



VERSION 1.5
FARO Gage
BASIC TRAINING WORKBOOK
STUDENTS BOOK
AUGUST 2007



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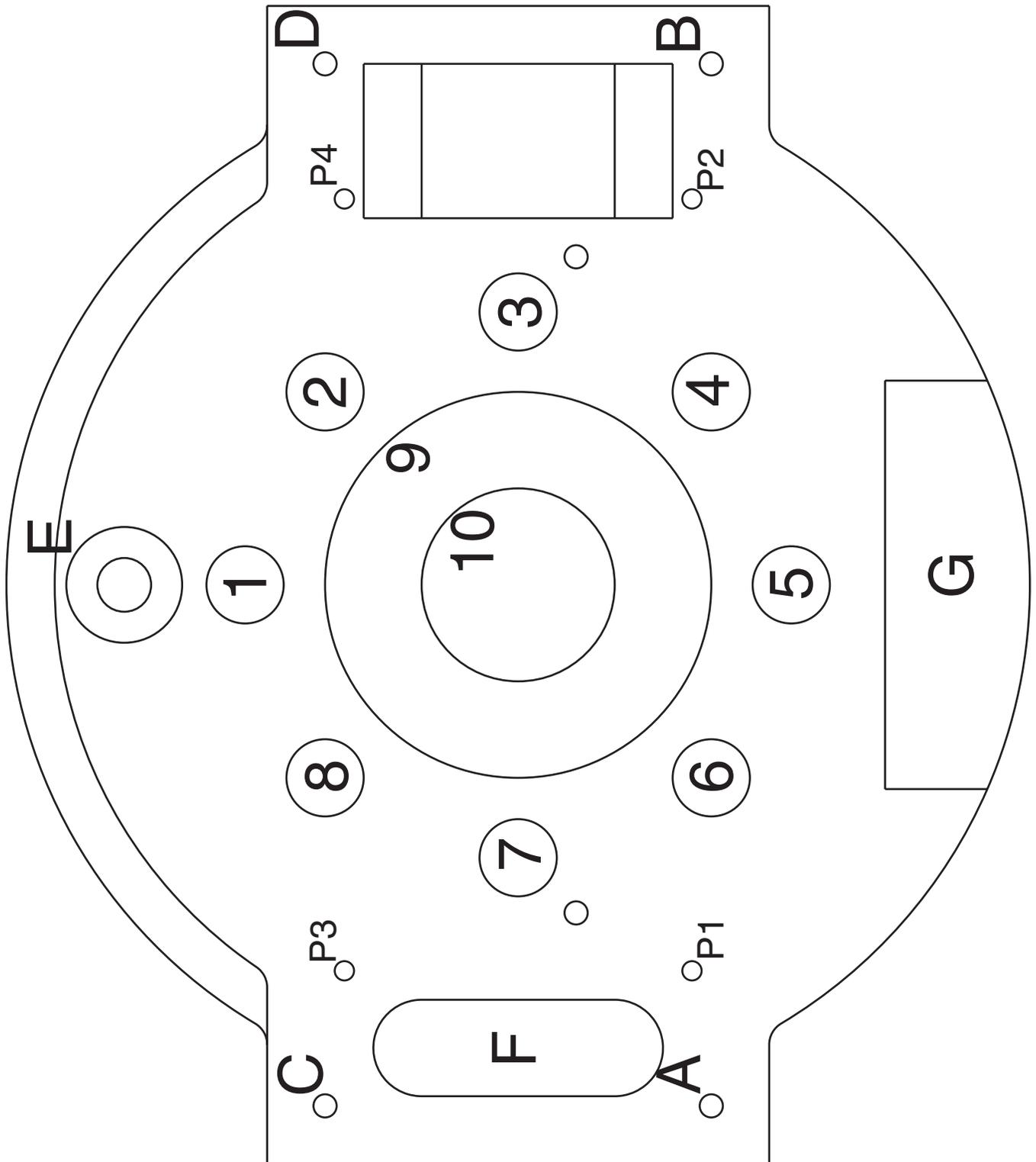
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- ***Course Introduction:***
- ***This course will explain the new and modified commands of FARO Gage, Version 1.5.***
- ***There will be lectures, as well as hands-on exercises, that will allow the student to practice the skills learned.***

FARO Standard Demonstration Part - Plate



Remove this page from your workbook and refer to it in the practical exercises to locate the features of the part.

Course Checklist

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 - Build Command
 - Dimensions
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 - Run Custom Tool

Chapter 1: Getting Started

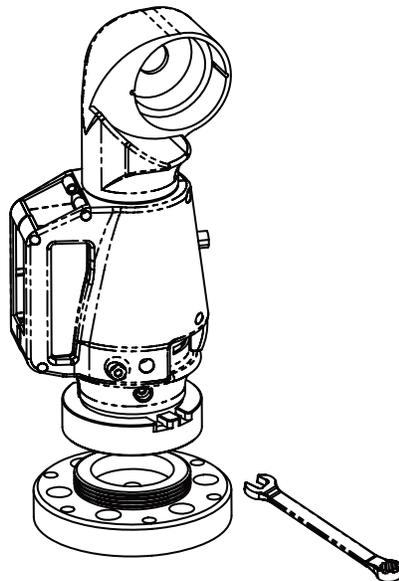
- **Objective: Learn the basic FARO Gage system setup procedure, familiarize yourself with the screen layout, and calibrate the probe.**

Setup

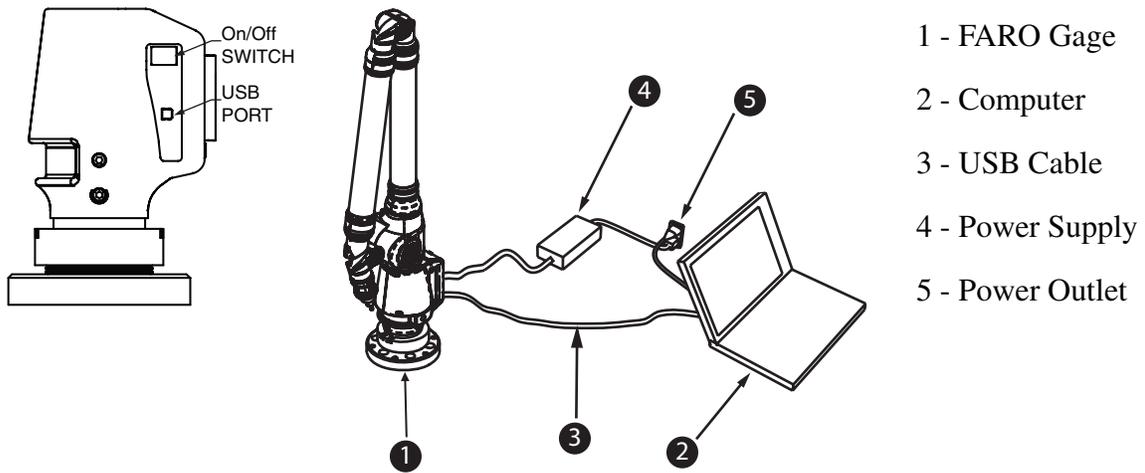
The FARO Gage must be mounted in an upright position. Do not mount the FARO Gage in an inverted (upside-down) or sideways position.

To fasten the FARO Gage:

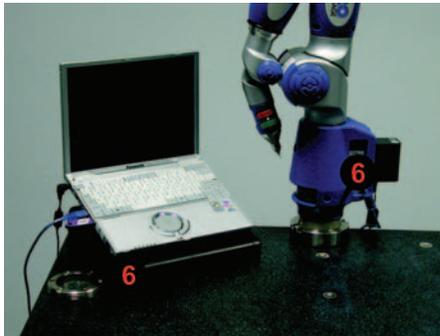
- 1 Attach the 3.5" threaded ring and surface mount plate to any stable location. Tighten all mounting bolts to 100-inch pounds.
- 2 Place the FARO Gage on top of the 3.5" threaded ring.
- 3 Screw the threaded collar clamp onto the base of the FARO Gage and the 3.5" threaded ring.
- 4 Use the wrench to tighten the threaded collar clamp.



- 5 Complete all cable connections before applying power to the computer and the FARO Gage.



- 6 Switch on the FARO Gage and then the Gage computer.

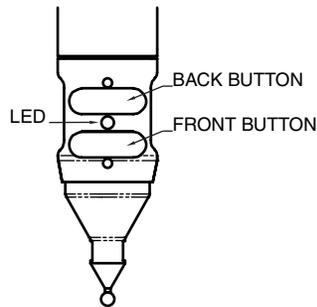


- 7 The FARO Gage software will launch automatically after you have turned on the computer.



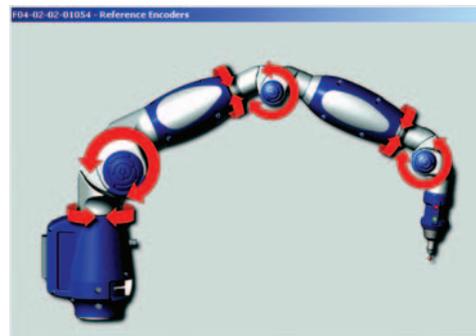
Hardware Operation

The FARO Gage has two sets of buttons. The GREEN (Front) button is used to collect data, and the RED (back) button to accept the data. When a button is pressed, the LED light illuminates (red or green).



Every time you power on the FARO Gage Arm, you must reference the encoders (joints). The LED in the handle will flash red until the encoders have been cleared.

Each of the six encoders in the FARO Gage must be referenced before the system can output data. If you attempt to execute a FARO Gage command prior to referencing the encoders, the end stop warning window will show all six encoders in error until each is referenced. In a systematic manner, rotate links 1 through 6 until each warning clears.

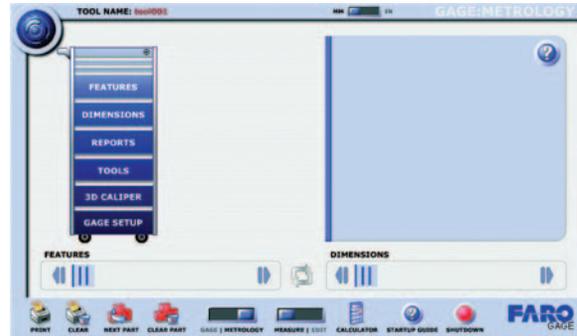


Software Modes

The FARO Gage software operates in two separate modes: GAGE and METROLOGY. GAGE mode is designed for quick measurement of simple parts; METROLOGY mode is designed for measurement of larger and more complex parts, or if you measure many different parts each day. In METROLOGY mode, you create, store, and run tools on your computer as well as store and print all data for parts that you measure.



GAGE MODE



METROLOGY MODE

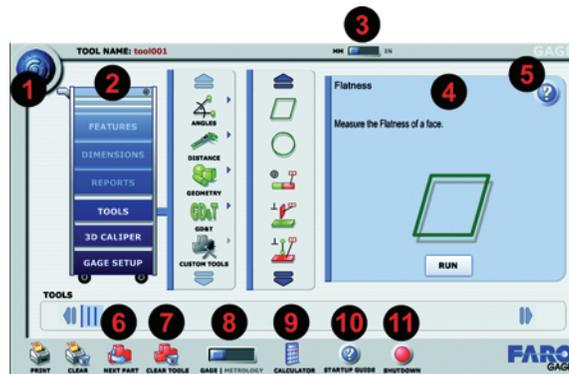
NOTE: The FARO Gage software restarts in whichever mode was operating during the previous shutdown.

Arm as Mouse

The FARO Gage can control the mouse cursor on the computer screen.

- The GREEN button is the left mouse button, and selects items on the screen.
- The RED button places the mouse cursor in the center of the screen.
- In the Results screen, the GREEN button selects the OK button, and the RED button selects the CANCEL button.

Screen Layout (General)



- 1 ABOUT button
 - Displays the current version of the software.
- 2 Toolbox - The main FARO Gage software menu is displayed as a Toolbox.
 - Each "Drawer" of the Toolbox opens into specific functions.
 - Scroll up and down in each Drawer menu to display additional items.
 - The scroll arrows are dark blue if there are additional items.
- 3 MM/IN switch
 - Use the MM/IN switch to set the measuring units for your part.
- 4 Command Description
 - There is an icon and a description of the function for each command.
 - This area responds to any selection from the Toolbox or the tools list.
 - Select the RUN button to start a command from the Toolbox.

NOTE: Choose the correct units before starting a measurement session. Changing the measuring units will reset the Tools list. You cannot switch units in the middle of a measurement session.

5 HELP button

- Select the HELP button to see instructions for a command.
- Select the MORE button to see more details for a command.
- Select the RETURN button to return to the Command Description.



6 NEXT PART button

- Select the NEXT PART button to repeat the tool list.

7 CLEAR TOOLS button

- Select the CLEAR TOOLS button to erase all tools from the tools list.

8 GAGE/METROLOGY switch

- Select the GAGE/METROLOGY switch to toggle between GAGE and METROLOGY modes.

NOTE: Switching between GAGE and METROLOGY modes will reset the tool file.

9 CALCULATOR

- Launches the MS Windows® Calculator.

10 QUICK START GUIDE

- Launches an electronic version of the Quick Start Guide.

11 SHUTDOWN

- Use this button to close Gage software and turn off the computer.

Screen Layout (Gage Mode)



1 Tools List

- An icon for each tool you use will be displayed here to keep record of your work.

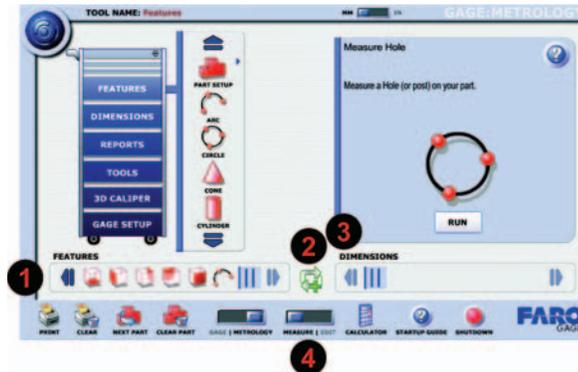
2 PRINT Button

- Select to generate and print a report.
- All results from previous measurement sessions are kept; new results are appended and separated by a header with tool information.
- One report with both previous and recent results is created.

3 CLEAR Button

- Select to clear results from previous measurement session.
- All previous results will be deleted.
- Make sure you have printed or saved the existing data before clearing.

Screen Layout (Metrology Mode)



1 Features List

- An icon for each feature you use will be displayed here, keeping record of your work.
- Existing commands in the current tool file show up in the order that they are entered.
- Completed commands appear in color; incomplete commands appear grayed-out.

2 Alignment Tool

- This tool creates an alignment, or coordinate system, from previously measured features.

3 Dimensions List

- An icon for each dimension you use or feature you build will be displayed here, keeping record of your work.
- Existing commands in the current tool file show up in the order that they are entered.
- Completed commands appear in color; incomplete commands appear grayed-out.

4 MEASURE/EDIT Button

- This button switches between MEASURE and EDIT modes.

Calibration

What is Calibration?

Calibration is the process by which a measurement device is optimized to perform measurements accurately. The FARO Gage is calibrated at the factory and will maintain its accuracy unless it is damaged.

Probe Calibration

The FARO Gage collects data with a probe attached to the end of the handle. Once the probe is attached, the location of the probe tip relative to the Gage's coordinate system must be determined prior to measuring, hence the need for probe calibration.

Calibrate the probe prior to every measurement session and whenever you switch probes.

There are two acceptable ways to calibrate a probe:

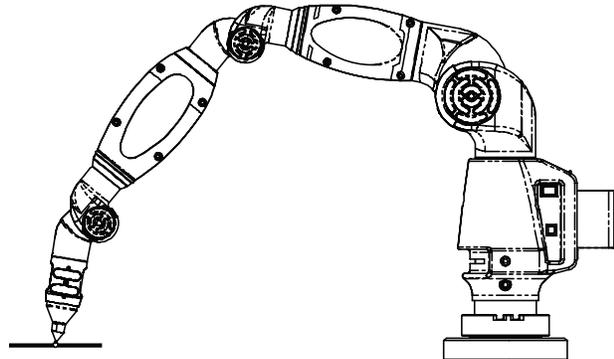
- Single Hole method - recommended for standard ball probes.
- Sphere method - recommended for touch trigger probes and point probes.

In this guide, we will cover the Single Hole method.

NOTE: Please refer to the Gage manual CD included with your system for Sphere Method and Single Hole Method with Guidance instructions.

Practical - Calibration

Securely attach the FARO Probe Calibration cone near the FARO Gage. For best results, position the calibration cone approximately 2/3 of the Gage arm's reach away from the base.



- 1 Choose Gage Setup < Probe Calibration.
- 2 Select the RUN button.

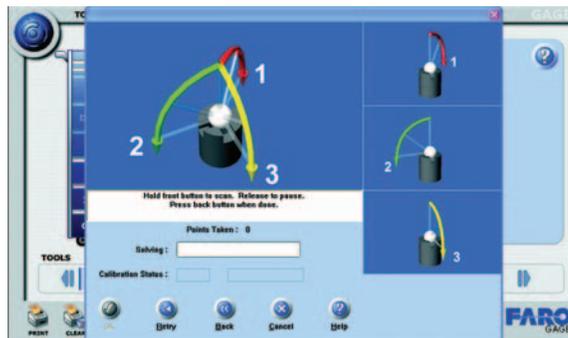


- 3 Choose your probe from the Current Probe list.



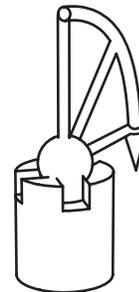
- 4 Select the HOLE CALIBRATION icon to start the probe calibration.

- 5 Follow the on-screen instructions and press the GREEN button to digitize the points for the probe calibration.

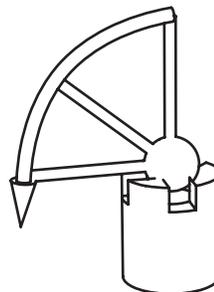


NOTE: All of the points in this method will be collected by holding down the GREEN button. The FARO Gage will collect points as fast as possible (scanning) until you release the GREEN button.

- 6 Place the ball probe in the hole. Start in a vertical position.
- 7 Press and hold the GREEN button. Sweep the handle down to to one of the horizontal positions. Be sure that the ball probe remains seated in the hole.
- 8 Release the GREEN button and repeat for each position.
- 9 Digitize points in the hole and sweep to position #1.



- 10 Digitize points in the hole and sweep to position #2.



- 11 Digitize points in the hole and sweep to position #3.

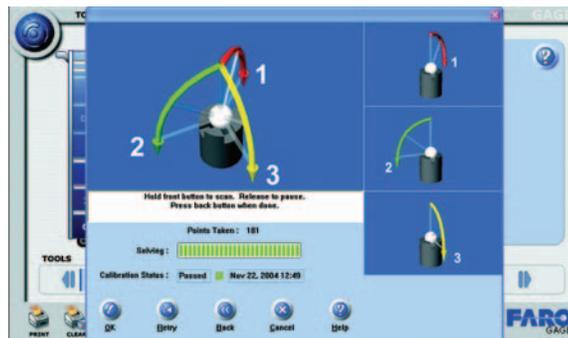


CAUTION: The probe *must* be well-seated in the hole when digitizing all calibration points. Even one or two poorly digitized points can significantly affect the optimization process, which may reduce the accuracy of the FARO Gage.

The calibration points are then calculated and the probe calibration status is updated. If the probe passes, then the current date and time is added to the probe information.

- 12 You may view the details for all of the calibrations of a probe by selecting the VIEW LOG button.

- If you calibrate the probe correctly, the calibration status changes to PASS.



- If the probe calibration fails, select the RETRY button and repeat the calibration until the probe passes.

You are now ready to measure with the FARO Gage.

Chapter 2: Basic Measurements (Gage Mode)

- **Objective: Familiarize yourself with the screen layout and tools, and learn to take basic measurements in Gage mode.**

Tools

The FARO Gage Tools Drawer contains all the commands to quickly measure a single distance, angle, or geometric value on a part. This drawer also contains many tools to measure your part if it uses the GD&T tolerancing system. The Tools commands are organized into the ANGLES, DISTANCE, GEOMETRY, GD&T, and CUSTOM TOOLS menus within the Tools Drawer. The Tools Drawer is available in both GAGE and METROLOGY modes.



- ANGLES - Measure angles between features on your part.
- DISTANCE - Measure the distance between features on your part.
- GEOMETRY - Measure geometric shapes such as faces, holes, edges, points, spheres, etc. on your part.
- GD&T - Measure your part using the GD&T system. Features and feature datums will be measured in each command.
- CUSTOM TOOLS - Save, load, and run your tools.

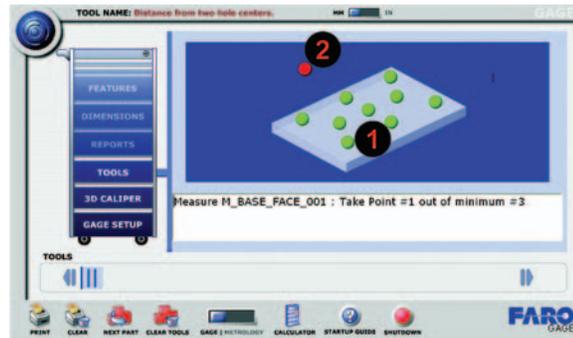
Measuring

To measure with the FARO Gage, make sure you're in GAGE mode (switch to GAGE mode, select OK), choose a tool, and follow the on-screen pictures and text prompts.

The basic geometry illustration shows how a specific features needs to be measured, and the text prompt below indicates the minimum number of points that you will need to collect.

NOTE: For better feature definition, take more points than the minimum allowed.

- 1 The GREEN button is used to take points on the part. Green balls/spheres illustrate where to touch the part with the probe and press the GREEN button to measure.
- 2 The RED button ends the feature measurement. A red ball/sphere indicates the general location where the probe should be held before pressing the RED button.



NOTE: When you press the RED button, the location of the probe is critical. The FARO Gage uses a ball probe to measure and all measurements are taken from the center of the probe. To compensate the measurements for the ball probe radius, points must be digitized off the feature. Look at each illustration carefully to see the location of the red ball.

Measurement results display after a measurement is complete and out of tolerance.

- 3 A results screen appears when the tool is complete.
- 4 Enter Nominal and Tolerance information. (optional)
- 5 Select the ADD TO REPORT check box if you don't want the result to show up in the report to remove the feature from the report.
- 6 Select OK to complete the measurement, or CANCEL to remeasure. Choose more FARO Gage tools to complete your part.



You can continue selecting more tools to inspect your part. Each new tool will appear in the Tools list.

Printing

The results of all tools can be printed.

- Select the PRINT button to print a report of your part.
- Select the CLEAR button to clear all the results of your tools from the report.

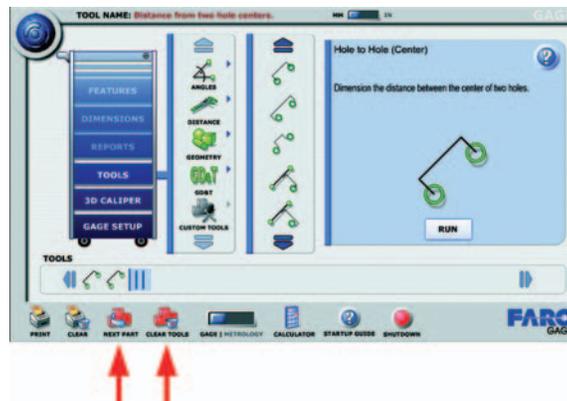


Repeat the Part

If you have to check the same set of features in multiple parts, you can easily repeat the measurements by selecting NEXT PART.

After adding all of the tools to your part:

- Select the NEXT PART button to repeat the tool list. This command will automatically prompt you to remeasure all the tools in your tool list.
- Select the CLEAR TOOLS button to erase all tools from the tool list and start a new project or measurement session.



NOTE: In GAGE mode, you are not able to save a tool list. Shutting down Gage software erases all active tools and resets your tool list. Measurement results are saved automatically. You can review your results and print a report using the PRINT button.

Practical - Using Tools

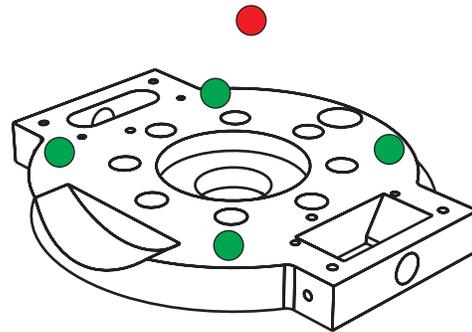
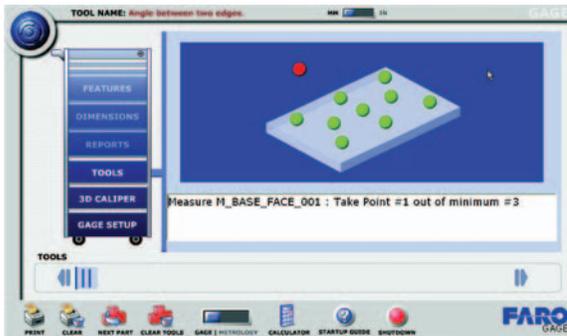
Angle - Edge to Edge

Use the Edge to Edge command to dimension the angle between two edges. The angle is the smallest angle. You may use the FARO Training part or your own part.

- 1 Select the TOOLS drawer in the Toolbox.
- 2 Select the ANGLES group.
- 3 Select the Edge to Edge command.
- 4 Select the RUN button.



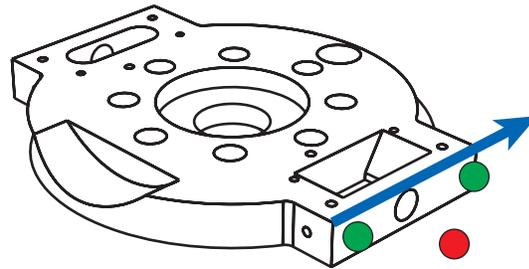
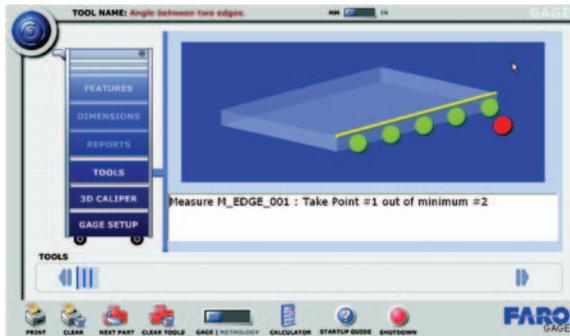
- 5 Measure the face for the edges on your part.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the planar surface.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

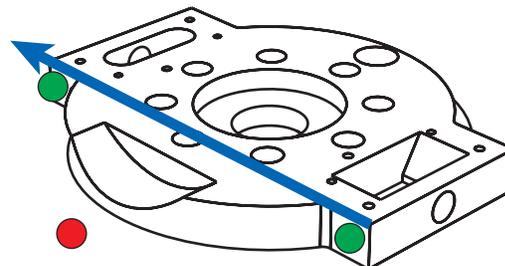
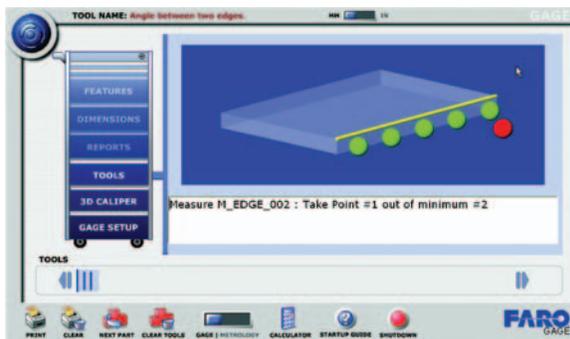
NOTE: If any measurement of an individual feature is out of form tolerance, a RESULTS dialog box appears. Select the OK button to continue, or select CANCEL to remeasure the feature.

6 Measure an edge on your part.



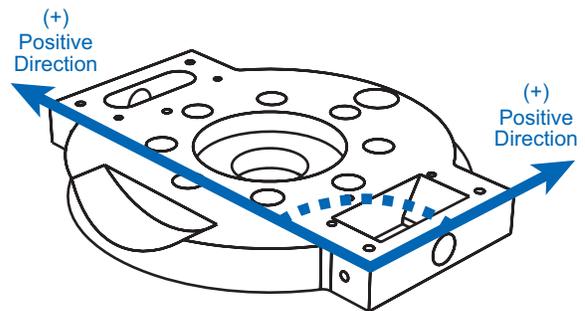
- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 2 or more points on the edge. Note the direction in which you take the points.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

7 Measure another edge on your part.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 2 or more points on the edge. Note the direction in which you take the points.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

- 8 View the results of your measurement in the RESULTS dialog box.



- You may type any Nominal and Tolerance values for the angle.

- 9 Select OK to add the angle to your FARO Gage tool list.

NOTE: The angle reported will always be the smallest angle based on the positive ends of your measurement direction. The last point taken on the edge determines the positive direction.

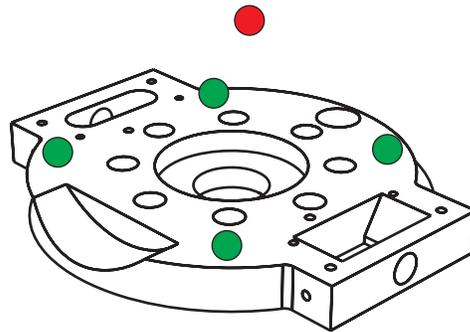
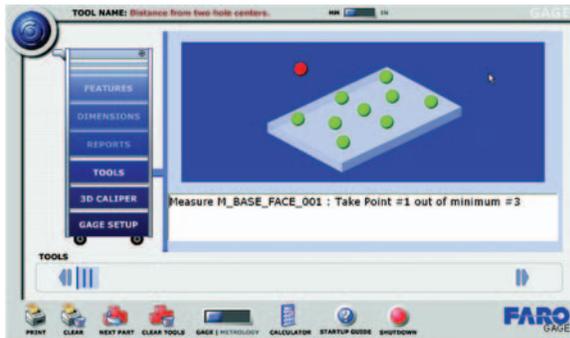
Distance - Hole to Hole (Center)

Use the Hole to Hole (Center) command to dimension the distance between two holes (from the center of the first hole to the center of the second hole).

- 1 Select the TOOLS drawer in the Toolbox.
- 2 Select the DISTANCE group.
- 3 Select the Hole to Hole (Center) command.
- 4 Select the RUN button.



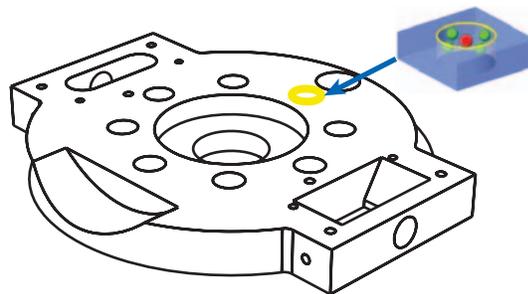
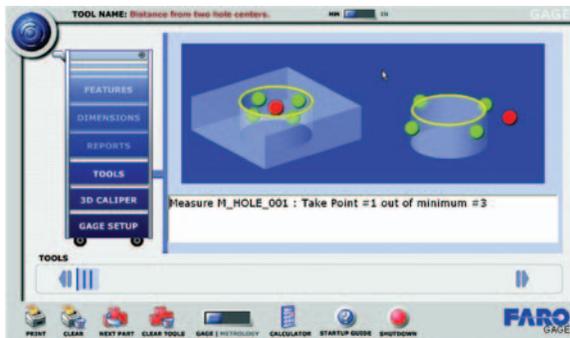
5 Measure the face for the holes on your part.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the planar surface.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

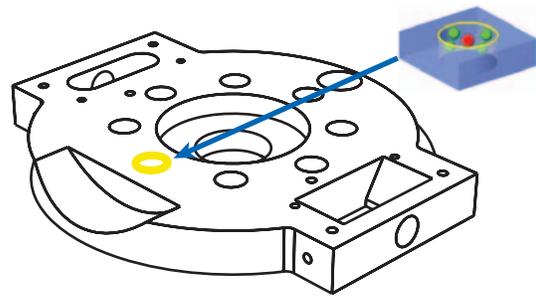
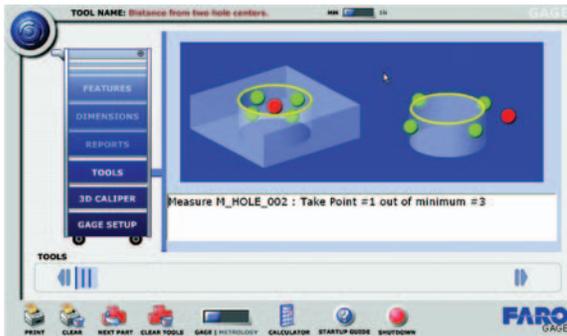
NOTE: If any measurement of an individual feature is out of tolerance, a RESULTS dialog box appears. Select the OK button to continue, or select CANCEL to remeasure the feature.

6 Measure a hole on your part.



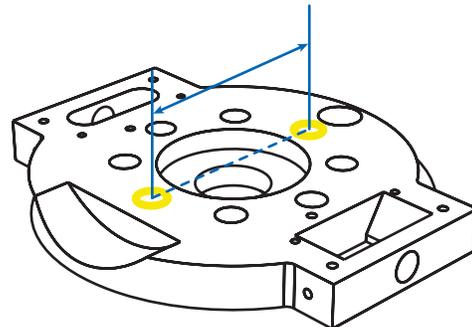
- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the hole. If measuring a hole, follow the illustration on the left which depicts a hole. (The picture on the right depicts how you would measure a cylindrical pin.)
- Pull away from the part and digitize 1 point with the RED button to complete the command.

7 Measure another hole on your part.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the hole.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

8 View the results of your measurement in the RESULTS dialog box.



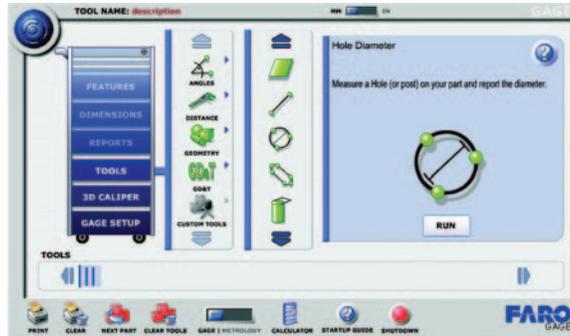
- You may type any Nominal and Tolerance values for the distance.

9 Select OK to add the distance to your FARO Gage tool list.

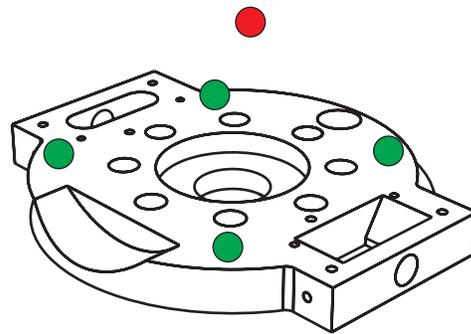
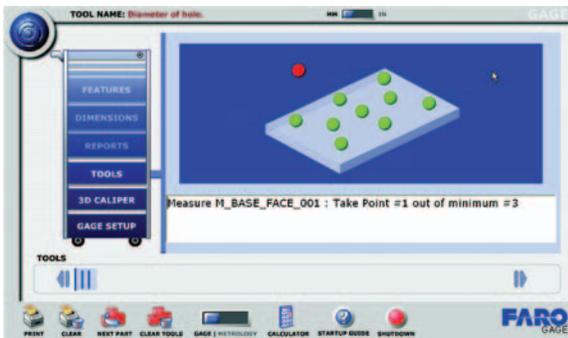
Geometry - Hole Diameter

Use the Hole Diameter command to measure a hole (or post) on your part and report the diameter. The Hole measurement best-fits a hole through digitized points.

- 1 Select the TOOLS drawer in the Toolbox.
- 2 Select the GEOMETRY group.
- 3 Select the Hole Diameter command.
- 4 Select the RUN button.

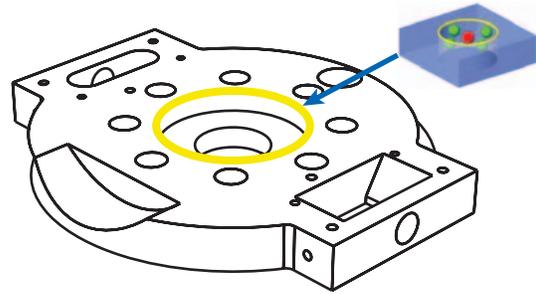
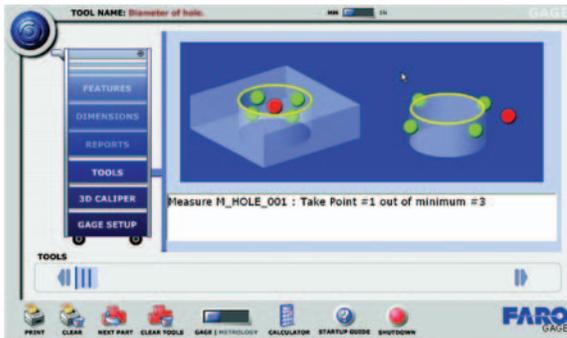


- 5 Measure a face for the hole. The digitized points are projected to the face before the best-fit calculation.



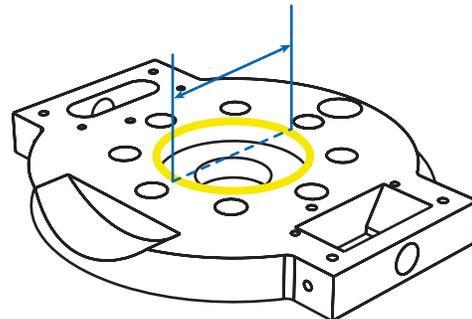
- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the planar surface.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

6 Measure a hole on your part.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the hole.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

7 View the results of your measurement in the RESULTS dialog box.



- You may type any nominal and tolerance values for the feature.

8 Select OK to add the feature to your FARO Gage tool list.

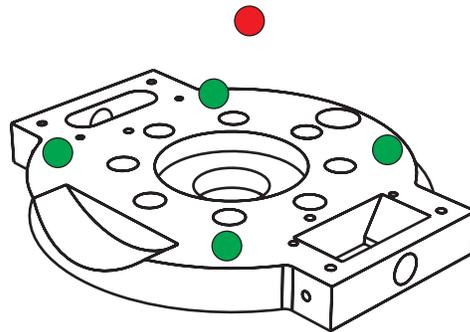
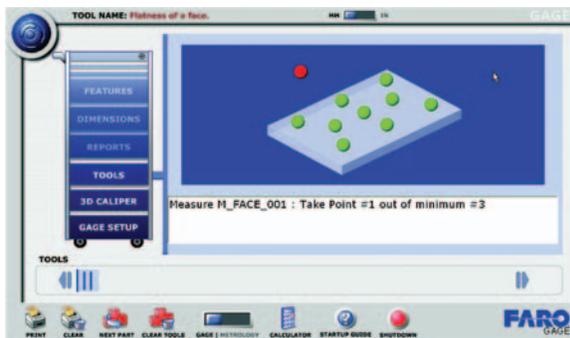
GD&T - Flatness

Use the Flatness Form tool to measure the flatness of a face. Flatness measures the form deviation of a face.

- 1 Select the TOOLS drawer in the Toolbox.
- 2 Select the GD&T group.
- 3 Select the Flatness command.
- 4 Select the RUN button.

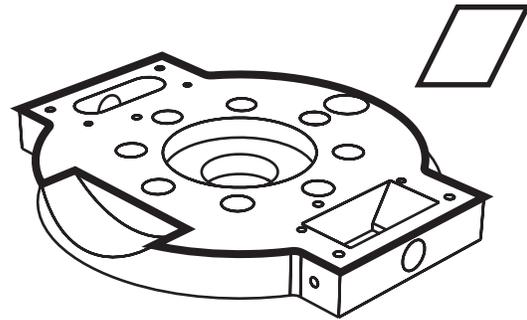
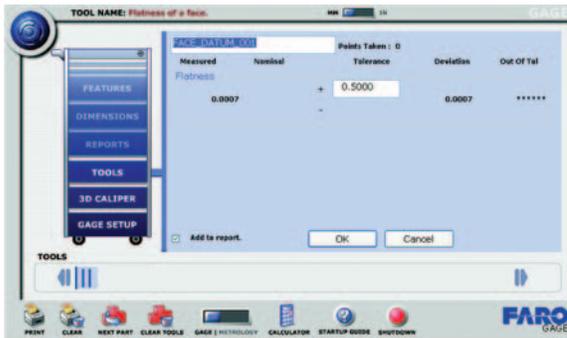


- 5 Measure a face on your part.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the planar surface.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

- 6 View the results of your measurement in the RESULTS dialog box.



- You may type any Nominal and Tolerance values for the feature.

- 7 Select OK to add the feature to your FARO Gage tool list.

Repeat and Print

Select the NEXT PART button to repeat the tool list. This command will automatically prompt you to remeasure all the tools in your tool list.

Select the PRINT button to print a report of your part.

3D Caliper

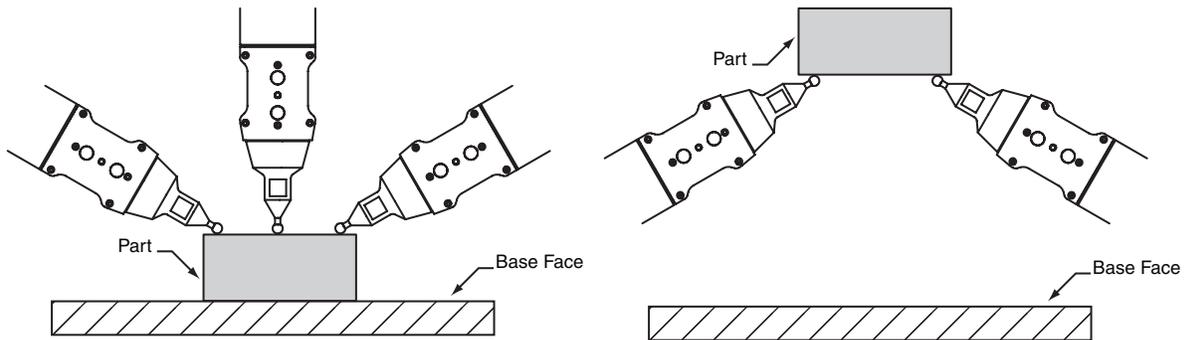
The FARO Gage 3D Caliper command replaces a traditional height gage tool by providing a quick distance measurement.



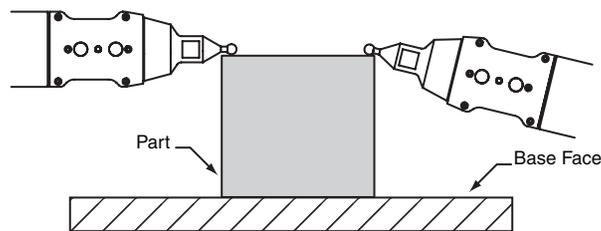
You must setup a base face (measurement table, gage block, etc.) and touch your part to check the distance from the base face to the surface on the part.

You can set or reset three separate base faces for your part (X,Y,Z).

The 3D Caliper command automatically compensates for the radius of the probe.

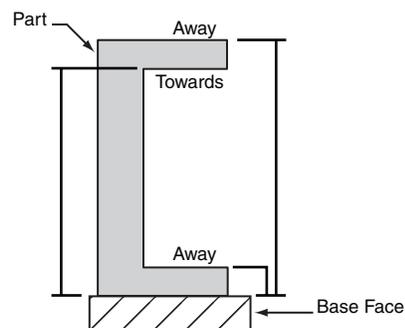


- You should always try to touch the surface with the probe pointing towards the surface you want to measure.
- Avoid the following positions.



You may set the 3D Caliper compensation to either manual setting, Towards the base face or Away from the base face.

- Manual compensation allows you to touch the surface in any position.



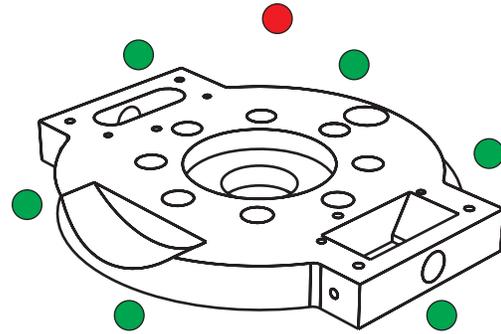
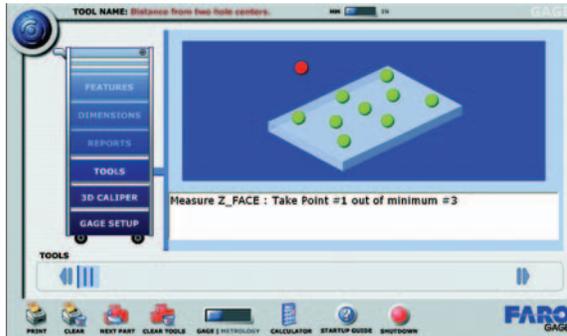
- AWAY FROM BASE compensates when the surface faces away from the base face.
- TOWARD BASE compensates when the surface faces the base face.

Practical - Using 3D Caliper

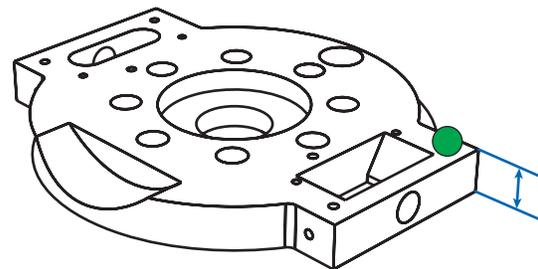
- 1 Select the SETUP tab.



- 2 Select the SET button for the X, Y, or Z base face and measure base face (table).



- 3 After setting the base face, place the FARO Gage probe on top of your part. Look at the screen to see the height from the base face to the surface.
- 4 Press the GREEN button to freeze the Height display.
 - The 3D Caliper automatically compensates for the radius of the probe.



NOTE: The face measurement remains until you reset or clear it.

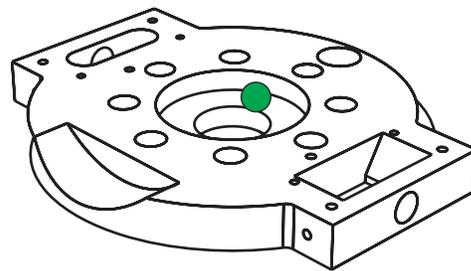
If the Height is incorrect (higher or lower) by the diameter of the probe, select a manual compensation setting.

- 5 Press the GREEN button again to unfreeze the height display and continue.
- 6 Select the AWAY FROM BASE radio button to manually compensate when the surface faces away from the base face.
- 7 Select the TOWARD BASE radio button to manually compensate when the surface faces the base face.

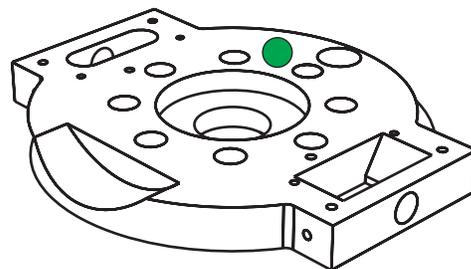
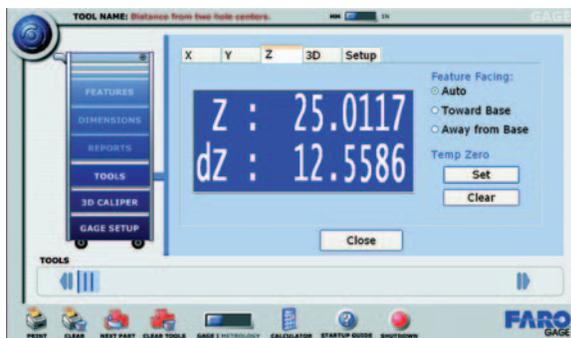
3D Caliper Temporary Zero

You can set a temporary zero with the 3D Caliper to measure relative distances.

- 1 Touch your part at the temporary zero height. If using the FARO Training part take a point on the step inside the large hole.
- 2 Press the GREEN button to freeze the display.



- 3 Press the RED button on the FARO Gage to set the temporary zero height.
- 4 Press the GREEN button to unfreeze the display.
- 5 Place the FARO Gage probe on your part. Look at the screen to see the height from the base face to the probe, and the height from the temporary zero height to the probe.



NOTE: Pressing the GREEN button to freeze and unfreeze the display is optional. Press and Hold the RED button to clear the temporary zero height. You can repeat these steps at another height.

6 Select the CLOSE button.

Chapter 3: Feature Measurements (Metrology Mode)

- **Objective: Familiarize yourself with the screen layout and tools, and learn to take feature measurements in Metrology mode.**

Features

The FARO Gage Features drawer contains all the commands to measure the individual faces, holes, edges, etc. of a part. After measuring the individual features, you can use the Dimensions commands to calculate distances and angles between the existing Features. The Features drawer is only available in METROLOGY mode.

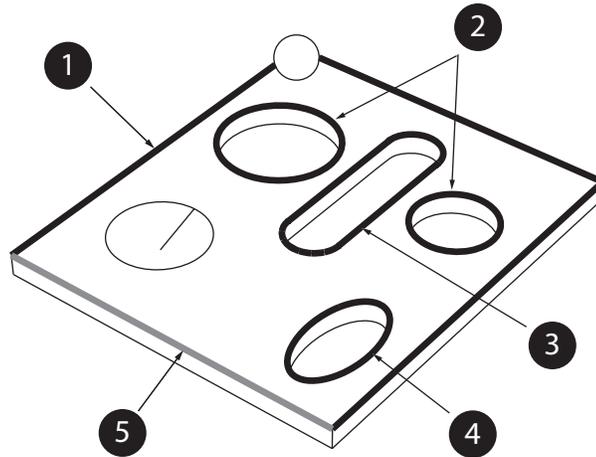


Types of Features

There are two basic types of features in Gage software: *2D* and *3D*. *2D* features are flat features that require a base face or plane of projection. *3D* features have some depth and do not require a plane of projection.

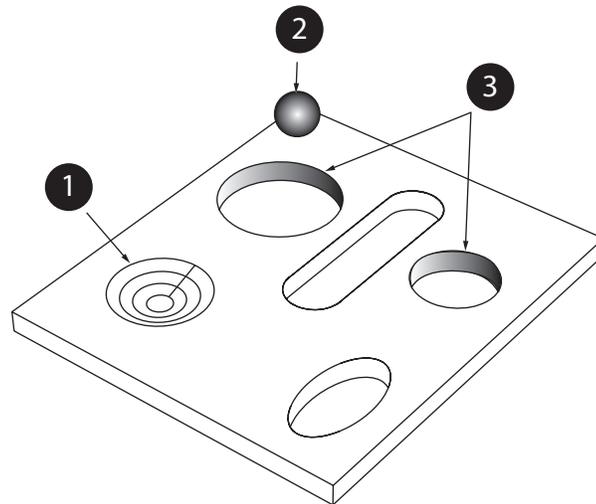
2D Features

- 1 Rectangular Slot
- 2 Holes
- 3 Round Slot
- 4 Ellipse
- 5 Edge



3D Features

- 1 Cone
- 2 Sphere
- 3 Cylinder



NOTE: When selecting a 2D feature from the FEATURES menu, you will be prompted to select a base face. You will always need to select the face to which the points will be projected.

NOTE: Gage software will automatically add the prefix "M_" to all measured features to indicate that these are measured features.

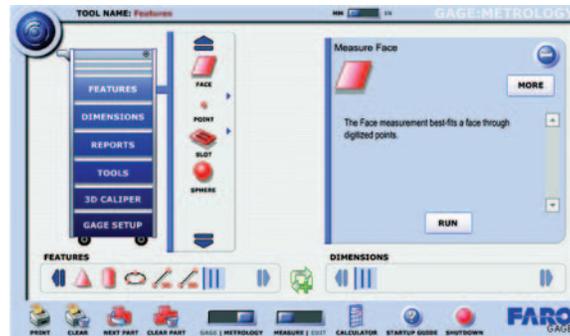
Practical - Measuring Features

Face

Use the Face command to measure a face (planar surface) on your part. The face measurement best-fits a face using digitized points.

Make sure you're in Metrology Mode (select the Metrology switch, and select OK).

- 1 Select the FEATURES drawer in the Toolbox.
- 2 Scroll through the FEATURES list and select the Face command.
- 3 Select the RUN button.

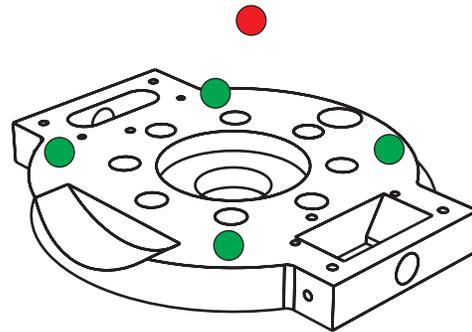
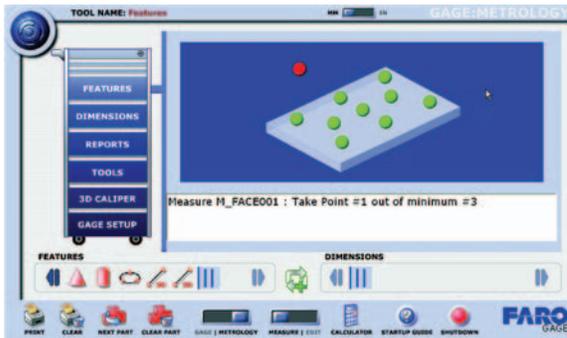


- 4 Type a name for your measured face, or use the default name.



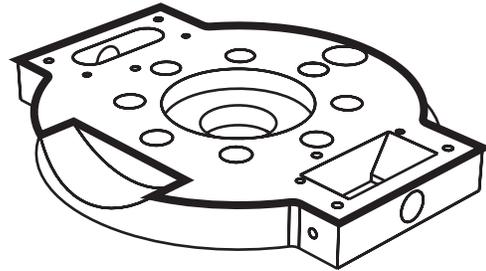
- If this face is a datum of your part, select the DATUM check box.
- 5 Select OK to measure the face.

6 Measure the face with the FARO Gage.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the planar surface.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

7 View the results of your measurement in the RESULTS dialog box.



- The nominal value for the face form is 0.

8 Select OK to add the face to your FARO Gage part file.

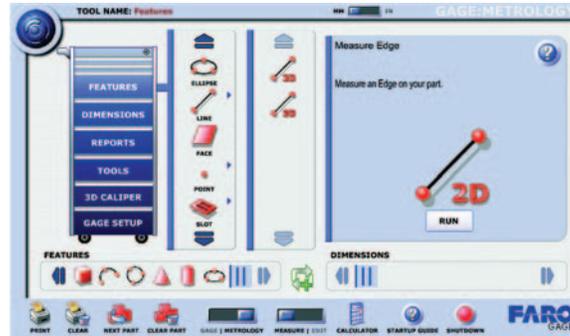
9 When prompted to measure the next face, select CANCEL.

NOTE: All feature commands are set to auto-repeat.

Edge (2D)

Use the 2D command to measure an edge (straight line) on your part. The edge measurement best-fits an edge through digitized points.

- 1 Select the FEATURES drawer in the Toolbox.
- 2 Select the EDGE group.
- 3 Select the 2D command.
- 4 Select the RUN button.

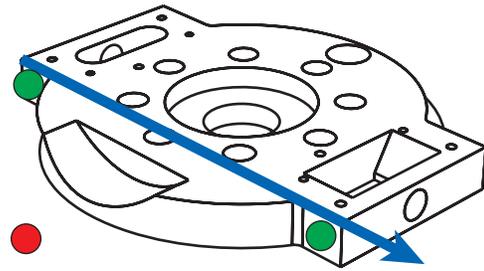
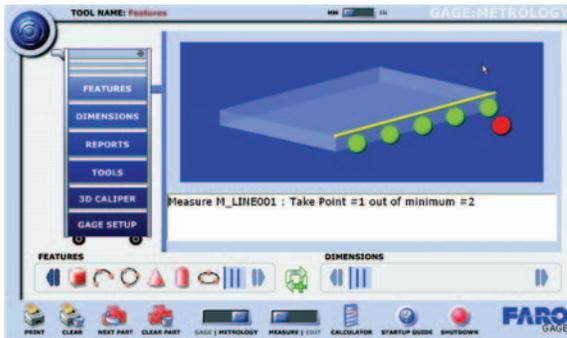


- 5 Type a name for your measured edge, or use the default name.
- 6 Choose the previously measured face for the edge. The digitized points are projected to the face before the best-fit calculation.



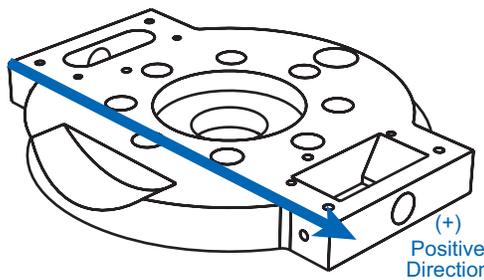
- If this edge is a datum of your part, select the DATUM check box.
- 7 Select OK to measure the edge.

8 Measure the edge with the FARO Gage as shown.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 2 or more points on the Edge. Note the direction in which you take the points.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

9 View the results of your measurement in the RESULTS dialog box.



10 Select OK to add the edge to your FARO Gage part file.

11 When prompted to measure the next edge, select CANCEL.

Hole

Use the Hole command to measure a hole, circle, or post on your part. The hole measurement best-fits a hole through digitized points.

- 1 Select the FEATURES drawer in the Toolbox.
- 2 Select the Hole command.
- 3 Select the RUN button.

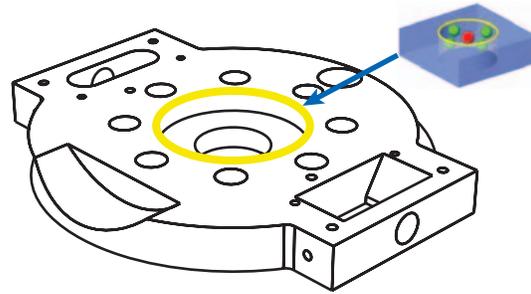
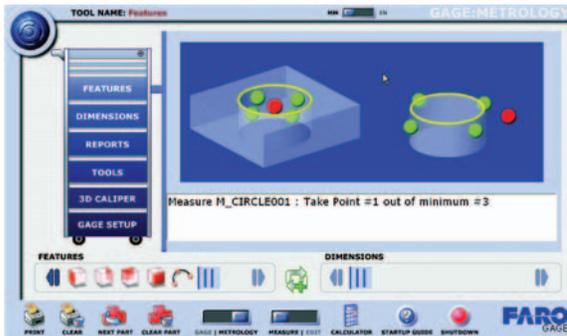


- 4 Type a name for your measured face, or use the default name.
- 5 Choose the previously measured face for the hole. The digitized points are projected to the face before the best-fit calculation.



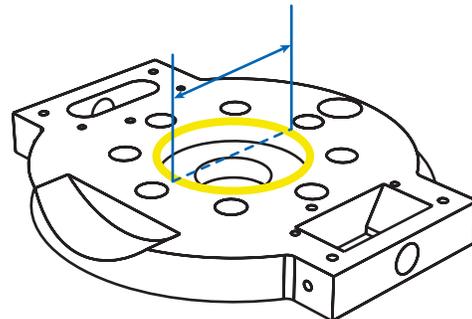
- If this hole is a datum of your part, select the DATUM check box.
- 6 Select OK to measure the hole.

7 Measure the center hole with the FARO Gage.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points in the hole.
- Pull away from the hole edge and digitize 1 point with the RED button to complete the command.

8 View the results of your measurement in the RESULTS dialog box.



9 Type Nominal diameter = 1.00 and Tolerance = +0.25, -0.10.

10 Select OK to add the hole to your FARO Gage part file.

11 When prompted to measure the next hole, select CANCEL.

Cone

Use the Cone command to measure a cone on your part. The cone measurement best-fits a face through digitized points.

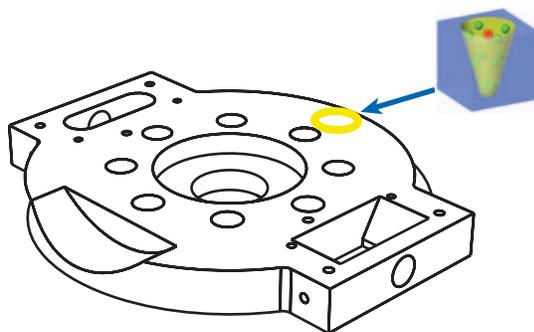
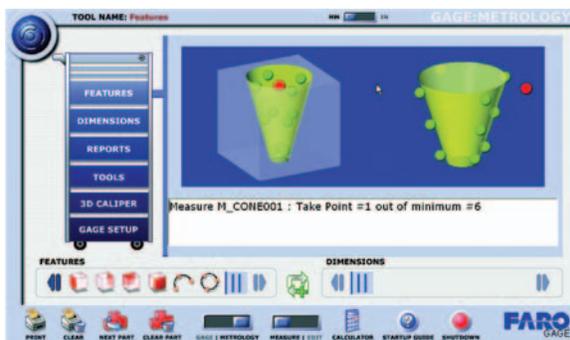
- 1 Select the FEATURES drawer in the Toolbox.
- 2 Select the Cone command.
- 3 Select the RUN button.



- 4 Type a name for your measured cone, or use the default name.



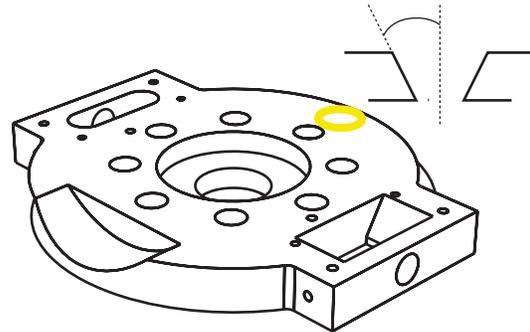
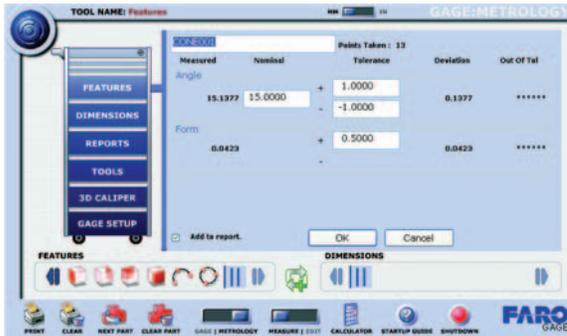
- If this cone is a datum of your part, select the DATUM check box.
- 5 Select OK to measure the cone.
 - 6 Measure the cone with the FARO Gage.



- Place the ball probe on the part and digitize points with the GREEN button.

- Digitize 6 or more points on the cone.
- Pull away from the edge and digitize 1 point with the RED button to complete the command.

7 View the results of your measurement in the RESULTS dialog box.



8 Type Nominal angle = 15 and Tolerance = +/- 1 values for the cone.

9 Select OK to add the cone to your FARO Gage part file.

10 When prompted to measure the next cone, select CANCEL.

Review Results

Select any FEATURE icon from the Features List to review the measurement data. You can also edit labels, nominal data, tolerances, etc., or remove the feature from the tool file.



Repeat and Print (Optional)

- 1 Select the NEXT PART button to repeat the tool list. This command will automatically prompt you to remeasure all the tools in your tool list.
- 2 Select the PRINT button to print a report of your part.

Chapter 4: Basic Part Measurements (Metrology Mode)

- **Objective: Familiarize yourself with the screen layout and tools, and learn to measure parts in Metrology mode.**

Dimensions

The FARO Gage Dimensions drawer contains all the commands for creating dimensions using existing features. Dimensions are often the values that are listed on the design print for your part. The Dimensions commands are organized into the ANGLE, LENGTH, GD&T, DRO, BUILD HOLE, BUILD EDGE, BUILD FACE, and BUILD POINT groups within the Dimensions drawer. The Dimensions drawer is only available in METROLOGY mode.

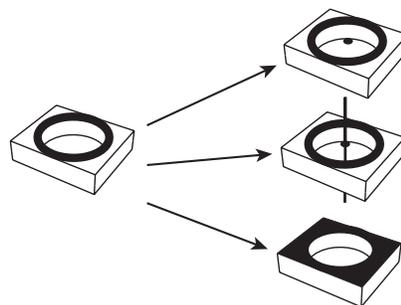


Gage Metrology Concepts

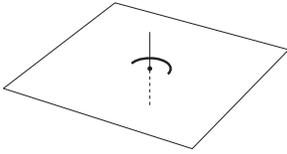
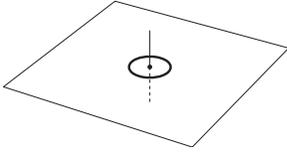
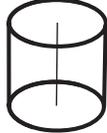
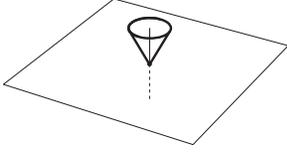
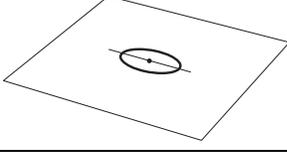
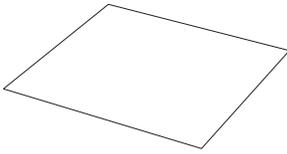
Feature Reducibility

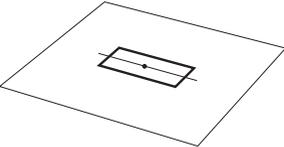
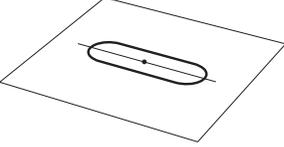
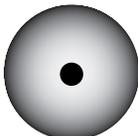
Feature Reducibility is a term used to describe that one type of feature can be used like another type for alignments, build commands (constructions) and dimensions.

For example, a circle is point reducible, which means it can be used like a point for alignments, constructions, or dimensions.



Feature Reducibility Table

	Plane	Line	Point	
Arc				
Circle				
Cylinder				
Cone				
Ellipse				
Line				
Plane				
Point				

	Plane	Line	Point	
Rectan- gular Slot				
Round Slot				
Sphere				

Alignments

What is an Alignment?

The term alignment comes from the traditional CMM (Coordinate Measuring Machine) to indicate that the part needs to be aligned to the coordinate system of the machine.

In FARO Gage, the coordinate system of the measured features can be aligned with the coordinate system of nominal features, allowing you to compare the measured part to the design data.

If you are tolerancing the location of features (X,Y,Z), you must build an alignment. The alignment is also known as the X,Y,Z coordinate system of your part, and references the location of features from an Origin point (0,0,0).

In METROLOGY mode, the ALIGNMENT icon is located between the Features and Dimensions list. In every part file, the ALIGNMENT icon will display in the following colors:

- Gray - the proper features do not exist to build an alignment.
- Green - the proper features exist to build an alignment.
- Red and Blue - An alignment exists in the part file.



In metrology, the traditional way to establish a coordinate system or alignment requires a plane (or face), a line (or edge) and an origin (point). This is also known as 3-2-1 (3 points define a plane, 2 points for a line or axis and 1 point is the origin).

FARO Gage software has a *smart alignment* feature that recognizes when you have met the minimum requirements to create a coordinate system and also tries to determine whether they should be used based on the available features.

Typical 3-2-1 Coordinate Systems:

- Face/Edge/Hole - If you have measured a face, an edge, and a hole, the alignment command will pre-define the face as the XY plane, the edge as the X axis, and the center of the hole as the origin (or 0,0,0 point of the coordinate system).
- Face/Edge/Edge - If you have measured a face and two edges, the alignment command will pre-define the face as the XY plane, the first EDGE as the X axis, and the origin (or 0,0,0 point of the coordinate system) will be at the intersection of the two edges.
- Face/Face/Face - If you have measured 3 faces, the alignment command will pre-define the first face as the XY plane, the edge (or line) formed by the intersection of the first and second faces as the X axis, and the origin (or 0,0,0 point of the coordinate system) will be at the point formed at the intersection of all three faces.

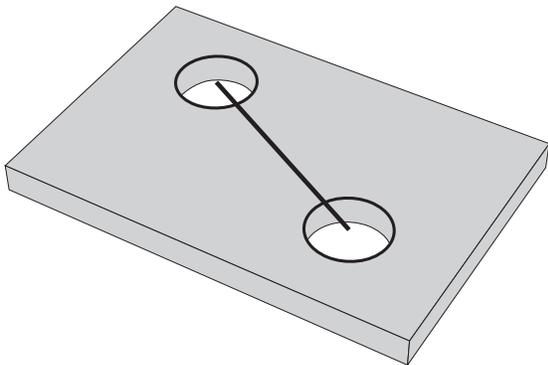
NOTE: The face or XY plane also defines the Z axis, which is perpendicular to the XY plane. X,Y,Z location results do not display for features and dimensions until you build an alignment.

Dimensions

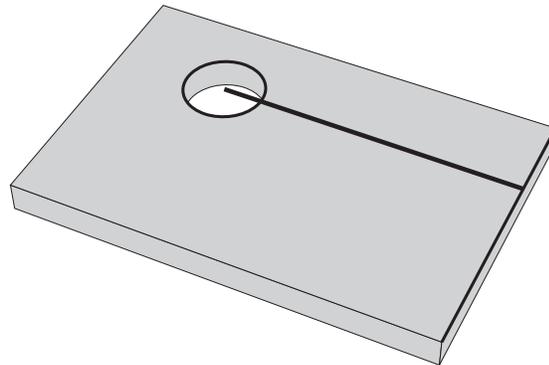
What is a Dimension?

A dimension describes the relationship between two or more features. There are several types of dimensions available in FARO Gage, such as:

- 1 Length: Displays the 3D distance between two features as well as the change in X, Y and Z.

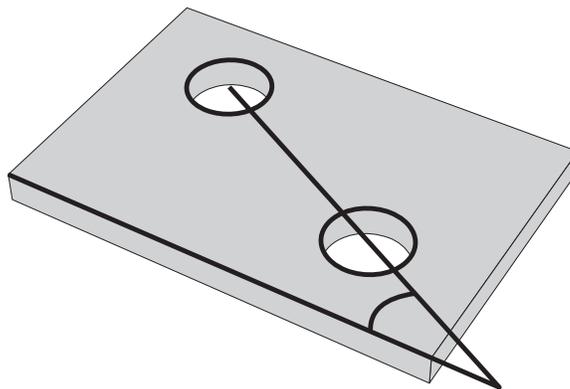


LENGTH > POINT TO POINT



LENGTH > POINT TO EDGE

- 2 Angle: Displays the angle between two (or three) features.



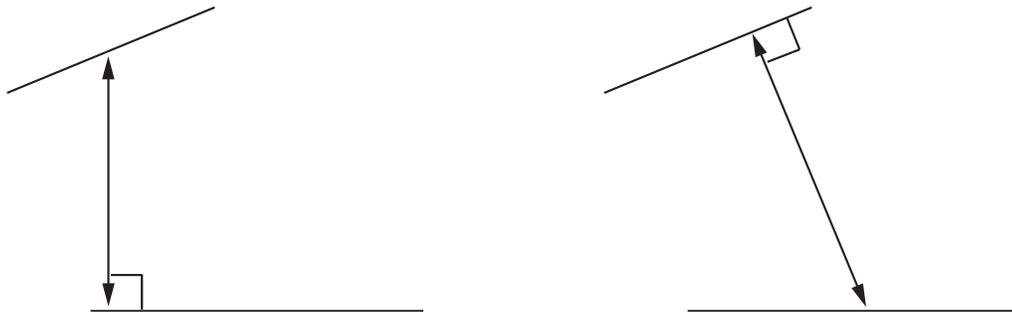
- 3 GD&T: These are geometric dimensioning and tolerancing features that display a length result. Gage has a variety of GD&T dimensions.

Tricky Dimensions

Most GAGE dimensions are fairly straight forward, but there are few that might be confusing:

- Edge to Edge
- Face to Face

This gives the minimum distance between two features. The length is measured from the center point of one feature to the perpendicular distance of the other feature. Selecting the features in the opposite order will generate a different result.



A measured or constructed point on one of the features and the dimension Point to Edge or Point to Face provides the best solution.

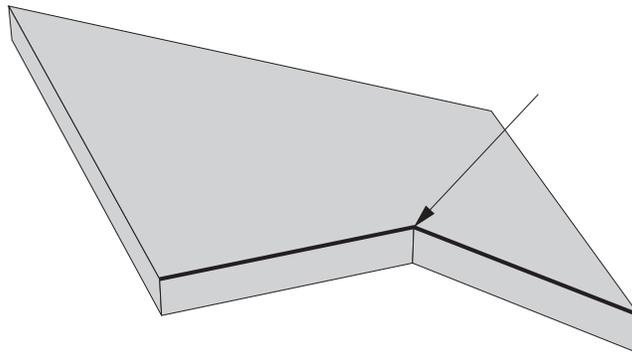
Build Commands

What is a Build Command?

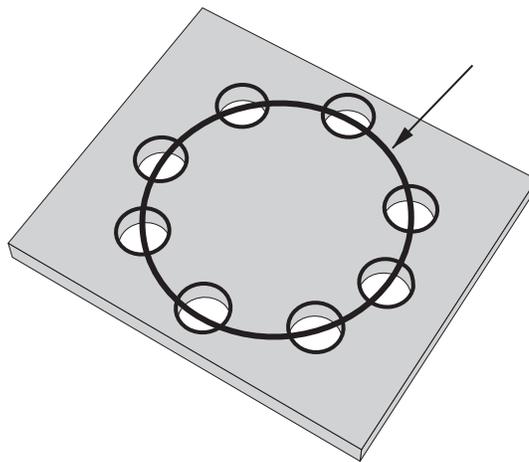
Build Commands are also known as *constructions*. A construction allows you to create or build features that cannot be directly measured. For example, sometimes points or other features are specified on a drawing but do not actually exist on the part, such as the intersection of two lines where the corner has a fillet or radius.

There are several types of build commands in FARO Gage, such as:

- 1 Point: Two Edges - Intersection of two lines.



- 2 Circle: Best-fit - Bolt circle diameters.



Review the constructions to evaluate which commands can be applied to a measurement task.

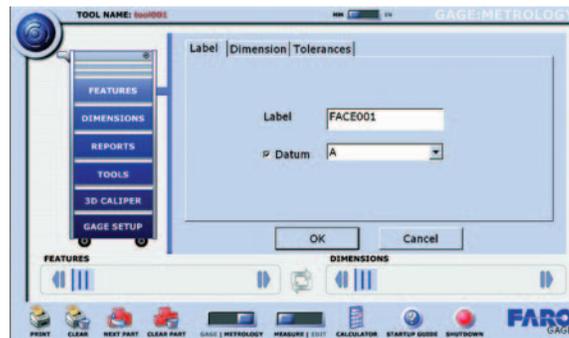
NOTE: Gage software will automatically add the prefix "C_" to all dimensions, alignments and built features to indicate that these are constructed features.

- The edge next to holes A and B is Datum B. (Typically defines the X axis)
- Hole location #9 is Datum C. (Typically defines the coordinate system's 0,0,0 origin)

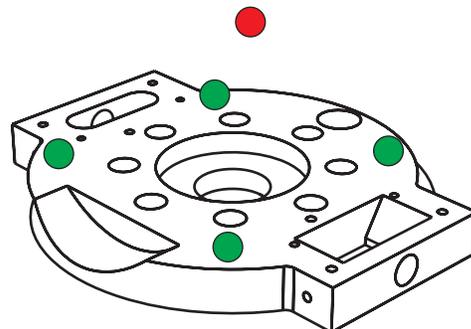
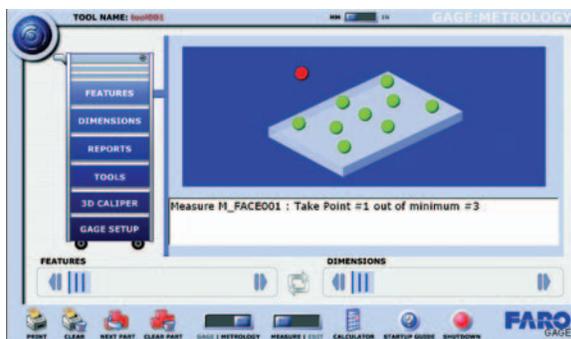
- 4 Select the FEATURES drawer in the Toolbox.
- 5 Scroll through the FEATURES list and select the Face command.
- 6 Select the RUN button.



- 7 Type a name for your measured face (or use the default name).



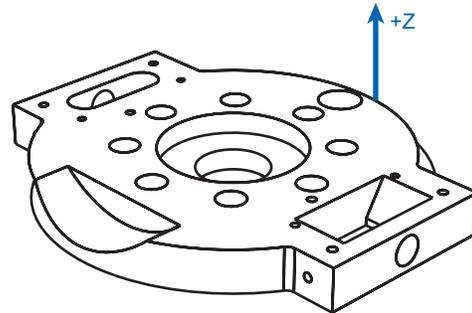
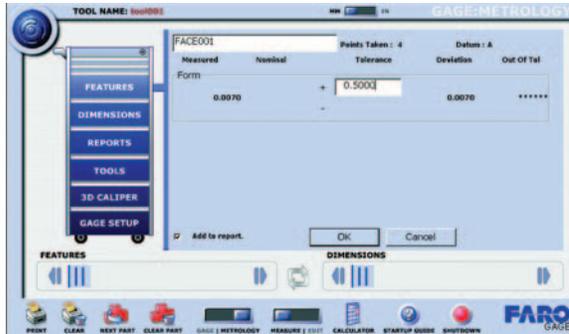
- 8 Select the DATUM check box and choose A.
- 9 Select OK to measure the face.
- 10 Measure the face with the FARO Gage.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points on the planar surface.

- Pull away from the part and digitize 1 point with the RED button to complete the command.

11 View the results of your measurement in the RESULTS dialog box.



12 Select OK to add the face to your FARO Gage part file.

- This will be your XY plane. (Z axis)

13 Select the CANCEL button to exit the command.

14 Select the EDGE group.

15 Select the 2D command.

16 Select the RUN button.

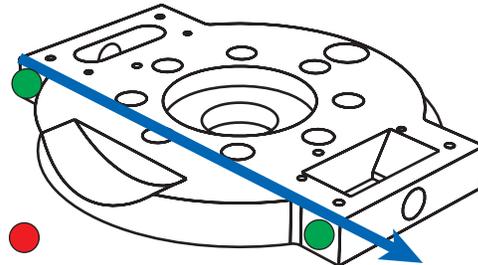
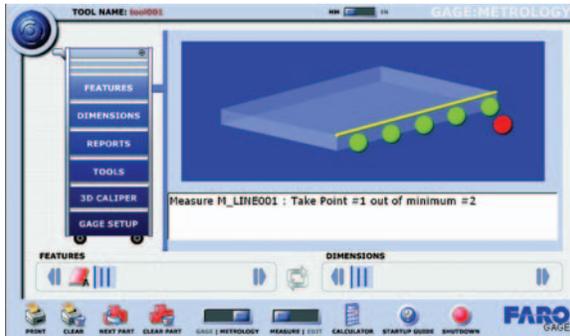


17 Type a name for your measured edge (or use the default name).

18 Choose the previously measured face for the edge. The digitized points are projected to the face before the best-fit calculation.

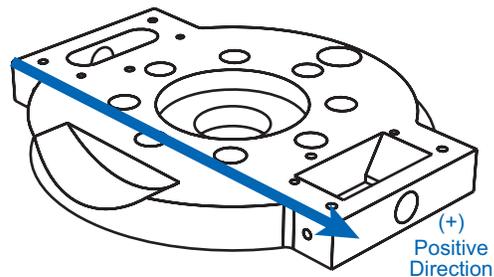


- 19 Select the DATUM check box and choose B.
- 20 Select OK to measure the edge.
- 21 Measure the edge with the FARO Gage as shown.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 2 or more points on the edge. Note the direction in which you take the points.
- Pull away from the part and digitize 1 point with the RED button to complete the command.

- 22 View the results of your measurement in the RESULTS dialog box.



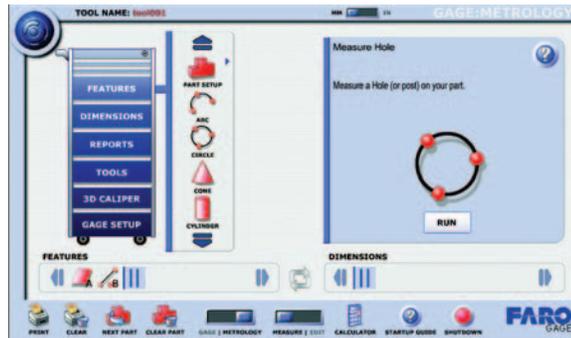
- 23 Select OK to add the edge to your FARO Gage part file.

- This will be your X axis. The direction in which you take the points will determine the direction of the axis.

24 Select the CANCEL button.

25 Select the Hole command.

26 Select the RUN button.



27 Type a name for your measured face ("Hole9" is recommended), or use the default name.

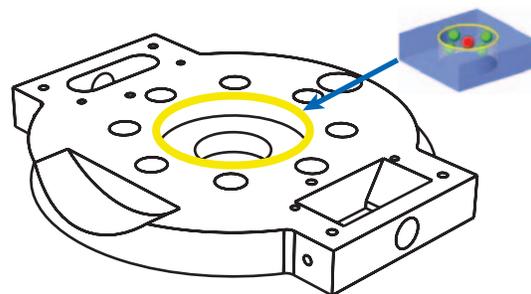
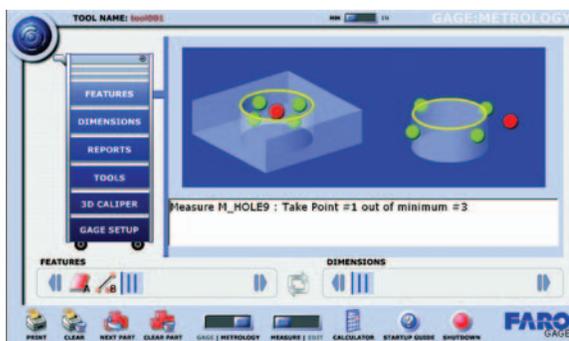
28 Choose the previously measured face for the hole. The digitized points are projected to the face before the best-fit calculation.



29 Select the DATUM check box and choose C.

30 Select OK to measure Hole #9.

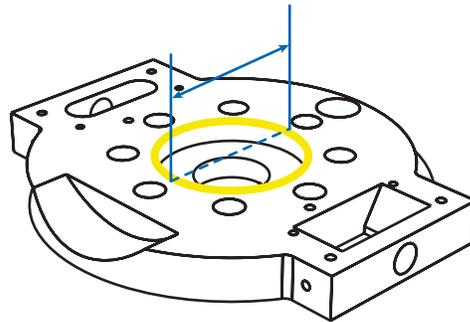
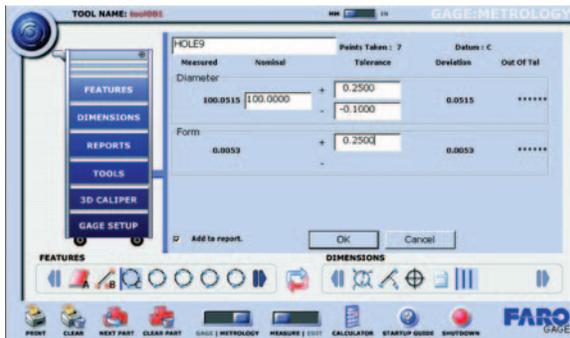
31 Measure the center hole with the FARO Gage.



- Place the ball probe on the part and digitize points with the GREEN button.

- Digitize 3 or more points in the hole.
- Pull away from the hole edge and digitize 1 point with the RED button to complete the command.

32 View the results of your measurement in the RESULTS dialog box.



33 Type Nominal diameter = 100 and Tolerance = +0.25, -0.10.

34 Select OK to add the hole to your FARO Gage part file.

- This will be your 0,0,0 coordinate system origin.

35 Select the CANCEL button.

36 Select the Alignment command.
(The button should be green).

37 Select the RUN button.



38 Select the features.

- The software should have pre-selected the face for the first feature, the edge for the second and the hole for the third feature.

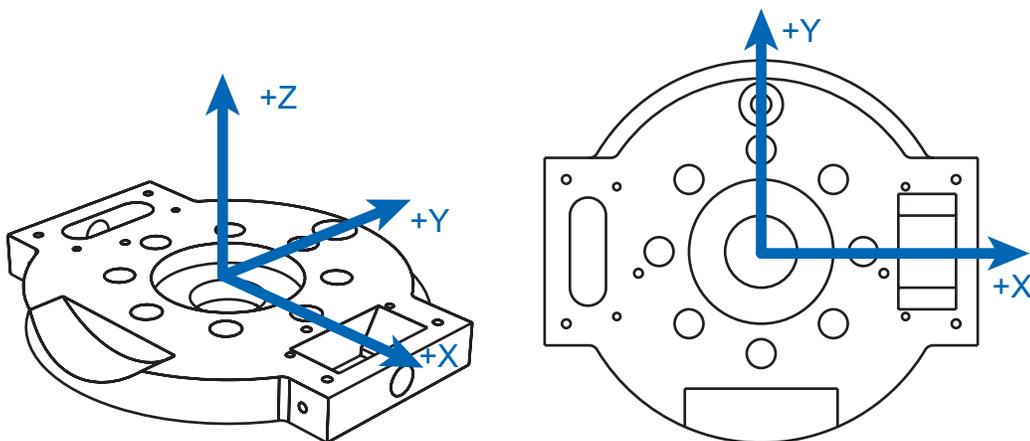


39 Select OK to complete the alignment.

NOTE: The alignment icon will now display a red and blue arrow indicating that an alignment is present.

The face determines the XY plane and Z axis orientation; the edge determines the X axis direction; the hole determines the origin point. The Y axis is set automatically as it will always be in the same orientation relative to X and Z, according to the commonly used Right Hand Rule.

The coordinate system created should look like this:



Verifying the Alignment

To verify that the alignment orientation was properly set, select 3D CALIPER, select the SETUP tab, select the USE ALIGNMENT check box, then select the 3D tab. Observe the X,Y,Z readings as you move the probe around the part.

Select CLOSE to exit 3D Caliper.

Inspecting the Part

Let's now check the part using the part print on page 46 and the pre-established alignment.

- 1 Select the Hole command.
- 2 Select the RUN button.

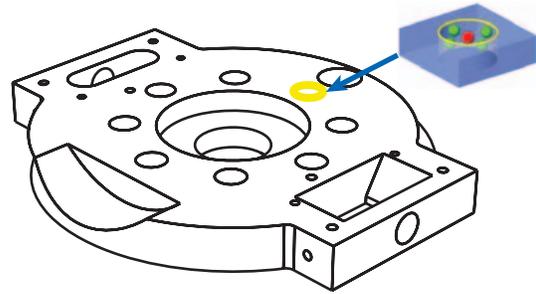
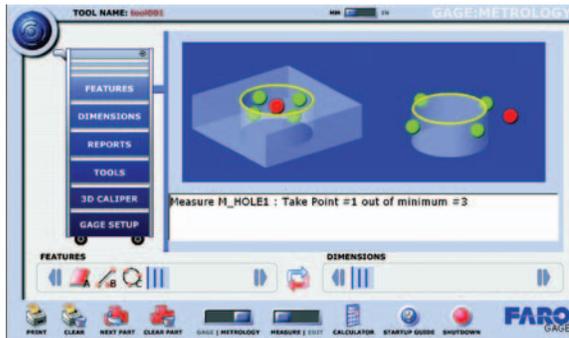


- 3 Type a name for your measured hole ("Hole1" is recommended), or use the default name.
- 4 Choose the previously measured face for the hole. The digitized points are projected to the face before the best-fit calculation.



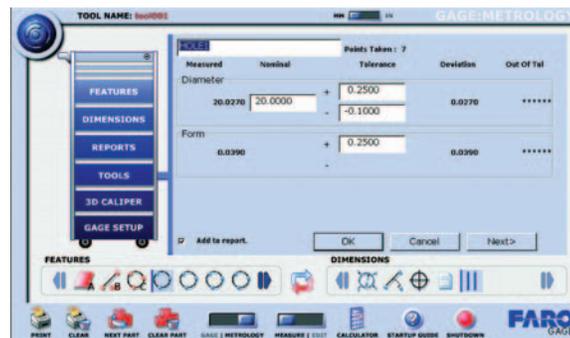
- 5 Select OK to measure Hole #1.

6 Measure the center hole with the FARO Gage.



- Place the ball probe on the part and digitize points with the GREEN button.
- Digitize 3 or more points in the hole.
- Pull away from the hole edge and digitize 1 point with the RED button to complete the command.

7 View the results of your measurement in the RESULTS dialog box.



8 Type Nominal diameter = 20 and Tolerance = +0.25, -0.10.

- 9 Select NEXT to add the nominal X, Y, Z values.



- 10 Based on the print and the alignment orientation, enter $X=0$, $Y=70$, $Z=0$.

- 11 Repeat steps 1 through 7 for Holes #3, #5 and #7.

- For Hole #3 use $X=70$, $Y=0$, $Z=0$.
- For Hole #5 use $X=0$, $Y=-70$, $Z=0$.
- For Hole #7 use $X=-70$, $Y=0$, $Z=0$.

- 12 After finishing Hole #7, select the CANCEL button to exit the command.

NOTE: When measuring multiple holes, it is recommended to change their labels according to your print or reference guide to make them easier to identify later. After you have measured a feature, you may edit the corresponding label by choosing the feature from the list, then selecting EDIT. Once edited, choose OK to apply changes and highlight the vertical bars at the end of the list to continue measuring.

Build Command

Let's check the bolt circle specified on the print. The eight 20mm holes are equally spaced in a 140mm bolt circle which cannot be measured directly with the FARO Gage. We'll use the build command to create it from the four previously measured 20mm holes.

- 1 Select the DIMENSIONS drawer in the Toolbox.
- 2 Select the BUILD HOLE group.
- 3 Select the Best Fit command.
- 4 Select the RUN button.

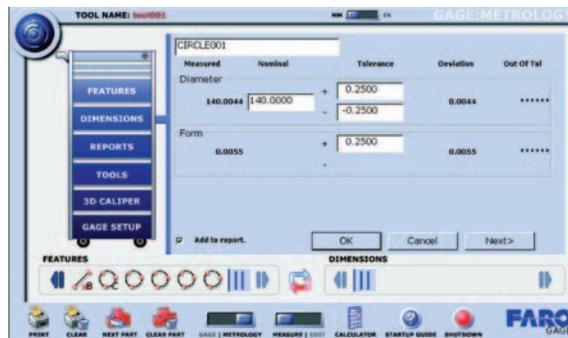


NOTE: Use the Best Fit command to build a best-fit hole from previously measured features and/or dimensions. The Best Fit command builds a best-fit hole from existing features and/or dimensions. The points project to the face before the best-fit calculation starts.

- 5 Type a name for your dimension, or use the default name.



- 6 Choose the four measured holes from the list.
- 7 Choose the measured face.
- 8 Select OK to create the dimension.
- 9 View the results of your hole.



10 Type Nominal Diameter = 140 and Tolerance = +0.25, -0.10.

11 Select OK to add the hole to your FARO Gage part file.

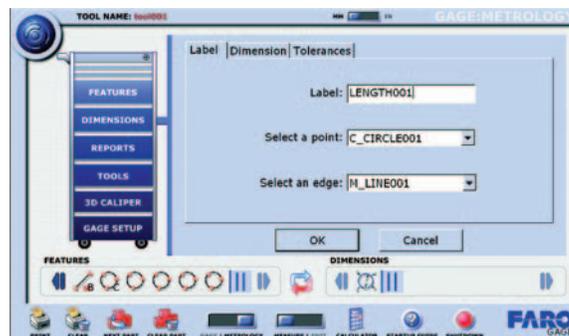
Dimensions

Let's check the distance between the center of the bolt circle and Datum Edge B. Use the Point To Edge command to build a length between a point and an edge. The length is the distance from the point to the edge.

- 1 Select the DIMENSIONS drawer in the Toolbox.
- 2 Select the LENGTH group.
- 3 Select the Point to Edge command.
- 4 Select the RUN button.

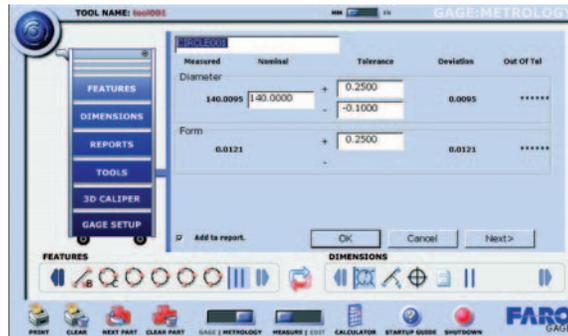


5 Type a name for your dimension, or use the default name.



- 6 Choose constructed circle 1 (C_CIRCLE001) as the point.
- 7 Choose measured line 1 (M_LINE001) as the edge.
- 8 Select OK to create the dimension.

- 9 View the results of your dimension.



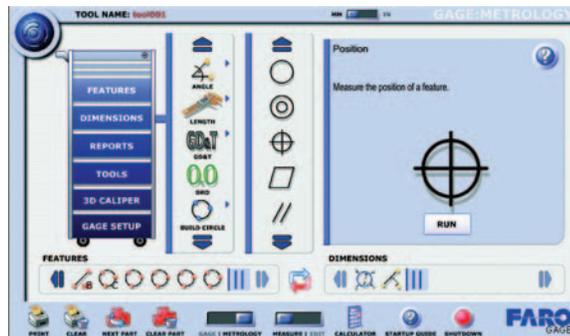
- 10 Type Nominal Length = 65 and Tolerance = ± 0.25 .

- 11 Select OK to add the dimension to your FARO Gage part file.

GD&T (Optional)

Let's check the Position of the 20mm holes. Use the Position command to measure the GD&T Position of an existing feature. Position measures a feature RFS (Regardless of Feature Size) and MMC (Maximum Material Condition).

- 1 Select the DIMENSIONS drawer in the Toolbox.
- 2 Select the GD&T group.
- 3 Select the Position command.
- 4 Select the RUN button.



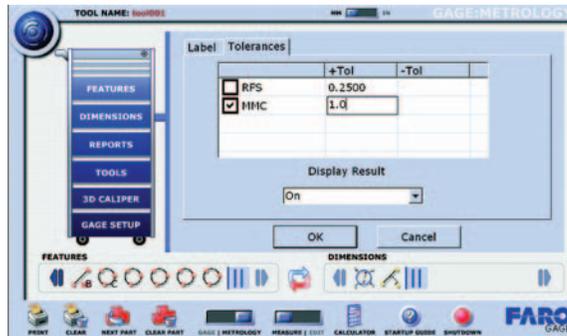
- 5 Type a name for your dimension, or use the default name.



6 Choose Hole #1.

NOTE: Features without nominal values are not available.

7 Select the TOLERANCES tab.



- On the drawing, the "M" next to the tolerance value in the feature indicates MMC tolerance (Maximum Material Condition).

8 Uncheck RFS (Regardless of Feature Size).

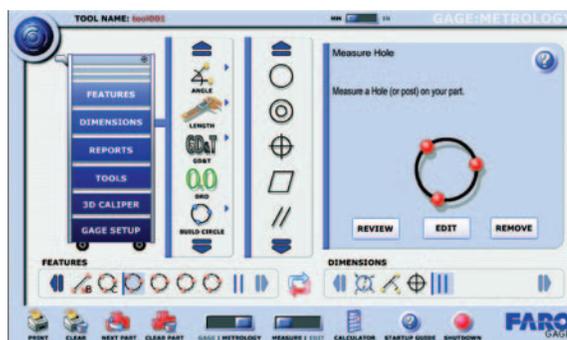
9 Select the MMC tolerance field and type Position Tolerance = 1 . 0.

10 Select OK to review the results.

11 Select OK to add the dimension to your FARO Gage part file.

Review Results and Reports

To review the results of your measurements at any time, select a feature or dimension from the list and choose REVIEW.

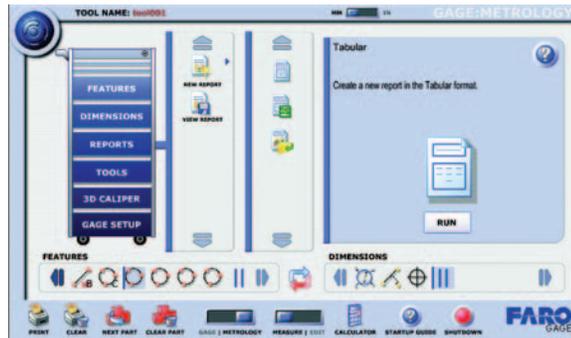


You can also edit the nominal information or remove features from the list.

The FARO Gage Reports drawer contains all the commands to create reports for your part. The Reports drawer is only available in METROLOGY mode.

Use the Tabular command to create a report of the features and dimensions on your part.

- 1 Select the REPORTS drawer in the Toolbox.
- 2 Select the NEW REPORT group.
- 3 Select the Tabular command.
- 4 Select the RUN button.



- 5 Type your name, the part name, and the serial number, or use the defaults.



NOTE: Select the ADVANCED check box to choose from existing part names or serial numbers.

- 6 Select OK to generate the report preview.



- Select OK to exit the command.
- Select PRINT to send the report to any printer connected to your computer.
- Select SAVE to create a report file on your computer. You may view and print this file later using the View Report command.

There are two additional report formats in FARO Gage: *Excel* and *SPC*. Use these to create output files that can easily be imported to other applications for data analysis.

Both the Excel and SPC formats will create .csv text files. They are both saved automatically to C:\DOCUMENTS AND SETTINGS\ALL USERS\APPLICATION DATA\FARO\CAM2 MEASURE\EXCEL.

If you choose the Excel report, the name format will be partname~serialnumber.csv with the corresponding part name and serial number for the reported part. Choosing the SPC report will generate a file called "spcout.csv". Every report you generate using the SPC option will append to this file. The "spcout.csv" file can be imported and parsed using the most common SPC/database management applications.

To generate CSV output files, repeat the reporting exercise and choose Excel and/or SPC instead of Tabular.

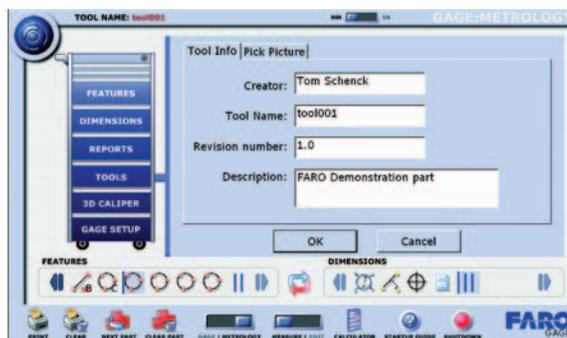
Save Custom Tool

Once you have created an inspection routine, you can save your custom tool for later use.

- 1 Select the TOOLS drawer in the Toolbox.
- 2 Select the CUSTOM TOOLS group.
- 3 Select the Save command.
- 4 Select the RUN button.



- 5 Type in your name, the name of the tool, a revision number, and a description of your part.



- 6 Select the PICK PICTURE tab and choose a picture, or use the default picture.



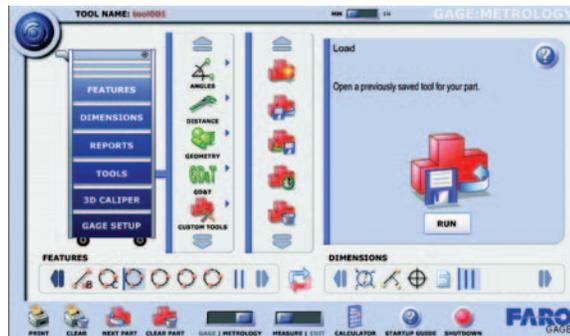
NOTE: Select the NAMES radio button to see the names of the pictures in a list.

- 7 Select the OK button to save the tool.

Load Custom Tool

Use the Load command to open a saved tool for your part.

- 1 Select the TOOLS drawer in the Toolbox.
- 2 Select the CUSTOM TOOLS group.
- 3 Select the Load command.
- 4 Select the RUN button.



You will have the option to save any existing tool.

- 5 Select a tool file.



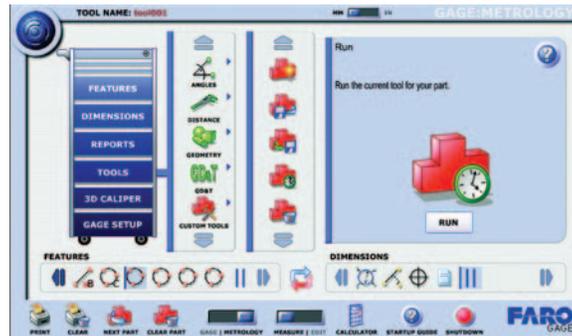
NOTE: Select the NAMES radio button to see the tools without pictures.

- 6 Select the OK button to load the tool.

Run Custom Tool

Use the Run command to reset a saved tool to the beginning, which will take you through the measurement routine to measure another part.

- 1 Select the TOOLS drawer in the Toolbox.
- 2 Select the CUSTOM TOOLS group.
- 3 Select the Run command.
- 4 Select the RUN button.





Contact Information

For Technical Support

World Wide Web site: www.faro.com

E-mail: support@faro.com

Telephone Number: 800.736.2771

For Sales Inquiries

Electronic Product Catalog on www.faro.com

E-mail: info@faro.com

Telephone Number: 800.736.0234, extension 2265

For Training or Technical Services

E-mail: training@faro.com

Telephone Number: 800.736.0234, extension 1111