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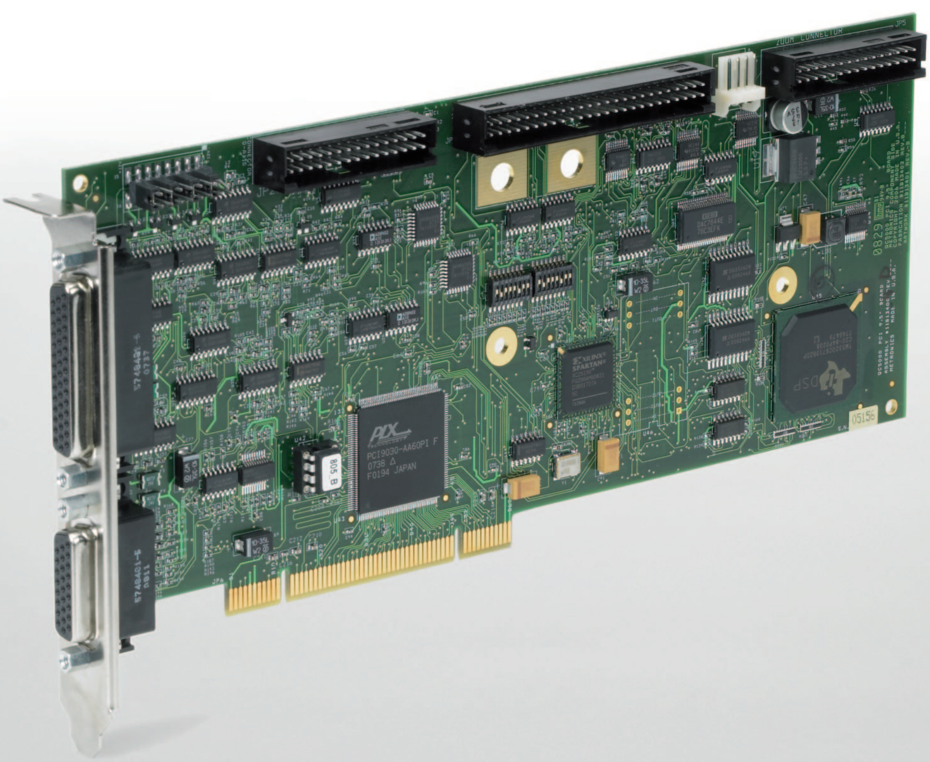

Operating Instructions

IK 5000 QUADRA-CHEK

(QC 5000)

Manual 3D Systems

English (en)
2/2010

Quadra-Chek® 5000

User's Guide

Proprietary notice

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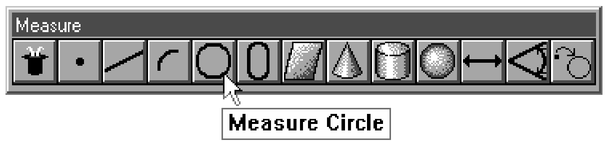
QC5000 User's Guide
Contents

Chapter 5: Advanced Measuring & Output 161

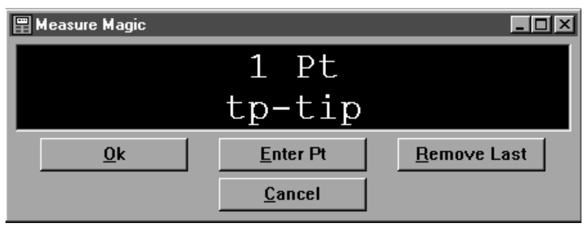
Chapter 1
Overview

Welcome to the QC5000

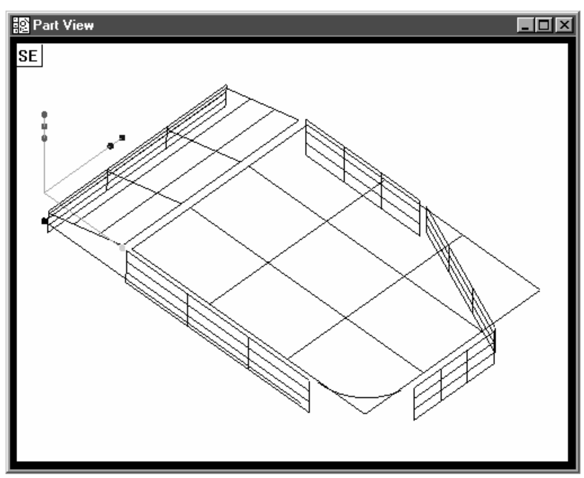
The Quadra-Chek 5000 software suite is an advanced software application for coordinate measurement machines (CMM). It features a graphical user interface for simple point and click operation. Point the cursor to a feature on the measure toolbar and click.



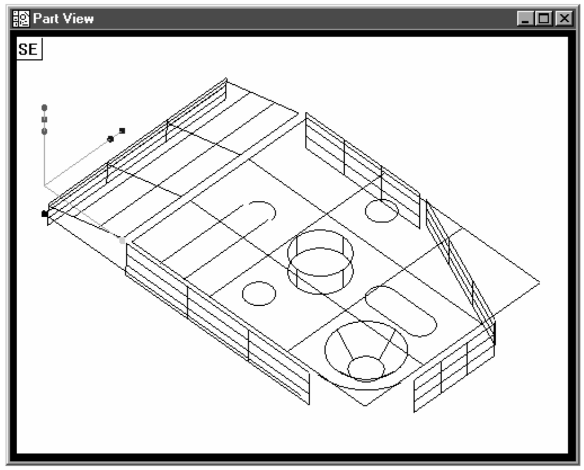
The QC5000 measures part features using the simplest geometric components: points. Lines can be created from two points, circles from three points, and cones from six points. Simply probe the points and the QC5000 measures the feature.



Once the required number of points are entered the QC5000 displays the feature in the part view window.



The QC5000 continues building the part in the part view window as features are added.



It is easy to use the QC5000 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 QC5000 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 QC5000 metrology software, supervisory, and installation personnel. A basic familiarity with the Windows computing environment and coordinate measuring machine (CMM) operation is assumed. Material in this guide is divided into six 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 QC5000 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 QC5000.

Chapter 2: Quick Start
This chapter gets you up and running quickly. Use this chapter to learn the most basic QC5000 tasks. Each task in this chapter is described in greater detail elsewhere in this guide.

Chapter 3: Using Probes
If it's about probes, it's in this chapter. The probe is where the QC5000 and the coordinate measuring machine (CMM) meet. Learn proper probing techniques and you can't go wrong.

Chapter 4: General Measuring
A solid knowledge of how to create and combine features to form a part is essential: this chapter helps you get it. Working from the basic to the complex, this chapter describes features and their relationships.

Chapter 5: Advanced Measuring & Output
Picking up where chapter 4 leaves off this chapter covers datum magic, measure magic, layers, offset alignments, and tolerancing. This chapter also describes how to export QC5000 data to other software.

Chapter 6: Templates
The QC5000 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.

Chapter 7: 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 QC5000.

Chapter 8: System Setup & Configuration
Everything you need to setup and configure the QC5000. This final chapter gives setup procedures for shift supervisors and OEMs. End users should apply the information in this chapter ONLY at the direction of a supervisor, distributor, or OEM.

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 lighting bolt 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

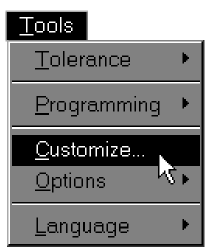
The note icon indicates additional or supplementary information about an activity or concept. Notes are shown in bold type.

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.

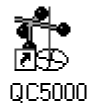


The italics instruct the user that *customize* is an item on the tools pull-down menu.

Starting The QC5000

To open the QC5000

Step 1



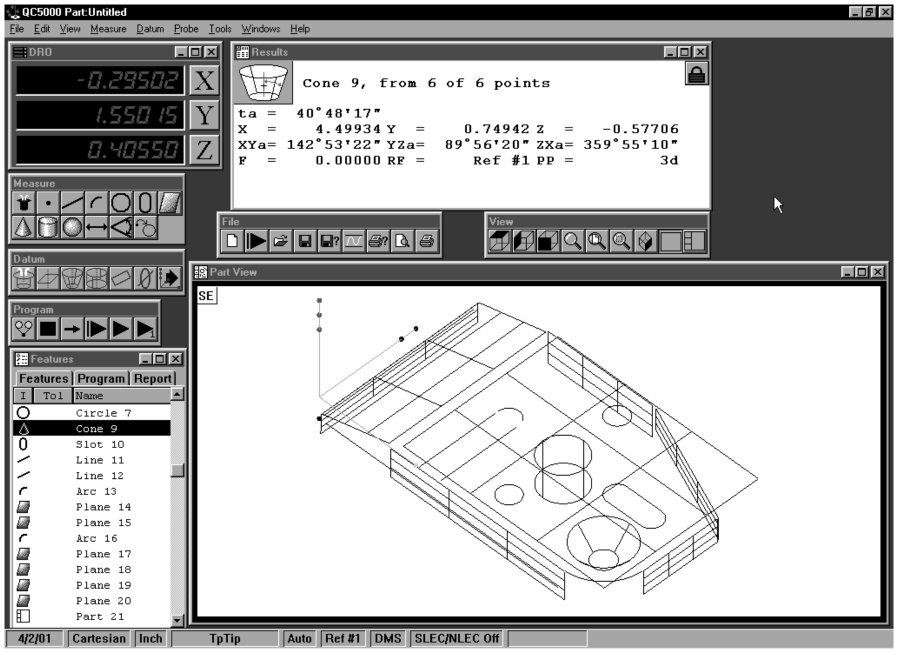
Double-click the QC5000 icon on the Windows NT desktop.

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

Windows and Toolbars

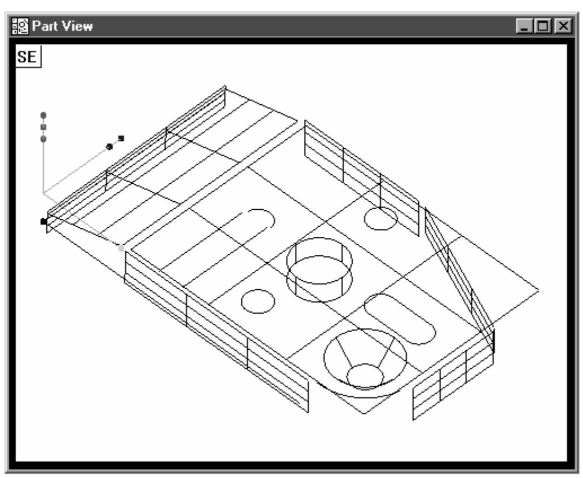
The QC5000 uses a graphical user interface which means that instead of typing in a bunch of complicated commands you can do things by pointing and clicking the mouse.

In this manual we'll refer to the graphical user interface as the QC5000 desktop. Although setups may vary, a typical QC5000 desktop looks like this.

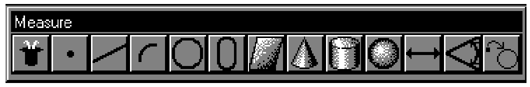


There are only two things to point and click at on the QC5000 desktop: windows and toolbars. Here's how to tell them apart.

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 contains buttons that 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.).



QC5000 Windows

The QC5000 desktop has four windows: DRO (digital readout), results, part view, and features list.

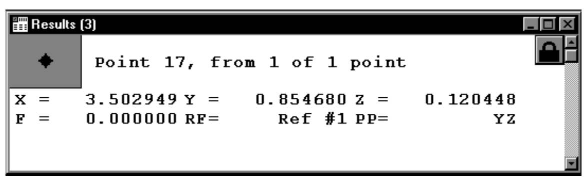
DRO

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

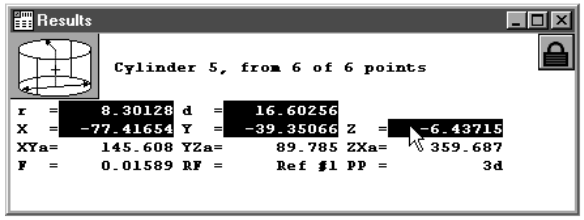


Feature Specifications

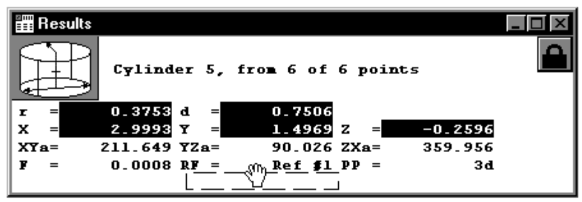
Feature information is displayed in the results window. Use the results window to add information to the features list.

To move information from the results window to the features list

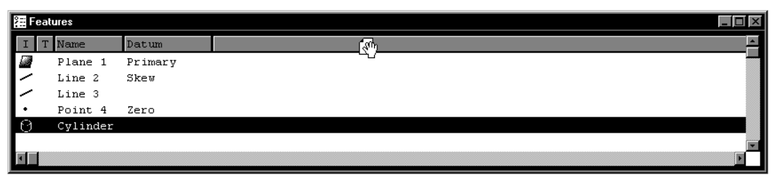
Step 1
Highlight the desired information in the results window.



Step 2
Hold down the left mouse button and drag the information to the features list.

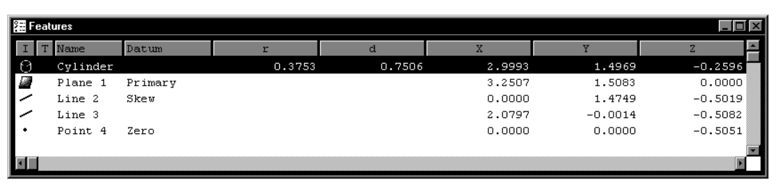


Step 3
Release the mouse button.



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 are displayed in their own reference frame. Unlocked features are displayed in the current reference frame.

To unlock a feature

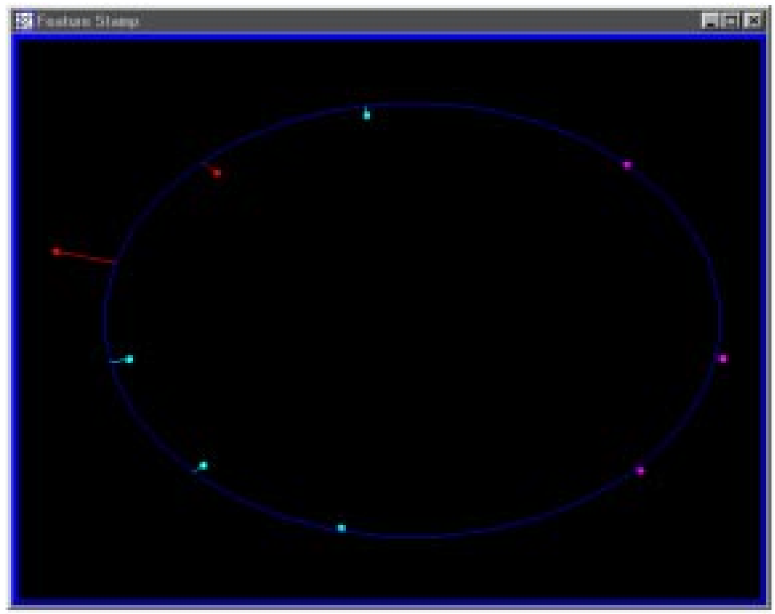
Step 1
Click the lock icon in the results window.

To lock a feature

Step 1
Click the lock icon in the results window.

Feature type diagram /feature stamp

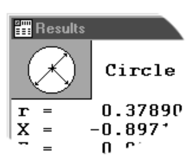
Clicking on the feature stamp icon opens the feature stamp window. The feature stamp window shows a graphic display of the feature and the distibution of the measurement points. Points discarded from the measurement are shown in red. Use the view toolbar to change the perspective in the feature stamp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



To open the feature stamp window

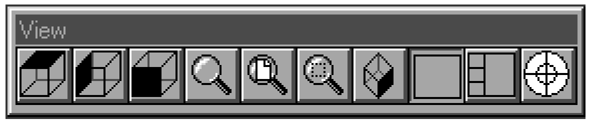
Step 1

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



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 appearence of the part view window.

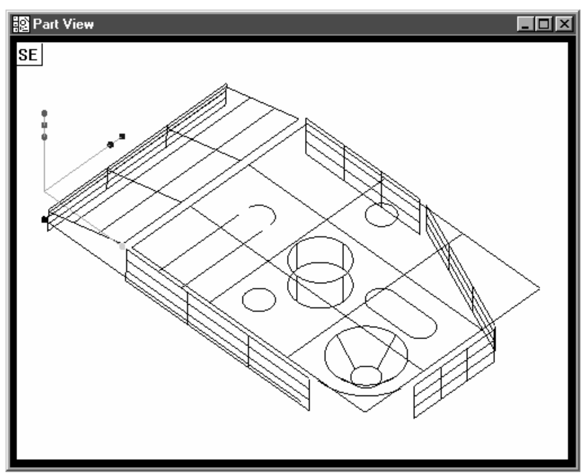


This is a typical view toolbar. Remember that QC5000 toolbars can be customized. Toolbars pictured in this guide may vary from those on your system.

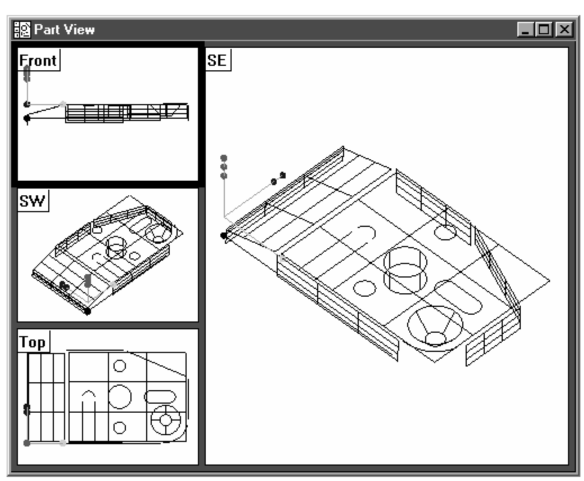
Four pane part view displays the part from four separate vantage points. Highlighted panes are outlined in blue. Place the cursor on the pane and click to highlight. Only one pane can highlighted at a time.

The most common part view window appearences are shown here.

Single pane part view



Four pane part view

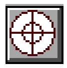


View Rotator

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

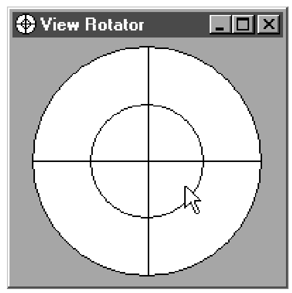
To use the view rotator

Step 1

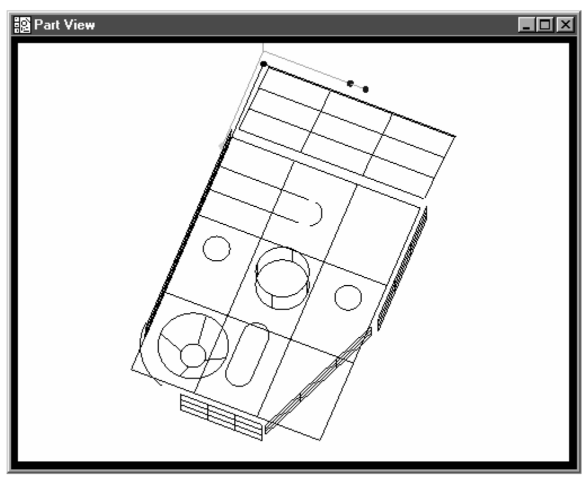


Click the *view rotator* button on the view toolbar OR select *view rotator* from the view menu..

Step 2
Place the cursor over the view rotator window as shown.



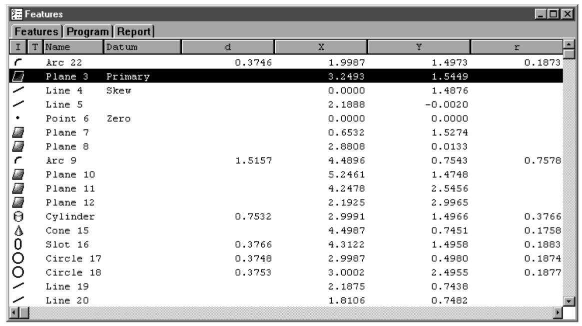
Step 3
Move the cursor over the view rotator window until the part is displayed as desired.



Template Windows

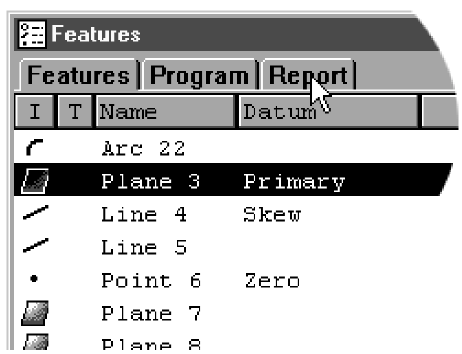
Template windows display data output from QC5000 measurements and programs. See Chapter 4: *Advanced Measuring & Output* for more information on using template windows.

Nest templates windows as shown to conserve space on the QC5000 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.

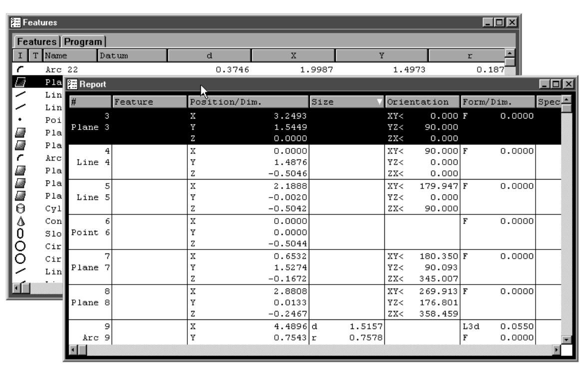


To separate template windows

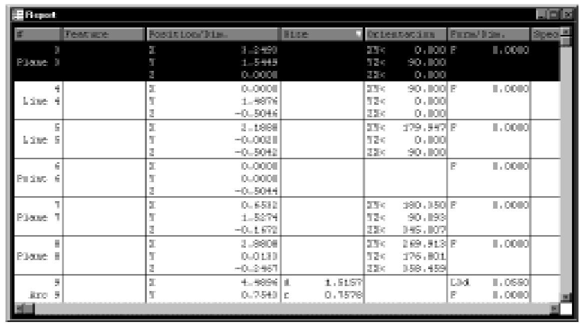
Step 1
Place the cursor over the desired tab as shown.



Step 2
Hold the left mouse button and drag the tab outside the current window as shown.

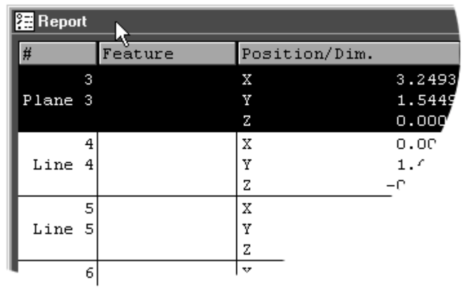


Step 3
Release the left mouse button.

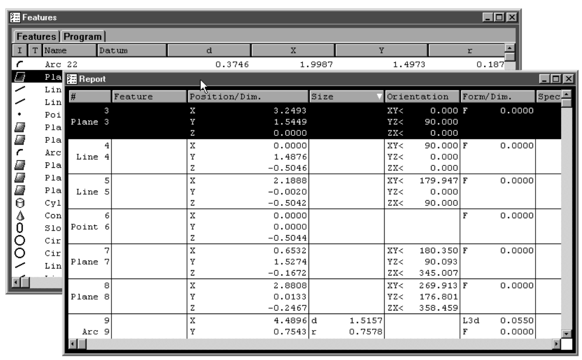


To nest template windows

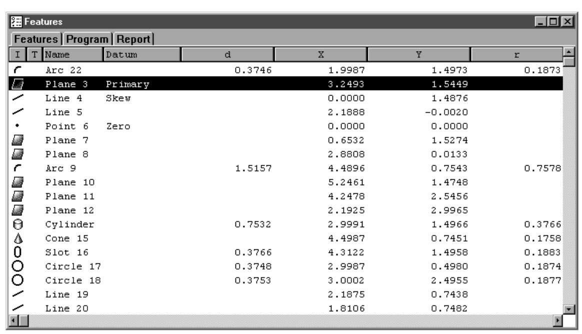
Step 1
Place the cursor over the desired template window as shown.



Step 2
Hold the left mouse button and drag the template over the desired window.



Step 3
Release the mouse button.



Status Bar

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

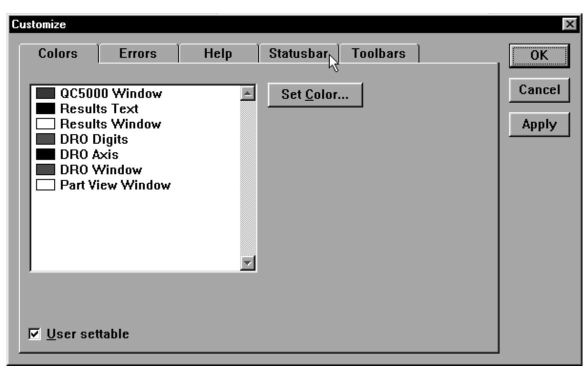
- Date
- Type of coordinates (Polar/Cartesian)
- Selected units of measurement (in./mm)
- Active Layer
- Active probe tip
- Projection Plane
- Active Reference Frame
- Angle Display Mode
- SLEC Status
- Recording or Editing Mode

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.

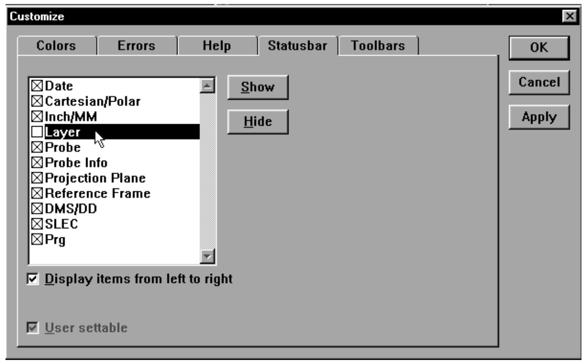
To add items to the status bar

Step 1
Select *customize* from the tools menu.

Step 2
Select the *status bar* tab as shown.



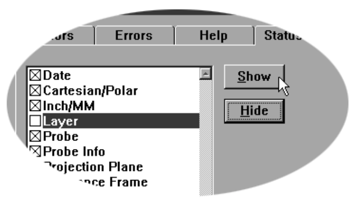
Step 3
Highlight the desired item as shown.



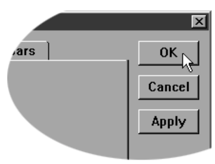
NOTE

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.



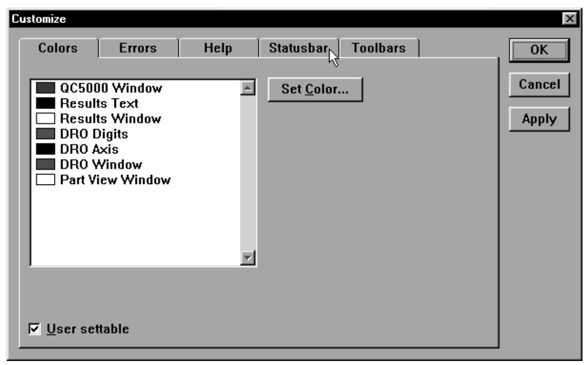
Step 5
Click OK.



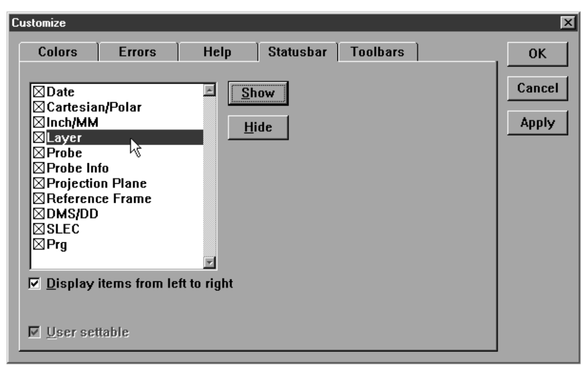
To delete items from the status bar

Step 1
Select *customize* from the tools menu.

Step 2
Select the *status bar* tab as shown.



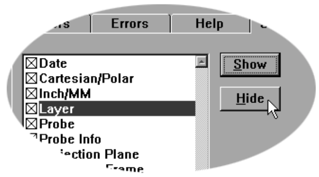
Step 3
Highlight the desired item as shown.



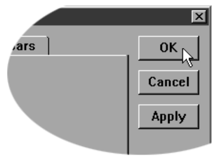
NOTE

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.

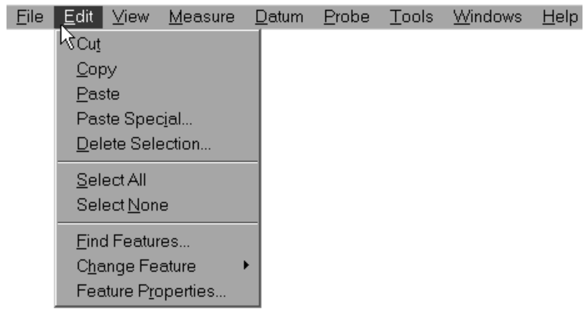


Step 5
Click OK.



Main Menu Bar

This section shows the content of the QC5000 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.



The main menu bar contains the following pull down menus:

File

Use the *file* menu to access the following commands:

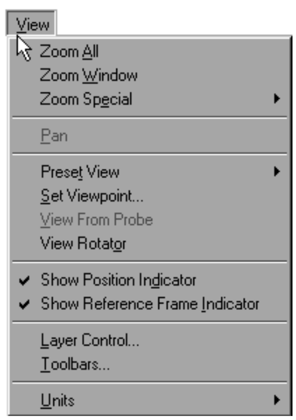
- New
- Open
- Save
- Save As
- Import
- Export
- DDE Output (dynamic data exchange)
- Page Setup
- Print Preview
- Print
- Exit

Edit

Use the *edit* menu to access the following commands:

- Cut
- Copy
- Paste
- Paste Special
- Delete Selection
- Select All
- Select None
- Find Features
- Change Feature
- Features Properties

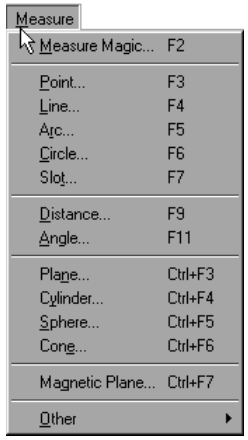
View



Use the *view* menu to access the following commands:

- Zoom All
- Zoom Window
- Zoom Special
- Pan
- Preset View
- Set Viewpoint
- View From Probe
- View Rotator
- Show Position Indicator
- Show Reference Frame Indicator
- Layer Control
- Toolbars....
- Units

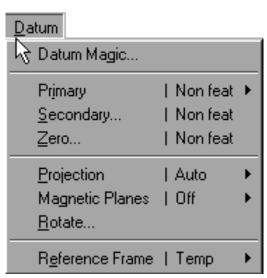
Measure



Use the *measure* menu to access the following commands:

- Measure Magic
- Point
- Line
- Arc
- Circle
- Slot
- Distance
- Angle
- Plane
- Cylinder
- Sphere
- Cone
- Magnetic Plane
- Other

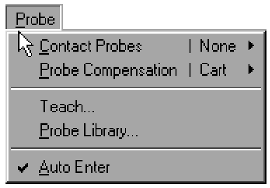
Datum



Use the *datum* menu to access the following commands:

- Datum Magic
- Primary
- Secondary
- Zero
- Projection
- Magnetic Planes
- Rotate
- Reference Frame

Probe

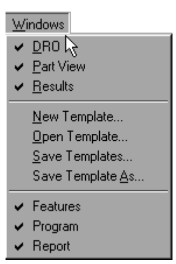


Use the *probe* menu to access the following commands:
- Contact Probes
- Probe Compensation
- Teach
- Probe Library
- Auto Enter

Tools

Use the *tools* menu to access the following commands:
- Tolerance
- Programming
- Customize
- Options
- Language

Windows



Use the *windows* menu to access the following commands:
- DRO
- Part View
- Results
- New Template...
- Open Template...
- Save Templates As
- Features
- Program
- Report

Help

Use the *help* menu to access the following commands:

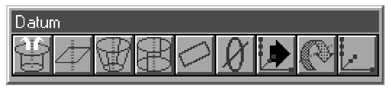
- What’s New?
- Backup Settings
- Restore Settings
- About QC5000

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.

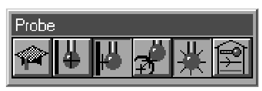


Measure toolbar

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

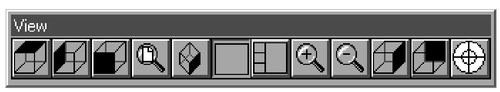
Probe toolbar

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



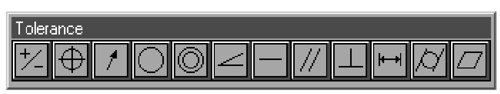
View toolbar

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



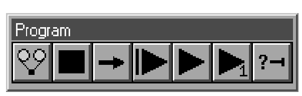
Tolerance toolbar

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



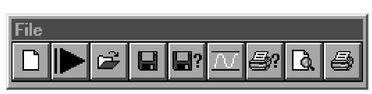
Program toolbar

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



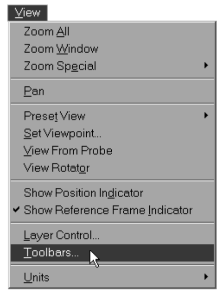
File toolbar

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

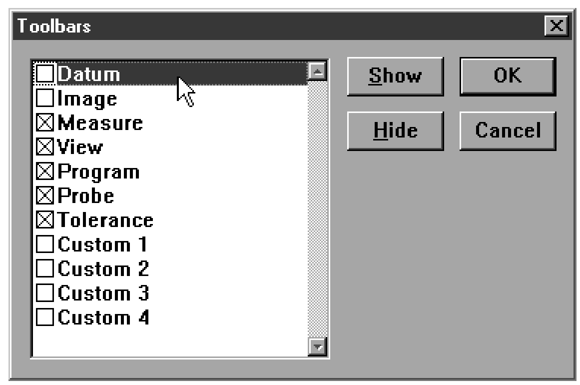


To place a toolbar on the QC5000 desktop

Step 1
Select *toolbars* from the view menu.



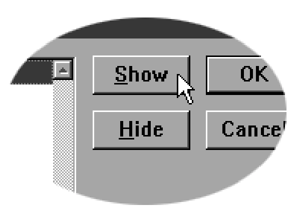
Step 2
Highlight the desired toolbar as shown.



NOTE

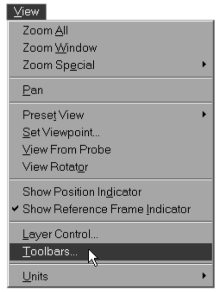
Toolbars on the QC5000 desktop have an 'X' in the box next to them. An empty box indicates the item is currently NOT on the desktop.

Step 3
Click the *show* button.

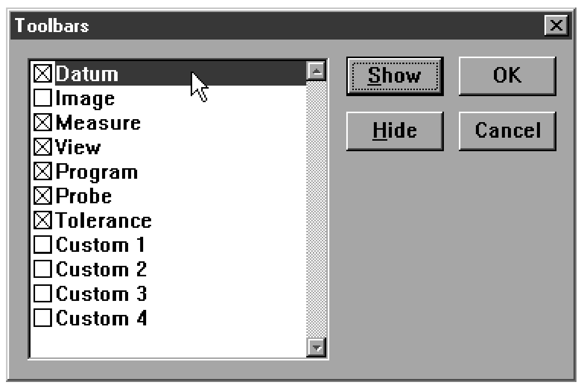


To remove a toolbar from the QC5000 desktop

Step 1
Select *toolbars* from the view menu.



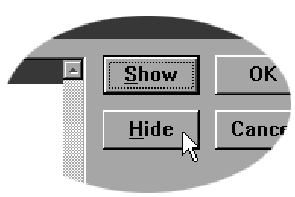
Step 2
Highlight the desired toolbar as shown.



NOTE

Toolbars on the QC5000 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.

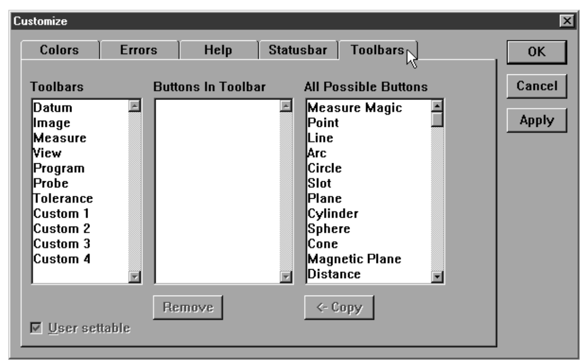


Customize your toolbars by adding or deleting buttons. Add buttons for common tasks . Delete seldom used buttons to keep toolbar size manageable.

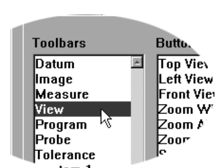
To add buttons to a toolbar

Step 1
Select *customize* from the tools menu.

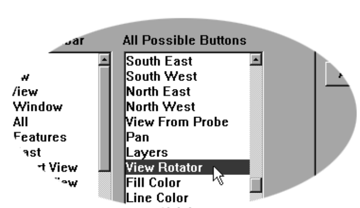
Step 2
Select the *toolbars* tab in the customize dialog box.



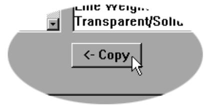
Step 3
Highlight the desired toolbar in the *toolbars* list as shown.



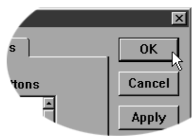
Step 4
Highlight the desired button in the *all possible buttons* list.



Step 5
Click the *copy* button.



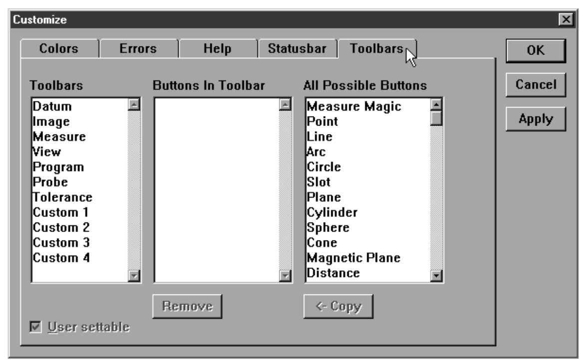
Step 6
Click OK.



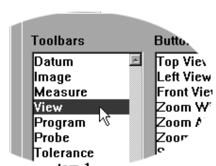
To remove buttons to a toolbar

Step 1
Select *customize* from the tools menu.

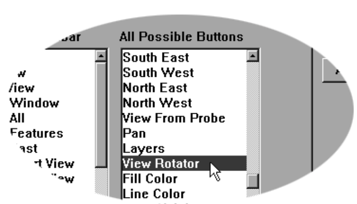
Step 2
Select the *toolbars* tab in the customize dialog box.



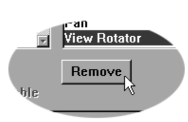
Step 3
Highlight the desired toolbar in the *toolbars* list as shown.



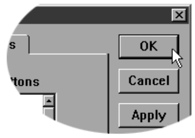
Step 4
Highlight the desired button in the *buttons in toolbar* list.



Step 5
Click the *remove* button.



Step 6
Click OK.



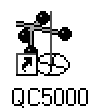
Chapter 2
Quick Start

Quick Start

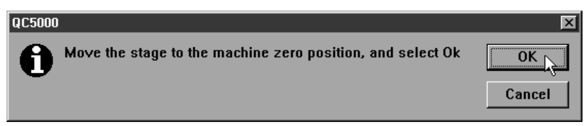
Use the *quick start* chapter to begin using the QC5000 immediately. This chapter will describe the most common user tasks associated with the QC5000. More detailed explanations for each task are found in subsequent chapters of this guide.

Set machine zero

Step 1
Double-click the QC5000 icon on the Windows NT desktop.



Step 2
Move the axes of the CMM to the machine zero position (consult the CMM user guide for more information) when the dialog box appears o the screen.



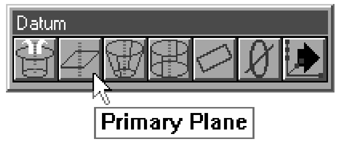
Step 3
Click OK in the dialog box.

CAUTION

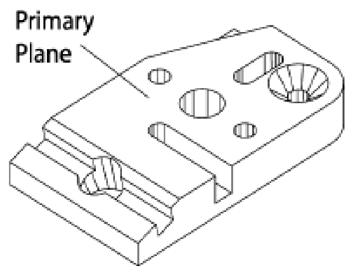
Set machine zero every time you begin a QC5000 session. Machine zero is used by QC5000 for SLEC (segmented linear error correction) functions. If machine zero is not set, SLEC functions will not work properly.

Create a reference frame

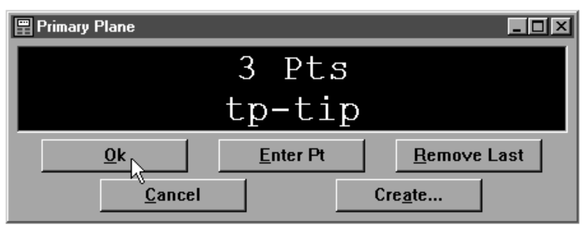
Step 1
Click the primary plane button on the datum toolbar.



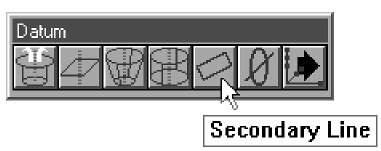
Step 2
Measure three points on the plane as shown.



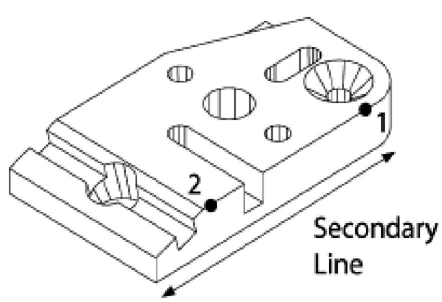
Step 3
Click OK in the dialog box.



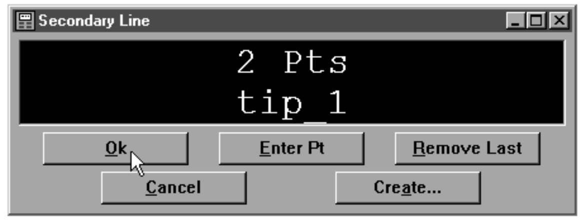
Step 4
Click the secondary line button on the datum toolbar.



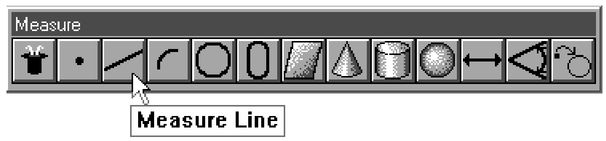
Step 5
Probe two points on the secondary line. Space the points close to the opposite ends of the line.



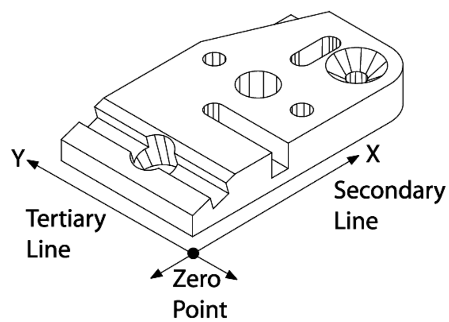
Step 6
Click OK in the dialog box.



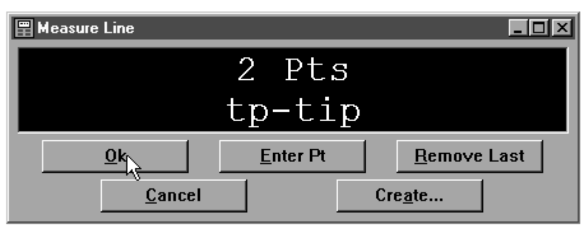
Step 7
Click the line button on the measure toolbar.



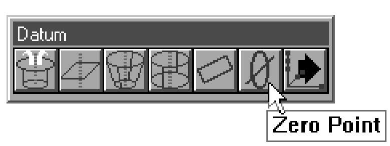
Step 8
Probe two points along the tertiary alignment as shown.



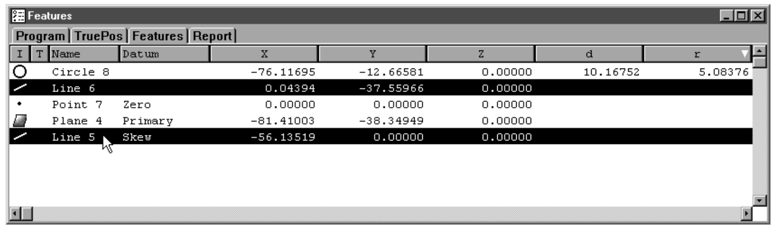
Step 9
Click OK in the dialog box.



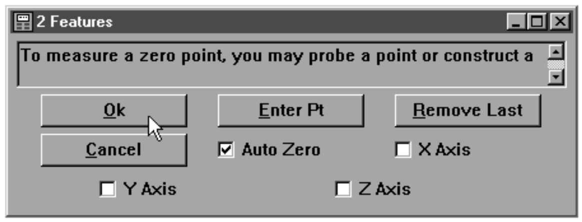
Step 10
Click the zero point button on the datum toolbar.



Step 11
Use the mouse to highlight the secondary and tertiary lines in the features list.

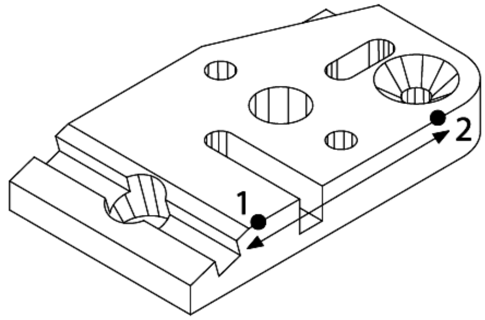


Step 12
Click OK in the dialog box.



Measure a line (minimum 2 points)

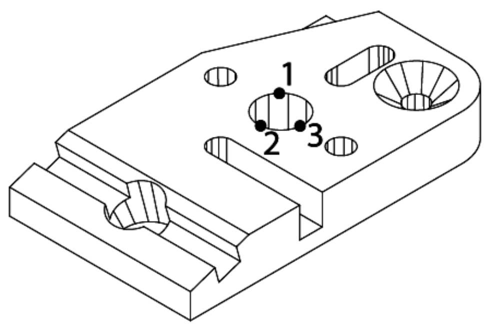
Step 1
Probe two points on the line as shown.



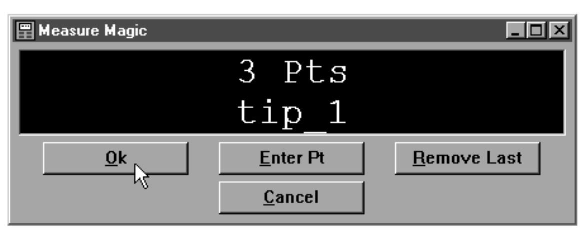
Step 2
Click OK in the dialog box.

Measure a circle (minimum 3 points)

Step 1
Probe three points on the circle as shown.

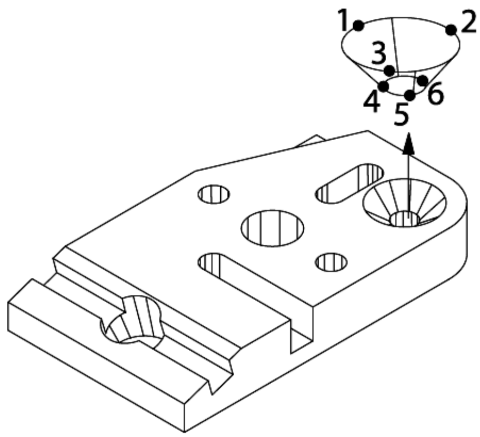


Step 2
Click OK in the dialog box.

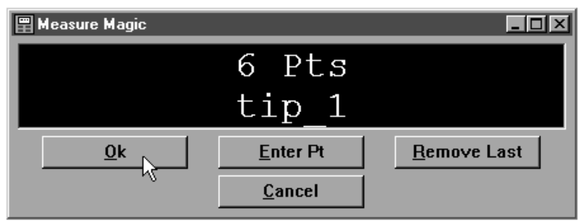


Measure a cone (minimum 6 points)

Step 1
Probe six points on the cone as shown.

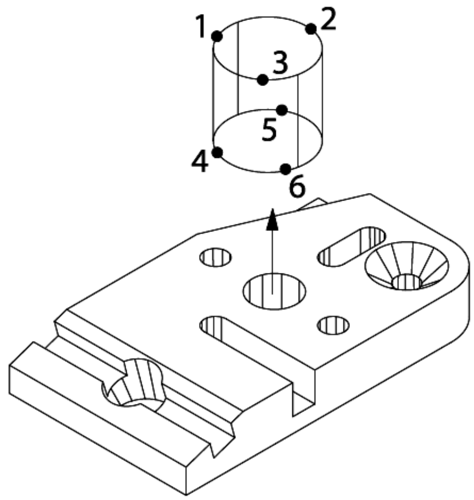


Step 2
Click OK in the dialog box.

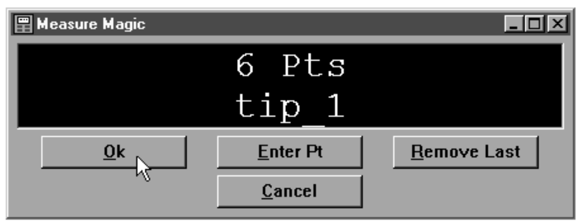


Measure a cylinder (minimum 6 points)

Step 1
Probe six points on the cylinder as shown.



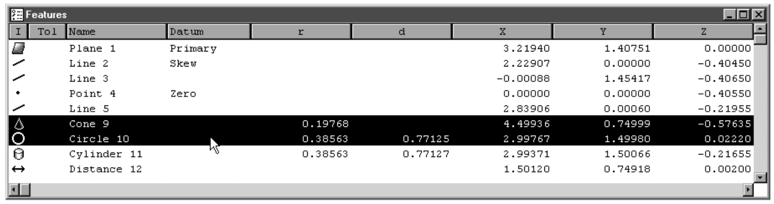
Step 2
Click OK in the dialog box.



Measure a distance

Step 1

Highlight two linear feature on the features list.



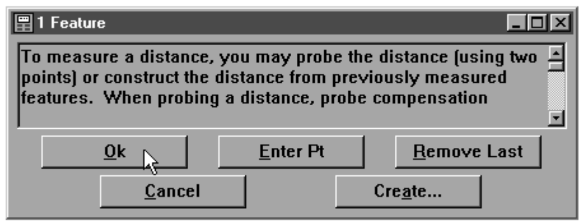
I	Tol	Name	Datum	r	d	X	Y	Z
		Plane 1	Primary			3.21940	1.40751	0.00000
		Line 2	Skew			2.22907	0.00000	-0.40450
		Line 3				-0.00088	1.45417	-0.40650
		Point 4	Zero			0.00000	0.00000	-0.40550
		Line 5				2.83906	0.00060	-0.21955
		Cone 9		0.19768		4.49936	0.74999	-0.57635
		Circle 10		0.38563	0.77125	2.99767	1.49980	0.02220
		Cylinder 11		0.38563	0.77127	2.99371	1.50066	-0.21655
		Distance 12				1.50120	0.74918	0.00200

Step 2

Click the distance button on the measure toolbar.

Step 3

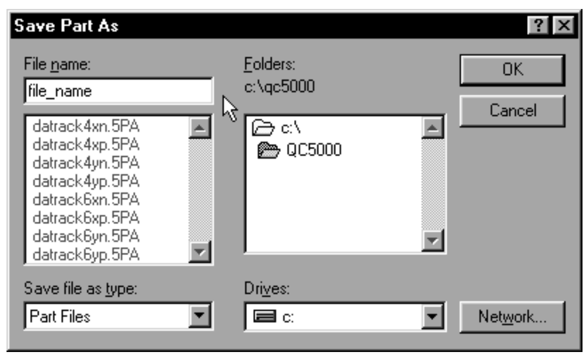
Click OK in the dialog box.



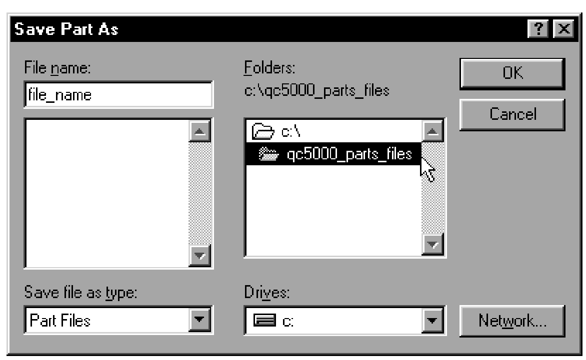
Save a part file

Step 1
Select save as from the file menu.

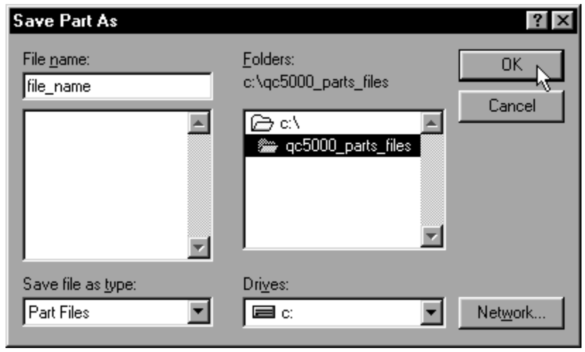
Step 2
Type a name for the part file in the file name text box in the dialog box.



Step 3
Select a storage location for the file using the folders box and/or drives box.



Step 4
Click OK in the dialog box.



Chapter 3
Using Probes

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

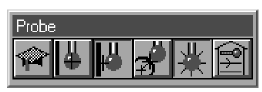
- approach the feature from a 90 degree angle
- approach the feature from a distance of at least 1mm
- do not probe a feature from an angle of 45 degrees or less

Bad probing techniques

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

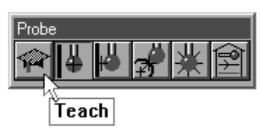
Probe Toolbar

The probe toolbar contains several buttons for intitiating probe functions.



- Probe teach
- Probe compensation
- Cardinal probe compensation
- Polar probe compensation
- Auto enter
- Probe library

Probe teach

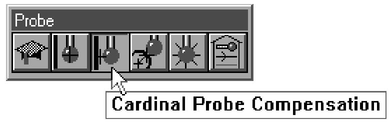


Click the probe teach button to begin the calibration of a probe tip.

Probe compensation off

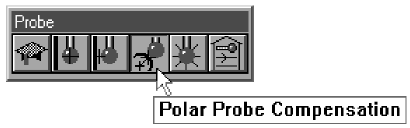
Click the probe compensation button to toggle off probe compensation.

Cardinal probe compensation



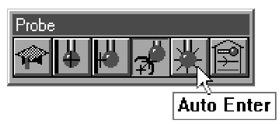
Click the cardinal probe compensation button to toggle on/off probe cardinal compensation. Use cardinal probe compensation for general measuring of features to apply compensation for the probe tip radius in the probe direction.

Polar probe compensation



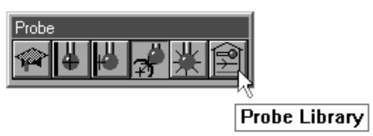
Click the polar probe compensation button to toggle on/off polar probe compensation. Use polar probe compensation for probing point features in polar coordinate mode.

Auto enter



Click the auto enter icon to toggle on/off auto enter. Use auto enter to automatically enter a point from a touch probe upon contact.

Probe library



Click the probe library button to access the probe library window.

Probe compensation

Use the probe compensation feature to allow for less than perfect probe technique. It is simple enough to use good probe technique when measuring flat features. Features on angled surfaces are more difficult.

Since perfect technique is difficult to achieve even on flat surfaces use probe compensation all measurements. Probe compensation makes up for less than perfect probe technique; it does not make up for bad probe technique.

Click the probe compensation button on the probe toolbar to toggle on/off probe compensation. Probe compensation is the amount of offset applied for the diameter of the probe tip. The direction compensation is applied is determined by the direction the probe travels immediately before taking a point.

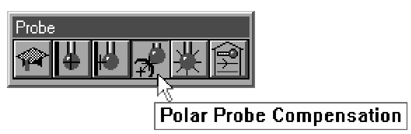
Probe compensation off

Click the probe compensation button to toggle off probe compensation. Use porbe compensation off to turn off probe or cardinal compensation.

Cardinal probe compensation

Click the cardinal probe compensation button to toggle on/off probe cardinal compensation. Use cardinal probe compensation for general measuring of features to apply compensation for the probe tip radius in the probe direction.

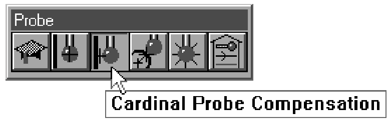
Polar probe compensation

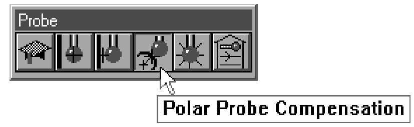


Click the polar probe compensation button to toggle on/off polar probe compensation. Use polar probe compensation for probing point features in polar coordinate mode.

To activate probe compensation

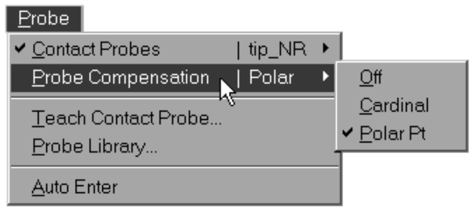
Step 1
Click the *polar* or *cardinal probe compensation* button on the probe toolbar.



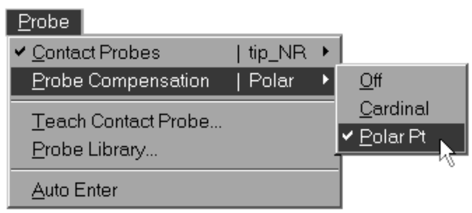


OR

Step 1
Select *probe compensation* from the probes menu.



Step 2
Select *cardinal* or *polar* from the submenu as shown.



Auto Enter

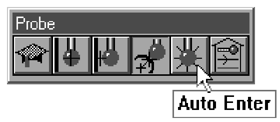
The simplest way to enter points is to use Auto Enter. Auto Enter records each probe hit as a point. This allows point entry without keyboard, mouse, or footswitch input after each probe hit.

NOTE

Auto Enter does not work with hard probes.

To activate auto enter

Step 1
Click the *auto enter* button on the probe toolbar.

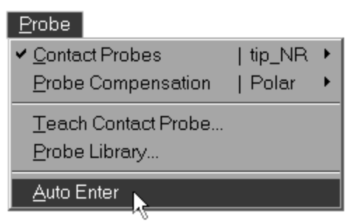


NOTE

The *auto enter* button remains depressed on the probe toolbar while activated.

OR

Step 1
Select *auto enter* from the probes menu.



NOTE

A check-mark appears next to auto enter on the menu when active.

Probe Library

Probe library organizes all the probes used with the QC5000 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

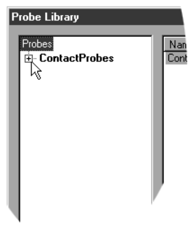
Click the tool library button on the probe toolbar to view the tool library dialog box. Probes are organized into families and groups. Families consist of groups. Groups consist of probes.

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

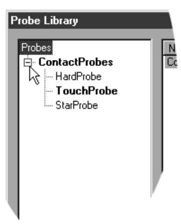
NOTE

QC5000 metrology software for manual CMMs uses only the contact probes family. New probe families cannot be created.

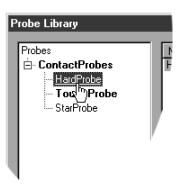
Click on the plus (+) sign next to the contact probes family.



Observe the three default probe groups: HardProbe, TouchProbe, StarProbe.

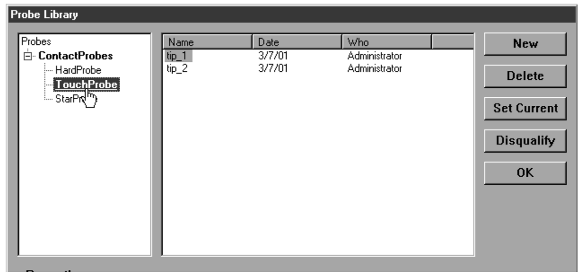


HardProbe group



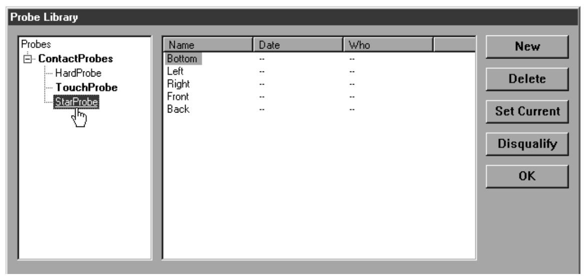
Hard probes have no internal switching mechanism to detect contact with the part. User simply position a hard probe in contact with the part and manually enters the point.

TouchProbe group



Touch probes have an internal switch that sends an electronical signal when the probe contacts the part. This electronic signal allows the auto-enter feature of the QC5000 to automatically enter the point.

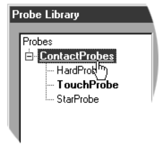
StarProbe group



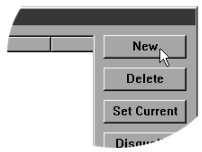
Star probes are actually a variant of touch probes. Each star probes have five tips arranged bottom, left, right, front, and back. These tips appear by default in the StarProbe group.

To create a new probe group

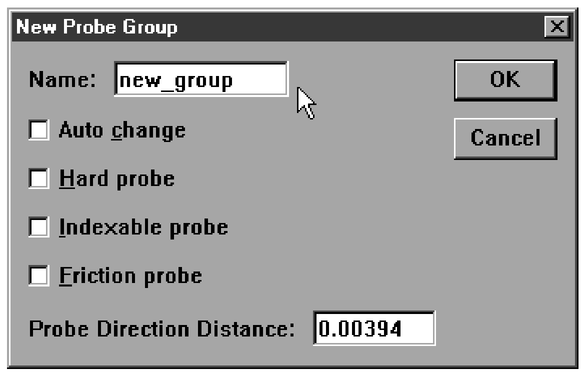
Step 1
Highlight the desired probe family for the new group.



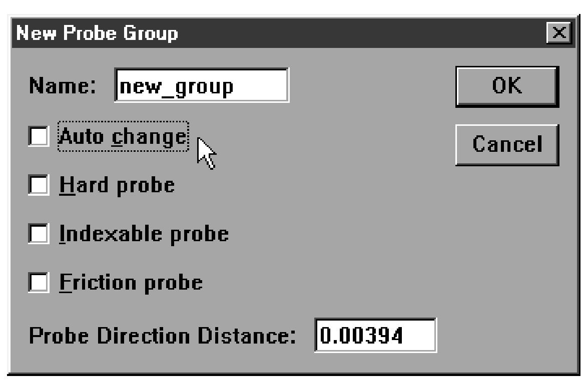
Step 2
Click on the *new* button.



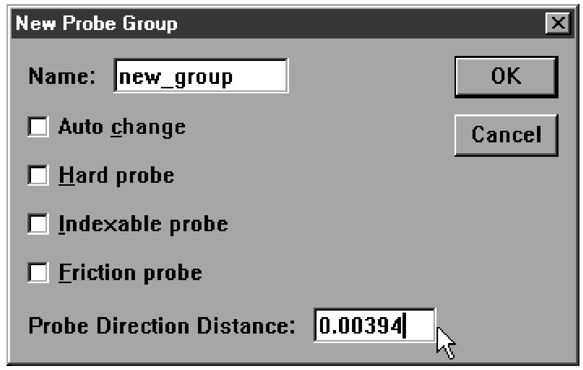
Step 3
Type a name for the group in the *name* text box.



Step 4
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 distance the probe must travel in a direction prior to making contact with the part in the probe direction distance text box.



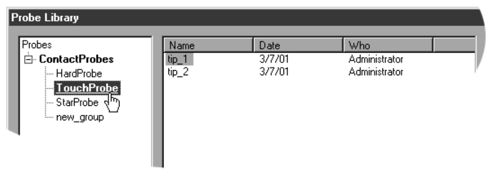
NOTE

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

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 hts on a qualification sphere with a known diameter. Qualifying, or teaching, a probe also provides offsets for probe compensation.

Master probe tips

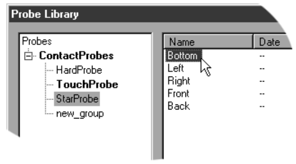
Teaching a probe also establishes the spatial (X, Y, and Z) position of the probe tip (master probe tip) or the X,Y, and Z offsets (non-master tips) from the master tip. Each probe group has one master probe tip. The X, Y, and Z values of each probe in a group is compared to the master probe. The difference 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 their X, Y, and Z offset from 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.

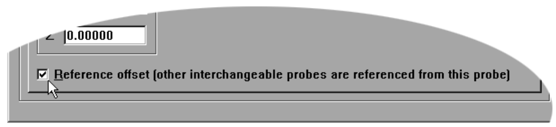
The same holds true for index probes that can be moved into various repeatable positions. Each position can be entered into probe library as a new tip. Establishing one position as the master tip allows all the non-master tips (positions) to update when the master tip is re-taught.

To teach (qualify) a master probe tip

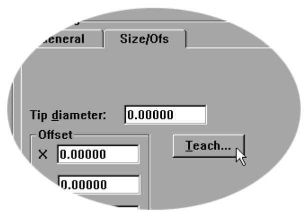
Step 1
Highlight the desired probe as shown.



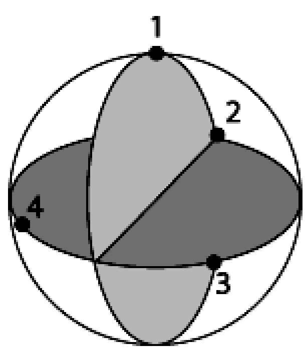
Step 2
Check the r*eference offset* checkbox as shown.



Step 3
Click on the *teach* button.



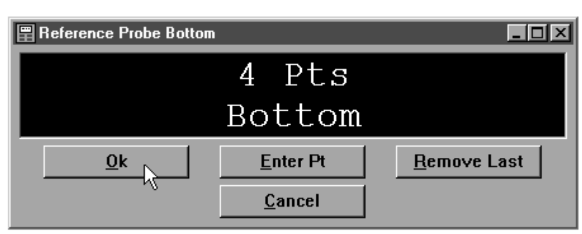
Step 4
Probe the qualification sphere as shown.



NOTE

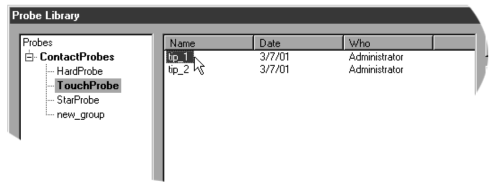
4 points are the minimum required for a sphere measurement. Use more points to increase the accuracy of your measurements.

Step 5
Click OK in the dialog box.

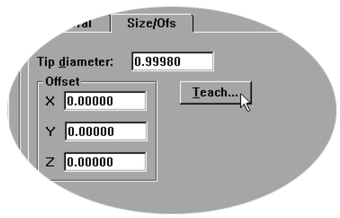


To teach (qualify) a non-master probe tip

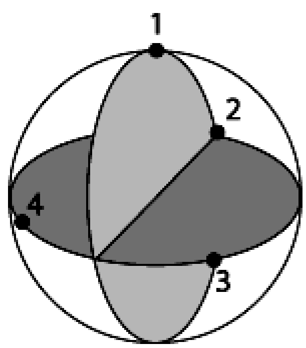
Step 1
Highlight the desired probe as shown.



Step 2
Click the *teach* button.



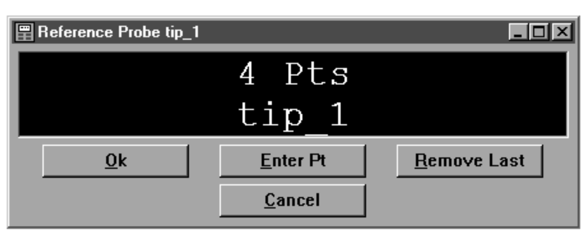
Step 3
Probe the qualification sphere as shown.



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.

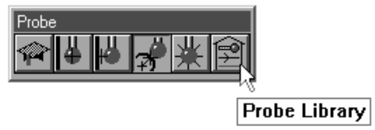


Changing Probes

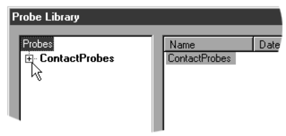
There are a number of ways to select different probes. This section shows how to view available probes, change probes, and add/delete probes.

To view the probes in a group

Step 1
Click the *probe library* button on the probe toolbar.

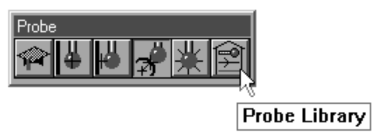


Step 2
Click on the plus sign to view the groups in the family.

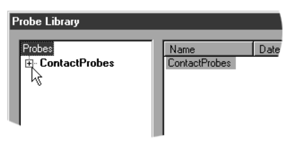


To change the current probe tip

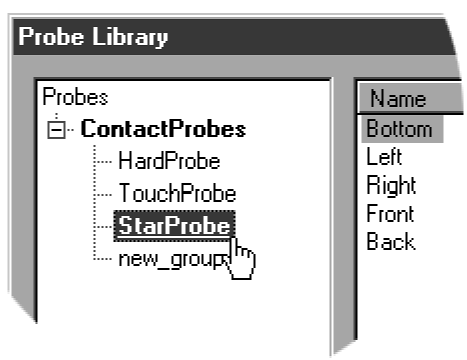
Step 1
Click the *probe library* button on the probe toolbar.



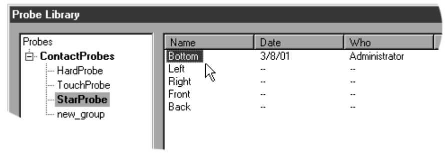
Step 2
Click on the plus sign next to the desired group in the left-hand box.



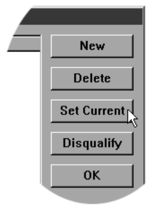
Step 3
Highlight the desired group.



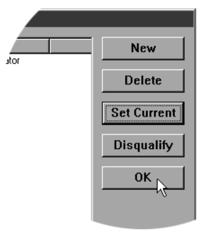
Step 4
Highlight the new probe tip as shown.



Step 5
Click the *set current* button



Step 6
Click OK.



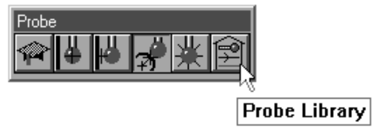
OR

Step 1
Place the cursor over the status bar as shown.

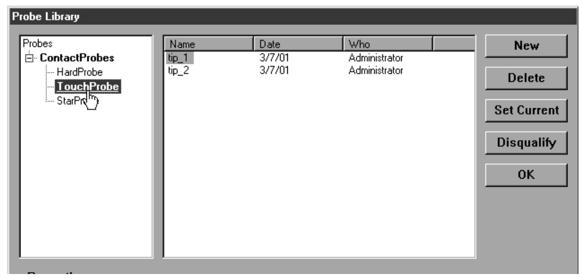
Step 2
Click until the desired probe appears in the status bar.

To add probe tips

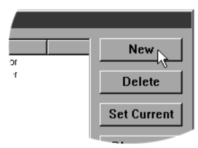
Step 1
Click the *probe library* button on the probe toolbar.



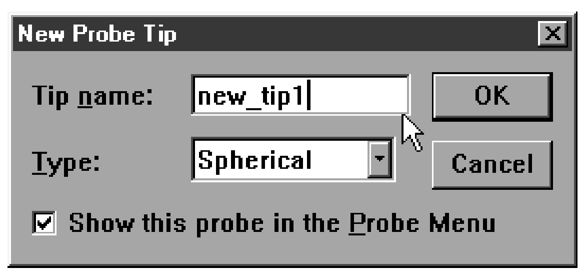
Step 2
Highlight the desired group.



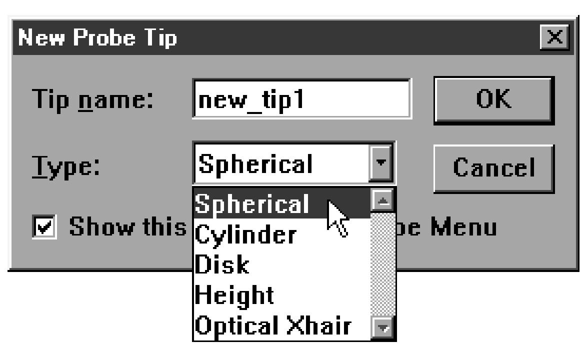
Step 3
Click the *new* button.



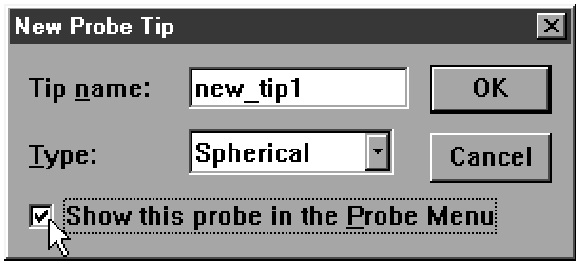
Step 4
Type a name for the probe tip in the *name* text box.



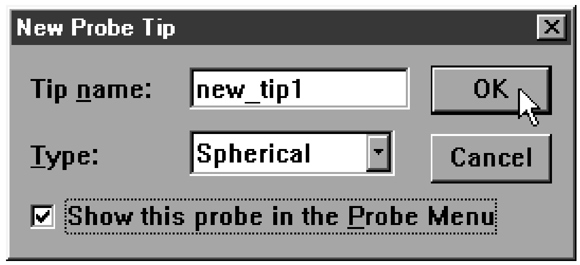
Step 5
Select the appropriate probe type from the pull down list.



Step 7
Check the *show this probe in the probe menu* box.

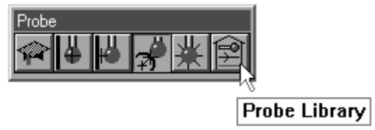


Step 8
Click OK.

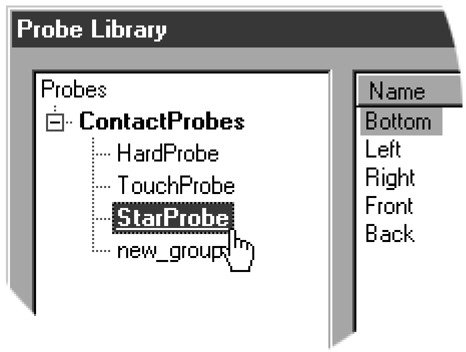


To delete probe tips

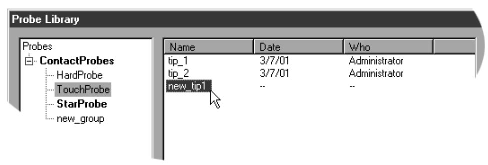
Step 1
Click the *probe library* button on the probe toolbar.



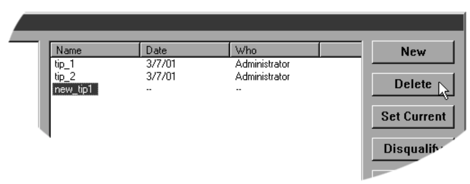
Step 2
Click on the plus sign next to the desired group in the left-hand box.



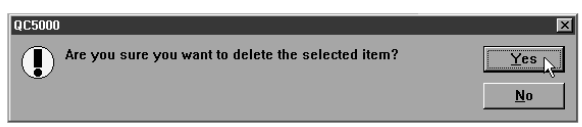
Step 3
Highlight the probe tip to be deleted.



Step 4
Click on the *delete* button.



Step 5
Click *yes* in the dialog box.



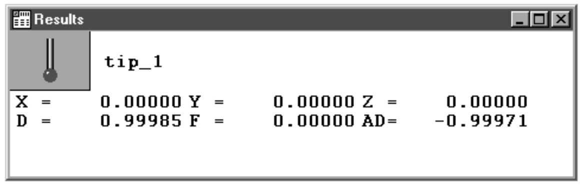
NOTE

The QC5000 does not permit the probe in current use to be deleted. The current can be deleted only after a new probe tip is assigned as current.

Probe Results Window

The results window displays the following information for probe qualification

- X,Y,Z offsets (measured from the center of the probe)
- probe diameter
- form (a numerical representation of the deviance from the nominal form)
- qualification sphere diameter



NOTE

The qualification results window is a view only window. No information can be dragged into other windows from the qualification results window.

NOTE

If the F (form) value shown in the *probe results* window is large re-teach the probe. In general, an *F value* larger than the resolution of the encoders is considered large. For example, an *F value* of 3 microns is large if using 2 micron encoders.

Chapter 4
General Measuring

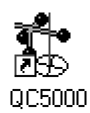
Getting Started

Set machine zero

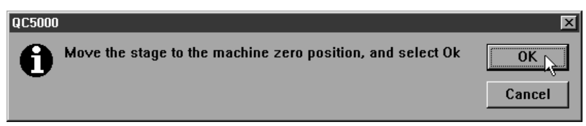
Machine zero is the location where all three axes of the coordinate measuring machine (CMM) read zero. This is an arbitrary point usually selected because it is at the end of negative travel for each axis. Since the machine zero position can vary from machine to machine, consult the distributor or manufacturer information for the specific procedure.

To set machine zero

Step 1
Double-click the QC5000 icon on the Windows NT desktop.



Step 2
Move the axes of the CMM to the machine zero position (consult the CMM user guide for more information) when the dialog box appears o the screen.

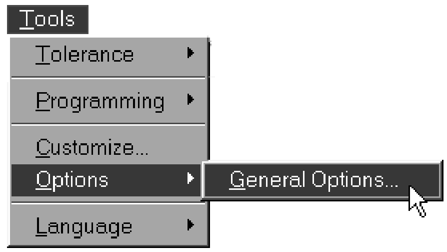


Step 3
Click OK in the dialog box.

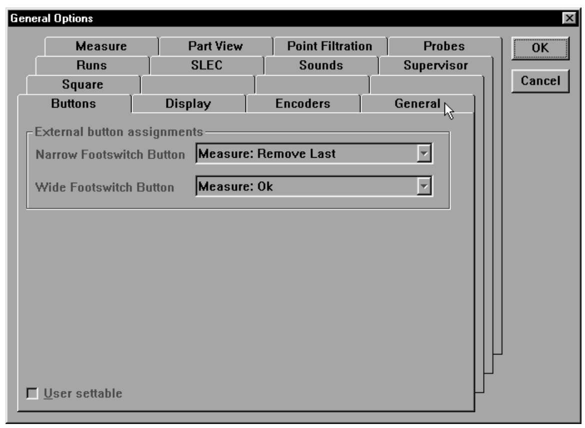
NOTE

Use the following procedure if the QC5000 software is already running and machine zero is not set.

Step 1
Select options, then general options, from the tools menu.



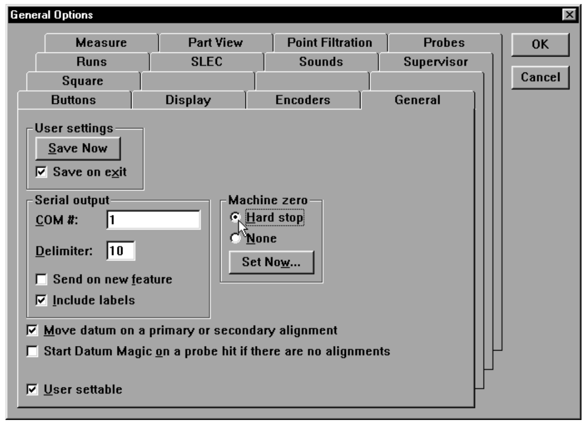
Step 2
Select the general tab in the general options window.



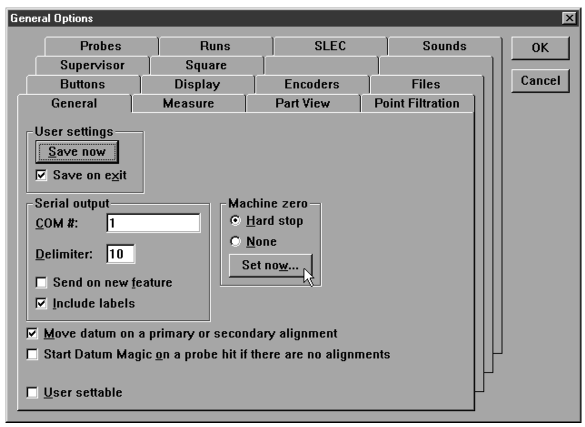
NOTE

If the general tab is greyed out, enter the supervisor password on the supervisor tab.

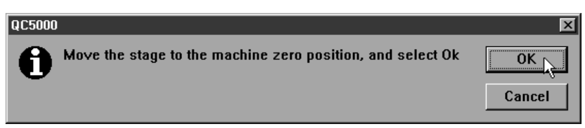
Step 3
Select hard stop in the machine zero box.



Step 4
Click the set now button.

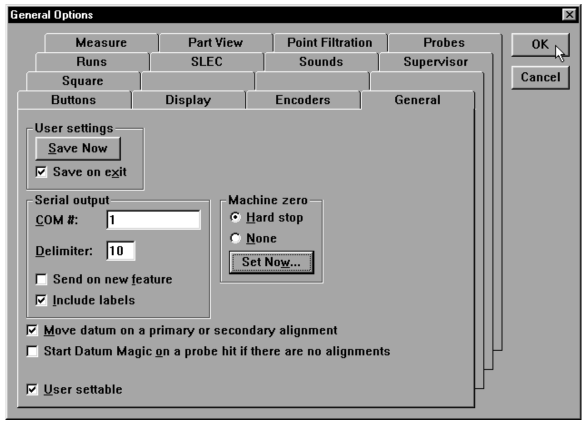


Step 5
Move the axes of the CMM to the machine zero position (consult the CMM user guide for more information) when the dialog box appears o the screen.



Step 6
Click OK in the dialog box.

Step 7
Click OK in the general options window.

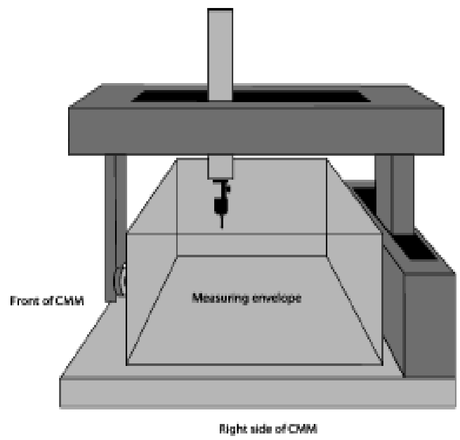


CAUTION

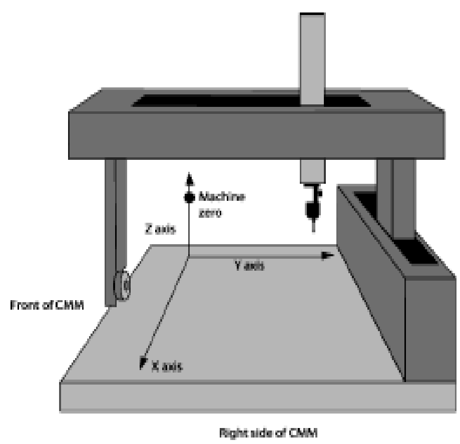
Set machine zero every time you begin a QC5000 session. Machine zero is used by QC5000 for SLEC (segmented linear error correction) functions. If machine zero is not set, SLEC functions will not work properly.

Reference Frame

Parts are made up of features. Features are made up of points. Points are locations within the measuring envelope of the CMM. The measuring envelope is the area of the CMM that can be reached by the probe.

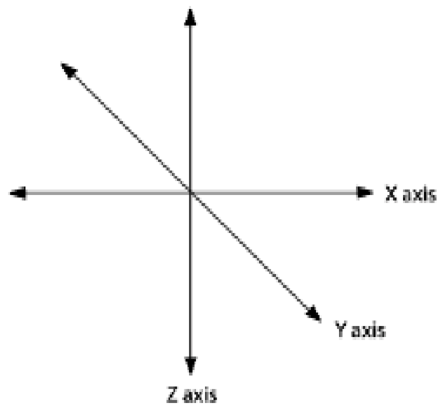


The machine coordinate system defines all the points in the measuring envelope starting a machine zero. Machine zero is the beginning of positive travel on each axis.

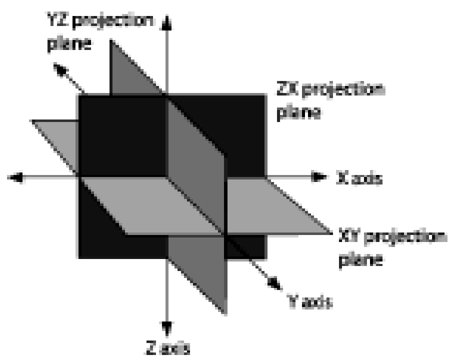


Projection planes

A projection plane is the lateral extension of one axis along another axis in the machine coordinate system.



For example, the XY plane is the lateral extension of the X axis along the Y axis.



Machine coordinates

Machine coordinates describe the distance of points within the measuring envelope from machine zero. Until a reference frame is created the QC5000 displays machine coordinates in the DRO window. Once a reference frame is established the DRO display part coordinates.

Part coordinates

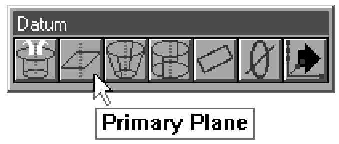
Part coordinates describe the distance of points from the datum, or zero point, of the reference frame. Reference frames are created by probing a primary plane, a secondary line, and a zero point.

NOTE

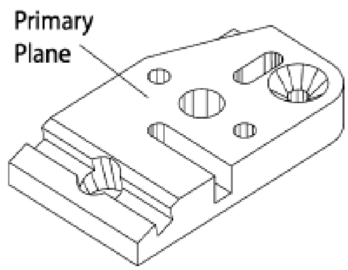
Set machine zero before establishing a reference frame and be sure the current probe is qualified.

To create a reference frame

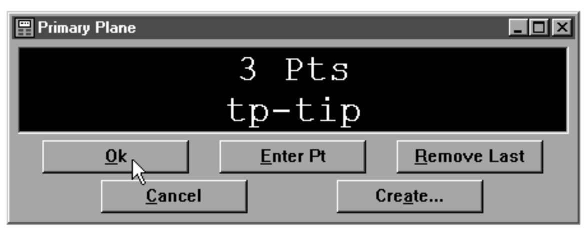
Step 1
Click the primary plane button on the datum toolbar.



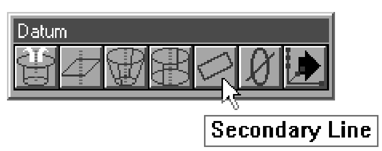
Step 2
Measure three points on the plane as shown.



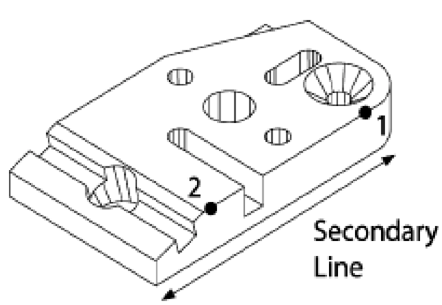
Step 3
Click OK in the dialog box.



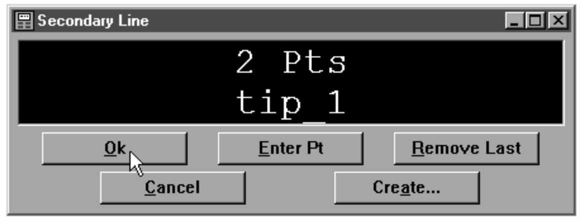
Step 4
Click the secondary line button on the datum toolbar.



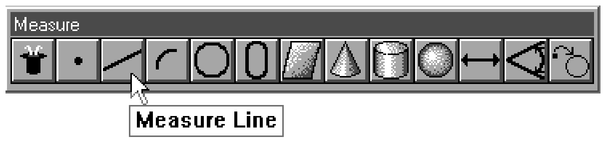
Step 5
Probe two points on the secondary line. Space the points close to the opposite ends of the line.



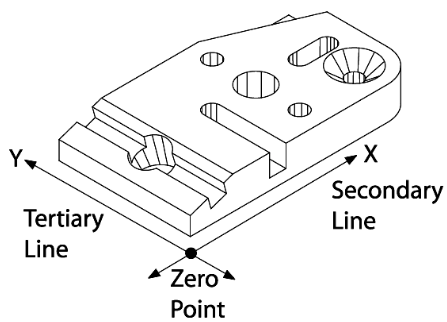
Step 6
Click OK in the dialog box.



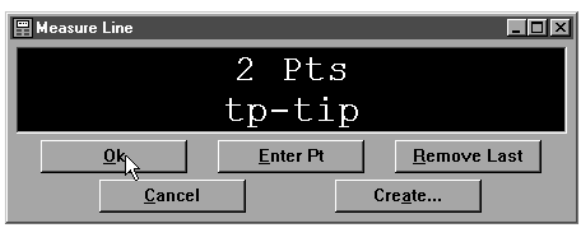
Step 7
Click the line button on the measure toolbar.



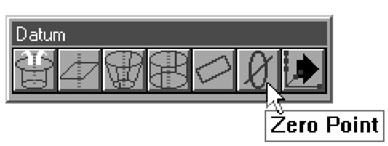
Step 8
Probe two points along the tertiary alignment as shown.



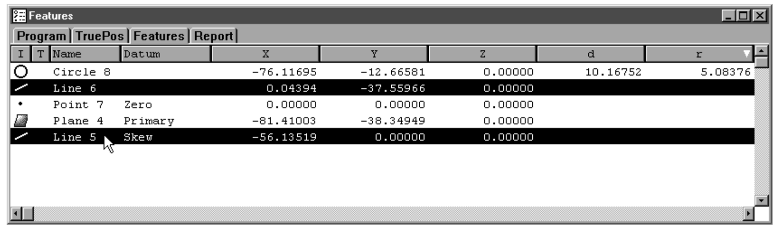
Step 9
Click OK in the dialog box.



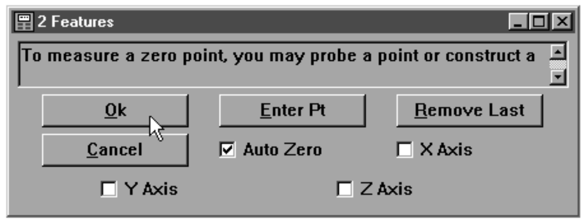
Step 10
Click the zero point button on the datum toolbar.



Step 11
Use the mouse to highlight the secondary and tertiary lines in the features list.

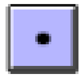


Step 12
Click OK in the dialog box.

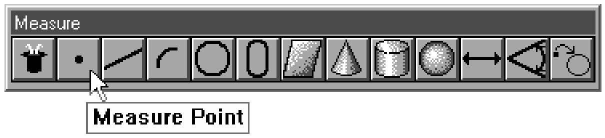


Measuring 2D Features

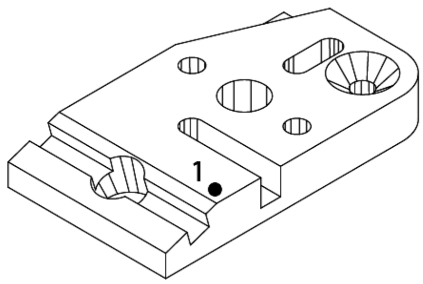
To probe a point



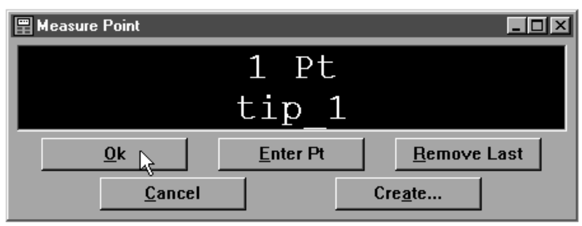
Step 1
Click the point button on the measure toolbar.



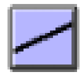
Step 2
Probe the point as shown.



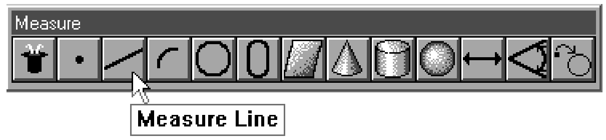
Step 3
Click OK in the dialog box.



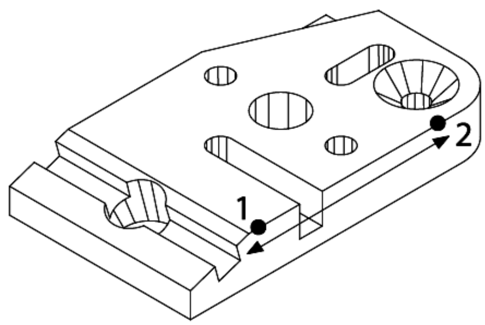
To probe a line (2 points)



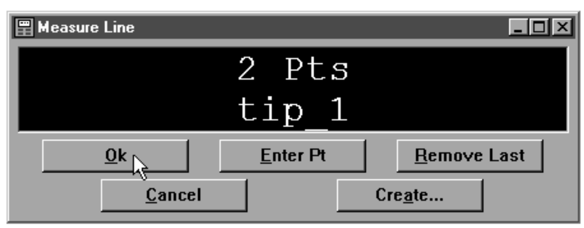
Step 1
Click the line button on the measure toolbar.



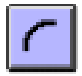
Step 2
Probe two points on the line as shown. Space the points close to the opposite ends of the line.



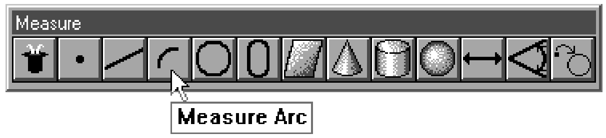
Step 3
Click OK in the dialog box.



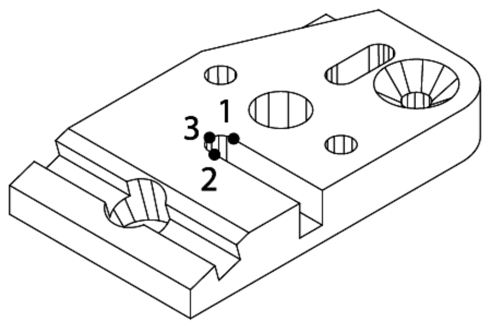
To probe an arc (3 points)



Step 1
Click the arc button on the measure toolbar.

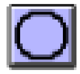


Step 2
Probe three points on the arc in the order shown.

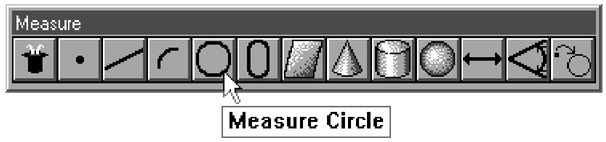


Step 3
Click OK in the dialog box.

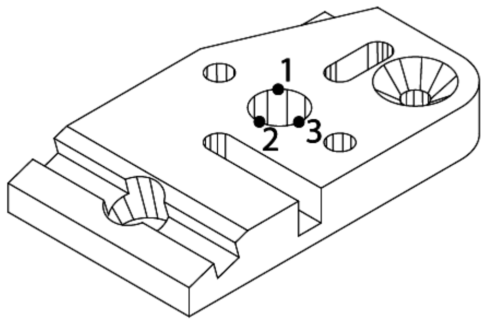
To probe a circle (3 points)



Step 1
Click the circle button on the measure toolbar.



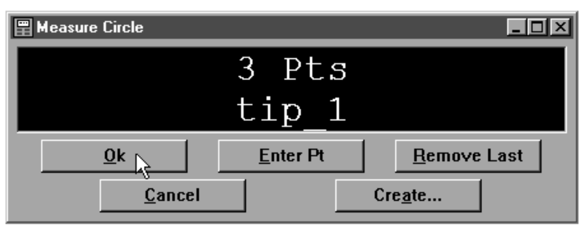
Step 2
Probe a point on the edge of the circle



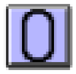
Step 3
Probe the second point approximately 120 degrees from the first point.

Step 4
Probe the third point approximately 120 degrees from the second point.

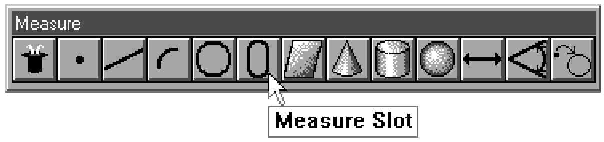
Step 5
Click OK in the dialog box.



To probe a slot (5 points)

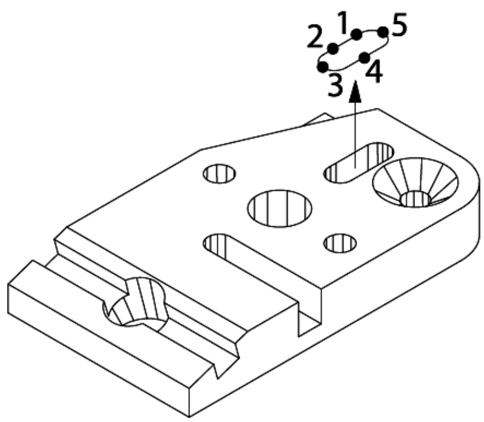


Step 1
Click the slot button on the measure toolbar.



Step 2
Probe the first two points as shown.

Step 3
Probe a point, as near the center as possible, on the first arc.

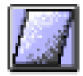


Step 4
Probe a point near the middle of the second side of the slot.

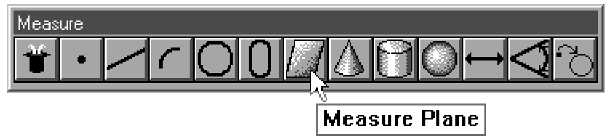
Step 5
Probe a point, as near the center as possible, on the second arc.

Step 6
Click OK in the dialog box.

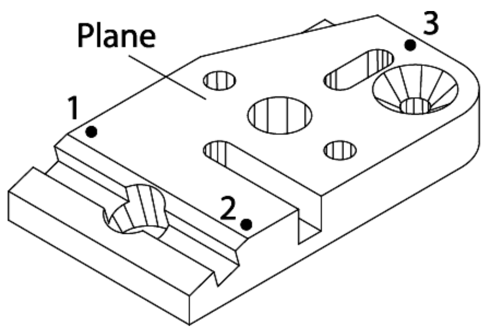
To probe a plane (3 points)



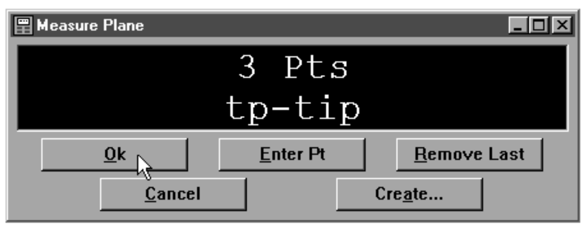
Step 1
Click the plane button on the measure toolbar.



Step 2
Measure three points on the plane as shown.



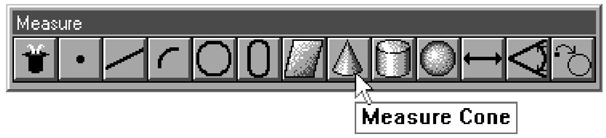
Step 3
Click OK in the dialog box.



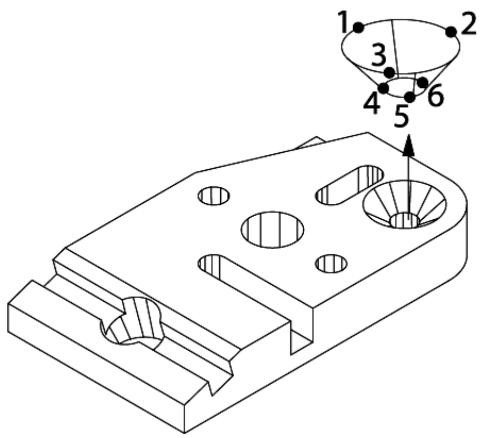
Measuring 3D Features

To probe a cone (3 points)

Step 1
Click the cone button on the measure toolbar.

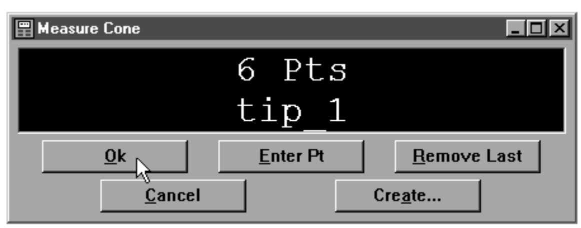


Step 2
Probe three points around the top of the cone spacing the points evenly as shown.



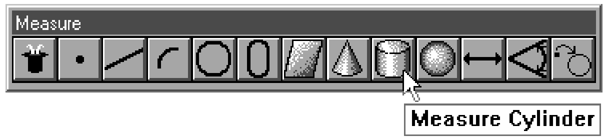
Step 3
Probe three points around the bottom of the cone spacing the points evenly as shown.

Step 4
Click OK in the dialog box.

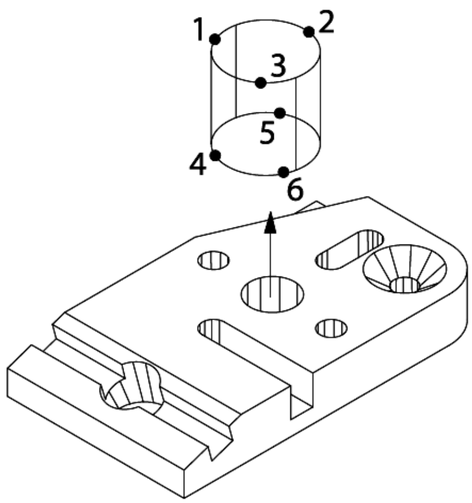


To probe a cylinder (6 points)

Step 1
Click the cylinder button on the measure toolbar.

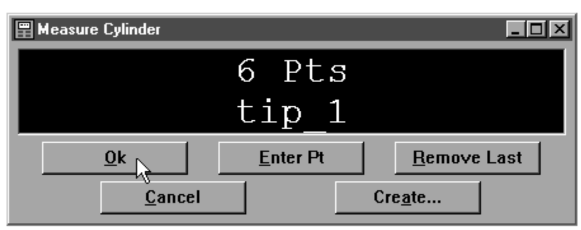


Step 2
Probe 3 points around the top of the cylinder spacing the points evenly as shown.

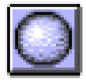


Step 3
Probe 3 points around the bottom of the cylinder spacing the points evenly as shown.

Step 4
Click OK in the dialog box.

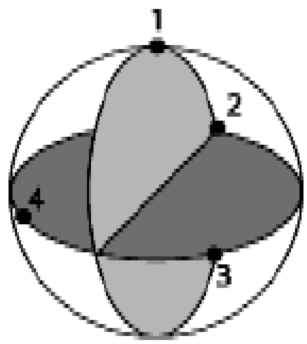


To probe a sphere (5 points)



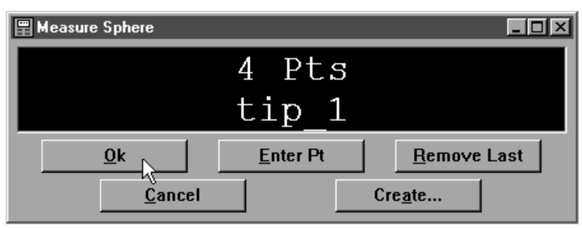
Step 1
Click the sphere button on the measure toolbar.

Step 2
Probe a point on the top of the sphere as shown.



Step 3
Probe 3 points around the equator of the sphere as shown.

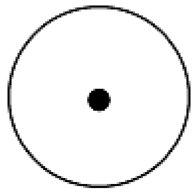
Step 4
Click OK in the dialog box.



Constructing Features

It is sometimes useful to construct a new feature from existing features. This section demonstrates all feature constructions.

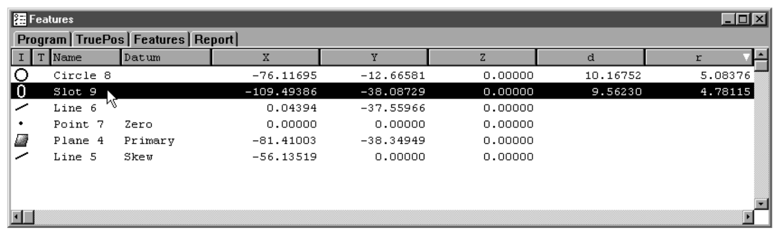
Point Constructions



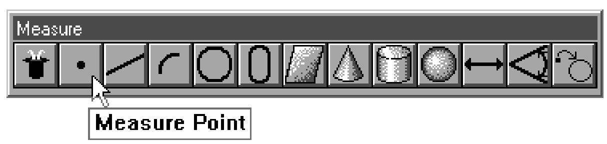
Center Point

To construct a center point

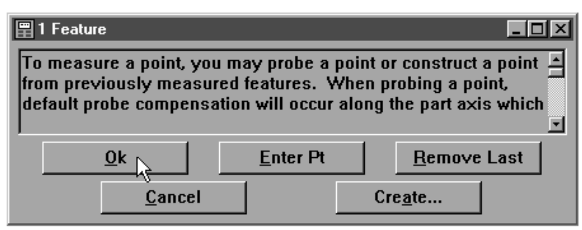
Step 1
Use the mouse to highlight a slot, circle, or other positional feature on the features list.

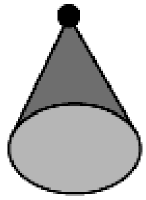


Step 2
Click point button on the measure toolbar.



Step 3
Click OK in the dialog box.

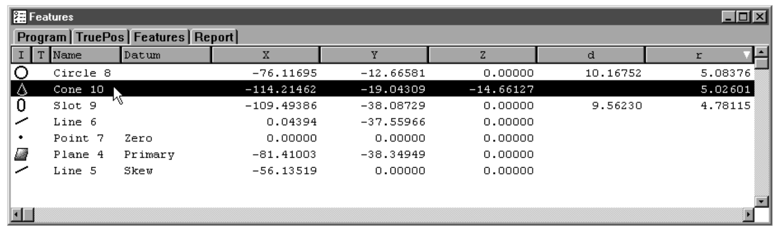




Apex Point

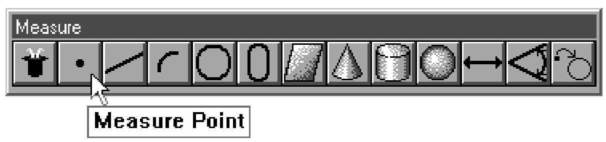
To construct an apex point

Step 1
Use the mouse to highlight a cone or an angle on the features list.

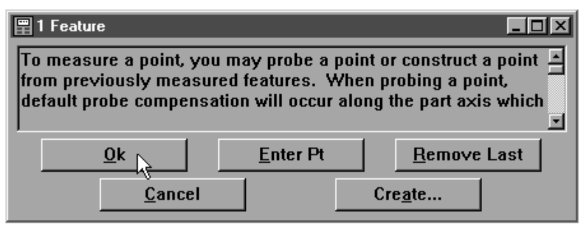


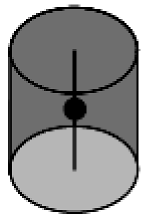
I	T	Name	Datum	X	Y	Z	d	r
		Circle 8		-76.11695	-12.66581	0.00000	10.16752	5.08376
		Cone 10		-114.21462	-19.04309	-14.66127		5.02601
		Slot 9		-109.49386	-38.08729	0.00000	9.56230	4.78115
		Line 6		0.04394	-37.55966	0.00000		
		Point 7	Zero	0.00000	0.00000	0.00000		
		Plane 4	Primary	-81.41003	-38.34949	0.00000		
		Line 5	Skew	-56.13519	0.00000	0.00000		

Step 2
Click the point button on the measure toolbar.



Step 3
Click OK in the dialog box.



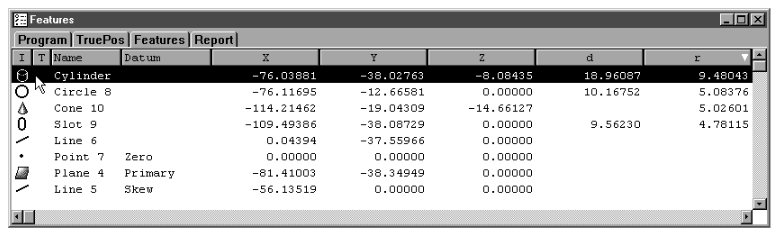


Application Point

Midpoint of a linear feature or plane

To construct an application point

Step 1
Use the mouse to highlight a linear feature or plane on the features list.

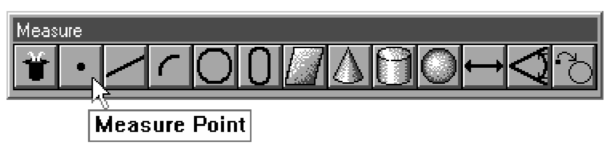


Features

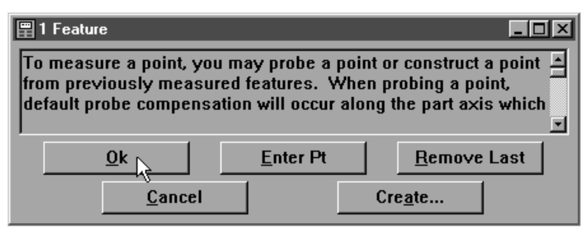
Program | TruePos | Features | Report

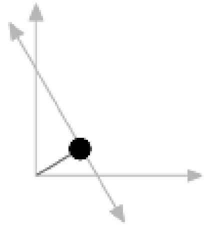
I	T	Name	Datum	X	Y	Z	d	r
		Cylinder		-76.03881	-38.02763	-8.08435	18.96087	9.48043
		Circle 8		-76.11695	-12.66581	0.00000	10.16752	5.08376
		Cone 10		-114.21462	-19.04309	-14.66127		5.02601
		Slot 9		-109.49386	-38.08729	0.00000	9.56230	4.78115
		Line 6		0.04394	-37.55966	0.00000		
		Point 7	Zero	0.00000	0.00000	0.00000		
		Plane 4	Primary	-81.41003	-38.34949	0.00000		
		Line 5	Skew	-56.13519	0.00000	0.00000		

Step 2
Click the point button on the measure toolbar.



Step 3
Click OK in the dialog box.

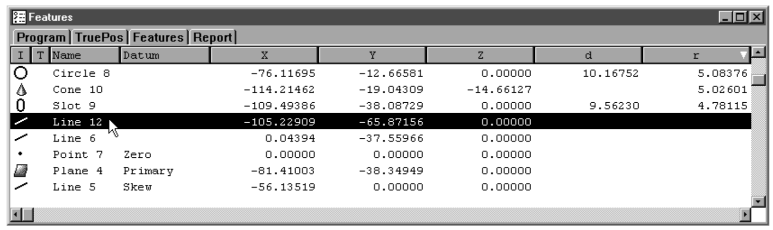




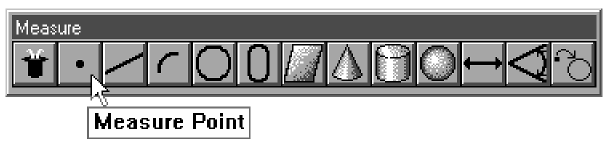
Anchor Point

To construct an anchor point

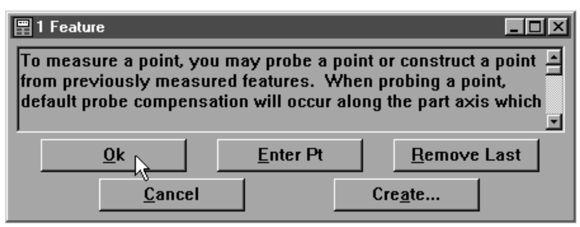
Step 1
Use the mouse to highlight a linear feature on the features list.



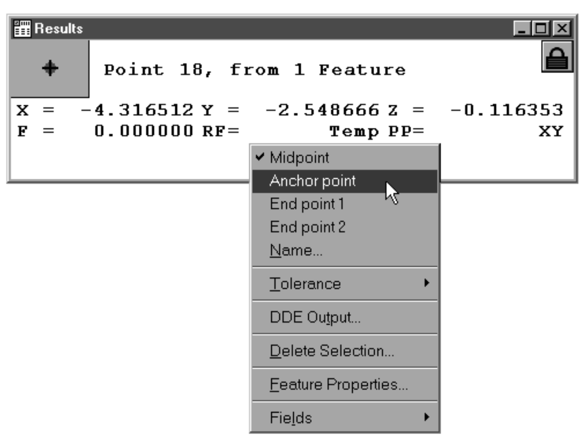
Step 2
Click the point button on the measure toolbar.

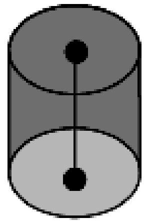


Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select anchor point from the list.

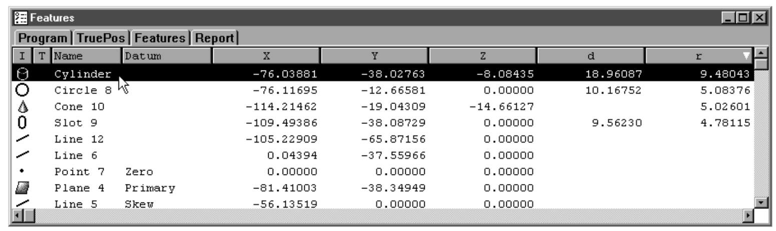




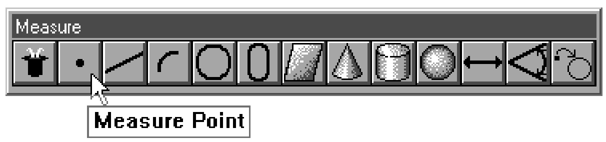
Bounding Points

To construct bounding points

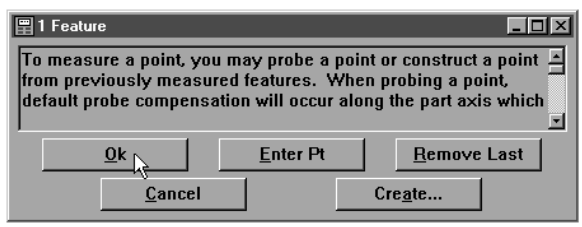
Step 1
Use the mouse to highlight a linear feature on the features list.



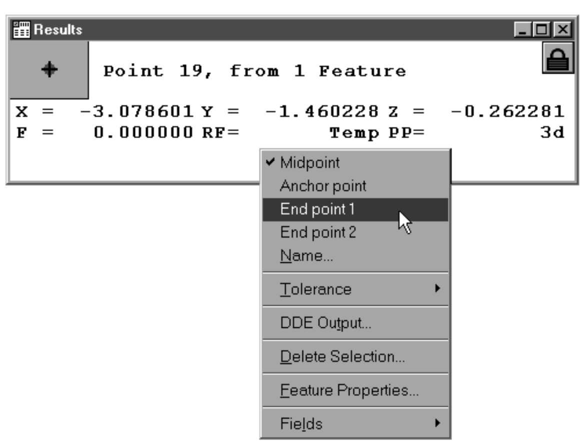
Step 2
Click the point button on the measure toolbar.

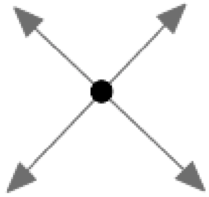


Step 3
Click OK in the dialog box.



Step4
Right click in the results window and select endpoint 1 (top) or endpoint 2(bottom) from the list.

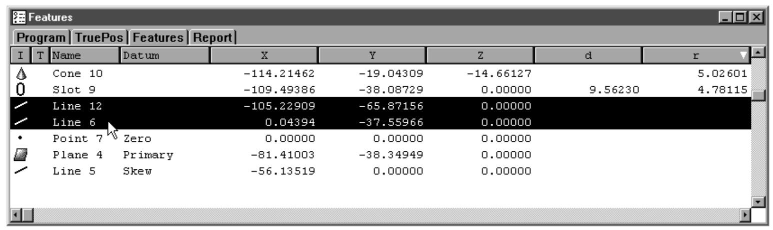




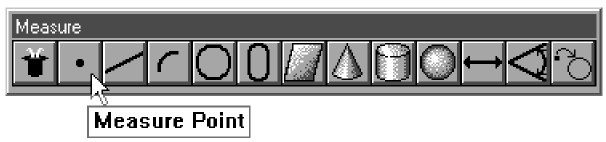
Intersection of 2 Lines

To construct a point from 2 intersecting lines

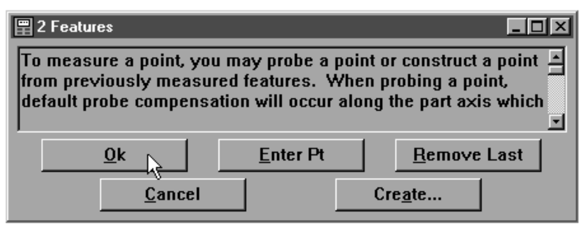
Step 1
Use the mouse to highlight two intersecting lines on the features list.

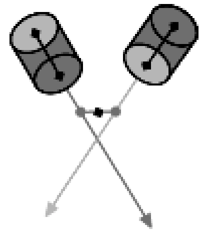


Step 2
Click the point button on the measure toolbar.



Step 3
Click OK in the dialog box.

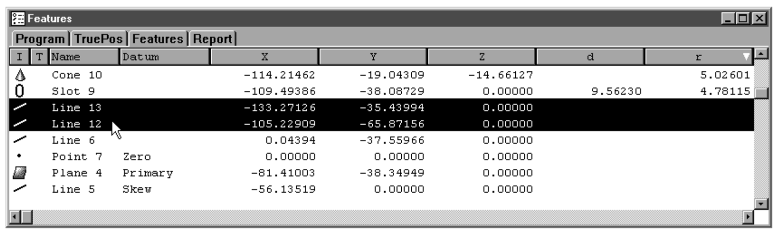




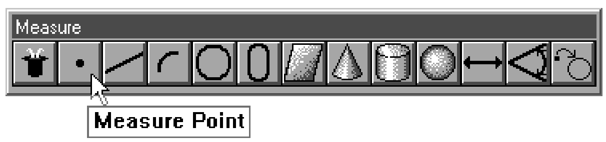
Closest Point of Approach

To construct a closest point of approach point

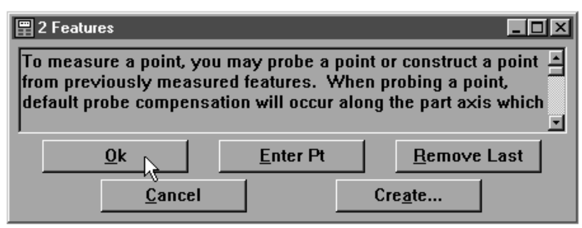
Step 1
Use the mouse to highlight two linear features on the features list.



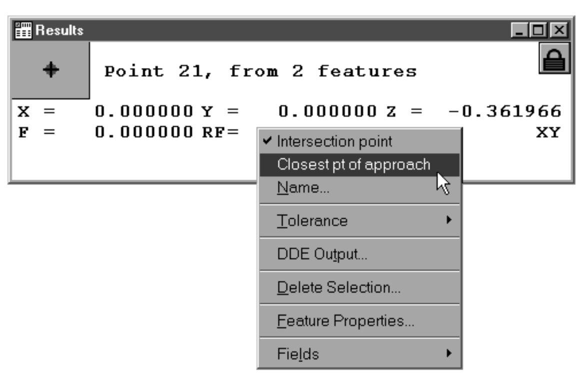
Step 2
Click the point button on the measure toolbar.

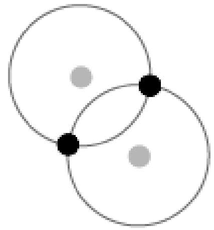


Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select closest point of approach from the list.

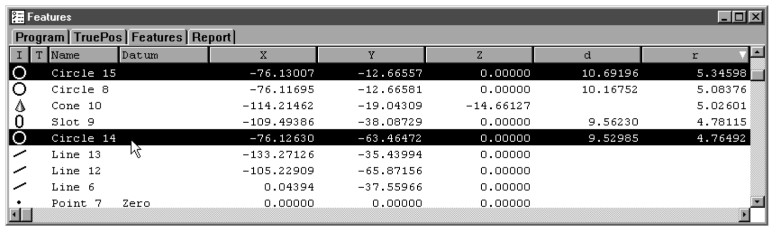




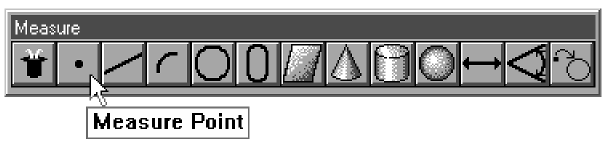
Intersection of 2 Circles

To construct points from intersecting circles

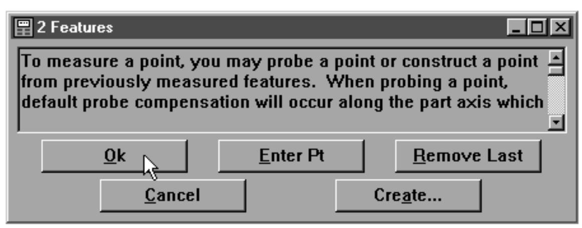
Step 1
Use the mouse to highlight two overlapping circles on the features list.



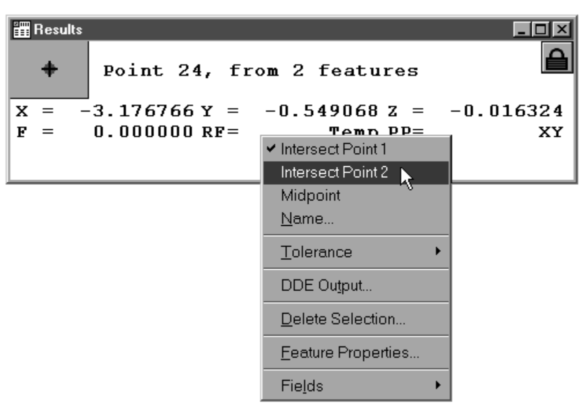
Step 2
Click the point button on the measure toolbar.

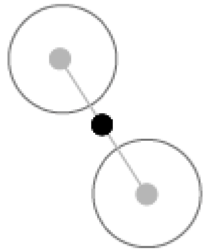


Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select intersect point 1 or intersect point 2 from the list.

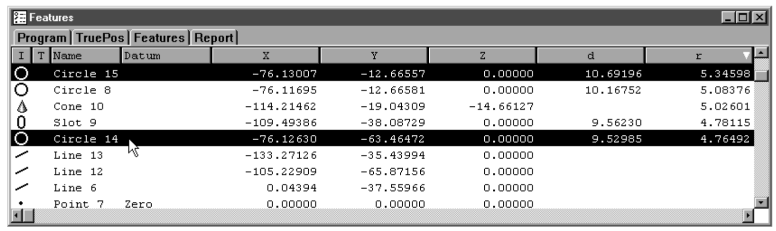




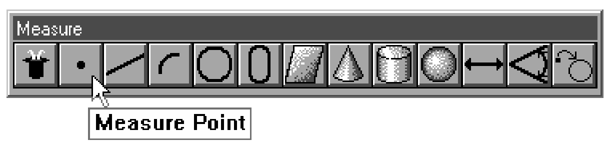
Midpoint of 2 Circles

To construct a midpoint from two circles

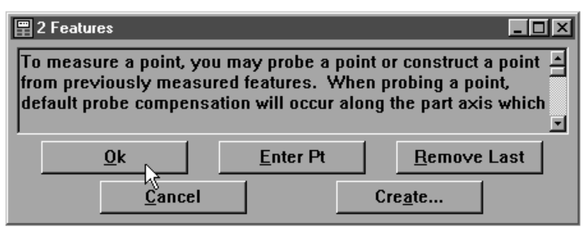
Step 1
Use the mouse to highlight two circles on the features list.



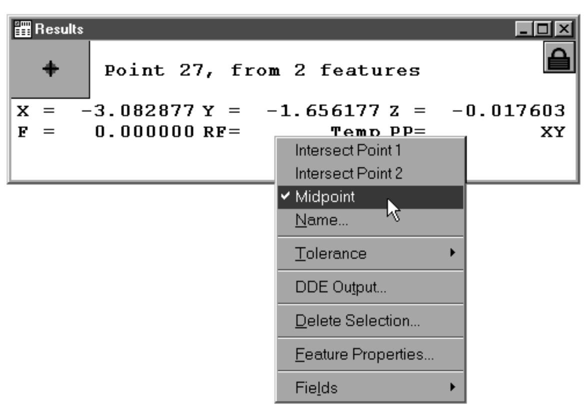
Step 2
Click the point button on the measure toolbar.

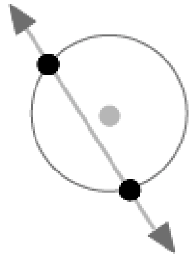


Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select midpoint from the list.

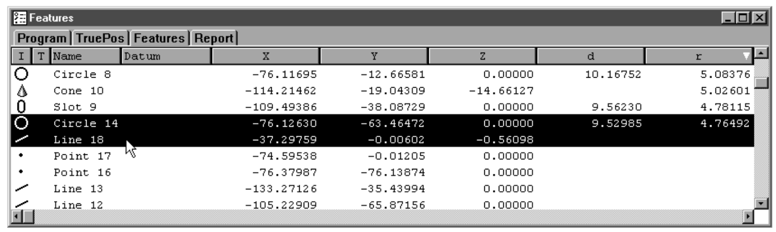




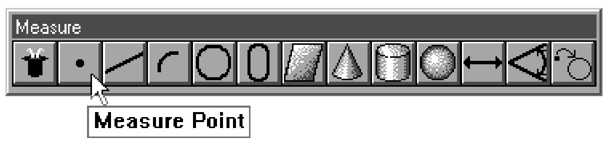
Intersection of a Line and a Circle

To construct a point from the intersection of a line and a circle

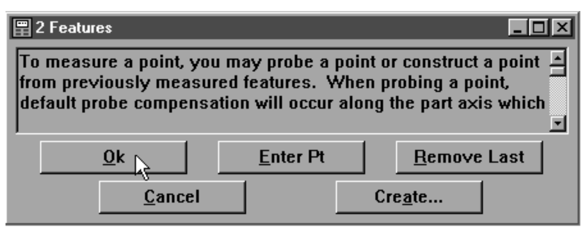
Step 1
Use the mouse to highlight a circle and an intersecting line on the features list.



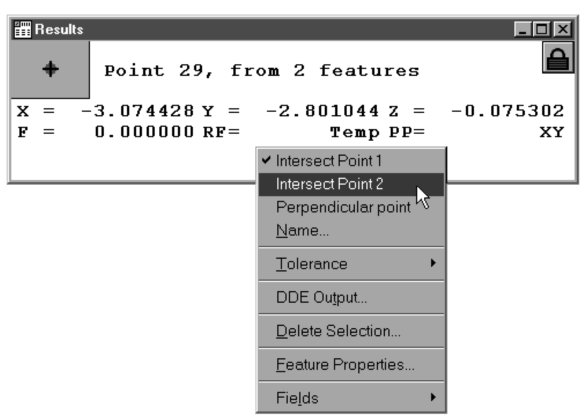
Step 2
Click the point button on the measure toolbar.

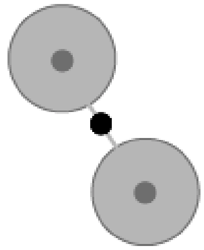


Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select intersect point 1or intersect point 2 from the list.

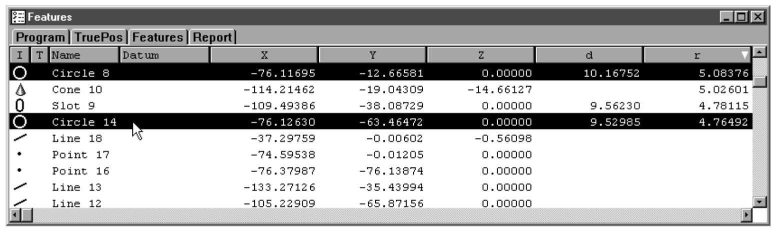




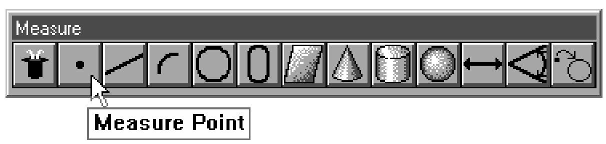
Midpoint of 2 Positional Features

To construct a midpoint from 2 positional features

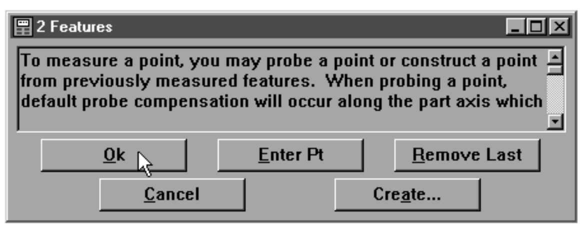
Step 1
Use the mouse to highlight two positional (circles, spheres, cylinders, etc.) features on the features list.



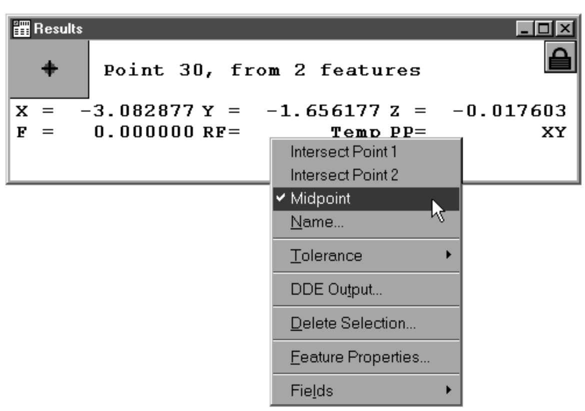
Step 2
Click the point button on the measure toolbar.

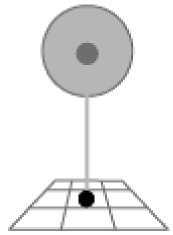


Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select midpoint from the list.

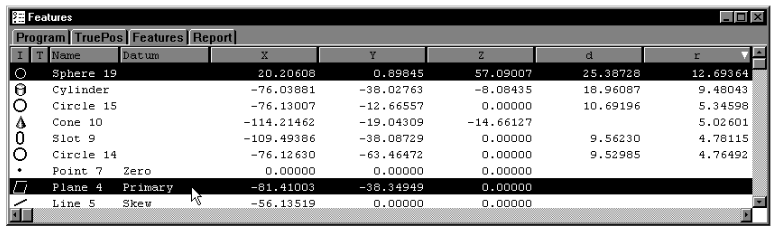




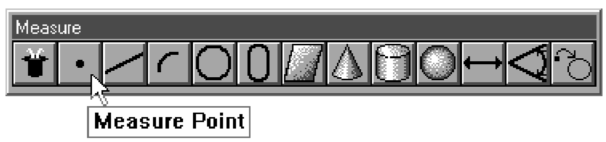
Perpendicular Point Constructed from a Plane and a Positional Feature

To construct a perpendicular point from a positional feature and a plane

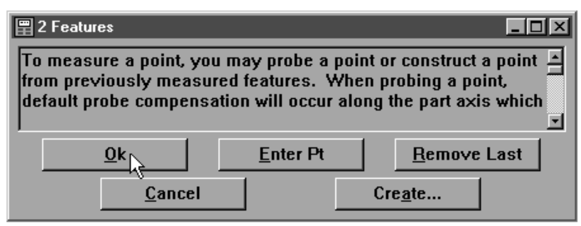
Step 1
Use the mouse to highlight a plane and a positional feature on the features list.



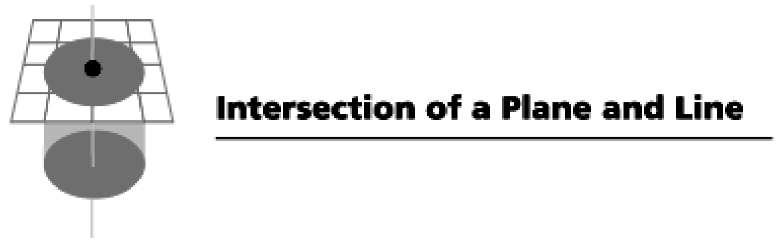
Step 2
Click the point button on the measure toolbar.



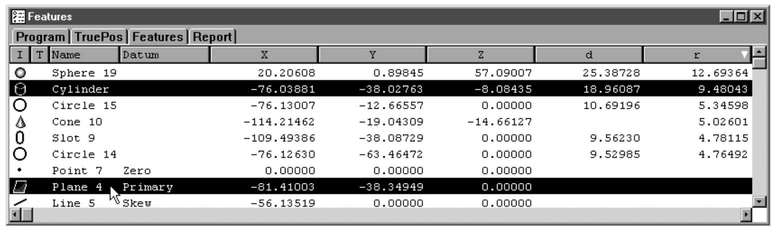
Step 3
Click OK in the dialog box.



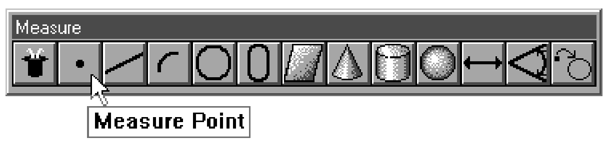
To construct a point from a linear feature and a plane



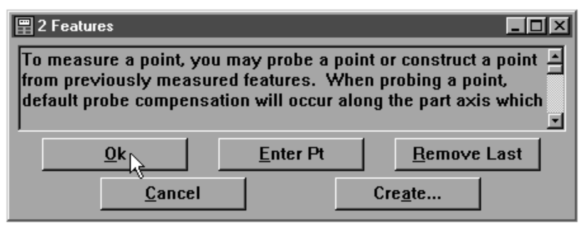
Step 1
Use the mouse to highlight a linear feature and a plane on the features list.

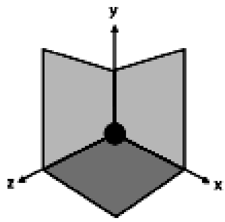


Step 2
Click the point button on the measure toolbar.



Step 3
Click OK in the dialog box.

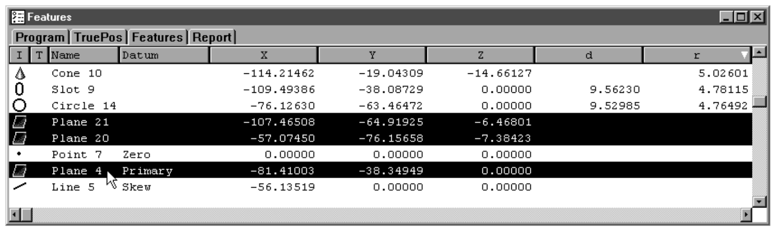




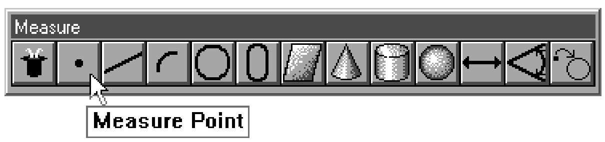
Intersection of 3 Planes

To construct a point from the intersection of 3 planes

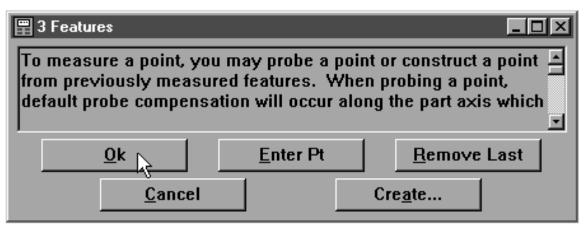
Step 1
Use the mouse to highlight 3 planes on the features list.



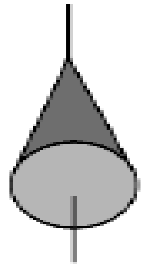
Step 2
Click the point button on the measure toolbar.



Step 3
Click OK in the dialog box.



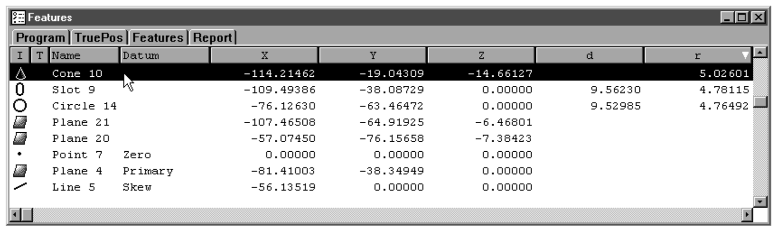
Line Constructions



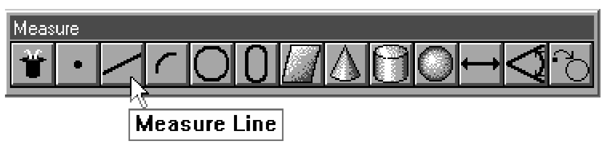
Axis Line

To construct an axis line from a linear feature

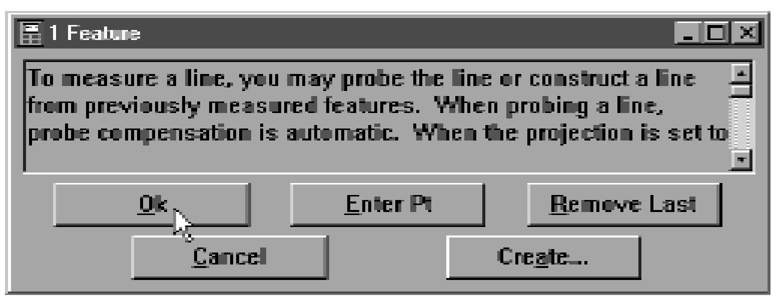
Step 1
Use the mouse to highlight a linear feature in the features list.

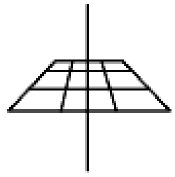


Step 2
Click the line button on the measure toolbar.



Step 3
Click OK in the dialog box.

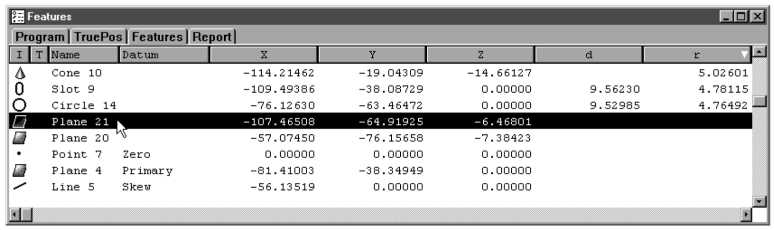




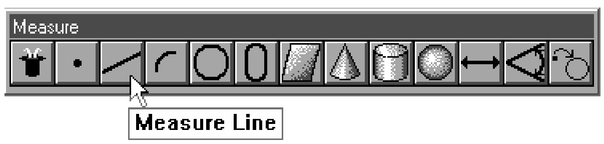
Plane Axis (Normal Line)

To construct a plane axis line (Normal Line)

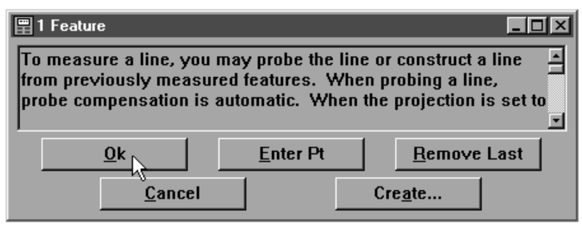
Step 1
Use the mouse to highlight a plane on the features list.



Step 2
Click the line button in the measure toolbar.



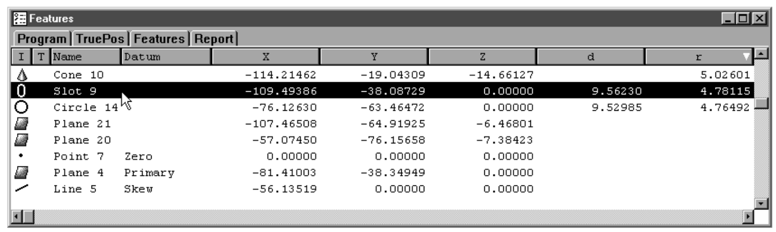
Step 3
Click OK in the dialog box.



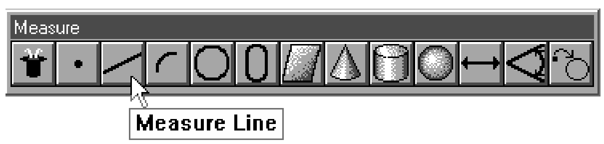
Slot Lines

To construct a midline from the sides of a slot

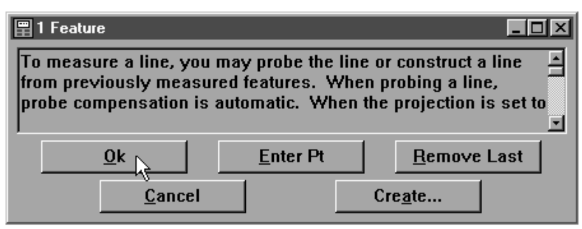
Step 1
Use the mouse to highlight a slot on the features list.

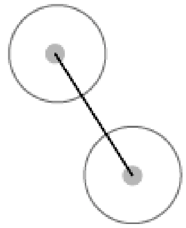


Step 2
Click the line button in the measure toolbar.



Step 3
Click OK in the dialog box.

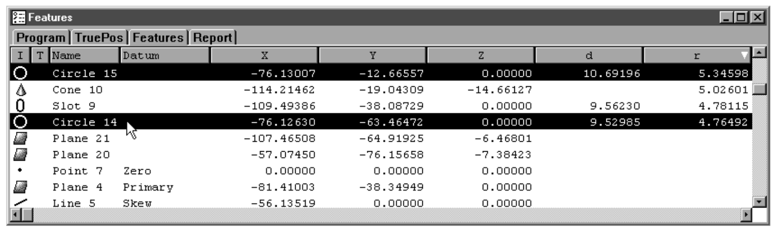




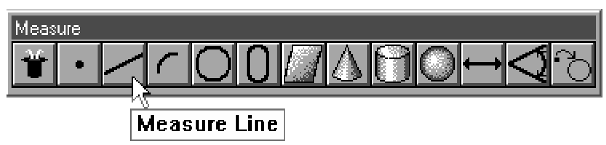
Two Point Line Constructed from 2 Positional Features

To construct a 2 point line from two positional features

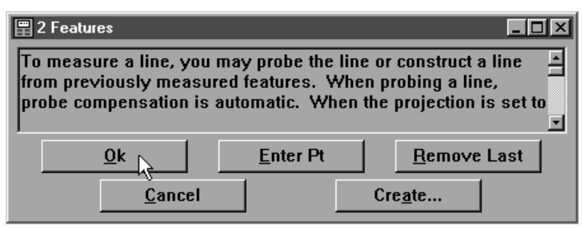
Step 1
Use the mouse to highlight two positional features on the features list.

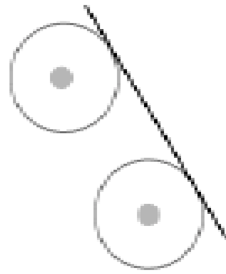


Step 2
Click the line button on the measure toolbar.



Step 3
Click OK in the dialog box.

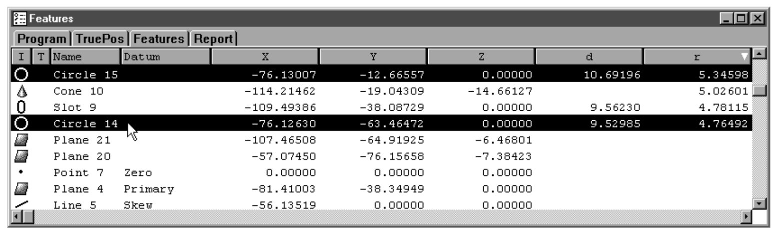




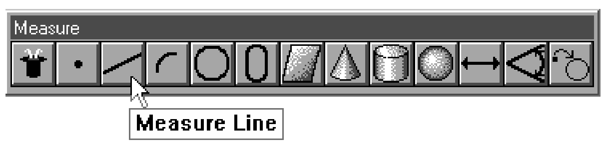
Tangent Line Constructed from 2 Radial Positional Features

To construct a tangent line from 2 radial positional features

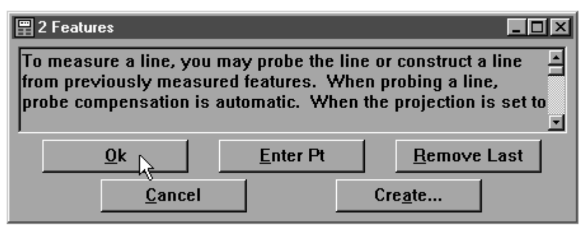
Step 1
Use the mouse to highlight two radial positional features on the features list.



Step 2
Click the line button on the measure toolbar.

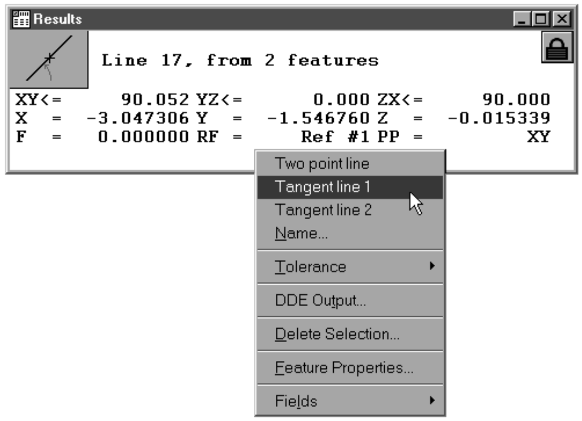


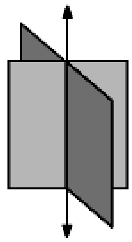
Step 3
Click OK in the dialog box.



Step 4

Right click in the results window and select tangent 1 or tangent 2 from the list.

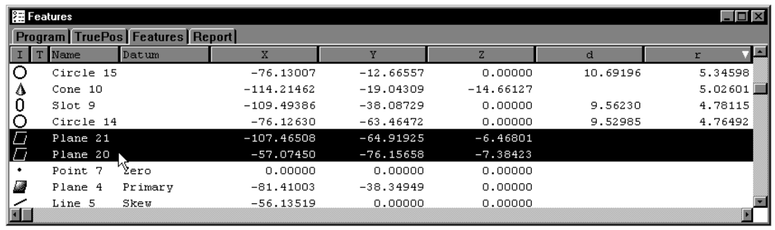




Intersection of 2 Planes

To construct a line from the intersection of 2 planes

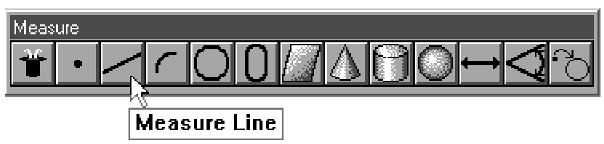
Step 1
Use the mouse to highlight two planes on the features list.



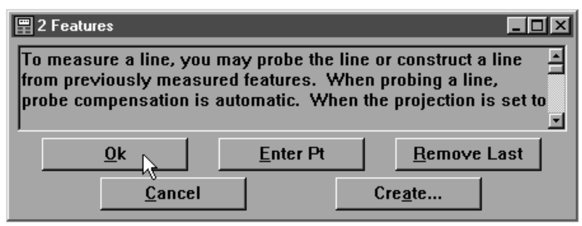
Features
Program | TruePos | Features | Report

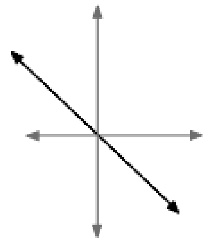
I	T	Name	Datum	X	Y	Z	d	r
		Circle 15		-76.13007	-12.66557	0.00000	10.69196	5.34598
		Cone 10		-114.21462	-19.04309	-14.66127		5.02601
		Slot 9		-109.49386	-38.08729	0.00000	9.56230	4.78115
		Circle 14		-76.12630	-63.46472	0.00000	9.52985	4.76492
		Plane 21		-107.46508	-64.91925	-6.46801		
		Plane 20		-57.07450	-76.15658	-7.38423		
		Point 7	Zero	0.00000	0.00000	0.00000		
		Plane 4	Primary	-81.41003	-38.34949	0.00000		
		Line 5	Skew	-56.13519	0.00000	0.00000		

Step 2
Click the line button on the measure toolbar.



Step 3
Click OK in the dialog box.

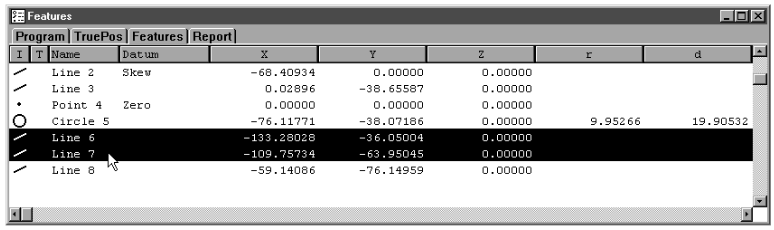




Bisector of 2 Linear Features (Bisector Line 1)

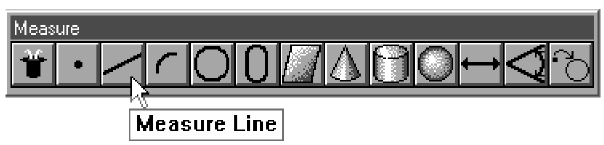
To construct a bisector of 2 linear features

Step 1
Use the mouse to highlight two linear features on the features list.

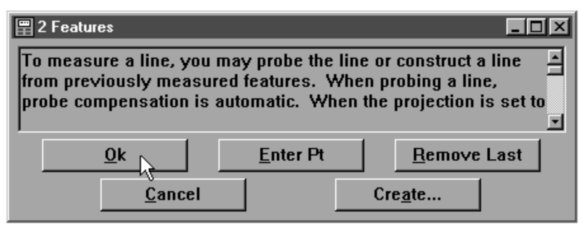


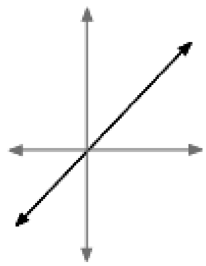
I	T	Name	Datum	X	Y	Z	r	d
		Line 2	Skew	-68.40934	0.00000	0.00000		
		Line 3		0.02896	-38.65587	0.00000		
		Point 4	Zero	0.00000	0.00000	0.00000		
		Circle 5		-76.11771	-38.07186	0.00000	9.95266	19.90532
		Line 6		-133.28028	-36.05004	0.00000		
		Line 7		-109.75734	-63.95045	0.00000		
		Line 8		-59.14086	-76.14959	0.00000		

Step 2
Click the line button on the measure toolbar.



Step 3
Click OK in the dialog box.

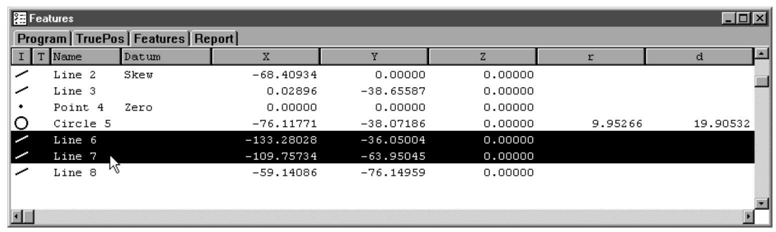




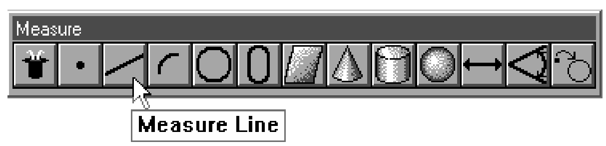
Bisector of 2 Linear Features (Bisector Line 2)

To construct a perpendicular bisector of 2 linear features

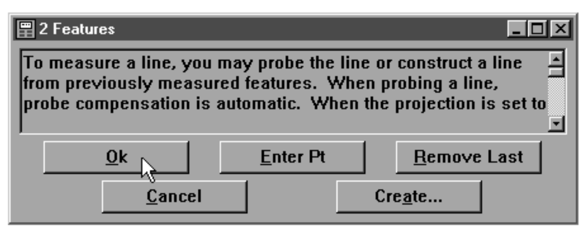
Step 1
Use the mouse to highlight two positional features on the features list.



Step 2
Click the line button on the measure toolbar.

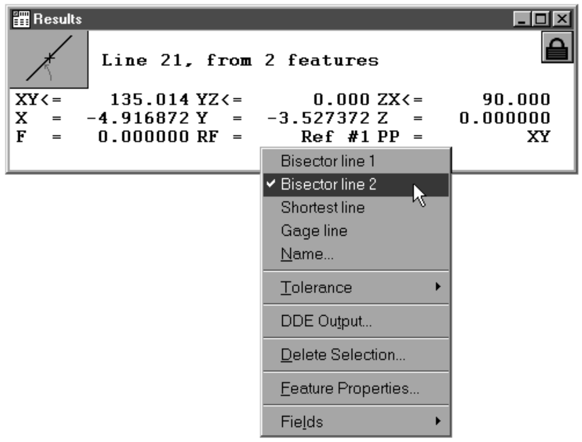


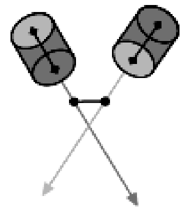
Step 3
Click OK in the dialog box.



Step 4

Right click in the results window and select bisector 2 from the list.

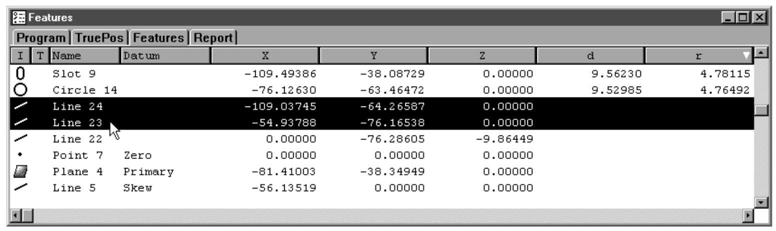




Line Constructed from the Closest Points of 2 Non-Intersecting Linear Features

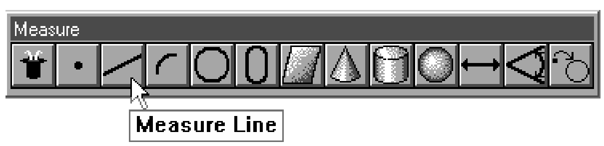
To construct a closest point of approach line from 2 linear features

Step 1
Use the mouse to highlight two linear features on the features list.

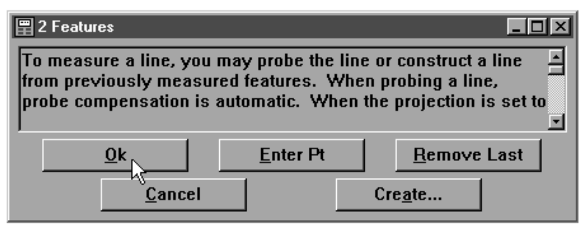


I	T	Name	Datum	X	Y	Z	d	r
		Slot 9		-109.49386	-38.08729	0.00000	9.56230	4.78115
		Circle 14		-76.12630	-63.46472	0.00000	9.52985	4.76492
		Line 24		-109.03745	-64.26587	0.00000		
		Line 23		-54.93788	-76.16538	0.00000		
		Line 22		0.00000	-76.28605	-9.86449		
		Point 7	Zero	0.00000	0.00000	0.00000		
		Plane 4	Primary	-81.41003	-38.34949	0.00000		
		Line 5	Skew	-56.13519	0.00000	0.00000		

Step 2
Click the line button on the measure toolbar.

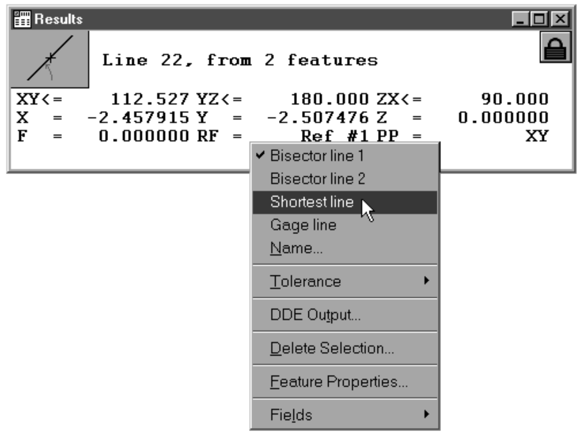


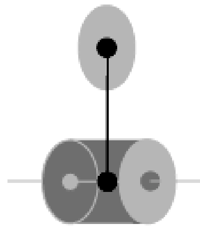
Step 3
Click OK in the dialog box.



Step 4

Right click in the results window and select closest from the list.

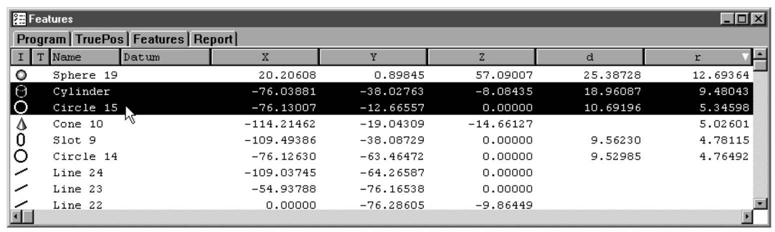




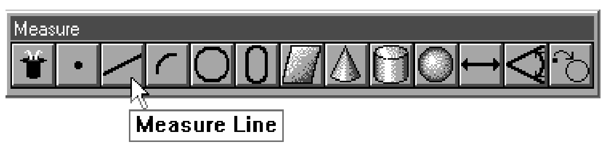
Perpendicular Line Constructed from a Positional Feature to a Linear Feature

To construct a line from a positional feature perpendicular to a linear feature

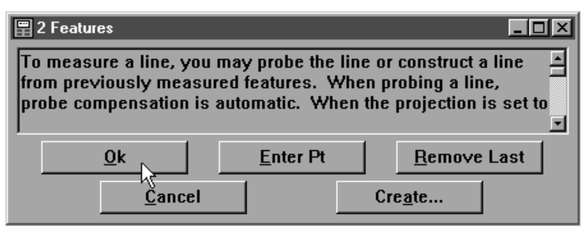
Step 1
Use the mouse to highlight a positional feature and a linear feature on the features list.

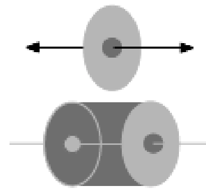


Step 2
Click the line button on the measure toolbar.



Step 3
Click OK in the dialog box.

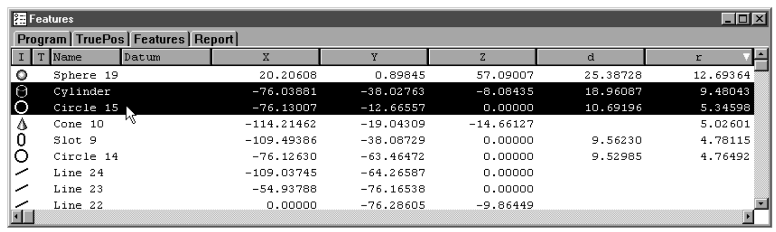




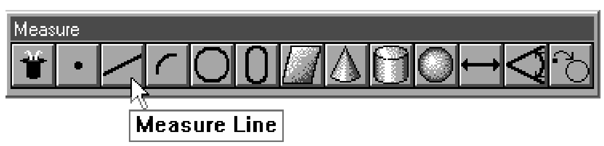
Parallel Line Constructed from a Positional Feature and a Linear Feature

To construct a line parallel to a linear feature using a positional feature

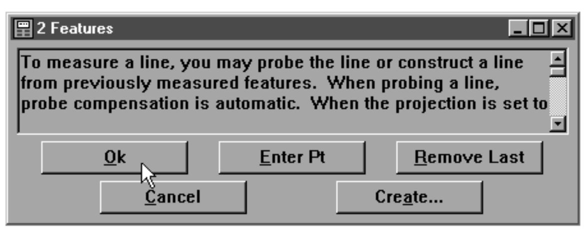
Step 1
Use the mouse to highlight a positional feature and a linear feature on the features list.



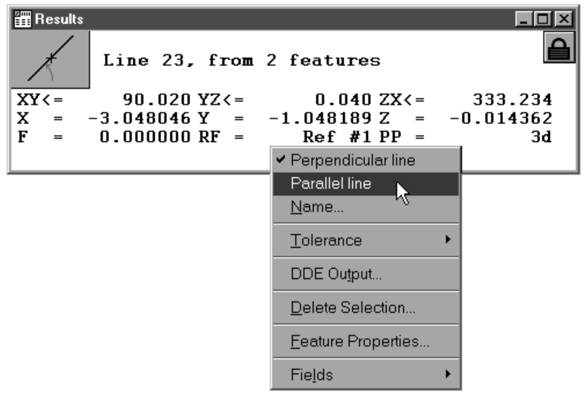
Step 2
Click the line button on the measure toolbar.

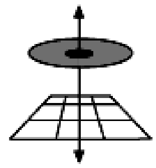


Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select parallel from the list.

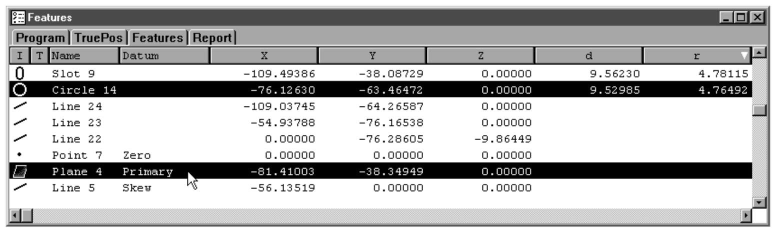




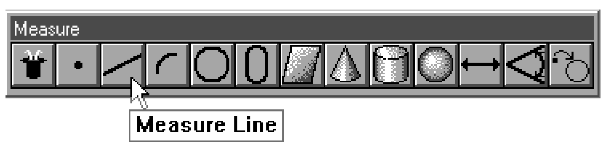
Perpendicular Line Constructed from a Positional Feature and a Plane

To construct a perpendicular line through a plane and a positional feature

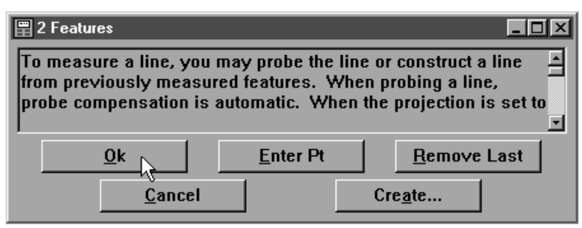
Step 1
Use the mouse to highlight a positional feature and a plane on the features list.

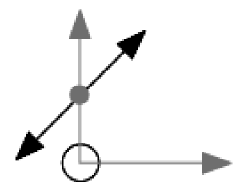


Step 2
Click the line button on the measure toolbar.



Step 3
Click OK in the dialog box.

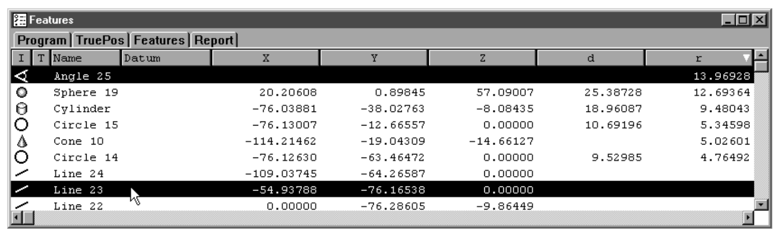




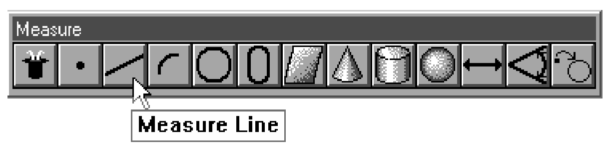
Line Rotated from Leg of an Angle

To construct a rotated line from the leg of an angle and the angle

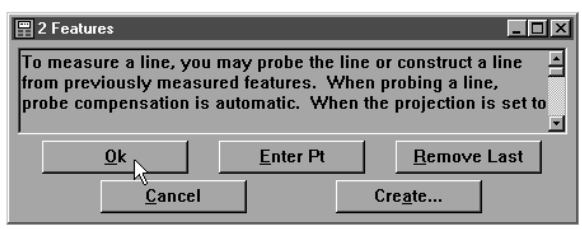
Step 1
Use the mouse to highlight an angle and a leg of an angle on the features list.

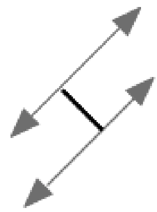


Step 2
Click the line button on the measure toolbar.



Step 3
Click OK in the dialog box.

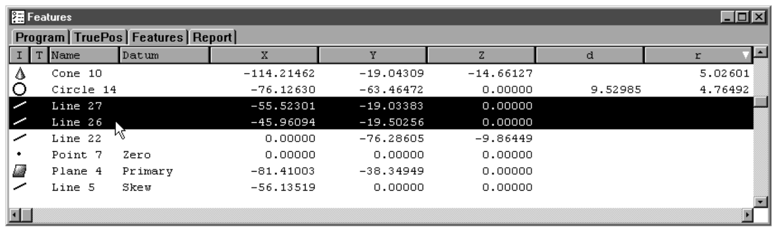




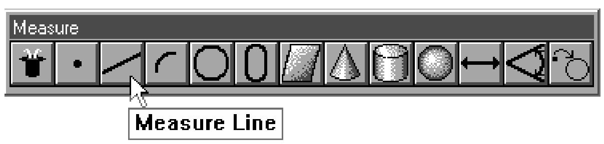
Gage Line from 2 Lines

To construct a gage line

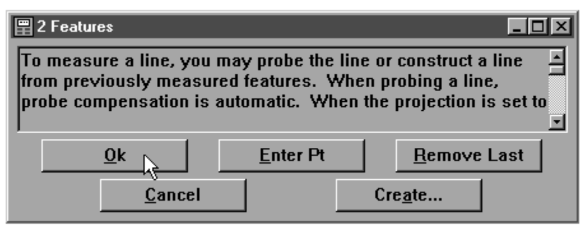
Step 1
Use the mouse to highlight 2 lines on the features list.



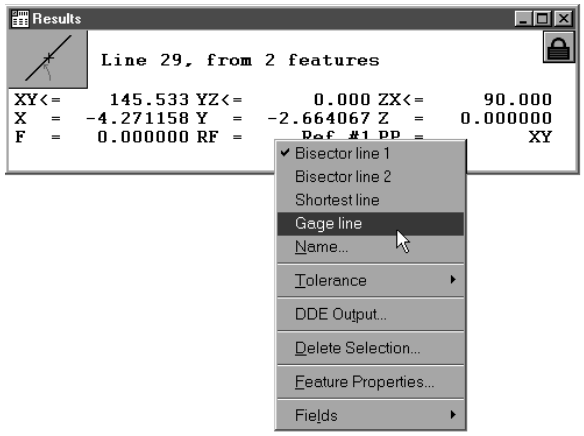
Step 2
Click the line button on the measure toolbar.



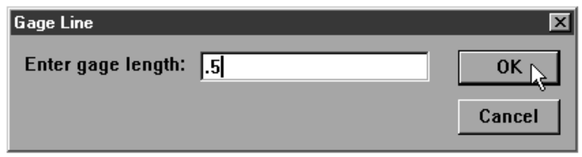
Step 3
Click OK in the dialog box.

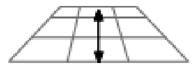


Step 4
Right click in the results windowand select gage line from the list.



Enter a length in the gage line dialog box and click OK if the lines are not parallel.

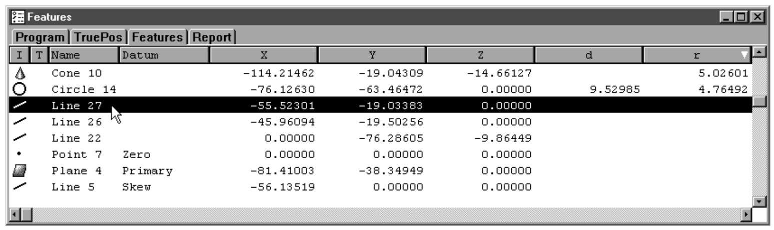




Projection of a Line to a Plane

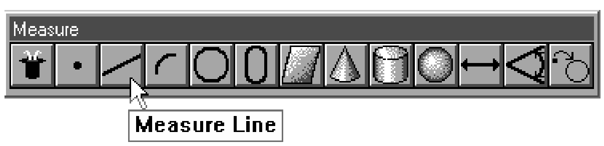
To construct a line by projecting an existing line on a new projection plane

Step 1
Use the mouse to highlight a line on the features list.

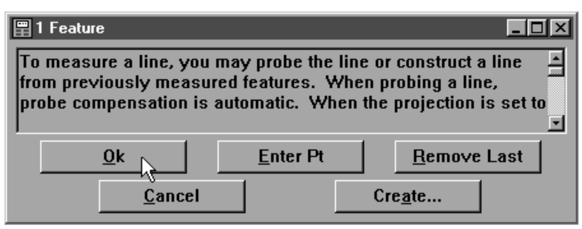


Step 2
Click on the projection box in the status bar until the desired projection (XY, YZ, ZX) plane appears.

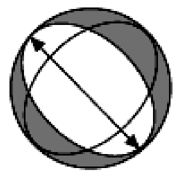
Step 3
Click the line button on the measure toolbar.



Step 4
Click OK in the dialog box.



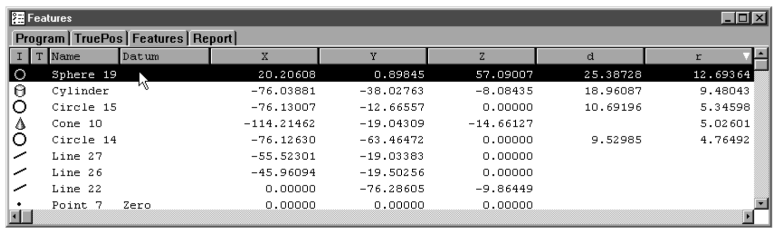
Circle Constructions



Circle Constructed from a Sphere

To construct a circle from a sphere

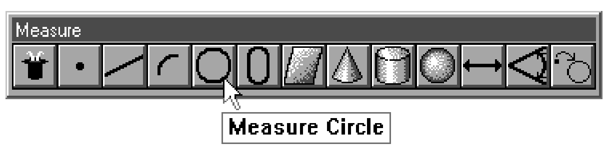
Step 1
Use the mouse to highlight a sphere on the features list.



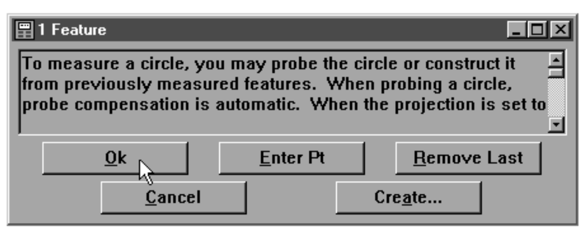
I	T	Name	Datum	X	Y	Z	d	r
		Sphere 19		20.20608	0.89845	57.09007	25.38728	12.69364
		Cylinder		-76.03881	-38.02763	-8.08435	18.96087	9.48043
		Circle 15		-76.13007	-12.66557	0.00000	10.69196	5.34598
		Cone 10		-114.21462	-19.04309	-14.66127		5.02601
		Circle 14		-76.12630	-63.46472	0.00000	9.52985	4.76492
		Line 27		-55.52301	-19.03383	0.00000		
		Line 26		-45.96094	-19.50256	0.00000		
		Line 22		0.00000	-76.28605	-9.86449		
		Point 7	Zero	0.00000	0.00000	0.00000		

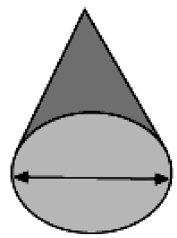
Step 2
Click on the projection box in the status bar until the desired projection (XY, YZ, ZX) plane appears.

Step 3
Click the circle button on the measure toolbar.



Step 4
Click OK in the dialog box.

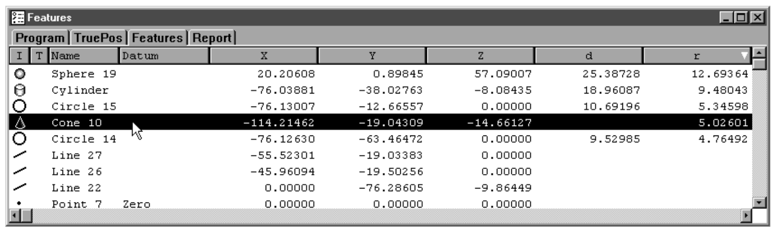




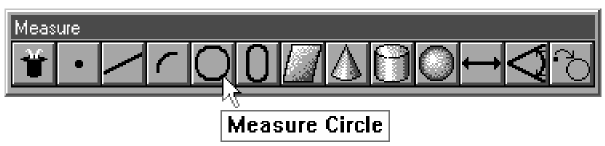
Circle Constructed from a Cone

To construct a circle from a cone

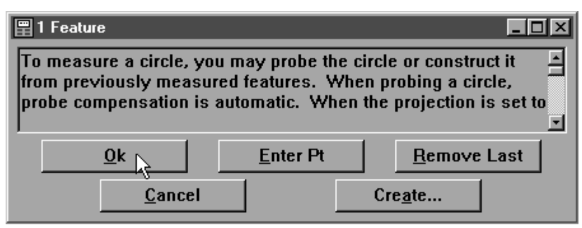
Step 1
Use the mouse to highlight a cone on the features list.



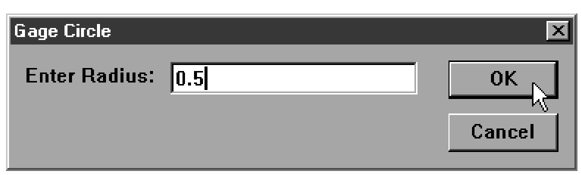
Step 2
Click the circle button on the measure toolbar.

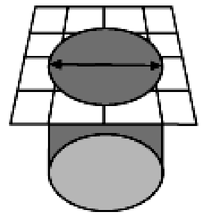


Step 3
Click OK in the dialog box.



Step 4
Enter the desired radius in the gage circle dialog box and click OK.

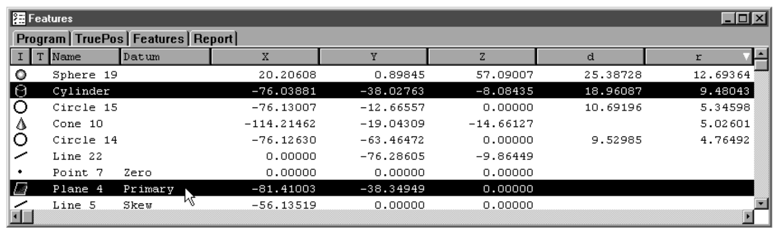




Circle Constructed from an Intersecting Plane and Cylinder

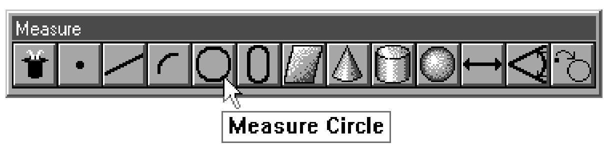
To construct a circle from an intersecting plane and cylinder

Step 1
Use the mouse to highlight a cylinder and a plane on the features list.

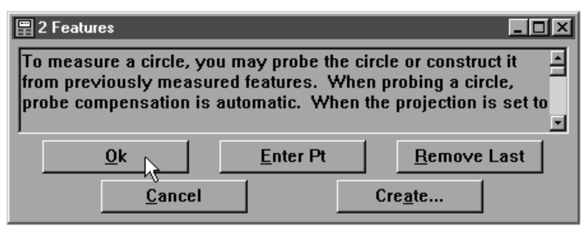


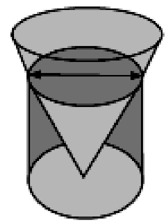
I	T	Name	Datum	X	Y	Z	d	r
		Sphere 19		20.20608	0.89845	57.09007	25.38728	12.69364
		Cylinder		-76.03881	-38.02763	-8.08435	18.96087	9.48043
		Circle 15		-76.13007	-12.66557	0.00000	10.69196	5.34598
		Cone 10		-114.21462	-19.04309	-14.66127		5.02601
		Circle 14		-76.12630	-63.46472	0.00000	9.52985	4.76492
		Line 22		0.00000	-76.28605	-9.86449		
		Point 7	Zero	0.00000	0.00000	0.00000		
		Plane 4	Primary	-81.41003	-38.34949	0.00000		
		Line 5	Skew	-56.13519	0.00000	0.00000		

Step 2
Click the circle button on the measure toolbar.



Step 3
Click OK in the dialog box.

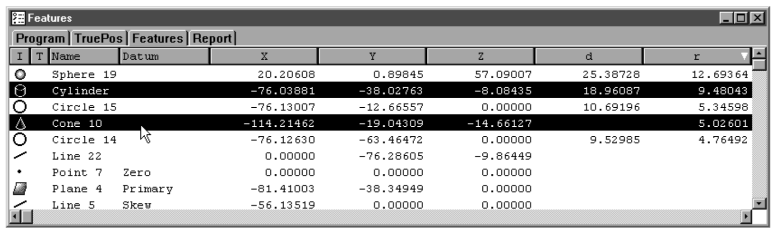




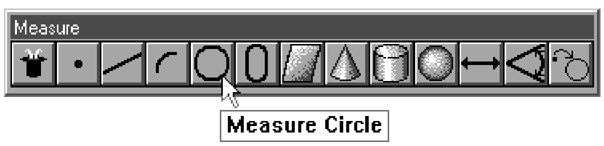
Circle Constructed from an Intersecting Cylinder and Cone

To construct a circle from an intersecting cylinder and cone

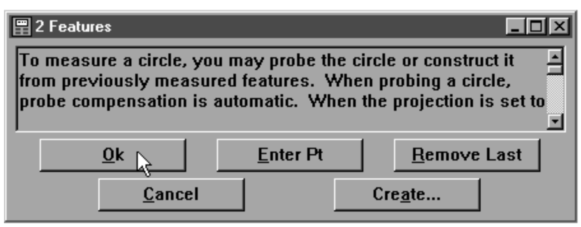
Step 1
Use the mouse to highlight a cylinder and a cone on the features list.

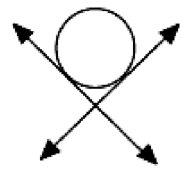


Step 2
Click the circle button on the measure toolbar.



Step 3
Click OK in the dialog box.

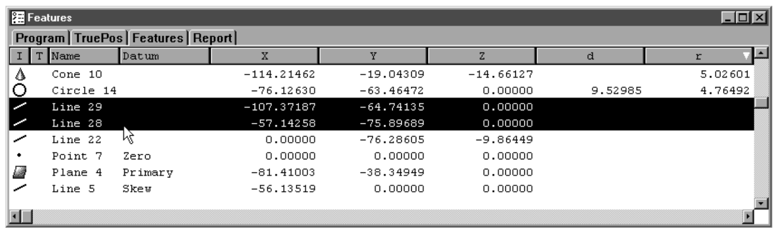




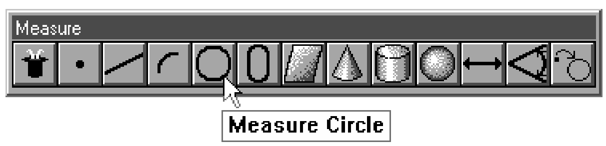
Circle Constructed Tangent to 2 Intersecting Lines

To construct a circle tangent to 2 intersecting lines

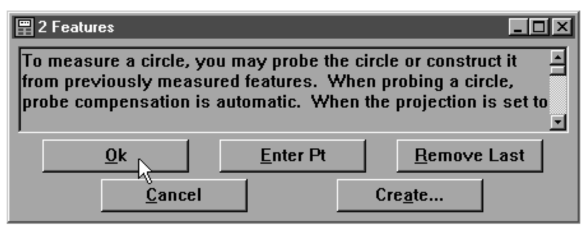
Step 1
Use the mouse to highlight 2 intersecting lines on the features list.



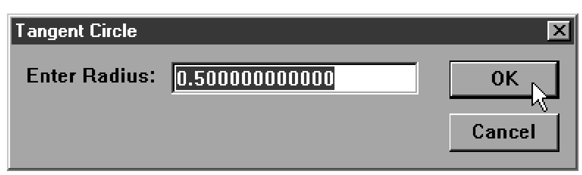
Step 2
Click the circle button on the measure toolbar.

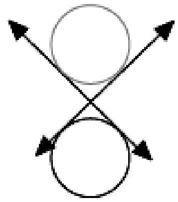


Step 3
Click OK in the dialog box.



Step 4
Enter the desired radius in the gage circle dialog box and click OK.

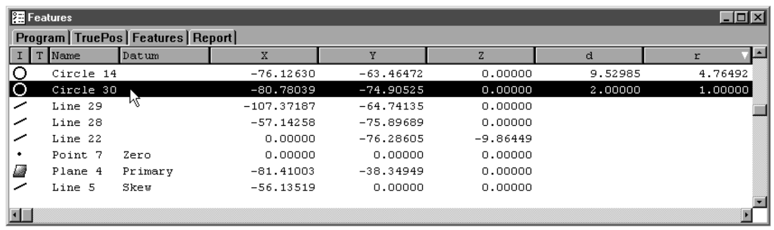




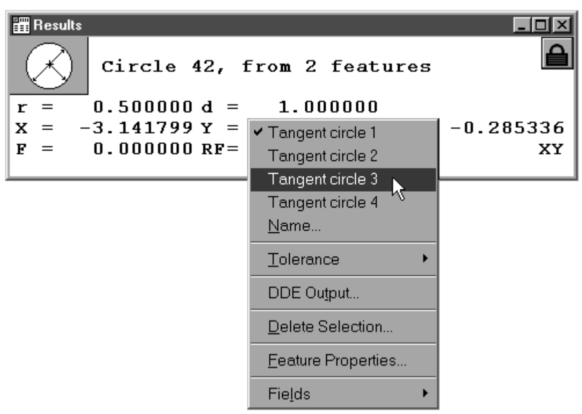
Changing the Location of a Tangent Circle Construction

To change the location of a tangent circle

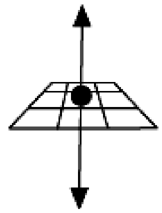
Step 1
Use the mouse to highlight the tangent circle on the features list.



Step 2
Right click in the results window and select tangent 1, tangent 2, tangent 3, or tangent 4 from the list.



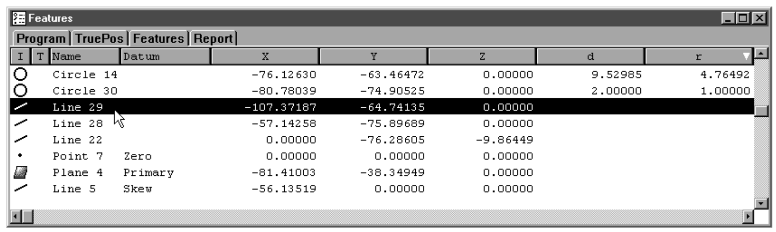
Plane Constructions



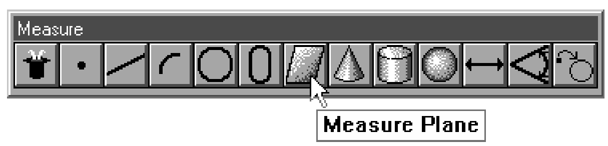
Plane Constructed from the Midpoint of a Line

To construct a plane from the midpoint of a line

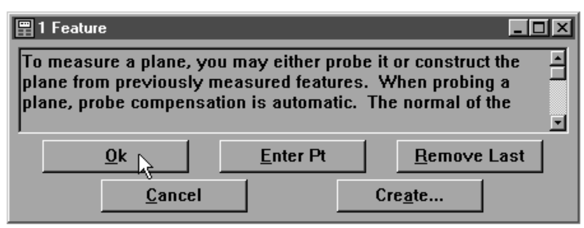
Step 1
Use the mouse to highlight a line on the features list.

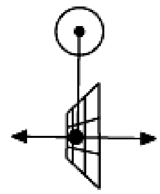


Step 2
Click the plane button on the measure toolbar.



Step 3
Click OK in the dialog box.

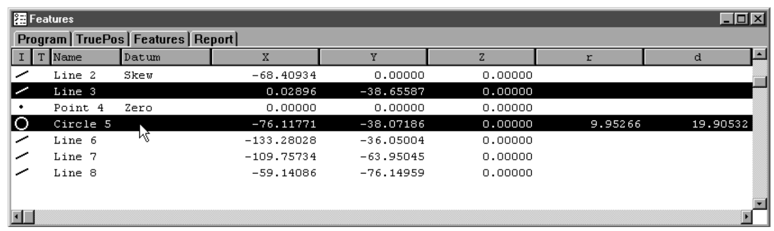




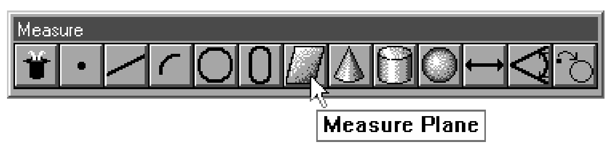
Plane Constructed from a Line and a Positional Feature

To construct a plane from a line and a positional feature

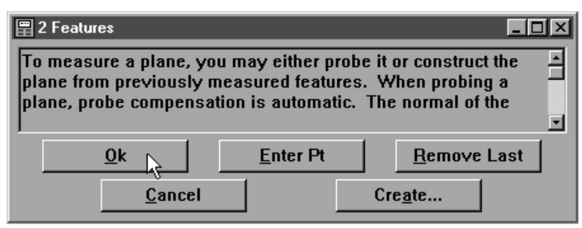
Step 1
Use the mouse to highlight a line and a positional feature on the features list.

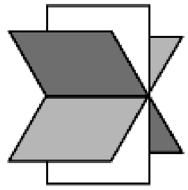


Step 2
Click the plane button on the measure toolbar.



Step 3
Click OK in the dialog box.

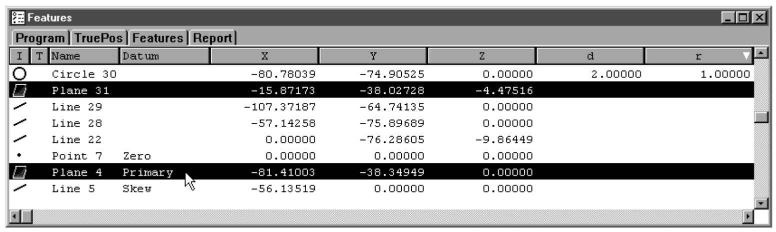




Midplane Constructed from 2 planes (Midplane 1)

To construct a midplane from 2 planes

Step 1
Use the mouse to highlight 2 planes on the features list.

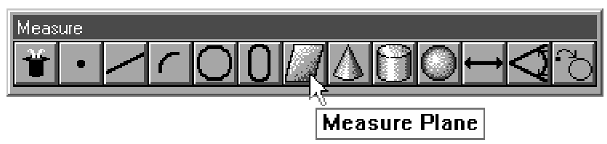


Features

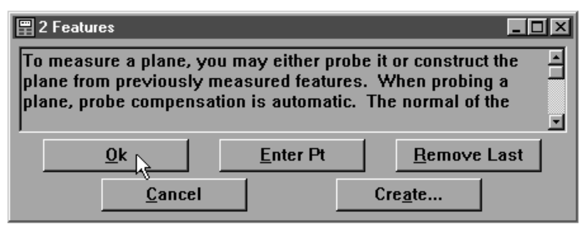
Program | TruePos | Features | Report

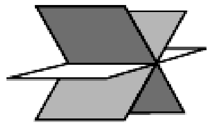
I	T	Name	Datum	X	Y	Z	d	r
		Circle 30		-80.78039	-74.90525	0.00000	2.00000	1.00000
		Plane 31		-15.87173	-38.02728	-4.47516		
		Line 29		-107.37187	-64.74135	0.00000		
		Line 28		-57.14258	-75.89689	0.00000		
		Line 22		0.00000	-76.28605	-9.86449		
		Point 7	Zero	0.00000	0.00000	0.00000		
		Plane 4	Primary	-81.41003	-38.34949	0.00000		
		Line 5	Skew	-56.13519	0.00000	0.00000		

Step 2
Click the plane button on the measure toolbar.



Step 3
Click OK in the dialog box.

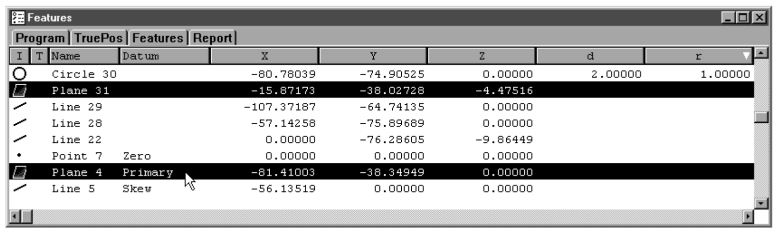




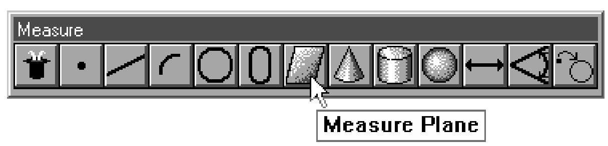
Midplane Constructed from 2 planes (Midplane 2)

To construct a perpendicular midplane from 2 planes

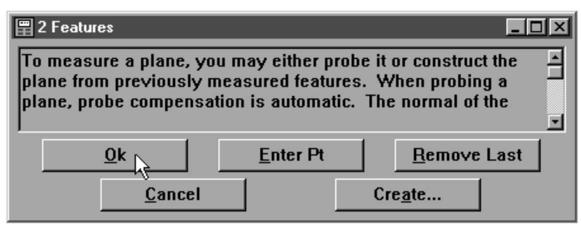
Step 1
Use the mouse to highlight 2 planes on the features list.



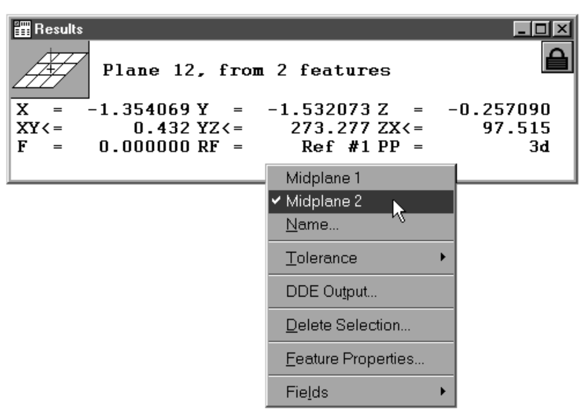
Step 2
Click the plane button on the measure toolbar.



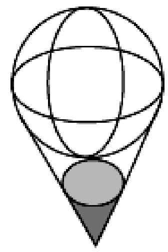
Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select midplane 2 from the list.



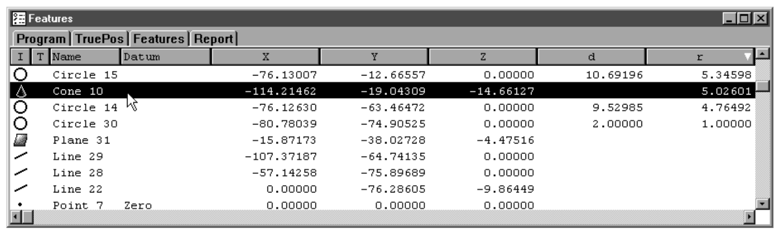
Sphere Constructions



Sphere Constructed from a Cone

To construct a sphere from a cone

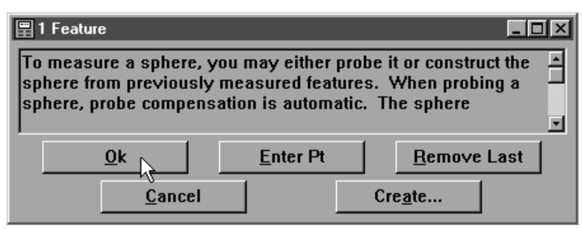
Step 1
Using the mouse to highlight a cone on the features list.



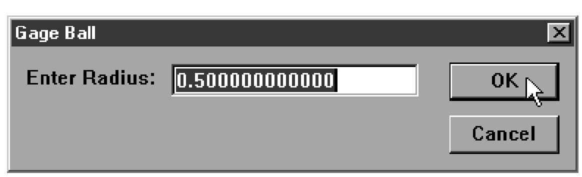
I	T	Name	Datum	X	Y	Z	d	r
		Circle 15		-76.13007	-12.66557	0.00000	10.69196	5.34598
		Cone 10		-114.21462	-19.04309	-14.66127		5.02601
		Circle 14		-76.12630	-63.46472	0.00000	9.52985	4.76492
		Circle 30		-80.78039	-74.90525	0.00000	2.00000	1.00000
		Plane 31		-15.87173	-38.02728	-4.47516		
		Line 29		-107.37187	-64.74135	0.00000		
		Line 28		-57.14258	-75.89689	0.00000		
		Line 22		0.00000	-76.28605	-9.86449		
		Point 7	Zero	0.00000	0.00000	0.00000		

Step 2
Click the sphere button on the measure toolbar.

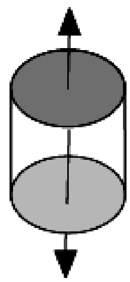
Step 3
Click OK in the dialog box.



Step 4
Enter the desired radius in the gage ball dialog box and click OK.



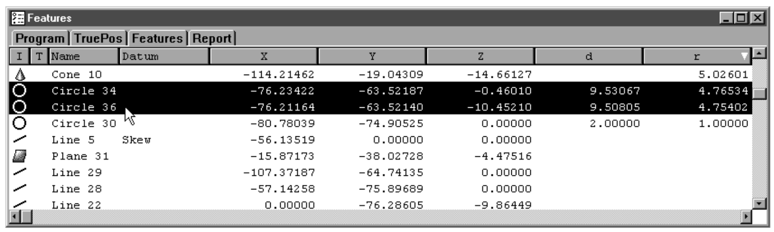
Cylinder Constructions



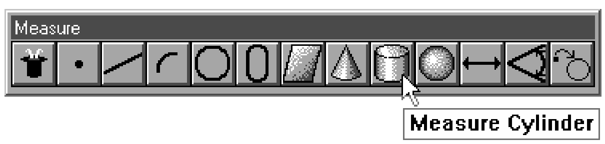
Cylinder Constructed from 2 Co-axial Circles

To construct a cylinder from to 2 co-axial circles

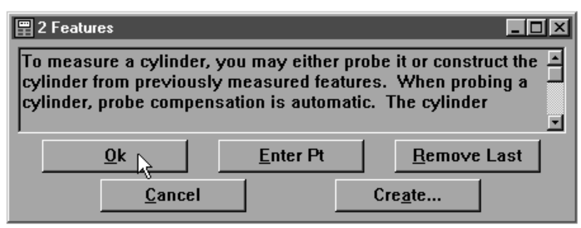
Step 1
Use the mouse to highlight 2 co-axial circles on the features list.



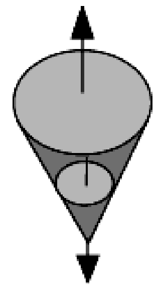
Step 2
Click the cylinder button on the measure toolbar.



Step 3
Click OK in the dialog box.



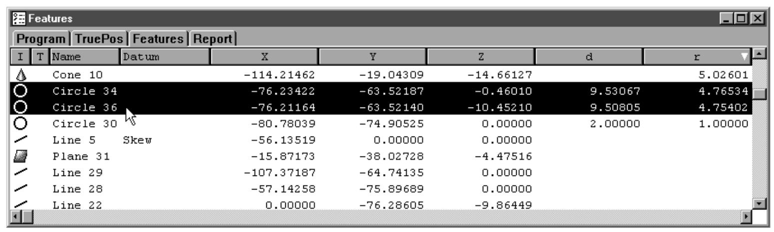
Cone Constructions



Cone Constructed from 2 Co-axial Circles

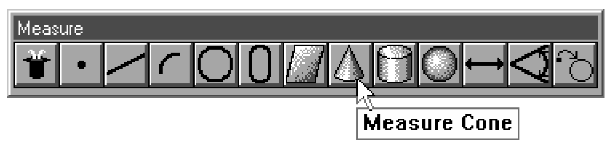
To construct a cone from 2 co-axial circles

Step 1
Use the mouse to highlight 2 co-axial circles (with different diameters) on the features list.

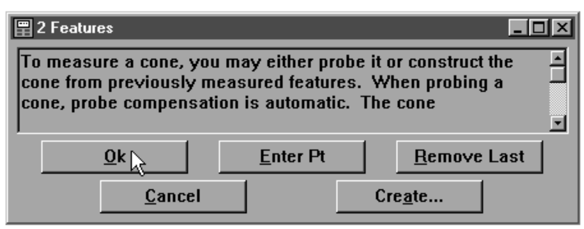


I	T	Name	Datum	X	Y	Z	d	r
		Cone 10		-114.21462	-19.04309	-14.66127		5.02601
		Circle 34		-76.23422	-63.52187	-0.46010	9.53067	4.76534
		Circle 36		-76.21164	-63.52140	-10.45210	9.50805	4.75402
		Circle 30		-80.78039	-74.90525	0.00000	2.00000	1.00000
		Line 5	Skew	-56.13519	0.00000	0.00000		
		Plane 31		-15.87173	-38.02728	-4.47516		
		Line 29		-107.37187	-64.74135	0.00000		
		Line 28		-57.14258	-75.89689	0.00000		
		Line 22		0.00000	-76.28605	-9.86449		

Step 2
Click the cone button on the measure toolbar.



Step 3
Click OK in the dialog box.



Measuring Relations

There are two types of relations used by the QC5000 software: distances and angles. Distances describe how far one feature is from another and angles describe where one feature lies in relation to another.

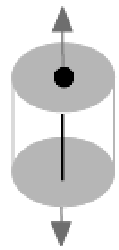
Distance

Distances are constructed using previously measured features. The simplest distance to construct is between two points. More complex distances can be constructed between two circles or by a combination of features such as a circle and a point. The basic method for constructing distances is the same as below.

Angle

Angles are constructed using previously measured features. The simplest angle to construct is between two lines. More complex angles can be constructed between two planes or by a combination of features such as a cylinder and a plain. The basic method for constructing angles is the same as below.

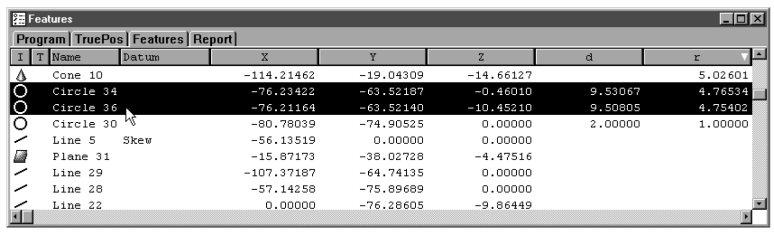
Distance Constructions



Length of an Axis

To construct the length of an axis

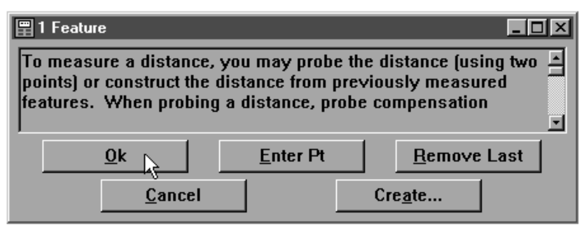
Step 1
Use the mouse to highlight a linear feature on the features list.

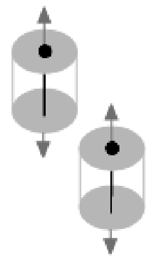


I	T	Name	Datum	X	Y	Z	d	r
		Cone 10		-114.21462	-19.04309	-14.66127		5.02601
		Circle 34		-76.23422	-63.52187	-0.46010	9.53067	4.76534
		Circle 36		-76.21164	-63.52140	-10.45210	9.50805	4.75402
		Circle 30		-80.78039	-74.90525	0.00000	2.00000	1.00000
		Line 5	Skew	-56.13519	0.00000	0.00000		
		Plane 31		-15.87173	-38.02728	-4.47516		
		Line 29		-107.37187	-64.74135	0.00000		
		Line 28		-57.14258	-75.89689	0.00000		
		Line 22		0.00000	-76.28605	-9.86449		

Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.

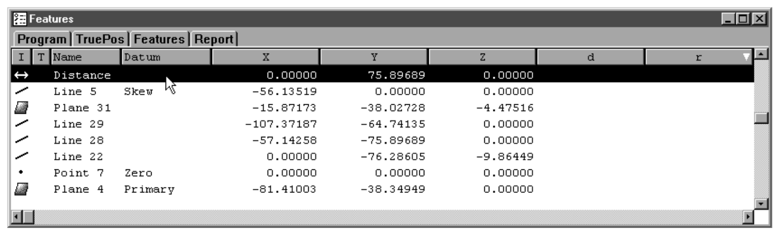




Duplicate Distance

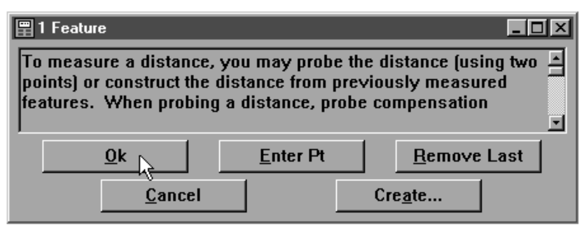
To construct a duplicate distance

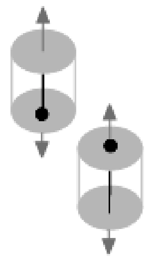
Step 1
Use the mouse to highlight a distance on the features list.



Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.

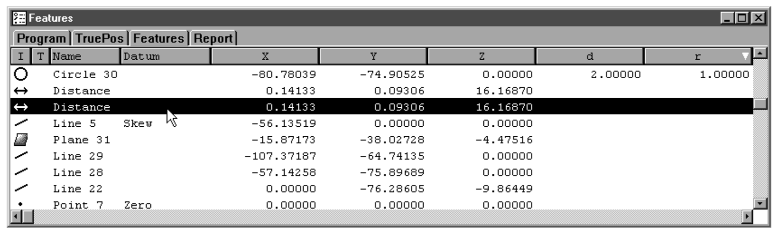




Reverse Direction Distance

To construct a reverse direction distance

Step 1
Use the mouse to highlight a duplicate distance on the features list.

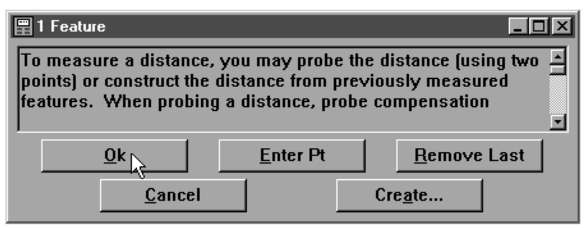


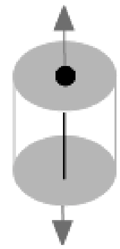
Features
Program | TruePos | Features | Report

I	T	Name	Datum	X	Y	Z	d	r
		Circle 30		-80.78039	-74.90525	0.00000	2.00000	1.00000
		Distance		0.14133	0.09306	16.16870		
		Distance		0.14133	0.09306	16.16870		
		Line 5	Skew	-56.13519	0.00000	0.00000		
		Plane 31		-15.87173	-38.02728	-4.47516		
		Line 29		-107.37187	-64.74135	0.00000		
		Line 28		-57.14258	-75.89689	0.00000		
		Line 22		0.00000	-76.28605	-9.86449		
		Point 7	Zero	0.00000	0.00000	0.00000		

Step 2
Click the distance button on the measure toolbar.

Step 3
Right click in the results window and select reverse distance from the list.

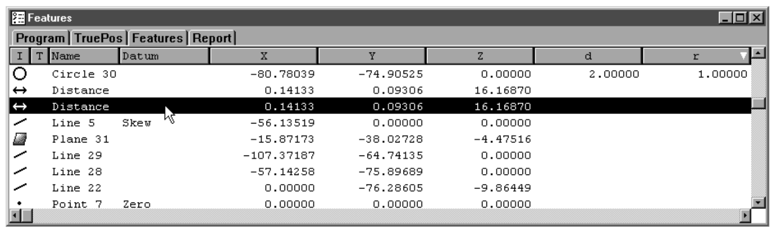




Absolute Distance

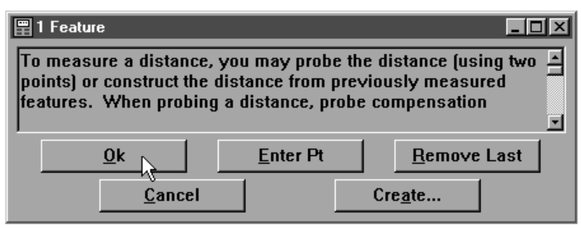
To construct an absolute distance

Step 1
Use the mouse to highlight a duplicate distance on the features list.

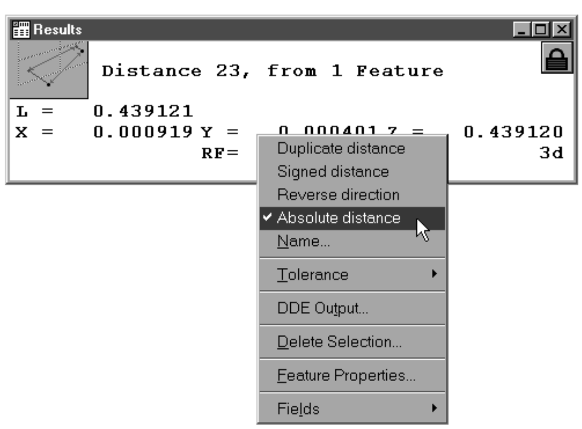


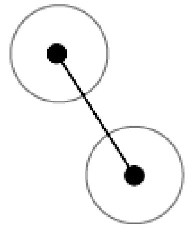
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select absolute distance from the list.

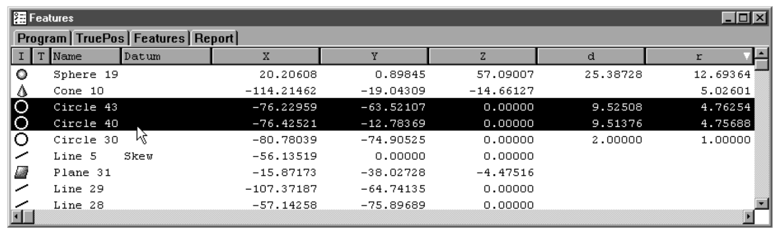




Distance Constructed from Center to Center of 2 Positional Features

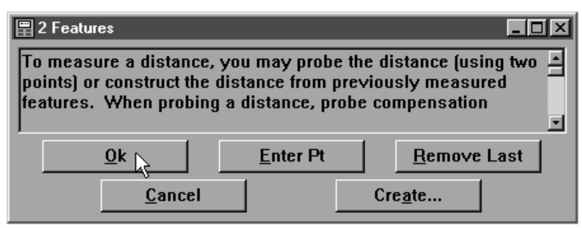
To construct a center to center distance

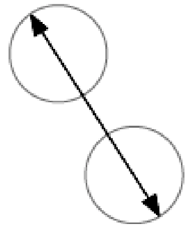
Step 1
Use the mouse to highlight 2 positional features on the features list.



Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.

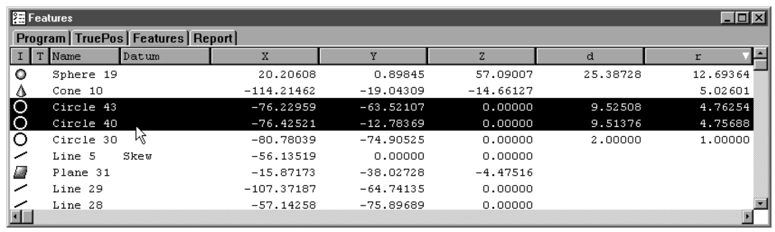




Distance Constructed from the Farthest Edge of 2 Positional Features

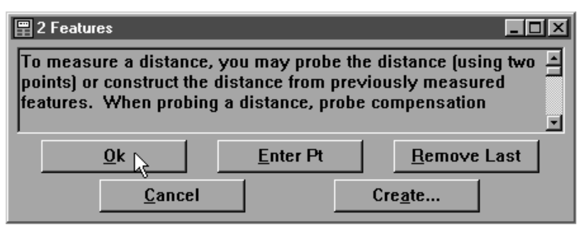
To construct a farthest edge distance

Step 1
Use the mouse to highlight 2 positional features on the features list.

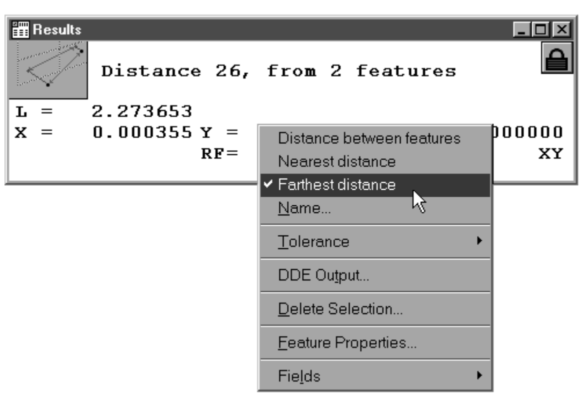


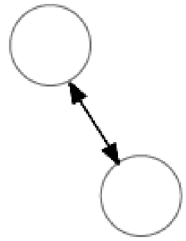
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step4
Right click in the results window and select farthest distance from the list.

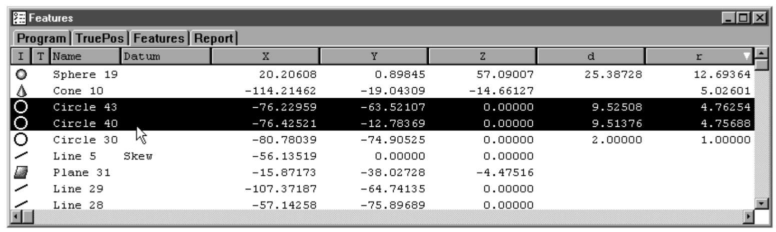




Distance Constructed from the Nearest Edge of 2 Positional Features

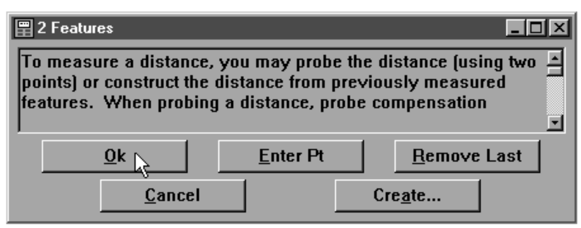
To construct a nearest edge distance

Step 1
Use the mouse to highlight 2 positional features on the features list.

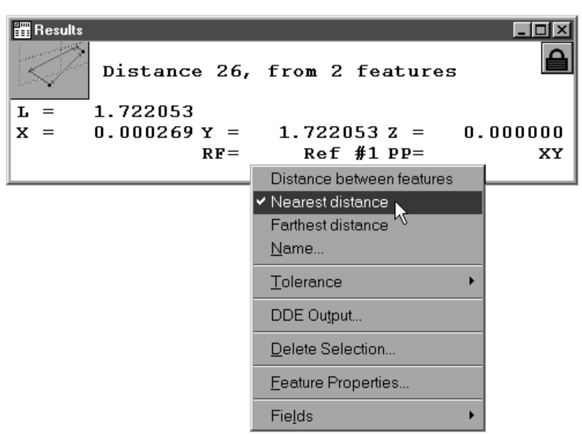


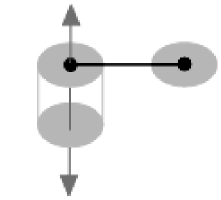
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step4
Right click in the results window and select nearest distance from the list.

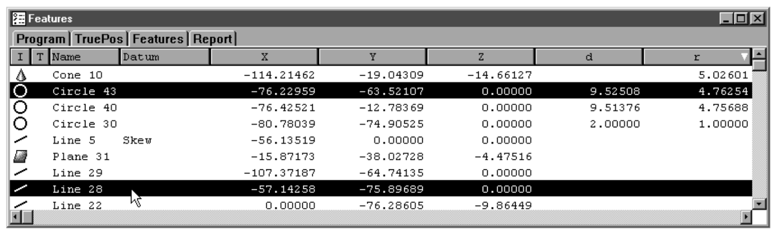




Distance Constructed from the Center of a Positional Feature to Linear Feature

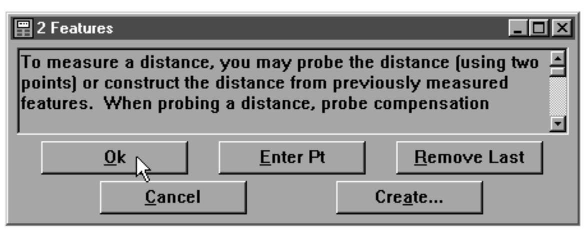
To construct a distance from a positional feature perpendicular to a linear feature

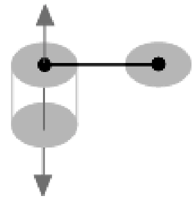
Step 1
Use the mouse to highlight a positional feature and a linear feature on the features list.



Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.

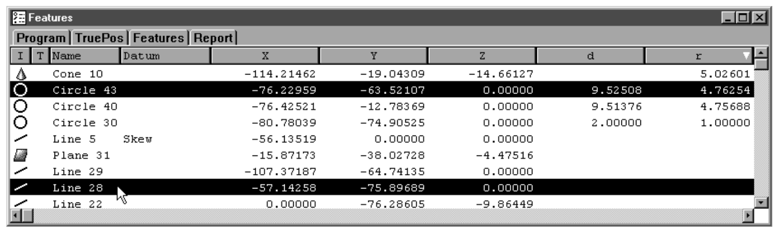




Distance Constructed from the Center of a Positional Feature to Linear Feature

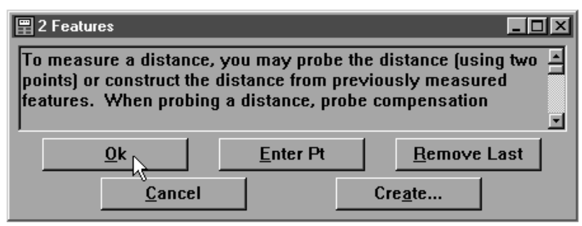
To construct the nearest to line distance

Step 1
Use the mouse to highlight a circle (or arc) and a line on the features list.

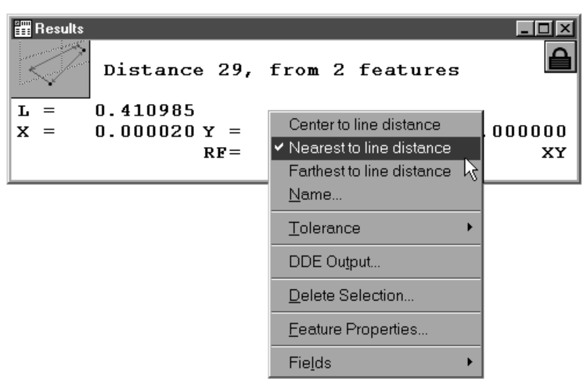


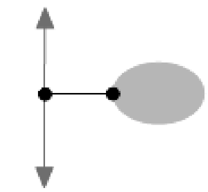
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select nearest to line distance from the list.

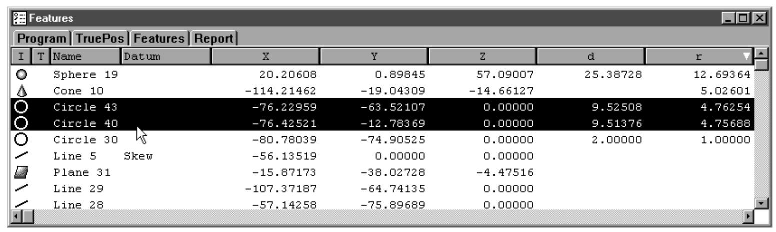




Nearest Distance Constructed from a Positional Feature to a Line

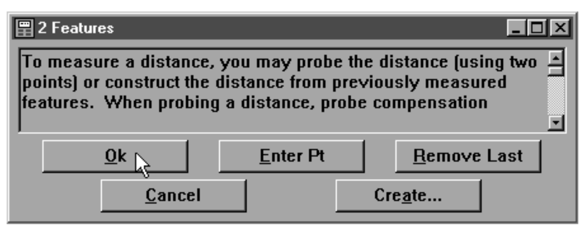
To construct the farthest to line distance

Step 1
Use the mouse to highlight a circle (or arc) and a line on the features list.

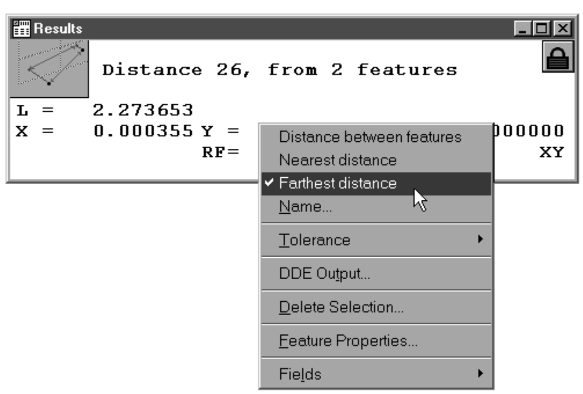


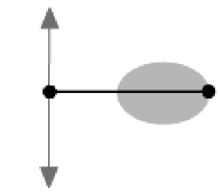
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select farthest to line distance from the list.

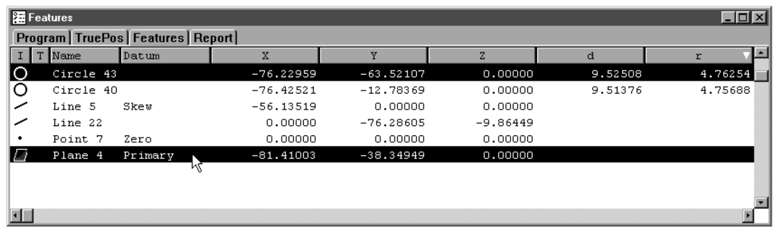




Farthest Distance Constructed from a Positional Feature to a Line

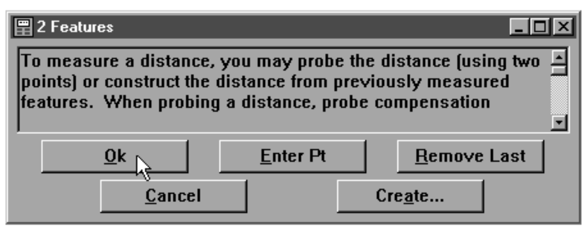
To construct a distance from a positional feature to a plane

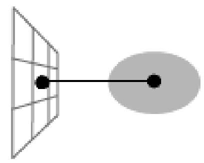
Step 1
Use the mouse to highlight a positional feature and a plane on the features list.



Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.

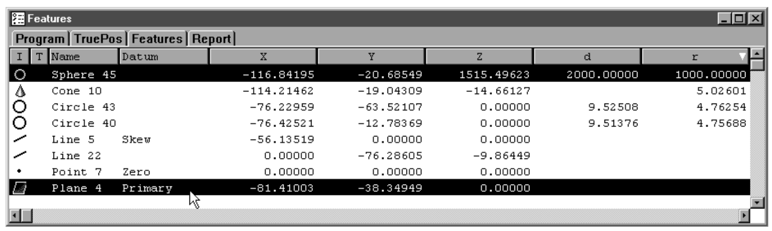




Distance Constructed from a Positional Feature to a Plane

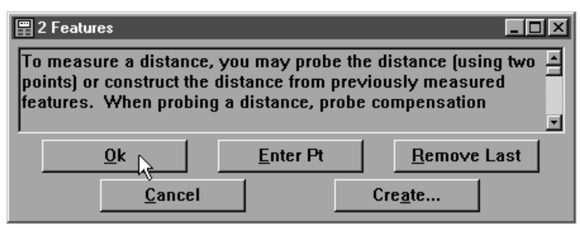
To construct a center to plane distance from a sphere

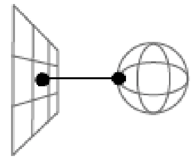
Step 1
Use the mouse to highlight a sphere and a plane on the features list.



Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.

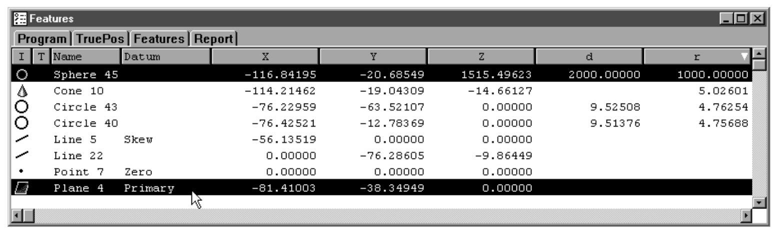




Distance Constructed from the Nearest Point on a Sphere to a Plane

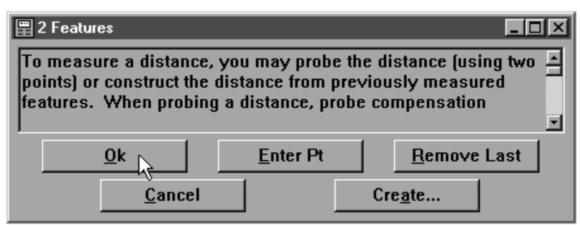
To construct the nearest plane distance from a sphere

Step 1
Use the mouse to highlight a sphere and a plane on the features list.

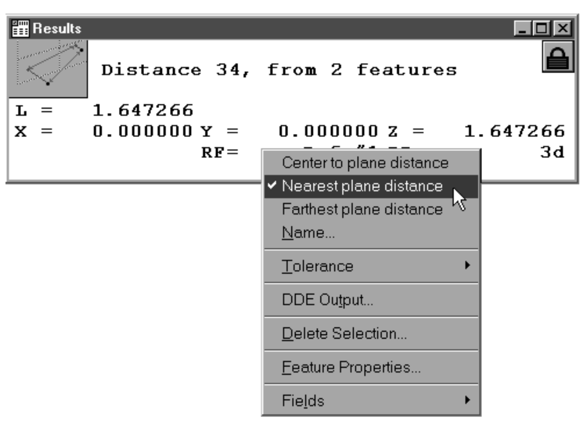


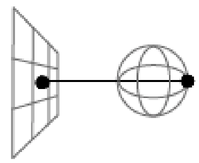
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select nearest plane distance from the list.

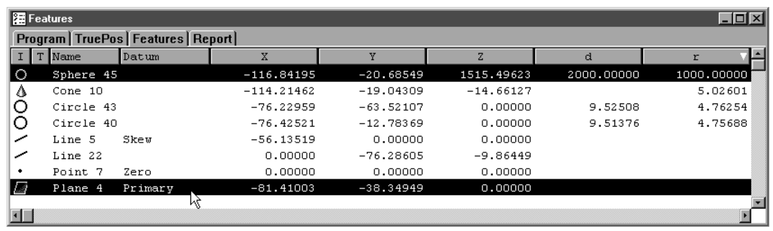




Distance Constructed from the Farthest Point on a Sphere to a Plane

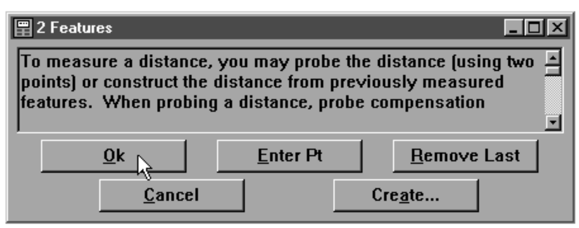
To construct the farthest plane distance from a sphere

Step 1
Use the mouse to highlight a sphere and a plane on the features list.

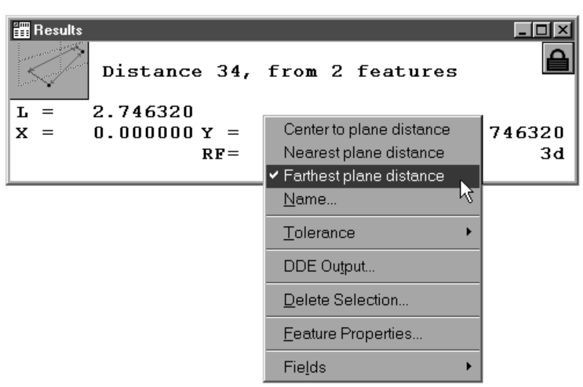


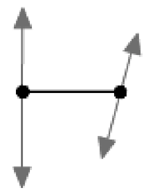
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select farthest plane distance from the list.

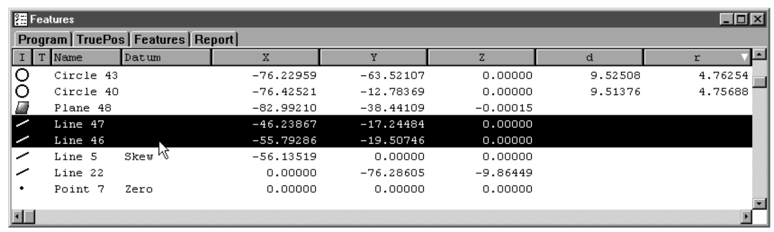




Distance Constructed from 2 lines (Bounded Line)

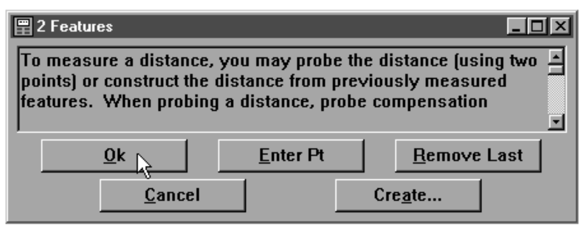
To construct a bounded line distance from 2 lines

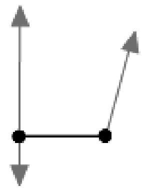
Step 1
Use the mouse to highlight 2 lines on the features list.



Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box

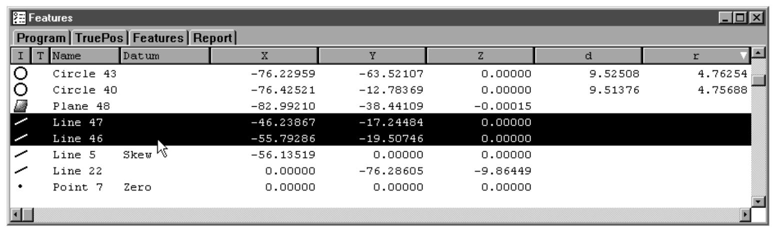




Distance Constructed from 2 lines (Nearest Bounded Line)

To construct a nearest bounded line distance from 2 lines

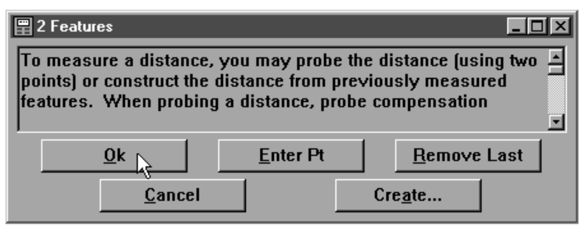
Step 1
Use the mouse to highlight 2 lines on the features list.



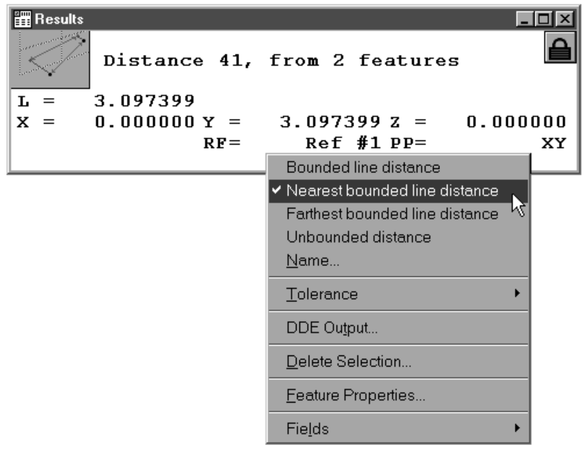
I	T	Name	Datum	X	Y	Z	d	r
		Circle 43		-76.22959	-63.52107	0.00000	9.52508	4.76254
		Circle 40		-76.42521	-12.78369	0.00000	9.51376	4.75688
		Plane 48		-82.99210	-38.44109	-0.00015		
		Line 47		-46.23867	-17.24484	0.00000		
		Line 46		-55.79286	-19.50746	0.00000		
		Line 5	Skew	-56.13519	0.00000	0.00000		
		Line 22		0.00000	-76.28605	-9.86449		
		Point 7	Zero	0.00000	0.00000	0.00000		

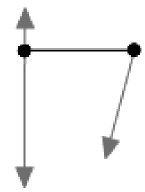
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select nearest bounded line distance from the list.

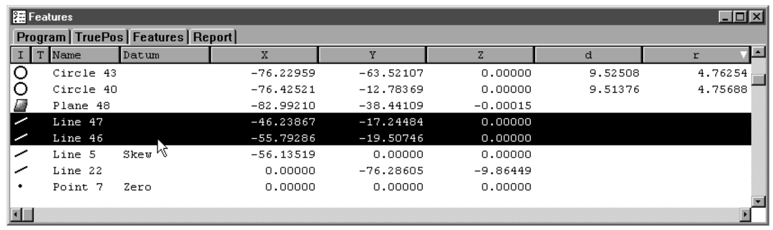




Distance Constructed from 2 lines (Farthest Bounded Line)

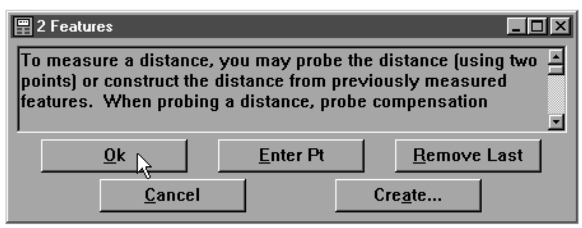
To construct a farthest bounded line distance from 2 lines

Step 1
Use the mouse to highlight 2 lines on the features list.

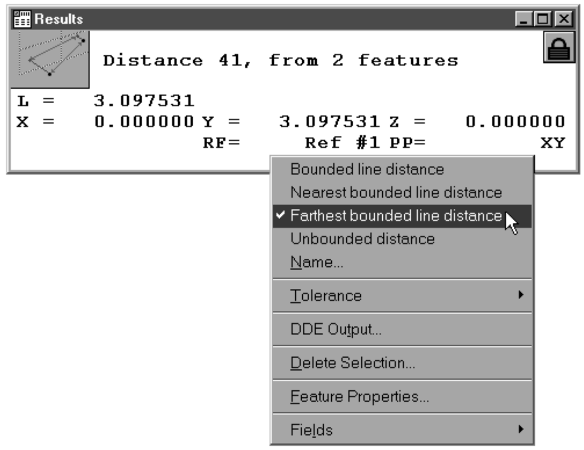


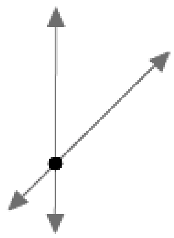
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select farthest bounded line distance from the list.

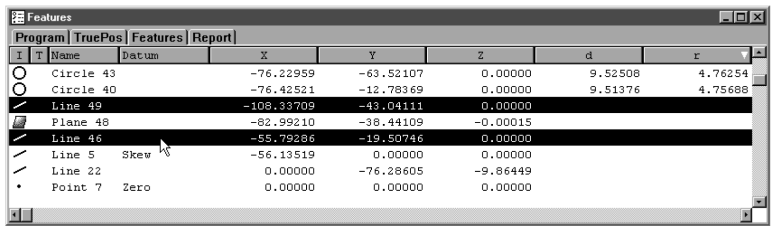




Distance Constructed from 2 Lines (Unbounded Distance)

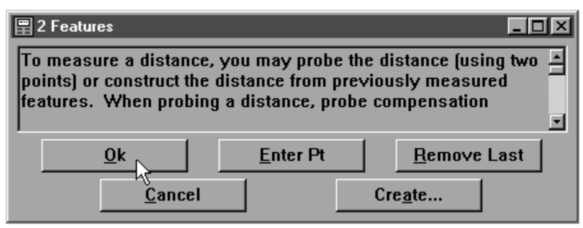
To construct an unbounded distance from 2 linear features

Step 1
Use the mouse to highlight 2 linear features on the features list.

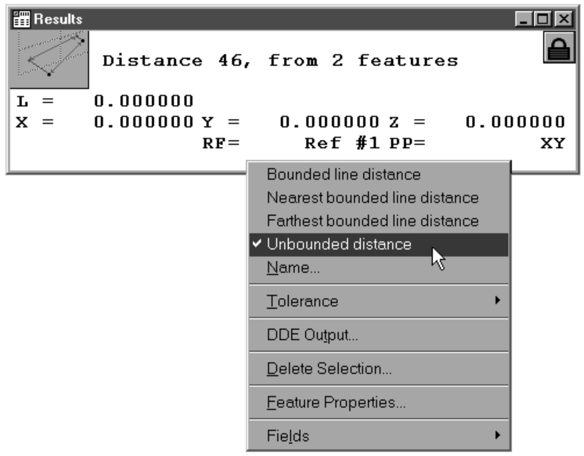


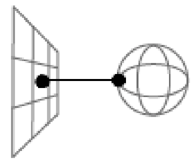
Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



Step 4
Right click in the results window and select unbounded distance from the list.

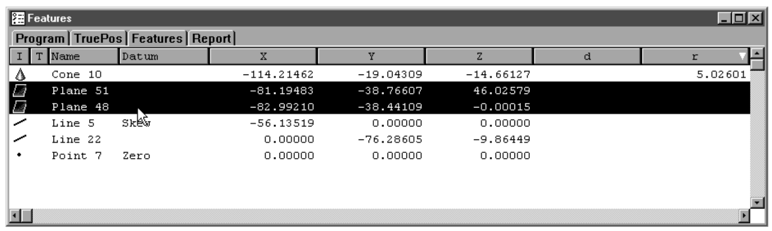




Distance Constructed from the Nearest Point on a Sphere to a Plane

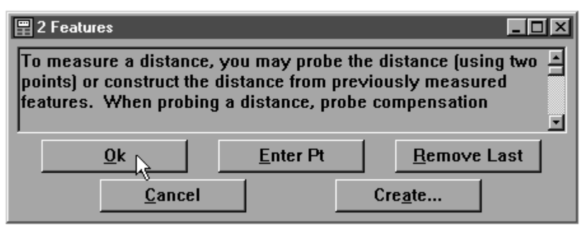
To construct a distance between 2 co-axial planes

Step 1
Use the mouse to highlight 2 co-axial planes on the features list.

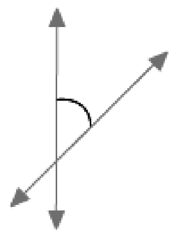


Step 2
Click the distance button on the measure toolbar.

Step 3
Click OK in the dialog box.



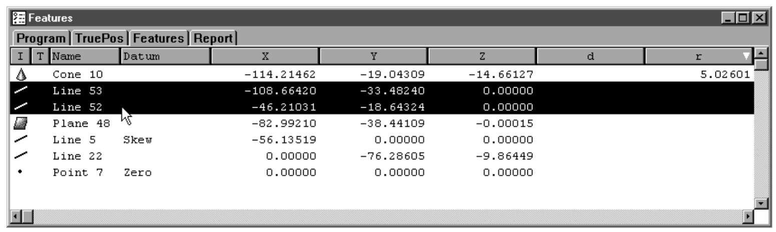
Angle Constructions



Angle Constructed from 2 Linear Features

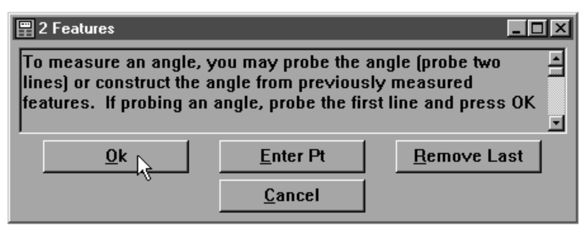
To construct an angle from 2 linear features

Step 1
Use the mouse to highlight 2 linear features on the features list.



Step 2
Click the angle button on the measure toolbar.

Step 3
Click OK in the dialog box.



Saving Your Work

Each part file you create is an electronic record of the part and its inspection results. For this reason it is important to save a new part file for each part you inspect.

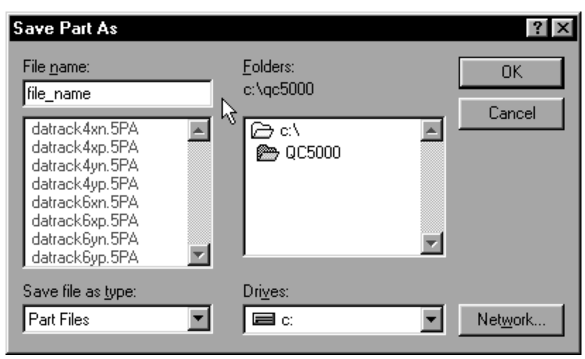
CAUTION

Create a new file for each part inspected. This ensure a unique record for every inspection. Failing to create a new file for each part will result in loss of data and records.

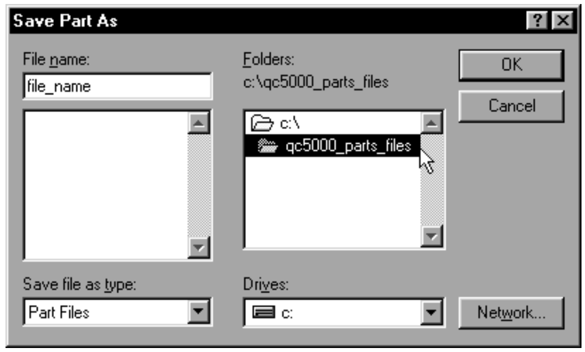
To save a part file

Step 1
Select save as from the file menu.

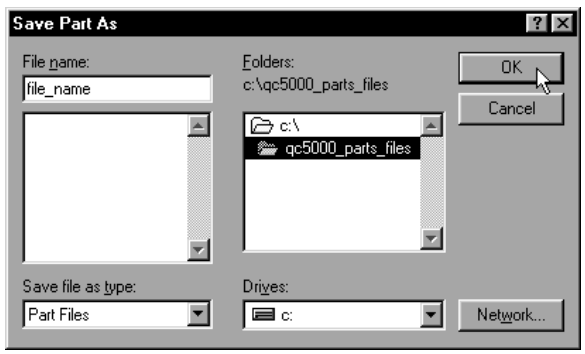
Step 2
Type a name for the part file in the file name text box in the dialog box.



Step 3
Select a storage location for the file using the folders box and/or drives box.

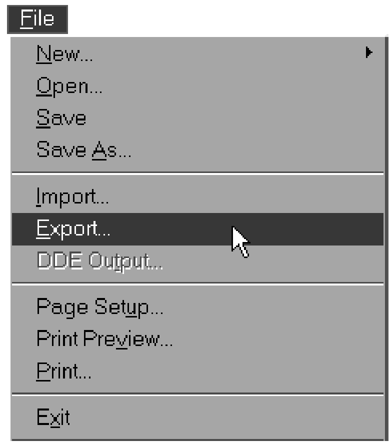


Step 4
Click OK in the dialog box.

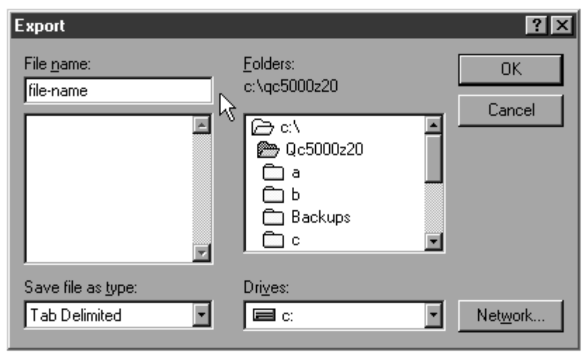


To export to a CAD file

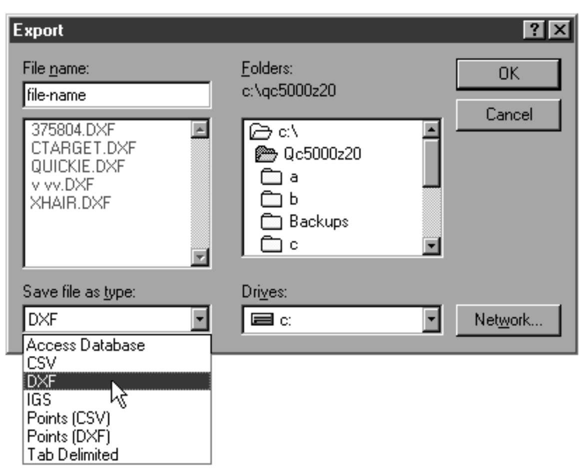
Step 1
Select export from the file menu.



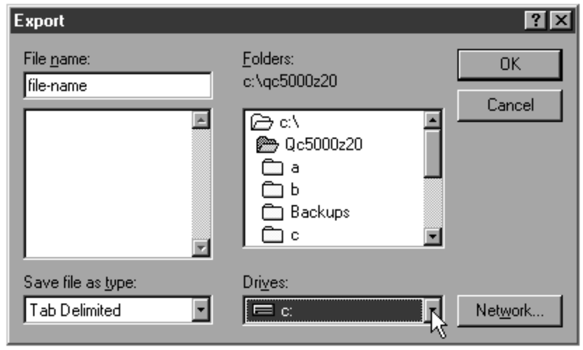
Step 2
Type a name for the part file in the file name text box in the dialog box.



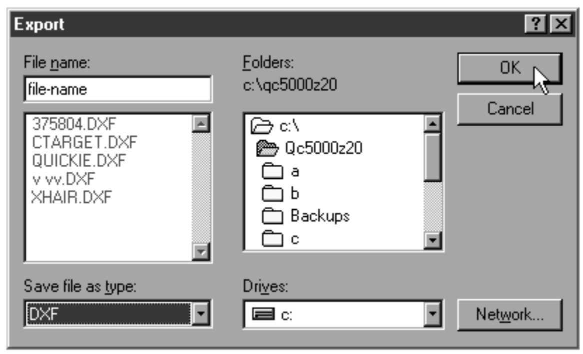
Step 3
Select DXF in the save file as type pull down list.



Step 4
Select a storage location for the file using the folders box and/or drives box.

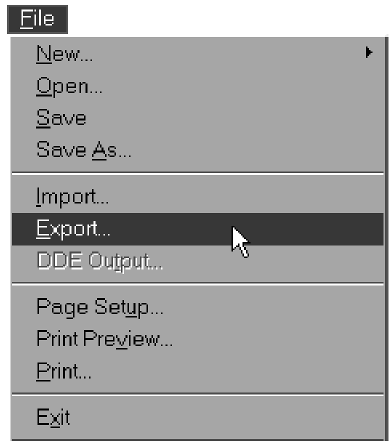


Step 5
Click OK.

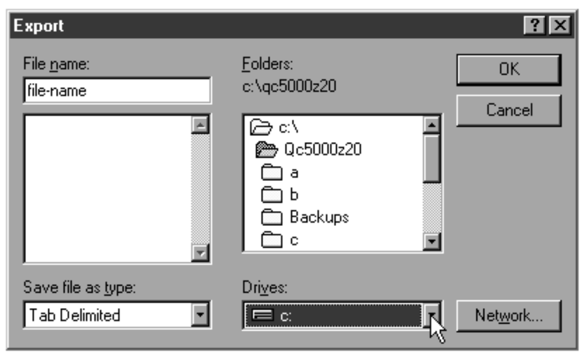


To export to SPC software

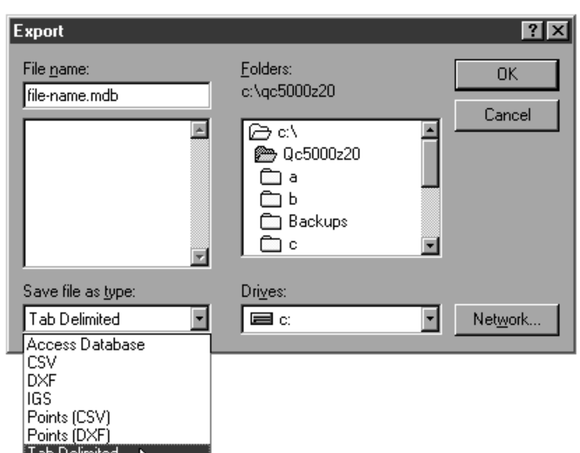
Step 1
Select export from the file menu.



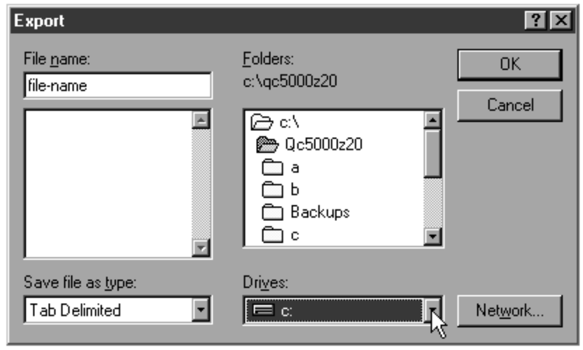
Step 2
Type a name for the part file in the file name text box in the dialog box.



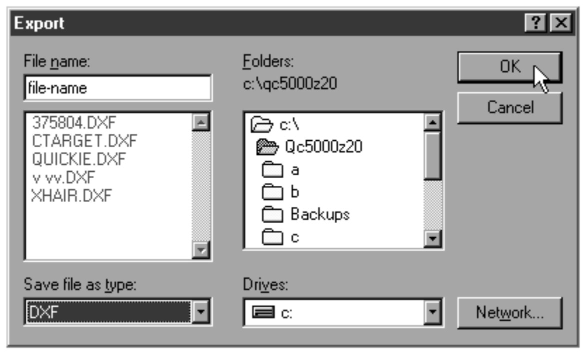
Step 3
Select tab delimited (or other format specified by SPC software) in the save file as type pull down list.



Step 4
Select a storage location for the file using the folders box and/or drives box.



Step 5
Click OK.

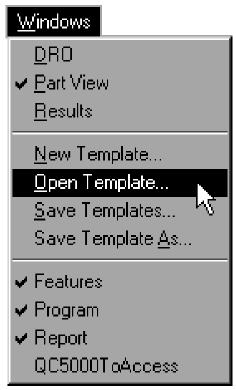


To export to Microsoft Access

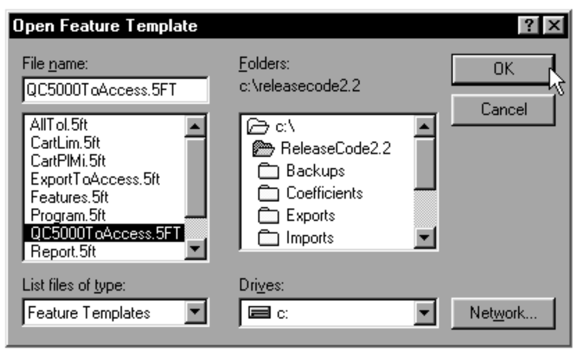
NOTE

Make sure Access is open before exporting. QC5000 data cannot be exported if Access is closed.

Step 1
Select *open template* from the windows menu.



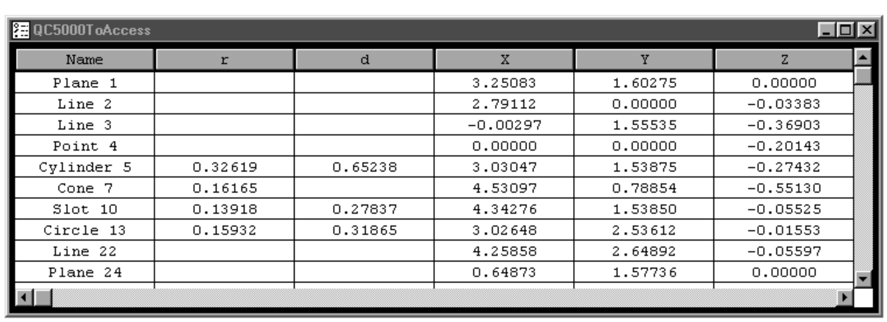
Step 2
Open the *QC5000ToAccess.5ft* template as shown.



NOTE

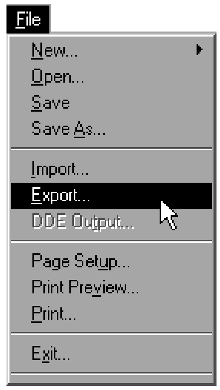
The QC5000ToAccess.5ft template is located in the *c:\qc5000* directory.

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

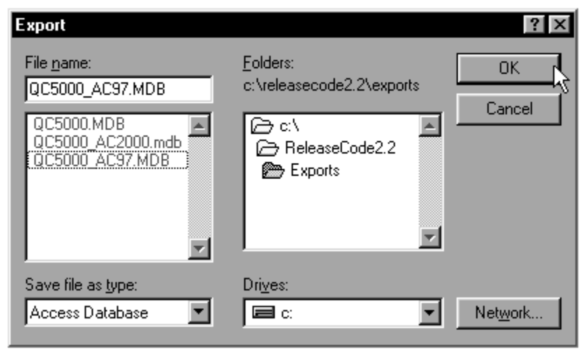

QC5000ToAccess

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

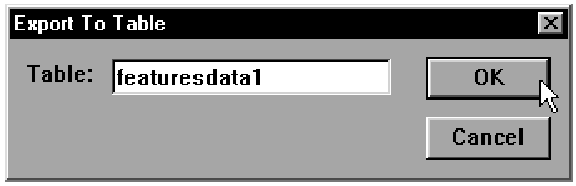
There are three pre-defined exportable databases. Use *QC5000_AC2000.mdb* and *QC5000_AC97.MDB* to export to Access2000 and Access97 respectively. Use QC5000.mdb to export to all other database applications.

NOTE

Pre-defined 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 pre-defined QC5000 databases.

Step 6

Open Access to view the data in the table.

FeatureData1 : 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

Chapter 5
Advanced Measuring & Output

Datum Magic

Datum magic is an automated tool designed to help the user create a datum. A series of dialog boxes guides the user to create the primary plane, secondary alignment, and tertiary alignment. Using datum magic is the fastest and easiest way to establish a datum on most parts.

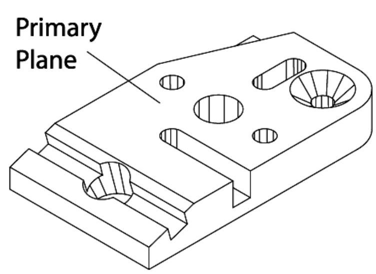
NOTE

Datum magic requires the use of a primary plane. Primary cones and cylinders are not allowed with datum magic.

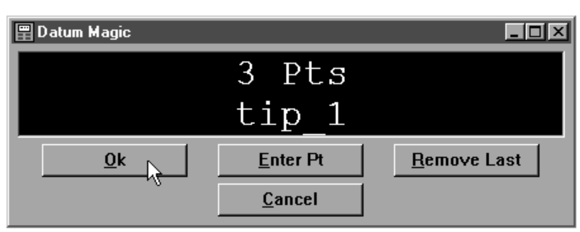
To create a datum using datum magic

Step 1
Click the *datum magic* button on the datum toolbar.

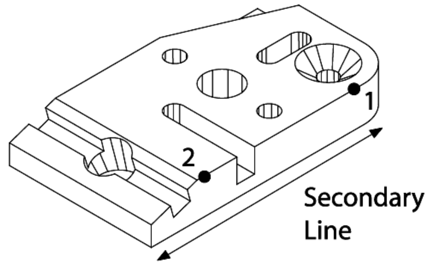
Step 2
Measure three points on the plane as shown.



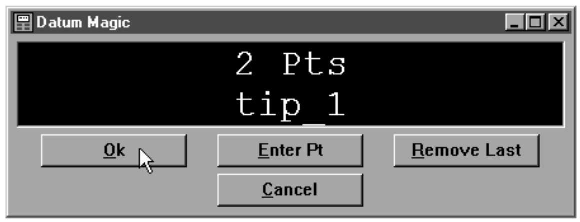
Step 3
Click OK in the dialog box.



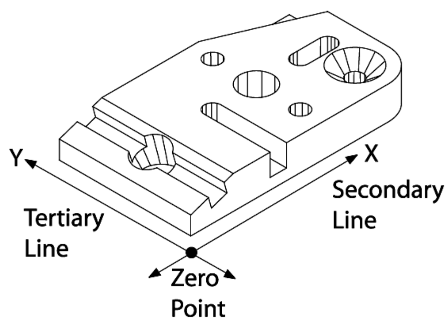
Step 4
Probe two points on the secondary line as shown.



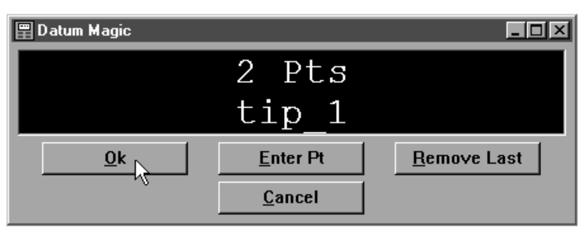
Step 5
Click OK in the dialog box.



Step 6
Probe two points on the tertiary alignment as shown.



Step 7
Click OK in the dialog box.

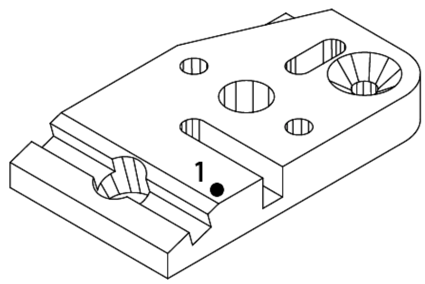


Measure Magic

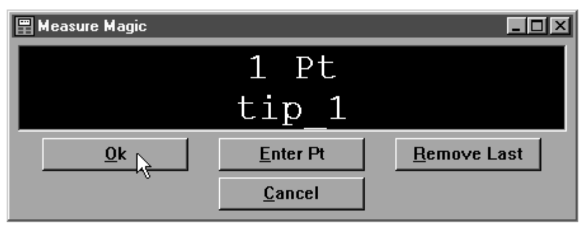
Measure magic is an automated tool designed to help the user measure features. Activate measure magic by probing a feature. Click OK in the measure magic dialog box to complete the measurement. The new feature will appear in the part view window and on the features list. Use measure magic to measure the following types of features: points, lines, arcs, circles, planes, cones, cylinders, spheres. Measure magic cannot measure slots, distances, or angles.

To measure a point using measure magic

Step 1
Probe the point as shown.

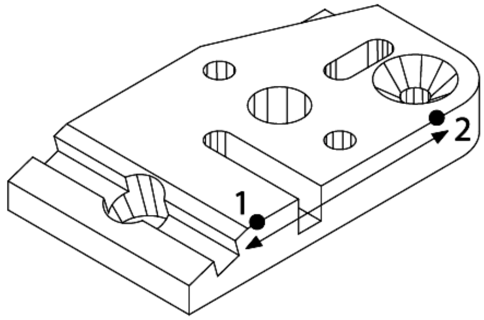


Step 2
Click OK in the dialog box.



To measure a line using measure magic (2 points)

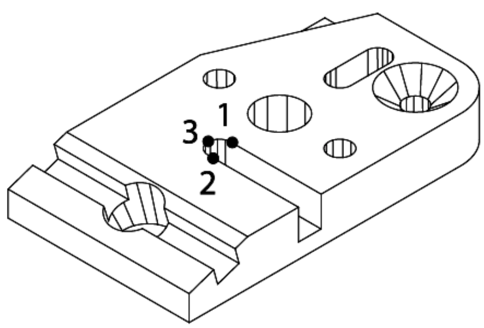
Step 1
Probe two points on the line as shown.



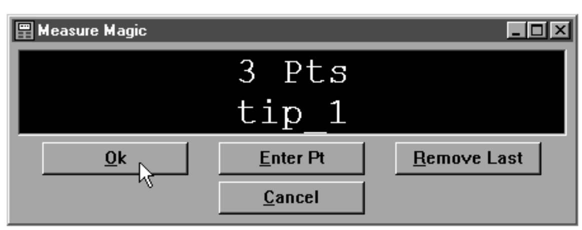
Step 2
Click OK in the dialog box.

To measure an arc using measure magic (3 points)

Step 1
Probe three points on the arc as shown.

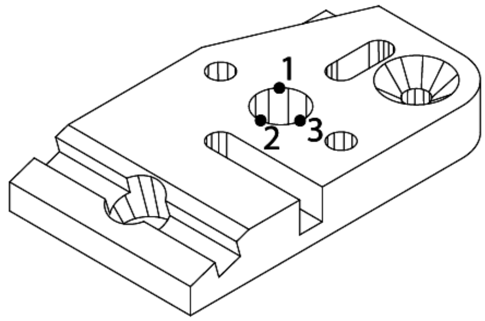


Step 2
Click OK in the dialog box.

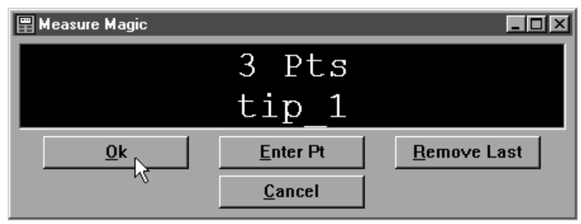


To measure a circle using measure magic (3 points)

Step 1
Probe three points on the circle as shown.

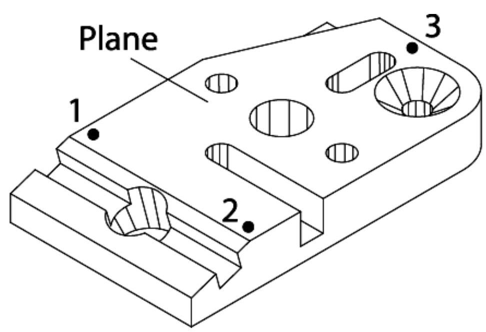


Step 2
Click OK in the dialog box.

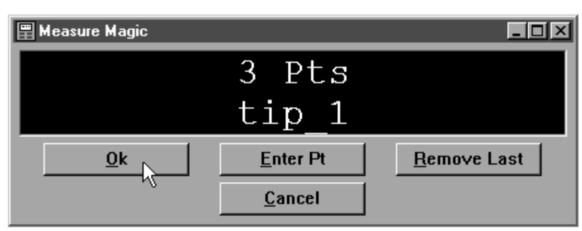


To measure a plane using measure magic (3 points)

Step 1
Probe three points on the plane as shown.

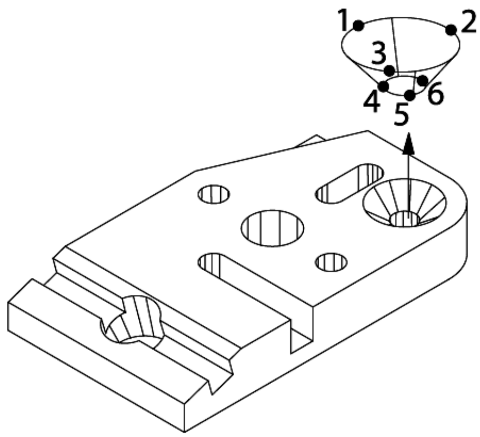


Step 2
Click OK in the dialog box.

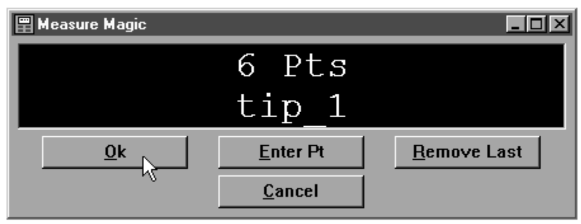


To measure a cone using measure magic (6 points)

Step 1
Probe six points on the cone as shown.

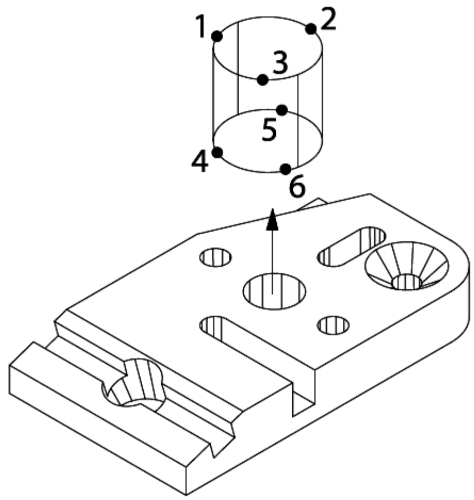


Step 2
Click OK in the dialog box.

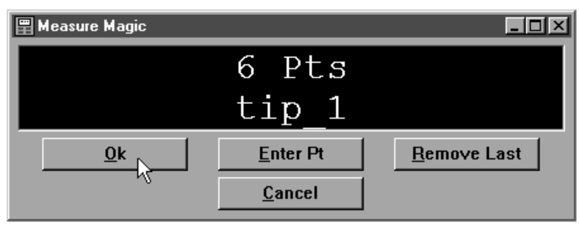


To measure a cylinder using measure magic (6 points)

Step 1
Probe six points on the cylinder as shown.

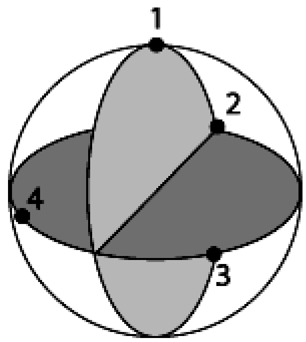


Step 2
Click OK in the dialog box.

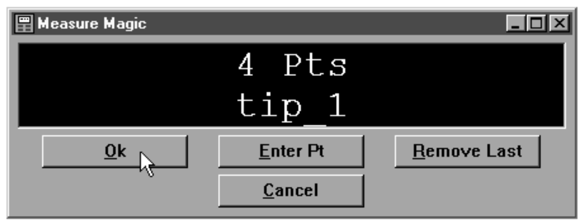


To measure a sphere using measure magic (4 points)

Step 1
Probe four points on the sphere as shown.



Step 2
Click OK in the dialog box.



Layers

The part view window is made up of layers similar to a CAD drawing. Each layer contains features and can be displayed alone or with other layers. This allows the user to sort features into related groups and assign them to one layer. Layers can be hidden from view, turned on/off, and assigned colors.

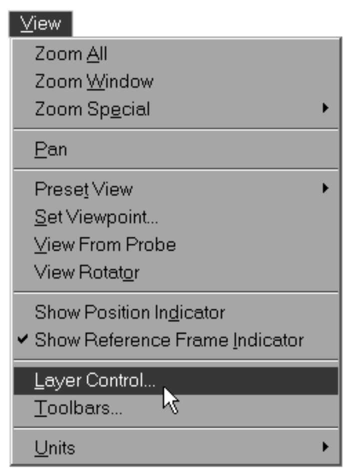
Assign features that are related or likely to be viewed together to the same layer. This allows features to be selected as layer instead of selecting each feature individually.

NOTE

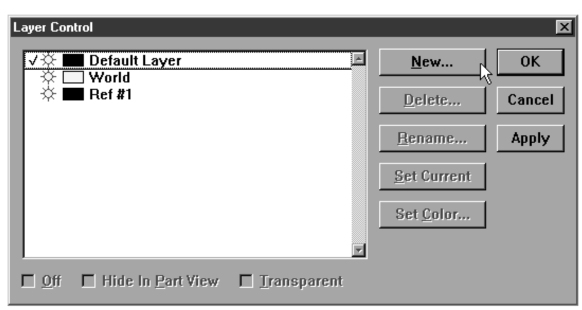
The features in the following procedures are for demonstration purposes only. These procedures will work with any features you choose.

To create a new layer

Step 1
Select *layer control* from the view menu.



Step 2
Click the *new* button in the dialog box.



Step 3
Type the desired name of the new layer in the text box and click OK.

NOTE

This demonstration uses layers named as follows:

- **Primary Layer**
- **Cylinders**
- **Distances**

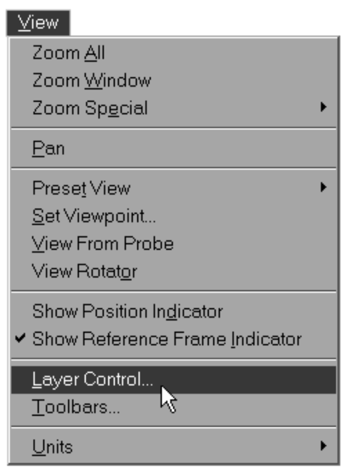
Create these layers to follow along with this demonstration.

Current Layer

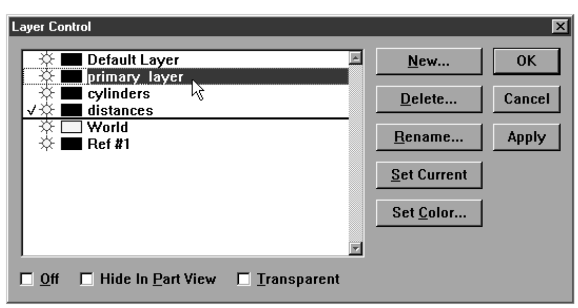
All new features are assigned to the current layer.

To set a layer as current

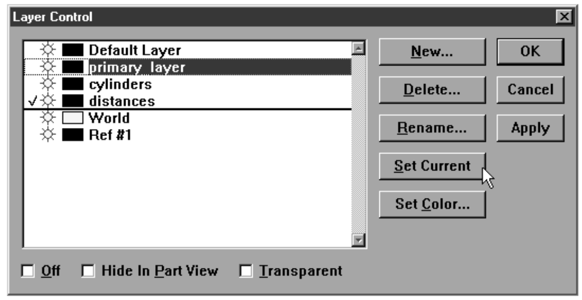
Step 1
Select *layer control* from the view menu.



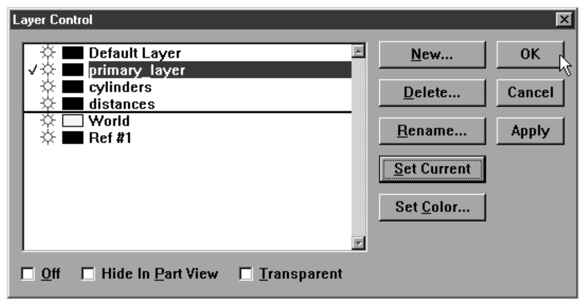
Step 2
Highlight the desired layer as shown.



Step 3
Click the *set current* button. A checkmark indicates that the layer is now the current layer.

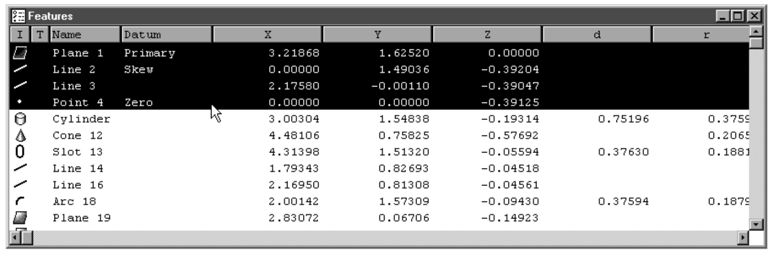


Step 4
Click OK in the dialog box.



To assign features to new layers

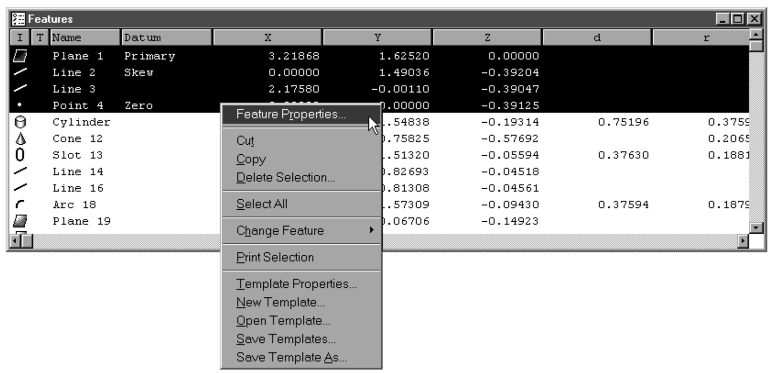
Step 1
Select the desired features from the features list.



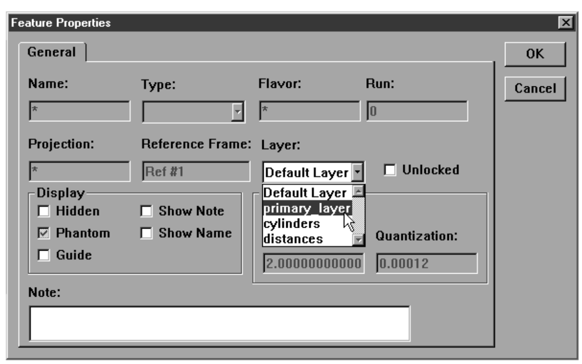
NOTE

Hold down the ctrl key to make multiple selections.

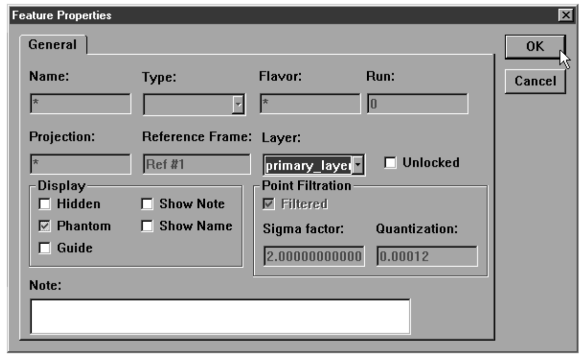
Step 2
Right click and select *features properties* from the list.



Step 3
Select the desired layer from the layers pull down list.



Step 4
Click OK in the dialog box.

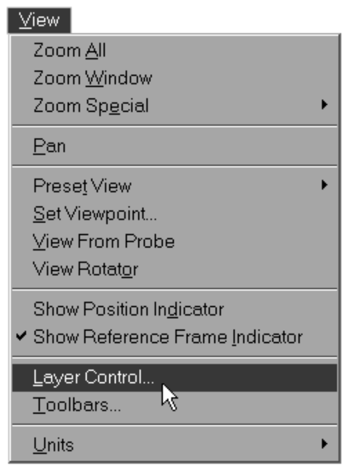


Displaying Layers

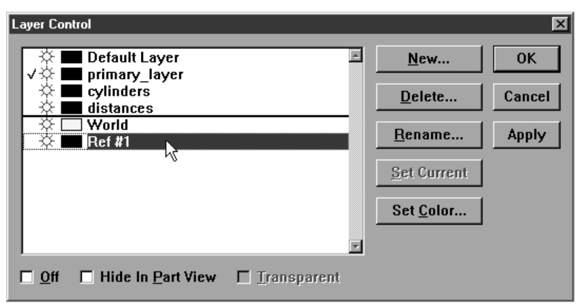
Hiding a layer allows the user to remove a layer (and its features) from the part view window. This allows other layers to be viewed without additional features cluttering the part view. Hidden features remain in the features list even though they are not visible in the part view window.

To hide a layer

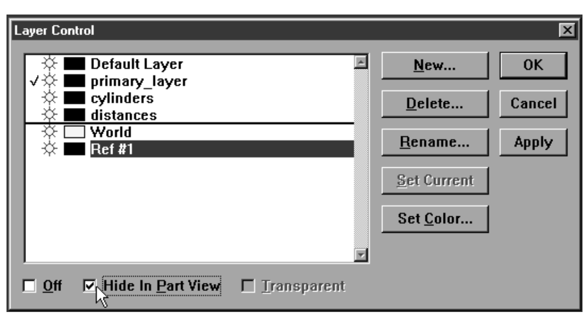
Step 1
Select *layer control* from the view menu.



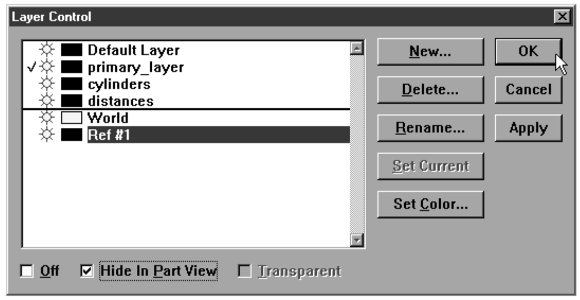
Step 2
Highlight the desired layer as shown.



Step 3
Check the *hide in part view* box as shown.

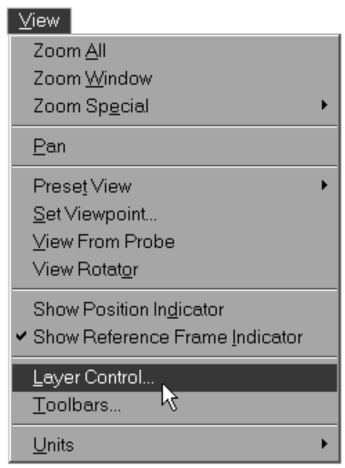


Step 4
Click OK in the dialog box.

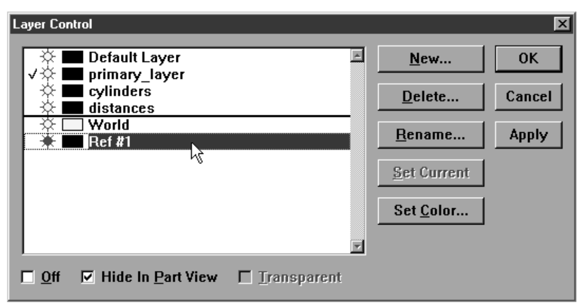


To show a hidden layer

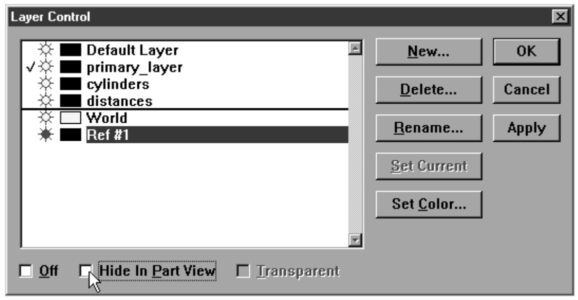
Step 1
Select *layer control* from the view menu.



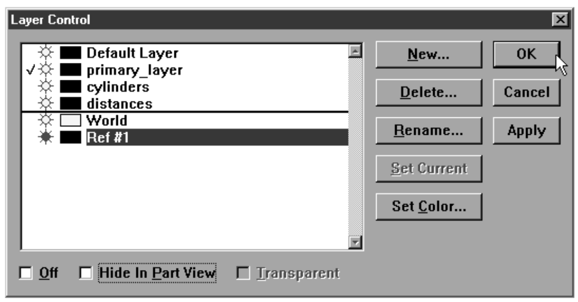
Step 2
Highlight the desired layer as shown.



Step 3
Uncheck the *hide in part view* box as shown.



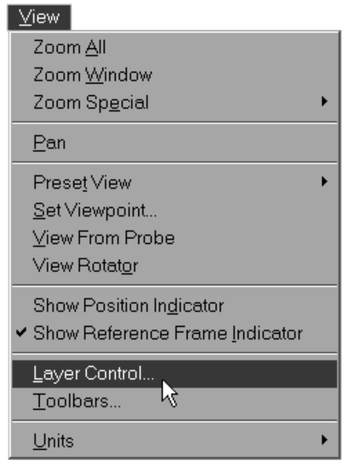
Step 4
Click OK in the dialog box.



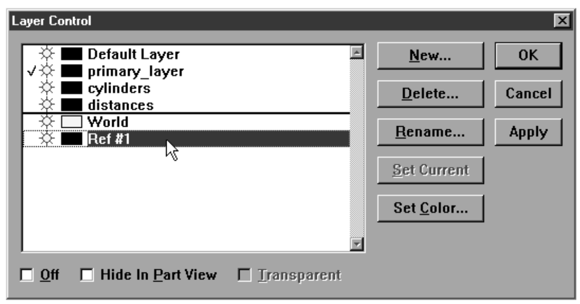
Turning a layer off completely removes the layer (and its features) the the part view window and the part file itself. Features onlayers that are off are no longer displayed in the features list. Turn the layer on to restore the features to the features list and the part file.

To turn off a layer

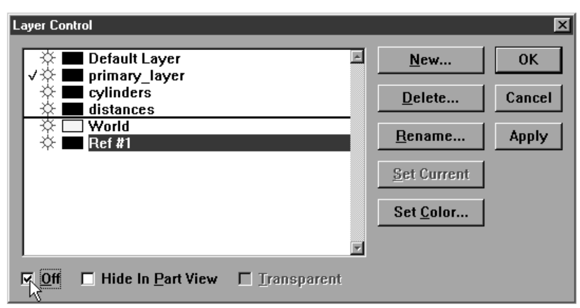
Step 1
Selct *layer control* from the view menu.



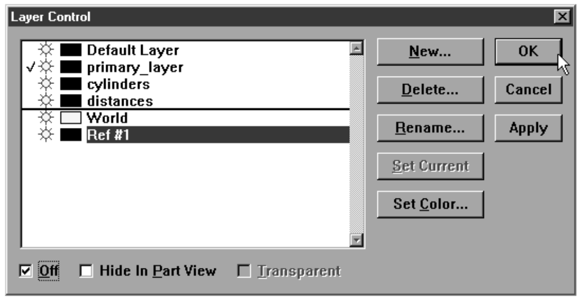
Step 2
Highlight the desired layer as shown.



Step 3
Check the *off* box as shown

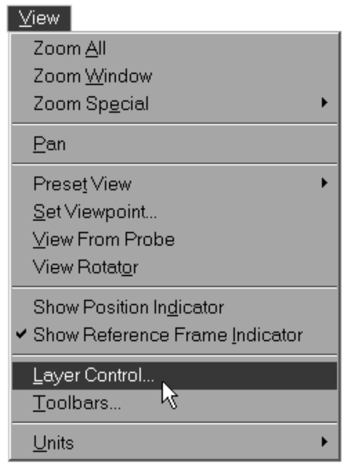


Step 4
Click OK in the dialog box.

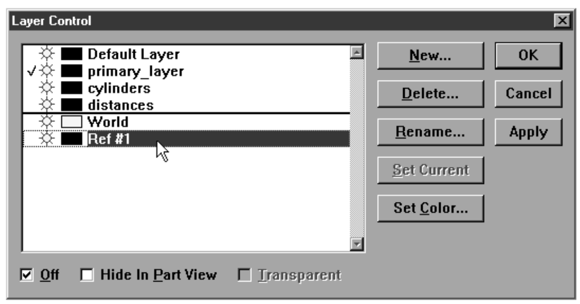


To turn on a layer

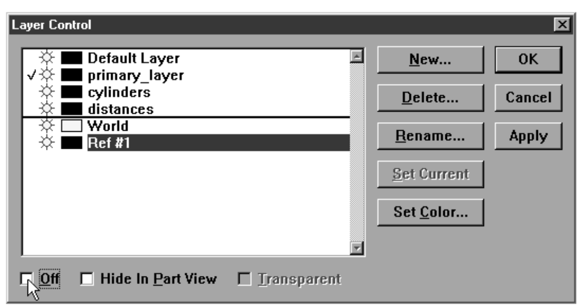
Step 1
Select *layer control* from the view menu.



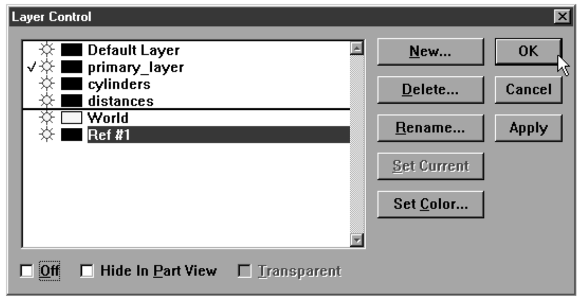
Step 2
Highlight the desired layer as shown.



Step 3
Uncheck the *off* box as shown.



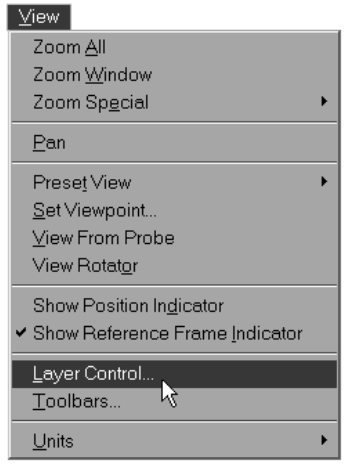
Step 4
Click OK in the dialog box.



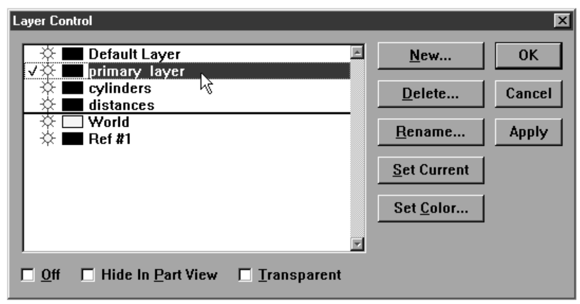
Assign colors to distinguish layers from one another. For example, features used to construct the reference frame can be assigned to a layer. This layer can be assigned the color black. All features of this layer appear black in the part view window.

To assign a color to a layer

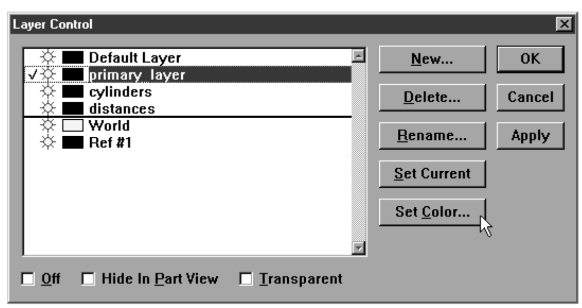
Step 1
Select *layer control* from the view menu.



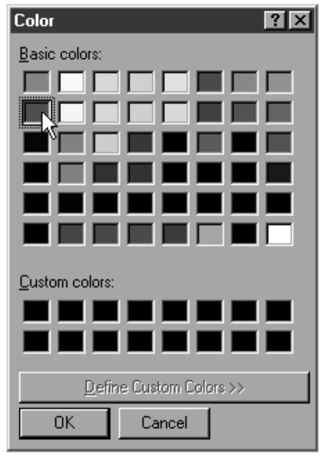
Step 2
Highlight the desired layer as shown.



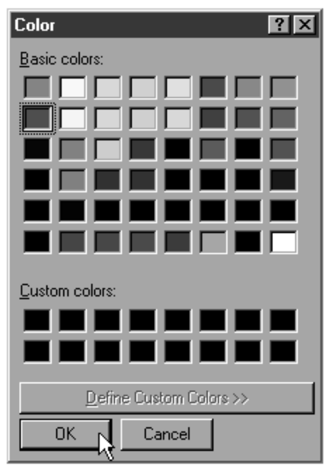
Step 3
Click the *set color* button.



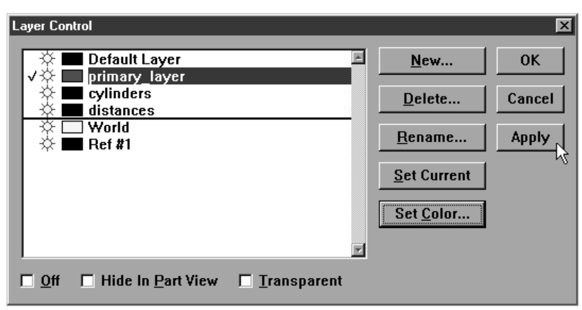
Step 3
Select the desired color.



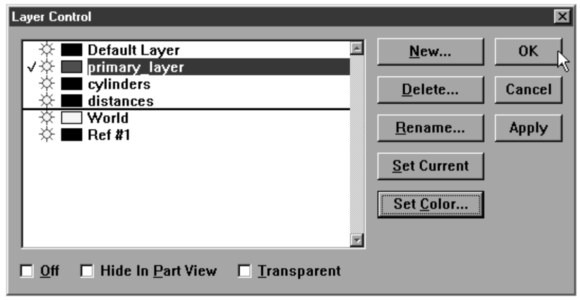
Step 4
Click OK.



Step 5
Click *apply* .



Step 6
Click OK.

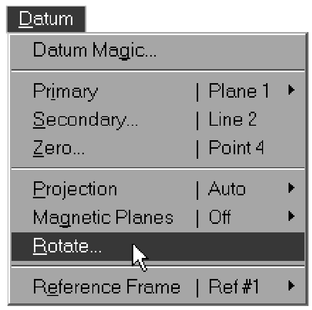


Alternate Datums

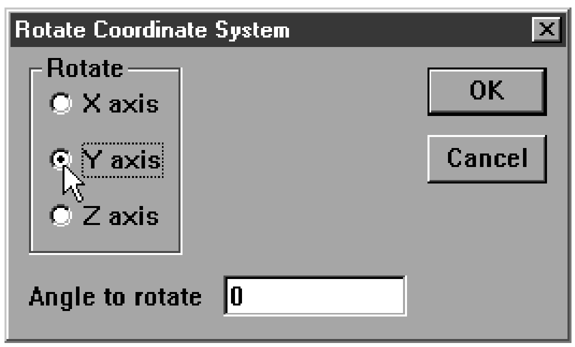
Use the rotate function to rotate the current reference frame. Note the position of the reference frame indicator (RFI) in the part view window. Its relationship to the measured part changes after rotation.

To rotate the reference frame (datum)

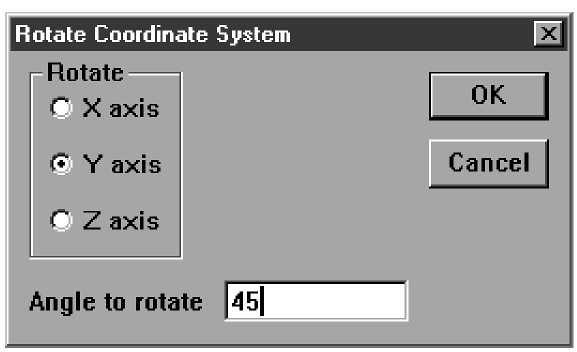
Step 1
Select *rotate* from the datum menu.



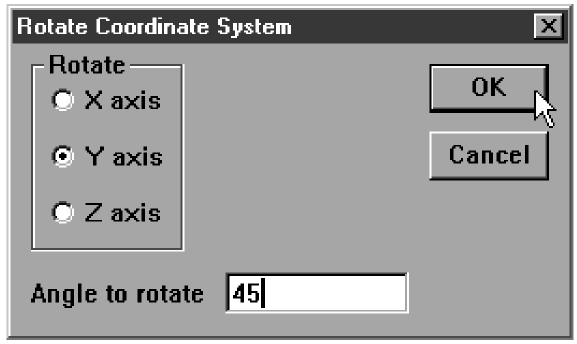
Step 2
Select the axis the reference frame will rotate around as shown.



Step 3
Enter the amount of rotation in degrees.



Step 4
Click OK in the dialog box.



Offset Alignments

Offset alignments require the nominal location of three points. Use non-projected (projection plane is indicated as 3d or off) positonal features.

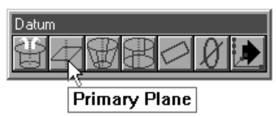
For example, the nominal center points of three positional features is acceptable.

To perform an offset alignment (primary plane)

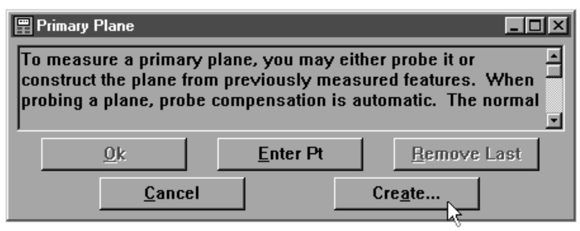
NOTE

It may be simpler to delete all other features from the features list before beginning the offeset alignment. This is optional and is NOT required.

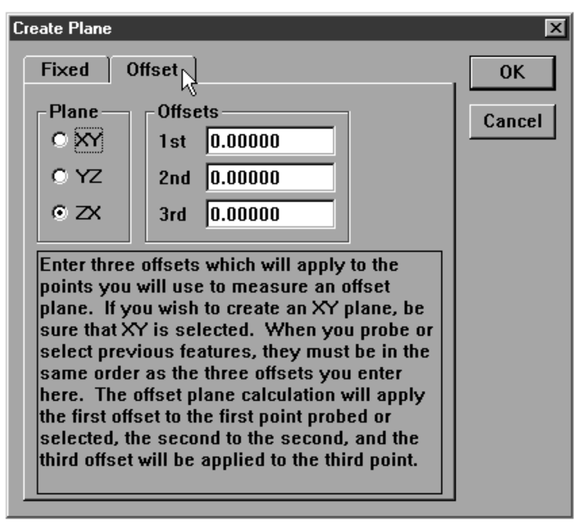
Step 1
Click the *primary plane* button on the datum toolbar.



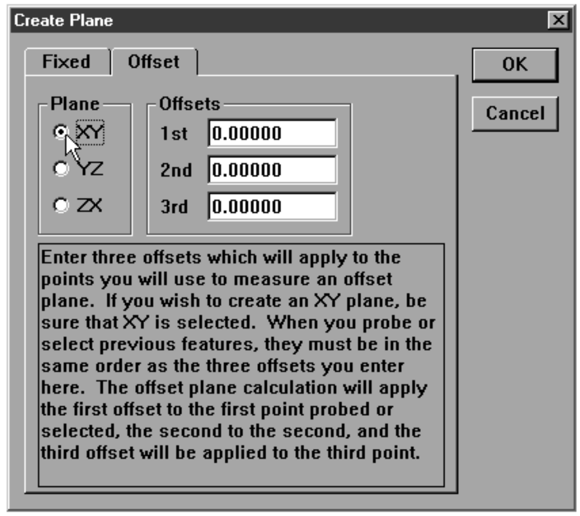
Step 2
Click on *create*.



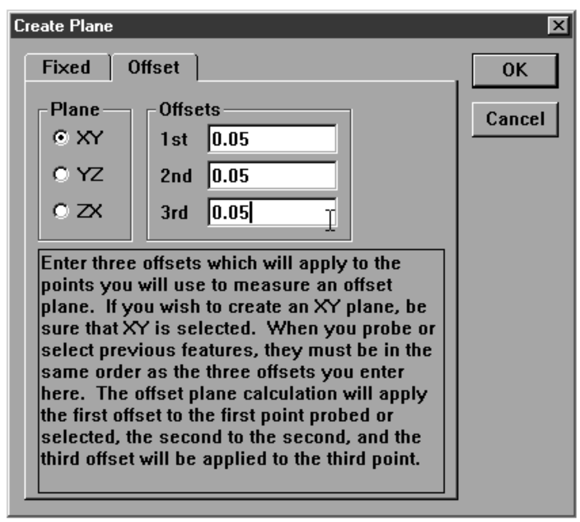
Step 3
Select the *offset* tab.



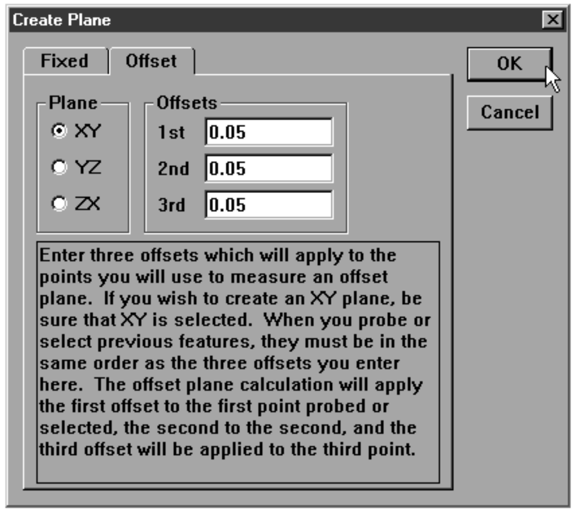
Step 4
Select the desired plane (XY, YZ, ZX) as shown.



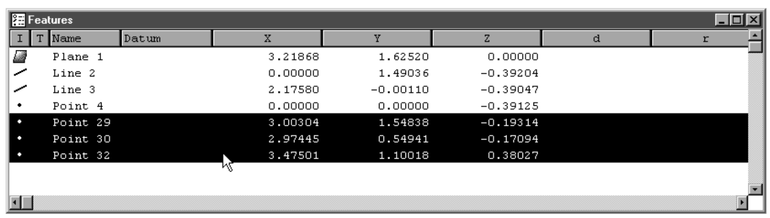
Step 5
Enter the offset value for each of the features as shown.



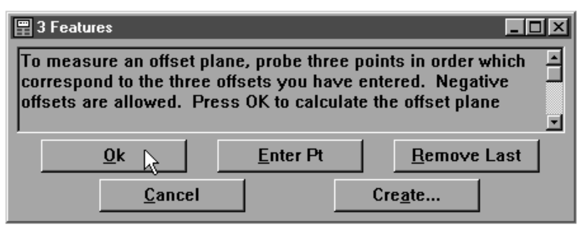
Step 6
Click OK in the dialog box.



Step 7
Highlight the three points (features) in the features list.

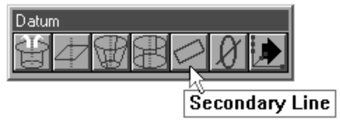


Step 8
Click OK in the measure offset plane dialog box.

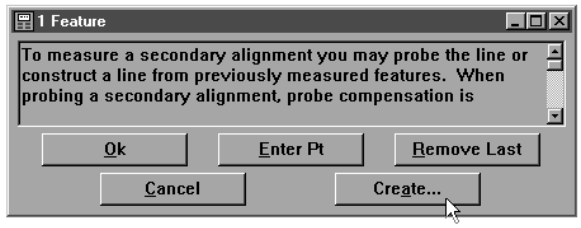


To perform an offest alignment (secondary line)

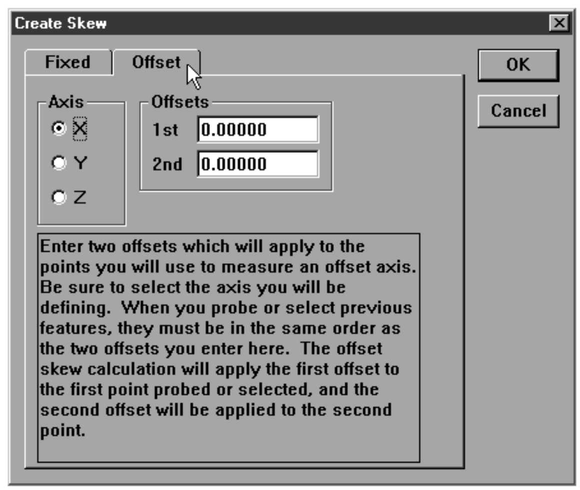
Step 1
Click the secondary line button on the datum toolbar.



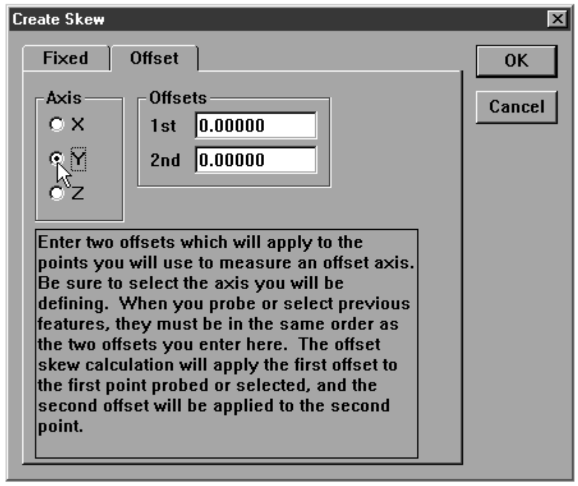
Step 2
Click on create.



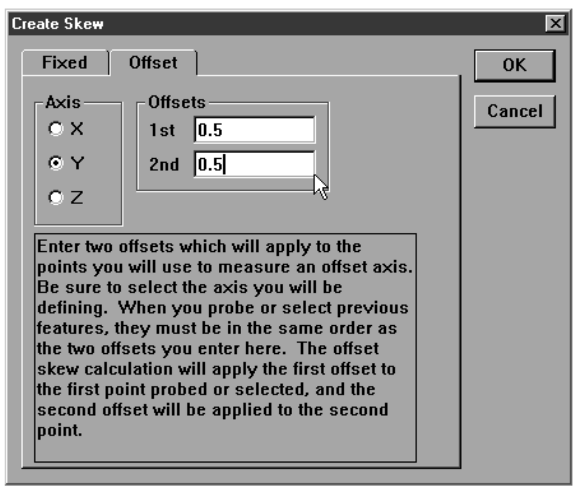
Step 3
Select the offset tab.



Step 4
Set the axis as shown.



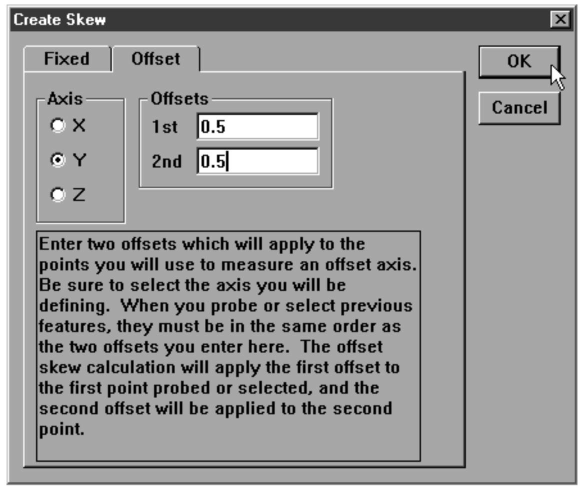
Step 5
Enter the nominal values for two of the points (features).



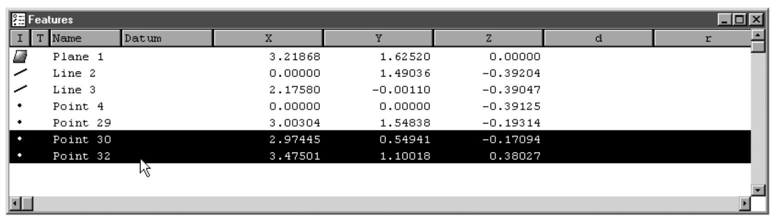
NOTE

Use the nominal values for the axis that is NOT the skew. For example, if the skew is the X axis enter the Y nominal.

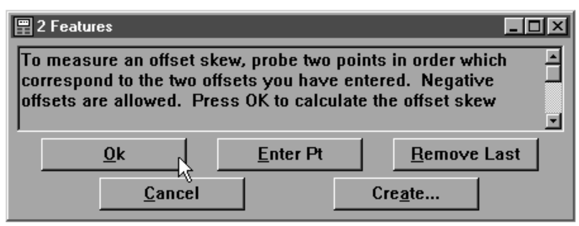
Step 6
Click OK in the dialog box.



Step 7
Highlight the skew points (entered in Step 4) in the features list.

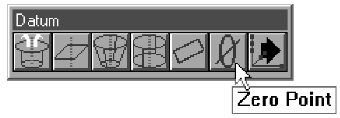


Step 8
Click OK in the secondary line dialog box.

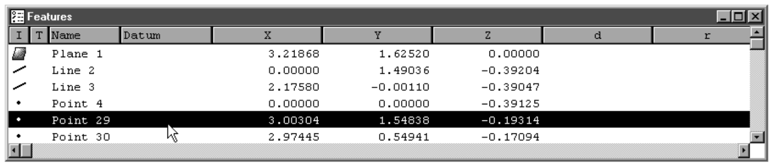


To perform an offest alignment (zero point)

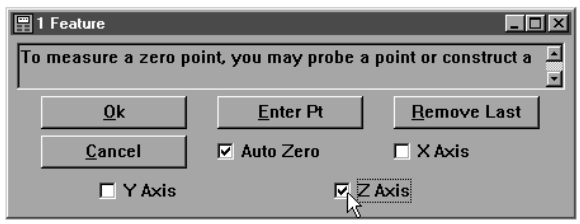
Step 1
Click the *zero point* button on the datum toolbar.



Step 2
Highlight one of the three original points (features) in the features list.



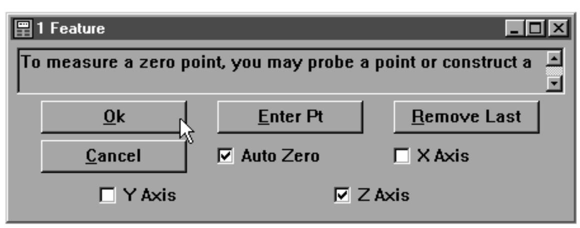
Step 3
Check the axis to be zeroed as shown.



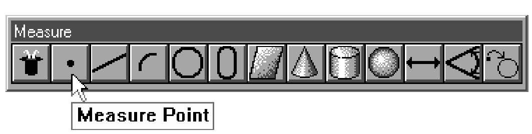
NOTE

Check the axis used as the skew in (secondary line) Step 4. For example, if you input Y nominals in (secondary line) Step 4, check the X axis.

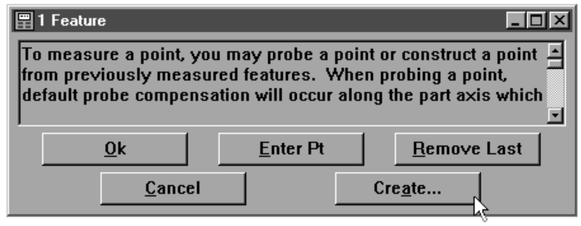
Step 4
Click OK in the dialog box.



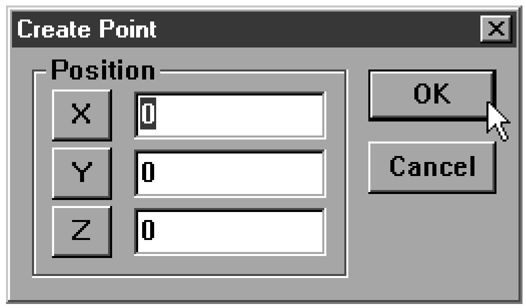
Step 5
Click the *point* button on the measure toolbar.



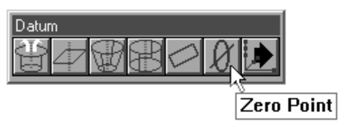
Step 6
Click the *create* button.



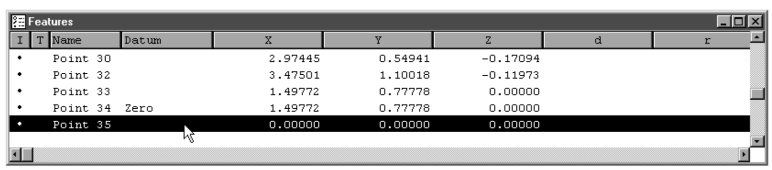
Step 7
Click OK in the dialog box.



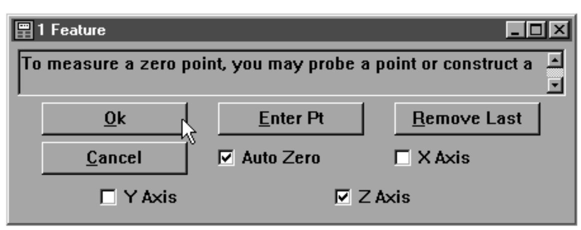
Step 8
Click the *zero* button on the datum toolbar.



Step 9
Highlight the point created in Step 6.



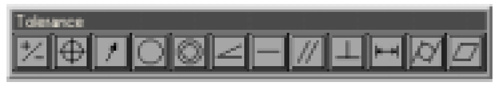
Step 10
Click OK in the dialog box.



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 succesfully use it with the QC5000.

Tolerance Toolbar



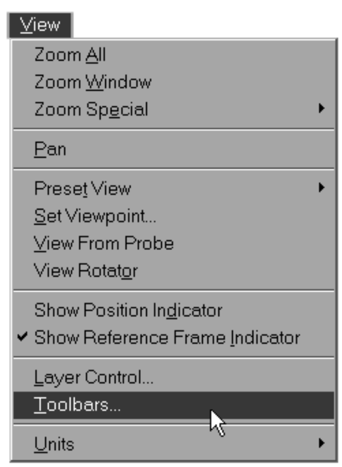
Use the tolerance toolbar to activate any of the 12 tolerance functions supported by the QC5000.

NOTE

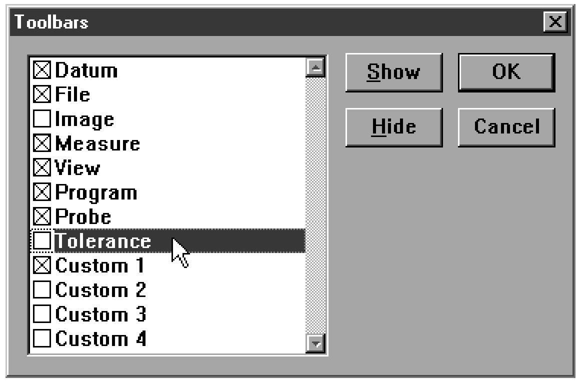
Tolerance is feature dependent. This means that only certain tolerance functions apply to certain features. For example, a cylindricity tolerance cannot be performed on a point.

To view the tolerance toolbar

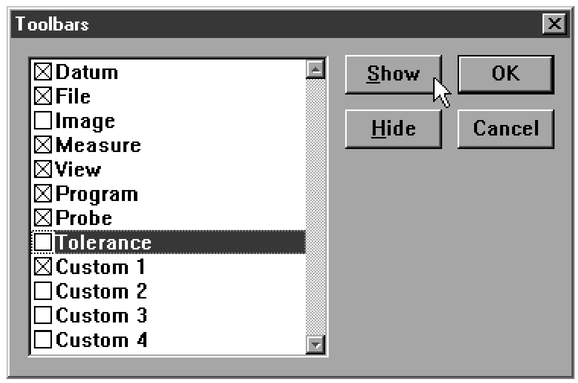
Step 1
Select *toolbars* from the view menu.



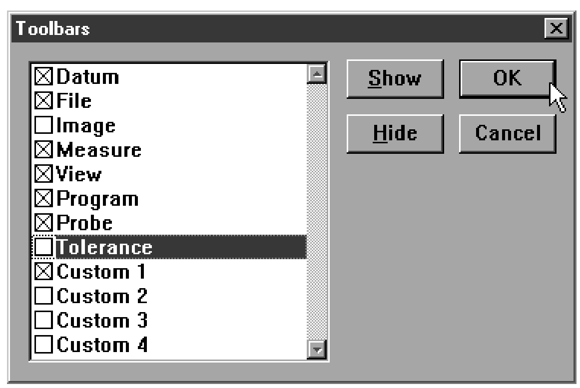
Step 2
Highlight tolerance as shown.



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



Step 4
Click OK in the dialog box.

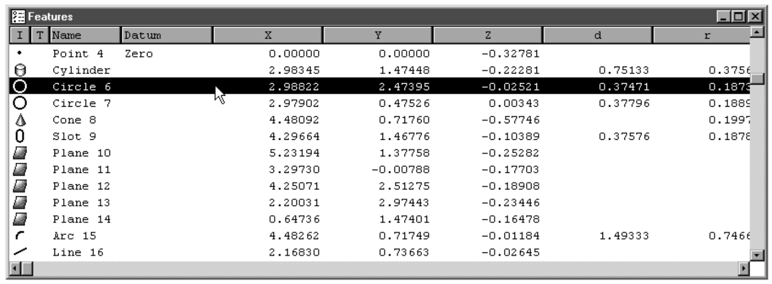


Bi-directional tolerance (circles, points, arcs, spheres)

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.

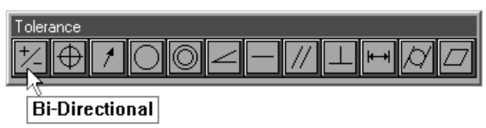


I	T	Name	Datum	X	Y	Z	d	r
		Point 4	Zero	0.00000	0.00000	-0.32781		
		Cylinder		2.98345	1.47448	-0.22281	0.75133	0.3756
		Circle 6		2.98822	2.47395	-0.02521	0.37471	0.1873
		Circle 7		2.97902	0.47526	0.00343	0.37796	0.1889
		Cone 8		4.48092	0.71760	-0.57746		0.1997
		Slot 9		4.29664	1.46776	-0.10389	0.37576	0.1878
		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		

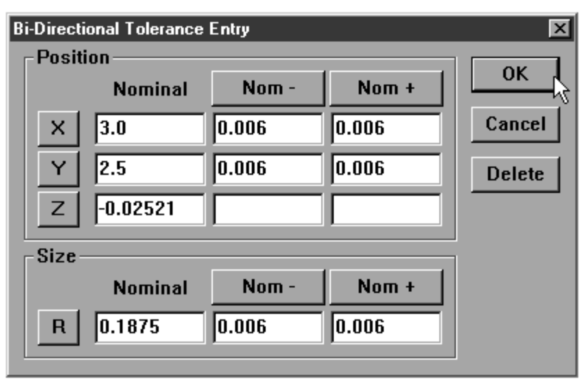
NOTE

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

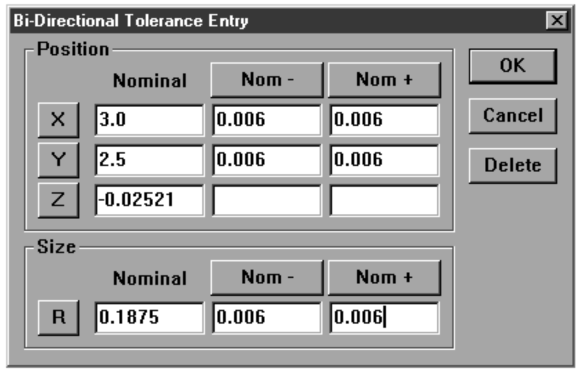
Step 2
Click the *bi-directional* button on the tolerance toolbar.



Step 3
Type the nominal X and Y values for your part in the boxes as shown.



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



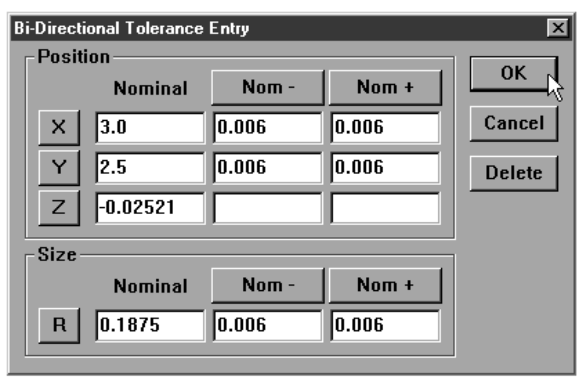
NOTE

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 n0minal - values are 0.006 inches.

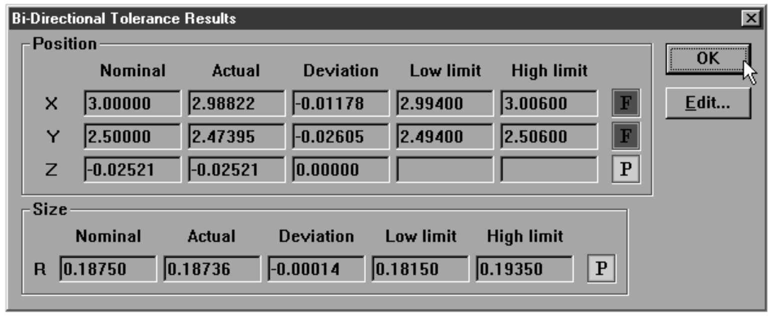
CAUTION

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.

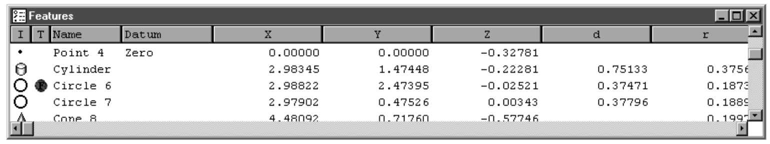


The tolerance result window appears as shown.

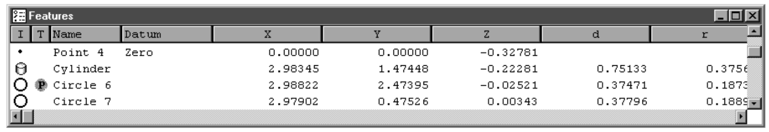


Pass/ Fail Displays

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



Red symbols indicate the feature failed one or more tolerances.



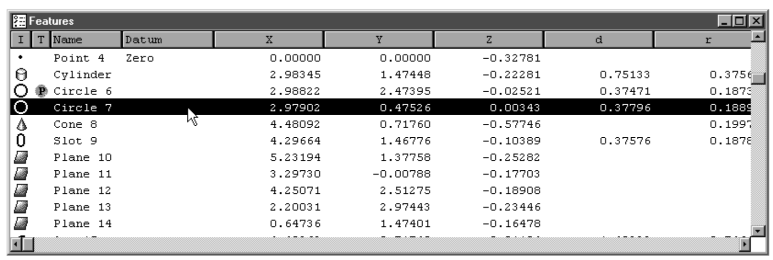
True position tolerance (circles, points arcs, spheres)

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.

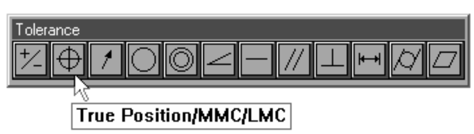


NOTE

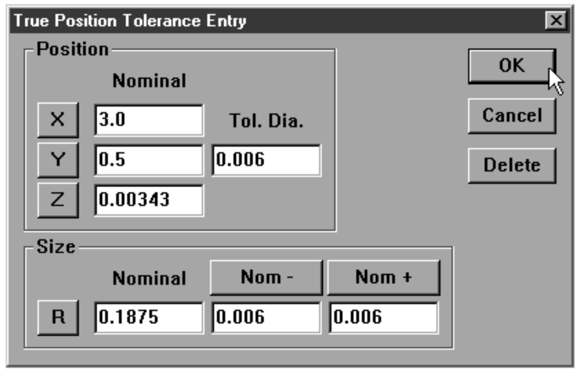
Use only a circle, point, arc, or sphere. True position tolerances do not apply to other types of features.

Step 2

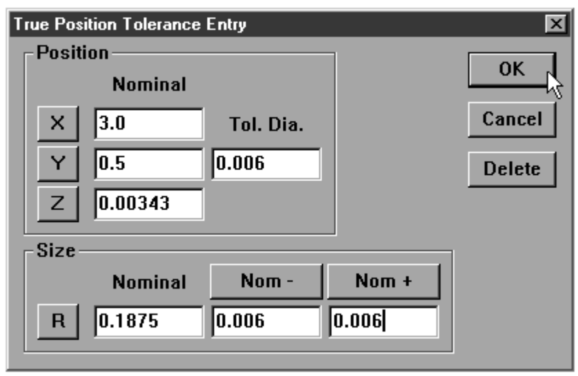
Click the *true position/MMC/LMC* button on the tolerance toolbar.



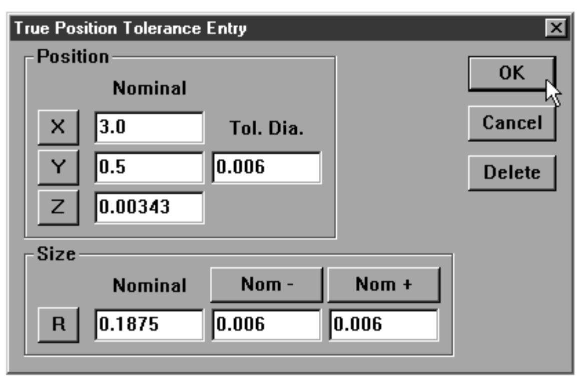
Step 3
Type the nominal X and Y values for your part in the boxes as shown.



Step 4
Enter the specified diameter as shown.



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



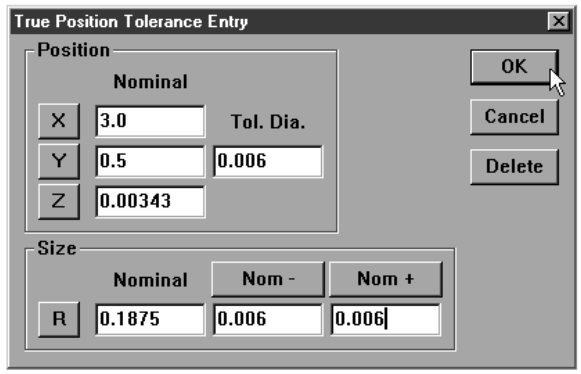
NOTE

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 n0minal - values are 0.006 inches.

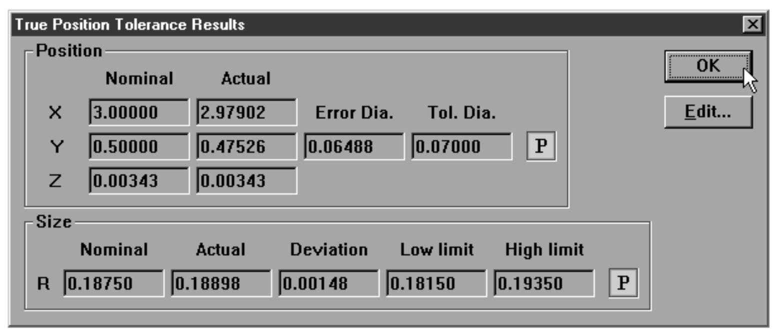
CAUTION

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

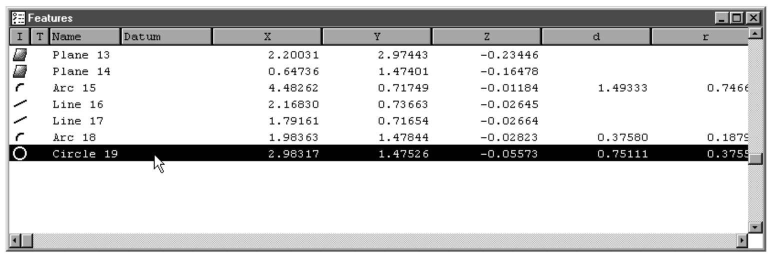
Position and size may have a different pass/fail result from each other. A red fail marker will appear in the features list if either parameter fails.

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

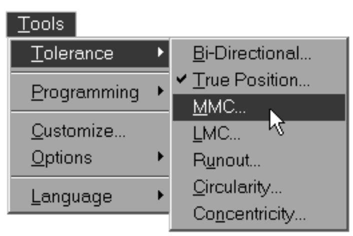
Step 1
Highlight the desired feature in the features list.



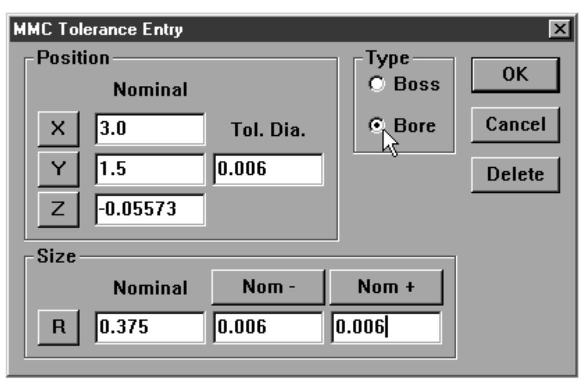
NOTE

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

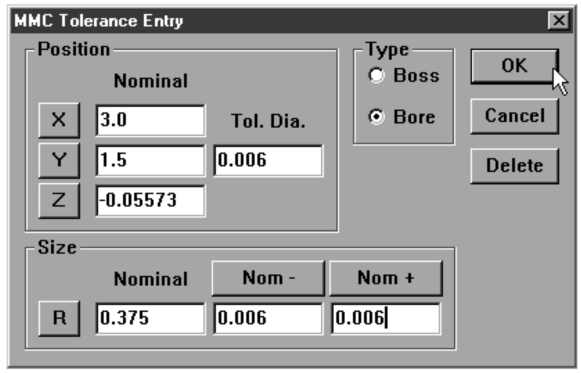
Step 2
Select *tolerance* then *MMC* from the tools menu.



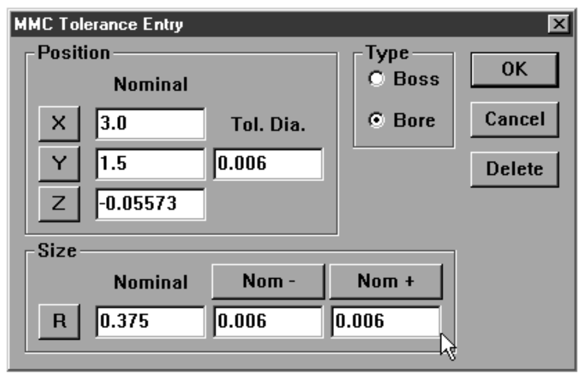
Step 3
Type the nominal X and Y values for your part in the boxes as shown.



Step 4
Enter the specified diameter as shown.



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



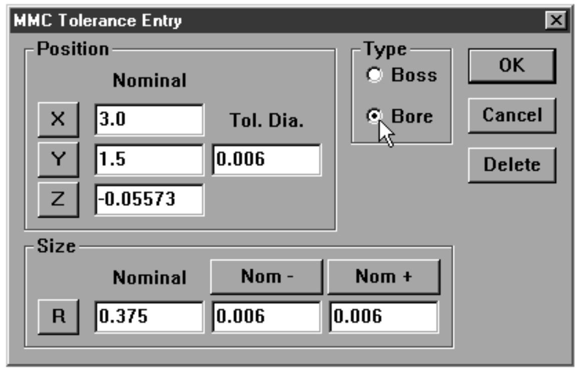
NOTE

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 n0minal - values are 0.006 inches.

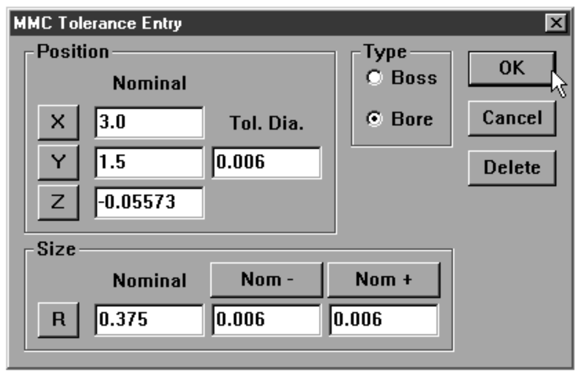
CAUTION

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

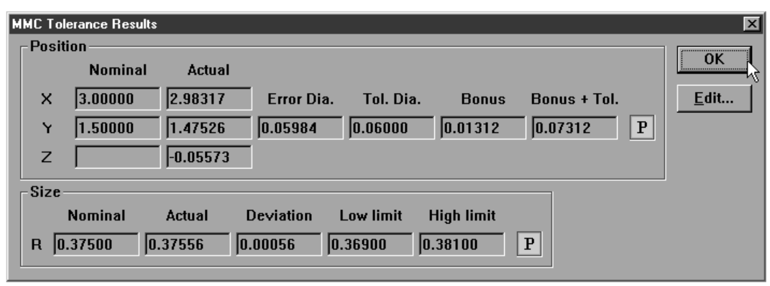
Step 6
Select *boss* or *bore* as shown.



Step 7
Click OK in the dialog box.

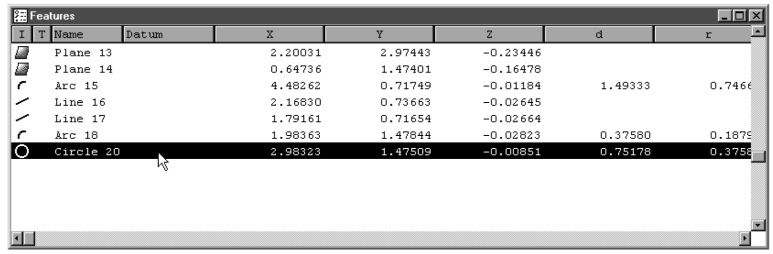


The tolerance result window appears as shown.



To perform a LMC

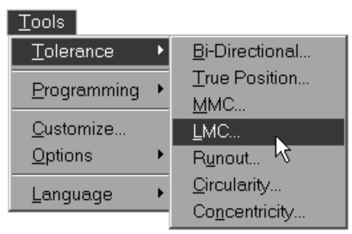
Step 1
Highlight the desired feature in the features list.



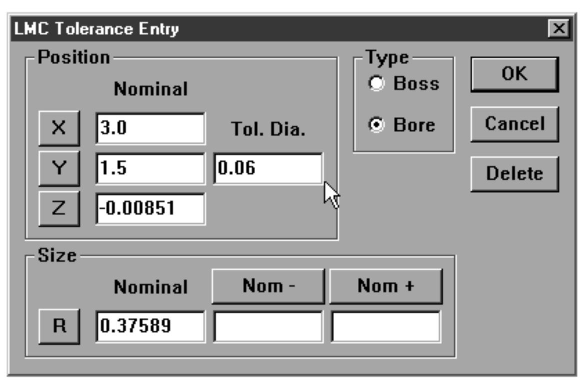
NOTE

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

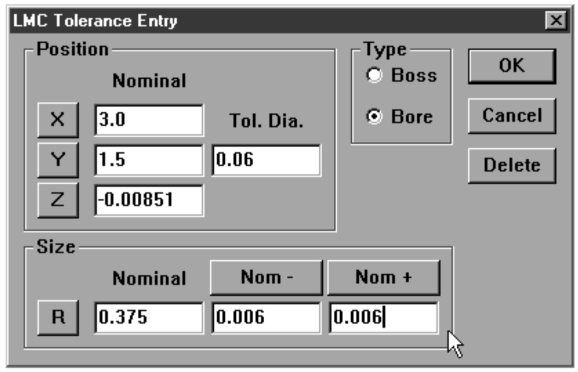
Step 2
Select *tolerance* then *LMC* from the tools menu.



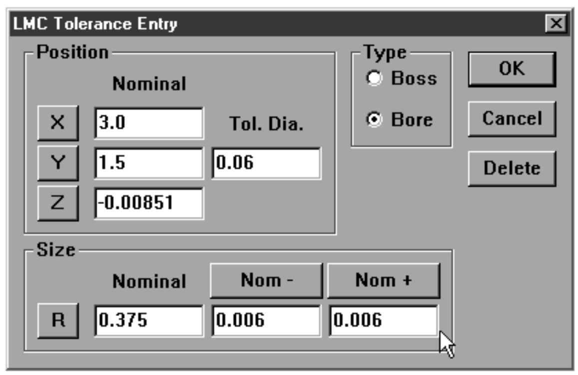
Step 3
Type the nominal X and Y values for your part in the boxes as shown.



Step 4
Enter the specified diameter as shown.



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



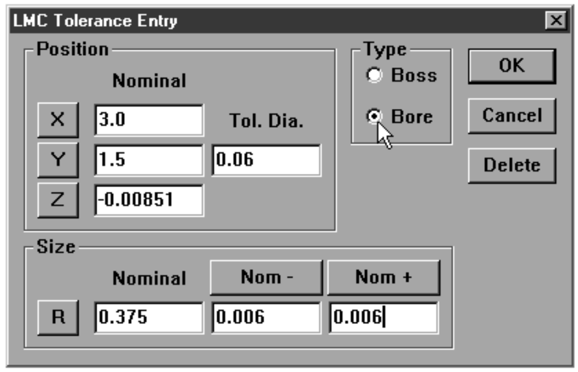
NOTE

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 n0minal - values are 0.006 inches.

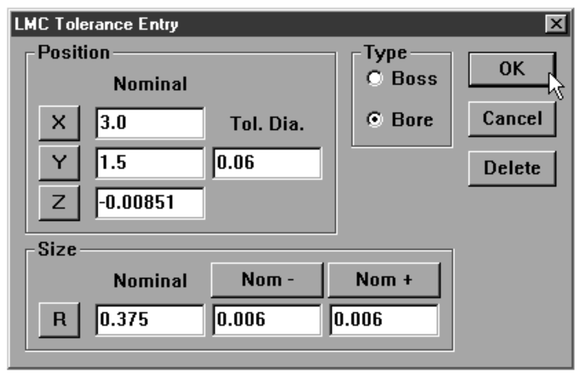
CAUTION

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

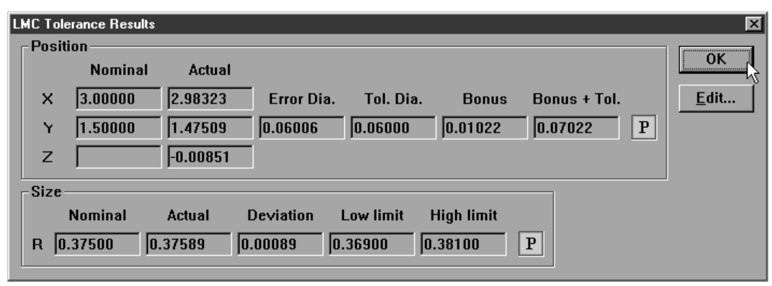
Step 6
Select *boss* or *bore* as shown.



Step 7
Click OK in the dialog box.



The tolerance results window appears as shown.

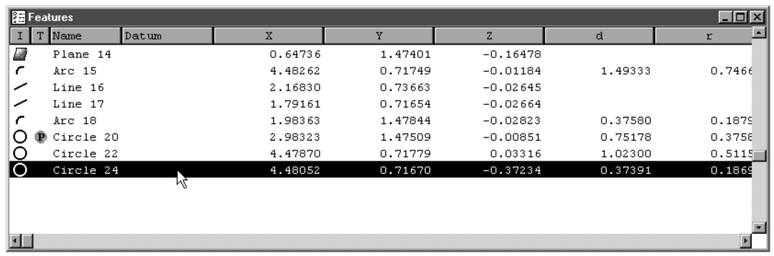


Concentricity tolerance (circles, arcs)

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

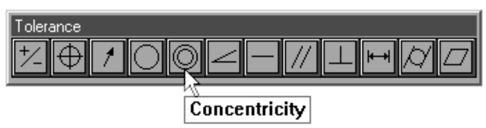
Step 1
Highlight the desired feature in the features list.



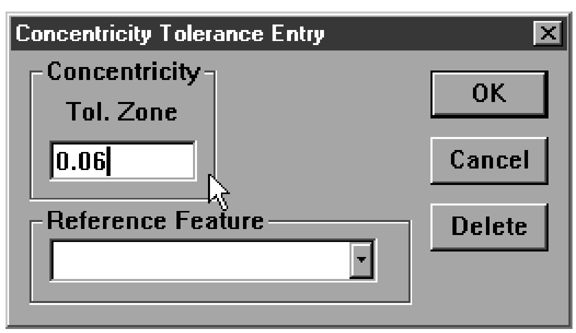
NOTE

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.



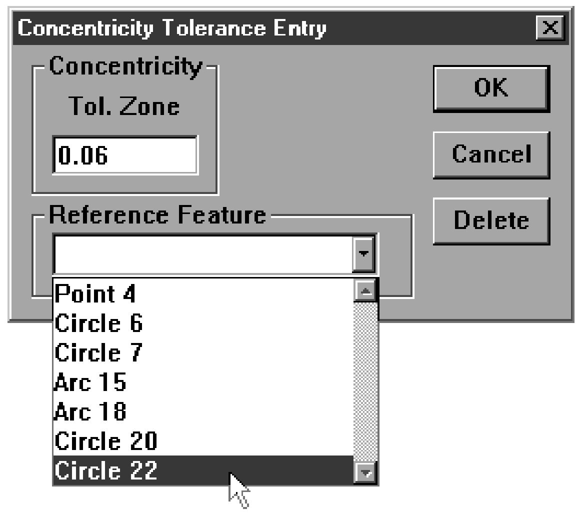
NOTE

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).

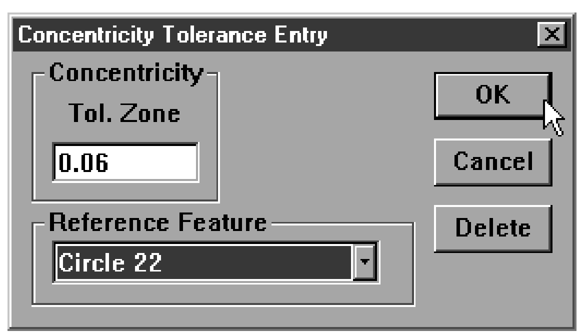
Step 4
Select the reference feature as shown.



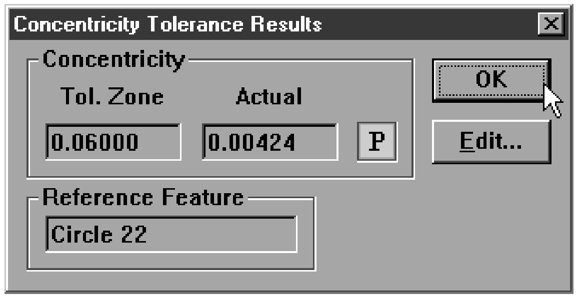
NOTE

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.



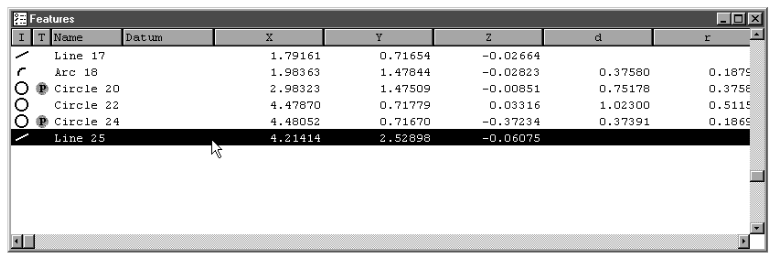
Straightness tolerance (lines)
Use straightness tolerancing to calculate the straightness of a line and pass/fail results. Each point probed on a line is checked against the straightness tolerance. A minimum of three points distributed along the line are required (more points increase accuracy).

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 mimimum of three points when performing a straightness tolerance.

To perform a straightness tolerance (lines)

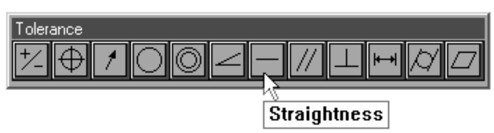
Step 1
Highlight the desired feature in the features list.



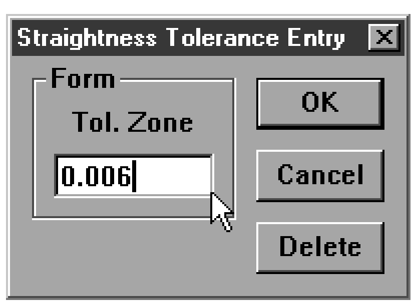
NOTE

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.

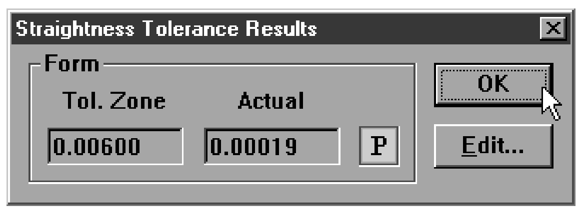


CAUTION

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.

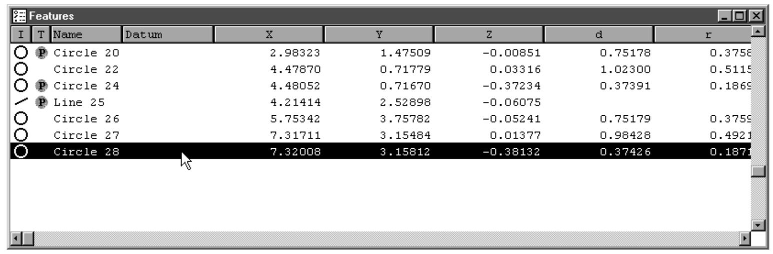


Circularity/sphericity tolerance (circles, spheres)

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 fianl result.

To perform a circularity tolerance

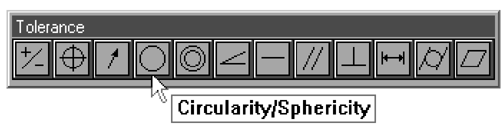
Step 1
Highlight the desired feature in the features list.



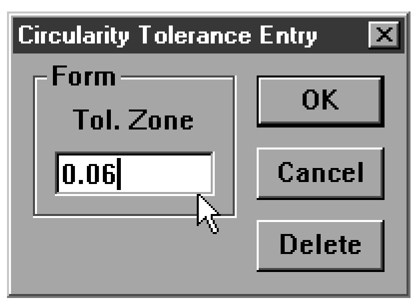
NOTE

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.



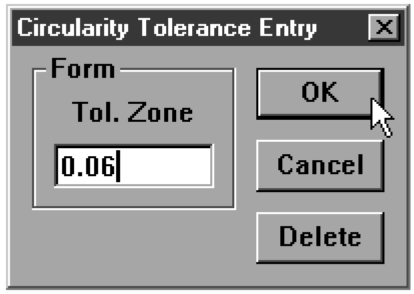
Step 3
Enter a value in the tolerance zone box as shown.



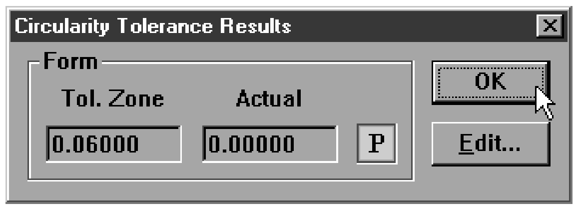
CAUTION

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.

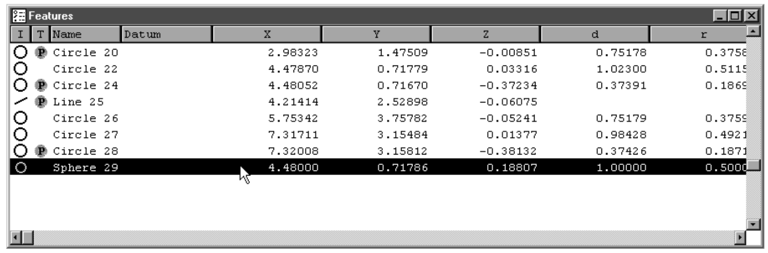


The tolerance results window appears as shown.



To perform a sphericity tolerance

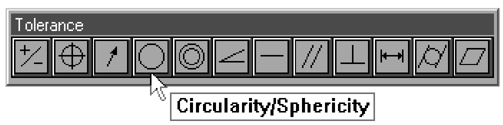
Step 1
Highlight the desired feature in the features list.



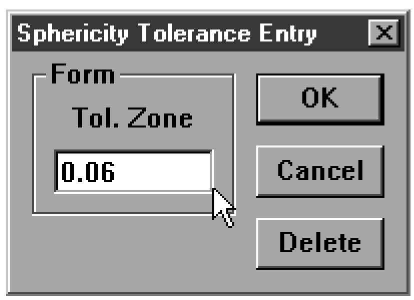
NOTE

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.



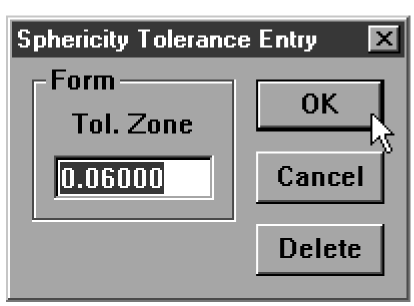
Step 3
Enter a value in the *tolerance zone* box as shown.



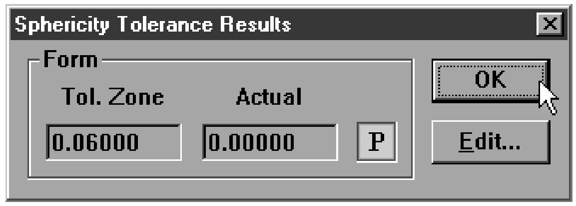
CAUTION

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.

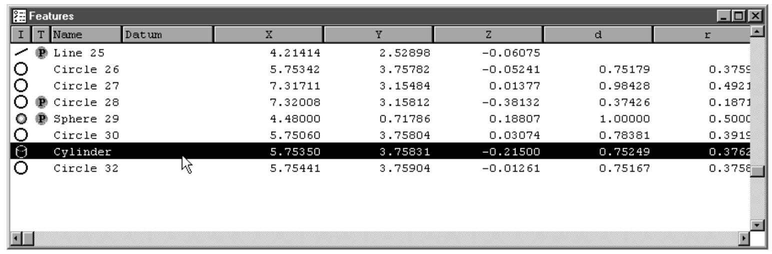


Cylindricity tolerance (cylinders)

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

To perform a cylindricty tolerance

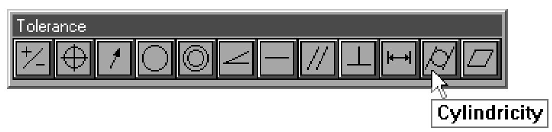
Step 1
Highlight the desired feature in the features list.



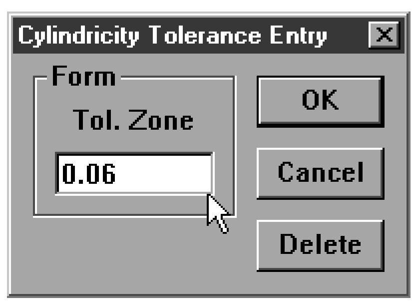
NOTE

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

Step 2
Click the *cylindricity* button on the tolerance toolbar.



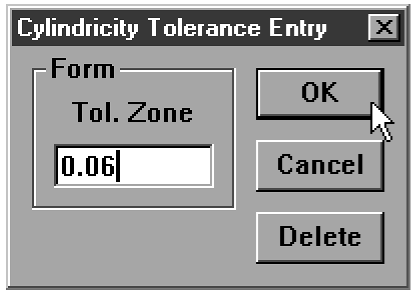
Step 3
Enter a value in the tolerance zone box as shown.



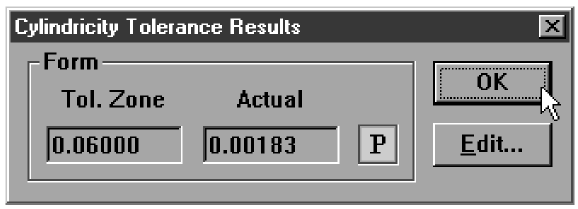
CAUTION

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.



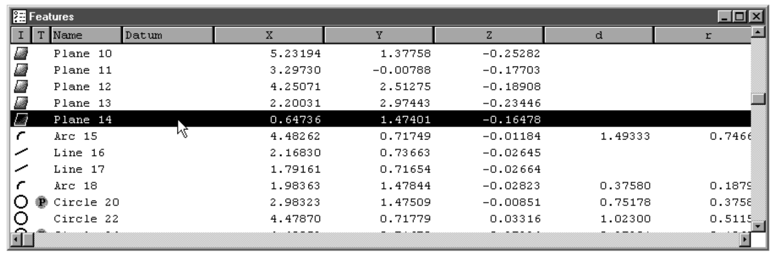
Flatness tolerance (planes)

Use flatness to specify form tolerance for planes. Flatness tolerances require a minumum 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.

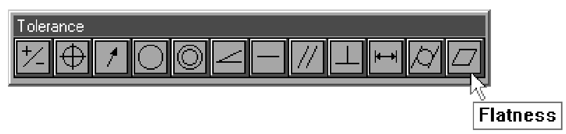


NOTE

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

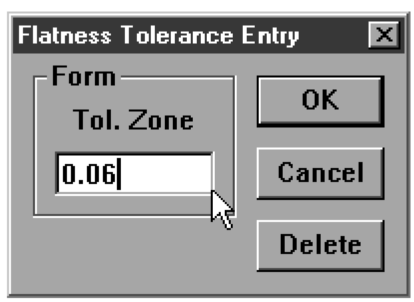
Step 2

Click the *flatness* button on the tolerance toolbar.



Step 3

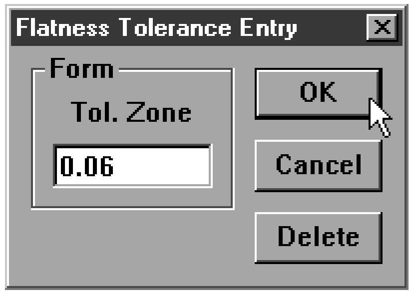
Enter a value in the tolerance zone box as shown.



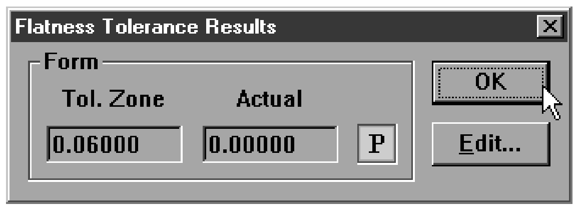
CAUTION

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.

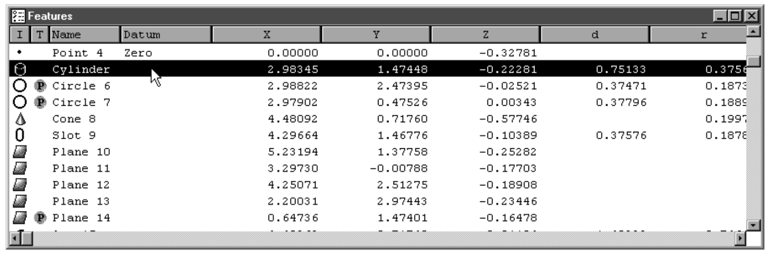


Perpendicularity tolerance (lines, cylinders, cones)

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 tolerence feature. Specify the diameter of the cylindrical tolerance zone to create the tolerance.

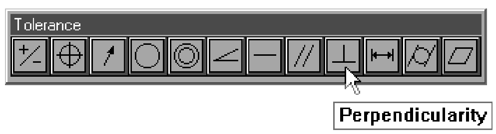
To perform a perpendicularity tolerance

Step 1
Highlight the desired feature in the features list.

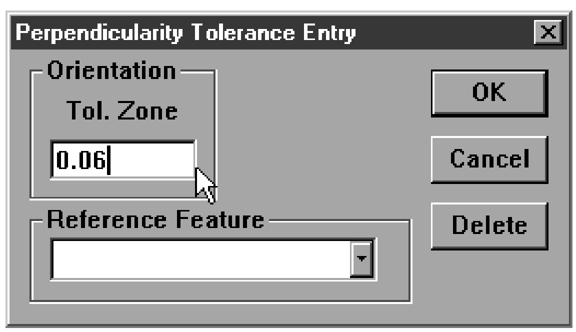


NOTE
Use a linear features only. Perpendicularity tolerances do not apply to other types of features.

Step 2
Click the *perpendicularity* button on the tolerance toolbar.



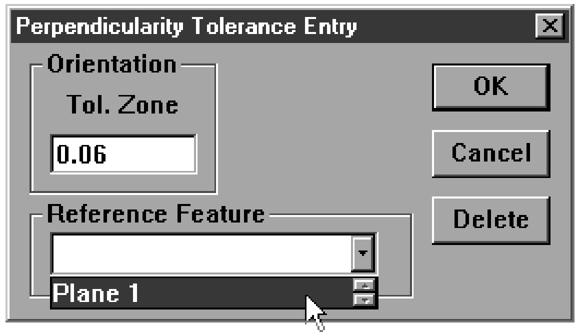
Step 3
Enter a value in the tolerance zone box as shown.



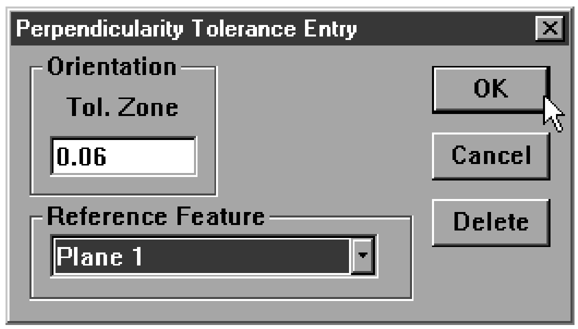
CAUTION

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

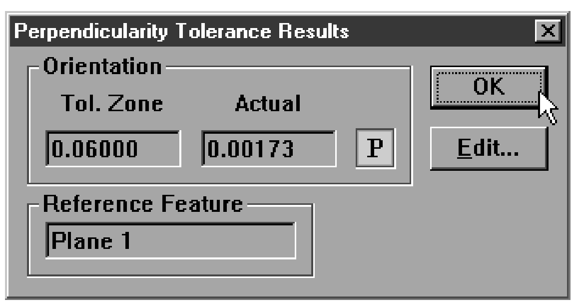
Step 4
Select a reference feature from the pull down list.



Step 5
Click OK in the dialog box.



The tolerance result window appears as shown.



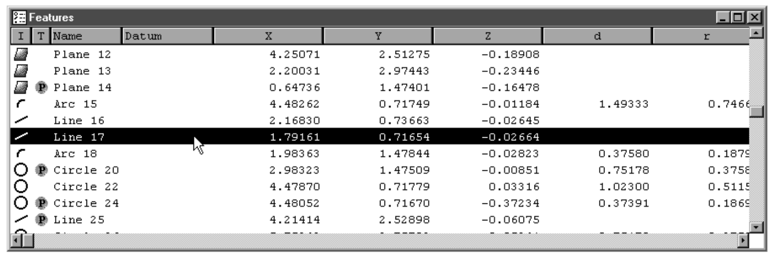
Parallelism/Co-planarity tolerance (linear features)

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 tolerence feature. Specify the diameter of the cylindrical tolerance zone to create the tolerance.tolerancing compares the orientation of the axis of the toleranced 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

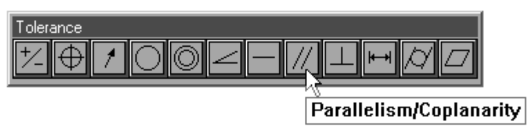
Step 1
Highlight the desired feature in the features list.



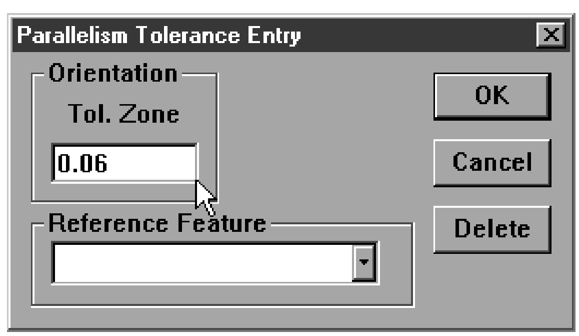
NOTE

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.



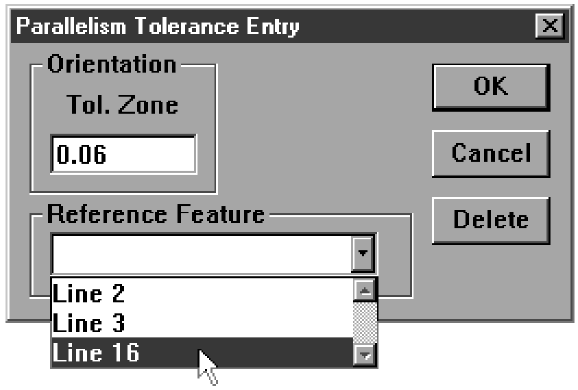
Step 3
Enter a value in the *tolerance zone* box as shown.



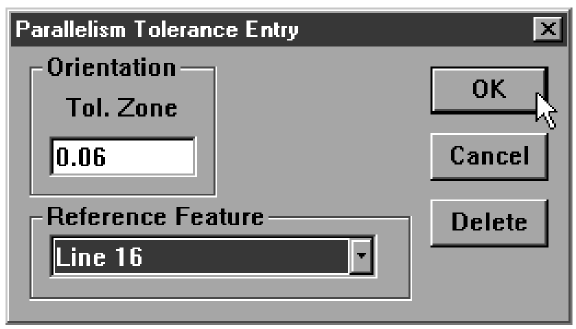
CAUTION

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

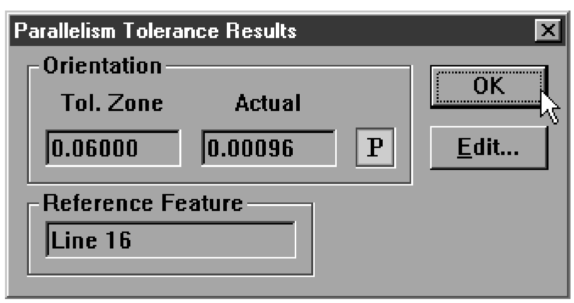
Step 4
Select a reference feature from the pull down list.



Step 5
Click OK in the dialog box.

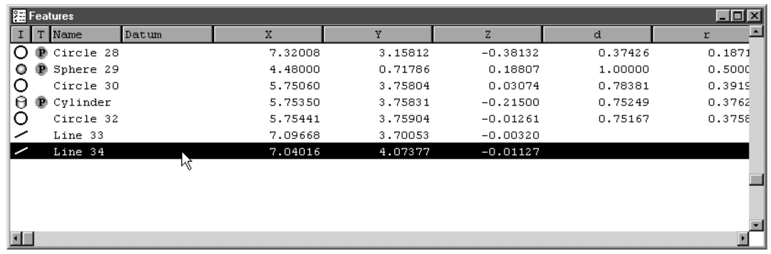


The tolerance results window appears as shown.



To perform a co-planarity tolerance

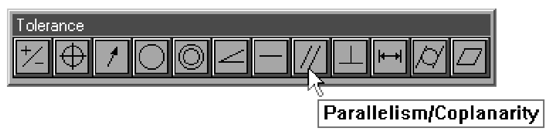
Step 1
Highlight the desired feature in the features list.



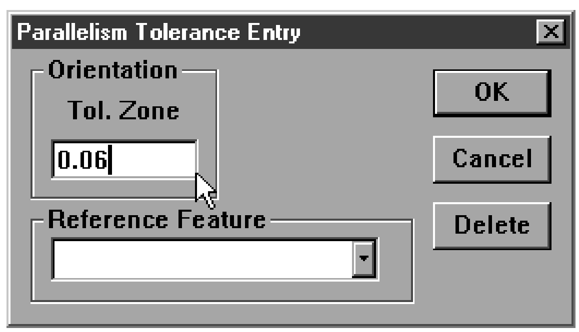
NOTE

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.



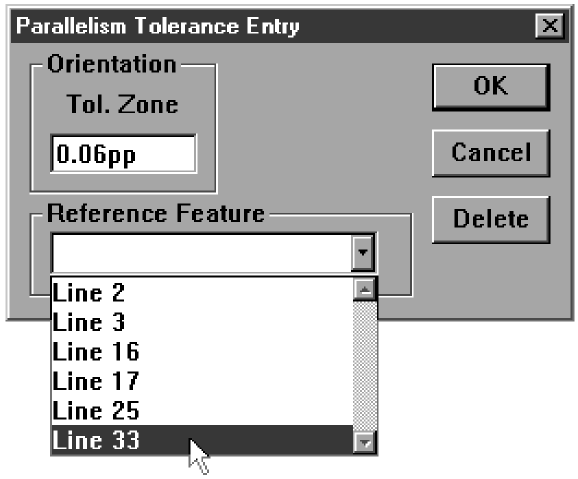
Step 3
Enter a value in the *tolerance zone* box as shown.



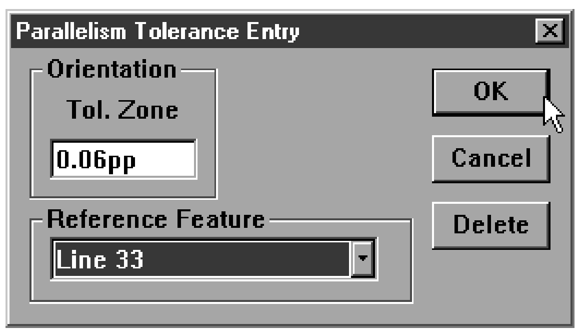
CAUTION

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

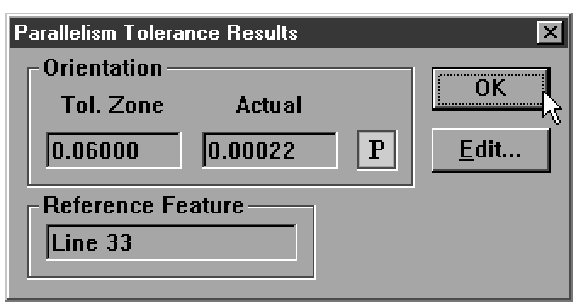
Step 4
Select a reference feature from the pull down list.



Step 5
Click OK in the dialog box.



The tolerance results window appears as shown.



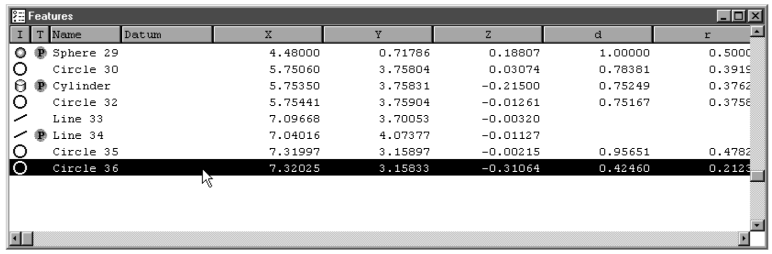
Circular runout tolerance

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.

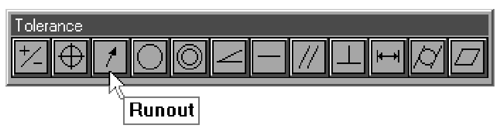


NOTE

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

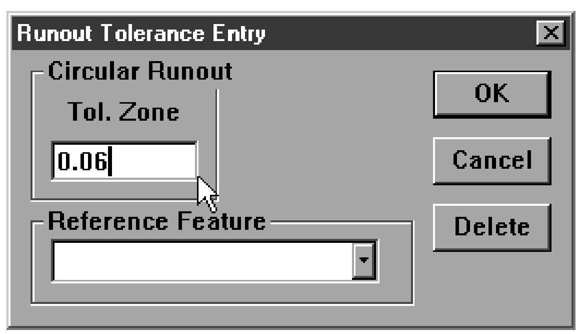
Step 2

Click the *circular runout* button on the tolerance toolbar.



Step 3

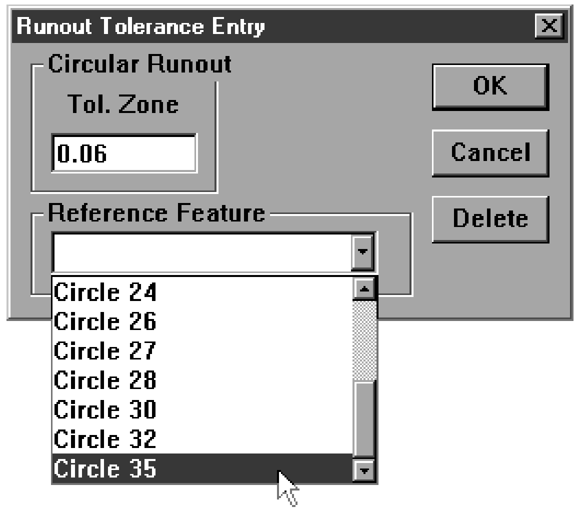
Enter a value in the *tolerance zone* box as shown.



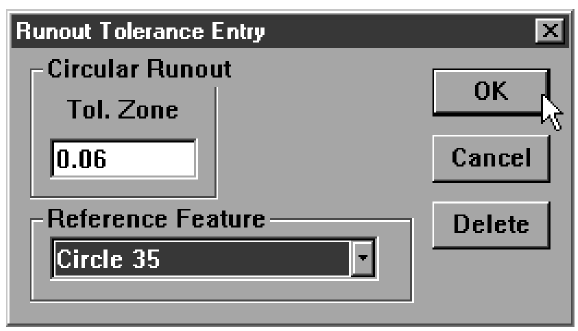
CAUTION

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

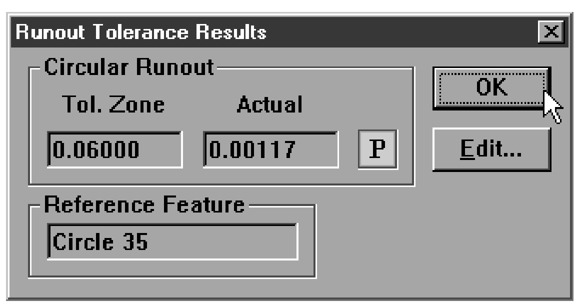
Step 4
Select a reference feature from the pull down list.



Step 5
Click OK in the dialog box.



The tolerance results window appears as shown.

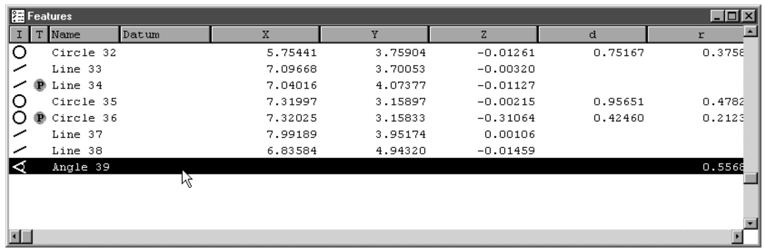


Angle tolerance

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

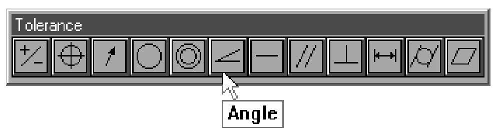
Step 1
Highlight the desired angle in the features list.



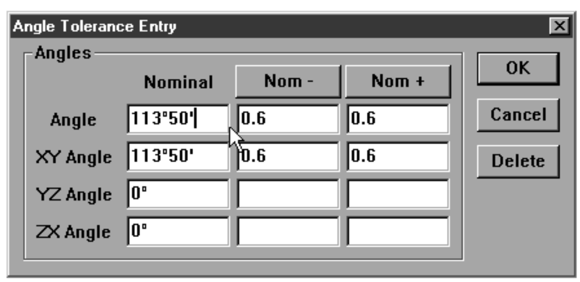
NOTE

Use angles only. Angle tolerances do not apply to other types of features.

Step 2
Click the *angle* button on the tolerance toolbar.



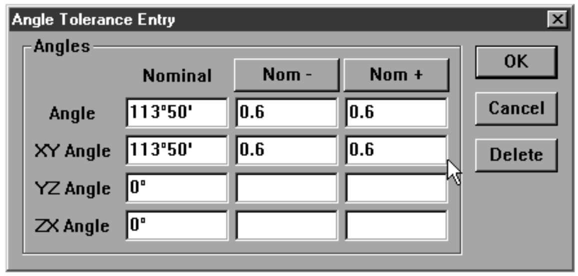
Step 3
Enter the nominal values as shown.



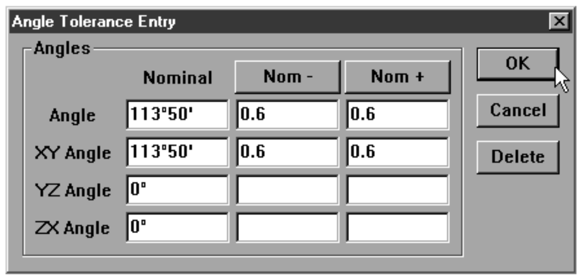
CAUTION

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

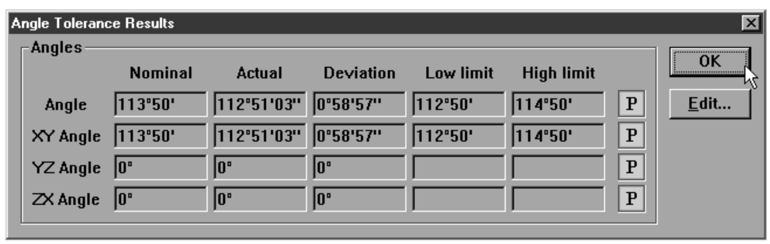
Step 4
Enter the nominal + and nominal - values as shown.



Step 5
Click OK in the dialog box.



The tolerance results window appears as shown.



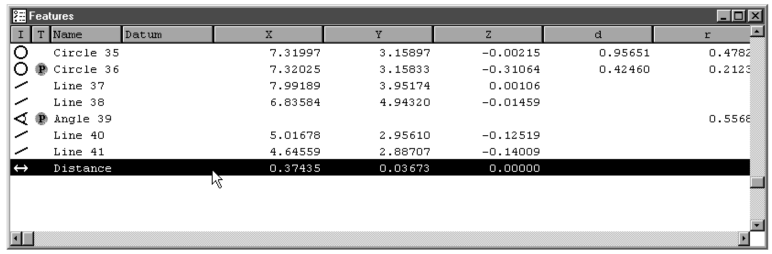
Width tolerance

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.

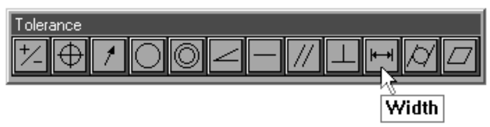


NOTE

Use a distance only. Width tolerances do not apply to other types of features.

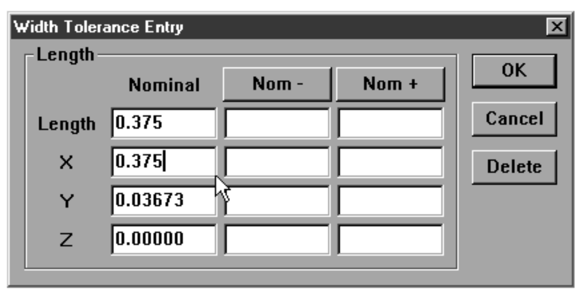
Step 2

Click the *width* button on the tolerance toolbar.



Step 3

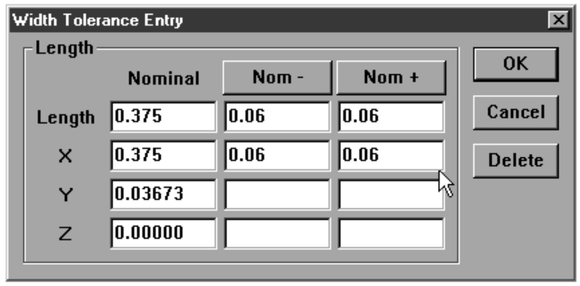
Enter the nominal values as shown.



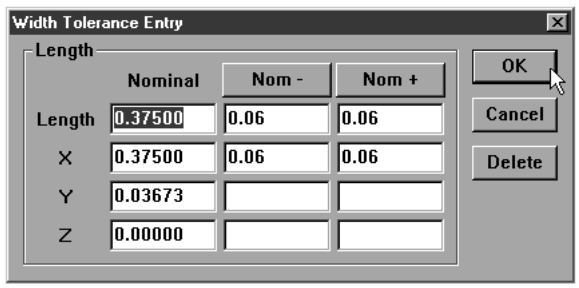
CAUTION

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

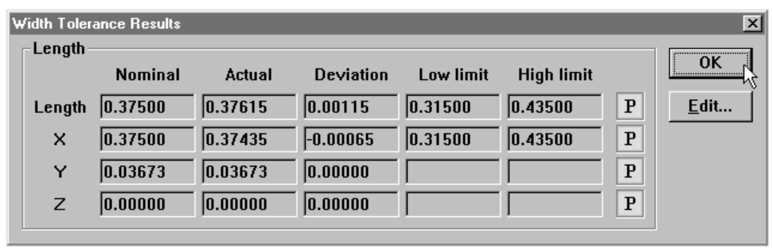
Step 4
Enter the nominal + and nominal - values as shown.



Step 5
Click OK in the dialog box.



The tolerance results window appears as shown.



Chapter 6
Templates

Templates

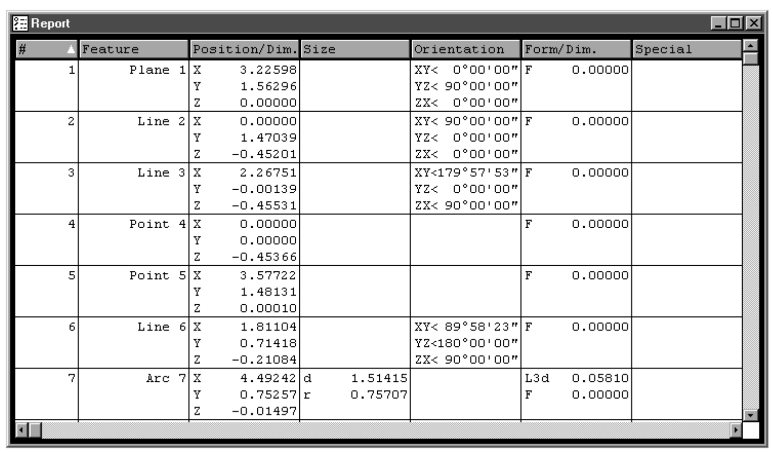
Templates control the format of output. There are four templates used by the QC5000:

- 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.

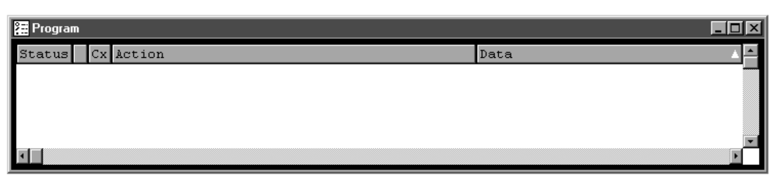
I	T	Name	Datum
		Plane 1	Primary
		Line 2	Skew
		Line 3	
		Point 4	Zero
		Point 5	
		Line 6	
		Arc 7	
		Circle 8	
		Point 9	
		Cylinder	
		Sphere 11	

Format print output using the report template.



#	Feature	Position/Dim.	Size	Orientation	Form/Dim.	Special
1	Plane 1	X 3.22598		XY< 0°00'00"	F 0.00000	
		Y 1.56296		YZ< 90°00'00"		
		Z 0.00000		ZX< 0°00'00"		
2	Line 2	X 0.00000		XY< 90°00'00"	F 0.00000	
		Y 1.47039		YZ< 0°00'00"		
		Z -0.45201		ZX< 0°00'00"		
3	Line 3	X 2.26751		XY<179°57'53"	F 0.00000	
		Y -0.00139		YZ< 0°00'00"		
		Z -0.45531		ZX< 90°00'00"		
4	Point 4	X 0.00000			F 0.00000	
		Y 0.00000				
		Z -0.45366				
5	Point 5	X 3.57722			F 0.00000	
		Y 1.48131				
		Z 0.00010				
6	Line 6	X 1.81104		XY< 89°58'23"	F 0.00000	
		Y 0.71418		YZ<180°00'00"		
		Z -0.21084		ZX< 90°00'00"		
7	Arc 7	X 4.49242	d 1.51415		L3d 0.05810	
		Y 0.75257	r 0.75707		F 0.00000	
		Z -0.01497				

Program and runs templates are associated with QC5000 functions. Use the program template to construct, edit, and monitor your parts programs.



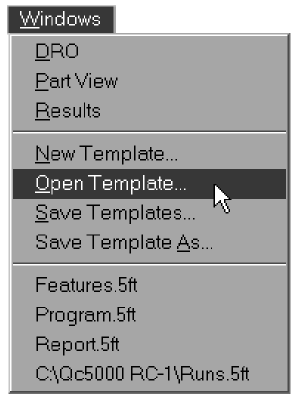
Compare program results from one run to the next using the runs template.

Features Template

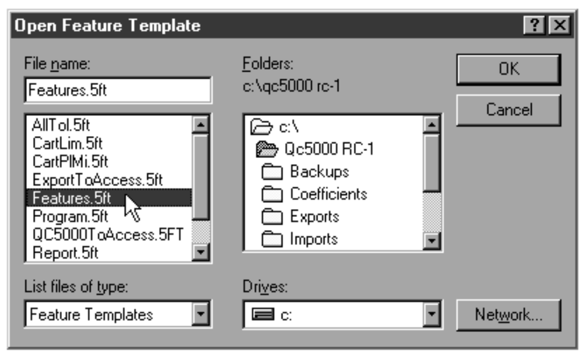
Use the features template to create the features list. The features list displays feature data and prepares it for export to other software applications.

To open the features template

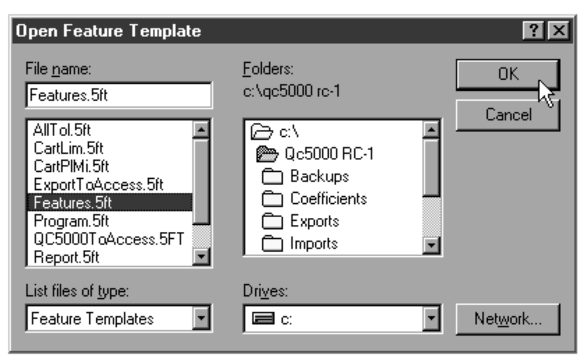
Step 1
Select *open template* from the windows menu.



Step 2
Select *features.5ft* from the file name list box. The file path is c:\qc5000\templates.

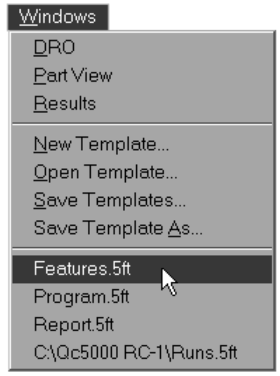


Step 3
Click OK.



OR

Step 1
Select features.5ft from the windows menu.

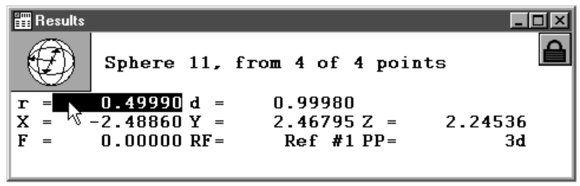


Adding Data to Templates

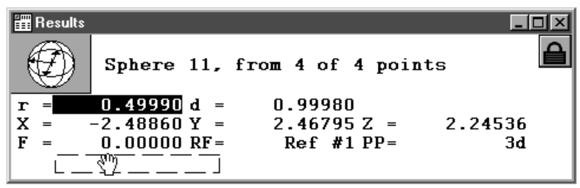
Add data to the features list by dragging and dropping information from the results window.

To drag and drop a single results window field into the features list

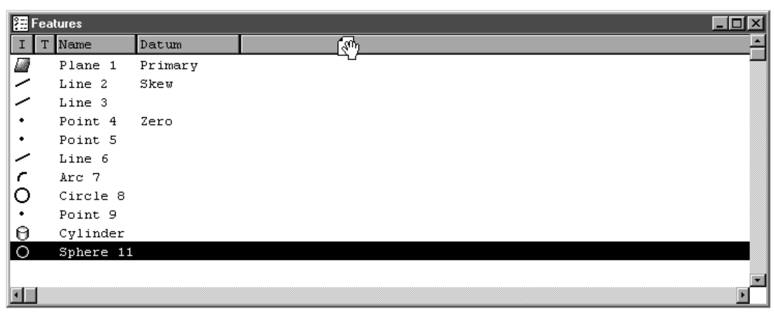
Step 1
Highlight the desired field in the results window.



Step 2
Hold down the left mouse button and move the field over the features list.

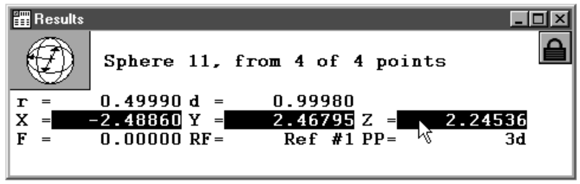


Step 3
Release the left mouse button.

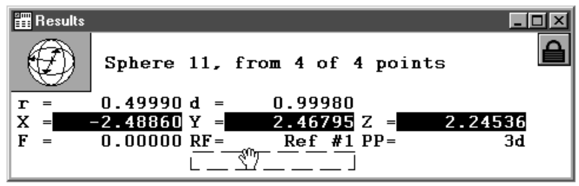


To drag and drop a multiple results window fields into the features list

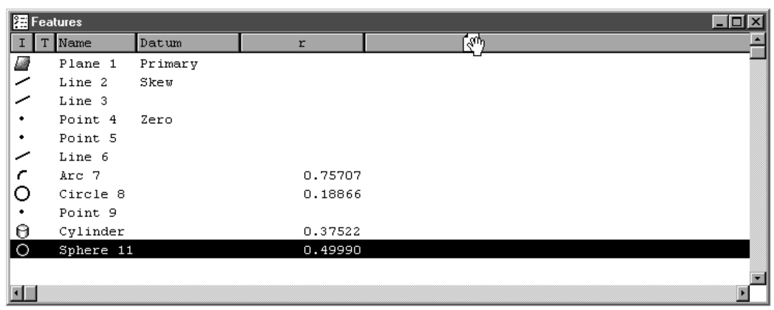
Step 1
Highlight the desired fields in the results window.



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

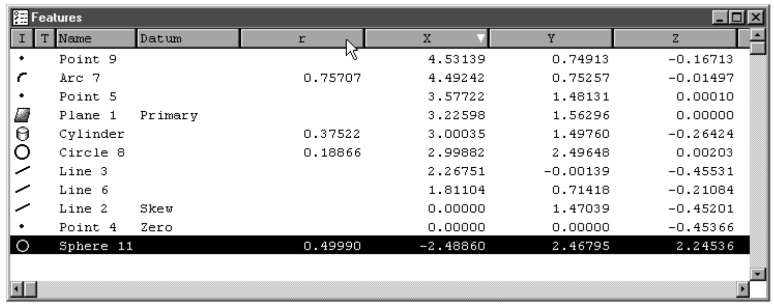
Use the as 1 new column button if the fields are intended to occupy only one column.

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.

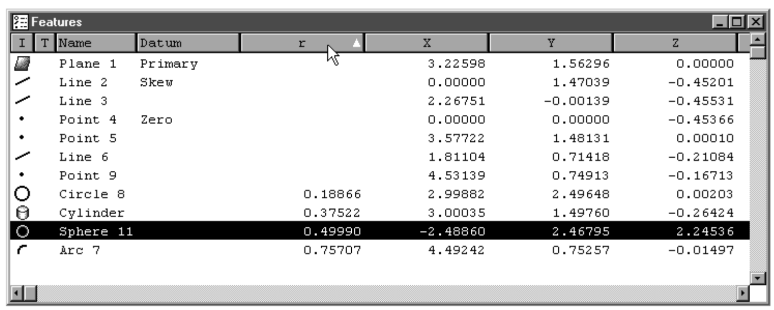
To sort data in the features list

Step 1
Place the cursor on the desired column header.


Features

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

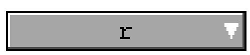
Step 2
Click on the column header.


Features

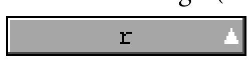
I	T	Name	Datum	r	X	Y	Z
		Plane 1	Primary		3.22598	1.56296	0.00000
		Line 2	Skew		0.00000	1.47039	-0.45201
		Line 3			2.26751	-0.00139	-0.45531
		Point 4	Zero		0.00000	0.00000	-0.45366
		Point 5			3.57722	1.48131	0.00010
		Line 6			1.81104	0.71418	-0.21084
		Point 9			4.53139	0.74913	-0.16713
		Circle 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)



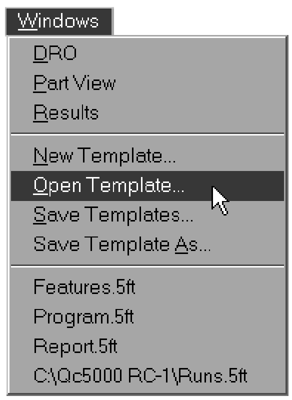
- order entered (no arrow)

Reports Template

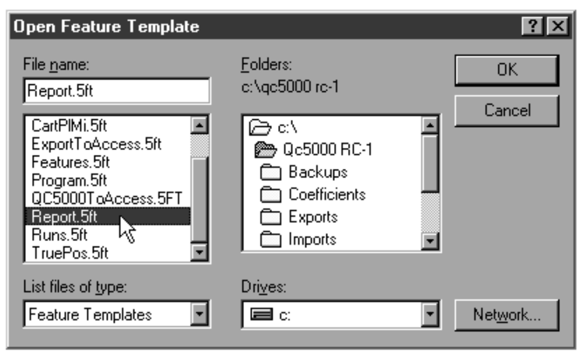
Use the reports template to prepare data in a standard print format. The reports template displays the same feature data as the features template in a printer-friendly format. Add data to the reports template by dragging and dropping information from the results window.

To open the reports template

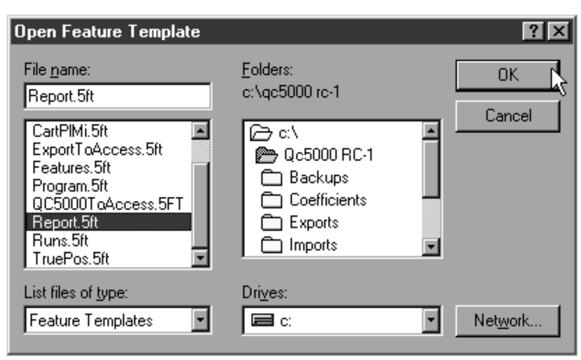
Step 1
Select *open template* from the windows menu.



Step 2
Select *report.5ft* from the file name list box. The file path is c:\qc5000\templates.

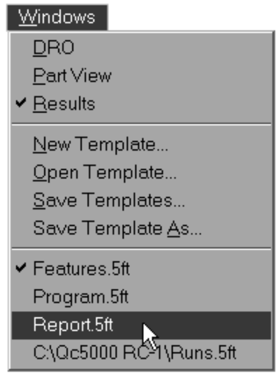


Step 3
Click OK.



OR

Step 1
Select *reports.5ft* from the windows menu.

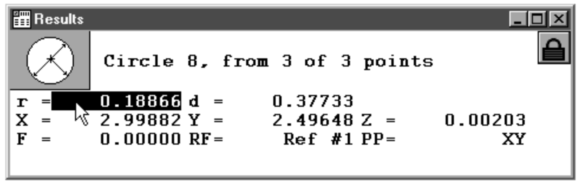


Adding Data to the Reports Template

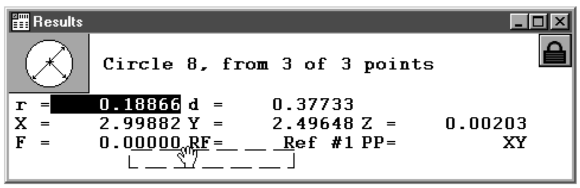
Add data to the reports template by dragging and dropping information from the results window.

To drag and drop a single results window field into the reports template

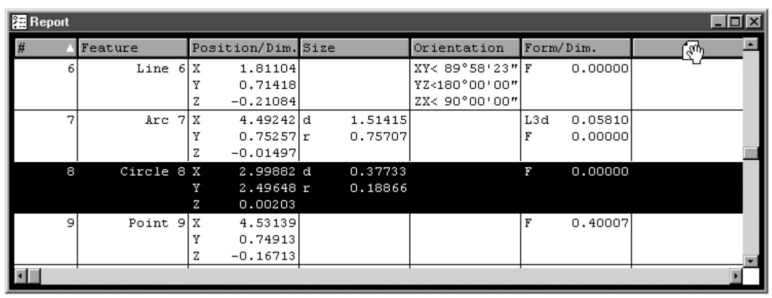
Step 1
Highlight the desired field in the results window.



Step 2
Hold down the left mouse button and move the field over the reports template.

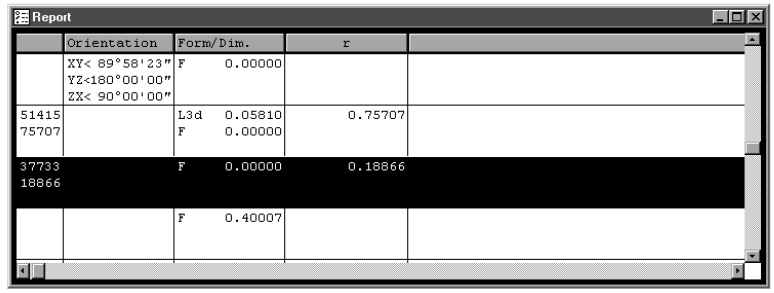


Step 3
Release the left mouse button.

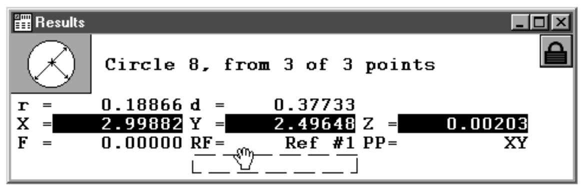


To drag and drop a multiple results window fields into the reports template

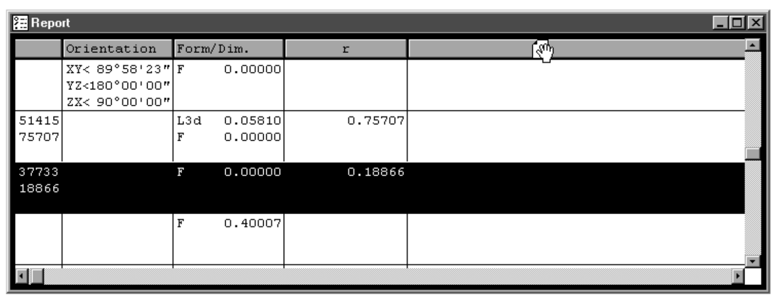
Step 1
Highlight the desired fields in the results window.



Step 2
Hold down the left mouse button and move the fields over the reports template.



Step3
Release the left mouse button.



Step 4
Click the *as multiple new columns* button in the dialog box.

NOTE

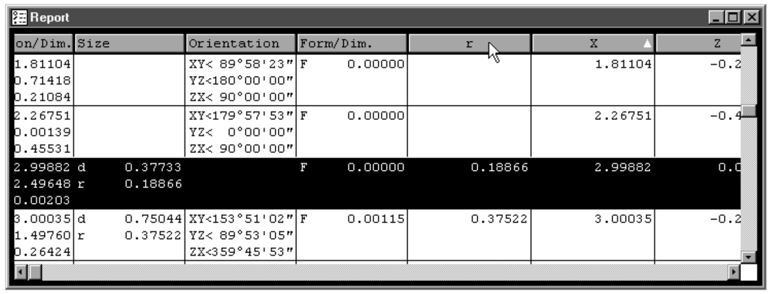
Use the as 1 new column button if the fields are intended to occupy only one column.

Sorting Data in the Reports Template

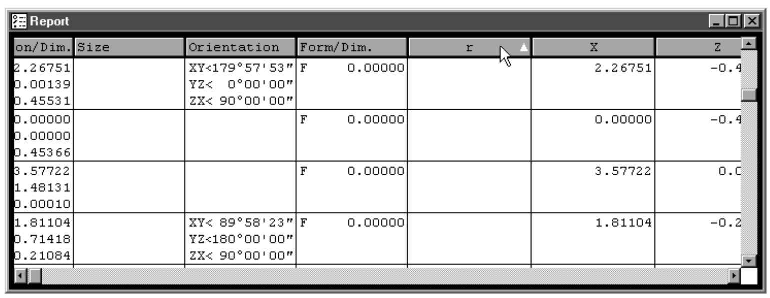
Sort data in the reports template by clicking on the column header. Each data column can be arranged from high to low, low to high, or by order entered.

To sort data in the reports template

Step 1
Place the cursor on the desired column header.



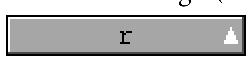
Step 2
Click on the column header.



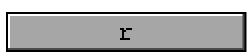
A small arrow to the right of the column label indicates the arrangement:

- high to low (arrow down)

- low to high (arrow up)



- order entered (no arrow)

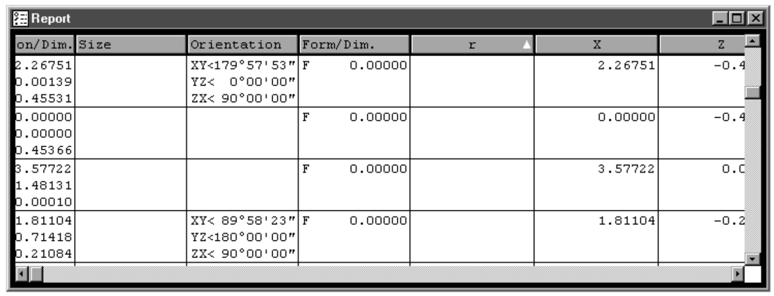


Report Headers

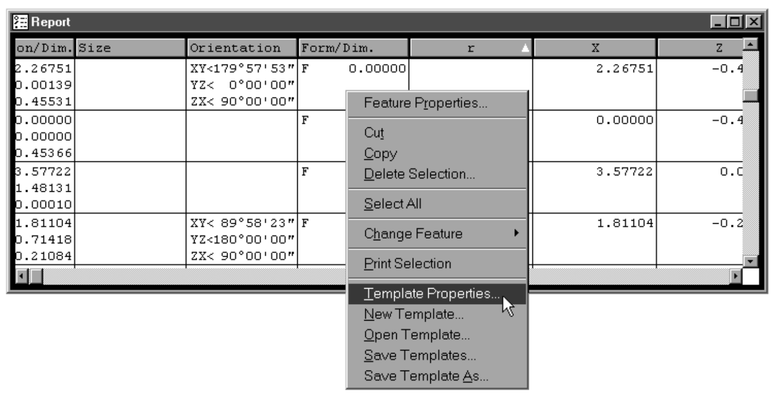
Report headers contain additional information that is placed at the top of the first report page. Users can customize report headers to suit specific application or documentation needs.

To show a report header

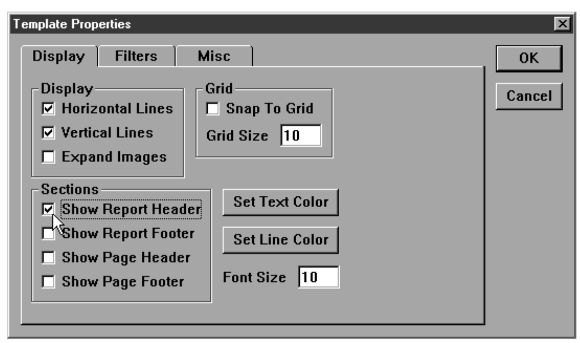
Step 1
Right click on the reports template.



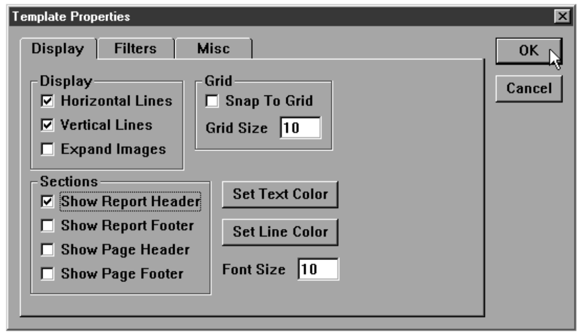
Step 2
Select *template properties* from the list.



Step 3
Use the mouse to check the show report header check box.



Step 4
Click OK in the dialog box.

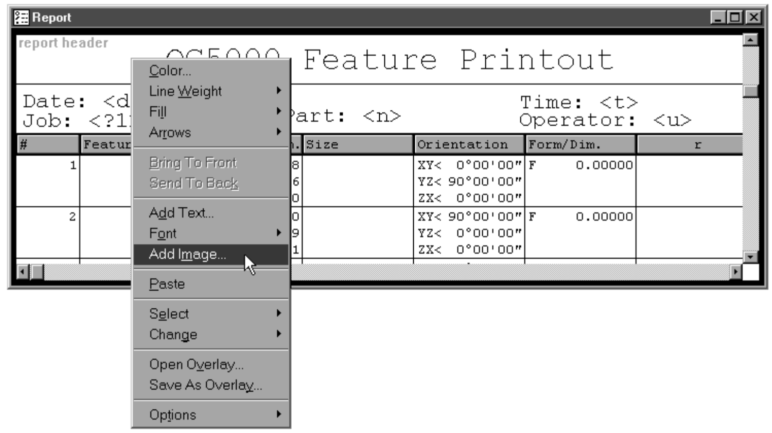


Customizing Report Headers

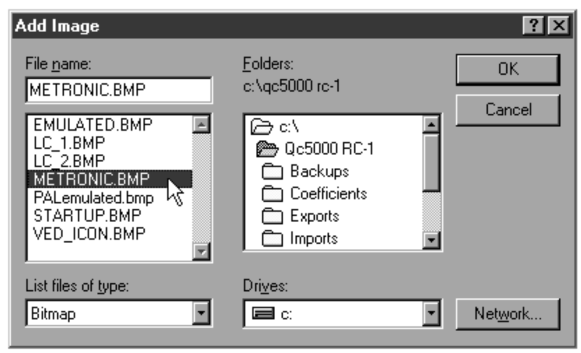
Users can edit report headers to suit individual needs. Report headers can include text and graphics.

To place a graphic in a report header

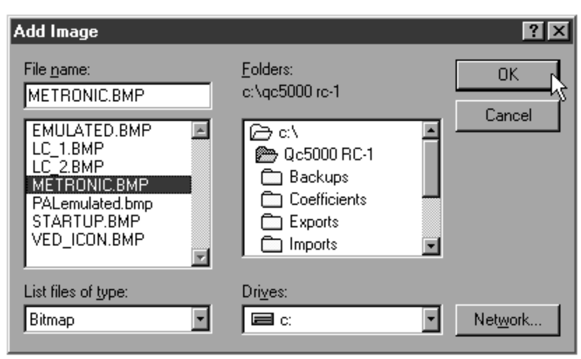
Step 1
Right click on the report header and select *add image* from the list.



Step 2
Select the graphic file.

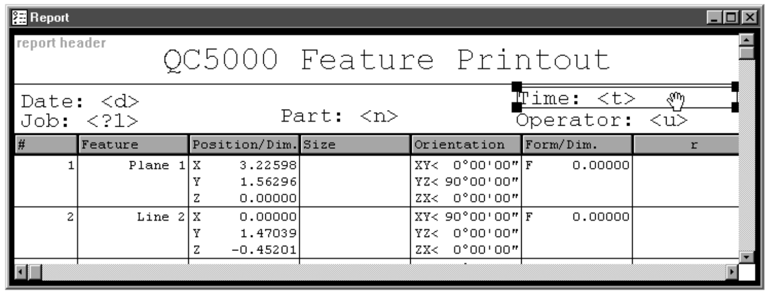


Step 3
Click OK in the dialog box.

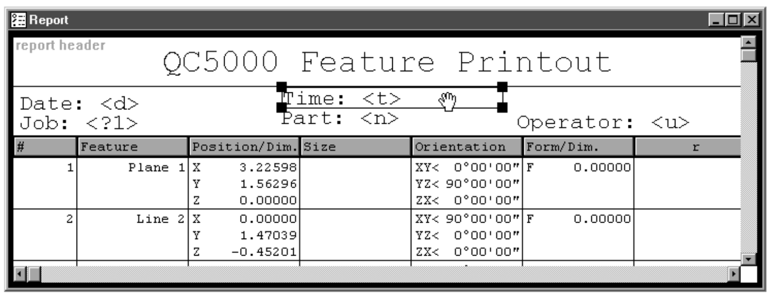


To arrange text and graphics in a report header

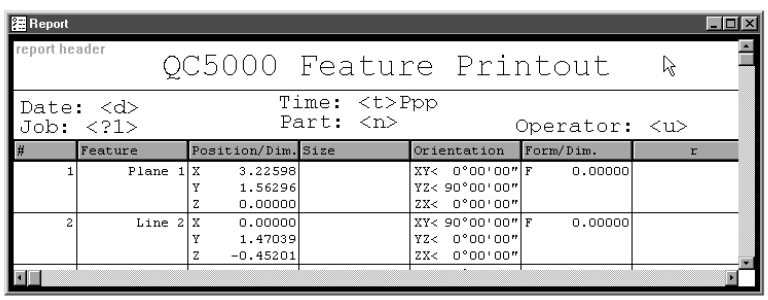
Step 1
Click on the text or graphic to be moved.



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 QC5000 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.

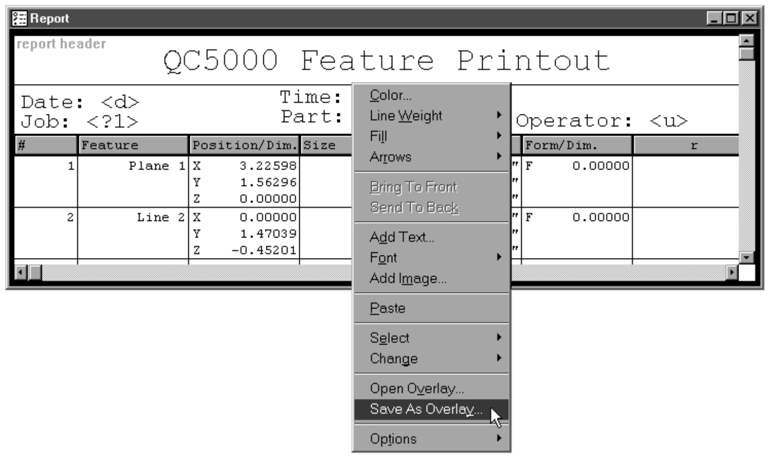
Enter automated input prompts sequentially. For example, if <?1> is used for prompting the part number use <?2> for the next input prompt.

Overlays

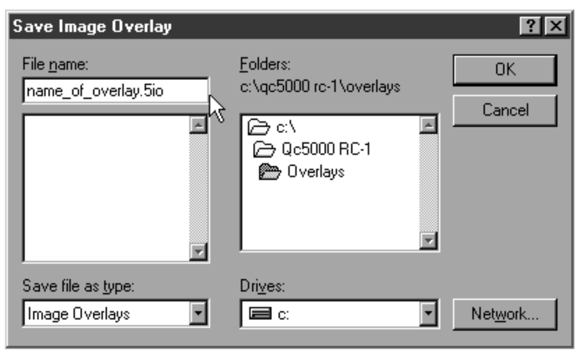
Save headers for repeated use as overlays. Using an overlay saves the time and trouble of creating the same header for each new job.

To save a report header as an overlay

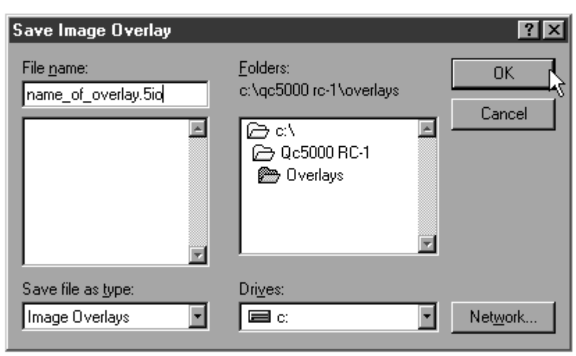
Step 1
Right click on the report header and select *save as overlay* from the list.



Step2
Type a name for the overlay as shown.

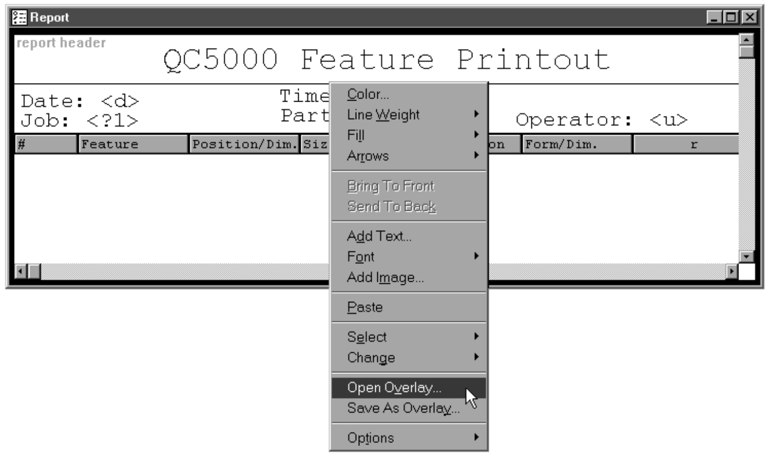


Step 3
Click OK in the dialog box.

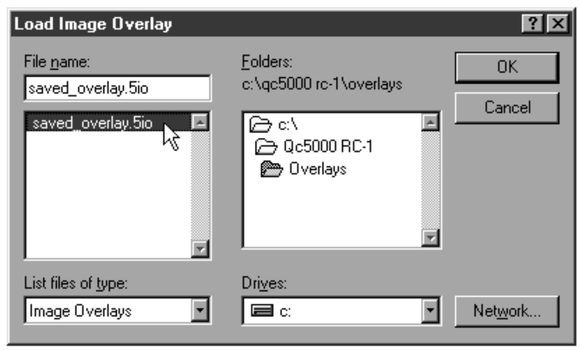


To place an overlay in a report header

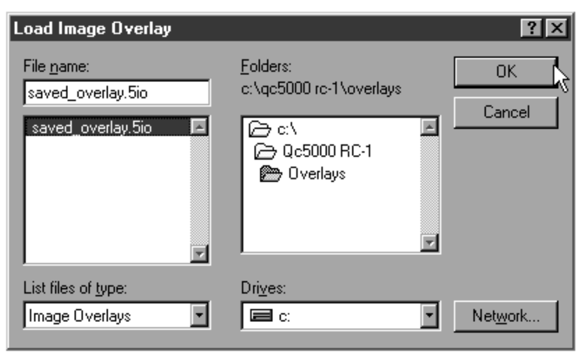
Step 1
Right click on the report header and select *open overlay* from the list.



Step 2
Select the overlay as shown.



Step 3
Click OK in the dialog box.



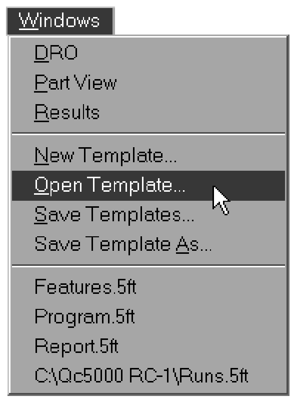
Program Template

Use the program template to monitor the steps of a parts program. Green checkmarks indicate steps succesfully 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.'

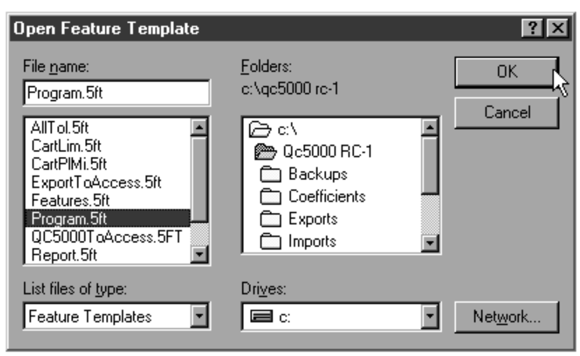
Program templates display information only. No data from the features list can be imported to the the program template.

To open the program template

Step 1
Select *open template* from the windows menu.

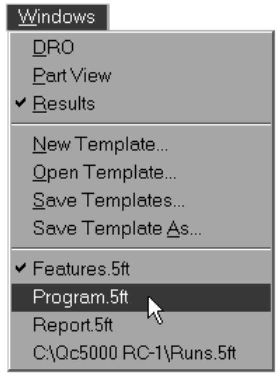


Step 2
Select *program.5ft* from the file name list box. The file path is c:\qc5000\templates.



OR

Step 1
Select *program.5ft* from the windows menu.

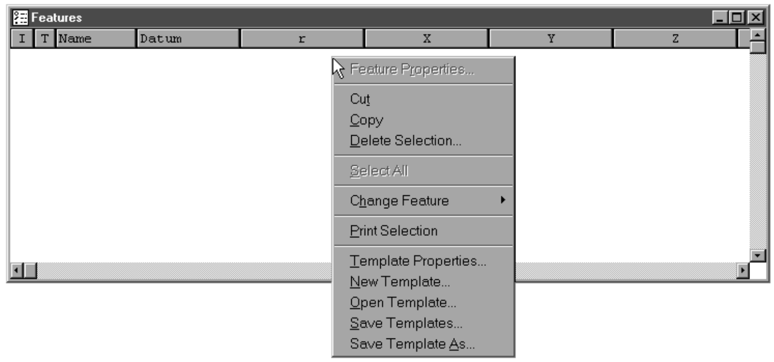


Template Properties

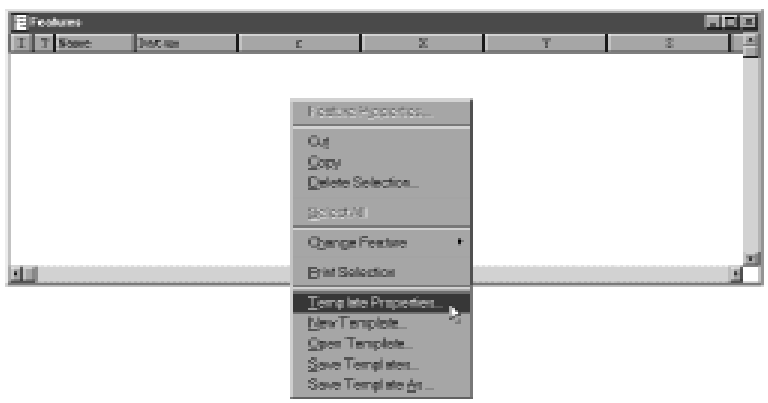
Standard template features can be modified by the user. Use the template properties dialog box to modify QC5000 templates to suit your application.

To access the template features dialog box

Step 1
Right click on any template.

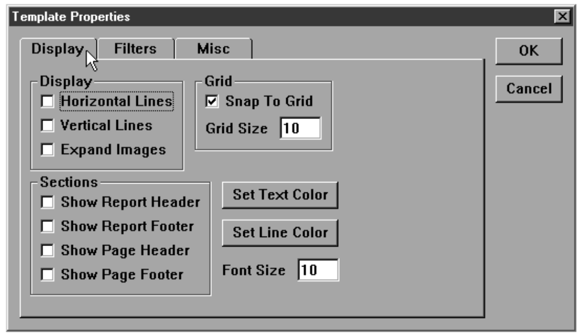


Step 2
Select *template properties* from the list.



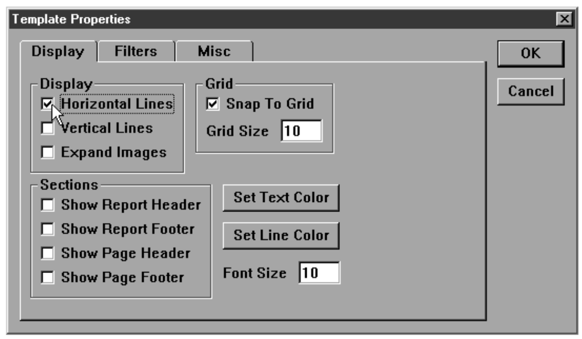
Template Features Dialog Box

The template features dialog box contains three tabs: display, filters, and misc (miscellaneous). Click on the *display* tab to modify template display features.

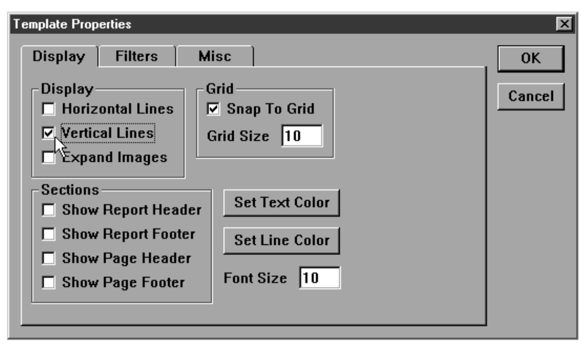


Display tab

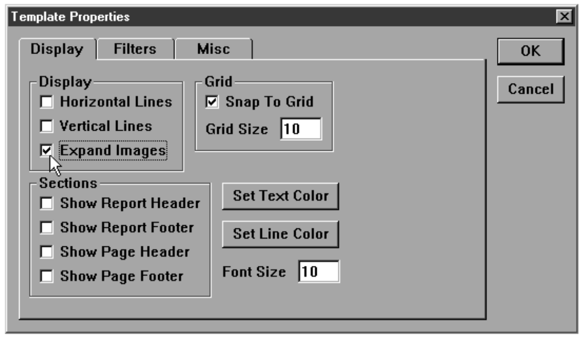
Use the mouse to place check in the horizontal lines check box to display horizontal separator line between each template row.



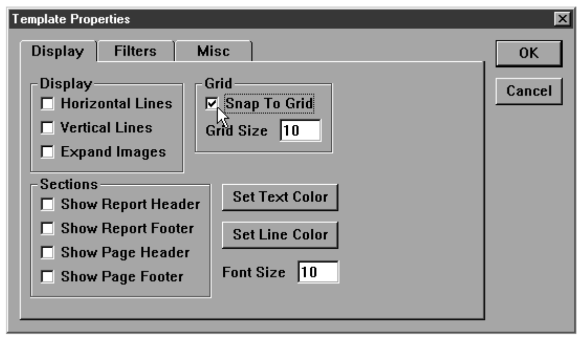
Check the vertical lines box to display vertical separator lines between each template column.



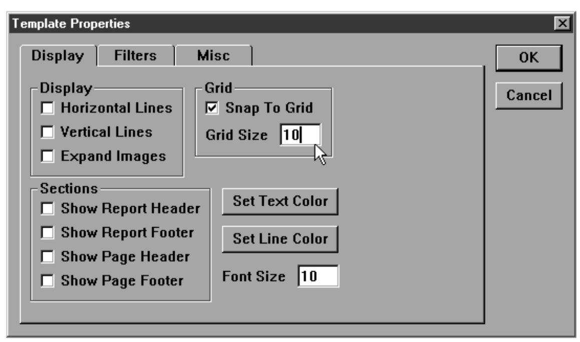
Display partview/image features in a template by checking the e*xpand images* box.



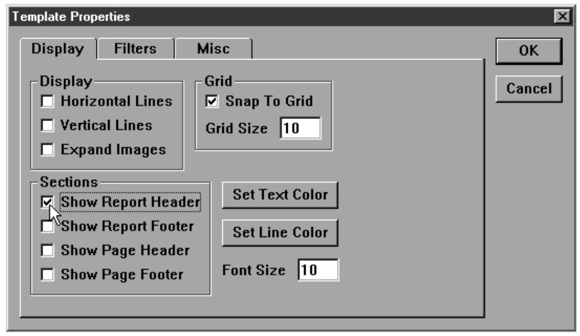
Check the *snap to grid* box to activate the alignment grid in the template. When *snap to grid* is checked fields in the template are automatically aligned to the nearest grid intersection.



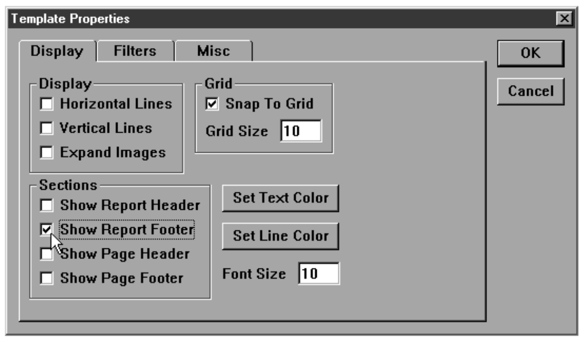
Set the size of the grid squares using the *grid size* text box.



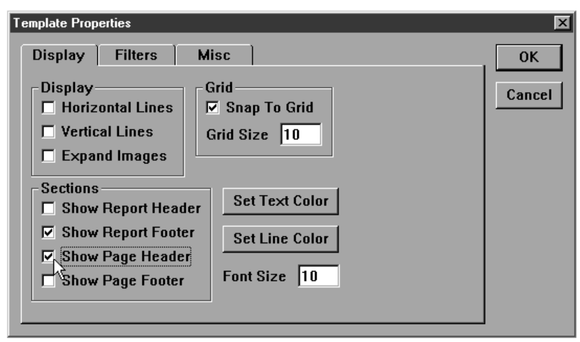
Display a report header at the top of a template by checking the *show report header* box. The report header can include custom text and graphics. Report headers print at the top of the first page of a report.



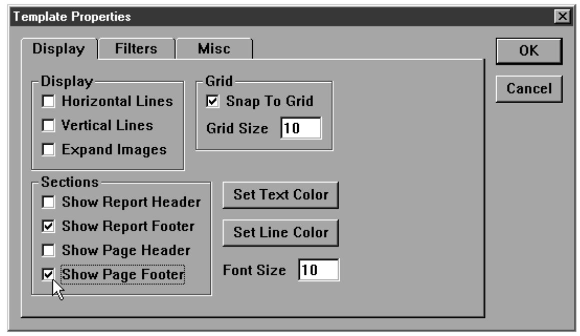
Create a report footer at the bottom of a template by checking the *show report footer box*. Report footers can include custom text and graphics. The report footer prints at the end of a report.



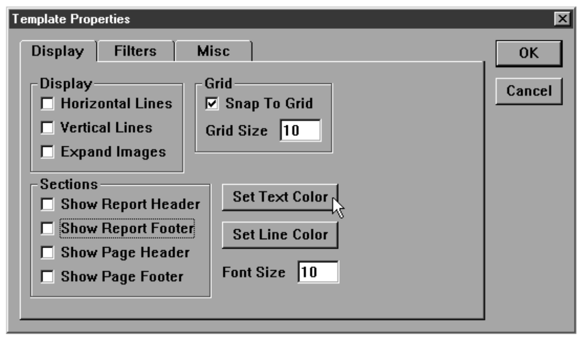
Display a page header at the top of each report page by checking the *show page header* box. The page header can include custom text and graphics.



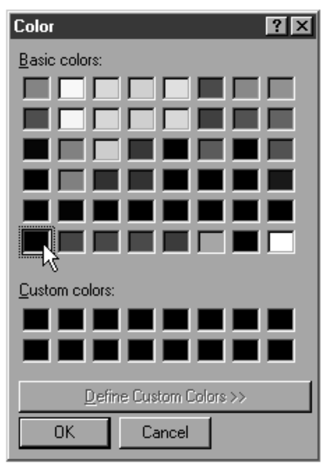
Create a page footer at the bottom of each report page by checking the *show page footer box*. Page footers can include custom text and graphics.



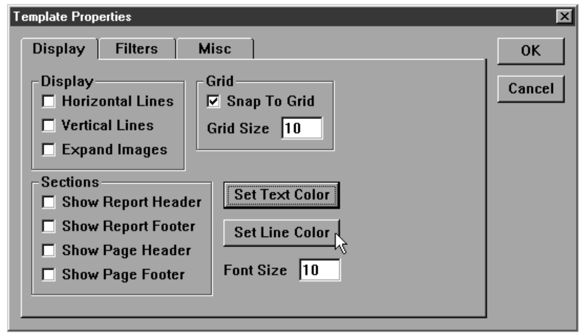
Click on the *set text color* button to change the color of text in the template.



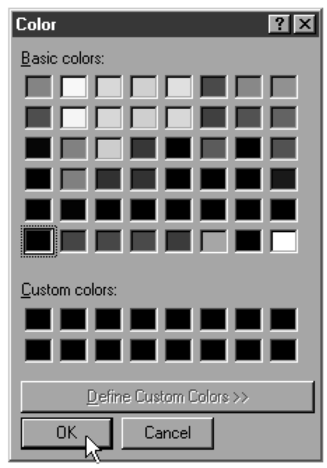
Select a color from the *color* window as shown.



Click on the *set line color* button to change the color of horizontal and vertical lines in the template.

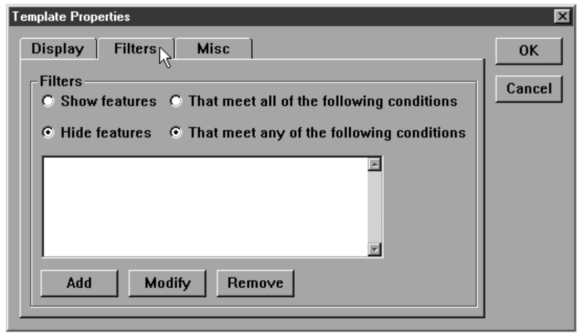


Select a color from the *color* window as shown.



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.



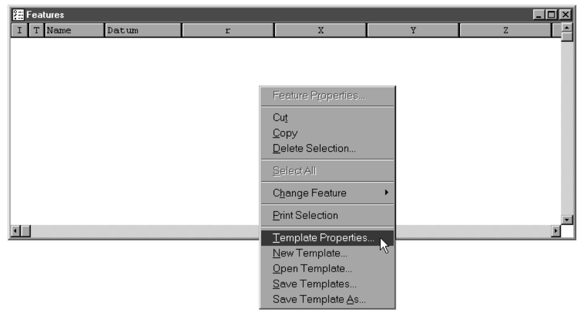
For example, if a part drawing calls for a circle to have a diameter of 0.375 inches with a tolerance of 0.006 inches, you can create a template that displays only circles with a diameter greater than 0.381 inches or less than 0.370 inches. This filter allows the user to track features that fail to meet specifications without having to sort through all the features.

To create a filter

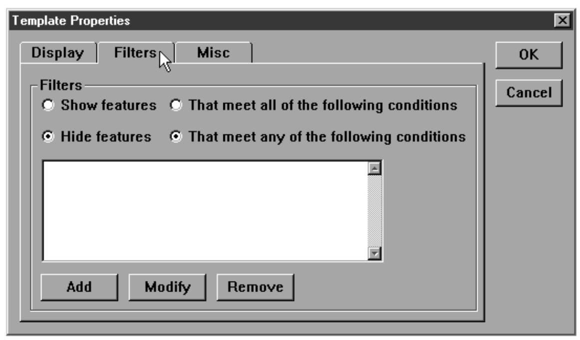
NOTE

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.

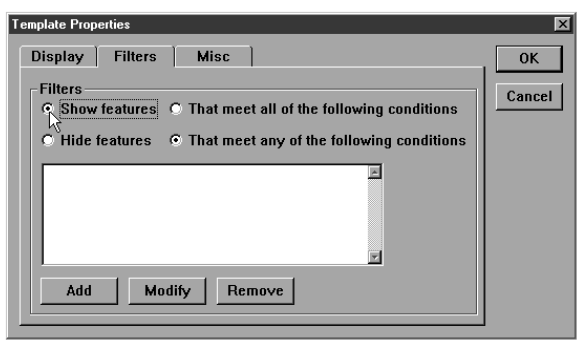
Step 1
Right click on the template and select *template properties* from the list.



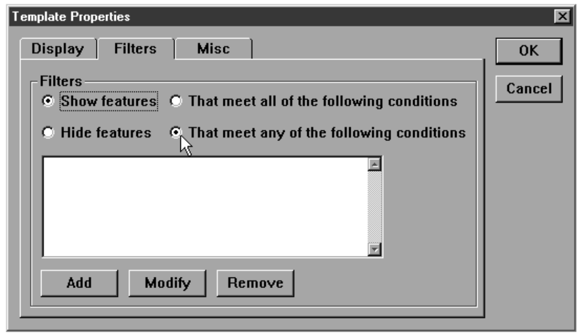
Step 2
Select the *filters* tab in the dialog box.



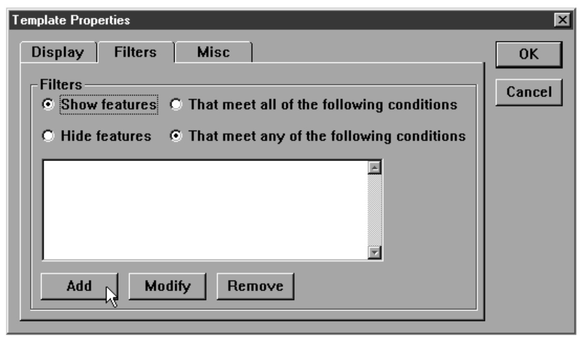
Step 3
Click on the *show features* button.



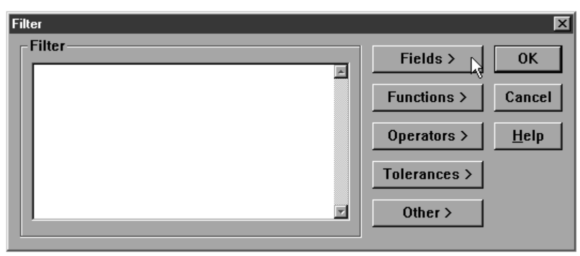
Step 4
Click on the *that meet any conditions* button.



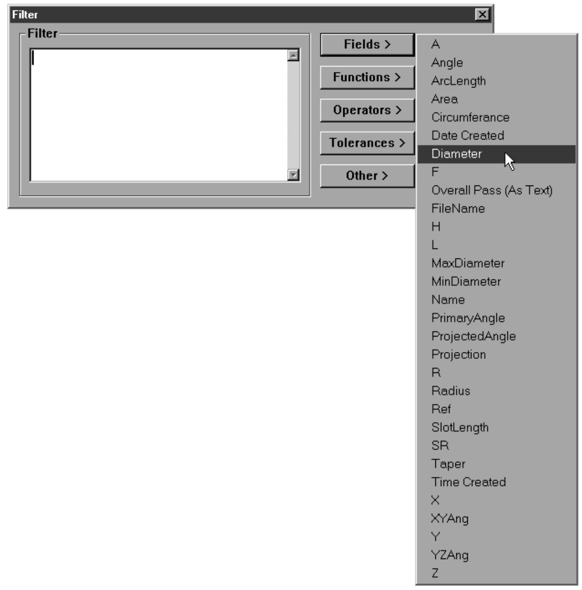
Step 5
Click the *add* button.



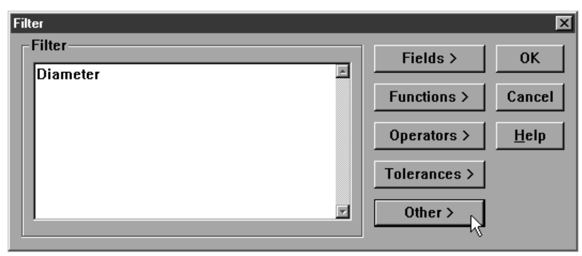
Step 6
Click the *fields*> button in the filter dialog box.



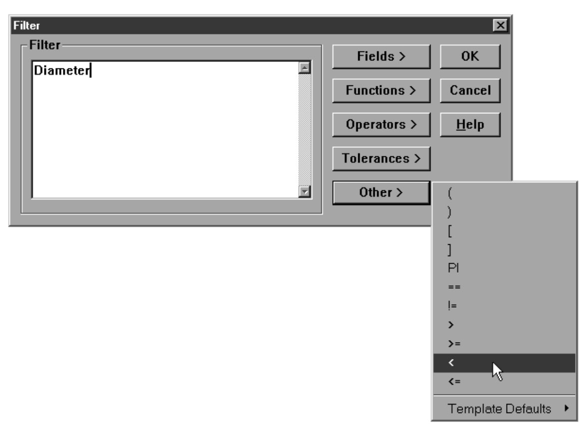
Step 7
Select *diameter* from the list.



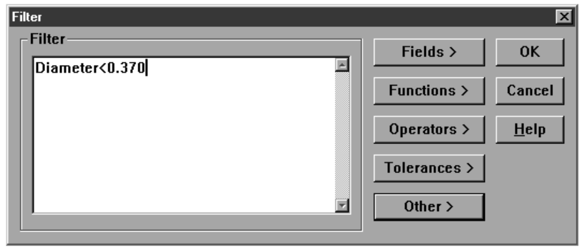
Step 8
Click the *other*> button.



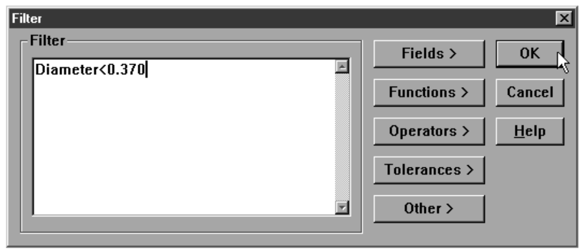
Step 9
Select the < (less than) symbol from the list.



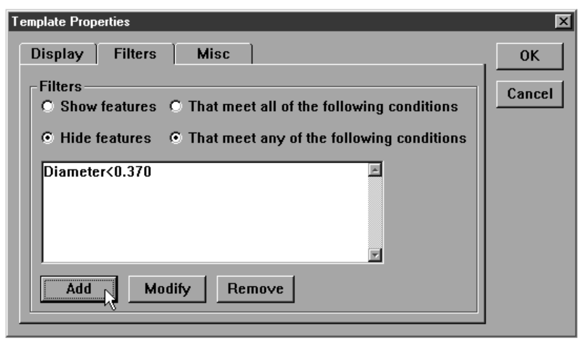
Step 10
Type 0.370 in the text box as shown.



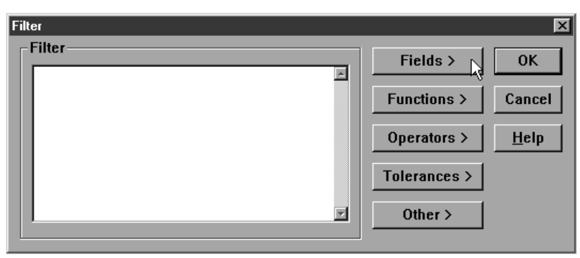
Step 11
Click OK in the filter dialog box.



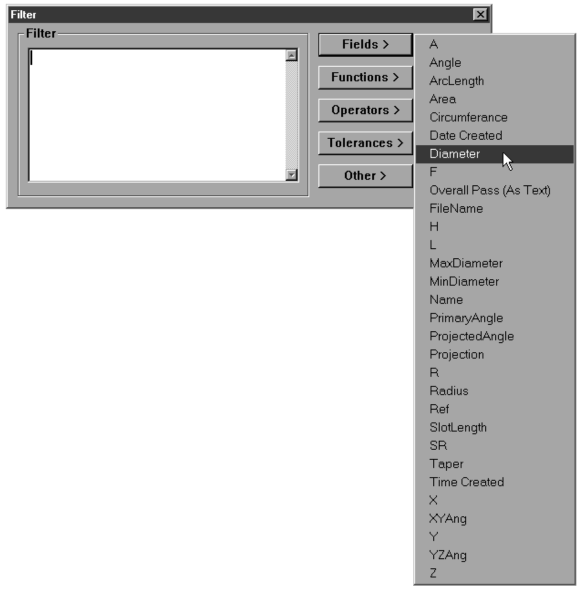
Step 12
Click the *add* button.



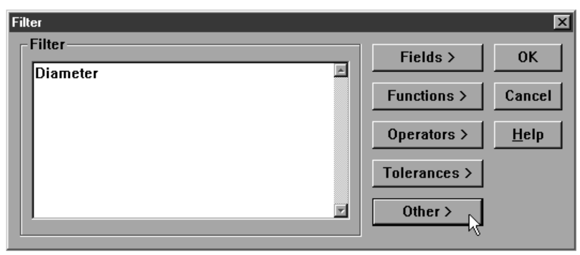
Step 13
Click the *fields>* button in the filter dialog box.



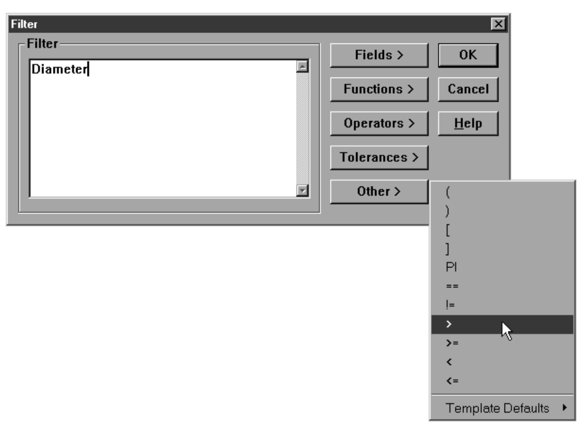
Step 14
Select *diameter* from the list.



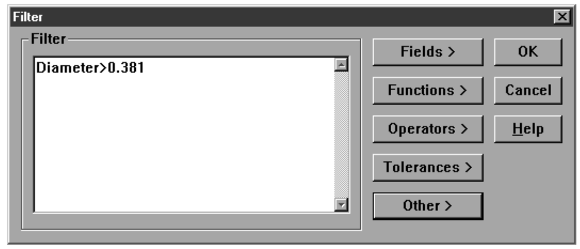
Step 15
Click the *other*> button.



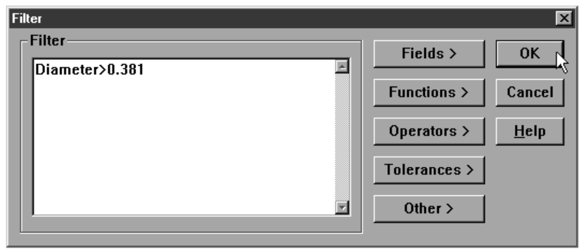
Step 16
Select the > (greater than) symbol from the list.



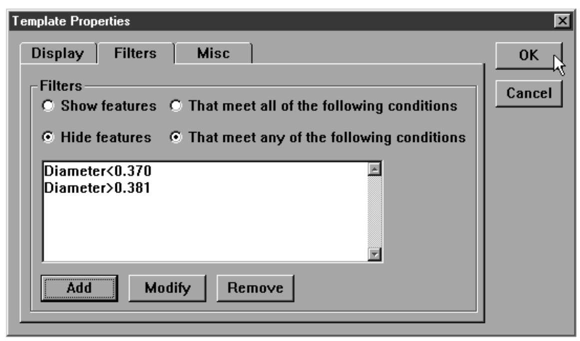
Step 17
Type 0.381 in the text box as shown.



Step 18
Click OK in the filter dialog box.

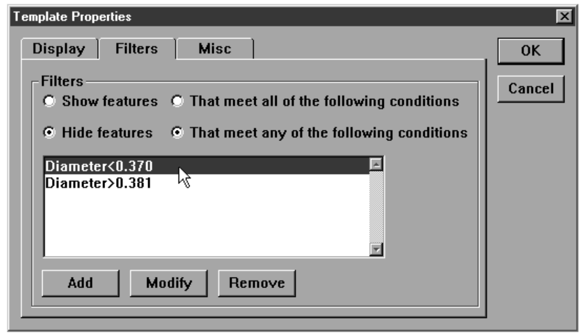


Step 19
Click OK in the template properties dialog box.

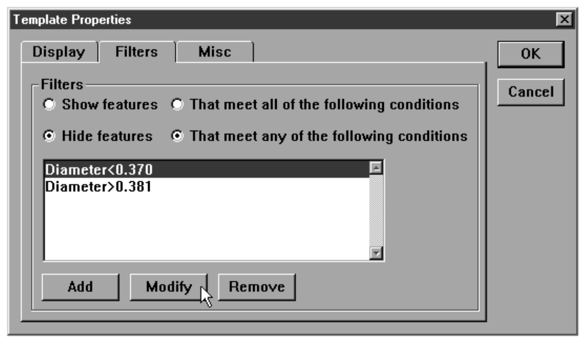


To modify a filter

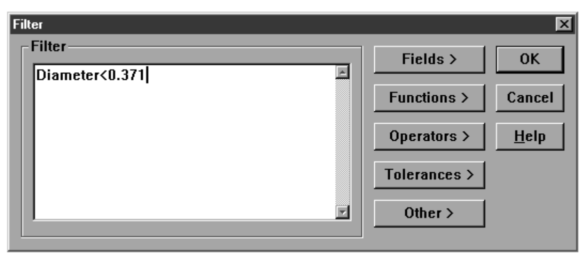
Step 1
Highlight the desired filter.



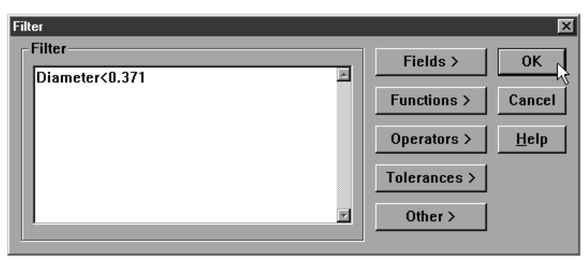
Step 2
Click the *modify* button on the filters tab (template properties dialog box).



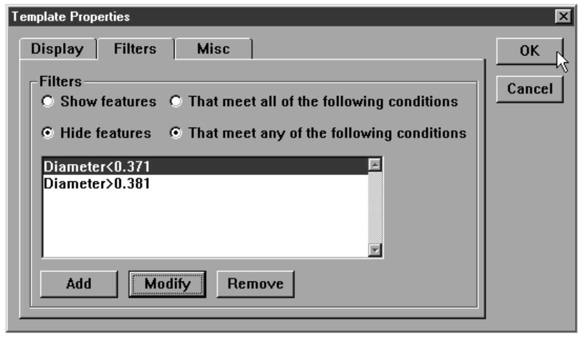
Step 3
Type in the modification.



Step 4
Click OK in the filters dialog box.

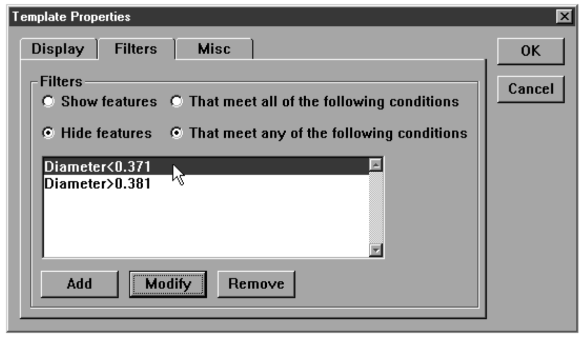


Step 5
Click OK in the template properties dialog box.

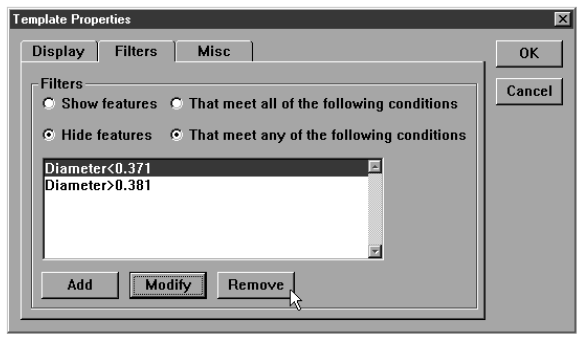


To remove a filter

Step 1
Highlight the desired filter on the *filters* tab (template properties dialog box).



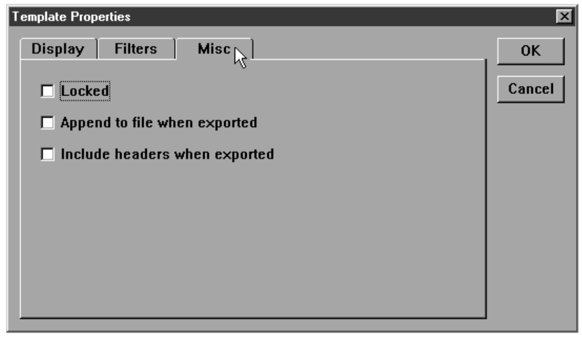
Step 2
Click the *remove* button.



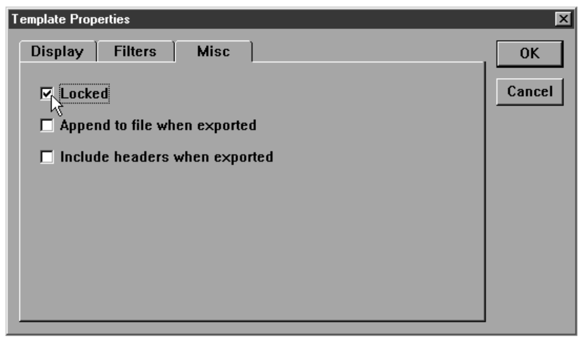
Step 3
Click *yes* in the dialog box.

Misc tab (miscellaneous)

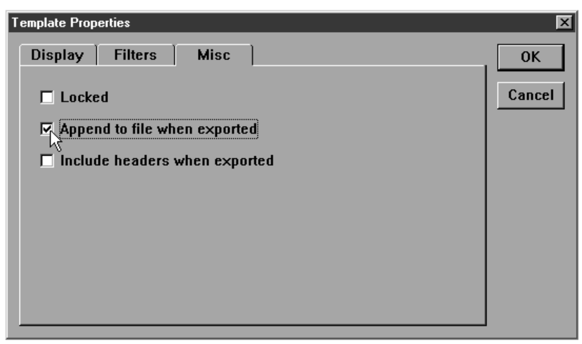
The miscellaneous tab contains three check boxes.



Place a check in the *locked* box to require the supervisor password before templates are editied.



Place a check in the *append to file when exported* box to export template properties.



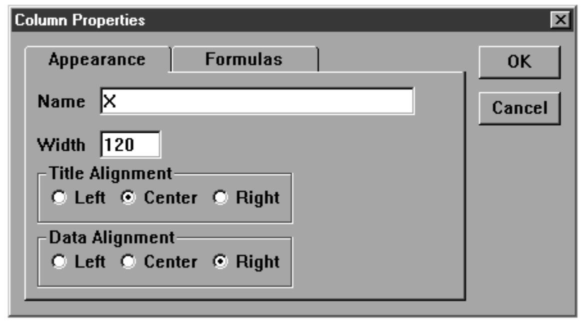
Place a check in the *include headers when exported* box to export report and page headers.

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 a column properties unique to specific templates.

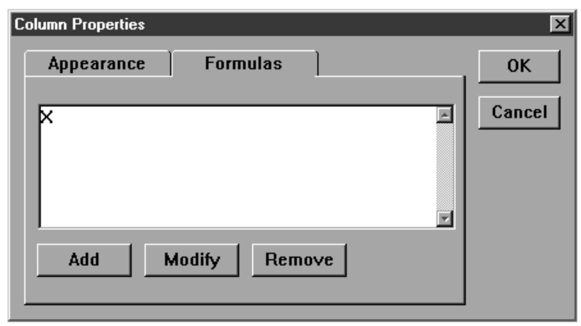
Standard column properties

Right click on any template and select column properties from the list. This brings up the column properties dialog box.



Appearence tab

The appearence 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 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 mathmetical 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 mathemetical 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,

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

sqr([Circle 1]radius)*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")

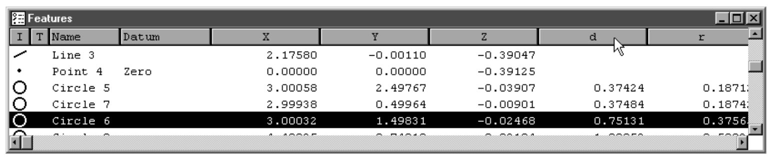
to sort circle features into two groups: large or small.

To create the sample formula

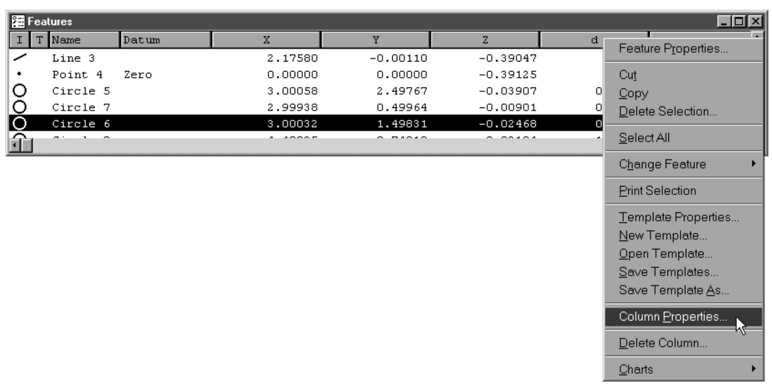
NOTE

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.

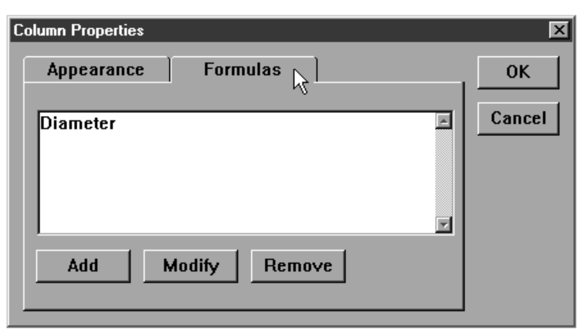
Step 1
Right click at the top of the template column as shown.



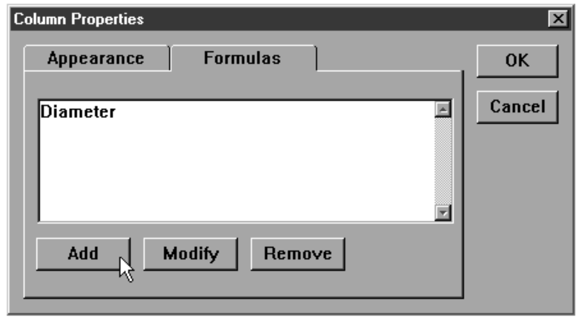
Step 2
Select *column properties* from the list.



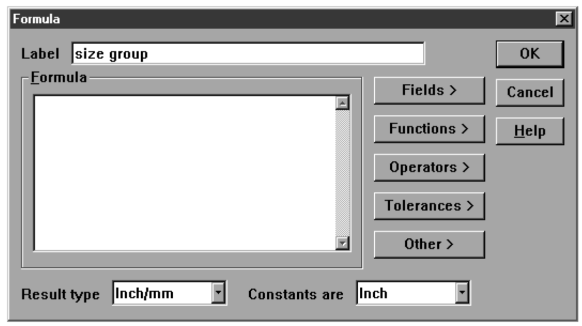
Step 3
Click on the *formulas* tab.



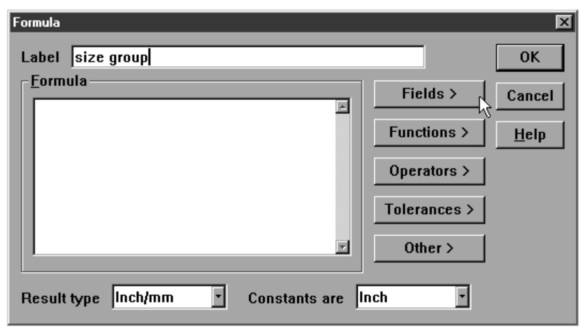
Step 4
Click *add*.



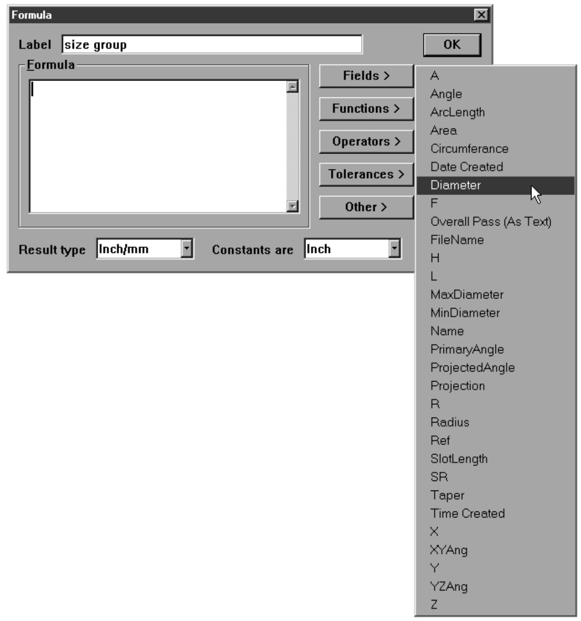
Step 5
Type 'size group' in the label text box.



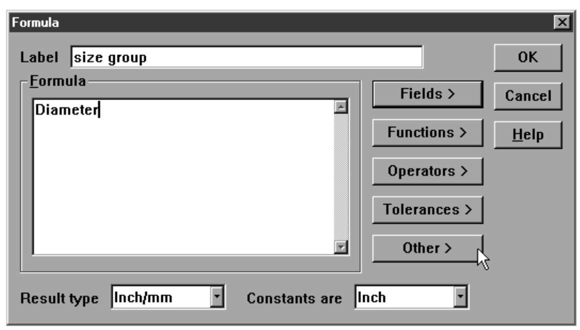
Step 6
Click on the *fields*> button.



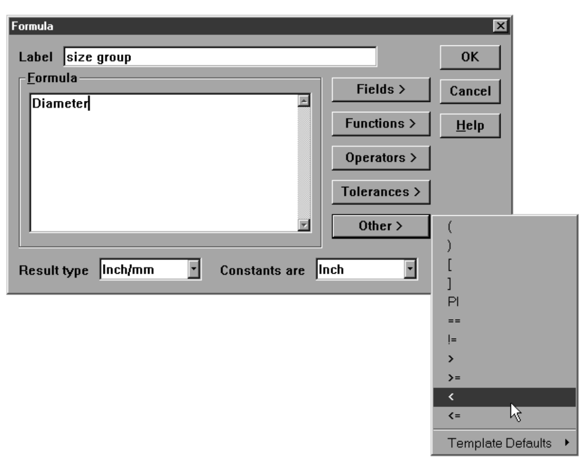
Step 7
Select *diameter* from the list.



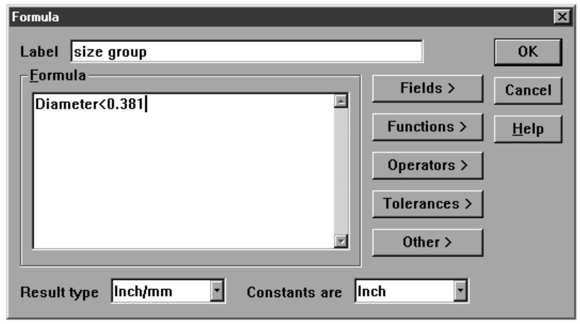
Step 8
Click on the *other*> button.



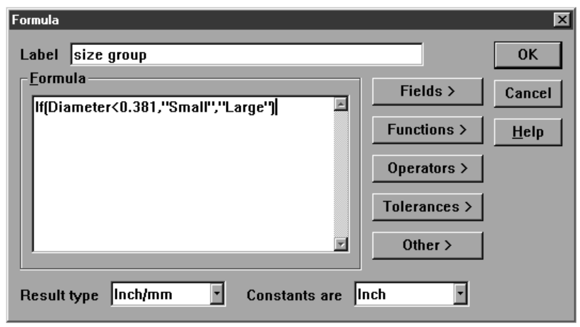
Step 9
Select the < (less than) symbol from the list.



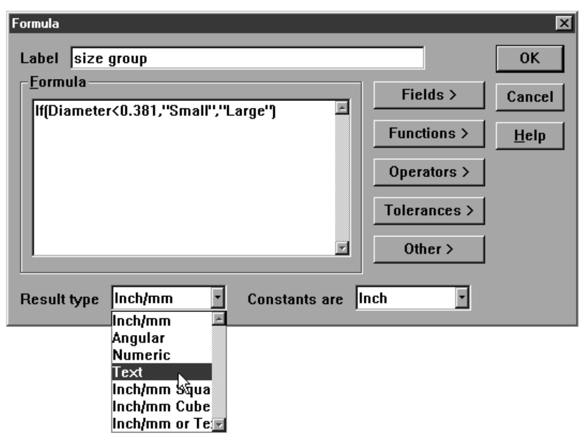
Step 10
Type 0.381 in the text box as shown.



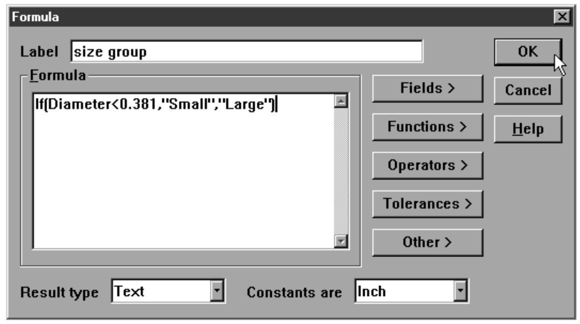
Step 11
Type in the rest of the formula as follows:
If(Diameter<0.381,"Small","Large")



Step 12
Select *text* from the result type list box.

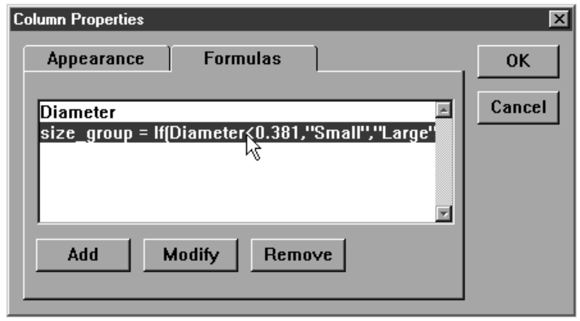


Step 13
Click OK in the formula dialog box.

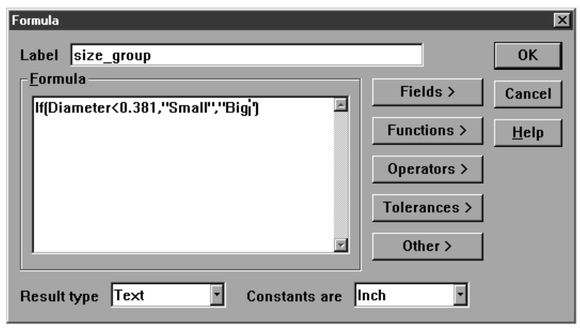


To modify a formula

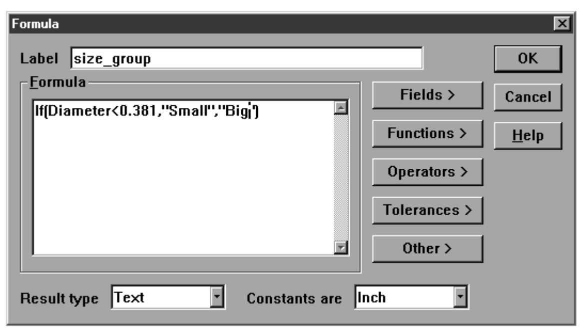
Step 1
Highlight the desired formula.



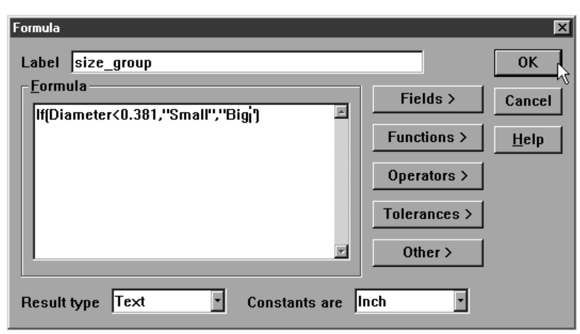
Step 2
Click the *modify* button on the formulas tab (column properties dialog box).



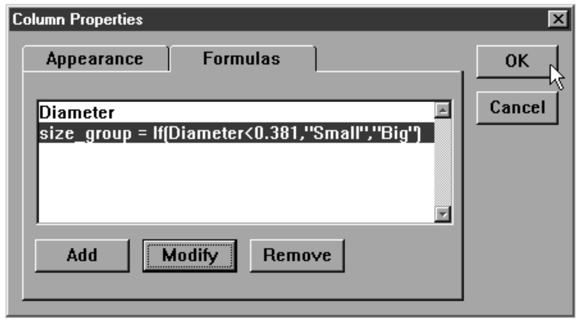
Step 3
Type in the modification.



Step 4
Click OK in the formulas dialog box.

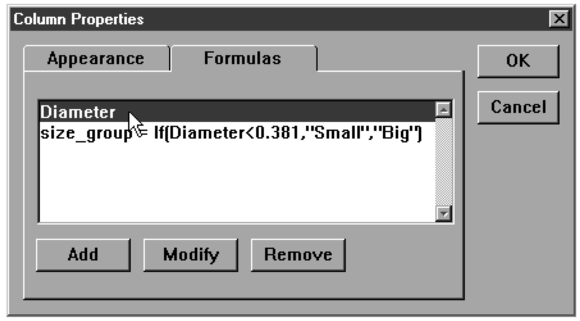


Step 5
Click OK in the column properties dialog box.

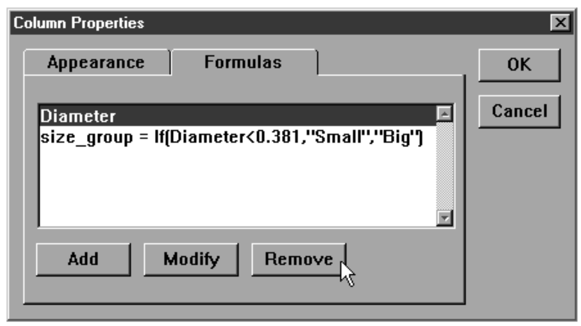


To remove a formula

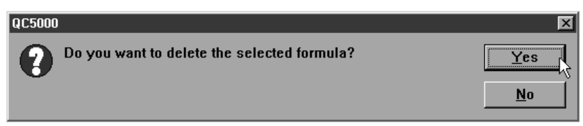
Step 1
Highlight the desired formula in the text box on the formula tab (column properties dialog box).



Step 2
Click the *remove* button.



Step 3
Click *yes* in the dialog box.

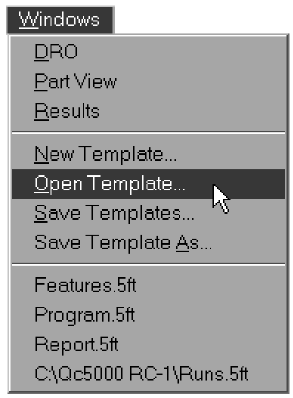


Runs Template

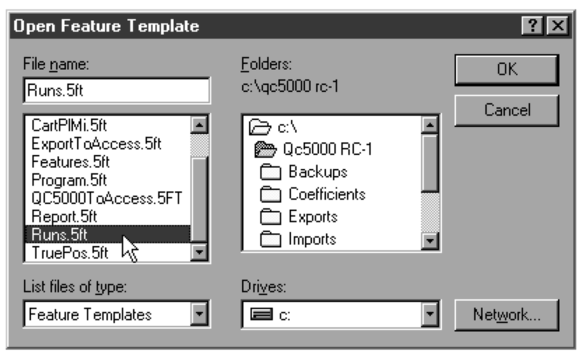
Use the runs template to track critical features from one program run to the next. Data in the runs is restricted to one feature attribute per column. For example, a column may display only the 'x' value for a given circle.

To open the runs template

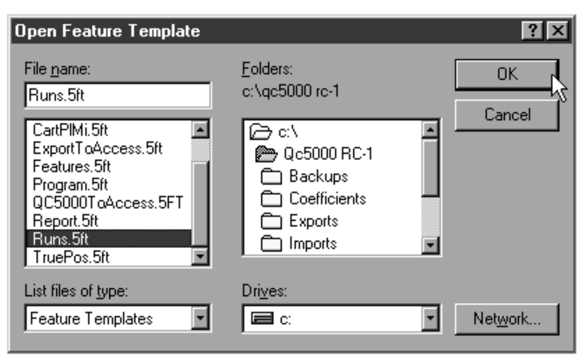
Step 1
Select *open template* from the windows menu.



Step 2
Select *runs.5ft* from the file name list in the open template dialog box.

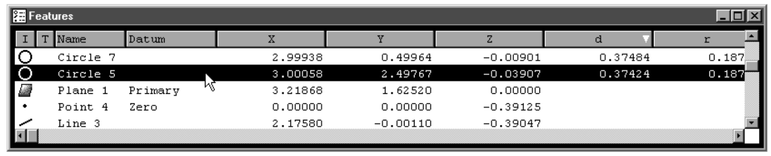


Step 3
Click OK in the dialog box.

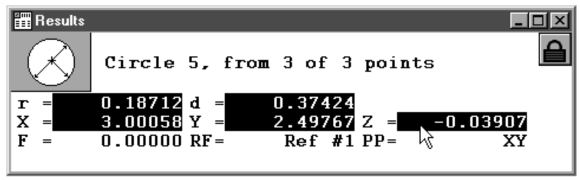


To add data to the runs template

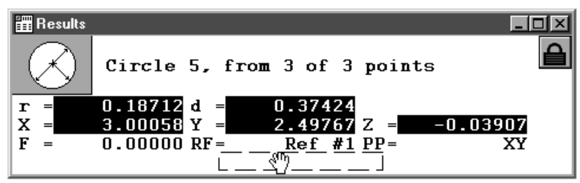
Step 1
Highlight a feature in the features list.



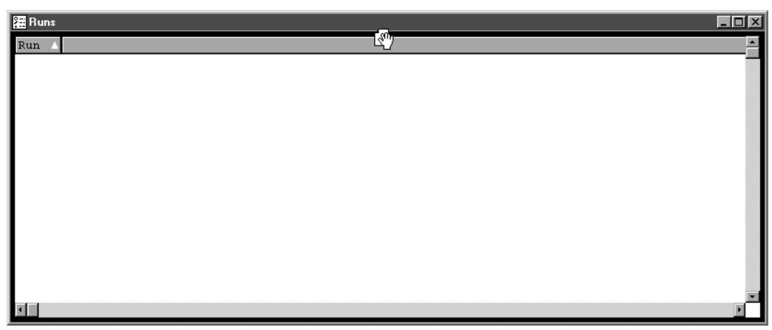
Step 2
Click on the desired fields in the results window to highlight them.



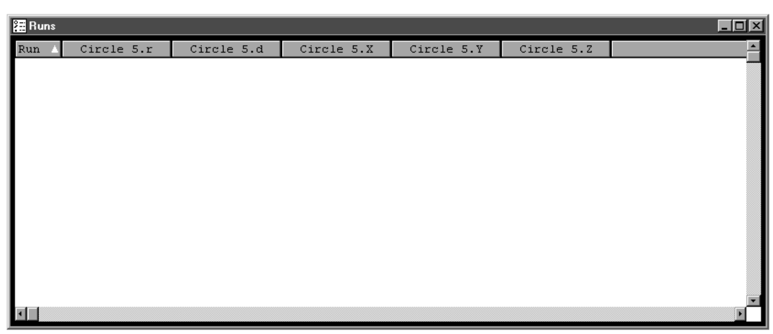
Step 3
Place the cursor over the highlighted fields and hold down the left mouse button.



Step 4
Drag the fields into the runs template.



The new fields appear in the template as shown.



Nesting Template Windows

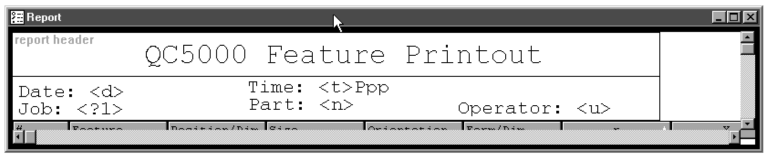
Up to ten can be open at one time. Nest templates within a single window to organize the desktop. Use the tabs to view nested windows.

NOTE

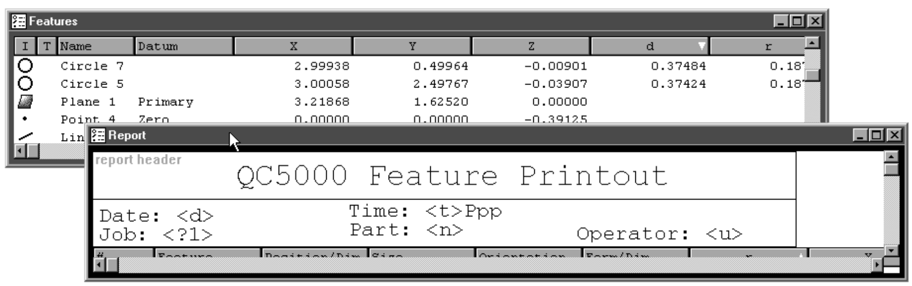
Do not open unneeded templates. System speed decreases as more templates are opened. Use the minimum number of templates required for fastest processing.

To nest template windows

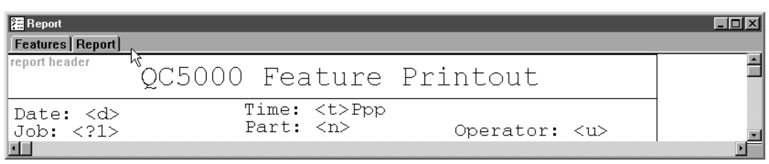
Step 1
Place the cursor over the title bar of the template window.



Step 2
Hold down the left mouse button and drag the window another template window.

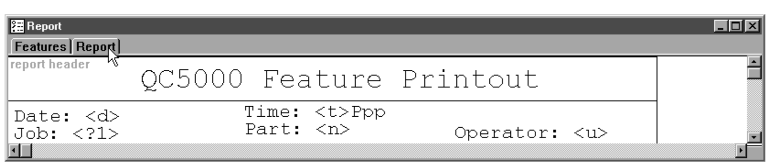


Step 3
Release the left mouse button.

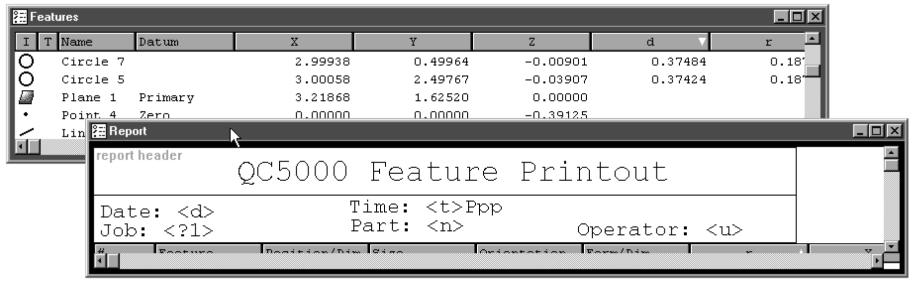


To separate template windows

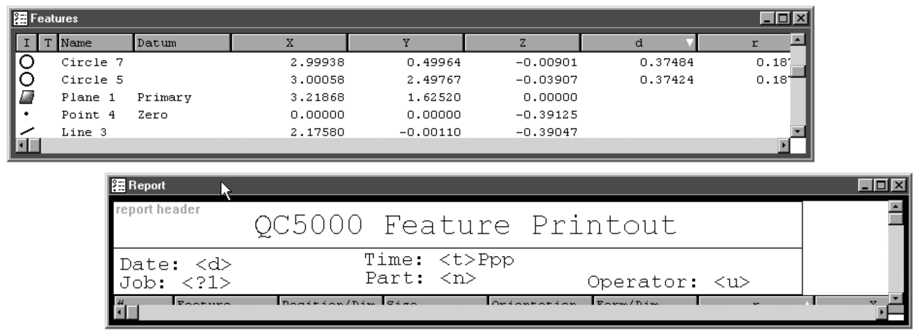
Step 1
Place the cursor of the desired template tab.



Step 2
Hold down the left mouse button and drag the template out of the window.



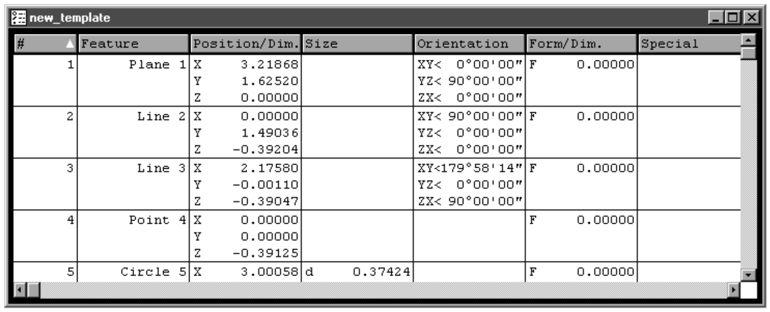
Step 3
Release the mouse button.



Creating New Templates

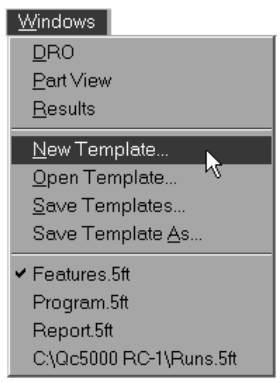
Creating a new template allows you to customize report formats and information in the features list. For example, templates can be designed to export data in a certain format.

To create a new template

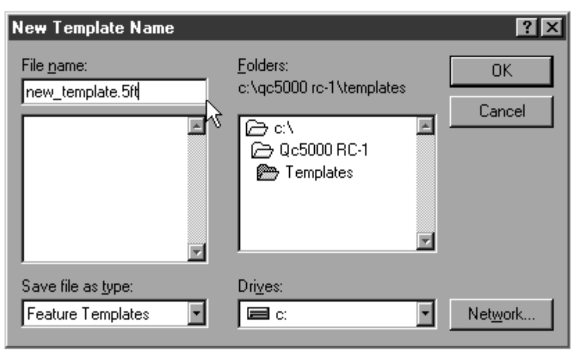


#	Feature	Position/Dim.	Size	Orientation	Form/Dim.	Special
1	Plane 1	X 3.21868 Y 1.62520 Z 0.00000		XY< 0°00'00" YZ< 90°00'00" ZX< 0°00'00"	F 0.00000	
2	Line 2	X 0.00000 Y 1.49036 Z -0.39204		XY< 90°00'00" YZ< 0°00'00" ZX< 0°00'00"	F 0.00000	
3	Line 3	X 2.17580 Y -0.00110 Z -0.39047		XY<179°58'14" YZ< 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	

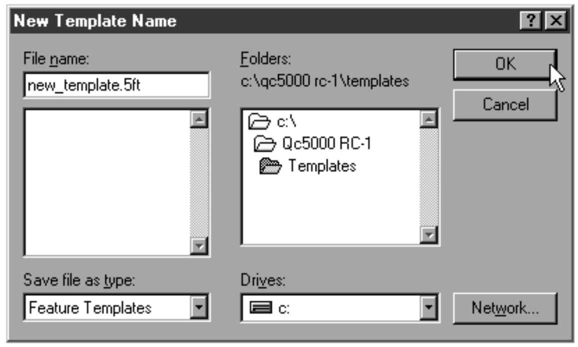
Step 1
Select *new template* from the windows menu.



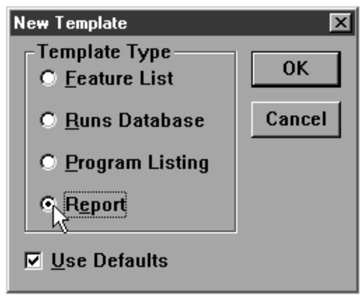
Step 2
Type a name for the template in the file name text box.



Step 4
Click OK in the new template name dialog box.



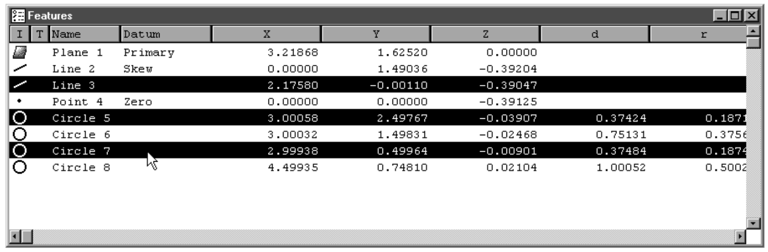
Step 5
Select type of template to create in the dialog box.



Export

To export a tab delimited file to a spreadsheet

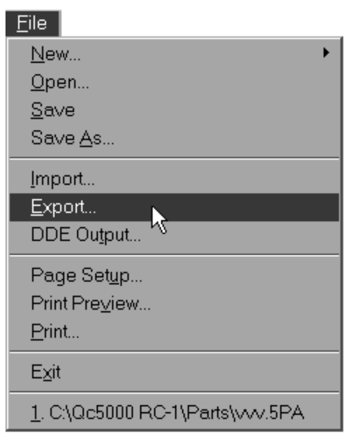
Step 1
Select the features to be exported from the features list.



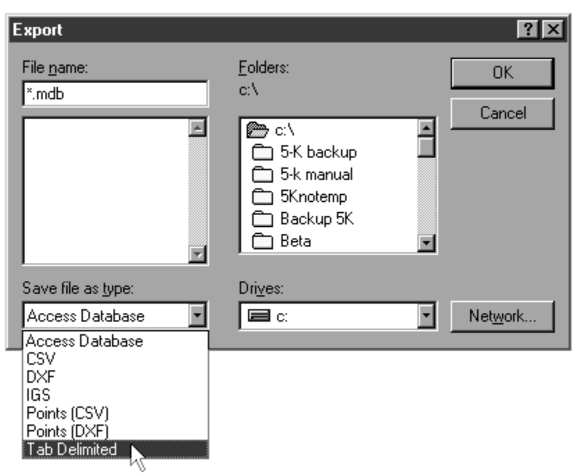
NOTE

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

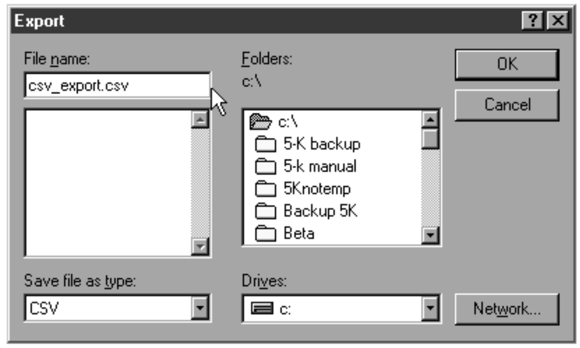
Step 2
Select *export* from the file menu.



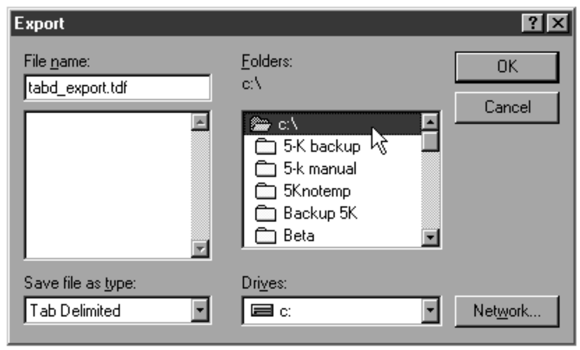
Step 3
Select *tab delimited* from the *save file as type* list in the export dialog box.



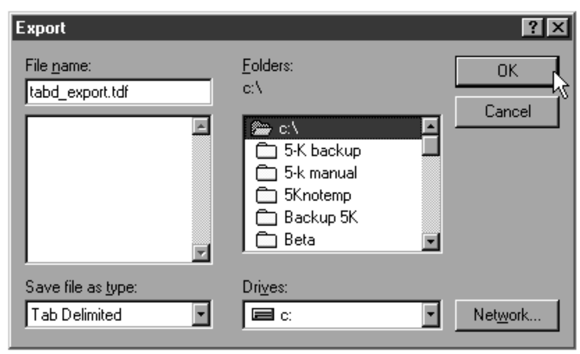
Step 4
Type the name of the file in the file name text box.



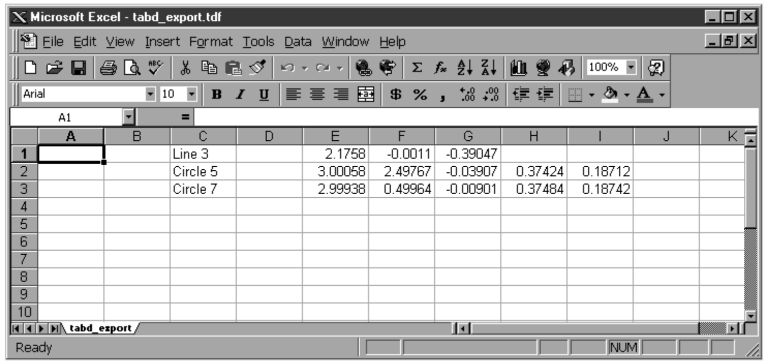
Stpe 5
Use the *folders* box and drives list to select the storage location for the file.



Step 6
Click OK in the export dialog box.

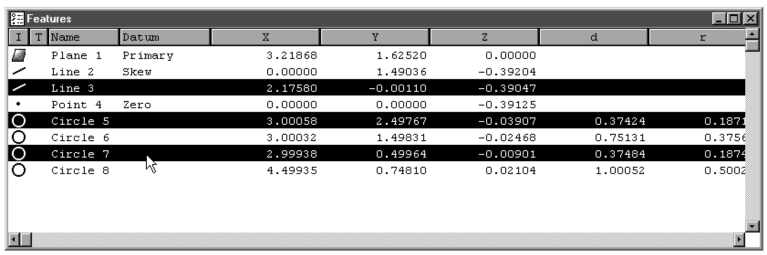


Step 7
Open the spreadsheet application and open the saved file.



To export a CSV (comma separated value) file to a spreadsheet

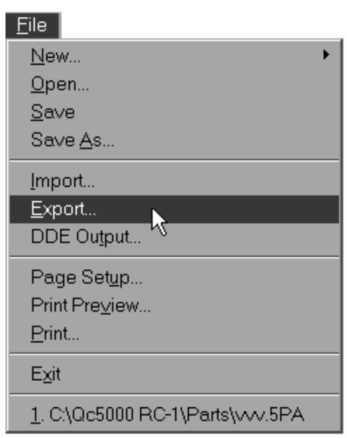
Step 1
Select the features to be exported from the features list.



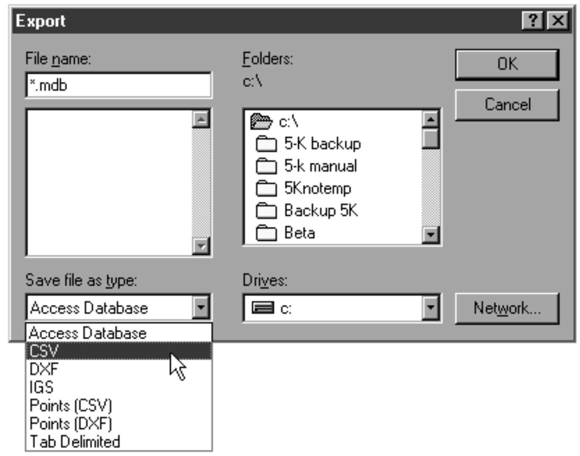
NOTE

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

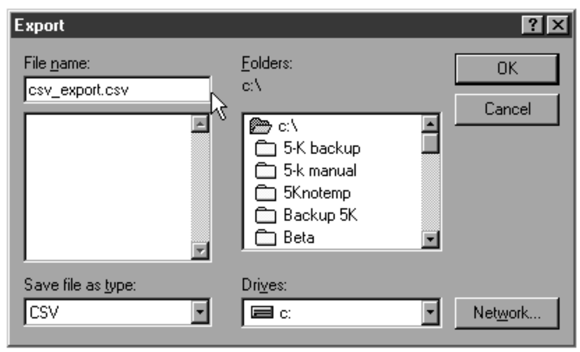
Step 2
Select *export* from the file menu.



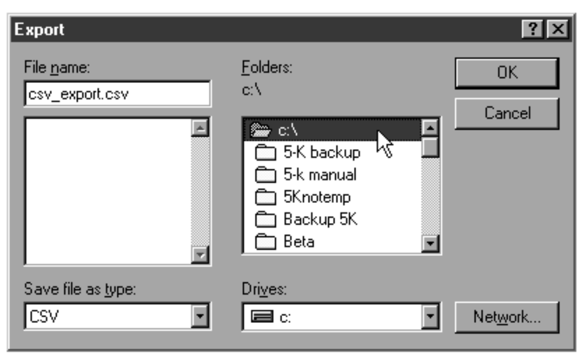
Step 3
Select *CSV* from the save file as type list in the export dialog box.



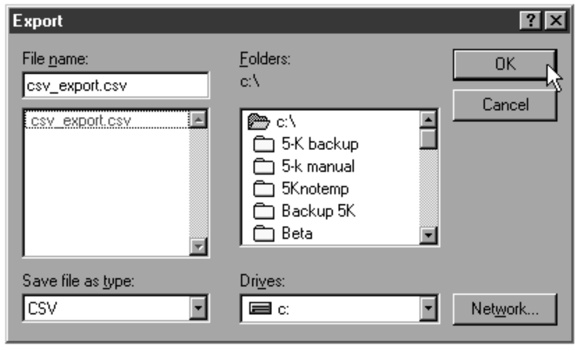
Step 4
Type the name of the file in the file name text box.



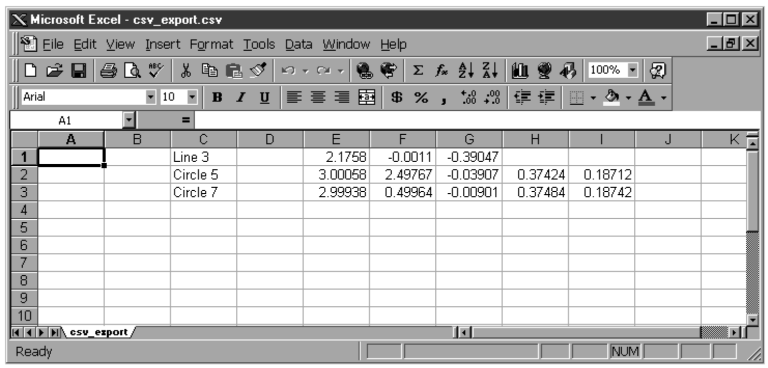
Step 5
Use the *folders* box and drives list to select the storage location for the file.



Step 6
Click OK in the export dialog box.



Step 7
Open the spreadsheet application and open the saved file.



Chapter 7
Programming

The QC5000 is user programmable. Users can enter a series of steps and save it as a program for later use. When the program is executed the QC5000 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. QC5000 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 QC5000 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 QC5000 demo part for the following sections. Any multi-feature part may be substituted in later programs.

Keep in mind that QC5000 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 QC5000 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.

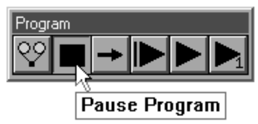
The Program Toolbar

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

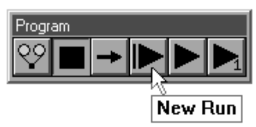
Click the record/edit button to start recording a program. The QC5000 software will record all actions from this point as a new program or as an addition to an existing program. To stop recording, click the Pause Program button (see below).

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

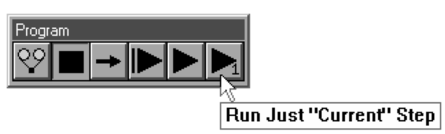


Click the New Run button to run a program from the first step. When New Run is clicked the program begins from the first step regardless of the step selected in the program window.

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

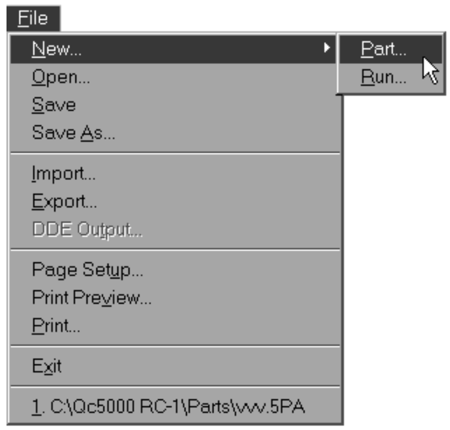


Click the Run Just Current Step to execute only the currently selected step and then pause the program.

Recording a Program

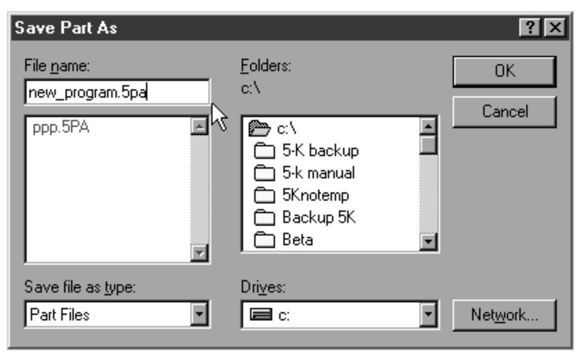
To create a program

Step 1
Select *new* from the file menu. Then select *part*.

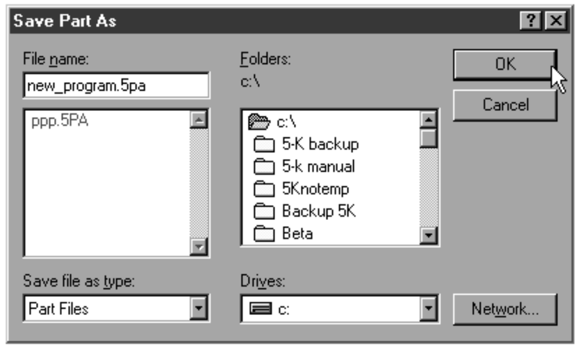


Step 2
Click the *record/edit button* on the program toolbar.

Step 3
Type a progam name as shown.



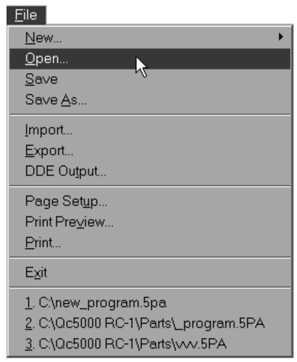
Step 4
Click OK.



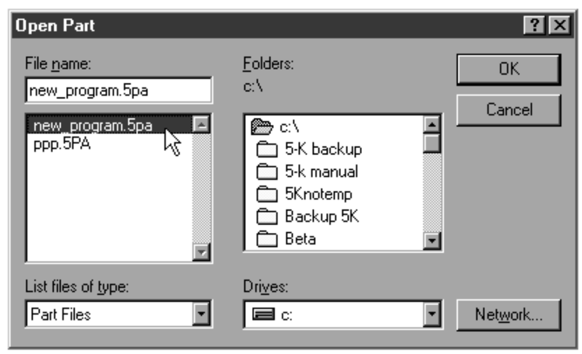
Step 5
Perform the desired steps.

To open a saved program

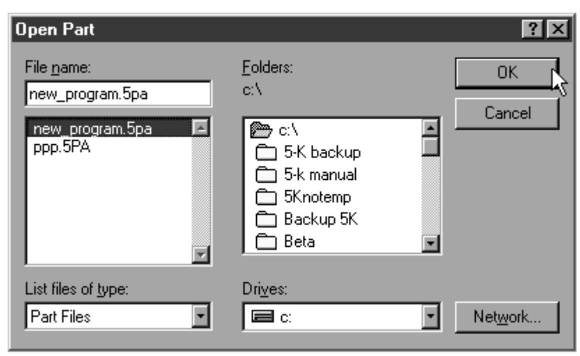
Step 1
Select *open* from the file menu.



Step 2
Highlight the desired program as shown.



Step 3
Click the OK button.

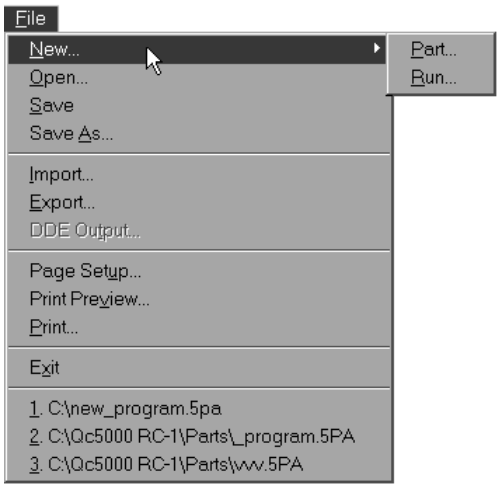


Running A Program

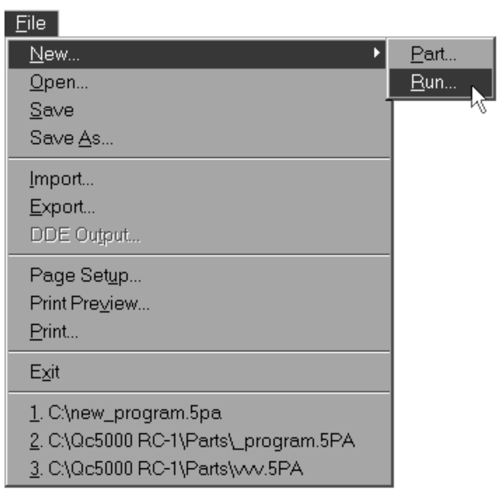
Running a saved program is easy. Open the part file using the method shown in above.

To run a program

Step 1
Select *new* from the file menu.

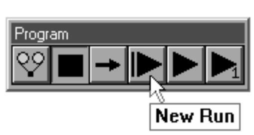


Step 2
Select *run* from the sub-menu.



OR

Step 1
Click the *new run button* on the program toolbar.



Sample Program

The following demonstration shows the entire programming process from start to finish. Use the QC5000 demonstration part to avoid confusion, but a program for any multi-feature part can be made with this method. This program will prompt the user to:

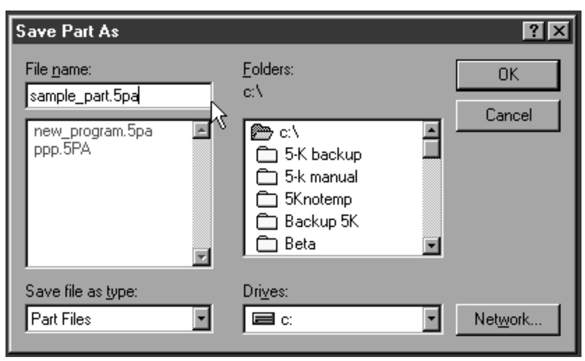
- Construct a circle
- Construct a pierce point
- Measure three dimensional features (cylinder and cone)
- Measure two dimensional features (circles and planes)
- Perform a True Position on a circle
- Perform a perpendicularity tolerance
- Perform a width tolerance
- Enter a conditional statement
- Enter a label

Follow the steps straight through to avoid confusion. Each procedure in the program is described in detail elsewhere in this manual. For more information on a particular step consult the index.

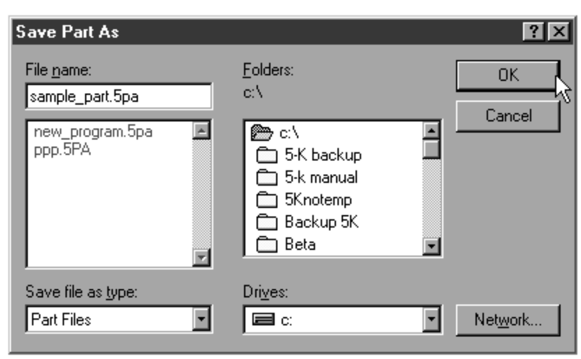
To record the sample program

Step 1
Click the *record/edit button* on the program toolbar.

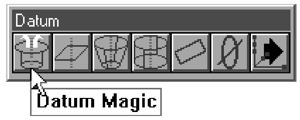
Step 2
Type a name for the program as shown.



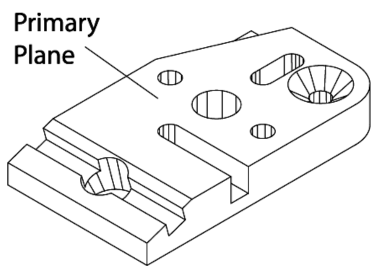
Step 3
Click OK in the dialog box.

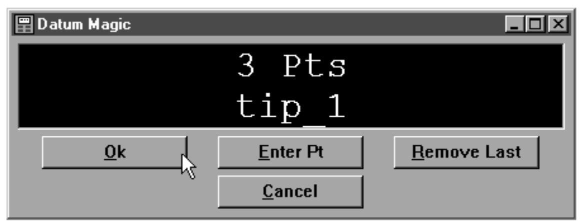


Step 4
Click the *datum magic button* on the datum toolbar.

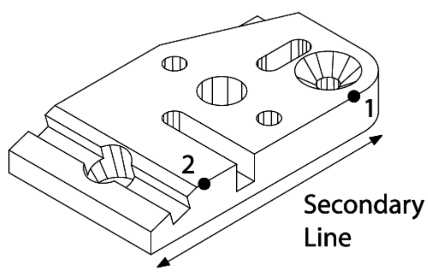


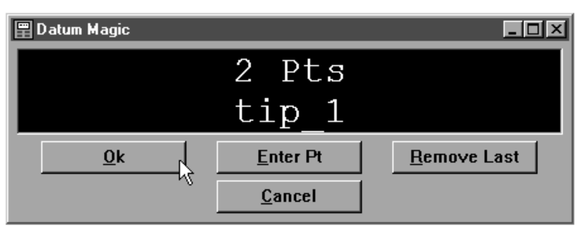
- create the primary plane



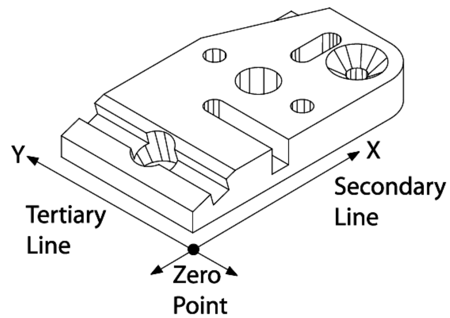


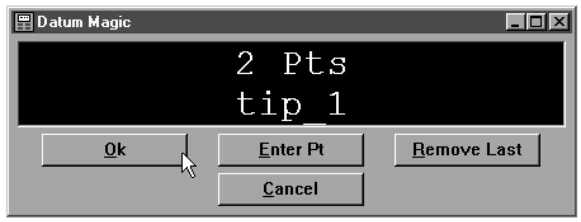
- create the secondary line



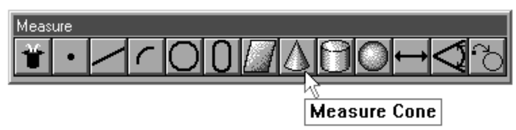


- create the zero point

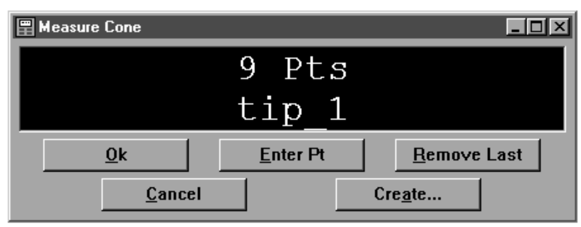




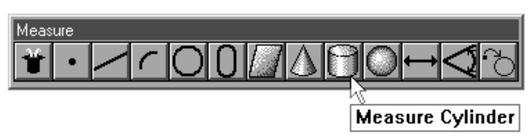
Step 5
Click the *cone button* on the measure toolbar.



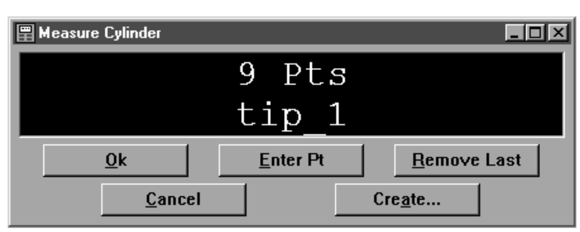
- measure the cone using 9 points



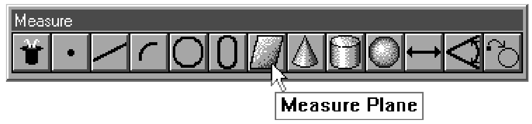
Step 6
Click the *cylinder button* on the measure toolbar.



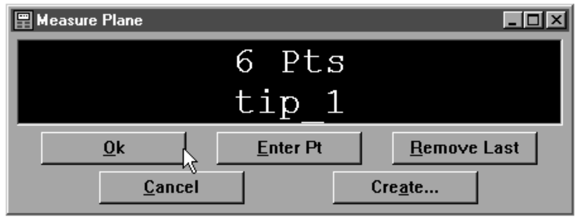
- measure the cylinder using 9 points



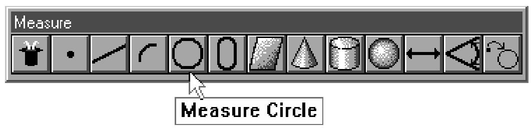
Step 7
Click the *plane button* on the measure toolbar.



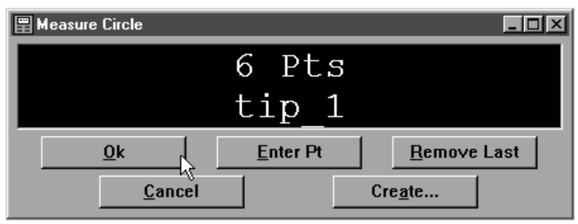
- measure the plane using 6 points



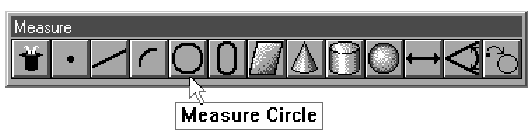
Step 8
Click the *circle button* on the measure toolbar.



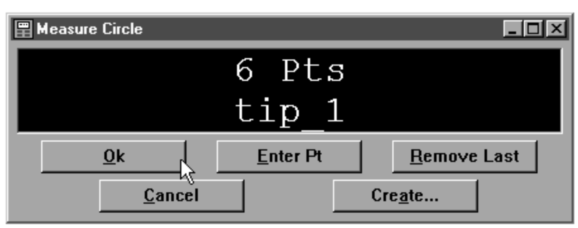
- measure the circle using 6 points



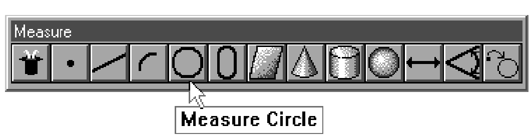
Step 9
Click the *circle button* on the measure toolbar.



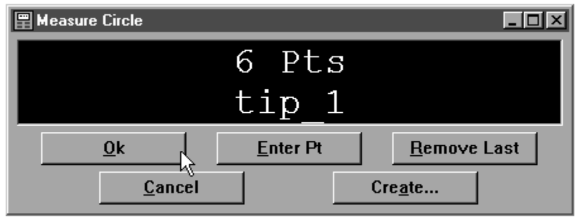
- measure the circle using 6 points



Step 10
Click the *circle button* on the measure toolbar.



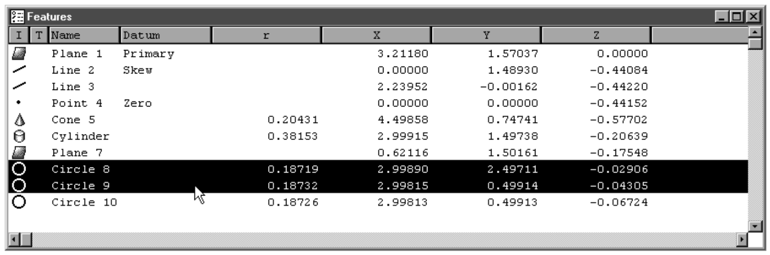
- measure the circle using 6 points



Step 11

Construct a center-to-center distance between the circles 8 and 9.

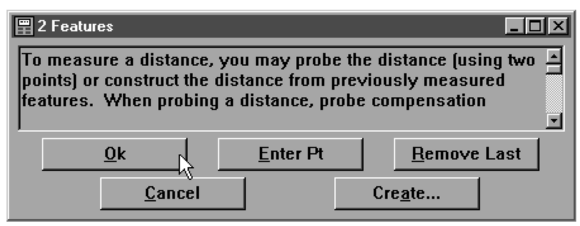
- Highlight circles 8 and 9 in the features list



I	T	Name	Datum	r	X	Y	Z
		Plane 1	Primary		3.21180	1.57037	0.00000
		Line 2	Skew		0.00000	1.48930	-0.44084
		Line 3			2.23952	-0.00162	-0.44220
		Point 4	Zero		0.00000	0.00000	-0.44152
		Cone 5		0.20431	4.49858	0.74741	-0.57702
		Cylinder		0.38153	2.99915	1.49738	-0.20639
		Plane 7			0.62116	1.50161	-0.17548
		Circle 8		0.18719	2.99890	2.49711	-0.02906
		Circle 9		0.18732	2.99815	0.49914	-0.04305
		Circle 10		0.18726	2.99813	0.49913	-0.06724

- Click the measure distance button on the measure toolbar

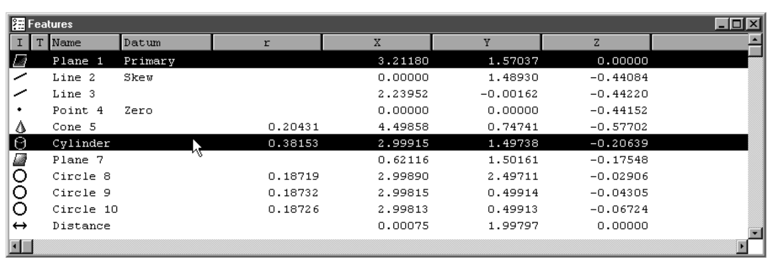
- Click OK in the dialog box



Step 12

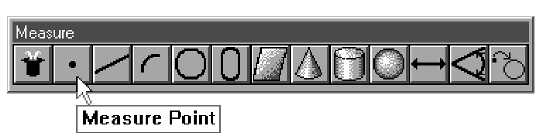
Construct a point from the cylinder and the primary plane.

- Highlight the cylinder and the primary plane in the features list

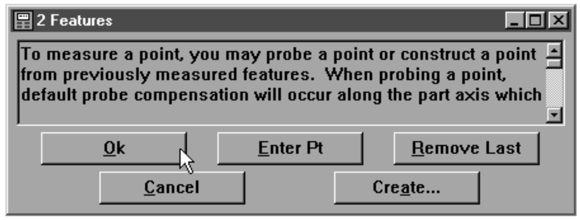


I	T	Name	Datum	r	X	Y	Z
		Plane 1	Primary		3.21180	1.57037	0.00000
		Line 2	Skew		0.00000	1.48930	-0.44084
		Line 3			2.23952	-0.00162	-0.44220
		Point 4	Zero		0.00000	0.00000	-0.44152
		Cone 5		0.20431	4.49858	0.74741	-0.57702
		Cylinder		0.38153	2.99915	1.49738	-0.20639
		Plane 7			0.62116	1.50161	-0.17548
		Circle 8		0.18719	2.99890	2.49711	-0.02906
		Circle 9		0.18732	2.99815	0.49914	-0.04305
		Circle 10		0.18726	2.99813	0.49913	-0.06724
		Distance			0.00075	1.99797	0.00000

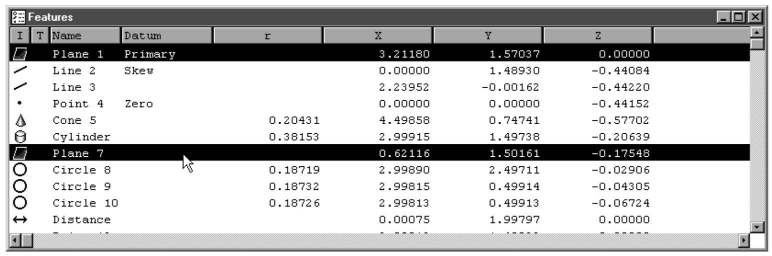
- Click the point button on the measure toolbar



- Click OK in the dialog box

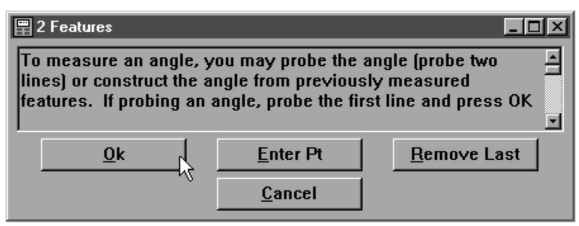


Step 13
Construct an angle between the primary plane and plane 7.
- Highlight the primary plane and plane 7in the features list

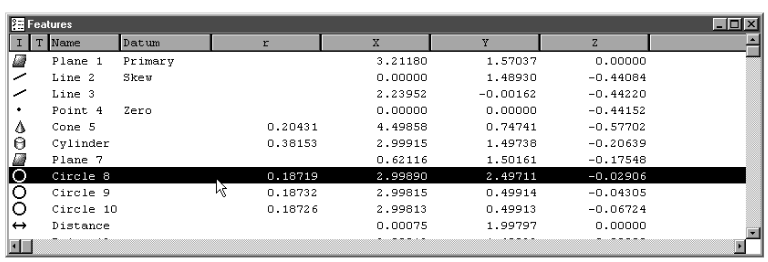


- Click the angle button on the measure toolbar

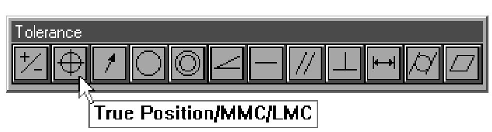
- Click OK in the dialog box



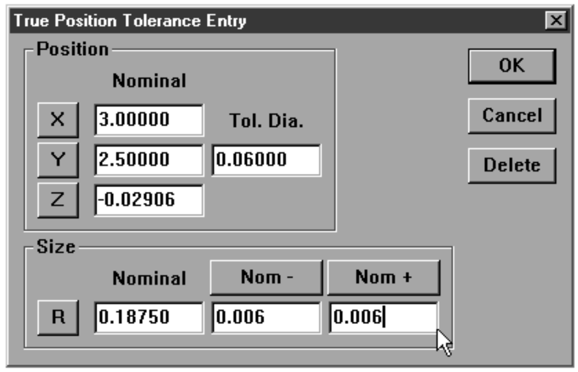
Step 14
Enter a true position tolerance for circle 8.
- highlight circle 8 in the features list



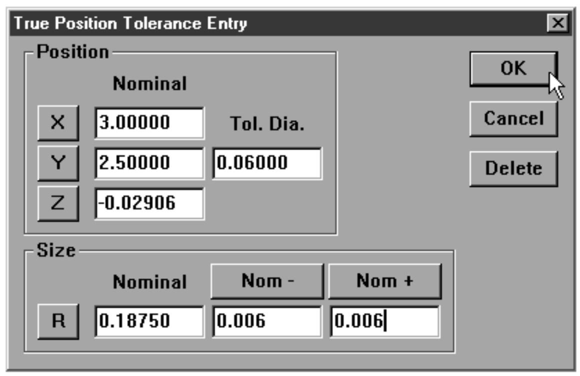
- click the true position/MMC/LMC button on the tolerance toolbar



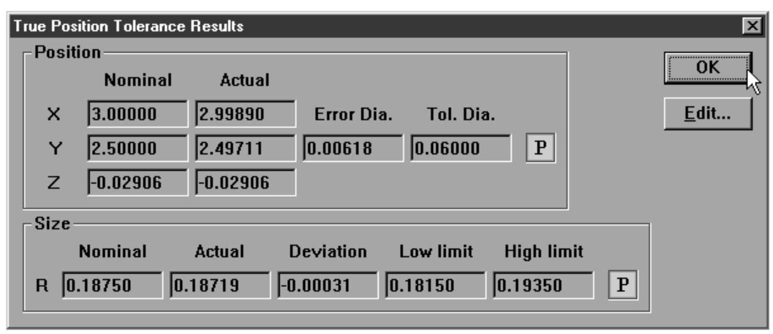
- enter the tolerance data as shown



- Click OK

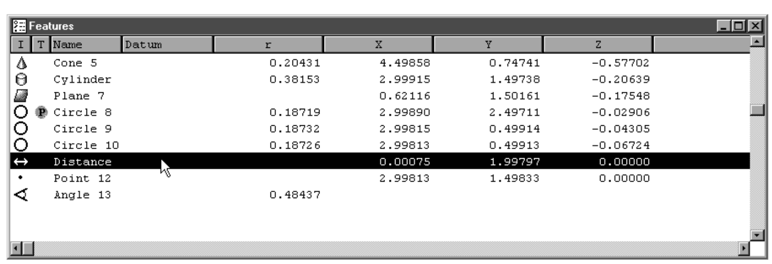


- Click OK in the tolerance results window

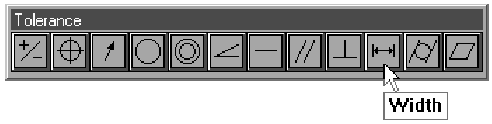


Step 15
Enter a width tolerance for the distance.

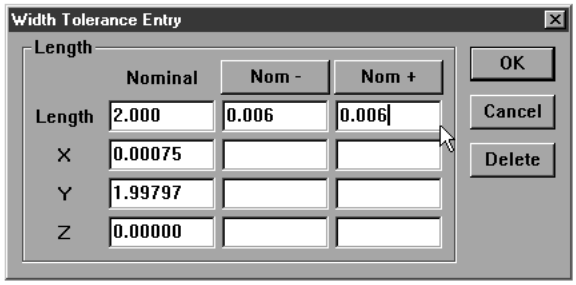
- highlight the distance in the features list



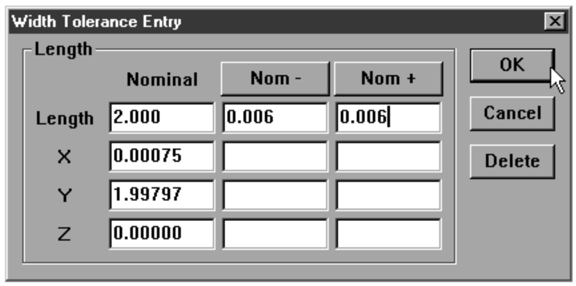
- click the *width* button on the tolerance toolbar



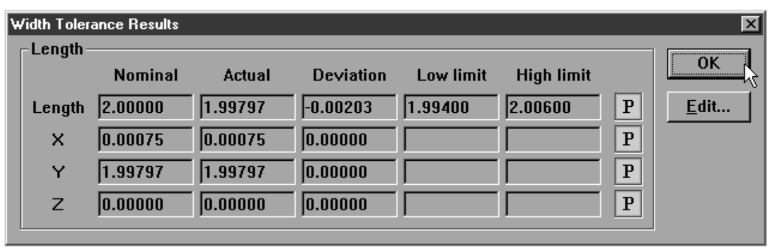
- enter the tolerance data as shown



- click OK

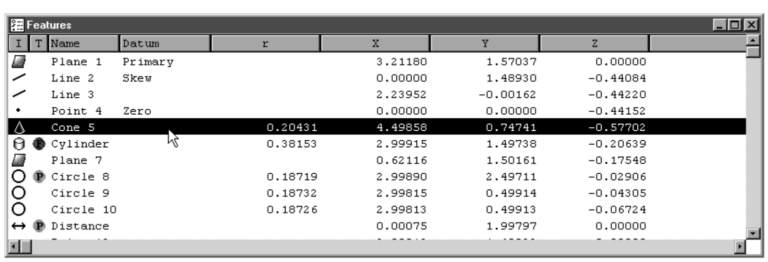


- click OK in the tolerance results window



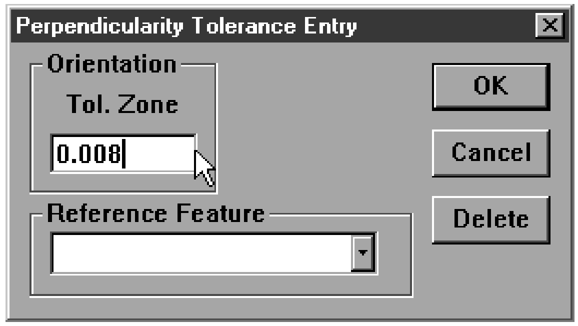
Step 16
Enter a perpendicularity tolerance for the primary plane.

- highlight the primary plane in the features list

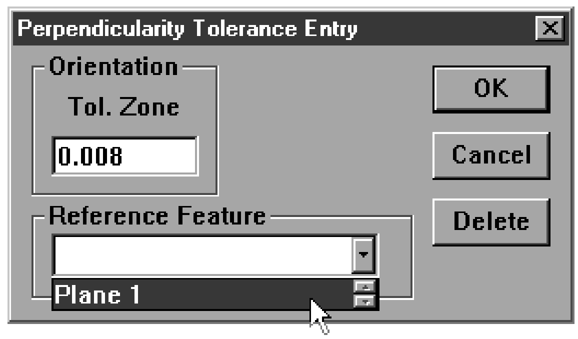


- click the *perpendicularity* button on the tolerance toolbar

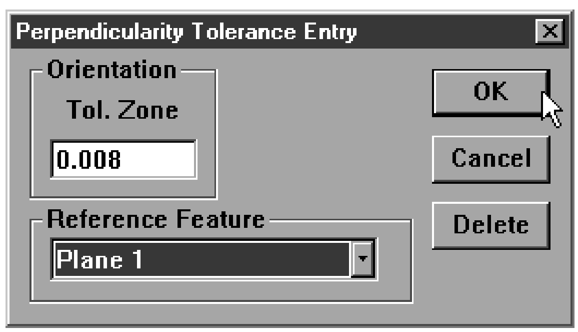
- enter the tolerance zone (0.008 inches) as shown



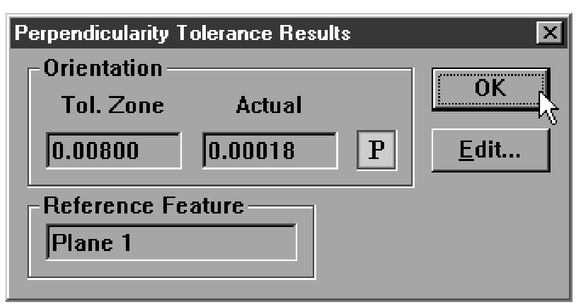
- select the cylinder from the reference feature list



- click OK



- click OK in the tolerance results window

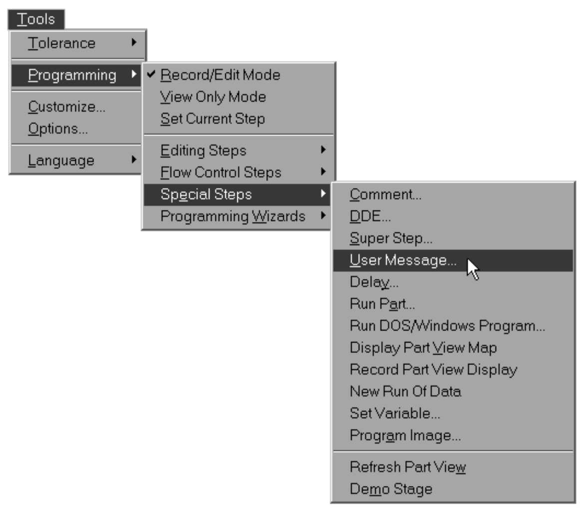


Creating User Messages

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 Insert A User Message

Step1
Select *programming* then *special steps* then *user message* from the tools menu.



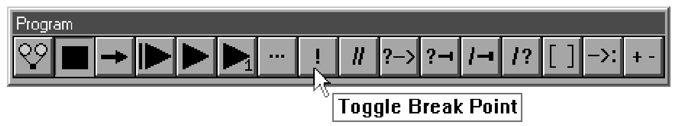
Step 2
Type the desired message as shown.

Step 3
Click OK in the dialog box.

Expanding the Program Toolbar

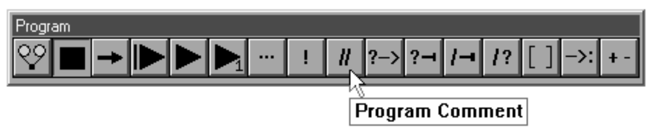
This section describes buttons commonly added to the program toolbar by QC5000 users. A procedure for adding buttons to a toolbar follows this section.

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

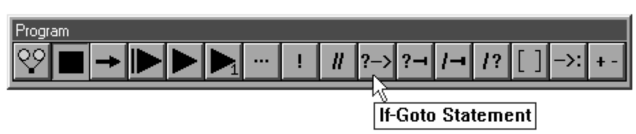


Click to enter a note into the program for future reference. Program comments are simply to explain a step or add information that might hellp later. Comments do not perform functions.

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

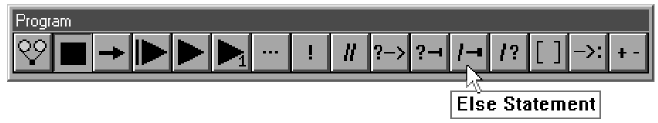


Click to place an If-Goto statement in a program, see the Conditional Statements section for more information.

If-Then

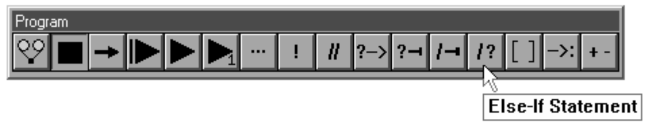
Click to place an If-Then statement in a program, see the Conditional Statements section for more information.

Else



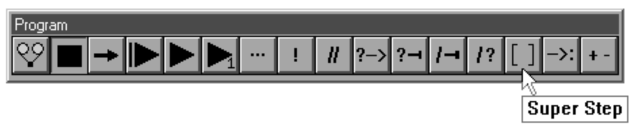
Click to place an Else statement in a program, see the Conditional Statements section for more information.

Else-If



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

Super Step

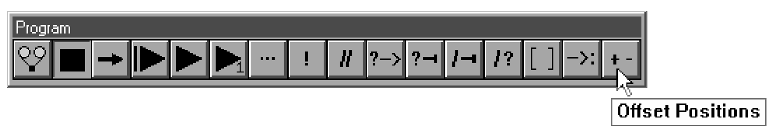


Click to group a selection of steps into a collapsible group (SuperStep). This organizes and shortens the display of large programs in the Program window.

Goto Label

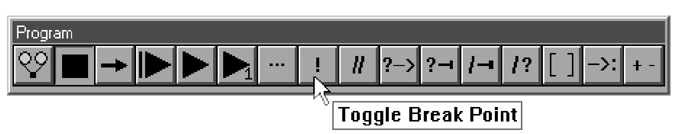
Click to create a Goto Label for use with an If- Goto conditional statement. The Goto Label is the action carried out if the test condition is true.

Offset Positions



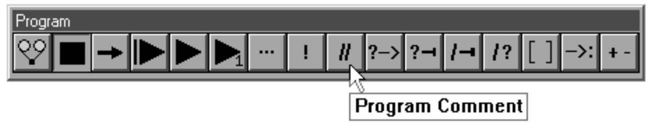
Click to manually enter a coordinate that will offset the current coordinate. This feature is useful for inspecting multiple parts mounted on a fixture.
ed Program Toolbar
This section describes other buttons that users commonly place on the program toolbar. A procedure for adding buttons to the toolbar 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

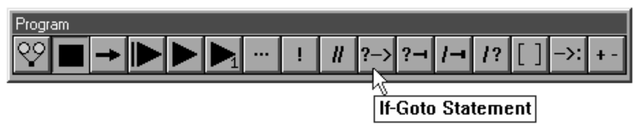


Click to enter a note into the program for future reference. Program comments are simply to explain a step or add information that might hellp later. Comments do not perform functions.

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.

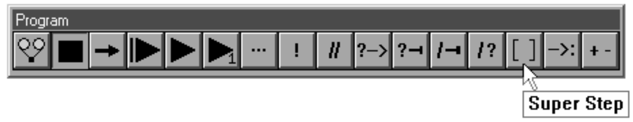
Else

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

Else-If

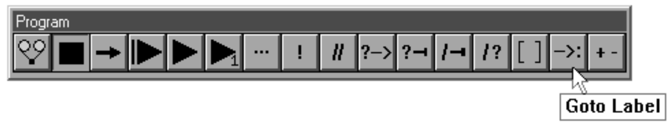
Click to place an Else-If statement in a program, see the Conditional Statements section for more information.

Super Step



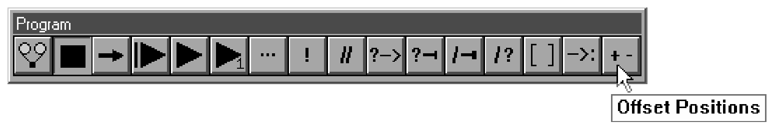
Click to group a selection of steps into a collapsible group (SuperStep). This organizes and shortens the display of large programs in the Program window.

Goto Label



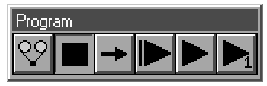
Click to create a Goto Label for use with an If- Goto conditional statement. The Goto Label is the action carried out if the test condition is true.

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.

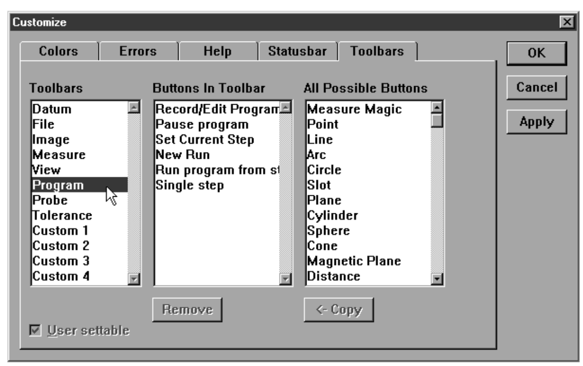
To add buttons to a toolbar



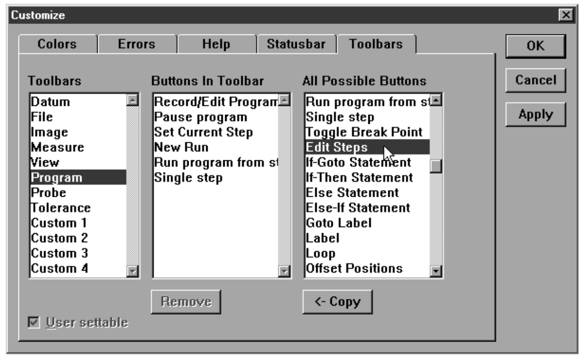
Step 1
Select *customize* from the tools down menu.

Step 2
Select the *toolbars* tab.

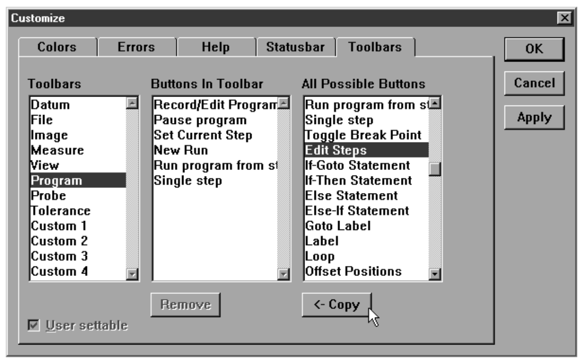
Step 3
Highlight the desired toolbar as shown.



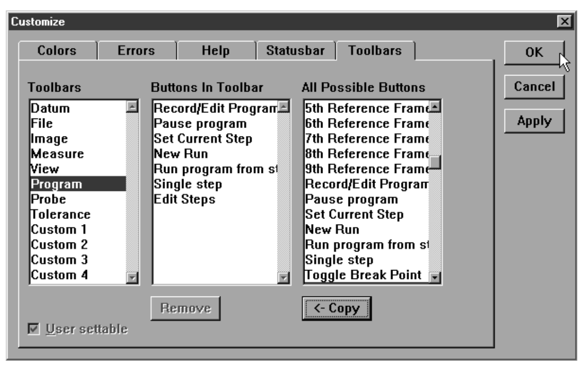
Step 4
Click on the desired button in the *all possible buttons* list.



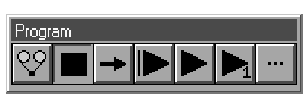
Step 5
Click the *copy* button.



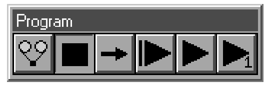
Step 6
Click OK.



The new button appears in the toolbar.



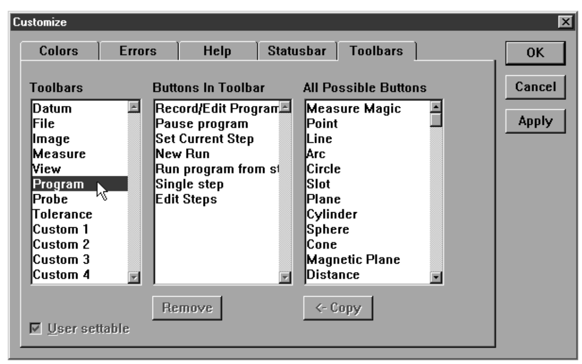
To delete buttons from a toolbar



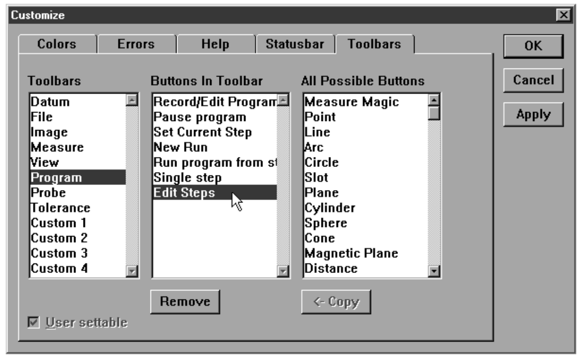
Step 1
Select *customize* from the tools down menu.

Step 2
Select the *toolbars* tab.

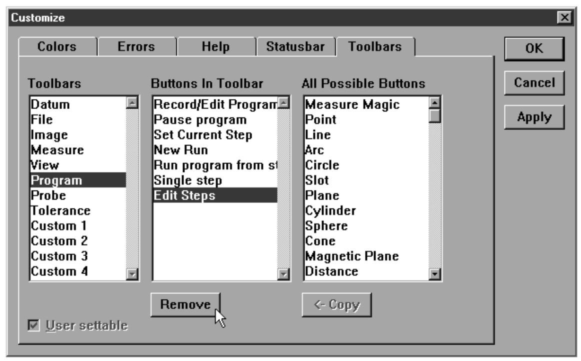
Step 3
Highlight the desired toolbar as shown.



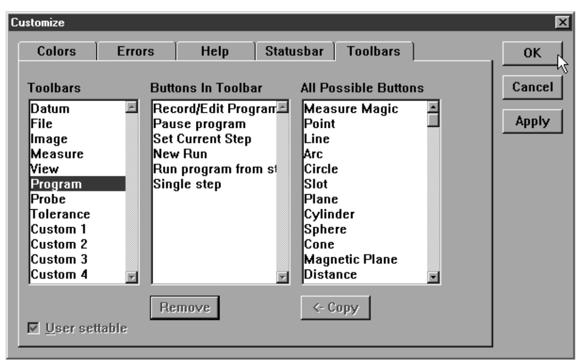
Step 4
Click on the desired button in the *buttons in toolbar* list.



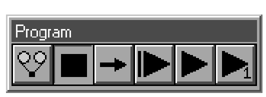
Step 5
Click the *remove* button.



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 QC5000 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.

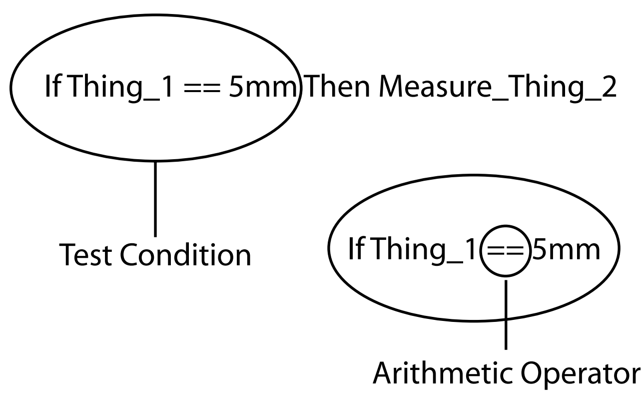
Arithmetic Operators

Test conditions are essentially mathematical equations. The chart below lists the arithmetical operators used in the QC5000 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.

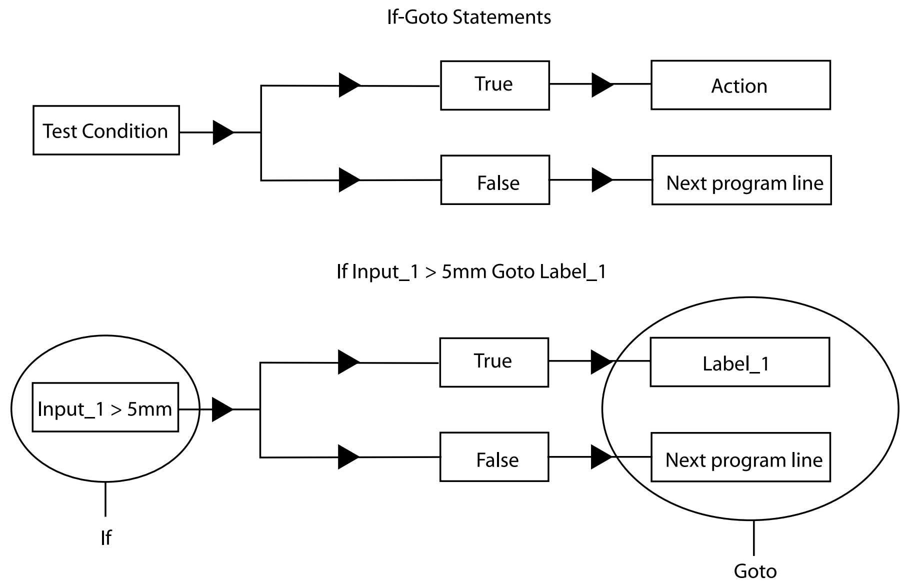


In this example, the '==' arithmetic operator determines that Thing_1 must equal 5mm for the test condition to be true. The entire test condition reads: if Thing_1 is equal to 5mm. This means the action Measure_Thing_2 will only be carried out if Thing_1 equals 5mm.

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.

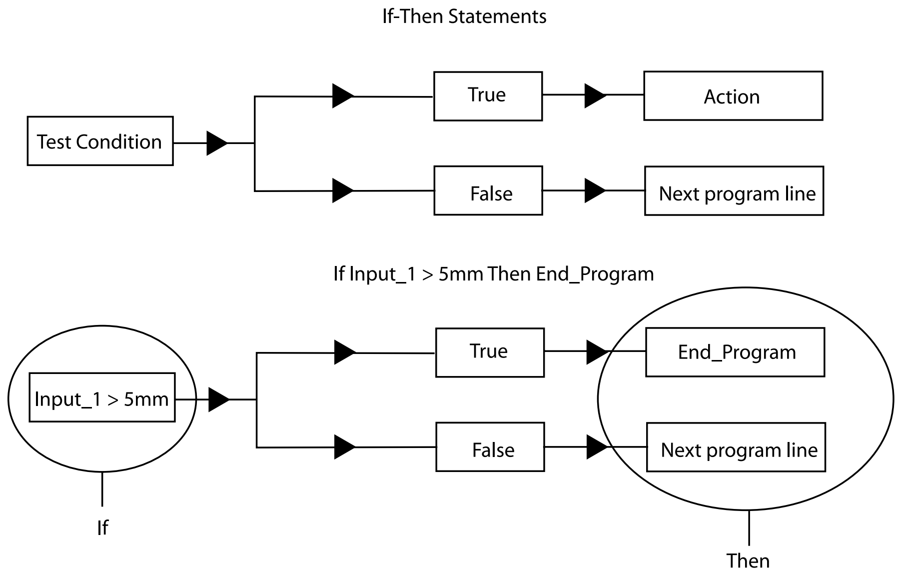


In this example, if the feature measures greater than 5mm the program goes to the line labeled 'Label_1.'

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.

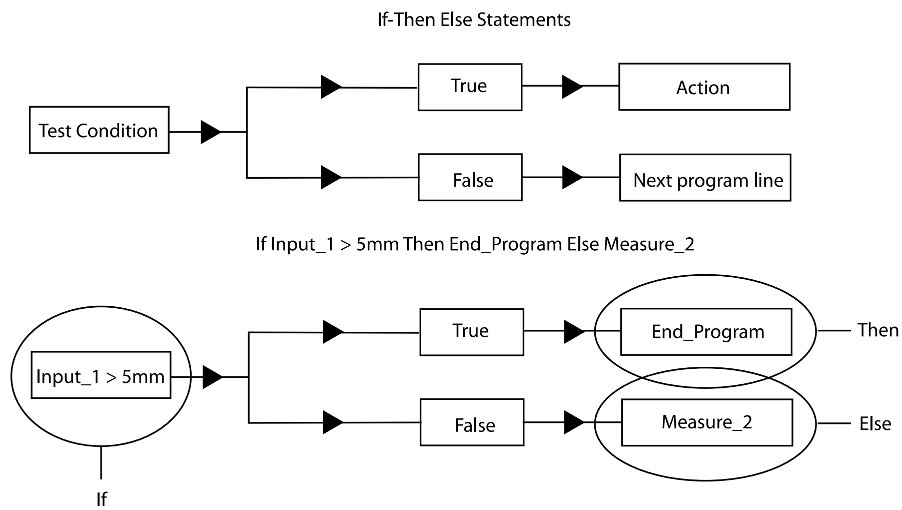


In this example, if the feature measures greater than 5mm the program carries out the action 'End_Program.' If the feature measures less than 5mm the program continues to the next line.

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.



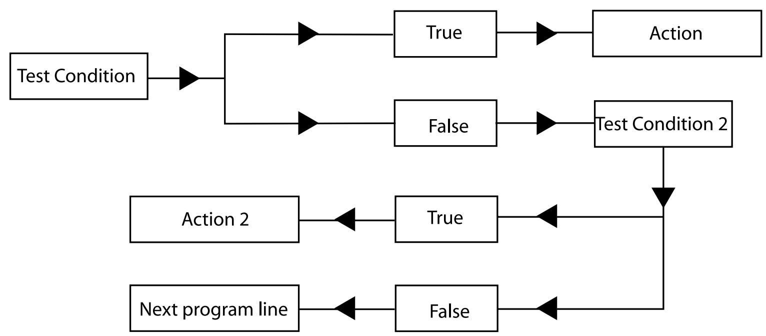
In this example, if the feature measures greater than 5mm the program then carries out the action 'End_Program.' If the feature measures less than 5mm the program carries out the action 'Measure_2.'

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

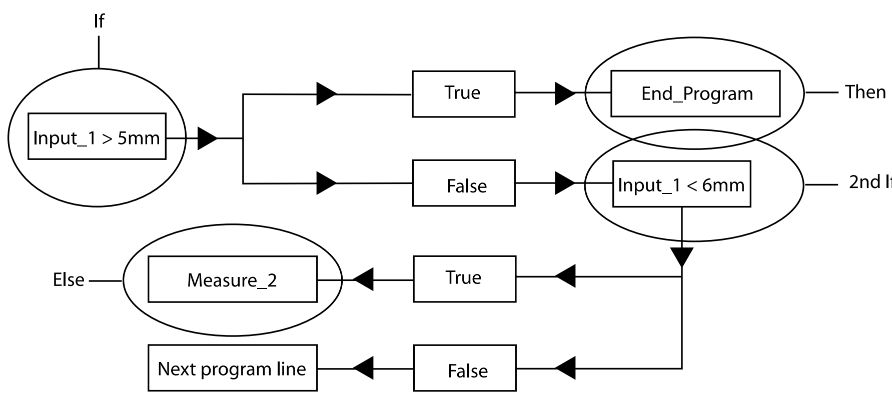
Else-If Statement

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.

If-Then Else-If Statements



If Input_1 > 5mm Then End_Program Else Measure_2 If Input_1 < 6mm



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 mathmetical 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 mathemetical 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,

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

sqr([Circle 1]radius)*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 8
System Setup & Configuration

Before You Begin

You will rarely need to alter settings in the system and encoder setups. The information in this chapter mainly applies to initial setup. It is recommended that system settings be changed only on direction of your dealer or OEM.

CAUTION

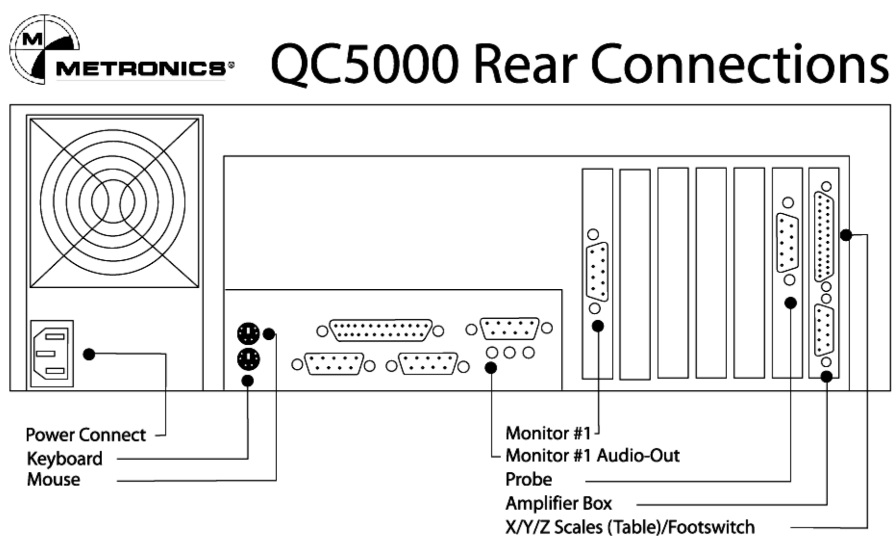
Do not change settings in the encoder setup program or supervisor setup options experimentally. Changing these settings can cause serious measurement errors. Contact your dealer or OEM before making an changes to setup functions.

NOTE

Scale errors cannot be caused by the QC5000. Input from the CMM is read by the software and measurements are performed accordingly. Make certain the CMM is mechanicly sound and properly calibrated before installing QC5000.

Hardware Setup

Follow the diagram to connect axis and probe cables to the rear of the CPU.

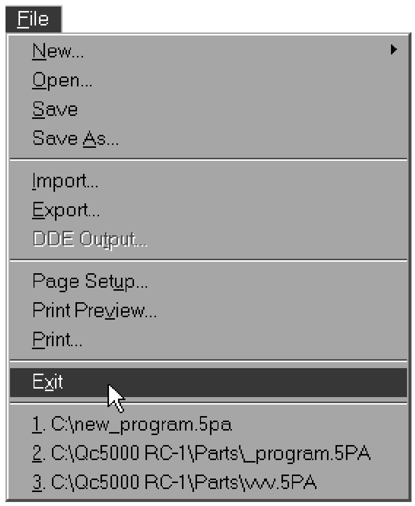


Encoder Setup

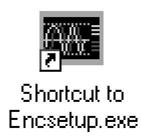
Use the encoder setup program to detect scale errors and calibrate encoders. Double click on the encoder setup icon to open the program.

To setup encoders

Step 1
Shut down the QC5000

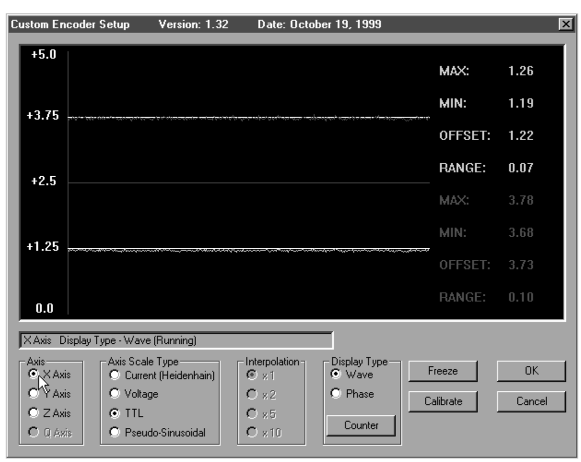


Step 2
Double-click the encoder setup icon.

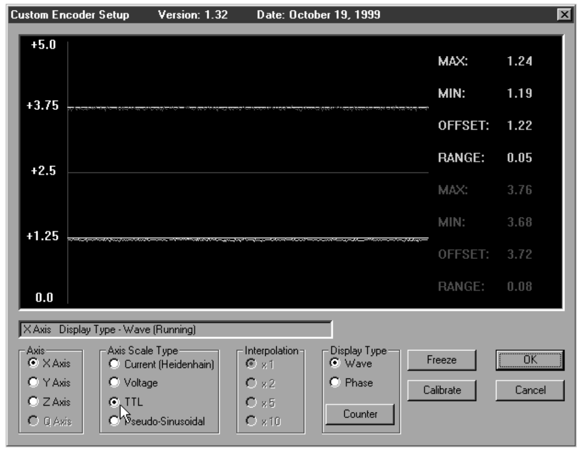


Step 3
Click OK in the dialog box.

Step 4
Select the desired axis as shown.



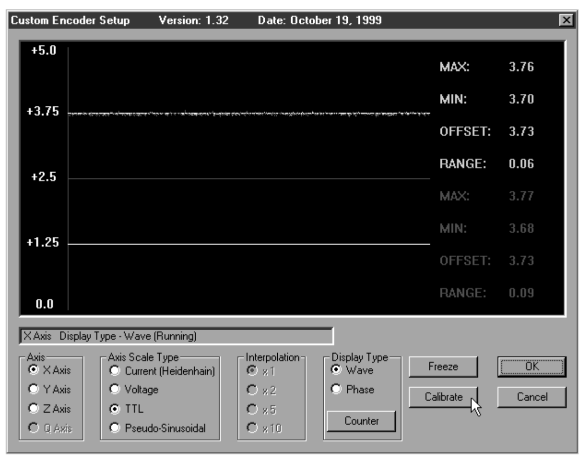
Step 5
Select the scale type as shown.



NOTE

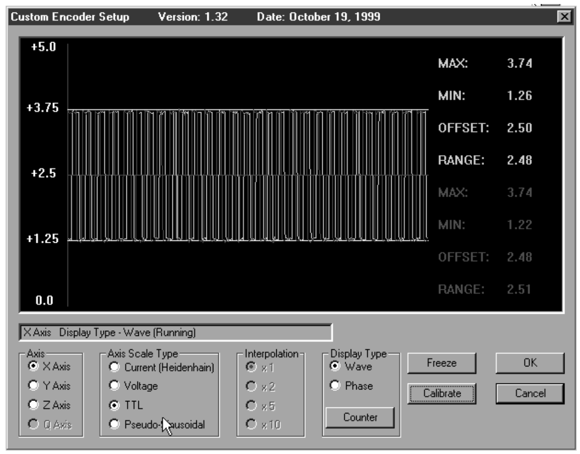
Consult your distributor/OEM for scale type.

Step 6
Click the *calibrate button*.



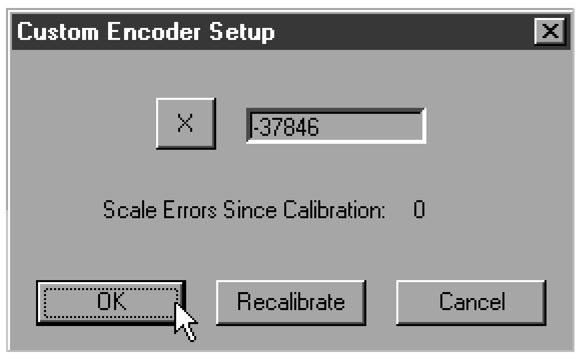
Step 7
Click OK.

Step 8
Move the encoder back and forth along the selected axis.

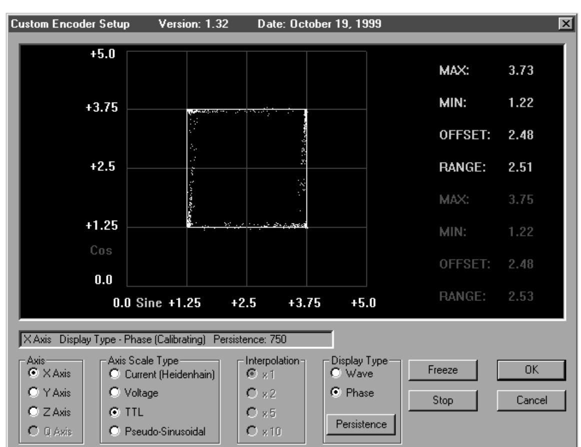


The custom encoder setup window indicates that the calibration is complete and reports the number of scale errors.

Step 9
Click OK to accept calibration results.

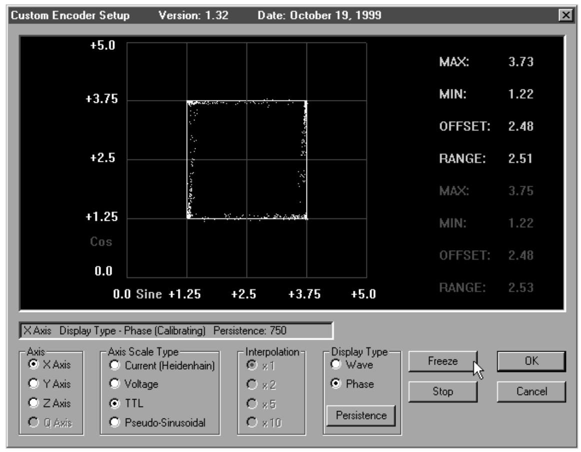


Use the phase mode to determine if the encoder's two waveforms are adjusted to each other. Properly adjusted encoders results in a circle as shown.

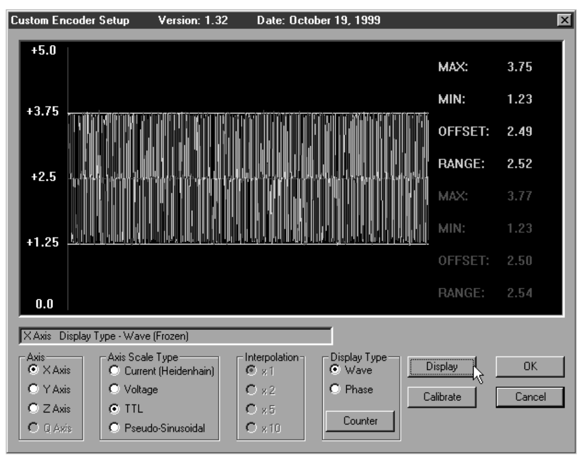


Encoder reader heads may need re-alignment if the wave display appears correct but the phase display does not.

Use the freeze button to freeze the display and examine encoder signals.



Click the display button to reactivate the display.



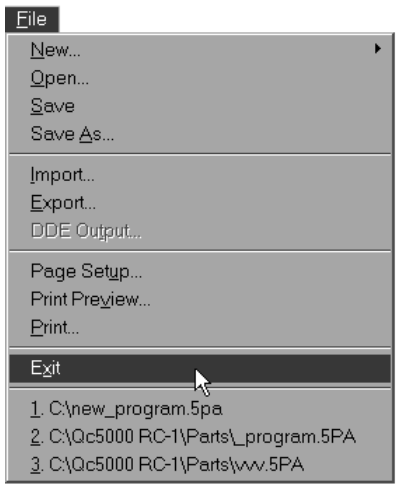
NOTE

Do not use the encoder setup program for TTL encoders. Only use the encoder setup program for analog encoders.

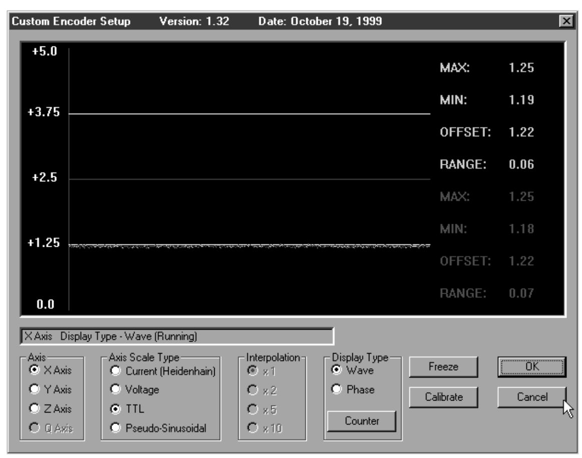
Troubleshooting Encoder Setup

Encoder setup shows continual errors, beeps, or inconsistent wave output

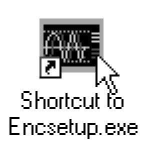
Step 1
Make sure the QC5000 is closed.



Step 2
Close the encoder setup program.



Step 3
Re-open the encoder setup program.

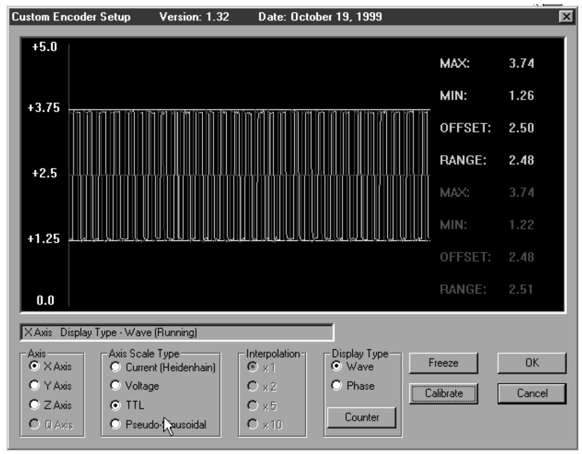


NOTE

Check the Windows NT taskbar to be certain no other copies of QC5000 or Encoder Setup are running.

Encoder setup show one or two errors after calibrating an axis

Move the axis in a smooth, continuous, back-and-forth motion while calibrating. Uneven, stop/start motion can result in errors.



NOTE

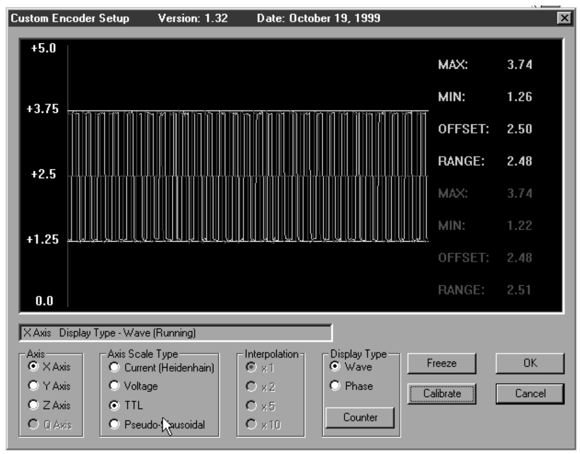
One or two errors that do not count continually should not affect your measurements. Follow the procedure below for four or more errors.

Encoder setup shows numerous errors after calibrating an axis

NOTE

Check the Windows NT taskbar to be certain no other copies of QC5000 or Encoder Setup are running.

Step 1
Re-calibrate the axis using a smooth, continuous, back-and-forth motion.



NOTE

If re-calibrating the axis does not solve the problem continue to step 2.

Step 2
Check all other axes for calibration problems.

NOTE

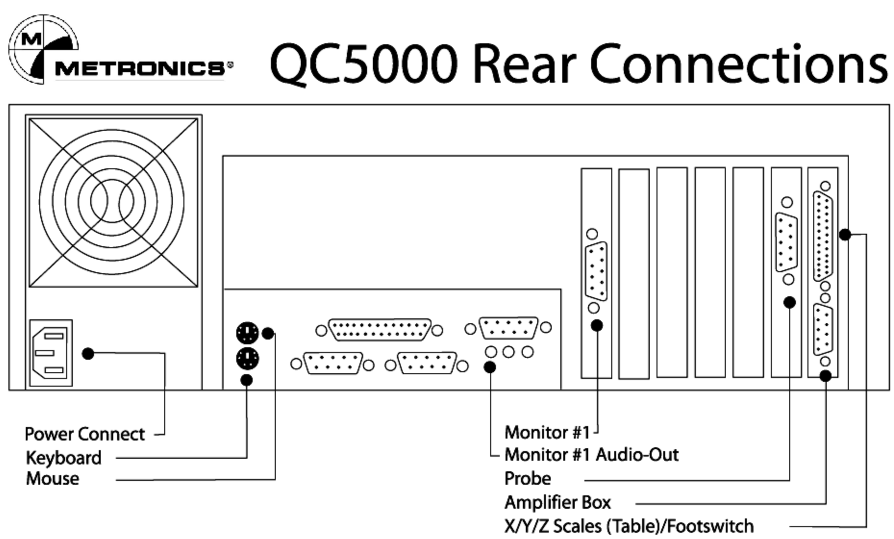
Discontinue troubleshooting and contact your distributor/OEM if no axis will calibrate properly.

Step 3
Turn off the QC5000 computer.

CAUTION

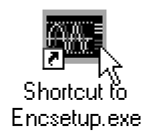
Do not disconnect QC5000 cables while the computer is on. This can result in damage to the system.

Step 4
Disconnect the axis cables for the axes calibrating properly.

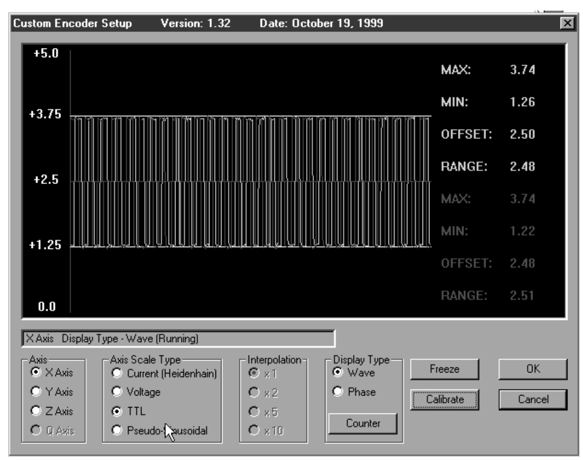


Step 5
Disconnect the malfunctioning axis cable and connect it to one of the properly calibrating axis ports. For example, if the X axis calibrates properly and the Y does not, connect the Y axis to the X axis port.

Step 6
Turn on the computer and open encoder setup.



Step 7
Calibrate the desired axis. For example, if you have moved the Y axis cable to the X axis, calibrate the X axis.



NOTE

Discontinue troubleshooting and contact your distributor/OEM if the axis will not calibrate properly. There is an error on the CMM/encoder side of the system that may require repair.

NOTE

Discontinue troubleshooting and contact your distributor/OEM if the axis calibrates properly. There is an error on QC5000 axis port that may require repair.

Wave (amplitude) calibrates, phase does not calibrate

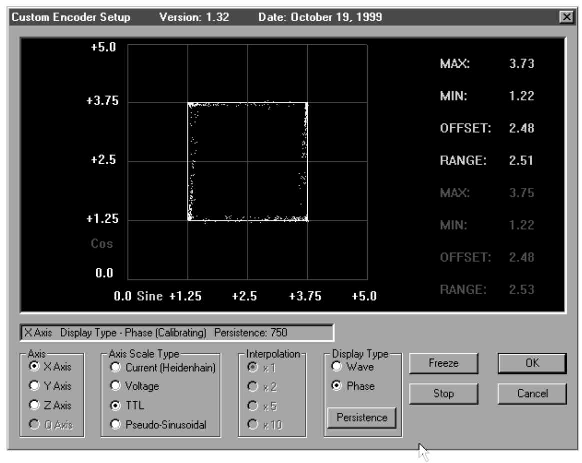
NOTE

If the phase display appears not to calibrate but the axis is not showing errors the system is functioning.

NOTE

Check the Windows NT taskbar to be certain no other copies of QC5000 or Encoder Setup are running.

Step 1
Re-calibrate the axis using a smooth, continuous, back-and-forth motion.

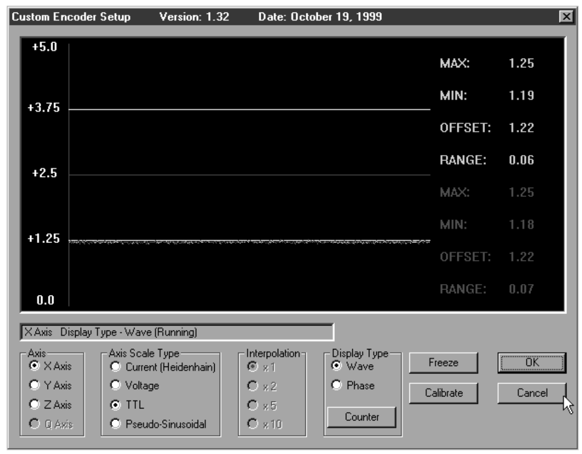


TTL encoders will not calibrate

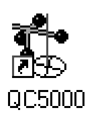
NOTE

TTL encoders do not require encoder setup. Use the following procedure.

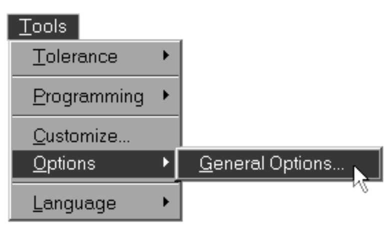
Step 1
Close encoder setup.



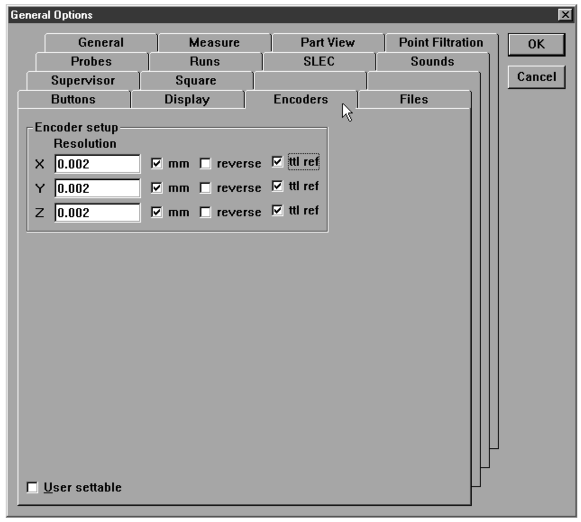
Step 2
Open QC5000.



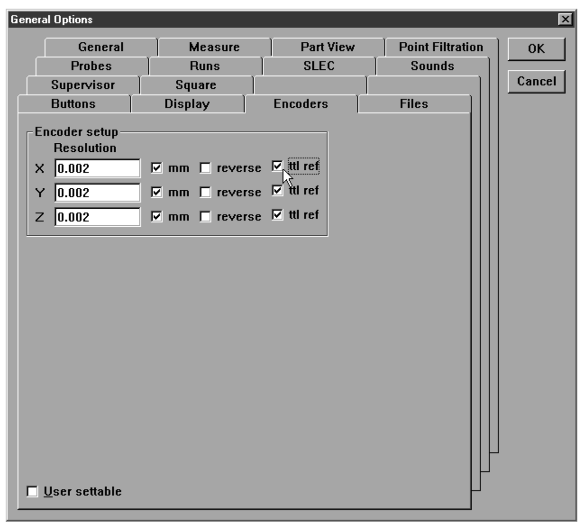
Step 3
Select *options* then *general options* from the tool menu.



Step 4
Select the *encoders* tab.

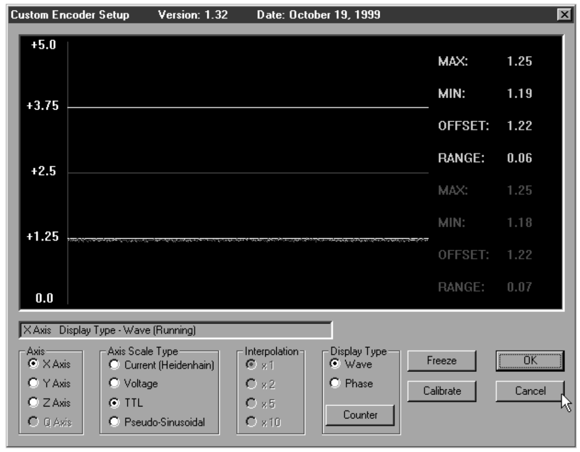


Step 5
Select *TTL* as shown.



Status bar freezes during calibration or other error message

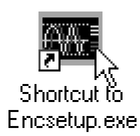
Step 1
Close encoder setup.



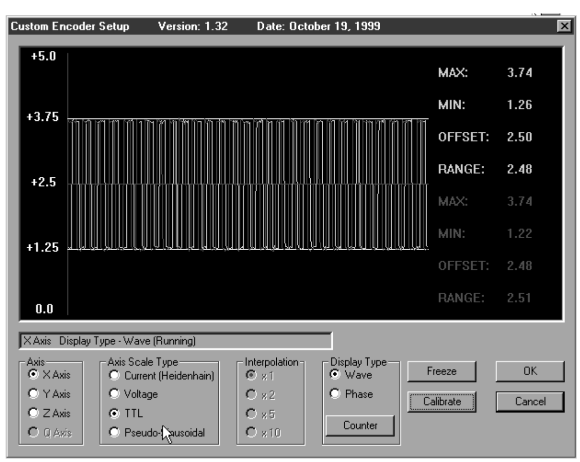
NOTE

Check the Windows NT taskbar to be certain no other copies of QC5000 or Encoder Setup are running.

Step 2
Open encoder setup.



Step 3
Calibrate the desired axis.



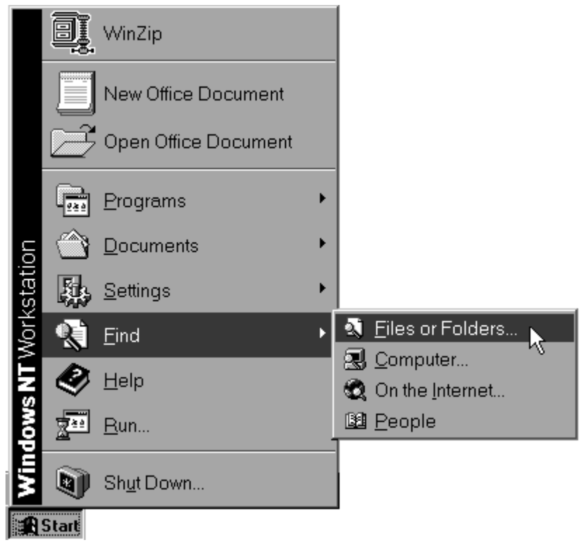
NOTE

Discontinue troubleshooting and contact your distributor/OEM if the problem persists.

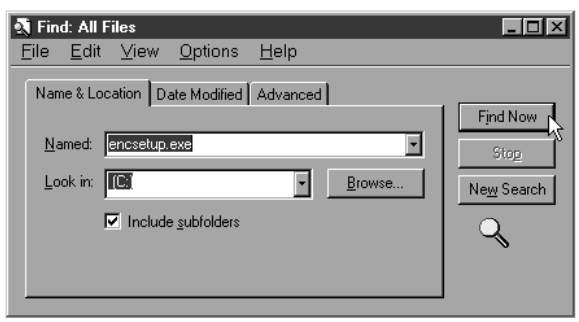
Encoder setup icon is missing

Step 1
Click the Windows NT *start button*.

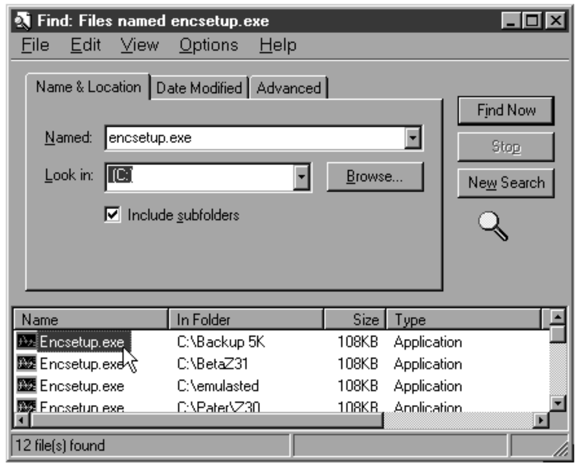
Step 2
Select *find*.



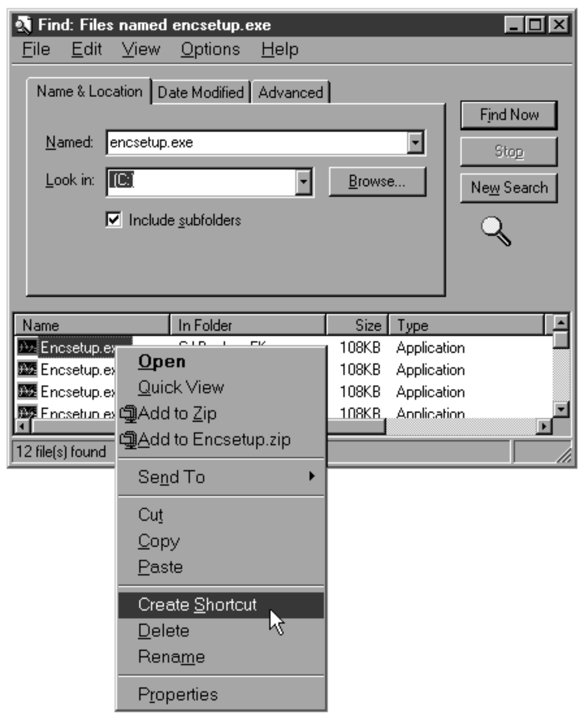
Step 3
Type in the name *encsetup.exe* and click the *find now* button.



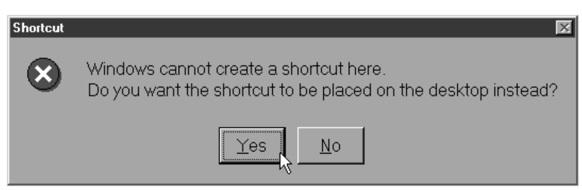
Step 4
Highlight the *encsetup.exe* file.



Step 5
Right click and select *create shortcut*.



Step 6
Click *yes* in the dialog box.

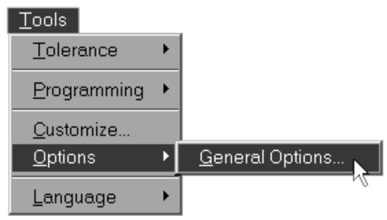


QC5000 counts double, half, or wrong

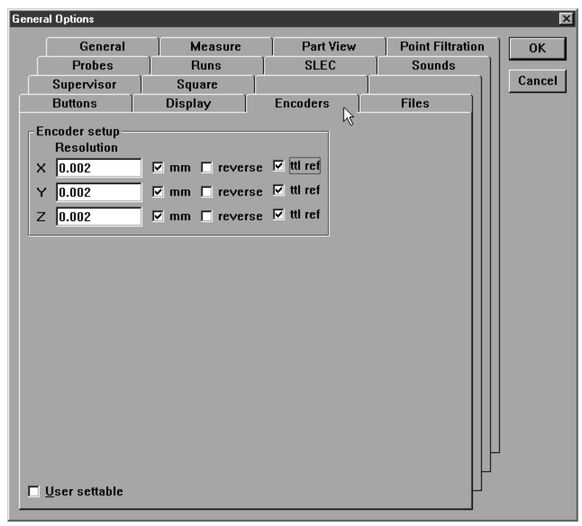
NOTE

This process requires the EXACT resolution of the scales. Contact the manufacturer for this information if it is unavailable.

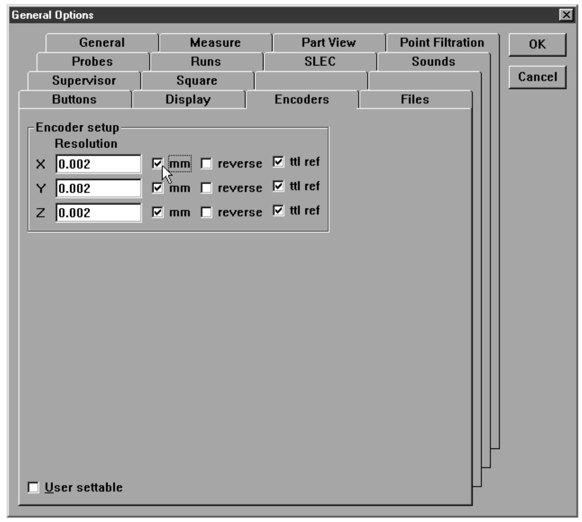
Step 1
Select *options* from the tools menu.



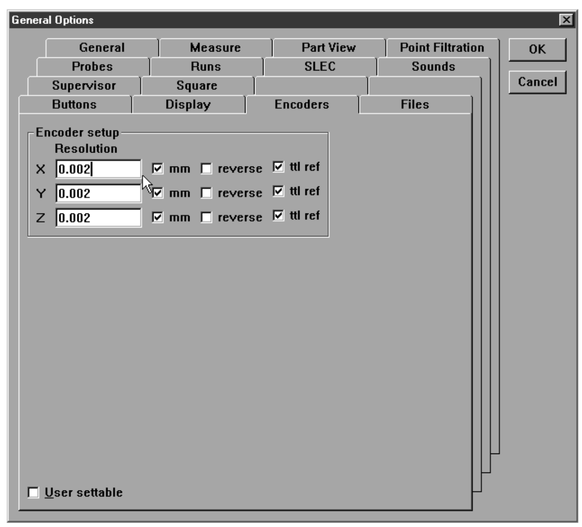
Step 2
Select the *encoders* tab.



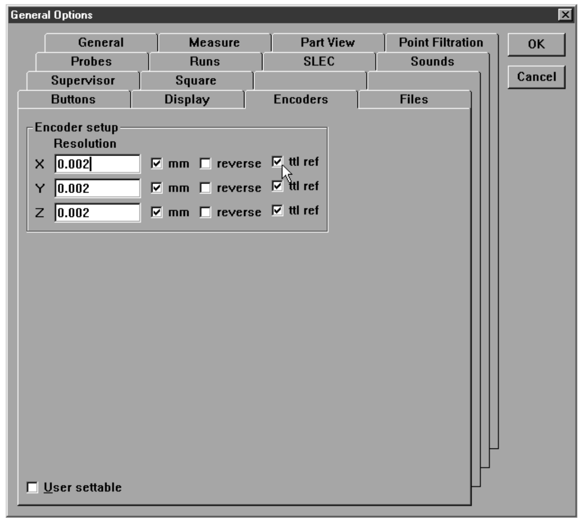
Step 3
Check the *mm check box* if the encoder resolution is metric. Remove the check if encoder resolution is english.



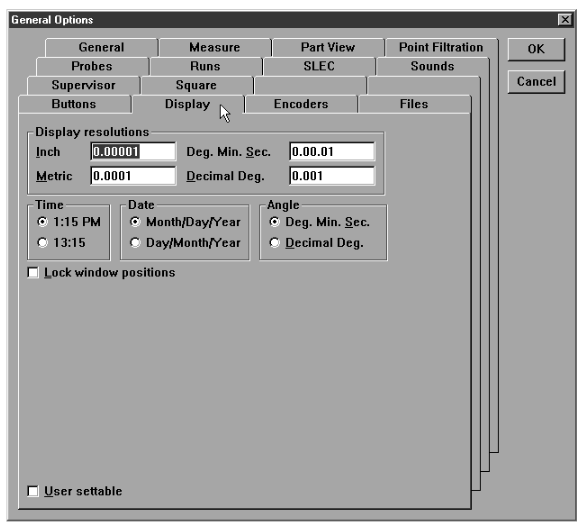
Step 4
Enter the proper resolution for each axis as shown.



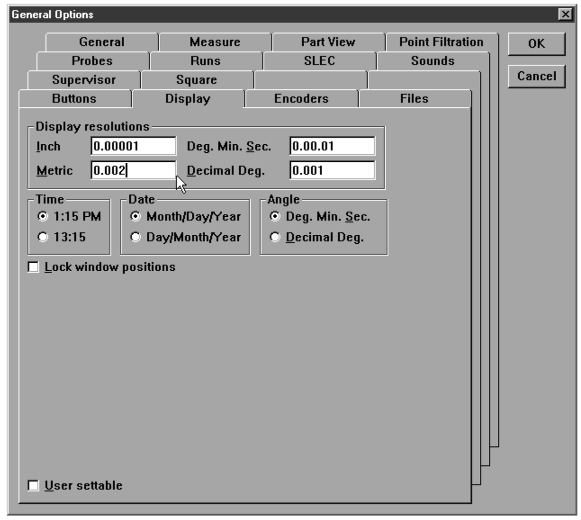
Step 5
Select the proper encoder type.



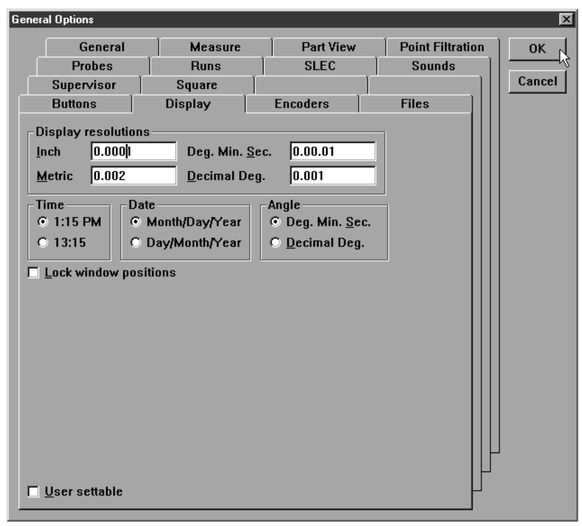
Step 6
Select the display tab.



Step 7
Set display resolutions the same as the encoder resolutions.



Step 8
Click OK.



NOTE

Measure a gage block to check the new settings. If the result is half the standard, repeat this procedure and double the resolution settings.

Supervisor Password

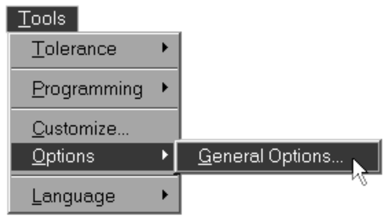
System level functions in the QC5000 are password protected. The supervisor password must be entered before changes can be made in these areas.

NOTE

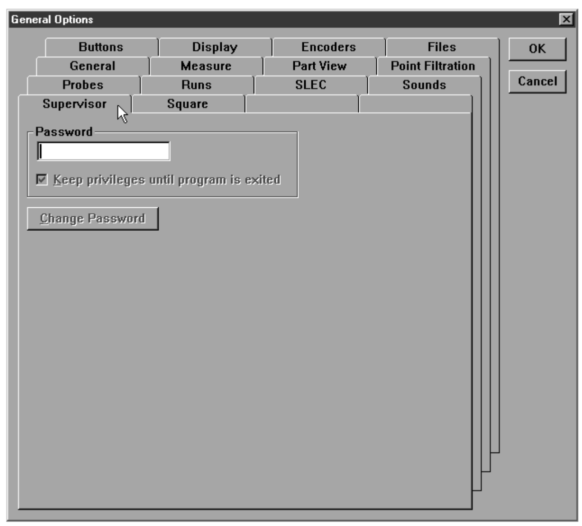
Contact your Metronics distributor or OEM for lost or misplaced passwords.

To enter the supervisor password

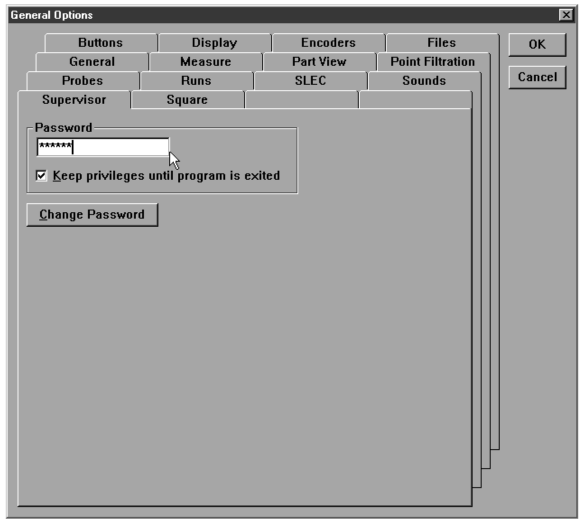
Step 1
Select *options* then *general options* from the tools menu.



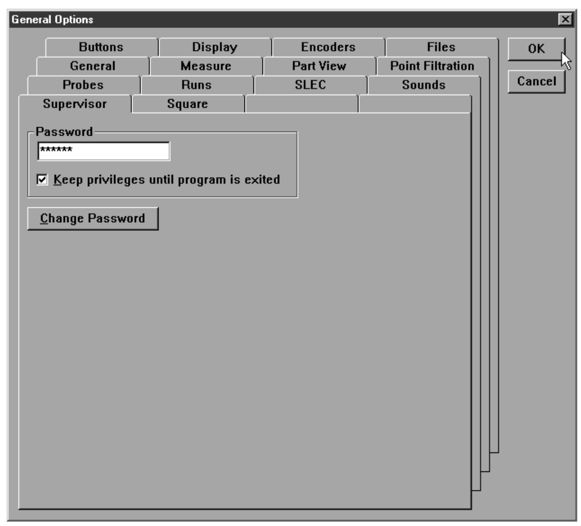
Step 2
Select the *supervisor* tab.



Step 3
Enter the password as shown.



Step 4
Click OK in the dialog box.



NOTE

Click the verify button and place a check in the *keep privilieges until program is exited* box to continue supervisor access until exiting the QC5000.

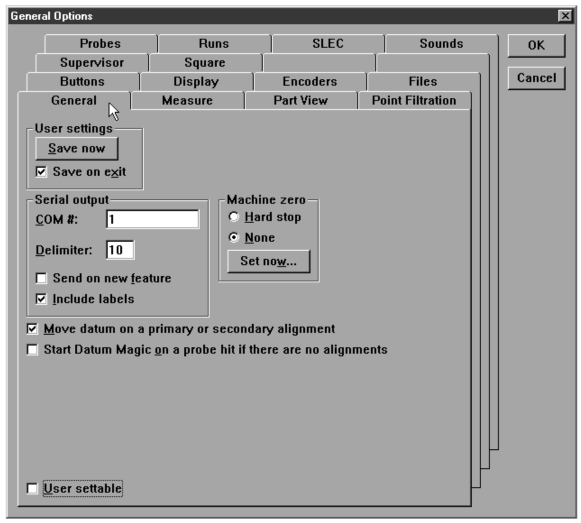
Supervisors may restrict access to any portion of the options window.

To restrict access to general options tabs

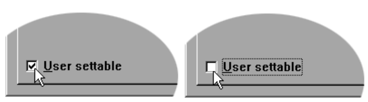
NOTE

This demonstration uses the *display* tab but the steps may be used to restrict access to any tab in the options window.

Step 1
Click on the desired tab.



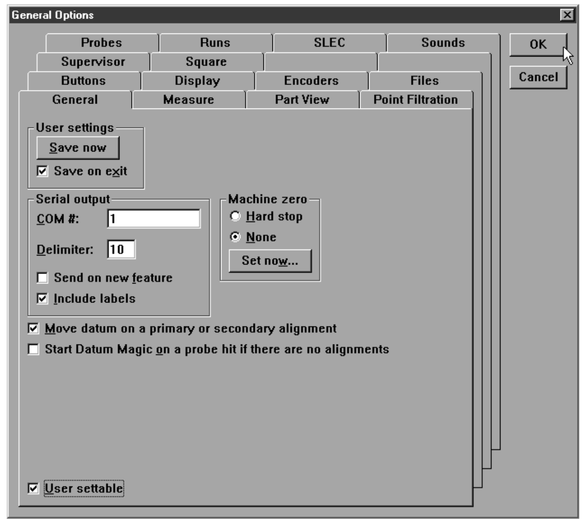
Step 2
Remove the check from the *user settable* box.



NOTE

If there is no check in the box the tab is already restricted.

Step 3
Click OK.



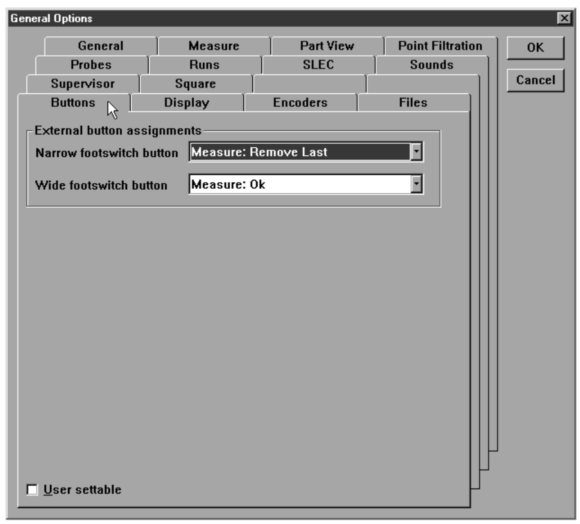
General Options

Use the general options window to manage and change QC5000 settings. Tabs in the general options windows are:

- Buttons
- Display
- Encoders
- General
- Measure
- Part view
- Probes
- SLEC
- Sounds
- Supervisor
- Square

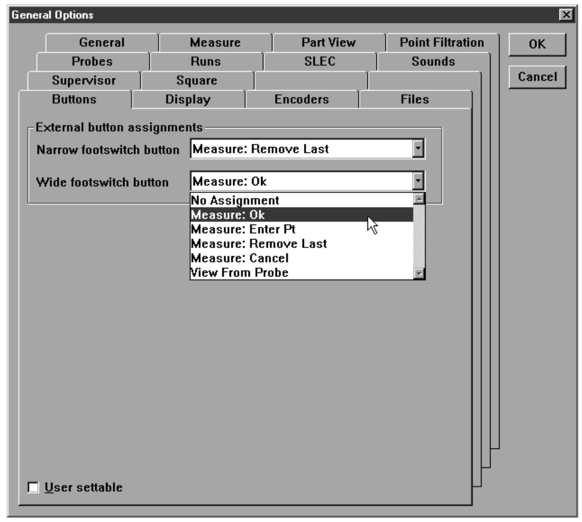
Buttons

Use the buttons tab to set the function of external input buttons (footswitch, etc).



Select one of the following functions to be executed by external devices:

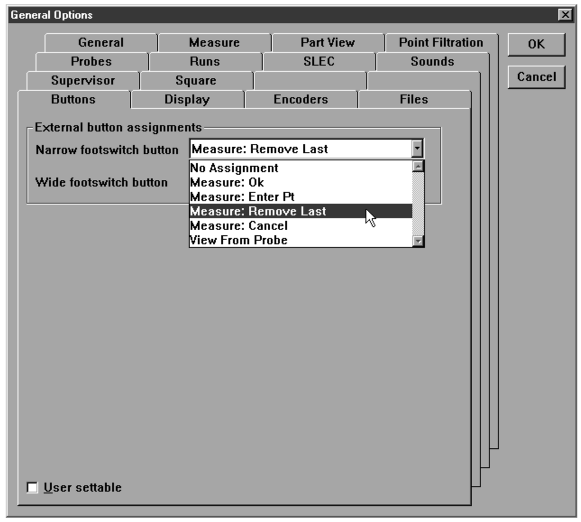
- Measure: OK
- Measure: Enter
- Measure: Remove Last
- Measure: Cancel
- View From Probe



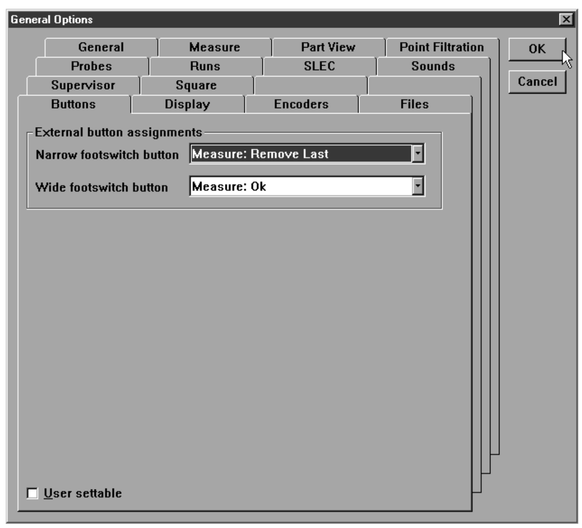
For example, set button 1 to Measure: OK. Each time button 1 is pressed during a measurement it is the same as clicking OK in the measure dialog box.

To set a button function

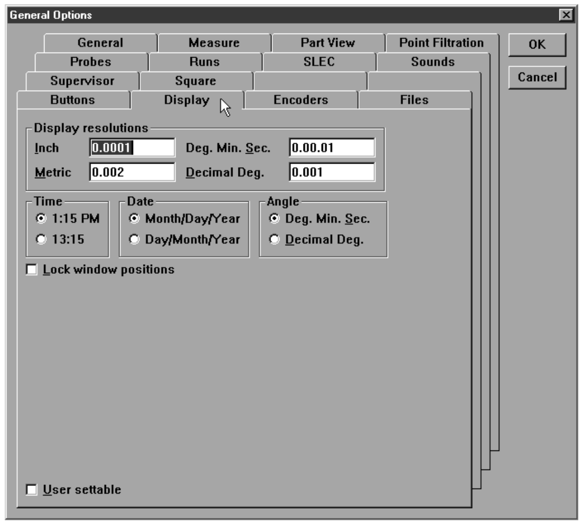
Step 1
Select the desired function from the pull down list.



Step 2
Click OK.

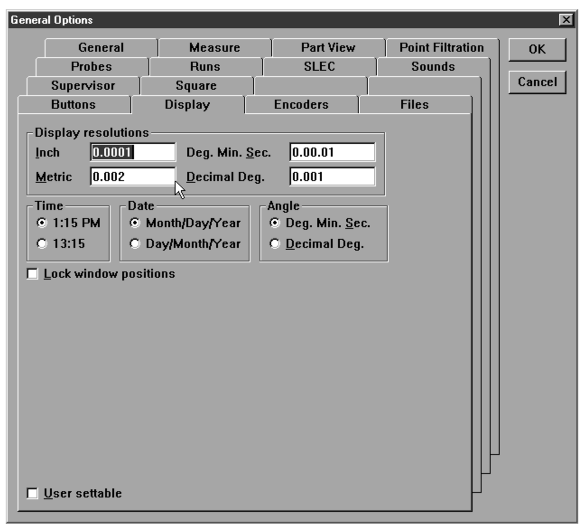


Display

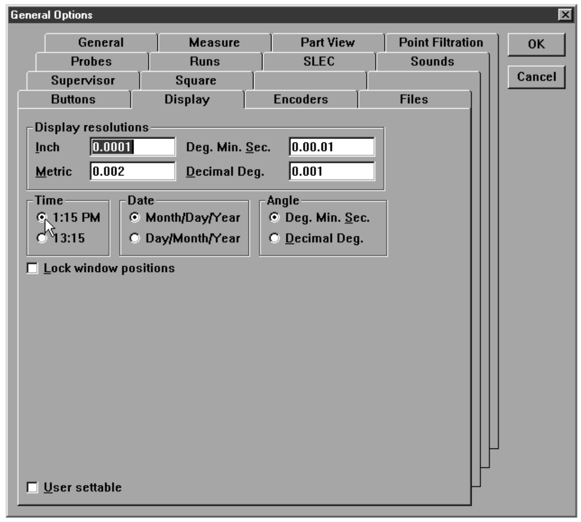


Use the display tab to manage display resolutions, time/date display, and angle units display.

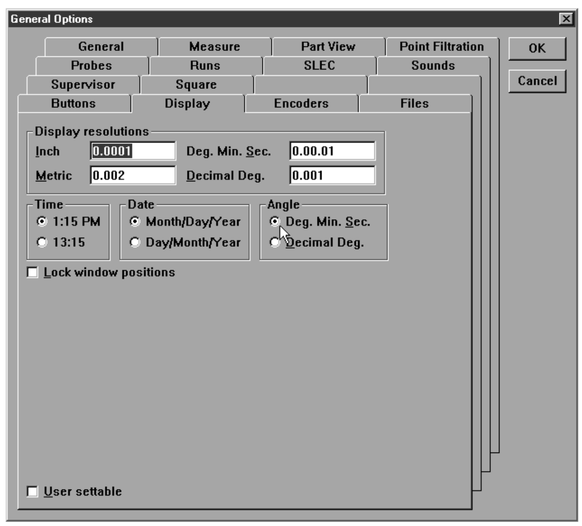
Enter the resolution of the CMM's encoders in the display resolution boxes. Make sure to enter the values in the proper units. For example, do not enter a metric (unconverted) resolution in the inch display resolution box.



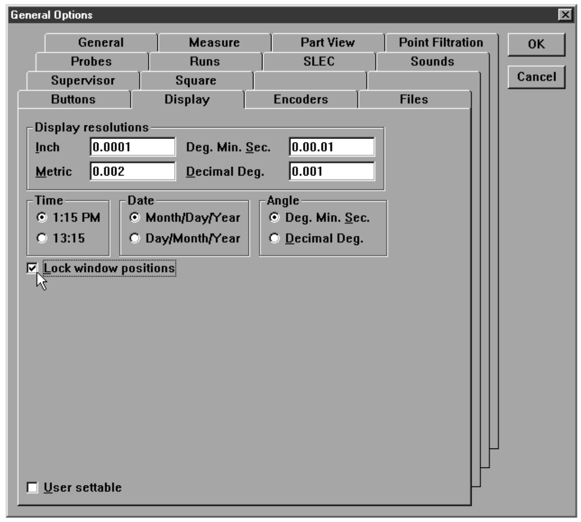
Select the time and date display from the radial button options.



Select angle units to be displayed as degrees/minutes/seconds OR decimal degrees.

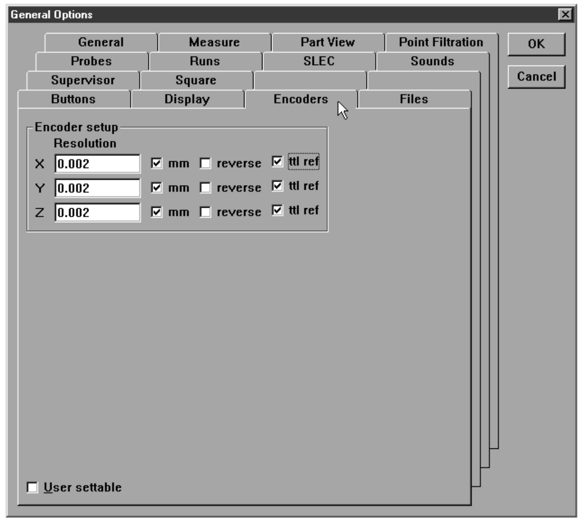


Check the *lock windows position* box to lock QC5000 windows in their current locations.



Encoders

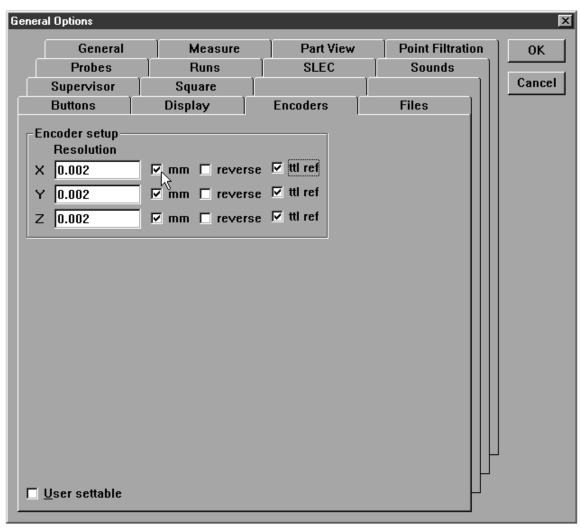
Use the encoders tab to enter the encoder resolution. Enter the resolution values carefully; incorrectly entered resolutions will result in inaccurate measurements.



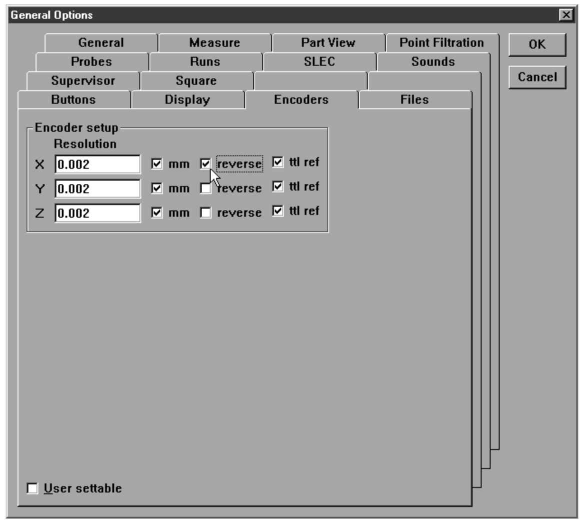
NOTE

Enter the resolution in the proper units (mm or inches).

Check the *mm* box if encoder units are metric.

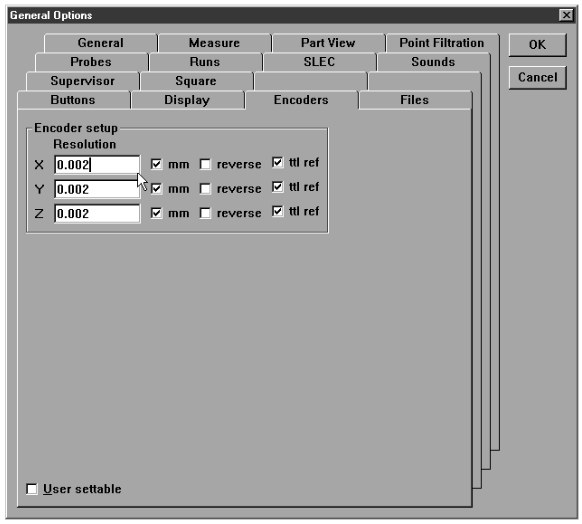


Check the *reverse* box to reverse the count direction of an axis.

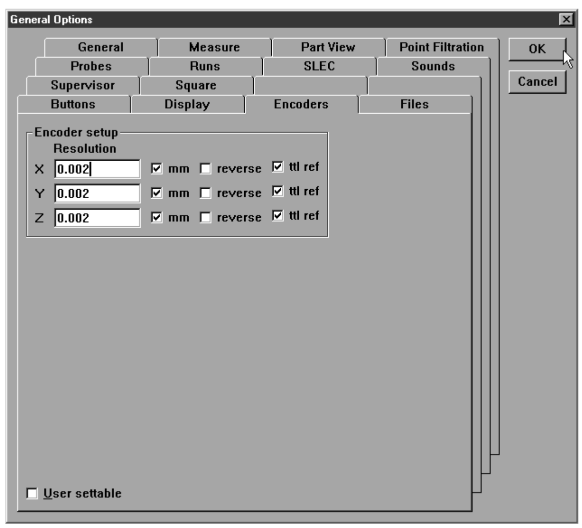


To enter encoder resolution

Step 1
Type the encoder resolution for the desired axis box as shown.

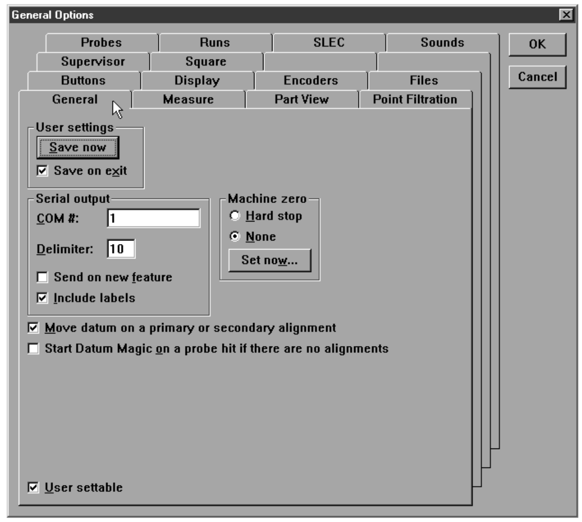


Step 2
Click OK.



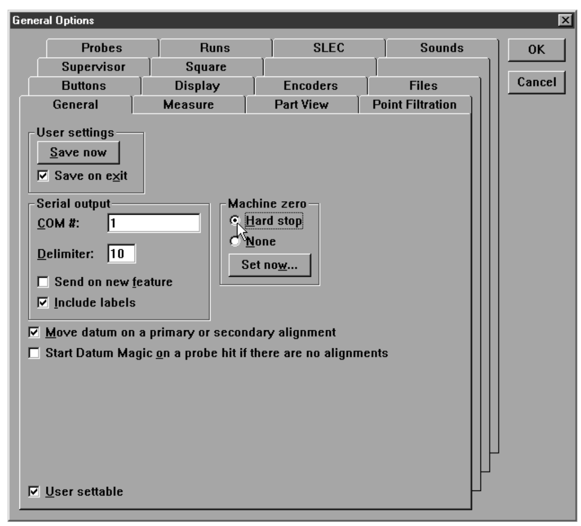
General

Use the general tab to save option settings without exiting the options window and specify machine zero method.

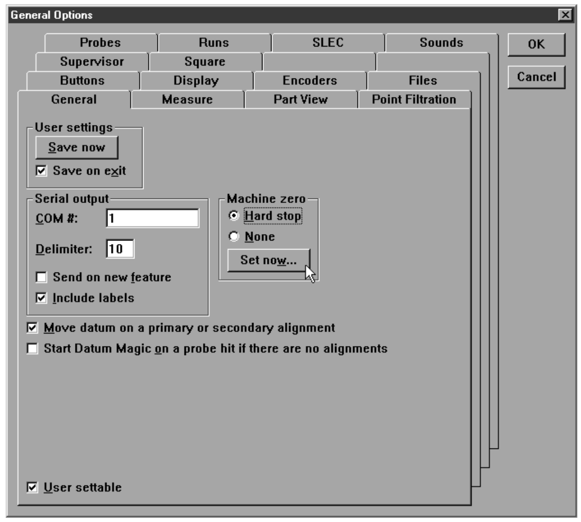


To set machine zero

Step 1
Select *hard stop* in the machine zero box.

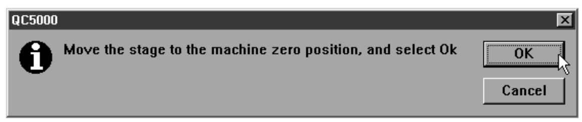


Step 2
Click the *set now* button.

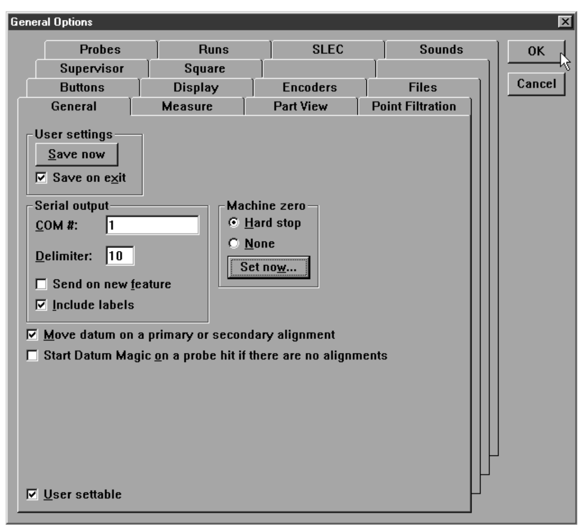


Step 3
Move the axes of the CMM to the machine zero position.

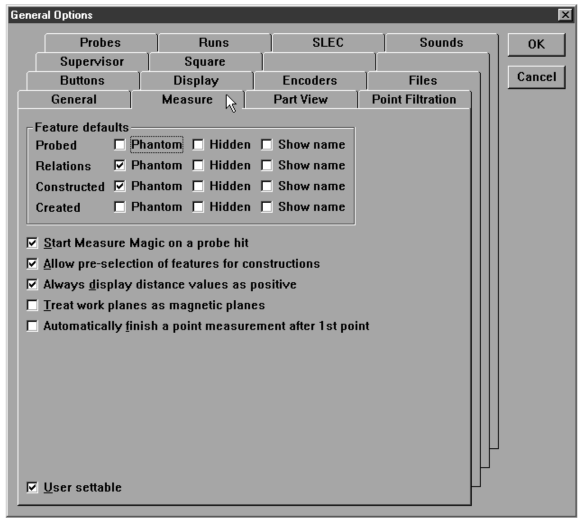
Step 4
Click OK in the dialog box.



Step 5
Click OK in the *general options* window.



Measure



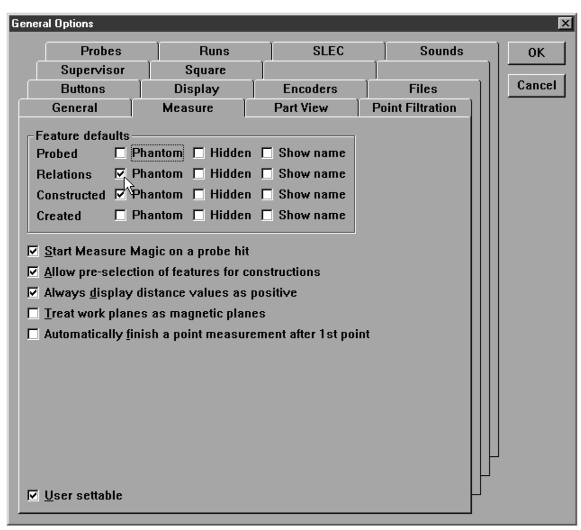
Use the measure tab to establish the default display characteristics in the part view window. Defaults established on this tab apply to all features in the slected category:

- probed
- relations
- constructed
- created

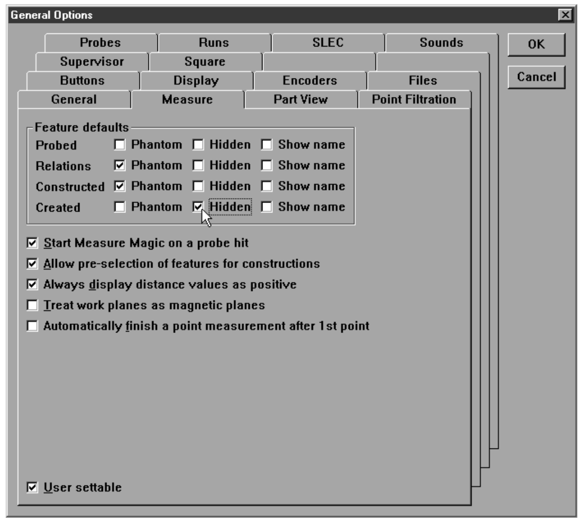
NOTE

Individual feature display characteristics (as opposed to groups of features) can be modified using feature properties.

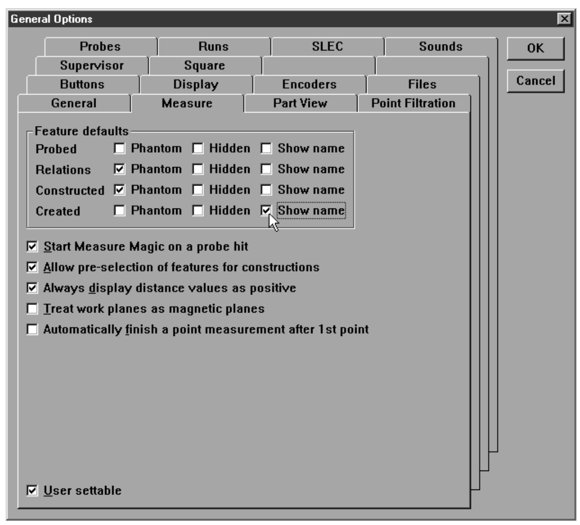
Select *phantom* to show features as dotted lines in the part view window.



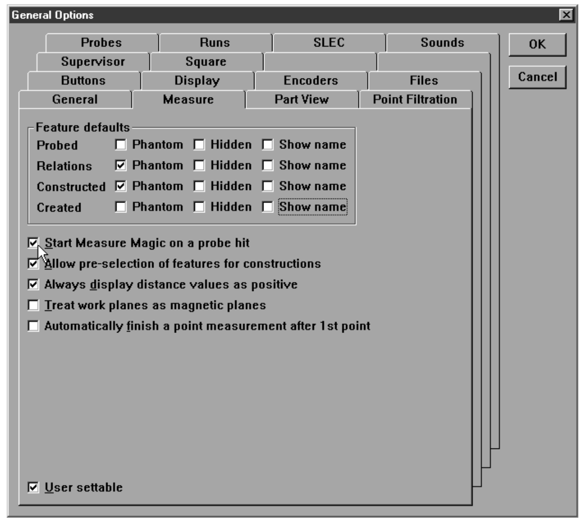
Check *hidden* to remove a feature from the part view window; hidden features still appear in the features list.



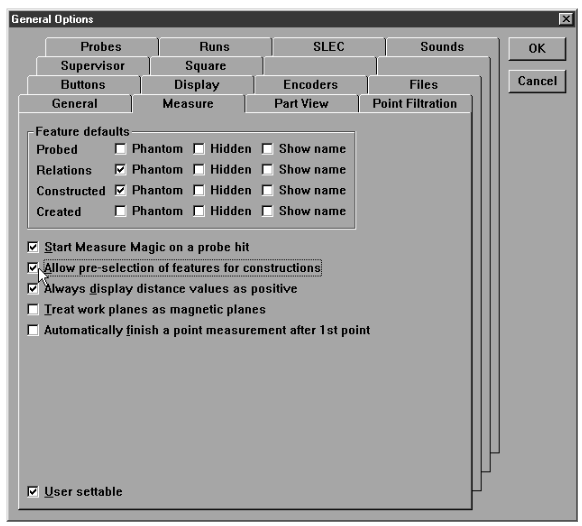
Display the feature name by placing a check in the *show name* box.



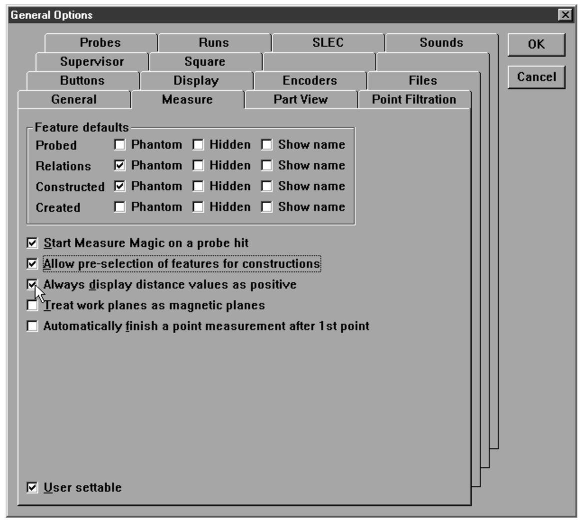
Check *start measure magic on a probe hit* to start measure magic at the first point probed.



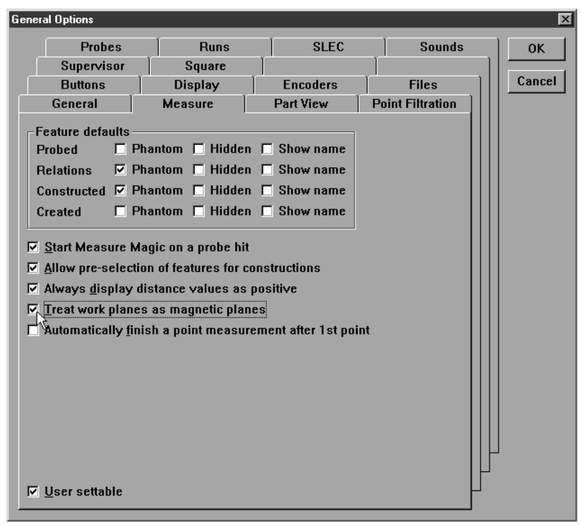
Check *allow pre-selection of features for construction* to permit users to select features for a construction then select the type of construction.



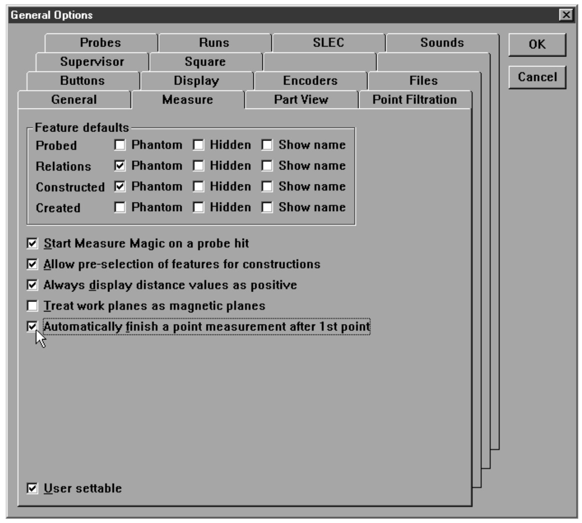
Check *always display distance values as positive* to show distance measurements in positive numbers regardless of the actual direction of measurement.



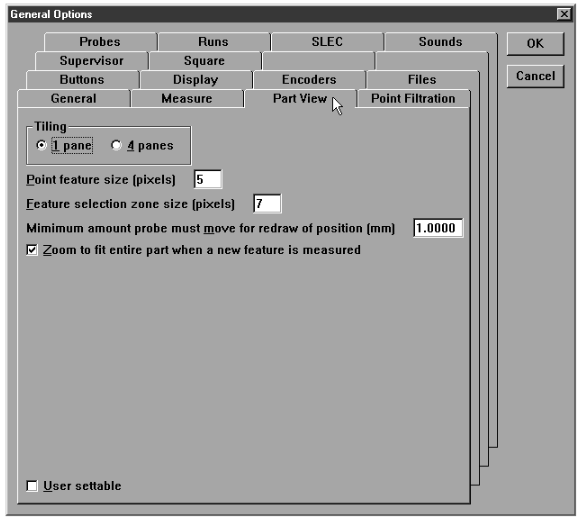
Check *treat work planes as magnetic* to snap two-dimensional figures to the current plane.



Check *automatically finish a point measurement after the 1st point* to limit point measurements to one probe hit.

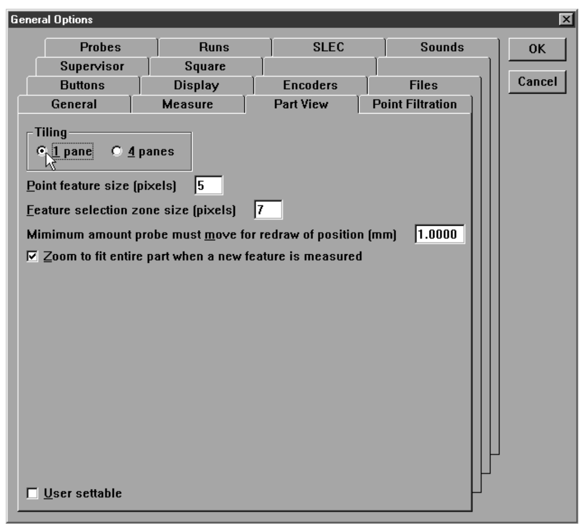


Part view

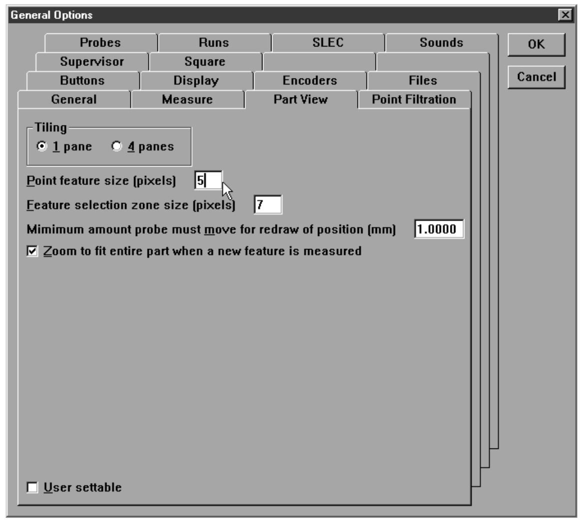


Use the part view tab to toggle the part view window between 1 pane and 4 pane mode, set the pixel size of points in the part view, and set the amount of probe movement required to redraw the part view (view from probe mode).

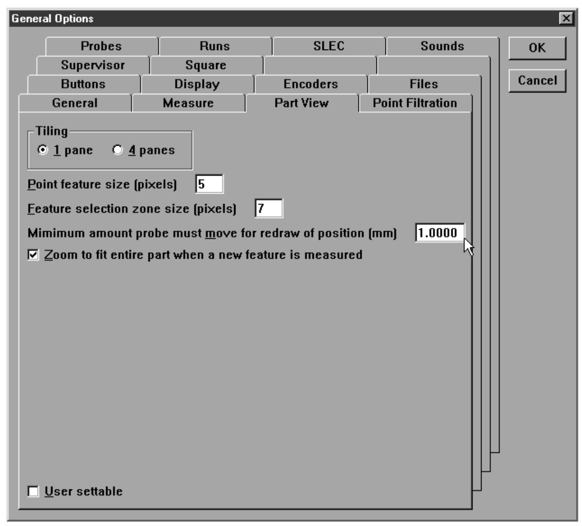
Click the radial button to select 1 pane or 4 pane part view.



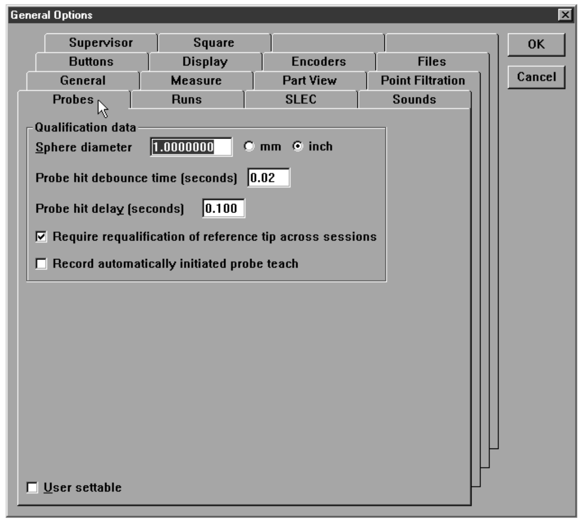
Enter a value for the size of a point (in pixels) in the part view window.



Enter the distance the probe must move for the part view to be re-drawn.



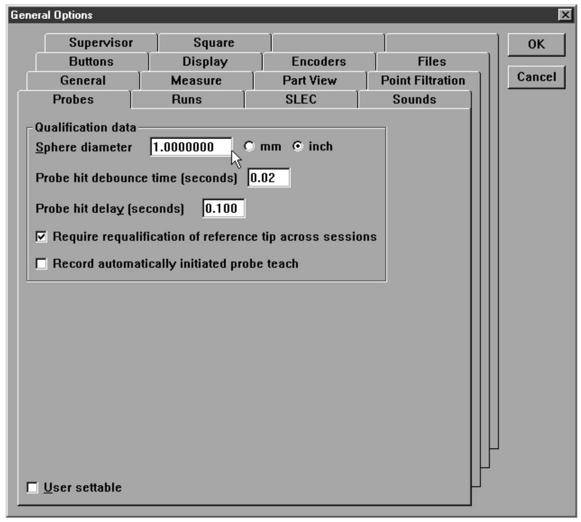
Probes



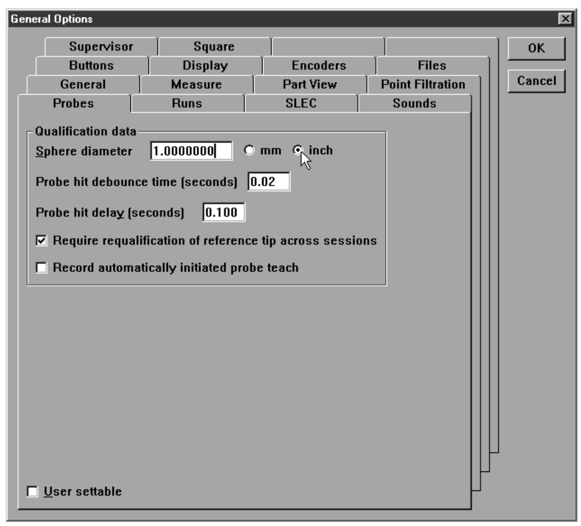
Use the probes tab to enter the diameter of qualification spheres, set probe hit de-bounce time, and set probe direction threshold.

To enter the diameter of a qualification sphere

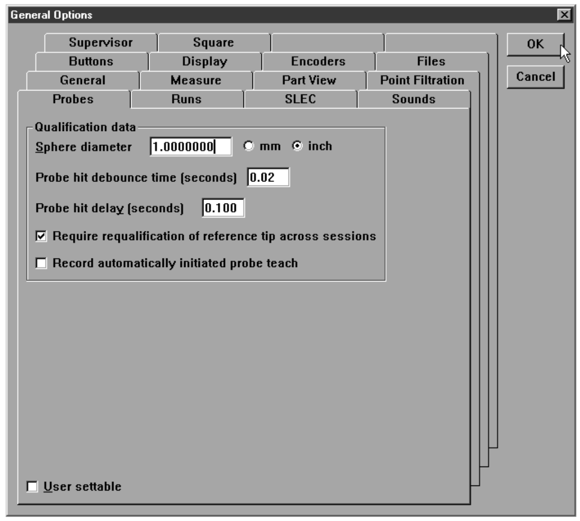
Step 1
Type the resolution in as shown.



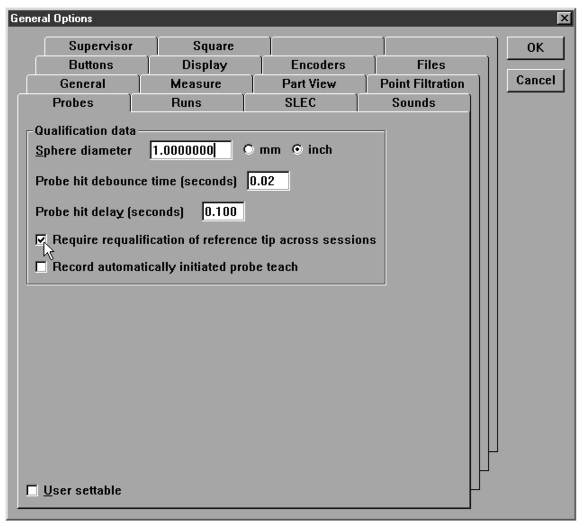
Step 2
Check the *mm* box if units are metric, otherwise leave unchecked.



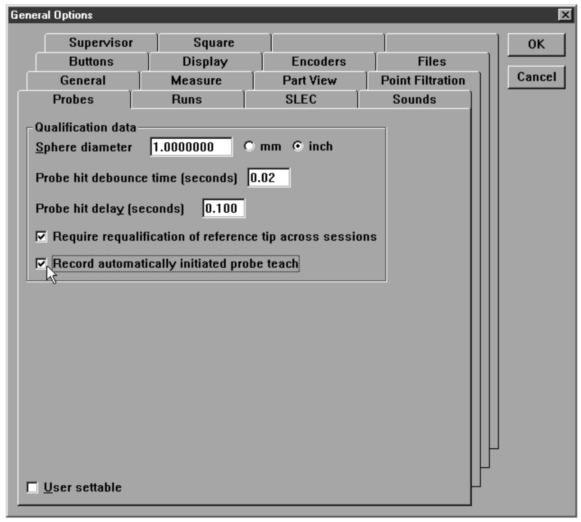
Step 3
Click OK



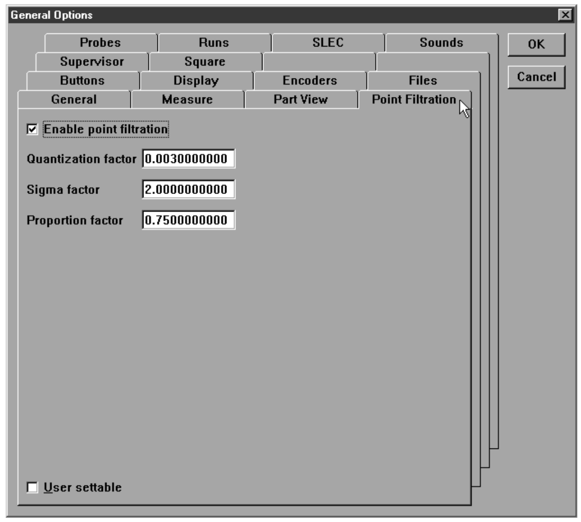
Check *require re-qualification of reference tip across sessions* to prompt the user to teach the reference tip at startup.



Check *record automatically initiated probe teach* to record a teach program when an unqualified probe tip is selected.

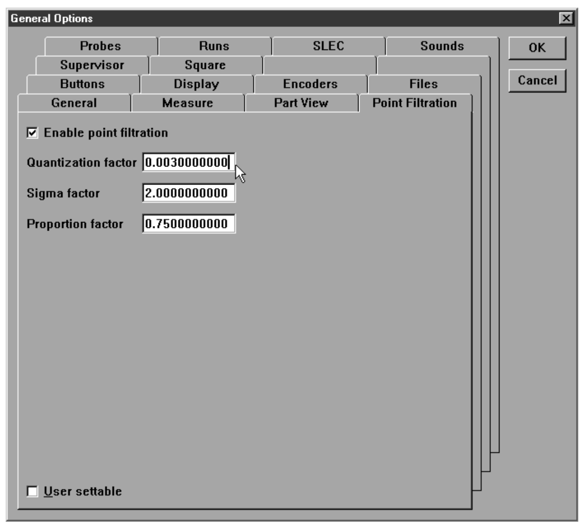


Point Filtration

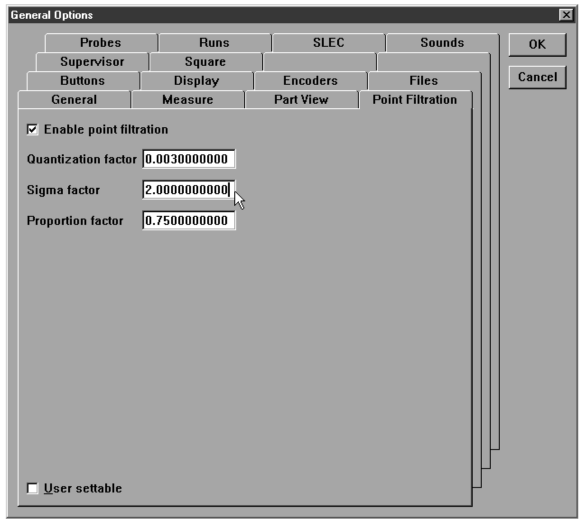


Use the point filtration tab to remove outlier points from measurements. Enter the following values on this tab:

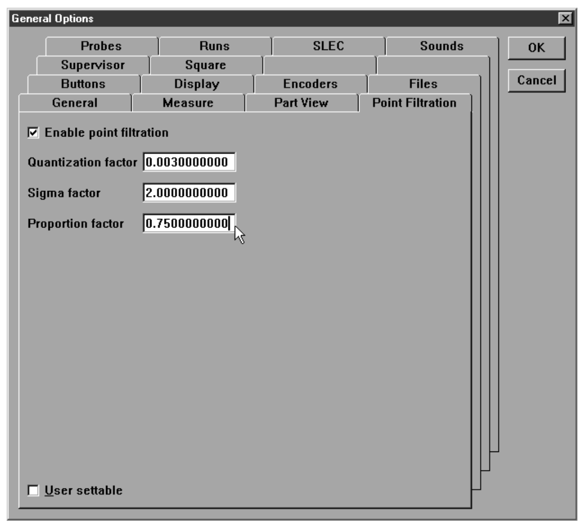
- quantization factor (absolute threshold for outlier points)



- sigma factor (number of standard deviations points must lie within)

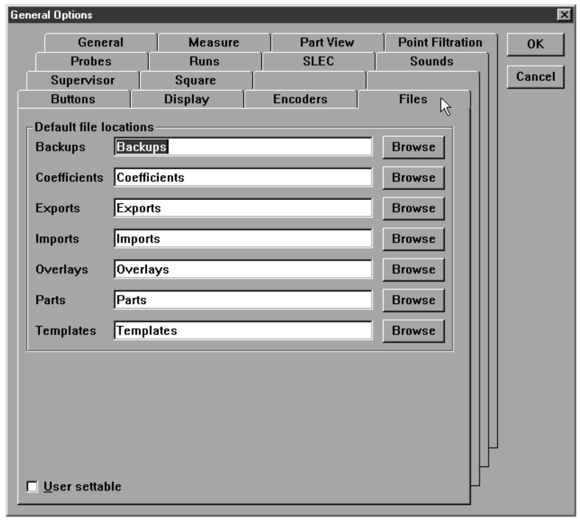


- proportion factor (percentage of original points that must be retained)



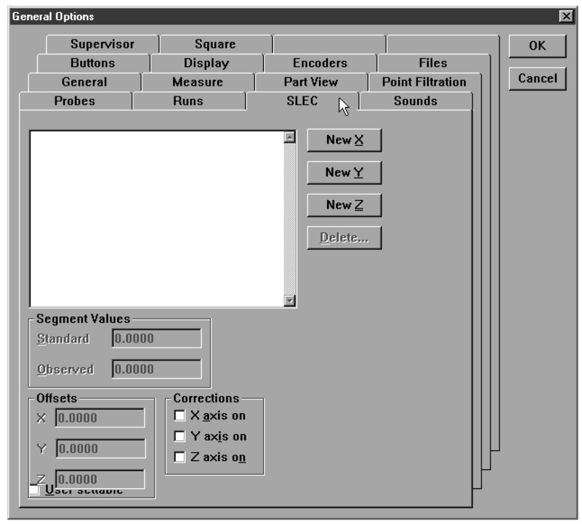
Files

Use the files tab to manage QC5000 system specific files. Determine default directories for system files on this tab.



SLEC (segmented linear error correction)

Use the SLEC tab to setup and enter SLEC data. SLEC applies linear error correction coefficients to segments of each axis to compensate for encoder and machine travel variations. Use a standard to measure each axis and compare the measured (observed) values to the nominal (standard) values to generate correction coefficients. Correction coefficients are generated for each segment that deviates from the standard value and provide linear compensation for that segment.



Enter the zero point first for each axis. This does not mean that each axis must start a zero: negative values can be entered. For example, you can enter the zero point for the X axis and then enter standard and observed values for -2.

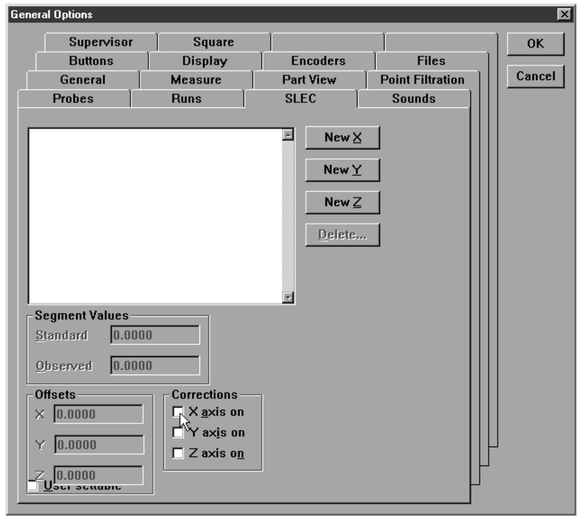
Correction for the final point on each axes continues in constant manner. Thus a correction applied to the final point continues for all points past the final point. Likewise, if no correction is applied to the final point, no correction applies to points beyond it.

NOTE

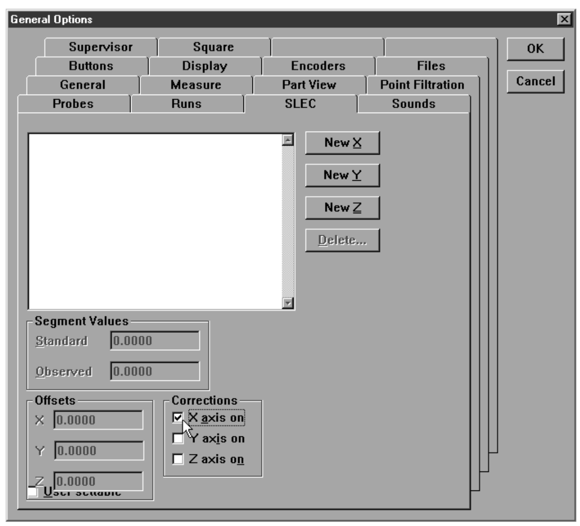
Do not use SLEC if your CMM does NOT have a repeatable machine zero. SLEC requires a repeatable machine zero point.

To enter SLEC data

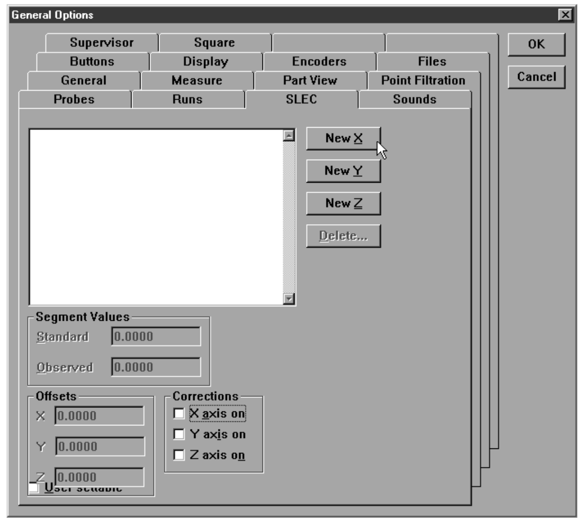
Step 1
Move the CMM to machine zero.



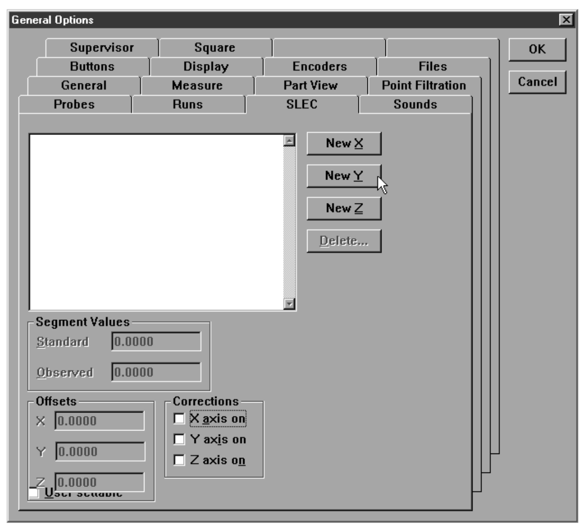
Step 2
Disable (uncheck) *corrections* on the X, Y, and Z axes on the SLEC tab.



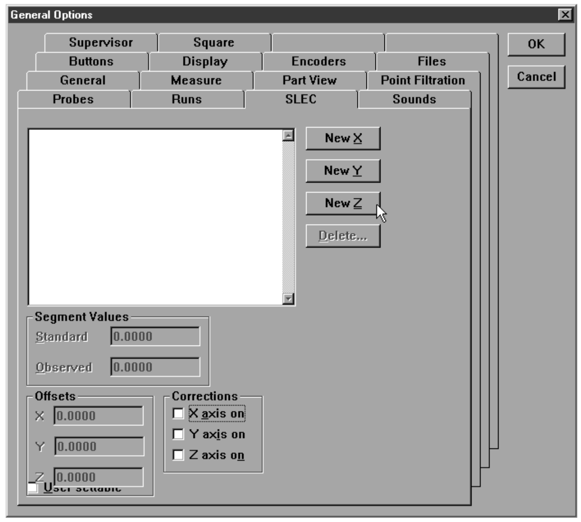
Step 3
Click *new X*.



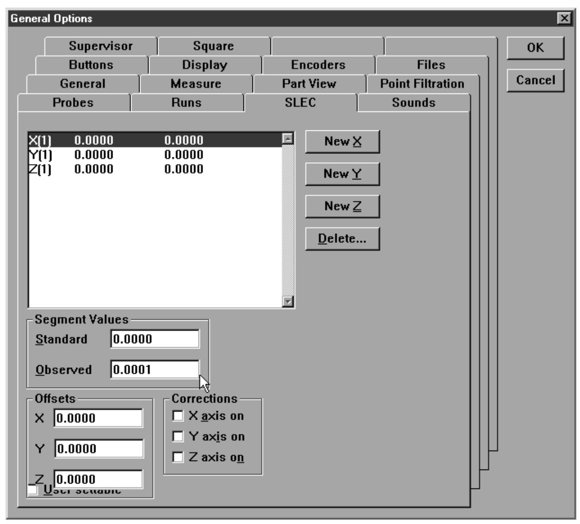
Step 4
Click *new Y*.



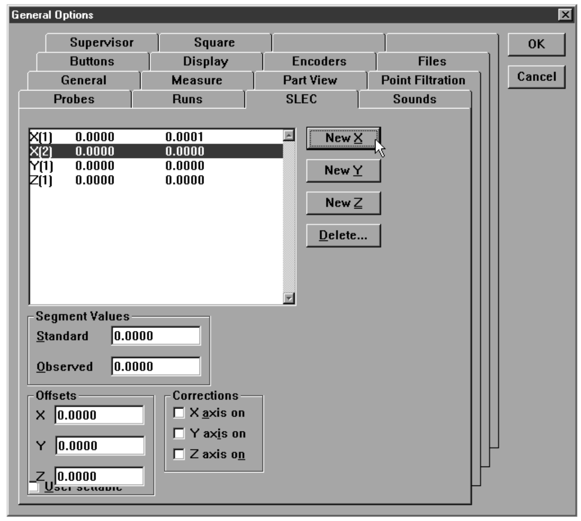
Step 5
Click *new Z*.



Step 6
Enter the standard and observed value for the first point on the X axis as shown.



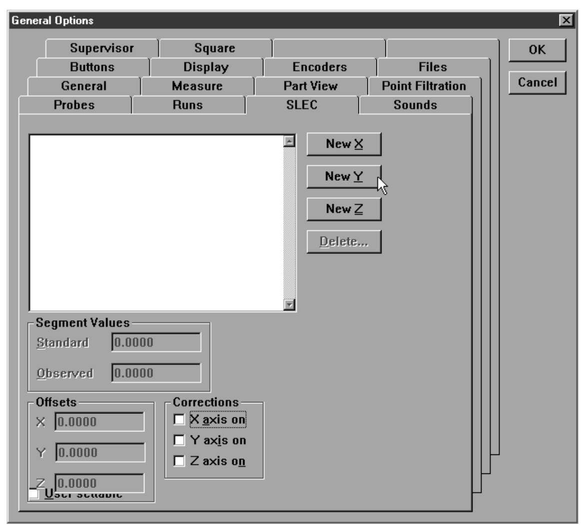
Step 7
Click *new X*.



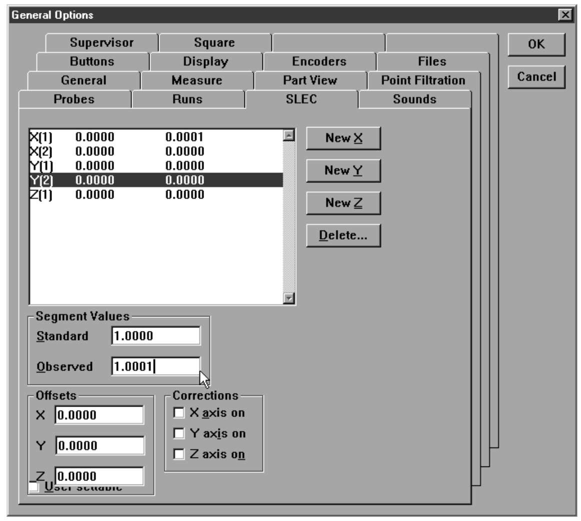
NOTE

Repeat steps 6 and 7 until all points are entered.

Step 8
Enter the standard and observed value for the first point on the Y axis as shown.



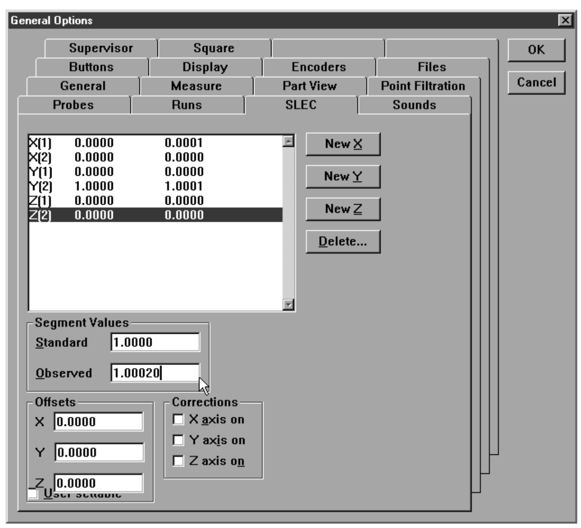
Step 9
Click *new Y*.



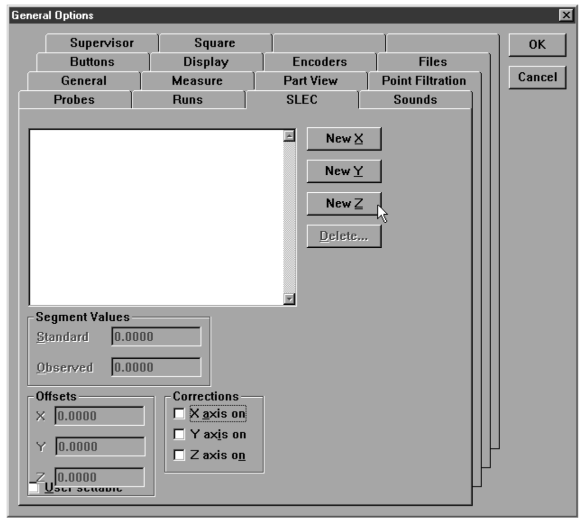
NOTE

Repeat steps 8 and 9 until all points are entered.

Step 10
Enter the standard and observed value for the first point on the Z axis as shown.



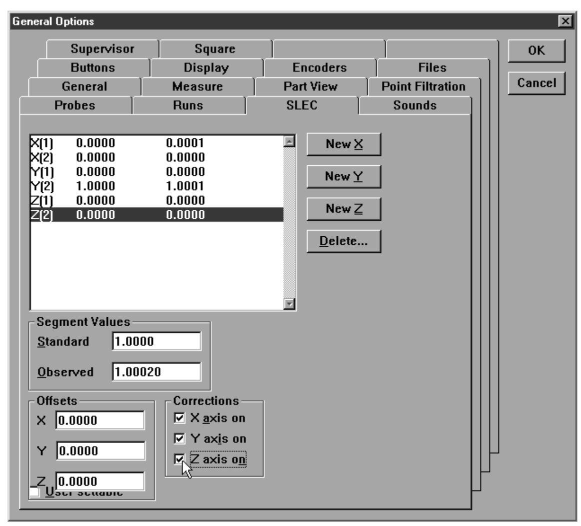
Step 11
Click *new Z*.



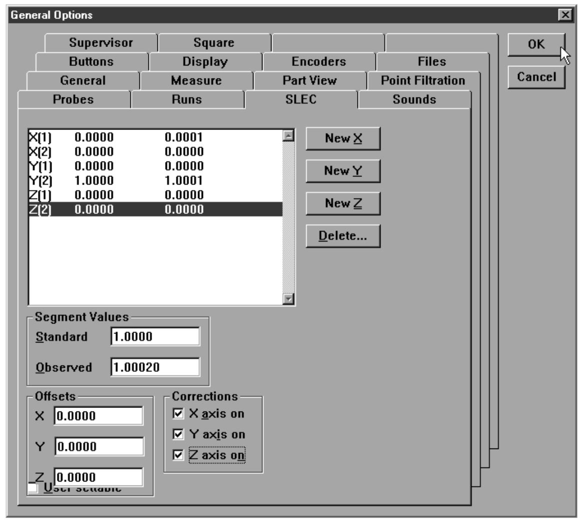
NOTE

Repeat steps 10 and 11 until all points are entered.

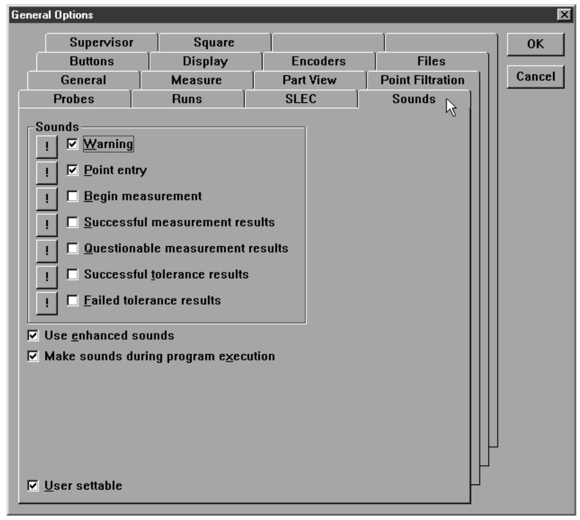
Step 12
Enable corrections on the X, Y, and Z axes as shown.



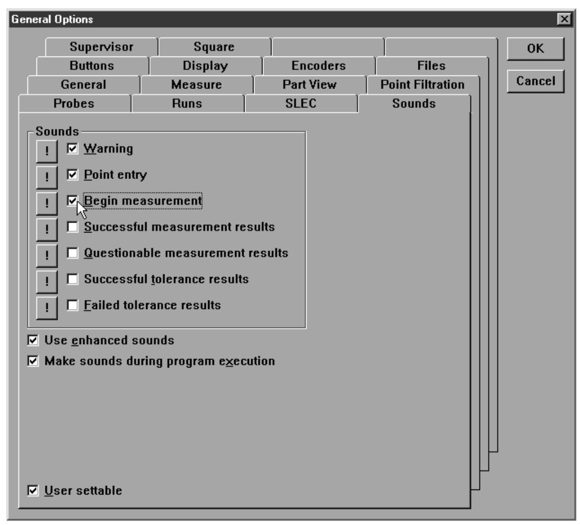
Step 13
Click OK.



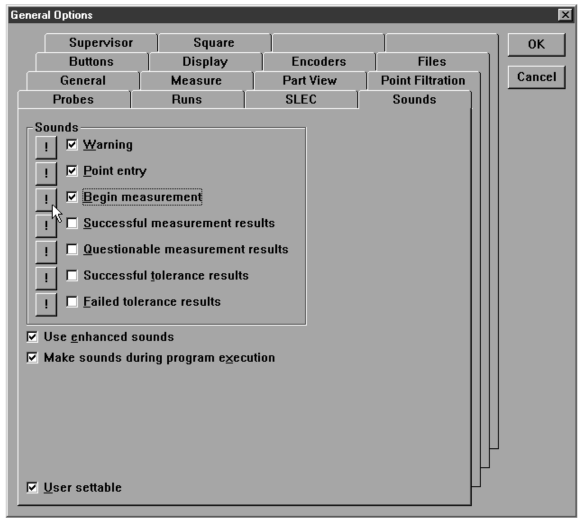
Sounds



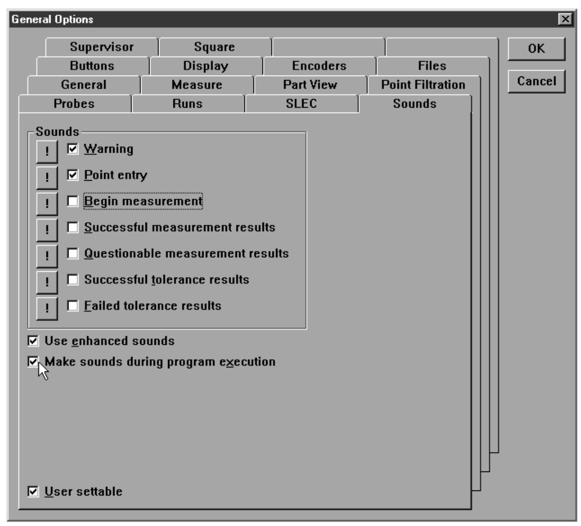
Use the *sound* tab to toggle on/off various system sounds. Place a check beside any item to enable the sound.



Preview sounds by clicking on the exclamation point as shown.



Check *make sounds during program execution* to enable sounds while running a parts program.



Square

Use the square tab to correct for small deviations from 'squareness' in the geometry of the CMM.

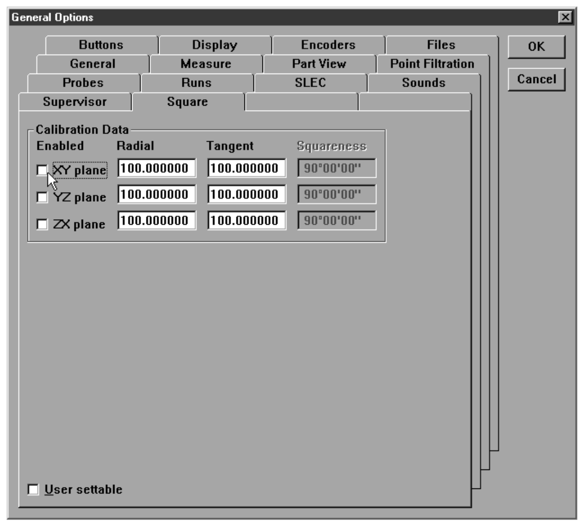
To test for squareness

NOTE

Use a bar-ball standard to perform this test.

Step 1

Disable (uncheck) current squareness correction as shown.



Step 2

Place the bar-ball on the XY plane of the CMM at angle 45 degrees to the X axis.

Step 3

Measure the length of the bar-ball.

Step 4

Place the bar-ball on the XY plane of the CMM at angle 135 degrees to the X axis.

Step 5

Measure the length of the bar-ball.

NOTE

Use this procedure to test squareness of each plane (XY, YZ, and ZX).

Compare the two measurement results. Results that vary significantly indicate the axes are out square.

To square axes

Step 1
Enter the length of the bar-ball at the 45 degree orientation in the radial text box for the XY plane.

Step 2
Enter the length of the bar-ball at the 135 degree orientation in the tangent text box for the XY plane.

NOTE

Use the same procedure to square the other axes.

Index

A

B

C

U

V

W

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