Getting Started with FARO Insight

Overview

This chapter is intended to serve as an introduction to the basics of FARO Insight. It provides a good review for the operator who has had the initial training course on the tracker but needs to jog his or her memory. It is also a good self-taught tutorial for operators with no tracker experience who need to figure it out for themselves.

The information here is presented in a semi-tutorial fashion with a few examples that continue throughout the chapter. If you want to take advantage of this feature you should glue three flat nests onto a planar surface. These targets will provide all the necessary targeting referred to in the tutorial.

A working knowledge of Microsoft® Windows NT is assumed. The explanations are detailed, but they may still be too vague for a Windows NT novice. The best resource for Windows NT information is the manual or online help that comes with Windows NT.

Software Installation

Installing the Software

It is not necessary to install the software *each time you run FARO Insight*. Instructions for loading FARO Insight onto a new machine or for installing a software upgrade accompany the CD.

Getting Started

Starting FARO Insight

You can start FARO Insight using either the mouse or the keyboard. If you create a shortcut to FARO Insight into the Startup group, FARO Insight will run every time you start Windows™ NT.

To start FARO Insight

1. Double click on the FARO Insight icon , or use the arrow keys to select the FARO Insight icon and press enter.

   It takes a few moments for FARO Insight to load. The program then displays the FARO Insight splash screen.

FARO Insight Splash Screen

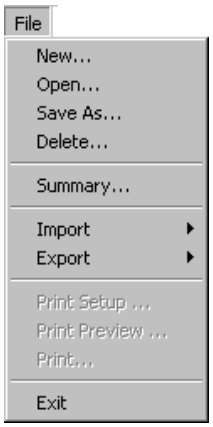
2. To continue, press any key or click on the splash pad.

Creating a New Job

For more information on opening jobs, see "Job Files and Templates".

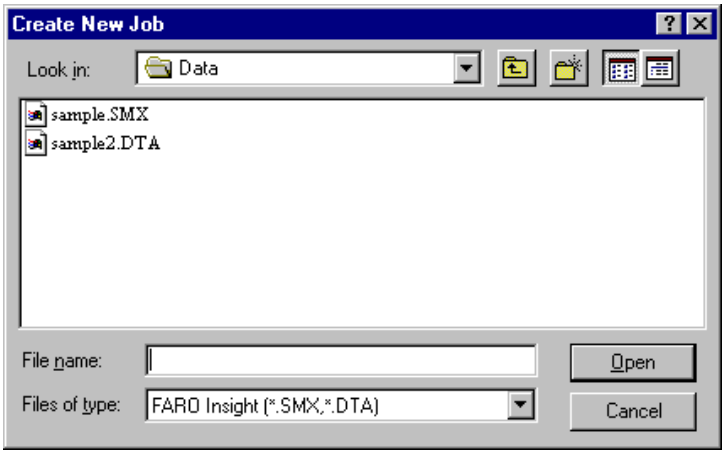
FARO Insight stores the name of your most recent data file and loads that file each time you run the program. When you open a new job, FARO Insight automatically closes the job that is currently open.

1. From the File menu, choose New (Alt, F, N) or press the Open New Job button .



File Menu

FARO Insight displays the Create New Job dialog.



Create New Job Dialog

2. In the File Name box, type the name of the file you want to use for this job.

   If you want to open the job file in another drive or directory, select a drive and directory, or type the complete path in the File Name box.

3. Choose the ‘Open’ button.

   After a few moments, FARO Insight displays the name of the new file in the title bar of the FARO Insight program window.

Geometric Entities

The Gents Worksheet

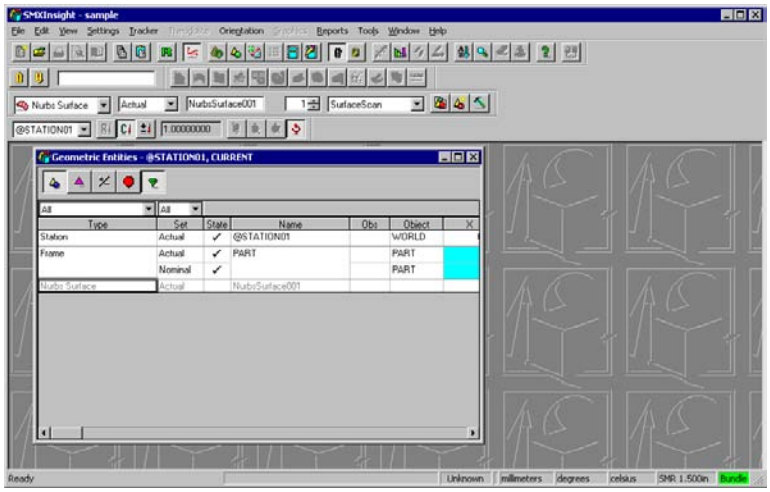
The Gents worksheet and worksheets in general, are described thoroughly in "FARO Insight Worksheets".

The Gents (Geometric Entities) worksheet is where geometric features such as lines, points, frames, circles, etc., are declared, measured, computed and compared. Most of the work you do in FARO Insight, and all of the measurement work, is performed in the Gents worksheet; it is typically the first window you open when starting FARO Insight.

Opening the Gents worksheet

When you open a new file, FARO Insight closes any worksheets that were open. Follow this procedure whenever you open a new job.

Press the Gents button on the tool bar. FARO Insight opens the Gents worksheet.



The FARO Insight Screen

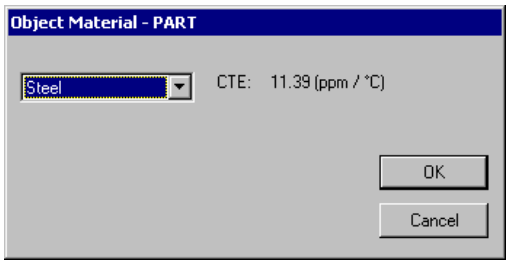
If you want the Gents worksheet to fill the entire workspace, click the maximize button in the upper-right corner of the worksheet.

Setting the initial PART scale

This important concept is covered in "Objects, Scale and Movement".

You can set the initial scale of the PART object either by entering its coefficient of thermal expansion (CTE) and temperature or by defining the Actual PART frame using a best-fit. This allows you to view the PART object at both Current and Reference condition.

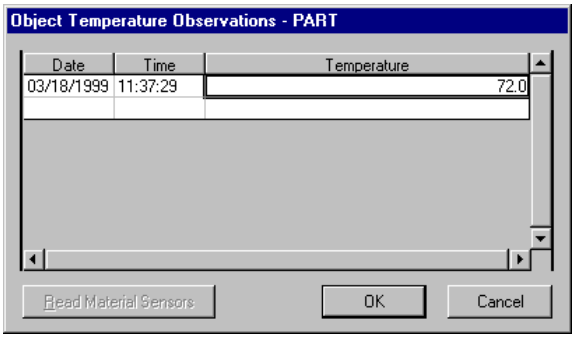
1. From the Orientation menu, choose Material (Alt, N, A), or click the Object Material button .



Object Material dialog

2. From the list of materials, select the PART material, and then choose 'OK'.
3. From the Orientation menu choose Temperature (Alt, N, T), or click the Object Temperature button .

   FARO Insight displays the Object Temperature Observations dialog.



Object Temperature Dialog

4. Enter the PART temperature, then choose OK.

   FARO Insight automatically recalculates the PART Object scale.

Declaring Features

Before you can measure a feature, you must first declare it. When you declare a feature, you tell FARO Insight what type of feature you want to measure, the name of the feature, and how the feature is to be measured. Features can be declared offline prior to a measurement where the various parameters can be customized, or they can be declared on the fly at the time the feature is measured. The following give examples of how some features are declared.

Declaring Actual points

In this procedure, we will declare four points ‘p1’ through ‘p4’.

1. From the Feature toolbar select ‘Point’ from the first dropdown list.
2. Select ‘Actual’ from the second dropdown list.
3. Enter the name of the feature, in this case ‘p1’, in the third field. You may also accept the default value if desired.
4. In the fourth field enter the number 4. This will determine the number of features you wish to create.
5. In the fifth field select ‘StdPoint’ as the method by which the features will be measured.
6. The feature toolbar should appear as follows:

Feature toolbar set to create point ‘p1’

7. Click the Create Features button  from the Feature toolbar.

   Four point features named p1, p2, p3, and p4 will now appear in the Geometric Entities sheet.

Declaring an Actual Plane

In this procedure, we will declare the plane ‘Plane1’.

1. From the Feature toolbar select ‘Plane’ from the first dropdown list.

2. Select ‘Actual’ from the second dropdown list.
3. Enter the name of the feature, in this case ‘Plane1’, in the third field.
4. In the fourth field enter 1.
5. In the fifth field select the ‘SurfaceScan’ method.
6. The feature toolbar should appear as follows:

Feature toolbar set to create plane ‘Plane1’

7. Click the Create Features button from the Feature toolbar.

   The feature ‘Plane1’ will now appear in the Gents sheet.

Operating the tracker

Setting up the FARO Laser Tracker

The procedure for setting up, checking and calibrating the tracker can be found in Guides located in the Appendix of the FARO Laser Tracker Operators Guide. Before the tracker is used for inspection, these procedures should be performed to verify that the tracker is operating optimally.

Communicating with the tracker

The FARO Insight software communicates with the tracker over a network using an Ethernet connection. You must connect to the tracker before commanding it from within FARO Insight.

Connecting to the tracker

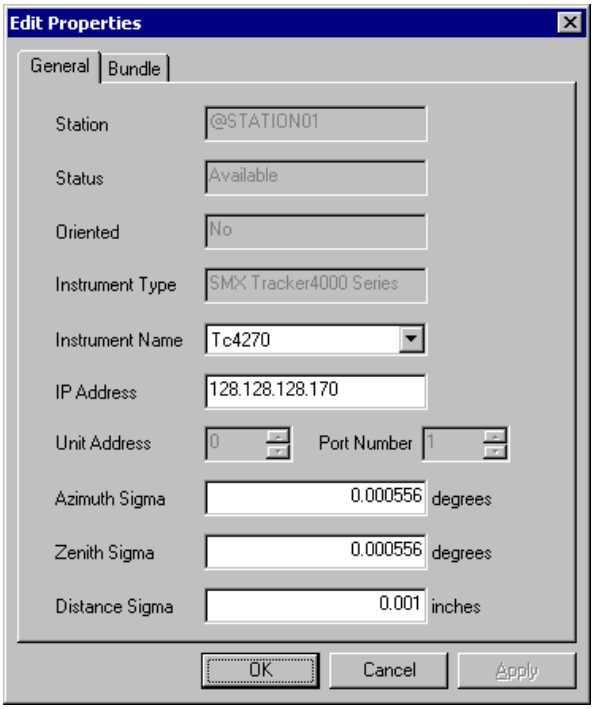
You can not access any measurement functionality unless you have connected to the tracker.

If you are starting a new job or are working from a job file that has never been used to run a tracker, you will need to activate the Station before connecting to the tracker.

To activate the station:

1. Open the Geometric Entities worksheet.
2. Open the Edit Properties dialog box for the feature ‘@STATION01.’ Select @STATION01 and select Edit, Properties… (Alt E, T) from the menu option or by using the speed menu.

   FARO Insight displays the Edit Properties dialog.



Edit Properties dialog

From the 'Instrument' dropdown menu, select the tracker that you will using and click OK to close the window. The trackers available in the instrument list are created in the Hardware Manager.

3. With the '@STATION01' cell still highlighted, from the Edit menu select Activate Station (Alt E, V) or right-click on the '@STATION01' cell and select Activate.

Note: You can avoid the activation process for new job files if the default properties for a Station are configured to have FARO Insight automatically assign the correct tracker and activate it.

To connect to the tracker:

1. Connect the computer to the tracker using the networking cable.
2. From the Tracker menu choose Connect (Alt T, C), or click the Connect button .

   It will take a few moments for the computer to connect to the tracker. When FARO Insight has successfully completed connected, the Connect button will change to the Disconnect button .

   When connection in is successful, a message indicating the IP Address appears on the status bar. The actual numbers that appear will be different than the numbers shown in the example. The actual numbers you see will indicate the IP Address of the tracker that you have connected to.

   Logged in at address 128.128.128.130

   Successful Connection message

Disconnecting from the tracker

You should disconnect from the tracker before closing FARO Insight.

- From the Tracker menu choose Disconnect (Alt, T, D), or click the Disconnect button .

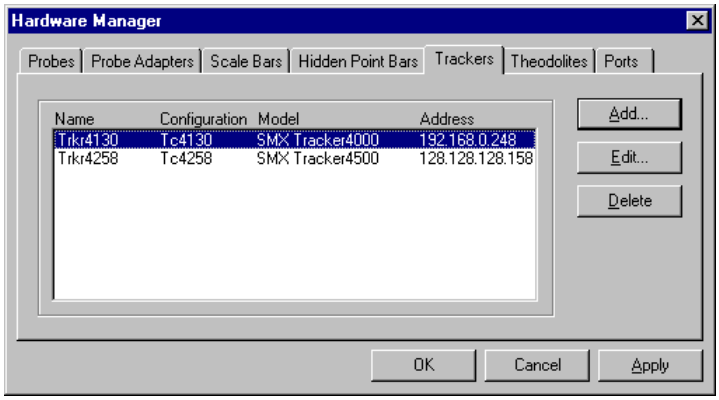
It takes a few moments to disconnect from the tracker. When you are disconnected from the tracker, most of the Tracker Toolbar buttons will no longer be enabled.

Adding a tracker to the Hardware Manager

You cannot define a Station as a particular tracker until you've defined that tracker in the Hardware Manager.

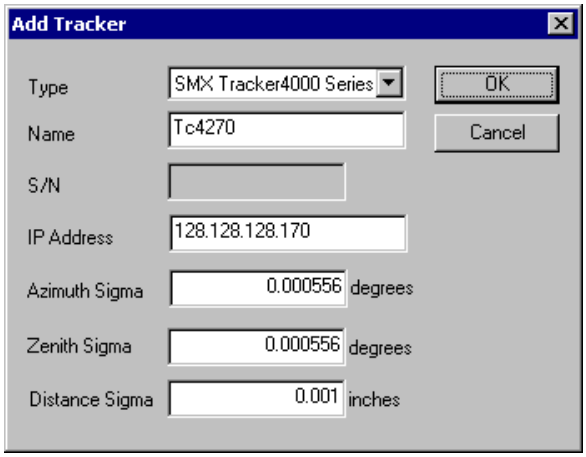
1. From the Tools menu select Hardware Manager then Trackers (Alt L, H, T).

   FARO Insight displays the Hardware Manager dialog.



Hardware Manager dialog

2. Click on the 'Add' button. FARO Insight displays the Add Tracker dialog box.



Add Tracker dialog

Choose the Type of Tracker you are adding from the 'Type' field, enter the in the Name of the tracker in the 'Name' field and then enter the IP

address of you Tracker in the ‘IP Address’ field. Click OK when finished.

3. Click OK on the Hardware Manager.

The Tracker Toolbar

The use of the tracker is described in more detail in "Tracker Basics".

The Tracker Toolbar gives you access to the most common tracker functions. You can initiate a measurement, home or reset the tracker, aim the tracker to a known position, set the distance, clear observations, measure a level plane, and perform the operator checks, all from the tracker toolbar. Other tracker functions are accessed from the Tracker menu.

Opening the tracker toolbar

The tracker toolbar can be displayed on top of any other windows or worksheets in the FARO Insight workplace or docked to the toolbar portion of the workspace. You can move the tracker toolbar if it gets in the way. Most of the buttons on the tracker toolbar will only be accessible after the user has logged in to the tracker.

From the View menu select Toolbars, Tracker (Alt, V, T, R). The tracker toolbar will appear as follows:

Tracker toolbar

You can position the tracker toolbar anywhere on the screen. If you close the tracker toolbar, it will reappear in its previous position when you reopen it.

Sending the tracker home

If you break the laser beam, you must reset the interferometer counter at a known distance from the tracker.

1. Place the SMR in the Tracker Mounted Reset (TMR).
2. On the Tracker toolbar, press the Home button  or press F9.

   It takes about one second (when ADM is not enabled) for the laser to reset.

Measuring with the tracker

The features you measure with the tracker fall into two categories: discrete and continuous. Point locations such as tooling holes and drift points are discrete features; all other features such as lines, planes, circles, spheres and general surfaces are continuous, since they are comprised of multiple points.

Measuring points

Points are discrete features: they consist of a single X, Y, Z value.

1. Open the Tracker toolbar and home the laser.
2. In the Gents worksheet, set focus on the point ‘p1’.

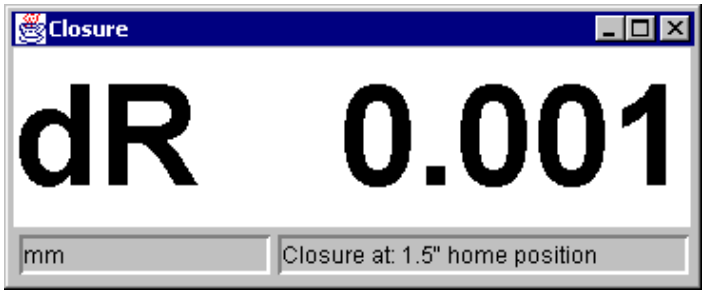
It is not necessary to click directly on the features name; you can click anywhere on that row.

3. Track the SMR to the point you want to measure, and place it in the appropriate nest or tooling.
4. From the Tracker menu, choose Measure (Alt, M), click the Measure button on the Tracker toolbar, or press F3. FARO Insight will initiate the measurement immediately, and display the Measure dialog.

Measure dialog

5. While measuring, the red light on the tracker will light up. When the light turns off, the measurement is complete, and the coordinates are displayed in the X, Y, and Z columns of the Gents sheet. The Measure dialog will close when the measurement is finished.
6. Repeat steps 1 through 4 for points ‘p2’ and ‘p3’.
7. Track the SMR back to the Home position (in the TMR) and check closure. To do this, go to the Tracker menu, Closure (Alt, O). You can also press on the Check Closure button, on the Tracker toolbar.

   FARO Insight displays the Closure window.



Closure Window

When the SMR is in the Home position the Closure should be zeroed and appear as it does above.

Measuring a plane

Planes are continuous features that consist of multiple points. For this example you will need a flat surface on which to measure a plane. For this demonstration, the surface does not need to be perfect.

1. Open the Tracker toolbar and send the Tracker Home.
2. In the Gents worksheet, focus on the plane ‘Plane1’.
3. Press the Measure button on the Tracker toolbar.

FARO Insight displays a message indicating it is ready to measure the point.

4. Track the SMR to a flat surface such as a table and hold it in contact with the surface.
5. To begin the measurement, press ENTER, or click the ‘OK’ button with the mouse.
6. Move the SMR smoothly over the surface, making sure to maintain a continuous line-of-sight to the SMR.

   While measuring, the red light on the tracker will light up. When the light turns off, the measurement is complete. When the plane fit is done, the feature values are displayed in the Gents worksheet.
7. Track the SMR back Home and check closure.

Working with Frames

Overview

The chapter "Intuitive Function Definition" explains how to assign functions and describes each frame function in detail. The use of the Display frame is described in "The FARO Insight Interface".

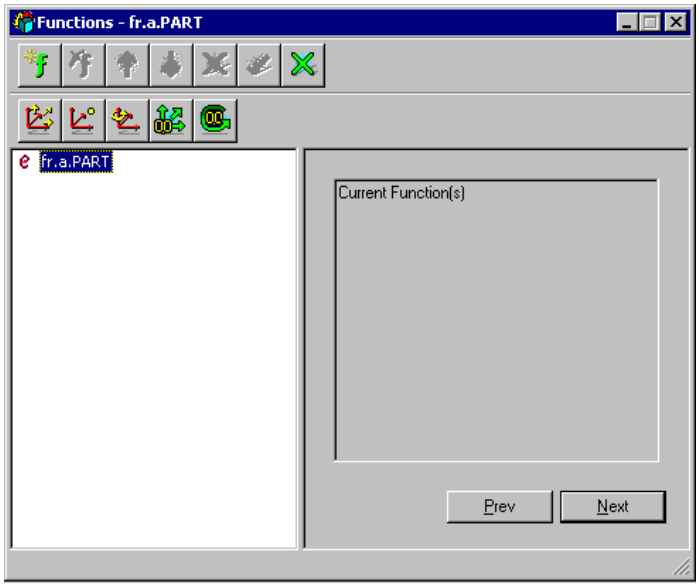
A frame is a three-dimensional reference system, also referred to as a Cartesian coordinate system, in which geometric features such as points, lines, circles, etc., are displayed or resolved. When you open a job, the view frames ‘@STATION01’ and ‘PART’ are automatically defined. The @STATION01 condition is the base coordinate system that is associated with an instrument at a specific location. For example, the condition @STATION01 is a view frame for an instrument at a specific location at a specific time. Subsequent stations will be ‘@STATION02’, ‘@STATION03’, etc. The PART frame is a user definable frame that can be assigned any one of the nine creator frame functions provided in FARO Insight.

Creating an Origin-Point-Point frame

This procedure explains how to create a frame from the three points ‘p1’ through ‘p3’ that you previously measured.

1. In the Gents worksheet, set focus on the frame ‘PART’ for the associated with the Actual Set.
2. Use the right mouse button to access the speed menu and select Edit Functions.

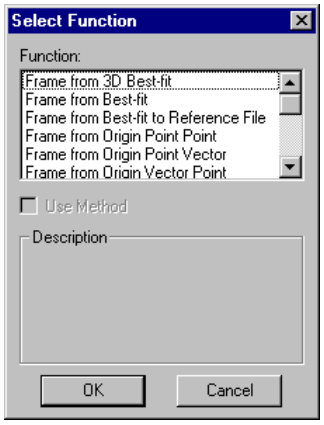
   FARO Insight displays the Function Editor.



Function editor dialog

3. Select the Add Function button .

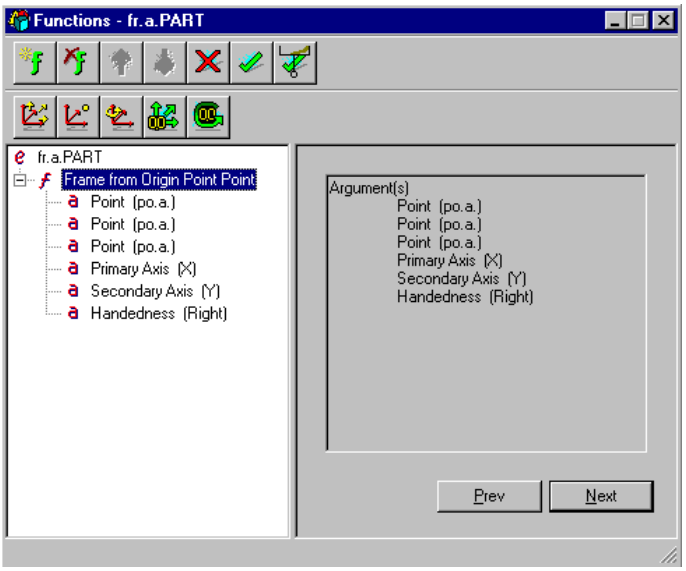
   FARO Insight displays the Select Function dialog.



Select Function dialog

4. Select ‘Frame from Origin Point Point’ from the function list.

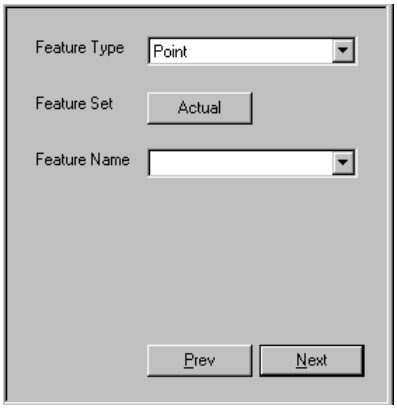
   FARO Insight inserts the OPP function and lists the six arguments labeled *Point*, *Point*, *Point*, *Primary axis*, *Secondary axis* and *Handedness*.



Part frame programmed using OPP function

5. Select the first *Point* argument in the left pane.

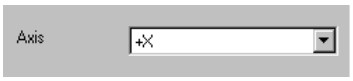
   FARO Insight displays the Argument Parameters form in the right pane.



Argument Parameter dialog

6. Set the object Tag to ‘Point | Actual | p1’ by selecting Point from the Feature Type list, ‘Actual’ from the button, and ‘p1’ from the Feature Name list.
7. Repeat steps 5 and 6 for the second and third cells labeled *Point*, using points ‘p2’ and ‘p3’ in respectively.
8. Select the *Primary Axis* argument.

   FARO Insight displays the Select an Axis controls in the Argument Parameter form.



Axis selection control

9. Select '+X' to indicate that the primary axis (defined by point 'p2') is the X-axis.

10. Repeat steps 8 and 9 for the *Secondary Axis* Argument, choosing '+Y' as the secondary axis.

11. Select the *Handedness* argument.

    FARO Insight displays the Handedness controls in the Argument Parameter form.

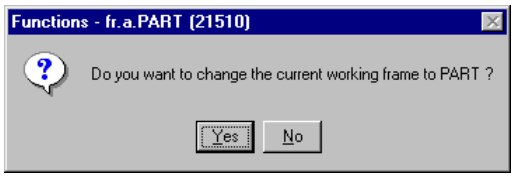
    

    Handedness control

12. Select 'Right' to indicate that the coordinate system is right-handed.

13. Select the Save and Close button to return to the Gents worksheet.

14. FARO Insight displays the following message asking whether or not you would like to view all of the data in the newly constructed Part Frame.

    View Frame Message

15. Click the 'Yes' button.

    FARO Insight resolves all features in the Gents worksheet in the PART frame.

    Notice that all three coordinates of 'p1' are zero, the x and z values of 'p2' are zero, and that only the z value of 'p3' is zero. This is because 'p1' is at the origin, 'p2' lies on the x-axis, and 'p3' lies in the x-y plane of the PART frame.

Changing the View frame

You can resolve the display (view) in any coordinate frame that has been defined and calculated. When you change the view frame, FARO Insight resolves all displayed features in the new view frame. In the previous step FARO Insight prompted the user to automatically update the view frame. To change back to the original setting, use the following procedure.

1. From the View menu, select Toolbars then Display Settings (Alt, V, T, P), or click the Display Settings button .

   FARO Insight opens the Display Settings Toolbar.

   Display Settings Toolbar

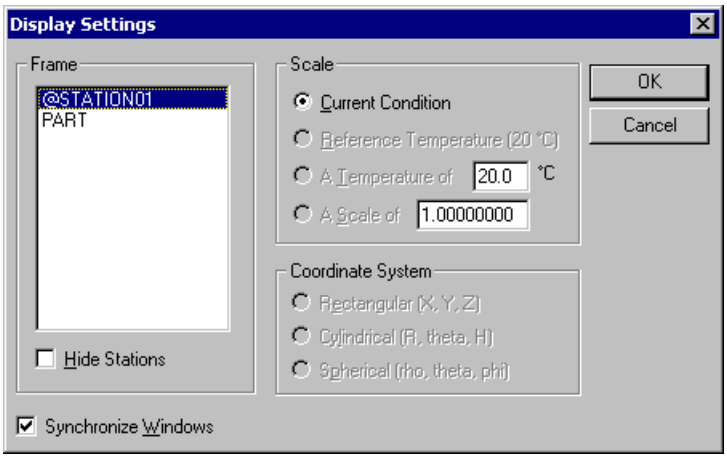
2. In the DISPLAY FRAME dropdown menu, choose ‘@STATION01’

   FARO Insight resolves all features in the Gents worksheet in the default tracker frame @STATION01.

3. Repeat steps 1 and 2 selecting the PART frame in step 2 instead of @STATION01.

4. The Display Settings may also be changed from the View menu by selecting Display Settings (Alt V, D).

   FARO Insight opens the Display Settings Window.



Display Settings dialog

5. In the DISPLAY FRAME dropdown menu, choose ‘@STATION01’

   FARO Insight resolves all features in the Gents worksheet in the default tracker frame @STATION01.

6. Repeat steps 4 and 5 selecting the PART frame in step 2 instead of @STATION01.

Scalar Entities

The Sents worksheet, and worksheets in general, are described thoroughly in "FARO Insight Worksheets"

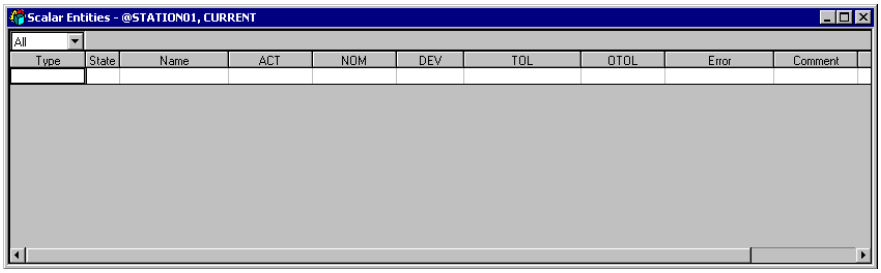
The Sents (Scalar Entities) worksheet is where scalar features such as angles and distances are declared, computed and compared. If you want to find the angle between two measured planes or the distance between two features, you will do so in the Sents worksheet.

The Sents Worksheet

Opening the Sents worksheet

1. From the View menu choose Scalar Entities (Alt, V, C) or click the Sents button on the Standard toolbar.

2. FARO Insight opens the Sents worksheet.



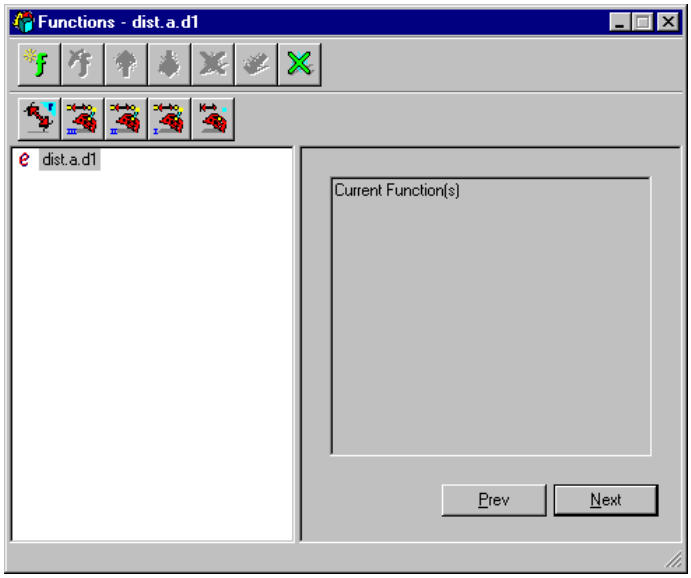
Scalar Entities Worksheet

Computing Angles and Distances

Before you can calculate a scalar entity, you must declare it. When you declare a feature, you tell FARO Insight what type of feature you want to compute the name of the feature, and how the feature is to be evaluated. This procedure describes how to calculate the distance between two points.

1. Change feature type to Distance by selecting Distance from the drop-down list above the Type column.
2. In the Name column, type the name of the Distance, for example ‘d1’.
3. Press ENTER on the keyboard.
4. Double-click in the Actual column of the distance ‘d1’.

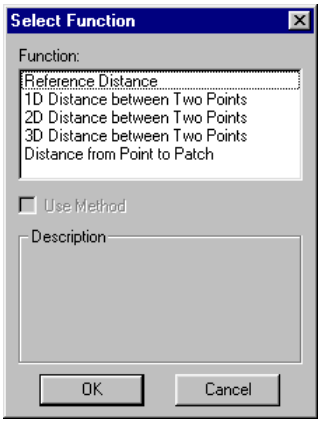
   FARO Insight displays the Function Editor.



Function editor

5. Select the Add Function button .

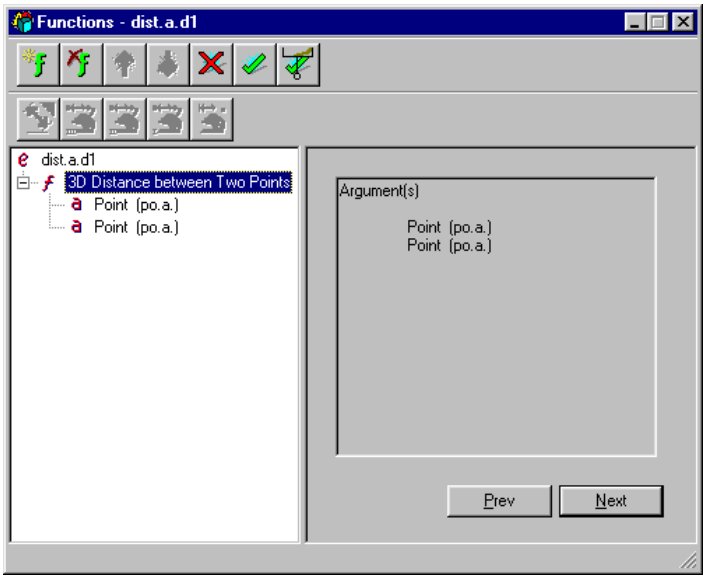
   FARO Insight displays the Select Function dialog.



Select Function dialog

6. Select the function ‘3D Distance between Two Points’ from the function list.

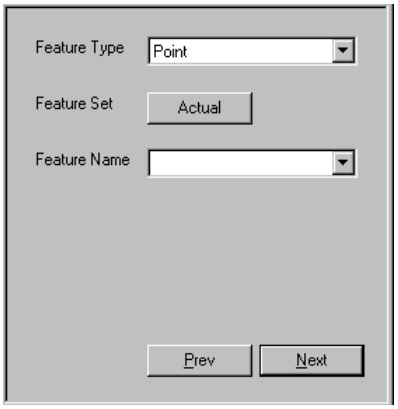
   FARO Insight inserts the ‘3D distance between ‘Two Points’ function and lists the two point arguments



Function dialog

   FARO Insight displays the Argument Parameters form in the right pane.

7. Select the first Point argument in the left pane.



Function Argument dialog

8. Set the object Tag to ‘Point | Actual | p1’ by selecting Point from the Feature Type list, ‘Actual’ from the button, and ‘p1’ from the Feature Name list.
9. Repeat steps 7 and 8 using ‘p2’ for the second point argument.
10. Select the Save and Close button to return to the Sents worksheet.

    Notice that the distance calculated is equal to the X value of point ‘p2’.

Using Watch Windows

Overview

Watch Windows are described thoroughly in “FARO Insight Worksheets”.

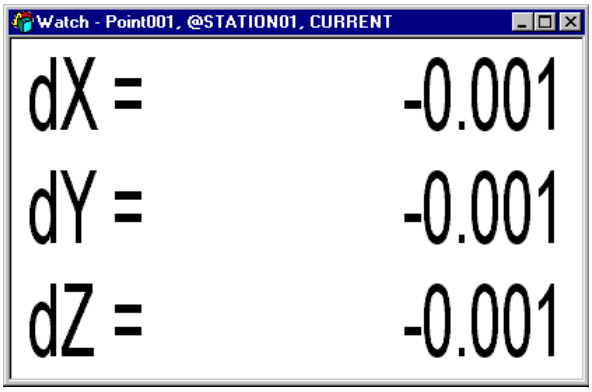
Watch windows display a real-time comparison between the current position of the SMR and an Actual or Nominal value of a feature. For example, when checking drift, you can watch the actual (previously measured) position of a point to determine whether the tracker (or part) has moved since the point was first measured. On the other hand, by watching the nominal (design) coordinates, you can set a detail by moving the SMR until the difference from nominal is zero.

Checking for drift

In order to monitor drift, you need to first measure at least three points whose positions are stable with respect to both the part and the tracker. For geometric reasons these points must not lie on or near a straight line. This procedure describes how to check drift at the points ‘p1’ through ‘p3’.

1. In the Gents worksheet, set focus on the Actual value of point ‘p1’.
2. Track the SMR to point ‘p1’ and place it in the nest.
3. Press the Watch Window button , or press F4 to launch the watch window.

   FARO Insight displays the X, Y and Z differences between the measured location of ‘p1’ and the current position of the SMR.



Watch Window

4. Inspect the differences in X, Y, and Z between the current and previous coordinates. If these differences are large, either the tracker or the point has moved since it was measured.
5. For points ‘p2’ and ‘p3’, repeat steps 1 through 4.

Watching a plane

When you open a watch window on a feature such as a plane, FARO Insight compares the position of the SMR to the measured plane and displays the distance from the SMR to the closest point of approach on the plane.

1. Focus on the Actual plane ‘Plane1’ in the Gents worksheet.
2. Track the SMR to the plane ‘Plane1’ and hold it there.
3. Press the Watch Window button , or press F4 to launch the watch window.

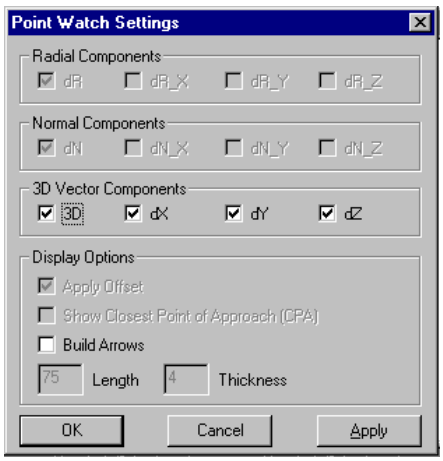
   FARO Insight displays dN, the distance from the measured plane to the closest point of approach of the SMR. Notice how this value changes as you move the SMR over the plane. Slip a shim of known thickness under the SMR and note the change dN.

Changing Watch Settings

When a Watch Window is open it is possible to change its parameters to display all coordinates as in 3D or just specific coordinates such as dX, dY or dZ.

1. From the Settings menu, click on Watch (Alt S, W). If a Watch Window is open, right-click anywhere inside the Watch Window to open the same dialog box.

   FARO Insight displays the Watch Settings dialog box.



Watch Settings Dialog

2. For Points, you may display specific components (3D, dX, dY, and dZ) by checking the corresponding box(es) in the 3D Vector Components portion of this window.
3. For features that have a radial component (circles, spheres, etc.) you may display specific components (dR, dR_X, dR_Y, and dR_Z) by checking the corresponding box(es) in the Radial Components portion of this window.
4. The same may be done for features that have normal components (planes, circles, etc.). To display specific components (dN, dN_X, dN_Y, and dN_Z) check the corresponding box(es) in the Normal Components portion of this window.
5. You may also configure this window to apply an offset (for tooling). The Closest Point of Approach (CPA) coordinates may be displayed as well as Build Arrows for use in the Graphics Window. For more information on Build Arrows, see *the Watch Windows with a Tolerance* section of the *Graphics View Window* chapter.

Viewing and Graphing Observations

Observations

Graphing and Observation windows are described thoroughly in "FARO Insight Worksheets".

When you scan an object such as a circle or plane, FARO Insight displays only the essential information in the Gents sheet such as position and a vector. The potentially hundreds or thousands of observations that make up the feature are stored separately within FARO Insight. For any measured feature, the user can view the individual observations.

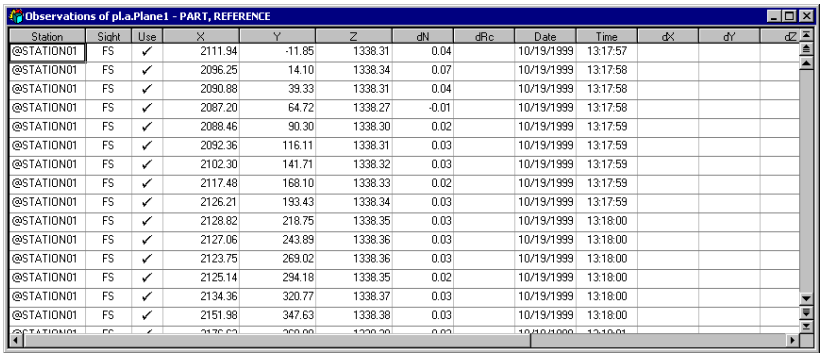
Viewing a feature's observations

Storing and viewing observations separately allows you to concentrate on the bigger picture - like thinking of a circle as an individual entity, rather than as a collection of hundreds of points - and still have access to the details when you need them. This procedure describes how to view the observations of plane 'Plane1' that was measured previously.

1. Set focus on the Actual plane 'Plane1' in the Gents worksheet.

2. Click on the Actual plane ‘Plane1’ using the right mouse button and selecting Observations from the speed menu, or select the Observations button  from the toolbar.

   FARO Insight displays the Observations worksheet.



Observations of pl.a.Plane1 - PART, REFERENCE

Station	Sight	Use	X	Y	Z	dN	dRc	Date	Time	dX	dY	dZ
@STATION01	FS	✓	2111.94	-11.85	1338.31	0.04		10/19/1999	13:17:57			
@STATION01	FS	✓	2096.25	14.10	1338.34	0.07		10/19/1999	13:17:58			
@STATION01	FS	✓	2090.88	39.33	1338.31	0.04		10/19/1999	13:17:58			
@STATION01	FS	✓	2087.20	64.72	1338.27	-0.01		10/19/1999	13:17:58			
@STATION01	FS	✓	2088.46	90.30	1338.30	0.02		10/19/1999	13:17:59			
@STATION01	FS	✓	2092.36	116.11	1338.31	0.03		10/19/1999	13:17:59			
@STATION01	FS	✓	2102.30	141.71	1338.32	0.03		10/19/1999	13:17:59			
@STATION01	FS	✓	2117.48	168.10	1338.33	0.02		10/19/1999	13:17:59			
@STATION01	FS	✓	2126.21	193.43	1338.34	0.03		10/19/1999	13:17:59			
@STATION01	FS	✓	2128.82	218.75	1338.35	0.03		10/19/1999	13:18:00			
@STATION01	FS	✓	2127.06	243.89	1338.36	0.03		10/19/1999	13:18:00			
@STATION01	FS	✓	2123.75	269.02	1338.36	0.03		10/19/1999	13:18:00			
@STATION01	FS	✓	2125.14	294.18	1338.35	0.02		10/19/1999	13:18:00			
@STATION01	FS	✓	2134.36	320.77	1338.37	0.03		10/19/1999	13:18:00			
@STATION01	FS	✓	2151.98	347.63	1338.38	0.03		10/19/1999	13:18:00			

Observations worksheet

Clearing observations

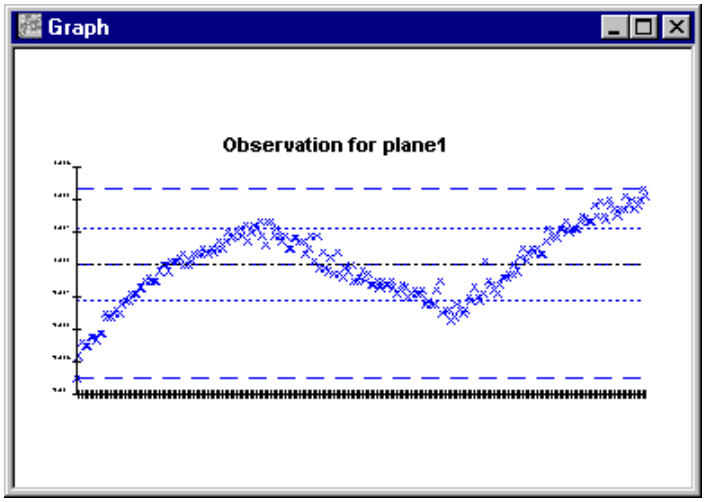
If you make a mistake while measuring a feature, such as lifting the SMR off the surface while scanning a plane, you can clear the bad observations and re-measure the feature.

1. In the Gents worksheet, set focus on the Actual feature whose observations you want to clear.
2. From the Edit menu choose Clear Obs. (Alt, E, B), click the Clear Obs button  , or press F7.
3. FARO Insight prompts you to verify your selection.
4. Choose ‘Yes’ to clear the feature’s observations.

Graphing observations

When you scan a feature such as a circle, line, plane or sphere, you often want to view and plot the residuals from the feature fit. Graphing is also a quick way to check trends such as the straightness of a line. This procedure describes how to plot the normal residuals from the plane ‘Plane1’ that was measured previously.

1. Open the Observation window for the feature whose observations you want to plot.
2. Select the dN column by clicking on the column header.
3. Click the Graph button  .
4. FARO Insight displays a plot of the planes residual errors.



Sample Plot of Observations

Quitting FARO Insight

Closing FARO Insight

FARO Insight automatically saves any changes made to the job file, making unnecessary for you to do so. However, before you exit FARO Insight, it is recommended that you disconnect the tracker.

1. From the Tracker menu choose Disconnect (Alt, T, D), or press the Disconnect button  .
2. From the File menu choose Exit (Alt, F, X).

Job Files and Templates

Job Files

All job files in FARO Insight are given a default extension of .SMX. The .SMX file is a compressed file containing the three files that make up your job. When you open the .SMX file in FARO Insight, you are decompressing the file and creating working files in the same directory as the *.SMX file. After FARO Insight decompresses the .SMX file, it opens the following working files: a database file, a job description file, and an index file. The database file (*.DTA) contains the actual observations, the functional relationships between the data, and feature information such as offset and method definitions. The index file (*.IDX) contains FARO Insight directory of features in the database file, and the summary file (*.SMY) contains information such as job specific to the inspection, such as the date, the company name and operators. When you close a job, FARO Insight compresses these files to create the .SMX file.

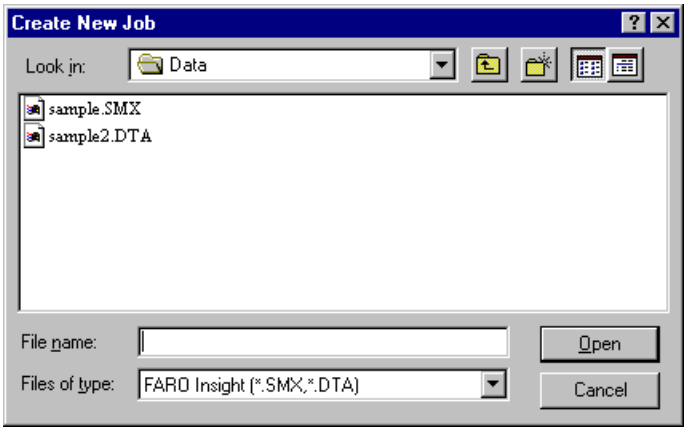
Creating a New Job

When creating a new job, FARO Insight allows you to select the name of the file, and the drive and directory in which it is stored. The user can also create new folders and change the display view directly through the Create New Job dialog box using a typical Microsoft® interface. After the job is created, FARO Insight closes the job that is currently open and opens the newly created job. The new job file will automatically be given an extension of .SMX.

You can not create a new job using the name of an existing job in the same directory.

1. From the File menu, choose New (Alt, F, N) or press the Create New Job button .

   FARO Insight displays the Create New Job dialog.



Create New Job dialog

2. In the File Name box, type the file name you want to use for this job.
3. FARO Insight creates the job file in the current drive and directory and adds the filename extension .SMX.
4. If you want to create the job file in another drive or directory, select the drive and directory, or type the complete path in the File Name box.
5. Press the OK button.

Opening an Existing Job

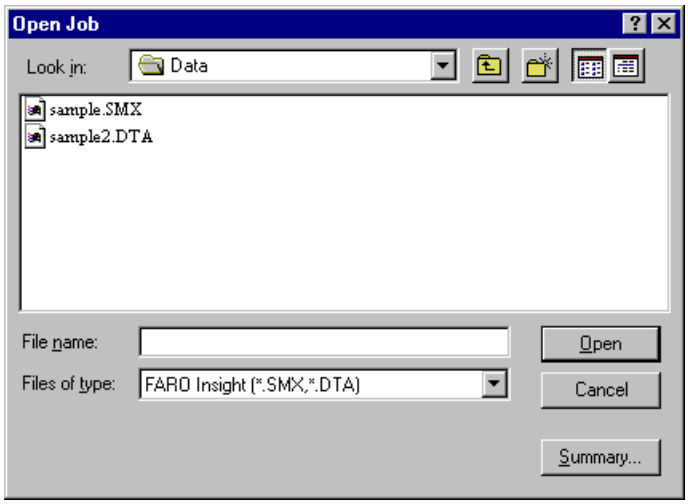
FARO Insight stores the name of your most recent job file in the INSIGHT.INI file, and automatically loads that file each time you run the program. If you want to continue working on that job, you are ready to begin as soon as the program loads. Or, you can open another job you had previously created, and continue working on that job.

To open an existing job

FARO Insight stores all the information related to each job in separate files. The user can resume work on an existing job at any time simply by opening that job file. When the operator opens an existing job, one can pick up where the job was left off. As with the Create New Job dialog box, the user can create new folders and change the display view directly through the Open Job dialog box using a typical Microsoft® interface.

1. From the File menu, choose Open (Alt, F, O), or press the Open Job button .

   FARO Insight displays the Open Job dialog box.



Open Job dialog

2. To select the file to open, you can double-click the name on the file name list, type the filename in the file name box, or press the UP or DOWN arrow keys and press enter.

3. If the job you want to open is on another drive and/or directory, either choose the appropriate drive/directory, or type the complete path in the File Name box.
4. Click the ‘OK’ button.
5. If you would like to see job specific information for a pre-existing job file without opening it, you can click the ‘Summary’ button. See the “File Summary” section in this chapter for more information on the ‘Summary’ button.

Saving a Job

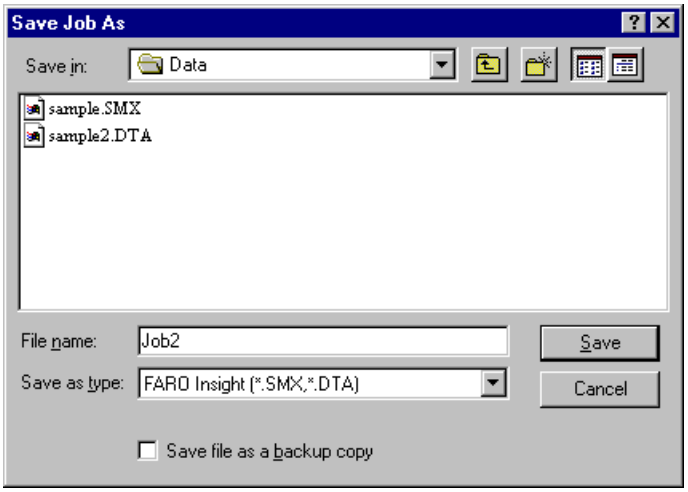
You will notice that there is no Save function within FARO Insight; saving is not necessary. FARO Insight automatically saves all observations, functions, methods and offset definitions, and all other information such as comments and manually input coordinates *as you enter them*. This way, if you accidentally lose power, there is no loss of data. It is possible, however, for an abnormal termination to corrupt your database. *For this reason, it is advised that you periodically make a backup file to protect your data.*

Saving a Job under a New Name

To save the current job file under another name and make *it* the currently active job, use the Save As command from the File menu. For example, you may wish to change the name of the current job file from 'Job1' to 'Job2' and continue working in 'Job2'

1. From the File menu, choose Save As (Alt, F, S).

   FARO Insight displays the Save As dialog.



Save Job As dialog

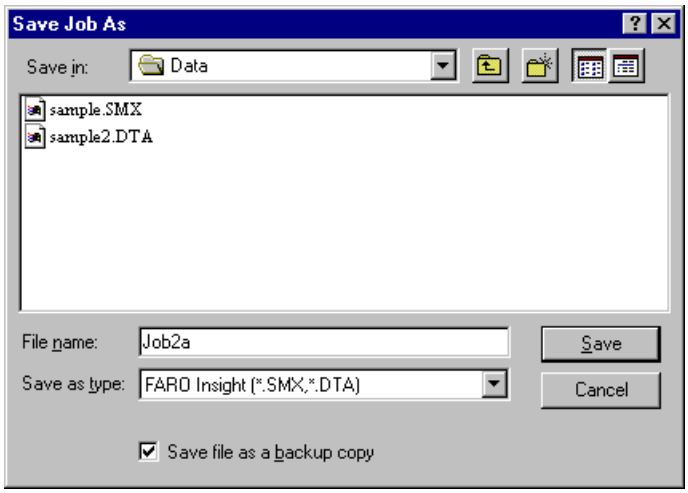
2. In the File Name box, type the new name for the file.
3. If you want to save the file to another drive or directory, either select a drive and directory in the dialog or type the complete path in the File Name box.
4. Click the ‘Save’ button.
5. The new job name will appear in the title bar of the main window.

Make a Backup Copy of a Job

To save a copy of the active job and continue to work in the original job, use the Save As command with the ‘Save file as a backup copy’ option checked. For example, you would save 'Job2' as 'Job2a' but continue working in 'Job2'.

1. From the File menu, choose Save as (Alt, F, S).

   FARO Insight displays the Save As dialog.



Save Job As dialog

2. In the File Name box, type the new name for the file.
3. Check the ‘Save file as backup copy’ box.
4. If you want to save the file to another drive or directory, either select a drive and directory in the dialog or type the complete path in the File Name box.
5. Click the ‘Save’ button.

Auto Backup

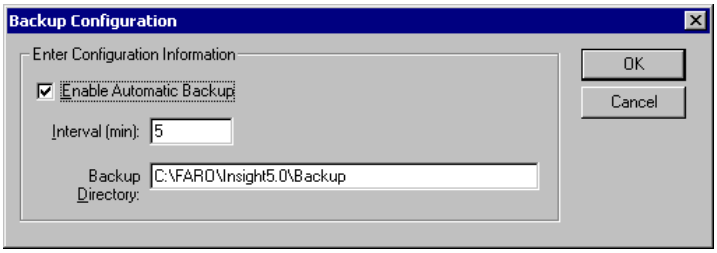
During the course of a measurement session, you should periodically backup the current job. All computer systems are subject to failures related to either hardware or software. Some failures may result in the loss of data. To safeguard against loss of data, FARO Insight automatically creates a backup copy of the active job file. If an error occurs during a job, the backup copy of the job may be opened and all previously recorded data may be recovered.

Configuring Auto Backup

The Auto Backup feature may be disabled or modified by opening the Backup Configuration dialog box.

1. From the Settings menu, select Backup (Alt S, B).

   FARO Insight will display the Backup Configuration dialog



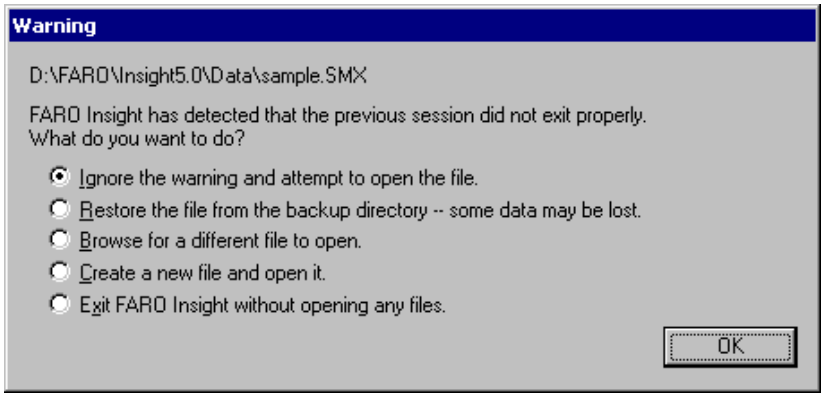
AutoBackup Configuration dialog

2. To enable Automatic Backup put a check mark in the Check box labeled Enable Automatic Backup.
3. In the field labeled Interval, enter the time in minutes you wish FARO Insight to backup the file.
4. In the field labeled Backup Directory enter the path on your computer were you want the backup file to be stored. This directory must already exist on the computer; FARO Insight will not create it.

   Backup files are created in this directory using the current job file name but replacing the first letter of the extension with the ~ character. For example Job1.SMX would be saved in the backup directory as Job1.~MX.

Restoring a Backup File after a Failure

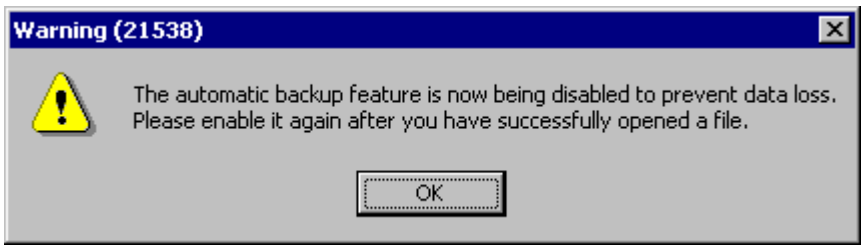
If FARO Insight terminates improperly for any reason the following message will appear the next time the program is started.



Database Failure warning

Ignore the warning and attempt to open the file.

Continues loading the original job and displays a message that prompts the user to disable the *initial* Auto Backup upon reentering the job.



Notification of AutoBackup being disabled

When FARO Insight terminates improperly, the current job file may be corrupted. Because of this, Auto Backup is automatically turned off so that the remote possibility of the backup file being overwritten by a corrupt job file does not exist. It is recommended that you enable automatic backup when you are satisfied that you corrent job file has not been corrupted due to improper termination. Auto Backup can be enabled through the Settings, Backup…. Menu (Alt, S, B) menu.

Restore the file from the backup directory – some data may be lost.

Restores the job from the backup file from the backup directory. This option overwrites the original job with the backup.

Browse for a different file to open.

Allows the user to open another existing job.

Create a new file and open it.

Allows the user to create a new job.

Exit FARO Insight without openeing any files.

Exits FARO Insight.

Manually Restoring a Backup File

A backup file can be manually restored using Microsoft Explorer; copy it from the backup directory to a new directory and rename it with the .SMX extension.

Deleting Job Files

You can delete obsolete or duplicate job files directly from FARO Insight.

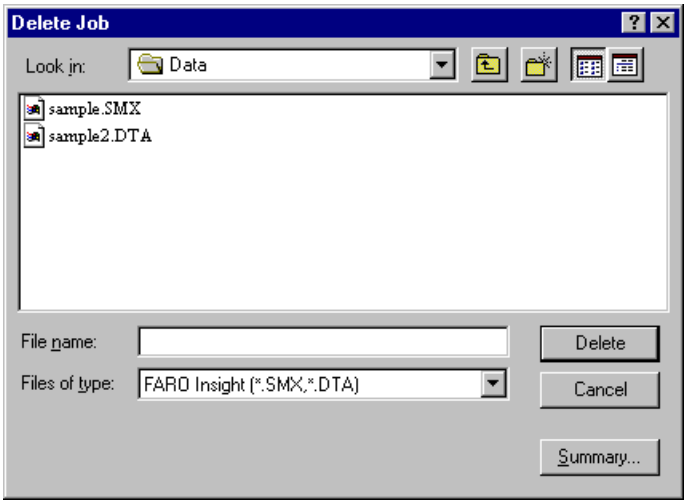
Warning: A file deleted in this manner is not sent to the Windows Recycle Bin and cannot be restored.

Deleting a job file

If you delete a job file, it is removed from the hard disk. If you simply want to clear the observations from a job, see to "*Clearing and Deleting Observations*" for more information.

1. From the File menu, choose Delete (Alt, F, L).

   FARO Insight displays the Delete Job dialog.



Delete Job dialog

2. To select the file to delete, you can double-click the name in the file name list, type the name in the file name box, or press the UP and DOWN arrow keys, to select the file name and press ENTER.
3. If the job you want to open is on another drive and/or directory, either choose the appropriate drive/directory, or type the complete path in the File Name box.
4. Click the 'Delete' button.
5. If you would like to see job specific information for a pre-existing job file without opening it, you can click the 'Summary' button. See the "File Summary" section in this chapter for more information on the 'Summary' button.

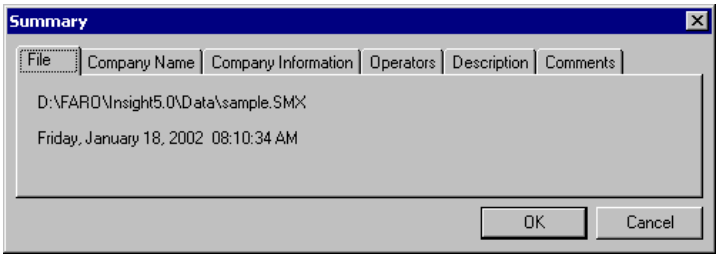
File Summary

The File Summary provides a way to maintain non-measurement information pertaining to the current job file such as filename, date, and operators. Also, a brief description of the job, comments, company name and company information can be entered. This information will appear on a report's coversheet and/or in the headers or footers of report pages.

To enter file summary information

1. From the File menu, select Summary… (Alt, F, M).

   FARO Insight displays the Summary dialog box.



Summary dialog

By default, the File tab will be active. This will display general job information that cannot be edited by the user. The time/date stamp will reflect the time in which the job was first created. If the user performs a 'Clear All' (see the section on "Clearing ALL Observations in a File" in the "FARO Insight Worksheets" chapter), all measured data will be erased and a new time/date stamp will be issued.

2. For the Company Name, Company Information, Operators, Description, and Comments tab, input the job information.
3. Click the 'OK' button when finished.

Job Templates

What are Templates?

Job files store not only recorded observations, but also all programming associated with each feature. The record of the features, their methods, and the functional relationships between features comprise a job template; the recorded observations are the data upon which the template operates.

For example, if you measure two lines using the StdScan method and then compute the angle between them, the job file contains a record of how the lines were measured (the method) and how the they were used to compute an angle (the function). This information remains in the job file even if the observations are removed. In fact, you can program the entire job without measuring a single feature.

This is a rather simple example, but the idea extends to other cases. If you perform a complex inspection, all the information necessary to execute the same inspection is stored in the job file. To repeat the inspection, all you must do is clear the observations and re-measure the necessary features. There is no need to re-program job. This ability saves time and ensures consistency between inspections.

Creating and Using Templates

There are two ways to create a job template: by programming the job file from scratch, or by clearing the observations from an existing job. It's not an either/or situation, however. You can always modify the original job file, or add features 'as you go.' Either way, you end up with a file that contains the necessary information.

Creating a template from scratch

The benefit to creating a template from scratch is that it forces you to think through the entire job, thereby reducing measurement time.

1. Define any methods and offsets that will be required.
2. Declare all of the fundamental geometric features - those which will be measured - and assign their methods.
3. If necessary, declare any Scalar entities such as distances and angles that are required in function definitions.
4. Declare the geometric features that will be evaluated from functions based on the fundamental geometric features.
5. Declare any Scalar entities that will be evaluated from functions based on the geometric features declared in step 4.

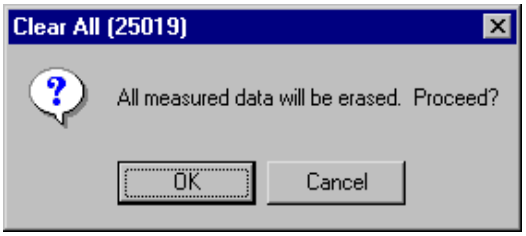
Steps 4 and 5 can be iterative, depending on the complexity of the template. The rule is that you must declare a feature before it can be used to define a function.

Creating a template from a job file

The easiest way to create a template is to clear the measured data from a job file you have already successfully executed. Using this approach, you edit the template 'as you go,' thereby working out any bugs in the inspection sequence.

1. Execute a measurement job as you normally would, by measuring and calculating all the necessary features.
2. Make a backup copy of the completed job. This is **very** important.
3. If you want to make the backup copy into a template, open the backup copy. Otherwise, leave the current job file open.
4. From the Edit menu choose Clear All (Alt, E, A).

   FARO Insight prompts you to verify your choice.



Clear all warning message

5. Press 'OK.'

   FARO Insight will clear all measurements from the current job.

Using a template

When you open a job based on a template, it is important that you work with a *copy* of the template, rather than the template file itself. If you forget to work on a copy, you can always create a template from the new file.

1. Open the template *upon which* you want to base the new job.
2. Save the template using the name of the new file.
3. Verify that the file name displayed in the FARO Insight title bar is correct. You are now ready to begin measuring.

The FARO Insight Interface

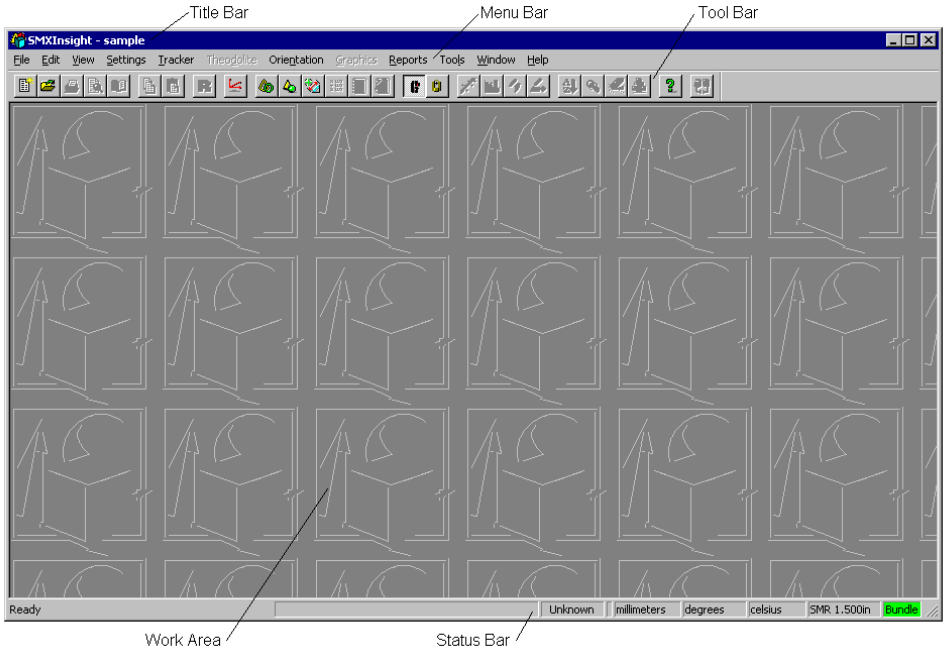
The FARO Insight Workplace

Overview

FARO Insight is a procedurally driven toolbox of functionality whose features are accessed through a spreadsheet interface. This section describes the elements of the FARO Insight interface: menus, toolbar buttons, worksheets and windows are all explained here, along with a description of how to operate them. A good understanding of the interface is essential for efficient and productive use of the software.

The FARO Insight Screen

The FARO Insight screen is comprised of the Title Bar, the Menu Bar, and the Work Area. The Title Bar displays the program name and the name of the current job file. The Menu Bar displays menu headings such as File, Edit, etc., and the Work Area contains the various worksheets and windows employed by the software. There are also a number of additional bars which may be displayed such as Toolbars, which display buttons that access the most common functions and features of FARO Insight, and the Status Bar which displays various information regarding the status of the software and the tracker.



FARO Insight Screen

FARO Insight Menus

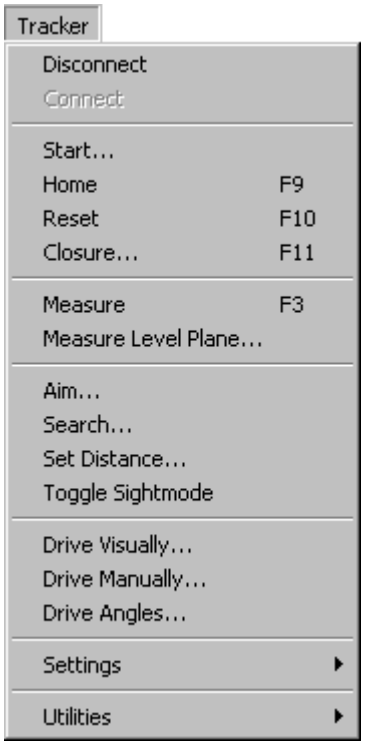
Overview

The menu provides access to all of the functions in FARO Insight (the tool bars provide access to the most common ones). Functionality is grouped into logical categories by heading - the File menu allows you to Open, Save, Print, etc., the Settings menu provides access to Units, Defaults, Status Bar, etc., and so on.

Menu Bar

Using the Menus

Some menu items carry out an action immediately, such as when you open a watch window; others (such as choosing Edit, Method) display a dialog that allows you to provide additional input.



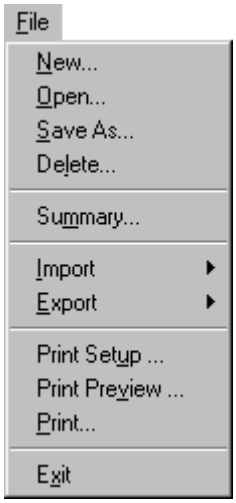
Example Menu

To choose a command using the mouse, click the name of a menu on the menu bar, then click the command name. To close a menu without choosing a command, click outside the menu.

To choose a command using the keyboard, press ALT to make the menu bar active, then press the key corresponding to the underlined letter in the command name. To close a menu without choosing a command, press ESC.

To choose a command using shortcut keys (not available for all commands), press the key or combination of keys listed next to that command on the menu. For example, you can press F3 to initiate a measurement.

File Menu

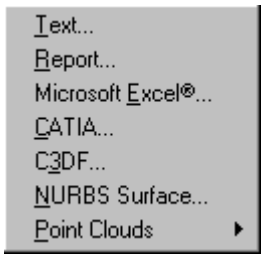


New…	Creates a new job file.
Open…	Opens an existing job file.
Save As…	Saves the current job under a new name.
Delete…	Deletes a job from disk.
Summary…	Describes the current job information.
Import	Imports an ASCII, IGES or CATIA file.
Export	Exports data to a file.
Print Setup…	Changes settings for the printer.
Print Preview…	Previews what is to be printed.
Print…	Prints to a printer.
Exit	Exits FARO Insight.

File - Import Menu

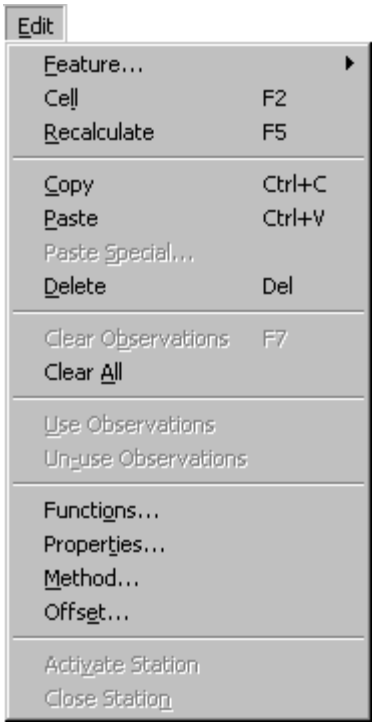
Standard…	Imports standard ASCII text files.
Enhanced…	Imports ASCII data and creates features.
IGES…	Imports an IGES formatted CAD model.
CATIA…	Imports CATIA *.MOD(EL) and *.EXP files.

File - Export Menu



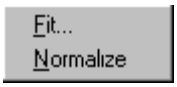
Text…	Exports selected cells to an ASCII text file.
Report…	Exports data in a Report window to an ASCII text file.
Microsoft Excel®…	Exports data in a Report window to Microsoft Excel.
CATIA…	Exports to a CATIA file.
C3DF…	Exports data to a C3DF report.
NURBS Surface…	Exports NURBS surfaces.
Point Clouds…	Export point cloud data as text or as an IGES file.

Edit Menu



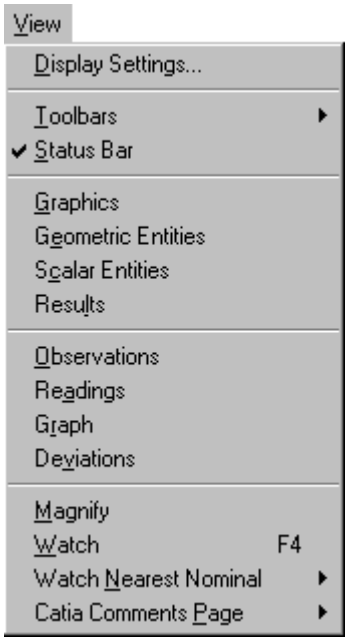
Feature…	Edits a feature fit or normalize a vector.
Cell	Edits the contents of a cell.
Recalculate	Recalculates the selected features.
Copy	Copies the contents of a worksheet cell.
Paste	Pastes the contents of a clipboard into a cell.
Paste Special	Pastes functions with absolute or relative references.
Delete	Deletes a record from the database.
Clear Observations	Clears a feature's observations.
Clear All	Clears all measured data from a job file.
Use Observations	Uses an un-used observation.
Un-use Observations	Un-uses a used observation.
Functions…	Opens the Functions dialog for the selected feature.
Properties…	Opens the Properties dialog for the selected feature.
Method…	Opens the Method Manager.
Offset…	Opens the Offset Manager.
Activate Station	Activates the currently selected Station.
Close Station	Closes the currently selected Station.

Edit - Feature Menu



Fit…	Opens the Fit Options dilaog for the selected feature.
Normalize	Normalizes the vector of the selected feature.

View Menu

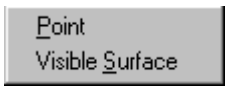


Display Settings…	Opens the Display Settings dialog box.
Toolbars	Opens menu to select toolbars for display.
Status Bar	Toggles on/off the Status Bar.
Graphics	Opens a Graphics window.
Geometric Entities	Opens a Geometric Entities window.
Scalar Entities	Opens a Scalar Entities window.
Results	Opens a Results window.
Observations	Opens an Observations window for the selected feature.
Readings	Opens a Readings window for the selected point.
Graph	Opens a graph for the selected column of data.
Deviations	Opens a Deviations window for a surface deviation.
Magnify	Opens a window on a selected worksheet column.
Watch	Opens a watch window on the selected feature.
Watch Nearest Nominal	Opens a watch window that goes to the closest nominal.
Catia Comments Page	Opens a menu to the comments page for imported CAITA files.

View - Toolbars Menu

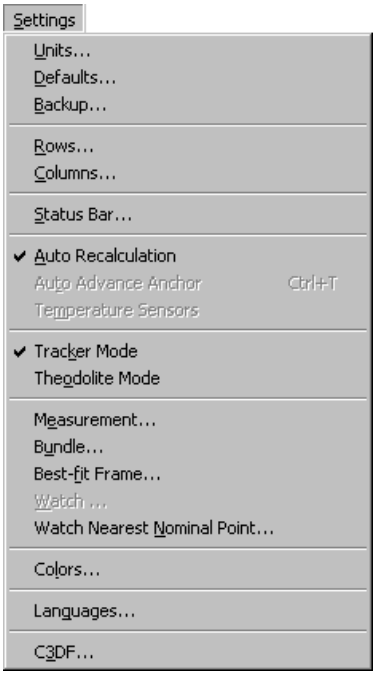
Standard	Displays the Standard toolbar.
Feature	Displays the Feature Generation toolbar.
Display Settings	Displays the Display Settings toolbar.
Orientation	Displays the Orientation toolbar.
Function	Displays the Function toolbar.
Tracker	Displays the Tracker toolbar.
Theodolite	Displays the Theodolite toolbar.
Target Acquisition	Displays the Target Acquisition toolbar.
Survey	Displays the ADM Survey toolbar.
Sensor	Displays the Temperature Sensor toolbar.
Graphics View	Displays the Graphics View toolbar.
Graphics Settings	Displays the Graphics Settings toolbar.
Graphics Active Feature	Displays the Graphics Active Feature toolbar.
Search	Displays the Search toolbar.
Large Buttons	Displays all toolbars in the large (32x32) format.

View – Watch Nearest Nominal Menu



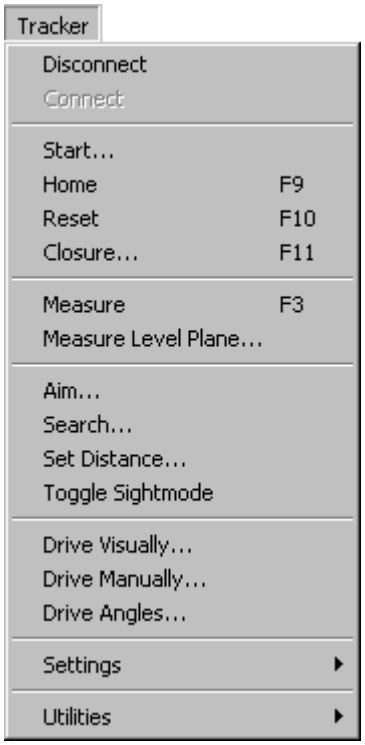
Point	Opens a watch window on the nearest nominal point.
Visible Surface	Opens a watch window on the nearest nominal surface.

Settings Menu



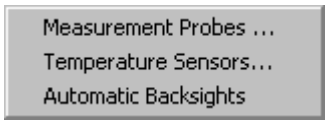
Units…	Opens the Numerical Format dialog box.
Defaults…	Opens the Default Properties dialog box.
Backup…	Opens the Backup Configuration dialog box.
Rows…	Opens the Sort dialog box for sorting rows.
Columns…	Opens the Spreadsheet Column Setup dialog box.
Status Bar…	Opens the Status Bar Options dialog box.
Auto Recalculation	Toggles on/off automatic recalculation.
Auto Advance Anchor	Toggles on/off the Auto Advance option.
Temperature Sensors	Toggles on/off the use of external temperature sensors.
Tracker Mode	Configures FARO Insight to operate laser trackers.
Theodolite Mode	Configures FARO Insight to operate theodolites.
Measurement…	Opens the Measurement Tolerance Settings dialog box.
Bundle…	Opens the Bundle Settings dialog box.
Best-fit Frame…	Opens the Best-fit Frame Settings dialog box.
Watch…	Opens the Watch Settings dialog box.
Watch Nearest Nominal Point…	Opens the Nearest Nominal Point Watch Settings dialog box.
Colors…	Opens the Color Settings dialog box.
Languages…	Opens the Multi Language Support dialog box.
C3DF…	Opens the C3DF File Headers dialog box.

Tracker Menu



Disconnect	Disconnects the FARO Insight from the Tracker.
Connect	Connects FARO Insight to the Tracker.
Start…	Performs a tracker wakeup.
Home	Resets the tracker at the tracker mounted reset nest.
Reset	Resets the tracker at the designated reset point.
Closure	Opens a Closer window to check interferometer repeatability.
Measure	Initiates a measurement of a selected geometric entity.
Measure Level Plane…	Measures the plane perpendicular to the gravity vector.
Aim…	Points the laser at a selected geometric entity.
Search…	Initiates a search pattern to acquire the target.
Set Distance…	Sets the radial distance to the target.
Toggle Sightmode	Toggles the sightmode between Frontsight and Backsight.
Drive Visually…	Allows the user to steer the Tracker using the mouse or arrow keys.
Drive Manually…	Allows the user to steer the Tracker by physically moving its head and activates the motors at the posed location.
Drive Angles…	Moves the Tracker head to specified azimuth and zenith angles.
Settings	Opens menu to adjust various tracker settings.
Utilities	Opens menu to run various tracker utilities.

Tracker - Settings Menu



Measurement Probes…	Opens the Probe Settings dialog box.
Temperature Sensors…	Opens the Remote Temperature Sensors dialog box.
Automatic Backsights	Toggles on/off automatic backsight measurements.

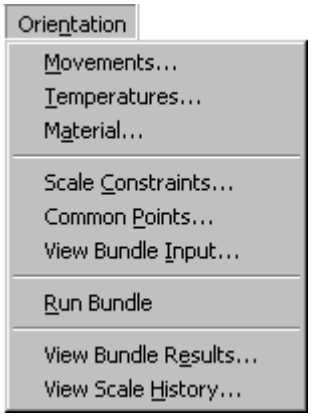
Tracker – Utilities Menu

Control Pad…	Opens the Tracker Control Pad.
Health Checks….	Opens the Tracker Health Checks.
Diagnostics…	Opens the Tracker Diagnostics.
Compensation…	Allows for compensation of the Tracker.

Theodolite Menu

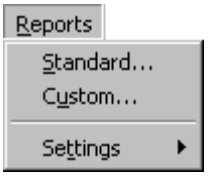
Disconnect	Disconnects from the Theodolite(s) if connected.
Connect	Connects to the Theodolite(s) not already connected.
Measure	Initiate measurement of point from synchronized Theodolites.
Build Mode	Enable/Disable Build Mode
Real Time	Enable/Disable Read Time Update
Name Settings…	Opens a dialog box to set the naming convention.
Target Thickness	Set Target Thickness

Orientation Menu



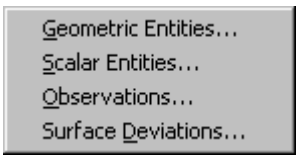
Movements…	Opens Object Movements dialog box.
Temperatures…	Opens the Object Temperatures dialog box.
Material…	Opens the Object Material dialog box.
Scale Constraints	Opens the Scale Constraints dialog box.
Common Points	Opens the Common Points dialog box.
View Bundle Input…	Opens the Bundle Input window.
Run Bundle	Initiates a bundle calculation.
View Bundle Results…	Opens a text file containing the job’s bundle results.
View Scale History…	Opens a text file containing the job’s scale history.

Reports Menu



Standard…	Opens the Standard Report dialog box.
Custom…	Opens the Custom Report dialog box.
Settings	Opens a menu to adjust report settings.

Reports - Settings Menu

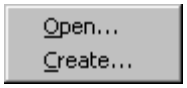


Geometric Entities…	Opens the Report Settings dialog box for Geometric Entities.
Scalar Entities…	Opens the Report Settings dialog box for Scalar Entities.
Observations…	Opens the Report Settings dialog box an Observations Window.
Surface Deviations…	Opens the Report Settings dialog box for a Deviations Window.

Tools Menu

Microsoft Excel® Macro…	Opens a user defined Microsoft Excel.
Seagate Crystal Reports®	Opens menu to either open or create a Seagate Crystal Report.
Layout…	Initiates the Layout Wizard.
Automated Survey	Opens menu to ADM surveys
Method/Offset Library…	Opens the Library Management dialog box.
Hardware Manager	Opens menu to start the Hardware Manager dialog for a specific tab

Tools – Seagate Crystal Reports®

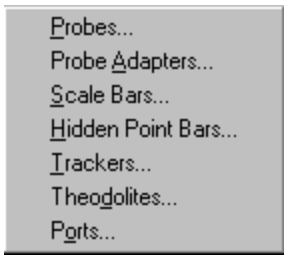


Open…	Opens a dialog used to open saved Seagate Crystal Reports.
Create…	Opens a dialog used to create new Seagate Crystal Reports.

Tools – Automated Survey Menu

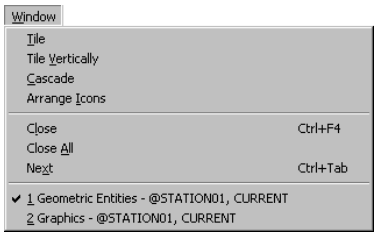
Build	Starts survey to build pre-selected points into position.
Inspect	Starts survey for a periodic inspection of pre-selected points.
Monitor	Starts survey to monitor drift of pre-selected points.
Settings	Opens the Survey Settings dialog box.

Tools – Hardware Manager Menu



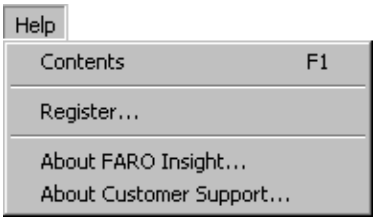
Probes...	Opens the Hardware Manager dialog box at the Probes tab.
Probe Adapters	Opens the Hardware Manager dialog box at the Probe Adapters tab.
Scale Bars…	Opens the Hardware Manager dialog box at the Scale Bars tab.
Hidden Point Bars…	Opens the Hardware Manager dialog box at the Point Bars tab.
Trackers…	Opens the Hardware Manager dialog box at the Trackers tab.
Theodolites…	Opens the Hardware Manager dialog box at the Theodolites tab.
Ports…	Opens the Hardware Manager dialog box at the Ports tab.

Window Menu



Tile	Tiles the open windows horizontally.
Tile Vertically	Tiles the open windows vertically.
Cascade	Cascades the open windows.
Arrange Icons	Arranges window icons in the work area.
Close	Closes the active window.
Close All	Closes all windows.
Next	Change focus to the next window
1 Geometric etc.	A list of all open windows appears at the bottom. A check indicates which window is active.

Help Menu



Contents	Opens the FARO Insight Help file.
Register…	Opens the Register FARO Insight dialog box.
About FARO Insight…	Displays information about FARO Insight.
About Customer Support	Displays information about FARO Customer Support.

FARO Insight Toolbars

Overview

The toolbars provide access to the most frequently used functions and features of FARO Insight. For example, the standard toolbar allows you to recalculate features, update the display, plot graphs, and open worksheets and windows.

To access the function, window, or dialog associated with any tool on the toolbar, clicks the appropriate button. The following is a brief description of each of the buttons on the toolbars. These tools are also explained at length in later sections of this manual.

Note: Toolbars can be dragged to any convenient location on the screen as well as docked on the left or right side or top or bottom of FARO Insight. “Tool Tips” are also displayed when the mouse cursor is placed over toolbar icon.

The Standard Toolbar

Standard Toolbar

Create New Job Button — Creates a new job.

Open an Existing Job Button — Opens a job previously created in FARO Insight.

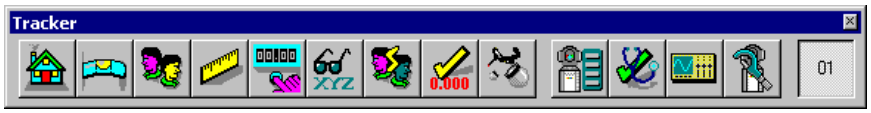
Print Button — Print selected data to a printer.

Print Preview Button — Opens a preview window displaying what will be printed.

	**Print Setup Button**	Opens a dialog to adjust printer settings.
	**Copy to Clipboard Button**	Copies selected (highlighted) items to the clipboard.
	**Paste from Clipboard Button**	Pastes items from the clipboard into FARO Insight.
	**Graphics Window Button**	Open the Graphics View Window. See *"Graphics View"* for more information. (available in *Visual*)
	**Geometric Entities Button**	Open the Geometric Entities worksheet. See *"Geometric Entities Worksheet"* for more information.
	**Scalar Entities Button**	Open the Scalar Entities worksheet. See *"Scalar Entities Worksheet"* for more information.
	**Results Window Button**	Opens the Results Window.
	**Standard Report Button**	Opens the Standard Report dialog box.
	**Custom Report Button**	Opens the Custom Report dialog box.
	**Tracker Mode Button**	Activates the tracker measurement mode.
	**Theodolite Mode Button**	Activates the theodolite measurement mode.
	**Observations Button**	View observation(s) of selected geometric entity.
	**Graph Button**	Plot a graph of a set of values such as residual errors. See *"Graph Windows"* for more information.
	**Edit Functions Button**	Opens the Function Editor. See *"Intuitive Function Definition"* for more information.
	**Edit Properties Button**	Opens the Feature Properties Page. See *"Features Display Options"* in *"Graphics View Window"* for more information. (available in *Visual*)
	**Sort Button**	Sort the records in the Geometric or Scalar Entities worksheets. See *"Sorting Rows"* for more information.

Magnify Button	Open a magnified window on a worksheet cell. See "*Magnify Windows*" for more information.
Clear Observations Button	Clears observation(s) of selected geometric entity.
Auto Advance Button	Switches between automatic and manual advancing after measurements.
About FARO Insight Button	Gives the version FARO Insight.
Connect Button	Connects to the tracker. See *"Connecting to the Tracker"* for more information.
Disconnect Button	Disconnects from the tracker. This button is available only when logged in to the tracker. See *"Disconnecting from the Tracker"* for more information.

The Tracker Toolbar



Tracker Toolbar

Home Button	Resets the laser beam at the home location.
Measure Level Button	Measures gravity vector using the trackers level sensor.
Toggle Sight Button	Toggles the sight mode from front sight to back sight.
Measure Button	Measures selected geometric entity.
Go To Reset Button	Resets the laser beam at the programmed location.
Watch Window Button	Opens the watch window for the selected feature. See *"Other Windows"* in *"FARO Insight Worksheets"* for more information.
Automatic Backsight Button	Enables / disables automatic backsight capability.

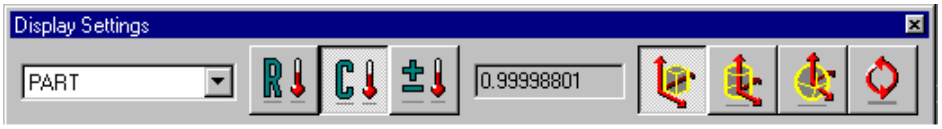
Check Closure Button	Checks laser interferometer closure.
Measurement Probes Settings	Opens the Measurement Probe Settings Dialog.
Control Pad	Opens the Tracker Control Pad.
Health Checks	Initiates the Health Checks.
Diagnostics	Performs Tracker Diagnostics.
Compensations	Performs Tracker Compensations

Feature Toolbar

Feature Create Toolbar

Select Feature Type Dropdown List	Select Type of feature to be created.
Actual/Nominal List	Select data set feature will be created in (Actual, Nominal, or both)
Proposed Name Field	Edit the name of proposed feature.
Quantity Spinner Control	Select number of features to be created.
Method List	Select measurement method to be assigned to the proposed feature(s). This field changes to allow the user to select the assigned instrument when creating new stations.
Set Properties Button	Edit feature properties.
Create Feature Button	Create feature(s) in worksheet.
Function Toolbar Button	Show/Hide the creator Function Toolbar.

Display Settings



Display Settings Toolbar

	**Select Frame**	Select Name of View Frame.
	**Reference Condition Button**	Selects Reference Condition
	**Current Condition Button**	Selects Current Condition.
	**Custom Condition Button**	Opens Display Settings Dialog to select custom condition, temperature or scale.
 0.99998801	**Scale**	Shows display scale.
	**Rectangular Coordinate System Button**	Selects Rectangular Coordinate System.
	**Cylindrical Coordinate System Button**	Selects Cylindrical Coordinate System.
	**Spherical Coordinate System Button**	Selects Spherical Coordinate System.
	**Synchronize Windows**	Synchronizes windows.

Orientation Toolbar

Orientation Toolbar

	**Object Material Button**	Specify the material (for scaling purposes) associated with each Object. See *"Object Temperature and CTE"* under *"Scale, Objects, and Movement…Scaling"* for more information.

Object Temperature Button	Input the object temperature. See *"Object Temperature and CTE"* for more information.
Object Movement Button	Declare and compensate for Part object movement. See *"Movement and Relocation"* for more information.
Scale Constraints Button	Selects scale bar constraints.
Bundle Input Button	Shows Bundle Input Window.
Run Bundle Button	Runs the Bundle calculation.
3D Best Fit Frame Button	Create a 3D Best-Fit PART frame. See *"3D Best Fit"* for more information. (available in *Visual*Pro)
Best-fit to Reference File Button	Create a Best-Fit PART frame to a Reference file. See *" Best-fit Frame to a Reference File"* for more information.
Best-fit Frame Button	Create a Best-Fit PART frame. See *" Best-fit Frame"* for more information.

Target Acquisition

Target Acquisition Toolbar

Search Button	Searches for target.
Aim Button	Aims laser at the selected geometric entity.
Set Distance Button	Sets the distance along the laser beam path.
Drive Visually	Allows the Tracker to be aimed at a location using the mouse and arrow keys.
Drive Manually	Allows the Tracker to be aimed at a location by manually turning the Trackers aperture.

Drive Angles Allows the Tracker to be aimed to specific Azimuth and Zenith angles.

The Search Toolbar

Search Toolbar

Search Up Button Searches upward in the Geometric Entities Worksheet to match the character string entered into the field with a feature name.

Search Down Button Searches downward in the Geometric Entities Worksheet to match the character string entered into the field with a feature name.

The Sensor Toolbar

Sensor Toolbar

Air Set Button Establishes air sensor set points.

Material Set Button Establishes material sensor set points.

Sensor Properties Button Establishes remote temperature sensor properties.

The Survey Toolbar (ADM Tracker only)

The Survey Toolbar

Toolbuilder Button Use ADM to build a pre-selected set of points into position.

Periodic Inspection Button	Use ADM for periodic inspection of pre-selected points.
Drift Monitor Button	Use ADM to monitor drift of pre-selected points.
Survey Settings Button	Define settings for automated survey.
Pause Survey Button	Pause the automated survey.
Terminate Survey Button	End the automated survey.

Function toolbars

Circle

Circle Function Toolbar

Reference Circle Button	Create a circle from another circle or cylinder.
Constructed Circle Button	Create a circle from a Point, Vector and calculated distance.
Circle from Features Button	Creates a circle from a list of specific features.

Cone

Cone Function Toolbar

Reference Cone Button	Create a cone from another cone.
Constructed Cone Button	Create a cone from a Vector, Angle, Small Radius and Large Radius.

Cylinder

Cylinder Function Toolbar

Reference Cylinder Button — Create a cylinder from another cylinder or circle.

Cylinder from Features Button — Creates a cylinder from a list of specific features.

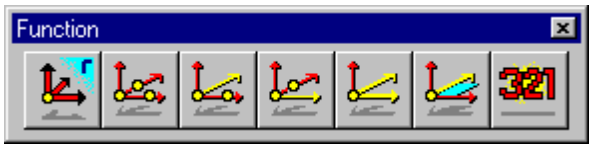
Ellipsoid

Ellipsoid Function Toolbar

Reference Ellipsoid Button — Create an ellipsoid from another ellipsoid.

Constructed Ellipsoid Button — Creates an ellipsoid from a Vector, Major Axis and a Minor Axis.

Frame



Frame Function Toolbar

Reference Frame Button — Create a frame from another frame.

Frame OPP Button — Create a frame using the Origin, Point, Point function.

Frame OPV Button — Create a frame using the Origin, Point, Vector function.

Frame OVP Button — Create a frame using the Origin, Vector, Point function.

Frame OVV Button Create a frame using the Origin, Vector, and Vector function.

Frame PLP Button Create a frame using the Plane, Line, Point function.

Frame 321 Button Create a frame using the 3-2-1 Points function.

Hyperboloid

Hyperboloid Function Toolbar

Reference Hyperboloid Button Create a hyperboloid from another hyperboloid.

Constructed Hyperboloid Button Creates a hyperboloid from a Vector, Transverse Axis and a Conjugate Axis.

Line

Line Function Toolbar

Reference Line Button Create a line from another features vector.

Line from Two Points Button Create a line using two points.

Line between Two Lines Button Create a line between two other features vectors.

Line from Point and Vector Button Create a line from a Point and a Vector.

Intersect Plane-Plane Button Create a line from the intersection of two planes.

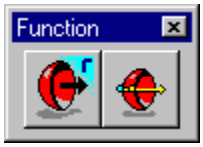
Line from Features Button — Creates a line from a list of specific features.

Nurbs Surface

Nurbs Surface Function Toolbar

Reference Nurbs Surface Button — Create a Nurbs Surface from another Nurbs Surface.

Paraboloid



Paraboloid Function Toolbar

Reference Paraboloid Button — Create a paraboloid from another paraboloid.

Constructed Paraboloid Button — Create a paraboloid from a Vector, and two measured distances. The first as the Focal length, the second as the Eccentricity.

Patch

Patch Function Toolbar

Reference Patch Button — Create a patch from another patch.

Plane

Plane Function Toolbar

Reference Plane Button	Create a plane from a Plane, Line, Plane or Circle.
Plane from Three Points Button	Create a plane from three points.
Plane between Two Planes Button	Create a plane between two other planes.
Plane from Point and Vector Button	Create a plane by defining its centroid and its normal vector.
Plane from Features Button	Creates a plane from a list of specific features.

Point

Point Function Toolbar

Reference Point Button	Create a point from another feature.
Intersect Point-Line Button	Create a point by intersecting a vector and a point.
Intersect Point-Paraboloid Button	Create a point by intersecting a paraboloid and a point.
Intersect Point-Patch Button	Create a point by intersecting a point and a patch.
Intersect Point-Sphere Button	Create a point by intersecting a point and sphere.
Intersect Point-Plane Button	Create a point by intersecting a point and a plane.
Intersect Line-Line Button	Create a point by intersecting two lines.
Intersect Line-Plane Button	Create a point by intersecting a line and a plane.
Intersect Line-Patch Button	Create a point by intersecting a line and a patch.

Intersect Point-Point Button	Create a point by intersecting two points.
Intersect Line-Cylinder Button	Create a point by intersecting a line and a cylinder.
Hidden Point by Reference Button	Create a point on a Hidden Point Bar by defining two points and defining a calculated distance.
Hidden Point by Value Button	Create a point on a Hidden Point Bar by defining two points and entering a distance.
Hidden Point Button	Creates a point from a hidden point bar function based on a specified bar.
Intersect Point-Surface Button	Creates a point by intersecting a point and a surface.

Point Cloud

Point Cloud Function Toolbar

Intersect Point Cloud-Plane Button	Create a point cloud by Intersecting a point cloud to a plane.
Point Cloud from Features Button	Creates a point cloud from a list of specific features.

Sphere

Sphere Function Toolbar

Reference Sphere Button	Create a sphere from another sphere.
Sphere from Features Button	Creates a sphere from a list of specific features.

Surface Deviation (available in VisualPro)

Surface Deviation Function Toolbar

3D Calculate Deviation Button	Create a surface deviation between a point cloud and a surface.

CAD Generated Surfaces (Tabulated, Revolution, Ruled and Spline Surface)

Surface Function Toolbar

Reference Surface Button	Create a CAD generated surface from another CAD generated surface.

Graphics View Toolbar (available in Visual)

Graphics View Toolbar

Select Feature Type Dropdown List	Select Type of feature to be displayed in the Graphics View.
Actual/Nominal List	Select data set that will be displayed (Actual, Nominal, or All).
Zoom In	Zoom in on the Graphics View by a factor of 2.
Zoom Out	Zoom out on the Graphics View by a factor of 2.
Zoom Box	Manually select an area in the Graphics View to zoom in on.
Zoom All	Adjusts the Graphics View so that all features are displayed.

Top View	Adjust the Graphics View so that you are looking down the +Z axis.
Bottom View	Adjust the Graphics View so that you are looking down the -Z axis.
Front View	Adjust the Graphics View so that you are looking down the +X axis.
Back View	Adjust the Graphics View so that you are looking down the -X axis.
Left View	Adjust the Graphics View so that you are looking down the -Y axis.
Right View	Adjust the Graphics View so that you are looking down the +Y axis.
Isometric View	Adjust the Graphics View so that all positive axes are towards you.
Magnify Deviations	Increase the scale of the deviations.
Demagnify Deviations	Decrease the scale of the deviations.
Toggle Surface Shading	Display the shading of a surface.

Graphics Settings Toolbar (available in Visual)

Graphics Settings Toolbar

World Center Rotation	Set the mouse control in the Graphics View to rotate about the center of the display.
Active Feature Center Rotation	Set the mouse control in the Graphics View to rotate about the active feature.
Deviation Spikes	Set the display of deviations in the Graphics View to Spikes.

	**Deviation Connected Points**	Set the display of deviations in the Graphics View to Connected Points.
	**Deviation Spikes & Connected Points**	Set the display of deviations in the Graphics View to Spikes and Connected Points.
	**Increase Smoothness**	Increase the display smoothness of features in the Graphics View.
	**Decrease Smoothness**	Decrease the display smoothness of features in the Graphics View.
	**Modify by Polygon Select**	Modify observations or a Point Cloud in the Graphics View using Polygon Select.

Graphics Active Feature Toolbar (available in Visual)

Graphics Active Feature Toolbar

	**Show Deviations**	Display the deviations of a calculated feature and its nominal or observations.
	**Show Deviation Statistics**	Display the statistics between features and its nominal or observations.
	**Show Observations**	Display the observations of a measured feature.
	**Show Normal**	Display the direction of a features normal vector.
	**Flip Normal**	Assigns the Flip Normal function to the active surface.

The Status Bar

Overview

Status Bar

The status bar displays messages and information that helps you while using FARO Insight. It can be broken up into three sections, Help Messages, Operational Messages, and Options. The Help Messages section will display a description of whatever menu item you have highlighted or toolbar button you have the mouse pointer over. It displays “Ready” when there is no help text to be displayed.

The Operational Messages section will display a description of whatever action FARO Insight is performing or has just completed. You can see if FARO Insight is recalculating, if any errors were encountered during the calculation, or the name of the feature you have just activated.

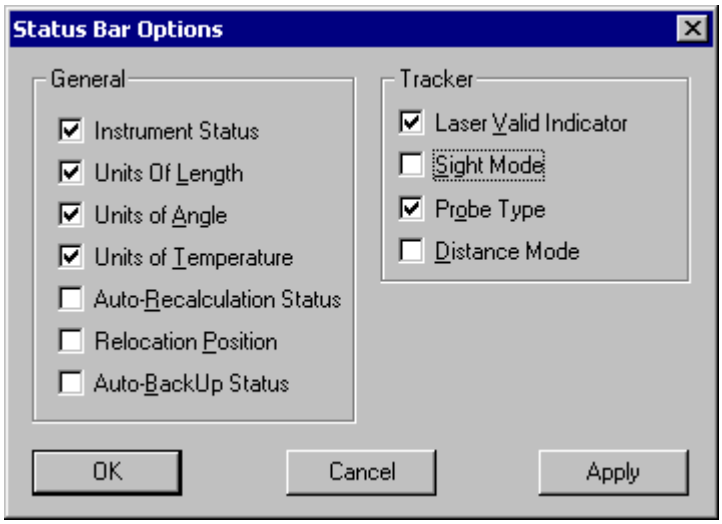
The Options section will display any additional information that you choose to show. Here, you can display the sight mode, the units of length, angle or temperature you are working in, whether auto-recalculation is on or off, the relocation position, or other options. You can also show the laser status, which indicates whether the laser beam has been broken.

Customizing the Status Bar

The Options section of the Status Bar can be customized in the following manner:

1. From the Settings menu, choose Status Bar (Alt, S, S).

   FARO Insight displays the Status Bar Options dialog.



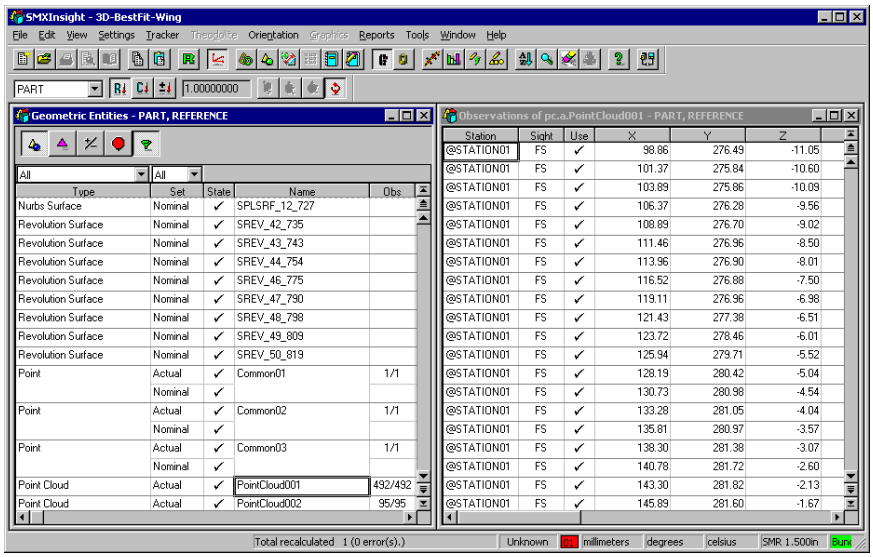
Status Bar Options Dialog

2. To add an option, click in its box. A check mark will appear. To remove an option, click once more in its box. The check mark will disappear.
3. When you have selected the desired options, press the ‘Apply’ button.
4. When finished, click the ‘OK’ button.

The Work Area

The remainder of the FARO Insight program window, between the toolbars and the Status Bar, comprises the Work Area. The Work Area displays the worksheets, views, windows, and dialogs through which FARO Insight accepts user input. When

the user opens the Gents and the Sents worksheets, they are displayed in the work area. Likewise, watch windows, magnified cells, and graph plots are all windows that FARO Insight displays in its work area.



Observation window tiled with the Gents sheet in the work area

The commands in the Window menu allow you to control the layout and arrangement of the work area. You can open, close, tile, cascade, minimize, and maximize windows and worksheets in order to arrange the work are in the most effective format for the current job.

Tiling and cascading windows

Tiling refers to the placement of a group of windows so they lie next to one another. This arrangement is convenient when you want to open a number of watch windows in order to build a tool. When tiling, you have the option of tiling either vertically, or horizontally. Tiled windows tend to be small since they share the screen with other windows.

Cascading refers to an arrangement whereby the windows are overlapped so that only one is completely visible, but it occupies more of the screen than if the same number of windows were tiled.

You can tile or cascade a series of windows in the following manner:

1. Open whichever windows you want to arrange. Do not minimize them, however; minimized windows are not automatically restored when the work area is tiled or cascaded.
2. From the Window menu, choose Tile (Alt, W, T) to tile the windows horizontally. Choose Tile Vertically (Alt, W, V) to tile the windows vertically. Choose Cascade (Alt, W, C) to cascade the windows.

Closing, minimizing and restoring windows

You can close, minimize and restore windows as required to arrange the necessary information on the screen.

- To minimize a window, click its control menu in the upper left-hand corner, and select Minimize.

- To restore a minimized window, click on it once and select Restore, or double-click on it.
- To close the active window, go to the Window menu item, choose Close (Alt, W, L), or double-click in its control menu.
- To close all windows in the work area, go to the Window menu, choose Close All (Alt, W, A).

Moving and resizing windows

You can move and resize windows to get the most effective use of the screen.

- To resize a window, grab one of its borders with the mouse pointer, hold down the left mouse button, and drag to the desired size. Grab the corner of the window to resize it both vertically and horizontally.
- To move a window, hold the mouse pointer over its title bar, hold down the left mouse button and drag it to its new position.

Viewing Data

FARO Insight allows you to view your data in many different ways at any time in a job. This section describes ways of adjusting viewing conditions such as changing units, setting the frame or, coordinate system, in which you see your data, and controlling calculation. Setting these controls correctly will ensure that you view meaningful results.

Units and Display Resolution

FARO Insight stores all data internally in S.I. units: meters, radians, C, and mmHG. You can, however, display data in many units of measure such as inches, decimal degrees, F, and inHg. You can also select the total number of display digits and the number of places after the decimal.

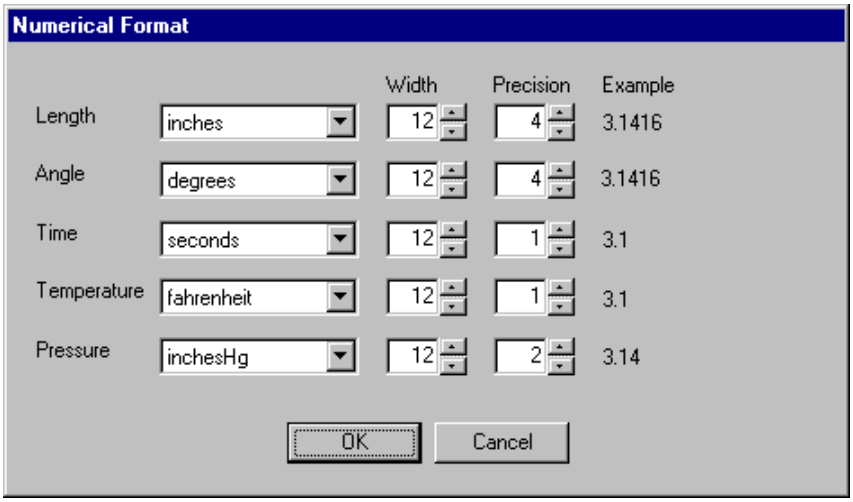
There is no loss in accuracy when switching between units. However, you should be careful to maintain an appropriate resolution when importing and exporting in ASCII format.

Changing units and resolution

FARO Insight automatically selects the number of places after the decimal when you change units. You can override this setting if you want more or less resolution.

1. From the Settings menu, choose Units (Alt, S, U).

   FARO Insight displays the Numerical Format dialog.



Numerical Format Dialog

2. For each of the measured values – Length, Angle, Time, Temperature, and Pressure – select the desired units from the drop down box.
3. Under Precision, select the number of places after the decimal for each type of measure.
4. Under Width, select the total number of display digits for each type of measure.
5. Press the 'OK' button. FARO Insight will update the display.

Condition and Display Frame

The Condition and Display Frame controls how feature values, such as position and orientation, are resolved when displayed in a worksheet. Condition refers to the scale of the feature; Current condition is the actual scale of the feature as it currently exists; Reference condition is the scale of the feature at reference temperature (20 C).

The Display Frame controls the coordinate reference frame or station in which the features are resolved. You can select the display frame to be any frame or station that has been defined. You can always select the station @STATION01 or PART frame because they exist by default. You must define any other frame or station before attempting to select it as the view frame.

When you import data, it is necessary to set the condition and display frame to match the condition and frame of the data you are importing; otherwise FARO Insight will incorrectly convert the data as it is imported. See *"Scale, Objects, and Movement"* for more information.

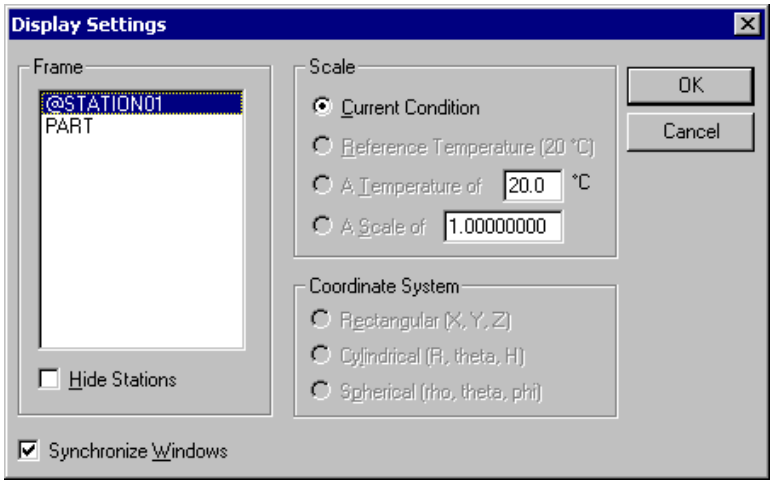
Setting the condition and display frame

The condition and display frame can quickly be selected using the Display Settings toolbar. Any frame or station can be selected from the toolbar's Select Frame list. The condition can be quickly changed from Current to Reference using the Current and Reference Condition buttons on the toolbar. Other conditions must be selected using the Custom button to open the Display Settings dialog.

To use the Display Settings dialog to set the condition and display frame, do the following:

1. From the View Menu, choose Display Settings (Alt, V, D) or click on the Custom button, , on the Display Settings toolbar.

   FARO Insight displays the Display Settings dialog.



Display Settings Dialog

2. To change the Display Frame, select the desired frame.
3. To change the Condition, do one of the following
   - To display all objects at Reference condition (20 C, or 68 F), choose *Reference Temperature*.
   - To display all objects at a particular temperature, select *degC* (degF if you are working in Fahrenheit) and enter the desired temperature. Note: You must also specify the object material. Refer to *"Scale, Objects, and Movement"* for more information.
   - To display all objects at a particular scale, choose *A Scale of* and enter the desired scale.
   - To display each object at its current condition, or current scale, choose *Current Condition*.
4. Press 'OK' when you are done.

Note: The Coordinate System options are available when the Display Settings dialog is accesses while importing data, using a Watch Window or viewing a Results window.

Controlling Calculation

FARO Insight automatically handles the calculations that are performed on features, such as fitting observations to a geometric shape. There are two different ways FARO Insight can handle the recalculation of features that are dependent upon others: with or without the use of the automatic recalculation feature. Although the end result of each calculation is exactly the same, you may choose not to use the auto recalculation feature to save time.

Automatic Recalculation

When you measure a feature, FARO Insight automatically calculates the feature fit and updates the display *for that feature*. For example, when you measure a point, FARO Insight calculates the centroid of the set of observations and displays the calculated X, Y, and Z values in the Gents worksheet. Anytime you subsequently modify its observations, or apply a function to it; FARO Insight will automatically recalculate the point.

If the auto recalculation feature is activated, recalculation is hierarchical and accomplished immediately following any change in the worksheet. FARO Insight uses a dependency tree to recalculate the worksheet starting with the changed feature affected, in hierarchical order, all features dependent upon the changed feature. When auto recalculation is activated, you do not need to recalculate the worksheet after any change.

For example, consider the following situation. You measure three tooling balls as spheres, declare three points that reference the centers of the spheres, and use the three points to define a best-fit frame. You then decide to constrain the spheres to a fixed radius. To properly calculate the frame, FARO Insight will automatically recalculate the spheres, then the points that are dependent on the spheres, and finally the best-fit frame.

Manual Recalculation

Auto recalculation, when activated, will react to any change in the Gents or Sents worksheets. The resulting calculations could be time consuming if the changing feature affects many other features. In order to save time, you may want to deactivate the auto recalculation feature and initiate recalculations manually.

To deactivate auto recalculation, from the Settings menu, choose Auto Recalculation (Alt, S, A). If a check appears next to Auto Recalculation, the feature is active. When deactivated, the check will not be visible.

If auto recalculation is deactivated and a change is made to a feature, that feature will still automatically recalculate with each change, but dependent features will not change. When you want to enact the resulting changes on the dependent features, from the Edit menu, choose Recalculate (Alt, E, R) or press the F5 key. If numerous changes have been made without a recalculation, all necessary recalculations will be made when the recalculation is initiated.

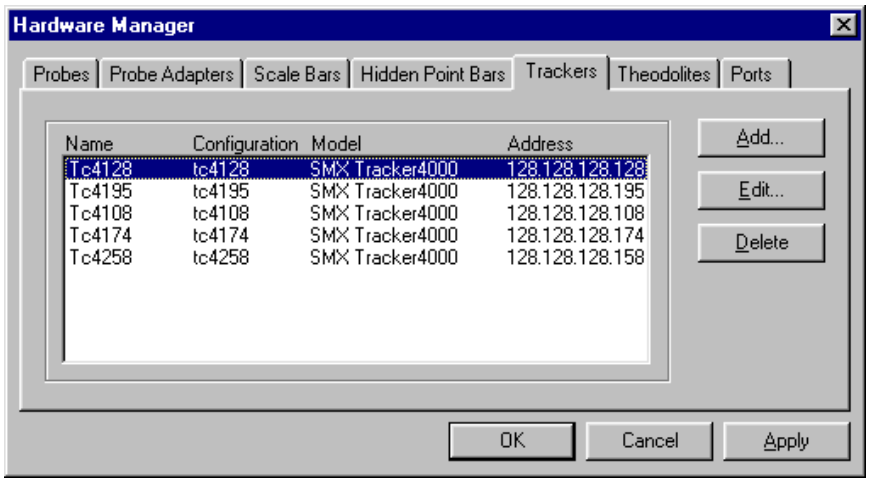
Hardware Manager

Hardware Manager Basics

The Hardware Manager is a group of dialogs that organize and maintain specified hardware for use within a FARO Insight job. This dialog can be accessed from the Tools Menu and then by selecting a particular type of hardware. The dialog arranges each type of hardware into its own location where they can be added, deleted, or modified.

The types of hardware found in this interface are Probes, Probe Adapters, Scale Bars, Hidden Point Bars, Trackers, and Theodolites. Some jobs may require the use of only a few items, or it is possible to need to use many of the same type of hardware within a particular job.

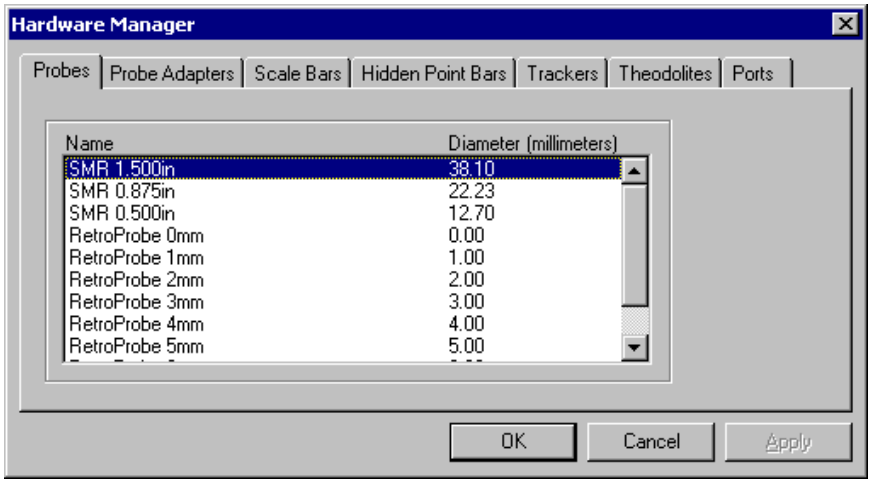
The Hardware Manager dialog lists all of the items within a particular category in the window portion of the dialog. The name of the item, along with some key information is listed here, so the user can easily locate which piece of hardware they are looking for. All of the information within the Hardware Manager is stored in a file called Hardware.ini, which is located within the main FARO Insight directory.



Hardware Manager Dialog (Tracker Tab Open)

Probes

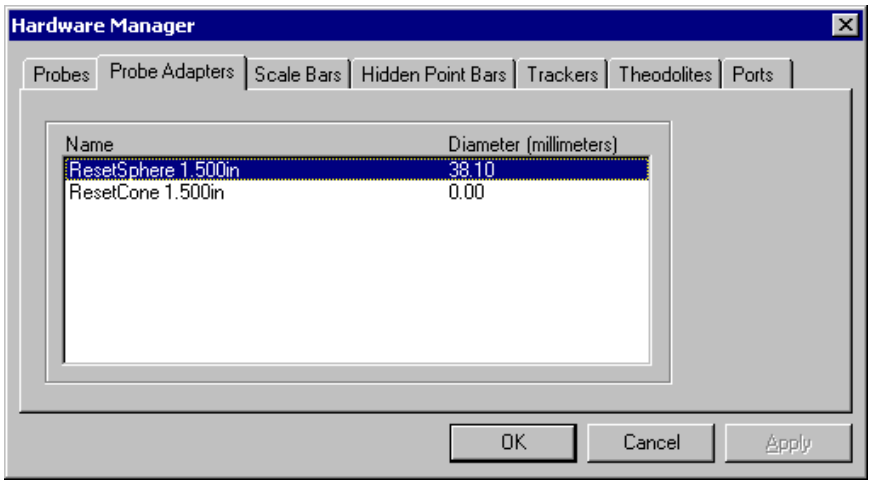
The Probes tab in the Hardware Manager dialog maintains the measurement probes that can be used within FARO Insight. It will contain a list of default probes. The dialog will list all of the probes available, along with their diameters given in the currently set units.



Probes Tab of Hardware Manager Dialog

Probe Adapters

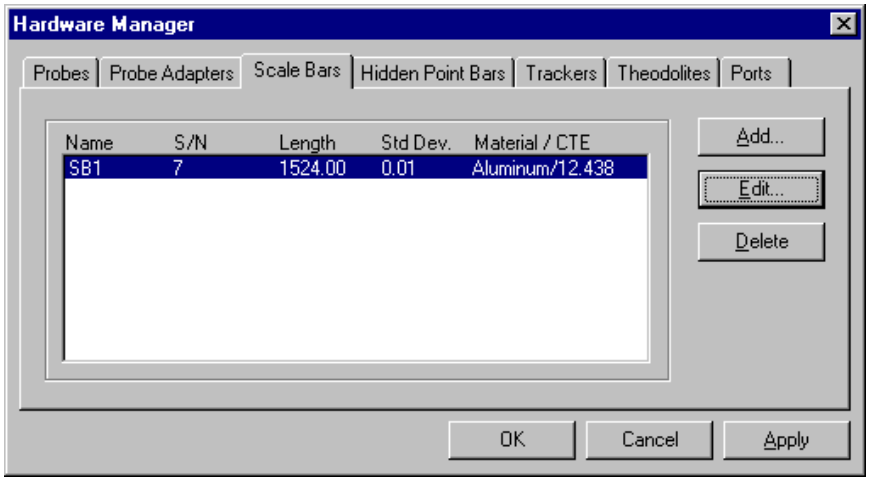
The Probe Adapters tab in the Hardware Manager dialog maintains the probe adapters that can be used within FARO Insight. It will contain a list of default probe adapters. The dialog will list all of the adapters available, along with their diameters given in the currently set units.



Probe Adapters Tab of Hardware Manager Dialog

Scale Bars

The Scale Bars tab in the Hardware Manager dialog maintains the bars of known length that can be used within FARO Insight for theodolite measurements. (For use within a Scale Constraint.) Initially, there will be no bars within this portion of the Hardware Manager. The dialog will list all of the bars available, along with their Serial Number, Length, Standard Deviation, Material, and CTE. (All items are displayed in the currently set units.)



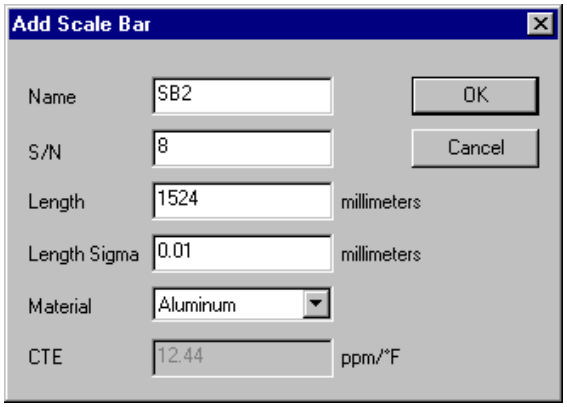
Scale Bars Tab of Hardware Manager Dialog

Adding a New Scale Bar

New scale bars will need to be added initially to FARO Insight. Others can be entered later when needed. Each bar will need an exclusive name and associated values for its properties.

1. From the Scale Bars Tab of the Hardware Manager (Alt, L, H, S), choose Add (Alt A).

   FARO Insight displays the Add Scale Bar dialog.



   Add Scale Bar Dialog

2. Enter a name for the bar that is to be added.
3. Enter the serial number of the scale bar.
4. Enter the known length of the scale bar.
5. Enter the known Standard Deviation of the scale bar.
6. Choose the Material of the scale bar. (The CTE will be displayed automatically, based on given materials.)
7. Press the ‘OK’ button.

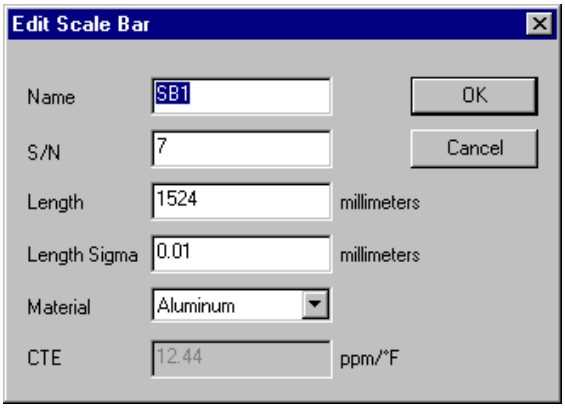
   FARO Insight will then add the bar to the list of Scale Bars that are available to be used in a job.

Editing a Scale Bar

There is a chance that the user may want to edit the name or other properties of an already existing bar, without having to delete the existing one and re-create it. Doing so will update the Hardware Manager and any references to it within the active job file.

1. Open the Scale Bars Tab of the Hardware Manager (Alt, L, H, S).
2. Select the scale bar from the list that is to be updated and choose Edit (Alt E).

   FARO Insight displays the Edit Scale Bar dialog.



Edit Scale Bar Dialog

3. Change the desired properties for the scale bar to their new values.
4. Press the OK button.

   FARO Insight will then update the existing scale bar specifications to the new ones just entered.

Deleting a Scale Bar

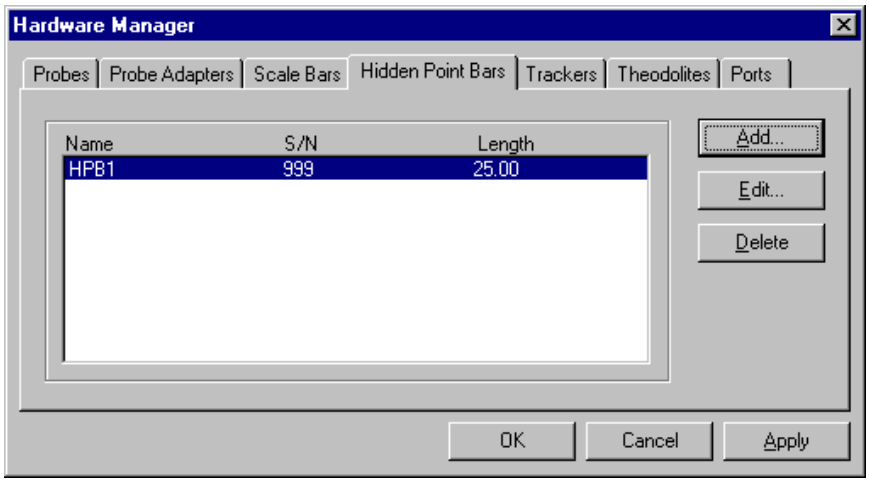
Scale bars may get replaced or never used, so the user may want to remove these from the list of bars to keep a more concise list of those that would be used. By using the delete option, the user can remove any of the existing bars from the Hardware Manager.

1. Open the Scale Bars Tab of the Hardware Manager (Alt, L, H, S).
2. Select the Scale Bar from the list that is to be removed and choose Delete (Alt D).
3. FARO Insight will remove the bar from the list of available scale bars.

Hidden Point Bars

The Hidden Point Bars tab in the Hardware Manager dialog maintains the hidden point bars of known length that can be used within FARO Insight. Initially, there will be no bars within this portion of the Hardware Manager. The dialog will list all

of the bars available, along with their Serial Number and Length (displayed in the currently set units).



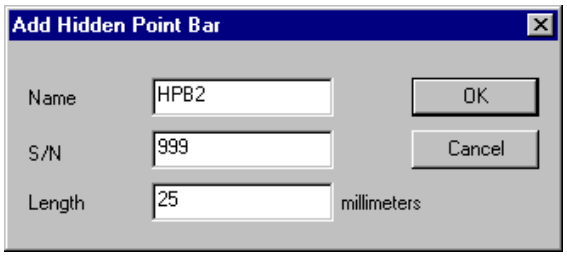
Hidden Point Bars Tab of Hardware Manager Dialog

Adding a New Hidden Point Bar

New hidden point bars will need to be added initially to FARO Insight. Others can be entered later when needed. Each bar will need an exclusive name with an associated serial number and length.

1. From the Hidden Point Bars Tab of the Hardware Manager (Alt, L, H, H), choose Add (Alt A).

   FARO Insight displays the Add Hidden Point Bar dialog.

   Add Hidden Point Bar Dialog

2. Enter a name for the bar that is to be added.
3. Enter the serial number of the hidden point bar.
4. Enter the known length of the hidden point bar.
5. Press the OK button.

   FARO Insight will then add the bar to the list of Hidden Point Bars that are available to be used in a job.

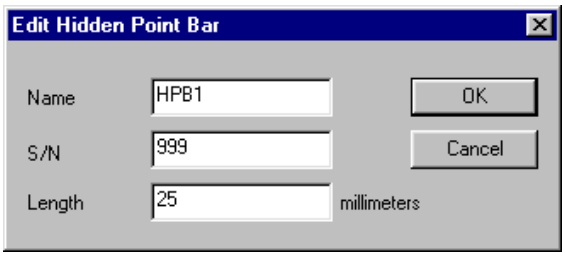
Editing a Hidden Point Bar

There is a chance that the user may want to edit the name or other properties of an already existing bar, without having to delete the existing one and re-create it. Doing

so will update the Hardware Manager and any references to it within the active job file.

1. Open the Hidden Point Bars Tab of the Hardware Manager (Alt, L, H, H).
2. Select the hidden point bar from the list that is to be updated and choose Edit (Alt E).

   FARO Insight displays the Edit Hidden Point Bar dialog.



3. Change the desired properties for the hidden point bar to their new values.
4. Press the OK button.

   FARO Insight will then update the existing hidden point bar specifications to the new ones just entered.

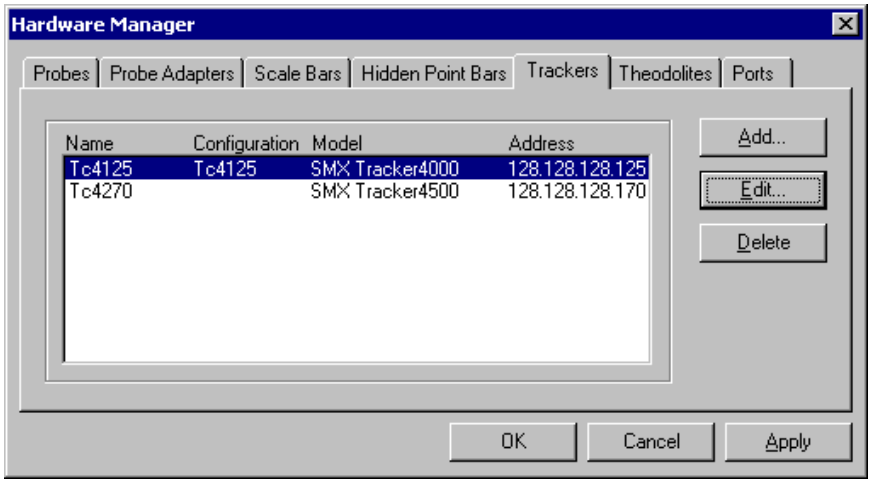
Deleting a Hidden Point Bar

Hidden Point bars may get replaced or never used, so the user may want to remove these from the list of bars to keep a more concise list of those that would be used. By using the delete option, the user can remove any of the existing bars from the Hardware Manager.

1. Open the Hidden Point Bars Tab of the Hardware Manager (Alt, L, H, H).
2. Select the Hidden Point Bar from the list that is to be removed and choose Delete (Alt D).
3. FARO Insight will remove the bar from the list of available hidden point bars.

Trackers

The Trackers tab in the Hardware Manager dialog maintains the trackers that can be used within FARO Insight. The dialog will list all of the trackers available, along with their Serial Number and Model type.



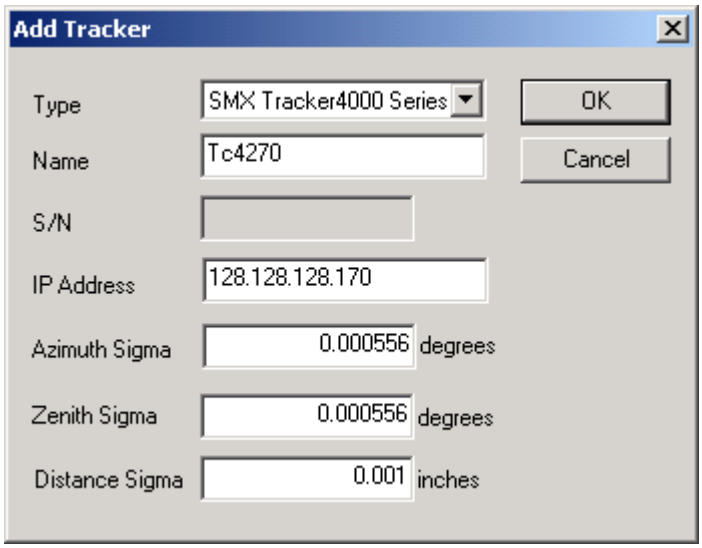
Trackers Tab of Hardware Manager Dialog

Adding a New Tracker

New trackers will need to be initially added to FARO Insight. Others can be entered later when needed. Each tracker will need the model type, a name, the IP Address and uncertainties, which affect the results of the Bundle.

1. From the Trackers Tab of the Hardware Manager (Alt, L, H, T), choose Add (Alt A).

   FARO Insight displays the Add Tracker dialog.



   Add Tracker Dialog

2. Select a specific type of tracker.
3. Enter a name for the tracker that is to be added. The name is usally TcXXXX where XXXX is the tracker's serial number.
4. FARO Insight will automatically enter an IP address based on the tracker serial number.

5. Enter the uncertainties for the tracker and environment. The default uncertainties are derived from the trackers specifications combined with environmental effects found in the average users environment. If the environment the tracker is going to be used in has a great deal of vibration or air movement, these uncertainty values may need to be increased.
6. Press the 'OK' button.

   FARO Insight will then add the tracker to the list of trackers that are available to be used in FARO Insight.

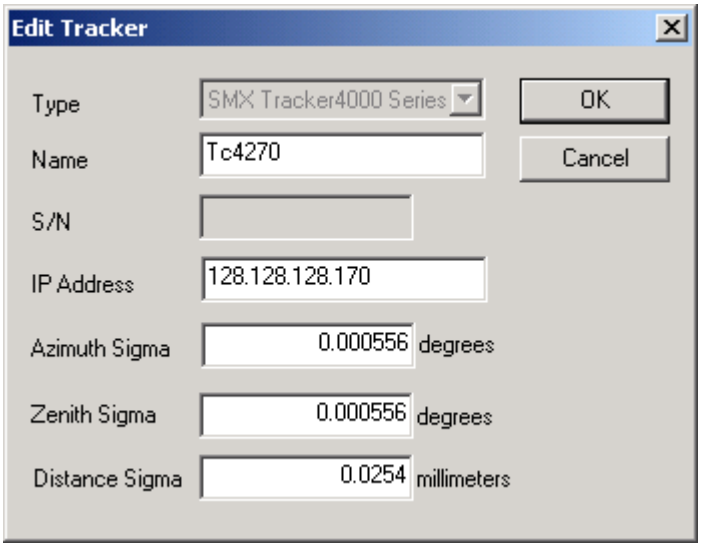
Editing a Tracker

There is a chance that the user may want to edit the name or other properties of an already existing tracker, without having to delete the existing one and re-create it. Doing so will update the Hardware Manager but not any references to it within the job files.

Note: A tracker's properties are stored within the station when they are initially selected for that station. Any changes made to the properties of a tracker from the Hardware Manager will not be reflected until it is used in a new station or a new job.

1. Open the Trackers Tab of the Hardware Manager (Alt, L, H, T).
2. Select the tracker from the list that is to be updated and choose Edit (Alt E).

   FARO Insight displays the Edit Tracker dialog.



Edit Tracker Dialog

3. Change the desired properties for the tracker to their new values. (The type can not be modified.)
4. Press the 'OK' button.

   FARO Insight will then update the existing tracker specifications within the Hardware Manager to the new ones just entered.

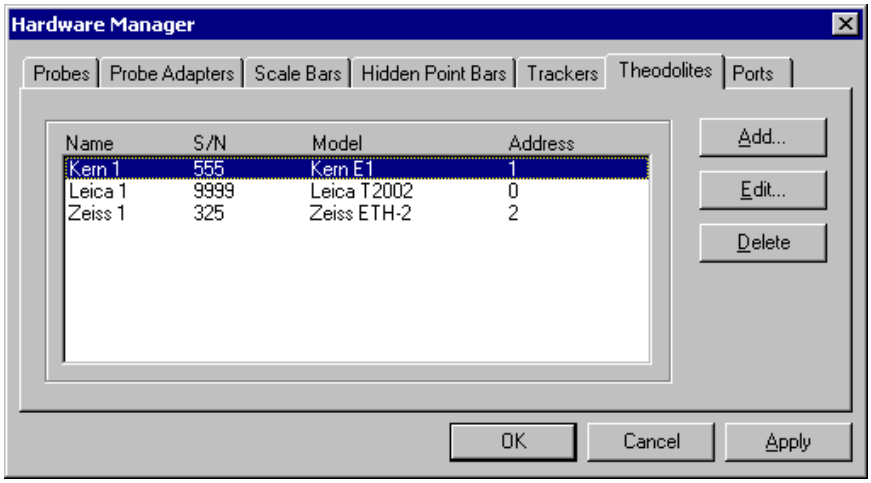
Deleting a Tracker

A tracker may get replaced, so the user may want to remove one from the list of to keep a more concise list of those that would be used. By using the delete option, the user can remove any of the existing trackers from the Hardware Manager.

1. Open the Trackers Tab of the Hardware Manager (Alt, L, H, T).
2. Select the tracker from the list that is to be removed and choose Delete (Alt D).
3. FARO Insight will remove the tracker from the list of available Trackers within the Hardware Manager.

Theodolites

The Theodolites tab in the Hardware Manager dialog maintains the theodolites that can be used within FARO Insight. Initially, there will be no theodolites within this portion of the Hardware Manager. The dialog will list all of the theodolites available, along with their Serial Number, Model type, and Unit Address. (The Unit Address will be 0 when it is not required.)



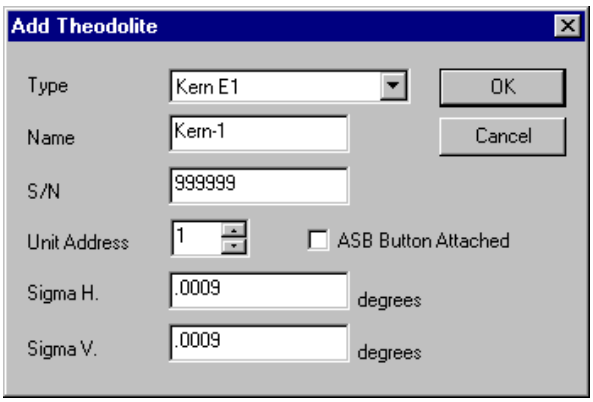
Theodolites Tab of Hardware Manager Dialog

Adding a New Theodolite

New theodolites will need to be added initially to FARO Insight. Others can be entered later when needed. Each theodolite will need an exclusive name with an associated serial number, a model type, unit address (if required), and uncertainties (which use the currently set units).

1. From the Theodolites Tab of the Hardware Manager (Alt, L, H, D), choose Add (Alt A).

   FARO Insight displays the Add Theodolite dialog.



2. Select a specific type of theodolite.
3. Enter a name for the theodolite that is to be added.
4. Enter the serial number of the theodolite.
5. Enter the unit address of the theodolite, if needed.
6. Check the ASB Button Attached option if the theodolite is going to use an ASB button to record the measurements.
7. Enter the known uncertainties of the theodolite.
8. Press the 'OK' button.

   FARO Insight will then add the theodolite to the list of theodolites that are available to be used in FARO Insight.

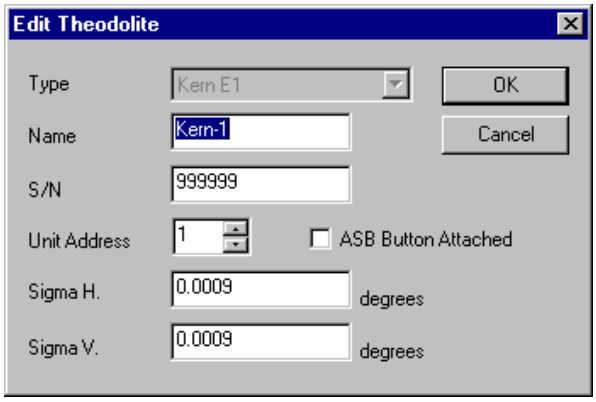
Editing a Theodolite

There is a chance that the user may want to edit the name or other properties of an already existing theodolite, without having to delete the existing one and re-create it. Doing so will update the Hardware Manager but not any references to it within the job files.

Note: Theodolite properties are stored within the stations when they are initially selected for that station, therefore any changes made to the theodolites within the Hardware Manager will not be reflected.

1. Open the Theodolites Tab of the Hardware Manager (Alt, L, H, D).
2. Select the theodolite from the list that is to be updated and choose Edit (Alt E).

   FARO Insight displays the Edit Theodolite dialog.



Edit Theodolite Dialog

3. Change the desired properties for the Theodolite to their new values. (The type can not be modified.)
4. Press the 'OK' button.

   FARO Insight will then update the existing theodolite specifications within the Hardware Manager to the new ones just entered.

Deleting a Theodolite

A theodolites may get replaced, so the user may want to remove one from the list of to keep a more concise list of those that would be used. By using the delete option, the user can remove any of the existing theodolites from the Hardware Manager.

1. Open the Theodolites Tab of the Hardware Manager (Alt, L, H, D).
2. Select the theodolite from the list that is to be removed and choose Delete (Alt D).
3. FARO Insight will remove the theodolite from the list of available Theodolites within the Hardware Manager.

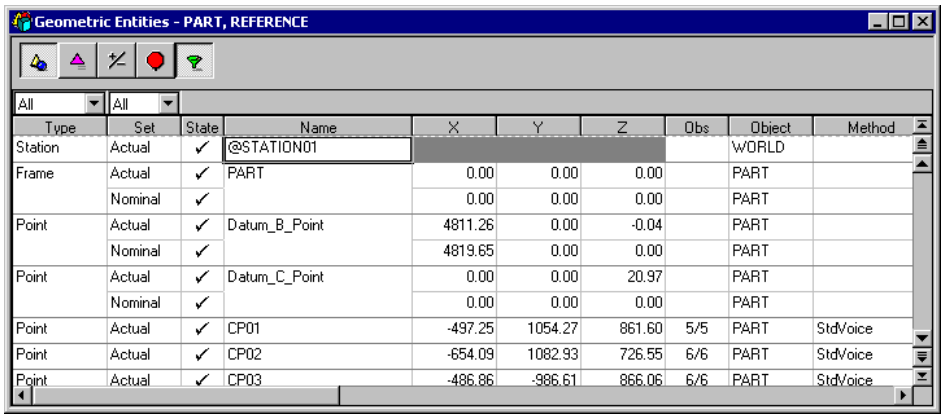
FARO Insight Worksheets

Worksheet Basics

What are worksheets?

Worksheets are spreadsheet-like windows that display a certain class of data. They arrange data such as feature names, feature locations, and feature orientation in a layout that is easy to work with. Virtually all of the information you enter into, and get out of, the program is done through a worksheet interface.

FARO Insight uses three types of worksheets: Geometric Entities, Scalar Entities, and Observations. Geometric entities are features such as points, lines and frames - they are multi-dimensional objects. Scalar entities are single dimensional features such as angles and distances - objects that are completely described by a scalar value. Observations are the fundamental measurements of position (x, y, z) that are stored when a geometric entity is measured. They are displayed in their own worksheets in order to make viewing data more manageable.



Type	Set	State	Name	X	Y	Z	Obs	Object	Method
Station	Actual	✓	@STATION01					WORLD	
Frame	Actual	✓	PART	0.00	0.00	0.00		PART	
	Nominal	✓		0.00	0.00	0.00		PART	
Point	Actual	✓	Datum_B_Point	4811.26	0.00	-0.04		PART	
	Nominal	✓		4819.65	0.00	0.00		PART	
Point	Actual	✓	Datum_C_Point	0.00	0.00	20.97		PART	
	Nominal	✓		0.00	0.00	0.00		PART	
Point	Actual	✓	CP01	-497.25	1054.27	861.60	5/5	PART	StdVoice
Point	Actual	✓	CP02	-654.09	1082.93	726.55	6/6	PART	StdVoice
Point	Actual	✓	CP03	-486.86	-986.61	866.06	6/6	PART	StdVoice

The Geometric Entities Worksheet

These three worksheets are the primary interface to FARO Insight. Whenever you want to measure a feature such as a point, sphere or plane, to create a coordinate reference frame, to compute the angle between two lines, or to compare measurements to a nominal data set, you will do it through a worksheet.

Navigating in a Worksheet

Worksheets are virtual windows into the job database; since it is usually not possible to view the entire contents of a job at once, FARO Insight virtualizes the display and

allows you to view select portions at one time, either by scrolling the display or by hiding feature attributes.

Cell focus

In each spreadsheet, one cell will have the focus, indicated by a double line border. Having the focus means that input from the keyboard, mouse, or tracker is directed toward that cell. For example, to edit the name of a point, you must set focus on (by clicking with the mouse or using the arrow keys) the name cell.

Actual	✓	Origin	0.0000	0.0000	-0.0000
Actual	✓	X_Axis	78.7401	0.0000	-0.0000
Actual	✓	Y_Axis	66.0401	56.9097	-0.0000
Actual	✓	CP01	*This cell has the focus*		
Actual	✓	CP02	52.4511	66.1773	-33.1617

When you have multiple worksheets open simultaneously, each sheet will have at least one cell with a double line border, but only one (or possibly none) will be active. For example, you may have three observation windows open, but the active window is the Gents worksheet. Focus will be on the Gents worksheet.

Another situation occurs when you set focus on a cell, then use one of the display filters such as the drop-down list that control feature type. Even though one cell has a double line border, the input focus is still on the list box and any keyboard input is directed to the list.

Note: At times, a cell in the active window may have the focus, but will refuse to accept input. To overcome this, move off the cell and then back on using either the mouse or the arrow keys.

Moving around a worksheet

It is usually necessary to scroll up/down and left/right in order to view the entire contents of a worksheet.

- To scroll the worksheet horizontally, click the left or right arrows, or , at the ends of the scroll bar. If a scroll bar does not appear, the worksheet is too small to be scrolled in that direction.

  You can also scroll by dragging the thumb button in the scroll bar. To scroll one screen at a time, click on the scroll bar between the arrow and the thumb button.

- To scroll the worksheet vertically line by line, click the upper or lower inner arrows, or , at the ends of the vertical scroll bar.

  You can also scroll vertically one screen at a time by clicking the upper or lower middle arrows, or , at the ends of the vertical scroll bar.

  To go directly to the top or to the bottom of the worksheet, click the upper or lower outer arrows, or , at the ends of the vertical scroll bar.

Selecting cells

Sometimes it is necessary to select a range of cells for a number of operations, such as reporting, copying the contents of one cell to another, selecting points for a best-fit frame, etc.

- With the mouse, hold down the left button while dragging over the cells that you want to select.
- Using the keyboard, hold down the SHIFT key and use the arrow keys to mark the cells you want to select.
- You can select multiple ranges of cells by holding down the CTRL key while selecting subsequent ranges of cells.

Editing, copying, and deleting cells

FARO Insight allows you to edit, copy and delete cells after they have been created. This is useful when you want to rename a feature that has already been created, if you want to make it similar to another feature, or if you don't need a feature anymore.

Editing the contents of a cell

The means of editing vary from column to column; the most common way is to set focus on the cell and, from the Edit menu, choose Cell (Alt, E, L), press the F2 key, or double-click directly in the cell. Some cells are for status or results and can only be viewed, not edited.

Copying cell contents

To save time, you can copy the contents of one cell and paste is in a range of other cells. This expedites assigning methods, offsets and even functions.

1. Select the cell whose contents you want to copy.
2. From the Edit menu, choose Copy (Alt, E, C) or press CTRL+C.
3. Select the cells into which you want to paste the cell contents.
4. From the Edit menu, choose Paste (Alt, E, P) or press CTRL+V.

If Auto Recalculation isn't on, it may be necessary to update the display before the pasted information is displayed.

Deleting a feature

When you delete a feature, it is removed from the job database. See to "*Clearing and Deleting Observations*" for information on how to re-measure a feature without deleting it.

1. Set focus on the feature you want to delete.
2. From the Edit menu choose Delete (Alt, E, D), or press DELETE. FARO Insight prompts you to verify the deletion.

Searching the Gents Sheet

The Search toolbar allows the user to search the Gents sheet for a particular feature name. This toolbar becomes available for use any time the Gents sheet is the active

window. When used, FARO Insight will highlight the first cell in the name column that matches the search requirements.

Search Toolbar

The operator simply types in the name of a feature in the field, and presses either the up or down arrow to search either up or down in the Gents sheet for any matching feature name. The search is not case sensitive, and will stop on any feature in which the **first** characters of the feature's name match the search entry. For example, if the letters 'Poin' are entered into the search field and one of the search arrows are clicked, FARO Insight will highlight the first name cell that has the string 'Poin' as its **first** four characters. Subsequent searches for 'Poin' will highlight the next cell with a matching feature name. A feature name that possesses characters that precede the string 'Poin', such as 'Datum_A_Point', will be passed up by the search. To find a featured named 'Datum_A_Point', the user should use a string like 'Datum' as the search criteria.

Rearranging Rows and Columns

The columns in each of the FARO Insight worksheets can be rearranged by adding, deleting, and moving columns in order to display more or less information, or to display data in a format that is most appropriate for a given task. For example, it is necessary to display the focal length and eccentricity when you are working with paraboloids, but it is useless information otherwise. Likewise, when you are working with lines and planes, it is convenient to rearrange the worksheet so that the features' vectors are displayed in a prominent location.

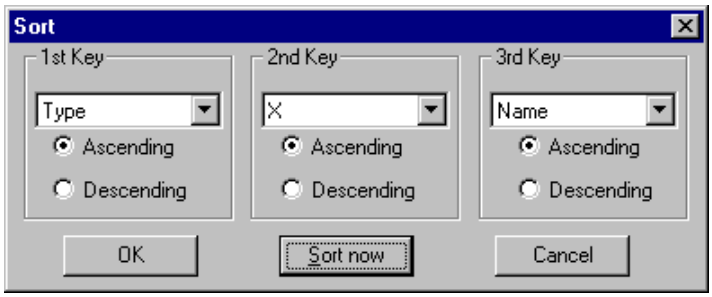
Sorting Rows

By default, FARO Insight sorts the rows in the order that the features were created. New features are always put at the bottom of the list. The default sort method may be overridden by specifying a custom sort order. Once a custom sort order is specified, it will persist for the rest of the job, or until another custom sort order is specified.

To set the sort order, do the following:

1. From the Settings menu, choose Rows (Alt, S, R).

   FARO Insight displays the Sort dialog.



Sort Dialog

2. In the 1st Key dropdown box, select the primary key (worksheet column) according to which you want to sort, and the sort order – Ascending or Descending.

For example, to sort all records primarily by the ascending type (circle, sphere, etc) select Type from the sort list and click Ascending.

3. To define a secondary sort order, select a second key and sort order in the 2nd Key dropdown.

   For example, if you sort primarily by Name, you can sort duplicate names according to Type.

4. In the 3rd Key dropdown, select a tertiary key and order, if desired.

5. To sort the worksheet right away, choose Sort now. Choose OK when you are done.

   Clicking the Sort button, , on the Standard Toolbar will immediately arrange the worksheet to the current sort settings.

Resizing columns

You may want to resize the columns in a worksheet in order to accommodate for longer feature names, or to squeeze the greatest number of columns possible out of a limited screen size.

- To resize the width of a single column, move the mouse pointer to the right edge of its heading (the mouse pointer becomes a double arrow). Drag the right boundary of the column to the desired width while holding down the left mouse button.

- To resize multiple columns, select the columns (drag over their column headings with the mouse pointer while holding down the left mouse button, they must be adjacent) and then resize one of the columns as described previously. The selected columns will be identical in width to the column you resized.

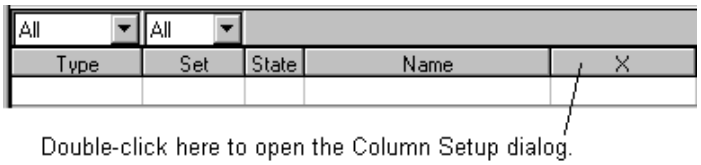
  Force FARO Insight to write the new column widths to the INSIGHT.INI file by moving the worksheet slightly.

Adding, deleting, and moving columns

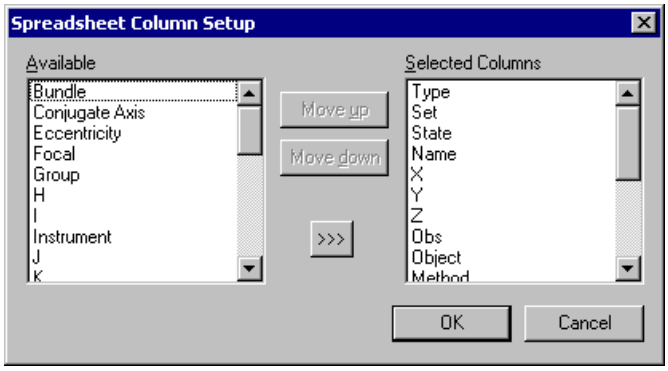
When you rearrange columns in the Scalar, Geometric Entities, and Observations worksheets, the changes are stored in the INSIGHT.INI file.

To add, delete or move columns, do the following:

1. From the Settings menu, choose Columns (Alt, S, C) or double click anywhere on the column header of the worksheet.



2. FARO Insight displays the Spreadsheet Column Setup dialog.



Spreadsheet Column Setup Dialog

- To add a column, double-click on the column name in the Fields to Add list, or highlight the name and press the add button, >>>.
- To delete a column, double-click on the column name in the Spreadsheet Columns list, or highlight the name and press the delete button, <<<.
- To move a column left or right, click on that column in the Spreadsheet Columns list. To move the column left, press the Move Up button, Move up. To move a column right, press the Move Down button, Move down. Do this as many times as necessary.

- To prevent the name column from moving when you scroll the worksheet left and right, click on the Freeze Name Column check box.

3. When you are done, press 'OK.'

Note: The user can move multiple column names at the same time when using the Spreadsheet Column Setup dialog box.

Saving multiple column configurations

There are a variety of applications that require different column layouts, especially in the Geometric Entities worksheet. You can avoid having to manually rearrange the columns when you switch tasks by storing your favorite configurations in the INSIGHT.INI file. You should feel comfortable editing system files before trying this operation.

1. Arrange the columns for a particular configuration.
2. Edit the INSIGHT.INI file (located in the directory FARO Insight is installed in) and look for the section marked [Layout]; it should be near the bottom of the file.
3. Create a new section labeled [MyLayout] – you can substitute a more descriptive label – and then copy the line that begins "Geometric Entities Columns" (followed by a series of numbers) into the new section.
4. Repeat Steps 1 through 3 for any other configurations you want to save. You can store each configuration in its own section.

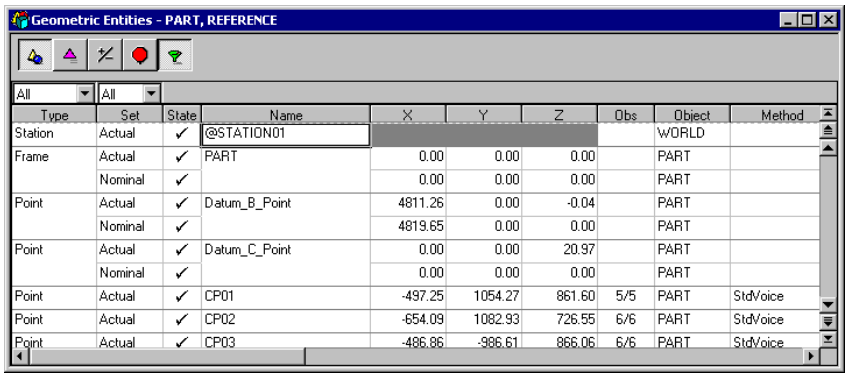
5. When you want to change configurations, replace the “Geometric Entities Columns” from the [Layout] section with one of your own layouts. You must restart FARO Insight for the change to be in effect.

Geometric Entities Worksheet

Geometric Entities

Geometric Entities - or Gents - are features such as points, lines, spheres, and frames. Entities that are defined by an X, Y, Z (depending on the coordinate system used) location and which may also have associated with them an I, J, K direction vector, and possibly a size/shape parameter such as radius or focal length. Geometric entities may be contrasted with scalar entities, such as angles and distances: entities that are expressed by a single value.

The Geometric Entities worksheet is where most of the work can be done. In this window, you will create, edit, measure, and view results of features such as points, circles, and spheres. You can configure it in multiple ways to show only the information you need.



Type	Set	State	Name	X	Y	Z	Obs	Object	Method
Station	Actual	✓	@STATION01					WORLD	
Frame	Actual	✓	PART	0.00	0.00	0.00		PART	
	Nominal	✓		0.00	0.00	0.00		PART	
Point	Actual	✓	Datum_B_Point	4811.26	0.00	-0.04		PART	
	Nominal	✓		4819.65	0.00	0.00		PART	
Point	Actual	✓	Datum_C_Point	0.00	0.00	20.97		PART	
	Nominal	✓		0.00	0.00	0.00		PART	
Point	Actual	✓	CP01	-497.25	1054.27	861.60	5/5	PART	StdVoice
Point	Actual	✓	CP02	-654.09	1082.93	726.55	6/6	PART	StdVoice
Point	Actual	✓	CP03	-486.86	-986.61	866.06	6/6	PART	StdVoice

Geometric Entities Worksheet

Opening the Geometric Entities worksheet

The Gents worksheet appears as a spreadsheet within the FARO Insight work area. You can maximize or minimize it, tile or cascade it with other windows or worksheets in the work area. It is possible to have multiple copies of the Gents worksheet open at a single time.

- To open the Gents worksheet, from the View menu, choose Geometric Entities (Alt, V, E) or press the Gents button, , on the Standard Toolbar.
- If the Gents window is minimized, you can restore it by double clicking on its control icon.

Declaring Features

Each geometric entity that you measure, or compute must first be declared in the Gents worksheet. Declaring an object accomplishes two things: it creates a record in the database for that object, and it tells FARO Insight how the object is to be measured, input or calculated.

Every object in the Gents worksheet is defined in one of three ways: by measurement, by calculation based on other objects, or by manual entry. For example, you *measure* the actual values of objects such as control points, you *manually enter* (by typing or importing) the nominal values of these same points, and you *calculate* the frame using a function that relates the measured actuals to the entered nominals.

What is declaring a feature?

You must declare an entity in FARO Insight before you can measure it, calculate it, print it, or even see it on the screen. Declaring a feature is telling FARO Insight what the feature **Type** is, what data **Set** it is defined in, what its Name is, and what **Method** and/or **Function** FARO Insight should use to evaluate it. The Gents worksheet has columns that correspond to these items.

Declaring the **Type** of a feature is your way of telling FARO Insight what you are trying measure or create - a point, circle, sphere, etc. When you measure a feature, you are measuring X, Y, Z positions. By declaring the type, you are telling FARO Insight what shaped feature those X, Y, Z positions came from. Once you declare a feature, you cannot change its type. See "*Feature-Fit Reference*" for more information.

Declaring the **Set** of a feature is your way of telling FARO Insight whether this feature is going to be measured / calculated, or is a known position from a blueprint or a CAD model. You can create an Actual feature (one that is measured / calculated), a Nominal feature (one from a blueprint), or All (which will create both). See

Declaring the **Name** of a feature is your way of telling FARO Insight what this feature will be called. Whenever you want to use this feature in a calculation, you will reference it using its name. You can edit the name of a feature after it has been declared.

Declaring the **Method** of a feature is your way of telling FARO Insight if and how the Tracker will measure this feature. There are several predefined methods that can be used and you can create your own if you need. You can change the method of a feature after it has been declared. See "*Methods*" for more information.

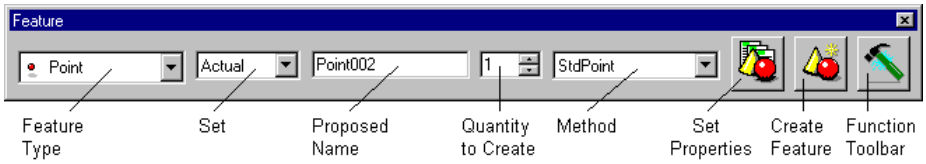
Declaring the **Function** of a feature is your way of telling FARO Insight how to create this feature (if it is going to be calculated instead of measured) or how to modify its position, orientation or size. One use of functions is compensation for tooling that was used for measurement. Not all features need to be given a function, and you can edit the function after it has been declared. See "*Intuitive Function Definition*" for more information.

Declaring a feature

This manual will often use the phrase *"Declare an Actual (or Nominal) feature of the desired Type"* as shorthand for the procedure described here. Make sure the Gents worksheet has the Type, Set, Name, Method, and Function columns displayed so you have access to them.

The easiest way to declare features in FARO Insight is using the Feature Toolbar.

1. Display the Feature Toolbar. From the View menu, choose Toolbars, then Feature (Alt, V, T, F).



The Feature Toolbar

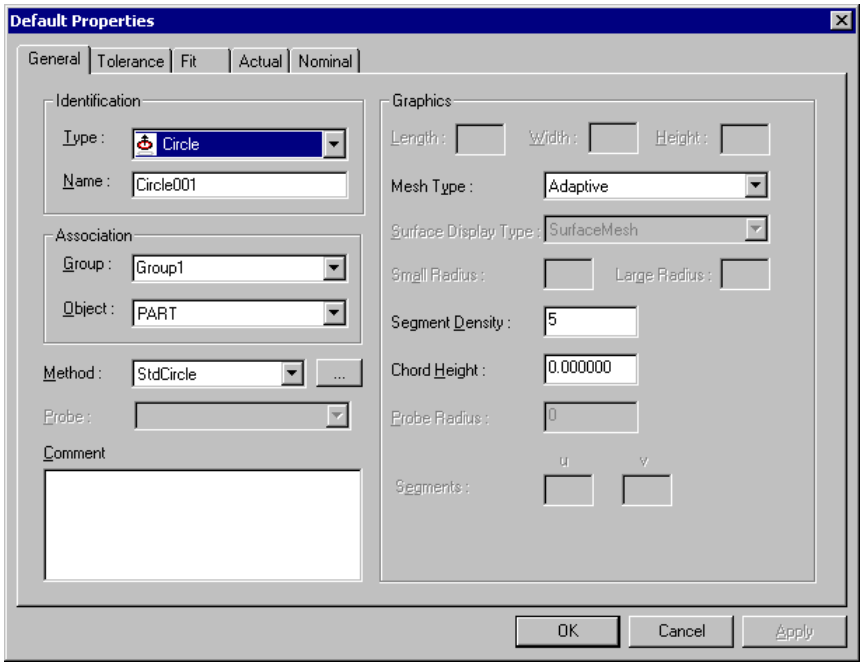
2. From the Feature Type dropdown, choose the type of feature(s) you want to create.
3. From the Set dropdown, choose the data set of the feature(s) you want to create.
   - Choose Actual if you only want to create an actual feature(s).
   - Choose Nominal if you only want to create a nominal feature(s).
   - Choose All if you want to create both, Actual and Nominal feature(s).
4. Select the Proposed Name text box and type in the name of the feature you want to create.
5. In the Quantity to Create control, enter the number of features you want to create.
   - If you only want to create one feature, set this control to 1.
   - If you want to create multiple features, the first feature will have the name that is entered in the Proposed Name box. Subsequent features will follow in either numerical or alphabetical order. For example, if Point001 is the first feature, the following features will be named Point002, Point003, Point004, etc. If Point_A is the first feature, the following features will be named Point_B, Point_C, Point_D, etc.
6. From the Method dropdown, choose the method that is going to be used to measure the feature(s).
   - If you are going create a feature without a method (a calculated feature), you can open the Function Toolbar by going to View, Toolbars, Function on the menu bar or by pressing the Function Toolbar button. The Function Toolbar will allow you to create the feature, insert the constructor function and open the Function Editor in one step. See *"Intuitive Function Definition"* for more information.
7. Press the Create Feature button to create the feature(s).

Note: When declaring Nominal features, the Viewing Condition must be set to the Frame that the nominal value is known in (usually the PART Frame) and REFERENCE Condition. See *Viewing Data* for more information on setting the Viewing Condition.

Setting Feature Properties

Each feature contains more properties than the required Type, Set, Name, Method / Function. These properties are not always required but can be useful. These properties can be defined before or after the feature is declared. To define these

features before you create the feature, open the Default Properties Dialog by clicking on the Set Properties button, , on the Feature Toolbar.



Default Properties Dialog

The default properties of all features can be set here. Any changes made here will not be applied to all newly created features in this job. If you want to make the changes here affect new jobs, you must go to the Settings menu, and Choose Defaults (Alt, S, D). This dialog is broken down into three or four sections or tabs, depending on the feature.

General Tab

Type – Type is a drop-down list that identifies the type of feature for which default properties will be defined. When the user changes the feature type, the dialog displays the default properties for the selected feature type. The feature type selected here effects every property page. For example, if the user selects the type 'Circle', the dialog displays the default general properties, fit-options, actual functions and nominal functions for Circles.

Name – Name is an edit control that displays the default name for the chosen feature type. The user can change the default name on the Feature Toolbar or in the Default Properties dialog.

Group – Group is a drop-down list that displays the group to which new features of the chosen type will belong. If the desired group does not exist, the user may create a new group by entering its name here.

Object – Object is a drop-down list that identifies the object upon which new features of the chosen type will be located. By default, this is the PART object. See *"Scale, Objects and Movement"* for more information.

Method – Method is a drop-down list that displays the method for new features of the chosen type. The user can change the default method on the toolbar or in the Default Properties dialog. The user can access the Method Manager (to create and/or

edit methods) using the browse button to the right of the method field. See *"Methods"* for more information.

Probe – Probe is a drop-down list that displays different target types used in FARO Insight. This option is only available for point features and is used for ADM survey functionality only.

Comment – Comment is an edit control that displays the comment that will be assigned to each feature (of the given type) that is created.

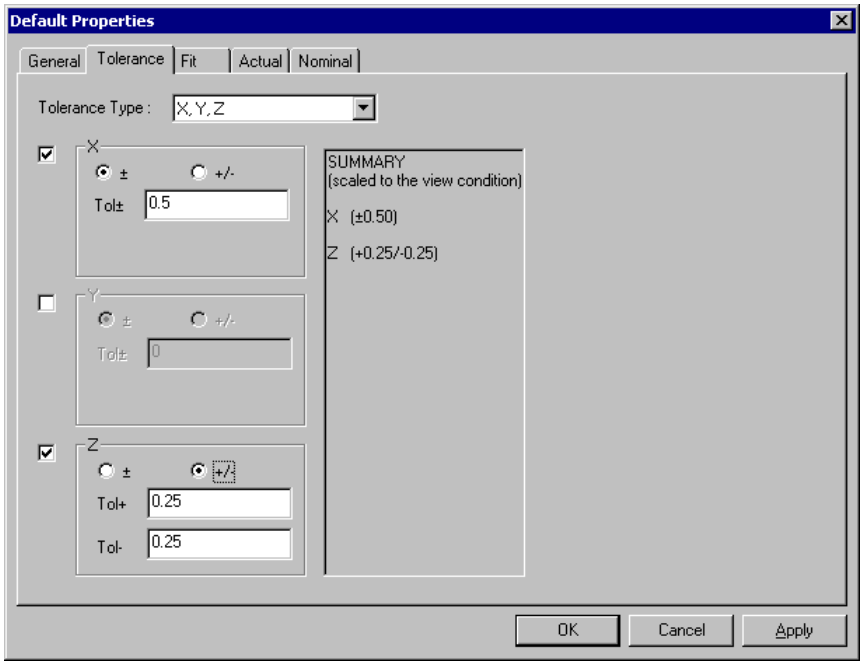
Graphics – Graphics is a set of controls that define how the feature will be displayed in the Graphics View. See *"Graphics View"* for more information.

Probe Radius – The Probe Radius field is only available for Point Cloud features. FARO Insight uses the probe radius for various Point Cloud operations.

Tolerance Tab

See the section entitled "Tolerancing in FARO Insight" for more information on tolerances.

The Tolerance tab applies to all features except for Frames, Point Clouds, Stations and Surface Deviations. This tab displays the current tolerance options for the corresponding feature type.



Tolerances may be set in any or all of the coordinate systems offered by FARO Insight (rectangular, cylindrical or spherical). This is controlled by the 'Tolerance Type' drop-down list.

There is also the capability to set three-dimensional tolerancing for size, shape and form. However, different feature types will have different three dimensional tolerance settings. For instance, a circle will have diameter and axial tolerancing, while a plane will only have surface tolerancing.

The '±' and '+/-' controls in the Tolerance and Size/Shape group boxes determine whether the corresponding tolerance is uniform bilateral ('±') or non-uniform bilateral ('+/-'). In the former case, a single input control is displayed for each value. In the latter case, two controls are displayed: one for the upper and one for the lower tolerance, as shown for the X and Z coordinates in the preceding figure. The

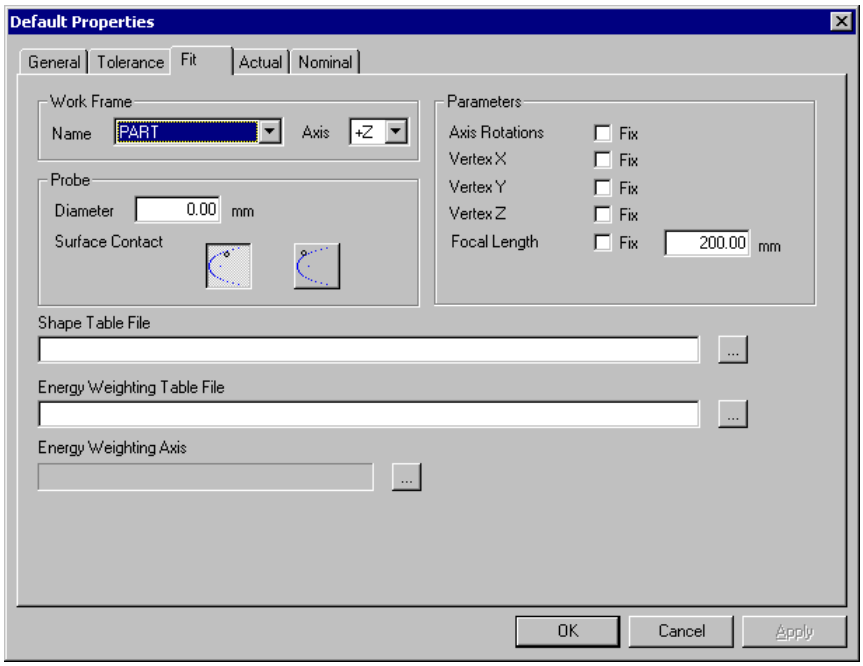
coordinates can also have their tolerances deactivated as illustrated by the unchecked Y coordinate of either figure.

Note: For unequal tolerances, a negative value is assumed for the lower tolerance. It is not required to enter a negative sign before the tolerance value. A unilateral tolerance may be assigned by entering a zero value for either the upper or lower tolerance.

The tolerances entered into and displayed by the dialog will always be considered to be at the Reference Condition (Scale = 1.00000). The values are stored internally at this condition, and are calculated for the display condition in the appropriate windows. The 'Summary' portion of the dialog box will display the values at the viewing condition of the window from which the dialog is opened.

Fit Tab

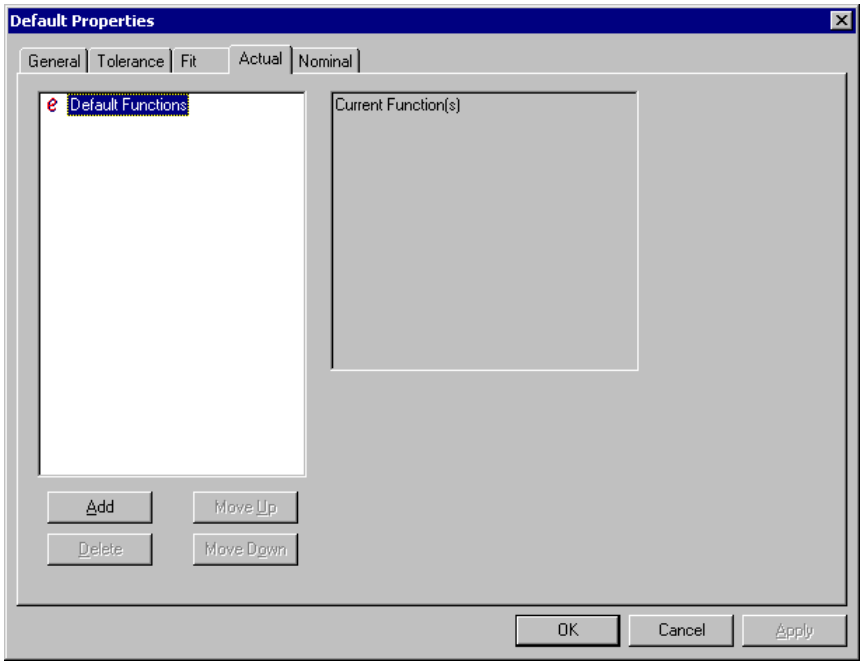
The Fit Tab applies only to circles, cones, cylinders, ellispoids, hyperboloids, paraboloids, patches, spheres, and NURBS surfaces. This tab displays the current fit options dialog for the corresponding feature type. For example, the fit-options tab for circles, cylinders, patches, and spheres allow the user to enter the features' radius and indicate whether or not it is fixed. For paraboloids, the user will see the following paraboloids fit dialog.



See "Feature-Fit Reference" *for more information.*

Actual and Nominal Tabs

The Actual and Nominal tab displays a Function Editor dialog for actual or nominal features. The user can program any number of functions to be assigned to new actual and nominal features of the chosen type. The following figure displays the Actual tab, the Nominal tab looks and operates the same, but only affects nominal features.



See "Intuitive Function Definition" for more information.

Controlling the Layout

Depending on the circumstances, you will at various times want to display deviations between the Actual and Nominal sets, display and change tolerances, show out of tolerance conditions, and possibly suppress the display of the features themselves in order to get more information on the screen. The Layout buttons controls these functions:

Notice that the first button is similar to what is displayed on the Standard Toolbar; the two buttons serve different purposes, as explained here. When a Layout button is depressed, the option is selected. When all the layout buttons are selected, the worksheet looks similar to this:

All	All						
Type	Set	State	Name	X	Y	Z	Obs
Point	Actual	✓	Point001	1002.03	553.62	200.10	1/1
	Nominal	✓		1002.00	554.00	200.00	
	Act-Nom			0.03	-0.38	0.10	
	Tol			±0.25	±0.25	±0.25	
	OTOL				-0.13		

Features Button

Controls the display of the Actual & Nominal values. When selected, the Actual and/or Nominal values are displayed. Notice, once again, that this button is similar to one on the Standard Toolbar, but they serve different purposes.

Deviations Button

Controls the display of the Actual / Nominal deviations. When selected, the deviations between Actual and Nominal position are displayed.

Tolerances Button	Controls the display of the tolerance values. When selected, the X, Y, and Z tolerance values are displayed.
Out of Tolerance Button	Controls the display of Out of Tolerance condition. When selected, the deviation between what is displayed in the Deviations row and the Tolerances row are displayed and highlighted.
Filters Button	Controls the display of the column filters. When selected, the column filters are displayed.

Changing the screen layout

You can use the Layout in the following manner:

- To display the Actual / Nominal values (whichever combination has been chosen using the Set filter), select the Feature button ; to hide them, de-select the button.
- To display the differences between the actual and nominal, select the Act-Nom button ; to hide them, de-select the button.
- To display the tolerance values (Tol) select the Tolerance button ; to hide them, de-select the button.
- To display the Out of Tolerance condition (OTOL), select the Out of Tolerance button . To hide them, de-select the button.
- To display the drop-down list filters above the column headers, select the Filters button . To hide them, de-select it.

Tolerancing in FARO Insight

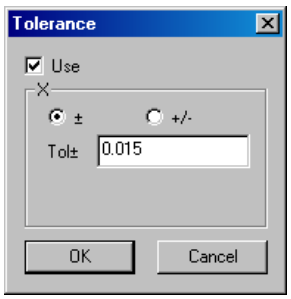
FARO Insight provides support for both positional and size/shape/form tolerancing on a per-feature basis.

Actual tolerances are used to check size, shape or form parameters of a given feature. For example, an actual radial tolerance of 0.010” may be set to a circle so that when a watch window is opened on that circle, the radius of the circle (dR) may be checked for uniformity. If at any location along that circle the dR exceeds the assigned actual radial tolerance (in this case 0.010”), the color of the reading in the watch window will change. See the section entitled “Other Windows” for more information on watch windows and actual tolerances.

Conversely, a nominal size/shape/form tolerance will compare an actual solved parameter to a nominally entered value. For example, if a tolerance is placed on the radius of a nominal circle, FARO Insight will compare the actual radius to the nominal radius and apply the tolerance to the deviation. If the deviation exceeds the tolerance, the color of the deviation in that cell in the Gents sheet will change. In addition, a nominal tolerance may also be used when checking the positional location a feature. If a tolerance is entered for any or all of the X, Y and Z coordinates, the deviation of the actual feature’s center is reported and checked against the feature’s nominal location. If any or all of the X, Y and Z deviations exceed the assigned tolerance, the color of the deviation in that cell will change.

Applying a Nominal Tolerance from the Gents Sheet

In addition to the Tolerance tab under the Default Properties dialog box, modifications to an individual nominal feature's tolerance setting may be made directly from within the Geometric Entities Sheet. With the Tolerance button, ±, depressed in the Gents sheet, double click in either the X, Y, Z, diameter, radius or any other feature specific shape parameter cell in the tolerance row for the feature whose tolerance you wish to modify. (This row will only appear when a nominal is present.) The Tolerance dialog box will appear.



Tolerance Dialog

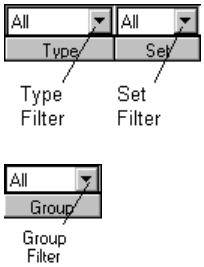
Note that only those features that have a specific shape parameter (radius, focal length, etc.) will allow for tolerancing of these types. Like the Default Properties dialog, the Tolerance dialog displays one or two input controls in the Tolerance group box, depending on whether the user has selected '±' or '+/-' tolerancing.

Type, Data Set and Group Filters

The Geometric Entities worksheet has filters that control the data set and feature type. These filters can control both input and output: when you change them, FARO Insight updates the worksheet to display all features of the selected type and set. These filters can be used to simplify your display for easier viewing, faster screen updates, printing particular information to a file or printer, importing data, or manually creating features.

Selecting the feature type and data set

When the Filters button on the Gents worksheet is selected, FARO Insight displays two drop-down filters above the column headers. One filter controls the type feature being displayed; the other controls the feature set being displayed.



Type, Set and Group Filters

- To select the feature type you want to view, click on the Type Filter. FARO Insight will display a list of feature types that you can select from. You can only select one at a time.

- To select the data set you want to view, click on the Set Filter. FARO Insight will display a list of the data sets that you can choose from.
- To select the group you want to view, click on the Group Filter. FARO Insight will display a list of the groups that you can choose from.
- When you are done selecting from the filters, you must click on any cell in the Gents worksheet in order to take focus off the filter.

Note: You cannot use the Feature Toolbar to create a feature(s) when the Type Filter is set to something other than 'All' or the feature you are creating. If you try to do so, you will be asked if you want FARO Insight to change the filter to all for you. If you choose to, FARO Insight will set the filter to 'All' and create the feature(s). If you choose not to, FARO Insight will cancel the operation.

Manually declaring features

Using the Type and Set Filters, you can create features without the use of Feature Toolbar. In order to do so, the Feature Toolbar must not be visible. While using this method for creating actual features may be tedious, it can be useful for importing a large number of nominal features.

1. Set the Type Filter to the feature type you want to create. If you are creating a Point, you can select either 'Point' or 'All'.
2. Set the Set Filter to the data set of the feature you want to create. If you are creating an actual, you can select either 'Actual' or 'All'.
3. In the Name column on the last row of the Gents worksheet – the only blank one – type the name of the feature you want to create.
4. FARO Insight will assign a Method and Function according to what is set in the Default Properties of the feature you created. You can change these if you wish.

Speed Menu

The Gents worksheet has a Speed Menu to gain quick access commonly used functions. To access this menu, drag the mouse pointer over feature you want, or select a range of features, and click the right mouse button. The following menu will be displayed:

Observations	Opens the Observations Window of the feature.
Readings	Opens the Readings Window of the feature.
Edit Functions…	Opens the Function Editor for the feature.
Edit Properties…	Opens the Edit Properties dialog for display properties.
Delete	Deletes the feature from the database.
Measure	Measure the feature with a Tracker.
Aim	Aim the laser at the feature.
Paste Special	Use the Paste Special command to paste a function in the feature.

You can then select whichever option you desire. Depending on the feature, and its state, not all options may be available. A Deviations Window can also be accessed from the Speed Menu for the appropriate features in FARO Insight *Visual*Pro.

Observations

Overview

An observation - an X, Y, Z (if using rectangular coordinates) position - is recorded when you measure a feature. When you measure a point, for example, a single X, Y, and Z value typically is recorded, but when you scan a plane, thousands of observations, or X, Y, Z values, may be recorded, depending on the scan density. The required accuracy and the size of the feature determine the number of observations required to adequately define a feature.

In order to prevent the operator from dealing with potentially huge amounts of data at a time, FARO Insight provides access to observations in the form of an Observations worksheet. The observations are normally hidden from view, but are available when you need them. You can use the Observations worksheet to detect outliers, plot residuals, and selectively use and un-use individual observations to improve a feature fit, or diagnose a measurement problem.

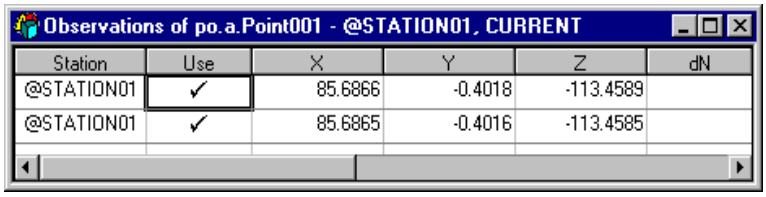
Observations column in the Gents sheet

FARO Insight will count observations as they are taken and display the total in the Observations column of the Gents worksheet. The total will be displayed as a ratio - for example 1/1, 2/2, 3/3, etc. However, when performing a relocation, the Obs column will not update the total until the Relocation has been performed. For example, before the relocation solves, the total may appear as 1/2, 2/3, 3/4, etc. Once the relocation has been solved, the totals will be 2/2, 3/3, 4/4, etc.

Viewing individual observations

In the Gents worksheet, use the right mouse button to click on the feature whose observations you want to view, and choose Observations from the Speed menu. You can also view them by setting focus on the feature and pressing the Observations button, , from the Standard Toolbar, or by selecting Observations from the View menu (Alt, V, O).

FARO Insight displays the feature's observations in a worksheet.



Station	Use	X	Y	Z	dN
@STATION01	✓	85.6866	-0.4018	-113.4589	
@STATION01	✓	85.6865	-0.4016	-113.4585	

Observations Worksheet for a Point

The X, Y and Z columns list the observations for the feature. The Date and Time columns provide a time stamp for each observation. Depending on what type of feature is displayed, the worksheet will also list the residuals from the feature fit. See "*Feature-Fit Reference*" for more information.

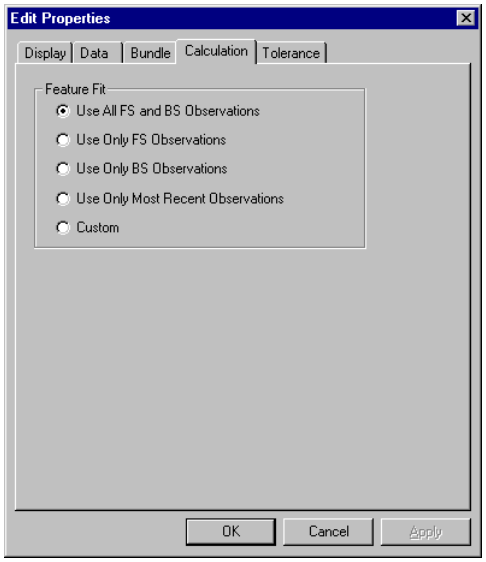
Using and un-using observations

When you use and un-use observations, you do not actually delete them, you simply instruct FARO Insight not to use them when calculating the feature. If you un-use an observation, FARO Insight updates the observation count in the Gents worksheet, but the residual value(s) are still displayed in the observations window. Once you

have determined which observations (if any) are bad, you can permanently delete them. See "*Clearing and Deleting Observations*" for more information.

- To un-use an observation, double-click on the check mark in the Use column. FARO Insight will remove the check mark.
- To un-use multiple observations, select them with the mouse (multiple selections can be made with the SHIFT and CTRL keys in conjunction with the mouse) and choose Edit, Un-use Observations (Alt, E, -) from the menu bar.
- To use an un-used observation, double-click on the blank Use column. FARO Insight will replace the check mark.
- To use multiple un-used observations, select them with the mouse (multiple selections can be made with the SHIFT and CTRL keys in conjunction with the mouse) and choose Edit, Use Observations (Alt, E, U) from the menu bar.

Observations can also be used and un-used from the Calculation Tab of the Edit Properties dialog box for a particular feature that has not been formed from a constructor function.



Calculation Tab of the Edit Properties Dialog

- **Use All FS and BS Observations**: Uses all of the features observations.
- **Use Only FS Observations**: Uses only observations collected while the tracker was in Front Sight Mode.
- **Use Only BS Observations**: Uses only observations collected while the tracker was in Back Sight Mode.
- **Use Only Most Recent Observations**: Uses only observations collected during the latest measurement (the number of observations in the latest measurement will depend on the Method that was used).
- **Custom**: Active when the user individually selects which observations to use from the Observations Window.

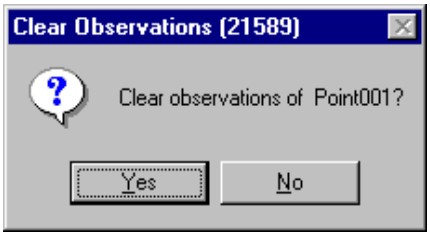
Clearing and Deleting Observations

When you clear a feature's observations, the feature record and all associated functions and fit constraints remain intact. Clearing observations is useful when you want to re-measure a feature and when you want to recycle a job file. Do not confuse clearing observations with deleting a feature.

Clearing a feature's observations

To clear the observations of one or more (but not all) features, use the following procedure:

1. In the Gents worksheet, set focus on the feature(s) whose observations you want to clear.
2. From the Edit menu choose Clear Obs (Alt, E, B), or press F7. FARO Insight prompts you with the following dialog to verify your selection.

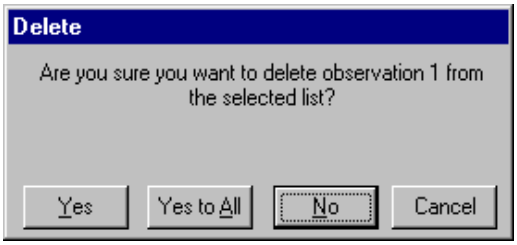


3. Click 'Yes' to clear the observations. If you select more than one feature in Step 1, FARO Insight prompts you to do this for each feature.

Deleting individual observations

You can determine whether some of a feature's observations are outliers by selectively using and un-using them and then recalculating the feature. This allows you to determine which observations are bad while keeping the good observations. When you determine which observations are outliers, you can selectively delete these observations using the following procedure.

1. In the Observations worksheet, set focus on the observation(s) you want to delete.
2. From the Edit menu, choose Delete (Alt, E, D) or press DEL. FARO Insight prompts you to verify your selection.



3. Choose 'Yes' or 'Yes to All.'
4. FARO Insight will display the new feature values and the new number of observations.

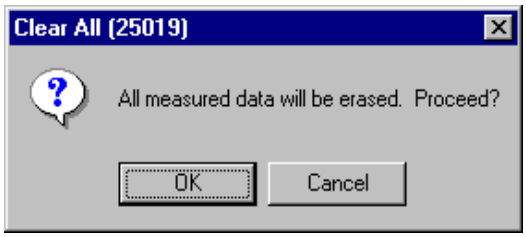
Clearing ALL observations in a job file

There may be times when you are doing the same, or very similar, jobs repeatedly. FARO Insight makes this easier by giving you the ability to clear ALL observations

from a previous job. By doing this, most, if not all, of your programming and setup is already done for you. In other words, your original job has just become a template.

Note: This operation can not be reversed. Be sure you have a copy of the original job before you clear all observations.

1. From the Edit menu, choose Clear All (Alt, E, A). FARO Insight prompts you to verify your selection.



2. Click ‘OK’ to clear the observations from the entire job file.

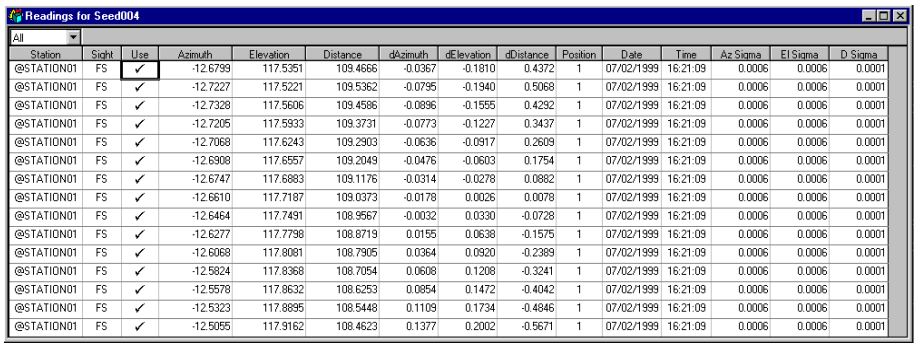
In addition to clearing all of the observations, the Clear All command will clear the Operators Tab and the Comments Tab of the Summary Dialog. It will also reset the time and date in the File Tab of the Summary Dialog.

Readings Worksheet

The Readings Window is similar in fashion to the existing Observations window, but instead of reporting the solved coordinates of the feature, it provides the user a reporting of the actual instrument measurements. It will report both the angles and the distances of the point measured, relative to the instrument's frame of reference. This functionality only applies to Point features, but can be used for both tracker and theodolite measurements.

Accessing the Readings Window

The Readings Window can be accessed for any measured point, from either a tracker or a theodolite. The window can also be opened prior to the point being solved, since it reports only the values received from the instrument. Opening the window is accomplished from either the View menu (Alt V, A) or from the speed menu that opens in either the GENTS sheet or an Observations window.



Readings for Seed004

All

Station	Sight	Use	Azimuth	Elevation	Distance	dAzimuth	dElevation	dDistance	Position	Date	Time	Az Sigma	El Sigma	D Sigma
@STATION01	FS	✓	-12.6799	117.5351	109.4666	-0.0367	-0.1810	0.4372	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.7227	117.5221	109.5362	-0.0795	-0.1940	0.5068	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.7328	117.5606	109.4586	-0.0896	-0.1555	0.4292	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.7205	117.5933	109.3731	-0.0773	-0.1227	0.3437	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.7068	117.6243	109.2903	-0.0636	-0.0917	0.2609	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.6908	117.6557	109.2049	-0.0476	-0.0603	0.1754	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.6747	117.6883	109.1176	-0.0314	-0.0278	0.0882	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.6610	117.7187	109.0373	-0.0178	0.0026	0.0078	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.6464	117.7491	108.9567	-0.0032	0.0330	-0.0728	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.6277	117.7798	108.8719	0.0155	0.0638	-0.1575	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.6068	117.8081	108.7905	0.0364	0.0920	-0.2389	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.5824	117.8368	108.7054	0.0608	0.1208	-0.3241	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.5578	117.8632	108.6253	0.0854	0.1472	-0.4042	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.5323	117.8895	108.5448	0.1109	0.1734	-0.4846	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001
@STATION01	FS	✓	-12.5055	117.9162	108.4623	0.1377	0.2002	-0.5671	1	07/02/1999	16:21:09	0.0006	0.0006	0.0001

Readings Window

Readings Window Columns

The Readings window has 15 columns available for display in the spreadsheet. The Station column can be filtered to either 'All', to show all the readings, or a particular station to show the readings from that station only. The Readings window can also be sorted in a similar manner as the Gents sheet.

The following table describes the columns in the Readings window.

Column	Description
Station	The station from which the reading was taken.
Sight	The sight (front or back) in which the measurement was taken.
Use	Toggle that indicates whether or not each reading should be used. This value is identical to the use status for the corresponding record in the Observations window.
Azimuth, Zenith, Distance	The instrument readings of azimuth and zenith angles and the linear distance corresponding to the records in the Observations window. All three are present for tracker measurements; there is no value in the Distance or d Distance columns for theodolite measurements.
dAzimuth, dZenith, dDistance	The deviations between the individual readings from a station and the mean of the set of readings from that station.
Position	The object position at which the reading was taken.
Date	The date the reading was taken.
Time	The time the reading was taken.
Az Sigma	Uncertainty of a Station's Azimuth reading.
Ze Sigma	Uncertainty of a Station's Zentih reading.
D Sigma	Uncertainty of a Station's Distance reading.

Scalar Entities Worksheet

Scalar Entities

Scalar Entities - or Sents - are angles and distances: features that are expressed by a single value. Scalar entities may be contrasted with geometric entities, such as points, frames and planes: features that are defined by an X, Y, Z location and which may also have associated with them an I, J, K direction vector, and possibly a size/shape parameter.

Opening the Scalar Entities worksheet

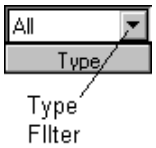
The Sents worksheet appears as a spreadsheet within the FARO Insight work area. You can maximize it, minimize it, tile it, or cascade it with other windows or worksheets in the work area.

- Press the Scalar Entities button, , on the Standard Toolbar, or, from the View menu, choose Scalar Entities (Alt, V, C).

If the Sents window is minimized, you can restore it by double clicking on its control icon.

Scalar entity type filter

Like the Gents worksheet, you can view data in the Sents worksheet through a filter. This type filter is used primarily for declaring a Scalar entity, but is also useful for viewing or printing purposes.



Type Filter

- To select the scalar type you want to view, click on the Type Filter. FARO Insight will display a list of scalar types that you can select from. You can only select one at a time.
- When you are done selecting from the filters, you must click on any cell in the Gents worksheet in order to take focus off the filter.

Declaring Scalar Entities

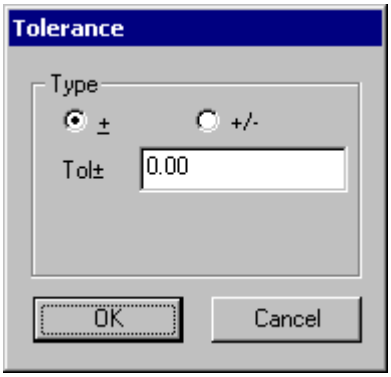
Each scalar entity that you compute must first be declared in the Sents worksheet. Declaring an entity accomplishes two things: it creates a record in the database for that entity, and it tells FARO Insight how the entity is to be calculated. Every Actual scalar entity in the Sents worksheet is calculated using an assigned function. Every Nominal is assigned directly by typing the value in the nominal cell.

Declaring a scalar

Make sure the Type, Name, Actual, Nominal, and Tolerance columns are displayed so you have access to them.

1. Using the Type filter column, choose the type of scalar (Angle or Distance) that you want to declare.
2. In the Name column of the last row - it’s the only blank one - type the name of the scalar you want to create, then press the ENTER key.
3. Double-click in the scalar's Actual column to open the Function Editor and assign a function so that FARO Insight knows how to evaluate it. Before assigning a function to a feature, the features upon which the function depends must already be declared. See the chapter entitled “Intuitive Function Definition” for more information.
4. If you know the scalar's nominal value, enter it in the Nominal column.
5. To specify a tolerance for the deviation from nominal, double-click in the Tolerance column.

   FARO Insight displays the Tolerance dialog.



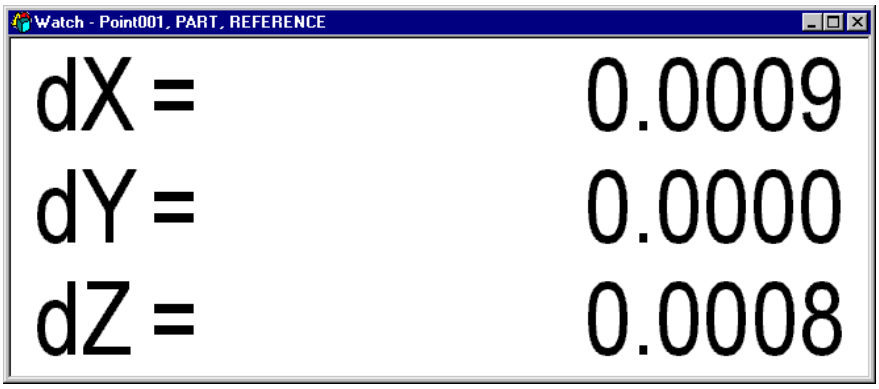
Tolerance Dialog

6. In the Type group box, select the type of tolerance you want to specify for the scalar.
7. For '±' tolerance, enter the tolerance value; for '+/-' tolerance, enter the Lower and Upper tolerance values.
8. Press the 'OK' button.

Other Windows

Watch Windows

A Watch Window displays the difference in position between the Actual (or Nominal) values of a selected feature and the current position of the target. Watch windows are useful for checking drift (they allow you to quantify target movement without recording position) or for checking conformance of a surface to a shape (such as checking a plane for flatness or a circle for roundness). They are also well suited to building, since they allow you to observe the position of a detail relative to nominal - in real-time - as you move it into position.



A Watch Window for a Point

The content of a watch window depends on the type of feature you are watching. When you watch a point for instance, FARO Insight displays the difference between the feature and the target location. If you watch a line, FARO Insight displays the radial distance from the line.

You can have several watch windows open at time, with 3-4 being the typical upper limit. Opening a watch on three different points of a detail allows you to control all six degrees-of-freedom of the detail.

You can change the coordinate sytem for a Watch window using the Display Settings Dialog box.

Using Watch Windows

Watch Windows have a variety of uses. Some of them are listed here and described briefly.

- Monitoring Drift - If you measure a set of fixed monuments at the beginning of a job, you can periodically watch the original positions of these points in order to check for drift.
- Setting a Detail - If you enter the Nominal coordinates of known points on a detail, you can position the detail by zeroing out the differences in position from nominal.
- Checking Flatness - If you measure a plane (or any other feature) you can observe the high and low spots (or radial and normal errors) by watching the measured feature.
- Checking Level - If you create a level coordinate system, you can watch the height value of various points on a surface relative to a vertical datum in order to level a tool.

Opening a Watch Window

You can open a watch window on either the Actual or Nominal values of a feature. You typically watch Actual features when you are checking drift and watch Nominal features when you are setting a detail. However, these are generalizations, you can use watch windows in many different ways.

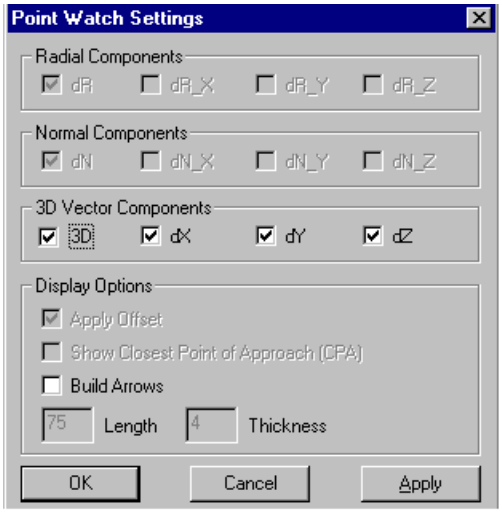
1. In the Gents worksheet, set focus on the feature you want to watch.
2. Click the Watch Window button on the Tracker or Theodolite Toolbar,  , from the View menu, choose Watch (Alt, V, W), or press F4.

FARO Insight opens the watch window at an arbitrary location on the screen; you can then move, resize or tile it.

You can open additional watch windows by repeating Steps 1 and 2.

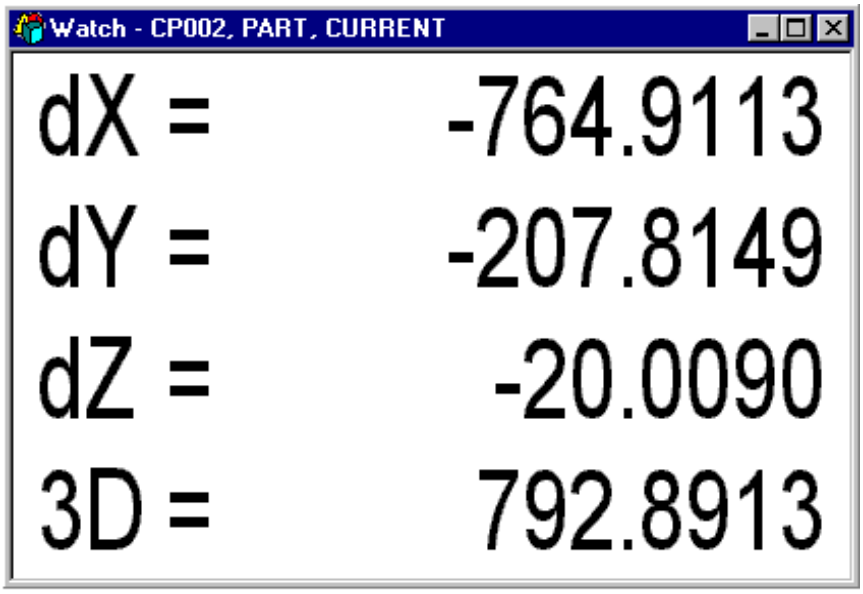
Watching various features

The watch windows are user configurable for each type of feature. A watch window is configured by right clicking on an open watch window or by selecting Watch from the Settings menu (Alt, S, W) with an open watch window.



Point Watch Settings Dialog

When the settings are configured as above the point watch window will look like this:



The Watch Settings Dialog will allow different settings for different feature types. The following table lists the types and their allowable settings. The Build Arrow settings are only available in FARO Insight *Visual*Pro and FARO Insight *Visual*.

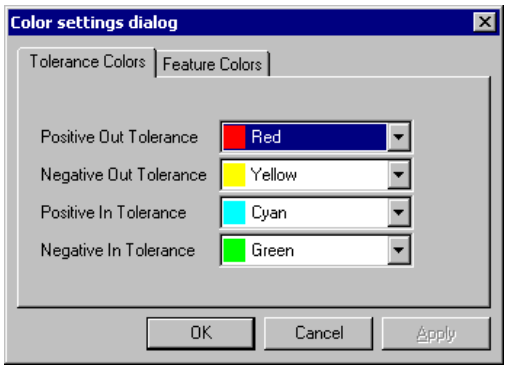
Feature Type	Radial	Normal	3D Vector	Offset	CPA	Build
Circle	X	X		X	X	X
Cone		X		X	X	X
Cylinder	X			X	X	X

Ellipsoid		X		X	X	X
Frame			X			
Hyperboloid		X		X	X	X
Line	X			X	X	X
Surfaces		X		X	X	X
Patch		X		X	X	X
Plane		X		X	X	X
Point			X			X
Paraboloid		X		X	X	X
Sphere	X			X	X	X
Station			X			

Watch Window Settings by Feature Type

Watch Window Tolerance

If a tolerance is applied to an actual feature, the watch window numbers will be displayed in colors to indicating if current position of the target is in our out of tolerance. The settings for display colors can be modified from Tolerance Colors tab in the Color Settings dialog box. This dialog can be accessed from the Colors option under the Settings menu (Alt, S, L). See the section "*Watch Windows with a Tolerance*" in the "*Graphics View window"* Chapter for more information on watch windows with a tolerance.



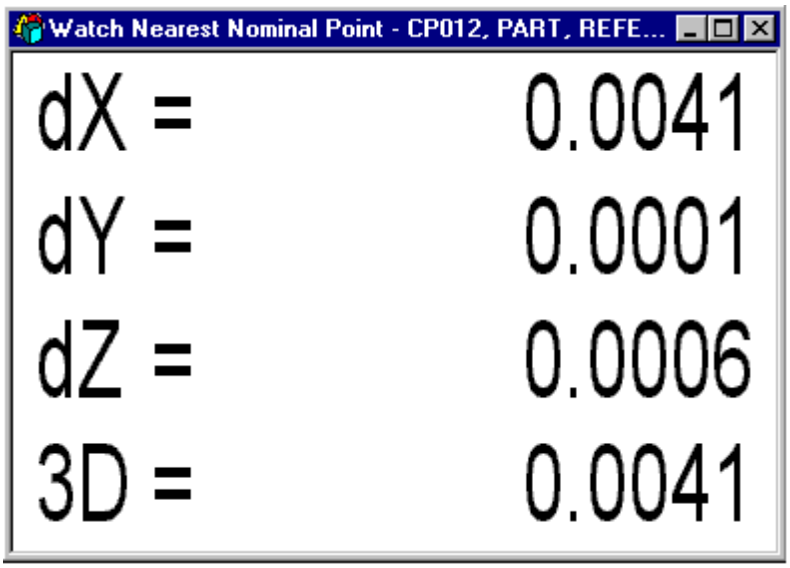
Tolerance Colors Tab in the Color Settings Dialog

Watch Nearest Nominal Windows

FARO Insight features a second type of watch window called a Watch Nearest Nominal Window. Watch Nearest allows you to open a single, large watch window that displays the difference in position between the probe and the *nearest nominal point*. As you move the probe from point to point, FARO Insight will determine, based on proximity, which is the appropriate nominal point with which to compare the probe location.

1. From the View menu, choose Watch Nearest Nominal, Point (Alt, V, N, P).

FARO Insight will open a Watch Nearest Point window. The window remains blank until the probe is moved to within the Lock-on Threshold of a nominal point (see *Setting Thresholds for Watch Nearest Windows* below).



2. Move the probe to the approximate location of any nominal point.

   When the distance between the probe and the nominal point is less than the Lock-on Threshold, FARO Insight will display the difference in position between the probe and the coordinates of the nominal point.

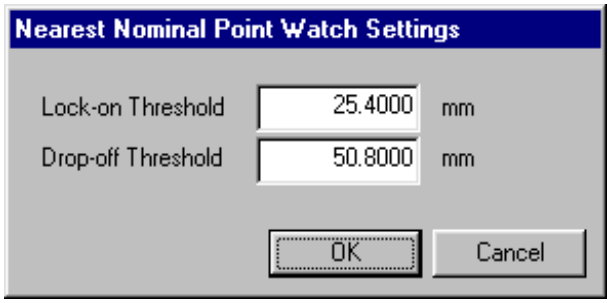
   When the probe is moved to a distance greater than the Drop-off Threshold from the point, the watch window will clear until the probe is again moved to within the Lock-on Threshold of a nominal point.

3. Initiating a measurement by pressing F3, or by using any of the menu options, will measure the actual point that corresponds with the nominal point being watched. If no acutal point exists in the spreadsheet, an actual point that has the same name as the nominal point will be created.

Setting Thresholds for Watch Nearest Windows

When using a Watch Nearest Nominal Window the Lock-on and Drop-off thresholds must be set. These parameters will tell FARO Insight when to lock on and drop off of specific nominals.

1. From the Settings menu, select Watch Nearest Nominal Point (Alt, S, N). FARO Insight displays the Nearest Nominal Point Watch Settings dialog.



2. Enter a value for the Lock-on Threshold. This is the maximum separation between the probe and a nominal point *before* which FARO Insight will begin to compare the probe position to the nominal point.

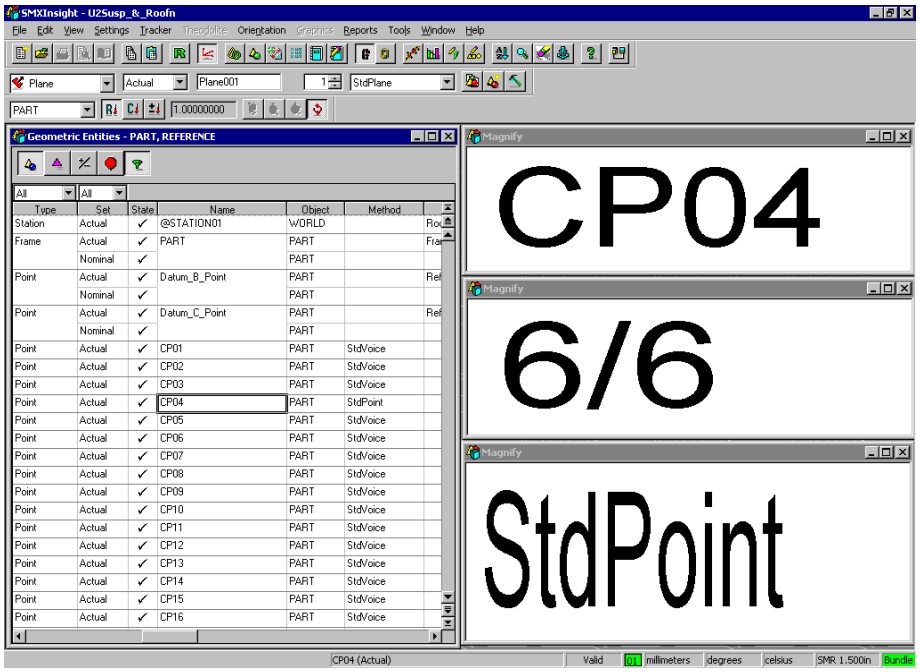
3. Enter the Drop-off Threshold. This is the minimum separation between the probe and a nominal point *beyond* which FARO Insight will no longer compare the probe position to the nominal point.

   The program will not accept Drop-off Threshold values that are less than or equal to the Lock-on Threshold value.

4. Press the 'OK' button.

Magnify Windows

A Magnify Window displays the contents of one cell within a column in a window that can be resized and placed on the screen for increased visibility. You can magnify the contents of virtually any column, but the most common ones are the Name, Obs, Method, and State columns. Magnify windows allow you to see, from a distance, which feature has the focus, whether or not it has been observed, what the method of observation is, whether or not the feature fit was successful, etc.



Magnify Windows for Name, Obs and Method

When you magnify a column, FARO Insight opens a window that displays the contents of *that column* for the feature that has the focus. When you change focus to another feature, the values for that feature *in the columns you have magnified* are displayed. For example, if you magnify the Name column, FARO Insight displays the name of whichever feature has the focus.

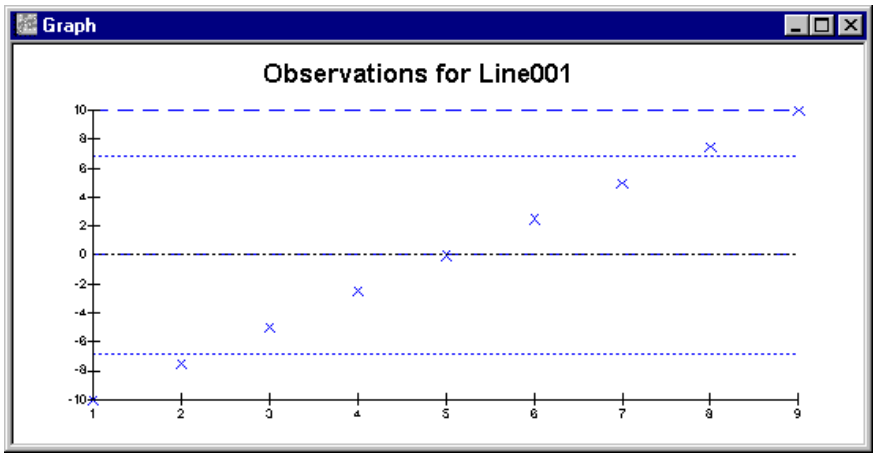
Magnifying a column

1. In the Gents worksheet, set focus on any cell in the column you want to magnify.
2. Click the Magnify button on the Standard Toolbar, , or from the View menu, choose Magnify (Alt, V, M).

FARO Insight opens a window with the contents of the column displayed. You can then move and resize the window as necessary.

Graph Windows

A Graph window displays a series of data that shows the mean value, standard deviation, minimum value and maximum value of the data. Graph windows are ideal for plotting residuals from a feature fit, and for plotting a set of coordinates in order to detect trends in data.



A Graph of Observations

The mean, minimum, and maximum values are marked with coarse dotted lines, and the standard deviation with fine dotted lines. Magnitude is displayed along the vertical axis and the data is numbered consecutively from left to right along the horizontal axis for identification purposes.

Graphing a series of values

You can graph data from the Geometric and Scalar Entities worksheets, as well as from an Observations worksheet.

1. Select the cells whose contents you want to graph. If you select a range of columns, FARO Insight displays only the first column.
2. Click the Graph button from the Standard Toolbar, , or from the View menu, choose Graph (Alt, V, R).

3. FARO Insight will prompt you for a title for the graph. You may enter a name if so desired, but it is not necessary. To enter a graph title, type in the name and click the OK button. To continue with out entering a title, simply click the Cancel button.

   FARO Insight opens a window with the selected data in a graph. You can then move and resize the window as necessary.

Importing, Reporting, Exporting and Printing

Importing

You can import ASCII text data directly into the Actual, or Nominal records in the Gents worksheet, or into the Observation worksheet for a geometric entity. FARO Insight currently contains two methods for importing data, Import and Enhanced Import.

The Import feature may be used to import nominal circle, line, plane, point, sphere, and cylinder features directly into a Gents worksheet or the names of any actual feature. Import may only create one type of feature at a time. The Enhanced Import feature may be used to import actual names and nominal point, line, circle, or plane features simultaneously. The Enhanced Import may create up to four features with the same name (two actual and two nominal) at a time.

It is also possible to import IGES and CATIA files with FARO Insight *Visual*Pro. See the chapter covering FARO Insight *Visual*Pro for more details.

Standard Import

Import File Formats

The data you import may be in a comma, space, or tab delimited ASCII file. The Enhanced Import is capable of importing ASCII text or a design file. If you are importing Nominal features into the Gents worksheet, each record may begin with a feature name. However, if no name is specified, FARO Insight will assign a default name. Subsequent fields in each record must contain the coordinates, vector components, radii, etc., necessary to completely describe a feature of the type being imported. If you are importing observations, names are not permitted, and there can be only three columns of coordinate data. Native ManCAT *.REF files are not useable unless modified.

If you want only to declare Gent or Sent names, the import file should contain only valid feature names listed in one column

Importing Nominal Features

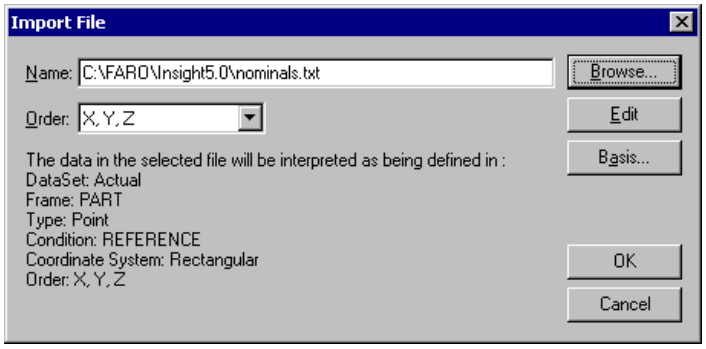
Nominal circle, line, plane, point, sphere, and cylinder features can be imported directly into a Gents worksheet using the Import feature.

1. Select Nominal from the Set filter.
2. Select the appropriate feature type from the Type filter.

3. Make sure the displayed unit of length matches the units of the import data. If not, change the display units to match the import units.

4. From the File menu, choose Import then Standard (Alt, F, I, T).

   FARO Insight displays the Import File dialog box.



Import File dialog

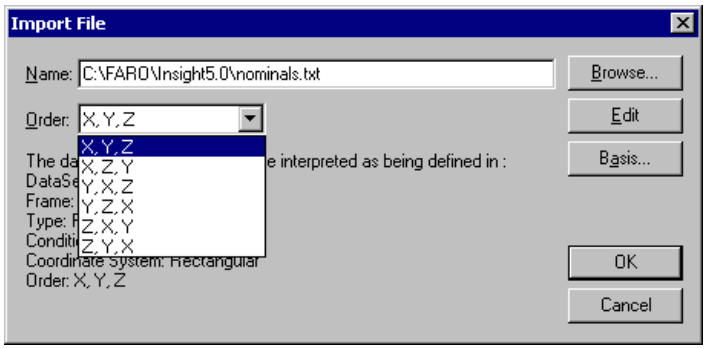
5. Press the 'Browse' button and use the Browse dialog to select the file that contains the Nominal coordinates.

   The summary in the Import File dialog should indicate that the data is in the set and type you selected in Steps 1 and 2. If not, close the dialog and start over at Step 1.

6. By pressing 'Edit', you can open the import file in a text editor to confirm it is the correct file or make changes to the file.

7. Select the Basis button to open the Display Settings dialog. Change the settings to the desired frame, scale, and coordinate system settings for the import data and click 'OK' to return to the Import File dialog. Normally, nominal features are to be imported in the PART frame and REFERENCE condition.

8. Select the import order of the nominal feature coordinates in the text file using the drop down list arrow on the right side of the selection box.



Import File dialog with the Order drop down list activated

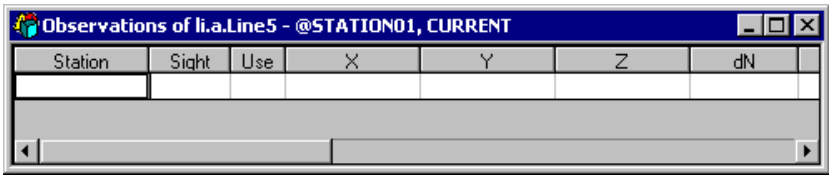
9. Press 'OK' to import the features.

Importing Actual features and observations

The ability to import observations allows you to take data acquired with another measurement system and analyze it as though it was measured within FARO Insight.

1. Set the displayed unit of length to match the units of the import data.
2. Set the display frame to '@STATION01' and the condition to CURRENT.
3. Declare an Actual feature of the Type you want to import. Assign a method to it.
4. Press the Observations button, , or press the right mouse button on the feature whose observations you want to enter and choose Observations from the speed menu that appears.

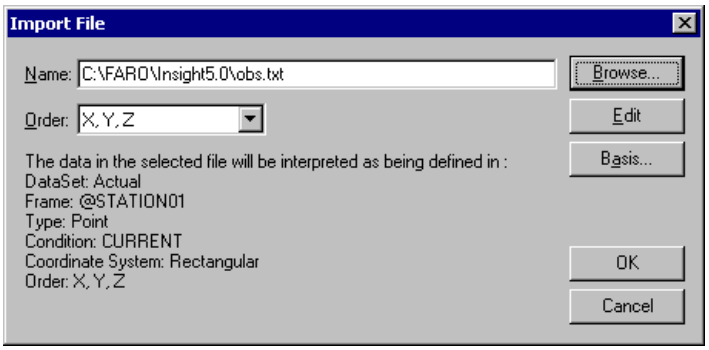
   FARO Insight displays the Observations Window.



Observations Window

5. From the File menu, choose Import, then Standard (Alt, F, I, T).

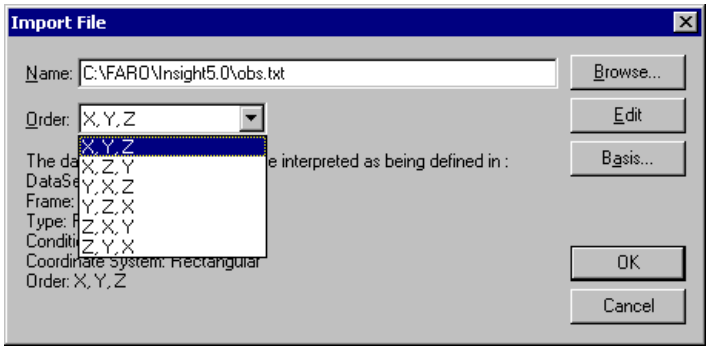
   FARO Insight displays the Import File dialog.



Import File dialog

6. Press the 'Browse' button and use the Browse dialog to select the file that contains the import observations.

   The summary in the Import File dialog should indicate that the data is in the Actual set, and the frame and condition you selected in Steps 2 through 3. If not, close the dialog and repeat Step 2.
7. By pressing 'Edit', you can open the import file in a text editor to confirm it is the correct file or make changes to the file.
8. Select the import order using the drop down list arrow on the right side of the selection box.



Import File dialog with the Order drop down list activated

9. Click ‘OK’ to import the observations.
10. Close the observation window.

Enhanced Import

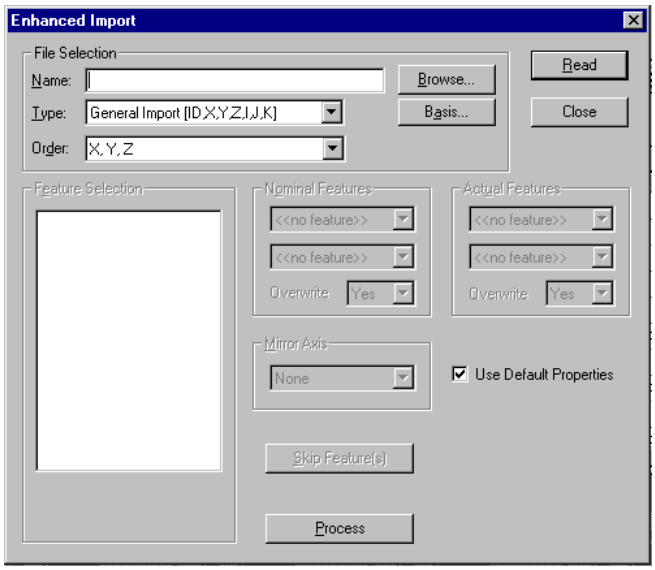
The Enhanced Import feature may be used to import multiple features simultaneously. For example, a single data file may be imported to create all of the entities necessary to best fit to tooling ball values.

Data must be in either ASCII text (*.csv, *.txt, or *.prn) or design (*.des) format. ASCII text files must be in the following format: name, x, y, z, i, j, k. The i, j, k values are only needed if the imported feature has a vector associated with it.

Selecting and Reading in Files

1. Make sure the displayed unit of length matches the units of the import data.
2. Under the File menu, select Import, then Enhanced Import (Alt, F, I, E).

   The Enhanced Import dialog box will appear:



Enhanced Import dialog

3. Select the name of the import file by either typing it in the Name box or open the browser by pressing the ‘Browse’ button, then select the import file. In the browser, the ‘List Files of Type’ filter may need to be set to view the desired files.

4. Select the Basis button to open the Display Settings dialog. Change the desired frame, scale, and coordinate system settings for the import data and press OK to return to the Enhanced Import dialog.

5. Set the Type of file to match the format of the import file by clicking on the pull down menu next to Type. The General Import type is used for ASCII text.

6. Select the import order using the pull down menu next to Order.

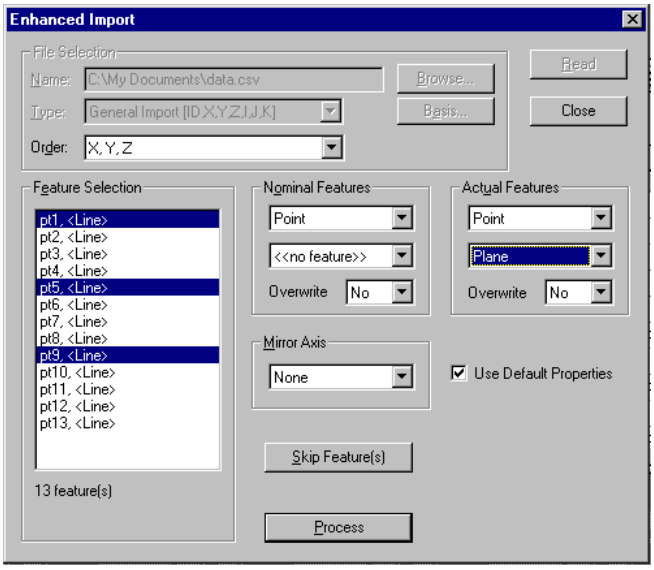
7. Press ‘Read’ and FARO Insight will list all of the names of the features from the import file in the Feature Selection box. If the import file does not match the designated file type, an error message will appear.

Defining the Features to be Created

1. Select the items to be edited. Different entities may be created for each item in the import file by selecting the item in the Feature Selection box. The feature selection box is a multi-select list (more than one item may be selected by pressing the SHIFT key to select adjacent items, or hold the CTRL key to select non-adjacent items).

2. Select the type of features to create. The Enhanced Import will allow four features (two actual and two nominal) to be imported at a time for each item in the import file. The types of features may be selected from the pull down menus under ‘Nominal Features’ and ‘Actual Features’ respectively. If less than four features are needed, select ‘<<no feature>>’ from the pull down menu. If there is an item in the import file that does not need to be used, select that item from the Feature Selection list and click on ‘Skip Feature.’

   In the example below, we will create a nominal point, an actual point, and an actual plane for items “pt1, pt5, and pt9.”



Enhanced Import Dialog

3. The ‘Overwrite’ drop down menus determines if the values in the import file should overwrite existing values in the Gents worksheet. Set each Overwrite to Yes or No.

Other Settings

The ‘Mirror Axis’ pull down menu allows an axis and vector to be selected as a line of symmetry. FARO Insight will change the sign of the value in the designated direction. For example, if the X-axis is designated as the mirror axis and the X value in the import file is positive, the sign of the X value would be changed to negative. Select the Mirror Axis if necessary.

The ‘Use Default Properties’ will create the actual features and give them the default properties set from the Settings, Default Properties menu.

Processing the File to Create Features

Press ‘Process’ and FARO Insight will import the nominal entities and create corresponding actual entities as defined in the previous sections.

FARO Insight Standard and Custom Reports

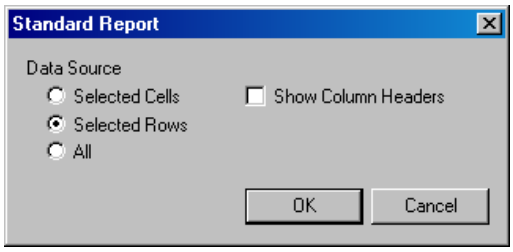
FARO Insight can generate Standard and Custom reports from which user selected information can be printed and exported.

Preparing a Standard Report

A Standard Report can be created from any standard spreadsheet style window in FARO Insight®. When a valid window is open, the Standard Report toolbar button and menu option will become available.

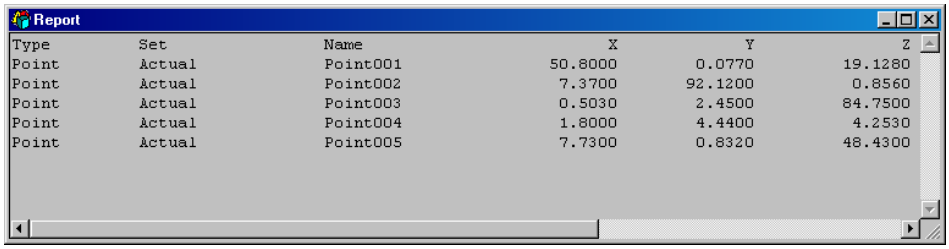
Open the window from which the operator would like to make a Standard Report.

From the Reports menu select Standard (Alt R, S) or click the  toolbar button. The Standard Report dialog box will appear.



Standard Report Dialog

This dialog box allows the user to select what data to report. The ‘Show Column Headers’ checkbox may be checked if the user would like to see column headers appear at the top of the report. If ‘Selected Cells’ is selected, any/all cells that are currently highlighted in the last active window will be printed.



Report

Type	Set	Name	X	Y	Z
Point	Actual	Point001	50.8000	0.0770	19.1280
Point	Actual	Point002	7.3700	92.1200	0.8560
Point	Actual	Point003	0.5030	2.4500	84.7500
Point	Actual	Point004	1.8000	4.4400	4.2530
Point	Actual	Point005	7.7300	0.8320	48.4300

Sample Standard Report with selected Cells and Column Headers options selected

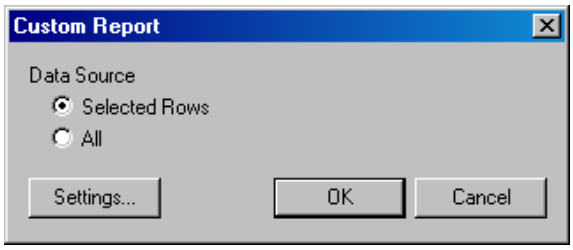
If 'Selected Rows' is selected, the entire row will be printed for any/all cells that are currently highlighted in the last active window. If 'All' is selected, the entire active sheet will be printed. The column width in the report will be based off of the column with that is displayed in the window from which the reported information is selected.

Preparing a Custom Report

A Custom Report can be created from a Geometric Entities worksheet, a Scalar Entities Worksheet, an Observations Window, or a Deviations Window. When a valid window is open, the Custom Report toolbar button and menu option will become available.

Open the window from which the operator would like to make a Custom Report.

From the Reports menu select Custom (Alt R, C) or click the  toolbar button. The Custom Report dialog box will appear.



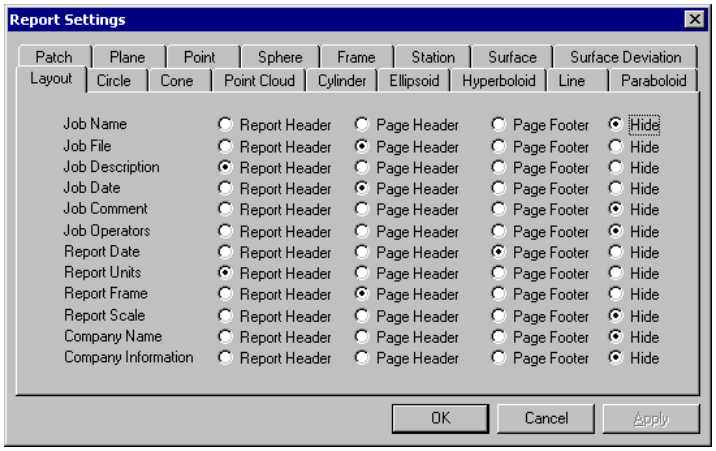
Custom Report Dialog

This dialog box allows the user to select what data to print. Again, if 'Selected Rows' is selected, the entire row will be printed for any/all cells that are currently highlighted in the last active window. If 'All' is selected, the entire active sheet will be printed. A Custom Report generated from an Observations Window or a Deviations Window will not allow the operator to use the 'Selected Rows' option. In this case, only the entire window may be reported.

Adjusting the Settings of a Customized Report

With a FARO Insight Custom Report, the user can customize what information will be displayed in the report's headers and footers. In addition, the user can customize what information will be displayed in the report for each type of item in the active window.

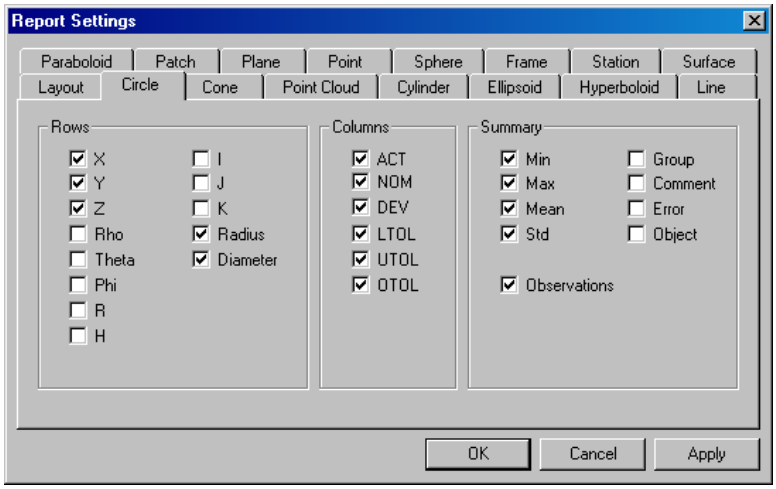
The 'Settings' button in the Custom Report dialog box will display the Custom Report Settings dialog box.



Custom Report Settings Dialog for a report from the Gents sheet

From the Layout tab, the user is able to define what information will appear as headers or footers in the Custom Report. Items selected for the 'Report Header' will be displayed only at the top of the first page of the Custom Report. Items selected for 'Page Header' will be displayed at the top of every page of the custom report. Items selected for 'Page Footer' will be displayed at the bottom of every page, and finally, items checked 'Hide' would not be displayed on any pages.

The other tabs in the Report Settings dialog box allow the user to select what data is printed for each type item specific to the active window from which the report is to be generated. With the Report Settings dialog box open, the user can click on any of the tabs and select what information it to be printed to the report. Note that the tabs will be different depending upon what window the report is being generated from.

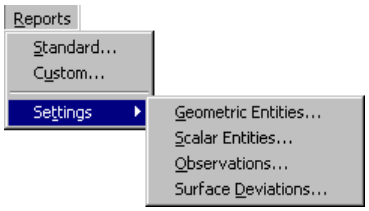


Report Settings for a Circle

Changes made in the Report Settings dialog will be considered a global change in FARO Insight. This means that any changes will be remembered by FARO Insight and will be the same in any other job file opened.

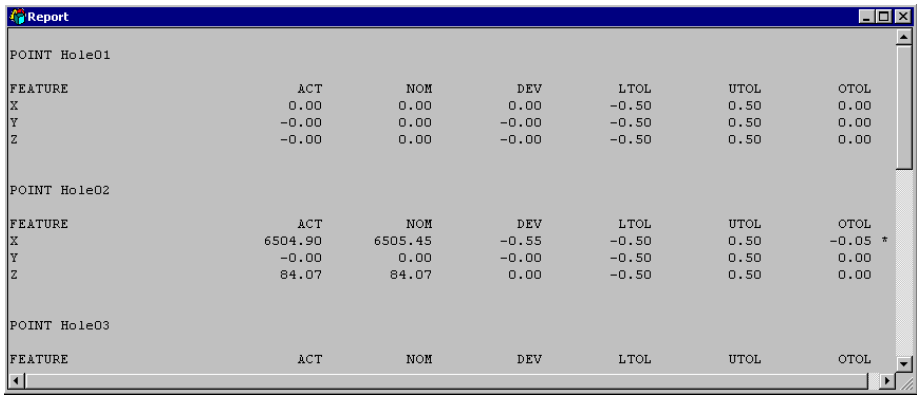
In addition to the 'Settings' button in the Custom Report dialog box, the Report Settings dialog box may be accessed directly through menus. To access the Report Settings dialog box using FARO Insight menus, click on the Reports menu, then Settings (Alt, R, T). The user can then choose the Report Settings dialog box for the

Geometric Entities worksheet, the Scalar Entities worksheet, the Observations Window, or the Deviations Window.



Selecting the Report Settings Dialog from the menus

Once all settings have been arranged as desired, a Report Window can be created.



Report

POINT Hole01

FEATURE	ACT	NOM	DEV	LTOL	UTOL	OTOL
X	0.00	0.00	0.00	-0.50	0.50	0.00
Y	-0.00	0.00	-0.00	-0.50	0.50	0.00
Z	-0.00	0.00	-0.00	-0.50	0.50	0.00

POINT Hole02

FEATURE	ACT	NOM	DEV	LTOL	UTOL	OTOL
X	6504.90	6505.45	-0.55	-0.50	0.50	-0.05 *
Y	-0.00	0.00	-0.00	-0.50	0.50	0.00
Z	84.07	84.07	0.00	-0.50	0.50	0.00

POINT Hole03

FEATURE	ACT	NOM	DEV	LTOL	UTOL	OTOL

Custom Report Window

Print, Print Preview and Print Setup

Once a Report window has been generated or if a Graphics window is opened, all of the Print options in FARO Insight become available. From the File menu, select Print Preview (Alt, F, V), or click on the toolbar button. This will permit the user to see a preview of what will physically be printed. If it is not necessary to view the document before it is printed, the user may go directly to printing. Again from the File menu, select Print (Alt, F, P), or click on the toolbar button. FARO Insight will send the document to the currently configured default printer to be printed. If it is necessary to make changes to the print properties, either click on the toolbar button, or from the File menu, select Print Setup (Alt, F, U), and make the appropriate print setup changes.

If only the Geometric Entities Sheet, an Observations window, or a Deviations window is opened, only the Print and Print Setup options are available. The user can highlight specific cells in one of these windows and then select the Print option to send the data to a printer.

Exporting

FARO Insight has multiple exporting capabilities.

- Data can be exported to text files in the form of Standard or Custom reports.

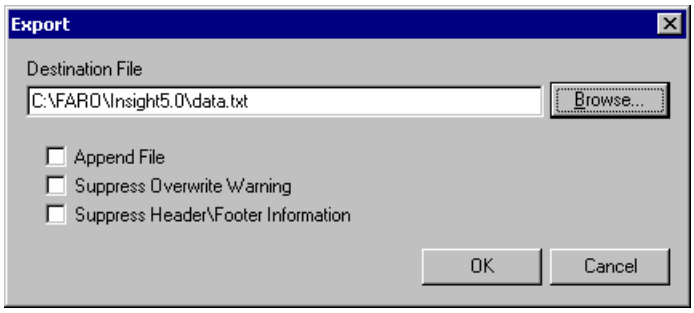
- Data can be exported through a linked Microsoft Excel Macro or directly to a Microsoft Excel worksheet.
- Data can be exported as a CATIA file (covered in the chapter on FARO Insight *Visual*Pro).
- Data can be exported in a C3DF Report.
- NURBS surfaces can be exported to an IGES file (covered in the chapter on FARO Insight *Visual*Pro).
- Point clouds can be exported to a text file (covered in the chapter on the Graphics View Window).
- Point cloud can be exported to an IGES file (covered in the chapter on FARO Insight *Visual*Pro).

Note: The export dialog boxes described in the following sections contain options that the user can use to customize the export. These options are reset to default values when FARO Insight is closed.

Exporting Data to Text Files

Once a Report window has been generated, the report can be exported to a text file. The Report Export dialog box can be accessed by selecting Export from the File menu, and then by selecting Report (Alt, F, E, R). The name and location of the file to be created will be displayed in the 'Destination File' box. The user may click the 'Browse' button to search for the proper directory.

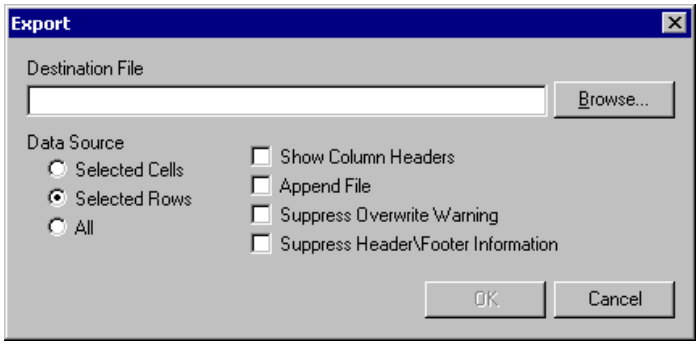
FARO Insight can create text files with three different file extension options: *.txt, *.prn, or *.csv. Once a proper path and file name with one of these three extensions is entered, the 'OK' button will become active. The user can then click the 'OK' button to save the file.



Export Dialog

In addition, there are three options available when exporting. By clicking the appropriate box, the operator can choose to append an existing file, can choose that have FARO Insight not warn the user that an existing file will be overwritten and can choose to not export the header/footer information specified in the Report Settings dialog box for Custom Reports. For Standard Reports, the Header\Footer Information will pertain to the file Summary information.

The user can also export data directly to a text file by highlighting the desired cells, and by selecting Export, then Text from the File menu (Alt, F, E, T).



Export Dialog

When exporting data directly to a text file, the user has several options. Four options are 'Selected Cells', 'Selected Rows', 'All', and 'Show Column Headers.' These options work identically to the options when generating a Standard Report Window. The 'Append File', 'Suppress Overwrite Warning', and 'Suppress Header\Footer Information' options work identically to the Export Report options.

Once the desired options have been selected and a file name with either a .txt, .prn, or .csv file extension has been entered, the 'OK' button will be activated and the data can be exported. After the 'OK' button is selected, FARO Insight will generate and open a Standard Report window and the text file that was created or appended.

Exporting to a Customized Microsoft Excel Macro

Note: This option only available *on* systems that have MS Excel installed

You can easily export your data to a custom report created with an Excel Auto Open macro. Please note a user can not select a set of data for macro processing that is incompatible with the selected macro.

Configuring FARO Insight to run a custom Excel Macro

1. Open FARO Insight Settings file from the FARO Insight program group.
2. Find the Section labeled `[Excel].` This section should appear similar the following:

   ```
   [Excel]

   excel=C:\Program Files\Microsoft Office\excel.exe
   dir=C:\FARO\Insight\books
   transfer=insight.csv
   printer=printer.xls
   workbook=workbook.xls
   ```

   Ensure that the filename path found at the line, "**`excel =`**" is configured to point to the proper location of the Excel executable.
3. Increment the line "**`workbooks = n`**" by n + 1 too add a new workbook macro.
4. Add a line below any existing macro add-ons using the following format.

```
<num>=<workbook name>, <export option>, <description in
quotes>
```

<num> = workbook index number
<workbook name> = the name of the excel file that contains the macro
<export option> = the type of data that will be sent to the "insight.csv" data file used by the Excel macro.
These options are:

1 - Geometric Entities.
2 - Geometric Entities and Observations.
3 - Scalar and Geometric Entities.
4 - Scalar and Geometric Entities and Observations.
5 - Scalar Entities.

<description> = Brief description of the macro. Use "\n" to mark carriage returns in the description text.

Example:

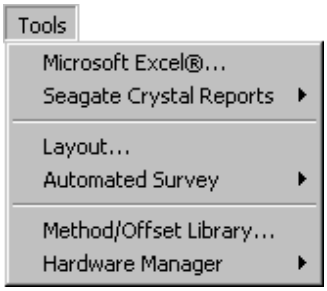
```
workbooks=2
default=2
1=printer.xls, 5, "Print all scalars.\n Return
to FARO Insight"
2=sample.xls, 1 ,”Print all Gents.\n Return to
FARO Insight”
```

5. Find the line under "`workbooks=`" labeled "`default=`". Enter the index number of the macro file that you want to appear as the default selection in the Microsoft Excel Macro Dialog box.

Note: The text entered into the FARO Insight Settings File must be formatted exactly as shown above. If it is not, the custom Excel Macros will not run properly.

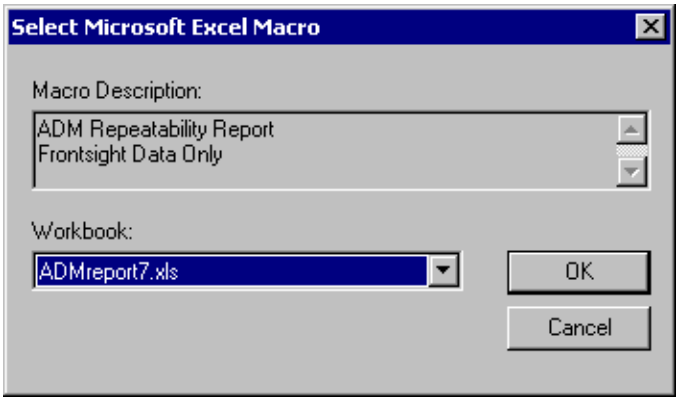
To run the Excel Macro

1. In FARO Insight, select Microsoft Excel Macro under the Tools menu (Alt, L, E).



Tools Menu

The Select Microsoft Excel Macro dialog will appear.



Select Microsoft Excel Macro Dialog

2. Select the Workbook from the drop down menu to be used and press the 'OK' button.

FARO Insight does not create the report macro automatically. See your Excel manual for instruction on how to create a report macro.

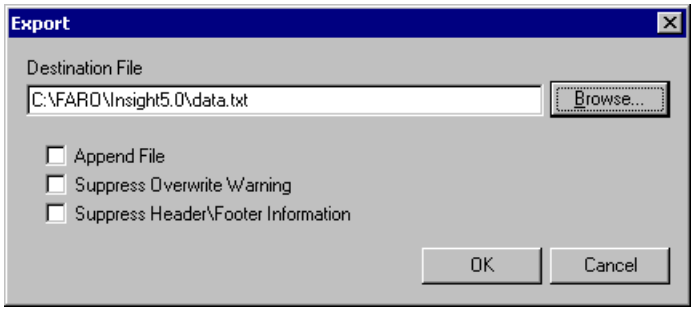
Exporting Data to a Microsoft Excel Workbook

Note: This option only available *on* systems that have MS Excel installed

Once a Report window has been generated, the report can be exported to a Microsoft Excel workbook. The export is identical to a text export except that FARO Insight will automatically launch MS Excel and open the text file. The FARO Insight Settings file from the FARO Insight program group must be modified as indicated in steps 1 and 2 from the section in this chapter entitled "Printing to a Customized Microsoft Excel Macro."

The Export dialog box can be accessed by selecting Export from the File menu, and then by selecting Microsoft Excel (Alt, F, E, E). The name and location of the file to be created will be displayed in the 'Destination File' box. The user may click the 'Browse' button to search for the proper directory.

FARO Insight can create text files with three different file extension options: *.txt, *.prn, or *.csv. Once a proper path and file name with one of these three extensions is entered, the 'OK' button will become active. The user can then click the 'OK' button to save the file.



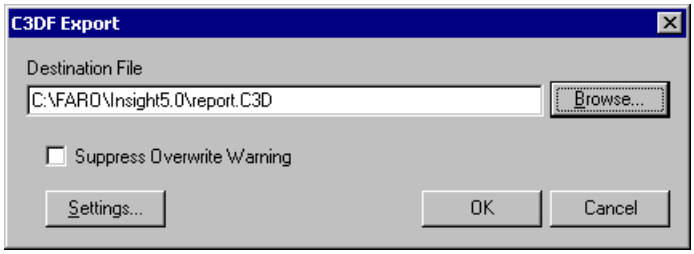
Export Dialog

In addition, there are three options available when exporting. By clicking the appropriate box, the operator can choose to append an existing file, can choose that have FARO Insight not warn the user that an existing file will be overwritten and can choose to not export the header/footer information specified in the Report Settings dialog box for Custom Reports. For Standard Reports, the Header\Footer Information will pertain to the file Summary information.

C3DF Reporting

C3DF (Chrysler CMDANA CMM DATA FORMAT) is a specific report format that DiamlerChryser uses to send measurement data to a central CMM database. FARO Insight can create reports using this format.

To create a C3DF report, open up the Gents sheet and highlight the features that need to be reported. Note that the first 10 characters of a feature's name must be unique to the job file. FARO Insight will automatically report the proper information that needs to be exported for each feature type, so it is only necessary to highlight any cell in a feature's row for it to be reported properly. If only one cell is selected, FARO Insight will assume that all features are to be exported. Once the proper cells have been selected, the user clicks on the File menu, then Export, and then C3DF (Alt, F, E, 3). The following dialog box will come up.

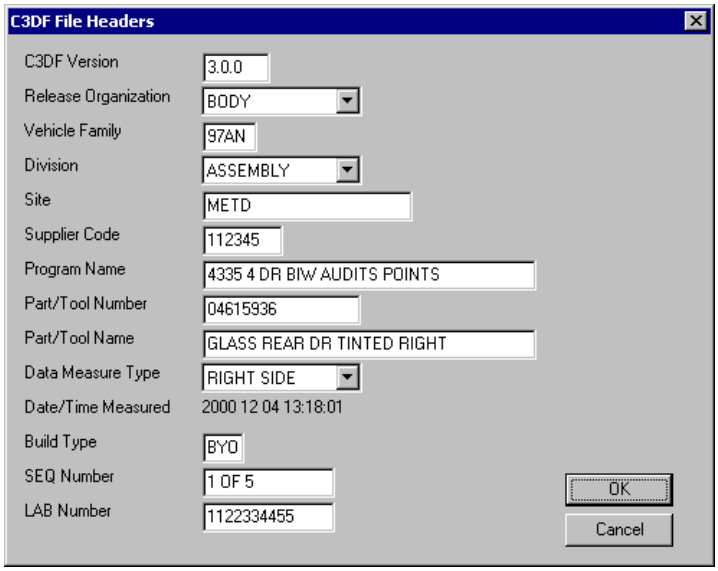


C3DF Export Dialog

Similar to the regular Export dialog box, the destination file name and location must be specified. The file can only have a *.C3D extension name. Once a proper file name and location is entered, the 'OK' button will become activated. Press 'OK' to save the file. FARO Insight will then automatically open the file for the user to view. If the 'Suppress Overwrite Warning' option is checked, then FARO Insight will not warn the user that the file name specified already exists and will overwrite the old file with the new one.

C3DF File Headers

The 'Settings' button in the C3DF Export dialog box will open up the C3DF File Headers dialog box. This dialog can also be accessed by selecting Settings then C3DF (Alt, S, 3) from the main menus. This dialog box allows the user to enter the appropriate header information that will be specific to the report.



C3DF File Headers Dialog

Adjusting fields in the C3DF File Headers dialog box

Fields available in the C3DF File Headers dialog box can be added, deleted, or modified by making changes to the 'insight.ini' file. This file can be accessed from the Microsoft Windows Start menu by selecting Start, Programs, FARO, FARO Insight 5.0, and finally, FARO Insight Settings. The default 'insight.ini' file profile looks like the following figure.

```
[C3DF File Headers]
Count=14
1="C3DF Version",Edit,5,"3.0.0"
2="Release Organization",DropList,"BODY,CHASSIS,ELECTRICAL,TRIM,POWERTRAIN","BODY"
3="Vehicle Family",Edit,4,"97AN"
4="Division",DropList,"STAMPING,ASSEMBLY","ASSEMBLY"
5="Site",Edit,16,"SMX"
6="Supplier Code",Edit,6,"112345"
7="Program Name",Edit,31,"4335 4 DR BIW AUDITS POINTS"
8="Part/Tool Number",Edit,12,"04615936"
9="Part/Tool Name",Edit,31,"GLASS REAR DR TINTED RIGHT"
10="Data Measure Type",DropList,"RIGHT SIDE,LEFT SIDE,MERGED,ASYMMETRICAL","RIGHT SIDE"
11="Date/Time Measured",DateTime,"YYYY MM DD HH:NN:SS",""
12="Build Type",Edit,3,"BYO"
13="SEQ Number",Edit,10,"1 OF 5"
14="LAB Number",Edit,10,"1122334455"
```

Default 'insight.ini' file settings for the C3DF File Headers section

In general, the section must contain a count entry followed by at least one file header row description entry. The count entry must contain a positive integer value that indicates how many file header rows will be used in the C3DF file header. The index numbers of the file header row description entries must begin at one and increase sequentially by one. There must be at least as many row description entries as specified by the count value. If the count value is less than the number of row description entries present, the row description entries with indices greater than the count value are ignored. Furthermore, each file header row description entry must conform to one of the following formats:

Format 1:

<index> = "<name>",Edit,<max string length>,"<default string>"

The “name” field must be a text string contained in quotation marks. The string may contain spaces but may not exceed the length specified by the C3DF 3.0.0 specification. Refer to the C3DF 3.0.0 specification for details.

The “Edit” field indicates that the file header row specified by the index shall be presented in the C3DF File Headers Dialog as an edit control. The control shall limit the length of the text string to the number of characters specified in the subsequent field.

The “default string” field must be a text string contained in quotation marks. The string may be empty if no default text is desired and the string should be in all capital letters.

Format 2:

<index> = “<name>”,DropList,“<comma-separated list of strings>”,“<default string>”

The “name” field must be a text string contained in quotation marks. The string may contain spaces but may not exceed the length specified by the C3DF 3.0.0 specification. Refer to the C3DF 3.0.0 specification for details.

The “DropList” field indicates that the file header row specified by the index shall be presented in the C3DF File Headers Dialog as a drop list control. The control shall offer a list of text selections constructed from the comma-separated list of strings supplied in the subsequent field. The list of strings should be in all capital letters.

The “default string” field must be a text string contained in quotation marks. Furthermore, the string supplied must match one of the strings supplied in the comma-separated list. An empty string is not allowed. The string should be in all capital letters.

Format 3:

<index> = “<name>”,DateTime,“<date-time format string>”,“”

The “name” field must be a text string contained in quotation marks. The string may contain spaces but may not exceed the length specified by the C3DF 3.0.0 specification. Refer to the C3DF 3.0.0 specification for details.

The “DateTime” field indicates that the file header row specified by the index shall be presented in the C3DF File Headers Dialog as an edit control. The control shall limit the length of the text string to the length implied by the format string specified in the subsequent field. The control shall also check the user's input against the supplied format string for correctness. The format string may contain any permutation of the codes “YY”, “MM”, “DD”, “HH”, “NN”, “SS” as well as white space and punctuation characters for formatting. However, the string supplied with FARO Insight is the one that conforms to the C3DF 3.0.0 specification. It should only be changed if it the C3DF specification for date-time strings changes.

The “default string” field must be an empty string contained in quotation marks. It is reserved for future developments.

If the user adds more than 14 rows to the file header, the C3DF File Headers Dialog will contain a vertical scroll bar. The scroll bar will allow the user to scroll the additional rows of controls into view for editing.

Note: For all three formats, the text “Edit”, “DropList”, and “DateTime” is case sensitive.

Creating and Printing Seagate Crystal Reports

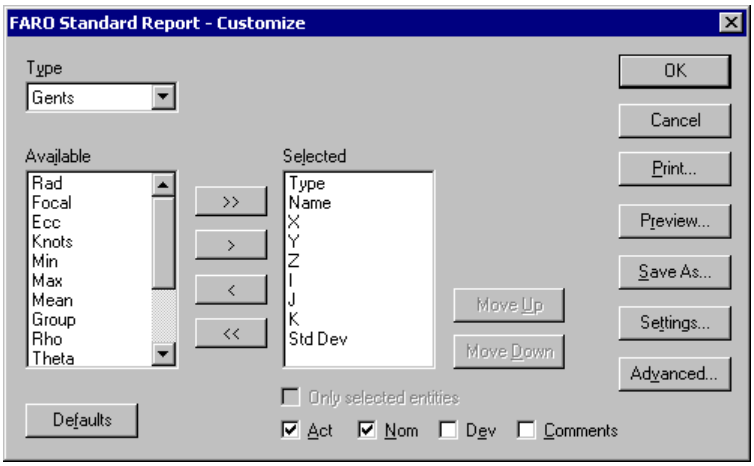
Separate from the FARO Insight Standard and Custom Reports, FARO Insight offers the Seagate Crystal Report as another format for creating reports. The Seagate Crystal Report generates a customized report form in which selected information from FARO Insight can be displayed. Features include the ability to:

- Customize the report content.
- Change the report format settings.
- Perform complex queries, sorting, and grouping.
- Save the current report for future printing.
- View the existing report with a print preview.

Customizing the Report Content

Three default report formats can be set up one for the Geometric Entities Spreadsheet, one for the Scalar Entities Spreadsheet and one for the Observation Spreadsheet. You can change the options for any of these reports and save the changes as a new Default.

1. From the Tools menu, choose Seagate Crystal Report, and then Create… (Alt L, R, C).
2. Select the type of report, fields to be included in the report and whether actual and/or nominal data are to be included. The left and right arrows move selected fields between the Available and Selected areas. The double arrow moves all fields. The Up and Down arrows change the order selected items.



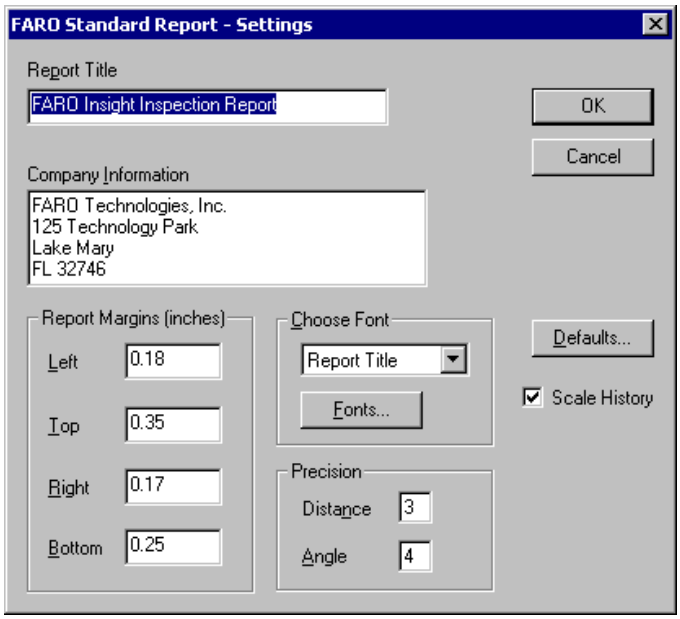
FARO Standard Report – Customize Dialog

Changing the Report Format Settings

The report fonts, margins and titles can be set and saved as default.

1. From the FARO Standard Report - Customize dialog box, select the ‘Settings…’ button.

2. Enter the Report Title, Company Information, Margins, Precision and Fonts.



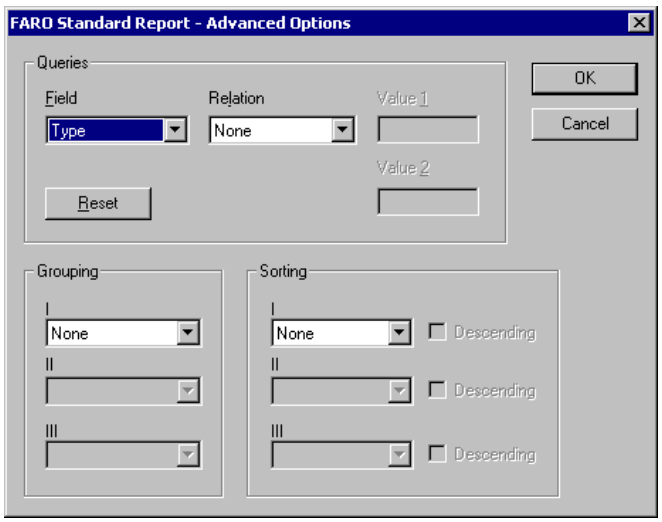
FARO Standard Report – Settings Dialog

3. The ‘Defaults…’ button allows you to restore the original settings.

Performing Complex Queries, Sorting, and Grouping

The Seagate Crystal Report enables you to filter a report based on field values, group features and sort hierarchy.

From the FARO Standard Report - Customize dialog box, press the ‘Advanced…’ button.



FARO Standard Report - Advanced Options Dialog

Queries - Allows the user to select the field to set the filtering attribute. The Relation and Value boxes will adjust depending on the Field that is selected. The Reset button clears the current Query. The Cancel button closes the dialog and does not save any changes. The Queries can be previewed and printed from the FARO Standard Report - Customize dialog.

Examples:

- To view all features whose name starts with string "dat" – Select "Name" in the Field and select "Starts With" as the Relation and then enter "dat" in Value1 and press OK.
- To view all features whose names end with string "xyz" and with Tolerance less than 0.5 – Select the "Name" in the Field and select "Ends With" in Relation and then enter "xyz" in Value1. Then select "Tol" in the Field and "<" in Relation and then Enter 0.5 in Value1.

Grouping - Provides the user with 3-levels of grouping by Field. In the case the user wishes to reselect/nullify his grouping at a level, then all the below groups are also nullified.

Examples:

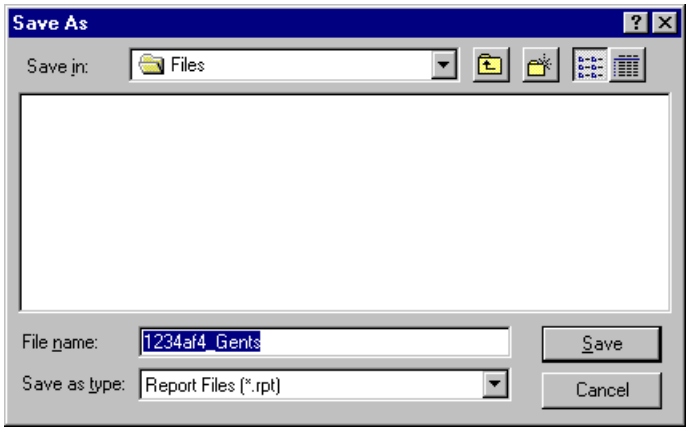
- To group by "Type" the user needs to select the "Type" in Group I combination box.
- To group by 2-levels the user selects a field in the Group I as well as Group II combination box.

Sorting - Allows the user to sort by any Field with up to three sort levels. By default the sorting is done in increasing order for any field specified. The user can override this by checking the Descending checkbox and the field will be sorted in descending order.

Saving the Current Report

Seagate Crystal Reports can be saved for future printing by FARO Insight. The reports are saved as ".rpt" file.

From the FARO Standard Report - Customize dialog box, press the 'Save As…' button.



Save As Dialog

Previewing a Report

Seagate Crystal Reports can be previewed prior to printing or saving.

From the FARO Standard Report - Customize dialog box, press the ‘Preview…’ button.

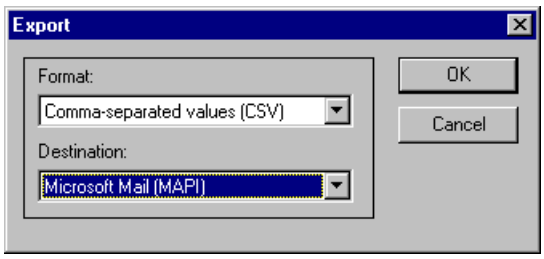
Preview Window

The Preview Window displays the data along with all the current settings and queries applied. Icons along the toolbar allow for direct printing/exporting, display sizing, and moving between pages.

The  buttons to move to the next page, previous page, top of the report and end of the report are available.

The print button,  , prints directly to the default printer.

The export button,  , is for exporting to a user selected file type. Pressing this button opens the export dialog box.



Export Dialog

The report can be exported in many different formats (CSV, Text, and Tab Separated, Word, Excel, Access, HTML, etc…) and to a variety of destinations (Disk File, Mail, Exchange Folder … etc). The user is also prompted for any other information that is required for exporting.

Graphics View Window

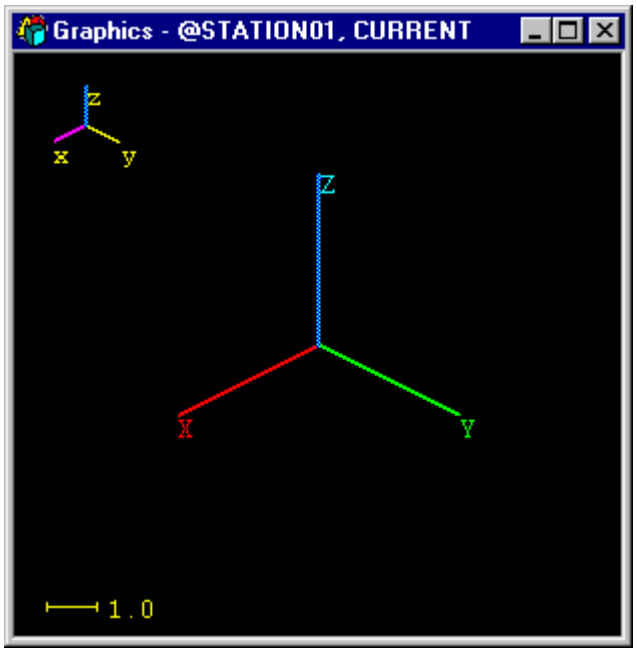
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

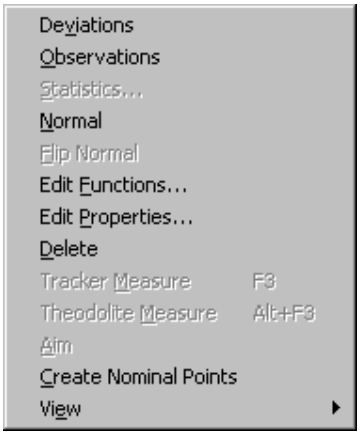
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

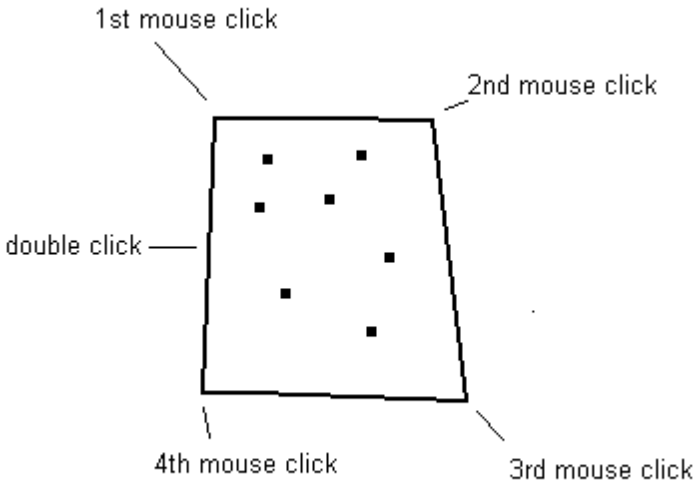
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

1. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

2. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

   For example, if you want to select the following observations, press the mouse button in the following locations.



   When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

3. From the Polygon Select Options Dialog, choose from the following options:

   All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

   Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

   Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

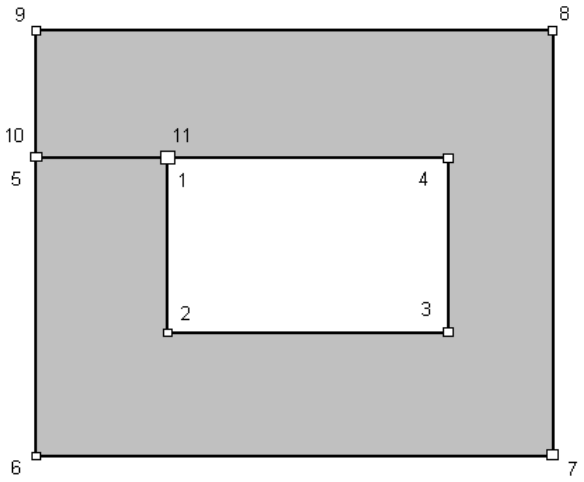
   Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

   Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

   Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

4. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

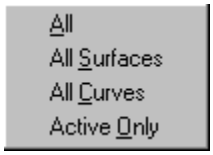
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

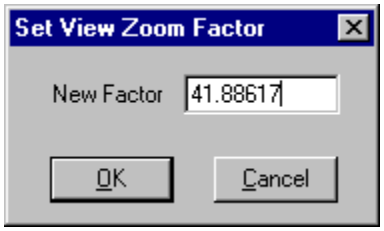
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

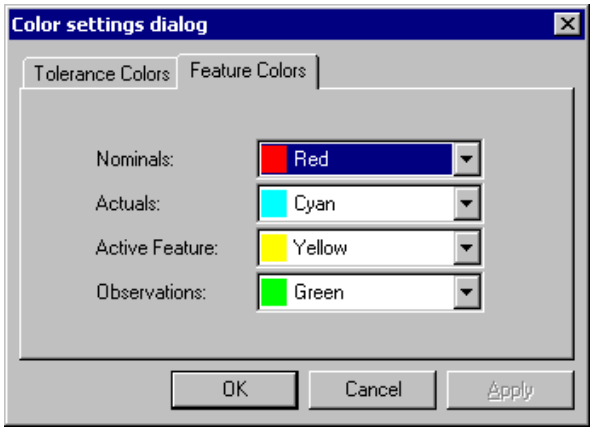
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

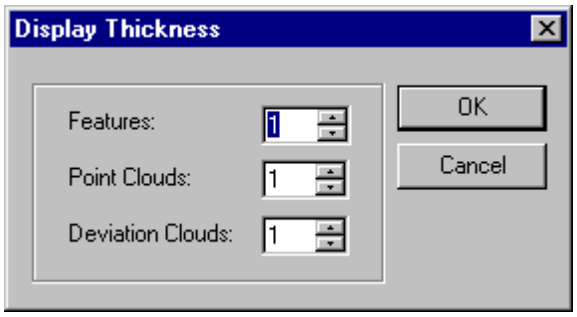
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

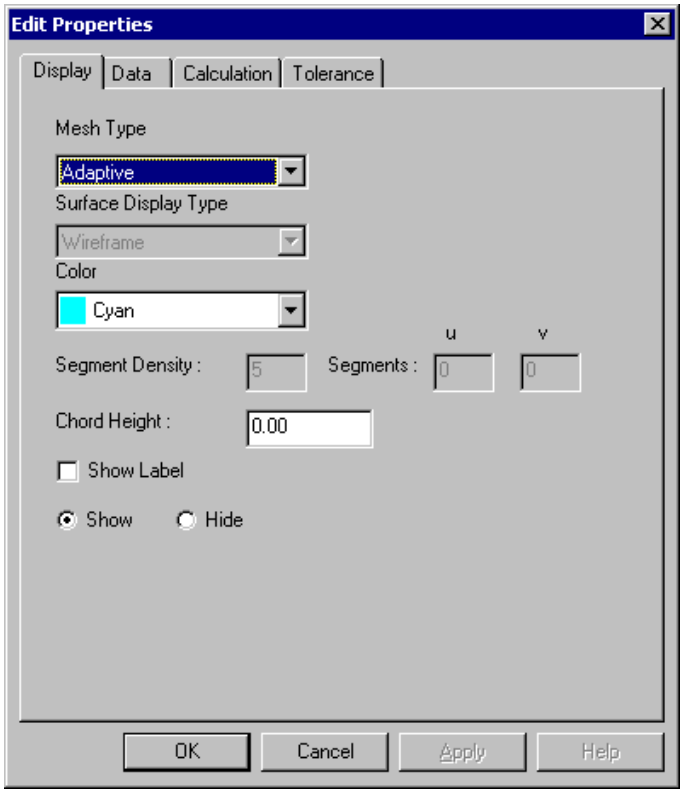
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button, , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

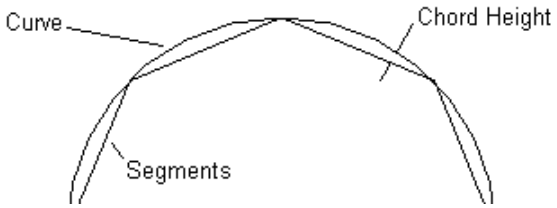
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

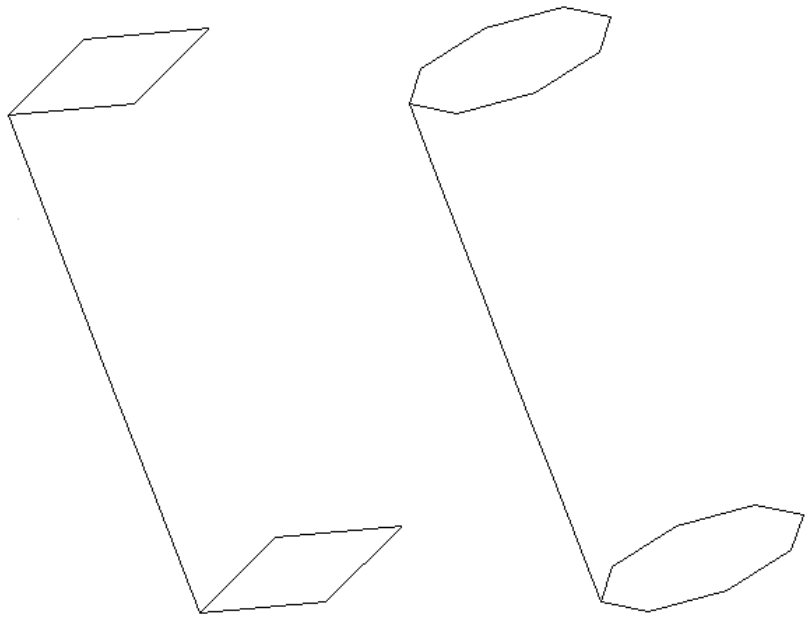


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

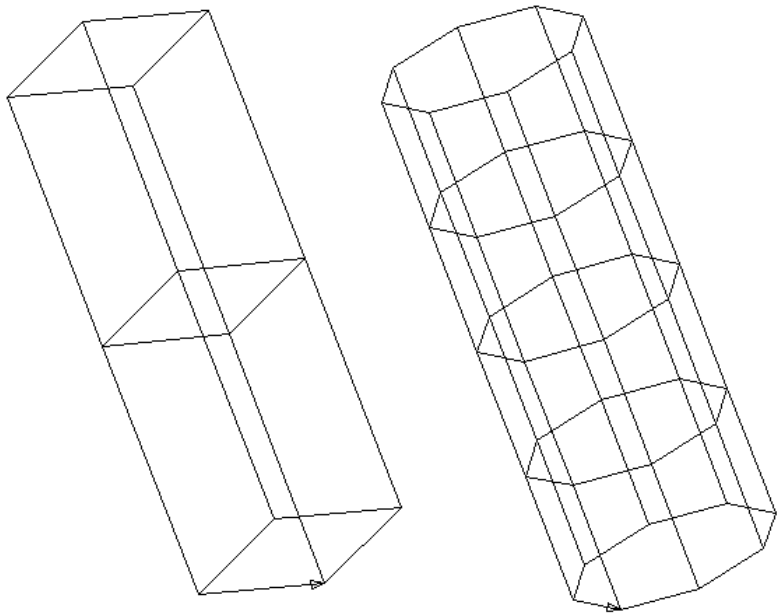
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

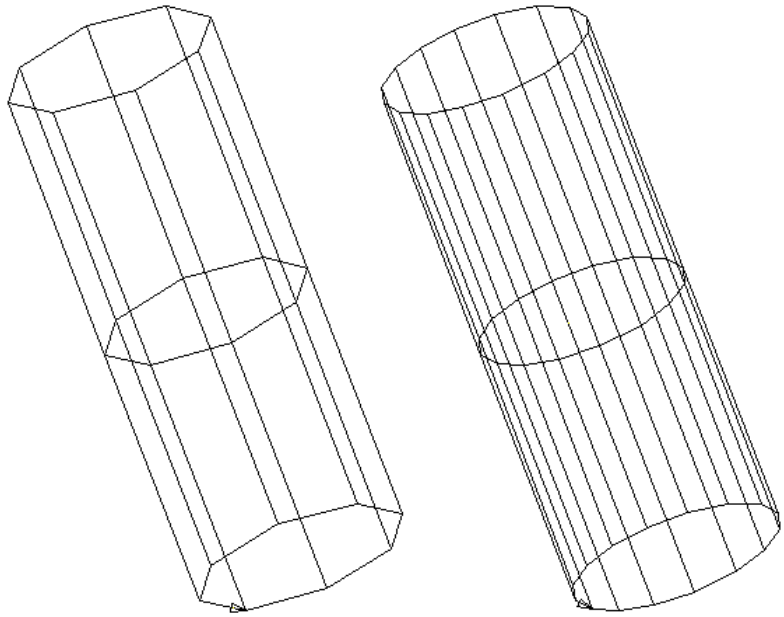
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

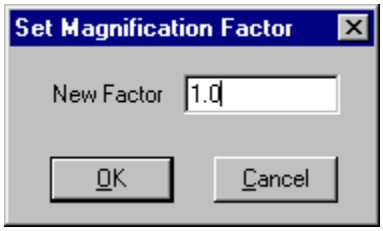
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



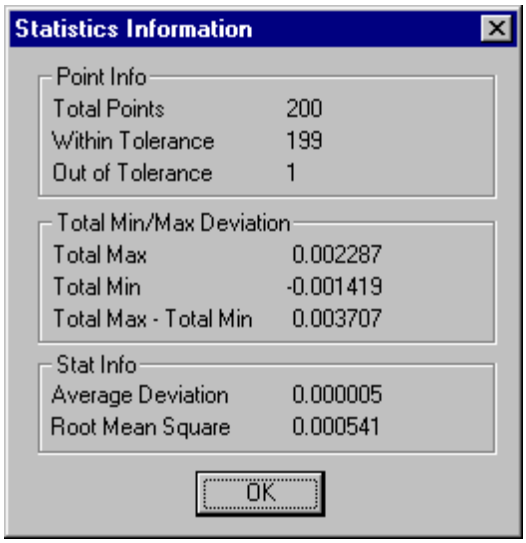
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

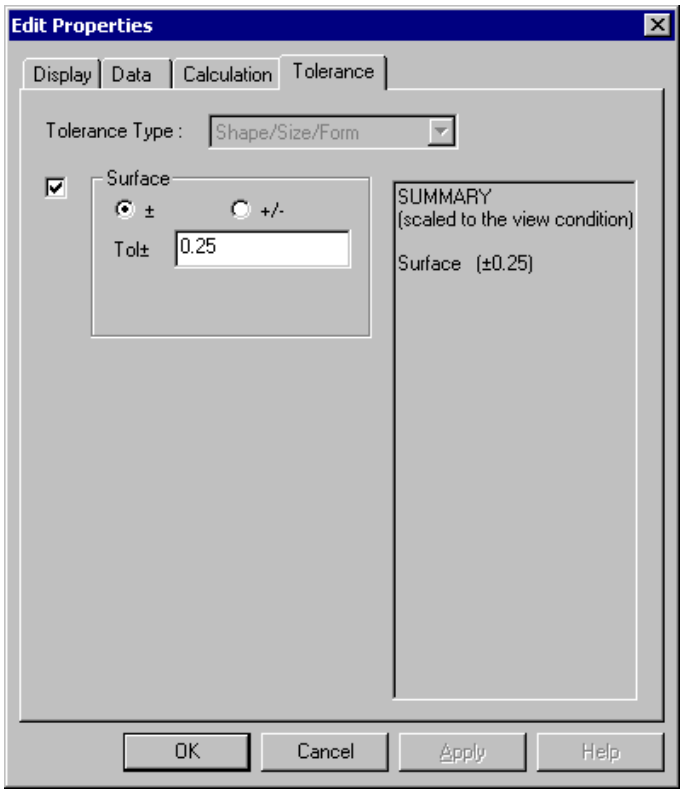
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

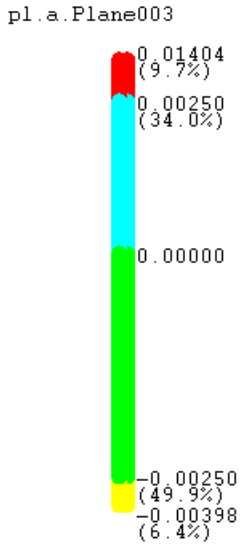


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

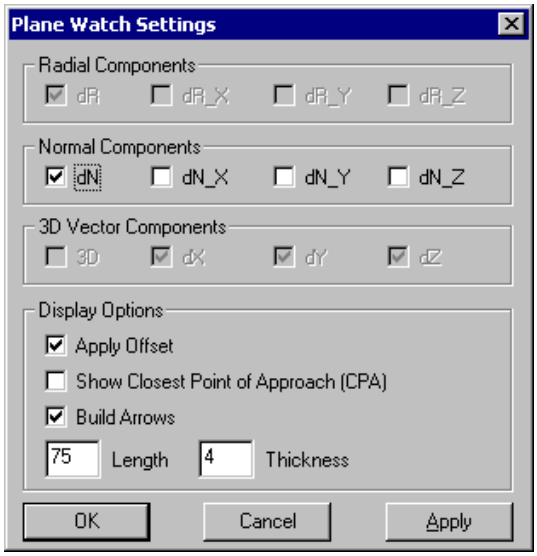
Doing the following can open a watch window with a tolerance:

1. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
2. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

   The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

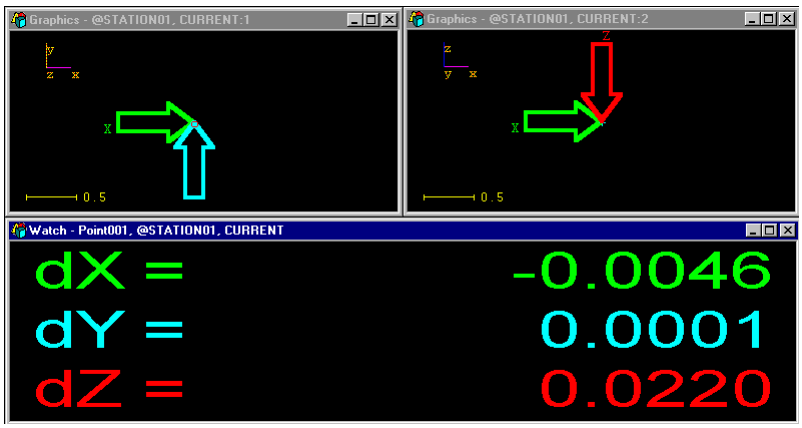
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets”* Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

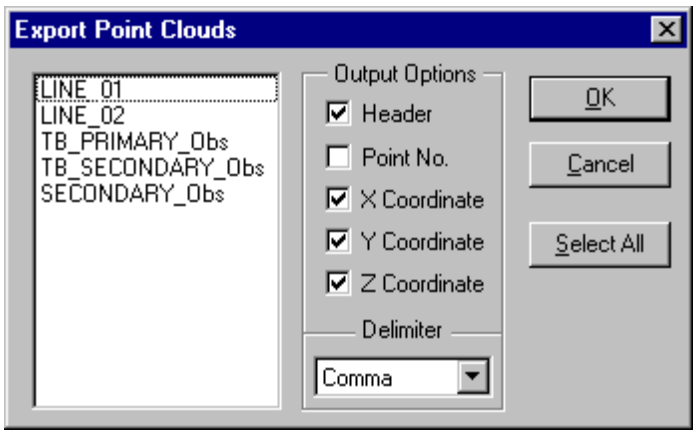
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

1. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
2. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
3. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

4. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
5. Choose the appropriate Output Options

   Header – Puts a header at the top of file.

   Point No. – Puts the point number in the first column of the file.

   X Coord – Prints out the X value.

   Y Coord. – Prints out the Y value.

   Z Coord – Prints out the Z value.

   Delimiter – Comma or Space, set the character between each column.
6. Press 'OK' when done selecting.

   FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

1. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
2. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
3. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
4. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
5. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

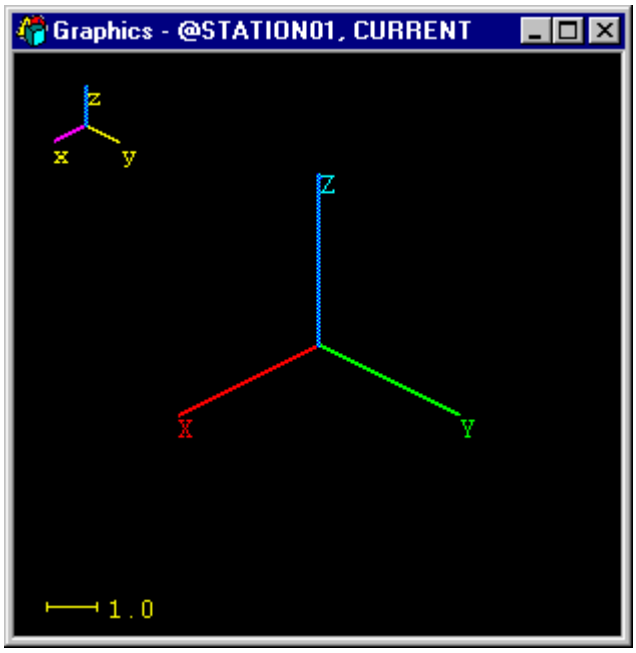
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

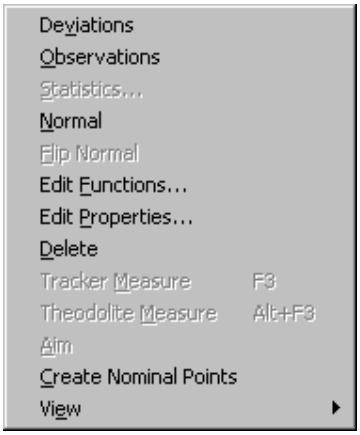
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



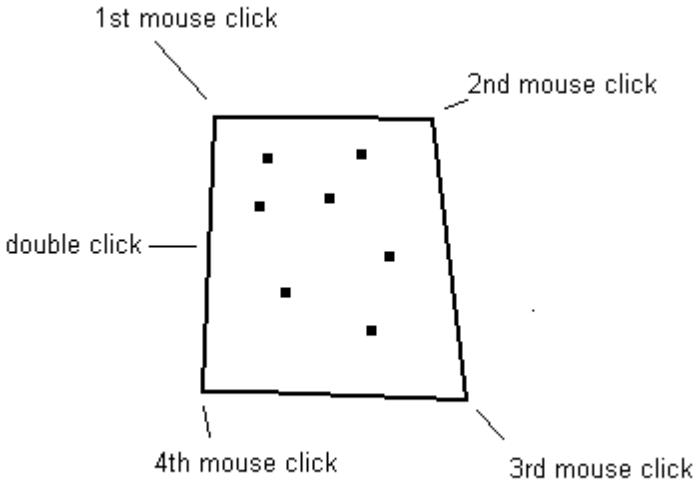
Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

5. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.
6. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

   For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

7. From the Polygon Select Options Dialog, choose from the following options:

   All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

   Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

   Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

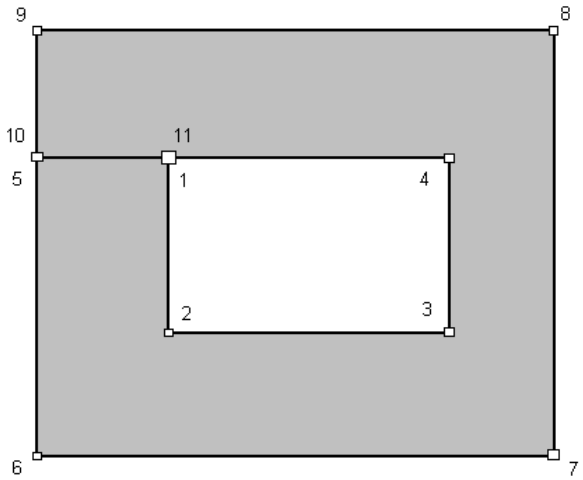
   Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

   Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

8. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

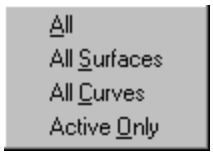
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

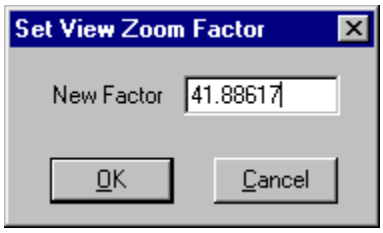
Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the

screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button,  , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button,  , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a  symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a  symbol. In this mode, holding the left mouse

button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

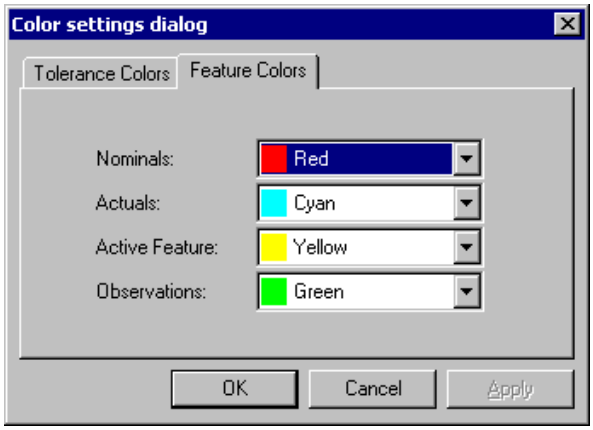
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

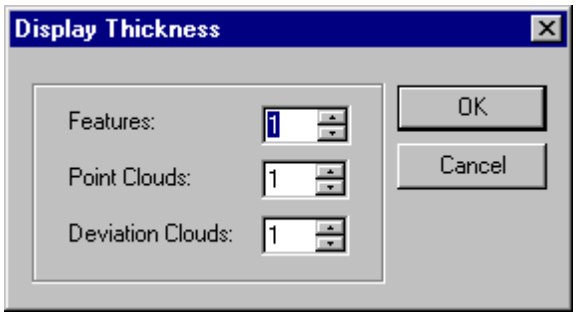
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

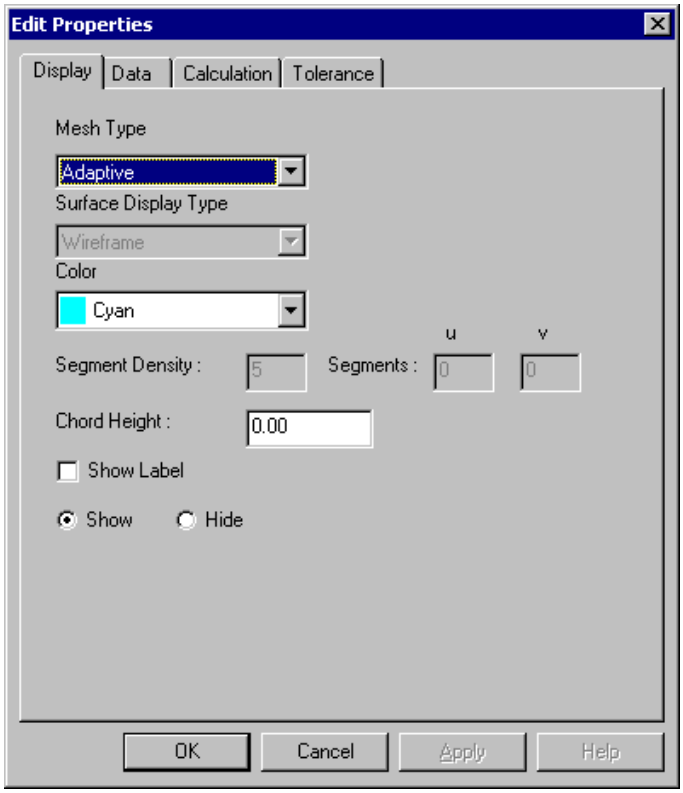
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button,  , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

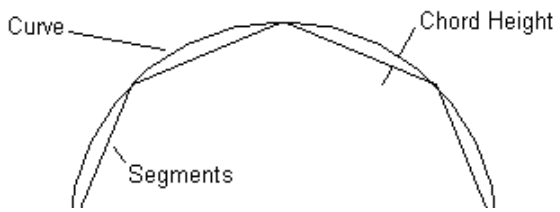
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

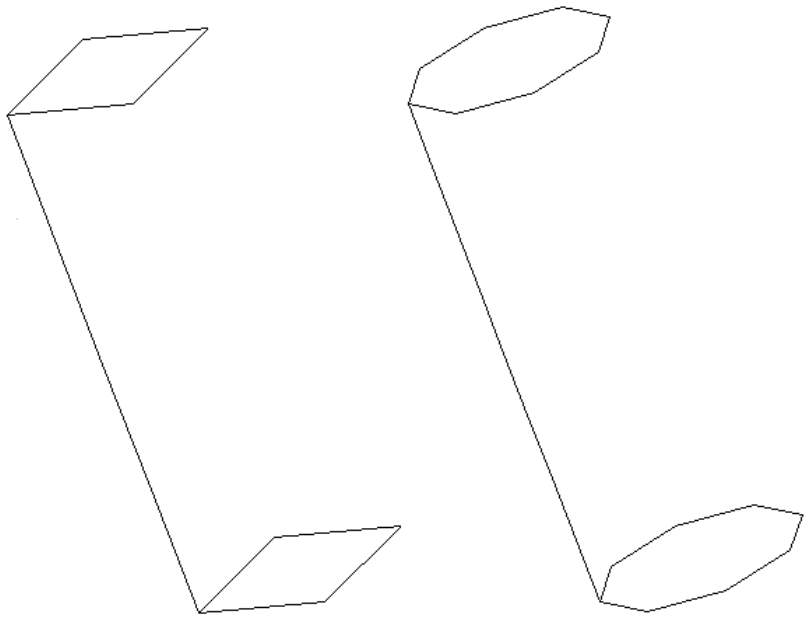


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

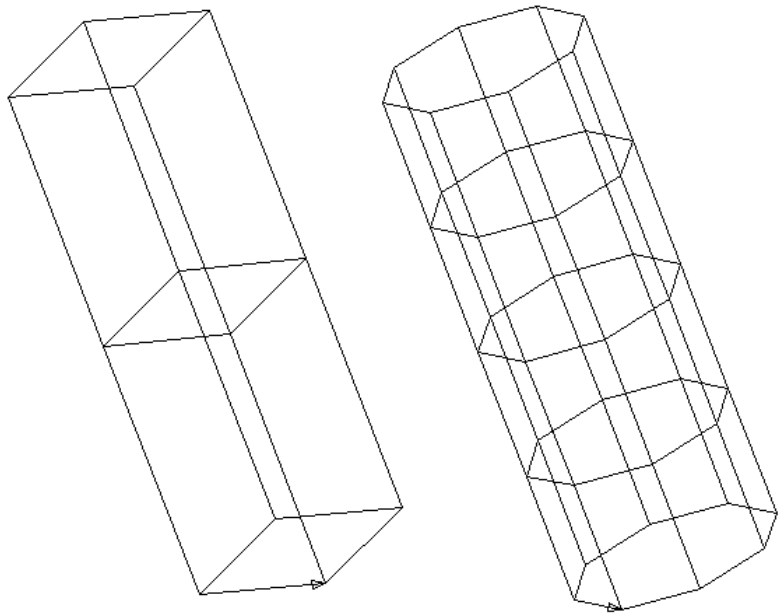
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

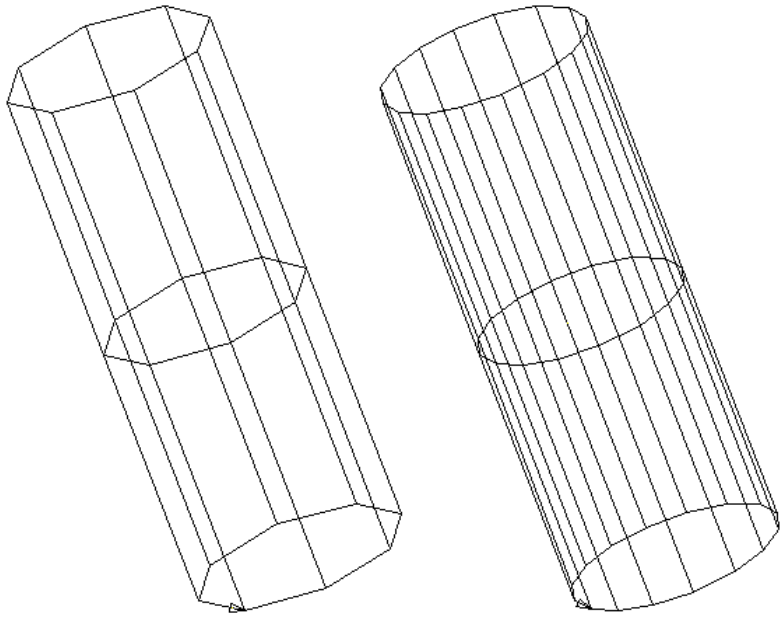
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

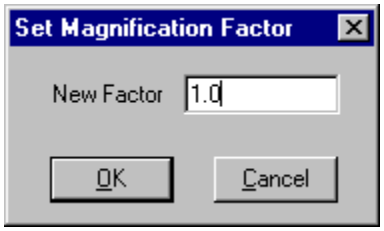
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



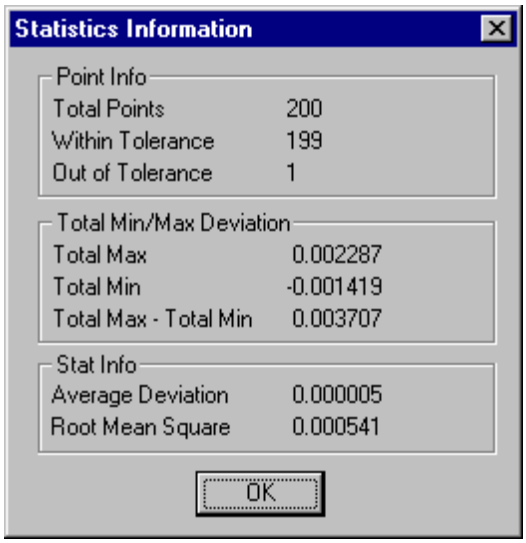
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

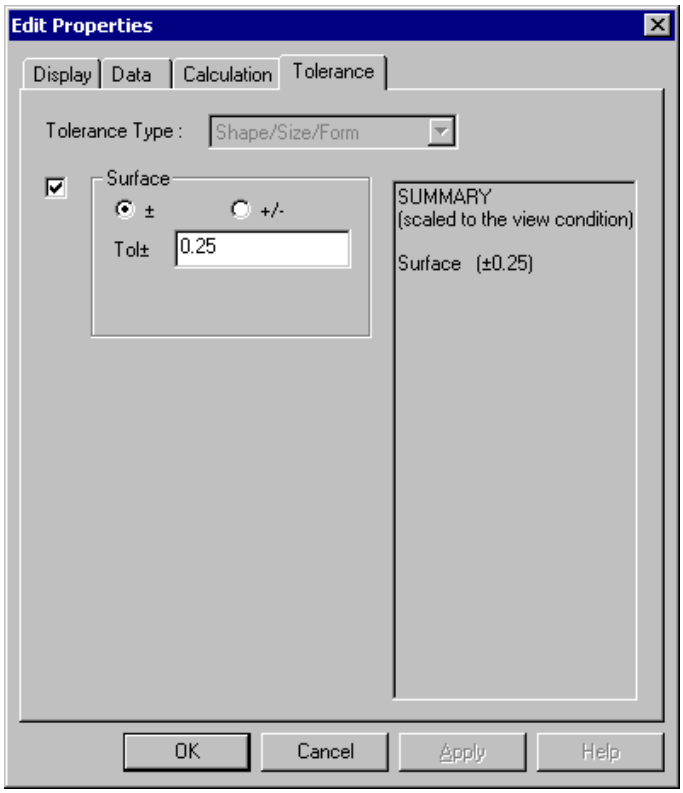
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

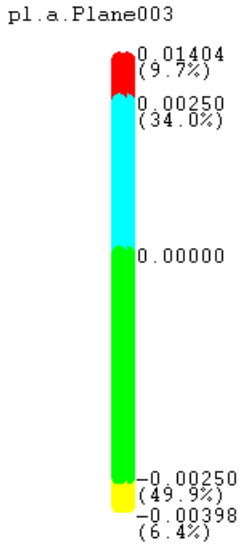


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

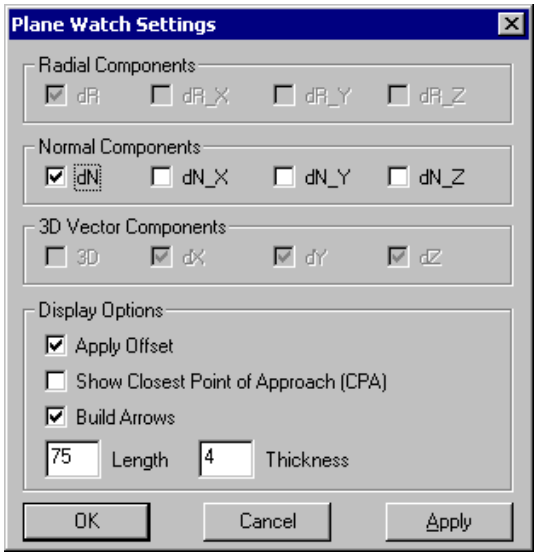
Doing the following can open a watch window with a tolerance:

3. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
4. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

   The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

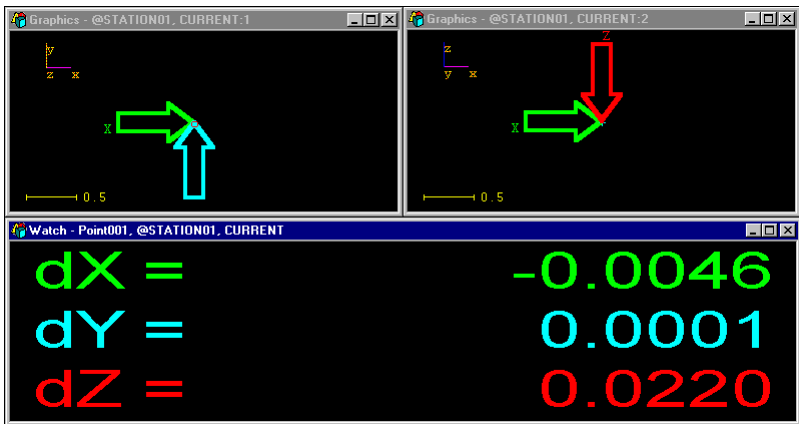
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets*” Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

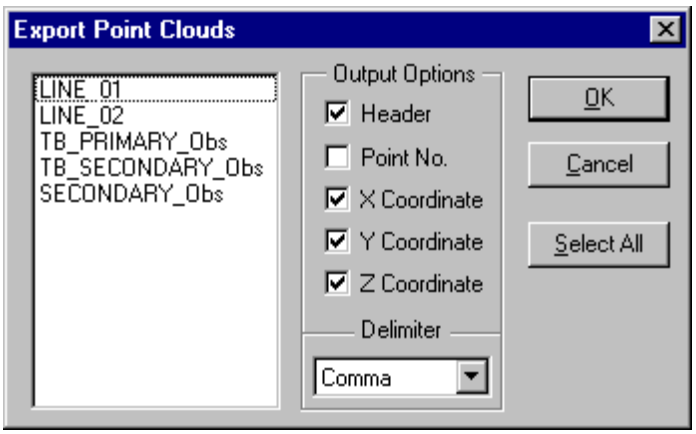
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

7. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
8. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
9. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

10. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
11. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
12. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

6. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
7. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
8. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
9. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
10. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

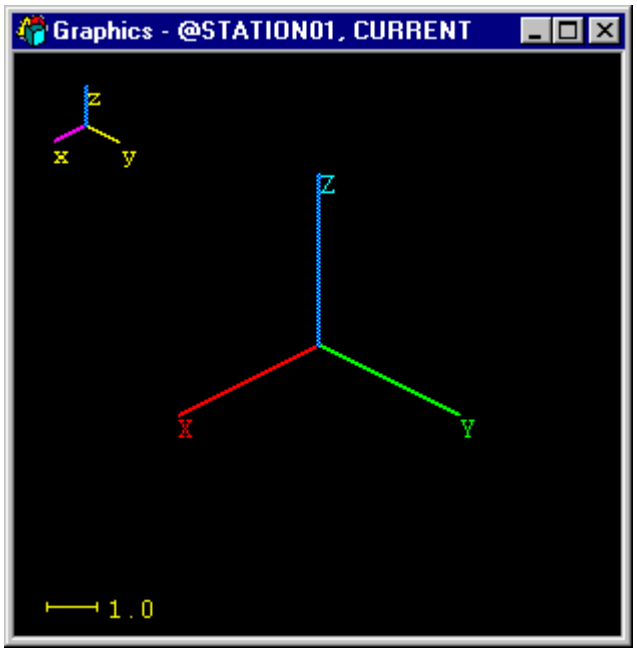
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

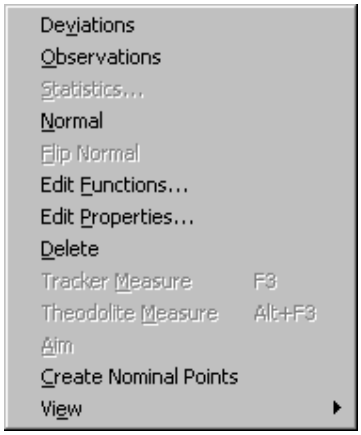
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

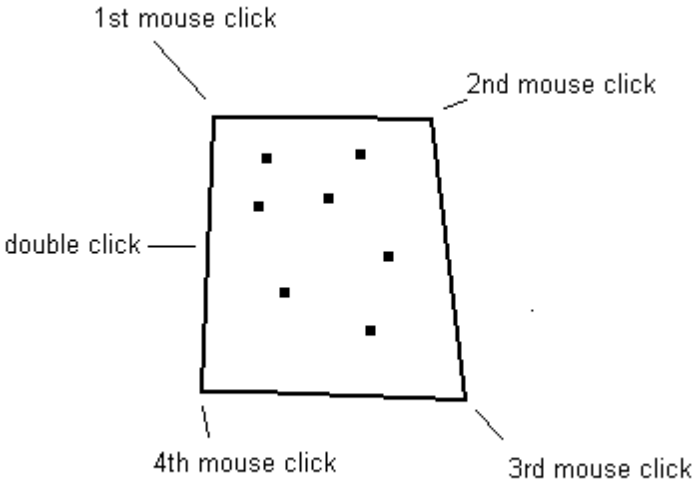
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

9. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

10. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

11. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

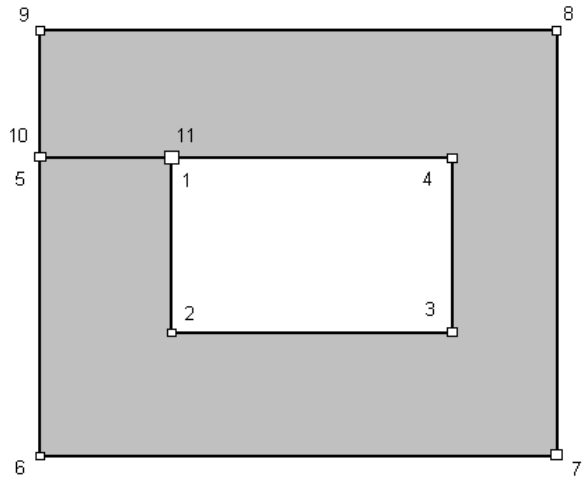
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

12. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

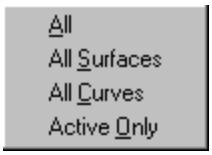
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

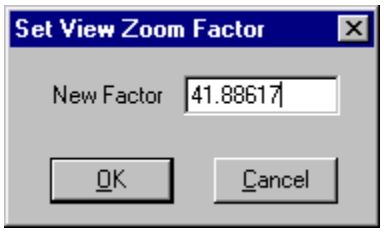
Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the

screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button,  , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button,  , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a  symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a  symbol. In this mode, holding the left mouse

button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

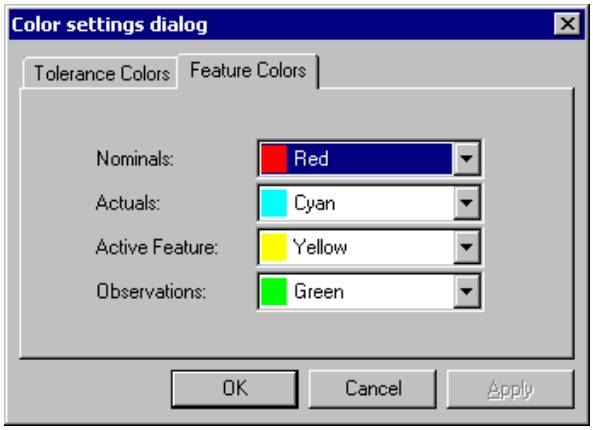
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

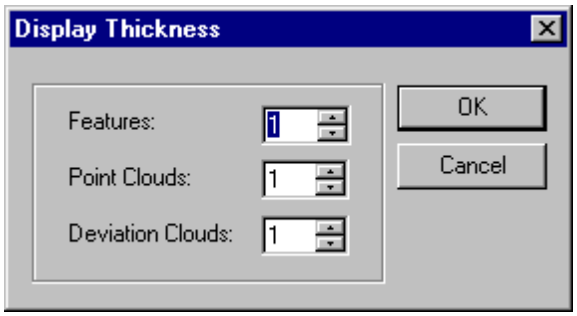
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

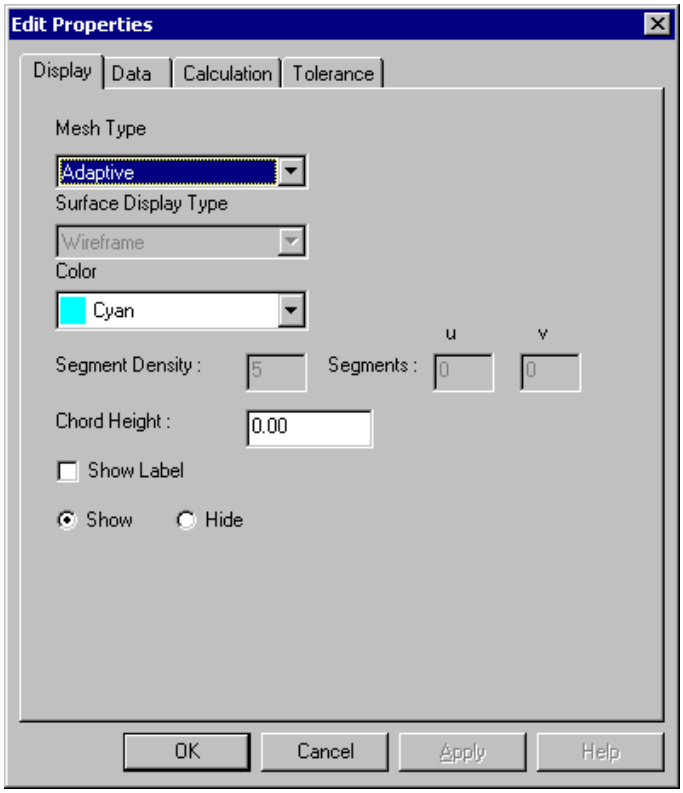
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button, , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

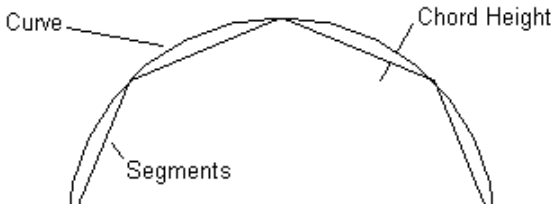
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

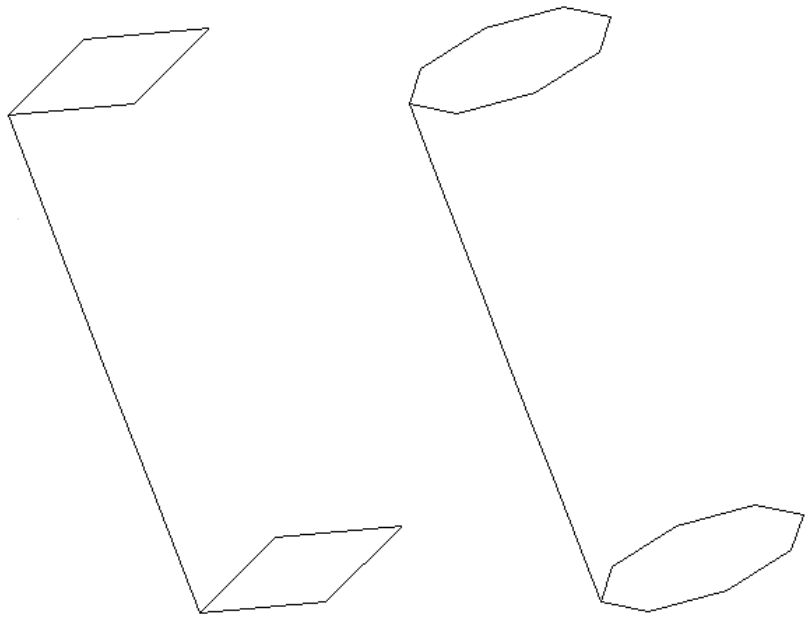


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

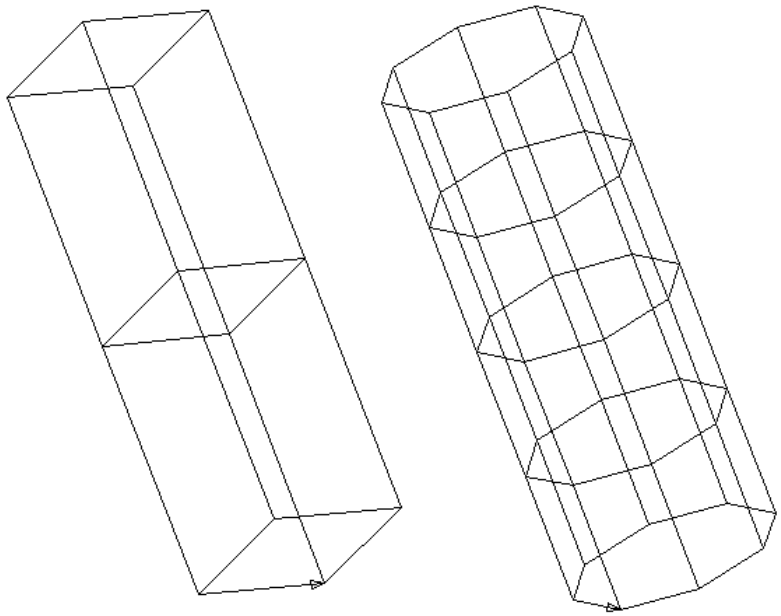
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

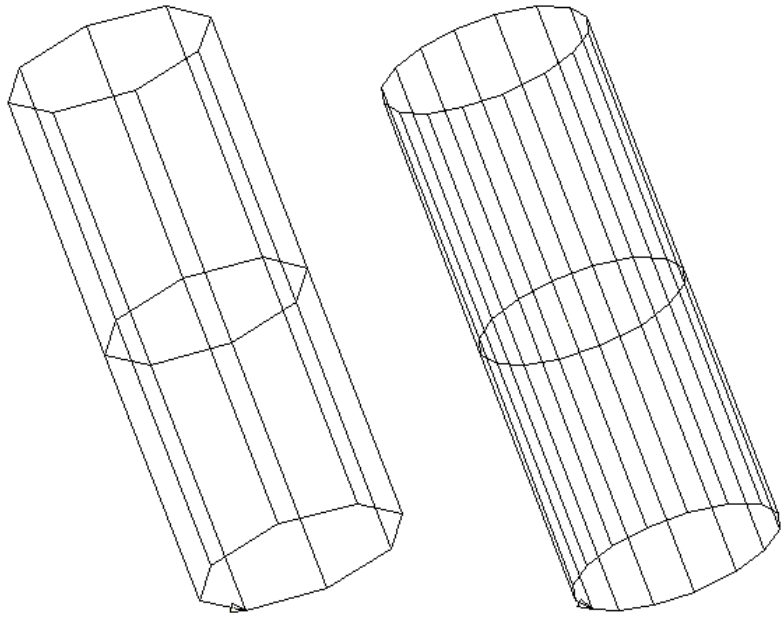
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

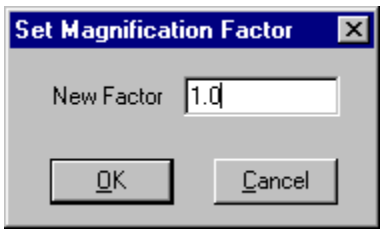
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



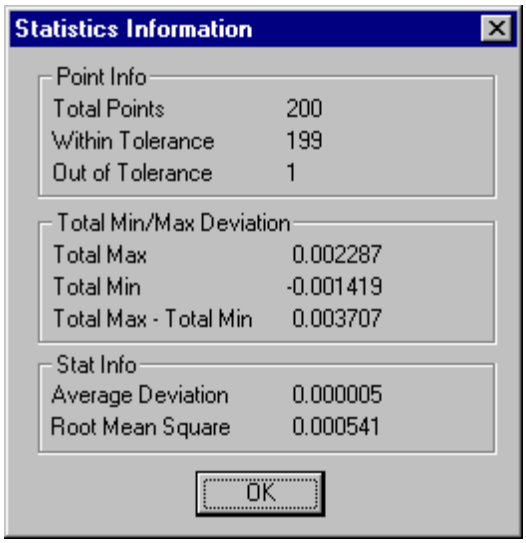
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

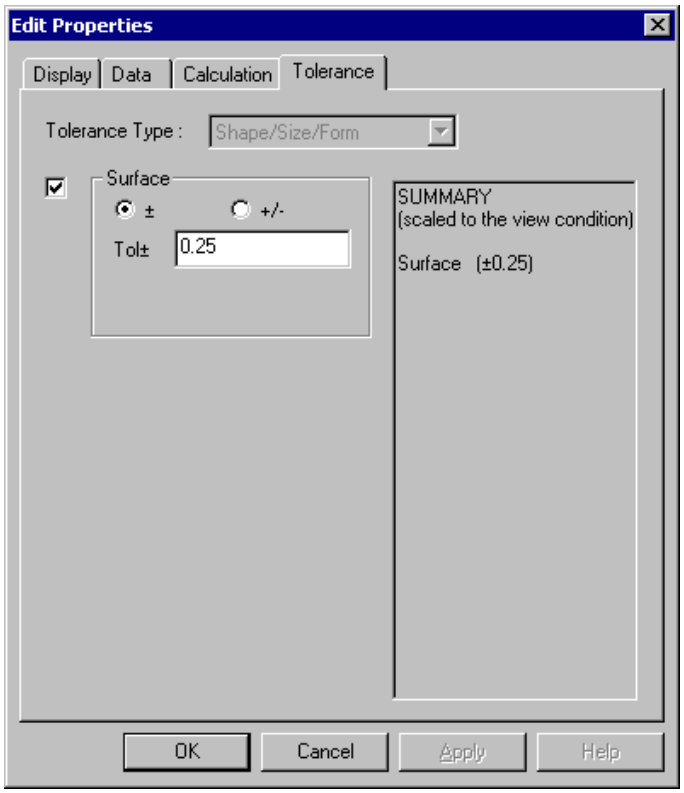
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

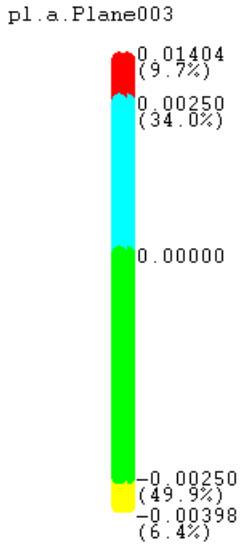


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

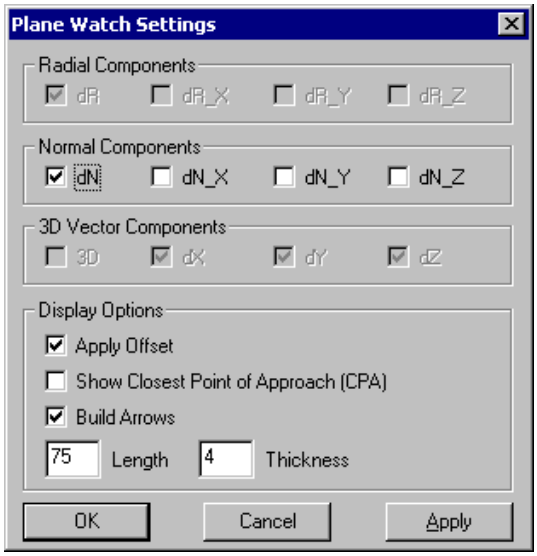
Doing the following can open a watch window with a tolerance:

5. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
6. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

   The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

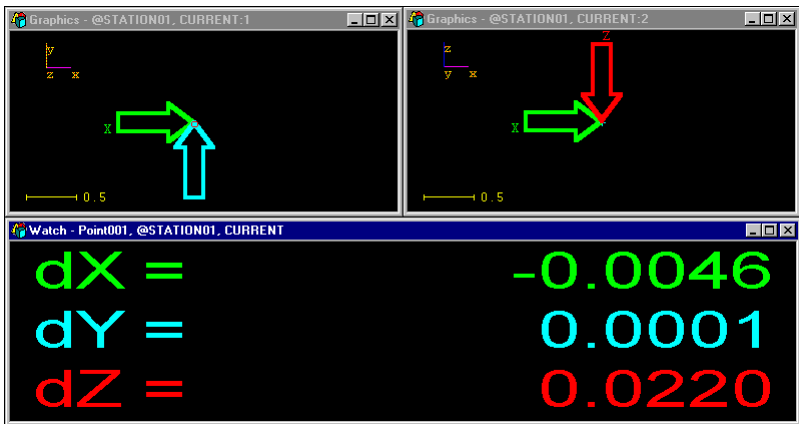
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets”* Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

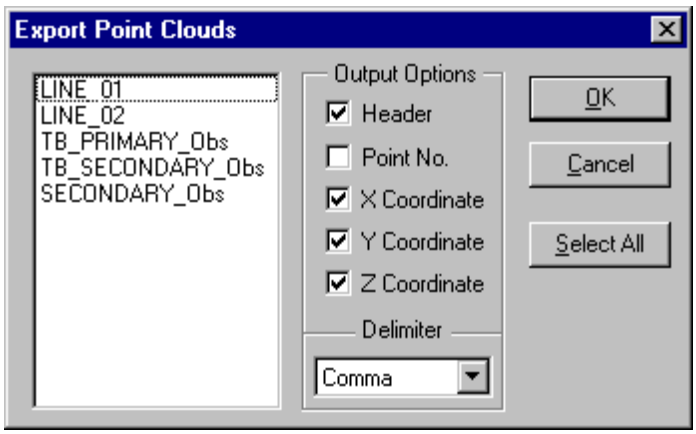
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

13. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
14. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
15. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

16. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
17. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
18. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

11. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
12. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
13. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
14. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
15. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

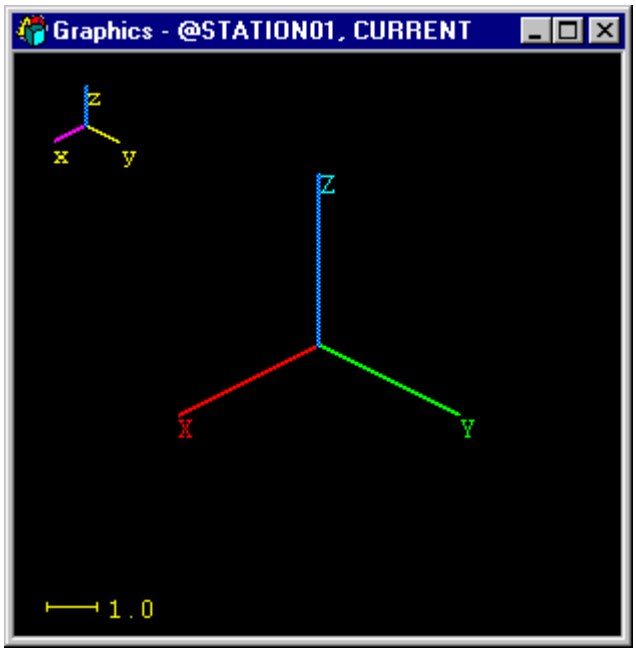
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

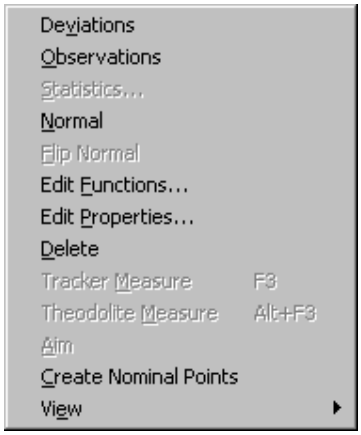
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

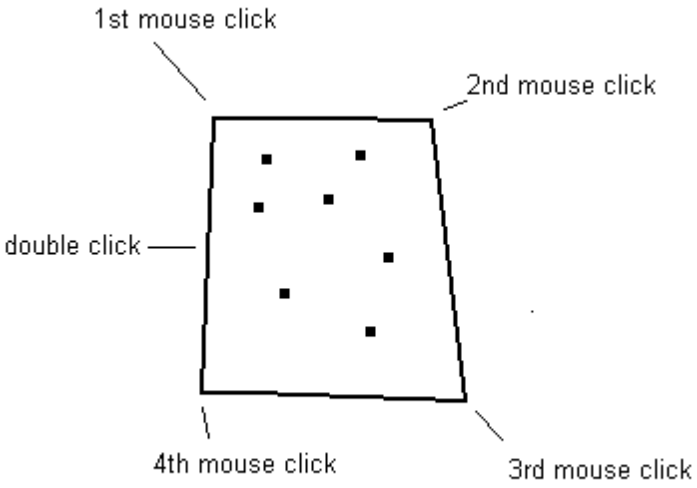
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

13. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

14. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

15. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

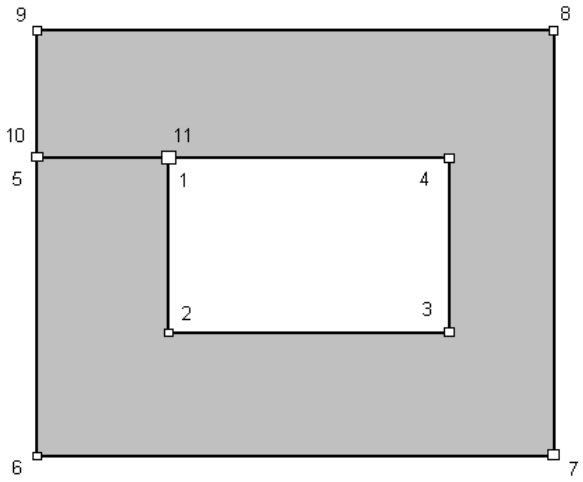
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

    Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

16. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

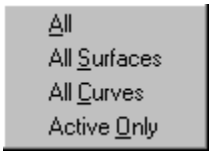
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

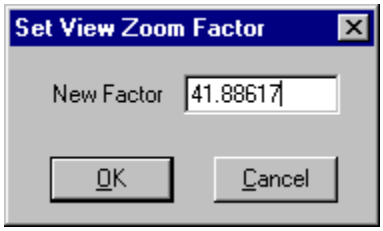
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

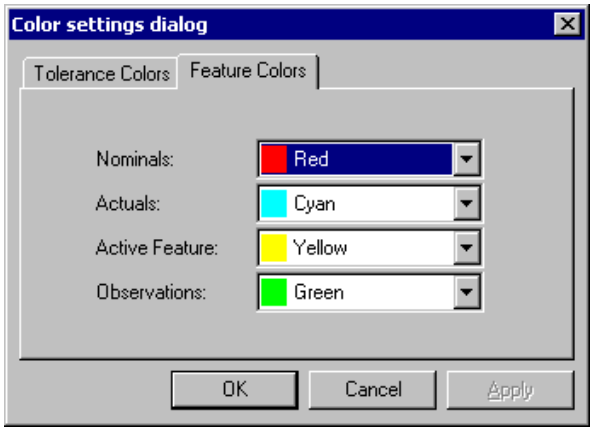
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

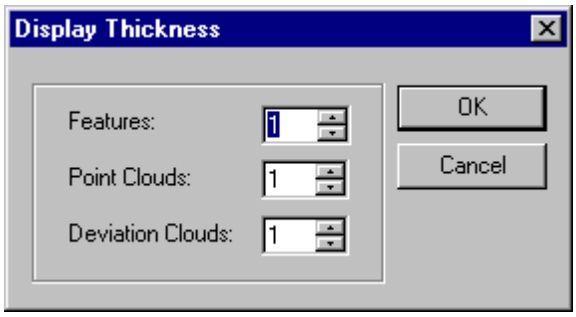
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

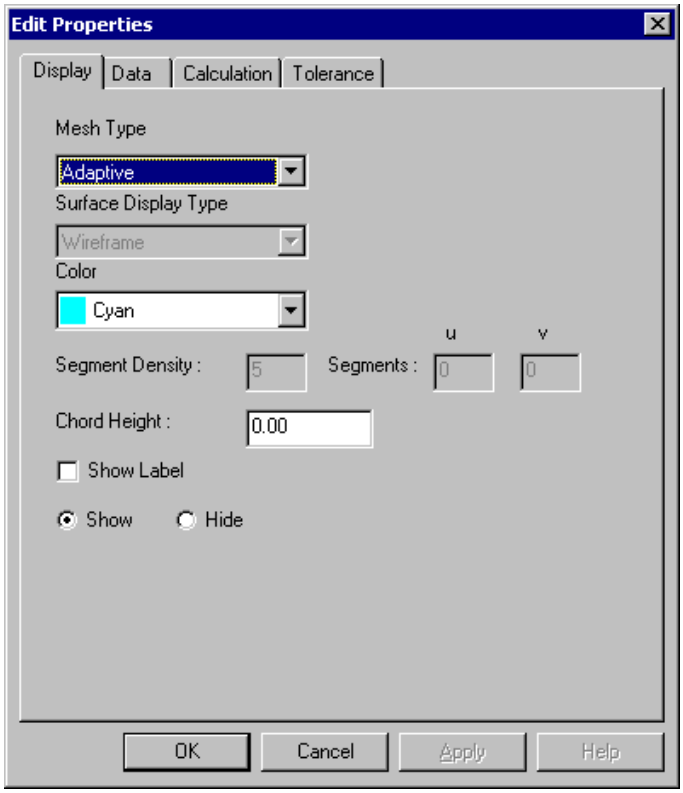
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button,  , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

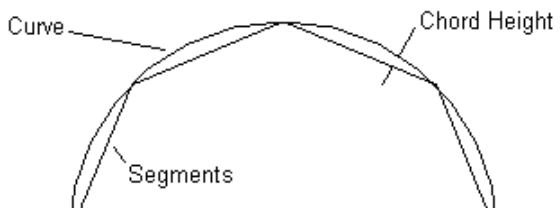
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

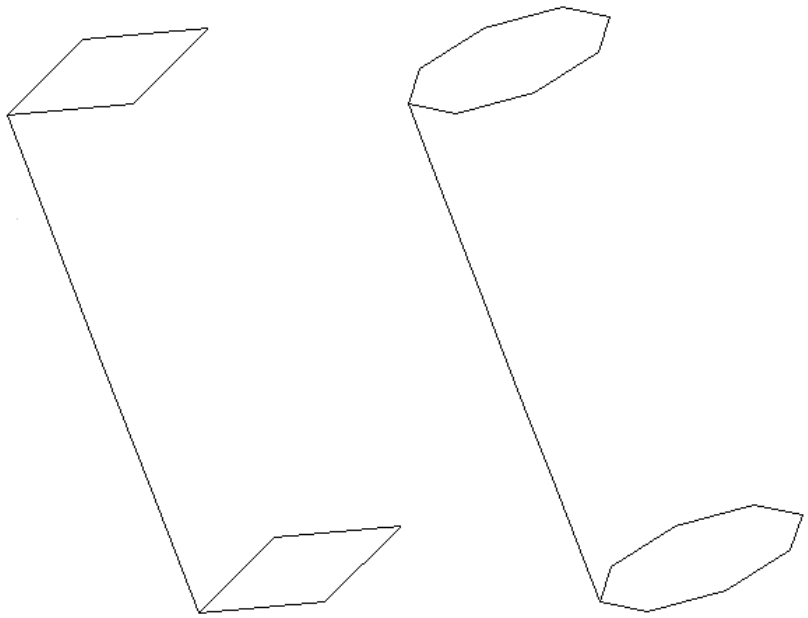


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

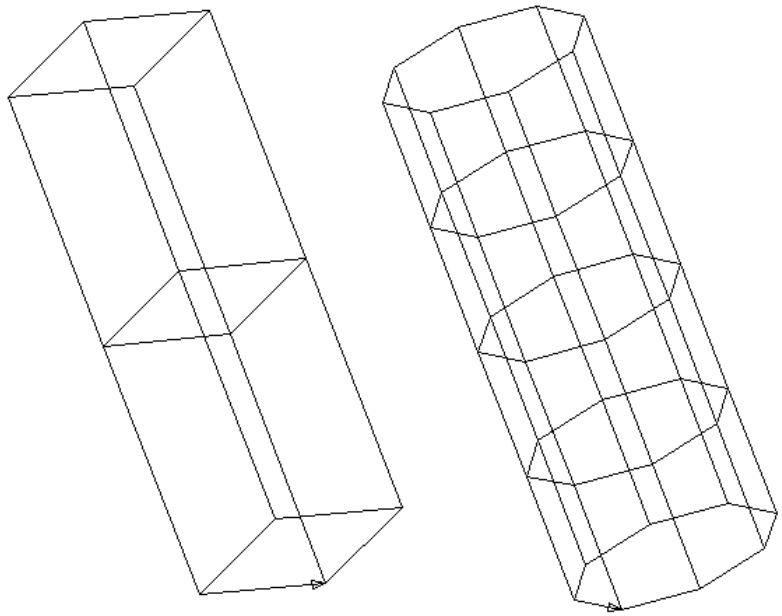
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

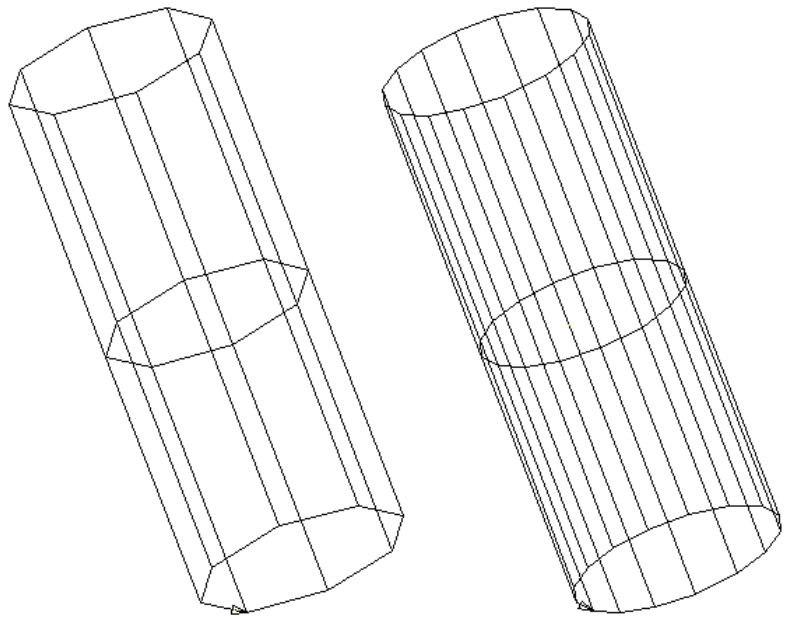
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

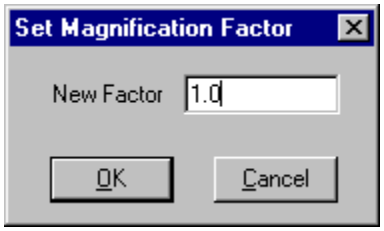
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



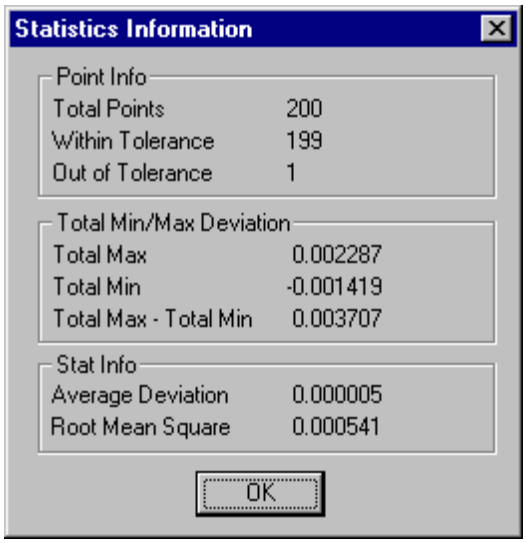
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

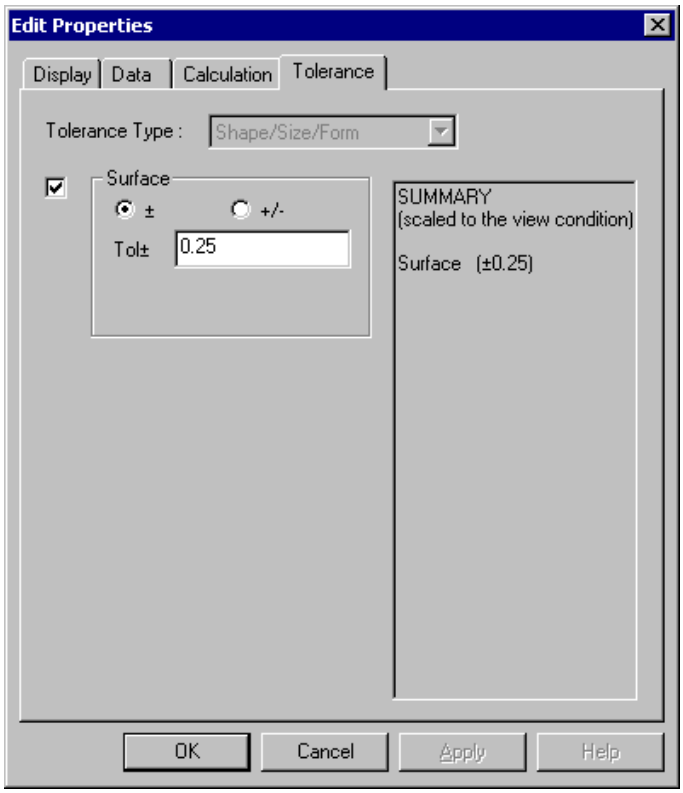
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

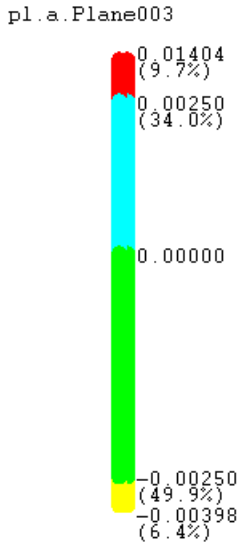


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

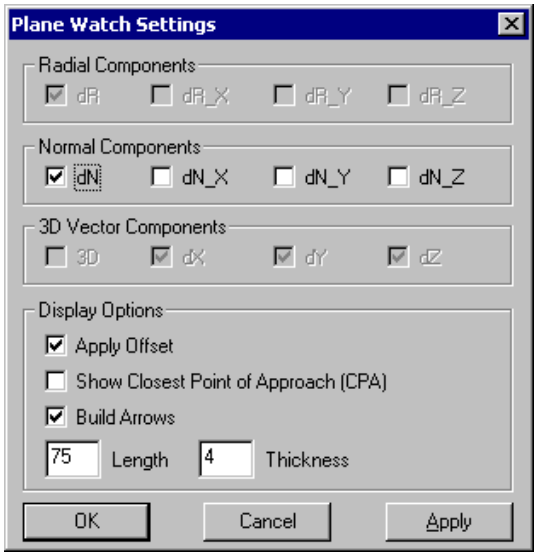
Doing the following can open a watch window with a tolerance:

7. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
8. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

   The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

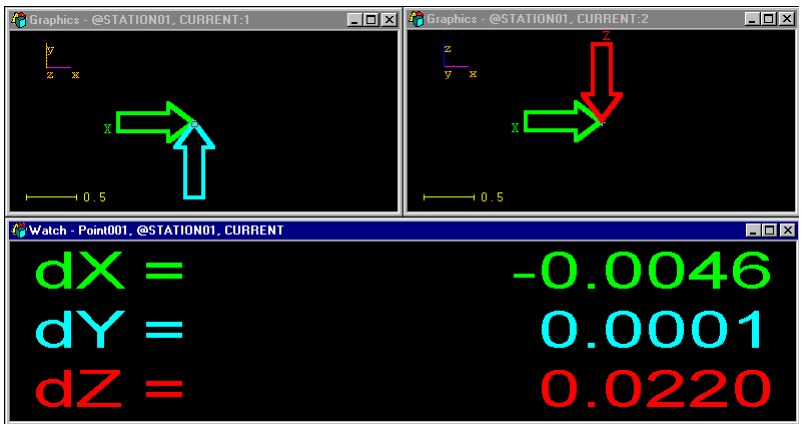
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets*” Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

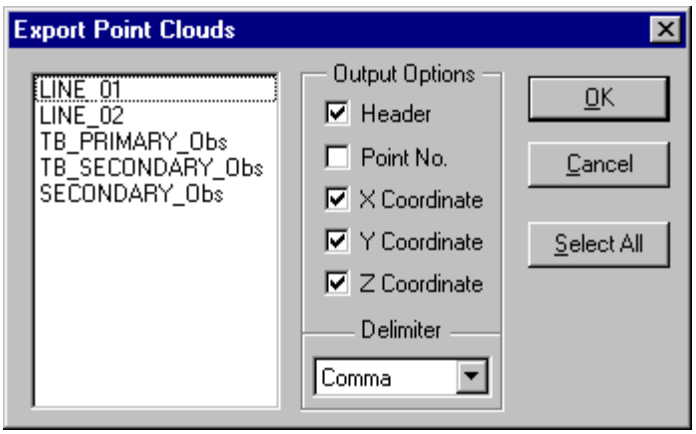
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

19. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
20. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
21. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

22. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
23. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
24. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

16. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
17. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
18. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
19. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
20. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

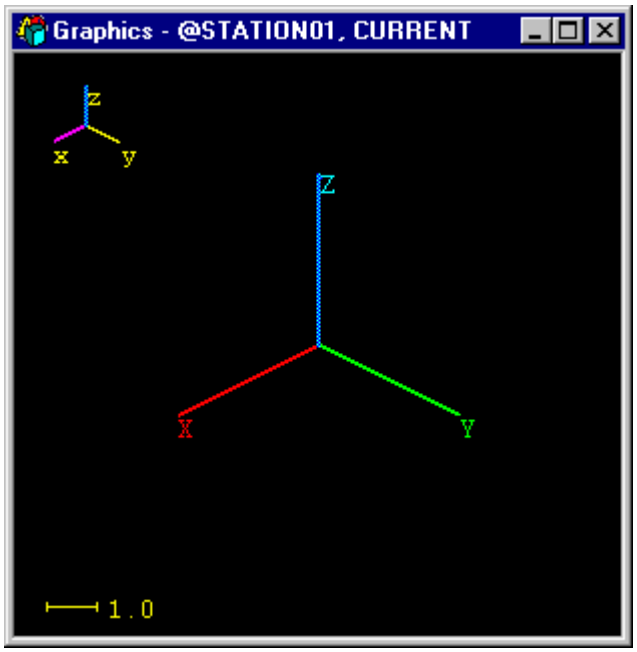
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

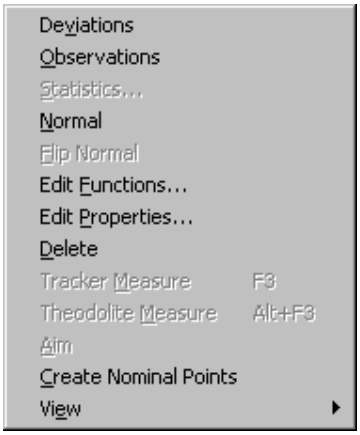
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

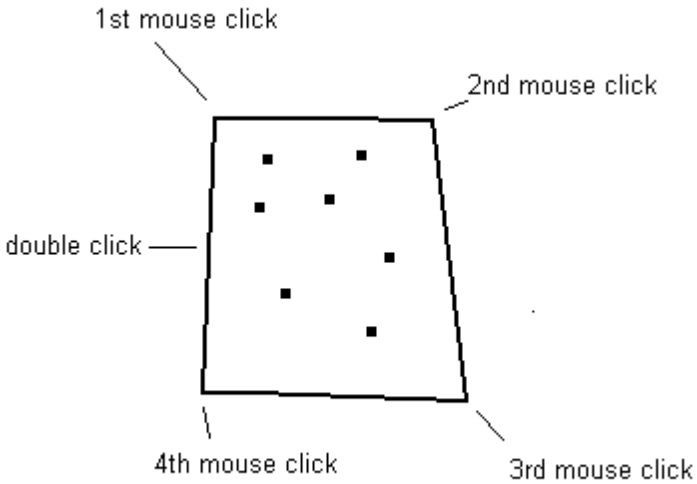
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

17. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

18. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

19. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

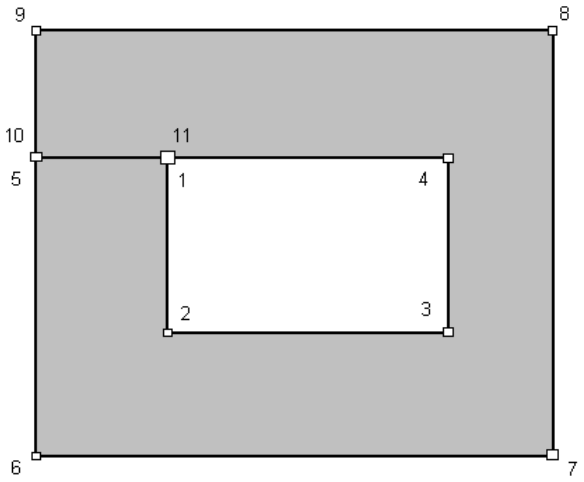
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

    Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

20. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

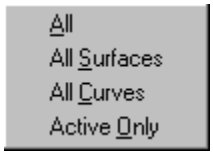
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

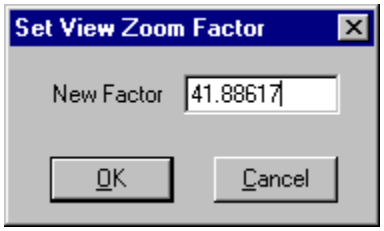
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

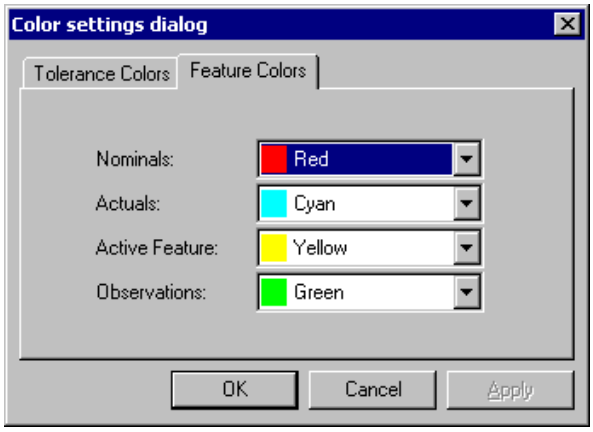
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

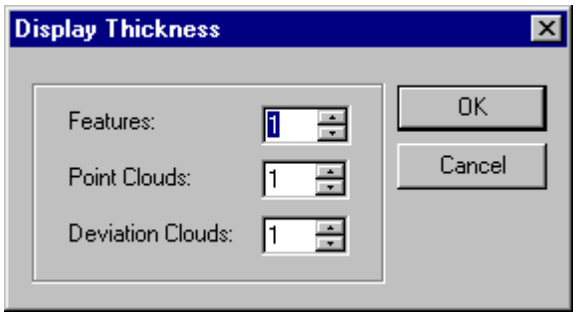
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

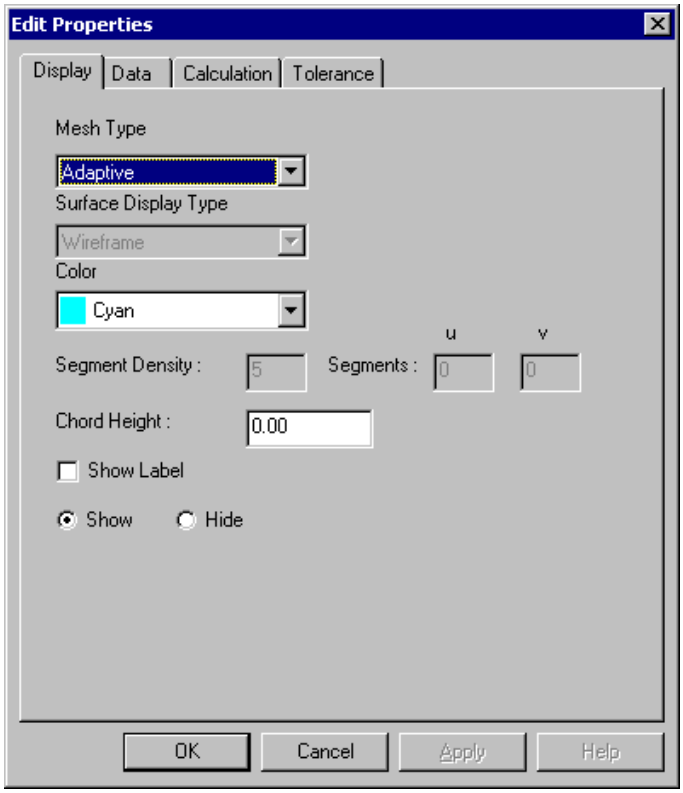
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button, , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

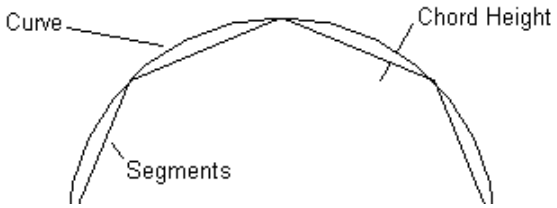
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

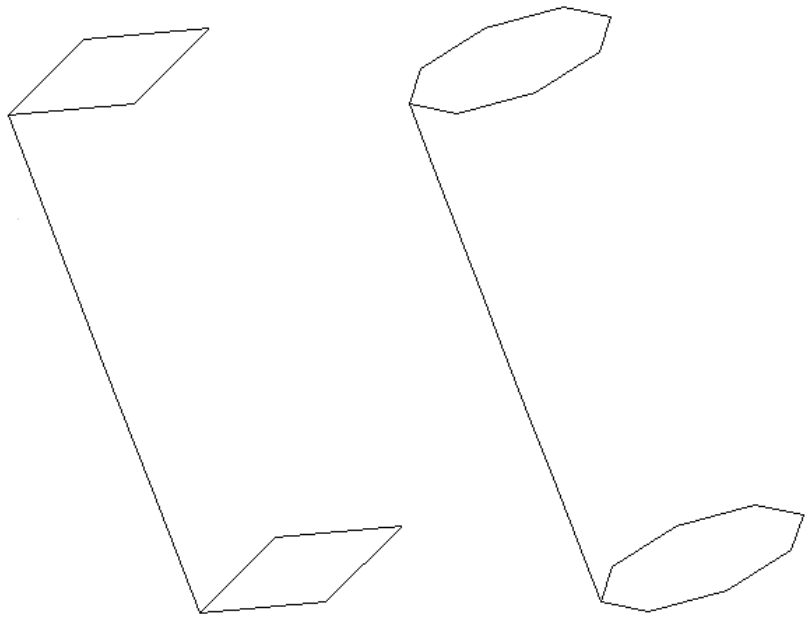


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

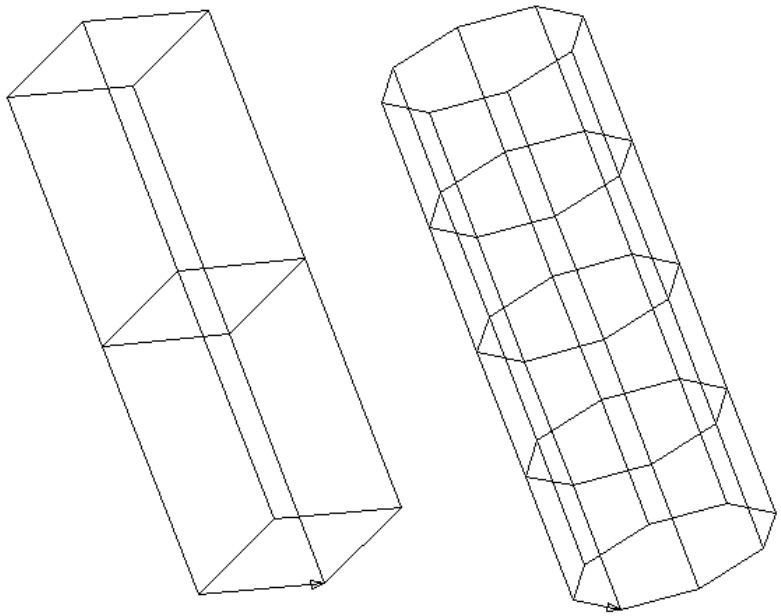
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

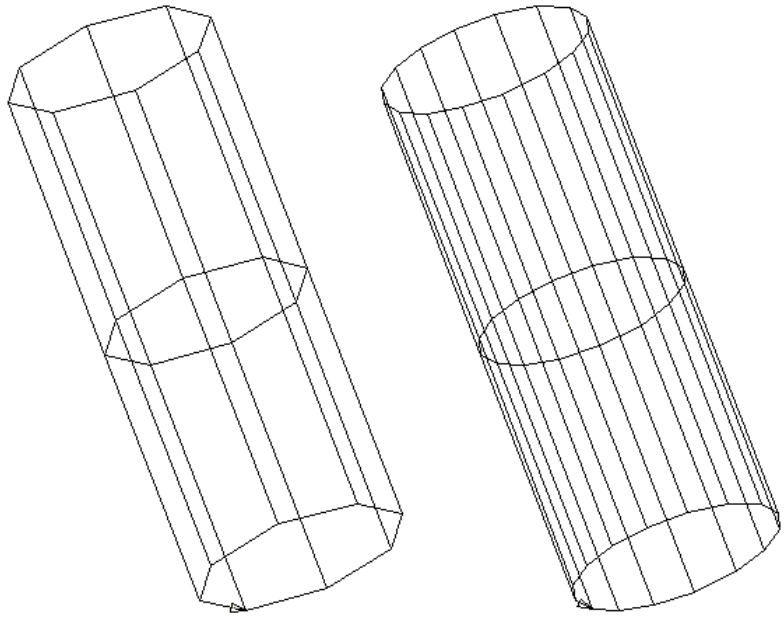
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

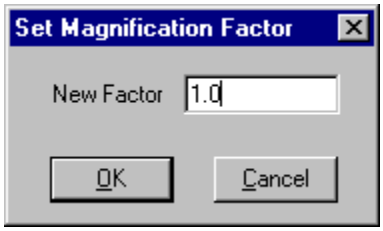
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



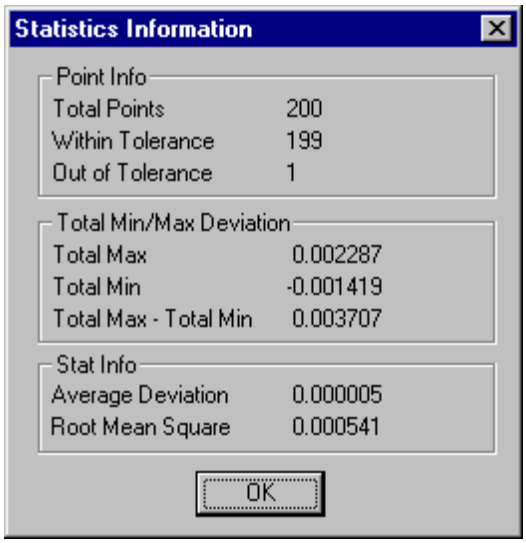
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

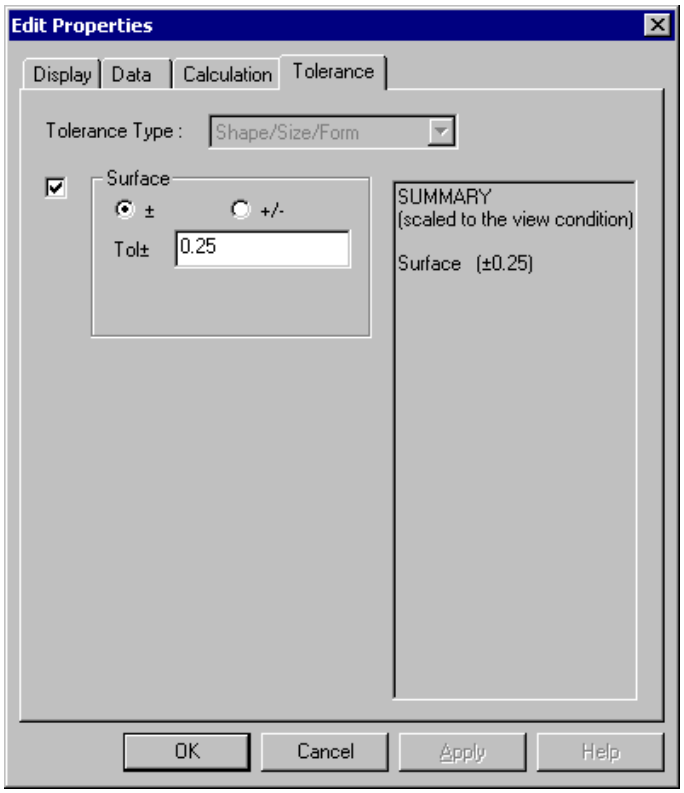
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

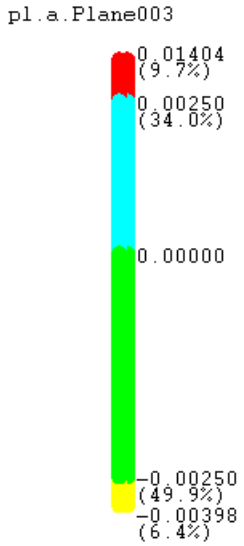


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

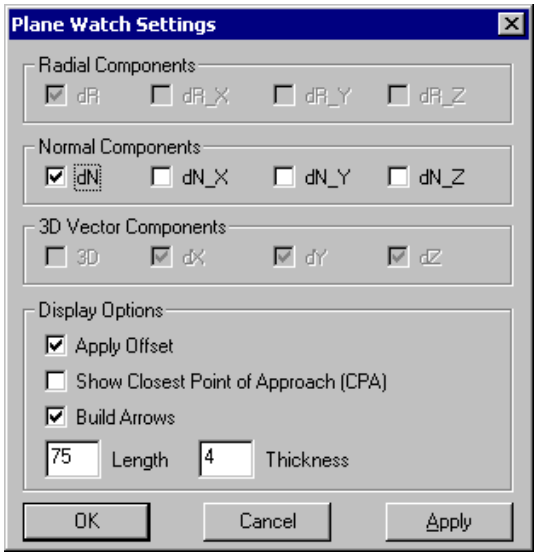
Doing the following can open a watch window with a tolerance:

9. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
10. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

    The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

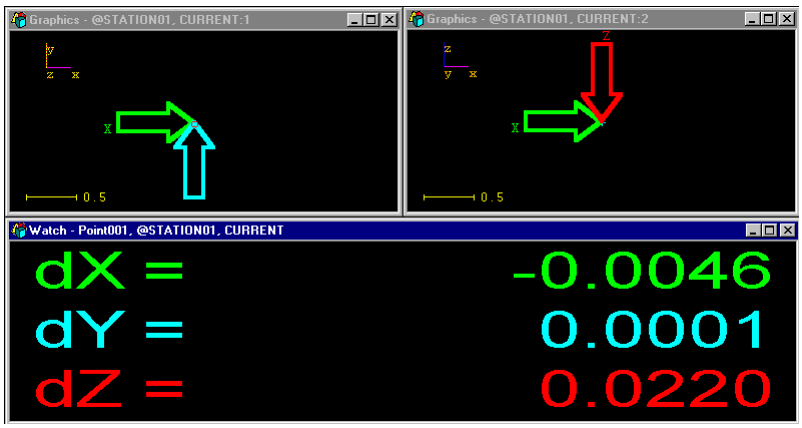
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets”* Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

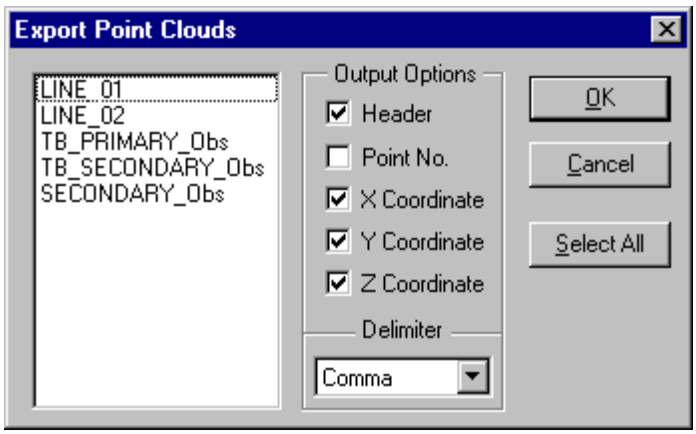
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

25. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
26. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
27. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

28. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
29. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
30. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

21. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
22. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
23. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
24. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
25. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

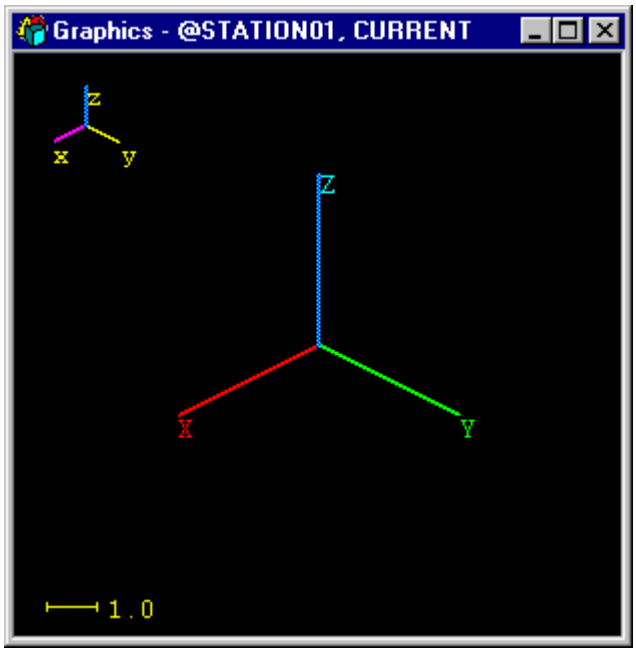
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

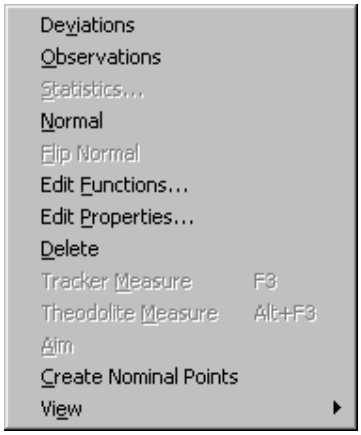
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

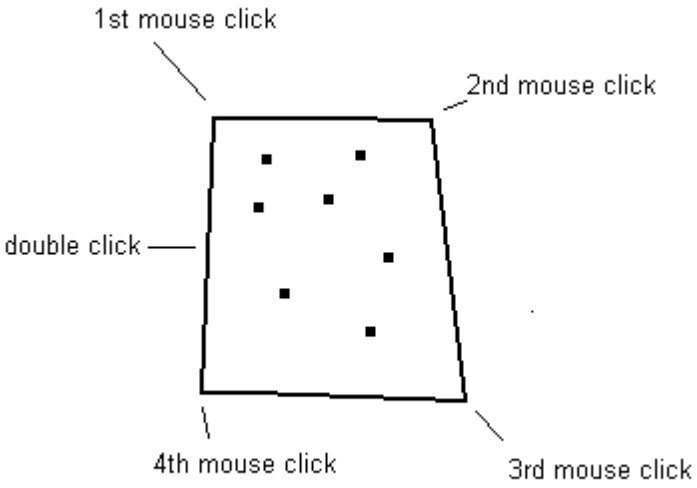
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

21. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

22. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



    When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

23. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

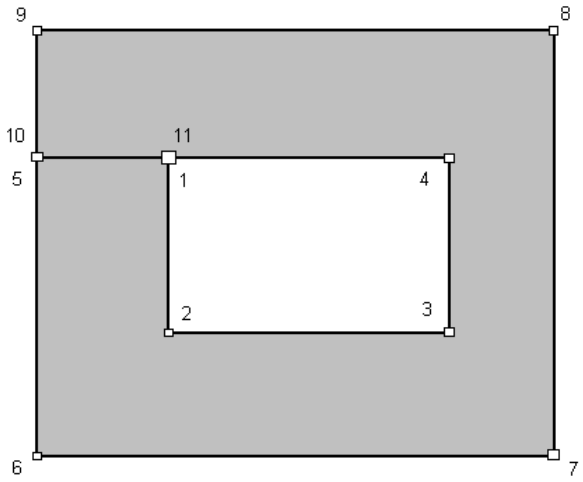
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

    Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

24. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

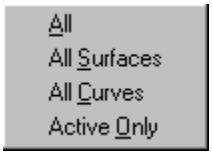
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

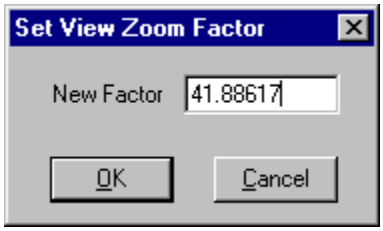
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

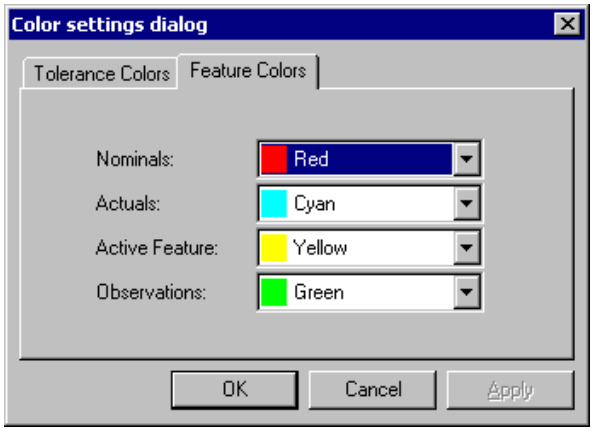
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

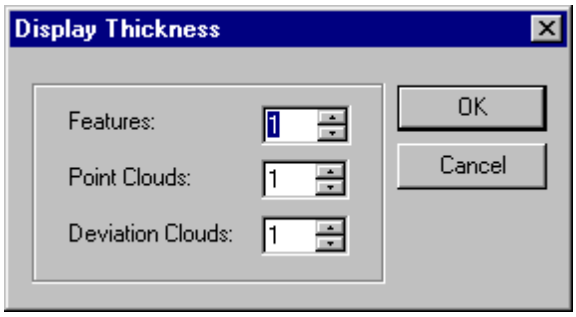
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

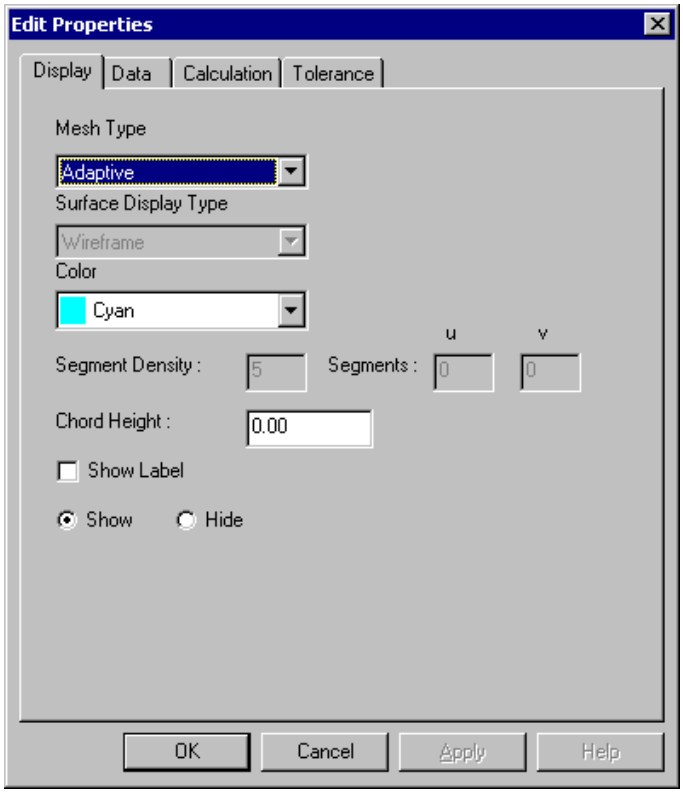
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button,  , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

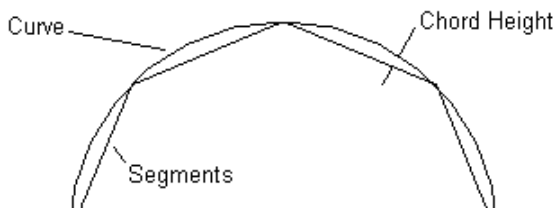
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

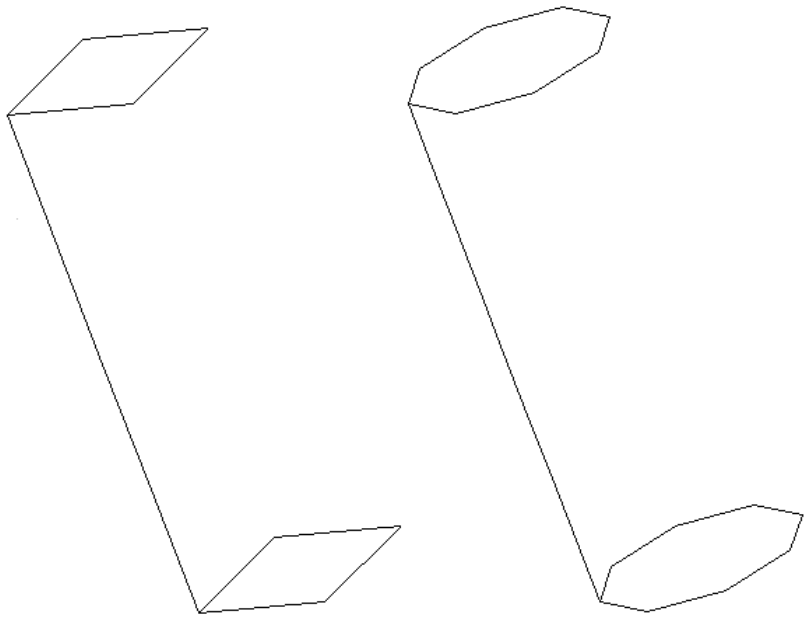


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

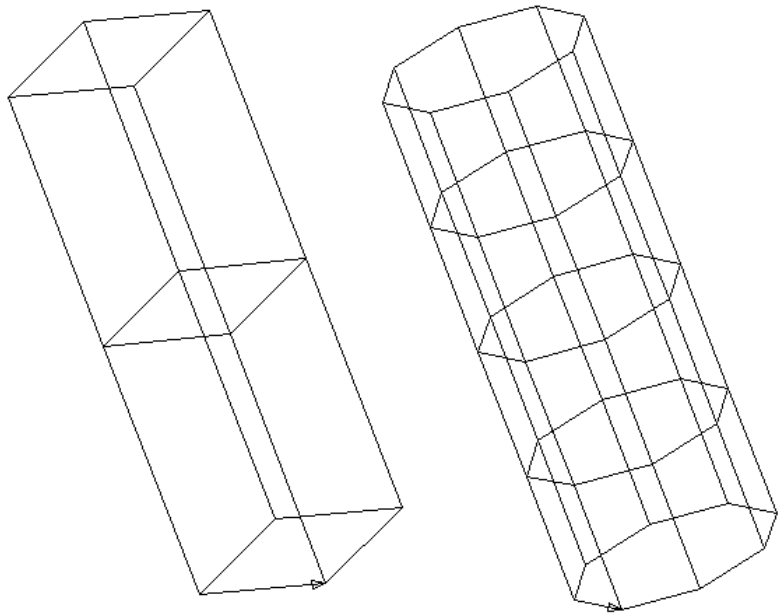
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

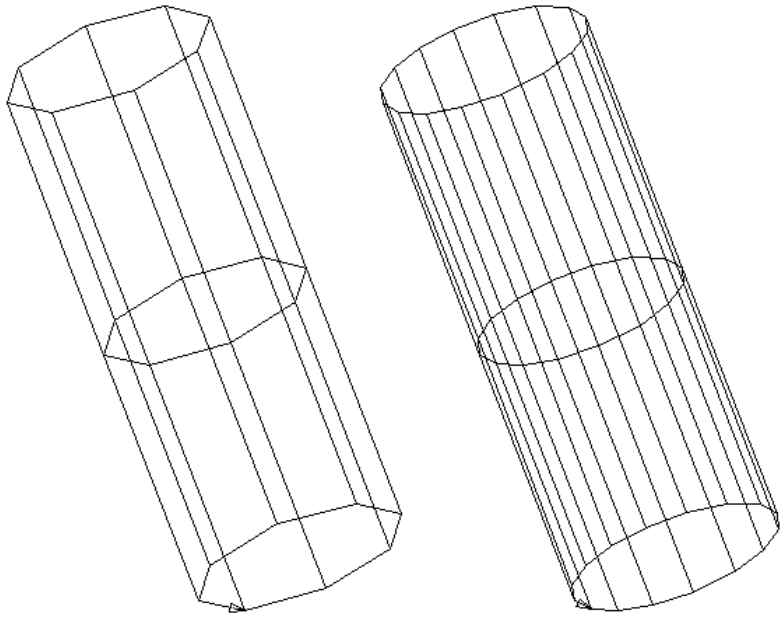
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

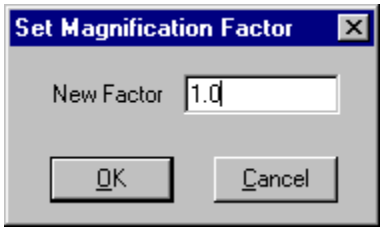
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



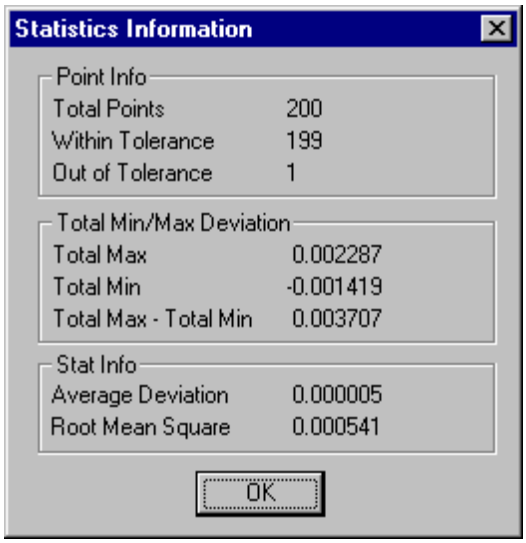
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

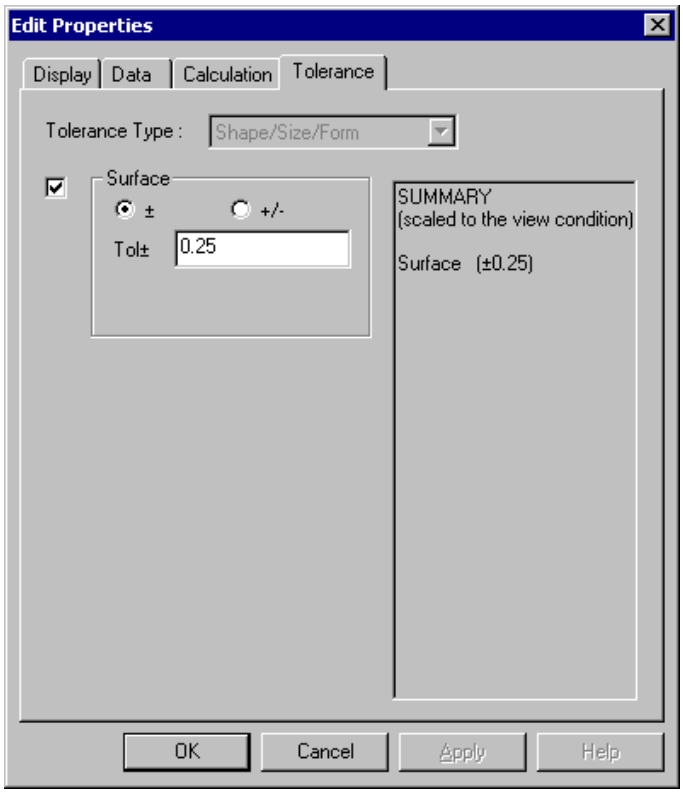
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

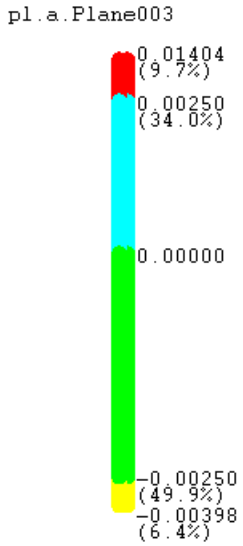


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

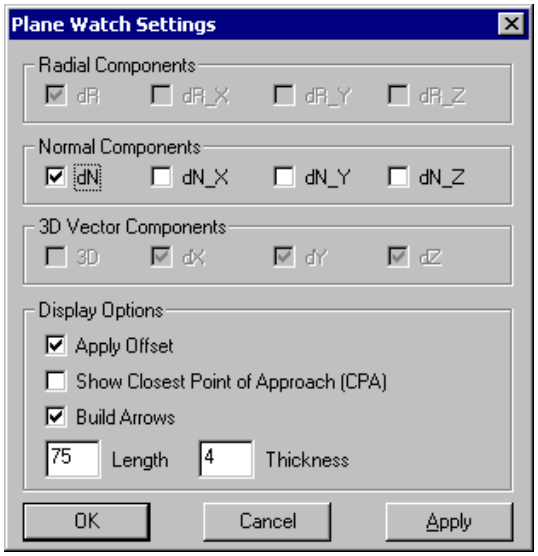
Doing the following can open a watch window with a tolerance:

11. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
12. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

    The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

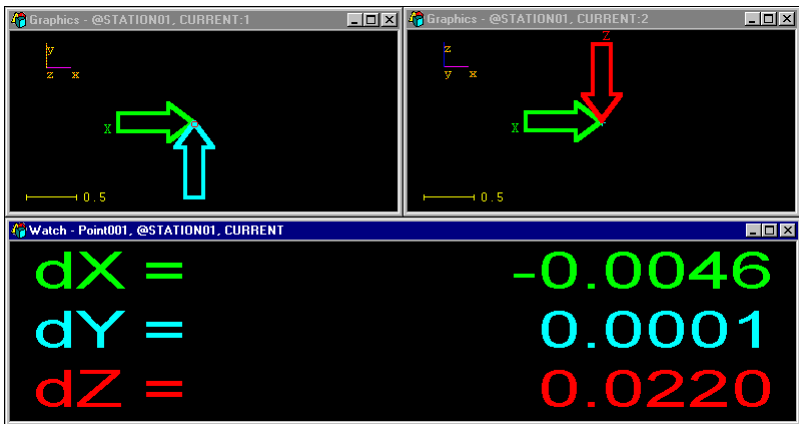
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets*” Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

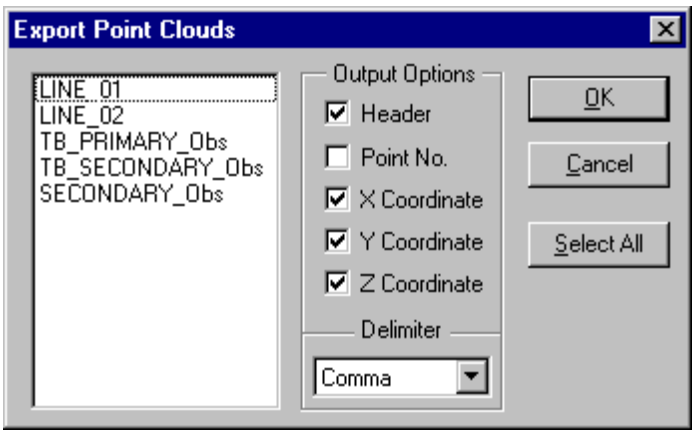
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

31. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
32. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
33. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

34. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
35. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
36. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

26. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
27. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
28. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
29. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
30. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

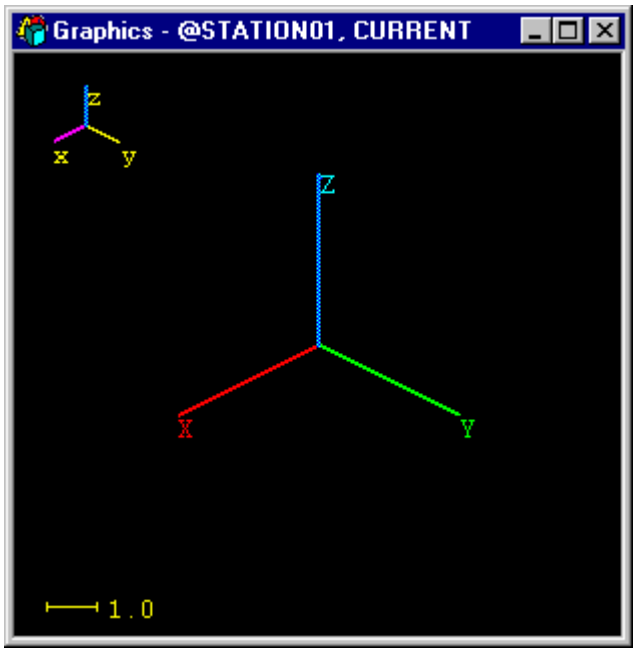
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

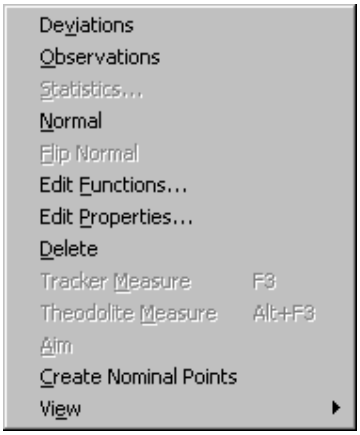
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

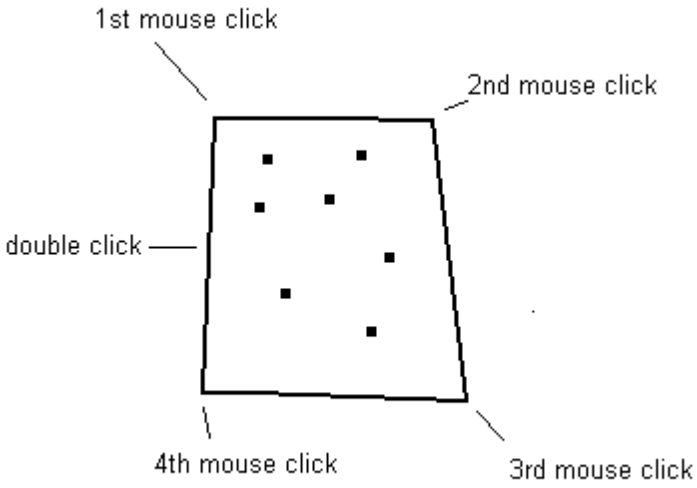
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

25. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

26. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

27. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

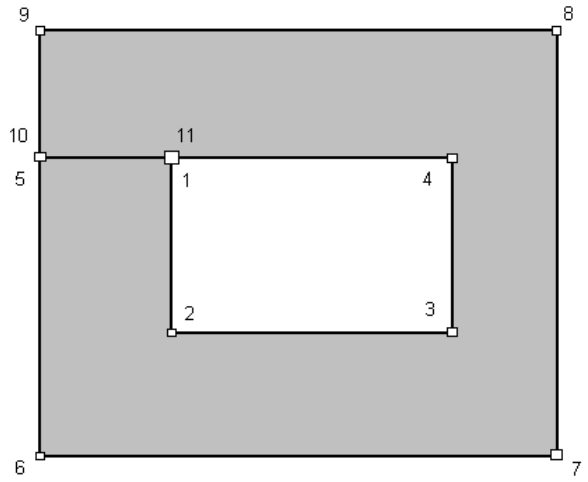
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

    Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

28. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

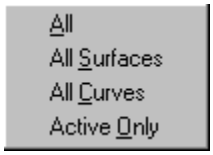
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

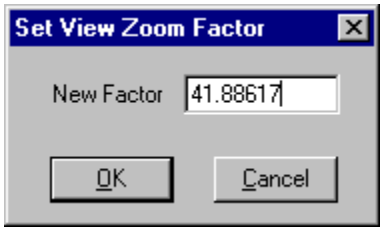
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

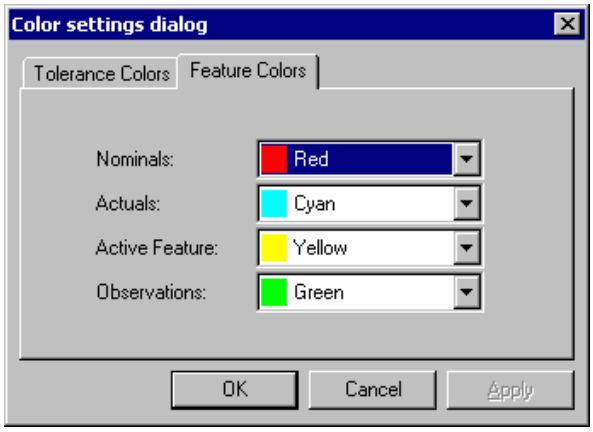
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

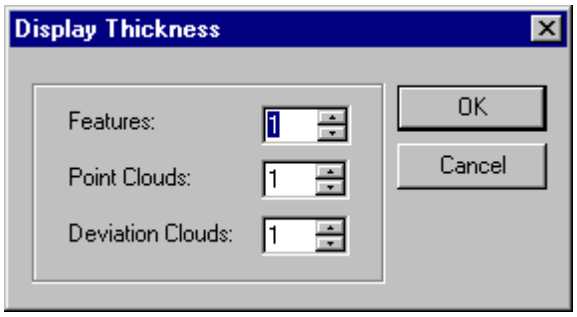
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

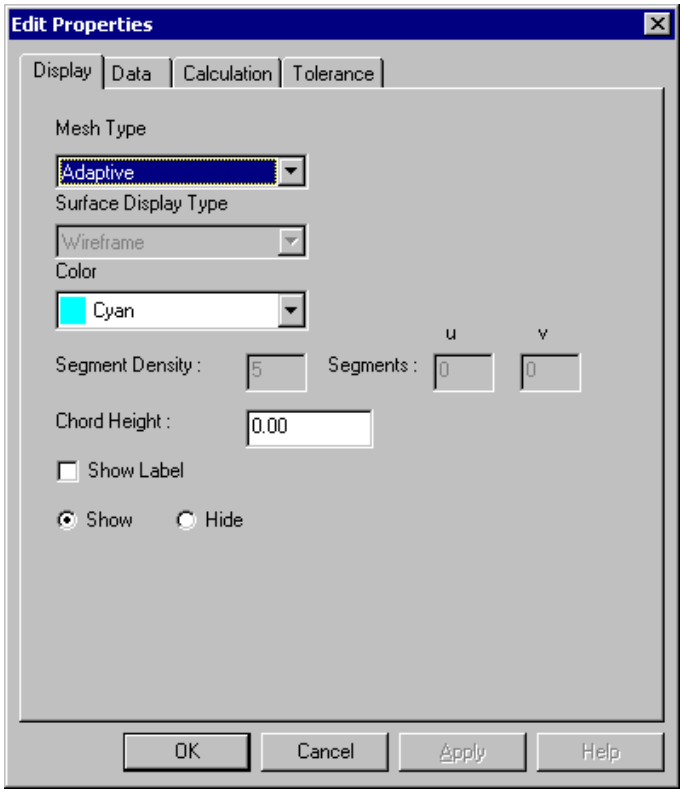
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button,  , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

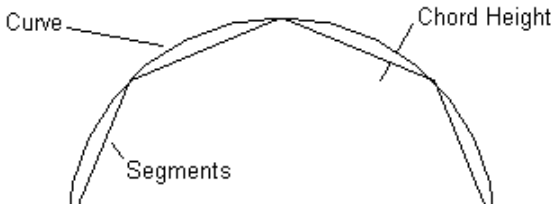
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

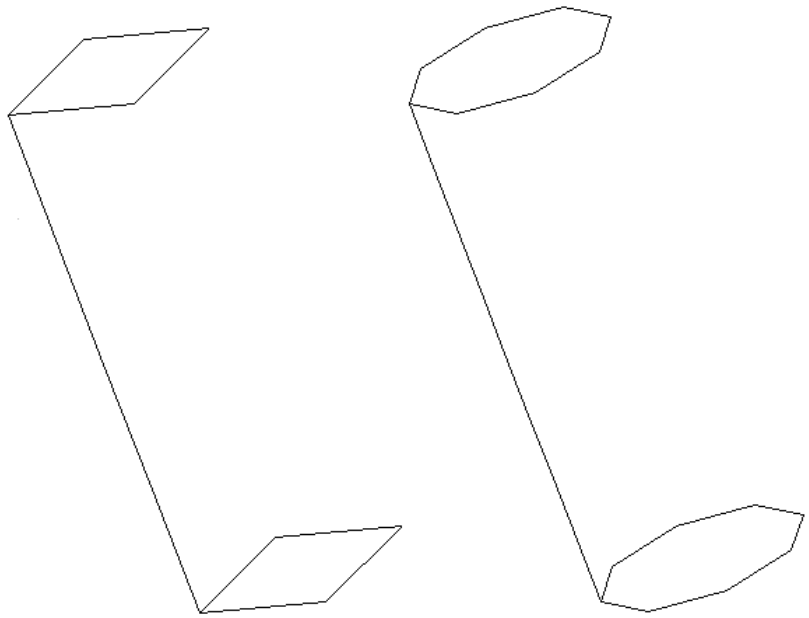


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

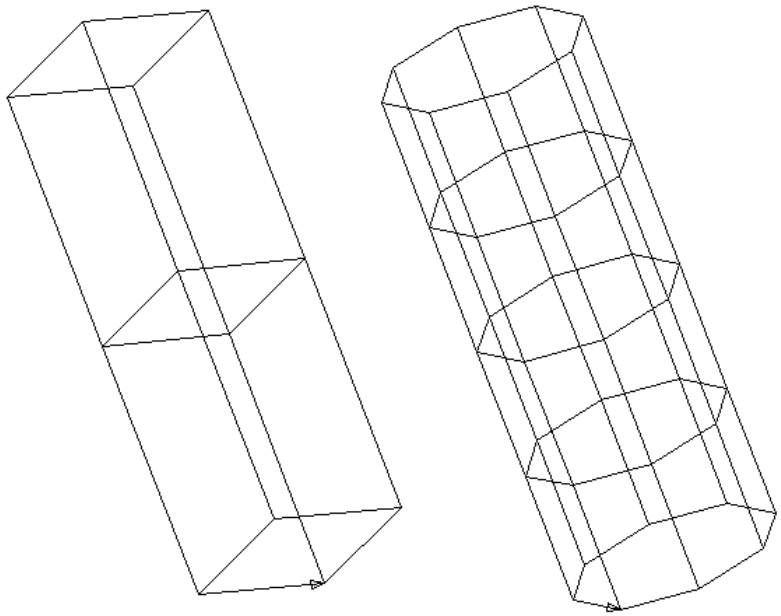
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

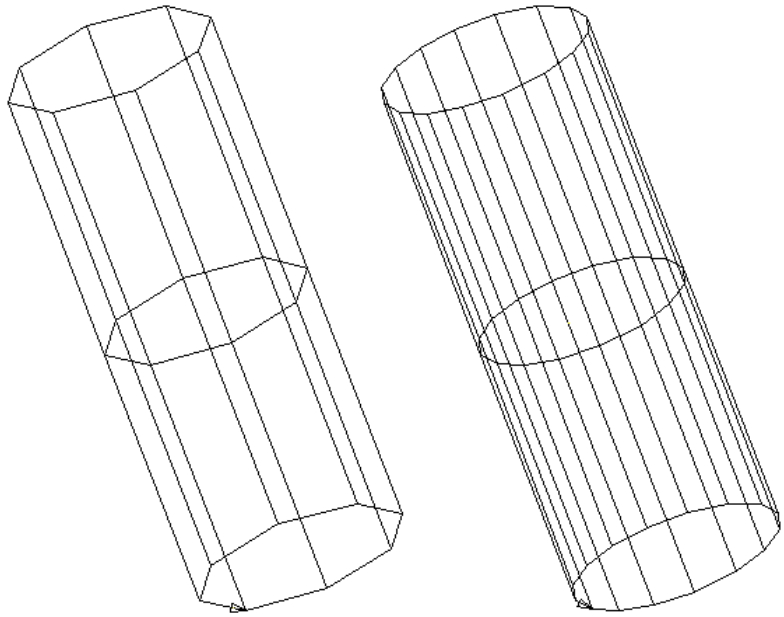
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

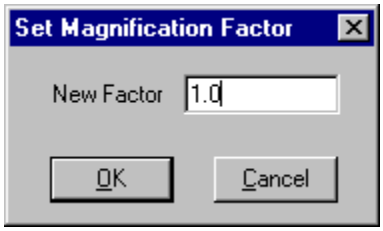
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



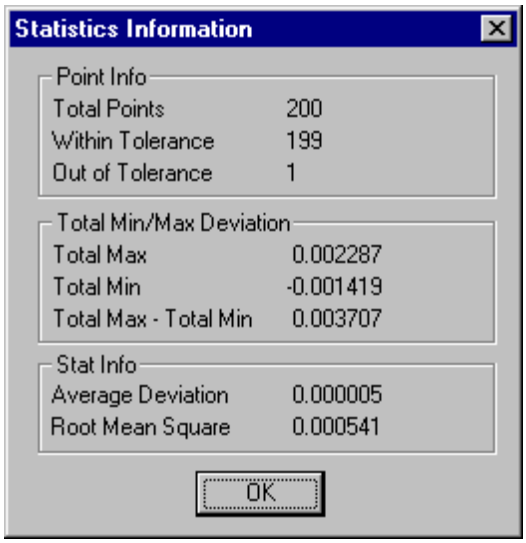
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

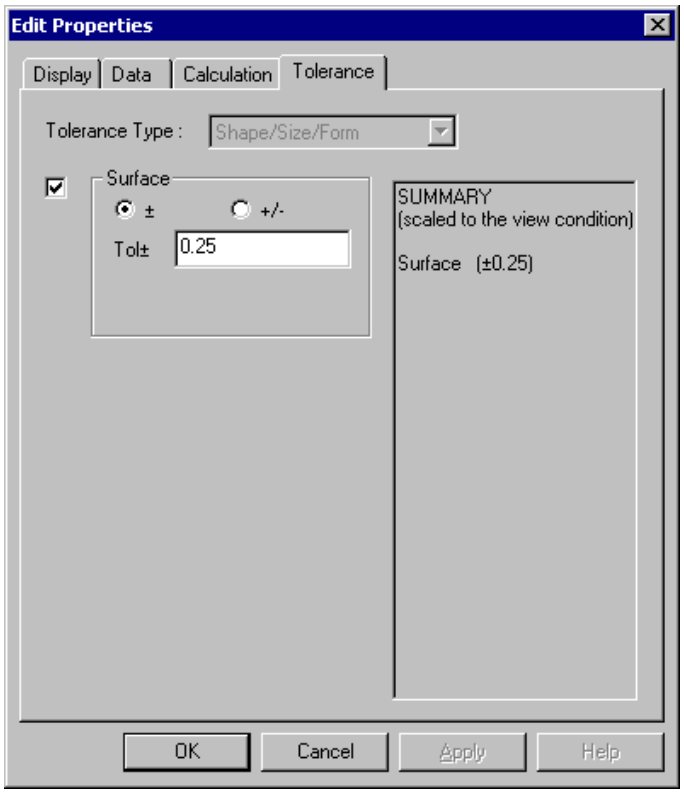
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

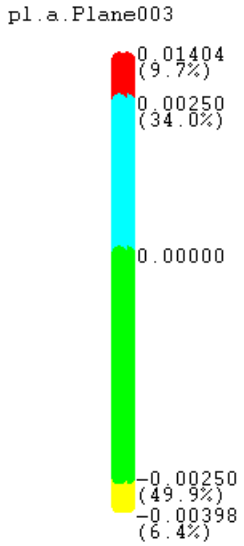


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

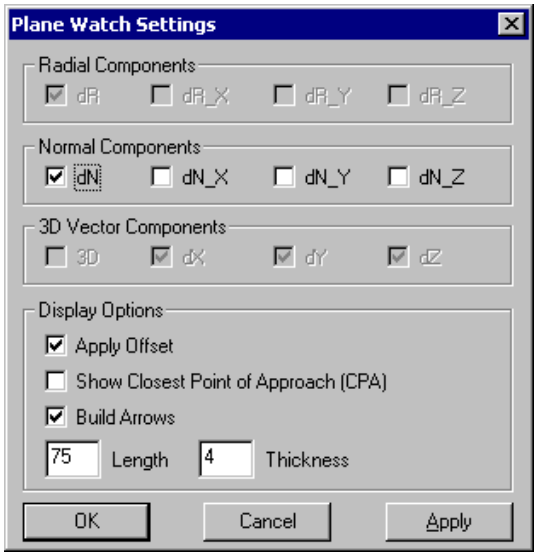
Doing the following can open a watch window with a tolerance:

13. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
14. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

    The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

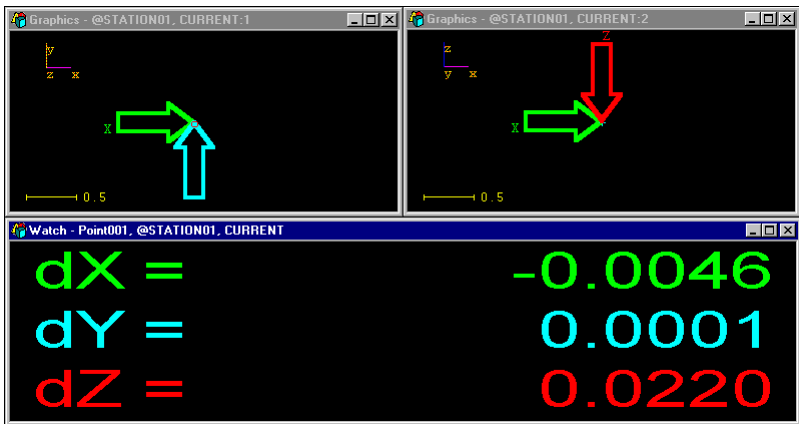
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets”* Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

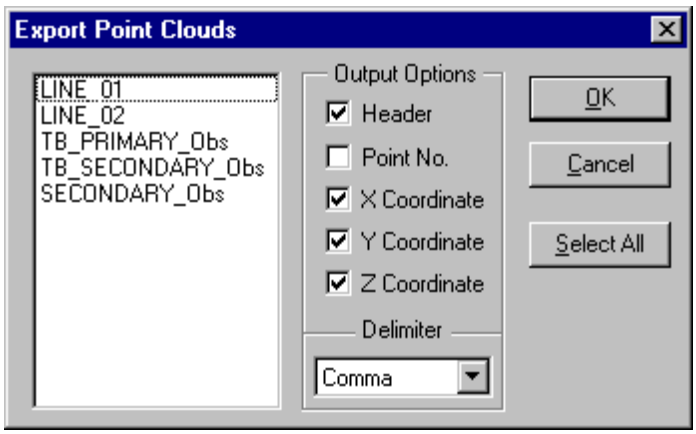
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

37. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
38. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
39. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

40. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
41. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
42. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

31. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
32. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
33. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
34. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
35. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

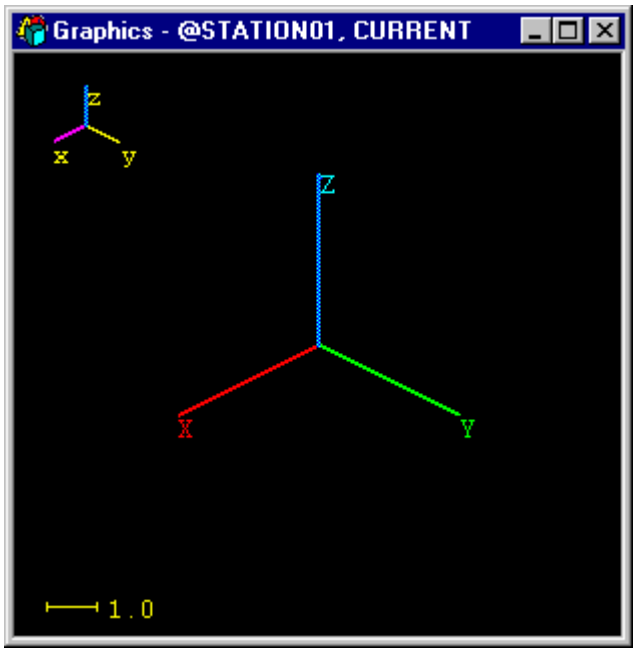
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

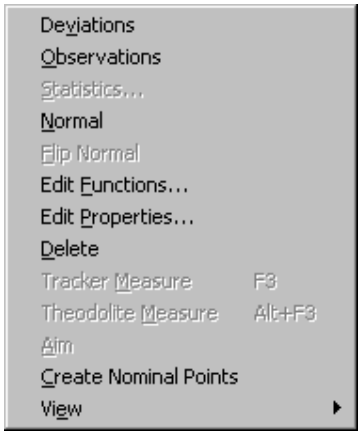
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

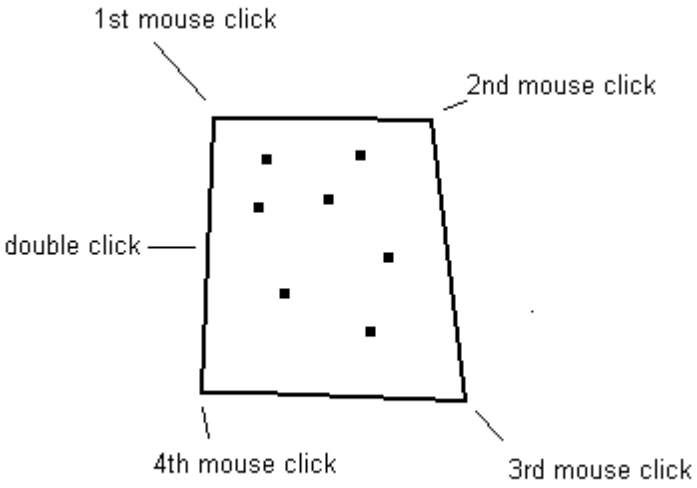
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

29. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

30. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

31. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

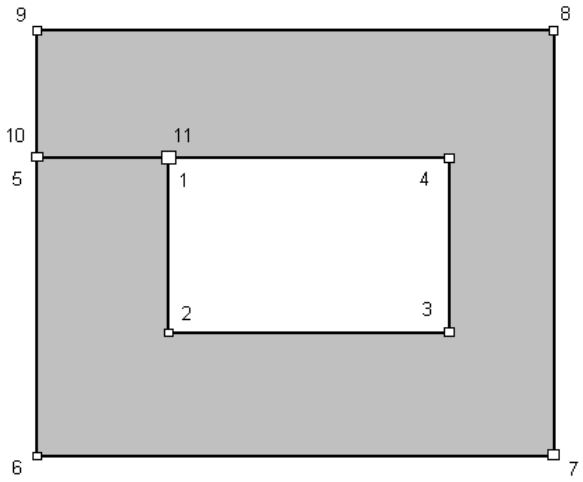
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

    Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

32. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

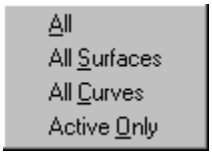
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

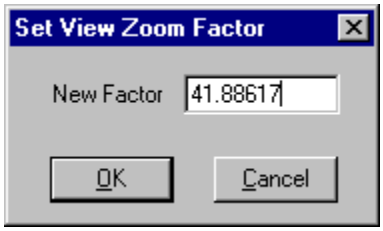
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

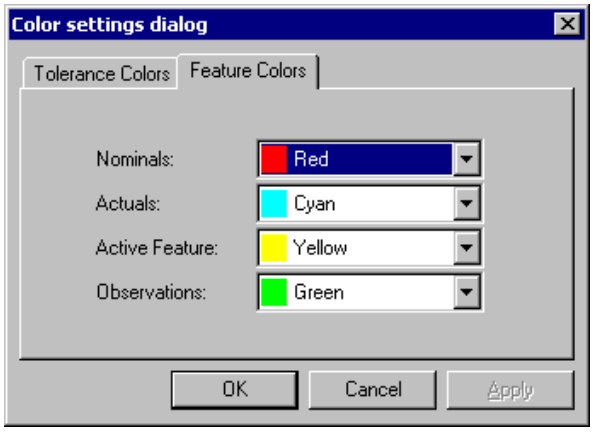
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

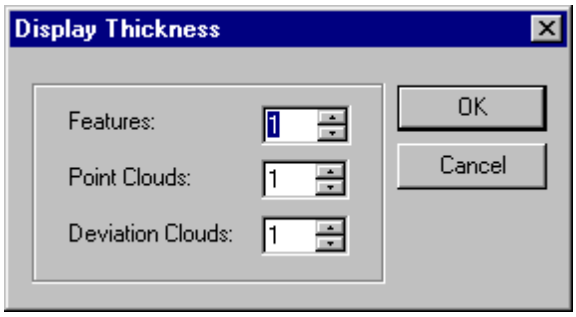
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

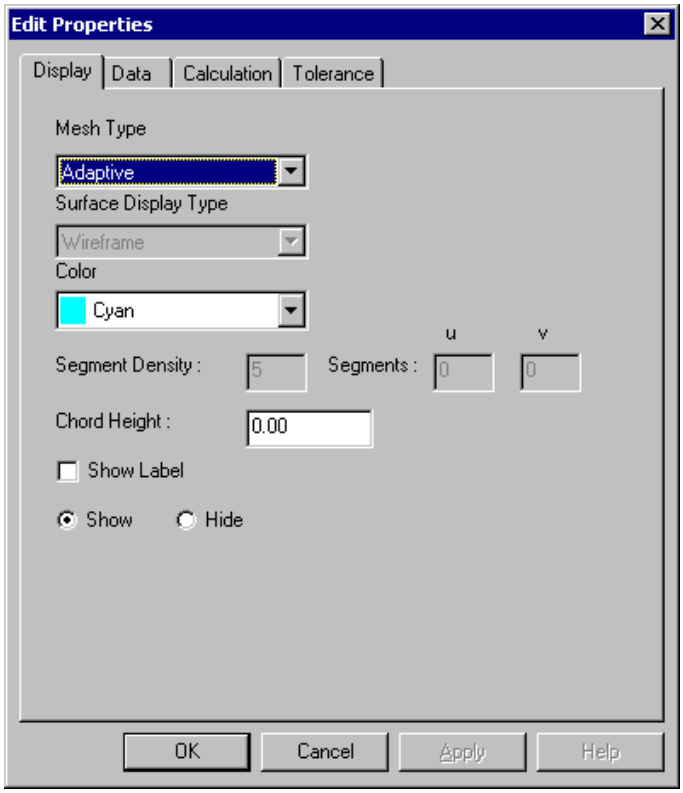
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button,  , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

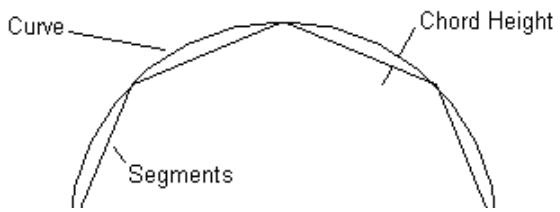
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

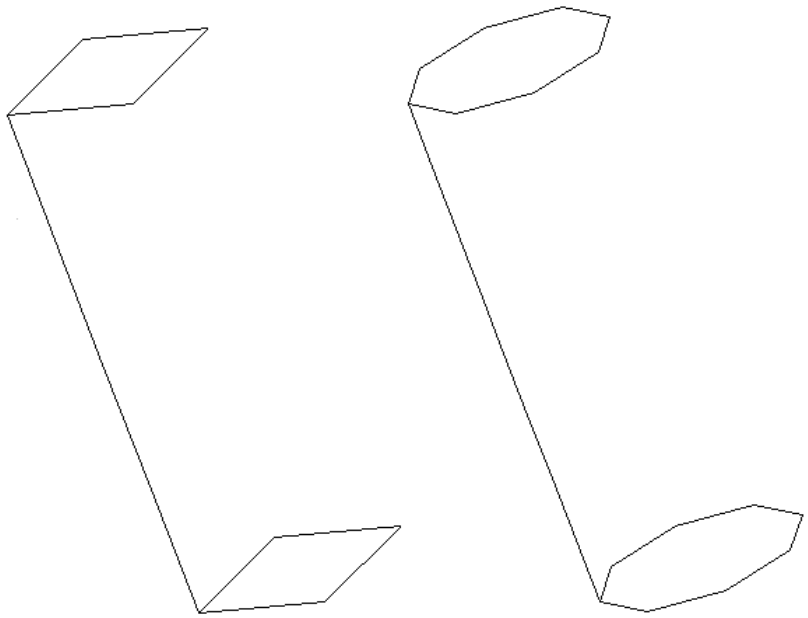


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

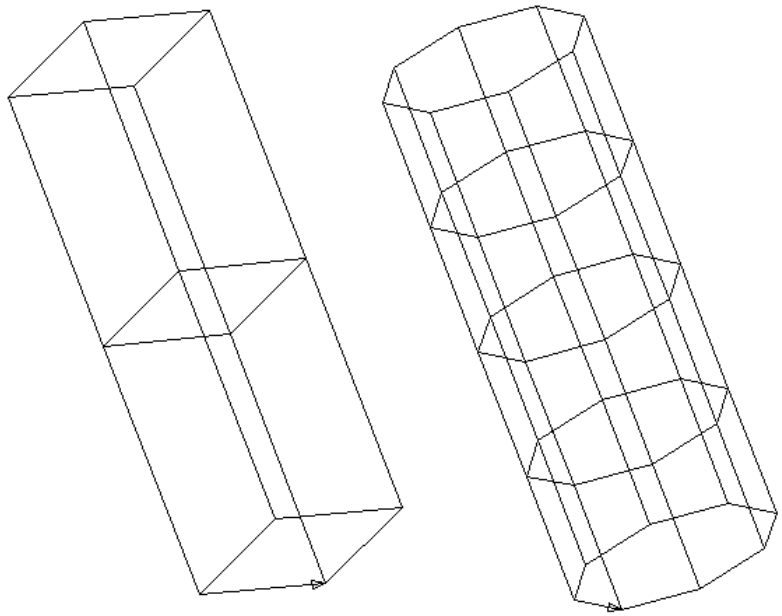
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

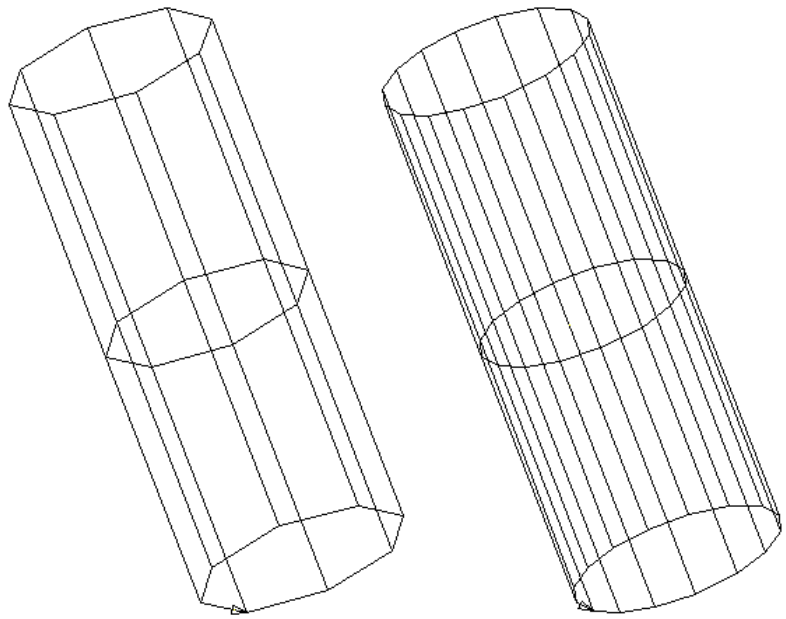
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

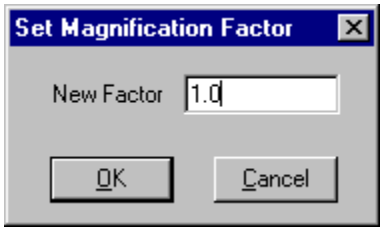
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



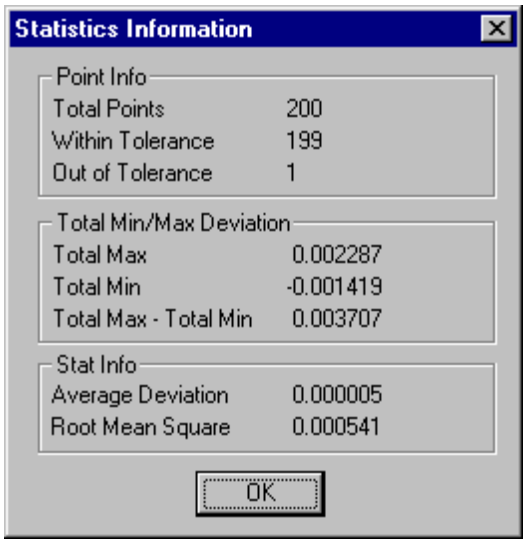
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

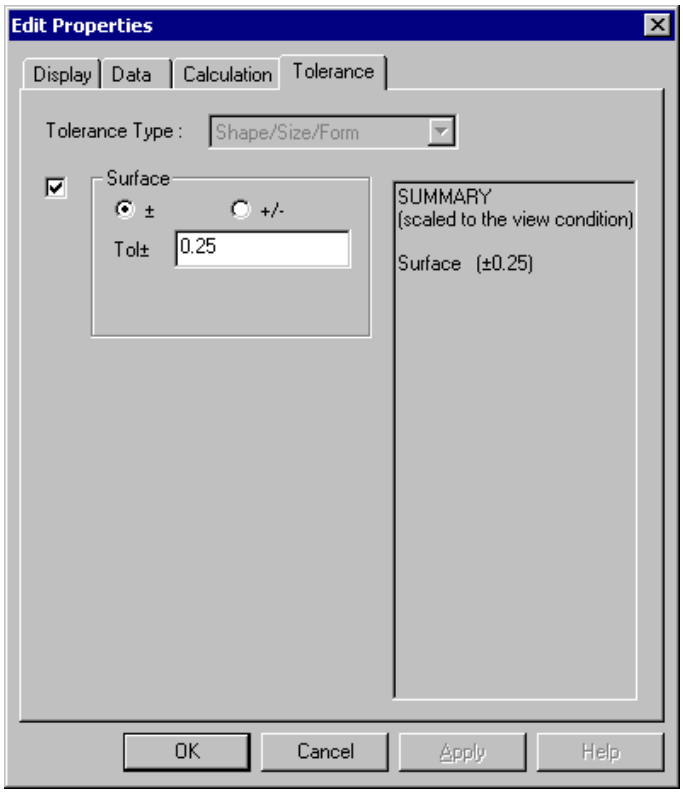
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

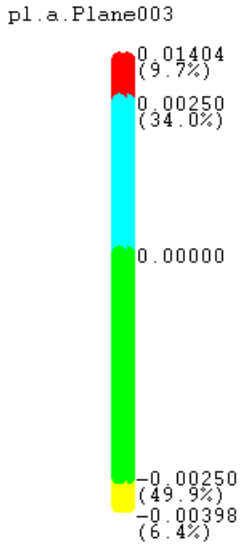


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

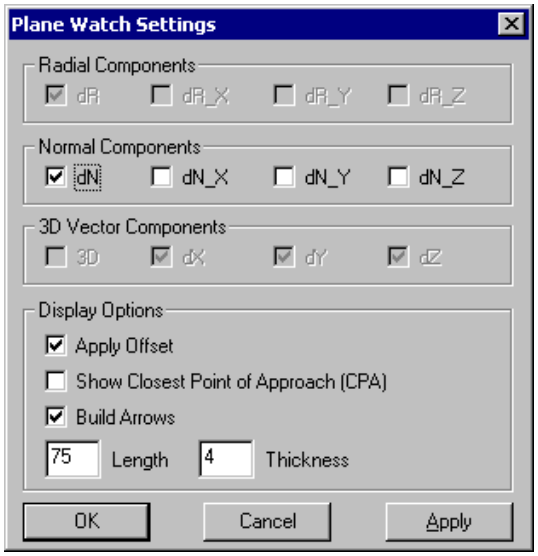
Doing the following can open a watch window with a tolerance:

15. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
16. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

    The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

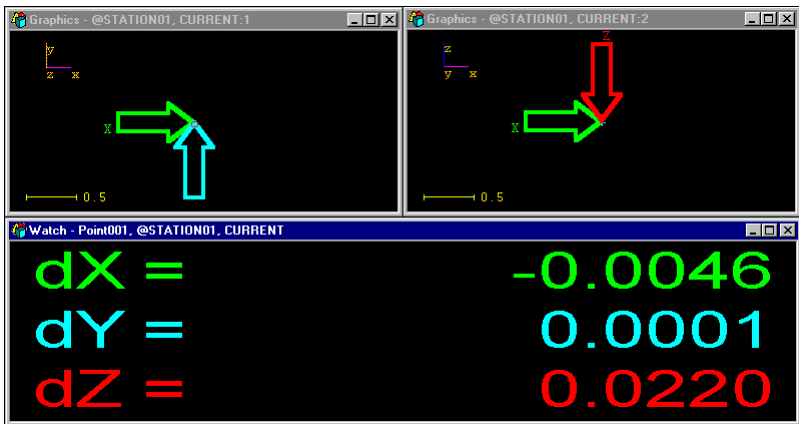
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets*” Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

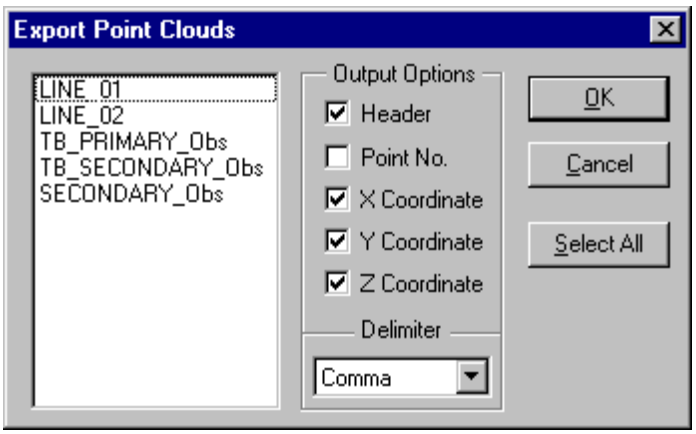
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

43. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
44. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
45. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

46. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
47. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
48. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

36. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
37. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
38. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
39. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
40. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

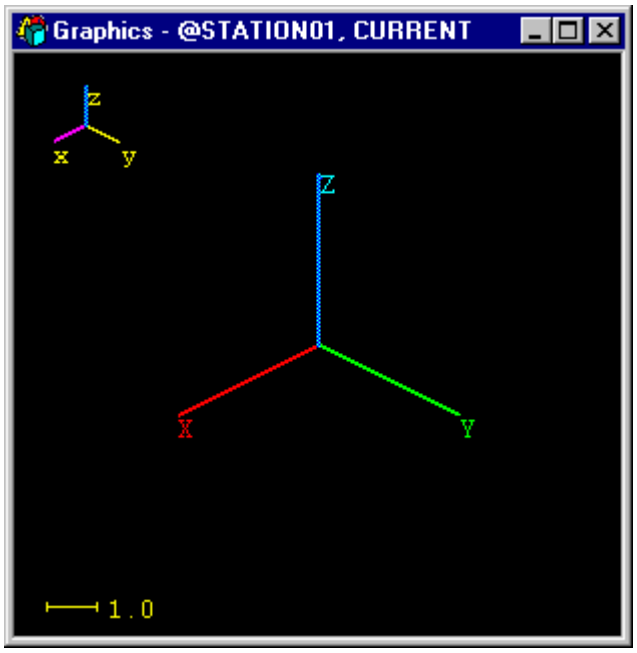
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

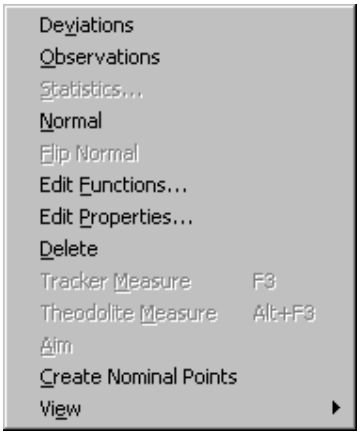
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

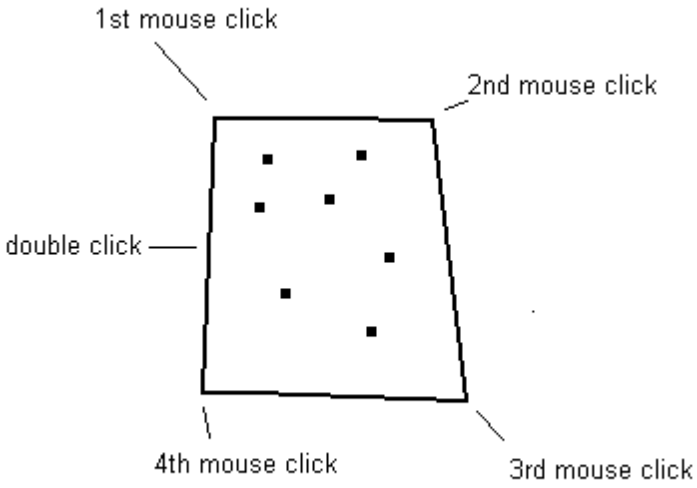
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

33. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

34. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

35. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

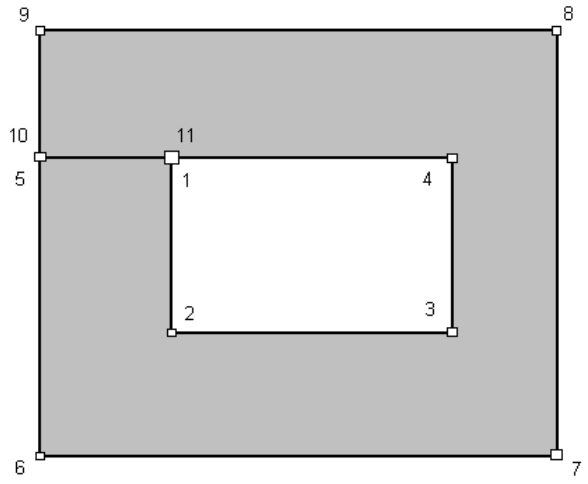
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

    Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

36. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

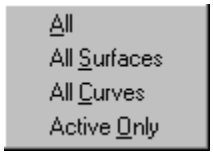
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

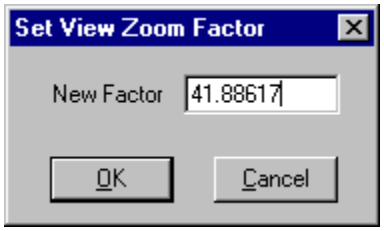
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

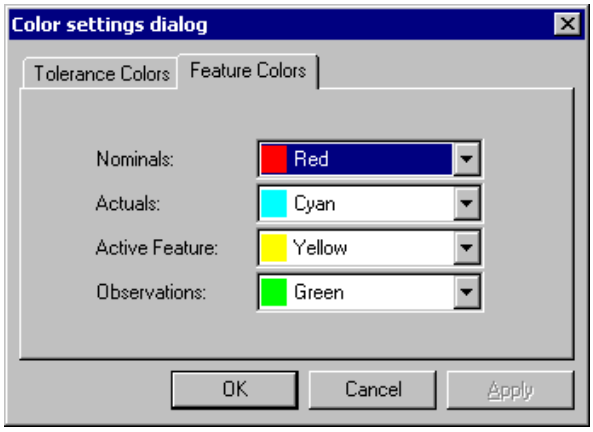
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

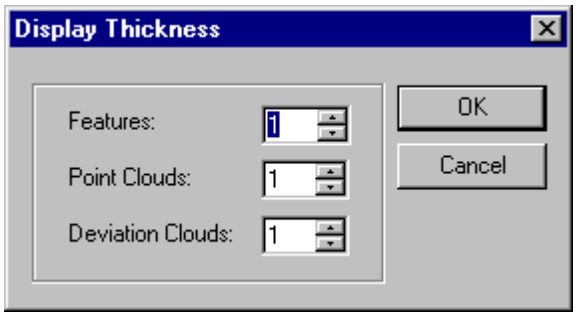
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

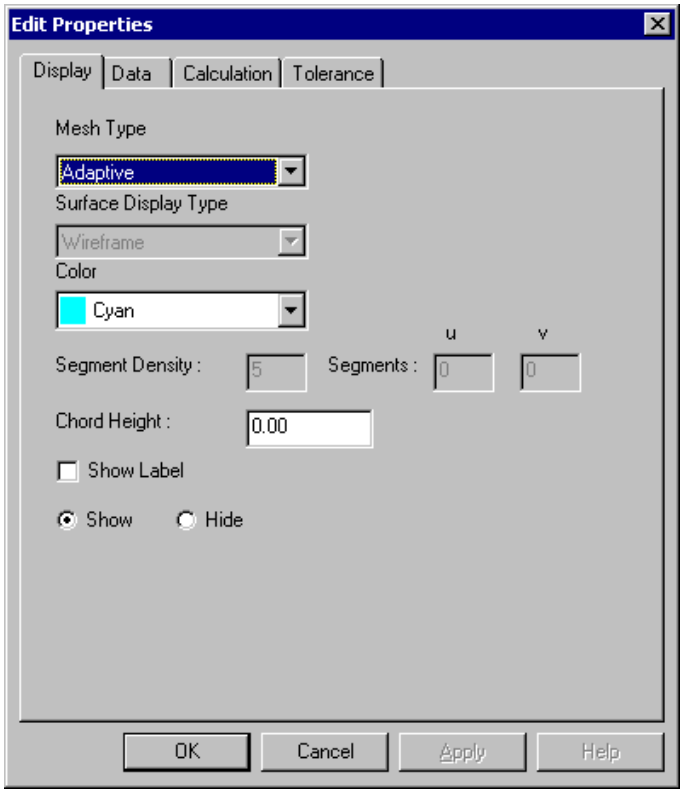
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button, , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

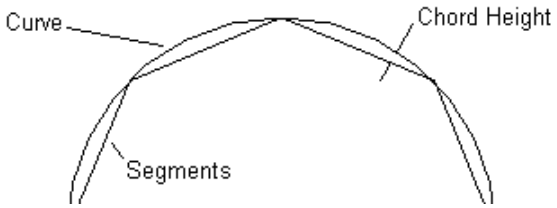
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

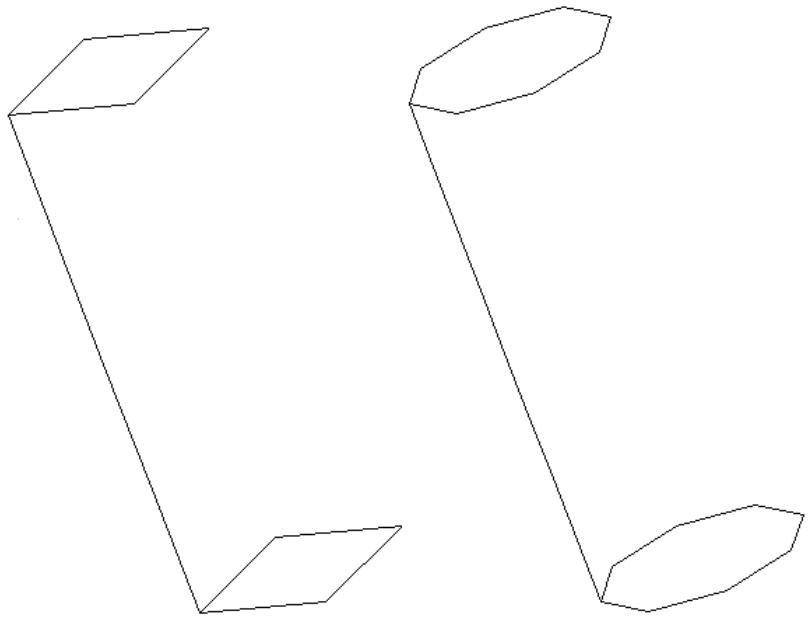


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

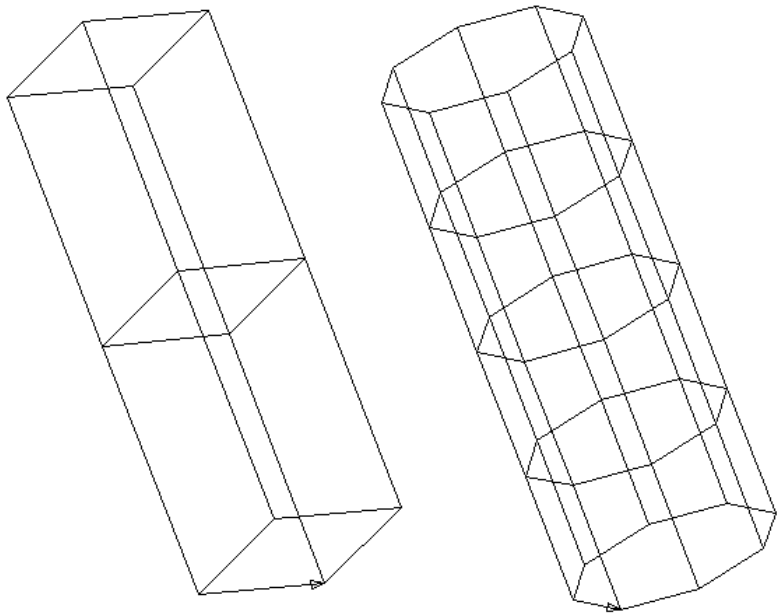
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

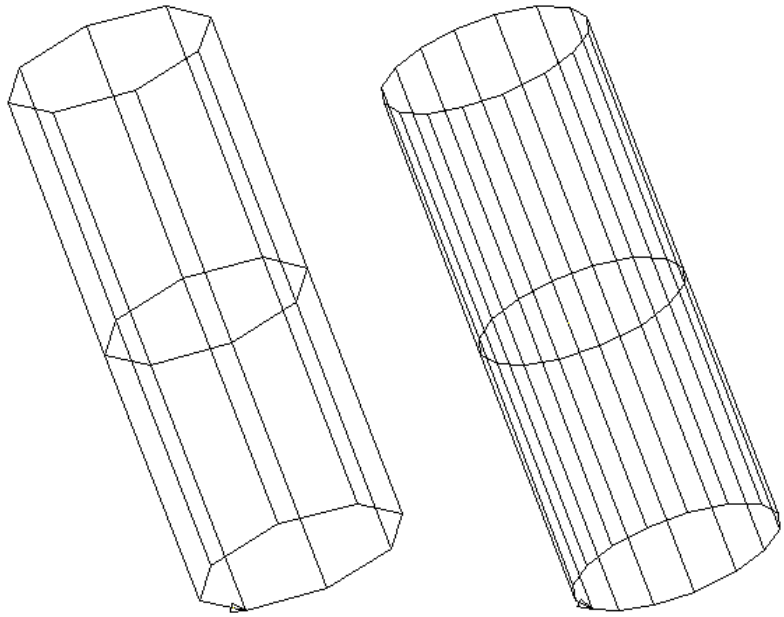
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

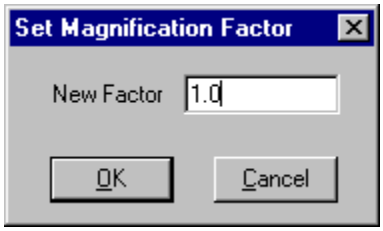
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



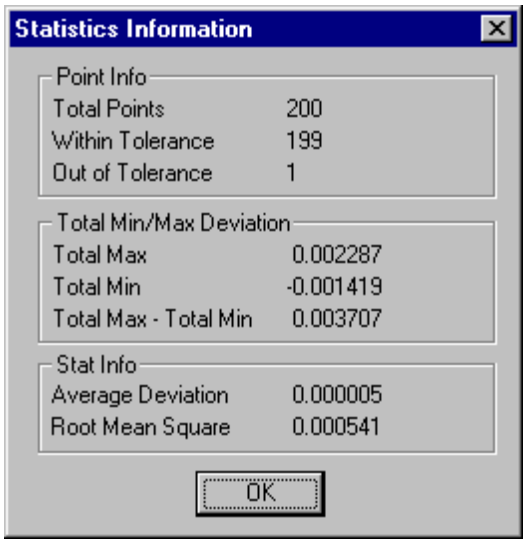
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

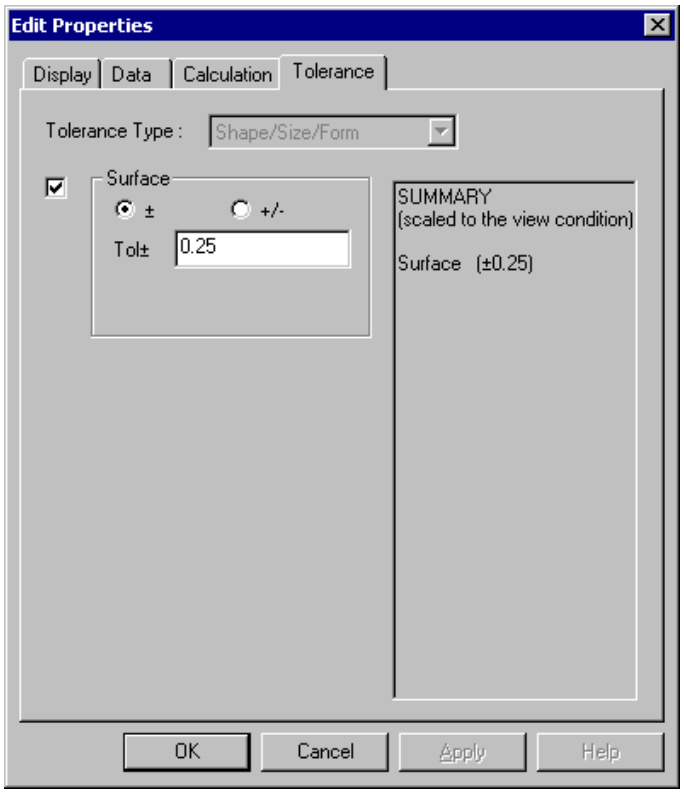
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

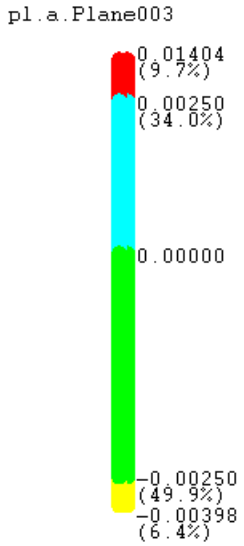


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

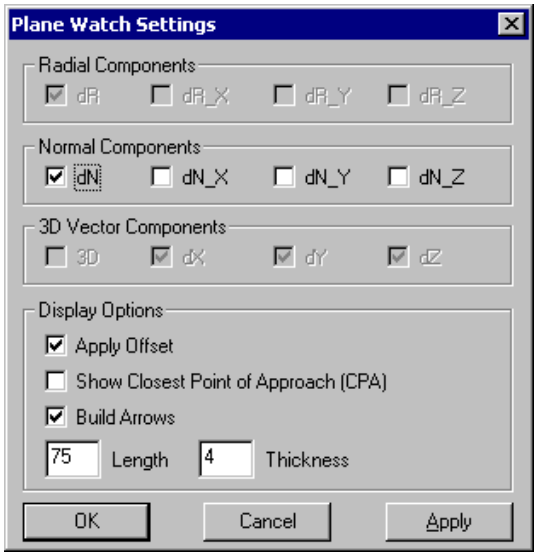
Doing the following can open a watch window with a tolerance:

17. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
18. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

    The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

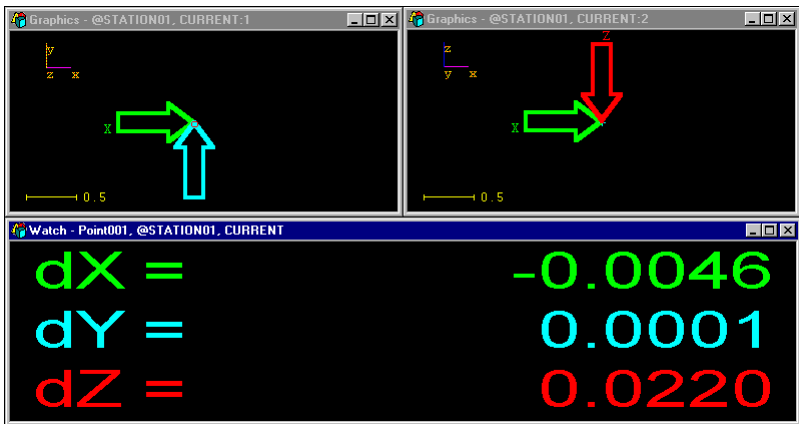
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets”* Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

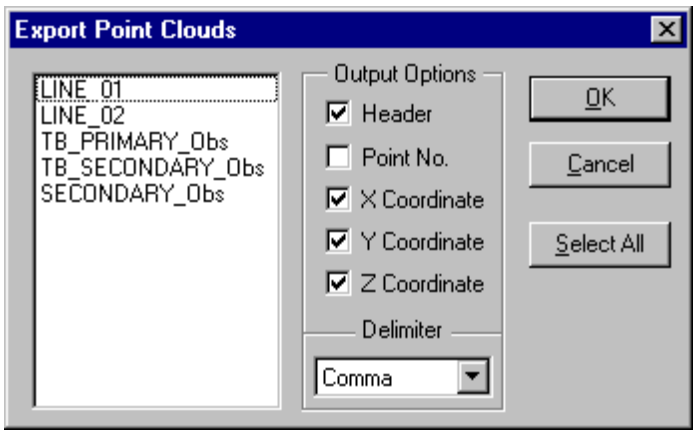
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

49. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
50. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
51. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

52. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
53. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
54. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

41. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
42. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
43. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
44. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
45. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

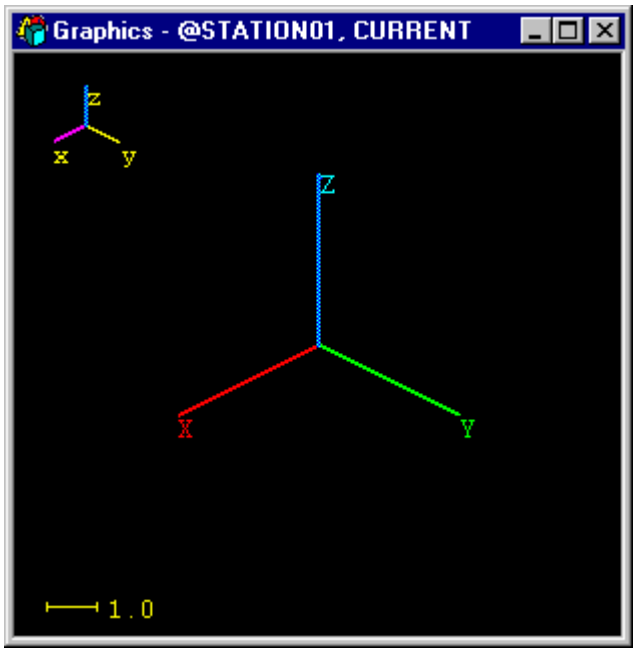
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

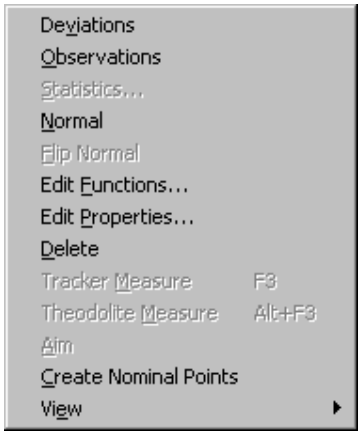
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

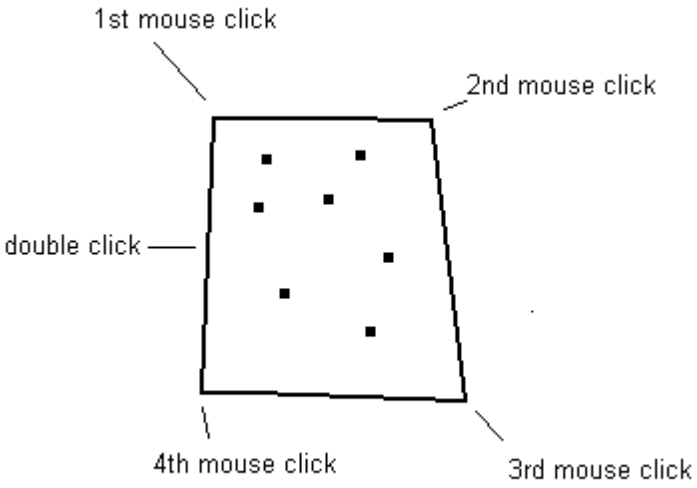
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

37. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

38. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

39. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

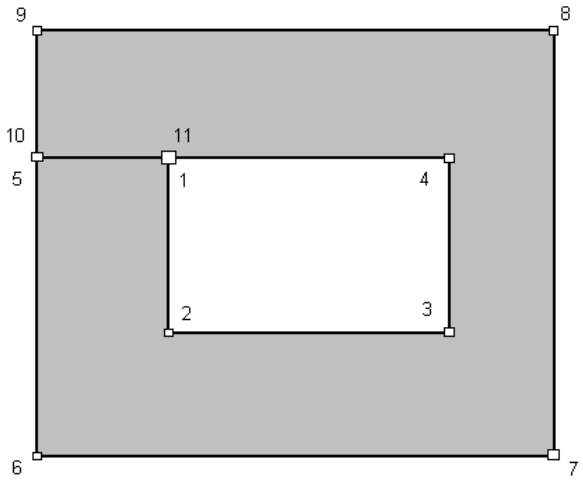
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

    Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

40. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

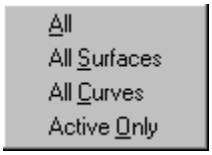
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

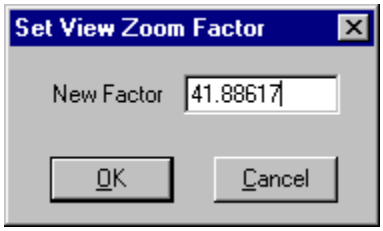
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

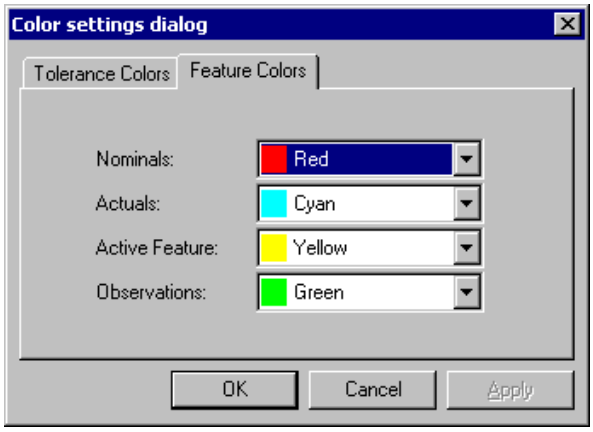
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

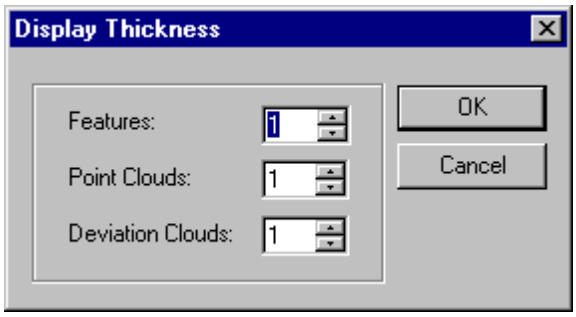
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

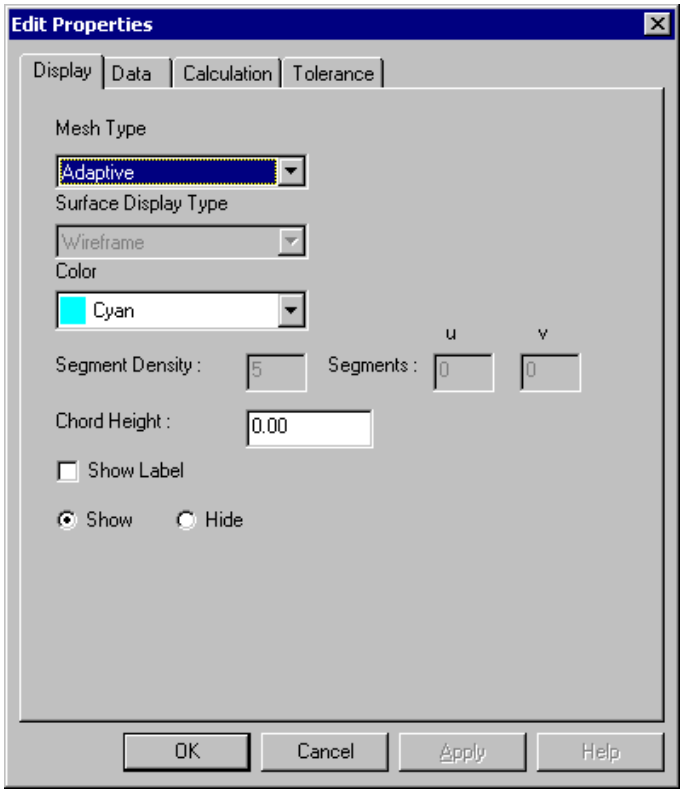
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button, , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

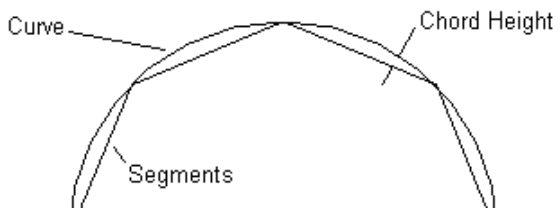
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

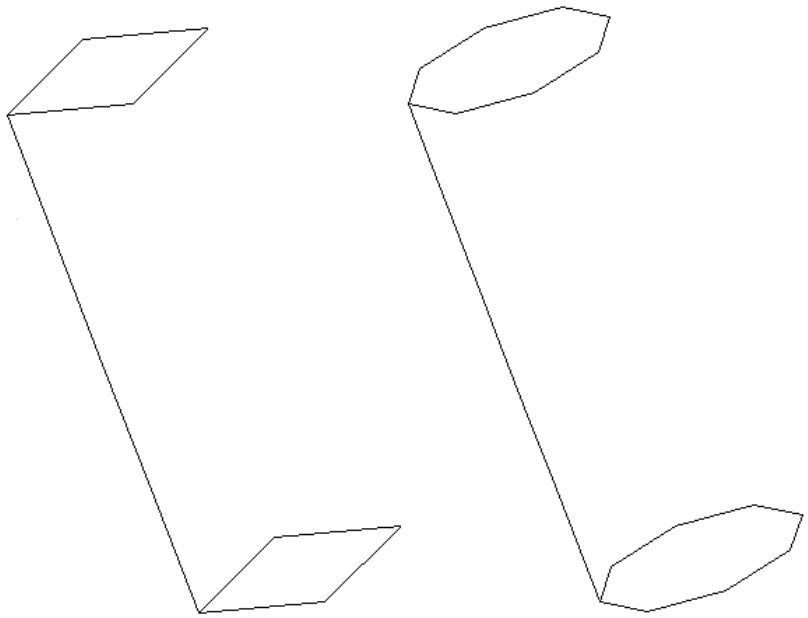


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

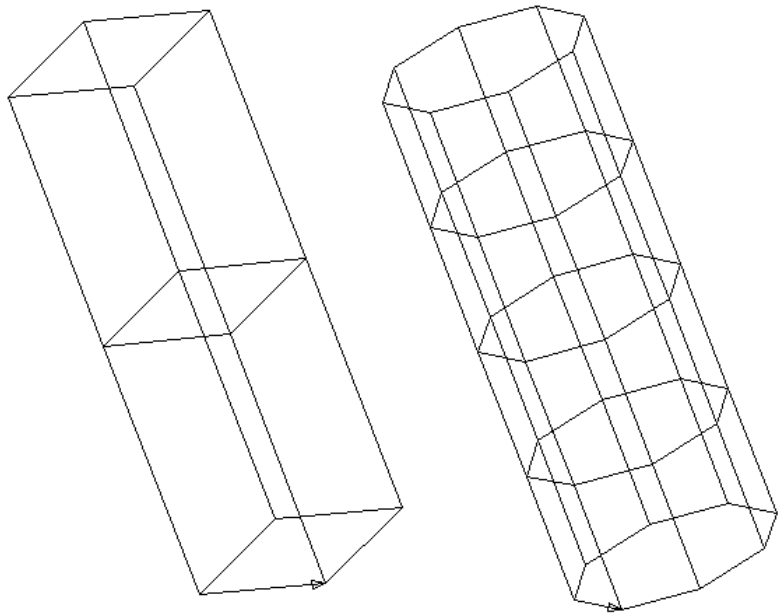
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

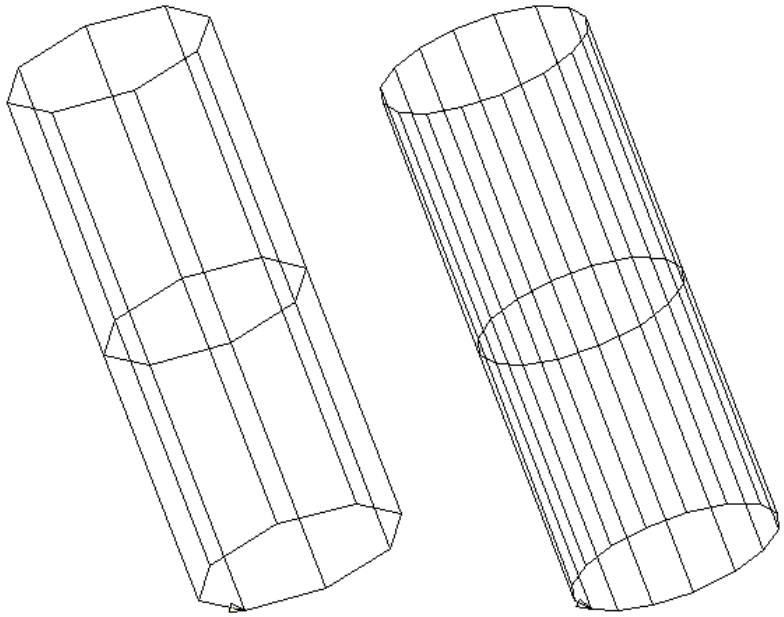
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

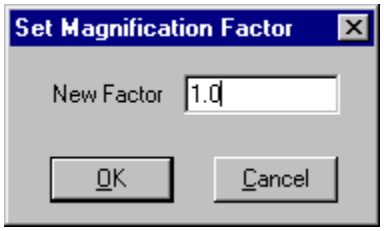
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



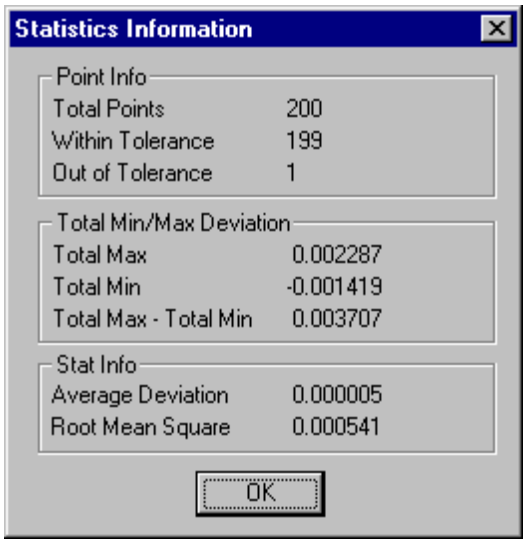
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

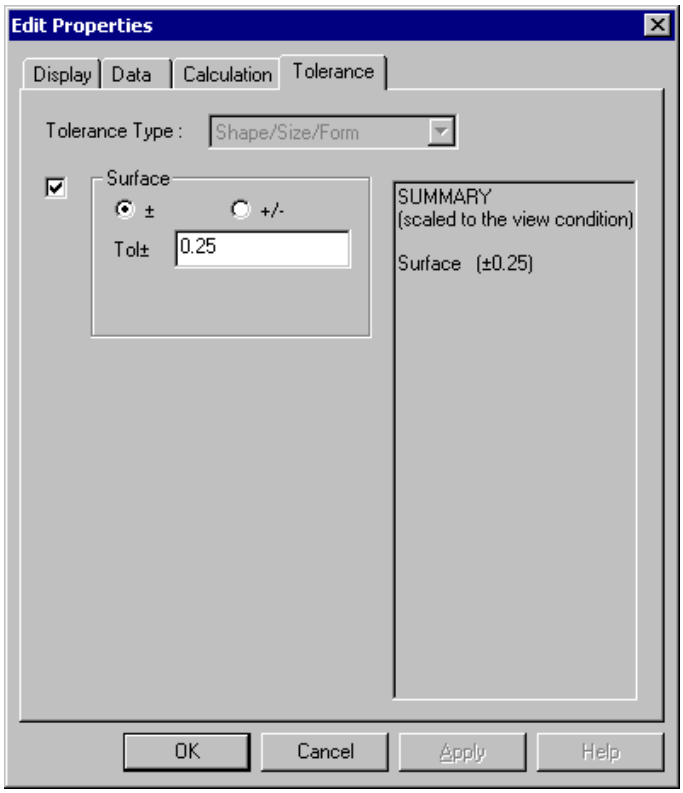
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

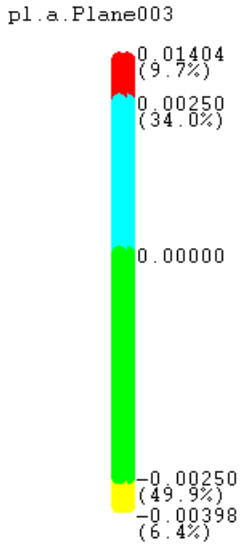


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

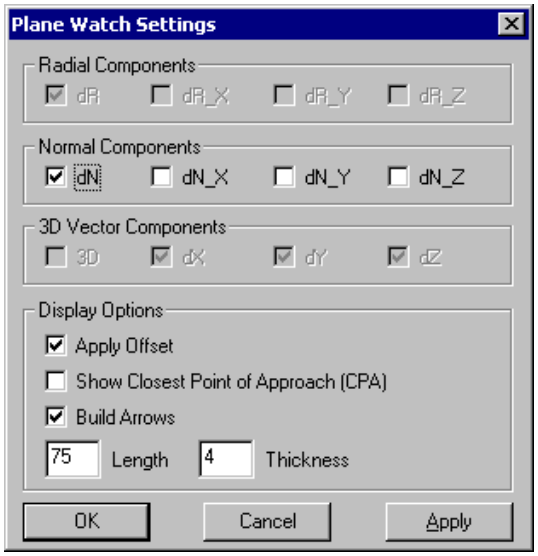
Doing the following can open a watch window with a tolerance:

19. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
20. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

    The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

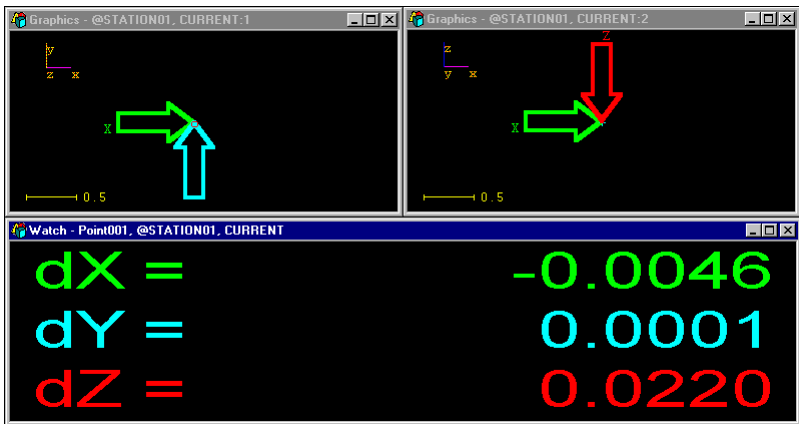
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets*” Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

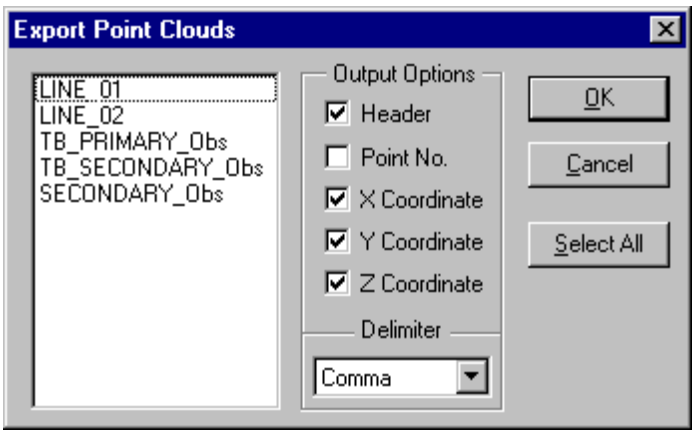
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

55. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
56. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
57. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

58. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
59. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
60. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

46. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
47. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
48. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
49. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
50. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.

Graphics View Window

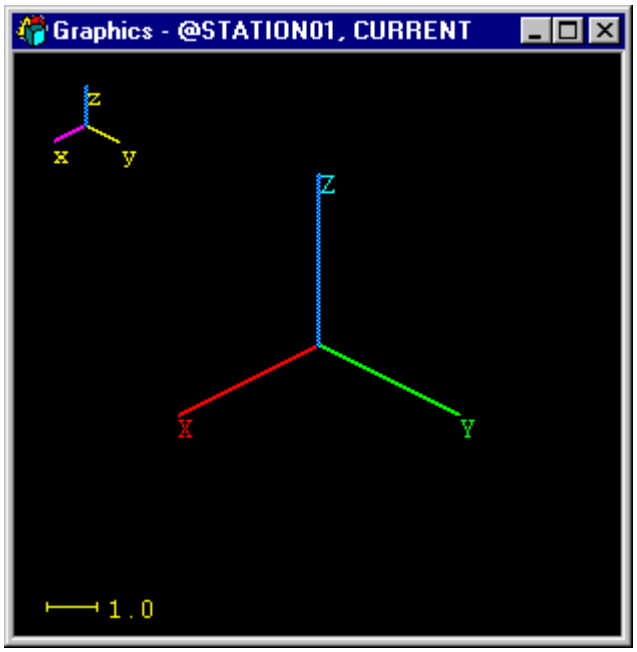
Graphics View Basics

What is the Graphics View?

FARO Insight *Visual* and *Visual*Pro have an additional window called the Graphics View. This view enables you to view all actual and nominal features in a three dimensional graphical representation. This makes for easier visualization of your job, as well as allowing for an array of additional analysis tools that can be used for checking the quality of actual features or comparing actual and nominal features and surfaces.

World Orientation Axis

Located in the upper left corner of the graphics window is a coordinate axis representation called the World Orientation Axis.



Graphics View with World Orientation Axis

This orientation axis displays the current view orientation within the graphics window. While the view is being rotated, the axes will also rotate. This representation gives the user a constant reference to the currently viewed orientation.

Navigating through the Graphics View

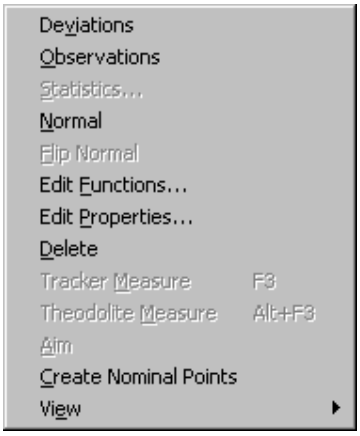
Selecting Features

To select a feature, or make it the active feature, choose it from the Gents Worksheet, or click on it in the Graphics View. You can choose more than one feature in the Graphics view by selecting the first feature and holding the CTRL key down when selecting subsequent features. When selecting from the Graphics View, if there is one or more features overlapping, or if features are very close together in the chosen area, the following dialog will appear, allowing the user to choose which feature to select from a list.

From this dialog, you can select the feature or features you want to activate. You can choose multiple features by using the CTRL key or the SHIFT key while pressing the mouse button.

Speed Menu

Like the Gents Worksheet, the Graphics View has a speed menu that allows you to quickly access commonly used functions. The speed menu *works only on the active feature*. To display the speed menu, first select a feature, then press the right mouse button in the Graphics View. The following menu will appear.



Deviations	Shows or hides the active feature's deviations.
Observations	Shows or hides the active feature's observations.
Statistics…	Shows the Statistics Information window.
Normal	Shows or hides the active feature's normal vector.
Flip Normal	Assigns the Flip Normal function to the active feature.
Edit Functions…	Opens the edit Functions dialog for the active feature.
Edit Properties…	Opens the edit Properties dialog for the active feature.
Delete	Deletes the active feature.
Tracker Measure	Takes a measurement for the active feature.
Theodolite Measure	Takes a measurement for the active feature.
Aim	Aims at the active feature.
Create Nominal Points	Creates nominals points on the feature's surface.
View	Opens the View menu.

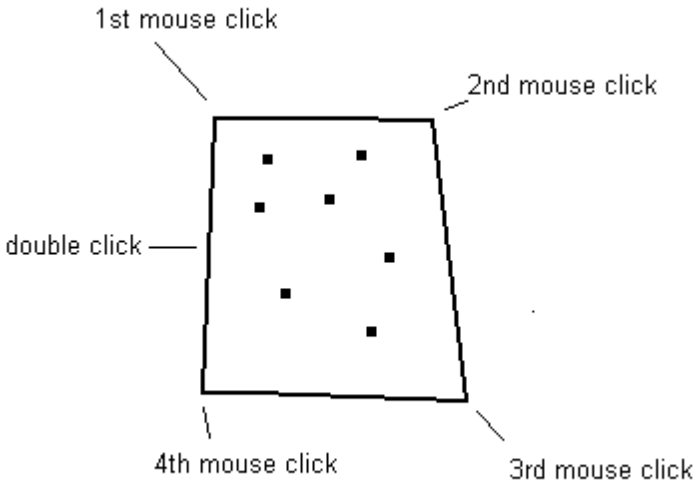
Editing observations with polygon select

FARO Insight *Visual* allows you to edit point clouds while in the Graphics View by using the Polygon Select command. This feature allows you to use the mouse to select an area and un-use or delete the observations of a feature.

41. From the Graphics menu, select Point Cloud, then Modify by Polygon Select… (Alt, G, P, M). This option is only available when the active feature's observations have been selected to be shown in the Graphics window.

42. The mouse cursor will now display a pencil when it is over the Graphics View. Press the mouse button near where you want to start the selection process. Drag the mouse to the second corner of the polygon and press the mouse button again and repeat this for the third, fourth, etc. Double click to connect the last corner to the first corner.

    For example, if you want to select the following observations, press the mouse button in the following locations.



When you are done selecting, the Polygon Select Options Dialog will be displayed.

Polygon Select Options Dialog

43. From the Polygon Select Options Dialog, choose from the following options:

    All Visible Clouds – Select this to have Polygon Select work on all features that are currently visible in the Graphics View.

    Active Cloud Only – Select this to have Polygon Select work only on the active cloud(s).

    Inside Polygon – Select this to have Polygon Select work only on the points inside the polygon.

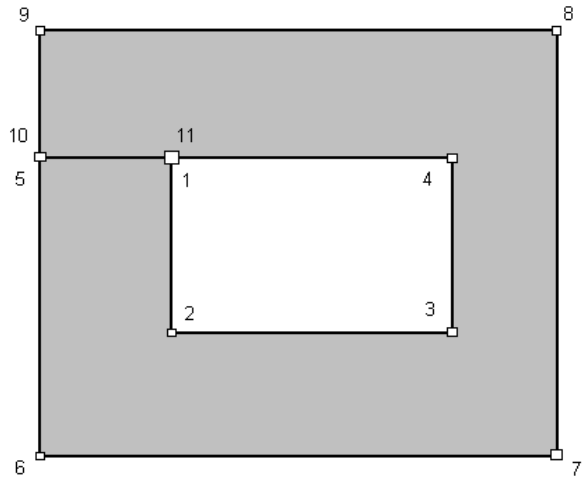
    Outside Polygon – Select this to have Polygon Select work only on the points outside the polygon.

    Delete Selected Points – Select this to have Polygon Select delete all the selected observations from the FARO Insight database.

    Un-use Selected Points – Select this to have Polygon Select un-use all the selected observations.

44. Click ‘OK’ when done.

When you create a closed area using the polygon select, you are creating an inside and an outside. When you select around an already closed area, the inside area now becomes the area between the two boxes. In the following example, the shaded area is the inside.



Controlling View

Just as the Geometric Entities sheet can be viewed in many different ways, so can the Graphics View. With the Graphics View Toolbar (shown below) and items from the Graphics menu, you can view specific types of features, zoom in or out on certain features, rotate or pan the view, etc. Using these commands, you should be able to view measured features in a manner that is most appropriate to your needs.

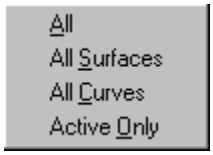
The Graphics View Toolbar

Displaying Features

Just as the Gents Worksheet has filters that enable you to view features of only one type (circles, spheres, etc) or only one set (Actual or Nominal), the Graphics View allows you to do the same.

The Feature Type filter and the Set filter are the first two items in the Graphics View Toolbar. To use them, click on the arrow on the right side of the filter, then select the feature type, or set, that you want to view from the drop down list.

Another way to show a certain type of features is by using the *Show* and *Hide* commands. By selecting Graphics, Feature, Show from the menu bar (Alt, G, F, S), you get the following menu.



All	Shows all features.
All Surfaces	Shows cylinders, planes, paraboloids, and spheres.
All Curves	Shows circles, lines, and points.
Active Only	Shows only the Active Feature(s).

Choosing Graphics, Feature, Hide (Alt, G, F, H) results in a similar menu, but hides features instead of showing them.

Both the filters and the Show/Hide commands from the menu bar work on all features. Features can be shown or hidden on an individual basis through their Properties. See *"Feature Display Options"* for more information.

Displaying Labels

FARO Insight *Visual* makes it easier to determine what each feature is in the Graphics View by giving you the option to display *Labels*. A label is the name of the feature displayed next to its graphical representation. To display labels, choose Graphics, Feature, then Labels from the menu bar (Alt, G, F, L). To hide the labels, choose this menu item again. When labels are displayed, a check mark will appear next to this menu item.

The Labels command from the menu applies labels to all features. A features label can be displayed on an individual basis through its Properties. See *"Feature Display Options"* for more information.

Zooming In and Out

Zooming in and out is changing the view by adjusting the magnification factor or display scale. By doing this, you can either view a large portion of your job at a lower magnification factor or view only one or two features with a high level of detail at a larger magnification factor.

Zooming in and out can be done both by the Graphics menu and by the Graphics View Toolbar. Below are the Graphics View Toolbar buttons that control display scale.

Zoom In — Increase the magnification of the Graphics View by a factor of 2.

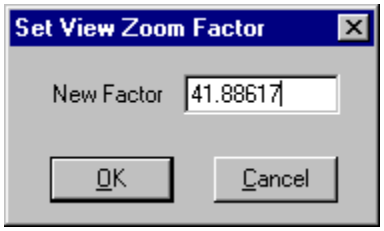
Zoom Out — Decrease the magnification of the Graphics View by a factor of 2.

Zoom Box — Enclose a box around the desired features to be displayed. Graphics View zooms in on those features.

Zoom All — Adjust the Graphics View so that all features are displayed.

The Zoom In, Zoom Out, Zoom Box, and Zoom All commands can all be accessed by selecting Graphics, Zoom (Alt, G, Z) from the menu bar.

Another way to adjust the view is by manually adjusting the Zoom Factor. The Zoom Factor is how many times the Graphics View will be scaled up or down. With the Zoom Factor set to 1, one unit in model space will be mapped to 1 pixel on the screen. With the Zoom Factor set to 100, one unit in model space will be mapped to 100 pixels on the screen. To set the Zoom Factor, select Graphics, Zoom, then Factor (Alt, G, Z, F) from the menu bar. The View Zoom Factor Dialog will be displayed.



Zoom Factor Dialog

Enter the new Zoom Factor and click the 'OK' button.

As you zoom in and out of the Graphics View, you are adjusting the *Dimension Scale*. The Dimension Scale, shown in the lower left-hand corner of the Graphics View, has two small vertical lines connected by a long horizontal line. Next to this is a number. This number represents how far the distance between the two vertical lines on the screen represents in the current unit of length you are working in. Zooming in, or increasing the magnification, decreases the Dimension Scale and zooming out, or decreasing the magnification, increases the Dimension Scale.

View Orientations

Another aspect of the Graphics View is orientation, or the angle at which the features are being viewed. FARO Insight *Visual* provides several predefined views to choose from, as well as allowing the user to manually rotate or translate the view.

Preset Views

FARO Insight *Visual* has seven preset views from which you can choose. All of the views can be selected using the Graphics View Toolbar or the menu bar. Below is a list of the preset views FARO Insight *Visual* provides and their icon on the Graphics View Toolbar.

Top View — View the Graphics View Window looking down the +Z axis of the current coordinate system.

Bottom View — View the Graphics View Window looking down the -Z axis of the current coordinate system.

Front View — View the Graphics View Window looking down the +X axis of the current coordinate system.

Back View — View the Graphics View Window looking down the -X axis of the current coordinate system.

Left View — View the Graphics View Window looking down the -Y axis of the current coordinate system.

Right View — View the Graphics View Window looking down the +Y axis of the current coordinate system.

Isometric View — View the Graphics View Window looking down from first quadrant of the current coordinate system (all axis positive direction towards you).

These preset views can also be accessed by selecting Graphics, then View (Alt, G, V) from the menu bar.

Rotation

Sometimes, it is difficult to see important features clearly after selecting one of the preset views. In this situation, it is possible to rotate the view slightly so that those features can be inspected.

Before you can rotate the view, you must set *Pivot Point*, or a point about which you are going to rotate. You can set the pivot point to one of two places, the World Center or the Active Feature Center. Setting the pivot point to the World Center will allow you to rotate about the center of the current Graphics View. Setting the pivot point to the Active Feature Center will allow you to rotate about the center of the active feature.

You can set the pivot point using either the Graphics Settings Feature toolbar or the menu bar. To set the pivot point to the World Center, either press the button, , or choose Graphics, Set Pivot Point To, World Center (Alt, G, T, W) from the menu. This button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set. Note that each time a new feature is made active, this button must be reactivated in order to lock on to that feature. To set the pivot point to the Active Feature Center, either press the button, , or choose Graphics, Set Pivot Point To, Active Feature Center (Alt, G, T, F) from the menu. Once again, this button will be depressed and there will be a check mark next to the menu item to confirm the pivot point has been set.

Once the pivot point has been set, you need to tell the FARO Insight *Visual* that you are going to use the mouse to rotate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the SHIFT key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to rotate in whichever direction you move the mouse. For example, if you want to view the current display from above, move the mouse up.

Translation

Sometimes, as a result of zooming and rotating, features of interest may have drifted out of boundaries of the Graphics View. To bring the features back into the display range, you must translate, or Pan, the view left, right, up or down. This can be done with either the mouse or the keyboard.

To translate the Graphics View with the keyboard, press the corresponding arrow key. For example, if the feature of interest is only partially visible at the bottom of the screen, you need to translate the view up, so you would press the up arrow.

To translate the view using the mouse, you need to tell the FARO Insight *Visual* that you are going to use the mouse to translate the Graphics view. This is done by making the Graphics view the active window, and then by pressing the CRTL key. The mouse pointer will change to a symbol. In this mode, holding the left mouse button down while moving the mouse will cause the graphics View to translate in whichever direction you move the mouse.

View Orientations for a Feature

The Graphics View Toolbar and the Graphics menu give the ability to activate a preset orientation for the current frame or coordinate system. An easy way to view

an individual feature with closer detail is to adjust the view orientation about that detail. Doing this will also adjust the display scale so that the feature fills the Graphics View display. To change orientation about an individual feature, activate the feature and select View from the Graphics View Speed Menu. A second menu will appear, allowing you to view that feature from the Top, Bottom, Front, Back, Left, Right, or Isometric views.

Surface Shading

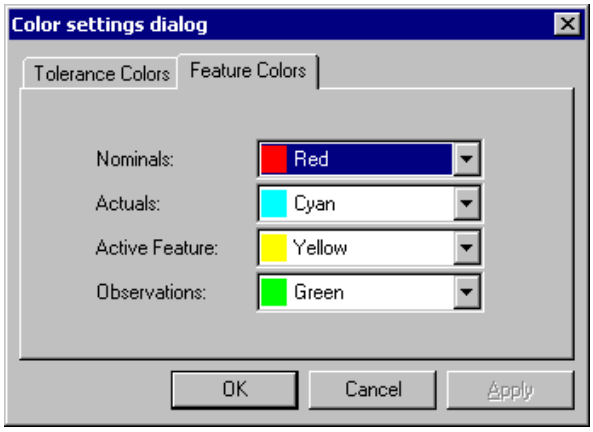
For features such as planes, spheres, cylinders, etc, FARO Insight *Visual* displays them as wireframes or meshes by default. This is desirable for most uses, but there may be times when a more presentable representation is desirable. Typically, when you want to print your results out to a printer for a report. This can be done through the use of *Surface Shading*. Surface shading will take the wireframe and mesh representations and give them a solid, three-dimensional appearance. Two colors will be used for shading, gray and purple. Gray will be used to denote the features outside, or the positive side of a feature with a normal vector. Purple will be used to denote the features inside, or the negative side of a feature with a normal vector.

You can display shading by either pressing the Toggle Surface Shading button,  , from the Graphics View Toolbar or by choosing Graphics, then Shading (Alt, G, H) from the menu bar. After surface shading has been created, you can turn it on or off by again pressing the Toggle Surface Shading button, on the Graphics View Toolbar or by choosing Graphics, Shading (Alt, G, H) from the menu bar.

Color Display

The Graphics View has default colors for features or items with different characteristics. These default colors make it easier to determine what features are actuals or nominals, which feature is the active feature, which deviations are in or out of tolerance, etc. FARO Insight *Visual* also gives you the ability to change these colors to suit personal preferences.

To change the color display, choose Settings, then Colors (Alt, S, L) from the menu bar. FARO Insight *Visual* will display the Display Colors Dialog.



Color Settings Dialog with Feature Colors Tab selected

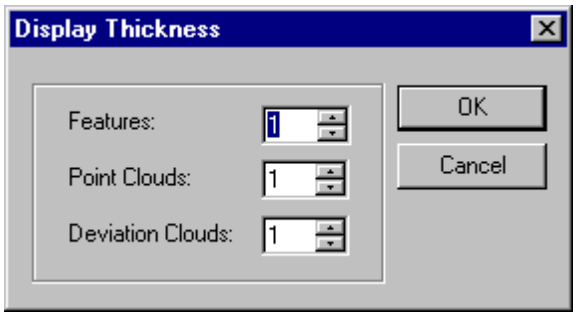
From the Tolerance Colors tab, the user can select four fields for deviations displays: Positive Out of Tolerance, Negative Out of Tolerance, Positive In Tolerance, and Negative In Tolerance.

From the Feature Colors tab, the user can select four filed for feature displays: Nominals, Actuals, Active Feature, and Observations.

Display Thickness

The *Display Thickness*, or how thick features appear in the Graphics View, can also be changed. This can sometimes make it easier to distinguish between features.

To change the display thickness, choose Graphics, then Thickness (Alt, G, T) from the menu bar. FARO Insight *Visual* will display the Display Thickness Dialog.



Display Thickness Dialog

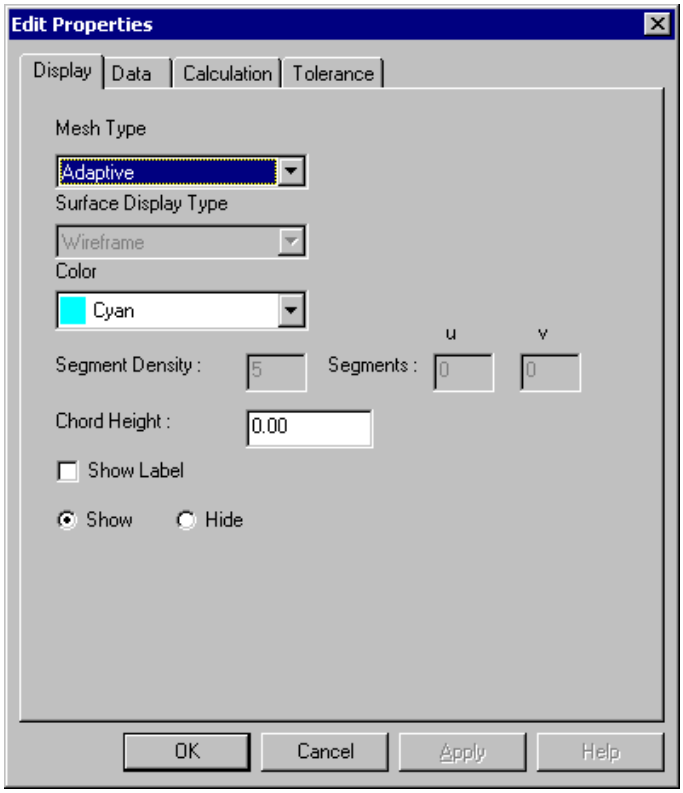
There are three fields that may be adjusted: *Features*, *Point Clouds*, and *Deviation Clouds*. Each of these fields may be changed by either clicking on the up/down arrows directly to the right of the open field or by simply typing in the desired size.

Feature Display Options

Editing Properties

When a feature is created, it has a set of default properties that control how it will be displayed in the Graphics View. Throughout a job, it may be necessary to change these properties for ease of viewing or analysis. After a feature has been created, its properties can be changed at anytime by using the Edit Properties Dialog.

The Edit Properties Dialog can be opened in several different ways. You can select Edit Properties from the Speed Menu (accessed by right clicking on the feature in the Gents sheet or the Graphics View), press the Edit Properties button,  , from the Standard Toolbar, or select Edit, Properties (Alt, E, T) from the menu bar.



The Edit Properties Dialog

The Edit Properties Dialog has four distinct tabs (five for Points). The Display tab controls how the feature is displayed in the Graphics View. The Tolerance tab allows a tolerance to be applied to the feature. This tolerance can be used for analysis in the Graphics View. The Data tab shows the X, Y, Z, I, J, K, and radius values of the feature. These values correspond to what is displayed in the Gents sheet. The Calculation tab allows the user to filter out observations so that either the Front Sight, Back Sight, or both types of observations are used to calculate the feature.

Display Properties

The Display Properties tab controls how the feature will be shown on the Graphics View. A brief description of each option follows.

Mesh Type – Controls the type of mesh used to display the feature. May be Adaptive or Uniform. See *"Displaying Surfaces"* for more information.

Surface Display Type – Controls the type of surface displayed in the Graphics View. See *"Displaying Surfaces"* for more information.

Color – Changes the display color of the feature in the Graphics View.

Segment Density – Changes the number of segments used to display a Uniform Wireframe. See *"Displaying Surfaces"* for more information.

Segments – Changes the number of segments used to display a Uniform Mesh. See *"Displaying Surface"* for more information.

Chord Height – Changes the display tolerance used to display an Adaptive surface. See *"Displaying Surfaces"* for more information.

Show Label – Displays the features name in the Graphics View.

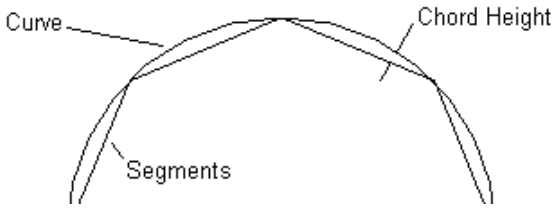
Show – Displays the feature in the Graphics View.

Hide – Hides the feature from the Graphics View.

Displaying Surfaces

In FARO Insight *Visual*, cylinders, paraboloids, planes and spheres are considered surfaces. Surfaces can be displayed in the Graphics View in several different ways. Sometimes, it may be necessary to change the way in which these surfaces can be viewed. For example, sometimes it may be desirable to display a surface can be displayed with finer precision for presentation purposes, but set to a lower precision to speed up screen displays.

When a surface is displayed on the screen, it is shown as a series of segments, or mesh, that approximates the actual surface. Changing how the surface is displayed is actually defining how the surface is broken down into these segments (Mesh Type) and how they are displayed on the screen (Surface Display Type). In the picture below, a surface has been simplified as a curve to show how it is displayed on the screen.

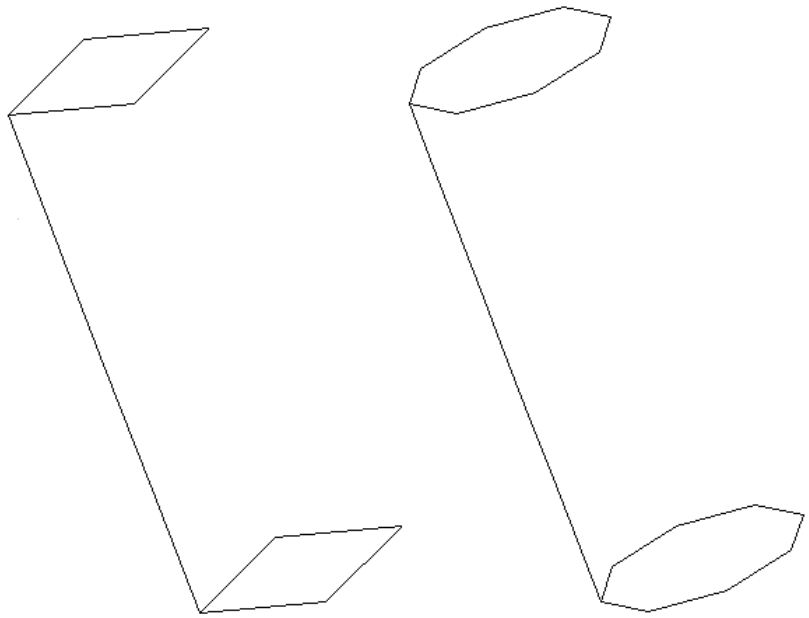


There are two Mesh Types, Uniform and Adaptive. A **Uniform Mesh** is one in which the user can manually enter the number of segments used to approximate the surface. Depending on the Surface Display Type, **Segments** are either defined in the Segment's u, v field or the Segment Density. More segments mean the surface displayed will be of higher accuracy, but take longer to display on the screen.

An **Adaptive Mesh** is one in which the computer will calculate the number and distribution of the segments used to approximate the surface based on the **Chord Height**. The Chord Height, which is defined by the user, is a tolerance value. The mesh is calculated so that distance between the curve of the actual surface and the segment of the approximated surface never deviate from a value greater than that amount. The chord height is defined in the units of length you currently have FARO Insight *Visual* set to. A lower chord height means the surface displayed will be of higher accuracy, but take longer to display on the screen.

After choosing the Mesh Type, the Surface Display Type needs to be defined. There are three types to choose from, Wireframe, SurfaceMesh and TrimmedMesh. For all features in FARO Insight *Visual*, there is no difference between SurfaceMesh and TrimmedMesh. A **Wireframe** is the simplest display type. It essentially breaks the feature down so that the features surface is not immediately apparent. A **SurfaceMesh** displays a grid that represents the features surface.

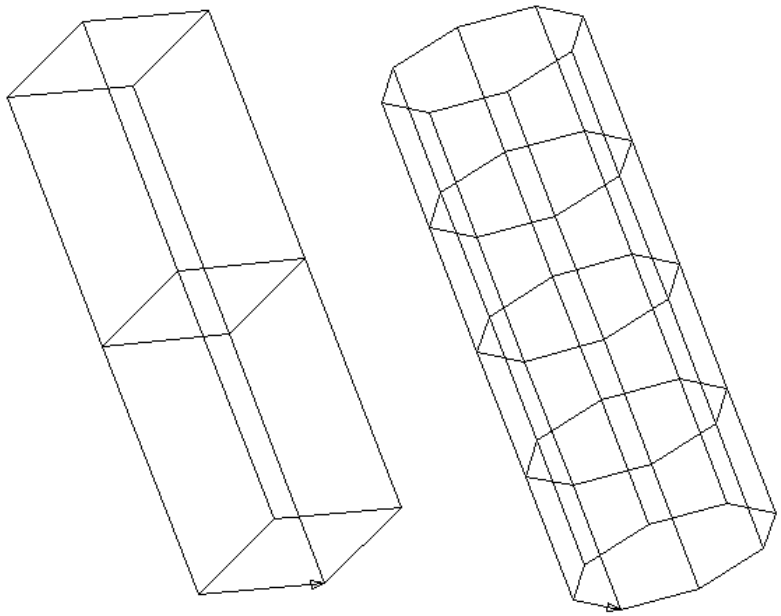
Following is a series of cylinders, displayed in different combinations of Uniform, Adaptive, Wireframe and SurfaceMesh.



Uniform Mesh – Wirframe Display

Left: Segment Density of 4

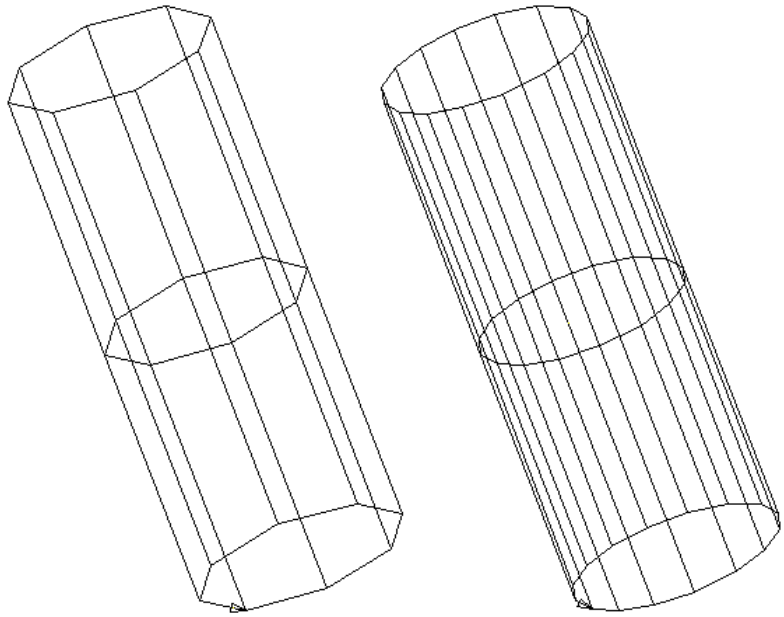
Right: Segment Density of 8



Uniform Mesh – SurfaceMesh Display

Left: Segments U of 4, Segments V of 2

Right: Segments U of 8, Segments V of 4



Adaptive Mesh – SurfaceMesh Display

Left: Chord Height of 0.3 inches

Right: Chord Height of 0.15 inches

Increasing and Decreasing Smoothness

The Smoothness of a surface refers to the amount of detail displayed in the Graphics View. This can be set on a feature by feature basis by changing the chord height or the segments in the Properties page, but it is sometimes useful to do this for the entire display at once. To increase the smoothness of all features (lower chord height or more segments) press the Increase Smoothness button, , on the Graphics Settings Toolbar. To decrease the smoothness of all features (increase the chord height or fewer segments) press the Decrease Smoothness button, , on the Graphics Setting Toolbar. Using these buttons does not permanently change a feature's smoothness setting, after a recalculation; the features will revert back to their original settings.

Viewing Observations

FARO Insight *Visual* allows you to view the measured observations used to create a feature. This is useful for analysis and, when used in conjunction with the Polygon Select function, is useful for deleting or un-using observations. Observations can be viewed by selecting the feature and choosing Observations from the Speed Menu in the Graphics View, pressing the Observations button, , from the Graphics Active Feature Toolbar, or choosing Graphics, Active Feature, Observations (Alt, G, A, O) from the menu bar.

Viewing Normals

FARO Insight *Visual* has the option to display a features normal vector in the Graphics View. This can be useful for determining which offset to use or when using a features vector in a function (such as using a planes vector in a frame). To display a features normal vector, select the feature and press the Show Normals

button, , from the Graphics Active Feature Toolbar, select Graphics, Active Feature, Normal (Alt, G, A, N) from the menu bar, or select Normal from the Graphics View Speed Menu.

NOTE: For a circle, cylinder and a sphere, the radial direction will be shown instead.

Deviation Display

FARO Insight *Visual* provides many ways to view the deviations of both measured observations to its fit feature and actual features to their corresponding nominal.

Viewing Deviations

The deviations of a feature can be displayed by selecting the feature pressing the Deviations button, , from the Graphics Active Feature Toolbar, choosing Graphics, Active Feature, Deviations (Alt, G, A, D) or choosing Deviations from the Graphics View Speed Menu.

There are four display modes for a deviation cloud, Point, Spike, Connect, and Spike & Connect. When the display mode is set to Point, the end point of each deviation vector will be displayed. When set to Spike, the deviation vector is displayed. When set to Connect, a line connected each end point is displayed. When set to Spike & Connect, both a line connecting the endpoints and the deviation vector are displayed.

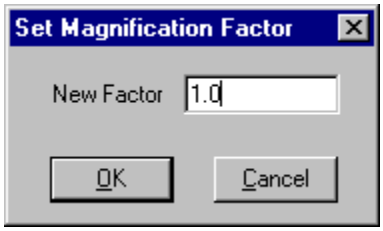
The display mode can be set from the Graphics, Deviation Cloud, Display Mode menu (Alt, G, D, Y). The Graphics Settings Toolbar can also be used. For Spikes, press , for Connected Points, press , and for Spikes and Connected Points, press .

Deviation Display Scale

Because deviations are much smaller than the size of what is being analyzed, they have a display scale independent of actual and nominal features. The current deviation display scale can be displayed in the lower right hand corner of the Graphics View from the Graphics, Scale, Deviation (Alt, G, S, V) from the menu bar.

For easier viewing, the deviations can be magnified by pressing the Magnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Magnify (Alt, G, D, M, M) from the menu bar. The deviations can be de-magnified by pressing the Demagnify Deviations button, , on the Graphics View Toolbar or by selecting Graphics, Deviation Cloud, Magnification, Demagnify (Alt, G, D, M, D) from the menu bar.

The display scale can also be set manually by selecting Graphics, Deviation Cloud, Magnification, Magnification Factor (Alt, G, D, M, F) from the menu bar. This will display the Set Magnification Dialog.



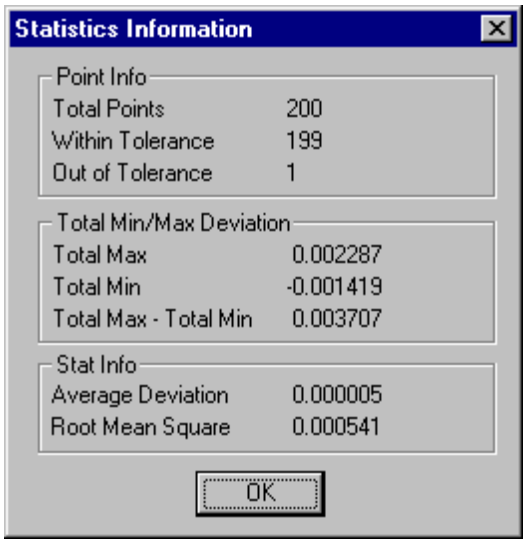
Set Magnification Factor Dialog

The Deviation Scale is always current Dimension Scale divided by the Magnification Factor. If the Dimension Scale is 1.0 and the Magnification Factor is 0.5, the Deviation Scale would be 2.0. If the Dimension Scale is 1.0 and the Magnification Factor is 2, the Dimension scale would be 0.5.

Deviation Statistics

When the deviations for a feature are displayed, the ability to view Deviation Statistics is available. This is useful for evaluating the fit of a sphere, checking flatness of a measured plane, or comparing a nominal feature to an actual feature.

The Deviations Statistics for a feature, or set of features, can be viewed by clicking the Deviations Statistics button, , on the Graphics Active Feature Toolbar or by choosing Graphics, Active Feature, then Statistics (Alt, G, A, S) from the menu bar or by choosing Statistics from the Graphics View Speed Menu.



Statistics Information Dialog

This dialog shows useful statistical information including the total number of points, number of points in and out of a specified tolerance, max and min deviations, bandwidth, average deviation and the Root Mean Square (RMS).

The Deviation Statistics can be viewed from an actual or a nominal feature. The statistics shown from an actual feature are calculated from the deviations between the measured observations used to create the actual feature and the actual feature itself. The statistics shown from a nominal feature are from the deviations of the measured observations to the nominal feature.

The Statistics from Polygon Select command from the Graphics, Deviation Cloud (Alt, G, D, S) menu allows you to view the deviation statistics from an are chosen using the Polygon Select command.

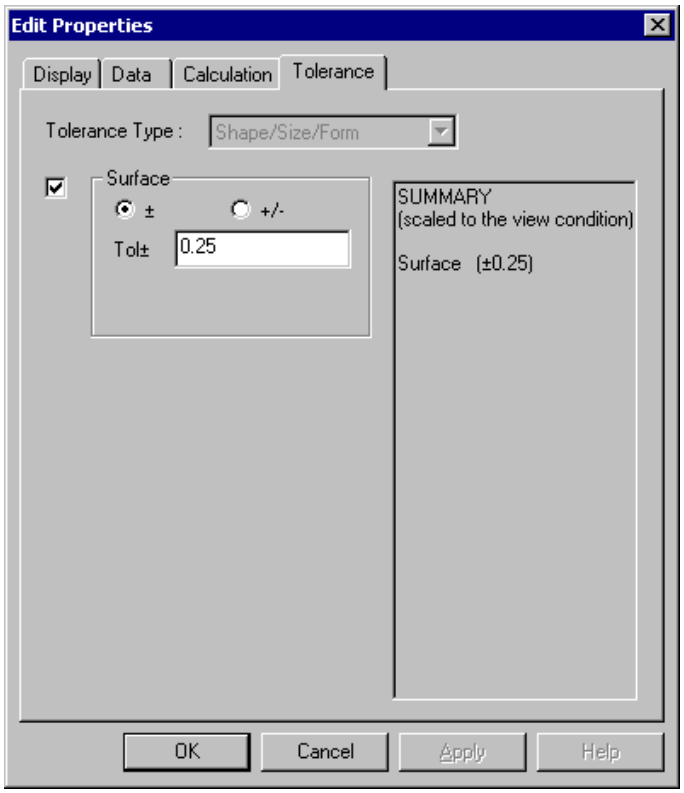
Deviation Max and Min

The maximum and minimum deviations of a feature can be marked in the Graphics View by selecting Graphics, Deviation Cloud, Mark Max/Min Deviations (Alt, G, D, K) from the menu bar. This will display a marker on top of the maximum and minimum deviations of each feature. This is useful for determining where high or low spots are and for determining bad observations.

Setting a Tolerance

A Tolerance can be added to each feature through its Edit Properties Dialog. When used with the Deviation Statistics, this tolerance is useful in determining the quality of your measurement or the position of your details.

To add a Tolerance to a feature, select it and open its Edit Properties Dialog. Select the Tolerance tab and enter an Upper and Lower Tolerance in the units you are currently working in. Click 'OK' when you are done. Following is an Upper and Lower tolerance of 0.25 millimeters applied to a feature.

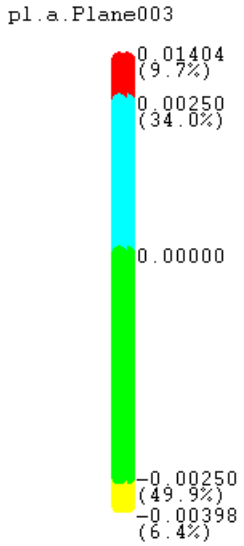


An Upper and Lower Tolerance of 0.25 millimeters

In the Statistics Information Window, the number of points that are out of the entered tolerance will be displayed in the *Out of Tolerance* row. In the Graphics View, the colors of In Tolerance observations and Out of Tolerance observations will be determined by the settings in the Display Colors dialog. See "*Color Display*" for more information.

Deviation Color Bar

Another feature in FARO Insight is the Deviation Color Bar, a visual representation of a deviation plot's statistics. This bar will be displayed any time the user chooses to display a feature's deviations in the Graphics View. The displayed bar will correspond to the active feature that has its deviations displayed, therefore it may or may not be for the active feature. The bar, shown below, corresponds to the colors for deviation spikes and displays the highest and lowest deviations, as well as the percentage of observations in each zone of the bar. Additionally, if there is a tolerance applied to the feature, the deviation bar will display the upper and lower tolerance with the percentage of observations in and out of tolerance.



Deviation Color Bar

Watch Windows with a Tolerance

FARO Insight *Visual* uses any tolerance associated with a feature inside of a Watch Window. This can be useful when using a watch window on a plane. When the normal deviation is greater than a specified tolerance, the watch window display changes color.

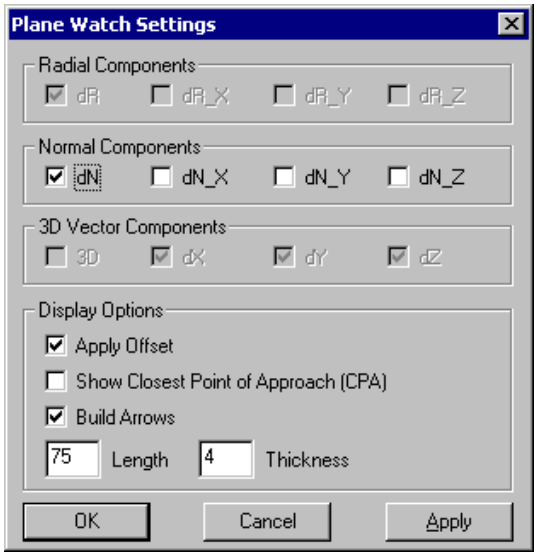
Doing the following can open a watch window with a tolerance:

21. Select a feature, and use the Edit Properties dialog to set an upper and lower tolerance to a feature.
22. While the feature is selected, open a watch window by pressing F4, pressing the Watch Window button, , on the Tracker Toolbar, or selecting View, Watch Window (Alt, V, W) from the menu bar.

    The displayed colors in the watch window will correspond with the color settings set in the Display Colors Dialog. See "*Controlling View*" for more information. In the Graphics View, deviation spikes corresponding to each watch component will appear. The color of each deviation spike will correspond to the applied tolerance. The type of spike (3D or X, Y, Z component) is configurable through the Watch Setting Dialog. See the "*Watch Windows*" section in the "*FARO Insight Worksheets*" Chapter for more information.

Build Mode

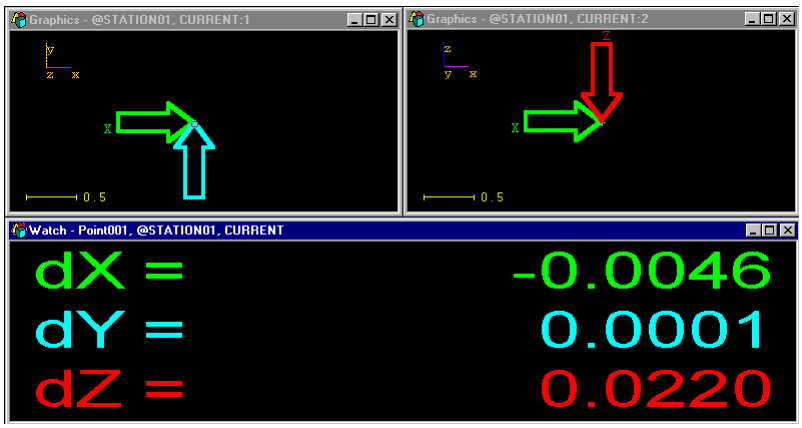
Inside of the Watch Settings dialog box, which is accessed by selecting Watch from the Settings menu (Alt, S, W), exists a “Build Arrows” check box. Checking this box places the watch window and graphics view in Build Mode.



Watch Settings Dialog with the Build Arrows Option Checked

Build Mode displays arrows in the Graphics View in addition to the deviation spikes. The arrows will be pointing in the direction towards the feature being watched, thus if a watch window is opened on a nominal point, the arrows will indicate what direction the target needs to be moved to be in the nominal position. If the arrow is perpendicular to the Graphics View’s orientation, then either a “O” or a “+” will be displayed. A “O” indicates that the arrow is coming out of the screen and a “+” indicates that the arrow is going into the screen. The Watch Window and the Graphics View will display deviation colors based on the feature’s tolerance. The arrow and spike combination only displays one color dependant on if it is in or out of tolerance.

The Arrow Length and the Arrow Line Width can be adjusted from within the Watch Settings dialog box to make viewing from a distance easier. See the “*Watch Windows*” section in the “*FARO Insight Worksheets”* Chapter for more information.



Component Deviations Shown in Watch and Graphics with Build Arrows

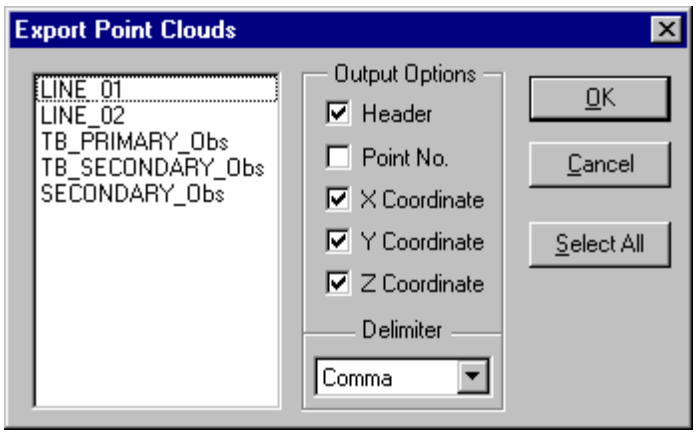
Exporting from the Graphics View

Exporting Point Clouds

Point Clouds and the observations of a feature can easily be exported out of FARO Insight *Visual* using the Graphics View windows. Point Cloud observations may be exported as raw data (no offset) or with an offset adjustment. This can be useful for taking measured data to a CAD program or CATIA.

To export a point cloud or a set of observations, the Graphics View must be open.

61. Set the display parameters to the proper Frame and Condition. (PART Frame, REFERENCE Condition).
62. If observations of a measured feature are to be exported, display the feature's observations in the Graphics View.
63. Select File, Export, Point Clouds, then Text (Alt, F, E, P, T) from the menu bar. The Export Point Clouds Dialog will be shown.



The Export Point Clouds Dialog

64. Choose the features to be exported from the list box on the left-hand side. An "_Obs" extension is shown after features other than Point Clouds.
65. Choose the appropriate Output Options

    Header – Puts a header at the top of file.

    Point No. – Puts the point number in the first column of the file.

    X Coord – Prints out the X value.

    Y Coord. – Prints out the Y value.

    Z Coord – Prints out the Z value.

    Delimiter – Comma or Space, set the character between each column.
66. Press 'OK' when done selecting.

    FARO Insight *Visual* will display a File Save As dialog. You can name the file and put it in whatever directory you choose.

Note: FARO Insight *Visual*Pro is capable of exporting data as an IGES file. See the Chapter entitled *"FARO Insight VisualPro"* for more information.

Creating Nominal Points

FARO Insight *Visual* has the ability to create nominal points from features other than a point. A nominal point can be created from a feature by doing the following.

51. You must set the viewing conditions to REFERENCE and the proper frame (i.e. PART).
52. The name of the nominal points will come from the Feature Toolbar Set the Feature Toolbar to create a nominal point and enter the appropriate name in the Proposed Name field. See the *"Declaring Features"* section in the *"FARO Insight Worksheets"* chapter for more information.
53. Set the feature creating the Nominal points to be the active feature. Choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Clouds, Create Nominal Points (Alt, G, P, N) from the menu bar.
54. The mouse pointer will become a small hand. Press the mouse button on the surface where the nominal point is to be created.
55. When done, choose Create Nominal Points from the Graphics View Speed Menu or choose Graphics, Point Cloud, Create Nominal Points (Alt, G, P, N) from the menu bar.

Printing the Graphics View

All or part of the Graphics View can be printed out on a printer for a final report if needed. FARO Insight *Visual* will print whatever is displayed in the Graphics View. Selecting File, Print Preview (Alt, F, V) from the menu bar can see a preview of what will be printed. To print the Graphics View, select File, then Print (Alt, F, P) from the menu bar.