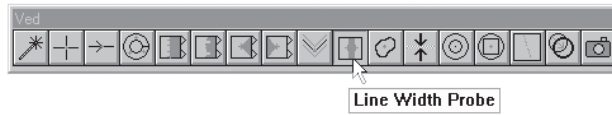
Height probe



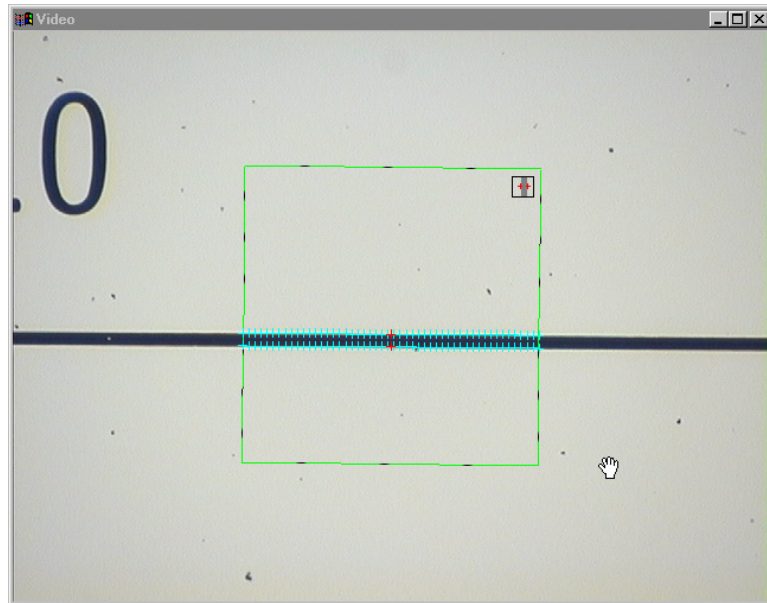
Use the *height probe* in conjunction with autofocus to perform a point or height measurement.



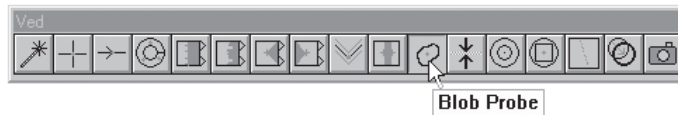
Width probe



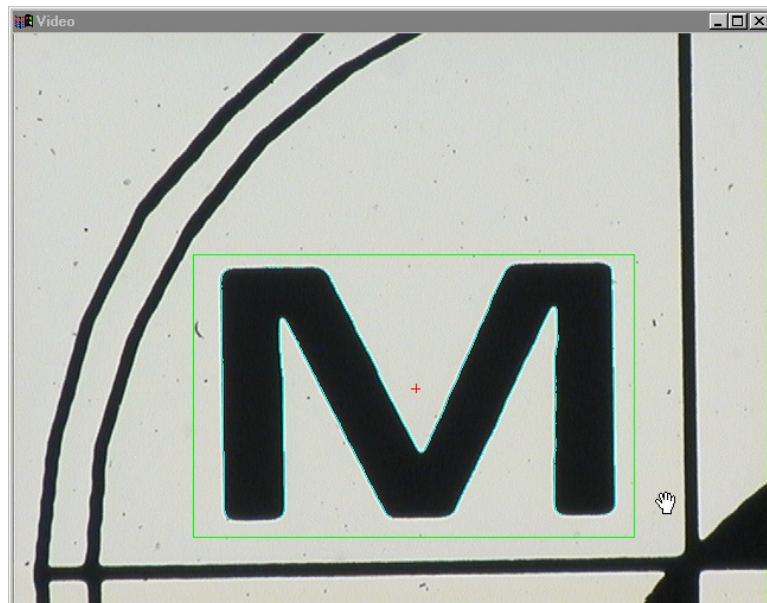
Use the *width probe* to perform a width measurements or to determine a mid-point.



Blob probe



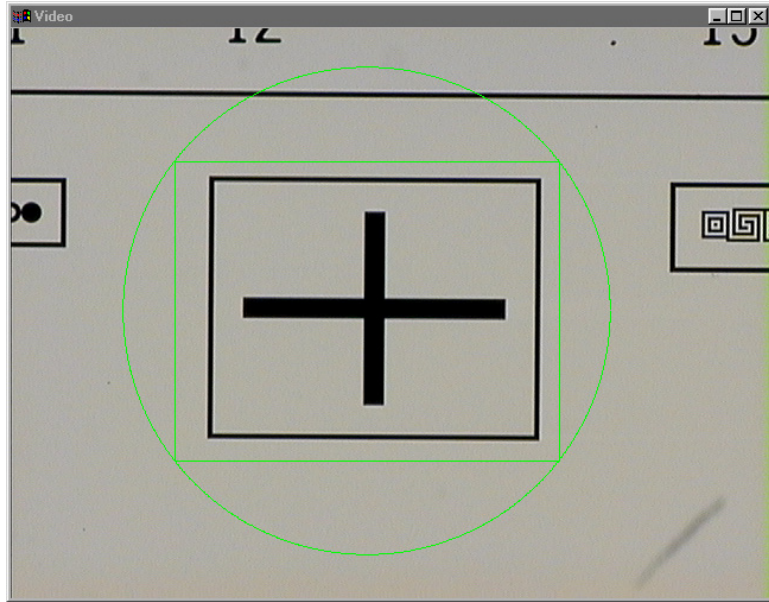
Use the *blob probe* to find the center of mass on irregular features.



Pattern probe



Use the *pattern probe* to perform pattern recognition.

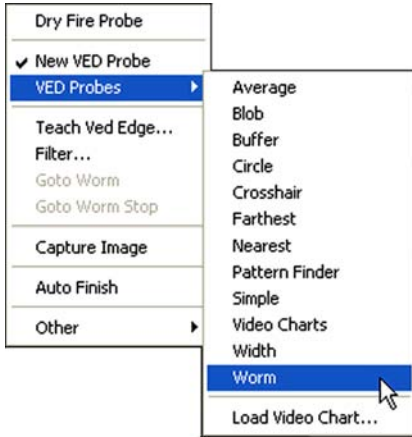


Worm probe

The worm probe is used to measure regular and irregular features, totally included within the field of view or extending beyond the field of view. The worm tool can be used to measure points, lines, arcs, circles and profiles.

Selecting the worm probe

The worm probe is selected by clicking Worm in the VED Probes menu, or by clicking the Worm probe icon of the VED toolbar.



Create the worm probe using the New VED Probe

The worm probe can be created by double-clicking and dragging the New VED Probe cursor icon in the desired scan direction.



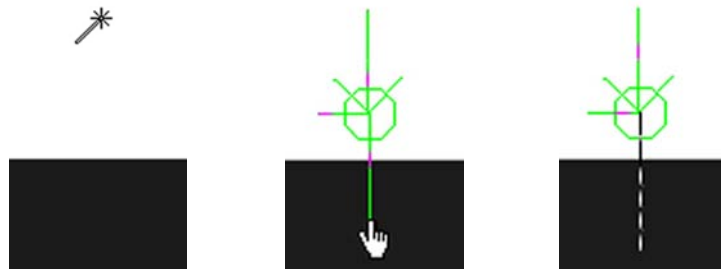
Select the New VED Probe...



double-click and...

drag the probe cursor in the desired scan direction

Creating the worm probe across a light-to-dark or dark-to-light boundary automatically orients to scan across the boundary properly, as shown below.



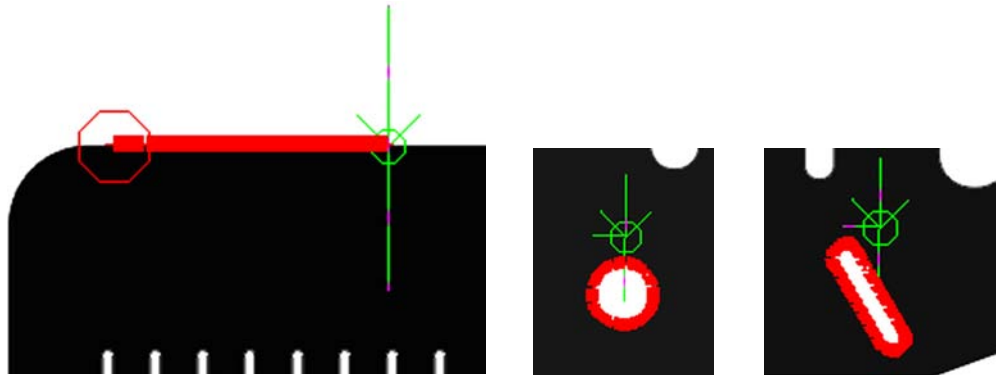
Double-clicking the New VED Probe...

and dragging it across a boundary...

correctly orients the Worm probe

Firing the Worm probe

Firing the worm probe causes a number of scans to be generated perpendicular to and across the perimeter of the image edge in the perpendicular direction indicated by the probe. Each scan acquires a data point at the edge of the image. Click the middle mouse button or the Enter Pt button to fire the probe.

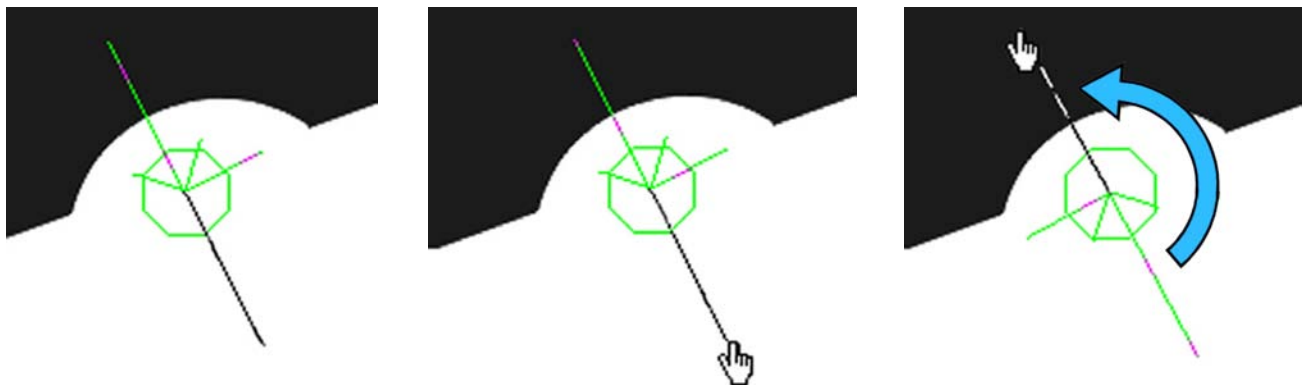


Examples of the Worm tool acquiring points along a line... around a circle... and around a slot

This process of scanning to acquire points is functionally identical to firing a series of simple probes across the image edge.

Changing the perpendicular scan direction

The perpendicular scan direction can be changed by clicking and dragging either end of the worm probe rotationally.



To change the scan direction...

click the probe tip...

and drag the tip rotationally

Selecting the light contrast orientation

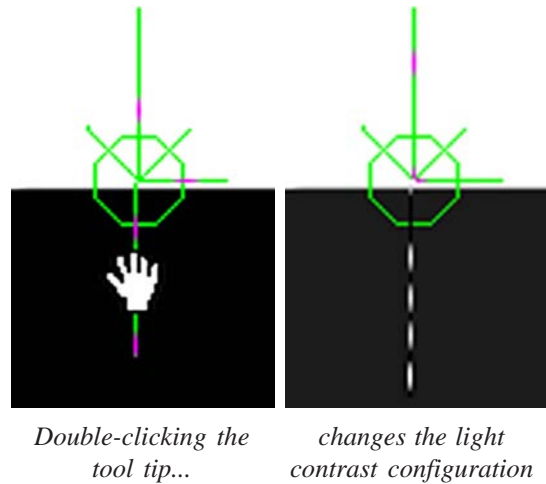
The Worm probe light-to-dark or dark-to-light scan orientation must be configured properly to acquire points. An orientation can be selected by clicking the desired VED toolbar icon. Orientations include:

- Light to dark transition
A probe configured to acquire a point on a light to dark transition will not function on dark to light transitions.
- Dark to light transition
A probe configured to acquire a point on a dark to light transition will not function on light to dark transitions.
- First transition
A probe configured to acquire a point on the first transition will function properly on any clean, well-defined transition



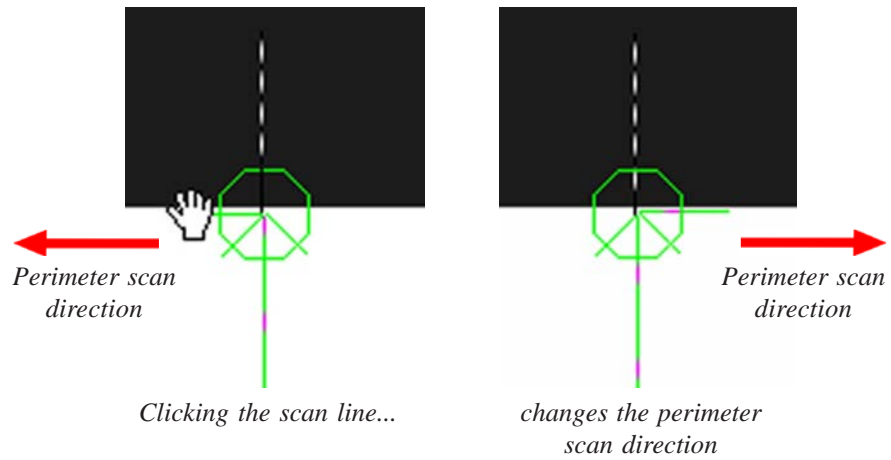
Orientations can be changed by double-clicking the front tip of the probe as shown here.

Repeatedly double-clicking the probe tip cycles through the three light contrast orientations.



Changing the perimeter scan direction

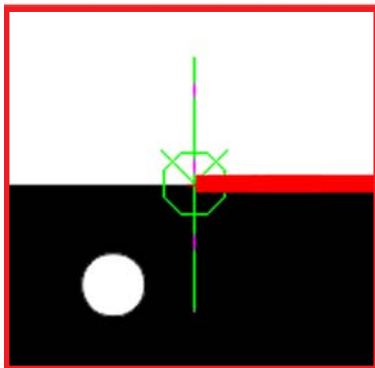
The direction shapes are scanned around their perimeters can be toggled from side to side by clicking the hand cursor on the scan line.



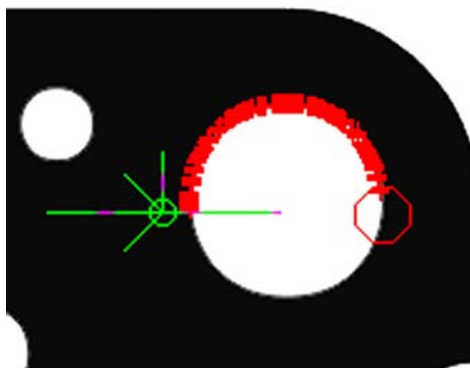
Terminating perimeter scans

The scanning process stops when:

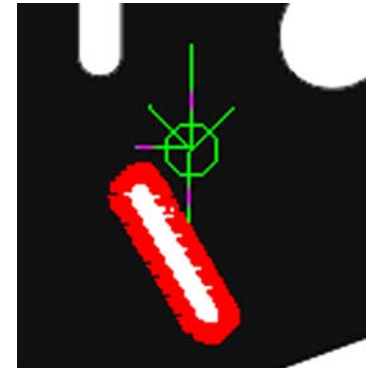
- The scans are interrupted by the field of view rectangle
- The scans are terminated by the stop sign
- Scans are completed around an entire perimeter



Scans are interrupted by the field of view rectangle



Scans are terminated by the stop sign



Scans are completed around an entire perimeter

Terminating scans with the stop sign

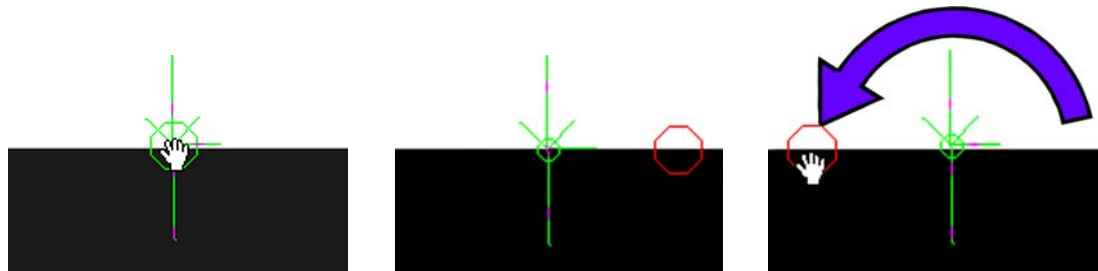
When separated from the worm probe, the stop sign can be placed at any point on the image edge to terminate the scanning process.



Stop sign placed for scanning left

Stop sign placed for scanning right

The stop sign is separated from the worm probe by double-clicking the hand icon over the center of the probe. The stop sign can then be positioned at any point by clicking and dragging it.



Separate the stop sign by double-clicking it

Once the stop sign is separated...

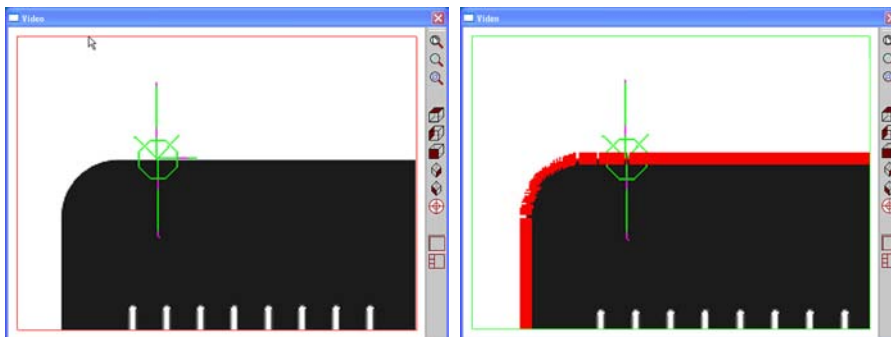
Click and drag it to the desired location

The stop sign is green when connected, and red when separated from the probe.

The stop sign is reunited with the probe by clicking and dragging it back over the center of the probe and releasing the mouse button, or by double-clicking the stop sign.

Extending scans beyond the field of view

The field of view is indicated by a rectangle that encloses the contents of the video window. Red rectangles stop scans at the edge of the field of view, green rectangles permit the scanning to extend beyond the field of view.



Click on the field of view rectangle...

to toggle it to green and permit scanning beyond the field of view

The field of view rectangle can be toggled from red to green to extend scanning beyond the field of view rectangle. Click on the field of view rectangle to toggle it between red and green. When scans are extended beyond the field of view, the CNC stage will repeatedly reposition the camera over the part so that all required perimeter edges are scanned.

Video Probes

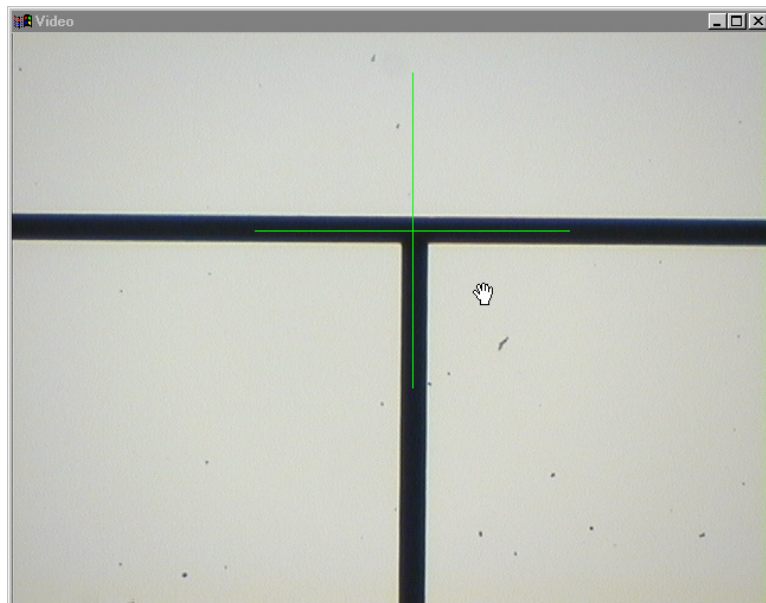
In addition to the VED probes there are two video probes that are not properly considered edge detecting. They are:

- Crosshair probe
- Video chart probe

Crosshair probe



Use the *crosshair probe* take individual points.



Video charts probe



Use the *video charts probe* to place .dxf file overlays on the video screen.

Edge Teaching

Use the teach button on the VED toolbar to teach edge characterization. There are three edge algorithms used by the QC-5000. They are as follows:

- First
- Strongest
- Auto

Select *first* to instruct the QC-5000 to select the first edge meeting the minimum edge strength.



Select *strongest* to find all edges in the scan direction and select the strongest edge found.



Select *auto* to instruct the QC-5000 to re-calculate the minimum edge strength each time the probe tool is fired.



To perform a simple edge teach

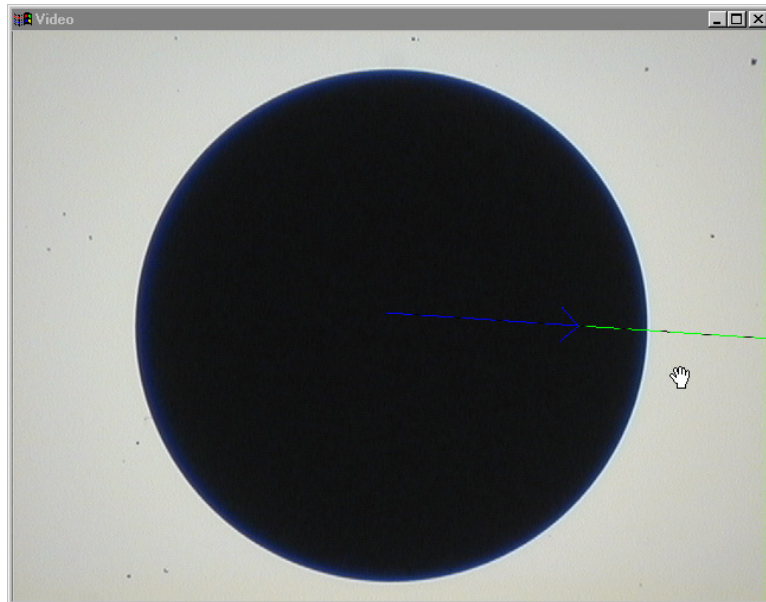
Step 1

Click on the *simple probe* button on the VED toolbar.



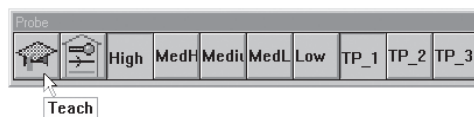
Step 2

Place the *simple probe* over the desired edge.



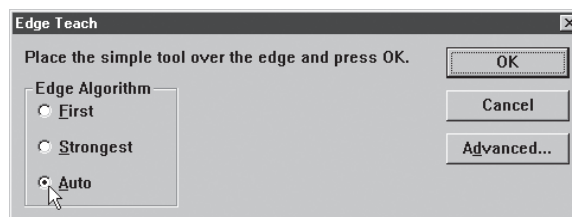
Step 3

Click on the *teach* button on the VED toolbar.

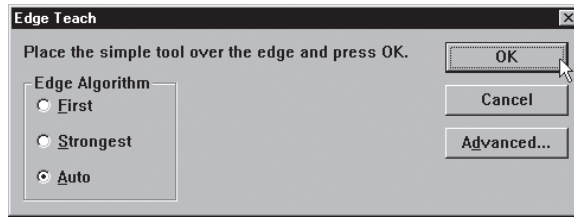


Step 4

Select the desired edge algorithm (*first*, *strongest*, or *auto*).



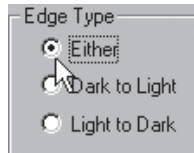
Step 5
Click *OK* in the dialog box.



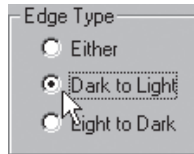
There are three edge types recognized by the QC-5000. They are as follows:

- Either
- Light-to-dark
- Dark-to-light

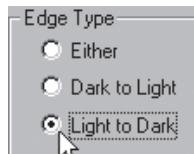
Select *either* to instruct the probe tool to seek the first edge it encounters, either light-to-dark OR dark-to-light.



Select *dark-to-light* to force the probe tool to seek dark-to-light edges only.



Select *light-to-dark* to force the probe tool to seek light-to-dark edges only.



To perform an advanced edge teach

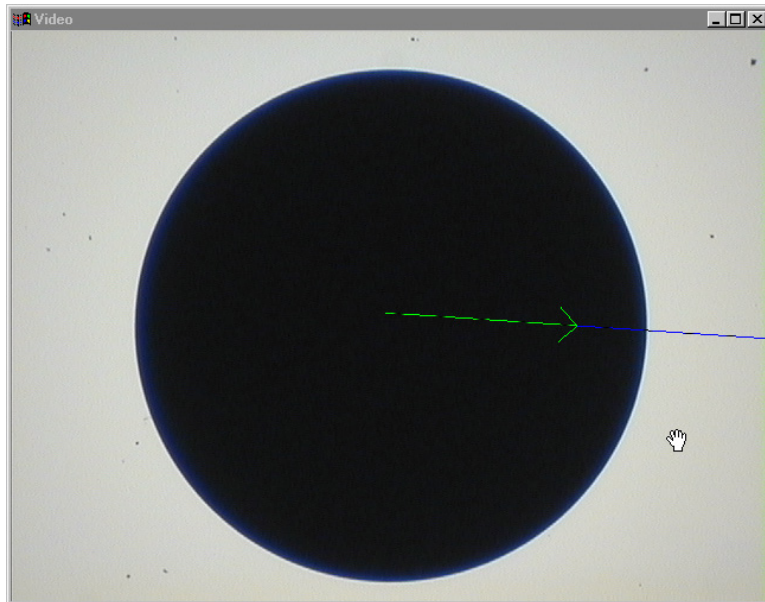
Step 1

Click on the *simple probe* button on the VED toolbar.



Step 2

Place the *simple probe* button over the desired edge.



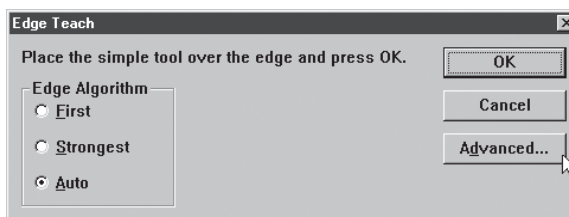
Step 3

Click on the *teach* button on the VED toolbar.

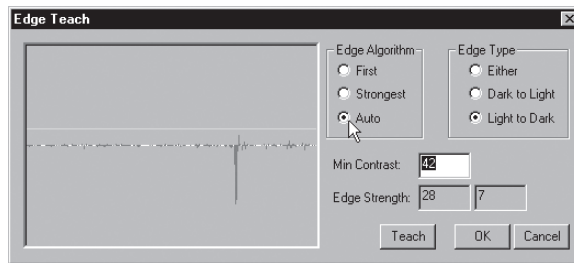


Step 4

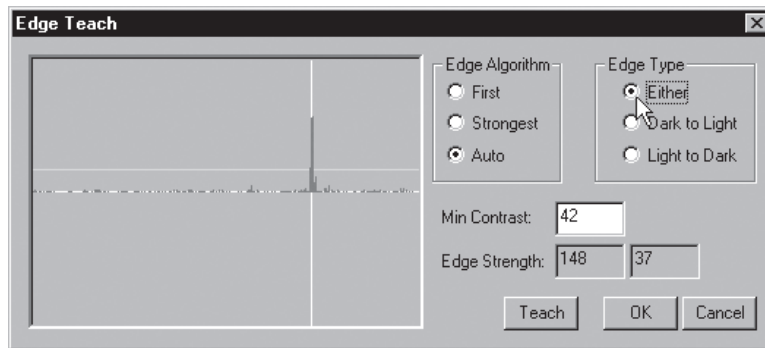
Click on the *advanced* button as shown.



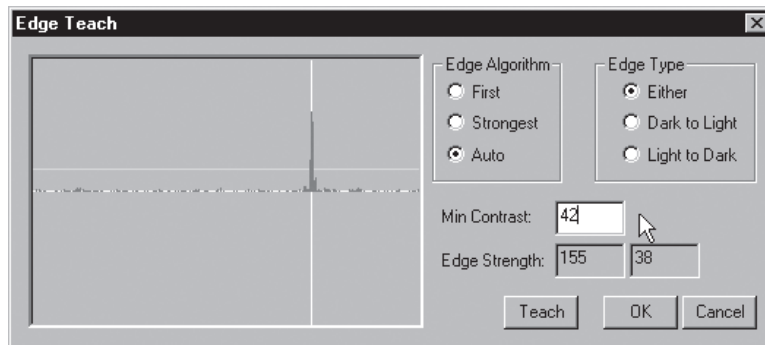
Step 5
Select the desired edge algorithm.



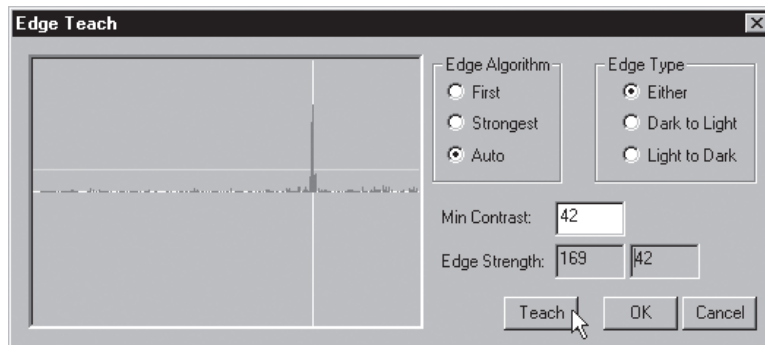
Step 6
Select the desired edge type.



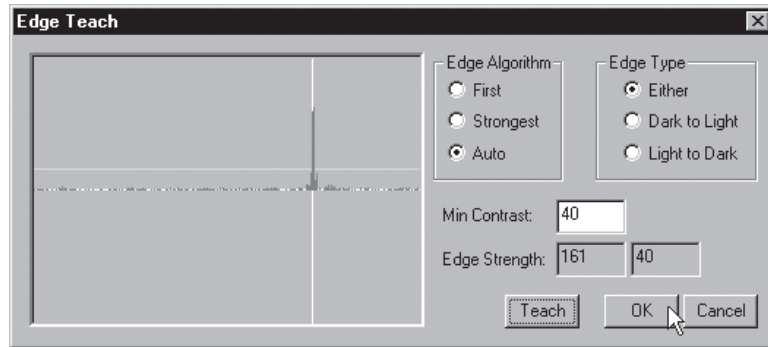
NOTE
Set the desired minimum contrast by entering a value in the *min contrast* text box if a specific level is desired. Otherwise click the *teach* button after selecting algorithm and edge type.



Step 7
Click on the *teach* button.



Step 8
Click *OK*.



Probe Library

Probe library organizes all the probes used with the QC-5000 software. Use probe library to set up and manage probes and probe settings.

Probe set up functions include:

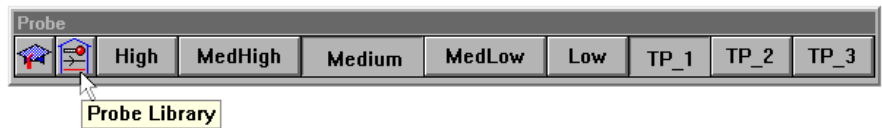
- creating probe groups
- designating a master probe

Management functions include:

- storing reference offset data
- storing probe qualification data
- adding/deleting probes from groups

Probe Families & Groups

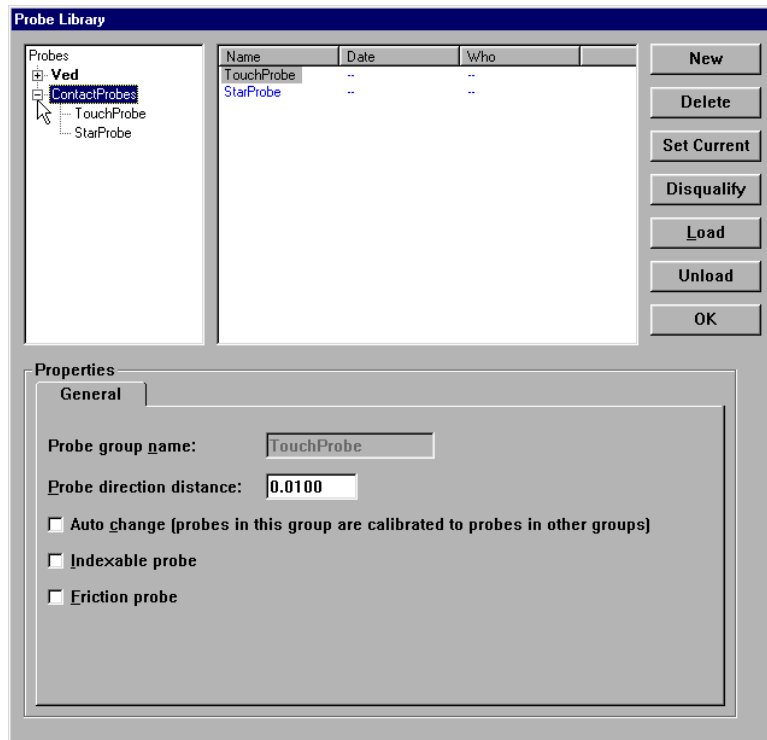
Click the probe library button on the probe toolbar to view the tool library dialog box.



Probes are organized into families and groups. Families consist of groups. Groups consist of probe tips.

Probe families organize similar probe groups. For example, the contact probes family contains the groups: TouchProbe and StarProbe.

Click on the plus (+) sign next to the contact probes family.



Observe the three default probe groups: TouchProbe and StarProbe.

TouchProbe group

Touch probes have an internal switch that sends an electronic signal when the probe contacts the part. This electronic signal allows the auto-enter feature of the QC-5000 to automatically enter the point.

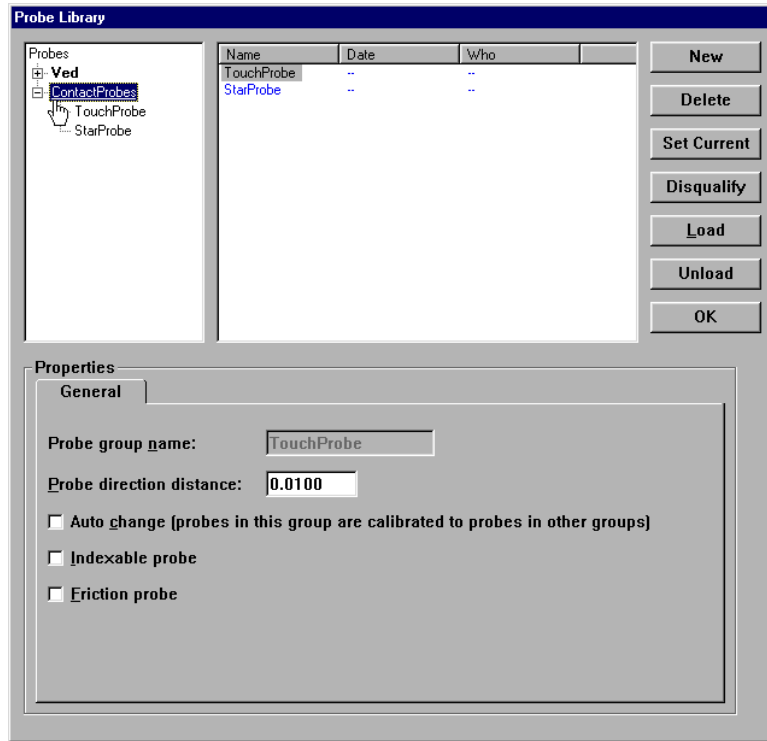
StarProbe group

Star probes are actually a variant of touch probes. Each star probes have five tips arranged bottom, left, right, front, and back. These tips appear by default in the StarProbe group.

To create a new probe group

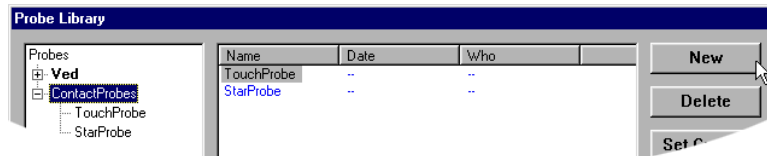
Step 1

Highlight the desired probe family for the new group.



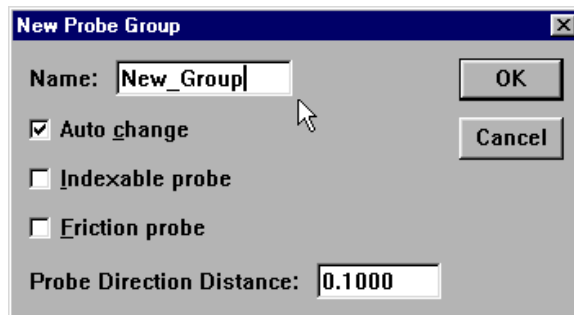
Step 2

Click on the new button.



Step 3

Type a name for the group in the name text box.



Check the auto change box for probes interchangeable with other groups. If using an indexable or friction probe, check the appropriate box. Otherwise, proceed to step 4.

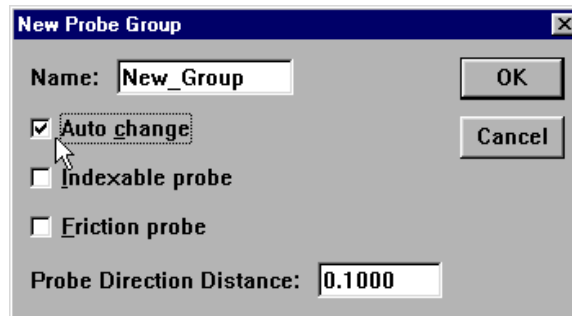
Step 4

Enter the desired *probe direction distance*. This is the distance the probe must travel in a direction prior to making contact with the part.



NOTE

Probe direction distance determines in which direction probe compensation is applied.

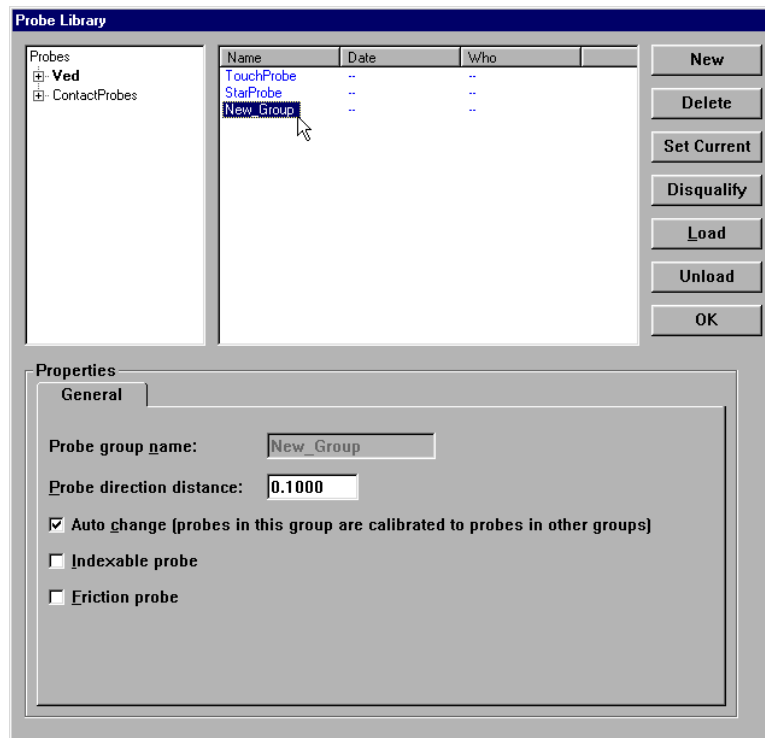


Step 5

Click OK in the dialog box.



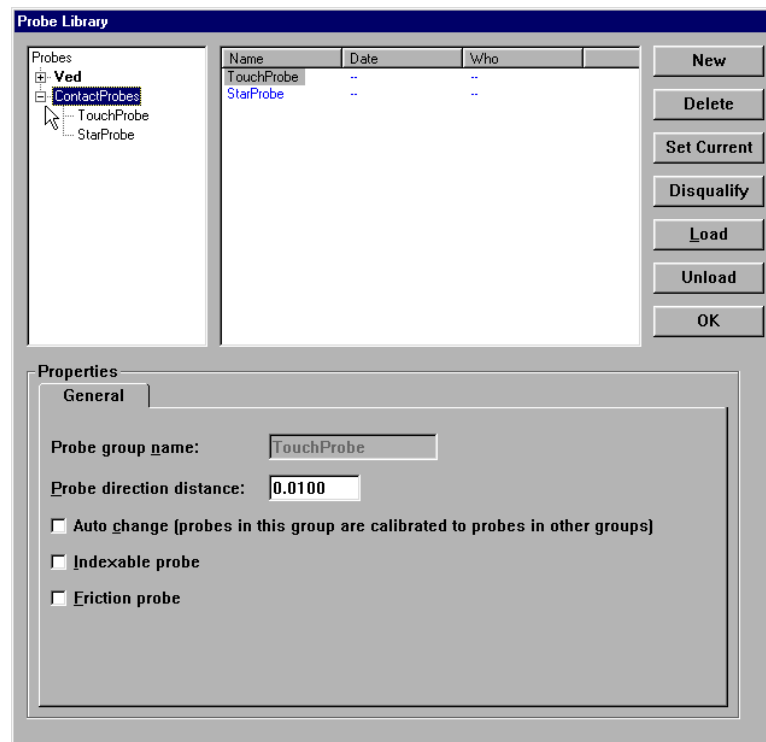
The new group appears in the probe library as shown.



Probe Calibration

There are two factors that influence probe measurements: the radius of the probe tip and the spatial (X, Y, and Z) position of the probe tip. All measurements are based on the location of the center of the probe tip. Probe compensation applies a calculation to correct for the radius of the probe on each measurement. The compensation for each probe tip is calculated automatically when the probe is taught.

Click on the TouchProbe group and observe the probes in the right-hand data box. The following information appears in the probe data box by default name of the probe, date of probe qualification, and the name of the person who performed the qualification.



NOTE

The date and the name of the person qualifying the probe are taken from the Windows system clock and login respectively.

Probe qualification, or probe teaching, refers to the process of establishing the dimension of the probe tip. This process typically involves taking a number of probe hits on a qualification sphere with a known diameter. Qualifying, or teaching, a probe also provides offsets for probe compensation.

Master probe tips

Teaching a probe also establishes the spatial (X, Y, and Z) position of the probe tip (master probe tip) or the X, Y, and Z offsets (non-master tips) from the master tip. There is only one master tip for multi-sensor systems. All tips are referenced to the master tip regardless of group. The X, Y, and Z values of each probe in a group is compared to the master probe. The difference becomes the X, Y, and Z offset value for each non-master probe tip.

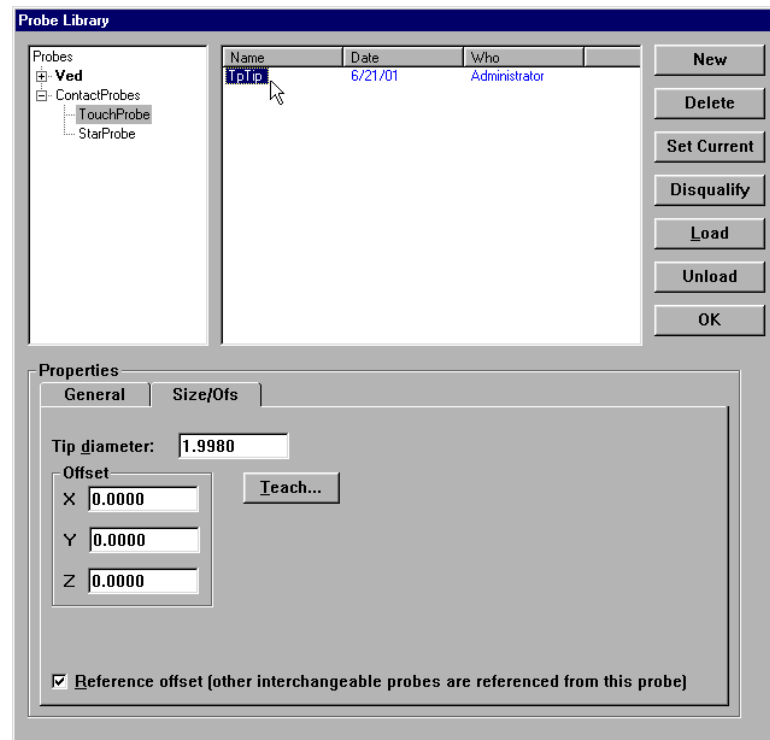
For example, a star probe group has five probe tips: one master tip and four non-master tips. The X, Y, and Z position on the non-master tips are all calculated by the offset from the position of the master tip. Since the tips on a star probe are fixed and repeatable simply re-teaching the master tip is sufficient to update the entire group.

The same holds true for index probes. Each position can be entered into probe library as a new tip. Establishing one position as the master tip allows all the non-master tips (positions) to update when the master tip is re-taught.

To teach (qualify) a master probe tip

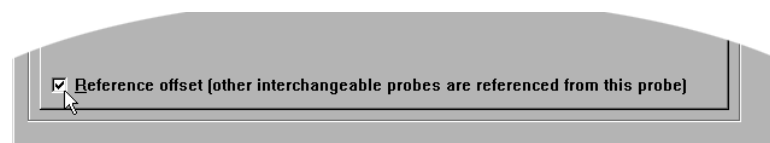
Step 1

Highlight the desired probe as shown.

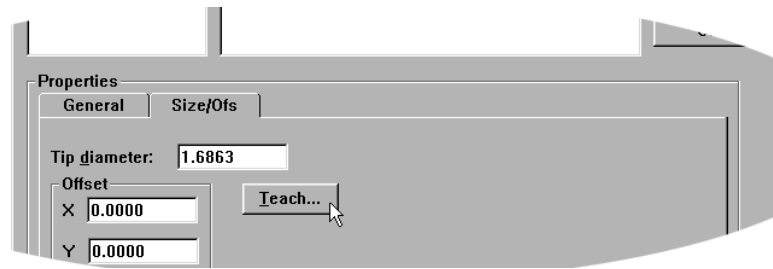


Step 2

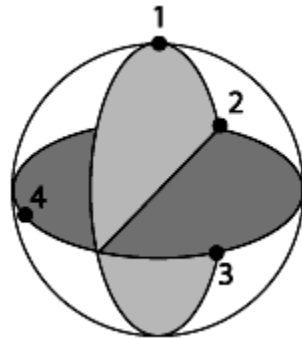
Check the reference offset checkbox as shown.



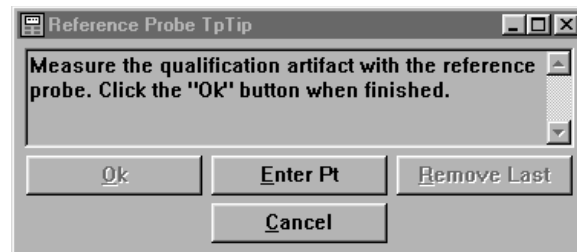
Step 3
Click on the teach button.



Step 4
Probe the qualification sphere as shown.



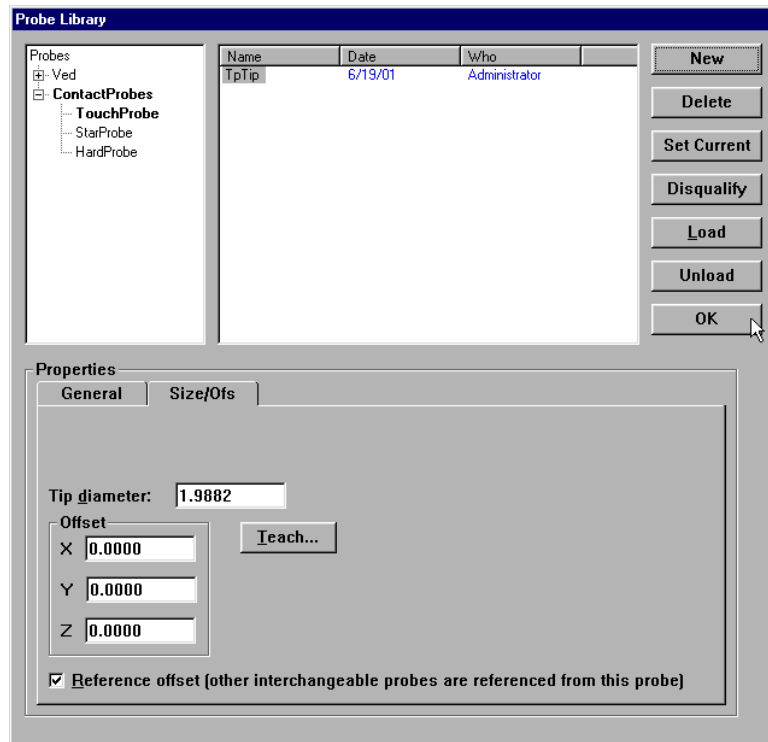
NOTE
4 points are the minimum required for a sphere measurement.
Use more points to increase the accuracy of your measurements.



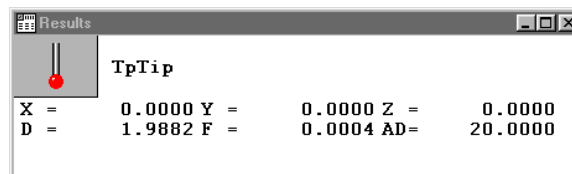
Step 5
Click OK in the dialog box.



The probe information is updated in the probe library.



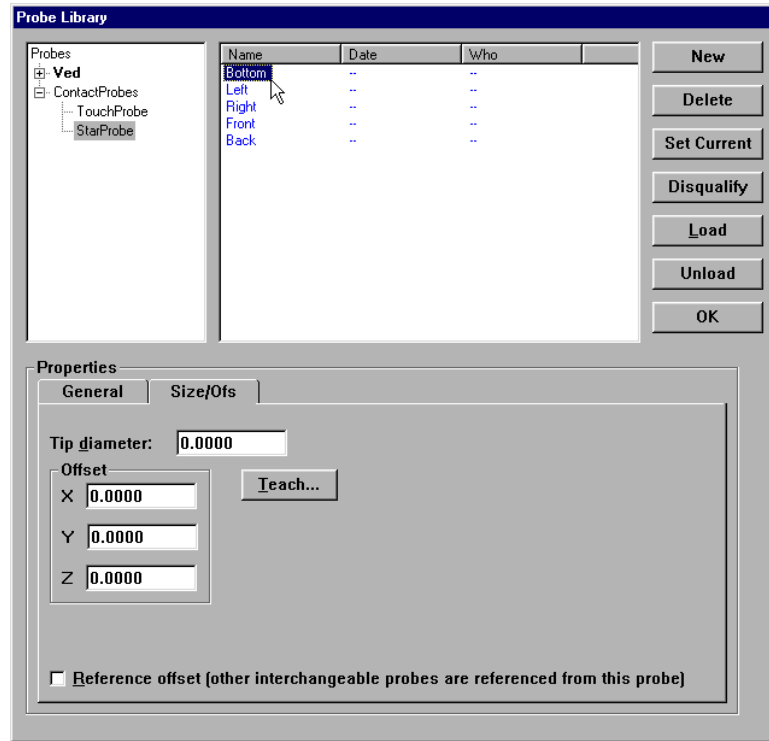
Qualification results are displayed in the results window.



To teach (qualify) a non-master probe tip

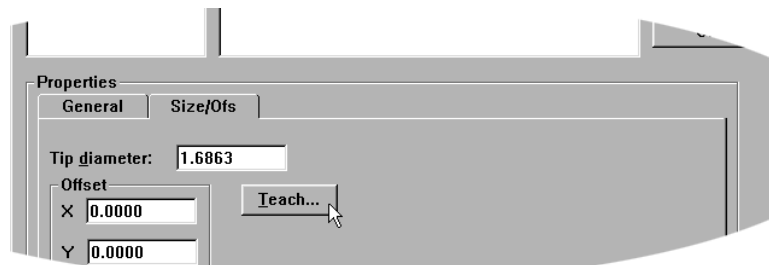
Step 1

Highlight the desired probe as shown.

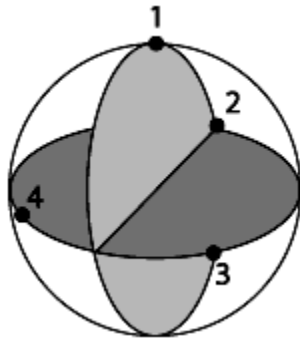


Step 2

Click the teach button.



Step 3
Probe the qualification sphere as shown.

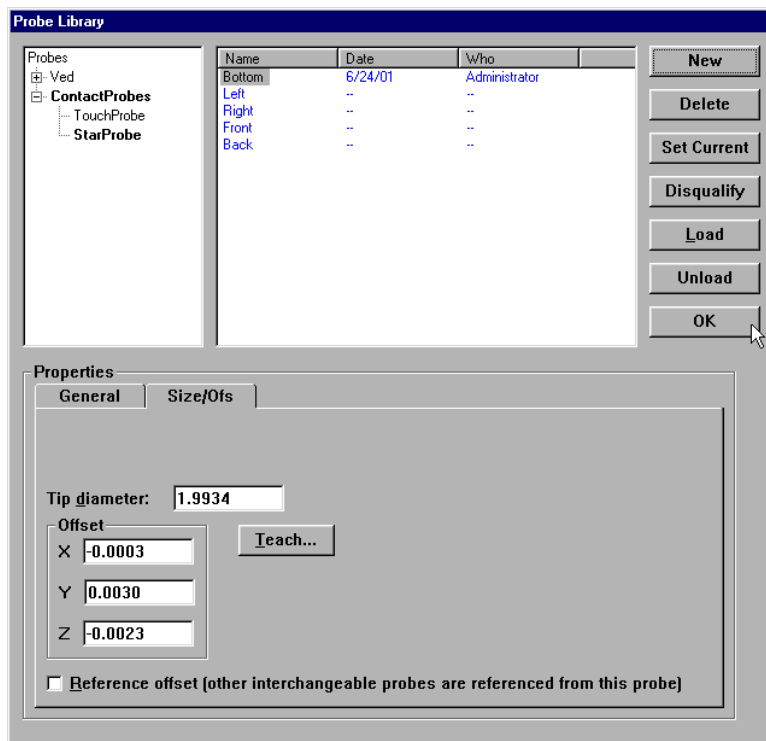


NOTE
4 points are the minimum required for a sphere measurement. Use more points to increase the accuracy of your measurements.

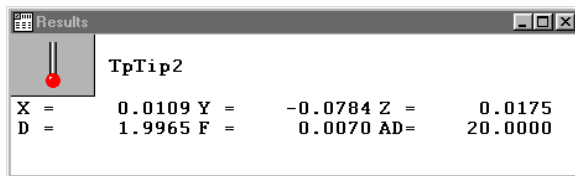
Step 4
Click OK in the dialog box.



The updated probe information appears in the probe library.



Qualification results are displayed in the results window.



Cross Calibration of Touch Probe and Camera

Touch probes and VED cameras are mounted in different physical locations on the measuring system. Cross-calibrate the touch probe and the VED camera to compensate for the offset.



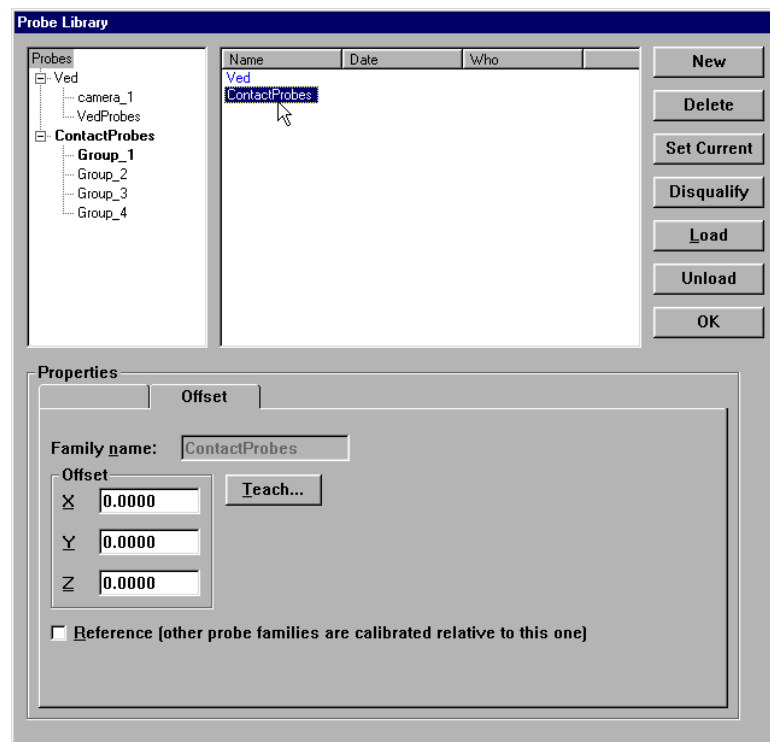
NOTE

The VED family is the master family in this demonstration.

To cross calibrate a touch probe to a VED camera

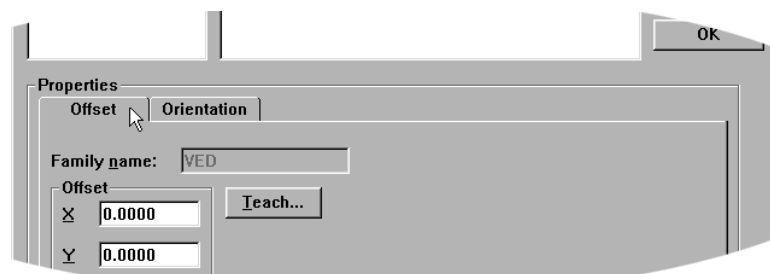
Step 1

Click on *contact probes* as shown.

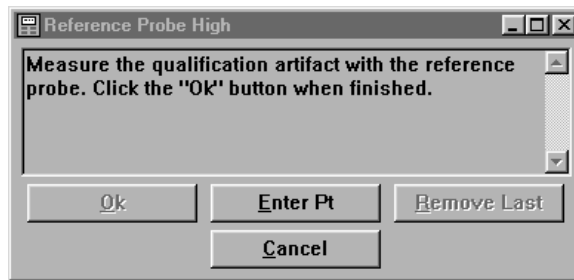


Step 2

Click on the offset tab.

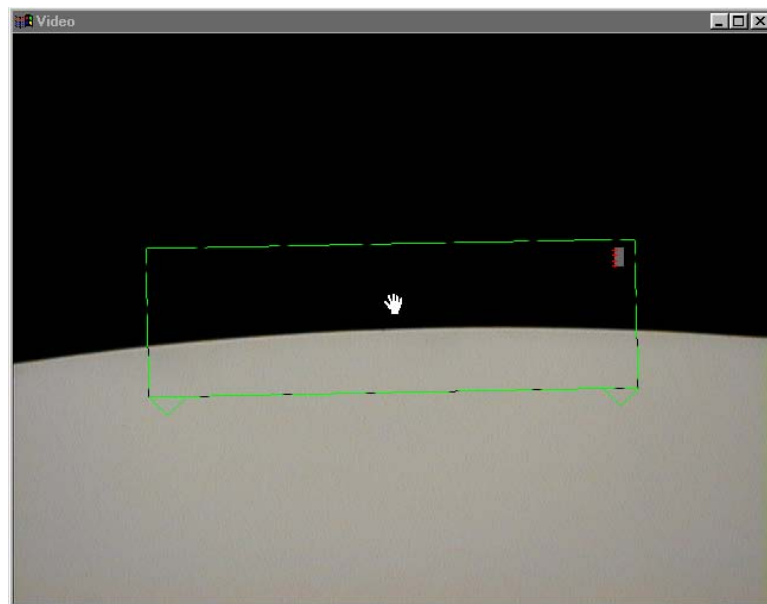


The reference probe high dialog box appears as shown.



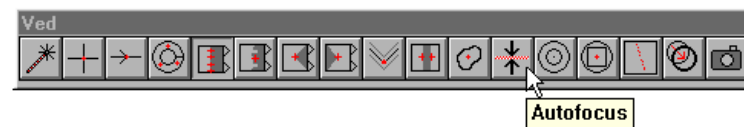
Step 3

Position the ring gauge in the *video* window as shown and place the *buffer tool* as shown.



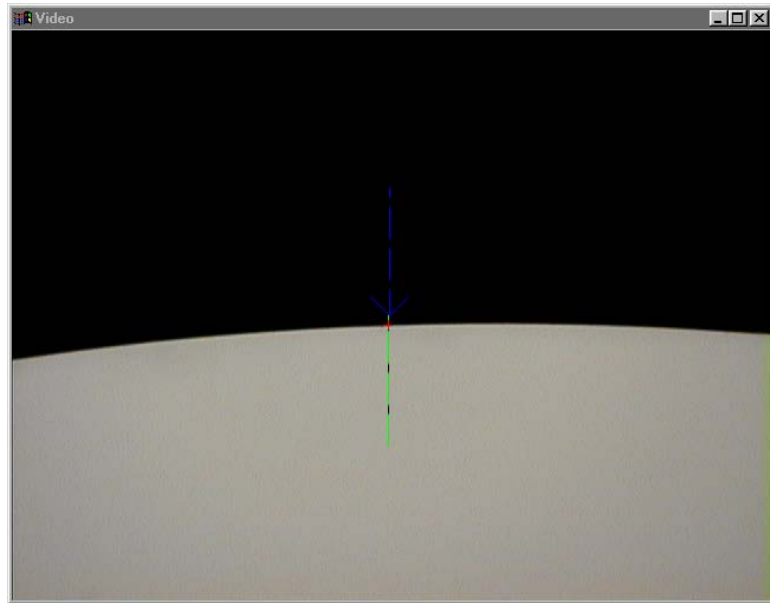
Step 4

Click the *autofocus* button on the *VED* toolbar.

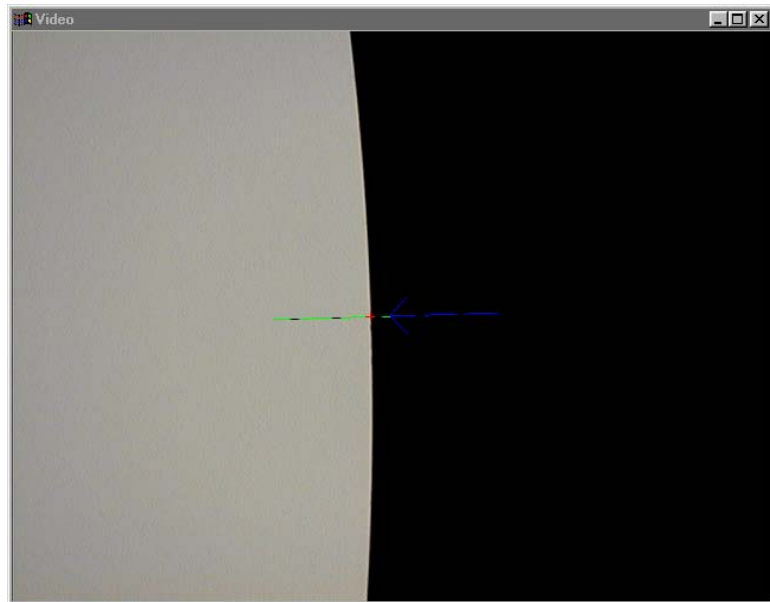


When the autofocus is complete, use the simple tool to measure the ring gauge.

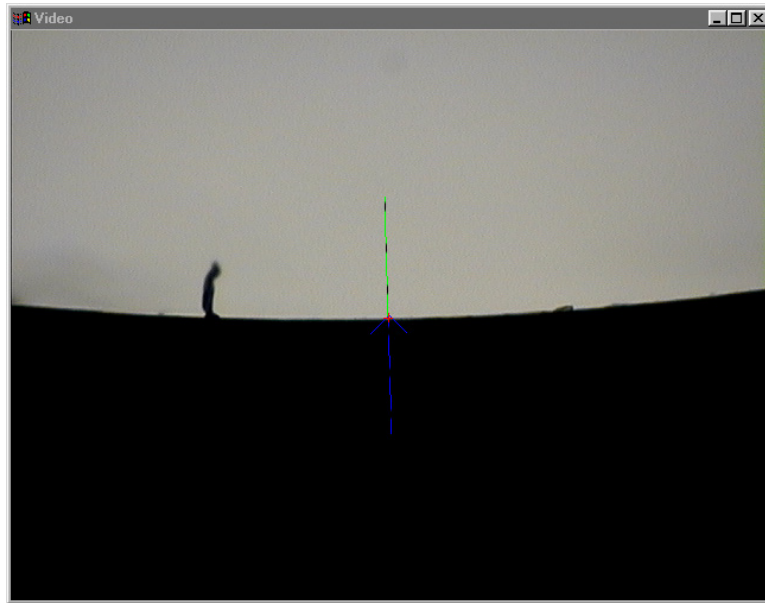
Step 5
Probe the first point as shown.



Step 6
Probe the second point as shown.



Step 7
Probe the third point as shown.

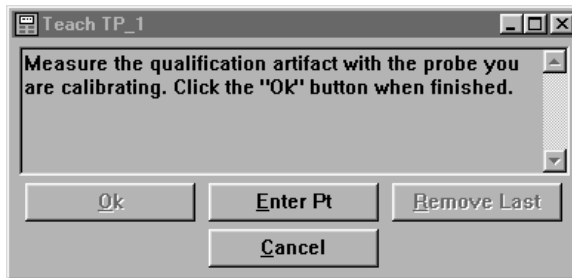


Continue taking points in this manner until 8 points have been taken.

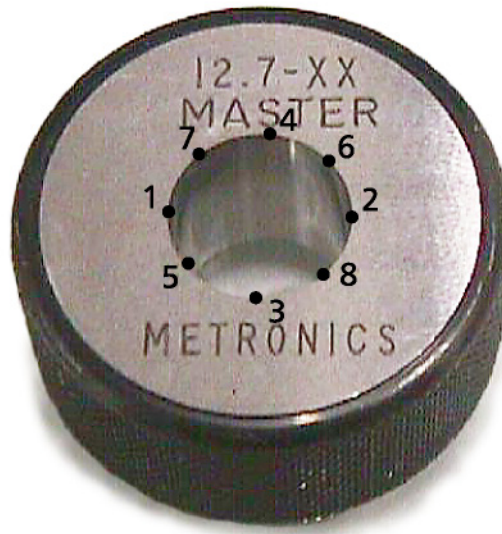
Step 8
Click OK in the dialog box.



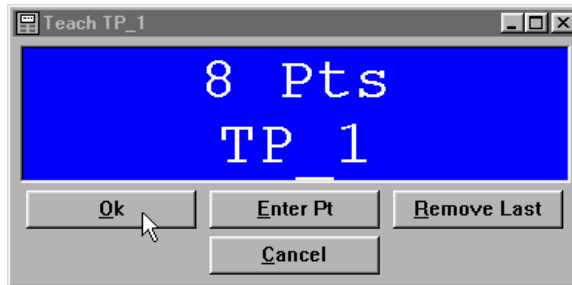
The *teach probe tip* dialog box appears as shown and the QC-5000 switches to the reference touch probe tip.



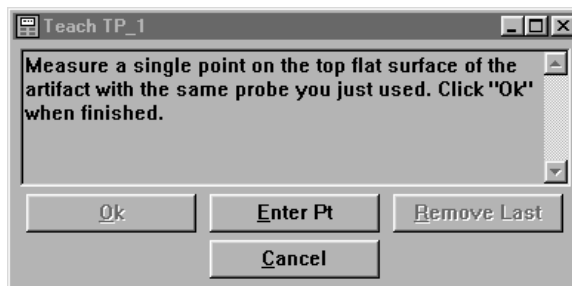
Step 9
 Probe 8 points on the ring gauge as shown.



Step 10
 Click OK in the dialog box.

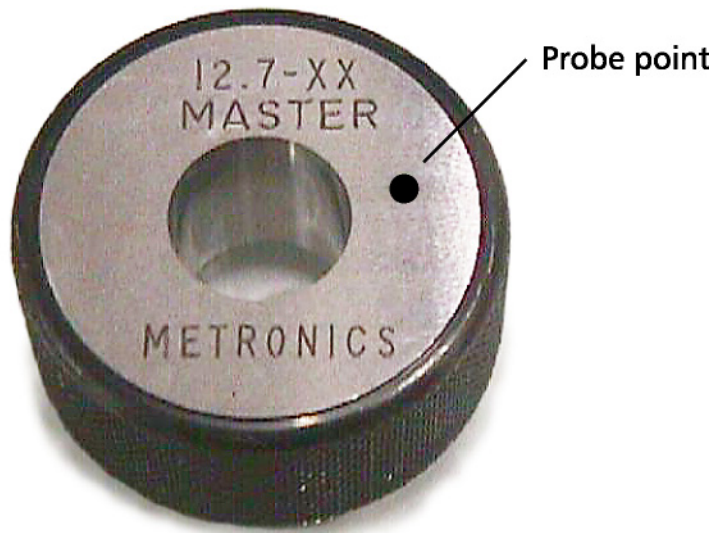


The *teach probe tip* dialog box appears as shown.



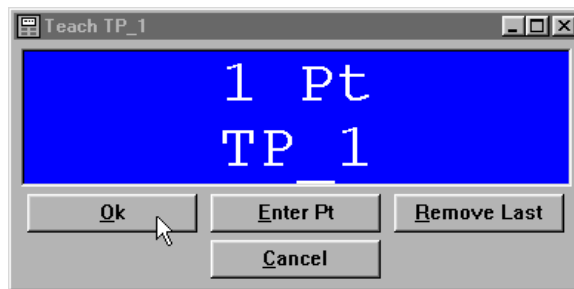
Step 11

Probe a point on top of the ring gauge as shown.

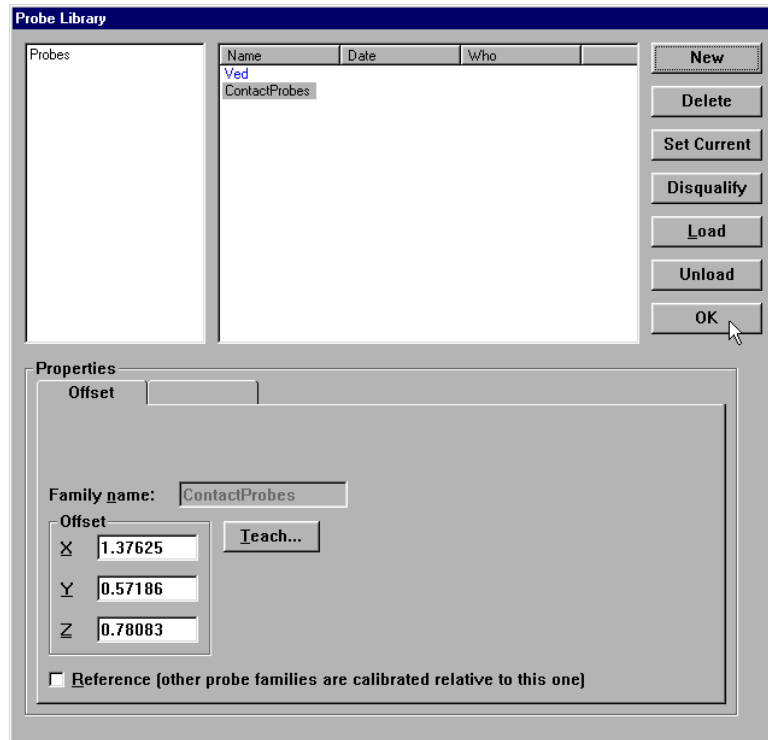


Step 12

Click OK in the dialog box.



Step 13
Click OK in probe library.



The calibration is complete. Check the accuracy by measuring the ring gauge with both probes a second time.

Using a Probe Rack

Use a probe rack to store additional probe tips. Probe tips housed in the probe rack can be exchanged during inspections according to need. For example, a probe rack allows the user to switch from a single probe tip to a star probe tip.

All probe transitions must occur through the appropriate established methods. You must never manually change a probe tip or manually place/remove probes from ports in the rack. Valid probe transitions can be set in the Probe Library dialog box by selecting the probe you wish to switch to, then select the "Set Current" button. Proper probe transitions can also be included in a program. If at any time, either during normal operation or while a program is executing, the QC-5000 fails to correctly perform a probe change, then the affected probes will need to be unloaded from the probe rack, then reloaded.

Probe Rack Setup

Set machine zero each time you launch the QC-5000. A repeatable machine zero position is required to find the probe rack.

Follow the instructions of the probe rack manufacturer to install the probe rack on your system. Once the probe rack is mounted and it's position entered in the QC-5000 it cannot be moved.



NOTE

Mount the probe rack so the current probe can reach each of the ports.



NOTE

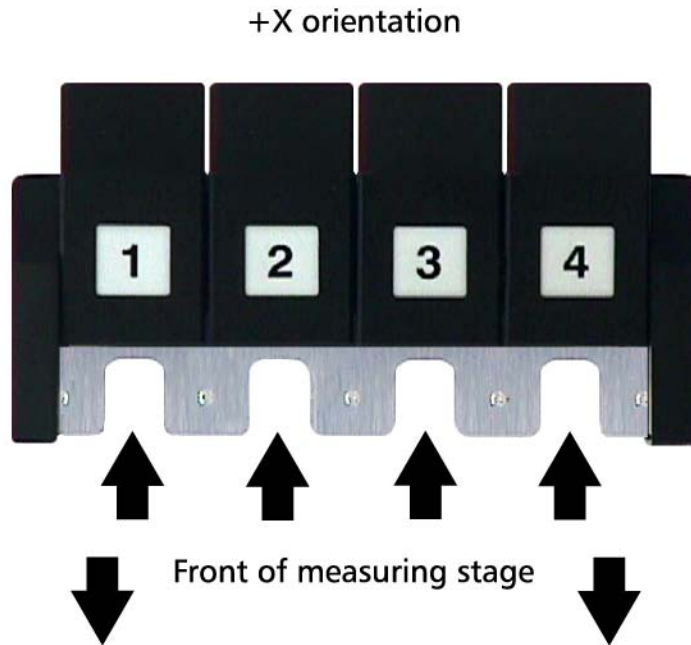
Mount the rack firmly so there is no movement in any direction.

Probe rack orientation

The four orientations accepted by the QC-5000 are as shown.

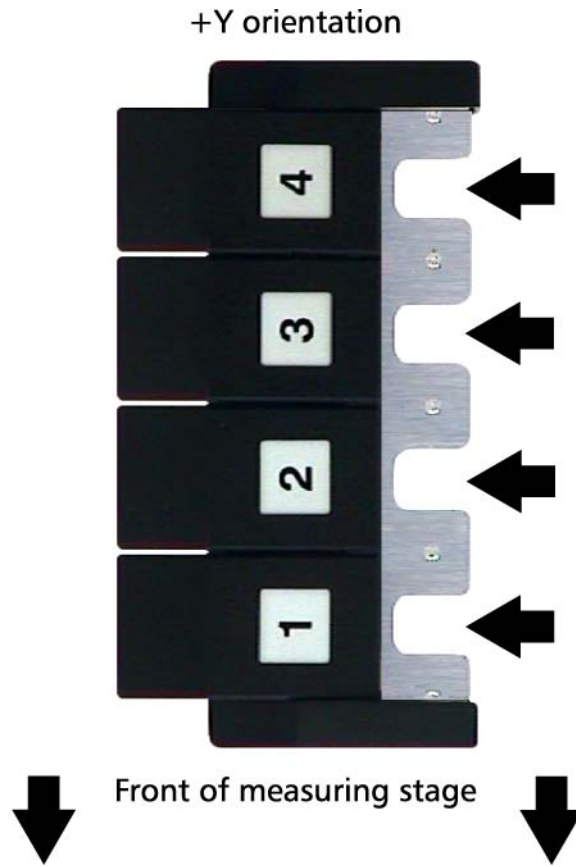
+X Orientation

Along the back edge of the table with the docking side of the rack facing in the +X direction (see below).



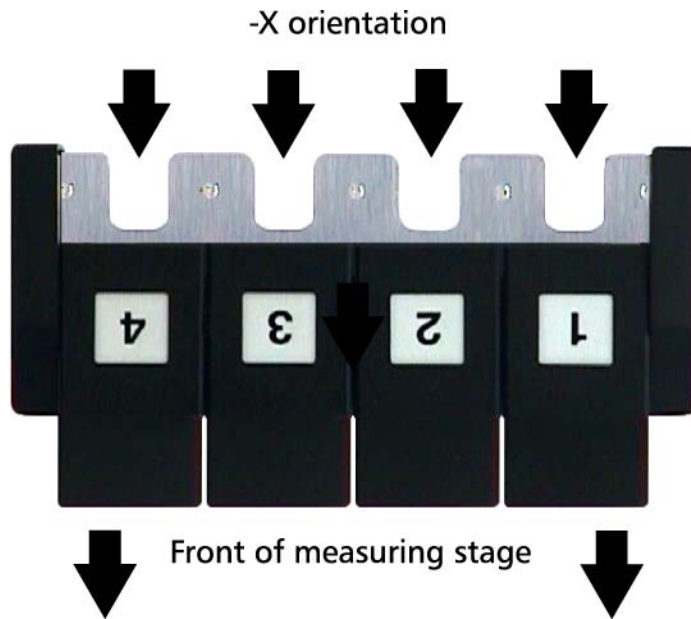
+Y Orientation

Along the left edge of the table with the docking side of the rack facing in the +Y direction (see below).



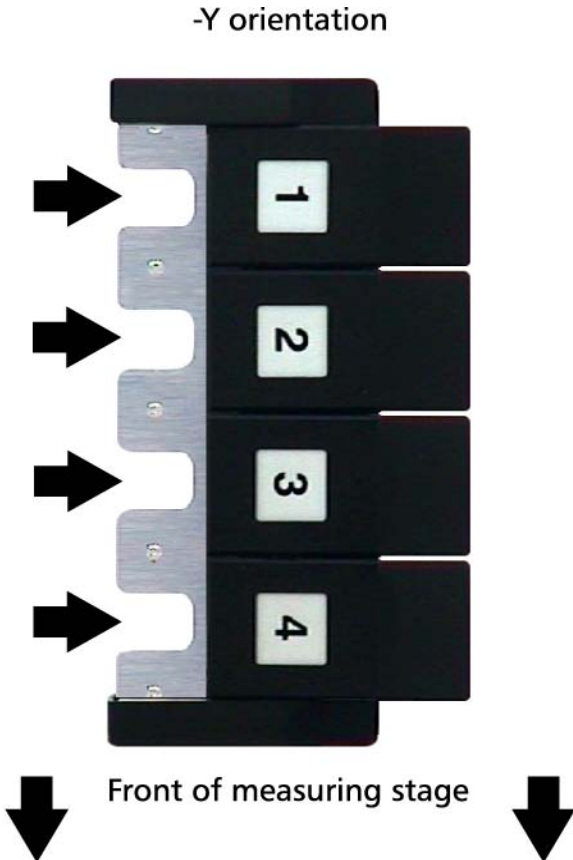
-X Orientation

Along the front edge of the table with the docking side of the rack facing in the -X direction (see below).



-Y Orientation

Along the right edge of the table with the docking side of the rack facing in the -Y direction (see below).

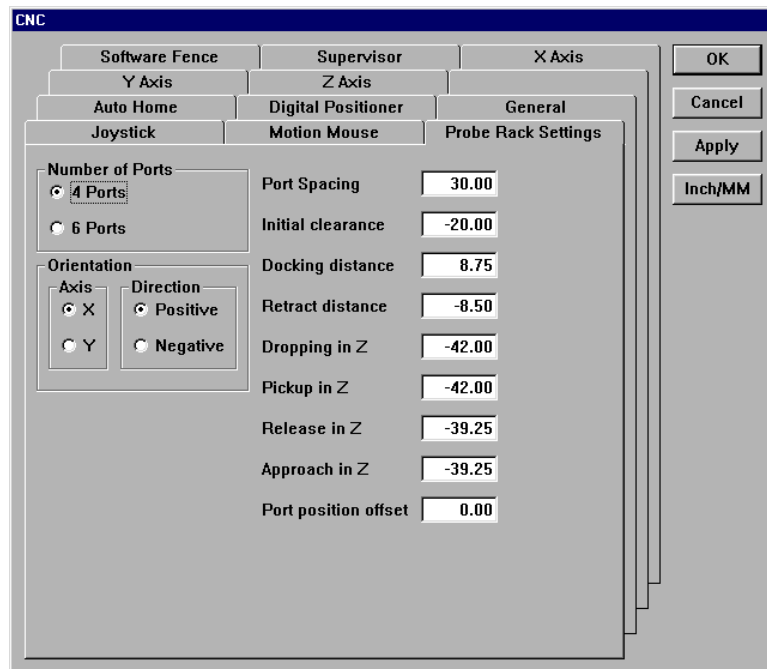


Probe Rack Calibration

Calibrate the probe rack to establish its position on the measuring table and define the location of probes within the rack.

Select *CNC* from the *tools* menu to display the CNC window. Calibration information is entered on the *probe rack settings* tab of the CNC window.

Select the appropriate number of ports and orientation for the rack you will be using. Other settings on this tab are explained below but require adjustment only if there is difficulty loading a probe tip.



Initial clearance:

the position the probe moves in preparation for docking.

Docking distance:

the distance the probe moves into the rack port to dock or pickup a probe.

Retract distance:

the distance the probe moves from the rack port after docking.

Dropping in Z:

the distance the Z axis moves into the rack during a probe drop.

Pickup in Z:

the distance the Z axis moves from the docking port after probe pickup.

Release in Z:

the distance the Z axis moves from the docking port during a probe drop.

Approach in Z:

the distance the Z axis moves into the rack during a probe pickup.

Port position offset:

the offset distance along the axis of the rack between the center of the docking module and the center of the probe tip used for calibration.

Enter port position offsets in the QC-5000 as follows:

If the rack orientation is X Positive: Enter the X value

If the rack orientation is X Negative: Enter the negative of the X value

If the rack orientation is Y Positive Enter the Y value

If the rack orientation is Y Negative Enter the negative of the Y value

DATRACK part program

Use the DATRACK part program to establish and save the coordinate system of the rack. There are eight DATRACK programs stored in the *c:\qc5000\Probe Rack* folder. Select the appropriate program for the probe rack installed.

- 4 port rack in the +X orientation DATRACK4XP.5pa
- 4 port rack in the +Y orientation DATRACK4YP.5pa
- 4 port rack in the -X orientation DATRACK4XN.5pa
- 4 port rack in the -Y orientation DATRACK4YN.5pa
- 6 port rack in the +X orientation DATRACK6XP.5pa
- 6 port rack in the +Y orientation DATRACK6YP.5pa
- 6 port rack in the -X orientation DATRACK6XN.5pa
- 6 port rack in the -Y orientation DATRACK6YN.5pa

To check probe rack orientation

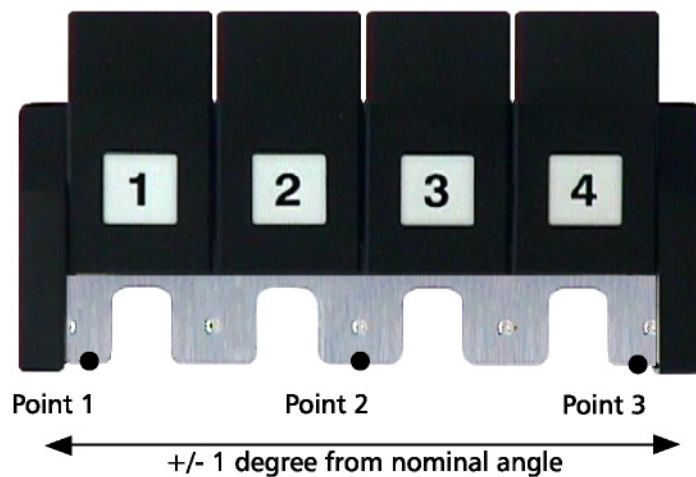


NOTE

Enter NLEC or SLEC data before calibrating the probe rack.

Step 1

Measure a line along the front of the probe rack as shown.



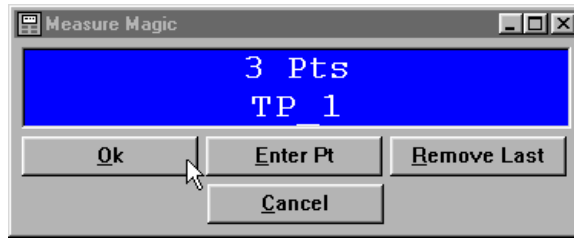
Checking probe rack alignment



NOTE

Do not move the Z axis.

Step 2
Click OK in the dialog box.



NOTE
Re-adjust the orientation of the probe rack if the angle of the line is greater than 1.0 degree from the nominal orientation.

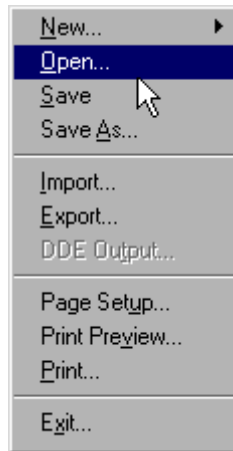
Run the desired DATRACK part program.

To run the DATRACK program

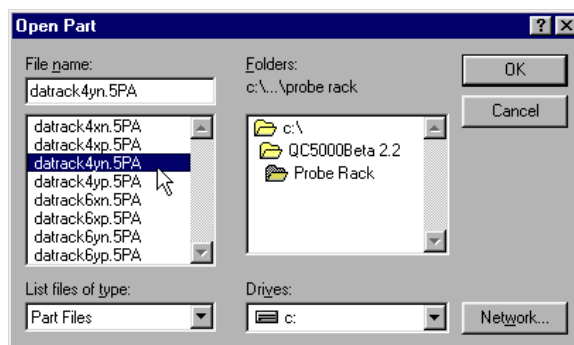


NOTE
Use a 2mm probe tip with a 20 mm stylus when running the DATRACK program.

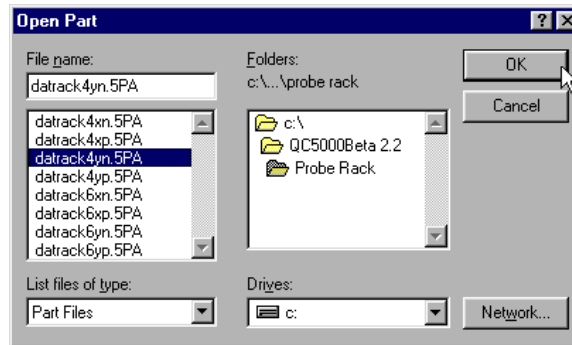
Step 1
Select open from the file menu.



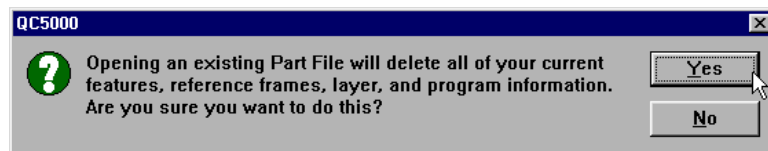
Step 2
Select the desired DATRACK program as shown.



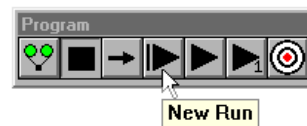
Step 3
Click OK in the dialog box.



Step 4
Click yes in the dialog box.



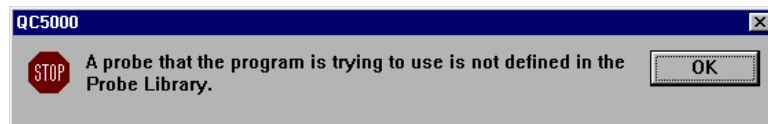
Step 5
Click the new run button on the program toolbar.



Follow the on-screen prompts to complete the DATRACK program.

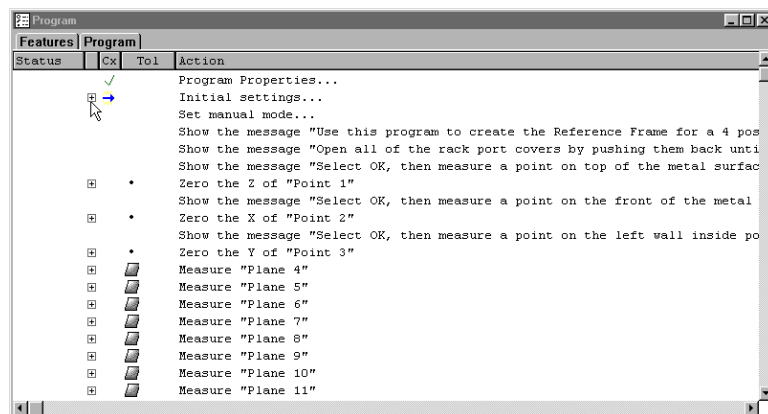


NOTE
Use the following procedure if this error message is displayed.

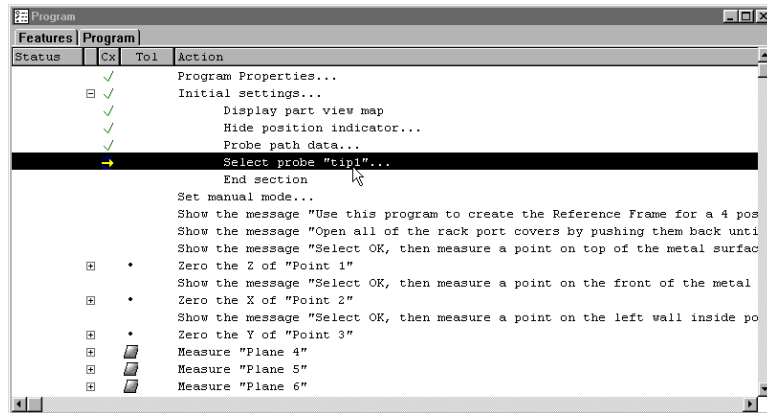


To edit the initial settings of the DATRACK program

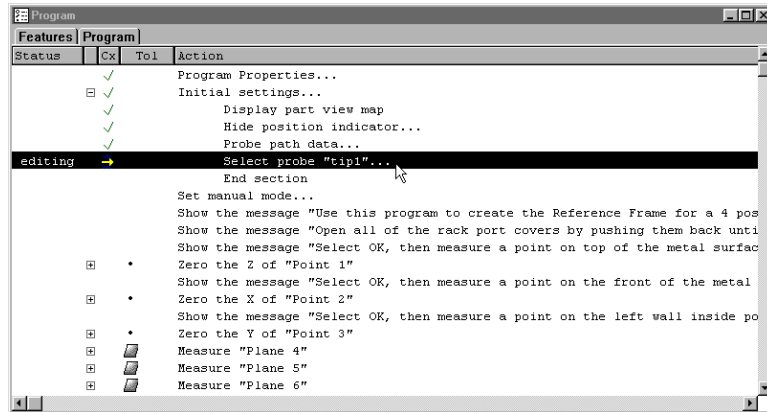
Step 1
Click on the + next to *initial settings* as shown.



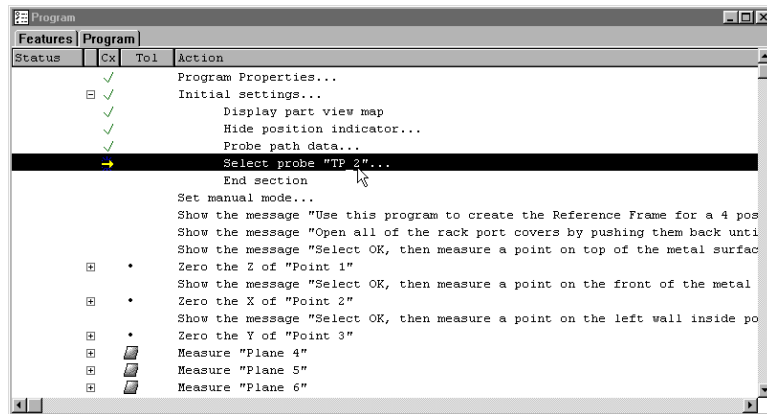
Step 2
Highlight the *select probe* line as shown.



Step 3
Double-click on the line to edit it.



Step 4
Click to insert the current probe as shown.

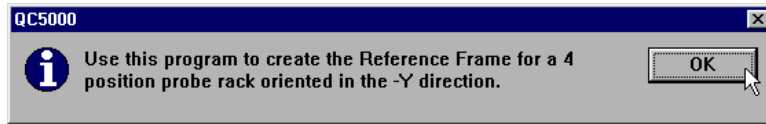


Click the *new run button* on the program toolbar to run the edited program.

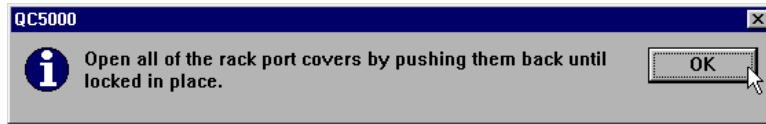
As the DATRACK program runs the user is prompted to complete several tasks. Use the following procedures to complete the DATRACK program.

To enter the datum in the DATRACK program

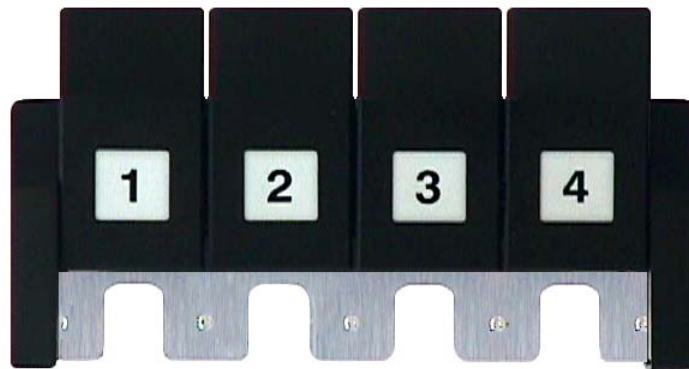
Step 1
Click OK in the dialog box.



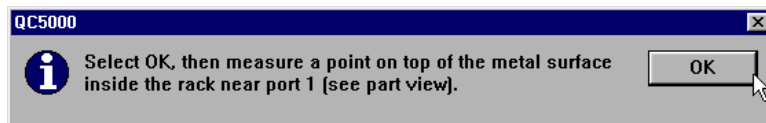
Step 2
Click OK in the dialog box.



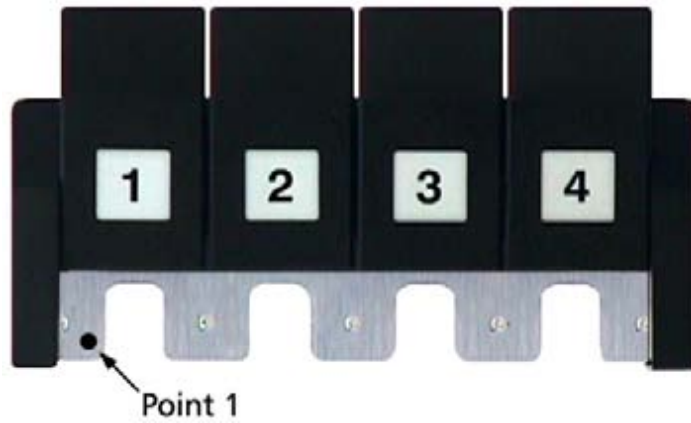
Step 3
Open all probe rack ports as shown.



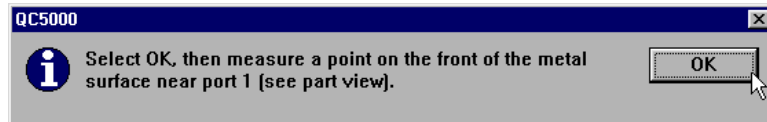
Step 4
Click OK in the dialog box.



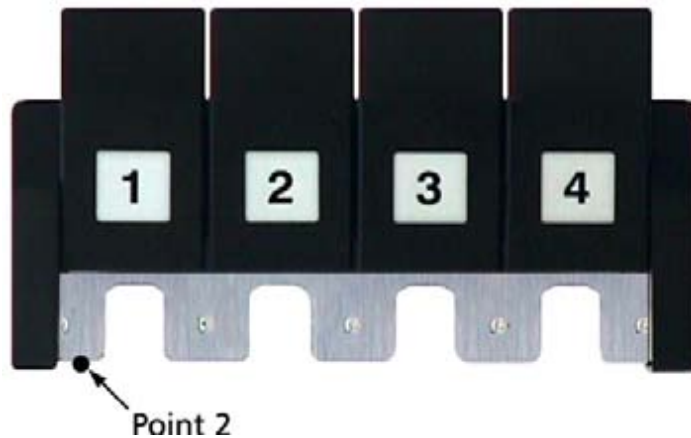
Step 5
Probe the first point on the probe rack as shown.



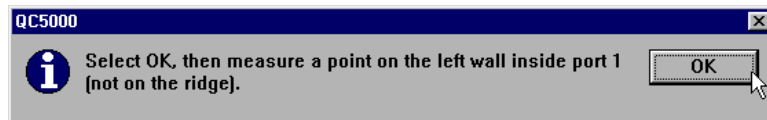
Step 6
Click OK in the dialog box.



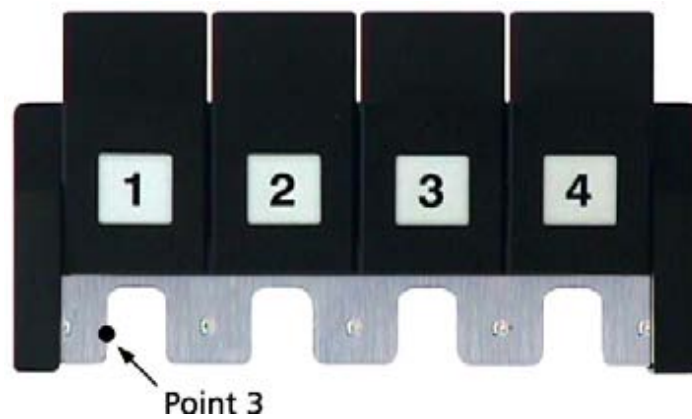
Step 7
Probe the second point on the probe rack as shown.



Step 8
Click OK in the dialog box.



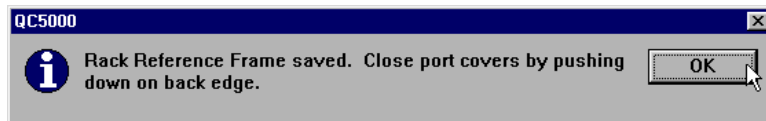
Step 9
 Probe the third point on the probe rack as shown.



Step 10
 Click OK in the dialog box.

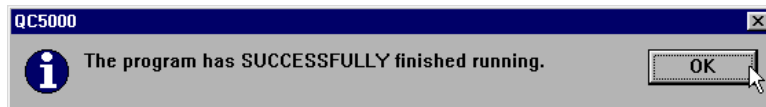


Step 11
 Click OK in the dialog box.

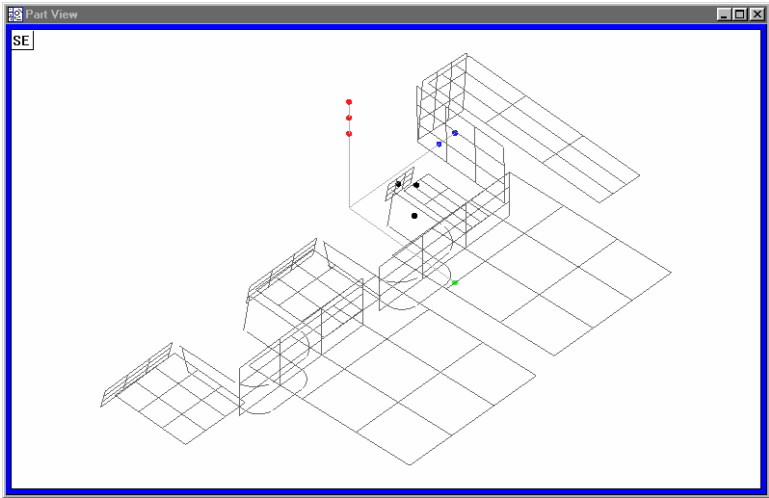


At this point the program completes the necessary steps to create a reference frame for the probe rack.

Step 12
 Click OK in the dialog box.



The probe rack appears in the part view window as shown.

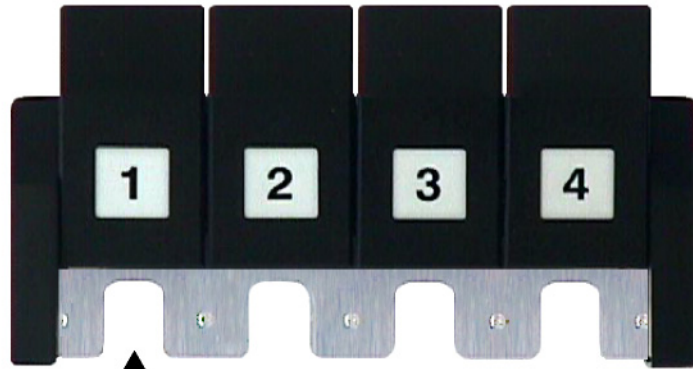


The probe rack is calibrated and ready for probes to be loaded.

To load a probe

Step 1

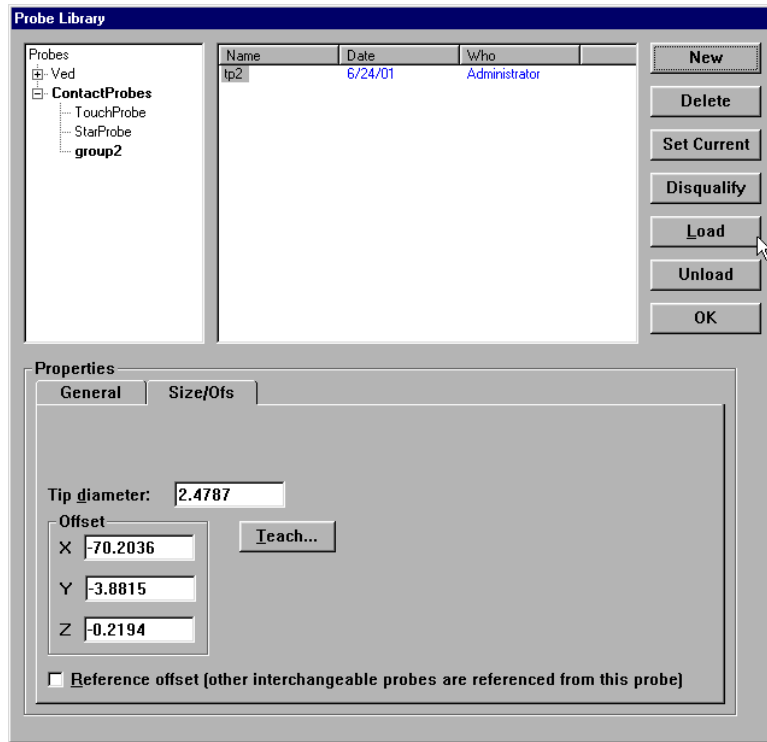
Position the probe in front of the desired port as shown.



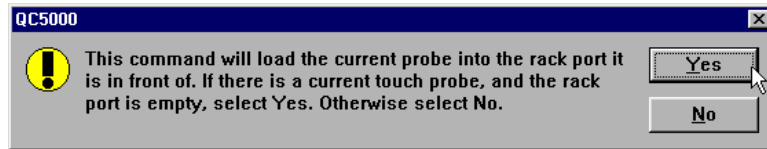
X

Position probe for loading

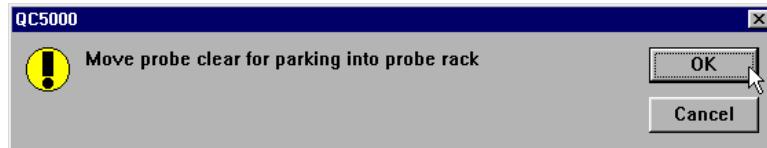
Step 2
Click the load button as shown.



Step 3
Click OK in the dialog box.



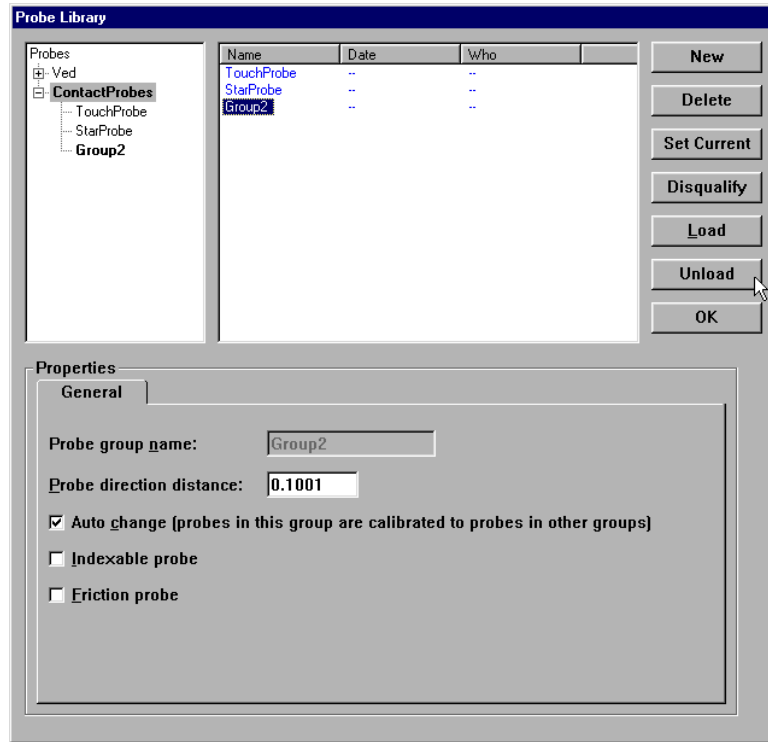
Step 5
Click OK in the dialog box.



To unload a probe

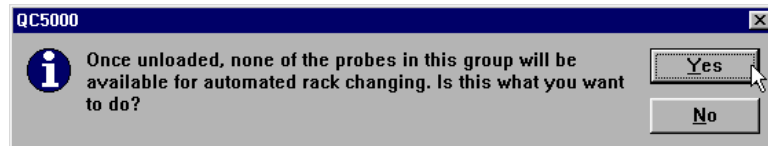
Step 1

Click the unload button as shown.



Step 2

Click OK in the dialog box.



Chapter 4

Programming

The QC-5000 is user programmable. Users can perform a series of steps and save it as a program for later use. When the program is executed the QC-5000 prompts the user to perform the necessary steps for the inspection of the part. This function is useful for repetitive measuring of large quantities of parts. QC-5000 programs are part specific, that is each program is for a specific part. A sample program and instructions to create it are included in this chapter.

Programming Overview

The QC-5000 programming feature works like a tape recorder. The following sections explain programming features and demonstrate how to create, save, and run a program. To avoid confusion, use the QC-5000 demo part for the following sections. Any multi-feature part may be substituted in later programs.

Keep in mind that QC-5000 programs execute sequentially. If a step references a feature, that feature must already be measured. Here are two simple tips for hassle free programming:

- Only reference features that have been measured prior to the step that references them.
- Do not delete a features that are part of a construction.



NOTE

In this section all instructions refer to the program toolbar. The same procedures can be performed using the pull down menus at the top of the screen as well.



NOTE

Toolbars in the QC-5000 software can be customized. This manual attempts to display the most common toolbar arrangements. Some users may find the toolbar setup on their system varies from those shown here.

The Program Toolbar

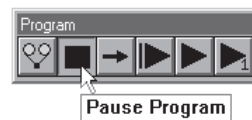
To display the program toolbar select 'toolbars' from the View pull down menu. In the Toolbars dialog box, click on 'program' in the list box on the left then click the Show button. Click the OK button to continue.

Record/Edit Program



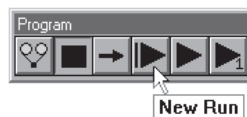
Click the record/edit button to start recording a program. The QC-5000 software will record all actions from this point as a new program or as an addition to an existing program. To stop recording, click the Pause Program button (see below).

Pause Program



Click the Pause Program button to stop a currently running program or to stop recording/editing a program. The last step executed before the program was paused is highlighted in the program window.

New Run



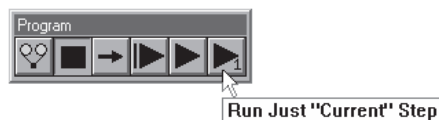
Click the New Run button to run a program from the first step. When New Run is clicked the program begins from the first step regardless of the step selected in the program window.

Run Program From Current Step



Click the Run Program From Current Step button to run a program from the currently selected step in the program window.

Run Just Current Step



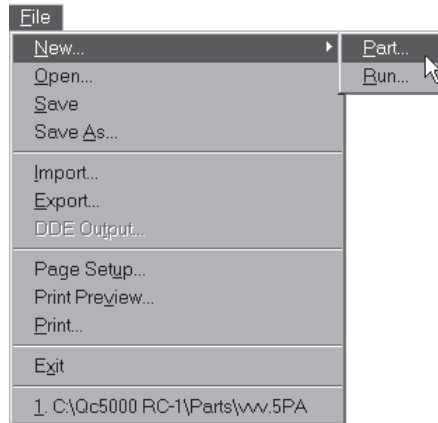
Click the Run Just Current Step to execute only the currently selected step and then pause the program.

Recording a Program

To create a program

Step 1

Select *new* from the file menu. Then select *part*.



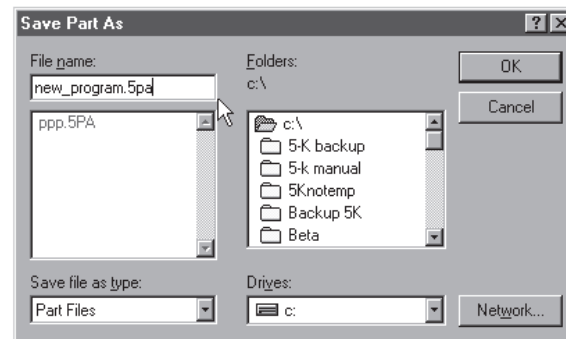
Step 2

Click the *record/edit* button on the program toolbar.

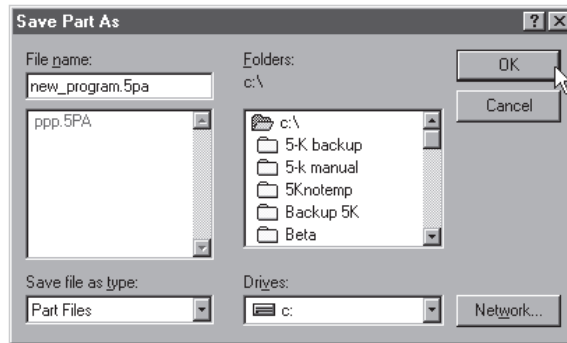


Step 3

Type a program name as shown.



Step 4
Click OK.

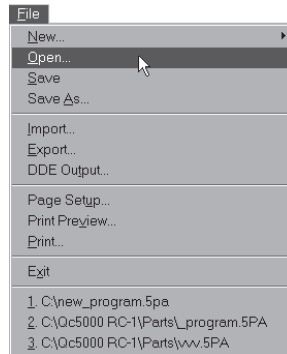


Step 5
Perform the desired steps.

To open a saved program

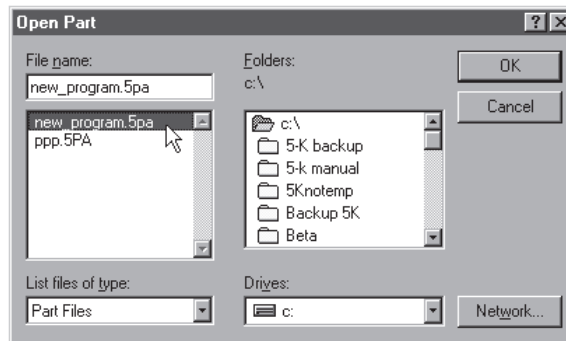
Step 1

Select *open* from the file menu.



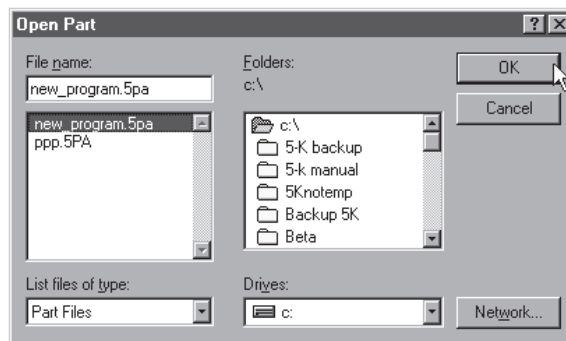
Step 2

Highlight the desired program as shown.



Step 3

Click the OK button.



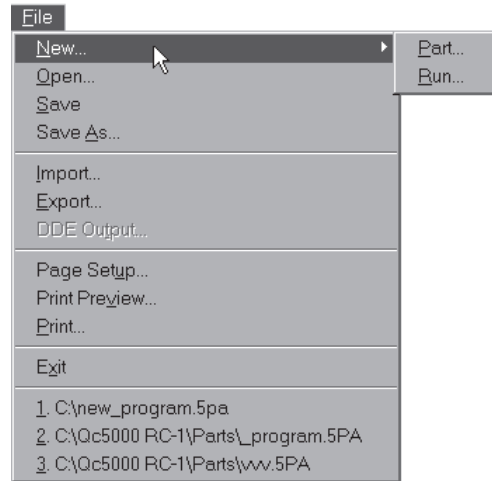
Running A Program

Running a saved program is easy. Open the part file using the method below.

To run a program

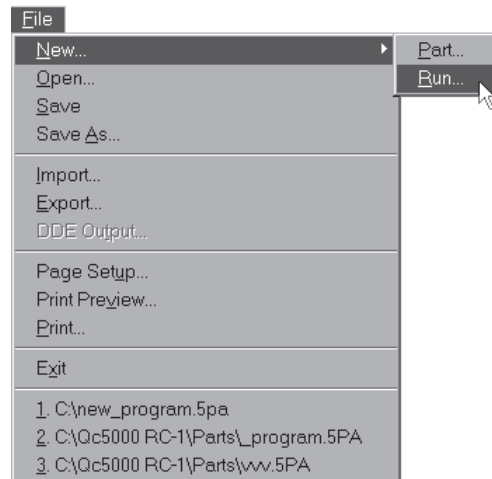
Step 1

Select *new* from the file menu.



Step 2

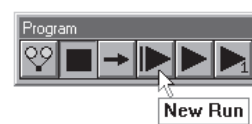
Select *run* from the sub-menu.



OR

Step 1

Click the *new run button* on the program toolbar.



Sample Program

Automate repetitive measurement task using the QC-5000 programming feature. Use the information in this chapter to create QC-5000 part programs. A part program is a series of measurements and associated tasks that run automatically when executed. For example, a part program may contain the measurement of a feature as well as the CNC moves required for the measurement.

Click the record/edit button on the program toolbar to begin a program. Next, measure a series of geometric features. Each step is recorded into the program including probe changes, light control, and probe movements.

Use advanced programming features such as conditional statements, arrays, and palletization to measure complex parts with a minimal set of instructions. Import CAD files to streamline and simplify programming.

Demonstrations in this chapter use the demo part included with the QC-5000 system.

Begin each part program with a new part file. This ensures that only the desired tasks are included in the part program.

To create a new part file

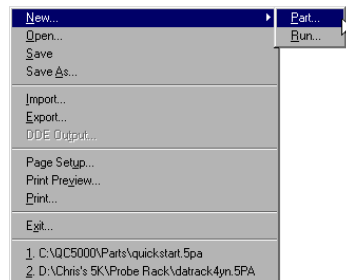


NOTE

Save any files that are currently open before creating a new part file.

Step 1

Select new part from the file menu.



NOTE

The following joystick setup options are used in this chapter:

- Button 1 – speed toggle
- Button 2 – axis lock
- Button 3 – goto command

Users may find it helpful to match these settings.

Establish a reference frame to align the part on the stage and set a datum. Use the primary plane, secondary line, and zero as shown for this demonstration.



NOTE

This demonstration uses a multi-sensor system equipped with a touch probe and VED (video edge detection). The steps can be completed using a single sensor system (VED or touch probe) if necessary.

To record a program

Step 1

Click the record/edit button on the program toolbar.



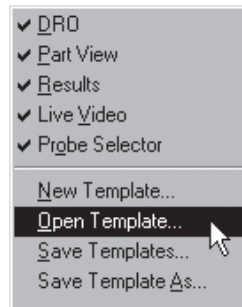
The status bar displays recording in red.



To display the feature list

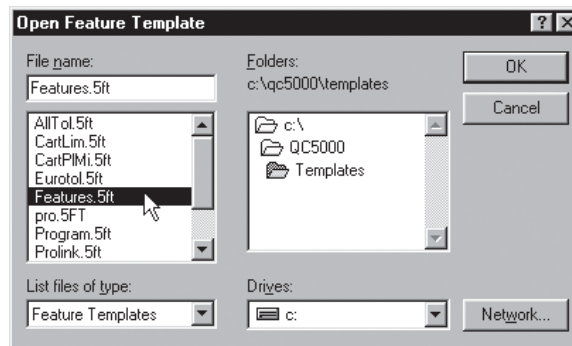
Step 1

Select *open template* from the windows menu.



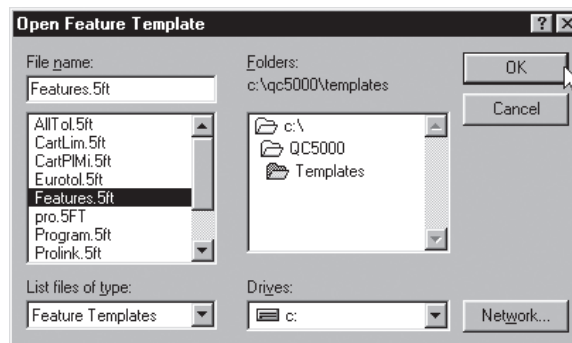
Step 2

Select *features.5ft* as shown.



Step 3

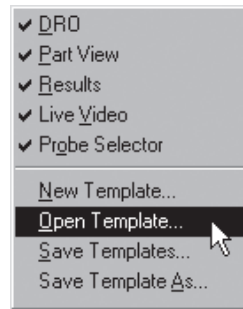
Click OK in the dialog box.



To display the program template

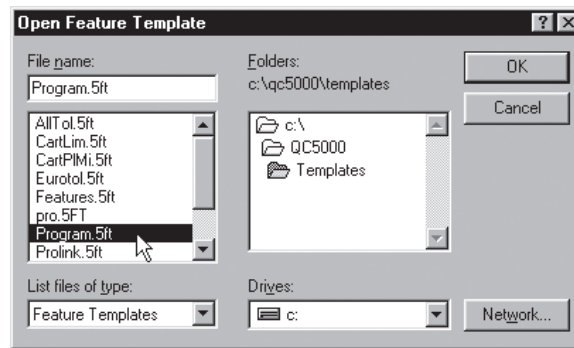
Step 1

Select *open template* from the windows menu.



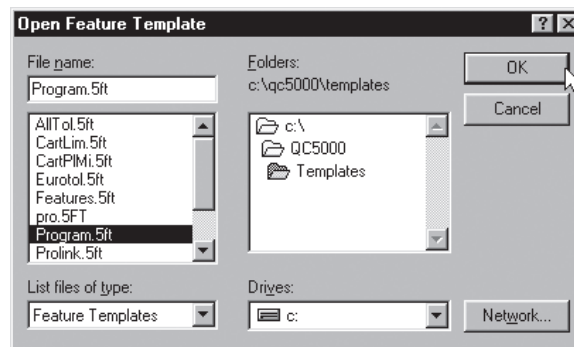
Step 2

Select *program.5ft* as shown.



Step 3

Click OK in the dialog box.

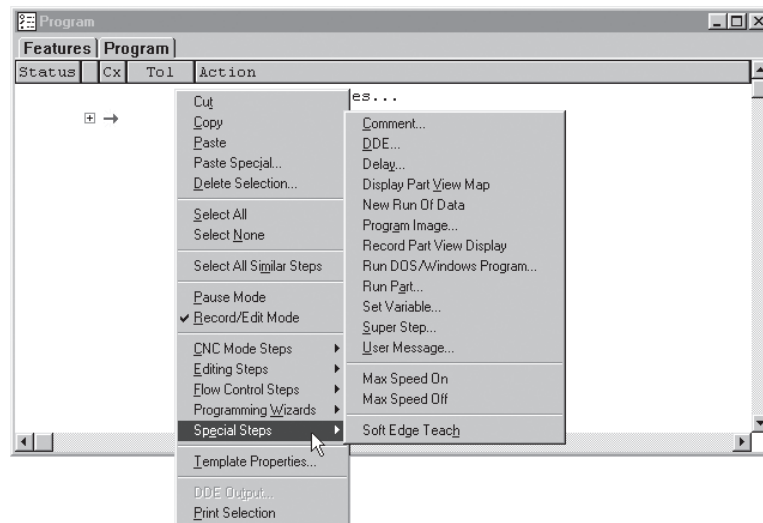


Follow the instructions below to record the part view display into a program. Use this procedure every time the part view window display is changed while recording a program.

To record the part view window display

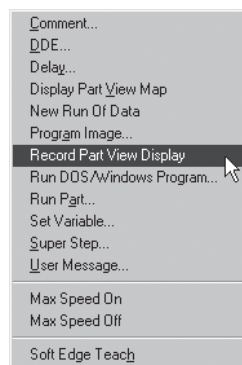
Step 1

Right-click on the program template and select special steps as shown.



Step 2

Select record part view display.



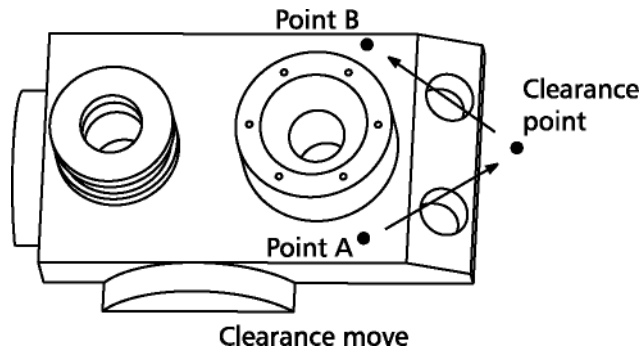
CAUTION

Use clearance moves to ensure the probe does not collide with the part or other obstructions on the measuring stage. For example, to safely move the probe from point A to point D, insert clearance moves at point B and point C. If the clearance moves are omitted, the probe will move in a straight line from point A to point D. The resulting collision could damage the probe.

To insert a clearance move

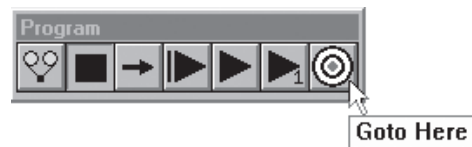
Step 1

Move the probe to the desired clearance point. Select a point that will allow the probe to travel safely away from obstacles.



Step 2

Click the goto button on the program toolbar.

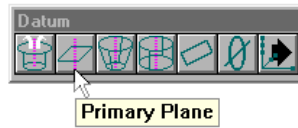


Use this procedure whenever directed to insert a clearance move in a program.

To measure the primary plane

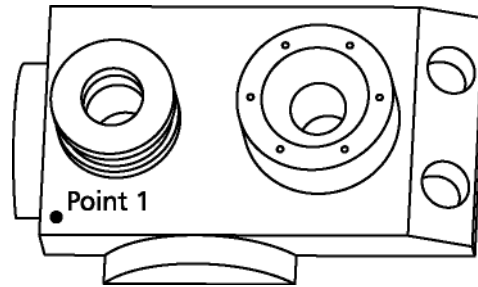
Step 1

Click the primary plane button on the datum toolbar.



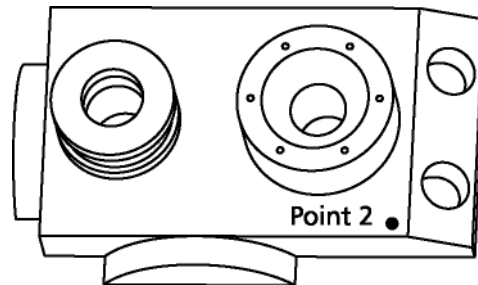
Step 2

Probe the first point as shown.



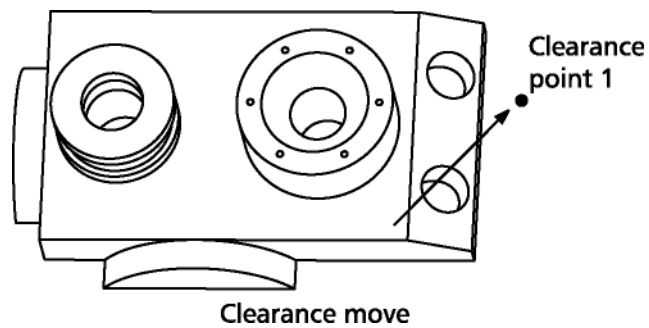
Step 3

Probe the second point as shown.



Step 4

Insert a clearance move at *clearance point 1* as shown.

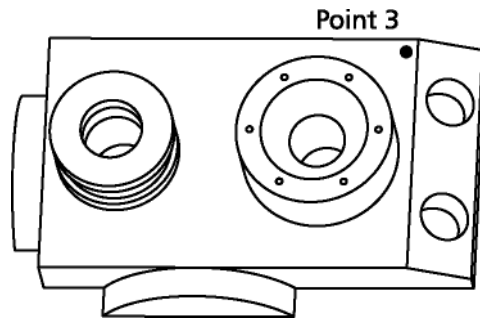


Step 5

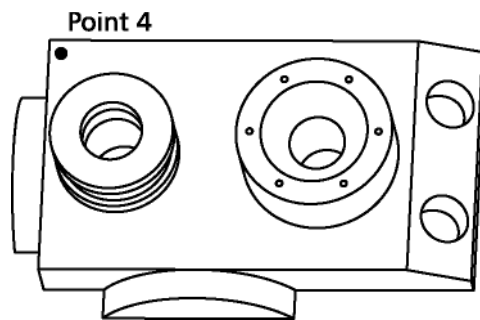
Click on the goto button on the program toolbar.



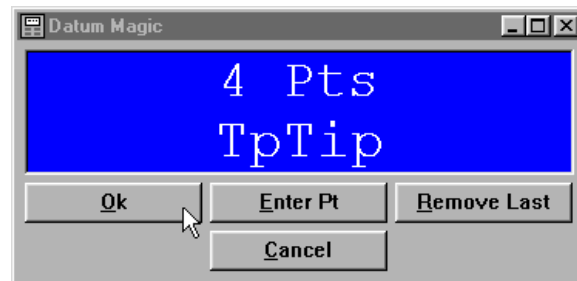
Step 6
Probe third point as shown.



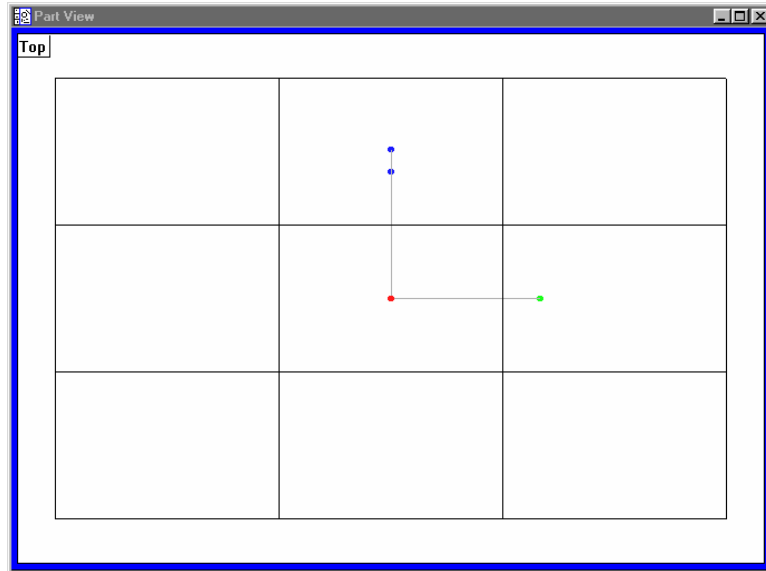
Step 7
Probe fourth point as shown.



Step 8
Click OK in the dialog box.



The primary plane with the RFI (reference frame indicator) is displayed in the part view window.

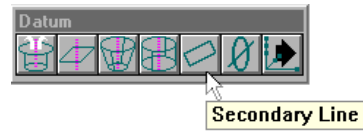


Use clearance moves to position the probe for the next measurement.

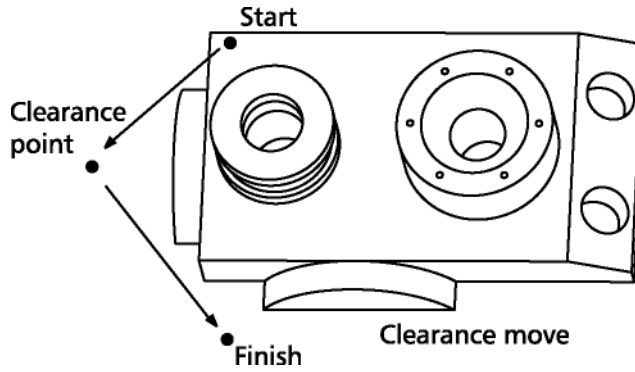
To measure the secondary line

Step 1

Click the secondary line button on the datum toolbar.



Insert a clearance move as shown.



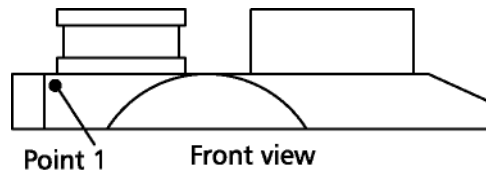
Step 2

Click the *goto* button on the program toolbar.



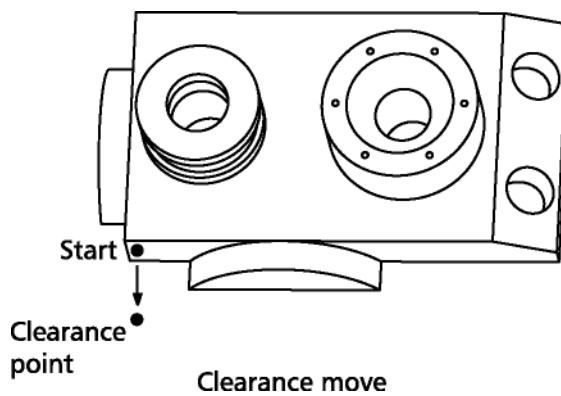
Step 3

Probe the first point as shown.



Step 4

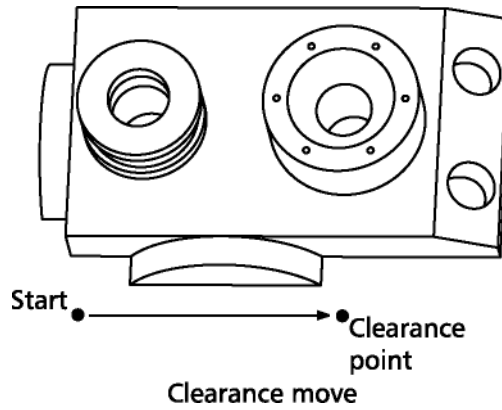
Insert a clearance move as shown.



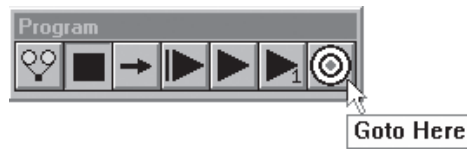
Step 5
Click the *goto* button on the program toolbar.



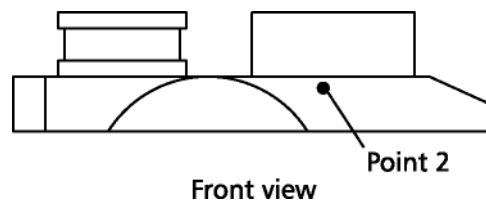
Step 6
Insert a clearance move as shown.



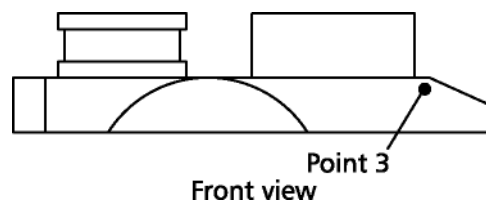
Step 7
Click the *goto* button on the program toolbar.



Step 8
Probe the second point as shown.



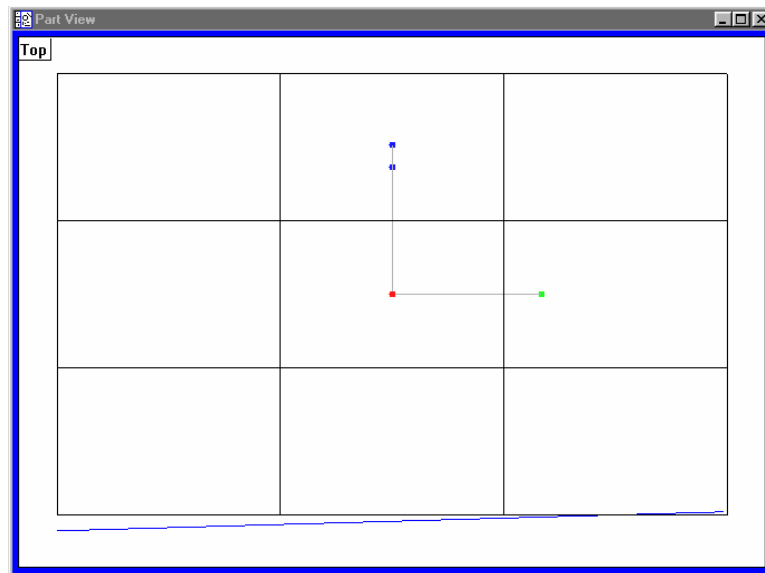
Step 9
Probe the third point as shown.



Step 6
Click OK in the dialog box.



The secondary line is displayed in the part view window.



To switch the active probe to VED

Step 1

Click on the status bar until VED is displayed.



Step 2

Click on the status bar until the desired magnification is displayed.



NOTE

Systems equipped with a probe rack display the following prompt:

Use clearance moves to position the probe for the next measurement.

To create an arc tool

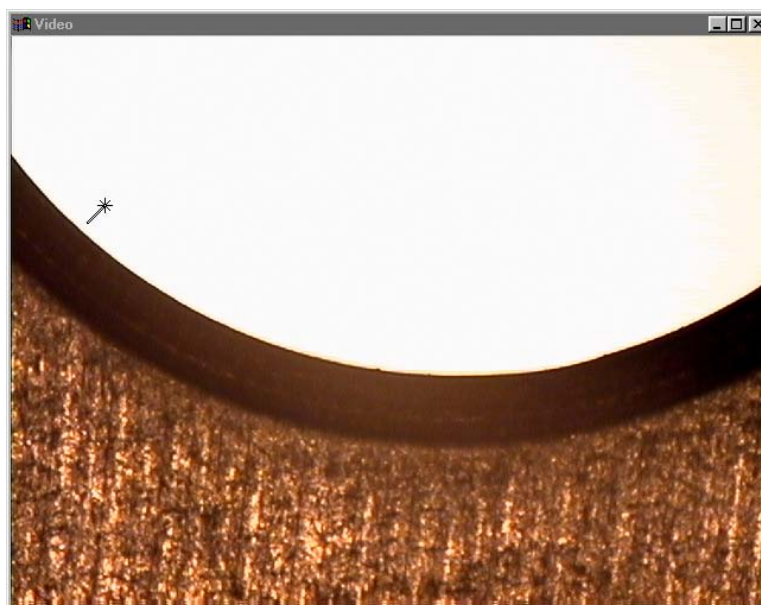
Step 1

Right click and select *new VED probe* from the list.

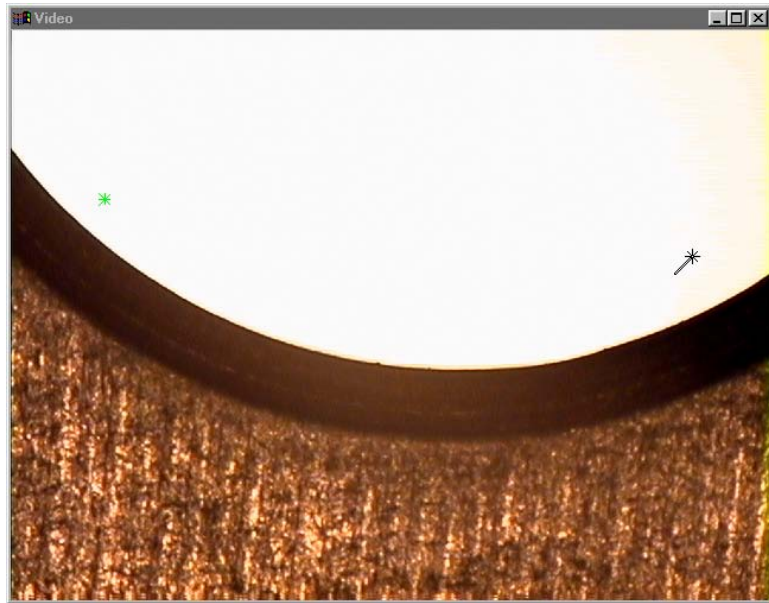


Step 2

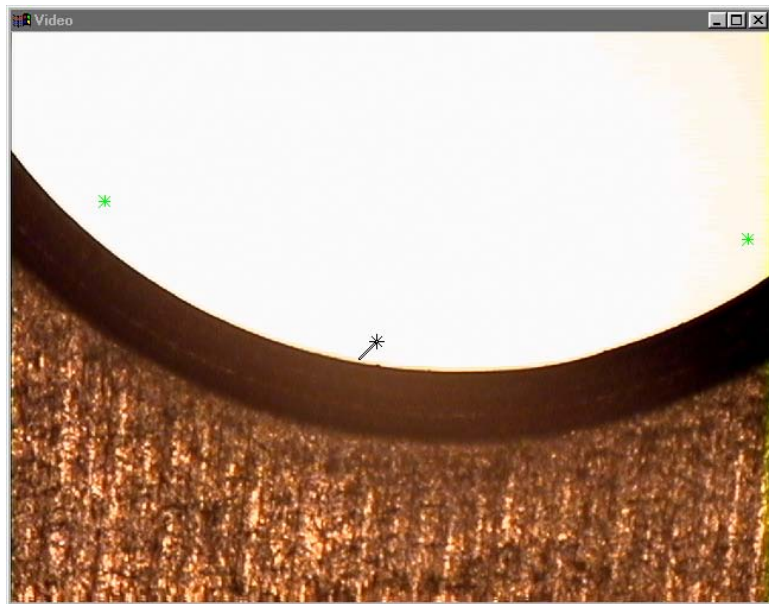
Place the wand tool as shown and click.



Step 2
Place the wand tool as shown and click.

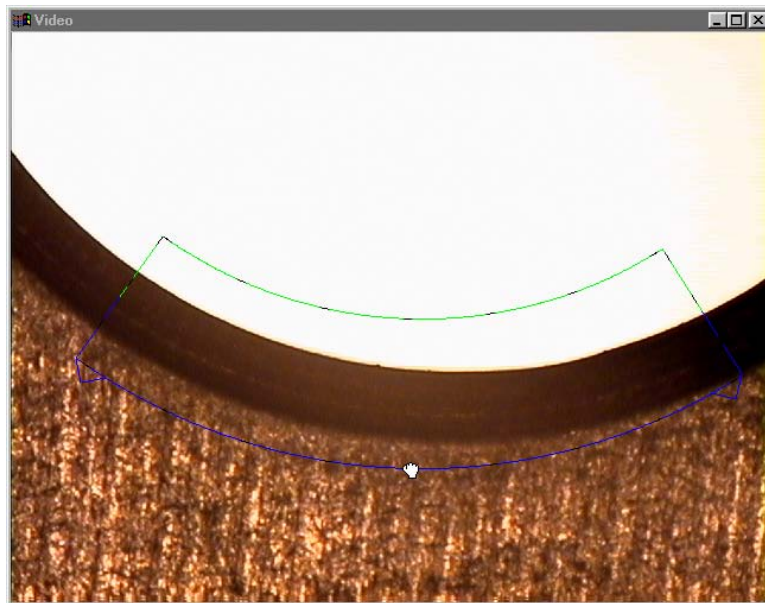


Step 3
Place the wand tool as shown and hold down the mouse button.



Step 4

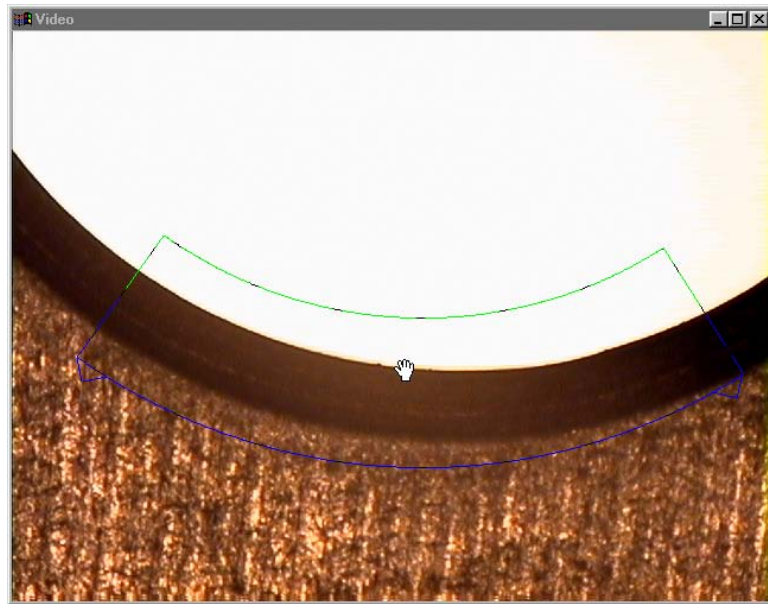
Drag the wand tool in the desired scan direction.



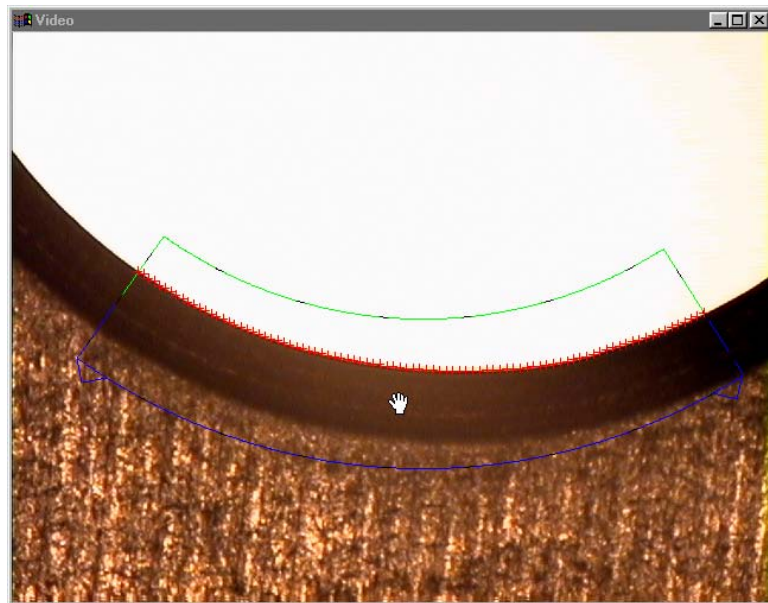
An arc tool is created with edge scan in light-to-dark direction.

To measure the zero feature

Step 1
Place the probe tool as shown.

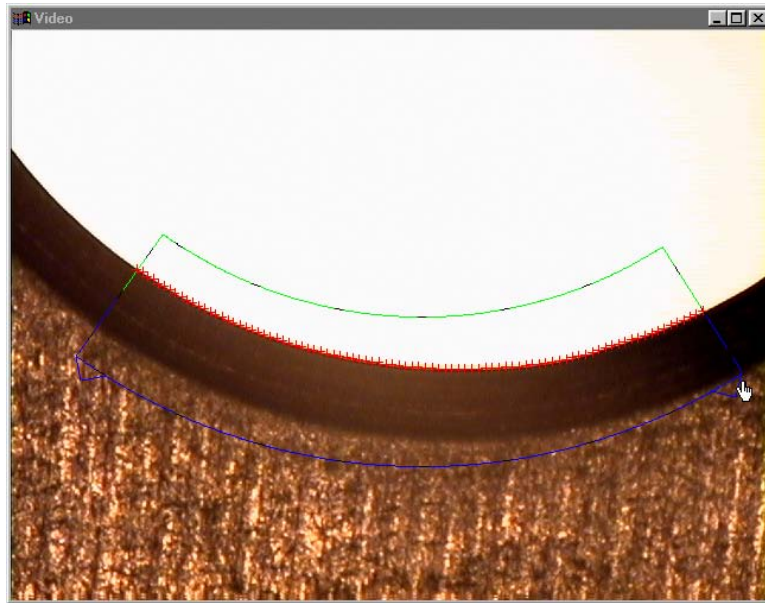


Step 2
Click the center mouse button.



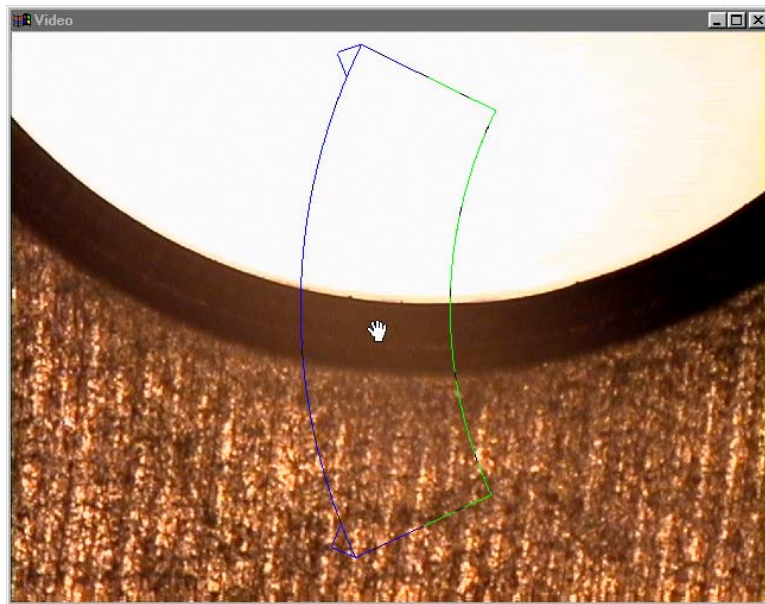
Step 3

Place the hand cursor over the corner of the probe tool as shown.

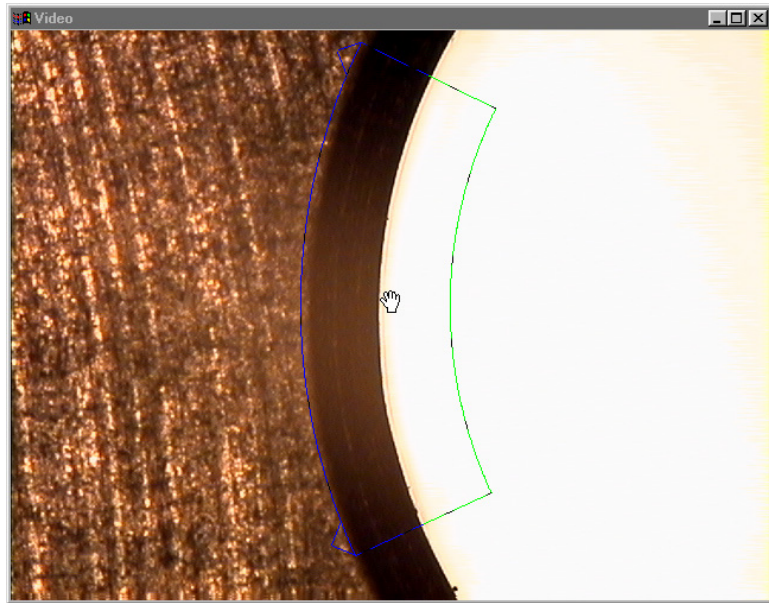


Step 4

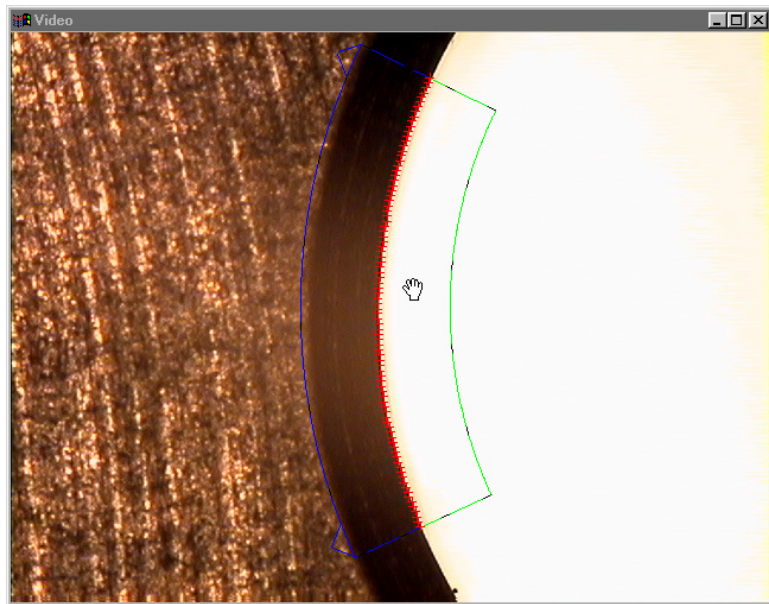
Hold the mouse button and drag the corner of the probe tool to rotate as shown.



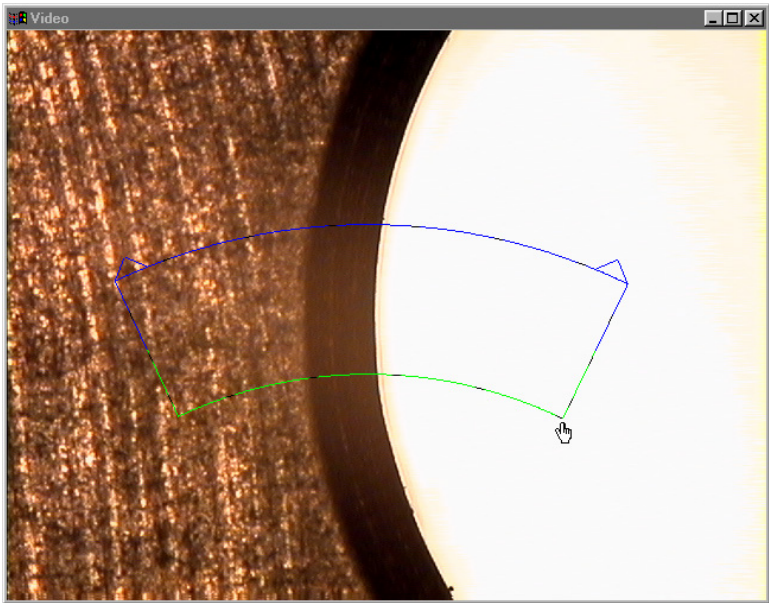
Step 5
Move the part and place the probe tool as shown.



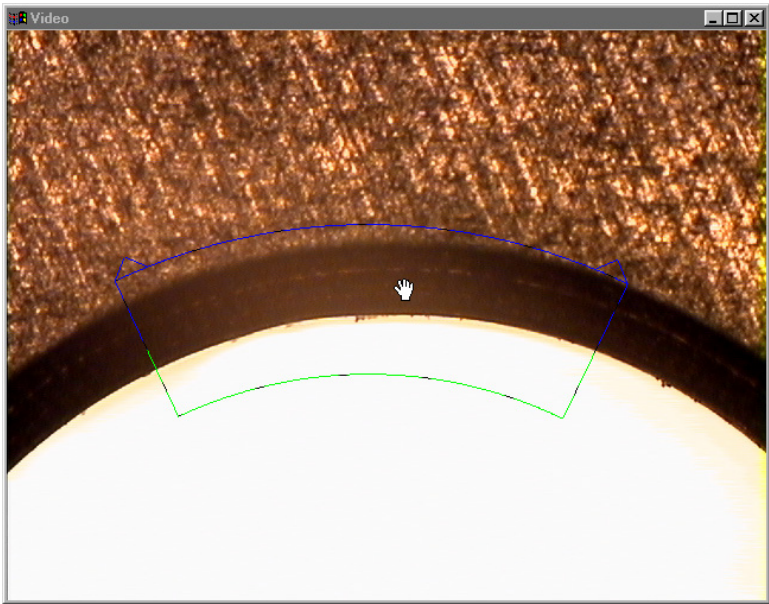
Step 6
Click the center mouse button.



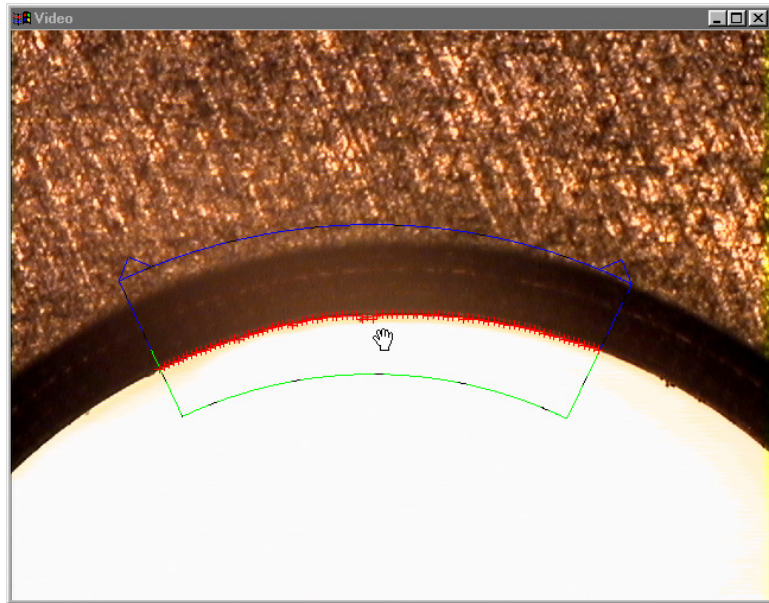
Step 7
Rotate the probe tool as shown.



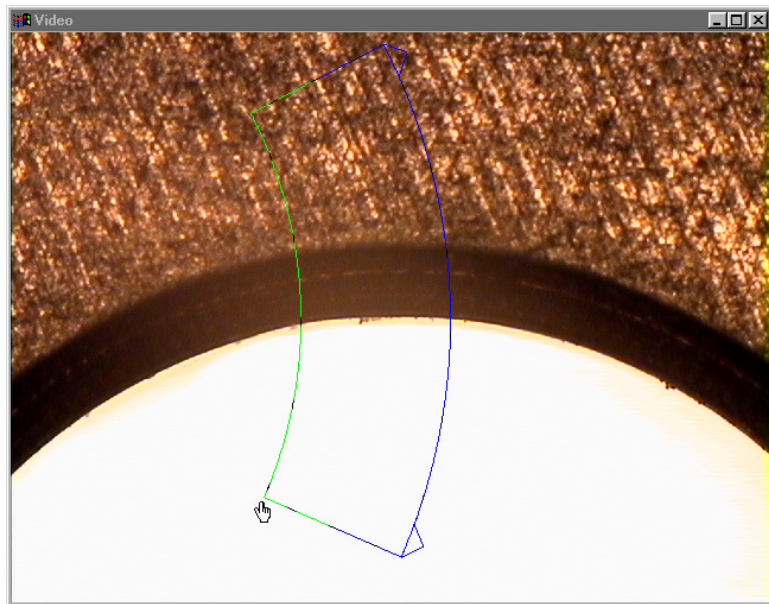
Step 8
Move the part and place the probe tool as shown.



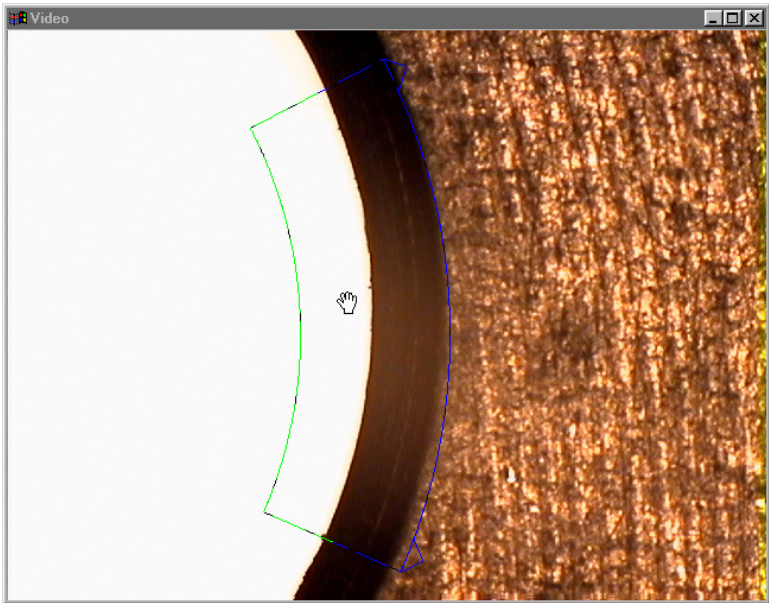
Step 9
Click the center mouse button.



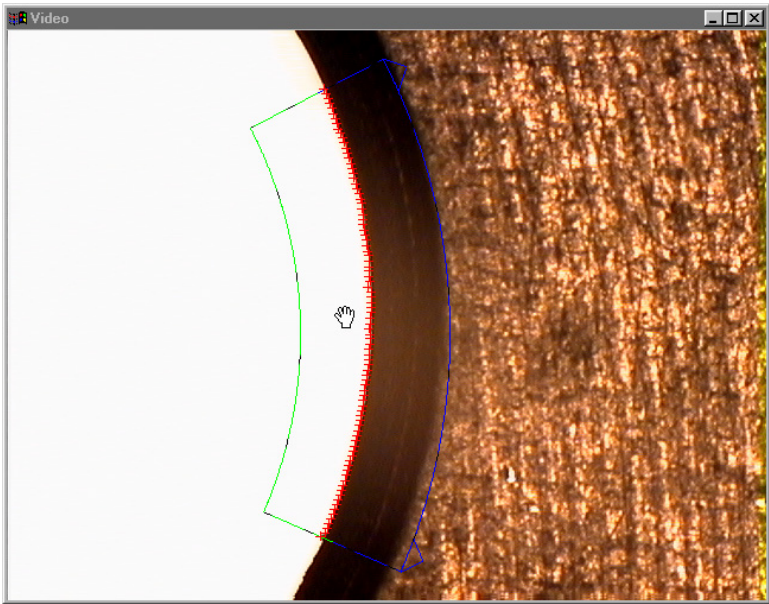
Step 10
Rotate the probe tool as shown.



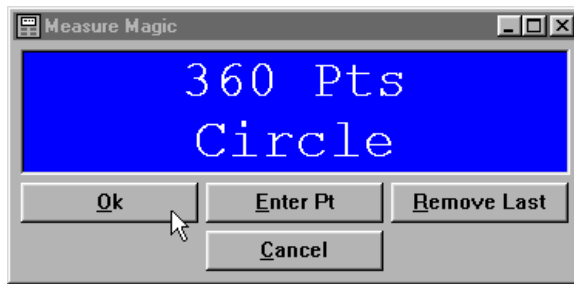
Step 11
Move the part and place the probe tool as shown.



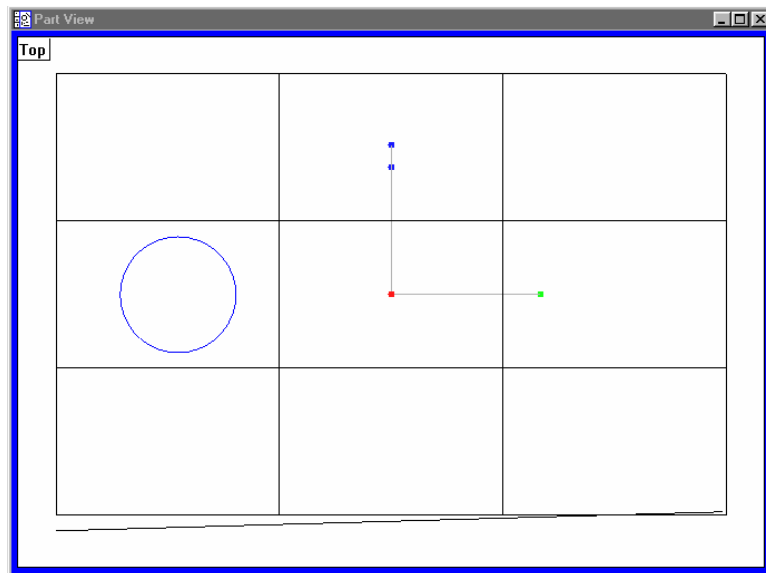
Step 12
Click the center mouse button.



Step 13
Click OK in the dialog box.



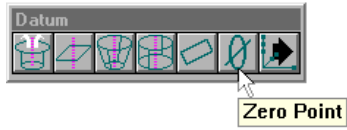
The circle is displayed in the part view window.



To create a zero point

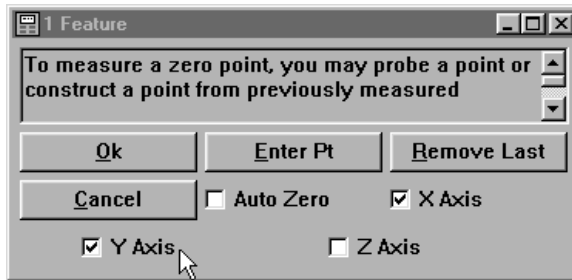
Step 1

Click the zero button on the datum toolbar.



Step 2

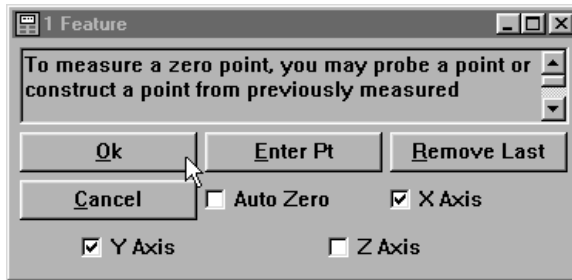
Check the X and Y axes as shown.



Step 3

Click OK in the dialog box.

The center of the circle is XY datum and the Z datum is the primary plane.



To save the reference frame

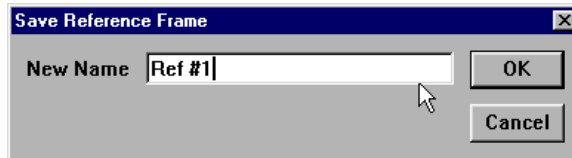
Step 1

Click the save reference frame button on the datum toolbar.



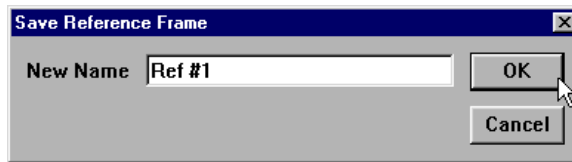
Step 2

Type a name for the reference frame.



Step 3

Click OK in the dialog box.



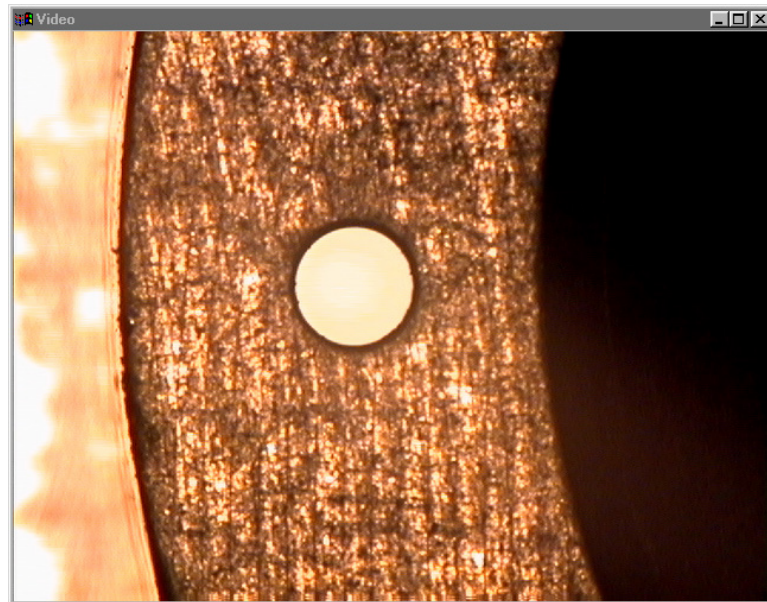
Use one of the small circles around the cone feature for the next measurement. Follow the directions below to complete the task.



To measure a circle

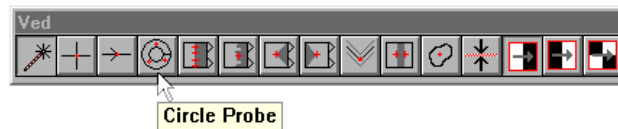
Step 1

Position circle 2 in the FOV (field of view) as shown.



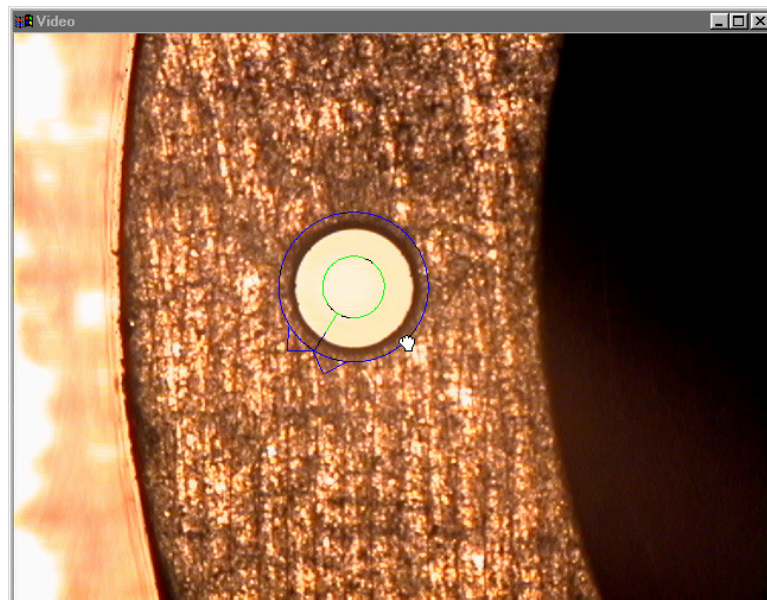
Step 2

Click the circle tool button on the VED toolbar.

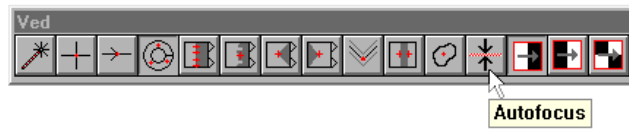


Step 3

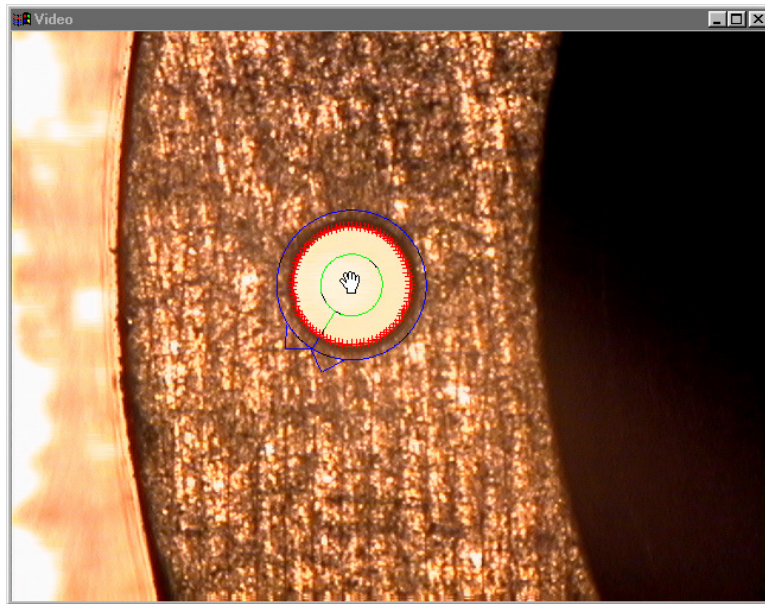
Use the hand cursor to re-size the circle tool.



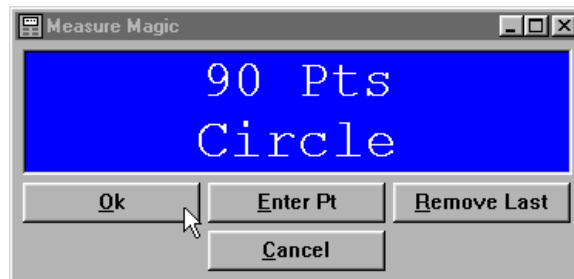
Step 4
Click the autofocus button on the VED toolbar.



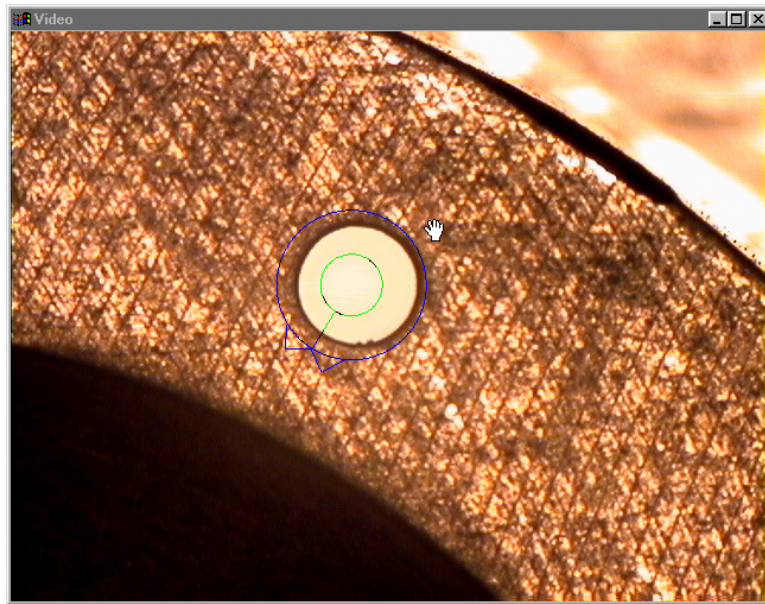
Step 5
Click the center mouse button.



Step 6
Click OK in the dialog box.



Move circle 3 into the FOV as shown and measure it using the same process.



To construct a distance

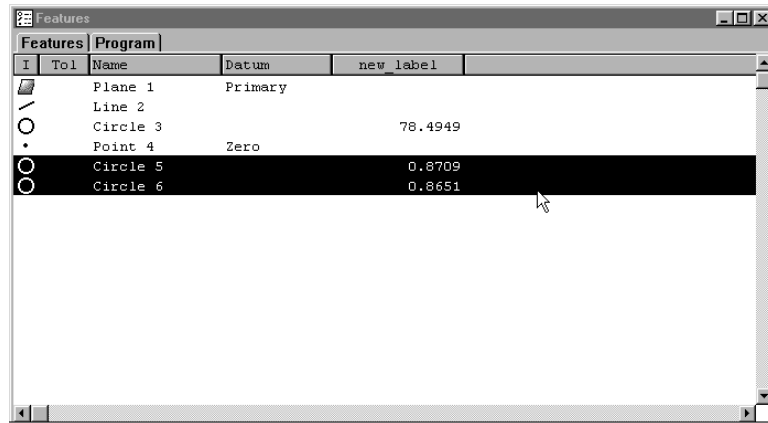
Step 1

Click the distance icon on the measure toolbar.



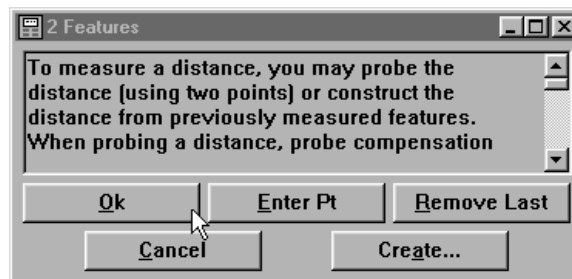
Step 2

Highlight circles 2 and 3 in the features list as shown.

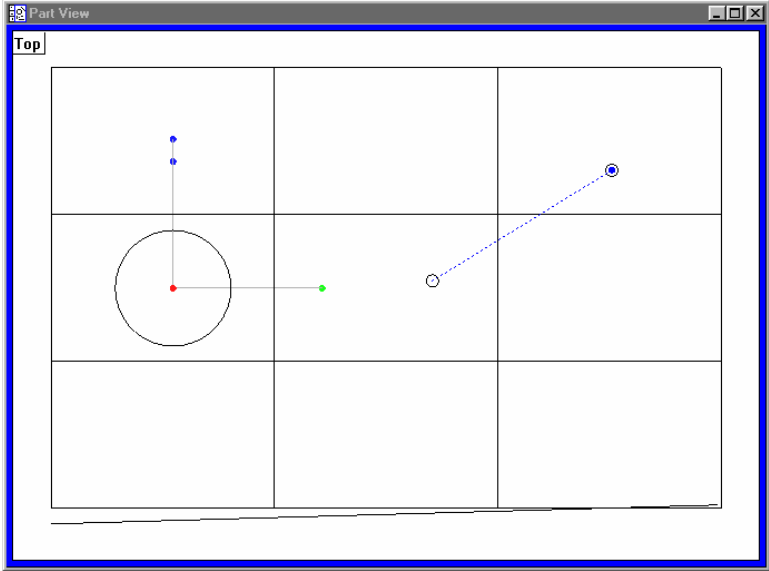


Step 3

Click OK in the dialog box.



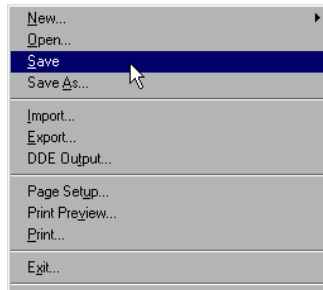
The distance is displayed in the part view window.



To save a program

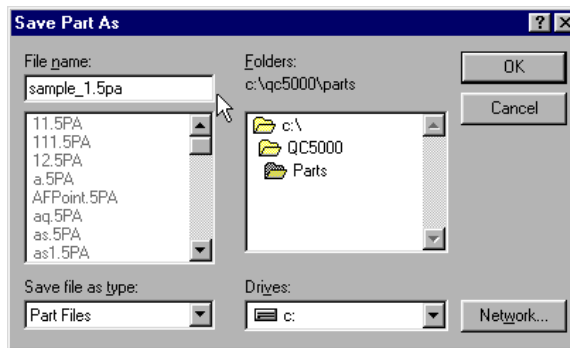
Step 1

Select save from the file menu.



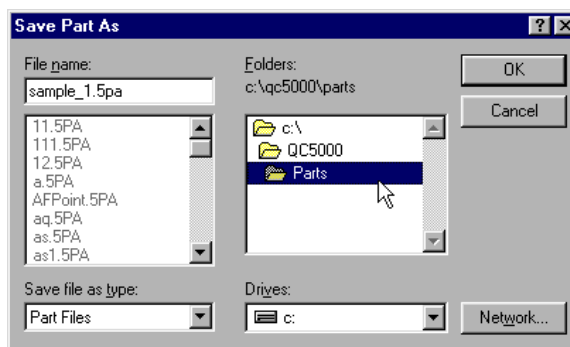
Step 2

Type the desired name as shown.



Step 3

Select the desired directory and click OK.

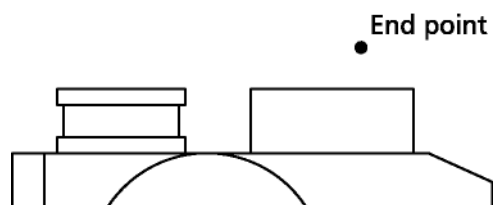


This completes the program.

To run a program

Step 1

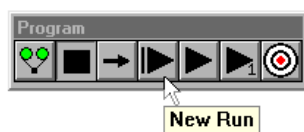
Position the probe clear of the part as shown.



Front view

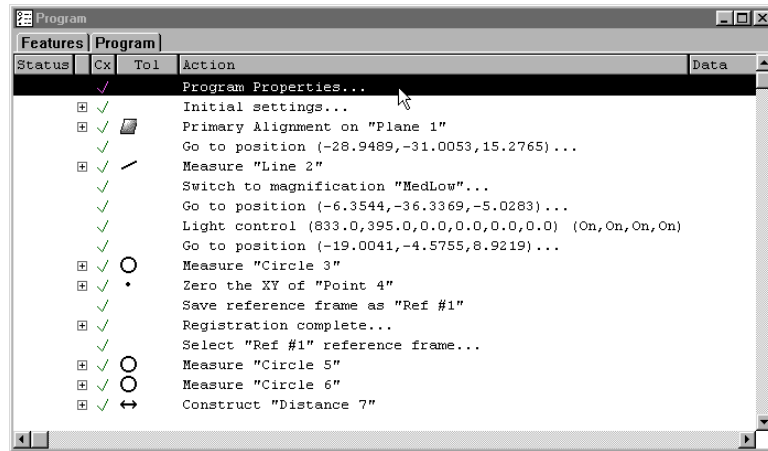
Step 2

Click the new run button on the program toolbar.

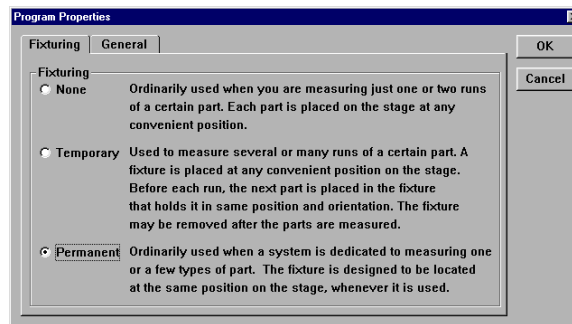


Program Properties

Double-click on the program properties step to view the program properties dialog box.



The program properties dialog box appears as shown.



NOTE

The supervisor password is required to access the program properties dialog box.



NOTE

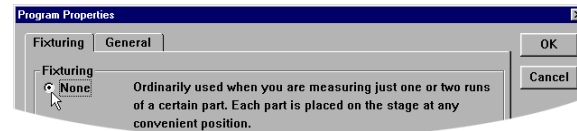
Program properties is the first step of every program and cannot be deleted.

Fixturing tab

The fixturing tab contains the following options: none, temporary, and permanent. These refer to the type of fixture used to position parts on the stage. The default is permanent.

None

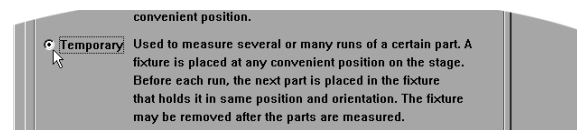
Select *none* if no fixture is to be used. The user must measure the reference frame manually for each part. Once the reference frame is measured the QC-5000 will complete the program automatically.



Temporary

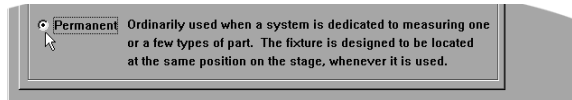
Select *temporary* for fixtures that are not permanently positioned on the stage. For example, a temporary fixture may be placed on the stage to measure only certain types of parts. It is removed to measure other parts.

To use the *temporary* fixture mode, save the reference frame when creating the part program. The next time the program is run, the QC-5000 will prompt the user to measure the reference manually before completing the program in CNC mode. Once the user measures the reference frame, the remaining parts and their reference frames are measured automatically.



Permanent

Select *permanent* for fixtures that are permanently positioned on the stage. Choose permanent if the system is always used to measure the same parts in the same fixture. In *permanent* fixture mode, the QC-5000 automatically measures the entire part when the user selects *new run*.



General tab

The general tab contains the following checkboxes:

- Use machine reference frame
- Empty feature list before running
- Use probe teach values as recorded
- Do not report any errors during program running
- Prevent program from being modified by anyone but the supervisor
- On a measurement failure goto label
- Randomly measure this percent of guide features

Use machine reference frame

Check to use machine zero at the start of a program. Uncheck to use part zero.



Empty feature list before running

Check to delete all features from the features list before running.



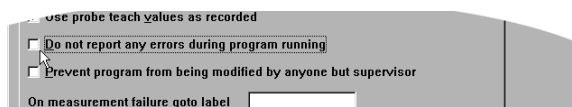
Use probe teach values as recorded

Check to use previously recorded probe teaches.



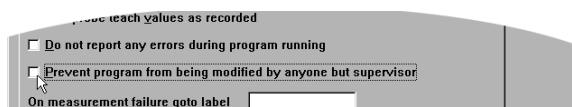
Do not report any errors during program running

Check to ignore all errors while running the program



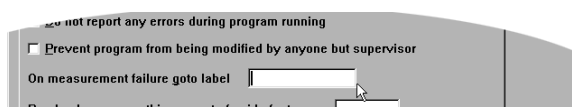
Prevent program from being modified by anyone but the supervisor

Check to require the supervisor password from users before allowing changes.



On a measurement failure goto label

Check to create a goto step if a measurement fails.



Randomly measure this percent of guide features

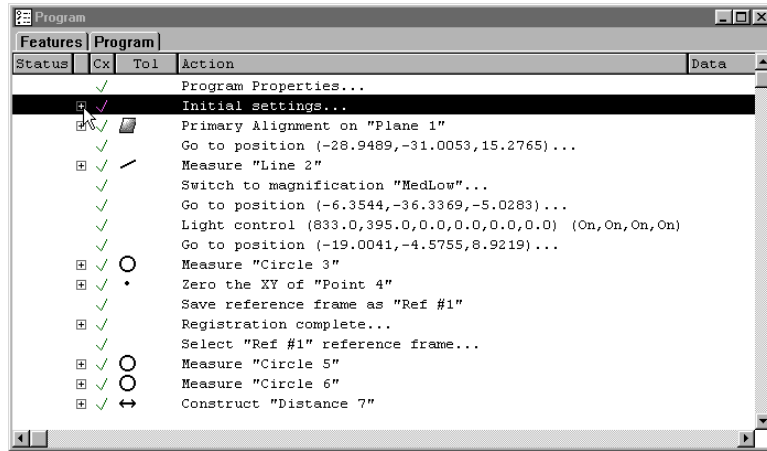
Used to measure a random number of features on a part, normally guide features are features that are never measured except in this special case where a percentage of them will be.



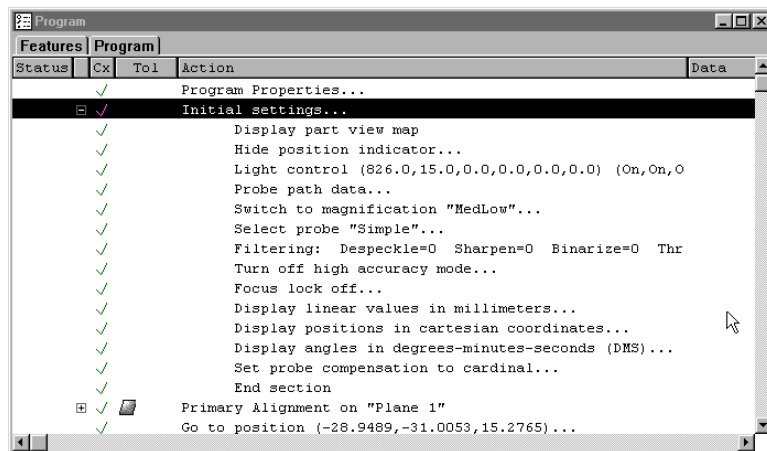
Initial Settings

Initial settings are the system settings when record button is clicked. Unless intentionally removed by the programmer, initial settings is always the second step of every program.

Click the + sign in front of the initial settings to view its steps.



The initial settings super step is expanded as shown.



Display part view map

Draws the part as it is measured in the part view window.

Hide position indicator

Hides the position indicator until the reference frame is saved.

Light control

Captures the current light control when the user clicks the record/edit button.

Probe path data

Inserts the default probe path data parameters into the program. Probe path Data determines the velocity of the system when probing and traversing. It also sets the approach, search, and retract distances for touch probes. Double-click on the probe path data step to display the probe path data dialog box.

Velocity factor

Probing %:

percent of the max speed the stage will move as it takes touch probe points.

Non-probing %

speed the stage moves when not probing. This is generally set to 100%.

Approach

the point at which the system transitions from non-probing speed to probing speed.

Search

distance the system will continue probing to acquire a probe hit beyond the nominal coordinate.

Retract

distance the probe will retract upon making contact with the part.

Depth

Not Implemented for this release.

Clearance

Not implemented for this release.

Switch to magnification

sets the active VED magnification as the default magnification for the part.

Select probe

Sets the active touch probe as the default touch probe for the part.

Filtering

Inserts the values and toggles on/off the 4 image analysis filters.

Turn off high accuracy mode

Notes if high accuracy mode is on or off at the beginning of the program.

Focus lock

Notes if focus lock is on or off at the beginning of the program.

Display linear values in millimeters

Notes current units (inches or mm) at the beginning of the program.

Display positions in cartesian coordinates

Notes the current coordinate system (polar or cartesian) at the beginning of the program.

Display angles in degrees-minutes-seconds

Notes the current angle display (decimal degrees or degrees-minutes-seconds) at the beginning of the program.

Set probe compensation to cardinal

Notes the current probe compensation (cardinal or polar) at the beginning of the program.

Editing Programs

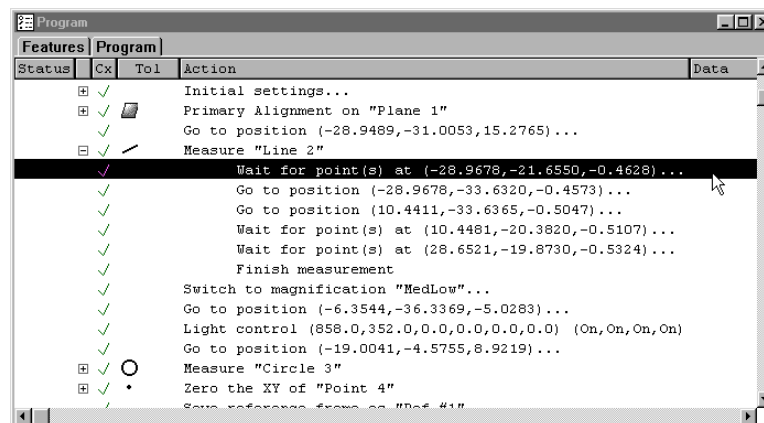
Use the editing feature to make changes to previously recorded programs. QC-5000 programs consist of steps and super steps. Super steps are actually a series of related individual steps. For example, click the plus sign in front of Circle 6 to view its four sub steps.

Double-click on a step followed by an ellipsis (...) to edit it. For example, double click on the select probe "circle" step. The fields for size, position, scan direction, probe tool can all be edited.

To edit a wait for point(s) step

Step 1

Double-click on the desired step.

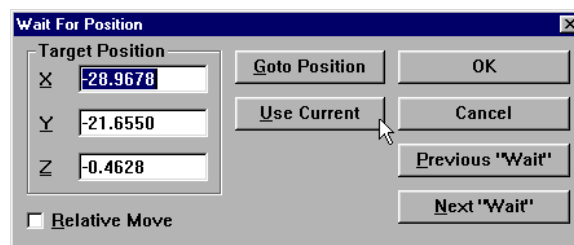


Step 2

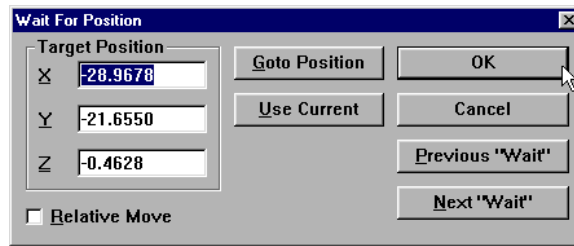
Move the probe to the desired position.

Step 3

Click use current in the dialog box.



Step 4
Click OK in the dialog box.



NOTE

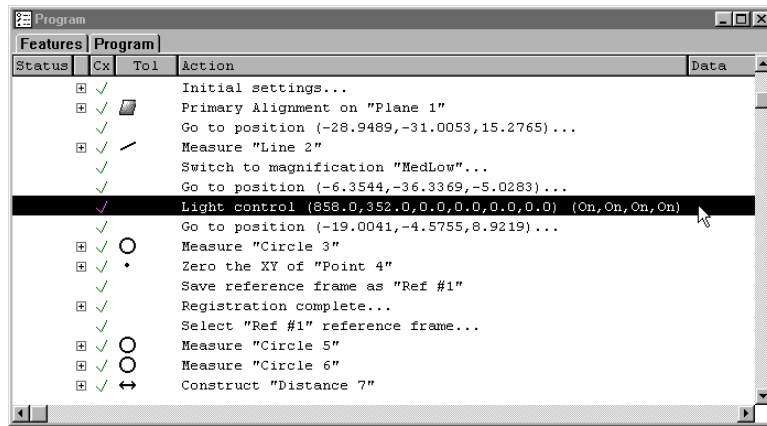
When editing touch probe positions, the system will move close to the actual probing position but will not actually make contact with the surface. To edit the actual touch probe position, probe the edge at the desired position. The QC-5000 will update the position in the dialog box.

The new position is entered into the program.

To edit a light control statement

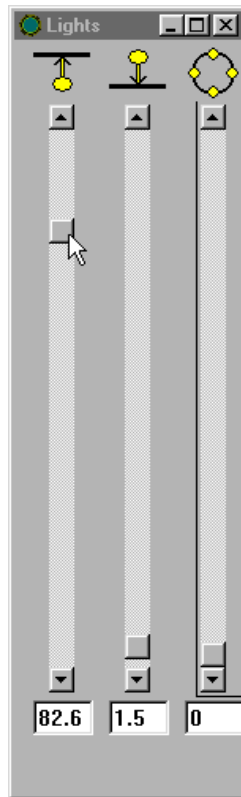
Step 1

Double-click on the desired light control statement.

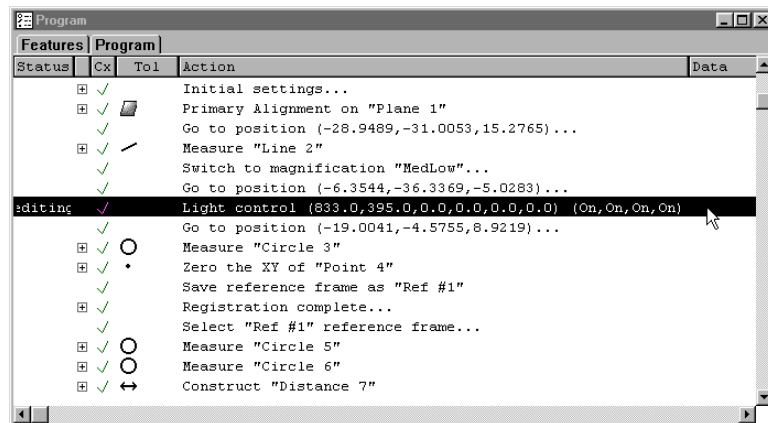


Step 2

Use the light controls to adjust the lighting to the desired settings.



Step 3
Click on the light control statement.

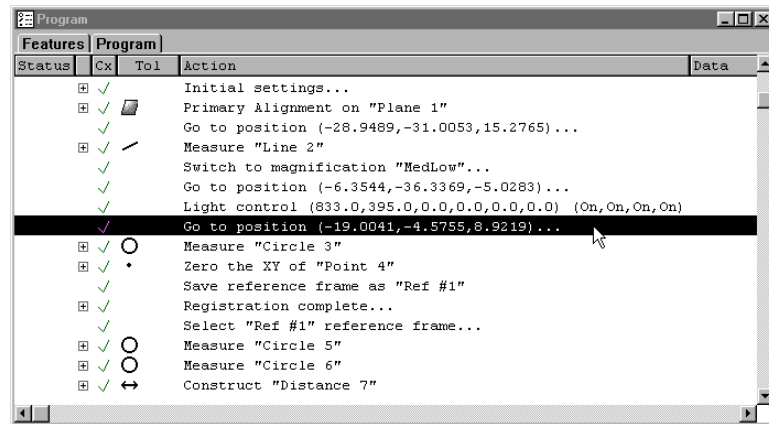


The new light settings are now entered into the program.

To change the coordinate of a clearance move or goto position step

Step 1

Double-click on the desired position step.

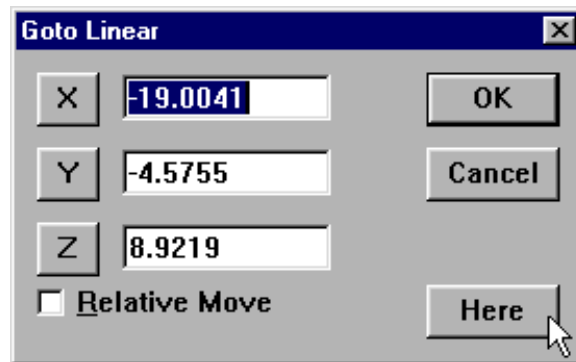


Step 2

Move the probe to the new position.

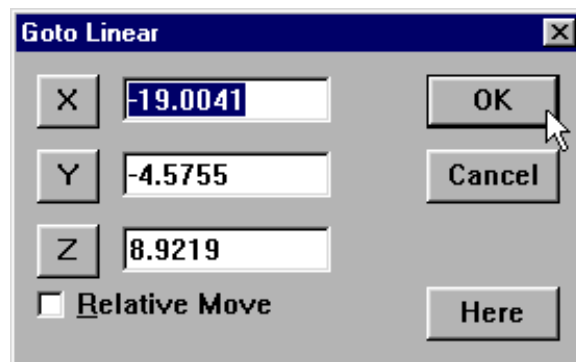
Step 3

Click the here button in the dialog box.



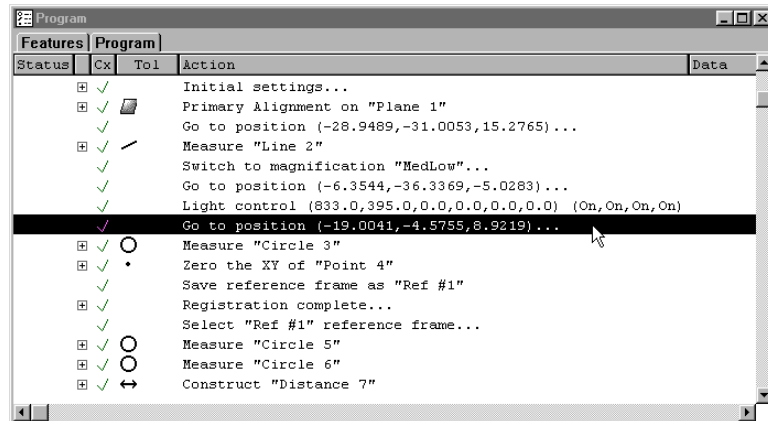
Step 4

Click OK in the dialog box.



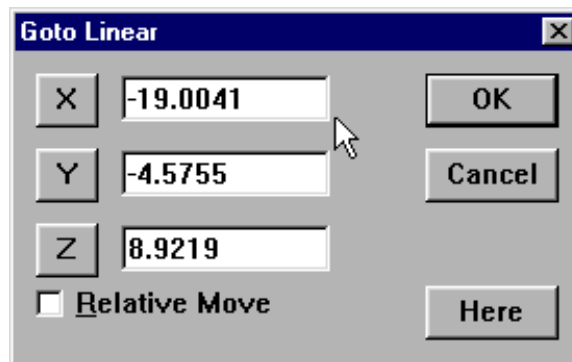
OR

Step 1
 Double-click on the desired position step.

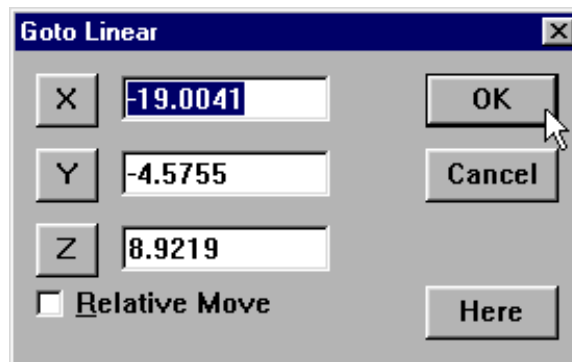


NOTE
 Relative coordinates can be entered by clicking the relative button and entering the desired XYZ coordinates.

Step 2
 Enter manual coordinates in the dialog box.



Step 3
 Click OK in the dialog box.



Creating User Messages

A user message is an onscreen message that is a part of a program. For example, it may be useful to remind an operator to check a certain feature in a particular way. To do this you might insert the message "Make sure to take points clockwise from the left." User messages can say anything, even "Have a nice day."

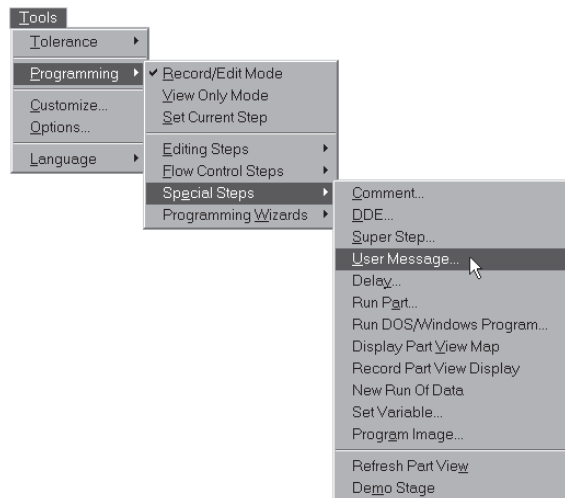
To create A User Message

Step 1

Highlight the place in the program template where the message is to be inserted.

Step 2

Select *programming* then *special steps* then *user message* from the tools menu.



Step 3

Type the desired message as shown.



Step 4

Click OK in the dialog box.



Programming Wizards

Use programming wizards to create the following program steps:

- Grids
- Polar grids
- Palletizations
- Random placements

Grids

Use the create a grid wizard to measure arrays or a series of like features within a single part. For example, create a grid to measure an array of evenly spaced holes on a pc board. The QC-5000 requires the user to input the X and Y offset distance, the X and Y distance from one feature to the next.



NOTE

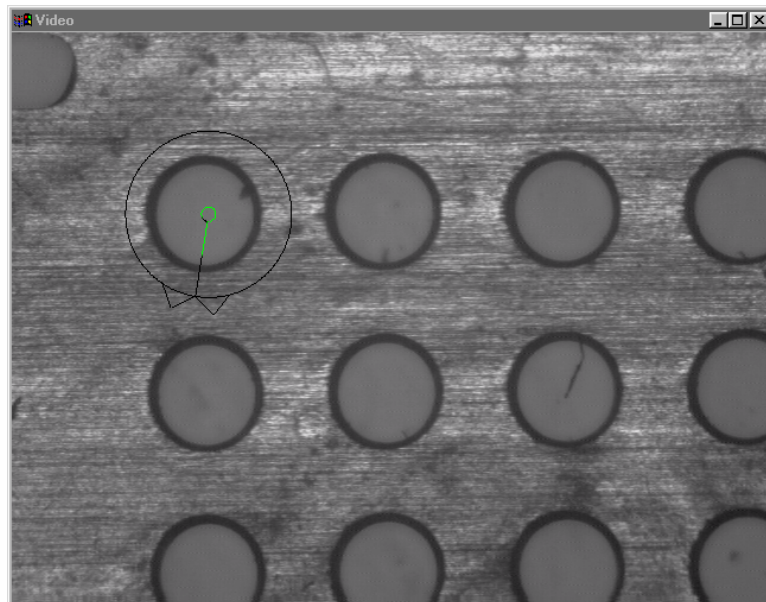
All features in a grid must be evenly spaced.

Before creating a grid begin a new part program with a datum.

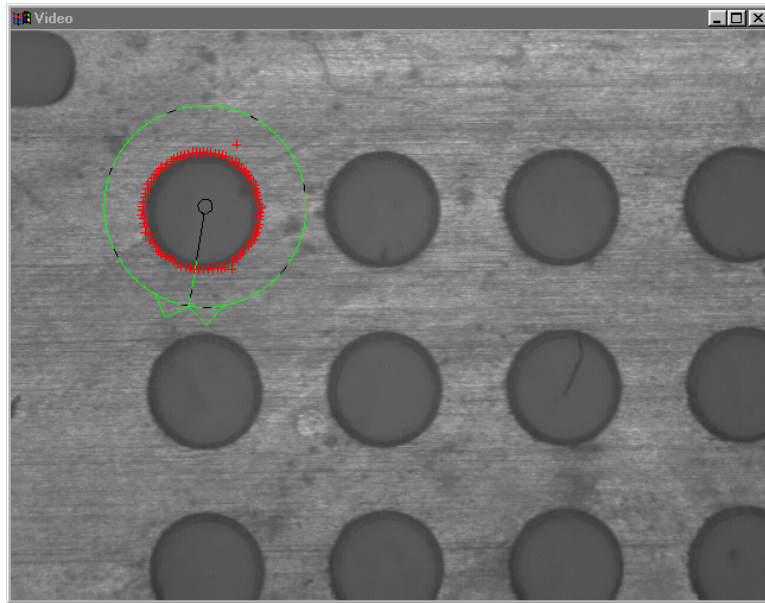
To create a grid

Step 1

Position the first array feature as shown.



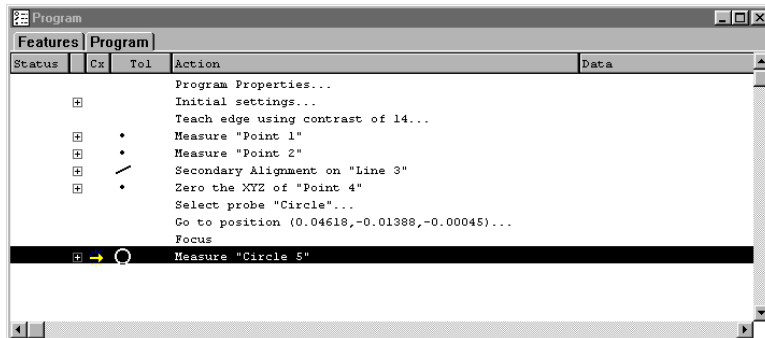
Step 2
Click the center mouse button to fire the probe tool.



Step 3
Click OK in the dialog box.

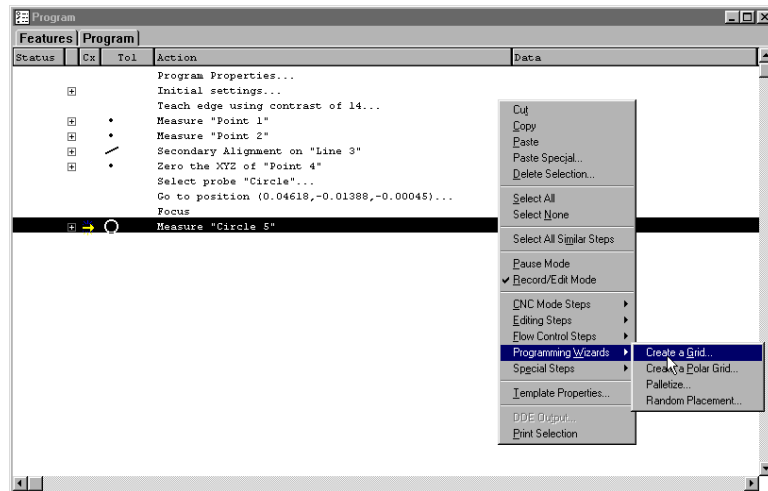


Step 4
Highlight the first array feature in the program template as shown.



Step 5

Right-click in the program template and select programming wizards, then select create a grid.



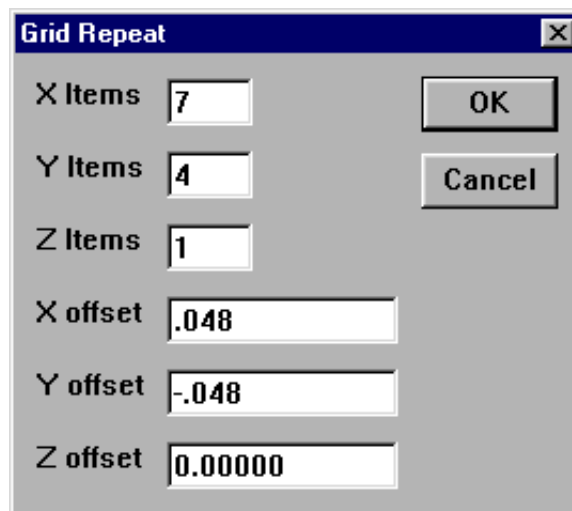
Step 6

Enter the number of features and type in the desired X and Y offsets as shown.

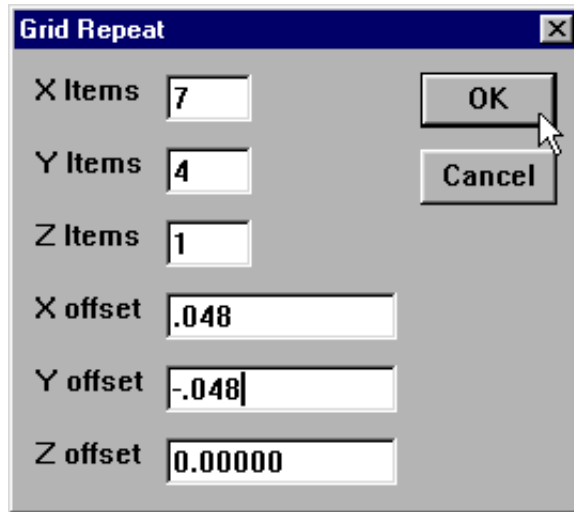


NOTE

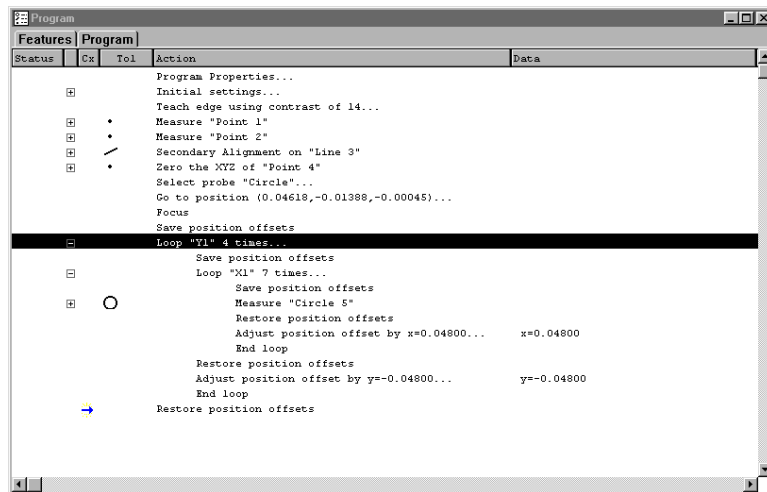
Items are the number of features in each axis direction. Offsets are the distance to the next feature relative from previous feature.



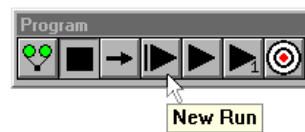
Step 7
Click OK in the dialog box.



The grid is created and the program is ready to run.



Click new run to run the program.



Polar grids

Use the create a polar grid wizard to measure a part with like features that are in a rotational array. For example, create a polar grid to measure a bolt hole pattern. This wizard requires the user to input the number of features and the angle between the features.



NOTE

All features in a polar grid must be evenly spaced.

Before creating a polar grid, create a new part program. Use the center of the polar grid feature as the zero point of the part.

To create a polar grid

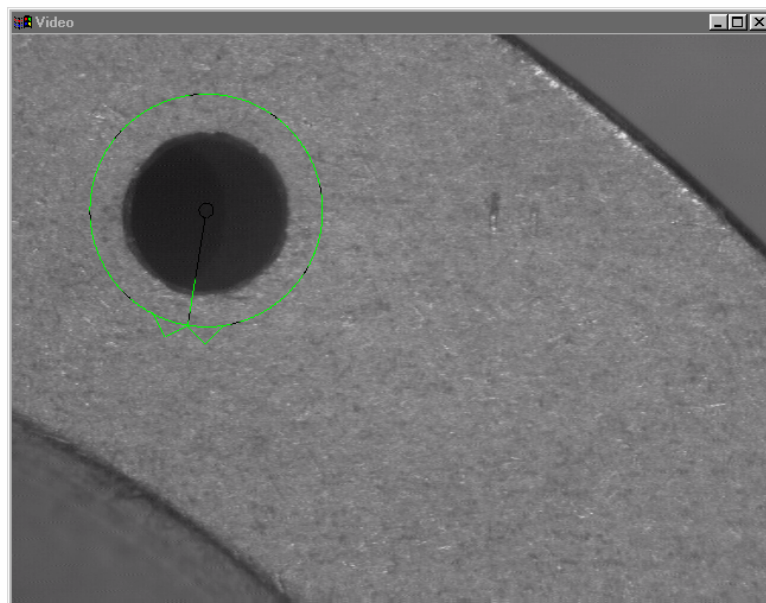


NOTE

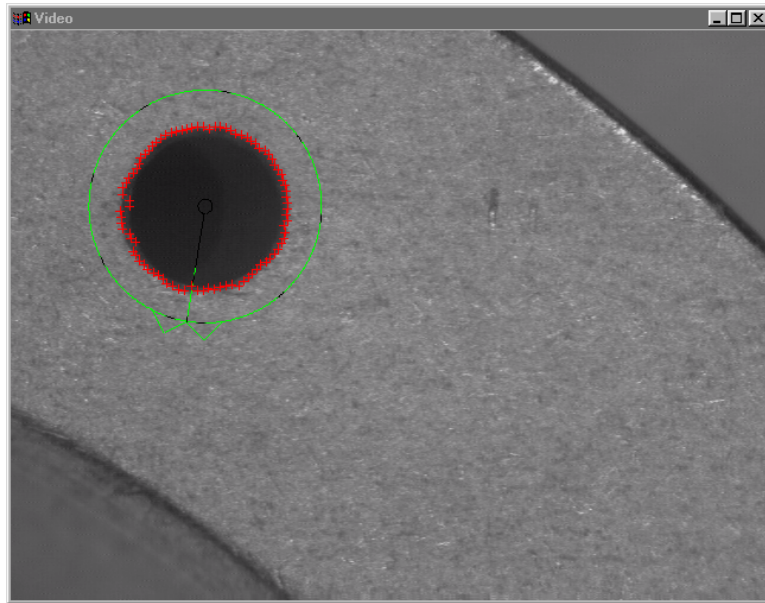
Make certain the program is recording before completing the following steps.

Step 1

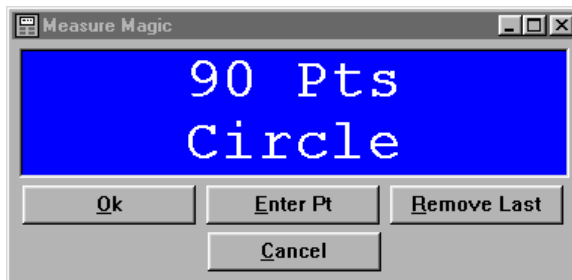
Position the first feature in the polar array in the center of the field of view as shown.



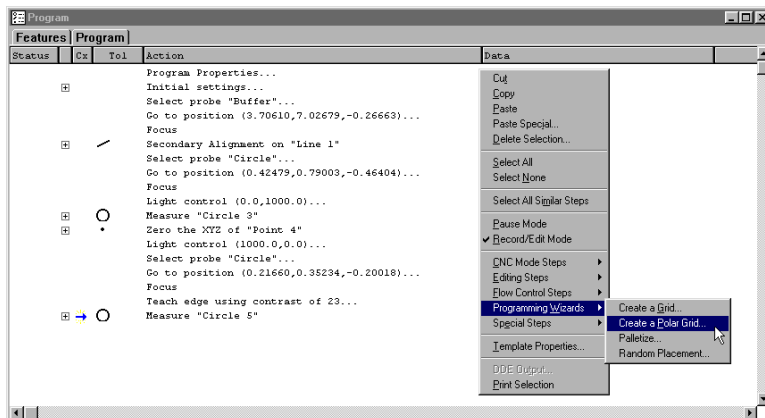
Step 2
Click the center mouse button to fire the probe tool.



Step 3
Click OK in the dialog box.



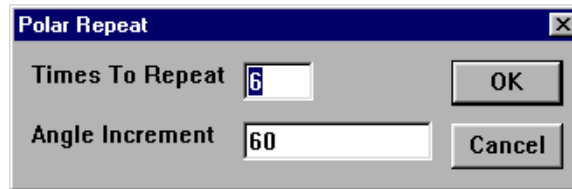
Step 4
Right-click in the program template and select programming wizards, then select create a polar grid.



Step 5
Enter the desired number of features in the times to repeat box.



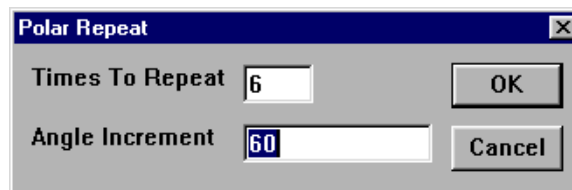
NOTE
Enter the number of features in the polar grid in this box.



Step 6
Enter the desired angle in the angle increment box.

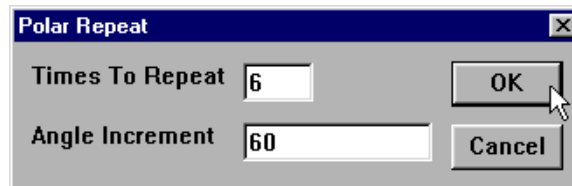


NOTE
Enter the angle between the features in the polar grid.



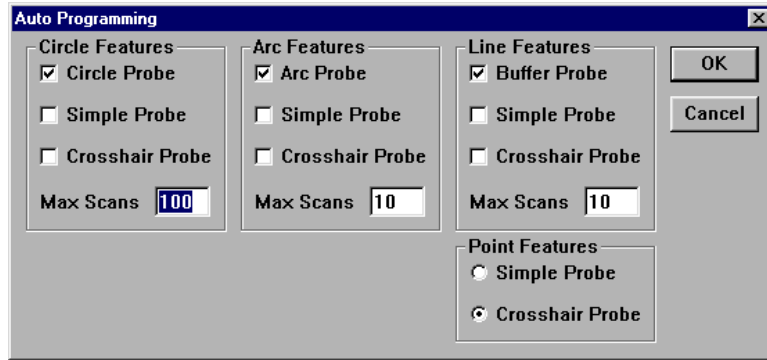
NOTE
The polar grid wizard can be used to measure any number of feature in the polar grid. For example, to measure only the first three (of six) features, enter 60 for the angle and 3 for the number of features.

Step 7
Click OK in the dialog box.



Step 8

Select the desired probe tool and enter the desired number of scans as shown.

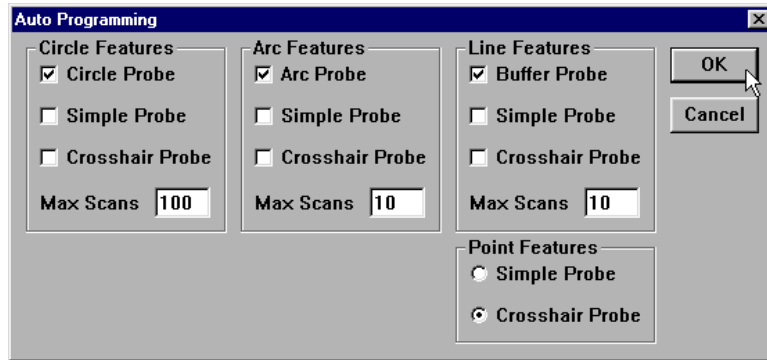


NOTE

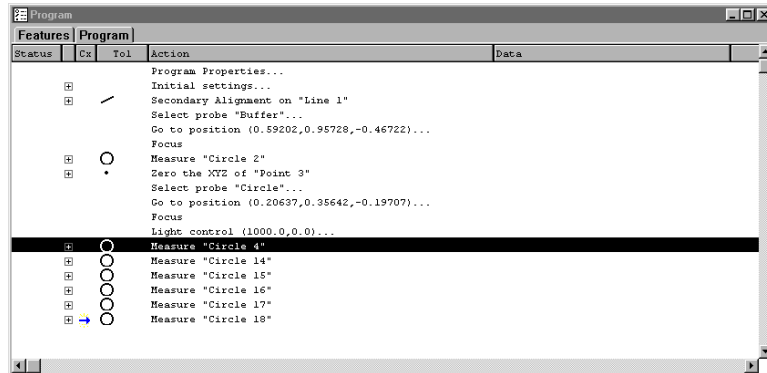
The QC-5000 will default to the appropriate set probe tool for the feature type. Users may ignore the boxes for other feature types.

Step 9

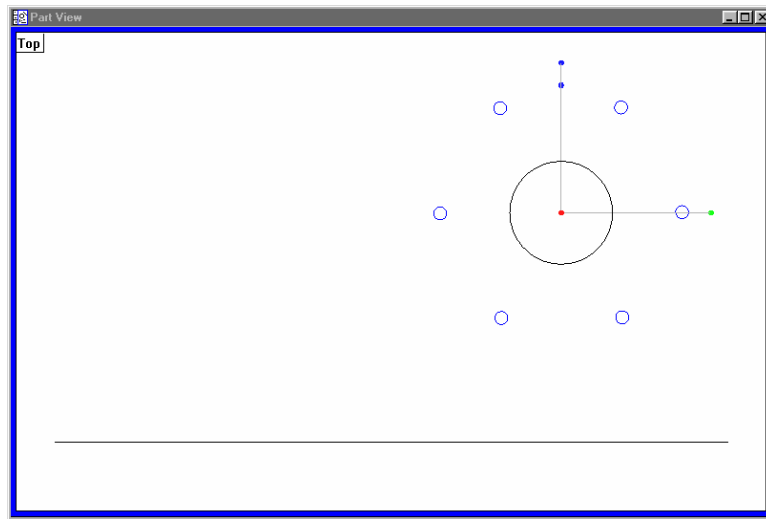
Click OK in the dialog box.



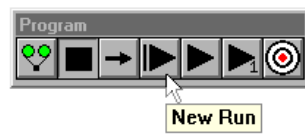
The polar grid is created and the program is ready to run.



The polar array appears in the part view window as shown.



Click new run to run the program.



Palletize

Use the palletize wizard for measuring multiple parts placed on a precision fixture.



NOTE

All palletized parts must be in a fixture that evenly spaces the individual parts.

Before palletizing parts, create a new part program measuring all the features of the part.



NOTE

Save the reference frame in the part program immediately after creating the datum.

To palletize multiple parts

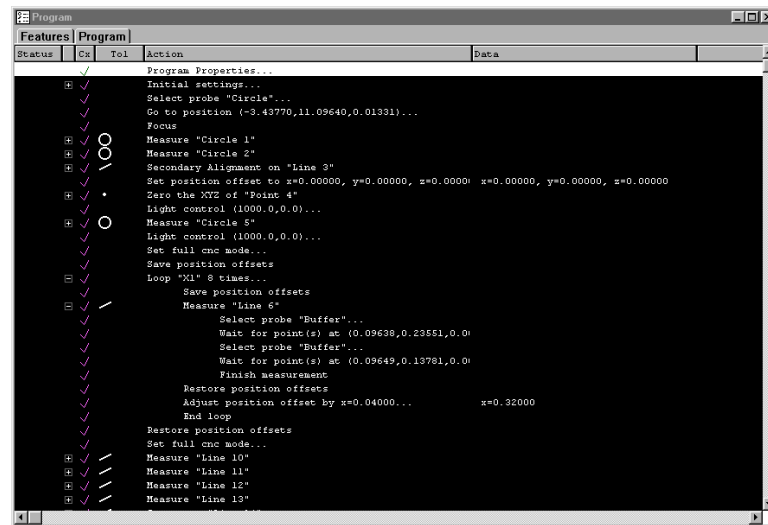


NOTE

Make certain the program is recording before completing the following steps.

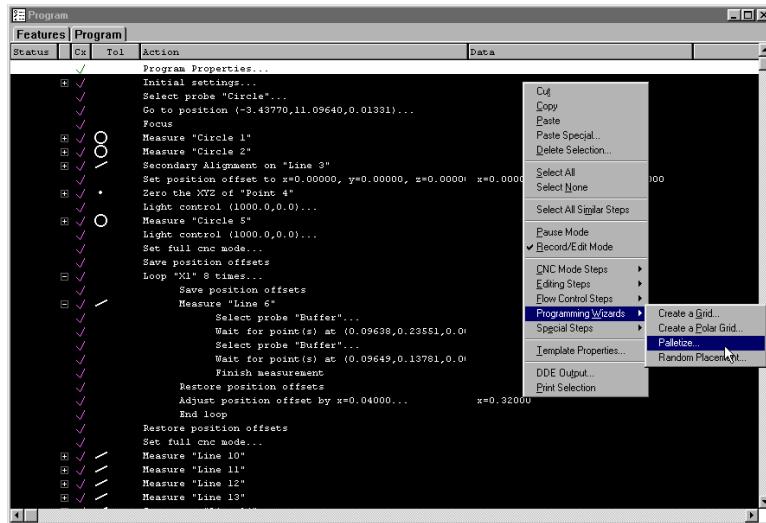
Step 1

Highlight the desired features and the initial settings step as shown.



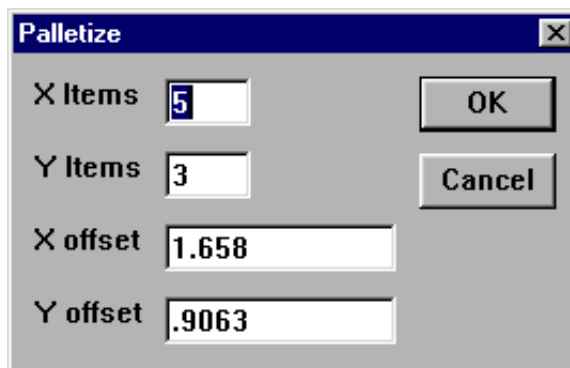
Step 2

Right-click in the program template and select programming wizards, then select palletize.



Step 3

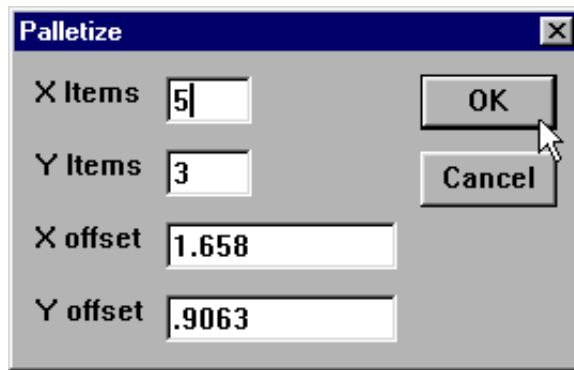
Enter the number of features and type in the desired X and Y offsets as shown.



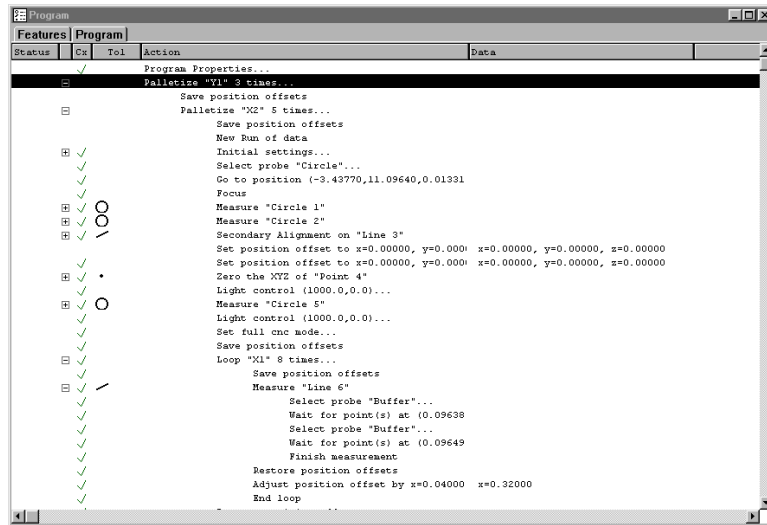
NOTE

Items are the number of parts in each axis direction. Offsets are the distance to the next part relative from previous part.

Step 4
Click OK in the dialog box.



The palletization is completed and the program is ready to run.



Click new run to run the program.

Random Placement

Use the random placement wizard for multiple parts on a stage without a fixture.



NOTE

All parts must have the same orientation on the stage and be square to the axes of the machine.

Before creating a random placement, create a new part program with reference steps.

To insert reference steps in a part program

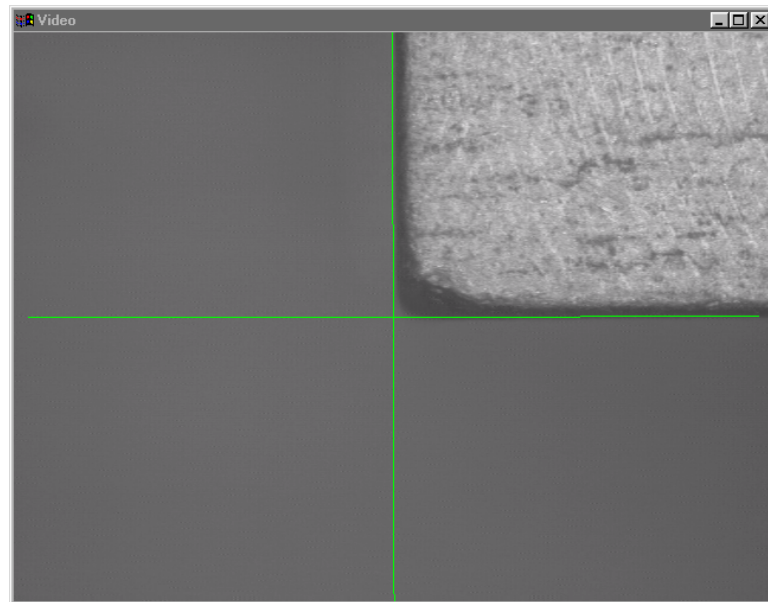
Step 1

Click the record/edit button on the program toolbar.



Step 2

Position the desired reference feature as shown.

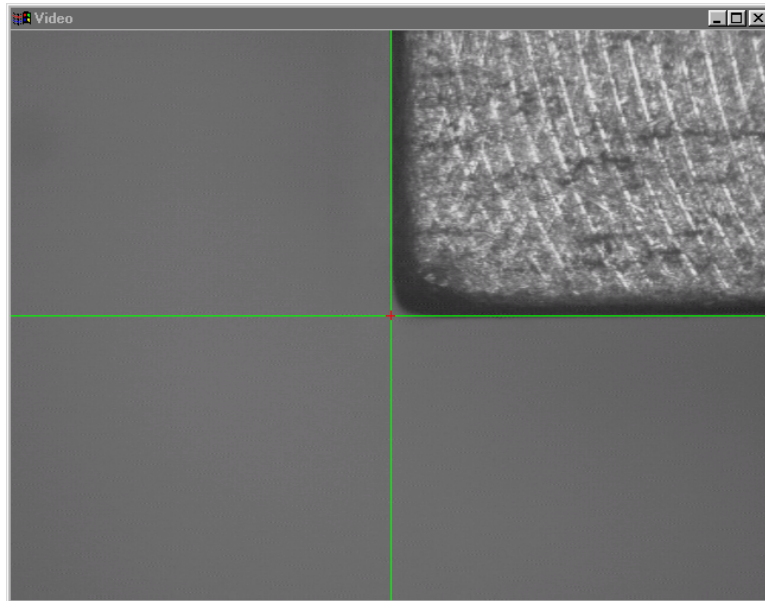


NOTE

The reference feature is a repeatable point to help the QC-5000 locate the randomly placed parts.

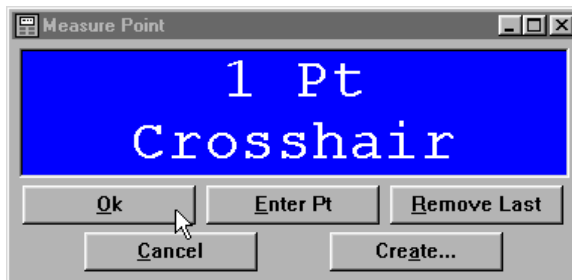
Step 3

Click the center mouse button to fire the probe tool.



Step 4

Click OK in the dialog.



The QC-5000 will use this feature to locate the randomly place parts.

Create a the rest of the part program measuring all the features of the part.



NOTE

Save the reference frame in the part program immediately after creating the datum.

To create a random placement

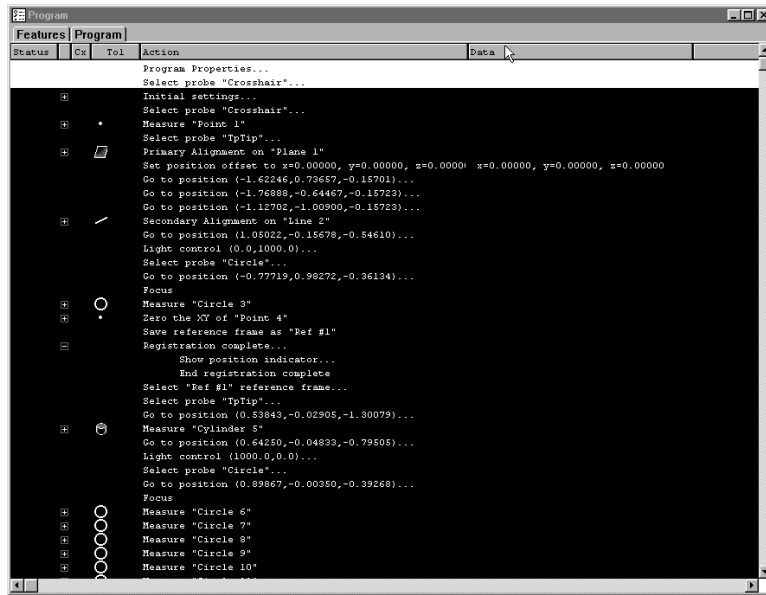


NOTE

Make certain the program is recording before completing the following steps.

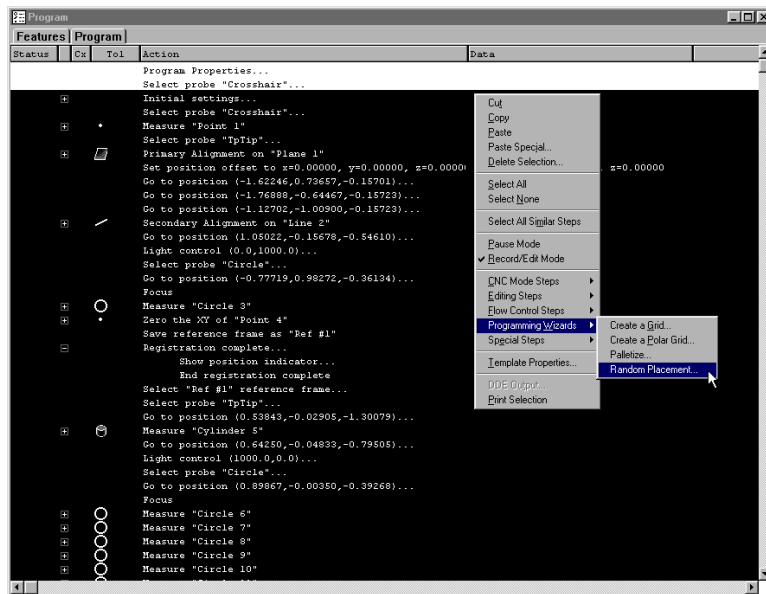
Step 1

Highlight the desired features, the reference point, and the initial settings step as shown.

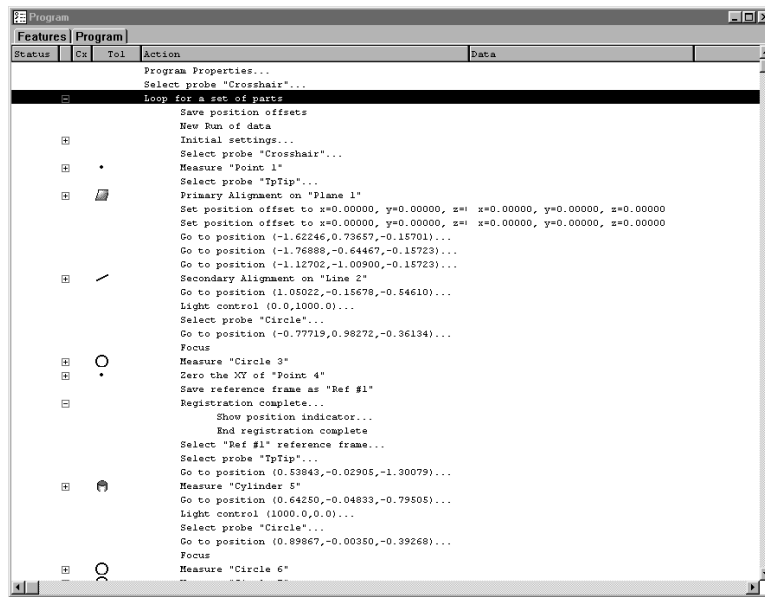


Step 2

Right-click in the program template and select programming wizards, then select random placement.



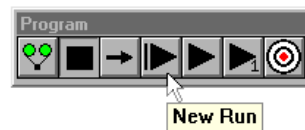
The QC-5000 inserts the required steps for the random placement.



To run a parts program with a random placement

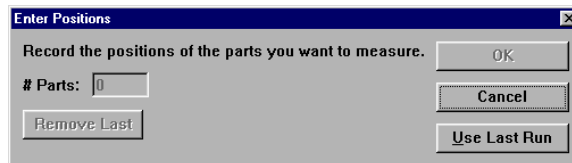
Step 1

Click the new run button on the program toolbar.



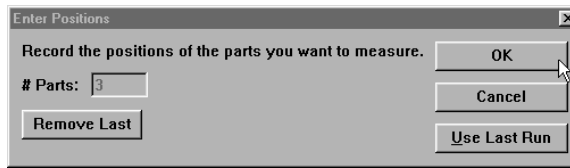
Step 2

Measure the reference point for the first part.



Repeat these steps until all parts are entered.

Step 3
Click OK in the dialog box.



NOTE
Click the remove last button to remove the last point enter. Re-enter the point for that part.

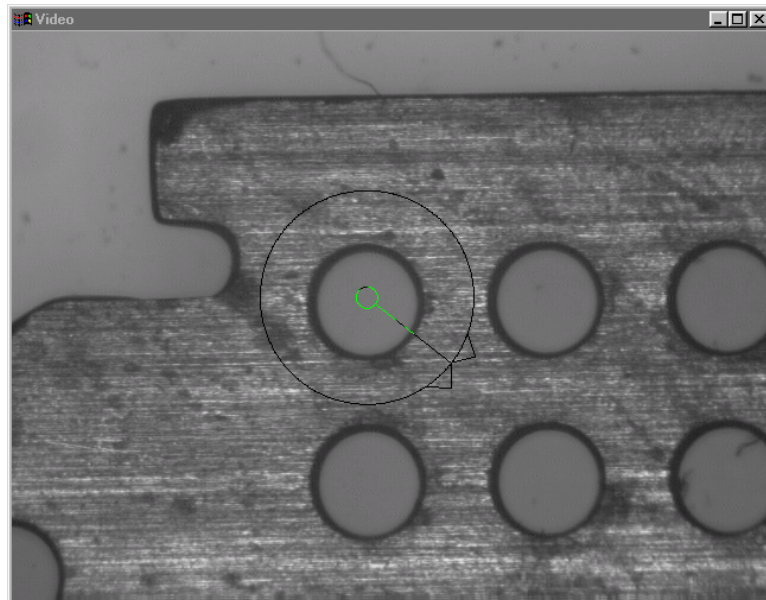


NOTE
Click the use last run button to use the same offsets as the previous run.

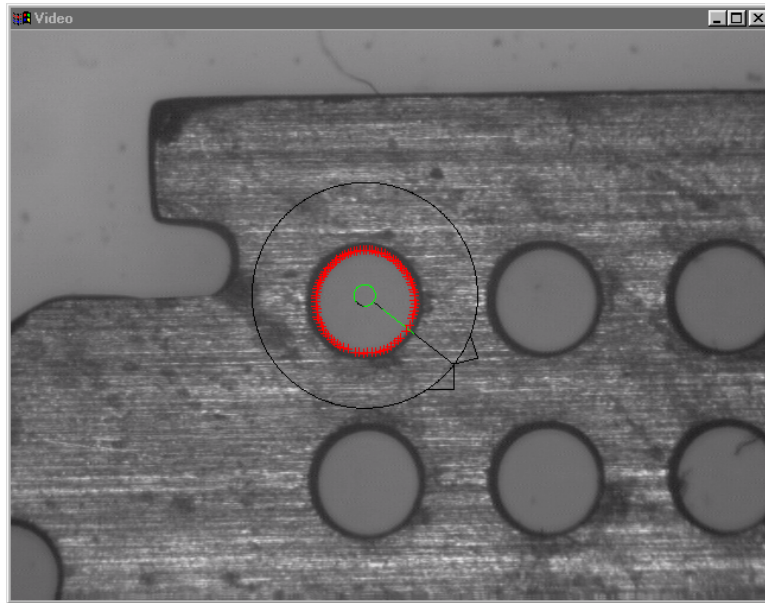
Before performing a copy and paste special, record a new part program with a datum.

To copy and paste special

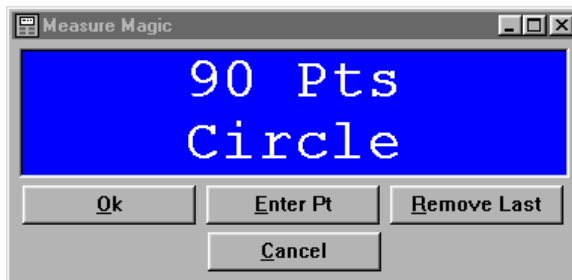
Step 1
Position the first array feature as shown.



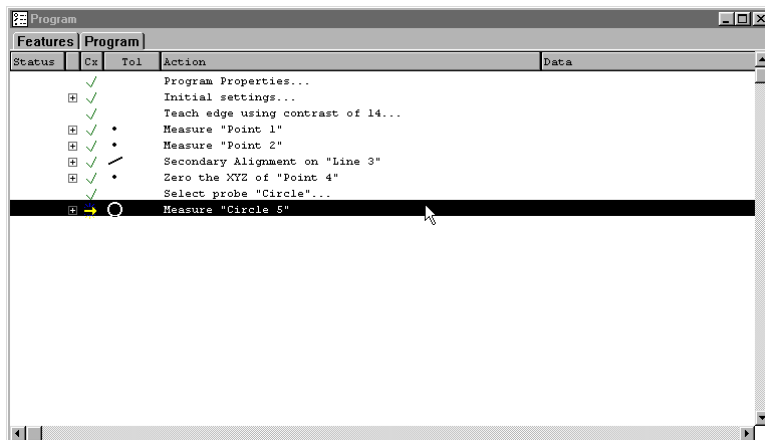
Step 2
Click the center mouse button to fire the probe tool.



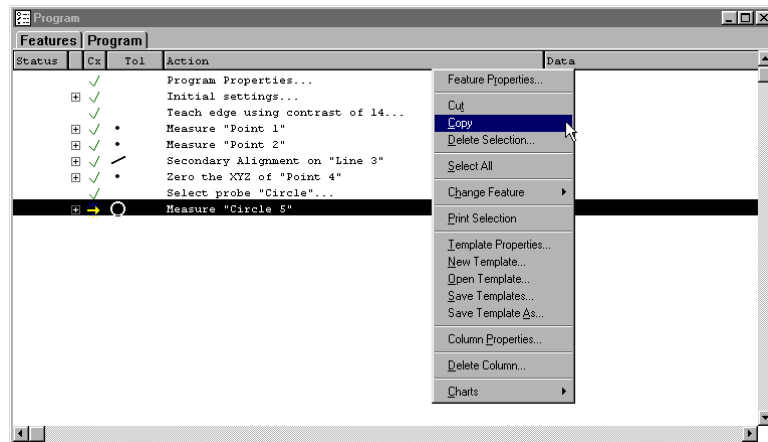
Step 3
Click OK in the dialog box.



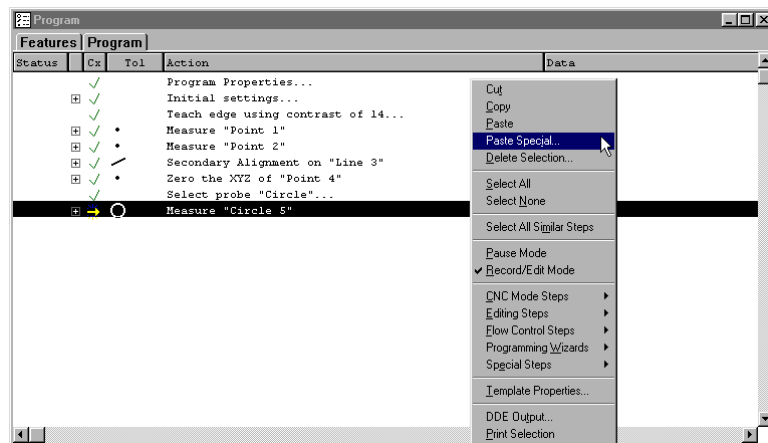
Step 4
Highlight the first array feature in the program template as shown.



Step 5
Right-click in the program template and select copy,

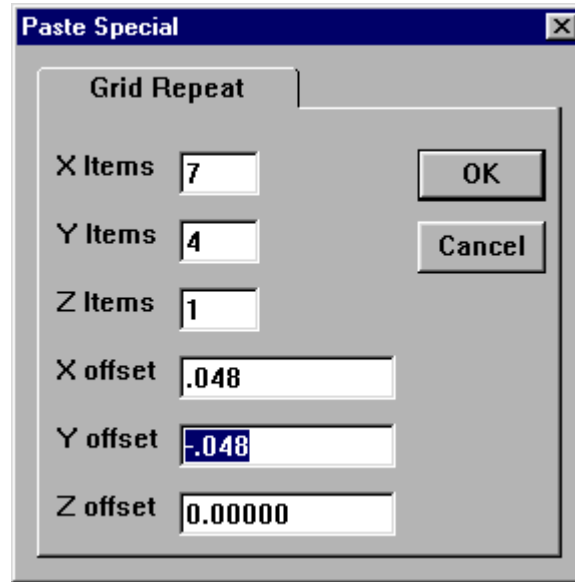


Step 6
Right-click in the program template and select paste special.



Step 7

Enter the number of items and type the desired X and Y offsets as shown.

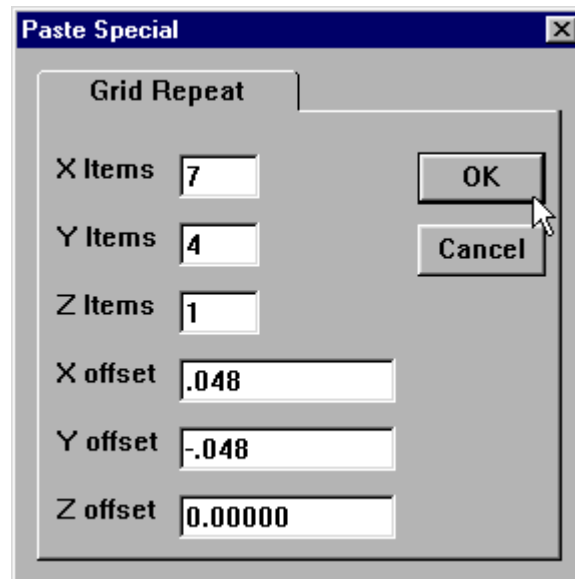


NOTE

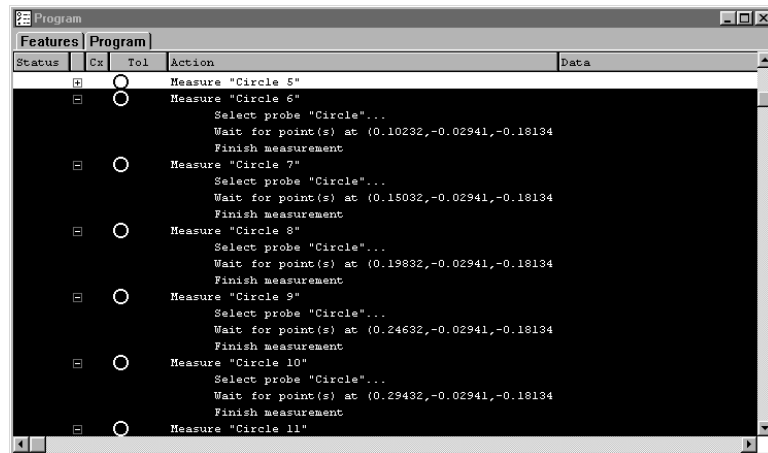
Items are the number of features in each axis direction. Offsets are the distance to the next feature relative from previous feature.

Step 8

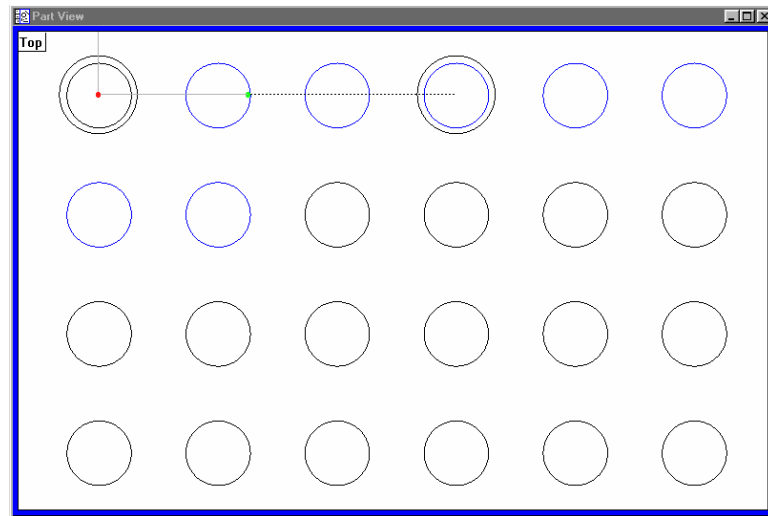
Click OK in the dialog box.



The QC-5000 creates a grid on the part view and assigns a numbered feature name to each feature in the grid.



The cut and pasted parts appears in the part view window as shown.

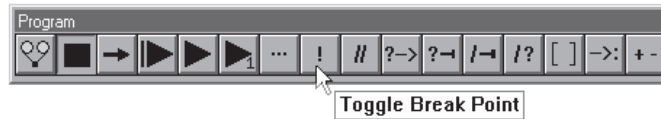


The program is ready to run.

Expanding the Program Toolbar

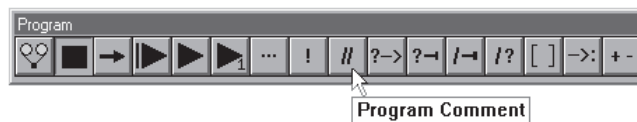
This section describes buttons commonly added to the program toolbar by QC-5000 users. A procedure for adding buttons to a toolbar follows this section.

Toggle Break Point



Click the Toggle Break Point button to attach a marker to the currently selected step. A marker instructs the program to stop at a step in the program. To remove a marker, select the step with the marker and click the Toggle Break Point button. Markers can be placed on more than one step within a program.

Program Comment



Click to enter a note into the program for future reference. Program comments are simply to explain a step or add information that might help later. Comments do not perform functions.

Edit Steps



Click the Edit Steps button to edit the currently selected step. The options presented depend on which functionality is associated with the currently selected step. For example, if the current step is the following options are presented, ...

If-Goto



Click to place an If-Goto statement in a program, see the Conditional Statements section for more information.

If-Then



Click to place an If-Then statement in a program, see the Conditional Statements section for more information.

Else



Click to place an Else statement in a program, see the Conditional Statements section for more information.

Else-If



Click to place an Else-If statement in a program, see the Conditional Statements section for more information.

Super Step



Click to group a selection of steps into a collapsible group (SuperStep). This organizes and shortens the display of large programs in the Program window.

Goto Label



Click to create a Goto Label for use with an If- Goto conditional statement. The Goto Label is the action carried out if the test condition is true.

Offset Positions

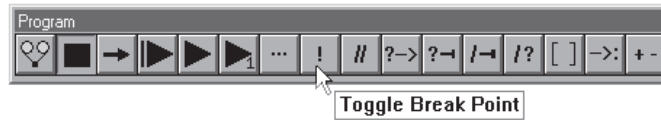


Click to manually enter a coordinate that will offset the current coordinate. This feature is useful for inspecting multiple parts mounted on a fixture.

Program Toolbar

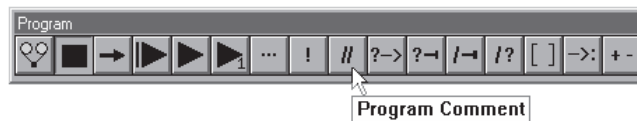
This section describes other buttons that users commonly place on the program toolbar. A procedure for adding buttons to the toolbar follows this section.

Toggle Break Point



Click the Toggle Break Point button to attach a marker to the currently selected step. A marker instructs the program to stop at a step in the program. To remove a marker, select the step with the marker and click the Toggle Break Point button. Markers can be placed on more than one step within a program.

Program Comment



Click to enter a note into the program for future reference. Program comments are simply to explain a step or add information that might help later. Comments do not perform functions.

Edit Steps



Click the Edit Steps button to edit the currently selected step. The options presented depend on which functionality is associated with the currently selected step. For example, if the current step is the following options are presented, ...

If-Goto



Click to place an If-Goto statement in a program, see the Conditional Statements section for more information.

If-Then



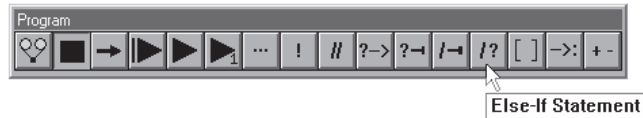
Click to place an If-Then statement in a program, see the Conditional Statements section for more information.

Else



Click to place an Else statement in a program, see the Conditional Statements section for more information.

Else-If



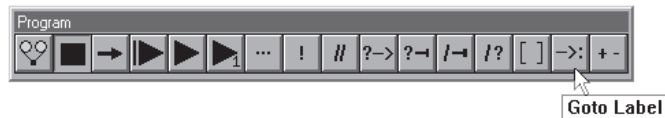
Click to place an Else-If statement in a program, see the Conditional Statements section for more information.

Super Step



Click to group a selection of steps into a collapsible group (SuperStep). This organizes and shortens the display of large programs in the Program window.

Goto Label



Click to create a Goto Label for use with an If- Goto conditional statement. The Goto Label is the action carried out if the test condition is true.

Offset Positions



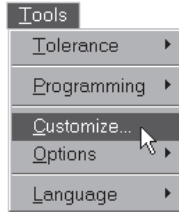
Click to manually enter a coordinate that will offset the current coordinate. This feature is useful for inspecting multiple parts mounted on a fixture.

To add buttons to a toolbar



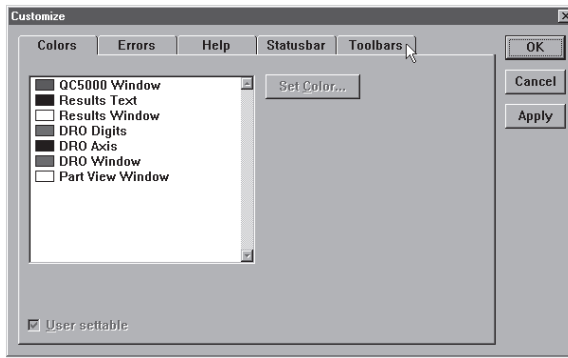
Step 1

Select *customize* from the tools down menu.



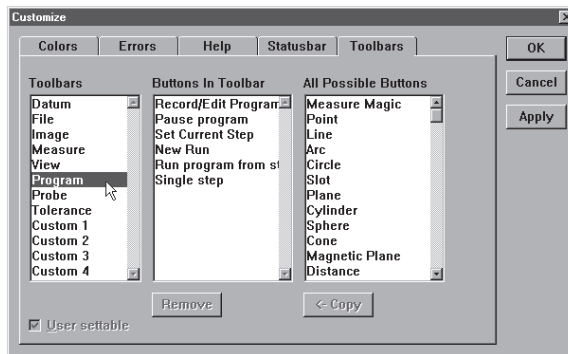
Step 2

Select the *toolbars* tab.



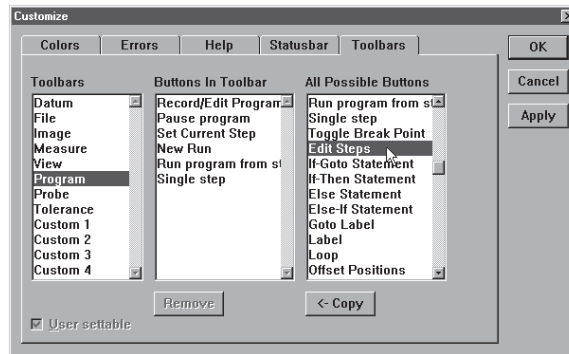
Step 3

Highlight the desired toolbar as shown.



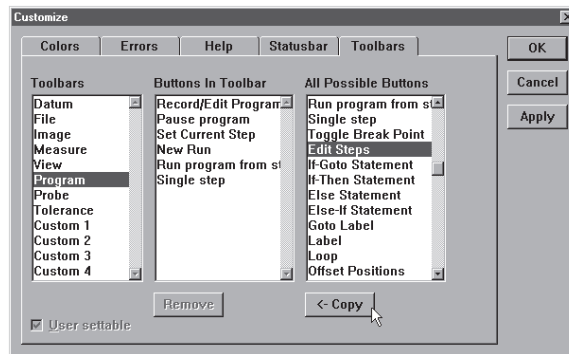
Step 4

Click on the desired button in the *all possible buttons* list.



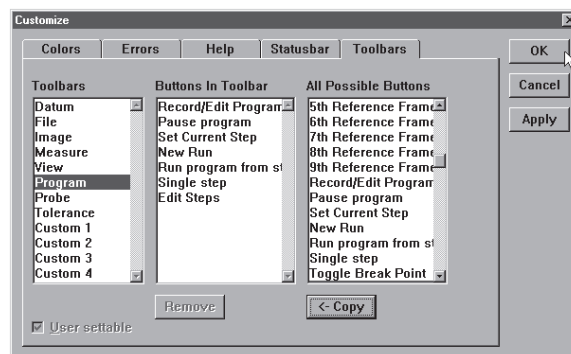
Step 5

Click the *copy* button.



Step 6

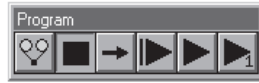
Click OK.



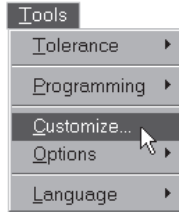
The new button appears in the toolbar.



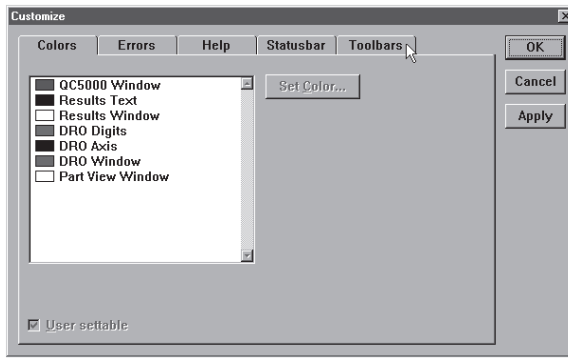
To delete buttons from a toolbar



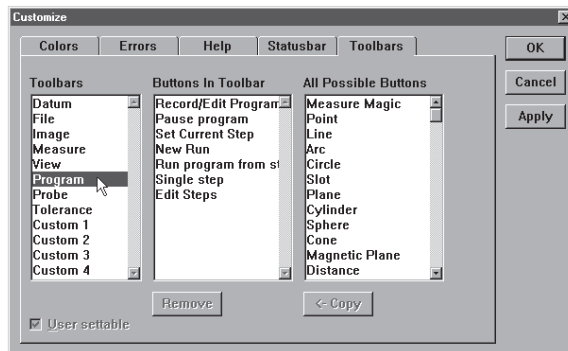
Step 1
Select *customize* from the tools down menu.



Step 2
Select the *toolbars* tab.

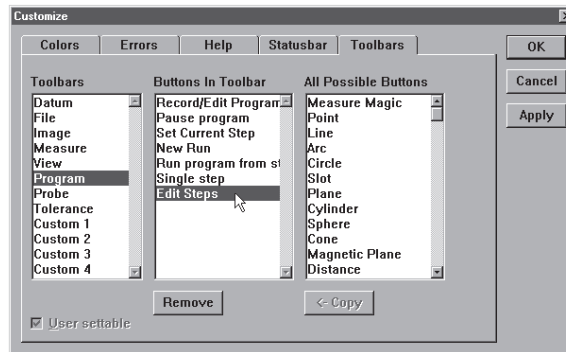


Step 3
Highlight the desired toolbar as shown.



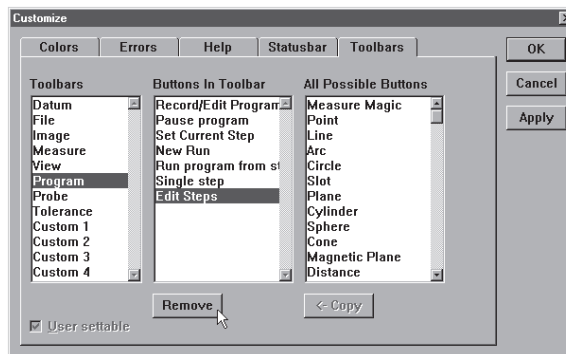
Step 4

Click on the desired button in the *buttons in toolbar* list.



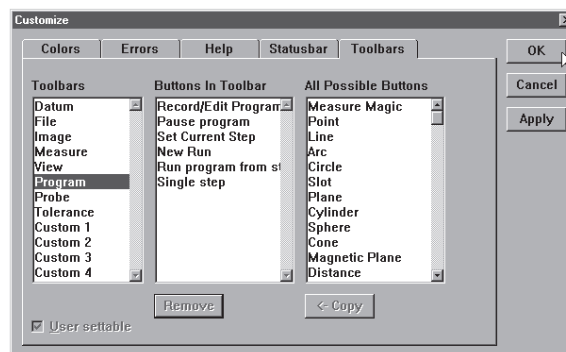
Step 5

Click the *remove* button.



Step 6

Click OK.



The button is removed from the toolbar.



Conditional Statements

Conditional statements can be a handy way to handle many inspection tasks. For example, if a feature fails to meet specifications a conditional statement can stop the inspection or require a second inspection. A conditional statement can also check that a feature is within a tolerance by using arithmetical operators (more on this later).

The two basic elements of a conditional statement are the test condition and the action. Essentially conditional statements check the test condition and then do something if the test condition is true and something else if it is false.

Test Conditions

Test conditions are the inspected feature of the part and any arithmetical operations required by the user. If that seems a bit complex take a look at the conditional statement below.

In this example, 'If Input_1 > 5mm' is the test condition. 'Input_1' is the inspected feature and '> 5mm' is the arithmetical operation. If you were to read the test condition out loud it would be: If Input_1 is greater than 5mm. This is the test condition. All that is needed now is an action.

Actions

Actions are any steps to be carried out by the program or a labeled line. If-Then statements carry out the steps described and If-Goto statements skip to the labeled line. Both types are shown below.

In this example, 'Measure_1' is the action.

The types of conditional statements used in QC-5000 programs are: If-Goto, If-Then, Else, and Else-If. Else and Else-If statements can only be used with an If-Then statement for example: If-Then Else or If-Then Else-If.

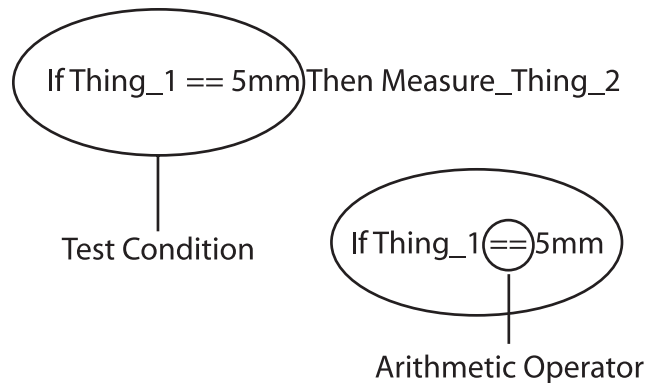
Arithmetic Operators

Test conditions are essentially mathematical equations. The chart below lists the arithmetical operators used in the QC-5000 software.

QC5000 Arithmetic Operators

Operator	Function
+	addition
-	subtraction
*	multiple
/	division
PI	pi =3.14
==	equals
!=	not equal to
>	greater than
<	less than
>=	greater than or equal to
<=	less than or equal to

Arithmetic operators determine what happens in the test condition. Take a look at the following test condition to get a better understanding.

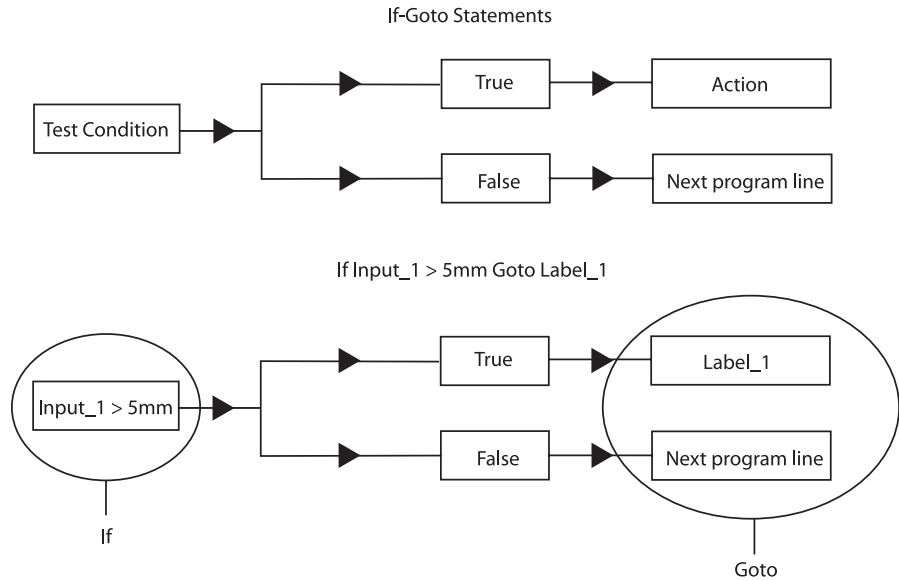


In this example, the '=' arithmetic operator determines that Thing_1 must equal 5mm for the test condition to be true. The entire test condition reads: if Thing_1 is equal to 5mm. This means the action Measure_Thing_2 will only be carried out if Thing_1 equals 5mm.

Changing the arithmetic operator changes the entire test condition. For example, if the '=' in the example is changed to '<=' Thing_1 must be less than or equal to 5mm for the test condition to be true.

If-Goto Statement

If-Goto statements check the test condition and, if it is true, go to a labeled line within the program. Use an if-Goto statement to skip ahead in a program if the test condition is true.

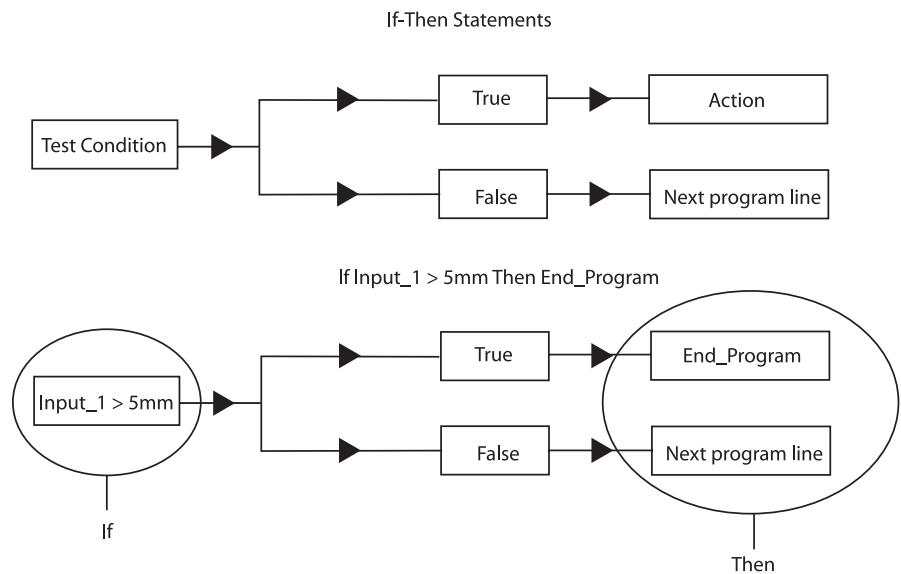


In this example, if the feature measures greater than 5mm the program goes to the line labeled 'Label_1.'

To place an If-Goto statement in a program, click the If-Goto Statement button in the program toolbar.

If-Then Statement

If-Then statements check the test condition and, if it is true, carries out the action and proceeds to the next program line. If the test condition is false the program continues to the next line without carrying out the action.

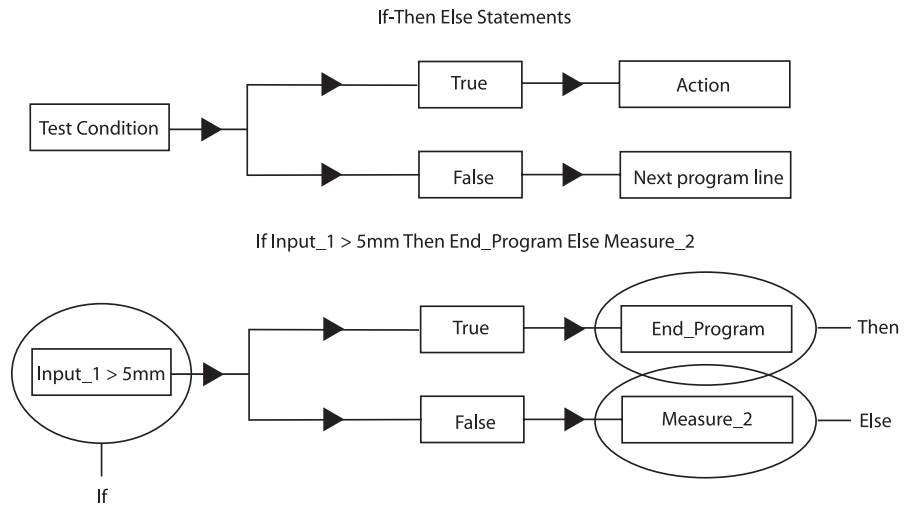


In this example, if the feature measures greater than 5mm the program carries out the action ‘End_Program.’ If the feature measures less than 5mm the program continues to the next line.

To place an If-Then statement in a program, click the If-Then Statement button in the program toolbar.

Else Statement

Else statements are used in conjunction with an If-Then statement. If the test condition for the If-Then statement is false the program carries out the 'else' action.

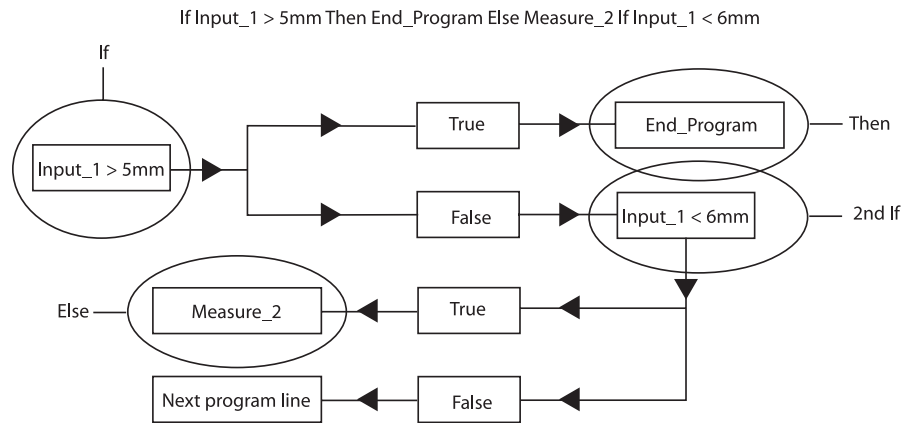
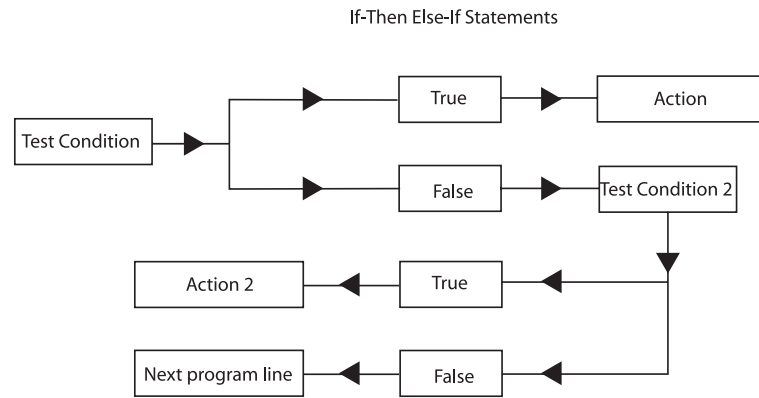


In this example, if the feature measures greater than 5mm the program then carries out the action 'End_Program.' If the feature measures less than 5mm the program carries out the action 'Measure_2.'

To place an Else statement in a program, click the Else Statement button in the program toolbar.

Else-If Statement

Else-If statements are also used in conjunction with an If-Then statement. If the test condition for the If-Then statement is false the program skips the ‘then’ action and checks the second test condition. If the second test condition is true the program carries out the second action and if it is false the program continues to the next line.



In this example, if the feature measures greater than 5mm the program carries out the action ‘End_Program.’ If the feature measures less than 5mm the program checks the second test condition. If the feature measures less than 6mm the program carries out the action “Measure_2’ and if greater than 6mm goes to the next program line.

To place an Else-If statement in a program, click the Else-If Statement button in the program toolbar.

Test conditions are constructed as formulas. Use the following information to help construct useful test conditions.

Parantheses()

Use parantheses to order mathematical equations. For example, in the following equation

$$6*(4+2) = 36$$

the 4 and 2 are added together before being multiplied by the 6.

The same equation without the parantheses is as follows:

$$6*4+2 = 26$$

Here 6 is multiplied by 4 then added to 2.

Work from the innermost set of parantheses to the outermost set in equations using multiple sets of parantheses.

For example,

$$((4+2)*(4+2)+1) = 37$$

Here the addition in the innermost parantheses is performed first, then the two sums are multiplied and added to 1.



NOTE

The mathematical order of operations is always multiplication, division, addition, subtraction.

Parantheses can also be used to call functions such a squares, square root, max, min, etc. For example,

$$\text{sqrt}(100) = 10$$

the function (square root) is performed on the number in the parantheses (100).

Brackets []

Use brackets to recall previously measured features for a formula. For example,

[Circle 1]x

recalls the 'x' value of Circle 1.

A more complex equation might be

$$\text{sqr}([\text{Circle 1}]\text{radius})*\text{PI}$$

Here the radius of Circle 1 is squared and multiplied by pi which produces the area of Circle 1.

Quote marks ""

Use quote marks to indicate an output in a formula. For example, `If([Circle 1]radius<=2.0,"Small")`

prints the word "Small" in the column if the radius of Circle 1 is less than or equal to 2.0.

A more complex equation might be

`If([Circle 1]radius<=2.0,"Small","Big")`

Here the "Small" is printed if the radius of Circle 1 is less than or equal to 2.0 and "Big" is printed if it is greater than 2.0.

Use empty quote marks "" to show no output. For example,

`If([Circle 1]radius>2.0,"","Small")`

gives the same output as

`If([Circle 1]radius<=2.0,"Small")`

using a slightly different formula.

Min/Max

Use the min and max functions to find the minimum or maximum parameter for a series of features. For example,

`Max(-1,-10,"Diameter")`

will produce the maximum diameter of the last 10 circles measured.

Chapter 5

Tolerancing & Templates

Tolerancing

Tolerance is the acceptable amount of deviation from the perfect, or nominal, values of a part. For example, a bi-directional tolerance states how much (+ or -) the location of a feature may deviate from its nominal location. Use the tolerancing function to calculate positions, orientations, and bonuses to keep tolerancing simple and manageable. It is not even necessary to thoroughly understand tolerancing to successfully use it with the QC-5000.

Tolerance Toolbar



Use the tolerance toolbar to activate any of the 12 tolerance functions supported by the QC-5000.



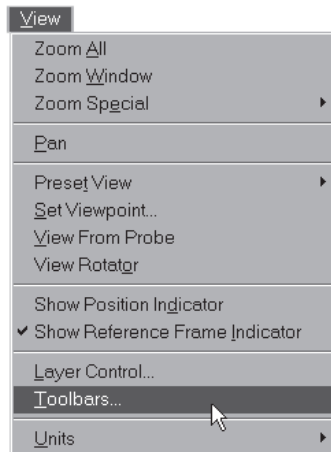
NOTE

Tolerance is feature dependent. This means that only certain tolerance functions apply to certain features. For example, a cylindricity tolerance cannot be performed on a point.

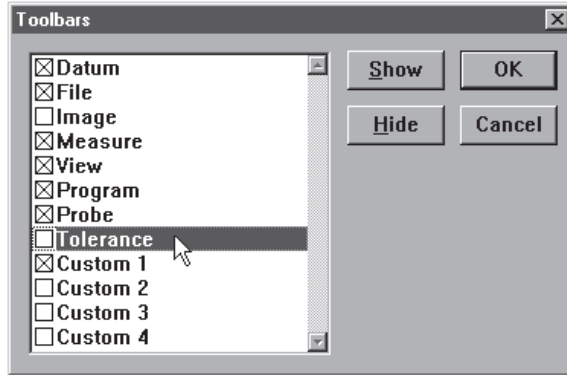
To view the tolerance toolbar

Step 1

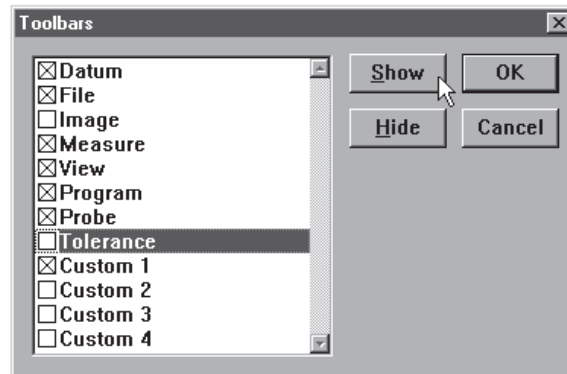
Select *toolbars* from the view menu.



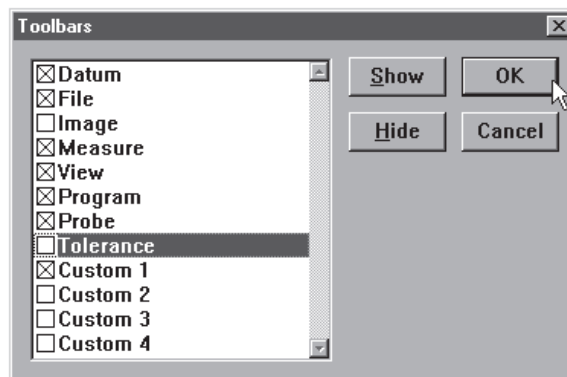
Step 2
Highlight tolerance as shown.



Step 3
Click the *show* button. An 'X' appears next to tolerance.



Step 4
Click OK in the dialog box.



Bi-directional tolerance (circles, points, arcs, spheres)

Use bi-directional tolerance to specify nominal position and size for a selected feature, specify upper and lower deviation allowed from nominal position and size, and calculate pass/fail results. Bi-directional tolerance compares the measured location of a center point (on at least one axis) to the nominal location of that feature's center point.

To perform a bi-directional tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
*		Point 4	Zero	0.00000	0.00000	-0.32781		
		Cylinder		2.98345	1.47448	-0.22281	0.75133	0.3756
		Circle 6		2.98822	2.47395	-0.02521	0.37471	0.1875
		Circle 7		2.97902	0.47526	-0.00343	0.37796	0.1885
		Cone 8		4.48092	0.71760	-0.57746		0.1997
		Slot 9		4.29664	1.46776	-0.10389	0.37576	0.1876
		Plane 10		5.23194	1.37758	-0.25282		
		Plane 11		3.29730	-0.00788	-0.17703		
		Plane 12		4.25071	2.51275	-0.18908		
		Plane 13		2.20031	2.97443	-0.23446		
		Plane 14		0.64736	1.47401	-0.16478		
		Arc 15		4.48262	0.71749	-0.01184	1.49333	0.7460
		Line 16		2.16830	0.73663	-0.02645		

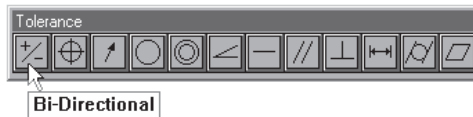


NOTE

Use only a circle, point, arc, or sphere. Bi-directional tolerances do not apply to other types of features.

Step 2

Click the *bi-directional* button on the tolerance toolbar.



Step 3

Type the nominal X and Y values for your part in the boxes as shown.

Bi-Directional Tolerance Entry			
Position			
	Nominal	Nom -	Nom +
X	3.0	0.006	0.006
Y	2.5	0.006	0.006
Z	-0.02521		
Size			
	Nominal	Nom -	Nom +
R	0.1875	0.006	0.006
		OK	Cancel
		Delete	

Step 4
Type in the nominal + and nominal - values for your feature as shown.

Bi-Directional Tolerance Entry			
Position			
	Nominal	Nom -	Nom +
X	3.0	0.006	0.006
Y	2.5	0.006	0.006
Z	-0.02521		
Size			
	Nominal	Nom -	Nom +
R	0.1875	0.006	0.006



NOTE
Nominal + and - values are the same as the tolerance value for the feature. For example, if a feature has a tolerance of + or - 0.006 inches then the nominal + and nominal - values are 0.006 inches.



CAUTION
Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 5
Click OK in the dialog box.

Bi-Directional Tolerance Entry			
Position			
	Nominal	Nom -	Nom +
X	3.0	0.006	0.006
Y	2.5	0.006	0.006
Z	-0.02521		
Size			
	Nominal	Nom -	Nom +
R	0.1875	0.006	0.006

The tolerance result window appears as shown.

Bi-Directional Tolerance Results					
Position					
	Nominal	Actual	Deviation	Low limit	High limit
X	3.00000	2.98822	-0.01178	2.99400	3.00600
Y	2.50000	2.47395	-0.02605	2.49400	2.50600
Z	-0.02521	-0.02521	0.00000		
Size					
	Nominal	Actual	Deviation	Low limit	High limit
R	0.18750	0.18736	-0.00014	0.18150	0.19350

Pass/ Fail Displays

A green pass symbol in the features list indicates the feature is within its tolerances.

I	T	Name	Datum	X	Y	Z	d	r
•		Point 4	Zero	0.00000	0.00000	-0.32781		
○		Cylinder		2.98345	1.47448	-0.22281	0.75133	0.3756
○		Circle 6		2.98822	2.47395	-0.02521	0.37471	0.1875
○		Circle 7		2.97902	0.47526	0.00343	0.37796	0.1885
△		Cone 8		4.48092	0.71760	-0.57746		0.1997

Red symbols indicate the feature failed one or more tolerances.

I	T	Name	Datum	X	Y	Z	d	r
•		Point 4	Zero	0.00000	0.00000	-0.32781		
○		Cylinder		2.98345	1.47448	-0.22281	0.75133	0.3756
○		Circle 6		2.98822	2.47395	-0.02521	0.37471	0.1875
○		Circle 7		2.97902	0.47526	0.00343	0.37796	0.1885

True position tolerance (circles, points arcs, spheres)

Use true position tolerance to specify nominal position and size for a selected feature, specify upper and lower deviation allowed from nominal position and size, and calculate pass/fail results. True position tolerance compares the measured location of a center point (on at least one axis) to the nominal location of that feature's center point and separately compares the size of that feature. True position tolerancing is regardless of size tolerancing. This means that position and size are calculated independently and do produce true position bonuses.

To perform a true position tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
•		Point 4	Zero	0.00000	0.00000	-0.32781		
○		Cylinder		2.98345	1.47448	-0.22281	0.75133	0.3756
○		Circle 6		2.98822	2.47395	-0.02521	0.37471	0.1875
○		Circle 7		2.97902	0.47526	0.00343	0.37796	0.1885
△		Cone 8		4.48092	0.71760	-0.57746		0.1997
○		Slot 9		4.29664	1.46776	-0.10389	0.37576	0.1876
□		Plane 10		5.23194	1.37758	-0.25282		
□		Plane 11		3.29730	-0.00788	-0.17703		
□		Plane 12		4.25071	2.51275	-0.18908		
□		Plane 13		2.20031	2.97443	-0.23446		
□		Plane 14		0.64736	1.47401	-0.16478		

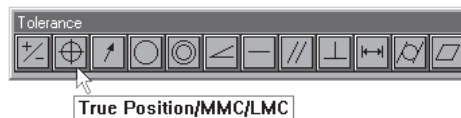


NOTE

Use only a circle, point, arc, or sphere. True position tolerances do not apply to other types of features.

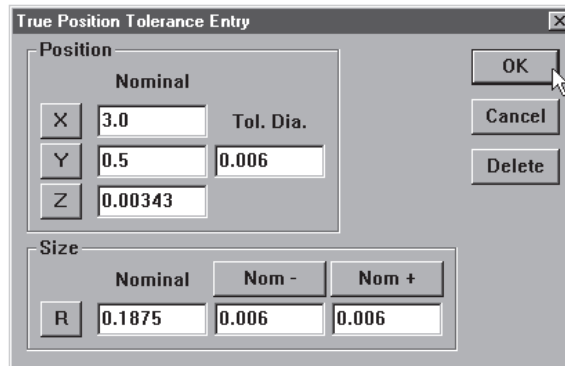
Step 2

Click the *true position/MMC/LMC* button on the tolerance toolbar.



Step 3

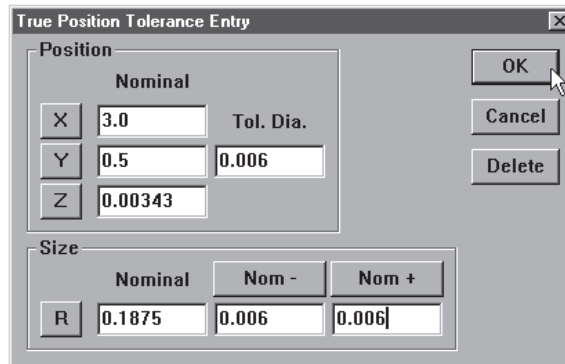
Type the nominal X and Y values for your part in the boxes as shown.



The dialog box 'True Position Tolerance Entry' has a 'Position' section with a 'Nominal' sub-section. It contains three rows of input fields: X (3.0), Y (0.5), and Z (0.00343). To the right of the X and Y fields is a 'Tol. Dia.' field with the value 0.006. Below the 'Position' section is a 'Size' section with three columns: 'Nominal', 'Nom -', and 'Nom +'. The 'R' row has values 0.1875, 0.006, and 0.006. On the right side of the dialog are three buttons: 'OK', 'Cancel', and 'Delete'.

Step 4

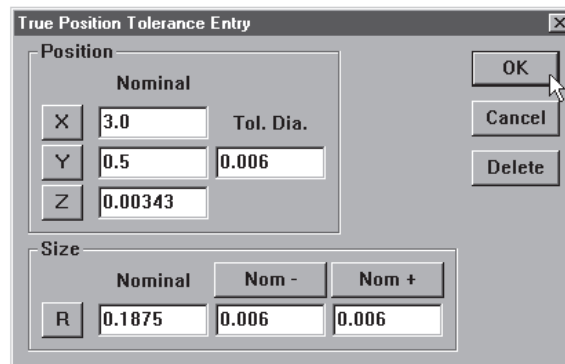
Enter the specified diameter as shown.



This dialog box is identical to the one in Step 3, showing the same input values for X, Y, Z, Tol. Dia., and Size.

Step 5

Type in the nominal + and nominal - values for your feature as shown.



This dialog box is identical to the one in Step 3, showing the same input values for X, Y, Z, Tol. Dia., and Size.



NOTE

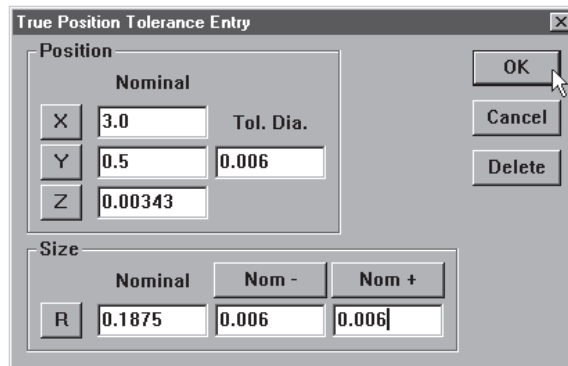
Nominal + and - values are the same as the tolerance value for the feature. For example, if a feature has a tolerance of + or - 0.006 inches then the nominal + and nominal - values are 0.006 inches.



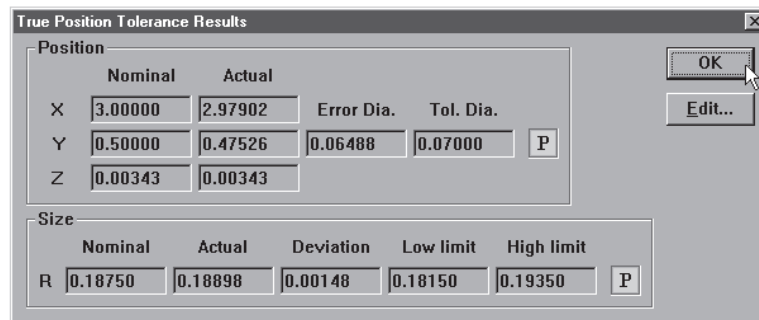
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 5
Click OK in the dialog box.



The tolerance results window appears as shown.



NOTE

Position and size may have a different pass/fail result from each other. A red fail marker will appear in the features list if either parameter fails.

MMC/LMC (maximum material condition/least material condition) tolerance (circles, points arcs, spheres)

Use MMC/LMC tolerances for bores and bosses to specify nominal X, Y, and Z positions for a selected feature, specify nominal diameter, specify nominal size, specify bore or boss setting, and calculate pass/fail results. MMC/LMC tolerancing factors true position bonus into its calculations.

To perform a MMC tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
		Plane 13		2.20031	2.97443	-0.23446		
		Plane 14		0.64736	1.47401	-0.16478		
		Arc 15		4.48262	0.71749	-0.01184	1.49333	0.7466
		Line 16		2.16830	0.73663	-0.02645		
		Line 17		1.79161	0.71654	-0.02664		
		Arc 18		1.98363	1.47844	-0.02823	0.37580	0.1875
		Circle 19		2.98317	1.47526	-0.05573	0.75111	0.3758

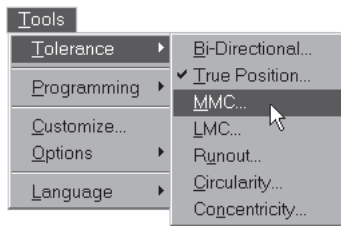


NOTE

Use only a circle, point, arc, or sphere. MMC tolerances do not apply to other types of features.

Step 2

Select *tolerance* then *MMC* from the tools menu.



Step 3

Type the nominal X and Y values for your part in the boxes as shown.

MMC Tolerance Entry

Position

Nominal

X: 3.0 Tol. Dia.: 0.006

Y: 1.5

Z: -0.05573

Type

Boss

Bore

Buttons: OK, Cancel, Delete

Size

Nominal Nom - Nom +

R: 0.375 0.006 0.006

Step 4
Enter the specified diameter as shown.

The screenshot shows the 'MMC Tolerance Entry' dialog box. It is divided into three main sections: Position, Type, and Size. The Position section contains a 'Nominal' sub-section with input fields for X (3.0), Y (1.5), and Z (-0.05573), and a 'Tol. Dia.' field (0.006). The Type section has two radio buttons: 'Boss' (unselected) and 'Bore' (selected). The Size section has three columns: 'Nominal' (0.375), 'Nom -' (0.006), and 'Nom +' (0.006). On the right side, there are three buttons: 'OK', 'Cancel', and 'Delete'. A mouse cursor is pointing at the 'OK' button.

Step 5
Type in the nominal + and nominal - values for your feature as shown.

This screenshot is identical to the previous one, showing the 'MMC Tolerance Entry' dialog box. The only difference is that the mouse cursor is now pointing at the 'Nom +' input field in the Size section, which contains the value 0.006.



NOTE

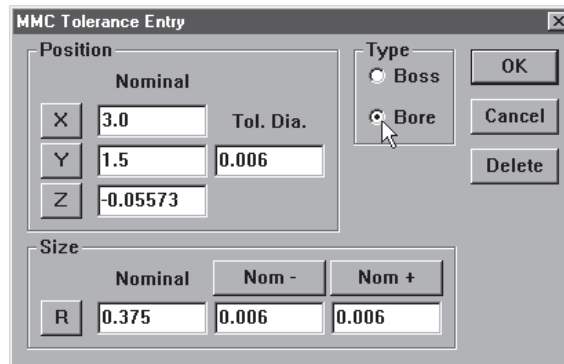
Nominal + and - values are the same as the tolerance value for the feature. For example, if a feature has a tolerance of + or - 0.006 inches then the nominal + and nominal - values are 0.006 inches.



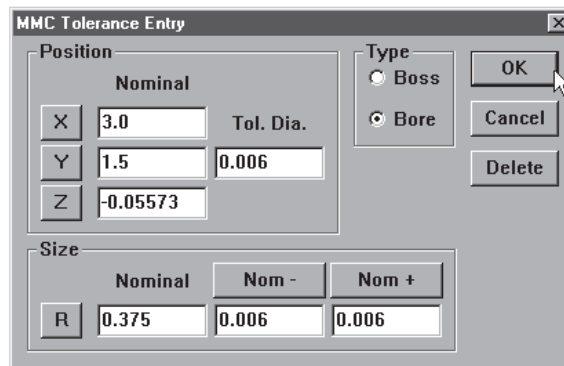
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

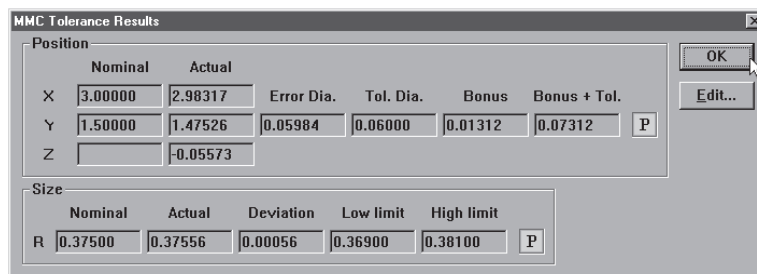
Step 6
 Select *boss* or *bore* as shown.



Step 7
 Click OK in the dialog box.



The tolerance result window appears as shown.



To perform a LMC

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
		Plane 13		2.20031	2.97443	-0.23446		
		Plane 14		0.64736	1.47401	-0.16478		
		Arc 15		4.48262	0.71749	-0.01184	1.49333	0.7466
		Line 16		2.16830	0.73663	-0.02645		
		Line 17		1.79161	0.71654	-0.02664		
		Arc 18		1.98363	1.47844	-0.02823	0.37580	0.1875
		Circle 20		2.98323	1.47509	-0.00851	0.75178	0.3758

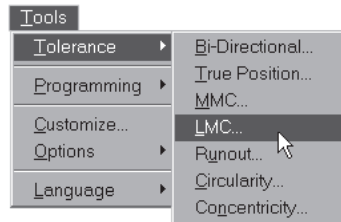


NOTE

Use only a circle, point, arc, or sphere. MMC tolerances do not apply to other types of features.

Step 2

Select *tolerance* then *LMC* from the tools menu.



Step 3

Type the nominal X and Y values for your part in the boxes as shown.

LMC Tolerance Entry

Position

	Nominal	Tol. Dia.
X	3.0	
Y	1.5	0.06
Z	-0.00851	

Type

Boss

Bore

OK

Cancel

Delete

Size

	Nominal	Nom -	Nom +
R	0.37589		

Step 4

Enter the specified diameter as shown.

LMC Tolerance Entry

Position

Nominal

X 3.0 Tol. Dia. 0.06

Y 1.5

Z -0.00851

Type

Boss

Bore

OK

Cancel

Delete

Size

Nominal Nom - Nom +

R 0.375 0.006 0.006

Step 5

Type in the nominal + and nominal - values for your feature as shown.

LMC Tolerance Entry

Position

Nominal

X 3.0 Tol. Dia. 0.06

Y 1.5

Z -0.00851

Type

Boss

Bore

OK

Cancel

Delete

Size

Nominal Nom - Nom +

R 0.375 0.006 0.006



NOTE

Nominal + and - values are the same as the tolerance value for the feature. For example, if a feature has a tolerance of + or - 0.006 inches then the nominal + and nominal - values are 0.006 inches.



CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 6
 Select *boss* or *bore* as shown.

LMC Tolerance Entry

Position

	Nominal	Tol. Dia.
X	3.0	
Y	1.5	0.06
Z	-0.00851	

Type

Boss

Bore

OK

Cancel

Delete

Size

	Nominal	Nom -	Nom +
R	0.375	0.006	0.006

Step 7
 Click OK in the dialog box.

LMC Tolerance Entry

Position

	Nominal	Tol. Dia.
X	3.0	
Y	1.5	0.06
Z	-0.00851	

Type

Boss

Bore

OK

Cancel

Delete

Size

	Nominal	Nom -	Nom +
R	0.375	0.006	0.006

The tolerance results window appears as shown.

LMC Tolerance Results

Position

	Nominal	Actual	Error Dia.	Tol. Dia.	Bonus	Bonus + Tol.
X	3.00000	2.98323				
Y	1.50000	1.47509	0.06006	0.06000	0.01022	0.07022 P
Z		-0.00851				

Size

	Nominal	Actual	Deviation	Low limit	High limit
R	0.37500	0.37589	0.00089	0.36900	0.38100 P

OK

Edit...

Concentricity tolerance (circles, arcs)

Use concentricity tolerancing to compare the measured position of a feature to the measured position of another concentric feature (reference feature). The measured position of the of the basis feature is the nominal of the feature being toleranced.

To perform a concentricity tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
		Plane 14		0.64736	1.47401	-0.16478		
		Arc 15		4.48262	0.71749	-0.01184	1.49333	0.7466
		Line 16		2.16830	0.73663	-0.02645		
		Line 17		1.79161	0.71654	-0.02664		
		Arc 18		1.98363	1.47844	-0.02823	0.37580	0.1879
		Circle 20		2.98323	1.47509	-0.00851	0.75178	0.3758
		Circle 22		4.47870	0.71779	0.03316	1.02300	0.5115
		Circle 24		4.48052	0.71670	-0.37234	0.37391	0.1868

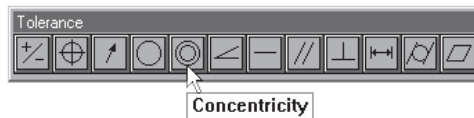


NOTE

Use only a circle or arc. Concentricity tolerances do not apply to other types of features.

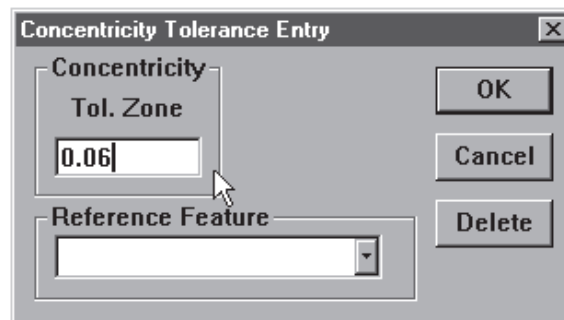
Step 2

Click the *concentricity* button on the tolerance toolbar.



Step 3

Enter a value in the tolerance zone box as shown.



NOTE

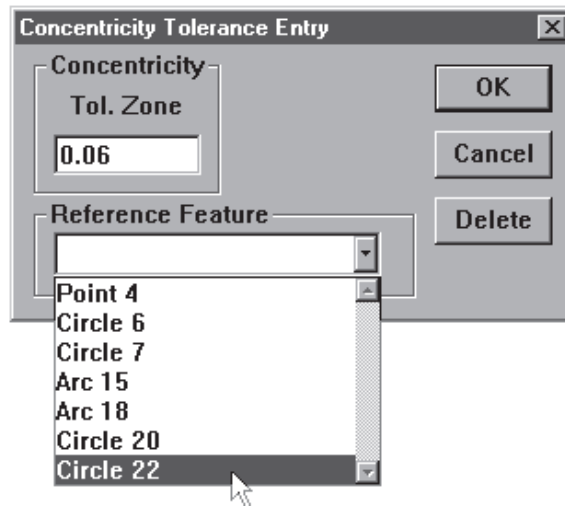
The center point of the tolerance feature must lie within the tolerance zone to pass. The tolerance zone is defined by the diameter specified in the tolerance zone box. This is the tolerance value.



CAUTION

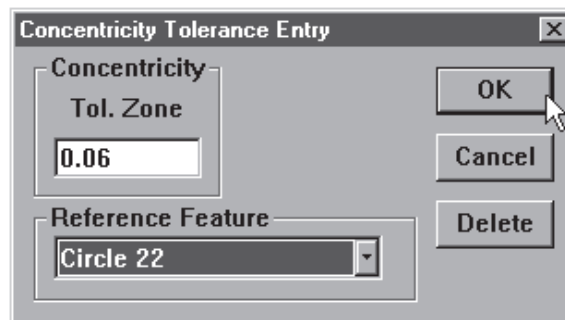
Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 4
 Select the reference feature as shown.

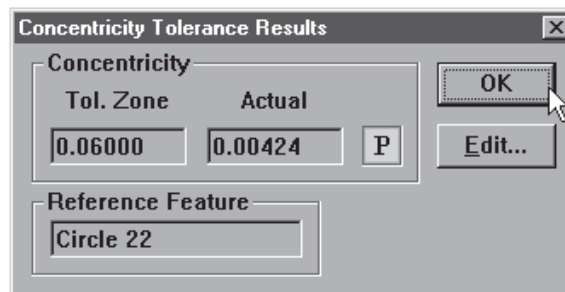


NOTE
 If no features appear in the reference feature list concentricity tolerancing is not possible.

Step 5
 Click OK in the dialog box.



The tolerance results window appears as shown.



Straightness tolerance (lines)

Use straightness tolerancing to calculate the straightness of a line and pass/fail results. Each point probed on a line is checked against the straightness tolerance. A minimum of three points distributed along the line are required (more points increase accuracy).



NOTE

It is possible to perform a straightness tolerance on a line with only two points. This tolerance is meaningless because it is impossible for either point to be 'out' of the tolerance zone. Use a minimum of three points when performing a straightness tolerance.

To perform a straightness tolerance (lines)

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
✓		Line 17		1.79161	0.71654	-0.02664		
✓		Arc 18		1.98363	1.47844	-0.02823	0.37580	0.1875
○		Circle 20		2.98323	1.47509	-0.00851	0.75178	0.3758
○		Circle 22		4.47870	0.71779	0.03316	1.02300	0.5115
○		Circle 24		4.48052	0.71670	-0.37234	0.37391	0.1865
✓		Line 25		4.21414	2.52898	-0.06075		

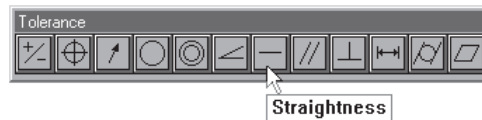


NOTE

Use a line only. Straightness tolerances do not apply to other types of features.

Step 2

Click the *straightness button* on the tolerance toolbar.



Step 3

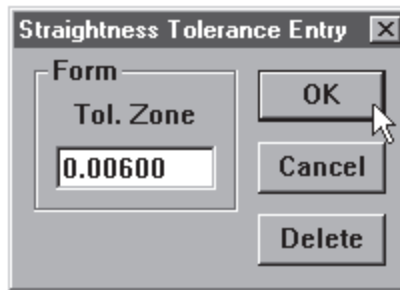
Enter a value in the tolerance zone box as shown.



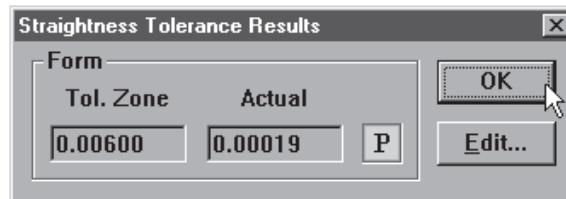
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 4
Click OK in the dialog box.



The tolerance results window appears as shown.



Circularity/sphericity tolerance (circles, spheres)

Use circularity/sphericity as form tolerance for circles and spheres. This tolerance defaults to circularity when the selected feature is a circle and sphericity when the selected feature is a sphere. A minimum of four points is required for a circularity tolerance and five points for a sphericity tolerance. The more points used in the tolerance the more accurate the final result.

To perform a circularity tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
○		Circle 20		2.98323	1.47509	-0.00851	0.75178	0.3756
○		Circle 22		4.47870	0.71779	0.03316	1.02300	0.5115
○		Circle 24		4.48052	0.71670	-0.37234	0.37391	0.1865
○		Line 25		4.21414	2.52898	-0.06075		
○		Circle 26		5.75342	3.75782	-0.05241	0.75179	0.3756
○		Circle 27		7.31711	3.15484	0.01377	0.98428	0.4921
○		Circle 28		7.32008	3.15612	-0.38132	0.37426	0.1871



NOTE

Use a circle only. Circularity tolerances do not apply to other types of features.

Step 2

Click the *circularity/sphericity* button on the tolerance toolbar.



Step 3

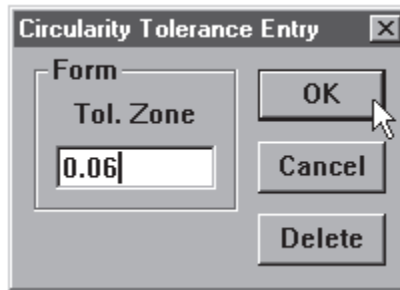
Enter a value in the tolerance zone box as shown.



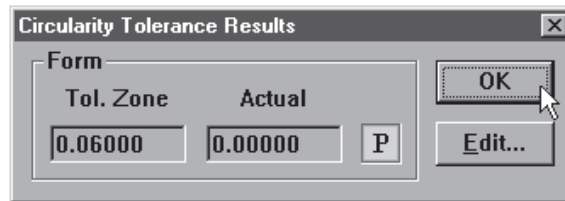
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 4
Click OK in the dialog box.



The tolerance results window appears as shown.



To perform a sphericity tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
○	●	Circle 20		2.98323	1.47509	-0.00851	0.75178	0.3755
○	○	Circle 22		4.47870	0.71779	0.03316	1.02300	0.5115
○	●	Circle 24		4.48052	0.71670	-0.37234	0.37391	0.1865
○	∨	Line 25		4.21414	2.52898	-0.06075		
○	○	Circle 26		5.75342	3.75782	-0.05241	0.75179	0.3755
○	○	Circle 27		7.31711	3.15484	0.01377	0.98428	0.4921
○	●	Circle 28		7.32008	3.15812	-0.38132	0.37426	0.1871
○	○	Sphere 29		4.48000	0.71786	0.18807	1.00000	0.5000



NOTE

Use a circle only. Sphericity tolerances do not apply to other types of features.

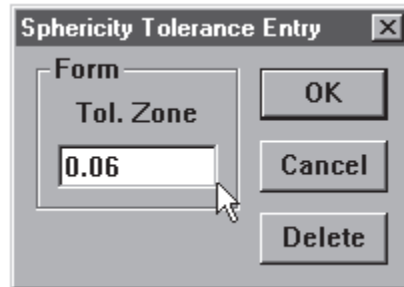
Step 2

Click the *circularity/sphericity* button on the tolerance toolbar.



Step 3

Enter a value in the *tolerance zone* box as shown.

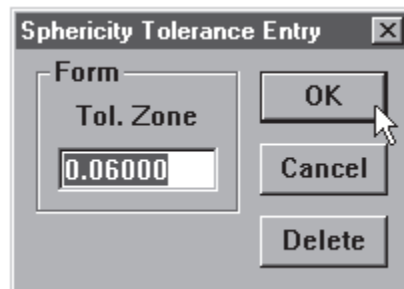


CAUTION

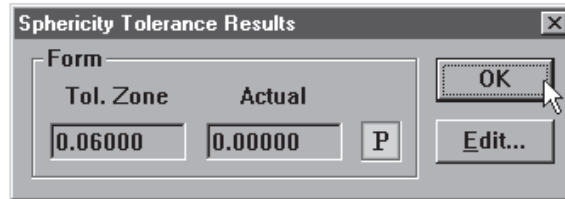
Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 4

Click OK in the dialog box.



The tolerance results window appears as shown.



The image shows a software dialog box titled "Sphericity Tolerance Results". It contains a "Form" section with two columns: "Tol. Zone" and "Actual". The "Tol. Zone" column has a text box containing "0.06000". The "Actual" column has a text box containing "0.00000". To the right of the "Actual" text box is a small button labeled "P". To the right of the "Form" section are two buttons: "OK" and "Edit...". A mouse cursor is pointing at the "OK" button. The dialog box has a standard Windows-style title bar with a close button (X) in the top right corner.

Form	
Tol. Zone	Actual
0.06000	0.00000

P

OK

Edit...

Cylindricity tolerance (cylinders)

Use cylindricity to compare the measured form of a cylinder to a specific tolerance zone and calculate pass/fail results. Cylinder measurement requires a minimum of six points. Enter additional points to increase the accuracy of your measurements.

To perform a cylindricity tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
✓		Line 25		4.21414	2.52898	-0.06075		
○		Circle 26		5.75342	3.75782	-0.05241	0.75179	0.3756
○		Circle 27		7.31711	3.15484	0.01377	0.98428	0.4921
○		Circle 28		7.32008	3.15812	-0.38132	0.37426	0.1871
○		Sphere 29		4.48000	0.71786	0.18807	1.00000	0.5000
○		Circle 30		5.75060	3.75804	0.03074	0.78381	0.3915
○		Cylinder		5.75350	3.75831	-0.21500	0.75249	0.3762
○		circle 32		5.75441	3.75904	-0.01261	0.75167	0.3756



NOTE

Use a cylinder only. Cylindricity tolerances do not apply to other types of features.

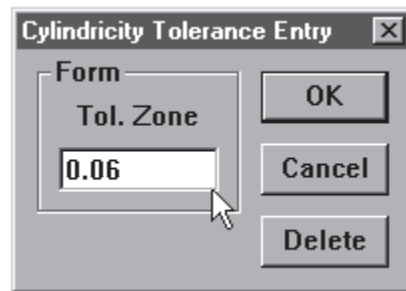
Step 2

Click the *cylindricity* button on the tolerance toolbar.



Step 3

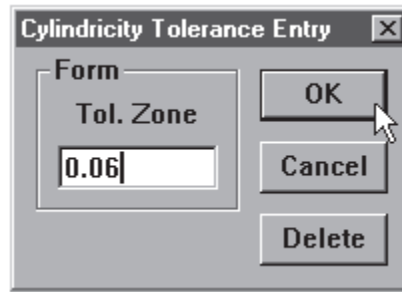
Enter a value in the tolerance zone box as shown.



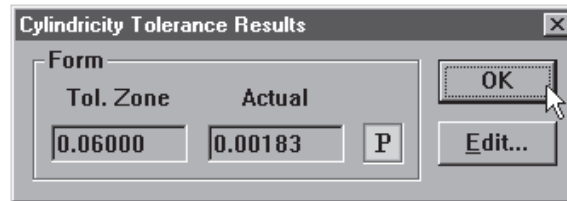
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 4
Click OK in the dialog box.



The tolerance results window appears as shown.



Flatness tolerance (planes)

Use flatness to specify form tolerance for planes. Flatness tolerances require a minimum of four points. Enter additional points to increase the accuracy of your measurements.

To perform a flatness tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
		Plane 10		5.23194	1.37758	-0.25282		
		Plane 11		3.29730	-0.00788	-0.17703		
		Plane 12		4.25071	2.51275	-0.18908		
		Plane 13		2.20031	2.97443	-0.23446		
		Plane 14		0.64736	1.47401	-0.16478		
		Arc 15		4.48262	0.71749	-0.01184	1.49333	0.7466
		Line 16		2.16830	0.73663	-0.02645		
		Line 17		1.79161	0.71654	-0.02664		
		Arc 18		1.98363	1.47844	-0.02823	0.37580	0.1875
		Circle 20		2.98323	1.47509	-0.00851	0.75178	0.3758
		Circle 22		4.47870	0.71779	0.03316	1.02300	0.5115

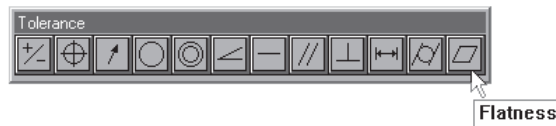


NOTE

Use a plane only. Flatness tolerances do not apply to other types of features.

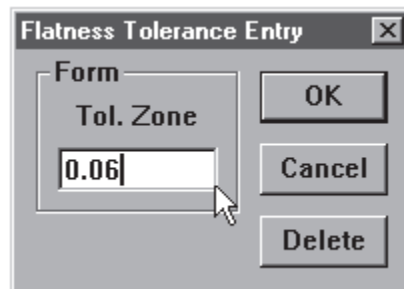
Step 2

Click the *flatness* button on the tolerance toolbar.



Step 3

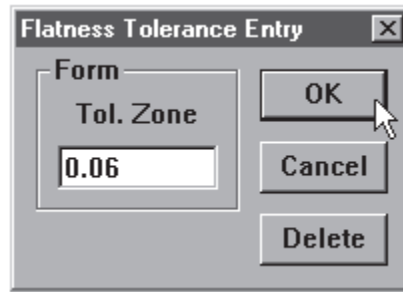
Enter a value in the tolerance zone box as shown.



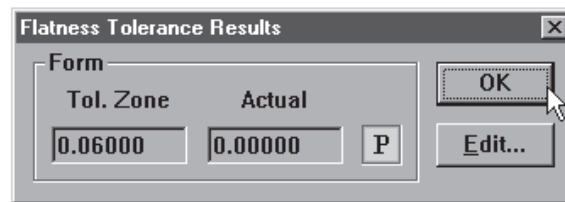
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 4
Click OK in the dialog box.



The tolerance result window appears as shown.



Perpendicularity tolerance (lines, cylinders, cones)

Use perpendicularity to establish an orientation tolerance between linear features. Perpendicularity tolerancing compares the axial orientation of the selected feature to the axis of a reference feature. The actual tolerance zone is a cylindrical area around the axis of the tolerance feature. Specify the diameter of the cylindrical tolerance zone to create the tolerance.

To perform a perpendicularity tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
•		Point 4	Zero	0.00000	0.00000	-0.32781		
○		Cylinder		2.98845	1.47448	-0.22281	0.75133	0.3754
○		Circle 6		2.98822	2.47395	-0.02521	0.37471	0.1873
○		Circle 7		2.97902	0.47526	0.00343	0.37796	0.1885
△		Cone 8		4.48092	0.71760	-0.57746		0.1997
0		Slot 9		4.29664	1.46776	-0.10389	0.37576	0.1876
		Plane 10		5.23194	1.37758	-0.25282		
		Plane 11		3.29730	-0.00788	-0.17703		
		Plane 12		4.25071	2.51275	-0.18908		
		Plane 13		2.20031	2.97443	-0.23446		
		Plane 14		0.64736	1.47401	-0.16478		



NOTE

Use a linear features only. Perpendicularity tolerances do not apply to other types of features.

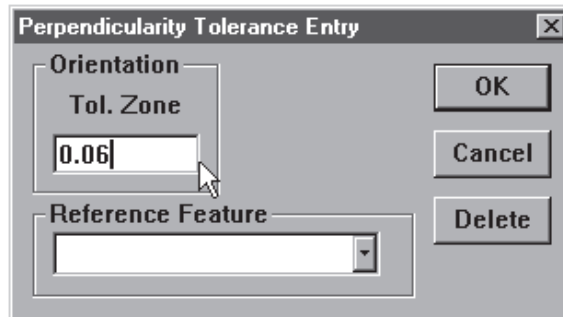
Step 2

Click the *perpendicularity* button on the tolerance toolbar.



Step 3

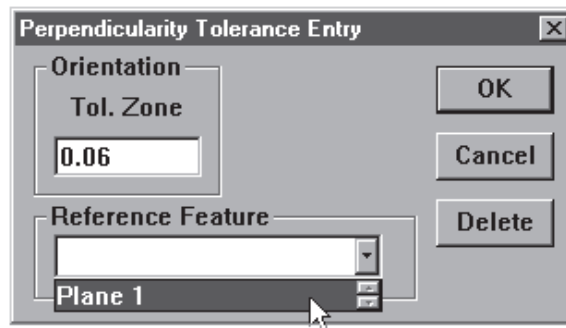
Enter a value in the tolerance zone box as shown.



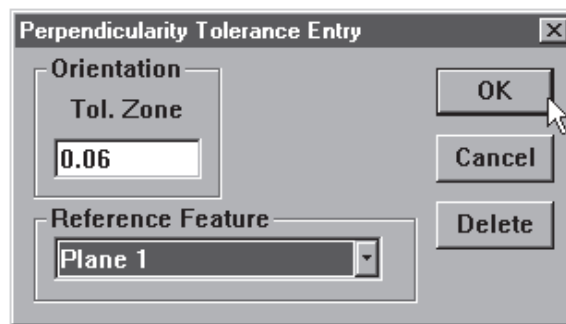
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

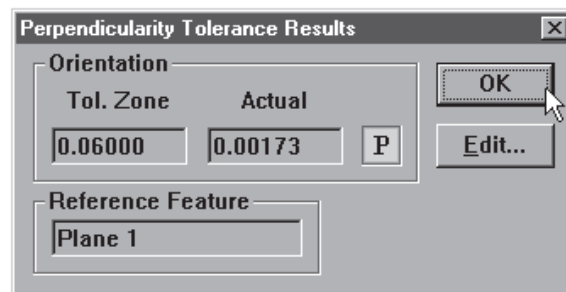
Step 4
 Select a reference feature from the pull down list.



Step 5
 Click OK in the dialog box.



The tolerance result window appears as shown.



Parallelism/Co-planarity tolerance (linear features)

Use parallelism as an orientation tolerance for cylinders, cones, and lines. Parallelism tolerancing compares the axial orientation of the selected feature to the axis of a reference feature. The actual tolerance zone is a cylindrical area around the axis of the tolerance feature. Specify the diameter of the cylindrical tolerance zone to create the tolerance. Tolerancing compares the orientation of the axis of the tolerated feature to a reference feature.

Use co-planarity as an orientation tolerance between planes. Two planes spaced evenly apart with the same orientation are said to be co-planar.

To perform a parallelism tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
		Plane 12		4.25071	2.51275	-0.18908		
		Plane 13		2.20031	2.97443	-0.23446		
		Plane 14		0.64736	1.47401	-0.16478		
		Arc 15		4.48262	0.71749	-0.01184	1.49333	0.7466
		Line 16		2.16830	0.73663	-0.02645		
		Line 17		1.79161	0.71654	-0.02664		
		Arc 18		1.98363	1.47844	-0.02823	0.37580	0.1875
		Circle 20		2.98323	1.47509	-0.00851	0.75178	0.3756
		Circle 22		4.47870	0.71779	0.03316	1.02300	0.5115
		Circle 24		4.48052	0.71670	-0.37234	0.37391	0.1866
		Line 25		4.21414	2.52898	-0.06075		

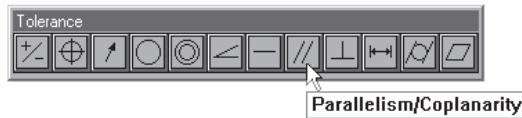


NOTE

Use a linear features only. Parallelism tolerances do not apply to other types of features.

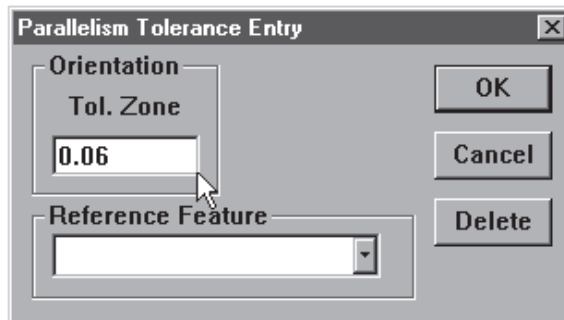
Step 2

Click the *parallelism/co-planarity* button on the tolerance toolbar.



Step 3

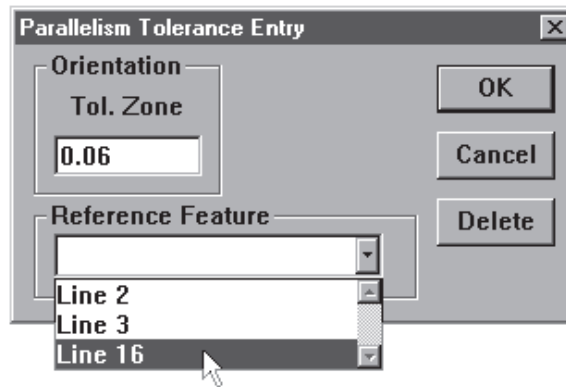
Enter a value in the *tolerance zone* box as shown.



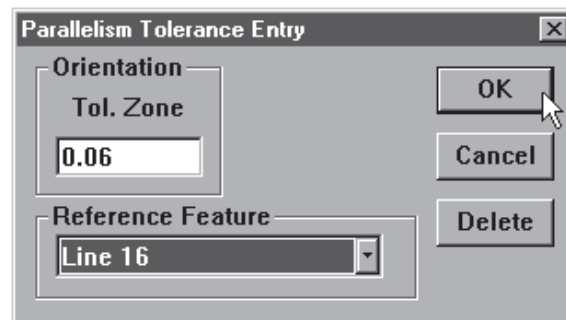
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

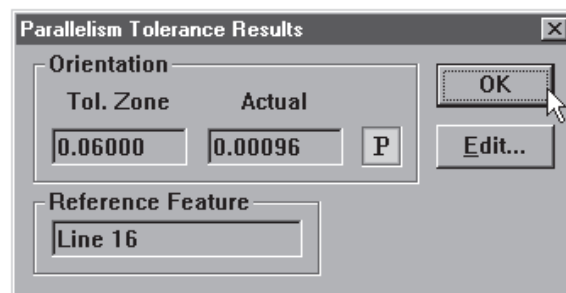
Step 4
 Select a reference feature from the pull down list.



Step 5
 Click OK in the dialog box.



The tolerance results window appears as shown.



To perform a co-planarity tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
○	●	Circle 28		7.32008	3.15812	-0.38132	0.37426	0.1871
○	●	Sphere 29		4.48000	0.71786	0.18807	1.00000	0.5000
○	●	Circle 30		5.75060	3.75804	0.03074	0.78381	0.3915
○	●	Cylinder		5.75350	3.75831	-0.21500	0.75249	0.3762
○	●	Circle 32		5.75441	3.75904	-0.01261	0.75167	0.3756
✓		Line 33		7.09668	3.70053	-0.00320		
✓		Line 34		7.09016	4.07377	-0.01127		

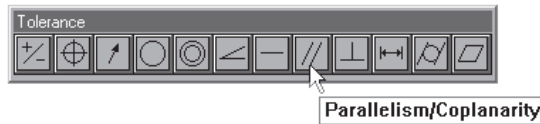


NOTE

Use a plane only. Co-planarity tolerances do not apply to other types of features.

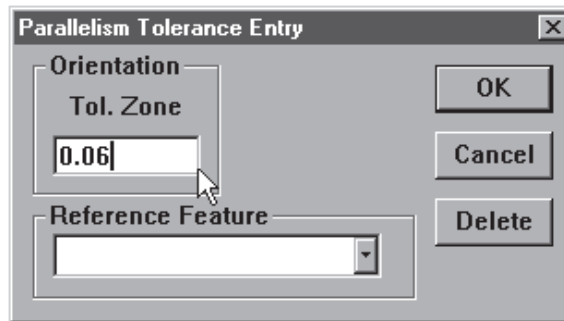
Step 2

Click the *parallelism/co-planarity* button on the tolerance toolbar.



Step 3

Enter a value in the *tolerance zone* box as shown.

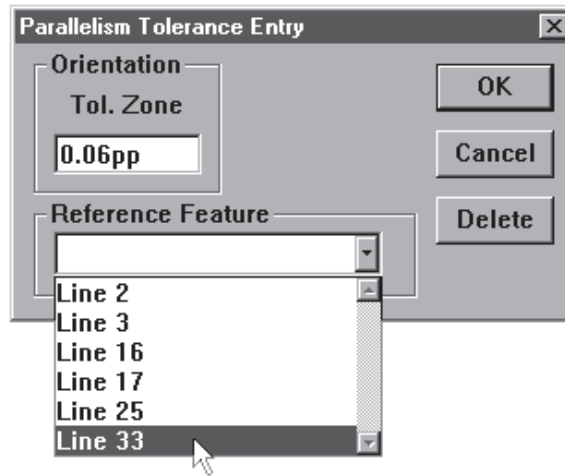


CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

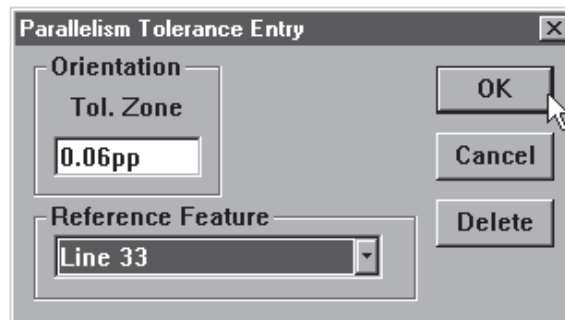
Step 4

Select a reference feature from the pull down list.

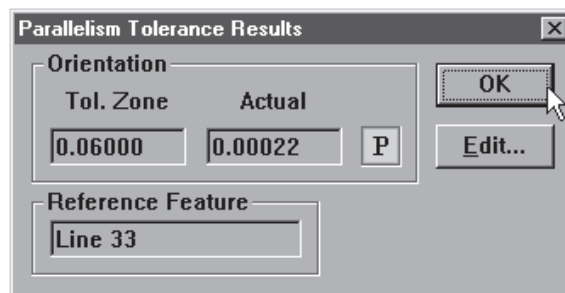


Step 5

Click OK in the dialog box.



The tolerance results window appears as shown.



Circular runout tolerance

Use circular runout to set a tolerance of how far circular features may deviate from the center of a reference feature in 360 degrees of rotation.

To perform a circular runout tolerance

Step 1

Highlight the desired feature in the features list.

I	T	Name	Datum	X	Y	Z	d	r
●		Sphere 29		4.48000	0.71786	0.18807	1.00000	0.5000
○		Circle 30		5.75060	3.75804	0.03074	0.78381	0.3919
●		Cylinder		5.75350	3.75831	-0.21500	0.75249	0.3762
○		Circle 32		5.75441	3.75904	-0.01261	0.75167	0.3756
/		Line 33		7.09668	3.70053	-0.00320		
/		Line 34		7.04016	4.07377	-0.01127		
○		Circle 35		7.31997	3.15897	-0.00215	0.95651	0.4782
○		Circle 36		7.32025	3.15833	-0.31064	0.42460	0.2123

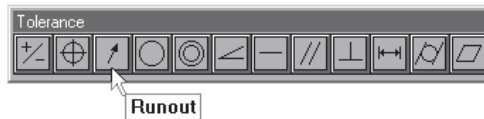


NOTE

Use a circle only. Circular runout tolerances do not apply to other types of features.

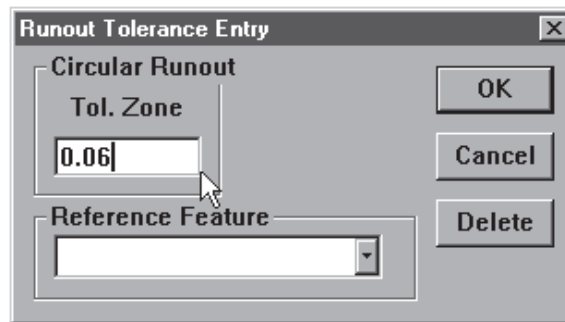
Step 2

Click the *circular runout* button on the tolerance toolbar.



Step 3

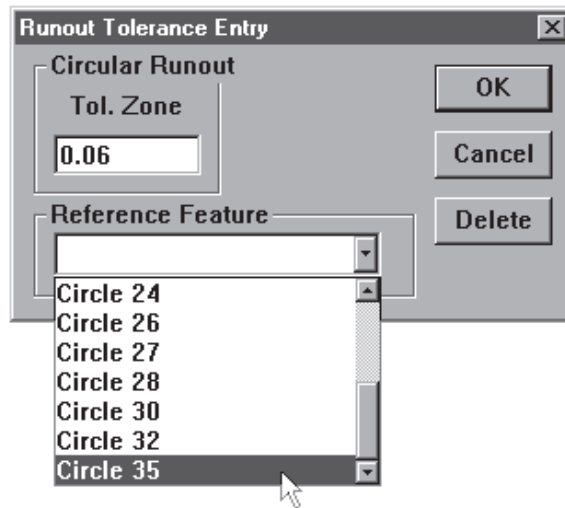
Enter a value in the *tolerance zone* box as shown.



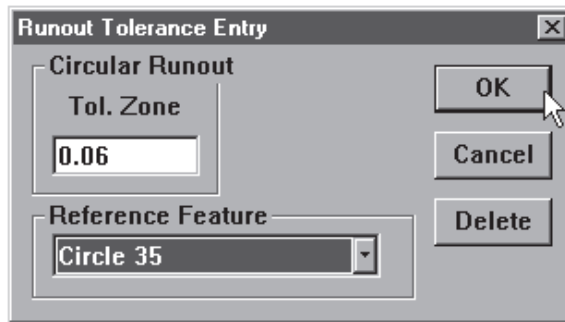
CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

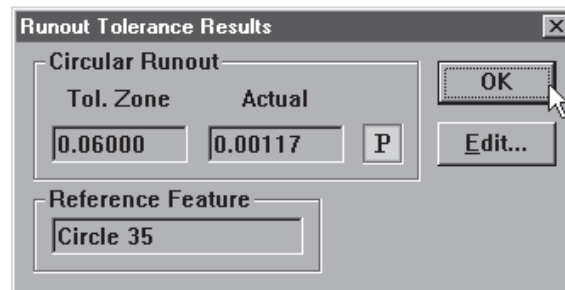
Step 4
 Select a reference feature from the pull down list.



Step 5
 Click OK in the dialog box.



The tolerance results window appears as shown.



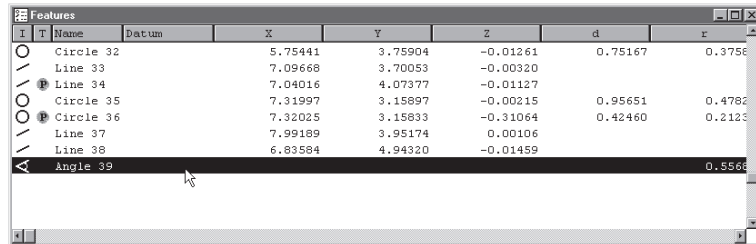
Angle tolerance

Use angle tolerance to set tolerance values for angles in a specified plane. Enter the respective nominal values for the angle according to its plane. For example, enter XY nominal values for angles in the XY plane.

To perform an angle tolerance

Step 1

Highlight the desired angle in the features list.

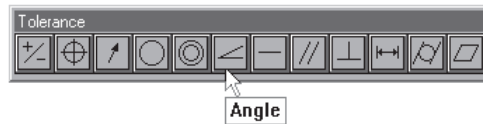


NOTE

Use angles only. Angle tolerances do not apply to other types of features.

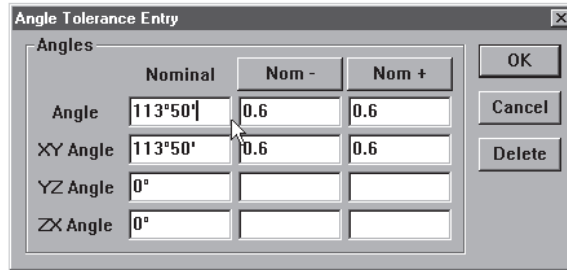
Step 2

Click the *angle* button on the tolerance toolbar.



Step 3

Enter the nominal values as shown.



CAUTION

Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 4

Enter the nominal + and nominal - values as shown.

Angles	Nominal	Nom -	Nom +
Angle	113°50'	0.6	0.6
XY Angle	113°50'	0.6	0.6
YZ Angle	0°		
ZX Angle	0°		

Step 5

Click OK in the dialog box.

The tolerance results window appears as shown.

Angles	Nominal	Actual	Deviation	Low limit	High limit	
Angle	113°50'	112°51'03"	0°58'57"	112°50'	114°50'	P
XY Angle	113°50'	112°51'03"	0°58'57"	112°50'	114°50'	P
YZ Angle	0°	0°	0°			P
ZX Angle	0°	0°	0°			P

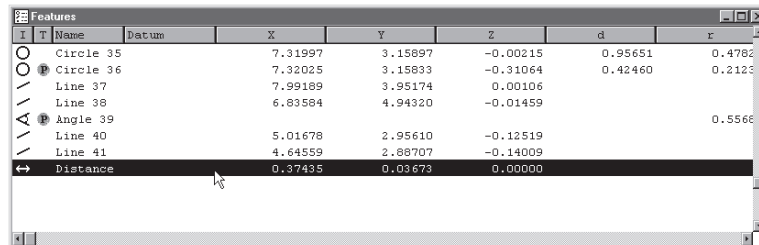
Width tolerance

Use the width tolerance to establish the amount of deviation in the distance between two linear features.

To perform a width tolerance

Step 1

Highlight the desired distance in the features list.

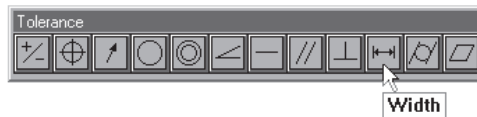


NOTE

Use a distance only. Width tolerances do not apply to other types of features.

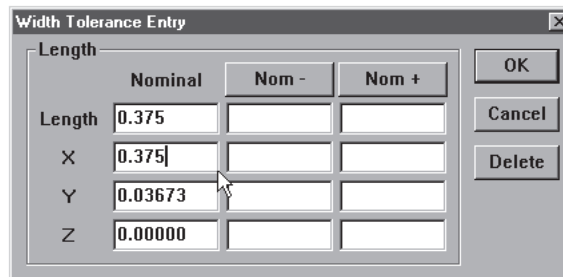
Step 2

Click the *width* button on the tolerance toolbar.



Step 3

Enter the nominal values as shown.

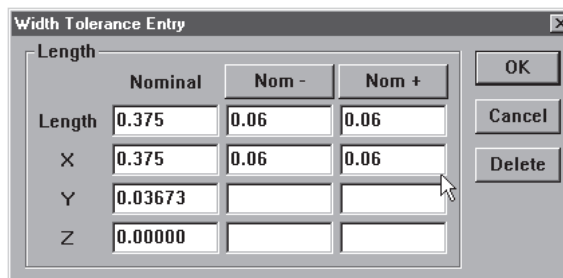


CAUTION

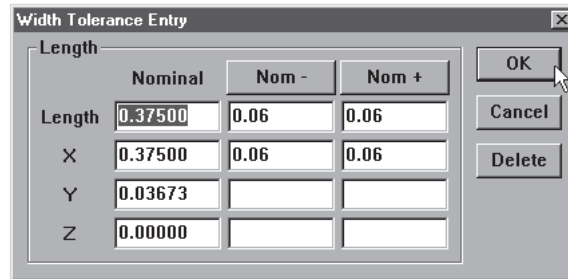
Enter tolerance values in the appropriate units of measurement. For example, if you are measuring in metric (mm) enter tolerance data in metric (mm).

Step 4

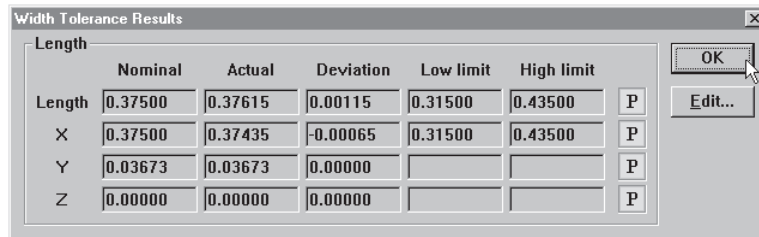
Enter the nominal + and nominal - values as shown.



Step 5
Click OK in the dialog box.



The tolerance results window appears as shown.



Templates

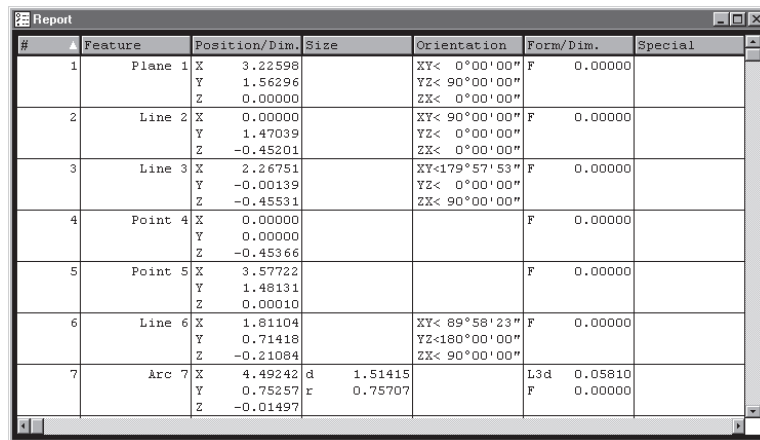
Templates control the format of output. There are four templates used by the QC-5000:

- Features Template
- Report Template
- Program Template
- Runs Template

Features and report templates are associated with data output. Use the features template to format data for output to other software applications.



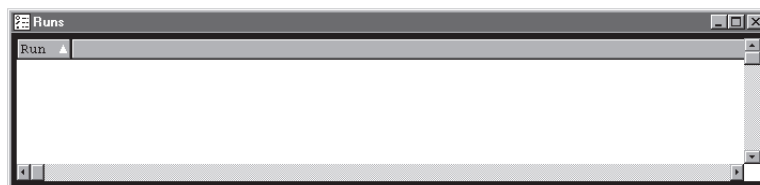
Format print output using the report template.



Program and runs templates are associated with QC-5000 functions. Use the program template to construct, edit, and monitor your parts programs.



Compare program results from one run to the next using the runs template.



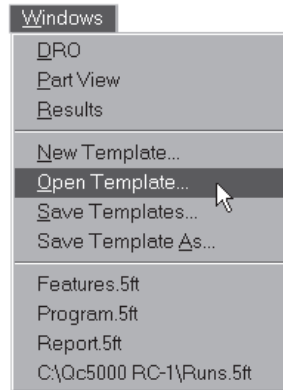
Features Template

Use the features template to create the features list. The features list displays feature data and prepares it for export to other software applications.

To open the features template

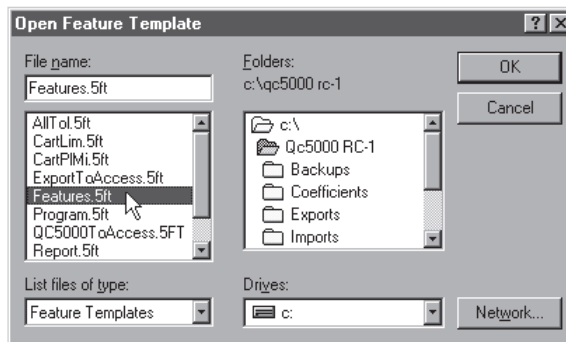
Step 1

Select *open template* from the windows menu.



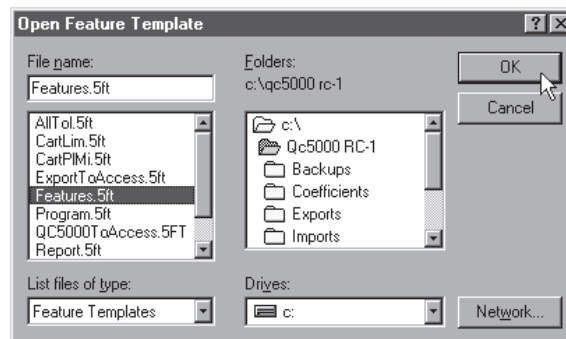
Step 2

Select *features.5ft* from the file name list box. The file path is c:\qc5000\templates.



Step 3

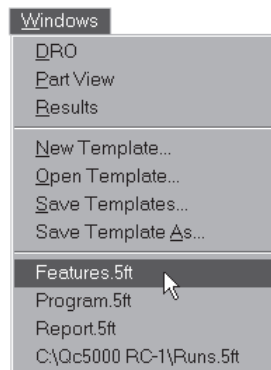
Click OK.



OR

Step 1

Select features.5ft from the windows menu.



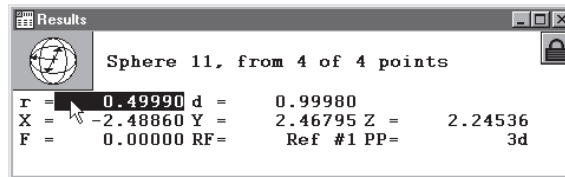
Adding Data to Templates

Add data to the features list by dragging and dropping information from the results window.

To drag and drop a single results window field into the features list

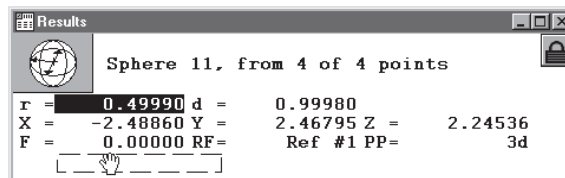
Step 1

Highlight the desired field in the results window.



Step 2

Hold down the left mouse button and move the field over the features list.



Step 3

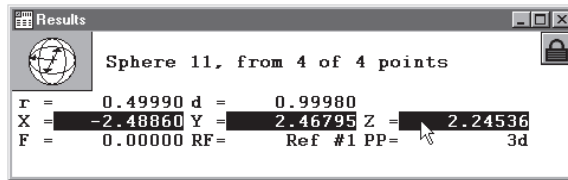
Release the left mouse button.



To drag and drop a multiple results window fields into the features list

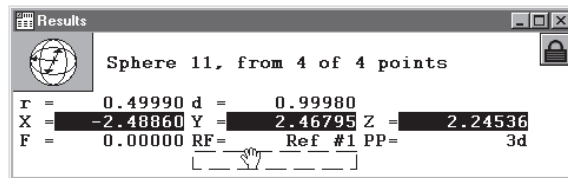
Step 1

Highlight the desired fields in the results window.



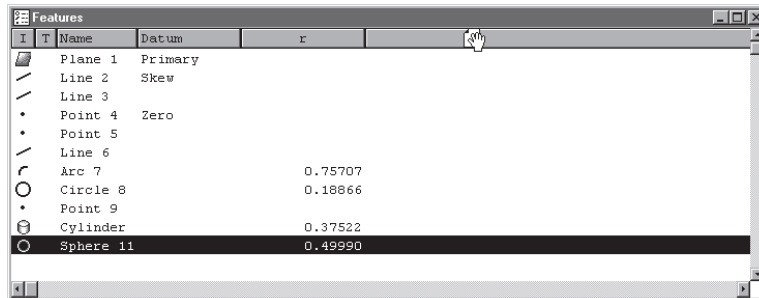
Step 2

Hold down the left mouse button and move the fields over the features list.



Step 3

Release the left mouse button.



Step 4

Click the *as multiple new columns* button in the dialog box.



NOTE

Use the *as 1 new column* button if the fields are intended to occupy only one column.

Sorting the Features List

Sort data in the features list by clicking on the column header. Each data column can be arranged from high to low, low to high, or by order entered.

To sort data in the features list

Step 1

Place the cursor on the desired column header.

I	T	Name	Datum	r	X	Y	Z
•		Point 9			4.53139	0.74913	-0.16713
∩		Arc 7		0.75707	4.49242	0.75257	-0.01497
•		Point 5			3.57722	1.48131	0.00010
▢		Plane 1	Primary		3.22598	1.56296	0.00000
○		Cylinder		0.37522	3.00035	1.49760	-0.26424
○		Circle 8		0.18866	2.99882	2.49648	0.00203
/		Line 3			2.26751	-0.00139	-0.45531
/		Line 6			1.81104	0.71418	-0.21084
/		Line 2	Skew		0.00000	1.47039	-0.45201
•		Point 4	Zero		0.00000	0.00000	-0.45366
○		Sphere 11		0.49990	-2.48860	2.46795	2.24536

Step 2

Click on the column header.

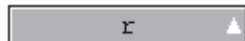
I	T	Name	Datum	r	X	Y	Z
▢		Plane 1	Primary		3.22598	1.56296	0.00000
/		Line 2	Skew		0.00000	1.47039	-0.45201
/		Line 3			2.26751	-0.00139	-0.45531
•		Point 4	Zero		0.00000	0.00000	-0.45366
•		Point 5			3.57722	1.48131	0.00010
/		Line 6			1.81104	0.71418	-0.21084
•		Point 9			4.53139	0.74913	-0.16713
○		Circle 8		0.18866	2.99882	2.49648	0.00203
○		Cylinder		0.37522	3.00035	1.49760	-0.26424
○		Sphere 11		0.49990	-2.48860	2.46795	2.24536
∩		Arc 7		0.75707	4.49242	0.75257	-0.01497

A small arrow to the right of the column label indicates the arrangement:

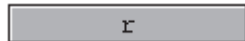
- high to low (arrow down)



- low to high (arrow up)



- order entered (no arrow)



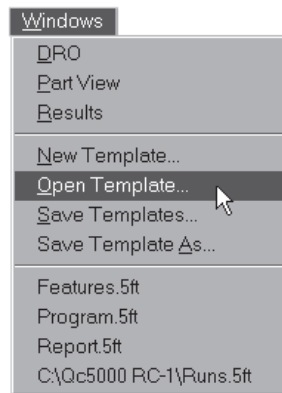
Reports Template

Use the reports template to prepare data in a standard print format. The reports template displays the same feature data as the features template in a printer-friendly format. Add data to the reports template by dragging and dropping information from the results window.

To open the reports template

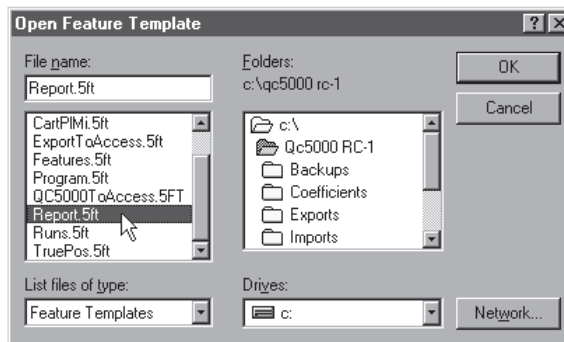
Step 1

Select *open template* from the windows menu.



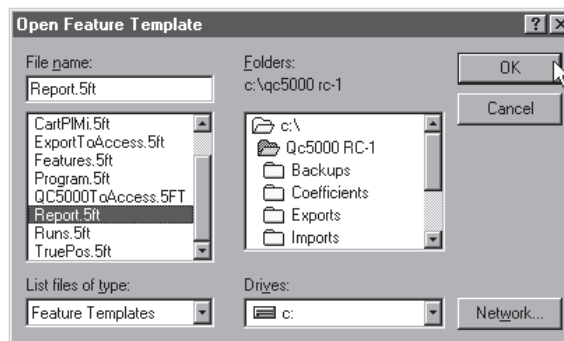
Step 2

Select *report.5ft* from the file name list box. The file path is *c:\qc5000\templates*.

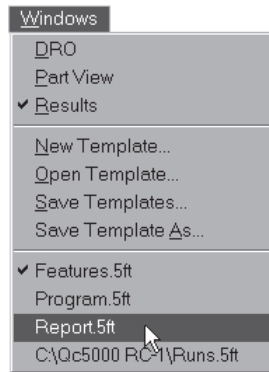


Step 3

Click OK.



OR
Step 1
Select *reports.5ft* from the windows menu.



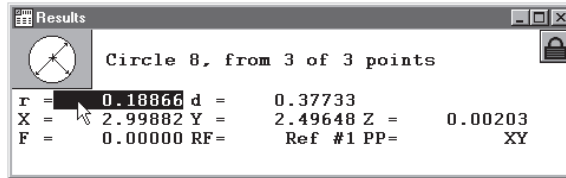
Adding Data to the Reports Template

Add data to the reports template by dragging and dropping information from the results window.

To drag and drop a single results window field into the reports template

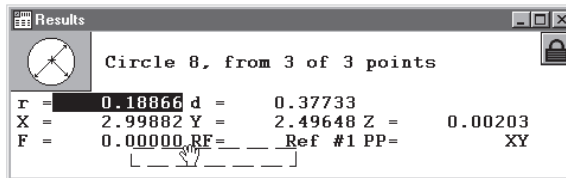
Step 1

Highlight the desired field in the results window.



Step 2

Hold down the left mouse button and move the field over the reports template.



Step 3

Release the left mouse button.

#	Feature	Position/Dim.	Size	Orientation	Form/Dim.
6	Line 6	X 1.81104 Y 0.71418 Z -0.21084		XY< 89°58'23" YZ<180°00'00" ZX< 90°00'00"	F 0.00000
7	Arc 7	X 4.49242 Y 0.75257 Z -0.01497	d 1.51415 r 0.75707		L3d 0.05810 F 0.00000
8	Circle 8	X 2.99882 Y 2.49648 Z 0.00203	d 0.37733 r 0.18866		F 0.00000
9	Point 9	X 4.53139 Y 0.74913 Z -0.16713			F 0.40007

To drag and drop a multiple results window fields into the reports template

Step 1

Highlight the desired fields in the results window.

	Orientation	Form/Dim.	r	
	XY< 89°58'23"	F 0.00000		
	YZ<180°00'00"			
	ZX< 90°00'00"			
51415		L3d 0.05810	0.75707	
75707		F 0.00000		
37733		F 0.00000	0.18866	
18866				
		F 0.40007		

Step 2

Hold down the left mouse button and move the fields over the reports template.

Circle 8, from 3 of 3 points

r = 0.18866 d = 0.37733
 X = 2.99882 Y = 2.49648 Z = 0.00203
 F = 0.00000 RF = Ref #1 PP = XY

Step3

Release the left mouse button.

	Orientation	Form/Dim.	r	
	XY< 89°58'23"	F 0.00000		
	YZ<180°00'00"			
	ZX< 90°00'00"			
51415		L3d 0.05810	0.75707	
75707		F 0.00000		
37733		F 0.00000	0.18866	
18866				
		F 0.40007		

Step 4

Click the *as multiple new columns* button in the dialog box.

QC5000

? How do you want the fields added to this template?

Include labels with data



NOTE

Use the *as 1 new column* button if the fields are intended to occupy only one column.

Sorting Data in the Reports Template

Sort data in the reports template by clicking on the column header. Each data column can be arranged from high to low, low to high, or by order entered.

To sort data in the reports template

Step 1

Place the cursor on the desired column header.

on/Dim.	Size	Orientation	Form/Dim.	r	X	Z
1.81104		XY< 89°58'23"	F 0.00000		1.81104	-0.2
0.71418		YZ<180°00'00"				
0.21084		ZX< 90°00'00"				
2.26751		XY<179°57'53"	F 0.00000		2.26751	-0.4
0.00139		YZ< 0°00'00"				
0.45531		ZX< 90°00'00"				
2.99882	d 0.37733		F 0.00000	0.18866	2.99882	0.0
2.49648	r 0.18866					
0.00203						
3.00035	d 0.75044	XY<153°51'02"	F 0.00115	0.37522	3.00035	-0.2
1.49760	r 0.37522	YZ< 89°53'05"				
0.26424		ZX<359°45'53"				

Step 2

Click on the column header.

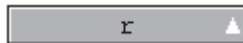
on/Dim.	Size	Orientation	Form/Dim.	r	X	Z
2.26751		XY<179°57'53"	F 0.00000		2.26751	-0.4
0.00139		YZ< 0°00'00"				
0.45531		ZX< 90°00'00"				
0.00000			F 0.00000		0.00000	-0.4
0.00000						
0.45366						
3.57722			F 0.00000		3.57722	0.0
1.48131						
0.00010						
1.81104		XY< 89°58'23"	F 0.00000		1.81104	-0.2
0.71418		YZ<180°00'00"				
0.21084		ZX< 90°00'00"				

A small arrow to the right of the column label indicates the arrangement:

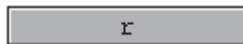
- high to low (arrow down)



- low to high (arrow up)



- order entered (no arrow)



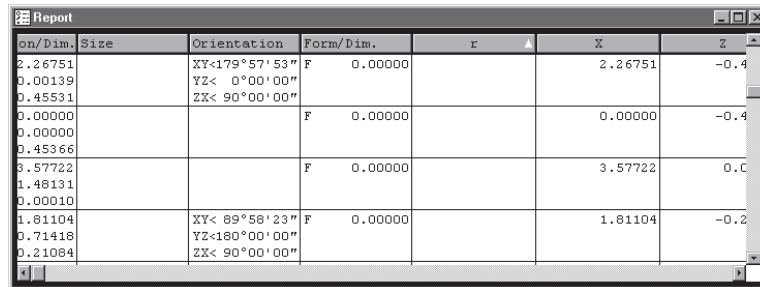
Report Headers

Report headers contain additional information that is placed at the top of the first report page. Users can customize report headers to suit specific application or documentation needs.

To show a report header

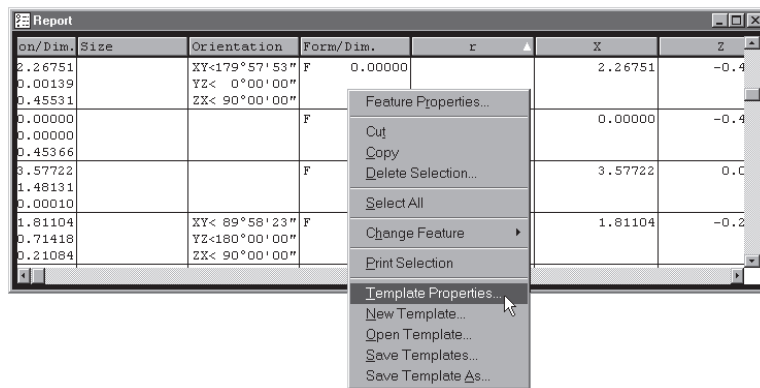
Step 1

Right click on the reports template.



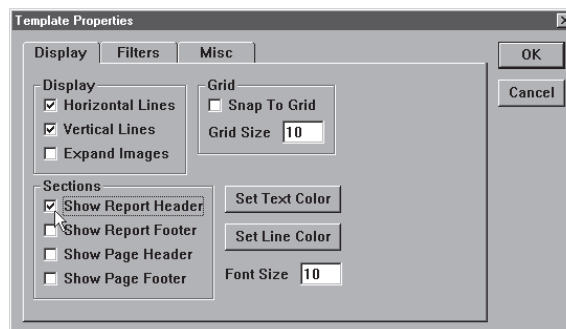
Step 2

Select *template properties* from the list.

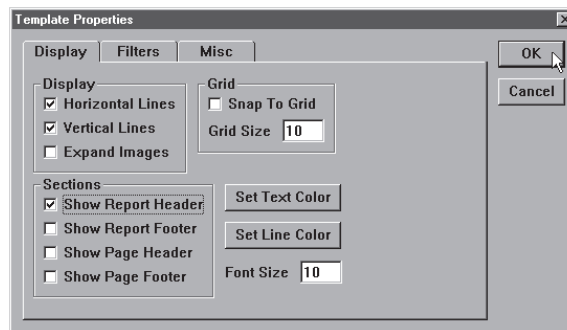


Step 3

Use the mouse to check the show report header check box.



Step 4
Click OK in the dialog box.



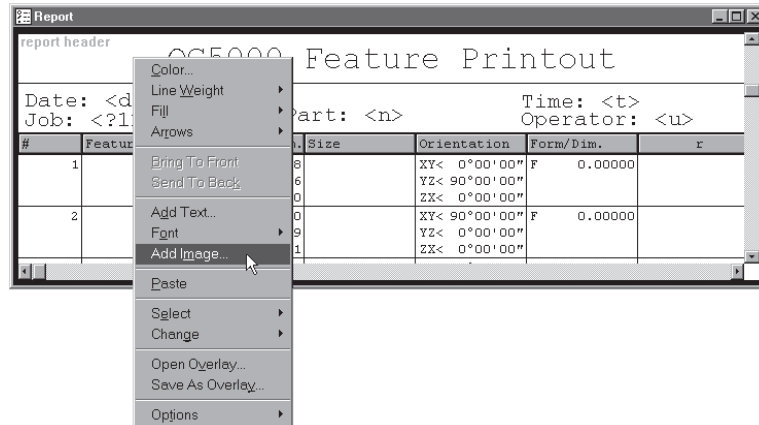
Customizing Report Headers

Users can edit report headers to suit individual needs. Report headers can include text and graphics.

To place a graphic in a report header

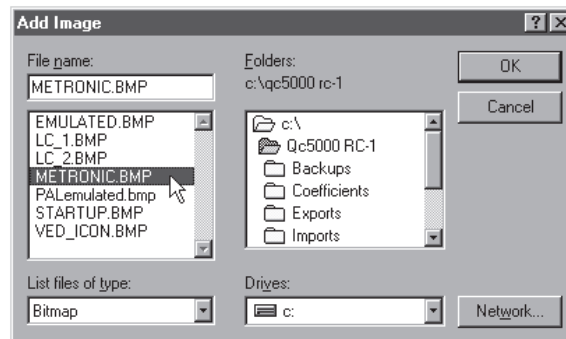
Step 1

Right click on the report header and select *add image* from the list.



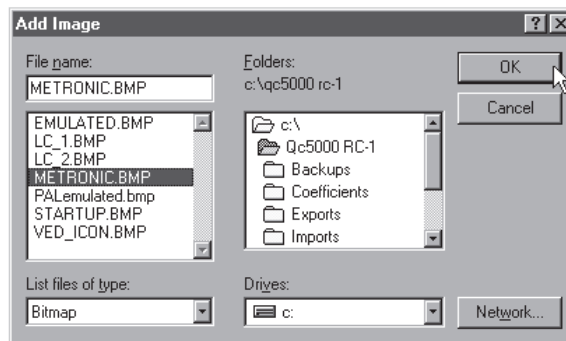
Step 2

Select the graphic file.



Step 3

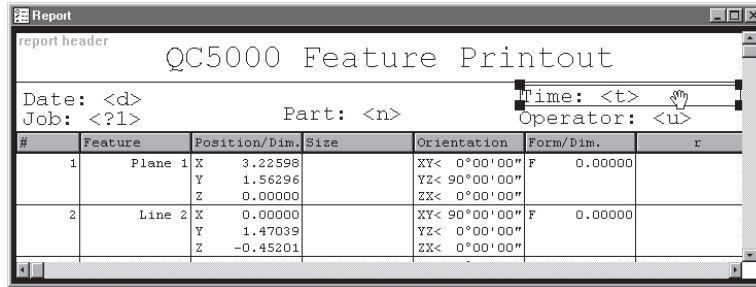
Click OK in the dialog box.



To arrange text and graphics in a report header

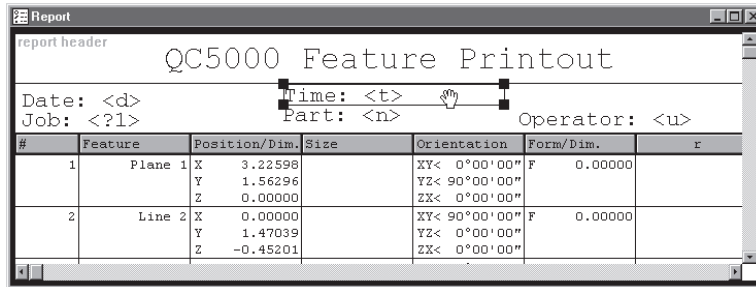
Step 1

Click on the text or graphic to be moved.



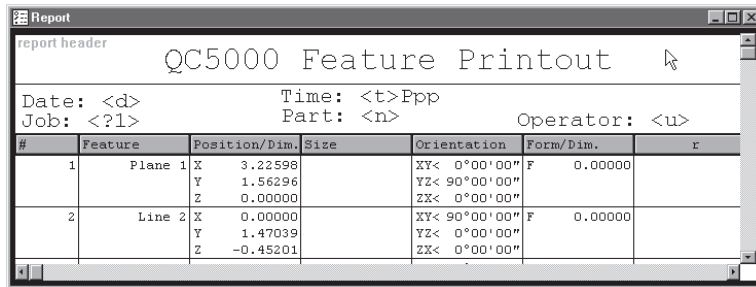
Step 2

Hold down the mouse button and drag the object to the desired location.



Step 3

Release the mouse button.



Automated Text Input & Prompting

Use automated text input and prompting to automatically supply text input or to request it from the user. The QC-5000 recognizes these automated text inputs:

- <u> prints the user name from login
- <n> prints the part name
- <d> prints the date
- <t> prints the current time
- <x> prints the max number of pages
- <p> prints the current page number



NOTE

Automated text inputs are case sensitive. For example, <U> is NOT the same as <u>.

Use automated input prompts to request text entry from the user. For example,

Part number: <?1>

prompts the user to enter the part number in the report header before printing.

Enter automated input prompts sequentially. For example, if <?1> is used for prompting the part number use <?2> for the next input prompt.

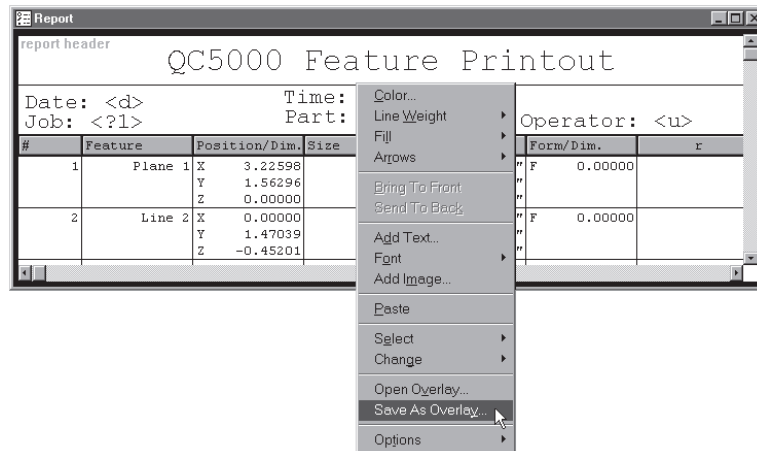
Overlays

Save headers for repeated use as overlays. Using an overlay saves the time and trouble of creating the same header for each new job.

To save a report header as an overlay

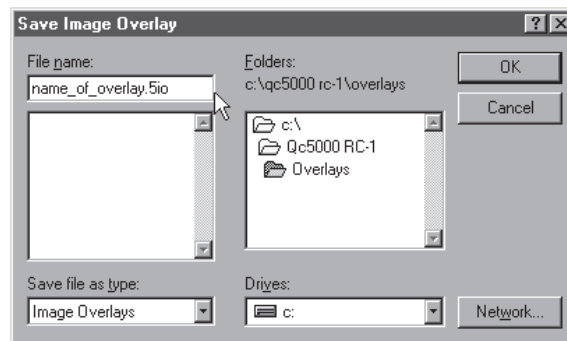
Step 1

Right click on the report header and select *save as overlay* from the list.



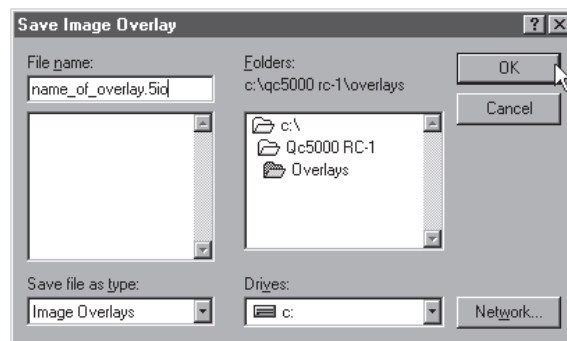
Step 2

Type a name for the overlay as shown.



Step 3

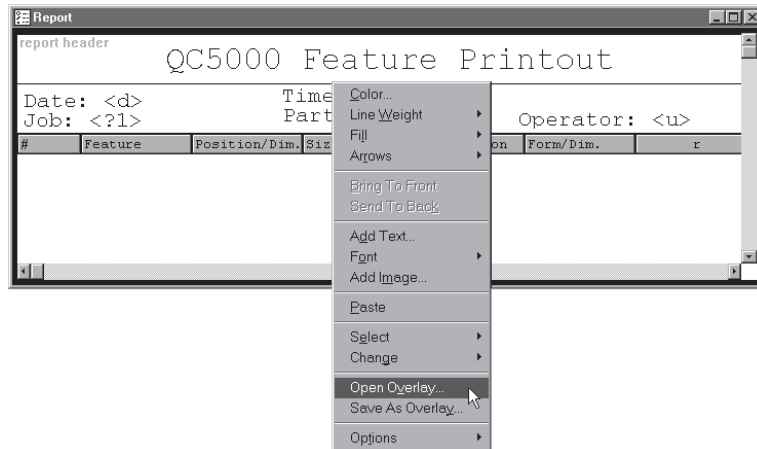
Click OK in the dialog box.



To place an overlay in a report header

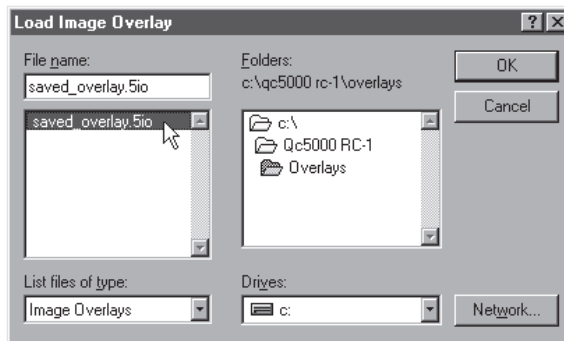
Step 1

Right click on the report header and select *open overlay* from the list.



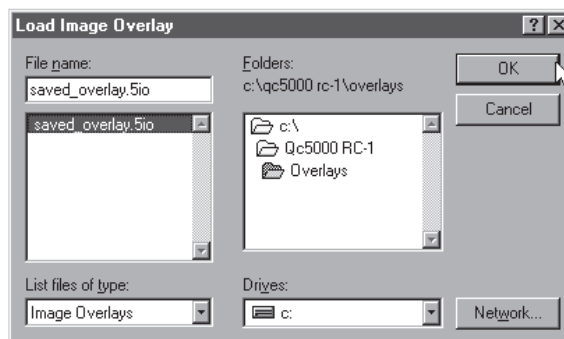
Step 2

Select the overlay as shown.



Step 3

Click OK in the dialog box.



Program Template

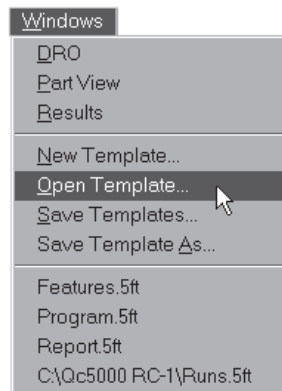
Use the program template to monitor the steps of a parts program. Green checkmarks indicate steps successfully completed and a blue arrow points to the current step. Loop counts are displayed in the data column. Programs can be set to run a certain number of times. This is referred to as 'looping' and each individual run is a 'loop.'

Program templates display information only. No data from the features list can be imported to the program template.

To open the program template

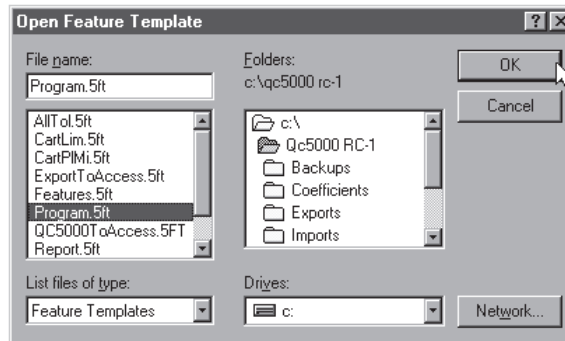
Step 1

Select *open template* from the windows menu.



Step 2

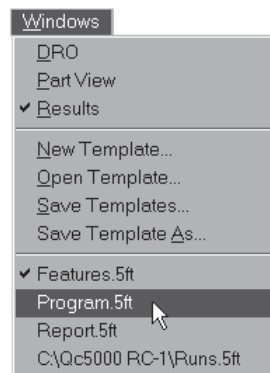
Select *program.5ft* from the file name list box. The file path is *c:\qc5000\templates*.



OR

Step 1

Select *program.5ft* from the windows menu.



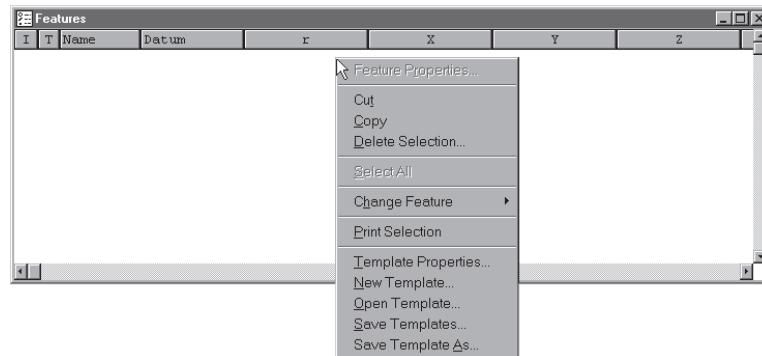
Template Properties

Standard template features can be modified by the user. Use the template properties dialog box to modify QC-5000 templates to suit your application.

To access the template features dialog box

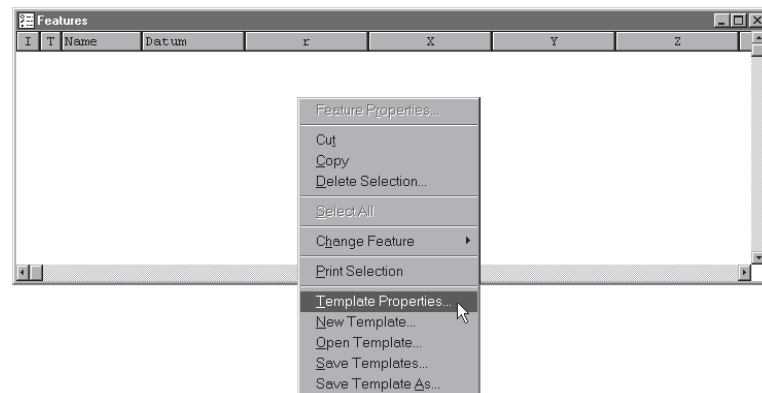
Step 1

Right click on any template.



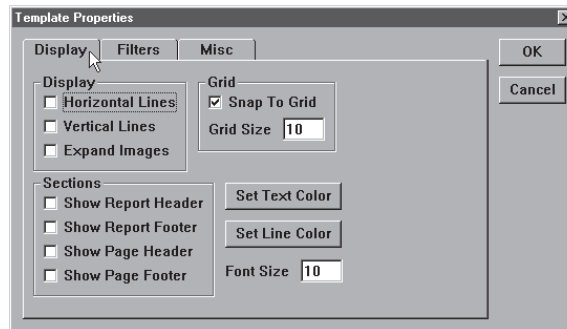
Step 2

Select *template properties* from the list.



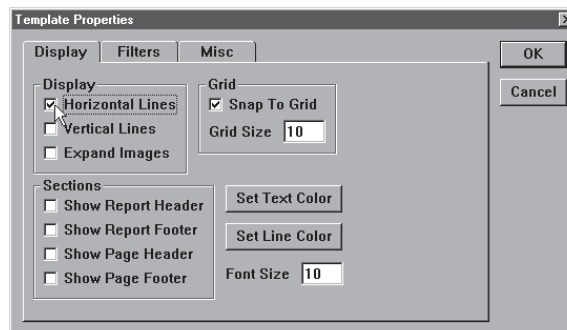
Template Features Dialog Box

The template features dialog box contains three tabs: display, filters, and misc (miscellaneous). Click on the *display* tab to modify template display features.

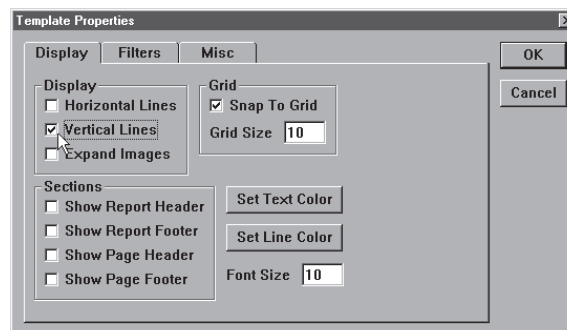


Display tab

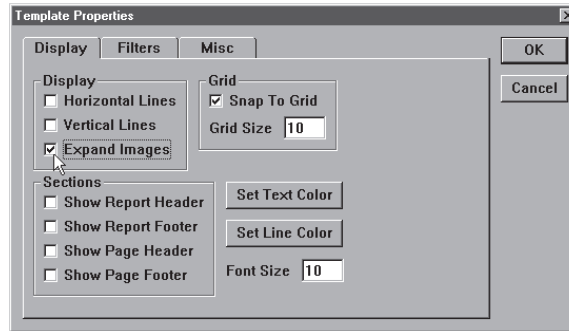
Use the mouse to place check in the horizontal lines check box to display horizontal separator line between each template row.



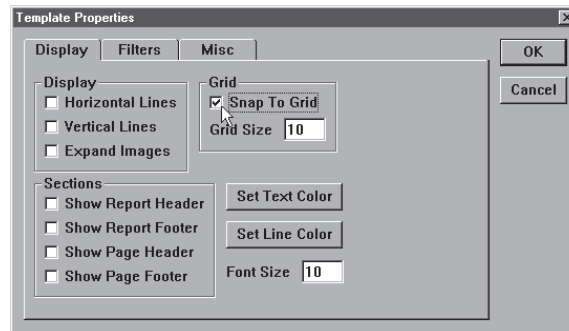
Check the vertical lines box to display vertical separator lines between each template column.



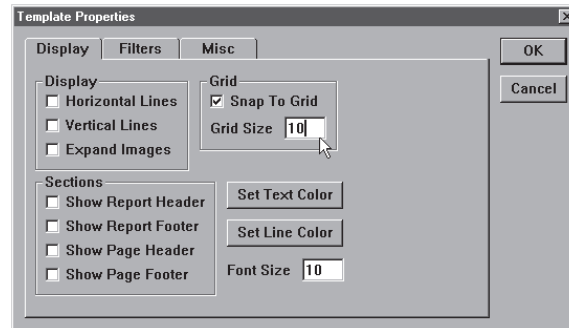
Display partview/image features in a template by checking the *expand images* box.



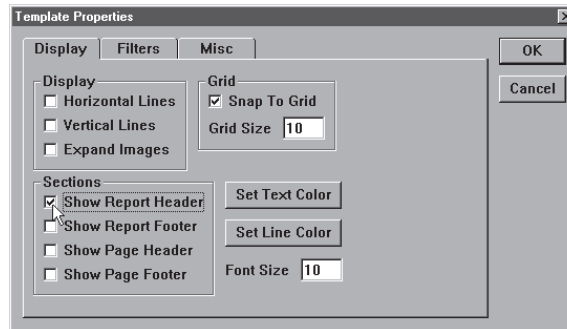
Check the *snap to grid* box to activate the alignment grid in the template. When *snap to grid* is checked fields in the template are automatically aligned to the nearest grid intersection.



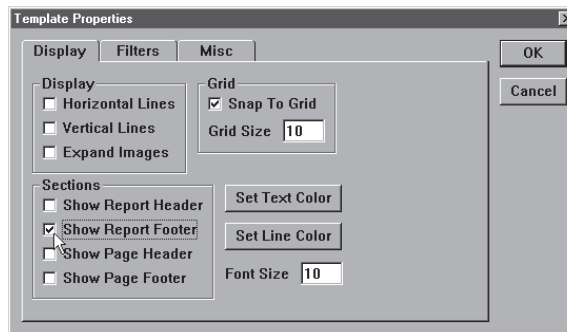
Set the size of the grid squares using the *grid size* text box.



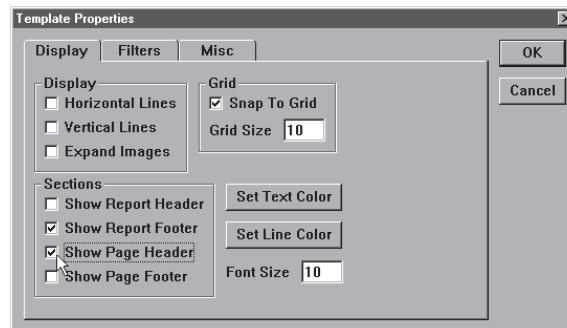
Display a report header at the top of a template by checking the *show report header* box. The report header can include custom text and graphics. Report headers print at the top of the first page of a report.



Create a report footer at the bottom of a template by checking the *show report footer* box. Report footers can include custom text and graphics. The report footer prints at the end of a report.

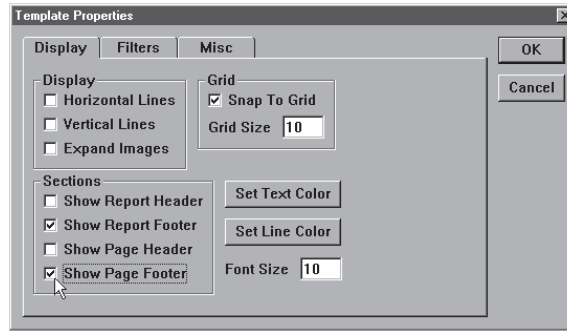


Display a page header at the top of each report page by checking the *show page header* box. The page header can include custom text and graphics.

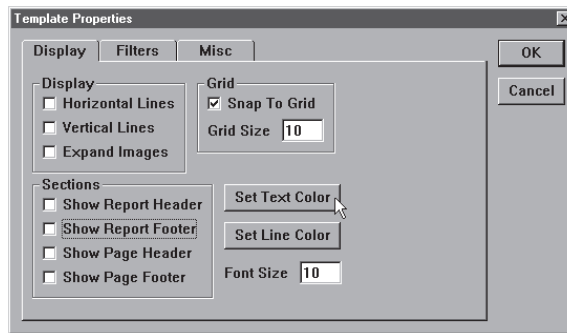


Chapter 5 Tolerancing & Templates

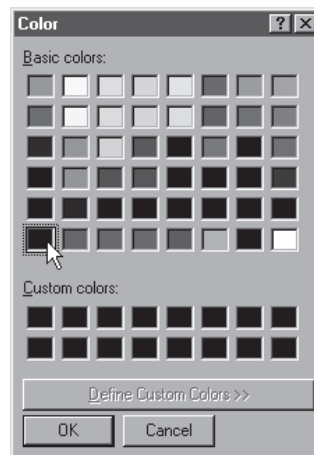
Create a page footer at the bottom of each report page by checking the *show page footer box*. Page footers can include custom text and graphics.



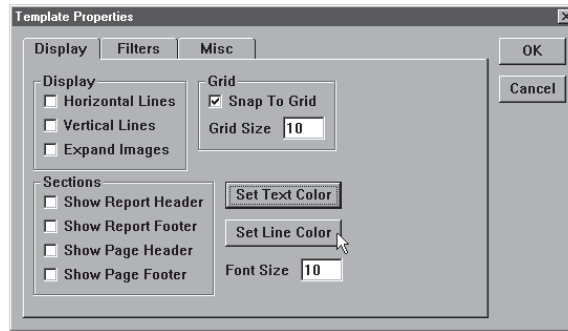
Click on the *set text color* button to change the color of text in the template.



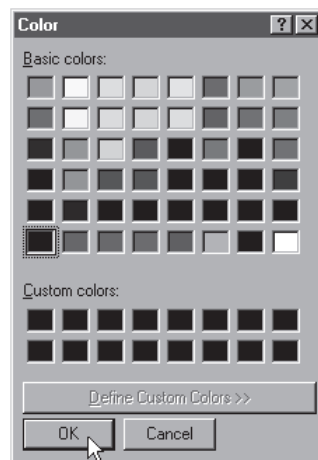
Select a color from the *color* window as shown.



Click on the *set line color* button to change the color of horizontal and vertical lines in the template.

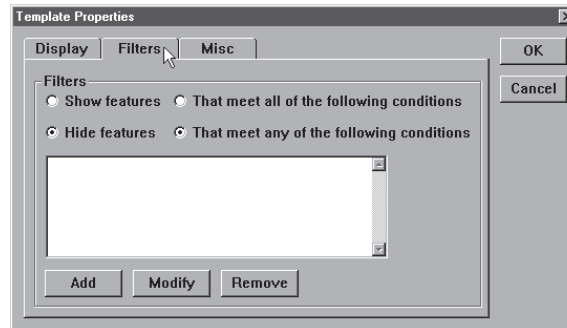


Select a color from the *color* window as shown.



Filters tab

Filters are conditions (or sets of conditions) that determine what features appear (or do not appear) on a template. Use the filters tab to establish the conditions features must meet to be included or excluded from the template.



For example, if a part drawing calls for a circle to have a diameter of 0.375 inches with a tolerance of 0.006 inches, you can create a template that displays only circles with a diameter greater than 0.381 inches or less than 0.370 inches. This filter allows the user to track features that fail to meet specifications without having to sort through all the features.

To create a filter

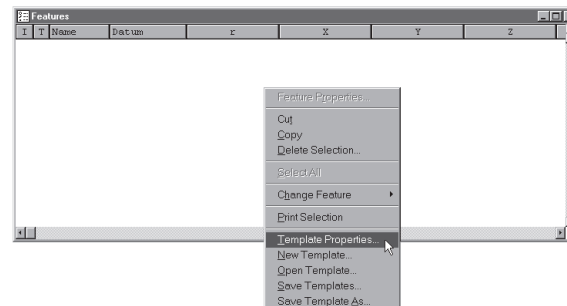


NOTE

This filter is based on the example above but steps can be varied to suit specific applications. Once you have created this filter it is easy to create other filters for your applications.

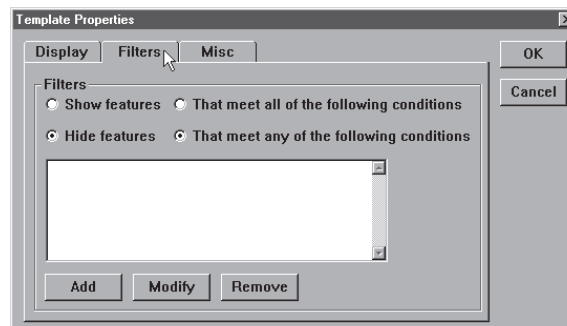
Step 1

Right click on the template and select *template properties* from the list.

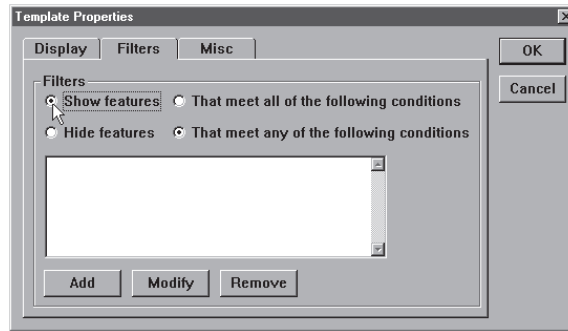


Step 2

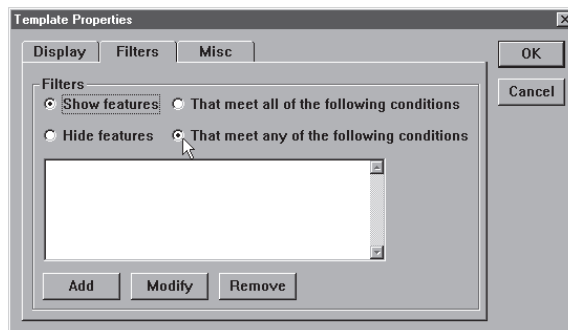
Select the *filters* tab in the dialog box.



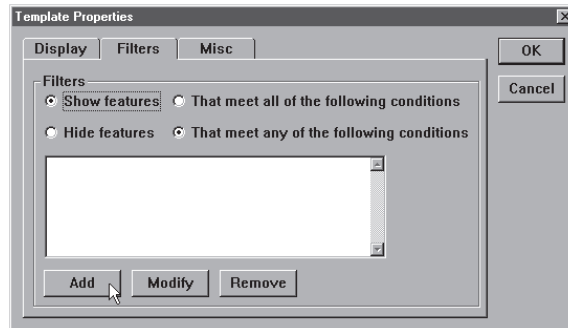
Step 3
Click on the *show features* button.



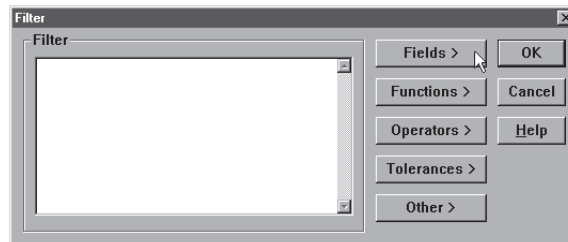
Step 4
Click on the *that meet any conditions* button.



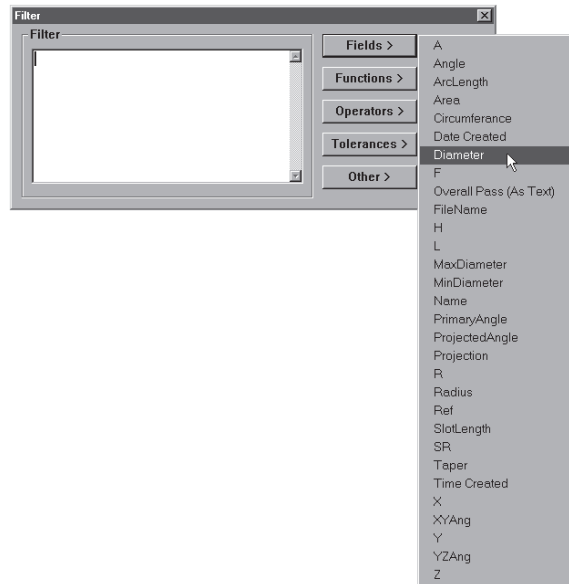
Step 5
Click the *add* button.



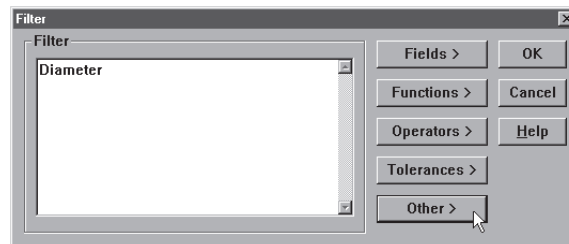
Step 6
Click the *fields>* button in the filter dialog box.



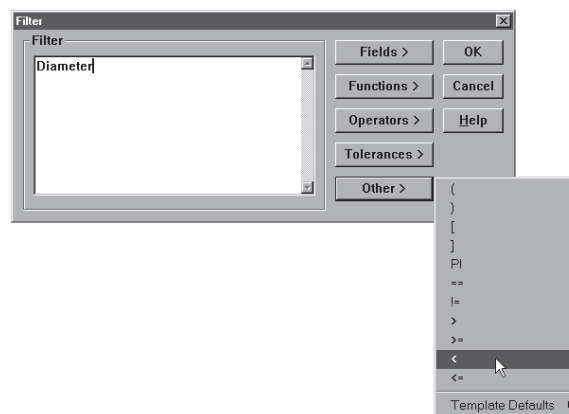
Step 7
Select *diameter* from the list.



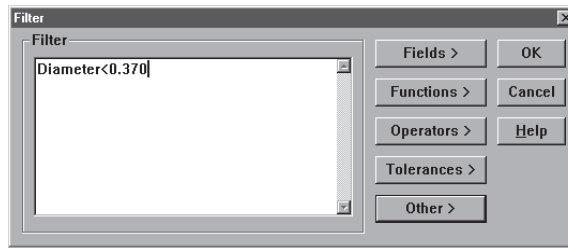
Step 8
Click the *other*> button.



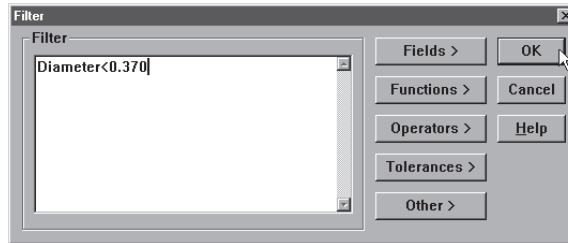
Step 9
Select the < (less than) symbol from the list.



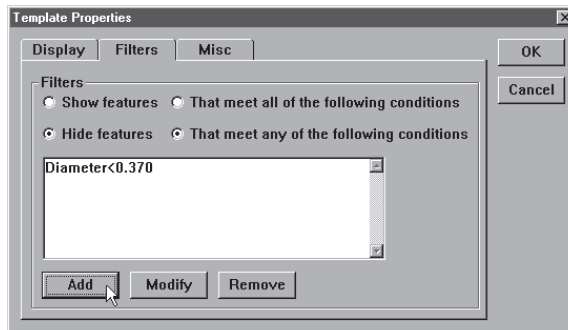
Step 10
Type 0.370 in the text box as shown.



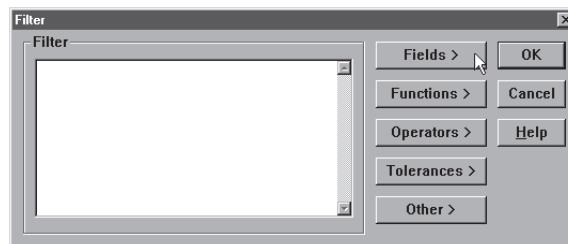
Step 11
Click OK in the filter dialog box.



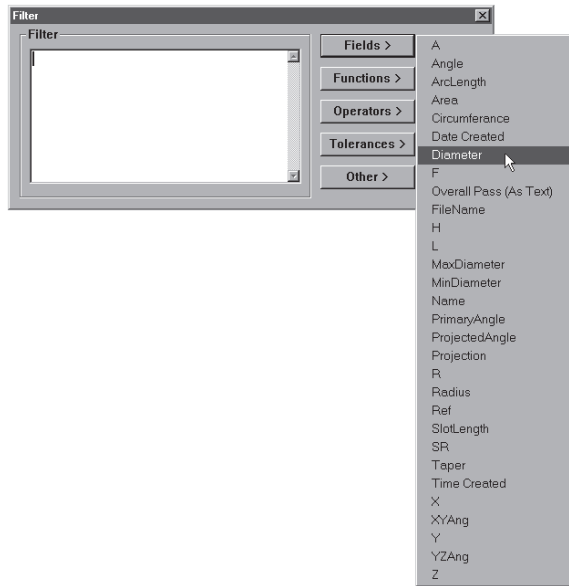
Step 12
Click the *add* button.



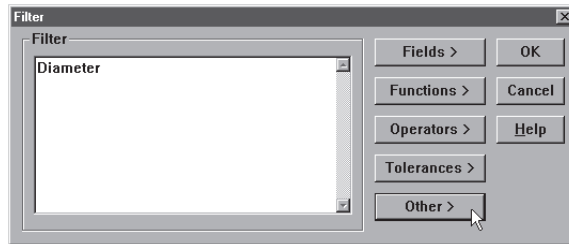
Step 13
Click the *fields*> button in the filter dialog box.



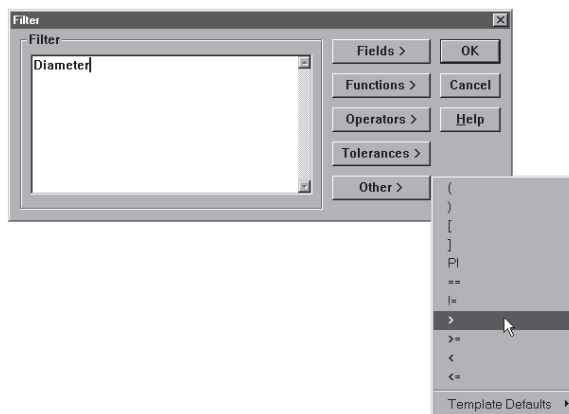
Step 14
Select *diameter* from the list.



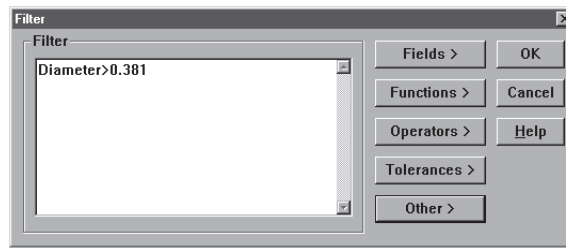
Step 15
Click the *other>* button.



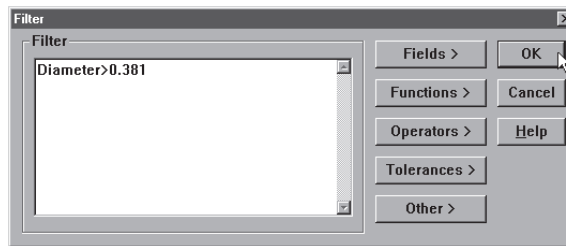
Step 16
Select the > (greater than) symbol from the list.



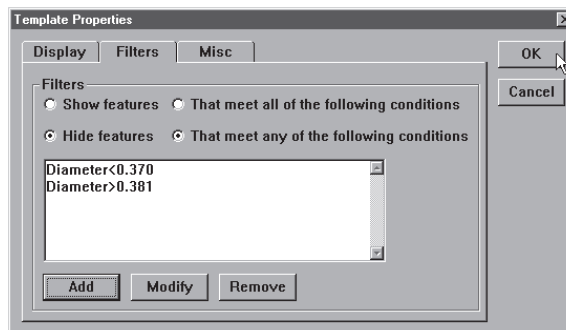
Step 17
Type 0.381 in the text box as shown.



Step 18
Click OK in the filter dialog box.

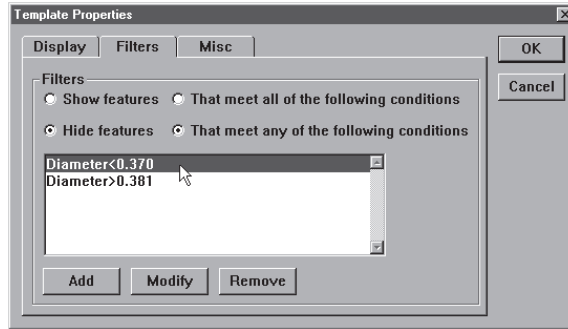


Step 19
Click OK in the template properties dialog box.

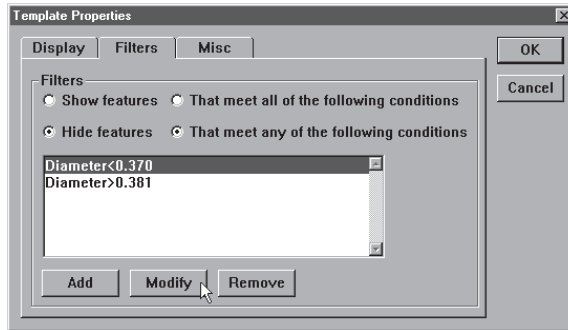


To modify a filter

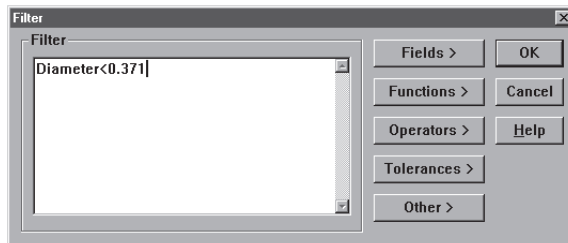
Step 1
Highlight the desired filter.



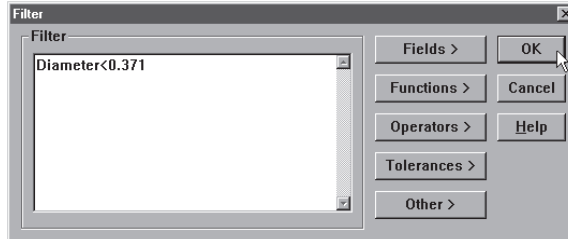
Step 2
Click the *modify* button on the filters tab (template properties dialog box).



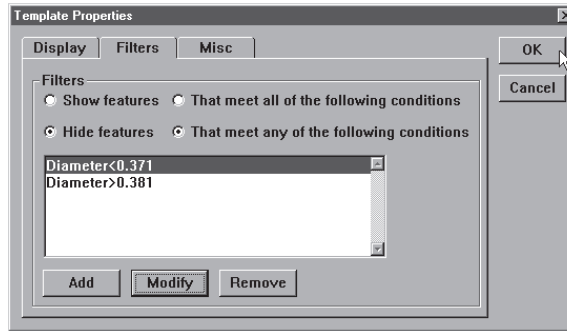
Step 3
Type in the modification.



Step 4
Click OK in the filters dialog box.



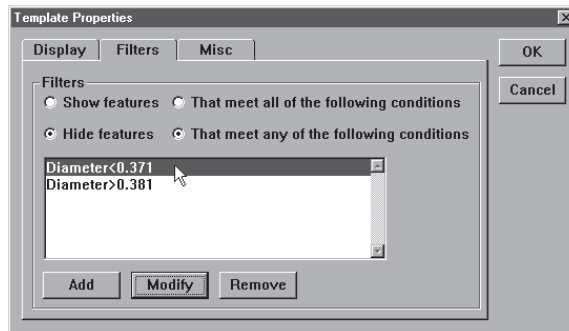
Step 5
Click OK in the template properties dialog box.



To remove a filter

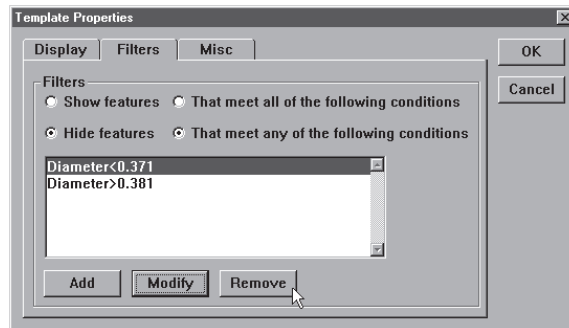
Step 1

Highlight the desired filter on the *filters* tab (template properties dialog box).



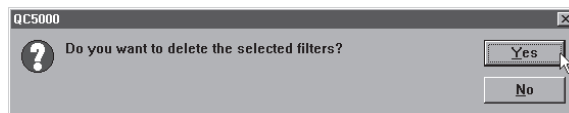
Step 2

Click the *remove* button.



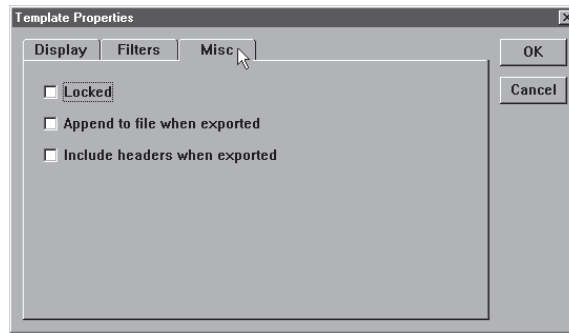
Step 3

Click *yes* in the dialog box.

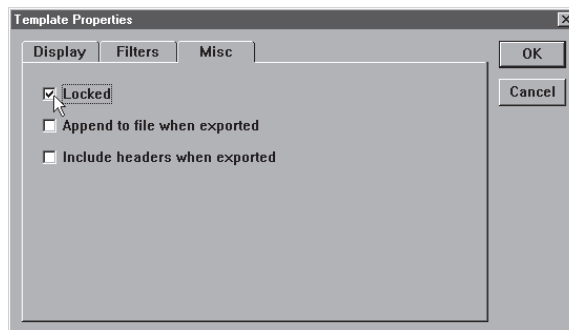


Misc tab (miscellaneous)

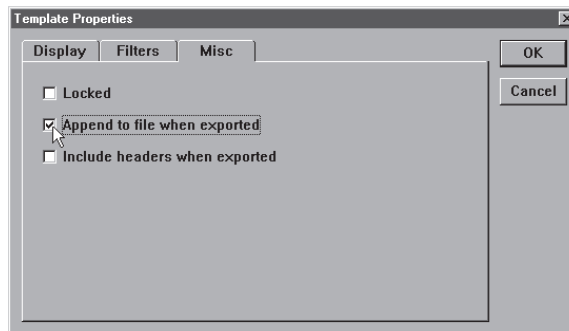
The miscellaneous tab contains three check boxes.



Place a check in the *locked* box to require the supervisor password before templates are edited.



Place a check in the *append to file when exported* box to export template properties.



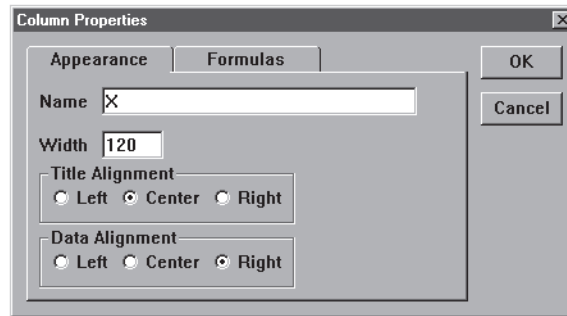
Place a check in the *include headers when exported* box to export report and page headers.

Column Properties

Columns in each template have properties that can be modified to suit specific application needs. Standard column properties apply to columns in every template. Additionally, there are column properties unique to specific templates.

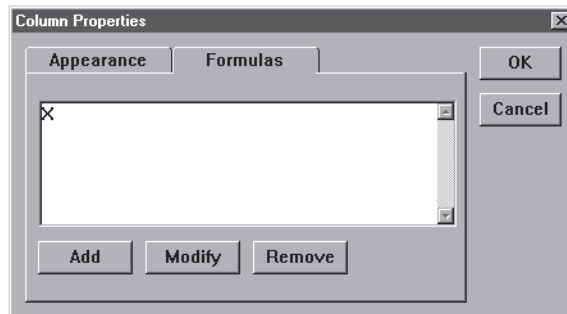
Standard column properties

Right click on any template and select column properties from the list. This brings up the column properties dialog box.



Appearance tab

The appearance tab allows the user to assign a name to the column, establish column width, title alignment, and data alignment.



Formulas tab

Column formulas are conditions (or sets of conditions) that determine what labels appear (or do not appear) with features in a column. Use the formulas tab to establish the conditions features must meet to be labeled.

Use formulas to customize column data and perform calculations. For example, a formula can be written to display the 'X' value of a feature.

A more complex formula can be written to display the standard deviation of several diameters.

Parantheses()

Use parantheses to order mathematical equations. For example, in the following equation

$$6*(4+2) = 36$$

the 4 and 2 are added together before being multiplied by the 6.

The same equation without the parantheses is as follows:

$$6*4+2 = 26$$

Here 6 is multiplied by 4 then added to 2.

Work from the innermost set of parantheses to the outermost set in equations using multiple sets of parantheses.

For example,

$$((4+2)*(4+2)+1) = 37$$

Here the addition in the innermost parantheses is performed first, then the two sums are multiplied and added to 1.

**NOTE**

The mathematical order of operations is always multiplication, division, addition, subtraction.

Parantheses can also be used to call functions such a squares, square root, max, min, etc. For example,

$$\text{sqrt}(100) = 10$$

the function (square root) is performed on the number in the parantheses (100).

Brackets []

Use brackets to recall previously measured features for a formula. For example,

[Circle 1]x

recalls the 'x' value of Circle 1.

A more complex equation might be

$$\text{sqr}([\text{Circle 1}]\text{radius})*\text{PI}$$

Here the radius of Circle 1 is squared and multiplied by pi which produces the area of Circle 1.

Quote marks ""

Use quote marks to indicate an output in a formula. For example,

If([Circle 1]radius<=2.0,"Small")

prints the word "Small" in the column if the radius of Circle 1 is less than or equal to 2.0.

A more complex equation might be

If([Circle 1]radius<=2.0,"Small","Big")

Here the "Small" is printed if the radius of Circle 1 is less than or equal to 2.0 and "Big" is printed if it is greater than 2.0.

Use empty quote marks "" to show no output. For example,

If([Circle 1]radius>2.0,"","Small")

gives the same output as

If([Circle 1]radius<=2.0,"Small")

using a slightly different formula.

Min/Max

Use the min and max functions to find the minimum or maximum parameter for a series of features. For example,

Max(-1,-10,"Diameter")

will produce the maximum diameter of the last 10 circles measured.

Sample Formula

The following example creates a formula to group circle features into by size.

Use the formula:

If(Diameter<0.381,"Small","Large")

to sort circle features into two groups: large or small.

To create the sample formula

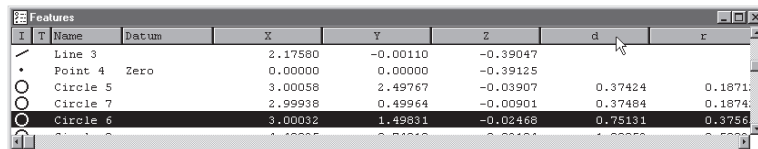


NOTE

This formula is an example. Steps can be varied to suit specific applications. Once you have created this formula it is easy to create other formulas for your applications.

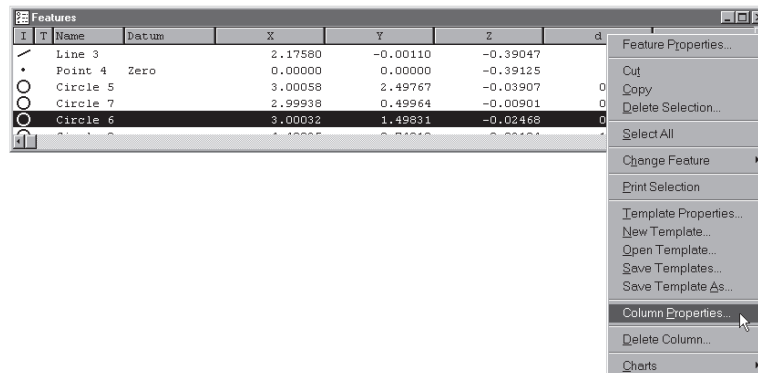
Step 1

Right click at the top of the template column as shown.



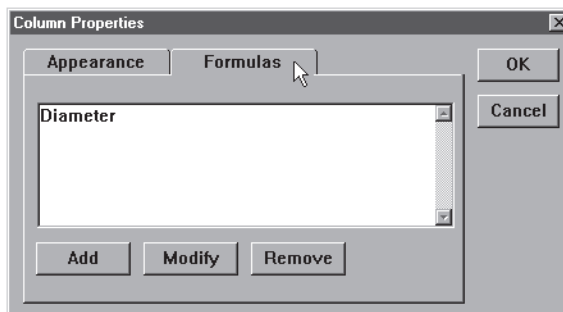
Step 2

Select *column properties* from the list.

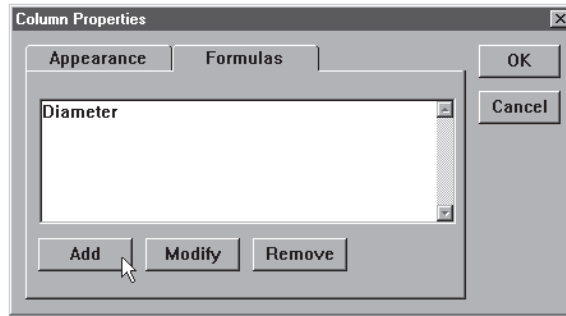


Step 3

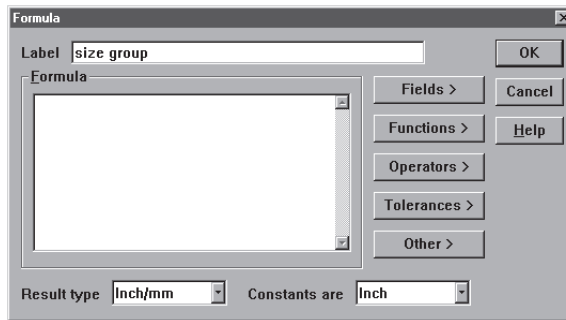
Click on the *formulas* tab.



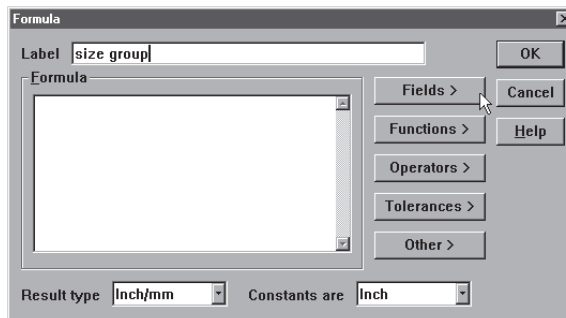
Step 4
Click *add*.



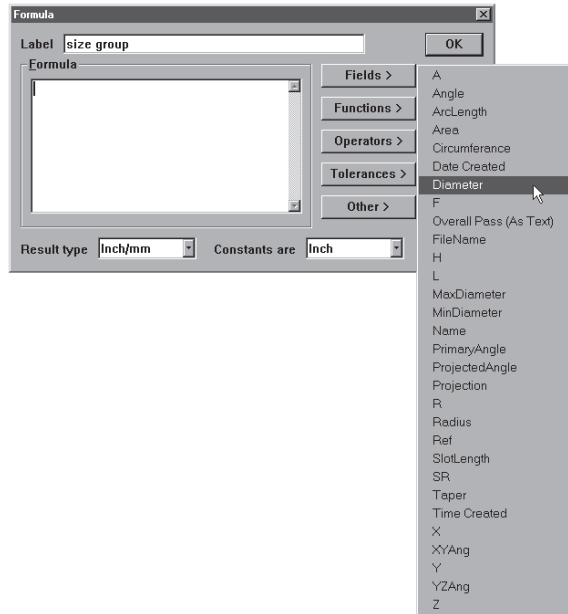
Step 5
Type 'size group' in the label text box.



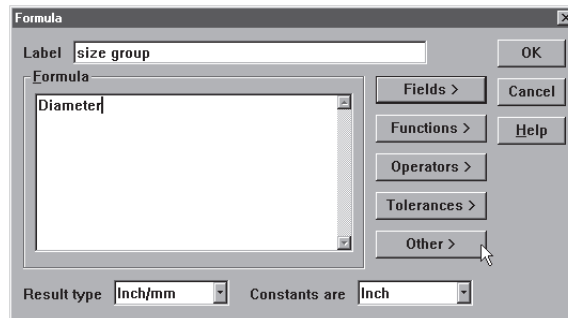
Step 6
Click on the *fields>* button.



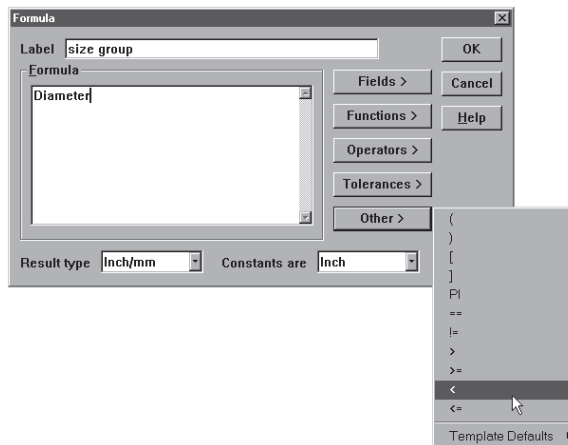
Step 7
 Select *diameter* from the list.



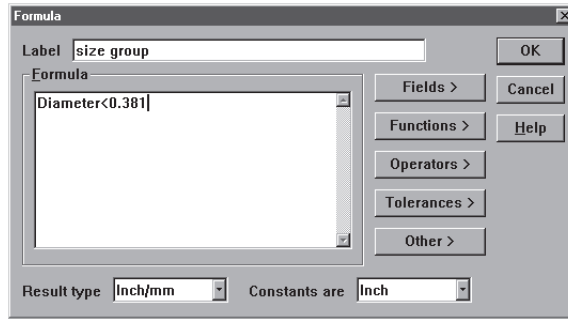
Step 8
 Click on the *other>* button.



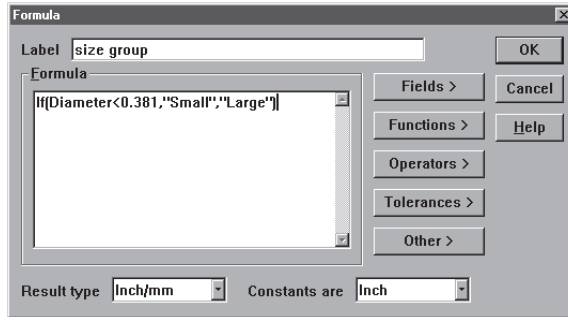
Step 9
 Select the < (less than) symbol from the list.



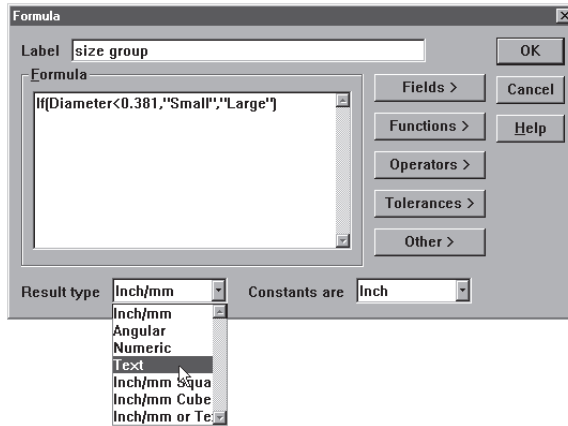
Step 10
Type 0.381 in the text box as shown.



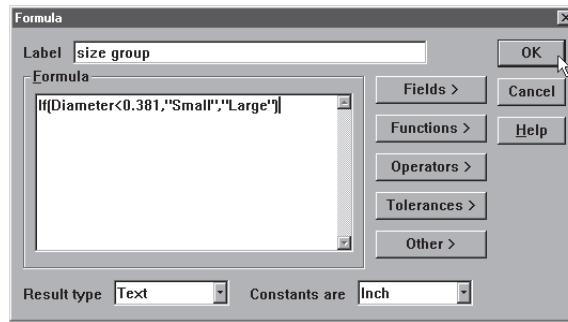
Step 11
Type in the rest of the formula as follows:
If(Diameter<0.381,"Small","Large")



Step 12
Select *text* from the result type list box.

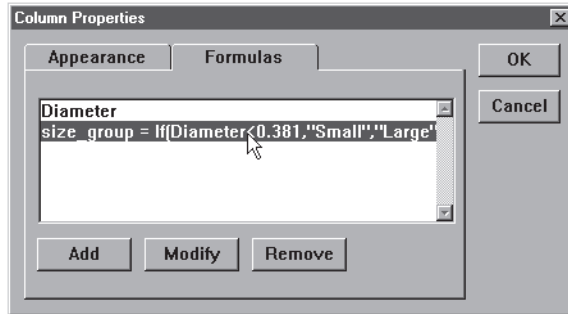


Step 13
 Click OK in the formula dialog box.

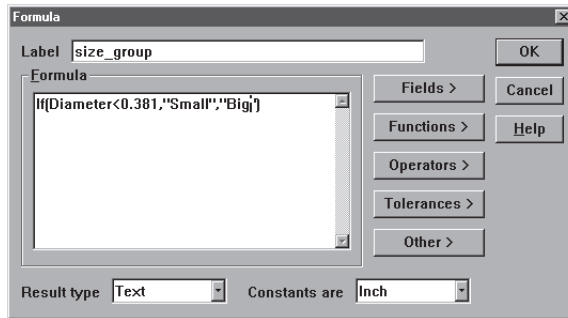


To modify a formula

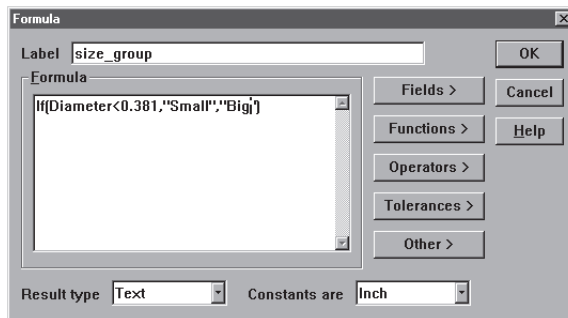
Step 1
Highlight the desired formula.



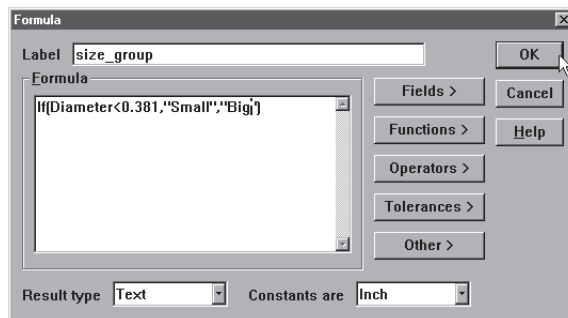
Step 2
Click the *modify* button on the formulas tab (column properties dialog box).



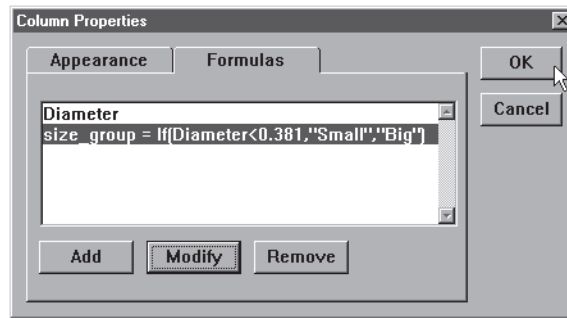
Step 3
Type in the modification.



Step 4
Click OK in the formulas dialog box.



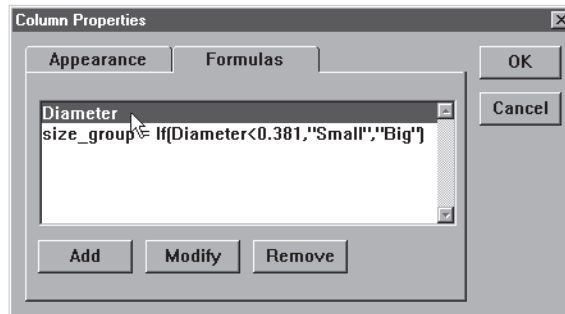
Step 5
Click OK in the column properties dialog box.



To remove a formula

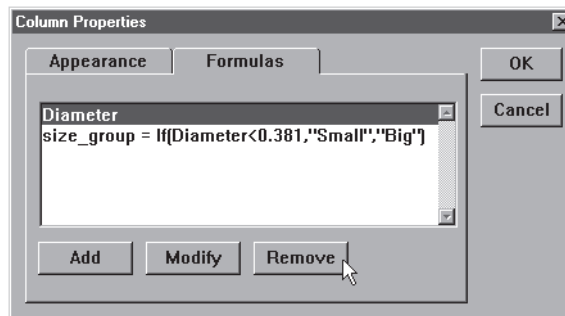
Step 1

Highlight the desired formula in the text box on the formula tab (column properties dialog box).



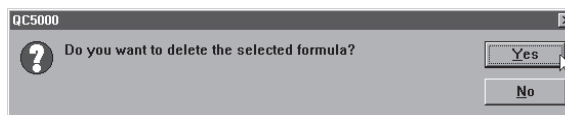
Step 2

Click the *remove* button.



Step 3

Click *yes* in the dialog box.



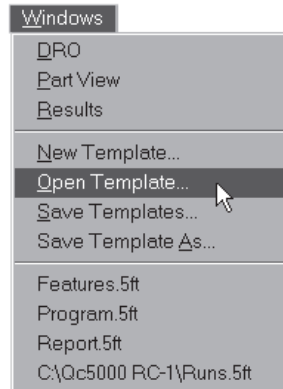
Runs Template

Use the runs template to track critical features from one program run to the next. Data in the runs is restricted to one feature attribute per column. For example, a column may display only the 'x' value for a given circle.

To open the runs template

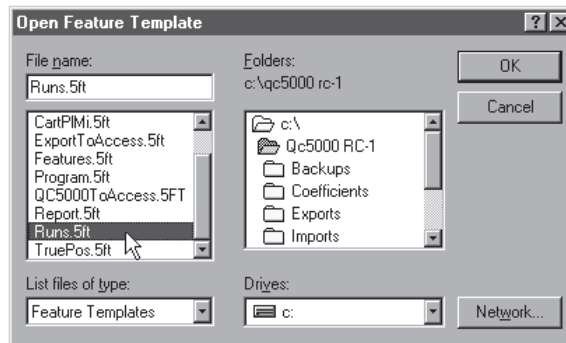
Step 1

Select *open template* from the windows menu.



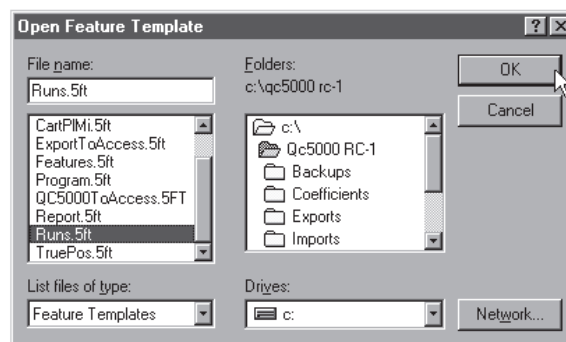
Step 2

Select *runs.5ft* from the file name list in the open template dialog box.



Step 3

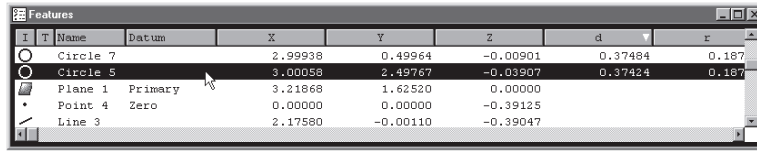
Click OK in the dialog box.



To add data to the runs template

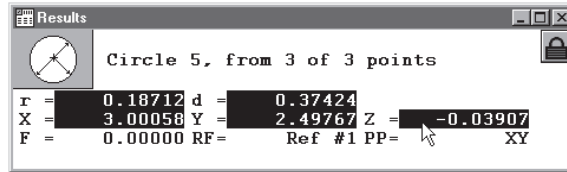
Step 1

Highlight a feature in the features list.



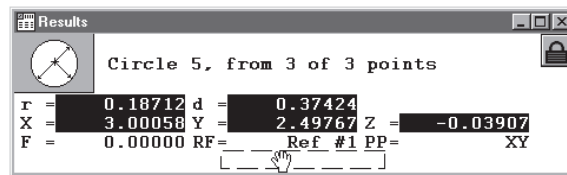
Step 2

Click on the desired fields in the results window to highlight them.



Step 3

Place the cursor over the highlighted fields and hold down the left mouse button.

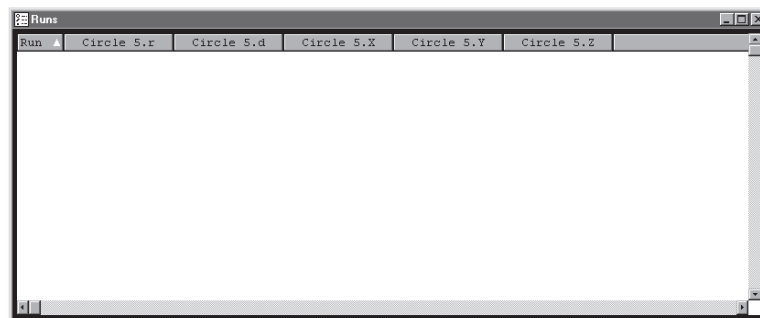


Step 4

Drag the fields into the runs template.



The new fields appear in the template as shown.



Nesting Template Windows

Up to ten can be open at one time. Nest templates within a single window to organize the desktop. Use the tabs to view nested windows.



NOTE

Do not open unneeded templates. System speed decreases as more templates are opened. Use the minimum number of templates required for fastest processing.

To nest template windows

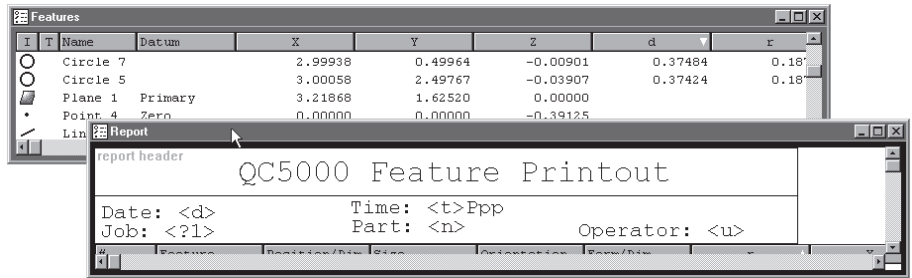
Step 1

Place the cursor over the title bar of the template window.



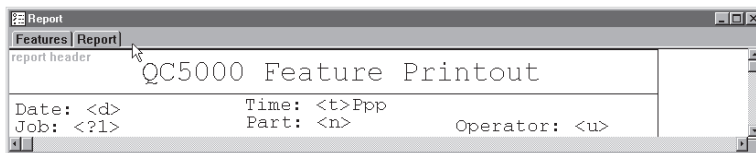
Step 2

Hold down the left mouse button and drag the window another template window.



Step 3

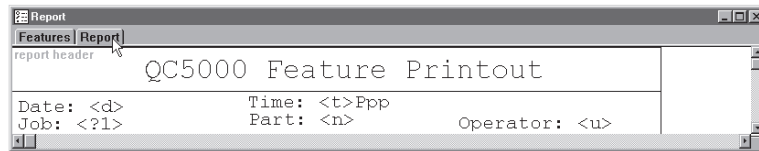
Release the left mouse button.



To separate template windows

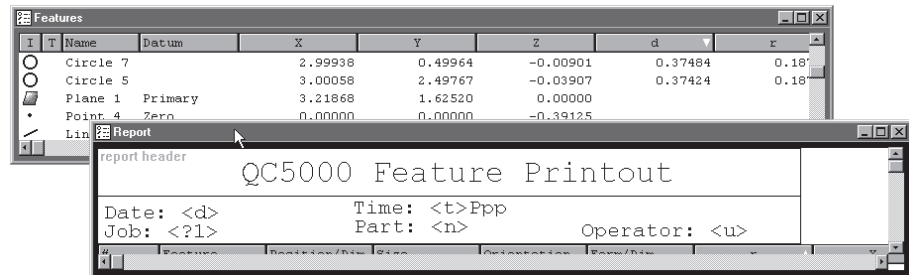
Step 1

Place the cursor of the desired template tab.



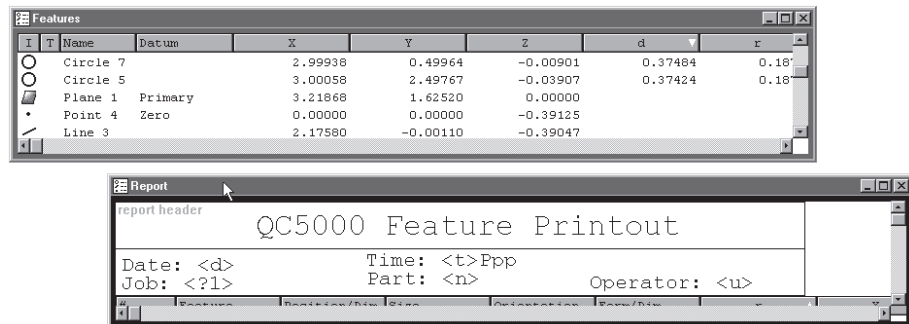
Step 2

Hold down the left mouse button and drag the template out of the window.



Step 3

Release the mouse button.



Creating New Templates

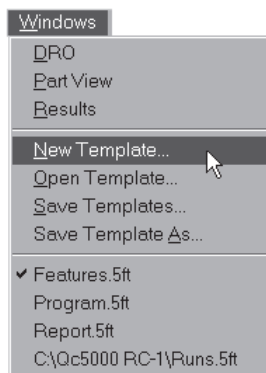
Creating a new template allows you to customize report formats and information in the features list. For example, templates can be designed to export data in a certain format.

To create a new template

#	Feature	Position/Dim.	Size	Orientation	Form/Dim.	Special
1	Plane 1	X 3.21868 Y 1.62520 Z 0.00000		XY< 0°00'00" YZ< 90°00'00" ZX< 0°00'00"	F 0.00000	
2	Line 2	X 0.00000 Y 1.49036 Z -0.39204		XY< 90°00'00" YZ< 0°00'00" ZX< 0°00'00"	F 0.00000	
3	Line 3	X 2.17580 Y -0.00110 Z -0.39047		XY<179°58'14" YZ< 0°00'00" ZX< 90°00'00"	F 0.00000	
4	Point 4	X 0.00000 Y 0.00000 Z -0.39125			F 0.00000	
5	Circle 5	X 3.00058	d 0.37424		F 0.00000	

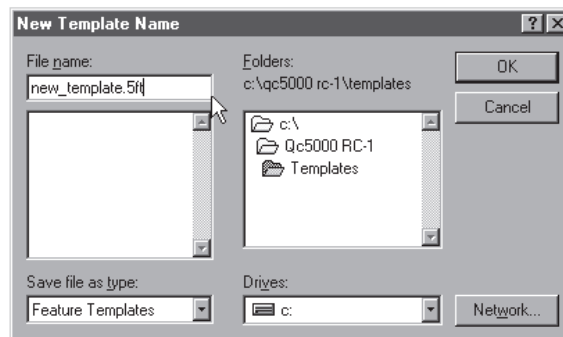
Step 1

Select *new template* from the windows menu.



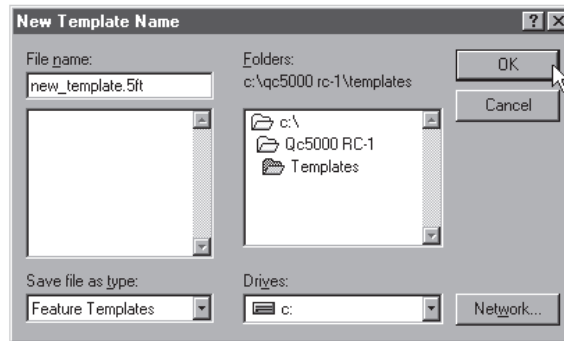
Step 2

Type a name for the template in the file name text box.



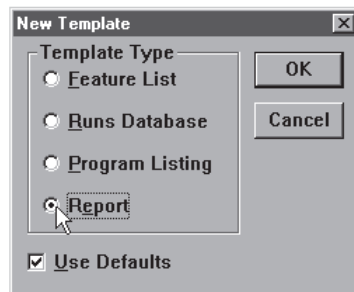
Step 4

Click OK in the new template name dialog box.



Step 5

Select type of template to create in the dialog box.



Chapter 6

User Setup Screens

Setup screens are available to the user for customizing display and some measurement parameters. The specific screens that are available are often determined for each system by the OEM or by the supervisor responsible for system setup and maintenance. A collection of setup screens typically made available to the user is included in this chapter. Screens presented in this chapter are listed below:

Setup task	Screen	Page
Setting up axis encoders	Encoder set up program	6-2
Tools/Customize Screens		
Customizing screen colors	Tools/Customize/Colors	6-6
Including a startup message	Tools/Customize/Miscellaneous	6-14
Specifying error messages	Tools/Customize/Errors	6-15
Specifying status bar information	Tools/Customize/Status bar	6-17
Specifying toolbar contents	Tools/Customize/Toolbars	6-18
Tools/Options Screens		
Setting up video parameters	Tools/Options/VED	6-23
Setting up touch probe parameters	Tools/Options/Probes	6-36
Setting up programming parameters	Tools/Options/Programming	6-39
Specifying the number of program executions	Tools/Options/Runs	6-45
Selecting system sounds	Tools/Options/Sounds	6-46
Locking display and set up settings	Tools/Options/Locks	6-47
Specifying measurement parameters	Tool/Options/Measure	6-49
Specifying displays of parts and probes	Tools/Options/Part view	6-53
Assigning functions to joystick and foot switch buttons	Tools/Options/Buttons	6-63
Specifying display resolution and formatting time/date	Tools/Options/Display	6-67
Specifying encoder resolution	Tools/Options/Encoder	6-69
Specifying system file locations	Tools/Options/Files	6-71
Saving user settings and configuring general parameters	Tools/Options/General	6-74
Tools/CNC/Screens		
Setting up the joystick	Tools/CNC/Joystick	6-79
Setting up the motion mouse	Tools/CNC/Motion mouse	6-83
Setting up and calibrating a probe rack	Tools/CNC/Probe rack	6-86

Encoder setup program

The Encoder Setup Program is used to define and calibrate the system encoders. The program must be run prior to attempting to configure other QC5000 setup parameters.



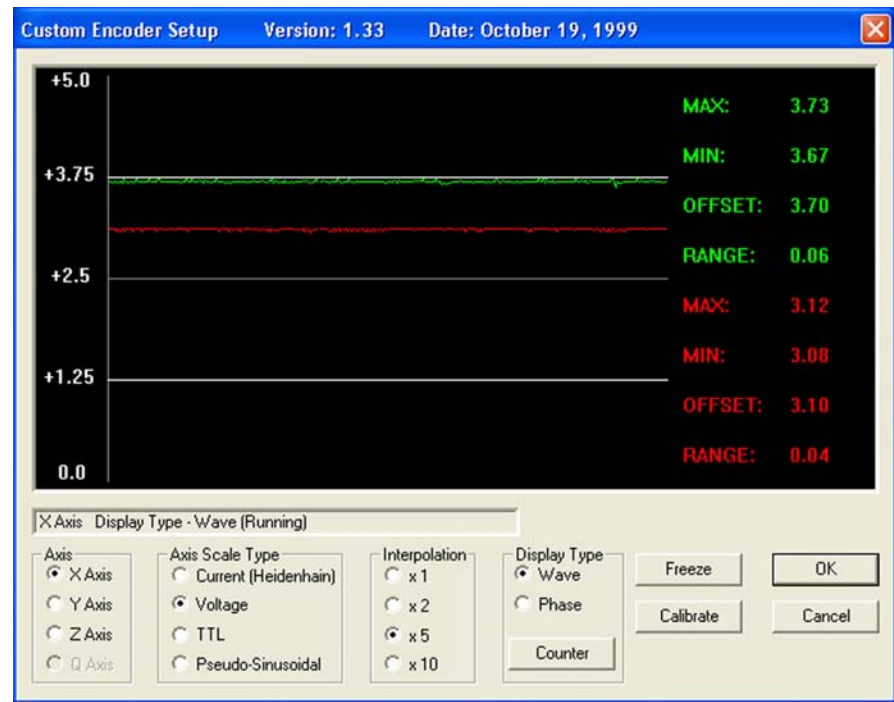
NOTE

Analog encoders must be configured and then calibrated. TTL encoders only need to be configured.

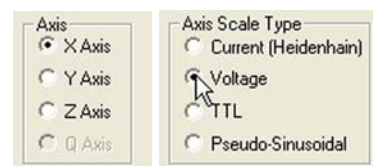
Configuring analog and TTL encoders

Each system axis can be configured independently to accept input counts from an analog encoder or a TTL encoder. Analog encoders require calibration, TTL encoders do not. To configure an analog or a TTL axis encoder:

- 1 Shut down the QC5000 if necessary.
- 2 Double-click the encoder setup icon to launch the Encoder program. The Custom Encoder Setup screen will be displayed.



- 3 Click an Axis radio button to select the desired axis, then click an Axis Scale Type radio button to select the desired encoder (scale) type.





NOTE

Select *Pseudo-Sinusoidal* if your TTL encoder output waveshape is degraded by the capacitive characteristics of its cable/wiring.

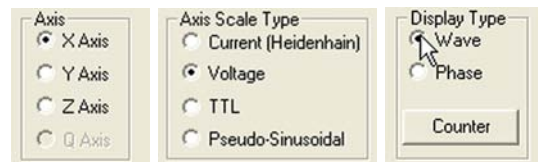
- Repeat step 3 for the remaining axes.

Proceed to the next section to calibrate analog encoders. TTL encoders require no further action.

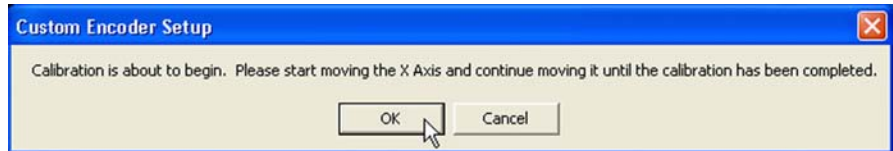
Calibrating analog encoders

Analog encoders require calibration. The process of calibrating analog encoders is very straightforward and is identical for current and voltage output devices. To calibrate an analog encoder:

- Select the desired axis, confirm that the correct Axis Scale Type is selected and click the Wave Display Type.



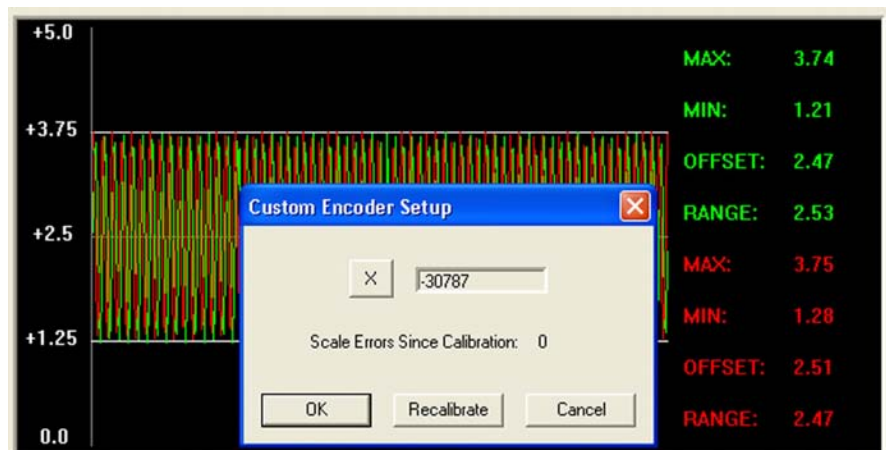
- Click the Calibrate button. You will be instructed to move the axis. Begin moving the axis in slow, gradual back and forth or up and down motions, and



click OK. The sinewave output of the analog encoder will be displayed as the axis is moved. The display is shown as two sinewaves that are 90 degrees out of phase. The real-time display changes as the encoder is moved, however, still images can be captured for evaluation at any time by clicking the Freeze button. Clicking the Display button reverts to the real-time display.



After a moment the Custom Encoder Setup window will also be displayed and will show the changing output count value and the number of count errors detected since the calibration began.



3 Continue moving the encoder slowly between the limits of motion until a few full limit-to-limit motions have been completed.

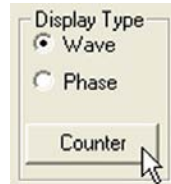


NOTE

The waveshape can include imperfections that won't affect the accuracy of measurements. However, erratic frequency or amplitude variations or high noise content can cause inaccuracies. If any erratic output is noted, or if scale errors appear, check the encoder head mounting, alignment and wiring for problems.

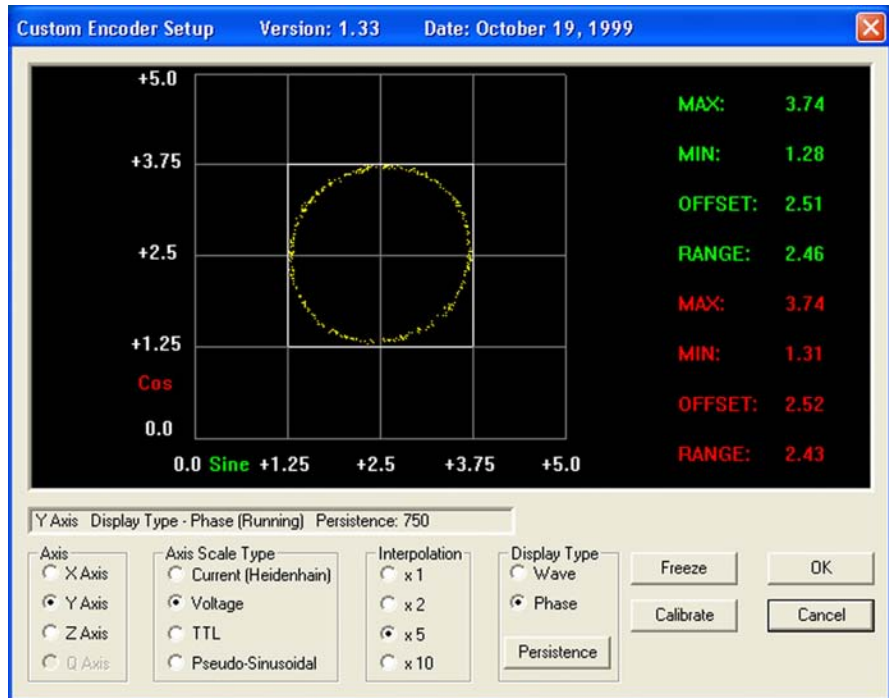
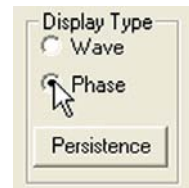
4 When a few full limit-to-limit motions have been completed without scale errors, click OK to close the Custom Encoder Setup window and proceed to the next step.

The display of scale and error counts can be recalled at any

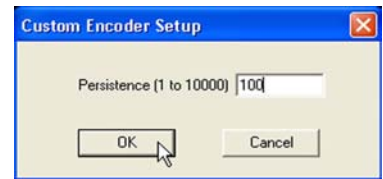


time by clicking the Counter button.

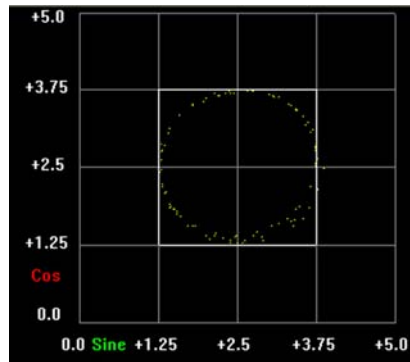
5 Select the Phase Display Type to display the combined phases of the encoder output as an ellipsoidal pattern in the Custom Encoder Setup window as the encoder is moved slowly between the limits of motion. Move the encoder and evaluate the resulting pattern.



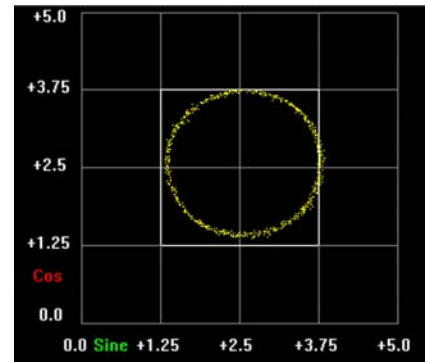
The relative brightness of the pattern can be changed to facilitate the evaluation. Click the Persistence button to display the Persistence Adjustment data field.



The persistence of the pattern image can be changed from 1 to 1000. Higher numbers result in brighter pattern images. The combined-phase pattern will form a circle when the encoder output phase



A Persistence of 100 produces a dim display



A Persistence of 1000 produces a bright display

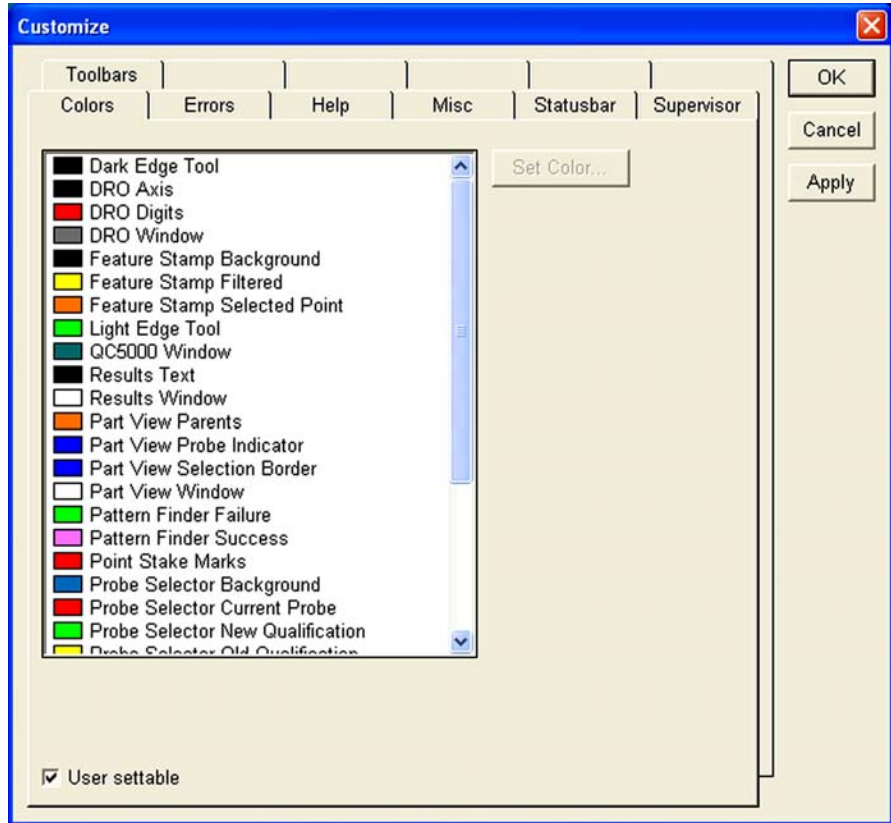
amplitudes are equal. Generally when the pattern displayed is not circular, the reader head will need to be realigned, and the encoder recalibrated from the beginning.

6 When the pattern is circular, repeat the process described in steps 1 through 5 to calibrate any remaining analog encoders.

Setup Tools/Customize screens

Colors screen

Most items on QC5000 screens are displayed in colors that can be changed using tools provided on the Colors screen.

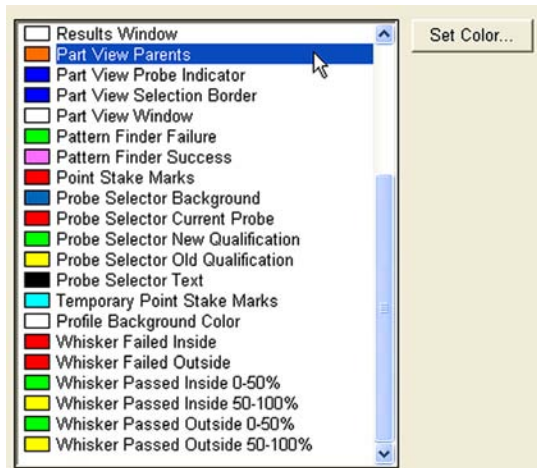


The default color of each item is shown next to the items name in the list box.

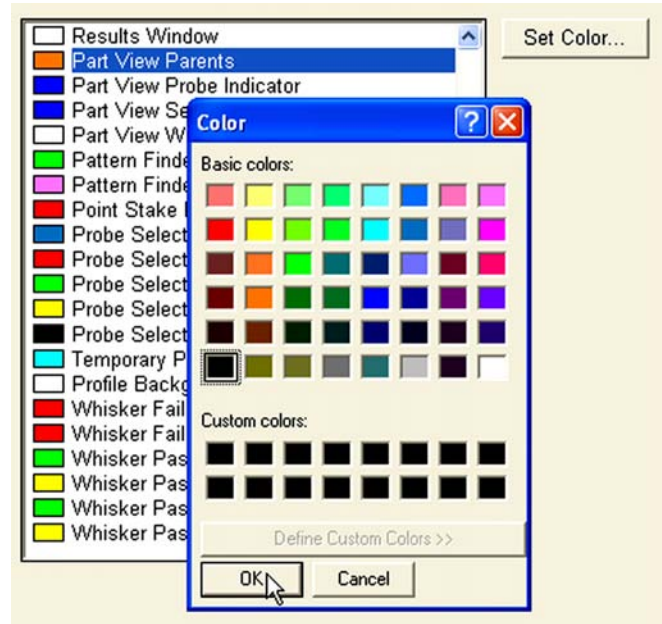
Changing item colors

To change the color of an item:

- 1 Scroll to the desired item if necessary and highlight it by clicking the mouse cursor on the item name.
- 2 Click the Set Color button. The color palette will be displayed.
- 3 Click the new color for the selected item and click OK.



Color list items



Items included in the list are shown below and described in subsequent pages.

- Dark Edge Tool
- DRO Axis
- DRO Digits
- DRO Window
- Feature Stamp Background
- Feature Stamp Filtered
- Feature Stamp Selected Point
- Light Edge Tool
- QC5000 Window
- Results Text
- Results Window
- Part View Parents
- Part View Probe Indicator
- Part View Selection Border
- Part View Window
- Pattern Finder Failure
- Pattern Finder Success
- Point Stake Marks
- Probe Selector Background
- Probe Selector Current Probe
- Probe Selector New Qualification
- Probe Selector Old Qualification
- Probe Selector Text
- Temporary Point Stake Marks
- Profile Background Color
- Whisker Failed Inside
- Whisker Failed Outside
- Whisker Passed Inside 0-50%
- Whisker Passed Inside 50-100%
- Whisker Passed Outside 0-50%
- Whisker Passed Outside 50-100%

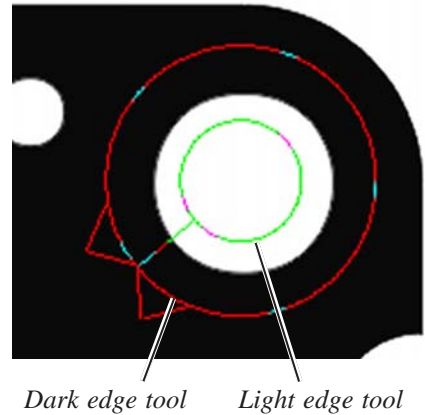
Dark edge and light edge tools

Each VED probe consists of a dark edge tool and a light edge tool. The dark and light edge tools must be oriented properly to scan across an edge:

- The dark edge tool must be on the dark side of an edge
- The light edge tool must be on the light side of an edge

In the example shown here the Circle VED probe is correctly oriented with the dark side tool in the black, and the light side tool in the white.

The default colors are:
Dark edge tool: Black
Light edge tool: Green



DRO axis, digits and window

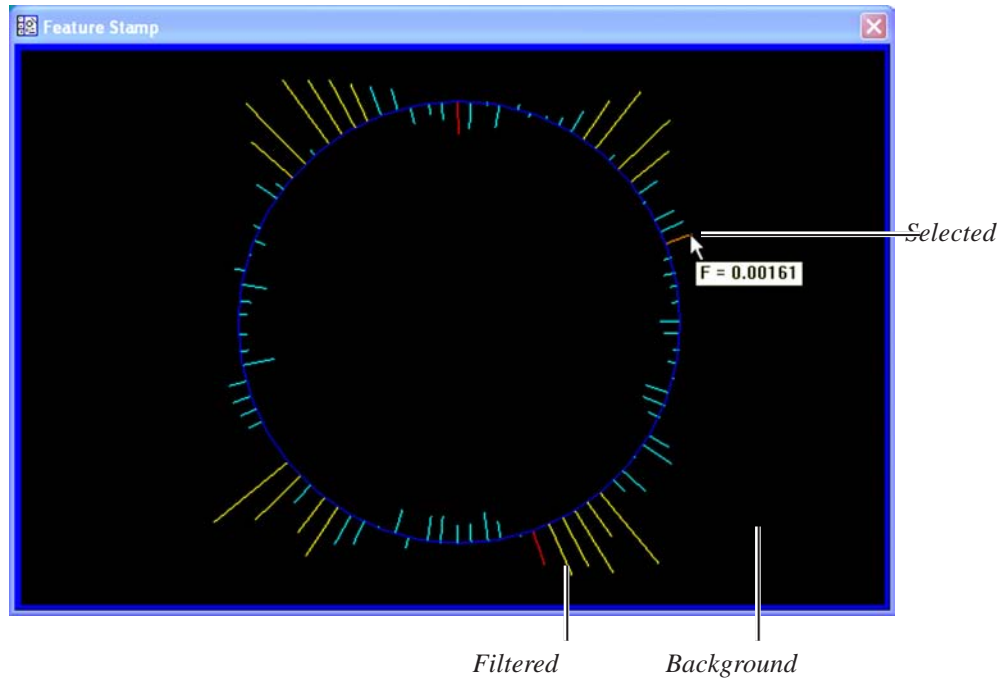
DRO colors that can be changed are shown below:



The default colors are:
Axis: Black
Digits: Red
Window: Gray

Feature stamp background, filtered and selected point

The feature stamp colors that can be changed are shown below:



The default colors are:

- Selected: Orange
- Background: Black
- Filtered: Yellow

QC5000 window

The background color of the QC5000 window can be changed.

The default color is: Dark green

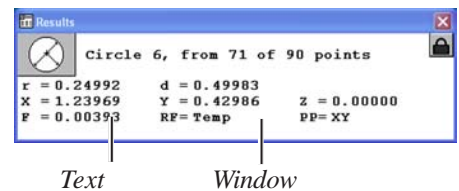


Results text and window

The Results window text and background colors can be changed.

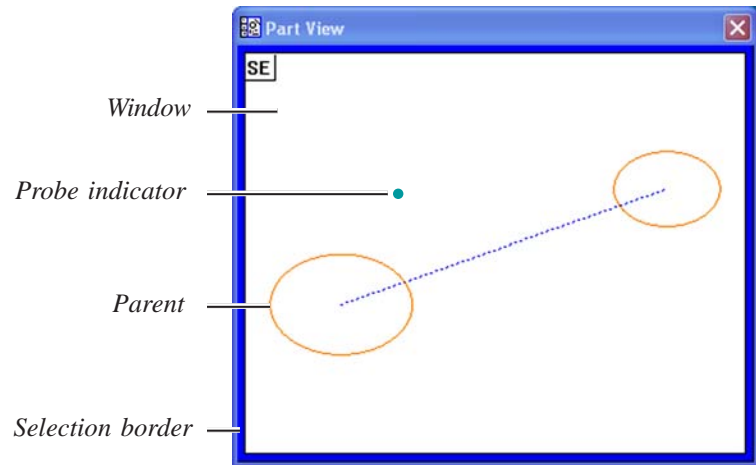
The default colors are:

- Text: Black
- Window: White



Part view parents, probe indicator, selection border, window

The part view colors that can be changed are shown below:



Line constructed of two parent circles



NOTE

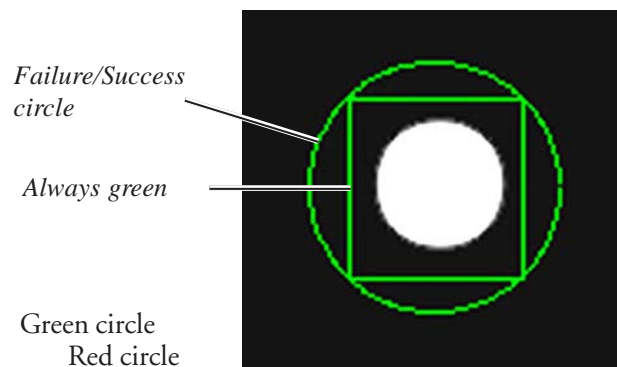
The probe indicator is enabled by clicking the View/Show position indicator menu item.

The default colors are:

- Window: White
- Parent: Orange
- Probe indicator: Blue
- Border: Blue

Pattern finder failure and success

When attempting to teach the pattern finder VED probe a new pattern, failure or success is indicated by a brief message on the screen and by the color of the pattern finder Circle.



The default colors are:

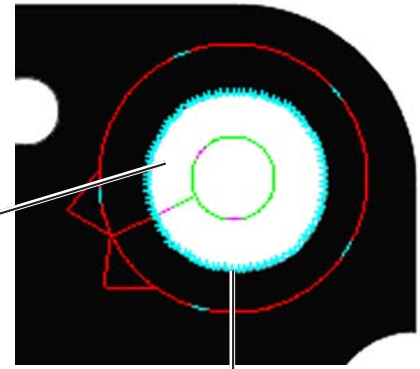
- Successful teach: Green circle
- Unsuccessful teach: Red circle

Point stake marks

As points are acquired, point stake marks are displayed on the screen indicating data point locations.

The default color of point stake marks is Red.

Point stake marks

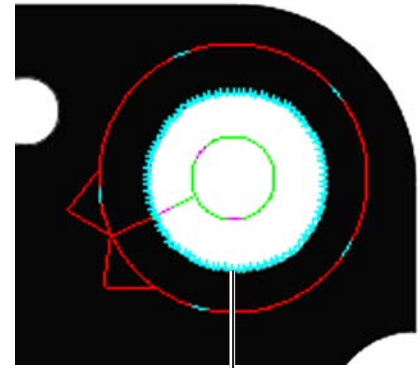


Temporary stake marks

Temporary stake marks

VED probes can be fired manually at the user's discretion, or continuously by the system. When VED probes are fired continuously, temporary point stake marks are continuously displayed on the screen to indicate data point positions. These point stake marks are smaller and generally different in color than the point stake marks described above.

The default color of temporary stake marks is cyan.

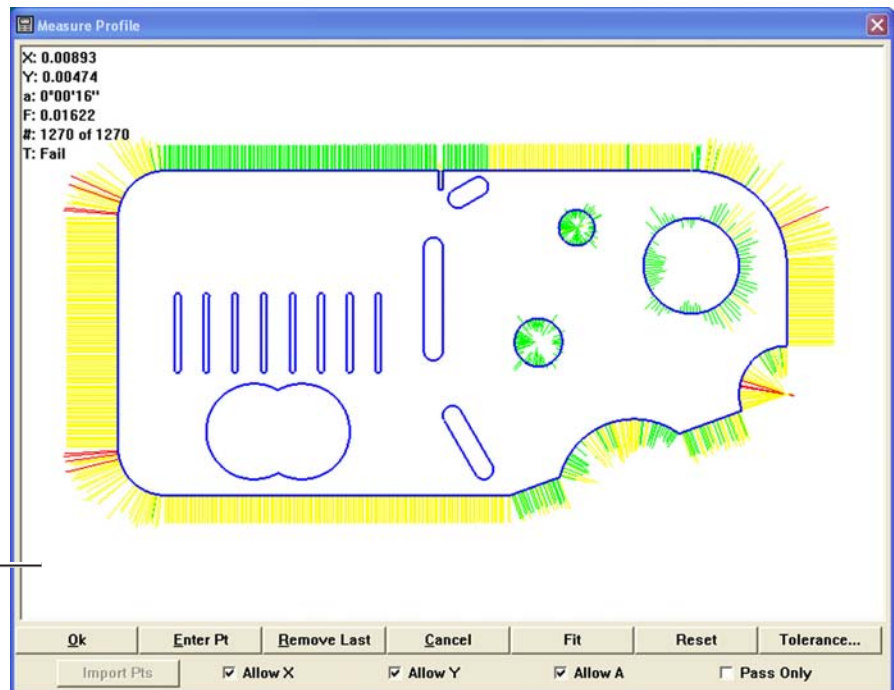


Temporary stake marks

Profile background

The background color of the Measure Profile window can be changed.

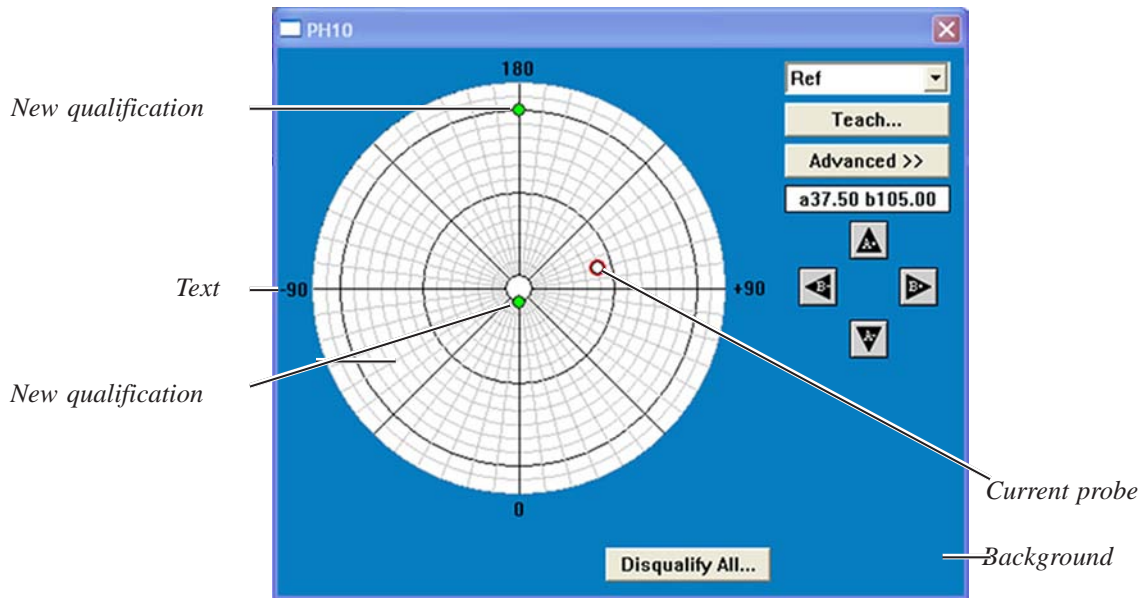
Background



The default color of the background is white.

Probe selector background, current probe, new qualification, old qualification and text

The probe selector is used to select and qualify the positions of indexable probe heads. The probe selector colors that can be changed are shown below:

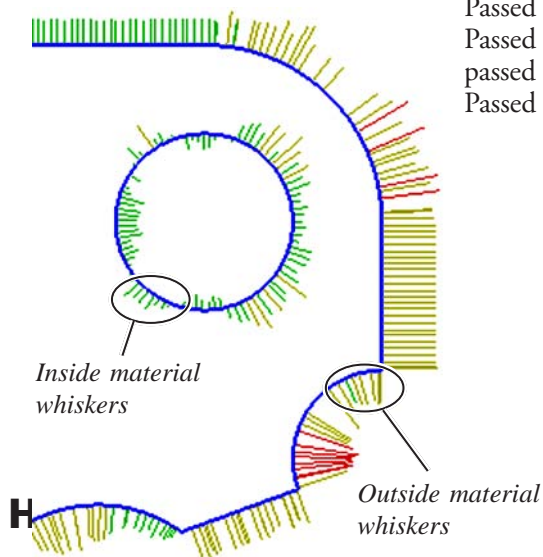


- The default colors are:
- Background : Blue
 - Current probe: Red
 - New qualification: Green
 - Old qualification: Yellow
 - Text: Black

Whiskers (used to display profile form errors)

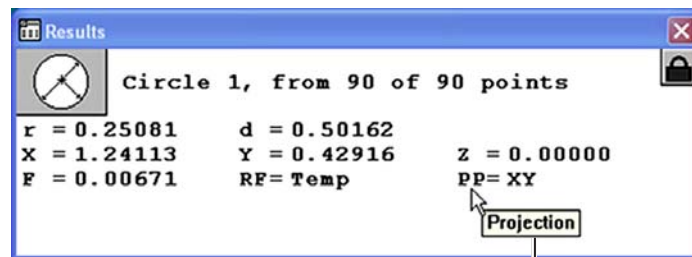
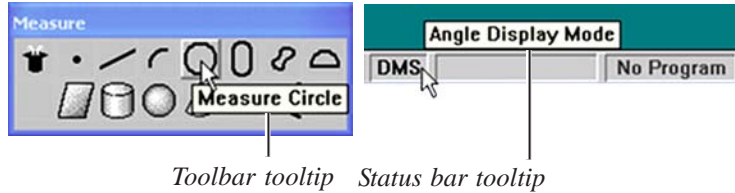
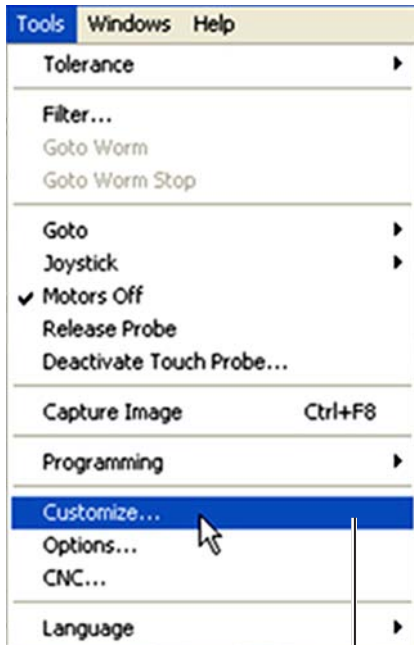
During profile measurements, shapes are measured and compared to nominal profiles. The differences between actual and nominal data generate form errors inside and outside material surfaces. The default colors of whiskers are:

- Failed inside: Red
- Failed outside: Red
- Passed inside 0-50% of tolerance: Green
- Passed inside 50-100% of tolerance: Yellow
- Passed outside 0-50% of tolerance: Green
- Passed outside 50-100% of tolerance: Yellow



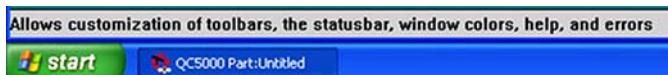
On-screen help is available in the form of tool tips for:
 Menus (tips for menus appear in the status bar)
 Toolbars
 Status bar
 Results window

Check the desired box(es) on the Help screen to show tips for the associated item(s).

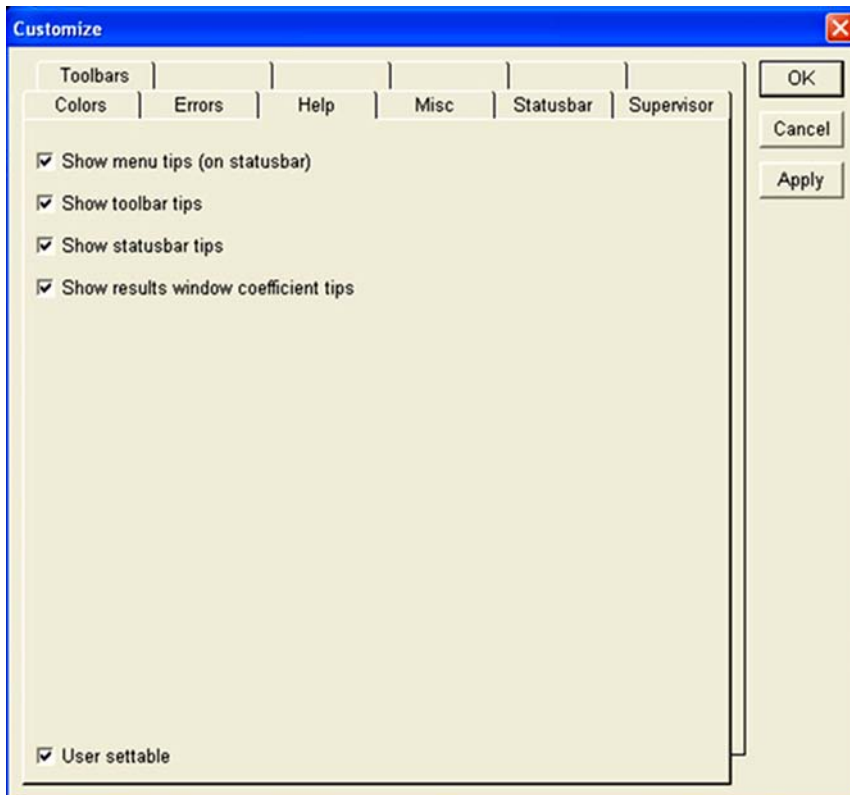


Tips for highlighted menu items appear in the status bar

Results window tooltip

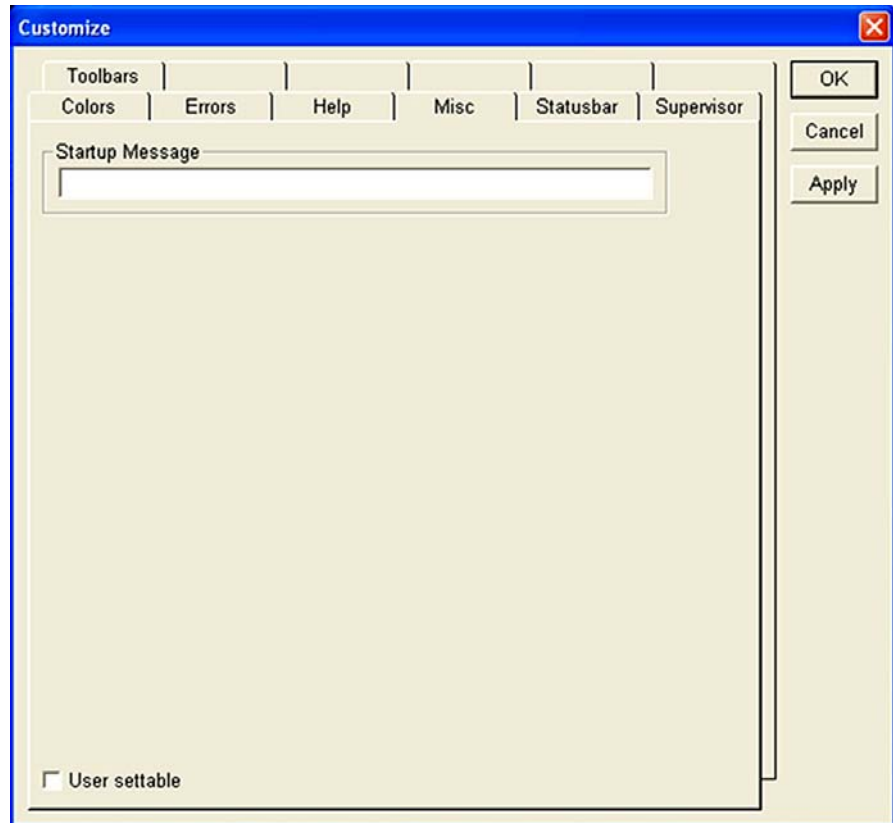


All tooltip boxes are checked by default.



Misc screen

The Misc screen contains a data field for entering a message that will be displayed when the QC5000 program is started.



Enter the desired message directly into the data field.



Startup message example

The message field is empty by default.

Errors screen

Error messages can be displayed that describe most system errors. These messages are listed below.



NOTE

The error messages are not necessarily listed in their order of appearance in the Error screen list box.

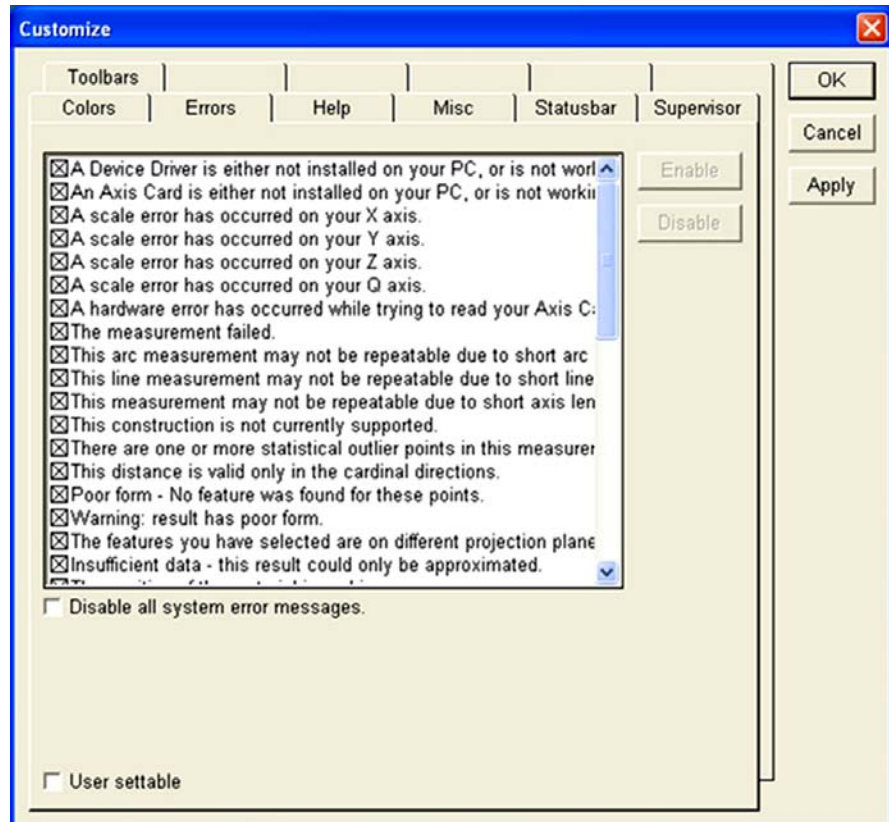
System error messages

- Temperature Compensation should be disabled before doing any kind of Teach or Calibration.
- NC control off.
- A Device Driver is either not installed on your PC, or is not working properly. Because of this, the Axis Cards will not work.
- An Axis Card is either not installed on your PC, or is not working properly. Because of this the DRO will not work, and measurements can only be probed using the Demo Stage (located under the Windows menu).
- A scale error has occurred on your X axis.
- A scale error has occurred on your Y axis.
- A scale error has occurred on your Z axis.
- A scale error has occurred on your Q axis.
- A hardware error has occurred while trying to read your Axis Card.
- The measurement failed.
- This arc measurement may not be repeatable due to short arc length.
- This line measurement may not be repeatable due to short line length.
- This measurement may not be repeatable due to short axis length.
- This construction is not currently supported.
- There are one or more statistical outlier points in this measurement.
- This distance is valid only in the cardinal directions.
- Poor form - No feature was found for these points.
- Warning: result has poor form.
- The features you have selected are on different projection planes. The result will be 3-D.
- Insufficient data - this result could only be approximated.
- The position of the material is ambiguous.
- This alignment can be done only in the primary workplane.
- This alignment will delete magnetic planes.
- This alignment may convert projected features to 3-D.
- Projection must be on to measure this feature.
- The result is out of range.
- There is no intersection between these features.
- Lines intersect.
- The points probed in Measure Magic do not make a good enough feature of that type.
- Datum Magic could not complete successfully because an invalid feature type was measured.
- This alternate fit computation failed
- Please use the blob probe for this measurement
- Cannot complete programmed move
- You can't use the crosshair probe while using Measure Magic or Datum Magic.
- The magnification that you are in has not been calibrated. The points that are about to be entered into the measurement may be invalid.
- Sorry, but motors are currently turned off.
- A following error has occurred on your X axis.

Chapter 6 System Setup

- A following error has occurred on your Y axis.
- A following error has occurred on your Z axis.
- A following error has occurred on your Q axis.
- A limit switch on the X axis has been hit!
- A limit switch on the Y axis has been hit!
- A limit switch on the Z axis has been hit!
- A limit switch on the Q axis has been hit!

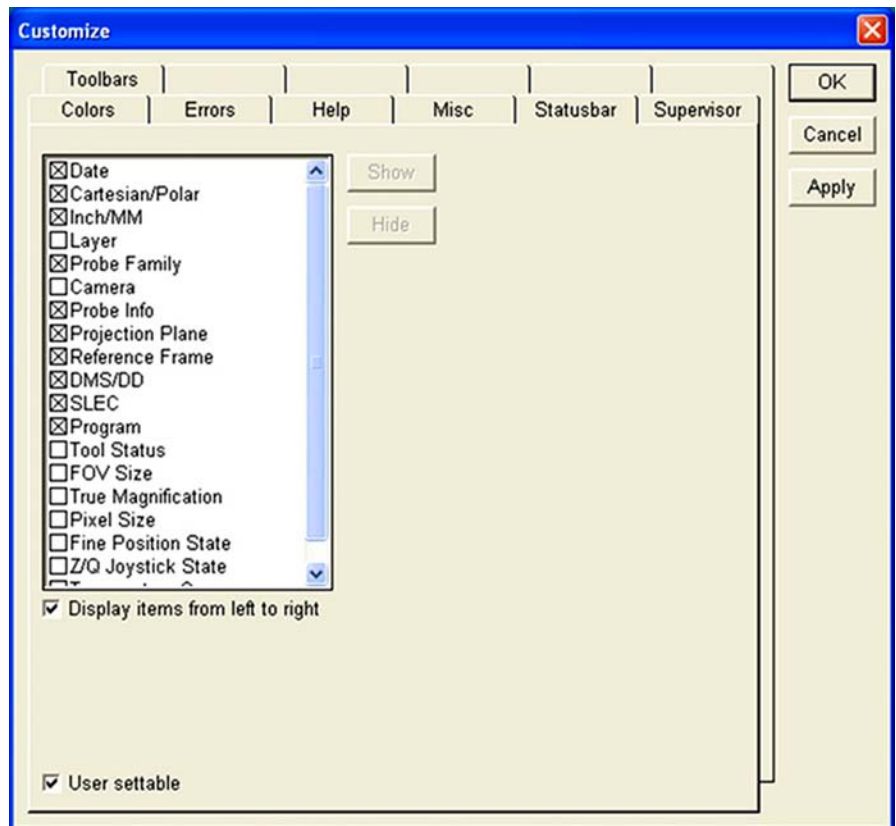
Any of these error messages can be disabled by clearing their check boxes. All error messages can be disabled simultaneously by checking the Disable all system error messages box.



All error messages are enabled by default.

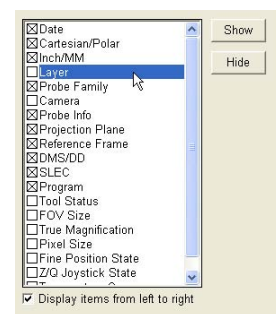
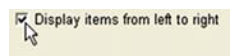
Statusbar screen

The status bar extends across the bottom of the QC5000 screen. The status bar can be customized to display a variety of system and measurement status information by checking or clearing boxes in the Statusbar screen.



To display information in the status bar, highlight the desired item and click Show.

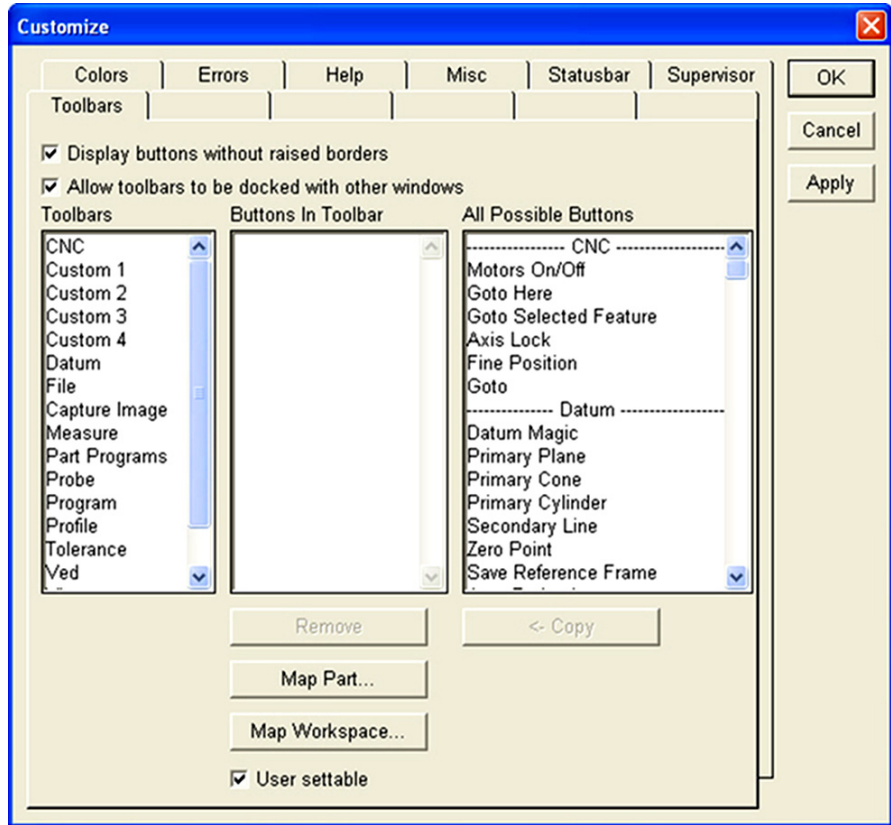
Information can be displayed in the status bar from left to right, or from right to left. Click the Display items from left to right box for left to right presentations.



The default status of the status bar depends on system configuration.

Toolbars screen

Toolbars can be customized to facilitate measurement, programming, file and other activities using functions provided by the Toolbars screen.



All QC5000 toolbars are shown in alphabetic order in the Toolbars listbox.

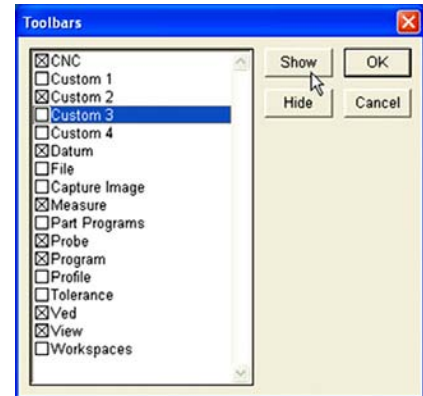
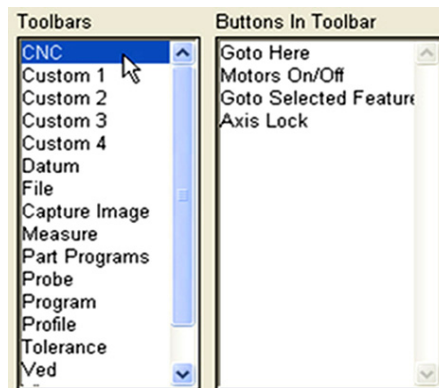


NOTE

Toolbars are shown or hidden by checking or clearing boxes contained in the View/Toolbars screen.

Displaying toolbar buttons

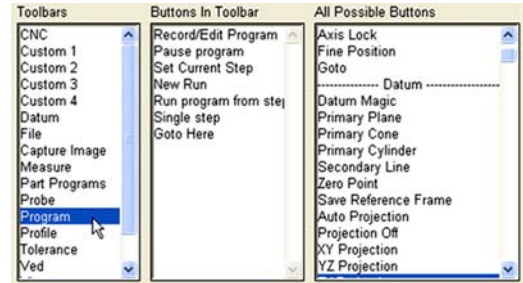
Click a toolbar name in the Toolbars listbox to display its contents in the Buttons in Toolbar listbox.



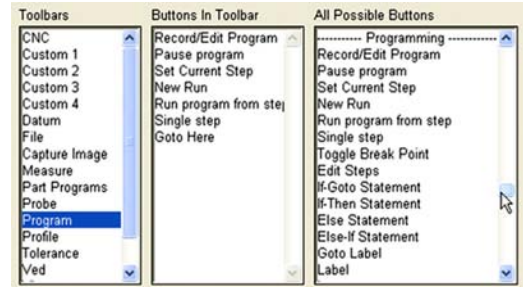
Adding buttons to a toolbar

To add a button to a toolbar:

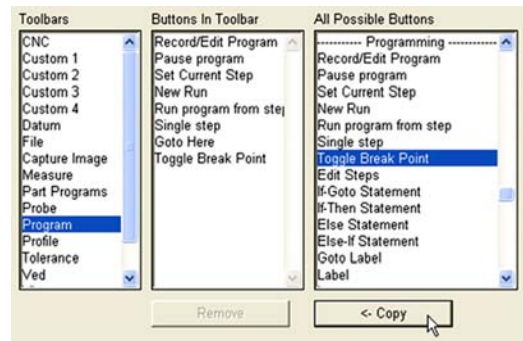
- 1 Click a toolbar name in the Toolbars listbox.



- 2 Scroll to the matching toolbar button group in the All possible buttons listbox.



- 3 Click the desired button name and click Copy.

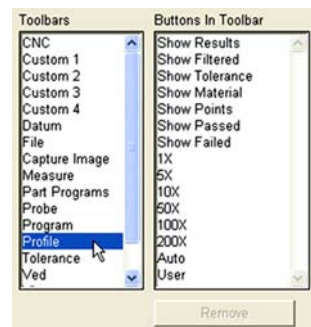


The new button will be shown in the middle Buttons in Toolbar listbox and added to the toolbar.

Removing buttons from a toolbar

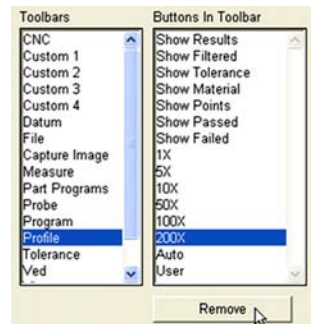
To remove a button from a toolbar:

- 1 Click the toolbar name in the Toolbars listbox.



- 2 Click the button you wish to remove and click the Remove button.

The button will be removed from the Buttons in Toolbar listbox and from the toolbar.





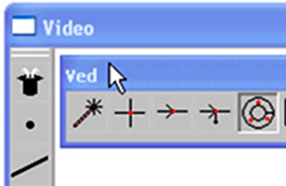
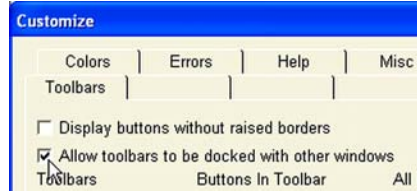
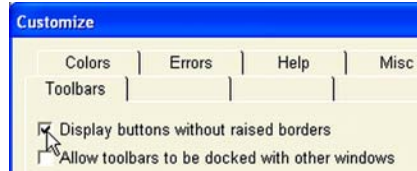
With raised edges



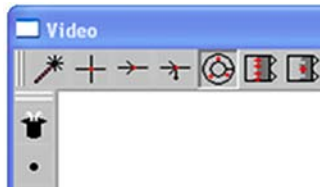
Without raised edges

Enable/Disable raised edges for toolbar buttons

Toolbar buttons can be displayed with or without raised button edges. Check or clear the Display buttons without raised borders box as desired.



Docking the VED toolbar...



inside the Video window

Allows/Prohibit toolbar docking

Toolbars can be docked to the inside edges of QC5000 windows. Check or clear the Allow toolbars... box as desired.

Mapping parts to a toolbar

Parts can be mapped to toolbar buttons when more structured or automated operator environments are required. To map a part to a toolbar:

1 Click the toolbar that will include the new part button.

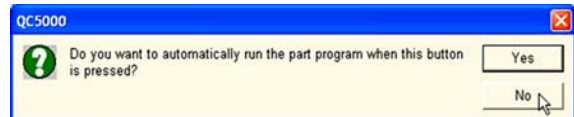
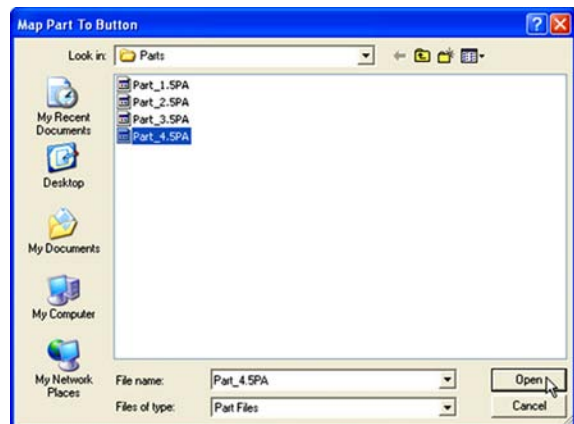
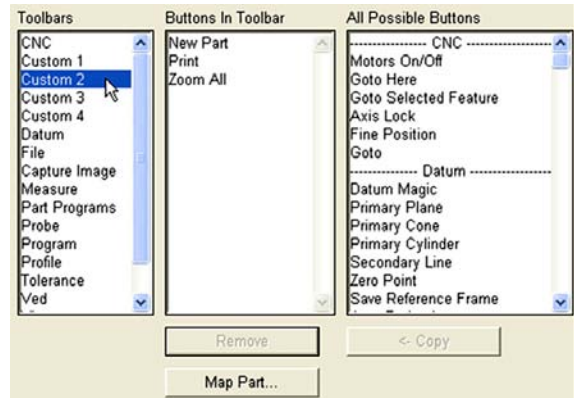
2 Click the Map Part button.

The Map Part to Button file dialog box will be displayed.

3 Click the file name of the desired part and click Open.

You will be asked if you wish to have the part's program run automatically when the button is pressed.

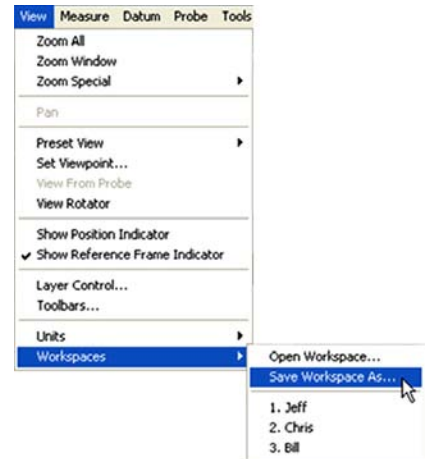
Click Yes or No as desired.



The new part button will appear in the Buttons in Toolbar list.

4 Click OK. The new part button will be displayed in the toolbar.

5 The current workspace was changed when the new button was added, and now must be saved. Click View/Workspaces/Save workspace as...



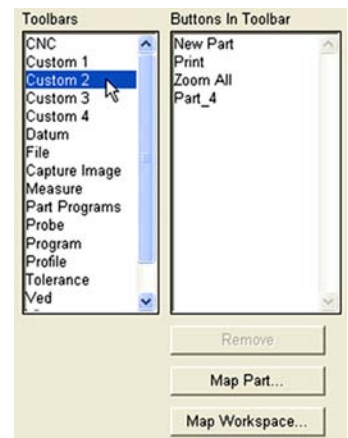
Save the workspace under an existing or a new file name.

Mapping workspaces to toolbar

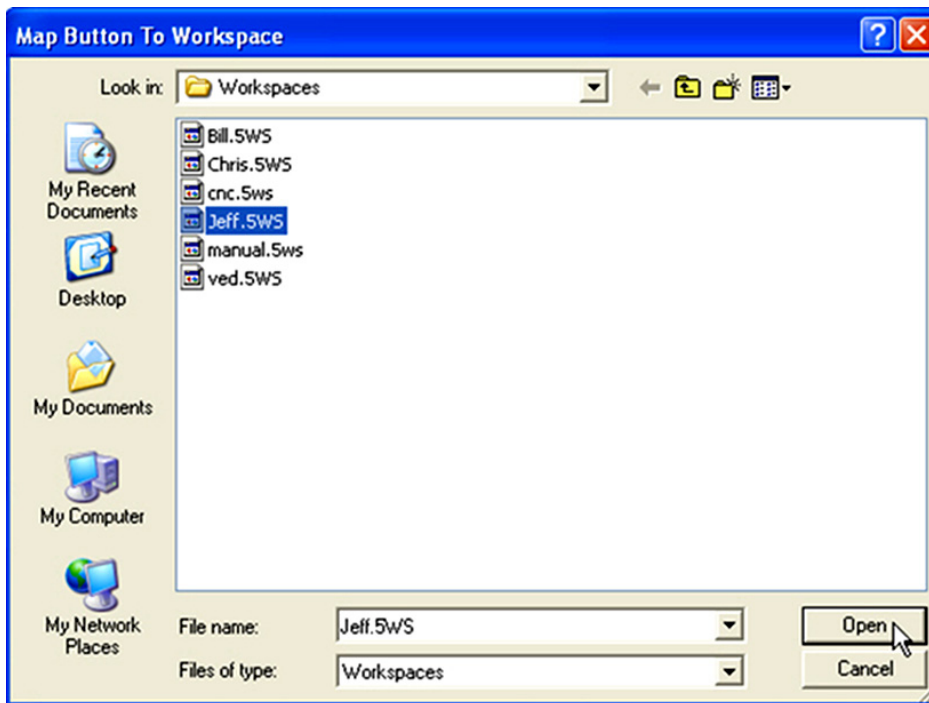
Workspaces can be mapped to toolbar buttons to simplify and speed the process of changing operators. To map a workspace to a toolbar:

1 Click the toolbar that will include the new workspace button.

2 Click Map Workspace.

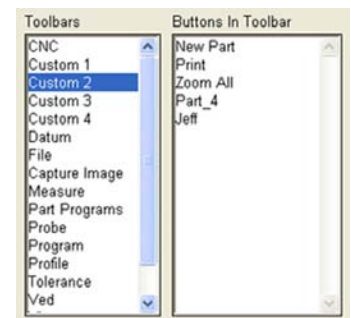


The Map Button to Workspace file dialog box will be displayed.



3 Click the file name of the desired workspace and click Open.

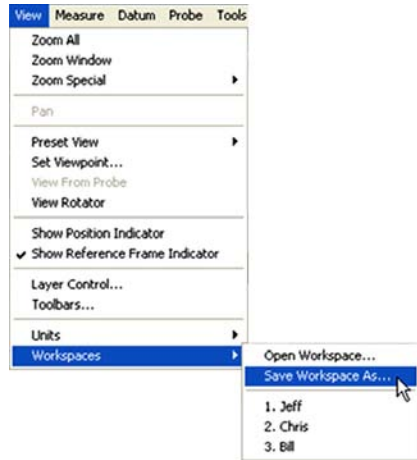
The new button will appear in the Buttons in Toolbar listbox.



4 Click OK. The new workspace button will be displayed in the toolbar.



5 The current workspace was changed when the new button was added, and now must be saved. Click View/Workspaces/Save workspace as...



Save the workspace under an existing or a new file name.

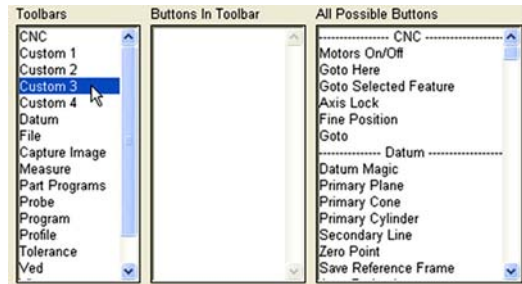
Creating custom toolbars

Custom toolbars can be created to include any combination of buttons that organize measurement functions, parts, workspaces and other elements of the QC5000 operating environment. Up to four custom toolbars can be constructed to provide unique work environments that satisfy specific operator and application requirements. To create a custom toolbar:

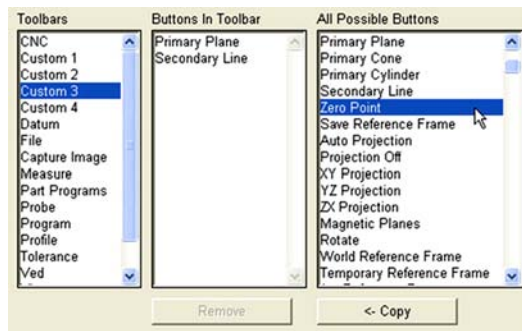
1 Click one of the four custom toolbars in the Toolbars listbox.



NOTE
If the custom toolbar contains buttons already, it might be necessary to select another custom toolbar or to remove the existing buttons.

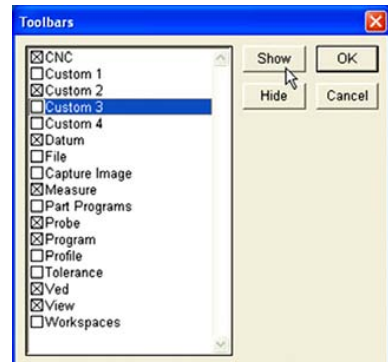


2 Add any desired buttons from the All possible buttons listbox, and map parts or workspaces to buttons if desired.



3 Show the new custom toolbar by highlighting it in the View/Toolbars listbox and clicking Show.

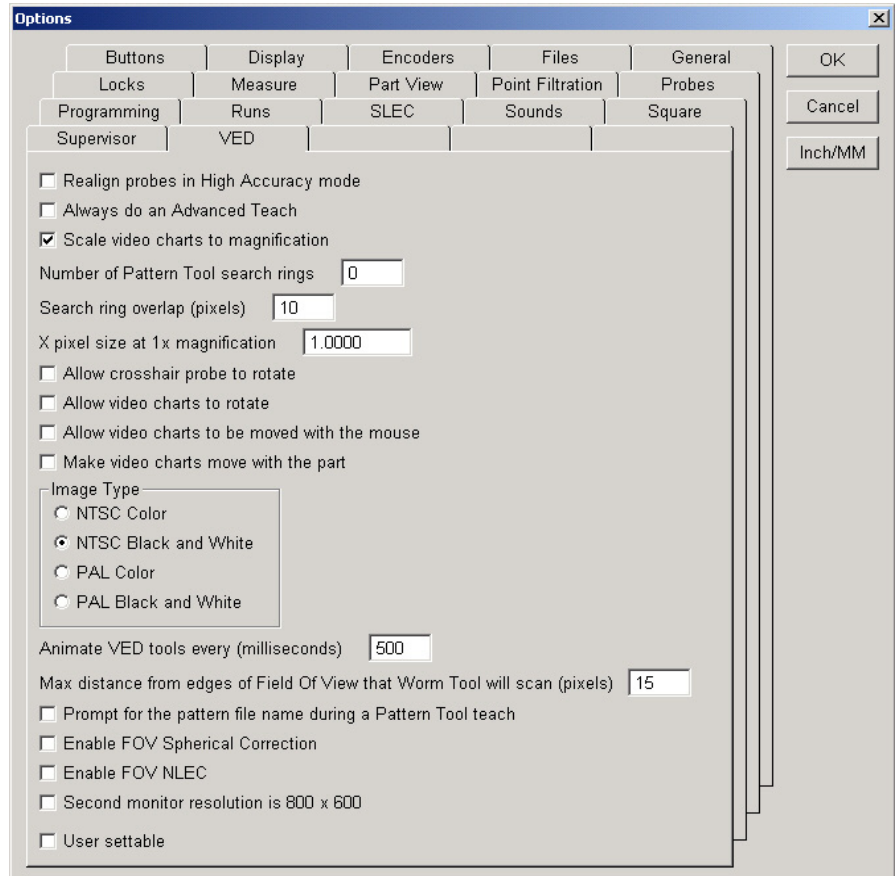
The new toolbar will be displayed.



Setup Tools/Options screens

VEDscreen

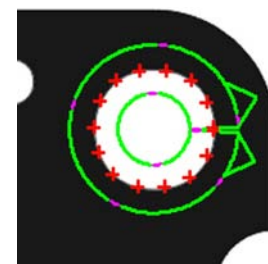
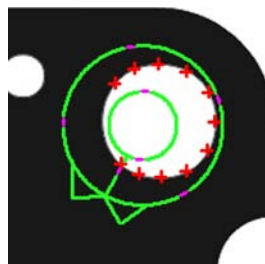
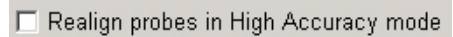
Use the VED screen to configure video measurement and display parameters.



Automatic probe alignment and the high accuracy mode

VED probe alignment affects the quality of feature data. Improperly aligned probes can result in inaccurate feature measurement results.

Check the *Realign probes...* box to automatically optimize the alignment of VED probes when they're fired.

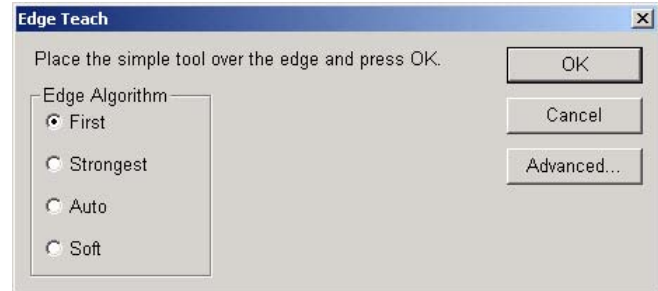


Probe alignment optimized

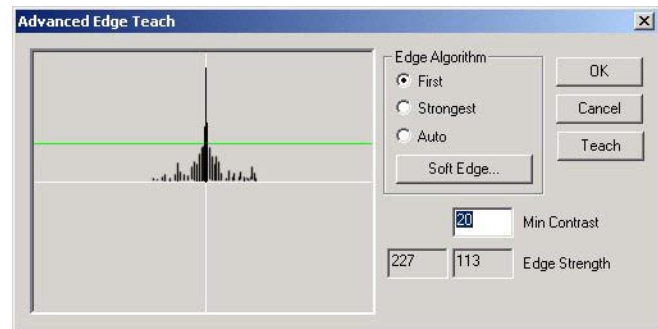
Specifying the advanced teach mode

Video probe edge recognition is optimized using either the Standard or Advanced edge teach tool.

The Standard edge teach tool automatically optimizes video edge recognition based on 1 of 4 specified edge algorithms; First, Strongest, Auto or Soft.



The advanced edge teach tool optimizes video edge recognition based on a specified edge algorithm or permits the user to optimize edge recognition manually.



Check the *Always do an advanced teach box* to specify the advanced edge teach tool as the default.

Always do an Advanced Teach

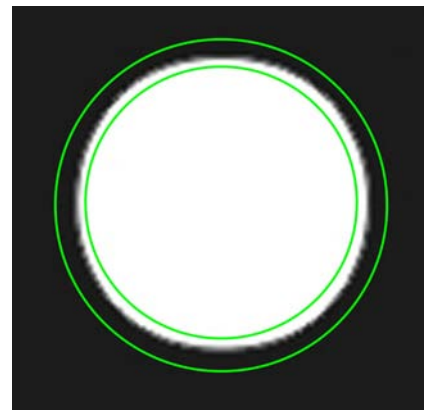
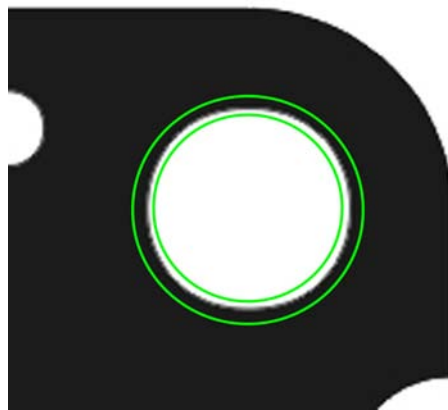
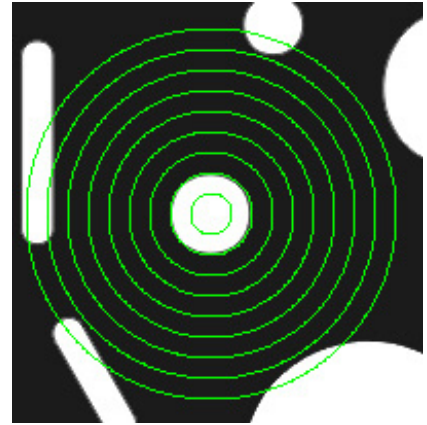
Scaling video charts to magnification



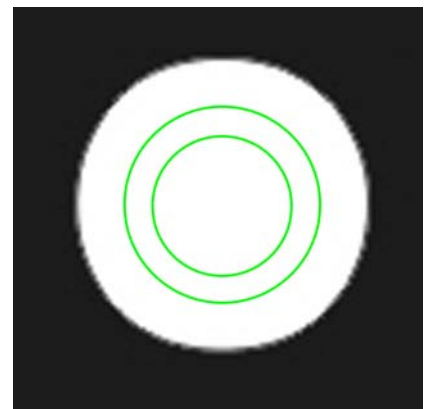
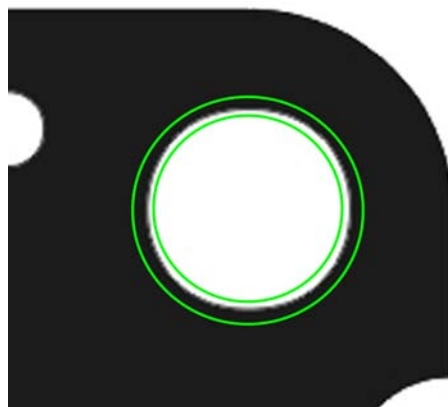
Video charts are overlays that are superimposed over part images to facilitate visual inspections.

NOTE
The video charts are drawings created for specific parts and saved as .DXF files in the QC5000 Imports directory.

Check the *Scale video charts to magnification box* to automatically maintain a consistent chart-to-image ratio as the video magnification is changed.



Video chart scaled to maintain consistent chart-to-image ratio



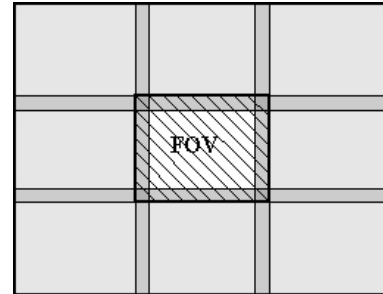
Video chart not scaled

Specifying pattern search rings

Search rings expand the area evaluated by the pattern tool beyond the current field of view during CNC program execution. Each search ring expands the pattern tool search in a clockwise series of rectangles. The size of each rectangle depends on the pattern tool size and the search ring overlap specified.



Initial FOV



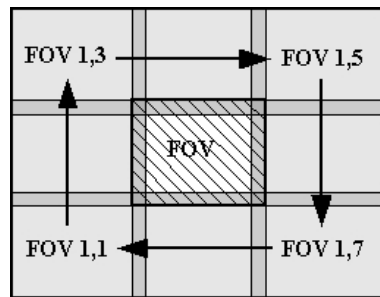
FOV plus 1 search ring

During program execution, the initial field of view is evaluated. If the target pattern is not found, and search rings were specified, the field of view is moved to the lower-left corner of the first search ring. Then the pattern search continues as a clockwise series of (field of view) rectangles is added until a feature is found.

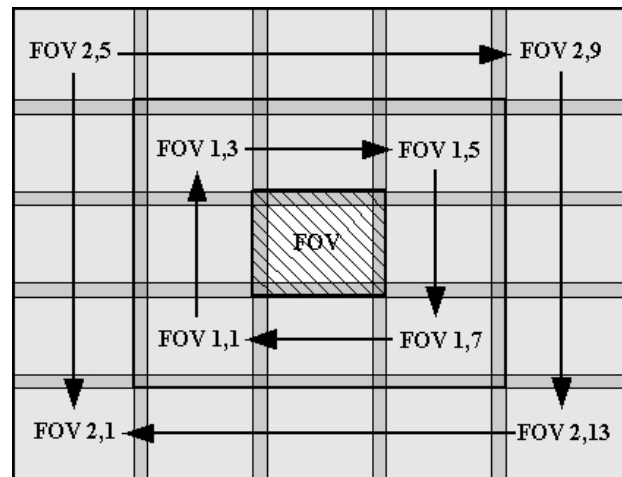
If the target feature is not found, the search continues to the next ring, or stops if no additional rings were specified.



Initial FOV



FOV plus 1 search ring



FOV plus 2 search rings

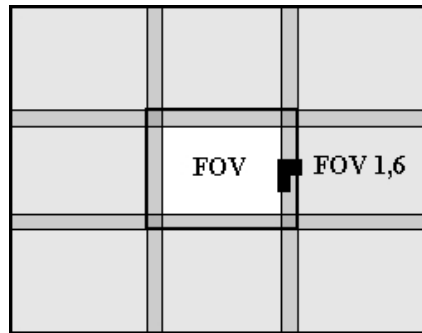
Enter the number of desired the search rings into the *Number of pattern... field.*

Number of Pattern Tool search rings

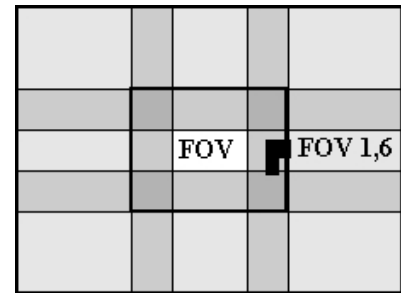
Specifying search ring overlap

Pattern tool search rings and fields of view must overlap to ensure that target features will be found. This search ring overlap is specified in pixels.

Target features must be enclosed completely within a field of view to be recognized. Since features can sometimes be located across the boundary between two adjacent field of view rectangles, the specified search ring overlap must be slightly larger than the target feature, as shown in the example below.



Search ring overlap too small, feature not recognized



Search ring overlap OK, feature found in FOV 1, 6



NOTE

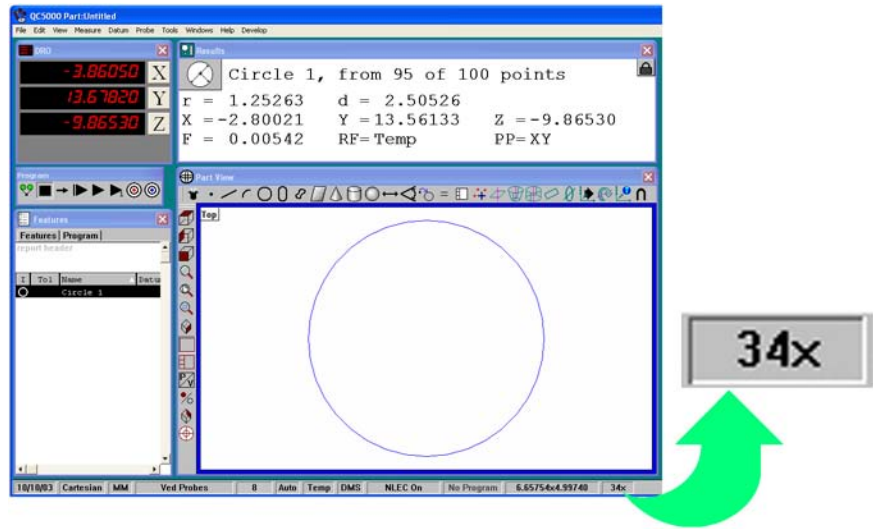
A more detailed discussion of search rings is included in [Chapter 3: Probes](#).

Enter the desired overlap in the *Search ring overlap field* in pixels.

Search ring overlap (pixels)

Calibrating the display of magnification value

The video window image magnification is displayed in the bottom-right corner of the QC5000 main screen.



The image magnification depends on the optical characteristics of the system and must be found by performing the measurement procedure provided below.

Calibration procedure

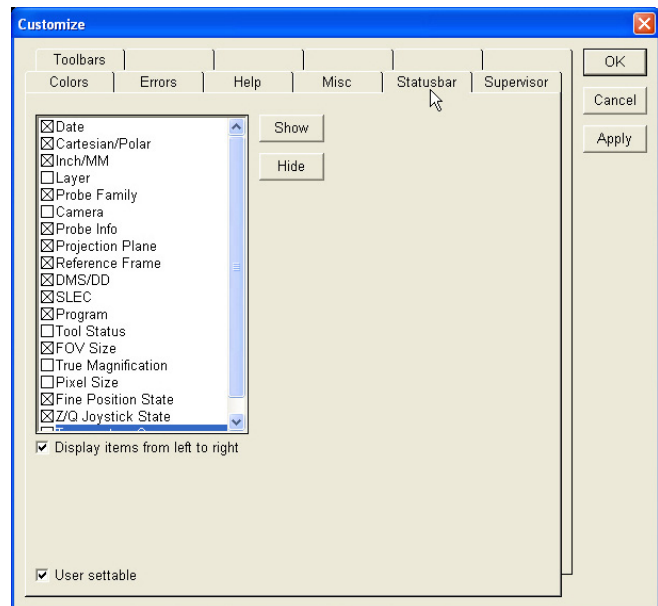
Step 1

Verify that the *X pixel size... field* is set to 1.000



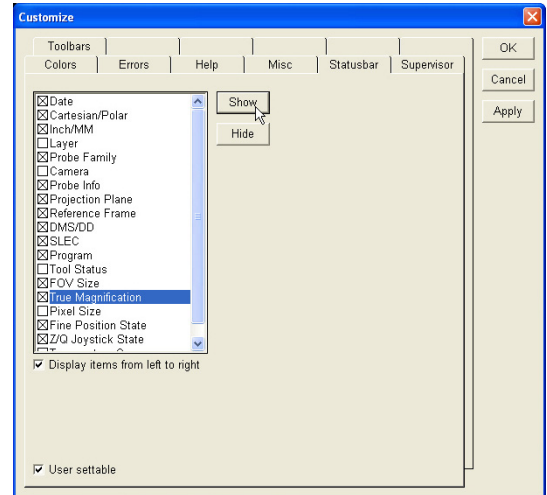
Step 2

Click *Tools, Customize* and then click the *Status bar tab*.



Step 3

True magnification must be enabled. If the True magnification box is not checked, click on *True magnification* and then click *Show*.



Step 4

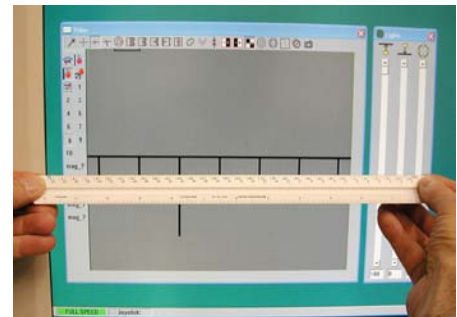
Click *OK* to close the Customize screen, and then return to the *Tools/Options/VED* tab.

Step 5

Bring a standard artifact into sharp focus in the video Window's field of view. The Metronics calibration slide is an excellent standard to use for this procedure.

Step 6

Measure the distance between 2 of the standard's marks on the computer screen using a scale or ruler. Measure as great a distance as possible.



Step 7

Calculate the measured magnification by dividing the measured distance (Step 6) by the actual distance shown on the standard.

$$\text{Measured magnification} = \text{Measured} / \text{Actual}$$

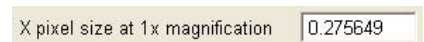
Step 8

Calculate the pixel size factor by dividing the measured magnification by the magnification value currently displayed in the right corner of the status bar.

$$\text{Pixel size factor} = \text{Measured Magnification} / \text{Status bar value}$$

Step 9

Enter the pixel size factor into the *X pixel size... field*.



NOTE

The value shown here is only an example.

Allow crosshair probes to rotate

Probes that detect edges are most effective when oriented orthogonally to the edge. Since feature edges can be positioned at any angle, edge detection probe rotation is enabled by default. However, crosshair probes are point measurement tools and probe rotation is disabled by default. Crosshair probe rotation can be useful when the feature geometry makes the crosshairs difficult to see on the screen.



Default crosshairs are difficult to see



Rotated crosshairs are easy to see

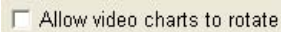
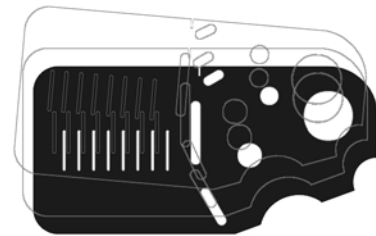
Check the *Allow crosshair probe to rotate* box to enable crosshair rotation.



Allowing video charts to rotate

Video chart rotation is disabled by default. Video chart rotation can be useful when the alignment of the part in the field of view does not match that of the imported chart.

Click on the *Allow video charts to rotate* box to enable video chart rotation.

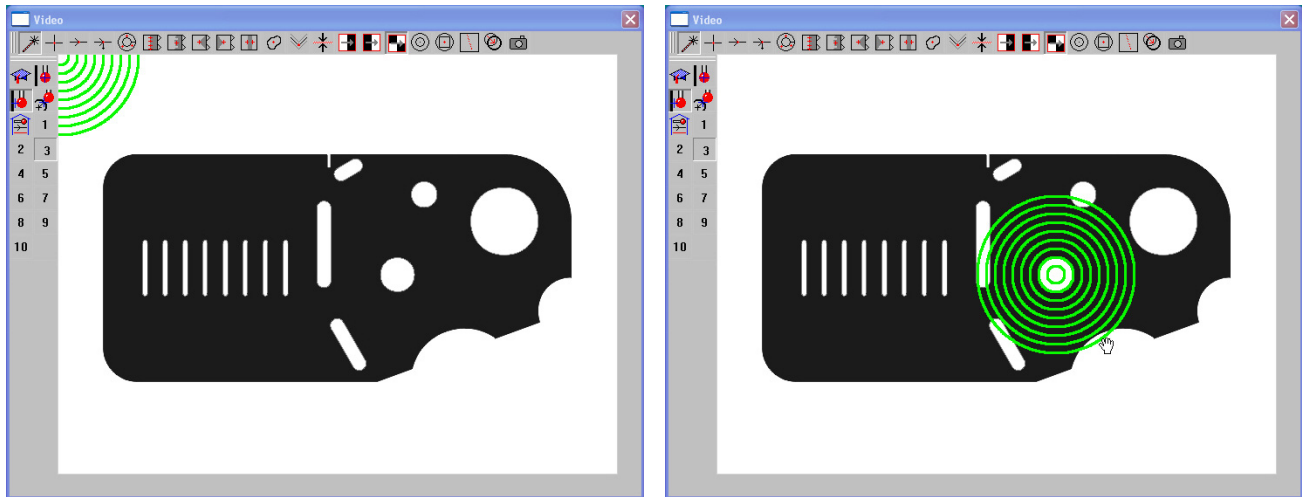


Moving video charts with a mouse

The video window origin is located in the top-left corner of the video window. When a video chart is loaded, the video chart origin is positioned over the video window origin. This initial alignment can sometimes cause portions of the imported chart to fall outside the boundaries of the video window.

Check the *Allow video charts...* box to allow repositioning of the chart using the mouse.

Allow video charts to be moved with the mouse



Moving video charts with the part

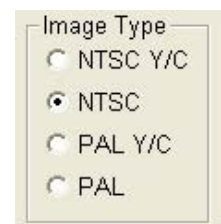
Video charts are positioned over part features with the mouse. By default, if the part position is changed, the chart position must be realigned manually using the mouse. This is acceptable for small parts, but when parts and associated charts extend beyond the field of view, the part position will usually be changed repeatedly and manual realignments would reduce throughput.

Check the *Make video charts...* box to automatically maintain chart-to-part alignment as the part is moved.

Make video charts move with the part

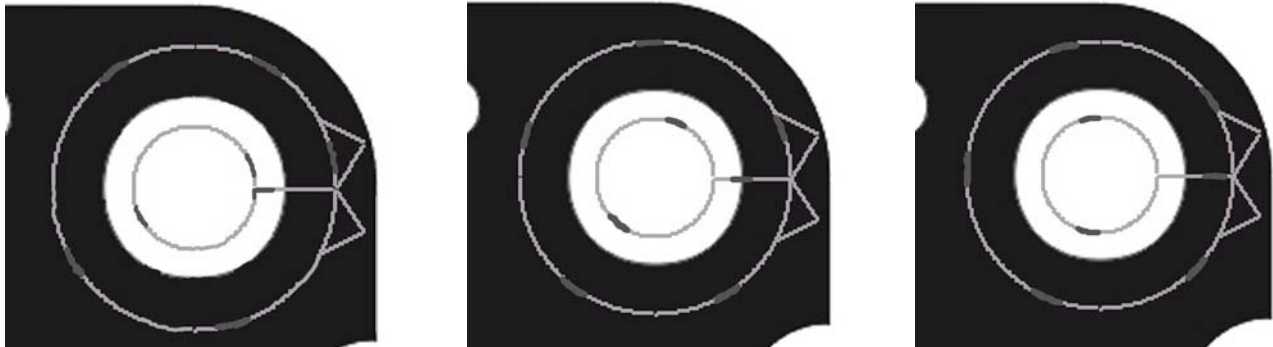
Specifying video camera image type

Check the *Image type radio button* that corresponds to the output format of your video camera system.



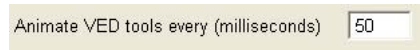
Specifying video probe animation rate

Video probes are animated to indicate video scan direction and to enhance visibility. The animation shows dashed lines moving along the probe path in the direction of the scan.



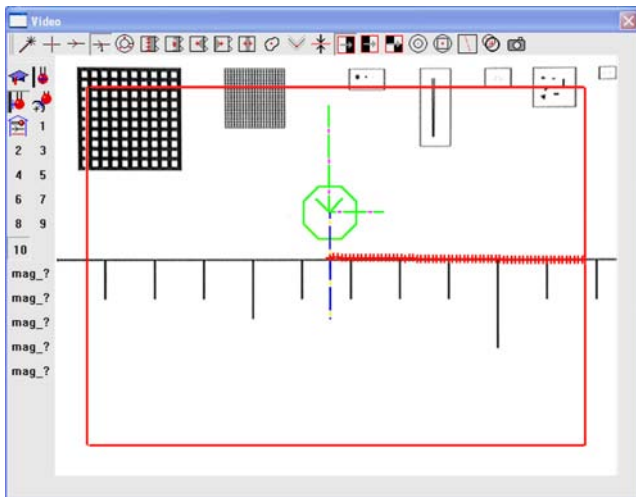
Animation intervals are entered to increase or decrease the animation rate. Small intervals result in high rates and smooth animations, but commit more computer resources. Large intervals result in lower rates and animation hesitation, but commit fewer resources.

Enter the desired animation interval into the *Animate VED... field* in milliseconds.

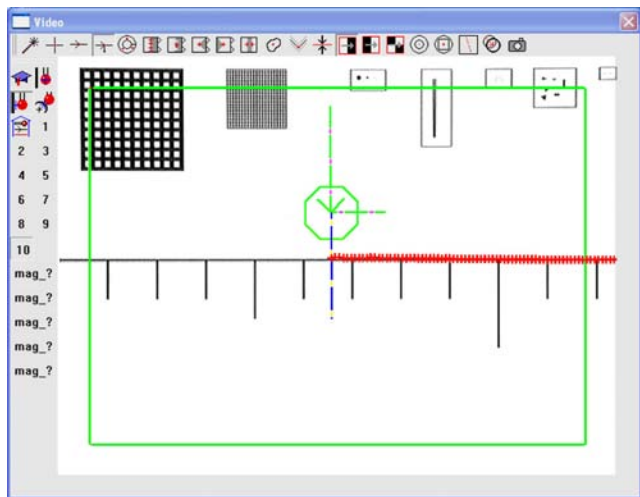


Specifying maximum field of view for worm tool (probe)

The worm probe scans along an edge until the scanning process is complete, or the scanning is terminated by an error or by an enabled scan-limit boundary. The scan-limit boundary is shown in red when enabled, and in green when disabled.



*Red boundary line
Scanning stops at scan-limit boundary*

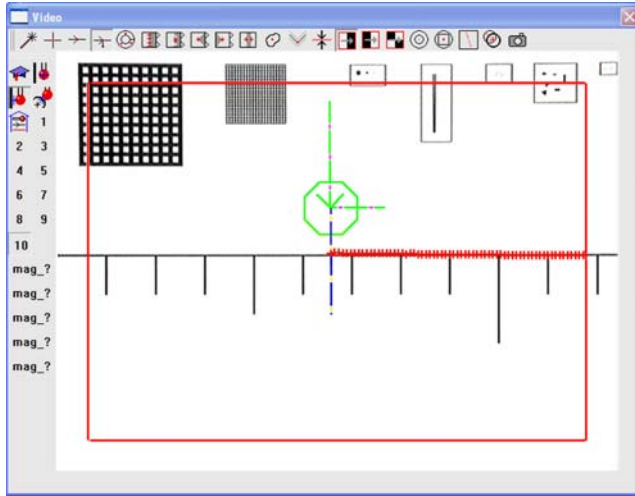


*Green boundary line
Scanning continues beyond field of view*

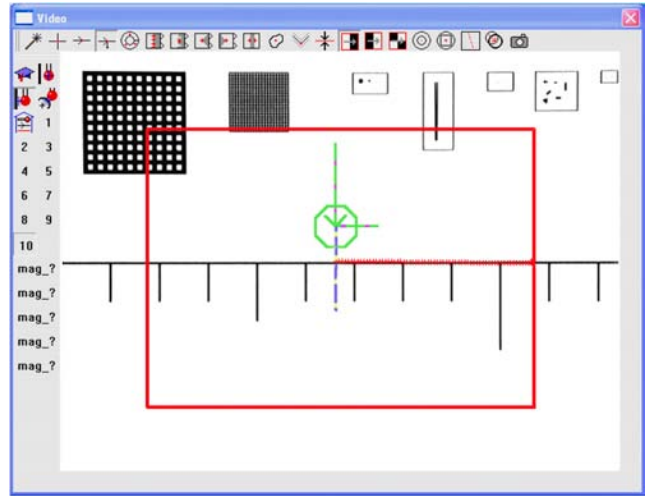


NOTE
A more detailed discussion of the worm tool is provided in Chapter 3: Probes.

When the scan-limit is enabled, the limit boundary can be configured to prevent scanning within a specified number of pixels from the edge of the field of view.



Scanning prevented 30 pixels from edge of field of view



Scanning prevented 75 pixels from edge of field of view

Limiting worm tool scanning to the center of the field of view eliminates the effects of lens-edge aberrations.

Enter the desired boundary distance into the *Max distance from edge... field.*

Max distance from edges of Field Of View that Worm Tool will scan (pixels)

Specifying pattern file names

Whenever the pattern tool is taught a new pattern, it can be saved automatically in the Parts folder using a default filename, or can be saved in another folder using a user-specified filename.

The default file naming convention is:

Part name_Pattern (n).5pt

Where n is incremented for each new file.

Check the *Prompt for pattern file name... box* to specify a pattern file name and storage location whenever a pattern is taught to the pattern tool.

Prompt for the pattern file name during a Pattern Tool teach

FOV spherical and NLEC corrections

Normally, measurements are made at or near the center of the optical system to avoid aberrations normally present near lens edges. Spherical and NLEC corrections compensate for these aberrations, but can only be enabled by OEMs and distributors after performing specific calibration procedures.



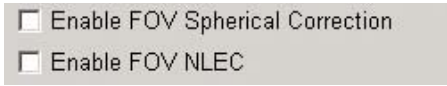
NOTE

Contact your OEM or distributor for more information regarding these two corrections.



CAUTION

Do not change the status of the Enable FOV spherical correction or Enable FOV NLEC check boxes without specific instructions from your OEM or distributor.



Specifying a larger video window

Windows XP systems that include smaller monitors can sometimes benefit from larger live video part displays. The default display resolution of the monitor used for live video displays is 1024 X 768 pixels. Changing the resolution to 800 X 600 pixels enlarges the video display of parts.



NOTE

Larger video displays of parts do not provide increased measurement accuracy.

To change the resolution of live video displays on Windows XP systems:

Step 1

Close the QC5000 program

Step 2

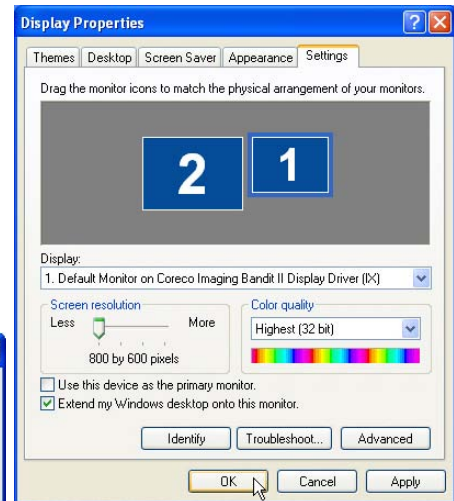
Right-click the *desktop*, click *Properties* and then click *Settings*.

Step 3

Click the *monitor* used for live video displays and then change the *screen resolution* to 800 X 600 pixels.

Step 4

Click *OK* to save the revised Settings. You will be asked if you wish to retain the new Settings. Click *Yes*.



Step 5
Launch the QC5000 program.

Step 6
Click *Tools/Options/VED tab*.

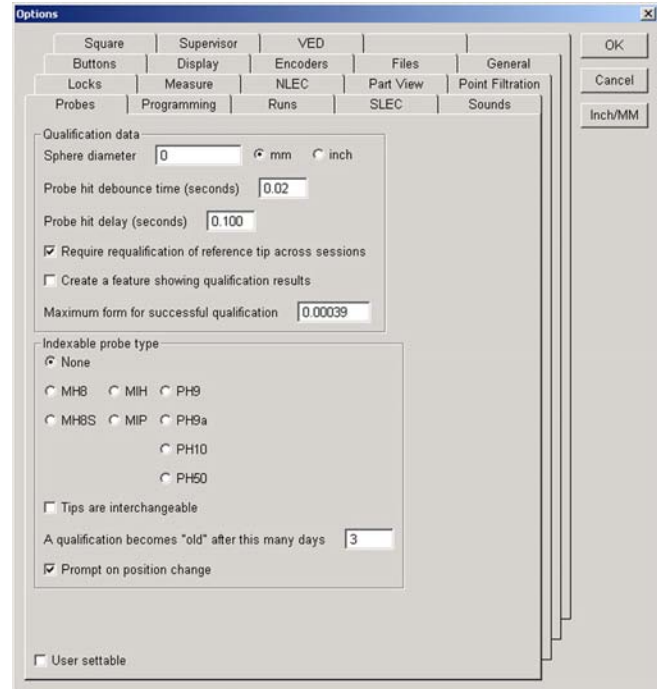
Step 7
Check the *Second monitor resolution is 800 X 600 box*.

Second monitor resolution is 800 x 600

Probes screen

Use the Probes screen to configure touch probe parameters including:
Probe qualification sphere diameter

- Probe hit debounce time
- Probe hit delay
- Probe qualification requirements
- Indexable probe type



Specifying probe qualification sphere diameter

A qualification sphere standard is used to teach the QC5000 the dimensions of all touch probes. The qualifications sphere diameter can be entered in millimeters or inches.

Enter the qualification sphere diameter into the *Sphere diameter field*, and then click the mm or inch radio button.



Debouncing the touch probe

Debounce time is the elapsed time of uninterrupted probe contact with a surface required for a valid position measurement. Debounce time eliminates measurement inaccuracies caused by CMM machine vibration and mechanical switch noise. The default 0.02 seconds of debounce time is adequate for most applications. Increase the debounce time in 0.02 second increments to accommodate noisy environments. Enter the debounce time into the *Probe hit debounce time field* in seconds.



Preventing multiple probe hits

Probe hit delay is the minimum quiet time between valid probe hits. Probe hit delay eliminates the possibility of unintended multiple probe measurements due to probe vibration against a surface or, mechanical switch noise. The default of 0.10 seconds of delay is adequate for most applications. Increase the delay in 0.10 second increments if multiple probe hits occur.

Enter the probe hit delay into the *Probe hit delay field*.

Probe hit delay (seconds)

Specifying probe re-qualification across sessions

A lack of encoder reference marks, temperature variations, different operators and other measurement conditions might make it necessary to re-qualify the reference position of a touch probe before each new measurement session.



NOTE

It is only necessary to re-qualify the reference position of indexable probes.

Check the *Require requalification...* box to require requalification before each new session.

Require requalification of reference tip across sessions

Adding requalification to the features list

Check the *Create a feature...* box to include probe re-qualifications in the features list.

Create a feature showing qualification results

Specifying maximum form error for qualification

Form error is the difference between a nominal dimension and the measured value of the dimension. The maximum form error allowed for probe calibration should be set slightly higher than the machine repeatability specified by the system provider or installer. For example, if machine repeatability is found to be 3 microns, the form error might reasonably be set to 5 microns.

Enter the maximum allowable qualification form error into the *Maximum form for...* field.

Maximum form for successful qualification

Specifying indexable probe type

The QC5000 supports indexable probes listed in the *Indexable probes type group*.

Click the *radio button* of the desired indexable probe. Click the *None radio button* if the desired probe is not indexable.

Indexable probe type

None

MHB MIH PH9

MHBS MIP PH9a

PH10

PH50

Tips are interchangeable

A qualification becomes "old" after this many days

Prompt on position change

Specifying interchangeable probes

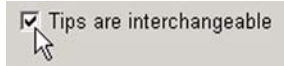
Magnetic interchangeable probe tips are supported by the QC5000, and do not require requalification.



NOTE

Threaded probe tips are not interchangeable.

Check the *Tips are interchangeable box* to use interchangeable probe tips.



Specifying the probe requalification interval

Probe qualifications remain valid for the number of days specified. Outdated qualifications change from green to yellow in the Probe selector window. Users are prompted to re-qualify the probes after the specified interval. Enter the desired interval in the *A qualification becomes... field*.



Specifying user prompts for probe position change

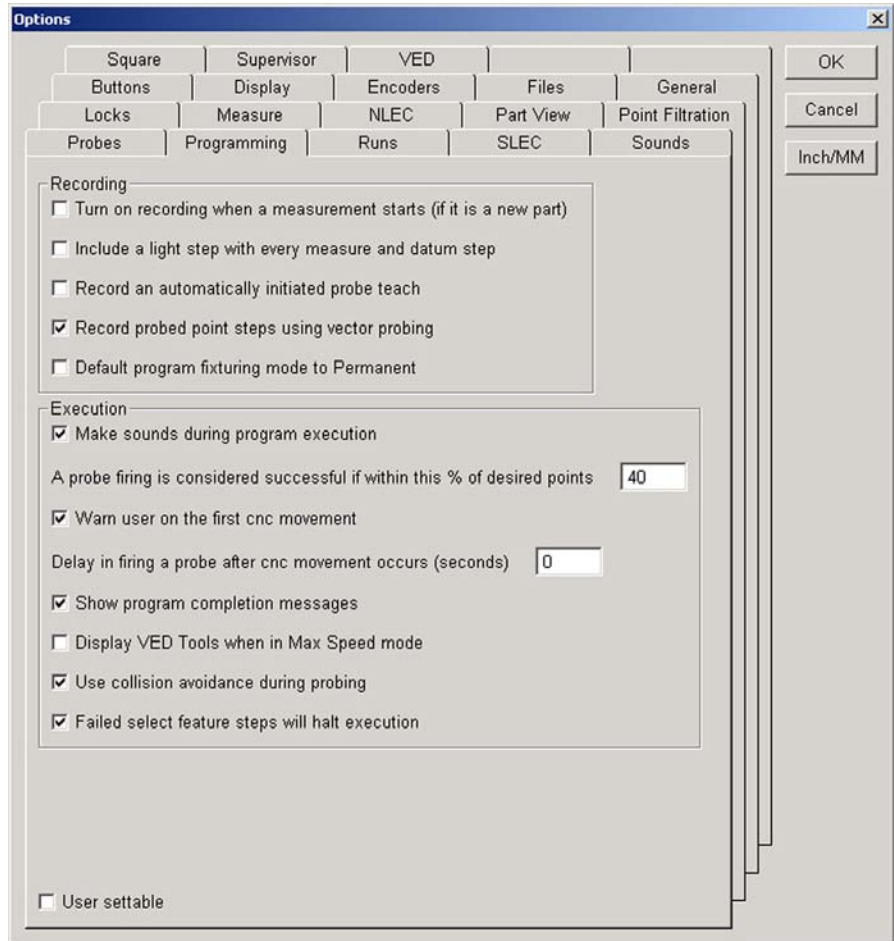
Messages can be displayed during program execution that ask the user to change the position of an indexable probe for the next measurement.

Check the *Prompt on position change box* to include user prompts.



Programming screen

Use the Programming screen to configure program recording and execution parameters.



Starting program recording automatically

Programming recording can be started automatically when the first part measurement is made.

Check the *Turn on recording... box* to enable automatic programming on each new part.



Including light adjustments in programs

Video edge detection measurements typically include adjustments of lighting to optimize the contrast of different feature images. These light adjustments can be recorded in the part program.

Check the *Include a light step... box* to include VED light adjustments in part programs.

Include a light step with every measure and datum step

Including probe qualifications in programs

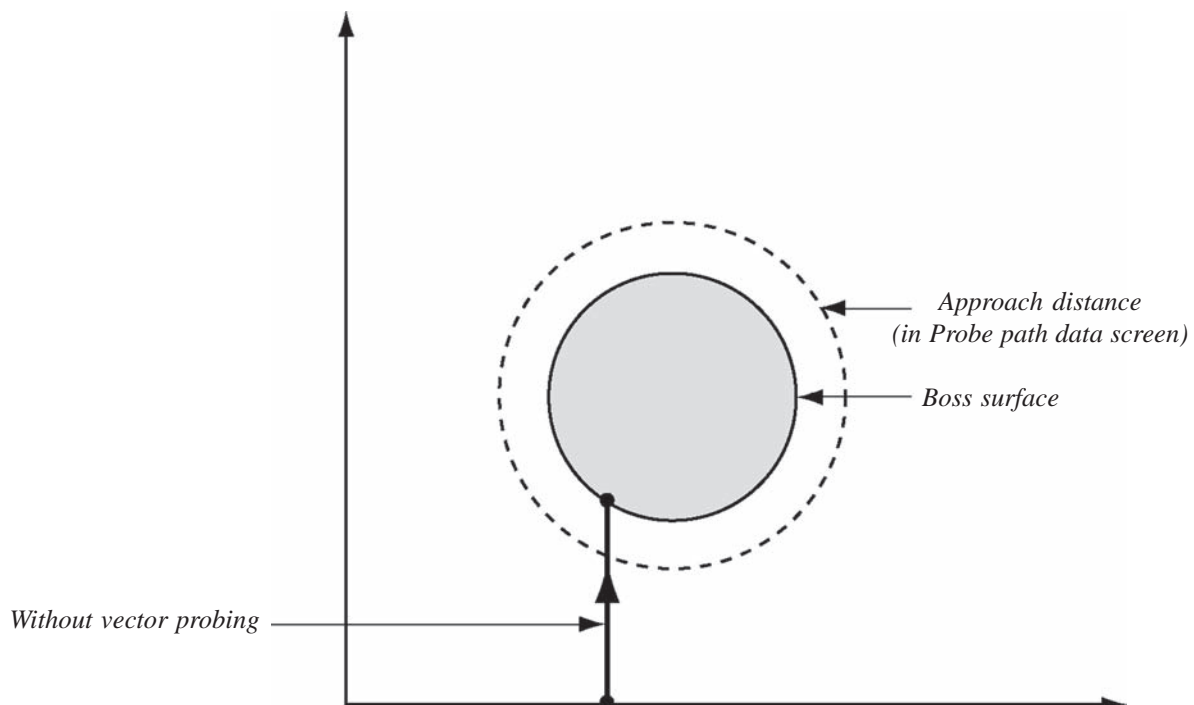
Probe qualifications conducted before or during part measurements can be included in a part program. This feature is helpful when an application requires probe qualification prior to each series of part feature measurements.

Check the *Record an automatically... box* to include probe qualification in programs.

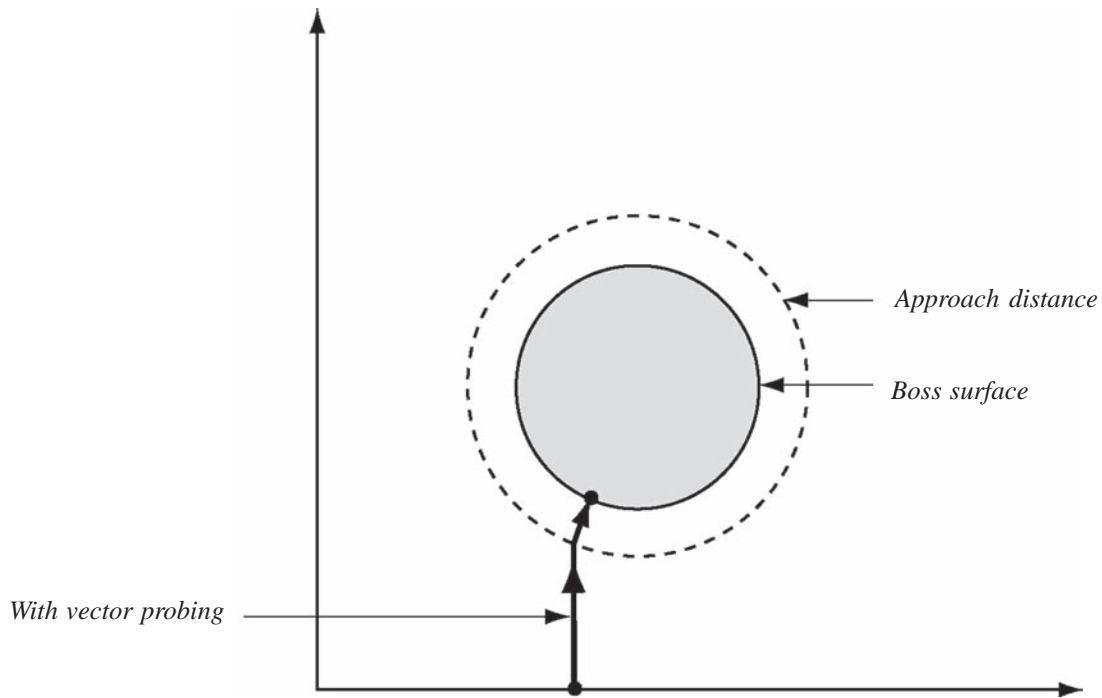
Record an automatically initiated probe teach

Specifying vector probing

During program execution, the touch probe moves in a straight-line from the last probe contact point or GO TO point, along the machine axis taken when the program was recorded. Under these circumstances, the probe does not necessarily make rightangle contact with the target surface.



Vector probing increases probing accuracy by modifying the probe path to become orthogonal to the target surface at contact.



Check the *Record probed points... box* to enable vector probing.



CAUTION

Some probing applications might include tight part geometry that doesn't provide adequate space for vector probing using default parameters. The probe approach distance can be reduced in the Probe data path screen of the Probe menu if required. Be careful to provide enough distance to avoid probe collisions.



NOTE

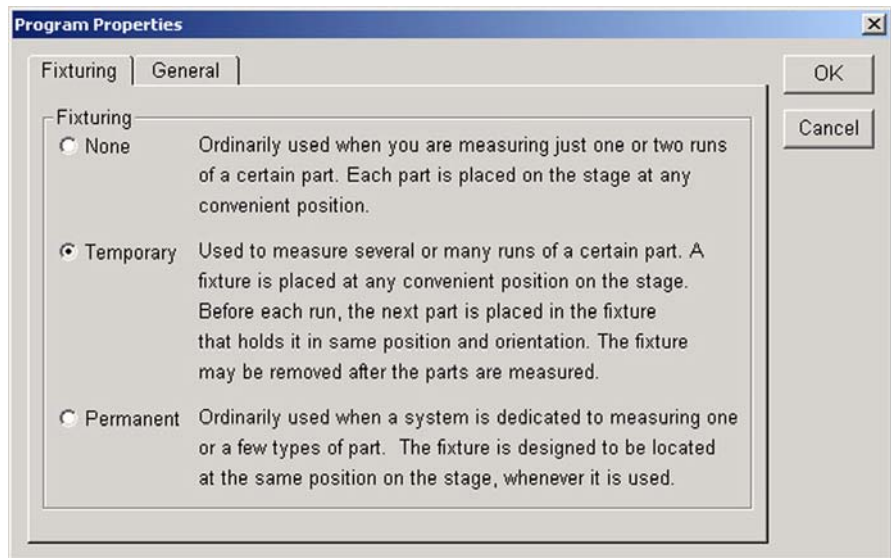
More detailed information regarding probe path configuration is included in the discussion of the Probe Path Data screen of the Probe menu.

Specifying permanent fixturing as the system default

The properties of each program include one of three possible fixturing modes; None, Temporary and Permanent. Each fixturing mode requires different datum activities when the program is executed:

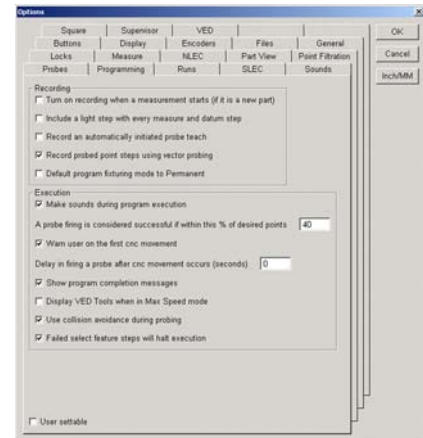
- None: No fixture is used.
A part datum must be created for each part.
- Temporary: A temporary fixture is used.
A part datum must be created for the first only series of parts.
- Permanent: A permanent fixture is used.
The part datum is assumed to be constant.
It is not necessary to create a part datum.

The fixturing mode of each program can be changed from the default mode in the *Program Properties window*.



The default fixturing mode for all programs can be set to Permanent in the Programming Options screen.

Click the *Default programming fixturing...* box to set the default program fixturing to Permanent. Uncheck the box to set the default fixturing to Temporary.



Enabling sounds during program execution

System sounds configured in the Sounds Options screen alert the operator to various conditions during program execution. These sounds can be enabled or disabled in the Programming Options screen.

Click the Make sounds... box to enable sounds during program execution.



Specifying the minimum percentage of VED points

VED tools generate up to the maximum number of points specified in the Measure Options screen when fired on a feature edge. Fewer than the maximum number might actually be generated when a program is recorded depending on the video tool used and the sharpness of the edge being measured. Measurement failures occur when the number of points missed during program execution equals or exceeds the specified percentage of points generated when the program was recorded.

For example, when 40% is specified, 60% of the points generated when the program was recorded must be collected when the program is executed.

A probe firing is considered successful if within this % of desired points

Specify the percentage of points that can be missed in the *A probe firing... field*.



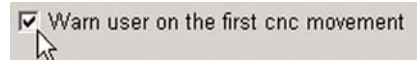
NOTE

The default value should only be changed by qualified product support personnel.

Specifying CNC movement warnings

Users can be warned prior to the first CNC movement executed by a program as a means of avoiding probe collisions.

Click the Warn user on the first CNC movement box to enable warnings.



Delaying VED tool firing after CNC moves

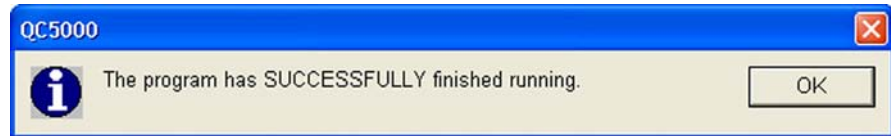
Settling time can be included in programs to eliminate the effects of machine vibration caused by CNC stage movements if necessary.

Enter the settling time delay into the *Delay in firing... field*.

Delay in firing a probe after cnc movement occurs (seconds)

Showing program complete messages

Check the *Show program completion messages box* to display the program complete message each time a program execution is complete.



Showing VED tools in the video window in max speed mode

VED tools can be shown in the video window in the max speed mode as points are collected, or can be hidden to further accelerate program execution.

Check the *Display VED tools... box* to display VED tools during program execution.



NOTE

The max speed mode is discussed in detail in Chapter 6: Programming.

Enabling collision avoidance for touch probes

Collision avoidance separates XY motion from Z motion so that:

- For motions including + Z movements, the Z-axis movement is executed (straight up), then the XY movement is executed
- For motions including - Z movements, the XY movement is executed, then the Z-axis movement is executed (straight down)

Check the *Use collision avoidance... box* to enable collision avoidance CNC moves.



Halting execution for failure to select features

Feature constructions recorded in programs require the successful selection of parent features. Under certain circumstances, it is possible that one or more parent features will be missing due to feature measurement irregularities. Program execution can automatically be halted if a parent feature is missing from a construction to avoid new feature construction inaccuracies and omissions.

Check the *Failed select features... box* to halt program execution when one or more features required for a new feature construction are missing.



Runs screen

Use the Runs screen to specify the maximum number of program executions (runs) to be displayed in the Runs template.

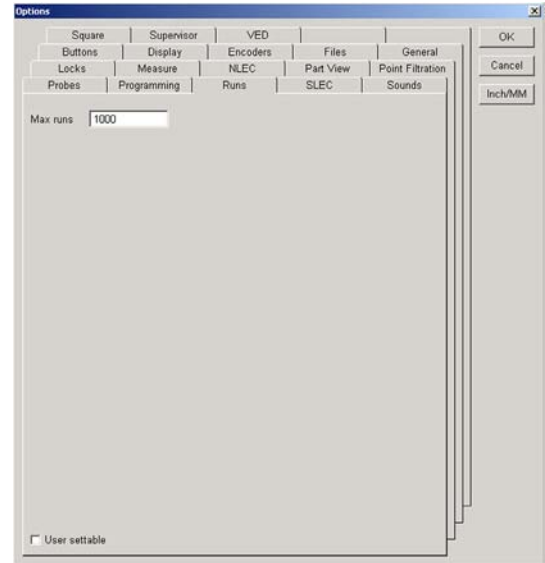
As the number of runs increases, the amount of system memory available for processing and storage decreases. This can eventually degrade QC5000 program performance as the number of runs grows large.



NOTE

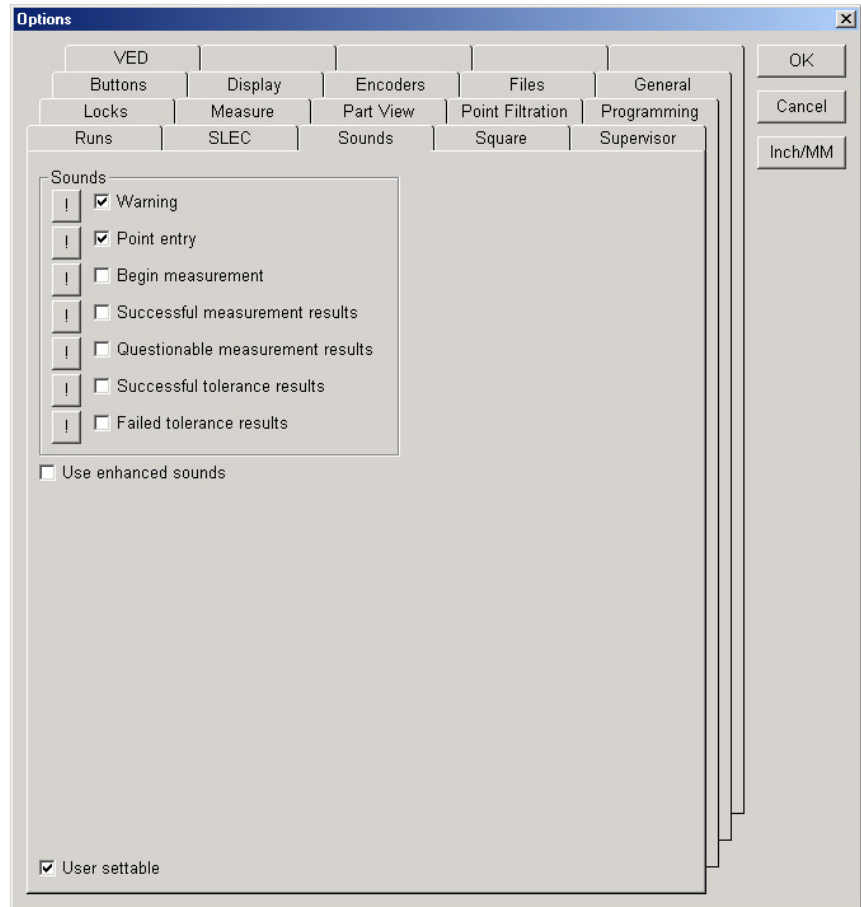
If the number of runs displayed in the Runs template exceeds the Max Runs setting, the oldest run data will be deleted as new runs are added. Regular backups of the Runs data are recommended.

Enter the desired number of runs to be displayed into the *Max runs field*.



Sounds screen

Use the Sounds screen to toggle various system sounds on or off. Check the box associated with a sound to enable it.

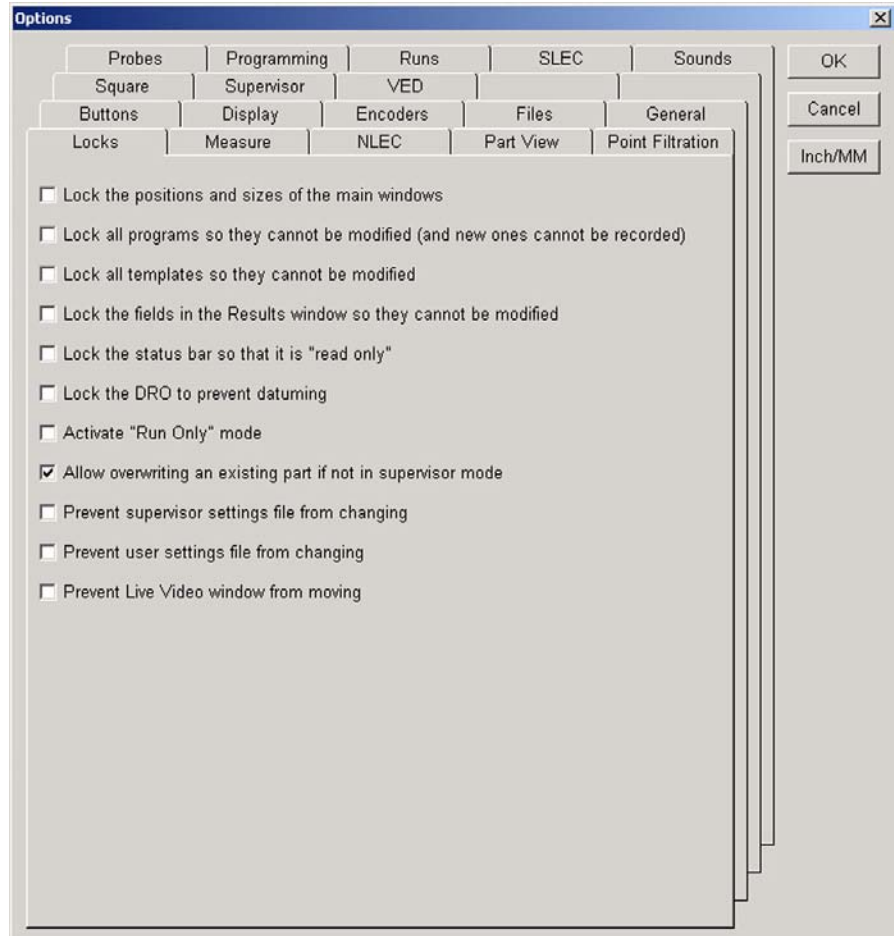


Preview a sound by clicking the *Exclamation point button* associated with it.

Check the box labeled *Use enhanced sounds* to use the sound created for the QC5000. Leave this box unchecked to use default Windows sounds. The use of QC5000 or Windows sounds is a matter of user preference.

Locks screen

Use the Locks screen to lock display and setup parameters in order to prevent unintended or unauthorized changes.



NOTE

The locks option screen is accessible only to individuals that can provide the correct supervisor password.

Locking Windows

Check the *Lock positions...* box to prevent changes in the display window position and size.

Lock the positions and sizes of the main windows

Locking programs

Check the *Lock all programs...* box to prevent changes to existing programs, and to prevent the creation of new programs.

Lock the positions and sizes of the main windows

Locking templates

Check the *Lock all templates...* box to prevent changes to existing templates, and to prevent the creation of new templates.

Lock all templates so they cannot be modified

Locking results

Check the *Lock the fields... box* to prevent changes to the contents of the results window. This also prevents dragging results from the results window into a template window.

Lock the fields in the Results window so they cannot be modified

Locking the status bar

Check the *Lock the status bar... box* to prevent status bar changes.

Lock the status bar so that it is "read only"

Locking the DRO

Check the *Lock the DRO... box* to prevent zeroing an axis datum.

Lock the DRO to prevent datuming

Locking the run mode

Check the *Activate "Run Only" mode box* to limit QC5000 activities to only running existing programs.

Activate "Run Only" mode

Locking part

Leave the *Allow overwriting box* unchecked to prevent non-supervisory personnel from saving new part files using existing part file names.

Allow overwriting an existing part if not in supervisor mode

Locking supervisor settings

Check the *Prevent supervisor... box* to prevent changes to the configuration settings made by supervisory personnel in the Tools Custom, Tools Options and Tools CNC screens.

Prevent supervisor settings file from changing

Locking user settings

Check the *Prevent user settings... box* to prevent changes to the configuration settings made by non-supervisory personnel in the Tools Customize, Tools Options and Tools CNC screens.

Prevent user settings file from changing

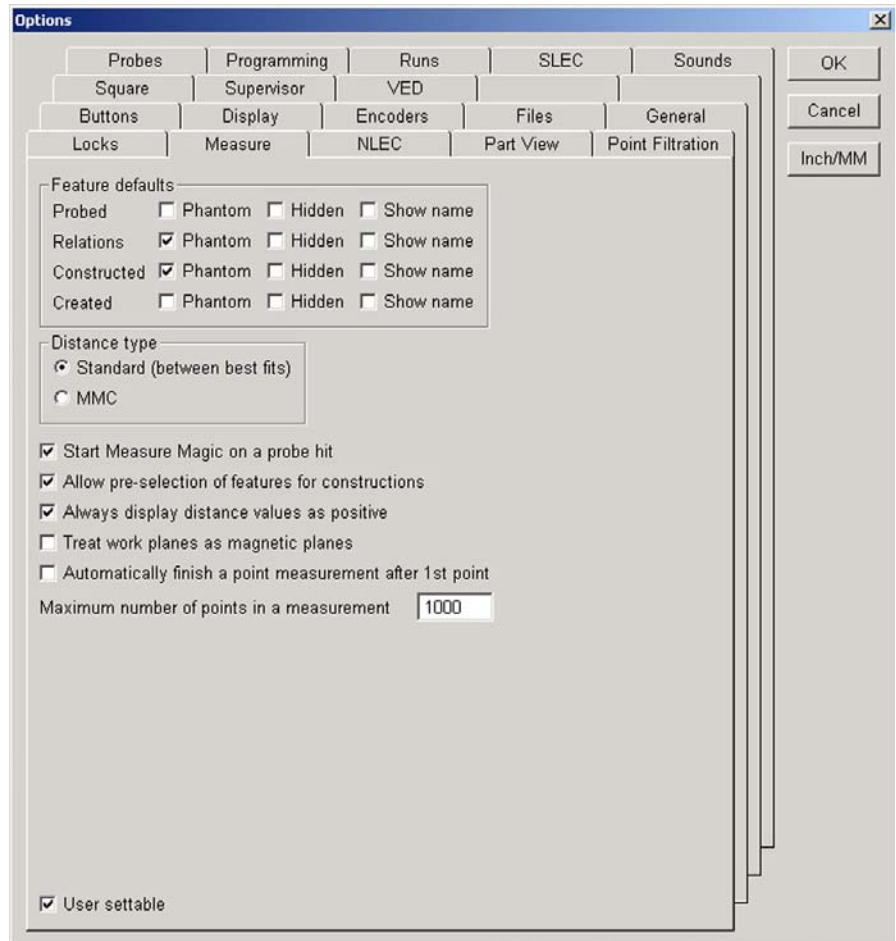
Locking the video window

Check the *Prevent live video... box* to lock the position of the video window.

Prevent Live Video window from moving

Measure screen

Use the Measure option screen to configure the display, the number of data points and other parameters governing QC5000 measurements.

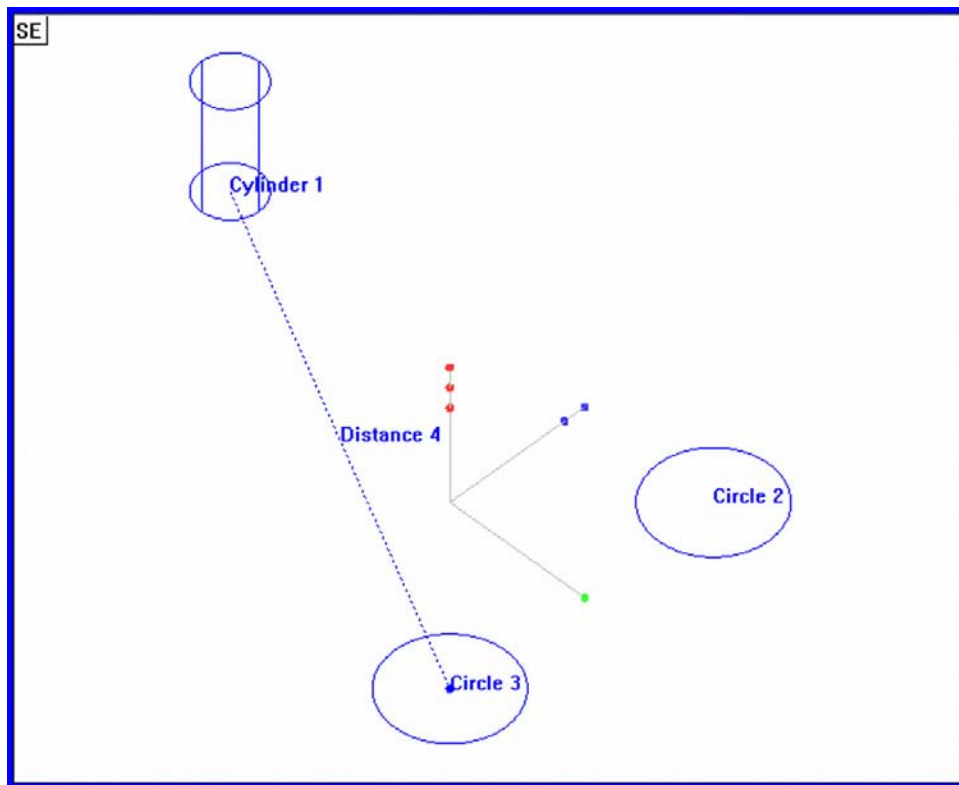


Specifying feature display defaults

Features can be displayed in the Part window as solid lines as dashed lines, or can be hidden. Displayed features can also include the names that appear in the results window.

Four types of features are displayed:

- Features that are probed
- Features that are relations of two other existing features (angles and distances)
- Features that are constructed of other existing features
- Features created by entering data



Specify the display defaults of each feature type by checking the desired box in the *Feature defaults* group.

Feature defaults							
Probed	<input type="checkbox"/>	Phantom	<input type="checkbox"/>	Hidden	<input type="checkbox"/>	Show name	<input type="checkbox"/>
Relations	<input checked="" type="checkbox"/>	Phantom	<input type="checkbox"/>	Hidden	<input type="checkbox"/>	Show name	<input type="checkbox"/>
Constructed	<input checked="" type="checkbox"/>	Phantom	<input type="checkbox"/>	Hidden	<input type="checkbox"/>	Show name	<input type="checkbox"/>
Created	<input type="checkbox"/>	Phantom	<input type="checkbox"/>	Hidden	<input type="checkbox"/>	Show name	<input type="checkbox"/>

Specifying distance type

Distances can be calculated by the system as Standard (least squares best fit) or MMC (maximum material condition). Click the desired *Distance type* radio button.

Distance type	
<input checked="" type="radio"/>	Standard (between best fits)
<input type="radio"/>	MMC

Starting Measure Magic automatically

Measure Magic can be configured to start automatically at the beginning of each new feature measurement. Check the *Start Measure Magic...* box to automatically start Measure Magic.

<input checked="" type="checkbox"/>	Start Measure Magic on a probe hit
-------------------------------------	------------------------------------

Pre-selecting features for construction

Two methods can be used to construct features:

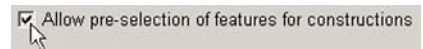
Method 1

- Click a measure tool
- Select existing features
- Click measure OK

Method 2

- Select existing features
- Click a measure tool
- Click measure OK

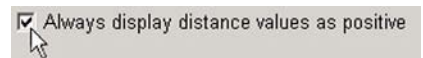
The required steps and resulting constructions are the same in either case. However, the order of steps can be specified to suit the preferences of the user. Check the *Allow pre-selection...* box to select features before choosing a measure tool.



Displaying distances as absolute values

Distance values can be positive or negative depending on the locations of features selected for distance constructions, and on the order of selection. However, the system can be configured to display the absolute values (always positive) of distances regardless of feature location and selection order.

Check the *Always display distance...* box to display distances as positive values.



Enabling magnetic planes

Normally, 2-D features are shown where they were probed or constructed in 3-D space. Alternatively, they can be shown on their projection planes in 2-D space.

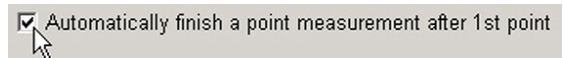
Check the *Treat work planes as magnetic planes* box to show 2-D features on their projection planes.



Automatically complete point measurements

Normally, point measurements are completed by clicking *OK* in the Feature measure dialog box after probing the point. This last step can be eliminated for point measurements.

Check the *Automatically finish a point measurements...* box to automatically complete point measurements.



Specifying the maximum number of measurement points

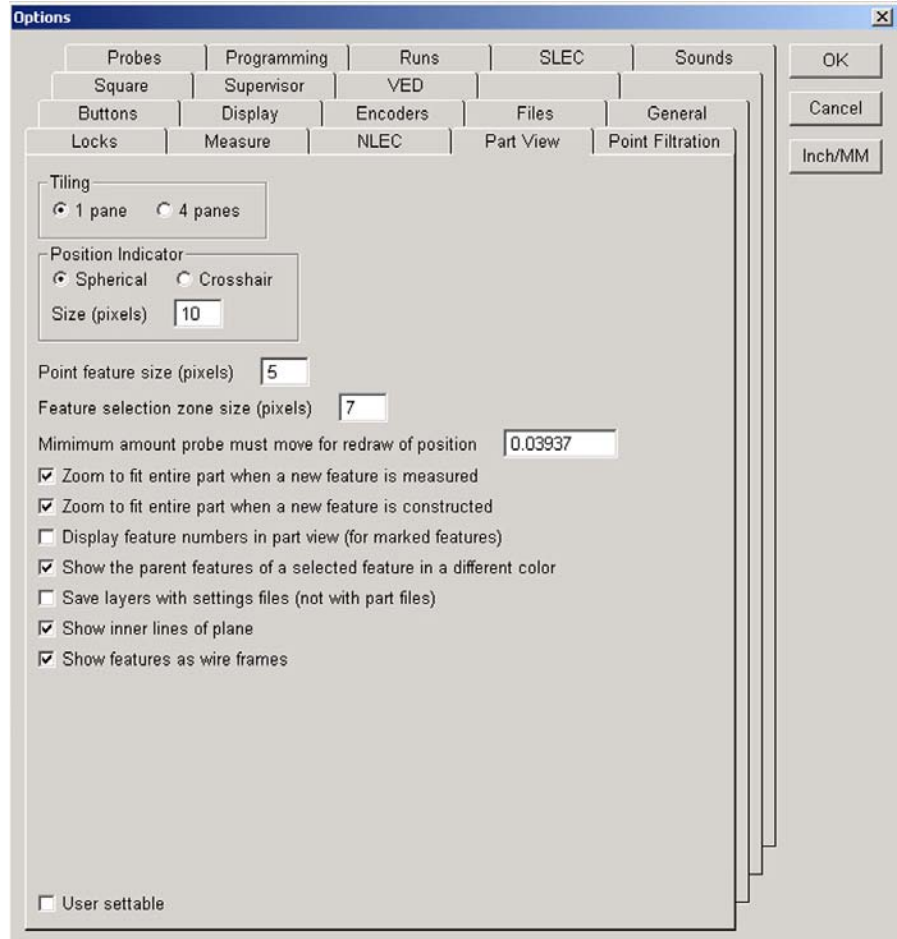
Each video probe can be configured in the video library to collect a specific maximum number of points when it's fired. These points accumulate as a video probe is repeatedly fired during a feature measurement. The system can be configured to collect up to 3000 points for an entire feature measurement.

Enter the maximum number of points for a complete feature measurement into the *Maximum number... data field*.

Maximum number of points in a measurement

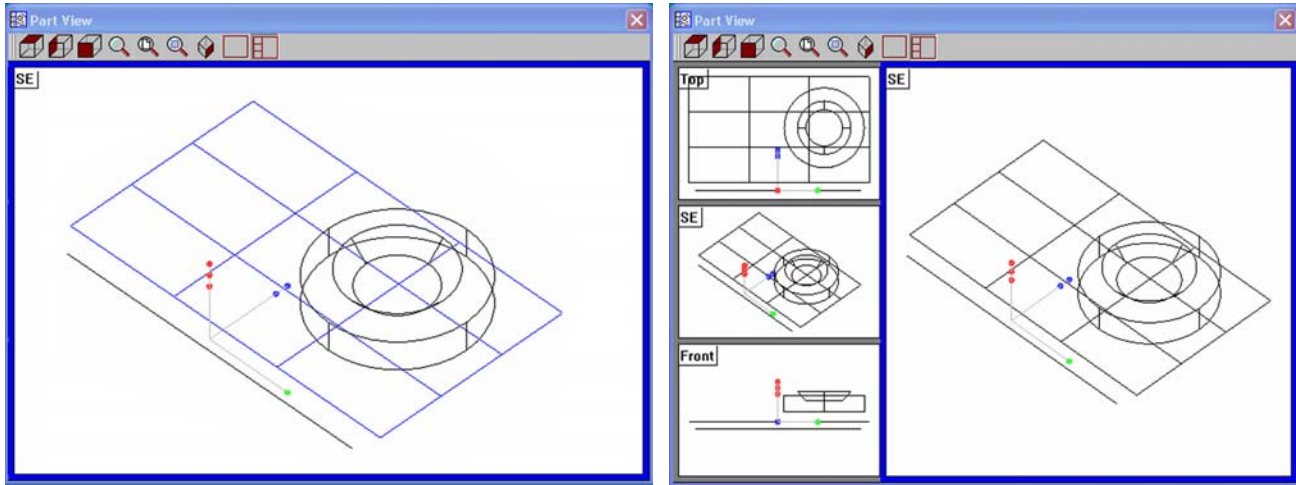
Part view screen

Use the part view screen to configure the default displays of parts, video probes and touch probes. The default pixel size of constructed points and feature selection zones are also configured in the part view screen.



Specifying part view tiles

Parts can be displayed in single and multiple tile views.



The orientation of the part in each tile is selected by the user in the Part View toolbar, and is independent of part orientations in other tiles.

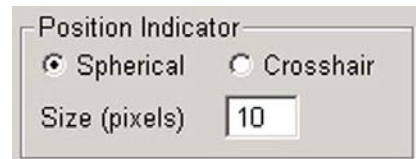
Click the radio button of the desired tile view in the *Tiling group*.



Specifying probe position indicator type

The default probe indicator shown in the Part View window during program execution can be specified as Spherical (asterisk) or Crosshairs.

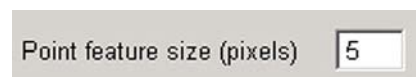
Click the radio button of the desired probe position indicator in the *Position Indicator group*, and then enter the desired indicator size.



Specifying point size

The displayed size of measured and constructed points can be specified in pixels.

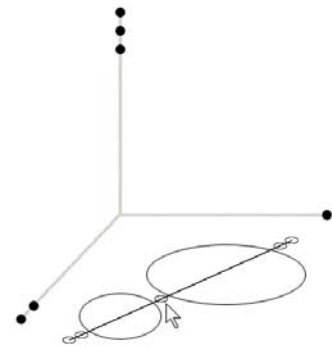
Enter the desired size for displaying point features into the *Point feature... field*.



Specifying feature selection zones size

The feature selection zone is the circular area around the tip of the arrow cursor. Features are recognized by the QC5000 system only within this area.

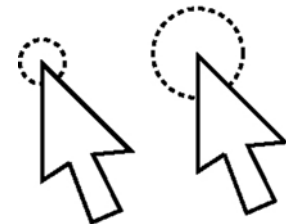
The diameter the selection zone can be increased or decreased by entering a size into the *Feature selection... data field*.



Feature selection zone

Feature selection zone size (pixels)

Increasing the diameter of the selection zone makes feature selection less sensitive, but increases the danger of accidentally selecting multiple features. Decreasing the diameter of the selection zone reduces the danger of accidentally selecting multiple features, but increases the difficulty of selecting an individual feature.



NOTE

The default 7 pixel diameter strikes an excellent balance of sensitivity and ease of operation, and should be retained if possible.

Specifying automatic redraw of part view

During program execution, the part view is periodically redrawn to show the probe position changing as features are measured. The part view is redrawn each time the probe moves the distance specified in the data field. Change the

Mimimum amount probe must move for redraw of position

redraw rate by entering a new value into the *Minimum amount... field*.

Zooming to view whole part on measurements

Check the Zooming to fit... box to zoom to display the entire part when a feature is measured or created.

Zoom to fit entire part when a new feature is measured

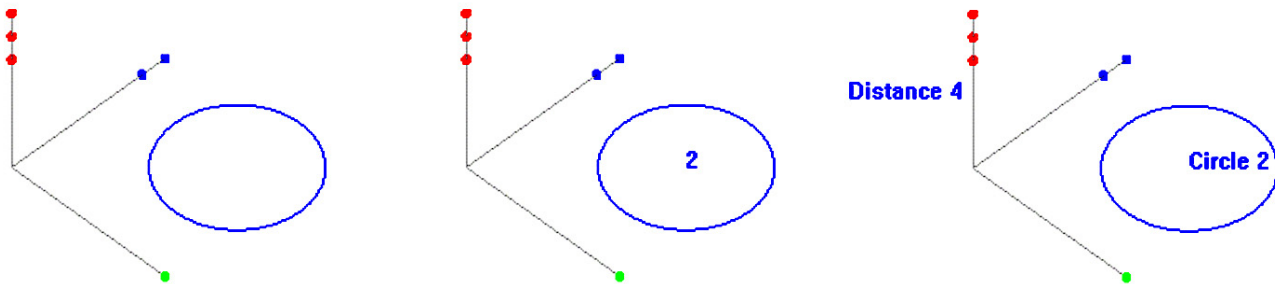
Zooming to view whole part on constructions

Check the *Zoom to fit... box* to zoom to display the entire part when a feature is constructed.

Zoom to fit entire part when a new feature is constructed

Displaying feature numbers and names on part views

Feature properties and the part view options screen can be configured to show only features, features with numbers or features with numbers and names of selected features.



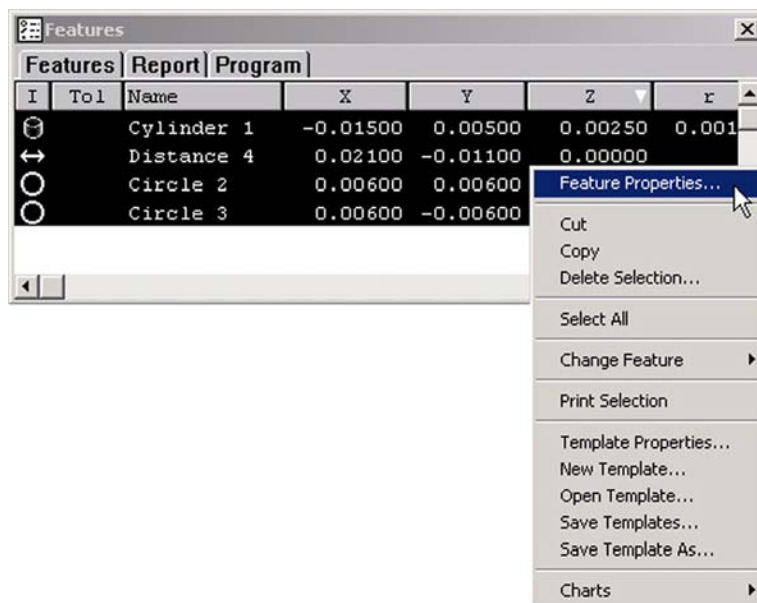
When feature properties are configured to show names, the Part View options screen can be set to show numbers or numbers and names on the part view screen.

Displaying only features

To display selected features without numbers or names on the part view screen:

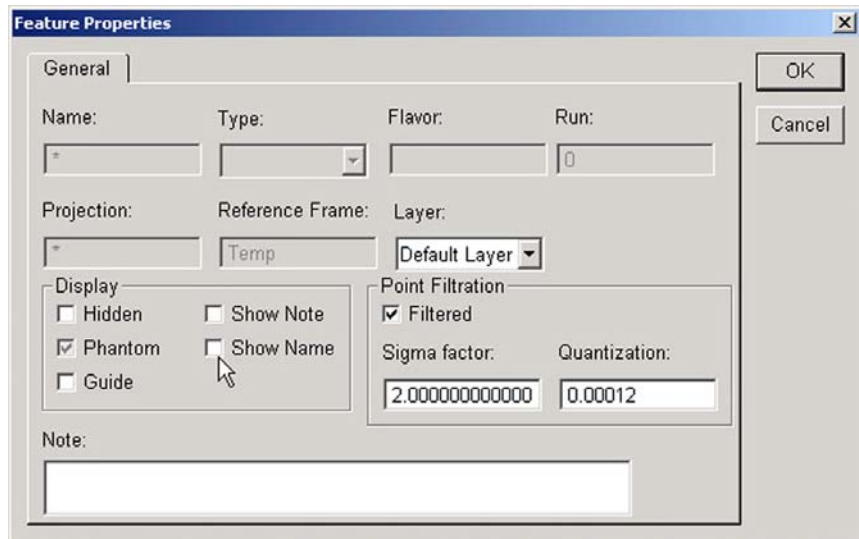
Step 1

Close the Part View Options screen, highlight and right-click the desired features, and then click *Feature Properties*. The Feature Properties window will be displayed.

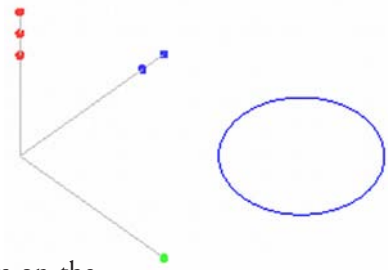


Step 2

Uncheck the *Show Name* box, and then click *OK*.



Only the selected features will be shown on the part view screen, without numbers or names, regardless of settings in the Part View options screen.

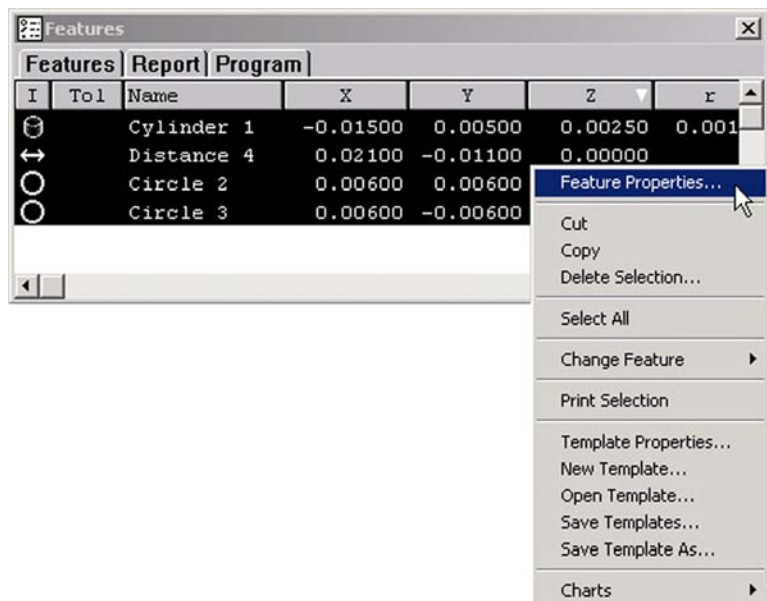


Displaying features with numbers

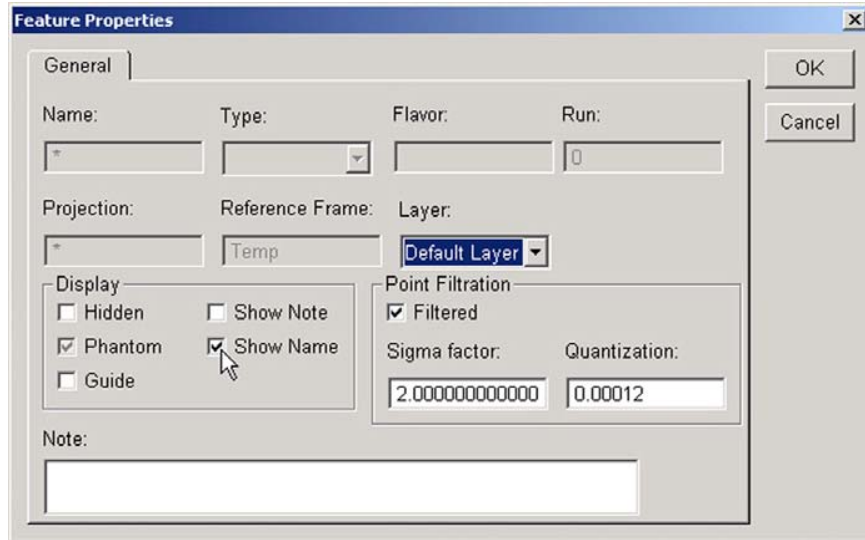
To display selected features with numbers on the part view screen:

Step 1

Close the Part View Options screen, highlight and right-click the desired features, and then click *Features Properties*. The Feature Properties window will be displayed.



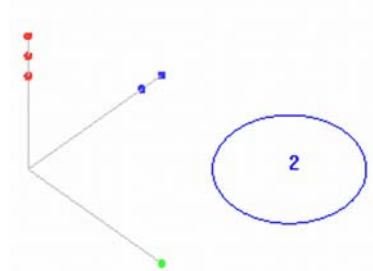
Step 2
Check the *Show Name* box and then click *OK*.



Step 3
Reopen the Part View Options screen and check the *Display a feature numbers...* box.

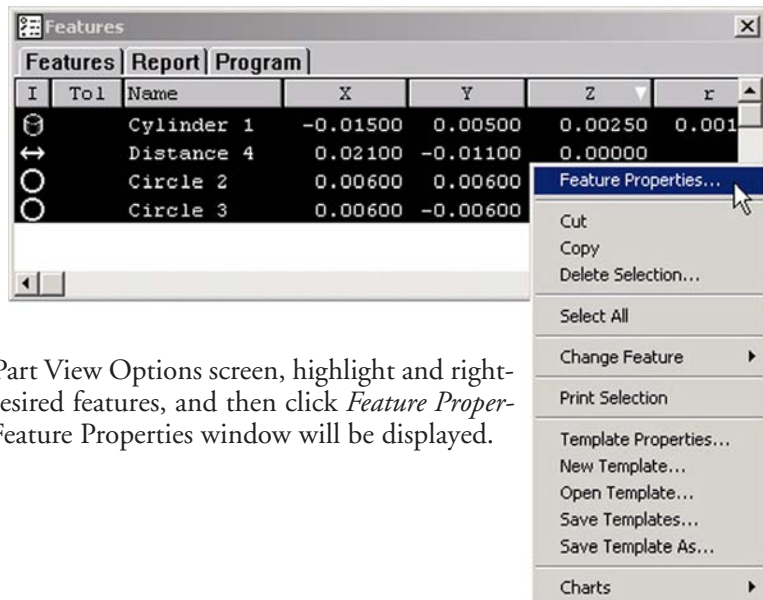


Selected features will be displayed with a feature numbers on the Part View screen.



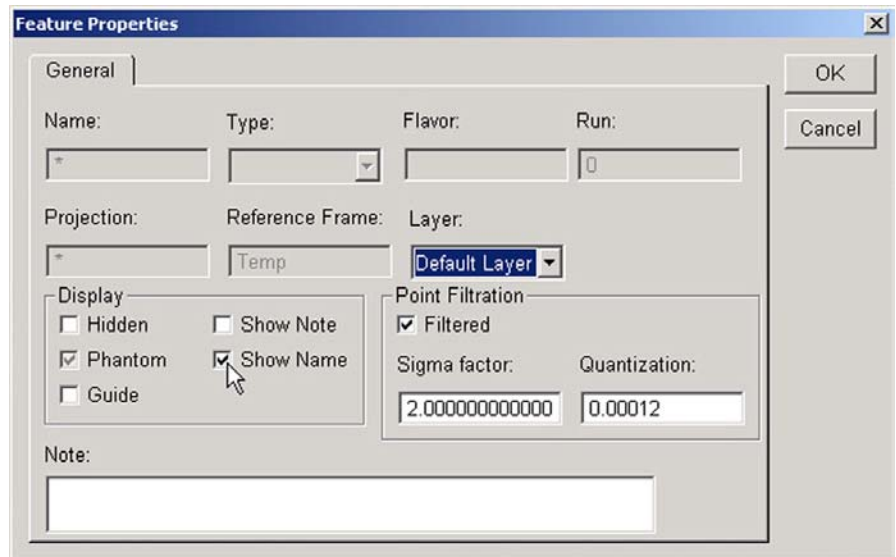
Displaying features with numbers and names

To display selected features with numbers and names on the part view screen:



Step 1
Close the Part View Options screen, highlight and right-click the desired features, and then click *Feature Properties*. The Feature Properties window will be displayed.

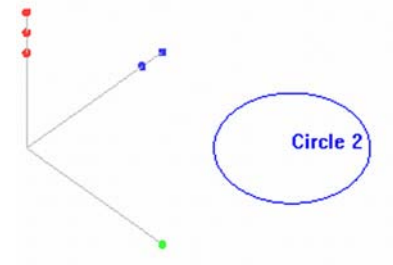
Step 2
Check the *Show Name* box, and then click *OK*.



Step 3
Reopen the Part View Options screen and uncheck the *Display Feature numbers...* box.

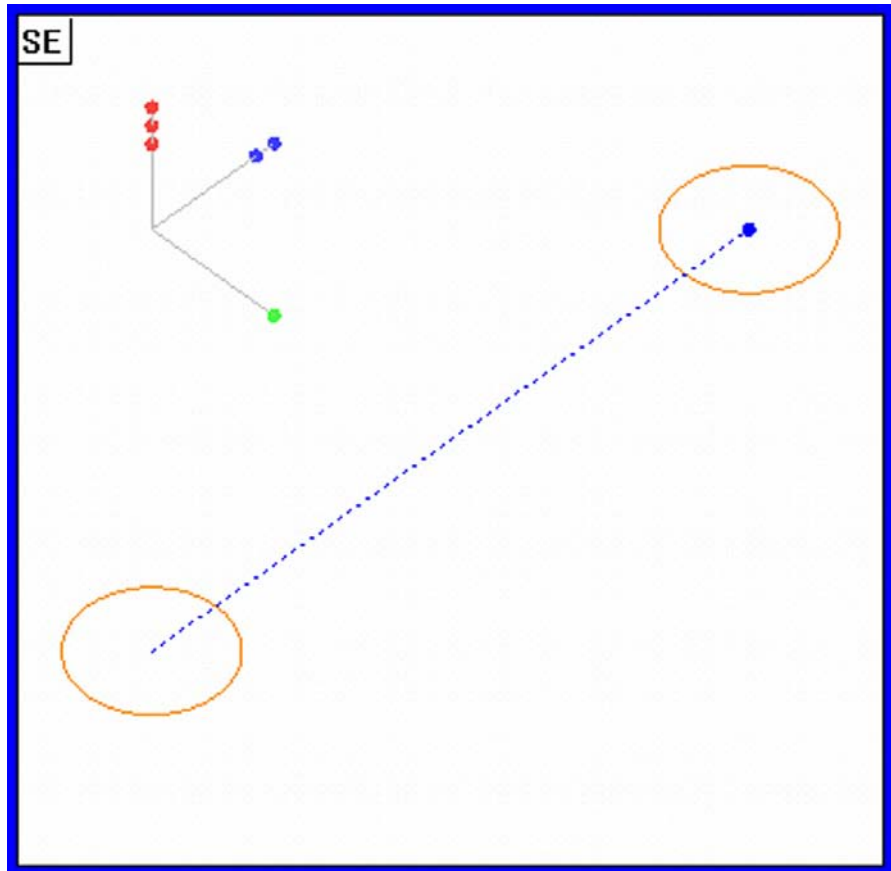


Selected features will be displayed with feature numbers and names on the Part View screen.



Highlighting parents of constructed features

Parent features, used to construct new features, can be highlighted on the Part View screen using a different color.



To highlight parent features:
Check the *Show the parent features...* box to show parent features in a different color.



NOTE
The color used to display parent features is specified in the Customize Color screen of the Tools menu.

Saving layers with settings files

Layers, layer feature assignments and layer colors can be saved in the QC5000 settings file, eliminating the need to create and configure commonly used layers each time the program is launched.

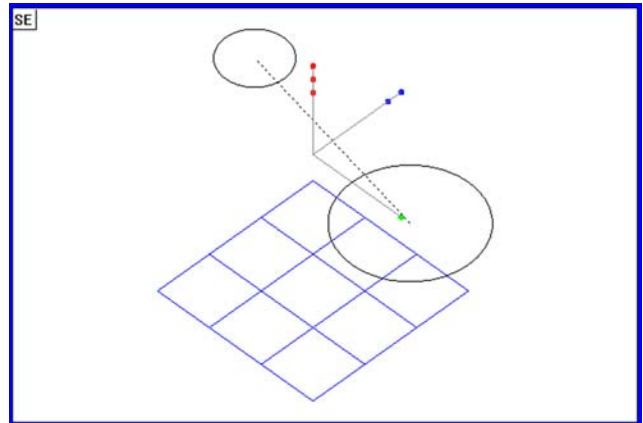
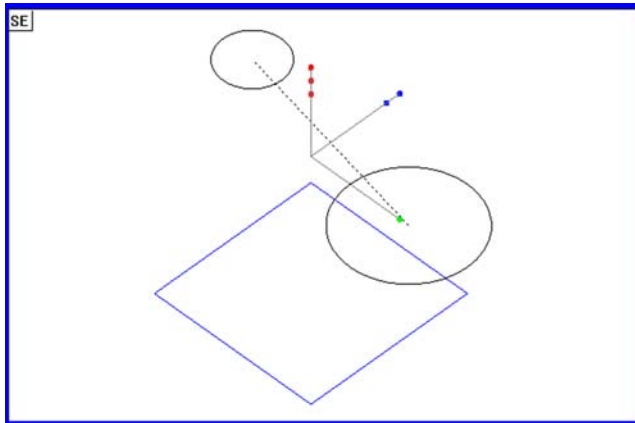
To save layers with settings:

Check the *Save layers...* box to save layers in the QC5000's settings file.

Save layers with settings files (not with part files)

Displaying grid lines in planes

Planes can be displayed as empty, or can include grid lines.

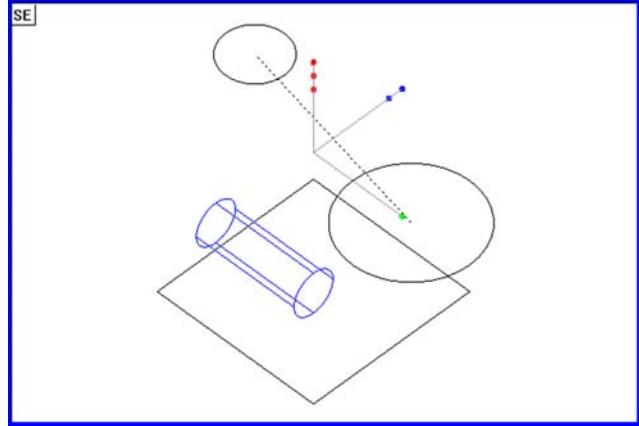
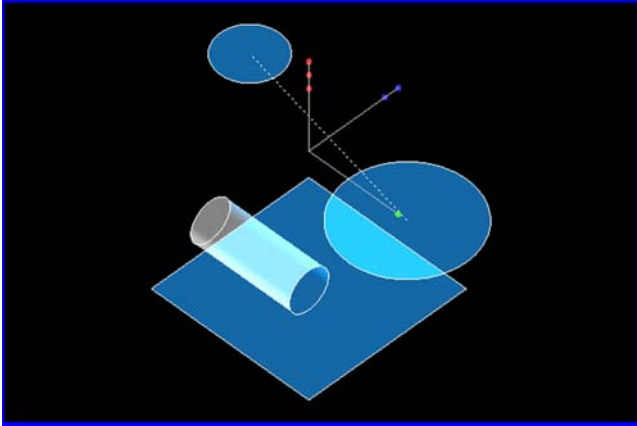


Check the *Show inner lines...* box to display grid lines in planes.

Show inner lines of plane

Displaying 3-D features as wireframes

Three-dimensional features can be shown as solids, or as wireframes in the part view window.



Check the Show features as wireframes box to display 3-D features as wireframes.



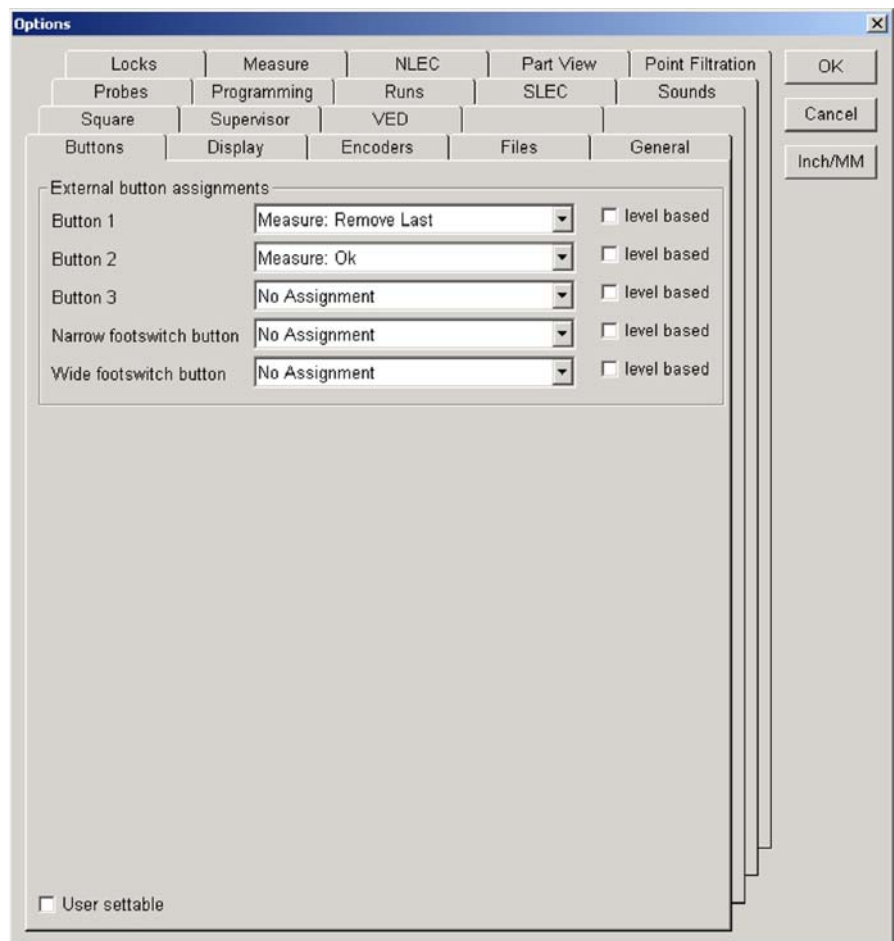
Buttons screen

Use the buttons screen to assign frequently used QC5000 system functions to joystick and foot switch buttons. Using preassigned buttons saves the time normally required to navigate menus to invoke frequently used functions.

Each of the joystick and foot switch buttons can be assigned to 1 of 14 QC5000



system functions in the Buttons screen. Thereafter, pressing the button invokes the assigned function.



Level-based button functions

Many button functions are invoked only once when the button is pressed. Others can be configured to be momentary (level-based) or to toggle functions on or off. Momentary functions are active only while the button is pressed and held. Toggle functions are activated when the button is pressed and deactivated when the button is pressed again.

Button functions that are invoked only once

Button functions that are invoked only once when the button is pressed include:

- Measure: *OK*
- Measure: *Enter pt*
- Measure: *Remove last*
- Measure: *Cancel*
- View from probe*
- Go to here*
- Pause program*
- Run program*



NOTE

None of the eight button functions listed above can be configured as momentary (level-based).

Button functions that can be momentary or toggled

Buttons that are active while pressed and held, or toggled on and off include:

- Axis lock*
- Speed toggle*
- Motors off*
- Swap Z joystick*
- Swap Z digital positioner*
- Swap Q joystick*

Configure any of the six button functions listed above as level-based by checking the button's Level-based box.

External button assignments		
Button 1	Axis Lock	<input checked="" type="checkbox"/> level based
Button 2	Measure: Ok	<input type="checkbox"/> level based
Button 3	No Assignment	<input type="checkbox"/> level based
Narrow footswitch button	No Assignment	<input type="checkbox"/> level based
Wide footswitch button	No Assignment	<input type="checkbox"/> level based

Button functions

Descriptions of the functions are provided in the following paragraphs:

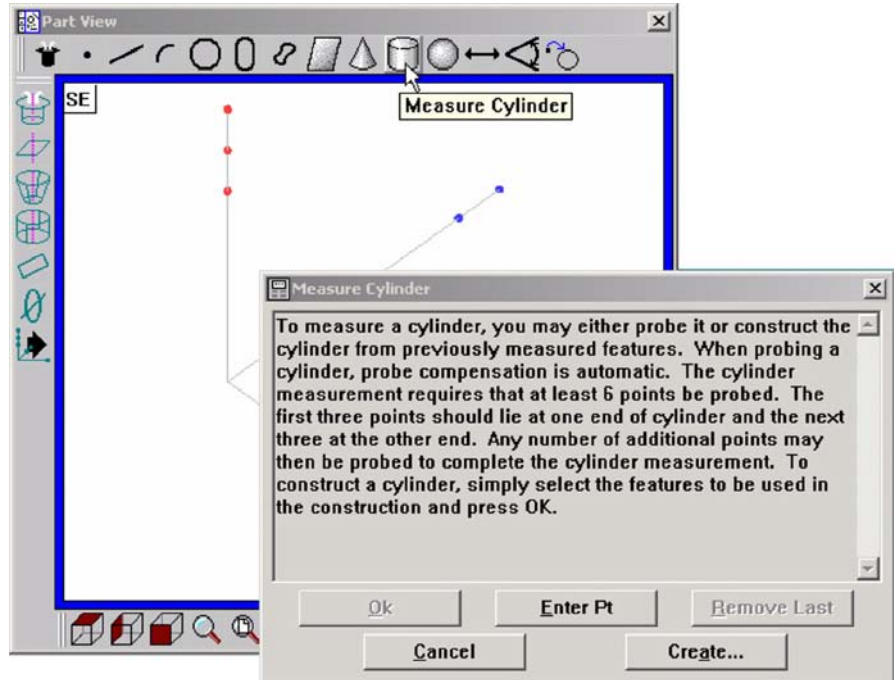
No assignment

Pressing the button causes no action

Feature measure functions

The functions below duplicate those shown on *Feature measure dialog boxes*.

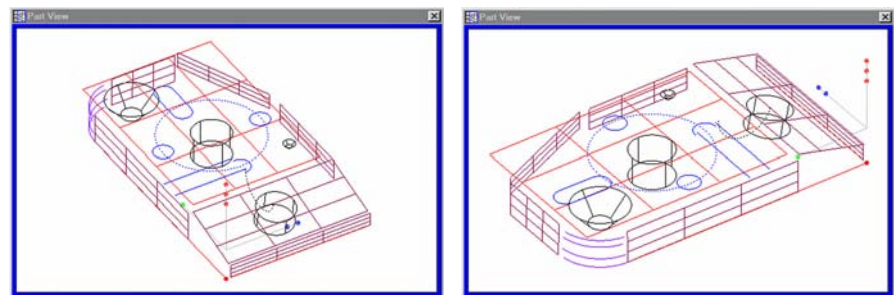
- Measure: *OK*
- Measure: *Enter pt*
- Measure: *Remove last*
- Measure: *Cancel*



The Feature measure dialog box is displayed each time a feature measurement is selected.

View from probe

Pressing the button refreshes the Part View screen image to show the current view of the part being measured from the perspective of the probe tip. The example screens below show how the view might change when the probe is moved from the front to the rear of the part.



Axis lock

Pressing the button toggles the Axis Lock function on or off. When Axis lock is toggled on, motion is permitted on only one Axis at a time; diagonal motion is not permitted. This function duplicates the Axis Lock found in the Joystick Tools menu.



Speed toggle

Pressing the button toggles all Axis motor speeds between fast and slow.

NOTE

Axis motor speeds are defined in the CNC Tools screen.

Motors off

Pressing the button toggles all Axis motors on or off. This function duplicates the Motors Off found in the Tools menu.

Swap Z joystick

Pressing the button toggles the vertical joystick motion between the Y-axis and the Z-axis.

Swap Z digital positioner

Pressing the button toggles the vertical trackball motion between the Y-axis and the Z-axis.



Swap Q joystick

Pressing the button toggles the vertical joystick motion between the Y-axis and the rotary Q-axis.

Go to here

Pressing the button inserts a *Goto Here* step into the current line of the program being recorded.

This function duplicates the *Goto Here* found on the program toolbar.



Pause prg

Pressing the button pauses the current program execution.

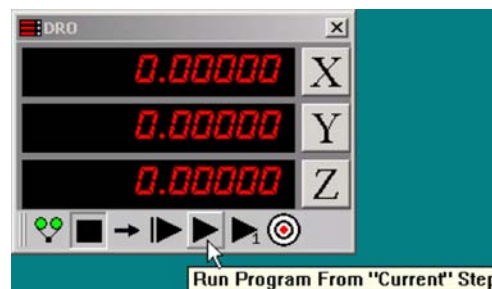
This function duplicates the Pause found on the program toolbar.



Run prg

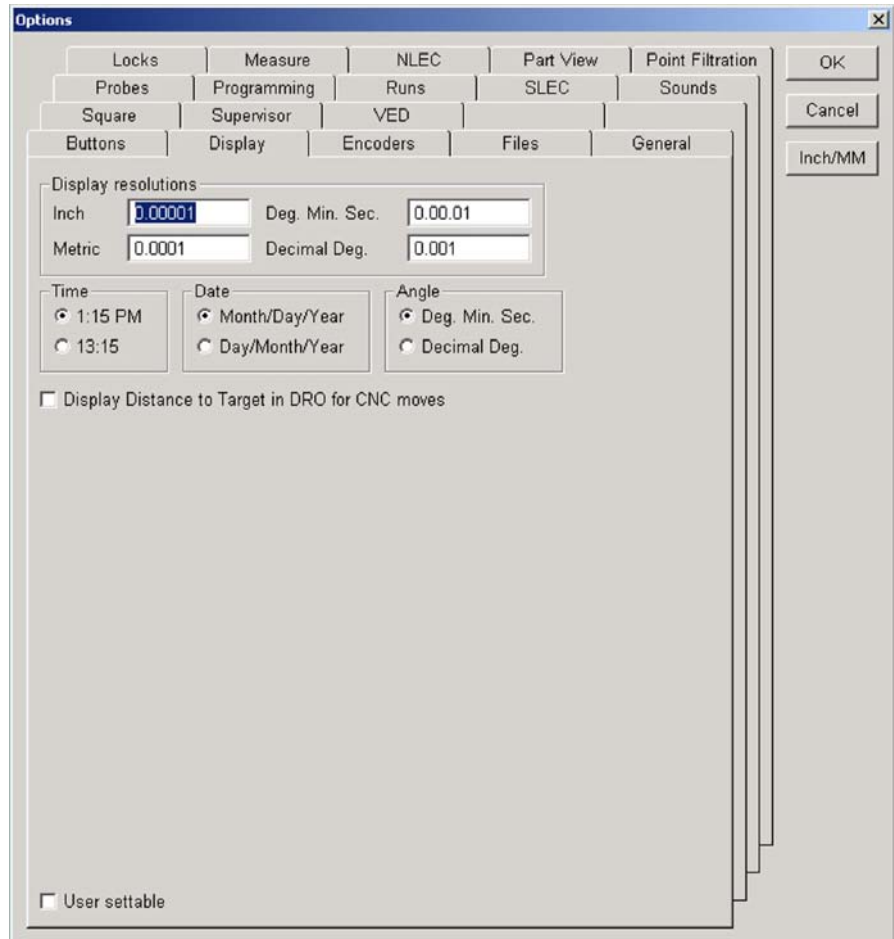
Pressing the button runs the current program starting from the current step, and is typically used to resume program execution after a pause.

This function duplicates the *Run Program From Current Step* found on the program toolbar.



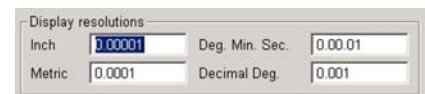
Display screen

Use the display screen to define the display resolution of linear and angular values, and to format the display of time, date and angles.



Specifying display resolution

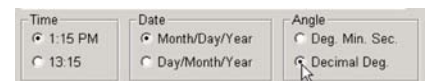
Enter the display resolutions for linear and angular values into the appropriate fields. Metric values are expressed in millimeters.



Display resolutions that exceed the resolution of the input encoders result in unnecessary zeros at the right of the displayed value. Display resolutions less than the resolution of input encoders result in the display of rounded values.

Formatting the display of time, date and angles

Format the display of time, date and angles by clicking the desired radio button.



NOTE
The time and date are set in the Windows operating system.

Displaying the distance to target surfaces for CNC moves

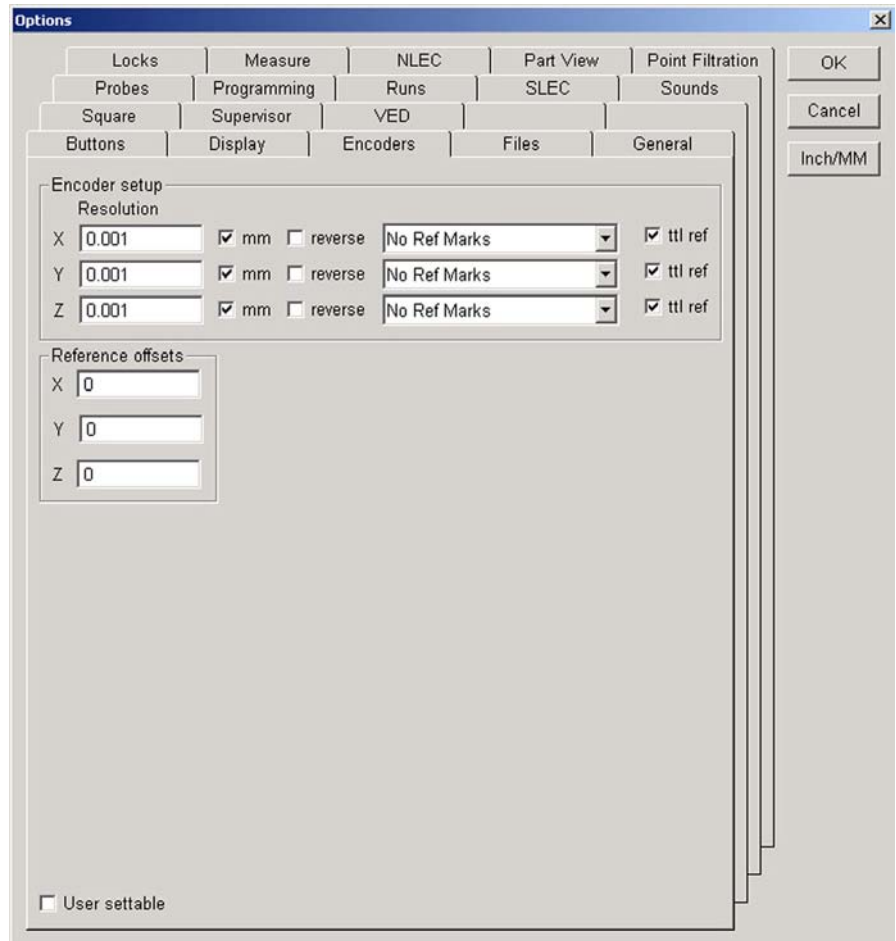
Normally, the DRO displays the current input sensor position.

Checking the *Display distance to target ... box* changes the DRO to display the distance to the next CNC target while running a program. This distance decreases during CNC moves until the continuation zone around the CNC target point is reached. At that time, the DRO displays the current position until the measurement at the target is complete. When the measurement is complete, the DRO changes to display the distance to the next CNC target again. When the program is completed or halted, the DRO displays the current position until the next program execution begins.



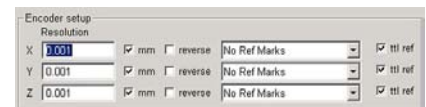
Encoder screen

Use the encoder screen to specify encoder resolution, units of measure, count direction and reference mark type.



Specifying encoder resolution

Enter the resolution specification of the encoders used with your system into the *X, Y and Z Resolution fields*.



Specifying encoder unit of measure

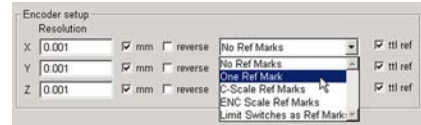
Check the *mm box* for metric encoders, or uncheck the *mm box* for encoder output values in inches.

Specifying encoder count direction

Check or uncheck the *reverse boxes* to achieve the desired DRO count directions.

Specifying encoder reference marks

Highlight the desired reference mark type in the drop-down lists, and then uncheck the *TTL Ref box* for analog reference marks.



Reference offsets

The *Reference offsets fields* are used by OEM setup personnel and qualified service technicians to move the location of the system's machine zero.

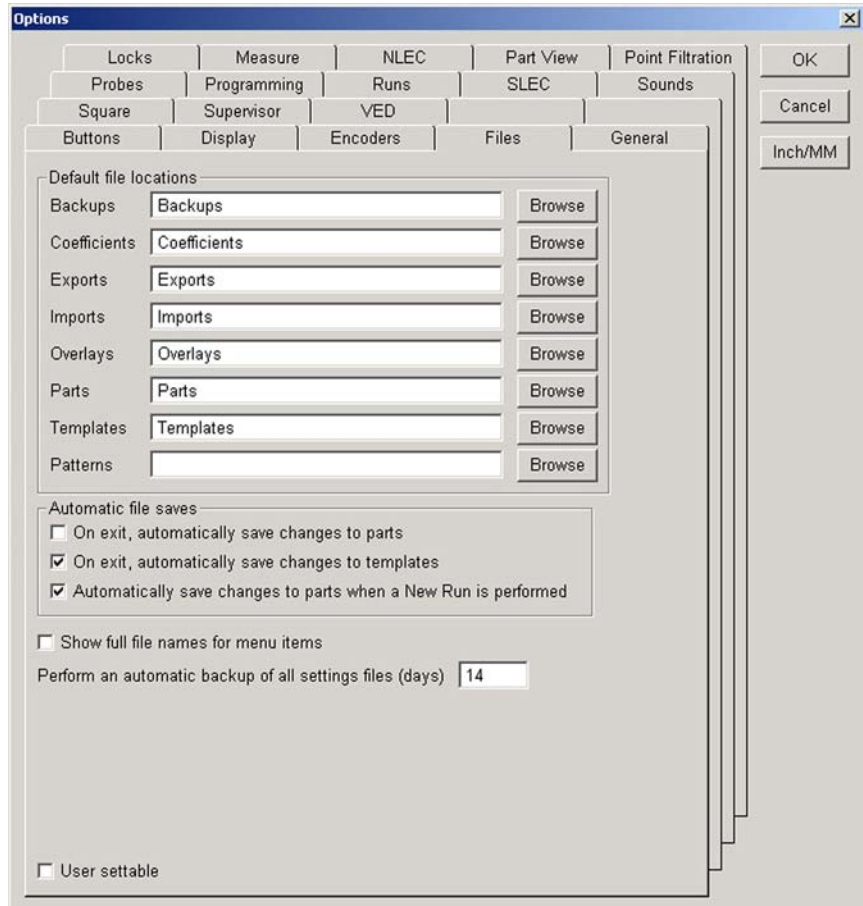


CAUTION

The machine zero location must be undisturbed to ensure correct operation and accurate error correction. Do not change to reference offsets values.

Files screen

Use the files screen to specify QC5000 system file locations, methods of automatic file saving, file name display and automatic file backup interval.



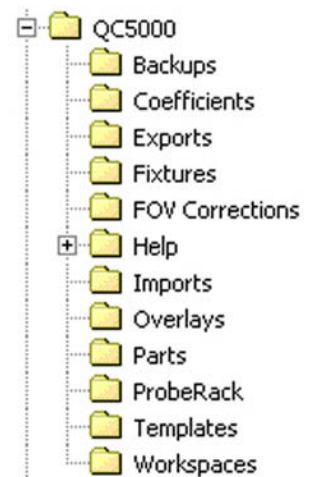
Specifying file locations

The default storage location for files is:
C:\QC5000

The storage location for any file can be changed by selecting a new location using the *Browse tool*.



CAUTION
Storing files in the QC5000 directory is recommended. Storing files in other directories or on other drives can lead to lost files and program execution problems. Never store files on network drives. Network priorities and timing requirements can cause program execution problems when writing to or reading from network drives.



File types

The file types are described below:

Backups

Automatic and manual QC5000 backup files contain QC5000 system and encoder configuration settings. A QC5000 installation can be completely restored from a backup file if necessary. The backup file extension is:

Filename.5fi

Exports

Any feature(s) in the Feature list can be highlighted and exported as an export file. Export files can be drawing, database or delimited string files. Export file extensions include:

.tdf

.csv

.dxf

.igs

Imports

Features can be imported to the Feature list and Part view from drawing files contained in the default imports directory or from other directories accessed by browsing. Imported files include geometric features and video charts. Import file extensions include:

.dxf

.igs

Overlays

Templates can include page and report headers and footers. Headers and footers are created of text and graphic images, and are saved in the overlays folder to be recalled and added to pages or reports later. Overlay files have the following extension:

.5io

Parts

Part files contain all aspects of a part including geometric features, part view and program. Part files have the following extension:

.5pa

Templates

Template files can be created by the user to organize program, feature, report and other information into columns in the report window. Template files have the following extension:

.5ft

Patterns

Geometric patterns can be created by the user to automatically recognize part features. These patterns are stored by default at the root of the QC5000 directory. A Pattern folder can be created and specified as the default storage location if desired by using the *Browse tool*.

Saving part files automatically

Part and template files can automatically be saved upon exiting the program. Part files can also automatically be saved upon the completion of a program run. Check the desired *Automatic File Saves box*.

Automatic file saves

On exit, automatically save changes to parts

On exit, automatically save changes to templates

Automatically save changes to parts when a New Run is performed

Showing full file names

File names displayed in menus can be shown in an abbreviated form, or can be displayed with complete file names and paths. Check the *Show full file names box* to display complete file names and paths.



Performing automatic backups

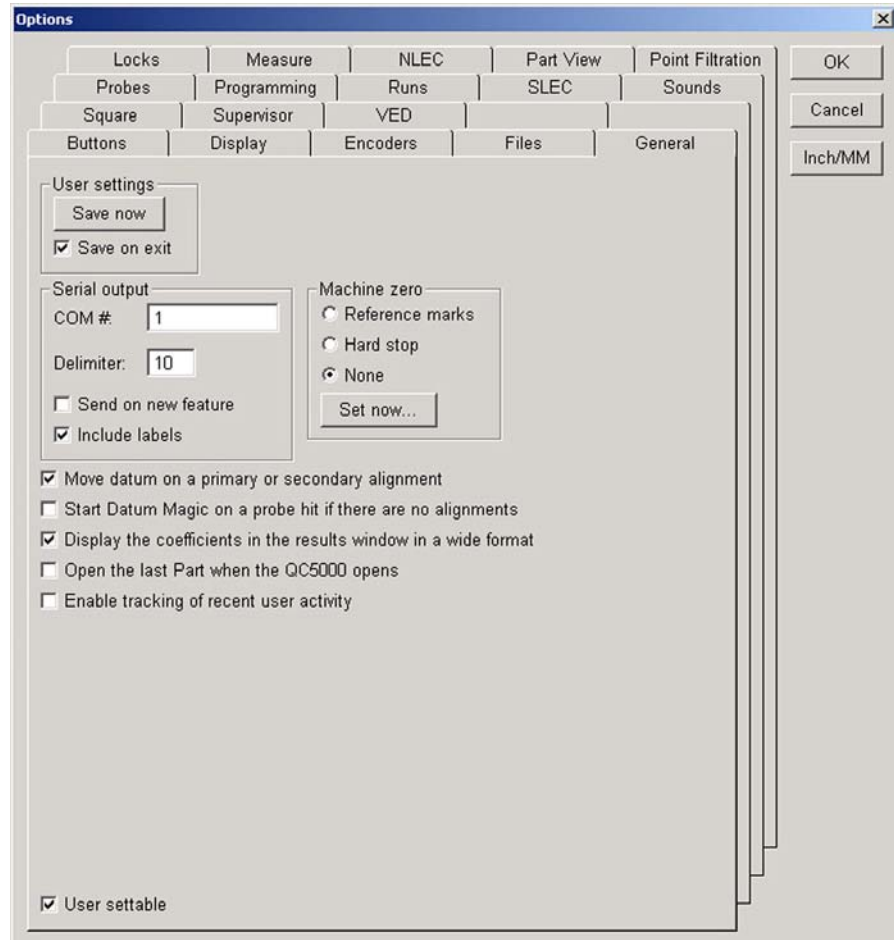
Backup files of QC5000 configuration settings can be saved automatically at an interval set by the user in the *Perform an automatic backup... data field*.

Perform an automatic backup of all settings files (days)

Enter the desired number of days between automatic backups directly into the *Perform an automatic... data field*.

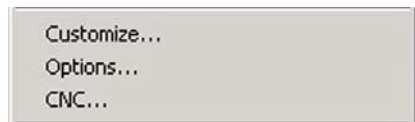
General screen

Use the General screen to save QC5000 configuration settings, configure serial communication data, set machine zero or configure other general settings.



User access to settings

Many QC5000 system settings are configured on the Customize, Options and CNC screens of the Tools menu.

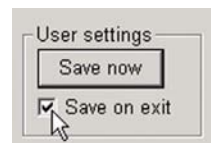


The supervisor determines which of the settings screens are accessible to the user by checking the *User settable* box at the bottom-left of many configuration screens.



User accessible settings are saved in the Filename.5us file at the root of the QC5000 directory.

To save the user settings immediately, click the *Save now* button.



To automatically save the user settings when the QC5000 program is closed, check the *Save on exit* box.

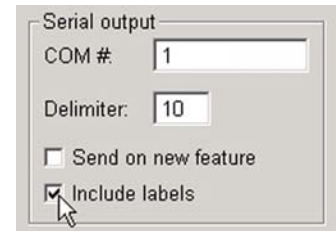
Sending coefficient data to the serial port

Coefficients from the current results window can be sent to an RS-232 serial port of the user's choice whenever a new feature is measured. The user can also insert an ASCII delimiter between the coefficients and include coefficient labels in the data transmission.

To send coefficients:

Step 1

Enter the desired COM port number for the RS-232 transmission of coefficient data into the *COM# field*. Verify that the specified COM port is not already reserved for some other purpose.



Step 2

Enter the ASCII code of the delimiter used to separate coefficient data fields into the *Delimiter field*. A delimiter is required to separate data fields.



NOTE

A chart of ASCII codes is provided in [Chapter 9: Reference Material](#).

Step 3

Check the *Send on new feature box* to send coefficient data to the RS-232 port. Coefficient data will be sent from the results window each time a new feature is measured.

Step 4

Check the *Include labels box* to transmit the result window's alpha labels with the numeric coefficient data. Without labels, the data is transmitted as a series of numeric data fields.

Setting machine zero

The QC5000 machine zero can be specified and set at any time to facilitate set up, testing and encoder replacement.

To set machine zero:

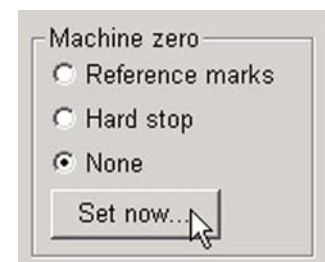
Step 1

Click the *Reference marks, Hard stop or None radio box* to specify the type of machine zero used.



CAUTION

The type of machine zero specified here should be consistent with the type specified on the Encoder Options screen.

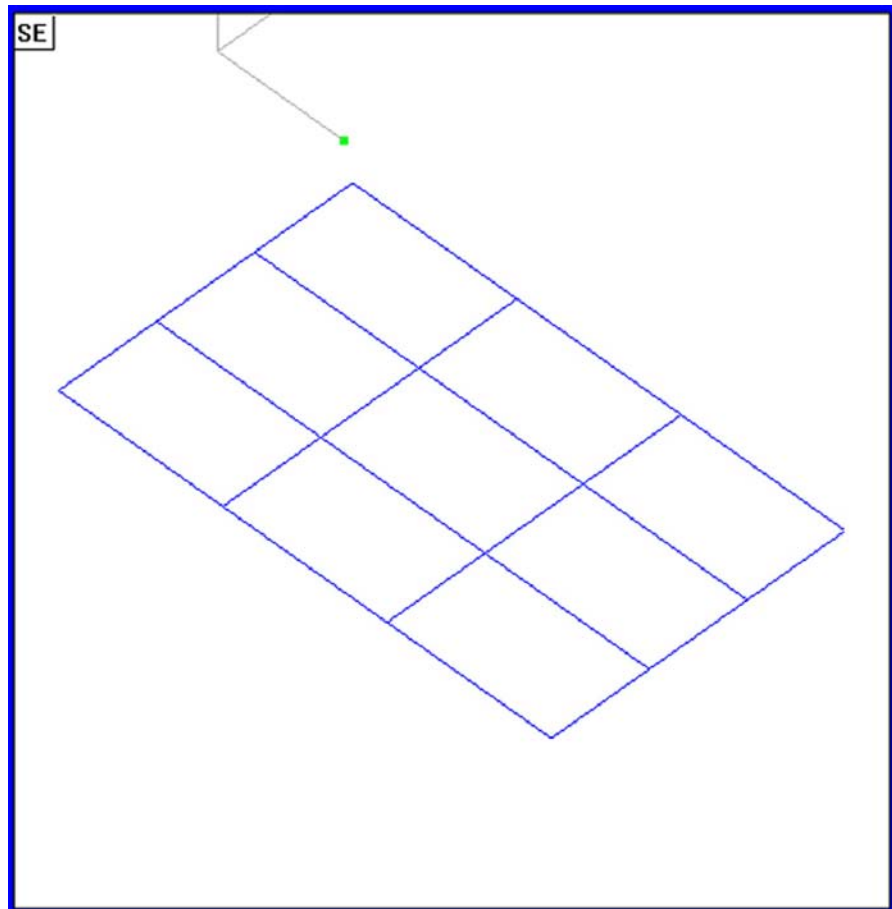


Step 2

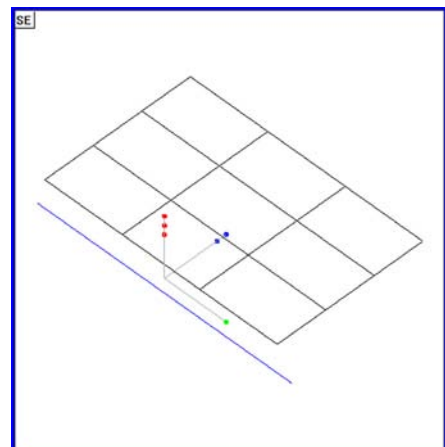
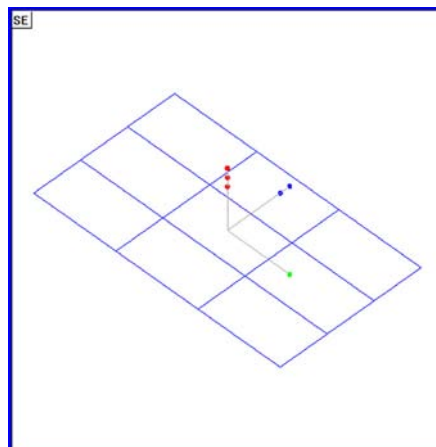
Click the *Set now button* to set machine zero.

Moving the datum on alignments

Until a datum is created by the user, machine zero is the datum used to display features in the part view window. This can exclude the datum from view during primary plane measurement and secondary alignment, depending on the proximity of the part to machine zero as shown in this example.



The system can be configured to automatically move the datum to the center of the primary plane, and then to the center of the secondary line as the user creates a datum.

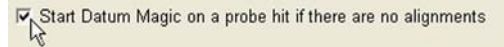


Check the *Move datum on a primary...* box to automatically move the datum during primary plane measurement and secondary alignment.



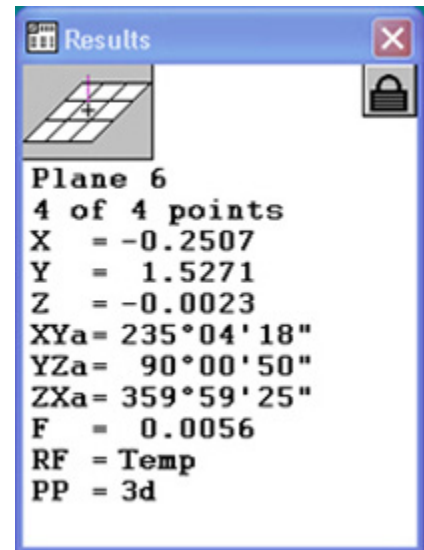
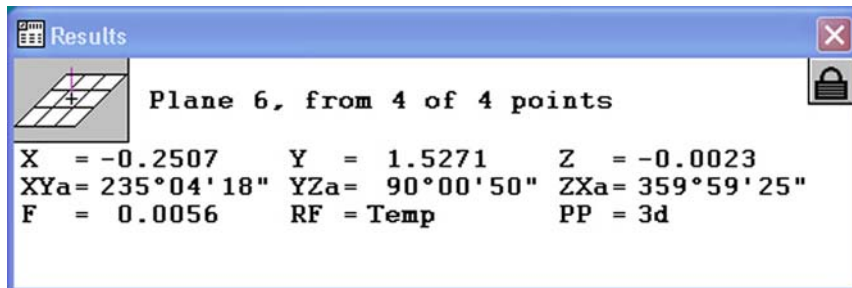
Starting Datum Magic automatically

Datum Magic can be configured to automatically establish the primary plane and secondary alignment at the beginning of each measurement session. Check the *Start datum magic...* box to start datum magic on the first probe hit if no alignments exist.

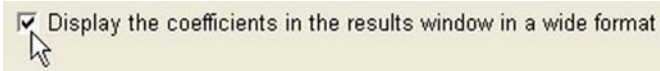


Displaying results in wide format

The contents of the Results window can be displayed in narrow or wide format.

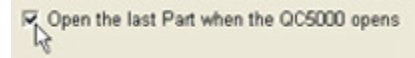


Check the *Display the coefficients...* box to display the results window in wide format.



Opening the last part automatically

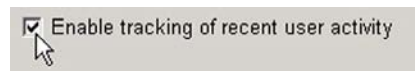
The QC5000 can be configured to automatically open the last active part file upon startup. Check the *Open last part...* box to open the last part file.



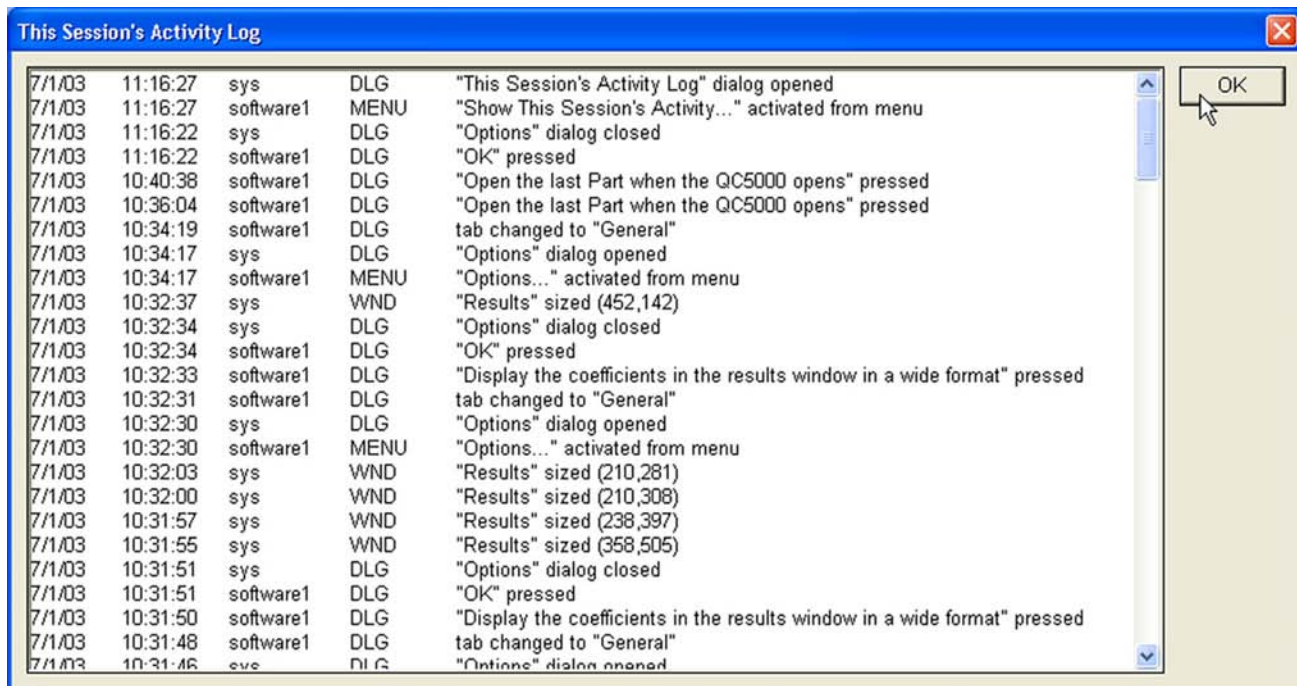
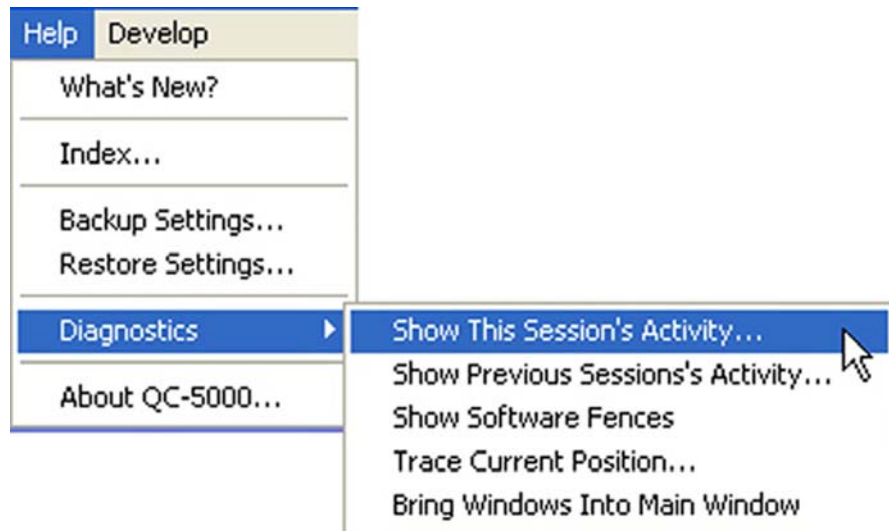
Tracking user activity

User activities such as key presses and mouse clicks can be logged to facilitate troubleshooting and other diagnostic processes. The logged file is stored in the Recent Activity folder at the root of the QC5000 directory.

Click the *Enable tracking...* box to log user activities.



Click *Help*, *Diagnostics*, and then *Show this session's activity* to display the logged file.



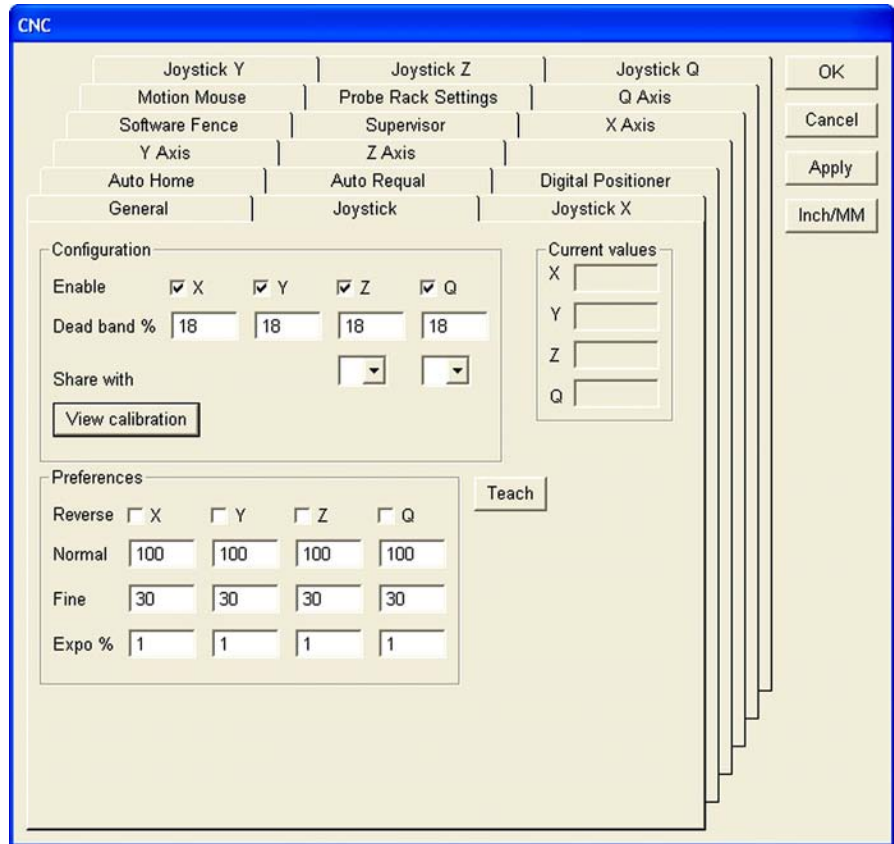
NOTE

Enabling this logging feature uses small amounts of system memory and processor time. However, older systems might run a little slower when the logging feature is enabled.

Setup Tools/CNC screens

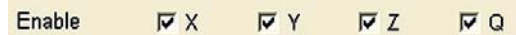
Joystick screen

Use the joystick screen to enable, calibrate, and configure motions controlled by the joystick on all axes.



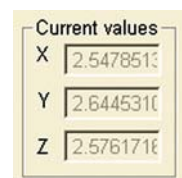
Enabling/Disabling joystick motion control

Check or clear the Enable box to enable or disable joystick motion control for the designated axes.



Viewing current position values

The current joystick position is indicated by the Current Values fields. These values can range from a low of 0 to a high of 5.0. The center of each axis at rest should be near 2.5. The Current values displays provide useful information for joystick performance evaluations and troubleshooting.



Sharing axes

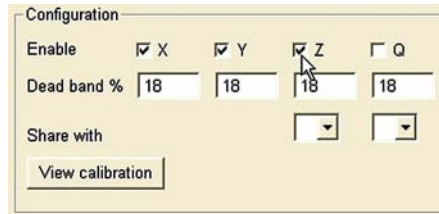
When machine motion axes outnumber joystick axes, the Z and Q axes can be shared with the X and Y axes using buttons on the digital positioner as diagrammed in this example of sharing the Z axis.



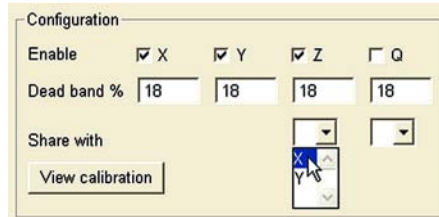
NOTE
Refer to the description of the **Tools/Options/Buttons** screen for details regarding the configuration of digital positioner buttons.

To share the Z axis:

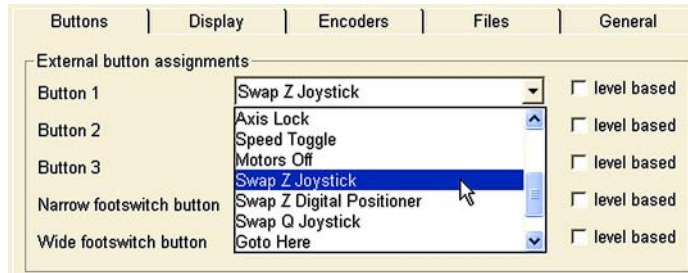
- 1 Enable the Z axis.



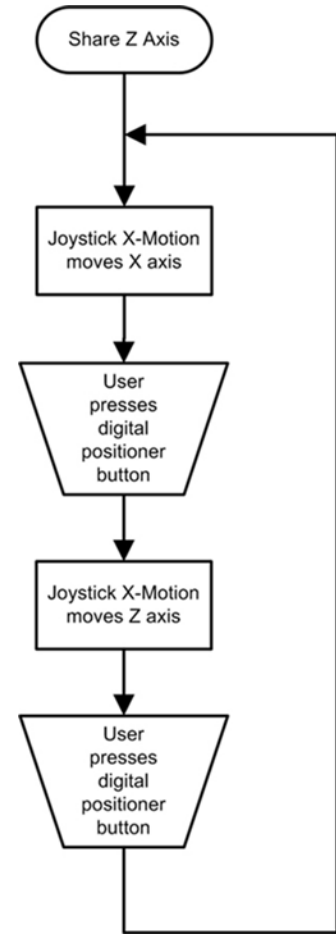
- 2 Select the axis with which to share the Z axis.



- 3 Assign Swap Z Joystick to a button of the digital positioner using the Tools/Options/Buttons screen.



The process shown above can also be used to share the Q axis.



Specifying a deadband

Mechanical vibrations in the work environment and joystick noise can generate small joystick output signals when the joystick is at rest. These signals can result in unintended axis motions. A deadband can be created around the joystick's rest (zero) position to prevent these axis motions.

Create the desired deadband around each axis zero position by entering the minimum percentage of the total joystick range of motion required to cause axis motion.

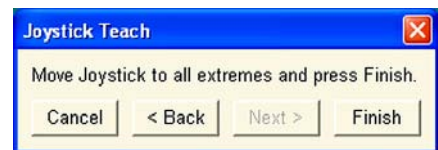
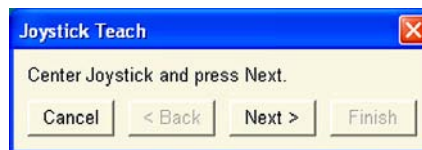
Dead band %

The default deadband is 18% of the joystick's total range of motion.

Calibrating the joystick

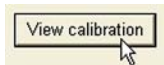
The full range of joystick motion must be calibrated for optimum control. To calibrate the joystick:

- 1 Click the Teach button. The Joystick Teach wizard will be displayed.
- 2 Follow the instructions provided by the wizard screens.

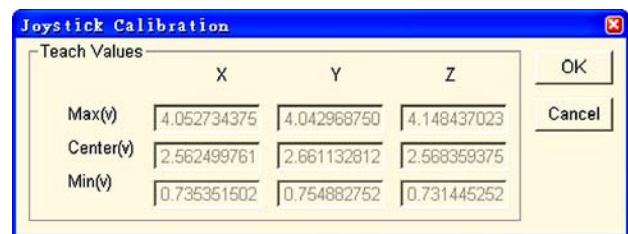


Viewing calibration values

Joystick calibration values will fall somewhere between a low of 0 and a high of 5.0. Click the View Calibration button to display the current values.



The Min and Max values should be almost evenly distributed around the center values. The center values should be approximately 2.5.



Specifying axis motion direction

Check or clear the axis Reverse boxes to specify the direction of motion of all axes.

Reverse X Y Z Q

Specifying normal and fine velocities

Normal velocity is generally used to move between probed points. Fine velocity is generally used to probe points. The normal and fine velocities of each axis are expressed as percentages of the maximum velocities specified in individual Tools/CNC/Axis set up screens.

Preferences				
Reverse	<input type="checkbox"/> X	<input checked="" type="checkbox"/> Y	<input checked="" type="checkbox"/> Z	<input type="checkbox"/> Q
Normal	<input type="text" value="100"/>	<input type="text" value="100"/>	<input type="text" value="100"/>	<input type="text" value="100"/>
Fine	<input type="text" value="30"/>	<input type="text" value="30"/>	<input type="text" value="30"/>	<input type="text" value="30"/>
Expo %	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>

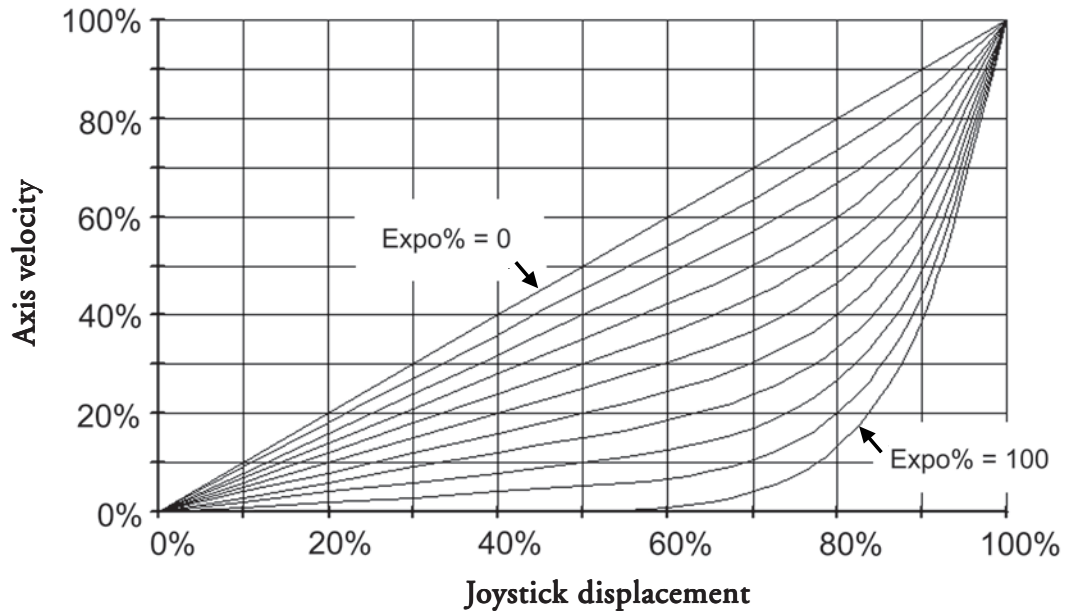
Normal velocities are usually set as high as the manual joystick control of each axis will permit. The fine velocities are usually set to optimum probing velocities for touch probes (approximately 5 mm per second).

Enter the desired percentages directly into the Normal and Fine data fields of each axis. The default percentages are 100% for normal velocities, and 30% for fine velocities.

Specifying the axis motion profile

The joystick control of axis motion can be linear, exponential or a mixture. Linear control causes the axis velocity to increase in direct proportion to joystick displacement. Exponential control causes little or no axis motion in response to early joystick displacements, but quickly increases the axis velocity toward the extreme end of joystick displacement.

Exponential control is useful when very small and precise motions are required at low velocities. The Expo % field is used to specify the amount of exponential control for each axis. This range can extend from 0% (linear control) to 100% (exponential control) as shown by the graph below.

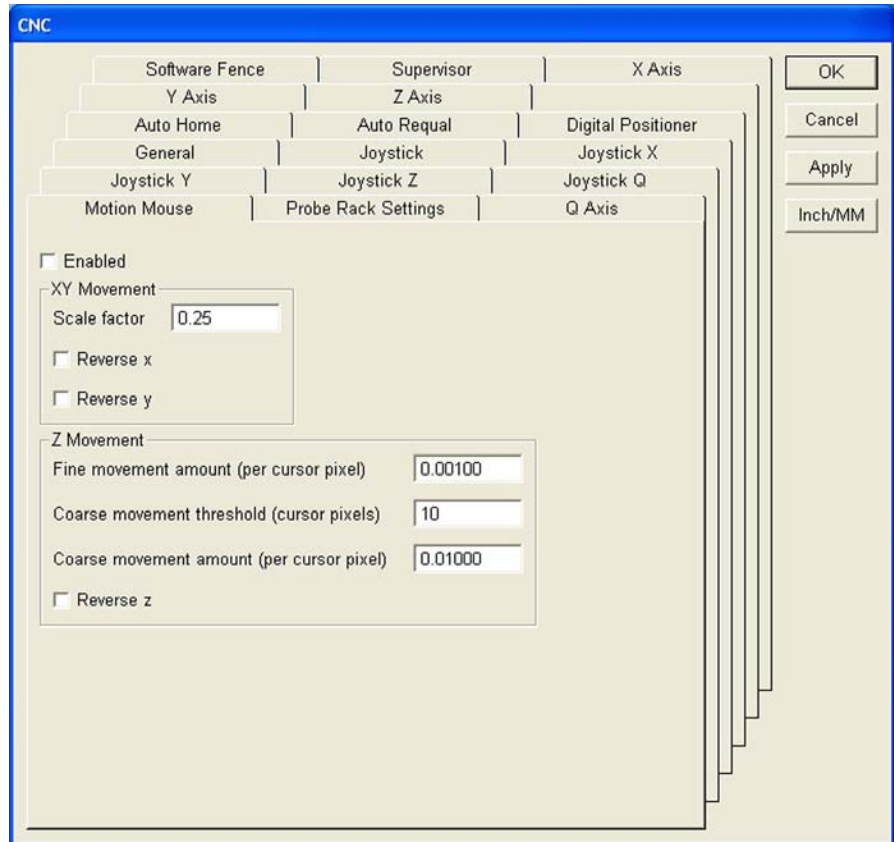


Enter the desired value into the Expo % field for each axis. The default values are 1% for each axis and provides nearly linear response.

Expo %	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>
--------	--------------------------------	--------------------------------	--------------------------------	--------------------------------

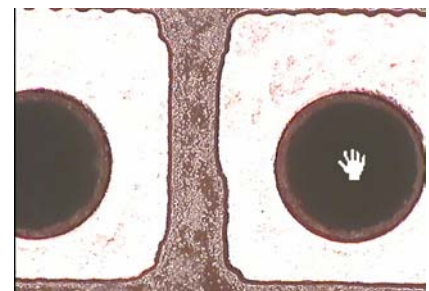
Motion mouse screen

The 3-button mouse can be used to control movement on the X, Y and Z axes when manual control is required. The Motion mouse screen contains tools for specifying X, Y and Z axis movement direction and sensitivity. The Z-axis can also be configured to include fine and coarse movements.

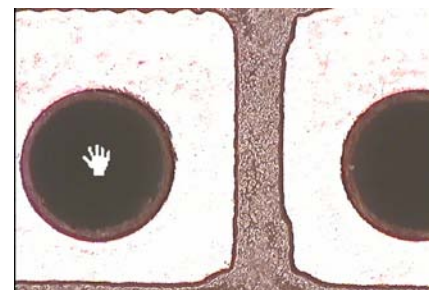
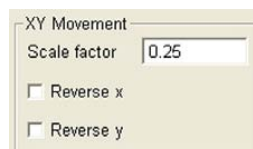


Specifying X and Y axis movement sensitivity

The stage can be moved in the XY plane by clicking and dragging the Image with the middle mouse button in the video window. The amount of X and Y axis stage movement is expressed as a scale factor of the cursor movement in the video window. As shown in this example, a scale factor of 1.0 will cause the stage to move an XY distance on the screen equal to the distance moved by the cursor.

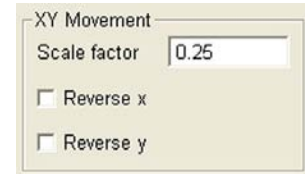


The scale factor can be a fraction or a multiple of the cursor movement on the screen. Enter the desired value from 0.1 to 5.0 directly into the Scale factor data field.



Specifying X and Y axis movement direction

Check or clear the Reverse X and Reverse Y boxes to specify the desired axis movement directions.

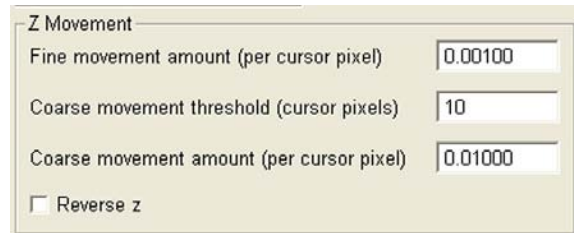


Specifying Z-axis movement sensitivity

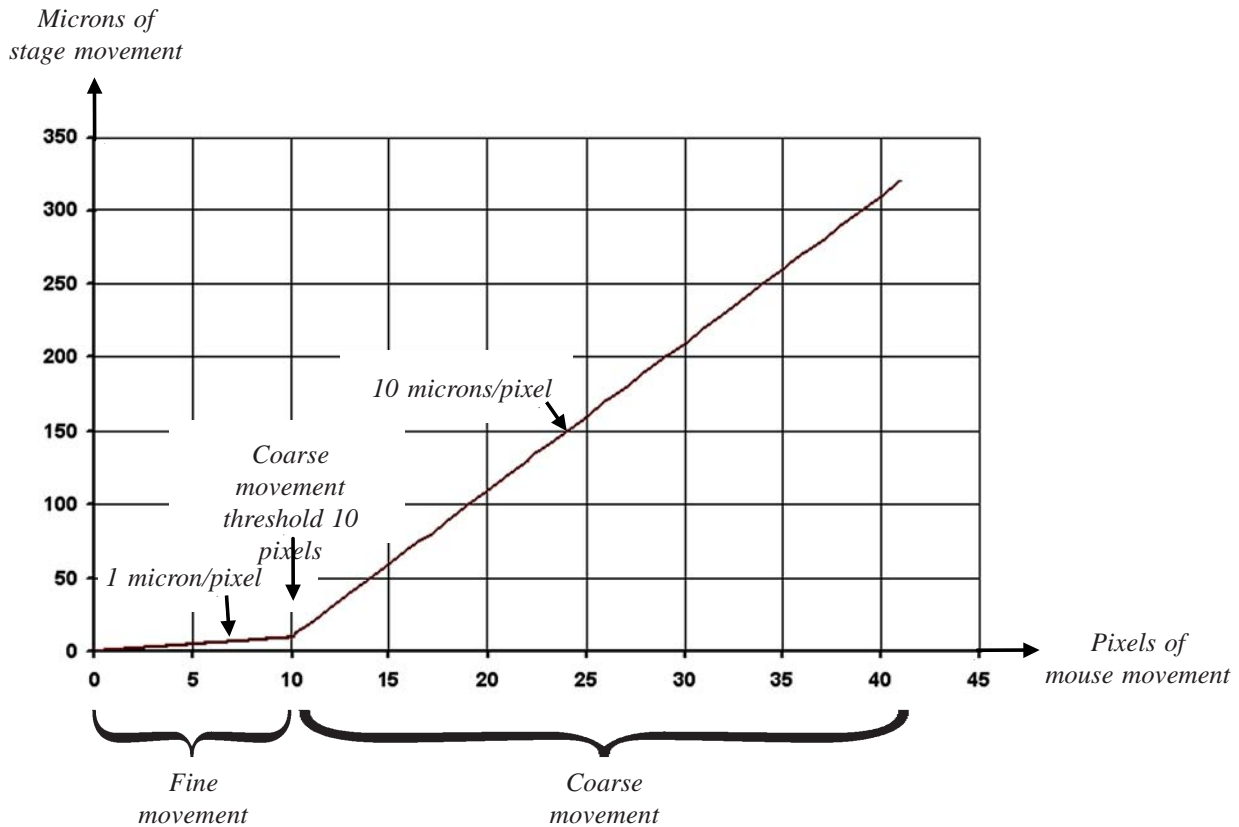
The Z-axis movement is controlled by clicking and dragging the right mouse button up or down over the Image in the video window.

Control of the Z-axis is divided into fine and coarse movements. The fine and coarse movements are expressed in inches/pixel or mm/pixel depending on the unit of measure currently used by the system.

Fine Z-axis movement continues until a threshold distance in pixels is traversed across the screen. Once the threshold is reached, further Z-axis movement is coarse. Releasing the right mouse button resets the movement sensitivity back to fine. The example shown in this screen is graphed below.



Enter the desired Fine, Threshold and Coarse values into the corresponding data fields.



Specifying Z-axis movement direction

Check or clear the Reverse Z box to specify the desired Z-axis movement direction.

Z Movement	
Fine movement amount (per cursor pixel)	<input type="text" value="0.00100"/>
Coarse movement threshold (cursor pixels)	<input type="text" value="10"/>
Coarse movement amount (per cursor pixel)	<input type="text" value="0.01000"/>
<input type="checkbox"/> Reverse z	

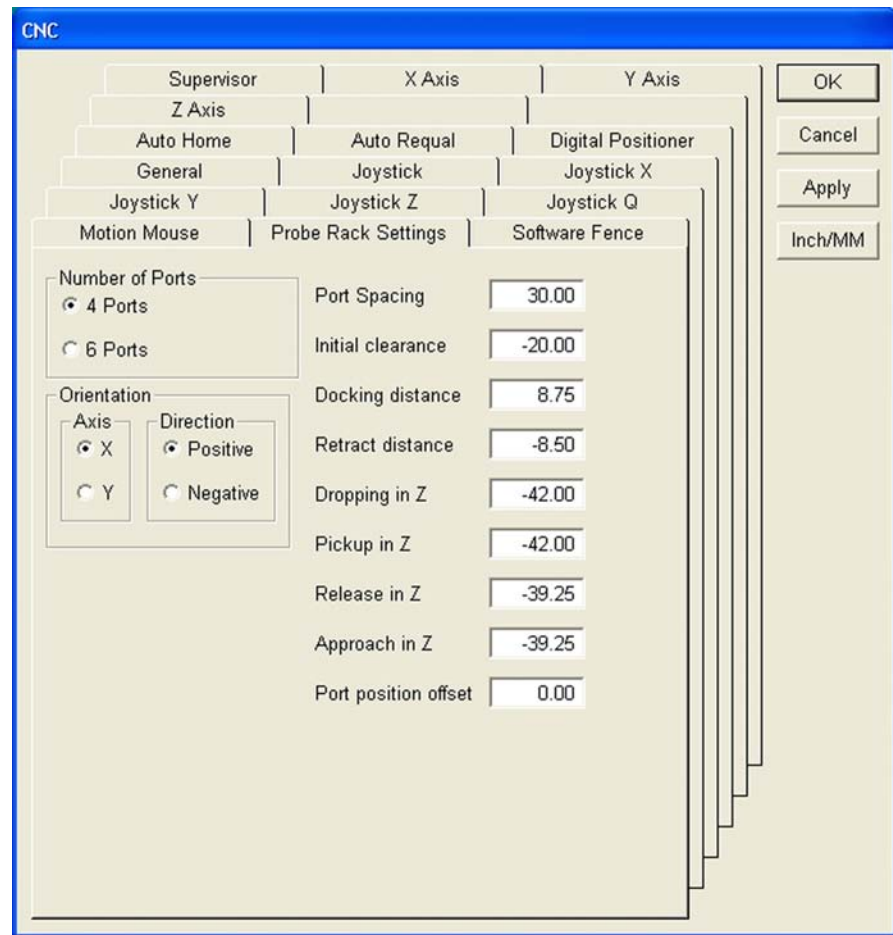
Enabling/disabling the motion mouse

Check or clear the Enabled box to enable or disable the motion mouse functions.

Enabled

Probe Rack Settings screen

The Probe Rack Settings screen provides tools for calibrating the storage locations of touch probe tips in a rack of 4 or 6 probe tip ports. Probe rack calibration should be performed immediately after rack installation.



Probe tips housed in the probe rack can be exchanged during inspections according to need. For example, a probe rack allows the user to switch from a single probe tip to a star probe tip.

All probe transitions must occur through the appropriate established methods. Never manually change a probe tip or place/remove probes from ports in the rack. Valid probe transitions can be set in the Probe Library dialog box by selecting the probe you wish to switch to, then clicking the Set Current button. Proper probe transitions can also be included in a program.

If at any time, during normal operation or while a program is executing, the QC-5000 fails to correctly perform a probe change, then the affected probes will need to be unloaded from the probe rack, and then reloaded.

Probe rack installation

Set machine zero each time you launch the QC-5000. A repeatable machine zero position is required to find the probe rack.

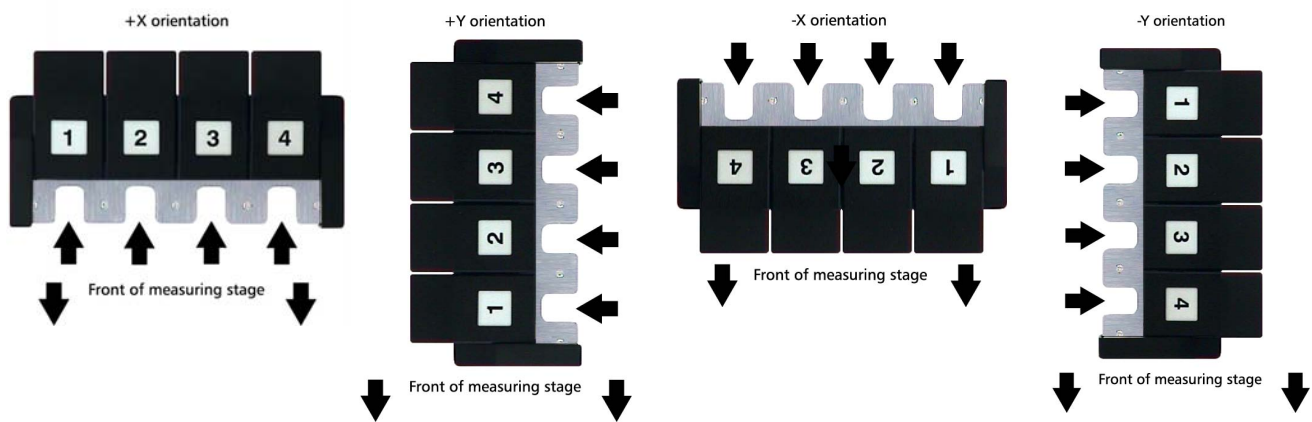
Follow the instructions of the probe rack manufacturer to install the probe rack on your system. Once the probe rack is mounted and its position entered in the QC-5000, it cannot be moved.



NOTE

Mount the probe rack so the current probe can reach each of the ports, and so there is no probe rack movement in any direction.

Probe rack orientation



The four orientations accepted by the QC-5000 are shown below.

+X Orientation

Along the back edge of the table with the docking side of the rack facing in the +X direction.

+Y Orientation

Along the left edge of the table with the docking side of the rack facing in the +Y direction.

-X Orientation

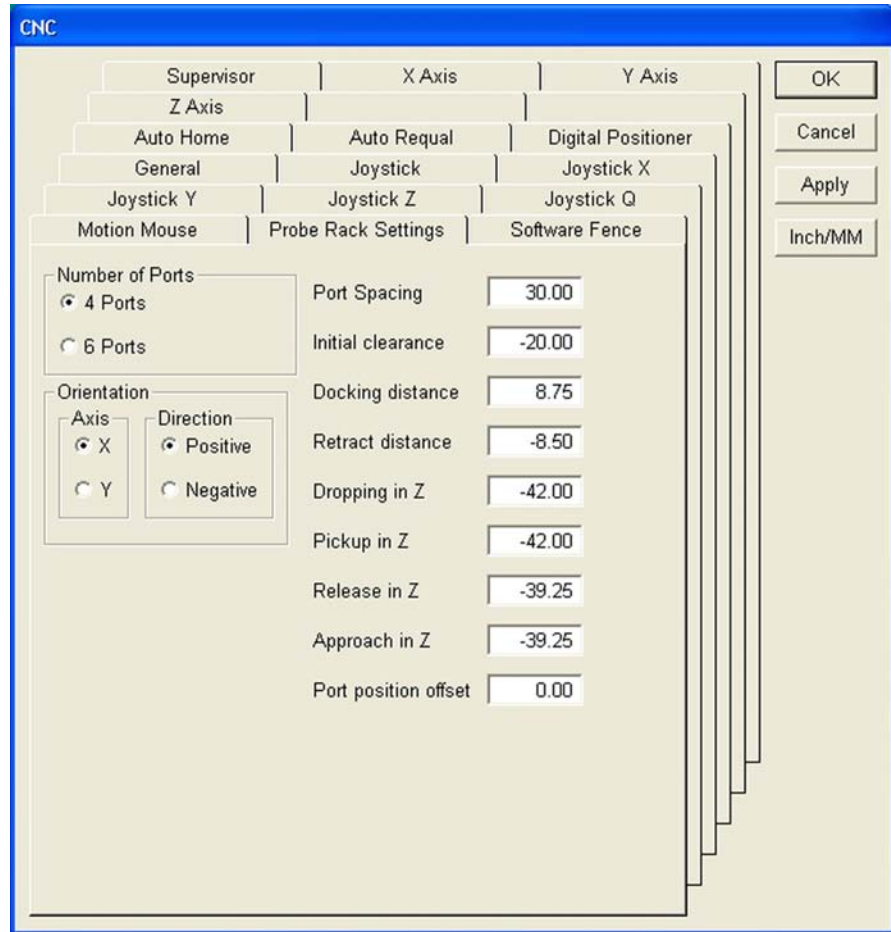
Along the front edge of the table with the docking side of the rack facing in the -X direction.

-Y Orientation

Along the right edge of the table with the docking side of the rack facing in the -Y direction.

Probe Rack Calibration

Probe rack calibration establishes the rack's position on the measuring table and defines the location of probe tip ports within the rack.



Defining the probe rack type

To define the probe rack type, select the appropriate number of ports and the probe rack orientation on the table.

Probe rack parameters

The probe rack parameters explained below require adjustment only if there is difficulty loading a probe tip.

Initial clearance

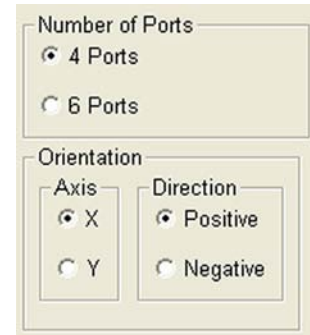
The position the probe moves in preparation for docking.

Docking distance

The distance the probe moves into the rack port to dock or pickup a probe.

Retract distance

The distance the probe moves from the rack port after docking.



Dropping in Z

The distance the Z axis moves into the rack during a probe drop.

Pickup in Z

The distance the Z axis moves from the docking port after probe pickup.

Release in Z

The distance the Z axis moves from the docking port during a probe drop.

Approach in Z

The distance the Z axis moves into the rack during a probe pickup.

Entering port position offset

The offset distance along the axis of the rack between the center of the docking module and the center of the probe tip used for calibration. Enter port position offsets in the QC-5000 as follows:

Rack orientation is X Positive

Enter the X value

Rack orientation is X Negative

Enter the negative of the X value

Rack orientation is Y Positive

Enter the Y value

Rack orientation is Y Negative

Enter the negative of the Y value

Checking the probe rack orientation

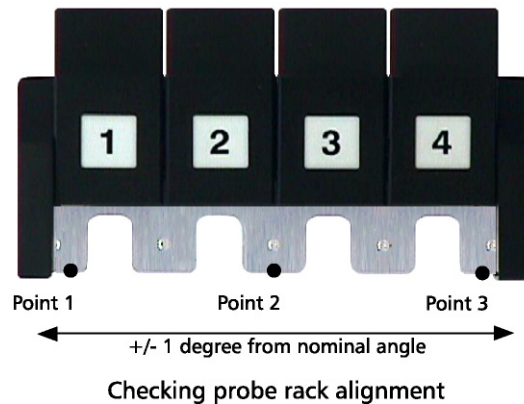
The probe rack must be aligned within 1 degree of the nominal X or Y axis orientation to ensure reliable probe rack operation.



NOTE

When error correction is enabled, the error correction (NLEC or SLEC) data entry must be performed before calibrating the probe rack.

- 1 Lock Z-axis motion and measure a line along the front of the probe rack.



- 2 Re-adjust the orientation of the probe rack if the angle of the line is greater than 1.0 degree from the nominal orientation.

Running the DATRACK part program

Run the DATRACK part program to establish and save the coordinate system of the rack. There are eight DATRACK programs stored in the *c:\qc5000\Probe Rack* folder. Select the appropriate program for the probe rack installed.

4 port rack, X Positive

DATRACK4XP.5pa

4 port rack, Y Positive

DATRACK4YP.5pa

4 port rack, X Negative

DATRACK4XN.5pa

4 port rack, Y Negative

DATRACK4YN.5pa

6 port rack, X Positive

DATRACK6XP.5pa

6 port rack, Y Positive

DATRACK6YP.5pa

6 port rack, X Negative

DATRACK6XN.5pa

6 port rack, Y Negative

DATRACK6YN.5pa

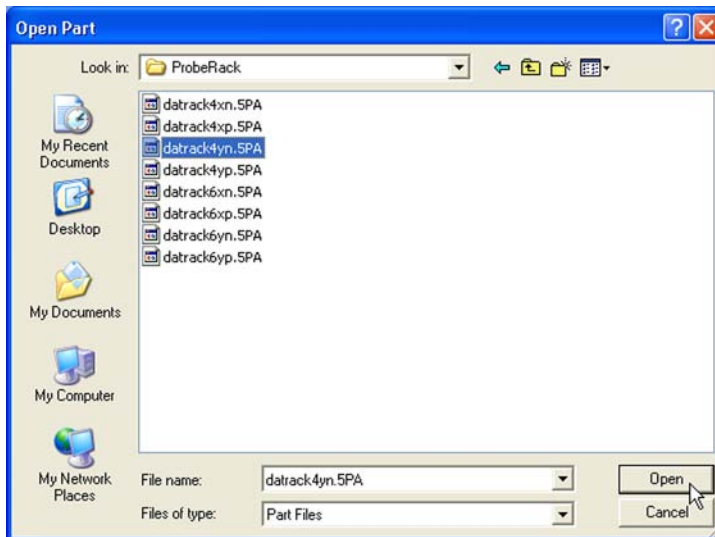


NOTE

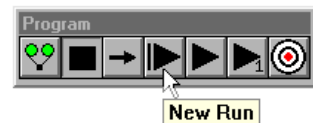
Use a 2mm probe tip with a 20 mm stylus when running the DATRACK program.

To run the DATRACK program:

- 1 Click File/Open to display the Part Open file dialog box, then navigate to C:\QC5000\ProbeRack, select the desired DATRACK program and click Open.
- 2 Click the New Run button on the program toolbar to execute the selected DATRACK program.



- 3 Follow the on-screen prompts to complete the DATRACK program.



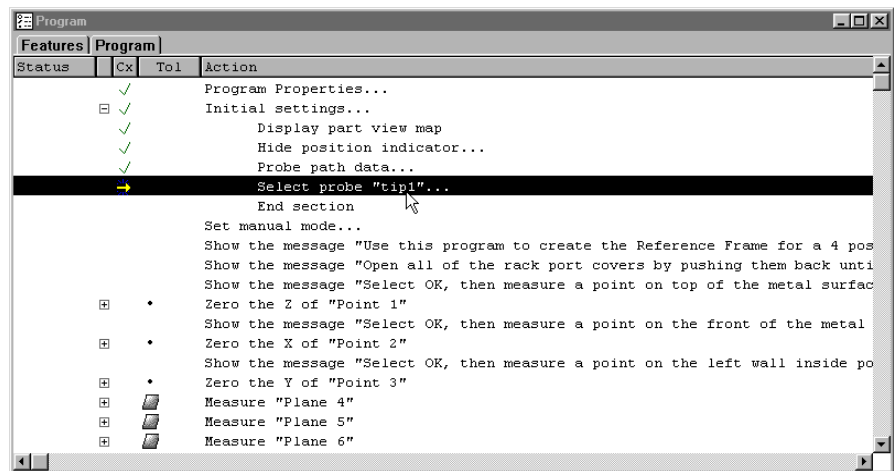
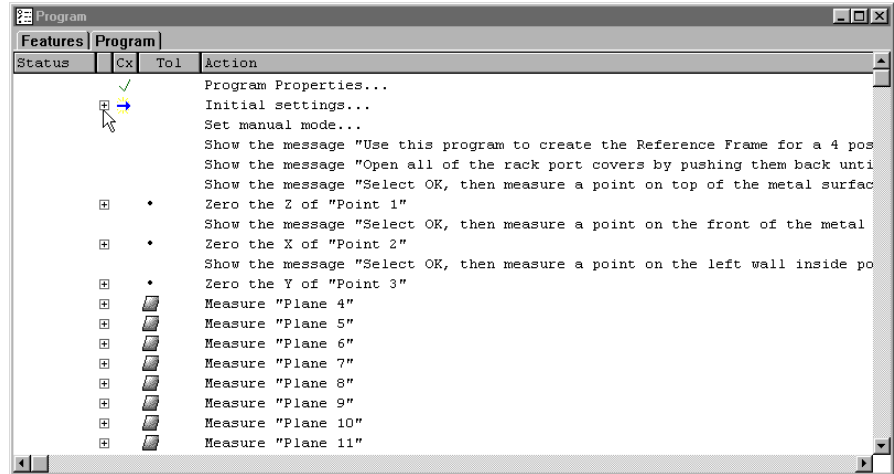


NOTE

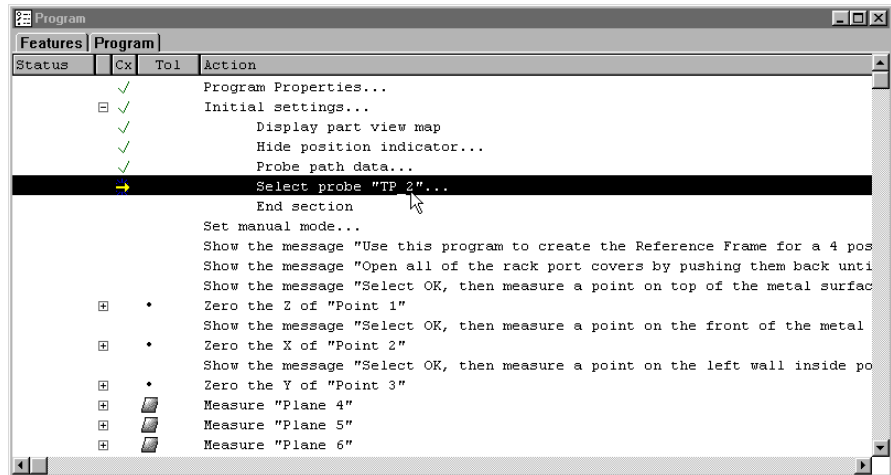
Use the following procedure to edit the initial settings of the DATRACK program if this error message is displayed.

To edit the initial settings of the DATRACK program

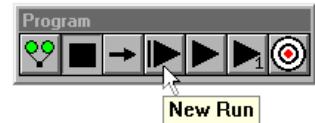
- 1 Click on the + next to *initial settings* to expand the content.
- 2 Double-click on the *Select Probe* line to edit it.



3 Click the line again to automatically insert the current probe into the program in place of the original probe.



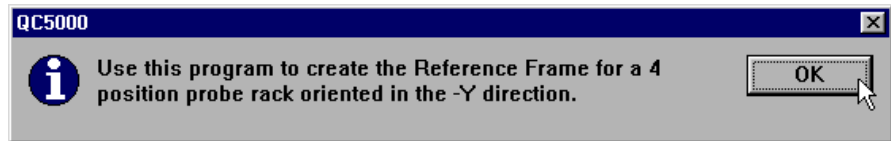
Click the New Run button on the program toolbar to run the edited program.



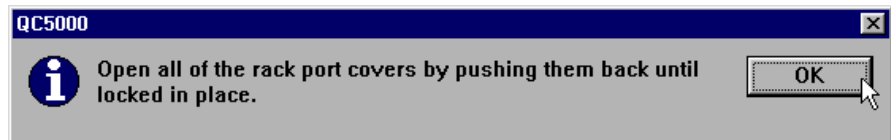
When the DATRACK program runs, the user will be prompted to complete several tasks. Use the following procedures to complete the DATRACK program.

Entering the datum in the DATRACK program

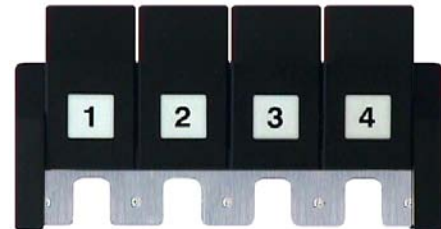
1 Click OK to acknowledge reference frame creation.



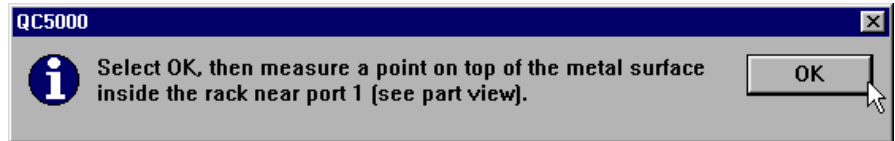
2 You will be instructed to open the rack port covers. Click OK and open the



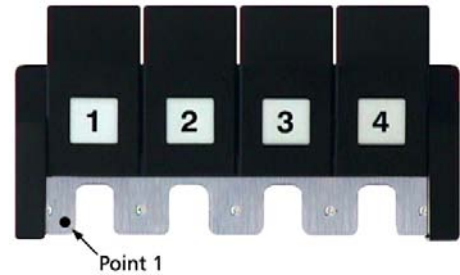
port covers.



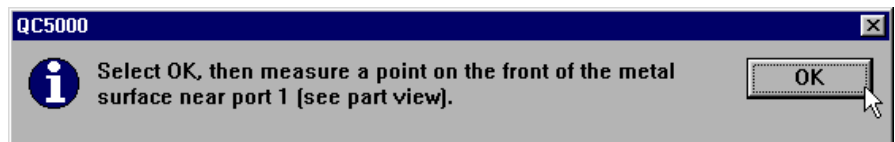
3 You will be instructed to measure a point on the top-inside of the rack.



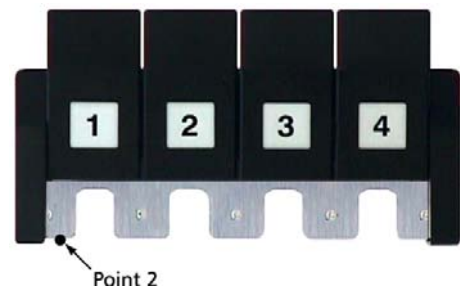
Click OK and probe the first point on the probe rack.



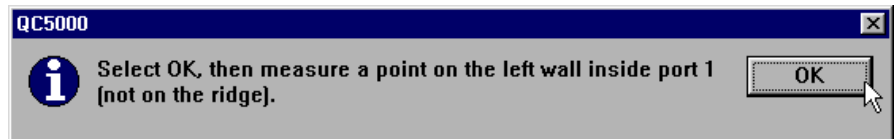
4 You will be instructed to measure a point on the front of the rack. Click



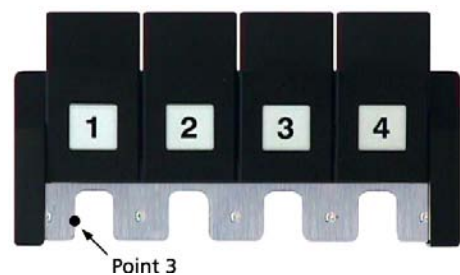
OK and probe the second point on the probe rack.



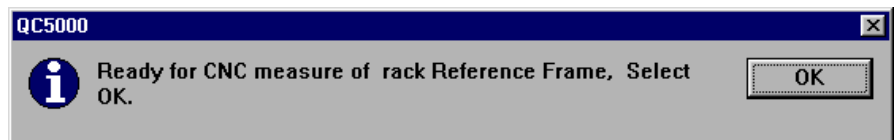
5 You will be instructed to measure a point on the left-inside wall of the rack.



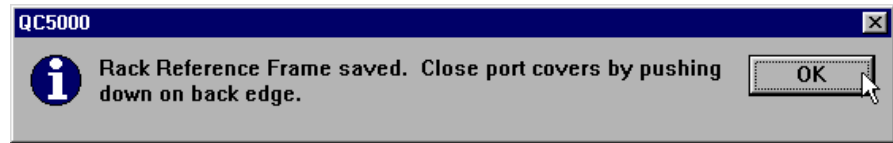
Click OK and probe the third point on the probe rack.



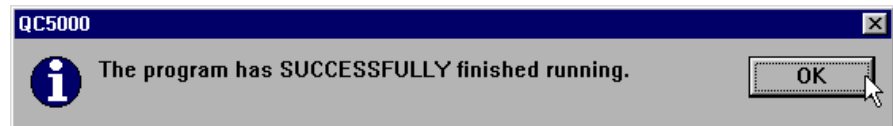
6 You will be informed that the system is ready to create a reference frame. Click OK to continue.



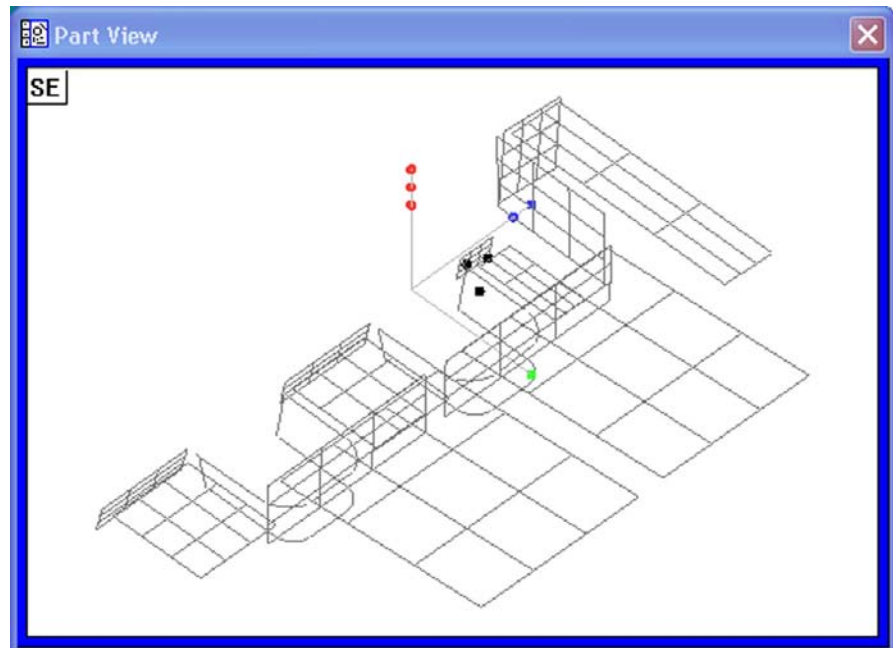
- 7 You will be informed that the probe rack reference frame is saved, and instructed to close the port covers. Close the covers and click OK to continue.
- 8 The program will complete execution. Click OK to close the DATRACK



program and display the Part View window.



The probe rack will be displayed in the Part View window.



The probe rack is calibrated and ready for probes to be loaded.

Appendix A

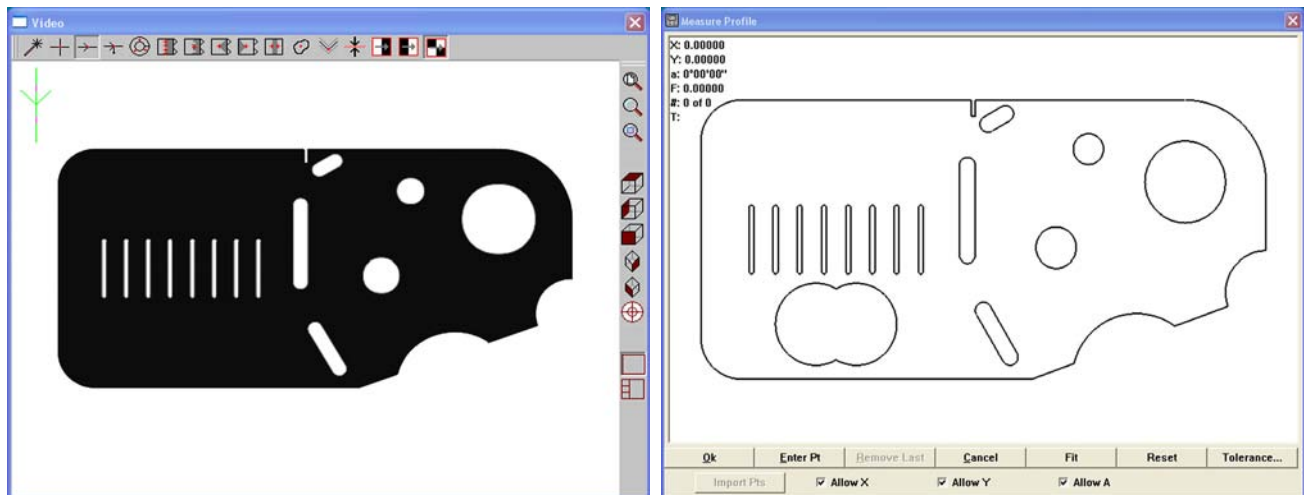
Profile measurement

Profile measurements compare part features acquired by video, touch-probe or other measurement technologies to nominal part profiles from drawing or part data files. Measured features and nominal profile features are shown in the Measure Profile window.



NOTE

Video measurement tools are shown throughout these instructions to illustrate the various aspects of profile measurement. However, the concepts apply equally well to other measurement technologies.

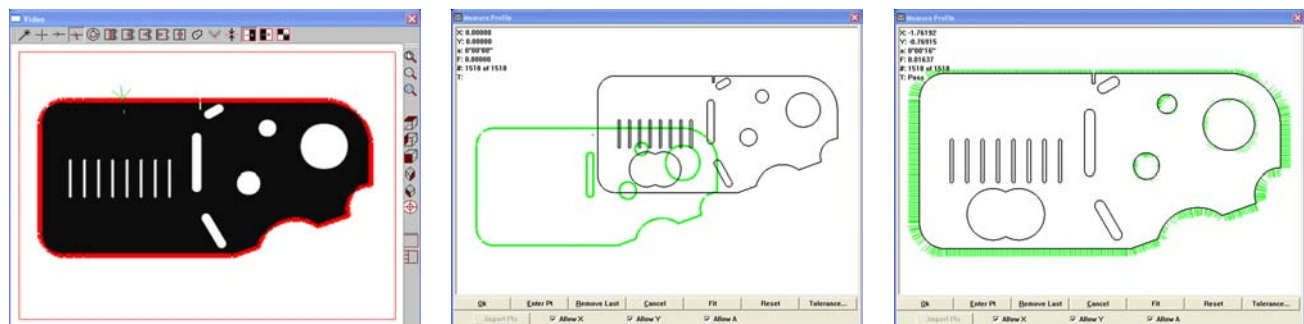


Part shown in the Video window

Nominal profile shown in the Measure Profile window

The nominal profile in the Measure Profile window can be imported from a drawing file in .IGS or .DXF formats, or as a collection of features from the Features template.

As features are measured, their points can be displayed in the Measure Profile window. When the desired feature measurements are complete a Fit operation can be performed. During the Fit operation, the system superimposes the measured data over the nominal profile and adjusts the X, Y and rotational orientation of the data cloud to achieve the best fit. Data points can be shown as dots, form errors can be shown as whiskers.



Part measured in the Video window

Measured points displayed in the Measure Profile window

Fit performed and form errors displayed as whiskers

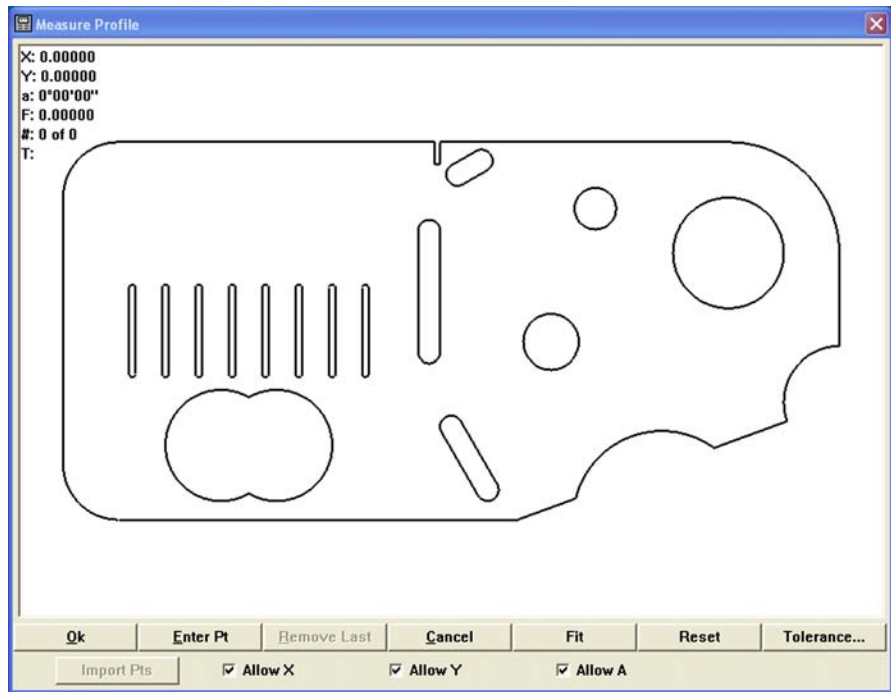
Tolerances can be applied to profile measurements as bilateral or unilateral pass/fail boundaries. Bilateral tolerances can be distributed equally or unequally around the nominal edges of the part, and are specified by the user.

The X, Y and angular offsets, the maximum form error, the number of data points and tolerance pass/fail results can be displayed in the Measure Profile window at the conclusion of the Fit operation. Upon completion of the profile measurement the profile feature is created in the Features template.

Operator screens and menus

Functions for conducting profile measurements are located across the bottom of the Measure Profile window. Functions for evaluating, displaying and printing results are contained in the Measure Profile menu and in the Measure profile toolbar. These functions are discussed in detail later in the profile measurement operating instructions.

The Measure Profile window

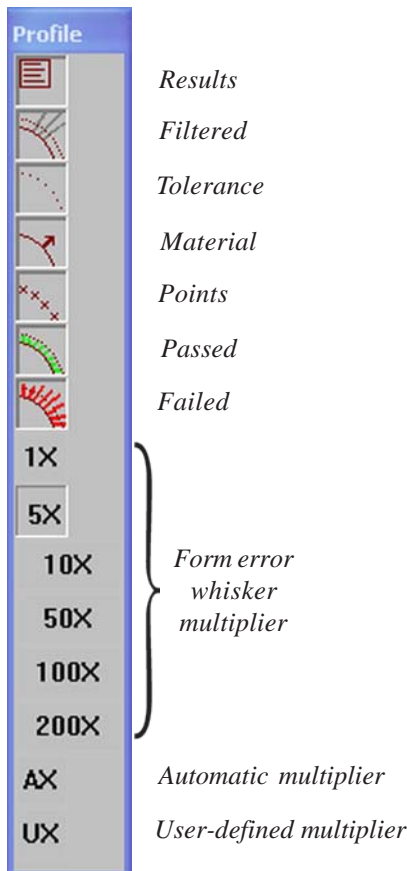
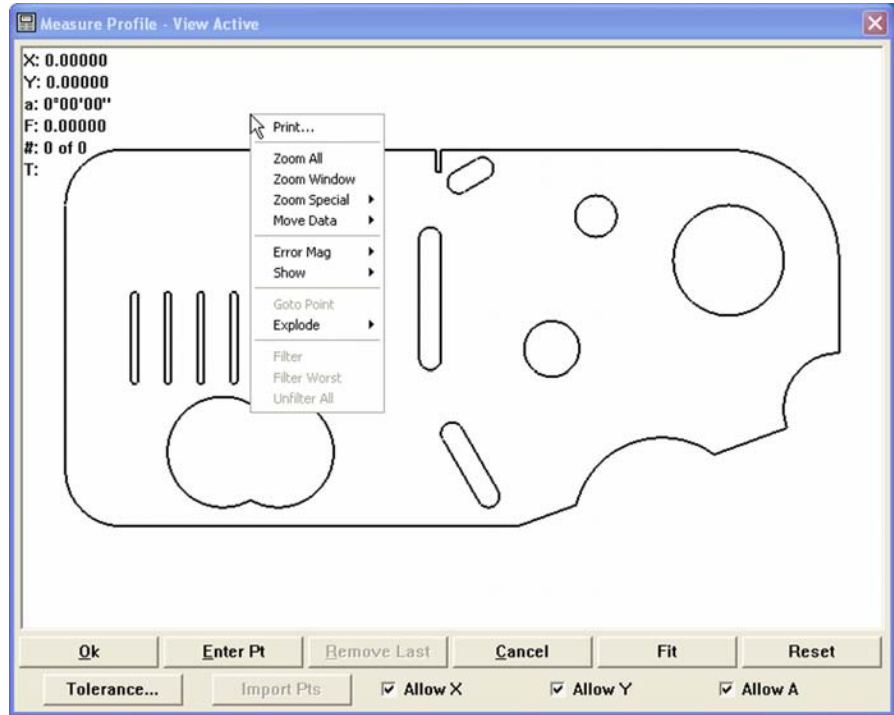


The Measure Profile window contains functions for:

- Allowing (or prohibiting) data shifts during profile fit analyses
- Assigning measurement tolerances
- Entering part data
- Importing part data from the Features template
- Removing the last point data entered
- Initiating a fit analysis
- Cancelling a fit measurement
- Resetting the fit results and restoring data points
- Selecting specific data
- Accessing the Measure Profile menu
- Completing the profile measurement

Measure profile menu and toolbar

Right-click anywhere in the Measure profile window to display the measure profile menu.



The Measure profile menu contains tools for:

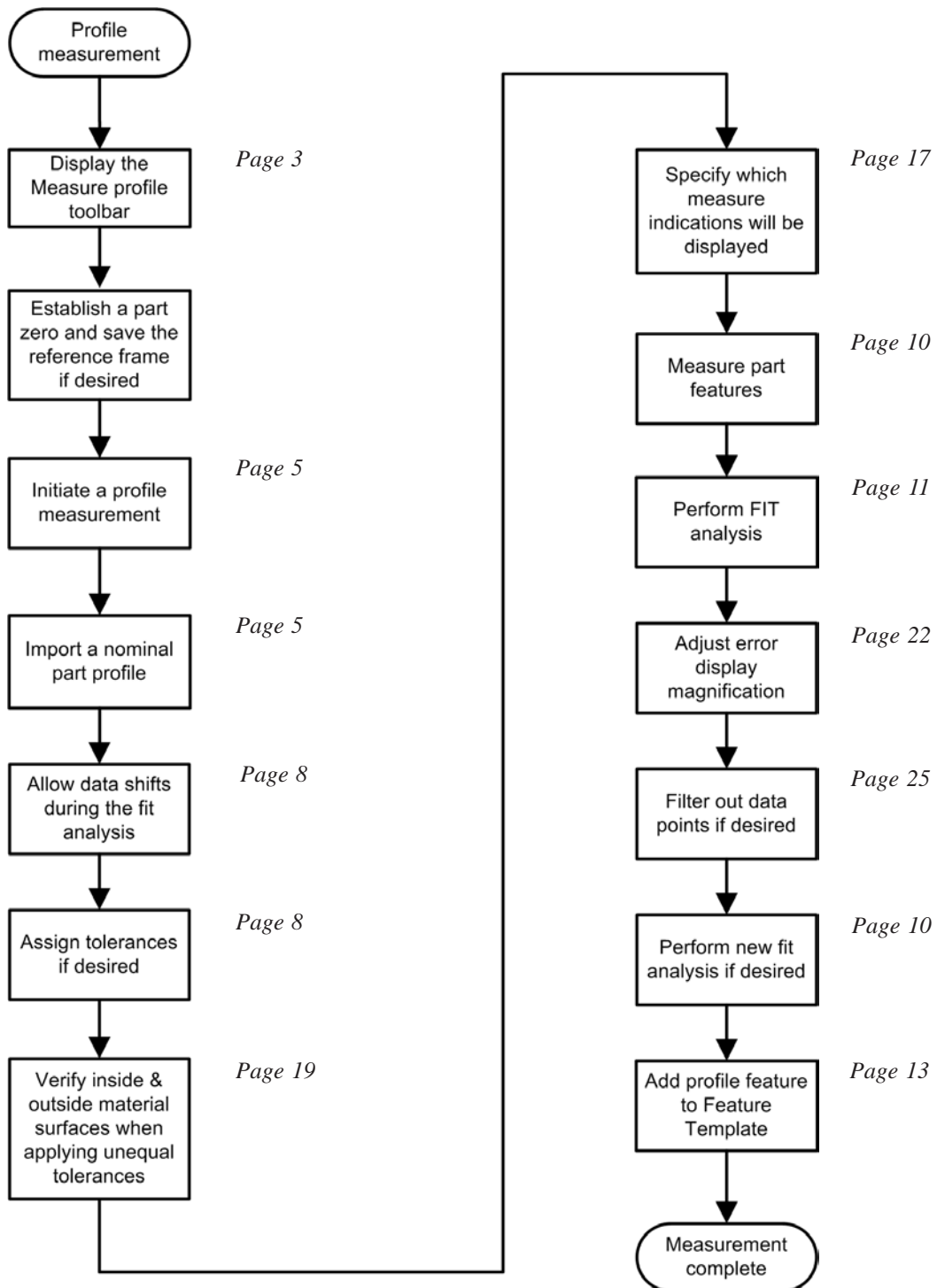
- Printing the contents of the Measure Profile window
- Zooming in and out to display more or less detail
- Moving the data cloud manually to facilitate the fit operation
- Magnifying the display of form error whiskers
- Showing or hiding profile fit information
- Driving the CNC stage to a selected data point location
- Sending (exploding) profile fit data to the Features template as points and distances
- Filtering selected points from the part data
- Filtering the worst point from the part data
- Restoring filtered data (unfiltering) to the part data

The Show/hide profile fit information and form error multiplier functions of the Measure profile menu are duplicated in the Measure profile toolbar shown at the right.

Conducting manual profile measurements

The diagram shown below outlines the minimum steps required to complete a profile measurement. Details regarding the use of measurement windows, menus and tools are described in the referenced pages.

The complete collection of profile measurement functions is listed in the table of contents.



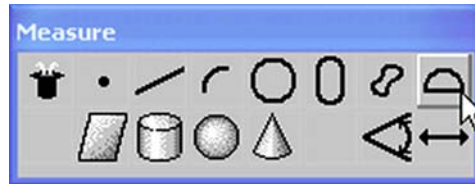
Displaying the Measure toolbar

Check the Profile box of the View/Toolbars checkbox list to display the Measure toolbar.

- Program
- Profile
- Tolerance

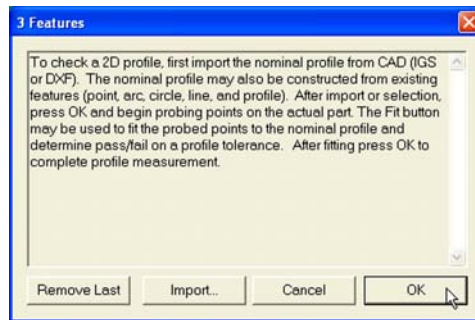
Initiating a profile measurement

Click the Profile icon in the Measure toolbar, or click Profile in the Measure drop-down menu to initiate a profile measurement.



Measure	Datum	Probe	Tools
Measure Magic...		F2	
Point...		F3	
Line...		F4	
Arc...		F5	
Circle...		F6	
Slot...		F7	
Blob...		F8	
Distance...		F9	
Angle...		F11	
Plane...		Ctrl+F3	
Cylinder...		Ctrl+F4	
Sphere...		Ctrl+F5	
Cone...		Ctrl+F6	
Profile...			
Magnetic Plane...		Ctrl+F7	
Other			▶

A dialog box will be displayed for importing a nominal part profile.



Importing a nominal part profile

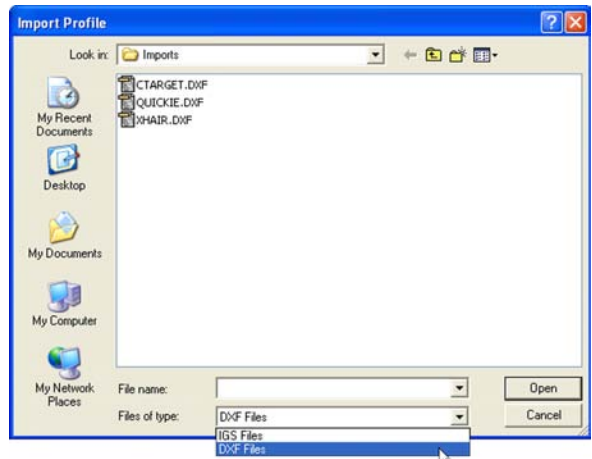
A nominal part profile can be imported from a drawing file or from the Features template.

Importing from a drawing file

Nominal part profiles can be imported from .IGS or .DXF drawing files. Click the Import button to import a profile from a drawing file. The Import Profile dialog box will be displayed.



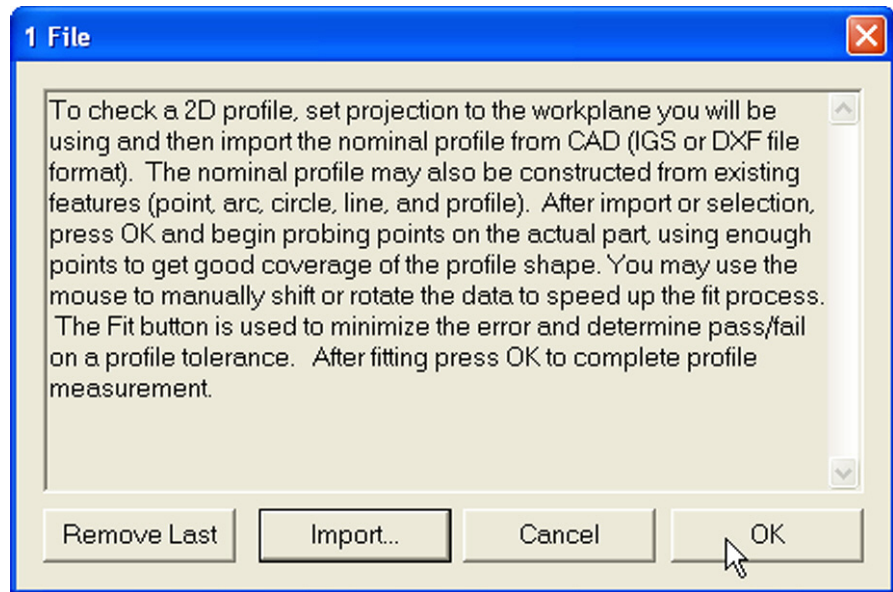
Select the .IGS or .DXF file type, highlight the desired file name and Click Open to specify the nominal profile data file.



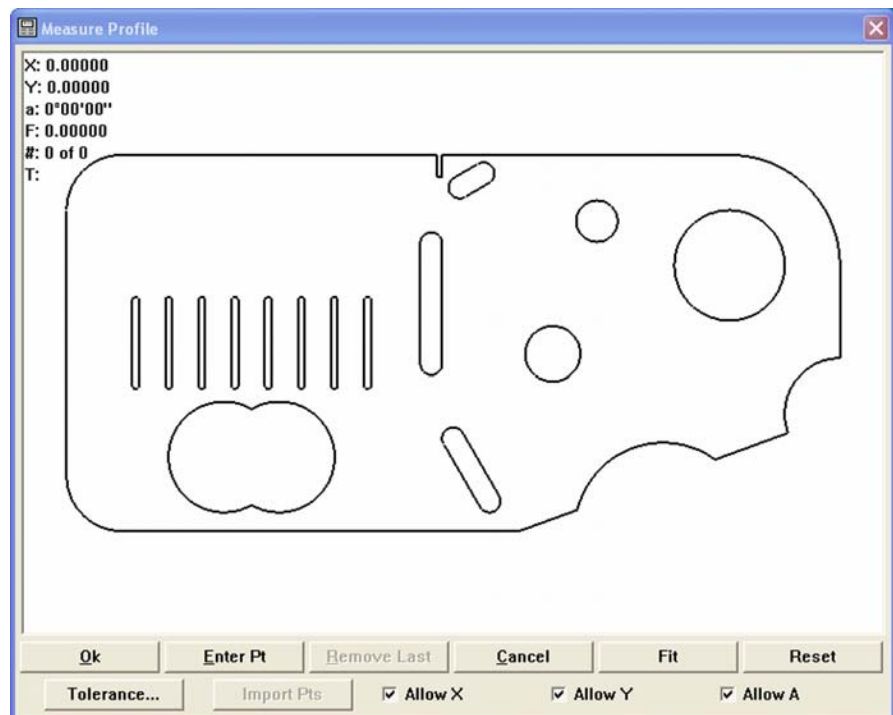
When importing data from .DXF files, the Import Options dialog box will be displayed. Specify the unit of measure originally used to create the file and click OK.



The title bar will show "1 file" indicating that an import file was selected.



Click OK to import the file. The nominal profile will be displayed in the Measure Profile window.

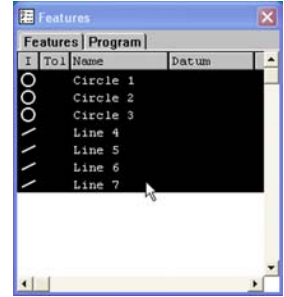
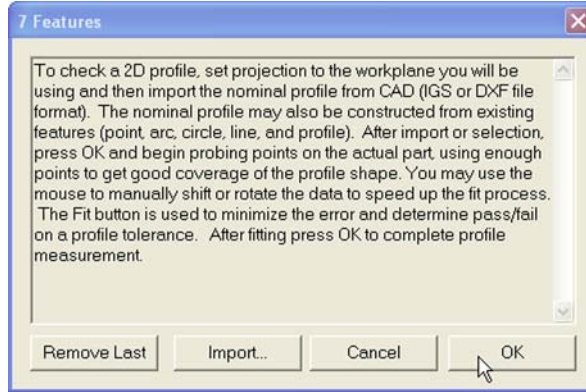


Importing from the Features template

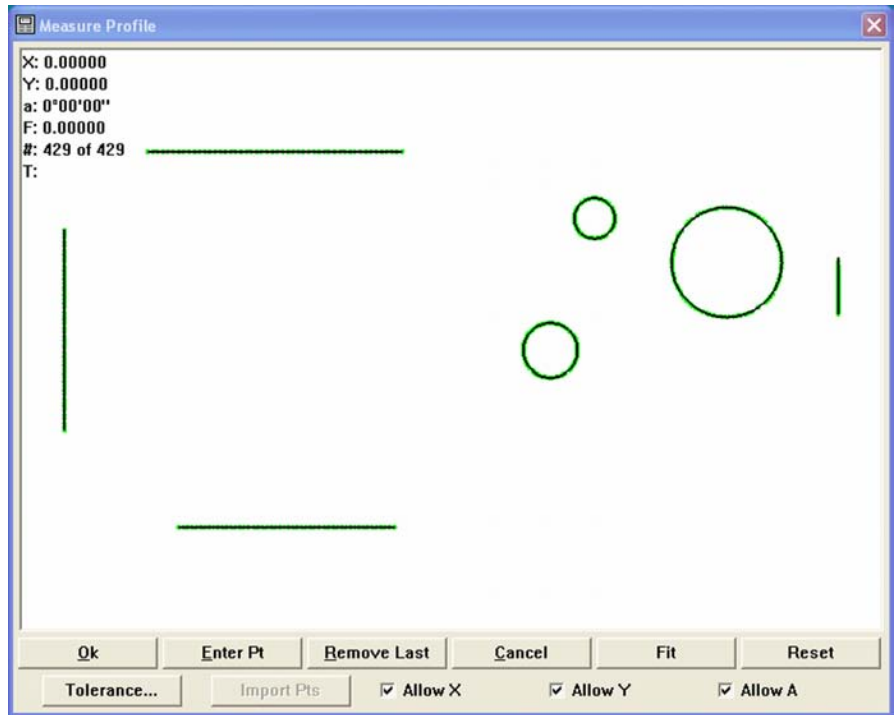
Nominal part profile data can be imported from the Features template when the nominal profile is based on previous measurements of standard part.

Highlight the desired features in the Features template.

The title bar will show the number of features selected.



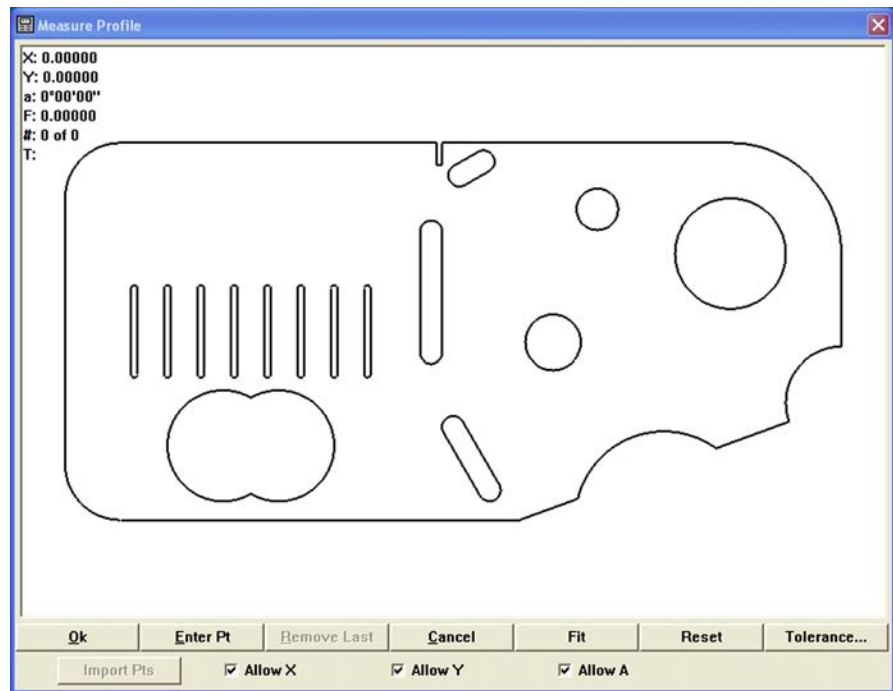
Click OK to import the feature data. The nominal profile will be displayed in the Measure Profile window.



Measure Profile window functions

The Measure Profile window contains functions for:

- Allowing (or prohibiting) data shifts during profile fit analyses
- Assigning measurement tolerances
- Entering part data
- Importing part data from the Features template
- Removing the last point data entered
- Initiating a fit analysis
- Cancelling a fit measurement
- Resetting the fit results and restoring data points
- Selecting specific data
- Accessing the Measure Profile menu
- Completing the profile measurement



Allowing (or prohibiting) data shifts during profile fit analyses

The fit algorithm shifts the data cloud obtained from measurements in the Video window in the Cartesian and polar coordinate systems to achieve the best fit between the data and the nominal part profile.

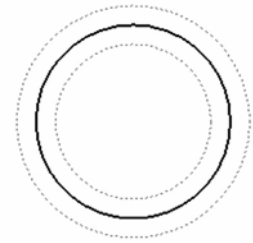
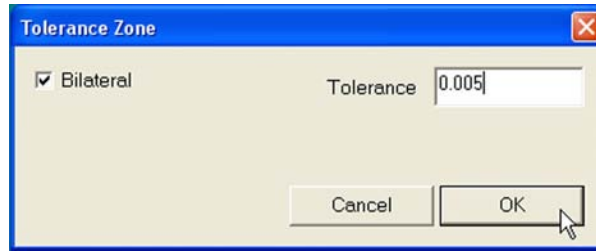
Maximum degrees of freedom are given to the fit algorithm by checking the Allow X, Allow Y and Allow a boxes across the bottom of the window. Clearing a box prohibits data cloud movement in the indicated orientation.

Assigning measurement tolerances

Bilateral or unilateral tolerances can be assigned to profile measurements. Bilateral tolerances can be equal and unequal. Click the Tolerance button to display the tolerance zone dialog box.

Equal bilateral tolerances

Bilateral tolerance values will be centered around the edges of the nominal profile. For example, an equal bilateral tolerance of 0.005 will be applied as ± 0.0025 .



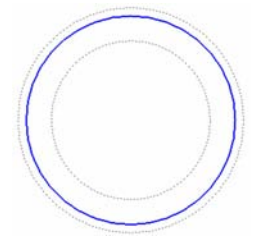
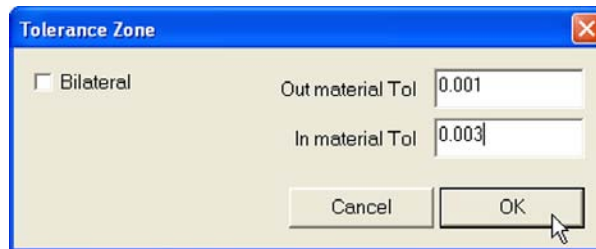
An equal Bilateral tolerance of 0.005 is applied as...

± 0.0025

Check the Bilateral box and enter the desired tolerance value into the Tolerance data field for equal bilateral tolerances.

Unequal tolerances

Unequal bilateral or unilateral tolerance values are specified by the user for In-material tolerance and Out-material tolerances. The example below shows a bore with different In-material and Out-material tolerances.



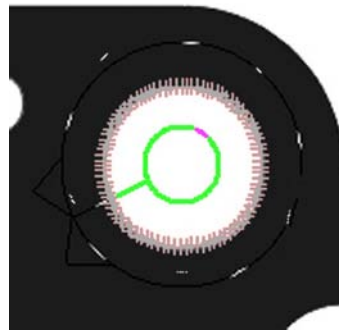
*In this example,
Unequal bilateral tolerances are applied as...*

*Bore tolerances of
 $+0.003$ and -0.001*

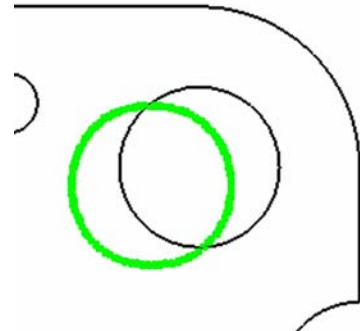
Uncheck the Bilateral box and enter the desired In-material and Out-material tolerance values in the data fields provided.

Entering part data from the Measure Profile window

As points are acquired they appear (in green) in the Measure Profile window, as shown in this example of a video circle measurement.



Firing a tool in the Video window...



Causes points to appear in the Measure Profile window

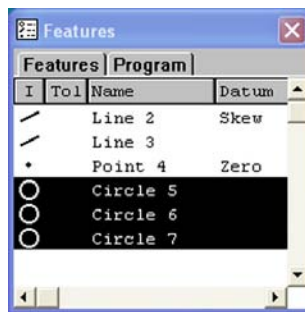
Video tools are typically fired from the Video window, however, they can also be fired from the Measure Profile window.

Position the video tool over the desired feature in the Video window and click the Enter Pt button in the Measure Profile window.

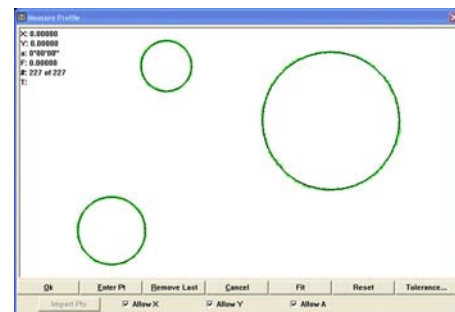


Importing point data from the Features template

Point data that were previously measured can be imported to the Measure Profile window from the Features template.



Circle points from the Features template...



are imported to the Measure Profile window

Select the desired features in the Features template and click the Import Pts button.



Removing the last data point entered

The last data points entered into the Measure Profile window can be removed by clicking the Remove Last button.



Multiple data points can be removed by repeatedly clicking the Remove Last button, until no points remain.

Initiating a fit analysis

When all the required points for a profile measurement have been acquired from the Video window, press the Fit button to initiate the fit analysis.



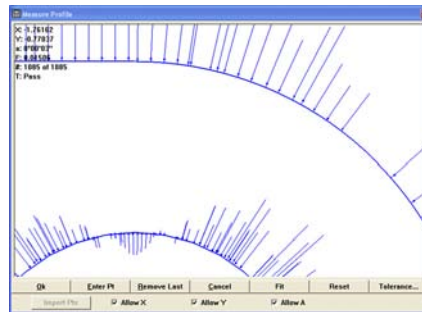
Canceling a profile measurement

Click the Cancel button to cancel the profile measurement and close the Measure Profile window.

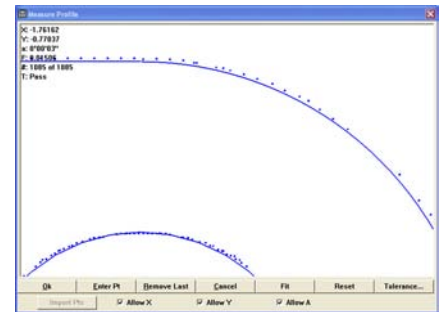


Resetting the fit results and restoring data points

The results of the fit analysis can be reset to review the positions of data points, remove data points or change the degrees of freedom for the fit analysis (allow X, Y or a).



The results of a fit analysis...



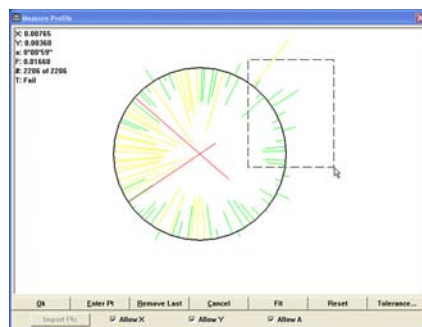
are reset and the original data points are displayed

Click the Reset button to reset the last fit results and restore the data points to their original positions prior to the analysis.

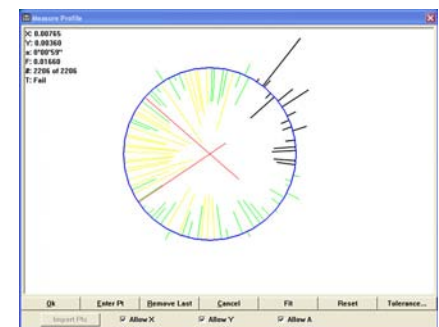


Selecting data

Multiple or single data points or error whiskers can be selected in the Measure Profile window using the 3-button mouse. To select data points or whiskers, press and hold the left mouse button and drag a marquee around the points or whiskers of interest, then release mouse button. Single data points or whiskers can be selected by clicking the mouse cursor on the point or whisker.



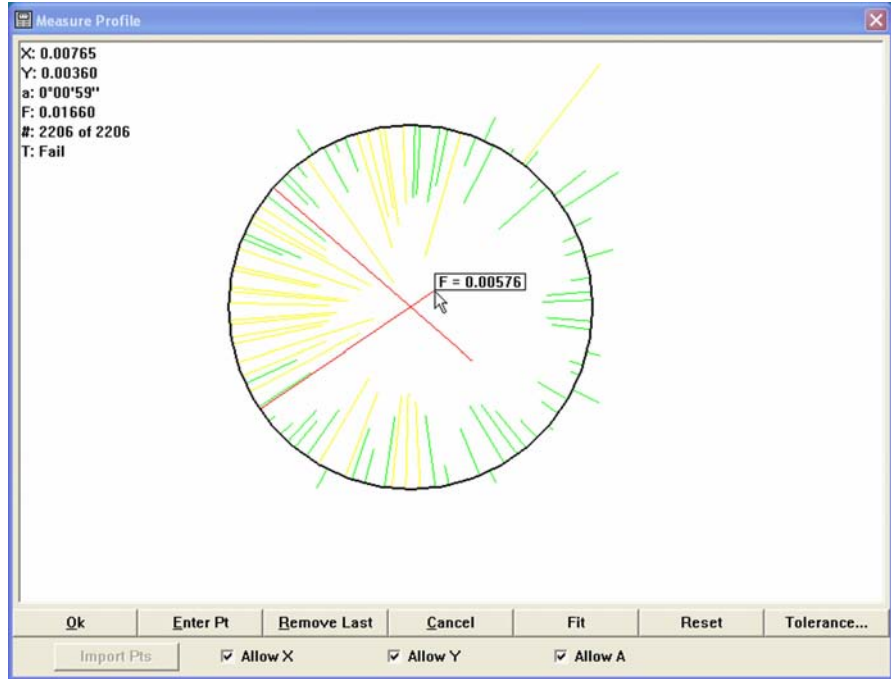
Data is selected with the mouse...



and the color of the selected data changes to blue

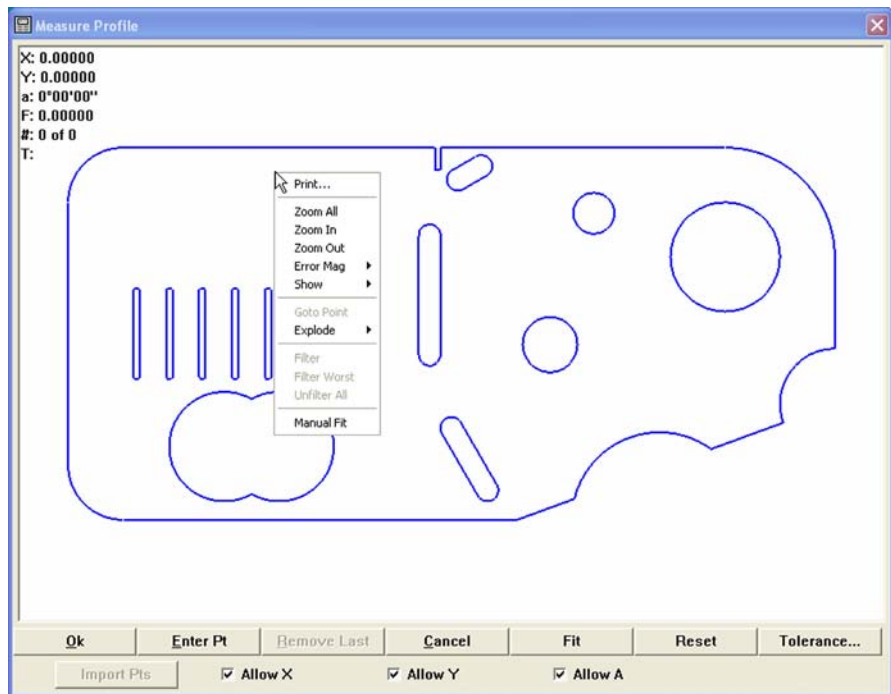
Displaying the form error of a single data point or whisker

Display the form error of a data point or whisker by positioning the mouse cursor to hover over the point or whisker of interest. A pop-up information box will be displayed.



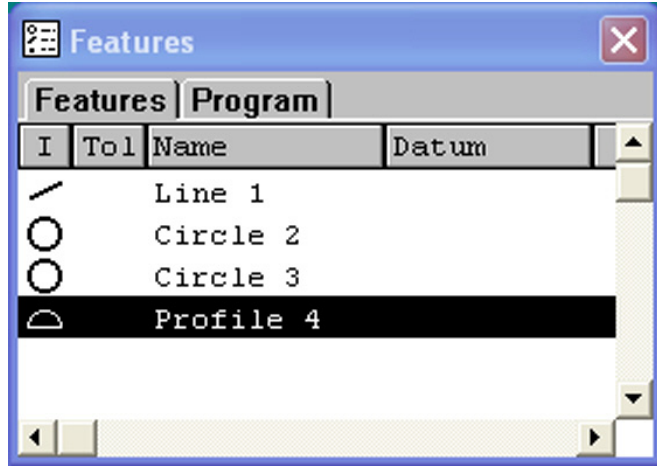
Accessing the Measure Profile menu

Many measurement and display functions are provided by the Measure Profile menu. Right-click anywhere in the Measure Profile window to display the Measure Profile menu



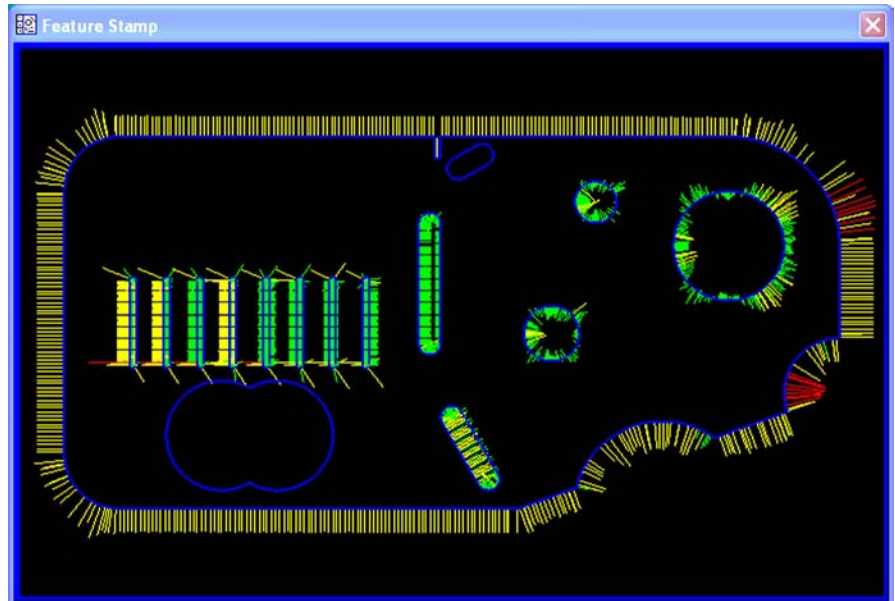
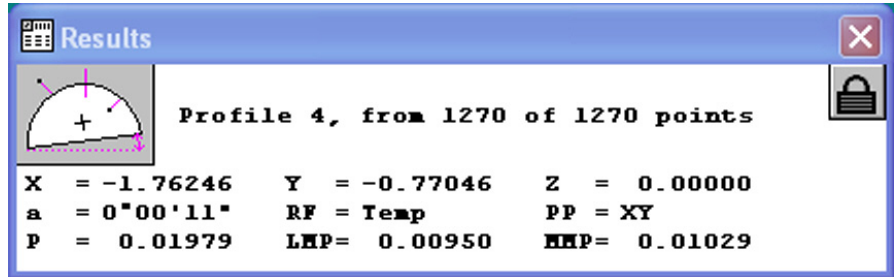
Completing the profile measurement

When the profile measurement is complete, press the OK button to create the profile feature in the Features template and close the Measure Profile window.



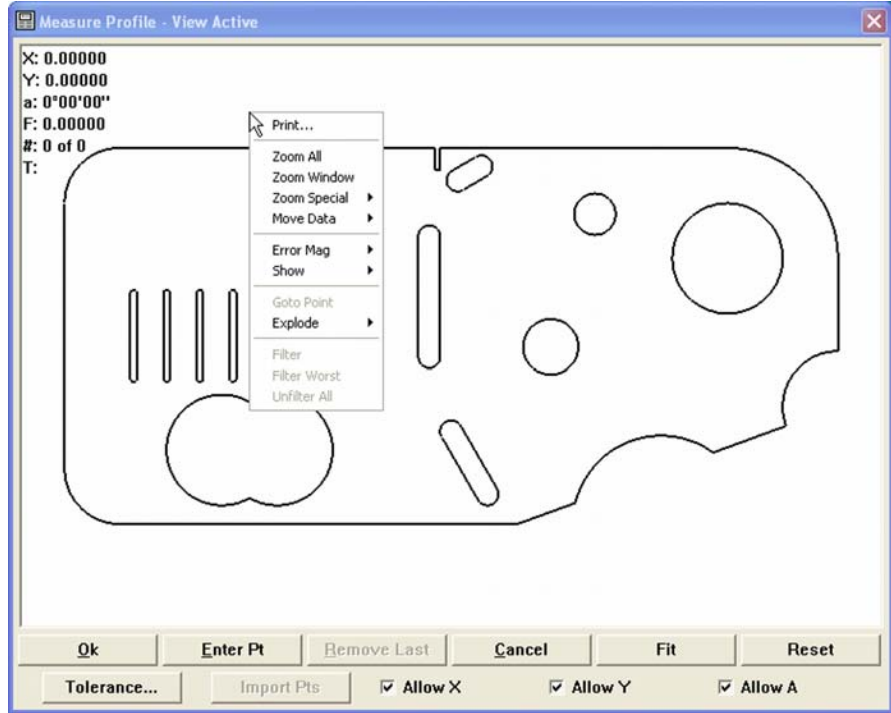
Completing the profile measurement closes the Measure Profile window and creates a profile feature in the Features template

The profile feature will be labeled and color-coded to indicate whether the profile measurement passed or failed any specified tolerance tests. Profile feature characteristics are shown in the Results and Feature Stamp windows.

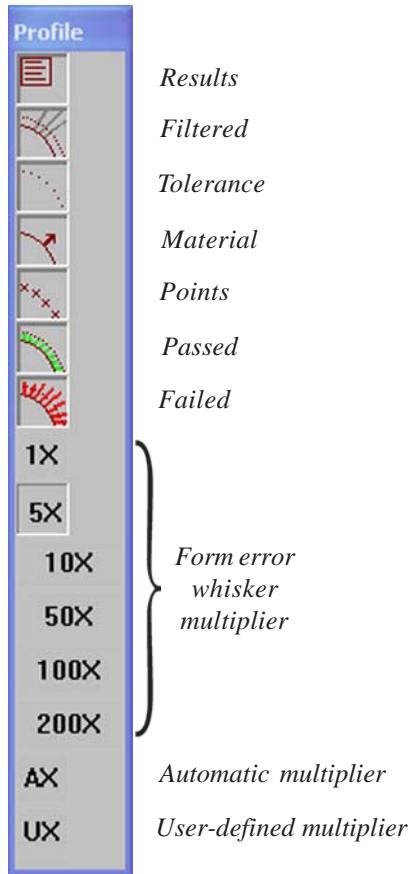


Measure profile menu and toolbar functions

Right-click anywhere in the Measure profile window to display the measure profile menu.



Right-click anywhere in the Measure Profile window to display the Measure Profile menu



The Measure profile menu contains tools for:

- Printing the contents of the Measure Profile window
- Zooming in and out to display more or less detail
- Moving the data cloud manually to facilitate the fit operation
- Magnifying the display of form error whiskers
- Showing or hiding profile fit information
- Driving the CNC stage to a selected data point location
- Sending (exploding) profile fit data to the Features template as points and distances
- Filtering selected points from the part data
- Filtering the worst point from the part data
- Restoring filtered data (unfiltering) to the part data

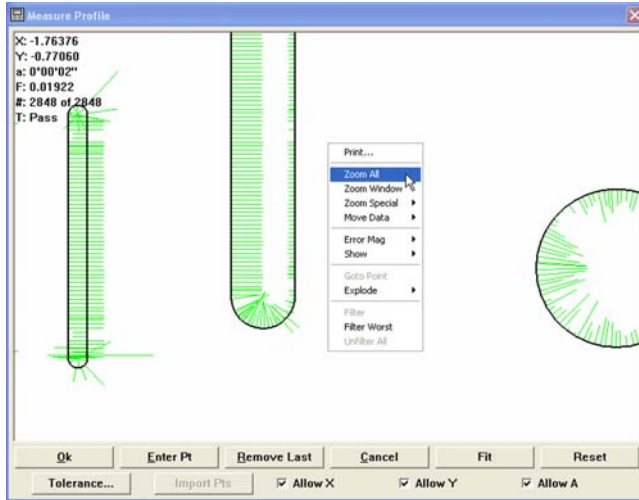
The Show/hide profile fit information and form error multiplier functions of the Measure profile menu are duplicated in the Measure profile toolbar shown at the right.

Printing the contents of the Measure Profile window

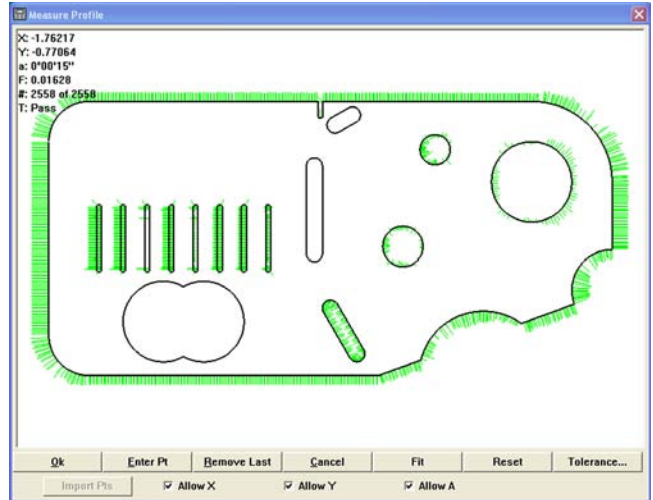
Clicking Print prints the Measure profile window on the specified Windows printer.

Zooming to display all images in the Measure Profile window

Click Zoom All to position all nominal profile and fit data in the center of the measure profile window.



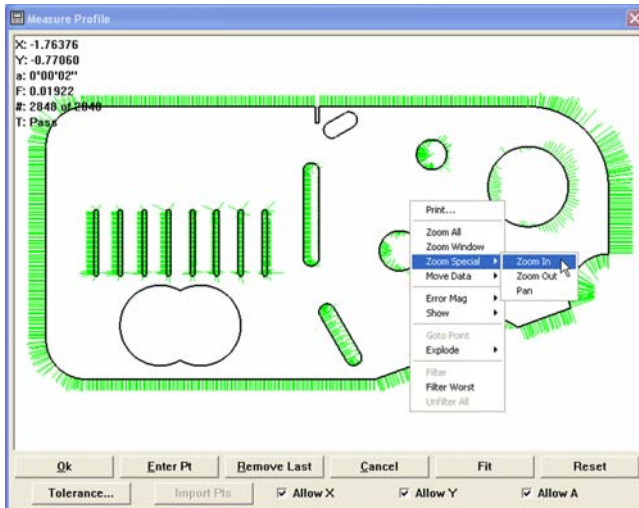
Click Zoom All...



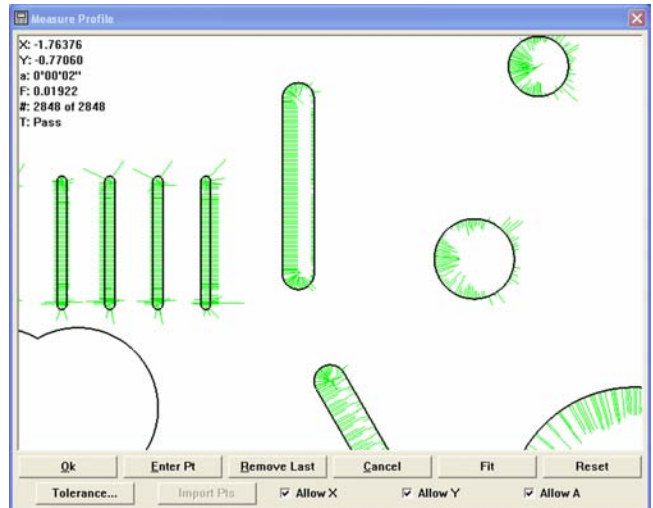
To display the entire image

Zooming in and out to display more or less detail

Click Zoom Special/Zoom In to increase magnification and display more detail.

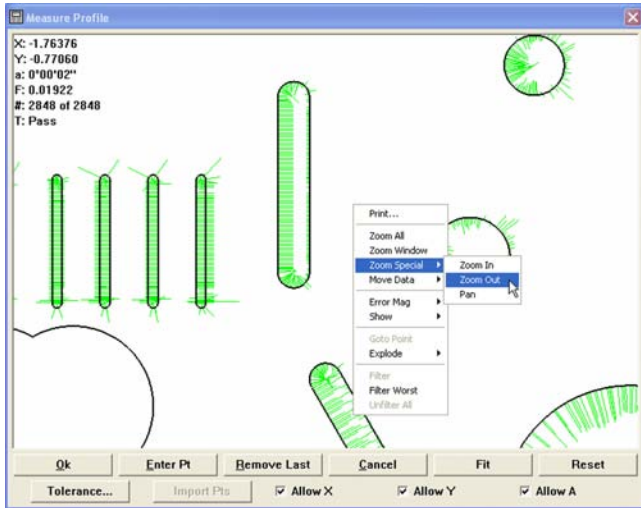


Click Zoom In...

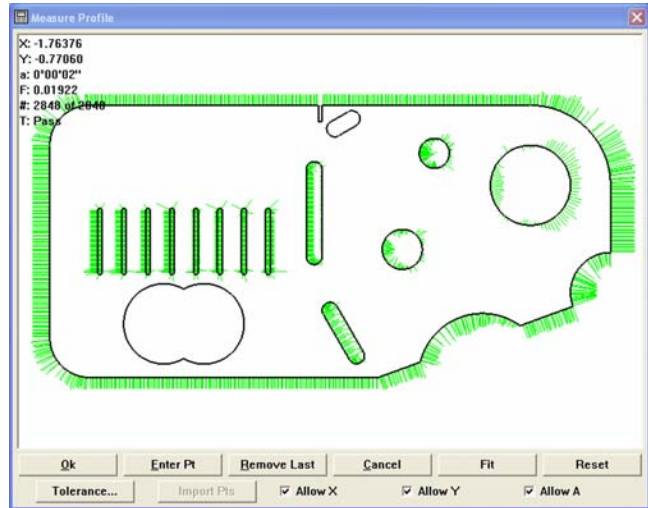


To display more detail

Click Zoom Special/Zoom Out to display a larger percentage of the image and less detail.



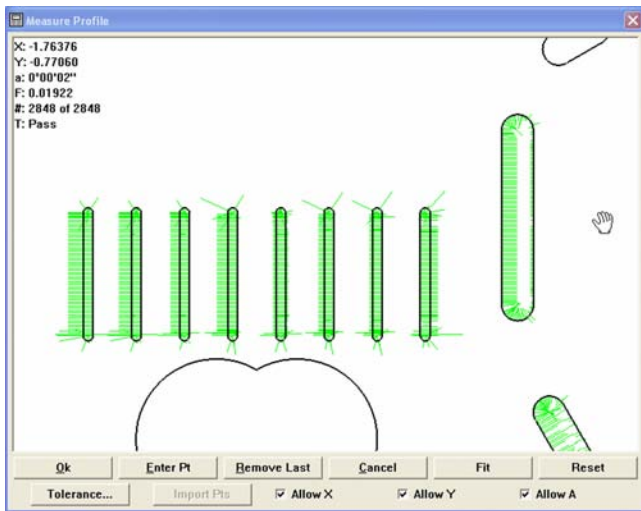
Click Zoom Out...



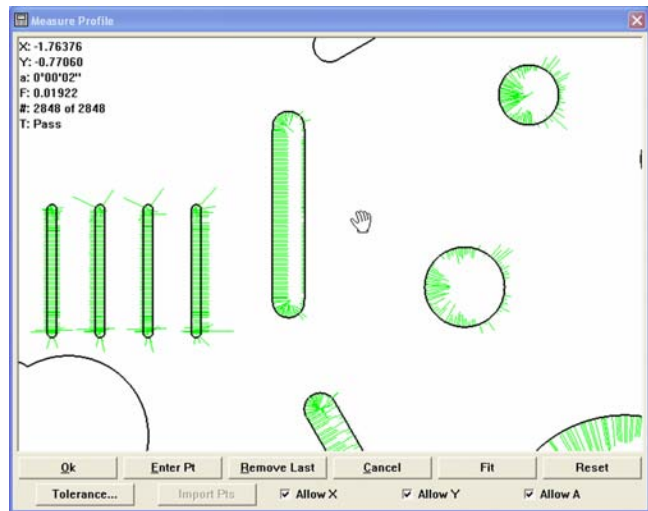
To display less detail

Panning to reposition the image in the Measure Profile window

The contents of the Measure Profile window can be moved to any location of the user's choice by panning the image with the mouse. To pan an image, click Zoom Special/Pan. The cursor will change to the hand shape. Press and hold the left mouse button and move the mouse to shift the image to the desired location. When the mouse is released, the cursor will change back to the arrow shape.



Press and hold the left mouse button...



and move the image to the desired location

Showing or hiding profile fit information

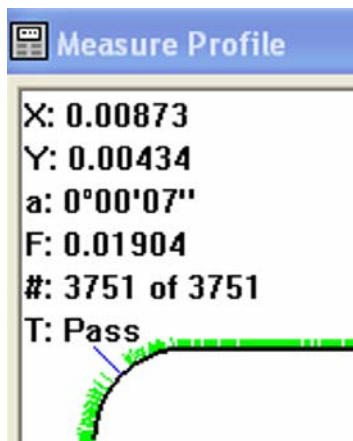
Clicking Show displays a menu of profile fit information that can be toggled on or off in the Measure profile window. Click the desired item to display or hide it in the window. Displayed information can include:

- Results: Numeric profile measurement results
- Filtered: Points filtered out of fit calculation
- Tolerance: Tolerance boundaries as dotted lines
- Material: Surface normals indicating material
- Points: Part profile data points
- Passed: Whiskers indicating form error within tolerance
- Failed: Whiskers indicating form error outside tolerance

The items contained in the Show menu are duplicated in the Profile toolbar. Clicking an icon in the toolbar toggles the display of the corresponding information on or off in the Measure Profile window.



Click Results to display profile fit results

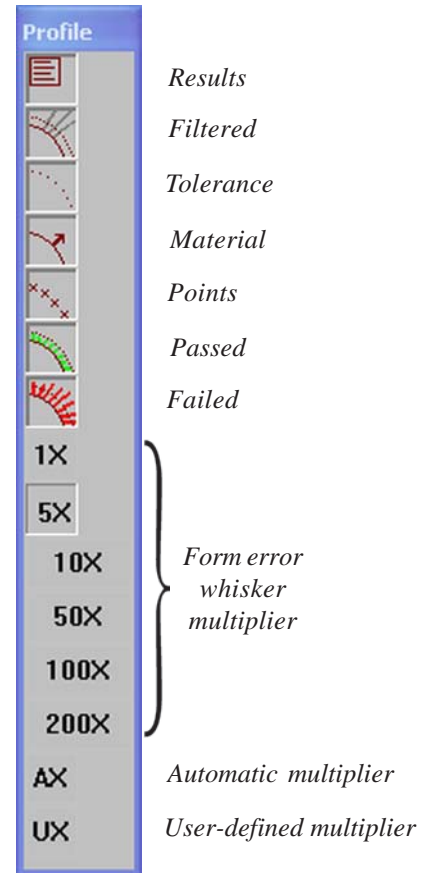


Results

Click the Show/Results menu item or toolbar icon to display numeric profile fit results in the upper-left corner of the Measure Profile window.

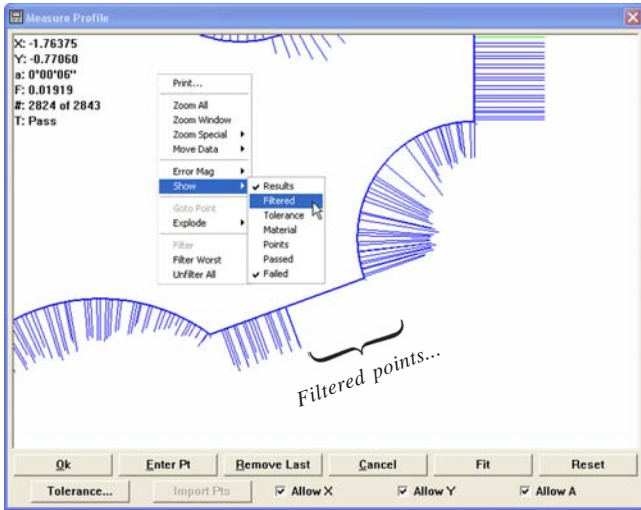
Profile fit results include:

- X: The x-axis offset after shifting the data cloud to achieve the best fit.
- Y: The y-axis offset after shifting the data cloud to achieve the best fit.
- a: The angular offset after shifting the data cloud to achieve the best fit.
- F: The form error
- #: The number of points acquired, and the number of points used to determine profile fit results.
- T: The tolerance Pass/Fail result.

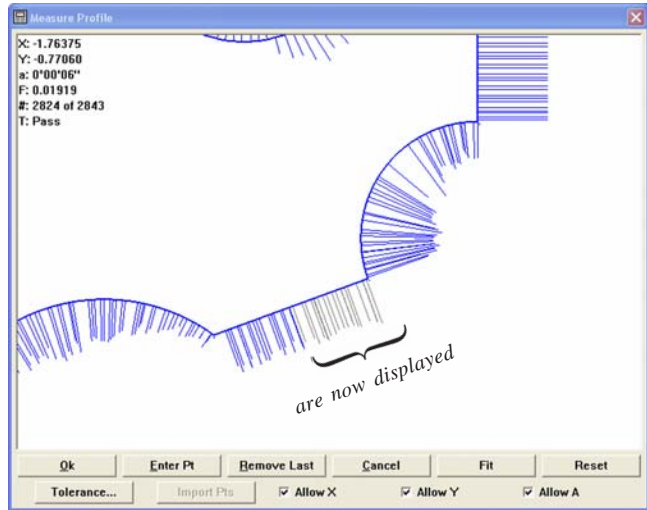


Filtered

Click the Show/Filtered menu item or toolbar icon to display points and error whiskers that were filtered earlier using the Filter or Filter Worst profile menu command. Filtered points appear as dark gray.



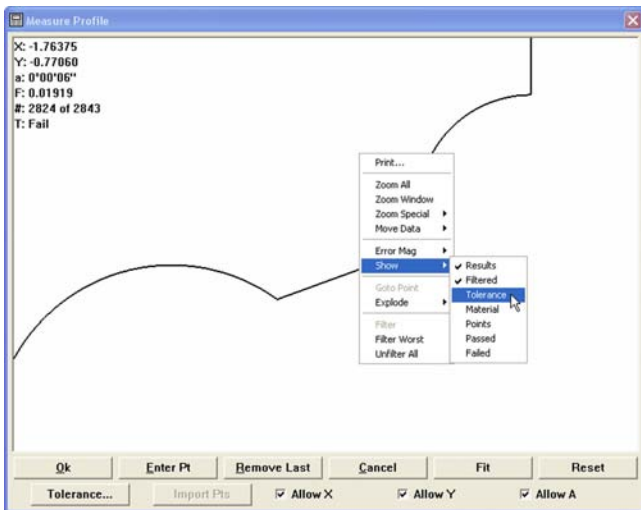
Click Show/Filtered...



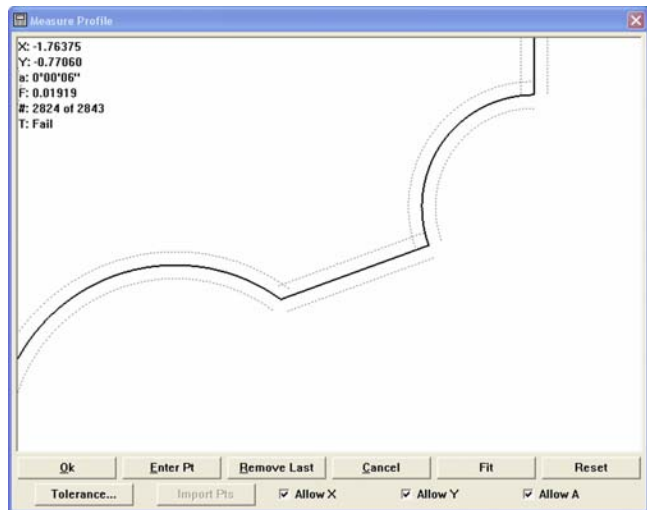
To display previously filtered data

Tolerance

Click the Show/Tolerance menu item or toolbar icon to display dotted lines that indicate the tolerance zones around profile edges specified earlier using the Tolerance button in the Measure profile window.



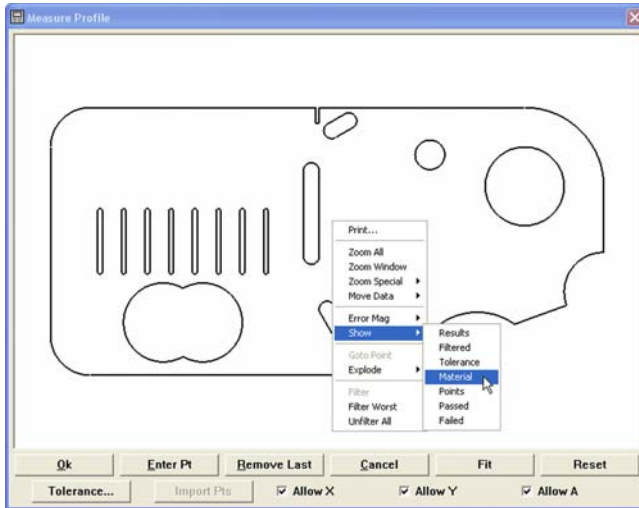
Click Show/Tolerance...



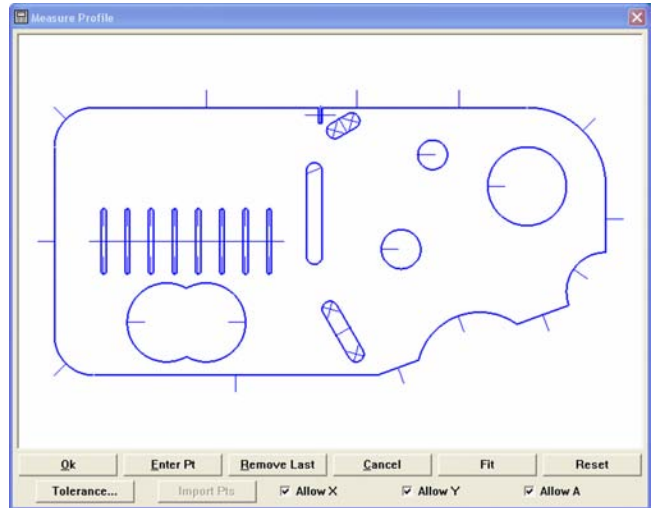
To display tolerance zones

Material

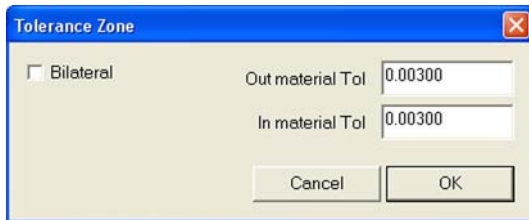
Click the Show/Material menu item or toolbar icon to display surface normals that are outside the material and normal to the material surfaces.



Click Show/Material...



To display material indicator lines

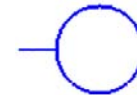


Unequal tolerances applied

The material indicator lines are used by the system to identify the material sides of nominal part surfaces. This is necessary when unequal inside/outside tolerances are applied to the nominal profile. Material indicator lines must be positioned outside the material surface as shown below.

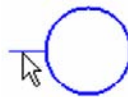


Material indicator within a hole

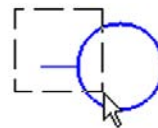


Material indicator outside a boss

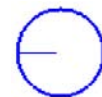
The orientation of the material indicator lines can be changed by selecting them with the mouse. Select by clicking on a line, or by dragging a marquee around a line and releasing the mouse button.



Clicking on a line...



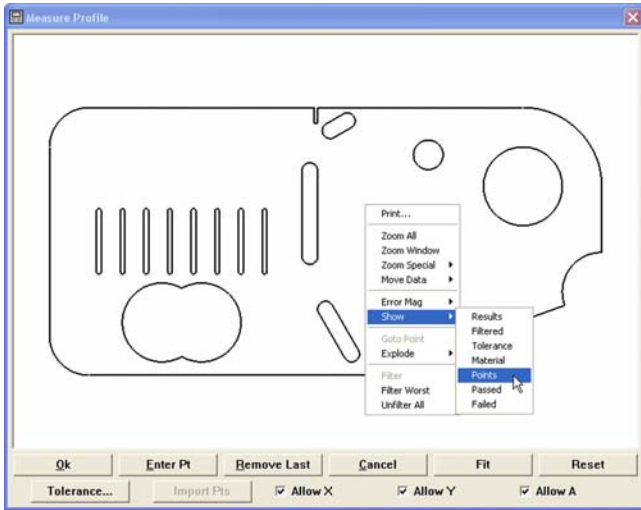
or selecting a line with a marquee...



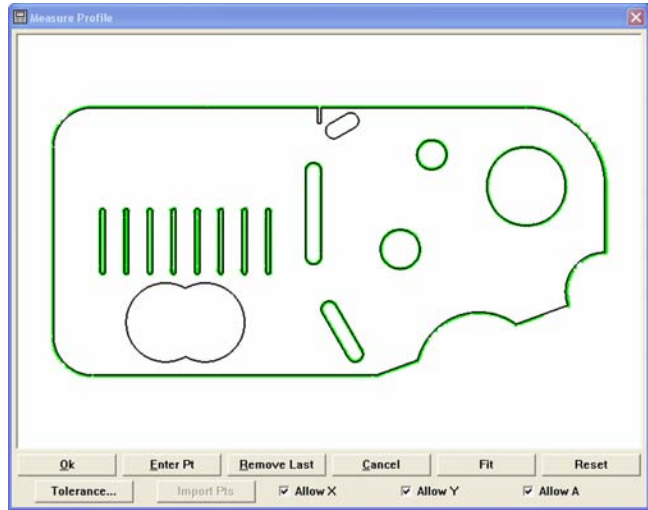
Changes the orientation of the line

Points

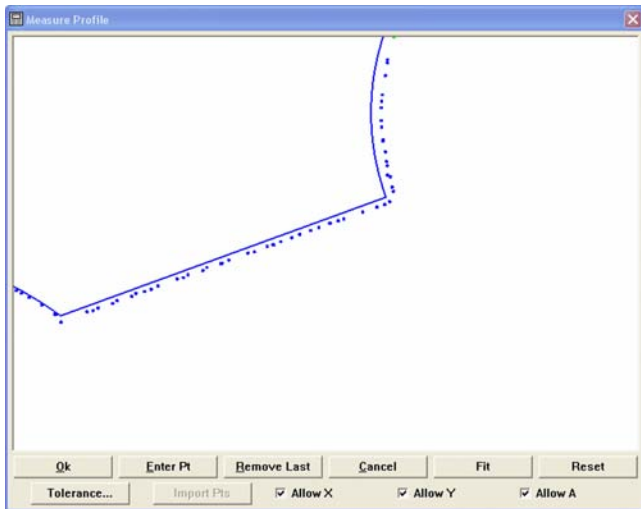
Click the Show/Points menu item or toolbar icon to display the points acquired from measurements in the Video window.



Click Show/Material...



To display material indicator lines

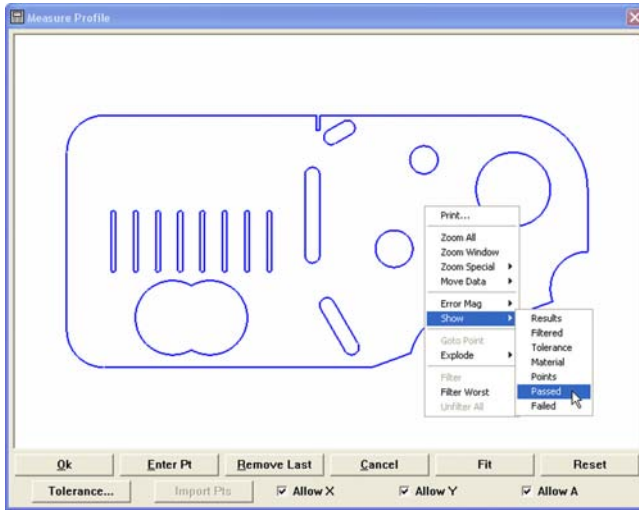


Display magnification increased to show individual points

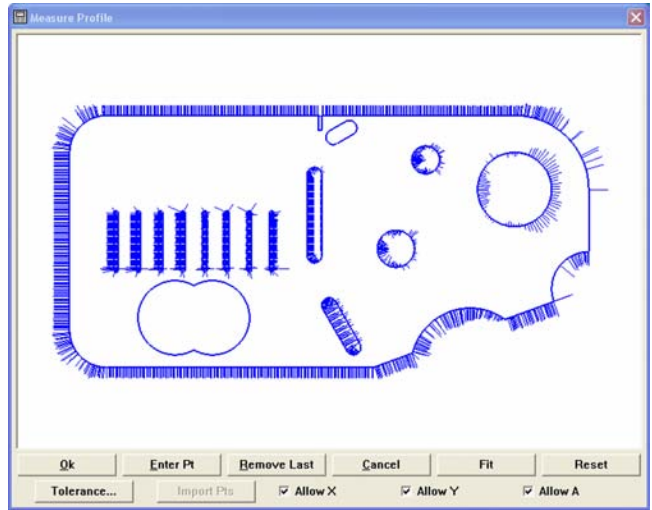
Points will appear as a green dotted line near measured surfaces until the display magnification is increased to show individual data points.

Passed

Click the Show/Passed menu item or toolbar icon to display the points and form error whiskers that passed the tolerance criteria. The default colors of points and form error whiskers that passed are green for 0 to 50% and yellow for 51% to 100% of the tolerance value.



Click Show/Passed...

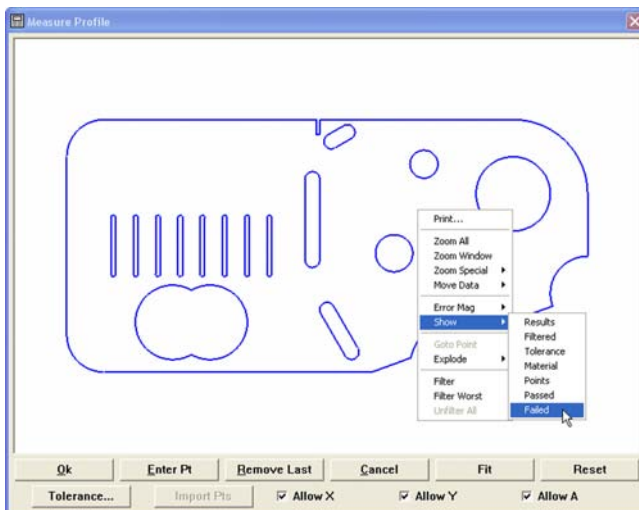


To display points/whiskers that passed the tolerance criteria

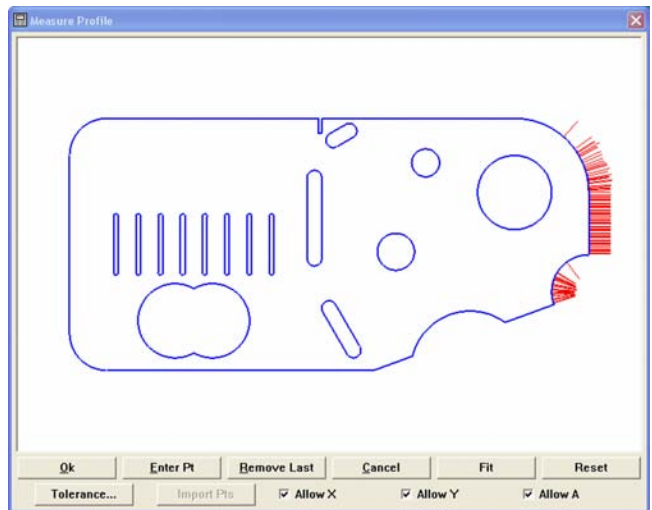
The default colors can be changed in the Tools/Customize/Colors setup screen.

Failed

Click the Show/Failed menu item or toolbar icon to display the points and form whiskers that failed the tolerance criteria. The default color of points and form whiskers that fail is red for greater than 100% of the tolerance value.



Click Show/Failed...



To display points/whiskers that fail tolerance criteria

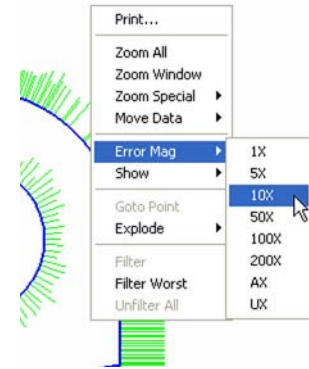
The default color can be changed in the Tools/Customize/Colors setup screen.

Magnifying the display of form error whiskers

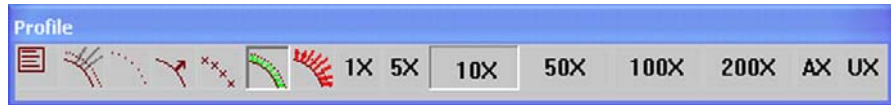
During the fit operation, points acquired that do not fall precisely on the nominal profile generate form errors. When tolerances are specified, the errors are divided into two groups, those that pass (Passed) and those that fail (Failed) tolerance criteria.

The passed and failed errors can be displayed as whiskers that extend orthogonally from the nominal surface. The length of each whisker is proportional to its magnitude of error.

Typically, the magnitude of most form errors is so small in proportion to the part displayed that without magnification they would not be visible. The Error Mag menu item provides fixed, automatic and user-definable levels of magnification for displaying error whiskers.



Error magnification levels are also available in the profile toolbar.



Error magnification set at 10X

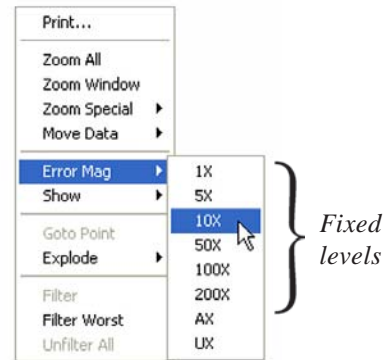


NOTE

The Show/Passed or Show/Failed menu item must be checked or toolbar icon must be clicked for whiskers to be displayed.

Fixed magnification

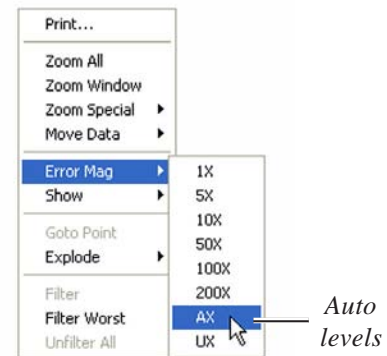
Click the Error Mag menu item, then click the desired level of magnification, or click the desired level icon in the toolbar.



Automatic magnification

Click the Error Mag menu item, then click AX for automatic adjustment of magnification, or click the AX icon in the toolbar.

When automatic magnification is selected, the system optimizes the display of error whiskers based on the maximum form error value.

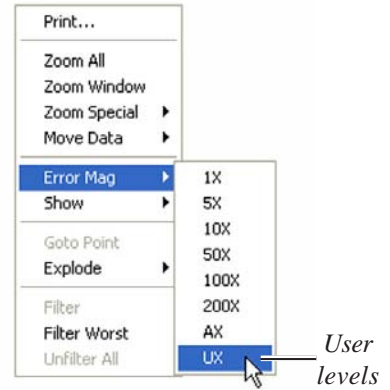


User-defined magnification

Click the Error Mag menu item, then click UX to specify a level of magnification, or click the UX icon in the toolbar. A data field will be displayed for specifying the level of magnification.



Magnification of 30 specified by the user

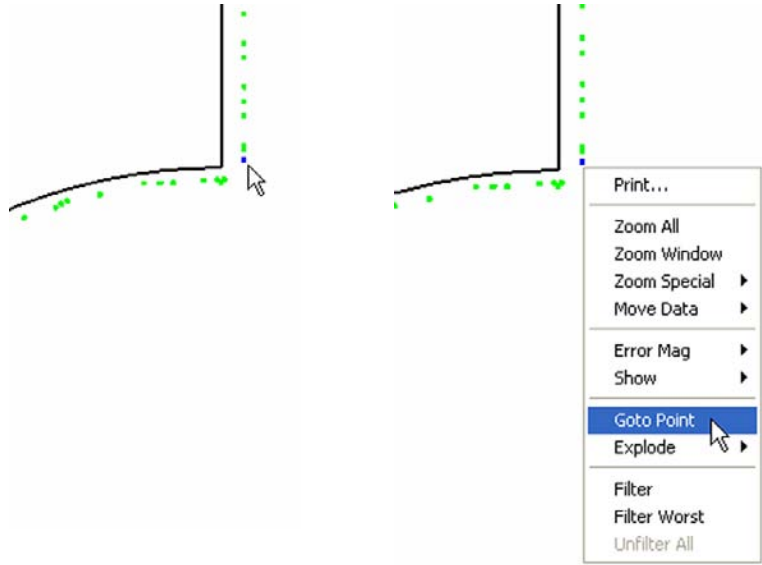


Enter the desired level of magnification and click OK.

Driving the CNC stage to a selected point location

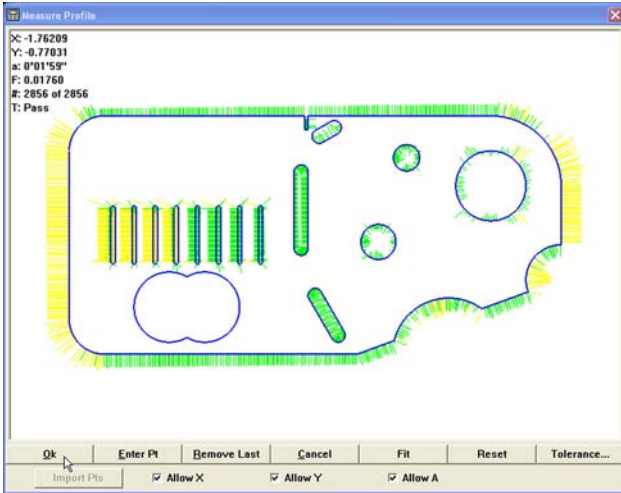
The CNC stage can be moved by the system to position the video camera over a specified point.

Zoom to show individual points, then right-click the desired point to display the Measure Profile menu. Click Goto Point to drive the stage and position the selected point under the video camera.

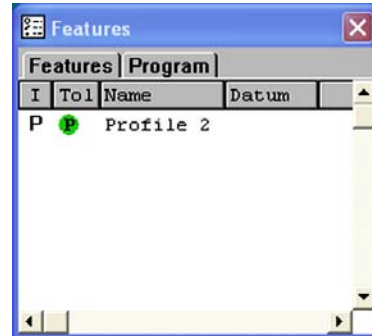


Sending (exploding) the profile fit data as points and distances in the Features template

The results of a profile measurement can be used to create a single profile feature by clicking the OK button in the measure profile window, or can be used to create individual point features or distance features by clicking one of the Explode profile menu items.



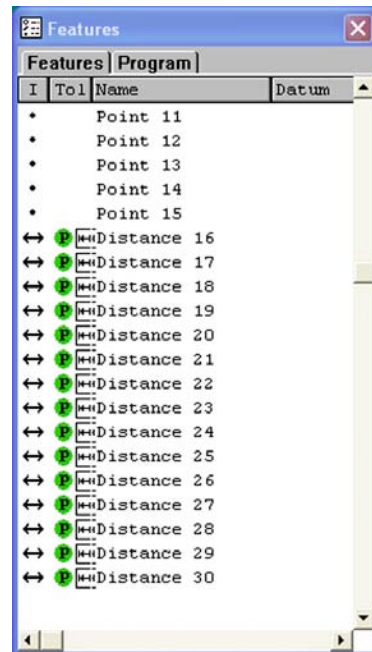
Clicking OK in the Measure profile window...



Creates a single profile feature in the feature template



Clicking Explode/Points or Explode/Errors menu items...



Creates point or distance features in the feature template

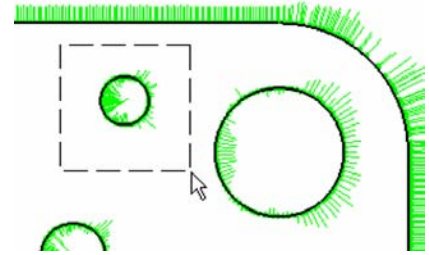
Data points explode as point features, and form errors as distances.

Filtering selected points from the part data

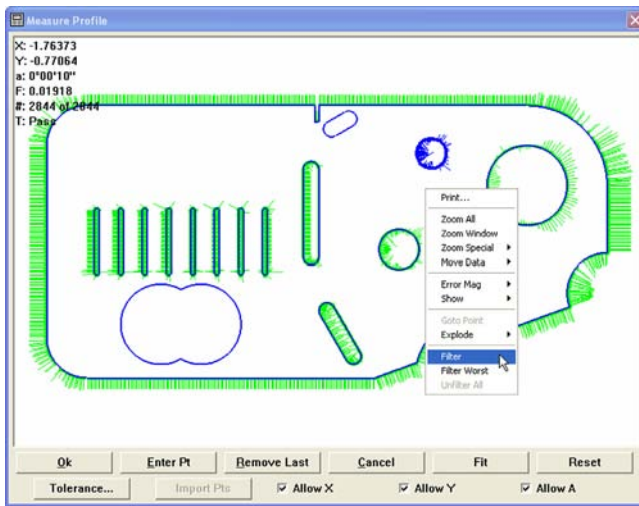
Data points can be selectively filtered out of fit operations to evaluate the influence of specific points on fit results, or to eliminate the effects of unwanted measurement artifacts.

Select the point(s) to be filtered, then right-click anywhere in the Measure Profile window to display the Measure Profile menu.

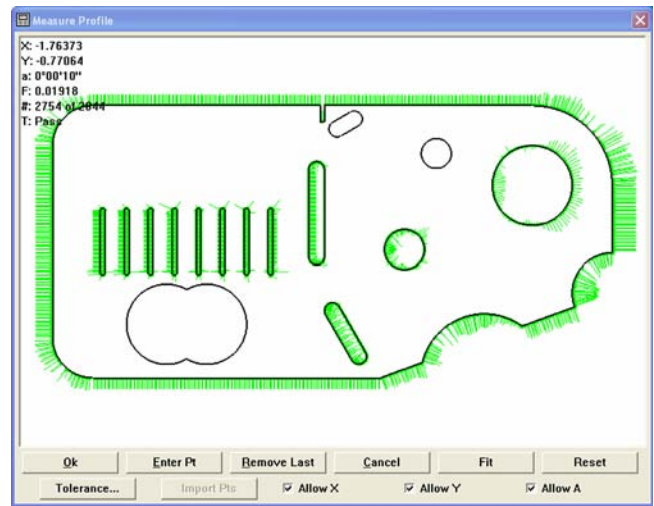
Click on Filter to filter out the selected points, then click Fit to perform a new fit operation. The new results will not include the filtered points.



Select points to be filtered out of a fit analysis



Click Filter...



to remove selected points from the next fit analysis

Filtering the worst (form error) point from the part data

Right-click anywhere in the Measure Profile window to display the Measure Profile menu. Click Filter Worst to exclude the data point with the greatest form error from the next fit analysis.

Click Filter Worst repeatedly to filter a group of data points with the greatest form errors.

Click Fit to perform a new fit operation. The new results will not include the filtered points.

Unfiltering (restoring) filtered data points

Right-click anywhere in the Measure Profile window to display the Measure Profile menu. Click Unfilter All to restore all previously filtered data points to the data cloud for the next fit analysis.

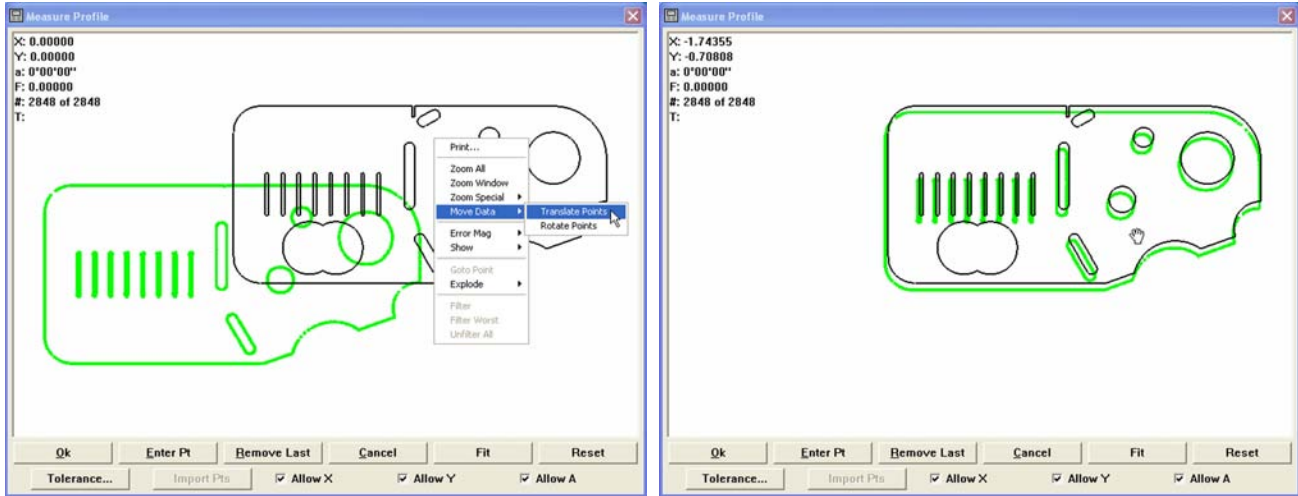


Manually fitting part data to the nominal profile

The position of data points can be moved manually prior to facilitate a difficult fit operation by clicking and dragging or rotating the data points.

Clicking and dragging (translating) data points

Click Move Data/Translate. The cursor will change to the hand shape. Click and drag the entire cloud of data points to the desired location. The offset coordinates are shown in the upper left corner of the Measure Profile window, and change as the data cloud is dragged into position.



Once the data cloud is in the desired position, right-click the mouse to display the Move data menu. Click Done to return to the normal cursor mode.

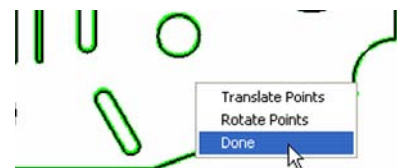
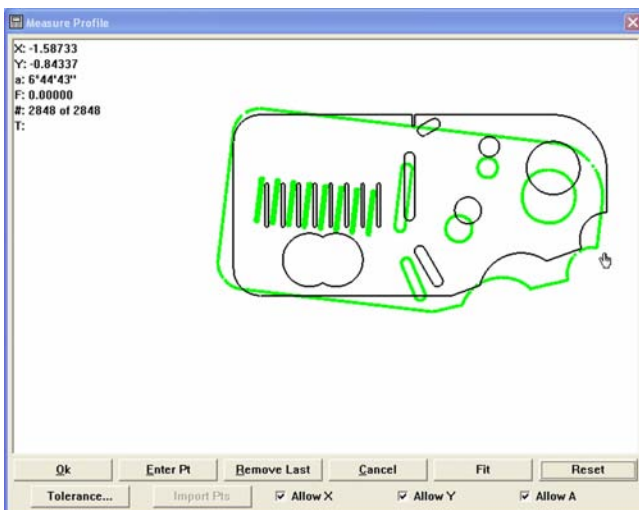


Clicking and rotating data points

Click Move Data/Rotate points. The cursor will change to the pointing-hand shape. Click and rotate the entire cloud of data points to the desired angle. The offset coordinates are shown in the upper left corner of the Measure Profile window, and change as the data cloud is rotated into position.



Once the data cloud is rotated to the desired position, right-click the mouse to display the Move data menu. Click Done to return to the normal cursor mode.



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HEIDENHAIN

DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 8669 31-0

☎ +49 8669 5061

E-mail: info@heidenhain.de

www.heidenhain.de