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CHAPTER 1

Introduction to Coordinate Metrology

Understanding the CMM

We use a **coordinate system** to describe the movements of a measuring machine. The coordinate system, invented by the famous French philosopher and mathematician René Descartes in the early 1600's, lets us locate features relative to other features on a part.

A coordinate system is a lot like an elevation map where the combination of a letter along one edge of the map, a number along the other, and elevations shown throughout uniquely describes each location on the map. This letter/number/elevation combination is called a coordinate and represents a specific place relative to all others.

Another example is a street map with buildings shown (Figure 1). To walk to your hotel room at the Ritz Hotel from the train station (your origin), you walk 2 blocks along Elm street, 4 blocks on Maple and up 3 floors in the Ritz. This location can also be described by the coordinates 4-E-3 on the map, corresponding to the X, Y and Z axes on the machine. These coordinates uniquely describe your room and no other location on the map.

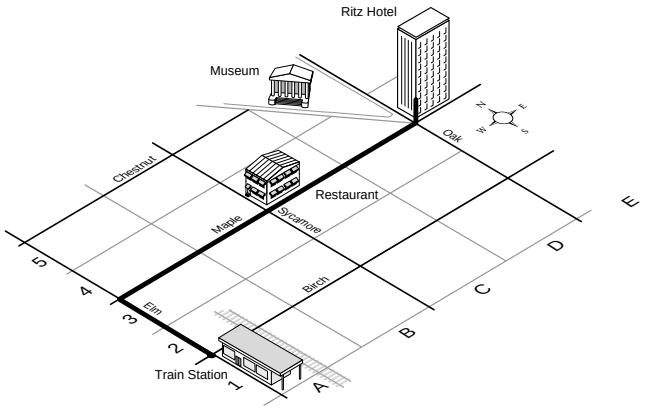


Figure 1

Understanding the CMM

A **coordinate measuring machine** (CMM) works in much the same way as your finger when it traces map coordinates; its 3 axes form the machine's **coordinate system**. Instead of a finger, the CMM uses a probe to measure points on a part (Figure 2). Each point on the workpiece is unique to the machine's **coordinate system**. The CMM combines the measured points to form a feature that can now be related to all other features.

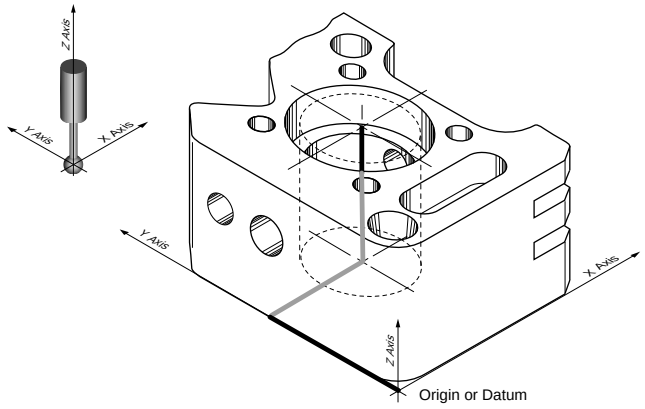


Figure 2

The Machine Coordinate System

There are two types of coordinate systems in the world of measurement. The first is called the **Machine Coordinate System**. Here, the X, Y, and Z axes (Figure 3) refer to the machine's motions. When viewed from the front of the machine, the X axis runs from left to right, the Y axis runs from front to back, and the Z axis runs up and down, vertically perpendicular to the other two.

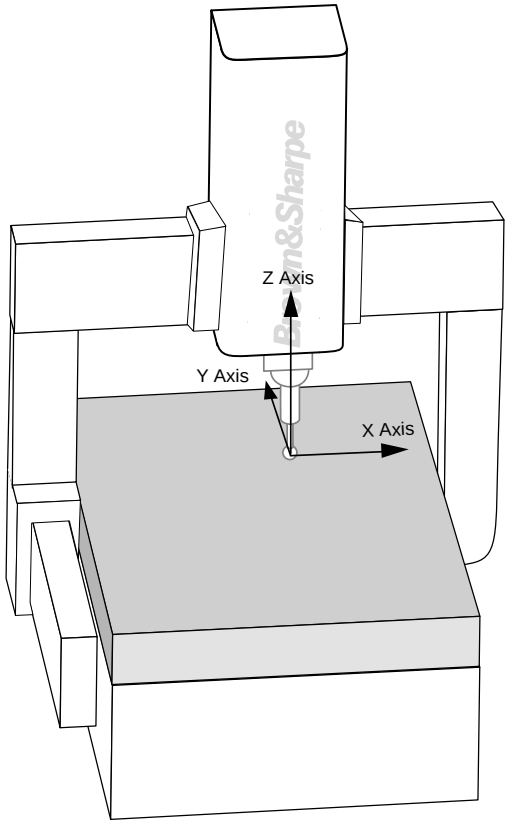


Figure 3

The Part Coordinate System

The second coordinate system is called the **Part Coordinate System** where the 3 axes relate to the **datums** or features of the part.

Before the introduction of computer software to coordinate measurement, parts were physically aligned parallel to the machine's axes so that the Machine and Part Coordinate Systems were parallel to one another. This was very time consuming and not very accurate. When the part was round or contoured, rather than square or rectangular, the measurement task was nearly impossible.

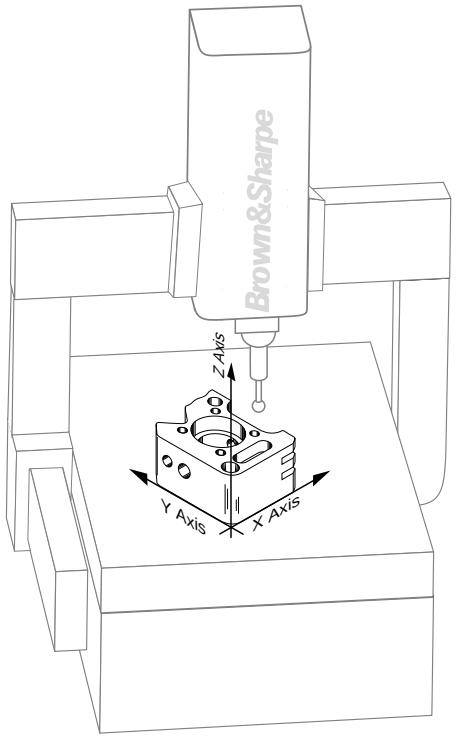


Figure 4

Alignments

With today's CMM software, the CMM measures the workpiece's **datums** (from the part print), establishes the **Part Coordinate System**, and mathematically relates it to the Machine Coordinate System.

The process of relating the two coordinate systems is called **alignment** (Figure 4). *W*ith a street map, we do this automatically by turning the map so that it is parallel to street (datum) or to a compass direction (i.e., north). When we do this, we're actually locating ourselves to the "world's coordinate system".

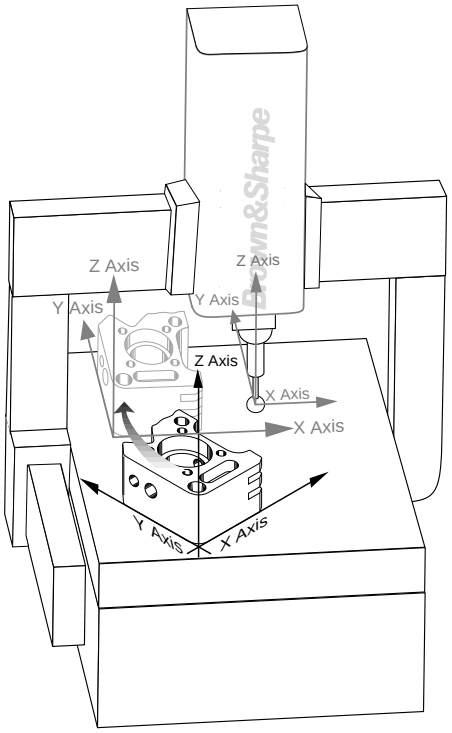


Figure 5

Datums

A **datum** is simply a location. We use datums as guides to tell others where we are or as directions on how to get to places. On the map, the Ritz Hotel is a datum. So are streets, the train station, the museum and the restaurant. Thus, by using an **origin**, datums, directions and distances people have all the information they need to get from one location to another.

For example, to get from the train station (origin) to the restaurant, you walk 2 blocks north on Elm Street (datum), take a right, and walk 2 blocks east on Maple (datum).

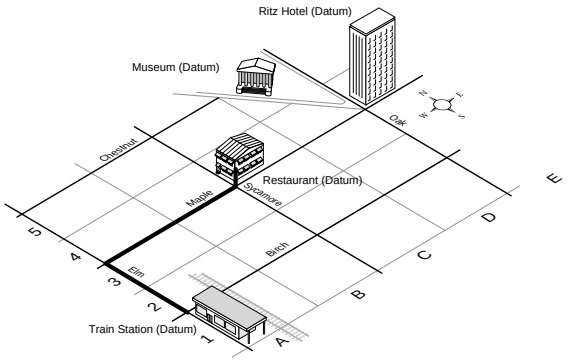


Figure 6

In metrology, a datum is a feature on a part such as a hole, surface or slot. We measure a part to determine the distance from one feature to another (Figure 7).

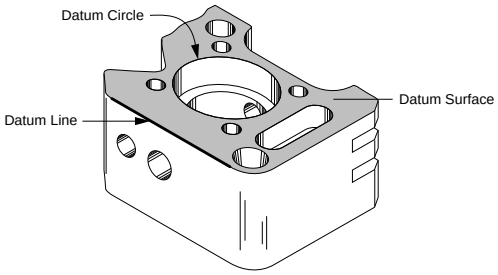


Figure 7

Translations

Suppose you need to know how far a specific feature of a part is from another feature (Figure 8). Take, for example, the distance to the centers of each of four holes from a central hole. To do this you would first measure the central hole, **translate** the **origin** to the center of this hole, and then measure each of the four surrounding holes. Moving the starting point (origin) of the measurement from its present position to another place on the part is called **translation.** The CMM does this mathematically when you request an alignment routine from it's geometric measuring software.

In terms of our street map, once you arrive at your hotel and decide to eat at a legendary restaurant on your visit to the city, you need to find it on the map. The hotel now becomes your new starting point, or **origin**. By knowing your location, you can tell by looking at the map that you will have to travel two blocks west along Maple Street to reach the restaurant (Figure 6).

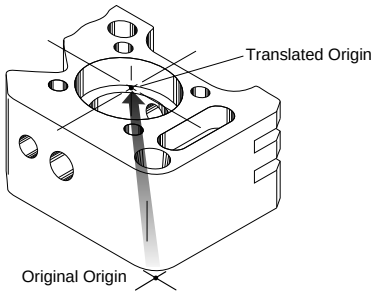


Figure 8

Rotations

Not all **datums** are at right angles to other datums. For example, looking at your street map (Figure 9), you see that the Museum is located on a street that's neither parallel nor at right angles to the streets the Hotel, Restaurant and Train Station are on. Thus to determine how far it is from the Hotel to the Museum, you have to first **translate** your origin to the Hotel and then **rotate** the key to be parallel to the street on which the Museum is located. Now you can easily measure the distance from the Museum to the Hotel.

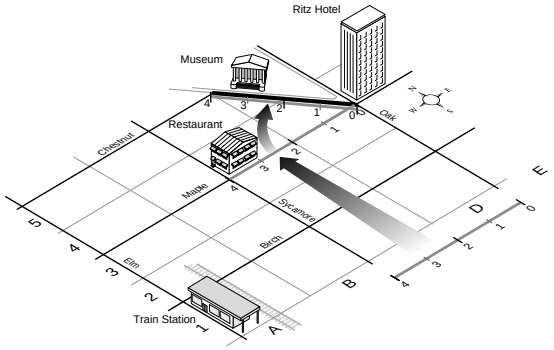


Figure 9

The exact same procedure applies to the part (Figure 10). The distance between the two holes on the part can be measured once the original origin is translated to the smaller hole and the part coordinate system is mathematically rotated 45°. Now both holes lie along the new Y axis and the distance can be calculated automatically.

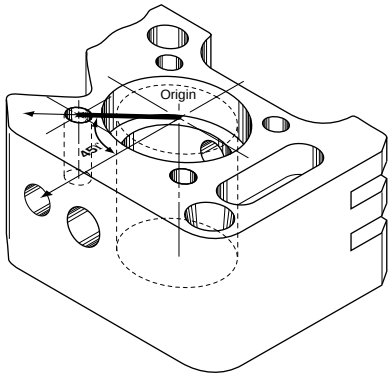


Figure 10

Measured and Constructed Features

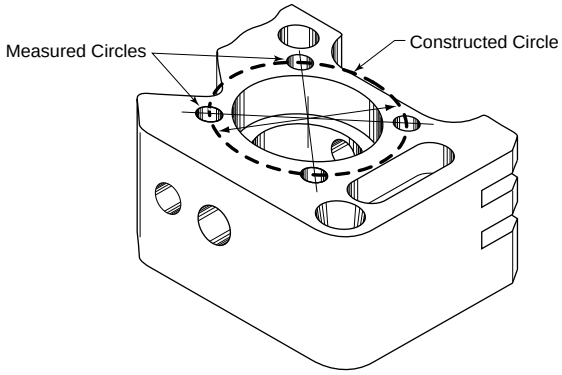
What’s the difference between measured and constructed features?

The vast majority of parts are made up of simple geometric elements created by machining or forming. These primary elements (points, lines, circles, planes, cylinders, cones, spheres) are called features.

When a CMM can measure these features directly, by probing the feature's surfaces, the features are referred to as **measured features**.

Other features, such as distances, symmetries, intersections, angles and projections, cannot be measured directly but must be constructed mathematically from measured features before their values can be determined. These are called **constructed features**.

In Figure 11 the "constructed circle" is constructed from the center points of the 4 measured circles.



Constructed Features

The relationships between features are critical to many manufacturing processes. For example, the constructed intersection point from two measured cylinders of an engine block can be used to determine how well other parts will fit together.

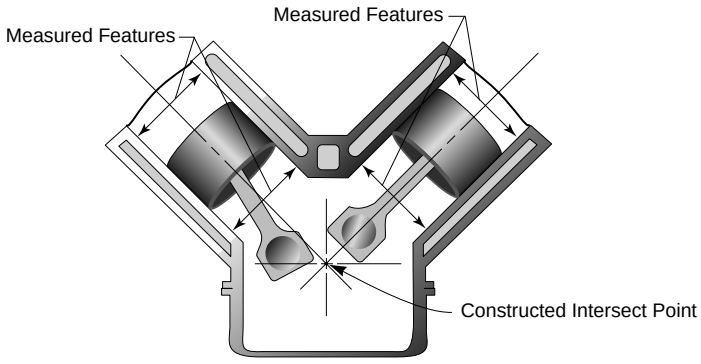


Figure 12

Volumetric Compensation

Although advanced manufacturing technology makes it possible to tolerance and make parts very precisely, imperfections still exist. Small as they may be, the fact that there are tolerances means that there are errors.

Coordinate measuring machines are no different from other products in this respect. While they are built to extremely tight tolerances, there are errors (roll, pitch, yaw, straightness, squareness and scale errors) in their structure that effect their accuracy. As manufacturing tolerances become increasingly tighter, it is necessary for CMMs to become more accurate.

The majority of the CMM's inaccuracies can be corrected automatically in the CMM's controller. Once all of the geometric errors of the CMM are measured (called error mapping), they can be minimized or even eliminated by powerful algorithms in the CMM's software. This technique is called **volumetric error compensation**.

By eliminating errors mathematically, you lower the cost of manufacturing and provide the customer more performance for their money.

For more information on how the RefleX system handles its volcomp files, see Section 11 of this manual.

Volumetric Compensation

Volumetric compensation or "volcomp" can be best understood in terms of the relationship between a map and a compass. If you want to sail to a particular location, you have to know its true direction from your current position (origin). A compass and a map are used determine your direction, or bearing. There is, however, a difference between true north and magnetic north. This difference is called variation and is caused by the offset between the true north pole and the magnetic north pole. Thus, to determine the true direction from one point to another, the variation between true north and magnetic north must be added or subtracted from the compass bearing.

In the map shown (Figure 13), the difference between true north and magnetic north (15½ at Brown & Sharpe Headquarters in RI, as of 1998), must be compensated for or a sailor would end up northwest of the intended goal and would run aground before reaching the final destination.

A coordinate measuring machine does a similar compensation automatically to remove the variations of the machine from the measurement.

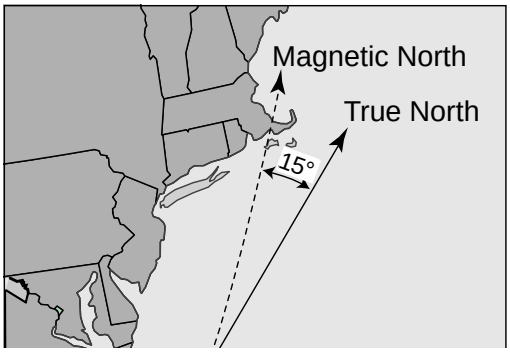


Figure 13

Projections

A **projection** is the reproduction of a part feature on another feature, such as projecting a circle or line onto a plane, or a point onto a line.

Projecting one part feature onto another can be compared with the creation of the traditional "flat" map of the world (Mercator projection). The flat map is made by projecting a globe of the world (sphere) (Figure 14), onto a plane (Figure 15).

Figure 14

Figure 15

Projections

In metrology, **projections** allow the operator to measure more accurately and to see how mating parts will eventually fit together.

The automotive industry often makes cylindrical measurements such as those found in engine blocks. By projecting a cylinder into the plane of the head, you can determine how the piston will fit into the cylinder and how that piston will fit the combustion chamber in the head.

A minimum number of three points is necessary to measure the diameter of a circle. But, if those points are not at the same distance from the top of the bore, the measured diameter will be shown as elliptical (Figure 16). To overcome this misrepresentation, the measurement data is projected onto a plane that is perpendicular to the centerline of the cylinder. The result is an accurate determination of the circle's properties.

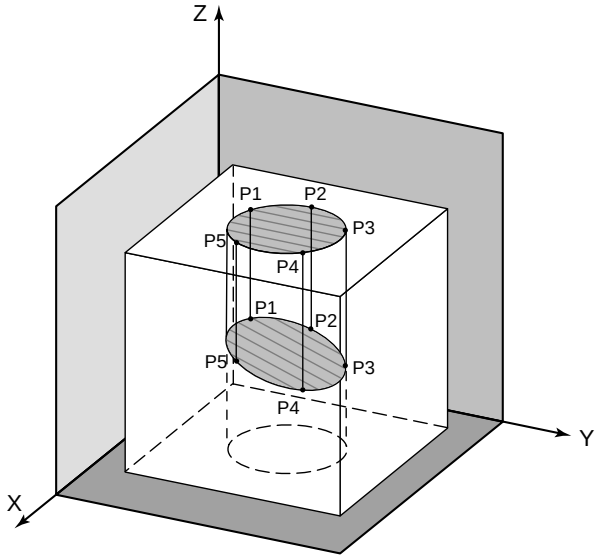


Figure 16

Tip Compensation

CMMs gather their data by touching the part with a probe (either a solid probe or an electronic touch trigger probe). Because it's the tip's circumference that touches the part, the probe's center and radius must be known prior to measuring. This is done by measuring a very accurate sphere, called a qualification sphere.

Once this tip information (center location and radius) is known, the system will go back and add or subtract 1 tip radius from the points after a feature has been measured.

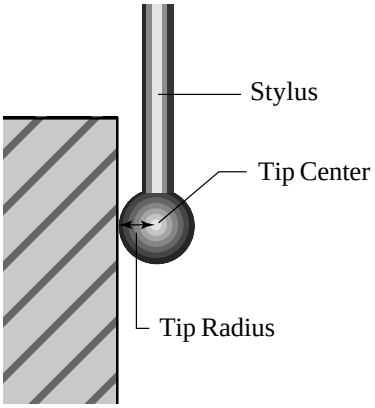


Figure 17

Effective Probing Techniques

By using effective probing techniques when inspecting a part, you can eliminate many common causes of measurement error.

For example, probe measurements should be taken perpendicular to the workpiece surface whenever possible (Figure 18). Touch trigger probes used on coordinate measuring machines are designed to give optimal results when the probe tip touches the workpiece perpendicularly. Ideally, you should take hits within ±30° of perpendicular to avoid skidding the probe tip. Skidding produces inconsistent, non-repeatable results.

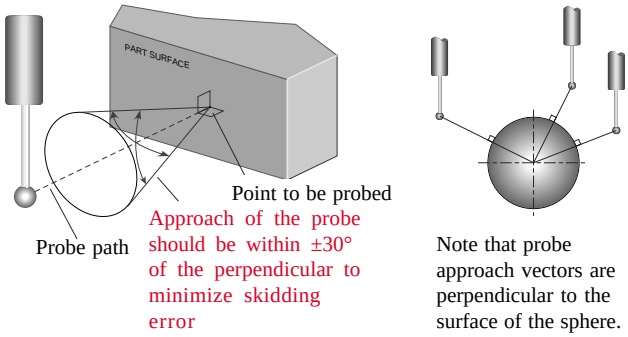


Figure 18

Probe hits taken parallel to the probe body, that is, along the axis of the stylus, are not as repeatable as those taken perpendicular to the axis (Figure 19).

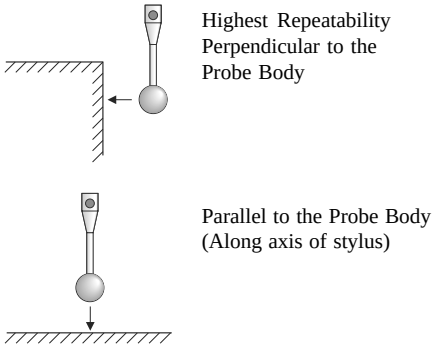


Figure 19

Effective Probing Techniques

Probe hits that are neither perpendicular nor parallel to the probe body (Figure 20) produce results that are even less repeatable than those taken parallel to the probe body. You should avoid taking probe hits parallel to the stylus and at an angle to the probe body, since they will produce large errors.

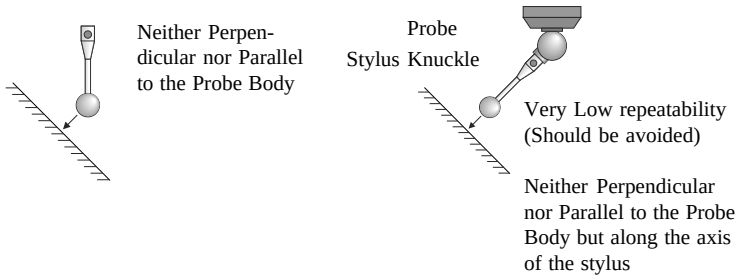


Figure 20

Shanking is another cause of measurement error (Figure 21). When the probe contacts the part with the shank of the stylus and not the tip, the measuring system assumes the hit was taken in a normal manner and large errors will occur.

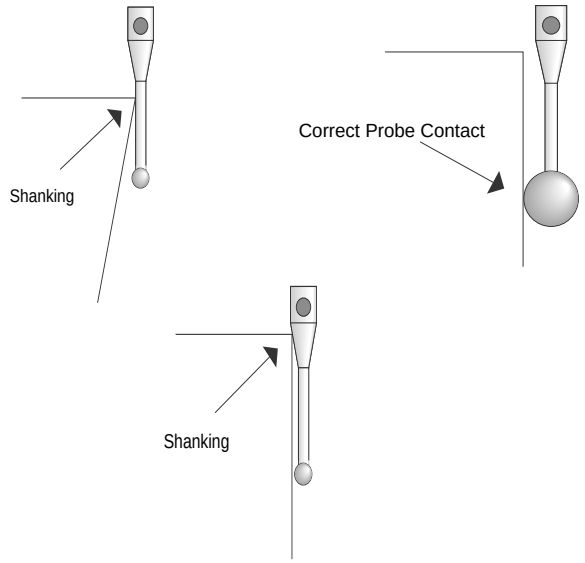


Figure 21

Effective Probing Techniques

You can reduce the likelihood of shanking by using a larger diameter tip. This will increase the clearance between the stem and the part's surface (Figure 22). In addition, the larger the tip, the less the measurement is effected by the part's surface finish because the contact point is spread over a larger area. However, the largest tip that can be used is limited by the size of the smallest holes to be measured.

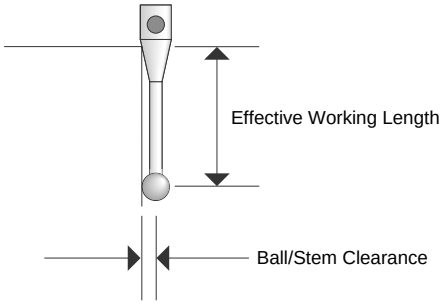


Figure 22

Measurement points taken with a touch trigger probe are recorded when the stylus is deflected enough to break its internal electrical contacts. The longer the probe tip extension, the larger the pre-travel error. In addition, longer probes are not as stiff as shorter ones. The more the stylus bends or deflects, the lower the accuracy. When you wish to obtain optimum accuracy and repeatability, long styli and extensions should be avoided.

CHAPTER 2

Startup Tutorial

Startup Tutorial

Working with the “Smart” Cards
Welcome to the startup tutorial. The best way to learn the RefleX software is to try it. Before proceeding we suggest that you read chapter 1: “Introduction to Coordinate Metrology”. Although it may seem like there are many steps to starting the system, most experienced users can do this quite quickly.

1. Turn the system off via the switch located at the front left corner of the controller.

Controller: card installation location

2. If currently inserted, remove the two “smart cards” from the controller by pressing the eject buttons located at the front of the controller.

3. The card on the left in the picture below is the upper “software” card where the system’s software resides. The card on the right is the lower “storage” card, where your programs are stored.

Storage Card *Software Card*

4. Flip the software card over and note the version number on the back. Reinsert the storage card in the bottom, and the software card in the top.

5. Turn the RefleX controller on. If this is a DCC system, turn the machine’s controller (FB-PC) on first, then the RefleX controller.

Startup Tutorial

Loading the Software

6. For the first 10 seconds, the system's screen may flicker as the controller performs a self-diagnosis. This is completely normal. After successful completion of this self-diagnosis, the system will begin to load the RefleX software. This software loading process will take an additional 1 minute.

Optional Air Saver

7. If the self-diagnostic test fails, the "Frown face" (or the "skull & crossbones" in older controllers) icon appears. Normally this means that a hardware error has occurred inside the controller. However, there are other causes. See Chapter 11 "Troubleshooting" for more information.

"Insert Card" icon

TIP: With multiple storage cards, you may "hot swap" the lower cards. That is, remove and insert cards while the power is on. These additional storage cards may be purchased through Brown & Sharpe only!

"Frown Face" icon

8. If the system cannot load the software, the "Insert Card" icon will appear. This is often caused by accidently swapping the software and storage cards. Fortunately, this will not damage the controller.

9. Ten seconds into the software loading process, the copyright screen appears. Notice the software version number located in the upper left corner. Notice also, the web address in the center of the screen. This support site contains information such as release notes, frequently asked questions, and supplemental documentation. In addition, you can always send e-mail to reflexsupport@us.bnsmc.com. If your system is equipped with an Air Saver, the air will be turned on at this time.

Copyright Screen

Startup Tutorial

The Language Screen

10. The Language Screen appears next and a tune is played. The languages currently supported are: English, German, Italian, French, Spanish, Portuguese, Swedish, Finnish, Polish, Dutch, Danish, Czech, Simplified Chinese, Traditional Chinese, Japanese & Korean. For a unilingual environment, you can disable this screen in page 1 of the system options. If disabled, the system proceeds to the home screen.

Select down - Moves the highlighted selection down.

Select right - Moves the highlighted Selection right.

Done - Accepts the current selection and proceeds to the next screen.

Language Screen

11. Try moving the Zmouse, located on the Z rail, up and down. Notice how moving the Zmouse highlights different buttons, or softkeys, on the screen.

Abort

Select
(Up Down)

Press Selected
Softkey
(often 'Done')

Zmouse

TIP: You can operate virtually the entire system from the Z-Mouse. Note: On a desk mouse, these buttons are reversed.

12. Select the desired language and press the Done softkey.

Startup Tutorial

The Volcomp Screen

Important: Once the (upper) software card has been installed, there is no reason to remove it, except in the case of a software update.

13. When using machines other than DCC or Arms, it is possible that a volcomp problem screen may appear. If this screen is displayed, consult the Troubleshooting, Chapter 11 before proceeding!

Volcomps Mismatch Screen

Important: Never swap software cards between systems. Because the volcomp file is stored on the software card, as well as the controller, moving the software card to a new controller can cause problems which will require a service call!

Tip: It is not necessary to power down the system between measurement jobs. The system uses less electricity than most household light bulbs!

Startup Tutorial

The Home Screen

Serial Number - For non-DCC and non-arm systems, this number must match the serial number of the machine. If it does not, contact your local service representative, as accuracy will be affected.

System Options - This area, described in Chapter 10, allows you to set options such as volume, contrast, machine type, etc.

Service Utilities - For service personnel only in the event of a problem.

Machine - The correct machine must be chosen in the system options. If it is not, part drawing scaling will not work correctly.

Done - Tells system the machine is homed and to move to the next screen.

14. The next screen to appear will be the home screen which prompts you to perform the homing process. As shown on the screen, move the machine to the upper left front position. Locking the XYZ airlocks is recommended at this point. Because the Z-Mouse will be hidden inside of the Z-rail, the Done button must be pressed on the controller’s keypad.
14. The next screen to appear will be the home screen which

prompts you to perform the homing process. Stand in back of the machine and move it to the upper, left, back position. Locking the XYZ airlocks is recommended at this point. Press the done softkey to continue.

14. The next screen to appear will be the home screen which prompts you to perform the homing process. Rotate all of the arm's joints until all red LEDs turn off. Press Done to continue.

14. The next screen to appear will be the home screen which prompts you to perform the homing process. Press and hold the "Mach. Start" button on the jog box until the green light turns on. Press the "Go" Softkey when ready. The "Homing In Progress" screen will be displayed as the machine moves around the volume searching for the home position.

XYZ Air Locks

Go

Important: Failure to properly home the machine will result in reduced accuracy as well as improper part drawing scaling.

Startup Tutorial

Probe Qualification: Select a Probe

Next, unless a "startup probe" has been saved previously, the system will prompt you to qualify a probe. Now we will simply qualify a Touch Trigger Probe, or TTP, but you can refer to Chapter 5, "The Measurement Mode" for more information. The "Select Probe Type" screen, shown below, is the first screen in the probe qualification sequence.

Abort - Returns you to home screen.

Scroll up - Moves highlighted selection up.

Scroll down - Moves highlighted selection down.

Cycle option - Allows you to change option.

Done - The current probe settings are accepted and the qualification process will continue.

Select Probe Screen

15. Leave all settings at their default values (as shown) and select the Done softkey.

16. If you have not already done so, clamp (bolt) the qualification sphere to the table as shown below. Pick a spot where the qualification

sphere will not interfere with measuring parts.

Qualification Sphere Location

Startup Tutorial

Probe Qualification: Locating the Sphere

17. If currently inserted, remove the probe from the end of the Z-rail. Place the cup in the bottom of the Z-rail on the qualification sphere as shown. At this point, it is recommended, that you lock the axes with the air locks. Press the Done softkey to continue.

Remove Probe Screen

Important: Make sure the TTP probe displayed in these screens matches the one you are actually using. If it doesn't, be sure to switch probe types in the system options, page 4.

Important: To make the probe qualification process more efficient, the "Remove Probe" screen is not shown in subsequent qualifications. Since the system knows where the qualification sphere is located, there is no need to tell it the sphere's location again. Because of this, if the sphere is moved, you must reboot the system and locate the sphere again. Failure to follow this procedure will result in faulty probe offset values.

Two TTPs: The TP-ES (left) and the TP-MIP (right)

Startup Tutorial

Probe Qualification: Inserting a Probe

18. Reinsert the probe as shown in the screen. The probe locking mechanism must be secure. Use a stylus key to tighten the stylus securely. Press the Done softkey to continue.

Insert Probe Screen

Important: Do not use paper clips in place of stylus keys. Stylus keys are designed to bend before high torque forces break probes. Replacing a stylus key is always preferable to replacing a TTP.

Probe Locking Mechanism

Using a Stylus Key

Startup Tutorial

Probe Qualification: Measuring the Sphere

Important: When taking a point, do not overtravel the probe. Probe damage can occur after just a couple of millimeters of travel!

Measure Sphere Screen

19. Begin taking points as shown above. Notice the approach vectors. They are perpendicular to the surface of the sphere. The lengths of the approach vectors have been exaggerated for demonstration purposes. Whenever measuring any feature, always allow at least 1 probe radius of approach vector. After taking the first point, the “Measuring Qualification Sphere” screen is displayed. After taking 12 points (27 on arm machines), press the Done softkey to continue. The Done button will remain dimmed, or disabled, until at least 4 points are taken.

Abort

Note: Because the system knows that we are about to measure a sphere here, only 4 points are required. Later, during normal measurement operation, the feature recognition engines require at least 10 points for spheres.

Clear Last Hit
Done

Tip: Use the “Clear Last Hit” softkey to clear the previous hit as opposed to using the Abort key to clear all hits.

Startup Tutorial

Probe Qualification: The Probe Summary Screen
20. At this point, the “Probe Summary” Screen will be displayed. Check the diameter and form error. Try to get below 10 microns form error for your tip and within 5 microns on the diameter. If your values are too high, press the “Remeasure Sphere” softkey and try again. Otherwise, press the Done softkey. If this is a DCC machine, the system will now go back and remeasure the qual sphere in DCC mode.

Tip: If you are planning on using the same probe for multiple sessions, you may want to save a “startup probe”. To do this, go to the second page of the System Options and set the “Startup Probe” from “Qualify” to “Saved”.

Remeasure Sphere

Qualify Additional Tip
Done

Probe Summary Screen

Troubleshooting: If your probe's diameter is consistently high or low, it could be because the qualification sphere's diameter is set incorrectly. Check the diameter stamped on the side of the sphere. Then check that the "Qual Sphere Dia", found in page 2 of the System Options, is set correctly.

Troubleshooting: If you are consistently getting "Can Not Solve" errors at this screen, it is probably because the system is not seeing movement in an axis. See chapter 11 "Troubleshooting" for more information.

Tip: When qualifying a disk probe, follow the same procedure as describe previously, being careful not to shank the probe. Be sure to move slightly in Z also. Otherwise the system will compute a circle instead of a sphere, resulting in a "Can not solve" error screen.

Good
Bad

Startup Tutorial

The System Modes Screen

21. At this point, the "System Modes" Screen is displayed. The first 5 softkeys represent different measuring modes. If you do not see all the modes shown here, it is because they have been disabled in the System Options, page 5.

Note: The Dial Indicator and XYZ Counters/Scribe mode will remain dimmed unless a hard (ball) probe is qualified.

System Modes Screen

Tip: Turn off the modes you don't use. This will help alleviate confusion when starting the system.

Tip: The "System Startup" button, located below the "Help" button will bring you back to the "System Modes" screen. If the system is in a state unknown to you, it will help you get where you want to be. This feature helps you to simply "Step up and measure". Note: If the system has not been homed, this button will bring you to the "Home" screen.

The System Startup Button
The Help Button

Startup Tutorial

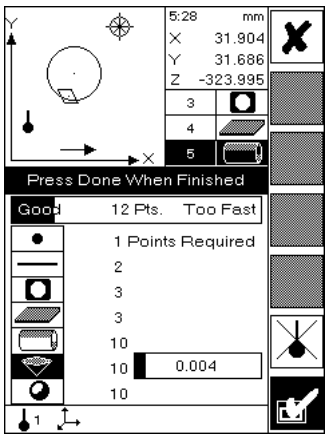
System Modes Screen

The Measurements Mode

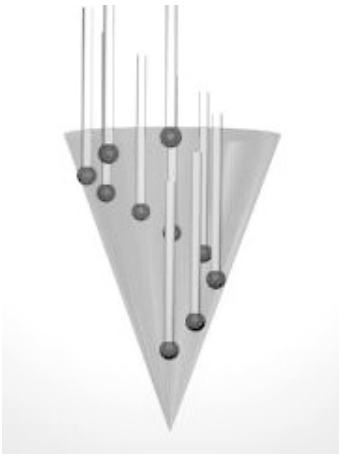
Measuring a Cone

How to measure a cone:

- Unlock all 3 machine axes.
- Approach perpendicularly to the surface of the cone.
- When the probe comes in contact with the surface, you will hear a beep. You will also see the probe light go out and the "Touch Trigger Preview Screen will appear.
- Take at least 10 points at different depths. Do not overtravel the probe. The "TTP Preview Screen" should show a cone after 10 points have been taken.
- Press the Done softkey or the right button on the Z-Mouse to continue.
- Lock the machine axes.

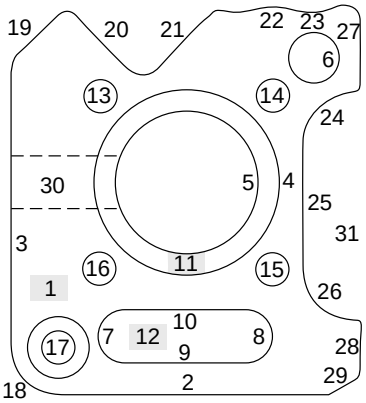


TTP Preview Screen



One possible method of measuring a cone

25. Measure cone #17 at the lower left of the demo block as shown.



CHAPTER 4

Alignments Tutorial

Alignments Tutorial

This Measurement mode lab is a continuation of the "Measuring Features Tutorial". You are already in the measurement mode with the RefleX demo block clamped down and a single tip TTP qualified. The focus of this lab is to get you comfortable with the alignment function.

Tools

1. Begin by resetting to clear features measured during Measuring Tutorial. Press in succession the softkeys "Tools", "Reset Measurement Mode" and "Done".

Reset Measurement Mode

Line Line Intersect Alignment

It is rarely possible to manually align a part exactly to a machine. However, a part can be aligned by measuring features and assigning datum designations to those features (A, B, C).

> **Important:** It is important to remember the Datum A, B, C sequence which you will use 99% of the time. Datum A, C, B, is also allowable. All other variations of the datum ABC sequence will result in inaccurate measurements!!!

Datum A

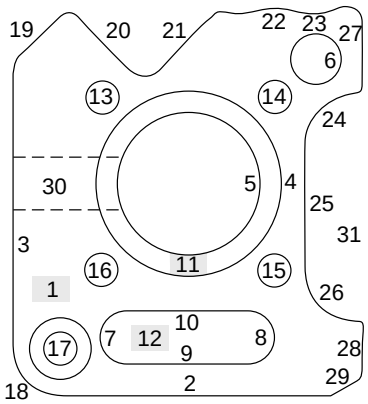
2. Measure plane #1 on the top of the demo block as instructed in the Measuring Features Tutorial. Press the "Datum A" softkey. The part is now "leveled"!

Datum B

3. Measure line #2 on the front of the demo block. Press the "Datum B" softkey. The part is now "clocked"!

Datum C

4. Measure line #3 on the side of the demo block. Press the "Relationships" softkey to display the intersection point. Press the "Datum C" softkey. The origin is now set and the alignment is complete.



Alignments Tutorial

5. With the alignment complete, move the probe tip to the upper, left, front corner of the part. Notice the counters are near 0.000, 0.000, 0.000. If the part had been clamped at an angle, you would see that as you move the probe along the front side of the demo block, the X axis counter would increment while the Y axis would remain unchanged.

> **Tip:** For more complicated parts, you can use the power of alignments to your advantage. While this part's alignment is easy to visualize, parts with compound angles and odd datum surfaces are not. If the system can measure a part in one orientation, it can also measure it in a different orientation. If you are having trouble writing a program, align the part so it is easy to visualize. When you have the desired results, rewrite the program for the orientation that facilitates part clamping.

Another alignment:
This time align the block by setting datum B on the line between two holes. Set the origin at the center of a bore.

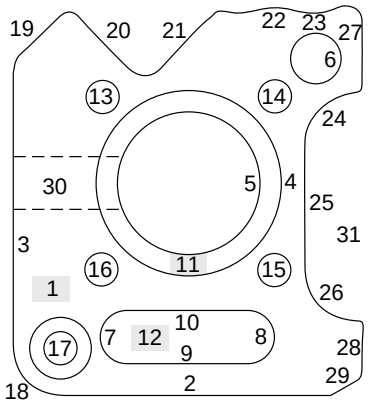
6. Reset the measurement mode as instructed in step 1.

7. Measure the top surface of the demo block again as instructed in step 2.

8. Measure circle #16. Measure circle #15. Press the "Relationships" softkey and scroll to the "Line Through Centers" screen. Press the "Datum B softkey".

9. Measure the center circle #4. Press the "Relationships" softkey to toggle back to single feature mode. Press the "Datum C" softkey. The alignment is complete.

> **Note:** Under normal circumstances, there is no need to save the datum. The current alignment is active until you do another datum operation. Most of the time, the only reason for saving and recalling a datum is to transfer an alignment to another measuring mode, such as the Dial Indicator Mode.



Alignments Tutorial

> **Note:** For more information on how a datums are used with a particular feature, see Chapter 5.

Tools

Construction

Symmetries

Symmetry Point

Datum

Translate

Translating an alignment:
Some part drawings have features dimensioned from a constructed feature, such as a symmetry point. Because this point cannot be measured directly, it must be constructed by measuring two other features. To translate the alignment to this symmetry point, use the "Translate to Last Feature" function where the last feature is the symmetry point.

Other part drawings have features offset from a particular point. For example, 1 mm in from the edge of the part. To translate the alignment to this point, use the "Translate by Offset" function.

10. To construct a symmetry point between the two small circles (#16, #15) just measured, press the "Tools" softkey, the "Construction" softkey, the "Symmetries" softkey, and the "Symmetry Point" softkey. Select features 3 and 4. Press the Done softkey.

11. To translate the alignment to this symmetry point, press the "Tools" softkey, the "Datum" softkey, and the "Translate" softkey. Leave the X, Y, and Z axes set to "Last Feature". Press the Done softkey. The origin has moved to the centerpoint between the two circles.

Alignments Tutorial

Rotating an alignment:
Unlike the demo block, some parts are aligned at specific angles. For example, a part must be aligned 45 degrees from an edge. To do this use the "Rotate by Angle" function. For the example, align the block 45 degrees from the centerline between the two bores (Our old datum B).

12. To rotate the alignment, press the "Tools" softkey, the "Datum" softkey and the "Rotate" softkey. Leave the "Rotate About" axis set to "Z". Enter a rotation angle of 45 degrees and press the Done softkey. Check the alignment. As you move the machine in a 45 degree angle, only the X counters should change while the Y counter remains unchanged.

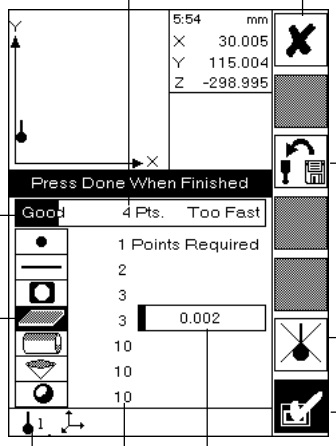
> **Note:** Instead of a specific angle, such as 45 degrees, some drawings specify two rotation offsets such as 2 mm and 3 mm. In this case you do not have to calculate the angle. The system will do it for you! Leave the rotation angle blank and key in the offsets in the "Value" fields below. After entering the second offset, the system will display the rotation angle.

CHAPTER 5

Measurement Mode

Measurement Mode

The TTP Preview Screen



Total Number of Points
Shows the number of points taken.

Abort Current Measurement
All measurement points will be deleted.

Velocity Bar Speedometer
Shows the probe velocity. You should keep it in the "Good" area!

Recall Tip
Allows the operator to switch to another tip on a MIP.

Current Feature
The arrow points to the feature type you are currently measuring. The system determines the type of feature based on the measurements you are taking. Remember that in order to measure a feature of a given type, you must take at least the minimum number of points for that feature.

Delete Last Measurement
The last measurement point will be deleted.

Done With Current Measurement
The system will determine automatically the type of feature you just measured and display the Measurement results Screen.

Status Bar
Shows the various icons that tell you about the status of the system. (Additional Icons may be displayed.)

Minimum Points Required
Shows the minimum number of points required in order to solve the desired feature.

Form Error
Shows the form error as you take measurements of the feature. The form error is represented as a black bar ranging from 0 to 50. If the form error is greater than 50 microns, the bar will be completely black.

Measurement Mode

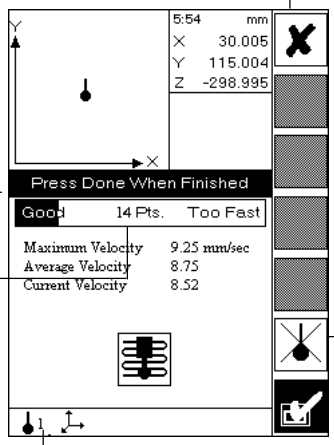
The Hard Probe Scanning Screen

Measurement Speedometer
Shows the velocity of the probe as it moves along the surface of the feature. Try to keep the bar in the "Good" area!

Abort Current Measurement
All measurement points will be deleted.

Total Number of Points
Shows the number of measurement points you have taken. Remember you must take at least the minimum number of points per feature type as follows:

Feature	Points Req.
Point	1
Line	2
Plane	3
Circle	3
Cylinder	10
Cone	10
Sphere	10



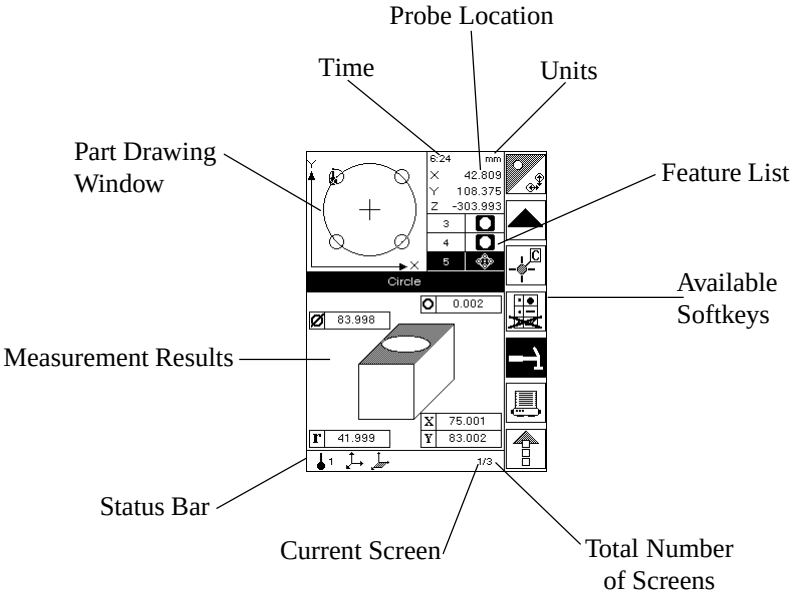
Delete Last Measurement
The last measurement point will be deleted.

Done With Current Measurement
The system will determine automatically the type of feature you just measured and display the Measurement results Screen.

Status Bar
Shows the various icons that tell you about the status of the system. (Additional Icons may be displayed.)

Measurement Mode

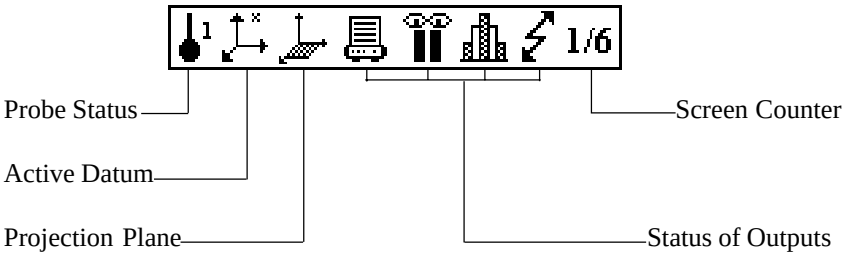
Measurement Results Screen
After a measurement has been taken, the system determines the feature's properties and displays them as shown below.



Current Screen	The identification number of the current screen.
Total Number of Screens	The total number of possible screens. Use the right arrow softkey to view the other possible screens.
Probe Location	The XYZ coordinates of the probe's center. This location is also shown graphically as the "flying probe" in the Part Drawing Window.
Feature List	This list displays the current and previous features. Only the last 100 features are saved for playback.
Part Drawing Window	This window displays a drawing of the measured features. The system automatically scales this drawing, based on the selected machine type, to fit the area.
Status Bar	This area represents the current status of the system's probes, datums, etc.
Measurement Results	The computed results of a measured feature, such as diameter, form error, or true position, are displayed.

Measurement Mode

The Status Bar
The Status Bar displays information about the current state of the system.



Probe Status Indicates the current active probe / probe tip. The probe status icons are:

1	Hard probe, or TTP tip number 1 is currently active. Up to 9 TTP tips may be qualified.
	Edge probe with zero diameter
	Tapered probe
	Optical Probe

Datum Status Indicates the current datum system. The datum status icons are:

	No datum system active. The system is using the machine coordinates.
*	The datum system has been modified but not saved.
1-9	Up to 9 datum systems can be created. These systems can be saved and recalled within the same inspection.

Measurement Mode

The Status Bar

Projection Plane Indicates the plane into which the feature was projected.


The feature was projected into the Top (XY) plane


The feature was projected into the Side (YZ) plane


The feature was projected into the Front or Back (ZX) plane

Output Status Indicates the status of output devices. Once a block is sent to an output device, selecting it again will disable the output during the playback mode. The output devices are:


Output to printer


Output to internal statistics


Output to serial port


During playback, pause to view measurement results.

> **Note:** These outputs are configured in page 3 of the system options. See section 10-11 for more info.

Screen Counter Displays the current screen, as well as the total number of possible screens.

Feature List Blocks

After a feature has been measured, the system assigns it a sequential number and stores it in the feature list. The system also stores other functions such as probe qualification and datums manipulations in the feature list. A maximum of 100 program blocks are stored for playback. After the 100th block, you will still be allowed to continue measuring, but, if you decide to save this program, only the last 100 features will be stored.

Measurement Mode Softkeys

After a feature has been measured, the system will display various results screens. These screens have the following softkeys available:

Single Feature

Single Feature Display Mode
When this softkey is toggled to "Single Feature", only the results of the previous measured feature are displayed.

Relationships

Relationship Display Mode
When this softkey is toggled to "Relationships", the calculated results between the previous 2 features are displayed.

Scroll Up

Scroll Up
This softkey lets you display the results of previous features by scrolling back through the Feature List.

Next Screen

Next Screen
This softkey brings you to the next available result screen. Notice the status bar's screen counter increment as this softkey is pressed.

Tolerance

Tolerance
When this softkey is pressed, the system displays a screen for entering nominal and tolerance information.

Output

Output
This softkey can do multiple operations: Print (shown), serial out, send to internal statistics, playback stop, or any combination of these 4 options.

Lower Menu

Lower Menu
When this softkey is pressed, you are brought to the lower result screen menu.

Upper Menu

Upper Menu
When this softkey is pressed, you are brought to the upper result screen menu.

Tools Menu

Tools Menu
This softkey displays the system's "Tools" menu. Operations such as constructions, probe qualifications, and Relationship between 2 non-sequential features can be executed from this menu.

Note: For more information about Measurement Mode softkeys, see Chapter 3's Measurement Mode Tutorial.

Measurement Mode Softkeys

Change Feature Type

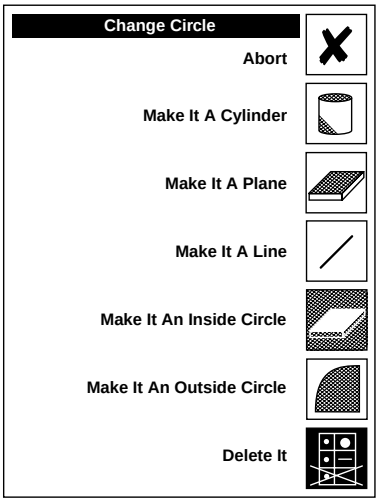
Change Feature Type

The Change Feature Type softkey allows you to override the system's feature recognition results for the last measured feature. For example, the system solves the measured feature as a circle when the operator really meant for the feature to be a cylinder.

The following table summarizes the features that can be changed into other features:

	Line	Circle	Plane	Cylinder	Cone
Line		X	X		
Circle	X		X	X	
Plane	X	X			
Cylinder		X			X
Cone	X	X	X	X	
Sphere			X		

When the Change Feature Type softkey is selected, the system displays a screen similar to the following:



Measurement Mode Softkeys

Set Level

Set Level: This softkey creates new reference plane (Datum A) and corresponding major and minor axes from the measured features.

Feature Type	Description
Any Point	Because a point has no direction component (vector), this option is disabled.
Any Line*	For a line, this softkey rotates the reference plane (Datum A) to the line's perpendicular. Also, the origin is projected into the new reference plane.
Plane	For a plane, this softkey rotates the Datum A to the measured plane. Also, the origin is projected into the new reference plane.
Circle	Because a circle has no direction component (vector), this option is disabled.
Cylinder	For a cylinder, this softkey rotates the reference plane (datum A) to the plane perpendicular to the cylinder's centerline. The origins are also translated to the cylinder's pierce point.
Cone	For a cone, this softkey rotates the reference plane (datum A) to the plane perpendicular to the cone's centerline. The origin is also translated to the cones apex.
Sphere	Because a sphere has no direction component (vector), this option is disabled.

* Note: For a measured line, the level (third axis zero point) is set at the centroid of the points taken to create the line. Setting a known origin (datum C) is suggested.

Measurement Mode Softkeys

Set Axis

Set Axis:
This softkey rotates the current datum system to the current measured feature (Datum B). The datum axis closest to the measured feature is rotated. The general direction (sign) of the datum axis is not changed.

Feature Type	Description
Any Point	This option is disabled because a point does not have a direction component (vector).
Line	This softkey projects the line into the current Datum A, then rotates the closest datum axis to be parallel with it.
Plane	This softkey projects the line perpendicular to the plane into the current Datum A, then rotates the closest datum axis to be parallel with it.
Circle	This option is disabled because a circle does not have a direction component (vector).
Cylinder	This softkey projects the cylinder's centerline into the current Datum A, then rotates the closest datum axis to be parallel with it.
Cone	This softkey projects the cone's centerline into the current Datum A, then rotates the closest datum axis to be parallel with it.
Sphere	This option is disabled because a sphere does not have a direction component (vector).

Measurement Mode Softkeys

Set Origin

Set Origin:
This softkey translates the origin (Datum C) of the datum system as follows:

Feature Type	Description
Any Line or Plane	Because there is no repeatable single point created by a line or plane, this option is disabled.
Measured Point	Translates the origin to the point's tip compensated location.
Constructed Point	Translates the origin to the point's location.
Point Measured with Tapered Probe	Translates the origin to the point's location.
Circle	Translates the origin to the circle's center.
Cylinder	Translates the origin to the cylinder's pierce point.
Cone	Translates the origin to the cone's apex.
Sphere	Translates the origin to the sphere's center.

Measurement Mode Softkeys

Delete Block

Delete Last Block
This option deletes the last program block. The block can be a measured feature or a system function. When you delete a non-feature block, the system restores the previous block values as follows:

Block Type	Operation
Any Feature	Feature is deleted
Probe Qualification	Qualification file is cleared
	Probe from last block is recalled
Recall Tip	Probe/Tip from last block is recalled
Tapered Probe	Probe from last block is recalled
Save Datum	Saved datum is cleared
	Recall datum from previous block
Recall Datum	Recall datum from previous block
New Level	Recall datum from previous block
New Axis	Recall datum from previous block
New Origin	Recall datum from previous block

Store Relationship

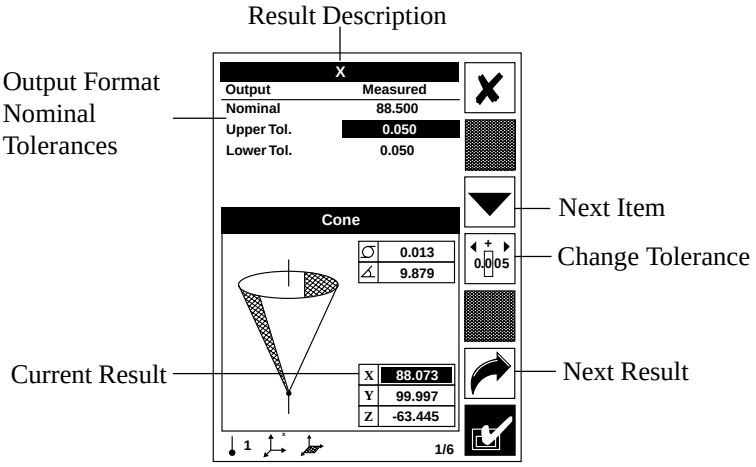
Store Relationships
This option is only available when the current displayed relationship creates a feature. The relationship is stored at the end of the feature list. The following are the relationships that create a feature:

Relationship	Description
Point/Point	2D Line & Midpoint
Line/Line	Intersection Point & Midpoint
Line/Plane	Intersection Point
Line/Circle	Intersection Points
Line/Cylinder	Halfway Point
Line/Cone	Halfway Point
Plane/Plane	Intersection Line
Plane/Circle	Intersection Points
Plane/Cylinder	Pierce Point
Plane/Cone	Pierce Point
Plane/Sphere	Intersection Point
Circle/Circle	2D Line & Intersection Points
Circle/Cylinder	2D Line
Circle/Cone	2D Line
Cylinder/Cylinder	Halfway Point
Cylinder/Cone	Halfway Point
Cone/Cone	Halfway Point
Cone/Sphere	3D Perpendicular Line

Measurement Mode

Tolerance

Tolerancing Results
To tolerance a feature result, nominals and tolerance values must be entered in the tolerance screen shown below.



The output choices are as follows: "Measured" (default), "Full", "Tol. Band", "Out of Tol.", "None". Each choice changes the display on the screen, as well as the "Print Format" style printout / serial output. When this value is set to "None", that result disappears from the screen and will not be printed or sent out of the serial port.

The softkeys available in the tolerance screen are as follows:

Abort

Abort
The system discards the changes made in the tolerance screen and returns you to the Result screen.

Next Item

Next Item
This softkey advances the highlight to the next item (Output, Nominal, Upper Tol., Lower Tol.).

ISO Tolerance

ISO Tolerance Table
This softkey is only available when entering tolerance information for circle or cylinder diameters. The system displays ISO Tolerance Codes and Grades based on the nominal size of the circle or bore and whether the measurement is internal or external (bore or pin).

Next Result

Next Result
This option advances the highlight to the next result.

Measurement Mode

Cycle Option

Cycle Option
In the tolerance screen, the cycle option softkey is used to choose the desired tolerance type. Below are examples of the 5 tolerance types in "Print Format:"

Measured: ==> Circle (1) ..: Circle Diameter 15.018	**Tol Band:** ==> Circle (1) ..: Circle Diameter ===*===	**None:** (The value is not outputted or displayed on the screen)

Full:
==> Circle (1)
..: Circle

	MEASURED	NOMINAL	UPPER TOL	LOWER TOL	DEVIATION	OUT/TOL
Diameter	15.018	15.018	0.020	-0.020	-0.000	

===*===

Out-Of-Tol:
==> Circle (1)
..: Circle

	MEASURED	NOMINAL	UPPER TOL	LOWER TOL	DEVIATION	OUT/TOL
Diameter	15.018	15.018	0.020	-0.020	-0.000	

===*===

(Same as Full format except the results are only outputted when the feature is out of tolerance.)

Keyin Value

> **Note:** For a listing of all of the serial outputs, see section 10-12

Keyin Value:
This softkey is used for entering nominal and tolerance values. Use the +1, -1, and +/- softkeys, followed by the Done softkey to change a nominal or tolerance value.

Done

Done:
All changes are accepted and you are returned to the Measurement Mode result screen.

> **Important:** The system will approximate the nominal value based on the measured value using the "Nom. Nearest" option in the system options. The next time a similar feature is measured, the system will reuse the nominal used the previous time.

Measurement Mode

GD&T Symbols
The results of most measurements are referenced with a GD&T (Geometric Dimensioning & Tolerancing) symbol. The following is a description of GD&T symbols that the system uses:

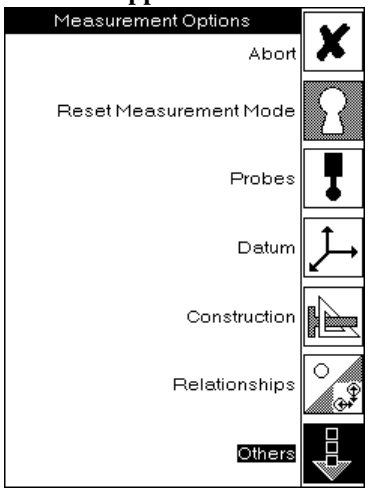
Symbol	Result Description
X	Location along the X axis
Y	Location along the Y axis
Z	Location along the Z axis
U	Polar coordinate - radial distance from the origin
V	Polar coordinate - angle with major axis of ref. plane
Ø	Diameter
r	Radius
L	Length of slot
W	Width of slot
ΔX	Distance along X axis between two features
ΔY	Distance along Y axis between two features
ΔZ	Distance along Z axis between two features
ΔXY	2D distance between two features along the Top (XY) plane
ΔYZ	2D distance between two features along the Side (YZ) plane
ΔZX	2D distance between two features along the Front or Back (ZX) plane
ΔXYZ	3D distance between two features
⊥Δ	Perpendicular distance between two features
⊥Δ⊕	Perpendicular distance between a feature and the origin of the datum
○	Form error: roundness
▱	Form error: flatness
⏤	Form error: straightness
⌭	Form error: cylindricity
⌓	Form error: cones and spheres
∠ X	Included angle with X axis
∠ Y	Included angle with Y axis
∠ Z	Included angle with Z axis
∠XY	Included angle with Top (XY) plane
∠YZ	Included angle with Side (YZ) plane
∠ZX	Included angle with Front or Back (ZX) plane
∠	Included angle between two features
Ø⊕Ⓜ	True position: MMC with diametrical tolerance zone
Ø⊕Ⓢ	True position: RFS with diametrical tolerance zone
⊥	Perpendicularity or squareness
//	Parallelism
∠	Angularity
◎Ø	Concentricity with diametrical tolerance zone

The Tools Menu

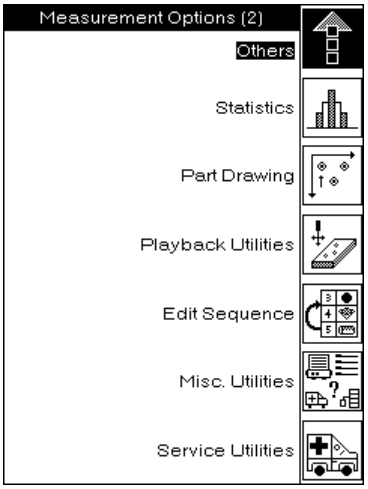
Tools

The Tools Menu is accessed by pressing the tools softkey in Measurement Mode. The menu is in two levels:

Upper Menu



Lower Menu



Abort

Tools Menu: Abort:
When this softkey is pressed, all changes are aborted and you are returned to the Measurement Mode.

Reset Measurement Mode

Tools Menu: Reset Measurement Mode:
The Reset Measurement Mode softkey is used to clear completed work by restoring the Measurement Mode to default conditions. After the Reset Measurement Mode screen appears, press the "Done" softkey to reset the system or "Abort" to cancel. When the Measurement Mode is reset, the following operations are performed:

1. Delete All Features
2. Clear the Datum
3. Activate Probe Tip 1
4. Reset Statistics
5. Reset Tolerances

The Tools Menu - Probes

Probes

Tools/Probe Menu: Select Probe Type
The probe menu's "Select Probe Type" softkey is used to qualify a probe. A probe can be qualified with a qualification sphere or by keying in the probe's diameter and offsets. In addition to the probe qualification steps listed here, you should review the Startup Tutorials probe qualification procedure in Chapter 2.

Select Probe Type (Begin Qualification)

1. Select the probe type from the following list:

   TTP: Touch trigger probe
   Ball probe [ac]: Solid probe with spherical tip (hard probe)
   Taper probe [abcd]: Solid probe with conical tip
   Edge probe [abcd]: Solid probe with flat edge
   Optical probe [abcd]: Camera style probe with monitor
   Scribe probe [acd]: Solid probe with sharp tip.

Keyin Value

a - Not currently available for Mistral machines.
b- Not available on horizontal machines.
c- Can not be used in DCC playback on DCC machines.
d- Not available on arm machines.

> **Note:** For a picture of each of the above probes, see appendix 4-2.

2. By default, when the diameter and offsets are set to "Qualify", the system will automatically calculate those values. But, by using the change option softkey, you can key in values for the diameter and offsets. The offsets are measured from the bottom of the Z rail to the center of the probe tip. With a MIP, the offsets is to the center of the first tip.

Change Option

3. The system will now guide you through the probe qualification process using the following screens:
   a. The "Remove Probe" & "Locate Sphere" screen
   b. The "Reinsert Probe" screen
   c. The "Measure Sphere" screen
   d. The "Qualification Results" screen

The Tools Menu - Probes

Probes

4. While measuring the qualification sphere, it is recommend that you take at least 12 points as described in the Startup Tutorial's Chapter 2.

Troubleshooting: If you are consistently getting "Can Not Solve" errors in the probe qualification screen, it is probably because the system is not seeing movement in an axis. See Chapter 11, "Troubleshooting" for more information.

Remeasure Tip

5. After you are done measuring the sphere, the system displays the qualification results screen. If the results are not satisfactory, press the "Remeasure Sphere" softkey. If you have a multi-tip probe, press the "Qualify Next Tip" softkey to qualify an additional tip.

Next Tip

Note: - When qualifying a multi-tip probe, record the probe tips orientation. This information will be needed during measuring.

Recall Tip

Tools/Probe Menu: Recall Probe Tip
This softkey lets you recall a previously qualified probe tip when using a multitip probe. When this softkey is selected, the Recall Tip screen is displayed. Use the arrow softkeys to select the desired tip number. Note: For multitip probes, the current active tip number is displayed in the status bar.

Qualify Additional Tip

Tools/Probe Menu: Qualify Additional Tip
With a multitip probe, this option allows you to qualify a new tip.

Save Startup Probe

Tools/Probe Menu: Save Startup Probe
This softkey allows you to save a startup probe. This feature tells the system to skip the startup sequence's probe qualification the next time the system is started. This function can also be accessed from screen 1 of the System Options.

The Tools Menu - Datums

Datum Menu

Save Datum

Tools/Datum Menu: Save Datum
This softkey lets you store the current datum for later use. With the exception of transferring datums to other measuring modes, if you plan the measurement sequence correctly, this softkey is seldom used.

Note: When the power is turned off, the saved datums are lost.

Note: Many first time operators use the Save Datum softkey incorrectly. After an alignment, you do not need to save a datum unless you plan to do an additional alignment, and then return to the current alignment.

Recall Datum

Tools/Datum Menu: Recall Datum
This softkey lets you recall a previously saved datum. In addition to user-created datums, you can also recall the machine datum system.

Translate Datum

Tools/Datum Menu: Translate Current Datum
This softkey lets you translate the origin to a keyed in location or the location of the last measured feature. A value of 0 in a particular axis will cause that axis not to be translated.

Rotate Datum

Tools/Datum Menu: Rotate Current Datum
This softkey lets you rotate the current datum system. You can use a keyed in angle, or keyed in offsets to achieve the desired rotation.

Note: After the 2 offset values are entered, the system displays the calculated rotation angle.

Note: In playback, the operations listed above will be executed automatically.

The Tools Menu - Construction

Construction

Select Feature

To construct a feature:

1. Measure the features needed for the constructed feature.
2. Select the desired construction softkey from the Construction Menu.
3. Use the arrow softkeys to move the highlight over the features to be used in the construction and press the Select key. Press the key a second time to deselect a feature. As a feature is highlighted, a cross is displayed over that feature in the part drawing window. When the feature is selected, it is remarked with a double cross.
4. When features are selected, press the Done softkey to construct the desired feature.

Construct a Line

Tools/Construction Menu: Constructing a Line

This softkey lets you construct a line through the center of previously measured features. For a given feature, the system constructs a line as follows:

Feature Type	Description
Point	Uses the XYZ location of the measured point
Circle	Uses the XYZ of the center of the circle
Cylinder	Uses the XYZ of the pierce point of the cylinder
Cone	Uses the XYZ of the pierce point of the cone
Sphere	Uses the XYZ of the center of the sphere

If all selected features were projected into the same reference plane, a 2D line will be created in that plane.

If all selected features weren't projected into the same reference plane, you will be asked to select a reference plane or to make it a 3D line.

The Tools Menu - Construction

Construct a circle

Tools/Construction Menu: Constructing a Circle (Bolt Hole Pattern)
This softkey lets you construct a circle through the center of previously measured features. For a given feature, the system constructs a circle as follows:

Feature Type	Description
Point	Uses the XYZ location of the measured point
Circle	Uses the XYZ of the center of the circle
Cylinder	Uses the XYZ of the pierce point of the cylinder
Cone	Uses the XYZ of the pierce point of the cone
Sphere	Uses the XYZ of the center of the sphere

To construct a circle, follow the procedure on the previous page. If all selected features weren't projected into the same reference plane, you will be asked to select a reference plane.

Construct a plane

Tools/Construction Menu: Constructing a Plane
This softkey lets you construct a plane through the center of previously measured features. For a given feature, the system constructs a plane as follows:

Feature Type	Description
Point	Uses the XYZ location of the measured point
Circle	Uses the XYZ of the center of the circle
Cylinder	Uses the XYZ of the pierce point of the cylinder
Cone	Uses the XYZ of the pierce point of the cone
Sphere	Uses the XYZ of the center of the sphere

To construct a plane, follow the procedure on the previous page.

Symmetry Point

Tools/Construction/Symmetries Menu: Symmetry Point
This softkey lets you construct a point halfway between two measured features. For a given feature, the system constructs a symmetry point as follows:

Feature Type	Description
Point	Uses the XYZ location of the measured point
Circle	Uses the XYZ of the center of the circle
Sphere	Uses the XYZ of the center of the sphere

To construct a symmetry point, follow the procedure on the previous page.

The Tools Menu - Construction

Symmetry Line

Tools/Construction/Symmetries Menu: Symmetry Line
This softkey lets you construct a symmetry line through the center of previously measured features. For a given feature, the system constructs a symmetry line as follows:

Feature Type	Description
Line	Uses the XYZ centroid of the line
Cylinder	Uses the XYZ of the pierce point of the cylinder
Cone	Uses the XYZ of the pierce point of the cone

Symmetry Plane

Tools/Construction/Symmetries Menu: Symmetry Plane
This softkey lets you construct a symmetry plane through the center of previously measured features. For a given feature, the system constructs a symmetry plane as follows:

Feature Type	Description
Line	Uses the XYZ centroid of the line
Cylinder	Uses the XYZ of the pierce point of the cylinder
Cone	Uses the XYZ of the pierce point of the cone

Projection Point

Tools/Construction Menu: Projection Point
This softkey lets you construct a point by projecting a point, circle or sphere into a line, plane, cylinder or cone. A point type feature (point, circle or sphere) and a vector type feature (line, plane, cylinder or cone) must be selected.

Construct From Datum

Tools/Construction Menu: Construct From Datum
This softkey lets you construct a feature by copying one of the current datum system components. You can create a point from the origin, a line from one of the datum axes, and a plane (offset if desired) from one of the datum planes.

The Tools Menu - Relationships

Relationships

Tools Menu: Relationships:
The Measurement Mode's Relationship softkey lets you view the relationship between the last 2 measured features. This softkey lets you view the relationship between any 2 non-sequential previously measured features.

This function does not operate by creating a new block. Rather, it copies the first selected block to the end of the list and sets the other as a temporary reference feature. Because of this the block sequence may appear out of order. For example:

Suppose you measured the following sequence:

1. Circle
2. Plane
3. Line
4. Circle
5. Cylinder
6. Cone

After completing this sequence, you would like to see the relationship between Circle 1 and Circle 4. Press the Tool menu's Relationships softkey, select Circles 1 and 4 and then press the Done softkey. The new sequence would be as follows:

1. Circle
2. Plane
3. Line
4. Circle
5. Cylinder
6. Cone
1. Circle
4. Circle (This is with Relationships turned on)

> **Tip:** Think for a moment. Because Circle 1 and Circle 4 are not new measured or constructed features, it does not make sense to create a new block for them. The system simply references the existing blocks.

If you turn off the Relationships softkey before continuing, the sequence would look like this.

1. Circle
2. Plane
3. Line
4. Circle
5. Cylinder
6. Cone (This is with Relationships turned off)
1. Circle (Notice that the lower Circle 4 is no longer visible. The next measured feature will be block 7.)

The Tools Menu - Statistics


Statistics


Lower Menu


Upper Menu

Enable Statistics


Add Record


Delete Record


Summary Data


Run Chart


Histogram.


Copy Mean

Tools Menu: Others:
Because not all softkeys could fit into one menu, they have been broken up into an upper level tools menu and a lower level tools menu.

Tools Menu: Statistics:
The Internal Statistics softkey lets you perform a statistical evaluation on a number of part measurements. The system provides summary reports, run charts and histograms of the measured features.

Collecting Statistics Data:

1. Enable internal statistics using the "Enable Statistics" softkey.
2. Measure a desired feature. Press the Add Record softkey. At the "Adding New Record" screen, press the "Done" softkey.
3. Continue measuring. Each time a new feature is measured, an "Adding new Record" screen is displayed. When an existing feature is measured, an "Adding Observation" screen is displayed. The system can store up to 5 records with 100 observations in each. All measure ments in a record must be within 10% of the mean value. If not, a new record is created.
4. To delete a record, press the "Delete Record" softkey.

Display Reports and Charts:

1. Press the "Summary Data" softkey to enter nominal and tolerance values for the desired features.
2. At any point after you begin taking data, a statistical summary, histogram, or run chart can be displayed. To do so, select either the "Summary Data", "Run Chart", or "Histogram" softkeys from the Statistics menu.
3. The system now asks you to select a desired feature. Use the scroll up and scroll down softkeys to select a feature.
4. Finally, the system will ask you to select a desired characteristic of the selected feature. Use the scroll up and scroll down softkeys to select the desired characteristic.

Copy Mean:
To save time, you can use the "Copy Mean" softkey to copy the computed mean to the nominal.

> **Note**: If you desire more advanced statistical functions, consider purchasing an external statistic package such as DataPage™.

The Tools Menu - Part Drawing

Part Drawing Menu

Tools Menu: Part Drawing:
From the Part Drawing menu, you can select 2 different methods for making a printout of the part. The first method involves printing either the top, front, or side views. The second method, called digitize outline allows you to select specific regions to be displayed. The softkeys that are available from the Part Drawing menu are as follows:

Print Top View

Tools/Part Drawing: Print Top View (XY)
When you select the Print Top View softkey, all features measured in the top plane, as well as all 3D features are printed.

Print Front View

Tools/Part Drawing: Print Front View (ZX)
When you select the Print Front View softkey, all features measured in the front plane, as well as all 3D features are printed.

Print Side View

Tools/Part Drawing: Print Side View (YZ)
When you select the Print Side View softkey, all features measured in the side plane, as well as all 3D features are printed.

Digitize Outline

Tools/Part Drawing: Digitize Outline:
The Digitize Outline softkey lets you print out a specific region of a part in either the top, side, or front planes. After this softkey is selected, a "Scan outline of the part" screen appears. When you complete scanning the outline of the part, the Print softkey appears. Press the Print softkey to begin part printout or the Abort softkey to exit.

The Tools Menu - Playback Utilities

Playback

Playback overview:
The Playback Mode facilitates the inspection of frequently measured parts. For example, if you need to inspect multiple parts, all of which are the same, you would write a program to aid the measurement process.

Although you may not realize it, ever time you perform a measurement sequence, you are creating a part program. You simply have not chosen to save or replay the program. After completing an inspection sequence, you have 2 choices:

1 Replay the part program immediately (without saving it).
2. Store Program- Store the current inspection sequence for later replay.

Understanding and using the playback capabilities of this software are extremely important. Because steps such as manipulating datums, entering nominal and tolerance information, and outputting results are executed automatically, part inspection time is significantly reduced. The chances of making a mistake are also reduced.

Planning the Inspection Sequence
The following should be considered when planning a part inspection:

1. Review the part print and mark all features you wish to measure and their order. A playback program can have at most 200 blocks. If more blocks are needed, create and store a separate inspection sequence.
2. Identify all callouts and note datums, nominals and tolerances.
3. Identify the probe tips/orientations needed for this part.
4. For more complicated parts, use the power of alignments to your advantage. Some part alignments are easy to visualize. Other parts, with their compound angles and odd datum surfaces, are not as easy. Remember, if the system can measure a part in one orientation, it can also measure that part in another orientation. If you are having trouble writing a program, align the part so it is easy to visualize. When you have the desired results in that orientation, rewrite the program in the orientation which facilitates part clamping.

The Tools Menu - Playback Utilities

Creating the Inspection Sequence

When the inspection sequence is planned, create it as follows:

1. Enter screen 3 of the System Options to setup the output devices to be used: Printer, Serial Output, Playback Pause. Consider enabling Statistics also.
2. Clear the system of all previous work by selecting the Reset Measurement Mode softkey from the Tools Menu.
3. Clamp the part to the table and insert the proper probe.
4. Always start the inspection sequence with a probe qualification block. This prompts you to qualify the correct probe tips in the correct orientations.
5. Begin measuring features. Enter nominals and tolerances and output results. The system will replay these steps in the order they were measured.

Reset Measurement Mode

Playback (Without Saving)

Executing a Playback Program

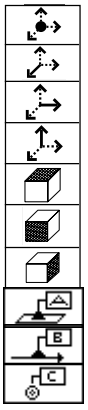
When the inspection sequence is complete, you can choose to replay that program by selecting the Playback softkey. This will not save the program. The next time you select the Reset Measurement Mode softkey, or the power is shut off, the program will be lost.

The system will prompt you to measure the required features in the order they were created. Blocks that don't prompt you to measure will be executed automatically.

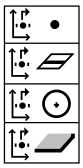
Blocks which execute automatically:

The system automatically executes the following blocks without prompting:

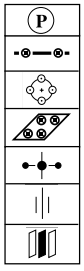
Datum Features



Stored Features



Constructed Features



The Tools Menu - Playback Utilities

Playback Error Recovery:
When there is an error during the Playback Mode, the system displays the Error Message screen. The possible playback error screens are:

Error Message	Cause of Error	Recommended Solution
Can Not Solve	The measured element or relationship could not be computed	Ensure you are measuring the correct element Re-execute the current block
Qualification Failed	A computation error was detected while qualifying the probe	Ensure you are measuring the qualification sphere. Re-execute the current block
Abort Selected	This is not an error. When you press Abort from any screen, the system will display the error screen so you can execute a specific block or exit Playback	Select the proper option

Execute Block

Execute Block:
The Execute Block softkey allows you to execute a specific program block. This softkey is often used to remeasure a block when you are not satisfied with the previous measurement results.

Exit Playback

Exit Playback:
The Exit Playback softkey exits playback and returns you to the Measurement Mode.

Re-run Program

Re-run Program:
The Re-run program softkey appears at the end of a playback program. Simply clamp down a new part and press this softkey to begin inspection again.

Jump to below alignment

Re-run Program, Jump to below alignment:
This softkey, is intended for fixture programming. See Chapter 12 for more information.

The Tools Menu - Playback Utilities

Save Program

To Store a Program:
The Store Program softkey allows you to save an inspection sequence to the storage card. The program must be 100 blocks or less. To store a program to the storage card:

1. Verify that the storage card is inserted. (If you have only one machine, this card should always be inserted. If you have multiple machines, storage cards are sometimes interchanged to transfer programs from one system to another.)

2. From the Tools menu, select Playback Utilities, followed by Store Program. Enter a program name that describes the measured part. Similar to MS-DOS convention, program names can have up to 8 characters, with no spaces, or special characters allowed. If the program name already exists, you will be told that the program already exists and asked whether or not to overwrite it.

Note: Because the structure of smart cards vary from type to type, Brown & Sharpe only supports the use of official 2 meg RefleX Smart Cards. To purchase additional storage cards, contact your local sales person. See Appendix 4 for the part number.

Note: Because the size of a program varies, depending on number of blocks, tolerance information, and screens marked, there is no fixed number of programs that will fit on a card. On average a smart card will hold about 50 non-DCC programs.

Note: To backup your programs obtain storage cards from your Brown & Sharpe distributor. Save a copy of your program to your regular card. Insert the backup card into the system and repeat the save process. RefleX storage cards cannot be read or backed up on a PC.

The Tools Menu - Playback Utilities

Recall Program

Recall Program
The Recall Program softkey lets you recall a program stored on the storage card.

> **Important** - A recalled program will overwrite any inspection sequence on the system. Use the Store Program softkey to save an existing sequence before recalling a new program.

To recall a program from a storage card:

1. Verify that the storage card is inserted. (If you have only one machine, this card should always be inserted. If you have multiple machines, storage cards are sometimes interchanged to transfer programs from one system to another.)

2. From the Tools menu, select Playback Utilities, followed by Recall Program. Select the desired program using the up and down arrows. Press the Done softkey.

Delete Program

Delete Program
The Delete Program softkey lets you delete a program from the storage card.

To delete a program from the storage card:

1. Verify that the storage card is inserted. (If you have only one machine, this card should always be inserted. If you have multiple machines, storage cards are sometimes interchanged to transfer programs from one system to another.)

2. From the Tools menu, select Playback Utilities, followed by Delete Program. Select the desired program using the up and down arrows. Press the Done softkey.

> **Note:** When a program is deleted from the storage card, the %full graph will not change immediately, due to hardware implementations. When the card is about 90% filled, the system performs a storage reclamation process. The previously deleted programs are realized and an increase in space is shown.

The Tools Menu - Playback Utilities

List Programs

List Programs
The List Programs softkey lets you list all programs saved on a storage card. To display a program listing:

1. Verify that the storage card is inserted. (If you have only one machine, this card should always be inserted. If you have multiple machines, storage cards are sometimes interchanged to transfer programs from one system to another.)

2. From the Tools Menu, select Playback Utilities, followed by List Programs. Use the Print softkey to print out a listing.

Format Card

Format card
This password-protected "Format Card" softkey lets you format a standard Brown & Sharpe storage card. Although the storage card that comes with the machine has been formatted at the factory, all subsequently purchased storage cards must be formatted before they can be used.

Important - When a card is formatted, all programs will be destroyed!!!

To format a data card:

1. Verify that the storage card is inserted. (If you have only one machine, this card should always be inserted. If you have multiple machines, storage cards are sometimes interchanged to transfer programs from one system to another.)

2. From the Tools Menu, select Playback Utilities, followed by Format Card. The system will ask for a confirmation for the format operation. Press Done to format the card.

3. While formatting, do not remove the card from the card slot.

The Tools Menu - Edit Sequence

The edit sequence menu is disabled until at least 2 blocks are measured and after 200 blocks are measured.

Edit Sequence Menu

Edit Sequence
The edit sequence menu allows you to delete, move, and replace blocks in your seqence. This menu only becomes available after 2 or more blocks have been measured.

Delete Any Block

Delete Any Measured Block
This softkey allows you to delete any measured block in the sequence. For simply removing the last measured block, using the main menu's delete last block softkey is faster.

Move Last Measured Block
This softkey allows you to move the last measured block above a selected block.

Move Block

Move Any Measured Block
This softkey allows you to move any selected measured block above another selected block.

> **Important**: Do not attempt to move or replace blocks across datum or probe blocks. The datum and probe aspects of the moved block are not recalculated after movement.

Replace Block

Replace Any Measured Block
Although you can do a "Delete Any Measured Block" and then a "Move Last Measured Block" to achieve the same results, using this "Replace Any Measured Block" softkey is faster.

The Tools Menu - Misc. Utilities

Printing Headers

Print Headers:
The Print Headers softkey lets you print identifying headers at any point in the measuring sequence. If enabled, this printout process will only happen when a playback program is executed, or when this softkey is pressed.

Enabling Headers:
Enter screen 3 of the system options. Enable the desired headers by either selecting the 'blank' option, which must be filled in with pen or pencil later, or by keying in a valid entry. Below are examples of possible headers:

Company: ACME Parts Inc.
Name: John Smith
Part Name: DemoBlk1
Date: 1/1/98
Time: 12:53 PM
Note: Measured By RefleX

Note: Older controllers from before Oct. 1999 do not have the hardware to keep track of time and date. In this case, the time and date have to be keyed in.

Select Reference Feature

Reference Features:
The Select Reference Feature softkey lets you select a previously measured feature to be used in all future relationship calculations.

Selecting a Reference Feature:

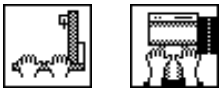
1. Press the Select Reference Feature softkey from the Tools Menu. The Select Reference Feature screen is displayed.

Select

2. Use the arrow softkeys to move the highlight over the feature to be used as the reference feature. Press the Select softkey and then the Done softkey. To deselect a feature, press the Select softkey while the highlight is over a selected feature.

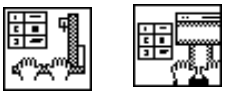
The Tools Menu - Misc. Utilities

Moving A Machine and Porting Features:
The “Move Machine” and “Port Features” softkeys are used only with arm and horizontal machines. This functionality is often called “Leap Frog” by other software packages. To users of all other types of machines, these functions will not be available, as they do not apply. These two softkeys allow a user to measure one side of a part, move the machine, reestablish the previous datum, and continue measuring. In this way, the Arm and Horizontal users are now able to measure larger parts.



Move Machine

Move Machine:
The "Move Machine" softkey is used for the first part of the of the leap frog process. The user will then move the machine to the it's new location, and press done.



Port Features

Port features:
After remeasuring his original alignment, the user will then press the "Port Features" softkey. After which, relationships between features measured in the two machine positions will be able compatible.

Create Work Instruction / Feature Labeling

Create Work Instruction / Feature Labeling:
This softkey is used to either instruct an operator during playback, or to customize a printout. Use the standard "Playback Pause", "Mark for Printing", or "Mark for Serial" softkeys to choose.

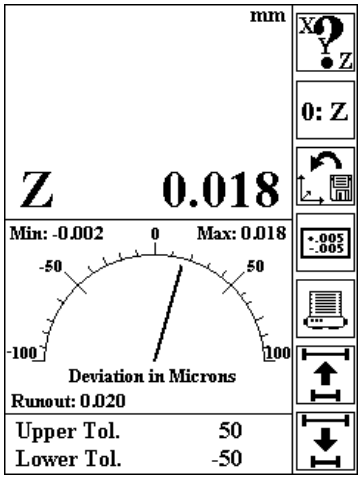
Service Utilities

Service Utilities:
The Service Utilities softkey is used to diagnose or repair the system. This password protected area is the same area available at the Home screen. Do not enter this area unless instructed by a qualified service person.

Dial Indicator Mode

Dial Indicator Mode

The Dial Indicator Mode is used to check straightness or flatness. When the Dial Indicator Mode is selected from the System Modes screen, the following screen is displayed:



Dial Indicator Screen

Important: In the System Modes screen, the Dial Indicator softkey will remained dimmed until a hard probe is qualified. A touch trigger probe will not work in this mode!

Note: Unlike a conventional dial indicator, the Dial Indicator mode's "Recall Datum" feature lets you check the surface of a feature, regardless of its orientation. Before using the "Recall Datum" feature, the Dial Indicator mode alignment is set to the "machine" alignment, regardless of status of other measuring modes.

Select Axis: Lets you select the desired axis for measurement.

Zero X, Y, Z Axis: Lets you zero the current selected axis at the current probe location.

Recall Datum: Lets you recall a datum that was previously saved in the Measurements Mode.

Tolerances: Displays the tolerance input screen for setting the upper and lower tolerance alarms. Use the Down Arrow key to move the highlight from the Upper to the Lower Tolerance and back. Use the +1 and -1 softkeys to change the tolerance values. Press and hold these keys to change in greater increments.

Print: Depending on the settings in the system options, this softkey allows you to print or send serial data out the serial port.

Scale Up: Lets you increase the scale of the dial indicator by a factor of 10 (10,100 and 1000 microns).

Scale Down: Lets you decrease the scale of the dial indicator by a factor of 10 (10,100 and 1000 microns).

CHAPTER 7

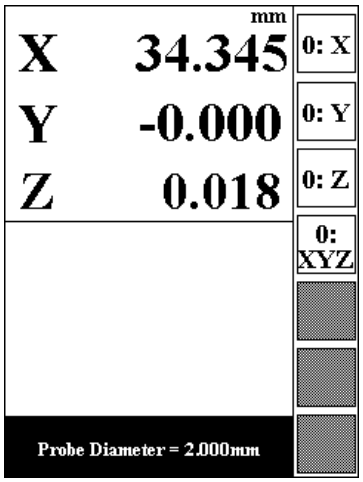
Counter/ Scribe Mode

XYZ Counter/Scribe Mode

XYZ Counters

XYZ Counter Mode

The XYZ Counter mode, available on non-horizontal machines only, is the simplest mode in the system. It shows the machine's counters and lets you zero each axis individually, or all 3 axes at once. The machine alignment is always active in this mode, regardless of datum manipulations in other measuring modes.



Important: In the System Modes screen, the XYZ Counters Mode softkey will remained dimmed until a hard probe is qualified. A touch trigger probe will not work in this mode! If this mode is not visible, it is because it has been disabled in the System Options, or the "Machine Type" option is set to a horizontal machine.

XYZ Counter/Scribe Mode

Scribe Mode

Scribe Mode
The Scribe Mode, available only on horizontal machines, displays the scribe tip location in machine coordinates. No datum functions are available in this mode. The part must be physically aligned to the machine. The following softkeys are available in the Scribe Mode:

Absolute Mode

Absolute:
The Absolute softkey lets you set an absolute zero point in any or all axes. The absolute zero point may be reestablished after an incremental zero has been set.

Incremental Mode

Incremental:
The Incremental softkey lets you set a secondary, local, zero point in any or all axes.

> **Note:** The normal number of decimal places shown, determined by the "Trailing Places" system option, does not apply in the scribe mode. When the system is set to mm, the scribe mode will display 2 decimal places. When the system is set to Inches, the scribe mode will display 3 decimal places.

CHAPTER 8

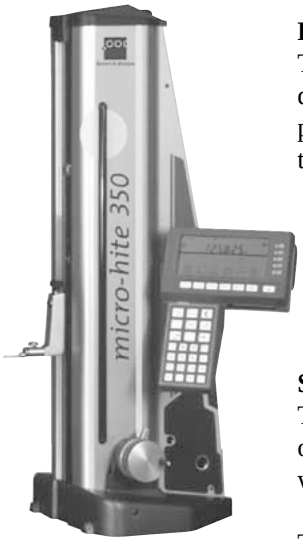
Height Gauge Mode

Height Gauge Mode

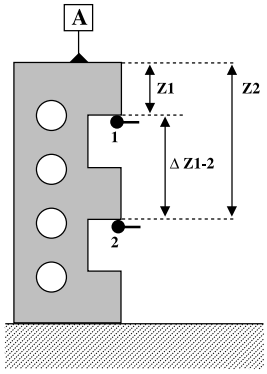
Height Gauge Mode

The Height Gauge Mode lets you measure point to point distances, slot widths, wall thickness, bore center to bore center distances, and bore diameters.

Height Gauge Measurements
In this mode you must take measurement points along one axis (X, Y, or Z). Select the axis and take points along that axis. In the example shown, the Z axis is selected.

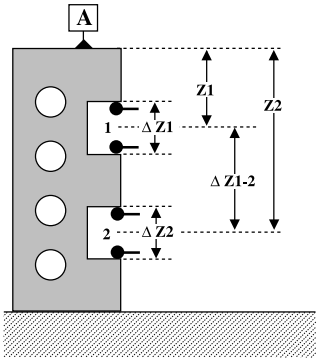


Point to Point
The first measurement point (1) gives the distance (Z1) from Datum A. The second point (2) gives the distance (Z2) and also the distance (DZ1-2) between points 1 and 2.

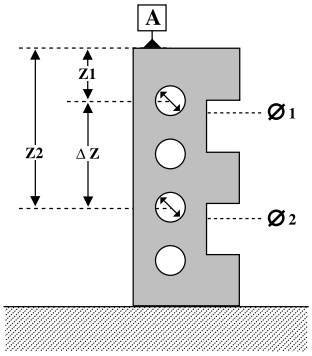


Slots or Walls
To measure a slot width or wall width, take one measurement on each side of the slot or wall.

Two measurement points at slot (1) give the distance of the midpoint (Z1) from Datum A and the width of the slot (DZ1).
Two measurement points at slot (2) give the distance of the midpoint (Z2) from Datum A and the width of the slot (DZ2).
The distance between the slots (DZ1-2) is also calculated.



Bore Locations and Diameters
When you measure bores, the system computes the diameter and location of the bore's center along the measurement axis. You can get center distance measurements by measuring various bores.



Measuring in the Height Gauge Mode

Height Gauge Mode

1. Select the Height Gauge Mode softkey from the "Startup Options" screen.

2. From the "Select Measurement Axis" screen, select the measurement axis you will use by pressing the "X Axis", "Y Axis" or "Z Axis" softkey.

> **IMPORTANT:** Once you have selected an axis, the system computes locations and distances only along that axis. You may only measure in that axis.

Recall Probe Tip

Recall Datum

3. Depending on the axis selected, the corresponding screen is displayed. This screen has a "Recall Probe Tip" softkey to recall a previously quali fied probe tip, a "Recall Datum" softkey to recall a previously saved datum and a "Select Axis" softkey to change the measurement axis. When you change the measurement axis, all previous measurements are deleted.

4. When you start taking measurements, the system displays the "Taking Points" screen. You can measure a single point, a slot or wall or a bore.

Select Axis

Measuring a Single Point:

Hard Probe	Move the probe along the selected axis and hold the probe against the surface. Press the Scan button once and then the Done button.
TTP	Move the probe along the selected axis until the probe deflects. Press the Done button.

Measuring in the Height Gauge Mode

Measuring a Slot or Wall (2 points):

Hard Probe	Move the probe along the selected axis and hold the probe against the first surface. Press the Scan button once. Move the probe against the second surface. Press the Scan button once and then the Done button. Be sure to take only one point on each side. If you take more than one point, the system will think its a bore.
TTP	Move the probe along the selected axis to the first point until the probe deflects. Move to the second point and deflect the probe. Press the Done button after taking two points.

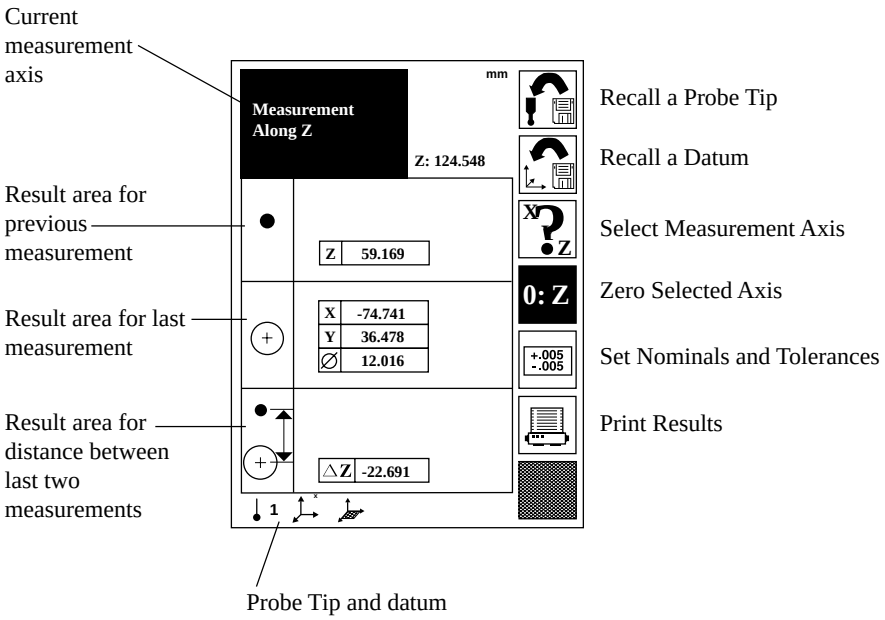
Measuring a Bore:

Hard Probe	Move the probe along the selected axis and hold the probe against the bore. Press and hold the Scan button while scanning the complete bore diameter. Press Done.
TTP	Move the probe along the selected axis to the bore until the probe deflects. Take at least 3 measurement points. Press Done.

IMPORTANT: You can measure a bore in the Top, Side or Front planes regardless of the measurement axis selected. The system will automatically determine the orientation of the bore.

Height Gauge Mode Results Screen

As you take measurements, the results are displayed for the last two features and the 1D distance between them. The Results screen for two slots or walls appears as shown:

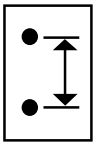
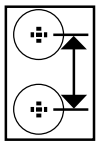
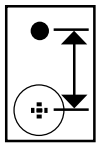


The system will track the last two measured features and the distance between them. The results are displayed as shown above.

> IMPORTANT: The system always shows the results of the last two measurements. When you measure a new feature it displaces a previously measured feature. If you press the Select Measurement Axis key, the screen will clear and you are ready to measure features in the new selected axis.

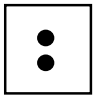
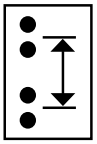
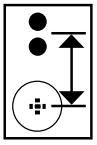
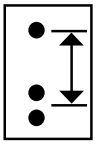
Height Gauge Mode Results Screen

Following are the Measurement Types and Result descriptions:

Type Symbol	Measured Axis	Description
	X Y Z	Location of a point along the measurement axis.
	X Y Z	Distance between two points along the measurement axis.
	XYPL (Top) YZPL (Side) ZXPL (Front/ Back)	Major and minor location of the bore center and the bore diameter. The major and minor axes are determined by the bore reference plane: Reference Plane / Major / Minor XYPL / X / Y YZPL / Y / Z ZXPL / Z / X
	XYPL YZPL ZXPL	Distance between two bores along the the bores' major and minor axes. Note: If the bores were measured in different planes, no relationship is computed.
	X Y Z	Distance between a point and a bore center. Note: The distance is computed only if the reference plane of the bore contains the measurement axis of the point.

Height Gauge Mode Results Screen

Following are the Measurement Types and Result descriptions:

Type Symbol	Measured Axis	Description
	X Y Z	Location of the midpoint of two measurements and the distance between the two along the measurement axis.
	X Y Z	Distance between two midpoints along the measurement axis.
	X Y Z	Distance between a midpoint and the center of a bore along the measurement axis. Note: The distance is computed only if the reference plane of the bore contains the measurement axis of the midpoint.
	X Y Z	Distance between a point and a midpoint along the measurement axis.

Height Gauge Mode Softkeys

The Height Gauge Mode softkeys:

Recall Probe Tip

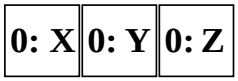
The "Recall Probe Tip" softkey lets you recall a previously qualified tip. To qualify a probe, use the "Probes" softkey in the "Startup Options" screen.

Recall Datum

The "Recall Datum" softkey lets you recall a previously saved datum created via the measurement mode.

Select Axis

The "Select Axis" softkey lets you choose the desired measurement axis.



Zero Axis

The "Zero Axis" softkeys zero the current measurement axis at the location of the current measured feature. The softkey displayed depends on the measurement axis. For slots and walls the zero is set at the center of the slot or wall. For bores the zero is set at the center of the bore.

Print

The "Print" softkey prints the results of Height Gage Measurements.

Tolerance

The "Tolerance" softkey displays the tolerance window. In this screen, you can set tolerances of measured features as well as setting the printer output format. See the next page for descriptions of softkeys used in the tolerance screen.

Height Gauge Mode Tolerance Softkeys

The Height Gage Mode's tolerance screen softkeys:

Abort

The "Abort" softkey discards changes made in the tolerance window and returns you to the Height Gauge Measurement screen.

Scroll Down

The "Scroll Down" softkey advances the highlight to the next item (Output, Nominal, Upper Tolerance, Lower Tolerance) in the tolerance window.

Change Option

The "Cycle Option" softkey cycles through the following "Output" choices:

Measured:	The system prints only the measured value.
Full:	The system prints the measured value, nominal value, upper tolerance, lower tolerance, deviation and out-of-tolerance graph.
Tol Band:	Prints only the tolerance graph showing measured value location in the tolerance zone or out-of-tolerance deviation.
Out-Of-Tol:	Same as Full Format except it is only printed when the selected feature is out of tolerance.
None:	Does not print the highlighted value. Use this option to print only the items desired. When None is selected, the value will not show on the screen or the printout.

ISO Tolerance

The "ISO Tolerance" softkey is only available when entering tolerance information for diameters. The system displays an ISO Tolerance Table based on the nominal diameter and whether the measurement is internal or external (bore or pin).

Keyin Value

The "Keyin Value" softkey is used for entering nominal or tolerance values. When this key is pressed, you can change the value of the highlighted item using the "+1", "-1", and "+/-" softkeys. After the value has been keyed-in, press the Done softkey to return to the tolerance window.

Next Result

The "Next result" softkey advances the highlight to the next result window. The nominal, tolerance, and output type must be specified for each window.

Done

When the "Done" softkey is selected, all changes are accepted and you are brought back to the Height Gage mode's measurement screen.

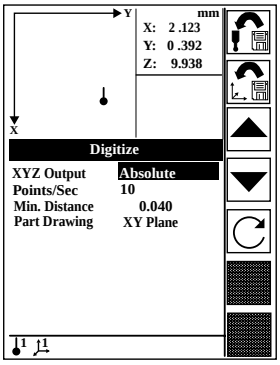
CHAPTER 9

Digitize & PassThrough Mode

The Digitize Mode

Digitize Mode Softkey

The Digitize Mode is used to send point data through a null modem serial cable to a waiting host computer. When the Digitize Mode softkey is selected from the "System Modes" screen, the following screen and options appear:



XYZ Output: This option determines if points will be output in "Absolute" coordinates or "Incremental" coordinates. Absolute coordinates are references from the current active datum. Incremental coordinates are referenced from the previous measured point.

Points/Sec: When using a hard probe, this option controls the number of points taken during the scanning of a part. Allowable values are 1-10 points per second and continuous.

Min. Distance: This option specifies the minimum distance the probe must travel before the next point is digitized. The smallest allowable distance is 0.000 mm. This is always a positive value.

Part Drawing: This option controls the part drawing display in the upper left corner. You can be view the points from the top (XY plane), front (YZ plane) or side (ZX plane). This option has no affect on the data being sent.

Note: As soon as the user begins taking points or scanning, data is automatically being sent out the serial port. It is because of this that using this mode is ideal for setting up serial communications.

Important: The data sent via the Digitize mode is tip center data only, and is not probe tip compensated!

Note: For information on how to send data to Windows 95, 98, or NT's Hyperterminal program or the optional RefleX Scan package, see appendices A5 and A6 respectively.

The Digitize Mode

The following softkeys are available in the Digitize mode:

Recall Probe

The "Recall Probe Tip" softkey allows you to recall a previously qualified tip. To qualify a probe, use the "Probes" softkey in the "Startup Options" screen.

Recall Datum

The "Recall Datum" softkey allows you to recall a previously saved datum created via the Measurement mode.

Scroll Up

The "Scroll up" softkey allows you to scroll upwards through the options listed on the previous page.

Scroll Down

The "Scroll down" softkey allows you to scroll downwards through the options listed on the previous page.

Change Option

The "Change Option" softkey cycles through the available choices for the highlighted option.

Keyin Value

The "Keyin Value" softkey is used to enter values for a selected option. When this key is pressed, you can change the value of the highlighted item using the "+1", "-1", and "+/-" softkeys. After the value has been keyed-in, press the Done softkey to return to the Digitize mode screen.

Done

When the "Done" softkey is pressed, all changes are accepted and you are brought back to the Digitize screen.

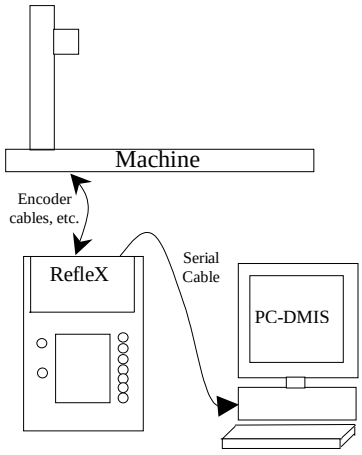
The following is an example of the Digitize mode's serial output:

```
!SOT
!inch
!abs
X 1.18085 Y 1.89919 Z-11.77133
X 4.72437 Y 1.35143 Z-11.77121
X 3.73981 Y 5.41855 Z-11.77128
X 1.18078 Y 4.65511 Z-11.77128
X 2.36207 Y 1.97911 Z-11.77121
X 1.15117 Y 1.90093 Z-11.77149
X 4.69475 Y 1.35325 Z-11.77129
!EOT
```

Passthrough Mode

Passthrough Mode Overview:

Passthrough mode is used to send data from RefleX to a PC software package such as PC-DMIS or Xact Measure. In a typical application, a user has many RefleX machines, yet only 1 laptop running PC-DMIS. For these jobs which require CAD functionality, an operator can simply bring the laptop to the RefleX station, plug in the null modem serial cable, and begin using PC-DMIS as usual.



Setting up PC-DMIS:

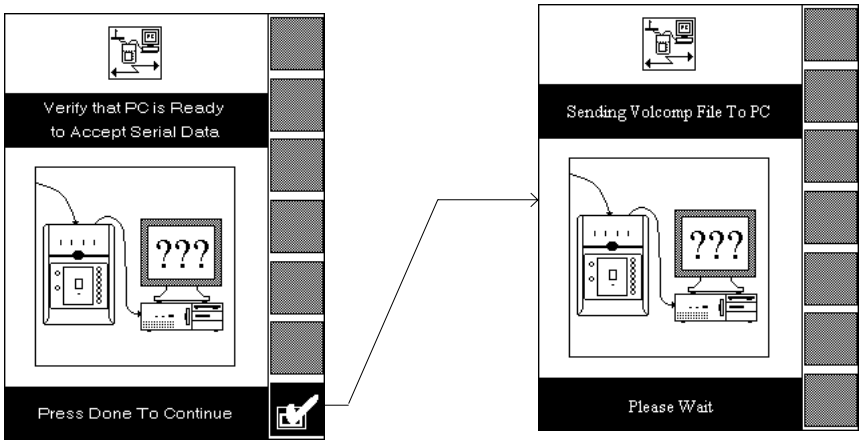
Before using PC-DMIS, the RefleX interface must be installed and enabled in the dongle. After that is done, simply start PC-DMIS.

Setting up RefleX:

In page 4 of the system options (see section 10-16), make sure that the serial settings are set up for 9600, 8, none, 1. This is the default for PC-DMIS's interface driver. Later, if you are having trouble communicating, make sure that these values are set correctly in PC-DMIS.

In the "System Modes" screen press the "Pass-Through" softkey. If the softkey is not visible, enable it in the system options. See section 10-18 for more information about enabling passthrough mode.

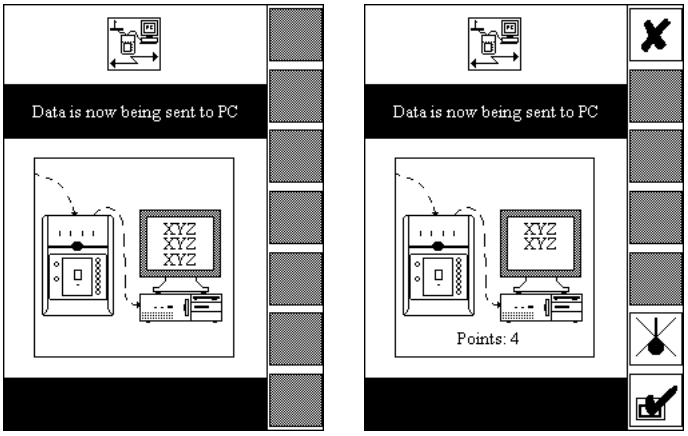
After the "Verify PC is Ready" is shown, press the "Done" softkey. The volcomp file in the RefleX controller will then be downloaded to the PC. Because of this methodology, the operator never has to worry about manually switching volcomp files in the PC. At this point, you will notice a "Volcomp File Being Recieved" in PC-DMIS.



Passthrough Mode

Using Passthrough Mode:

After the volcomp file has been sent, it is no longer necessary to look at the RefleX Controller. PC-DMIS can be used as usual, including Z-Mouse functionality. The operator can, however, use RefleX's "Abort Scan", "Clear Last Hit", and "Done Scan" softkeys if desired. A "Points Taken" display is also shown.



Abort Scan

Clear Last Hit

Scan Done

The System Startup Button

Exiting Passthrough Mode:

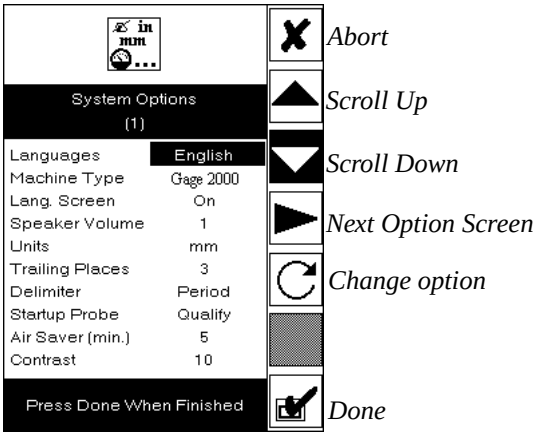
To exit passthrough Mode, simply press the system startup button located on the middle left of the RefleX controller.

CHAPTER 10

System Options

System Options

Introduction to System Options
System Options are used for setting such items as the machine type, the controller's screen contrast, and the qualification sphere's diameter. Because there are too many options to fit in a single screen, 5 screens are used. Shown below is the first screen of System Options, known as "Page 1" of the System Options.



Note: Because all system options are saved in the controller's memory, the system will remember these saved values next time the controller is started.

> **Important:** Never reinsert a previous version software card unless absolutely necessary. Because the structures that hold the options will most likely be different, doing so will result in a loss of your saved options.

System Options

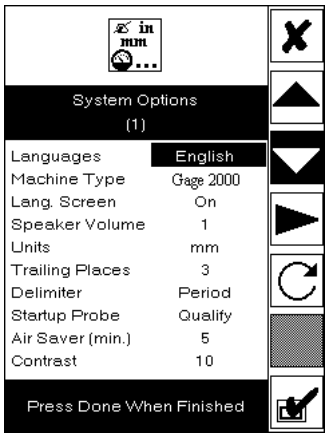
Language & Machine Type

Language

Default: English

Values: English, German, Italian, French, Spanish, Portuguese, Swedish, Finnish, Polish, Dutch, Danish, Czech, Simplified Chinese, Traditional Chinese, Japanese & Korean.

Description: The Language option sets the language of the system. The startup sequence's language screen alsoallows language selection. By placing this option here, the language can be set without rebooting the controller.



System Options Page 1

Machine Type

Default: Gage2000

Values: ***Bridge type machine*** *(Based on Volcomp file type):* Gage2000, Derby, uXcel 765/r, uXcel 7105/r, RefleX 343, RefleX 454, or other.
Horizontal type machine *(Based on Volcomp file type):* Gage2000H, or Derby II.
TTL type machine *(Based on Controller type):* Mistral 775, Mistral 1077, Mistral 7105, or Other.
Heidenhain Machine *(Based on Controller type):* Other.
DCC Machines *(Based on serial query):* Microval PFX 454
Arm Machines *(Based on serial query)*: Gage2000 A

Other Machine

Description: This option tells the system which machine is being used. When set to "Other", a "Other Machine" softkey appears which allows a user, after entering the password, to enter axis lengths, axis direction, pitch, etc. This machine type is used for upgrades purposes.

Troubleshooting: If you Measurement Mode's part drawing isn't scaling correctly, or the flying probe isn't visible, it can only be caused by two things:
1. The machine was not homed correctly, or
2. The "Machine Type" option is set incorrectly.

System Options

Language Screen, Speaker Volume& Units

Language Screen

Default: On

Values: On, Off

Description: This option allows you to turn the startup sequence's language screen on or off.

> **Tip:** If you are working in a uni-lingual shop, turn the "Language Screen" option off to facilitate system startup.

Speaker Volume

Default: 10

Values: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Description: The volume of the system's speaker can be set with a value from 0 to 10. At a value of 0 the speaker is off.

> **Note:** If you have a controller from before October, 1999, this option is not available. Older controllers have a "Sound" option which is either "Enabled" or "Disabled. Also note that some of these controllers were much quieter.

> **Note:** On Arm machines, there is also a "Arm Beep Volume" option which controls the volume of the arm's internal speaker.

Units

Default: mm

Values: Inches or mm.

Description: This option lets you set the system's measurement units to either metric millimeters or English Inches.

> **Tip:** Notice how switching between mm and Inches changes the "Trailing Places" option located below the "Units" option.

System Options

Trailing Places, Angles, Delimiter, Startup Probe
Trailing Places

Default: 3 for millimeters or 5 for Inches

Values: MM: 2, 3. Inches: 4, 5.

Description: This option lets you set the number of decimal places shown. For example, if the system's "Units" option was set to "mm" and the "Trailing Places" option was set to 3, a typical value would be displayed as "12345.678". See the "Units" option above.

Angles

Default: Decimal

Values: Decimal or DD:MM:SS

Description: This option lets you set an angle display. An angle displayed in "Decimal" format will look like "45.008". An angle displayed in "DD:MM:SS" will look like "045:00:27"

> **Tip:** Remember, for an angle, the decimal value "45.510" is very different than "45:51:00".

Delimiter

Default: Period

Values: Period, Comma

Description: This option lets you set the symbol to represent the decimal point. You can choose either a period (123.456) or a comma (123,456).

Startup Probe

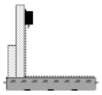
Default: Qualify

Values: Qualify, Saved

Description: This option specifies whether the system requires you to qualify a probe on startup, or allows you to use a previously saved probe. This option has the same effect as the "Save Startup Probe" found in the Probe menu.

System Options

Air Saver & Contrast



Air Saver

Default: 0 (Off)

Values: 0-999 minutes

Description: The Air Saver timeout sets the number of minutes the system will wait before turning off the air via the optional Air Saver. A value of 0 disables the Air Saver. This option is not shown for Arm or DCC machines.

Tip: For non-arm and non-DCC machines, the air filters are supposed to remove all of the oil from the air. But, some customers with extremely high concentrations of oil still have problems. By turning off the air when the machine is not in use, the air saver can provide a very inexpensive fix to a potentially serious problem.

Contrast

Default: Factory set to optimum contrast

Values: 0-25

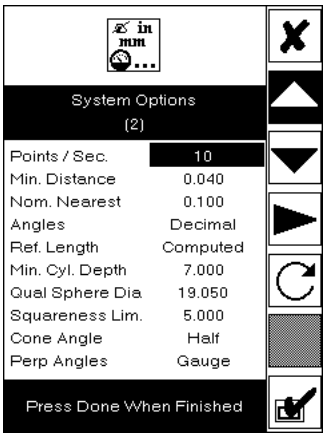
Description: This option lets you set the contrast of the controller's screen.

Note: The screen's contrast will change with temperature and location of the operator.

Note: Changing the contrast and setting the system's volume are the only options that can be set with the controller without having a software card inserted. The reason for this is so that if you set the contrast to a value in which the screen can not be viewed and then turn off the controller, there is no way for you to navigate the menus to get back to the system options to reset the contrast. Use the top and bottom right buttons to set the contrast.

System Options

Points / Sec. & Minimum Distance



Points / Sec.

Default: 10

Values: 1,2,3,4,5,6,7,8,9,10

Description: This option sets the number of points takenper second when scanning with a hard probe.

Troubleshooting: If Counters update slowly, it is because the "Points/Sec." option is set to a value lower than 10.

Min. Distance

Default: 0.040 mm.

Values: 0.000 mm. and up

Description: "Min. Distance" is the "Minimum Distance between points". This feature, especially important during hard probe scanning, prevents multiple points being taken when the machine has briefly stopped moving.

Troubleshooting: If while scanning, the system is taking points sporadically, or taking 1 and only 1 point, it is because the "Min. Distance" option is set to a high value.

System Options

Nearest Nom., Ref. Length, Min. Cyl. Depth

Nearest Nom.

Default: 0.100 mm.

Values: Any positive value greater than 0.000.

Description: This option (Nearest Nominal) defines how the system will calculate the nominal, based on the measured value.

0	Truncates the measured value
1	Rounds the value to nearest whole value
other	Approximates to nearest fractional value.

Example: For a measured value of 50.083 mm, the system will calculate a nearest nominal of 50.100 mm, when this option is set to 0.100.

Ref. Length

Default: Computed

Values: Computed, User Defined

Description: This option (Reference Length), is used to compute squareness, parallelism, and angularity. The value can be either based on the points measured, or you can key in a value.

Min. Cyl. Depth

Default: 7.000 mm

Values: 1.000 mm and up

Description: This option (Minimum Cylinder Depth) helps the system distinguish between circles and cylinders. If you do not lock the appropriate axis when measuring a circle, it may look like a cylinder to the system. Also, when you measure very small bores, they may look like circles to the system. This option helps distinguish between the two.

> **Tip:** Even if your cylinder is solved as a circle, or vise-versa, you can always force the solved feature to the desired feature. See Chapter 5 for more information.

System Options

Qual Sphere Diameter, Squareness Limit, Cone Angle

Qual Sphere Dia

Default: 19.050 mm

Values: All positive values

Description: The Qualification Sphere Diameter is the diameter of the qualification, or reference, sphere. This diameter is often stamped on the side of the sphere's support arm.

Troubleshooting: If this option is set incorrectly, the "Qualification Results" screen will consistently show high or low probe diameters.

Squareness Limit

Default: 5.000 degrees or 005:00:00 degrees

Values: All positive values.

Description: This option helps the system distinguish between parallel or square features and oblique features.

Example: If the Squareness Limit was set to 5 degrees, two cylinders with an included angle of 2 degrees would be considered parallel. If that squareness limit were set to 1 degree, they would be considered oblique.

Troubleshooting: If you cannot see intersection screens, such as the "intersection between two lines" screen, it is because you did not lock an axis and the two lines don't intersect. The other possibility is that the squareness limit is set to an invalid value. An appropriate value for the squareness limit option is 5.000 mm.

Cone Angle

Default: Half

Values: Half, Full

Description: This option is used to select the display of a cone's angle. The half angle represents the angle between the cone's axis and its surface. The full angle represents the included angle of the cone.

System Options

Perpendicular Angles, Send to Printer

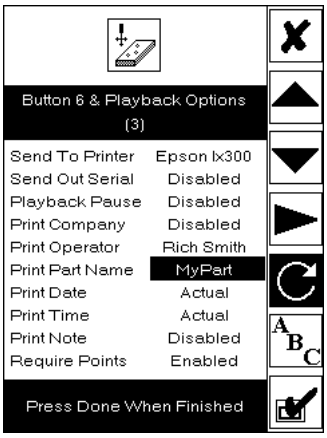
Perp. Angle

Default: Actual

Values: Actual, Gauge

Description: This option is used in the display of perpendicular angles. When "Actual" is selected, an angle of 89.997 will be displayed as 89.997 degrees. When "Gauge" is selected, the deviation between 90 degrees and the angle is shown. In this case the gauge angle would be 0.003 degrees.

Send to Printer



Default: Disabled

Values: Disabled, Epson LX300 (U.S. & China), Epson LQ570+ (U.S.), Okidata 320 (U.S.), Panisonic 2135 (Europe), Epson VP-600 (Japan), Epson LQ-570HD (Korea)

Print

Print Playback Stop Send to Stats Serial Out

Description: When a valid printer, has been chosen, the "Print" softkey will appear in the "Measurements", "Height Gage", and "XYZ Counters" modes. Note: The printer will not be visible in the Measurement Mode until a valid feature has been measured.

Note: The printers listed above are the only printers supported by Brown & Sharpe.

Troubleshooting: Most printing problems are a direct result of using unsupported printers. Before contacting your local service person, verify that you are using a supported printer.

Tip: Although the system may not be able to print to your favorite printer directly, there is another way. Use the serial output capabilities to transfer your measurement results to a serial capture utility such as Window's Hyperterminal program. Then print from there. Some customers even take it one step further and create a Microsoft Word™ template complete with logos, digital pictures, and work instructions. Using this procedure, you can create reports that are only limited by your imagination.

System Options

Send out Serial

Send out Serial

Serial Out

Default: Disabled

Values: Disabled, DataPage, Gage Talker, Mitutoyo, Generic, Print Format

Print
Playback Stop
Send to Stats
Serial Out

Description: This option sets the serial output format. Toleranced circle data, shown below, is sent out in the 5 formats. Because the system uses the serial port to communicate with the machine's controller, on a dcc system, serial output is disabled.

DataPage:

```
!SOT
DEFAULT  CIX1   X  75.076   75.100   0.100   -0.100
DEFAULT  CIY1   Y  87.272   87.300   0.100   -0.100
DEFAULT  CIID1  D  53.083   53.100   0.100   -0.100
!EOT
```

Gage Talker:

```
DEFAULT ,1, X, CI, 75.076,75.100,0.100,-0.100,-0.024
DEFAULT ,1, Y, CI, 87.272,87.300,0.100,-0.100,-0.028
DEFAULT ,1,ID, CI, 53.083,53.100,0.100,-0.100,-0.017
```

Mitutoyo:

```
01A  53.082737
```

Generic:

```
DEFAULT ,1, X, CI, 75.076,75.100,0.100,-0.100,-0.024
DEFAULT ,1, Y, CI, 87.272,87.300,0.100,-0.100,-0.028
DEFAULT ,1,ID, CI, 53.083,53.100,0.100,-0.100,-0.017
```

Print Format:

```
==> Circle (1)
..: Circle
```

	MEASURED	NOMINAL	UPPER TOL	LOWER TOL	DEVIATION	OUT/TOL
X	75.076	75.100	0.100	-0.100	-0.024	==*====
Y	87.272	87.300	0.100	-0.100	-0.028	==*====
Diameter	53.083	53.100	0.100	-0.100	-0.017	==*====

Note: For more information about the different Print formats, see section 5-15

System Options

Playback Pause, Print Company, Print Operator

Playback Pause

Playback Pause

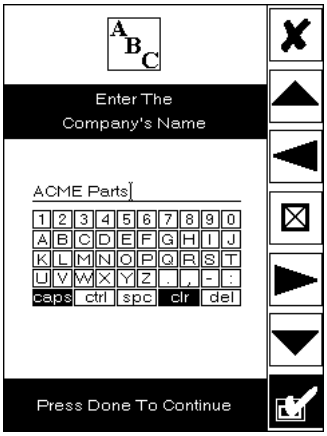
Default: Disabled

Values: Disabled, Enabled

Description: This option lets you stop and view the results of a measurement before continuing with the playback process.

Print PlaybackPause Send to Stats Serial Out

Print Company



Default: Disabled

Values: Disabled, (blank), Company1

Enter Text

Description: This option lets you enter the company's name into the system. The "Enter Text" softkey brings up a keyboard to enter text. Later, when the "Print Headers" softkey is pressed (See Chapter 5) or a program is recalled, the following will be sent to the printer:

Company: ACME Parts Inc.

Print Operator

Default: (blank)

Enter Text

Values: (blank), Name1, Name2, Name3, Name4, Name5, Disabled

Description: This option lets you enter your name into the system. The "Enter Text" softkey brings up a keyboard to enter text. Later, when the "Print Headers" softkey is pressed (See Chapter 5) or a program is recalled, the following will be sent to the printer:

Name: John Smith

System Options

Print Part Name, Print Date, Print Time

Print Part Name

Default: (blank)

Values: (blank), Actual, Disabled, Part1

Enter Text

Description: This option, set to Actual, prints out the saved program name at the top of the printout. It can also be used to key in a different, user defined part name.

Part Name: DemoBlk1

Print Date

Default: Disabled

Values: (blank), Actual, Disabled


Enter Date

Description: This option, set to Actual, displays the date at the top of a printout. When the "Print Headers" softkey is pressed (See Chapter 5) or a program is recalled, the following will be sent to the printer:

Date: 1/1/98

> **Note:** Regardless of software version, older controllers are unable to remember time and date. Newer controllers, however, have a Y2K (Year 2000 Compliant) clock, similar to ones found in a computer.

Print Time

Default: Disabled

Values: (blank), Actual, Disabled


Enter Time

Description: This option, set to Actual, displays the time at the top of a printout. When the "Print Headers" softkey is pressed (SeeChapter 5) or a program is recalled, the following will be sent to the printer:

Time: 12:53 PM

System Options

Print Note, Require Points
Print Note

Default: Disabled

Values: Disabled, (blank), Actual

Enter Text

Description: This option lets you print a comment at the top of a printout. The "Enter Text" softkey brings up a keyboard to enter text.. When the "Print Headers" softkey is pressed (See Chapter 5) or a program is recalled, the following will be sent to the printer:

Note: Measured By RefleX

> **Tip:** Use the "Print Headers" feature as often as possible to reduce confusion when dealing with many parts and printouts.

Require Points

Default: Disabled

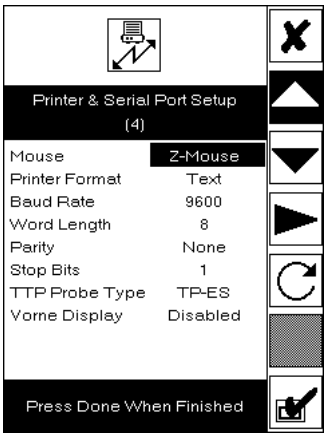
Values: Disabled, Enabled

Description: This option, when enabled required the operator to take as many points in playback, as was learned in the original inspection. So, for example, if a you take 13 points to measure a circle, in playback, the done button will not appear until you've taken 13 points.

> **Note:** This option should be enabled for DCC playback.

System Options

Mouse, Printer Format, Baud Rate, Word Length, Parity



Mouse

Default: ZMouse
Values: ZMouse, Desk Mouse, Scan/ Done, None.
Description: This option lets you switch between a ZMouse, Desk Mouse, and Scan Done assembly.

Troubleshooting: If the cursor only scrolls up and down through the softkeys when you move the ZMouse left to right, then you have a desk mouse selected, instead of a ZMouse.

Tip: When using an optical probe, use a desk mouse, or serial mouse, instead of a ZMouse. The ZMouse is difficult to access when the optical probe is installed. Using a desk mouse will reduce Z-rail movement.

Printer Format

Default: Text
Values: Text, Graphic, Both
Description: This option lets you chose the type of printout. A Graphic printout displays exactly what is shown in the results section of the Measurement Mode's screen. The Text printout sends text only to the printer. See the "Print Format" serial output format type in Chapter 5 for an example.

Baud Rate

Default: 9600
Values: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Description: This option sets the baud rate of the serial port.

Word Length

Default: 8
Values: 7, 8
Description: This option sets the word length of the serial port.

Parity

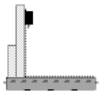
Default: None
Values: None, Even, Odd
Description: This option sets the parity for the serial port.

System Options

Stop Bits, Probe Holder, TTP Type, Vorne Display, Dial Indicator

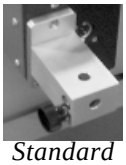
Stop Bits

Default: 1
Values: 1, 2
Description: This option sets the stop bits for the serial port.



Probe Holder


Universal


Standard

Default: Standard
Values: Standard, Universal
Description: This option, available for the horizontal machines only, is used to switch between the two possible probe holders. If the wrong holder is selected, the machine will not compute the correct offsets during probe qualification.

TTP Type


TP-ES


TP-MIP

Default: TP-ES
Values: TP-ES, TP-MIP
Description: This option chooses which TTPprobe is being used. After setting this option correctly, the correct probe will be shown in the qualification screens.

Vorne Display

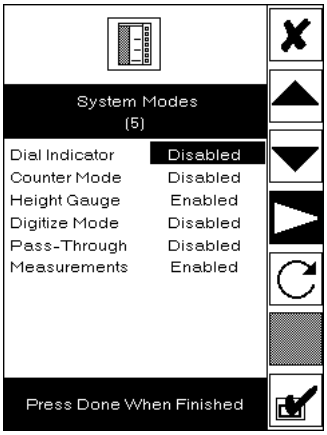

Vorne Display

Default: Disabled
Values: Disabled/Enabled
Description: This option enables or disables the external, optional Vorne XYZ counter display. Before using this display, its serial port must be set up. (Usually 9600 Baud, 8 data bits, 1 stop bit. - See Vorne manual) RefleX's serial port should also be set up accordingly (Section 10-16). Be sure to obtain the correct Vorne serial cable as it is not a standard "straight through" or "null-modem" cable. Note: The Vorne display will not work in the digitize and passthrough modes because the serial port is already being utilized.

Dial Indicator


Dial Indicator Mode

Default: Enabled
Values: Enabled, Disabled
Description: This option enables or disables the Dial Indicator Mode. When disabled, the Dial Indicator Mode softkey no longer appears in the system modes screen.



Note: The Dial Indicator mode is only available when a hard probe is qualified.

System Options

XYZ Counter Mode / Height Gage Mode, Digitize Mode, PassThrough Measurements

XYZ Counters /Scribe Mode

XYZ Counter Mode / Scribe Mode

Default: Enabled
Values: Enabled, Disabled
Description: If the machine is a horizontal type machine, this option will enable or disable the Scribe Mode. If the machine is a bridge type machine,this option will enable or disable the XYZ Counter Mode. When disabled, the XYZ Counter or Scribe softkey no longer appears in the system modes screen.

Height Gauge Mode

Height Gauge

Default: Enabled
Values: Enabled, Disabled
Description: This option enables or disables the Height Gauge Mode. When disabled, the Height Gauge softkey no longer appears in the system modes screen.

Digitize Mode

Digitize Mode

Default: Enabled
Values: Enabled, Disabled
Description: This option enables or disables the Digitize Mode. When disabled, the Digitize softkey no longer appears in the system modes screen. Because there are 6 modes and only 5 slots available to display the modes, when the digitize mode is enabled, passthrough mode is automatically disabled.

PassThrough Mode

Pass-Through Mode

Default: Enabled
Values: Enabled, Disabled
Description: This option enables or disables the PassThrough Mode. When disabled, the PassThrough softkey no longer appears in the system modes screen. Because there are 6 modes and only 5 slots available to display the modes, when the passthrough mode is enabled, digitize mode is automatically disabled.

Measurements Mode

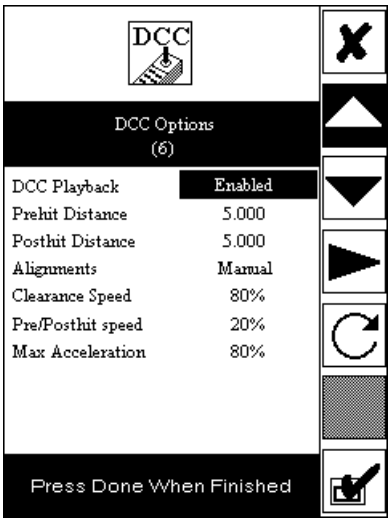
Measurements Mode

Default: Enabled
Values: Enabled, Disabled
Description: This option enables or disables the Measurements Mode. When disabled, the Measurements softkey no longer appears in the startup system modes.

Tip: Turn off the modes you do not use to alleviate startup confusion.

System Options

DCC Playback, Prehit Distance, Posthit Distance



Note: This "DCC Options" screen is only available if the controller is plugged into a DCC Machine.

DCC Playback

Default: Disable

Values: Enabled, Disabled

Description: This option turns DCC playback on or off. When disabled, no point information is saved and playback will run just like a manual system. When this option is enabled, the point information is saved.

Prehit Distance

Default: 5.000

Values: Any value greater than 0.000

Description: This option tells the system how far before the nominal measured point to begin searching for the part. During this "searching" period, the system's velocity is set to the "pre/posthit speed". If the system does not contact the part during the prehit region, it will continue searching through the poshit region.

Posthit Distance

Default: 5.000

Values: Any value greater than 0.000

Description: This option tells the system how far after the nominal measured point to continue searching for the part. During this "searching" period, the system's velocity is set to the "pre/posthit speed". If the system does not contact the part during the posthit region, an error screen will be displayed.

System Options

Alignments, Clearance Speed, Pre/Posthit Speed, Max Accelearation

Alignments

Default: Manual

Values: Manual, DCC

Description: When set to "Manual", playback will prompt the user to measure the first few features manually until a datum has been established. After that, DCC playback will begin. When set to "DCC", all steps will be measured in DCC mode. This means that subsequent measured parts must be in the same location as the part which was learned. (This is often used in fixture programming)

Clearance Speed

Default: 80%

Values: 10% - 100 %

Description: This option sets the velocity which the machine will move when it is not in the prehit / post hit zone.

Pre/Post hit Speed

Default: 20%

Values: 10% - 100 %

Description: This option sets the velocity which the machine will move in the prehit / post hit zone.

Max Acceleration

Default: 80%

Values: 10% - 100 %

Description: This option sets the maximum accelearation which the controller is allowed to exert on the machine.

CHAPTER 11

Frequently Asked Questions/ Troubleshooting

Frequent Questions/Troubleshooting

Question/Problem	Solution
Is the RefleX system **year 2000** Compliant?	See Chapter 10 Page 14
Which **printers** does RefleX Support?	See Chapter 10 Page 11
My controller is displaying a **frown face** or **skull & crossbones**.	See Chapter 11 Page 4
My controller **locks up**	See Chapter 11 Page 4
What is a **rate error** and what can I do about it?	See Chapter 11 Page 5
My part drawing isn't **scaling** correctly. I can't see the "**flying probe**"	See Chapter 10 Page 4
My controller **won't boot** up	See Chapter 11-4
I'm having **accuracy** problems	See Chapter A9-1
I consistently get an i**ncorrect probe tip diameter**.	See Chapter 10 Page 10
Why are the **Dial Indicator** and XYZ **Counter Mode softkeys** dimmed?	See Chapter 6 Page 3
How can I get more **storage cards**?	See Chapter 5 Page 30
How many programs does a storage card hold?	See Chapter 5 Page 30
What is the **Air Saver**	See Chapters 10 Page 7, 2 Page 5
What is **RefleX Scan**	See Chapter A5 Page 1
I consistently get a "**Can Not Solve**" error screen during my first probe qualification.	See Chapter 2 Page 12
I can not hear RefleX's **speaker**	See Chapter 10 Page 5
I can not see RefleX's **screen**	See Chapter 10 Page 7
How does RefleX Handle it's **volcomp** files?	See Chapter 11 Page 6
I can not see the "intersection between **two lines**" screen.	See Chapter 10 Page 10
I deleted some programs, but my **%filled** has not gotten any smaller.	See Chapter 5 Page 31
Even with the filters, there is still a lot of **oil** on my machine. What can I do?	See 10 - 7
My **ZMouse** only works when I press it left to right instead of up and down.	See Chapter 10 Page 15

Frequent Questions/Troubleshooting

Frown Face Errors

Frown Face Errors
A frown face error is often a sign that a serious hardware error has occurred and the controller must be replaced. There are, however, a few other reasons for these errors to occur.

1. If the ZMouse cable is plugged into the serial port, a frown face error will occur. ("5. EC_UART1") Remove the ZMouse cable from the serial port and plug into ZMouse port.

2. Any defective PCMCIA software card inserted into the controller will cause a frown face error. If this happens, there will be no error code under the icon. Replace any suspected card with a known good card. Be careful not to load a volcomp file from the card and into the controller when the 'Volcomps do not match' screen appears.

3. If there is a short in the ZMouse or extension cable, a frown face error will sometimes appear. To temporarily alleviate the problem, remove the ZMouse cable and contact your local Brown & Sharpe distributor for a new ZMouse and/or extension cable. This problem will also show itself by locking up the system at the first system startup (copyright, language, volcomp, or home) screen, or, by showing a blank screen on startup.

4. Frown face errors: ("19, 20, 21, 22: Measuring System Failed") will be displayed if the RefleX power supply is defective. Contact your local service representative for instructions on how to diagnose and fix this problem. This problem may also show itself by a bright, unreadable screen with little or no contrast.

> Note: In older controllers a "skull & crossbones" icon is used in place of the "frown face" icon.

Controller lockups:
Controllers with a defective power supply will lock up sporatically. It is for this reason, when ever returning a controller, always include the power supply. If the controller only locks up at the copyright or language screen, see #3 above.

Controller won't boot:
If the controller will not boot, unplug all external devices and remove both cards. If an alternate power supply is available, use it. Make sure the power cord is plugged in securely. If the box still can not boot to the "Insert Card" icon screen, the box is defective and should be returned (with power supply).

Frequent Questions/Troubleshooting

Rate Errors

What is a Rate error and how is it caused?:
A Rate error is the electronics way of notifying you that encoder signal quality is unacceptable. Because of that, exact machine position may be in error. There are many variables that can cause Rate errors. These include:

- This is a brand new controller not yet tuned to your machine.
- An encoder cable is not plugged in securely.
- Dust, dirt, oil, etc. on scales.
- The previous AutoTune was not performed correctly.
- An encoder's performance has degraded.
- An encoder has slipped out of alignment.
- The encoder or scale is defective.
- The encoder cable has a broken wire.
- A hardware error has occurred inside the RefleX controller.

Fixing a Rate Error:

- If this a brand new controller, perform an AutoTune as described in section A7.
- Check the encoder cables. Are they all tight? If not, screw them in tight.
- What is the machine's environment? If there is a lot of dust or oil in the air, check to see if the scales are clean. If dirty, clean them with a soft, lint-free cloth and rubbing alcohol.
- Try doing an AutoTune. If it is still not working, there are now only two possibilities. It is either a defective encoder system or a defective controller.
- To check, take the bad axis (the axis giving you the problem) and swap the connectors on the back of the controller with a good axis (one not having problems). Wait for another rate error to appear by starting a normal RefleX operation. Did the rate error switch axes? If so, then there is a problem in your encoder system. If not, there is a problem with the controller. For either problem, contact your local service representative.

Frequent Questions/Troubleshooting

RefleX Volcomp Files

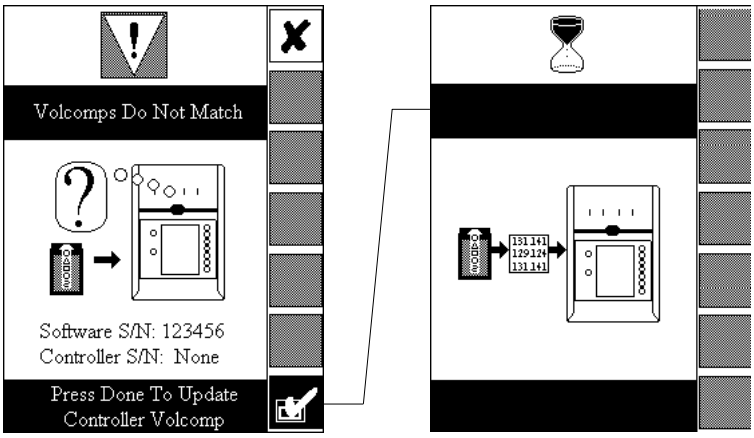
For non-DCC and non-arm systems, the RefleX controller stores it's volcomp file in two places: In its internal memory and on the software (upper) PCMCIA card. Do not exchange software cards between systems as you may accidentally load an incorrect volcomp file. On a DCC system, the volcomp is stored in the FB-PC and the screens and procedures below do not apply.

When Controller volcomp and Card volcomp do not match. Case 1:

Software SN: 123456
Controller SN: None
Default action - System will prompt user to upload from software card to the controller.
Reasoning - Facilitate Replacement of Controllers. If you are given a new controller, when you place your old card in the new controller, all you must do is press Done and your volcomp file will be loaded.

Loading Procedure:

1. Install RefleX controller as shown in manual (cables, mounting, etc.).
2. Remove PCMCIA cards from old RefleX controller (software and storage).
3. Insert old PCMCIA cards into new RefleX controller.
4. Turn on your new RefleX controller.
5. Wait for language screen to appear. Select a language and then press the Done button.
6. The volcomp load screen (shown below) appears. Press Done and your volcomp file is automatically loaded from the old card.



Note: The volcomp number, displayed at the upper left section of the homing screen, will now match the machine serial number found on the back of the RefleX machine.

Frequent Questions/Troubleshooting

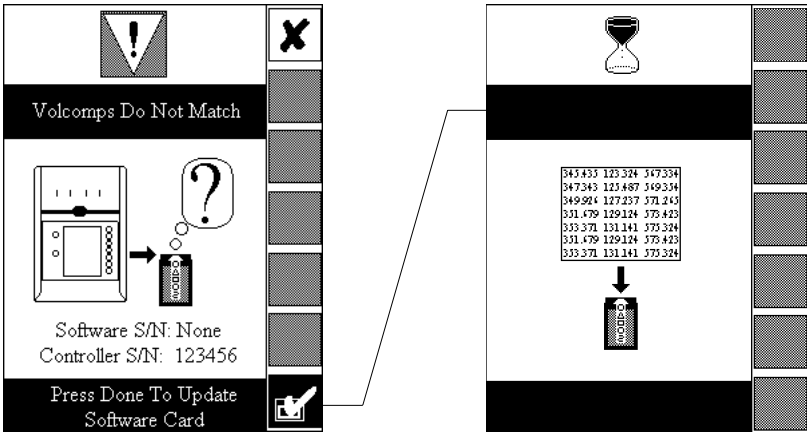
RefleX Volcomp Files

When Controller volcomp and Card volcomp do not match. Case 2:

Software SN: None **Controller SN**: 123456

Default action - System will prompt user to download volcomp file to software card.

Reasoning -Facilitate RefleX software updates. After a volcomp has been loaded into the controller via the doflex.exe program, the next time the controller is restarted, when the Done button is pressed, a duplicate copy is created on the software card.

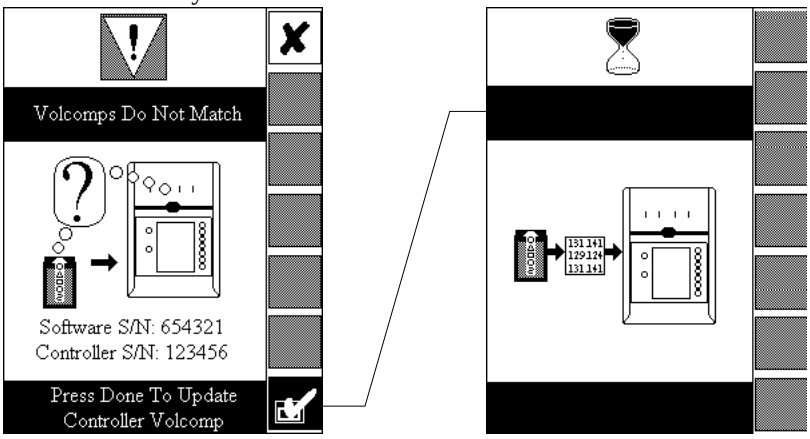


When Controller volcomp and Card volcomp do not match. Case 3:

Software SN: 123456 **Controller SN:** 654321

Default action: - System will prompt user to upload volcomp file from software card to the controller.

Reasoning: - No matter where a RefleX replacement controller comes from (or what volcomp file it has) you should be able place your old card (with your good volcomp file on it) into the controller and have it load automatically.



Alternative -If you want to download a volcomp file from the controller to the software card when volcomp files exist on both, do the following:

1. When above screen is shown, press cancel.
2. At the homing screen, record the number at the top left portion of the screen.
3. Press the service utilities button (ambulance).
4. At the password prompt, enter the last 5 digits of the recorded number reversed.
5. Press the "Squareness Corrections" button.
6. Press the "Save Volcomp to Software card" button. This procedure is only available when two non-zero volcomps are shown in the above screen.

CHAPTER 12

DCC Operation

DCC Operation

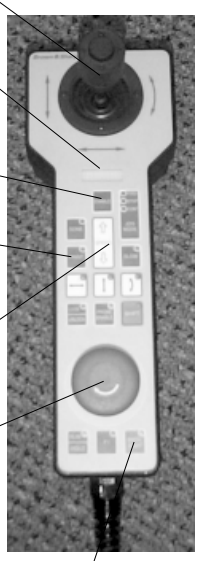
Introduction to DCC
Congratulations on the purchase of your RefleX DCC System. We believe that this is the easiest to use DCC package ever.

First and foremost, any operator using the dcc system for the first time have a full understanding of the standard (non -DCC) system. Perform chapters 1-4 tutorial exercises with the machine's drives disengaged, or with the jog box. Only then will you have the knowledge necessary to proceed with this DCC system.

The Jogbox
Not all of the features of the jog box are used in this system. See the diagram below:

Joystick - When not in playback, the joystick controls machine movement. The machine will only move when the "Enable" button is pressed and the green machine start light is on.

Velocity Indicator- This array of lights displays the current fraction of full speed.



Enable - The button prevents accidental movement of the machine. In non-playback mode, the machine will only move it this button is pressed.

Print (Clearance Point) - This button is used to take a clearance point. This will be described later. In this system, it has nothing to do with printing.

Faster / Slower - These buttons increase or decrease the current velocity. The velocity will then be displayed on the indicator above.

E-Stop - This is the button to press to stop the machine. After this button is pressed, controller will apply the brakes to stop the machine as soon as possible. This is the button which should be used in an emergency instead of the stop softkey.

DCC Stop Softkey

Machine Start - This essentially turns the machine on and off. The machine will not move until it is started. In order to start the machine, you will need to press and hold this button for about 1 second.

DCC Operation

Starting the system:
Starting the system is extremely similar to starting a non-DCC system. The only exception is that you must ensure that the FBPC controller is turned on first, or at the same time the RefleX controller is turned on. The "Go" softkey at the home screen signifies that RefleX is communicating with the machine's controller properly. Follow the procedures described in tutorial 2 to continue with system startup.

Before continuing, you should read sections 10-19 & 10-20 to get familiar with the system's DCC options.

First Time Setup:

1.) Verify that the "uXcel pfx 454" machine type is selected in the system option's page 1. See section 10-4 for details.
2.) Enable the "Require points" option in the system option's page 3. See section 10-15 for details.
3.) Enable the "DCC Playback" option in the system option's page 6. See section 10 -19 for details.
4.) Set the remaining DCC options in page 6 appropriately.

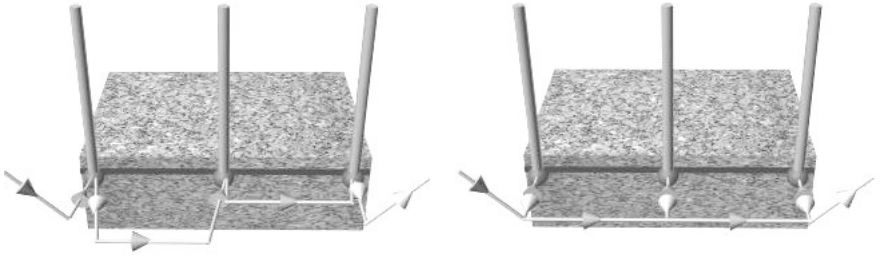
Measuring Features:

Measuring features with the DCC system is very similar to the non DCC system. The two primary rules still exist:

1.) Always approach perpendicularly.
2.) Always allow at least 1 probe radius of approach.

Only by following these two rules can the system reliably solve the feature type.

To measure a feature, you may use the system manually (I.E. unlock the airlocks) or use the system's jog box. If the your approach isn't perfect, when the program is played back, it will be normalized automatically. This is especially usefully for parts learned manually, or parts not orthogonal to the machine's axes when using the jog box.



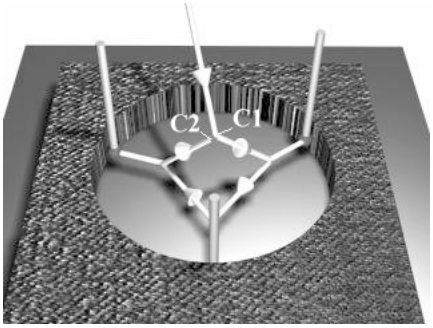
Learned Normalized for playback

DCC Operation

Clearance Points:
Clearance points, or move points, are use to move the machine without actually taking a measurement point. For example, the user would like to move over to the top of a bore, drop down inside, measure a circle, and then retreat out of the bore. The sequence would look like this.

1.) Move to the top of the bore.
2.) Press the jog box's "Print" button. A beep will be heard as the controller acknowledges the clearance point (C1 below).
3.) Move down into circle. Begin taking points. Note: A clearance point here is not necessary because the system will automatically move to the start of the prehit zone to begin taking the first point.
4.) Retreat out of the bore. Take another clearance point (C2 below).
5.) Press RefleX's "Done" softkey to solve the feature.

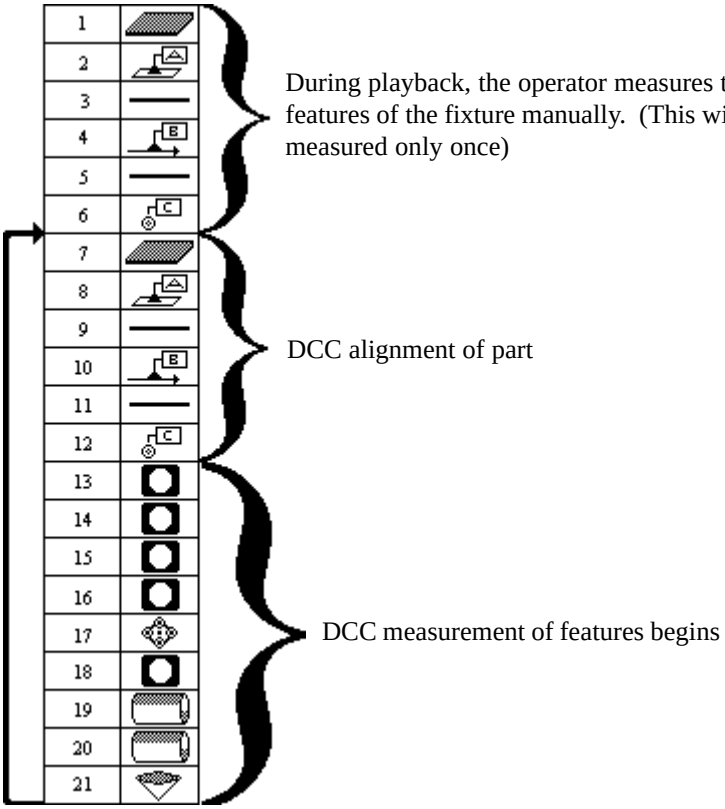
Tip: Notice how we took a clearance point before and after the feature. If we would like to rearrange (edit) the order of our program later, doing this will make it much easier.



Serial Output:
Because the system uses the serial port to communicate with the machine's controller, serial output on the DCC systems is disabled.

DCC Operation

A typical application:
The following example shows a program for measuring multiple parts in a fixture. For this example, the system options "Alignments" has been set to "Manual".



Loop to below alignment

At the "end of program" screen, the user removes the part, places a new part in the fixture, and presses the "Loop to below alignment" softkey to begin measurement of the next part.

Demonstration Mode:
The system can be placed in a demonstration mode for display purposes. Because most customers will never use this, it remains hidden from view to avoid confusion. To start the demonstration mode, at the "End of Program" screen, press the blank softkey 3 up from the bottom of the display. A "Demonstration Mode" screen will be displayed. Press the "Go" softkey. If the "Alignments" option is set to "DCC", the system will loop back to the block 1 of the program. If the option is set to "Manual", it will loop back to below the alignment. The machine will continue to cycle until the "Stop" softkey or E-Stop is pressed.

APPENDIX

Appendix

Measurement Results

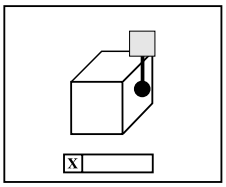
Point Measurement

A point can be measured along a single axis only. The surface must be approached along one of the machine's axes. The system compensates for the probe diameter along the approach axis.

If you do not approach within 30° of the machine axis, the system can not determine the approach direction. When this happens, a screen is displayed for you to select the measurement axis.

Points can be measured with a hard probe, a TTP or a tapered probe. You can also make a constructed point from the intersection of measured features.

Point Measured with a Hard Probe or TTP



Depending on the approach direction the screen shows the X, Y or Z coordinate of the point. The value is tip compensated. The status line at the bottom of the screen also shows the axis used. The Delta XYZ represents the perpendicular distance from the point to the origin.

The second resultscreen also shows the rectangular and polar coordinates of the point. The polar coordinates are given along the datum plane perpendicular to the measurement direction.

Measurement axis	Polar coordinates
Z axis	Top (XY) plane
X axis	Side (YZ) plane
Y axis	Front/Back (ZX) plane

U is the radial distance from the origin and V is the angle with the major axis. The point is probe compensated along the measurement axis only.

Measurement Results

Point Measured with a Tapered Probe
The screen shows the coordinates of the point along the major and minor axes of the reference datum plane and the polar coordinates of the center. The reference datum of the bore is determined by the approach direction.

Measurement axis	Reference datum	Major/Minor Coordin.
Z axis	Top (XY) plane	XY
X axis	Side (YZ) plane	YZ
Y axis	Front/Back (ZX) plane	ZX

U is the radial distance from the origin and V is the angle with the major axis.

Constructed Point
The screen shows the rectangular and polar coordinates of the point. The polar coordinates are reported on the Top plane (XY). U is the radial distance from the origin and V is the angle with the X axis.

Measurement Results

Line Measurement

Measured lines are always projected into one of the datum planes (Top, Side, Front/Back planes). The system determines the plane based on the measured line's approach direction.

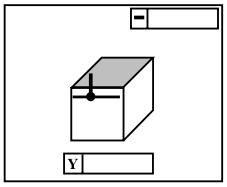
If the system can not determine the approach direction, a screen is displayed for you to select the datum plane. The system will compute the line on the selected datum.

When measuring a line, start your approach at least one ball diameter away from the surface. If you don't, the system will not know how to compensate for the probe diameter. A screen is displayed that instructs you to move away from the surface and press Done.

Lines can be measured with a hard probe or TTP. You can also construct a line through the center of measured features and a symmetry line between two other lines.

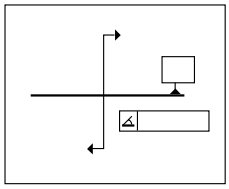
Measured Line (Always 2D) Results

If the line is square to a datum axis, the intersection of the line and the axis is shown. If not, the perpendicular distance to the origin is shown.The status line at the bottom of the screen shows the reference plane. The direction of the measured line is always from the first to last measured point.



The screen displays a straightness plot of the measured line. The top of the screen shows a histogram of the deviations. The limits are the minimum and maximum deviations. The plot shows the deviation from the calculated line to each of the measured points.

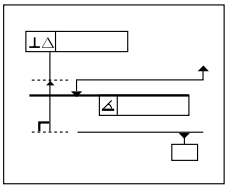
If the line is within the threshold value of being square to the datum axis, the screen displays the angle to that axis. If not, it displays the included angle to the major axis.



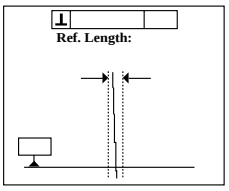
Appendix

Measurement Results

The screen shows the direction of out-of-square or out-of-parallel and the deviation angle from a perfect square (90°) or perfect parallel (0°). With parallel lines the perpendicular distance between the line and the datum axis is also shown.

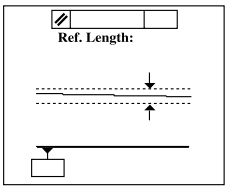


When the line is oblique to an axis, the included angle with the axis and the intersection point is shown.

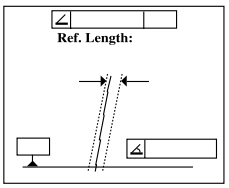


Squareness is computed as the tangent of the square angle multiplied by the reference length. It is only computed if the line is within the specified squareness threshold.

Parallelism is computed as the tangent of the parallel angle multiplied by the reference length.



Angularity is computed as the tangent of the deviation from the reference angle multiplied by the reference length. The system uses the measured included angle as the default reference angle. To set the reference angle, use the Tolerance Selection button.



Constructed 2D Line

2D lines are created using the Construction Option in the Utility Menu. The properties are the same as a measured 2D line except:

- Form error is computed only if there are more than 2 points in the line
- There is no straightness plot

Constructed 3D Line

A 3D line has no reference plane. They are created using the Construction Option in the Utility Menu.

The screen displays the included angle with each datum axis on the reference plane of the line. Angles are between 0° and 180°.

Measurement Results

Circle Measurement

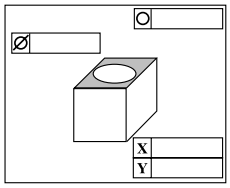
Measured circles are always projected into one of the datum planes (Top, Side, Front/Back planes). The system automatically determines the projection plane.

If the system can not determine the datum plane, a screen is displayed for you to select the datum plane. The system will compute the circle on the selected datum.

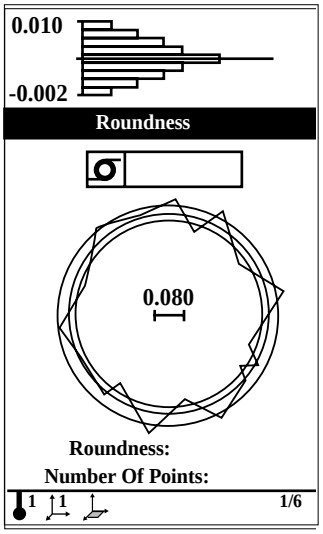
When measuring a circle, start your approach at least one ball diameter away from the surface. If you don't, the system will not know how to compensate for the probe diameter. A screen is displayed that instructs you to select an internal or external circle for measurement and press Done.

Circles can be measured with a hard probe or TTP. You can also construct a circle through the center of measured features.

Measured Circle Results



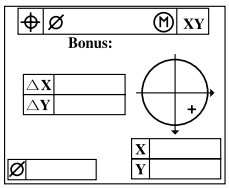
The screen displays the major and minor coordinates on the reference plane of the center of the circle, the circle diameter and the form error.



The screen displays a roundness plot of the measured circle. The top of the screen shows a histogram of the deviations. The limits are the minimum and maximum deviations. The plot shows the deviation from the calculated circle to each of the measured points.

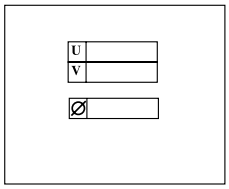
Measurement Results

The screen shows the true position location of the circle on the reference datum plane. You can switch between MMC Cartesian, MMC Polar, RFS Cartesian and RFS Polar and enter nominal values and tolerances by using the softkey for the tolerance window.



The bonus is displayed only for MMC. The computed true position is shown as the "cross" in the circle. An out-of-tolerance "cross" is drawn outside the circle.

Polar coordinates are calculated on the reference datum plane for the circle diameter. U is the distance along the line from the origin to the center of the circle and V is the angle between this line and the major axis.



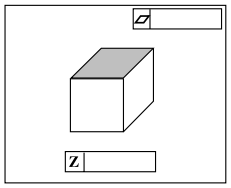
Measurement Results

Plane Measurement

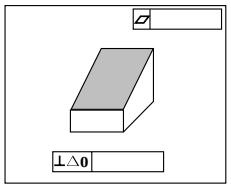
When measuring a plane, start your approach at least one ball diameter away from the surface. If you don't, the system will not know how to compensate for the probe diameter. A screen is displayed that instructs you to move away from the surface and press Done.

Measured Plane Results

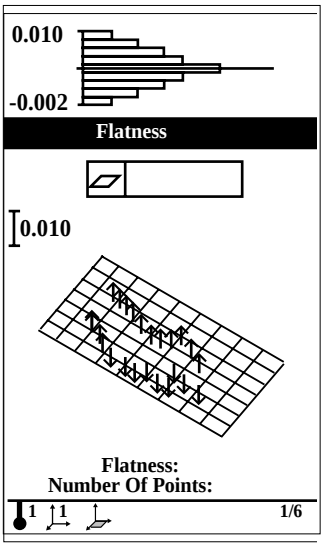
If the plane is parallel to one of the datum planes, the screen displays the displacement of the centroid to the parallel datum plane.



If the plane is oblique, the screen displays the perpendicular distance between the plane and the origin of the datum system.

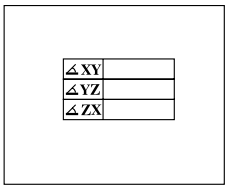


The screen displays a flatness plot of the measured plane. The top of the screen shows a histogram of the deviations. The limits are the minimum and maximum deviations. The plot shows the deviation of each point from the computed plane.



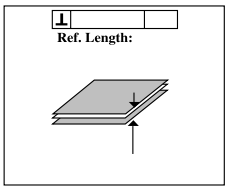
Measurement Results

The screen shows the included angle between the plane and each datum plane (0°-90°).



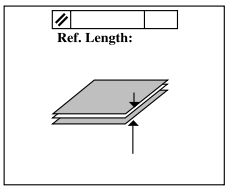
If the plane is parallel to one of the datum planes, the system computes the squareness to the other two datum planes.

The squareness is computed as the tangent of the deviation angle from parallel, multiplied by the reference length.

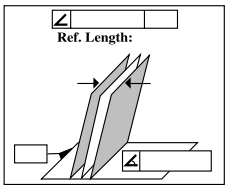


The screen shows the parallelism to one of the datum planes.

The parallelism is computed as the tangent of the deviation angle from parallel, multiplied by the reference length.



For oblique planes angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured included angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



Measurement Results

Cylinder Measurement

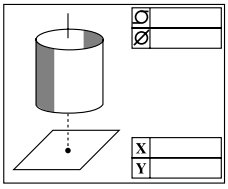
Measured cylinders are always projected into one of the datum planes (Top, Side, Front/Back planes). The system automatically determines the projection plane.

If the system can not determine the datum plane, a screen is displayed for you to select the datum plane. The system will compute the cylinder on the selected datum.

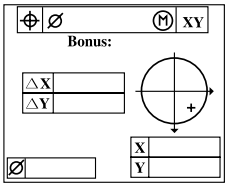
When measuring a cylinder, start your approach at least one ball diameter away from the surface. If you don't, the system will not know how to compensate for the probe diameter. A screen is displayed that instructs you to select an internal or external cylinder for measurement and press Done.

Measured Cylinder Results

The system computes the pierce point at the intersection of the cylinder's axis and the reference datum plane, the diameter and the form error. The direction is always out of the datum plane.



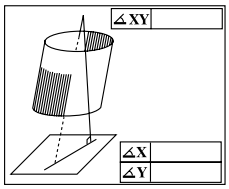
The screen shows the true position location of the cylinder on the reference datum plane. You can switch between MMC Cartesian, MMC Polar, RFS Cartesian and RFS Polar and enter nominal values and tolerances by using the softkey for the tolerance window.



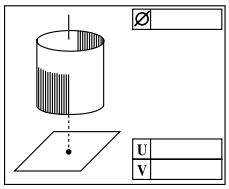
The bonus is displayed only for MMC. The computed true position is shown as the "cross" in the circle. An out-of-tolerance "cross" is drawn outside the circle.

Measurement Results

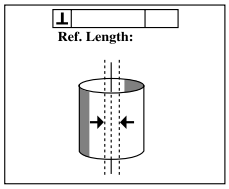
If the cylinder is not square to a datum plane, the system computes the elevation angle (0°-90°) with the datum and the rotation angles (0°-180°). Rotation angles are the included angles with the major and minor axes of the cylinder's direction vector projected on the reference plane.



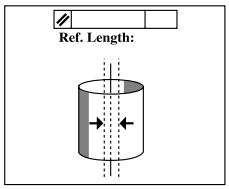
Polar coordinates of the pierce point of the reference datum plane and the cylinder diameter. U is the distance along the line from the origin to the pierce point and V is the angle between this line and the major axis.



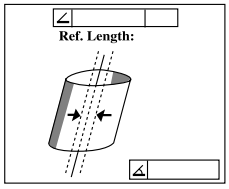
The screen shows the squareness. The squareness is computed as the tangent of the deviation angle from square, multiplied by the reference length.



The screen shows the parallelism. The parallelism is computed as the tangent of the deviation angle from parallel, multiplied by the reference length.



For oblique cylinders angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured elevation angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



Measurement Results

Cone Measurement

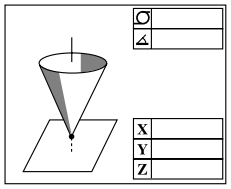
Measured cones are always projected into one of the datum planes (Top, Side, Front/Back planes). The system automatically determines the projection plane.

If the system can not determine the datum plane, a screen is displayed for you to select the datum plane. The system will compute the cone on the selected datum.

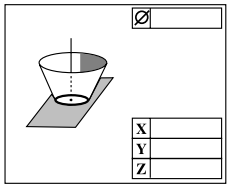
When measuring a cone, start your approach at least one ball diameter away from the surface. If you don't, the system will not know how to compensate for the probe diameter. A screen is displayed that instructs you to select an internal or external cone for measurement and press Done.

Measured Cone Results

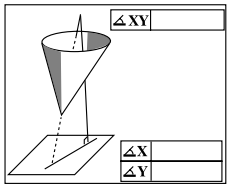
The screen displays the coordinates of the apex, angle, and the form error. The direction of the cone is from the base to the apex. Note: Use the System Option's "Cone Angle" option and specify half angle or full angle.



The system computes the pierce point at the intersection of the cone's axis and the reference datum plane, and the diameter at the pierce point level. If the cone does not intersect the reference plane, the diameter at the pierce point is zero.

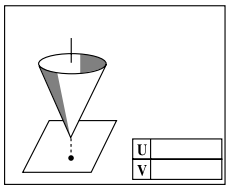


If the cone is not square to a datum plane, the system computes the elevation angle (0°-90°) with the datum and the rotation angles (0°-180°). Rotation angles are the included angles with the major and minor axes of the cone's direction vector projected on the reference plane.

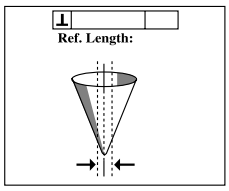


Measurement Results

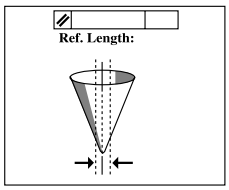
Polar coordinates of the pierce point of the reference datum plane and the cone diameter. U is the distance along the line from the origin to the pierce point and V is the angle between this line and the major axis.



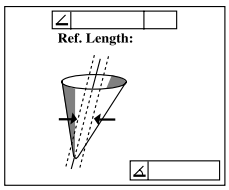
The screen shows the squareness. The squareness is computed as the tangent of the deviation angle from square, multiplied by the reference length.



The screen shows the parallelism. The parallelism is computed as the tangent of the deviation angle from parallel, multiplied by the reference length.



For oblique cones angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured elevation angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



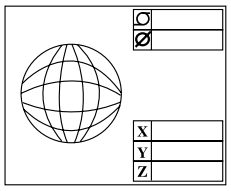
Measurement Results

Sphere Measurement

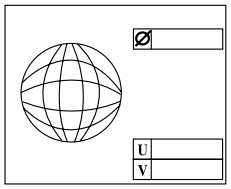
When measuring a sphere, start your approach at least one ball diameter away from the surface. If you don't, the system will not know how to compensate for the probe diameter. A screen is displayed that instructs you to select an internal or external sphere for measurement and press Done.

Measured Sphere Results

The screen displays the XYZ coordinates of the center, the diameter and the form error.



Polar coordinates and the sphere diameter. The polar coordinates are reported on the level plane (XY). U is the distance along the line from the origin to the projection of the sphere center onto the level plane and V is the angle between this line and the major axis.



Measurement Results - Relationships

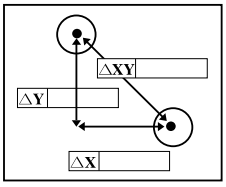
Point - Point

Both Points Measured with a Tapered Probe

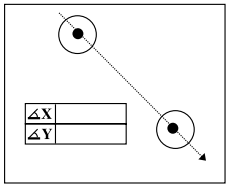
Same Reference Plane

The screen displays the distance along the major and minor axes and the 2D distance between the points. The axes are determined by the measurement approach direction.

Measurement Axis	Major and Minor Axes
Z Axis	X and Y
X Axis	Y and Z
Y Axis	X and Z

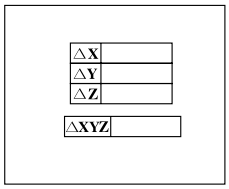


The screen displays a 2D line through both points. The direction is from the first to the second point. The angle of the line with the major and minor axes is displayed.



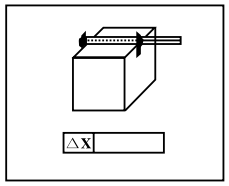
Different Reference Planes

The screen displays the 1D distance along the each datum axis and the 3D distance between the points.

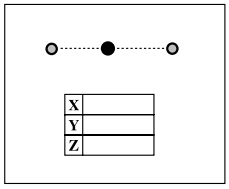


Both Points Measured with a Ball or TTP

The screen displays the distance between the two points along the measurement axis.



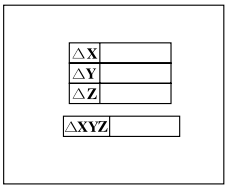
The screen displays the XYZ location of the midpoint between the two points, along the 3D line connecting the points.



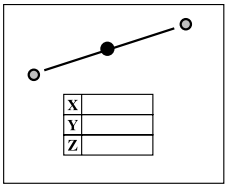
Measurement Results - Relationships

Both Points Are Constructed

The screen displays the 1D distance along the each datum axis and the 3D distance between the points.

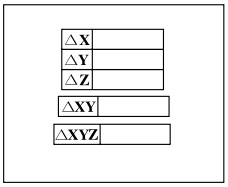


The screen displays the XYZ location of the midpoint between the two points, along the 3D line connecting the points.

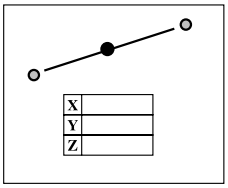


Points Are Measured with a Tapered Probe and Constructed

The screen displays the 1D distance along the each datum axis and the 2D and 3D distance between the points.

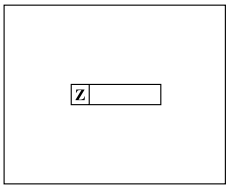


The screen displays the XYZ location of the midpoint between the two points, along the 3D line connecting the points.



Points Are Measured with a Ball or TTP and Constructed

The screen displays the 1D distance along the approach axis of the measured point.



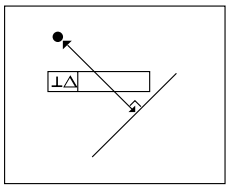
Appendix

Measurement Results - Relationships

Point - Line

Constructed Point and Any Line

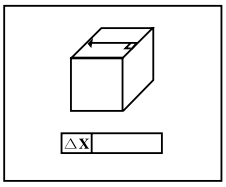
The screen displays the perpendicular distance from the point to the line.



Point and Line Measured with a Ball or TTP

The screen displays the perpendicular distance from the point to the line.

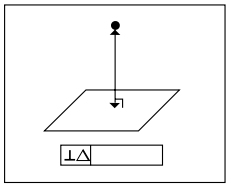
The point (without probe correction) is projected into the reference plane of the line. The distance is the perpendicular distance from the projected point to the line adjusted by the probe radius.



Point - Plane

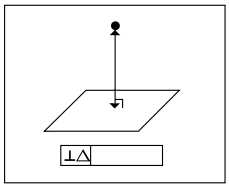
Constructed Point and Any Plane

The screen displays the perpendicular distance from the point to the plane.



Point and Plane Measured with a Ball or TTP

The screen displays the perpendicular distance from the point to the plane.

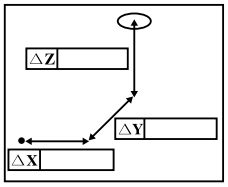


Measurement Results - Relationships

Point - Circle

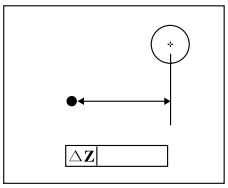
Constructed Point and Any Circle

The screen displays the 1D distance Between the center of the circle and the point along each datum axis.



Point Measured with a Ball or TTP and Any Circle

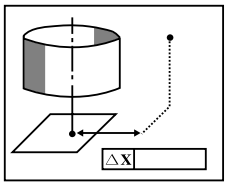
The screen displays the 1D distance between the point and the center of the circle along the measurement axis of the point.



Point - Cylinder

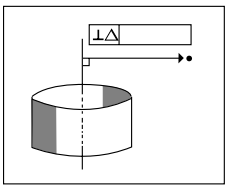
Point Measured with a Ball or TTP and Any Cylinder

The screen displays the 1D distance between the point and the pierce point of the cylinder along the measurement axis of the point.



Constructed Point and Any Cylinder

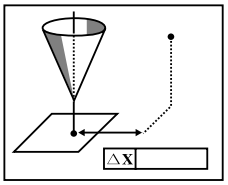
The screen displays the perpendicular distance from the point to the cylinder's axis.



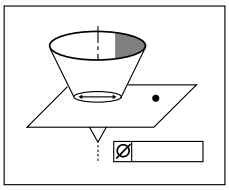
Measurement Results - Relationships

Point - Cone

Point Measured with a Ball or TTP and Any Cone

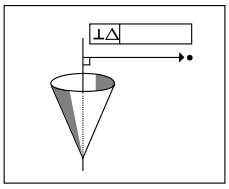


The screen displays the 1D distance between the point and the pierce point of the cone along the measurement axis of the point.

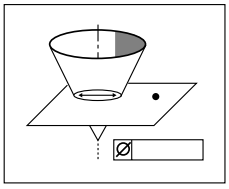


The screen displays the diameter of the cone at a plane perpendicular to the cone's axis passing through the point. If the plane is below the apex of the cone, the diameter is 0.

Constructed Point and Any Cone



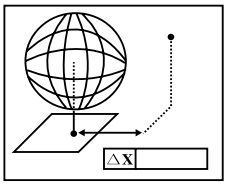
The screen displays the perpendicular distance from the point to the cone's axis.



The screen displays the diameter of the cone at a plane perpendicular to the cone's axis passing through the point. If the plane is below the apex of the cone, the diameter is 0.

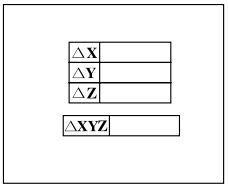
Point - Sphere

Point Measured with a Ball or TTP and Any Sphere



The screen displays the 1D distance between the point and the center of the sphere along the measurement axis of the point.

Constructed Point and Any Sphere



The screen displays the 1D and 3D distances between the point and the center of the sphere.

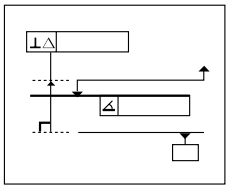
Measurement Results - Relationships

Line - Line

Both Lines on the Same Reference Plane

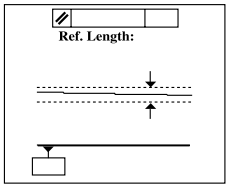
Parallel Lines

The screen displays the parallel angle and the perpendicular distance between the two lines. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).



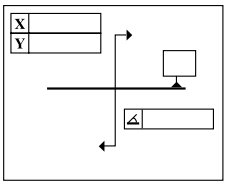
The perpendicular distance is computed from the centroid of the first line to the second line.

The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature.

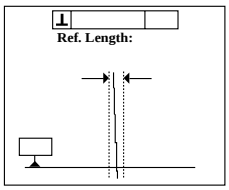


Square Lines

The screen displays the square angle and the intersection point of the two lines. The angle shows the direction of out-of-square and the deviation from a perfect square (90°).



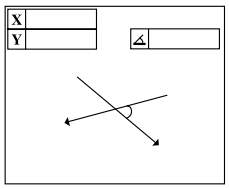
The squareness is computed as the tangent of the square angle multiplied by the reference length of the non-datum feature.



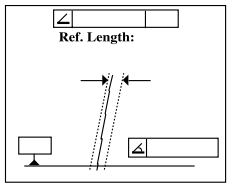
Measurement Results - Relationships

Non-Parallel and Non-Square Lines

The screen displays the intersection point and the included angle between the two lines. Each line is drawn in the measured orientation.

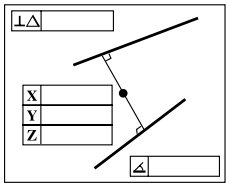


The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured included angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



Both Lines in Different Reference Planes

The screen displays the coordinates of the half-way point along the perpendicular between the two lines. It also displays the shortest distance between the lines and the included angle between the lines (0-180°).

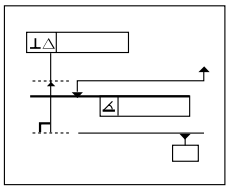


Measurement Results - Relationships

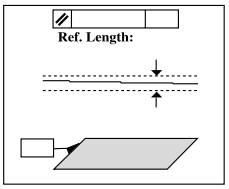
Line - Plane

Line (2D or 3D) Parallel to Plane

The screen displays the parallel angle and the perpendicular distance between the line and the plane. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).



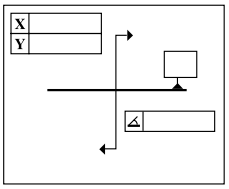
The perpendicular distance is computed from the centroid of the line to the plane.



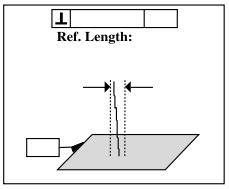
The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature.

Line Square to Plane

The screen displays the square angle and the intersection point between the line and the plane. The angle shows the direction of out-of-square and the deviation from a perfect square (90°).

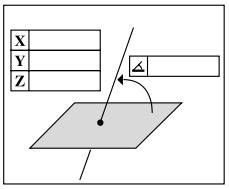


The squareness is computed as the tangent of the square angle multiplied by the reference length of the non-datum feature.

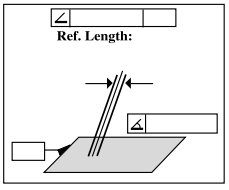


Line (3D) Oblique to Plane

The screen displays the coordinates of the intersection point and the elevation angle between the line and the plane (0-90°).



The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured elevation angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.

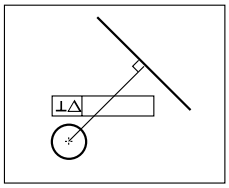


Measurement Results - Relationships

Line - Circle

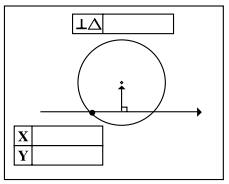
Non-Intersecting Line and Circle on Same Reference Plane

The screen displays the perpendicular distance from the center of the circle to the line.

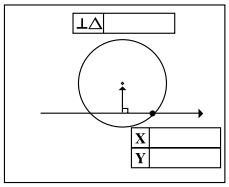


Intersecting Line and Circle on Same Reference Plane

The screen displays the first intersection point between the line and the circle. This is the point where the line enters the circle in the direction of the line. The perpendicular distance is computed from the center of the circle to the line.



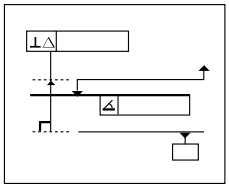
The screen displays the second intersection point between the line and the circle. This is the point where the line exits the circle in the direction of the line. The perpendicular distance is computed from the center of the circle to the line.



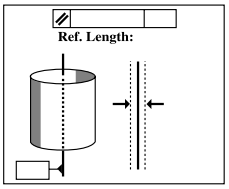
Measurement Results - Relationships

Line - Cylinder

Line Parallel to Cylinder



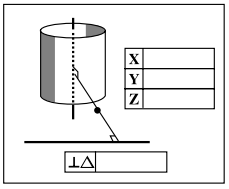
The screen displays the parallel angle and the perpendicular distance between the line and the cylinder. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).



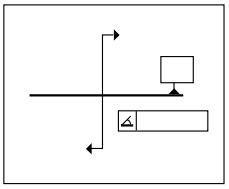
The perpendicular distance is computed from the pierce point of the cylinder to the line.

The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature.

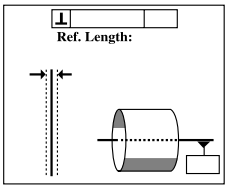
Line Square to Cylinder



The screen displays the coordinates of the half-way point along the perpendicular between the cylinder and the line. It also displays the shortest distance between the line and the axis of the cylinder.



The screen displays the square angle that shows the direction of out-of-square and the deviation from a perfect square (90°) between the line and the cylinder.

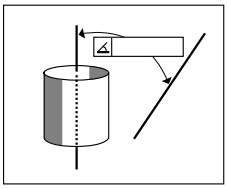


The squareness is computed as the tangent of the square angle multiplied by the reference length of the non-datum feature.

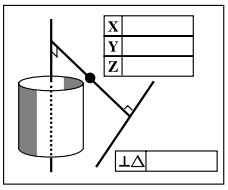
Measurement Results - Relationships

Line Oblique to Cylinder

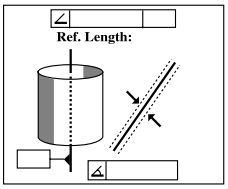
The screen displays the included angle between the line and the cylinder.



The screen displays the coordinates of the half-way point along the perpendicular between the cylinder and the line. It also displays the shortest distance between the line and the axis of the cylinder.



The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured included angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.

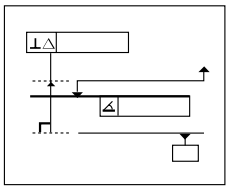


Measurement Results - Relationships

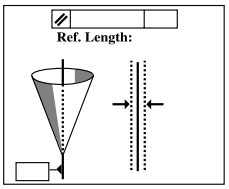
Line - Cone

Line Parallel to Cone

The screen displays the parallel angle and the perpendicular distance between the line and the cone. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).



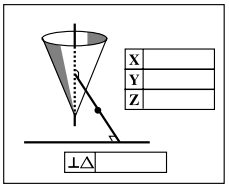
The perpendicular distance is computed from the apex of the cone to the line.



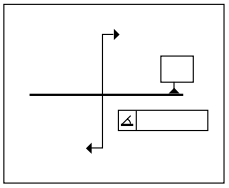
The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature.

Line Square to Cone

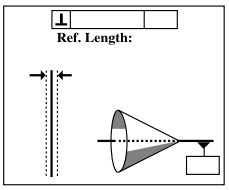
The screen displays the coordinates of the half-way point along the perpendicular between the cone and the line. It also displays the shortest distance between the line and the axis of the cone.



The screen displays the square angle that shows the direction of out-of-square and the deviation from a perfect square (90°) between the line and the cone.



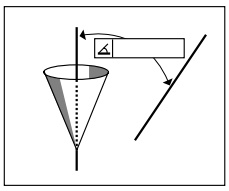
The squareness is computed as the tangent of the square angle multiplied by the reference length of the non-datum feature.



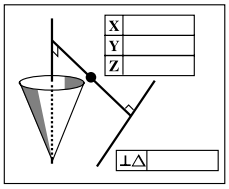
Measurement Results - Relationships

Line Oblique to Cone

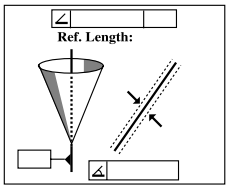
The screen displays the included angle (0-180°) between the line and the cone.



The screen displays the coordinates of the half-way point along the perpendicular between the cone and the line. It also displays the shortest distance between the line and the axis of the cone.

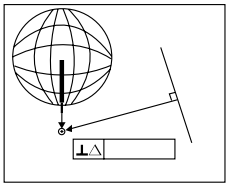


The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured included angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



Line - Sphere

The screen displays the perpendicular distance from the sphere center to the line projected onto the reference datum plane.

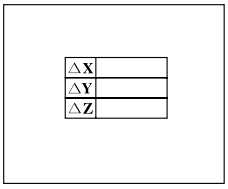


Measurement Results - Relationships

Circle - Circle

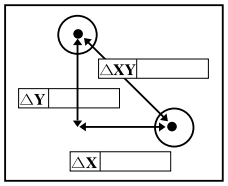
Different Reference Planes

The screen displays the distance between the centers of each circle along the datum axes.

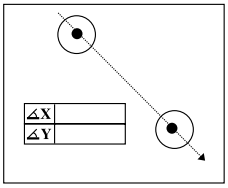


Same Reference Planes

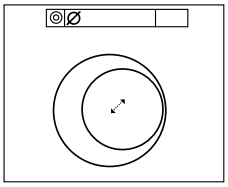
The screen displays the distance between the circle centers along the major and minor axes of the reference datum plane and the 2D distance between the centers.



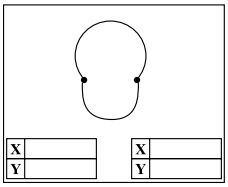
The screen displays the angles of the line passing through the center of the circles with the major and minor datum axes. The direction of the line is from the first to the second circle.



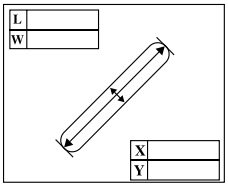
The concentricity is computed as twice the distance between the circle centers. It is displayed only if it is less than the maximum radius of the circles.



The screen displays the coordinates of the circle intersection points along the major and minor axes.



The screen displays the coordinates of the midpoint of the slot, the width and the length of the slot.

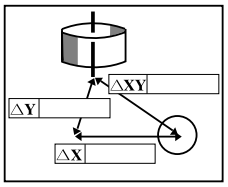


Measurement Results - Relationships

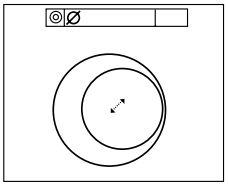
Circle - Cylinder

Same Reference Planes

The screen displays the distance between the circle center and the pierce point of the cylinder along the major and minor axes of the reference datum plane. It also displays the 2D distance between the two points.

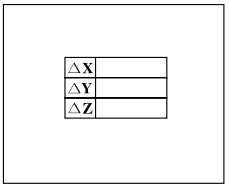


The concentricity is computed as twice the distance between the pierce point of the cylinder and the circle center. It is displayed only if it is less than the maximum radius of the circle and cylinder.



Different Reference Planes

The screen displays the distance between the center of the circle and the pierce point of the cylinder along the datum axes.

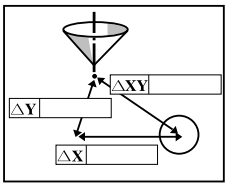


Measurement Results - Relationships

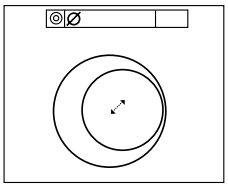
Circle - Cone

Same Reference Planes

The screen displays the distance between the circle center and the pierce point of the cone along the major and minor axes of the reference datum plane. It also displays the 2D distance between the two points.

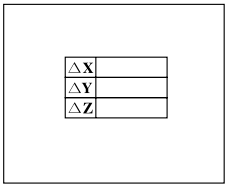


The concentricity is computed as twice the distance between the pierce point of the cone and the circle center. It is displayed only if it is less than the maximum radius of the circle.



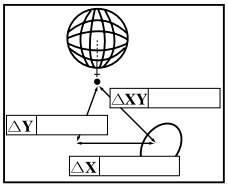
Different Reference Planes

The screen displays the distance between the center of the circle and the pierce point of the cone along the datum axes.



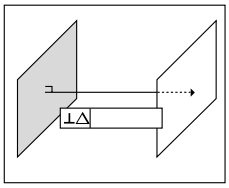
Circle - Sphere

The screen displays the distance between the sphere center and the circle center projected onto the reference datum plane. It also displays the 2D distances along the major and minor axes.



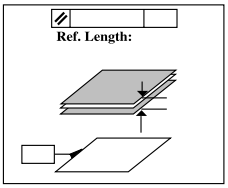
Measurement Results - Relationships

Plane - Plane



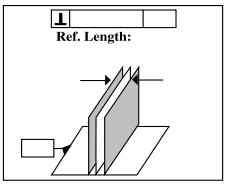
Parallel Planes

The perpendicular distance is computed from the centroid of the second plane to the first.

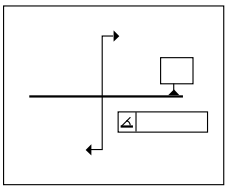


The parallelism is computed as the tangent of the deviation from parallel multiplied by the reference length of the non-datum feature (the second plane).

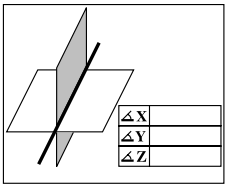
Square Planes



The squareness is computed as the tangent of the deviation from square multiplied by the reference length of the non-datum feature (the second plane).



The screen displays the square angle that shows the direction of out-of-square and the deviation from a perfect square (90°) between the two planes.

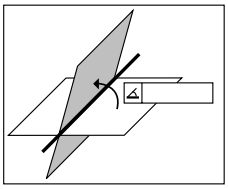


The screen displays the angles of the intersection line between the two planes with each datum axis.

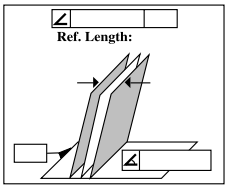
Measurement Results - Relationships

Plane - Plane

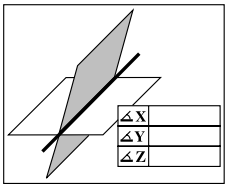
Non-Parallel and Non-Square Planes



The screen displays the included angle (0-90°) between the two planes.



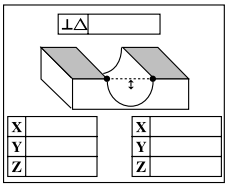
The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length of the non-datum feature. The system uses the measured included angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



The screen displays the angles of the intersection line between the two planes with each datum axis.

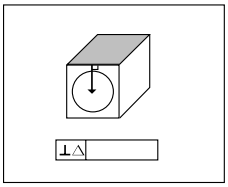
Plane - Circle

Intersecting



The screen displays the coordinates of both intesection points and the perpendicular distance from the center of the circle to the plane.

Non-Intersecting

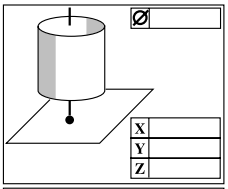


The screen displays the perpendicular distance from the center of the circle to the plane.

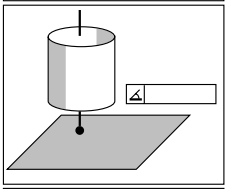
Measurement Results - Relationships

Plane - Cylinder

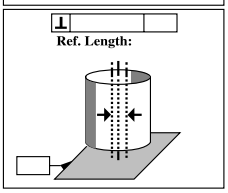
Plane and Cylinder are Orthogonal



The screen displays the coordinates of the intesection point of the cylinder's axis and the plane along with the diameter of the cylinder.

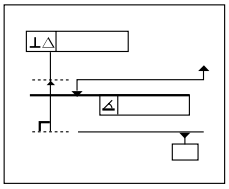


The screen displays the elevation angle (0-90°) between the cylinder and the plane.



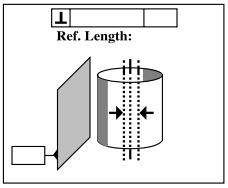
The squareness is computed as the tangent of the deviation from the square multiplied by the reference length of the non-datum feature.

Plane and Cylinder are Parallel



The screen displays the parallel angle and the perpendicular distance between the plane and the cylinder. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).

The perpendicular distance is computed from the pierce point of the cylinder to the plane.

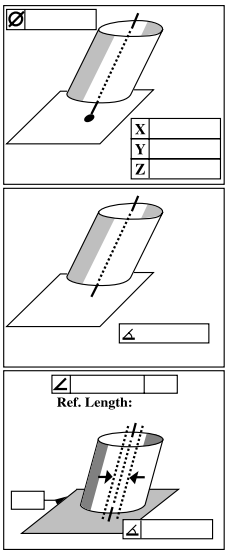


The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature.

Measurement Results - Relationships

Plane - Cylinder

Other



The screen displays the coordinates of the intesection point of the cylinder's axis and the plane along with the diameter of the cylinder.

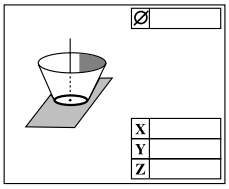
The screen displays the elevation angle (0-90°) between the cylinder and the plane.

The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length of the non-datum feature.

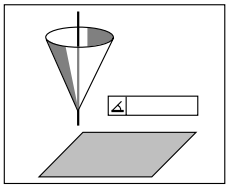
Measurement Results - Relationships

Plane - Cone

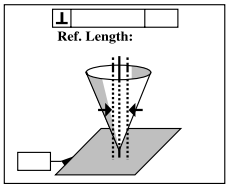
Plane and Cone are Orthogonal



The screen displays the coordinates of the intesection point of the cone's axis and the plane along with the diameter of the cone at the intersection point. If the plane does not intersect the cone, the diameter is zero.

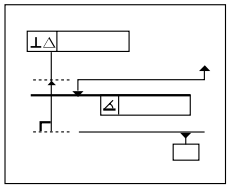


The screen displays the elevation angle (0-90°) between the cone and the plane.



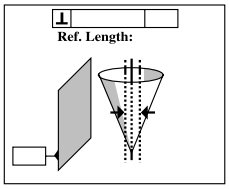
The squareness is computed as the tangent of the deviation from the square multiplied by the reference length of the non-datum feature.

Plane and Cone are Parallel



The screen displays the parallel angle and the perpendicular distance between the plane and the cone. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).

The perpendicular distance is computed from the apex of the cone to the plane.



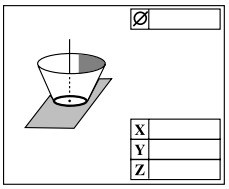
The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature.

Measurement Results - Relationships

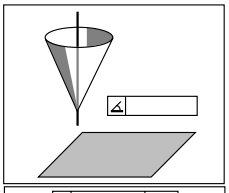
Plane - Cone

Other

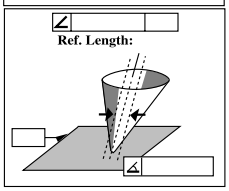
The screen displays the coordinates of the intesection point of the cone's axis and the plane along with the diameter of the cone at the intersection point. If the plane does not intersect the cone, the diameter is zero.



The screen displays the elevation angle (0-90°) between the cone and the plane.



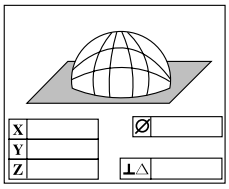
The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length of the non-datum feature.



Plane - Sphere

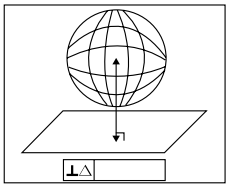
Plane Intersects With Sphere

The screen displays the diameter and coordinates of the center of the intesection circle and the perpendicular distance from the center of the sphere to the plane.



Plane Does Not Intersect Sphere

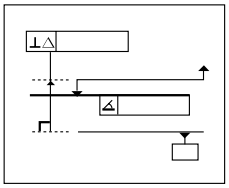
The screen displays perpendicular distance from the center of the sphere to the plane.



Measurement Results - Relationships

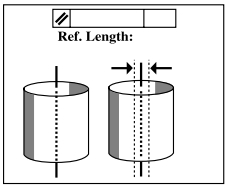
Cylinder - Cylinder

Parallel Cylinders



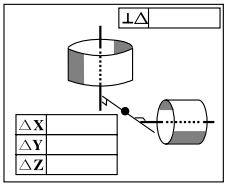
The screen displays the parallel angle and the perpendicular distance between the two cylinders. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).

The perpendicular distance is computed from the pierce point of the second cylinder to the axis of the first.

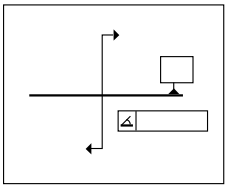


The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature (the second cylinder).

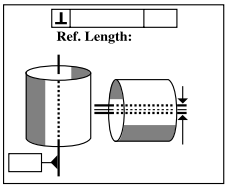
Square Cylinders



The screen displays the coordinates of the half-way point along the perpendicular between the two cylinders. It also displays the shortest distance between the cylinders.



The screen displays the square angle that shows the direction of out-of-square and the deviation from a perfect square (90°).

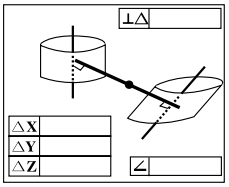


The squareness is computed as the tangent of the square angle multiplied by the reference length of the non-datum feature.

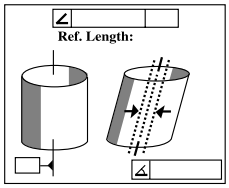
Measurement Results - Relationships

All Other Cases

The screen displays the coordinates of the half-way point along the perpendicular between the two cylinders. It also displays the shortest distance between the cylinders and the included angle.



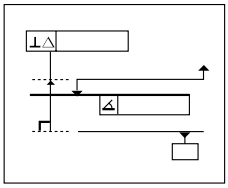
The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured included angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



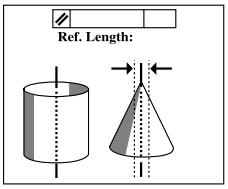
Measurement Results - Relationships

Cylinder - Cone

Cylinder Parallel to Cone

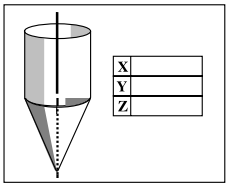


The screen displays the parallel angle and the perpendicular distance between the cone and the cylinder. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).



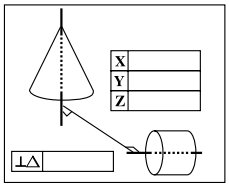
If the cone was measured first, the perpendicular distance is computed from apex of the cone to the axis of the cylinder.

The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature.

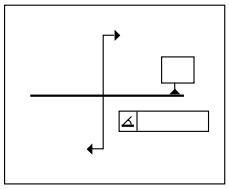


If the cone and cylinder are concentric, the system will display the "Intersecting Cone and Cylinder" screen. The X, Y, and Z coordinates are the coordinates of the intersect point.

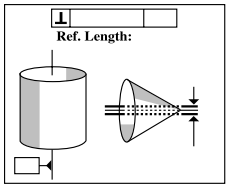
Cylinder Square to Cone



The screen displays the coordinates of the half-way point along the perpendicular between the cylinder and the cone. It also displays the shortest distance between the cone and the cylinder axis.



The screen displays the square angle that shows the direction of out-of-square and the deviation from a perfect square (90°).

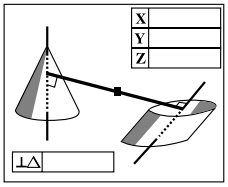


The squareness is computed as the tangent of the square angle multiplied by the reference length of the non-datum feature.

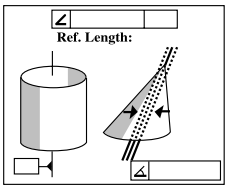
Measurement Results - Relationships

All Other Cases

The screen displays the coordinates of the half-way point along the perpendicular between the cylinder and the cone. It also displays the shortest distance between the cone and the cylinder axis.

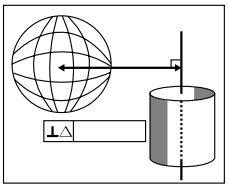


The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured included angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



Cylinder - Sphere

The screen displays the perpendicular distance computed from the center of the sphere to the axis of the cylinder.

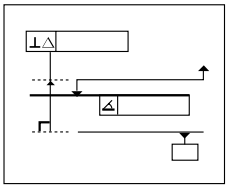


Measurement Results - Relationships

Cone - Cone

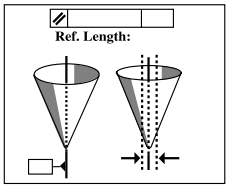
Parallel Cones

The screen displays the parallel angle and the perpendicular distance between the two cones. The angle shows the direction of out-of-parallel and the deviation from a perfect parallel (0°).

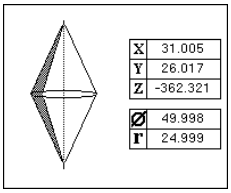


The perpendicular distance is computed from apex of the second cone to the axis of the first.

The parallelism is computed as the tangent of the parallel angle multiplied by the reference length of the non-datum feature (the second cone).

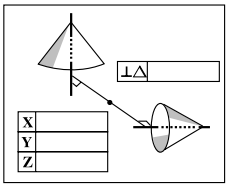


If the cones are concentric, the system will display the "Intersecting Cones" screen. The X, Y, Z and diameter coordinates are the coordinates of the intersect point.

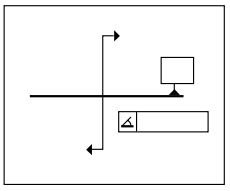


Square Cones

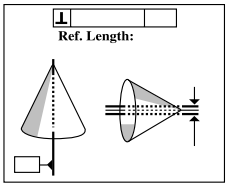
The screen displays the coordinates of the half-way point along the perpendicular between the two cones. It also displays the shortest distance between the cones.



The screen displays the square angle that shows the direction of out-of-square and the deviation from a perfect square (90°).



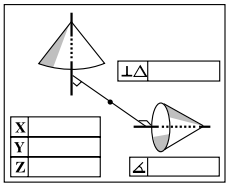
The squareness is computed as the tangent of the square angle multiplied by the reference length of the non-datum feature.



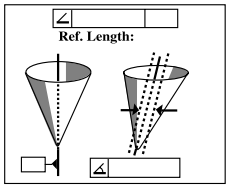
Measurement Results - Relationships

All Other Cases

The screen displays the coordinates of the half-way point along the perpendicular between the two cones. It also displays the shortest distance between the cones and the included angle.

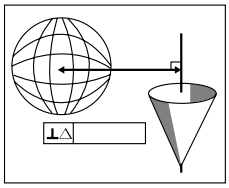


The angularity is computed as the tangent of the deviation from the reference angle, multiplied by the reference length. The system uses the measured included angle as the default reference angle. Use the Tolerance softkey to define the nominal reference angle.



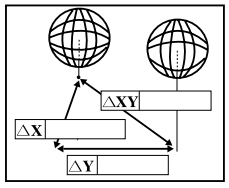
Cone - Sphere

The screen displays the perpendicular distance computed from the center of the sphere to the axis of the cone.

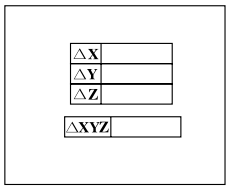


Sphere - Sphere

The screen displays the distances between the sphere centers projected onto the XY plane. It also displays the 2D distance.



The screen displays the distances along each axis and the 3D distance between the centers of the spheres.



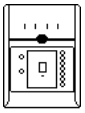
Measurement Results - Notes

System Softkeys

The following list of softkeys will help you identify them as they appear in the software:


Abort


Single Feature Mode


Insert Software Card


Enter Time


Done


Relationship Mode


Enter Date


Cycle Option


Clear Last Hit


Frown Face Error


Serial Out


Next Result Window


Print


ISO Tolerance


Scroll Up 10

Tolerance


Scroll Up

Change Axis


Scroll Down 10


Lower Menu


Scroll Down

Zero X Axis

Enter Text


Upper Menu


Next Screen, Move right

Zero Y Axis

Zero XYZ

Enter Value


Move Left

Zero Z Axis

X Axis


Change Feature


Probes


Scale Up

Y Axis

Set Level


Recall Datum


Scale Down

Z Axis

Set Axis

System Options

Service Utilities

Playback Stop

Set Origin

Minus 1

Requalify

Store Feature

Delete Current Block

Plus 1

Qualify Additonal Tip

Set Zero

Incremental Zero

Absolute Zero

Select

Recall Probe Tip

Tools Menu

Change Sign

Appendix

System Softkeys

The following list of softkeys will help you identify them as they appear in the software:

Counter / Scribe Mode


Dial Indicator Mode


Height Gauge Mode


Digitize Mode


Measurements Mode


Datum Menu


Translate Datum


Rotate Datum


Constructions


Construct a Line


Construct a Circle


Construct a Plane


Symmetry Line


Symmetry Point


SymmetryPlane

Projection Point


Construct From Datum


Reset Measure-ment Mode


Playback Utilities

Execute A Block


Exit Playback


Statistical Histogram

Enable Statistics

Disable Statistics


Delete Record


Statistical Summary


Statistical Run Chart

Copy Mean


Print Headers

Select Reference Feature


Part Drawing


Print Top View (XY)


Print Front View (ZX)


Print Side View (YZ)


Select Probe Type


Save Startup Probe


Delete Program


Format Storage Card


List Programs


Save Probe Tip

Save Program

Recall Program

Save Datum

Digitize Outline

Restart Playback

Force Cone

Inside Cone

Outside Cone

Inside Sphere

Outside Sphere

Force Cylinder

Outside Cylinder

Inside Cylinder / Circle

Outside Circle

Force Plane

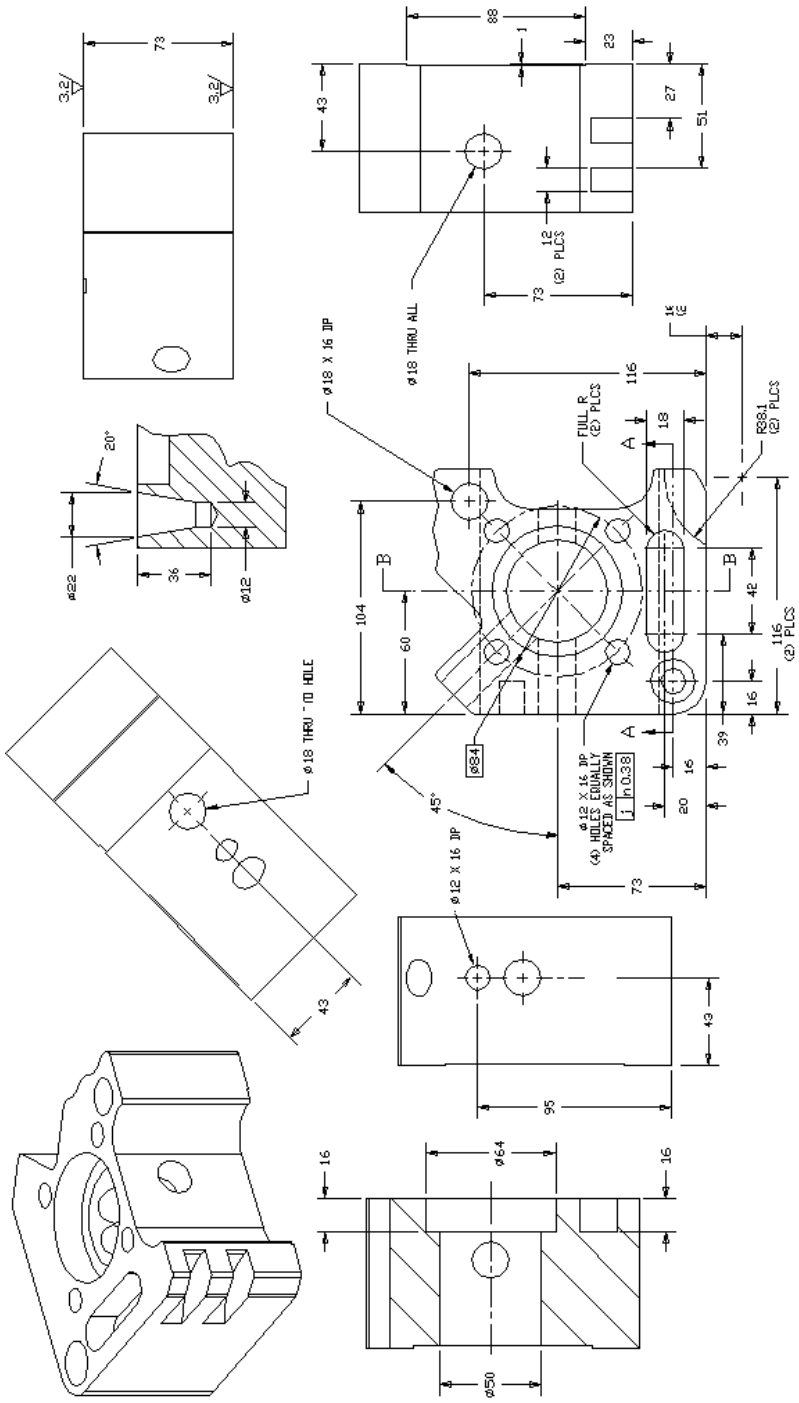
Force Line

X Axis

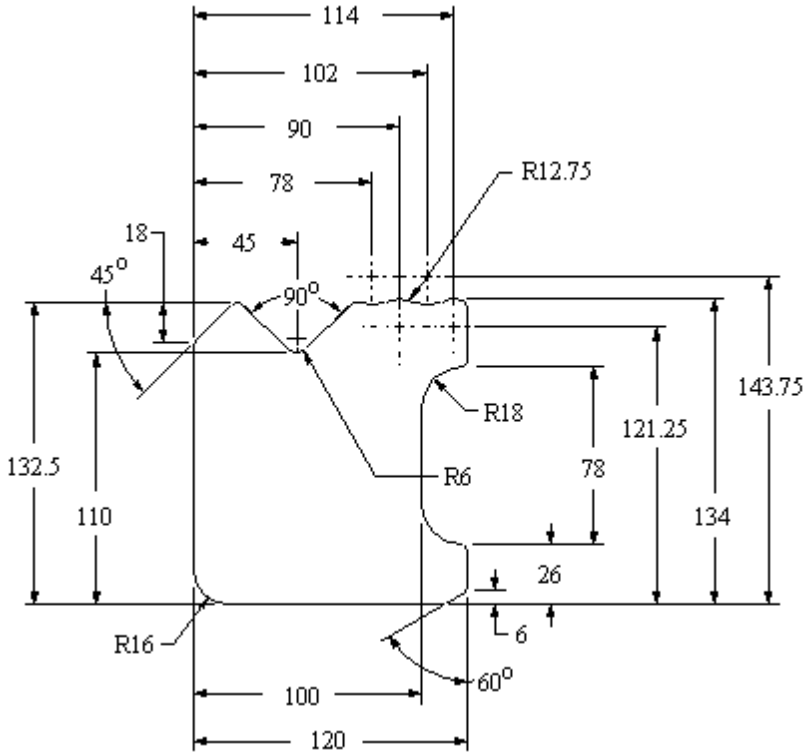
Y Axis

Z Axis

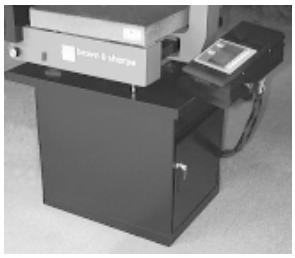
Demo Block Print



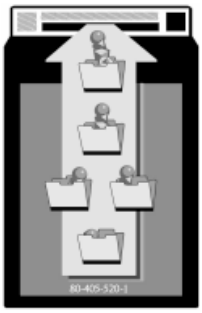
Demo Block Print



Optional Hardware



Machine Stand / Cabinet
80-480-152



Storage Card
80-405-520-1

10' Null Modem
Serial Cable
80-406-782

RefleX Scan
(Digitizing Utility)
180-489-635-2

Dot Matrix Printer
180-406-227-2

Switch Box kit
180-415-344

Air Saver
182-1206

"Derby" Ball Bar Kit
182-1160

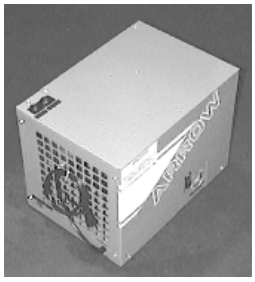
Clamp Kit
700-166

Data Page RT
180-489-292

RefleX Demo Block
82-1631

Vorne Display

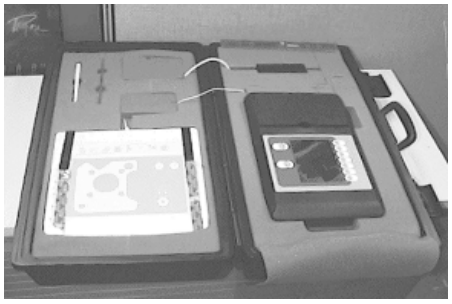
Picture Not available
Ball Bar Kit
682-104



80-462-113-1
Refrigerated Air Dryer

Machine Cover
82-1040

B&S Demo Block
82-586



Demo Kit (Distributors only)
181-242

Optional Hardware

Ball Probes
(1/4" shown)
1/8" Ball Probe 80-407-119
1/4" Ball Probe 80-407-120
3/8" Ball Probe 80-407-121
1/2" Ball Probe 80-407-122

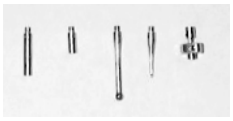
Adjustible Scribe
(Adj Probe Holder
Sold separately)
80-407-135
Replacement Tip
700-164

Adj Probe Holder
80-407-137

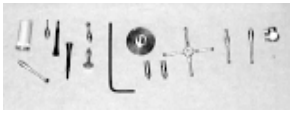
MIP Probe Kit
180-407-268-5

Adjustable Ball Probes
(1/8" shown)
(Adj Probe Holder sold separately)
1/8" Adj Ball Probe 80-407-123
1/4" Adj Ball Probe 80-407-124
3/8" Adj Ball Probe 80-407-125
3/4"Adj Ball Probe 80-407-136

Universal Probe Holder
(horizontal machines)
183-813



Stylus Kit #103
80-407-274



Stylus Kit #201
(Case Not Shown)
700-190-118

Ram Optical System
682-121

Chuck Adapter Probe
80-407-132

Adj. Probe Adapter
80-407-131

M3-M2 Adapter
REPBSA3RU

Edge Probe
(Zero Diameter Probe)
80-407-134

0-.57" Taper Probe
80-407-127

.37-.80" Taper Probe
80-407-128

.77-1.2" Taper Probe
80-407-129

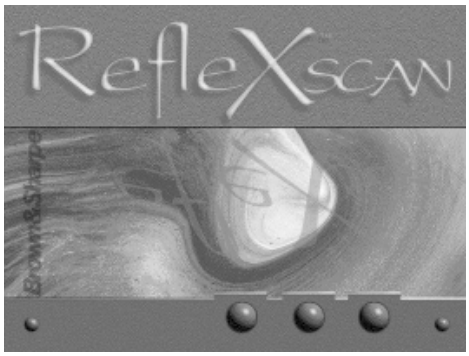
1.17-1.6" Taper Probe
80-407-130

RefleX Scan

RefleX Scan is an optional reverse-engineering package for Windows 95/98 used in conjunction with the RefleX system. As you take points in the Digitize mode, information sent out the serial port via the null modem cable is captured by this tool. RefleX Scan takes the data and converts it to workable DXF, IGES, VDA, or GCODE CAD files. These CAD files contain non-probe compensated data (ball center data) only. The user must rely on the capabilities of the CAD system to subtract out the probe radius.

Installation:

1. Place diskette 1 into floppy drive.
2. From the "Start" menu, select "Run".
3. Enter "a:\setup.exe".
4. Follow instructions on screen.
5. Further help is available in RefleX Scan's on-line help.



Normal operating procedure:

1. Turn on RefleX. Enter the Digitize mode
2. Turn on the host computer. Run RefleX Scan
3. Configure the RefleX Scan utility to match RefleX's serial port settings.
4. Enter an appropriate intermediate file name in the capture screen. (ex. "mypart.xyz"). Press the "Connect" button.
5. Begin scanning the part while RefleX Scan captures the data.
6. Press the "Disconnect" button to end the scan. Press "Cancel" to quit the "Data Capture" screen.
7. Press the "Convert" button.
8. Select the desired options for the output file. Verify the output file name is correct.
9. Press the "Start" button. After the "Conversion Successful" dialog appears, press "OK".

Package contents:

2 RefleX Scan installation disks.
1 RS232 Null Modem cable.

RefleX Scan

The Configure Dialog:

Port Select - This is the port RefleX Scan RS232 cable connects to on the host computer (Usually COM1 or COM2).

Baud Rate - This is the speed RefleX Scan receives the data. This setting must match the setting in RefleX's "Printer & Serial Port Setup" menu. Available options: 1200, 2400, 4800, 9600. If you have problems, set this option to 1200 in RefleX and RefleX Scan.

Parity - This setting helps prevent serial communication errors. This setting must match the setting in RefleX's "Printer & Serial Port Setup" menu. Available options: None, Odd, Even. If you have problems, set this option to either odd or even in RefleX and RefleX Scan.

Data Bits - Also known as "Word Length", this setting represents the amount of data to be sent at one time. This setting must match the setting in screen 4 of RefleX's system options.

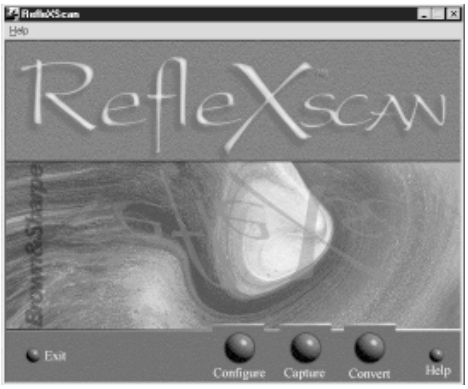
Stop Bits - This setting represents the number of bits used to represent the end of a word transmission. This setting must match the setting in RefleX's "Printer & Serial Port Setup" menu.

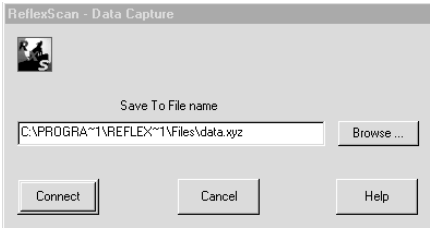
OK - Keeps these settings for this session only, unless the Save button has been pressed previously.

Cancel - Disregard all setting changes.

Help - Invoke on-line help, similar to this page.

Save - Saves all settings.





The Capture Dialog:

Connect - After entering a valid path and file name with the "xyz" extension, press this button to proceed to the next screen.

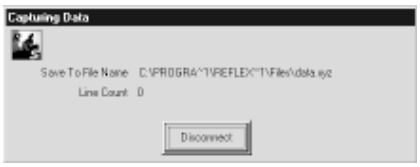
Cancel - Disregard all entered information.

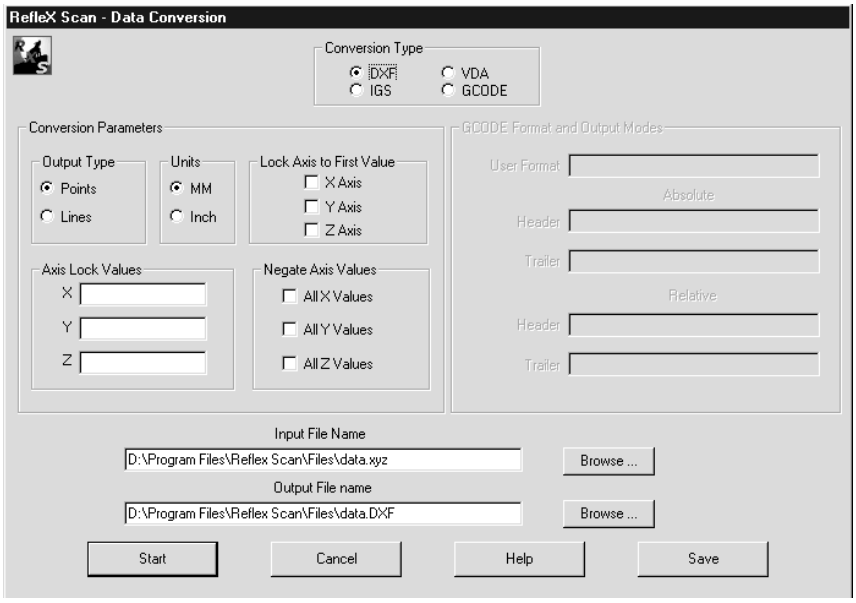
Help - Invoke on-line help, similar to this page.

Browse - Browse for a location to save the file.

RefleX Scan

The Capture Dialog #2:
After pressing the "Connect button" this dialog appears. As points are taken, the "Line Count" will increment: (0, 1, 2, 3... etc.)
Disconnect - When finished collecting data, press the disconnect button.





The Convert Dialog:
Conversion Type - Choose the output file type: DXF, IGS, VDA, GCODE.
Output Type - If "Points" is selected, the cad file will consist of points. If "Lines" is selected, the cad system will connect all of these points.
Units - Select Inches or millimeters: Inch, MM.
Lock Axis to first value - The first X, Y, or Z position, used in all subsequent points.
Axis Lock Value - The X, Y, or Z position entered, used in all subsequent points.
Input File Name - The name of the file entered in the capture screen. (ex. mypart.xyz)
Output File Name - The desired name for the output CAD file. (ex. mypart.dxf)
Start - Begins the conversion process.
Cancel - Disregard all setting changes.
Help - Invoke on-line help
Save - Save all settings.
Browse - Browse for a file location.

RefleX Scan - Frequently Asked Questions

Q: Will RefleX Scan work in Windows NT or 2000?
A: Some customers have reported that RefleX Scan 1.5 works in Win NT. However, because it has not been extensivly tested, it is not yet supported.

Q: What type of serial cable does RefleX Scan use?
A: RefleX Scan uses a standard null modem serial cable.

Q: How can I use DXF files in AutoCad 12/13?
A: Because of the changed requirements for AutoCad 12/13 DXF files, RefleX Scan version 1.0 will not work in AutoCad 12/13. To correct the problem, install RefleX Scan 1.2 or the later version 1.5

Q: How can I update to the latest version 1.5?
A: Contact reflexsupport@us.bnsmc.com

Q: Where can I get answers to my RefleX Scan questions and report any RefleX Scan problems?
A: You can talk with your local distributor and, in addition, you can use the RefleX support email address: reflexsupport@us.bnsmc.com

Q: Is RefleX Scan Year 2000 Compliant (Y2K)?
A: Because RefeX Scan does not use any time/date functions, RefleX Scan is inherently Year 2000 Compliant.

Q: When I look at a RefleX Scan CAD file, the points appear to be offset.
A: The points are offset because the RefleX and RefleX Scan systems do not probe compensate the data. For this operation, you must rely on the CAD system.

Q: My RefleX Scan won't install/run?
A: Verify that oleaut32.dll, olepro32.dll, msvcrt40.dll, & msvcrt.dll are in the Windows "System" directory. These files can be obtained from the Windows 95 and Windows 98 installation CDs.

Q: RefleX Scan seems to be installed correctly, but it is not collecting data.
A: Most problems with RefleX Scan involve the serial link between the host computer and the RefleX Controller. Establish that link, using the "Connect RefleX to a host PC" procedure. (next page)

Connecting RefleX to a Host Computer

The following is the setup and procedure for sending data from the RefleX system to a host computer running Windows NT or Windows 95 via the Hyperterminal program. Although there are slight differences between the Win NT version of Hyperterminal and the Win 95 version, the connection process is almost the same.

Finding Hyperterminal on the host computer:

1. Click on the Start Menu
2. Click on the Accessories folder
3. Click on the Hyperterminal folder
4. Click on the Hyperterminal program

Hyperterminal Configuration:

1. When prompted for a "Connection Description", press the cancel button.
2. From the File menu, select properties.
3. In the "Connect to" tab, select "Direct to COM1" in the "Connect using" option box.
4. Press the Configure button and set the following items and then press OK.
   Bits per Second: 9600
   Data bits: 8
   Parity: None
   Stop Bits: 1
   Flow Control: Xon/Xoff
5. In the "Settings" tab, change the Emulation type to VT100. Press OK
6. Hyperterminal is now properly configured. If you plan to perform this connection again, save this session using the "save as" in the file menu.

Capturing Data with Hyperterminal

1. From the "Transfer" menu, select the "Capture Text..." menu item. When prompted, enter an appropriate file name. (Default is: C:\Program Files\Accessories\Hyperterminal\ Capture.txt). Press the start button. Note: This name must be changed next time or your data will be overwritten!
2. From the "Call" menu, select the "Connect" menu item. In NT, the Connected "0:00:00" will now be incrementing. In Win 95 a name such as "RefleX" must be given to the "Connection Description" window, followed by OK, OK. This confirms the previously entered settings.

Connecting RefleX to a Host Computer

Sending Data from RefleX

1. From the second page of the Tools menu in the Measurement mode, Enter the "Output Selection" menu. Enable serial communications by selecting either Datapage, Gage Talker, Mitutoyo, Generic, or Print format.
2. As the part program is being created, press the mark screen button (looks like a lightning bolt) to designate which screens are to be outputted. If you do not wish to have certain values printed, tolerance them to "None".
3. Serial data will be exported when the program is executed in the playback mode.
4. Data can also be sent from the digitize mode.

Closing Hyperterminal

1. From the "Transfer" menu, select the "Capture Text..... Stop" menu items.
2. From the "Call" menu, select "Disconnect".
3. From the "File" menu, select "Exit" to close Hyperterminal.

Installing a Replacement Controller

General Procedure:

1. Load the Volcomp file.
2. AutoTune
3. Select Machine Type

1. Loading the Volcomp File

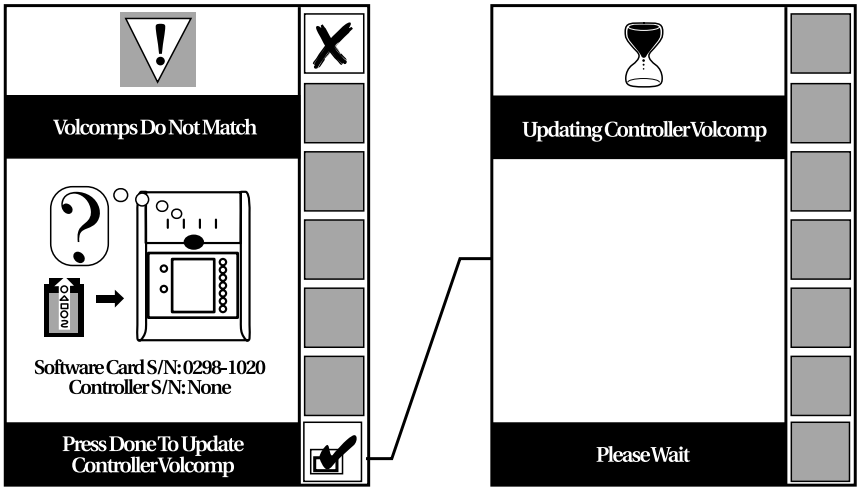
a. Install the controller as shown in the installation manual (cables, mountings, etc.)

b. Remove old software (top) and storage (bottom) smart cards from the old controller.

c. Insert the old cards into the new controller.

d. Turn on the new controller. Wait for language screen to appear. Select language. Press Done.

e. The volcomp load screen, shown below will appear. Press the Done softkey and your volcomp file will automatically be loaded from the software card.



IMPORTANT: Never swap software cards between multiple systems. Because the volcomp file is stored on the software card, as well as the controller, moving the software card to a new controller can cause problems which can only be resolved by a service call.

Note: The volcomp number, displayed at the upper left section of the homing screen, will now match the machine serial number found on the back of the machine.

Installing a Replacement Controller

2. AutoTuning

Please read the instructions in their entirety before attempting the AutoTune process. You will be entering the service utilities section of the software and can cause irreversible damage if not used correctly. Stay out of all areas unless specifically instructed by this document or by a service person. If you have questions, please contact your local service person before proceeding.

a. What is AutoTune?

AutoTune is the electronic process for adjusting the RefleX encoder signals. Before AutoTune, the tuning process had to be done by a qualified Brown & Sharpe service technician, resulting in downtime. Now, this process can be done faster and more accurately by you.

b. When should I do an AutoTune?

- After installing a replacement controller
- If "Rate Errors" appear.
- If instructed by a service person.

c. What should I do before an AutoTune?

- Verify that all encoder cables are plugged in securely in their proper port.
- Verify that scales are clean
- Check encoder's raw signal levels, described in section **g**.

d. What causes "Rate" errors?

A rate error is the electronics way of notifying you that the encoder signal quality is unacceptable. Because of that, exact machine position may be in error. There are many variables that can cause rate errors. There include:

- The controller is a new controller not yet Autotuned.
- An encoder cable is not plugged in securely
- The previous AutoTune was performed incorrectly.
- An encoder's performance has degraded or an encoder has slipped out of alignment.
- There is dust, dirt, oil, or a scratch on a scale.
- The encoder cable has a broken wire.
- A hardware error has occured inside the controller.

e. Where do I find the Service Utilities?

- At the home screen, record the number at the top left of the screen.
- Select the "Service Utilities" (ambulance) softkey.
- At the password promt, enter the last 5 digits of the recorded serial number, reversed.
- Press the "Done" softkey. You are now in the Service Utilites.

Installing a Replacement Controller

f. The AutoTune Process:

- Check the raw encoder signal levels. (Section g)
- AutoTune. (Section h)
- Recheck encoder signal levels. (Section i)
- Verify AutoTune in the Measurement Mode. (Section j)

g. Checking Raw Encoder Signal Levels:

- Enter the service Utilities. (Section e)
- Press the "Align Encoders" softkey.
- Confirm "Before AutoTune" is displayed at the top of the screen.
- Begin moving the axes back and fourth. Verify that all signal levels are above the dotted line while axes are in motion. If not, a service visit may be required.
- Press the "Done" softkey. This will return you to the Service Utilties menu.

h. The AutoTune Process:

- In the service menu, press the "AutoTune" softkey.
- As prompted, bring the Z-rail to the home (upper, left, front) position. Press the Done softkey.
- Immediatly after the Done button is pressed, begin moving the machine towards the lower, right, back position. Move so that it takes you approximately 25 seconds to reach this position (lower, right, back). DO NOT stop the machine during the AutoTune! All axes must be in continuous motion. AutoTune should finish before it reaches its desination, near the center of the volume.
- When the "AutoTune Passed" screen appears, press the "Done" softkey to save the results.
- If the "AutoTune Failed" screen appears, repeat the AutoTune process (Press cancel and repeat above steps). If still unsuccessful, contact your local service person.

i. Checking "After AutoTune" Signal Levels:

- In the Service Utilities menu, return to the "Align Encoders" section by pressing the "Align Encoders" softkey.
- Press the "Change Option" (circular arrow) softkey to look at the AutoTuned signal levels.
- Confirm "After AutoTune" is displayed at the top of the screen.
- Begin moving the axes back and fourth again. While the axes are in motion, verify that all signal levels remain between the dotted lines. If not, then repeat the AutoTune process.
- Press the "Done" softkey. This will return you to the Service Utilites menu.

Installing a Replacement Controller

j. Verifying Lissajous patterns

- In the Service Utilities menu, press the "Lissajous" softkey.
- Lock the Y & Z axes. Unlock the X axis.
- Begin moving the X axis slowly. Verify that a nice, round circle appears. The circle should move through, or close to the 4 tic marks. If it does not, you may need to try autotuning again.
- Repeat the process for the Y & Z axes.

> **Note**: The lissajous utility was developed so that signal levels can be viewed without the use of an oscilloscope. But, because the controller is not as fast as an oscilloscope, moving an axis too fast will cause the pattern to become elliptical, slanted at a 45% angle. If this happens, simply slow down.

k. Verify Tune in Measurement Mode.

- Press the "System Startup" button (below the help button). This will return you to the "homing" screen. After homing the machine, press the "Done" softkey.
- If the software asks you to qualify a probe, follow the instructions on the screen to qualify a probe as usual.
- Enter the measurement mode.
- Move the Z-rail in all 3 axes throughout the volume of the machine for a time period of 1 minute. If no rate errors appear, then AutoTune was successfull.

3. Setting the Machine Type:

The final step of installing a replacement controller is to inform the Controller about the machine. The system scales its part drawings depending on whether a Gage2000, MicroXcel, or other machine is used.

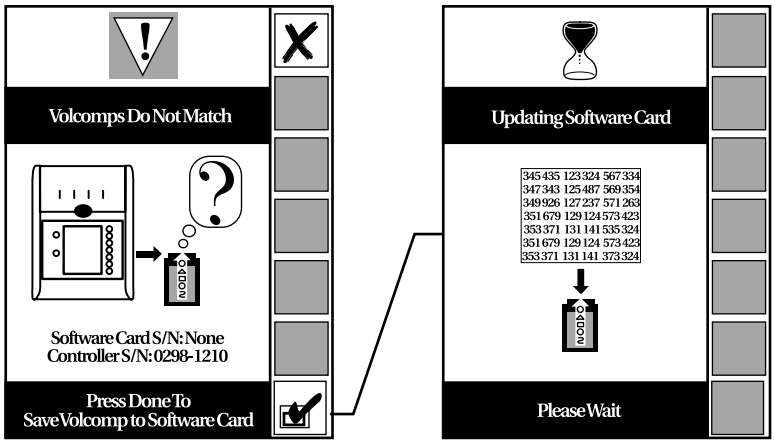
a. Enter Screen 1 of the System Options
b. Scroll down to "Machine Type".
c. Select your machine.
d. Press the "Done" softkey. Your specific machine will now appear in the home screen the next time your system is homed.

> **Note**: In the event that a controller has to be returned, be sure to include the power supply also. Only in that way can it be fully diagnosed and repaired.

Installing a Software Card

If you receive a new software card, do the following:

1. Remove the previous version software card from the top slot. (The controller can stay powered up.)
2 Insert the new software card in the top slot.
3. After a possible language screen, the "Volcomps Do Not Match" screen will appear as shown below. Simply press the Done softkey.



4. **Do Not** re-insert your previous version software card unless absolutely necessary. This may cause the loss of your system variables (Inches/mm, language, air-saver time, etc.).
5. If you received a defective or unprogrammed card resulting in a "frown face" icon being displayed with no error code written below it, contact your local service person for a replacement card. If there is an error code shown, the controller is experiencing other problems which may require the attention of a service person.
6. Return the old software card in the envelope provided.

RefleX Notes

Accuracy Troubleshooting

Question / Suggestion	Detail
Does Serial number of the machine match the number at the upper left corner of the home screen?	If RefleX's home screen is not showing the correct serial number, than this means that the controller does not have the correct volcomp installed. A new software card with the correct volcomp will have to be obtained. See section 11-6, 11-7.
Is the qual sphere diameter, found in page 2 of the system options, correct?	Enter the value stamped on the qual sphere's shaft into the system. See section 10-9.
Are proper measuring techniques being used to measure the part?	Always approach perpendicularly, allowing at least 1 probe radius of approach vector. If the operator fails to do this, values may be off by either 1 probe radius or diameter, if the system can even solve it.
Is the part secure?	Make sure the part is properly clamped to the granite.
Is the room at 20 degrees Celsius, away from direct sunlight, vents, vibrations, etc.?	The machine must be in an environmentally controlled area to obtain good measurement results.
Clean tip, qualification sphere and part with alcohol.	Dust, dirt, oil, etc. are common causes of measurement error. Clean these items regularly.
Is the qualification result good? +/- 5 microns for diameter, +/- 10 microns form error?	If not, first, use a stylus key verify stylus is tight. If that doesn't help, try a different stylus. Remove any extensions. If that doesn't help, and another probe is available, try replacing to eliminate the probe from the equation. If using a MIP, verify attenuation is set properly.
Use a ring gage to find out if the problem is in 1 axis, or in all 3.	Measuring a ring gage in the 3 different orientations will help diagnosing where the problem lies.
Verify signal quality using the service utilities "Lissajous Plot".	Poor signals increase sub division error. Re-AutoTune if necessary. See section A7-4.
Verify the measurement in question is valid for a accuracy / repeatability test.	For example, a user is getting unacceptable repeatability when measuring only a 10 degree slice of a circle. See section 3-13 for more information.
What size tip is being used?	For less than perfect surface finishes, consider increasing the tip size. See section 3-13, step 4 (towards the bottom)
What type of TTP is being used?	If you are using a TP-ES, consider upgrading to a TP-MIP. See section 3-13, step 6 (towards the bottom).

RefleX Notes

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