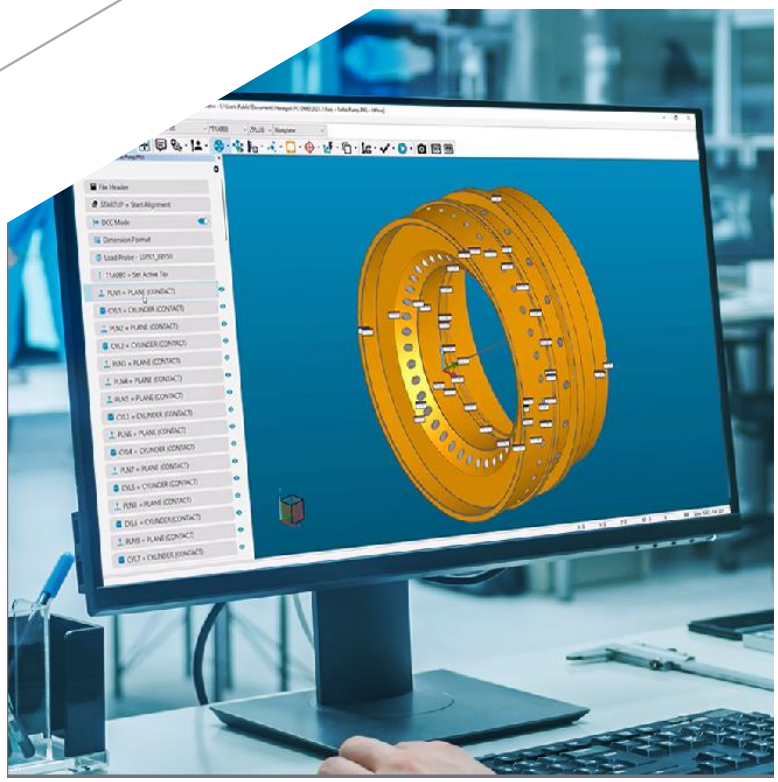
HEXAGON

PC-DMIS CMM Manual

2026.2



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Introduction to PC-DMIS CMM

Welcome to PC-DMIS CMM. This documentation discusses the PC-DMIS CMM software package. Specifically, it covers those items that you can use to create and run a measurement routine using a Coordinate Measuring Machine (CMM) with PC-DMIS. It also covers contact probing with touch trigger probes and other topics that are specific to CMMs.

The topics are:

- Getting Started
- Setting Up and Using Probes
- Using the Probe Toolbox
- Working with Measurement Strategies
- CMM QuickMeasure Toolbar
- Creating Alignments
- Measuring Features
- Scanning

For information on general PC-DMIS options, see the PC-DMIS Core documentation. For information on portable measuring machines, vision or laser devices, or other specific configurations of PC-DMIS, consult one of the other documentation projects.

If you are new to PC-DMIS and want to explore its capabilities, see "Getting Started", and follow along on your system.

Getting Started

Getting Started: Introduction

PC-DMIS is a powerful software application with a multitude of options and useful functionality. This section provides you with a "PC-DMIS CMM Tutorial" that you can follow to create and execute a measurement routine. This tutorial is not intended to train you on everything PC-DMIS can do. But, if you are new to PC-DMIS, it gives you a brief exposure to the software.

As you progress through the tutorial, you will become more familiar with how to:

- Create measurement routines
- Define probes
- Work with views
- Measure part features
- Create alignments
- Set preferences
- Add clearance planes
- Add programmer comments
- Construct features
- Create QuickFeatures
- Add move points
- Create dimensions
- Execute measurement routines
- View and choose reports
- Learn best practices

Since experience is the best teacher, go ahead and get started in the "PC-DMIS CMM Tutorial" topic.

PC-DMIS CMM Tutorial

This section helps you create a basic measurement routine. Once you create it, the measurement routine should be able to measure a few features with your CMM and report the results. This tutorial assumes that you have an online license of PC-DMIS. Even if you do not have an online license of PC-DMIS, you can follow through many of the tutorial's steps in Offline mode.

The tutorial also provides a high-level view of some of what PC-DMIS can do.



If you have any questions, you can use the PC-DMIS Core documentation at any time to get more information.

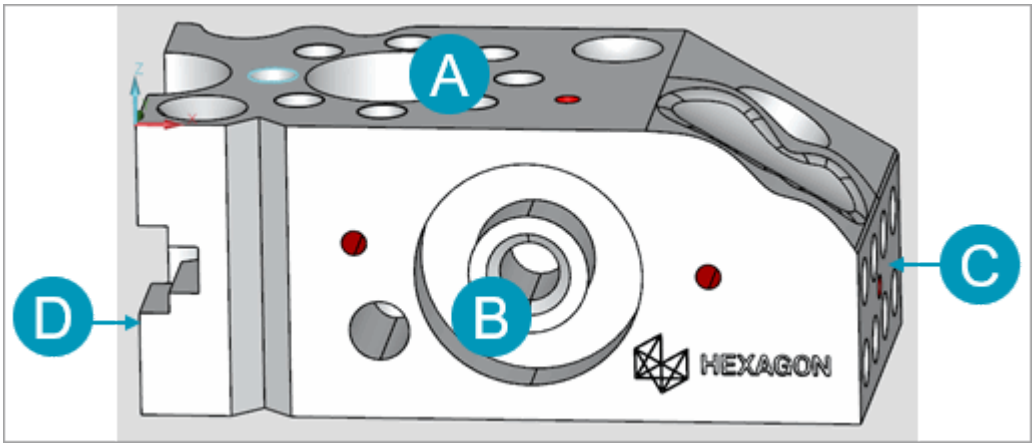
The tutorial guides you through these steps:

1. Connect Hardware to the CMM
2. Start Up and Home the CMM
3. Create a New Measurement Routine
4. Import the Hexagon Part Model
5. Configure the Interface
6. Define a Probe
7. Define Alignment Features
8. Scale the Image
9. Create an Alignment
10. Set Preferences
11. Add Comments
12. Select Additional Features
13. Construct New Features from Existing Features
14. Add a Tip Change Command
15. Add Another Clearance Plane
16. Add Move Point Commands
17. Calculate Dimensions

18. Mark Items to Execute
19. Test for Collisions
20. Adjust Feature Values
21. Set the Report Output and Type
22. Execute the Finished Measurement Routine
23. View the Report
24. Best Practices

Step 1: Connect Hardware to the CMM

This tutorial uses this Hexagon test block and CAD model.



This documentation refers to the above labeled faces as:

***A** - Top Face*
***B** - Front Face*
***C** - Right Face*
***D** - Left Face*

Connect this part to your CMM. You need to elevate it above the table so that the probe body can measure features on the side faces without hitting the CMM table. Also, be sure to connect a probe with a wrist to your CMM.

More Info

The CAD model comes with this version of PC-DMIS. Also, the tutorial assumes that you have the following:

- A baseplate fixture
- A post-like cylindrical fixture that can connect to the Hexagon test block



You can place the part directly on the table and ignore the fixture if you like. However, your probe may not have enough clearance to measure features on the side faces.

Connect the Fixture and Part

If you do not have this actual part, you can use a similar part that has several circles and a cone that you can measure.

1. Connect a cylinder fixture into a threaded base plate fixture or into the CMM table itself.
2. Connect the Hexagon test block to the top of the threaded cylinder fixture.
3. Orient the test block on your CMM table so that your probe can easily access the top and front faces.

For Offline Users

You might not have access to a CMM. In that case, you probably have an offline license and can still import the test block model and follow some of the steps. Instead of a probe to take hits, you can use your mouse pointer. You can click on the CAD model to simulate probe hits. This approach does not produce real measurement results, but you still may find the exercise useful.

To do this, follow the instructions in the "Import the Hexagon Part Model" topic sometime before you start step 4.

1. Connect a cylinder fixture into a threaded base plate fixture or into the CMM table itself.
2. Connect the Hexagon test block to the top of the threaded cylinder fixture.
3. Orient the test block on your CMM table so that your probe can easily access the top and front faces.

Connect the Probe

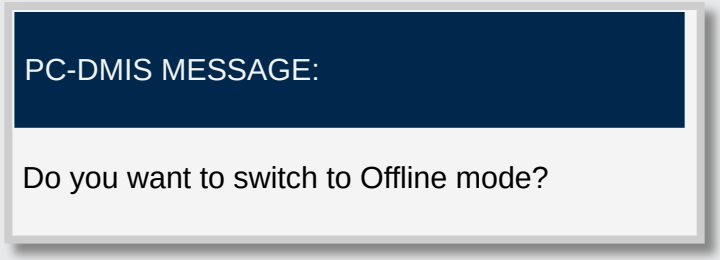
Attach a probe body, with any extensions, and a ruby tip for a contact probe onto the CMM's vertical ram. Make note of the hardware components you use, so that you can define the probe in PC-DMIS later.

- If your CMM is NOT powered on, continue with the "Start Up and Home the CMM" topic.
- If your CMM is already powered on, homed, and you've started PC-DMIS, continue on "Create a New Measurement Routine".

Step 2: Start Up and Home the CMM

Power on the controller and start PC-DMIS. After the machine moves to its home position and stops, you are ready to start the tutorial's first step.

If you start PC-DMIS in Online mode and the machine is not connected, PC-DMIS displays an error message that says the machine is not connected. It then shows this message and asks you if you want to switch to Offline mode.



To start PC-DMIS in offline mode, click **Yes**.

More Info

You can use PC-DMIS with your CMM to develop measurement routines and then run those routines to inspect your parts. To use PC-DMIS with a CMM, you need to run PC-DMIS in Online mode. You also need to make sure the PC-DMIS computer can communicate with your CMM.

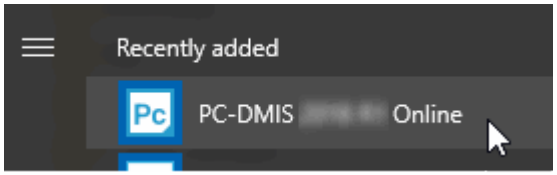
Offline programming techniques still work while in Online mode.

CMM Startup and Homing Procedure for PC-DMIS Online

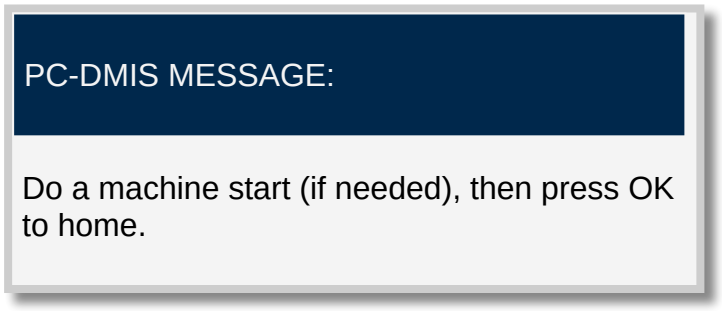
1. If you have a CMM that requires air pressure, turn on the air to the CMM.
2. Power on the controller.
    - Look for a large rotary switch, an on/off key, or a small rocker switch. The key or switch is likely on the controller mounted on the back of the CMM or workstation. Flip the switch or turn the key to start the controller.
    - All of the LEDs on the jog box (hand-held controller with a joy stick) illuminate for about 45 seconds. After that time, several LEDs turn off.



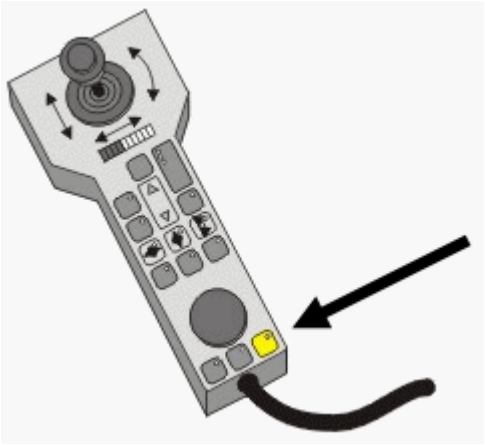
3. Power on your computer and all of its peripherals.
4. Log on to your computer.
5. To start PC-DMIS in Online mode, from the Windows **Start** menu, locate the **PC-DMIS 2026.2 Online** shortcut and click on it.



6. Once PC-DMIS opens, a message appears on the screen:



   - On your jog box, press the button that starts the machine, for example: **Mach Start**, or **Start**. Hold it for several seconds until the LED illuminates. On some models, the button is here:



- The CMM needs to move to a home position. The home position enables it to properly set the machine's zero position and enable the machine's parameters (such as speed, size limits, and so on). Click the **OK** button in the above PC-DMIS message to home the machine. The CMM slowly travels to its home position. This position is the machine's zero position for all the axes.

  WARNING: When you do this, the machine moves. To avoid injury, stay clear of the machine. To avoid hardware damage, run the machine at a slower speed.

Changing the Machine's Parameters

You can set numerous parameters to control the machine's speed and motion. If you need to change your machine's parameters, see "Setting Your Preferences" in the PC-DMIS Core documentation.

Step 3: Create a New Measurement Routine

This step creates a new measurement routine with millimeters as your units.

1. If you haven't already done so, launch PC-DMIS.
2. Once PC-DMIS starts, if you see an **Open** dialog box, click **Cancel** to close it.
3. Select **File | New** to open the **New Measurement Routine** dialog box.
4. In the **Part name** box, type **TEST**.
5. In the **Revision number** box, type a revision number.
6. In the **Serial number** box, type a serial number.
7. From the **Units** list, select **mm**.
8. From the **Interface** list, select **Online**. If PC-DMIS is not connected to your CMM, select **Offline** instead.

9. Click **OK** to create the new measurement routine. You now have a new measurement routine. PC-DMIS opens the main user interface.
10. If the **Temperature Compensation** dialog box appears, click **Cancel** to close it.
11. If the **Probe Utilities** dialog box appears, click **Cancel** to close it for now.

Step 4: Import the Hexagon Part Model

This tutorial uses a CAD model. A CAD model is virtual representation of the physical part. With a CAD model, you can select the areas that you want to measure from the Graphic Display window. PC-DMIS can then measure those areas on the physical part and compare the values. A report tells you if the values are within tolerance.

1. Select **File | Import | Iges** to open the **Import** dialog box.
2. Navigate to this folder:

   C:\Users\Public\Public Documents\Hexagon\PC-DMIS\2026.2\CAD

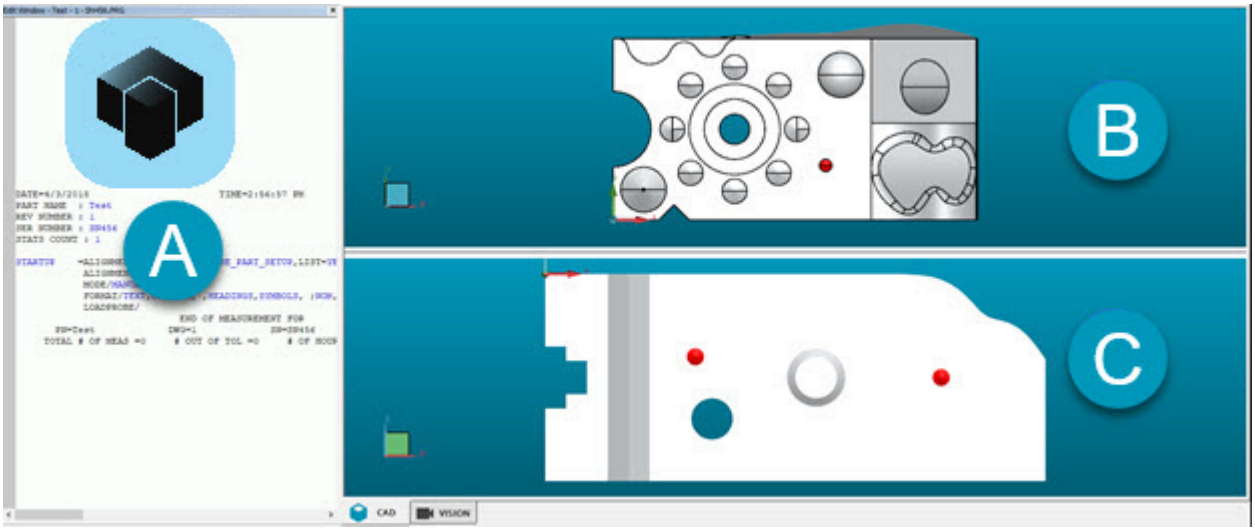
3. From that folder, select the **HexMI_DemoBlock_Small.igs** part model.
4. Click **Import** to import the part into the Graphic Display window.

Later steps walk you through how to use the CAD model to define features for the routine.

For more information on how to import IGES files, see the "Importing an IGES File" topic in the "Using Advanced File Options" chapter in the PC-DMIS Core documentation.

Step 5: Configure the Interface

This tutorial assumes that the Edit window is in Command Mode and that you split your Graphic Display window to show both a top-down view (B) and a front view (C).



***A** - The Edit window in Command mode.*

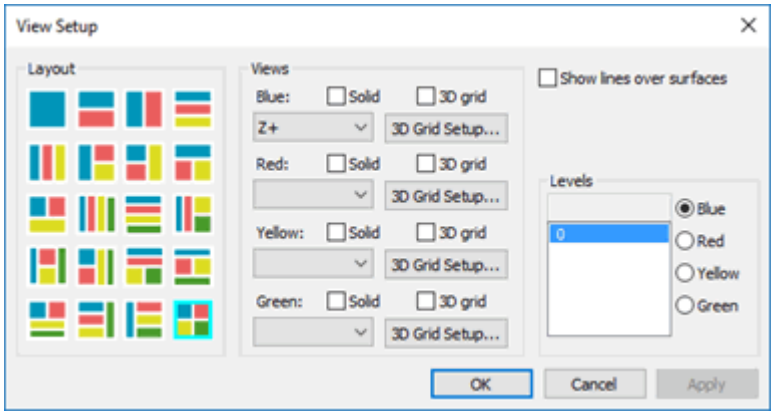
B *- The Graphic Display window split with top view in Z+.*
C *- The Graphic Display window split with bottom view in Y-.*

More Info

Configure the Graphic Display Window

This step uses the **View Setup** dialog box to change the views in the Graphic Display window.

1. To open this dialog box, from the **Graphic Modes** toolbar, click the **View Setup** button (), or select **Edit | Graphic Display Window | View Setup**.



2. From the **View Setup** dialog box, select the second button (top row and second from the left), which indicates a horizontally-split window:

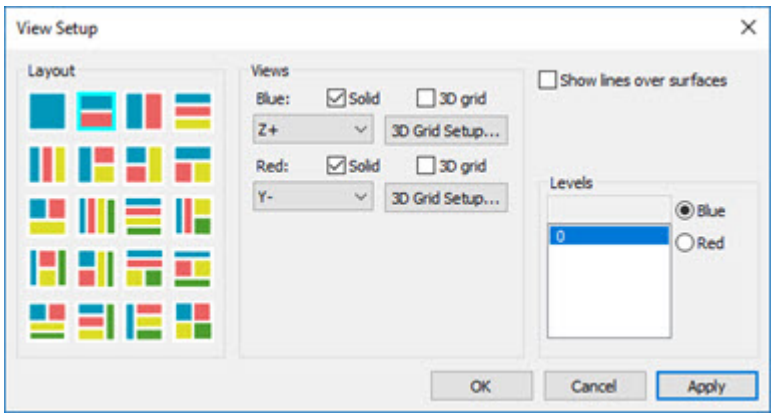


Button

3. In the **Views** area, from the **Blue** list, select **Z+** and mark **Solid**. This shows the upper part of the screen in the Z+ orientation.

4. In the **Views** area, from the **Red** list, select **Y-** and mark **Solid**. This shows the lower part of the screen in the Y- orientation.

5. The dialog box should look like this:



6. Click the **Apply** button to have PC-DMIS redraw the Graphic Display window with the two views that you selected. Since you haven't measured the part yet, PC-DMIS does not draw anything in the Graphic Display window. However, the screen is split according to the views you selected.

> These display options only affect how PC-DMIS displays the part image on the screen. They do not affect the measured data or inspection results.

Configure the Edit Window

This step places the Edit window in Command Mode.

To place the Edit window in Command Mode, choose **View | Command Mode**.

Step 6: Define a Probe

For this tutorial, your probe needs to support these two probe angles. They must be calibrated:

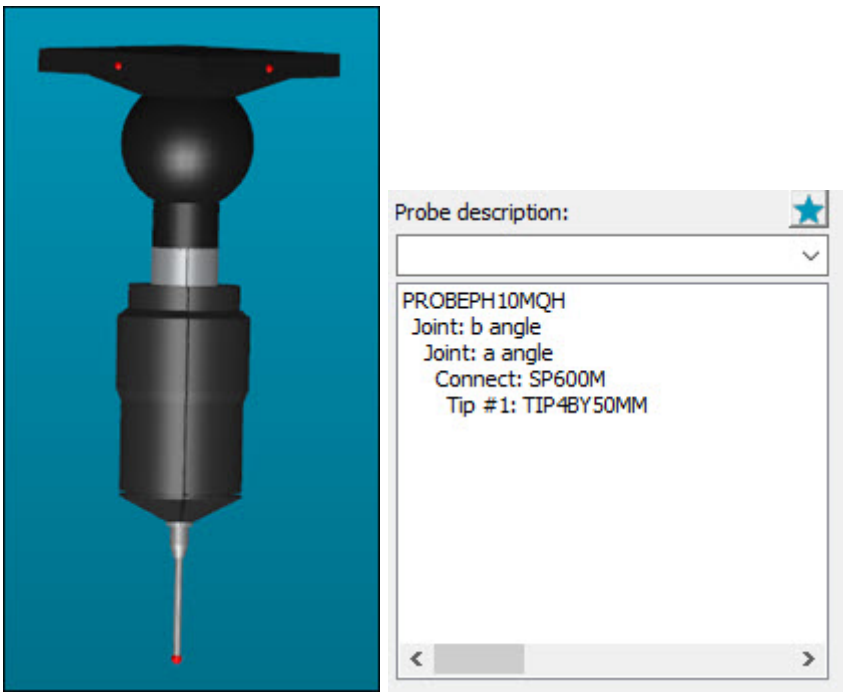
- T1A0B0
- T1A90B-180

Alternately, you may use a star probe with tips that can measure the top face and the front face of the part. If your probe on your machine can do either of these, then just make sure the probe in the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**) matches what is on your machine.

> The instructions in the remainder of this tutorial assume that you have a probe with a wrist with the above calibrated angles.

More Info

This tutorial uses a calibrated PH10MQH indexable probe with a 2 mm ruby tip on a 50 mm stem. The information here explains how to select or create a similar probe.



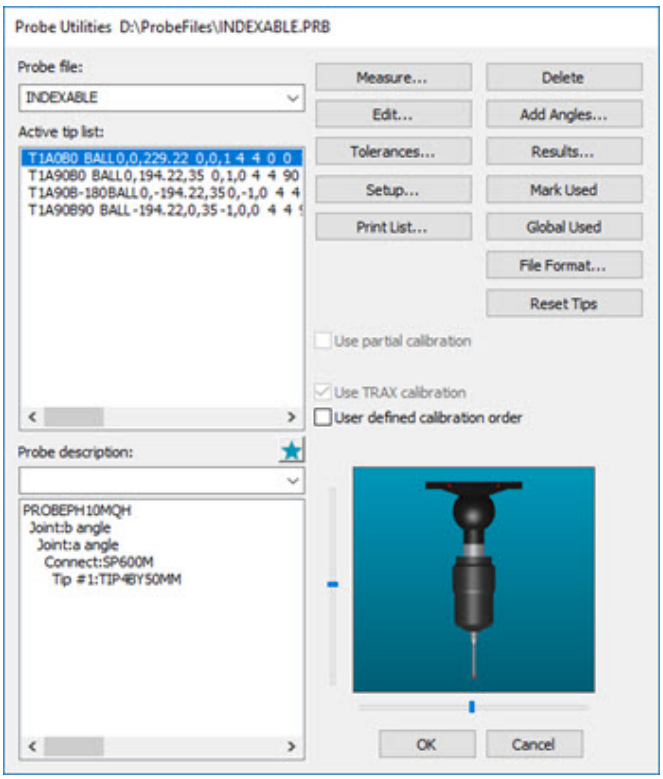
Your probe definition must have these two active tip angles. They must be calibrated:

- T1A0B0
- T1A90B-180

This tutorial does not cover the probe tip calibration process. If you need to calibrate a probe tip, see the "Calibrating Probe Tips" topic in the "Setting Up and Using Probes" chapter.

If the **Probe Utilities** dialog box is not open, select **Insert | Hardware Definition | Probe** to open it.

With the **Probe Utilities** dialog box, you need to select or create a similar contact probe.



Probe Utilities dialog box with some calibrated probe tips

Once you click **OK**, PC-DMIS uses that probe to measure your part.

For more information on how to define probes, see "Defining Probes" in the "Setting Up and Using Probes" chapter.

To Select an Existing Probe

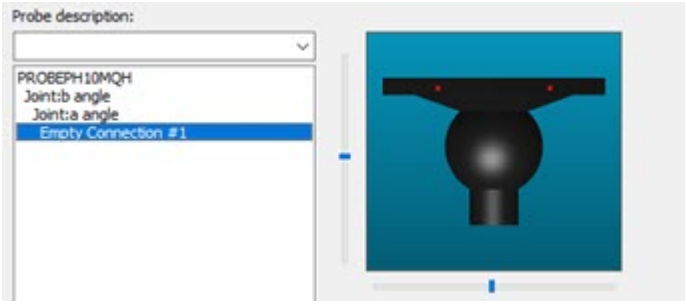
1. With the **Probe Utilities** dialog box, select the drop-down arrow for the **Probe File** list.
2. Choose a probe. It must have the two calibrated probe tips mentioned at the top of this topic. Calibrated probe files do not have an asterisk next to their tips in the **Active tip list**.
3. Choose tip **T1A0B0**.
4. Click **OK**.

To Create a New Probe

With the **Probe Utilities** dialog box, follow the procedure below. This procedure lets you choose the probe, any extensions, and the probe tip angles to use. The **Probe description** area displays the available probe options in alphabetical order.

1. From the **Probe file** box near the top of the dialog box, type a name for the probe.
2. From the **Probe description** area, select the statement: **No Probe defined.**
3. From the **Probe description** list, select the desired probe head and press Enter.

4. Select the line **Empty Connection #1**, and continue to select the necessary probe parts until you build your probe.



Empty Connection #1 Line

5. Your finished probe must have the two calibrated probe tips mentioned at the top of this topic.

6. When you are done, click the **OK** button to save your probe and close the **Probe Utilities** dialog box. PC-DMIS inserts a `LOADPROBE` command in the Edit window that points to this probe.

7. From the toolbar area, locate the **Settings** toolbar and look at the **Probe Tips** list. The defined probe tip appears there as well.



You can also click the **ProbeWizard** icon () on the **Wizards** toolbar to access the Probe Wizard and define your probe that way. The Probe Wizard helps you define your probe using a simpler interface.

Once you have a probe with the above calibrated tips, the next step defines what features to measure for the alignment.

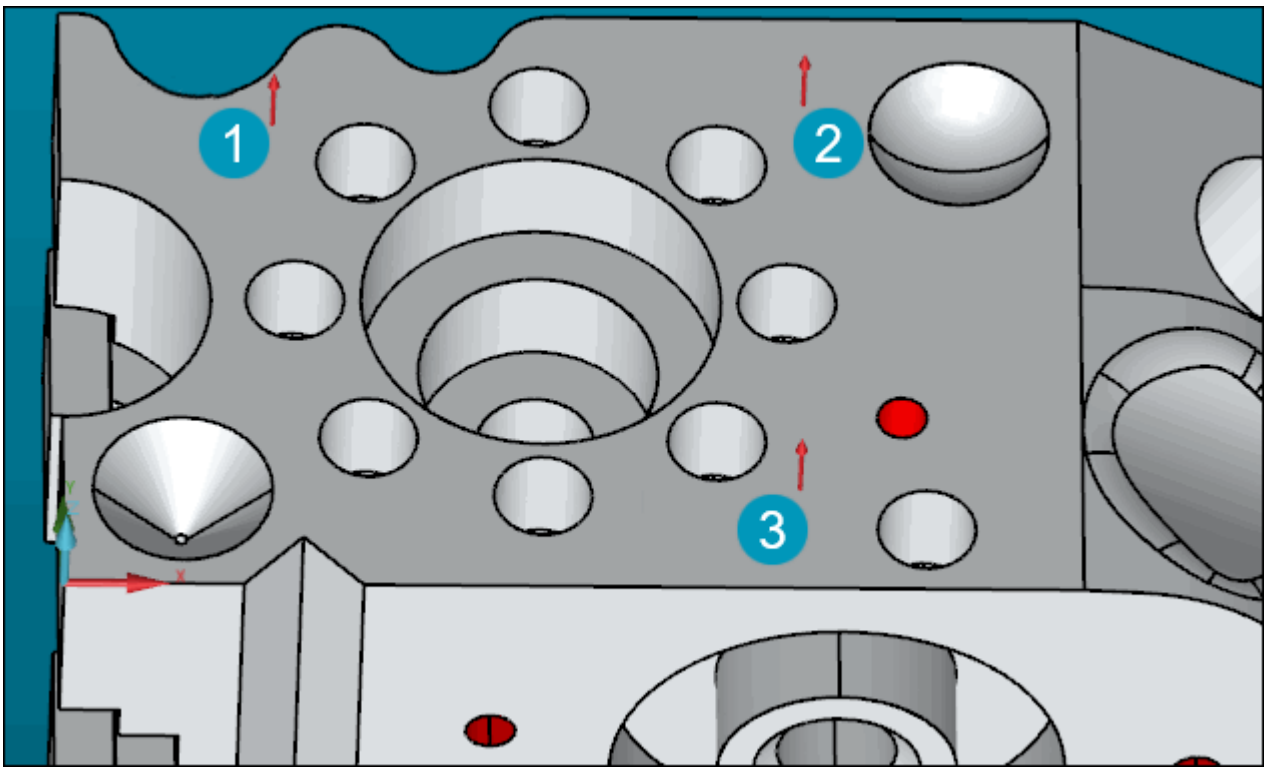
Step 7: Define Alignment Features

Now that you have configured the interface and defined the probe, you can begin the alignment process. First, you need to select the three alignment features below. With these features, you can define the 0,0,0 origin point for the part alignment.

Click on the CAD model to select these features at the indicated locations:

Define a Plane

First, you need to select a plane feature. To do this, you need to take three or more hits on the top surface of the CAD model. This example uses three hits.



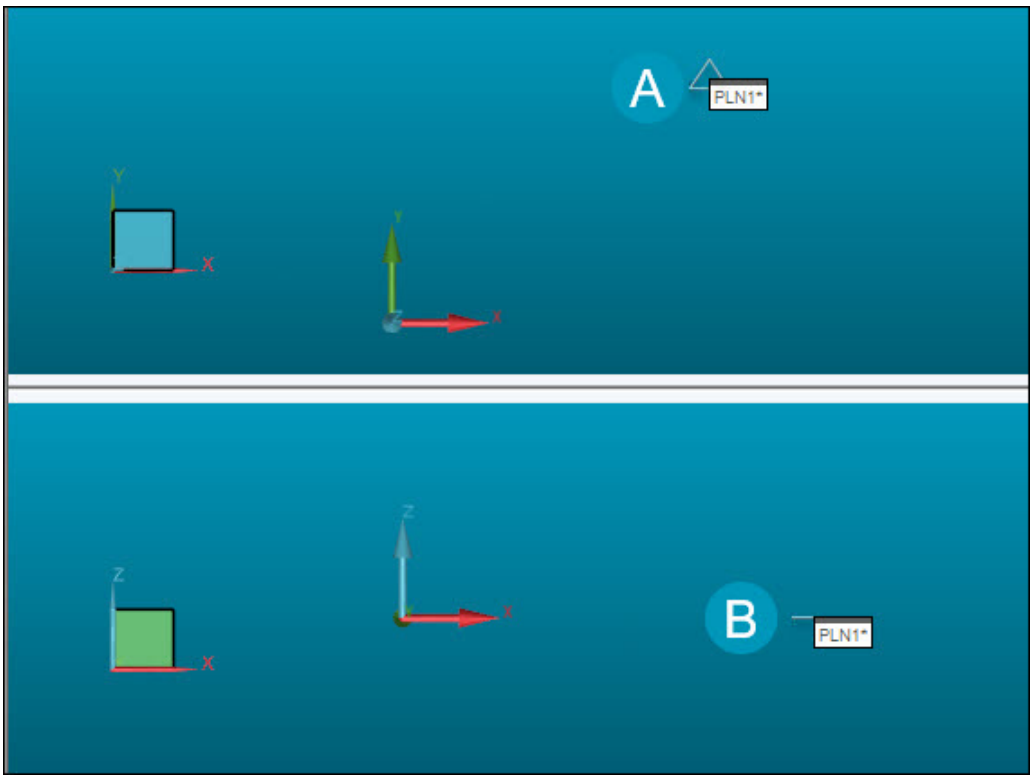
Red arrow bases show three hit locations on the part's surface

1. Before you take hits, verify that PC-DMIS is set to **Program Mode**. To do this, from the **Graphic Modes** toolbar, select the **Program Mode** button ( ).
2. In the Graphic Display window, in the top view, click on the top surface of the part to register a hit. This is the first hit.
    - Take at least three hits on the top surface, similar to the image above.
    - The hits must form an imaginary well-formed triangle or area.
    - The hits need to be well spread out.

    As you take hits, PC-DMIS stores them inside of a hit buffer. If you take a bad hit, press Alt + - (minus) on your keyboard to delete it from the hit buffer. You can then retake the hit.
3. After the final hit, press the End key to create a plane feature from the hits.

PC-DMIS displays a feature ID (PLN1) and a triangle in the Graphic Display window. The triangle in the Graphic Display window indicates your measured plane feature.

The images below, and the other images for the other alignment features intentionally do not show the CAD model. This is so you can more easily see what PC-DMIS inserts into the Graphic Display window when you create these features.



A. *Plane feature in the Z+ view*

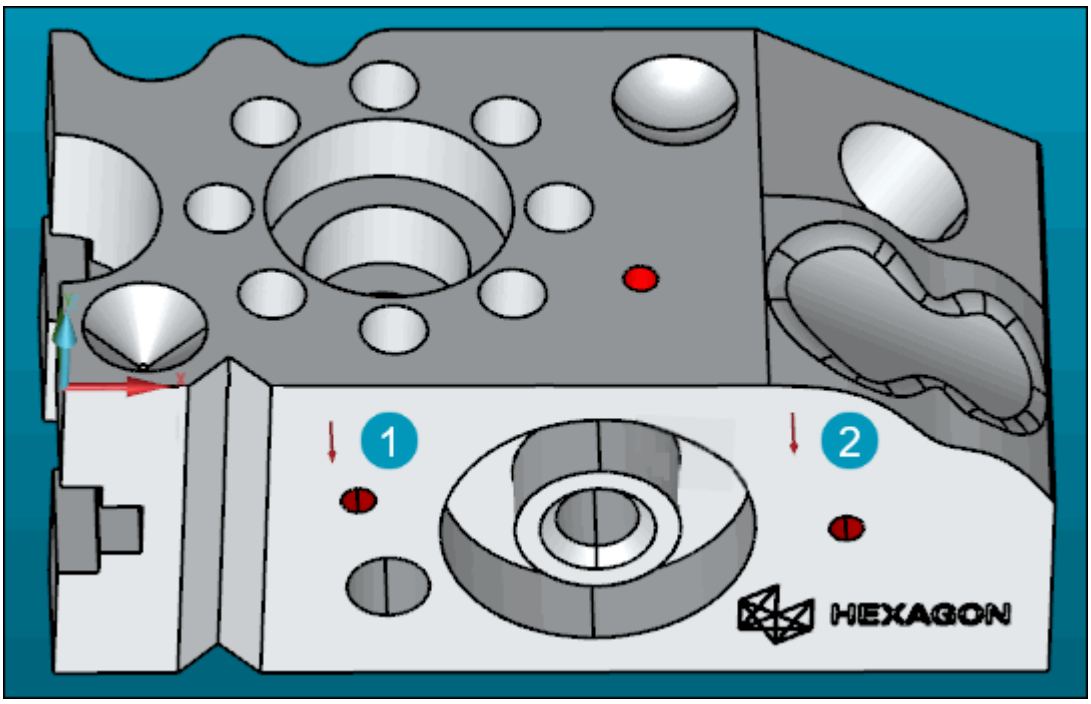
B. *Plane feature in the Y- view*

PC-DMIS also inserts a `FEAT/PLANE` command in the Edit window.

Define a Line

Second, you need to select a line with two or more hits on the front face of the part, just below the edge. This tutorial uses two hits.

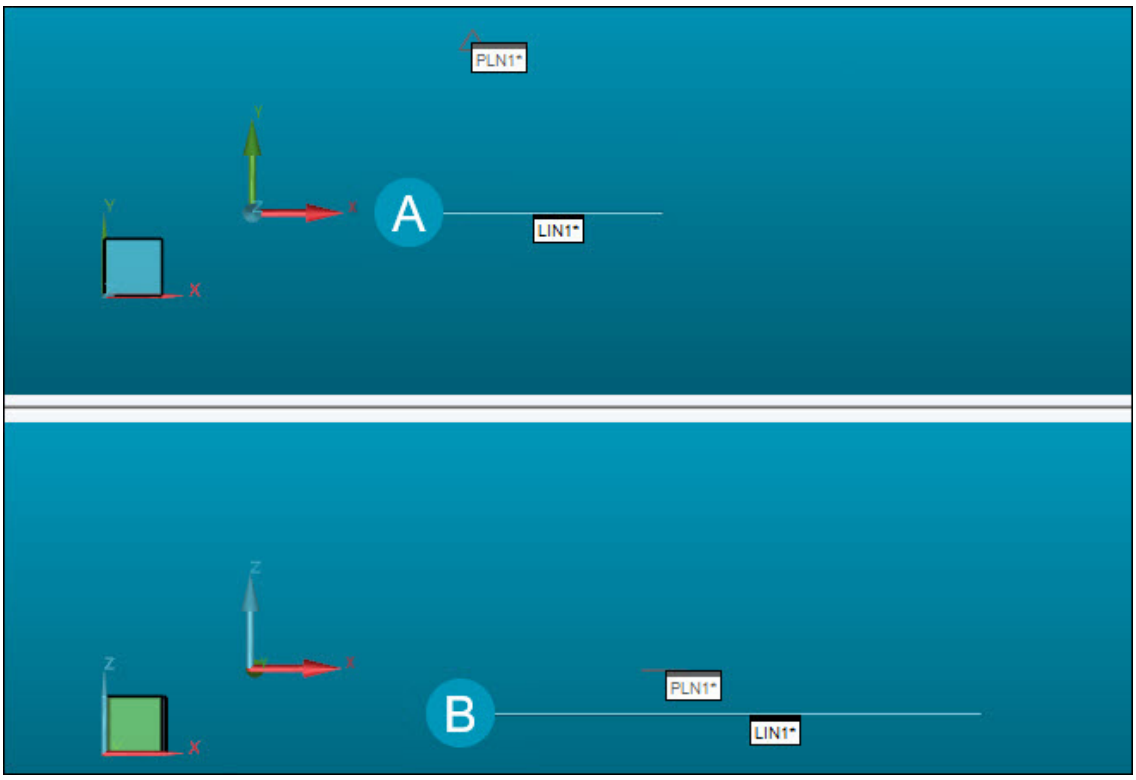
> **!** The order of the hits for line features is very important. It establishes the direction of the line from the first point to the second. PC-DMIS uses this direction information to create the coordinate axis system.



Red arrow bases show two hit locations

1. In the Graphic Display window, in the bottom view, move your pointer below the top edge.
2. Click the pointer on the front face of the part just below the edge.
3. Take the first hit on the left side of the front face.
4. Take the second hit to the right of the first hit on the front face.
5. Press the End key after two hits to accept the line feature.

PC-DMIS displays a feature ID (LIN1) and draws a line in the Graphic Display window:



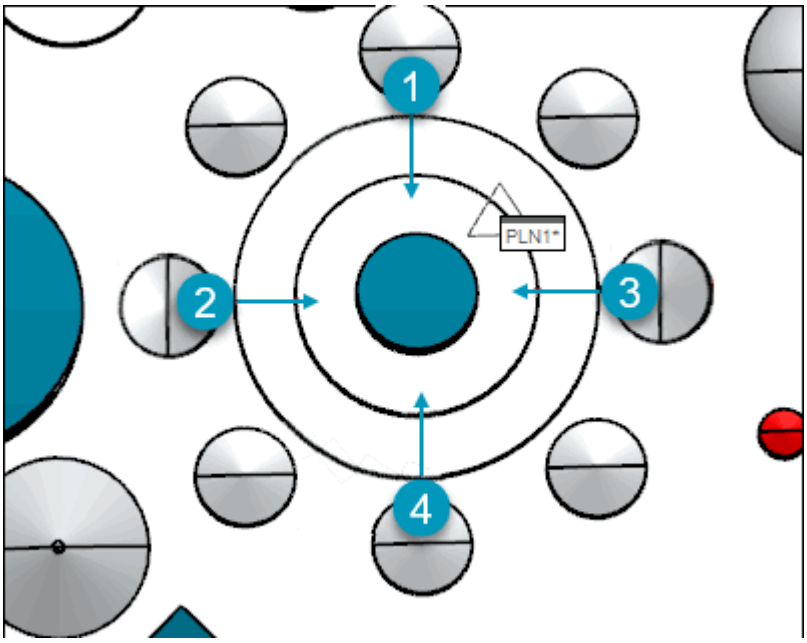
A. *Line feature in the Z+ view*

B. *Line feature in the Y- view*

PC-DMIS also inserts a `FEAT/LINE` command in the Edit window.

Define a Circle

Third, you need to measure a circle on the top face with three or more hits. This tutorial uses four hits.



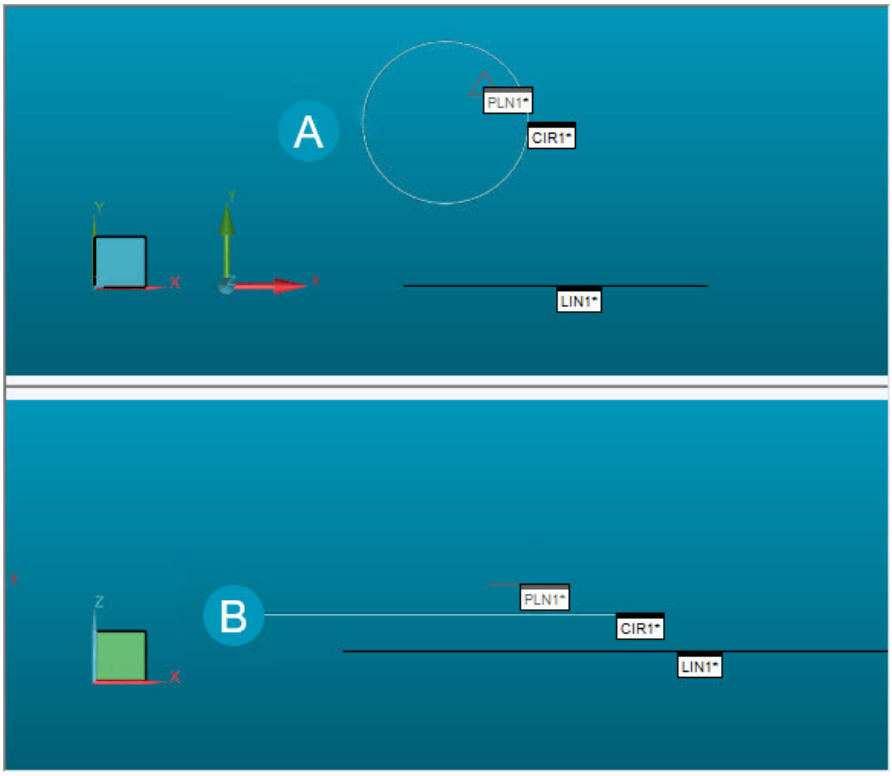
Example showing the four hit locations to define the circle

1. In the Graphic Display window, in the top view, move the pointer to the center of the large bore on the top face.
2. Click on the inside of the bore to take a hit. Take three or more hits in approximately equal distances around the inside of the bore.

   > This can help you position the feature in the Graphic Display window to take the hits: To zoom in and out, rotate the mouse wheel button. To rotate the part, click and hold the mouse wheel button, and then drag the pointer.

3. Press the End key after the last hit.

PC-DMIS displays a feature ID (CIR1) and a measured circle in the Graphic Display window:



A. *Circle feature in the Z+ view*

B. *Circle feature in the Y- view*

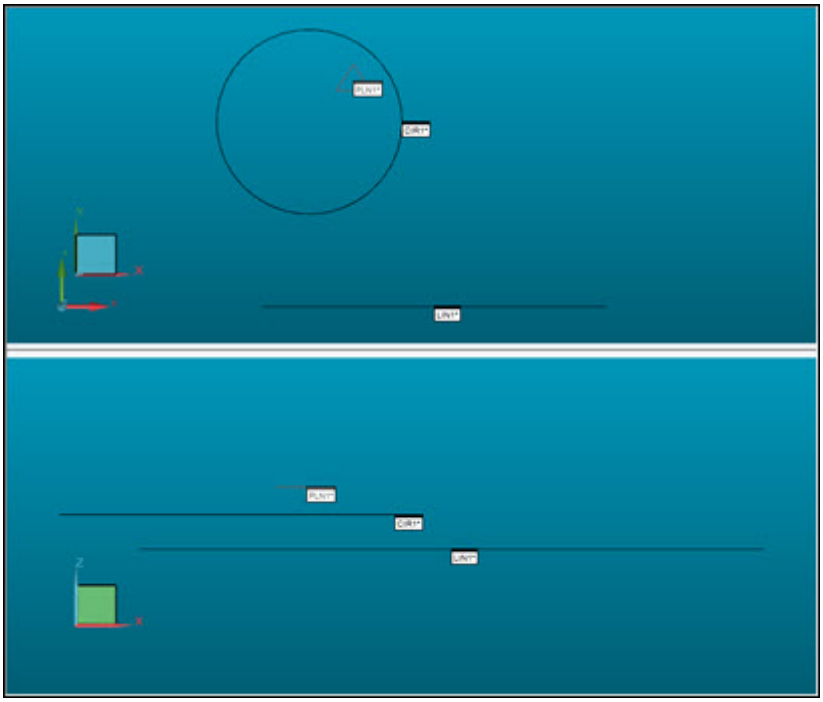
PC-DMIS also inserts a `FEAT/CIRCLE` command in the Edit window.

Go to the next step: "Scale the Image".

Step 8: Scale the Image

The **Scale to Fit** icon () on the **Graphic Modes** toolbar scales the image in the Graphic Display window.

After you measure the three features, click the **Scale to Fit** icon (or, select **Operation | Graphic Display Window | Scale To Fit**) to display all of the measured features in the Graphic Display window.



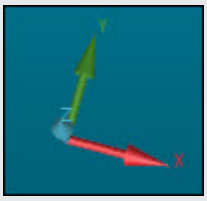
Graphic Display window with measured features

The next step in the measurement process is to create an alignment.

Step 9: Create an Alignment

This procedure sets the coordinate system's origin and defines the X, Y, and Z axes. For information about alignments, see the "Creating and Using Alignments" chapter in the PC-DMIS Core documentation.

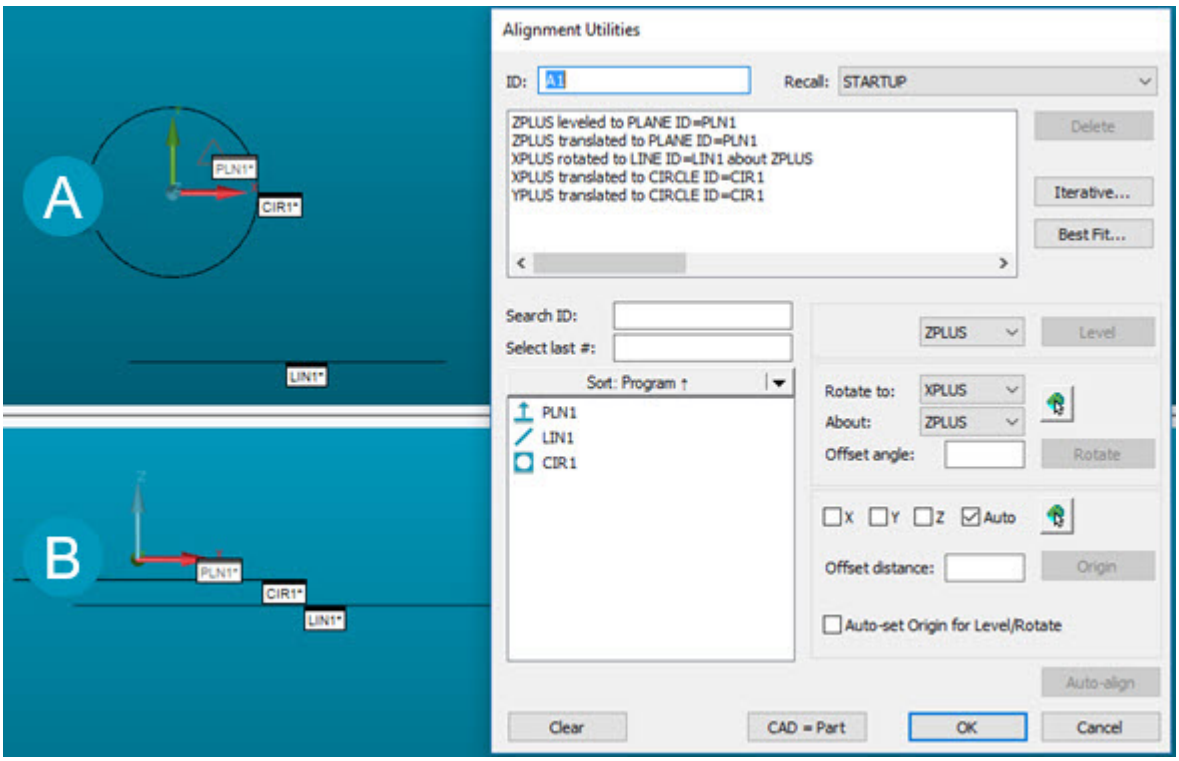
Throughout this process, pay attention to the trihedron symbol in the Graphic Display window. When you first open the **Alignment Utilities** dialog box, it begins to slowly move about somewhat.



This indicates that you have not finished the alignment, and there are still some degrees of freedom to resolve.

1. Select **Insert | Alignment | New** to open the **Alignment Utilities** dialog box.
2. Throughout this process, ensure that the **Auto** check box remains marked. This moves the axes based on the feature type and the orientation of that feature.
3. In the dialog box, from the list of features, select the plane feature ID (**PLN1**).
4. Click the **Level** button to establish the orientation of the normal axis of the current working plane.
5. Select the plane feature ID (**PLN1**) a second time.
6. Click the **Origin** button. This action translates (or moves) the part origin to a specific location (in this case, on the plane).
7. Select the line feature ID (**LIN1**).
8. Make sure **Rotate to** is set to **XPLUS**.
9. Make sure **About** is set to **ZPLUS**.
10. Click the **Rotate** button. This action rotates the defined axis of the workplane to the feature. PC-DMIS rotates the defined axis around the centroid that is used as the origin.
11. Select the circle feature ID (**CIR1**).
12. Click the **Origin** button. This action moves the origin to the center of the circle and keeps it at the level of the plane. You can see that the trihedron moves in both the Z+ and Y- views and is fixed in place. This indicates the position of the new alignment.

At this point, the **Alignment Utilities** dialog box and Graphic Display window should look similar to what's here:



*The left side of this image shows the Graphic Display window with the trihedron in Z+ view (**A**) and Y- view (**B**).*
The right side of this image shows the Alignment Utilities dialog box with the current alignment.

When you complete the above steps, click **OK** to insert the alignment into the Edit window:

```
A1          =ALIGNMENT/START,RECALL:STARTUP,LIST=YES
               ALIGNMENT/LEVEL,ZPLUS,PLN1
               ALIGNMENT/TRANS,ZAXIS,PLN1
               ALIGNMENT/ROTATE,XPLUS,TO,LIN1,ABOUT,ZPLUS
               ALIGNMENT/TRANS,XAXIS,CIR1
               ALIGNMENT/TRANS,YAXIS,CIR1
            ALIGNMENT/END
```

Example of the Edit window with the new alignment.

An alignment command defines the alignment for the feature commands that are below it in the Edit window.

If your cursor is at or below the A1 alignment, then on the **Settings** toolbar, the **Alignments** list shows **A1**, the name of the new alignment.



You can also use the **321Alignment** () button on the **Wizards** toolbar to access the PC-DMIS 3-2-1 Alignment Wizard.

Step 10: Set Preferences

You can customize PC-DMIS to meet your specific needs and preferences. Many options are available on the **Edit | Preferences** menu. This tutorial only covers those options that apply to this tutorial. For information on the available options, see the "Setting Your Preferences" chapter in the PC-DMIS Core documentation.

Modify or set these options:

Enter DCC Mode

This step adds a command that executes commands below it in Direct Computer Control (DCC) Mode. In DCC Mode, your computer controls the motions of the CMM.

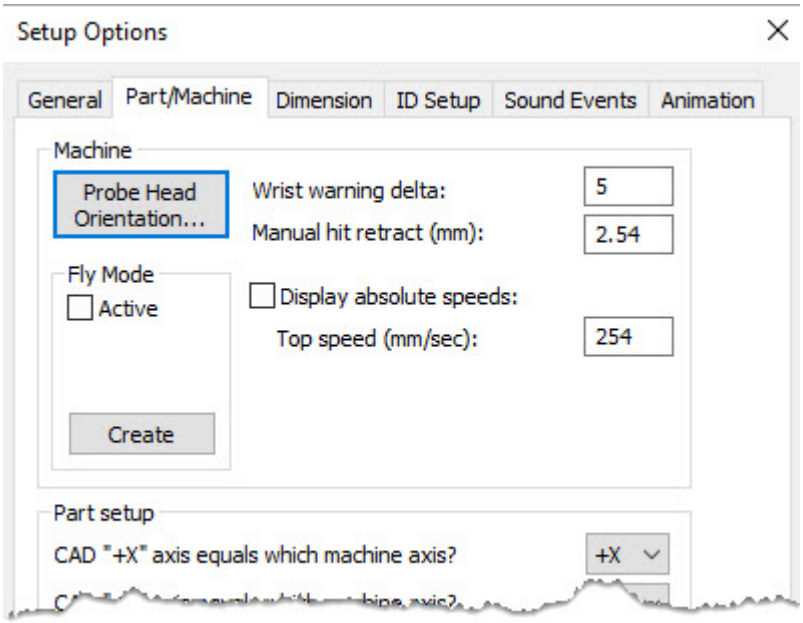
1. In the Edit window, place your cursor after the end of the A1 alignment command block.
2. From the **Probe Mode** toolbar, click the **DCC Mode** button ().
3. PC-DMIS inserts a `MODE/DCC` command into the Edit window after the `ALIGNMENT/END` command. When you execute, PC-DMIS executes commands after this in DCC Mode.

For more information about the CMM modes, see "Probe Mode Toolbar" in the "Using Toolbars" chapter.

Set Move Speed

This step adjusts the point-to-point positioning speed of the CMM.

1. Select **Edit | Preferences | Setup** to open the **Setup Options** dialog box.
2. Select the **Part/Machine** tab.
3. In the **Machine** area, clear the **Display absolute speeds** check box if it's marked.

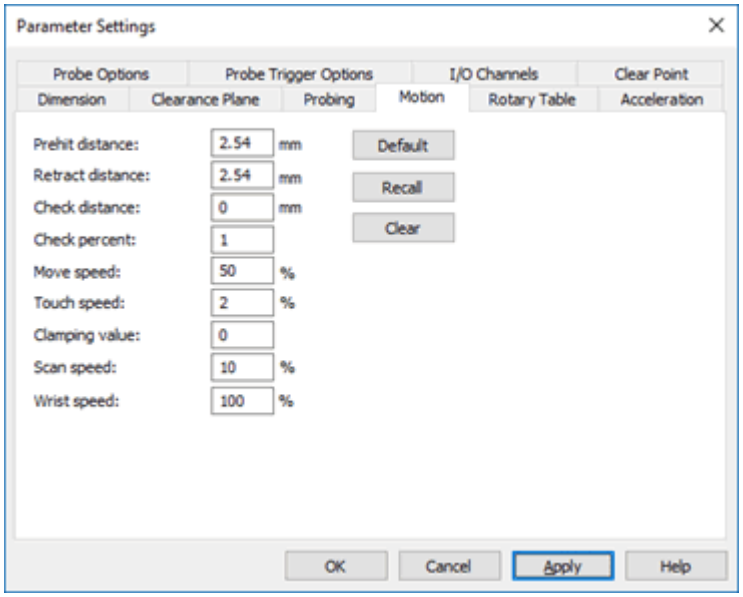


Part/Machine tab with Display absolute speeds cleared

4. Click **OK** to save the change, close the dialog box, and show speeds as percentages.

5. Select **Edit | Preferences | Parameters** to open the **Parameter Settings** dialog box.

6. From the **Motion** tab, set **Move Speed** box to **50**. The default settings for the other options are satisfactory for this tutorial.



Motion tab with Move speed set to 50%

7. Click **OK** to close the dialog box and insert a `MOVESPEED/50` command into the Edit window after the `MODE/DCC` command.

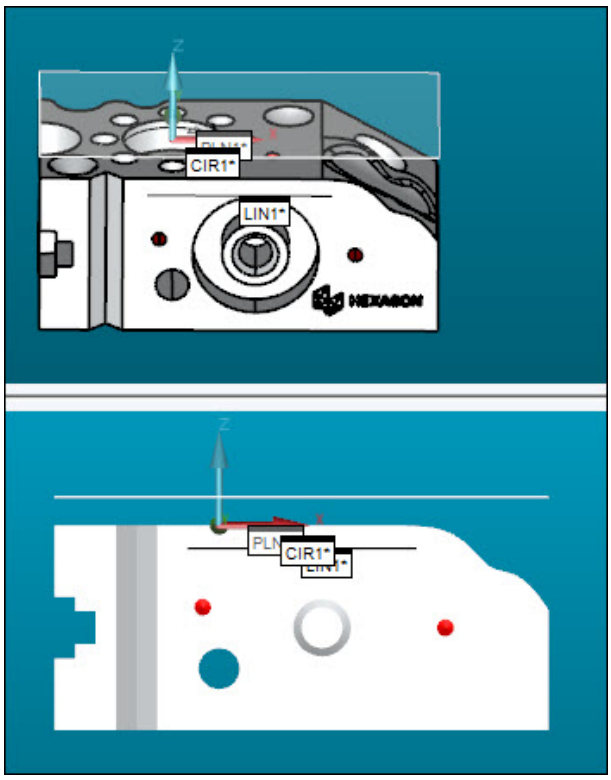
This command indicates a percentage of the full machine speed. Based on this command, PC-DMIS moves the CMM at half of its full speed for commands after it.

For more information about the move speed and other motion options, see "Parameter Settings: Motion tab" in the "Setting Your Preferences" chapter of the PC-DMIS Core documentation.

Add a Clearance Plane

This step adds a clearance plane seven millimeters above the top surface of your part. This helps protect your probe from collisions. During execution, when the probe moves between features, the probe moves up to this clearance plane.

1. Select **Edit | Preferences | Parameters** to open the **Parameter Settings** dialog box.
2. Click the **Clearance Plane** tab.
3. In the **Active plane** area, set the following items:
    - **Axis** to **ZPLUS**
    - **Value** to **7**
4. Select the **Clearance planes active (ON)** check box to automatically insert a `MOVE/CLEARPLANE` command between features you later measure in this tutorial.
5. Click **Apply** and then **OK** to close the dialog box. This also inserts a `CLEARP` command in the Edit window to define the clearance plane.
6. From the **Graphic Items** toolbar, click the **Show Clearance Plane** icon () to show the clearance plane as a translucent image. Your clearance plane should look something like this:



7. From the **Graphic Items** toolbar, click the **Show Clearance Plane** icon ( ) again to hide the clearance plane. The clearance plane is still there, it's just hidden.

For more information on clearance planes, see the "Parameter Settings: Clearance Plane Tab" topic in the "Setting Your Preferences" chapter of the PC-DMIS Core documentation.

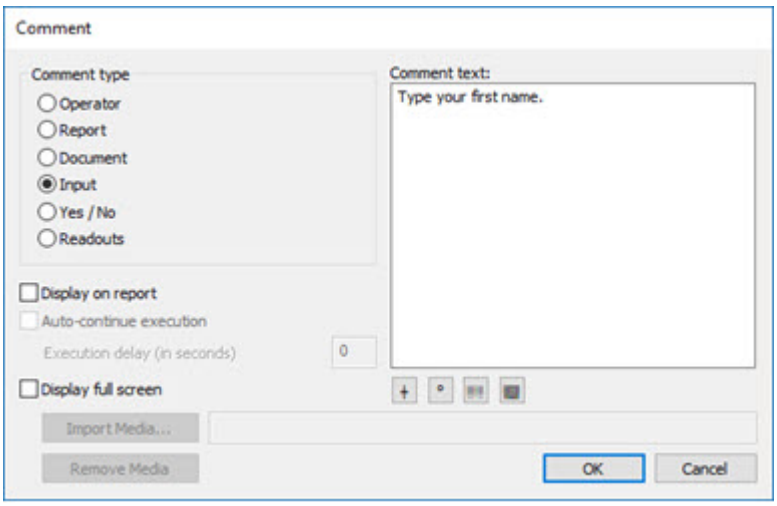
Step 11: Add Comments

This step adds three comments into the routine.

Insert an Input Comment

An **Input** comment collects information from the operator and stores it in a variable.

1. Select **Insert | Report Command | Comment** to open the **Comment** dialog box.
2. From the **Comment type** area, select the **Input** option.
3. In the **Comment Text** box, type this text: **Type your first name.**



Comment dialog box with an Input comment

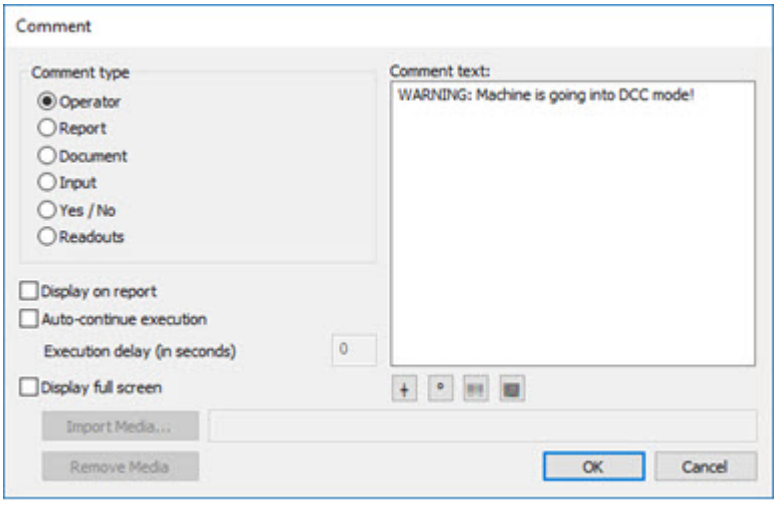
4. Click the **OK** button to close the **Comment** dialog box. PC-DMIS displays a `COMMENT/INPUT` command in the Edit window.

The comment has an ID of C1. During execution, the C1.INPUT variable holds the value that the operator types into the **Input** dialog box.

Insert an Operator Comment

An **Operator** comment shares information with the operator.

1. Select **Insert | Report Command | Comment** to open the **Comment** dialog box.
2. From the **Comment type** area, select the **Operator** option.
3. In the **Comment Text** box, type this text: **WARNING: Machine is going into DCC Mode!**



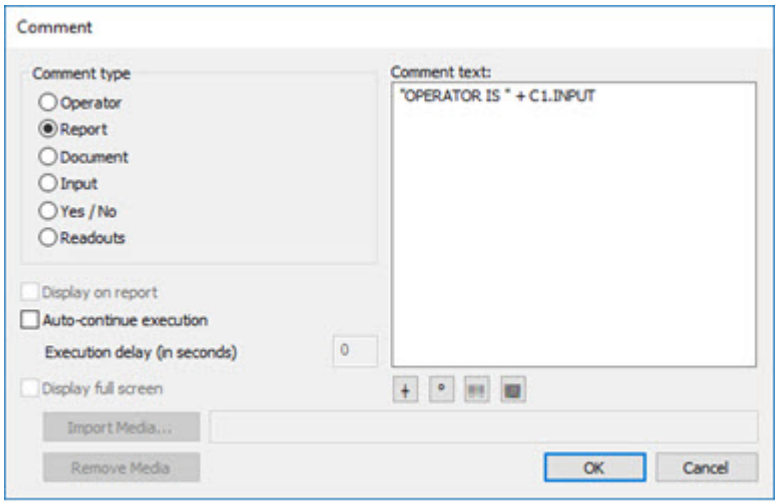
Comment dialog box with an Operator comment

4. Click the **OK** button to close the **Comment** dialog box. PC-DMIS displays a `COMMENT/OPER` command in the Edit window.

Insert a Report Comment

A **Report** comment sends information to the report.

1. Select **Insert | Report Command | Comment** to open the **Comment** dialog box.
2. From the **Comment type** area, select the **Report** option.
3. In the **Comment Text** box, type this text to use the variable from the earlier input value: **"OPERATOR IS " + C1.INPUT**



Comment dialog box with a Report comment

4. Click the **OK** button to close the **Comment** dialog box. PC-DMIS displays a `COMMENT/REPORT` command in the Edit window.

After you insert a PC-DMIS comment, to type additional PC-DMIS commands in Command mode, you must first press the Enter key *twice* after the `COMMENT` command. This tells PC-DMIS that you no longer want to add text to the comment and that you are now ready to add a new command.

For more information on comments, see "Inserting Programmer Comments" in the "Inserting Report Commands" chapter in the PC-DMIS Core documentation.

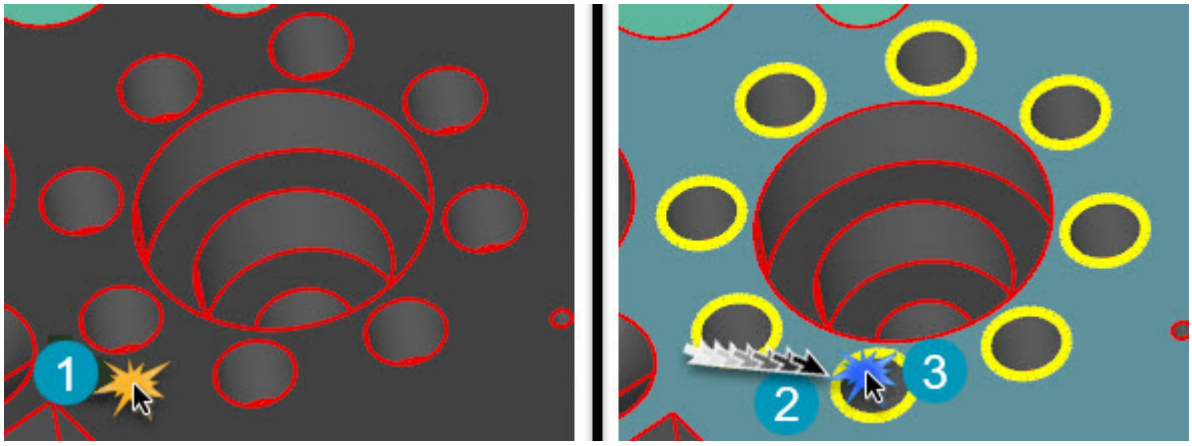
Step 12: Select Additional Features

Along with taking hits with your probe to measure features, you can use the QuickFeatures functionality to add features to your measurement routine. QuickFeatures provide a handy way to add features if you have a CAD model for the part.

Top Face - Add Bolt Hole Pattern of Eight Circles (CIR2 - CIR9)

This process adds eight more circle features into the measurement routine from a bolt-hole pattern.

1. From the **Graphic Modes** toolbar, click the **Translate Mode** ( ) button.
2. On your graphics model, click the top face to select it (1). It turns a highlighted, light-blue color.
3. Hold the Shift key and hover the pointer over a small circular feature. This tutorial uses the circle that is nearest to the bottom edge of the top face. This highlights all circular features of that diameter on that surface (2).
4. Once all those circle features are highlighted in yellow, click the feature to create the highlighted circular features (3).



PC-DMIS inserts all eight circle features (CIR2 through CIR9) into the Edit window.

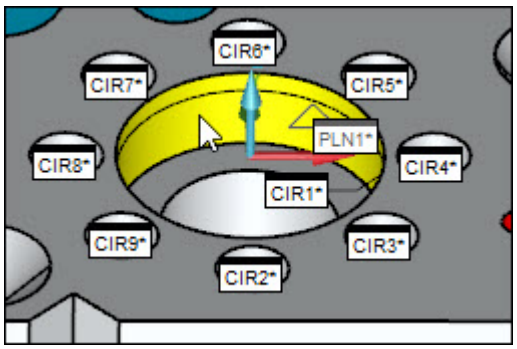
5. From the measurement strategy widget (if it appears), click the **Apply All** button to accept the features:



Top Face - Add Two Nested Large Inner Cylinders (CYL1 and CYL2)

This process adds two inner cylinder features nested within each other into the measurement routine.

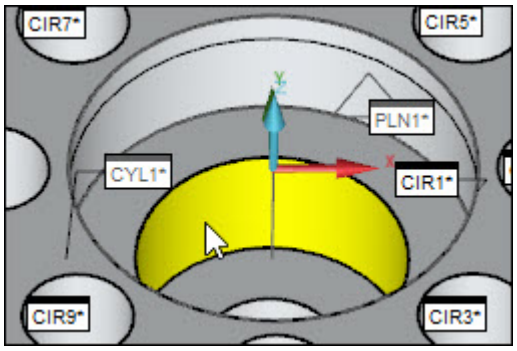
1. Click the top surface again to deselect it.
2. Hold the Shift key and hover the pointer over the inside surface of the larger inner cylinder. You may need to zoom in on the part to select the cylinder:



3. Once it highlights the cylinder in yellow, click the cylinder to create the feature. PC-DMIS inserts CYL1 into the Edit window.

4. From the measurement strategy widget, click **Apply** () to accept the feature.

5. Use QuickFeatures and repeat the above on the smaller nested inner cylinder:

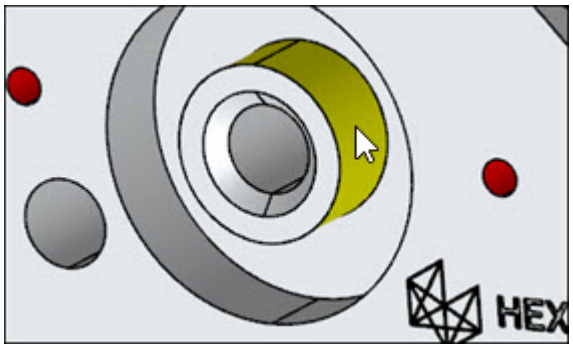


PC-DMIS inserts CYL2 into the Edit window.

Front Face - Add the Outer Cylinder (CYL3)

This process adds the outer cylinder features on the front face into the measurement routine.

1. Hold the Shift key and hover the pointer over the outside surface of the outer cylinder on the front face.



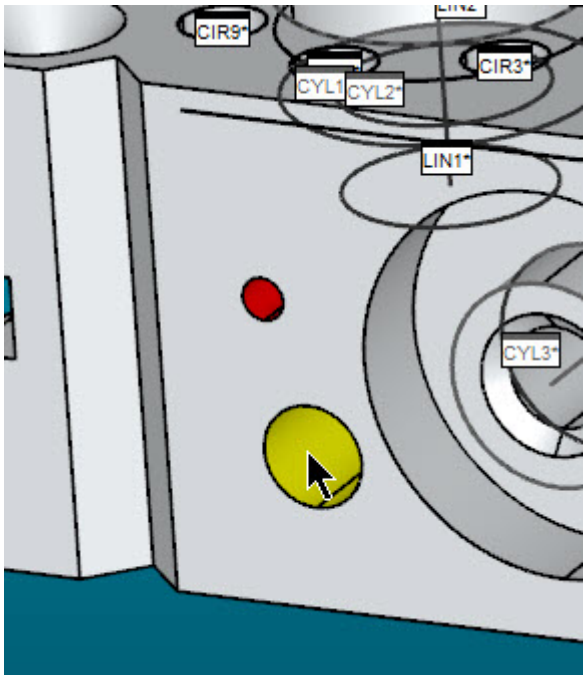
2. Once the pointer highlights the cylinder in yellow, click the cylinder to create the feature. PC-DMIS inserts CYL3 into the Edit window.

3. From the measurement strategy widget, click **Apply** ( ) to accept the feature.

Front Face - Add an Inner Cylinder (CYL4)

This process adds the inner cylinder features on the front face into the measurement routine.

1. On the front face, locate the inner cylinder that is directly beneath and perpendicular to the central bore on the top face.
2. Hold the Shift key and hover the pointer over the inside surface of the cylinder.



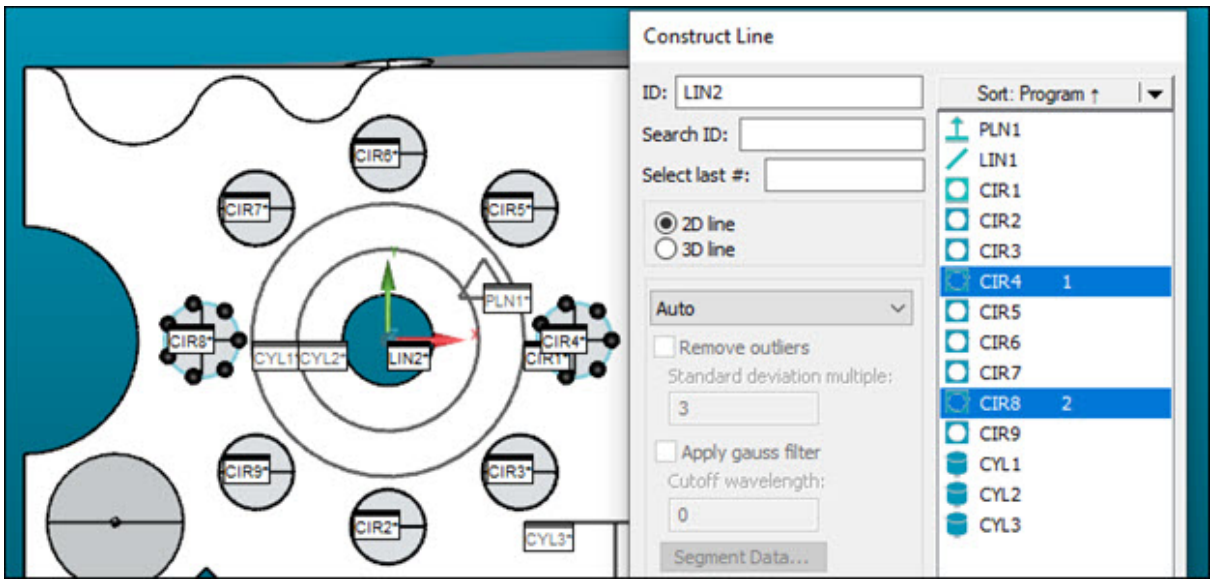
3. Once the pointer highlights the cylinder in yellow, click the cylinder to create the feature. PC-DMIS inserts CYL4 into the Edit window.
4. From the measurement strategy widget, click **Apply** ( ) to accept the feature.

For more information on QuickFeatures, see the "Creating QuickFeatures" topic in the "Creating Auto Features" chapter in the PC-DMIS Core documentation.

Step 13: Construct a New Feature from Existing Features

In this step, you use constructed features to create new features from existing features:

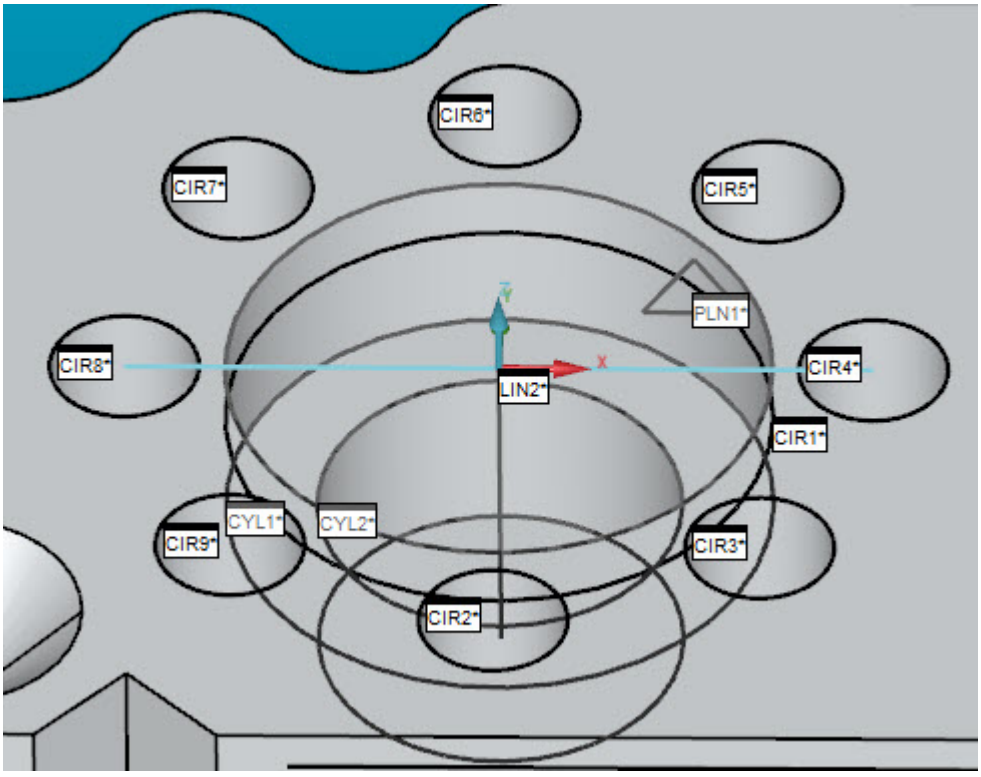
1. Select **Insert | Feature | Constructed | Line** to open the **Construct Line** dialog box. The **ID** should be **LIN2**.
2. With your pointer, click on **CIR8** and **CIR4** in the Graphic Display window. You can also select the circle features from the list box in the **Construct Line** dialog box. Once you select the circles, PC-DMIS highlights them.



Construct Line Dialog Box with CIR8 and CIR4 selected

3. Select the **2D Line** option.
4. From the drop-down list, select the **Auto** option.
5. Click the **Create** button to construct LIN2 from the centroids of those two features. PC-DMIS uses the most effective construction method to create the line.
6. Click **Close** to close the **Construct Line** dialog box.

The line (LIN2) and its feature ID appear in the Graphic Display window and Edit window:



Constructed line in the Graphic Display window

For more information on how to construct features, see the "Constructing New Features from Existing Features" chapter in the PC-DMIS Core documentation.

Step 14: Add a Tip Change Command

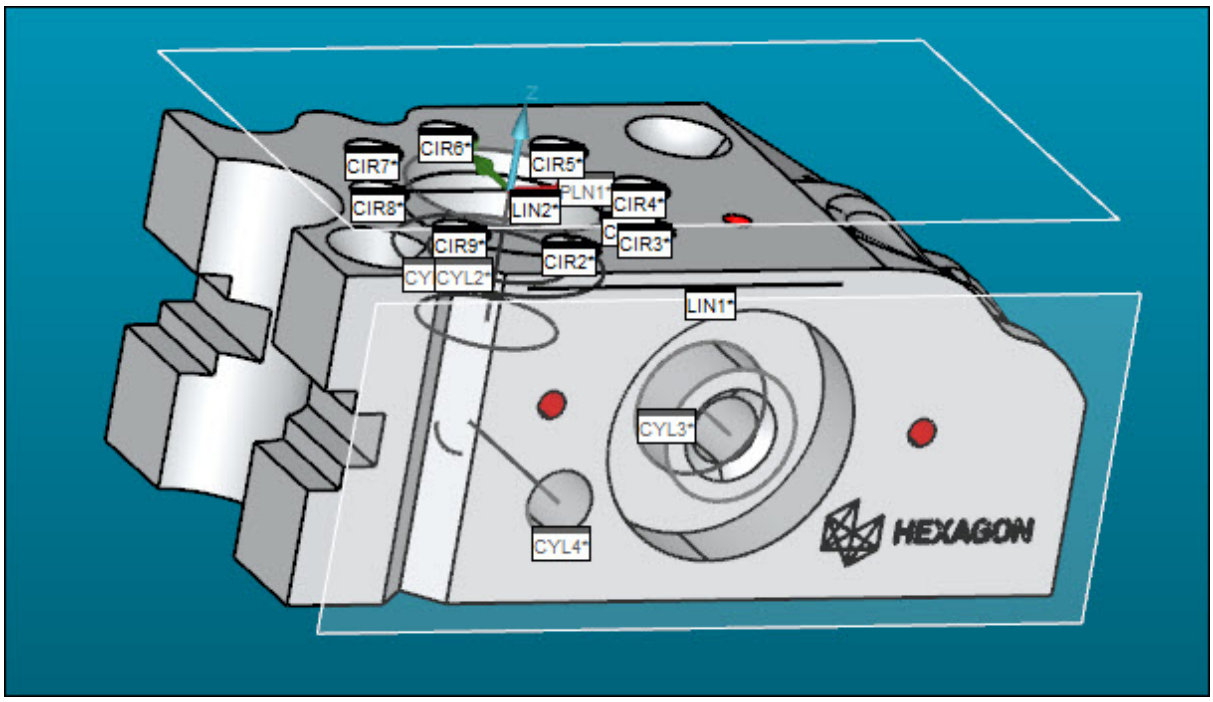
This step adds a command that tells your probe to move to a new angle so that it can measure CYL3 on the front face.

1. From the Edit window, make sure your cursor is at the end of the LIN3 command.
2. From the **Settings** toolbar, under **Probe Tips**, choose the calibrated active tip angle of **A90B-180**. This inserts a `TIP/T1A90B-180` command into the Edit window after that LIN3 constructed feature.

Step 15: Add Another Clearance Plane

This step adds in a second clearance plane for probe motion with the CYL3 feature on the front face.

1. From the Edit window, make sure the cursor is at the end of the `TIP/T1A90B-180` command.
2. Select **Edit | Preferences | Parameters** to open the **Parameter Settings** dialog box.
3. Click the **Clearance Plane** tab.
4. For the **Active plane** area, set the following items:
    - **Axis** to **YMINUS**
    - **Value** to **-40**
5. For the **Pass through plane**, set the following items:
    - **Axis** to **XPLUS**
    - **Value** to **100**
6. Mark the **Clearance planes active (ON)** check box.
7. Click **Apply** and then **OK** to close the dialog box.
8. Click the **Show Clearance Plane** icon () again to view the clearance planes. They should look like this:



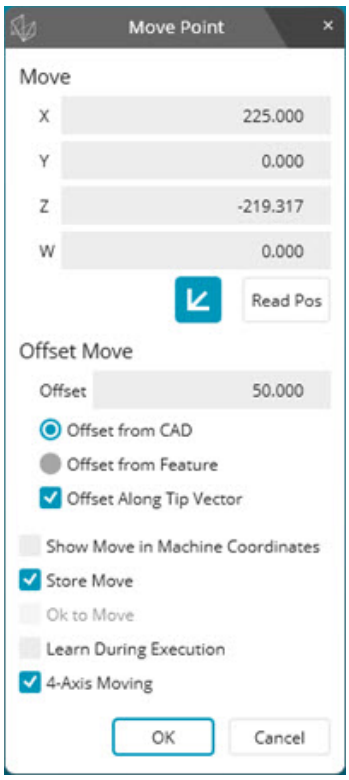
9. Click the **Show Clearance Plane** icon ( ) again to hide the clearance planes.

Step 16: Add Move Point Commands

Once you are done measuring features, it's always a good idea to move the probe to a safe location above and away from the part on the table.

This step adds in two move point commands. One to move the probe further away from the part and a second to move the probe to a safe location for future executions or measurement routines.

1. From the Edit window, make sure the cursor is at the end of the CYL3 feature.
2. Select **Insert | Move | Move Point** to open the **Move Point** dialog box.



Move Point dialog box

> If the **Move Point** dialog box does not appear, PC-DMIS likely already inserted a `MOVE/POINT` command into the Edit window at the current probe location. In that case, click on the command and press F9.

3. From the **Move Point** dialog box, or directly in the Edit window define the X, Y, and Z values to define the move point location. Use these recommended values:

   X of **25**

   Y of **-100**

   Z of **-25**

4. Click **Create** to insert the move point. The dialog box remains open.

5. Create a second `MOVE/POINT` command to bring the tip a safe distance high up above the part. Use these recommended values:

   X of **0**

   Y of **-50**

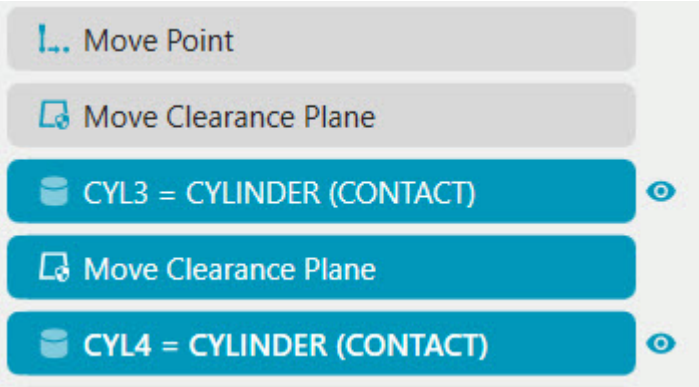
   Z of **250**

Here are some other ways you can insert a `MOVE/POINT` command.

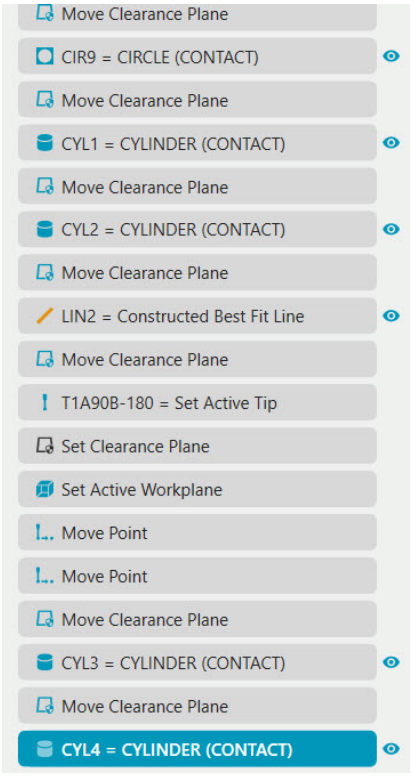
- Press Ctrl + M.
- With your jog box, move the probe to a desired location, then from the **Move Point** dialog box, press **Read Pos**. (On some jog boxes, you can press the **PRINT** button to insert the command.)

For more information on the `MOVE/POINT` command, see the "Inserting a Move Point Command" topic in the "Inserting Move Commands" chapter of the PC-DMIS Core documentation.

6. Click **Cancel** to close the **Move Point** dialog box.
7. Choose **View | Summary Mode** to put the Edit window in Summary Mode.
8. From the Edit window, select `CYL3` , the clearance plane below it, and `CYL4` :



9. Cut and paste those three commands so that they are now below the second `MOVE/POINT` command.
10. Check your work. The last part of your Edit window from CIR9 down, should look like this:



11. Choose **View | Command Mode** to return the Edit window to Command Mode.

If you need to make adjustments, you can modify values directly in the Edit window and even drag (cut and paste) commands to different locations. You can also press F9 on most commands to access a dialog box to change values there.

Step 17: Calculate Dimensions

Once you have created a feature, you can calculate dimensions for your report. You can generate dimensions at any time while you learn a measurement routine, and you can tailor them to fit individual specifications. PC-DMIS displays the result of each dimension operation in the Edit window.

This step generates four different dimensions:

- Circularity of circles 2 through 9
- Perpendicularity of line 2 with cylinder 4
- Concentricity of cylinder 1 with cylinder 2
- Perpendicularity of cylinder 3 with cylinder 2



This tutorial uses geometric tolerances to calculate the dimensions. Select **Insert | Dimension** and ensure that the **Use Legacy Dimensions** menu item is not selected. For information on how to create dimensions with geometric tolerances, see the "Using Geometric Tolerances" chapter in the PC-DMIS Core documentation.

Define Datums

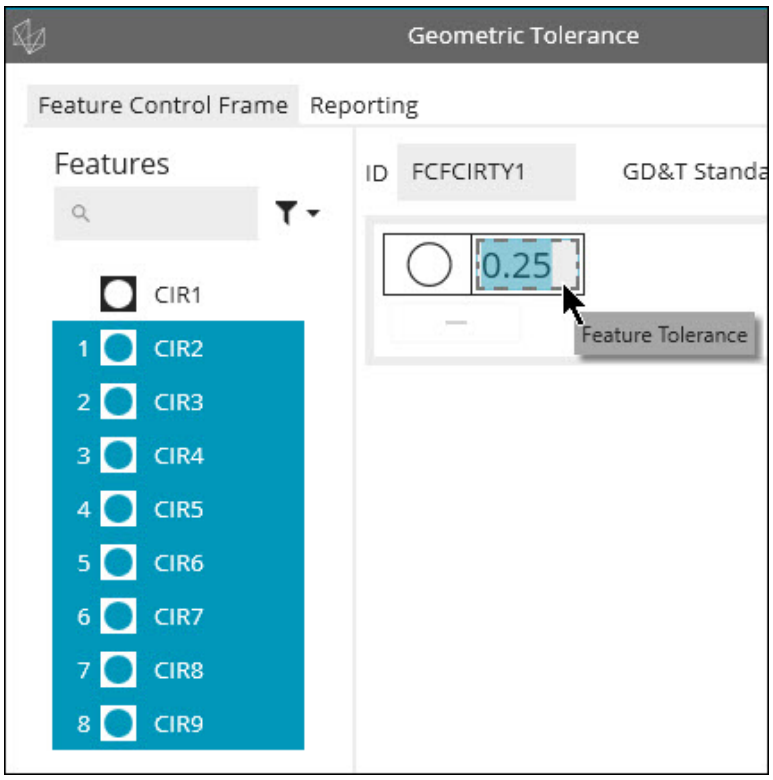
Before you can define the dimensions, you need to define the datums:

1. First, click at the end of the Edit window.
2. Select **Insert | Dimension | Datum Definition** to open the **Datum Definition** dialog box.
3. From the **Datum Definition** dialog box, create these datums:
    - Datum A - CYL4
    - Datum B - CYL2

First Dimension

Next, create the first dimension, the circularity of circles 2 through 9:

1. Select **Insert | Dimension | Circularity** to open the **Geometric Tolerance** dialog box.
2. Set the **ID** to **FCFCIRTY1**.
3. From the **Features** list, choose **CIR2**, press Shift, and choose **CIR9**.
4. In the Feature Control Frame (FCF) editor on the dialog box, click on the Feature Tolerance portion and define a tolerance of **0.25**.

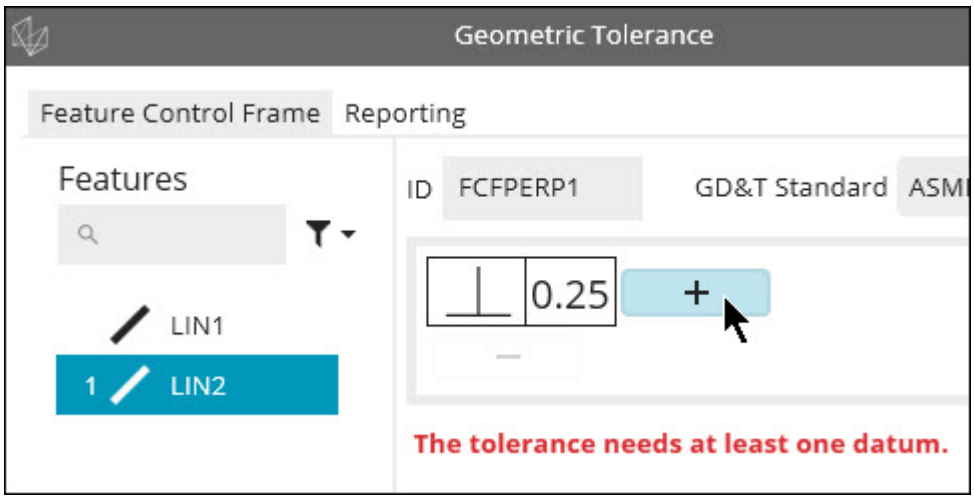


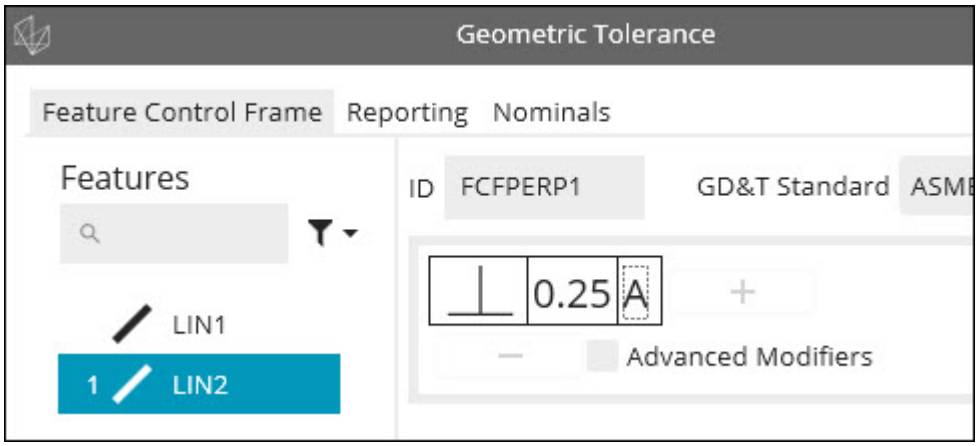
5. Click **Create** and then **Cancel**.

Second Dimension

Next, create the second dimension, the perpendicularity of line 2 with CYL4 (datum A):

1. Select **Insert | Dimension | Perpendicularity** to open the **Geometric Tolerance** dialog box.
2. Set the **ID** to **FCFPERP1**.
3. From the **Features** list, choose **LIN2**.
4. In the **Feature Control Frame editor**, in the FCF, click on the Feature Tolerance portion, and define a tolerance of **0.25**.
5. Click the + sign next to that to add the datum. Set it to **A**.



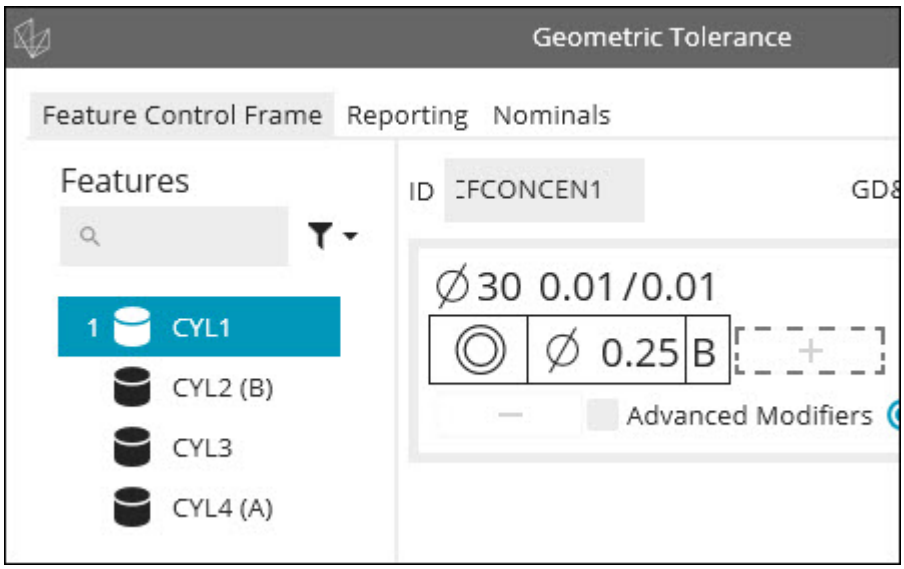


6. Click **Create** and then **Cancel**.

Third Dimension

Next, create the third dimension, the concentricity of cylinder 1 with cylinder 2 (datum B):

1. Select **Insert | Dimension | Concentricity** to open the **Geometric Tolerance** dialog box.
2. Set the **ID** to **FCFCONCEN1**.
3. From the **Features** list, choose **CYL1**.
4. In the Feature Control Frame editor, in the FCF, click on the Feature Tolerance portion, and define a tolerance of **0.25**.
5. Click the + sign next to that to add the datum. Set it to **B**.

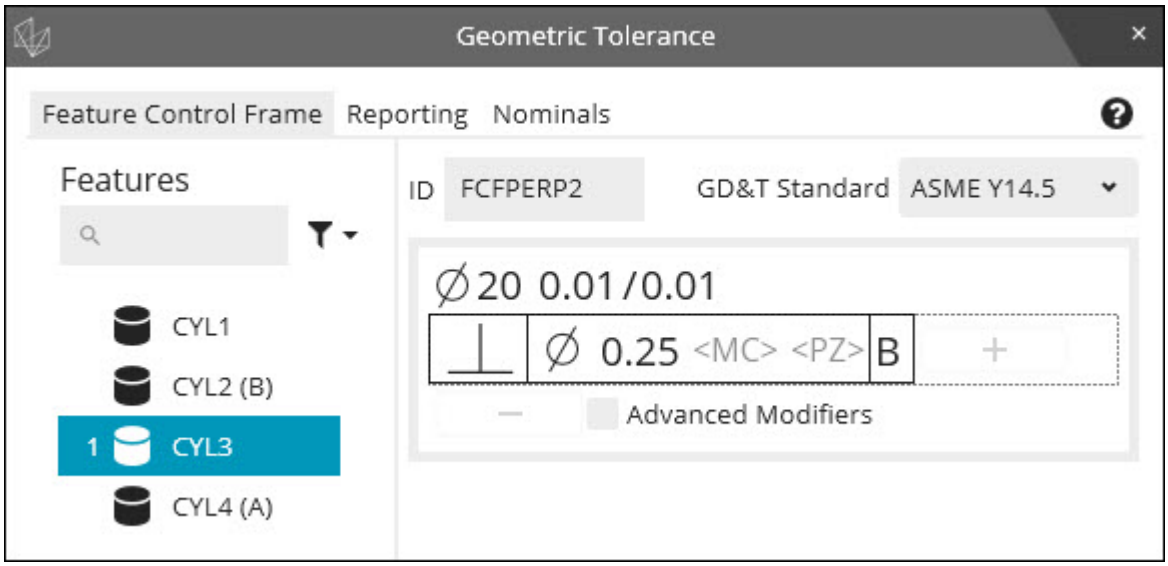


6. Click **Create** and then **Cancel**.

Fourth Dimension

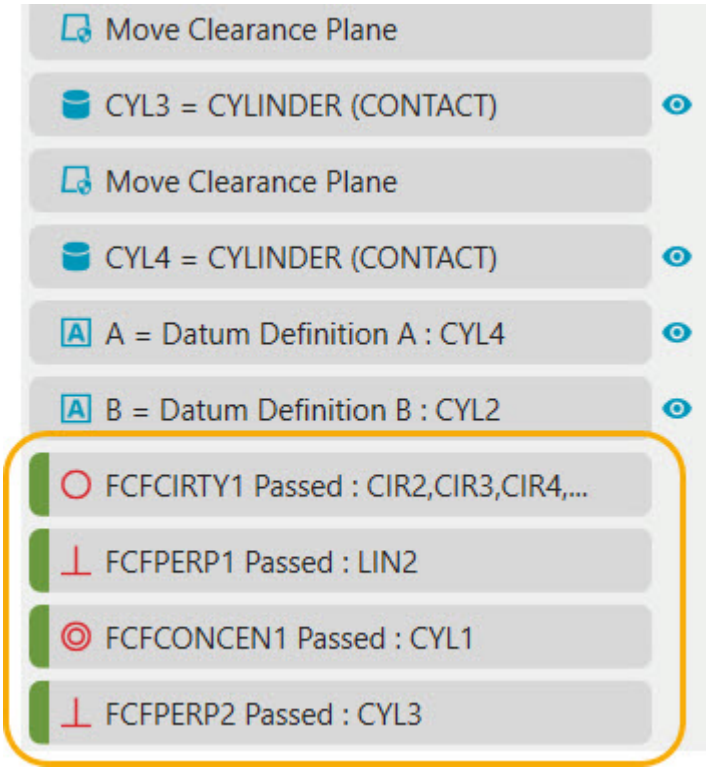
Finally, create the fourth dimension, the perpendicularity of cylinder 3 with cylinder 2 (datum B):

1. Select **Insert | Dimension | Perpendicularity** to open the **Geometric Tolerance** dialog box.
2. Set the **ID** to **FCFPERP2**.
3. From the **Features** list, choose **CYL3**.
4. In the Feature Control Frame editor, in the FCF, click on the Feature Tolerance portion, and define a tolerance of **0.25**.
5. Click the + sign next to that to add the datum. Set it to **B**.



6. Click **Create** and then **Cancel**.

Show the Summary Mode. Your measurement routine should have these datum definition and dimension commands:



Step 18: Mark Items to Execute

You can select items in the Edit window and mark or unmark them to selectively choose what commands you want to execute in your measurement routine.

This step marks all of the features:

1. Use the **Edit | Markings | Mark All** menu option to mark all of the features in the measurement routine. For additional information, see "Marking Commands for Execution" in the "Editing a Measurement Routine" chapter in the PC-DMIS Core documentation.

2. When PC-DMIS asks if it's okay to mark manual alignment features, click **Yes**.

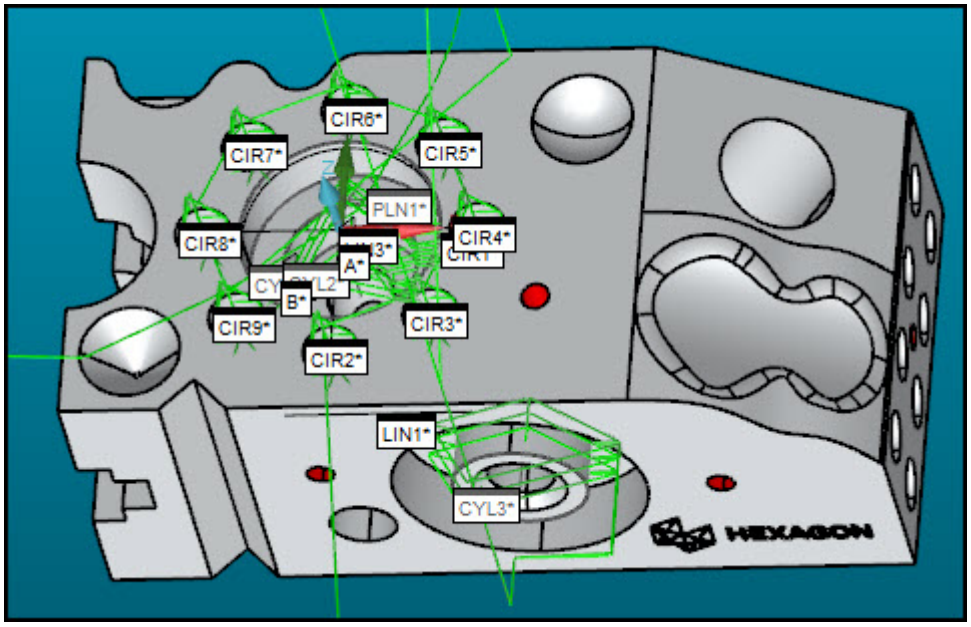
Step 19: Test for Collisions



It's always a good idea to test for collisions when you're about to execute commands in DCC Mode. This can help prevent hardware damage.

This step in the tutorial turns on path lines so that you can see the probe route and test for any collisions before you execute the measurement routine and measure the part with your hardware.

1. Select **Operation | Graphic Display Window | Collision Detection** to open the **Collision Detection** dialog box. PC-DMIS also shows green path lines in the Graphic Display window. These lines represent the path the probe takes during execution.



2. From the **Collision Detection** dialog box, turn on **Stop on Collision** ().

3. For each of the manual hits for your alignment features, click **Continue** () to simulate the probed hits on those features.

4. After your final manual hit, DCC Mode takes over, and the probe in the Graphic Display window follows the path lines. The **Collision List** dialog box shows any collisions. Path lines with collisions turn red. If something turns red, access the **Collision List** dialog box and resolve the collision (see the sub-topics below). If you don't see the list of collisions, it may be behind the **Collision Detection** dialog box.

Collisions may occur because of the probe's location before you even begin to execute a measurement routine. For example, a final manual hit on a manual feature or the final measurement on an earlier execution may have the probe in a position that could cause a collision later.

Always be aware of where the probe is before you begin to execute something in DCC Mode, and move it to a safe location at the beginning of a new execution.

If the **Collision List** dialog box shows "Basic Hit", you can ignore that collision. In this tutorial, those are manual hits, and you'll be moving the probe manually to those locations.

Resolving Collisions between Features

To resolve collisions between features, you can add `MOVE/POINT` or `MOVE/CLEARPLANE` commands into the Edit window to move to a specific point or plane. You can also add `MOVE/POINT` commands on path lines between features. For more information, see "Moving Path Lines" in the "Editing the CAD Display" chapter of the PC-DMIS Core documentation.

Resolving Collisions in a Feature

To resolve collisions for hits inside a single feature, you can adjust some feature settings. For example, the cylinder Auto features in this tutorial (CYL1, CYL2, CYL3, and CYL4) have **Depth** or **Ending Offset** values that may cause the probe to make contact with the material near the bottom or end of the cylinder.

To fix this, you can press F9 on each affected feature and change the **Depth** or **Ending Offset** values. For more information, see the "Adjust Feature Values" topic in the PC-DMIS CMM documentation.

Step 20: Adjust Feature Values

You only need to do this step if any of your cylinder features (CYL1, CYL2, CYL3, or CYL4) give collision results when you test them in the "Test for Collisions" step.

This step in the tutorial adjusts the **Depth** and **Ending Offset** values for the cylinder features (CYL1, CYL2, CYL3, CYL4). With this part and a probe of 2 mm, these features may end up colliding with material near the bottom or end of the cylinders.

1. From the Edit window, click on **CYL1** and press F9 to open the **Auto Feature** dialog box for that feature. The green lines show the path the probe takes to measure the different hits in the feature.
2. Click **Show Advancement Measurement Options** (>>).
3. From the bottom half of the dialog box, click the **Contact Properties** tab ().
4. Change the **Depth** to **3**.
5. Change the **Ending Offset** to **1**.
6. Click **OK**.
7. For **CYL2**, repeat the above steps and change those same values.

8. For **CYL3** and **CYL4**, the changes are different. This is because these cylinders are on the side of the part. So, for those cylinders, set the **Ending Offset** to **3** and the **Depth** to **1**.

9. Once you are done, do the "Test for Collisions" step again to ensure there are no more collisions.

Step 21: Set the Report Output and Type

PC-DMIS can send the final report to a file or printer. For this tutorial, send the report to a PDF file:

1. Select **File | Printing | Report Window Print Setup** to open the **Output Configuration** dialog box.

2. From the **Report** tab, mark the **Report output** check box and select **Auto**.

3. From the file types, choose the **Portable Document Format (PDF)** option.

4. Clear the **Printer** check box.

5. Mark **Print background colors**.

6. Click **OK**.

Next, choose the report type:

1. Choose **View | Report Window**.

2. From the **Report Window** toolbar, choose the **Text and CAD** icon ().

3. Choose **View | Report Window** to close the report window.

There is now enough information for PC-DMIS to execute the measurement routine that you created.

Step 22: Execute the Finished Measurement Routine

Now that you have finished the previous tutorial step, you can execute your measurement routine.

Many options are available to execute all or a portion of a measurement routine. For details, see the "Executing Measurement Routines" chapter in the PC-DMIS Core documentation.

To avoid damage to the probe, use the jog box to manually move the probe away and well above the part.

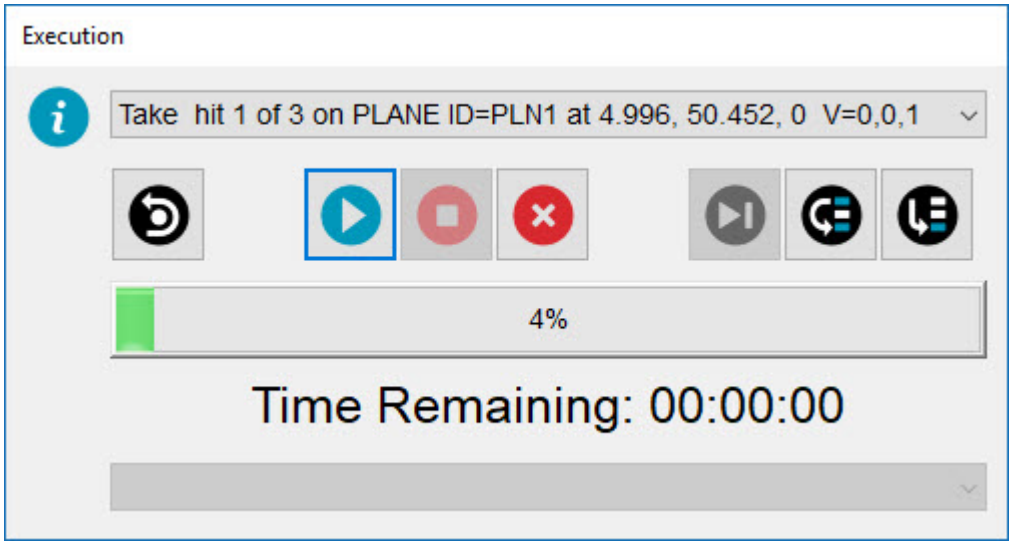
1. Select **File | Execute** to open the **Execution** dialog box and begin the measurement process.

   If PC-DMIS detects an error during the measurement routine execution process, the error appears in the **Machine Errors** list in the **Execution** dialog box. You need to resolve the error before the measurement routine can proceed. When you are ready to proceed, click the **Continue** button to complete the execution of the measurement routine.

   For complete information on the options in the **Execution** dialog box, see "Using the Execution Dialog Box" in the PC-DMIS Core documentation.

2. Read the instructions in the **Execution** dialog box. Follow the requests to take the specified hits. Make sure the ruby tip, and not the probe stem, contacts the part.

   PC-DMIS detects each hit and automatically displays the message to take the next hit.



Instructions in Execution dialog box

   PC-DMIS requests that you manually take these hits with your probe in the approximate location indicated in the Graphic Display window.

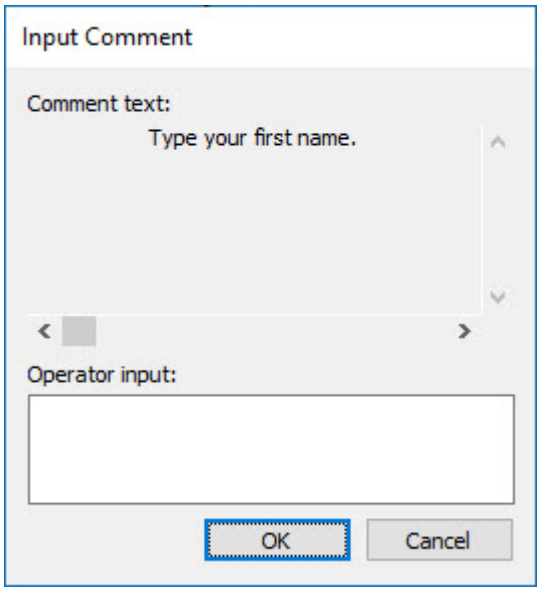
   a. Take three hits on the surface to create a plane. Press End.

   b. Take two hits on the edge to create a line. Press End.

   c. Take four hits inside the circle. Press End.

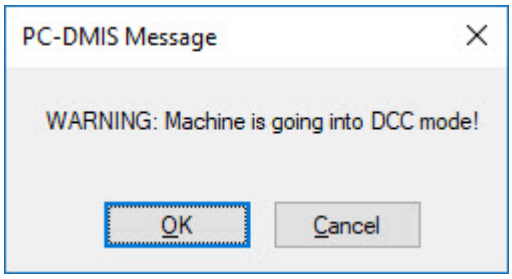
When PC-DMIS takes the last hit on the circle alignment feature (CIR1), it displays some comments and then moves into DCC Mode.

3. When the **Input Comment** dialog box appears, in the **Operator input** box, type your first name:



Input Comment dialog box

4. PC-DMIS displays the **PC-DMIS Message** dialog box. For example:



PC-DMIS Message dialog box

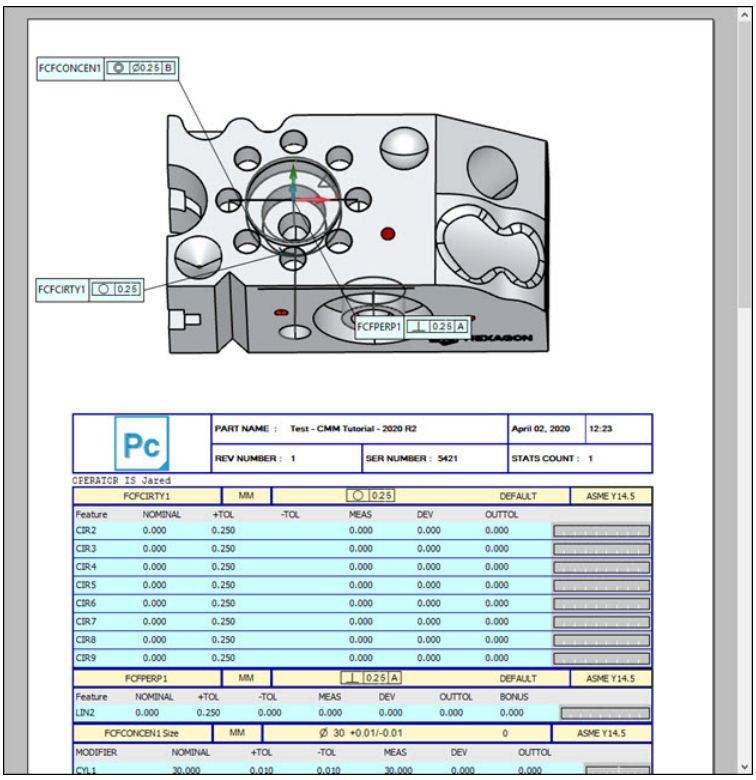
5. Click **OK**. PC-DMIS measures the rest of the features in DCC Mode.

WARNING: When you do this, the machine moves. To avoid injury, stay clear of the machine. To avoid hardware damage, run the machine at a slower speed.

Step 23: View the Report

After PC-DMIS executes the measurement routine, it automatically prints the report to the designated output source that you specify in the **Output Configuration** dialog box (**File | Printing | Report Window Print Setup**). Because you chose the PDF output in a previous step, the report is sent to a PDF file in the same directory as the measurement routine.

Select **View | Report Window** to view the final report inside the Report window:



The above image shows the first page of the Text and CAD report. Notice that there isn't any measurement data. That is because this image came from PC-DMIS in offline mode (without a real CMM). If you execute the measurement routine with a real CMM that probes a real part, the report contains actual measured data.

With the Report window, you can display variations of the same measurement data when you apply different pre-made report templates provided with PC-DMIS. You can also right-click on different areas of the report to toggle the display of available items.

For information on the reporting capabilities of PC-DMIS, see the "Reporting Measurement Results" chapter in the PC-DMIS Core documentation.

Step 24: Best Practices

This final topic of the tutorial discusses some recommended best practices.

Auto Features

If you intend to work with Auto features, it's best to turn on some options for each feature type you intend to use in your routine.

1. Select **Insert | Feature | Auto**, and then choose a feature type to access the **Auto Feature** dialog box for that feature.

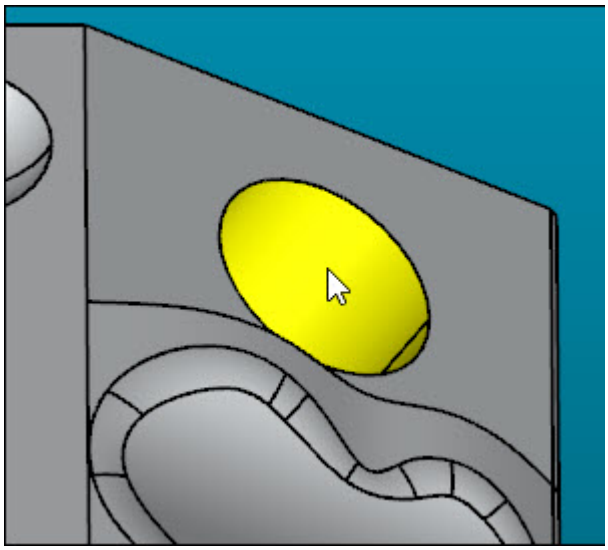
2. From the **Measurement Properties** area, turn on these options:

- **Circular Moves** - Makes the path lines more circular around circular features.
- **Auto Wrist** - Automatically picks the best probe angle for your feature.
- **Void Detection** - PC-DMIS detects hits that would be taken in empty space and repositions them.

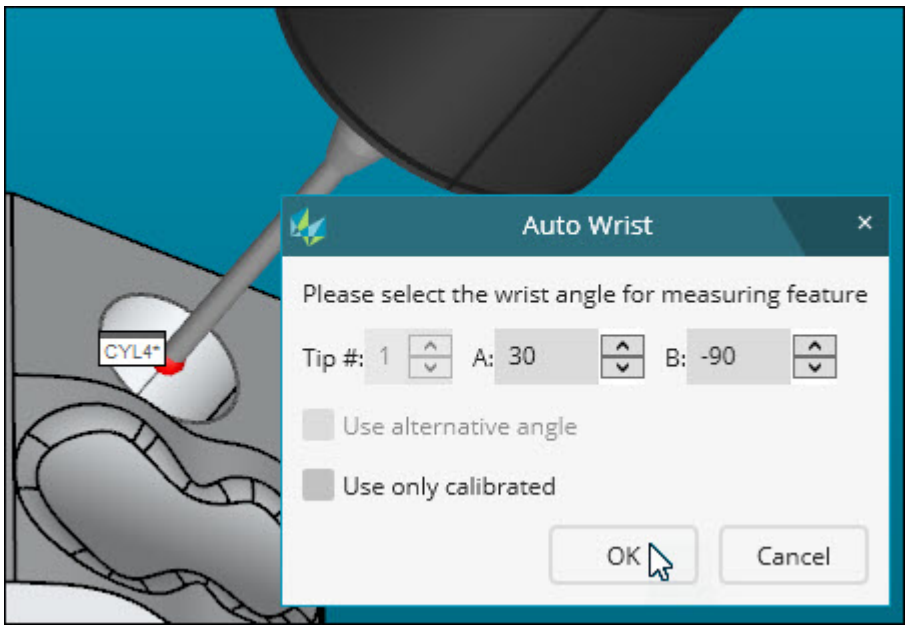
3. When you're done, click **Close** to close the **Auto Feature** dialog box. The next time you create that feature, PC-DMIS uses those changes.

To see the Auto feature best practices in action, do the following:

1. Turn on the above items for a Cylinder Auto feature.
2. Ensure that surfaces are not selected.
3. Press Shift and click on the inner cylinder on the slanted surface on the top face.

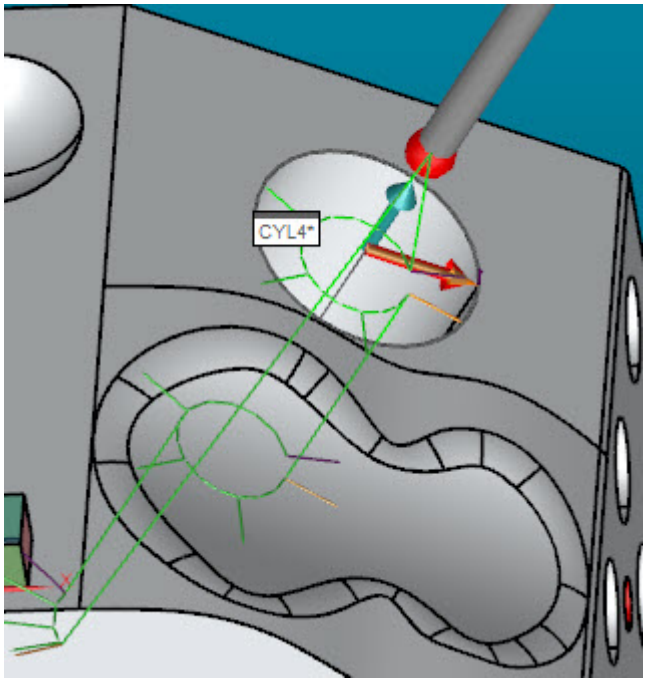


The animated probe in the Graphic Display window positions itself in the cylinder. The software displays the **Auto Wrist** dialog box to select the best angle:



4. Click **OK** to add CYL4 into the routine and close the **Auto Wrist** dialog box.

5. From the Edit window, select the **CYL4** feature and press F9. You can see that the path lines between the hits use a curve instead of a straight line:



Move Points

When you want to end a measurement routine, use `MOVE/POINT` commands at the end of the routine to move the probe to a safe position for future routines or measurements.

Congratulations! You've finished the tutorial.

Setting Up and Using Probes

Setting Up and Using Probes: Introduction

To measure your part with your CMM, you need to properly define the probe to use for your measurements. You define your probe by choosing the hardware components that make up the entire probing mechanism. These are the probe head, wrists, extensions, and specific probe tips. Once defined, you can then calibrate pre-defined tip angles to measure various features on your part. The tip calibration process allows PC-DMIS to know where the probe tip is in your coordinate system in relation to your part and your machine.

Once you define your probes and the probe tips are calibrated, use the `LOAD/PROBE` and `LOAD/TIP` commands in your measurement routine to use the calibrated tip angles in your routine's measurements.

To define and calibrate your probes, see the following topics:

- Using the Acceleration Command - This topic describes how to lower the default maximum acceleration value from the value that PC-DMIS reads in from the controller. You can do this for each axis of the machine's arm.
- Defining Probes
- Calibrating Probe Tips
- Using Different Probe Options - Once you are done with the calibration, see this topic for information on how to use the probe in Offline and Online modes.



For additional information on how to define and calibrate probes, see "Understanding the Probe Utilities Dialog Box" in the "Defining Hardware" chapter of the PC-DMIS Core documentation.

Using the Acceleration Command

You can use the `ACCELERATION` command to lower the default maximum acceleration value from the value that PC-DMIS reads in from the controller. You can do this for each axis of the machine's arm.

To do this, use the `ACCELERATION` command, along with the respective `MAXACCELX`, `MAXACCELY`, and `MAXACCELZ` commands.

For example:

```
ACCELERATION/MAXACCELX=1000, MAXACCELY=1000, MAXACCELZ=1000
```

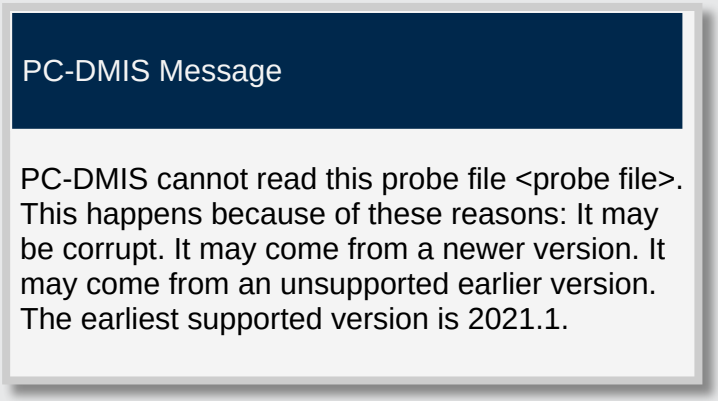
Once PC-DMIS executes this command, the maximum acceleration for each of the machine's axes remains at these values until PC-DMIS executes another acceleration command that changes the value.

Defining and Calibrating Probes

The first step in CMM programming is to define the probes to use during the inspection process. You must have created and/or loaded a probe file for a new measurement routine before you can begin the measurement process. You can accomplish little in a measurement routine until you load the probe.

You can only load probe files made in valid versions of PC-DMIS. For this version of PC-DMIS, if you attempt to load a probe file created before PC-DMIS version 2021.1, PC-DMIS shows an error message.

Example error message when you try to load an invalid probe file:



Where <probe file> is the name and location of the file you are trying to open.

PC-DMIS supports a wide variety of probe types and calibration tools. It also offers a unique method for calibrating a Renishaw PH9 /PH10 wrist.

The tools that you use to define your probe and calibrate it are in the **Probe Utilities** dialog box. To access this dialog box, select **Insert | Hardware Definition | Probe**. For information on the options in this dialog box, see "Understanding the Probe Utilities Dialog Box" in the PC-DMIS Core documentation.

You can also use the PC-DMIS Probe Wizard to define your probe. To access the Probe Wizard, click the **ProbeWizard** button ( ) on the **Wizards** toolbar.

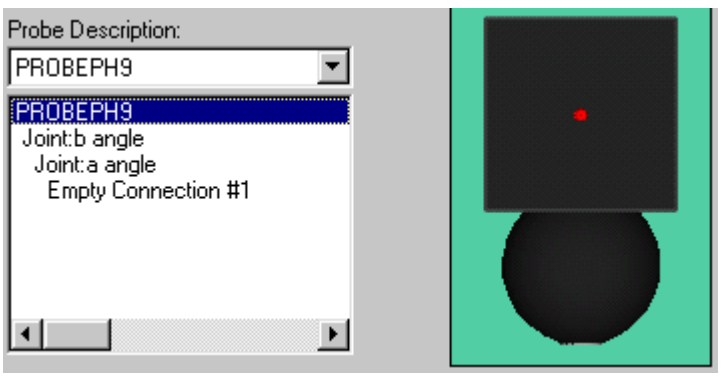
Defining a Contact Probe

Once you have opened the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**), you can define the entire probe unit from the probe head and extension down to the specific tip.

To define a contact probe, extensions, and tips:

1. In the **Probe file** list, type a name for the new probe.
2. In the **Probe description** list, select the statement **No probe defined**.
3. Select the **Probe description** list.
4. Select the desired probe head.
5. Press the Enter key to make probe options that are related to the currently-highlighted statement available for selection.

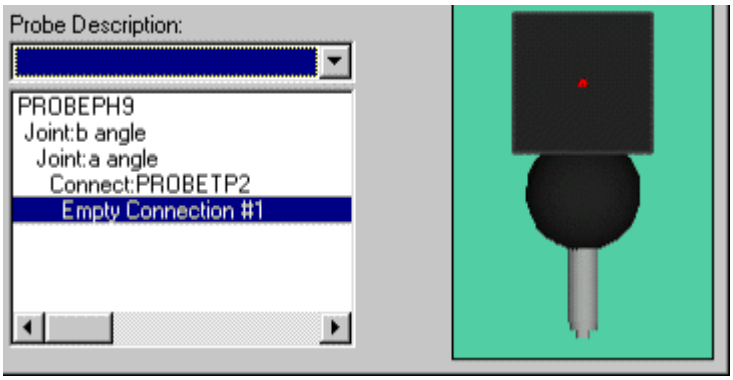
Generally, the probe-head orientation establishes the orientation of the first component in a probe file, usually the probe head. However, if you select a multi-connection probe adapter (such as a five-way adapter) as the first component, several possible connections become available. In these cases, the probe-head orientation establishes the orientation of the multi-connection probe adapter. The probe head, then, may not align correctly with the machine axes, and you may need to adjust the rotation angle about the connection using the **Probe description** list in the **Probe Utilities** dialog box. For details, see "Edit Probe Components" in the "Defining Hardware" chapter in the PC-DMIS Core documentation.



Selecting a probe head

The selected probe head appears in the lower **Probe description** box and in the graphical display box to the right.

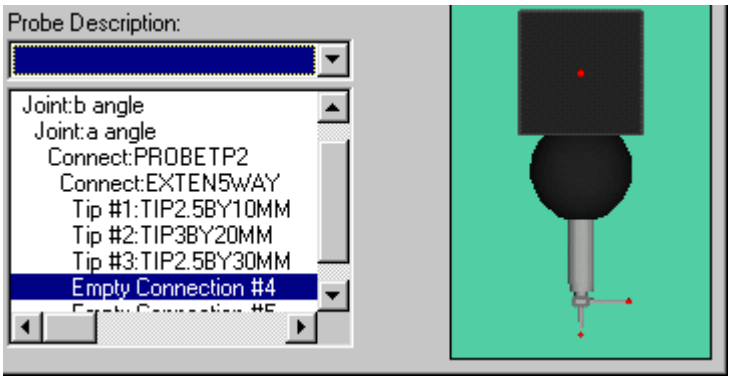
1. From the **Probe description** box, select **Empty Connection #1**
2. Select the list.
3. Select the next item to be attached to the probe head (either an extension or probe tip). Tips appear first by size and then by thread size.



Selecting a tip

If a 5-way extension is added, PC-DMIS offers five empty connections.

You may fill any or all of the needed connections with the appropriate probe tip(s). PC-DMIS always measures the lowest tip (lowest in the Z axis) in the extension first.



5-way extension

If a line in the **Probe description** box is selected that already contains an item, PC-DMIS displays a message that asks if you want to either insert before or replace the selected item:

"Click Yes to insert before or No to replace."

- If you click **Yes**, an additional line is created by inserting the new tip before the original item.

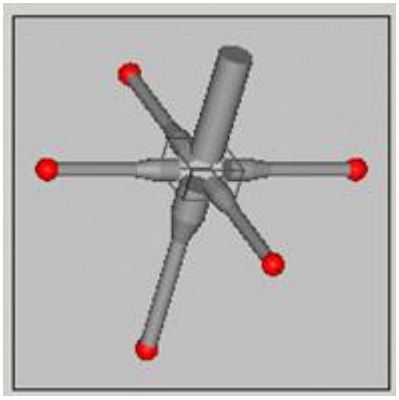
- If you click **No**, PC-DMIS deletes the original item and replaces it with the highlighted element.

> The selected item is inserted at the highlighted line in the **Probe description** box. PC-DMIS displays a message that enables you to insert the selected item before the marked line or replace the highlighted item when appropriate.

Continue selecting elements until you define all empty connections. You can then define the tip angles to calibrate.

Defining Star Probes

PC-DMIS enables you to define, calibrate, and work with several different star probe configurations. A star probe consists of a probe tip pointing vertically (in the Z- direction if you're using a vertical arm) toward the CMM plate with four additional tips pointing horizontally. For example:



A typical star probe configuration

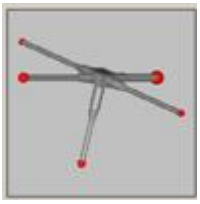
This section describes how to build the star probe.

> While there are many different machine types and arm configurations, the procedures and examples given assume that you are using a standard vertical arm CMM, where the arm points in the Z- direction toward the CMM plate.

Building the Star Probe

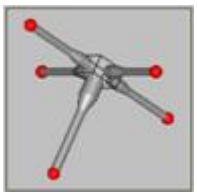
You can build these star probe configurations:

- **5-way customizable star probe with different probe tips.** *5-way customizable star probe.* This type of star probe uses a center cube that consists of five threaded holes into which you can screw various probe tips.



5-way customizable star probe

- **Non-customizable star probe with identical probe tips.** *Non-customizable star probe.* This type of star probe does not have a customizable 5-way center. While it does come with a cube, there are no threaded holes, and the four horizontal tips are permanently attached to the cube. The horizontal tips are all the same size.

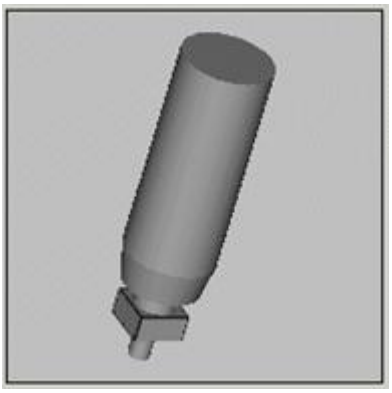


Non-customizable star probe

After you build your probe, click the **Measure** button in the **Probe Utilities** dialog box to calibrate it. See "Measure" for information on how to calibrate probe tips.

Building a 5-Way Customizable Star Probe

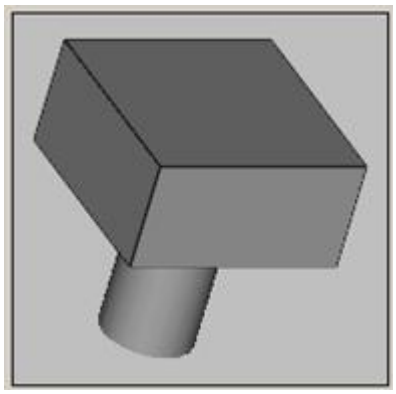
1. Access the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**).
2. Type a name for the probe file in the **Probe file** box.
3. Select **No probe defined** in the **Probe description** area.
4. Select the probe from the **Probe description** list. This documentation uses the PROBETP2 probe. The probe drawing should look something like this:



Probe Drawing

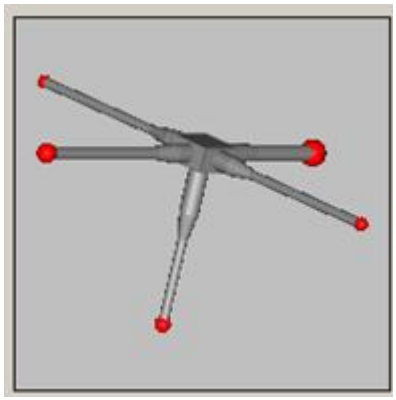
5. Hide the probe from view. To hide it, double-click on the PROBETP2 connection in the **Probe description** area and deselect the **Draw this component** check box.
6. Select **Empty Connection #1** in the **Probe description** area.

7. Select the 5-way cube extension, EXTEN5WAY, in the **Probe description** list. Five empty connections appear in the **Probe description** area. The probe drawing shows this:



Probe Drawing

8. Assign the appropriate tips and / or extensions needed for each **Empty Connection** until you have up to five total tips, such as shown here:



Five Total Tips

You don't have to fill all five connections.

- The tip assigned to **Empty Connection #1** points in the same direction as the rail on which it rests. This is the Z- direction.
- The tip assigned to **Empty Connection #2** points in the X+ direction.
- The tip assigned to **Empty Connection #3** points in the Y+ direction.
- The tip assigned to **Empty Connection #4** points in the X- direction.
- The tip assigned to **Empty Connection #5** points in the Y- direction.

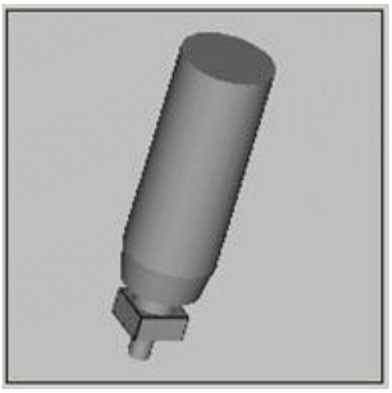
9. Click **OK** to save your changes, or click **Measure** to calibrate the probe. For information on how to calibrate the tips, see "Calibrating Probe Tips".

Notes:

- The probe tip offsets are calculated from the center of each tip to the center of the end of the ram (the machine column where the probe head attaches).
- The length of the tip component is from the center of the tip to the mating surface where it joins the previous component. This is where the threaded hole starts. The length does not include the length of the threaded hole.

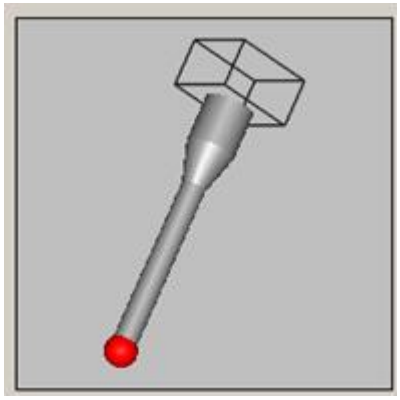
Building a Pre-Defined Star Probe

1. Open the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**).
2. Type a name for the probe file in the **Probe file** box.
3. Select **No probe defined** in the **Probe description** area.
4. Select the probe in the **Probe description** list. This documentation uses the PROBETP2 probe. The probe drawing should look something like this:



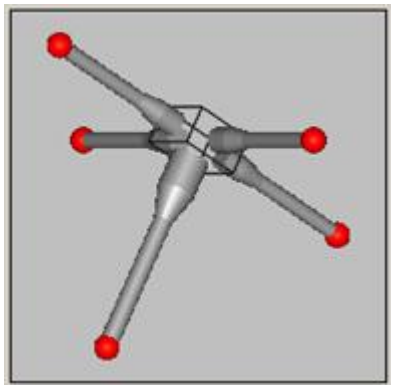
Probe Drawing

5. Hide the probe from view. To hide it, double-click on the PROBETP2 connection in the **Probe description** area and deselect the **Draw this component** check box.
6. Select **Empty Connection #1** in the **Probe description** area.
7. Select either 2BY18MMSTAR or 10BY6.5STAR. This documentation uses the 2BY18MMSTAR. The probe drawing displays something like this:



Probe Drawing

8. For each of the four **Empty Connection** items in the **Probe description** area, select the same probe tips four times, once per each horizontal tip. In this case, you could select either TIPSTAR2BY30 or TIPSTAR2BY18 four times. This documentation uses the TIPSTAR2BY30.

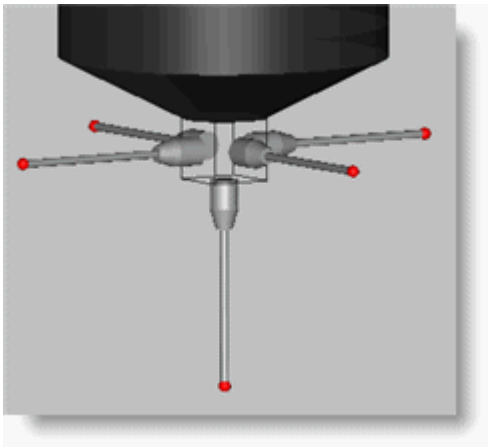


Drawing

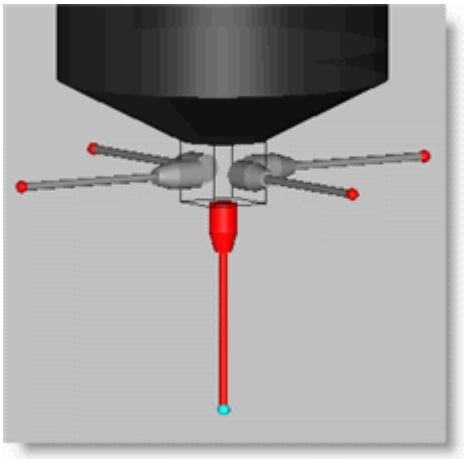
9. Click **OK** to save your changes, or click **Measure** to calibrate the probe. For information on calibrating tips, see "Calibrating Probe Tips".

Highlighting the Current Probe Tip

A highlighted probe tip in the Graphic Display window indicates which tip is active. PC-DMIS can highlight the active probe tip on probes that have more than one probe shank. PC-DMIS highlights the tip when you select a command that uses that probe tip.



Probe configuration with multiple tips



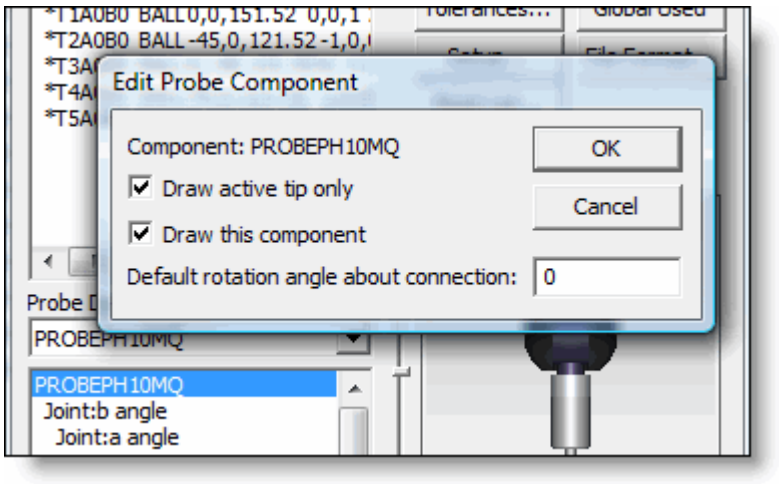
Probe configuration with active tip highlighted

Showing Only the Current Probe Tip

By default, PC-DMIS draws all tips and highlights the current probe tip. For star probes, similar to highlighting the active probe tip, you can choose to hide all non-active probe tips. When you hide non-active tips, only the current probe tip is visible.

To show only the current probe tip:

1. Select **Insert | Hardware Definition | Probe** to show the **Probe Utilities** dialog box.
2. In the **Probe description** area, double-click on the probe head component to show the **Edit Probe Component** dialog box.
3. Select the **Draw active tip only** check box.



Draw active tip only check box in the Edit Probe Component dialog box

4. Click **OK** to close the **Edit Probe Component** dialog box.
5. Click **OK** to close the **Probe Utilities** dialog box.

In the Edit window, whenever the cursor is below the `LOADPROBE` command, the measurement routine hides the non-active tips.

Defining Hard Probes

PC-DMIS CMM also allows you to define a hard (or fixed) probe. While touch trigger probes (TTP) cause the CMM to report the position whenever the probe comes in contact with the part, a hard probe does not behave this way. Instead, a hard probe registers a hit whenever you press a button on the machine or arm or, in the case of scanning, when certain conditions are met (such as crossing a predefined zone, elapsed time, elapsed distance, and so forth).

Generally, these types of probes are used with PC-DMIS Portable. To calibrate and use this type of probe, see "PC-DMIS Portable" in the PC-DMIS Portable documentation.

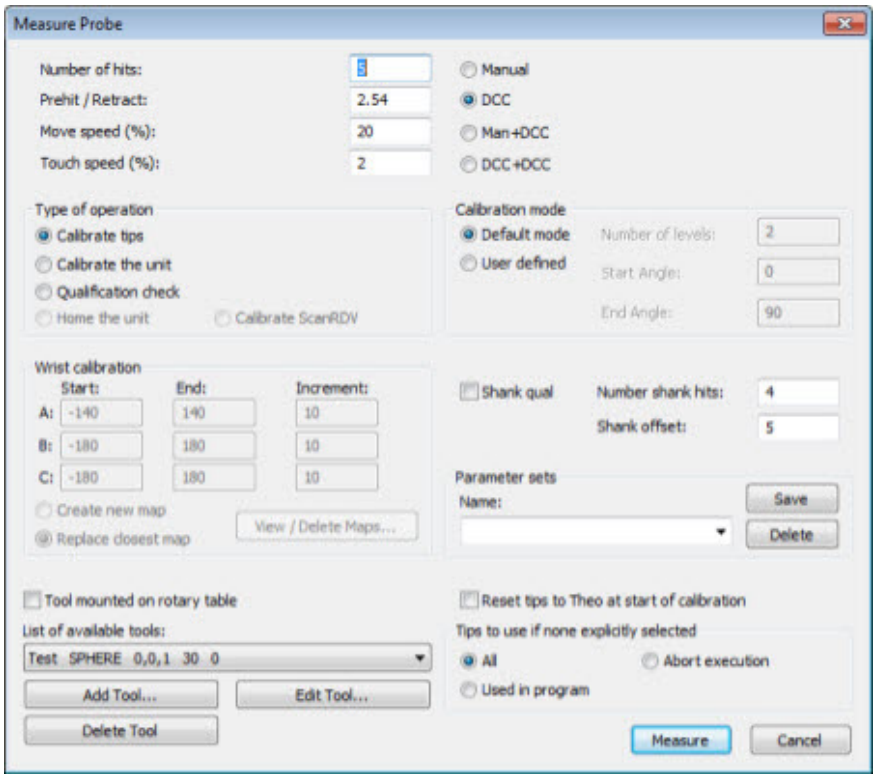
Calibrating Probe Tips

Calibrating your probe tips tells PC-DMIS the location and diameter of your probe tips. You cannot execute your measurement routine and measure your part until you calibrate the probe tips. The terms "calibrate" and "qualify" are used interchangeably.

To begin the calibration process, follow these steps:

1. Make sure the **Active tip list** in the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**) has the desired tip angles.
2. Select the probe tip or tips that you want to calibrate from the list.
3. Click **Measure** to display the **Measure Probe** dialog box.

If you have a probe changer and the currently active probe file is *not* the probe configuration in the probe head, PC-DMIS automatically drops off the currently loaded probe configuration and picks up the needed one.



Measure Probe Dialog Box

The **Measure Probe** dialog box displays the settings that apply to probe qualification measurements. Once you make the desired selections, click **Measure** to begin.

Requirements Prior to Calibration

To begin the calibration process, you must define a qualification tool. The type of measurement(s) to be made on the tool depends on the type of tool (typically a SPHERE) and the type of tip (BALL, DISK, TAPER, SHANK, OPTICAL).

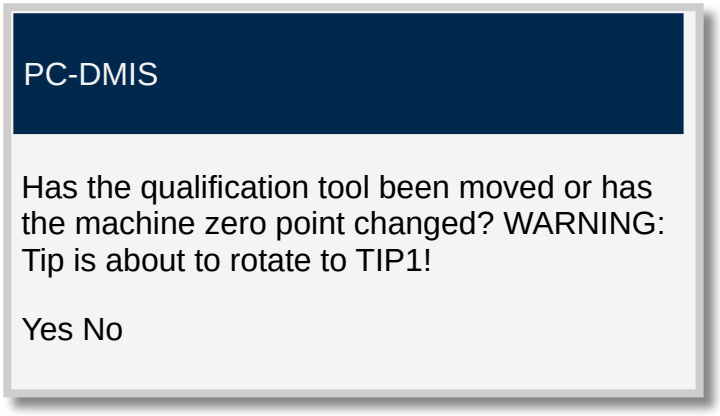
- Select a qualification tool from the **List of available tools** list.
- Click the **Add Tool** button to define a new qualification tool to add to the available tools listing.
- Click the **Edit Tool** button to change the configuration of the selected qualification tool.
- Click the **Delete Tool** button to delete the selected qualification tool.

Once Calibration Starts

PC-DMIS displays one of two styles of messages that ask if the qualifying tool has been moved. The type depends on your machine's ability to use DCC hits to locate the qualification tool:

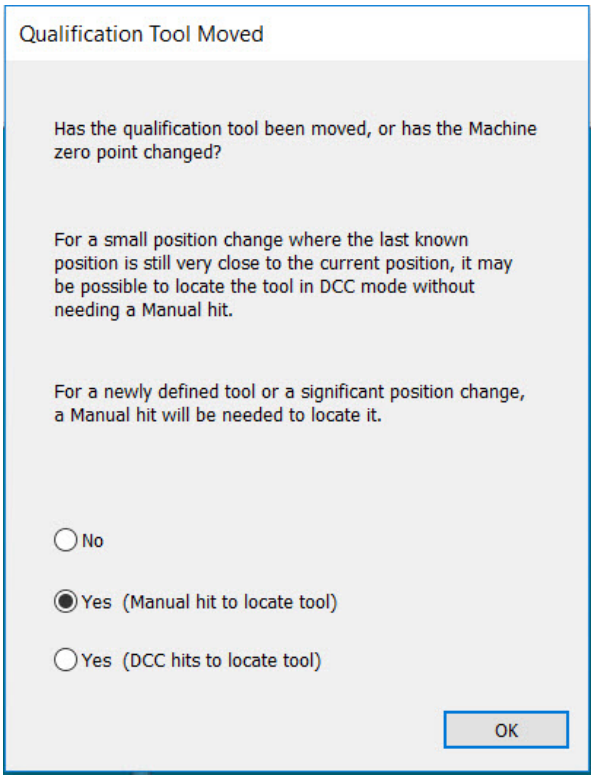
YES/NO Message Box

PC-DMIS displays this message box for machines that do not support the ability to locate the qualification tool using DCC hits (such as manual-only machines):



Qualification Tool Moved Dialog Box

PC-DMIS displays the **Qualification Tool Moved** dialog box if your measuring machine and probe configuration support the ability to locate the qualification tool using DCC hits:



Qualification Tool Moved Dialog Box

- If you select **No**, PC-DMIS displays the **Execution** dialog box. It does not require any manual hits unless they are appropriate for the selected measurement method (such as operating in Manual Mode).

- If you select **Yes (Manual hit to locate tool)**, PC-DMIS displays the **Execution** dialog box. It requires you to take one or more hits in Manual Mode (depending on the tool type) before it continues the calibration process.
- If you select **Yes (DCC hits to locate tool)**, PC-DMIS displays the **Execution** dialog box and automatically attempts to use DCC hits to locate the qualification tool. You may use this option when you have repositioned the qualification tool to nearly the same previous location.

> When the Qualification Tool position is not known and you need to run the Leg Collision Check for a list of tips, we recommend that you use this workflow:
>
> - First, when you start the calibration procedure, select SINGLE TIP to manually locate the Qualification Tool.
> - When you later start another calibration procedure and choose the list of tips, answer NO to the "Qualification Tool Moved" message box, and then answer YES to the "Collision check" message box.

Note About Collision Check Starting with PC-DMIS 2024.2

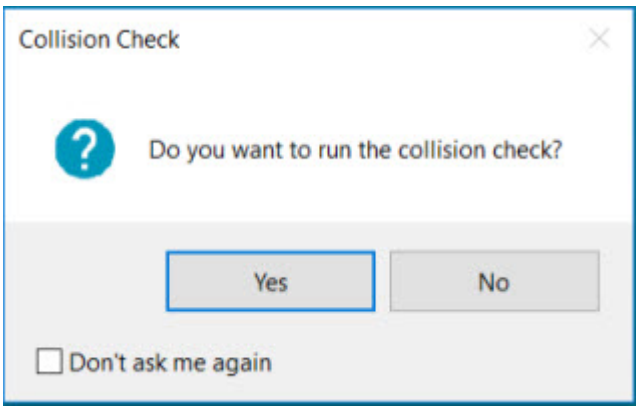
Starting with PC-DMIS 2024.2, you can only perform a Collision Check during the calibration or auto calibration procedures when you select the **No** option on the **Qualification Tool Moved** dialog box.

If you select **Yes**, PC-DMIS continues with the standard calibration routine (it does not perform the Leg Collision check).

For details, see the "AutoCalibrate Probe" topic in the PC-DMIS Core documentation.

About the Leg Collision Check for a Bridge CMM During Calibration

At this point, if you select **No** on the **Qualification Tool Moved** dialog box, PC-DMIS displays the **Collision Check** dialog box. It asks if you want to run the Leg Collision check:



Collision Check Dialog Box - Collision Check Message

- If you select **No**, PC-DMIS continues with the standard calibration routine (it does not perform the Leg Collision check).
- If you answer **Yes**, PC-DMIS verifies any collisions with the current limits in the **CMM Limits** area of the **Part/Machine** tab in the **Setup Options** dialog box. If necessary, PC-DMIS adds any safety movements.

  PC-DMIS displays the **Collision Check** dialog box with the name of the tip that it is currently checking:



Collision Check Dialog Box - Name of Tip

The Leg Collision check takes a few seconds to run. The time depends on the number of tips selected. You can use the **Stop** or **Cancel** button to stop or cancel the check. If needed, PC-DMIS adds safety movements (retracting the tip as needed) to avoid possible collisions with the CMM legs and the gauge (PC-DMIS supports multiple gauges on horizontal/dual arms).

After PC-DMIS runs the Leg Collision check, if it needs to, it executes the calibration routine which was improved with the safety movements.

In a few situations, the Leg Collision check may find some probe tip rotations that cause collisions that it cannot automatically resolve. In these cases, the calibration cannot safely execute, and PC-DMIS interrupts the calibration. It shows a "Can't calibrate" message and lists the problem tip names.

The Leg Collision check is available when you run the calibration routine directly from the **Probe Utilities** dialog box or the `AUTOCALIBRATE` command.

The Leg Collision option:

- Is not available for star probes and laser sensors
- Does not work with Automation functionality
- Does not cover accessories such as probe changers and rotary tables

Once Measurement Finishes

Once the measurement finishes, PC-DMIS calculates the qualification results as appropriate for the type of probe, tool used, and operation requested. The difference between the two **Yes** options in the **Qualification Tool Moved** dialog box only affects whether or not you need to perform a manual hit during measurement. For purposes of the post-measurement calculations, both **Yes** options are equivalent.

After calibration, a brief summary for each tip appears in the **Active tip list** in the **Probe Utilities** dialog box. To see detailed results of the calibration, click **Results** in that dialog box.

Recalibrating

In general, PC-DMIS cannot tell if a probe tip needs to be recalibrated. Be sure to perform a recalibration if anything changes with your probe.

Number of Hits



Number of Hits Box

PC-DMIS uses the number of indicated hits to measure the probe based on the Calibration Mode. The default number of hits is 5.

Prehit / Retract



Prehit / Retract Box

Use the **Prehit / Retract** box to define a distance value away from the part or calibration tool. The speed of PC-DMIS decreases to the defined touch speed while within this distance. It remains at the touch speed until the hit is taken and the distance is reached again. At that point, PC-DMIS returns to the defined move speed.

How the probe retracts depends on the CMM controller:

- **Some controllers handle the retract internally.** After a hit, the controller automatically retracts the probe, but it may only know the prehit distance, not the retract distance. In these cases, the controller retracts the probe to the prehit standoff, and PC-DMIS then issues an additional move to reposition the probe at the retract distance. If the retract distance is less than or equal to the prehit distance, the probe remains at the prehit standoff; PC-DMIS does not move the probe back toward the part after the controller's retract. *The retract value takes effect only when it is greater than the prehit.*
- **Some controllers do not retract on their own.** In these cases, PC-DMIS issues the move to perform the retract, and the distance is based on the probe tip's ball surface to the part's theoretical hit location.

When the controller does perform its own retract, the distance may be calculated from either the ball surface or the ball center to either the theoretical or measured hit location, depending on the particular controller.

Move Speed



Move Speed Box

Use the **Move Speed** box to specify the move speed for the PH9 calibration. Depending on the state of the **Display absolute speeds** check box on the **Part/Machine** tab in the **Setup Options** dialog box, the **Move Speed** box and **Touch Speed** box can either accept an absolute speed (mm/sec) or a percentage of the machine's defined top speed.

For additional ways to affect the speed in the measurement process, see "Move Speed %" in the "Setting your Preferences" chapter of the PC-DMIS Core documentation.

The number in the **Move Speed** box can contain no more than four decimal places. If you enter a number with more than four decimal places, PC-DMIS rounds the number off at the fourth decimal place.

Touch Speed



Touch Speed Box

Use the **Touch Speed** box to specify the touch speed for the PH9 calibration. Depending on the state of the **Display absolute speeds** check box on the **Part/Machine** tab in the **Setup Options** dialog box, the **Move Speed** box and **Touch Speed** box can either accept an absolute speed (mm/sec) or a percentage of the machine's defined top speed.

For more information, see "Touch Speed %" in the "Setting your Preferences" chapter in the PC-DMIS Core documentation.

The number in the **Touch Speed** box can contain no more than four decimal places. If you enter a number with more than four decimal places, PC-DMIS rounds the number off at the fourth decimal place.

System Mode



System Modes

The system modes for calibrating probes include the following:

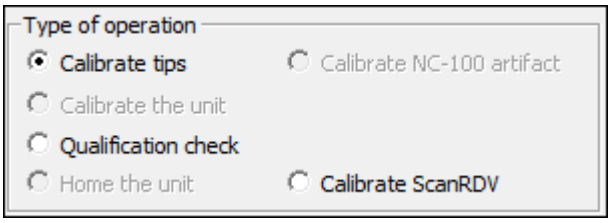
- Manual Mode requires you to take all hits manually even if the CMM has DCC capability.
- DCC CMMs use DCC Mode. It automatically takes all hits unless the qualification tool has been moved. In that case, you must take the first hit manually.
- Man+DCC Mode is a hybrid between Manual Mode and DCC Mode. This mode helps with calibrating odd probe configurations that aren't easy to model. In most cases, Man+DCC behaves like DCC Mode with the following differences:
    - You must always take the first hit manually for each tip, even if the qualification tool hasn't moved. PC-DMIS automatically takes the remaining hits for that tip in DCC Mode.
    - Since PC-DMIS does all the first hits manually, it does not perform pre-measurement clearance moves for any of the tips.
    - Once PC-DMIS completes the sphere measurement for a given tip, depending on the type of wrist you have, it may or may not perform the final retract moves.

  If you have a moveable wrist like a PH9, PH10, PHS, etc., PC-DMIS performs the final retract moves as it would in regular DCC Mode. It proceeds without prompting you thereby ensuring that the probe has sufficient clearance to move to the next tip's AB angles, and to perform the next AB move.

If you do not have a moveable wrist, PC-DMIS doesn't perform the final retract moves. Instead, PC-DMIS proceeds directly to the prompt for the manual hit for the next tip.

- DCC+DCC Mode functions like the Man+DCC Mode except that instead of taking the first hit manually for each tip, PC-DMIS takes DCC sampling hits to locate the sphere. You may find this mode useful if you want to fully automate the calibration process. However, be aware that the Man+DCC Mode may give more accurate results.

Type of Operation area



Type of Operation Area

You can use the **Type of operation** area to select the operation that PC-DMIS performs when you click the **Measure** button in the **Measure Probe** dialog box.

Calibrate Tips

Use this option to do a standard calibration of all marked tips.

Calibrate the Unit

This option creates error maps for infinite wrist devices and indexable wrist devices. For indexable wrist devices, see the information below. For information on infinite wrist devices, see "Calibrate the Unit for Infinite Wrist Devices" in the "Using a Wrist Device" chapter of the PC-DMIS Core documentation.

This option only functions with single arm configurations.

Calibrate the Unit (For Indexable Wrist Devices)

Use this option to error map a probe head or a wrist device. This section describes error mapping an indexing probe head, such as the PH9, PH10, or Zeiss RDS. A special probe configuration, consisting of three styli of the same diameter, is placed in the probe head and as many tip orientations (all possible orientations are best) that the user desires are measured with this probe configuration. Generally, you should arrange the styli in a "T" configuration at least 20 mm tall and 40 mm wide (like a star probe with styli at 20 mm from the center). The farther the styli are separated, the more accurate is the error map.

Once you have measured all possible orientations using the special configuration, you can change probe configurations without having to do a calibration of the entire tip list. Each orientation that is measured in the original map is then automatically calibrated in the new

configuration. PC-DMIS provides complete support for calibrating and using all Renishaw and DEA probe heads, as well as the Zeiss RDS head.

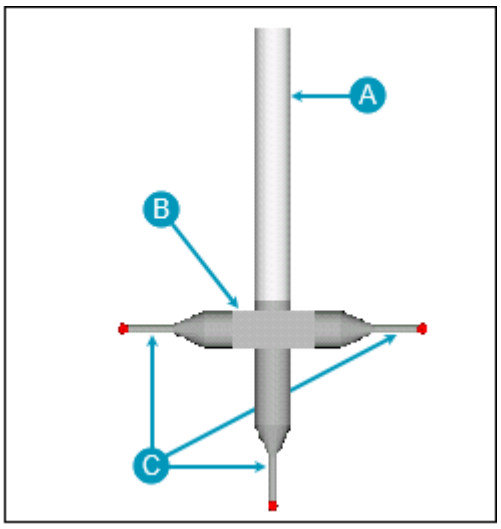


This option, as discussed here, refers exclusively to probe heads that have repeatable index positions such as the PH10. This calibration requires a 3-stylus star probe. After this calibration is performed, only the indexed positions that were qualified during the unit calibration can be used in future probe files without performing a full calibration. The **Calibrate the unit** option is not available when using an analog probe, regardless of whether the probe head is of a type that is either indexable or infinite. This is because an analog probe must have each individual position calibrated to obtain the required deflection coefficients.

For more information on calibrating wrists, see the "Using a Wrist Device" appendix in the PC-DMIS Core documentation.

"Calibrate the Unit" Process for Indexable Wrist Devices

1. Create the unit probe configuration like the one in the graphic below:



A *- 50 mm Extension*
B *- 5-way Center*
C *- Three 3BY20 Tips*

2. The exact sizes of the components may vary, but the shape *must* remain the same. It is also best to choose the lightest components possible, because gravity can cause some error in the measurements.

3. In the **Probe Utilities** dialog box, click the **Add Angles** button. Add as many different orientations as you desire. A complete mapping of the probe head would mean measuring each possible orientation.

4. In the **Probe Utilities** dialog box, select the **Measure** button to open the **Measure Probe** dialog box.

5. Type the default values to use.

6. Select **Calibrate the unit** for the type of operation to perform.
7. In the **Measure Probe** dialog box, click the **Measure** button. PC-DMIS then measures each of the three tips at each of the selected orientations. PC-DMIS uses this data to map the offset, pitch, and yaw of each orientation.
8. Place a probe configuration that you want to use for measurement on the probe head.
9. Choose at least four of the mapped orientations.
10. Select the **Use Unit Calib Data** check box in the **Probe Utilities** dialog box.
11. Calibrate this probe in the chosen orientations. To do this:
    - Click **Measure** in the **Probe Utilities** dialog box to open the **Measure Probe** dialog box.
    - Select the **Calibrate Tips** option for the type of operation to perform.
    - Click the **Measure** button in the **Measure Probe** dialog box. PC-DMIS then calculates the actual length offset for this probe configuration. PC-DMIS automatically creates tips for each mapped orientation.

Lower Matrix

Use this option to calibrate your contact scanning probe's lower level matrix. For information, see "Performing a Low Level Matrix Calibration".

Qualification Check

This option re-measures the tip orientations that you specify within the selected probe file. It does a comparison to the previously measured data for these tip orientations. You can use this comparison to determine if a complete calibration is needed. This is an audit-only procedure within the selected probe file and does not update the tip offsets.

Home the Unit

This option performs a partial wrist-mapping procedure on selected previously-qualified tip angles to determine the proper orientation of A = 0 and B = 0 within the wrist error map. PC-DMIS includes **Home the unit** for selection if the value of the PC-DMIS Settings Editor `RenishawWrist` entry is set to **1**. For help with modifying entries, see the "Modifying Setting Entries" chapter in the PC-DMIS Core documentation.



Your PC-DMIS license must have the wrist option turned on for PC-DMIS to enable the wrist support.

Calibrate ScanRDV

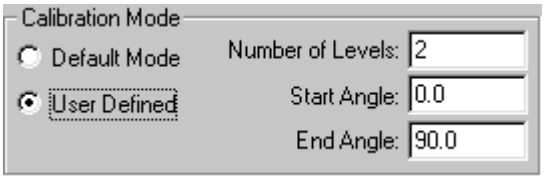
When using an analog scanning probe, some machine types support using a radius deviation from the tip's nominal size. This deviation from the nominal may be different for discrete hits (referred to as PRBRDV) as compared to continuous scanning (referred to as

SCANRDV). Use this option to calibrate a tip directly within this dialog box to calculate a scan-specific radius deviation. If your machine does not support the radius deviations separately from the tip size, this option is unavailable.

Before you use this option, you must first calibrate the tip in the usual manner, typically by using the **Calibrate tips** option. Once done, you may then use the **Calibrate ScanRDV** option to calculate a scan-specific deviation. PC-DMIS measures a single circular scan on the equator of the calibration tool to calculate this value.

PC-DMIS has an older method for measuring a scan-specific deviation. This method uses a measurement routine that contains suitable commands. While this older procedure still functions and remains a flexible approach, it requires considerable effort to develop a suitable calibration measurement routine. The new method is likely adequate for most situations, but you can still use the previous method as needed. For that method, see "Using Separate Deviations for Discrete and Scan Measurements".

Calibration Mode area

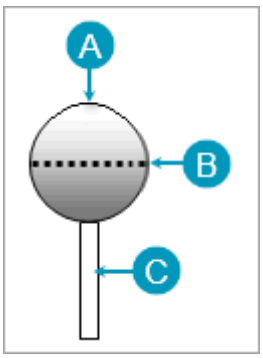


Calibration Mode Area

The **Calibration Mode** area contains options that you can use to switch between default mode and user-defined options as described below.

Default Mode

If you select the **Default Mode** option, PC-DMIS takes the number of indicated hits around the spherical tool at either 10 or 15 degrees from the equator. It also takes one additional hit normal to the probe, 90 degrees from the equator.



Sample Spherical Tool
(A) - Normal to Probe
(B) - Equator
(C) - Shaft

Taking the hits at either 10 or 15 degrees prevents the shank of the probe from hitting the calibration sphere when the shank diameter is almost as large as the probe's tip diameter.

- If your tip's diameter *is less than 1 mm*, PC-DMIS takes the hits around the sphere at 15 degrees.
- If your tip's diameter *is greater than 1 mm*, PC-DMIS takes the hits around the sphere at 10 degrees.

User Defined Mode

If you select this option, PC-DMIS enables you to access the levels and angles boxes. PC-DMIS measures the probe based on the number of levels, start angle, and end angle that you define in those boxes. The location of the level is based on the angles that you set. 0° is located at the equator of the probe. 90° is normal to the probe. Only one hit is taken when measuring normal to the probe.

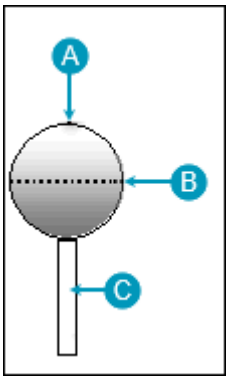
Number of Levels

The **Number of Levels** value sets the number of levels that PC-DMIS uses in the calibration process. PC-DMIS divides the number of hits by the number of levels to determine how many hits to take at each level.

Start and End Angles

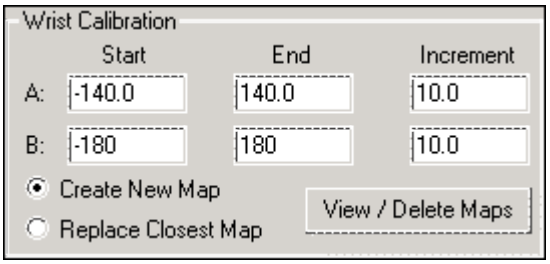
The **Start Angle** and **End Angle** values control the locations of the first and last levels. Any additional levels are located equally between these two levels.

- A starting angle of 0° is located at the equator of the sphere (relative to the probe).
- An ending angle of 90° is located at the top of the sphere (normal to the probe).



Start and End Angles
(A) - Normal to Probe: 90 Degrees
(B) - Equator: 0 Degrees
(C) - Shaft

Wrist Calibration area



Wrist Calibration Area

Use the **Wrist Calibration** area to specify the wrist positions in a pattern of up to nine sphere measurements for indexable wrist calibration. This area becomes available for selection when you meet the following conditions:

- Set up an infinitely indexable wrist device such as the PHS or the CW43L in the **Probe Utilities** dialog box. See "Defining Probes".
- Set the appropriate wrist entries (`DEAWrist` or `RenishawWrist`) in the **Option** section in the PC-DMIS Settings Editor to 1. For details, see "About the Settings Editor: Introduction" in the Settings Editor documentation.
- Select the **Calibrate the unit** option in the **Type of Operation** area in the **Measure Probe** dialog box.

For details on using and calibrating wrist devices, see "Using a Wrist Device" appendix in the PC-DMIS Core documentation.

Defining AB Wrist Positions to Calibrate

To calibrate the wrist, you need to calibrate wrist positions in a pattern of at least three A angle positions by at least three B angle positions for a total of nine sphere measurements. The **Wrist Calibration** area gives you the ability to specify the angles for calibrating both the A and the B axes. Use the **Start**, **End**, and **Increment** boxes to specify the start and end angles for mapping the wrist, and the increment for mapping in both the A and B axes.

Suppose you use these values:

A Angle:

Start = -90

End = 90

Increment = 90



B Angle:

Start = -180

End = 180

Increment = 180

PC-DMIS calibrates the positions of A-90B-180, A-90B0, A-90B180, A0B-180, A0B0, A0B180, A90B-180, A90B0, and A90B180.



Choose the actual start and end angles according to the type of wrist device that you use, the mechanical availability, and the manufacturer or vendor recommendations. In some cases, PC-DMIS automatically determines the start and end angles based on the controller's specifications (although in these cases, PC-DMIS only maps 359.9 degrees of the B axis roll).

While a minimum of nine positions is required to calibrate a wrist device, you may choose to use more than this minimum. PC-DMIS gives you a slightly more accurate calibration if you use more than the minimum number of positions.

When you calibrate a wrist, you can also create a wrist error map to correct for angular errors in the wrist between calibrated positions. For information, see "Calculate Error Map" in the "Using a Wrist Device" appendix of the PC-DMIS Core documentation.

If you're using an SP600 probe, be sure to read the cautionary section in the "Wrist Calibration" topic in the "Using a Wrist Device" appendix in the PC-DMIS Core documentation.

Using Wrist Error Maps

Use the following controls to create, replace, view, and delete wrist error maps.

- **Create New Map** - This option creates a new wrist error map when you click **Measure**.
- **Replace Closest Map** - This option replaces the closest existing wrist error map with a newly created wrist error map when you click **Measure**.
- **View / Delete Maps** - This button displays the **View / Delete Wrist Maps** dialog box. For each mapped wrist, this dialog box lists any wrist error maps found on your system. It also shows the probe's extension length, and it lists the number of AB angles and the angle increment value. To remove a wrist error map from your system, select a wrist error map, and click **Delete**.

Shank Qual



Shank Qual Check Box

Select the **Shank Qual** check box if you are using a shank tip to take edge hits. Use this check box to qualify the shank of the probe. If you select this option, you can manipulate the **Number Shank Hits** box and **Shank Offset** box.



Be aware that if you are using a shank probe, you only need to do a shank calibration if you'll be taking edge hits.

Number Shank Hits



Number Shank Hits Box

The **Number Shank Hits** box sets the number of hits that are used to measure the shank.

Shank Offset



Shank Offset Box

The **Shank Offset** box sets the distance (or length) up from the tip of the shank at which PC-DMIS takes the next set of qualification hits.

Parameter Sets area



Parameter Sets Area

Use the **Parameter Sets** area to create, save, and use saved sets of probe calibration parameters. PC-DMIS saves this information as part of the probe file. It includes the settings for the number of hits, prehit/retract distance, move speed, touch speed, system mode, qualification mode, and the qualification tool's name and location.

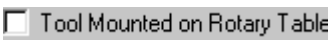
To create your own named parameter sets:

1. Allow PC-DMIS to automatically update your probe file to at least the version 3.5 format.
2. Open the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**).
3. Click the **Measure** button to open the **Measure Probe** dialog box.
4. Modify any parameters in the **Measure Probe** dialog box.
5. In the **Parameter Sets** area, in the **Name** box, type a name for the new parameter set.
6. Click **Save**. PC-DMIS displays a message to tell you that your new parameter set has been created. To delete a saved parameter set, from the list, select it and click **Delete**.
7. If you want to calibrate your probe tips right away, click the **Measure** button. If you want to calibrate them later, click **Cancel**.
8. In the **Probe Utilities** dialog box, click **OK**. To delete any changes that you made to the probe file, including any parameter sets, click **Cancel**.

Once you create a new parameter set, you can use it in the `AUTOCALIBRATE/PROBE` command. For information, see "AutoCalibrate Probe" in the "Defining Hardware" chapter in the PC-DMIS Core documentation.

A parameter set is specific to the probe that was in use when you created it.

Tool Mounted on Rotary Table



Tool Mounted on Rotary Table Check Box

Select the **Tool Mounted on Rotary Table** check box if the probe qualification tool is mounted on the rotary table. This check box is disabled if the machine does not have a rotary table.

Reset Tips to Theo at Start of Calibration



Reset tips to Theo at start of calibration Check Box

If you select this check box, the tip or tips undergoing calibration are automatically reset to their original theoretical conditions when the calibration starts. This essentially functions the same as if you had manually clicked the **Reset Tips** button in the **Probe Utilities** dialog box before calibration.

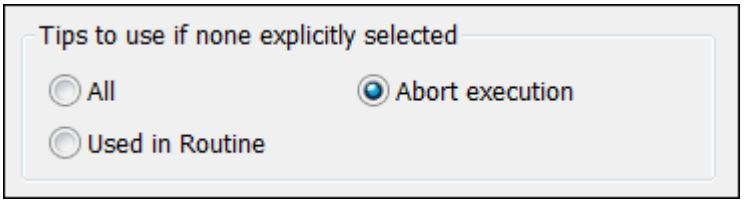
This functionality does not apply to all types of operations and all types of hardware, however.



It does not affect a "Qualification Check" operation, because that is only a test of the calibration and does not actually change any calibration related data. It also does not apply when you use infinite wrist devices in a mapped mode.

It is mainly used with the "Calibrate Tips" operation when used with a fixed head, indexing wrist, or infinite wrist if used in an indexing (non-mapped) mode.

Tips to Use if None Explicitly Selected



Tips to use if none explicitly selected Area

Use this area to specify the action that PC-DMIS should take if you did not explicitly select any probe tips in the **Active tip list** in the **Probe Utilities** dialog box prior to starting calibration.



If you explicitly choose tips in the **Probe Utilities** dialog box, PC-DMIS only uses the selected tips.

- **All** - PC-DMIS uses all existing probe tip angles in the current probe file.

- **Used in Routine** - PC-DMIS only uses the probe tip angles that are used in the current measurement routine for the current probe file. The restrictions are as follows:
    - This option may not achieve the desired result if you use it in a measurement routine for which the **Automatically Adjust Probe Head Wrist** option is enabled. The tips used in the measurement routine at the time of the calibration may change later as a result of the actual part alignment.
    - This option looks only at the measurement routine that is currently open. It does NOT try to look through references to external files, such as subroutines.
- **Abort execution** - PC-DMIS aborts the execution or measurement. It treats the condition of no tip angles selected as an error condition.

These options do not apply to all operation types and all hardware types. Mainly, they are used with the "Calibrate Tips" or "Qualification Check" operation when used with a fixed head, indexing wrist, or infinite wrist if used in an indexing (non-mapped) mode.

Measure



Measure Button

The **Measure** button performs the operation that you select in the **Type of Operation** area.

Contact Scanning Probe Calibration Information

This section discusses the calibration procedure for contact scanning probes for PC-DMIS versions 3.25 and higher.

Notes on the Contact Scanning Probe Upper Level Matrix (Regular Calibration)

The following notes apply to the Upper Level Matrix calibration when you use an analog type probe.

Using OPTIONPROBE Commands with Analog Probe Types

An `OPTIONPROBE` command is inserted into the measurement routine any time you change values on the **Opt. Probe** tab in the **Parameter Settings** dialog box. For information on the **Parameter Settings** dialog box, see "Parameter Settings: Probe Options tab" in the "Setting Your Preferences" chapter in the PC-DMIS Core documentation.

- If PC-DMIS encounters an `OPTIONPROBE` command in the current measurement routine before the probe's `LOADPROBE` command, the calibration uses the values from the `OPTIONPROBE` command.
- If the `OPTIONPROBE` command doesn't precede the `LOADPROBE` command, PC-DMIS uses the default values that are stored in the PC-DMIS Settings Editor application.

The default parameters are stored in the **ANALOG_PROBING** section of the PC-DMIS Settings Editor application. If the default values are acceptable, you do not need to include an `OPTIONPROBE` command in your measurement routine. This is because PC-DMIS will use the default values if it can't find an `OPTIONPROBE` command.



Using the `OPTIONPROBE` command may limit the portability of the measurement routine. Since PC-DMIS uses machine-specific data in the `OPTIONPROBE` command, you may get inaccuracies if you run the measurement routine on a computer using a different CMM. Unless you really need to use the `OPTIONPROBE` command (such as to measure a really soft part), you generally shouldn't use an `OPTIONPROBE` command in this version. PC-DMIS can automatically grab the default machine values from the PC-DMIS Settings Editor application.

Disk Stylus Calibration Notes and Procedure

When you perform a discrete hit calibration of a disk stylus on an analog probe with the qualification sphere, you need to use the Measure Probe dialog box and specify the following:

- Five hits in the **Number of Hits** box
- Two levels in the **Number of Levels** box

These do not apply for probes that use the Renishaw scan-based calibration.

Make sure that when you define your probe, you model a disk stylus and not a ball stylus. Once you click the **Measure** button in the **Measure Probe** dialog box, PC-DMIS automatically recognizes that you have an analog probe with a disk stylus and goes through this procedure:

- *If you moved the sphere*, or if you chose the **Man + DCC** mode, PC-DMIS prompts you to take one manual hit on the very top of the qualification sphere (the north pole) with the center of the bottom of the disk stylus. If your probe configuration has an additional ball stylus attached to the bottom of the disk stylus, be sure to take the hit with that ball stylus.
- *If you didn't move the sphere*, and you chose not to use **Man + DCC** mode, PC-DMIS takes the hit on the top of the qualification tool in DCC Mode.

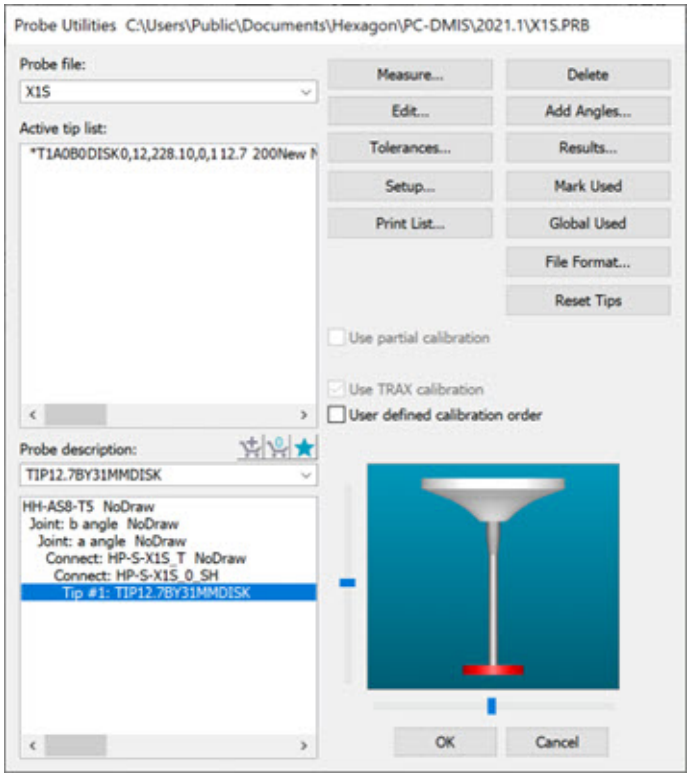
PC-DMIS uses the default value for these two entries when you build the disk probe:

- `ProbeQualAnalogDiskUsePlaneOnBottom`
- `ProbeQualAnalogDiskBottomHitsDistanceFromEdge`

The entries do not affect the probe once it is built. The values used when you calibrate the probe are stored inside the probe itself. You can change these two values from the **Probe Utilities** dialog box.

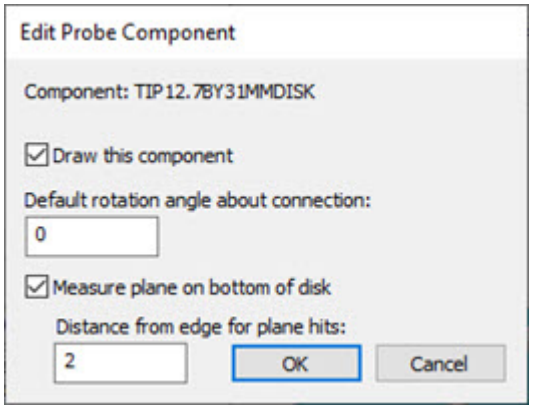
To do this, follow these steps:

1. Open the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**).



Probe Utilities dialog box for a disk stylus

2. Double-click the disk tip component (shown highlighted in the image above) to display the **Edit Probe Component** dialog box.



Edit Probe Component dialog box for a disk stylus

3. For the **Measure plane on bottom of disk** check box:

    - When selected (`ProbeQualAnalogDiskUsePlaneOnBottom` entry set to **1**), PC-DMIS takes four hits on top of the sphere using a circular pattern on the bottom of the disk stylus and calculates a plane from it. Measuring a plane helps ensure that the hits for calibrating the face are oriented properly to reflect the actual plane of the disk. *This is the default for the traditional calibration method using discrete hits.*

    - When not selected (`ProbeQualAnalogDiskUsePlaneOnBottom` entry set to **0**), PC-DMIS does not attempt to measure a plane on the bottom of the disk's face. Instead, it uses the design orientation of the disk. *This is the default for the Renishaw scan-based calibration.*

4. You can type in a value in the **Distance from edge for plane hits** box (`ProbeQualAnalogDiskBottomHitsDistanceFromEdge` entry). You can use it to affect the location of the hits on the bottom of the disk stylus during calibration.

PC-DMIS then finishes by doing the following in DCC Mode:

- After the hits are taken on top of the sphere, it takes six hits on two levels to get a close location of the center point of the sphere.

- It uses the center point along with the vector from either the plane measurement or the design orientation to correctly position the subsequent measurement.

- For discrete hit calibration, it takes five hits (four in a circular pattern around the equator of the sphere and the fifth hit on the top, or the pole, of the sphere).

- For scan-based calibration, it takes a series of scans at two different levels (one slightly below the equator and one slightly above the equator). Each level is scanned in both clockwise and counterclockwise directions. Each direction for each level is also scanned using two different scan force offsets. This results in a total of eight scans.

PC-DMIS also provides the `ProbeQualAnalogDiskPlaneStartAngle` entry in the PC-DMIS Settings Editor in the **ProbeCal** section. This is another entry that you can use to affect the location of the hits on the bottom of the disk stylus during calibration.

For more information on any of the entries discussed here, see the "ProbeCal" section of the PC-DMIS Settings Editor documentation.

Contact Scanning Probe Calibration Procedures

When you use a disk stylus in an analog contact probe, the 2D algorithm that calculates the resulting deflection matrix has a restriction:

It requires four equally spaced hits on the equator with 90 degrees between them to cover 270 degrees of the sphere.

When stem avoidance is required, it automatically starts at 45 degrees and stops at 315 degrees. This allows for enough room on both sides of the stem while still covering the required 270 degrees.

The algorithm does not allow for a reduction in sphere coverage. If the range of 45 to 315 degrees is not enough to avoid collision with the stem, you must use some type of physical avoidance. Some options are:

- Use a sphere with larger diameter
- Use a stem with a smaller diameter
- Use a different stem angle

Choose an option that provides sufficient clearance to avoid collision.

The following procedures describe how to calibrate your contact scanning probe's lower level and upper level matrices.

For best accuracy in the processes below, use a high-quality spherical calibration tool. Keep the calibration tool well-cleaned throughout both calibration processes.

Performing a Low Level Matrix Calibration

You should redo the low level matrix calibration at these times:

- Whenever you remove and remount the probe head or wrist
- Whenever the probe sustains damage or has been replaced
- During periodic intervals based on your specific needs

Prerequisites

Before following the calibration procedure below, ensure that you meet these prerequisites:

- You must run PC-DMIS in Online mode.
- You must run PC-DMIS using a CMM that has a lower matrix.

- You must have an analog probe that utilizes a lower matrix. Some of these include the SP600, SP80, LSP-X1, LSP-X3, and LSP-X5.
- You should use a rigid stylus that deflects as little as possible during the procedure.

Calibration Procedure

1. Access the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**).
2. Ensure that the angles that you need exist in the **Active tip list**.
3. From the **Active tip list**, select the angle used as the reference position. In most instances, this should be the angle used for the Z- direction. Unless you have a horizontal arm, this angle is usually the T1A0B0 tip.
4. Click the **Measure** button to open the **Measure Probe** dialog box.
5. Select the **Lower matrix** option button from the **Type of Operation** area. This option appears only when you work in Online mode with a machine type that supports a lower matrix, and a probe type that requires a lower matrix.
6. If desired, change the values in the **Prehit / Retract**, **Move Speed**, or **Touch Speed** boxes.
7. Select an appropriate tool from the **List of Available Tools** list.
8. Click the **Measure** button. PC-DMIS gives a warning message that if you continue, you will change the machine specific parameters for the lower level matrix on the controller itself. Click **Yes** to continue the calibration.
9. PC-DMIS displays another message asking if the qualification tool has moved. Click **Yes** or **No**.
10. PC-DMIS next displays a message asking you to take one hit normal to the calibration tool. If you're working from the Z- position, take the hit on the very top of the tool. After taking this one hit, PC-DMIS takes over and finishes determining the center location of the calibration tool. It does this by taking:
    - 3 hits around the sphere
    - 25 other hits around the sphere
11. Once PC-DMIS finds the center location of the tool, the actual low level matrix calibration begins. In most applications, PC-DMIS will take 22 hits (11 hits in one direction and 11 hits in another direction forming a cross pattern) on the X+, X-, Y+, Y-, and Z+ poles of the calibration sphere, for a total of 110 hits. This typically takes five to ten minutes to complete.
12. PC-DMIS then presents you with nine numbers along with a message asking if these numbers are correct. These are the lower level matrix values.

13. If the values are correct, click **OK**. PC-DMIS will then overwrite the lower level matrix values on the controller with the newer values. When complete, PC-DMIS prompts you to confirm it's OK to proceed. On some machine types, PC-DMIS may have to send an emergency stop command to the machine to update the values. If so, wait for the prompt and then restart the machine before you click OK.
14. Click **OK** in the message box.

PC-DMIS once again displays the **Probe Utilities** dialog box. Notice that the reference tip in the **Active tip list** isn't calibrated. The lower level calibration doesn't calibrate the actual tip angles. Tip angles get calibrated when you perform the upper level matrix calibration procedure.



If you don't have a good low level matrix, you will experience problems in some scanning routines, and the machine may not be able to complete some scans. In addition, you will experience inaccuracies.

Performing an Upper Level Matrix Calibration

After you've finished calibrating the lower level matrix, you can perform the regular calibration. This upper level calibration calibrates the actual probe tips. It also sends another matrix of numbers to the controller that gives small corrections to the lower level matrix based on the current probe configuration and orientation.

To achieve greater accuracy, PC-DMIS should take probe hits, measuring a full sweep, all around the equator of the calibration sphere. You get better results if you have a good angle of coverage on the sphere. You can control the start and end angles for the sweep around the sphere's equator from these entries in the **ProbeCal** section in PC-DMIS Settings Editor:

`FullSphereAngleCheck` - Set its value to 25.0

`ProbeQualToolDiameterCutoff` - Set its value to 18.0

`ProbeQualLargeToolStartAngle1` - Set its value to 50.0

`ProbeQualLargeToolEndAngle1` - Set its value to 310.0

`ProbeQualSmallToolStartAngle1` - Set its value to 70.0

`ProbeQualSmallToolEndAngle1` - Set its value to 290.0

For information on modifying entries, see the "Modifying Setting Entries" chapter in the PC-DMIS Core documentation.

Calibration Procedure

To do an upper level matrix calibration, follow these steps:

1. Open the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**).
2. Click the **Measure** button.
3. In the **Type of operation** area, select **Calibrate tips**.
4. In the **Calibration Mode** area, select **User defined**. Since the Default method only takes hits around the diameter and one hit on top of the calibration sphere, it doesn't give a very good 3D relationship of the probe center. However, if you want to calibrate using the Default method, be sure to read "Notes on the Default (2D) Calibration Mode" below.
5. In the **Number of levels** box, type **3**. You can type in additional levels as long as they don't exceed the number of hits you'll be taking. But, the minimum number of levels should be at least three.
6. In the **Start Angle** box, type **0**.
7. In the **End Angle** box, type **90**.
8. In the **Number of hits** box, type **25**. You can have PC-DMIS take as few as 12 hits, but it's generally recommended to take 25 hits.
9. Click the **Measure** button when you're ready to begin.
10. If you have turned on the analog probing hits option inside of the PC-DMIS Settings Editor, then PC-DMIS automatically takes 5 hits around the calibration sphere to better define the center of the calibration tool.
11. PC-DMIS then calibrates the AB angle positions and automatically writes the upper level matrix numbers to the controller. These numbers are correct if you correctly followed the lower level matrix calibration procedure.

PC-DMIS then displays the **Probe Utilities** dialog box. The active tips are now calibrated, and you're ready to program your measurement routine using the newly-calibrated probe.

Notes on the Default (2D) Calibration Mode

In the **Calibration Mode** area, if you select **Default**, PC-DMIS inserts five hits into the **Number of hits** box. When you begin the calibration procedure, PC-DMIS takes these hits on the axes normal to the probe position.



Be careful if you attempt to calibrate under these three conditions:

- You have a shank on the calibration sphere that comes out of the bottom (vector is 0, 0, 1).
- You use the **Default** calibration mode.
- You have an A90 angle in spheres.

If the above conditions are met, PC-DMIS crashes the probe into the shank of a calibration sphere. This happens because the probe tries to take a hit in the Z-position of the sphere.

To fix this, use an inclined shank, don't calibrate tips that have A90 angles, or choose to use the **User defined** calibration mode.

Working with Temperature Sensors

PC-DMIS supports the ability to apply temperature compensation using changeable temperature sensors or temperature sensors mounted on a CMM probe head. For more information about temperature compensation, see "Compensating for Temperature" in the "Setting Your Preferences" chapter in the PC-DMIS Core documentation.

PC-DMIS supports continuous contact and non-continuous contact temperature sensors.

Continuous Contact Temperature Sensors

These types of sensors are in continuous contact with the part. The temperature compensation command (`TempComp`) reads the temperature. For more information about the `TempComp` command, see "Using Temperature Compensation with Multiple Arm Calibration" in the "Using Multiple Arm Mode" chapter in the PC-DMIS Core documentation.

Non-Continuous Contact Temperature Sensors

The following non-continuous temperature sensors are available:

- Fixed - This type of sensor mounts directly on a LSPX5.2, LSP-S2, or similar probe head.
- Changeable - This sensor is a type of stylus assembly that contains a temperature sensor, and is part of the changeable probe assembly. You can place the sensor in a tool rack. It can also be attached (picked up) or detached (dropped off) in the same general manner as a stylus assembly for regular measurement. Some probe heads, such as the LSP-X5.3 and LSP-S8, support changeable temperature sensors.

Temperature probing, a function that automatically measures the temperature of a part, is required to measure a temperature with a non-continuous contact temperature sensor. You must measure the temperature probing point or points to measure the temperature. You

can then use the `TempComp` command to activate the temperature compensation after you measure the temperature.

Creating a Temperature Probe File

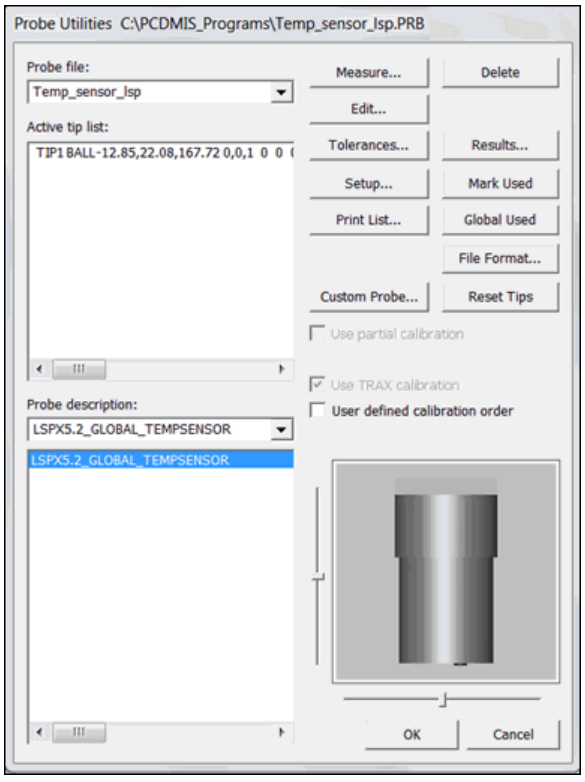
To create a temperature probe file:

1. Open the **Probe Utilities** dialog box (**Insert | Hardware Definition | Probe**).
2. Build the temperature probe.

   The description of the main probe body in the **Probe Description** area for a temperature sensor mounted on a probe head ends with "TEMPSENSOR", such as:

   LSPX5.2_GLOBAL_TEMPSENSOR

   The graphic below shows an example of a temperature sensor mounted on a CMM probe head.

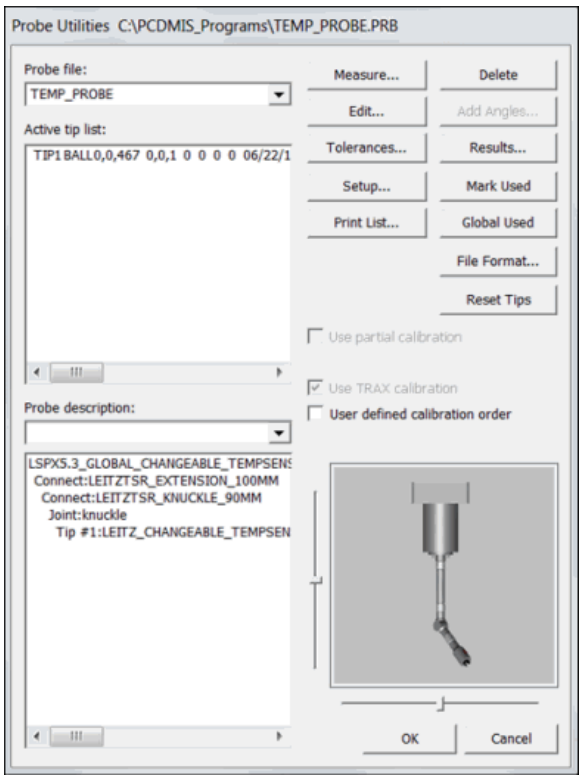


Example of Probe Utilities dialog box for temperature sensor mounted on CMM probe head

   The description of the main probe body in the **Probe Description** area for a changeable temperature sensor ends with CHANGEABLE_TEMPSENSOR, such as:

   LSPX5.3_GLOBAL_CHANGEABLE_TEMPSENSOR

   The graphic below shows an example of a probe file with a changeable temperature sensor.



Example of Probe Utilities dialog box for changeable temperature sensor

For information on the various options in the **Probe Utilities** dialog box, see "Understanding the Probe Utilities Dialog Box" in the "Defining Hardware" chapter in the PC-DMIS Core documentation.

Editing a Temperature Probe Component

You do not need to calibrate a temperature probe. However, if you are using a changeable temperature sensor, you need to ensure that the theoretical vector of the temperature probe is correct.



If you are using a knuckle component, you can adjust the theoretical vector by changing the rotation angle about the connection.

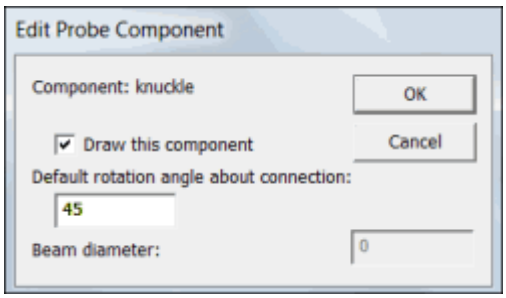
To edit a temperature probe component:

1. From the main menu, select **Insert | Hardware Definition | Probe** to access the **Probe Utilities** dialog box. (For information on that dialog box, see "Understanding the Probe Utilities Dialog Box" in the "Defining Hardware" chapter in the PC-DMIS Core documentation.)

2. From the **Probe Utilities** dialog box, in the **Probe Description** area, double-click on a component to show the **Edit Probe Component** dialog box.

3. In the **Default rotation angle about connection** box, type the desired angle (any angle from +180° to -180°), and click **OK**.

The image below shows an example for a knuckle component:



Example of Edit Probe Component dialog box

Measuring a Temperature Probing Point

A temperature probe works similarly to the way a normal probe works. The measurement starts when the sensor contacts the part.

The temperature probing point can be:

- A measured point
- A vector point

You must measure the temperature probing point along the vector of the temperature probe sensor. Therefore, when you select a temperature sensor as the probe tip and measure a point, PC-DMIS drives the CMM along the vector of the active temperature probe and ignores the theoretical vector of the measured point or vector point. This action ensures that the measurement is correct, and that the temperature sensor properly contacts the part.

Temperature Measuring Methods

PC-DMIS supports the following methods for measuring the temperature; however, this support depends on the capabilities of the specific CMM you are using. Some CMMs support only one method. A CMM with a B4 Leitz controller is an example of a configuration that supports both methods.

Temperature is measured after a certain interval of contact with the part (contact time):

In this method, the sensor stays in contact with the component for a defined time. The temperature is measured continuously to determine the part's temperature. Most of the CMMs that support this mode have a default contact time, which is commonly referred to as a delay time.

To measure the temperature with a contact time other than the default time for the CMM, you must specify the desired contact time by inserting an appropriate "Assign" in your PC-DMIS measurement routine somewhere before the points that will perform the measurement. The name of the variable for the assignment is:

```
TEMPSENSOR_CONTACT_TIME_SECONDS
```

An example of an assignment is:

```
ASSIGN/TEMPSENSOR_CONTACT_TIME_SECONDS=30
```

The choice of contact time depends on the sensitivity of the temperature sensor. If the time is too short, the temperature of the part may be read incorrectly.

It is not necessary to have an "Assign" statement in the measurement routine. This is required only if you do not want to use the default for the CMM.

Temperature measured by extrapolation method:

In this method, the sensor stays in contact with the component for only a short time, and the component's temperature is extrapolated from a few measured values. If you use an "Assign" statement that specifies a contact time of 0, then PC-DMIS attempts to use the extrapolation method if the CMM supports it. In this case, the controller controls the time for measuring the temperature.

The assignment for a contact time of 0 is:

```
ASSIGN/TEMPSENSOR_CONTACT_TIME_SECONDS=0
```

To enable extrapolation, specify a contact time of 0. To disable extrapolation and use the specified time interval, specify a contact time greater than 0.

Measuring the Temperature on a Large Part

You may want to measure the temperature on a large part at more than one location. In this case, the temperature compensation is based on an average of those temperature readings. To do this, you should measure multiple temperature points. PC-DMIS records the average temperature.

Measuring the Temperature Multiple Times

When you measure the temperature multiple times, PC-DMIS records each reading and calculates the average temperature for use in the `TempComp` command. When you execute the `TempComp` command, PC-DMIS resets the sum of the temperature readings so it can calculate a new average for subsequent measurements. It also records the calculated average temperature at that time. PC-DMIS resets the sum whenever you change the probe.

If you want to measure the temperature again, you must execute the `TempComp` command to "reset" the recorded temperature before you measure it again.

Using Temperature Probes with Tool Racks

A temperature sensor mounted on a probe head does not require the probe to be assigned to a garage/slot in a tool rack.

A changeable temperature sensor requires the probe to be assigned to a garage/slot in a tool rack to be able to automatically load or unload it.

Using Separate Deviations for Discrete and Scan Measurements



A newer and simpler Calibrate ScanRDV method, discussed in the "Type of Operation area" topic, is also available.

When you calibrate a contact-based analog scanning probe, the measured tip size may differ from the nominal tip size. This depends on the type of machine and the calibration method selected. On some machines, this deviation may be calculated and sent to the machine controller separately from the nominal size as a radial deviation. On these machines, this deviation can be sensitive to how the calibration data was collected, particularly in terms of whether discrete hits or scans were used. This can sometimes lead to an apparent size discrepancy during post-calibration measurement. This depends on whether a given feature is measured using discrete hits or scans.

To address this discrepancy, some of these machine controllers (currently those that use the Leitz interface) have been enhanced to support using separate deviations for discrete-hit measurement (PRBRDV) and scan measurement (SCANRDV). To support this, you can use the following procedure in PC-DMIS to update the SCANRDV after the regular calibration is complete.

Procedure Overview: To do this, scan a calibration artifact of known size. Typically, you would scan one or more circles around the equator of a calibration sphere or the inside of a ring gage. Construct a circle feature from the scans and then use a "Calibrate Active Tip" command to update the calibration data for the tip.

Calibration Procedure

1. Do a traditional tip calibration. This calculates the usual parameters such as the tip offset and deflection coefficients and sets both the PRBRDV and SCANRDV to the one resulting deviation. You can do this tip calibration in one of these ways:
    - Using a separate, already prepared, calibration measurement routine.
    - In a preceding portion of the same measurement routine used in step 2.
    - On the spot interactively by accessing the **Probe Utilities** dialog box and using the **Measure** buttons. See "Calibrating Probe Tips".
2. Create a measurement routine with the following:
    - One or more scans that measure a calibration artifact of known size. These are typically basic circle scans that measure the equator of a calibration sphere or the inside of a ring gage. The artifact does not have to be something defined as

a calibration tool inside PC-DMIS. For details, see "Performing a Circle Basic Scan".

- A best fit recompensated (BF Recomp) constructed circle feature that references the desired scans. For details, see "Constructing a Circle Feature" in the "Constructing New Features from Existing Features" chapter in the PC-DMIS Core documentation. Other constructed circle types or non-circle features are not currently supported for SCANRDV calculations.

  For Best Fit (BF) or Best Fit Recompensate (BFRE) constructions, while you can use any feature type for your input features, BF and BFRE fit types are typically used with point features or point sets (a scan of points, a feature set with points, or an expression that resolves to an array of points).

  For details on using the Best Fit and Best Fit Recompensate methods to construct features, see the "Understanding Best Fit (BF) and Best Fit Recompensate (BFRE) Constructions" topic in the PC-DMIS Core documentation.

  The theoretical size for the constructed feature must correctly match the size of the calibration artifact. Also, you must specify the theoretical diameter for the measured artifact in the input parameters for the constructed circle. The difference between the theoretical and measured size of the constructed circle is the basis for establishing the SCANRDV value.

- A "Calibrate Active Tip" command that references the constructed circle. For details, see "To Automatically Calibrate a Single Tip" in the "Defining Hardware" chapter in the PC-DMIS Core documentation. When you use this command with this type of circle as the input feature, the calibrate single tip command does not require a reference to a calibration sphere.

3. Execute the measurement routine described in the previous step. This updates the SCANRDV, based on the difference between the theoretical and the measured size for the constructed circle, while leaving the tip offset and PRBRDV unchanged.

   The BF recomp circle and "Calibrate Single Tip" commands described in step 2 must exist in the measurement routine at the time the scans are executed for calibration, because they affect how the scans are executed on the machine.

A Portion of a Sample Calibration Measurement Routine

```
SCN_FORCAL =BASICSCAN/CIRCLE,NUMBER OF HITS=54,SHOW
HITS=NO,SHOWALLPARAMS=NO
   ENDSCAN
CIR_PRECAL=FEAT/CIRCLE,CARTESIAN,IN,LEAST_SQR,YES
   THEO/<0,0,5>,<1,0,0>,50
   ACTL/<-0.0007,-0.0007,-0.0001>,<0,0,1>,49.9967
   CONSTR/CIRCLE,BFRE,SCN_FORCAL,,
   OUTLIER_REMOVAL/OFF,3
   FILTER/OFF,UPR=0
CALIBRATE ACTIVE TIP WITH FEAT_ID=CIR_PRECAL
```

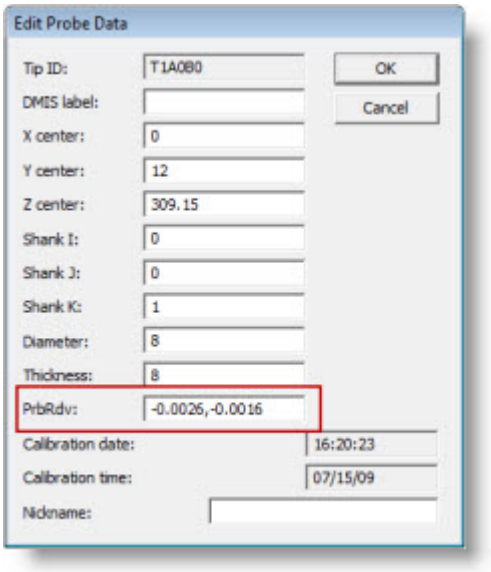
In the above sample, a single circle scan inside a 50 mm ring gage was performed, the constructed circle feature was created from that, and then the calibrate active tip command was used to update the SCANRDV value for the active tip. If appropriate for the particular measurement to be performed, the constructed circle may have more than one scan as input.

You can see in the code snippet that the measurement routine created the Constructed Circle feature using the Best Fit Recompensate (BFRE) method. For details on using the Best Fit and Best Fit Recompensate methods to construct features, see the "Understanding Best Fit (BF) and Best Fit Recompensate (BFRE) Constructions" topic in the PC-DMIS Core documentation.

In some cases, a better average value might be obtained by including both a clockwise scan and a counterclockwise scan.

Manually Editing SCANRDV

To view or manually edit the SCANRDV, select the desired tip in the **Probe Utilities** dialog box and click the **Edit** button. The **Edit Probe Data** dialog box appears with the **PrbRdv** box containing both the PRBRDV and SCANRDV values separated by commas, like this:



Renishaw SP25 Scanning Probes

The procedure above is primarily oriented towards traditional analog scanning probes that are initially calibrated using discrete hits. Due to the probe being calibrated with discrete hits, subsequent measurements with discrete hits are generally good. However, further adjustments are sometimes needed to get a SCANRDV that is more suitable for scan-based measurements.

For the Renishaw SP25 scanning probes, the situation is somewhat reversed because the initial (full) calibration is performed using a series of scans. The result of this calibration can sometimes be that the scan measurement is good, but a size discrepancy may then exist when your measurements use *discrete* hits.

To help address this issue, a modification has been made to the "Partial" calibration procedure for the SP25. That partial calibration uses discrete hits and updates the tip offset and size without changing the deflection coefficients produced by the full scan-based calibration. With this modification, when updating the result for size, the partial calibration procedure now updates PRBRDV but does not modify the SCANRDV value.

If a full calibration is followed by a partial calibration, the resulting PRBRDV is from the discrete hit-based partial calibration. The SCANRDV is still from the full scan-based calibration.

Although the initial scan-based calibration for an SP25 may make it less likely to be needed, if necessary, this new SCANRDV procedure can be used with an SP25 just like with any other analog scanning probe.

Using Different Probe Options

This topic assumes that the probe is loaded and your active tip is calibrated.

Using a Probe Online

To measure a point in Online Mode with a touch trigger probe:

1. Lower the probe to the surface where the point is to be taken.
2. Trigger the probe by touching it to the surface.
3. Press the End key to complete the measurement process.

PC-DMIS is designed to determine the feature type. The probe radius determines the probe compensation. The machine direction determines the compensation direction.



In measuring a circle, the probe is inside the circle moving outward. To measure a stud, the probe starts outside the circle and moves inward towards the part.



The approach direction must be normal (perpendicular) to the surface when you measure points. While this is not necessary when you measure other features, it improves the accuracy in determining the feature type.

To use a fixed probe to measure a point, you must specify the feature type that is to be measured and the probe compensation direction. For details, see "Using Hard Probes" in the PC-DMIS Portable documentation.

Using a Probe Offline

When you use PC-DMIS in Offline Mode, you can access all of the probe options. However, you cannot take actual measurements. You can either type the probe data or use the default settings.



A qualification tool cannot actually be measured to calibrate a probe. You must type the probe's nominal values.

To take a hit in Offline mode:

1. Make sure that PC-DMIS is in Program Mode. To do this, select the **Program Mode** button () on the **Graphic Modes** toolbar. (For details, see "Graphic Modes Toolbar" in the "Using Toolbars" chapter of the PC-DMIS Core documentation.)
2. Move the pointer on the screen to where you want to take the hit.
3. Click the right mouse button to move the probe's tip to the area of the part where the hit is to be taken. The probe is drawn on the screen, and the probe depth is set.
4. Click the left mouse button to register a hit on the part. If you have Wireframe Mode selected, hits are taken on the nearest wire. If you are in Surface Mode, the hit is taken on the selected surface.

5. Press the End key to complete the measurement process.

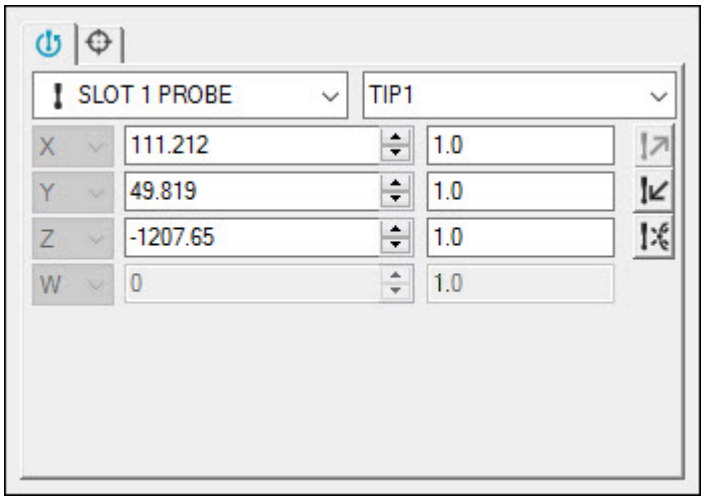
Using the Probe Toolbox

Using the Probe Toolbox: Introduction

In PC-DMIS CMM, you can use the Probe Toolbox to perform various probe-related manipulations specific to contact probes. If you use the **Probe Toolbox** by itself, it contains only two tabs. Additional tabs appear when you view the toolbox embedded within the **Auto Feature** dialog box.

Using the Probe Toolbox Dialog Box

1. Select **View | Other Windows | Probe Toolbox** to open the **Probe Toolbox**:



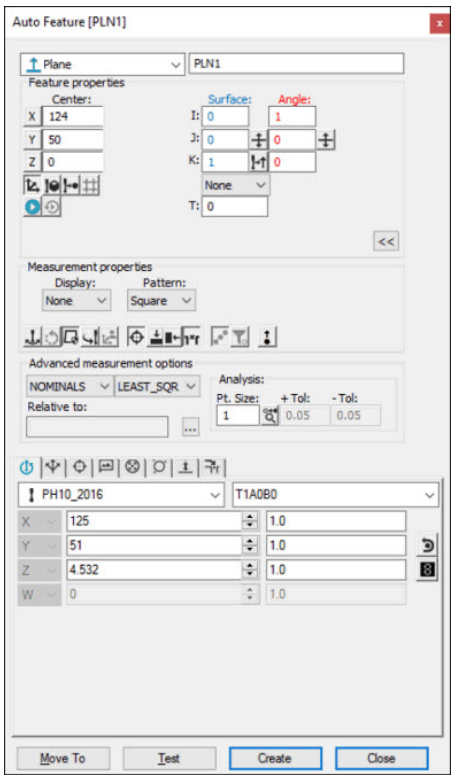
Probe Toolbox for a contact probe

2. Complete the properties on the two tabs that appear:

   - **Position Probe** tab - Use this tab to switch between existing configured probes and probe tips, view the current probe's location, access the Probe Readouts window, and remove probing hits from the hits buffer.
   - **Hit Targets** tab - Use this tab to view the hits used to measure the feature and the XYZ values for each hit.

Using the Probe Toolbox Embedded Within the Auto Feature Dialog Box

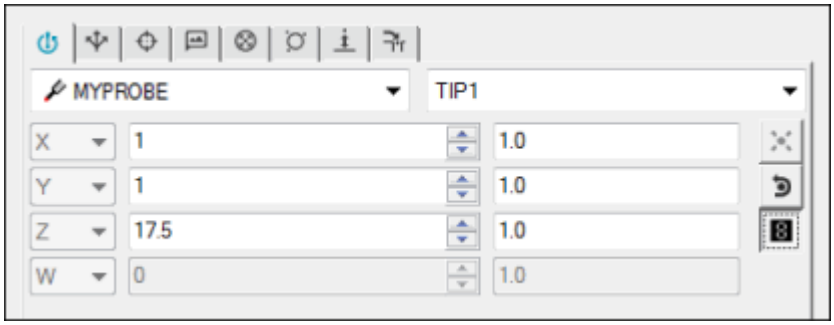
1. Open the **Auto Feature** dialog box. For help, see "Inserting Auto Features".
2. Select the Auto feature for the measurement strategy that you want to use.
3. Click the **>>** button. The **Measurement properties** area, **Advanced measurement options** area, and Probe Toolbox (with additional tabs in the lower portion of the dialog box) appear.



Sample Auto Feature dialog box

> This documentation set does not discuss the options in the **Measurement properties** area and **Advanced measurement options** area. Since many of these options are common to the different configurations of PC-DMIS, the PC-DMIS Core documentation contains this information. For in-depth information on the options in these areas, see the "Creating Auto Features" chapter in the PC-DMIS Core documentation.

The Probe Toolbox appears in the lower portion of the dialog box and displays the tabs for the Default PC-DMIS Measurement Strategy. The probe-related tabs and manipulations for standard contact probe types within the **Auto Feature** dialog box include additional tabs. For example:



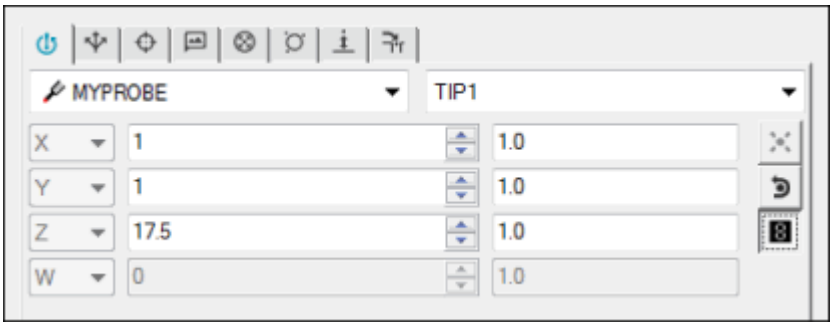
Probe Toolbox embedded within the Auto Feature dialog box

4. Complete the properties on the tabs.

   - **Contact Auto Move Properties** tab - Use this tab to modify properties for Auto Move (or Avoidance Move).

- **Contact Find Hole Properties** tab - Use this tab to modify properties for locating a hole.
- **Contact Path Properties** tab - Use this tab to modify properties that affect the probe path, such as number of hits, depth, hits per level, and so on.
- **Contact Sample Hits Properties** tab - Use this tab to modify sample hits properties.
- **Feature Locator** tab - Use this tab to define and view feature location instructions.
- **Feature Extraction** tab - Use this tab if a laser probe is your active probe type. For details, see the "Laser Probe Toolbox: Feature Extraction tab" topic in the PC-DMIS Laser documentation.
- **Hit Targets** tab - Use this tab to view the hits used to measure the feature and the XYZ values for each hit.
- **Measurement Strategies** tab - Use this tab to load different internal strategies for a specific type of Auto feature and change the way the feature executes.
- **Position Probe** tab - Use this tab to switch between existing configured probes and probe tips, view the current probe's location, access the Probe Readouts window, and remove probing hits from the hits buffer.

Working with Probe Position



Position Probe tab

The **Position Probe** tab (**View | Other Windows | Probe Toolbox**) lets you switch between existing configured probes and probe tips, view the current probe's location, access the Probe Readouts window, and remove probing hits from the hits buffer.

Changing the Current Probe

To use the Probe Toolbox (**View | Other Windows | Probe Toolbox**) to change the measurement routine's current probe:

1. Access the **Position Probe** tab.
2. Select the **Probes** list:



Probes list

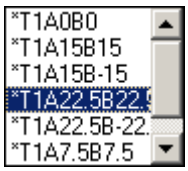
3. Select a new probe.

PC-DMIS inserts a `LOADPROBE` command for the selected probe into the measurement routine.

Changing the Current Probe Tip

To use the Probe Toolbox (**View | Other Windows | Probe Toolbox**) to change the measurement routine's current probe tip, do the following:

1. Access the **Position Probe** tab.
2. Select the **Probe Tips** list.



Probe Tips list

3. Select a new probe tip.

PC-DMIS inserts the `LOADPROBE` command for the selected probe into the measurement routine.

Viewing the Most Recent Hit in the Hits Buffer

Viewing the Last Hit

PC-DMIS displays the most recent hit stored in the hits buffer or the probe's current position on the **Position Probe** tab in the Probe Toolbox. In PC-DMIS CMM, these are read-only values.



Most recent hit information

Once you press End on your keyboard or DONE on your jog box, you accept the current feature that you are probing.

Moving the Animated Probe to a Specified Location

You can also change the XYZ and IJK values to show where a hit's location would be within the Graphic Display window and move the probe to that location. Type the desired values into the boxes, or click the small up and down arrows to increment a value along an axis. PC-DMIS moves the animated probe on the screen to that location.

Taking and Deleting Hits

To take a hit at the current probe's location, click the **Take a Hit** icon:



Take a Hit icon

PC-DMIS adds the hit into the hit buffer. This icon is enabled only when you use a defined hard probe.

To use the Probe Toolbox to delete a hit from the hit buffer, click the **Remove a Hit** icon:



Remove a Hit icon

If the Probe Readouts window is open, you'll notice the hit being deleted from the **Hits** portion of the window.

Accessing the Probe Readouts Window

To access the Probe Readouts window from the Probe Toolbox, click the **Probe Readouts** icon:



Probe Readouts icon

For information on the Probe Readouts window, see "Using the Probe Readouts Window" in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.

Placing the Probe into Readouts and Hits Mode

Some interfaces require that you toggle between Readouts and Hits Modes since these modes must operate exclusively from each other. This is due to the operation of these interfaces being in either a receiving state (Hits Mode - waiting for a hit signal) or a sending state (Readouts Mode - sending probe location data to the Probe Readouts window). An LK-RS232 interface is an example of this type of interface.

If you have an LK interface, from the **Probe Mode** toolbar, you can use the **Readouts Mode** icon to place the probe into Readouts Mode:



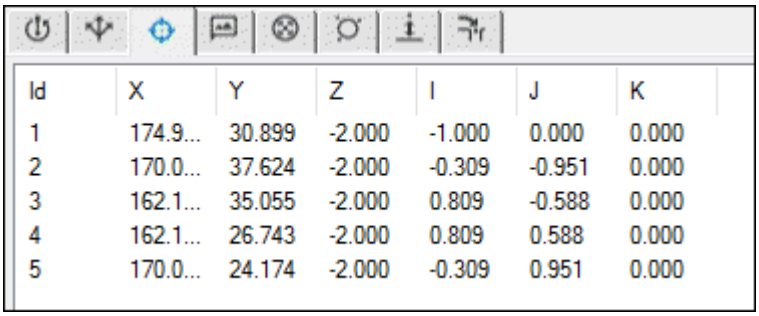
Readouts Mode icon

If you have an LK interface, from the **Probe Mode** toolbar, you can use the **Hits Mode** icon to place the probe into Hits Mode:



Hits Mode icon

Viewing Hit Targets

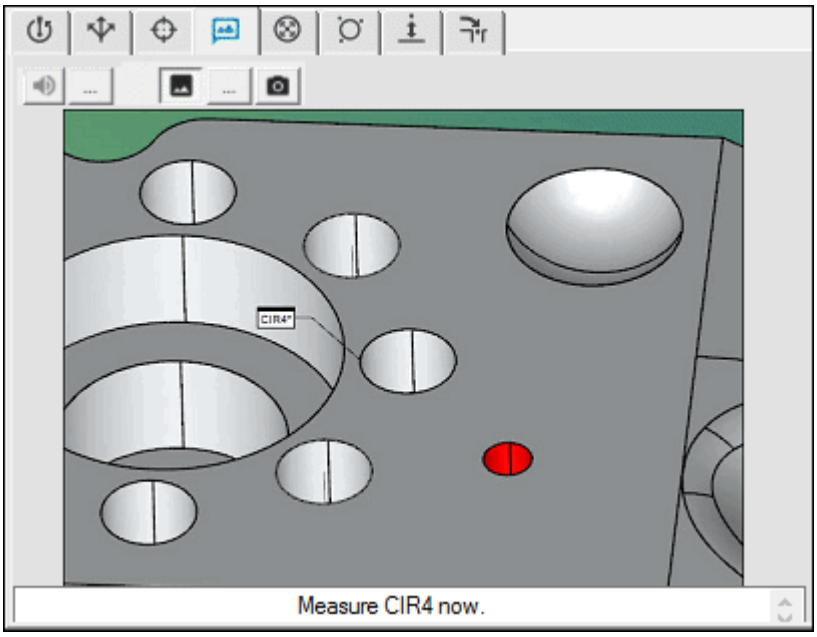


Id	X	Y	Z	I	J	K
1	174.9...	30.899	-2.000	-1.000	0.000	0.000
2	170.0...	37.624	-2.000	-0.309	-0.951	0.000
3	162.1...	35.055	-2.000	0.809	-0.588	0.000
4	162.1...	26.743	-2.000	0.809	0.588	0.000
5	170.0...	24.174	-2.000	-0.309	0.951	0.000

Probe Toolbox - Hit Targets tab

To view all the hits in the hits buffer, select the **Hit Targets** tab in the Probe Toolbox. PC-DMIS displays the XYZ and IJK data for each hit in the buffer. This read-only list changes dynamically as you take new hits or remove old hits from the hits buffer.

Providing and Using Feature Locator Instructions



Probe Toolbox - Feature Locator tab

You can use the **Feature Locator** tab in the Probe Toolbox to provide the operator with instructions for measuring the current auto feature. You may find this useful if your measurement routine requires some operator interaction in the Auto feature measurement (if the operator is working in Manual Mode, for example).

To provide these instructions, type textual descriptions, take screen shots of the feature, use pre-existing bitmap images, and use prepared audio files. If the operator displays the Probe Toolbox during measurement routine execution, but prior to the feature's execution, the instructions appear.

To Provide Feature Locator Instructions

1. Click the **Feature Locator** tab ( ) in the Probe Toolbox.
2. Add audio instructions.
    - Click the **Select Feature Locator WAV** icon ( ) next to the **Feature Locator WAV File** toggle icon ( ) to browse to the .wav file to associate with this Auto feature.
    - Click the **Feature Locator WAV** toggle icon ( ) to enable the playing of the audio file during measurement routine execution.
3. Add a bitmap image. You can either select a preexisting bitmap image or use a screen capture of the current Graphic Display window.

- To select a preexisting bitmap file, click the **Select Feature Locator BMP** icon ( ) next to the **Feature Locator BMP File** icon ( ). Browse to the .bmp file to associate with this Auto feature. Once you select it, a thumbnail of the selected image appears on the **Feature Locator** tab.
- To use a screen capture of the Graphic Display window, click the **Capture Feature Locator BMP** icon ( ). A thumbnail of the captured image appears on the **Feature Locator** tab. This file is indexed and saved in the PC-DMIS installation directory. For example, a measurement routine named bolthole.prg would yield bitmaps named bolthole0.bmp, bolthole1.bmp, bolthole2.bmp, and so on.
- Click the **Feature Locator BMP File** toggle icon ( ) to enable the display of the bitmap image during measurement routine execution.

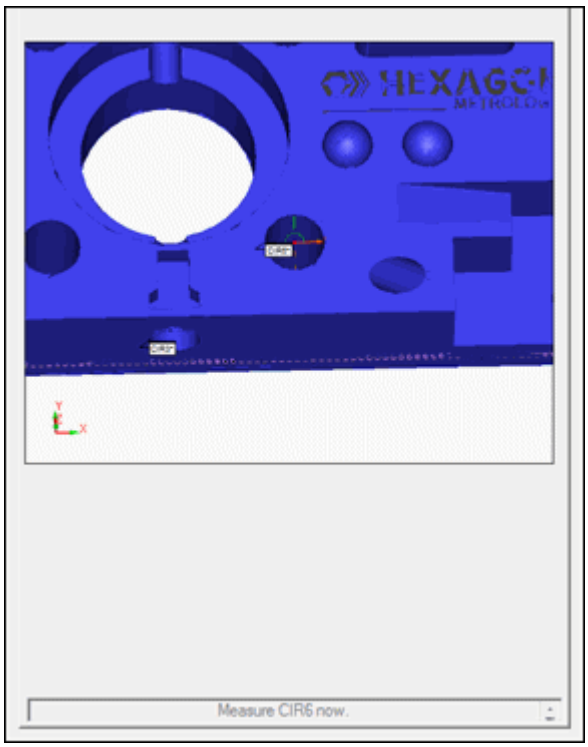
4. Add text instructions. In the **Feature Locator Text** box, type the textual instructions you want to display.
5. Click **Create** or **OK** to save the changes that you made in the **Auto Feature** dialog box.

To Use Feature Locator Instructions

1. Display the Probe Toolbox during execution. If the Probe Toolbox isn't visible during execution, the instructions do not appear. To display the Probe Toolbox, do the following:
   - Begin measurement routine execution.
   - Once the **Execution** dialog box appears, click the **Stop** button:

   - Select **View | Probe Toolbox** to display the toolbox.
   - Click the **Continue** button to proceed with the execution.
2. View the instructions. The instructions automatically appear on the **Feature Locator** tab in the Probe Toolbox when PC-DMIS begins to execute the feature:

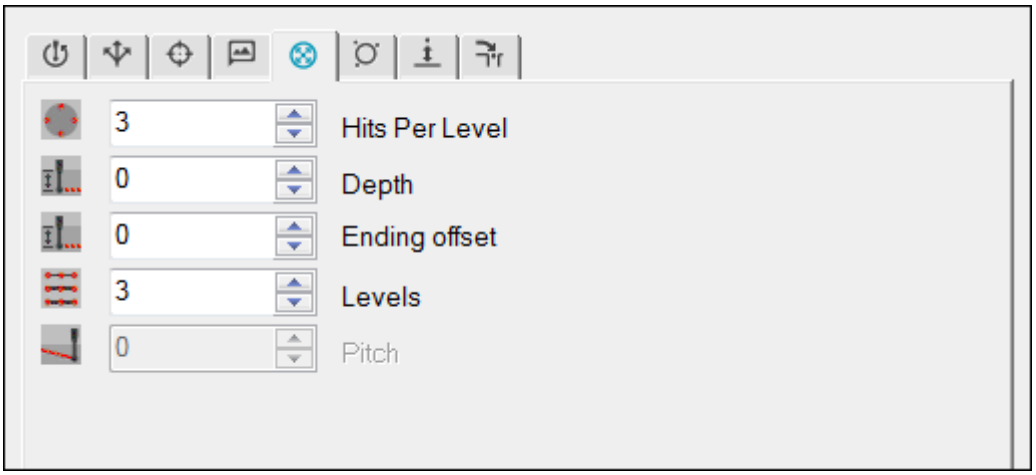


Feature Locator tab providing instructions during execution

- If you enabled audio, click the **Feature Locator WAV File** icon () as many times as you need to hear the instructions.
- In addition, you can drag the Probe Toolbox out onto the Graphic Display window and size it as desired.

3. Once the associated feature has been measured, PC-DMIS removes the **Feature Locator** tab with its instructions from the Probe Toolbox.

Working with Contact Path Properties



Probe Toolbox - Contact Path Properties tab

The **Contact Path Properties** tab becomes visible when you have the **Auto Feature** dialog box open (**Insert | Feature | Auto**) and a contact probe is enabled. This tab contains several items that you can use to change various hit properties for auto features that use contact probes.

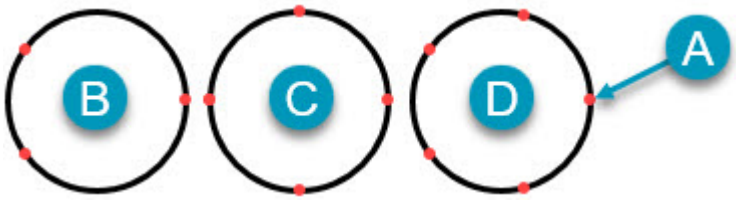
A useful way of visualizing how these properties affect the measurement is to display pathways and hits by using the **Show Hit Targets** icon .

Depending on the type of feature that you select in the **Auto Feature** dialog box, this tab may change to contain one or more of these items:

Hits

This item supports the Line, Circle, Ellipse, and Round Slot Auto features. It defines the number of hits that PC-DMIS uses to measure the feature. The number of hits that you specify are equally spaced between the start and end angles.

- Circle or Ellipse feature - If the start and end angles are the same or differ by a multiple of 360°, then only one hit is taken at the mutual start and end points.



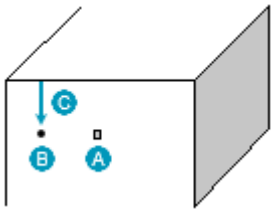
Location of hits
(A) - Start angle
(B) - 3 hits
(C) - 4 hits
(D) - 5 hits

- Round Slot feature - You must define a minimum of six hits. During execution, PC-DMIS maintains the hit distribution that was defined when you created the Round Slot feature.
- Line feature - You can type any number of hits. Depending on the type of line and the value you enter, PC-DMIS does the following:
  - *If you are creating a bounded line*, PC-DMIS uses the calculated length of the line and then spaces the number of hits equally along the line so that the first and last hits are at the start and end points.
  - *If it is an unbounded line*, PC-DMIS uses the typed length value and spaces the number of hits equally along the line's direction vector.

If you don't type a length value (or the value is zero), PC-DMIS uses the current probe tip's diameter as the distance between points.

Depth

This item supports the Edge Point, Line, Circle, Ellipse, Round Slot, Square Slot, Notch Slot, and Polygon Auto features. It defines where PC-DMIS takes hits on the feature itself and its surrounding sample hits.

Auto Feature	Description
Edge Point, Notch Slot	If you enter one, two, or three sample hits, then PC-DMIS applies the depth value from the measured surface value.  *Depth for an Edge Point Auto feature* ***A*** *- Target hit* ***B*** *- Sample hit* ***C*** *- Depth*

Circle, Ellipse, Round Slot, Square Slot, Polygon	For these features, PC-DMIS usually applies the depth value as a positive offset distance along the IJK centerline vector. The vector originates at each feature's center point. While the software allows negative depth values, this is not recommended for contact-based measurements of these features. For example, consider these two cases: • Case 1: If the nominal center point is at the base of the external feature, the depth is the distance from the bottom of the feature. • Case 2: If the nominal center point is at the top of the external feature, the depth is the distance from the top of the feature. A negative value in the first case causes the probe to move into the surface material surrounding the feature, possibly causing a collision. A negative value in the second case allows the probe to properly contact the feature. A positive depth value moves the probe above the feature where no material exists for the probe to contact. **Important Considerations:** *Centerline vector (IJK)*: The vector of the feature should point away from the plane in which the feature lies (2D feature). If sample hits are involved (for 2D or 3D features), that vector should reflect the approach vector for those sample hits. *Height or Length*: If the feature has a length or height with a negative value, PC-DMIS flips the vector orientation. The orientation of the vector along which the positive depth is applied (IJK') changes based on these conditions: *External features*: IJK' = IJK in case the feature has a Height or Length greater than or equal to zero. IJK' = -IJK in case the feature has a Height or Length less than zero.

	Internal features: The IJK' for internal features points in a direction opposite that of external features.
Line	The software applies the distance as a positive value along the perpendicular vector to the line vector and edge vector. The line's depth depends on the direction of the hits in relation to the current coordinate system. For example, if you have a typical orientation (X/Right, Y/Back, and Z/Up), and you take your first and second hits from left to right on the model, then you need to use a positive depth value. However, if you take your first and second hits from right to left on the model, then you need to use a negative depth value.

Starting Depth

This item supports the Cylinder and Cone Auto features.

- For features with multiple levels, it defines the starting depth of the first level of hits.
- It is an offset from the top of the feature.
- All other levels are equally spaced between the **Starting Depth** and **Ending Depth**.

Ending Depth

This item supports the Cylinder and Cone Auto features.

- For features with multiple levels, it defines the ending depth of the last level of hits.
- It is an offset from the bottom of the feature.
- All other levels are equally spaced between the **Starting Depth** and **Ending Depth**.

Ending offset

This item supports the Cylinder and Cone Auto features.

- It defines the location of the last row in combination with the length of a feature.
- If you do not define the length of the feature, then the value for **Ending offset** references the last row.

Starting with PC-DMIS 2023.2, for the Cylinder Auto feature, PC-DMIS performs a smart calculation of the Ending Offset parameter. This is only available when you load a CAD model.

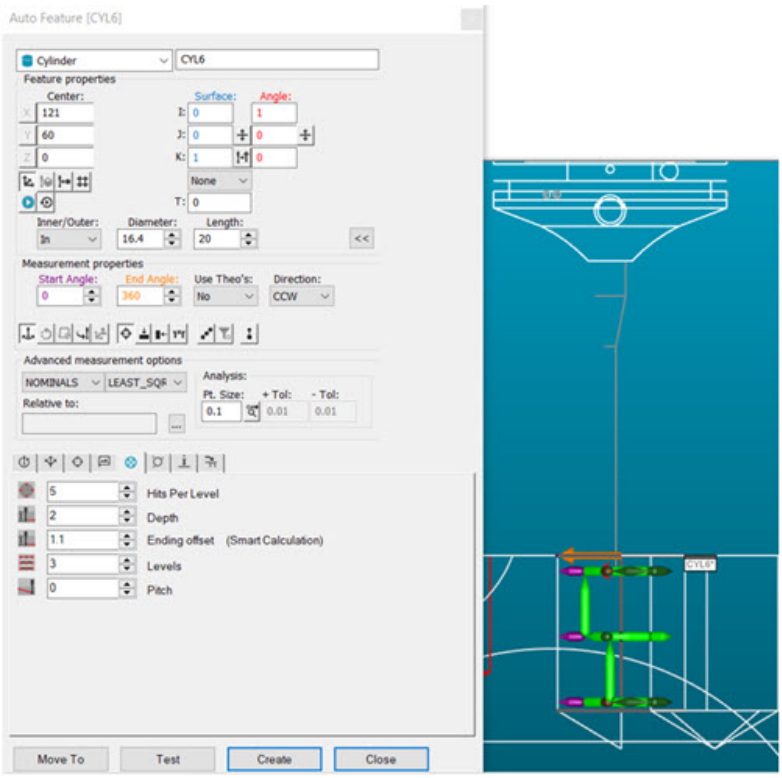
Once you click to select a Cylinder, PC-DMIS:

- Performs a smart calculation of the Ending Offset parameter
- Populates the related fields in the **Auto Feature** dialog box with values that are attainable by the currently loaded probe and tip combination
- Draws the related hit targets

The Cylinder feature makes use of the Auto Wrist feature because the smart calculation of the Ending Offset assumes that the position of the tip is oriented along the cylinder's axis. Whether you accept the proposed tip or you select your own tip from the **Auto Wrist** dialog box, the hit targets always refer back to this assumption.

You can always edit the smart calculation value.

You can see the **Ending offset** value from the smart calculation in the bottom section (the Probe Toolbox section) of the **Auto Feature** dialog box below. You can also see the resulting hit targets in the Graphic Display window based on the smart calculation of the Ending Offset:



Hits (Total)

This item supports the Sphere Auto feature.

- It is the same as the description for **Hits**, except that it defines the total number of hits the software uses to measure the feature among all available rows.
- You need at least four hits to measure a sphere.

Hits Per Level

This item supports the Cylinder and Cone Auto features.

- It defines the number of hits per level the software uses to measure the feature.
- A value of four would mean four hits per level.



At least six hits and two levels are necessary to measure a cylinder or cone (three hits at each level).

Hits Per Row or Hits per Ring

This item supports the Plane Auto feature.

- It defines the number of hits taken per row or ring on a Plane feature.
- The software uses rows on square patterns.
- The software uses rings on radial patterns.
- For more information, see "Pattern list" in the "Creating Auto Features" chapter in the PC-DMIS Core documentation.
- You must use a minimum of three hits to measure a plane.

Hits Per Side

This item supports the Polygon Auto feature. It defines the number of hits taken per side on a Polygon feature.

Levels

This item supports the Cylinder, Cone, and Sphere auto features. It defines the number of levels the software uses to measure the feature. You can use any integer greater than one. The software places the first level of hits at the **Starting Depth** and the last level of hits at the **Ending Depth**.

- For a cylinder or cone, the software equally spaces the levels between the **Starting Depth** and **Ending Depth** of the feature.
- For a sphere, the software equally spaces the levels between the **Start Angle 2** and **End Angle 2** value in the **Auto Feature** dialog box.
- For a plane, the number of levels and the number of hits determine how many total hits the software uses to generate the auto plane.

Pitch

This item supports the Circle and Cylinder Auto features. For threaded holes and studs, the **Pitch** value (also known as "threads per inch") defines the distance between threads along the axis of the feature. This allows for more accurate measurements of threaded holes and studs. If the value is anything other than zero, PC-DMIS staggers the feature's

hits along the feature's theoretical axis, spacing them around the feature using the **Start Angle** and **End Angle** values in the **Auto Feature** dialog box.



For details on pitch values for various thread sizes, please consult an appropriate authority (such as the ASME standard).

- Circle feature - To follow a standard (clockwise) thread pattern, you need to reverse the starting and ending angles (for example, 720 - 0) and in order to cause the measurement to reverse from a rising pitch to a falling pitch (up/down), you need to negate the value of the pitch.

  Example: If measuring a circle with four hits equally spaced around the circle:

  - The first hit is at the starting angle at the input depth.
  - The second hit is at a 90-degree rotation to the first and at a depth of (Depth – ((hitnum-1)/tothits * pitch)).
  - The third hit would be 180-degree rotation from the first hit with a depth of (Depth – ((hitnum-1)/tothits * pitch)).
  - The remaining hits follow this same pattern.

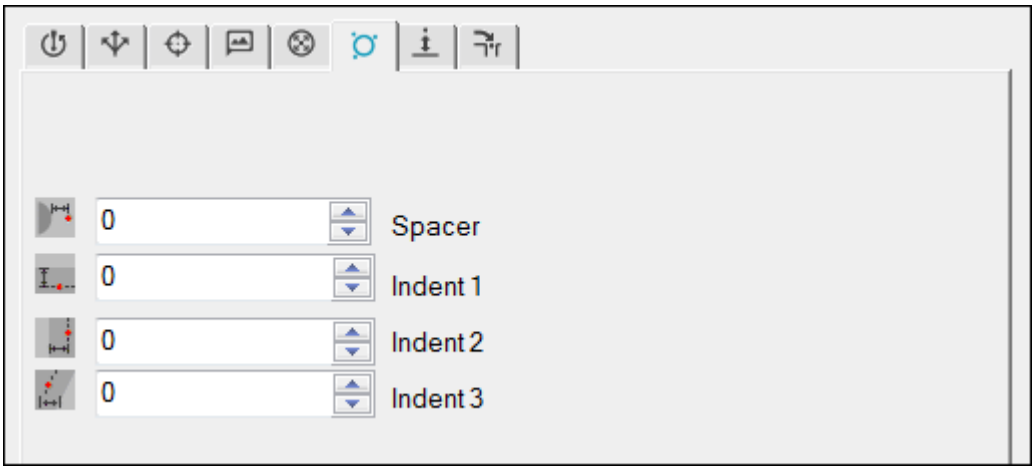
- Cylinder feature - Example: Suppose you measure a cylinder with two levels of four hits equally spaced around the cylinder:

  - The first hit in each level is at the starting angle at the input depth.
  - The second hit is at a 90-degree rotation to the first hit and a depth of (Depth - (hitnum-1)/# hits per level * pitch).
  - The third hit would be 180-degree rotation from the first hit with a depth of (Depth - (hitnum-1)/# hits per level * pitch).
  - The remaining hits follow this same pattern.

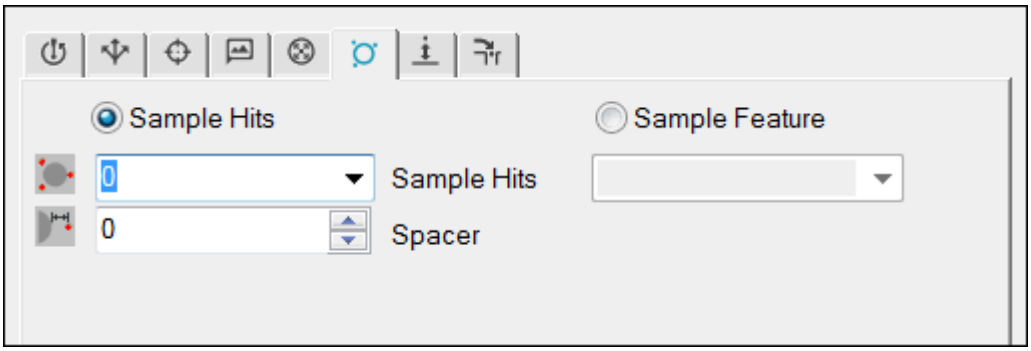
Rows

This item supports the Plane and Sphere Auto features. It defines the number of rows that the software uses to measure the feature.

Working with Contact Sample Hits Properties



Probe Toolbox - Sample Contact Sample Hits Properties tab for a Corner Point Auto feature



Probe Toolbox - Sample Contact Sample Hits Properties tab for a Circle Auto feature

The **Contact Sample Hits Properties** tab becomes visible when you have the **Auto Feature** dialog box open and a contact probe is active. This tab contains items that allow you to change the sample hits or sample feature properties for Auto features that use contact probes.

About Sample Hits and Sample Features

Sample hits measure the surface around the nominal point location, providing a sampling of the surrounding material. This serves the following purposes:

- To adjust the path of the feature - Because sheet metal parts can bend or flex, their measured location can differ quite a bit from the nominal. Sample hits can account for this by adjusting the path of a feature so that the hits are taken at the feature's correct location on the part.
- To change the plane that the feature is projected onto - All Auto features that use sample hits are projected onto the plane generated from the sample hits. The reason

for this is sometimes the nominal location for a feature does not lend itself to a good hit.



Suppose you want to measure the very top of a hole as a Circle feature. Trying to actually take hits on the lip of that hole would result in unreliable hit data. You can use a projected plane to solve this problem which automatically projects more reliable hits taken below the surface onto that plane.

A sample feature does the same thing as sample hits, but it provides you with an added benefit of measuring and using a single feature as the feature to project onto instead of using sample hits for each feature.



Suppose you have 10 holes to measure, but you don't need sample hits for each individual circle. You could define a single plane feature as a reference feature. PC-DMIS can measure that plane once and project all the circles' measured hits onto that plane, saving time usually taken by sample hits.

These Auto features support projection features: Surface Point, Circle, Cone, Cylinder, Ellipse, Polygon, Round Slot, Square Slot, and Line.

With sample hits and sample features, you can only use one or the other, not both. They both accomplish the same thing.



A useful way of visualizing how these sample hit properties affect the measurement is to display path lines and hits by using the **Show Hit Targets** icon ().

How the Number of Sample Hits Affects the Measurement

The number of sample hits determines whether PC-DMIS adjusts only the location (offset) of the feature or both the location and the orientation (vector):

- **0 sample hits** - PC-DMIS measures the feature at its programmed depth, projecting the feature onto its nominal plane along the nominal vector. PC-DMIS adjusts neither the offset nor the vector.
- **1 sample hit** - PC-DMIS uses the deviation between the sample hit's nominal and measured location to adjust the depth (offset) at which it measures the feature. This lets the feature be measured at its correct location on the part, such as on a thin or flexible sheet metal part. PC-DMIS does *not* change the feature's vector; it still measures the feature along the nominal vector.

- **3 or more sample hits** - PC-DMIS adjusts the offset as described above, and it also uses the measured sample hits to adjust the feature's vector (orientation). PC-DMIS then measures the feature relative to the measured sample plane. This lets the feature follow both the position and the orientation of the actual part.



Because three or more sample hits reorient the feature to the measured sample plane, PC-DMIS takes the hits that measure the feature relative to that plane rather than along the feature's nominal vector. This is the intended behavior, and it lets features follow the surface on parts that bend or flex. However, when the actual surface is tilted relative to the feature (for example, a cylinder whose axis is not perpendicular to the sample plane), the adjusted approach direction can differ noticeably from the nominal. In that situation, if you need PC-DMIS to measure the feature along a specific vector, use fewer sample hits or a sample feature.

Depending on the type of feature in the **Auto Feature** dialog box, this tab may change to contain one or more of the following items.

Sample Hits

This item supports the Surface Point, Edge Point, Angle Point, Line, Circle, Ellipse, Round Slot, Square Slot, Notch Slot, Polygon, Cylinder, Cone, and Sphere Auto features. Choosing this item enables the **Sample Hits** list and disables the **Projection Feature** items. You can use the **Sample Hits** list to select the number of sample hits taken for the Auto feature. These hits are used to measure the plane around the nominal point location, providing a sampling of the surrounding material. These are permanent sample hits. For more information on sample hits, see "Sample Hits - Feature Specific Information".

Sample Hits Init

This item supports the Surface Point, Edge Point, Angle Point, Line, Circle, Ellipse, Round Slot, Square Slot, Notch Slot, Polygon, Cylinder, Cone, and Sphere Auto features. By default, this list does not appear in the user interface because initial sample hits are used so infrequently. You can turn it back on using the `PTPSupportsSampleHitsInit` entry in the PC-DMIS Settings Editor.

You can use this item to specify initial sample hits. The initial sample hits are taken only on the initial measurement of the feature during execution of the measurement routine.

Spacer

This item supports the Surface Point, Edge Point, Angle Point, Line, Corner Point, Plane, Circle, Ellipse, Round Slot, Square Slot, Notch Slot, Polygon, Cylinder, and Cone Auto features. It defines the distance from the nominal point location that PC-DMIS uses to measure a plane if sample hits are specified. For more information, see "Spacer - Feature Specific Information".

Indent

This item supports the Edge Point and Notch Slot auto features. For an Edge Point, it defines the minimum offset distance from the point location to the first sample hit. For a Notch Slot, it defines the distance from the closed side of the notch (opposite the open edge). See "Indent - Feature Specific Information".

Indent 1

This item supports the Angle Point, Line, and Corner Point Auto features. For an Angle Point and Corner Point, it defines the minimum offset distance from the feature's center location to the first of two or three sample hits. For a Line, it defines the offsets distance from the line's end points to the second and third sample hits when three sample points are defined. See "Indent - Feature Specific Information".

Indent 2

This item supports the Angle Point, Line, and Corner Point Auto features. For an Angle Point and Corner Point, it defines the minimum offset distance from the feature's center location to the second of two or three sample hits. For a Line, it defines the offset distance from the line's midpoint to the first sample hit. See "Indent - Feature Specific Information".

Indent 3

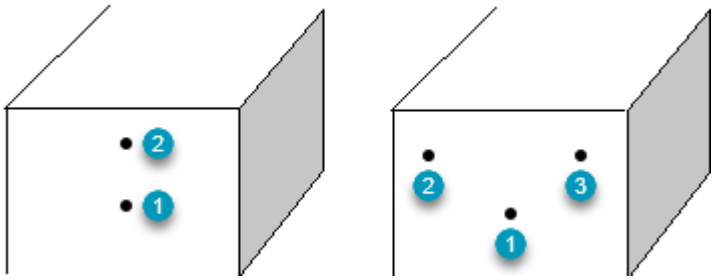
This item supports the Corner Point Auto feature. It defines the minimum offset distance from the feature's center location to the third of three sample hits. See "Indent - Feature Specific Information".

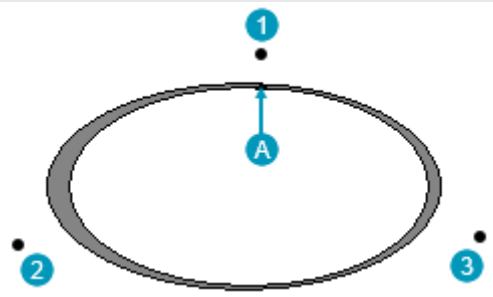
Sample Feature

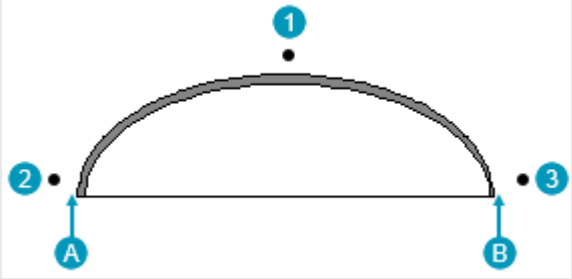
The **Sample Feature** item supports the Surface Point, Circle, Cone, Cylinder, Ellipse, Polygon, Round Slot, Square Slot, Notch, and Line Auto features. It enables the feature list below it and disables the **Sample Hits** items. The feature list contains all the existing features in your measurement routine that you can use as a sample feature. The current feature's hits are projected onto the selected feature. If set to **<None>**, no projection takes place.

Sample Hits - Feature Specific Information

Auto Feature	Sample Hits Description

Angle Point	The sample hits are used on each surface. PC-DMIS measures the point depending on the selected value. For example, if you select: • **2**, the hits are taken in a line perpendicular to the edge vector. • **3**, the hits form a plane on each surface as indicated in the drawing.  *Two and three sample hits for an Angle Point Auto feature*

Circle, Cone, or Cylinder	The defined sample hits are used to measure the surface normal to the feature. They are equally spaced between the indicated starting and ending angles. PC-DMIS measures the feature depending on the selected value: • If Type = HOLE, and you select **0**, PC-DMIS does not take any sample hits. • If Type = STUD, and you select **0**, PC-DMIS does not take any sample hits. PC-DMIS then treats the **Height** value as if the feature were a HOLE instead of a STUD. • If Type = HOLE, and you select **1**, PC-DMIS takes the hit on the outside of the feature. • If TYPE = STUD, and you select **1**, PC-DMIS measures the point on the top of the stud. • If you select **3**, PC-DMIS measures the surface at three equally spaced hits starting from the starting angle. The sample hits are relative to the measured plane, and any values are offset from these points. A single sample hit adjusts only the depth (offset) where PC-DMIS measures the feature; it does not change the feature's vector. Three sample hits also adjust the feature's vector, so PC-DMIS measures the feature relative to the measured sample plane. For example, if the sample plane is tilted relative to the cylinder axis, PC-DMIS takes the hits relative to that tilt rather than along the nominal axis. For more information, see "How the Number of Sample Hits Affects the Measurement" above.  ***A** - Start angle and end angle*

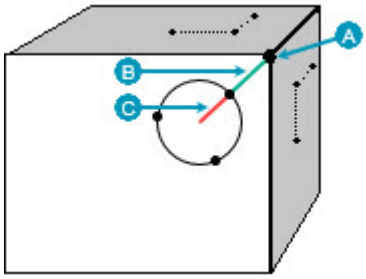


***A** - Start angle*
***B** - End angle*

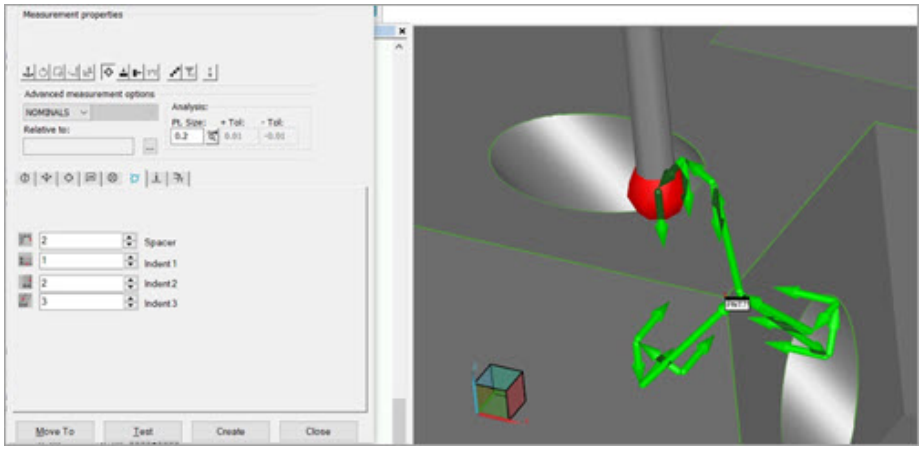
> PC-DMIS expects the X, Y, Z nominal of the stud to be at the base. If the center point is at the top of the stud, set the depth and spacer to a negative value.

Corner Point

The SPACER value defines the radius of the circular pattern of the three hits. PC-DMIS centers the circular pattern at the INDENT + SPACER location for each surface.

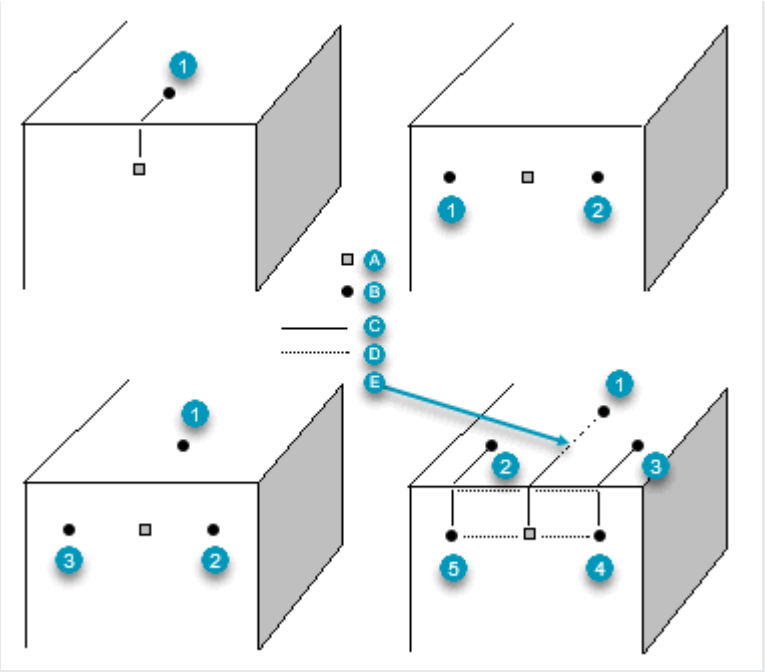


A - Target corner
B - Indent
C - Spacer



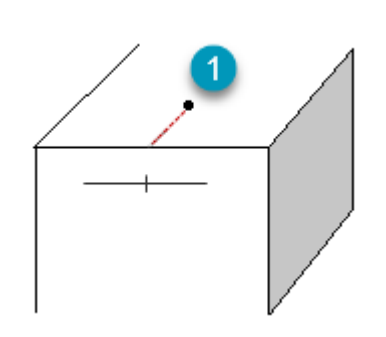
Example of Corner Point Auto feature sample hits in PC-DMIS

Edge Point	PC-DMIS measures the point depending on the selected value. For example, if you select: • **0**, PC-DMIS measures the point at the specified nominal approach and normal vectors. • **1**, PC-DMIS measures a point on the normal surface. It projects the edge onto the nominal surface through this point. Any DEPTH = values are offset from the point. • **2**, PC-DMIS measures two sample hits on the edge along the specified nominal approach direction. PC-DMIS then uses these hits to calculate a new approach vector for the actual point measurement along the edge. • **3**, PC-DMIS measures the point with the combined methods of using one and two sample hits respectively. This measurement method is commonly known as a "Flush and Gap" measurement point. • **4**, PC-DMIS measures the three sample hits on the normal surface and adjusts the surface normal vector. The edge measurement then projects onto this new nominal surface. Any DEPTH = values are offset from the point. Finally, the point is measured along the approach vector. • **5**, PC-DMIS measures the point by taking three hits on the normal surface and two hits on the edge along the specified nominal approach direction. This method of measurement is considered the most accurate.



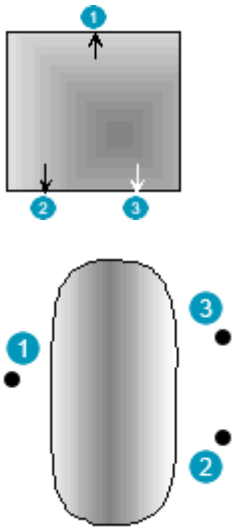
Various sample hits for Edge Point Auto features
***A** - Target hit*
***B** - Sample hits*
***C** - Indent*
***D** - Spacer*
***E** - Indent + Spacer*

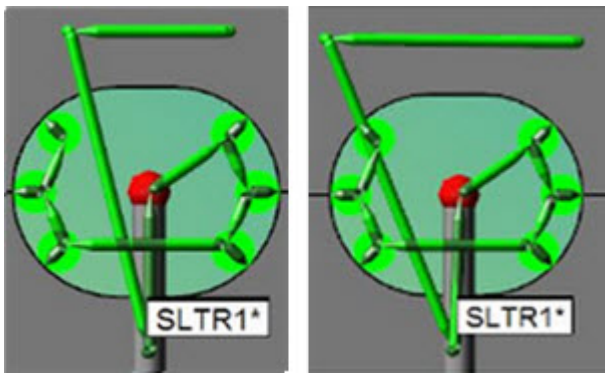
Ellipse	The only acceptable values are zero, one, and three. The measured plane is used as the centerline vector for projection and measurement depth purposes. PC-DMIS measures the ellipse depending on the entered value. For example, if you selected: • **0**, PC-DMIS measures the indicated ellipse. No sample hits are taken. • **1**, PC-DMIS takes a single sample hit at the location where the ANGLE VEC points to (i.e. 0° + SPACER), not at the center of the ellipse (being particularly difficult should the ellipse be a hole). • **3**, PC-DMIS measures the surface at points outside (or inside) the ellipse at the indicated distance from the outer edge (**Spacer** value). The first hit is at the indicated start angle. Hit number two is halfway between the start angle and end angle. The last hit is at the end angle. The hits are relative to the measured plane, and any values are offset from these points.  To take the hit on the opposite side of the ellipse, reverse the centerline vector.

Line	PC-DMIS measures the line depending on the selected value. For example, if you select: • **0**, PC-DMIS measures the indicated line. No sample hits are taken. • **1**, PC-DMIS measures a single sample hit, first on the closest adjoining surface to the line's location. Then the line's points are measured. The sample hit's initial position is based off of the midpoint of the line. • **3**, PC-DMIS measures three sample hits, first on the closest adjoining surface to the line's location. Then the line's points are measured. The sample hits' initial positions are based off of the midpoint, start point, and end point of the line.  *One and three sample hits for a Line Auto feature. The indent 1 (for points 2 and 3) and indent 2 (for point 1) values should not be identical.*

Notch Slot	The sample hits also define the edge for the angle vector and width. The *only* acceptable values are zero through five. The measured plane is used as the centerline vector for projection and measurement depth purposes. PC-DMIS measures the notch depending on the entered value. For example, if you selected: • **0**, PC-DMIS measures the indicated notch. No sample hits are taken. • **1**, PC-DMIS measures the surface at the edge of the notch. • **2**, PC-DMIS measures the edge along the open side of the notch. This defines the angle vector and is used to find the width of the notch. • **3**, PC-DMIS measures the surface at one end of the notch with two hits and one hit at the other end of the notch. The notch hits are relative to the measured plane, any values are offset from these points. • **4**, PC-DMIS measures the surface the same as three sample hits. A fourth hit is taken on the edge, along the open side in order to find the width of the notch. • **5**, PC-DMIS measures the surface the same as three sample hits. It also measures the edge along the open side in the same manner as two sample hits.

Polygon	PC-DMIS measures the polygon depending on the selected value. For example, if you select: • **0**, PC-DMIS measures the indicated polygon. No sample hits are taken. • **1**, PC-DMIS takes a single sample hit at the location to which the Angle vector points (i.e. 0° + SPACER).  *Example Polygon Auto feature (hexagon) with one sample hit* • **3**, PC-DMIS takes the three sample hits in a triangular position on the surface around the polygon if an internal polygon, or on the surface of the polygon itself if an external polygon. The first hit is always at the location to which the Angle vector points.  *Example Polygon Auto feature (hexagon) with three sample hits*

Round Slot or Square Slot	The measured plane is used as the centerline vector for projection and measurement depth purposes. PC-DMIS measures the slot depending on the entered value. For example, if you select: • **0**, PC-DMIS measures the indicated slot. No sample hits are taken. • **1**, PC-DMIS measures the surface at the center of the slot. The slot hit is to the right of the vector. • **3**, PC-DMIS measures the surface at three equally-spaced hits, starting from SLOT A. The slot hits are relative to the measured plane, and any values are offset from these points.  *Sample hits of three hits for a Square Slot Auto feature (top diagram) and a Round Slot Auto feature (bottom diagram)* To take the hits on the opposite side of the slot, reverse the centerline vector. **Change to Sample Hit Pattern of Round and Square Slots in PC-DMIS v2015 and Later** In PC-DMIS v2015 and later, the method for distributing the sample hit pattern for round and square contact slots changed. Two of the hits along the same line along the edge of the slot are now spaced the full length of the slot.



Example 3-hit sample hit pattern (Legacy on left, v2015 and later on right)

The change of the sample hit pattern for round and square slots is applied only when the following conditions are met:

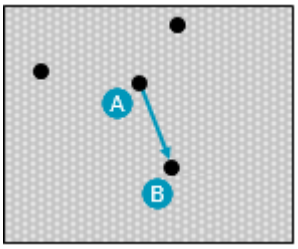
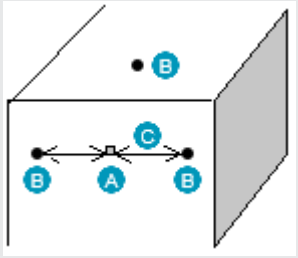
- The slot is an Inner Slot.
- If the slot is an Outer Slot with a Positive Spacer. (Outer slots with a negative spacer can only use the legacy pattern for sample hits.)

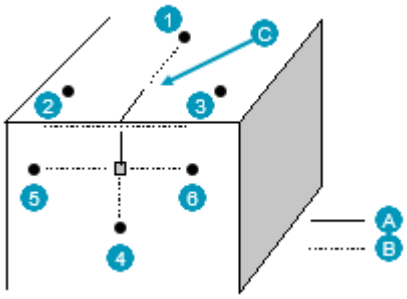
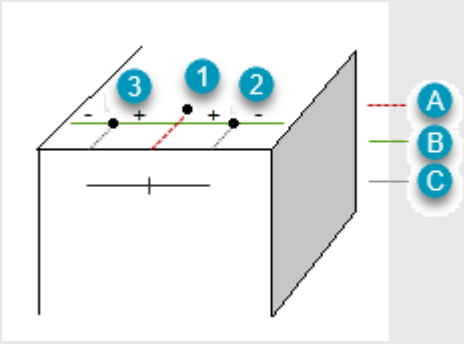
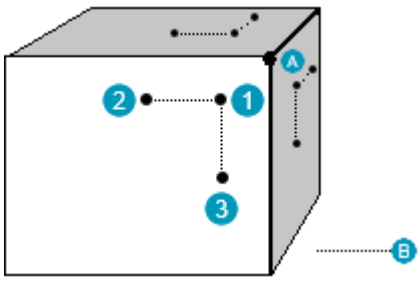
Measurement routines created in versions prior to v2015 that contain round or square slots retain the legacy pattern for sample hits. The exception is if you make relevant changes to the slot values requiring a path recomputation from the dialog box that appears after you press the F9 key.

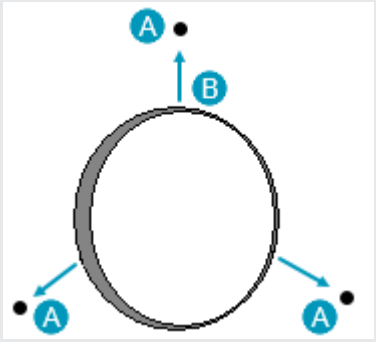
Sphere	For a sphere, you can only select one sample hit. When you select this sample hit, PC-DMIS follows this procedure once you execute the measurement routine: 1. Automatic measurement stops prior to measuring the sphere. 2. PC-DMIS requests that you take one hit normal to the direction the sphere should be measured. 3. After you take the sample hit, click **Continue**. 4. PC-DMIS then takes three more hits on the sphere in an area determined by the spacer. PC-DMIS takes these four hits and uses the calculated sphere location to measure the sphere with the given number of hits, rows, and angles.

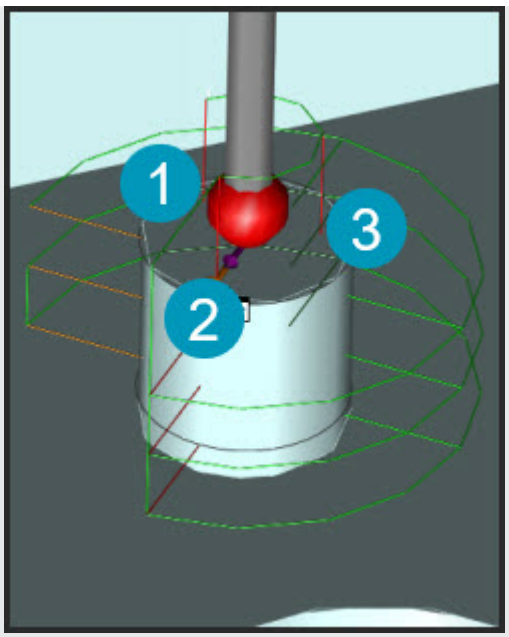
Surface Point	PC-DMIS measures the point depending on the selected value. For example, if you select: • **0**, PC-DMIS measures the point at the nominal approach vector specified. • **3**, PC-DMIS measures a plane around the nominal point location and uses the surface normal vector from the three measured hits to approach the nominal point location.

Spacer - Feature Specific Information

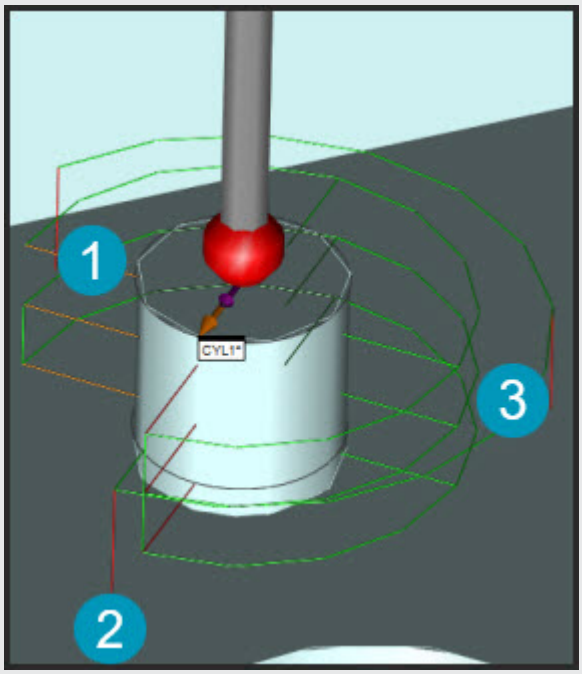
Auto Feature	Spacer Description
Surface Point	The **Spacer** box defines the radius of the circle on which the nominal (A) and the sample points (B) lie.  *Nominal and sample points*
Edge Point	The **Spacer** box defines the radius of an imaginary circle on which the nominal and the sample points lie.  ***A*** *- Target hit* ***B*** *- Sample hits* ***C*** *- Spacer distance*

Angle Point	The **Spacer** box defines the offset distance between the points on each side of the bend.  ***A*** *- Indent* ***B*** *- Spacer* ***C*** *- Indent + Spacer*
Line	The **Spacer** box defines the distance away from the original locations for points 2 and 3 when three sample points are defined. A positive value moves the points towards each other, while a negative value moves them further away.  ***A*** *- Indent 2* ***B*** *- Spacer* ***C*** *- Indent 1* If a single sample point is used, it does nothing.
Corner Point	The **Spacer** box defines the distance from the radius of the first hit to the other hits.  ***A*** *- Target corner* ***B*** *- Spacer*

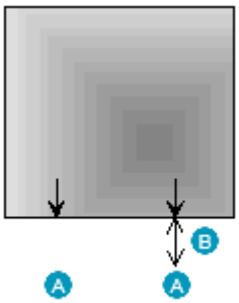
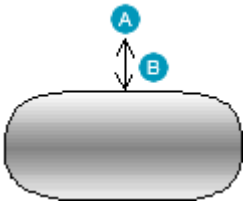
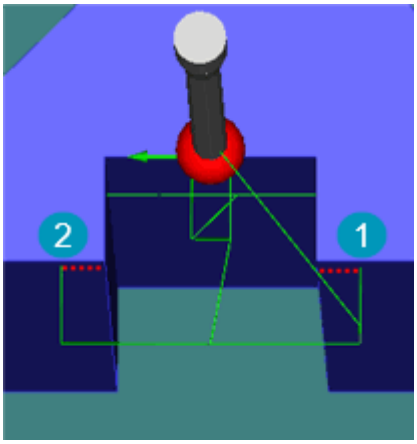
Circle, Cylinder, or Cone	The **Spacer** box defines the distance from the circumference of the circle to the sample hits.  ***A*** *- Sample hits* ***B*** *- Spacer* Notes for Outer Cylinders (studs): • Clearance planes are not used when taking sample hits. When measuring studs, it is important to set the spacer value to a distance that allows the probe to move around the stud. • PC-DMIS expects the X, Y, Z nominal of the stud to be at the base. If the nominal center point is at the top of the stud, set the depth and spacer to a negative value. • If you set the spacer to a negative number, the spacer distance is towards the nominal center point, away from the cylinder's edge. This causes the sample hits to be taken on top of the cylinder. If a positive spacer value is used instead, the spacer is on the surface of the surrounding part.

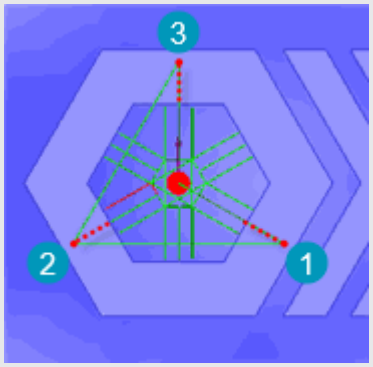


This stud has a top nominal point and a negative spacer value. The three sample hits (indicated by the red lines) are taken on top of the Cylinder Auto feature.

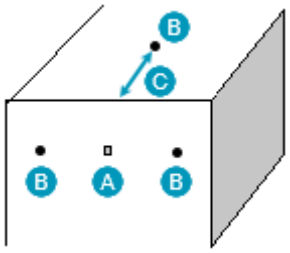


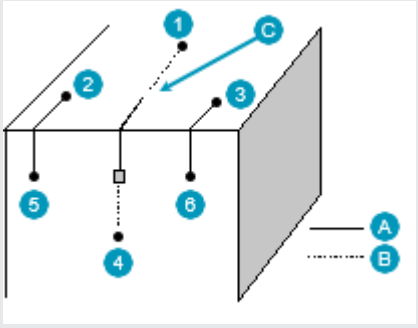
This stud has a top nominal point and a positive spacer value. The three sample hits are taken on the surface around the Cylinder Auto feature.

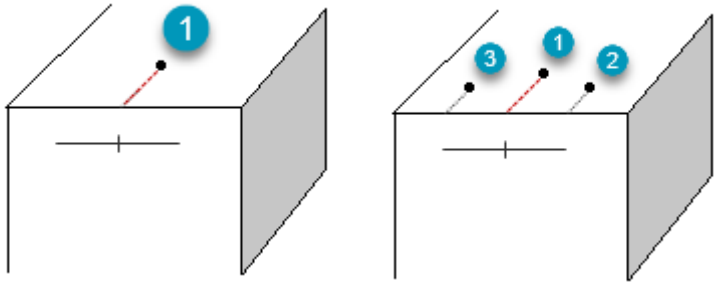
Square Slot, Round Slot, or Ellipse	The **Spacer** box defines the distance from the outer edge of the feature to the sample hit (or hits).  *Spacer for a Square Slot or Notch Auto feature (top)*  *Spacer for a Round Slot Auto feature* ***A** - Sample hits* ***B** - Spacer*
Plane	The **Spacer** box defines the distance between the hits making up the plane.
Notch Slot	The **Spacer** box defines the distance from the edges of the notch where the sample hits are taken.  *Spacer (dotted lines) for a Notch Slot Auto feature with two sample hits*

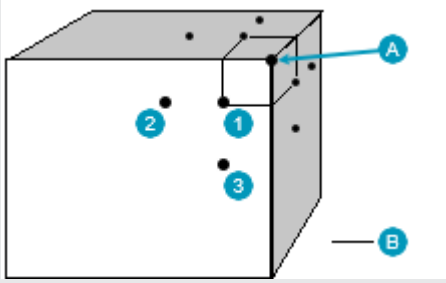
Polygon	The **Spacer** box defines the distance from the edges of the polygon where the sample hits are taken.  *Spacer (dotted lines) for a Polygon Auto feature with three sample hits (larger dots)*

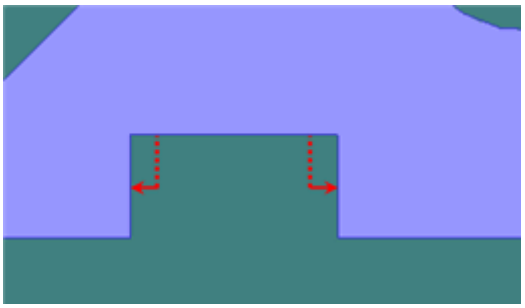
Indent - Feature Specific Information

Auto Feature	Indent Description
Edge Point	The **Indent** box displays the minimum offset distance from the point location to the first hit on each side of the bend (or edge).  *Offset distance from edge* ***A** - Target hit* ***B** - Sample hits* ***C** - Indent*

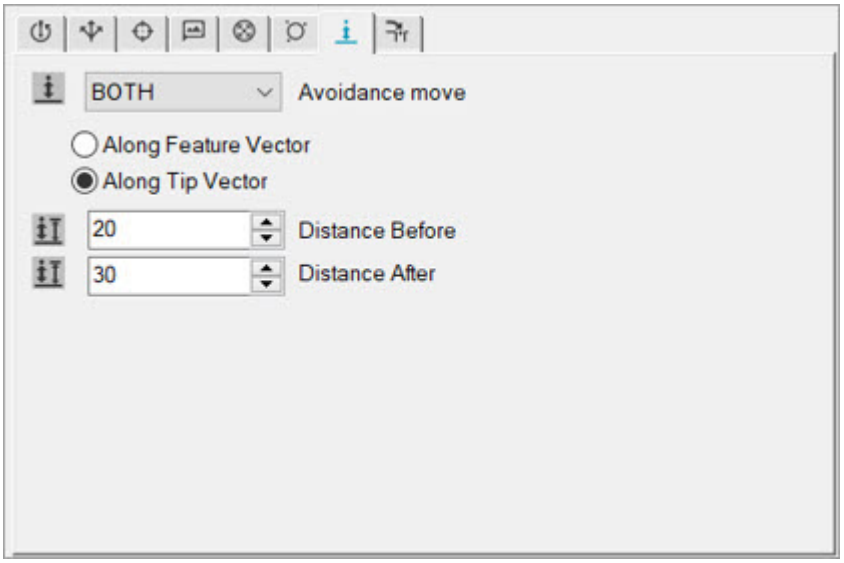
Angle Point	PC-DMIS provides two indent boxes, **Indent 1** and **Indent 2**, in order to set the offset distances from the point location to the sample hits on each of the two surfaces of the bend in an angle point.  *Indent in an Angle Point Auto feature* ***A** - Indent* ***B** - Spacer* ***C** - Indent + Spacer* • The **Indent 1** box sets the offset distance from the point location to the sample hits on the *first* surface of the bend. • The **Indent 2** box sets the offset distance from the point location for the sample hits on the *second* surface of the bend.

Line	PC-DMIS provides two indent boxes, **Indent 1** and **Indent 2**, to set the offset distances for the one or three sample hits for a line.  *Indents in a Line Auto feature* • The **Indent 1** box defines the offset distance from the edge on the sample surface for points 2 and 3. • The **Indent 2** box defines the offset distance from the edge on the sample surface for point 1. The values for Indent 1 and Indent 2 must be different in order to yield a proper sample plane.

Corner Point	PC-DMIS provides three indent boxes, **Indent 1** and **Indent 2**, and **Indent 3** in order to set the offset distances from the point location to the sample hits on each of the three surfaces of the bend in a corner point. • The **Indent 1** box sets the offset distance from the point location to the sample hits on the *first* of the three planes. • The **Indent 2** box sets the offset distance from the point location to the sample hits on the *second* of the three planes. • The **Indent 3** box sets the offset distance from the point location to the sample hits on the *third* of the three planes.  *Indent for a Corner Point Auto feature. For one of the surfaces, 1 shows the indent point, 2 and 3 are the sample hits* ***A** - Target corner* ***B** - Indent*

Notch Slot	The **Indent** box defines where along the two parallel sides of the notch PC-DMIS takes the hits. It is the distance from the closed side of the notch, moving towards the open side.  *Indent for a Notch Slot Auto feature (dotted lines)* If you click on the CAD to automatically create the Notch Slot, PC-DMIS automatically generates the indent value based on the size of your probe tip. You can later modify this if desired. • If your tip radius multiplied by the `NotchSafetyFactor` entry is greater than the notch's width, PC-DMIS displays a warning message telling you your tip radius is too large. • To generate correct measurement results, your probe's tip size multiplied by the `NotchSafetyFactor` entry should be less than the notch's width.

Working with Contact Auto Move Properties



Probe Toolbox: Contact Auto Move Properties tab

This tab becomes visible when you have the **Auto Feature** dialog box open and you enable a contact probe.

The **Contact Auto Move Properties** tab contains items that allow you to change Auto Move properties for Auto Features that use contact probes.

You define the `AVOIDANCE MOVE` command from the **Contact Auto Move Properties** tab of the **Probe Toolbox**. From this tab, you define the type of avoidance move from the **Avoidance move** list, the approach that you want the tip to take and the amount to move before and after you create the Auto feature.

A useful way of visualizing how these properties affect the measurement is to display pathways and hits with the **Show Hit Targets** icon ().

Auto moves are special moves added to your feature's path lines to help PC-DMIS avoid driving the probe through your feature when it actually measures.

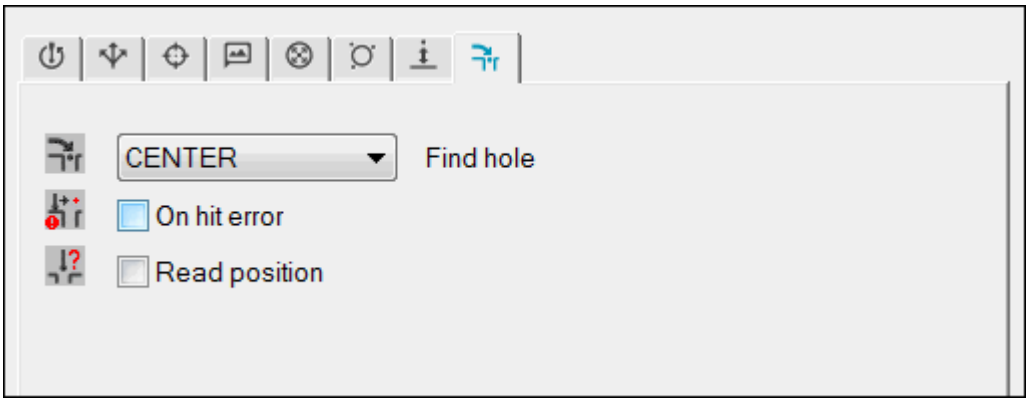
This tab also controls the distance away from voids that measurements are allowed. This tab contains the following items.

Item	Description

Avoidance move	This list lets you choose the type of avoidance move for your current Auto feature. This list contains these items: **NO** - PC-DMIS does not perform any avoidance move. This option sets the `PTP_AvoidMove` setting entry to 0 (zero). **BOTH** - PC-DMIS performs both the **Distance Before** and **Distance After** moves. This option sets the `PTP_AvoidMove` setting entry to 1. • The probe moves to a distance defined by the value set by the `PTP_AutoMoveDistance` setting entry above the centroid *before* it takes the first hit of the feature being created. • The probe moves to the distance defined by the value set by the `PTP_AutoMoveDistance2` setting entry *after* it takes the last hit of the feature being created. **BEFORE** - PC-DMIS only performs the **Distance Before** move where the probe moves to a distance defined by the `PTP_AutoMoveDistance` entry above the centroid *before* it takes the first hit of the feature being created. This option sets the `PTP_AvoidMove` setting entry to 2. **AFTER** - PC-DMIS only performs the **Distance After** move where the probe moves to the distance defined by the `PTP_AutoMoveDistance2` entry *after* it takes the last hit of the feature being created. This option sets the `PTP_AvoidMove` setting entry to 3. For details on the Auto Move settings in the Settings Editor application, see "`PTP_AutoMove`" in the PC-DMIS Settings Editor documentation.
Along Feature Vector	PC-DMIS applies the avoidance move along the feature's vector.
Along Tip Vector	PC-DMIS applies the avoidance move along the tip's vector.
Distance Before	This field specifies the distance that the probe moves to before it takes the first hit for the current Auto feature.

Distance After	This field specifies the distance that the probe moves to after it takes the last hit for the current Auto feature.
Void Detection	This area is only visible for a Plane Auto feature. It becomes enabled if you select the **Void Detection** icon located in the **Measurement properties** area of the **Auto Feature** bar. The **Use boundary offset** check box determines the minimum distance from the void's boundary (an edge) where PC-DMIS takes hits. This distance also defines the increment value the software uses when it searches for the surface after it detects a void. • If you clear this check box, PC-DMIS places hits the default distance of the probe tip's radius value from the void's edge. • If you select this check box, PC-DMIS places hits at the distance from the edge that you specify in the box beneath the check box.

Working with Contact Find Hole Properties



Probe Toolbox showing the Contact Find Hole Properties tab for an Auto Circle feature.

The **Contact Find Hole Properties** tab becomes visible when you enable a contact probe and then open the **Auto Feature** dialog box. The items become available to select when PC-DMIS is in DCC mode. This tab contains items that you can use to change the "Find hole" properties for Auto features that use contact probes.

Once you select an item in the **Find hole** list (**NOCENTER**, **SINGLE HIT**, or **CENTER**) and execute your measurement routine, PC-DMIS positions the probe a prehit distance above the theoretical center of the feature. It then drives normal to the feature surface vector searching for the hole at touch speed. The search continues until either the surface is touched (indicating that the hole is not there), or the "find hole" distance is reached (indicating that the hole is present). For more information and examples, see "Calculating the 'Find Hole' Distance".

If the "find hole" operation fails, PC-DMIS displays the **Read position** dialog box. These options are available:

- **Yes** - This option allows you to read a new position from which to continue searching for the hole. You can then use your jog box to move the probe to the new location.
- **No** - This option allows you to skip this feature and move on to the next feature. PC-DMIS moves the probe away from the hole by the distance specified for an avoidance move (see "Working with Contact Auto Move Properties") and continues running the measurement routine. This movement helps to prevent a possible probe collision.



For details on how PC-DMIS reports dimensions that use skipped features during execution, see the "Reporting a Dimension Using a Feature Skipped During Execution" topic in the PC-DMIS Core documentation.

Additionally, you can set PC-DMIS to automatically continue to execute the measurement routine when the hole cannot be found. For details, see "Auto Continue Execution if FindHole Fails" in the "Setting Your Preferences" chapter of the PC-DMIS Core documentation.

Depending on the type of feature in the **Auto Feature** dialog box, this tab may change to contain one or more of the following items:

- Find hole
- On hit error
- Read position

Find hole

This item supports these Auto features:

- Circle
- Cylinder
- Notch Slot
- Polygon

- Round Slot
- Square Slot

It contains the following options, which determine how PC-DMIS proceeds when it attempts to find a hole. If an option is not available, it is not supported for that feature type.

Option	Description
DISABLED	No "find hole" operation is performed.
NOCENTER	This item acts as the **CENTER** item, except that the probe does not take the three hits to find the rough estimate of the hole's center. It merely begins measuring the circle using the existing parameters set in the specific **Auto Feature** dialog box.
SINGLE HIT	This setting tells the probe to take one single hit. If it hits the surface and does not find the hole, then it automatically switches to the "If the hole is never found" case (for circles and slots) or "If the hole is not found" case (for notches) described in the Find Hole specifics links. If the probe finds the hole, it uses the **NOCENTER** option to proceed.
CENTER	This item first causes the probe to move down to the "find hole" distance to make sure it does not encounter any material. It then moves to either the feature's depth or to the "check" distance to search inside the hole for a rough estimate of the hole's center (see the note below). The probe does this by taking three hits equally spaced around the hole. Once the probe has the hole's general location, it then proceeds to measure the hole using the parameters set in the specific **Auto Feature** dialog box. Unless you select **NOCENTER** or **SINGLE HIT**, this is the default procedure that PC-DMIS follows if it finds the hole.



The entry in this note gives you greater control over the depth of the centering process for the "find hole" operation. By default, the feature's depth determines the centering process's Z component. This is often used in conjunction with an Rmeas (plane) feature. However, sometimes when you do not use an Rmeas feature, and the surface of the part varies greatly in Z, the centering process never finds the hole, because the part's surface lies below the search depth.

In this case, you can instead have the "find hole" centering process execute at the `Check Distance * Percent,` by setting the `FHCenteringAtChkDistTimesPercentInsteadOfDepth` entry to **TRUE** in the PC-DMIS Settings Editor documentation. This entry is located in the **USER_AutoFeatures** section. For information about the **Check distance** and **Check percent** values, see "Parameter Settings: Motion tab".

Circle or Cylinder

The following table describes the "find hole" specifics for a Circle or Cylinder.

If the hole is found	PC-DMIS moves down to the "check" distance and proceeds to take three hits equally spaced around the hole to determine the general location of the hole. Following this general adjustment, PC-DMIS then measures the hole using the parameters that are defined on the feature's tab. This includes sample hits, and so on. This is the same as the **CENTER** item described above.
If the hole is not found	PC-DMIS backs away from the surface and starts a circular search pattern that is (feature radius – probe radius) out from the theoretical feature center. The search tries (2 * PI * feature radius/(feature radius – probe radius)) locations around the search circle. If the hole is still not found, the search radius increases by (feature radius – probe radius) and continues until the search radius is equal to the prehit distance. If the prehit is smaller than (feature radius – probe radius), only one search pattern is completed.
If the hole is never found	PC-DMIS moves the probe to a position of a prehit above the final point of the searching cycle and prompts you to do a "Read Position". (See "Read position Item".)

Adjustments along the surface normal	As PC-DMIS searches and finds a surface instead of the hole, it continually updates the search height based on the found surfaces. Once the hole is found, it updates the depth of measurement of the hole based on the last surface found. If the hole is found the first time, no adjustments are made.
Adjustments with RMEAS	If you supply an **RMEAS** feature (or features), PC-DMIS assumes that you want to use the feature(s) as the reference for both the search height and the depth of the hole measurement. Therefore, there is no adjustment along the surface normal other than the RMEAS adjustment.

Square Slot or Round Slot

The following table describes the "find hole" specifics for a Square Slot or Round Slot.

If the hole is found	PC-DMIS moves down to the "check" distance and measures one hit on each of the four sides of the slot. It adjusts for the center of the four hits. It measures two hits on one of the long sides to adjust for the slot rotation. After it calculates a general location and orientation of the slot, it uses the parameters that you define on the tab for the feature to measure the slot.
If the hole is not found	PC-DMIS backs away from the surface and starts a circular search pattern that is (feature radius – probe radius) out from the theoretical feature center. The search tries (2 * PI * feature radius/(feature radius – probe radius)) locations around the search circle. If the hole is still not found, the search radius increases by (feature radius – probe radius) and continues until the search radius is equal to the prehit distance. If the prehit is smaller than (feature radius – probe radius), only one search pattern is completed.
If the hole is never found	PC-DMIS moves the probe to a position of a prehit above the final point of the searching cycle. It prompts you to do a "Read Position". (See "Read position Item".)
Adjustments along the surface normal	As PC-DMIS searches and finds a surface instead of the hole, it continually updates the search height based on the found surfaces. Once it finds the hole, it updates the depth of measurement of the hole based on the last surface found. If it finds the hole the first time, no adjustments are made.

Adjustments with RMEAS	If you supply an RMEAS feature (or features), PC-DMIS assumes you desire to use the feature (or features) as the reference for both the search height and the depth of the hole measurement. Therefore, there is no adjustment along the surface normal other than the RMEAS adjustment.

Notch Slot

The following table describes the "find hole" specifics for a Notch Slot.

If the hole is found	PC-DMIS moves down to the "check" distance to measure the hole's depth and then to measure the hole.
If the hole is not found	PC-DMIS backs away from the surface and starts a search pattern. The pattern is circular and is adjusted out one-half the width from the theoretical feature center (which, for notches, is the center of the inside edge). The search tries eight locations around that location. If it finds the hole, the probe moves to the depth to measure the hole's depth and then to measure the hole.
If the hole is never found	PC-DMIS moves the probe to a position of a prehit above the final point of the searching cycle. It prompts you to do a "Read Position". (See "Read position Item".)

Supported Interfaces

All of the DCC interfaces support the "find hole" functionality. If you experience a problem with a specific interface, contact Hexagon Technical Support.

On hit error

The **On hit error** item supports these Auto features:

Angle Point

Circle

Cone

Corner Point

Cylinder

Edge Point

Ellipse

Notch Slot

Polygon

Round Slot

Square Slot

It allows improved error checking when PC-DMIS detects an unexpected or missed hit. If you select this check box, PC-DMIS does the following:

- Automatically takes a read position whenever an unexpected probe hit or a missed probe hit takes place during the measurement cycle.
- Measures the entire feature with the new location obtained from the read position.

The Edit window command line for this option would read:

```
ONERROR = TOG
```

TOG: This toggle field switches between YES (on) and NO (off).

For additional information on what options you have when PC-DMIS detects unexpected or missed hits, see the "Branching on an Error" topic in the "Branching by Using Flow Control" chapter of the PC-DMIS Core documentation.



By default, when PC-DMIS performs a read position operation (such as used in Read Pos, Find Hole, or On Error), it returns only the X and Y values. However, two entries give you further control over returning the Z axis value as well. These are: `ReadPosUpdatesXYZ` and `ReadPosUpdatesXYZEvenIfRMeas`.

If these entries are set to FALSE, the location found by the read position is snapped to the feature's normal vector and stored as the target. However, since Edge Point, Angle Point, and Corner Point features do not have a normal vector, but are instead defined by a combination of vectors, for these feature types PC-DMIS does not snap the read position location to a feature vector as it did in versions prior to v43. Instead, PC-DMIS ignores the above entries and assigns the target (TARG field) the XYZ of the read position.

Supported interfaces: All of the DCC interfaces support the **On hit error** functionality. If you experience a problem with a specific interface, contact Hexagon Technical Support to investigate the issue.

Read position

The **Read position** item supports these Auto features: Circle, Ellipse, Round Slot, Square Slot, Notch Slot, Polygon, Cylinder, and Cone. If you select this check box, PC-DMIS pauses execution above the surface of the feature and displays the following message during execution time: "Read new probe position?". Do one of the following:

- If you want PC-DMIS to use the current target position to measure the feature, click **No**.
- If you want PC-DMIS to use the current tip position as the target value for measuring the feature, move the tip to the desired position and then click **Yes**. This message appears: "Do you wish to save this position as the new target?" Do one of the following:
  - If you want PC-DMIS to use the current target position for only the current execution, click **No**. PC-DMIS does not save this position for the next execution.
  - If you want PC-DMIS to use the current target position for the current execution and also save this position for the next execution that it takes, click **Yes**.

If you click **Yes**, PC-DMIS requires you to place the probe in a zone close to the center of the feature. The depth and orientation of the measurement are then automatically determined by one of the options in the following table.

Option	Description
RMEAS feature	If you provide an RMEAS feature, PC-DMIS assumes you want to measure the hole with respect to that feature (or features). Therefore, the feature (or features) is used to define the surface normal and depth of measurement, while the Read Pos is used to determine the other two axes of translation. If the search feature fails, the message "Read new probe position?" displays. In this case, click **No** to continue with the next feature.
Find Hole	If the "find hole" operation is used and the surface around the hole is touched at least one time, then PC-DMIS adjusts all three axes. Two of the axes are based on the location of the probe once it has found the hole. The third axis, along the surface normal, is based on the last surface touched. The "find hole" operation does not override an RMEAS feature.
Sample Hits	If sample hits are used, they are always the top priority when determining both the orientation and depth of the measurement of the hole.

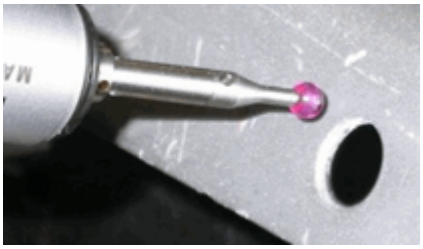
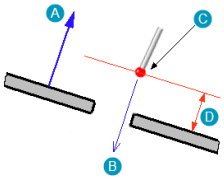
None of the above	If none of the above options are used, PC-DMIS probes the hole based on the provided target and depth values, adjusted by the probe placement within the cylindrical zone.

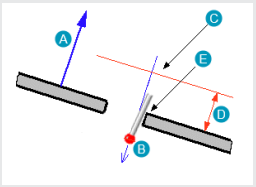
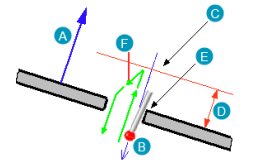
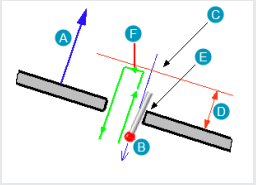
By default, when PC-DMIS performs a read position operation (such as used with the **Read position** check box, **Find hole** list, or **On hit error** check box), it returns only the X and Y values. However, two entries give you further control over returning the Z axis value as well. These are `ReadPosUpdatesXYZ` and `ReadPosUpdatesXYZEvenIfRMeas`.

Turning Off Find Hole's Default Last Hit Adjustment

When the probe registers a hit during a "find hole" operation, its ruby tip usually contacts with the surface (meaning it has not yet found the hole), and the Z value for the next search hit is then adjusted with the Z value of the last hit. This normal behavior is usually what you want, but in some cases, you may want to turn off this adjustment. You can do this by setting the `AdjustFindHoleByLastHit` entry to **FALSE** in the PC-DMIS Settings Editor.

If your wrist cannot move to a tip angle matching your feature's vector, your probe's stem may make contact with the hole's edge during the "find hole" operation. This contact results in a registered hit that PC-DMIS assumes is the part's surface at the ruby tip's location. By default, PC-DMIS attempts to adjust the Z value of the next search hit by the last value, resulting in a bad move. If you turn off this default last hit adjustment, then in a case like this, PC-DMIS continues searching without adjusting the Z value.

Sequence of Events		Figure and Description
Frame 1 The tip angle does not match the hole's vector.		 ***A*** *- U,V,W* ***B*** *- Direction of search* ***C*** *- Move* ***D*** *- Approach distance*

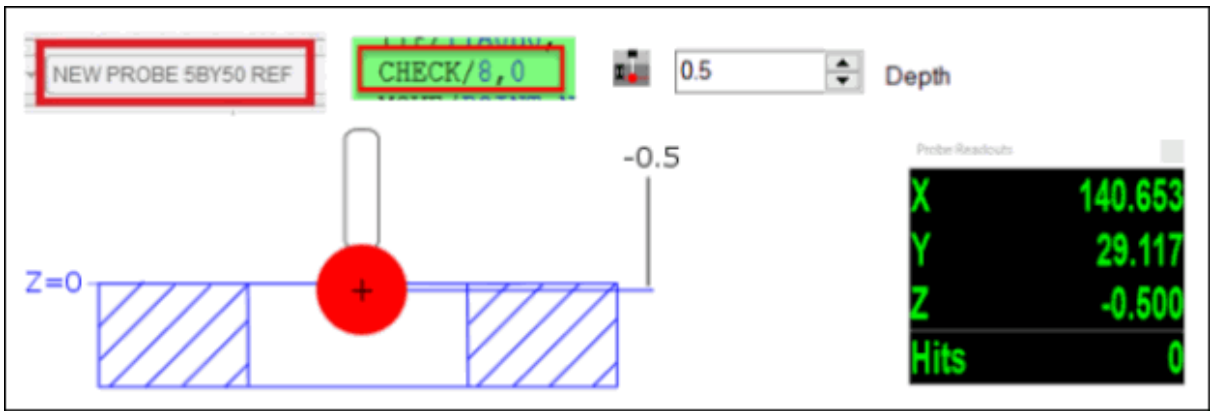
Frame 2 This results in the stem of the probe contacting the edge of the part at E and registering a hit at B.		 ***A*** *- U,V,W* ***B*** *- Hit* ***C*** *- Move* ***D*** *- Approach distance* ***E*** *- Stem contact*
Frame 3 (Default behavior) By default, PC-DMIS adjusts the Z value for the next search hit, but in this case, this results in a bad move at F.	This occurs if the `AdjustFindHoleByLastHit` entry is set to True.	 ***A*** *- U,V,W* ***B*** *- Hit* ***C*** *- Move* ***D*** *- Approach distance* ***E*** *- Stem contact* ***F*** *- Bad move*
Frame 3 (Modified Behavior) However, if you turn off the default adjustment, PC-DMIS continues searching for the hole using a correct move at F.	This occurs if the `AdjustFindHoleByLastHit` entry is set to False.	 ***A*** *- U,V,W* ***B*** *- Hit* ***C*** *- Move* ***D*** *- Approach distance* ***E*** *- Stem contact* ***F*** *- Correct move*

Calculating the "Find Hole" Distance

The calculation of the "find hole" distance depends on the feature type. For features of type Circle, Round Slot, Square Slot, Notch Slot, and Polygon, PC-DMIS calculates the "find hole" distance as follows:

- If check percent = 0, the center of the tip moves to the depth distance.

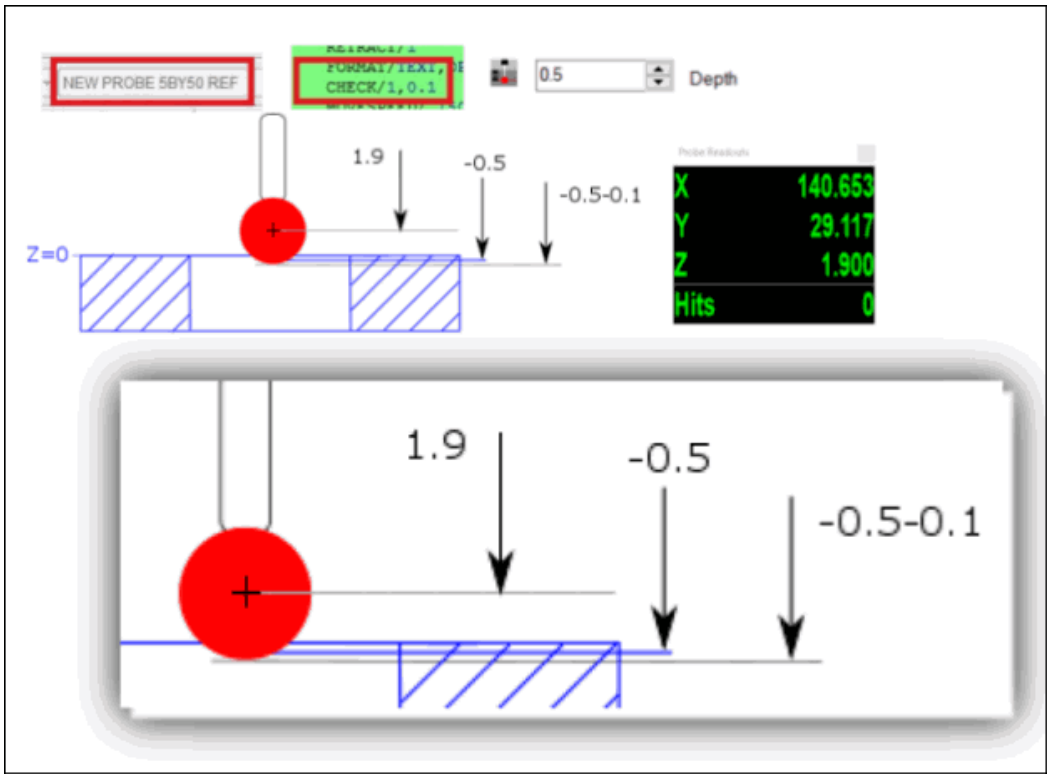
  In the example below, the center of the tip moves to 0.5 mm inside the feature (check percent = 0 and depth = 0.5):



Example of "find hole" distance

- If check percent > 0 and ≤ 1, the surface of the tip moves to the depth + (check * check percent) distance.

  In the example below, the surface of the tip moves to 0.6 mm inside the feature. This is calculated as: 0.5 mm depth + (1 mm check * 0.1 percent).



Example of "find hole" distance

Working with Measurement Strategies

You can use measurement strategies for specific Auto Features to select predefined schemes that change how PC-DMIS measures those features. The measurement strategies are grouped as follows:

- Default PC-DMIS Measurement Strategy - This strategy is the default touch point strategy. It is available for all Auto features.
- Adaptive scanning strategies - The names of these strategies start with "Adaptive". When you execute a measurement routine, these strategies refer to the database to determine the scanning parameters.
- Non-adaptive scanning strategies - These strategies (Gage Scan Calibration, Cylinder Centering Thread Scan, Self-Centering Point, and Sphere Scan) do not need to refer to the database to determine the scanning parameters.
- TTP strategies - The names of these strategies start with "TTP". These strategies use touch trigger probes to measure a feature.



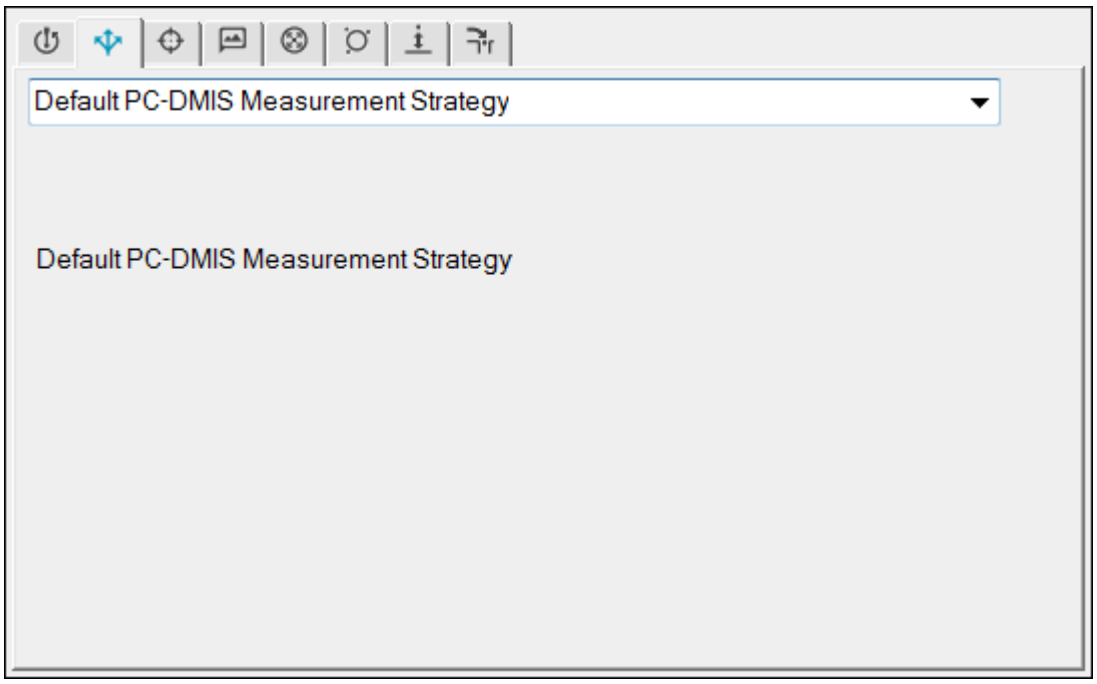
For best results for all measurement strategies, you should have the "`VariableHighSpeedScanning`" (VHSS) setting enabled in the PC-DMIS Settings Editor application.



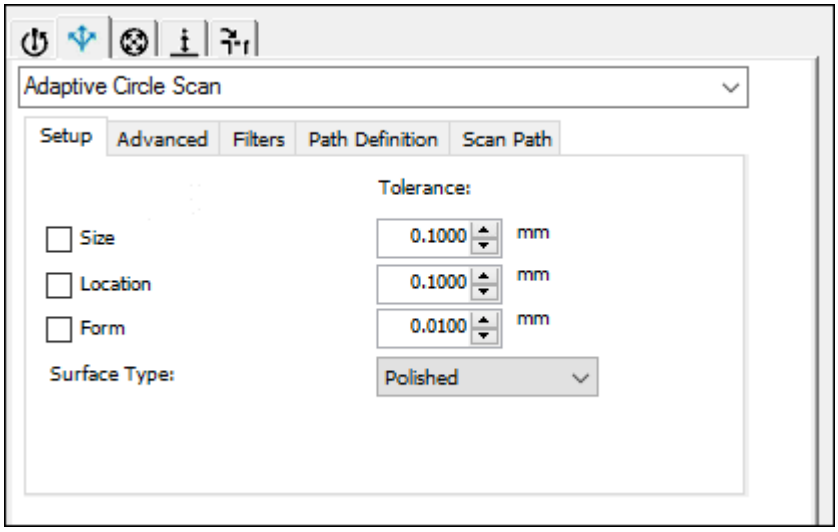
You can also use the Measurement Strategy Editor (MSE) to modify certain strategies. With the MSE, you can modify and store custom strategies at a feature level. In addition, you can modify and store groups of settings for all the Auto features. For more information on the MSE, see "Using the Measurement Strategy Editor" in the PC-DMIS Core documentation.

To select a measurement strategy, follow these steps:

1. From the **Probe Toolbox**, select the **Measurement Strategies** tab ( ). Initially, PC-DMIS shows the **Default PC-DMIS Measurement Strategy**.



2. Click the drop-down arrow and then select the measurement strategy that you want to use. The Probe Toolbox tabs change to show only the tabs that apply to that strategy. For example, an Adaptive Circle Scan (available to scanning probes) strategy looks like this:



Sample Probe Toolbox tabs

3. Complete the properties on the measurement strategy's tabs (**Setup**, **Advanced**, **Filters** and so on) with all known information about the strategy.

    - To complete the properties for an adaptive scanning strategy, see "Using Adaptive Scanning Strategies".
    - To complete the properties for a non-adaptive strategy, see "Using Non-Adaptive Scanning Strategies".
    - To complete the properties for a TTP strategy, see "Using TTP Strategies".

4. To test the feature, click **Test**.

    - For the Default PC-DMIS Measurement Strategy, PC-DMIS measures the feature according to the settings that you specified in the **Auto Feature** dialog box.
    - For an adaptive scanning measurement strategy, PC-DMIS scans the feature according to the parameters that you specified on the strategy's tabs.
    - For a non-adaptive scanning strategy, PC-DMIS measures the feature according to the settings that you specified on the strategy's tabs.
    - For a TTP strategy, PC-DMIS measures the feature with touch points according to the settings that you specified on the strategy's tabs.

5. Click **Create**. If the **Measure Now** button () in the **Feature properties** area is selected, the probe moves according to the settings specified on the **Advanced** tab using the Auto feature's properties for feature location and other characteristics.

Using Adaptive Scanning Strategies

Not every user with access to scanning hardware is an expert and understands how to configure various controlling parameters that affect accuracy and throughput such as scan speed, point density, and offset force. With Adaptive Scanning, you don't need to be an expert, since it removes the guesswork from configuring such scanning parameters. Adaptive Scanning uses a system comprised of expert knowledge to calculate those parameters based on known inputs, such as tolerance, feature type and size, stylus length, and surface finish. You only need to supply the information known to you. The Adaptive Scanning algorithms perform the work of choosing the other settings.

Adaptive Scanning is "controller aware". This means that if a certain capability exists on a controller that will improve the scanning accuracy and throughput, the software automatically uses those capabilities as needed.

The measurement strategies for the Adaptive Scanning feature are available only for an analog tip.

The strategies are located on the **Measurement Strategies** tab in the Probe Toolbox. The strategies are:

- Circle Auto feature:
    - Adaptive Circle Scan strategy
- Cone Auto feature:
    - Adaptive Cone Concentric Circle Scan strategy

    - Adaptive Cone Line Scan strategy
- Cylinder Auto feature:
    - Adaptive Cylinder Line Scan strategy
    - Adaptive Cylinder Spiral Scan strategy
    - Adaptive Cylinder Concentric Circle Scan strategy
- Line Auto feature:
    - Adaptive Linear Scan strategy
- Plane Auto feature:
    - Adaptive Free Form Plane Scan strategy
    - Adaptive Plane Circle Scan strategy
    - Adaptive Plane Line Scan strategy

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Adaptive Circle Scan Strategy

The Adaptive Circle Scan strategy for the Circle Auto feature measures the circle by scanning.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Circle**):

- **Setup** tab
- **Advanced** tab
- **Filters** tab
- **Path Definition** tab
- **Scan Path** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Circle Scan Strategy

You can use the **Setup** tab for the Adaptive Circle Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Size

If the purpose of the measurement is size tolerance, select this check box. When you select it, PC-DMIS scans the feature based on the **Size** tolerance value that you enter. If the **Size** tolerance value that you enter is loose, for example +/- 0.25 mm, PC-DMIS increases the scan speed proportionally. For a tighter size tolerance, for example +/- 0.5 mm, PC-DMIS reduces the scan speed proportionally.



Suppose you have a 30 mm hole without the **Size** option selected. PC-DMIS scans the hole at 10 mm/s. For a larger tolerance of 0.25 mm , the scan speed increases to 42 mm/s. For a smaller tolerance of 0.05 mm, the scan speed decreases to 18 mm/s.



When you make changes to the **Size**, **Location**, or **Form** tolerance values in the **Setup** tab, you can observe the effect of those changes in the **Advanced** tab.

Location

If the purpose of the measurement is location tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Location** tolerance value that you enter. The looser the **Location** tolerance value, the slower the scan. The tighter the **Location** tolerance, the faster the scan.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation in the **Size**, **Location**, and **Form** boxes.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

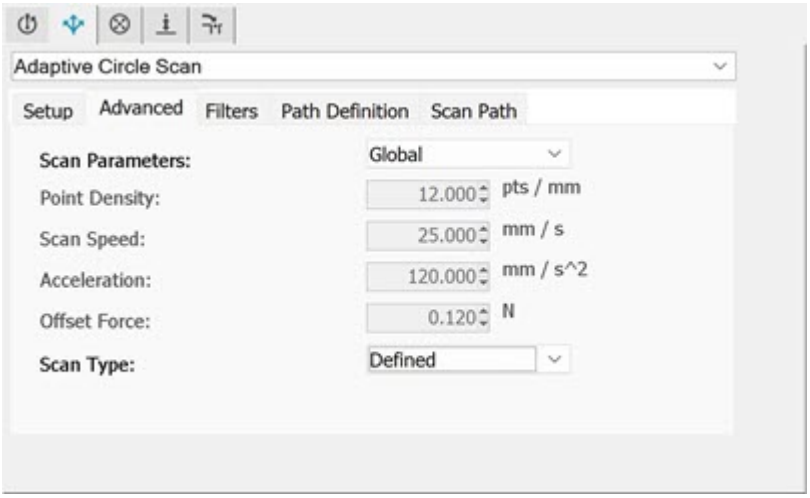
The options are:

- Polished

- Machined
- Ground
- Cast

Advanced Tab - Adaptive Circle Scan Strategy

You can use the **Advanced** tab for the Adaptive Circle Scan strategy to override the calculated settings and any automatically configured parameters.



Probe Toolbox Adaptive Scan Strategies tab for Adaptive Circle scan

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

Type or select the level of force to maintain during a scan. The value is specified in newtons.

Scan Type

Select the type of scan that you want to execute on the controller:

- **Defined** - Executes the defined path scan on a B3C, B4, or FDC controller.
- **CIR** - Executes the CIR type of scan on a B4 or B5 Leitz controller.

Filters Tab - Adaptive Circle Scan Strategy

You can use the **Filters** tab for the Adaptive Circle Scan strategy to set up filters.

Outlier

You can choose to remove outliers based on the distance from the best fit feature. This allows the removal of anomalies that arise in the measurement process.

PC-DMIS first fits a circle to the data and then determines which points are outliers based on the standard deviation multiple. It then does the following:

- Recalculates the best fit circle with those outliers removed.
- Checks for outliers again.
- Recalculates the best fit circle.
- Continues repeating this process until no more outliers exist or until PC-DMIS cannot compute the circle. (PC-DMIS cannot compute the circle if there are fewer than three data points.)

Filter

The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

UPR

Type or select the undulations per revolution. The default is 50. This item is hidden if you select **None** in the **Filter** list.

Use Gage Scan Filter

When you select the **Use Gage Scan Filter** check box, PC-DMIS corrects the measured scan data by comparing it to similar scan data from a gage. For more information, see the "Enabling the Gage Scan Filter" topic in the PC-DMIS CMM documentation.

Use Adjust Filter

When you select this check box, PC-DMIS corrects measured scan data by ensuring that all the measured points are at the same height on the sphere or cone. This option is available only when you select **Spherical** or **Conical** in the **Control Element** list on the **Path Definition** tab. For information on Adjust Filter, see the "Constructing an Adjusted Filter" topic in the PC-DMIS Core documentation.

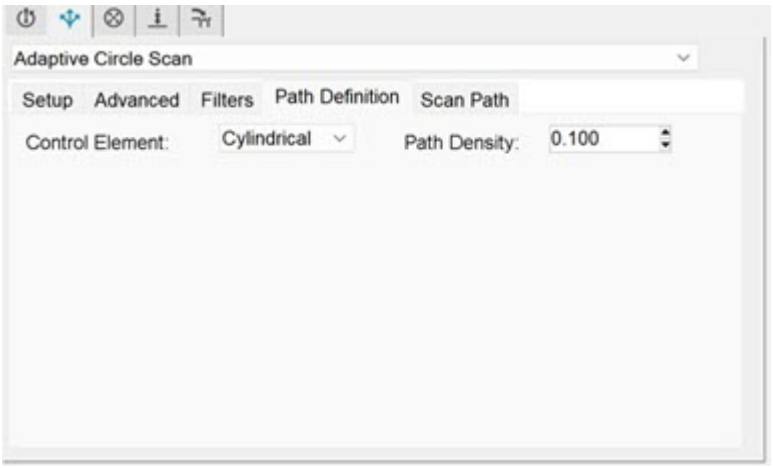
Path Definition Tab - Adaptive Circle Scan Strategy

The **Path Definition** tab for the Adaptive Circle Scan strategy provides you with additional options to define a circular scan path. You can view the scan path whenever you update a path definition parameter. You can also view the updated scan path in the Graphic Display window.

Control Element - Specifies the type of geometry on which to perform the circle scan. You can select **Cylindrical**, **Spherical**, or **Conical**.

Circle on Cylinder

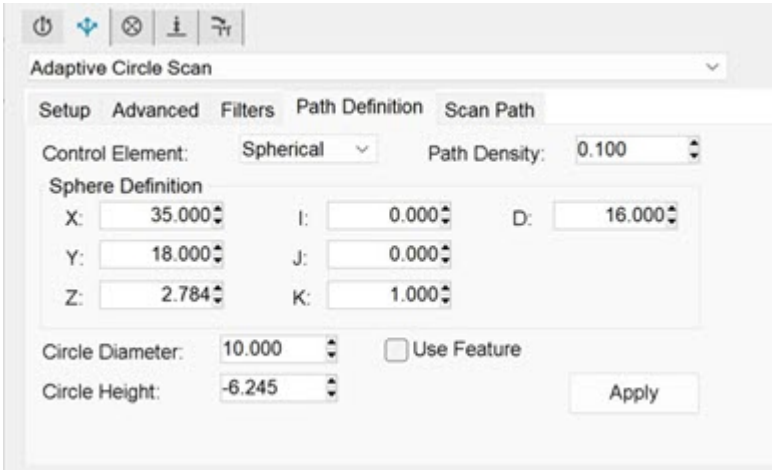
When you select **Cylindrical** as the **Control Element**, PC-DMIS performs the circle scan on a cylinder.



Path Density - When you perform a scan on a circle, PC-DMIS determines the optimum number of points sent to the controller based on the circle's diameter. If you enter the Path Density value, and if that value generates a greater number of points than the number PC-DMIS determined, then PC-DMIS calculates the points based on the Path Density value you typed. To improve performance, use the default number of points calculated by PC-DMIS.

Circle on Sphere

When you select **Spherical** as the **Control Element**, PC-DMIS performs the circle scan on a sphere.



Path Density - When you perform a scan on a circle, PC-DMIS determines the optimum number of points sent to the controller based on the circle's diameter. If you enter the Path Density value, and if that value generates a greater number of points than the number PC-DMIS determined, then PC-DMIS calculates the points based on the Path Density value you typed. To improve performance, use the default number of points calculated by PC-DMIS.

Sphere Definition - This area defines the sphere on which PC-DMIS measures the circle. You can define the sphere by selecting a point on the sphere in the CAD model where you want to measure the circle or by entering its values from the blueprint.

X, **Y**, and **Z** - Specify the coordinates of the sphere.

I, **J**, and **K** - Specify the surface vector based on the tip vector PC-DMIS uses to measure the sphere.

D - Specify the diameter of the sphere.

Use Feature - Select this check box to adjust the measured hit points to the surface of the measured sphere. When you select this check box, you can select an already measured sphere feature from the dropdown list.

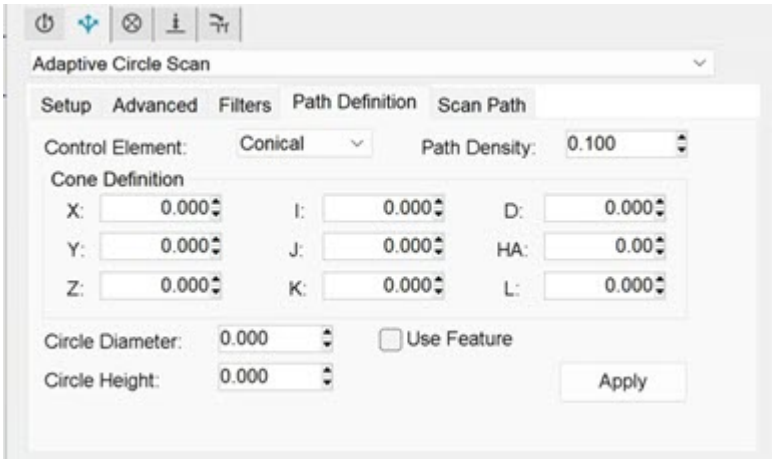
Clear the check box to adjust the measured hit points to the surface of the theoretical sphere. The check box is cleared by default.

Circle Diameter and **Circle Height** - These values are linked. The Circle Diameter specifies the diameter of the circle to measure, and Circle Height specifies the height of the circle relative to the sphere center. PC-DMIS measures the positive height values in the direction of the sphere vector, and negative values in the opposite direction. Type a value in either box, and PC-DMIS automatically calculates the corresponding value in the other box.

Apply - Click this button to update the centroid and vector values in the **Auto Feature** dialog box for a circle.

Circle on Cone

When you select **Conical** as the **Control Element**, PC-DMIS performs the circle scan on a cone.



Path Density - When you perform a scan on a circle, PC-DMIS determines the optimum number of points sent to the controller based on the circle's diameter. If you enter the Path Density value, and if that value generates a greater number of points than the number PC-DMIS determined, then PC-DMIS calculates the points based on the Path Density value you typed. To improve performance, use the default number of points calculated by PC-DMIS.

Cone Definition - This area defines the cone on which PC-DMIS measures the circle. You can define the cone by selecting a point on the cone in the CAD model where you want to measure the circle or by entering its values from the blueprint.

X, **Y**, and **Z** - Specify the coordinates of a point on the cone axis.

I, **J**, and **K** - Specify the surface vector of the cone.

D - Specify the diameter of the cone at the specified point.

HA - Specify the half angle of the cone.

L - Specify the length of the cone.

Use Feature - Select this check box to adjust the measured hit points to the surface of the measured cone. When you select this check box, you can select an already measured cone feature from the dropdown list.

Clear the check box to adjust the measured hit points to the surface of the theoretical cone. The check box is cleared by default.

Circle Diameter and **Circle Height -** These values are linked. The Circle Diameter specifies the diameter of the circle to measure, and Circle Height specifies the height of the circle relative to the cone. PC-DMIS measures the positive height values in the direction of the cone vector, and negative values in the opposite direction. Type a

value in either box, and PC-DMIS automatically calculates the corresponding value in the other box.

Apply - Click this button to update the centroid and vector values in the **Auto Feature** dialog box for a circle.

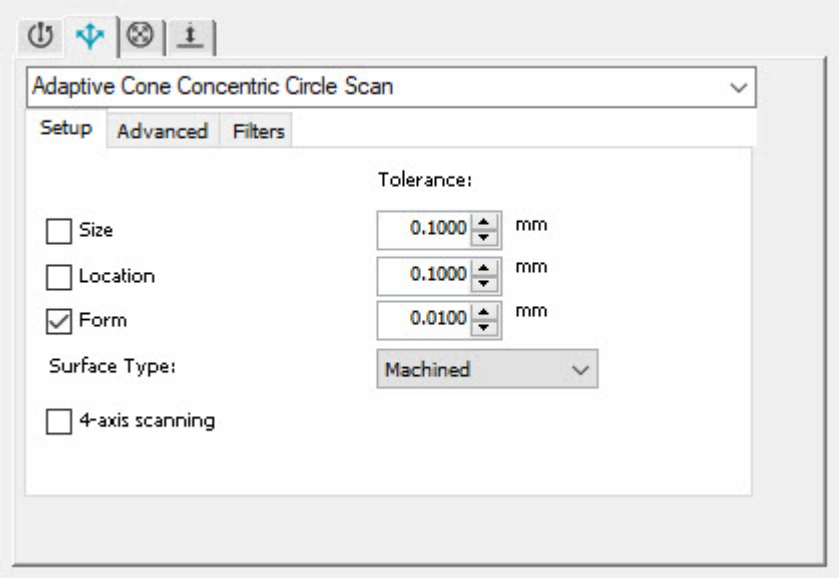
Scan Path Tab - Adaptive Circle Scan Strategy

You can use the **Scan Path** tab for the Adaptive Circle Scan strategy to display scan points.

The following items appear in the points list area:

- **#** - A number that identifies the generated point
- **X**, **Y**, and **Z** - The XYZ values
- **I**, **J**, and **K** - The IJK values.

Adaptive Cone Concentric Circle Scan Strategy



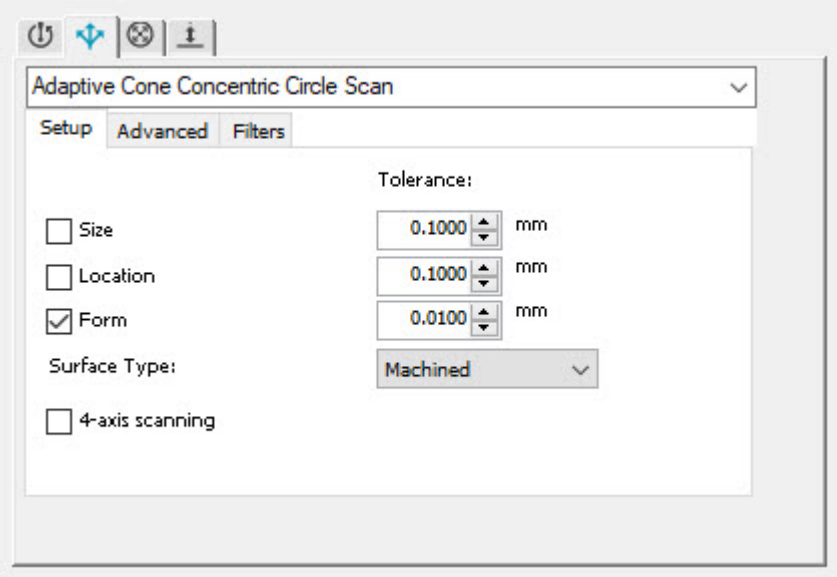
The Adaptive Cone Concentric Circle Scan strategy for the Cone Auto feature performs a number of concentric circle measurements at various heights along the cone axis.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Cone**):

- **Setup** tab
- **Filters** tab
- **Advanced** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Cone Concentric Circle Scan Strategy



You can use the **Setup** tab for the Adaptive Cone Concentric Circle Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Size

If the purpose of the measurement is size tolerance, select this check box. When you select it, PC-DMIS scans the feature based on the **Size** tolerance value that you enter. If the **Size** tolerance value that you enter is loose, for example +/- 0.25 mm, PC-DMIS increases the scan speed proportionally. For a tighter size tolerance, for example +/- 0.5 mm, PC-DMIS reduces the scan speed proportionally.

Suppose you have a 30 mm hole without the **Size** option selected. PC-DMIS scans the hole at 10 mm/s. For a larger tolerance of 0.25 mm , the scan speed increases to 42 mm/s. For a smaller tolerance of 0.05 mm, the scan speed decreases to 18 mm/s.

When you make changes to the **Size**, **Location**, or **Form** tolerance values in the **Setup** tab, you can observe the effect of those changes in the **Advanced** tab.

Location

If the purpose of the measurement is location tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Location** tolerance value that you enter. The

looser the **Location** tolerance value, the slower the scan. The tighter the **Location** tolerance, the faster the scan.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation in the **Size**, **Location**, and **Form** boxes.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

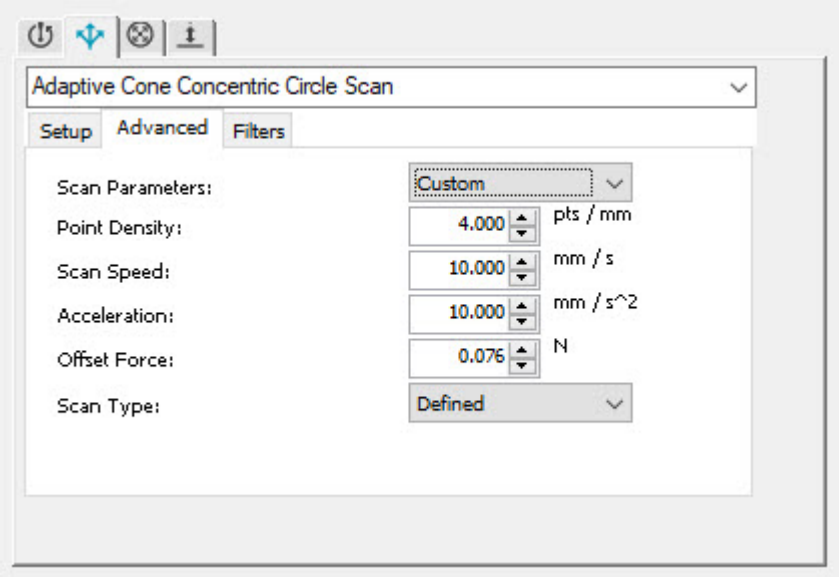
The options are:

- Polished
- Machined
- Ground
- Cast

4-axis scanning

For details on the **4-axis scanning** check box, see the "4-Axis Scanning" topic in the PC-DMIS CMM documentation.

Advanced Tab - Adaptive Cone Concentric Circle Scan Strategy



You can use the **Advanced** tab for the Adaptive Cone Concentric Circle Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

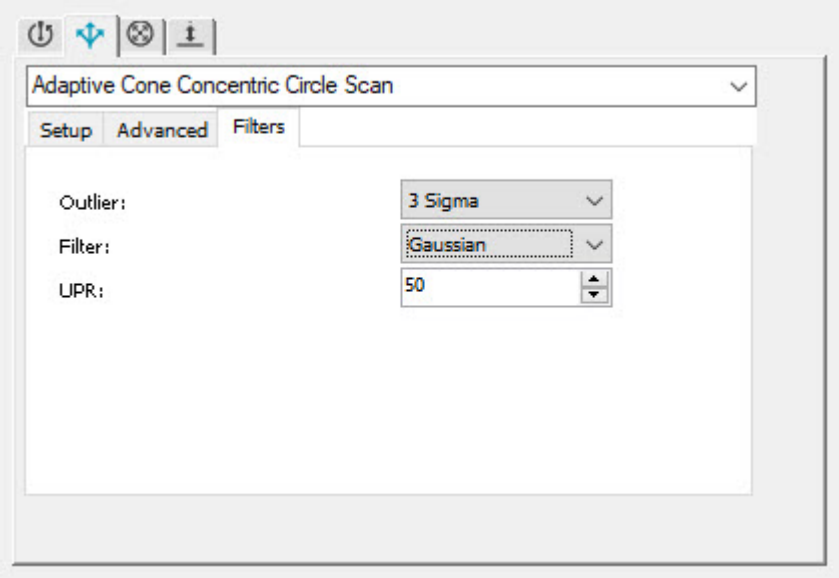
Type or select the level of force to maintain during a scan. The value is specified in newtons.

Scan Type

Select the type of scan that you want to execute on the controller:

- **Defined** - Executes the defined path scan on a B3C, B4, or FDC controller.
- **CIR** - Executes the CIR type of scan on a B4 or B5 Leitz controller.

Filters Tab - Adaptive Cone Concentric Circle Scan Strategy



You can use the **Filters** tab for the Adaptive Cone Concentric Circle Scan strategy to set up filters.

Outlier

You can choose to remove outliers based on the distance from the best fit feature. This allows the removal of anomalies that arise in the measurement process.

PC-DMIS first fits a circle to the data and then determines which points are outliers based on the standard deviation multiple. It then does the following:

- Recalculates the best fit circle with those outliers removed.
- Checks for outliers again.
- Recalculates the best fit circle.
- Continues repeating this process until no more outliers exist or until PC-DMIS cannot compute the circle. (PC-DMIS cannot compute the circle if there are fewer than three data points.)

Filter

The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.

- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

UPR

This option defines the Undulations Per Revolution (UPR). The default value is 50. This value only applies to Circle and Cylinder features. The software hides this option if you select **None** as the filter type.

Adaptive Cone Line Scan Strategy

The Adaptive Cone Line Scan strategy for the Cone Auto feature performs a number of line scans on the specified cone.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Cone**):

- **Setup** tab
- **Filters** tab
- **Advanced** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Cone Line Scan Strategy

You can use the **Setup** tab for the Adaptive Cone Line Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

The options are:

- Polished
- Machined

- Ground
- Cast

Advanced Tab - Adaptive Cone Line Scan Strategy

You can use the **Advanced** tab for the Adaptive Cone Line Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

Type or select the level of force to maintain during a scan. The value is specified in newtons.

Filters Tab - Adaptive Cone Line Scan Strategy

You can use the **Filters** tab for the Adaptive Cone Line Scan strategy to set up filters.

Filter

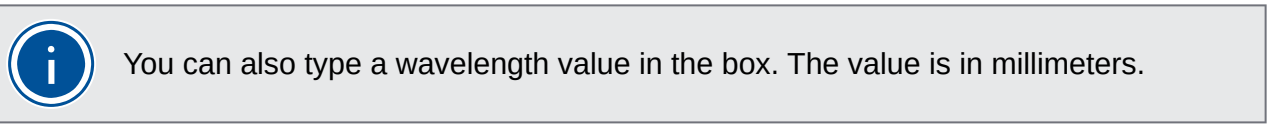
The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

Wave Length (mm)

Oscillations in data smaller than the value you select in the list are smoothed when applying the linear Gaussian filter. This applies to lines and planes.



You can also type a wavelength value in the box. The value is in millimeters.

This option is hidden if you select **None** in the **Filter** list.

Adaptive Cylinder Line Scan Strategy

The Adaptive Cylinder Line Scan strategy for the Cylinder Auto feature scans a number of lines along the cylinder parallel to its axis. The cylinder can be a threaded surface or a smooth surface.

When you use this strategy, the diameter of the probe tip must exceed the size of the valleys in-between the threads in order to prevent probe shanking.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Cylinder**):

- **Setup** tab
- **Filters** tab
- **Advanced** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Cylinder Line Scan Strategy

You can use the **Setup** tab for the Adaptive Cylinder Line Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

The options are:

- Polished
- Machined
- Ground
- Cast

Advanced Tab - Adaptive Cylinder Line Scan Strategy

You can use the **Advanced** tab for the Adaptive Cylinder Line Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

Type or select the level of force to maintain during a scan. The value is specified in newtons.

Pre-Probe Cylinder

This value takes touch points to locate the cylinder prior to scanning.

Threaded Hole

If you select this check box, it turns on a filter on B3 controllers to increase accuracy when scanning threads.

Filters Tab - Adaptive Cylinder Line Scan Strategy

You can use the **Filters** tab for the Adaptive Cylinder Line Scan strategy to set up filters.

Filter

The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

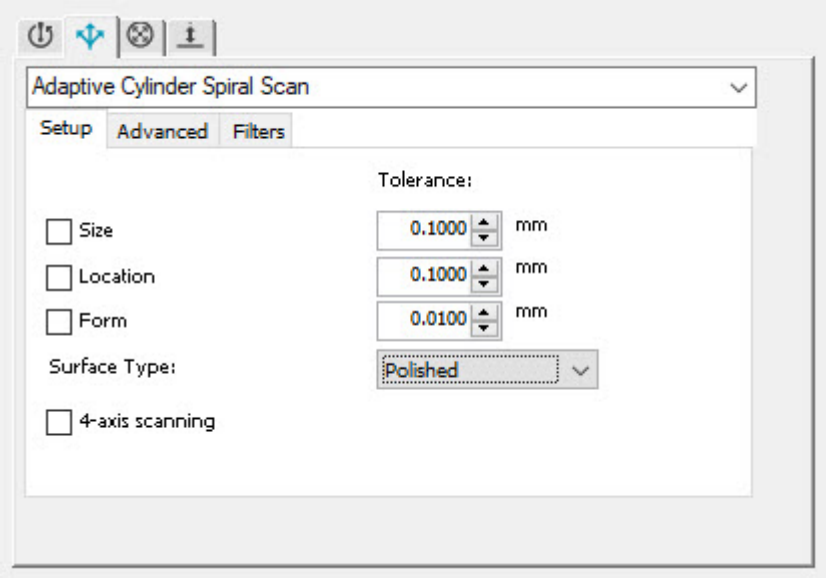
Wave Length (mm)

Oscillations in data smaller than the value you select in the list are smoothed when applying the linear Gaussian filter. This applies to lines and planes.

> You can also type a wavelength value in the box. The value is in millimeters.

This option is hidden if you select **None** in the **Filter** list.

Adaptive Cylinder Spiral Scan Strategy



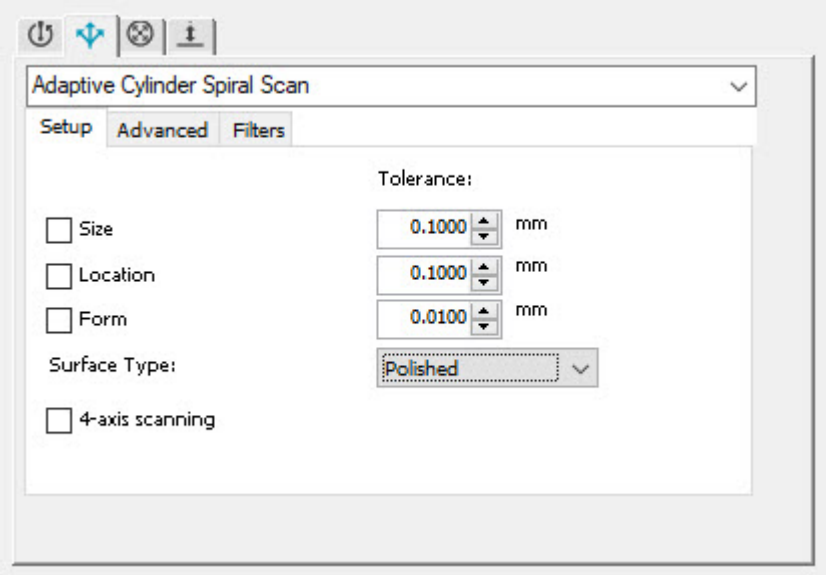
The Adaptive Cylinder Spiral Scan strategy for the Cylinder Auto feature performs a spiral scan measurement pattern.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Cylinder**):

- **Setup** tab
- **Filters** tab
- **Advanced** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Cylinder Spiral Scan Strategy



You can use the **Setup** tab for the Adaptive Cylinder Spiral Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Size

If the purpose of the measurement is size tolerance, select this check box. When you select it, PC-DMIS scans the feature based on the **Size** tolerance value that you enter. If the **Size** tolerance value that you enter is loose, for example +/- 0.25 mm, PC-DMIS increases the scan speed proportionally. For a tighter size tolerance, for example +/- 0.5 mm, PC-DMIS reduces the scan speed proportionally.

Suppose you have a 30 mm hole without the **Size** option selected. PC-DMIS scans the hole at 10 mm/s. For a larger tolerance of 0.25 mm , the scan speed increases to 42 mm/s. For a smaller tolerance of 0.05 mm, the scan speed decreases to 18 mm/s.

When you make changes to the **Size**, **Location**, or **Form** tolerance values in the **Setup** tab, you can observe the effect of those changes in the **Advanced** tab.

Location

If the purpose of the measurement is location tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Location** tolerance value that you enter. The looser the **Location** tolerance value, the slower the scan. The tighter the **Location** tolerance, the faster the scan.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation in the **Size**, **Location**, and **Form** boxes.

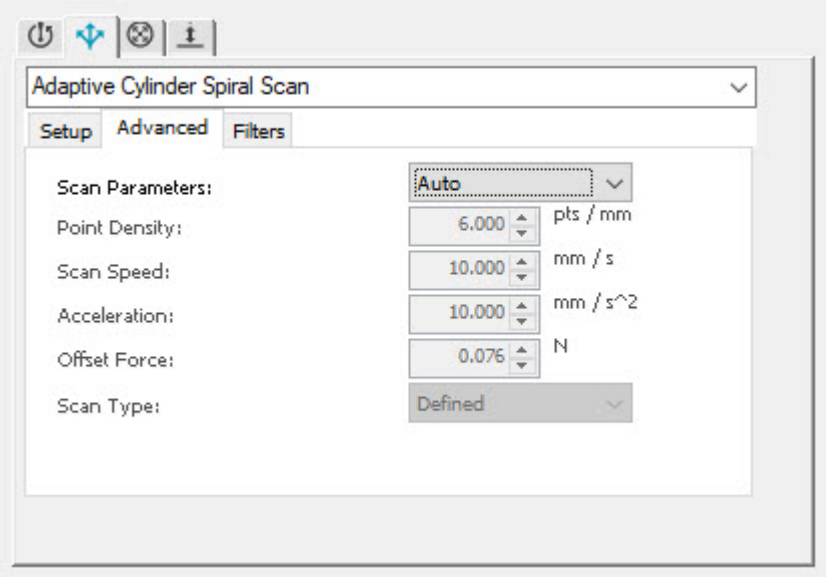
Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

The options are:

- Polished
- Machined
- Ground
- Cast

Advanced Tab - Adaptive Cylinder Spiral Scan Strategy



You can use the **Advanced** tab for the Adaptive Cylinder Spiral Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

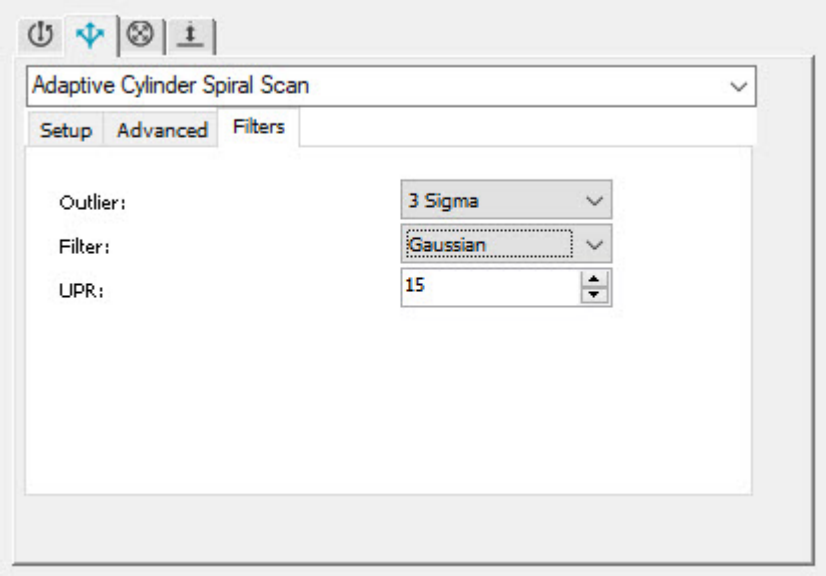
Type or select the level of force to maintain during a scan. The value is specified in newtons.

Scan Type

Select the type of scan that you want to execute on the controller:

- **Defined** - Executes the defined path scan on a B3C, B4, or FDC controller.
- **CIR** - Executes the CIR type of scan on a B4 or B5 Leitz controller.

Filters Tab - Adaptive Cylinder Spiral Scan Strategy



You can use the **Filters** tab for the Adaptive Cylinder Spiral Scan strategy to set up filters.

Outlier

PC-DMIS first fits a circle to the data and then determines which points are outliers based on the standard deviation multiple. It then does the following:

- Recalculates the best fit circle with those outliers removed.
- Checks for outliers again.
- Recalculates the best fit circle.
- Continues repeating this process until no more outliers exist or until PC-DMIS cannot compute the circle. (PC-DMIS cannot compute the circle if there are fewer than three data points.)

Filter

The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

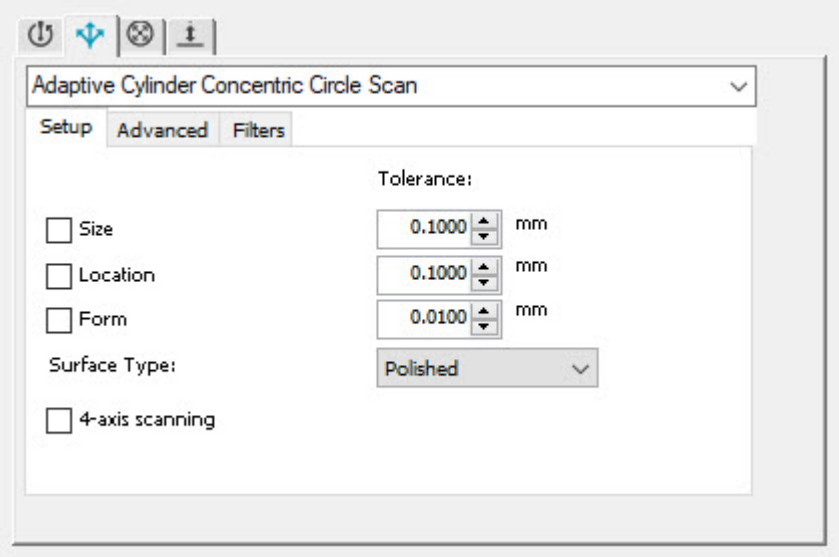
The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

UPR

This option defines the Undulations Per Revolution (UPR). The default value is 50. This value only applies to Circle and Cylinder features. The software hides this option if you select **None** as the filter type.

Adaptive Cylinder Concentric Circle Scan Strategy



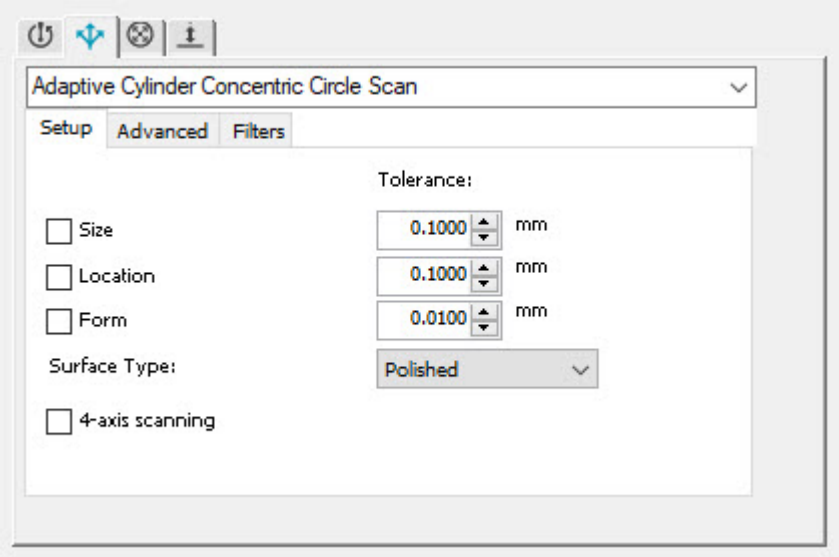
The Adaptive Cylinder Concentric Circle Scan strategy for the Cylinder Auto feature performs a number of concentric circle measurements at various heights along the cylinder axis.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Cylinder**):

- Setup tab
- Advanced tab
- Filters tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Cylinder Concentric Circle Scan Strategy



You can use the **Setup** tab for the Adaptive Cylinder Concentric Circle Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Size

If the purpose of the measurement is size tolerance, select this check box. When you select it, PC-DMIS scans the feature based on the **Size** tolerance value that you enter. If the **Size** tolerance value that you enter is loose, for example +/- 0.25 mm, PC-DMIS increases the scan speed proportionally. For a tighter size tolerance, for example +/- 0.5 mm, PC-DMIS reduces the scan speed proportionally.

Suppose you have a 30 mm hole without the **Size** option selected. PC-DMIS scans the hole at 10 mm/s. For a larger tolerance of 0.25 mm , the scan speed increases to 42 mm/s. For a smaller tolerance of 0.05 mm, the scan speed decreases to 18 mm/s.

When you make changes to the **Size**, **Location**, or **Form** tolerance values in the **Setup** tab, you can observe the effect of those changes in the **Advanced** tab.

Location

If the purpose of the measurement is location tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Location** tolerance value that you enter. The looser the **Location** tolerance value, the slower the scan. The tighter the **Location** tolerance, the faster the scan.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation in the **Size**, **Location**, and **Form** boxes.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

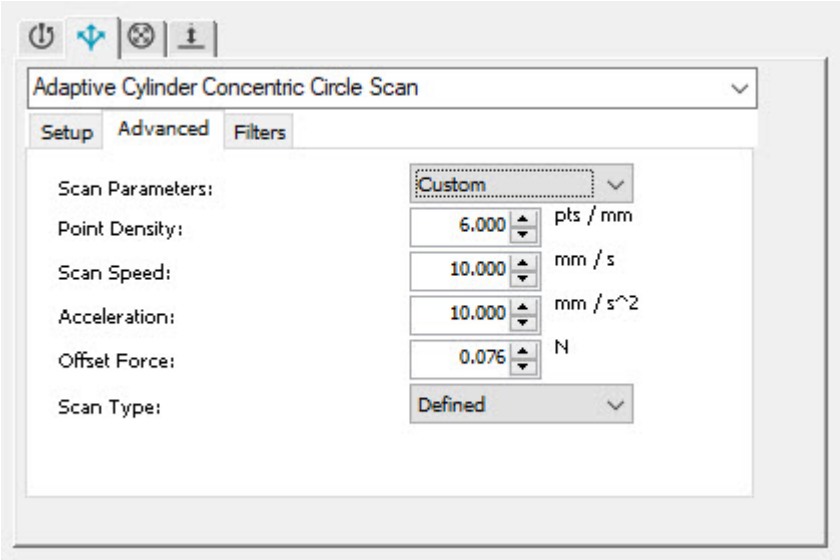
The options are:

- Polished
- Machined
- Ground
- Cast

4-axis scanning

For details on the **4-axis scanning** check box, see the "4-Axis Scanning" topic in the PC-DMIS CMM documentation.

Advanced Tab - Adaptive Cylinder Concentric Circle Scan Strategy



You can use the **Advanced** tab for the Adaptive Cylinder Concentric Circle Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

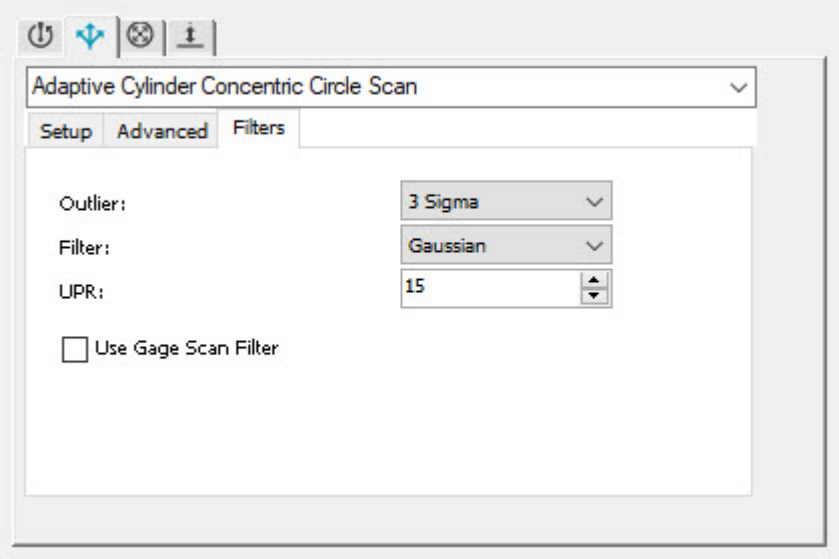
Type or select the level of force to maintain during a scan. The value is specified in newtons.

Scan Type

Select the type of scan that you want to execute on the controller:

- **Defined** - Executes the defined path scan on a B3C, B4, or FDC controller.
- **CIR** - Executes the CIR type of scan on a B4 or B5 Leitz controller.

Filters Tab - Adaptive Cylinder Concentric Circle Scan Strategy



You can use the **Filters** tab for the Adaptive Cylinder Concentric Circle Scan strategy to set a filter type for your scan.

Outlier

You can choose to remove outliers based on the distance from the best fit feature. This allows the removal of anomalies that arise in the measurement process.

PC-DMIS first fits a circle to the data and then determines which points are outliers based on the standard deviation multiple. It then does the following:

- Recalculates the best fit circle with those outliers removed.
- Checks for outliers again.
- Recalculates the best fit circle.
- Continues repeating this process until no more outliers exist or until PC-DMIS cannot compute the circle. (PC-DMIS cannot compute the circle if there are fewer than three data points.)

Filter

The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

UPR

This option defines the Undulations Per Revolution (UPR). The default value is 50. This value only applies to Circle and Cylinder features. The software hides this option if you select **None** as the filter type.

Use Gage Scan Filter

When you select the **Use Gage Scan Filter** check box, PC-DMIS corrects the measured scan data by comparing it to similar scan data from a gage. For more information, see the "Enabling the Gage Scan Filter" topic in the PC-DMIS CMM documentation.

Adaptive Linear Scan Strategy

The Adaptive Linear Scan strategy for the Line Auto feature performs a single line scan along the specified line.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Line**):

- **Setup** tab
- **Filters** tab
- **Advanced** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Linear Scan Strategy

You can use the **Setup** tab for the Adaptive Linear Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

The options are:

- Polished
- Machined
- Ground
- Cast

Advanced Tab - Adaptive Linear Scan Strategy

You can use the **Advanced** tab for the Adaptive Linear Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

Type or select the level of force to maintain during a scan. The value is specified in newtons.

Filters Tab - Adaptive Linear Scan Strategy

You can use the **Filters** tab for the Adaptive Linear Scan strategy to set up filters.

Filter

The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.

- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

Wave Length (mm)

Oscillations in data smaller than the value you select in the list are smoothed when applying the linear Gaussian filter. This applies to lines and planes.



You can also type a wavelength value in the box. The value is in millimeters.

This option is hidden if you select **None** in the **Filter** list.

Adaptive Free Form Plane Scan Strategy

The Adaptive Free Form Plane Scan strategy for the Plane Auto feature scans a plane by moving along a path defined by a set of points. The scan path can be continuous, contain a break, or contain move points. Break and move points in the scan path can help to scan a face as one single plane even if the path is not continuous due to any reason.

The path of the scan can be dynamically read from a text file when you run the measurement routine. This can help to scan the plane on variants of the part where the shape of the face being scanned is changed between variants.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**):

- **Setup** tab
- **Filters** tab
- **Advanced** tab
- **Path Definition** tab
- **Scan Path** tab
- **Execution** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Free Form Plane Scan Strategy

You can use the **Setup** tab for the Adaptive Free Form Plane Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

The options are:

- Polished
- Machined
- Ground
- Cast

Advanced Tab - Adaptive Free Form Plane Scan Strategy

You can use the **Advanced** tab for the Adaptive Free Form Plane Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

Type or select the level of force to maintain during a scan. The value is specified in newtons.

Filters Tab - Adaptive Free Form Plane Scan Strategy

You can use the **Filters** tab for the Adaptive Free Form Plane Scan strategy to set up filters.

Outlier

PC-DMIS first fits a plane to the data and then determines which points are outliers based on the standard deviation multiple. It then does the following:

- Recalculates the best fit plane with those outliers removed.
- Checks for outliers again.
- Recalculates the best fit plane.
- Continues repeating this process until no more outliers exist or until PC-DMIS cannot compute the plane. (PC-DMIS cannot compute the plane if there are fewer than three data points.)

Filter

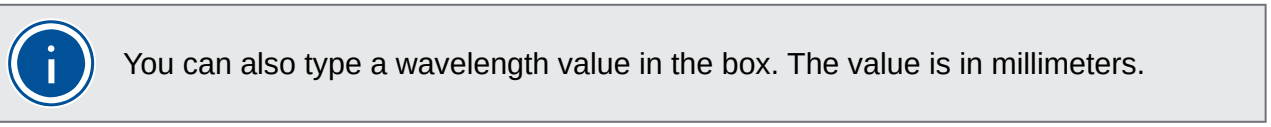
The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

Wave Length (mm)

Oscillations in data smaller than the value you select in the list are smoothed when applying the linear Gaussian filter. This applies to lines and planes.



This option is hidden if you select **None** in the **Filter** list.

Path Definition Tab - Adaptive Free Form Plane Scan Strategy

Use the **Path Definition** tab for the Adaptive Free Form Plane Scan strategy to generate a scan path.

Type

The scan path can be generated by the following types of methods:

- Perimeter Paths
- Free Form Paths
- Teach Path

Points List Area

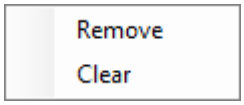
The points list area displays the points that you select on the CAD model or take manually with the CMM (for the Teach Path type only).

- Displays a number or letter that identifies the point.

X, **Y**, **Z** - The X, Y, and Z values appear in this area.

Pt. Type - This column indicates the type of point for the Teach Path method of generating the scan path.

To delete points, right-click in the points list area. The **Remove** and **Clear** options appear:



Points options

Remove - To delete one point, highlight it in the points list area, right-click, and then select this option.

Clear - To delete all points, right-click in the points list area and then select this option. When the **Remove all points?** message appears, click **OK**.

>>

To set additional properties for the type you selected and generate the scan path, click this button.

<<

To return to the points list area, click this button.

Perimeter Paths

This method generates the scan path along the perimeter of the surface. It requires CAD.

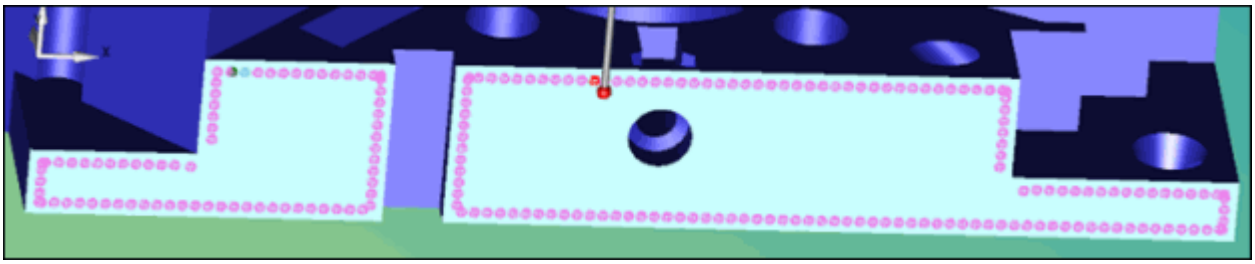
Generating a Default Perimeter Scan Path

You can generate a default perimeter scan path for a given plane. The start point of the default path is the edge closest to the point (centroid) of the selected plane. The direction of the scan is counterclockwise in a given plane. The start and end points for scan are the same. The default path generation will use the parameter set in the second screen of

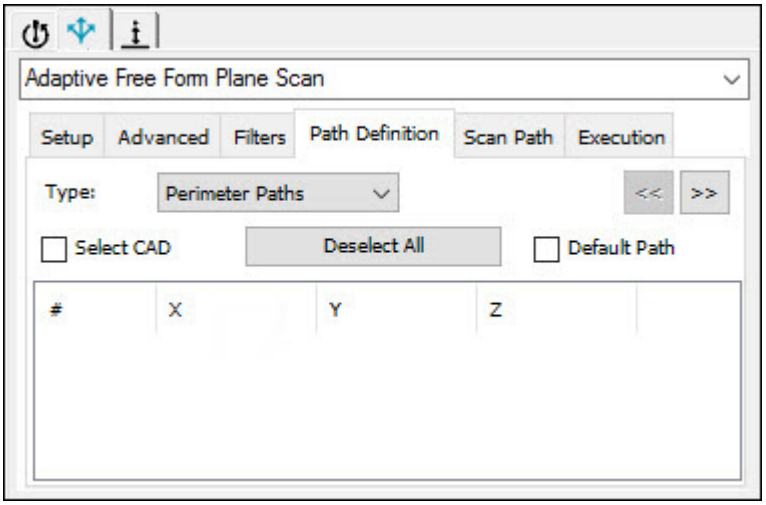
definition of path generation. When you select **Create**, the **Scan Path** tab is filled up with the default path.

Selecting Multiple Surfaces of a Plane

A perimeter path supports planes that are separated.



Example of front face on demo block



Path Definition tab

To select multiple surfaces of a plane:

1. Select the **Select CAD** check box.
2. If required, click **Deselect All** to deselect any selected surfaces.
3. Click on the first surface. PC-DMIS highlights the surface.
4. Click on the second surface. PC-DMIS highlights the surface.

   If the first and second surfaces are separated, then PC-DMIS automatically selects the **Default Path** check box. The default path on each selected surface will be generated.
5. Select any more surfaces by clicking on them.

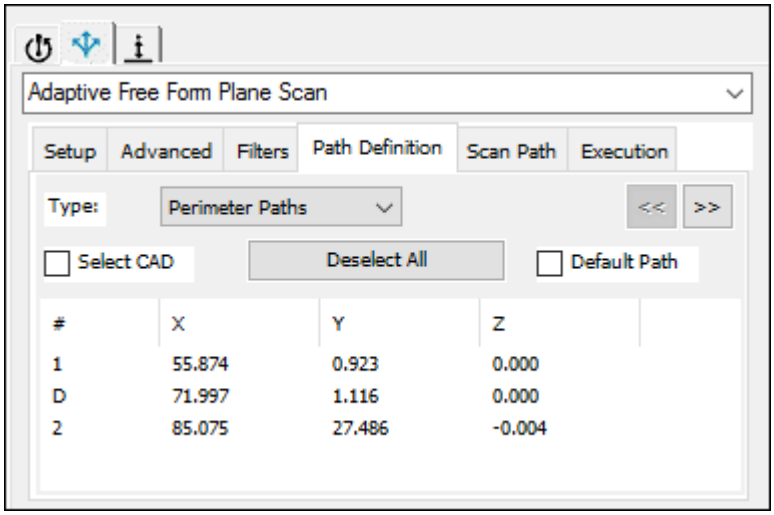
   PC-DMIS completes the **Scan Path** tab when you select **Create**.

Generating a Perimeter Path by Selection

You can generate a perimeter path by selecting the start, direction, and end point on any one CAD surface, or by selecting the start and direction point on any one CAD surface to generate a closed scan path.

1. Do one of the following:

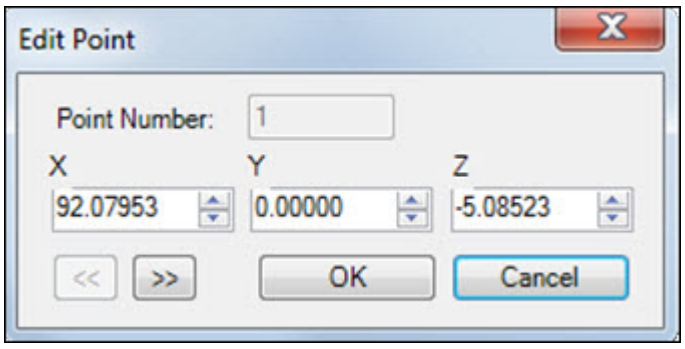
   - To define the start point, direction point, and end point, click on three points on the CAD. The points appear in the points list area. In the # column, 1 = start point, D = direction point, and 2 = end point.



Sample Path Definition tab

   - To define the start point and direction point, click on two points on the CAD. The points appear in the points list area. In the # column, 1 = start point and D = direction point. When point 2 (the end point) is not defined, PC-DMIS uses point 1 to create a closed path.

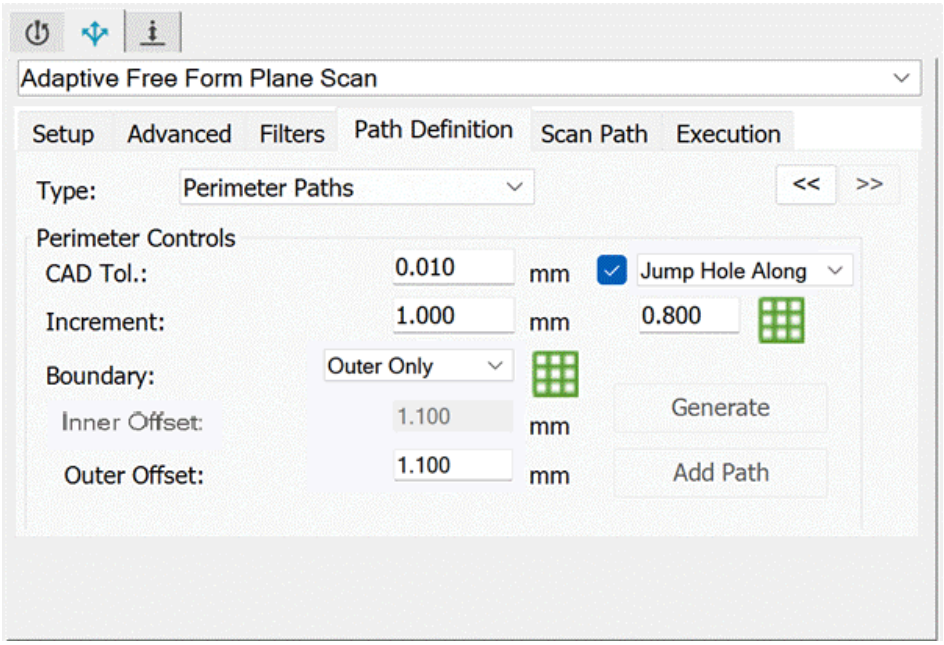
     If you need to edit a point, double-click the point. The **Edit Point** dialog box appears.



Edit Point dialog box

     Change the values as required. To navigate to and modify points, click **>>**.

2. To set perimeter controls, click **>>**. The **Perimeter Controls** area appears. Use the properties in this area to control perimeter point generation.



Sample Perimeter Controls area

CAD Tolerance - Type the tolerance that the point locating algorithm uses.

Increment - Type the minimum distance between adjacent points.

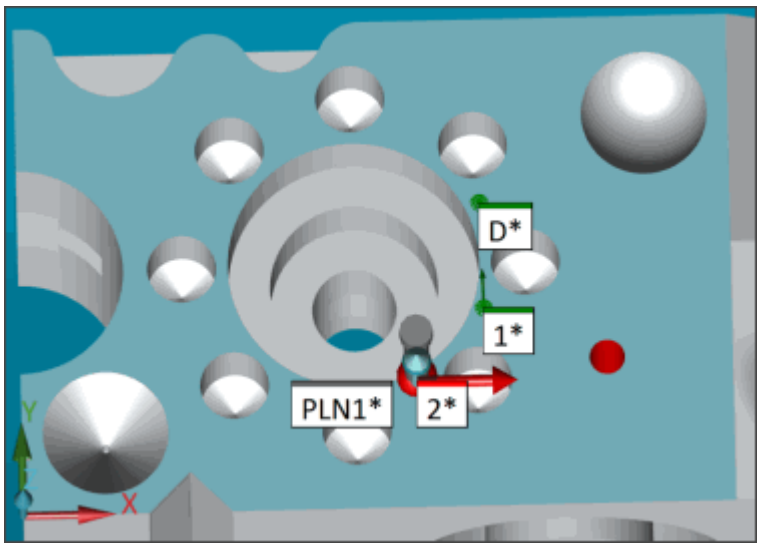
Boundary Type - Select the boundary type on the selected surface that you want PC-DMIS to consider in the path calculation:

- **Inner Only** - PC-DMIS uses the inner boundaries to generate the scan path.
- **Inner and Outer** - PC-DMIS uses the inner boundary or outer boundary based on the hits taken to generate the scan path.
- **Outer Only** - PC-DMIS uses the outer boundaries to generate the scan path.

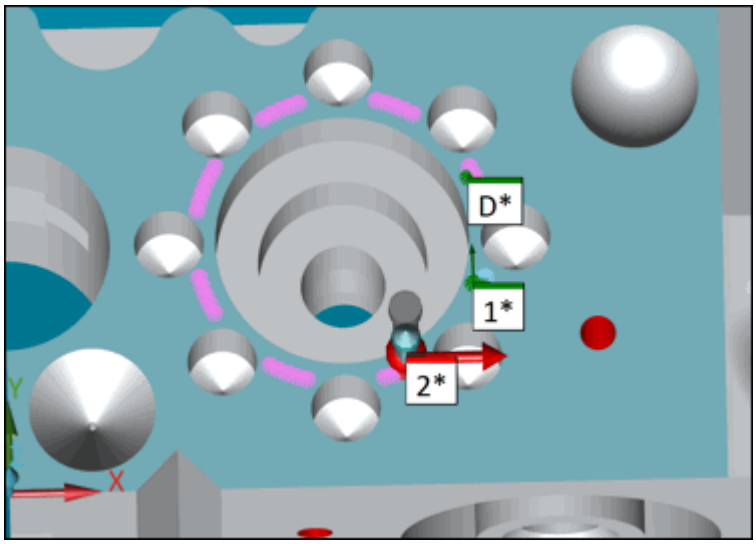
  Inner Offset - Use this option to generate the scan path along the inner boundary. Type the desired distance of the scan path from the boundary.

  Outer Offset - Use this option to generate the scan path along the outer boundary. Type the desired distance of the scan path from the boundary.

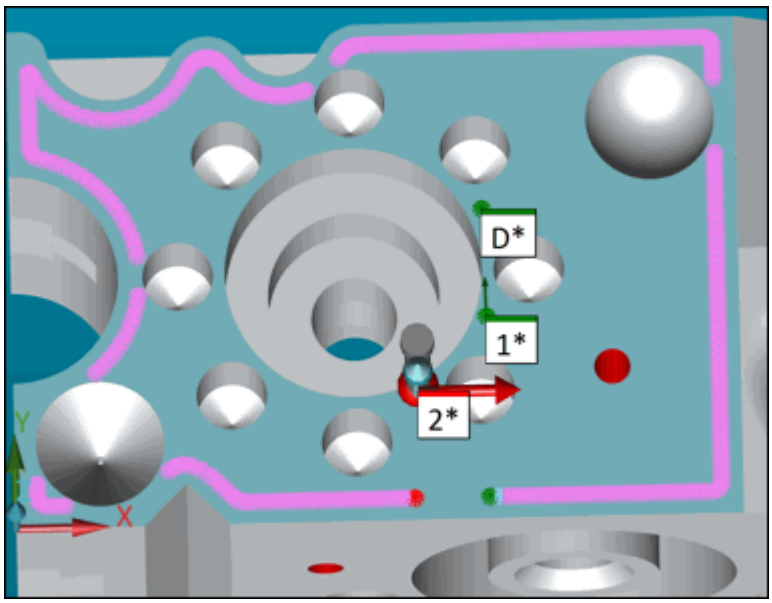
If there are multiple inner boundaries and you want to scan a specific one, we recommend you define points 1, D, and 2 near the inner boundary that you want to scan. For example, suppose you take points 1, D, and 2, as shown in this image:



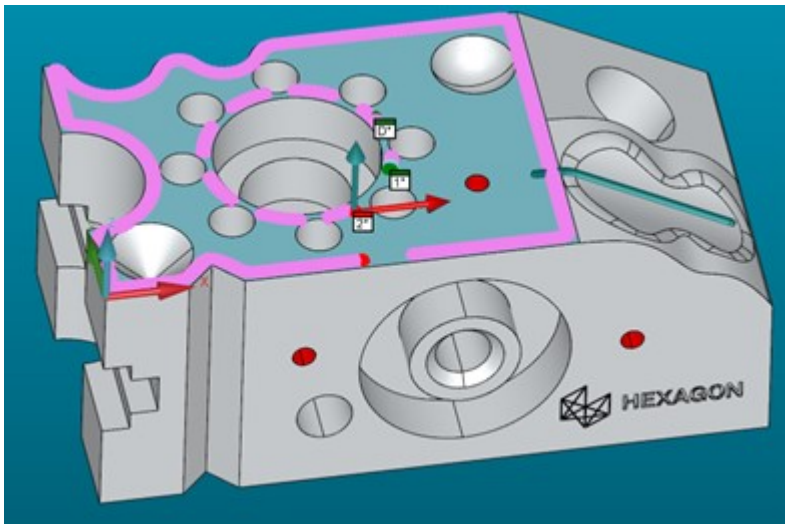
If you select **Inner Only**, PC-DMIS generates the scan path as follows:



If you select **Outer Only**, PC-DMIS generates the scan path as follows:



If you select **Inner and Outer**, PC-DMIS generates the scan path as follows:



Jump Hole Type - Select the jump hole type that you want PC-DMIS to consider during path generation.

- **Jump Hole Along** - If you select this check box, PC-DMIS creates a break point in the scan path only when a scan path point falls within a hole on the CAD surface. Type the required distance from the edge in the box.
- **Jump Hole Around** - If you select this check box, PC-DMIS looks for holes in all directions (360 degrees) around the scan path and creates a break point when it detects a hole. Type the required distance from the edge in the box.

Smart Calculations - Smart calculations are available for offset and jump holes, as indicated by a grid button next to these options. Smart calculations take into consideration the tip's radius, dynamically sets the offset to the tip radius, and adds a 0.1 mm safety distance. It also sets the jump hole distance to half of the offset distance.

A grey, crossed-out grid button indicates that smart calculations are turned off, while a green grid button indicates they are turned on. By default, smart calculations are turned on. However, if you enter a value other than the calculated one, PC-DMIS turns off smart calculations.

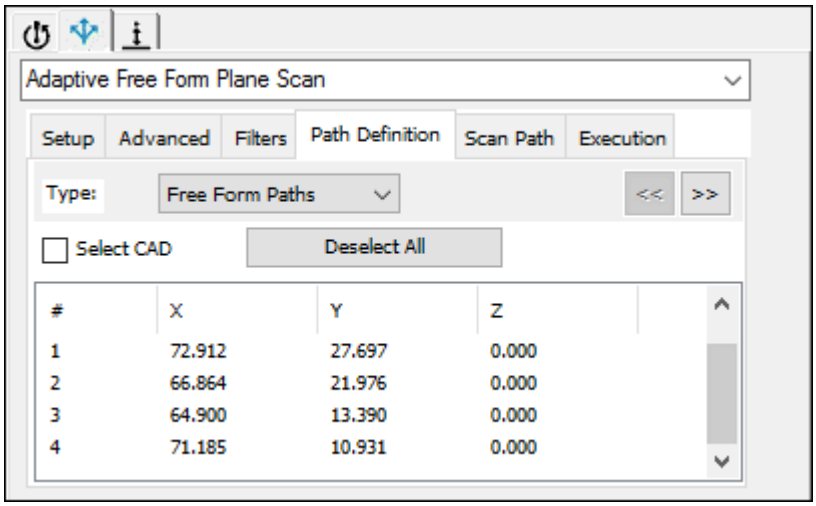
Generate - To generate the points and display them in the points list area, click this button. PC-DMIS shows the generated path on the CAD in the Graphic Display window. You can change the start point, direction point, and end point and then regenerate the scan path, if required.

Add Path - To add the points to the **Scan Path** tab, click this button.

Free Form Paths

This method generates the scan path along the path of the points defined. It requires CAD. To generate the scan path using this method:

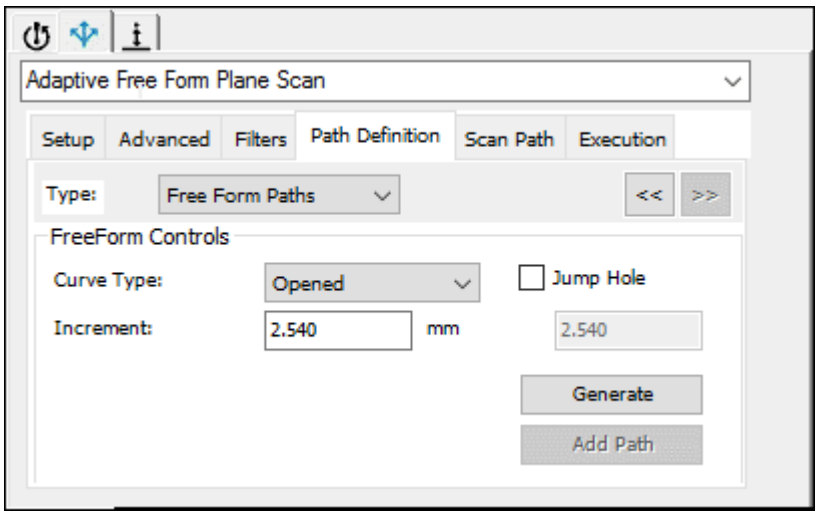
1. Click on the CAD to define the free form path. A minimum of five points must be recorded to calculate the scan path. The points appear in the points list area.



Sample Path Definition tab

The # column lists the number that identifies the point. To edit a point, double-click it. The **Edit Point** dialog box appears. Change the values as required. To navigate to and modify points, click **>>**.

2. To set free-form path controls, click **>>**. The **FreeForm Controls** area appears. Use the properties in this area to control free-form point generation:



Sample Free Form Controls area

Curve Type - Select the type of path to generate: open or closed.

Increment - Type the minimum distance between adjacent points.

Jump Hole - If you select this check box, PC-DMIS generates a break point in the scan path whenever the scan path is over the holes in the CAD surface. Type the required distance from the edge in the box.

For tactile probes, the **Jump Hole** check box on the **Path Definition** tab is always selected. This is because the probe lifts between the scans on each polyline. For spot laser probes, the **Jump Hole** check box is available for selection, and PC-DMIS uses its last-used value. For more information about the check box, see the "Theoretical Path Area" topic in the PC-DMIS Core documentation.

The **Jump Hole** check box is not used for laser probes.

Generate - To generate the points and display them in the points list area, click this button. PC-DMIS shows the generated path on the CAD in the Graphic Display window. You can change the points defining the free form path and then regenerate the scan path, if required.

Add Path - To add the points to the **Scan Path** tab, click this button.

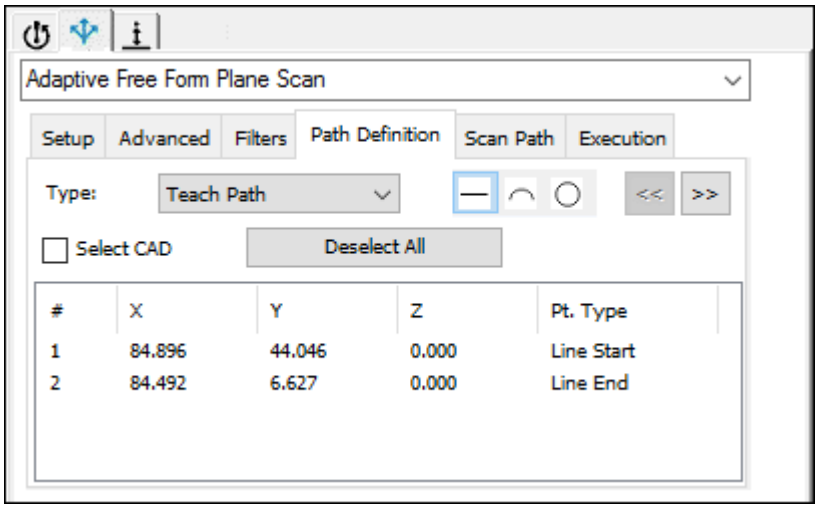
Teach Path

You can generate this type of scan path by taking hits on the CMM or CAD to teach or learn the path. The scan path is made of lines, arcs, and/or circles.

For help with generating a teach path, refer to the example of a detailed procedure in the "Sample Teach Path for Adaptive Free Form Plane Scan Strategy" topic for scanning the top surface along a specific path.

To define the teach path:

1. Select the button for the type of path:
   - **Line**
   - **Arc**
   - **Circle**
2. For a line path, take one or two manual hits. For an arc path or a circle path, take two or three manual hits. The points appear in the points list area. For example:



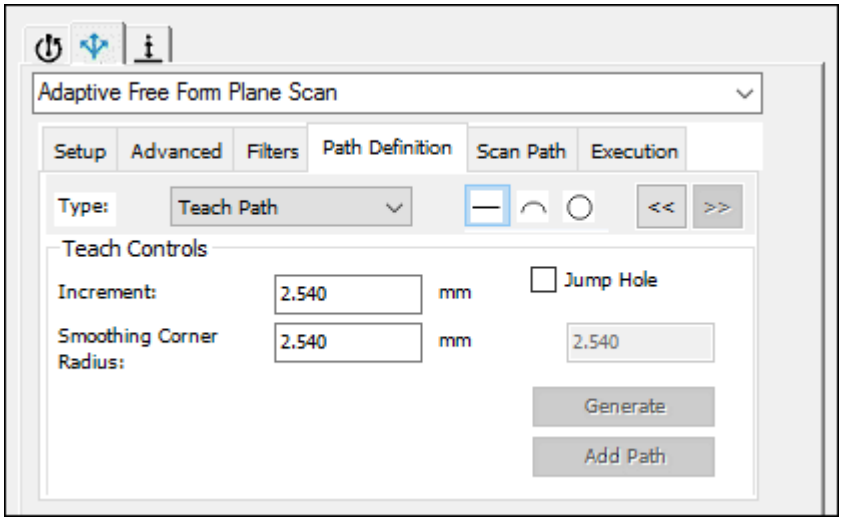
Sample Path Definition tab - Line path

The following items apply to the points list area:

- The # column lists the number that identifies the point. The **Pt. Type** column describes the type of point, such as: Line Start, Line End, Circle End, or Circle Midpoint<number>.
- Red points indicate that the path is incomplete. PC-DMIS does not use these points to generate the path. If you change the path type (for example, from a line to an arc), the red point(s) will be removed.
- To edit a point's X, Y, and Z values, double-click the point. The **Edit Point** dialog box appears.

If you edit the start point or the end point of a circle path, both points will change because they are the same point.

3. To set teach controls, click **>>**. The **Teach Controls** area appears. Use the properties in this area to control point generation:



Sample Teach Controls area

Increment - Type the minimum distance between adjacent points.

Jump Hole - When you select this option, PC-DMIS generates a break point in the scan path whenever the scan path is over the holes in the CAD surface. Type the required distance from the edge in the box.

> For tactile probes, the **Jump Hole** check box on the **Path Definition** tab is always selected. This is because the probe lifts between the scans on each polyline. For spot laser probes, the **Jump Hole** check box is available for selection, and PC-DMIS uses its last-used value. For more information about the check box, see the "Theoretical Path Area" topic in the PC-DMIS Core documentation.
>
> The **Jump Hole** check box is not used for laser probes.

Smoothing Corner Radius - When PC-DMIS generates a scan path, the intersections will have sharp corners. A sharp corner requires the controller to slow down the scan speed. Smoothing the corner radius helps to smooth out the sharp corner. PC-DMIS defines the circle with the center as the intersection point, and the radius as entered in this box. PC-DMIS smooths out all of the points in the scan path found within this circle.

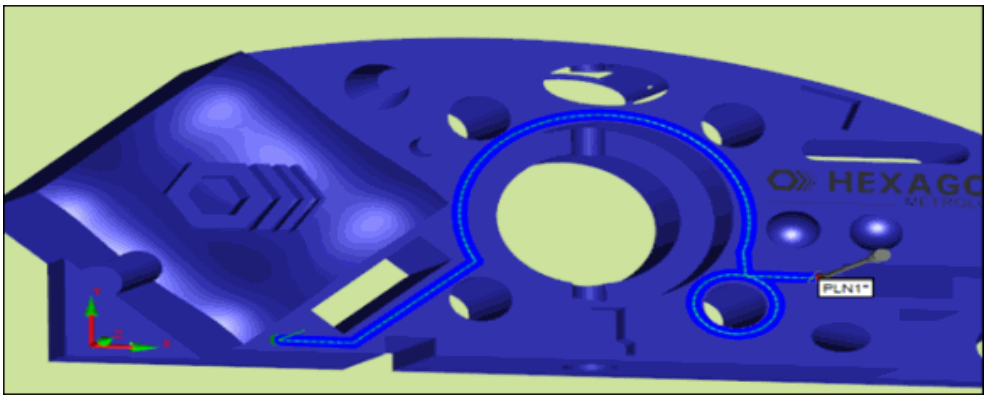
Generate - To generate the points and display them in the points list area, click this button. PC-DMIS shows the generated path on the CAD in the Graphic Display window. You can change the points that define the teach path and then regenerate the scan path, if required.

Add Path - To add the points to the **Scan Path** tab, click this button.

Sample Teach Path - Adaptive Free Form Plane Scan Strategy

This example of the teach path method for the Adaptive Free Form Plane Scan strategy shows a detailed procedure for scanning the top surface along a specific path.

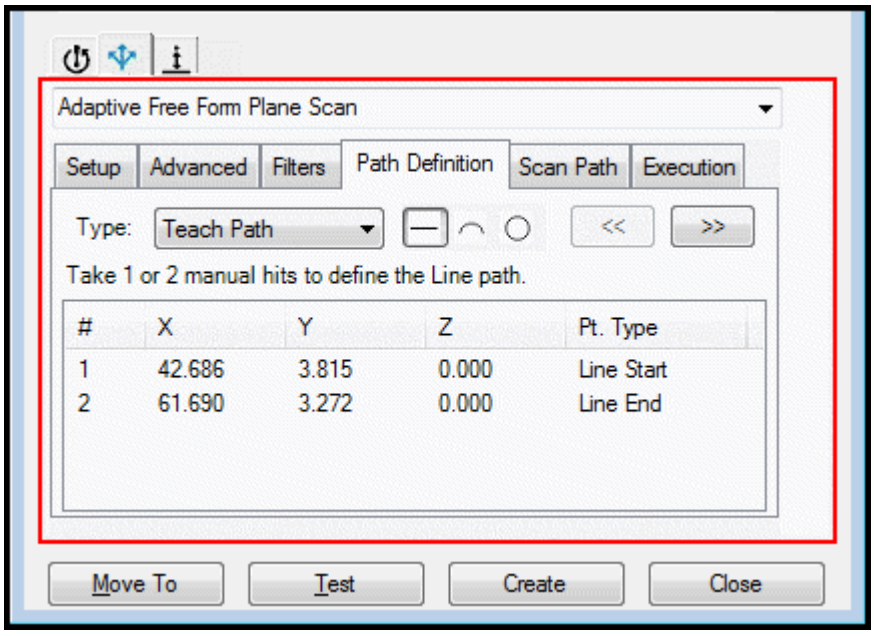
In this example, suppose that you want to scan the top surface along the path shown below:



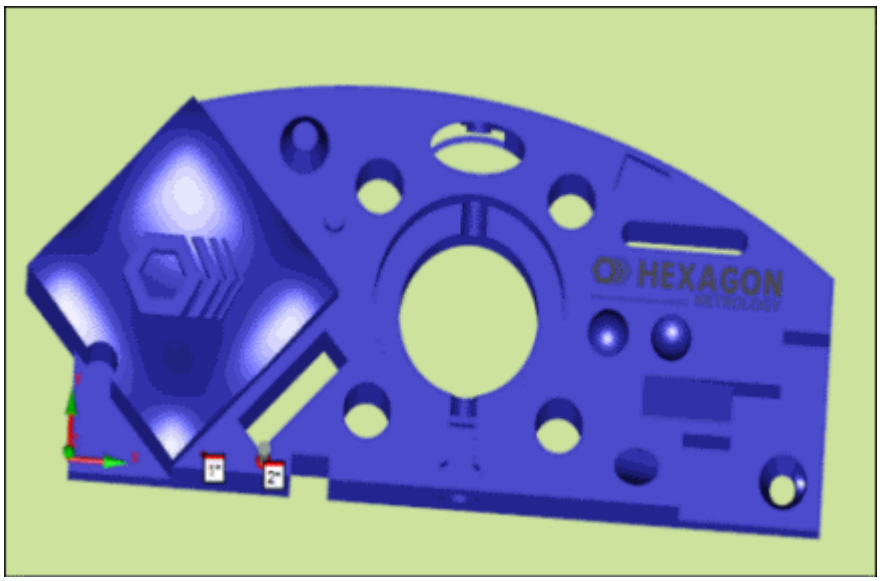
Scan path

To generate this path, take the hits to define the points as described below. The points are recorded in the list of points on the **Path Definition** tab. They are marked on the CAD as shown in the procedure.

1. The first segment in the path is linear. To generate this line:
    a. Select the ⊟ button.
    b. Because this is the first segment, take two hits to define points 1 and 2 for the line.



Points 1 and 2 in first segment

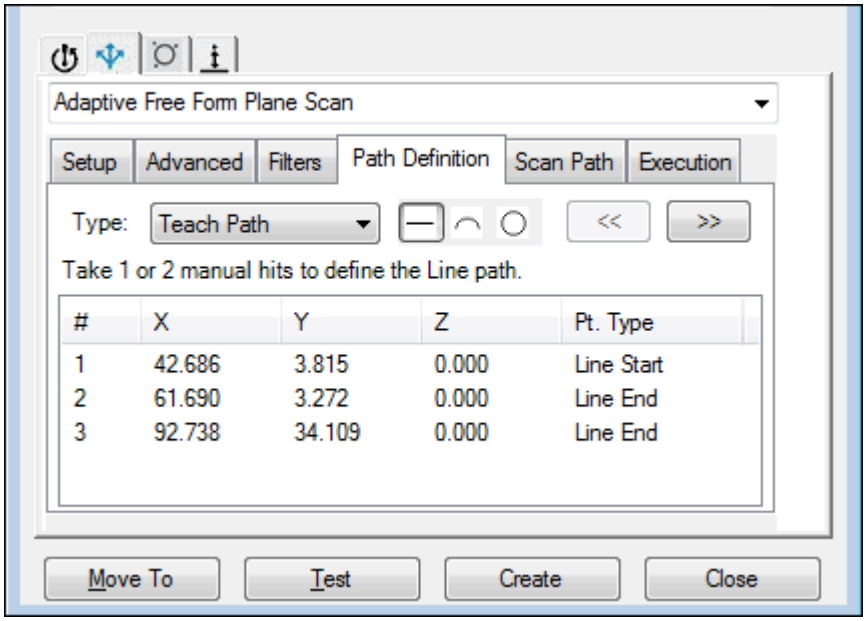


Points 1 and 2 marked on CAD

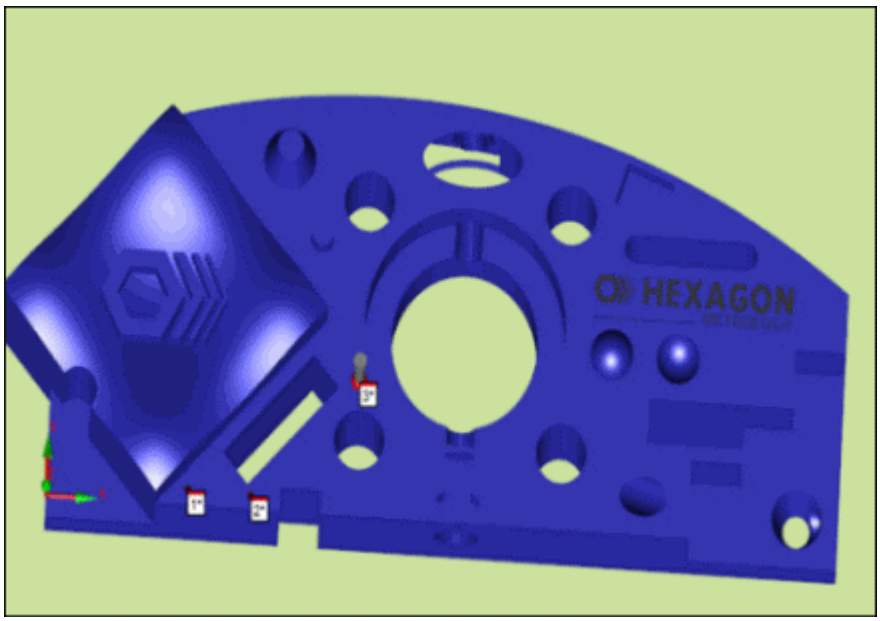
2. The second segment in the path is also linear. Point 2 (the last point of the first segment line) is the start point of the second segment line. To generate this line:

   a. Keep the ⊟ button selected.

   b. Take one hit to define point 3, the end point of the line for the second segment.



Point 3 in second segment

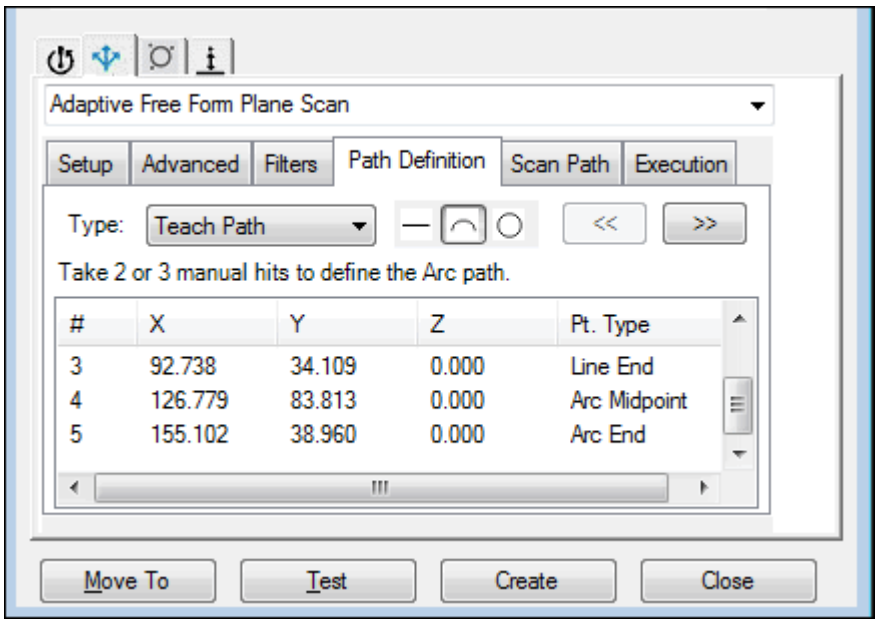


Point 3 marked on CAD

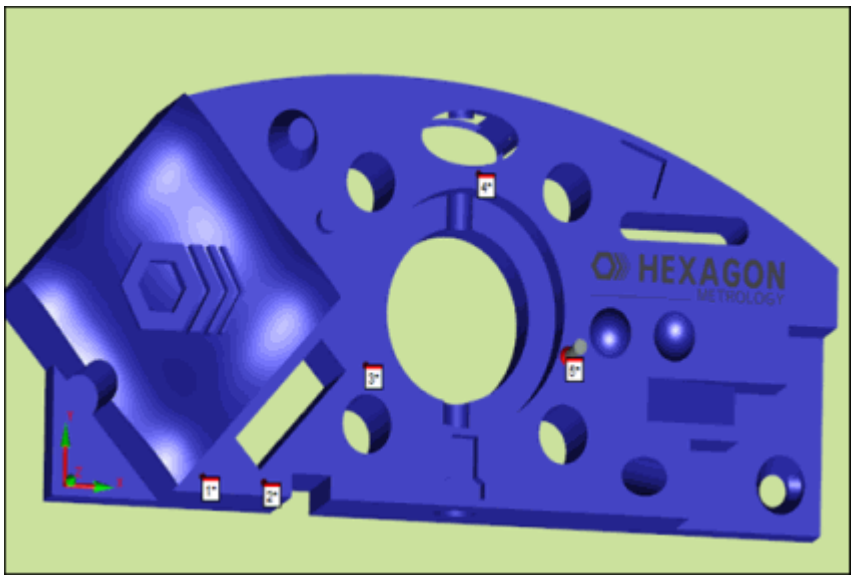
3. The third segment in the scan path is an arc along the big circle. Point 3 (the last point of the second segment line) is the start point of the arc. The last point is the end point of the arc. To generate this arc:

    a. Select the button.

    b. Take two more hits on the arc to define points 4 and 5.



Points 4 and 5 in third segment

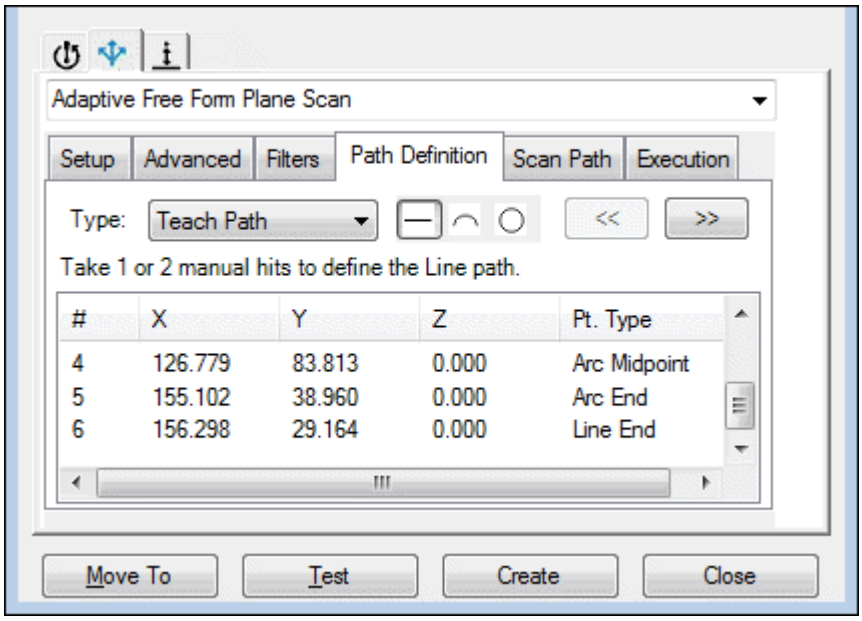


Points 4 and 5 marked on CAD

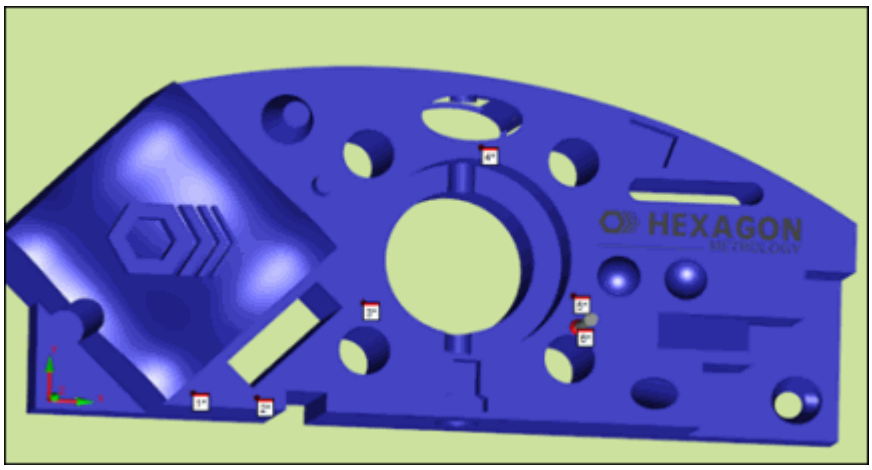
4. The fourth segment is a line. The end point of the arc becomes the start point of the line. To generate this line:

   a. Select the ⊟ button.

   b. Take one hit to define point 6, the end point of the line for the fourth segment.



Point 6 in fourth segment

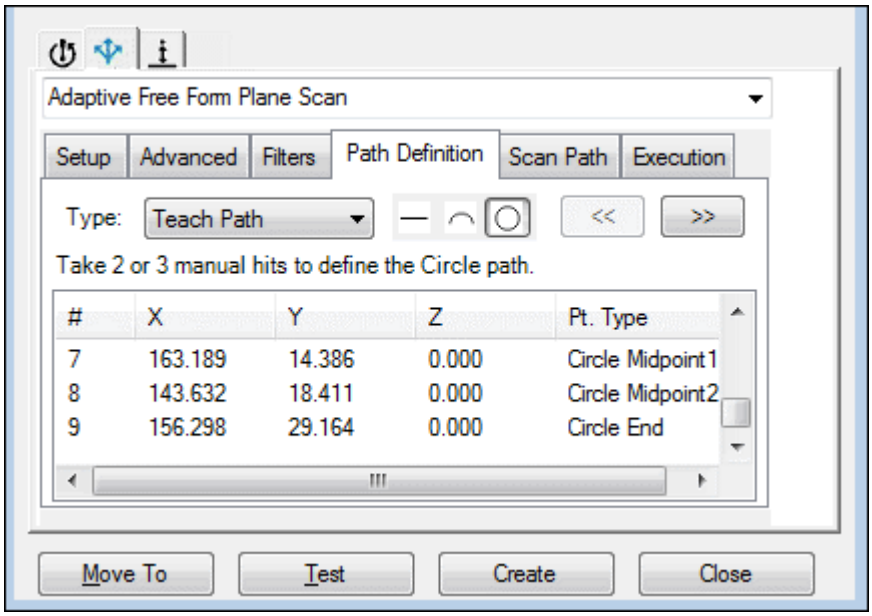


Point 6 marked on CAD

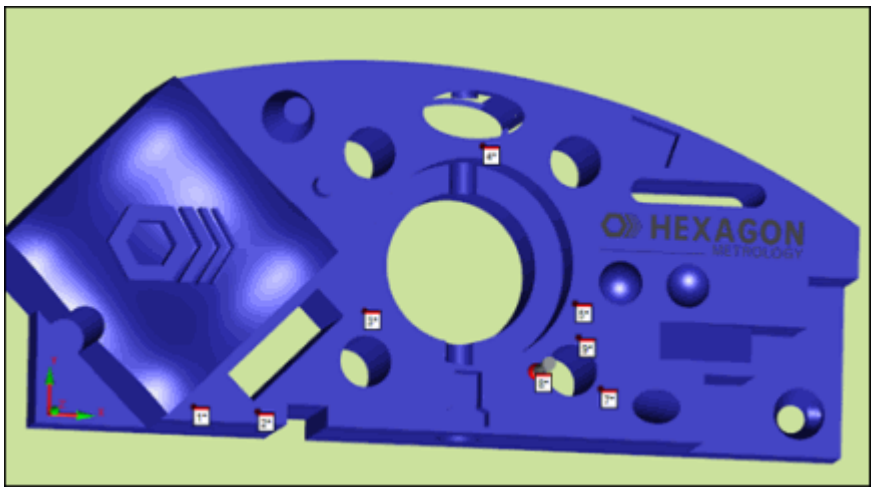
5. You now need to scan 360 degrees around the small circle. The end point of the line of the fourth segment becomes the start point of the circle. To generate this circle:

   a. Select the ◯ button.

   b. Take two more hits to define points 7 and 8 for the circular path. Because a circle is 360 degrees, point 9 - the end point of the circle - is automatically recorded at the same location as the start point of the circle.



Points 7 through 9 in circle

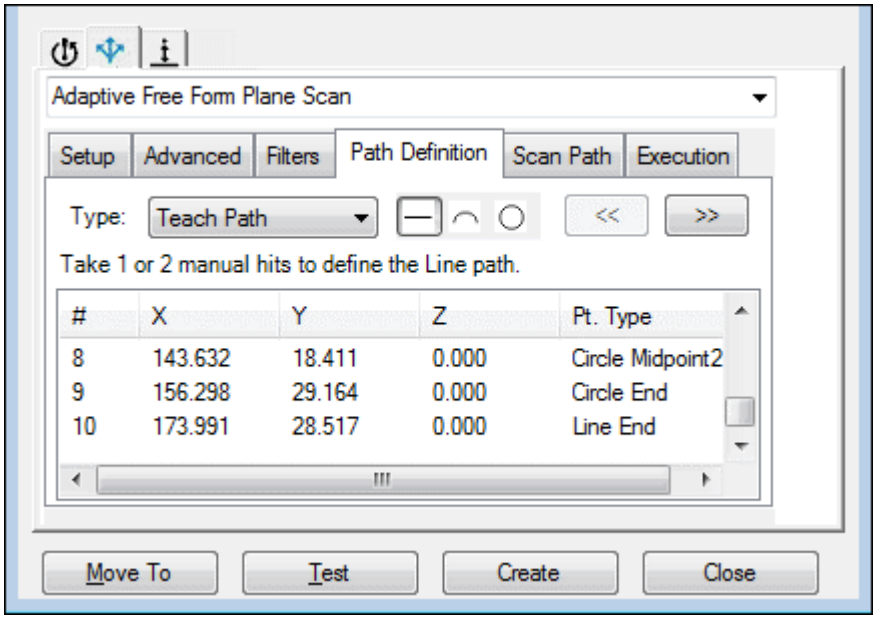


Points 7 through 9 marked on CAD

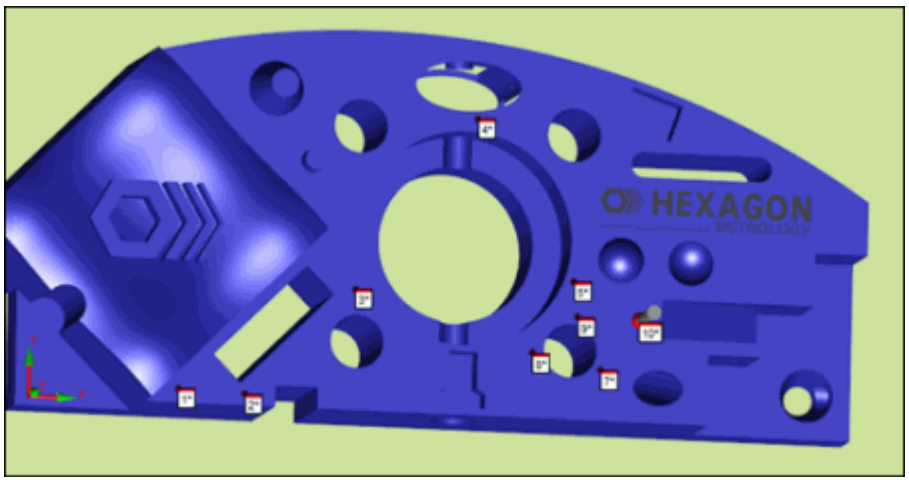
6. The last segment is a line. Point 9, the end point of the circle, becomes the start point of the line. To generate this line:

   a. Select the ⊟ button.

   b. Take the last hit to define point 10, which completes the scan path.

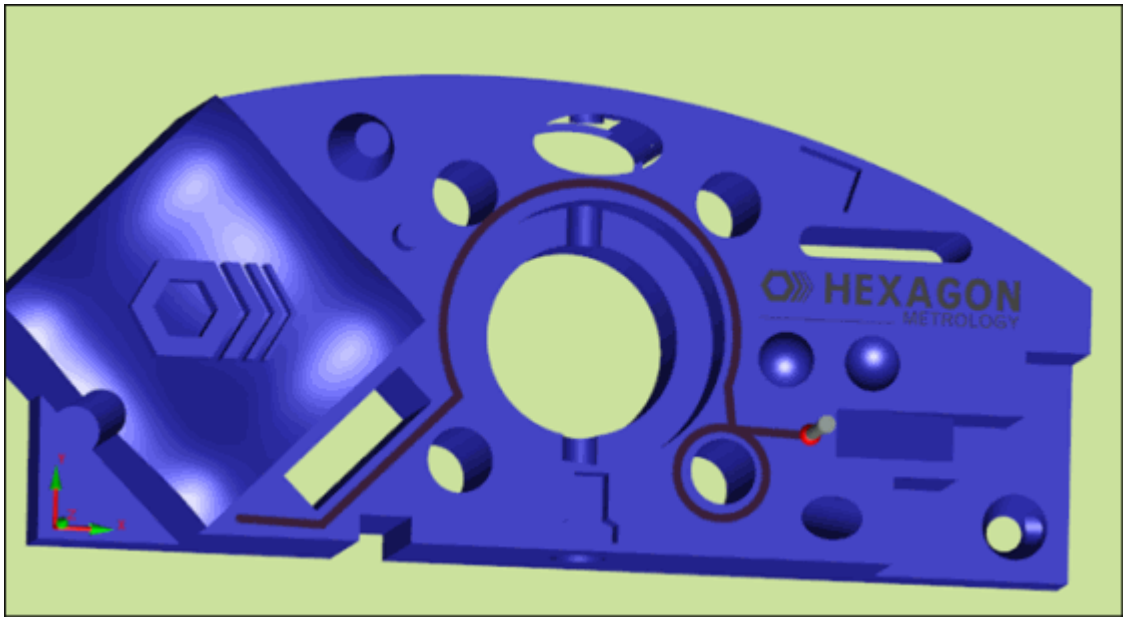


Point 10 in last segment



Point 10 marked on CAD

7. Select the **>>** button. In the **Teach Controls** area, in the **Increment** box, type 1.
8. Click **Generate**. The generated scan path appears in the Graphic Display window.



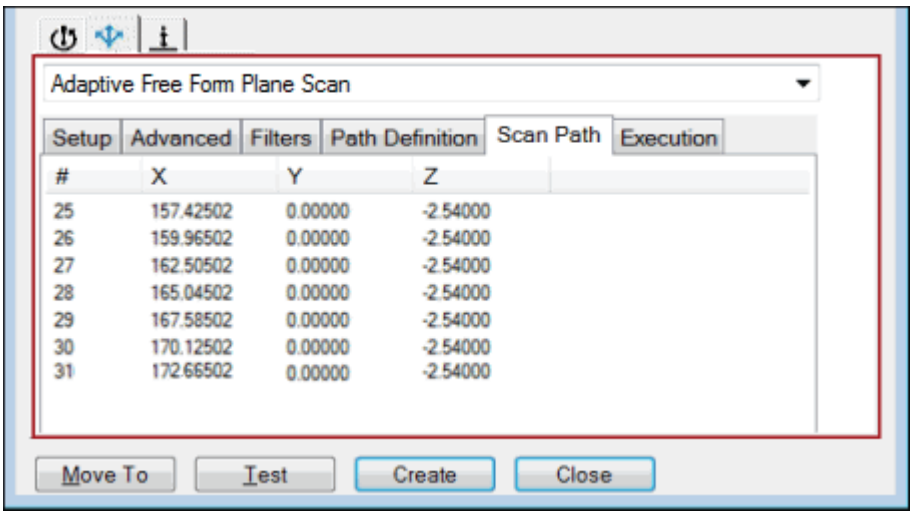
Generated scan path

Scan Path Tab - Adaptive Free Form Plane Scan Strategy

You can use the **Scan Path** tab for the Adaptive Free Form Plane Scan strategy to do the following:

- Display scan points and move points
- Import scan points and move points from a text file
- Export scan points and move points to a text file
- Insert a move point or break point

Following is an example:

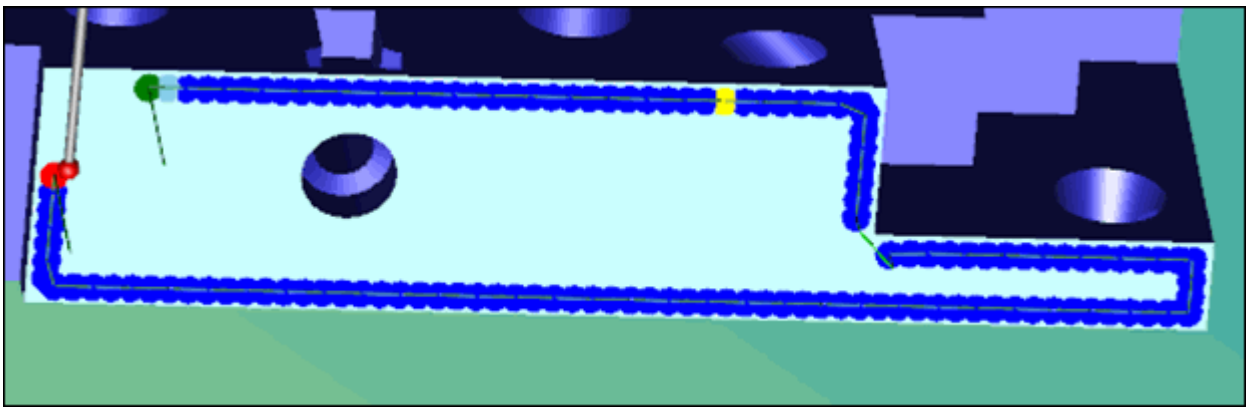


Sample Scan Path tab

The following items appear in the points list area:

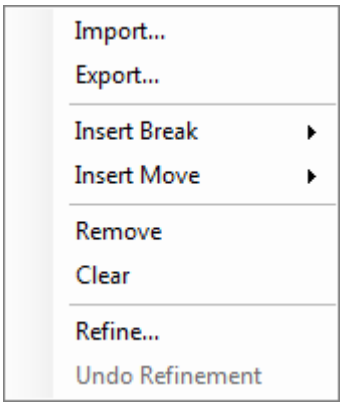
- # - A number that identifies the generated point
- **X**, **Y**, and **Z** - The XYZ values

When you click on any point in the scan path, PC-DMIS highlights the point on the CAD surface. For example:



Example of highlighted point on CAD surface

To perform additional functions, right-click in the points list area. The following options appear:



Points List options

Import

To import the scan points and move points from a text file, select this option. The path of the scan can be dynamically read from a text file when you run the measurement routine. This can help to scan the plane on variants of the part where the shape of the face being scanned is changed between variants.

Following is a sample of a partial text file:

```
-32.23,14.067,-0.001,SCAN
-29.2,6.684,-0.006,SCAN
-24.389,1.846,-0.008,SCAN
-19.309,-3.982,-0.004,SCAN
-15.327,-8.125,-0.004,SCAN
-9.949,-9.576,-0.004,SCAN
-4.838,-11.112,-0.001,SCAN
6.786,-10.431,-0.005,SCAN
12.121,-4.769,-0.003,SCAN
17.941,1.332,-0.005,SCAN
21.889,7.432,-0.002,SCAN
26.623,10.02,-0.004,SCAN
0,0,0,BREAK
27,10,50,MOVE
30.361,9.192,-0.003,SCAN
```

In this sample:

- SCAN - Indicates a point that will be added to the scan.
- BREAK - Indicates a move to the Retract, and then another scan will begin at the next SCAN point.
- MOVE - Indicates a move to the location specified.

Export

To export the scan path to a text file, select this option.

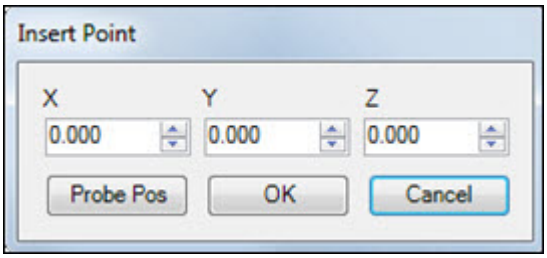
Insert Break

To insert a break between scan points, select this option. As a result, PC-DMIS will send multiple scan commands to the controller. Break points in the scan path can help to scan a face as one single plane even if the path is not continuous for any reason. The scan will do the following:

1. Retract off the part based on the current value for the Retract parameter.
2. Move to the next scan point at a prehit distance based on the current value for the Prehit parameter.
3. Begin the next scan.

Insert Move

To insert a move point to avoid an obstacle, select this option. Move points in the scan path can help to scan a face as one single plane even if the path is not continuous for any reason. The **Insert Point** dialog box appears:



Insert Point dialog box

You can position the probe and click **Probe Pos** to insert a move point at that location.

Remove

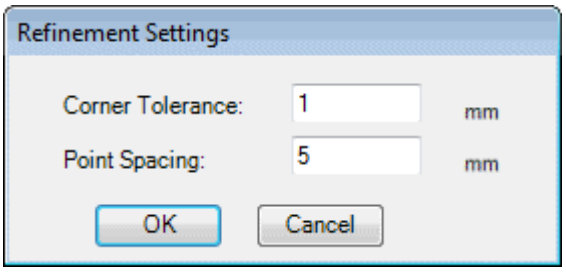
To delete one point, highlight it in the points list area, right-click, and then select this option.

Clear

To delete all points, right-click in the points list area and then select this option. When the "Remove all points?" message appears, click **OK**.

Refine

To vary the point density of the path based on the curvature of the path, select this option to display the **Refinement Settings** dialog box:



Refinement Settings dialog box

Corner Tolerance - The path regions with curvatures less than the value you type in this box will be converted into arc-segments.

Point Spacing - Type the maximum distance between adjacent points for linear portions of the path.

Undo Refinement

To undo the changes that you made in the **Refinement Settings** dialog box, select this option.

Execution Tab - Adaptive Free Form Plane Scan Strategy

Use the **Execution** tab for the Adaptive Free Form Plane Scan strategy to set additional options for this strategy.

Read File Prior To Execution

To read the scan path prior to execution from a text file, select this check box. This will help to measure the variants of a part.

File Name

Type the path and name of the file to be read in prior to execution. To select the file, click **Browse**.

Prehit / Retract Dist.

Type the distance of a prehit and retract move for each scan segment. A value of 0.0 disables these moves.

Probing Period

This property applies only to B3 controllers (non-VHSS scans). It controls the number of milliseconds between path points.

Adaptive Plane Circle Scan Strategy

The Adaptive Plane Circle Scan strategy for the Plane Auto feature measures the plane by scanning it on a circular path.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**):

- **Setup** tab
- **Filters** tab
- **Advanced** tab
- **Path Definition** tab
- **Scan Path** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Plane Circle Scan Strategy

You can use the **Setup** tab for the Adaptive Plane Circle Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

The options are:

- Polished
- Machined
- Ground
- Cast

Select Center

The option enables you to click on the CAD to indicate the center point. You can select a surface point or a wireframe point. PC-DMIS fills in the **Feature properties** area in the **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**) with the information for the selected point. It also completes the **First Diameter** box on the **Path Definition** tab.

Advanced Tab - Adaptive Plane Circle Scan Strategy

You can use the **Advanced** tab for the Adaptive Plane Circle Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

Type or select the level of force to maintain during a scan. The value is specified in newtons.

Filters Tab - Adaptive Plane Circle Scan Strategy

You can use the **Filters** tab for the Adaptive Plane Circle Scan strategy to set up filters.

Outlier

PC-DMIS first fits a plane to the data and then determines which points are outliers based on the standard deviation multiple. It then does the following:

- Recalculates the best fit plane with those outliers removed.
- Checks for outliers again.
- Recalculates the best fit plane.
- Continues repeating this process until no more outliers exist or until PC-DMIS cannot compute the plane. (PC-DMIS cannot compute the plane if there are fewer than three data points.)

Filter

The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

Wave Length (mm)

Oscillations in data smaller than the value you select in the list are smoothed when applying the linear Gaussian filter. This applies to lines and planes.

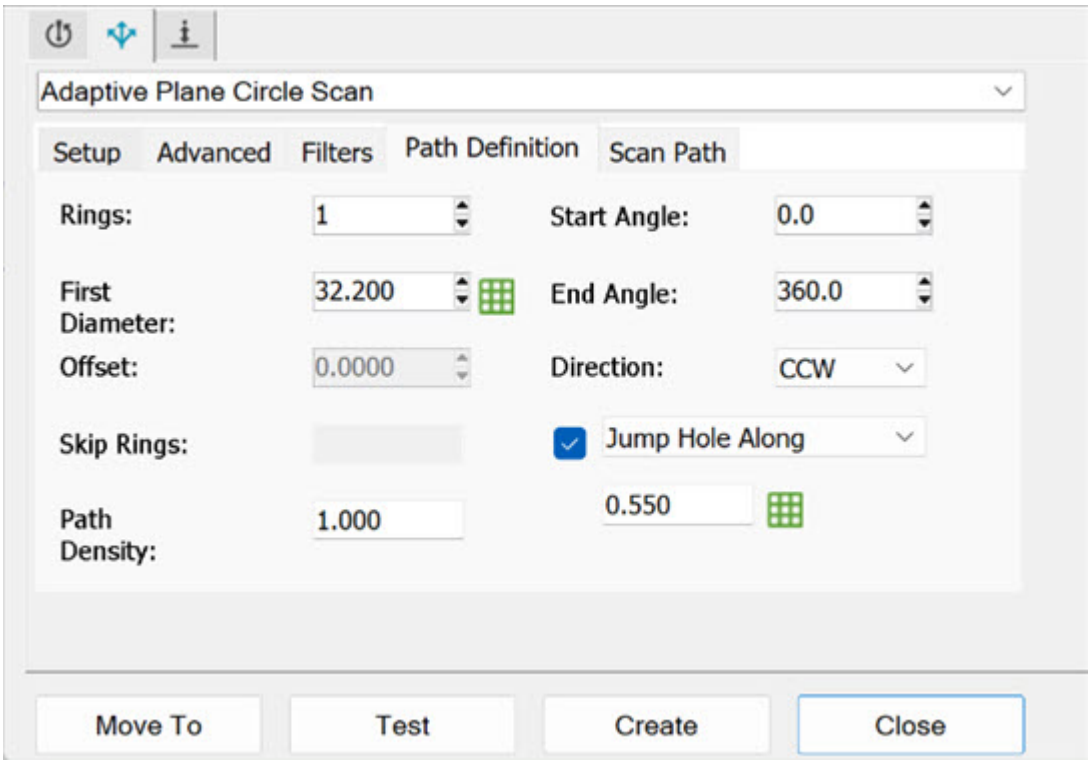


You can also type a wavelength value in the box. The value is in millimeters.

This option is hidden if you select **None** in the **Filter** list.

Path Definition Tab - Adaptive Plane Circle Scan Strategy

You can use the **Path Definition** tab for the **Adaptive Plane Circle Scan** strategy to define additional options for a circular scan path. You can view the scan path whenever you update a path definition parameter. You can also view the updated scan path in the Graphic Display window.



Rings - Type or select the number of rings.

First Diameter - Type the diameter of the first ring.

Offset - Type the distance between two rings.

Skip Rings - Type the ring number or numbers that you want to skip.

To skip rings 2 and 4, type **2,4**. To skip rings 2 through 5, type **2-5**.

Path Density - Type the number of points per mm that you want to use to create the scan path.

Start Angle - Type or select the start angle, in decimal degrees.

End Angle - Type or select the end angle, in decimal degrees.

Direction - Select **CW** (clockwise) or **CCW** (counterclockwise).

Jump Hole Type - Select the jump hole type that you want PC-DMIS to consider during path generation.

- **Jump Hole Along** - If you select this check box, PC-DMIS creates a break point in the scan path only when a scan path point falls within a hole on the CAD surface. Type the required distance from the edge in the box.
- **Jump Hole Around** - If you select this check box, PC-DMIS looks for holes in all directions (360 degrees) around the scan path and creates a break point when it detects a hole. Type the required distance from the edge in the box.

Smart Calculations - Smart calculations are available for First Diameter and Jump Holes, indicated by a grid button next to these options. Smart calculations take into consideration the tip's radius, dynamically adds the tip's diameter to the first circle's diameter, and adds a 0.2 mm safety distance. It also sets the jump hole distance to half of tip radius plus 0.1 mm, divided by two.

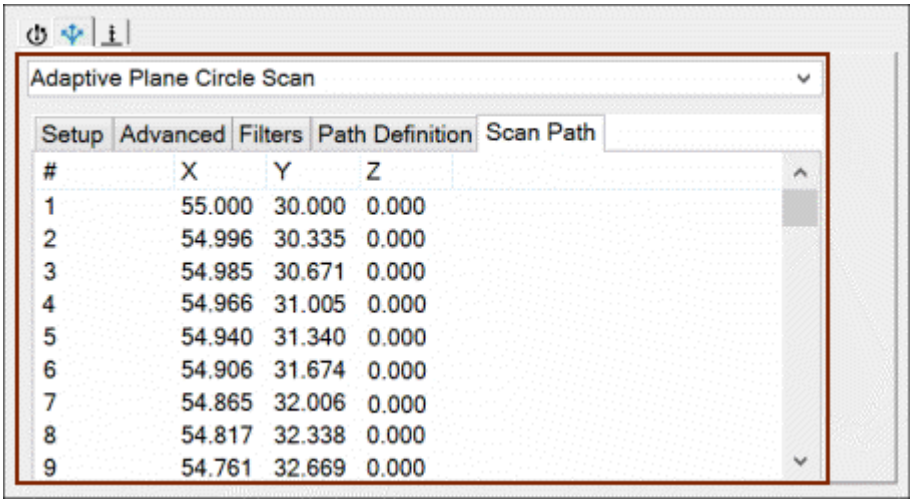
A grey, crossed-out grid button indicates that smart calculations are turned off, while a green grid button indicates they are turned on. By default, smart calculations are turned on. However, if you enter a value other than the calculated one, PC-DMIS turns off smart calculations.

Scan Path Tab - Adaptive Plane Circle Scan Strategy

You can use the **Scan Path** tab for the Adaptive Plane Circle Scan strategy to do the following:

- Display scan points and move points
- Insert a move point or break point
- Remove a point from the scan path

Following is an example:



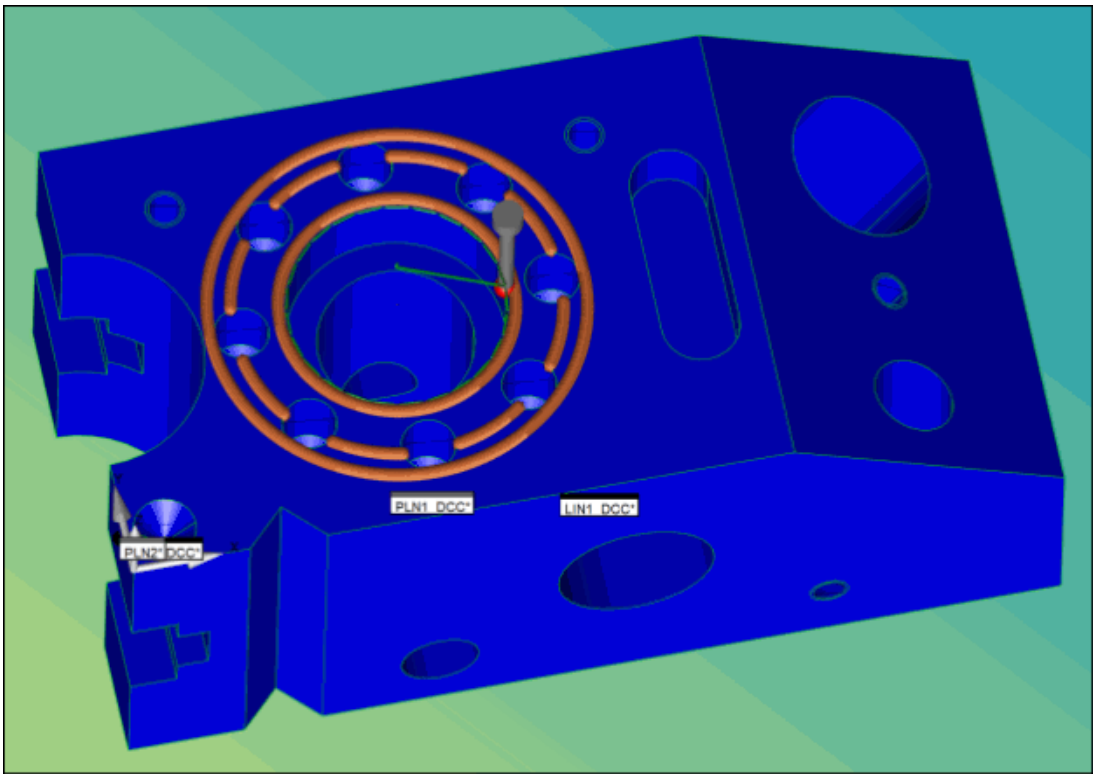
Sample Scan Path tab

The following items appear in the points list area:

- # - A number that identifies the generated point

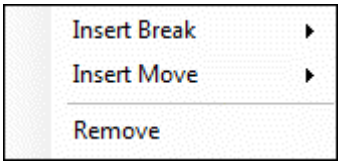
- **X**, **Y**, and **Z** - The XYZ values

When you click on any point in the scan path, the point will be highlighted on the CAD surface. For example:



Example of highlighted point on CAD surface

To perform additional functions, right-click in the points list area. The following options appear:



Points List options

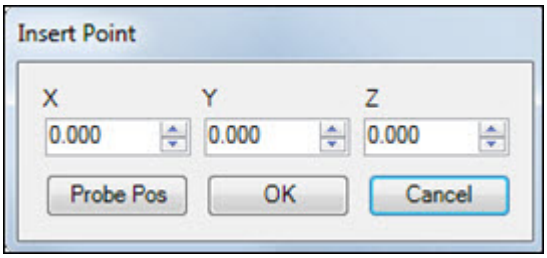
Insert Break

To insert a break between scan points, select this option. As a result, PC-DMIS will send multiple scan commands to the controller. Break points in the scan path can help to scan even if the path is not continuous for any reason. The scan does the following:

1. Retracts off the part based on the current value for the **Retract** parameter.
2. Moves to the next scan point at a prehit distance based on the current value for the **Prehit** parameter.
3. Begins the next scan.

Insert Move

To insert a move point to avoid an obstacle, select this option. Move points in the scan path can help to avoid any obstruction in the scan path. The **Insert Point** dialog box appears:



Insert Point dialog box

You can position the probe and click **Probe Pos** to insert a move point at that location.

Remove

To delete one point, highlight it in the points list area, right-click, and then select this option.

Adaptive Plane Line Scan Strategy

The Adaptive Plane Line Scan strategy for the Plane Auto feature measures the plane by scanning along straight lines.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**):

- **Setup** tab
- **Filters** tab
- **Advanced** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - Adaptive Plane Line Scan Strategy

You can use the **Setup** tab for the Adaptive Plane Line Scan strategy to supply all known information about a feature's tolerance requirements and surface type, and PC-DMIS does the rest.

Form

If the purpose of the measurement is form tolerance, select this check box. If you select it, PC-DMIS scans the feature based on the **Form** tolerance value that you enter. The looser the **Form** tolerance value, the faster the scan. The tighter the **Form** tolerance, the slower the scan.

Tolerance

Type or select the permissible limit or the limit of variation.

Surface Type

From the **Surface Type** list, select the option that best matches the type of surface to measure.

The options are:

- Polished
- Machined
- Ground
- Cast

Advanced Tab - Adaptive Plane Line Scan Strategy

You can use the **Advanced** tab for the Adaptive Plane Line Scan strategy to override the calculated settings and any automatically configured parameters.

Scan Parameters

Scan parameters provide you with these options on how the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** parameters are determined:

- **Auto** - PC-DMIS automatically sets the scan parameters.
- **Global** - PC-DMIS applies the current global scan parameters during the execution. You can set the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - You can manually enter the desired scan parameters.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

Type or select the level of force to maintain during a scan. The value is specified in newtons.

Filters Tab - Adaptive Plane Line Scan Strategy

You can use the **Filters** tab for the Adaptive Plane Line Scan strategy to set up filters.

Outlier

PC-DMIS first fits a plane to the data and then determines which points are outliers based on the standard deviation multiple. It then does the following:

- Recalculates the best fit plane with those outliers removed.
- Checks for outliers again.
- Recalculates the best fit plane.
- Continues repeating this process until no more outliers exist or until PC-DMIS cannot compute the plane. (PC-DMIS cannot compute the plane if there are fewer than three data points.)

Filter

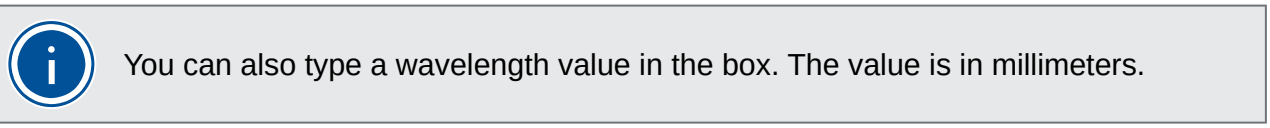
The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

Wave Length (mm)

Oscillations in data smaller than the value you select in the list are smoothed when applying the linear Gaussian filter. This applies to lines and planes.



You can also type a wavelength value in the box. The value is in millimeters.

This option is hidden if you select **None** in the **Filter** list.

Using Non-Adaptive Scanning Strategies

The non-adaptive scanning strategies and their tabs are located on the **Measurement Strategies** tab in the Probe Toolbox. The strategies are:

- Gage Scan Calibration
- Cylinder Centering Thread Scan
- Self-Centering Point

- Sphere Scan Strategy

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Gage Scan Calibration Strategy

The gage scan filter enables you to measure forms of circles and cylinders with the highest possible accuracy by comparing the scan on a master ring or plug of a similar size and placed at the same location on a CMM. You can use this filter to measure production rings or plugs, and circular features on parts with very tight form tolerances.

The Gage Scan Calibration strategy for Auto Circles calibrates a probe tip for use with the gage scan filter. The Gage Scan Calibration data is stored in the probe file. The gage scan filter is available with the **Adaptive Circle Scan** and **Adaptive Cylinder Concentric Circle Scan** strategies.



If you calibrate the probe tip again, PC-DMIS deletes the Gage Scan Calibration data. You will need to perform the Gage Scan Calibration again.

The **Gage Scan Filter** option is in the **Edit Probe Data** dialog box (**Insert | Hardware Definition | Probe | Edit** button). The **Gage Scan Filter** option for each probe tip indicates if Gage Scan Calibration data is available. For information on this option, see "Gage Scan Filter" in the "Defining Hardware" chapter in the PC-DMIS Core documentation.

For best results:

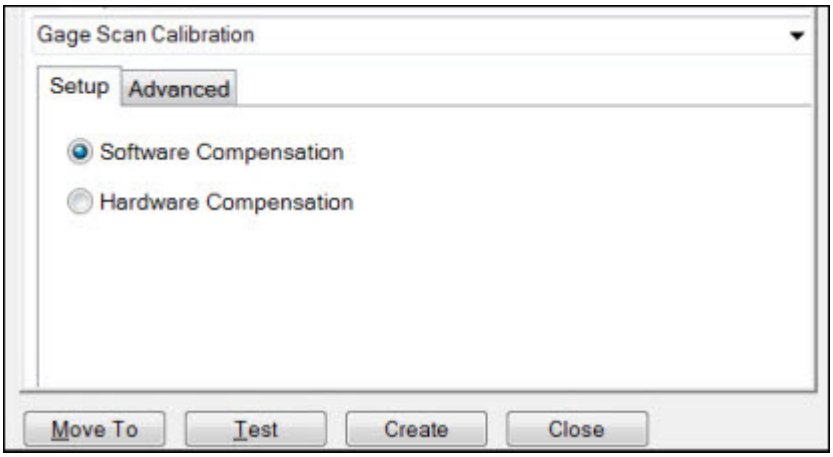
- Use Gage Scan Calibration to calibrate a probe tip with a ring gage to accurately measure inside holes.
- Use Gage Scan Calibration to calibrate a probe tip with a plug gage to accurately measure outside holes.
- Use Gage Scan Calibration to calibrate the probe tip using a ring or plug gage with the diameter as close as possible to the part that needs to be accurately inspected.
- To get the highest accuracy, you may want to place the ring or plug gage at the same location on the CMM where you would place the part for inspection.
- If you use the **Software Compensation** option for Gage Scan Calibration, you can improve the accuracy by defining a point density (sample frequency) for the feature to measure with a value as close as possible to the point density used in the gage calibration. Since the gage scan filter is applied in the frequency domain, achieving a greater similarity between the gage's point density compared to the feature scan's point density results in a correction that is more effective.

The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Circle**):

- **Setup** tab
- **Advanced** tab

Setup Tab - Gage Scan Calibration Strategy

Use the **Setup** tab for the Gage Scan Calibration strategy to select the gage scan filter compensation type:



Sample Setup tab

For more information about the gage scan filter, see "Enabling the Gage Scan Filter".

Software Compensation

This type of gage scan filter is available for all types of controllers. For this type:

- PC-DMIS calculates the gage scan filter parameters to compensate the measured data and improve the accuracy of the circular feature measurement.
- PC-DMIS performs software calibration by scanning a defined path circle on a master ring or plug.
- The scanning parameters are determined at runtime using an adaptive database.
- The circle must be scanned for 360 degrees.

If you select this type, the gage scan filter corrects the measured scan data by comparing it to similar scan data from a gage. This comparison reduces the amplitude of frequencies found in the measured scan data by gage amplitudes of the same frequency. This adjustment eliminates noise characteristics that are intrinsic to the measuring machine and probe. As a result, it provides more accurate measurements of the part.

If necessary, you can use the options on the **Advanced** tab (similar to the **Advanced** tab for Adaptive Scanning measurement strategies) to modify the scanning parameters.

Hardware Compensation

This type of gage scan filter is only available for B5 and higher Leitz controllers. It applies to only one probe tip in one probe file. For this type:

- The controller performs hardware calibration by scanning a master ring or plug.
- The controller calculates the measured data to improve circular feature measurement and compensate for errors.
- The circle is scanned in the counterclockwise (CCW) direction by starting at -90 degrees and ending at +90 degrees (a 540-degree scan). The start and end angles are defined in the local coordinate system, and cannot be changed.

Results

After you execute the Gage Scan Calibration strategy by selecting the hardware compensation type, the feature's measured values are set to the same values as its theoretical values. As a result, if you dimension the Gage Scan Calibration feature, the nominal and measured values will be the same.

The Gage Scan Calibration strategy records the gage calibration results to the probe file (for example, MYPROBE.PRB). The strategy appends the results to the results file (for example, MYPROBE.Results).

Following is an example of a .results file:

```
Gage Calibration   Date=03/03/2015   Time=01:06:59 PM
TIP1          Hardware THEO X   770.039 Y   503.871 Z -
 145.345 D   20.000  IN   StdDev:   0.001
```

Gage scan calibration always appends the results to the results file. If the results file does not exist, the strategy creates it. The strategy updates the results and appends them to the results file each time you execute the strategy.

The results file shows the following:

- **Date** and **Time** of the gage calibration.
- **ID** of the active tip.
- The compensation method (**Software** or **Hardware**).
- Theoretical (**THEO**) **X**, **Y**, and **Z** values of the location of the center of the ring or plug in the **machine coordinate system**. These values indicate where you placed the ring or plug on the CMM table for calibration.
- Nominal diameter (**D**) of the ring or plug. **IN** or **OUT** indicates if a ring or plug was used.

- Standard deviation (**StdDev**) of the calibration.
- The unit of calibration follows the unit of the measurement routine that you used to calibrate the tip.



You can calibrate one tip for one inside diameter and one outside diameter. If you use a different diameter for calibration, the original data is overwritten. The results file displays the history of the gage calibration that was performed until the probe calibration process recreates it.

Enabling the Gage Scan Filter

The gage scan filter improves the accuracy of circular feature measurements for the Adaptive Circle Scan and Adaptive Cylinder Concentric Circle Scan Adaptive Scanning measurement strategies. The filter uses parameters that are determined by gage scan calibration and stored in the probe file to correct measured scan data. The probe tip can be calibrated with an inside circle or an outside circle (or both).

To enable the gage scan filter:

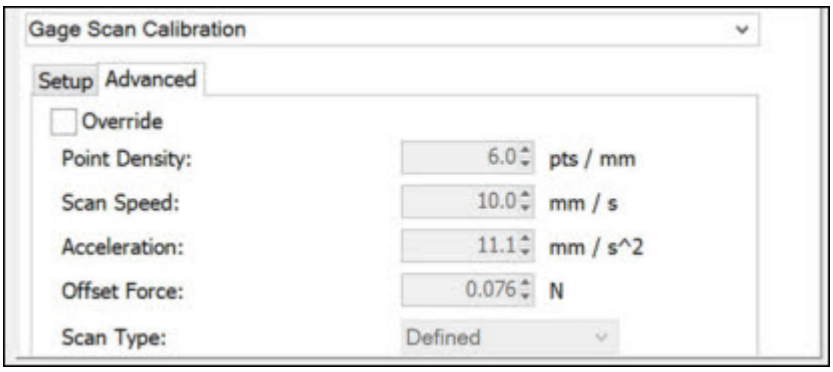
1. From the **Probe Toolbox**, select the **Measurement Strategies** tab ( ).
2. Perform gage scan calibration for the active probe tip. This step determines the gage scan parameters for the given tip.
3. Use the Adaptive Circle Scan or Adaptive Cylinder Concentric Circle Scan strategy to measure a circular feature.
4. Select the **Filters** tab for the selected strategy.
5. Select the **Use Gage Scan Filter** check box. The calculation of the circle will use the gage scan filter data.



If the probe file does not contain any calibration data for the active probe tip, an error appears during measurement.

Advanced Tab - Gage Scan Calibration Strategy

You can use the **Advanced** tab for the Gage Scan Calibration strategy to override the calculated settings and any parameters that PC-DMIS automatically configured:



Sample Advanced tab

Override

If you select this check box, it overrides any parameters that PC-DMIS automatically configured. It also enables the **Point Density**, **Scan Speed**, **Acceleration**, and **Offset Force** options. You can use these options to change the scanning characteristics for this measurement.

If you selected the **Hardware Compensation** option on the **Setup** tab, the **Override** check box is selected by default.

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Acceleration

Type or select the acceleration to use during a scan. The value is specified in mm/sec/sec.

Offset Force

Type or select the level of force to maintain during a scan. The value is specified in newtons.

Scan Type

Select the type of scan that you want to execute on the controller:

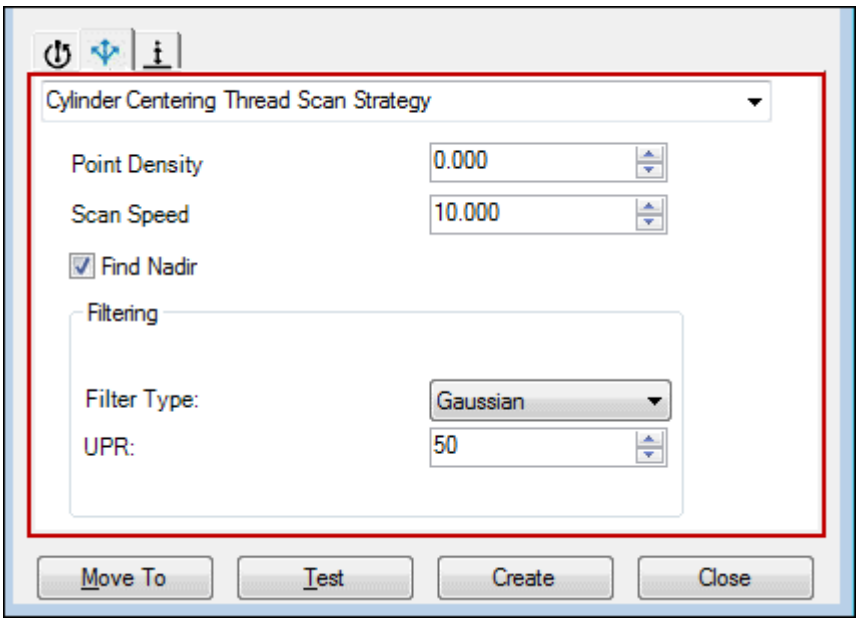
- **Defined** - Executes the defined path scan on a B3C, B4, B5, or FDC controller.
- **CIR** - Executes the CIR type of scan on a B4 or B5 Leitz controller.

Cylinder Centering Thread Scan Strategy

The Cylinder Centering Thread Scan strategy for the Cylinder Auto feature performs a thread scan by maintaining the probe centered within the thread. When you use this strategy, the diameter of the probe tip must be larger than the size of the valleys in-between the threads to prevent probe shanking.

This strategy is supported only on B4 and B5 Leitz controllers.

The following properties are available:



Sample Cylinder Centering Thread Scan properties

Point Density

Type or select the number of readings to take per unit of measurement during the scan.

Scan Speed

Type or select the scan speed (mm/sec).

Find Nadir

Select this check box to take two hits at slightly different points on the thread to determine the best place to start the scan. The software uses the deepest point of the thread.

Filtering Area

Filter

The **Filter** or **Filter Type** option indicates the filter type that you want to use for the scan. Some filtering options are specific to certain strategies.

The available filter types are:

- **None** - Does not apply any filter type to the scan data set.
- **Gaussian** - Applies a Gaussian filter to the scan data set, which smooths the data.

UPR

This option defines the Undulations Per Revolution (UPR). The default value is 50. This value only applies to Circle and Cylinder features. The software hides this option if you select **None** as the filter type.

Self-Centering Point Strategy

The Self-Centering Point strategy for the Vector Auto feature measures a self-centering point on a part. Two types of self-centering points are available:

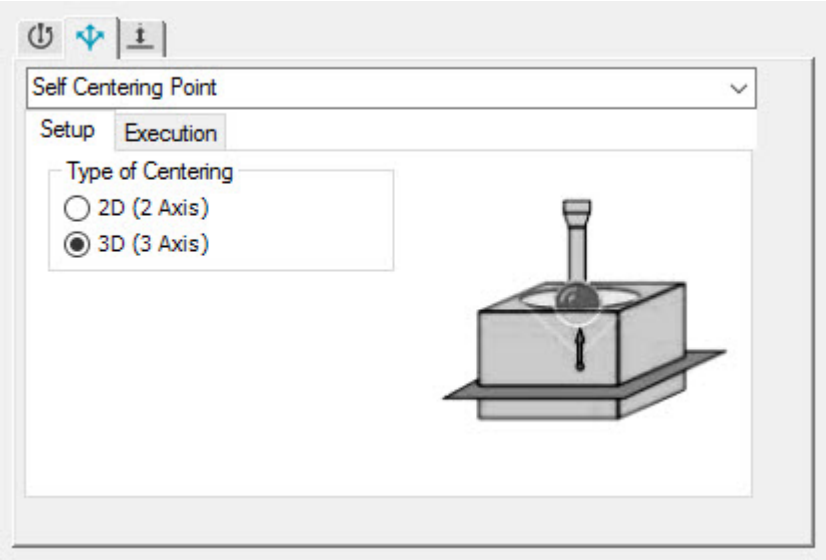
- 2D (2 axis) - A self-centering point in an internal V shape or in an internal arc is an example.
- 3D (3 axis) - A self-centering point in an internal cone, internal cylinder, or internal spherical section is an example.

To measure a self-centering point, do the following:

1. Open the **Auto Feature** dialog box for a Vector Point (**Insert | Feature | Auto | Point | Vector**). For help, see "Inserting Auto Features".
2. From the Probe Toolbox, select the **Measurement Strategies** tab ().
3. From the list of strategies, select **Self Centering Point**.
4. In the **Point** area in the **Auto Feature** dialog box, type the nominal X, Y, and Z values.
5. In the **Surface** area in the **Auto Feature** dialog box, type the surface vectors.
6. Complete the properties on the tabs:
    - **Setup** tab
    - **Execution** tab

Setup Tab - Self-Centering Point Strategy

Use the **Setup** tab for the Self Centering Point strategy to select the type of self-centering point:

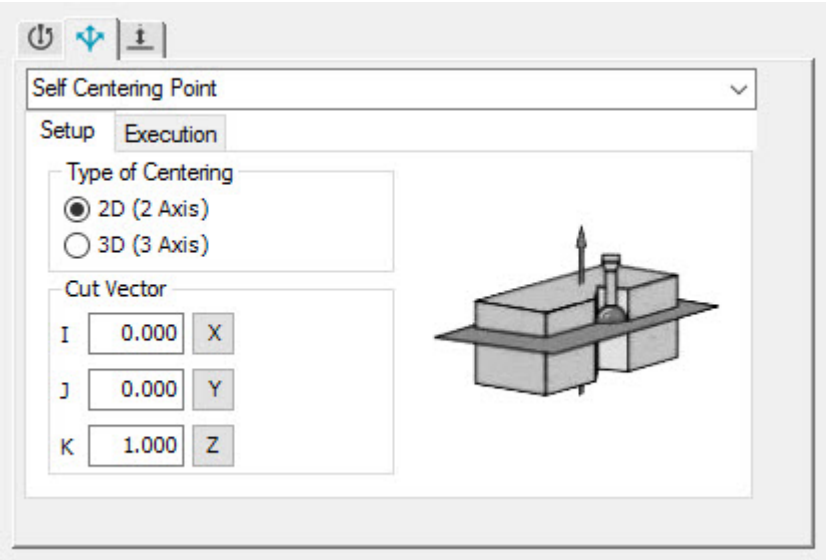


Sample Setup tab for 3D type

Type of Centering

Select the centering type:

- 2D (2 Axis) - To measure a 2D self-centering point, select this option and type the cut vectors. The cut vector is the vector of the plane in which the point is measured. For example:



Sample Setup tab for 2D type

- 3D (3 Axis) - To measure a 3D self-centering point, select this option.

Using a Surface CAD Model to Create a 3D Self-Centering Point

You can create a 3D self-centering point from an internal cone, internal cylinder, or internal sphere.

1. Select the **3D (3 Axis)** option. This message appears in the status bar:

   "Please select a cone, sphere, or cylinder for 3D self centering."

2. Click on the internal cone, internal cylinder, or internal sphere.

The self-centering point depends upon the diameter of the current tip.

- If it is feasible to use the current probe to self-center, PC-DMIS calculates a self-centering point and completes the **X**, **Y**, and **Z** boxes in the Vector Point **Auto Feature** dialog box with this point.
- If it is not feasible to use the current probe to self-center, PC-DMIS calculates the center of the internal cone, internal cylinder, or internal sphere and completes the Vector Point **Auto Feature** dialog box with this point.

Using a Surface CAD Model to Create a 2D Self-Centering Point

1. Select the **2D (2 Axis)** option. This message appears in the status bar:

   "Please select a point on the first surface for 2D self centering."

2. Ensure that the values for the I, J, and K cut vectors are correct.
3. Click on the first surface.
4. Click on the second surface.

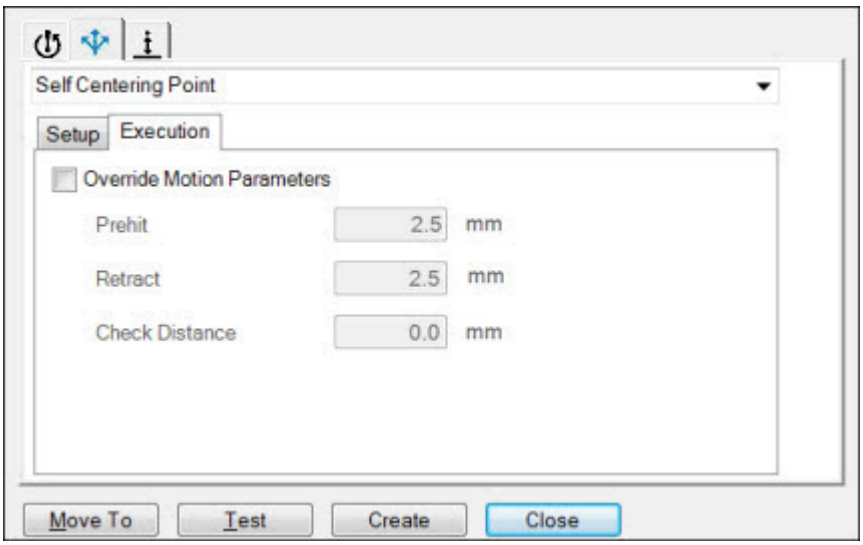
If it is feasible to use the current probe to self-center, PC-DMIS calculates a self-centering point and completes the **X**, **Y**, and **Z** boxes in the Vector Point **Auto Feature** dialog box with this point.

If PC-DMIS cannot locate the self-centering point, the message "2D self-centering calculations failed" appears in the status bar.

PC-DMIS takes the first point as the vector point and creates a plane perpendicular to that point. Similarly, PC-DMIS creates a second plane perpendicular to the second point. It then tries to calculate the self-centering point between the two planes. If the geometry of the part is different, this will only be an approximation. You can override the calculated value and type your own values.

Execution Tab - Self-Centering Point Strategy

Use the **Execution** tab for the Self Centering Point strategy to override the global machine motion values that are specified on the **Motion** tab in the **Parameter Settings** dialog box (**Edit | Preferences | Parameters**):



Sample Execution tab

By default, the probe tip radius is not compensated for the self-centering point. The measured point is the center of the ruby tip.

Override Motion Parameters

If you want to use motion values that are different than the global machine motion values, select this check box.

Prehit

Type the distance away from the theoretical hit location on the surface where PC-DMIS starts searching for the part. For more information, refer to "Prehit Distance" in the "Setting Your Preferences" chapter in the PC-DMIS Core documentation.

Retract

Type the distance the probe retracts from the surface after it takes a hit. For more information, refer to "Retract Distance" in the "Setting Your Preferences" chapter in the PC-DMIS Core documentation.

Check Distance

Type the distance past the theoretical hit location that the machine continues to search or check for the surface of the part. This distance is after it traverses the **Prehit Distance** value. For more information, refer to "Check Distance" in the "Setting Your Preferences" chapter in the PC-DMIS Core documentation.

Sphere Scan Strategy

The Sphere Scan strategy for the Sphere Auto feature measures the sphere by scanning.

The tabs for this strategy are available in the **Measurement Strategies** tab of the **Auto Feature** dialog box (**Insert | Feature | Auto | Sphere**):

- **Path Definition** tab

- **Scan Path** tab
- **Filters** tab
- **Parameters** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Path Definition Tab - Sphere Scan Strategy

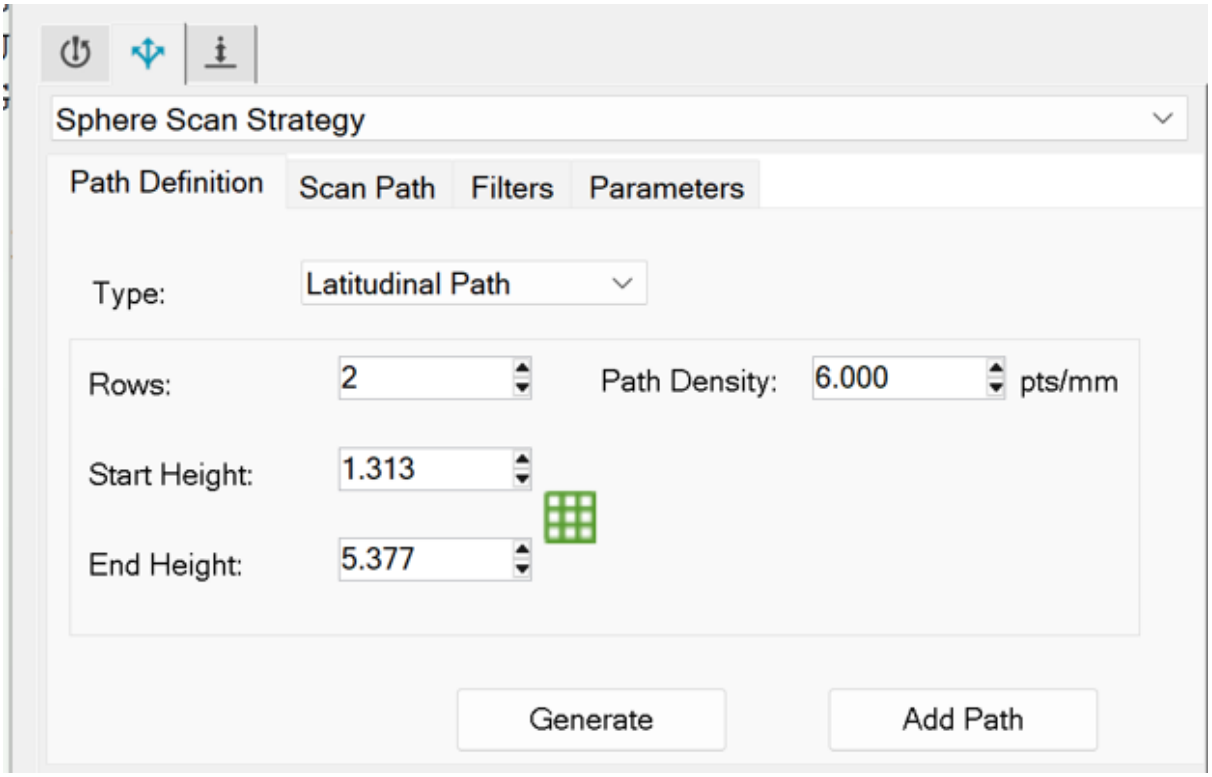
You can use the **Path Definition** tab to generate a scan path.

> You can define the **Start Angle**, **End Angle**, **Start Angle 2**, and **End Angle 2** values mentioned in this topic in the **Measurement properties** area of the **Auto Feature** dialog box. For more information, see the "Start and End Angles" topic in the PC-DMIS Core documentation.

Type - Select the scan path type to generate. Each path type creates a different scan pattern on the sphere. You can combine multiple path types to create the desired scan path.

Latitudinal Path

A latitudinal path generates concentric circular scan paths on a sphere in planes that are perpendicular to the sphere surface vector. PC-DMIS generates multiple scan paths between the **Start Height** and **End Height** values, with alternate scan paths executed in opposite directions.



Rows - Type or select the number of rows to generate.

Path Density - Type or select the density of the generated scan path in points per millimeter (pts/mm). PC-DMIS calculates the recommended path density based on the size of the sphere you are scanning. You can increase the value if needed, but do not decrease it.

Start Height - Type or select the starting height relative to the center of the sphere along the surface vector. PC-DMIS measures positive values in the direction of the surface vector, and negative values in the opposite direction.

End Height - Type or select the ending height relative to the center of the sphere along the surface vector. PC-DMIS measures positive values in the direction of the surface vector, and negative values in the opposite direction.

Smart Calculations - PC-DMIS automatically calculates **Start Height** and **End Height** based on **Start Angle 2** and **End Angle 2** values. It calculates the maximum height at 70 degrees.

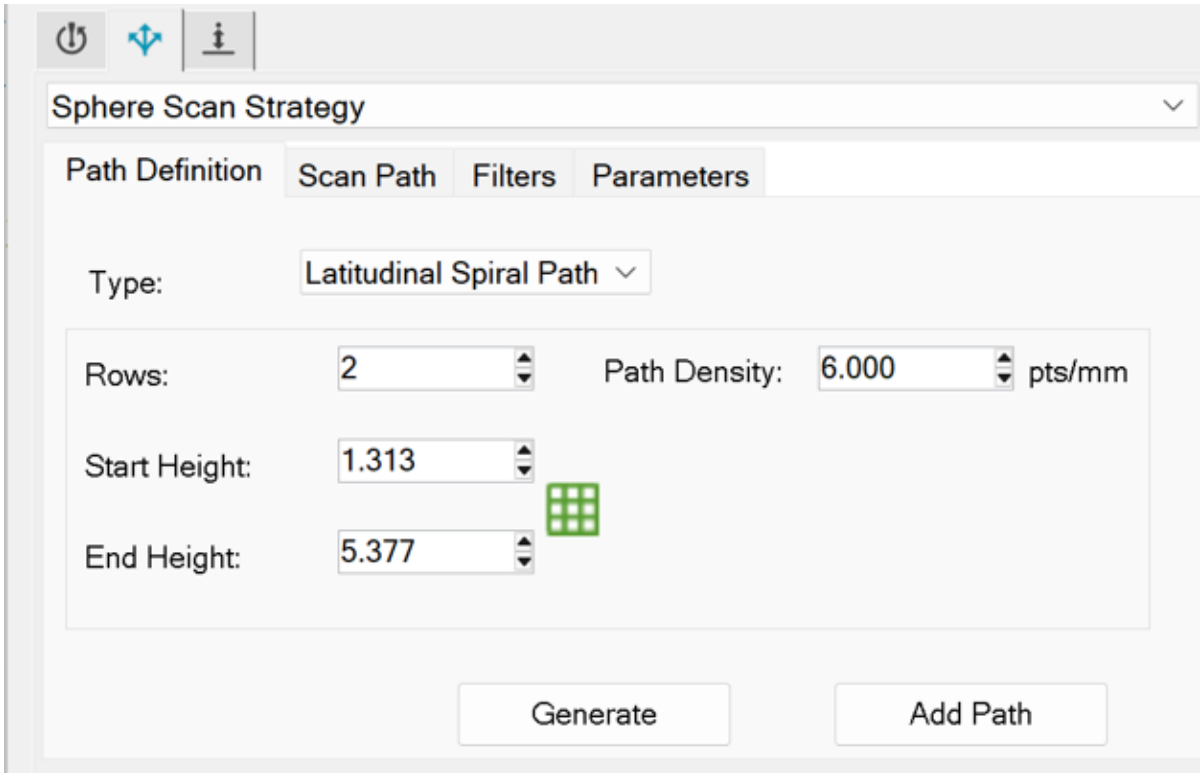
A grey grid button indicates that smart calculations are disabled. A green grid button indicates that smart calculation is enabled. By default, smart calculations are enabled. If you enter a value other than the calculated one, PC-DMIS automatically disables smart calculations.

The smart calculation of latitudinal height depends on the **Start Angle 2** and **End Angle 2** values. Make sure that these values are not equal. If you use the Measurement Strategy Editor (MSE), you can set these angle values to 0 in the

MSE. When an angle value is set to 0, PC-DMIS reads the CAD geometry when you click the CAD and provides an appropriate value for the sphere being measured.

Latitudinal Spiral Path

A latitudinal spiral path generates a continuous spiral scan path on the sphere. The path starts at the **Start Height** value and progresses to the **End Height** value while following a spiral pattern around the sphere.



Rows - Type or select the number of rows to generate.

Path Density - Type or select the density of the generated scan path in points per millimeter (pts/mm). PC-DMIS calculates the recommended path density based on the size of the sphere you are scanning. You can increase the value if needed, but do not decrease it.

Start Height - Type or select the starting height relative to the center of the sphere along the surface vector. PC-DMIS measures positive values in the direction of the surface vector, and negative values in the opposite direction.

End Height - Type or select the ending height relative to the center of the sphere along the surface vector. PC-DMIS measures positive values in the direction of the surface vector, and negative values in the opposite direction.

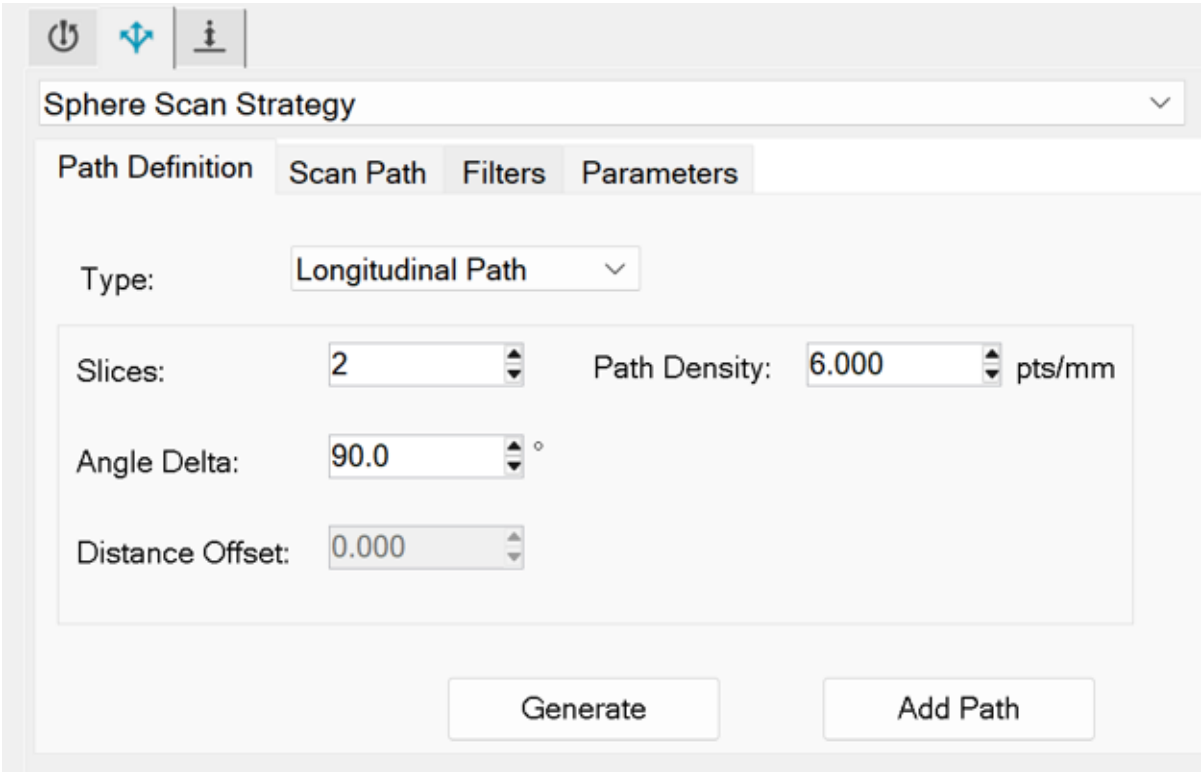
Smart Calculations - PC-DMIS automatically calculates **Start Height** and **End Height** based on **Start Angle 2** and **End Angle 2** values. It calculates the maximum height at 70 degrees.

A grey grid button indicates that smart calculations are disabled. A green grid button indicates that smart calculation is enabled. By default, smart calculations are enabled. If you enter a value other than the calculated one, PC-DMIS automatically disables smart calculations.

The smart calculation of latitudinal spiral height depends on the Start Angle 2 and End Angle 2 values. Make sure that these values are not equal. If you use the Measurement Strategy Editor (MSE), you can set these angle values to 0 in the MSE. When an angle value is set to 0, PC-DMIS reads the CAD geometry when you click the CAD and provides an appropriate value for the sphere being measured.

Longitudinal Path

A longitudinal path generates scan paths that extend between the poles of a sphere. The scan starts at the **Start Angle 2** value and ends at the **End Angle 2** value.



Slices - Type or select the number of longitudinal scan paths to generate. PC-DMIS generates the first slice at the **Start Angle** value.

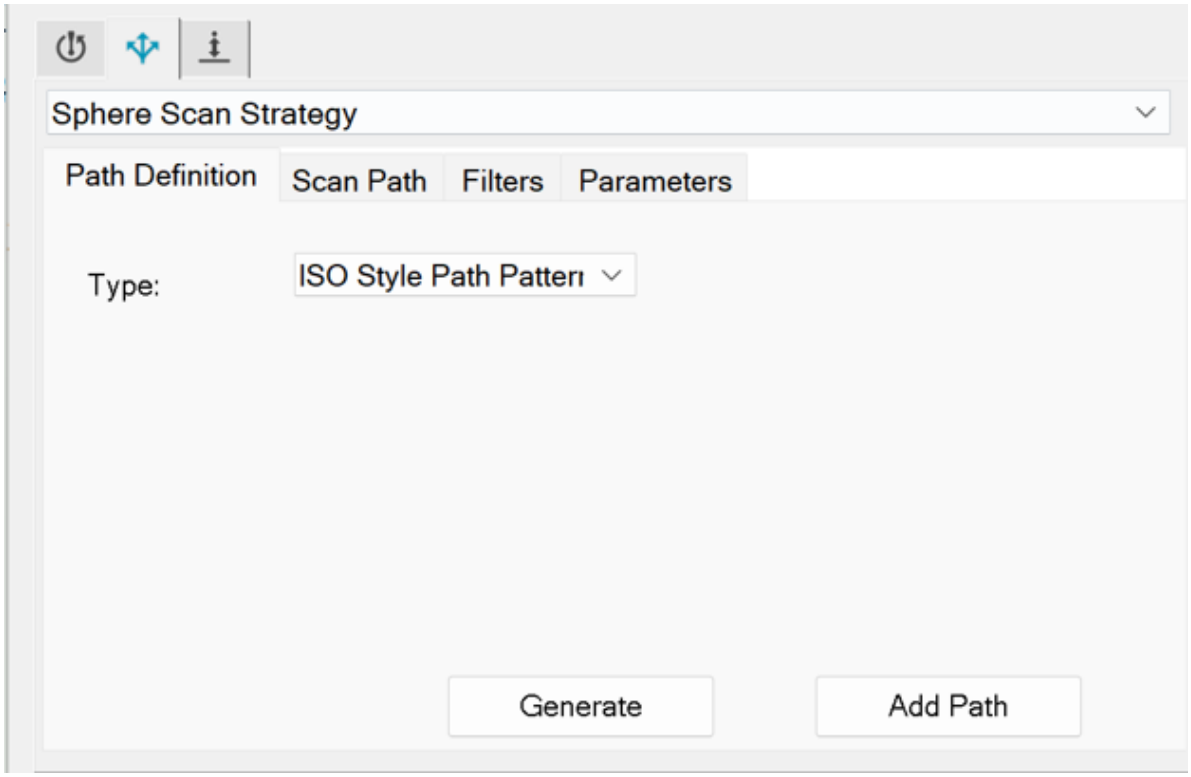
Path Density - Type or select the density of the generated scan path in points per millimeter (pts/mm). PC-DMIS calculates the recommended path density based on the size of the sphere being scanned. You can increase this value if needed, but do not decrease it.

Angle Delta - Type or select the angular distance between adjacent slices. This option is available only when the **Slices** value is greater than **1**. PC-DMIS generates additional slices at the specified angular interval.

Distance Offset - Type or select the distance used to offset the scan path from the north pole. By default, the slice passes through the north pole of the sphere. This option is available only when the **Slices** value is equal to 1.

ISO Style Path Pattern

An ISO style path pattern generates scan paths similar to those defined in ISO 10360-4. No additional parameters are required.



PC-DMIS generates the following four scan paths:

1. A latitudinal path at the height defined by the **Start Angle 2** value. The path extends from the **Start Angle** value to the **End Angle** value.
2. A second latitudinal path parallel to the first path and offset by a distance equal to 0.32 times the sphere diameter (8 mm for a 25 mm diameter sphere).
3. A longitudinal path at the **Start Angle** value. The path starts at **Start Angle 2** and ends at **End Angle 2**.
4. A second longitudinal path generated 90 degrees from the third path and offset by a distance equal to 0.32 times the sphere diameter.



ISO style scan path pattern

Generate - Generates the scan path and displays it on the CAD model in the Graphic Display window. If necessary, you can modify the parameters that define the path and regenerate the scan path.

Add Path - Adds the generated points to the **Scan Path** tab.

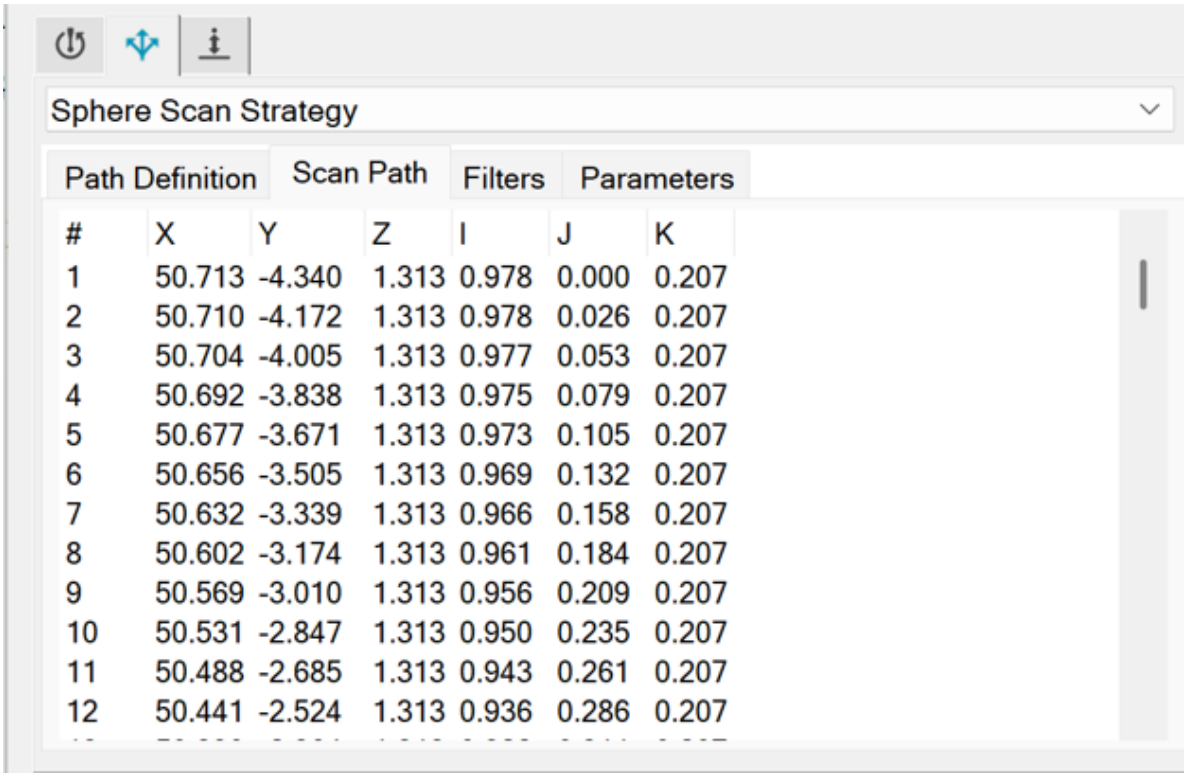
Points to Consider

- You can combine multiple path types in a single scan path. To create a combined path, generate a path and add it to the scan path. Next, select and generate another path, and add it to the scan path. Repeat this process until the required scan path is created.
- Path generation uses the angle values defined in the **Measurement properties** area of the **Auto Feature** dialog box. The selected path type determines which angle values PC-DMIS uses.
- At least two scan paths in different planes are required to measure a sphere.
- A single spiral path is sufficient to measure a sphere.
- PC-DMIS executes alternate scan paths in opposite directions.
- For external spheres, PC-DMIS moves the probe tip from the end of one scan path to the start of the next using a circular motion. For internal spheres, PC-DMIS moves the probe tip directly to the start of the next scan path.

Scan Path Tab - Sphere Scan Strategy

Use the **Scan Path** tab to view and edit scan points. PC-DMIS adds scan points to the Points List area when you click **Add Path** on the **Path Definition** tab.

For external spheres, PC-DMIS moves the probe tip from the end of one scan path to the start of the next along a circular path to help avoid collisions. If needed, you can add move points between scan paths to define a different transition path.



#	X	Y	Z	I	J	K
1	50.713	-4.340	1.313	0.978	0.000	0.207
2	50.710	-4.172	1.313	0.978	0.026	0.207
3	50.704	-4.005	1.313	0.977	0.053	0.207
4	50.692	-3.838	1.313	0.975	0.079	0.207
5	50.677	-3.671	1.313	0.973	0.105	0.207
6	50.656	-3.505	1.313	0.969	0.132	0.207
7	50.632	-3.339	1.313	0.966	0.158	0.207
8	50.602	-3.174	1.313	0.961	0.184	0.207
9	50.569	-3.010	1.313	0.956	0.209	0.207
10	50.531	-2.847	1.313	0.950	0.235	0.207
11	50.488	-2.685	1.313	0.943	0.261	0.207
12	50.441	-2.524	1.313	0.936	0.286	0.207

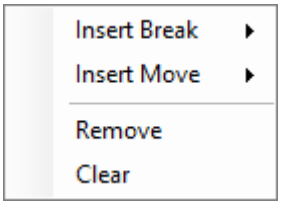
- A number that identifies the generated point.

X, **Y**, and **Z** - The XYZ values.

I, **J**, and **K** - The IJK values.

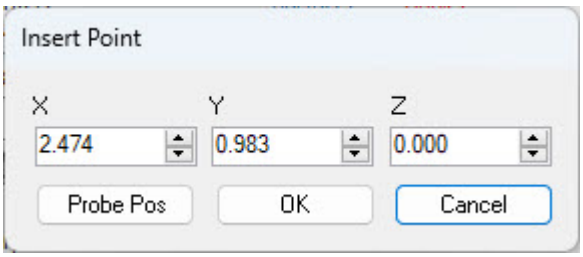
When you click on any point in the scan path, PC-DMIS highlights the point on the CAD surface.

To perform additional functions, right-click on a point. PC-DMIS displays these options:



Insert Break - To insert a break between scan points, right-click a point, point to **Insert Break**, and then select **Before** or **After**. PC-DMIS inserts a break point before or after the selected point.

Insert Move - To insert a move point between scan points, right-click a point, point to **Insert Move**, and then select **Before** or **After**. PC-DMIS displays the **Insert Point** dialog box.



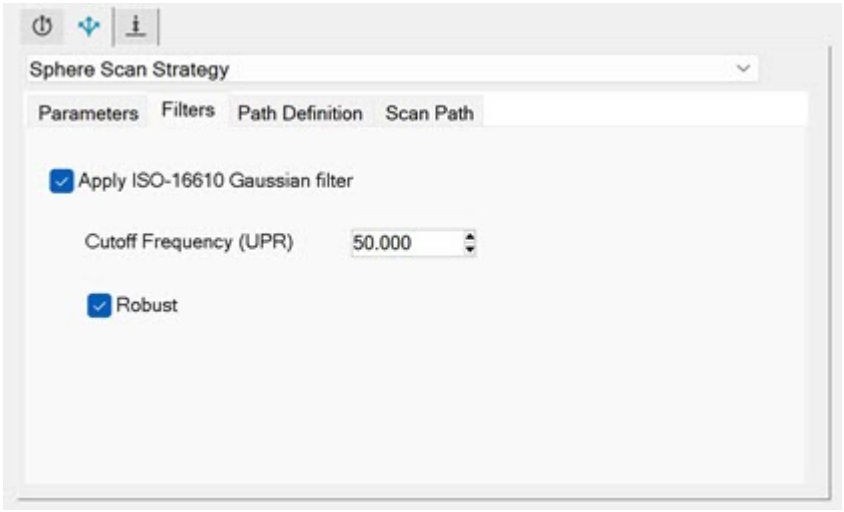
Type the **X**, **Y**, and **Z** values of the move point, or position the probe and click **Probe Pos** to insert a move point at that location.

Remove - To delete a point, select it in the points list area, right-click it, and then select this option.

Clear - To delete all points, right-click in the points list area and then select this option.

Filters Tab - Sphere Scan Strategy

You can use the **Filters** tab to configure filters for the scan data.



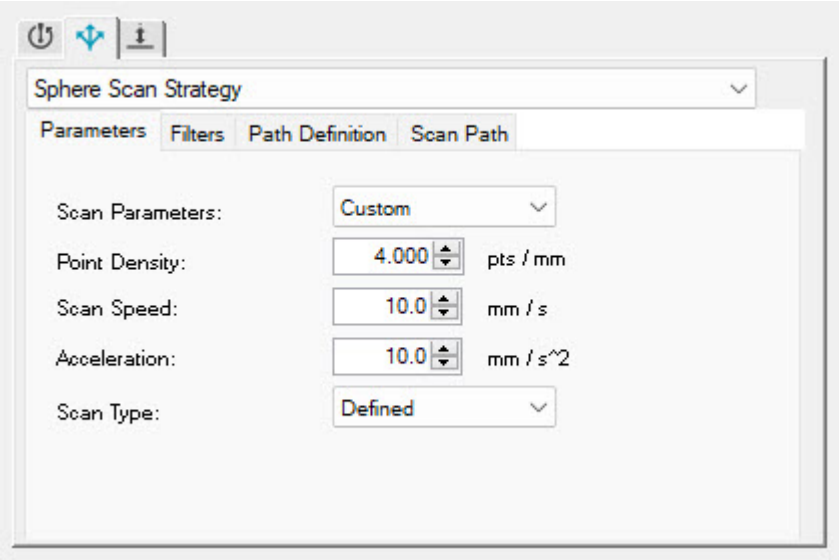
Apply ISO-16610 Gaussian Filter - Select this check box to apply an ISO-16610 Gaussian filter to the scan data. This filter smooths the scan data. If you clear this check box, PC-DMIS does not apply any filter to the scan data.

Cutoff Frequency (UPR) - Type or select the undulations per revolution value. The default value is **50**.

Robust - Select this check box to apply the ISO 16610-31 and ISO 16610-71 filtering method, which reduces the effects of outliers. PC-DMIS does not remove points from the scan data.

Parameters Tab - Sphere Scan Strategy

You can use the **Parameters** tab for the Sphere Scan strategy to set the scanning parameters.



Scan Parameters - Defines how the **Point Density**, **Scan Speed**, **Acceleration**, and **Scan Type** values are set.

- **Global** - PC-DMIS applies the current global scan parameters during execution. You can define the global scan parameters using the `OPTIONPROBE` and `SCANSPEED` commands.
- **Custom** - Allows you to manually specify the scan parameters.

Point Density - Type or select the number of points to take per mm during the scan.

PC-DMIS requires a minimum point density and provides a recommended point density for applying the ISO Gaussian filter for the specified cutoff frequency (UPR) on the **Filters** tab.

- If the specified **Point Density** value is less than the minimum point density, PC-DMIS prompts you to change the **Point Density** value and doesn't insert the sphere feature into the Edit window.
- If the specified **Point Density** value is greater than or equal to the minimum point density but less than the recommended point density, PC-DMIS displays a message but still lets you create the sphere feature.
- If the minimum or recommended point density is greater than 25 points/mm, PC-DMIS prompts you to verify the UPR value for the ISO filter. You must ensure that the machine controller can collect the required number of points, and adjust the scan speed and acceleration as needed.

Scan Speed - Type or select the scan speed (mm/sec).

Acceleration - Type or select the acceleration to use during a scan. The value is specified in mm per second squared.

Scan Type - Select the type of scan to execute on the controller.

- **Defined -** Executes a defined path scan.

- **Undefined** - Executes an undefined path scan.

Using TTP Strategies

The TTP strategies and their tabs are located on the **Measurement Strategies** tab in the Probe Toolbox. The strategies are:

- TTP Free Form Plane Strategy
- TTP Plane Circle Strategy
- TTP User Defined Plane Strategy

TTP strategies are available when PC-DMIS is in Manual Mode or DCC Mode.

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

TTP Free Form Plane Strategy

The Touch Trigger Probe (TTP) Free Form Plane strategy for the Plane Auto feature measures a plane by selecting hit points along a path defined by a set of points (scan path).

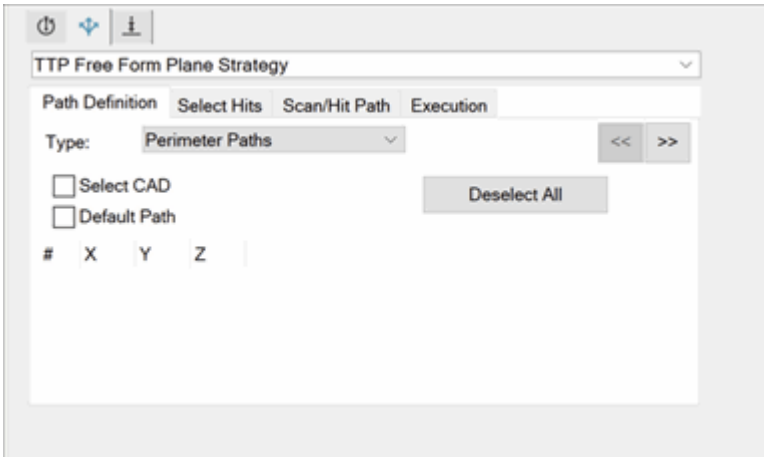
The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**):

- **Path Definition** tab
- **Select Hits** tab
- **Scan/Hit Path** tab
- **Execution** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Path Definition Tab - TTP Free Form Plane Strategy

You can use the **Path Definition** tab for the TTP Free Form Plane strategy to generate a scan path/hit path.



Sample Path Definition tab

The scan/hit path methods appear in the **Type** list:

- Perimeter Paths
- Free Form Paths
- Teach Path
- User Defined Path

It is possible to use a combination of methods to generate a scan or hit path.

Points List Area

The points list area displays the points that you select on the CAD or take on the CMM manually (for the Teach Path and User Defined Path types only):

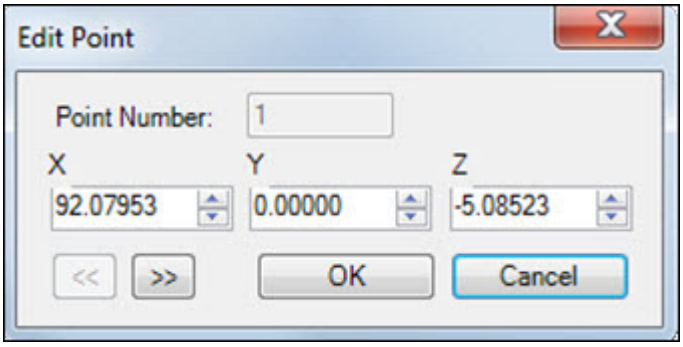
- # - Displays a number or letter that identifies the point.
- **X**, **Y**, **Z** - The XYZ values appear in this area.
- **Pt. Type** - Indicates the type of point for the Teach Path method of generating the scan path.
- **>>** - To set additional properties for the type you selected and generate the scan path, click this button.
- **<<** - To return to the points list area, click this button.

To delete one or more points, right-click in the points list area. PC-DMIS displays the **Remove** and **Clear** options.

To delete one point, highlight it in the points list area, right-click, and select **Remove**. To delete all points, right-click in the points list area and select **Clear**; when the **Remove all points?** message appears, click **OK**.

To edit a point's X, Y, and Z values, double-click the point. The **Edit Point** dialog box appears. To navigate to and modify points, click **>>**.

For example:



Sample Edit Point dialog box

Perimeter Paths Method

This method generates the scan path along the perimeter of the surface. It requires CAD. This method of path generation is the default method when PC-DMIS is in DCC Mode.

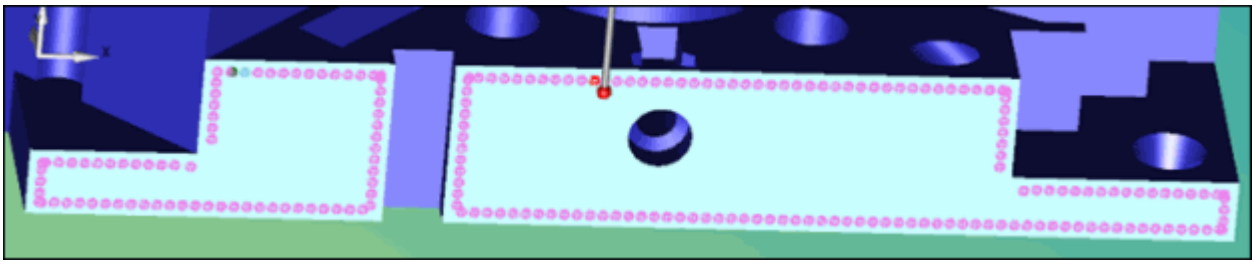
Generating a Default Perimeter Scan Path

You can generate a default perimeter scan path for a given plane. The start point of the default path is the edge closest to the point that you clicked to select the plane. The direction of the scan is counterclockwise in a given plane. The start and end points for the scan are the same. The default path generation uses the parameter set on the second screen that defines the path generation. When you select **Create**, the **Scan/Hit Path** tab displays the default path.

If you select the default path, you cannot modify any other parameters.

Selecting Multiple Surfaces of a Plane

A perimeter path supports planes that are separated. For example, the following is the front face on a demo block:



Example of front face on demo block

To select multiple surfaces of a plane, follow these steps:

1. Select the **Select CAD** check box.
2. If required, click **Deselect All** to deselect any selected surfaces.
3. Click on the first surface to select and highlight it.
4. Click on the second surface to select and highlight it.

If the first and second surfaces are separated, then PC-DMIS automatically selects the **Default Path** check box. The default path on each selected surface is generated.

5. Click on other surfaces to select and highlight them.

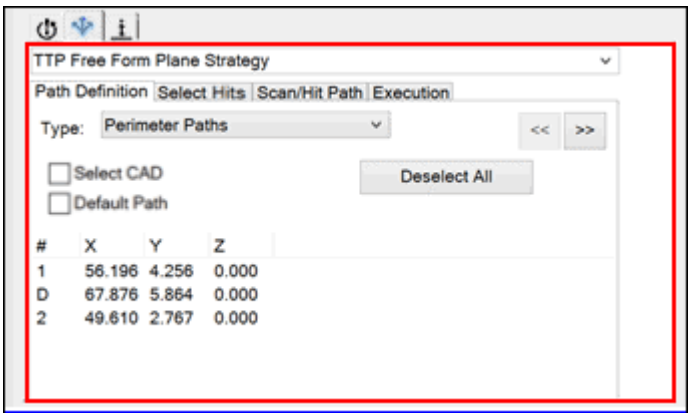
   PC-DMIS completes the **Scan/Hit Path** tab when you click the **Create** button.

Generating a Perimeter Path by Selection

You can generate a perimeter path when you select the start, direction, and end point on any one CAD surface. For a closed scan path, on any CAD surface, you can do this with just the start and direction point.

1. Do one of the following:

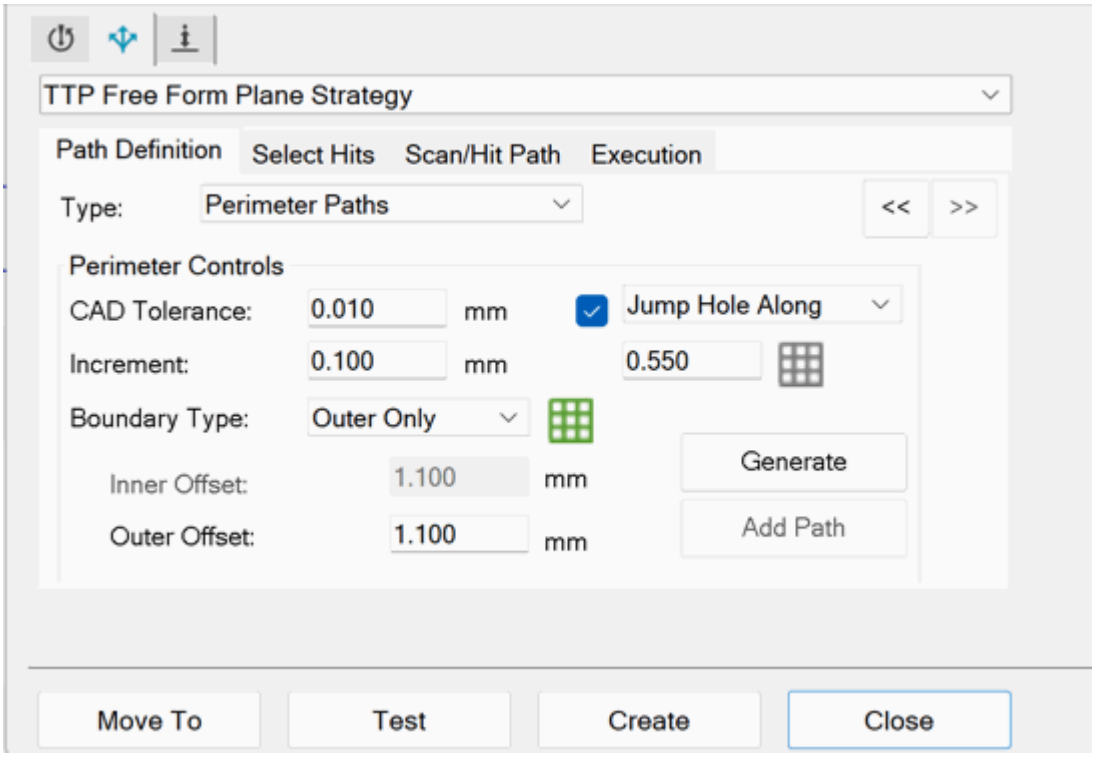
   - To define the start point, direction point, and end point, click on three points on the CAD. The points appear in the points list area. In the # column, **1** = start point, **D** = direction point, and **2** = end point. For example:



Sample perimeter path

   - To define the start point and direction point, click on two points on the CAD. The points appear in the points list area. In the # column, **1** = start point and **D** = direction point. When point 2 (the end point) is not defined, PC-DMIS uses point 1 to create a closed path.

2. To set perimeter controls, click **>>**. The **Perimeter Controls** area appears. Use the properties in this area to control perimeter point generation.



Sample Perimeter Controls area

CAD Tolerance - Type the tolerance that the point locating algorithm uses.

Increment - Type the minimum distance between adjacent points.

Boundary Type - Select the boundary type on the selected surface that you want PC-DMIS to consider in the path calculation:

- **Inner Only** - PC-DMIS uses the inner boundaries to generate the scan path.
- **Inner and Outer** - PC-DMIS uses the inner boundary or outer boundary based on the hits taken to generate the scan path.
- **Outer Only** - PC-DMIS uses the outer boundaries to generate the scan path.

  Inner Offset - Use this option to generate the scan path along the inner boundary. Type the desired distance of the scan path from the boundary.

  Outer Offset - Use this option to generate the scan path along the outer boundary. Type the desired distance of the scan path from the boundary.

Jump Hole Type - Select the jump hole type that you want PC-DMIS to consider during path generation.

- **Jump Hole Along** - If you select this check box, PC-DMIS creates a break point in the scan path only when a scan path point falls within a hole on the CAD surface. Type the required distance from the edge in the box.

- **Jump Hole Around** - If you select this check box, PC-DMIS looks for holes in all directions (360 degrees) around the scan path and creates a break point when it detects a hole. Type the required distance from the edge in the box.

 **Smart Calculations** - Smart calculations are available for offset and jump holes, as indicated by a grid button next to these options. Smart calculations take into consideration the tip's radius, dynamically sets the offset to the tip radius, and adds a 0.1 mm safety distance. It also sets the jump hole distance to half of the offset distance.

A grey, crossed-out grid button indicates that smart calculations are turned off, while a green grid button indicates they are turned on. By default, smart calculations are turned on. However, if you enter a value other than the calculated one, PC-DMIS turns off smart calculations.

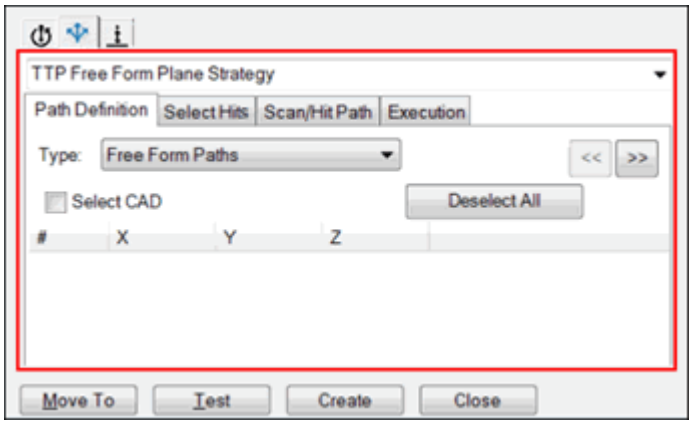
Generate - To generate the points and display them in the points list area, click this button. PC-DMIS shows the generated path on the CAD in the Graphic Display window. You can change the start point, direction point, and end point and then regenerate the scan path, if required.

Add Path - To add the points to the **Scan/Hit Path** tab, click this button. When the scan path is added, the hit points are also selected based on the selection criteria that is currently specified on the **Select Hits** tab.

Free Form Paths Method

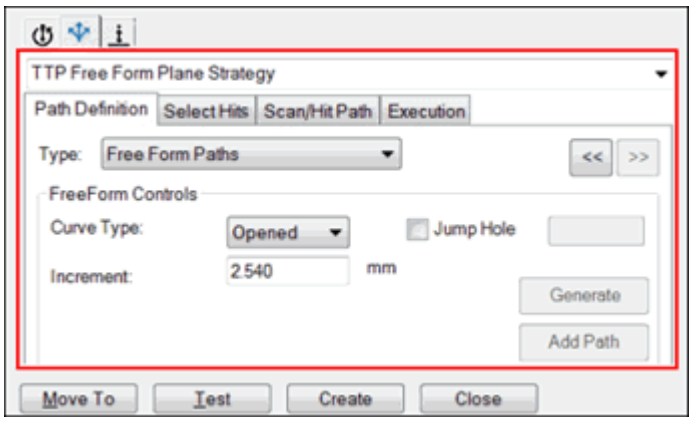
This method generates the scan path along the path of the points defined. It requires CAD. To use this method to generate the scan path:

1. Click on the CAD to define the free form path. A minimum of five points must be recorded to calculate the scan path. The points appear in the points list area. For example:



Sample free form path

2. To set free-form path controls, click **>>**. The **FreeForm Controls** area appears. Use the properties in this area to control free-form point generation:



Sample FreeForm Controls area

Curve Type - Select the type of path to generate: open or closed.

Increment - Type the minimum distance between adjacent points.

Jump Hole - If you select this check box, it generates a break point in the scan path whenever the scan path is over the holes in the CAD surface. Type the required distance from the edge in the box.

For tactile probes, the **Jump Hole** check box on the **Path Definition** tab is always selected. This is because the probe lifts between the scans on each polyline. For spot laser probes, the **Jump Hole** check box is available for selection, and PC-DMIS uses its last-used value. For more information about the check box, see the "Theoretical Path Area" topic in the PC-DMIS Core documentation.

The **Jump Hole** check box is not used for laser probes.

Generate - To generate the points and display them in the points list area, click this button. The generated path is shown on the CAD in the Graphic Display window. You can change the points defining the free form path and then regenerate the scan path, if required.

Add Path - To add the points to the **Scan/Hit Path** tab, click this button. When the scan path is added, the hit points are also selected based on the selection criteria that is currently specified on the **Select Hits** tab.

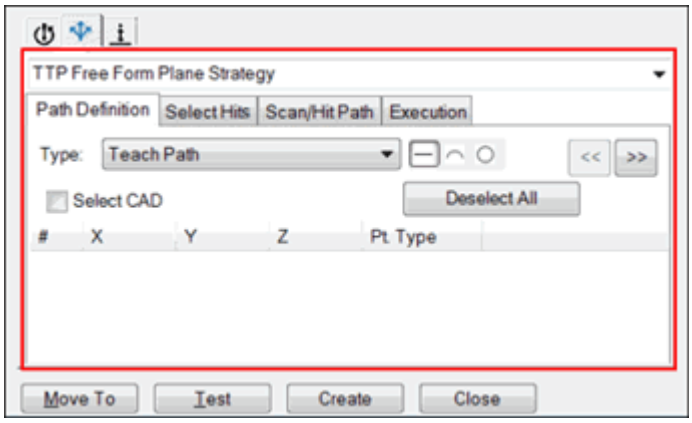
Teach Path Method

You can teach or learn the scan path by taking hits on the CMM or CAD. The scan path is made of lines, arcs, and/or circles.

For help with generating a teach path, refer to the example of a detailed procedure in the "Sample Teach Path for TTP Free Form Plane Strategy" topic for scanning the top surface along a specific path.

To define the teach path, follow these steps:

1. Select the button for the type of path:
   - **Line**
   - **Arc**
   - **Circle**
2. For a line path, take one or two manual hits. For an arc path or a circle path, take two or three manual hits. The points appear in the points list area. For example:

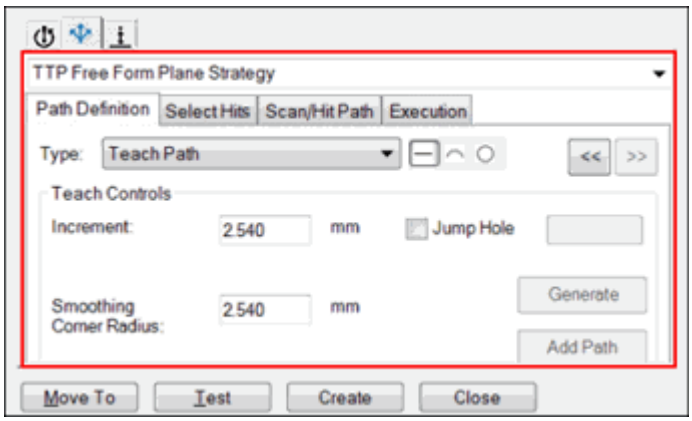


Sample line path

The following apply to the points list area:

- The **Pt. Type** column describes the type of point, such as: Line Start, Line End, Circle End, or Circle Midpoint<number>.
- Any red points indicate that the path is incomplete and the points are not used to generate the path. If you change the path type (for example, from a line to an arc), the red points are removed.
- If you edit the start point or the end point of a circle path, both points change because they are the same point.

3. To set teach controls, click **>>**. The **Teach Controls** area appears. Use the properties in this area to control point generation:



Sample Teach Controls area

Increment - Type the minimum distance between adjacent points.

Jump Hole - When selected, this check box generates a break point in the scan path whenever the scan path is over the holes in the CAD surface. Type the required distance from the edge in the box to the right of **Jump Hole**.

For tactile probes, the **Jump Hole** check box on the **Path Definition** tab is always selected. This is because the probe lifts between the scans on each polyline. For spot laser probes, the **Jump Hole** check box is available for selection, and PC-DMIS uses its last-used value. For more information about the check box, see the "Theoretical Path Area" topic in the PC-DMIS Core documentation.

The **Jump Hole** check box is not used for laser probes.

Smoothing Corner Radius - When PC-DMIS generates a scan path, the intersections have sharp corners. Smoothing the corner radius helps to smooth out the sharp corners. A circle with the center as the intersection point, and the radius that you enter in this box, is defined. All of the points in the scan path within this circle are smoothed out.

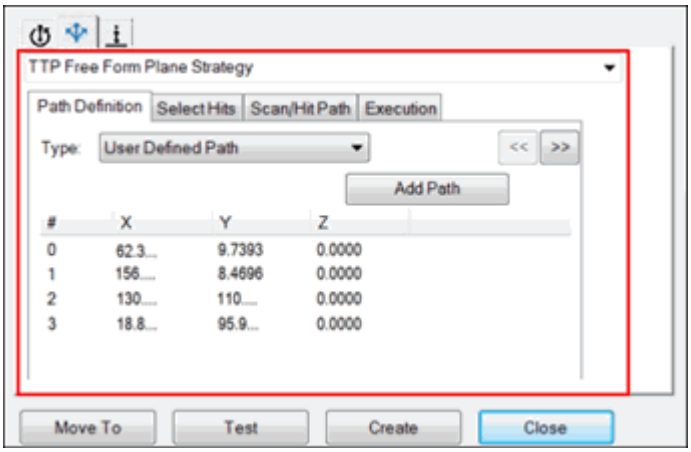
Generate - To generate the points and display them in the points list area, click this button. The generated path appears on the CAD in the Graphic Display window. You can change the points that define the teach path and then regenerate the scan path, if required.

Add Path - To add the points to the **Scan/Hit Path** tab, click this button. When the scan path is added, the hit points are also selected based on the selection criteria that is currently specified on the **Select Hits** tab.

User Defined Path Method

This method teaches the hits that you want to take to measure a plane. To teach hits, you can use CAD or take hits on the machine. This method of path generation is the default

method when PC-DMIS is in Manual Mode. To use this method, click points at the desired locations on the CAD or take hits on the machine. The points appear in the points list area. For example:



Sample User Defined Path

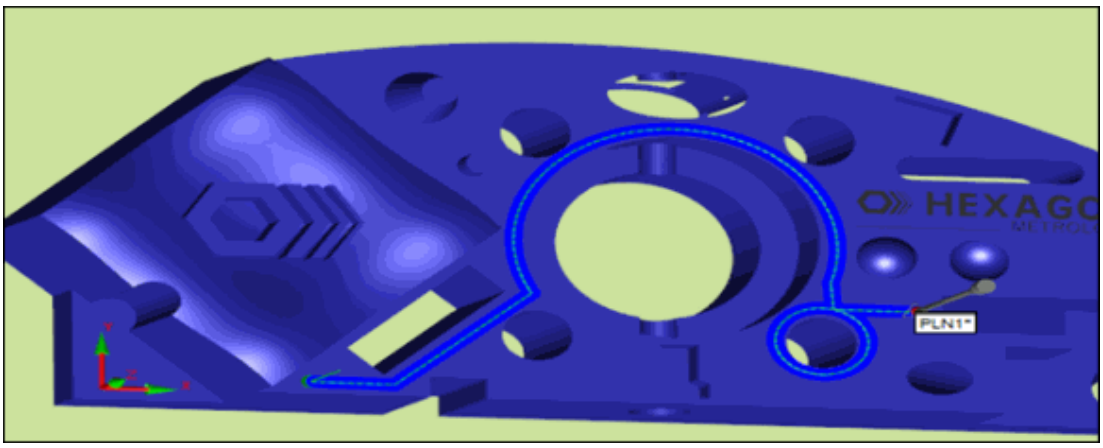
Add Path - To add the points to the **Scan/Hit Path** tab, click this button. PC-DMIS adds the points to the **Scan/Hit Path** tab and selects hit points as follows:

- If no points were previously available in the points list area, PC-DMIS selects all of the points on the **Scan/Hit Path** tab as hit points. Note that the selection method on the **Select Hits** tab is set to **Sector Hit Spacing** with 0 as the spacing (all of the hit points in the scan path are selected).
- If points were previously available in the points list area, PC-DMIS selects the hit points on the **Scan/Hit Path** tab according to the selection criteria that is currently specified on the **Select Hits** tab.
- If necessary, you can add move points to the **Scan/Hit Path** tab.

Sample Teach Path for TTP Free Form Plane Strategy

This example of the teach path method for the **TTP Free Form Plane** strategy shows a detailed procedure for scanning the top surface along a specific path.

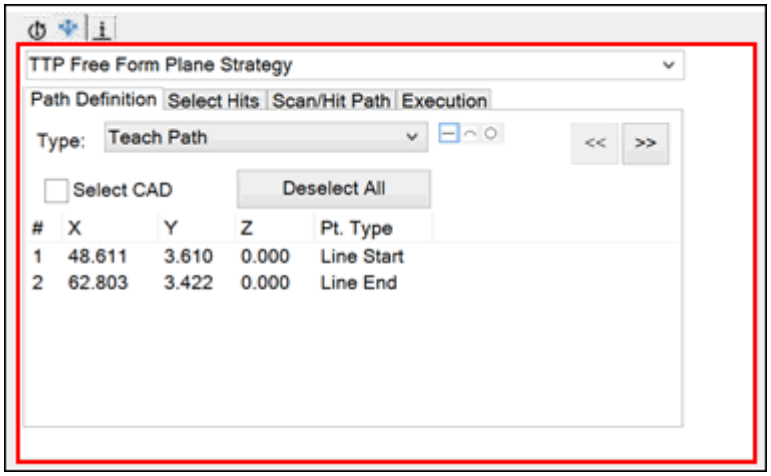
In this example, suppose that you want to scan the top surface along the path shown below:



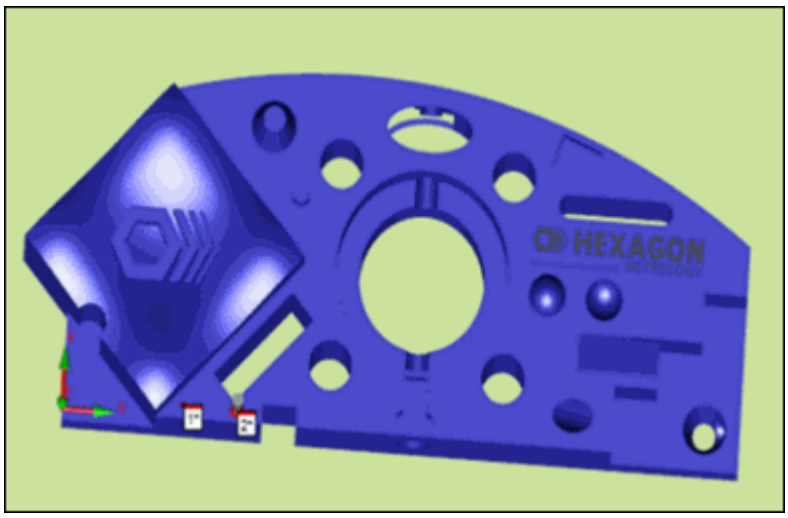
Scan path

To generate this path, take the hits to define the points as described below. The points are recorded in the list of points on the **Path Definition** tab. They are marked on the CAD as shown in the procedure.

1. The first segment in the path is linear. To generate this line:
    a. Select the ⊟ button.
    b. Because this is the first segment, take two hits to define points 1 and 2 for the line.



Points 1 and 2 in first segment

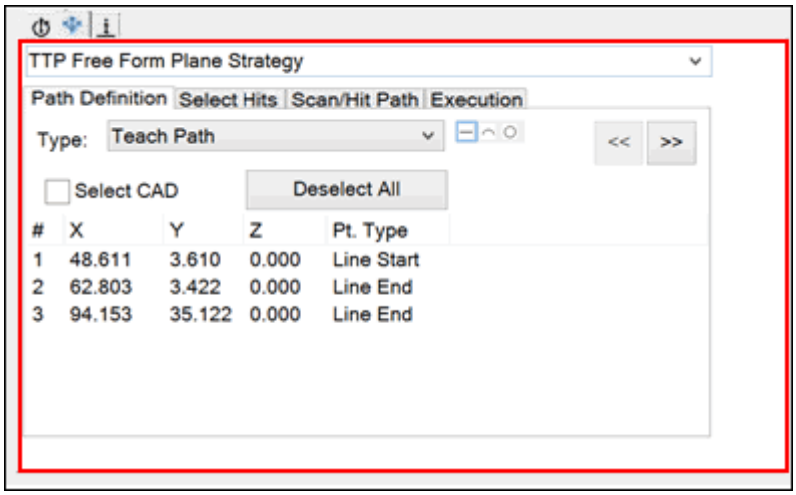


Points 1 and 2 marked on CAD

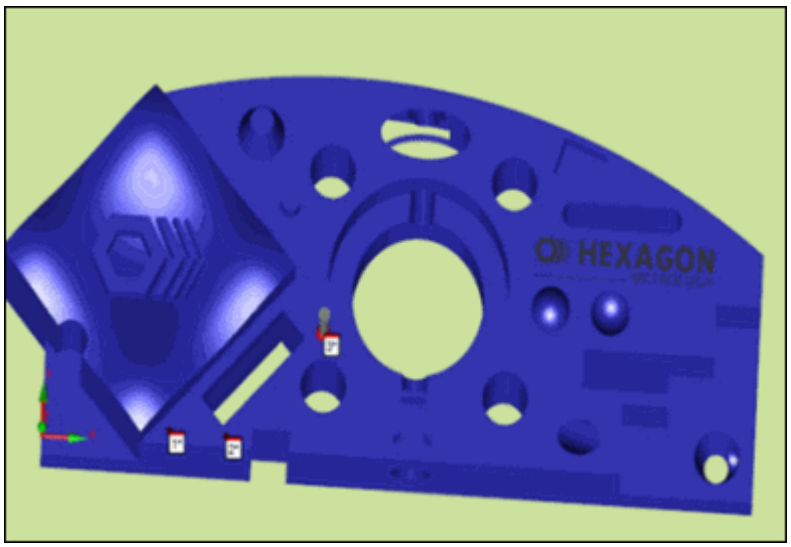
2. The second segment in the path is also linear. Point 2 (the last point of the first segment line) becomes the start point of the second segment line. To generate this line:

   a. Keep the ⊟ button selected.

   b. Take one hit to define point 3, the end point of the line for the second segment.



Point 3 in second segment

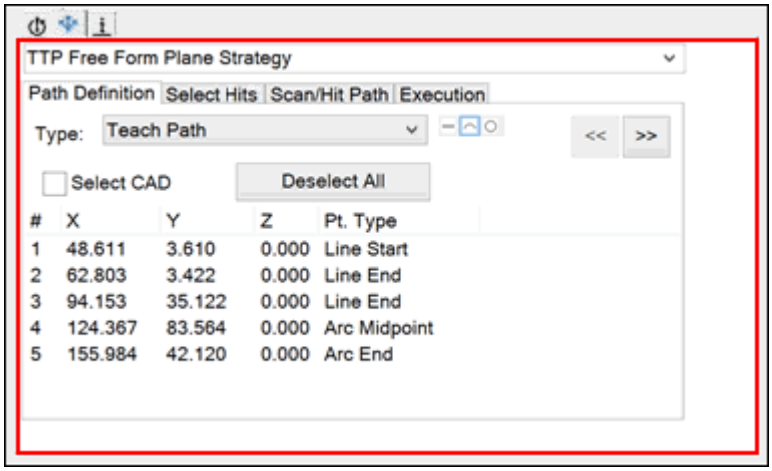


Point 3 marked on CAD

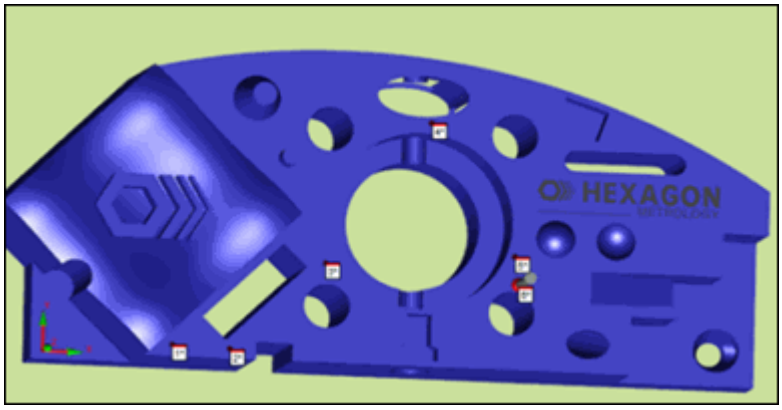
3. The third segment in the scan path is an arc along the big circle. Point 3 (the last point of the second segment line) becomes the start point of the arc. The last point is the end point of the arc. To generate this arc:

   a. Select the  button.

   b. Take two more hits on the arc to define points 4 and 5.



Points 4 and 5 in third segment

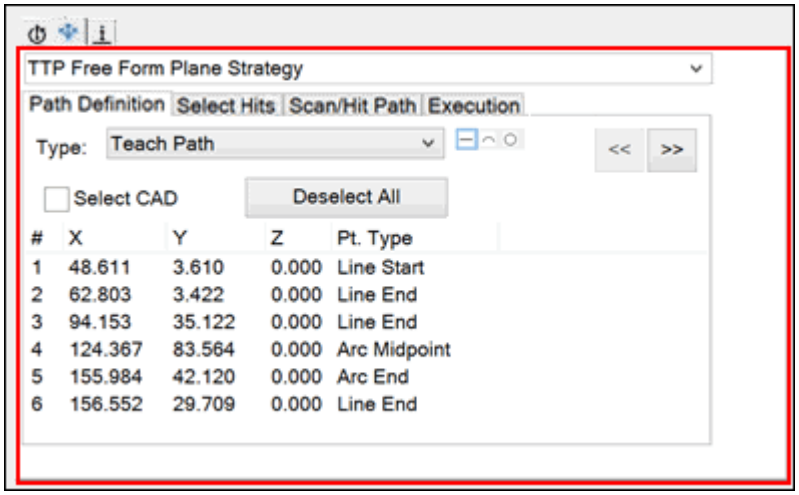


Points 4 and 5 marked on CAD

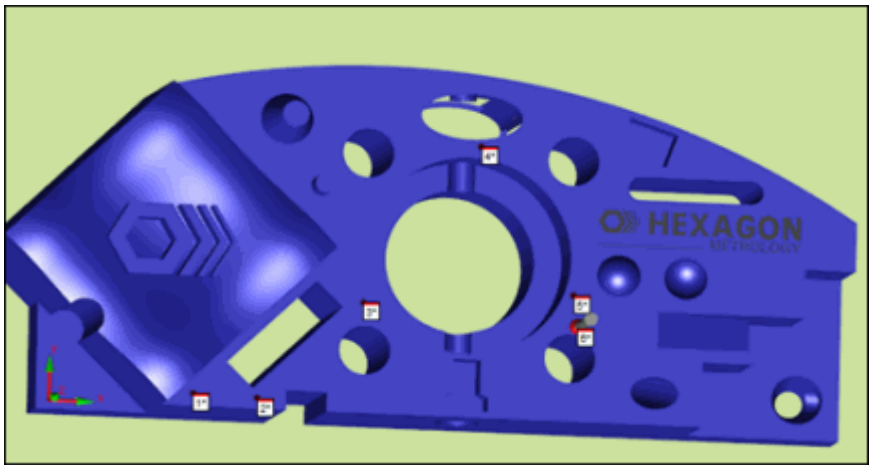
4. The fourth segment is a line. The end point of the arc becomes the start point of the line. To generate this line:

    a. Select the button.

    b. Take one hit to define point 6, the end point of the line for the fourth segment.



Point 6 in fourth segment

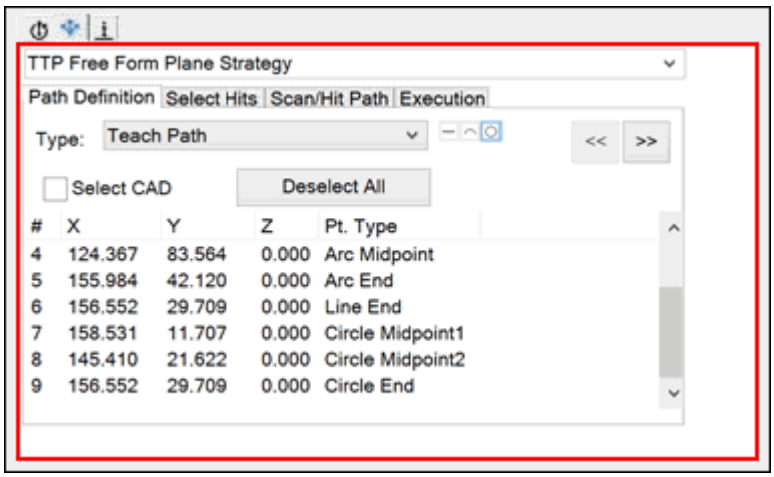


Point 6 marked on CAD

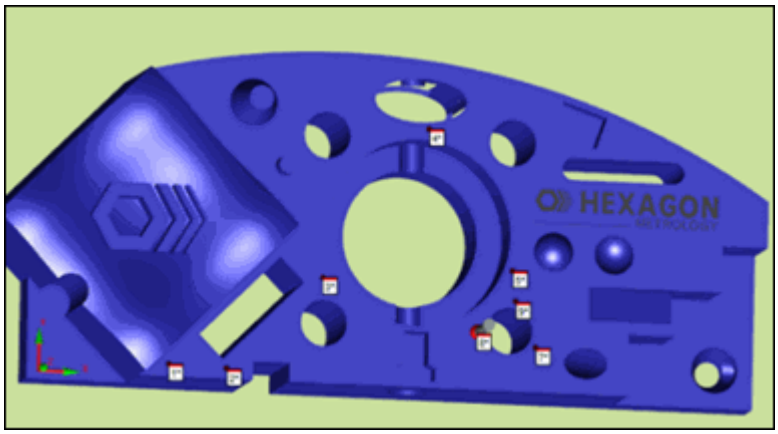
5. You now need to scan 360 degrees around the small circle. The end point of the line of the fourth segment becomes the start point of the circle. To generate this circle:

    a. Select the button.

    b. Take two more hits to define points 7 and 8 for the circular path. Because a circle is 360 degrees, point 9 - the end point of the circle - is automatically recorded at the same location as the start point of the circle.



Points 7 through 9 in circle

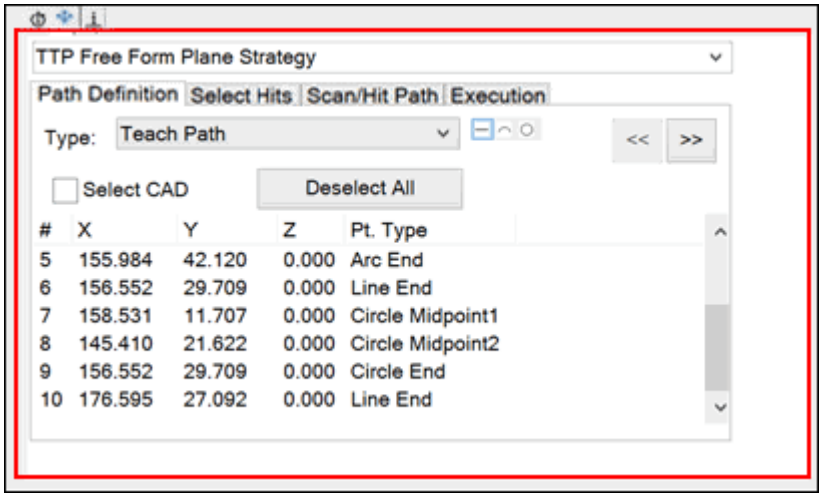


Points 7 through 9 marked on CAD

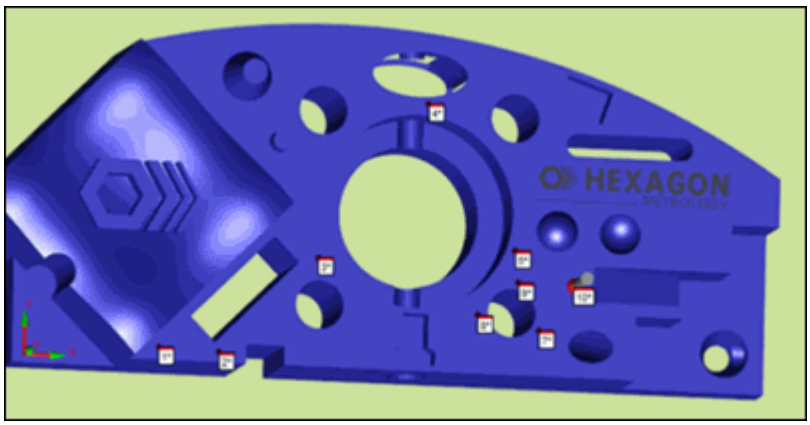
6. The last segment is a line. Point 9, the end point of the circle, becomes the start point of the line. To generate this line:

    a. Select the ⊟ button.

    b. Take the last hit to define point 10, which completes the scan path.

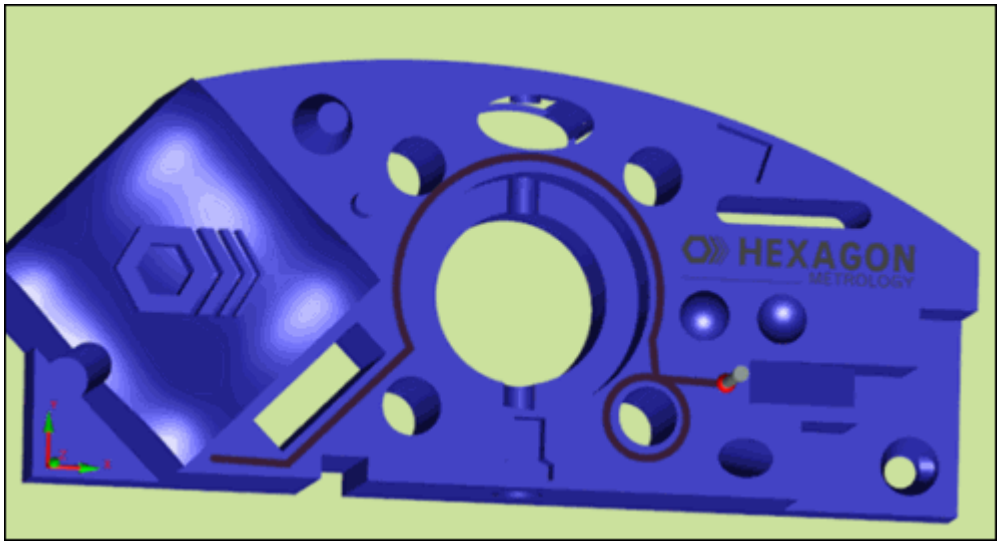


Point 10 in last segment



Point 10 marked on CAD

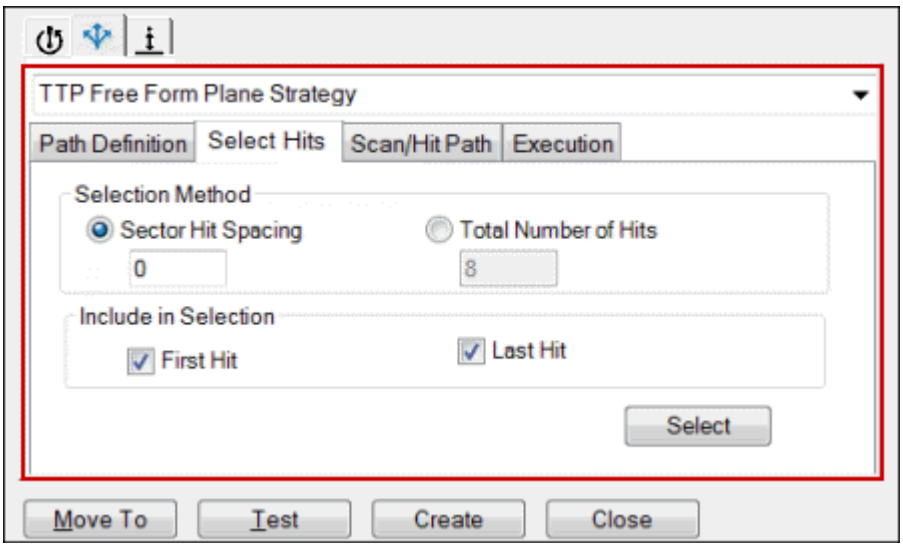
7. Select the **>>** button. In the **Teach Controls** area, in the **Increment** box, type 1.
8. Click **Generate**. The generated scan path appears in the Graphic Display window.



Generated scan path

Select Hits Tab - TTP Free Form Plane Strategy

The **Select Hits** tab for the TTP Free Form Plane strategy helps you select hit points from the generated scan path. The points in the scan path are broken into "sectors". Each "SectorEnd" in the scan path indicates the end of the sector. You cannot select the "SectorEnd" in the hit path.



Sample Select Hits tab

The **Select Hits** tab is not available if the **Type** list on the **Path Definition** tab is set to **User Defined Path**. To enable the options on the **Select Hits** tab, change the type on the **Path Definition** tab.

Selection Method Area

To select hit points from scan path points, select the appropriate method:

- **Sector Hit Spacing** - For this method, the hits are selected in the sector. Type the spacing between the selected hits in each sector. The number that you enter is the spacing between two selected hits.

The following indicate the points that are selected if the value is **0**, **1**, or **3**:

0 = All of the hit points in the scan path are selected.

1 = Alternate hit points are selected. For example, only hit points 1, 3, 5, and 7 are selected.

3 = Three hit points after the selected hit point are not selected. For example, if you select hit point number 1, the next selected hit point is 5; hit points 2, 3, and 4 are not selected. The next selected hit point is 9; hit points 6, 7, and 8 are not selected.

The default setting for the **Sector Hit Spacing** option is 0. If the value is 0, PC-DMIS selects all hit points in the scan path as a hit point in the hit path.

- **Total Number of Hits** - For this method, type the total number of hits required. The number of hits selected from the scan path are equal to the number that you enter. PC-DMIS does not consider the sectors for the selection of hits.

Include in Selection

Choose whether to include the first hit, the last hit, or both hits.

First Hit - The first hit is selected based on your selection method.

Last Hit - The last hit is selected based on your selection method.

If you selected the **Sector Hit Spacing** option, the first and last hits in each sector are selected by default.

If you selected the **Total Number of Hits** option, the first and last hits from the complete list are selected by default.

Select

To select the hit points with the criteria that you specified on this tab, click this button. The selected hit points are highlighted on the **Scan/Hit Path** tab.



All of the move points in the scan path are selected in the hit path.

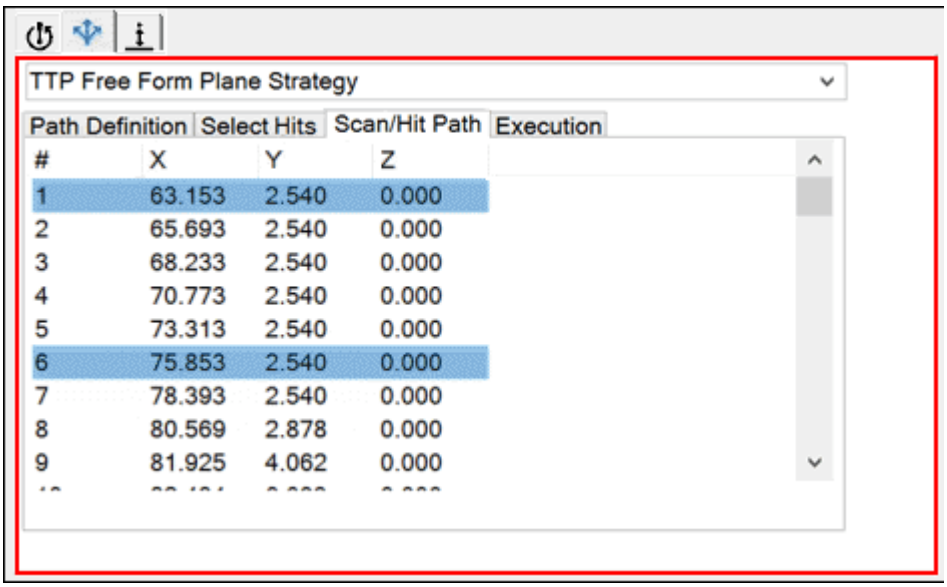
When PC-DMIS generates the path, it selects the hits according to the criteria that you specify on the **Select Hits** tab. You can modify the criteria on the tab and then click the **Select** button to modify the selection of hits.

Scan/Hit Path Tab - TTP Free Form Plane Strategy

You can use the **Scan/Hit Path** tab for the TTP Free Form Plane strategy to:

- Display scan points and move points
- Import scan points and move points from a text file
- Export scan points and move points to a text file
- Insert a move point or break point
- Remove a point from the scan path or hit path
- Add a point from the scan path to the hit path

For example:

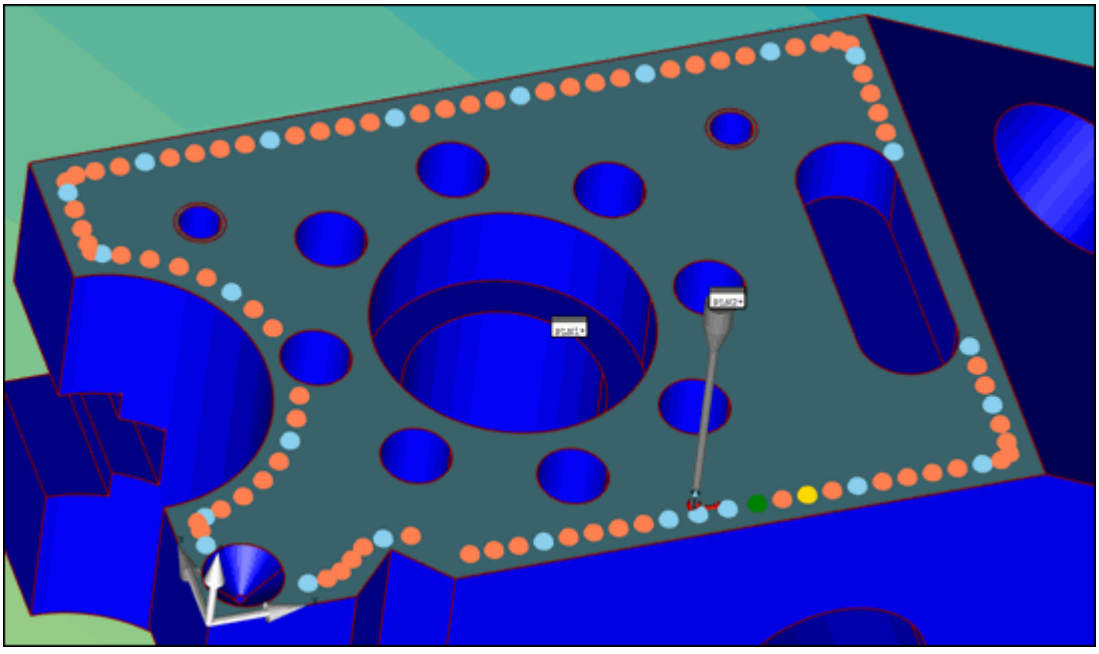


Sample Scan Path tab

The following items appear in the points list area:

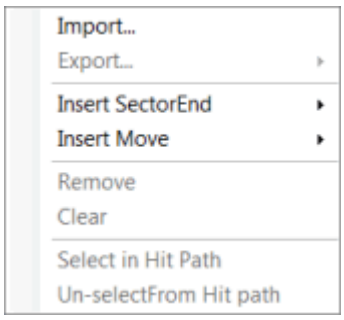
- # - A number that identifies the generated point
- **X**, **Y**, and **Z** - The XYZ values

When you click on any point in the scan path, PC-DMIS highlights the point on the CAD surface.



Example of highlighted point on CAD surface

To perform additional functions, right-click in the points list area. The following options appear:



Points List options

Import - To import the scan points and move points from a text file, select this option. When you run the measurement routine, PC-DMIS dynamically reads the path of the scan from a text file. This can help to scan the plane on variants of the part where the shape of the face being scanned is changed between variants.

Following is a sample of a partial text file:

```
-32.23,14.067,-0.001,SCAN
-29.2,6.684,-0.006,SCAN
-24.389,1.846,-0.008,SCAN
-19.309,-3.982,-0.004,SCAN
-15.327,-8.125,-0.004,SCAN
-9.949,-9.576,-0.004,SCAN
-4.838,-11.112,-0.001,SCAN
6.786,-10.431,-0.005,SCAN
12.121,-4.769,-0.003,SCAN
17.941,1.332,-0.005,SCAN
21.889,7.432,-0.002,SCAN
26.623,10.02,-0.004,SCAN
0,0,0,BREAK
27,10,50,MOVE
30.361,9.192,-0.003,SCAN
```

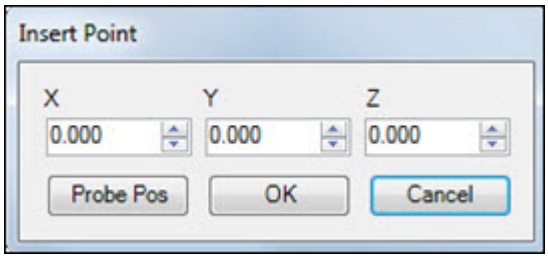
In this sample:

- SCAN - Indicates a point that will be added to the scan.
- BREAK - Indicates a move to the Retract, and then another scan will begin at the next SCAN point.
- MOVE - Indicates a move to the location specified.

Export - To export the scan path to a text file, select this option.

Insert Sector End - To insert a sector end between scan points, select this option. As a result, PC-DMIS will create "sectors". Sector end points in the scan path are generated when the path is not continuous due to any reason.

Insert Move - To insert a move point to avoid an obstacle, select this option. Move points in the scan path can help to scan a face as one single plane even if the path is not continuous for any reason. PC-DMIS opens the **Insert Point** dialog box.



Insert Point dialog box

You can position the probe and click **Probe Pos** to insert a move point at that location.

Remove - To delete one point, highlight it in the points list area, right-click, and then select this option.

Clear - To delete all points, right-click in the points list area and then select this option. When the "Remove all points?" message appears, click **OK**.

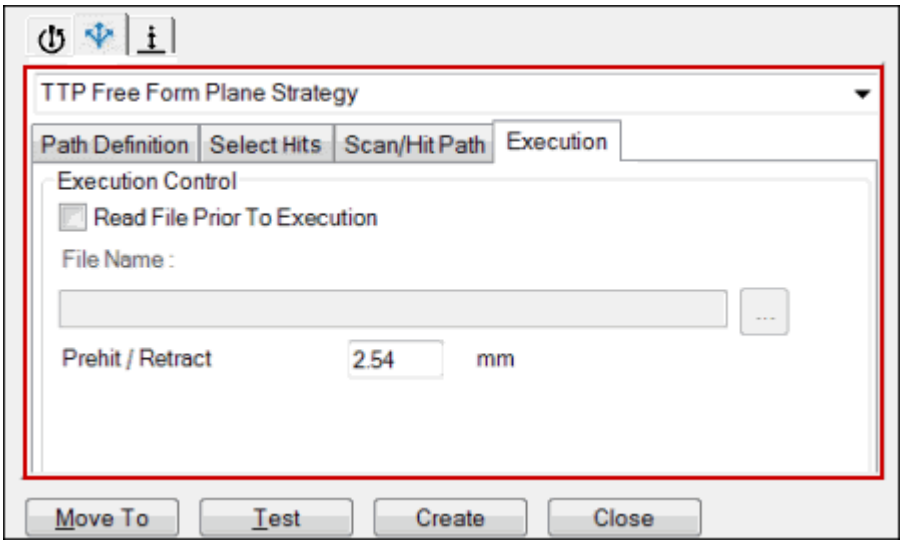
Select in Hit Path - To add a point to the hit path (and highlight the point), right-click on the path, and choose **Select in Hit Path**.

Un-select From Hit Path - To remove the point from the hit path, select this option.

Execution Tab - TTP Free Form Plane Strategy

Use the **Execution** tab for the TTP Free Form Plane strategy to set additional options for this strategy.

When you select the tab, the **Execution Control** area appears. For example:



Sample Execution tab

Read File Prior To Execution - To read the hit path prior to execution from a text file, select this check box. This will help to measure the variants of a part.

File Name - Type the path and name of the file to be read in prior to execution. To select the file, click **Browse**.

Prehit / Retract - Type the distance of a prehit and retract move. These values will override the global prehit and retract values.

TTP Plane Circle Strategy

The Touch Trigger Probe (TTP) Plane Circle strategy for the Plane Auto feature measures a plane by generating hit points in a circular path. As its name suggests, this strategy takes single hits. It is available for touch trigger probes and scanning probes.

The advantage of this strategy is being able to generate a hit path according to the criteria that you specify on the strategy's tabs. You can add move points to avoid obstructions in the path.

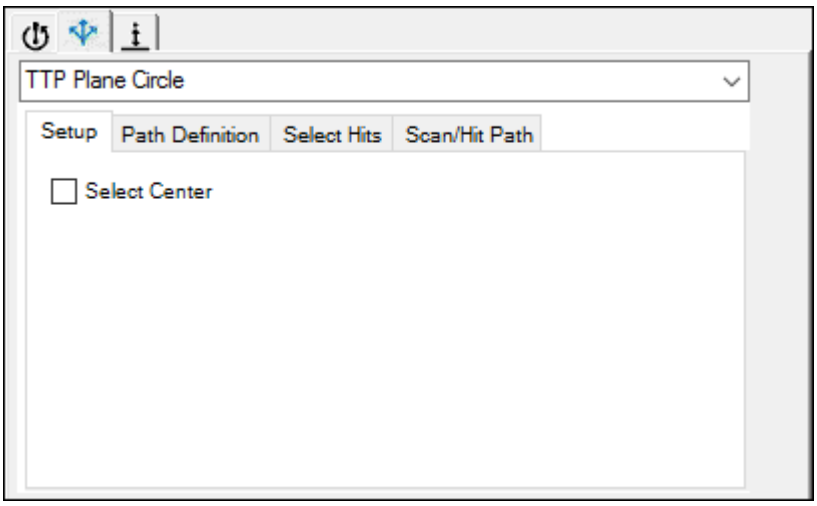
The strategy's tabs are located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**):

- **Setup** tab
- **Path Definition** tab
- **Select Hits** tab
- **Scan/Hit Path** tab

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Setup Tab - TTP Plane Circle Strategy

Use the **Setup** tab for the TTP Plane Circle strategy to select the center of the circular path. For example:



Sample Setup tab

Select Center

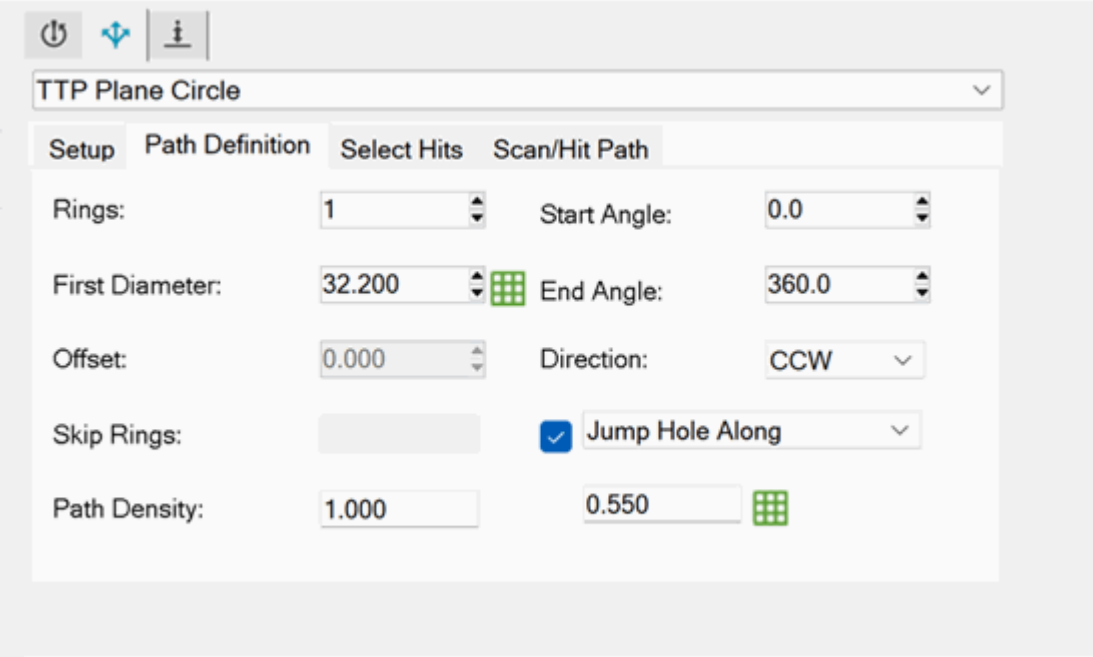
If you select this check box, you can click on the CAD to indicate the center point of a circular path. You can select a circle, cylinder, or any circular feature. PC-DMIS does the following:

- Fills in the **Feature properties** area in the **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**) with the information for the selected point.
- Completes the **First Diameter** box on the **Path Definition** tab.
- Generates and selects hits based on the selection criteria that is currently specified on the **Select Hits** tab.

Path Definition Tab - TTP Plane Circle Strategy

The **Path Definition** tab for the **TTP Plane Circle** strategy provides you with options to define a circular scan path. When the scan path is generated, the hit points are also selected based on the selection criteria that is currently specified on the **Select Hits** tab.

You can view the scan path whenever you update a path definition parameter and then move the cursor away. You can also view the updated scan path in the Graphic Display window.



Sample Path Definition tab

Rings - Type or select the number of rings.

First Diameter - Type the diameter of the first ring.

Offset - Type the distance between two rings.

Skip Rings - Type the ring number or numbers that you want to skip.

To skip rings 2 and 4, type **2,4**. To skip rings 2 through 5, type **2-5**.

Path Density - Type the number of points per mm that you want to use to create the scan path.

Start Angle - Type or select the start angle, in decimal degrees.

End Angle - Type or select the end angle, in decimal degrees.

Direction - Select **CW** (clockwise) or **CCW** (counterclockwise).

Jump Hole Type - Select the jump hole type that you want PC-DMIS to consider during path generation.

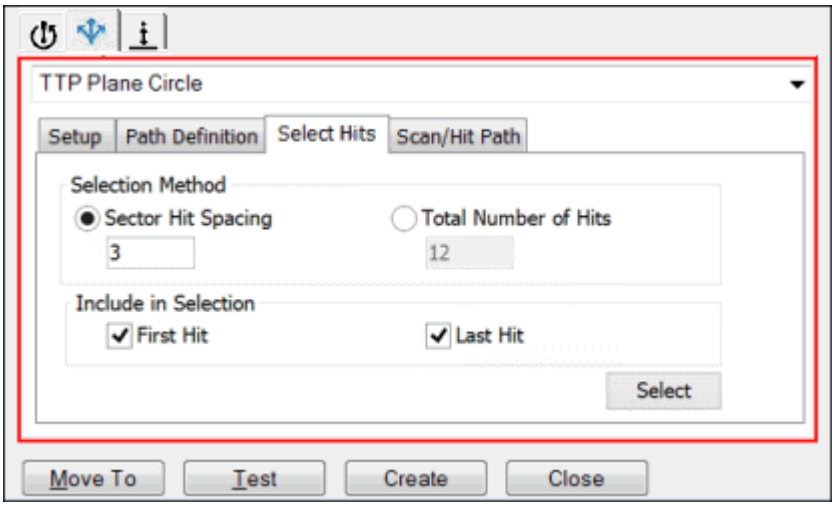
- **Jump Hole Along** - If you select this check box, PC-DMIS creates a break point in the scan path only when a scan path point falls within a hole on the CAD surface. Type the required distance from the edge in the box.
- **Jump Hole Around** - If you select this check box, PC-DMIS looks for holes in all directions (360 degrees) around the scan path and creates a break point when it detects a hole. Type the required distance from the edge in the box.

Smart Calculations - Smart calculations are available for First Diameter and Jump Holes, indicated by a grid button next to these options. Smart calculations take into consideration the tip's radius, dynamically adds the tip's diameter to the first circle's diameter, and adds a 0.2 mm safety distance. It also sets the jump hole distance to half of tip radius plus 0.1 mm, divided by two.

A grey, crossed-out grid button indicates that smart calculations are turned off, while a green grid button indicates they are turned on. By default, smart calculations are turned on. However, if you enter a value other than the calculated one, PC-DMIS turns off smart calculations.

Select Hits Tab - TTP Plane Circle Strategy

You can use the **Select Hits** tab for the TTP Plane Circle strategy to select hit points from the generated scan path. The points in the scan path are broken into "sectors". Each sector end point in the scan path indicates the end of the sector. You cannot select sector end points in the hit path.



Sample Select Hits tab

Selection Method Area

To select hit points from scan path points, select the appropriate method:

- **Sector Hit Spacing** - For this method, the hits are selected in the sector. Type the spacing between the selected hits in each sector. The number that you enter is the spacing between two selected hits.

The following indicate the points that are selected if the value is **0**, **1**, or **3**:

0 = All of the hit points in the scan path are selected.

1 = Alternate hit points are selected. For example, only hit points 1, 3, 5, and 7 are selected.

3 = Three hit points after the selected hit point are not selected. For example, if you select hit point number 1, the next selected hit point is 5; hit points 2, 3, and 4 are not selected. The next selected hit point is 9; hit points 6, 7, and 8 are not selected.

The default setting for the **Sector Hit Spacing** option is 0. If the value is 0, PC-DMIS selects all hit points in the scan path as a hit point in the hit path.

- **Total Number of Hits** - For this method, type the total number of hits required. The number of hits selected from the scan path are equal to the number that you enter. PC-DMIS does not consider the sectors for the selection of hits.

Include in Selection

Choose whether to include the first hit, the last hit, or both hits.

First Hit - The first hit is selected based on your selection method.

Last Hit - The last hit is selected based on your selection method.

If you selected the **Sector Hit Spacing** option, the first and last hits in each sector are selected by default.

If you selected the **Total Number of Hits** option, the first and last hits from the complete list are selected by default.

Select

To select the hit points with the criteria that you specified on this tab, click this button. The selected hit points are highlighted on the **Scan/Hit Path** tab.

All of the move points in the scan path are selected in the hit path.

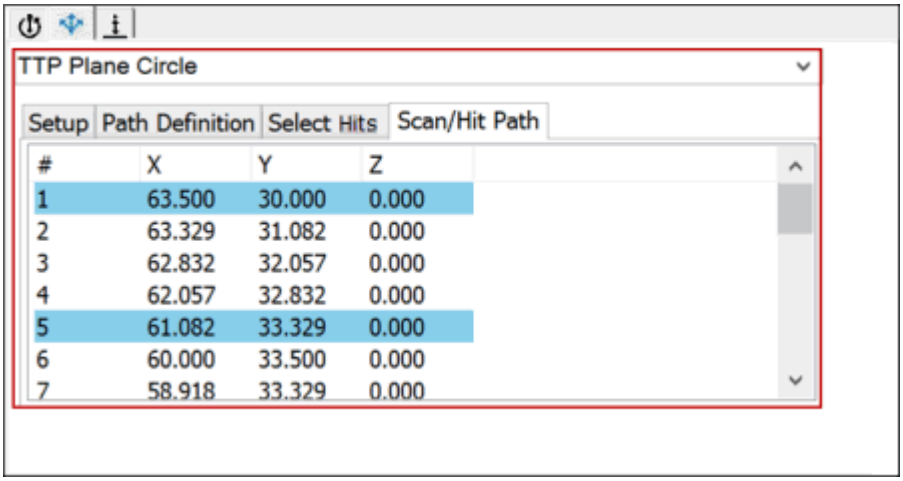
When PC-DMIS generates the path, it selects the hits according to the criteria that you specify on the **Select Hits** tab. You can modify the criteria on the tab and then click the **Select** button to modify the selection of hits.

Scan/Hit Path Tab - TTP Plane Circle Strategy

You can use the **Scan/Hit Path** tab for the TTP Plane Circle strategy to:

- Display the hit points in the path (these points are highlighted on this tab)
- Display the scan path points and move points
- Insert a move point or sector end point
- Remove a point from the scan path or hit path
- Add a point from the scan path to the hit path

For example:

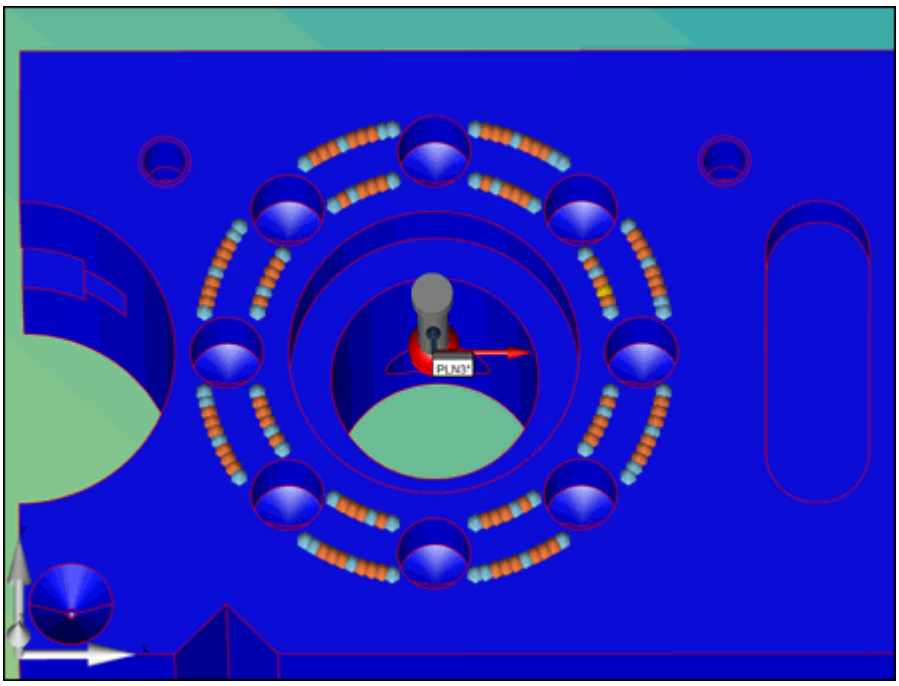


Sample Scan/Hit Path tab

The following items appear in the points list area:

- # - A number that identifies the generated point
- **X**, **Y**, and **Z** - The XYZ values
- Highlighted points - The hit points in the path

When you click on any point in the scan/hit path, PC-DMIS highlights the point on the CAD surface. For example:



Example of highlighted point on CAD surface:
Orange = Scan path point
Blue = Hit path point
Gold = Point that you clicked

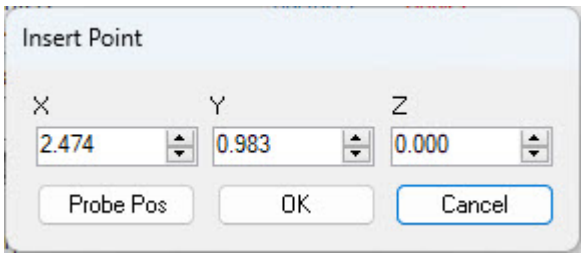
To perform additional functions, right-click in the points list area. The following options appear:



Points List options

Insert Sector End - To insert a sector end between scan points, select this option. As a result, PC-DMIS will create "sectors". Sector end points in the scan path are generated when the path is not continuous due to any reason.

Insert Move - To insert a move point to avoid an obstacle, select this option. Move points in the scan path can help to avoid any obstruction in the scan path. The **Insert Point** dialog box appears:



Insert Point dialog box

You can position the probe and click **Probe Pos** to insert a move point at that location.

Remove - To delete one point, highlight it in the points list area, right-click, and then select this option.

Select in Hit Path - To add a point to the hit path (and highlight the point), right-click on the path, and choose **Select in Hit Path**.

Un-select From Hit Path - To remove the point from the hit path, select this option.

TTP User Defined Plane Strategy

The Touch Trigger Probe (TTP) User Defined Plane strategy for the Plane Auto feature measures a plane by taking hits at learned points. You can use this strategy instead of the Measured Plane feature option.

The Measurement Strategies tab is located in the **Probe Toolbox** in the **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**).

For more information, see:

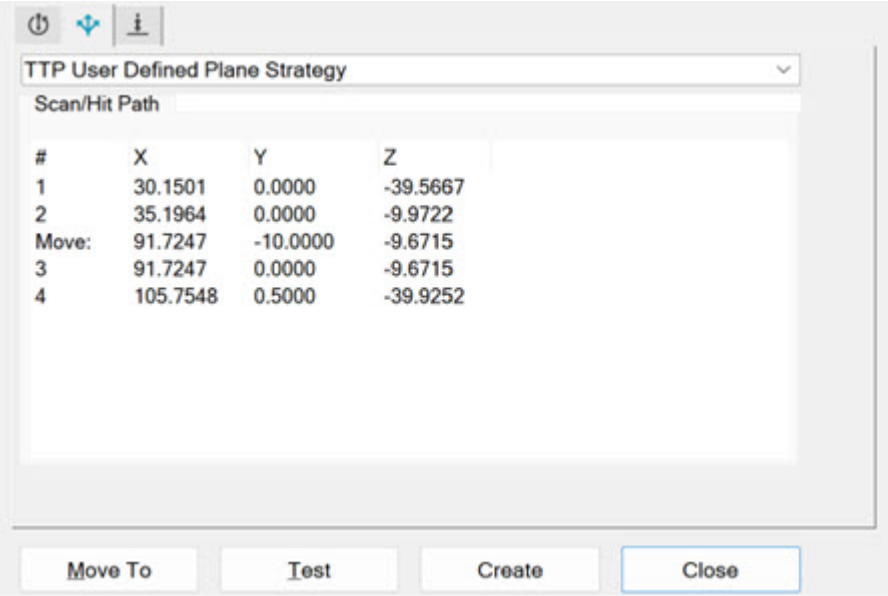
- Scan/Hit Path Tab - TTP User Defined Plane Strategy
- Working with Quick Feature

For information about how to select and use measurement strategies, see the "Working with Measurement Strategies" section of the PC-DMIS CMM documentation.

Scan/Hit Path Tab - TTP User Defined Plane Strategy

TTP User Defined Path Method

This method teaches the hits that you want to take to measure a plane. To use this method, click points at the desired locations on the CAD or take hits on the machine. The points appear in the Scan/Hit Path area. For example:



Sample TTP User Defined Plane Path

You can use the **Scan/Hit Path** tab to:

- Display hit points and move points
- Insert hit points in between other hit points
- Import hit points and move points from a text file
- Export hit points and move points to a text file
- Insert a move point before or after a selected point
- Remove a point from the scan path or hit path

Edit Co-ordinates

To edit a hit or move point, double-click on the point. The **Insert Point** dialog box appears.

Insert Hit Point

To insert a hit point, position your mouse pointer on a point after which you want to insert the point. Use the Teach Point method to insert the hit point.

Right-Click Menu Items

To perform additional functions, right-click in the points list area to display these options:

Import - Select this option to import scan points and move points from a text file.

Here is a sample of a partial text file:

```
VECTOR,0,-1,0
29.5323410053599,0,-37.6988009316524,SCAN
31.1528542315656,0,-14.9794257639399,SCAN
91.8402432752159,-10,-7.93984347807685,MOVE
91.8402432752159,0,-7.93984347807685,SCAN
102.495262284169,0,-40.8164277082473,SCAN
```

In this sample:

- SCAN - Defines the point added to the hit point
- MOVE - Defines the location that PC-DMIS moves the next point to

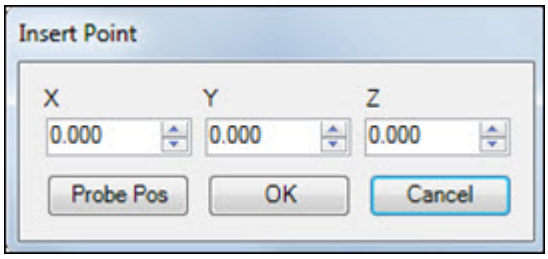
Export - To export the scan path to a text file, select this option.

Insert Move - To insert a move point to avoid an obstacle, select this option. Move points in the scan path can help to scan a face as one single plane even if the path is not continuous for any reason.

You can insert a move point before or after the selected scan or hit path point.

- To insert a move point before the scan or hit path point, select **Before**.
- To insert a move point after the scan or hit path point, select **After**.

PC-DMIS opens the **Insert Point** dialog box.



Insert Point Dialog Box

You can position the probe and click **Probe Pos** to insert a move point at that location.

Remove - To delete one point, highlight it in the points list area, right-click, and then select this option.

Clear - To delete all points, right-click in the points list area and then select this option. When the "Remove all points?" message appears, click **OK**.

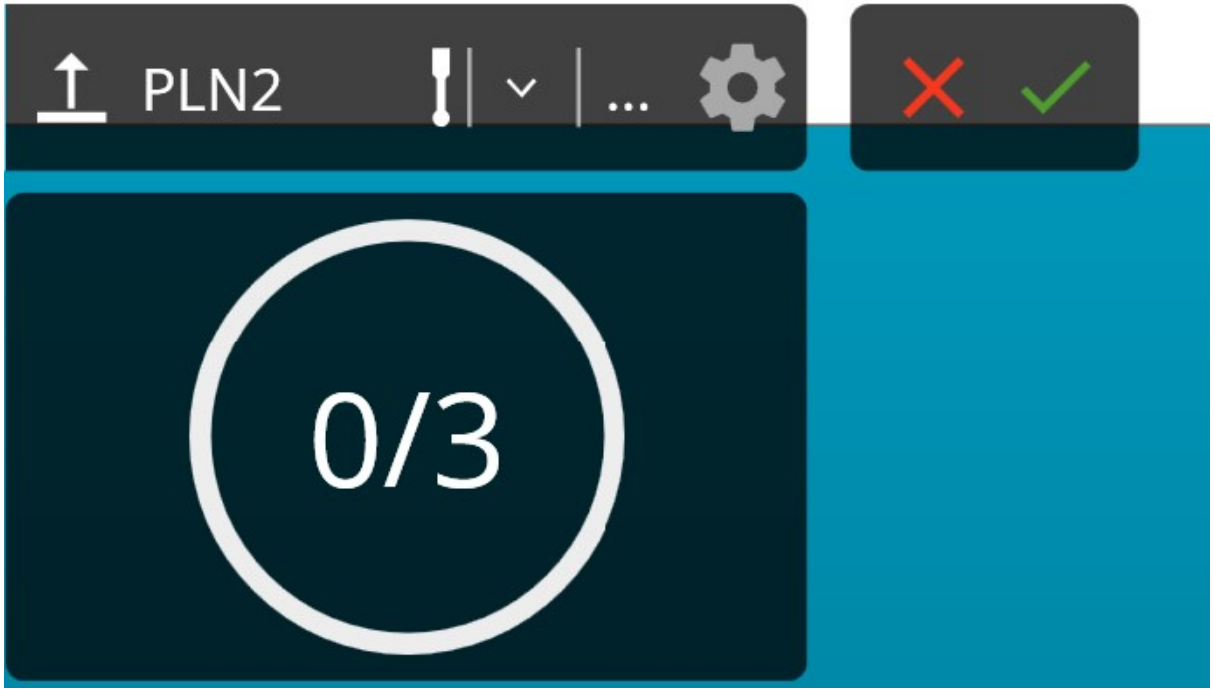
Working with Quick Feature

You can use QuickFeature for the TTP User Defined Plane strategy. You can use Measurement Strategy Editor to select TTP User Defined Plane strategy for manual and DCC Mode.

To create a TTP User Defined Plane strategy using QuickFeature:

1. Press the Shift key and click on any plane on a CAD model in the Graphic Display window.

   If you select TTP User Defined Plane strategy for QuickFeature, PC-DMIS displays the widget:

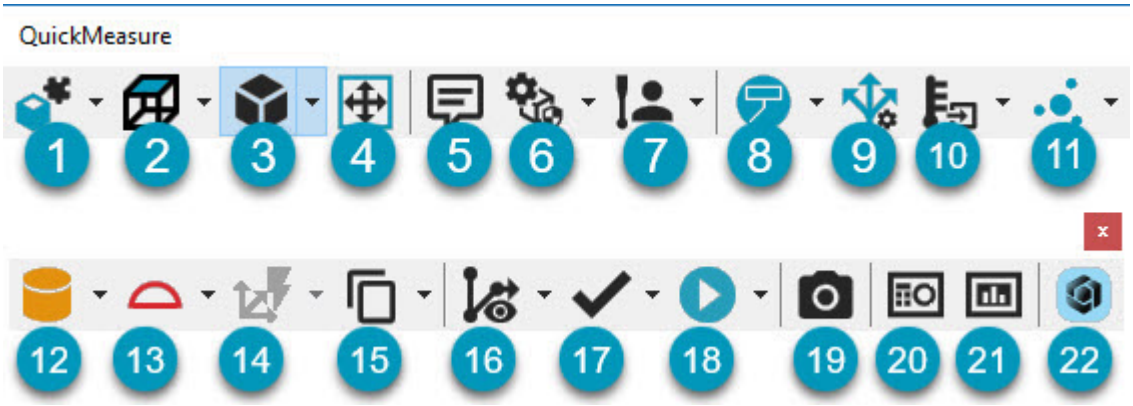
   Quick Feature Widget

2. Take the necessary hits at the desired locations on the CAD model in the Graphic Display window.

3. Click the **Done** button on the widget to create the plane.

PC-DMIS displays the widget even if you clear the **Use Measurement Strategy Widget** check box in the **Setup Options** dialog box.

CMM QuickMeasure Toolbar



PC-DMIS CMM QuickMeasure toolbar

From left to right, the **CMM QuickMeasure** toolbar models the typical flow of operation on a CMM. To access it, select **View | Toolbars | QuickMeasure**.

The toolbar provides drop-down functionality for many of the buttons. PC-DMIS stores the last-selected option for each button and displays it the next time you display the **QuickMeasure** toolbar.

You can add the drop-down buttons to any customizable toolbar from the **View | Toolbars | Customize** menu option. For details, see the "Customizing Toolbars" chapter in the PC-DMIS Core documentation.

The following buttons are available on the **CMM QuickMeasure** toolbar:

When you run PC-DMIS in Operator mode, the following options appear on the **CMM QuickMeasure** toolbar: **Graphic View**, **Graphic Items**, **Scale to Fit**, **Probe Mode**, **Execute** (full execute only), **Status Window**, and **Report Window**.

1. **CAD Setup** - This button provides options to set up the CAD model.

   Click the small black arrow to display the **CAD Setup** toolbar:

   For details, see "CAD Setup Toolbar" in the PC-DMIS Core documentation.

2. **Graphic View** - This button resets the graphic in the Graphic Display window to the graphical view shown on the button.

   Click the arrow to display the **Graphic View** toolbar:



For details, see "Graphic View Toolbar" in the PC-DMIS Core documentation.

3. **Graphic Items** - This button resets the graphic in the Graphic Display window to display or hide the graphical item shown on the button.

Click the small black arrow to display the **Graphic Items** toolbar:



For details, see the "Graphic Items Toolbar" topic in the PC-DMIS Core documentation.

4. **Scale to Fit** - This button redraws the part image to fit entirely within the Graphic Display window. This function is useful whenever the image becomes too large or small. You can also press Ctrl + Z to redraw the image.

5. **Comment** - This button opens the **Comment** dialog box so that you can insert different comment types into the measurement routine. By default, the software selects the **Operator** option. For details, see the "Inserting Programmer Comments" chapter in the PC-DMIS Core documentation.

6. **ClearanceCube** - This button performs the ClearanceCube function shown on the button.

Click the small black arrow to display the **ClearanceCube** toolbar:



For details, see the "ClearanceCube Toolbar" topic in the PC-DMIS Core documentation.

7. **Probe Mode** - This button sets the probe mode feature shown on the button and adds the feature to the measurement routine.

Click the small black arrow to display the **Probe Mode** toolbar:



For details, see the "Probe Mode Toolbar" topic in the PC-DMIS Core documentation.

8. **Graphic Modes** - This button sets the screen mode that is related to the icon shown on the button.

Click the small black arrow to display the **Graphic Modes** toolbar:



For details on the different graphic modes, see "Graphic Modes toolbar" in the PC-DMIS Core documentation.

9. **Measurement Strategy Editor** - This button opens the **Measurement Strategy Editor** dialog box so that you can modify the settings for all Auto features and store them as custom groups. For details, see "Using the Measurement Strategy Editor" topic in the PC-DMIS Core documentation.

10. **Gage** - This button opens the **Gage** dialog box for the Gage command shown on the button. From the dialog box, you can select a Gage command to insert into the measurement routine.

Click the small black arrow to display the **Gage** toolbar. The available gages are:

Caliper gage - For details on the **Caliper** gage, see the topic "Caliper Overview" in the PC-DMIS Laser documentation.

Temperature Compensation gage - For details on the **Temperature Compensation** gage, see the topic "Using Simplified Temperature Compensation" in the PC-DMIS Core documentation.

Thickness gage - For details on the **Thickness** gage, see the topic "Thickness Gage" in the PC-DMIS Core documentation.

11. **Auto Feature** - This button opens the **Auto Feature** dialog box for the Auto feature icon shown on the button. From the dialog box, you can select a feature command to insert into the measurement routine.

Click the small black arrow to display the **Auto Feature** toolbar:



For details, see "Inserting Auto Features" in the "Creating Auto Features" chapter in the PC-DMIS Core documentation.

12. **Constructed Feature** - This button opens the **Constructed Feature** dialog box for the constructed feature icon shown on the button. From the dialog box, you can select a feature command to insert into the measurement routine.

Click the small black arrow to display the **Constructed Feature** toolbar:



For details, see "Constructing New Features from Existing Features: Introduction" in the "Constructing New Features from Existing Features" chapter in the PC-DMIS Core documentation.

13. **Dimension** - This button opens the **Dimension** dialog box for the dimension icon shown on the button. From the dialog box, you can select a dimension command to insert into the measurement routine.

Click the small black arrow to display the **Dimension** toolbar:



For details, see "Dimensioning Location" in the "Using Legacy Dimensions" chapter in the PC-DMIS Core documentation.

14. **Alignment** - Click this button to perform the alignment shown on the button. The alignment options are defined based on the types of features selected, the order in which you select the features, and the positions of the features relative to each other.

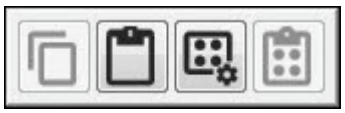
Click the small black arrow to display the **Alignment** toolbar:



For information on alignments, see the "Creating and Using Alignments" chapter in the PC-DMIS Core documentation.

15. **Copy/Paste** - This button provides standard copy and paste functions for editing your measurement routine in the Edit window. The button also provides the ability to define and paste patterns of features into your measurement routine.

Click the small black arrow to display the **Copy/Paste/Pattern** toolbar:



For details, see these topics in the PC-DMIS Core documentation:

"Copy" and "Paste" in the "Using Standard Edit Commands" chapter

"Paste with Pattern" in the "Editing Patterns of Features" chapter

16. **Path** - This button performs the path function shown on the button.

Click the small black arrow to display the **Path** toolbar:



The **Path** toolbar contains these options:

 **Path Lines** - This button shows or hides the path lines on the part in the Graphic Display window.
(For more information, see "Viewing Path Lines" in the "Using Other Windows, Editors, and Tools" chapter of the PC-DMIS Core documentation.)

 **Regenerate Path** - This button regenerates the path lines.
(For more information, see "Regenerating the Path" in the "Editing the CAD Display" chapter of the PC-DMIS Core documentation.)

 **Path Optimizer** - This button optimizes the path. To do this, PC-DMIS re-orders commands in your Edit window.
(For more information, see "Optimizing the Path" in the "Editing the CAD Display" chapter of the PC-DMIS Core documentation.)

 **Animate Path** - This button shows an animated probe that takes hits on the CAD model in the Graphic Display window.
(For more information, see "Animating the Path" in the "Editing the CAD Display" chapter of the PC-DMIS Core documentation.)

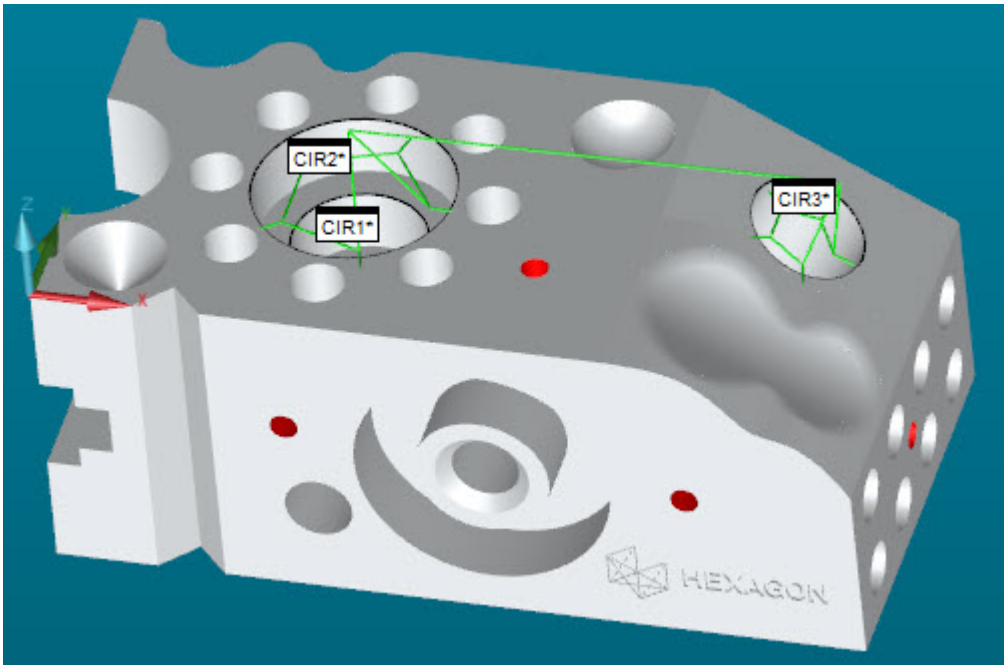
 **QuickPath** - This button turns on the options in the list below. When you turn on these options, they work together to improve your experience with Quick Features. (For information on QuickFeatures, see "Creating QuickFeatures" in the "Creating Auto Features" chapter of the PC-DMIS Core documentation.) As you select features, PC-DMIS performs the path generation, and you don't need to deal with manually creating path commands (such as tip or move commands).

- **Operation | Graphic Display Window | Clearance Moves | With Feature Creation**
  (For information, see the "With Feature Creation" subtopic in "Inserting Clearance Moves Automatically" in the "Inserting Move Commands" chapter of the PC-DMIS Core documentation.)
- **Operation | Graphic Display Window | Clearance Moves | With Collision Detection**
  (For information, see the "With Collision Detection" subtopic in "Inserting Clearance Moves Automatically" in the "Inserting Move Commands" chapter of the PC-DMIS Core documentation.)

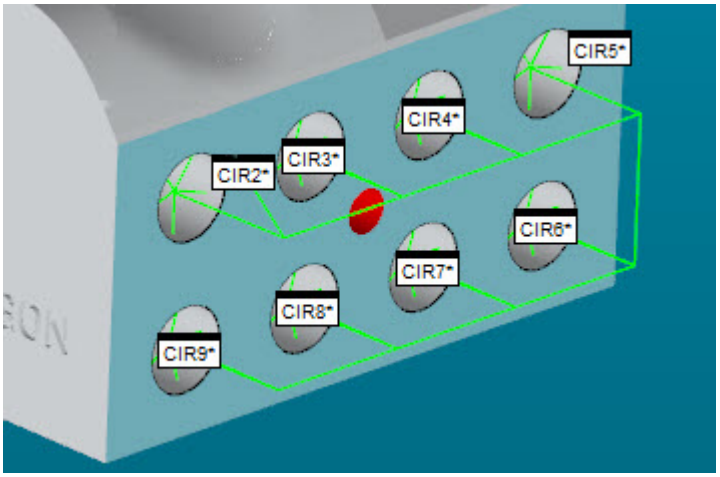
- The **Auto Wrist** button that's on the Auto Feature bar in the **Measurement Properties** area of the **Auto Feature** dialog box. (For information, see "Auto Wrist" in the "Creating Auto Features" chapter of the PC-DMIS Core documentation.)

If you click **QuickPath** again to disable it, the above options return to the state they were in before **QuickPath** turned them on.

With **QuickPath**, PC-DMIS automatically draws path lines from the previous feature to the current feature:



In addition, for patterns of features with QuickFeatures, PC-DMIS draws path lines between the features in the pattern:



 **Auto Wrist** - This button turns on or off the **Auto Wrist** button that's on the Auto Feature bar in the **Measurement Properties** area of the **Auto Feature** dialog box.

17. **Mark** - Depending on the selection made on the **Mark** toolbar, the button marks the currently-selected feature, marks all features, or clears all marked features in the Edit window.

Click the small black arrow to display the **Mark** toolbar:



For more information, see "Edit Window Toolbar" in the "Using Toolbars" chapter in the PC-DMIS Core documentation.

18. **Execute** - This button runs (or executes) the measurement process for any currently marked feature or features.

Click the small black arrow to display the **Execute** toolbar:



For details on the functions of the individual buttons, see "Executing Measurement Routines" in the "Using Advanced File Options" chapter in the PC-DMIS Core documentation.

19. **Snapshot** - This button inserts a `SNAPSHOT` command of the current Graphic Display window state into the Edit window. When you execute this command, it inserts an image capture at that state into your report. For more information, see "Inserting Snapshots" in the "Inserting Report Commands" chapter in the PC-DMIS Core documentation.

20. **Status Window** - This button opens the Status window. You can use this window to preview commands and features while you create them from the **Quick Start** toolbar. You can do this during feature execution, dimension creation or editing, and by clicking the item in the Edit window with the Status window open. For details, see "Using the Status Window" in the PC-DMIS Core documentation.

21. **Report Window** - This button opens the Report window. After execution of the measurement routine, this window displays your measurement results and automatically configures the output according to a default report template. For detailed information, see "About the Report Window" in the "Reporting Measurement Results" chapter in the PC-DMIS Core documentation.

22. **View Report in PC-DMIS FUSION** - If you have PC-DMIS FUSION installed, this button opens the latest report data for your current measurement routine in the PC-DMIS FUSION application.

Creating Alignments

Alignments are essential to setting the coordinate origin and defining the X, Y, and Z axes. If you've been through the tutorial in the "Getting Started" chapter, you have already created a simple 3-2-1 alignment.

PC-DMIS provides a handy **321Alignment** button () on the **Wizards** toolbar.

You can also use additional alignment options such as Iterative alignments and Best Fit alignments according to your needs. See the "Creating and Using Alignments" chapter in the PC-DMIS Core documentation for in-depth information on working with alignments.

Measuring Features

Measuring Features: Introduction

PC-DMIS provides you with two ways to define part features and add them into your measurement routine for PC-DMIS to measure during execution:

- Measured Features method
- Auto Features method

You can also add constructed features into your measurement routine. These are features constructed from other features, which is beyond the scope of this topic. For information on constructed features, see the "Constructing New Features from Existing Features" chapter in the PC-DMIS Core documentation.

Measured Features Method

Whenever your probe hits on the part, PC-DMIS interprets those hits into different features. These are called "Measured Features" and depend on the number of hits, their vectors, and so forth. The supported measured features are:

- Point
- Line
- Plane
- Circle
- Round Slot
- Square Slot
- Cylinder
- Cone
- Sphere
- Torus

For more information, see "Inserting Measured Features" below.

Auto Features Method

If your version of PC-DMIS supports Auto features, you can insert part features into your measurement routine as "Auto Features". In many cases, this automatic feature recognition is as simple as single-clicking with your mouse on the appropriate feature in the Graphic Display window. The supported Auto features are:

- Vector Point
- Surface Point
- Edge Point
- Angle Point
- Corner Point
- High Point
- Plane
- Line
- Circle
- Ellipse
- Flush and Gap
- Round Slot
- Square Slot
- Notch
- Polygon
- Cylinder
- Cone
- Sphere

For more information, see "Inserting Auto Features" below.

Inserting Measured Features

You can insert measured features into your measurement routine from the physical part by taking probe hits on that feature.

To insert a measured feature, follow this general procedure:

1. On the physical part, locate the desired feature.
2. From the **Measured Features** toolbar, click the feature type. This tells PC-DMIS that you are about to take hits on a feature of that type. This ensures that the proper feature is created in your measurement routine when you finish taking the necessary number of hits.



Measured Features toolbar

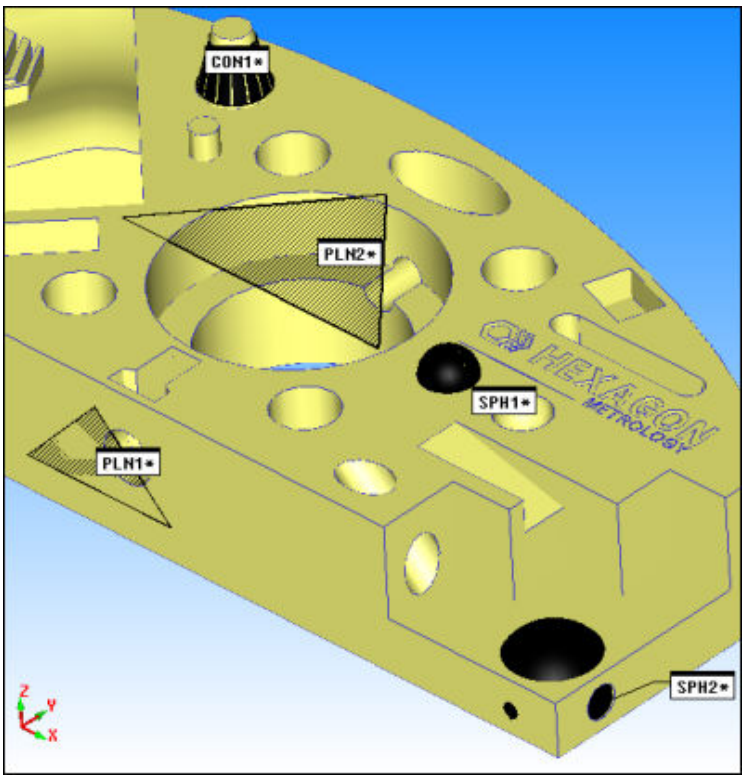
3. Use your jog box and probe the needed number of hits on the feature.
4. Then press the DONE button on your jog box or the End key on your keyboard to insert that feature into the Edit window.



You can also use the Quick Start interface to create measured features. For more information on that interface, see "Using the Quick Start Interface" topic in the "Using Other Windows, Editors, and Tools" chapter in the PC-DMIS Core documentation.

If you don't use any of these toolbar buttons, or if you click the **Measured Guess** button (), PC-DMIS guesses the correct feature type based on the number of hits and their vectors.

As you take hits and once you create the feature, PC-DMIS draws the measured feature on the screen. For 3D-measured features (Torus, Cylinder, Sphere, Cone) and for the 2D Plane feature, PC-DMIS draws the feature with a shaded surface.



Some sample measured features drawn with shaded surfaces

Hiding Shaded Plane Features

To hide shaded planes, set the **None** option in the **Display** area of the **Measured Plane** dialog box. To globally hide all drawn shaded planes for future plane features, mark the **Do Not Display Plane** check box in the **Setup Options** dialog box.

Changing Feature Color

You can use the **ID Setup** tab in the **Setup Options** dialog box to modify the feature color used during feature creation. See the **Color** check box that appears after you choose **Features** under the **Labels For** item.

For more information on measured features, see the "Creating Measured Features" chapter in the PC-DMIS Core documentation.

Creating a Measured Point



Measured Point button

You can use the **Point** button to measure the position of a point that belongs to a plane that is aligned with a reference plane (shoulder) or a point in space.

To create a measured point, you must take one hit on the part.

Creating a Measured Line



Measured Line button

With the **Line** button, you can measure the orientation and linearity of a line that belongs to a plane aligned with a reference plane or a line in space. To create a measured line, you must take two hits on the part.

Measured Lines and Workplanes

When PC-DMIS creates a measured line, it expects the hits for the line to be taken at a vector perpendicular to the current workplane.



If your current workplane is ZPLUS (with a vector 0,0,1), and you have a block-like part, the hits for the measured line must be on a vertical wall of that part, such as the front or side.

If you then wanted to measure a line feature on the top surface of the part, you would need to switch the workplane to XPLUS, XMINUS, YPLUS, or YMINUS, depending on the direction of the line.

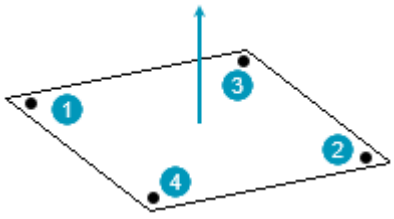
Creating a Measured Plane



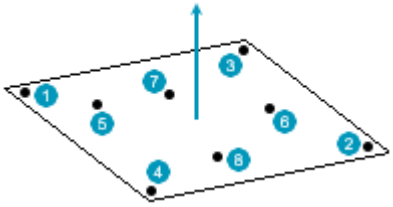
Measured Plane button

Use the **Plane** button to measure any flat or planar surface.

To create a measured plane, you must take a minimum of three hits on any flat surface. If you only use the minimum of three hits, it's best to select the points in a large triangular pattern that covers the widest area of the surface.

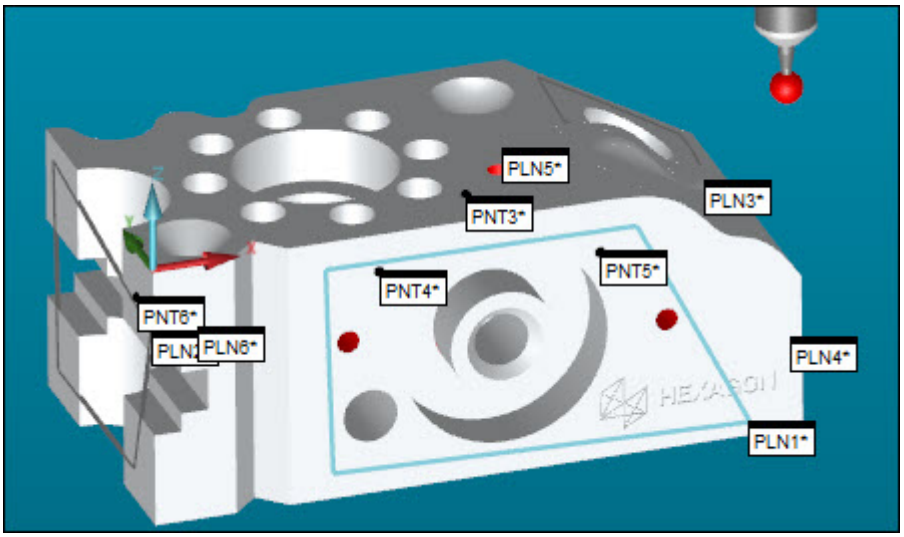


Example of a Plane Auto feature with four points



Example of a Plane Auto feature with eight points

When you create a Plane Auto feature, PC-DMIS shows the outline of the plane from the plane's hits in the Graphic Display window:



Sample Plane Auto feature from four hits taken on the Y- face

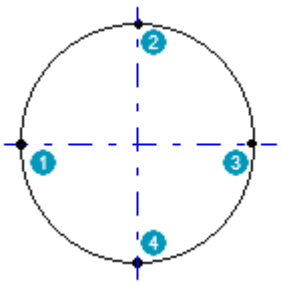
Creating a Measured Circle



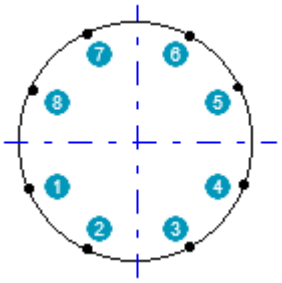
Measured Circle button

Use the **Measured Circle** button to measure the diameter, roundness, and position of the center of a hole or stud that is parallel to a reference plane; i.e. the perpendicular section of a cylinder aligned with a reference axis.

To create a measured hole or stud, you must take a minimum of three hits. The plane is automatically recognized and set by the system during measurement. You must pick points that are uniformly distributed on the circumference.



Example of a Circle Auto feature with four points



Example of a Circle Auto feature with eight points



Measure Single Point Circle toolbar button

You can also create circles from a single point by using the **Measure Single Point Circle** toolbar button. This is useful when you attempt to measure a hole with a probe whose sphere size is larger than the hole's diameter and therefore cannot fit entirely into the hole to take the usual minimum three hits required. For more information, see "Creating Single-Point Circle Features" in the PC-DMIS Portable documentation.

Creating a Measured Round Slot



Measured Round Slot button

Use the **Round Slot** button to create a measured round slot.

To create a measured round slot, you must take at least six hits on the slot. Usually, this is done by taking two hits on each straight side and one point on each curve.



Example of a Round Slot Auto feature with six points

Alternatively, you could take three points on each curve.

You can also create measured slots from two points.



Two points

This is useful when the probe sphere is larger than the slot's diameter, and you're not able to take the required hits. For more information, see "Creating Two-Point Measured Slot Features" in the PC-DMIS Portable documentation.

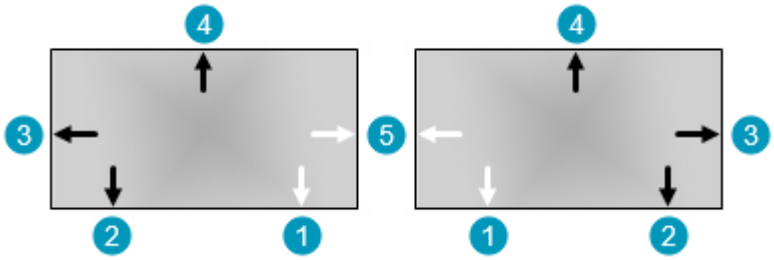
Creating a Measured Square Slot



Measured Square Slot button

Use the **Square Slot** button to create a measured square slot.

To create a measured square slot, you must take five hits on the slot. To do this, take two on one of the long sides of the slot and then one hit on each of the three remaining sides. The hits must be taken in a strictly clockwise (CW) or counterclockwise (CCW) direction.



Example of a Square Slot Auto feature with five points in CW (right) and CCW (left) directions

You can also create measured slots from two points.



Two points

This is useful when the probe sphere is larger than the slot's diameter, and you're not able to take the required hits. For more information, see "Creating Two-Point Measured Slot Features" in the PC-DMIS Portable documentation.

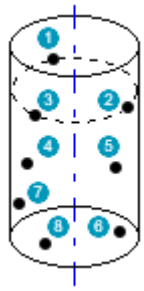
Creating a Measured Cylinder



Measured Cylinder button

Use the **Cylinder** button to measure the diameter, cylindricity, and orientation of the axis of a cylinder oriented in space. The position of the barycenter of the points picked is also calculated.

To create a measured cylinder, you must take a minimum of six hits. You must distribute the picked points uniformly over the surface. The first three points that you pick must lie on a plane perpendicular to the main axis.



Example of a Cylinder Auto feature with eight points

Be aware that certain patterns of points (such as two rows of three equally spaced points or two rows of four equally spaced points) result in multiple ways to construct or measure a cylinder. The PC-DMIS Best Fit algorithm may construct or measure the cylinder using an unexpected solution. For best results, measured or constructed cylinders should use a pattern of points that will eliminate unwanted solutions.

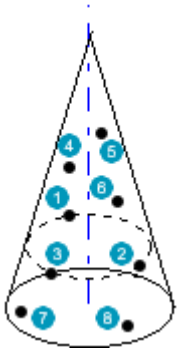
Creating a Measured Cone



Measured Cone button

Use the **Cone** button to measure the conicity, angle at the tip, and orientation in space of the axis of a cone. The position of the barycenter of the points picked is also calculated.

To create a measured cone, you must take a minimum of six hits. The points to be picked must be uniformly distributed on the surface. The first three points picked must lie on a plane perpendicular to the main axis.



Example of a Cone Auto feature with eight points

Creating a Measured Sphere

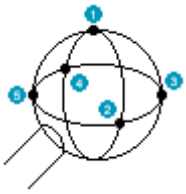


Measured Sphere button

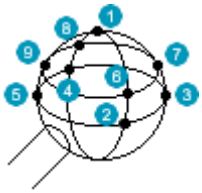
Use the **Sphere** button to measure the diameter, sphericity, and position of the center of a sphere.

To create a measured sphere, you must take a minimum of four hits.

- The points to be picked must be uniformly distributed over the surface.
- The first four points that are picked must not lie on the same circumference.
- The first point should be taken on the pole of the sphere's cup.
- The other three points are taken on a circumference.



Example of a Sphere Auto feature with five points



Example of a Sphere Auto feature with nine points

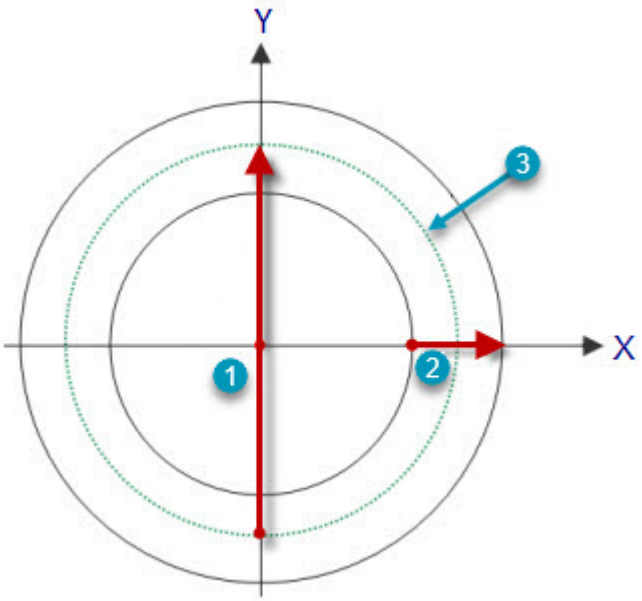
Creating a Measured Torus



Measured Torus button

Use the **Torus** button to measure the center diameter and ring diameter of the torus feature. The position of the barycenter of the points picked is also calculated.

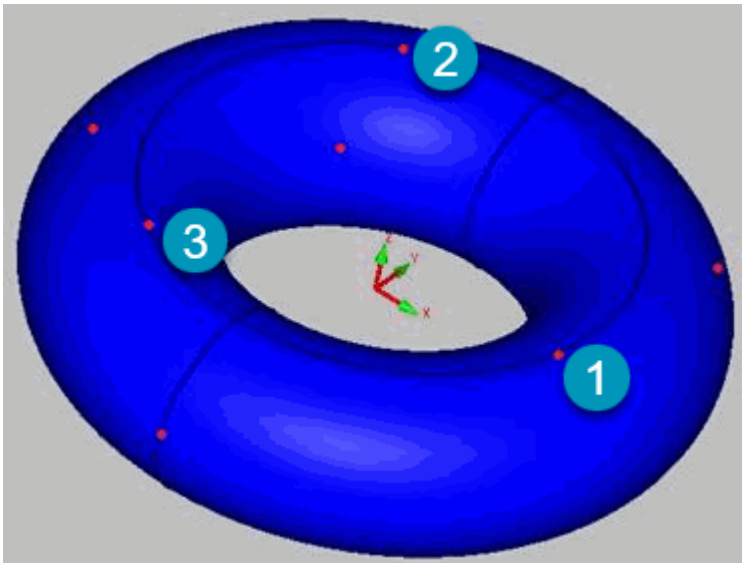
To create a measured torus, you must take a minimum of seven hits. Take the first three hits on one level of the torus's center line circle (see the diagrams below). These hits must represent the orientation of the torus so that an imaginary circle generated through these three hits would have roughly the same vector as the torus.



Top-down view of a torus. Note the major diameter (1), the minor diameter (2), and the center line circle (3).

If you orient the torus and are looking down on it from a bird's eye view, with Z+ pointing up towards you, take the first three hits in a counterclockwise direction to give the torus a vector of 0,0,1. If you take the hits in a clockwise direction, the torus will have a vector of (0,0,-1).

You can probe the remaining four hits in any random location as long as they all don't lie in the same plane.



Example of a torus created from seven points, with the first three taken in a counterclockwise direction

Creating a Measured Feature Set

You can measure a single point multiple times as a measured feature set (also called a Point Set). For information on how to do this, see "Creating Measured Feature Sets" in the "Creating Measured Features" chapter in the PC-DMIS Core documentation.

Inserting Auto Features

To create some Auto features without showing a dialog box at all, you can use QuickFeatures. You need to load a CAD model into the Graphic Display window. For more information on QuickFeatures, see "Creating QuickFeatures" in the "Creating Auto Features" chapter of the PC-DMIS Core documentation.

To insert Auto features into your measurement routine with the **Auto Feature** dialog box, select **Insert | Feature | Auto** and then select a feature type. This opens the **Auto Feature** dialog box for that feature type.

Alternatively, you can select the feature type from the **Auto Features** toolbar:



Auto Features toolbar

Once the **Auto Feature** dialog box opens for the selected feature, if you have a CAD model, click on the feature in the Graphic Display window. PC-DMIS fills in the dialog box with the necessary information taken directly from the CAD model. If you don't have access to a CAD model, you can probe hits directly on your part. Once you complete the dialog box, click **Create** in the dialog box (or press DONE on your jog box) to insert the feature into the Edit window.

This documentation set does not discuss the **Auto Feature** dialog box and its options. Because many of the **Auto Feature** dialog box options are common to the different configurations of PC-DMIS, this information is in the PC-DMIS Core documentation. For in-depth information on the options in the **Auto Feature** dialog box, consult the "Creating Auto Features" chapter in the PC-DMIS Core documentation.

For all internal or external features, be sure that you select the proper feature type: HOLE or STUD.

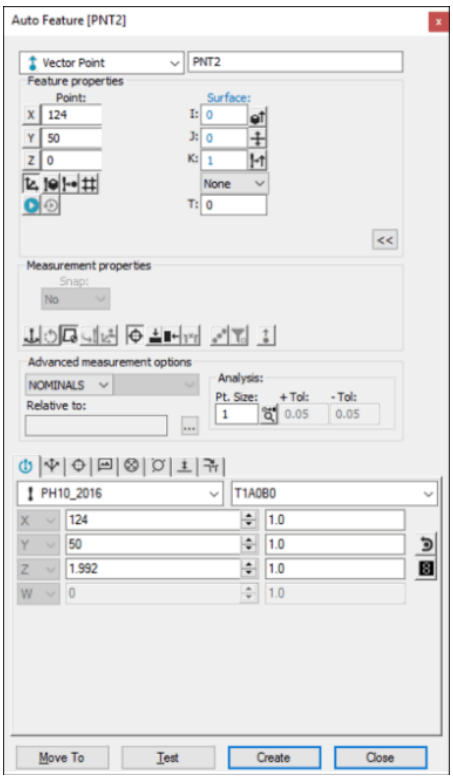
Creating an Auto Vector Point



Auto Vector Point button

The **Vector Point** auto option allows you to define a nominal point location as well as the nominal approach direction that the CMM uses to measure the point defined.

To access the **Vector Point** option, open the **Auto Feature** dialog box for a Vector Point (**Insert | Feature | Auto | Point | Vector**).



Auto Feature dialog box - Vector Point

With the dialog box open, use one of the following methods to create the feature.

Using Surface Data on the Screen

To use surface data to generate a vector point, perform the following steps:

1. Position the mouse pointer in the Graphic Display window to indicate the desired location of the point (on the surface).

2. Click on the surface. PC-DMIS highlights the selected surface.

3. Verify that you have selected the correct surface. PC-DMIS pierces the highlighted surface and displays the location and vector of the selected point. The direction of the surface normal vector is determined by the side of the part that is accessible to the probe. If both sides of the part are equally accessible, PC-DMIS uses the normal from the CAD data. The **Flip Vector** icon ( ) on the dialog box lets you change the direction of the approach.

4. Click **Create** to insert the feature into your measurement routine. If PC-DMIS detects additional mouse clicks before you select **Create**, PC-DMIS overwrites the previous information with the new data.

Using Surface Data with the CMM

To use surface data with the CMM to generate a vector point, touch on the desired surface of the part using the probe. PC-DMIS pierces the CAD surface closest to the probe contact point.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

- If the touch point is actually near the surface data, and the **Measure Now** icon is not selected, and the **Done** button on the jog box is pressed, PC-DMIS creates the point feature and adds it to the Edit window immediately. If the touch point is near the surface data, but the **Measure Now** icon is selected, PC-DMIS still uses the surface data, but it does not create the feature until you click **Create**.
- If the touch point is *not* near the surface data, PC-DMIS treats the touch as an actual hit. It displays the hit location and approach vector.
- If you take a second hit before you click **Create**, PC-DMIS uses the location data of the second hit.
- If you take a third hit, PC-DMIS uses the three hits to determine an approach vector. The last hit is used for the location.
- If you take more than three hits, PC-DMIS uses all but the last hit to determine the approach vector. PC-DMIS always uses the last hit to determine the location.

Using Wireframe Data on the Screen

To use wireframe CAD data to generate a vector point, perform the following steps:

1. Select two edges (wires) of the surface where the target point is by clicking on the desired wires with the left mouse button. (These wires should be on the same surface.) PC-DMIS highlights the selected wires.
2. Verify that you have selected the correct wires.
3. Select the target point on the created surface. This final selection is projected onto the plane that is formed by the two wire vectors and the first wire's height.

Using Wireframe Data with the CMM

To use wireframe data to generate a vector point, perform the following steps:



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

- The first hit that is taken indicates the X, Y, Z nominal. PC-DMIS also displays the I, J, K vector. This value indicates the opposite direction of the CMM approach vector (pointing away from the surface). You can accept this data, or you can follow the messages in the message box to request additional hits.

- A second hit updates the hit location and approach vector using the most recent hit.
- The third hit on the surface changes the displayed X, Y, Z nominal to the current hit location. PC-DMIS makes a plane out of the three hits to find the I, J, K approach vector.
- Any additional hits update the location of the hit with the most current hit information. The approach vector is also updated to reflect an average of all previous hits (does not include the most recent hit) for the vector point.

You can accept the displayed data at any time after you take the first, second, or third hit. Even if you did not accept the third hit, PC-DMIS internally resets the system. This causes the next hit (hit #4) to become the first hit in the series.

Without Using CAD Data

If the vector point is to be generated without the use of CAD data:

- The first hit that is taken indicates the X, Y, Z nominal. PC-DMIS also displays the I, J, K approach vector of that hit. This value indicates the opposite direction of the CMM approach vector (pointing away from the surface). You can accept this data, or you can follow the messages in the message box that request additional hits.
- A second hit updates the hit location and approach vector using the most recent hit.
- The third hit on the surface changes the displayed X, Y, Z nominal to the current hit location. PC-DMIS makes a plane out of the three hits to find the I, J, K approach vector.
- Any additional hits update the location of the hit with the most current hit information. The approach vector also will be updated to reflect an average of all previous hits (does not include the most recent hit) for the vector point.

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the vector point.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

Creating an Auto Surface Point



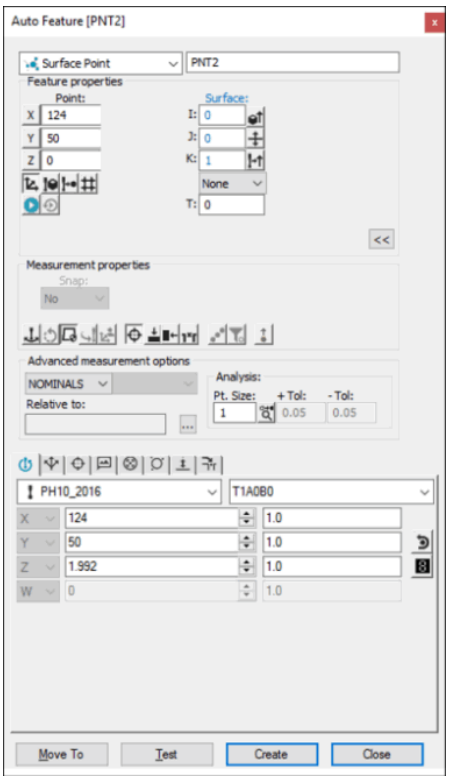
Auto Surface Point button

The **Surface Point** auto option allows you to define a nominal point location as well as a nominal approach direction that the CMM uses to measure the point defined. PC-DMIS allows you to define the number of points to use to measure a plane around the nominal point location, as well as the size of the plane. Once PC-DMIS measures the plane, it uses

the calculated surface normal vector of the plane to approach the nominal point location for measurement.

> The allowable number of sample hits needed to measure a surface point is zero or three.

To access the **Surface Point** option, open the **Auto Feature** dialog box for a Surface Point (**Insert | Feature | Auto | Point | Surface**).



Auto Feature dialog box - Surface Point

With the dialog box open, use one of the following methods to create the feature.

Using Surface Data on the Screen

To use surface data to generate a surface point:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
2. Position the mouse pointer in the Graphic Display window to indicate the desired location of the point (on the surface).
3. Click the left mouse button. PC-DMIS highlights the selected surface.
4. Verify that you have selected the correct surface. PC-DMIS pierces the highlighted surface and displays the location and vector of the selected point. The direction of the surface normal vector is determined by the side of the part that is accessible to

the probe. If both sides of the part are equally accessible, PC-DMIS uses the normal from the CAD data. The **Flip Vector** icon () on the dialog box lets you change the direction of the approach.

5. Click **Create** to insert the feature into the measurement routine. If PC-DMIS detects additional mouse clicks before you select the **Create** button, it overwrites the previous information with the new data.

Using Surface Data with the CMM

To use surface data with the CMM to generate a surface point, touch on the desired surface of the part using the probe. PC-DMIS pierces the CAD surface closest to where the probe touched.

- If the touch point is actually near the surface data, and the measured check box is *not* selected, the point feature is created and added to the Edit window immediately.
- If the touch point is near the surface data, but the measured check box *is* checked, the surface data is still used, but the feature is not created until you click the **Create** button.
- If the touch point is *not* near the surface data, PC-DMIS treats the touch as an actual hit and displays the hit location and approach vector.
- If you take a second hit *prior* to clicking the **Create** button, PC-DMIS uses the location data of the second hit.
- If you take a third hit, PC-DMIS uses the three hits to determine an approach vector. The last hit is used for the location.
- If you take more than three hits, PC-DMIS uses all but the last hit to determine the approach vector. PC-DMIS always uses the last hit to determine the location.

Using Wireframe Data on the Screen

To use wireframe CAD data to generate a surface point:

1. Select two edges (wires) of the surface where the target point is by clicking on the desired wires with the left mouse button. (These wires should be on the same surface.) PC-DMIS highlights the selected wires.
2. Verify that you have selected the correct wires. A message box appears.
3. Select the target point on the created surface. This final selection is projected onto the plane that is formed by the two wire vectors and the first wire's height.

Using Wireframe Data with the CMM

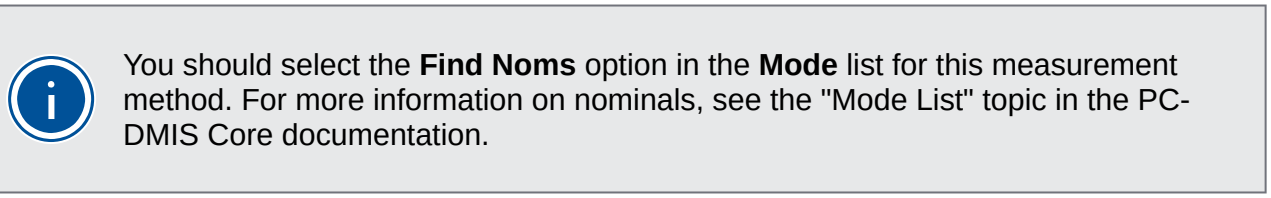
If the surface point is to be generated using wireframe CAD data:

- The first hit that is taken indicates the X, Y, Z nominal. PC-DMIS also displays the I, J, K vector. This value indicates the opposite direction of the CMM approach vector (pointing away from the surface). You can accept this data, or you can follow the

messages in the message box requesting additional hits. A second hit updates the hit location and approach vector using the most recent hit.

- The third hit on the surface changes the displayed X, Y, Z nominal to the current hit location. PC-DMIS makes a plane out of the three hits to find the I, J, K approach vector.
- Any additional hits update the location of the hit with the most current hit information. The approach vector is also updated to reflect an average of all previous hits (excluding the most recent hit) for the surface point.

You can accept the displayed data at any time after you take the first, second, or third hit. Even if the third hit was not accepted, PC-DMIS internally resets the system, causing the next hit (hit #4) to become the first hit in the series.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

To generate the surface point without the use of CAD data:

- The first hit that is taken indicates the X, Y, Z nominal. PC-DMIS also displays the I, J, K vector. This value indicates the opposite direction of the CMM approach vector (pointing away from the surface). You can accept this data, or you can follow the messages in the message box requesting additional hits.
- A second hit updates the hit location and approach vector using the most recent hit.
- The third hit on the surface changes the displayed X, Y, Z nominal to the current hit location. PC-DMIS makes a plane out of the three hits to find the I, J, K approach vector.
- Any additional hits update the location of the hit with the most current hit information. The approach vector also updates to reflect an average of all previous hits (does not include the most recent hit) for the surface point.

Typing the Data

This method enables you to type the desired X, Y, Z, I, J, K values for the surface point.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

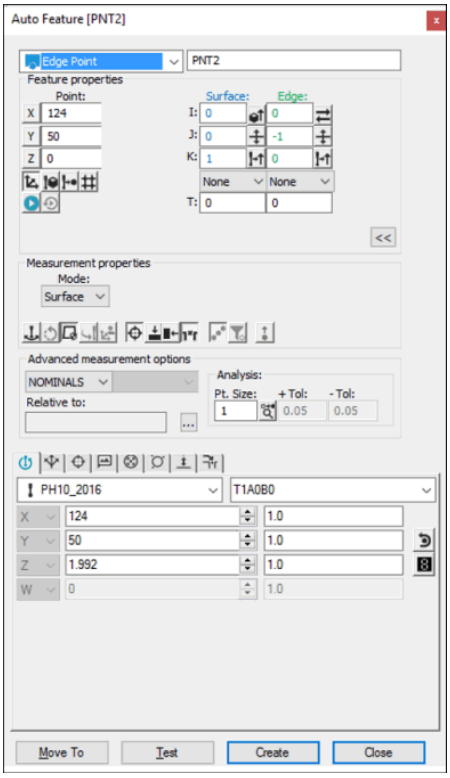
Creating an Auto Edge Point



Auto Edge Point button

The **Edge Point** auto option allows you to define a point measurement that is to be taken on the part's edge. This measurement type is particularly useful when the part's material is thin enough that a precisely controlled CMM measurement hit is required. Five sample hits are needed to accurately measure an edge point.

To access the **Edge Point** option, open the **Auto Feature** dialog box for an Edge Point (**Insert | Feature | Auto | Point | Edge**).



Auto Feature dialog box - Edge Point

With the dialog box open, use one of these methods to create the feature:

Using Surface Data on the Screen

To generate an edge point using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
2. Click once on the surface near the edge where you want to create the Auto Edge Point.

3. Verify that the correct surface has been selected. The dialog box displays the value of the selected edge point and vector once the point has been indicated. The direction of the surface normal vector is determined by the side of the part that is accessible to the probe. If both sides of the part are equally accessible, the normal from the CAD data is used. The **Flip Vector** icon () on the dialog box lets you change the direction of the approach.

4. Click **Create** to insert the feature into the measurement routine. If additional mouse clicks are detected before you click the **Create** button, PC-DMIS overwrites the previous information with the new data.

Using Surface Data with the CMM

To generate an edge point using surface data with the CMM:

1. Touch near the desired edge of the part using the probe.

2. Try to make the shank as normal to the surface as possible.

PC-DMIS pierces the CAD surface closest to where the probe touched. The displayed X, Y, and Z values reflect the closest CAD edge to the hit, not the actual hit. The I, J, K reflects the surface normal vector.

If a CAD edge is not found, PC-DMIS displays the closest point and asks you to take the additional hits.

If a second touch is taken on the opposite surface prior to clicking the **Create** button, PC-DMIS alters the location values as appropriate. The displayed vectors, however, remain constant.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

You can also use wireframe CAD data to generate an edge point.

To generate an edge point:

1. Click near the desired wire on the edge side (not within the boundary of the top surface). PC-DMIS highlights the selected wire.

2. Verify that the correct feature has been selected.

The probe approach is always perpendicular to the line, as well as perpendicular to the current probe centerline vector. The probe approaches from the side of the edge that was clicked on. The dialog box displays the value of the selected edge point and the vector once the wire has been indicated.

If an additional touch is necessary, click on the opposite wire of the (normal) surface.

Using Wireframe Data with the CMM

To generate an edge point using wireframe data with the CMM:

1. Touch near the desired edge of the part using the probe.
2. Try to make the shank as normal to the surface as possible.

PC-DMIS pierces the CAD wire closest to where the probe touched. The displayed X, Y, Z values reflect the closest CAD edge to the hit, not the actual hit. The I, J, K reflects the surface normal vector. If a CAD edge is not found, PC-DMIS displays the closest point and asks you to take the additional hits.

If a second touch is taken on the opposite surface prior to clicking the **Create** button, PC-DMIS alters the location values as appropriate. The displayed vectors, however, remain constant.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

If the edge point is to be generated without the use of CAD data:

1. The first three hits that are taken indicate the surface vector nominal.
2. The next two hits find and display the other vector. This value indicates the opposite direction of the CMM approach vector (pointing away from the surface).
3. The last hit (sixth hit) indicates the actual edge point location.

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the edge point.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

Creating an Auto Angle Point

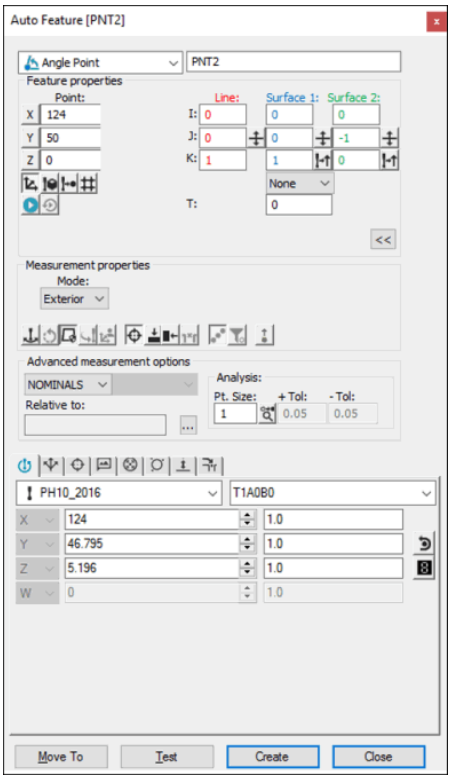


Auto Angle Point button

The **Angle Point** auto option enables you to define a point measurement that is the intersection of two measured lines. This measurement type allows you to measure the

intersection of two lines without measuring the lines separately and constructing an intersection point. Six hits are needed to accurately measure an angle point.

To access the **Angle Point** option, select **Insert | Feature | Auto | Point | Angle** to open the **Auto Feature** dialog box for an Angle Point.



Auto Feature dialog box - Angle Point

With the dialog box open, use one of these methods to create the feature.

Using Surface Data on the Screen

To generate an angle point using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
2. Click once near (but not on) the angled edge in the Graphic Display window. PC-DMIS highlights the selected surface.
3. Verify that the correct surface has been selected. The dialog box displays the value of the selected angle point and vector once the point has been indicated. The direction of the surface normal vector is determined by the side of the part that is accessible to the probe. If both sides of the part are equally accessible, the normal from the CAD data is used. The **Flip Vector** icon ( ) on the dialog box lets you change the direction of the approach.
4. Click **Create** to insert the feature into the measurement routine. If additional mouse clicks are detected before you click the **Create** button, PC-DMIS overwrites the

previous information with the new data. If an additional touch is necessary, click on the opposite surface of the angled edge.

Using Surface Data with the CMM

To generate an angle point using surface data with the CMM, touch once on each side of the angle edge. If the CAD angle point is not found, PC-DMIS displays the closest point and asks you to take the additional hits.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

You can also use wireframe CAD data to generate an angle point.

To generate the point:

1. Click once near (but not on) the angled edge. PC-DMIS highlights the selected surface.
2. Verify that the correct surface has been selected. The dialog box displays the value of the selected angle point and vector once the point has been indicated. The software determines the direction of the surface normal vector by the side of the part that is accessible to the probe. If both sides of the part are equally accessible, the software uses the normal from the CAD data. The **Flip Vector** icon () on the dialog box lets you change the direction of the approach.
3. Click **Create** to insert the feature into the measurement routine. If additional mouse clicks are detected before you click the **Create** button, PC-DMIS overwrites the previous information with the new data. If an additional touch is necessary, click on the opposite surface of the angled edge.

Using Wireframe Data with the CMM to Create the Feature

To generate an angle point using wireframe data with the CMM, touch once on each side of the angle edge. If the CAD angle point is not found, PC-DMIS displays the closest point and asks you to take the additional hits.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

If the angle point is to be generated without the use of CAD data, touch three times on each surface to find the two planes. The displayed angle point is at the first hit location.

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the angle point.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into the measurement routine.

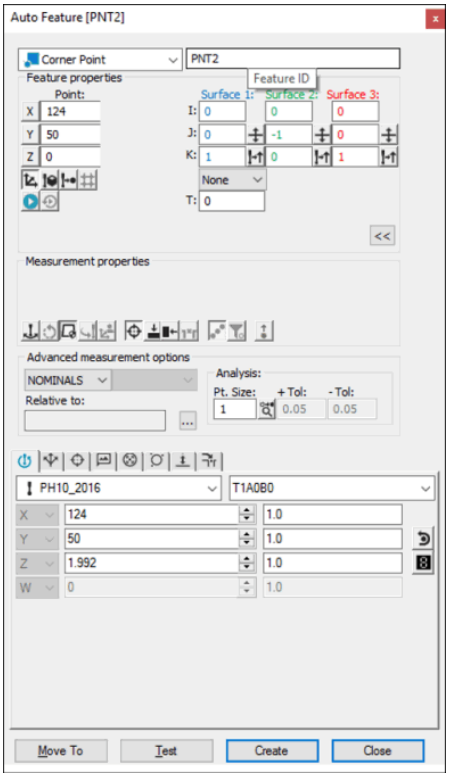
Creating an Auto Corner Point



Auto Corner Point button

The **Corner Point** auto option allows you to define a point measurement that is the intersection of three measured planes. You can do this without measuring the planes separately and constructing an intersection point. You must take nine hits (three hits on each of the three planes) to measure a corner point.

To access the **Corner** Point option, access the **Auto Feature** dialog box for a Corner Point (**Insert | Feature | Auto | Point | Corner**).



Auto Feature dialog box - Corner Point

With the dialog box open, use one of these methods to create the feature.

Using Surface Data on the Screen

To generate a corner point using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ().
2. Click once near the corner. You'll notice PC-DMIS automatically re-positions the animated probe on the corner point.
3. Verify that the correct corner point is selected. The dialog box displays the value of the selected corner point and vector once the point has been indicated.
4. Make any other modifications to the dialog box and the Probe Toolbox as needed.
5. Click **Create**.

Using Surface Data with the CMM

To generate a corner point using surface data with the CMM:

1. Touch once on each of the three surfaces that converge on the corner. PC-DMIS assumes that the surfaces are mutually perpendicular.
2. Make any other modifications to the dialog box and the Probe Toolbox as needed.
3. Click **Create**.

If the CAD corner point is not found, PC-DMIS displays the closest point and asks you to take the additional hits.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

Wireframe CAD data can also be used to generate a corner point.

To generate the point:

1. Click once near (but not on) the corner. PC-DMIS highlights the selected surface.
2. Verify that the correct surface has been selected. The dialog box displays the value of the selected corner point and vector once the point has been indicated. (If necessary, click on a different edge, leading into the corner.)
3. Make any other modifications to the dialog box and the Probe Toolbox as needed.
4. Click **Create**.

Using Wireframe Data with the CMM

To generate a corner point using wireframe data with the CMM:

1. Touch twice on the first surface.
2. Touch once near the edges that converge on the corner. PC-DMIS assumes that the surfaces are mutually perpendicular. If the CAD corner point is not found, PC-DMIS displays the closest point and asks that you take the additional hits.
3. Make any other modifications to the dialog box and the Probe Toolbox as needed.
4. Click **Create**.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

To generate a corner point without the use of CAD data:

1. Touch three times on the first surface.
2. Touch three times on the second surface.
3. Touch three times on the third surface.
4. Make any other modifications to the dialog box and the Probe Toolbox as needed.
5. Click **Create**.

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the corner point.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

Creating an Auto High Point



Auto High Point button

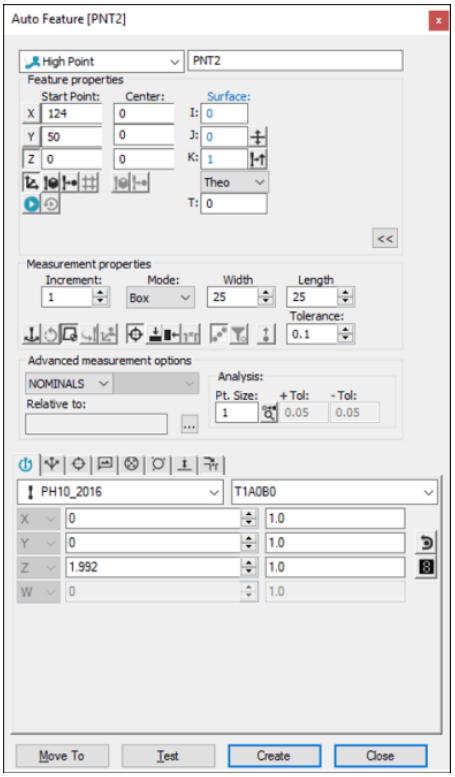
Use the **Auto High Point** option to search a user-defined region on the part to locate the highest point in the current workplane. This samples the region itself for the highest point. It does not search existing points in your measurement routine.

When you execute a High Point feature, PC-DMIS searches for and returns the highest point within the search region. The search result is a single point defined by its X, Y, and Z coordinates and approach vector.

Execution Details:

- PC-DMIS begins its search at the start point.
- It takes eight sampling hits around the start point at the distance specified for the **Increment** value.
- If a higher point is found, it becomes the new start point, and PC-DMIS again takes the eight sampling hits around the point. This continues until PC-DMIS cannot find a higher point at the **Increment** distance.
- PC-DMIS then continues taking sampling hits, reducing the **Increment** value until it matches the **Tolerance** value. This completes the high point search.
- Once the search finishes, PC-DMIS displays the new high point value on the CAD model by moving the point ID to the found High Point location within the search region.

To access the **High Point** option, open the **Auto Feature** dialog box for a High Point (**Insert | Feature | Auto | Point | High**).



Auto Feature dialog box - High Point

With the **Auto Feature** dialog box open, use one of the following methods to create the feature:

Using Surface Data on the Screen

To define the High Point search area using surface data, perform the following steps:

1. Ensure that your alignment's working plane matches the surface vector you want to use in the High Point calculation.

   > For example, suppose that the back of your part has a Y+ vector in your alignment. To calculate the High Point on that Y+ surface, you need to change your active work plane to **YPLUS**.

2. Select the **High Point** option in the **Auto Feature** dialog box.
3. Position the mouse pointer in the Graphic Display window to indicate the desired location of the start point (on the surface).
4. Click once to define the **Center** of the search region and the **Start Point** of the search as the same point. PC-DMIS highlights the selected surface.
5. Click again to define a different **Start Point**. As long as the dialog box remains open, every odd-numbered click on the part model's surface defines the **Center** and the **Start Point** to be the same as the clicked location. Every even-numbered click defines a new **Start Point** location only.
6. Verify that the correct surface has been selected. PC-DMIS pierces the highlighted surface and displays the location and vector of the selected point. The direction of the surface normal vector is determined by the side of the part that is accessible to the probe. If both sides of the part are equally accessible, PC-DMIS uses the normal from the CAD data. The **Flip Vector** icon () on the dialog box lets you change the probe's approach direction.
7. Define the type of search zone. To do this, choose either **Circular** or **Box** from the **Mode** list in the **Measurement Properties** area.
8. Define the size of the search zone:

   - For a box type search zone, change the values in the **Width** and **Length** boxes.
   - For the circular type search zone, change the values in the **Inner Radius** and **Outer Radius** boxes.

   PC-DMIS displays the search zone in the highlight color.
9. Define the **Increment** and **Tolerance** values that you want to use for the High Point procedure.
10. Make any other changes that you need in the dialog box.
11. Click **Create** to insert the feature into the measurement routine.

Using Surface Data with the CMM

To define the search region for the High Point with the CMM, perform the following steps:

1. Ensure that your alignment's working plane matches the surface vector that you want to use in the High Point calculation.
2. Select the **High Point** option in the **Auto Feature** dialog box.
3. Touch the desired surface of the part with your probe. This defines the **Center** of the search region and the **Start Point** of the search as the same point. PC-DMIS highlights the selected surface.
4. If you want a different search center, at the desired surface location, touch the surface with the probe a second time. This defines a new center for the search region. If you sample another location with the probe, it changes the location of the start point and approach vector. Each consecutive sample that you take alternates between the search center and the start point. Each time the probe samples the surface of the part, PC-DMIS pierces the CAD surface closest to the touch location of the probe.
5. Define the type of search zone. To do this, choose either **Circular** or **Box** from the **Mode** list in the **Measurement Properties** area.
6. Define the size of the search zone:
   - For a box type search zone, change the values in the **Width** and **Length** boxes.
   - For the circular type search zone, change the values in the **Inner Radius** and **Outer Radius** boxes.

   PC-DMIS displays the search zone in the highlight color.
7. Define the **Increment** and **Tolerance** values that you want to use for the High Point procedure.
8. Make any other changes that you need in the dialog box.
9. Click **Create** to insert the feature into the measurement routine.



For this method, make sure that you choose the **Find Noms** option in the **Mode** list. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

You can generate a High Point without the use of CAD data.

1. Ensure that your alignment's working plane matches the surface vector that you want to use in the High Point calculation.
2. Select the **High Point** option in the **Auto Feature** dialog box.
3. With the probe, touch the part's surface once.
    - The touch location indicates the X, Y, and Z nominal for both the search's **Start Point** and the search zone's **Center**.
    - PC-DMIS also displays the I, J, K approach vector of that hit. This vector points away from the surface.
4. To define a different start point, touch the part's surface again where you want the start point. More touches on the part alternate between the start point and the search center.
5. Define the type of search zone. To do this, choose either **Circular** or **Box** from the **Mode** list in the **Measurement Properties** area.
6. Define the size of the search zone:
    - For a box type search zone, change the values in the **Width** and **Length** boxes.
    - For the circular type search zone, change the values in the **Inner Radius** and **Outer Radius** boxes.

    PC-DMIS displays the search zone in the highlight color.
7. Define the **Increment** and **Tolerance** values that you want to use for the High Point procedure.
8. Make any other changes that you need in the dialog box.
9. Click **Create** to insert the feature into the measurement routine.

Typing the Data

With this method, you can type the exact center of the search region. You can also type the approach vector.

1. Ensure that your alignment's working plane matches the surface vector that you want to use in the High Point calculation.
2. Select the **High Point** option in the **Auto Feature** dialog box.
3. Under **Center**, type the **X**, **Y**, and **Z** values to define the center of the search region.
4. Under **Start Point**, type the **X**, **Y**, and **Z** values to define the start location of the search.

5. Under **Surface**, type the **I**, **J**, and **K** values to define the approach vector.
6. Define the type of search zone. To do this, choose either **Circular** or **Box** from the **Mode** list in the **Measurement Properties** area.
7. Define the size of the search zone:
    - For a box type search zone, change the values in the **Width** and **Length** boxes.
    - For the circular type search zone, change the values in the **Inner Radius** and **Outer Radius** boxes.

    PC-DMIS displays the search zone in the highlight color.
8. Define the **Increment** and **Tolerance** values that you want to use for the High Point procedure.
9. Make any other changes that you need in the dialog box.
10. Click **Create** to insert the feature into the measurement routine.

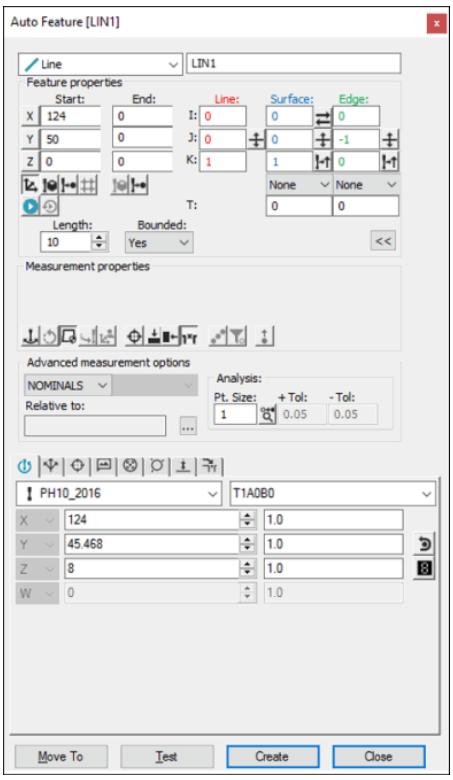
Creating an Auto Line



Auto Line button

The **Line** auto option allows you to define a nominal line that the CMM measures.

To access the **Line** option, access the **Auto Feature** dialog box for a Line (**Insert | Feature | Auto | Line**).



Auto Feature dialog box - Line

With the dialog box open, use one of these methods to create the feature.

Using Surface Data on the Screen

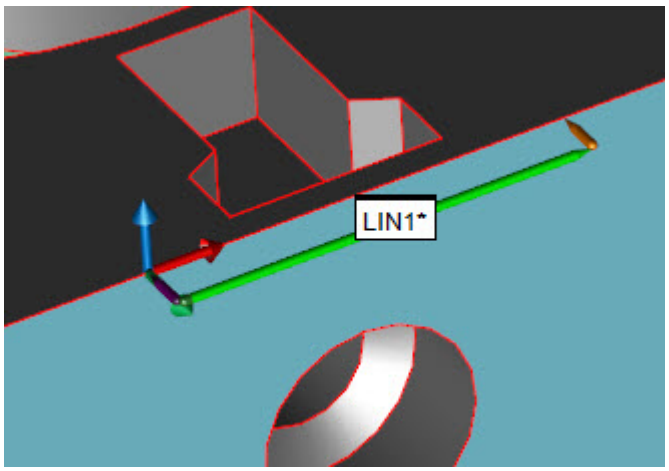
To generate an auto line on the screen using surface data, follow these steps:

1. Select **Yes** or **No** from the **Bounded** list. A bounded line ends when it reaches another defined point. An unbounded line ends based on a defined length.

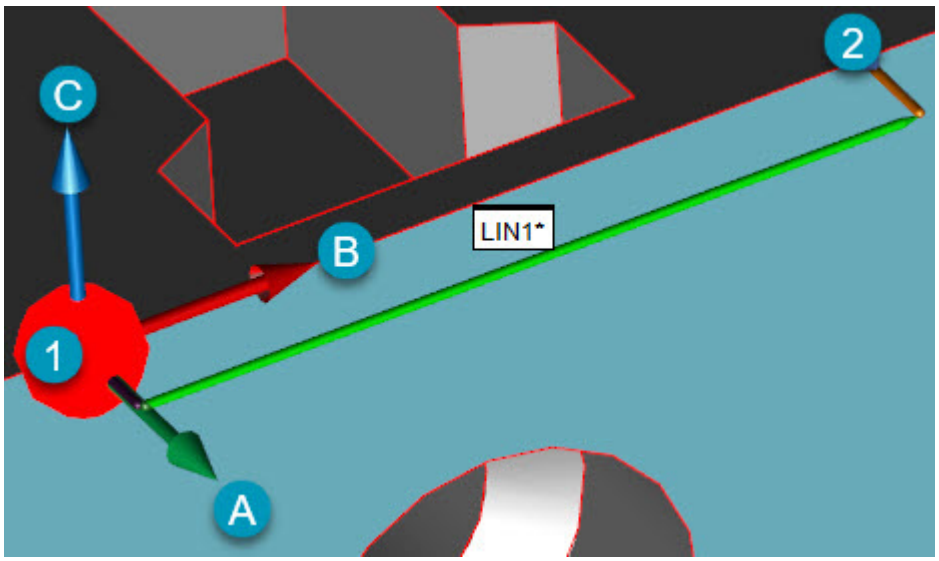
2. Define the auto line:

    - If you selected **Yes** from the **Bounded** list, take two clicks on the desired surface to define the line's start and end points respectively. PC-DMIS snaps the points to the nearest intersection with another surface, placing the points along the intersection line. PC-DMIS draws the start point location, the end point location, and line and edge vectors.

    - If you selected **No** from the **Bounded** list, take one click on the desired surface to define the line's start point. PC-DMIS snaps the point to the nearest intersection with another surface, placing it along the intersection line. Next, define the length of the line by typing it in the **Length** box. PC-DMIS draws the start point location and a line that matches the length. The line and edge vectors are drawn larger if the **Pt. Size** value is greater than 0.



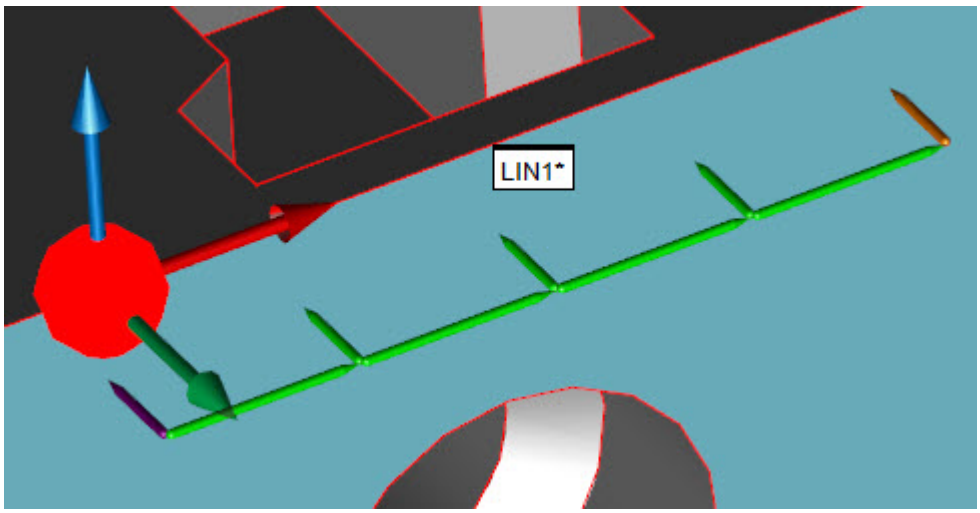
This example of a bounded Line Auto feature shows the start and end points



*This example of a bounded Line Auto feature shows the start and end points (1) and (2), an edge vector of 0,-1,0 (A), a line vector of 1,0,0 (B), a surface vector of 0,0,1 (C), and a **Pt. Size** value of 4:*

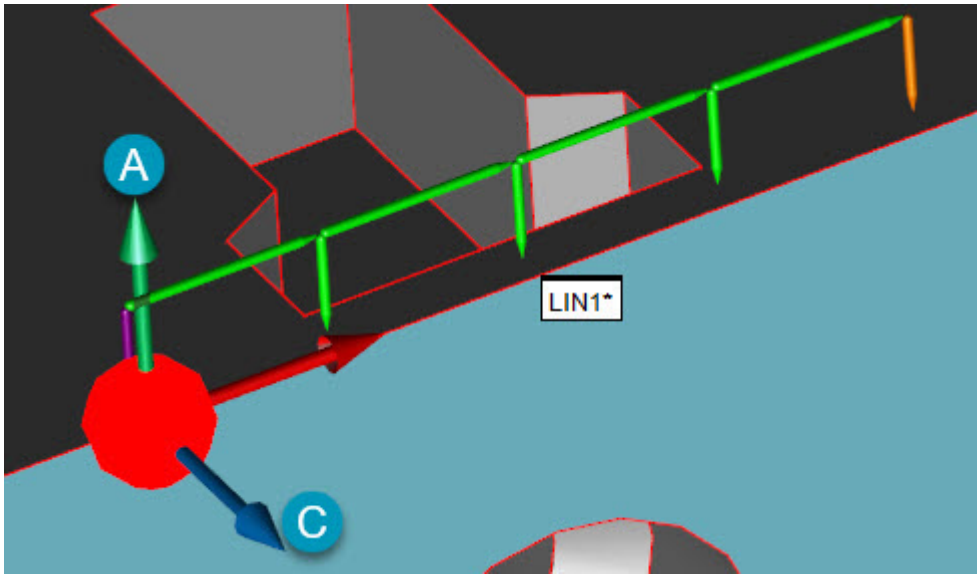
3. Modify any other options in the dialog box as needed.
4. Modify any items in the **Contact Path Properties** tab of the Probe Toolbox as needed.

   For example, you might want to change the **Hits** value and the **Depth** value:



Line Auto feature with five hits now and a depth of 3 mm

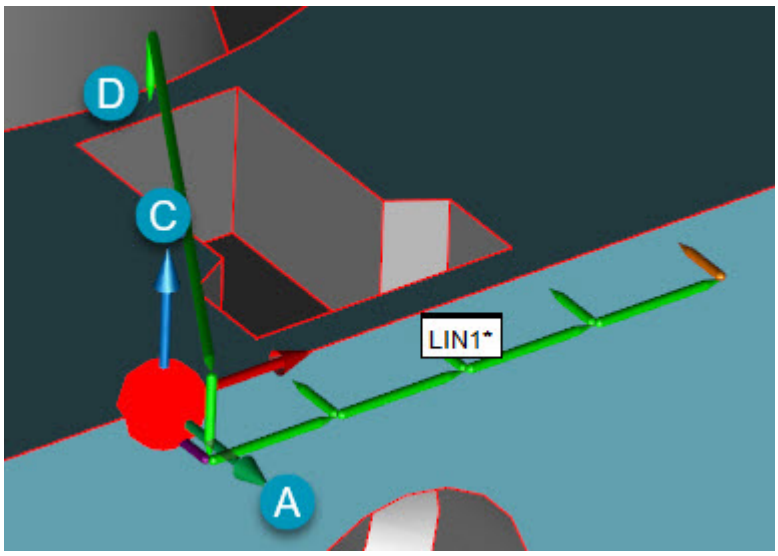
Or, you might want the line to be measured along the other surface by modifying the **Edge Vector**:



Line Auto feature with a modified edge vector of 0,0,1 (A), a modified surface vector of 0,-1,0 (C), and a depth of 1 mm

5. If you need sample hits, modify items in the **Contact Sample Hits Properties** tab of the Probe Toolbox as needed.

   For example, if you need to sample the surface material offset from the edge, you might have something like this:



This example shows the Line Auto feature with an edge vector of 0,-1,0 (A), a surface vector of 0,0,1 (C), a depth of 1 mm, and 1 sample hit using an indent 2 of 19 mm (D)

6. Click **Create**. PC-DMIS generates the Line Auto feature.

Using Wireframe Data on the Screen

To generate a line on the screen using wireframe data:

1. Select **Yes** or **No** from the **Bounded** list.
2. Select two edges (wires) of the surface where the target points are (if bounded by a second point, otherwise just click once) by clicking on the desired wires with the left mouse button. These wires should be on the same surface.
3. PC-DMIS draws the start location and, if creating a bounded line, the end point location. It also draws the line and edge point vectors.
4. Verify that the correct wires have been selected.
5. Modify any other options in the dialog box and the **Contact Path Properties** tab of the Probe Toolbox as needed.
6. Click **Create**. PC-DMIS generates a line.

Using Wireframe Data with the CMM

To generate a line using wireframe data:

- The first hit that is taken indicates the X, Y, Z nominal start point. A second hit (needed if you've selected **Yes** from the **Bounded** list) generates the end point for the line. After the second hit, PC-DMIS also displays the I, J, K line vector and the I, J, K edge vector.
- Any additional hits are equally spaced along the line's length. The approach vector is also updated to reflect an average of all previous hits (does not include the most recent hit) for the vector point.

The displayed data can be accepted at any time after the second hit is taken.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

If the line is to be generated without the use of CAD data:

1. Select **Yes** or **No** from the **Bounded** list.
2. If you are creating a bounded line, take two hits. If you are creating an unbounded line, take one hit.
3. Alter any other items on the dialog box and the **Contact Path Properties** tab of the **Probe Toolbox** as needed.
4. Click **Create**.

Typing the Data

This method allows you to type the values needed to create an auto line.

To create a bounded line:

1. Select **Yes** from the **Bounded** list.
2. Type the number of hits in the **Hits** box.
3. Type the depth for the line in the **Depth** box on the **Contact Properties** tab of the Probe Toolbox.
4. Type the X, Y, Z values for the **Start** and **End** points.
5. Type the I, J, K vectors.
6. Fill out any other options as needed in the dialog box.
7. Click **Create**. PC-DMIS generates a line based on the values you keyed into the dialog box.

To create an unbounded line:

1. Select **No** from the **Bounded** list.
2. Type the number of hits in the **Hits** box.
3. Type the depth for the line in the **Depth** box on the **Contact Properties** tab of the Probe Toolbox.
4. Type the X, Y, Z values for the **Start** point.

5. Type the I, J, K vectors.
6. Type the length of the line in the **Length** box.
7. Fill out any other options as needed in the dialog box.
8. Click **Create**. PC-DMIS generates a line based on the values you keyed into the dialog box.

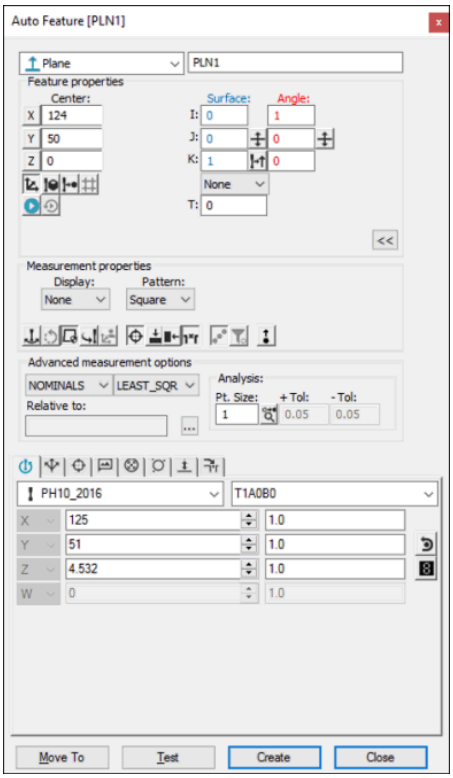
Creating an Auto Plane



Auto Plane button

The Plane auto option allows you to define a plane measurement. At least three hits are necessary to measure a plane.

To access the **Plane** option, access the **Auto Feature** dialog box for a Plane (**Insert | Feature | Auto | Plane**).



Auto Feature dialog box - Plane

With the dialog box open, use one of these methods to create the feature. When you create the plane, PC-DMIS shows the outline of the plane from the hits in the Graphic Display window.

Using Surface Data on the Screen

To generate an auto plane using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ().
2. Click once on the surface where you want the plane. PC-DMIS fills in the dialog box with information collected from the model.
3. Make any other modifications to the dialog box as needed.
4. Click **Create**.

Using Wireframe Data on the Screen

You can also use wireframe CAD data to generate an auto plane.

To generate the plane:

1. Access the Plane **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**).
2. Click at least three times on the surface.
3. Verify that the correct feature has been selected. The probe approach is *always* perpendicular to the feature, as well as perpendicular to the current probe centerline vector. The dialog box displays the value of the plane's center point and vector.
4. Make any other modifications to the dialog box and the **Contact Path Properties** tab of the Probe Toolbox as needed.
5. Click **Create**.

Using Wireframe Data with the CMM

To generate a plane using wireframe data with the CMM:

1. Access the Plane **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**).
2. Take one hit on the surface where you want to create the plane. PC-DMIS pierces the CAD surface closest to where the probe touched. The displayed X, Y, Z values reflect the center value for the plane. The I, J, K reflects the surface normal vector.
3. Modify any other items in the dialog box and the **Contact Path Properties** tab of the Probe Toolbox as needed.
4. Press the **Done** button on the jog box (or click the **Create** button in the dialog box).



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

To generate the plane without the use of CAD data:

1. Access the Auto feature **Plane** dialog box (**Insert | Feature | Auto | Plane**).
2. Take at least three hits on a surface.
3. Take additional hits if needed. PC-DMIS uses the data from all of the measured hits. The X, Y, Z that is displayed is the calculated center of the plane.
4. Make any other modifications to the dialog box and the **Contact Path Properties** tab of the Probe Toolbox as needed.
5. Click the **Create** button.

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K center value for the plane.

1. Access the Plane **Auto Feature** dialog box (**Insert | Feature | Auto | Plane**).
2. Type the X, Y, Z, I, J, K values.
3. Type the **Hits** and **Levels** values on the **Contact Properties** tab in the Probe Toolbox.
4. Make any other modifications to the **Auto Features** dialog box and Probe Toolbox.
5. Click **Create**.

PC-DMIS generates the proper number of hits using the pattern specified.

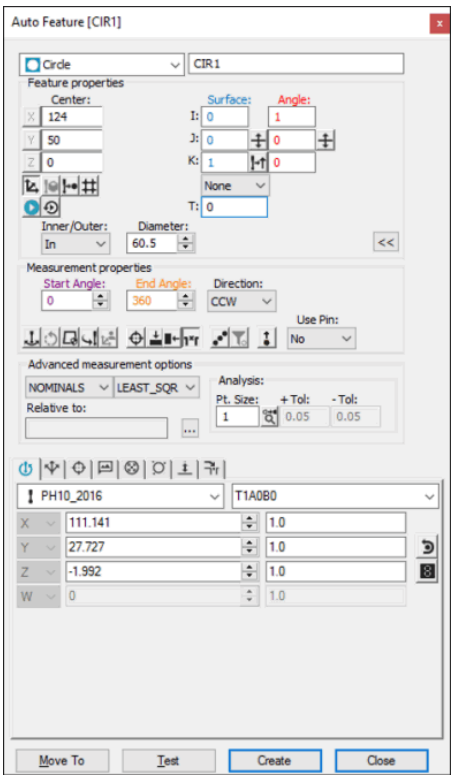
Creating an Auto Circle



Auto Circle button

The **Circle** auto option allows you to define a circle measurement. This measurement type is particularly useful when the circle is positioned in a specific plane that is not parallel with any of the workplanes, or if equally spaced hits are required for partial circles. At least three hits are necessary to measure a circle. The default number of hits needed to measure a circle is based on the default in SETUP mode.

To access the **Circle** option, access the **Auto Feature** dialog box for a Circle (**Insert | Feature | Auto | Circle**).



Auto Feature dialog box - Circle

In some cases when you create a Circle, Cone, or Cylinder Auto Feature, it may be necessary to move the first and last probed points away from the edges of the feature. To do this, you can use the `ArcReductionAngle` setting. For details, see the "Using the ArcReductionAngle Setting" topic in the "Creating Auto Features" chapter of the PC-DMIS Core documentation.

With the **Auto Feature** dialog box open for the Circle feature, use one of these methods to create the feature:

Using Surface Data on the Screen

To generate a circle using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
2. Click once either outside or inside the desired circle. The dialog box displays the center point and diameter from the CAD data of the selected auto circle closest to where you clicked on the part model.
3. Make any other modifications to the dialog box as needed.
4. Click **Create**.

Using Surface Data with the CMM

To generate a circle using surface data with the CMM, take a minimum of three hits in the hole or on the stud. PC-DMIS pierces the CAD surface closest to where the probe touched. The displayed X, Y, Z values reflect the closest CAD circle, not the actual hits. The I, J, K reflects the surface normal vector. If a CAD circle is not found, PC-DMIS displays the closest point and asks that you take the additional hits.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

Wireframe CAD data also can be used to generate an auto circle.

To generate the circle:

1. Click near the desired wire on the circle. PC-DMIS highlights the selected circle closest to where you clicked on the part model.
2. Verify that the correct feature has been selected. The probe approach is *always* perpendicular to the feature, as well as perpendicular to the current probe centerline vector. The dialog box displays the value of the selected circle's center point and diameter once the wire has been indicated.
3. Make any other modifications to the dialog box and the Probe Toolbox as needed.
4. Click **Create**.



If the underlying CAD element is not a circle or arc, additional clicks may be necessary to identify the feature. If PC-DMIS doesn't highlight the correct feature, try to click on at least two additional locations of the circle.

Without Using CAD Data

To generate the circle without the use of CAD data:

1. Take three hits on the surface to find the plane that the circle is lying in.
2. Take three additional hits in the hole (or on the stud). PC-DMIS calculates the auto circle using all three hits. Additional hits can be taken. PC-DMIS uses the data from all of the measured hits until the **Create** button is clicked. The X, Y, Z that is displayed is the calculated center of the circle (or stud).
3. Make any other modifications to the dialog box and the **Contact Path Properties** tab of the Probe Toolbox as needed.
4. Click **Create**.

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K center value for the circle.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

Gage Scan Calibration

The **Circle** auto option offers the Gage Scan Calibration strategy to calibrate a probe tip for use with the gage scan filter. For more information, see "Using the Gage Scan Calibration Strategy".

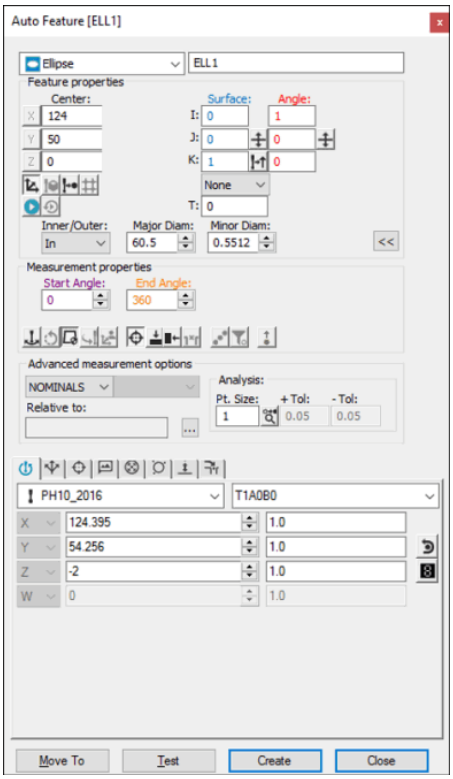
Creating an Auto Ellipse



Auto Ellipse button

The **Ellipse** auto option allows you to define an ellipse. The ellipse feature type works much like the sheet metal circle feature. It is particularly useful when the ellipse is positioned in a specific plane that is not parallel with any of the workplanes. It is also useful if equally spaced hits are required for partial ellipses. The minimum number of hits required to measure an ellipse is five.

To access the **Ellipse** option, access the **Auto Feature** dialog box for an Ellipse (**Insert | Feature | Auto | Ellipse**).



Auto Feature dialog box - Ellipse

With the dialog box open, use one of these methods to create the feature.

Using Surface Data on the Screen

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ().
2. Click once on the ellipse displayed in the Graphic Display window. PC-DMIS computes the necessary X, Y, Z and I, J, K data.
3. Make any other modifications to the dialog box as needed.
4. Click **Create**.

Using Surface Data with the CMM

To generate an ellipse measurement using surface data with the CMM, take a minimum of five hits on the ellipse. PC-DMIS pierces the CAD surface closest to where the probe touched. The displayed X, Y, Z values reflect the closest CAD ellipse, not the actual hits. The I, J, K reflects the surface normal vector. If a CAD ellipse is not found, PC-DMIS displays the closest point and asks that additional points be taken.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

1. Click near the desired wire on the ellipse. PC-DMIS highlights the selected wire.
2. Verify that the correct feature has been selected. The probe approach is *always* perpendicular to the feature, as well as perpendicular to the current probe centerline vector. The dialog box displays the value of the selected ellipse's center point and diameter once the wire has been indicated.
3. Make any other modifications to the dialog box and the Probe Toolbox as needed.
4. Click **Create**.



If the underlying CAD element is not an ellipse, additional clicks may be necessary to identify the feature. If PC-DMIS doesn't highlight the correct feature, try to click on at least two additional locations of the ellipse.

Without Using CAD Data

If the ellipse is to be generated without the use of CAD data:

1. Take three hits on the surface to find the plane that the ellipse is lying in.

2. Take five additional hits in the hole (or on the stud).

PC-DMIS uses the data to calculate the sheet metal ellipse. Additional hits can be taken until the **Create** button is clicked. The X, Y, Z that is displayed is the calculated center of the ellipse. Also shown are the calculated major and minor diameters, along with the orientation vector.

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the ellipse. In addition, the major and minor diameters of the ellipse as well as the angle vector I2, J2, K2 may also be keyed in.

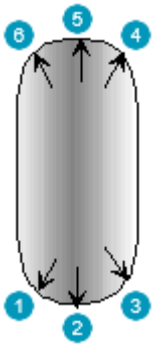
1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

Creating an Auto Round Slot



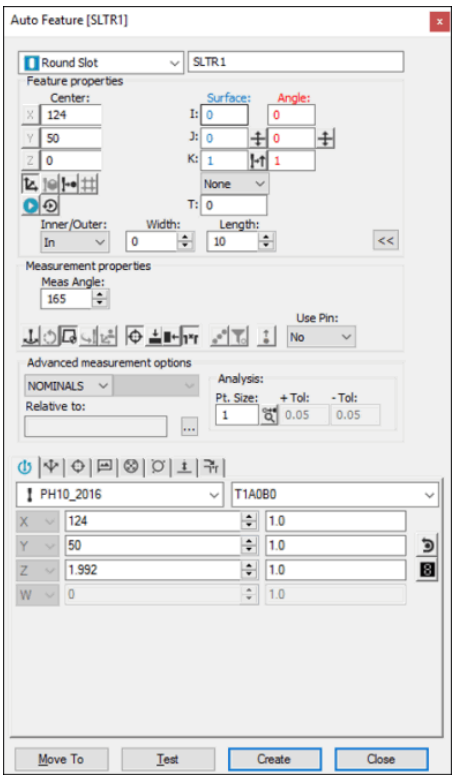
Auto Round Slot button

The **Round Slot** option allows you to define a round slot measurement. This measurement type is particularly useful when you do not want to measure a series of lines and circles, or construct intersections and midpoints from them. The minimum number of hits needed to measure a round slot is six.



Round Slot Auto feature with six minimum hits

To access the **Round Slot** option, access the **Auto Feature** dialog box for a Round Slot (**Insert | Feature | Auto | Round Slot**).



Auto Feature dialog box - Round Slot

With the dialog box open, use one of these methods to create the feature.

Using Surface Data on the Screen

To generate a round slot measurement using surface data, follow these steps:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
2. Click once on any portion of the slot displayed in the Graphic Display window.
3. Make any other modifications to the dialog box and the Probe Toolbox as needed.
4. Click **Create**.

Using Surface Data with the CMM

To generate a round slot measurement using surface data with the CMM, touch three times on each arc.

You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

Wireframe CAD data can also be used to generate a round slot. Using the animated probe, click once near any wire of the slot displayed in the Graphic Display window.

Using Wireframe Data with the CMM

To generate a round slot measurement using wireframe data with the CMM, touch one or three times on each arc.

> If the CAD data defining the ends of the slot is specifically a CIRCLE or ARC type (such as an IGES entity 100), PC-DMIS automatically takes two additional hits on the arc. If both ends are of this type, then one touch on each arc is sufficient to measure this feature type.

> You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

If the round slot is to be generated without the use of CAD data, touch three points on the slot surface and three times on each arc (for a total of nine hits).

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the round slot.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

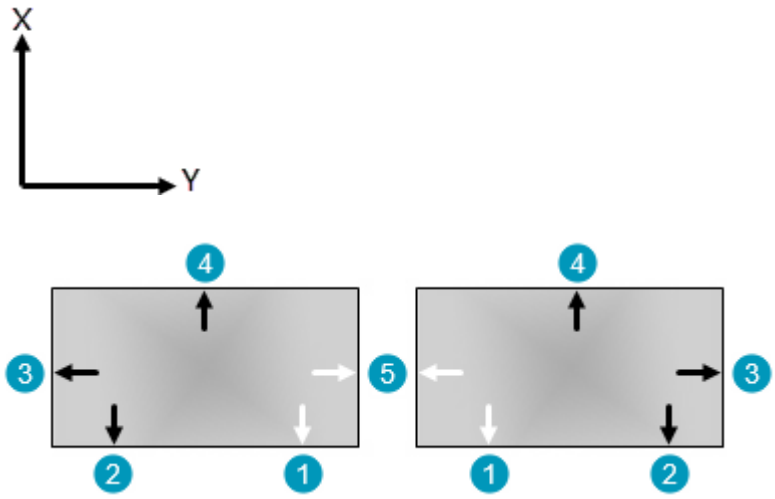
Creating an Auto Square Slot



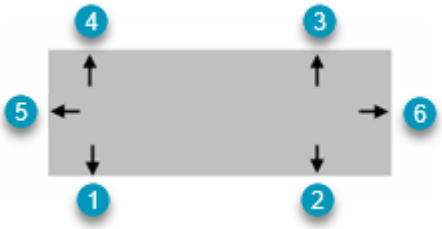
Auto Square Slot button

The **Square Slot** auto option allows you to define a square slot measurement. This measurement type is particularly useful when you do not want to measure a series of lines and construct intersections and midpoints from them. Square slots must be measured with five hits (or six if you select **Yes** in the **Meas Width** list).

If you had a surface vector of 0,0,1 and an angle vector of 1,0,0, PC-DMIS takes the hits as shown below:

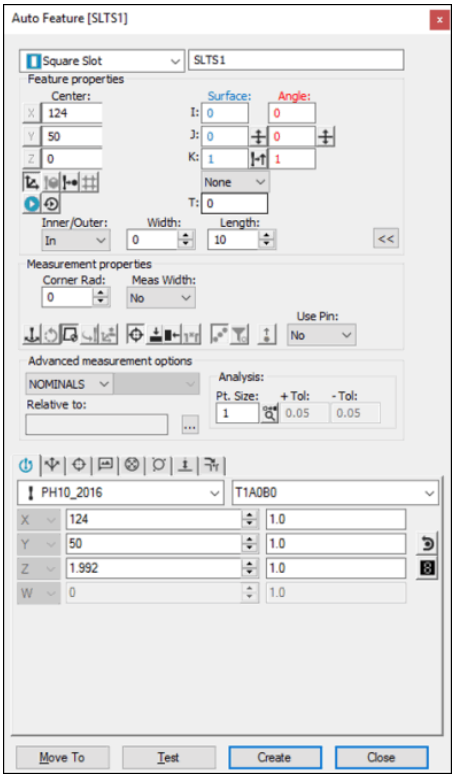


Square Slot Auto feature measured with five hits



Square Slot Auto feature measured with six hits

To access the **Square Slot** option, access the **Auto Feature** dialog box for a Square Slot (**Insert | Feature | Auto | Square Slot**).



Auto Feature dialog box - Square Slot

With the dialog box open, use one of these methods to create the feature.

Using Surface Data on the Screen

To generate a square slot using surface data, follow these steps:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
2. Click once on any surface near the square slot. PC-DMIS fills in the dialog box with information collected from the model.
3. Make any other modifications to the dialog box as needed.
4. Click **Create**.

Using Surface Data with the CMM

To generate a square slot measurement using surface data with the CMM, follow these steps:

1. Touch twice on the long side of the slot using the probe.
2. Touch the part on the short side of the slot.
3. Continue around the slot and touch the next long side.
4. Touch the last short side.
5. Make any other modifications to the dialog box and the Probe Toolbox as needed.
6. Click **Create**.

The order of touches should be in a circular pattern (clockwise or counterclockwise).

You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

To generate a square slot using wireframe CAD data, follow these steps:

1. Click once near the square slot. PC-DMIS fills in the dialog box with information collected from the model.
2. Make any other modifications to the dialog box and the Probe Toolbox as needed.

3. Click **Create**.

Using Wireframe Data with the CMM

To generate a square slot measurement using wireframe data with the CMM, follow these steps:

1. Touch twice on the long side of the slot using the probe.
2. Touch the part on the short side of the slot.
3. Continue around the slot and touch the next long side.
4. Touch the last short side.
5. Make any other modifications to the dialog box and the Probe Toolbox as needed.
6. Click **Create**.

> The order of touches should be in a circular pattern (clockwise or counterclockwise).

> You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Without Using CAD Data

To generate the square slot without the use of CAD data, follow these steps:

1. Find the top surface using three hits.
2. Take two hits on one of the long sides of the slot.
3. Take one hit on each of the three remaining sides of the slot in a clockwise direction. (There should be a total of eight hits.)
4. Make any other modifications to the dialog box and the Probe Toolbox as needed.
5. Click **Create**.

> The order of hits should be in a circular pattern (clockwise or counterclockwise).

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the square slot.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.

2. Click **Create** to insert the feature into your measurement routine.

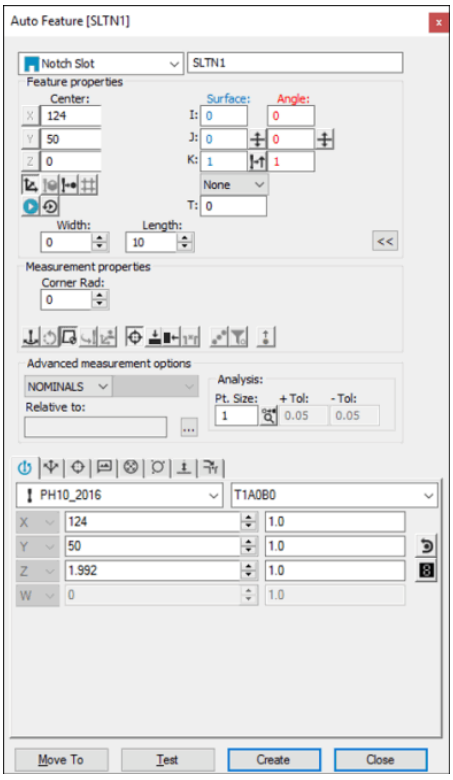
Creating an Auto Notch Slot



Auto Notch Slot button

The **Notch Slot** auto option allows you to define a notch measurement. A notch is a three-sided, square slot. This measurement type is particularly useful when you do not want to measure a series of lines and construct intersections and midpoints from them. Notches must be measured with four hits.

To access the **Notch Slot** option, access the **Auto Feature** dialog box for a Notch Slot (**Insert | Feature | Auto | Notch**).



Auto Feature dialog box - Notch Slot

With the dialog box open, use one of these methods to create the feature.

Using Surface Data on the Screen

To generate a notch measurement using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
2. Using the animated probe, take five hits on the CAD surface in the same order as if using a CMM (see "Using Surface Data with the CMM" below).

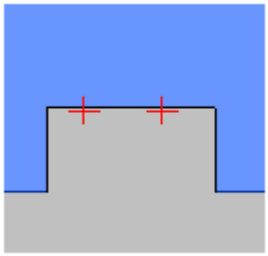
3. Make any other modifications to the dialog box and the Probe Toolbox as needed.
4. Click **Create**.

Using Surface Data with the CMM

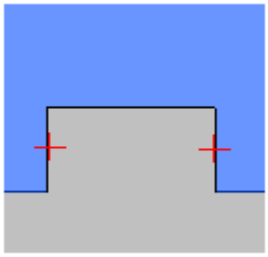
> You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

To generate a notch measurement using surface data with the CMM:

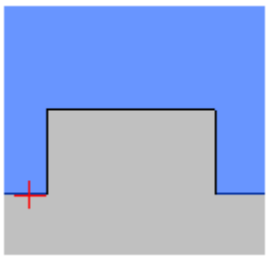
1. Touch two times on the side opposite the opening of the notch using the probe. This defines a line along the edge.



2. Touch the part once on one parallel side of the notch and once on the other parallel side. This defines the length. The point is along the edge line, midway between the parallel sides.



3. Take one hit on the open edge. This defines the width of the notch.



4. Make any other modifications to the dialog box and the Probe Toolbox as needed.

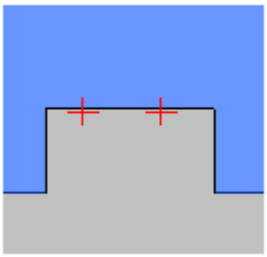
5. Click **Create**.

Using Wireframe Data on the Screen

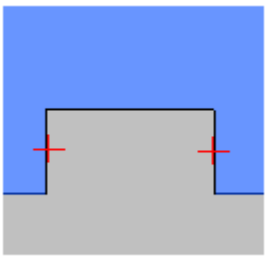
Wireframe CAD data can also be used to generate a notch.

Using the animated probe:

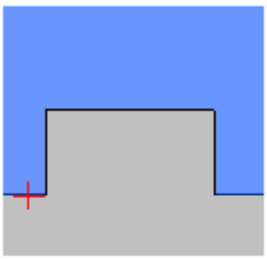
1. Touch twice on the side opposite the opening of the notch using the probe. This defines a line along the edge.



2. Touch the part on one parallel side of the notch and then on the other parallel side. This defines the length. The point is along the edge line, midway between the parallel sides.



3. Take a single touch on the open edge. This defines the width of the notch.



4. Make any other modifications to the dialog box and the Probe Toolbox as needed.
5. Click **Create**.

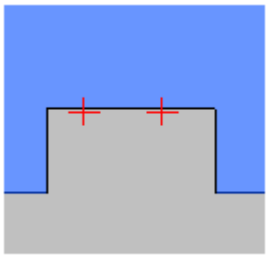
Using Wireframe Data with the CMM



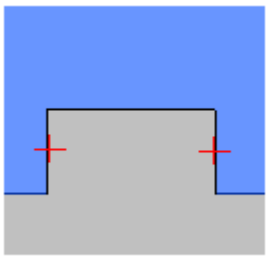
You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

To generate a notch measurement using wireframe data with the CMM:

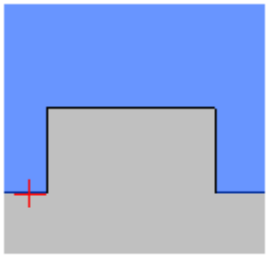
1. Touch twice on the side opposite the opening of the notch using the probe. This defines a line along the edge.



2. Touch the part on one parallel side of the notch and then on the other parallel side. This defines the length. The point is along the edge line, midway between the parallel sides.



3. Take a single touch on the open edge. This defines the width of the notch.



4. Make any other modifications to the dialog box and the Probe Toolbox as needed.
5. Click **Create**.

Without Using CAD Data

To generate a notch without the use of CAD data:

1. Find the top surface using three hits.
2. Touch twice on the side opposite the opening of the notch using the probe. This will define a line along the edge.
3. Touch the part on one parallel side of the notch and then on the other parallel side. This defines the length. The point is along the edge line, midway between the parallel sides.
4. Take a single touch on the open edge. This defines the width of the notch.
5. Make any other modifications to the dialog box and the Probe Toolbox as needed.
6. Click **Create**.

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the notch slot.

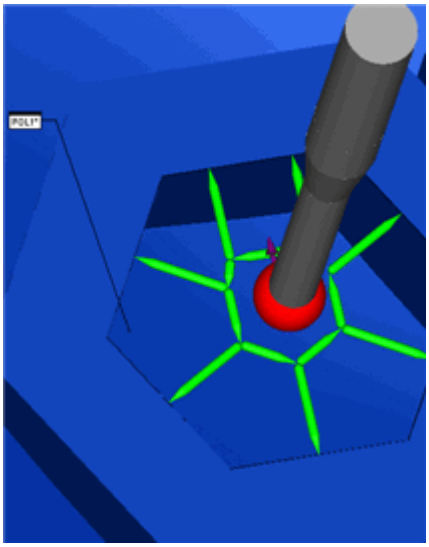
1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

Creating an Auto Polygon



Auto Polygon button

The **Polygon** auto option lets you define and insert a Polygon Auto feature into your measurement routine. A polygon is any feature composed of three or more sides of equal length.

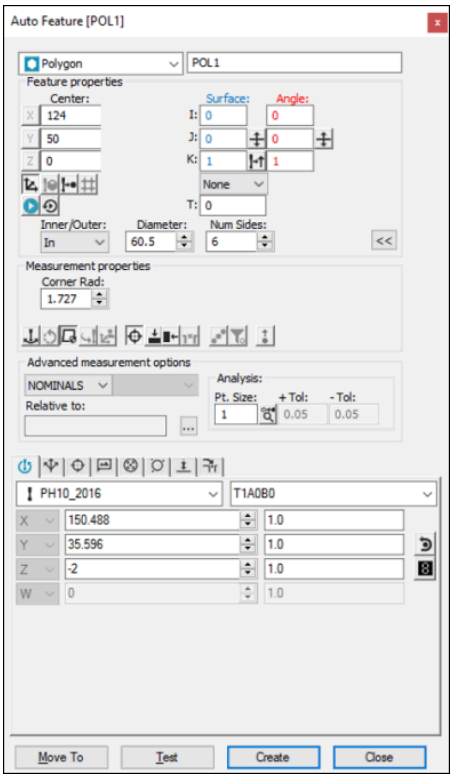


Example of a Polygon Auto feature

Hexagon and octagon shapes are both polygon features.

This Auto feature is primarily used to measure nuts and bolts.

To define and insert a polygon option, open the **Auto Feature** dialog box for a polygon (**Insert | Feature | Auto | Polygon**).

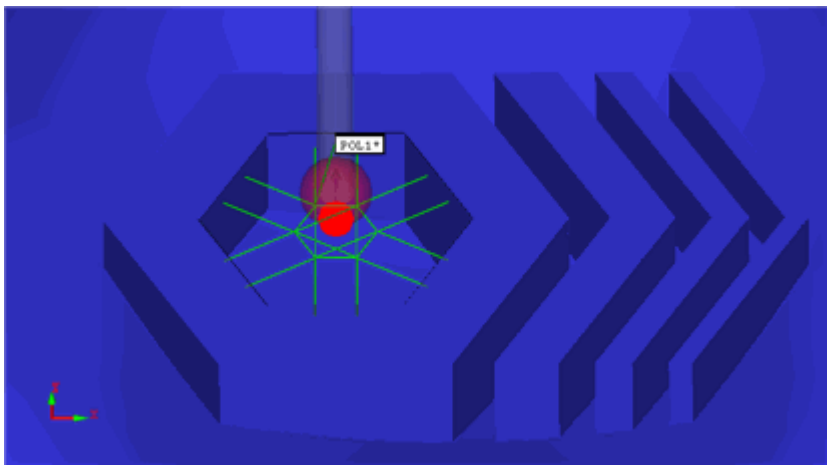


Auto Feature dialog box - Polygon

With the dialog box open, use one of these methods to create the feature.

Using the CAD Model

1. Access the **Polygon** Auto feature dialog box (**Insert | Feature | Auto | Polygon**).
2. In the **Number of Sides** box, define the number of sides that your polygon feature has.
3. Click once on the desired polygon feature in the Graphic Display window. PC-DMIS fills in the center point information for the polygon and draws some preliminary path lines. As you make changes to the dialog box, notice that PC-DMIS dynamically updates the path to reflect the changes.



Preliminary path lines displayed and showing two hits per side

CAD tolerances can affect the found polygon. For more information, see the "Changing CAD Tolerances" topic in the PC-DMIS Core documentation.

4. In the **Number of Hits** box, define how many hits that you want PC-DMIS to take when measuring each side. PC-DMIS always takes at least two hits on the very first side of the feature to determine the feature's angle vector.
5. In the **Orientation** area, determine whether it's an inner polygon or an outer polygon by selecting **Hole** or **Stud**, respectively.
6. In the **Corn. Rad.** box, define a corner radius. This determines how far away from the corners PC-DMIS should take hits on the polygon sides. This helps avoid taking hits directly in the corners.
7. In the **Diameter** box, ensure that you have a correct diameter for the polygon. For common, even-sided polygons, the diameter is the distance between two opposing sides. For other polygons, such as an equilateral triangle, it is twice the radius of the largest circle that you can inscribe inside the polygon. PC-DMIS automatically fills in this value when you click on the polygon.
8. Make any other modifications to the dialog box and the Probe Toolbox as needed.
9. Click **Create**. PC-DMIS inserts the Polygon Auto feature into your measurement routine.

Using the CMM

You can "learn" an Auto Polygon's position without using any CAD data by taking hits on the part with your machine's probe.

1. Fill out the dialog box with the necessary information.
2. With the Polygon **Auto Feature** dialog box remaining open, take a hit on one of the polygon's sides.

> After the first hit, the Status Bar at the bottom of your screen provides you with additional instructions.

3. Follow the prompts given in the Status Bar to complete the polygon creation.
4. Click **Create** when finished.

Without Using CAD Data

To generate the polygon without the use of CAD data, touch three points on the desired surface. Then take the hits to define the points of your polygon.

Typing the Data

If you know the theoretical data for the polygon, you can also type its theoretical data into the appropriate fields to create a polygon Auto feature. Use the Polygon Auto feature dialog box to specify the XYZ center and IJK vector information. Define the number of sides, the number of hits per side, the diameter, and the corner radius. Click **Create** when finished.

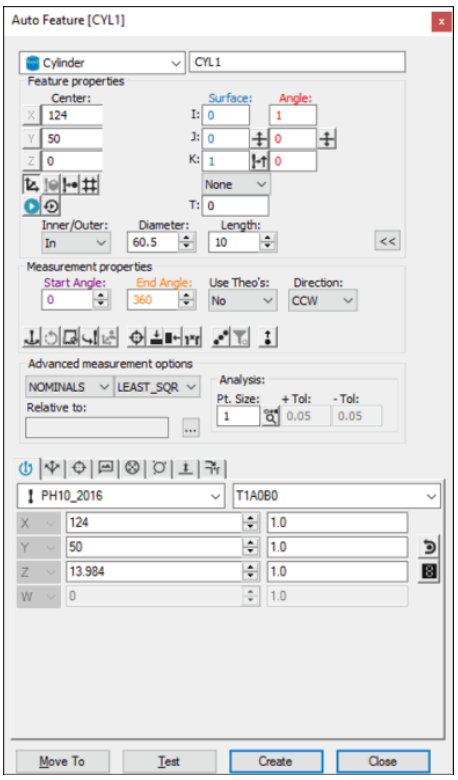
Creating an Auto Cylinder



Auto Cylinder button

The **Cylinder** auto option allows you to define a cylinder measurement. This measurement type is particularly useful when equal spacing of the hits is necessary for partial cylinders. The minimum number of hits needed to measure an Auto cylinder is six.

To access the **Cylinder** option, access the **Auto Feature** dialog box for a Cylinder (**Insert | Feature | Auto | Cylinder**).



Auto Feature dialog box - Cylinder

In some cases when you create a Circle, Cone, or Cylinder Auto Feature, it may be necessary to move the first and last probed points away from the edges of the feature. To do this, you can use the `ArcReductionAngle` setting. For details, see the "Using the ArcReductionAngle Setting" topic in the "Creating Auto Features" chapter of the PC-DMIS Core documentation.

Be aware that certain patterns of points (such as two rows of three equally spaced points or two rows of four equally spaced points) result in multiple ways to construct or measure a cylinder. Therefore, PC-DMIS's Best Fit algorithm may construct or measure the cylinder using an unexpected solution. For best results, use a pattern of points that eliminates unwanted solutions for measured or constructed cylinders.

With the **Auto Feature** dialog box open for the Cylinder feature, use one of these methods to create the feature.

Using Surface Data on the Screen

To generate a cylinder using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).

2. Position the mouse pointer (outside or inside the desired cylinder).
3. Click once on a surface near the cylinder. PC-DMIS highlights the selected cylinder. The dialog box displays the center point and diameter from the CAD data of the selected cylinder. It selects the end of the cylinder closest to where you clicked on the part model.
4. Define the length of the cylinder by defining the **Starting Depth** and the **Ending Depth** in the **Contact Path Properties** tab of the Probe Toolbox.
5. Make any other modifications to the dialog box and the **Contact Path Properties** tab of the Probe Toolbox as needed.
6. Click the **Create** button.

Using Surface Data with the CMM

To generate a cylinder using surface data with the CMM:

1. Take three hits in the hole or on the stud.
2. Move the probe to another depth.
3. Take three additional hits. PC-DMIS pierces the CAD surface closest to where the probe touched.

The displayed X, Y, Z values reflect the closest CAD cylinder, not the actual hits. The I, J, K reflects the surface normal vector. If a CAD cylinder is not found, PC-DMIS displays the closest point and asks you to take the additional hits.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

Wireframe CAD data can also be used to generate a cylinder.

To generate the cylinder using wireframe data:

1. Click near the desired wire on the cylinder. PC-DMIS highlights the selected wire and will select the end of the cylinder closest to where you clicked on the part model.
2. Verify that the correct feature has been selected.

The probe approach is always perpendicular to the feature, as well as perpendicular to the current probe centerline vector. The dialog box displays the value of the selected cylinder's center point and diameter once the wire has been indicated.

If the underlying CAD element is not a cylinder, circle, or arc, additional clicks may be necessary to identify the feature. If PC-DMIS doesn't highlight the correct feature, try to click on at least two additional locations on the cylinder.

Without Using CAD Data

To generate the cylinder without the use of CAD data:

1. Take three hits on the surface to find the plane that the cylinder is lying in.
2. Take three hits in the hole (or on the stud).
3. Take three additional hits on another level.

PC-DMIS calculates the sheet metal cylinder using all six hits. It is sometimes helpful to take a hit in between the two levels if PC-DMIS has difficulty in identifying the feature type. PC-DMIS uses the data from all of the measured hits until the **Create** button is selected. The X, Y, Z that is displayed is the calculated center of the cylinder (or stud).

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the cylinder.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

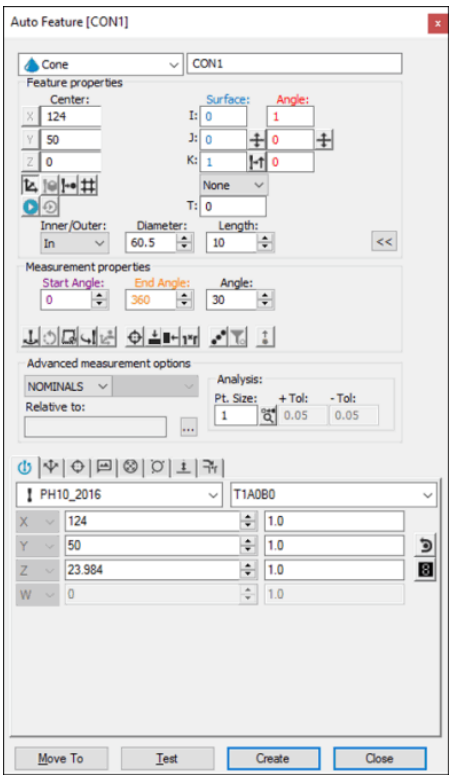
Creating an Auto Cone



Auto Cone button

The Cone auto option allows you to define a cone measurement. This measurement type is particularly useful when equal spacing of the hits is necessary for partial cones. The minimum number of hits needed to measure an auto cone is six.

To access the **Cone** option, access the **Auto Feature** dialog box for a Cone (**Insert | Feature | Auto | Cone**).



Auto Feature dialog box - Cone

In some cases when you create a Circle, Cone, or Cylinder Auto Feature, it may be necessary to move the first and last probed points away from the edges of the feature. To do this, you can use the `ArcReductionAngle` setting. For details, see the "Using the ArcReductionAngle Setting" topic in the "Creating Auto Features" chapter of the PC-DMIS Core documentation.

With the **Auto Feature** dialog box open for the Cone feature, use one of these methods to create the feature.

On the methods below, an external cone (stud) from PC-DMIS versions 3.6 and earlier may need to have its vectors and length negated to correctly measure.

For an Auto Cone, the **Diameter** value in the **Feature properties** area represents the nominal diameter at the location of the cone where you've defined the THEO XYZ location.

Using Surface Data on the Screen

To generate a cone using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).

2. Position the mouse pointer (outside or inside the desired cone).
3. Click once on the cone's surface. PC-DMIS highlights the selected cone. The dialog box displays the center point, angle, and diameter from the CAD data of the selected cone.
4. Make any other modifications to the dialog box as needed.
5. Click **Create**.

Using Surface Data with the CMM



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

To generate a cone using surface data with the CMM:

1. Take three hits in the hole or on the stud.
2. Move the probe to another depth.
3. Take three additional hits. PC-DMIS pierces the CAD surface closest to where the probe touched.

The displayed X, Y, Z values reflect the closest CAD cone, not the actual hits. The I, J, K reflects the surface normal vector. If a CAD cone is not found, PC-DMIS displays the closest point and asks you to take the additional hits.

Using Wireframe Data on the Screen

Wireframe CAD data can also be used to generate a cone.

To generate the cone using wireframe data:

1. Click near the desired wire on the cone. PC-DMIS highlights the selected wire. This gets the cone center, surface vector, and diameter.
2. Click on a second wire that represents the other end of the cone to calculate the angle.

The probe approach is always perpendicular to the feature, as well as perpendicular to the current probe centerline vector. The dialog box displays the value of the selected cone's center point and diameter once the wire has been indicated.



If the underlying CAD element is not a cone, circle, or arc, additional clicks may be necessary to identify the feature. If PC-DMIS doesn't highlight the correct feature, try to click on at least two additional locations on the cone.

Without Using CAD Data

To generate the cone without using CAD data:

1. Take three hits on the surface to find the plane that the cone is lying in.
2. Take three hits in the hole (or on the stud) at the same level.
3. Take at least one hit at either a lower or higher level than the first three hits (take up to three hits to get an accurate definition of the cone).

Typing the Data

This method allows you to type the desired X, Y, Z, I, J, K values for the cone.

1. Type the desired X, Y, Z, I, J, K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

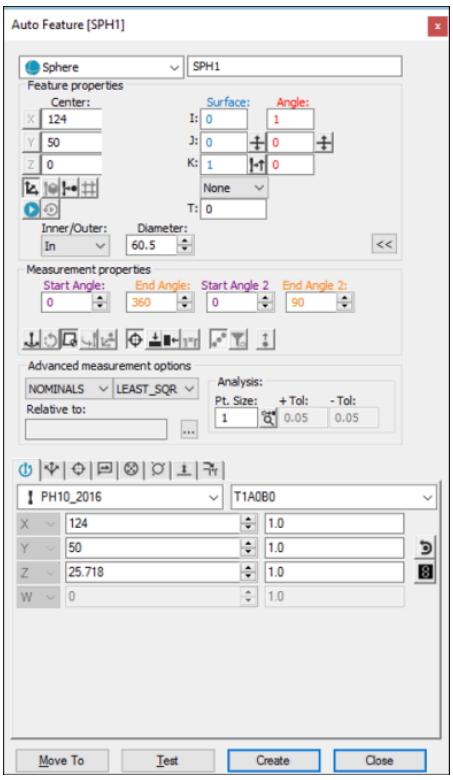
Creating an Auto Sphere



Auto Sphere button

The **Sphere** sheet metal option allows you to define a sphere measurement. This measurement type is particularly useful when the sphere lies in a specific plane that is not parallel with any of the workplanes. The minimum number of hits needed to measure an auto sphere is four.

To access the **Sphere** option, access the **Auto Feature** dialog box for a sphere (**Insert | Feature | Auto | Sphere**).



Auto Feature dialog box - Sphere

With the dialog box open, use one of these methods to create the feature:

- Using surface data on the screen
- Using surface data with the CMM
- Using wireframe CAD data on the screen
- Typing the data

Using Surface Data on the Screen

To generate a sphere using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
2. Click on a sphere in the Graphic Display window.

The dialog box displays the value of the selected sphere and vector once the points have been indicated.

Using Surface Data with the CMM

To generate a sphere using surface data with the CMM, touch the sphere in four locations using the probe. If additional mouse clicks are detected before you select the **Create** button, PC-DMIS finds the best sphere near the measured points.



You should select the **Find Noms** option in the **Mode** list for this measurement method. For more information on nominals, see the "Mode List" topic in the PC-DMIS Core documentation.

Using Wireframe Data on the Screen

To generate a sphere using wireframe CAD data:

1. Select the sphere to be measured. PC-DMIS highlights the selected sphere if it is available. (If another feature is selected, try to take two additional hits.)
2. Verify that the correct feature has been selected.

The dialog box displays the value of the selected DCC sphere and the vector once the sphere has been indicated.

Typing the Data

Use this method to type the desired X, Y, Z, I, J, and K values for the sphere.

1. Type the desired X, Y, Z, I, J, and K values for the feature into the dialog box.
2. Click **Create** to insert the feature into your measurement routine.

Scanning

Scanning: Introduction

With PC-DMIS and your CMM, you can scan your part's surface at specified increments in DCC (Direct Computer Control) mode using a touch trigger probe (TTP) or an analog (continuous contact) probe. Alternately, if you're working in Manual Mode, you can perform manual scans with touch trigger or hard probes as well.

About Touch Trigger Probe (TTP) Scans

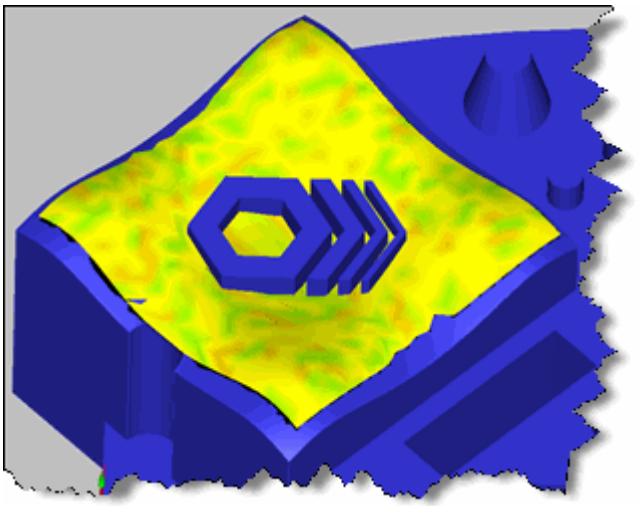
DCC TTP scanning is also known as "stitch-type" scanning because it resembles a sewing machine's stitching action as the probe moves up and down to contact the part's surface. DCC TTP scans are driven by PC-DMIS and the CMM controller. This provides an intelligent, self-adapting algorithm that can calculate surface normal vectors for accurate probe compensation.

About Continuous-Contact Scans

DCC continuous-contact scans are scans that are done with an analog probe head. The probe for this type of scan remains in continuous contact with the part's surface. PC-DMIS sends the scanning parameters to the controller. The controller scans the part and then informs PC-DMIS of the scan points based on the chosen parameters. Continuous-contact scans generally result in large amounts of point data being generated relatively quickly.

Available Scan Types

The different scanning approaches are useful in digitizing profiles on your part's surfaces.



Example of a surface plot of a patch scan

To scan your part's features and surfaces, PC-DMIS provides you with these scan types: Basic Scans, Advanced Scans, and Manual Scans.

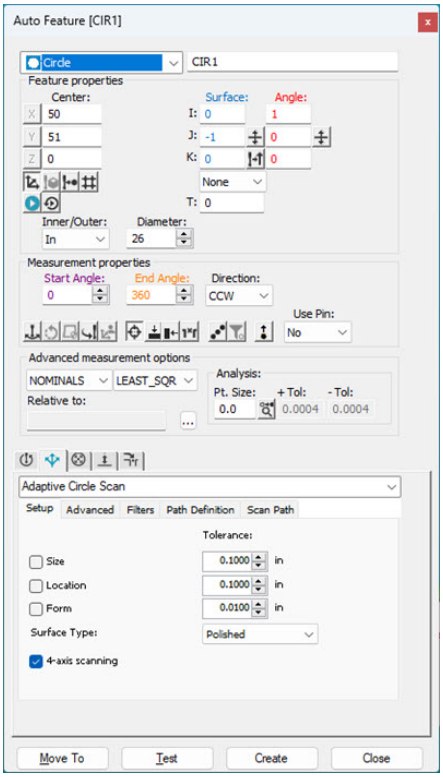
The main topics in this chapter discuss the options available from the **Insert | Scan** submenu:

- 4-Axis Scanning
- Performing Advanced Scans
- Creating Quick Scans
- Performing Basic Scans
- Performing Scans Manually

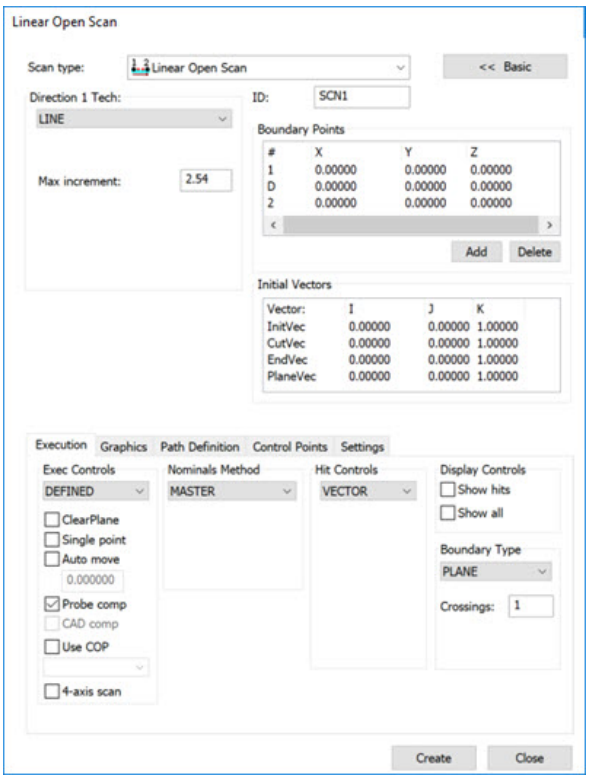
For details on the scan options, see the "Scanning Your Part" chapter in the PC-DMIS Core documentation.

4-Axis Scanning

Auto feature scanning strategies and legacy scans have an additional check box called **4-axis scanning**.



Auto Circle feature dialog box with 4-axis scanning option for Adaptive Circle Scan



Linear Open Scan dialog box with 4-axis scan option

This function is available in PC-DMIS Offline mode. If you are online, you must meet these conditions to use this function:

- You must use an analog probe or the HP-O laser probe.
- You must use an I++ client machine interface connected to Technology Server version 1.5 or higher and a CMM with the Leitz B5 controller.
- You must have a rotary table enabled.

PC-DMIS also has a 4-axis scan constraint angle calculation functionality. For details, see the "4-Axis Scan Constraint Angle Calculation" topic in the PC-DMIS CMM documentation.

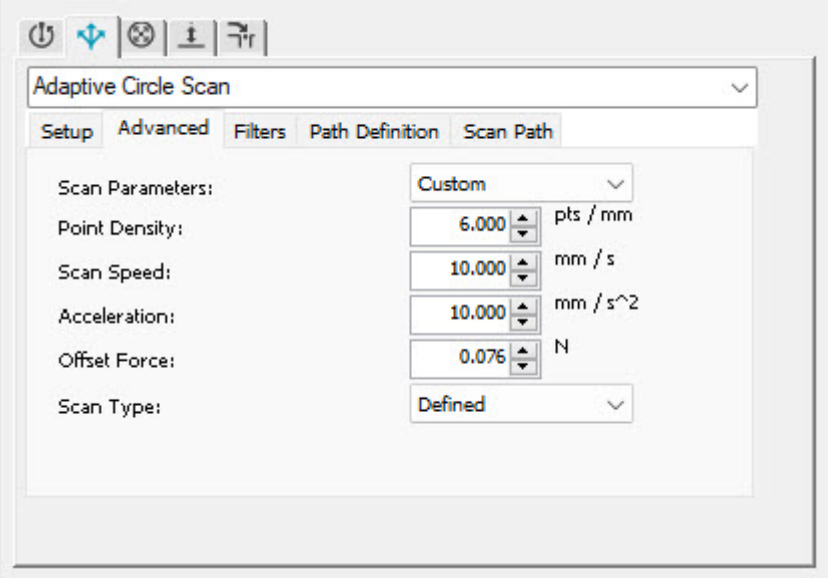
The main purpose of this capability is for defined scans. You can use the **4-axis scan** option for Auto feature Circle with scanning measurement strategy in undefined mode (CIR).

To use this option, scan your part or feature in the usual way as with normal scans. When done, select the **4-axis scanning** check box. PC-DMIS performs all the necessary calculations and moves.

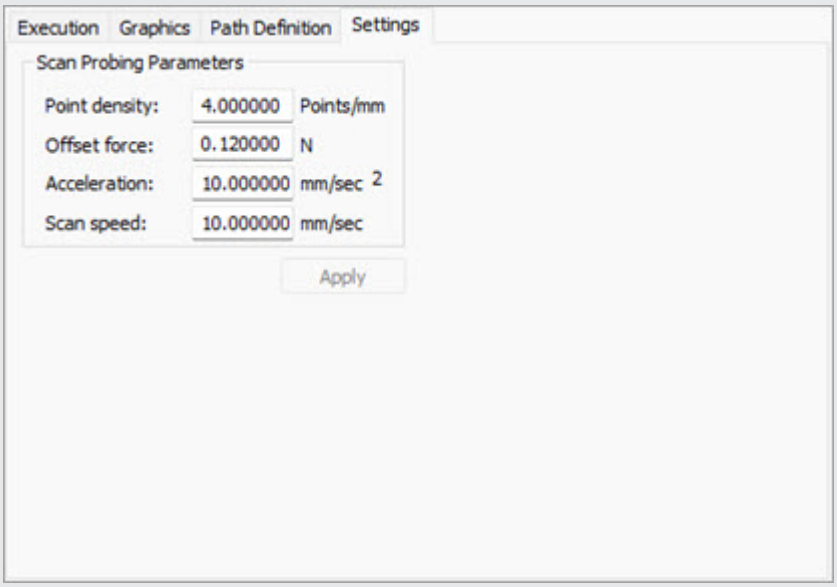
You must set the point density setting high enough so that your controller has time to react to changes in the curvature of the scan trajectory.

To do this:

- From the **Auto Features** dialog box, select the **Advanced** tab from the Probe Utility **Adaptive Scan** tab.



- From the DCC **Scan** dialog box, select the **Settings** tab.



To help PC-DMIS stay in contact with the part throughout the scan process, adjust the **Scan Speed** value to decrease the speed of the scan. This is required for rough surfaces as well as bent surfaces where the scan trajectory contains high curvatures.

The 4-axis scan strategy uses the scan point vectors to calculate the spin of the rotary table. So, after the software generates the scan trajectory, you should check the vectors visually in the CAD view. Verify the scan vectors are correctly oriented, and the changes in the orientation are smooth. Sharp changes could lead to instability in the controller.

When all the feature vectors are almost vertical (vectors are calculated in the plane of the rotary table), the software projects the scan trajectory into this plane. The software uses these new vectors for rotary table angles during scanning.

The purpose of this special case, for example, is when you scan a circle located at the top of a vertically-oriented cylindrical part. In this case, the part spins on the rotary table and the probe stays in one position while performing the scan.

4-Axis Scan Constraint Angle Calculation Setup Instructions

The 4-axis scan constraint angle calculation functionality is available in PC-DMIS Offline mode. If you are in Online mode, you must meet these conditions:

- You must use an analog probe or the HP-O sensor.
- You must use an I++ client machine interface connected to Technology Server version 1.5 or later and a CMM with the Leitz B5 controller.
- You must have a rotary table enabled.
- Set these PC-DMIS Settings Editor entries to these values:
  - `Disable4axisScan` = **False**
  - `SendHHSFullData` = **2**

This table lists the supported PC-DMIS 4-axis scan commands:

Advanced (DCC) Scans	Freeform Scan
	Linear Open Scan
	Linear Closed Scan
	Patch Scan
	Perimeter Scan
	Rotary Scan
	Section Scan

Auto Feature Adaptive (Basic) Scans	Circle	Adaptive Circle Scan	Define
			CIR
		Gage Scan Calibration	
	Cone	Adaptive Cone Concentric Circle Scan	
	Cylinder	Adaptive Cylinder Spiral Scan Adaptive Cylinder Concentric Circle Scan	
	Plane	Adaptive Free Form Plane Scan Adaptive Plane Circle Scan	

To use the 4-axis scan constraint angle calculation, follow these steps:

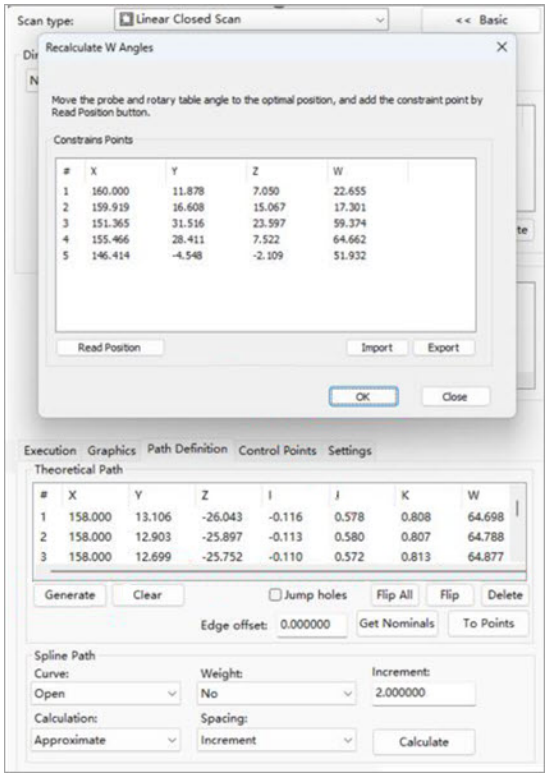
1. From the PC-DMIS **Scan** menu (**Insert | Scan**), select the appropriate scan type from the list.
2. Follow the appropriate scan section in this documentation to set up the options in the top half of the dialog box.
3. For DCC scan types, the 4-axis scan constraint angle calculation functionality is for defined scans. From the **Execution** tab at the bottom of the DCC scan dialog box, select the **DEFINED** option from the **Exec Controls** list.
4. Locate and select the **4-axis scan** check box. For example, for DCC scan types, select the **Execution** tab in the bottom half of the dialog box.
5. For DCC scan types, select the **Path Generation** tab to generate the theoreticals and the rotary table's angles. There are three ways to generate these values:
    - Click the **Generate** button. PC-DMIS automatically calculates the theoretical values and the W angles based on the default vector direction of the theoretical points and the current rotary table angle. This method is suitable for workpieces with no risk of interference, such as single blades or rotational parts.
    - Another option is to directly import an external theoretical value file that already includes the rotary table's W angles.
    - A third option is to use an Automation script to write the scanning instructions with pre-configured W angles.

Note that all XYZIJKW parameters of the theoretical points support manual editing.

You can update the theoretical W angles from the constraint angles. A minimum of five constraint points are required.

To do this:

1. Right-click the theoretical path list and select Recalculate W Angles from the popup menu to open the Recalculate W Angles dialog box.



2. You can manually update the values or import a file to update the values as described below.

    - **Real-time collection**: Manually adjust the CMM and rotary table (X, Y, Z, W) to reach a suitable position near the theoretical point on the workpiece surface. Then click the **Read Position** or the CLP/Print button on the controller. PC-DMIS automatically captures the current position and populates the current X, Y, Z, and W values into the constraint list.

    - You can also import a constraint angles file (.TXT format) directly from an external source.

The X, Y, Z, and W values in the constraint angles list support manual editing and can be exported for saving.

The point order of constraint points does not affect the calculation results.

Performing Advanced Scans

Advanced scans are DCC stitch-type scans done by a touch trigger probe (TTP) and in some scans, by an analog probe. PC-DMIS and the CMM controller drive these scans. The DCC scanning procedure uses an intelligent, self-adapting algorithm that can calculate surface normal vectors for accurate probe compensation.

A TTP probe allows automatic point-to-point digitizing of profiles on surfaces. Specify the necessary parameters for the DCC scan and select the **Measure** button. The scanning algorithm in PC-DMIS takes control of the measurement process.

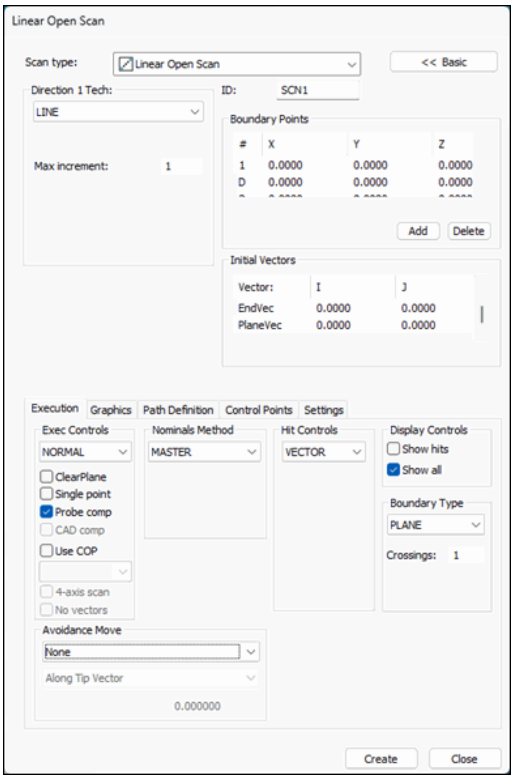
PC-DMIS supports the following advanced scans:

- Linear Open
- Linear Closed
- Patch
- Perimeter
- Section
- Rotary
- Freeform
- UV
- Grid
- Working with Section Cuts
- UniScan

To create these scans, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

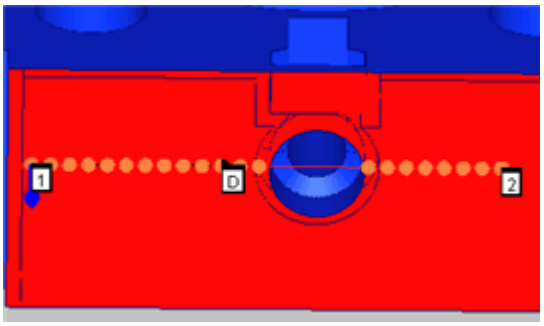
For information on the options available in the **Scan** dialog box (the dialog box that you use to perform these scans), see the "Common Functions of the Scan Dialog Box" chapter in the PC-DMIS Core documentation.

Performing a Linear Open Advanced Scan



Linear Open Scan dialog box

Select the Linear Open scan method (**Insert | Scan | Linear Open**) to scan a surface along an open-ended line. This procedure uses start and end points for the line. It also includes a direction point for the calculation of the cut plane. The probe always remains within the cut plane while it performs the scan.



A sample Linear Open Scan

To Create a Linear Open Scan

To create a Linear Open Advanced scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

To Use the Quick Scan Feature to Create a Linear Open Scan

You can use the Quick Scan functionality to create a Linear Open scan from a polyline or surface in Curve Mode or Surface Mode. For details, see "Creating Quick Scans" in the PC-DMIS CMM documentation.

To Create a Linear Open Scan in Curve Mode

If your CAD model contains curves or polylines, you can create a Linear Open scan in Curve Mode. To do this:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Curve Mode** icon ().
2. Select a curve or polyline. PC-DMIS highlights the selected curve or polyline. To select multiple curves or polylines, hold Ctrl and click each one. To deselect a curve or polyline, hold Ctrl and then click it again.

   The order in which you select the curves or polylines is important, as PC-DMIS generates the scan in the order of selection. PC-DMIS locates the nearest end of the next polyline from the end point of the scan on the first polyline. This end point becomes the starting point on the next polyline.
3. You now need to define the scan's boundary by defining a series of points.

   a. Click a location on the curve or polyline that you want to start your scan. PC-DMIS labels this starting point with a "1".

   b. Click a second point. This is the Direction point. PC-DMIS labels this point with a "D". It tells PC-DMIS in what direction to begin the scan.

   c. If desired, click a second point. PC-DMIS labels this point with a "2". This point defines the end point for the scan.
4. To specify the distance to skip from the end of the polyline, type a value in the **Edge offset** box in the **Theoretical Path** area of the **Path Definition** tab.

   For example, if the start point of the first polyline is closer than the specified edge distance, the scan starts from the edge distance away from the end point.
5. You can use the **Jump Hole** check box in the **Path Definition** tab to determine whether the probe raises up between scans on each polyline.

   - If you select the **Jump Hole** check box, the probe raises between the scan on each polyline.
   - If you clear the **Jump Hole** check box, the probe scans in a straight line from the end point of the first polyline to the start point of the next polyline.



For tactile probes, the **Jump Hole** check box on the **Path Definition** tab is always selected. This is because the probe lifts between the scans on each polyline. For spot laser probes, the **Jump Hole** check box is available for selection, and PC-DMIS uses its last-used value. For more information about the check box, see the "Theoretical Path Area" topic in the PC-DMIS Core documentation.

The **Jump Hole** check box is not used for laser probes.

6. From the **Theoretical Path** area of the **Path Definitions** tab, click the **Generate** button to generate the points for the scan's theoretical pathway on the CAD model in the Graphic Display window.



There must be a surface behind the polyline or curve to generate the scan.

7. To define the scan on another curve, click the **Deselect All** button on the **Graphics** tab.

To Create a Linear Open Scan on a 3D Wireframe CAD Model

To perform a scan on a wireframe model, use a 3D wireframe CAD file. The 3D wires define both the shape of the feature you want to scan and its depth (3D aspect). This type of scan follows the same procedure as above.

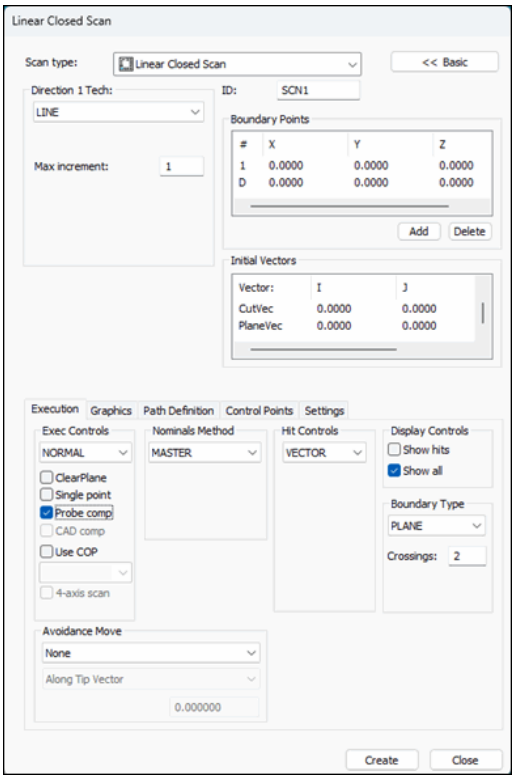
To Create a Linear Open Scan on a 2D Wireframe CAD Model

If you want to perform this type of scan on a 2D wireframe file, follow these steps:

1. Import the 2D CAD file. To simplify the process, ensure the CAD origin is positioned on the CAD model itself and not off in body coordinates.
2. Select the **Insert | Feature | Constructed | Line** menu option to open the **Construct Line** dialog box.
3. From the **Method** list, select **Alignment** to construct a line at the CAD origin that is normal to the surface of the 2D CAD data.
4. If your measurement routines use inches, skip this step. For millimeters, open the Edit window and increase the default line length from 1 to a longer value, such as 5 or 10.
5. Export the measurement routine (the features only) to either an IGES or DXF file type. Save the exported file in a directory of your choice.
6. Return to the measurement routine and delete the alignment line you created.

7. Import the exported file back into the same measurement routine. When PC-DMIS displays a prompt, asking if you want to merge or replace the CAD, click **Merge** to merge the CAD wire into the Graphic Display window. Your CAD model should now include a CAD wire normal to the rest of the other CAD wires.
8. Select the scan type from the **Insert | Scan** menu option to open its dialog box.
9. From the **Graphics** tab, mark the **Select** check box.
10. Click each wire that defines the feature you want to scan, in the desired scan order, starting with the wire that you want the scan to begin.
11. From the **Graphics** tab, select the **Depth** check box and then click on the imported wire that is normal to all the other wires.
12. Clear the **Select** check box. You can now select your 1 and D points on the theoretical surface defined by the wires representing the surface's shape and the depth.
13. If PC-DMIS is in Online mode, select the **Measure** check box. From the **Execution** tab, access the **Nominals Method** list and select **FindNoms**. In the **Tolerance** box, type a tolerance value that at least compensates for the probe's radius.
14. When done, click **Create**.
    - If PC-DMIS is in Offline mode, it inserts the scan into the Edit window.
    - If PC-DMIS is in Online mode, it immediately starts the scan and finds the nominals.

Performing a Linear Closed Advanced Scan

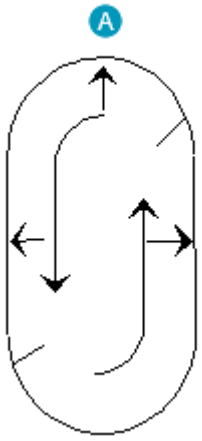


Linear Closed Scan dialog box

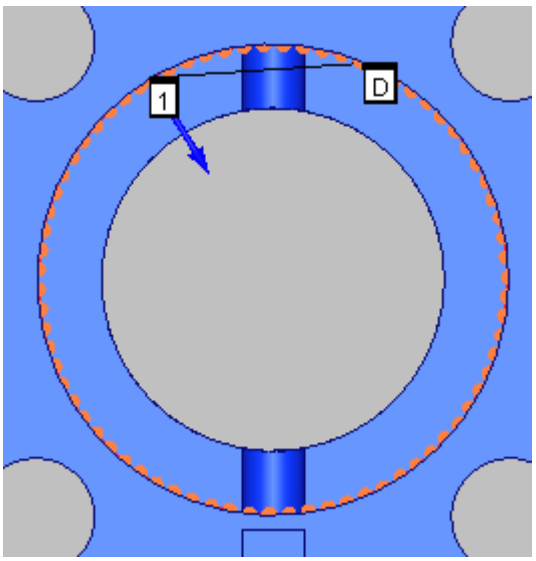
The **Insert | Scan | Linear Closed** method scans the surface, starting at the designated start point and ending the scan at the same point. This method creates a closed scan that returns to its initial starting point, making it useful for scanning circular features or slots.

To perform this scan, you need to define the starting point location and a direction point. Additionally, you must provide the incremental value for taking hits.

PC-DMIS scans the surface as shown below.



***A** - Starting point and ending point*



A sample Linear Closed Scan with scan points inside a hole

To Create a Linear Closed Scan

To create a Linear Closed Advanced scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

To Create a Linear Closed Scan on a 3D Wireframe CAD Model

To perform a scan on a wireframe model, use a 3D wireframe CAD file. The 3D wires define both the shape of the feature you want to scan and its depth (3D aspect). This type of scan follows the same procedure as above.

To Create a Linear Closed Scan on a 2D Wireframe CAD Model

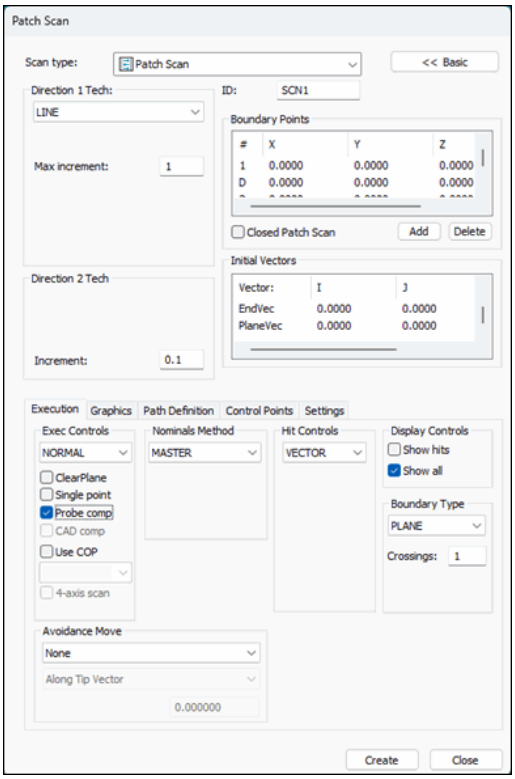
If you want to perform this type of scan on a 2D wireframe file, follow these steps:

1. Import the 2D CAD file. To simplify the process, ensure the CAD origin is positioned on the CAD model itself and not off in body coordinates.
2. Select the **Insert | Feature | Constructed | Line** menu option to open the **Construct Line** dialog box.
3. From the **Method** list, select **Alignment** to construct a line at the CAD origin that is normal to the surface of the 2D CAD data.
4. If your measurement routines use inches, skip this step. For millimeters, open the Edit window and increase the default line length from 1 to a longer value, such as 5 or 10.
5. Export the measurement routine (the features only) to either an IGES or DXF file type. Save the exported file in a directory of your choice.
6. Return to the measurement routine and delete the alignment line you created.
7. Import the exported file back into the same measurement routine. When PC-DMIS displays a prompt, asking if you want to merge or replace the CAD, click **Merge** to

merge the CAD wire into the Graphic Display window. Your CAD model should now include a CAD wire normal to the rest of the other CAD wires.

8. Select the scan type from the **Insert | Scan** menu option to open its dialog box.
9. From the **Graphics** tab, mark the **Select** check box.
10. Click each wire that defines the feature you want to scan, in the desired scan order, starting with the wire that you want the scan to begin.
11. From the **Graphics** tab, select the **Depth** check box and then click on the imported wire that is normal to all the other wires.
12. Clear the **Select** check box. You can now select your 1 and D points on the theoretical surface defined by the wires representing the surface's shape and the depth.
13. If PC-DMIS is in Online mode, select the **Measure** check box. From the **Execution** tab, access the **Nominals Method** list and select **FindNoms**. In the **Tolerance** box, type a tolerance value that at least compensates for the probe's radius.
14. When done, click **Create**.
    - If PC-DMIS is in Offline mode, it inserts the scan into the Edit window.
    - If PC-DMIS is in Online mode, it immediately starts the scan and finds the nominals.

Performing a Patch Advanced Scan

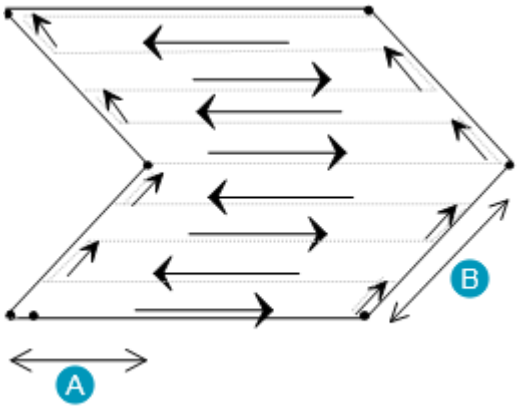


Patch Scan dialog box

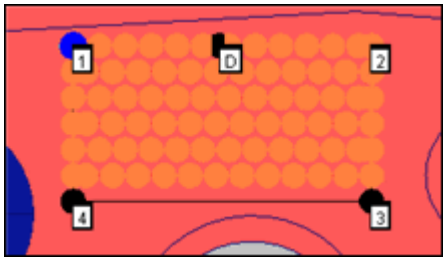
The Patch scan is like a series of Linear Open scans that are done parallel to each other.

The **Insert | Scan | Patch** method scans the surface according to the selected techniques in the **Direction 1 Tech** area and **Direction 2 Tech** area.

- The probe always remains within the cut plane while doing the scan.
- The Direction 1 technique indicates the direction between the first and second boundary points.
- The Direction 2 technique indicates the direction between the second and third boundary points.
- The probe scans the part on the surface indicated in the **Direction 1 Tech** area. When it encounters the second boundary point, the probe automatically moves to the next row as indicated in the **Direction 2 Tech** area.



A *- Direction 1 technique*
B *- Direction 2 technique*

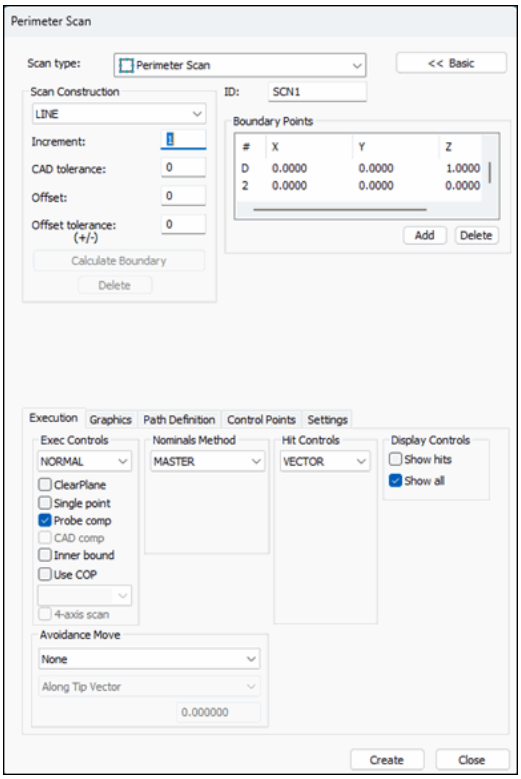


A sample Patch Scan

To Create a Patch Scan

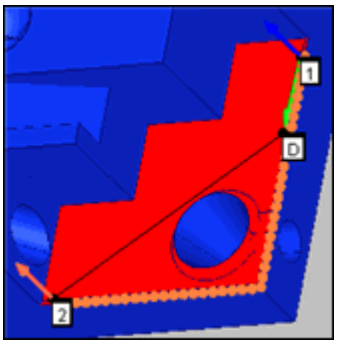
To create a Patch Advanced scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

Performing a Perimeter Advanced Scan



Perimeter Scan dialog box

The **Insert | Scan | Perimeter** scan differs from other linear scans because it is created entirely from CAD data before execution. This type of scan is available only when CAD surface data is available. It enables PC-DMIS to determine its path precisely before starting, with minimal error.



A sample exterior Perimeter scan

Two Types of Perimeter Scans

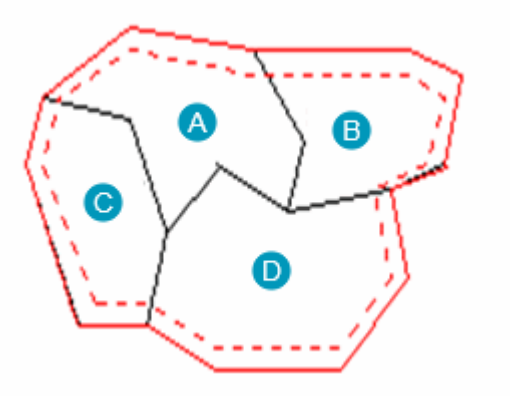
There are two types of Perimeter scans:

- An *exterior* scan that follows the outside of the selected surface boundary or boundaries. An exterior scan can traverse across multiple surface boundaries to create a single scan.

- An *interior* scan that follows a boundary curve inside a given surface. These types of curves usually define features such as holes, slots, or studs. Unlike the exterior scan, an interior scan is limited to the interior of a single surface.

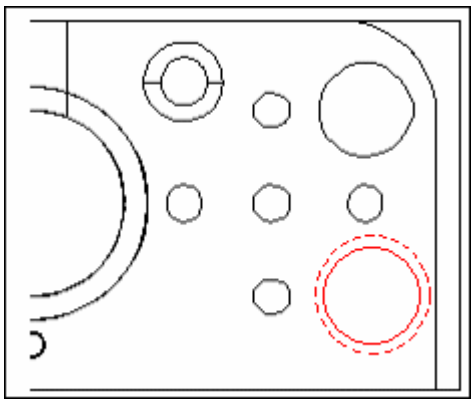
The figures below (*Scan 1* and *Scan 2*) illustrate the two types of Perimeter scans.

- In *Scan 1*, four surfaces have been selected, with each surface bordering another. The outer edges of these surfaces form the composite boundary, represented by a solid line. The offset distance indicates how far the scan is positioned from the composite boundary, shown as a broken red line.



Scan 1
***A** - Surface 1*
***B** - Surface 2*
***C** - Surface 3*
***D** - Surface 4*

- In *Scan 2*, the boundary of a hole creates the path for an interior Perimeter scan.



Scan 2

To Create a Perimeter Scan

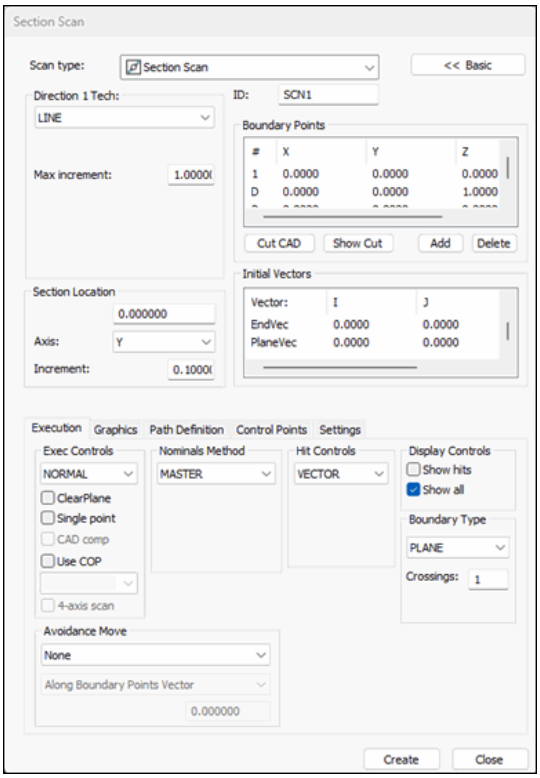
To create a Perimeter Advanced scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

Note on Hole Avoidance

The **Defined** mode in the **Exec Controls** area of the **Execution** tab does not support hole avoidance for Perimeter scans. Ensure there are no holes in the scan's pathway when

using this mode. If holes are present, adjust the path or switch to the **Normal** execution mode.

Performing a Section Advanced Scan



Section Scan dialog box

The **Insert | Scan | Section** scan is similar to the Linear Open scan. It scans the surface along a line on the part. This type of scan is only available when CAD surface data is available. With CAD surface data, PC-DMIS identifies a start point and end point in the section. Section scans use these points to define the line and include a direction point. The probe always remains within the cut plane during the scan.

Detect and Skip Holes

Section scans can detect holes and skip them while scanning along a part. This type of scan allows you to select "section lines" drawn on the screen by the CAD engineer and then continue the scan.

Multiple Scans Along a Fixed Axis

One advantage of using a Section scan is the ability to perform multiple scans along a fixed axis.

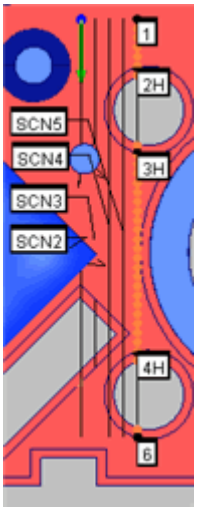
For example, suppose you want to scan a line along the Y axis at specific increments along the X axis. To do this:

- At X = 5.0, scan the first line.
- At X = 5.5, scan the second line.

- At X = 6.0, scan the third line.

You could accomplish this with several Linear Open scans, but the Section scan allows you to perform these incremental scans more efficiently.

To do this, you need to set up a Section scan with the X axis as the section axis and 0.5 as the section increment. You should also configure additional parameters. For details, see the "Performing a Linear Open Advanced Scan" topic in the PC-DMIS CMM documentation. After a scan is completed, PC-DMIS re-displays the **Section Scan** dialog box, shifting all boundary points to the next section by the increment you specified.

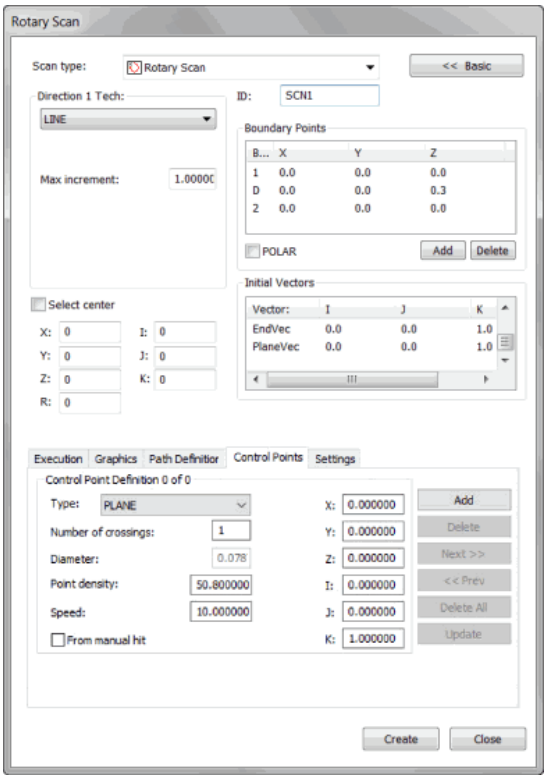


Sample incremental scans

To Create a Section Scan

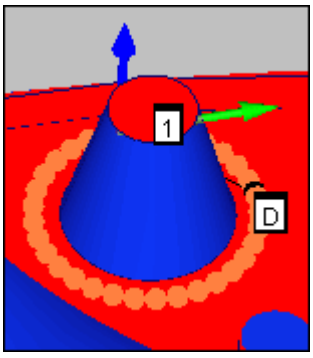
To create a Section Advanced scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

Performing a Rotary Advanced Scan



Rotary Scan dialog box

The **Insert | Scan | Rotary** scan method scans the surface around a given point at a specified radius from that point. The radius remains consistent regardless of surface changes. This method uses the starting and ending point for the arc of the measurement. It also includes a direction point to define the direction from start to end.



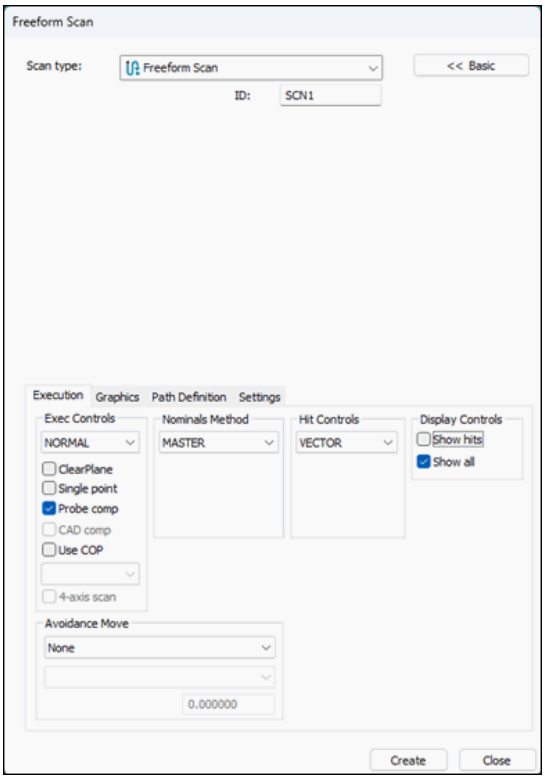
A sample Rotary Scan around a cone

For more details on the **Rotary Scan** dialog box, see the appropriate topics in the "Common Functions of the Scan Dialog Box" section of the PC-DMIS Core documentation.

To Create a Rotary Scan

To create a Rotary Advanced scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

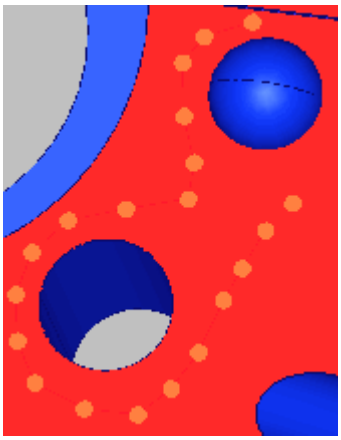
Performing a Freeform Advanced Scan



Freeform Scan dialog box

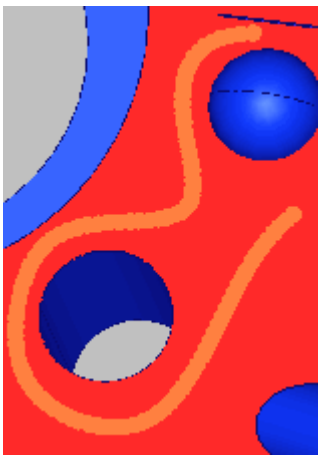
The **Freeform Scan** dialog box enables you to create any path on a surface. The scan follows the path you define, which can be curved or straight, with as many or as few hits as needed.

Example of a freeform scan before spline path:



Freeform scan before spline path

Example of a freeform scan after spline path:

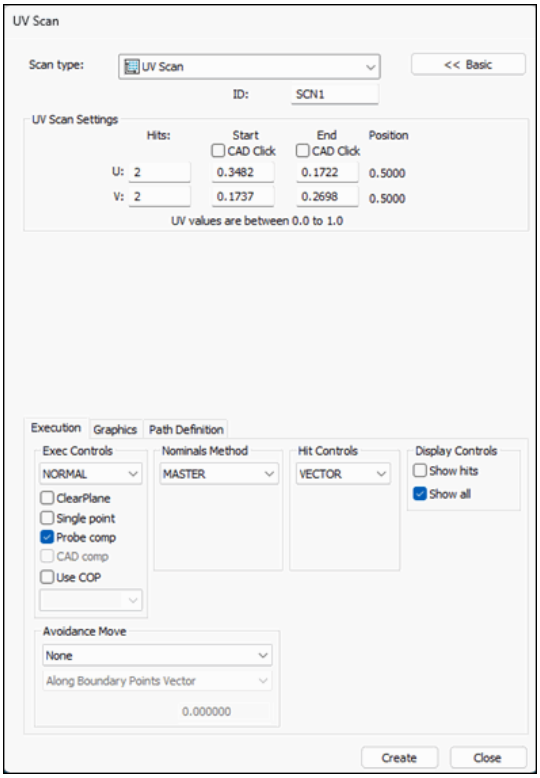


Freeform scan after spline path

To Create a Freeform Scan

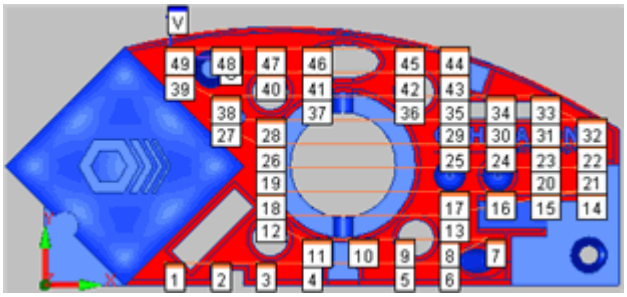
To create a Freeform Advanced scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

Performing a UV Advanced Scan



UV Scan dialog box

The **Insert | Scan | UV** method allows you to easily scan rows of points on any surface of a known CAD model (similar to the Patch scan). This method requires minimal setup, as it uses the UV space defined by the CAD model.



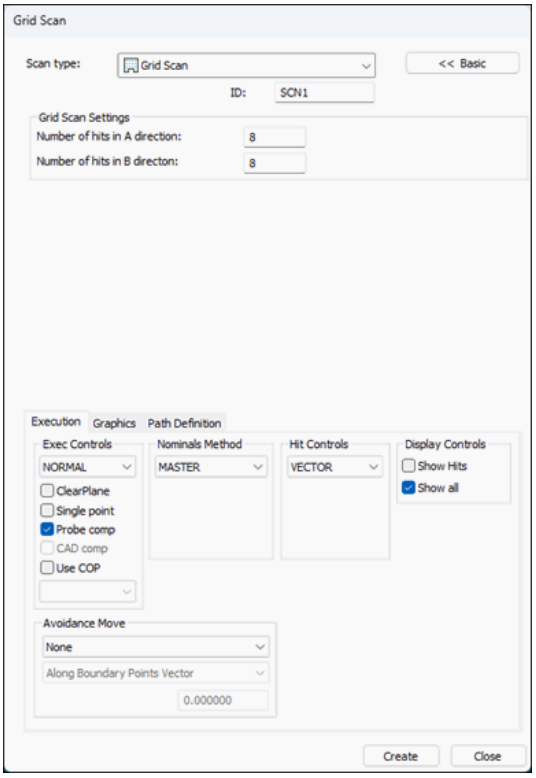
Example of a UV scan with each hit labeled

When PC-DMIS sets up the UV scan using this dialog box, it gets each of the points from the CAD model and uses the nominal data for each point.

To Create a UV Scan

To create a UV scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

Performing a Grid Advanced Scan



Grid Scan dialog box

The Grid scan, similar to the UV scan, enables you to create a grid of points within a visible rectangle and then project those points onto any selected surfaces. While both the UV and Grid scan construct and space points within a selected area, they differ in how the points are defined. UV scans use the UV space as defined by the CAD model. You can

use the Grid scan to create a grid on the current CAD orientation and then project the points onto the CAD surface.

Consider these two figures:

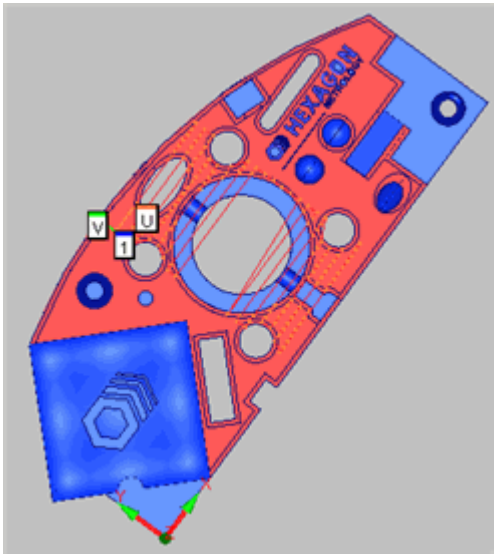


Figure 1 - UV scan on 2D rotated part

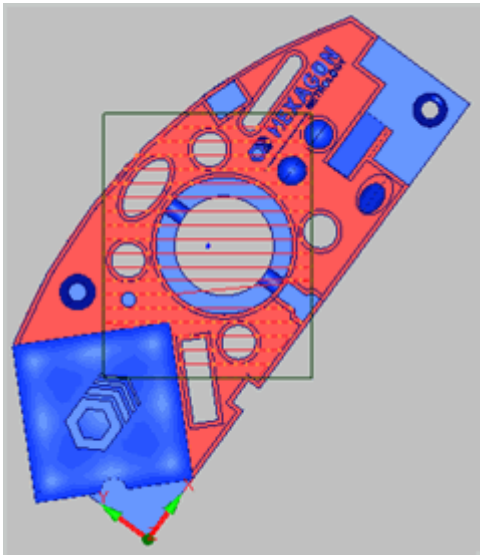


Figure 2 - Grid scan on 2D rotated part

Figure 1 shows a UV scan on the top surface of a 2D rotated sample block.

Figure 2 shows the same block with a Grid scan.

In Figure 1, notice how the UV axes align with the XY axes of the selected surface. The Grid scan, however, does not align. Instead, the points remain aligned with the rectangle view. The Grid scan projects the points onto the selected surface or surfaces, regardless of the part's orientation.

To Create a Grid Scan

To create a Grid scan, see the "Creating the Advanced Scan" topic in the PC-DMIS CMM documentation.

Creating the Advanced Scan

These are the advanced scans available from the **Insert | Scan** menu: Linear Open, Linear Closed, Patch, Perimeter, Section, Rotary, UV, Freeform, Grid, and Section Cut.

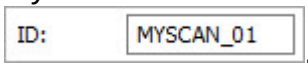
To create one of these scans, follow the steps below.

Note on creating Perimeter Scans

The procedure for creating an exterior or interior Perimeter scan is the same.

Step 1: Initial Setup

For Linear Open scans, you can use the REVO five-axis continuous scanning sensor. For details and how to configure your system to use the REVO sensor, see the "Using the REVO Continuous Scanning Sensor" section of the "Performing a Linear Open Advanced Scan" topic in the PC-DMIS CMM documentation.

1. Ensure that you have a TTP or analog probe enabled in your measurement routine.
2. From the **Probe Mode** or **QuickMeasure** toolbar (**View | Toolbars**), select the **DCC Mode** button  to place PC-DMIS into DCC Mode.
3. From the **Insert | Scan** menu, select the appropriate scan type to open its dialog box.
4. If you want to use a custom name, type the name of the scan in the ID box 

.
5. For UV and Grid scans:

   From the **Operation | Graphic Display Window** menu option or from the **Graphic Modes** toolbar (**View | Toolbars**), select the **Draw Surfaces** button  . This allows you to display the CAD surfaces in the Graphic Display window. For details, see the Drawing Surfaces topic in the PC-DMIS Core documentation.

Step 2: Define the Top Section Options

Depending on the type of advanced scan, PC-DMIS provides different sections at the top of the scan dialog box. From the sub-topics below, see a description of the settings required for the selected scan type.

Direction 1 Tech and Direction 2 Tech Area Descriptions

Direction 1 Tech Area

The **Direction 1 Tech** area is available for these scan types:

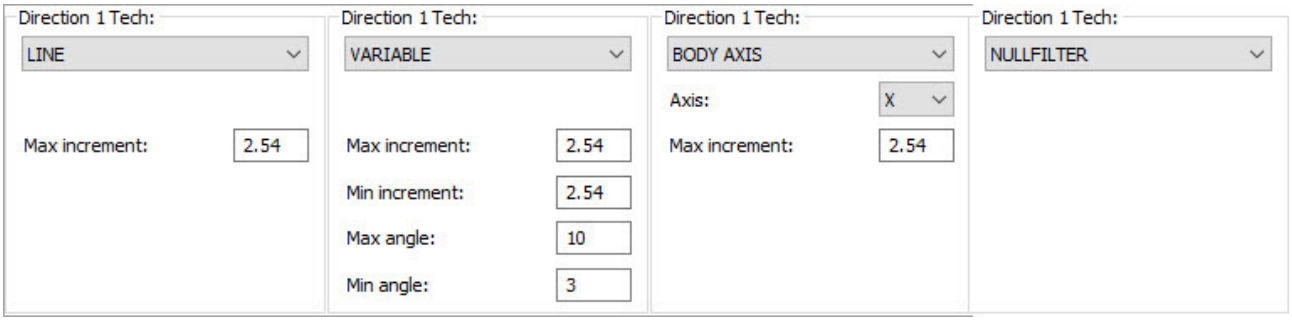
- Linear Open scan
- Linear Closed scan
- Patch scan
- Section scan
- Rotary scan

From the **Direction 1 Tech** list, select a technique for the direction as shown below.



The options in the list are based on the selected scan type.

Depending on the technique you select, type the appropriate values into the **Axis**, **Max increment**, **Min increment**, **Max angle**, and **Min angle** boxes.



Direction 2 Tech Area

The **Direction 2 Tech** area is only available for the Patch scan.

If you selected the Patch scan, PC-DMIS shows the **Direction 2 Tech** list. From the **Direction 2 Tech** list, select a technique for the second direction.

Similar to the **Direction 1 Tech** listing, depending on the technique you select, type the appropriate values into the **Axis**, **Max increment**, **Min increment**, **Max angle**, and **Min angle** boxes.

Note that if you select the **BODY AXIS** technique type for the **Direction 1 Tech** settings, you must also select it for the **Direction 2 Tech** setting.

Scan Construction Area Description for Perimeter Scans

Locate the Scan Construction area at the top of the dialog box and set these options:

1. Type the desired values into the **Increment**, **CAD tolerance**, **Offset**, and **Offset tolerance (+/-)** boxes.

2. After you define your points (1, D, 2, etc.), click the **Calculate Boundary** button to calculate the boundary that PC-DMIS uses to create the scan. The orange dots on the boundary indicate where PC-DMIS takes the hits during the scan.

The boundary calculation process is usually quick.

If the boundary does not look correct:

a. From the **Scan Construction** area, click the **Delete** button to remove the boundary and allow a new one to be created.



b. Adjust the CAD tolerance, as an incorrect boundary often indicates the need for a higher CAD tolerance.

c. After you increase the CAD tolerance, click the **Calculate Boundary** button to recalculate the boundary.

d. Ensure the boundary is correct before calculating the Perimeter scan, as calculating the scan path takes significantly longer than recalculating the boundary.

3. Verify that the **Offset** value is correct. Type in the correct value if necessary.

Section Location Description for Section Scans



The Section Location area is only available for the Section scan.

In the **Section Location** area, do the following:

- From the **Axis** list, select the axis along which you want subsequent Section scans to increment.
- Type the location value for that axis to set it for all the boundary points.
- Type the increment value in the **Increment** box. This value determines how far PC-DMIS shifts the scan when you click the **Create** button.



Suppose for your Section scan, you use a value of 10, an **Axis** of X, and an increment value of 1.0. The scan starts at ten units along the X axis and increments along the X axis every one unit in the +X direction once you click the **Create** button.

Select Center Area for Rotary Scans

> The **Select Center** area is only available for the Rotary scan.

Perform these steps to define the center point and radius for the rotary scan:

1. Define the center point for the rotary scan in one of these ways:
   - Select the **Select Center** check box located below the **Direction 1 Tech** area, and then click a point on the CAD model.
   - Manually type the circle's center location into the **X, Y, Z, I, J,** and **K** boxes.
2. Type a radius value for the rotary scan in the **R** box. Once you define the radius value, PC-DMIS draws the location of the scan on the CAD model in the Graphic Display window.
3. Verify that the scan's XYZ center and IJK information are correct.
4. Clear the **Select Center** check box.

Step 3: Select the Surfaces and Points

You now need to define the surfaces and points for your scan. To define the surfaces and points for UV and Grid scans, see the "For UV Scans" or the "For Grid Scans" sections below.

> For Linear Open scans, follow the appropriate steps below to define the points and surfaces. PC-DMIS uses the points to scan a surface along an open-ended line.

For most scans, you can define points by following one of the methods discussed in the "Boundary Points area" topic in the PC-DMIS Core documentation. This procedure uses the **CAD Data** method, and you click on CAD surfaces to define the points.

1. From the **Boundary Points** area, under the # column, click the **1** to select the initial point.
2. Click a location on the surface that you want to start your scan. PC-DMIS selects the surface and labels this starting point with a "1". In the **Boundary Points** area, PC-DMIS automatically selects the next boundary point, the **D**.
3. Click a location on the surface for the second point. This is the Direction point. PC-DMIS labels this point with a "D". It tells PC-DMIS the direction to begin the scan.

4. If required, click to define a third point. PC-DMIS labels this point with a "2". This tells PC-DMIS the location of the end point. For the Patch scan, this defines the end point of the first line.



PC-DMIS automatically provides an end point. If you do not want to use this point, delete it. To delete it, select #2 in the **Boundary Points** list and click the **Delete** button. You then need to repeat Step 4 to regenerate the point.



For Rotary scans, this point selects a curve to scan. If you wish to scan the entire circumference, delete point "2".

For Linear Closed scans, the scan comes back to the starting point, so you only need to define the "1" and "D" points.

For Patch scans, perform steps 5-7:

5. Click a fourth point. PC-DMIS labels this point with a "3". This point defines the minimum area of the scan.

6. Click a fifth point. PC-DMIS labels this point with a "4". This final point defines a rough rectangular area for the scan.

7. Click additional points to fine-tune the boundary of the scan.

8. For Section scans, from the **Boundary Points** area, click the **Cut CAD** button. The **Show Cut** button's name changes to **Show Bnd**. This divides the scan into subsections and displays the locations that PC-DMIS skips due to obstructions, such as holes, along the surface. You can also click the **Show Bnd** button to display the boundary points.

If your scan crosses multiple surfaces or you need to select multiple surfaces to define the boundary for the scan (Perimeter scans, for example), from the **Graphics** tab at the bottom of the dialog box, mark the **Select** check box and select the necessary surfaces. For details, see the "Graphics Tab" topic in the PC-DMIS Core documentation. Choose the surfaces in the order the scan should traverse them.



Once you select the required surfaces, make sure you clear the **Select** check box.

For scans with start and end points, if you want to scan all the surfaces between the start and end points, you do not need to manually select each surface. You can have PC-DMIS automatically scan across all those surfaces like this:

1. After you select points 1, D, and, if necessary, 2, navigate to the **CAD Controls** section of the **Graphics** tab.

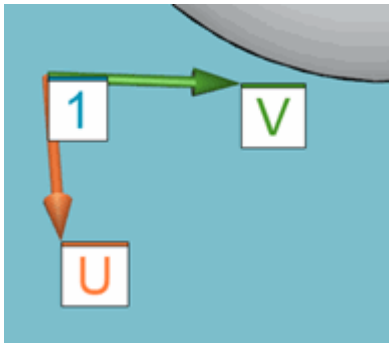
2. Since PC-DMIS selects the surfaces that you click on to create the 1, D, and 2 points, you must mark the **Select** check box, then click **Deselect All** to deselect any selected surfaces. This way, when you click the **Generate** button later in this procedure, PC-DMIS automatically generates the scan across all surfaces between the start and end points.

For UV scans

To select the surface and points for UV Advanced scans, follow these steps:

1. From the **Graphics** tab at the bottom of the dialog box, click the **Select** check box.

2. Click the surface to scan. PC-DMIS highlights the selected surface and displays a U and V on the CAD model, which indicates the direction of each axis.



3. From the **Graphics** tab, clear the **Select** check box.

4. From the **Start** column in the **UV Scan Settings** area, click the **CAD Click** check box.

5. Click a location on the selected surface that you want to start your scan. This location indicates the UV scan's start point and also defines the first corner of the rectangular scan area.

> The UV scan supports the scanning of multiple surfaces. To scan multiple surfaces, click each surface in the order you want them scanned. PC-DMIS displays a number to indicate the surface number along with U and V direction arrows. During execution, PC-DMIS executes the UV scan on the first surface, then the second surface, and so on.

After you click a location, PC-DMIS automatically selects the **CAD Click** check box in the **End** column of the **UV Scan Settings** area.

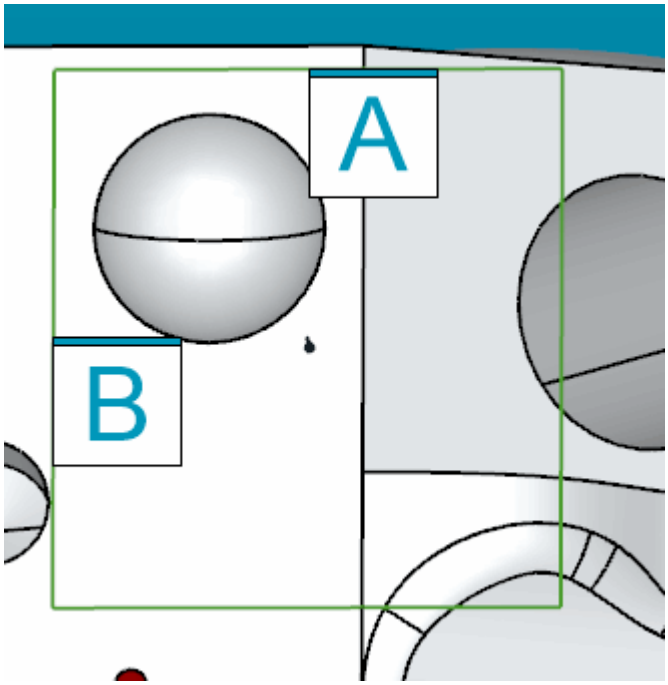
6. Click a second point on the selected surface to set the scan's end point. PC-DMIS displays U and V indicators on the CAD model. This defines the second corner of the rectangular scan area.

PC-DMIS automatically determines the start and end positions along both the U and V axes based on the points you clicked. You can change the scan direction by switching the Start and End values in the **U** and **V** rows. The UV space uses values between 0.0 and 1.0 to represent the entire surface. Typically, 0.0, 0.0 is the opposite diagonal corner from 1.0, 1.0. However, trimmed surfaces may start at a value greater than 0.0 and end with a value less than 1.0 in both the U and V directions.

For Grid scans

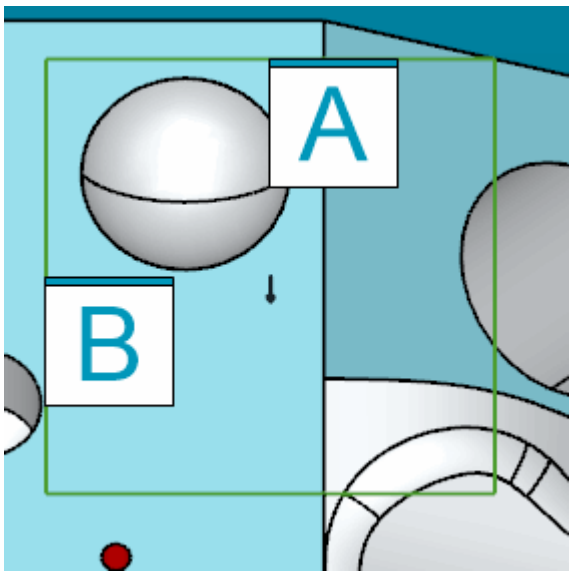
To select the surface and points for Grid Advanced scans, follow these steps:

1. Click and drag a rectangle in the Graphic Display window over the surface or surfaces you want to include in your scan. This rectangle defines the boundary of the grid, which PC-DMIS displays onto the CAD surface(s).



Example of a rectangle over multiple surfaces

2. From the **Graphics** tab, mark the **Select** check box.
3. Click the surface or surfaces to scan. PC-DMIS highlights the surfaces as you select them.



Example of selected surfaces, highlighted in blue

4. In the **Grid Scan Settings** area, type the values into the **Number of hits in A direction** and **Number of hits in B direction** boxes. PC-DMIS adds the hits onto the selected surface(s).

Step 4: Define the Initial Vectors Area

Update the **Initial Vector** area.

The **Initial Vector** area is only available in these scan types:

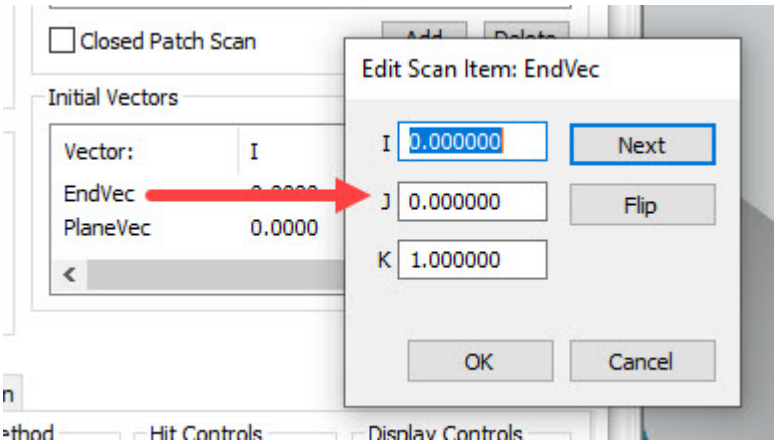
- Linear Open
- Linear Closed
- Patch
- Section
- Rotary

Make any needed changes to the vectors in the **Initial Vectors** area. To do this:

1. Double-click the vector label in the **Initial Vectors** area.
2. Make any changes to the **Edit Scan Item** dialog box.
3. Optionally, click the **Flip** button to change the direction of all the vectors.

4. Click **OK** to return to the scan dialog box.

For example, to edit the **EndVec** vector settings in the **Initial Vectors** area, double-click the **EndVec** label to open the **Edit Scan Item: EndVec** dialog box.



Edit the vector values as described above. You can then click the **Next** button to edit the next set of vectors (**CutVec**, **DirVec**, or **PlaneVec** depending on the scan type) as needed.

Step 5: Define the Options on the Bottom Tabs

Use the tabs on the bottom half of the scan dialog box to perform these steps:

> The available tabs depend on the selected scan type or hardware defined in your measurement routine. For example, PC-DMIS only shows the **Controls Point** tab for advanced scans when your active probe is an analog probe. You should use the following tab descriptions as a guide since not all tabs or options within tabs are relevant or necessary for every scan type.

1. From the **Execution** tab:

   > For details on the options available in the **Execution** tab, see the "Execution Tab" topic in the "Scanning Your Part" chapter of the PC-DMIS Core documentation.

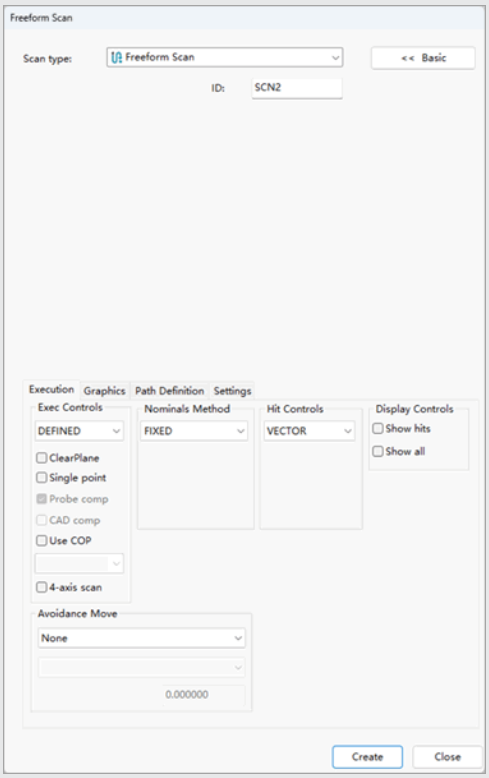
   a. Locate the **Exec Controls** area and select the appropriate execution mode from the **Exec Controls** list.

   b. If needed, select any of the check boxes in the **Exec Controls** area.

   c. Locate the list in the **Nominals Method** area and select the appropriate nominals mode to use for your scan. If you selected NOMINALS or the FINDNOMS method type from the list in the **Nominals Method** area, then in

the **Tolerance** box, type a tolerance value that at least compensates for the probe's radius.

The Freeform scan has another option called FIXED that you can select from the **Nominals Method** list. When you select this option, the theoretical path remains unchanged after you execute your measurement routine. PC-DMIS calculates the deviation of each theoretical point based on the actual scan path returned from the controller.



d. Locate the **Hit Controls** area and select the type of hits to take from the list.

   - For interior Perimeter scans, select the **Inner Bound** check box.
   - For some scans, such as the Grid, Rotary, Section, and UV scans, you can select either the **VECTOR** or **SURFACE** option.

e. If needed, select any of the check boxes from the other areas on this tab.

2. If you are using a thin part, select the **Graphics** tab and, in the **Thickness** box, type the part's thickness.
3. For a Rotary Scan, if your measurement routine uses an analog probe, you can use the **Control Points** tab to run your scan optimally.

Step 6: Generate and Review the Scan Path

Use the **Path Definitions** tab on the bottom half of the scan dialog box to generate your scan path.

For details on the various options on the **Path Definitions** tab, see the "Path Definition Tab" topic in the "Scanning Your Part" chapter of the PC-DMIS Core documentation.

1. From the **Path Definitions** tab, locate the **Theoretical Path** area and click the **Generate** button to generate the points for the scan's theoretical pathway on the CAD model in the Graphic Display window. PC-DMIS displays the points to be taken on the CAD model. If you marked the **Jump holes** check box, PC-DMIS automatically skips any obstructing holes along the surface.

Note on defining the path for Freeform scans

You can define the path of the scan using one of these methods:

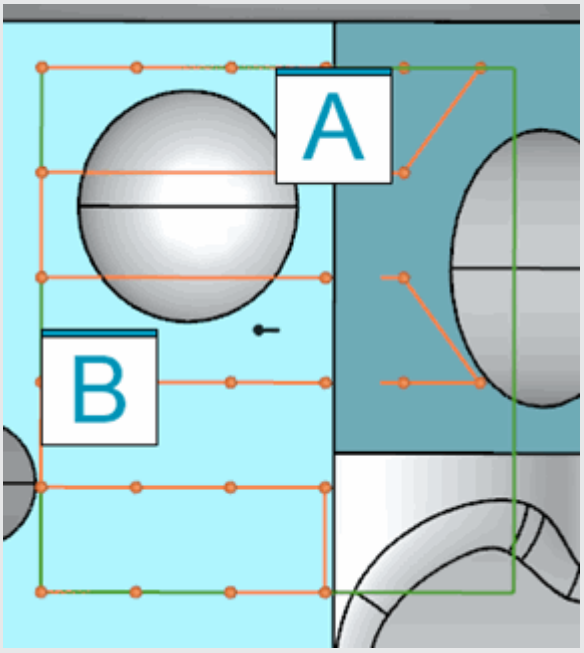
a. You can manually add hits to the **Theoretical Path** box. To do this, click on the surface of the part in the Graphic Display window. Each click adds an orange point to the CAD model, and PC-DMIS adds the point's definition in the **Theoretical Path** area.

b. You can use the **Read File** button to read the hits from a file. For details, see the description of the **Read File** button in the "Theoretical Path Area" topic in the PC-DMIS Core documentation.

Once you have five or more points, PC-DMIS enables the **Calculate** button in the **Spline Path** area.

Note on how points are drawn on selected surfaces for Grid scans

PC-DMIS draws the points only on the selected surfaces. It does not draw points on any unselected surfaces, even if the boundary of the rectangle includes the surfaces.



Example of points on the selected surfaces

When you generate the scan's pathway, PC-DMIS starts the scan at the start point (1) and follows the chosen direction (D) until it either returns to the start point (1), reaches the end point (2), or it reaches the boundary point. This depends on the

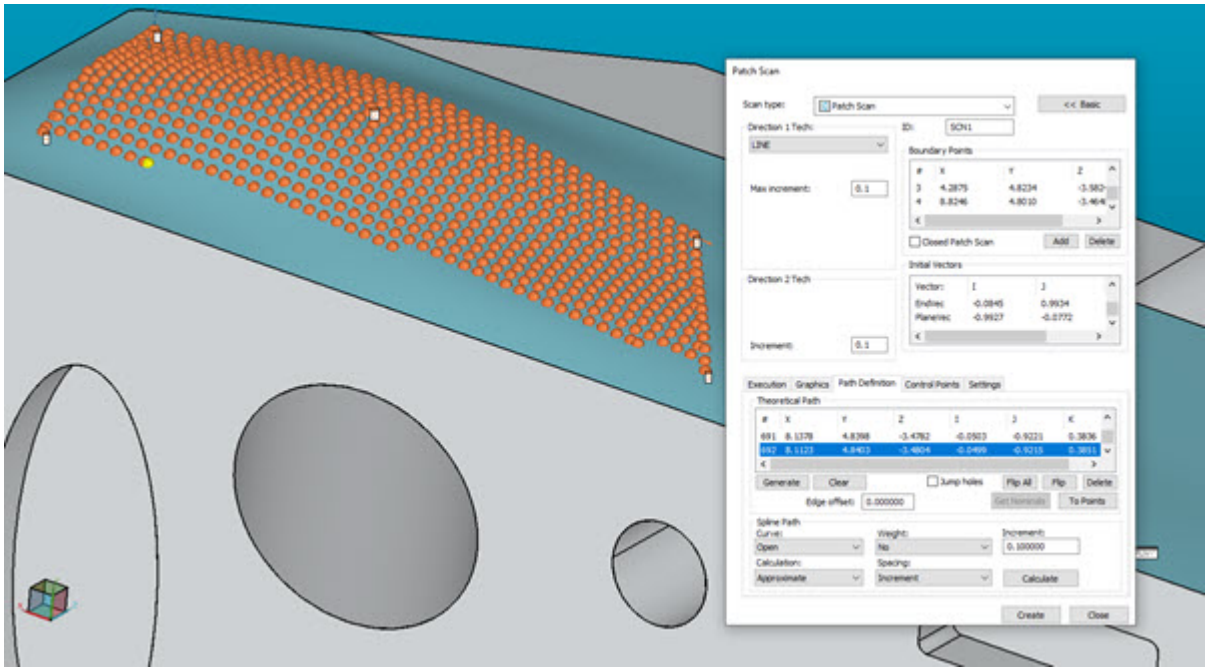
scan type. For scan types that have boundary points defined (Patch Scan, for example), the scan then moves back and forth, scanning in rows along the chosen area at the specified increment value, until it finishes the process.

This process uses a time-intensive algorithm, and the computation time depends on the complexity of the selected surfaces and the number of points being calculated. Because of this, for scans with a large number of surfaces to scan, the complexity of the surfaces, and if there are many thousands of points to scan, you can expect a wait time of up to five minutes.

> For many advanced scans, such as the Patch scan, PC-DMIS uses the increment values to determine the spacing of the generated points used in the pathway. If you want fewer points, increase the increment values. For more points, decrease the increment values.

2. If needed, you can delete individual generated points. To do this, select them one at a time from the **Theoretical Path** area and press the Delete key or click the **Delete** button.

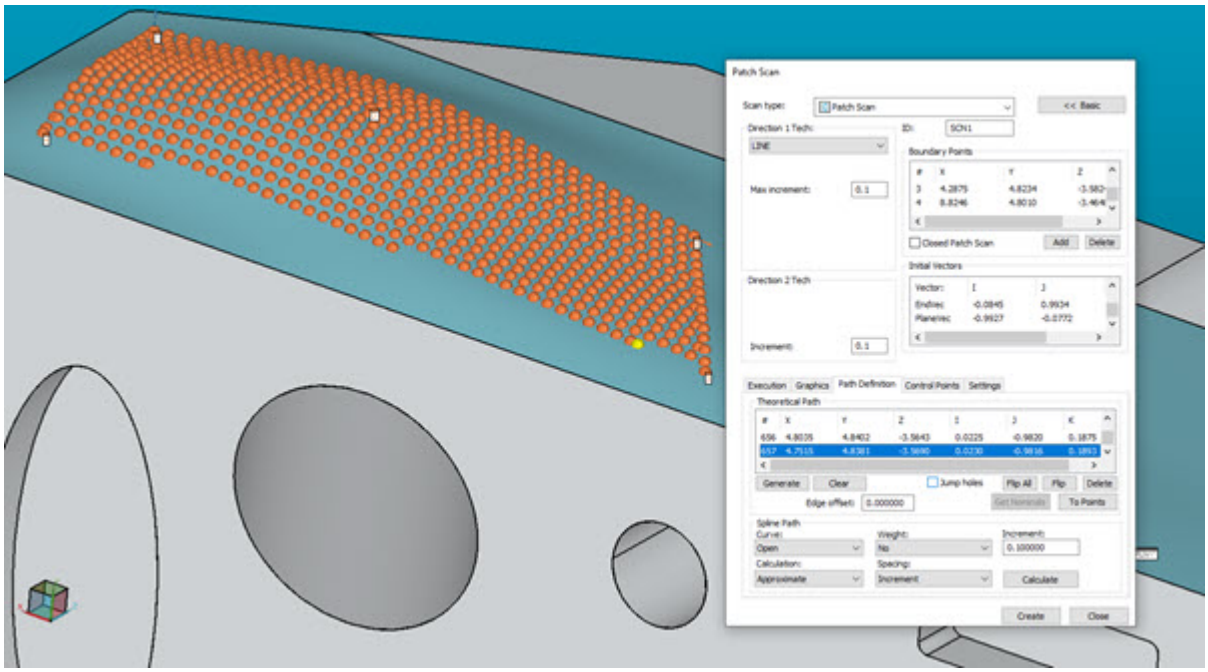
   For example, consider the scan shown below. After PC-DMIS completes the final scan row, the last point (#692 in the **Theoretical Path** listing) is highlighted in yellow while the other points are orange.



   Select one of the points in the **Theoretical Path** listing as a start. Use the up and down arrow keys on your keyboard to move through the scan points until you reach the point of interest. You can see the selected points turn yellow in the Graphic Display window as you move through the listing.

   In the next image, point #657 is the selected point in the **Theoretical Path** listing and its associated point in the Graphic Display window is highlighted in yellow.

If you have a lot of points, one way to locate a desired point more quickly is to select any point in your **Theoretical Path** and then hold your Up Arrow or Down Arrow key on your keyboard to quickly cycle up or down through the list of points until PC-DMIS highlights the desired point in the Graphic Display window. You can also hold down the Shift key when you do this to highlight a range of points.



When you highlight the point (or points) you want to remove, press the Delete key or click the **Delete** button. PC-DMIS removes the point (or points) from the list and from the Graphic Display window.

3. To create a smoother path for the probe to follow, select the options in the **Spline Path** area of the **Path Definition** tab and then click the **Calculate** button. This generates a spline curve along the theoretical points and recalculates the points in the **Theoretical Path** area.

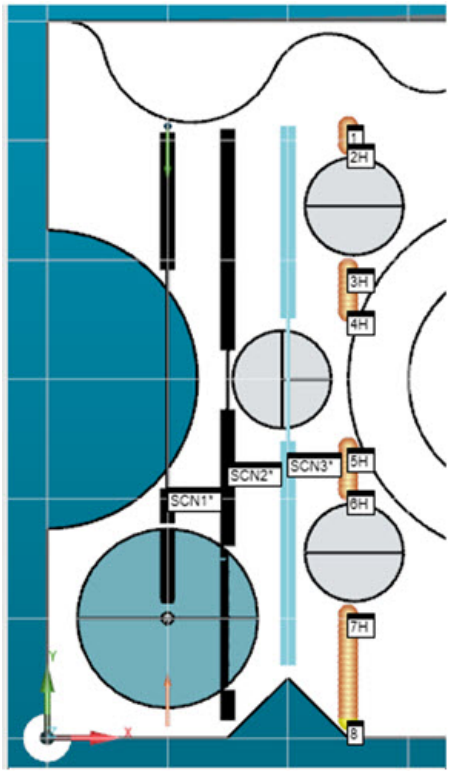
4. Some scan types provide a **Settings** tab, such as the Freeform scan. If this is available, review the default settings in the **Scan Probing Parameters** section and make any necessary changes for your scan. For details on the options in this tab, see the "Settings Tab" topic in the "Scanning Your Part" chapter of the PC-DMIS Core documentation.

Step 7: Review and Generate the Scan

Review the updates you made in the dialog box and make any additional changes to your scan settings as needed.

When done, click the **Create** button. PC-DMIS inserts the scan into the Edit window and displays the probe's path on the CAD model in the Graphic Display window.

For the Section scan, after you click the **Create** button, the **Section Scan** dialog box sets up a new scan along the axis defined by the **Increment** value. You can continue to click the **Create** button to generate multiple Section scans along the selected axis. For example, in the image below, the orange points indicate the fourth Section scan about to be created along the X axis at an **Increment** value of 1 unit each:



Example of a fourth Section scan with an Increment value of 1 along the X axis

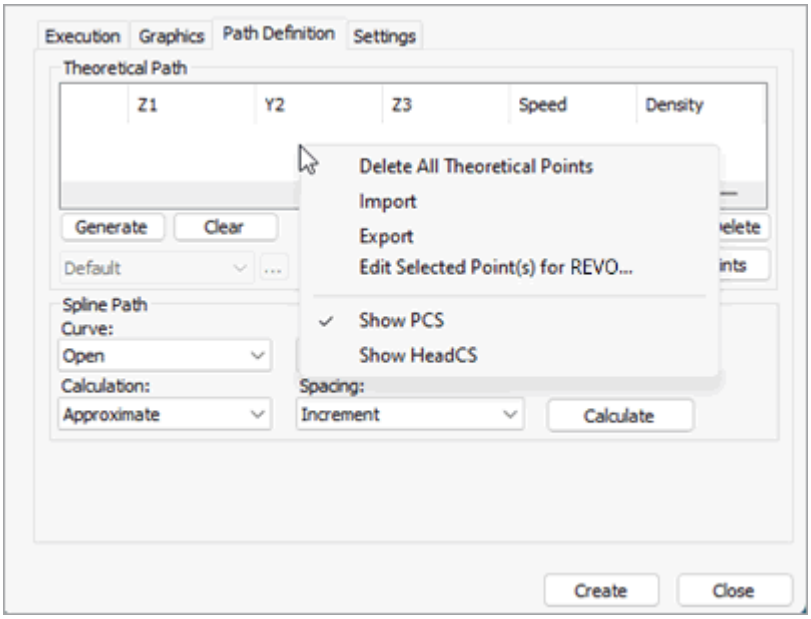
For some scans (Freeform scans for example), if the PC-DMIS AutoWrist method is enabled but no calibrated tips are available, PC-DMIS displays a message when it adds new probe tips that require calibration. In all other cases, PC-DMIS asks you whether it should use the closest calibrated tip for the required tip angle or to add a new, non-calibrated tip at the required angle.

Using the REVO Continuous Scanning Sensor

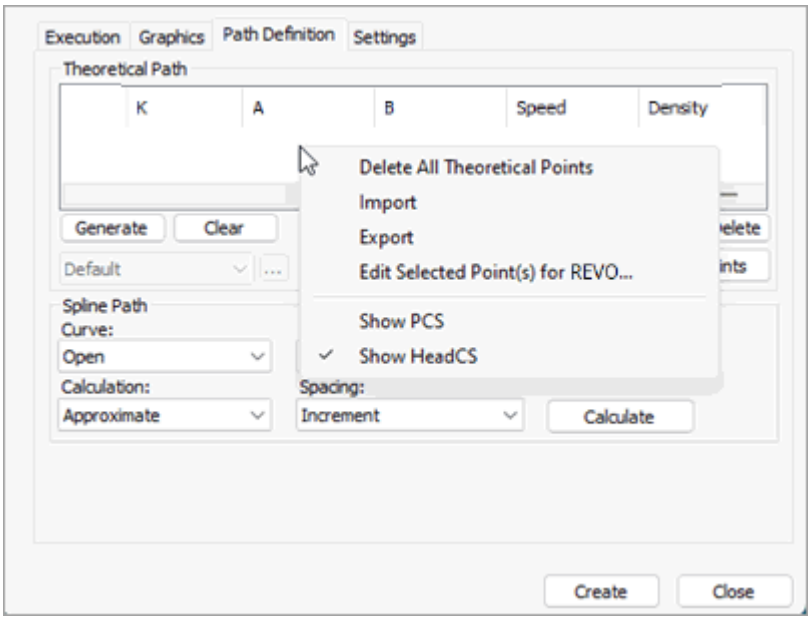
The REVO five-axis continuous scanning sensor only works with the Linear Open scan. It offers several advanced features compared to the traditional Linear Open scan used in conventional scanning probes.

For example, in addition to the standard display of the X, Y, Z, I, J, K, and scanning points, the interface now includes options for probe angles, speed, and density of scanning points. You can view the probe angles in either the default PCS format or in the HeadCS format.

To switch between them, right-click anywhere in the **Theoretical Path** display area to open a menu that lists the available options.



Theoretical Path - Show PCS format



Theoretical Path - Show HeadCS format

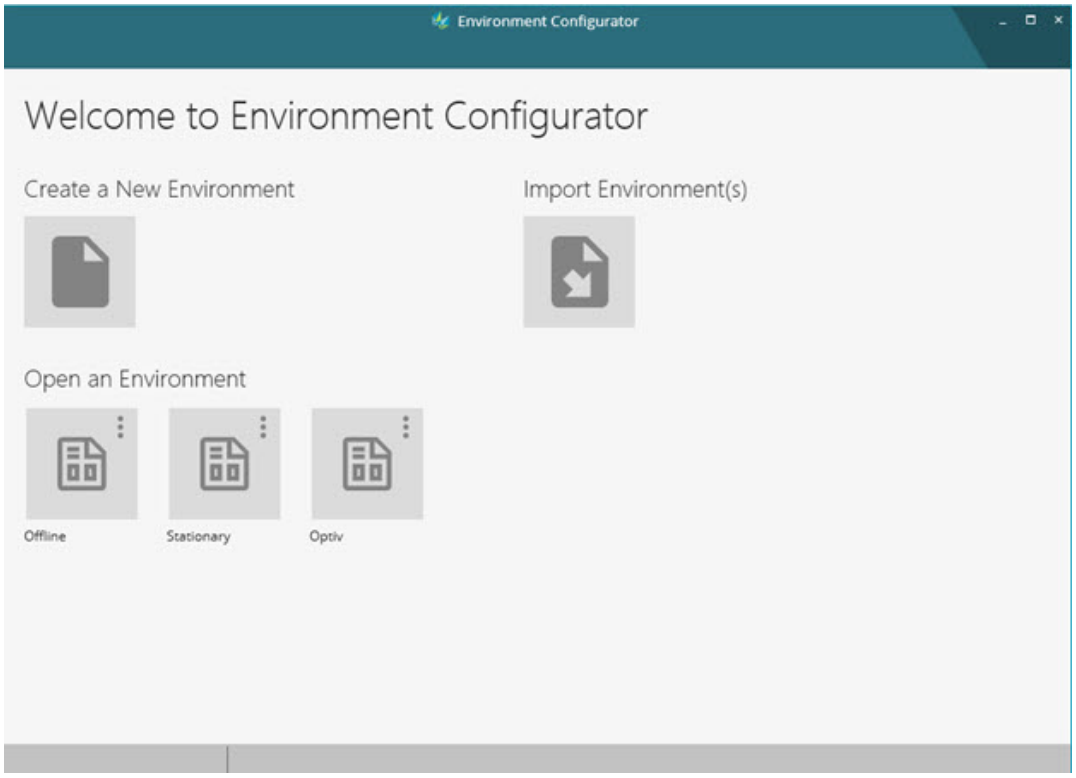
Configuring the REVO Continuous Scanning Sensor

Step 1: Initial Environment Setup

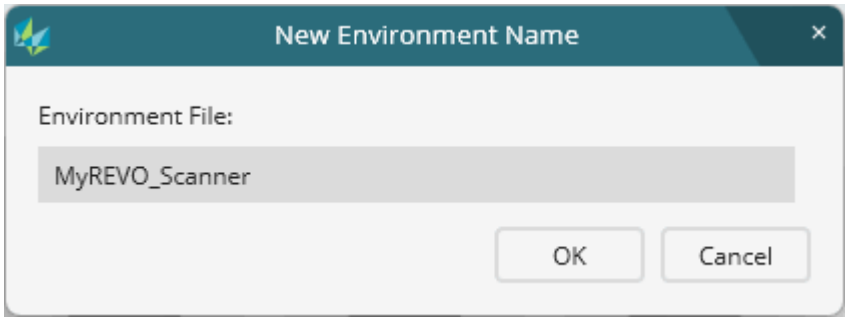
Before you can use the REVO sensor, you must configure the PC-DMIS environment and the sensor so they are properly connected to the UCC server.

To do this, follow these steps:

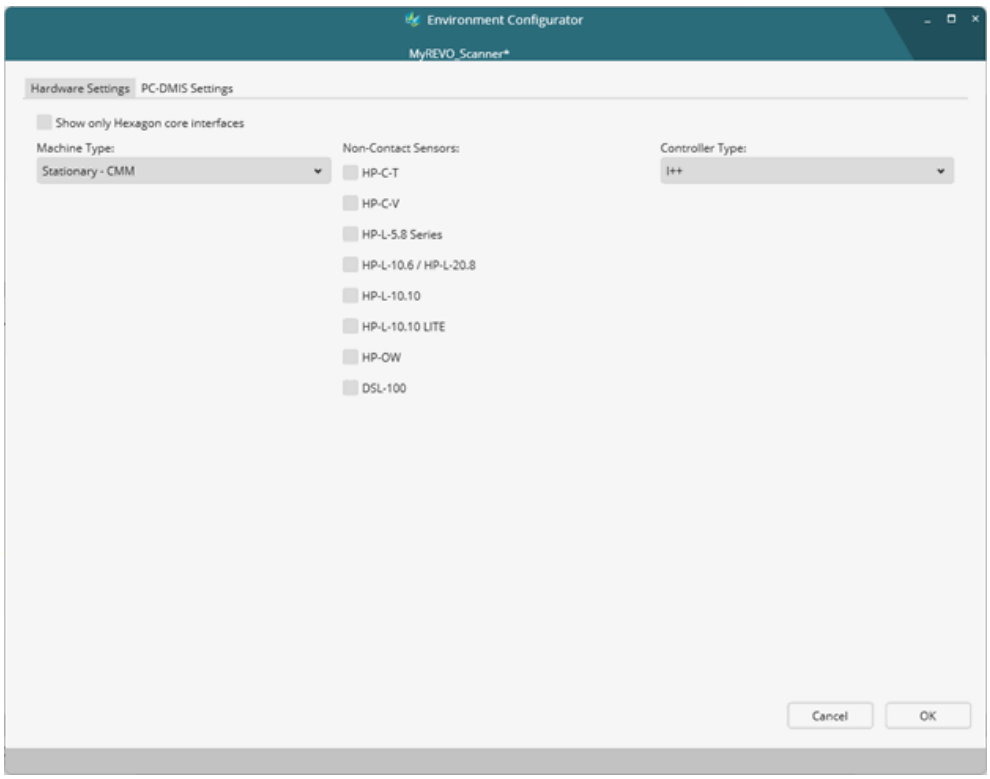
1. From the PC-DMIS Home screen, click **Edit | Create/Edit Environment** to open the **Welcome to Environment Configurator** screen.



2. Click the **Create a New Environment** option to open the **New Environment Name** dialog box.



3. In the **Environment File** box, type a name for your REVO environment configuration file and click the **OK** button.
4. From the **Machine Type** list, select the **Stationary - CMM** option.
5. From the **Controller Type** list, select the **I++** option.



Step 2: Configure the Settings Editor Entry

You now need to configure the `RenishawServer` entry in the Settings Editor application.

To do this, follow these steps:

1. Click the Windows **Start** button and navigate to the PC-DMIS Settings Editor application and run it as administrator.
2. When the Settings Editor application opens, click the **Connect** button.
3. With the Settings Editor application connected, click the **Find** button and search for the `RenishawServer` entry. Change the **Current value** option to **32**.
4. Click the **Save** button and close the Settings Editor application.

Step 3: Configure PC-DMIS to Communicate with the UCC Server

You now need to run the UCC server and configure PC-DMIS to communicate with it.

> For details on the UCC Server, please see the UCC Server Knowledgebase article on the Renishaw website.

To do this, follow these steps:

1. To launch the UCC Server, locate and double-click the UCC Server shortcut. The shortcut is typically found on your computer's desktop.

2. Start up PC-DMIS and, from the PC-DMIS Home screen, open the Environment Configurator (**Edit | Select Environment File**) and select the REVO environment you created in Step 1.

3. Review the probe type defined in the UCC Server application. Make sure the same probe is defined in PC-DMIS. The probes must be identical.

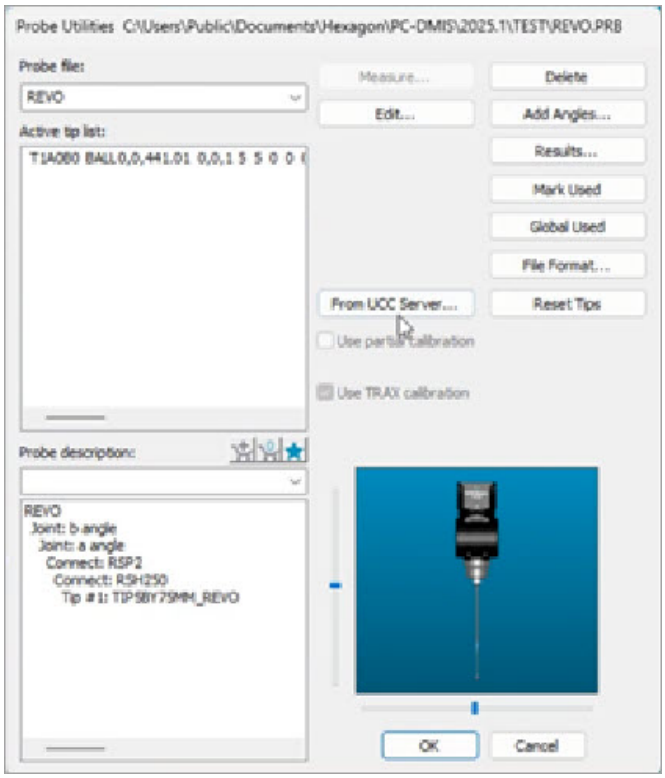
Tool Tip Management

Starting with version 2026.1, PC-DMIS provides you with the new Tool Tip Management feature which retrieves and lists all probe angles that are pre-defined on the UCC Server. This feature also allows you to retrieve and use custom angles in measurement routines that are created within PC-DMIS.

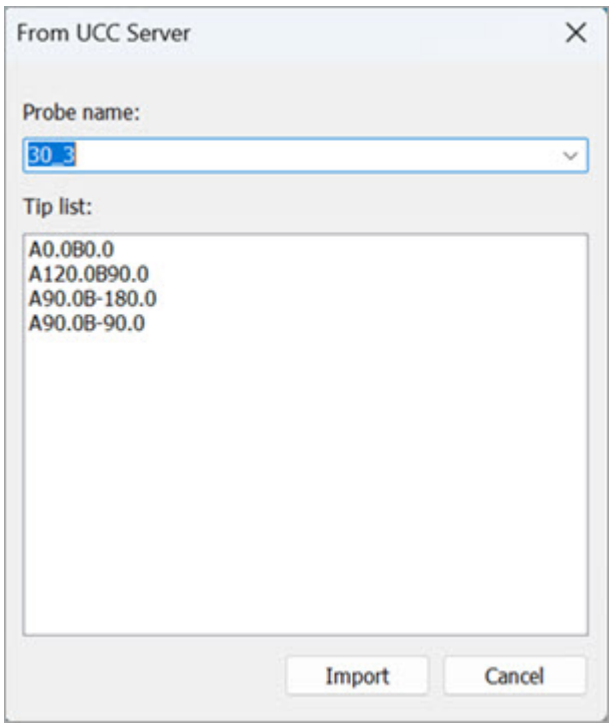
To do this:

1. First, verify that PC-DMIS is connected to the UCC Server. If not, use the procedure above to connect PC-DMIS to the UCC server.

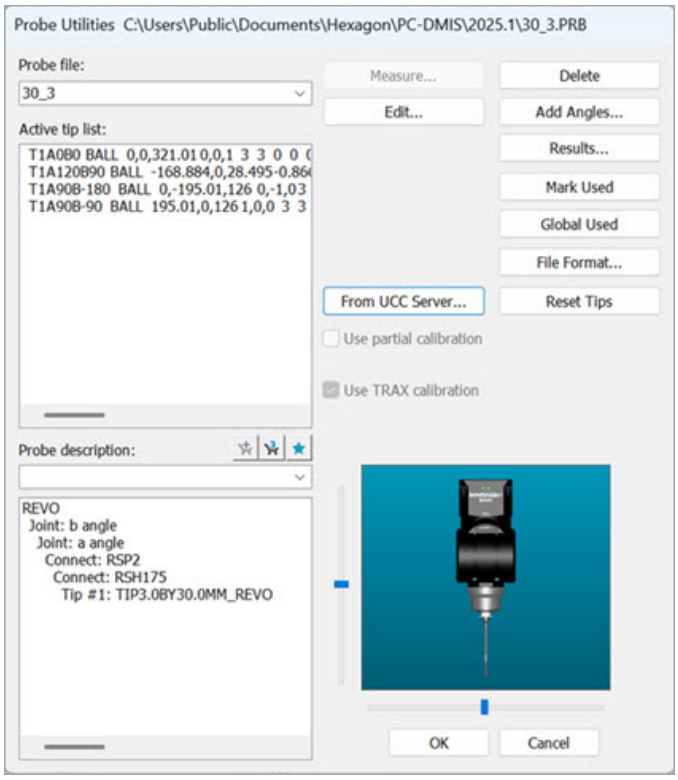
2. Open the **Probe Utilities** dialog box (**Insert | Hardware | Probes**). You can see the **From UCC Server** button is now available.



3. Click the **From UCC Server** button to show the **From UCC Server** dialog box. The dialog box shows all probe components and their corresponding tip angles that PC-DMIS can retrieve from the UCC Server.



4. Click the **Import** button to create a probe in PC-DMIS with the exact same name and components as the probe on the UCC Server. PC-DMIS also imports and adds all the tip angles used.



5. Click **OK** to save the results and insert the new probe configuration into your measurement routine.

Creating a Scan with the REVO Sensor

You can create a scan with the REVO Continuous Scanning sensor for these scan types:

- Linear Open scan
- Linear Closed scan
- Perimeter scan
- Freeform scan

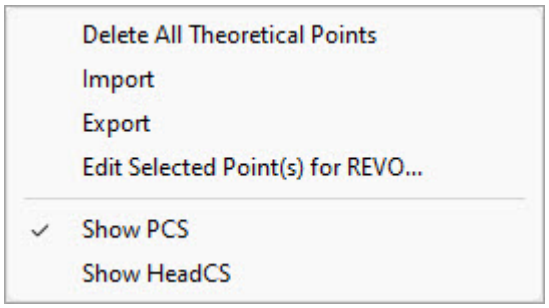


This help topic describes how to create a Linear Open scan using the REVO sensor, but the steps are the same for any of the listed scan types.

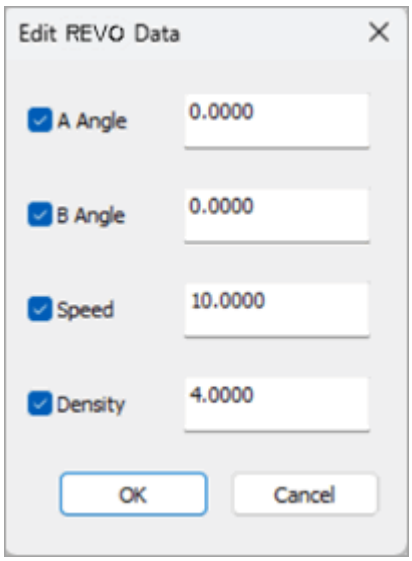
Once your system is set up, from the **Path Definition** tab, click the **Generate** button to create the initial set of scan points.

You can adjust the parameters that are linked to any of the scanned points. To do this, follow these steps:

1. From the **Theoretical Path** area of the **Path Definition** tab, select the points that you want to edit.
2. Right-click any of the selected points to display the **Theoretical Path** menu.

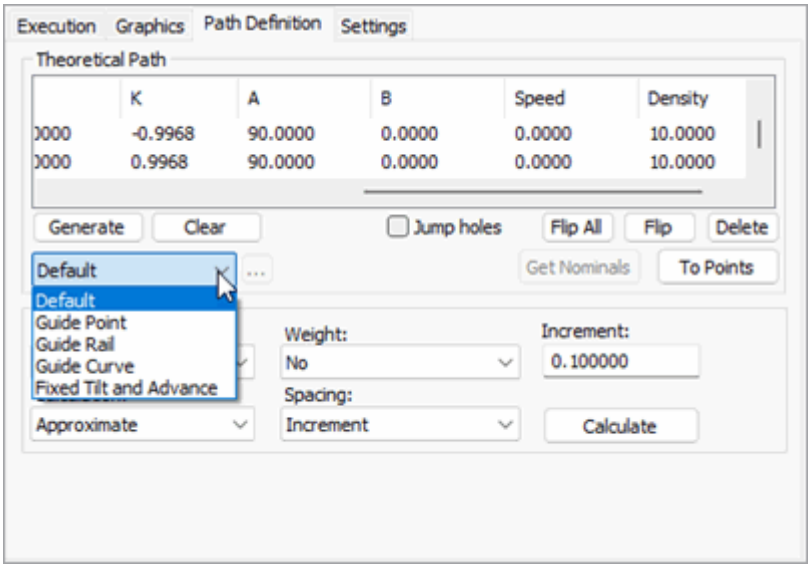


3. From the menu, click the **Edit Selected Point(s) for REVO** option to open the **Edit REVO Data** dialog box.



4. Update the values as needed and click the **OK** button to save the new settings.

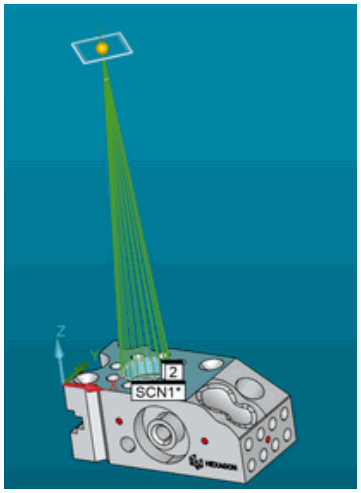
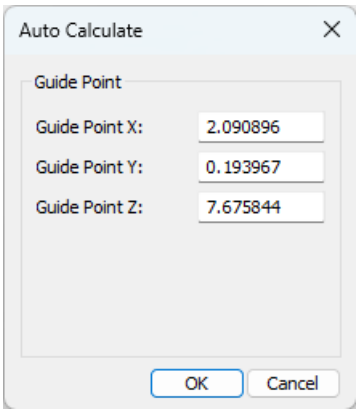
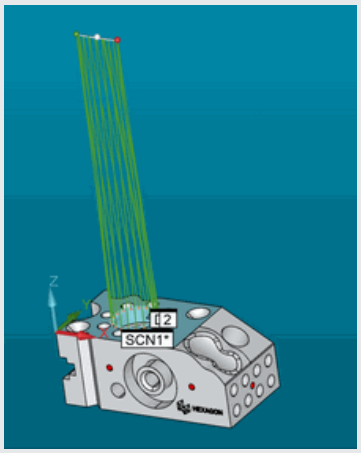
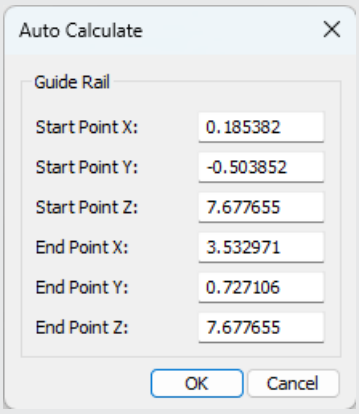
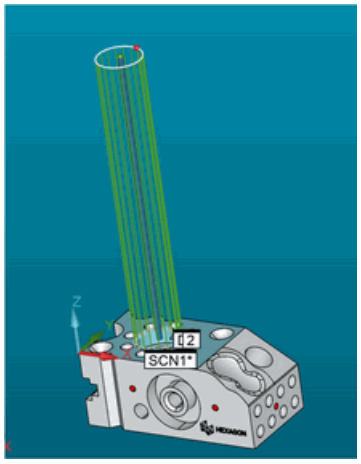
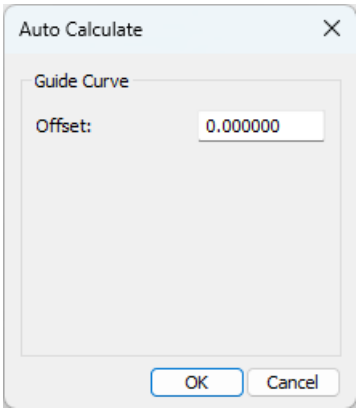
The REVO **Auto Calculate** list of methods provides you with four different methods to automatically compute angles A and B.



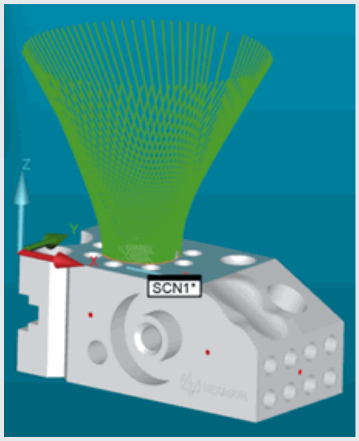
The Path Definition tab of the Linear Open Scan dialog box showing the list of Auto Calculate methods.

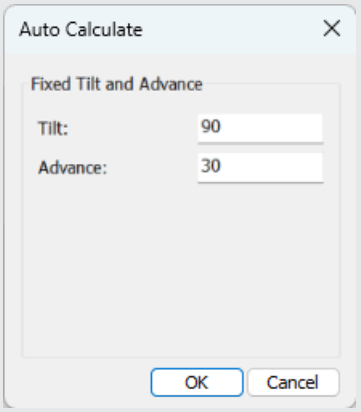
The following table provides descriptions of each of the **Auto Calculate** methods. Click the **Auto Calculate Options** (**...**) button to open the **Auto Calculate** dialog box for the selected method. You can then use the dialog box to adjust the relevant parameters for the selected method.

Description	Example	Auto Calculate Options

Guide Point - This method is established parallel to the plane that contains the curve. When you select this method, you can use the yellow guide point to change the angle and distance of the scan.		
Guide Rail - This method is established parallel to the plane of the curve. When you select this method, you can perform these actions: • Drag the white point to adjust the position of the rail • Drag the red point to stretch the length of the rail • Drag the green point to rotate the rail		
Guide Curve - This method is established parallel to the plane in which the curve resides. When you select this method, you can perform these actions: • Drag the green point to modify the position of the curve • Drag the red point to rotate the curve		

Fixed Tilt and Advance - This method allows for the creation of a path that you cannot drag as in the previous methods. You can use the **Auto Calculate** dialog box to make adjustments to the **Tilt** and **Advance** angle parameters.





The **Advance** angle parameter is an extra angle that is applied to the B angle.

Tilt - This is the angle from the primary (XY) plane of the Point Coordinate System.

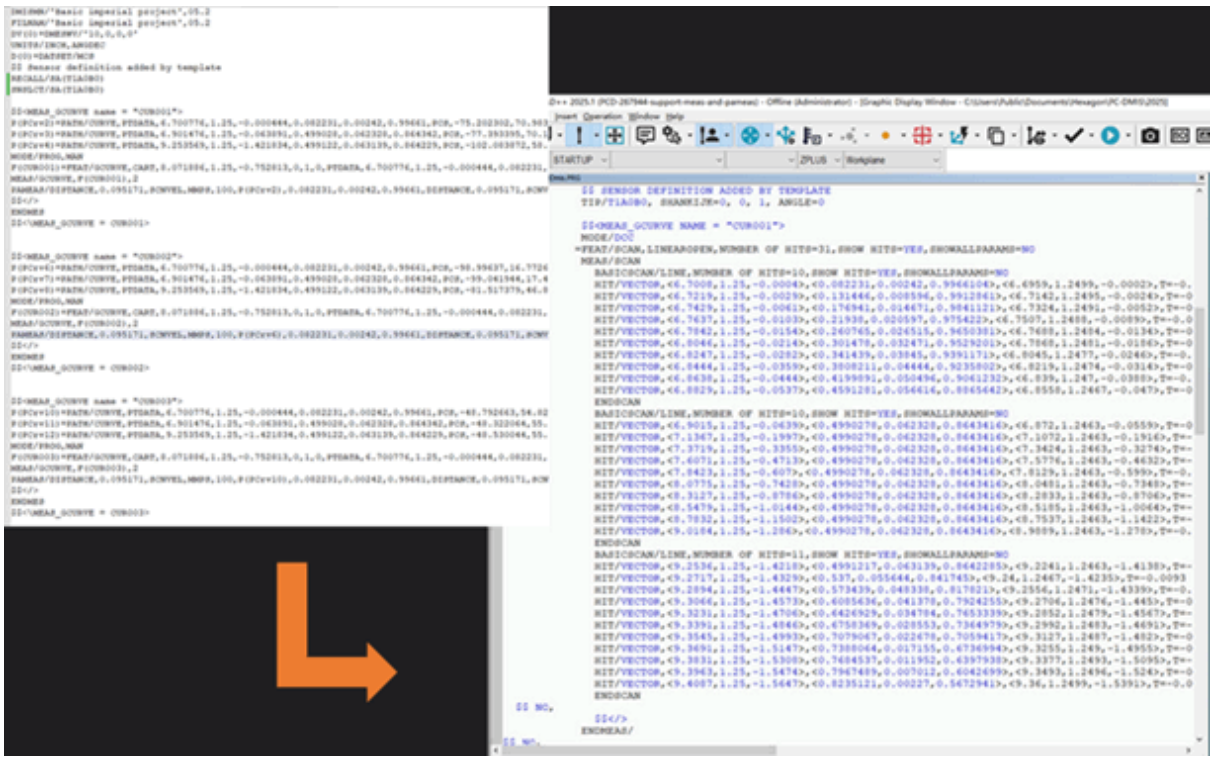
Advance - This is the angle about the Z axis of the Point Coordinate System, following the right-hand rule (counterclockwise about the Z Axis).

You can see below how changes to the value of the **Tilt** angle parameter alters the scan path.

Creating a REVO Scan Through DMIS Import

The REVO sensor provides seamless import of DMIS programs that include these REVO five-axis scanning capabilities:

- Extended the `FEAT/GCURVE` statement
- Improved parsing of the `PATH` statement within DMIS in PC-DMIS
- Enhanced parsing for the `MEAS` and `PAMEAS` statements



The import process is as follows:

1. Create a new PC-DMIS measurement routine.
2. Import the DMIS program (**File | Import | DMIS**).
3. Select a DMIS program.
4. Configure the import settings:
    a. Ensure that the full file path is correct.
    b. Click the **Replace/Merge** button to create the measurement routine.
    c. Select the appropriate arm based on your machine type.
    d. Select the REVO probe file. You can also select the **Create new default probe file** option.
    e. Leave all other options on the remaining two tabs with the default settings.
5. Finalize the import of the DMIS file.

Using the MOVE/ALL Command with the REVO Sensor

The REVO five-axis continuous scanning sensor supports the use of the `MOVE/ALL` command. You can use the command with the REVO sensor to navigate to a designated position and rotate to a specified angle, supporting both the PVS and HeadCS configurations.

```
STARTUP     =ALIGNMENT/START,RECALL:USE_PART_SETUP,LIST=YES
             ALIGNMENT/END
             MODE/MANUAL
             MOVESPEED/ 80
             FORMAT/TEXT,OPTIONS, ,HEADINGS,SYMBOLS, ;NOM,TOL,MEAS,DEV,OUTTOL,
             LOADPROBE/30_3
             MODE/DCC
SCN1        =FEAT/SCAN,LINEAROPEN,NUMBER OF HITS=10,SHOW HITS=NO,SHOWALLPARAMS
             MEAS/SCAN
               BASICSCAN/LINE,NUMBER OF HITS=10,SHOW HITS=NO,SHOWALLPARAMS=NO
               ENDSCAN
             ENDMEAS/
             MOVE/ALL,<0,0,0>,HEADCS,0,0
                                END OF MEASUREMENT FOR
```

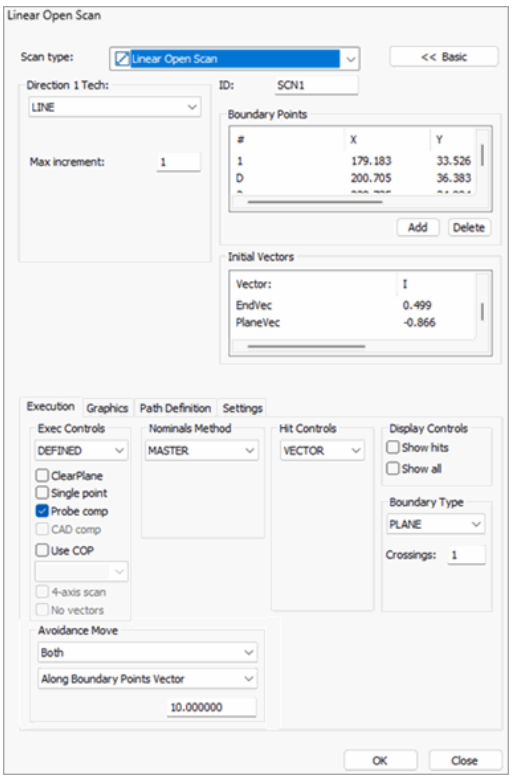


Example using the MOVE/ALL command with the REVO sensor.

To use the `MOVE/ALL` command with the REVO sensor, you must set the `UseWrist` entry in the PC-DMIS Settings Editor application to **True**.

Using Continuous Wrist Probes

PC-DMIS provides an updated version of the **Avoidance Move** function which is more suitable for 5-axis scanning when you use a REVO sensor.



When you enable the **Avoidance Move** option and a REVO sensor is your currently active probe in your measurement routine, PC-DMIS inserts a new `MOVE/ALL` command. Where PC-DMIS inserts the command depends on the option that you select from the **Avoidance Move** type list:

- If you select the **Before** or **Both** option from the **Avoidance Move** type list, PC-DMIS inserts the `MOVE/ALL` command for the first scan tip angle prior to the scan command.
- If you select the **After** or **Both** option from the **Avoidance Move** type list, PC-DMIS inserts the `MOVE/ALL` command with the last scan tip angle after the scan command.

A typical scan command using the **Avoidance Move** option with the **Both** option selected would look like this in the Edit window:

```
            MOVE/ALL,<179.183,34.978,7.95>,HEADCS,30,-87
SCN1       =FEAT/SCAN,LINEAROPEN,NUMBER OF HITS=59,SHOW HITS=NO,SHOWALLPARAMS=NO
            MEAS/SCAN
              BASICSCAN/LINE,NUMBER OF HITS=59,SHOW HITS=NO,SHOWALLPARAMS=NO
              ENDSCAN
            ENDMEAS/
            MOVE/ALL,<228.725,32.984,-22.444>,HEADCS,30,-87
```

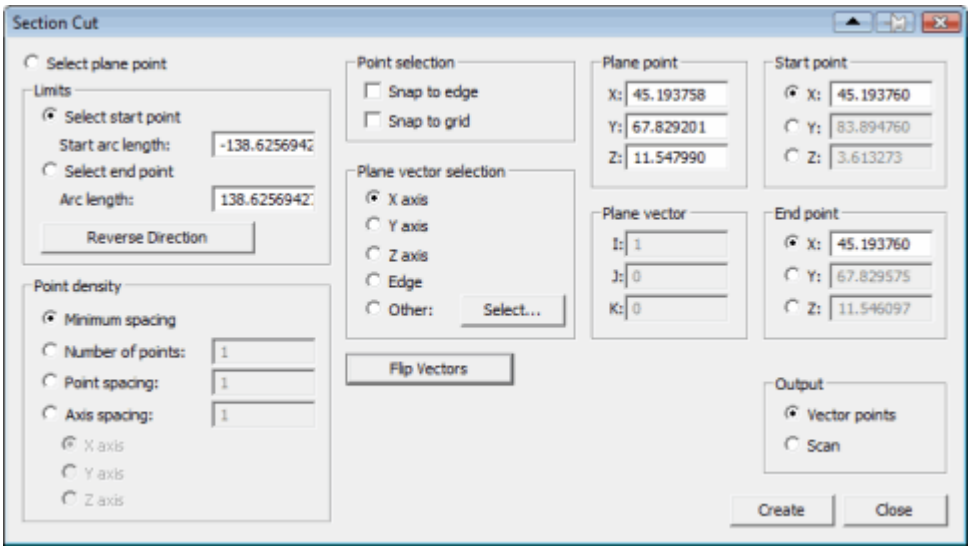
If a `MOVE/ALL` command already exists at the position where a new `MOVE/ALL` command is to be inserted, PC-DMIS shows this message:

PC-DMIS

Do you want to update the existing move command after scan with the new scan parameters?

Working with Section Cut Scans

The **Insert | Scan | Section Cut** menu item displays the **Section Cut** dialog box.

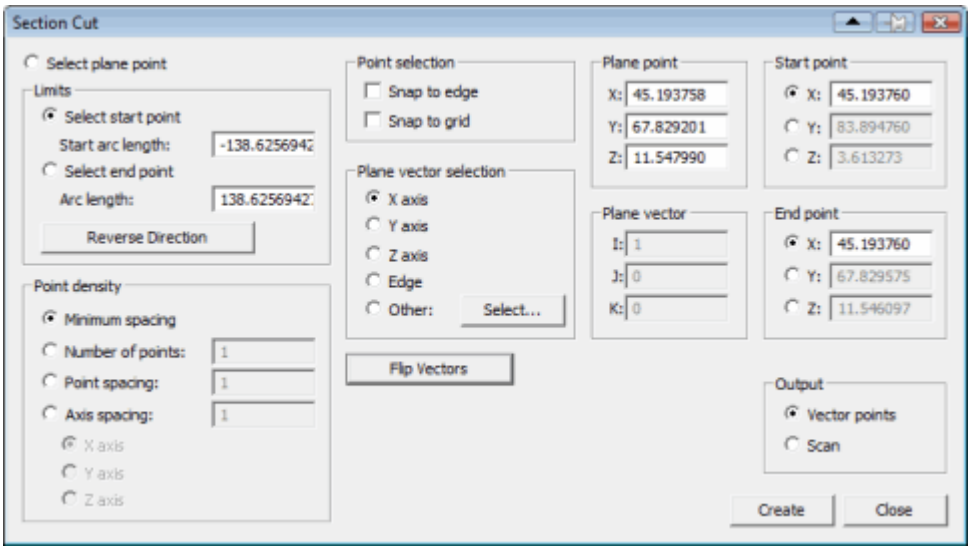


Section Cut dialog box

Use this dialog box to specify a cut plane that intersects with the CAD model. Along the intersection line, you can define a start and end point between which points are created. From these points, you can choose to create vector point features or a Linear Open scan.

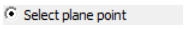
This process does not visually cut the CAD model in any way like the clipping plane functionality does; instead, it acts as a tool to help you create Auto Vector Points or a Linear Open scan along the intersection line of the cut plane and the CAD model.

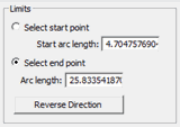
Description of the Section Cut Dialog Box

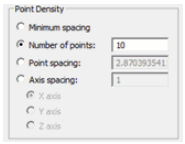
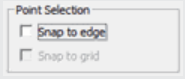


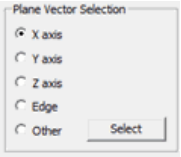
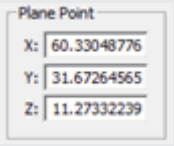
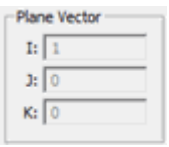
Section Cut dialog box

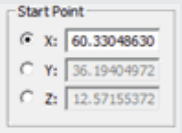
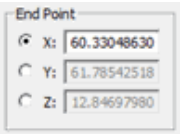
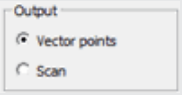
For detailed information about creating a section cut, see "Creating a Section Cut".

Item	Description
Select plane point option 	Select a point on the CAD model. This becomes the cut plane point.

Limits area 	Specify the start and end points along the intersection. You can select the points in the Graphic Display window, or specify an arc length to precisely position the start and end point. **Select start point** - Select the start point of the section cut by selecting the start point in the Graphic Display window. Select the point on the black intersection line. A red point appears on the screen to indicate the location of the start point. **Start arc length** - Use this box to precisely position the start point with respect to the cut plane point. Type the arc length between the projection of the cut plane point onto the section cut and the start point. You can also define a negative number. **Select end point** - Specify the end point on the section cut by selecting the end point in the Graphic Display window. Select the point on the black intersection line. A magenta point appears on the screen to indicate the location of the end point. **Arc length** - Use this box to precisely position the end point. The value you type is the arc length between the start and end points. You can also define a negative number. **Reverse Direction** - Click this button to swap the direction that the arc lengths are measured from the plane point.

Point Density area 	Use this area to control the point spacing and number of points computed between the start and end points. **Minimum Spacing** - This option uses a minimum number of points based on the curvature of the surfaces along the section cut. If the surfaces are flat, then only two points are created at the start and end points. If the surfaces are curved, then more points are created. The number of points created on curved surfaces depends on the value set in the tessellation multiplier defined in the **OpenGL Options** dialog box. See "Changing OpenGL Options" in the "Setting Your Preferences" chapter of the PC-DMIS Core documentation. **Number of points** - Type the number of points that you want to create. PC-DMIS evenly distributes the points between the start and end points. **Point spacing** - Specify the arc length between each point. **Axis spacing** - This option limits the creation of the points along only the selected axis. Once you select this option, the **X axis**, **Y axis**, and **Z axis** options are enabled. Use the box next to this option to define the spacing between points along that selected axis. For example, if you selected the X axis, then the points are spaced along the X axis according to the value you specified.
Point Selection area 	Use this area to specify the snap options for the plane, start, and end points. **Snap to edge** - This check box determines whether or not PC-DMIS snaps the point to the nearest surface edge or surface boundary. **Snap to grid** - This check box determines whether or not PC-DMIS snaps the point to the nearest grid intersection. You can use the snap to grid functionality even when the 3D grid is not showing. To enable the 3D Grid, see "Setting up the Screen View" in the "Editing the CAD Display" chapter in the PC-DMIS Core documentation. If you select both **Snap to edge** and **Snap to grid**, PC-DMIS snaps the point to the nearest grid line that intersects a surface edge or boundary.

Plane Vector Selection area 	Use this area to specify the cut plane normal vector. **X axis** - Sets the cut plane normal to the X axis vector (1,0,0). **Y axis** - Sets the cut plane normal to the Y axis vector (0,1,0). **Z axis** - Sets the cut plane normal to the Z axis vector (0,0,1). **Edge** - Sets the cut plane normal to the nearest surface boundary tangent vector. Whenever you select the plane point, the plane normal is updated to the nearest surface boundary tangent vector. **Other** - Defines the cut plane normal values manually. Once selected, you can type the IJK values in the **Plane Vector** area. Or, you can click the **Select** button to select a feature on the CAD model to use as the normal vector. **Select** - Displays the **Select Points** dialog box, which you can use to select a feature to use as the cut plane normal vector. This dialog box is documented in the "Transforming a CAD Model" topic in the "Editing the CAD Display" chapter in the PC-DMIS Core documentation.
Plane Point area 	This area shows the XYZ values of the plane point. You can manually modify the values by typing new values in the **X**, **Y**, and **Z** boxes. If the point you specify does not lie on a CAD surface, the actual point that is used is projected onto the CAD model. When you manually edit these values and then select the **Edge** option button from the **Plane Vector Selection** area, the surface boundary edge vector used for the plane vector is the vector that is closest to the previous plane vector. In other words, the edge vector that is most parallel with the previous plane vector is used as the new plane vector.
Plane Vector area 	This area shows the IJK values of the plane normal vector. You can manually modify these values by typing new values in the **I**, **J**, and **K** boxes.

Start Point area 	This area displays the XYZ values of the start point. You can also use this area to define or adjust the value of the selected axis. The other two axis values are computed from the intersection line.
End Point area 	This area displays the XYZ values of the end point. You can also use this area to define or adjust the value of the selected axis. The other two axis values are computed from the intersection line.
Output area 	Use this area to determine the type of feature or features created from the section cut. PC-DMIS creates the output feature or features only after you click the **Create** button. **Vector points** - This option specifies that vector points should be created. **Scan** - This option specifies that a Linear Open scan should be created from the points.
Flip Vectors button	Once you create a section cut, PC-DMIS identifies the number of points in the section cut with green arrows. The **Flip Vectors** button also becomes available for selection. This button flips the green arrows representing the points' vectors, which causes them to point in the opposite direction.
Create button	Creates the specified feature or features from the section cut. The type of feature depends on the option selected in the **Output** area.
Close button	Closes the **Section Cut** dialog box.

Creating a Section Cut

To create a section cut, you need to define these pieces of information:

- A cut plane
- A start point on the section cut

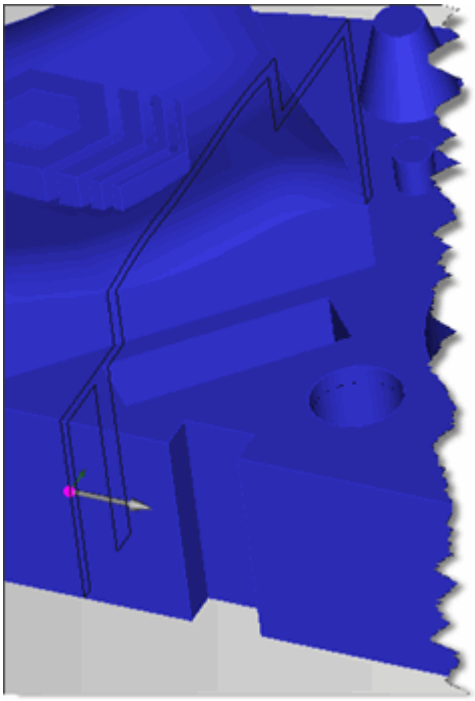
- An end point on the section cut

Step 1: Define the Cut Plane

To define the cut plane, specify a point on the plane. You can do this in two ways:

- You can select the **Select plane point** option. Then click a point on the CAD model.
- In the **Plane Point** area, you can manually type the XYZ values.

Once you define the cut plane, PC-DMIS draws a gray arrow that indicates the plane point and the direction of the cut plane normal vector. In addition, PC-DMIS draws a polyline (or one or more connected lines) on the CAD model. This represents the intersection of the plane (called the "cut plane") with the surfaces in the entire CAD model. Multiple section cuts are drawn as different-colored polylines to show when very small surface gaps are present. Since you haven't defined the start and end points yet, the red and magenta dots, which represent the start and end points respectively, initially appear on the CAD model at the plane point's location:



A sample plane point (indicated by the gray arrow) and cut plane (indicated by the black lines) drawn atop the CAD model

If the plane intersects the model in more than one location, PC-DMIS draws all the intersections.

Once you define the cut plane point, you can optionally specify the cut plane's normal vector. By default, the normal vector is (1,0,0). You can modify this normal vector by selecting an option in the **Plane Vector Selection** area. This shifts the normal along one of the selected axes. You can also define your own custom vector.

Step 2: Define the Start and End Points along the Section Cut

Now that you have defined the cut plane, you need to define a start and end point along the section cut. To define the start and end points, use any combination of these different methods, depending on your preference:

Method 1: Click on the CAD

1. Choose the **Select start point** option and then click a point on one of the black lines making up the section cut. This defines the distance away from the **Plane Point** along the section cut and places that distance in the **Start arc length** box. PC-DMIS places the XYZ values for the selected point into the **Start Point** area.

2. Choose the **Select end point** option, and then click another point on the same section cut. This defines the length of the arc between the start and end point. PC-DMIS places the XYZ values for the selected point into the **End Point** area.

Method 2: Type Arc Values

1. Define the start point by specifying the distance away from the Plane Point by typing the value in the **Start arc length** box.

2. Define the end point by specifying the arc's length. Do this by typing the value in the **Arc length** box.

Method 3: Type XYZ Values

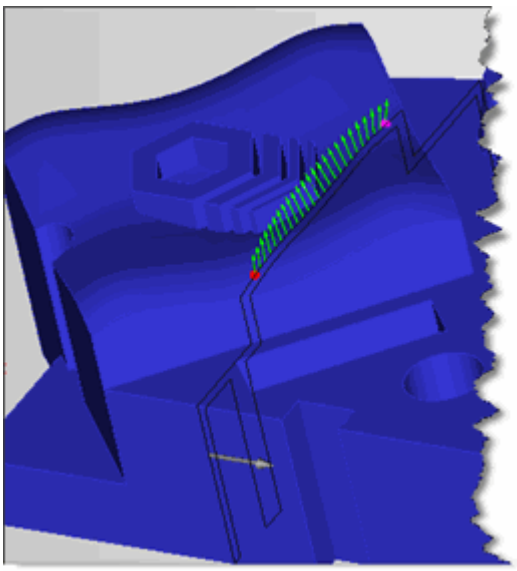
To define the start and end points, type the XYZ value in the **Start Point** and **End Point** areas.



The start and end points must be on the same section cut. For example, if a gap between two surfaces breaks your section cut into multiple cuts, the start and end points must be defined on only one cut. If you try to select the start and end points across different section cuts, the first selected point is removed, and you need to select it again.

A red dot appears on the CAD model representing the start point and a magenta dot appears representing the end point. Additionally, PC-DMIS draws green arrows along the section to show where PC-DMIS will create the section cut points. If the surface is curved, then PC-DMIS draws several arrows. If the surface is flat, then PC-DMIS draws these green arrows only at the start and end points (because the **Point Density** area has **Minimum Spacing** selected by default).

You can modify options in the **Point Density** area to control the number of points between the start and end points:



A sample section cut showing 25 equally spaced points between the start point (red dot) and the end point (magenta dot)

Step 3: Define and Create the Output

1. Select the desired output format in the **Output** area. The output can either be in individual Auto Vector Points or a Linear Open scan that contains the points.

2. Modify any other controls as needed. These enable you to customize the parameters that affect the plane, start and end points, point spacing, and feature type created.

3. Click the **Create** button to create the output features or scan.

PC-DMIS creates the specified feature or features in the measurement routine.

Fixing the Direction of Normals Along the Section Cut

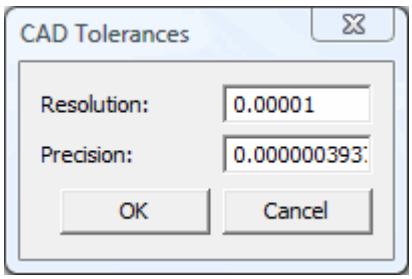
The green arrows represent the surface normal vectors at the points. The section cut algorithm is designed so that the surface normal vectors along the section cut do not flip as they transition across multiple surfaces. However, these vectors may all point in the wrong direction (inside the part). If these arrows point in the wrong direction, click the **Flip Vectors** button to fix them.

Fixing Gaps Between Surfaces

Because of small gaps between surfaces, sometimes the section cut ends before it has wrapped all the way around the part. This is caused by the CAD resolution being smaller than the gap distance. As long as the gap between surfaces is greater than the CAD resolution, it breaks the section cut. To help identify gaps, the separate section cuts are drawn in different colors. To fix this problem, increase the CAD resolution with the **CAD Tolerances** dialog box.

To do this:

1. Select **Edit | Graphic Display Window | CAD Tolerances** to open the **CAD Tolerances** dialog box.



CAD Tolerances dialog box

2. Change the resolution to a value greater than the gap distance. It may take some trial and error to find a resolution value that is large enough. For more information, see "Changing CAD Tolerances" in the "Editing the CAD Display" chapter in the PC-DMIS Core documentation.
3. Click **OK**.
4. Create the section cut again.

The section cut now jumps across the gap.

Performing a UniScan

UniScan is an automated way to create scan commands that cover selected faces while respecting the maximum incidence angle of the laser sensor. You can then use laser tips and eventually the machine volume.

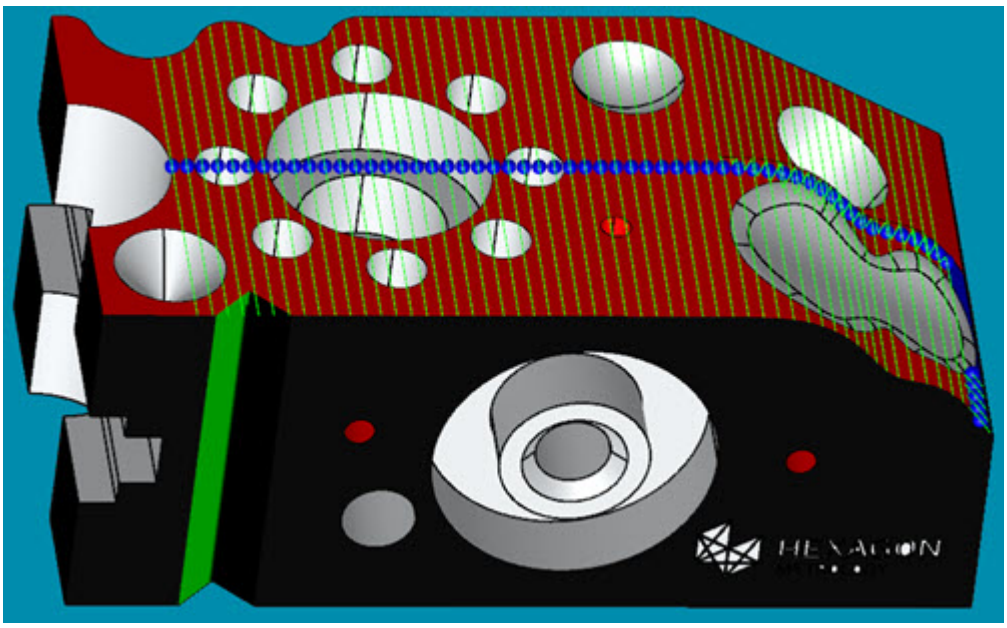
PC-DMIS applies optimization algorithms at various steps of the scan process to ensure the most ideal results within a pre-defined computational time limit. The main optimization criteria used are:

- Minimizing the number of tip changes
- Defining the shortest total path for the laser scans



You can use the `MaxOptimizationTimeMs` entry to define the maximum time in milliseconds that the UniScan optimization algorithms take. For details, see the "MaxOptimizationTimeMs" topic in the PC-DMIS Settings Editor documentation.

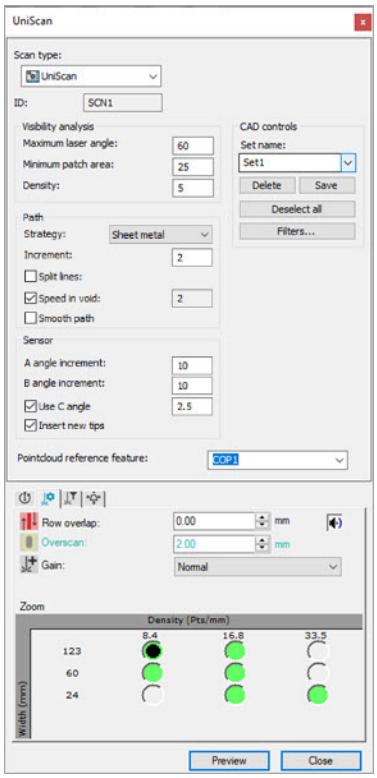
The UniScan performs the scan analysis based on the machine volume if you have an insert machine command in your measurement routine. If your part is located in such a way that some areas of the selected faces cannot be scanned due to machine volume limits, PC-DMIS notifies you. The software colors these areas black to inform you that they could not be scanned due to the part's position in the machine's volume.



Example of a UniScan with unable to scan areas shown in black

To perform a scan, follow these steps:

1. Open the **UniScan** dialog box (**Insert | Scan | UniScan**).



UniScan dialog box

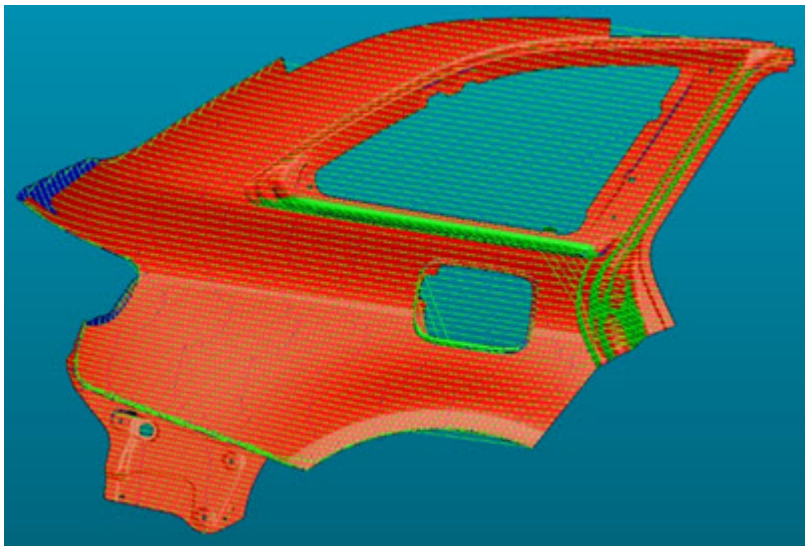
2. Make the necessary changes to the scan properties. For details on the **UniScan** dialog box properties, see "Description of the UniScan Dialog Box".

3. Select the surfaces that you want to scan or select the set name from the **Set name** list in the dialog box.

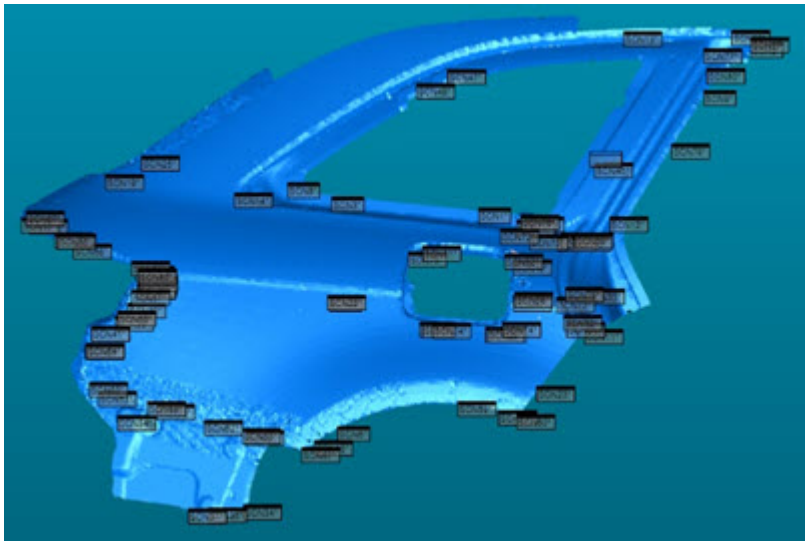
4. Click the **Preview** button to perform a scan analysis on the selected surfaces. When PC-DMIS finishes the scan analysis, PC-DMIS displays a message about the scan details and prompts you to create the scan.

5. Click **Yes** to create the scan, or **No** to return to the dialog box. If you click **Yes**, PC-DMIS creates the scan command in the Edit window and the Graphic Display window shows the scan on the selected surfaces.

   PC-DMIS generates the UniScan command into groups in the Edit window. Right-click the scan and select **Expand Groups** to display the entire command showing all grouped components of the command.



Example of the UniScan after scan analysis is completed but before scan is created



Example of the UniScan after the scan is created and executed

Example of a UniScan code snippet with groups collapsed:

```
UNISCN_COP1_60.0DEG_123.5WIDTH_2.0OSCAN_GRP1=GROUP/
SHOWALLPARAMS=NO

    ENDGROUP/
    ID=UNISCN_COP1_60.0DEG_123.5WIDTH_2.0OSCAN_GRP1
```

Example of the same UniScan code snippet with groups expanded:

```
UNISCN_COP1_60.0DEG_123.5WIDTH_2.0OSCAN_GRP1=GROUP/
SHOWALLPARAMS=YES

    TIP/T1A0B-90, SHANKIJK=0, 0, 1, ANGLE=-90

SCN1 =FEAT/SCAN,FREEFORM,NUMBER OF HITS=13,SHOW
HITS=NO,SHOWALLPARAMS=NO,POINTCLOUDID=COP1

    MEAS/SCAN

        BASICSCAN/FREEFORM,NUMBER OF HITS=13,SHOW
        HITS=NO,SHOWALLPARAMS=NO

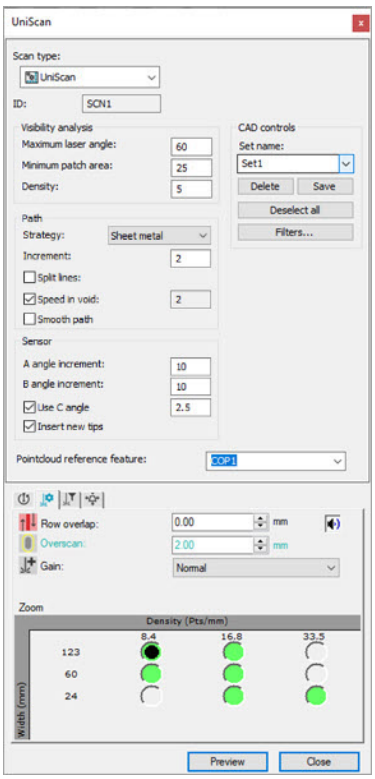
        ENDSCAN

    ENDMEAS/

    ENDGROUP/
    ID=UNISCN_COP1_60.0DEG_123.5WIDTH_2.0OSCAN_GRP1
```

Description of the UniScan Dialog Box

To open the **UniScan** dialog box, select **Insert | Scan | UniScan**.



UniScan dialog box

The top portion of the **UniScan** dialog box contains these areas:

Visibility analysis area

This area defines the parameters of the visibility analysis performed on the selected CAD surfaces.

It is important that you correctly orient the CAD surface vectors. PC-DMIS applies a black color to any incorrectly oriented surfaces in the Graphic Display window to alert you that they need to be fixed. For details on how to configure CAD vectors, see the "Editing CAD Vectors" topic in the PC-DMIS Core documentation.

Maximum laser angle box - This value defines the maximum angle the probe tip can have to the normal of each triangle on the CAD surfaces. The default maximum allowed value is 70 degrees. The default minimum value is 10 degrees. You can set these default values in the **UniScan** section of the Settings Editor with the `ConeAngleMaxValue` and `ConeAngleMinValue` entries, respectively. This parameter has a direct impact on the number of tips needed to fully cover the selected surfaces. The smaller the value, the more tips you will need.

Minimum patch area box - Based on the **Maximum laser angle** value, each laser tip covers a specific area or patch of the selected surfaces. PC-DMIS discards patches with an area smaller than this value.

This can be very useful if you have areas with small details, and you don't want to create scans on those areas.

Density box - The selected surfaces are tessellated with a maximum triangle size equal to this value in the measurement routine units. The smaller the **Density** value, the larger the tessellation and the longer the analysis takes to complete.

CAD controls area

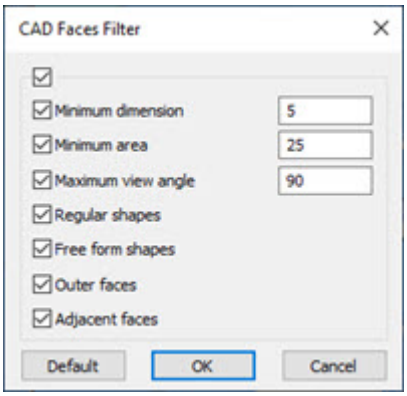
This area provides tools that you can use to help in the selection of the surfaces that the UniScan will cover. You can single-click or box-select the surfaces to select them in the Graphic Display window. You can also define filters that you can apply to the box-selected surfaces.

You can save the selected surfaces for later use. To do this, select the surfaces, type a name in the **Set name** box, and click the **Save** button. The software adds the set to the list. You can select different surfaces on the CAD and define other sets and save them the same way. You can switch from one set to another when you select a different set from the list.

To delete a set from the list, select a set name and click the **Delete** button.

To clear all selected surfaces, click the **Deselect all** button . The saved sets are still available in the list but no longer applied to the CAD.

To open the **CAD Faces Filter** dialog box, click the **Filters** button.



CAD Faces Filter dialog box with All Filters selected

From this dialog box, you can select the filters that you want to apply to the box-selected surfaces.

> You must box-select the surfaces for the **CAD Faces Filter** to take effect. To learn about box-selecting, see "Box-Selecting to Create Multiple Auto Features" in the PC-DMIS Core documentation.

To select all the filters, select the very top **All Filters** check box . See the descriptions below for each filter type.

Minimum dimension check box and input box - When you select this check box, you can type an entry into the **Minimum dimension** input box to set a minimum dimension value. This forces PC-DMIS to only select surfaces that have at least this dimension value.

Minimum area check box and input box - When you select this check box, you can type an entry into the **Minimum area** input box to set a minimum area value. This allows you to select surfaces that have at least this area value.

Maximum view angle check box and input box - When you select this check box, you can type an entry into the **Maximum view angle** input box. This allows you to box-select all faces in the current CAD view that have an angle smaller or equal to the entered value.

Regular shapes check box - This option forces PC-DMIS to select only regular shapes such as circles, cones, planes, and spheres.

Free form shapes check box - This option forces PC-DMIS to select only freeform-type surfaces.

Outer faces check box - This option forces PC-DMIS to select surfaces that are not internal surfaces such as cylinders and spheres.

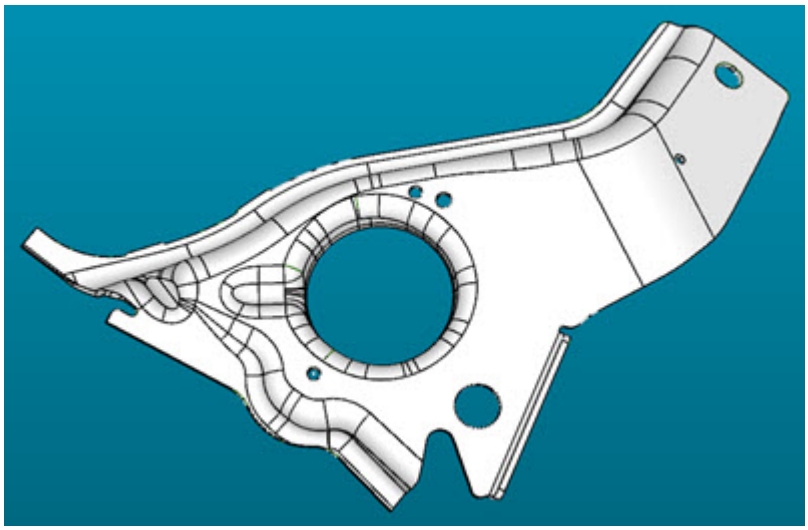
Adjacent faces check box - This option selects all faces that share a boundary with the selected face. If there are gaps between adjacent faces that are greater than the fixed accuracy of the CAD, PC-DMIS does not select them.

The **Default** button selects all but the **Adjacent faces** option.

Path area

Strategy list - The list provides these possible options:

Sheet metal - Select this option for sheet metal parts which mainly have freeform surfaces.

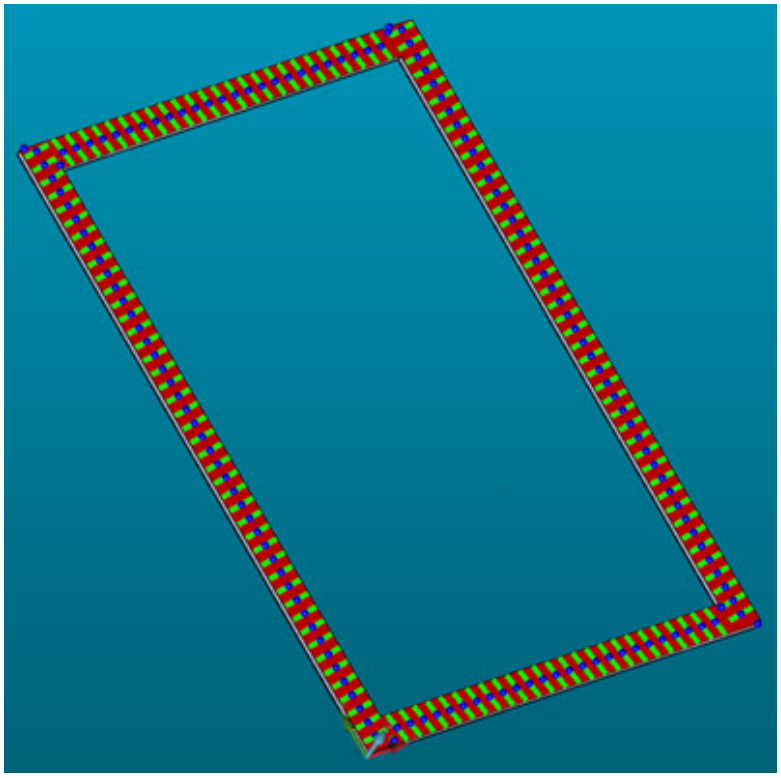


Example of a sheet metal part for UniScan

Prismatic - Select this option for more prismatic parts such as the Hexagon block.

Segmented - This option is only available when you have a CMS probe head with a C-joint. This strategy is for parts that have large holes. It sub-divides the patch using

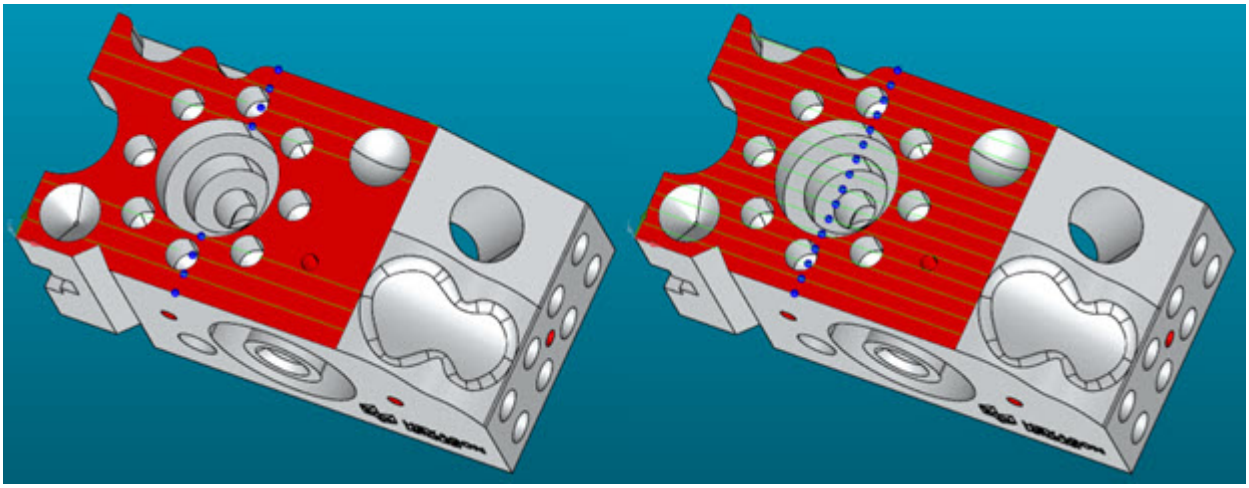
the same tip into areas that can be scanned along their longest direction. This reduces the number and length of scans.



Example of a segmented part for UniScan

Increment check box and input box - When you select this check box and type a value, this is the distance between the control points of the generated scan.

Split lines check box and input box - When you select this check box and type a value, scan paths are split when the distance between two consecutive points is larger than this value. This value should reflect the minimum size of the hole that the scan path should skip. When you click on a surface, this field is initialized with the size of the largest hole if any.

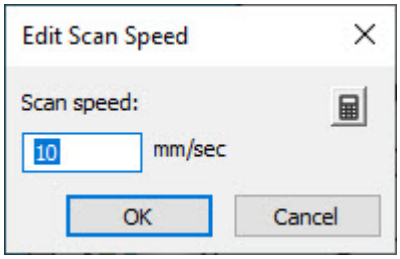


Example with the Split lines option enabled (left) and disabled (right)

Speed in void check box and input box - When you select this check box, you can set a faster scan speed when the software detects that control points are over empty spaces (such as holes).

There are two ways to change this value:

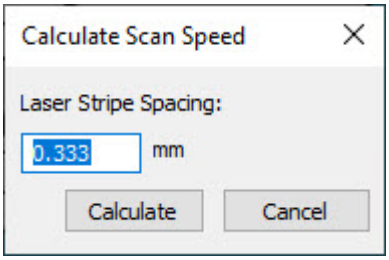
Once you select this check box, click in the **Speed in void** input box to open the **Edit Scan Speed** dialog box.



Option 1 is to type a value directly into the **Scan speed** input box.

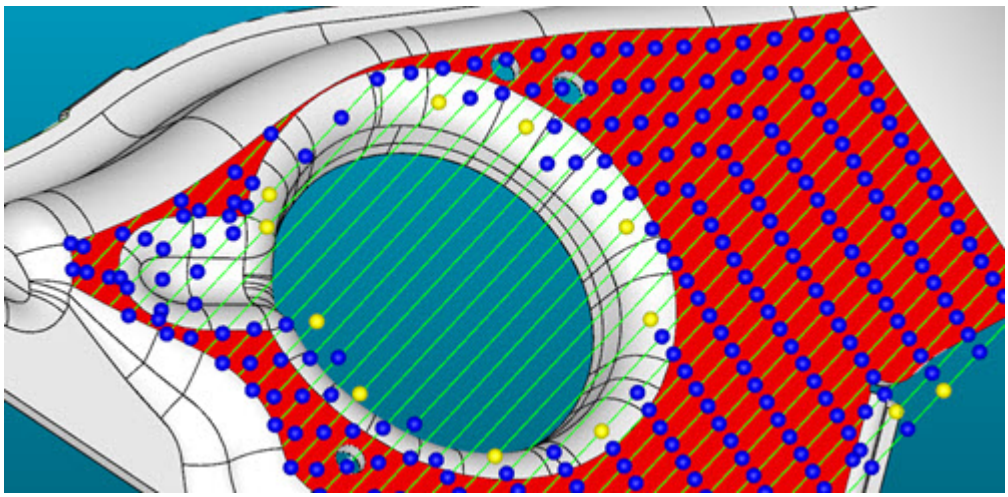
Option 2:

1. Click the **Calculate from stripe spacing** button to open the **Calculate Scan Speed** dialog box.



2. Type a value into the **Laser Stripe Spacing** input box and click the **Calculate** button. PC-DMIS calculates the new value and updates the value in the **Speed in void** input box.

The yellow control points in this image are the control points that PC-DMIS assigns a faster speed to when it performs the UniScan:



Example of yellow control points which you can apply a faster scan speed to with the Speed in void option

Smooth path check box - When you select this check box, PC-DMIS provides a B-spline path smoothing to the scan.

Sensor area

A angle increment box - Each sensor has its own pre-defined built-in A angle increment value. The software uses this value to generate all possible tips for use in the visibility analysis. You can change this value, but it cannot be less than the default value of 2.5. The smaller the value, the more tips you can use to perform the scan analysis and the longer the analysis takes.

B angle increment box - This is the same as the **A angle increment** option, but it applies to the B angle.



The value of these increment options has a direct impact on the speed of the analysis performed. The smaller the increment value, the more tips PC-DMIS uses to perform the visibility analysis and the longer the analysis takes.

The **A angle increment** and **B angle increment** options are only available if the **Insert new tips** check box is selected.

Use C angle check box and input box - This option is only available when the current active laser sensor is mounted on a continuous wrist. The software uses the angle increment value to correct the orientation of the laser when necessary. You must use this option for the Segmented strategy.

Insert new tips check box - When you select this check box, PC-DMIS enables the **A angle increment** and **B angle increment** options and only uses the tips defined in the current laser sensor in the analysis.

Miscellaneous

Pointcloud reference feature list - Use this list to select the pointcloud (COP) that you want to use for the scan.

Commands Area

This area is only available if you select the Prismatic strategy. When available, this area provides these options:

Linear - PC-DMIS creates linear open scans when it creates the UniScan group.

Patch - PC-DMIS creates patch scans when it creates the UniScan group.

Probe Toolbox Notes

Laser Scan Properties - PC-DMIS uses the **Row Overlap** option to define the coverage of the selected scan surfaces.

PC-DMIS considers the **Stripe Width**, **Clipping Region**, and **Field of View Offset** values when performing the visible scan analysis.



You must include the center of the laser trapezoid when setting the clipping regions. As an example:

Set the upper and right values to be greater than or equal to 50.

Set the lower and left values to be less than or equal to 50.

For details on the **Probe Toolbox Laser Scan Properties** tab, see the "Laser Probe Toolbox: Laser Scan Properties tab" topic in the PC-DMIS Laser documentation.

Creating Quick Scans

You can use the Quick Scan functionality to create a Linear Open or Patch scan from a polyline or surface.

For Linear Open quick scans:

- You can use either the Curve mode or Surface mode of the CAD to create a Linear Open quick scan.
- You can select a single polyline or multiple polylines. Polylines can be open-ended or closed.

For Patch quick scans:

- You can only use the Surface mode of the CAD to create a Patch quick scan.

- You must have the **Use Measurement Strategy Widget** option enabled. This is done from the **General** tab of the **Setup Options** dialog box (**Edit | Preferences | Setup** or press the F5 key).

For more information about the Curve or Surface modes, see "Switching Between Curve and Surface Modes" in the "Editing the CAD Display" chapter of the PC-DMIS Core documentation.

When you create a Linear Open or Patch quick scan with the **Use Measurement Strategy Widget** option enabled, PC-DMIS shows the Measurement Strategy Widget. If you also have the **Use Measurement Strategy Editor** option enabled from the **General** tab of the **Setup Options** dialog box, the Measurement Strategy Editor (MSE) settings control the scan parameters. However, you can use the widget to select the scan type and edit the properties for the scan. Click the widget's **Apply** button to create the scan or click the **Cancel** button if you do not want to create the scan.



For more information about the Measurement Strategy Editor (MSE), see the "Using the Measurement Strategy Editor (MSE)" topic in the PC-DMIS Core documentation.

For more information about the Measurement Strategy Widget, see the "Using the Measurement Strategy Widget" topic in the PC-DMIS Core documentation.

If the **Use Measurement Strategy Editor** option is disabled, PC-DMIS applies the last-used scan parameters. The distance between two points in the generated path depends on the scan point density. For a touch trigger probe (TTP), PC-DMIS also updates the value for the **Max increment** option in the Linear Open Scan dialog box based on the scan point density. To edit the scan point density, change the value for **Point density** on the **Probe Options** tab in the **Parameter Settings** dialog box (**Edit | Preferences | Parameters** or press the F10 key).

For a laser probe, to define the distance between two points in the generated path, PC-DMIS uses the value that was last set for the **Increment** option in the **Linear Open Scan** dialog box.

The scan start point on the first polyline is the point where you click and create a gesture. If this point is closer than the edge distance that is specified for the **Offset** option on the **Path Definition** tab in the **Linear Open Scan** dialog box, the scan starts from the edge distance away from the end point.

Quick Scan functionality supports spot laser probes on vision machines. Quick Scan also supports laser probes. However, please note that the Measurement Strategy Editor does not yet support vision and laser sensors and will therefore be ignored, even if you have the **Use Measurement Strategy Editor** option enabled. PC-DMIS always applies the last-used scan parameters for vision and laser quick scans.

Creating a Quick Scan on a Single Polyline

You can use the Quick Scan functionality to create a quick scan on a single polyline. The polyline can be open-ended or closed. For more information about quick scans, see "Creating Quick Scans".

To create a quick scan on a single polyline, do the following:

1. In your Edit window, click to define where to insert the new feature.
2. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Curve Mode** icon ().
3. In the Graphic Display window, hover the pointer over the CAD element polyline.
4. Press Ctrl + Shift and click on the polyline from which you want to start the scan. Drag the pointer along the polyline and in the direction of the scan.
5. Release the mouse button. PC-DMIS creates a scan and inserts it at the cursor position as follows:
   - If the polyline is open-ended, PC-DMIS generates the path from the point where you clicked to create a gesture up to the end of the polyline, minus the distance equal to the value that is entered for the **Offset** option on the **Path Definition** tab in the **Linear Open Scan** dialog box.

     For a laser probe, the scan is created until the end of the polyline.
   - If the polyline is closed, the scan is all-around. It starts from the point where you clicked to create a gesture.

Creating a Quick Scan on Multiple Polylines

You can use the Quick Scan functionality to create a quick scan on multiple polylines. The polylines can be open-ended or closed. For more information about quick scans, see "Creating Quick Scans".

To create a quick scan on multiple polylines, do the following:

1. In your Edit window, click to define where to insert the new feature.
2. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Curve Mode** icon ().
3. In the Graphic Display window, hover the pointer over the CAD element's first polyline and click on the part.

4. To select multiple polylines, press Ctrl and then click on each polyline.



The order in which you select the polylines is important. PC-DMIS generates the quick scan on the polylines in the order that you select them.

Make sure that the start points of subsequent polylines are accessible from the end of the scan of the previous polyline without collision.

5. Press Ctrl + Shift, and click on the start point on the polyline from which you want to start the scan. Drag the pointer along the polyline and in the direction of the scan.

6. Release the mouse button. PC-DMIS creates a scan and inserts it at the cursor position.

   PC-DMIS generates the scan on the polylines in the order that you selected the polylines, starting from the point of the scan gesture.

   After the end of the first polyline, PC-DMIS locates the nearest end of the next polyline. This end becomes the start end of the next polyline.



For tactile probes, the **Jump Hole** check box on the **Path Definition** tab is always selected. This is because the probe lifts between the scans on each polyline. For spot laser probes, the **Jump Hole** check box is available for selection, and PC-DMIS uses its last-used value. For more information about the check box, see the "Theoretical Path Area" topic in the PC-DMIS Core documentation.

The **Jump Hole** check box is not used for laser probes.

Selecting Multiple Polylines with the Quick Scan Gesture

You can also select multiple polylines along with the quick scan gesture. To do this:

1. Click on the first polyline.

2. Press Ctrl + Shift and then click on the start point on the first polyline from which you want to start the scan.

3. Drag the pointer along the polyline and in the direction of the scan.

4. Keep Ctrl + Shift pressed, and move the pointer over the subsequent polylines. Each polyline over which you move the pointer becomes selected. The order in which you highlight the polylines defines the order of the scan.

Creating Multiple Polylines on CAD Surfaces

For information on how to create multiple polylines on CAD surfaces in PC-DMIS, see "Creating a CAD Section Cut" in the "Editing the CAD Display" chapter in the PC-DMIS Core documentation.

Creating a Linear Open Quick Scan on a Surface

You can use the Quick Scan functionality to create a Linear Open Quick Scan on one or more surfaces as follows:

1. Click a location in the Edit window to define where to insert the new feature.
2. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ().
3. If required, select one or more surfaces on the CAD in the Graphic Display window.
4. In the Graphic Display window, hover your pointer over the surface that you want to scan.
5. Press Ctrl + Shift and then click a position from which you want to start the scan. Drag the pointer to the position where you want to stop the scan and then release the mouse button.
6. PC-DMIS creates a scan and inserts it at the cursor position in the Edit window. If the **Use Measurement Strategy Widget** option is enabled, PC-DMIS shows the Measurement Strategy widget which you can use to select the scan type or adjust parameter settings. For more information about the Measurement Strategy Widget, see the "Using the Measurement Strategy Widget" topic in the PC-DMIS Core documentation.



For tactile probes, the **Jump Hole** check box on the **Path Definition** tab is always selected. This is because the probe lifts between the scans on each polyline. For spot laser probes, the **Jump Hole** check box is available for selection, and PC-DMIS uses its last-used value. For more information about the check box, see the "Theoretical Path Area" topic in the PC-DMIS Core documentation.

The **Jump Hole** check box is not used for laser probes.

Note the following:

- If you pre-select one or more surfaces, and the Quick Scan gesture start point is on one of the selected surfaces, PC-DMIS generates the scan only on the selected surfaces. In this case, the surfaces that are not pre-selected are not highlighted,

even when you move the pointer over them. This indicates that PC-DMIS does not generate the Quick Scan on the surfaces that were not pre-selected.

- If you pre-select one or more surfaces, and the Quick Scan gesture start point is not on one of the selected surfaces, PC-DMIS selects the surface or surfaces over which you move the pointer and uses those surfaces to generate the scan.
- If you do not pre-select surfaces, PC-DMIS selects the surface or surfaces over which you move the pointer. The selected surfaces become highlighted as you move the pointer. The Quick Scan gesture point is the start point. PC-DMIS uses the surfaces that you selected in this manner to generate the scan.
- If the angle between the cut vector and any coordinate axis is within +/- 5 degrees, PC-DMIS snaps the cut vector to that coordinate axis. PC-DMIS projects the start point, direction point, and end point onto the cut vector plane.

Selecting One or More Surfaces

To select one surface, click a surface in Graphic view. PC-DMIS selects this surface and deselects all previously selected surfaces.

To select multiple surfaces, press Ctrl and click on the surfaces.

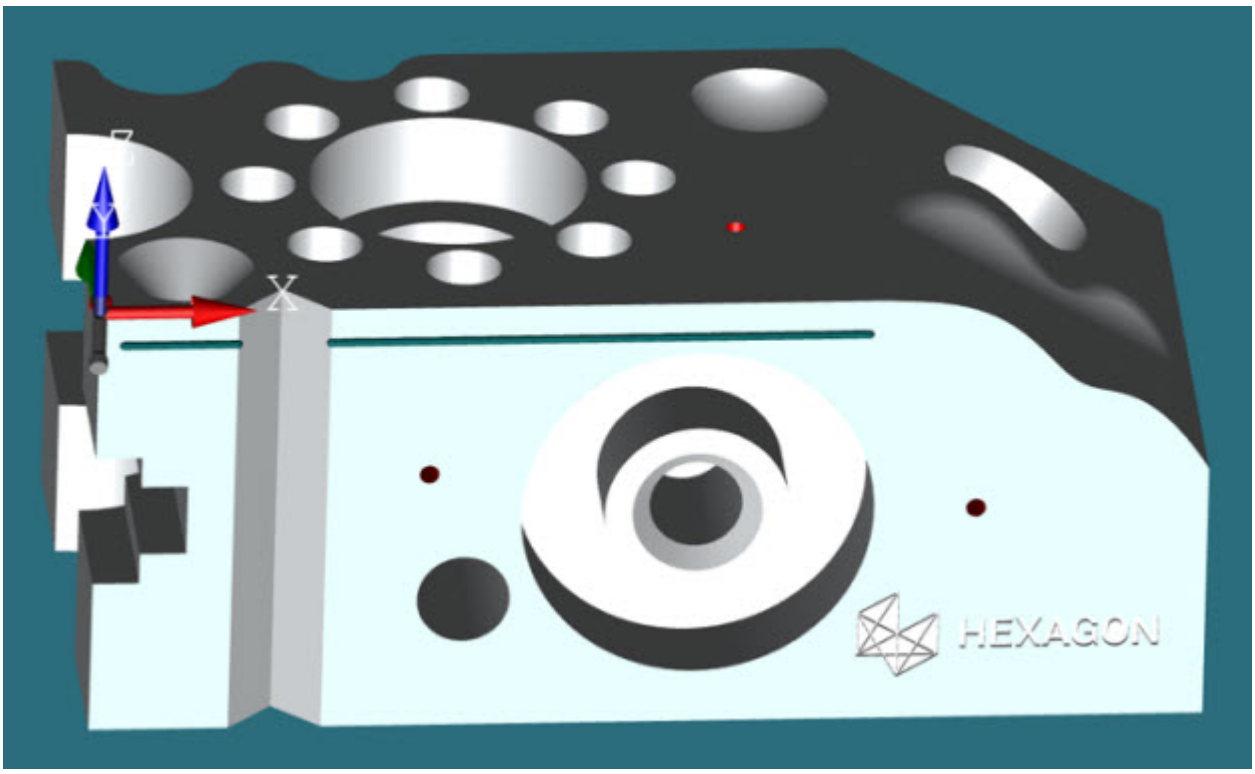
To deselect a surface, press Ctrl and click on the selected surface.

Example of a Quick Scan with Pre-Selected Surfaces

If you want to generate a Quick Scan on two front faces, do the following:

1. Select the front two faces.
2. Start the Quick Scan gesture from the left surface and drag the pointer to the end point.

PC-DMIS generates the Quick Scan as shown below:



Example of a Quick Scan on two front faces.

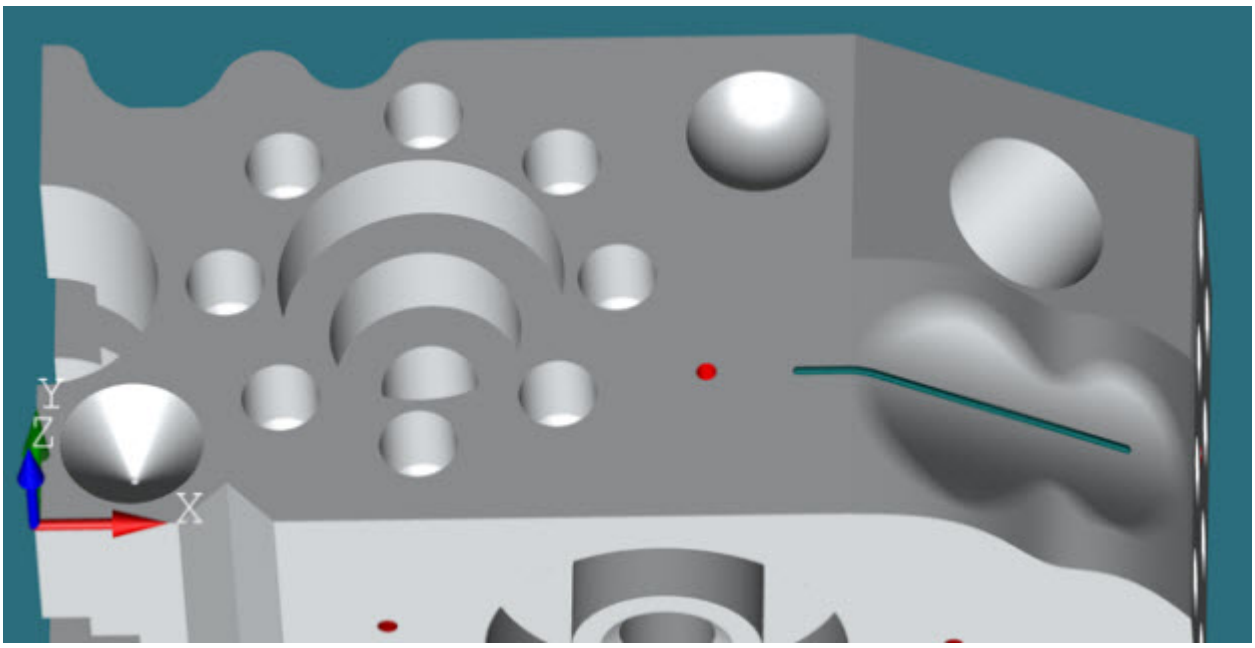
Example of a Quick Scan Without Pre-Selecting the Surfaces

If you want to generate a Quick Scan on an area that consists of multiple surfaces without pre-selecting the surfaces, do the following:

1. Ensure that no surfaces are selected or that the click of the scan gesture is on a non-selected surface.

2. Start the scan gesture and move your pointer to the desired end point of the scan.

As you move the pointer, PC-DMIS selects the surfaces and generates the Quick Scan as shown below:



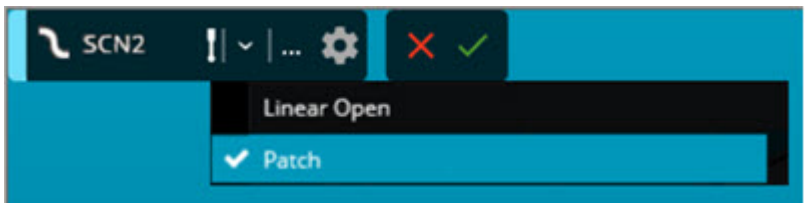
Example of a Quick Scan on multiple surfaces.

Creating a Patch Quick Scan on a Surface

To generate Patch Quick Scans, you must have the **Use Measurement Strategy Widget** option enabled. You can find this option on the **General** tab of the **Setup Options** dialog box. For more information about the Measurement Strategy Widget, see the "Using the Measurement Strategy Widget" topic in the PC-DMIS Core documentation.

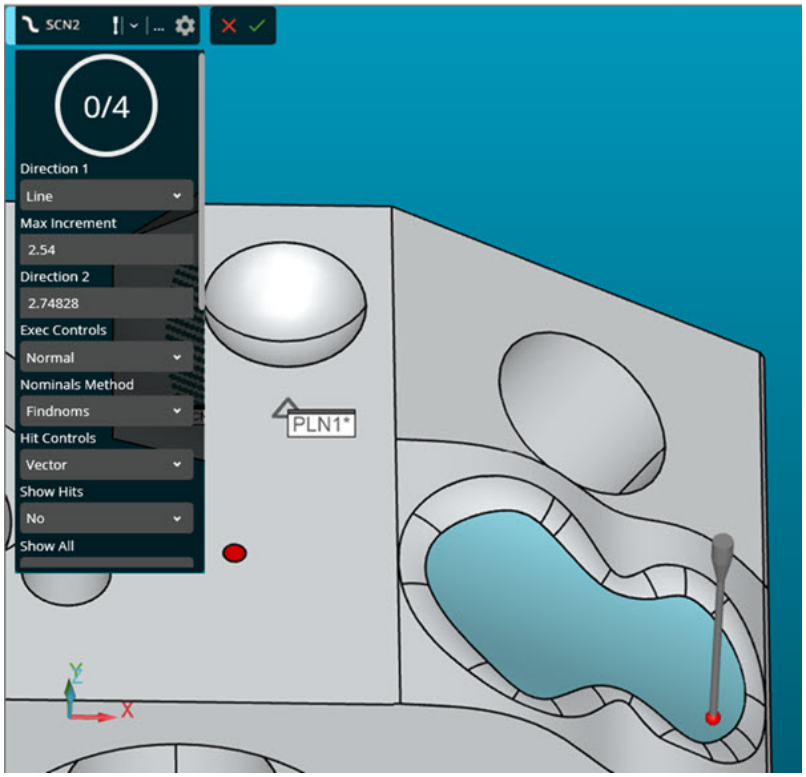
You can use the Quick Scan functionality to create a Patch Quick Scan on one or more surfaces as follows:

1. Click a location in the Edit window to define where to insert the new feature.
2. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).
3. If required, select one or more surfaces on the CAD in the Graphic Display window.
4. In the Graphic Display window, hover your pointer over the surface that you want to scan.
5. Press Ctrl + Shift and then click a position from which you want to start the scan. Drag the pointer to the position where you want to stop the scan and then release the mouse button. PC-DMIS shows the Measurement Strategy Widget.
6. From the Measurement Strategy widget, select the **Patch** option from the **Scan Type** list.



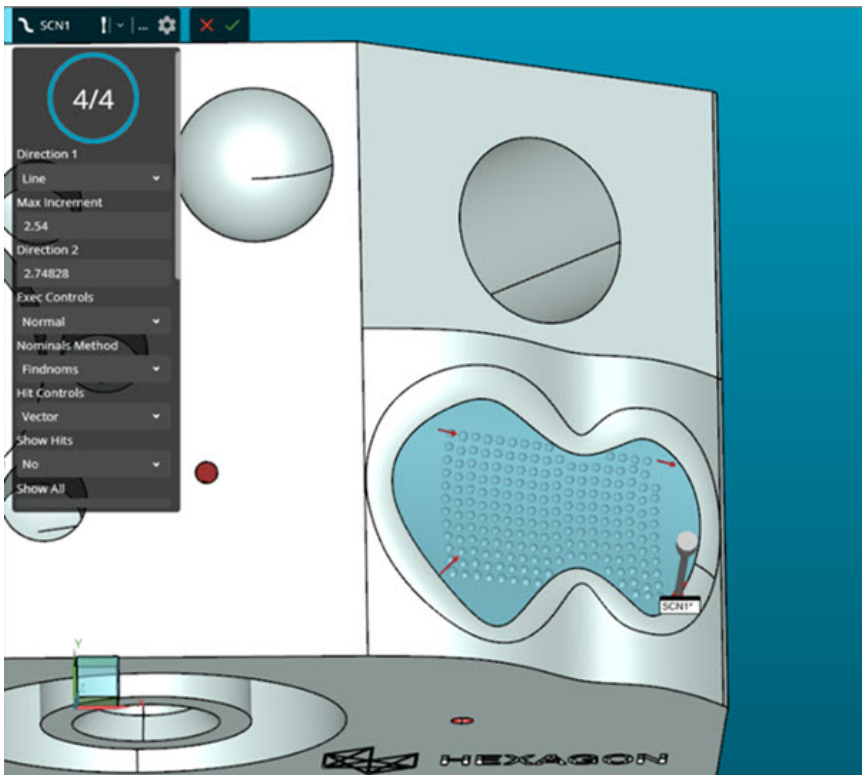
Example of the Measurement Strategy widget with the Patch scan option selected.

For the Patch scan, PC-DMIS displays an additional widget that prompts you to define more hits.



Example of the second widget for the Patch scan option.

7. Once you click the start point (point 1), each subsequent click defines the scan's direction (point 2) and the scan's boundary points. You must select a minimum of four points.



Example of the Patch Quick Scan after the selection of the fourth point.

8. You can continue to add more boundary points and edit any of the parameters as required. The scan path automatically regenerates after each edit.

9. From the Measurement Strategy widget, click the green check button to complete the definition of the quick scan or click the red X button to cancel the scan.

For tactile probes, you can use the Measurement Strategy Editor to control the Patch scan's parameters. If you are not using the Measurement Strategy Editor, PC-DMIS populates the parameters with their last-used values, apart from the following exception.

For tactile probes, the **Jump Hole** check box on the **Path Definition** tab is always selected. This is because the probe lifts between the scans on each polyline. For spot laser probes, the **Jump Hole** check box is available for selection, and PC-DMIS uses its last-used value. For more information about the check box, see the "Theoretical Path Area" topic in the PC-DMIS Core documentation.

The **Jump Hole** check box is not used for laser probes.

General Notes on Patch Quick Scans

- If you pre-select one or more surfaces and the quick scan gesture start point is on one of the selected surfaces, PC-DMIS generates the scan only on the selected surfaces. In this case, the surfaces that are not pre-selected are not highlighted, even when you move the pointer over them. This indicates that PC-DMIS does not generate a quick scan on the surfaces that were not pre-selected.
- If you pre-select one or more surfaces and the quick scan gesture start point is not on one of the selected surfaces, PC-DMIS selects the surface or surfaces over which you move the pointer and uses those surfaces to generate the scan.
- If you do not pre-select surfaces, PC-DMIS selects the surface or surfaces over which you move the pointer. The selected surfaces become highlighted as you move the pointer. PC-DMIS uses the surfaces that you selected in this manner to generate the scan.
- If the angle between the cut vector and any coordinate axis is within +/- 5 degrees, PC-DMIS snaps the cut vector to that coordinate axis. PC-DMIS projects the start point, direction point, and end point onto the cut vector plane.

Notes on Selecting and De-selecting Surfaces

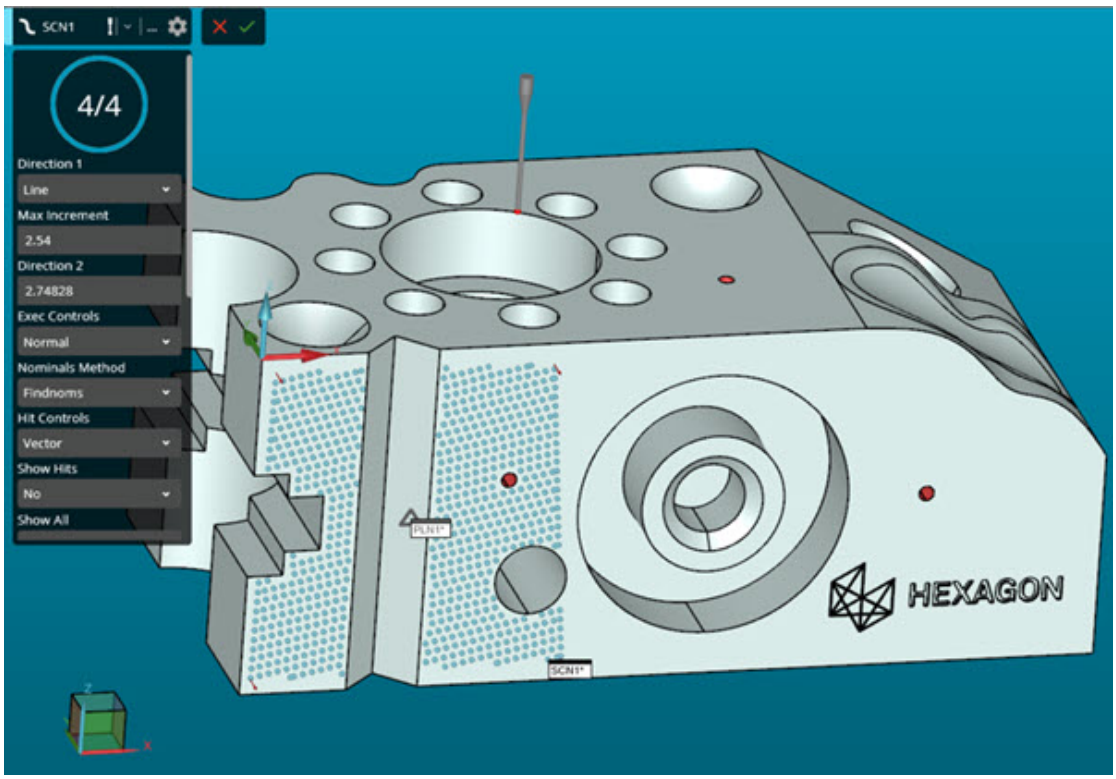
- To select one surface, click on any surface in the Graphic Display window. PC-DMIS selects this surface and deselects all previously selected surfaces.
- To select multiple surfaces, press the Ctrl key and click on the surfaces.
- To deselect a surface, press the Ctrl key and click the selected surface.

Example of a Quick Scan on Multiple Pre-Selected Surfaces

If you want to generate a quick scan on multiple pre-selected surfaces, do the following:

1. Select the surfaces to scan. Two front faces of a CAD are used for this example.
2. Start the Quick Scan gesture from the left surface and drag the pointer a short distance to trigger the Quick Scan widget.
3. From the widget, select the **Patch** option from the **Scan Type** list if required.
4. From the Graphic Display window, click a minimum of four points on the CAD to define your scan.

   PC-DMIS generates the Patch Quick Scan as shown in the example below:



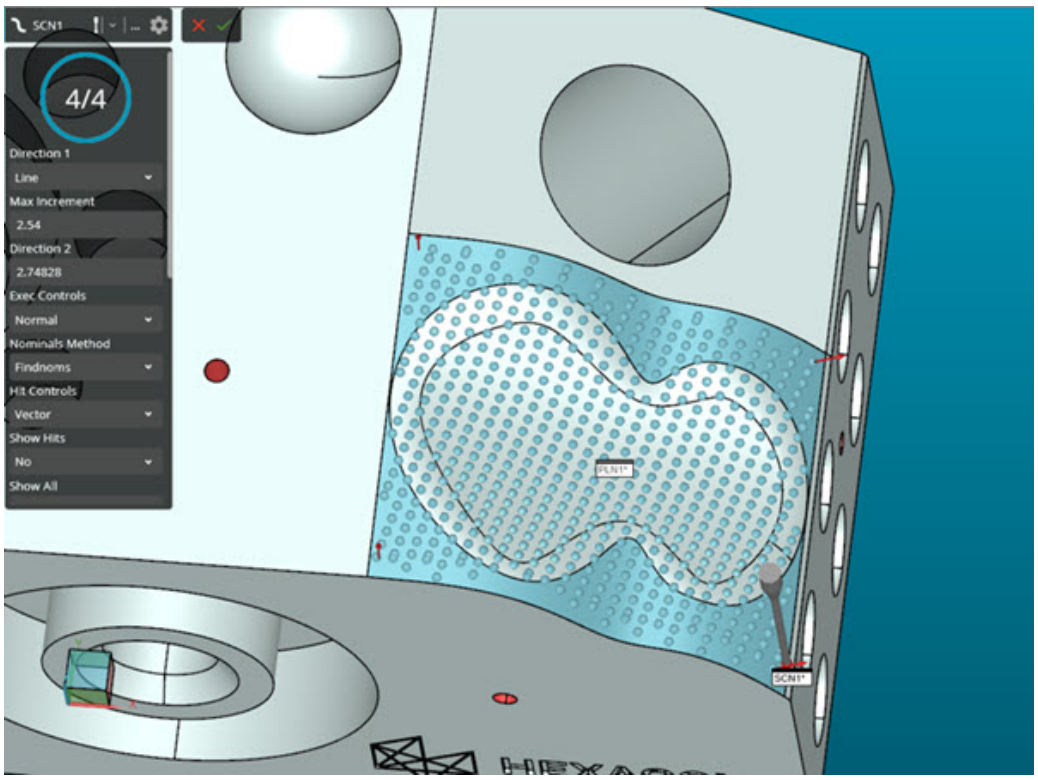
Example of a Patch Quick Scan generated on multiple pre-selected surfaces.

Example of a Quick Scan Without Pre-Selecting Surfaces

If you want to generate a Quick Scan on an area that consists of multiple surfaces without pre-selecting the surfaces, do the following:

1. Ensure that no surfaces are selected or that when you start the scan gesture, the initial click is on a non-selected surface.
2. Start the scan gesture and move your pointer over all the surfaces that you wish to use for the scan.
3. From the Measurement Strategy widget, select the **Patch** option from the **Scan Type** list if required.
4. From the Graphic Display window, click a minimum of four points on the CAD to define your scan.

   As you move the pointer and select the points, PC-DMIS selects the surfaces and generates the quick scan as shown below:



Example of a Patch Quick Scan generated on multiple non-selected surfaces.

Probe Results

Results with a Scanning Probe

When the active probe is a scanning type of probe, PC-DMIS sets the parameters in the **Linear Open Scan** dialog box as follows:

- **Direction 1 Tech** list = NULLFILTER
- **Execute** list = **Defined**
- **Nominals** list = **FIND NOMS**

PC-DMIS uses the other parameters in the dialog box to create the scan.

If the curve is 3D, PC-DMIS selects the **CAD comp** check box on the **Execution** tab in the **Linear Open Scan** dialog box. If the curve is 2D, PC-DMIS clears the check box.

Results with a Touch Trigger Probe

When the active probe is a touch trigger type of probe, PC-DMIS sets the parameters in the **Linear Open Scan** dialog box as follows:

- **Direction 1 Tech** = **LINE**
- **Execute** list = **Normal**

- **Nominals** list = **MASTER**
- **Hit Type** list = **VECTOR**

PC-DMIS uses the other parameters in the dialog box to create the scan.

Using a Quick Scan to Create Points

To use the Quick Scan functionality to generate points instead of scans, do one of the following:

- Select the **Point Only Mode** icon on the **Probe Mode** toolbar (**View | Toolbars | Probe Mode**).
- Select the **Point Only Mode** check box on the **General** tab in the **Setup Options** dialog box (**Edit | Preferences | Setup**).

A quick scan in Curve Mode or Surface Mode generates points instead of scans.

The generated points are grouped in the Edit window, and the group appears collapsed. The ID of the group is set to the ID of the scan. For example:

```
SCN1 =GROUP/SHOWALLPARAMS=NO
   EXECUTION CONTROL=AS MARKED
   ENDGROUP/ID=SCN1
```

Performing Basic Scans

PC-DMIS supports scans that are classified under a type called "basic scans". These scans are feature-based scans. That is, you could define a feature such as a circle or cylinder to be measured along with the appropriate parameters. PC-DMIS then executes a scan that uses the appropriate basic scanning capability.

The following basic scan options are available on the **Insert | Scan** menu if your TTP or analog probe is placed into DCC Mode: **Circle**, **Cylinder**, **Axis**, **Center**, and **Line**.

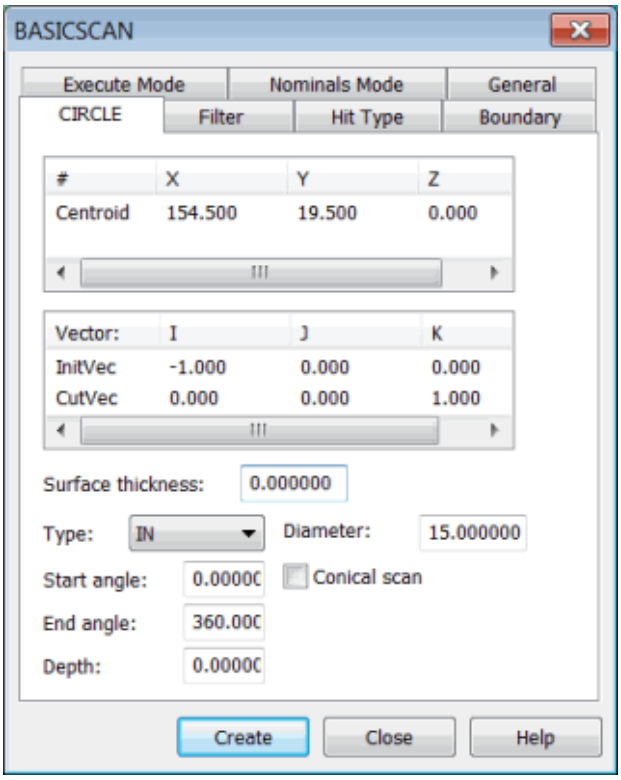
The **Center** option is only available for an analog probe head.

Advanced scans in PC-DMIS are composed of basic scans. While PC-DMIS does not allow you to pick basic scans from a list and create advanced scans from them, you can copy and paste basic scans into advanced scans that you have already created. For more information, see "Performing Advanced Scans".

This chapter covers the common functions that are available on each basic scan's tab in the **BASICSCAN** dialog box. It then describes how to perform the basic scan. For detailed information about the options on the other tabs in the dialog box, see the "Common Functions of the BASICSCAN Dialog Box" topic in the "Scanning Your Part" chapter in the PC-DMIS Core documentation.

Performing a Circle Basic Scan

To scan a circle feature, select **Insert | Scan | Circle**. The **CIRCLE** tab in the **BASICSCAN** dialog box appears. For example:



BASICSCAN dialog box - CIRCLE tab

This tab takes parameters such as the circle's center and diameter and enables the CMM to execute the scan.

The circle method:

- Enables use of the **DISTANCE** or **NULLFILTER** type on the **Filter** tab.
- Enables use of only the **VECTOR** type on the **Hit Type** tab.
- Does not need a boundary condition set on the **Boundary** tab.

The **Centroid** parameter in the # column is the center of the circle. You can directly type the center of the circle. Or, it can be obtained from the machine or CAD.

Defining a Circle Basic Scan

You can define a circle basic scan in one of these ways:

- Directly type the values. See "Circle Basic Scan - Type Values Method".
- Physically measure the points on the circle. See "Circle Basic Scan - Measured Point Method".
- Click on the circle in the CAD model in the Graphic Display window. See "Circle Basic Scan - Surface Data Method" or "Circle Basic Scan - Wireframe Data Method".

Once you create the scan, PC-DMIS inserts it into the Edit window. You can see in the following code the command line for a circle basic scan in the Edit window:

```
SCN2 =BASICSCAN/CIRCLE,NUMBER OF HITS=80,SHOW
HITS=NO,SHOWALLPARAMS=YES
    <25.399,76.2,0>,CutVec=0,0,1,IN
    InitVec=-1,0,0,DIAM=25.4,ANG=0,ANG=360,DEPTH=0,THICK
NESS=0,CCE=NO,
    PROBECOMP=YES,AVOIDANCE MOVE=NO,DISTANCE=0
    FILTER/DISTANCE,1
    EXEC MODE=FEATURE,USEHSSDAT=YES,USEDELAYPNTS=NO
    BOUNDARY/
    HITTYPE/VECTOR
    NOMS MODE=MASTER
    ENDSCAN
```

General Definitions for Basic Circle Scan

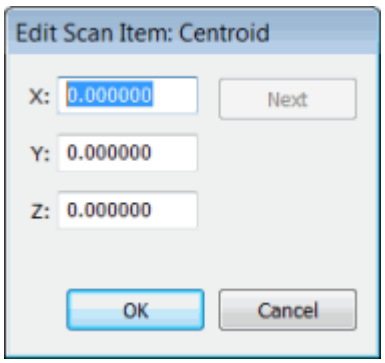
- **Centroid**: Center of the circle.
- **CutVec**: Defines the plane in which the circle lies.
- **InitVec**: The surface normal vector of the point the scan defines as 0 degrees. The scan will start at this location plus the **Start angle** degrees. It can also be thought of as a zero angle vector.

The **CutVec** and **InitVec** are normal to each other.

Circle Basic Scan - Type Values Method

Use this method to type the X, Y, and Z values of a circle's centroid, and the I, J, and K values of the **CutVec** and **InitVec** vectors.

1. Double-click on the centroid in the # column in the **BASICSCAN** dialog box (**Insert | Scan | Circle**). The centroid's **Edit Scan Item** dialog box appears:



Edit Scan Item - Centroid Dialog Box

The title bar of the dialog box displays the ID of the specific parameter being edited.

1. Edit the **X**, **Y**, and **Z** values.
2. Click **OK** to apply your changes or click **Cancel** to close the dialog box without saving.
4. Repeat this same procedure to type the circle's **CutVec** and **InitVec** values.

For more information about the **BASICSCAN** dialog box and the circle basic scan, see "Performing a Circle Basic Scan".

Circle Basic Scan - Measured Point Method

To generate a circle without the use of CAD data, take three hits in the hole (or on the stud). PC-DMIS calculates the circle using all three hits.

You can take additional hits. PC-DMIS uses the data from all of the measured hits.

- The **Centroid** that appears in the **BASICSCAN** dialog box (**Insert | Scan | Circle**) is the calculated center of the hole (or stud).
- The **CutVec** is automatically calculated from the plane defined by the three hits.
- The **InitVec** of the circle is calculated based on the first of the three hits that are used to calculate the circle.
- The **Angle** is calculated as the angle of the arc from the first hit to the last hit.

For more information about the **BASICSCAN** dialog box and the circle basic scan, see "Performing a Circle Basic Scan".

Circle Basic Scan - Surface Data Method

To generate a circle using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ( ).

2. Position the mouse pointer either outside or inside the desired circle.
3. Click once on a surface near the circle.

The **BASICSCAN** dialog box (**Insert | Scan | Circle**) displays the X, Y, and Z center point, diameter, and vectors for the circle from the selected CAD data.

- The **CutVec** is taken from the plane in which the circle lies. This comes from the CAD model.
- The **InitVec** is arbitrarily set from the CAD model. If the circle lies in the Y or Z plane, it is -X if it is an inner circle. It is +X if it is an outer circle.

  If the circle lies in the X plane, it is +Z if it is an inner circle. It is -Z if it is an outer circle.

For more information about the **BASICSCAN** dialog box and the circle basic scan, see "Performing a Circle Basic Scan".

Circle Basic Scan - Wireframe Data Method

You can also use wireframe CAD data to generate a circular scan.

To generate a circle:

1. Click near the desired wire on the circle. PC-DMIS highlights the selected wire.
2. Verify that the correct feature has been selected.

The **BASICSCAN** dialog box (**Insert | Scan | Circle**) displays the values of the selected circle's center point and diameter once the wire has been indicated.



If the underlying CAD element is not a circle or an arc, additional clicks may be necessary to identify the feature. If PC-DMIS does not highlight the correct feature, try to click on at least two additional points near the circle.

- The **CutVec** is taken from the plane in which the circle lies. This comes from the wireframe CAD model.
- The **InitVec** is arbitrarily set from the wireframe CAD model. If the circle lies in the Y or Z plane, it is -X if it is an inner circle. It is +X if it is an outer circle.

  If the circle lies in the X plane, it is +Z if it is an inner circle. It is -Z if it is an outer circle.

For more information about the **BASICSCAN** dialog box and the circle basic scan, see "Performing a Circle Basic Scan".

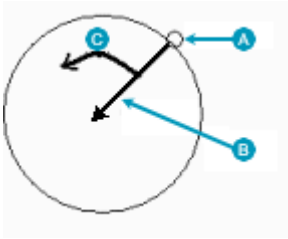
Circle Basic Scan - CAD Data Method

The following options in the **BASICSCAN** dialog box (**Insert | Scan | Circle**) apply to this method. For more information about this dialog box and the circle basic scan, see "Performing a Circle Basic Scan".

Type

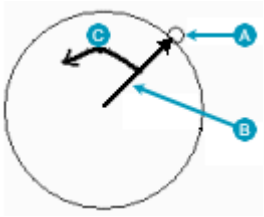
The **Type** list has these options:

- **IN**: A hole



A *- Starting point*
B *- Initial vector*
C *- Angle*

- **OUT**: A stud



A *- Starting point*
B *- Initial vector*
C *- Angle*

- **PLANE**: A plane circle executed on the plane that the circle is lying on.

Angle

The **Angle** box displays the angle (in degrees to scan) from the start point. Both positive angles and negative angles can be used.

- Positive angles are considered counterclockwise.
- Negative angles are considered clockwise.
- The **CutVec** is considered the axis about which the angle rotates.

Diameter

The **Diameter** box displays the diameter of the circle.

Depth

The **Depth** box displays the depth value that is applied against the **CutVec** direction. Both positive and negative values can be used.



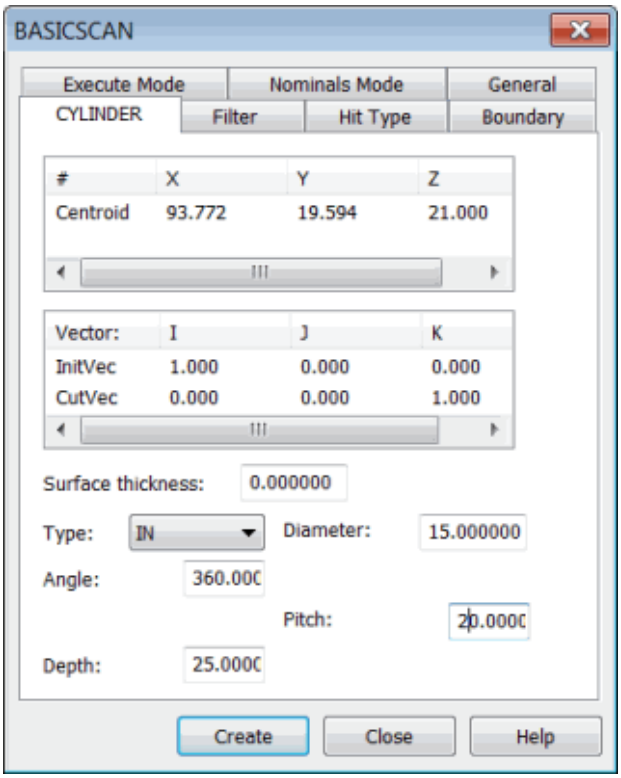
If the circle has a center of 1.0,1.0,3.0, a **CutVec** of 0.0,0.0,1.0, and a depth of 0.5, the circle center is set to 1.0, 1.0, 2.5 during execution. If a depth of -0.5 is used for the same circle, the centroid is shifted to 1.0,1.0,3.5 during execution.

Conical Scan

The **Conical scan** check box allows for proper scan compensation on cones or spheres. This check box lets you scan more quickly when not perpendicular to the part surface. PC-DMIS continues to monitor the probe force as needed.

Performing a Cylinder Basic Scan

To scan a cylinder feature, select **Insert | Scan | Cylinder** to open the **CYLINDER** tab in the **BASICSCAN** dialog box:



BASICSCAN dialog box - CYLINDER tab

This tab takes parameters such as the cylinder's diameter and pitch and enables the controller to execute the scan.

The cylinder method:

- Enables the **DISTANCE** on the **Filter** tab.

- Enables the **VECTOR** type on the **Hit Type** tab.
- Does not need a boundary condition set on the **Boundary** tab.

The **Centroid** parameter in the # column controls the scan execution. This point is the cylinder center from which the execution starts. You can directly type the center of the cylinder, or you can get it from the machine or CAD.

Defining a Cylinder Basic Scan

You can define a cylinder basic scan in one of these ways:

- Directly type the values. See "Cylinder Basic Scan - Type Values Method".
- Physically measure the points on the cylinder. See "Cylinder Basic Scan - Measured Point Method".
- Click on the cylinder in the CAD model in the Graphic Display window. See "Cylinder Basic Scan - Surface Data Method" or "Cylinder Basic Scan - Wireframe Data Method".

Once you create the scan, PC-DMIS inserts it into the Edit window. You can see in the following code the command line for a cylinder basic scan in the Edit window:

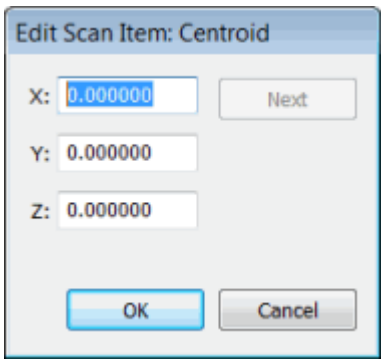
```
   SCN1 =BASICSCAN/CYLINDER,NUMBER OF HITS=80,SHOW
HITS=NO,SHOWALLPARAMS=YES
      <25.399,25.4,0>,CutVec=0,0,1,IN

InitVec=-1,0,0,DIAM=25.4,ANG=360,PITCH=5,DEPTH=0,THICKNESS=0
,
      PROBECOMP=YES,AVOIDANCE MOVE=NO,DISTANCE=0
      FILTER/DISTANCE,1
      EXEC MODE=FEATURE,USEHSSDAT=YES,USEDELAYPNTS=NO
      BOUNDARY/
      HITTYPE/VECTOR
      NOMS MODE=MASTER
      ENDSCAN
```

Cylinder Basic Scan - Type Values Method

Use this method to type the X, Y, and Z values of the cylinder's centroid and vectors.

1. Double-click on the desired centroid point in the # column in the **BASICSCAN** dialog box (**Insert | Scan | Cylinder**). The centroid's **Edit Scan Item** dialog box appears:



Edit Scan Item - Centroid Dialog Box

The title bar of the dialog box displays the ID of the specific parameter being edited.

1. Edit the **X**, **Y**, and **Z** values.
2. Click **OK** to apply your changes or click **Cancel** to close the dialog box without saving.
4. Use this same procedure to edit the cylinder's **CutVec** and **InitVec** values.

For more information about the **BASICSCAN** dialog box and the cylinder basic scan, see "Performing a Cylinder Basic Scan".

Cylinder Basic Scan - Measured Point Method

To generate a cylinder without the use of CAD data:

1. Take three hits on the surface to find the axis vector of the cylinder.
2. Take three additional hits in the hole (or on the stud). PC-DMIS calculates the diameter of the cylinder using all three hits.

You can take additional hits. PC-DMIS uses the data from all of the measured hits.

- The **Centroid** that appears in the **BASICSCAN** dialog box (**Insert | Scan | Cylinder**) is the calculated center of the hole (or stud).
- The **CutVec** is the cylinder axis.
- The **InitVec** of the cylinder is calculated based on the first of the last three hits that are used to calculate the diameter of the cylinder.
- The **Angle** is calculated as the angle of the arc from the first hit used to calculate the diameter of the cylinder to the last click.

For more information about the **BASICSCAN** dialog box and the cylinder basic scan, see "Performing a Cylinder Basic Scan".

Cylinder Basic Scan - Surface Data Method

To generate a cylinder using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ().
2. Position the mouse pointer either outside or inside the desired cylinder.
3. Click once on a surface near the cylinder.

The **BASICSCAN** dialog box (**Insert | Scan | Cylinder**) displays the center point and diameter from the CAD data of the selected sheet metal cylinder once the third point has been indicated.

If PC-DMIS detects additional mouse clicks, it finds the best cylinder near all of the hits.

- The **CutVec** is the cylinder axis.
- The **InitVec** of the cylinder is calculated based on the first click.
- The angle is calculated as the angle of the arc from the first click to the last click.

For more information about the **BASICSCAN** dialog box and the cylinder basic scan, see "Performing a Cylinder Basic Scan".

Cylinder Basic Scan - Wireframe Data Method

You can also use wireframe CAD data to generate a cylindrical scan.

To generate a cylinder:

1. Click near the desired wire on the cylinder. PC-DMIS highlights the selected wire.
2. Verify that the correct feature has been selected.

The **BASICSCAN** dialog box (**Insert | Scan | Cylinder**) displays the values of the selected cylinder's center point and diameter once the wire has been indicated.

> If the underlying CAD element is not a cylinder or an arc, you may need to perform additional clicks to identify the feature. If PC-DMIS does not highlight the correct feature, try to click on at least two additional locations of the cylinder.

- **CutVec**: This vector is the axis of the cylinder and the plane in which the scanning is done.

- **InitVec**: This vector describes the direction in which the probe takes its first hit to start the scan. This vector is calculated according to the mode of data entry. This vector and the **CutVec** are normal to each other.

For more information about the **BASICSCAN** dialog box and the cylinder basic scan, see "Performing a Cylinder Basic Scan".

Cylinder Basic Scan - CAD Data Method

PC-DMIS calculates the **InitVec** of a cylinder based on the first click that is used to calculate the cylinder with this method.

The following options in the **BASICSCAN** dialog box (**Insert | Scan | Cylinder**) apply to this method. For more information about the **BASICSCAN** dialog box and the cylinder basic scan, see "Performing a Cylinder Basic Scan".

Type

The **Type** list has these options:

- **IN**: Select this option for a hole.
- **OUT**: Select this option for a stud.

Angle

The **Angle** box displays the angle (in degrees to scan) from the start point. You can use both positive and negative angles.

- Positive angles are considered counterclockwise.
- Negative angles are considered clockwise.
- The **CutVec** is considered the axis about which the angle rotates. The angle can be over 360 degrees, and the scan continues for more than one revolution.



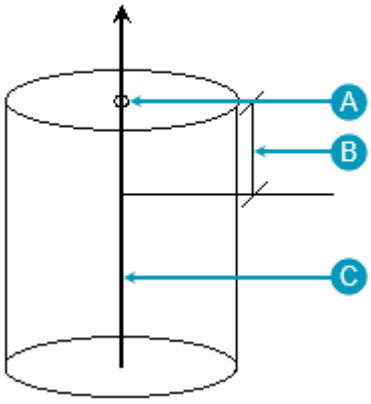
If you entered an angle of 720 degrees, the scan would execute two revolutions.

Diameter

The **Diameter** box displays the diameter of the cylinder.

Depth

The **Depth** box displays the depth value that is applied against the **CutVec** direction:



***A** - Centroid*
***B** - Depth*
***C** - CutVec*

If the cylinder has a center of 1,1,3, a CutVec of 0,0,1, and a depth of 0.5, the cylinder's center is set to 2.5 during execution.

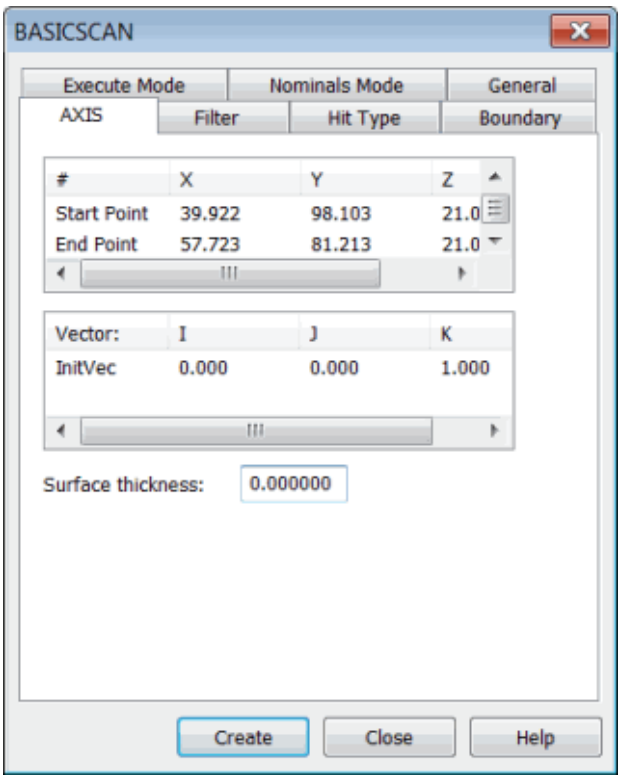
Pitch

The **Pitch** box displays the distance along the **CutVec** between the start and end of the scan when it does one complete revolution of 360 degrees. The cylinder's pitch can have a positive or negative value. When it is combined with the **CutVec** and the angle, it controls the direction of the scan up/down the cylinder axis.

If the cylinder has a **CutVec** of 0,0,1, a pitch value of 1.0, and a positive angle of 720, the scan would execute two revolutions and would move up the axis of the cylinder two units from the start point. If a negative pitch is entered for the same cylinder, the scan would execute down the axis of the cylinder two units.

Performing an Axis Basic Scan

To scan a straight line feature, select **Insert | Scan | Axis**. The **AXIS** tab in the **BASICSCAN** dialog box appears:



BASICSCAN dialog box - AXIS tab

This tab takes the start point and end point of the line, and enables you to execute the scan.

The axis method:

- Allows use of the **DISTANCE** option on the **Filter** tab.
- Allows use of the **VECTOR** type on the **Hit Type** tab.
- Does not need a boundary condition set on the **Boundary** tab.

The parameters that control the scan execution are:

- **Start Point**: This point is the start point from which the execution starts.
- **End Point**: This point is the end point at which the execution ends.

You can directly type the points, or they can be obtained from the machine or CAD.

Defining an Axis Basic Scan

You can define an axis basic scan in one of these ways:

- Directly type the values. See "Axis Basic Scan - Type Values Method".
- Physically measure the points on the part. See "Axis Basic Scan - Measured Point Method".

- Click points to define the axis in the CAD model in the Graphic Display window. See "Axis Basic Scan - Surface Data Method" or "Axis Basic Scan - Wireframe Data Method".

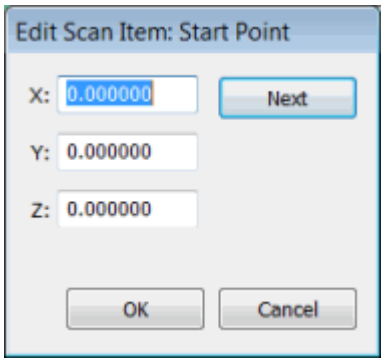
Once you create the scan, PC-DMIS inserts it into the Edit window. You can see in the code below the command line for an axis basic scan in the Edit window:

```
SCN3 =BASICSCAN/AXIS,NUMBER OF HITS=10,SHOW
HITS=NO,SHOWALLPARAMS=YES
    <75.149,90.467,0>,<78.2,62.832,0>
    InitVec=0,0,1,THICKNESS=0,PROBECOMP=YES,AVOIDANCE
MOVE=NO,DISTANCE=0
    FILTER/DISTANCE,2.54
    EXEC MODE=FEATURE,USEHSSDAT=YES,USEDELAYPNTS=NO
    BOUNDARY/
    HITTYPE/VECTOR
    NOMS MODE=FINDNOMS,10
    ENDSCAN
```

Axis Basic Scan - Type Values Method

Use this method to type the X, Y, and Z values of the start and end points for an axis basic scan.

1. Double-click on the desired point in the # column in the **BASICSCAN** dialog box (**Insert | Scan | Axis**). The **Edit Scan Item** dialog box appears:



Edit Scan Item Dialog Box

The title bar of the dialog box displays the ID of the specific parameter being edited.

1. Edit the **X**, **Y**, and **Z** values.
2. Click **OK** to apply your changes or click **Cancel** to close the dialog box without saving.
4. Use this same procedure to edit the **CutVec** and **InitVec** values of the axis.

For more information about the **BASICSCAN** dialog box and the axis basic scan, see "Performing an Axis Basic Scan".

Axis Basic Scan - Measured Point Method

To generate a line without the use of CAD data:

1. Select the desired point in the list in the **BASICSCAN** dialog box (**Insert | Scan | Axis**).
2. Take a hit on the part. This completes the values for that point.

The **CutVec** is the normal vector of the plane in which the straight line lies.

For more information about the **BASICSCAN** dialog box and the axis basic scan, see "Performing an Axis Basic Scan".

Axis Basic Scan - Surface Data Method

To generate a line using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ().
2. Select **Start Point** from the list in the **BASICSCAN** dialog box (**Insert | Scan | Axis**).
3. Click on the part in the Graphic Display window to define the start point.
4. Select **End Point** from the list in the dialog box.
5. Click on the part in the Graphic Display window to define the end point.

PC-DMIS completes the necessary values in the list.

For more information about the **BASICSCAN** dialog box and the axis basic scan, see "Performing an Axis Basic Scan".

Axis Basic Scan - Wireframe Data Method

Wireframe CAD data also can be used to generate points for a line.

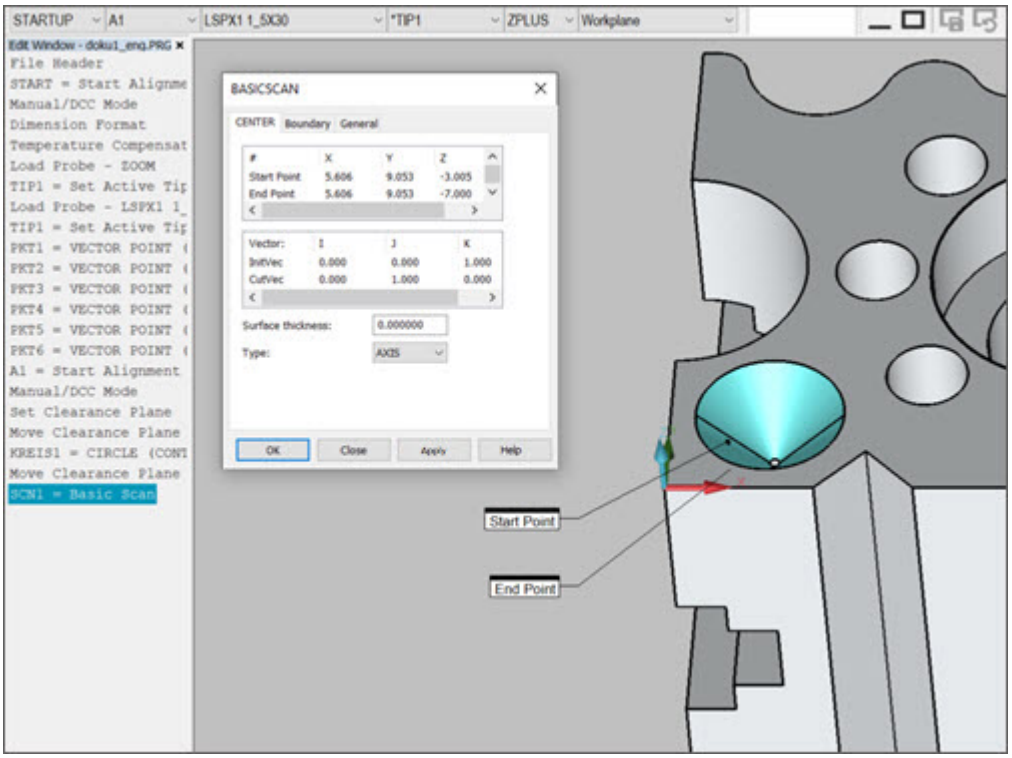
Click near the desired wire on the axis. PC-DMIS highlights the entire selected wire. It also completes the **Start Point** and **End Point** items in the **BASICSCAN** dialog box (**Insert | Scan | Axis**) with the start and end points of the selected wire.

The **CutVec** is the normal vector of the plane in which the straight line lies.

For more information about the **BASICSCAN** dialog box and the axis basic scan, see "Performing an Axis Basic Scan".

Performing a Center Basic Scan

To find a Low/High point in an area, select **Insert | Scan | Center**. The **CENTER** tab in the **BASICSCAN** dialog box appears:



BASICSCAN dialog box - CENTER tab

This tab takes a start point of the scan and an end point and enables the controller to execute the scan. The output from this scan is a single point only.

For the center method, you do not need to set a boundary condition on the **Boundary** tab.

These parameters control the scan execution:

- **Start Point**: This point is the start point from which the execution starts.
- **End Point**: This point is the end point at which the execution ends.

You can directly type the points or obtain them from the machine or CAD.

Defining a Center Basic Scan

You can define a center basic scan in one of these ways:

- Directly type the values. See "Center Basic Scan - Type Values Method".
- Physically measure the points on the part. See "Center Basic Scan - Measured Point Method".

- Click on the points on the CAD model in the Graphic Display window. See "Center Basic Scan - Surface Data Method" or "Center Basic Scan - Wireframe Data Method".

Once you create the scan, PC-DMIS inserts it into the Edit window. You can see in the code below the command line for a center basic scan in the Edit window:

```
SCN4 =BASICSCAN/CENTER,NUMBER OF HITS=1,SHOW
HITS=NO,SHOWALLPARAMS=YES

    <5.606,9.053,-3.005>,<5.606,9.053,-7.000>,CutVec=0,0
    ,1,AXIS

    InitVec=0,1,0,IN,THICKNESS=0,AVOIDANCE
    MOVE=NO,DISTANCE=0

    FILTER/DISTANCE,2.54

    EXEC MODE=RELEARN

    BOUNDARY/

    HITTYPE/VECTOR

    NOMS MODE=MASTER

ENDSCAN
```

Example of a Center Basic Scan

Suppose you have a "V" shaped block, where the "V" is in the Y axis of the machine and the apex of the "V" is in the Y+ direction of the part coordinate system:



Top-down (Z+) view of a V-Block with "V" apex in Y+ direction
***A** - Apex*

PLANE Method

To have a center basic scan find the apex of the "V" using the "PLANE" method, do the following:

1. Take a hit where you want the scan to start (on one of the sides of the V). PC-DMIS populates the **BASICSCAN** dialog box (**Insert | Scan | Center**) with the X, Y, and Z point information.
2. Give the start point and end point values the same X, Y, and Z values.
3. Ensure that the **InitVec** vector (initial vector) is 0,-1,0.

4. Ensure that the **CutVec** vector (cut vector) is 0,0,1.
5. Select **PLANE** from the **Type** list.
6. Click **Create**. PC-DMIS scans down the "V" to find its apex by searching for the lowest point along the initial vector.

AXIS Method

To have a center basic scan find the apex of the "V" using the "**AXIS**" method, do the following:

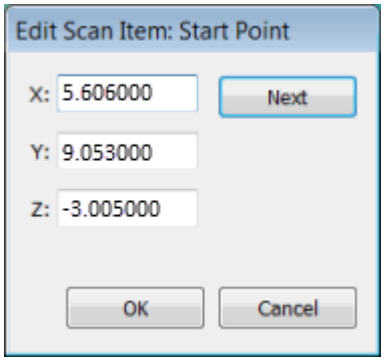
1. Take a hit where you want the scan to start (on one of the sides of the V). PC-DMIS populates the **Scan** dialog box with the X, Y, and Z point information.
2. Give the start point and end point values the same X and Z values. Then offset the Y of the end point into the material of the part.
3. Make sure the **InitVec** vector (initial vector) is 0,-1,0.
4. Make sure the **CutVec** vector (cut vector) is 0,0,1.
5. Select **AXIS** from the **Type** list.
6. Click **Create**. PC-DMIS scans down the "V" to find its apex by searching for the lowest point along the initial vector.

For more information about the **BASICSCAN** dialog box and the center basic scan, see "Performing a Center Basic Scan".

Center Basic Scan - Type Values Method

Use this method to type the X, Y, and Z values of the start and end points for a center basic scan.

1. Double-click the desired point in the # column in the **BASICSCAN** dialog box (**Insert | Scan | Center**). The **Edit Scan Item** dialog box appears:



Edit Scan Item Dialog Box

The title bar of the dialog box displays the ID of the specific parameter being edited.

1. Edit the **X**, **Y**, and **Z** values.
2. Click **OK** to apply your changes or click **Cancel** to close the dialog box without saving.
4. Use this same procedure to edit the center's **CutVec** and **InitVec** values.

For more information about the **BASICSCAN** dialog box and the center basic scan, see "Performing a Center Basic Scan".

Center Basic Scan - Measured Point Method

To generate a center basic scan without the use of CAD data:

1. Select the desired point in the list in the **BASICSCAN** dialog box (**Insert | Scan | Center**).
2. Take a hit on the part. This completes the values for that point.

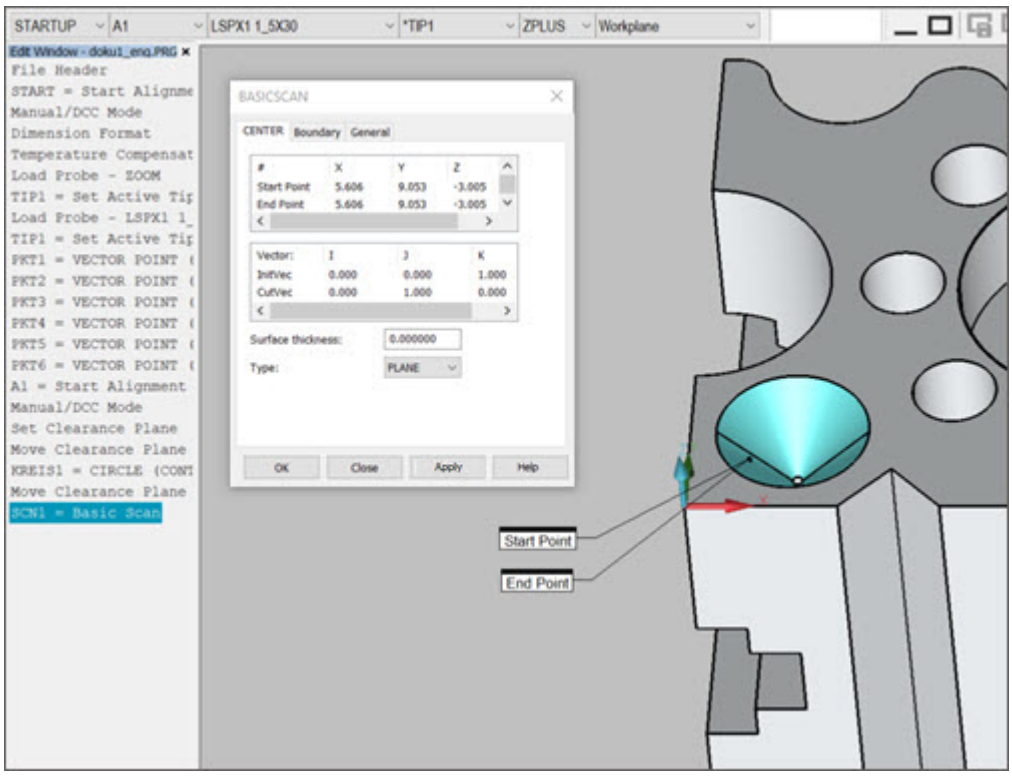
The **CutVec** is the normal vector of the plane in which the probe remains free while centering is done by the controller. The **InitVec** is the initial approach vector at the start point.

For more information about the **BASICSCAN** dialog box and the center basic scan, see "Performing a Center Basic Scan".

Center Basic Scan - Surface Data Method

To generate a centering scan using surface data:

1. From the **Graphic Modes** toolbar (**View | Toolbars | Graphic Modes**), click the **Surface Mode** icon ().
2. Select the desired point in the list in the **BASICSCAN** dialog box (**Insert | Scan | Center**).
3. Click on a location in the Graphic Display window. PC-DMIS completes the necessary values in the list.



For more information about the **BASICSCAN** dialog box and the center basic scan, see "Performing a Center Basic Scan".

Center Basic Scan - Wireframe Data Method

You can use wireframe CAD data to generate points.

To generate points, click near the desired wire on the center to highlight it. PC-DMIS finds the closest point in the wire to the clicked location and completes the values in the list in the **BASICSCAN** dialog box **(Insert | Scan | Center**).

- **CutVec**: This vector is the normal vector of the plane in which the probe remains free as centering happens.
- **InitVec**: This vector is the approach vector of the probe at the start point.

Type

You can use the following types of centering methods:

- **Axis**: The start point (S) is projected on the defined axis (A). The resulting point is (SP). The InitVec is projected in the plane defined by the projected point (SP) and the axial direction (A). The direction (N) thus defined is vertical to the axial direction. Thereafter, as centering is performed, the probe's center point remains in the plane defined by the axial direction and (SP). Centering takes with/against the direction (N) as an input, and the probe tip is free in the direction defined by the axial direction (A) crossing the direction (N).

  S = Start point

A = Defined axis/axial direction

SP = Projected start point

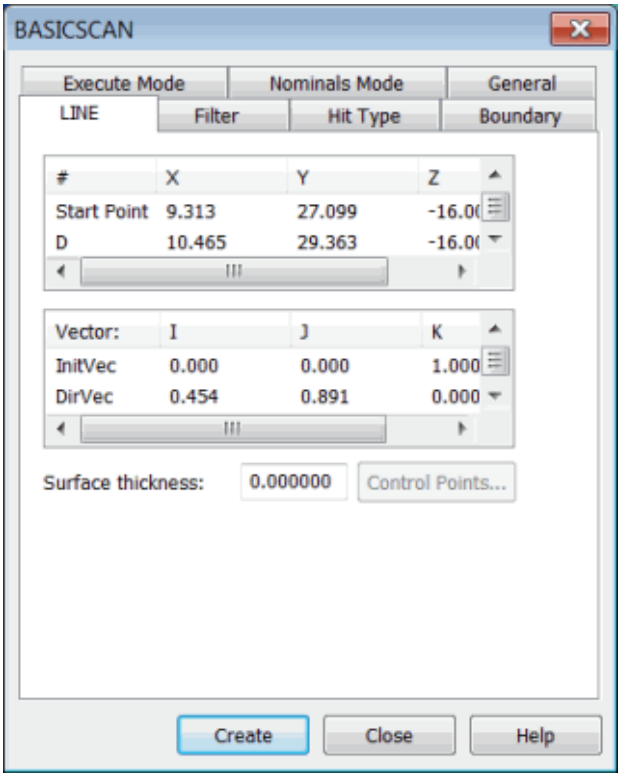
N = Direction vertical to the axial direction

- **Plane**: After the CMM probes the point defined by the start point, it centers with/ against the probe direction while remaining free in the plane defined by the **CutVec**.

For more information about the **BASICSCAN** dialog box and the center basic scan, see "Performing a Center Basic Scan".

Performing a Line Basic Scan

To scan the surface along a line, select **Insert | Scan | Line**. The **LINE** tab in the **BASICSCAN** dialog box appears:



BASICSCAN dialog box - LINE tab

This scan needs a start point, a direction point, and an end point. It uses the start and end points for the line, and the direction point to calculate the cut plane. The probe always remains within the cut plane while doing the scan.

The line basic scan also uses the following vectors for execution:

- **InitVec**: The initial touch vector indicates the surface vector of the first point in the scanning process.

- **CutVec**: The cut plane vector is the cross product of the **InitVec** and the line between the start and end point. If there is no end point, the line between the start point and direction point is used.
- **EndVec**: The end vector is the approach vector at the end point of the line scan.
- **DirVec**: The direction vector is the vector from the start point to the direction point.

The cut vector is the cross product of the initial touch vector and the line between the start and end points.

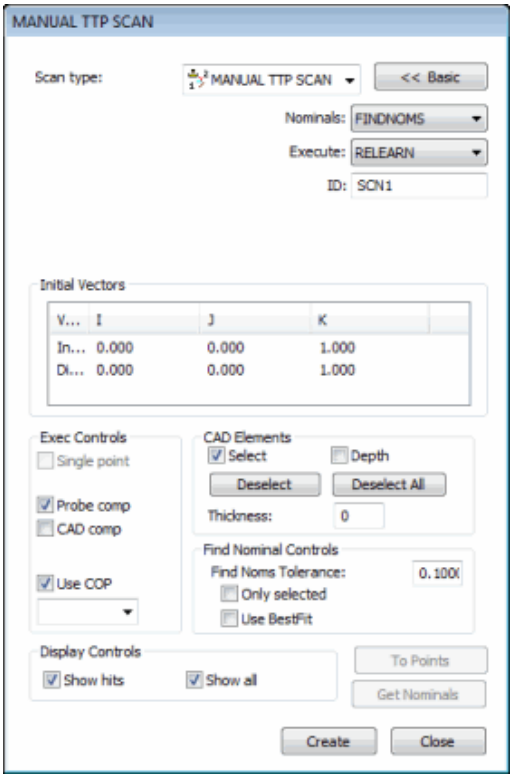
Defining a Line Basic Scan

1. Select the start point in the # column, and then either double-click it to type in a value, or click on the CAD model to select a point from the selected surface.
2. Select the direction point (**D**) in the # column, and then either double-click it to type in a value, or click on the CAD model to select a point from the selected surface.
3. Select the end point in the # column, and then either double-click it to type in a value, or click on the CAD model to select a point from the selected surface.
4. Modify the vectors as needed.
5. Complete the options on any other tabs as needed in the **BASICSCAN** dialog box, and then click **OK**. PC-DMIS inserts the line scan into the Edit window.

The Edit window command line for a line basic scan is:

```
SCN5 =BASICSCAN/LINE,NUMBER OF HITS=16,SHOW
HITS=NO,SHOWALLPARAMS=YES
   <194.592,96.658,0>,<208.587,92.377,0>,CutVec=0.2925585,0.
9562476,0,
   DirVec=0.9562476,-0.2925585,0
   InitVec=0,0,1,EndVec=0,0,1,THICKNESS=0,PROBECOMP=YES,AVOI
DANCE MOVE=NO,DISTANCE=0
   FILTER/DISTANCE,1
   EXEC MODE=RELEARN
   BOUNDARY/
PLANE,<208.587,92.377,0>,PlaneVec=-0.9562476,0.2925585,0,Cro
ssings=1
   HITTYPE/VECTOR
   NOMS MODE=NOM,10
   ENDSCAN
```

Introduction to Performing Scans Manually



A Manual TTP Scan dialog box

The manual method of scanning enables you to define a point measurement by manually scanning the surface of a part. This is particularly useful when user-controlled CMM measurement hits are desired.

There are two types of manual scans.

- Manual scans using a touch trigger probe (TTP)
- Manual scans using a hard probe

To begin creating manual scans, from the **Probe Modes** toolbar, place PC-DMIS into **Manual Mode** () and then select one of the available manual scan types from the **Scan** submenu. These include:

- Manual TTP (only available if you are using a TTP)
- Fixed Distance
- Fixed Time
- Fixed Time/Distance
- Body Axis
- Multisection

- Manual Freeform

The appropriate manual scan dialog box opens. For general information about the options in these dialog boxes, see the "Common Functions of the Scan Dialog Box" topic in the "Scanning Your Part" chapter in the PC-DMIS Core documentation.

Rules for Manual Scans

The following topics discuss rules governing manual scanning in general, rules for standard Horizontal and Bridge CMMs, and Arm CMMs.

Rules for Manual Scans in General

You should perform a manual scan along the machine axis (the X, Y, or Z axis):



Suppose that your part requires a scan along the surface of a sphere. To do this scan:

1. Lock the Y axis. This is done by using a lock switch on your CMM. You can set this switch to ON/OFF to prevent or allow movement in a particular axis.
2. Begin scanning in the +X direction.
3. Unlock the Y axis, and move to the next row along +Y or -Y.
4. Lock the Y axis again.
5. Scan back in the reverse (-X) direction.

When you do multiple rows of manual scans, we recommend that you reverse every other scan line. The internal algorithms depend on this kind of regularity and could give poor results if the scheme is not followed.

To do this:

1. Begin the scan along the surface in the +X direction.
2. Move to the next row, and scan along the -X axis.
3. Continue to switch the direction of the scan as needed.

Compensation Limitations



PC-DMIS automatically takes hits in a three-dimensional manner whenever you perform supported manual scans using a hard probe.

With Fixed Distance, Fixed Time / Distance, and Fixed Time scans, PC-DMIS automatically takes manual hits in a three-dimensional manner in any direction. This is useful when scanning using free-moving manual CMMs (such as a Romer or Faro arm) whose axes cannot be locked.

Since you can move the probe in any direction, PC-DMIS cannot accurately determine the proper probe compensation (or the Input and Direction vectors) from the measured data.

There are two solutions to the compensation limitations:

- *If CAD surfaces exist*, then you can select **FINDNOMS** from the **Nominals** list. PC-DMIS attempts to find the nominal values for each measured point in the scan. If the nominal data is found, then the point is compensated along the found vector, allowing proper probe compensation. Otherwise, it remains at Ball Center.
- *If CAD surfaces do not exist*, then probe compensation does not occur. All data remains at Ball Center.

Rules for Using Standard Horizontal and Bridge CMMs

The following description contains rules you should follow to have manual scanning compensate correctly and with greater speed on standard Horizontal and Bridge types of CMMs.

Fixed Distance Scans, Fixed Time Scans, and Fixed Time / Distance Scans

- You must lock one axis of the CMM during the scan. PC-DMIS takes the scan in a plane perpendicular to the locked axis.
- On each of these three types of scans, you must type the **InitVec** and **DirVec** values in the Machine Coordinate System. This is required because you are locking one of the machine axes.

Body Axis Scans

- You should not lock any axis during the scan. PC-DMIS takes the scan by crossing the probe over a keyed-in Body Axis location. Each time the probe crosses this given plane, the CMM takes a reading and passes it to PC-DMIS.
- On this type of scan, you need to type the **InitVec** and **DirVec** values in the Part Coordinate System. This is required so that the probe can traverse the body axis location indicated.
- Make sure you type the body axis in the Part Coordinate System.

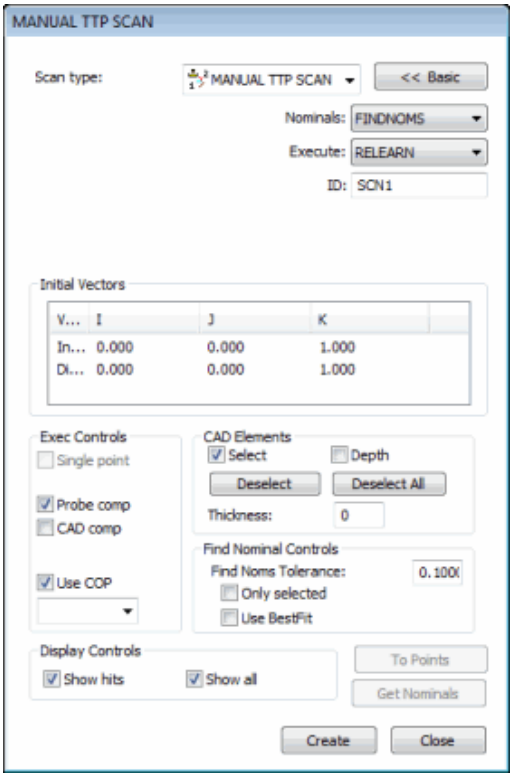
Rules for Using Arm CMMs (Gage 2000A, Faro, Romer)

The following description lists the rules that you need to follow to have manual scanning compensate correctly and with greater speed on Arm CMMs.

All Types of Manual Scans

- You should not lock any axis during the scan. PC-DMIS takes the scan by crossing the probe over a keyed-in body axis location. Each time the probe crosses this given plane, the CMM takes a reading and passes it to PC-DMIS.
- On this type of scan, you must type the **InitVec** and the **DirVec** values in the Part Coordinate System. This is required to work together with the body axis location.
- Make sure you type the body axis in the Part Coordinate System.

Performing Manual Scans with a Touch Trigger Probe



Manual TTP Scan dialog box

You can perform manual scans using a touch trigger probe (TTP). To do this:

1. Place PC-DMIS into Manual Mode.
2. Access the **Manual TTP Scan** dialog box (**Insert | Scan | Manual TTP**).
3. Define the necessary parameters.
4. Click the **Create** button. PC-DMIS displays the **Execution** dialog box and requests that you take a hit.
5. Take the hits as requested.

6. At the end of the scan, click the **Scan Done** button  in the **Execution** dialog box to stop the scan.

Some scanning methods are not available when you use a touch trigger probe.

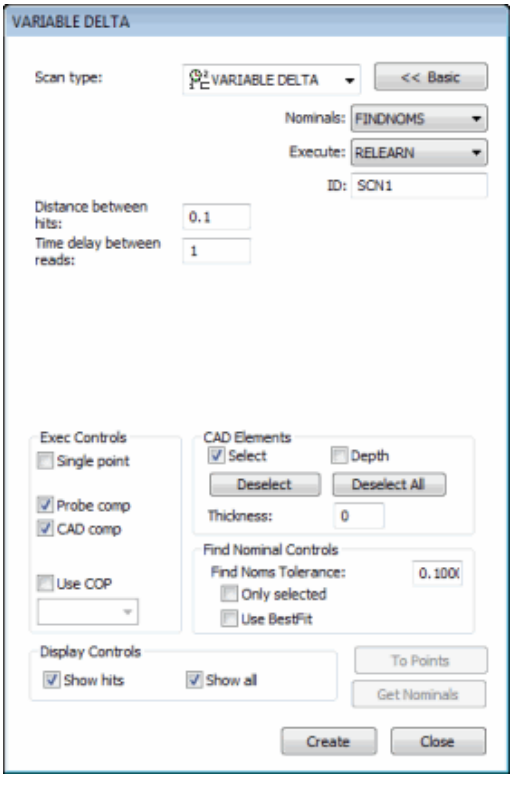
Performing Manual Scans with a Hard Probe

A hard probe must be used to access the four measurement methods. Manual scanning provides four different measurement methods that can be used with a hard probe. PC-DMIS collects the measured points as fast as they are read by the controller during the scanning process. Once the scan is complete, PC-DMIS provides the ability to reduce the collected data based on the scanning method you select.

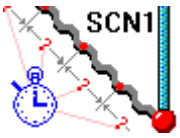
The four measurement methods with a hard probe are described below.

When a touch trigger probe is used, PC-DMIS requires individual hits be at each location. It does not offer the different measurement methods as described for a hard probe scan.

Performing a Variable Delta (Fixed Time/Distance) Manual Scan



Variable Delta Dialog Box



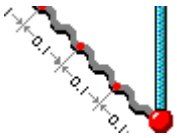
The **Fixed Time / Distance** method of scanning enables you to reduce the number of hits taken in a scan by specifying the distance the probe must move as well as the time that must pass before PC-DMIS can accept additional hits from the controller.

To create a fixed time / distance (variable delta) scan:

1. Open the **VARIABLE DELTA** dialog box (**Insert | Scan | Fixed Time/Distance**).
2. If you don't want to use the default name, specify a custom name for the scan in the **ID** box.
3. In the **Time delay between reads** box, type the time in seconds that needs to elapse before PC-DMIS takes a hit.

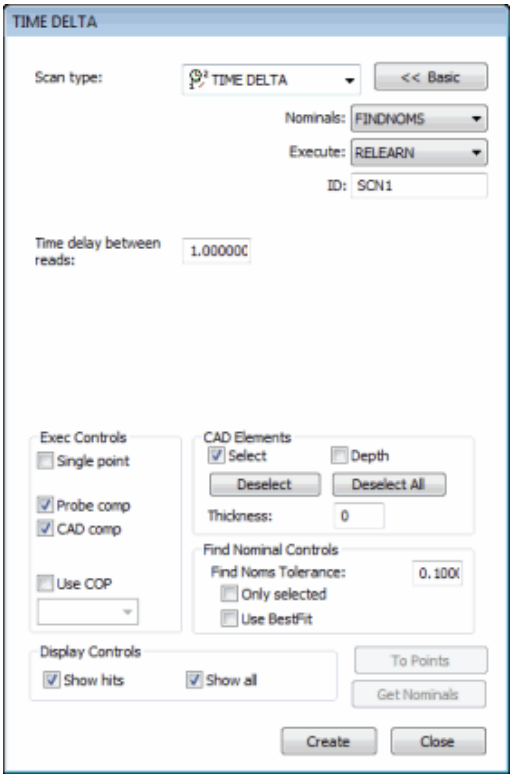
   
   Time in Seconds
4. In the **Distance between hits** box, type the distance that the probe needs to move before PC-DMIS takes a hit. This is the 3D distance between points.

   > If you type 5, and your unit of measurement is millimeters, the probe has to move at least 5 mm from the last point before PC-DMIS accepts a hit from the controller.

   
   Distance
5. If you're using a CAD model, type a find nominals tolerance in the **Find Nominal Controls** area. This defines how far away the actual ball center point can be from the nominal CAD location.
6. Set any other dialog box options as needed.
7. Click **Create**. PC-DMIS inserts the basic scan.
8. Execute your measurement routine. When PC-DMIS executes the scan, the **Execution Options** dialog box appears. PC-DMIS waits for data to come from the controller.
9. Manually drag the probe over the surface you want to scan.

PC-DMIS checks the amount of time elapsed and the distance the probe moves. Whenever the time and distance exceed the values specified, it accepts a hit from the controller.

Performing a Fixed Time Manual Scan



Time Delta Dialog Box

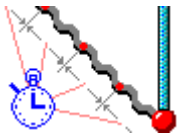
The **Fixed Time** method of scanning allows you to reduce the scan data by setting a time increment in the **Time Delay Between Reads** box. PC-DMIS starts from the first hit and reduces the scan by deleting hits that are read in faster than the specified time delay.



If you specify a time increment of 0.05 seconds, then PC-DMIS only keeps hits from the controller that are measured at least 0.05 seconds apart. It excludes the other hits from the scan.

To create a fixed time (time delta) scan:

1. Open the **TIME DELTA** dialog box (**Insert | Scan | Fixed Time**).
2. If you don't want to use the default name, specify a custom name for the scan in the **ID** box.
3. In the **Time delay between reads** box, type the time in seconds that needs to elapse before PC-DMIS takes a hit.

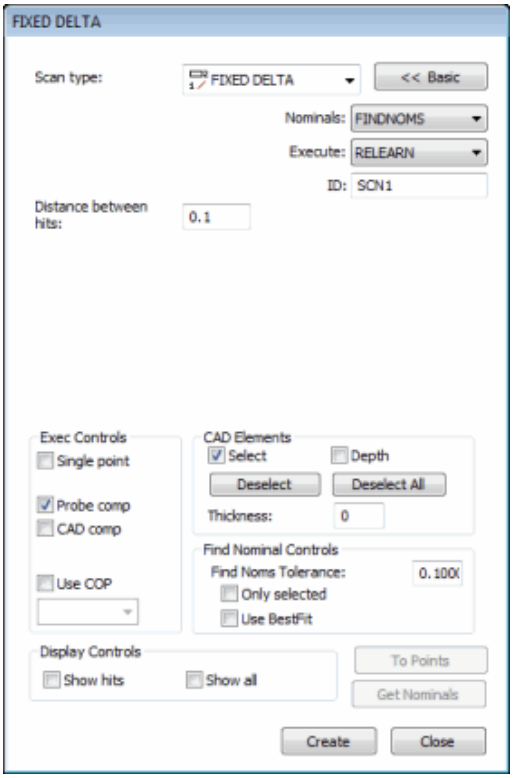


Time in Seconds

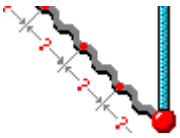
4. If you're using a CAD model, type a find nominals tolerance in the **Find Nominal Controls** area. This defines how far away the actual ball center point can be from the nominal CAD location.
5. Set any other dialog box options as needed.
6. Click **Create**. PC-DMIS inserts the basic scan.
7. Execute your measurement routine. When PC-DMIS executes the scan, the **Execution Options** dialog box appears. PC-DMIS waits for data to come from the controller.
8. Manually drag the probe over the surface you want to scan.

   Whenever the elapsed time exceeds the values specified in the **Time delay between reads** box, PC-DMIS accepts a hit from the controller.

Performing a Fixed Distance (Delta) Manual Scan



Fixed Delta Dialog Box



The **Fixed Distance** scan method enables you to reduce the measured data by setting a distance value in the **Distance between hits** box. PC-DMIS starts from the first hit and reduces the scan by deleting hits that are closer than the distance specified. The reduction of hits happens as data comes from the machine. PC-DMIS only keeps the points that are set apart by more than the specified increments.

If you have specified an increment of 0.5, PC-DMIS only keeps the hits that are at least 0.5 units apart from each other. It discards the rest of the hits from the controller.

To create a Fixed Distance (Delta) scan:

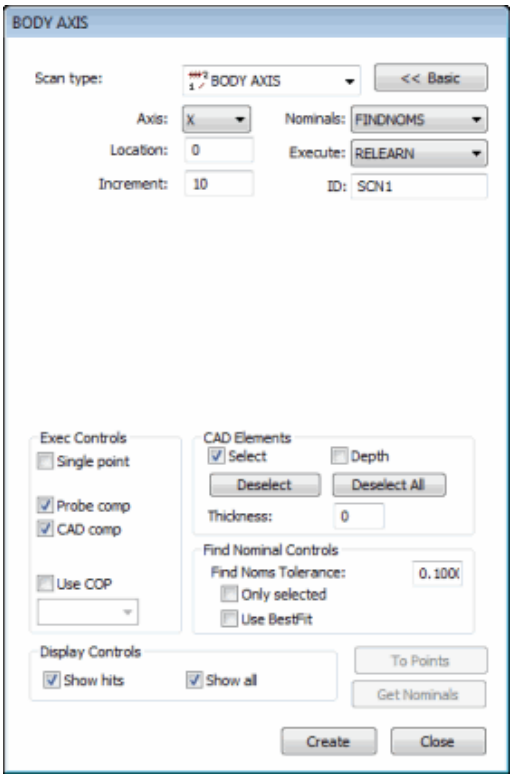
1. Open the **FIXED DELTA** dialog box (**Insert | Scan | Fixed Distance**).
2. If you don't want to use the default name, specify a custom name for the scan in the **ID** box.
3. In the **Distance between hits** box, type the distance that the probe needs to move before PC-DMIS takes a hit. This is the 3D distance between points.

   If you type 5, and your unit of measurement is millimeters, the probe has to move at least 5 mm from the last point before PC-DMIS accepts a hit from the controller.

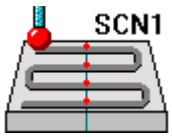
4. If you're using a CAD model, type a find nominals tolerance in the **Find Nominal Controls** area. This defines how far away the actual ball center point can be from the nominal CAD location.
5. Set any other dialog box options as needed.
6. Click **Create**. PC-DMIS inserts the basic scan.
7. Execute your measurement routine. When PC-DMIS executes the scan, the **Execution Options** dialog box appears. PC-DMIS waits for data to come from the controller.
8. Manually drag the probe over the surface you want to scan.

   PC-DMIS accepts hits from the controller that are separated by any distance greater than the distance you defined in the **Distance between hits** box.

Performing a Body Axis Manual Scan



Body Axis Dialog Box



Probe and Scan

The **Body Axis** scan enables you to scan a part by specifying a cut plane on a certain part axis and dragging the probe across the cut plane. As you scan the part, you should scan so that the probe crisscrosses the defined cut plane as many times as desired. PC-DMIS then follows this procedure:

1. PC-DMIS gets data from the controller and finds the two data hits that are closest to the cut plane on either side as you crisscross.

2. PC-DMIS then forms a line between the two hits, which pierces the cut plane.

3. The pierced point then becomes a hit on the cut plane.

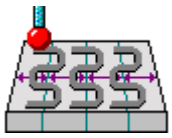
This operation happens every time you cross the cut plane. You will finally have many hits that are on the cut plane.

You can use this method to inspect multiple rows (PATCH) of scans by specifying an increment for the cut plane location. After PC-DMIS scans the first row, it moves the cut

plane to the next location by adding the current location to the increment. You can then continue scanning the next row at the new cut plane location.

To create a body axis scan:

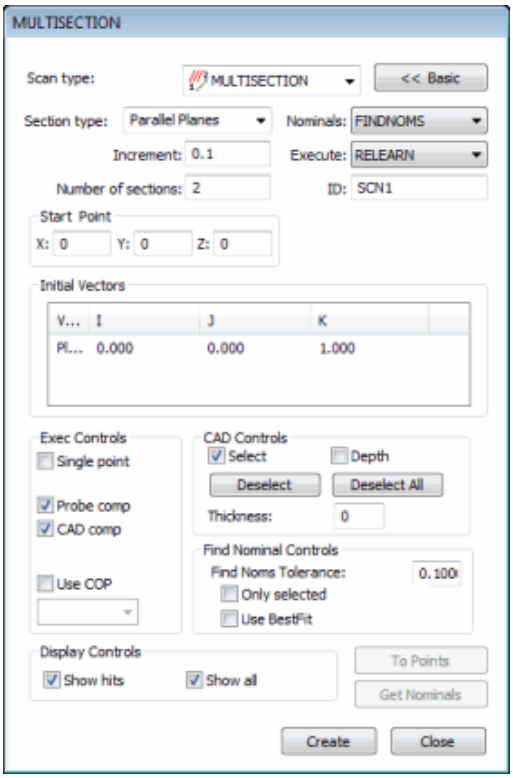
1. Open the **BODY AXIS** dialog box (**Insert | Scan | Body Axis**).
2. If you don't want to use the default name, specify a custom name for the scan in the **ID** box.
3. From the **Axis** list, select an axis. The available axes are X, Y, and Z. The cut plane that your probe crisscrosses will be parallel to this axis.
4. In the **Location** box, specify a distance from the defined axis where your cut plane is located.
5. In the **Increment** box, specify the distance between planes if you will be scanning across multiple planes.



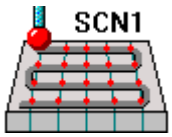
Distance

6. If you're using a CAD model, type a find nominals tolerance in the **Find Nominal Controls** area. This defines how far away the actual ball center point can be from the nominal CAD location.
7. Set any other dialog box options as needed.
8. Click **Create**. PC-DMIS inserts the basic scan.
9. Execute your measurement routine. When PC-DMIS executes the scan, the **Execution Options** dialog box appears. PC-DMIS waits for data to come from the controller.
10. Manually drag the probe back and forth over the surface that you want to scan. As the probe approaches a defined cut plane, a continual audible tone is heard that gradually increases in pitch until the probe crosses the plane. This audible cue helps you determine how close the probe is to any cut planes. PC-DMIS accepts hits from the controller each time the probe crosses the defined plane.

Performing a Multisection Manual Scan



Multisection Dialog Box



Probe and Scan

The **Multisection** method of scanning functions much like the Body Axis manual scan with these differences:

- It can cross multiple sections.

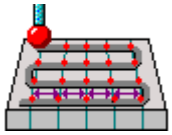
  Sections are areas (either planes or circles) on your part which, if crossed by the probe, cause a point to be taken at that location.

- It does not have to be parallel to the X, Y, or Z axis.

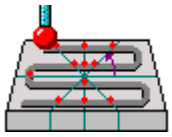
To create a multisection scan:

1. Open the **MULTISECTION** dialog box (**Insert | Scan | Multisection**).
2. If you don't want to use the default name, specify a custom name for the scan in the **ID** box.
3. From the **Section type** list, choose the type of sections that you want to scan. The available types include:

- Parallel Planes - The sections are planes running through your part. Every time the probe crosses a plane, PC-DMIS records a hit. Planes are relative to the start point and direction vector. If you select this type, define the vector of the initial plane in the **Initial Vectors** area.

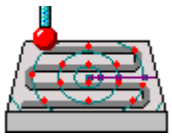


- Radial Planes - These sections are planes that radiate out from the start point. Every time the probe crosses a plane, PC-DMIS takes a hit. If you select this type, define two vectors in the **Initial Vectors** area:



  - The vector of the initial plane (PlaneVec)
  - The vector around which the planes are rotated (AxisVec)

- Concentric Circles - These sections are concentric circles with increasingly larger diameters centered around the start point. Every time the probe crosses a circle, PC-DMIS takes a hit. If you select this type, define a single vector in the **Initial Vectors** area which defines the plane in which the circle lies (AxisVec).

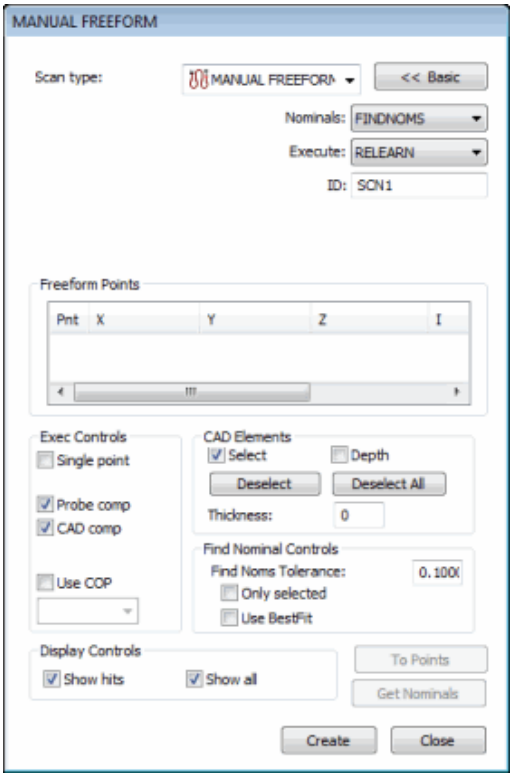


4. In the **Number of Sections** box, type how many sections you want to have in your scan.
5. If you chose at least two sections, specify the increment between sections in the **Increment** box. For parallel planes and circles, this is the distance between planes. For radial planes, this value is an angle. PC-DMIS automatically spaces the sections on the part.
6. Define the scan's start point. In the **Start Point** area, type the X, Y, and Z values. Or, click on your part to have PC-DMIS select the start point from the CAD drawing. The sections are calculated from this temporary point based on the increment value.
7. If you're using a CAD model, type a find nominals tolerance in the **Find Nominal Controls** area. This defines how far away the actual ball center point can be from the nominal CAD location.
8. Set any other dialog box options as needed.

9. Click **Create**. PC-DMIS inserts the basic scan.
10. Execute your measurement routine. When PC-DMIS executes the scan, the **Execution Options** dialog box appears. PC-DMIS waits for data to come from the controller.
11. Manually drag the probe over the surface that you want to scan. As the probe approaches each section, a continual audible tone is heard that gradually increases in pitch until the probe crosses the section. This audible cue helps you determine how close the probe is to a section crossing. PC-DMIS accepts hits from the controller each time the probe crosses the defined section(s).

    See the "Common Functions of the Scan Dialog Box" topic for information on the other controls in this dialog box.

Performing a Freeform Manual Scan



Manual Freeform Dialog Box

The **Manual Freeform** scan lets you create a freeform scan with a hard probe. This scan doesn't require an initial or direction vector, like many of the other manual scans. Similar to its DCC counterpart, all you need to do to create a freeform scan is to click points on the surface you want to scan.

To create a Manual Freeform scan:

1. Open the **MANUAL FREEFORM** dialog box (**Insert | Scan | Manual Freeform**).
2. Click the **Advanced>>** button to display the tabs at the bottom of the dialog box.

3. Click on the surface of the part in the Graphic Display window to define your scan's path. With each click, an orange point appears on the part drawing.

4. Once you have sufficient points for your scan, click **Create**. PC-DMIS inserts the scan into the Edit window.

Glossary

#
: Number

CCW
: Counterclockwise

CW
: Clockwise

DCC
: Direct Computer Control

Discrete Hit
: Discrete hits are individual hit measurements. The minimum number of discrete hits for a measured circle, for example, is three. This differs from a scan measurement which may include many more hits depending on the size of the circle and the properties of the scan.

mm
: Millimeters

ms
: Milliseconds

PMM
: This is a CMM brand manufactured by Leitz.

PRBRDV
: Probe Radial Deviation. This is the deviation type used for discrete hit measurement.

Pt.
: Point

SCNRDV
: Scan Radial Deviation. This is the deviation type used for scan-type measurements.

TTP
: Touch Trigger Probe

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