

AXIOM

The screenshot displays the AXIOM 3.1.3 software interface. The main window has a menu bar with 'File', 'Edit', 'Search', 'Options', and 'Window'. On the left, there are input fields for X, Y, Z, and R coordinates, each with a corresponding icon. The X, Y, and Z fields contain the value -1234.56789, and the R field contains 0.00000. Below these fields is a grid of icons. The main area shows a file tree with the following structure:

- Dcc (d:\intelmeas\IPP\run\dms\misc)
- Data (ANCCAL.DMS)
- Start (LINE 0)
- Step (ANCCAL.DMS)
- Abort
- Dmis
- Chart
- Mcg
- Dwg
- Trace

Below the main window are two command-line windows. The first window, titled 'd:\intelmeas\IPP\run\dms\misc\ANCCA...', contains the following text:

```
DMISMN/'ANCCAL 3.04'  
FILNAM/'ON'  
FILNAM/COORD,'ANC.CRD',OUTPUT,OVERWR  
FILNAM/COORD,'ANC.CRD',INPUT  
FILNAM/SENS,'ANC.SNS',OUTPUT,OVERWR  
FILNAM/SENS,'ANC.SNS',INPUT  
UNITS/INCH,ANGDEC  
PRCOMP/ON  
FINPOS/OFF
```

The second window, titled 'd:\INTELMEAS\IPP\run\COMERO.BAT', contains the following text:

```
DMESW/COMAND,'CCU=COM4'  
DMESW/COMAND,'PHC=COM2'  
DMESW/COMAND,'KPD=NONE'  
DMESW/COMAND,'JOY=COM3'  
DMESW/COMAND,'CMT=NONE'  
DMESW/COMAND,'ACC2_PORT=NONE'  
DMESW/COMAND,'PRINTER=USB...Virtual  
printer port for,NEC Pinwriter P3300'  
DMESW/COMAND,'FAST=NONE'
```

At the bottom of the interface, there is a status bar with the text 'AXIOM stopped with normal termination !!', a numerical value '90', and two buttons labeled 'PARK' and 'MCS'.



Intellegent Measurement, Inc.

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Overview

Overview

Review of Coordinate Measuring Machine

- Axiom (R) for windows is the software for the Host computer of the Coordinate Measuring Machines. This Windows based measuring software provides the best Graphical User Interface using easy to understand icons.
- A typical Coordinate Measuring Machine (CMM), is composed
 - Calibration Sphere
 - Granite Table
 - Moving structure
- The Moving Structure slides along 3 perpendicular axes, X, Y, Z and it can be one of the following types:
 - Gantry
 - Horizontal Arm
 - Bridge
- The Moving structure can be motorized in which case the CMM is called a DCC CMM, or it is manually driven in which case the CMM is called a Manual CMM.
- Any CMM utilizes one or many kinds of Sensors in order to measure features of a given part.
- A sensor is usually mounted on a sensor mount or otherwise called Probe Head, Such as PH9, PH10.
- Sensor Mount can be:
 - Fixed
 - Manually Indexable (such as MIP)
 - Motorized Indexable(such as PH9 or PH10)
 - The Sensor Mount includes a sensing device (Probe) which can be of the following types:
 - Contact (Such as Touch Probe , TP2, TP6)
 - Non-Contact (Such as Laser Probe)
- The Sensing device typically utilizes special tips depending on the applications.
- The following tip types are used for typical CMM's with Touch probes:
 - Ball Styli, Disk Styli, Cylindrical Styli, and Cluster Styli.
 - In some applications, a CMM is used with no sensing device (Hard Probing).
 - Various Options and accessories are used in different applications. Probe Change Systems and Rotary Table are typical Options for CMM's.
- Axiom (R) for windows runs under PC compatible Computers with Microsoft Windows operating system.
- Depending on your CMM's type, hardware configuration, options and probe system types, AXIOM is configured both in hardware and in software.
- Please examine your specific hardware and software requirements. A detailed description of your specific configuration is included in APPENDIX B.
- First Time installation instructions and installation instructions for software updates are explained in detail in APPENDIX A.

Overview

Axiom Features and Benefits

- Industry Standard PC hardware platform running WINDOWS operating system
- Highly interactive graphical User Interface utilizing intuitive and interactive operations.
- Context sensitive intelligent user interface eliminating redundant pop-up menus.
- Single screen user interface reducing the complexity of operation and learning of the system.
- Invoking all software functions through simple numerical keypad strokes mapped via the Joystick box membrane keypad.
- DCC (Direct Computer Control) of CMM through native interpretive DMIS part programs, a standard language for the industry.
- AXIOM (R) for windows provides full compatibility to the DMIS part-programs while it provides a friendly user interface with capable features as described here in more detail.
- Geometrical calculations of circles, cones, cylinders, lines, points, and spheres and full implementation of ANSI Y14.5 dimensioning and tolerancing.
- Capability of saving and recalling such data as coordinate systems, sensor calibrations and measured features as required for many complex applications.
- Detection and recovery of critical errors occurring during machine operation.
- Detection and automatic recovery from Air-Triggers.
- Recovery from Turning servo's Off during operation of the machine either during DCC or QUICK mode using single key stroke to continue operation.
- Recovery from Servo errors during machine operation through cooperative use of the Joystick at all times where user assistance is needed.
- Retry features with increasing search for points falling short of touching the part or through joystick assist without change in DCC mode .
- Retry features for accidental hits during GOTO's using Joystick assist as required if obstruction is present and / or single stroke key to retry.
- Increase in processing speed through use of BLOCK mode operation ensuring the fastest possible processing speed of the part program.
- Continuous X Y Z display updates even during programmed moves.

Overview

Axiom Main Screen

- Upon successful installation of AXIOM specific to your hardware and software configuration , Axiom can be invoked by double clicking on the AXIOM Icon in your AXIOM window.
- If you have difficulty in understanding and working with your computer hardware and Windows operating system, Please consult with your Computer System administrator for adequate instructions and manuals of operation specific to your machine.
- Please refer to APPENDIX A for additional information regarding your specific installation procedure and other information related to your specific machine.
- In general , Upon start-up , Axiom checks the hardware and software configuration for a number of essential information such as the type of probe system existing in the machine and the type of your machine.
- For example If you have a Manual CMM with MIP probe system, (Manually Indexable Probe) , AXIOM shows the Main screen followed by a windows to the operator prompting him for selecting the right sensor orientation of the sensor mount. After selecting the right orientation on your MIP system, Click OK on the sensor select prompt window . You should see the Axiom Main Screen appearing .
- However, If you have a DCC CMM with a Motorized Probe Head (PH9 or PH10) , This operation will be automatic, and your PH10 system will orient to the appropriate orientation upon start-up and the Main Screen appears without any sensor select prompt window.
- If you get any other prompt window such as the error prompt window, check your hardware for proper connections and configurations, click OK to retry.
- Axiom Main Screen is divided into several groups of User-interface elements such as displays, buttons, windows, list-boxes, toggle buttons, etc...
- Next section describes each one of these User-Interface Elements . Familiarity with these entities will help you to get familiar with the various operational features of the Axiom User-Interface.

Overview

Axiom Start-up Screen (Manual CMM)

Axiom Main screen is composed of several group of areas.

- **USER AREA**
 - This is the area on top of screen .
 - The user area is a tabbed section consisting of the following tabs:
MEAS,CONST,GOTO,PTMEAS,SENS,COORD,SET,TOL,ROTAB
 -
- **DCC AREAS**
 - This is the area below the user area to the left.
 - The DCC area displays the DMIS file that will be used in either DCC mode.
 -
- **DRAWING AREA**
 - This is the area to the right of DCC area.
 - The Drawing area displays an image of the part related to the DCC File.

User Interface Terminology

- **Window** - A selected area of screen which may or may not have all the typical properties such as a visible border , title , and others as described below.
- **Window Borders** - The borders are the visible lines boxing the window. Clicking on the borders is used for moving and resizing the window.
- **Window Header area** - The area on top of the window, If the header area is highlighted (or clicked by mouse) , that window will activate on top of any previous window , operation of keyboard will affect the window with the highlighted header.
- **Window Closing button** - Clicking the close button will cause the window to disappear and the functions of the task in the window to cease.
- **Window Enlarging button** - Clicking the enlarge button will cause the window to occupy the full screen.
- **Window Minimizing button** - Clicking the minimize button will cause the window to minimize and show the other windows beneath the current one.
- **Display** - Shows an information such as text or numeric number, Displays can not be edited.
- **Label Field** - Shows the active information , Label Field is editable , clicking the mouse button in the field allows the editing at the mouse position. A label field is used to show and edit an alphanumeric label of maximum 8 characters, starting with a letter.
- **Numeric Field** - Shows the active information , Numeric Field is editable , clicking the mouse button in the field allows the editing at the mouse position. A Numeric field is used to show and edit a numeric value a decimal point is not a must.
- **Label / Numeric Field** - Shows the active information , Label/Numeric Field is editable , clicking the mouse button in the field allows the editing at the mouse position. A label/Numeric field is used to show and edit either numeric or label. A numeric value must include a decimal point, A label must start with a letter.
- **Button** - Positioning the mouse and Clicking on a button will activate the function of that button which could be different for each button. Some buttons will pop new windows and highlight the new window, some others may activate a function and return.
- **Toggle button** - Toggle button is a special button which also displays the active status of the button.. Positioning the mouse and Clicking on a Toggle button once will change (Toggle) the status of the button. Each Toggle button may have 2 or more states. An example of a 2 button like ON/OFF state

Overview

- **State button** - State button is a special kind of toggle button that belongs to a group of buttons. Clicking on a state button will toggle the state of that button and will un-toggle any of the other buttons belonging to that group.
- **List Box** - List box is a table containing axiom data elements. The list box typically shows the labels of the elements.
- **Combo/Drop-down List Box** - Combo box is a special list box that shows a field with a control button next to it. upon clicking on the control button, a list box drops down and other elements of the table will be shown.

Overview

MODES OF OPERATION

Axiom Provides three basic modes of operation.

- **USER mode**
 - User mode provides easy and flexible measurement functionality through Axiom's user interface
- **DCC mode**
 - DCC mode provides measurement functionality through execution of part-programs written utilizing DMIS syntax.
 - DCC mode allows running the part-programs either through run or step modes.

All three modes of operation exist for both Manual and DCC type CMM's.

USER INTERACTIONS

The primary user interface, for all modes of operation utilizes the following:

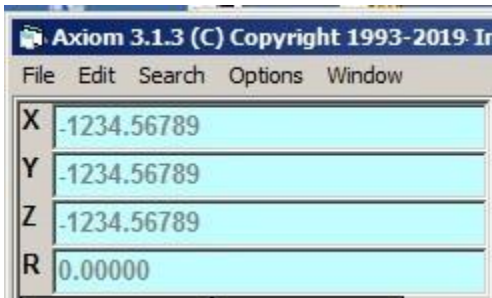
- Mouse
- Keyboard
- Joysticks(DCC machine only).
- Keypad
 - As an option, a special Numerical Keypad can provide an alternate means of invoking frequently used functions. Refer Numerical Keypad section in Appendix 'A'
 - Keypad normally is mounted on the joystick box for DCC machines.

Axiom User Mode of Operation

USER MODE

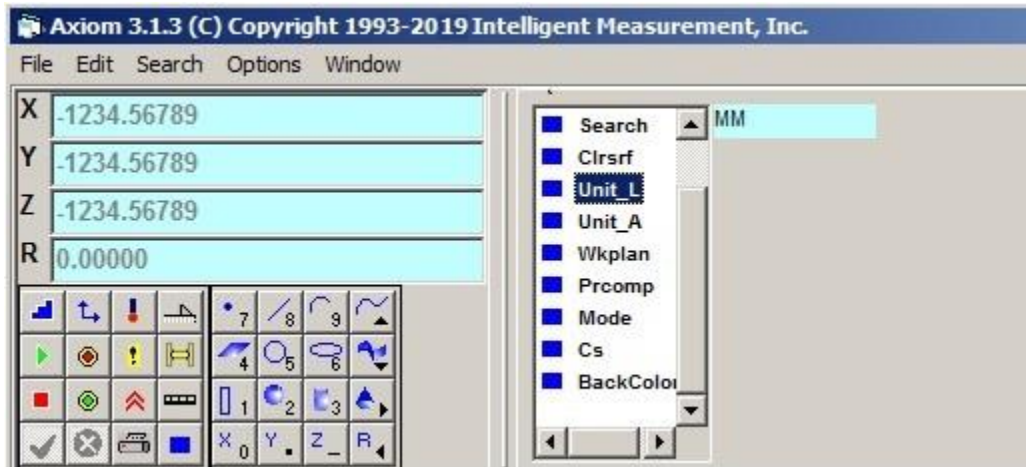
XYZ Display

- Upon Start-up the XYZ display of the main screen shows the location of the center of the selected probe tip in the active coordinate system.
- Manually move your CMM along each axes, left to right, Front to Back and Up and Down.
- Observe the XYZ display and notice the direction of the increasing counts for your CMM.



Active Units

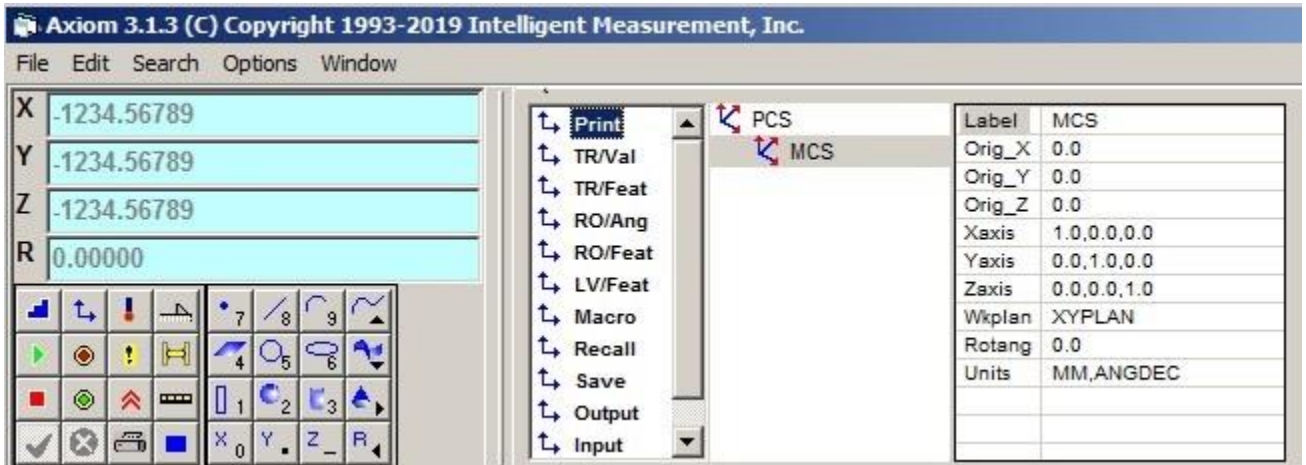
- The active units , is a toggle button, showing the active state of the units.
- Manually move your CMM along each axes, left to right, Front to Back and Up and Down. Notice that by changing the active units by Clicking the button, will affect the XYZ display.



Axiom User Mode of Operation

Active Coordinate System Display

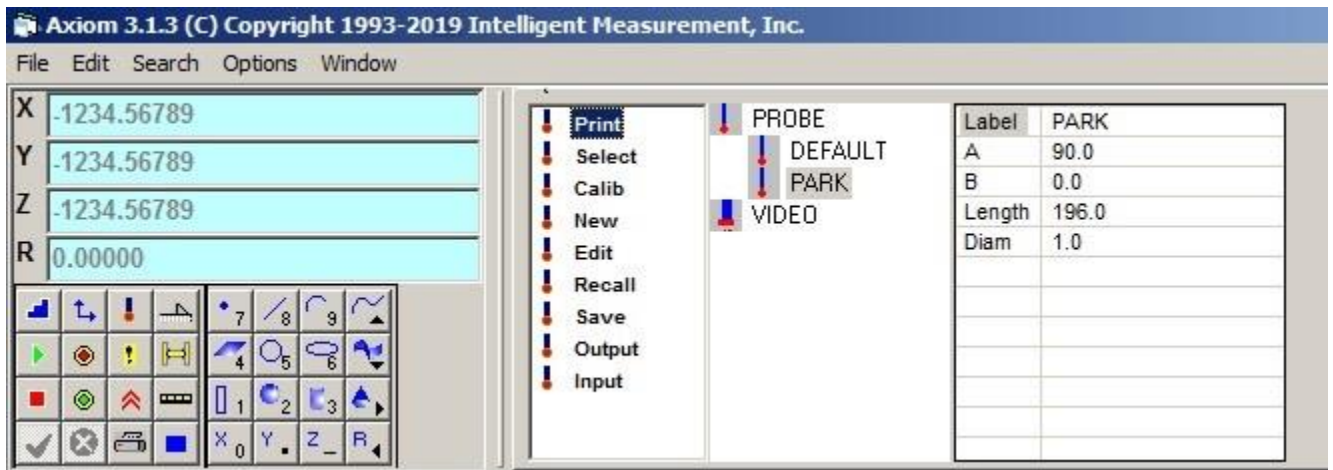
- The active Coordinate System (C.S) Display , is a display only, showing the active label for the coordinate system.
- Notice that upon start-up the display shows MCS on the display.
- MCS is the label for the Machine Coordinate System. This is a reference frame for your machine .
- Manually move your CMM along each axes, left to right, Front to Back and Up and Down. Notice that direction of increasing counts for each axis , is the positive directions of the axes of your Machine Coordinate System (MCS).
- The Origin of MCS on a Manual CMM is the location where the machine is turned on (The counters will read 0,0,0).This means that the origin is at different location each time the machine is turned on.
- The Origin of MCS on a DCC CMM must be established during the homin procedure. and therefore, the origin will be on a fixed location in reference to the Table.



Axiom User Mode of Operation

Active Sensor Display

- The active Sensor Display , is a display only, showing the active label for the Sensor system.
- Notice that upon start-up the display shows A00B00 on the display.
- A00B00 is the label for the selected sensor upon start up. If you do not see A00B00, this is due to the different Start-up configuration. For changing the start-up configuration please refer to Appendix B.
- Selecting a different orientation sensor, will affect the XYZ display.
- Click on another sensor label in your sensor list box.
- Notice that the Sensor Window Pops up. Click on select.
- If you have a Manual Probe with your CMM such as MIP system, the Sensor select Window Pops up, prompting the user to manually orient the probe to that orientation specified.
- If you have a motorized probe with your CMM, the sensor will be selected automatically .
- Notice the Active sensor display , showing the label for the new selected sensor.
- Now Observe the XYZ display and notice that the numbers are different from the previous. i.e. the numbers in the XYZ display show the center of Probe tip in the active coordinate system.



XYZ Display Relationships

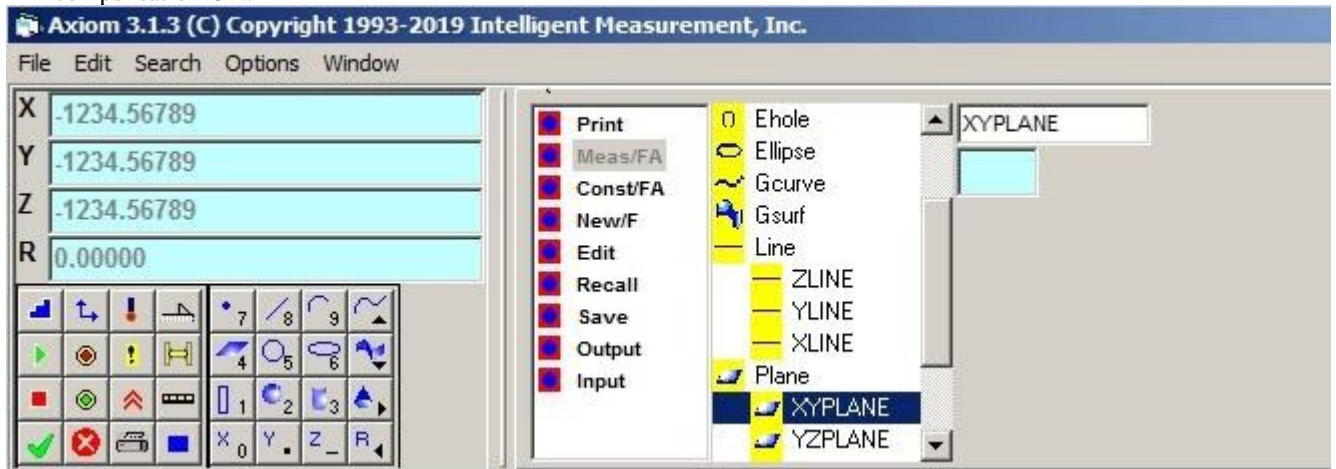
- The XYZ display has interdependency to the following:
 - Active Coordinate system display
 - Active Sensor display
 - Active units.

Taking points With Manual CMM

- Taking points with Touch Probe is simply done by moving your CMM in contact with the part .
- In order to take a point correctly make sure you probe normal to the surface of the part and follow in the same direction about 1mm further into the part.
- If you do not follow in the same direction into the part and back up too quickly upon contact , the point will be considered as a point in the air, (Air trigger) and will not be recorded and is discarded.
- If you do follow into the part , but no follow in the direction of normal to the surface of the part, the point will be recorded, However you should consider that the tip probe compensation will not be accurate in certain cases such as Measuring Point Features with Probe Compensation ON.

Axiom User Mode of Operation

- Axiom sounds for Recorded points and will cause the current point and total point display to increment.
- Other reasons why a point may not be recorded by axiom is either Deflecting the probe while CMM is stationary or points are taking too quickly and backed off.(Air Trigger) .
- If you take an unwanted point you can always erase that point by clicking on Erase Point.
- Notice the current Point Display and Total Points will decrement upon clicking on the erase point.
- Clicking on the Hard point, will cause a point to be recorded at the current location .
- Hard points are used while Hard Sensor's are selected.
- User must be aware of use of selecting correct probe tip diameters while using Hard points with Probe compensation ON.



Measuring a Feature

- When Measuring a Feature you can observe the following interdependencies:
 - XYZ of Measured Points (Meas Tab)
 - Active Feature type and Active Feature Label Field.
 - Probe Compensation
 - Active Feature Type
 - Active Feature Label Field
 - Done
 - Output results Window
 - Default Tolerancing Methods

Example: Measuring Sphere

The sample measurement process for a sphere is shown below with description of the step by step procedure

- Start up axiom .
- Select sensor A00B00
- Make sure there are no points in the current points and total points . If you see that the current points show a number , Click on erase points until you empty the counter in the total points display.

Axiom User Mode of Operation

- Select an active sensor label
- Check MCS as your active coordinate system label.
- Take 5 points on the Calibration Sphere.
- Click on sphere in the feature type group.
- Notice that the Active Feature Label is changed to SP01.
- Toggle on Probe Compensation ,making sure display shows PC/OFF
- Click on Done - Notice the following changes upon clicking on done:
 - Output results window shows the sphere center location and diameter.
 - The feature list box shows the SP01 and SP01* as new labels in the list box.
 - The active feature label field now shows SP02, the label for the next sphere to be measured.
 - The total number of points stays unchanged. Yet the points have been used up.
- Notice that there is additional relations between measurement and default tolerancing methods. These relationships will be described further in the Tolerancing section.

Now Re-measure the sphere with PC/ON

- In order to understand the relationship between the results of the sphere and the Probe Compensation Toggle, Measure the sphere again with PC/ON.
- Toggle Probe Compensation to PC/ON state.
- Take 5 points.
- You do not have to click on active feature type because it is already set for Sphere.
- Notice that the active feature label field shows SP02 as the label for the sphere .You can always change/edit this label before you click on done.
- Click on Done - Notice the following changes upon clicking on done:
 - Output results window shows the sphere center location and diameter. This time the diameter shows smaller. This is due to the compensation for the tip radius.
 - If you were using a calibrated sensor, the diameter of the sphere will be the true diameter for the sphere. The procedure to calibrate sensor will be discussed further in the sensor section.
 - The feature list box shows the SP02 and SP02* as new labels in the list box.
 - To look at the previous results for SP01, click on SP01* in the Feature list box . The feature actual window appears and shows a complete attributes of that feature. For further description of each feature presentation refer to the feature section.
 - The active feature label field now shows SP03, the label for the next sphere to be measured.
 - The total number of points stays unchanged. Yet the points have been used up.

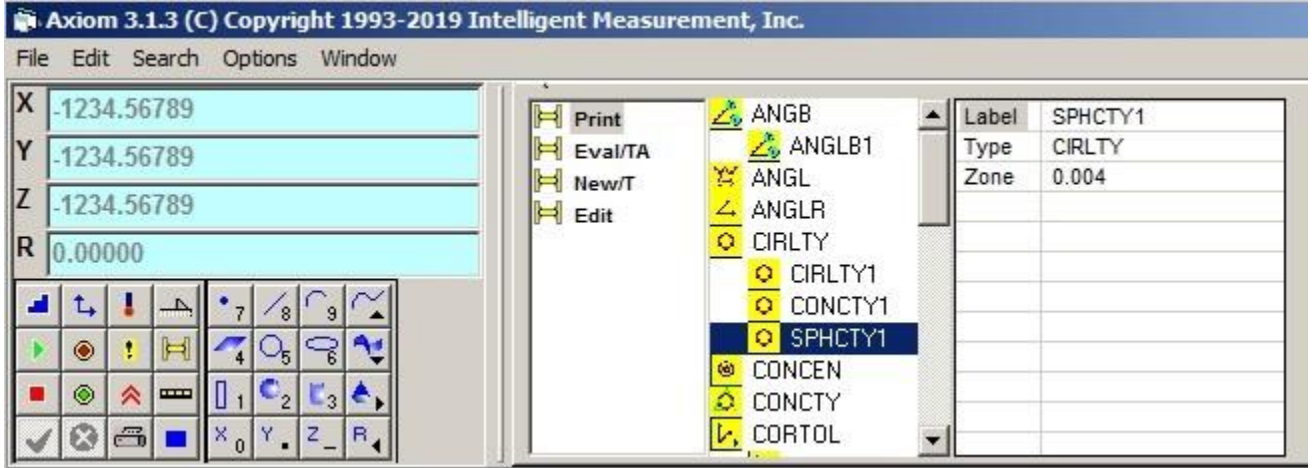
Axiom User Mode of Operation

Tolerancing a Feature

- Axiom provides a complete set of tolerancing functions based on ANSI Y14.5 standard.
- Tolerancing is applied to measured features.
- There is relationship between the measuring process and evaluation of tolerance.
- There is two methods to set tolerancing for features,
 - Automatic Feature Based Tolerancing method
 - User Selected Tolerancing method
- Automatic Feature based tolerancing is a powerful feature of AXIOM . Once a feature type is selected by clicking the Active Feature type , Axiom automatically selects the predefined tolerance method set for that feature. Upon clicking Done after taking points, the tolerance is evaluated and results are shown using the tolerance evaluation bar.
- User selected Tolerancing method is where the user overrides the automatically selected tolerance method.
- The tolerance evaluation window dynamically changes depending on the type of tolerancing.
- Measuring a feature has therefore additional relationships to Tolerancing method as shown below
- Relationships:
 - Active Feature type
 - Active Tolerance Method or Default Feature Based Tolerance Method
 - Active Tolerance Method Label Field.
 - Tolerance Feature Actual Drop Down List Box.
 - Nominal settings Field
 - Done
 - Output results Window
 - Tolerance List box
- The following is example of Automatic Feature based tolerancing for sphere.
 - Start up Axiom
 - Select sensor A00B00
 - Make sure there are no points in the current points and total points . If you see that the current points show a number , Click on erase points until you empty the counter in the total points display.
 - Select an active sensor label
 - Check MCS as your active coordinate system label.
 - Take 5 points on the Calibration Sphere.
 - Click on sphere in the feature type group.
 - Notice that the Active Feature Label is changed to SP01.
 - Click on Done - Notice the following changes upon clicking on done:
 - Output results window shows the sphere center location and diameter.
 - In addition the results of evaluating Roundness (Spharecity) tolerance is shown in the results window.
 - The feature list box shows the SP01 and SP01* as new labels in the list box.
 - The Tolerance List box shows ROUND* as new label in the list box.
 - The evaluation bar shows the results of deviation against the nominal graphically.

Axiom User Mode of Operation

- The predefined tolerance method for each feature can be set using Default tolerance button. The user can set the default tolerance method for each feature by clicking the Default tolerance button and selecting any applicable method.
- Once a feature is measured and the default tolerance is evaluated and shown, the user can :
 - Set other tolerances applied to current measured feature
 - Click on Done.
 - The results of the new evaluation will graphically will be displayed
- It is necessary to set and evaluate any additional tolerance methods that require access to the points (such as Form Tolerances) immediately after measurement.
- Other type of tolerancing types that do not require access to the points may be evaluated any time by selecting the feature from the feature control , tolerance from the tolerance control and clicking on Done.

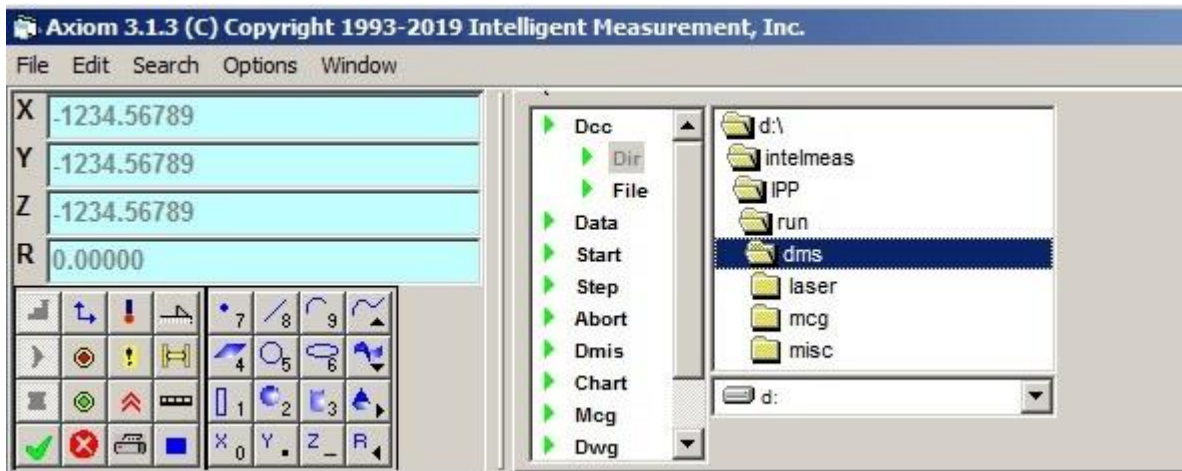


Axiom DCC Mode of Operation

DCC Mode

Open a Part Program File

- Click on Open part Program File to select a DMIS part program.
- The part program file browser pops up .
- Select your DMIS syntax based file (with Extension .DMS)
- upon click on OK , the part program is loaded to the program editor window.



Run a Part Program File

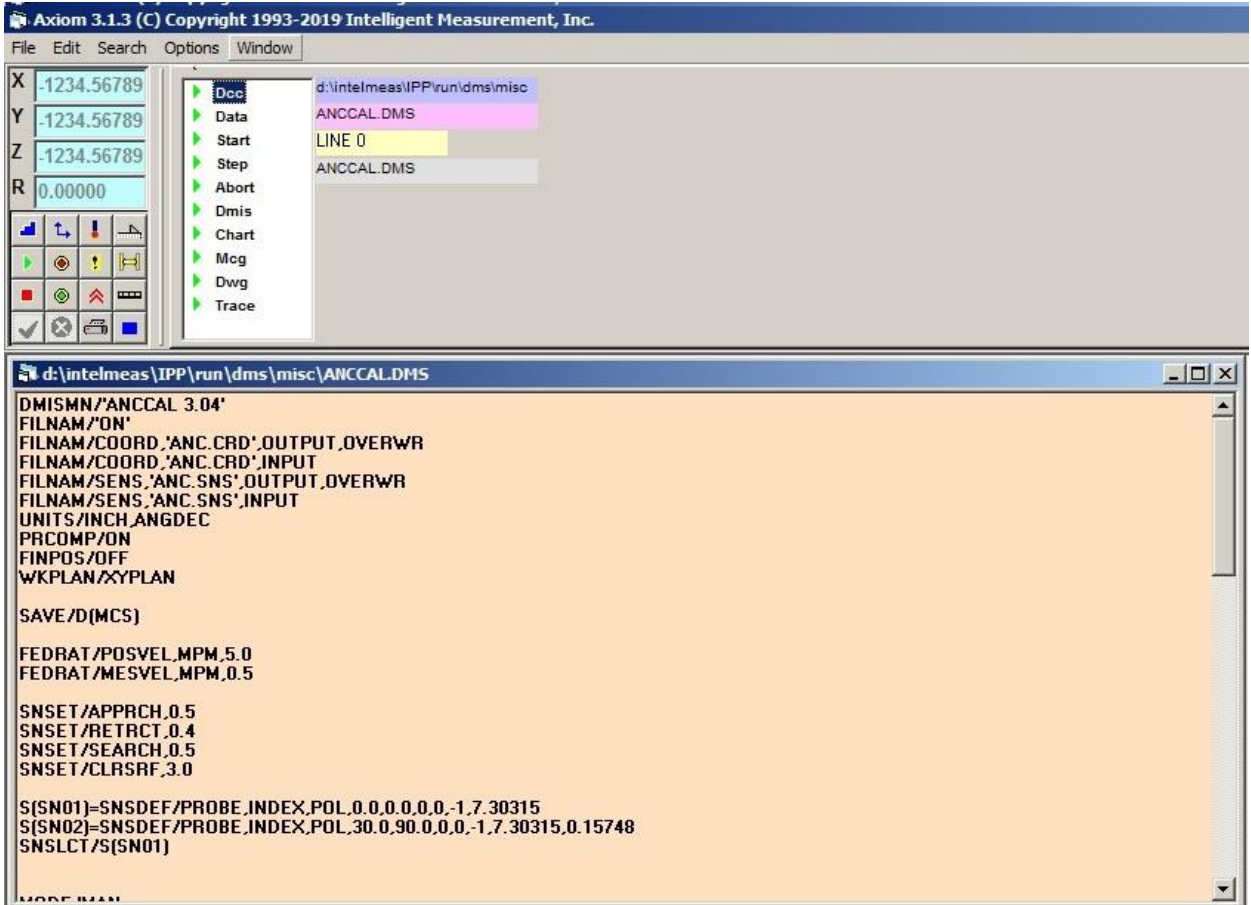
- Click on START mode to select continuous run cycle .
- Click on STOP to stop Execution .
- Click on STEP mode to select step by step run cycle.
- Every Click on STEP Executes one line of the file.
- Click on START will turn the mode back to continuous run cycle.
- Click on STOP followed by ABORT to abort execution of the program. Running the file again will start at the beginning.

Edit Part Program File

- After the part program is open, and the Part program Editor window shows the listing of the program, the user can click the mouse in the editor window and modify any part of the program.
- The part program can be saved by Clicking on the save button at the top of the screen..
- DMIS part programs are interpreted and user can select running modes to be STEP mode or RUN mode.
-

Axiom DCC Mode of Operation

Save Part Program File



SENSORS

SENSORS

Sensors

- A sensor is usually mounted via a sensor mount (Probe Head) to the third moving axis of CMM
Sensor Mount can be:
 - Fixed
 - Manually Indexable (such as MIP)
 - Motorized Indexable(such as PH9 or PH10)
- The Sensor Mount includes a sensing device (Probe) which can be of the following types:
 - Contact (Such as Touch Probe , TP2, TP6)
 - Non-Contact (Such as Laser Probe)
- The Sensing device typically utilizes special tips depending on the applications.
- The following tip types are used for typical CMM's with Touch probes:
 - Ball Styli, Disk Styli, Cylindrical Styli, Cluster styli
- In some applications , a CMM is used with no sensing device(Hard Probing).
- In any Measurement application , the user may use a combination of the sensor types in order to achieve his probing objective.
- Each sensor type, Styli and orientation has special parameters that accurately define the center of the tip and it's effective tip diameter in relation to the Active Coordinate System.
- Therefore it is important to accurately calibrate and represent each sensor and assign unique names / labels to them.
- Axiom provides specially prepared Macro example to calibrate Touch Probe sensor types. This Macro may be different depending on the type of your CMM. Also Please be advised that it is very important to set the exact Diameter of your calibration sphere in the appropriate section of the calibration Macro. For a detailed listing of the calibration Macro Please refer to the APPENDIX C.
- The touch probe calibration macro may be used for a wide range of styli types , However, certain types of styli's such as cylindrical, Disk type, or Cluster probes require different method of calibration. For a detailed method of how to write macro's please refer to the programmer's reference .

SENSORS

Sensors Selected by Default

- The default sensor is selected at the startup.
- The default sensor orientation is reported to the operator at startup and the operator must make sure that the proper sensor , styli length and orientation is manually selected
- The default selected sensor is specified in the start-up file. For detailed configuration please refer to Appendix B.
- The user may configure the start up software not to select any sensors.
- The start up selected sensor may or may not be a calibrated sensor, the user must make sure if the selected sensor is appropriate for his application.
- If you have a Manual CMM with MIP probe system, (Manually Indexable Probe) , AXIOM shows the Main screen followed by a windows to the operator prompting him for selecting the right sensor orientation of the sensor mount. After selecting the right orientation on your MIP system, Click OK on the sensor select prompt window . You should see the Axiom Main Screen appearing .
- However, If you have a DCC CMM with a Motorized Probe Head (PH9 or PH10) , This operation will be automatic, and your PH10 system will orient to the appropriate orientation upon start-up and the Main Screen appears without any sensor select prompt window.
- If you get any other prompt window such as the error prompt window, check your hardware for proper connections and configurations, click OK to retry.

Predefined Sensors

- A list of predefined sensors are loaded at startup.
- For detailed description of the predefined sensors see the start up file COMERO.BAT
- After start up of axiom the sensor list box shows the predefined sensors.
- User must calibrate the preferred orientations . the user must make sure if the selected sensor is appropriate for his application.
- The user may change the predefined sensors based by modifying the start up file COMERO.BAT.
- The list of predefined sensors will help the user to calibrate his often used sensors directly by clicking on the existing sensors in the list box.

Show a sensor

- Clicking on a sensor label inside the sensor list box ,shows the values of sensor variables in the appropriate text box..
- Clicking OK will accept all the changes and if there is any values of the parameters changed ,the user is prompted for a Sensor Exists . Over write Changes? prompt.
- Clicking OK on the prompt, will cause the old sensor to be rewritten with the new definition.
- If the sensor is not calibrated yet, the parameters show the same exact parameter values as the sensor was originally defined (or Predefined for Start up sensors).
- It is a good idea to do a show on the sensor after calibration is completed. A grossly different parameters may indicate incorrect calibration.

SENSORS

Calibrate an existing sensor

- Clicking on a sensor label inside the sensor list box ,pops up the sensor definition window.
- If the sensor is not calibrated yet, the parameters show the same exact parameter values as the sensor was originally defined (or Predefined for Start up sensors).
- To calibrate a sensor simply click on Calibrate.
- Axiom will run a specially prepared Macro to calibrate your sensor. This Macro may be different depending on the type of your CMM. Also Please be advised that it is very important to set the exact Diameter of your calibration sphere in the appropriate section of the calibration Macro. For a detailed listing of the calibration Macro Please refer to the APPENDIX C.
- It is a good idea to do a show on the sensor after calibration is completed. A grossly different parameters may indicate incorrect calibration.

Calibrate a new sensor

- Clicking on a Sensor Definition button, S , of the sensor group , the sensor definition window pops up.
- Edit each field in the sensor definition window and make sure that the numbers approximately represent the sensor you want to calibrate.
- To calibrate a sensor simply click on Calibrate.
- Axiom will run a specially prepared Macro to calibrate your sensor. This Macro may be different depending on the type of your CMM. Also Please be advised that it is very important to set the exact Diameter of your calibration sphere in the appropriate section of the calibration Macro. For a detailed listing of the calibration Macro Please refer to the APPENDIX C.
- It is a good idea to do a show on the sensor after calibration is completed. A grossly different parameters may indicate incorrect calibration.

Define a new sensor

- Clicking on a Sensor Definition button, S , of the sensor group , the sensor definition window pops up.
- Edit each field in the sensor definition window and make sure that the numbers approximately represent the sensor you want to define.
- After editing the fields click on OK . If the sensor label that was edited happens to exist, Axiom will prompt the user for Sensor Exists. Overwrite Changes? prompt.
- Clicking OK on the prompt, will cause the old sensor to be rewritten with the new definition.
- Defining new sensor specially comes handy for off-line programming. where the user plans only to prepare a part program.

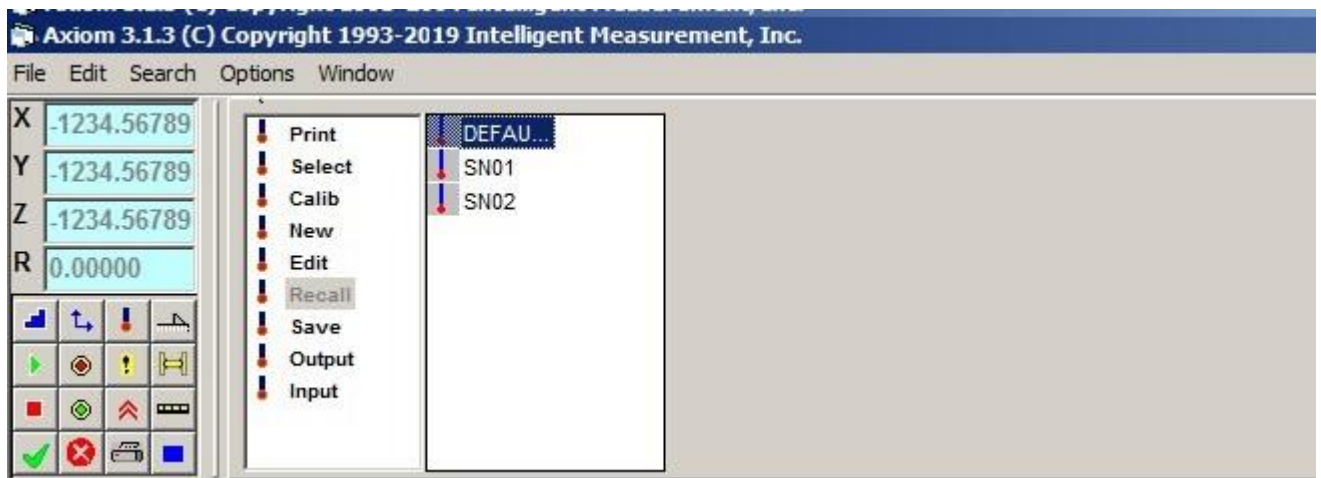
SENSORS

Selecting a sensor

- Clicking on a sensor label inside the sensor list box ,pops up the sensor definition window.
- The sensor definition window shows the critical parameters of the sensor.
- Clicking on the Select , will cause the orientation of the sensor to change and the parameters of the selected sensor to be used for the active sensor.
- If you have a Manual CMM with MIP probe system, (Manually Indexable Probe) , AXIOM shows the window to the operator prompting him for selecting the right sensor orientation of the sensor mount. After selecting the right orientation on your MIP system, Click OK on the sensor select prompt window .
- If you have a DCC CMM with a Motorized Probe Head (PH9 or PH10) , This operation will be automatic, and your PH10 system will orient to the appropriate orientation.
- If you get any other prompt window such as the error prompt window, check your hardware for proper connections and configurations, click OK to retry.

Recall a sensor

- To recall a number of previously saved sensors from a file , click on the recall button of the sensor list box.
- The recall window pops up and allows the user to select the directory path, drive, file name and the sensors listed in the Sensor File.The sensor files have typically extensions of .SNS.
- Clicking OK allows the selected list of highlighted labels to be recalled .
- If you want to undo the highlighted labels , click the select/Unselect button.
- The recalled sensors will be loaded into axiom's Sensor List box.
- It is a good idea to save calibrated sensors to sensor files for further recall. This minimizes the need to recalibrate every time you start up axiom.



Save a sensor

SENSORS

- To save a number of existing sensors(Calibrated or Non-calibrated) to a file , click on the save button of the sensor list box.
- The save window pops up and allows the user to select the directory path, drive, file name and the sensors listed in the Sensor File.The sensor files have typically extensions of .SNS.
- Clicking OK allows the selected list of highlighted labels to be saved.
- If you want to undo the highlighted labels, click the select/Unselect button.
- The list of the highlighted sensors to be saved can be appended to the the sensor file. This will cause any of the existing sensors in that file to remain except the sensor in the file that has the same label as one existing in the highlighted list. Toggle the Append/Overwrite button to choose the Append for this method.
- The list of the highlighted sensors to be saved can be overwritten to the selected sensor file. This will cause any of the existing sensors in that file to be completely erased. Toggle the Append/Overwrite button to choose the overwrite for this method.
- It is a good practice to save calibrated sensors to sensor files for further recall. This minimizes the need to recalibrate every time you start up axiom.

FEATURES

Features

Features

- Axiom provides means of measuring standard geometrical feature types as shown by their respective symbols.
- Each Feature element is uniquely labeled.
- For Each Actual Feature (a Measured feature) there will exist a Nominal Feature of the same label.
- The Actual Feature and Nominal Feature labels are stored in the Feature List Box.
- The List box sorts the Feature labels in order to show the last measured feature.
- Axiom Provides for means of storing up to 800 Features during a measuring session.

Predefined features

- A list of predefined Features are loaded at startup.
- For detailed description of the predefined Features please refer to the Appendix B.
- After start up of axiom the Feature list box shows the predefined Features
- The user may change the predefined sensors based by modifying the start up file.
- The list of predefined Predefined Features will help the user to work with Nominal Features that are often used for the purpose of constructing, tolerancing and various other operations.
- There 3 Predefined Features , XYPLANE, YZPLANE and ZXPLANE are the planes that make up any coordinate systems.
- These 3 planes are the only reserved Feature labels and they have a special property that will be discussed further in this section.



Define Nominal Feature

- Clicking on a Feature Definition button, F, of the Feature group , the Feature definition window for the active feature type pops up.
- Edit each field in the Feature definition window and make sure that the numbers approximately represent the Feature you want to define.
- After editing the fields click on OK . If the Feature label that was edited happens to exist, Axiom will prompt the user for Feature Exists, Overwrite? prompt.
- Clicking OK on the prompt, will cause the old Feature to be rewritten with the new definition.

FEATURES

Actual Features

- Actual Features are made either by taking points on the part or, by constructing methods between one or many other Features.
- Actual Feature parameters names and properties are the same as nominal properties.
 - Define Feature: ARC
 - Define Feature: CIRCLE
 - Define Feature: CONE
 - Define Feature: CYLINDER
 - Define Feature: ELLIPSE
 - Define Feature: LINE
 - Define Feature: PLANE
 - Define Feature: POINT
 - Define Feature: SPHERE

Recall a Feature

- To recall a number of previously saved Features from a file , click on the recall button of the Feature list box.
- The recall window pops up and allows the user to select the directory path, drive, file name and the Features listed in the Feature File.The Feature files have typically extensions of .FTS
- Clicking OK allows the selected list of highlighted labels to be recalled .
- If you want to undo the highlighted labels , click the select/Unselect button.
- The recalled Features will be loaded into axiom's Feature List box.
- The recalled feature is always an actual feature.

Save a Feature

- To save a number of existing Features (Calibrated or Non-calibrated) to a file, click on the save button of the Feature list box.
- The save window pops up and allows the user to select the directory path, drive, file name and the Features listed in the Feature File.The Feature files have typically extensions of .SNS.
- Clicking OK allows the selected list of highlighted labels to be saved.
- If you want to undo the highlighted labels, click the select/Unselect button.
- The list of the highlighted Features to be saved can be appended to the the Feature file. This will cause any of the existing Features in that file to remain except the Feature in the file that has the same label as one existing in the highlighted list. Toggle the Append/Overwrite button to choose the Append for this method.
- The list of the highlighted Features to be saved can be overwritten to the selected Feature file. This will cause any of the existing Features in that file to be completely erased. Toggle the Append/Overwrite button to choose the Overwrite for this method.
- Actual Features can only be saved.

AXIOM COORDINATE SYSTEM

COORDINATES

Introduction to Coordinate Systems

- A complete part coordinate system consists of three mutually orthogonal planes whose paired intersections represent the axes and whose mutual intersection depict the origin.
- The three coordinate planes are at right angles to each other. The line where any two coordinate planes meet is a coordinate axis, and the point where the three planes intersect is the origin.
- Coordinate systems are three dimensional with the three axes identified as X, Y and Z. Creating and manipulating coordinate system is an important function in Inspection.
- Usually the default coordinate system is called Machine Coordinate System(MCS).

Cartesian and Polar Coordinates

- Coordinate Recall
 - Recalls a coordinate system from previously saved coordinate system files.
- Coordinate Save
 - Saves a coordinate system to a Coordinate system file.
- Define Coordinate System
 - Define/Make a new coordinate system.
 - Coordinate List Box
 - Shows all the coordinate systems made and used in this session.
 - Also includes coordinate systems recalled from previously saved files.

AXIOM COORDINATE SYSTEM

Define Coordinate System

- A complete coordinate system can be created by a series of translations to set the origin and rotations to align axes.
- Origin
- Sets the origin of the coordinate system at a specific point. This is achieved by doing translations along each axis.
- Level
- The Level command refers to the process of leveling a part coordinate system so that it rests square to the feature specified. The level command performs two rotations.
- Align
- This aligns one of the Coordinate axis in the current work plane to the feature specified. Rotation is always performed about the axis perpendicular to the current work plane and in the positive direction.

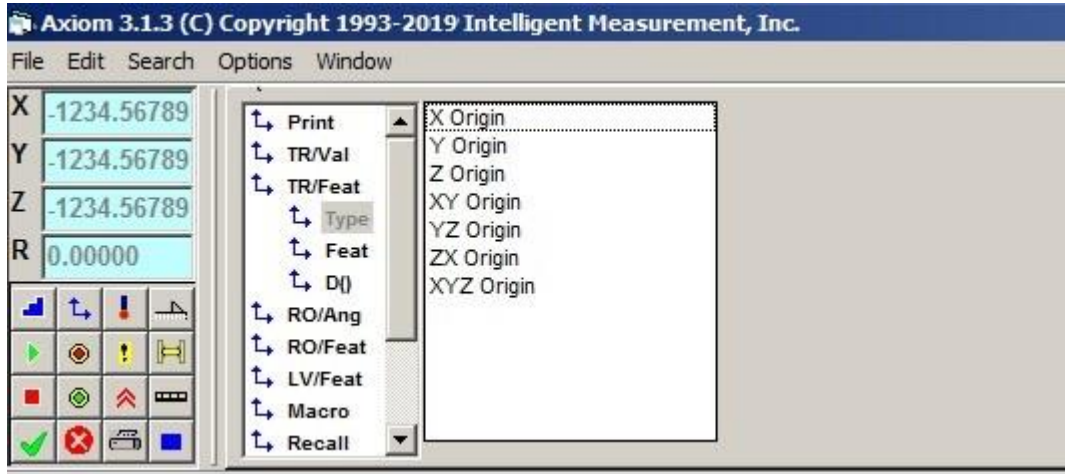
Origin/Translate

- Origin command sets the origin of the part coordinate system to the given feature.
- The above picture shows a sample when Clicked on Origin button.
- The Origin Feature Label shows the last actual feature measured by default.
- To change the Origin Feature, Click on Coordinate Feature Control and select appropriate feature to set Origin to.
- Click Ok when done.
- Click Cancel to quit this window.

- In the sample above the Origin is set at the center of the circle.

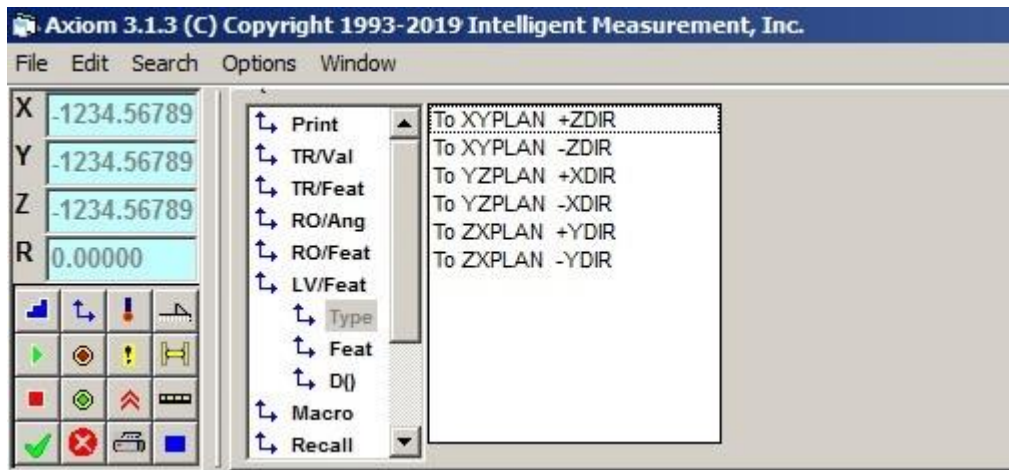
-
- Allows to translate the X-Origin, Y-Origin and/or Z-Origin of PCS.
- Click on Origin. Notice three fields labeled (X, Y and Z-Coordinate). These fields can be nominally defined or actual measured features to which the coordinate system origin is translated to Or a numeric value specifying the amount of translation.
- To perform no translation along an axis, leave an empty field or Enter 0.0 as the amount of translation.
- To delete a field, Click on the label and hit BACKSPACE key ("<-" The key above ENTER)
- Click Ok when done.

AXIOM COORDINATE SYSTEM



Level

- Level performs two rotations such that the active work plane is leveled to the given feature.
- The rotations are performed in the positive direction . i.e. in Counter Clock wise.
- The above figure shows the rotation steps assuming X-Y plane is the workplane.
 - A rotation about X-Axis such that Y-Axis is aligned with Y1.



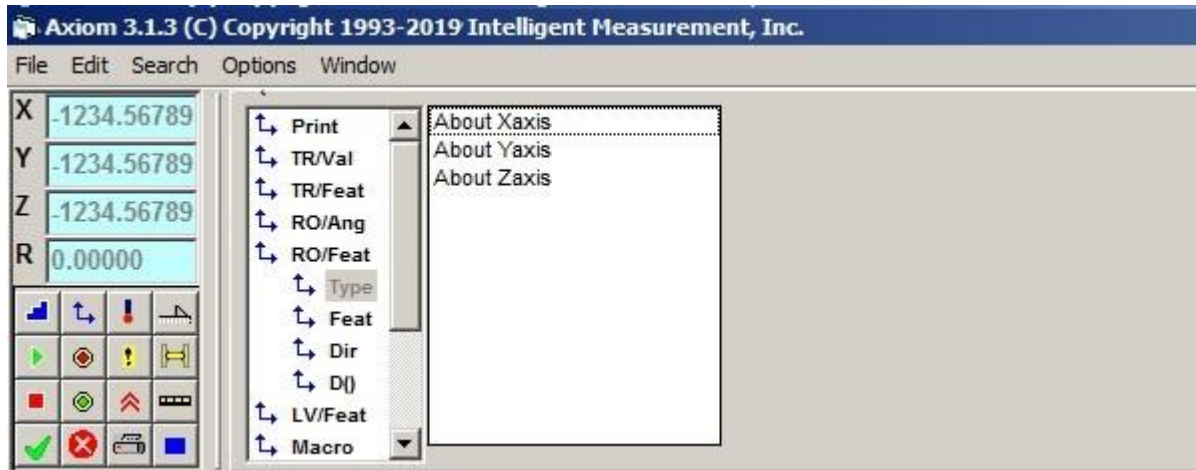
- A second rotation about Y-Axis such that X-Axis is aligned with X1.
- To Level, select the feature to level and Click Ok when done.
-
-

Align/Rotate

- Align command performs a single rotation of a Coordinate axis in the current work plane to the feature's primary vector. Rotation is always performed about the axis perpendicular to the current work plane and in the positive direction.

AXIOM COORDINATE SYSTEM

- The example above assumes X-Y plane as the current work plane and aligns the Positive X-Axis of PCS to the feature actual LI01*.
- Note: Only one feature must be specified, Either X-Axis feature or Y-Axis Feature.
- To Align Y-Axis follow the steps below:
 - Click on Y-Axis Feature Control and select the feature to align to from the drop down list box.
 - To delete X-Axis feature label, Click on X-Axis Feature. Notice the label is highlighted.
 - Press Delete or Backspace key.
 - Click Ok when done.



Align/Rotate

- Align/Rotate can be performed such that an axis is aligned to a feature.
- The coordinate system can also be Aligned/rotated by an angle.

Rotation About

- Rotation Axis Toggle
 - The Rotation Axis Toggle specifies the axis about which the rotation is performed.
- Direction Toggle
 - Specifies the rotation to be performed in the +/- direction. This is only used when the rotation is performed by feature.
- Axis Toggle
 - Specifies that this axis should be aligned to the feature. Only used in rotation by feature. The button toggles in the plane perpendicular to the Rotation About axis. If the rotation about axis is XAXIS, the button toggles to Y or Z only.
- Rotation By Value
 - To Rotate by Value, Click on Rotate Feature field to highlight label.
 - Press Delete or Backspace key.
 - Type in the angle of rotation.
 - Note: The value must always be specified as a real number ending with a decimal. (Ex. 45 degrees must be input as 45.0)

AXIOM COORDINATE SYSTEM

Example: Coordinate System with Test Block

- Set Coordinate System
 - The previous page shows a sample test block. Further discussion on coordinate system refers to this block.
 - It is assumed that the test block is placed such that Datum B is approximately aligned with positive X-Axis and the cylinder on to right side.
 - Also assumed that the probe is calibrated and MCS is the active coordinate system.
- This simple example shows new coordinate system setup.
 - The origin is at the mutual intersection of datum planes A, B and C.
 - X-Axis is aligned with the axis intersecting datum planes A and B.
 - Y-Axis is aligned with the axis intersecting datum planes A and C.
- Measure Datum Plane A (PL01*)
 - Click on Define Coordinate system.
 - Click on Rotate. Notice the feature label as PL01*.
 - Toggle Rotation about to XAXIS.
 - Toggle Axis to positive Z.
 - Click Ok to perform first rotation.
 - Again Toggle Rotation about to YAXIS.
 - Toggle Axis to positive Z.
 - Click on Ok to perform second rotation. Now the X-Y plane of PCS is leveled to Datum Plane A(PL01*).
 - Click on Translate.
 - Delete X-Coordinate and Y-Coordinate Fields.
 - Click Ok to translate the Z-Origin of PCS to PL01*.
 - Click Cancel to quit window.
- Measure Datum Plane B(PL02*)
 - Click on Define Coordinate System.
 - Click on Rotate and set the Rotate Feature Label as PL02*.
 - Toggle Rotation about to ZAXIS.
 - Toggle Axis to Negative Y.
 - Click Ok.
 - Click Cancel to quit window.
- Measure Datum Plane C(PL03*)
 - Define a Nominal Line(LI01) with it's direction in (0,0,1) and the it's plane as (0,-1,0)
 - Click on Construct button for intersection of PLANE and PLANE and notice the feature to be constructed as LI01.
 - Select first feature as PL02 and second feature as PL03.
 - Click Ok to construct line feature LI01*.
 - Click Cancel to quit this window.
 - Click on Feature Type Point.
 - Click construct point by intersection of a Line and a Plane. Notice the the feature label as PO01.
 - Select first feature as LI01* and second feature as PL01*.
 - Click Ok to construct a Point PO01*.
 - Click on Define Coordinate System and Click on Translate.
 - Choose X-Coordinate Feature to PO01* and Y-Coordinate Feature to PO01*.
 - Delete Z-Coordinate Feature Field.
 - Click Ok to translate X and Y origin of PCS to PO01*.

AXIOM COORDINATE SYSTEM

- Click Cancel to quit this window.
- This completes the coordinate system setup for the test block.

AXIOM COORDINATE SYSTEM

Coordinate System Macros

Axiom currently supports five quick macros to setup coordinate system. The macro icons show the actual coordinate system. The black dot represent the origin and it's 'Z' origin is always on the datum plane represented by the three yellow points. The longer axis is the positive X-Axis and the shorter axis is positive Y.

Coordinate System Macros

- Plane, Circle, Circle
 - Used when a plane and two circles are available for the coordinate system setup such that the center of the first circle is the origin and a line from first to second circle becomes the X-Axis.
- Plane, Circle, Line
 - Used when a plane, circle and a line are available for the coordinate system setup such that the center of the first circle is the origin and the line becomes the X-Axis.
- Plane, Bolt Hole Circles
 - Used when a plane, and Bolt Hole Circles are available for the coordinate system setup such that the center of the first circle is the origin and the line joining the first circle to second becomes X-Axis.

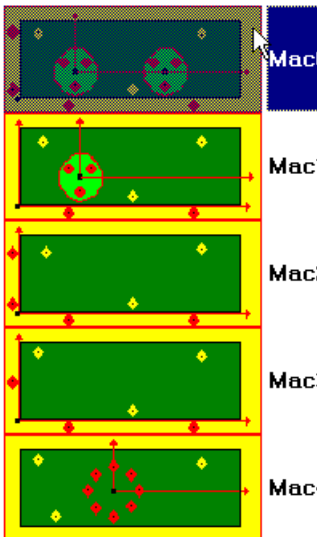
Coordinate System Macros

- Plane, Line, Line
 - Used when a plane and two lines are available for the coordinate system setup such that the intersecting point of the two lines is used as origin and the first line becomes X-Axis.
- Plane, 2 Points, Point (3-2-1)
 - The line joining the 2 Points becomes X-Axis.
- The intersecting point of this line with a line perpendicular to and passing through the third point becomes origin.
- Note:
 - On all lines the direction is determined by the point taking. i.e. the direction of the line is from the first point towards the second. This determines the Coordinate System's axis direction.
 - While in the middle of a Macro, Do not change any settings that affect the measurement.
 - All Macros reset Coordinate systems, Probe compensation and Units.

AXIOM COORDINATE SYSTEM

Coordinate System Setup with Macro

- The following steps guides through a Coordinate System setup Macro to set coordinate system for the Test Block. (Refer to Coordinate System with Test Block Section.).
- Make sure you are using the required work plane.
- Click on Macro Button and Notice the Coordinate System Macro Window popup.
- Click on Macro (Plane, Line, Line)
- Now measure the second line on Datum Plane C and Click Ok when done.
- Notice the Status window for the successful completion of the Macro.
- Click ABORT to quit the window. - That should complete the coordinate system setup for the Test Block. You can see how simple and easy it is to setup the Coordinate System using Macros.



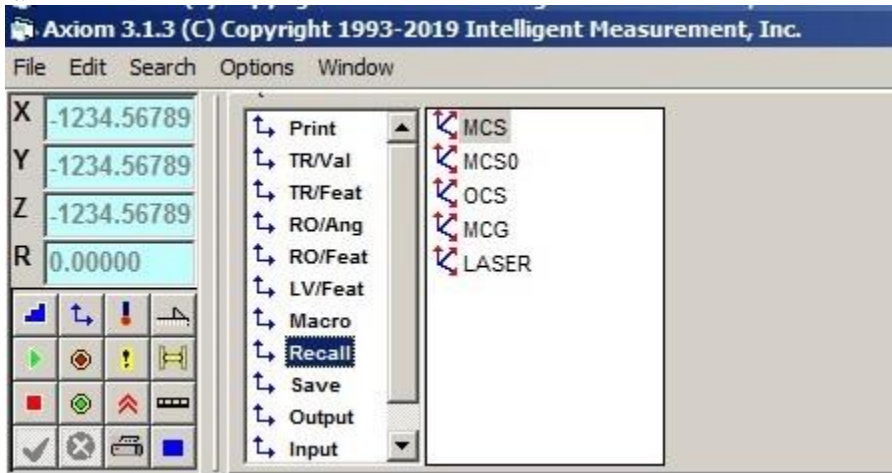
Plane, Bolt Hole Circles

- Before you run any Macro, make sure you are using the correct work plane.
- Click on Plane, Bolt Hole Circles Macro and notice the Operator information window. Be aware that there is a limitation of 20 Bolt Holes that can be used with this macro.
- Click Ok to continue.
- When prompted to Measure, Measure the datum plane and Click Ok when done.
- When prompted to Measure, Measure the circle which determines the origin of the coordinate system.
- Click Ok when done.
- Notice a Special Operator Query window. This window query's to continue measuring more bolt hole circles. To measure more bolt holes, hit Enter key or Click Ok/Yes button.
- When prompted to Measure, Measure first circle. A line constructed from the origin circle to this circle defines the orientation of X-Axis.
- Continue measuring Bolt Hole circles, By clicking Ok/Yes.
- When done with all the bolt holes, Click No to set the coordinate system.
- Notice the Status window for the successful completion of the Macro.
- Click ABORT to quit the window.

AXIOM COORDINATE SYSTEM

Recall a Coordinate System

- To recall a number of previously saved coordinate systems from a file , click on the recall button of the coordinate system list box.
- The recall window pops up and allows the user to select the directory path, drive, file name and the coordinate systems listed in the coordinate system File.The coordinate system files have typically extensions of .CRD.
- Clicking OK allows the selected list of highlighted labels to be recalled .
- If you want to undo the highlighted labels , click the select/Unselect button.
- The recalled coordinate systems will be loaded into axiom's coordinate system List box.
- It is a good idea to save the MCS if that happens to be the active coordinate system, at the beginning of your axiom session. This is so that if you have to start a new measuring process you can always recall it.



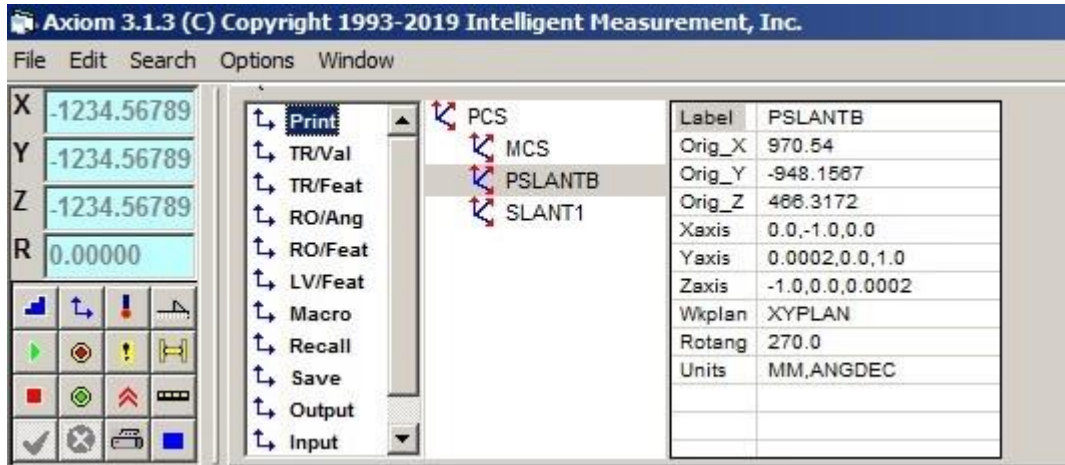
Save a Coordinate System

- To save a number of existing coordinate systems(Calibrated or Non-calibrated) to a file , click on the save button of the coordinate system list box.
- The save window pops up and allows the user to select the directory path, drive, file name and the coordinate systems listed in the coordinate system File.The coordinate system files have typically extensions of .CRD.
- Clicking OK allows the selected list of highlighted labels to be saved.
- If you want to undo the highlighted labels , click the select/Unselect button.
- The list of the highlighted coordinate systems to be saved can be appended to the the coordinate system file. This will cause any of the existing coordinate systems in that file to remain except the coordinate system in the file that has the same label as one existing in the highlighted list. Toggle the Append/Overwrite button to choose the Append for this method.
- The list of the highlighted coordinate systems to be saved can be Overwritten to the selected coordinate system file. This will cause any of the existing coordinate systems in that file to be completely erased. Toggle the Append/Overwrite button to choose the Overwrite for this method.
- It is a good idea to save the MCS if that happens to be the active coordinate system, at the beginning of your axiom session. This is so that if you have to start a new measuring process you can always recall it.

AXIOM COORDINATE SYSTEM

Show a Coordinate System

- Clicking on a coordinate system label inside the coordinate system list box ,pops up the coordinate system window.
- The coordinate system window shows the critical parameters of the coordinate system.
- This window does not allow any other functions.
- The coordinate system parameters describe the direction vectors of the primary , secondary and thirtiary axes of the coordinate system and the three dimensions of the origin of the coordinate system.



MEASURING FEATURES

MEASURING

Measuring a Feature

- Measuring a Feature has relationships among :
 - Taking Points (XYZ display Relationships)
 - Active Feature type and Active Feature Label Field.
 - Probe Compensation, Active Feature Type, Active Feature Label Field, Active Feature Drop Down List Box.
 - Done
 - Output results Window
 - Default Tolerancing Methods
- When x,y,z, point data are used to measure planar features, the plane in which the measured feature lies is the plane that is parallel to the primary datum plane of the active part coordinate system, best fit, through the measured points. Note that the defined feature's normal unit vector is perpendicular to the primary datum plane.
- In USER mode, when measuring a point, having probe compensation ON only produces accurate results if the user probes perfectly normal to the part. Otherwise, It is best not to have Probe compensation ON, make sure that the active Probe Compensation is PC/OFF and plan your measurement strategy accordingly.
- In USER mode, when measuring a line, the direction vector of the line is from the first point to the second point. Active Probe compensation is not taken into effect for Line measurement in USER mode. The default setting for Probe compensation when measuring line is OFF.
- In USER mode, generally there are certain assumptions required for each type of feature measurement. For each measurement assumption in the USER mode refer to the note section for that feature.
- In DCC mode, generally all measurements that may have ambiguity in directions rely on the nominal Feature.
- The minimum number of points required to measure each feature is:
 - ARC 3
 - CIRCLE 3
 - CONE 6
 - CYLNDR 6
 - GCURVE 2
 - GSURF 3
 - ELLIPS 5
 - LINE 2
 - PATTERN 2
 - PLANE 3
 - POINT 1
 - SPHERE 4

MEASURING FEATURES

Measuring Point

- Title ***FEAT/POINT
- Function Defines a nominal point and assigns to it a feature label.
- Default None.
- Input F(label)=FEAT/POINT,var_1 var_2
- Output FA(label)=FEAT/POINT,var_1 var_2
- var_1 CART,x,y,z or: POL,r,a,h
- var_2 ,i,j,k
- LABEL is an alphanumeric label assigned to the feature, and is up to 10 characters in length.
- POINT signifies that the feature is a general point.
- CART signifies that the coordinates of the point are stated in cartesian coordinates.
- POL signifies that the coordinates of the point are stated in polar coordinates.
- x,y,z are the cartesian coordinates of the point itself.
- r,a,h are the polar coordinates of the point itself.
- i,j,k is a vector normal to, and pointing away from, the surface in which the point lies.
- Note
 - The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN.
- In USER mode, when measuring a point, having probe compensation ON only produces accurate results if the user probes perfectly normal to the part. Otherwise, It is best not to have Probe compensation ON, make sure that the active Probe Compensation is PC/OFF and plan your measurement strategy accordingly.

Measuring Line

-
-
- Title ***FEAT/LINE
- Function Defines a nominal line and assigns to it a label.
- Default None.
- Input F(label)=FEAT/LINE,var_1 var_4
- Output FA(label)=FEAT/LINE,var_1 var_4
- var_1 UNBND, var_2 or: BND, var_3
- var_2 CART,x,y,z,i,j,k, or: POL,r,a,h,i,j,k,
- var_3 CART,e1x,e1y,e1z,e2x,e2y,e2z, or: POL,e1r,e1a,e1h,e2r,e2a,e2h, var_4 is: ni,nj,nk
- label is an alphanumeric label assigned to the feature, and is up to 10 characters in length.
- LINE signifies that the feature is a line.
- BND signifies that a bounded line is to be defined.
- UNBND signifies that an unbounded line is to be defined.
- CART signifies that the coordinates of the point on the line are stated in cartesian coordinates.
- POL signifies that the coordinates of the point on the line are stated in polar coordinates.
- x,y,z are the cartesian coordinates of a point on the line.
- r,a,h are the polar coordinates of a point on the line.
- i,j,k is the direction vector which lies along the line and points from the first point measured to the second point measured.
- ni,nj,nk is the normal vector of the plane in which the line lies.
- e1x,e1y,e1z are the cartesian coordinates of the two end points of the
- e2x,e2y,e2z line.
- e1r,e1a,e1h are the polar coordinates of the two end points of the

MEASURING FEATURES

- e2r,e2a,e2h line.

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Note The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN.

SPECIAL NOTE FOR USING LINES IN USER MODE

In USER mode, when measuring a line, the direction vector of the line is from the first point to the second point. Active Probe compensation is not taken into effect for Line measurement in USER mode. The default setting for Probe compensation when measuring line is OFF.

Measuring Plane

- Title ***FEAT/PLANE
- Function Defines a nominal plane and assigns to it a label.
- Default None.
- Input F(label)=FEAT/PLANE,var_1,i,j,k
- Output FA(label)=FEAT/PLANE,var_1,i,j,k
- var_1 CART,x,y,z or: POL,r,a,h
- label is an alphanumeric label assigned to the feature, and is up to 10 characters in length.
- PLANE signifies that the feature is a plane.
- CART signifies that the coordinates of the point on the plane are stated in cartesian coordinates.
- POL signifies that the coordinates of the point on the plane are stated in polar coordinates.
- x,y,z are the cartesian coordinates of a point on the plane.
- r,a,h are the polar coordinates of a point on the plane.
- i,j,k is the direction vector of the plane pointing away from the part.
- Note The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN.
- In USER mode the direction of the Measured plane is automatically detected based on the probing direction.
- The Active Probe Compensation is taken into effect for the results.

MEASURING FEATURES

Measuring Circle

- Title ***FEAT/CIRCLE
- Function Defines a nominal circle and assigns to it a label.
- Default None.
- Input F(label)=FEAT/CIRCLE,var_1,var_2,i,j,k,diam
- Output FA(label)=FEAT/CIRCLE,var_1,var_2,i,j,k,diam
- var_1 INNER or: OUTER
- var_2 CART,x,y,z or: POL,r,a,h
- label is an alphanumeric label assigned to the feature, and is up to 10 characters in length.
- CIRCLE signifies that the feature is a circle.
- INNER signifies that the inside of the circle is to be measured (i.e., a hole).
- OUTER signifies that outside of the circle is to be measured (i.e., a boss).
- CART signifies that the center is given by cartesian coordinates.
- POL signifies that the center is given by polar coordinates.
- x,y,z are the cartesian coordinates of the centerpoint of the circle.
- r,a,h are the polar coordinates of the centerpoint of the circle.
- i,j,k is the direction vector of the plane that the circle lies in.
- diam is the diameter of the circle.
- Note The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN.
- In USER mode the INNER or OUTER of the circle will be automatically determined based on the based on the probing direction.
- The Active Probe Compensation is taken into effect for the results.
- All points taken on the circle will be projected to the Active Workplane first. Then the center location and diameter of the circle is measured. However, the Height of the circle will remain as the average height of all points.

MEASURING FEATURES

Measuring Arc

- Title ***FEAT/ARC
- Function Defines a nominal arc and assigns to it a label. There are two formats.
- Default None.
- Input_1 F(label)=FEAT/ARC,var_1,var_2,i,j,k,rad,ang1,ang2
- Output_1 FA(label)=FEAT/ARC,var_1,var_2,i,j,k,rad,ang1,ang2
- var_1 INNER or: OUTER
- var_2 CART,x,y,z or: POL,r,a,h
- label is an alphanumeric label assigned to the feature, and is up 10 characters in length.
- ARC signifies that the feature is an arc.
- INNER signifies that the inside of the arc is to be measured (i.e., a fillet).
- OUTER signifies that outside of the arc is to be measured (i.e., a round).
- CART signifies that the center is given by cartesian coordinates.
- POL signifies that the center is given by polar coordinates.
- x,y,z are the cartesian coordinates of the centerpoint of the arc.
- r,a,h are the polar coordinates of the centerpoint of the arc.
- i,j,k is the direction vector of the plane that the arc lies in.
- rad is the radius of the arc.
- ang1 is the start angle of the arc lying on, or parallel to, the WKPLAN of the current part coordinate system, and relative to the major axis of the WKPLAN. Use the right hand rule for sign conventions.
- ang2 is the positive included angle of the arc relative to ang1.
- Note The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN.

MEASURING FEATURES

Measuring Arc

- Title ***FEAT/ARC
- Input_2 F(label)=FEAT/ARC,4POINT,var_1, e1x,e1y,e1z, mx,my,mz, e2x,e2y,e2z, cx,cy,cz
- Output_2 FA(label)=FEAT/ARC,4POINT,var_1, e1x,e1y,e1z, mx,my,mz, e2x,e2y,e2z, cx,cy,cz
- var_1 INNER or: OUTER
- label is an alphanumeric label assigned to the feature, and is up 10 characters in length.
- ARC signifies that the feature is an arc.
- 4POINT signifies that the arc is being defined with four points.
- INNER signifies that the inside of the arc is to be measured (i.e., a fillet).
- OUTER signifies that outside of the arc is to be measured (i.e., a round).
- e1x,e1y,e1z are the cartesian x,y,z coordinates for the first end point of the arc.
- e2x,e2y,e2z are the cartesian x,y,z coordinates for the second end point of the arc.
- mx,my,mz are the cartesian x,y,z coordinates for the midpoint on the arc.
- cx,cy,cz are the cartesian x,y,z coordinates for the center of the arc.

MEASURING FEATURES

Measuring Ellipse

- Title ***FEAT/ELLIPS
- Function Defines a nominal ellipse and assigns to it a label.
- Default None.
- Input F(label)=FEAT/ELLIPS,var_1,var_2,var_3,i,j,k,diam
- Output FA(label)=FEAT/ELLIPS,var_1,var_2,var_3,i,j,k,diam
- var_1 INNER or: OUTER
- var_2 CART,f1x,f1y,f1z,f2x,f2y,f2z or: POL,f1r,f1a,f1h,f2r,f2a,f2h
- var_3 MAJOR or: MINOR
- label is an alphanumeric label assigned to the feature, and is up to 10 characters in length.
- ELLIPS signifies that the feature is an ellipse.
- INNER signifies that the inside of the ellipse is to be measured (i.e., an elliptical hole).
- OUTER signifies that outside of the ellipse is to be measured (i.e., an elliptical boss).
- CART signifies that the coordinates of the foci are stated in cartesian coordinates.
- POL signifies that the coordinates of the foci are stated in polar coordinates.
- f1x,f1y,f1z are the cartesian coordinates of the two foci.
- f2x,f2y,f2z are the cartesian coordinates of the two foci.
- f1r,f1a,f1h are the polar coordinates of the two foci.
- f2r,f2a,f2h are the polar coordinates of the two foci.
- MAJOR signifies that the major diameter is to be defined.
- MINOR signifies that the minor diameter is to be defined.
- i,j,k is the direction vector of the plane that the ellipse lies in.
- diam is the diameter of the specified MAJOR or MINOR parameter.
- Note The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN. The TOL/DIAM is associated with the MAJOR or MINOR diameter defined here.

MEASURING FEATURES

Measuring Sphere

- Title ***FEAT/SPHERE
- Function Defines a nominal sphere and assigns to it a label.
- Default None.
- Input F(label)=FEAT/SPHERE,var_1,var_2,diam
- Output FA(label)=FEAT/SPHERE,var_1,var_2,diam
- var_1 INNER or: OUTER
- var_2 CART,x,y,z or: POL,r,a,h
- label is an alphanumeric label assigned to the feature, and is up to 10 characters in length.
- SPHERE signifies that the feature is a sphere.
- INNER signifies that the inside of the sphere is to be measured.
- OUTER signifies that outside of the sphere is to be measured.
- CART signifies that the center is given by cartesian coordinates.
- POL signifies that the center is given by polar coordinates.
- x,y,z are the cartesian coordinates of the centerpoint of the sphere.
- r,a,h are the polar coordinates of the centerpoint of the sphere.
- diam is the diameter of the sphere.
- Note The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN.
- In USER mode the INNER or OUTER of the sphere will be automatically determined based on the based on the probing direction.
- The Active Probe Compensation is taken into effect for the results.

MEASURING FEATURES

Measuring Cone

- Title ***FEAT/CONE
- Function Defines a nominal cone and assigns to it a label.
- Default None.
- Input F(label)=FEAT/CONE,var_1,var_2,i,j,k,ang
- Output FA(label)=FEAT/CONE,var_1,var_2,i,j,k,ang
- var_1 INNER or: OUTER
- var_2 CART,x,y,z or: POL,r,a,h
- label is an alphanumeric label assigned to the feature, and is up to 10 characters in length.
- CONE signifies that the feature is a cone.
- INNER signifies that the inside of the cone is to be measured (i.e., a conical hole).
- OUTER signifies that the outside of the cone is to be measured (i.e., a conical boss).
- CART signifies that the coordinates of the vertex are stated in cartesian coordinates.
- POL signifies that the coordinates of the vertex are stated in polar coordinates.
- x,y,z are the cartesian coordinates of the vertex.
- r,a,h are the polar coordinates of the vertex.
- i,j,k is the direction vector associated with the cone, which points along the cone's axis from the vertex to the open end of the cone. Refer to Figure 4.1.
- ang is the included angle of the cone.
- Note The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN.
- In USER mode points must be taken such that the first 3 make up a plane perpendicular to the axis of the cylinder.
- The active Probe Compensation is taken into effect.

MEASURING FEATURES

Measuring Cylinder

- Title ***FEAT/CYLNDR
- Function Defines a nominal cylinder and assigns to it a label.
- Default None.
- Input F(label)=FEAT/CYLNDR,var_1,var_2,i,j,k,diam
- Output FA(label)=FEAT/CYLNDR,var_1,var_2,i,j,k,diam
- var_1 INNER or: OUTER
- var_2 CART,x,y,z or: POL,r,a,h
- label is an alphanumeric label assigned to the feature, and is up to 10 characters in length.
- INNER signifies that the insides of the cylinder is to be measured (i.e., a cylindrical hole).
- CYLNDR signifies that the feature is a cylinder.
- OUTER signifies that outside of the cylinder is to be measured (i.e., a cylindrical boss).
- CART signifies that the coordinates of a point on the axis are stated in cartesian coordinates.
- POL signifies that the coordinates of a point on the axis are stated in polar coordinates.
- x,y,z are the cartesian coordinates of a point on the cylinder's axis; the point is the centerpoint for bounded cylinders.
- r,a,h are the polar coordinates of a point on the cylinder's axis; the point is the centerpoint for bounded cylinders.
- i,j,k is the direction vector associated with the cylinder, and points along the cylinder's axis; from the first end measured to the last end measured.
- diam is the diameter of the cylinder.
- Note The x,y,z point coordinates are given relative to the origin of the active part coordinate system. The r and a values are also given relative to the active part coordinate system. The h value is the perpendicular distance of the point from the WKPLAN.
- In USER mode points must be taken such that the first 3 make up a plane perpendicular to the axis of the cylinder.
- The active Probe Compensation is taken into effect.

CONSTRUCTING FEATURES

CONSTRUCTING

Constructing Point

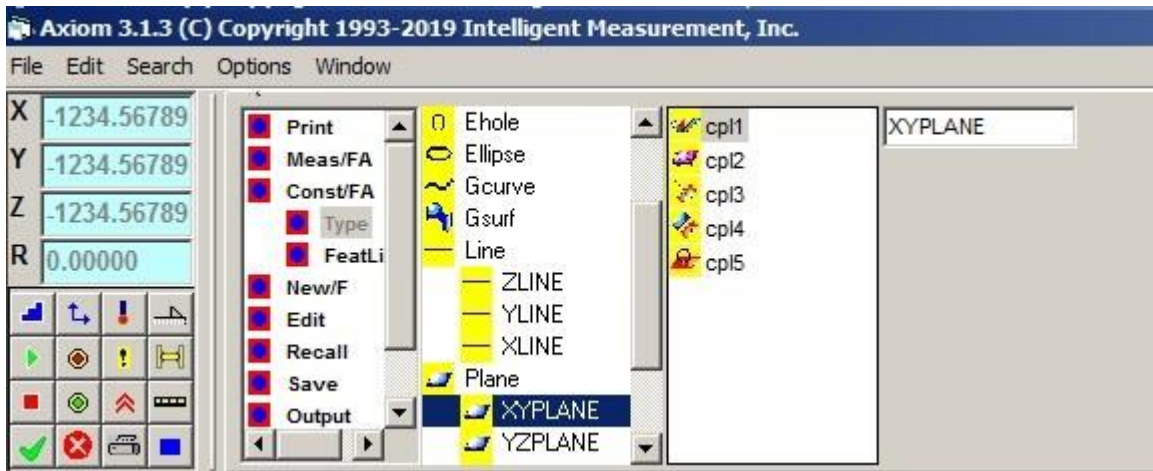
- When MIDPT is specified, there are two features which reduce to points, the first of which is measured.
- When VERTEX is specified is a cone.
- When PROJPT is specified, feature must reduce to a point.
- When MOVEPT is specified, the feature is an actual feature of point.
- In USER mode of operation since there may not be a nominal, The actual constructed feature must make certain assumptions .
- In DCC mode of operation there must be a nominal feature defined prior to the construction method for that feature therefore there should be no ambiguities in the construction. When more than one result is possible from a given construction, the desired result is that which most closely agrees with the nominal feature definition.

Constructing Line

- The MIDLI bisects intersecting lines and is parallel to, and half way between, parallel lines. In the case of two skew lines or axes (A) and (B), one or both of which are unbounded, the unbounded MIDLI can be described in the following way:
- Lines A and B have a midplane which is defined as perpendicular to the line of closest approach between A and B and passing through the midpoint of that line.
- The MIDLI between A and B, then, lies in the midplane and is the bisector of the angle between the respective projections of A and B into the midplane.
- In the case of two skew lines or axes (A) and (B), both of which are bounded, the bounded MIDLI can be defined in the following way.
- Two line segments C and D can be defined which connect the corresponding endpoints of line A and B. The MIDLI is the line segment connecting the midpoints of the lines C and D.
- In USER mode of operation since there may not be a nominal, The actual constructed feature must make certain assumptions .
- In DCC mode of operation there must be a nominal feature defined prior to the construction method for that feature therefore there should be no ambiguities in the construction. When more than one result is possible from a given construction, the desired result is that which most closely agrees with the nominal feature definition.

Constructing Sphere

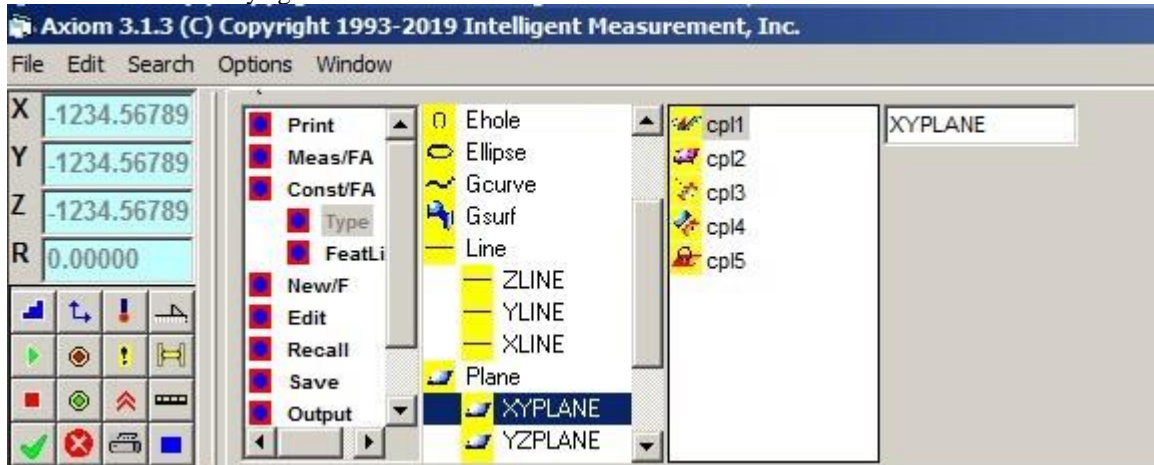
CONSTRUCTING FEATURES



CONSTRUCTING FEATURES

Constructing Plane

- The midplane bisects intersecting planes, lines or axes; is half way between, and parallel to parallel planes, lines or axes.
- Two skew lines (A) and (B) have a midplane which is defined as perpendicular to the line of closest approach between A and B passing through the midpoint of that line.
- Since all constructed features have a nominal feature definition, there should be no ambiguities in the construction. When more than one result is possible from a given construction, the desired result is that which most closely agrees with the nominal feature definition.



Constructing Ellipse

Constructing Arc

Constructing Cone

Constructing Circle

Projection Construction Method

Move Construction Method

Mid Construction Method

CONSTRUCTING FEATURES

Intersection Construction Method

CONSTRUCTING FEATURES

Best Fit Construction Method

- Any feature that reduces to a point (arc, circle, cone, ellipse, point, or sphere) can be used with BF; the point to which the feature reduces is used in the construction. Specifically, for arcs, circles and spheres, the center point is taken; for cones, the vertex is used; and for ellipses, the intersection point of the major and minor axes is taken. The minimum number of previously defined features required for these constructions is given as follows:
 - ARC 3
 - CIRCLE 3
 - CONE 6
 - CYLINDER 6
 - ELLIPSE 5
 - LINE 2
 - PLANE 3
 - SPHERE 4

Best Fit Construction Method

- In the case of an ARC construction, the end points will be defined as the points where the best-fit arc is intersected by radial lines drawn through and the last feature specified in the format list. All points are coplanar and lie on the arc.
- In the case of a CIRCLE construction, the points are coplanar and lie on the circle.
- In the case of a CONE construction, two parallel sets of at least three coplanar points are used, (each set resolves to a circle).
- In the case of a CYLNDR construction, two parallel sets of at least three coplanar points are used, (each set resolves to a circle).
- In the case of an ELLIPS construction, the points are coplanar and lie on the ellipse.
- In the case of a SPHERE construction, all points lie on the sphere.
- Since all constructed features are Feature actuals, There is a need for the Nominal to exist.
- In USER mode of operation since there may not be a nominal, The actual constructed feature must make certain assumptions .
- In DCC mode of operation there must be a nominal feature defined prior to the construction method for that feature therefore there should be no ambiguities in the construction. When more than one result is possible from a given construction, the desired result is that which most closely agrees with the nominal feature definition.

TOLERANCE

TOLERANCING

Tolerance Types

- Axiom provides a complete set of tolerancing functions based on ANSI Y14.5 standard.
- Tolerancing is applied to measured features or constructed features.
- There is relationship between the measuring process and evaluation of tolerance.

Predefined Tolerances

- A list of predefined Tolerances are loaded at startup.
- For detailed description of the predefined Tolerances please refer to the Appendix B.
- After start up of axiom the Tolerance list box shows the predefined Tolerances.
- The user may change the predefined Tolerances based by modifying the start up file.
- The list of predefined Tolerances greatly helps the user to automatically apply tolerances to measured features. The predefined tolerance labels appearing in the tolerance group can be modified by defining tolerance button.

Define Nominal Tolerances

- Tolerance definitions are used to describe generic tolerances. They also provide for label names to be assigned to each tolerance.

Tolerancing ANGL

- ANGL specifies an angular tolerance.
- If an angular tolerance such as 30 degrees ± 0.5 degrees, -0.4 degrees is given, then $uptol = +0.5$ and $lotol = -0.4$. Unsigned $lotol$ and $uptol$ values are assumed positive. An angular tolerance can be applied to a cone.

Tolerancing DIAM

- DIAM Specifies a diameter tolerance and assigns to it a label.
- If a diameter tolerance such as 5 ± 1 , -2 is given, then $uptol = +1$ and $lotol = -2$. Unsigned $lotol$ and $uptol$ values are assumed positive. A diameter tolerance can be applied to a circle, cylinder, sphere or ellipse. In the case of an ellipse, the diameter specified is that referenced in the feature definition. If both diameters are to be toleranced, then two feature definitions will be required.

Tolerancing RAD

TOLERANCE

- RAD Specifies a radial tolerance and assigns to it a label.
- If a radius tolerance such as $5 +1, -2$ is given, then $uptol = +1$ and $lotol = -2$. Unsigned $lotol$ and $uptol$ values are assumed positive. A radial tolerance can be applied to an arc, circle, cylinder, sphere, and ellipse. In the case of an ellipse, the diameter specified is that referenced in the feature definition. If both diameters are to be toleranced, then two feature definitions will be required.

Tolerancing CIRLTY

- CIRLTY Specifies a circularity tolerance and assigns to it a label.
- The width of the tolerance zone bounded by two concentric circles within which elements of the surface of the feature must lie, or actually lies.
- Regardless of Feature Size, RFS is assumed.

Tolerancing CYLCTY

- CYLCTY Specifies a cylindricity tolerance and assigns to it a label.
- The width of the tolerance zone bounded by two concentric cylinders within which elements of the surface of the feature must lie, or actually lies.
- Regardless of Feature Size, RFS is assumed.

Tolerancing FLAT

- FLAT Specifies a flatness tolerance and assigns to it a label.
- The width of the tolerance zone defined by two parallel planes within which the surface of the feature must lie, or actually lies.
- Regardless of Feature Size, RFS is assumed.

Tolerancing STRGHT

- STRGHT specifies a straightness tolerance and assigns to it a label.
- The width of the tolerance zone defined by two parallel lines within which all points of the feature must lie, or the distance between parallel planes within which the center plane of the feature must lie, or the diameter of a cylindrical tolerance zone within which the axis of the feature must lie, or actually lies.
- MMC signifies that maximum material condition is applied.
- LMC signifies that least material condition is applied.
- RFS signifies regardless of feature size.
- The results shows the sum of the tolerance plus the gain from MMC or LMC.
- MMC, or LMC can be applied to a center plane or axis.

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Tolerancing PROFL

- PROFL Specifies a profile of a line (curve) tolerance and assigns to it a label.
- DAT is datum to be used as a reference.
- The profile of a line tolerance specifies a tolerance zone which is a two dimensional band, extending along the length of the feature. If the tolerance is unbounded, it is applied along the length of the feature. The tolerance may be bounded when it is desired to apply it to only a portion of the feature. Regardless of Feature Size is assumed. The output of lotol and uptol define the tolerance zone within which the feature actually lies.
- This Method of Tolerancing is supported only through DCC mode

Tolerancing PROFS

- PROFS Specifies a profile of a surface tolerance and assigns to it a label.
- DAT is the datum to be used as a reference.
- The profile of a surface tolerance specifies a three dimensional tolerance zone which extends along the length and width or circumference of the feature. As with the profile of a line tolerance, it may be unbounded or bounded. Regardless of Feature Size is assumed.
- This Method of Tolerancing is supported only through DCC mode.

Tolerancing CRNOUT

- CRNOUT Specifies a circular runout tolerance and assigns to it a label.
- Zone is the width of the tolerance zone within which a single circular element i.e., circular cross section, must lie.
- DAT is the datum to be used as an axis, and can be in the form of (x-x) for constructed compound datums.
- Circular runout is applied to circular features. The tolerance is applied independently at any circular cross section as the part is rotated 360 degrees. When applied to features with an axis, circular runout controls the cumulative variations of the circularity and coaxiality. When applied to a plane feature which is perpendicular to the datum axis, circular runout controls wobble.

Tolerancing TRNOUT

- TRNOUT specifies a total runout tolerance and assigns to it a label.
- Zone is the width of the tolerance zone defined by two parallel lines within which all points of the feature must lie, or the distance between parallel planes within which the center plane of the feature must lie, or the diameter of a cylindrical tolerance zone within which the axis of the feature must lie.
- DAT is the datum to be used as an axis and can be in the form of (x-x) for constructed compound datums.
- Total runout provides composite control of an entire feature. The tolerance is applied simultaneously to all circular and profile measuring positions as the part is rotated 360 degrees. Where applied to surfaces constructed around a datum axis, total runout is used to control cumulative variations of circularity, straightness, coaxiality, angularity, taper, and profile of a surface. Where

TOLERANCE

applied to surfaces constructed at right angles to a datum axis, total runout controls cumulative variations of perpendicularity (to detect wobble) and flatness (to detect concavity or convexity).

TOLERANCE

Tolerancing ANGLB

- ANGLB specifies an angle and a tolerance, and assigns it to a label.
- signifies the value and tolerance are applied to the angle between two features.
- The nominal value is of an angle, or the measured angle.
- The nominal angle is to be used between two features that reduce to lines or planes i.e., cylinders and cones reduce to their centerlines, slots reduce to their centerplane. If an angle and tolerance such as 30 degrees +.5 degrees, -.4 degrees is given, then $uptol = +.5$ and $lotol = -.4$. Unsigned $lotol$ and $uptol$ values are assumed positive.

Tolerancing ANGLR

- ANGLR specifies an angularity tolerance and assigns to it a label.
- The nominal value is of an angle in the current primary datum plane relative to the specified datum, or the actual angle.
- Zone is the width of the tolerance zone defined by two parallel lines within which all points of the feature must lie, or the distance between parallel planes within which the center plane of the feature must lie, or the diameter of a cylindrical tolerance zone within which the axis of the feature must lie.
- MMC signifies that maximum material condition is applied.
- LMC signifies that least material condition is applied.
- RFS signifies regardless of feature size.
- F(Label) is the name of a feature to be used as a reference.
- FA(label) is the name of the feature actual to be used as a reference.
- DAT is the datum to be used, or used as a reference.
- The result is the sum of the tolerance plus the gain from MMC or LMC.
- The $tolzone$ in the Output results is the zone in which the actual feature lies.
- MMC and LMC can be applied to a center plane or axis.

Tolerancing DISTB

- DISTB specifies a distance and a tolerance, and assigns it to a label.
- signifies the value and tolerance are applied to the distance between two features.
- NOMINAL signifies a nominal distance with lower and upper tolerance. The $uptol$ and $lotol$ values are the tolerances applied to the nominal distance.
- LIMIT signifies a distance as a lower and upper limit. , the $uptol$ and $lotol$ values are the lower limit and upper limit tolerances.
- XAXIS signifies that the distance between is along the X axis.
- YAXIS signifies that the distance between is along the Y axis.
- ZAXIS signifies that the distance between is along the Z axis.
- PT2PT signifies that the distance between is point to point, or feature to feature.
- AVG signifies average or mean distance between two features.
- MAX signifies maximum distance between two features.
- MIN signifies minimum distance between two features.
- If a distance and tolerance such as 5 +1,-2 is given, then $uptol = +1$ and $lotol = -2$. Unsigned $lotol$ and $uptol$ values are assumed positive. In the output format, the $lotol$ and $uptol$ values define the zone in which the actual feature lies. When tolerancing the distance between two points or of features that resolve to points, AVG, MAX or MIN are not required.

TOLERANCE

Tolerancing PARLEL

- PARLEL specifies a parallelism tolerance and assigns to it a label.
- Zone is the width of the tolerance zone defined by two parallel lines within which all points of the feature must lie, or the distance between parallel planes within which the center plane of the feature must lie, or the diameter of a cylindrical tolerance zone within which the axis of the feature must lie.
- MMC signifies that maximum material condition is applied.
- LMC signifies that least material condition is applied.
- RFS signifies regardless of feature size.
- F(label) is the name of a feature to be used as a reference.
- FA(label) is the name of a feature actual to be used as a reference.
- DAT is the datum to be used as a reference.
- The result is the sum of the tolerance plus the gain from MMC or LMC.
- In the output format, the tolzon is the zone in which the actual feature lies.

Tolerancing PERP

- PERP Specifies a perpendicularity tolerance and assigns to it a label.
- Zone is the width of the tolerance zone defined by two parallel lines within which all points of the feature must lie, or the distance between parallel planes within which the center plane of the feature must lie, or the diameter of a cylindrical tolerance zone within which the axis of the feature must lie.
- MMC signifies that maximum material condition is applied.
- LMC signifies that least material condition is applied.
- RFS signifies regardless of feature size.
- F(label) is the name of a feature to be used as a reference.
- FA(label) is the name of a feature actual to be used as a reference.
- DAT is the datum to be used as a reference.
- The result is the sum of the tolerance plus the gain from MMC or LMC.
- In the output format, the tolzon is the zone in which the actual measured feature lies.

Tolerancing CONCEN

- CONCEN specifies a concentricity tolerance and assigns it to a label.
- Zone is the diameter of the cylindrical tolerance zone, or the actual measured zone in which the axis of the feature lies.
- F(label) is the name of a feature to be used as a reference.
- FA(label) is the name of a feature actual to be used as a reference.
- DAT is the datum to be used as a reference.
- A concentricity tolerance specifies a cylindrical tolerance zone around a datum axis within which the feature axis must lie. It applies on an RFS basis only.

Tolerancing CORTOL

- CORTOL specifies bidirectional positional tolerancing of features in cartesian, or polar coordinates, and assigns to it a label.
- Signifies bidirectional positioning tolerancing.
- XAXIS signifies that the rectangular coordinate method is to be used to tolerance the position along the X axis.

TOLERANCE

- YAXIS signifies that the rectangular coordinate method is to be used to tolerance the position along the Y axis.
- ZAXIS signifies that the rectangular coordinate method is to be used to tolerance the position along the Z axis.
- RADIUS signifies that the polar coordinate method is used to tolerance the radial position.
- ANGLE signifies the polar coordinate method is used to tolerance the angular position.
- The result is the deviation from the nominal value.
- When using the rectangular coordinate method, the tolerance zone can be square or rectangular. Note that the feature(s) being tolerated with this method must be defined with cartesian coordinates. Likewise, when using the polar coordinate method, the feature(s) being tolerated with this method must be defined with polar coordinates. The positional tolerance values of the polar coordinate method represent distances between two concentric arc boundaries and two parallel planes, respectively, equally disposed about the true position.

Tolerancing POS2D

- POS2D specifies a 2D true position tolerance and assigns to it a label.
- POS2D signifies a circular tolerance zone evaluated in a two dimensional plane which is parallel to the current WKPLAN.
- Zone is the diameter of the circular or cylindrical tolerance zone within which the feature center point or axis must lie, or actually lies.
- MMC signifies that maximum material condition is applied.
- LMC signifies that least material condition is applied.
- RFS signifies regardless of feature size.
- DAT is the datum to be used as a reference.
- The result is the sum of the tolerance plus the gain from MMC or LMC.
- The material condition will be specified as applied to the Feature to be tolerated.
- The material condition may or may not be applied for each datum(s).

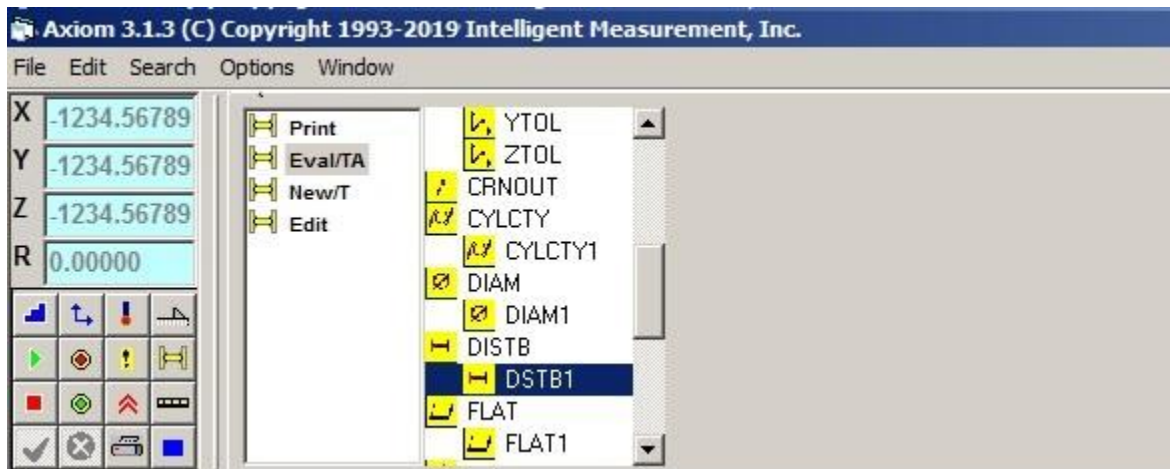
Tolerancing POS3D

- POS3D specifies a 3D true position tolerance and assigns to it a label.
- POS3D signifies a cylindrical tolerance zone whose axis is perpendicular to the current WKPLAN. Note that the feature cylinder being tolerated must be bounded.
- Zone is the diameter of the circular or cylindrical tolerance zone within which the feature center point or axis must lie, or actually lies.
- MMC signifies that maximum material condition is applied.
- LMC signifies that least material condition is applied.
- RFS signifies regardless of feature size.
- DAT is the datum to be used as a reference.
- The result is the sum of the tolerance plus the gain from MMC or LMC.
- The material condition will be specified as applied to the Feature to be tolerated.
- The material condition may or may not be applied for each datum(s).

TOLERANCE

Evaluating Actual Tolerance

- There is two methods to set/evaluate tolerance for features,
 - Automatic Feature Based Tolerancing method
 - User Selected Tolerancing method
- Automatic Feature based tolerancing is a powerfull feature of AXIOM . Once a feature type is selected by clicking the Active Feature type , Axiom automatically selects the predefined tolerance method set for that feature. Upon clicking Done after taking points, the tolerance is evaluated and results are shown using the tolerance evaluation bar.
- User selected Tolerancing method is where the user overrides the automatically selected tolerance method.
- The tolerance evaluation window dynamically changes depending on the type of tolerancing.
- Measuring a feature has therefore additional relationships to Tolerancing method as shown below
- Relationships:
 - Active Feature type
 - Active Tolerance Method or Default Feature Based Tolerance Method
 - Active Tolerance Method Label Field.
 - Tolerance Feature Actual Drop Down List Box.
 - Nominal settings Field
 - Done
 - Output results Window
 - Tolerance List box



OUTPUT

OUTPUT

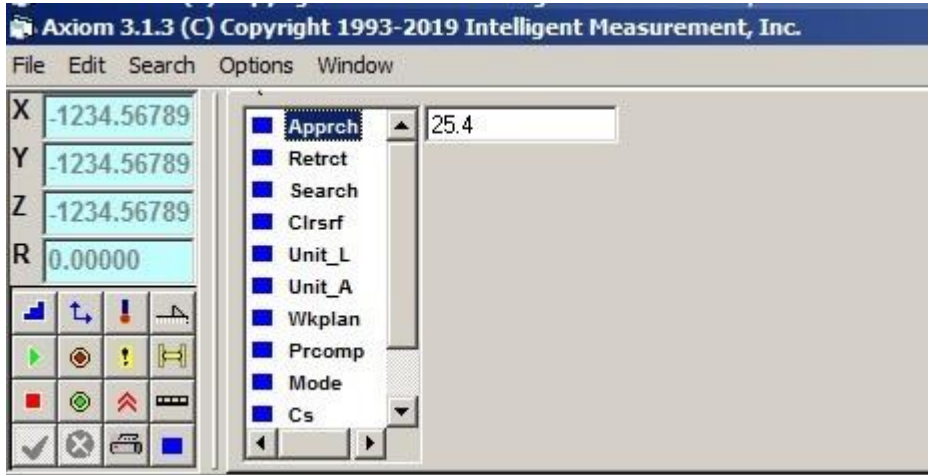
Output Formats

- DMIS format is a line format where the results are shown in lines of DMIS output syntax.
- VENDOR format is a tabular format suitable for printing to printers.
- Click on the desired format .
- Either format can be outputted to file or printer.

- To set the VENDOR output to go to printer click on the PRINTER VENDOR icon
- To set the DMIS output to go to printer click on the PRINTER DMISicon.
- To set the VENDOR output to go to a file click on the FILE VENDOR icon
- To set the DMIS output to go to file click on the FILE DMISicon.

SET

SET



- Clicking on the RESET causes all the elements of axiom to clear and initialize.
 - Features
 - Sensors
 - Coordinate System
 - Tolerances
 - Other settings
- Note that the predefined elements will not be loaded upon reset.
- MCS will be the active Coordinate system upon reset.
- A confirmation window will prompt user for before all elements are reset.

ROTAB

ROTAB