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Introduction

The objective of this manual is to provide a tutorial to help users getting started with the procedures to create a part program. By going through this tutorial, users will be familiar with the operations required to create a part program using CADPath. It is highly recommended that users should be familiar with the MeasureMax Level 1 for DCC to work with this tutorial.

The topics covered are listed as follows:

- Introduction
- System Requirements
- Installing CADPath
- Prepare IGES CAD Model for CADPath
- Launch CADPath from MeasureMax Quick Teach
- Import an IGES CAD File into CADPath
- Construct Path Reference Frame
- Setup Probe Dimension
- Setup Tip Selection Interval
- Assign a Name to a Path
- Create Inspection Points for Datum Alignment
- Create a CMM Path
- Modify Inspection Path
- Create a New Path
- Construct a CAD Reference
- Generate Inspection Points
- Construct a MP Reference Frame
- Map a MP Reference Frame to a CAD Reference Frame:
- Report a Feature to Multiple Reference Frames
- Playback CMM Path
- Switch MeasureMax to On-Line Operation
- Sensor Definition and Naming Convention
- Create a Tip File
- Calibrating Tips Defined in a Tip File
- Construct the Reference Frame #1 Manually On-Line Using CMM
- Verify CMM Path
- Verify CMM Path for Datum Alignment
- Export CMM Path for Datum Alignment
- Export CMM Path to a Part Program

This tutorial provides a step-by-step working example on major CADPath functions and users should use the on line help for detailed information on each CADPath function.

System Requirements

Currently, CADPath is only available for IBM PC-compatible Pentium class computers running Windows 95 or Windows NT 4.0. For better performance, it is recommended that the system should have sufficient memory (32Mb or more is highly recommended).

Installing CADPath

CADPath comes with a hardware protection key, which should be attached to the parallel port of the computer. If a printer cable is connected to the parallel port, you can first attach the key to the parallel port and then attach the printer cable to the key. The hardware key will be transparent to the printer.

To Install CADPath:

- Insert the diskette labeled "CADPath Installation Disk #1" into drive A: of your computer.
- Double click the "My Computer" icon on the desktop and then double click the floppy drive A:.



Setup

- Locate the Setup program and double click the icon to start the setup program.
- Follow the instruction of the setup program.
- At the end of the installation, user has to reboot the computer to be able to run CADPath.

Prepare IGES CAD Model for CADPath

CADPath supports commonly used **IGES** geometric entities listed in the table below. This table can also be served as a guideline for the CAD users to export **IGES** files for inspection using CADPath.

IGES Entity Types Supported by CADPath

IGES Entity Type #	Entity Type	IGES Entity Type #	Entity Type
100	Circular Arc	118	Ruled Surface
102	Composite Curve	120	Surface of Revolution
104	Conic Arc	122	Tabulated Cylinder
106	Copious Data	124	Transformation Matrix
108	Plane	126	Rational B-Spline Curve
110	Line	128	Rational B-Spline Surface
112	Parametric Spline Curve	142	Curve on a Parametric Surface
114	Parametric Spline Surface	144	Trimmed Parametric Surface

It is recommended that the CAD model to be exported as **wireframe** (containing boundary curves) together with the **trimmed surfaces**. If the CAD system doesn't have this option, the CAD model can be exported into two IGES files. The first one contains **wireframe** (boundary curves) only and the second one contains **trimmed surfaces**. These two files can be imported at the same time into CADPath to generate inspection part programs.

CADPath is an automatic inspection path generator based on the **CAD** model exported from various CAD systems. In general, **CADPath** can be used to create an inspection part program as long as the inspection points can be generated from the CAD model or imported from a text file. However, in order to perform collision detection and collision avoidance, it is recommended that the CAD model to be exported as trimmed surfaces. Furthermore, tolerance evaluations rely heavily on the curves such as lines, circles and eclipses etc. Using curves in the CAD model can simplify the tasks of creating inspection points and performing tolerance evaluations.

Note:

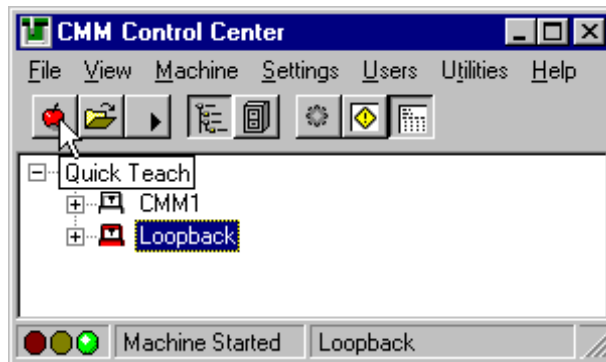
- In the CAD system, users can specify the types of geometric entities to be converted to equivalent IGES entities when the CAD model is exported.

Launch CADPath from MeasureMax Quick Teach

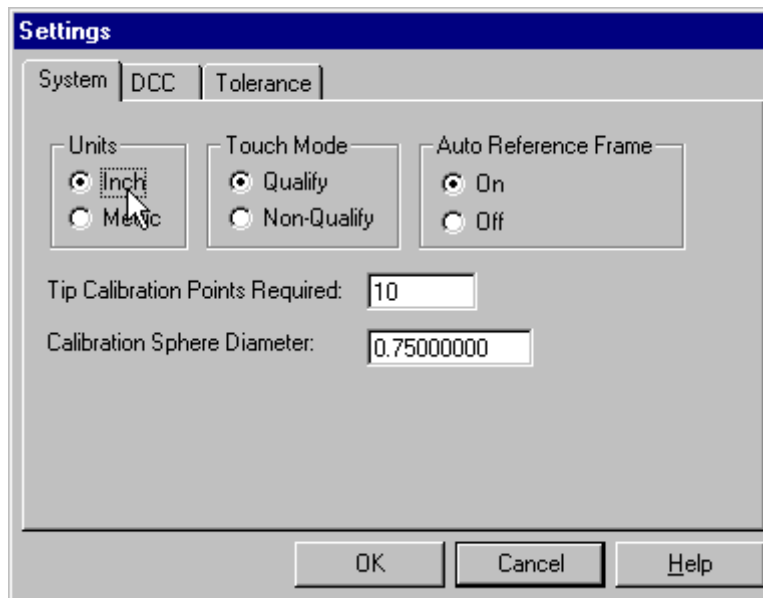
This section demonstrates the procedures on how to launch CADPath from MeasureMax


To launch **CADPath** from the **MeasureMax Quick Teach**:

- Start **MeasureMax**.
- Start **Loopback** for **off-line** operation.



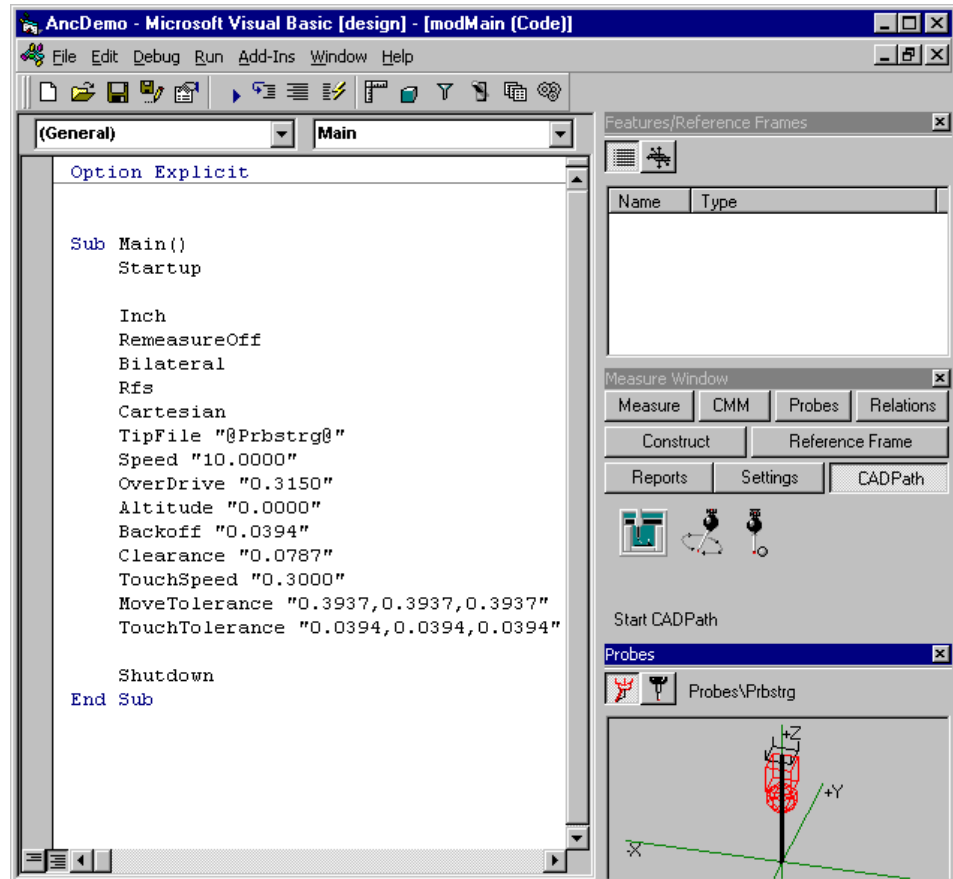
- From the **MeasureMax CMM Control Center**, select the menu item under **/Settings/System** and setup the **Working Units** to **Inch**.



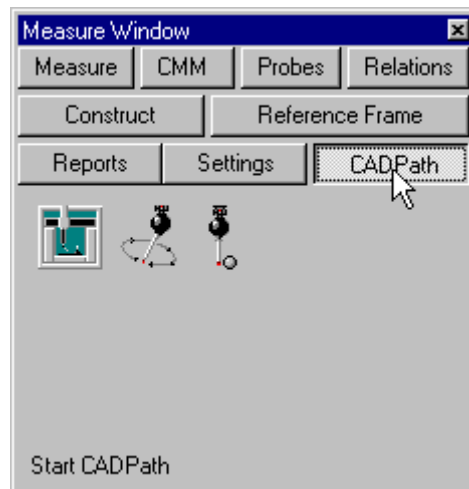
- Click on the **Apple**  to launch the **Visual Basic MeasureMax Teaching Shell**.

GETTING STARTED

- Under the **Quick Teach**, select **Save Project** under the **File Menu** and save current project as “AncDemo”.



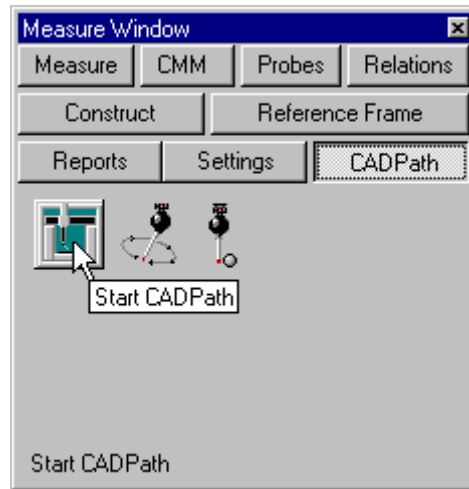
- Locate the **Measure Window** as shown below and click on the **CADPath** button to launch **CADPath**.



GETTING STARTED



- Locate the **Start CADPath** icon as shown in the next figure and click on it. **CADPath** will be launched and displayed on the top of the computer screen.



Note:

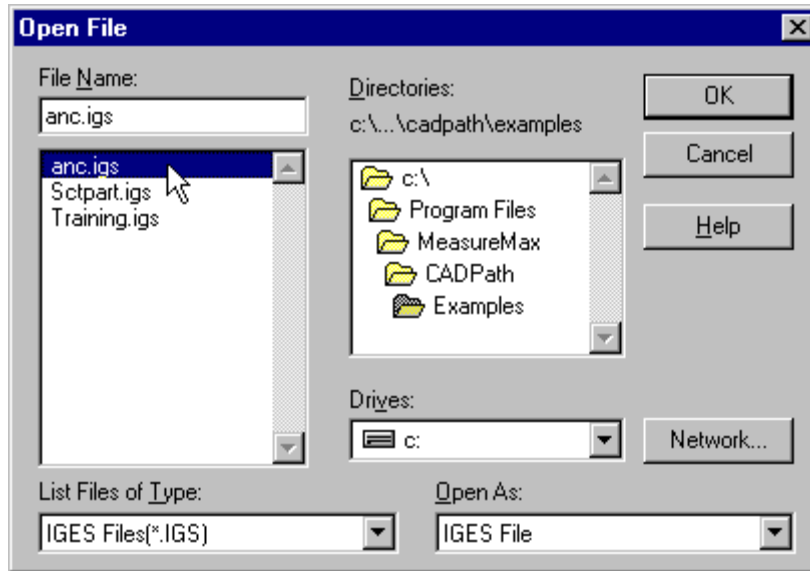
- It is very important that users specify the **right working units** before starting Quick Teach.

Import an IGES CAD File into CADPath


This section demonstrates the procedures on how to import an IGES CAD file into CADPath.

To import an IGES file into CADPath:

- Select the menu item **/File/Open** and the **Open File** dialog as shown below will prompt users to select the file to open.



- Under the “**Directories**” list box, locate the **CADPath** example directory “**c:\Program Files\MeasureMax\CADPath\Examples**”. Under the “**List Files of Type**”, click on the drop down list box and select the “**IGES Files (*.IGS)**”. The “**Open As**” drop down list box should display as “**IGES File**” at this time.
- Select the “**anc.igs**” under the “**File Name**” list box and then click on the “**OK**” button. The CAD model will be displayed in the view window in wireframe mode.

- Click on the shading icon  to display the CAD model in shaded mode. If the system prompts a message “**Automatic Correct Surface Normal**”, click on the “**YES**” button. If the CAD model is a solid, the model should be shaded in gray scale. If the CAD model is not a solid (the trimmed surfaces cannot enclose a closed volume) or CADPath failed to correct the surface normals automatically, then users might see surfaces displayed in **RED** which indicate the backface of surfaces.

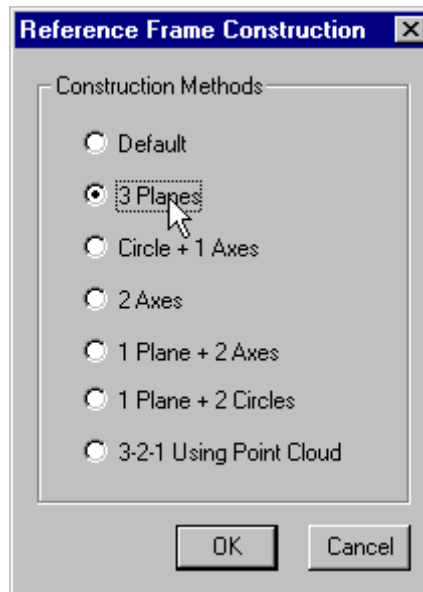
Construct Path Reference Frame

The first operation in CADPath after importing a CAD model is to construct a **Path Reference Frame**. The Path Reference Frame is the common reference between the CAD model in CADPath and part reference frame in CMM. The Path Reference Frame is the current active coordinate system in CADPath, which is the reference frame displayed in RGB (red, green and blue) colors. The Path Reference Frame for CMM is the reference frame #1 stored in MP (Measurement Processor).

The Path Reference Frame is the reference used to synchronize the coordinate system between CADPath and CMM. CADPath will recall reference frame #1("RR 1") in CADPath generated part programs prior to any motion drive command to be executed. It is a very important that the Path Reference Frame should be constructed and stored in the **MP reference #1** before CADPath generated part program can be executed.

To construct a path reference frame:

- Select the menu item **Alignments \CAD Reference Frame \Construct**. The **Reference Frame Construction** dialog as shown below will pop up. This is the dialog where users can select which construction method to be used to construct a CAD reference frame.

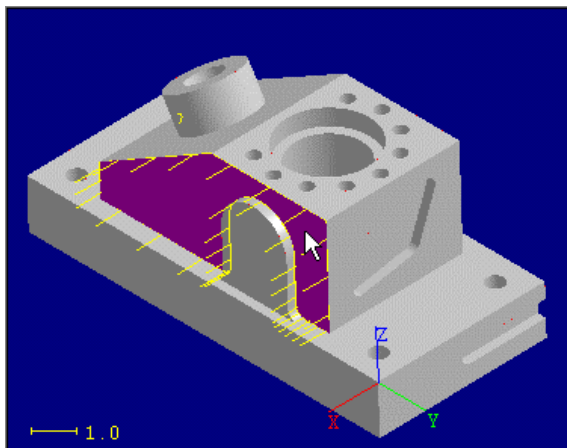
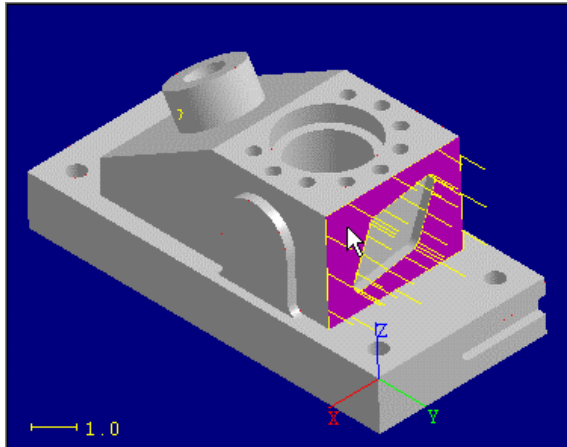
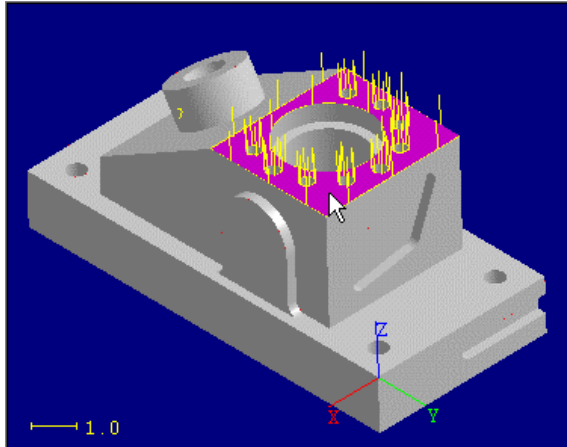


Note:

- The reference frame displayed in three different colors RGB is the **Path Reference Frame**.

GETTING STARTED

- Select the **“3 Planes”** reference frame construction method and select the three highlighted planes as displayed in the figures below.



- If the reference frame is constructed successfully, the **Modify Reference Frame** dialog will pop up. Please change the name from “CS1” to “RefFrame #1”. If the reference frame cannot be constructed, the **Modify Reference Frame** dialog will not show up on the screen. Users have to restart the reference frame construction procedures.

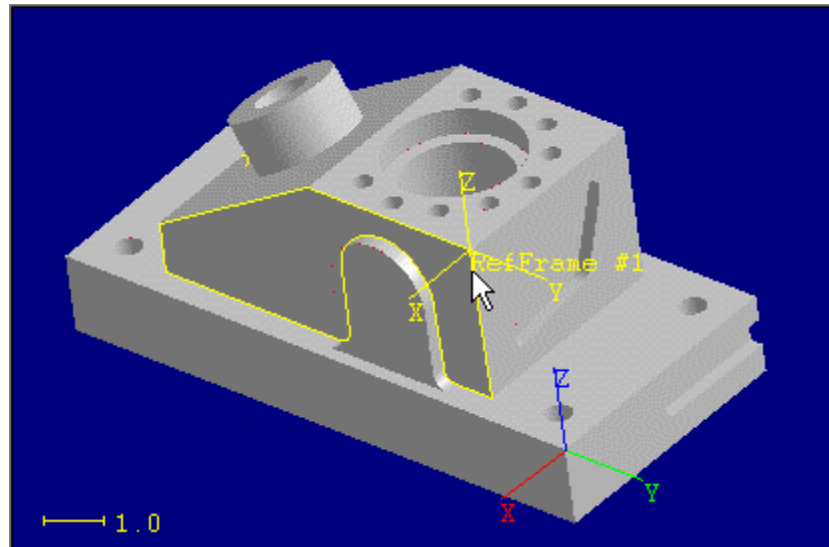


Note:

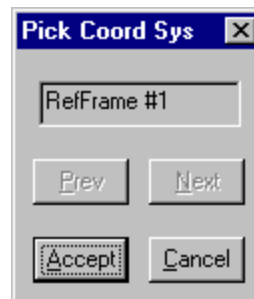
- Sometimes, the reference frame constructed does not have the right orientation, users can use combinations of **Flip the Main Axis**, **Switch the Axes between the Main Axis and the Target Axis** and **Rotate along the main Target Axis** to change the orientation of the reference frame.

GETTING STARTED

- If the reference frame is constructed successfully, the final result is as shown in the next figure.

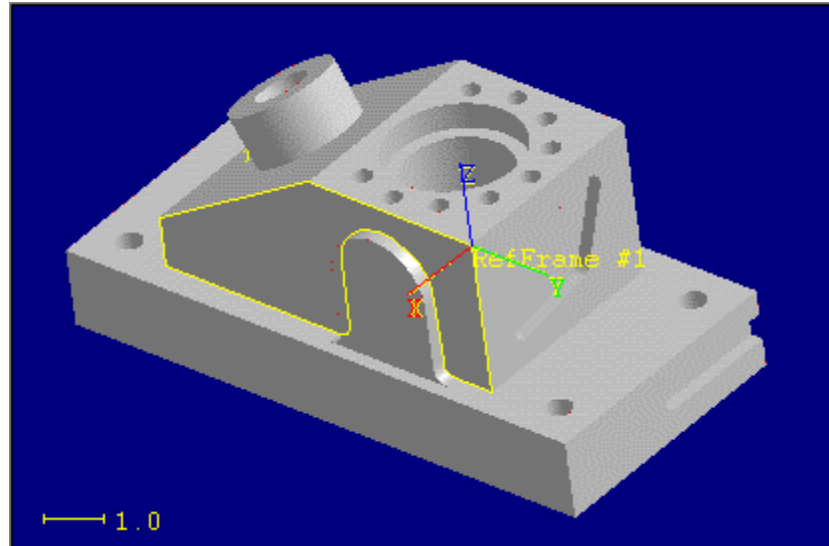


- **Recall** the previously constructed CAD reference frame and this reference frame becomes the **Path Reference Frame**. Select the menu item **\Alignments\CAD Reference Frame\Recall**. Move the mouse pointer to **point at the origin** of "RefFrame #1" and click on the left mouse button. The **Pick Coord Sys** dialog as shown below will pop up. Click on the "**Accept**" button to confirm the selection.



GETTING STARTED

- The **Path Reference Frame**, which is displayed in RGB, will be coincident with the reference frame named "**RefFrame #1**". This is the Path Reference Frame we are going to work on.



- Select the menu item **\File\Save** to save current model.

Note:

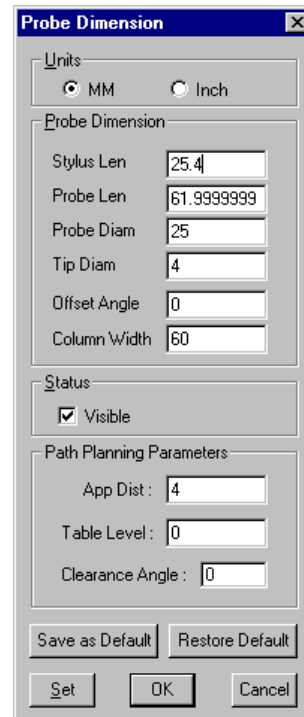
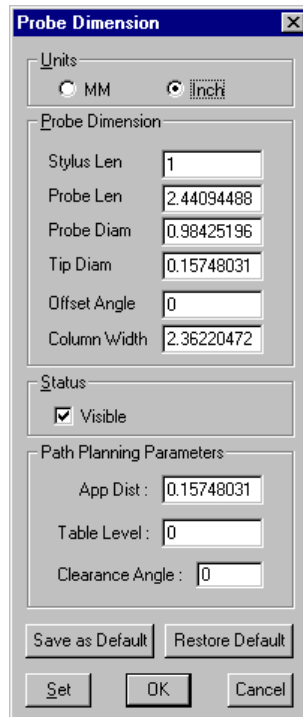
- There is only one Path Reference Frame in CADPath, which has to be constructed and recalled once and once only.

Setup Probe Dimension

The procedures to setup the probe dimension will be demonstrated in this section. The probe dimensions are specified based on the actual probe configuration. The parameters have to be specified correctly before we can create a valid inspection path.

To setup the probe dimension:

- Select the menu item under **Inspection \Setup \Probe Dimension**. The **Probe Dimension** dialog, as shown in the left figure below, will pop up. The current working units is **INCH** and the parameters in the **Probe Dimension** dialog display all the values in **INCH**. Users can click on the **MM** to convert all the parameters to millimeters and specify the dimensions based on millimeters. CADPath will convert all the parameters back to the working units when users close this dialog box.
- Check if the **Visible** check box is checked. The probe will not be displayed on the screen if the **Visible** flag is not checked. Change the dimension of the **Stylus Len** to “1” as shown on the left dialog and then click on the **Set** button. The display of the probe will be changed based on the value user specified in the dialog. Click on the **OK** button to close this dialog.

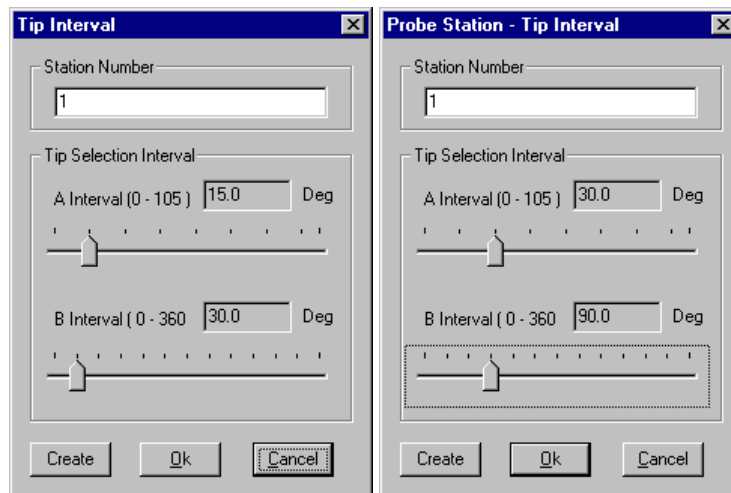


Setup Tip Selection Interval

There are two purposes to setup the probe interval. The first purpose is to setup the station number to be used for current inspection path. The second purpose is to constrain the available tips that can be used to generate the inspection path. There are two major advantages to limit the range of tip selection interval. The first advantage is to reduce the time to calibrate the tip. The second advantage is to speed up the inspection path generation.

To setup the tip selection interval:

- Select the menu item under **Inspection \Setup \Probe Interval**. The **Tip Interval** dialog as show on the left dialog below will pop up.



- Click on the indicator as show on the left dialog and then drag the indicator to change the **“A Interval”** from 15 degrees to 30 degrees.
- Repeat the previous operation and change the **“B interval”** from 30 degrees to 90 degrees.


Note:

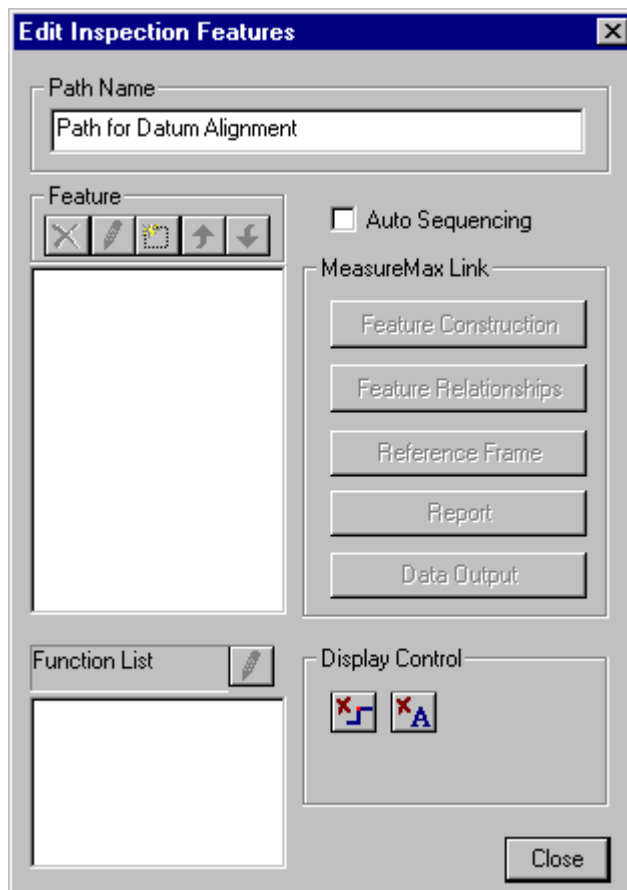
The **“Station Number”** in this dialog is to be used as an index to specify the names of the tips. The actual station been used is solely based on the configuration of the probe when the tip is calibrated. Please use the default value 1 if there is no probe changer or stylus changer.

Assign a Name to a Path

The purpose of this operation is to assign a name to an inspection path. The name of the path is to serve as a comment, which can be used to describe the task of this path.

To assign a name to a path:

- Select the menu item **Inspection \Insp. Points \Edit Properties** or click on the icon  to open the **Edit Inspection Properties** dialog. In the **Edit Inspection Properties** dialog as shown below, locate the **Path Name** edit box and change the name from "My New Path 0" to "Path for Datum Alignment".



Create Inspection Points for Datum Alignment

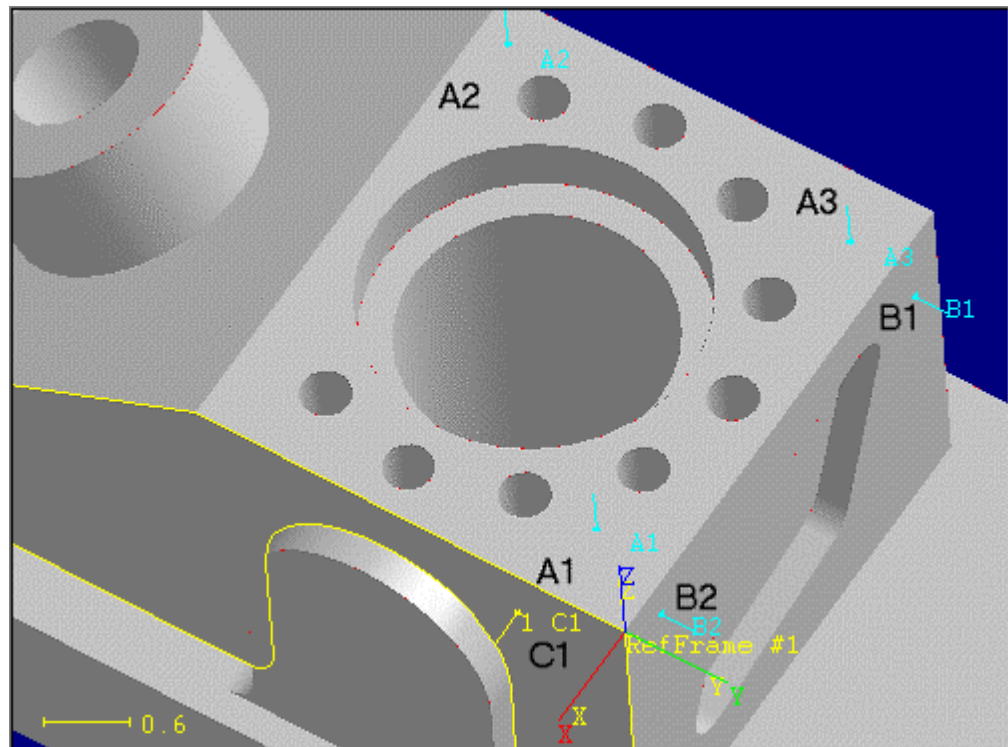
CADPath provides a very useful alignment utility called **Datum Alignment**. Datum alignment requires six datum points and a path created only for these points. These six datum points will be measured repeatedly that is controlled by the iteration control algorithm in datum alignment. The iteration will stop when all the measurement points are within the tolerance user specified or the maximum number of iterations have been reached.

There are two datum alignment approaches - **iterative 3-2-1** and **iterative bestfit**. Iterative 3-2-1 is suitable for a part that has datum points located on planar surfaces. **Iterative bestfit**, although slower, can be used to align a part with datum points located on free form surfaces.


The datum points can be imported from a text file or created in CADPath. In this tutorial, we will create six datum points in CADPath and then create a path later for datum alignment.

To create inspection points for datum alignment:

- We want to create six datum points (A1, A2, A3, B1, B2 and C3) at the locations as shown in the figure below. These six measurement points will be used by Datum Alignment to construct reference frame #1 in MP.

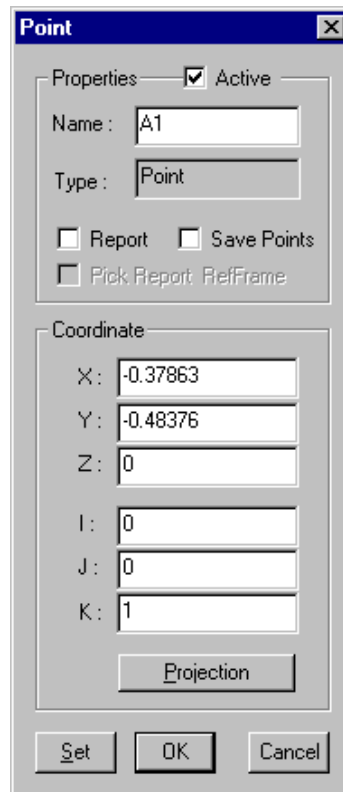


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- Click on the menu item **Inspection \Insp Points \Points** or click on the icon  to activate the inspection point generation interface.
- Move the mouse pointer to point at the “**A1**” datum point and click on the left mouse button. A **Pick Surface** dialog as shown below will pop up. Use this dialog to navigate through a list of surfaces and select the surface “**SPLSRF_7**” where “**A1**” is located.



- Change the name of the inspection point from “**_PNT1**” to “**A1**” as shown in the dialog below.




GETTING STARTED

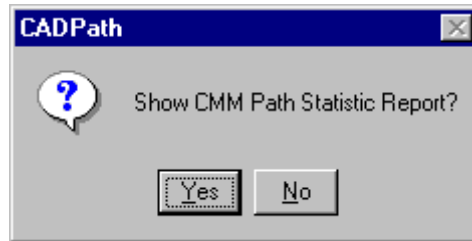
- Repeat previous two steps to create “A2”, “A3”, “B1”, “B2” and “C1” datum points.

Create a CMM Path

The procedures to create a CMM path are all the same. In this tutorial, we demonstrate an example to create a CMM path containing six datum points to be used for datum alignment. The only requirement for the path to be used for datum alignment is that the inspection path must consist of six datum points and these points must be able to construct a valid reference frame.

To create a CMM Path:

- Click on the menu item **Inspection \CMM Path \Create** or click on the icon  to create the inspection path. A message box as shown below will prompt users if the **CMM Path Statistic Report** is to be displayed on the screen. Select **Yes** to display the report.



- The **CMM Path Statistic Report**, as shown below, summarizes the path generation results after the path is created.

```

CMMPathReport.txt - Notepad
File Edit Search Help
Computer Name : IQ
User Name : CADPath
Model Name : C:\Program Files\MeasureMax\CADPath\Examples\Anc.iqf
Report File : C:\Program
Files\MeasureMax\CADPath\Examples\CMMPathReport.txt
Current Time : 15:01:12, Thursday, February 25, 1999

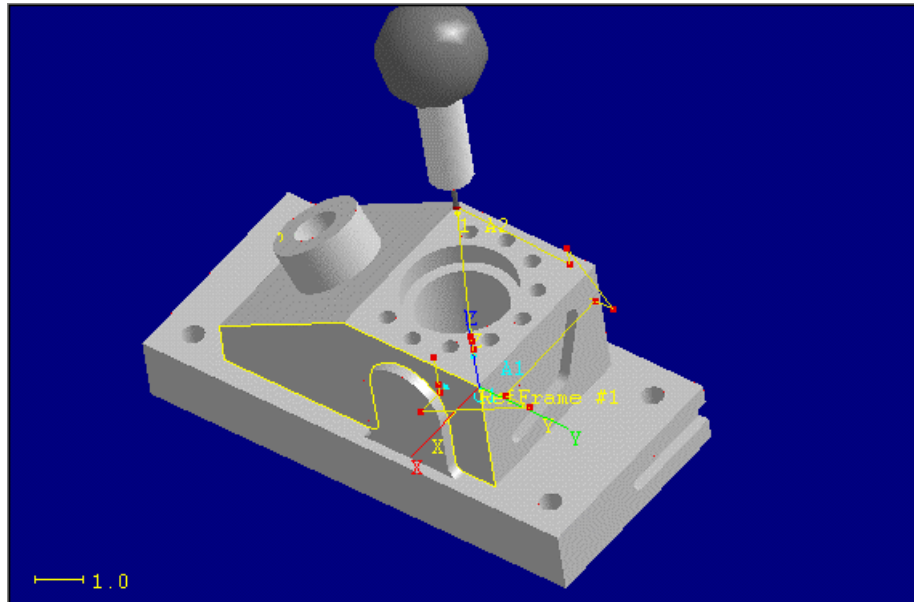
Features : 6

Name Total # Skipped #
-----
A1 1 0
A2 1 0
A3 1 0
B1 1 0
B2 1 0
C1 1 0

Features Skipped : 0
    
```

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- The inspection path will be displayed as yellow line segments on the screen, as shown in the figure below. Users can visually check the inspection path through the graphics window. CADPath also provides the animation capability to simulate the inspection process.




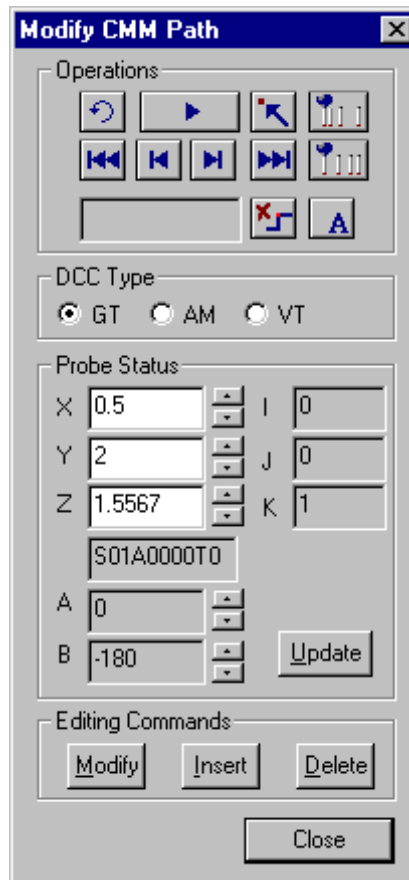
- Click on the menu item **File\Save** to save current document.

Modify Inspection Path

CADPath tries to generate an inspection path based on certain rules. It would be very difficult to create an inspection path that is optimal in the first time. Furthermore, there might be some other factors such as big deviations of the manufactured part from the CAD model, fixtures or features that are not included in the CAD file etc. To deal with the factors that are not provided in the CAD models, CADPath provides an inspection path modification interface, which is a very important tool that can be used to modify the inspection path. This interface extends the flexibility and capabilities of CADPath to be able to handle various inspection configurations.






To modify the inspection path:

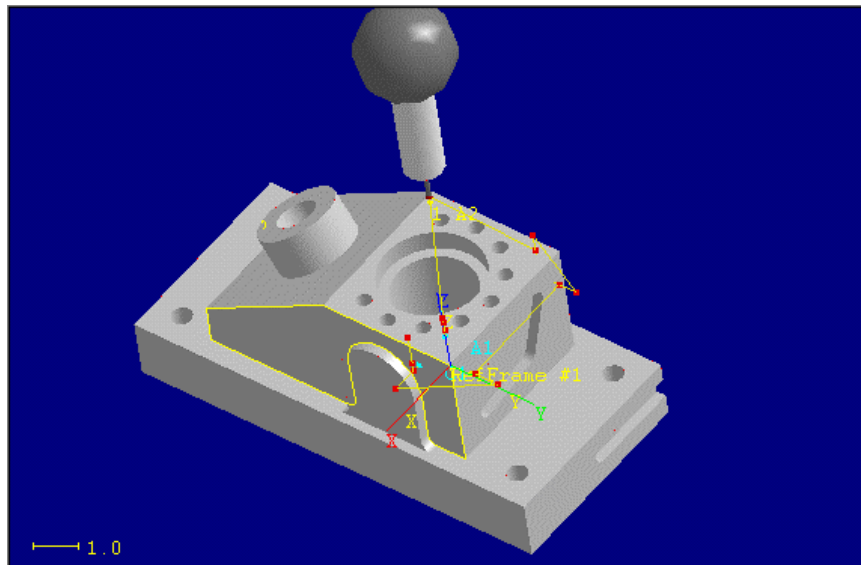
- Select the menu item **Inspection \CMM Path \Modify** or click on the icon  to launch the inspection path modification interface. The **Modify CMM Path** dialog as shown below will show up on the screen.



Note:

Users can hit **F1** on the keyboard to get more detailed information on the items shown in the dialog from the online help.

- Click on the **Restart**  button. This operation moves the probe to a location above the part model. This location is pre-defined by CADPath and should be considered as free state. No command will be generated when the probe is at this position and the probe information displayed in the dialog should be ignored.
- Click on the **Playback**  / **Pause**  button to toggle between playback and pause mode. Click on the **Increase**  / **Decrease**  button to change the number of intermediate points between two target points which in turn changes the animation speed. The maximum speed can be reached when the probe moves from current position to the next position without any intermediate step.
- As the probe moves along the path, the corresponding probe information will be displayed in the dialog box. The inspection path consists of three major DCC commands – **GT** (Get Tip), **AM**(Automatic Move) and **VT** (vector touch). These are the only three types of commands that can be modified through this interface.





- As the probe moves along the inspection path, **HOLD** down both the **SHIFT** button (on the keyboard) and the **LEFT** mouse button, drag the mouse in the graphics window to rotate the part around.

GETTING STARTED



- **HOLD** down both the **SHIFT** button and the **RIGHT** mouse button and drag the mouse in the graphics window to move the part around the window.
- **HOLD** down the **SHIFT** button and **BOTH** the **LEFT** and **RIGHT** mouse button and move the mouse forward and backward to room in and zoom out the model dynamically.
- Users can use the three operations as described above to have a better look at the point of interest as the probe move along the inspection path.

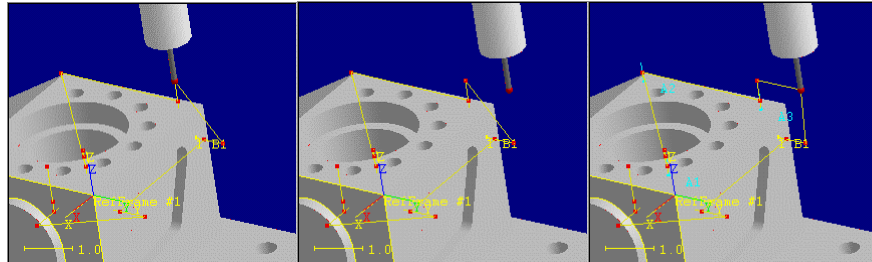
Note:

In this tutorial, we are going to change the probe angle at the beginning of the inspection path. **Insert** a **AM** command between “**A3**” and “**B1**”. **Delete** two **AM** commands and **insert** one **AM** command between “**B2**” and “**C1**”.

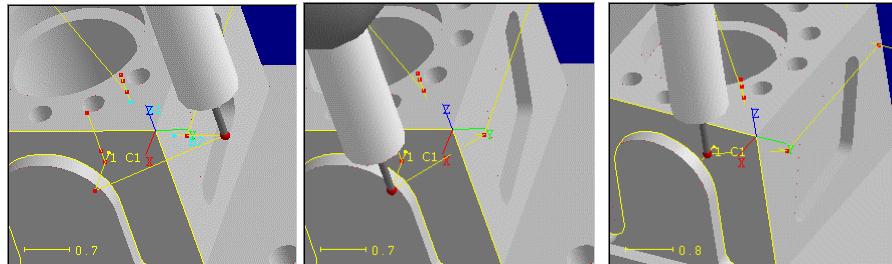
- Click on the **Restart**  button. The probe will be moved to a position above the part model, which is pre-defined by CADPath. Click on the **Move One Step Forward** button  to move the probe one step forward. The DCC command type is **GT** and the probe angle is A equal to 0 degree and B equal to -180 degrees. We want to change the B angle from -180 to 0 degree. . Click on the spin box beside the B angle edit box and click on the up arrow until the B angle reaches 0. Click on the **Modify** button to change the probe angle, which will also update the tip name to “**S01A0024T0**”.

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- This step will **insert** a **AM** command between point “**A3**” and point “**B1**”. Click on the playback button and pause at the location as shown on the left figure below. Users can also click on the **Pick Start Point** button  and place the mouse pointer at the point, which is displayed in **Red Square Dot**, and then click on the left mouse button. This operation will move the probe to the point directly. Click on the up spin  button beside the Y coordinate edit box until the probe move to the location as shown in the middle figure below. Select the **AM DCC** command type and then click on the **Insert** button. The modified path is shown in the right figure below.

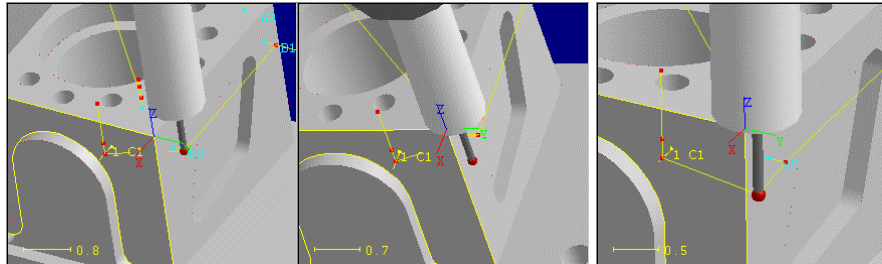


- This step will **delete** two **AM** commands between point “**B2**” and point “**C1**”. Move the probe tip to the location as shown on the left figure below. Click on the **Delete** button to delete this **AM** command. Move the probe tip to the location as shown in the middle figure below and hit the **Delete** button. After deleting the second **AM** command the final result is shown in the right figure below. The path passes through the part and we need to add a **AM** command in the middle to avoid the collisions of the probe with the part.

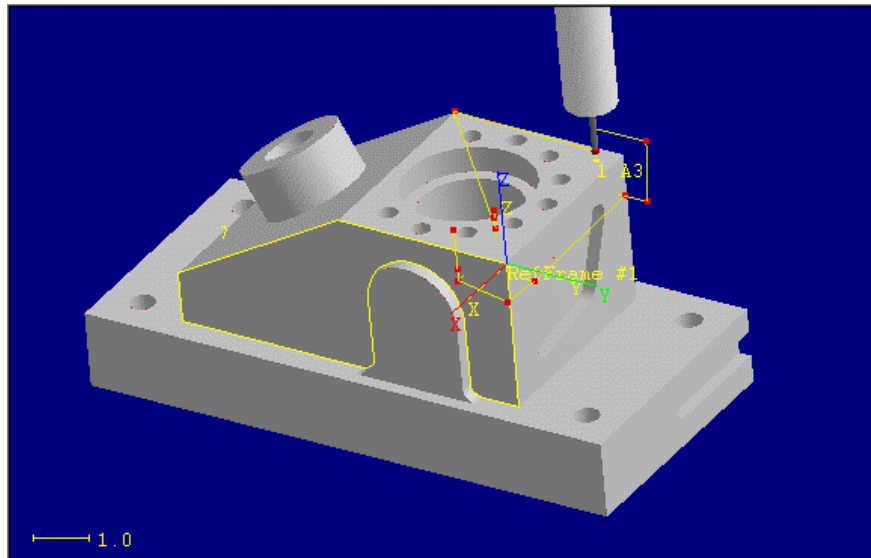


GETTING STARTED

- This step will insert one **AM** command between the points “**B2**” and “**C1**”. Move the probe tip to the location as shown on the left figure and make sure that the next command will move to the point above “**C1**”. Users can click on the **Move One Step Forward** button  and the **Move One Step Backward** button  to locate the right position to insert a **AM** command. After identifying the location, move the probe tip to the location as shown below. Make sure that the location provides enough clearance to avoid collision. Click on the **Insert** button. The result is shown on the right figure below.



- The next figure shows the final modified path. Click on the **Close** button to close the **Modify CMM Path** dialog.



Create a New Path

The ability to create multiple path segments in CADPath not only extends the ability of CADPath to support the **Probe Changer** and the **Stylus Changer** but also extends the flexibility of CADPath to handle different inspection setups managed under one CADPath document.

There are two major groups of properties associated with each inspection path. The first group of properties is the **station number** and the **tip selection intervals**. These parameters can be configured through the **Tip Selection Interval** dialog as described in the section - "**Setup Tip Selection Interval**". The second group of properties is the parameters that can be configured through the **Probe Dimension** dialog as described in the section - "**Setup Probe Dimension**". There are many advantages to be able to create multiple path segments in CADPath. For example, we can apply different parameters for each inspection path to suit different inspection needs. We can specify a larger **approach/retract** distance for the alignment path. We can also use a probe with smaller tip diameter in another station and specify a shorter approach/retract distance to measure smaller features.

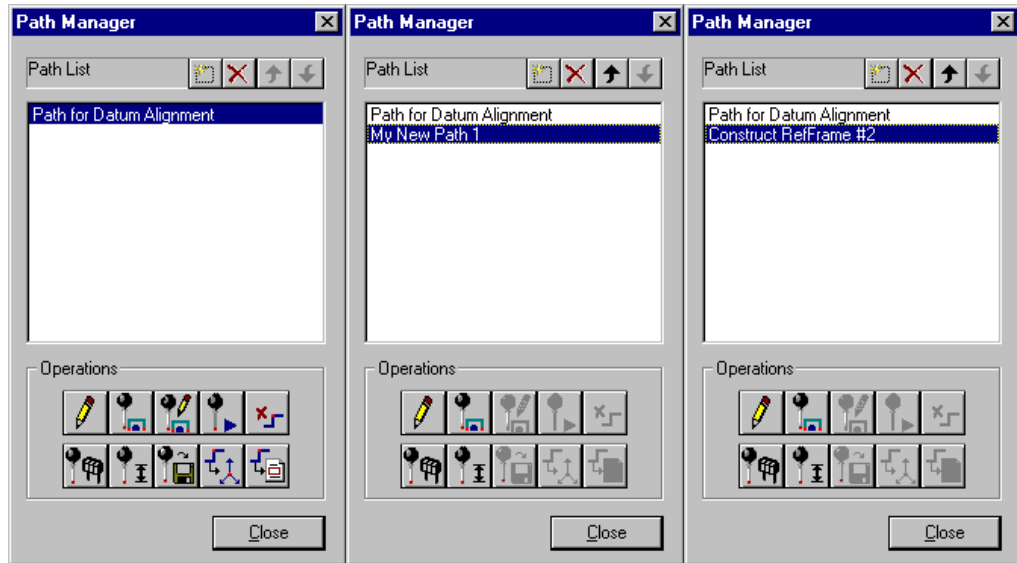
To create a new path:



- Select the menu item **Inspection \CMM Path \Path Manager** or click on the



button to open the **Path Manager** dialog as shown in the left figure below. There is one item in the path list box named "**Path for Datum Alignment**". This is the path created previously.

- Click on the **New Path** button  to create a new path. As shown in the middle figure, a default name “**My New Path 1**” will be assigned to the new path. Follow the steps described in the section “**Assign a Name to a Path**” to rename the path as “**Construct RefFrame #2**” as shown in the right figure.



- Click on the button  to open the interface to configure the station number and tip selection interval. Click on the button  to open the interface to setup the parameters in the **Probe Dimension** dialog. These are two short cuts associated with the items under the menu **Inspection\Setup**.

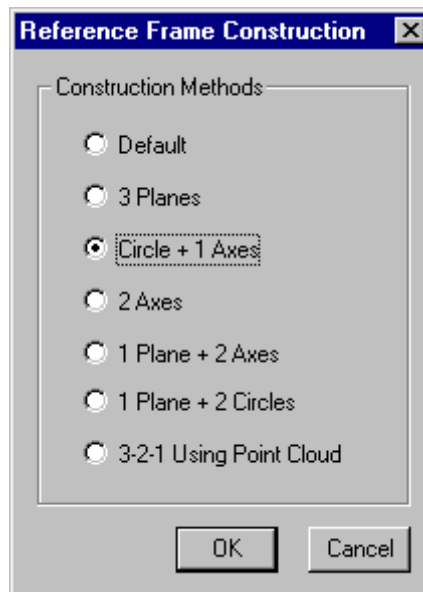
Construct a CAD Reference

There are two types of reference frames – **CAD reference frame** and **MP reference frame**. The CAD reference frame is the reference frame constructed using the features in CAD model. While the MP reference is the reference frame stored in MP, which has to be constructed using the reference frame construction commands supported by MP. In other word, the CAD reference frame and the MP reference frame have to be constructed separately in CADPath and MP. The corresponding reference frames also need to be mapped together so that the nominal values of the inspection features can be exported to the part program based on the CAD reference frame and the measurement features can be evaluated and reported correctly based on the MP reference frame.

We will first demonstrate the procedures to construct a CAD reference frame and then demonstrate an example to construct a reference frame in MP to be mapped to the CAD reference frame. Before the corresponding CAD reference frame can be constructed in MP, we need to measure the features required to construct a reference frame. In this example, we need to measure a plane to level to it, measure a line to offset to it and measure a circle to set the X, Y origin. These features are exactly the same as the ones used to construct the CAD reference frame. Notice that the plane is where the circle is located.

To construct a CAD reference frame:

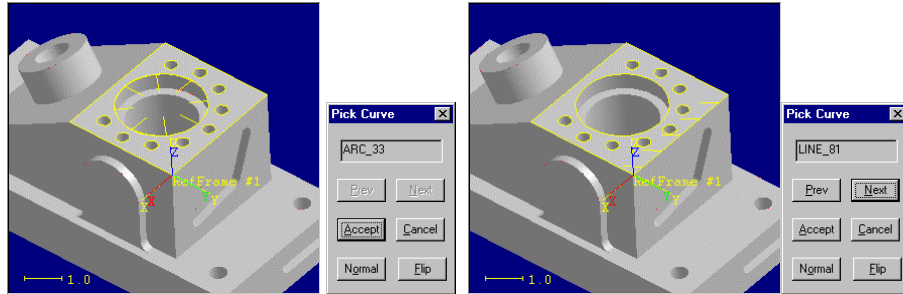
- Click on the menu **\Alignments \CAD Reference Frame \Construct**. The **Reference Frame Construction** dialog as shown below will pop up. Select the **“Circle + 1 Axes”** reference frame construction method. Click on the **OK** button to start constructing a CAD reference frame.



- According to the figures from left to right as shown below, select the circle and the line used to construct the CAD reference frame. Move the mouse pointer to point at the big circle and click on the left mouse button. Navigate thought a list

GETTING STARTED

of curves and select the circle as shown in the first figure. Move the mouse pointer to point at the line and click on the left mouse button. Navigate through a list of curves and select the line as shown in the right figure.

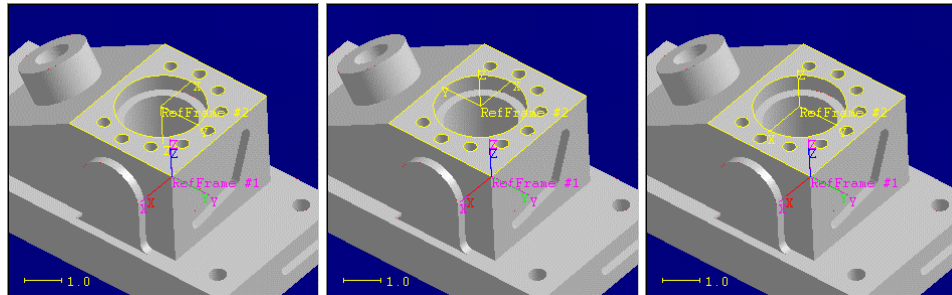


- If the reference frame is constructed successfully, the **Modify Reference Frame** dialog will pop up. Please change the name from “CS13” to “RefFrame #2”. If the reference frame is not constructed, the **Modify Reference Frame** dialog will not show up on the screen. Users have to restart the reference frame construction steps.



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- Check the orientation of “**RefFrame #2**” to see if the orientation is parallel to the working reference frame or not. If the orientation of the reference frame is not correct, use the tools provided in the **Modify Reference Frame** dialog to modify the orientation and position of the reference frame. In this example, we need to flip the Z-axis direction (check the Z-axis radio button and click on the **Flip** button) and then rotate the reference frame along the Z-axis for 180 degrees (type 180 in the **Rotate** edit box and click on the **Execute** button). The figure on the left shows the reference frame constructed from previous step. The second figure shows the result when the Z-axis is flipped. The third figure shows the result when the reference frame is rotated 180 degrees along the Z-axis.

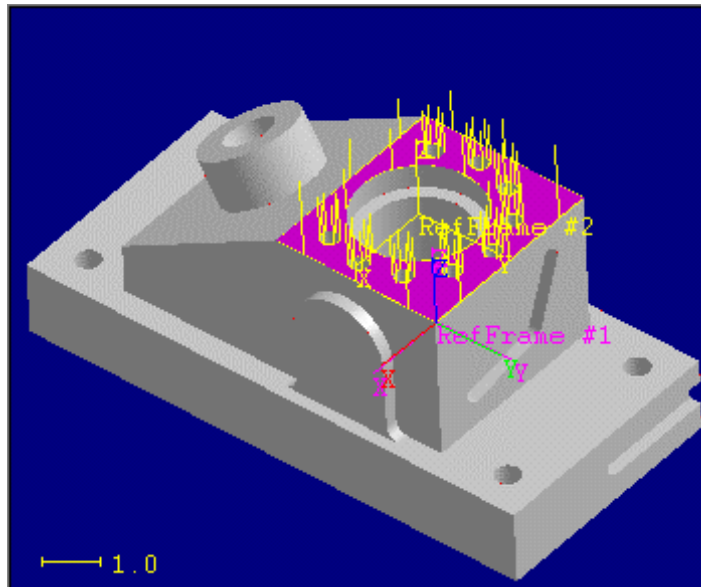


- Click on the **OK** button to accept the reference frame and close the dialog.

Generate Inspection Points

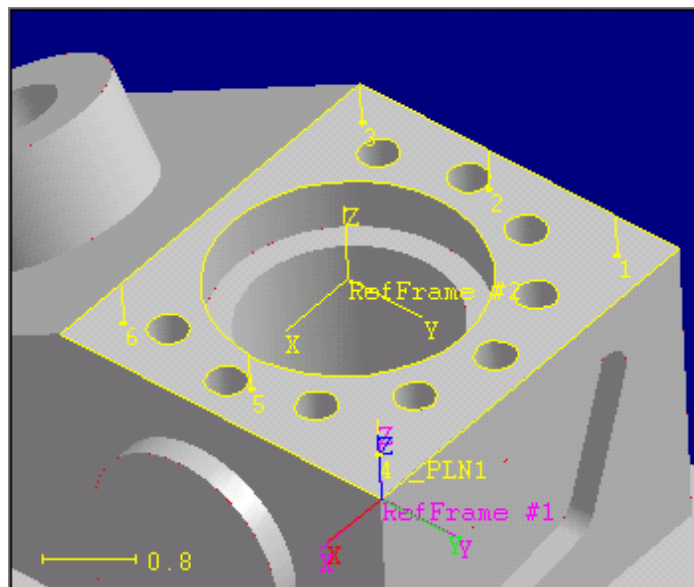
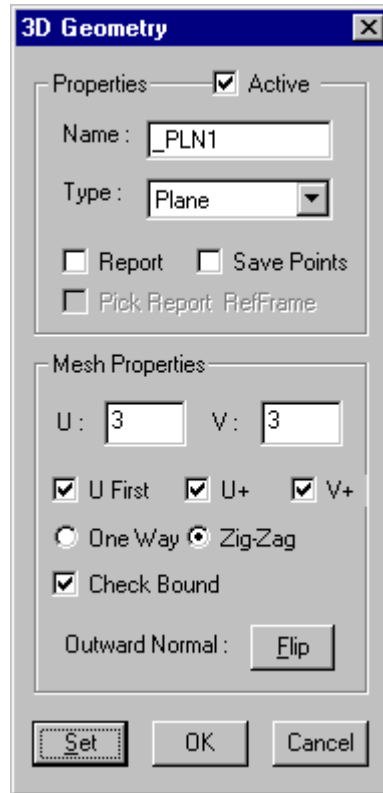
To generate inspection points:

- Select the menu item **Inspection \Insp. Points \3D Geometry** or click on the icon  to generate inspection points from a surface. Select the surface as highlighted in the figure below and click **Accept**.




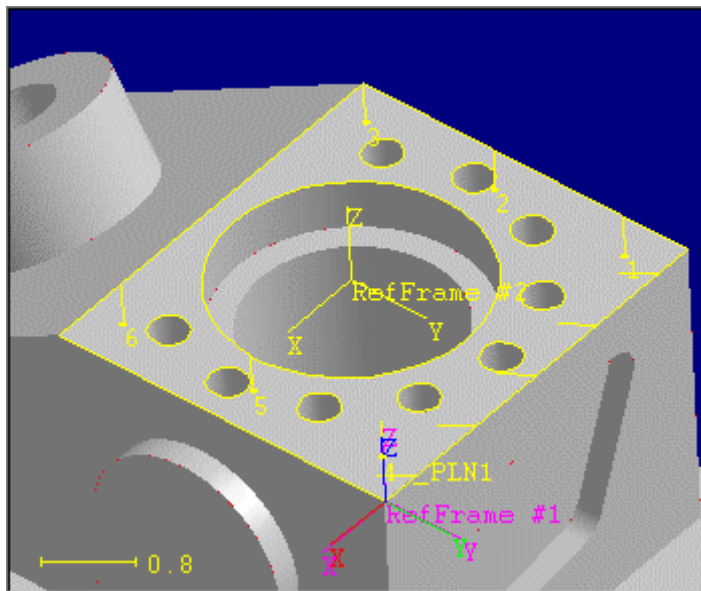
GETTING STARTED

- In the **3D Geometry** dialog as shown below, change the U V grids in the mesh properties from 4x4 to 3x3. Click on the **Set** button to display the result as shown in the figure below.



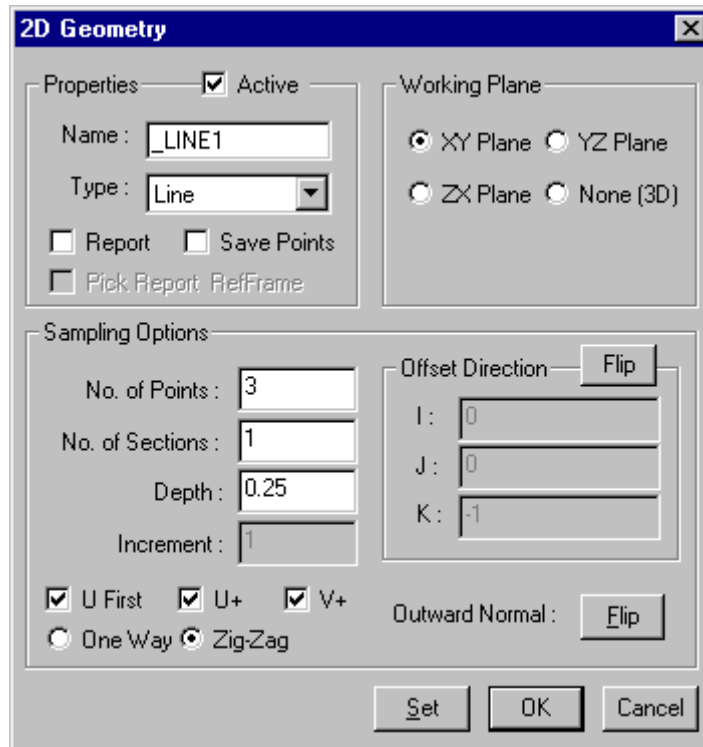
GETTING STARTED

- Select the menu item **Inspection Insp. Points V2D Geometry** or click on the button  to generate inspection points from a curve. Pick the curve "LINE_81" as highlighted in the figure below and click **Accept**.



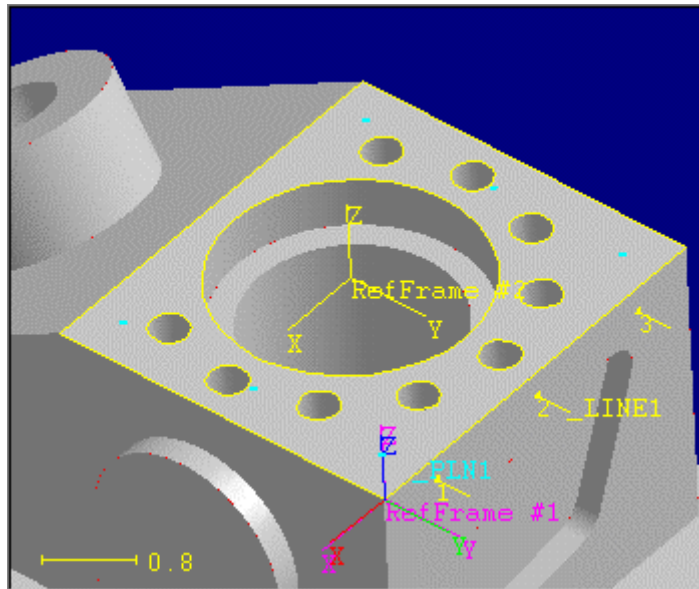
GETTING STARTED

- In the **2D Geometry** dialog, change the **Depth** value from **0** to **0.25** and keep all other parameters unchanged.

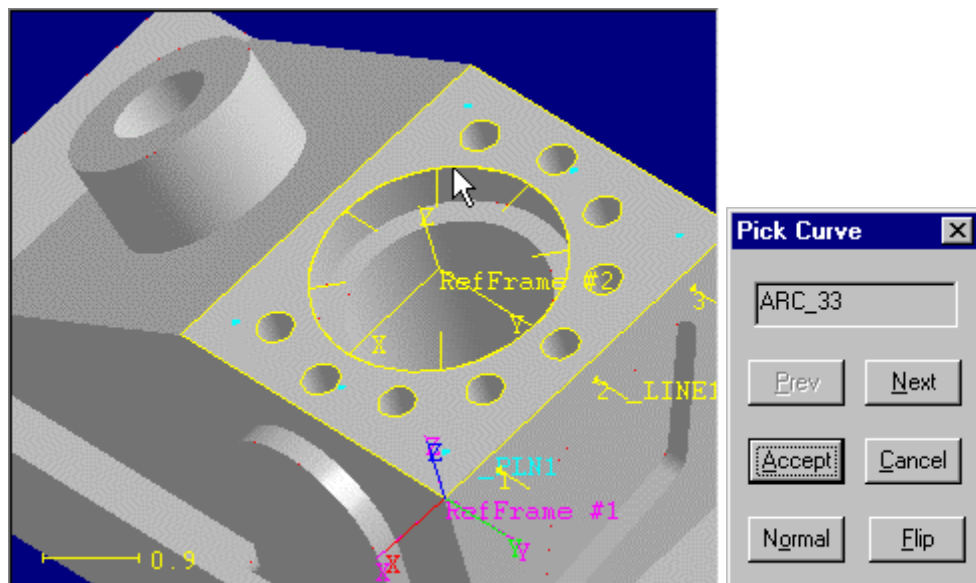


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- Notice that if the inspection points are not sitting on the surface, users have to click on the **Flip** button beside **Offset Direction** to change the direction of offset for the inspection points. Please also verify the normal direction of the inspection points and make sure that the outward normal direction is correct. If the outward normal is not correct, click on the **Flip** button beside **Outward Normal** to change the normal direction. Click on the **Set** button to display the result. The result is shown in the figure below.

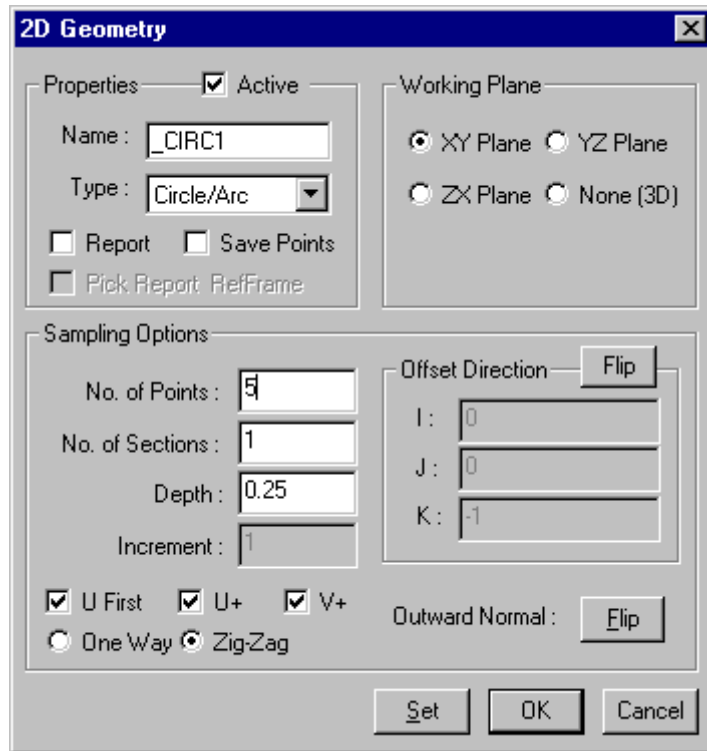


- Select the highlighted circle on top of the XY plane as shown in the figure below and click **Accept**.

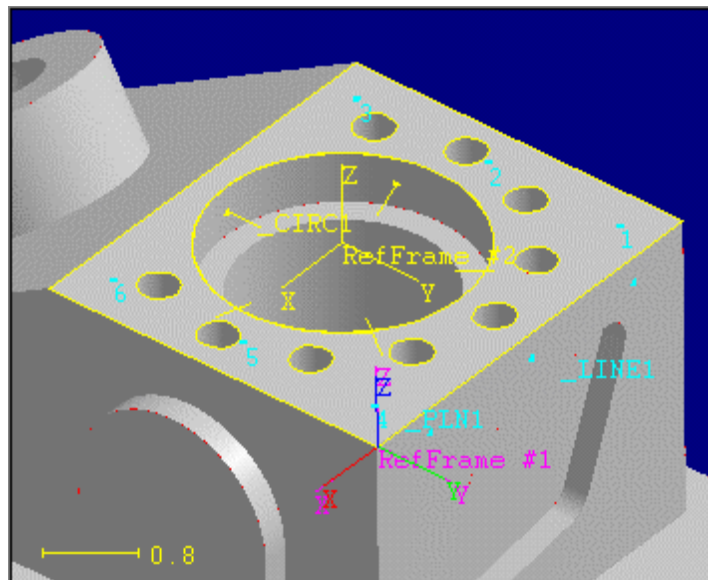


GETTING STARTED

- In the **2D Geometry** dialog, change the **No of Points** from 3 to 5 and keep all other parameters as shown in the next figure.




- Click on the **Set** button to display the result. The result is shown in the next figure. There will be five points generated from the circle with the offset direction (0, 0, -1) and the offset distance of .25 inch from the curve.

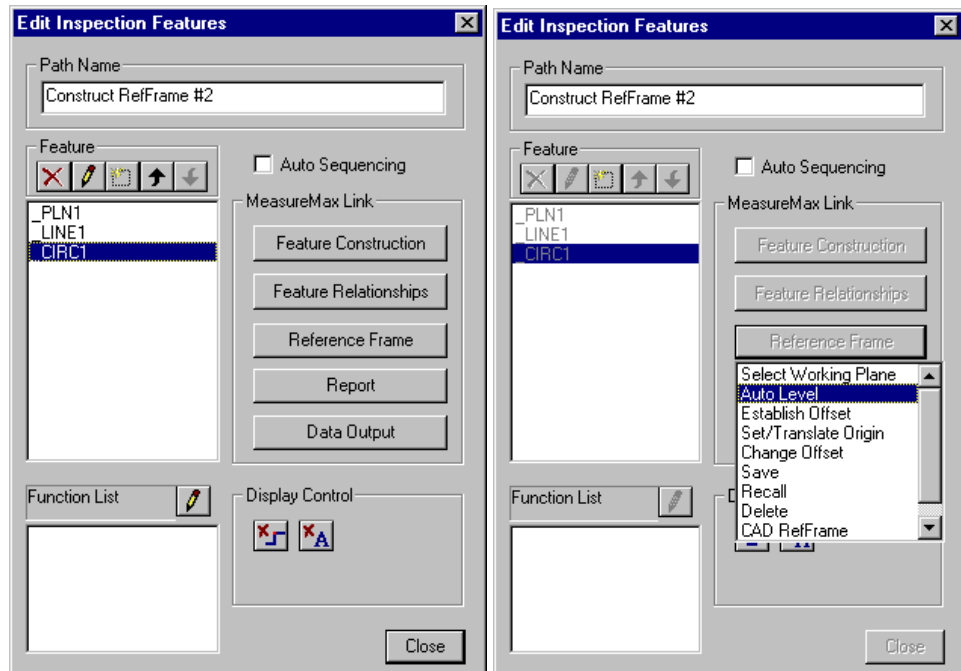


Construct a MP Reference Frame

This section will demonstrate an example to teach a MP reference frame construction based on the three features (a plane, a line and a circle) generated from previous section. This MP reference frame will be stored in the MP reference frame #2 and then mapped to the CAD reference frame “**RefFrame #2**”.

To construct a MP reference frame:

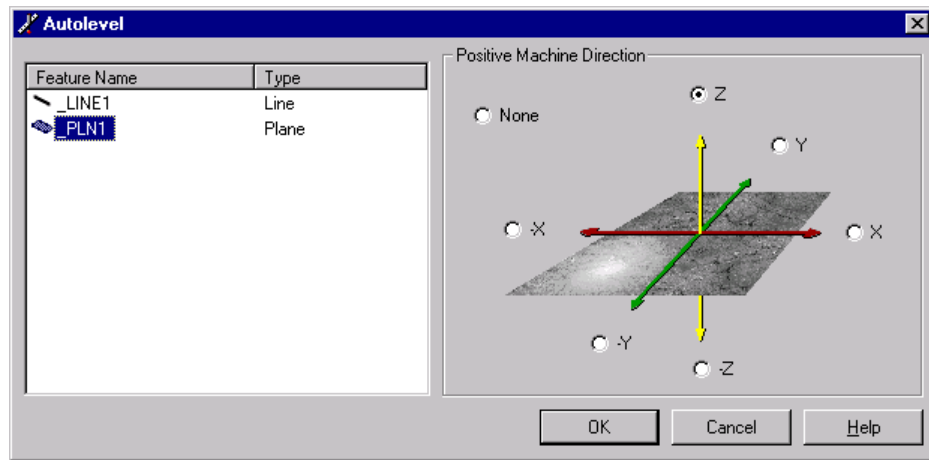
- Select the menu item **Inspection \Insp. Points \Edit Properties** or click on the icon  on the tool box to open the interface to edit the properties of the inspection features. In addition to modifying the properties of the inspection features, this is also the interface that links CADPath to MeasureMax teaching agents.
- As shown in the left figure, there are currently three features “**_PLN1**,” “**_LINE1**” and “**CIRC1**” in the feature list box. Select the feature “**_CIRC1**” in the list box so that all the teaching results will be appended to this feature. Click on the **Reference Frame** button in the **MeasureMax Link**, a list of teaching agents related to reference frame will be listed in the list box as shown in the right figure.




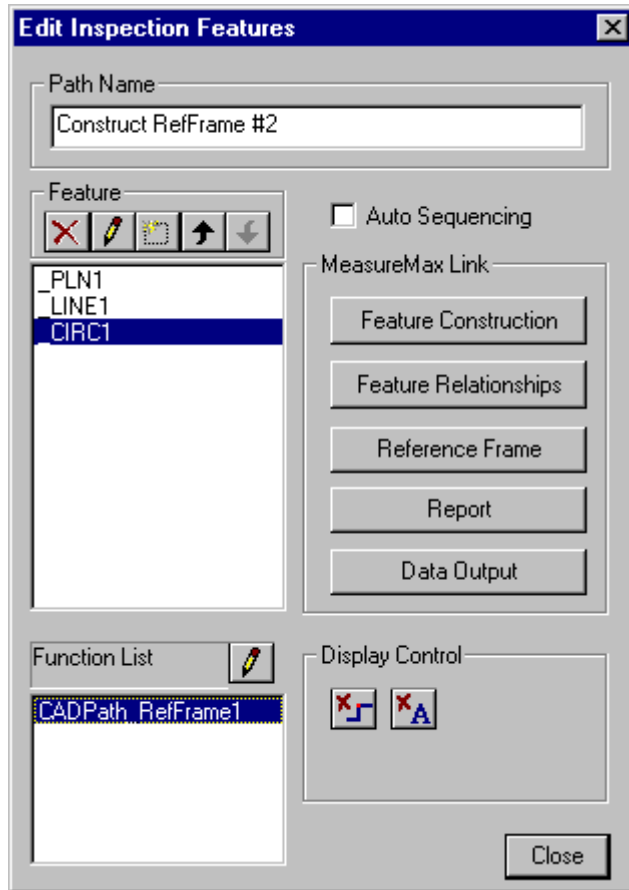
- Double** click on the “**Auto Level**” to launch the “**Auto Level**” teaching agent as shown in the figure below. Click on the feature named “**_PLN1**” to level the

GETTING STARTED

Positive Machine Direction to the **Z-axis**. Click on the **OK** button to accept and close this dialog.

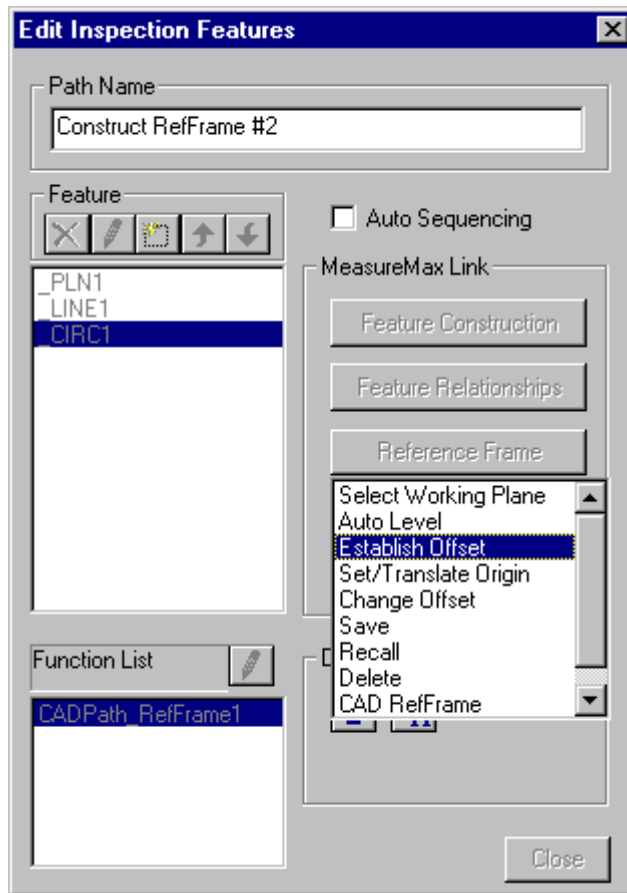


- A function named “**CADPath_RefFrame1**”, as shown in the next figure, is added to the function list box. This function, when exported to **Quick Teach**, will become a function call associated with the MLB commands to level the **Z-axis** to the plane “**_PLN1**”. Users can click on edit button  beside the **Function List** to review and edit the MLB commands associated with each function.

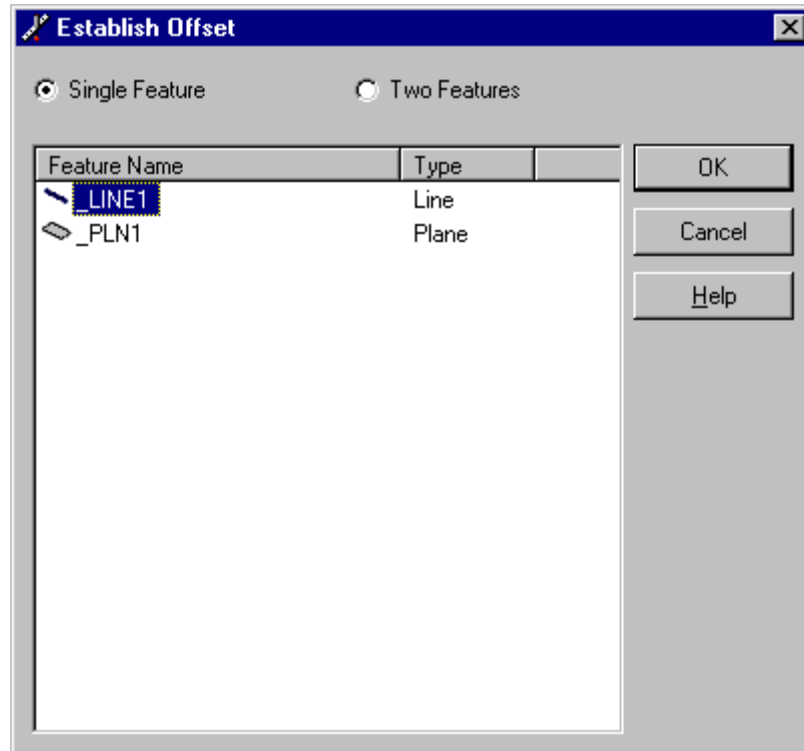


GETTING STARTED

- Click on the **Reference Frame** button and then **double** click on the “**Establish Offset**”, as shown below, to launch the “**Establish Offset**” teaching agent.

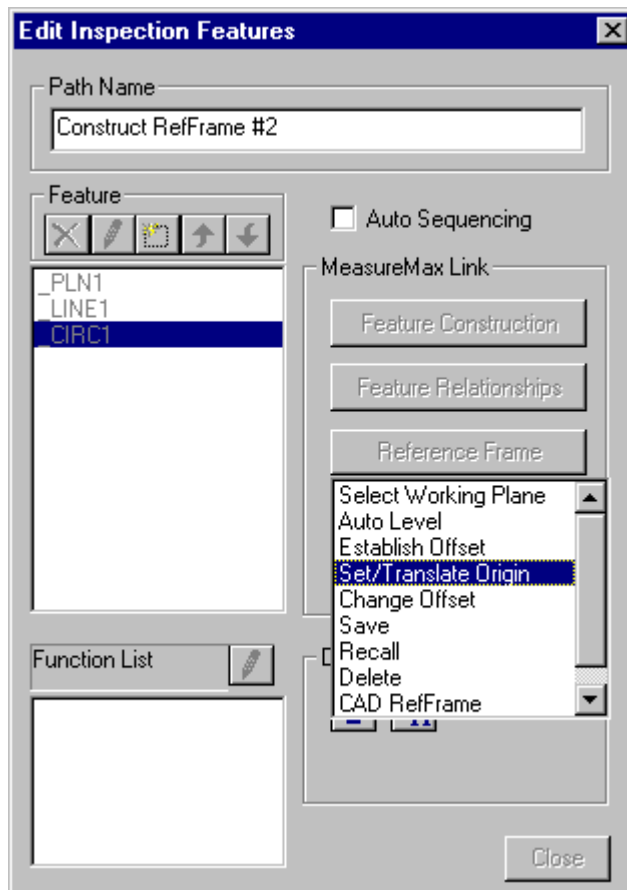


- In the **Establish Offset** dialog, as shown below, select on the feature “**_LINE1**” to offset the **X-axis** to the feature “**_LINE1**”. Click on the **OK** button to accept and close this dialog.

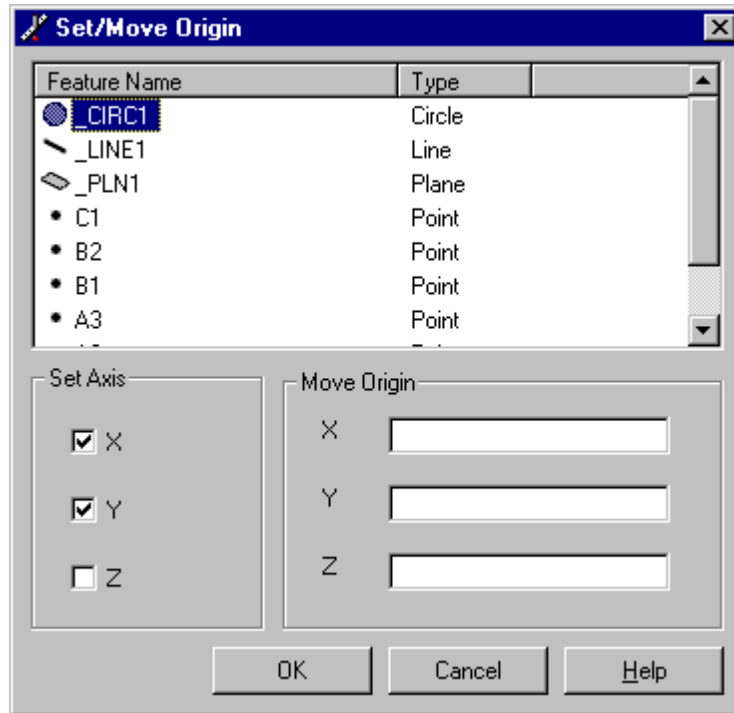


GETTING STARTED

- A function named “**CADPath_RefFrame2**” is added to the function list box. This function, when exported to a part program, will be a function call with the MLB commands to offset the X-axis to the feature “_LINE1”.
- Click on the **Reference Frame** button and then **double** click on the “**Set/Translate Origin**”, as shown in the figure below, to launch the “**Set/Translate Origin**” teaching agent.

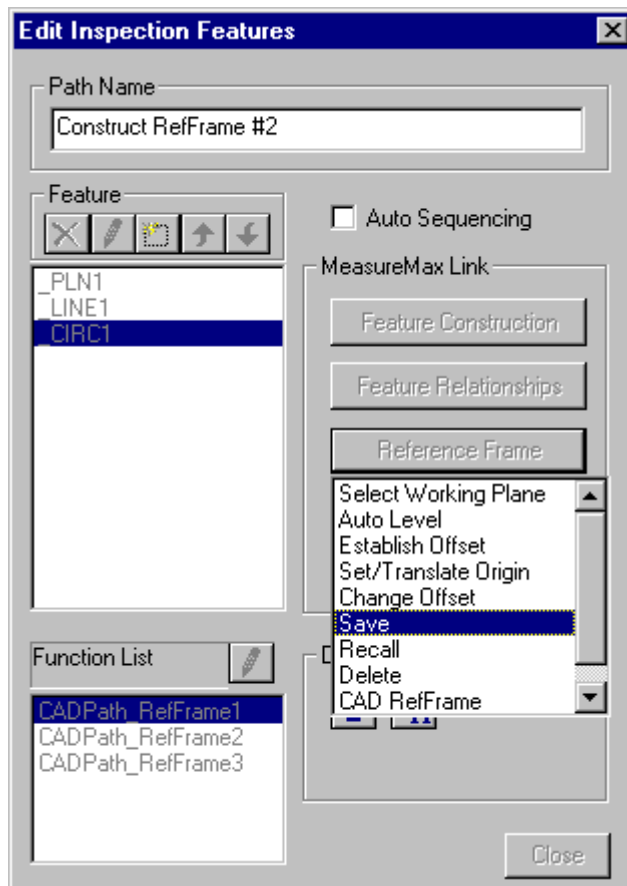


- In the **Set/Move Origin** dialog, as shown below, select the feature “**_CIRC1**” to offset the **Z-axis** to the feature “**_LINE1**”. Click on the **OK** button to accept and close this dialog.

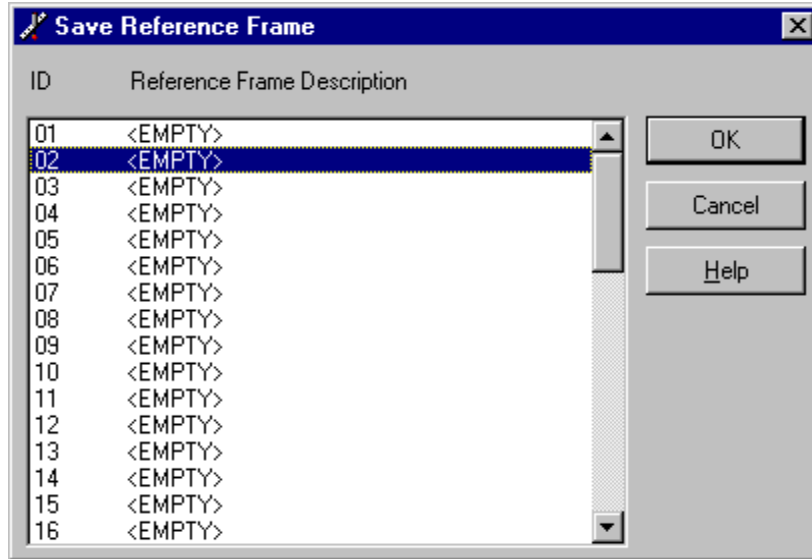


GETTING STARTED

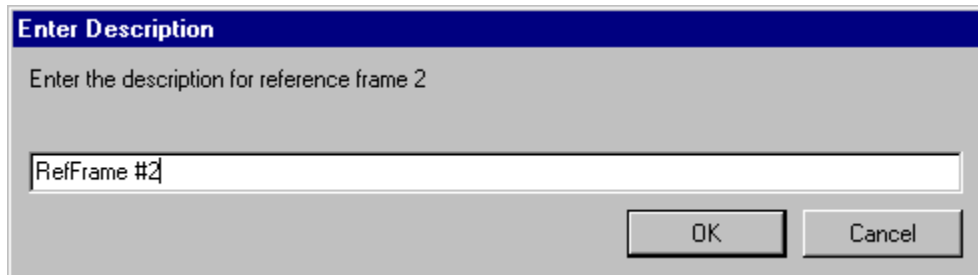
- A function named “**CADPath_RefFrame2**” is added to the function list. This function, when exported to a part program, will be a function containing the MLB commands to set the **X-axis** and the **Y-axis** origin.
- Click on the **Reference Frame** button and then **double** click on the “**Save**” item, as shown in the figure below, to launch the “**Save**” reference frame interface.



- In the **Save Reference Frame** dialog, as shown below, select the row with the reference frame ID **"02"**. Then click on the **OK** button. This action will save the active reference frame to the MP reference frame ID #2.



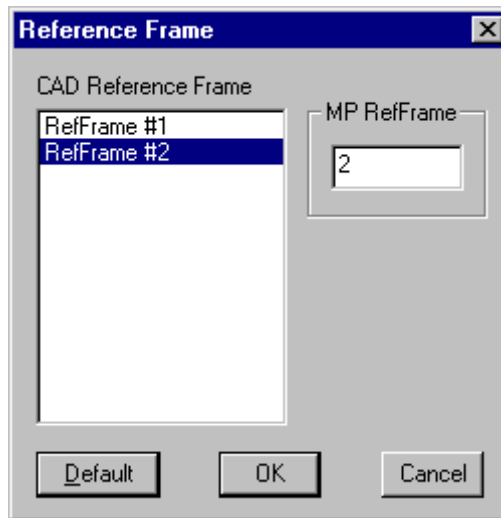
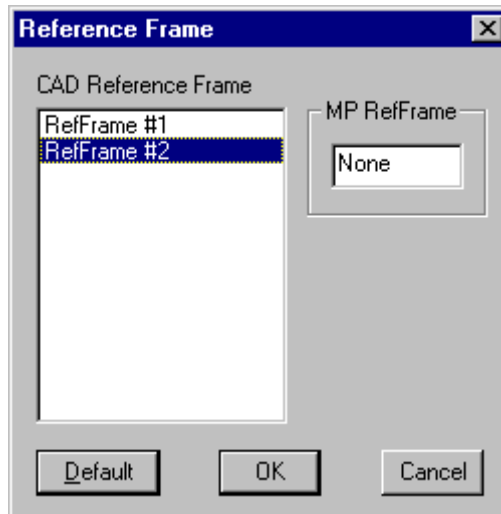
- A dialog box as shown below will pop up to prompt users to input a description for this reference frame. Type in **"RefFrame #2"** in the edit window and click on the **OK** button.



Map a MP Reference Frame to a CAD Reference Frame:

To map a MP reference frame to a CAD reference frame:

- Continue from the previous section after users clicking on the **OK** button in the **Enter Description** dialog.
- The **Reference Frame** dialog, as shown in the left figure below, will pop up. The list box shows a list of CAD reference frames defined in CADPath. The **MP RefFrame** in the dialog shows the mapping between the CAD reference frame and the MP reference frame. The mapping doesn't exist when "**None**" is displayed in the **MP RefFrame** edit box. Select the CAD reference frame labeled "**RefFrame #2**" in the list box and type in "**2**" in the **MP RefFrame** edit box.



- Select the OK button to accept the mapping. This operation maps the CAD reference frame labeled “**RefFrame #2**” to the MP reference frame **#2**.

Note:

- The **Reference Frame** dialog is the interface used to specify and review the mappings between the CAD reference frames and the MP reference frames. Users can select the CAD reference frame listed in the list box and check the corresponding MP reference frames displayed in the **MP RefFrame** edit box. “**NONE**” will be displayed in the edit box if the CAD reference frame is not mapped to any MP reference frame.
- The mapping between the CAD reference and the MP reference frame can be established when users **SAVE** the MP reference frame through the procedures as described in the previous two sections – **Construct a MP Reference Frame** and **Map a MP Reference Frame to a CAD Reference Frame**.
- The CAD reference frame has to be constructed before the mapping can be established. Under CADPath, if users try to save the MP reference frame while the CAD reference frame doesn't exist, the MLB codes will not be added to the function list.
- It is very important to teach the reference frame construction procedures at the last feature used to construct the reference frame. That is because when the features are inspected, CADPath always recalls reference frame #1.

Report a Feature to Multiple Reference Frames

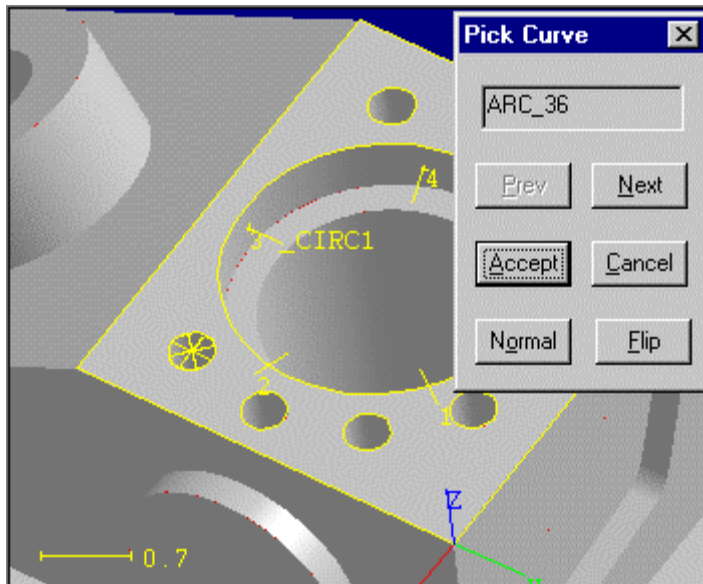
CADPath refers to the **Path Reference Frame** to drive the CMM machine, which is always stored in the **MP reference frame #1**. However, there are cases that inspection features need to refer to different reference frames other than the **Path Reference Frame** for tolerance evaluations. The ability to report a feature to multiple reference frames is the solution CADPath provided for a feature that refers to difference reference frame for tolerance evaluation.

In this section, the hole patterns on top of the part will be measured and reported to the CAD reference frame labeled "**RefFrame #2**" which is mapped to the MP reference frame indexed **#2**.

- Select the menu item **Inspection \Insp. Points \2D Geometry** or click on the



icon to generate inspection points from a curve. Select the circle as highlighted in the figure below and click **Accept**.



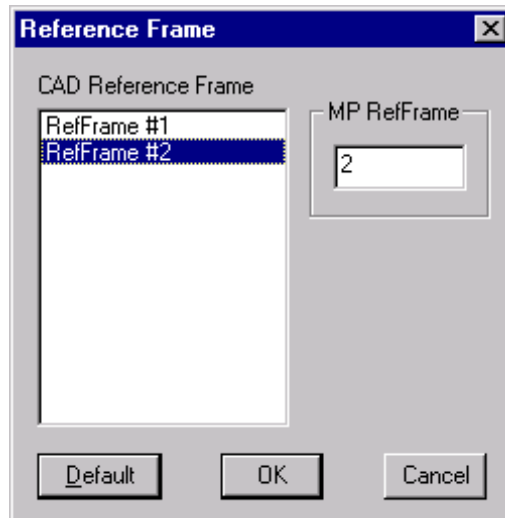
- In the **2D Geometry** dialog, change all the parameters to match the values as shown in the dialog below. Remember to check the “**Report**” and the “**Pick Report RefFrame**” check box. If the “**Report**” check box is checked, the report interface will pop up for users to specify the report parameters. If the “**Pick Report RefFrame**” is checked, the **Reference Frame** dialog will pop up for users to select the reference frame prior to the report interface. Click on the OK button.



Note:

- The **Report** check box is an option that enables CADPath to launch the **Inspection Report** interface after users click on the **OK** button. If the **Pick Report RefFrame** check box is not checked, CADPath uses the active CAD reference frame, which is the CAD reference frame displayed in **YELLOW** color, to report current feature.
- If the **Pick Report RefFrame** check box is selected, the **Reference Frame** dialog will prompt users to select a reference frame to report prior to the **Inspection Report** interface. Users will see the nominal values of current features displayed in the **Inspection Report** dialog.
- The nominal values of the feature will be exported to the part program with respect to the CAD reference frame users selected. On the other hand, the corresponding MP reference frame will be recalled before the feature is evaluated and reported.

- Select “**RefFrame #2**” in the CAD reference frame list box and click on the **OK** button. As described in the previous step, the **Reference Frame** dialog will pop up for users to select a reference frame for reporting prior to the **Inspection Report** interface.



- The **Inspection Report** dialog as shown in the next figure will pop up. Check the two options – “**Include Values**” and “**Include Column Headings**”. Notice that the X and Y coordinate under the **Nom** column shows the nominal values with respect to the CAD reference frame “**RefFrame #2**”. Please scroll down the report window to check the nominal values of the polar angle “A” and the polar radius “R”. These are the nominal values of the feature’s position in polar coordinate. Click on the **OK** button to close the **Inspection Report** dialog.

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Inspection Report

Format: Nominals/Tolerances

Feature Name: Sequence #: 1

Feature Type: Circle

Identification Data:

	Actual	Nom	+ Tol	- Tol	Dev	0-Tol
X:	0.0000	1.4073	0.0000	0.0000	-1.4073	-1.4073
Y:	0.0000	-0.8125	0.0000	0.0000	0.8125	0.8125
RD:	0.0000	0.1875	0.0000	0.0000	-0.1875	-0.1875
DI:	0.0000	0.3750	0.0000	0.0000	-0.3750	-0.3750

Include Values

Include Column Headings

Include Graph

Include Form Results

OK Cancel Help

Inspection Report

Format: Nominals/Tolerances

Feature Name: Sequence #: 1

Feature Type: Circle

Identification Data:

	Actual	Nom	+ Tol	- Tol	Dev	0-Tol
FM:			0.0000		0.0000	0.0000
A:	0.0000	-30.0000	0.0000	0.0000	30.0000	30.0000
R:	0.0000	1.6250	0.0000	0.0000	-1.6250	-1.6250
Unused:						

Include Values

Include Column Headings

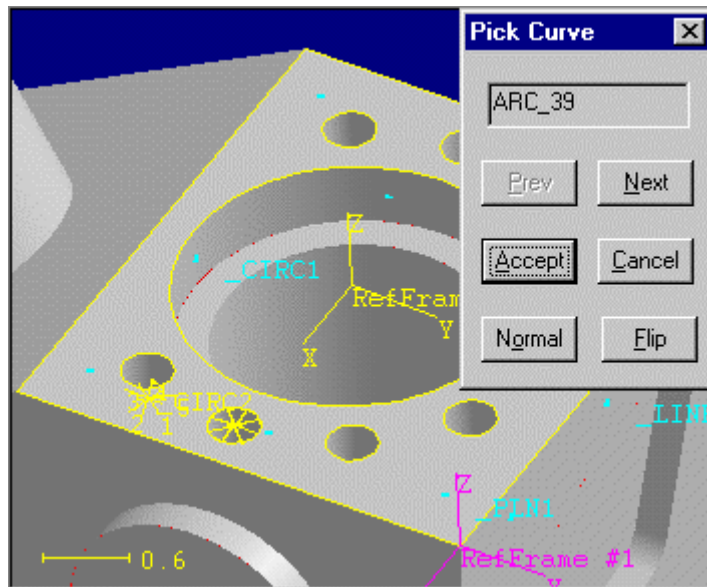
Include Graph

Include Form Results

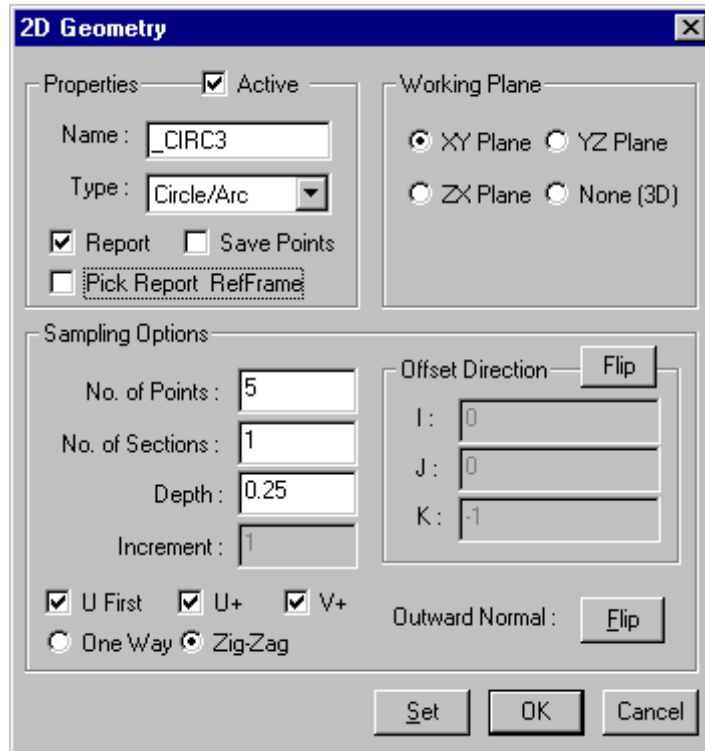
OK Cancel Help

GETTING STARTED

- Select the circle as highlighted in the figure below and click **Accept**.



- In the **2D Geometry** dialog, uncheck “**Pick Report RefFrame**” and then click on the **OK** button. The **Inspection Report** interface will pop up directly and the nominal values will be exported based on current active CAD reference frame “**RefFrame #2**”. The tolerance values users specified in the **Inspection Report** dialog will be preserved as defaults for the next inspection report.



Note:

- Please notice that if the tolerance parameters are unchanged in the **Inspection Report** interface, the MLB codes to output the tolerance values to MP will not be exported again. In other words, only the tolerance values that are changed in the **Inspection Report** interface will be exported to the part program.

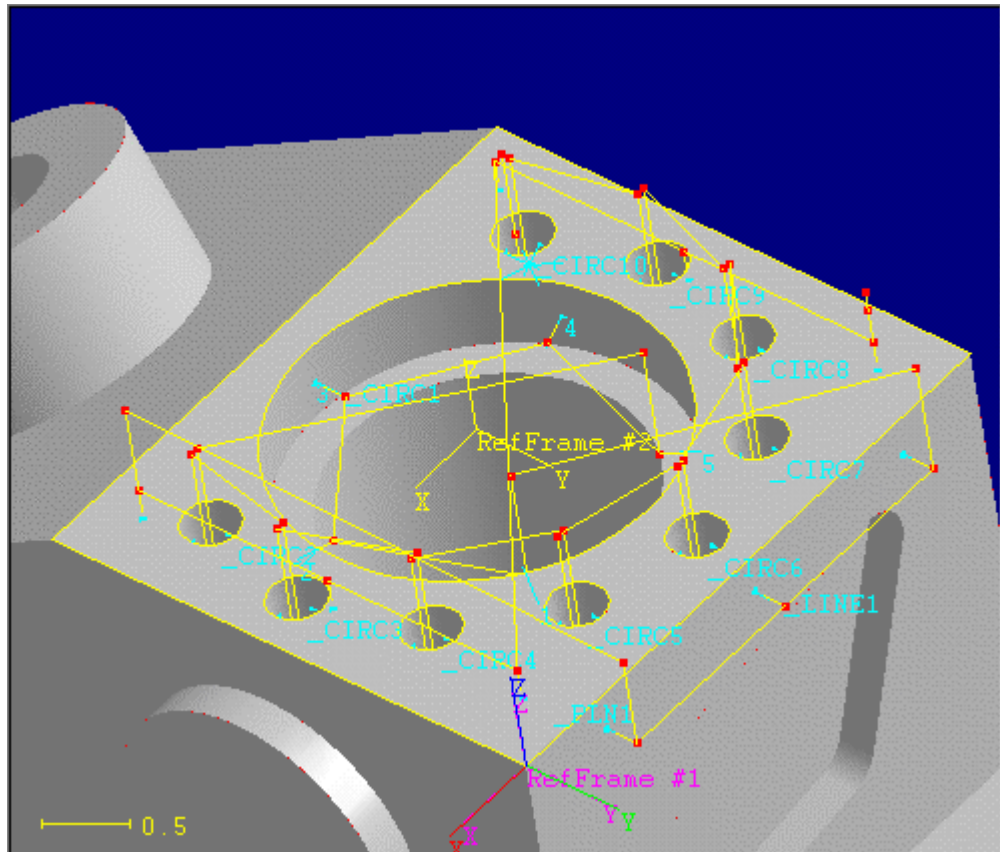
- Similar to the previous two steps, generate inspection points for all the other hole patterns and report them with respect to the CAD reference frame “**RefFrame #2**”.

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- Select the menu item **Inspection \CMM Path \Create** or click on the icon




to create the inspection path. The result is shown in the figure below.



- Select the menu item **\File \Save** to save current document.

Playback CMM Path

To playback CMM path:

- Select the menu item **Inspection \CMM Path \Playback** or click on the icon  to playback the inspection path. **CADPath** playbacks the inspection paths repeatedly until users hit the **ESCAPE** button on the keyboard. During playback, users can **hit** the “+” or “-” button on the keypad to increase or decrease the simulation speed.
- As the probe moves along the inspection path, **HOLD** down the **SHIFT** button (on the keyboard) and **LEFT** mouse button, drag the mouse in the graphics window to rotate the part around. **HOLD** down the **SHIFT** button and **RIGHT** mouse button and drag the mouse in the graphics window to move the part around the window. **HOLD** down the **SHIFT** button and **BOTH** the **LEFT** and **RIGHT** mouse button and move the mouse forward and backward to zoom in and zoom out the model dynamically. Users can use these three operations to have a better look at the point of interest as the probe moves along the inspection path.
- Press the **ESCAPE** button on the keyboard to stop playback CMM path.

Switch MeasureMax to On-Line Operation

In this tutorial, all previous operations are all performed off-line. We need to switch MeasureMax to on-line in order to do any operations that can be executed on line only.

To switch MeasureMax from off-line to on-line:

- Close CADPath and all other agents.
- Save the Visual Basic part program even through no code has been exported.
- Exit Visual Basic.
- Start CMM1 through the CMM control center.
- Open the previous part program through the CMM control center.

Note:

- The information related to the next available sequence of the features and function names are stored together with the part program. Save the part program and reuse the same part program to prevent the teaching agents from using the same function names or feature names

Sensor Definition and Naming Convention

All the tips used in CADPath use the naming convention as summarized in the table below.

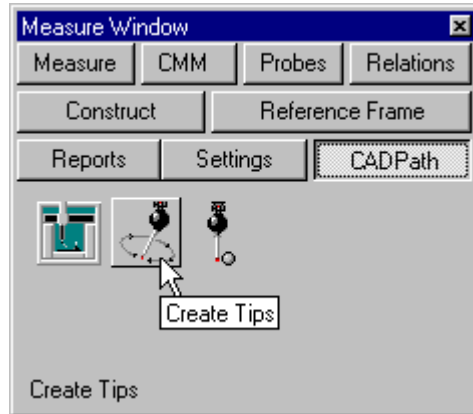
Tip Name: SxxAxxxxTx

	Format	Example	Description
Station Number	Sxx	S01,S21, S31	<ul style="list-style-type: none"> Sxx is a station number identifier. Legal station numbers are 01 to 08 (probe changer), 21 to 26 (stylus changer #1), and 31 to 36 (stylus changer #2). The command "GS 0" is a special form of the command used to unload equipment without loading more. A maximum of four stations may be specified but only the last station may correspond to one of the stylus changers. The order in which the stations are listed determines the order in which they are loaded. The last specified probe changer station may contain a probe tip but all previous stations must contain extensions.
Angle Index	Axxxx	A0000, A0424	<ul style="list-style-type: none"> The first two digits represent the probe angle A's index from 0 to 14 (0 to 105 degrees) with a total of 15 possible probe positions. The third and fourth digits represent the probe angle B's index from 0 to 48 (-180 to 172.5 degrees) with a total of 48 possible probe positions. A0000 is the probe orientation with A angle 0 (0 * 7.5) degree and B angle -180 ((0-24) * 7.5) degree. A0424 is the probe orientation with A angle 30 (4 * 7.5) degrees and B angle 0 ((24-24) * 7.5) degree.
Tip Index	Tx	T0	<ul style="list-style-type: none"> The digit "x" represents the tip index number. For example, if a single tip is added to the probe, then the default tip index is T0. If there are many tips, such as star tips, attached to the probe then the tip index for the second tip is T1 and the third one is T3 etc. This tip index is reserved for future expansion and the index should be "0".

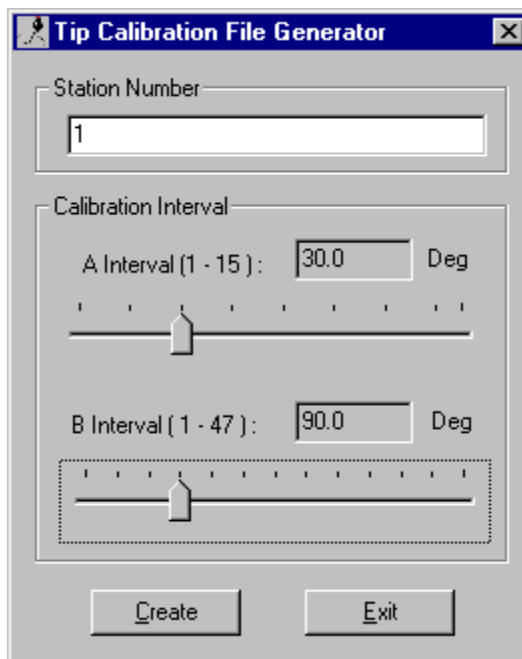
Create a Tip File

To create a tip file:

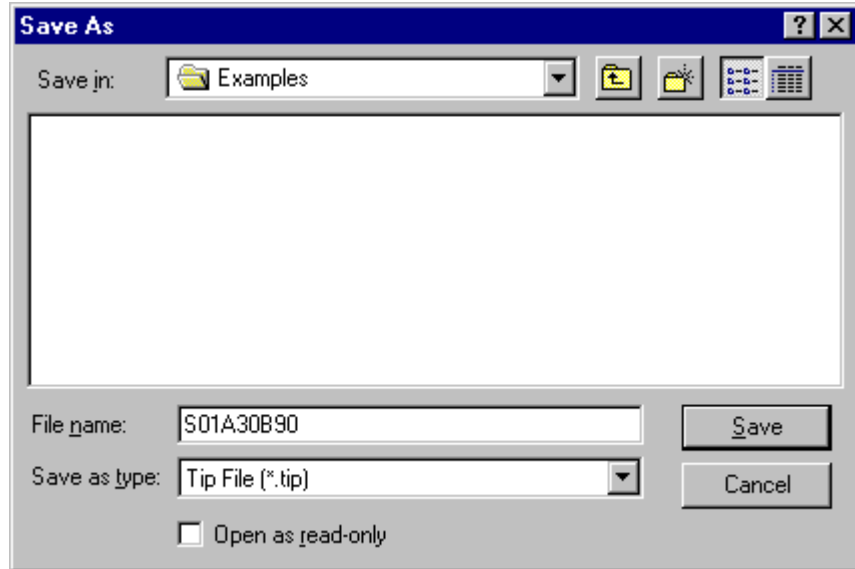
- Under Quick Teach, click on the **Create Tips** icon  as shown below.



- The **Tip Calibration File Generator** dialog as shown below will pop up. Change the “**A Interval**” from 15.0 degrees to 30.0 degrees. Change the “**B Interval**” from 30.0 degrees to 90.0 degrees. Keep the station number unchanged. If users have a probe changer or a stylus changer, type in the station name in the **Station Number** edit box. The station number will serve as a prefix added at the beginning of each tip name.



- Click on the **Create** button on the **Tip Calibration File Generator** dialog. A **Save As** dialog will pop up for users to choose the location of the tip file to be saved. Please select the **Examples** directory under CADPath installation directory, for example "**C:\Program Files MeasureMax \CADPath \Examples**". Type in the file name as "S01A30B90" and click on the **Save** button. All the tip information will be saved to the file "**S01A30B90.TIP**".



- The content of the tip file is shown below. The number in the first line describes the total number of tips defined in this file. From the second line to the end of the file defines all the tips in this tip file. The first column is the tip name, the second and third column are the corresponding A and B probe angles associated with the tip name.

```

16
S01A0000T0    0.000000    -180.000000
S01A0400T0    30.000000    -180.000000
S01A0800T0    60.000000    -180.000000
S01A1200T0    90.000000    -180.000000
S01A0012T0     0.000000     -90.000000
S01A0412T0    30.000000     -90.000000
S01A0812T0    60.000000     -90.000000
S01A1212T0    90.000000     -90.000000
S01A0024T0     0.000000      0.000000
S01A0424T0    30.000000      0.000000
S01A0824T0    60.000000      0.000000
S01A1224T0    90.000000      0.000000
S01A0036T0     0.000000     90.000000
S01A0436T0    30.000000     90.000000
S01A0836T0    60.000000     90.000000
S01A1236T0    90.000000     90.000000
    
```

Note:

- The station number is used as a prefix added to the tip name so as to distinguish the tip names between probe stations.
- There are special formats for a tip file. The automatic tip calibration tool might not be able to understand the tip format if users modify the content of the tip file.

Calibrating Tips Defined in a Tip File

This section demonstrates an example to calibrate the tips defined in a tip file using the **CADPath Tip Calibration** utility. This tip calibration utility is installed together with CADPath and can be used to calibrate tips with or without the probe changer and/or stylus changer(s). However, users have to make sure that the probe changer and the stylus changer(s) are initialized properly before this utility can use the **Get Station "GS"** command, which loads equipment from the probe changer station(s) and/or stylus changer stations onto the probe adapter.

The procedures to calibrate the tips defined in a tip file are described as follows:

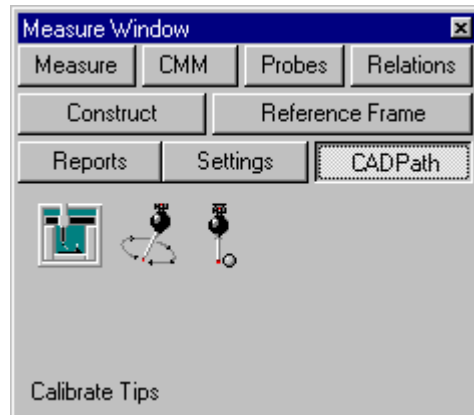
1. If the CMM equipped with the probe changer and/or the stylus changer, get the equipment in the station where the tip "0" is to be calibrated.
2. Calibrate tip "0".
3. Move the calibration sphere to a location so that CMM has enough clearance to move around when calibrating all the tips defined in a tip file.
4. Get the station where the tip is to be calibrated. This step can be skipped if the tips to be calibrated have the same station number as the tip "0".
5. Calibrating PH10 or PH9 parameters.
6. Calibrate all the tips defined in a tip file.
7. Repeat the steps 4, 5 and 6 to calibrate the tips in different station.

To calibrate tips defined in a tip file:

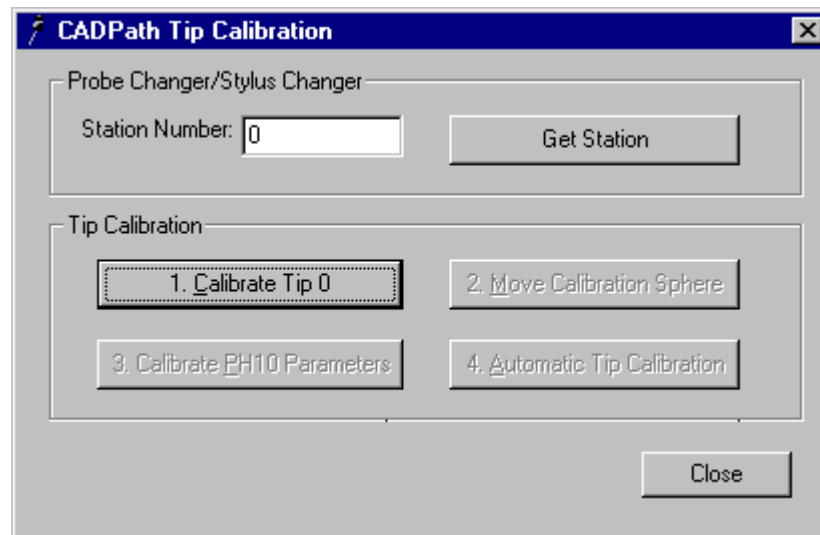
- Make sure that MeasureMax is operating on-line.

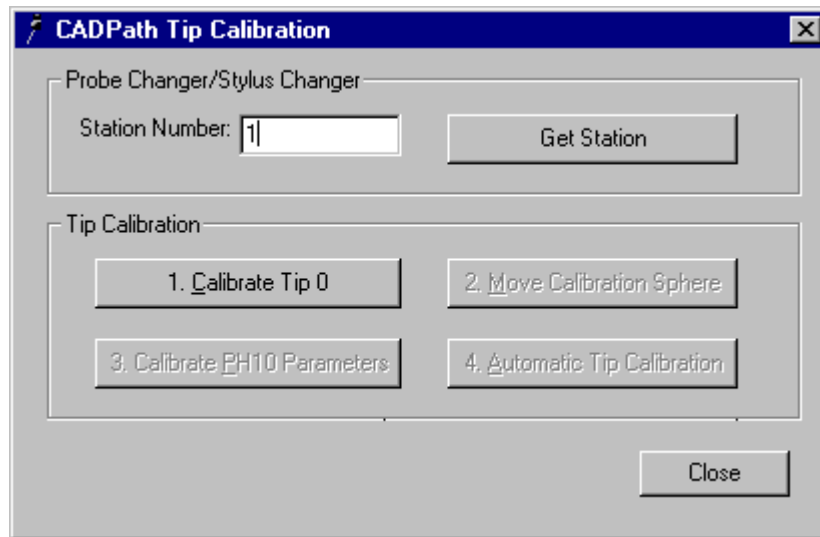
GETTING STARTED

- Under Quick Teach, click on the **Calibrate Tips** icon  as shown below.



- Type in the station number "1" where the **TIP 0** is to be located and then click on the **Get Station** button. The machine will get the equipment in station #1. This step loads equipment from station #1. Please ignore this step if the CMM is not equipped with the probe changer or the stylus changer. Notice that the probe changer and/or stylus changer has to be initialized properly before users can use this utility to calibrate the tips in different stations.

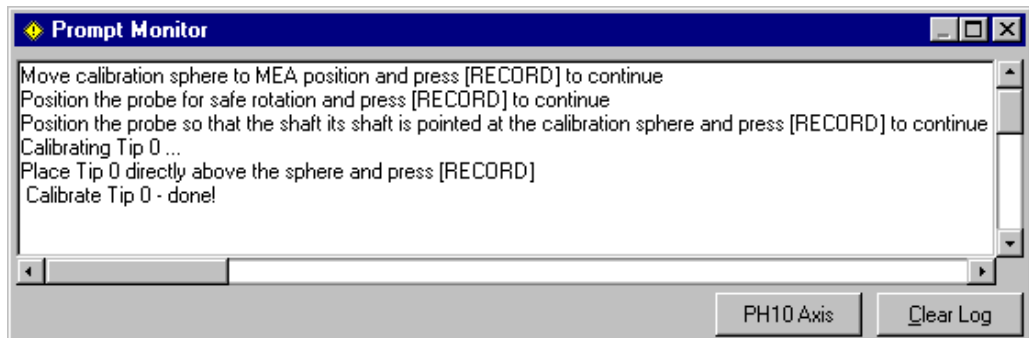




Note:

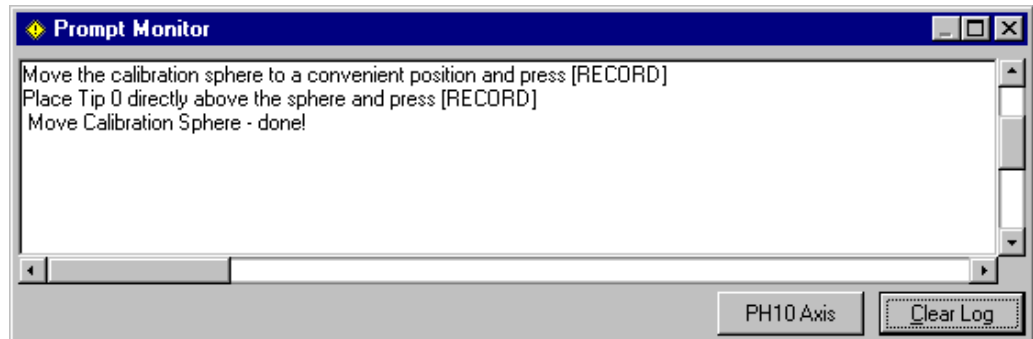
- Users can specify any valid combination of parameters in the **Station Number** edit box. For example, if users have a probe extension in station #7 and want it to be cascaded with the probe in station #1, specify “7,1” in the station number edit box and then click on the **Get Station** button to assemble this probe configuration.

- Click on the “**Calibrate Tip 0**” button and follow the instructions displayed in the prompt window to calibrate tip 0.

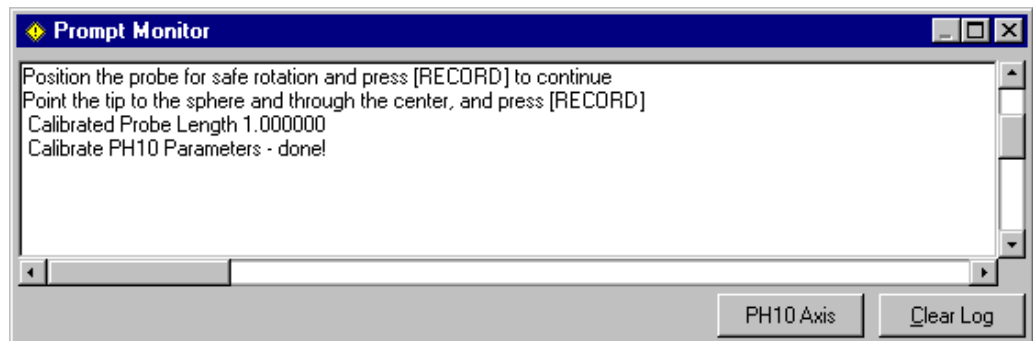


GETTING STARTED

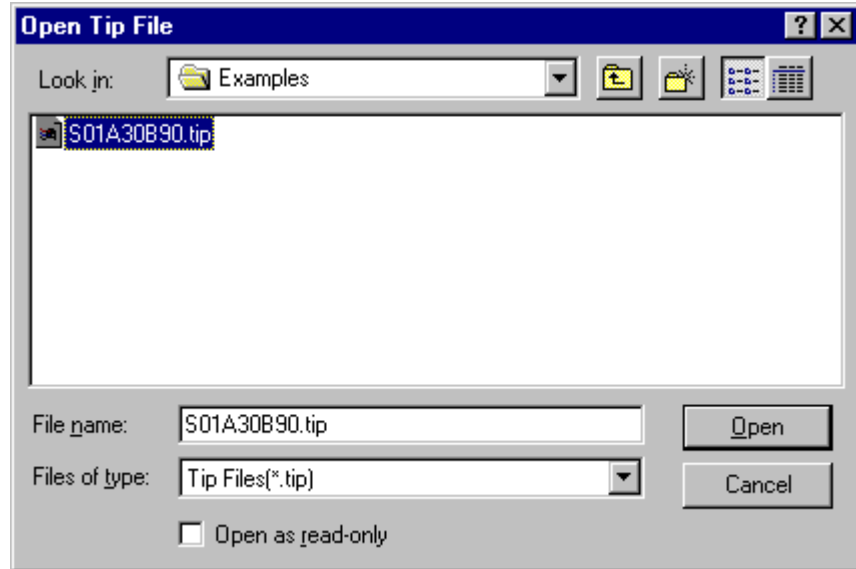
- Click on the “**Move Calibration Sphere**” button and follow the instructions displayed in the prompt window to move the calibration sphere.



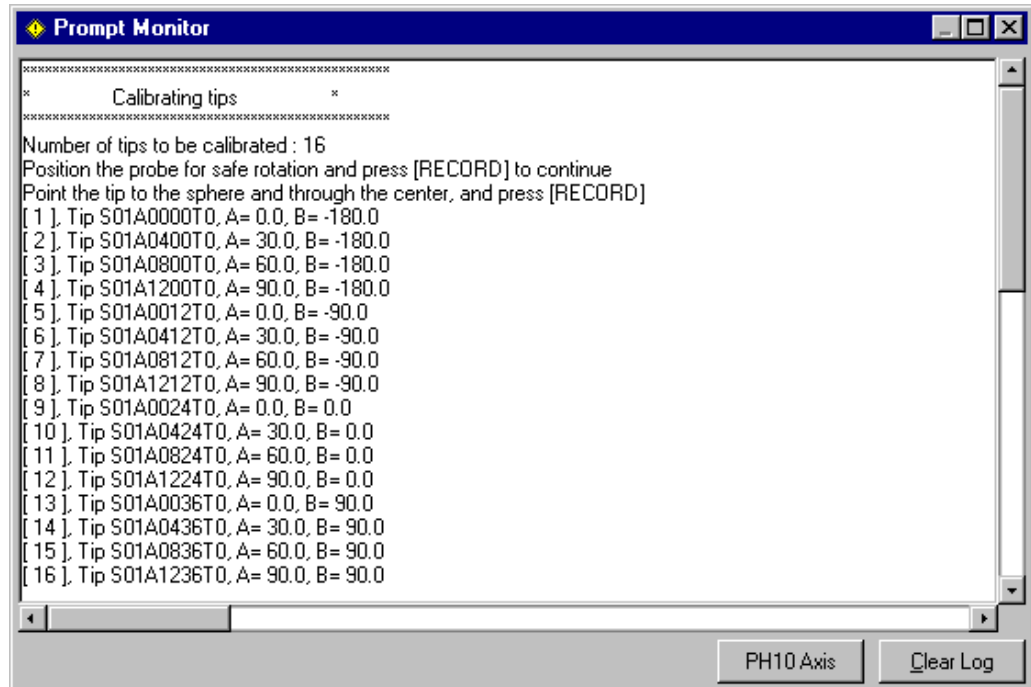
- Click on the “**Calibrate PH10 Parameters**” button and follow the instructions displayed in the prompt window to calibrate the PH10 parameters.



- Click on the “**Automatic Tip Calibration**” button and the **Open Tip File** dialog will prompt users to select the tip file to be calibrated. Select the tip file “**S01A30B90.TIP**” created from previous section and click on the **Open** button.



- Users have to perform two more operations on the CMM as instructed in the prompt window and then the program will start calibrating the tips defined in the tip file.



Construct the Reference Frame #1 Manually On-Line Using CMM

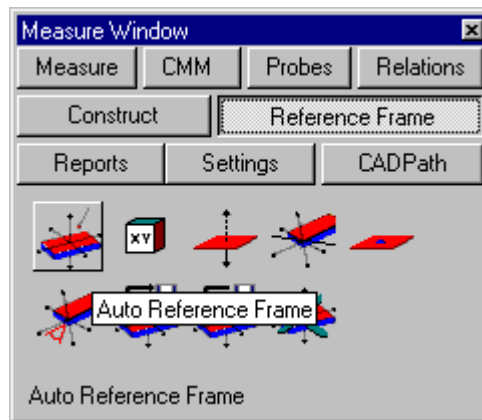
CADPath relies on MP reference frame #1 to *drive* the CMM machine. It is very important to establish the reference frame #1 so that CADPath can use DCC commands to drive the machine. For each part to be measured, users can also use CADPath exported part program to refine the reference frame #1 previously stored in MP. Notice that the part has to be placed on the CMM table so that the MP Reference Frame (reference frame #1) to be constructed is parallel to the machine coordinate.

There are many ways that the reference frame #1 can be constructed. In this tutorial, please use the **Auto Reference Frame** teaching agent to establish the Path Reference Frame and then save it to the MP reference frame #1.

If there are fixtures that can be used to place a part back to same location, it is not necessary to construct reference frame #1 manually as long as the reference frame #1 still exists in MP. However, users still have to include alignment procedures at the beginning of the part program to alignment the part more precisely. For example, users can separate the manual alignment procedures into a separate part program and run it only once for a batch inspection of the manufactured parts.

To construct MP reference frame #1

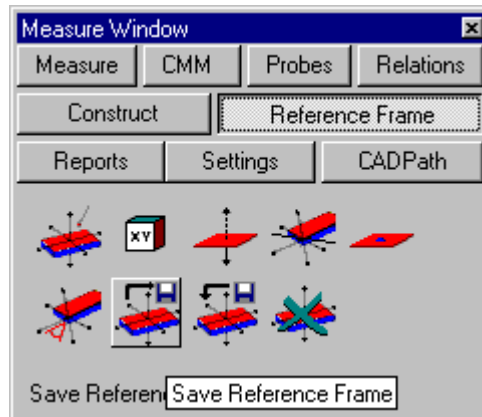
- Launch the Auto Reference Frame wizard.



- Follow the **Auto Reference Frame** wizard. Measure the plane “_PLN1” for **Auto Level**. Measure the line “_LINE1” for **Offset**. Measure the internal circle “_CIRC1” to setup the Origin.

GETTING STARTED

- Save the constructed reference frame to the MP reference frame #1.



Note:

- It is very important to verify that the constructed MP reference frame matches the path reference frame. Users can use the **RCU** to move the probe in the part coordinate system to check if the position and orientation of the reference frame #1 are correct or not.

Verify CMM Path

We have created two path segments from previous sections – “**Path for Datum Alignment**” and “**Construct RefFrame #2**”. Before these two path segments can be exported and executed safely, they have to be verified on-line first. It is assumed that before verifying the CMM path, the path is always verified **visually** through the **Playback** and/or **Modify CMM Path** interface and the tips used are all calibrated in advance. It is recommended that users check the items listed below before starting the inspection path verification interface:

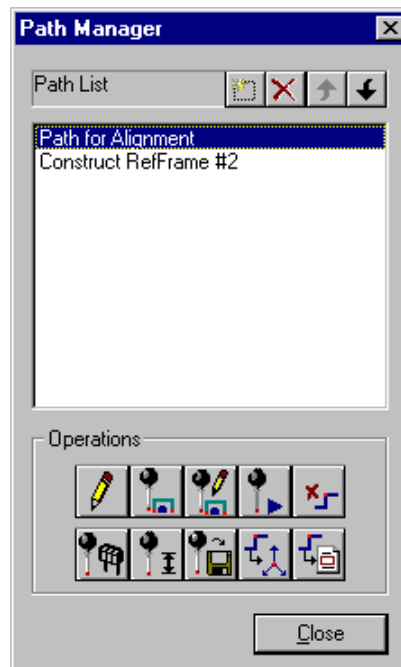
1. Check the operating units of the CMM. It should match the units of the CAD model.
2. Check if MP reference Frame #1 is constructed correctly or not.
3. Check if the tips are calibrated or not.

To verify CMM path:

- Launch CADPath and open the “**ANCDEMO.IQF**” file.
- Select the menu item **Inspection \CMM Path \Path Manager** or click on the




icon to open the **Path Manager** dialog as shown below. In the path list, select the item “**Path for Alignment**”. The corresponding path will be displayed on the screen.



GETTING STARTED

- Select the menu item **Inspection \CMM Path \Verify** to verify the CMM Path.

Verifying CMM path can also be activated by clicking on the icon  in the toolbox or the same icon shown in the **Path Manager** dialog.

- Please move the probe above the part and press **[RECORD]** button on the **RCU** (remove control unit). The purpose of this step is to make sure that the probe is moved to a clearance zone before CADPath issues the motion drive commands.
- Please use the slow traveling mode and press the **[RECORD]** button on the **RCU**.
- Press **[RECORD]** again to start verifying inspection path. Make sure the machine is in “**AUTO**” mode. When users press the **[RECORD]** button on **RCU**, the graphics window will display the animation for the next movement before CADPath sends out the command to CMM.

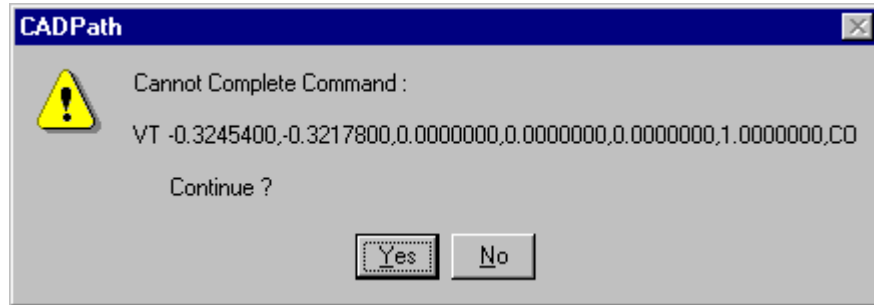
Note:

- In the verify mode, CADPath always wait for the previous command to be completed before it sends out another command. It is not unusual that that the CMM's motion drive is not smooth.
- Users can press the “**JOY**” button on the **RCU** to pause the execution.
- Users can hit the **ESCAPE** key on the keyboard and answer series of questions to either skip current command or stop verifying the path. When users press the **ESCAPE** key on the keyboard, the dialog as shown below will prompt users whether to abort current command or not. If users answer “**NO**” then the execution will continue.



GETTING STARTED

- Continue from the previous step, if users answer “**YES**” to the prompt, the dialog as shown below will prompt users whether to continue or not. If users answer “**YES**” to the dialog as shown below, CADPath will skip the command displayed in the dialog box and continue to execute the rest of the part program. If users answer “No” to the prompt, the verification of CMM path will stop immediately.



- If there is any unexpected touch, please stop immediately and then try to find the cause of the problem. Usually, the problem can be resolved by modifying the path.

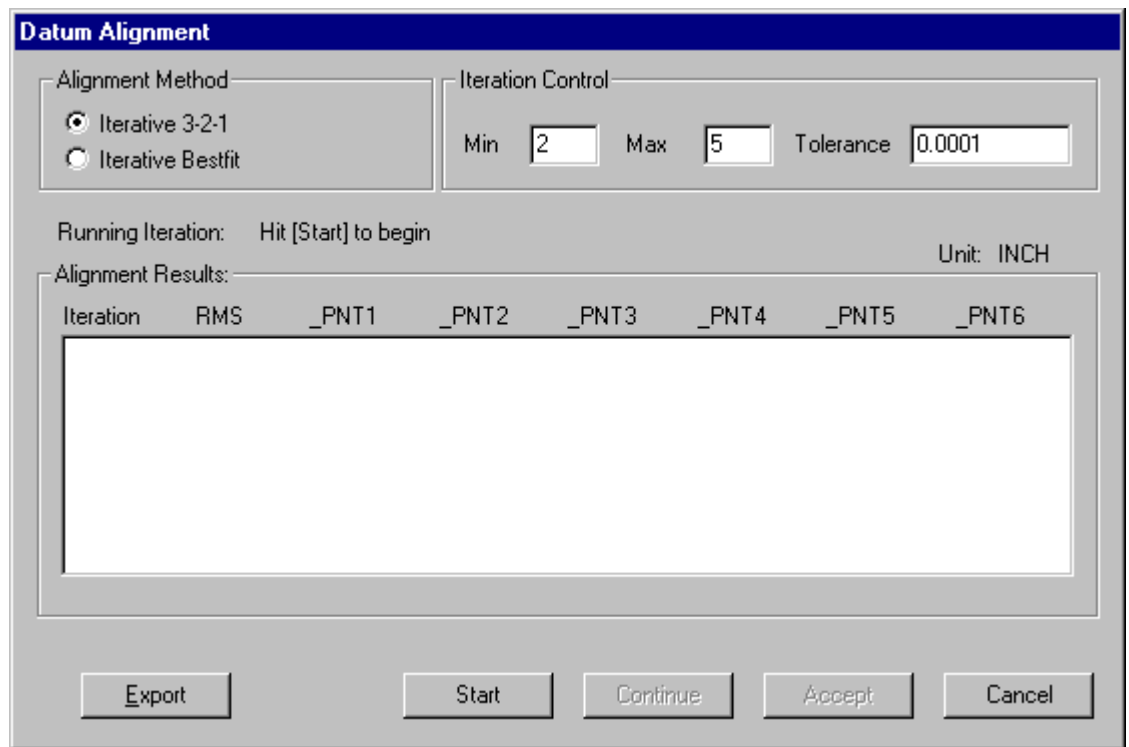
Verify CMM Path for Datum Alignment

This section demonstrates the procedures to use the **Datum Alignment** interface to verify the datum alignment process on-line. The path to be used for datum alignment has been verified in the previous section. However, there is no reference frame construction command contained in the “**Path for Datum Alignment**”. The actual construction commands will be executed through the Datum Alignment interface as described below.

To verify the CMM path for datum alignment:

- Use the **Path Manager** interface to select the path “**Path for Datum Alignment**” as the active path segment.

- Select the menu item **Alignments \Datum Alignment** or click the button  in the **Path Manager** dialog to launch the **Datum Alignment** interface as shown below.



- Change the **Min** value from 1 to 2 and change the **Tolerance** value from 0.001 to 0.0001 inch. The parameters in the datum alignment dialog can be interpreted as “using the Iterative 3-2-1 method to align the part. The iteration has to run at least 2 times no matter the **RMS** tolerance comes down to **0.0001** inch or not. The iteration will stop if the RMS tolerance is within 0.0001 inch or the number of iteration has reached 5.”

GETTING STARTED

- Click on the **Start** button to start verifying datum alignment.
- Please move the probe above the part and press **[RECORD]** button on the **RCU**.
- Please use slow traveling mode and press **[RECORD]** button on the **RCU**.
- Press **[RECORD]** to start verifying inspection path.
- The program will keep running until the iteration control conditions have been reached. The alignment results will be displayed in the list box after each iteration.
- Users can hit the **Continue** button to run one more iteration. If users specify new iteration conditions, this action will keep running until the new iteration control conditions have been reached.
- Click on the **Accept** button to accept the alignment result and update MP reference frame #1. If users click on the **Cancel** button, the MP reference frame #1, which was saved previously, will be restored.

Note:

- CADPath will check that if there are exactly six inspection points contained the path before the **Datum Alignment** interface can be launched.

Export CMM Path for Datum Alignment

To export CMM path for datum alignment:




- Continued from previous section. Switch to the **Quick Teach** (Visual Basic) window and move the mouse cursor to the position where the part program is to be exported.
- Switch back to CADPath, click on the **Export** button in the **Datum Alignment** dialog to export the “Path for Datum Alignment” as an alignment part program.

Note:

- In addition to the comments and the commands to setup the **Backoff** and **Clearance** distance. CADPath exports two important function calls – “**MeasureDatumPoints**” and “**DatumAlignment**”. The function “**MeasureDatumPoints**” basically measure all the six datum points and collects the measurement results into user summation array in MP. While the function “**DatumAlignment**” is the iteration control subroutine, which reads in the data stored in user summation array and controls the iterations based on the specified parameters. The last parameter passed to the subroutine “**DatumAlignment**” is the “**AddressOf MeasureDatumPoints**”, which passes the address of the **MeasureDatumPoints**” function to “**DatumAlignment**” routine so that “**DatumAlignment**” can call the datum points measurement subroutine.
- There are special arrangements in the path for datum alignment. Users should not modify the commands inside the “**MeasureDatumPoints**” subroutine.
- When the “**Path for Datum Alignment**” is exported though the Datum Alignment interface, only the measurement commands will be exported. The datum point measured will not be save as a point feature and any function attached to a feature will be ignored.

Export CMM Path to a Part Program

To export CMM path to a part program:

- Select the menu item **Inspection \CMM Path \Path Manager** or click on the icon  to open the **Path Manager Dialog**.
- Select the item “**Path for Alignment**” in the path list and the corresponding path will be displayed on the screen.
- Select the menu item **Inspection \CMM Path \Export Part Program** or click on the button  to export the inspection path to the part program.
- Select the item “**Construct RefFrame #2**” in the path list and the corresponding path will be displayed on the screen.
- Select the menu item **Inspection \CMM Path \Export Part Program** or click on the button  to export the inspection path to the part program.
- Save the CADPath document, exit CADPath and return to Quick Teach.

Note:

- Users can also attach tolerance evaluation function to the datum points and see the inspection results in the report window.
- Whenever users execute an operation successfully through the **MeasureMax Link**, there will be a function exported to the part program associated with each operation.