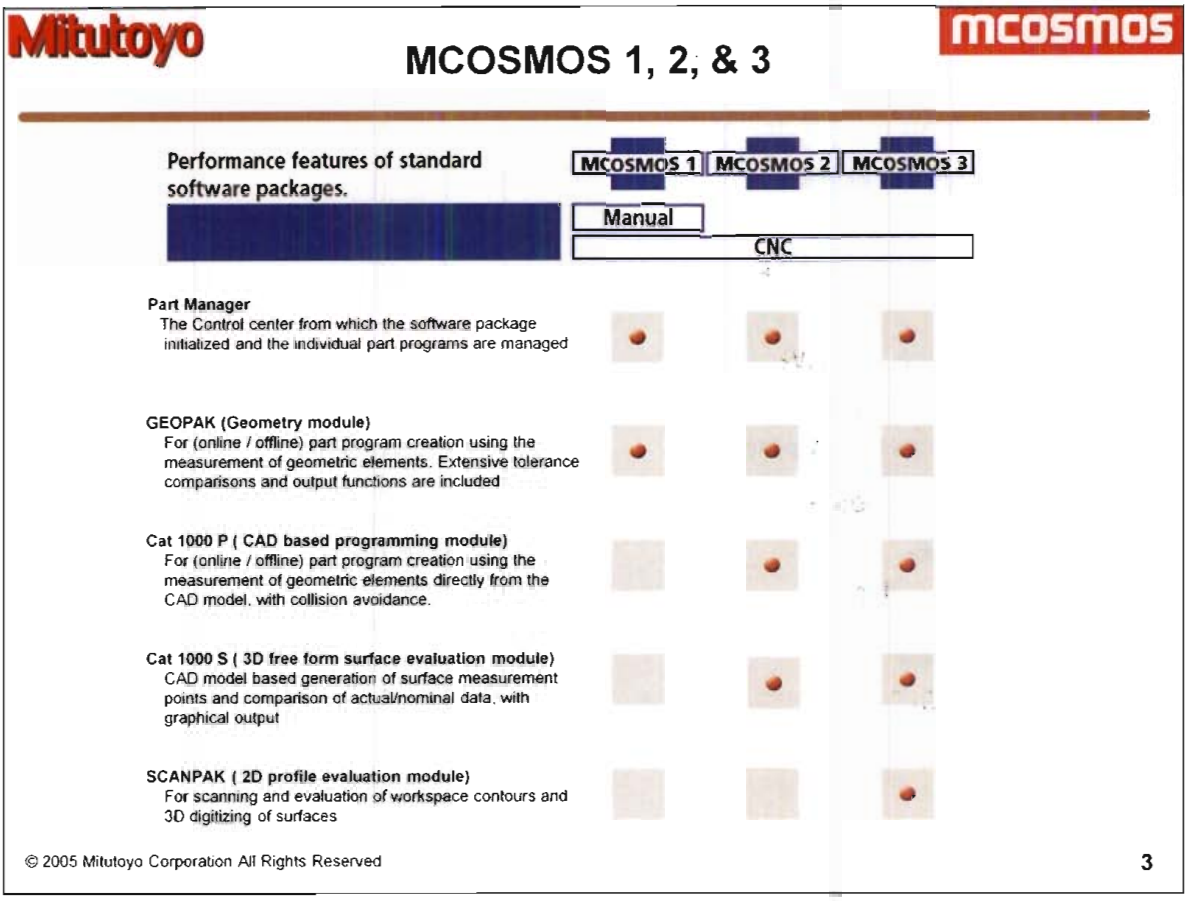
Mitutoyo mcosmos

MCOSMOS C1
CMM Software Tutorial

MiCAT
Mitutoyo Intelligent Computer Aided Technology
the standard in world
metrology software
CMM

MCOSMOS Overview

- MCOSMOS:
  - Mitutoyo Controlled Open System for Modular Operation Support
- Modular CMM software system
  - For Both CNC and Manual CMMs
  - Three Levels: 1,2,3
  - Optional Modules Available
- Provides CMM control, measurement and evaluation
- Runs on Microsoft® Windows® XP Pro or Wondows 7



- Level 1 Manual Day 1, and 2
- Level 1 CNC Day 3, and 4
- Level 2 Day 5
- Level 3 1 additional Day at a later time for Manual
  2 additional Days at a later time for CNC
- Note: Level 3 training to take place once lower levels are used, and understood.
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- **Fixture coordinate system**
- **Conversion to full CNC**

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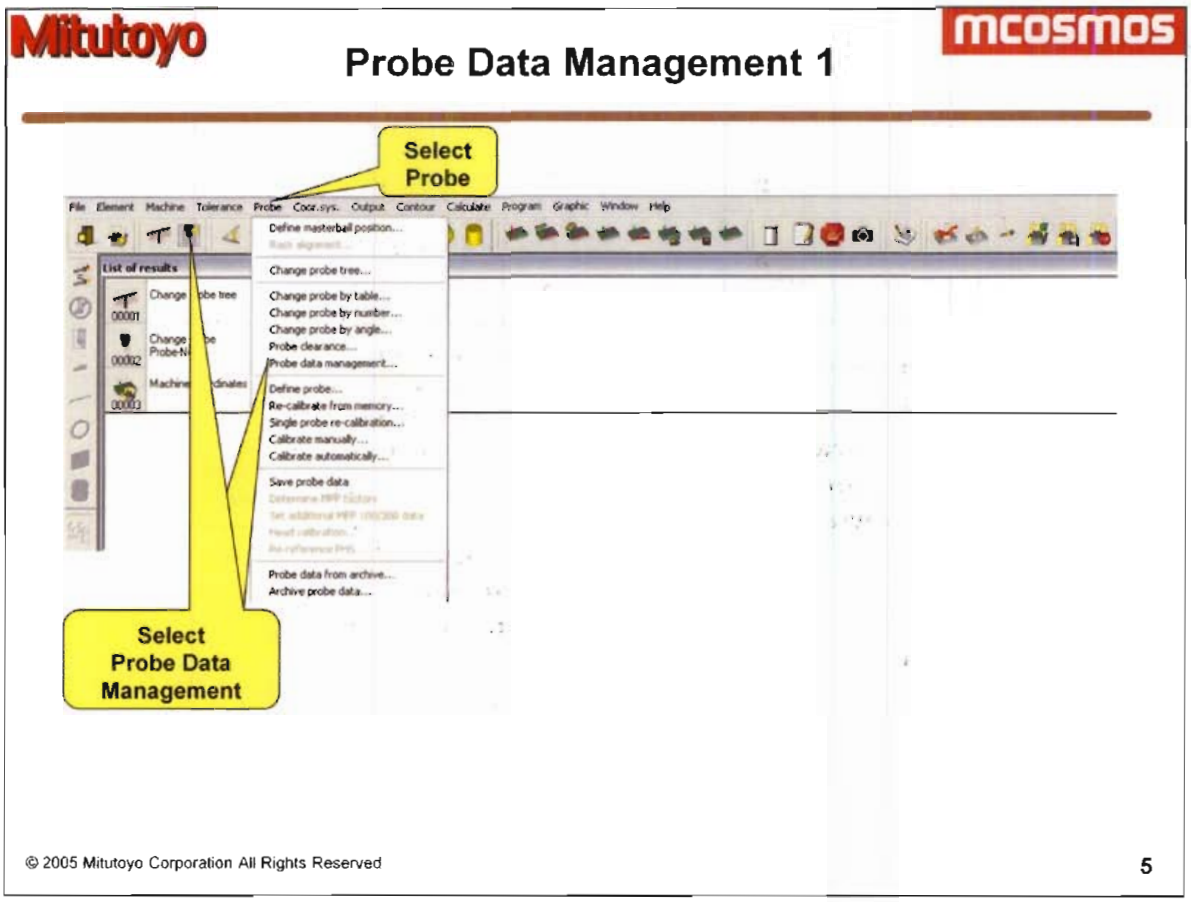
- **Techniques**
- **Operator instructions**



- In order to measure with the CMM, a probe must be defined and calibrated.
- To calibrate see Probe Data Management function.
- You can modify a probe configuration created in the CMM System Msnsger using

  the probe bilder or the CSM

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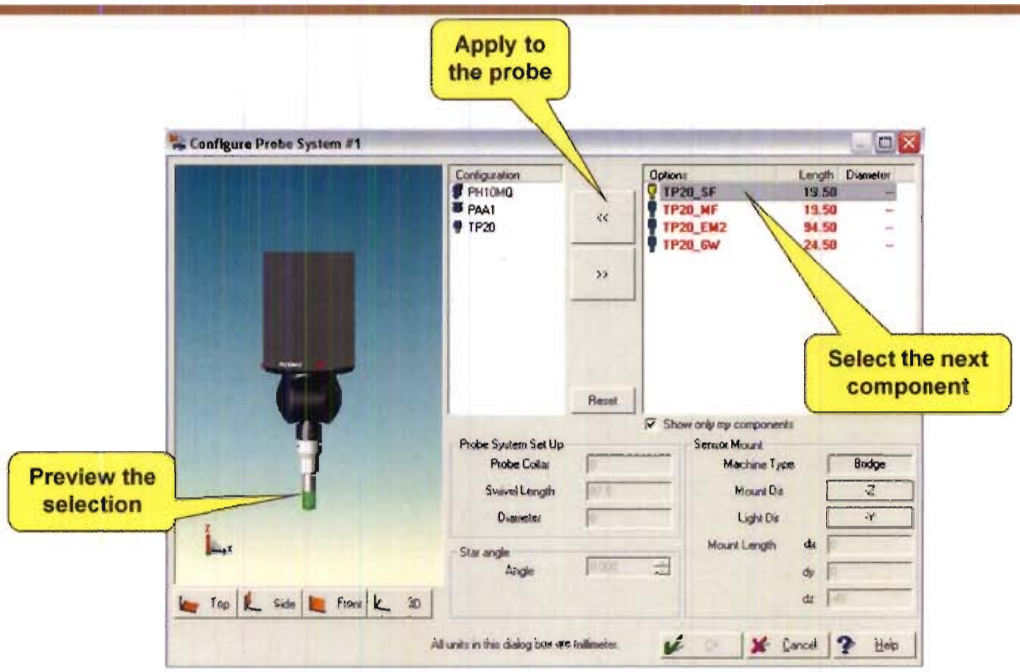
Configure probe system 1



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- Remove the unwanted components and select new ones to replace the ones removed
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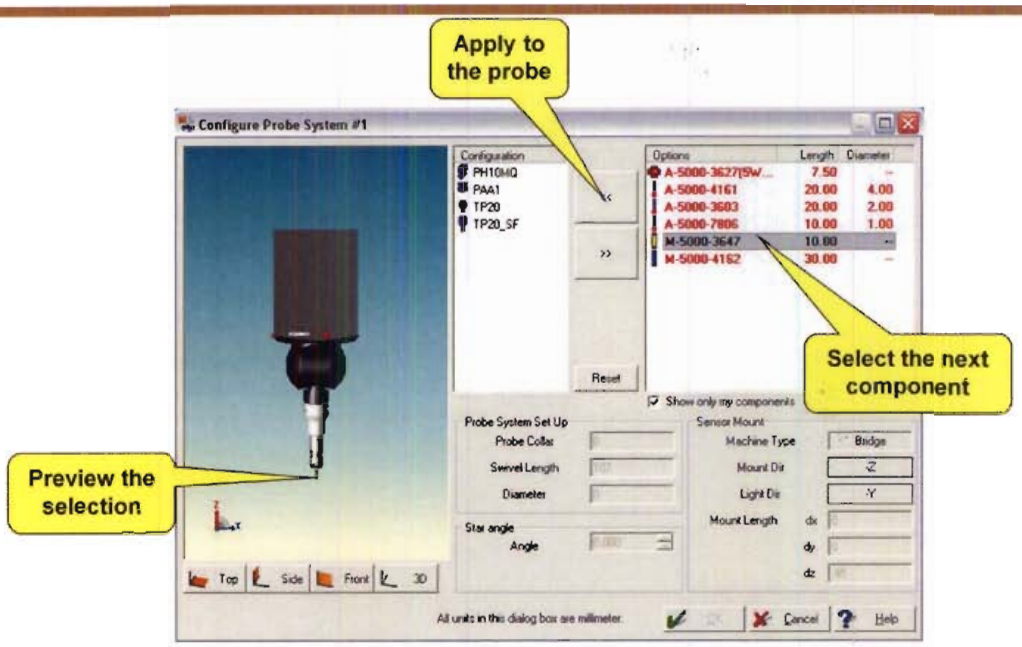
Configure probe system 2



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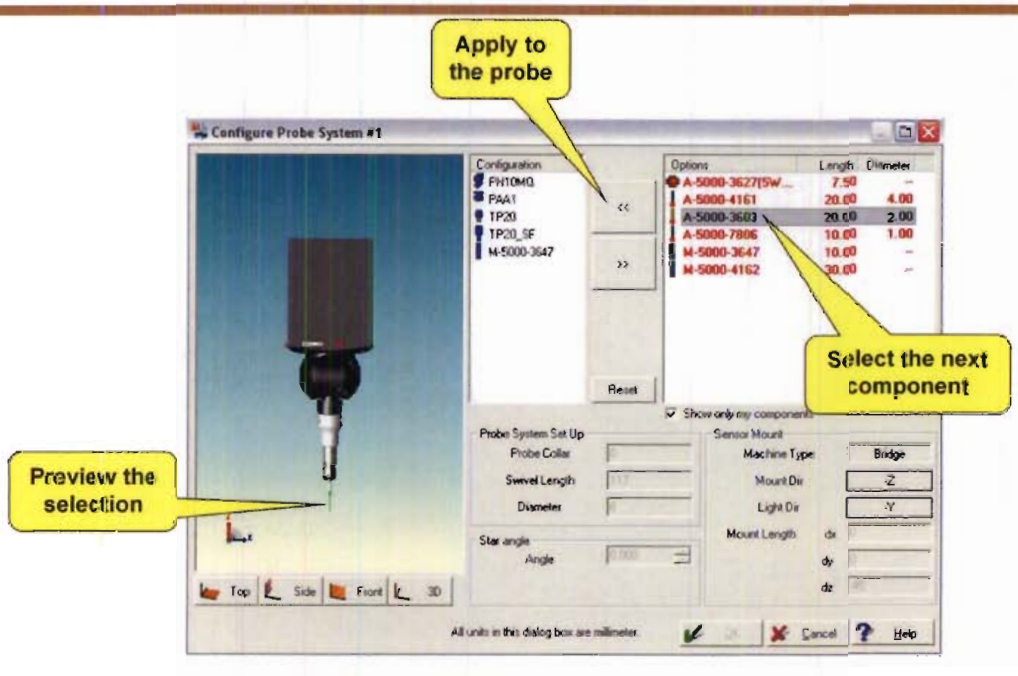
Configure probe system 3



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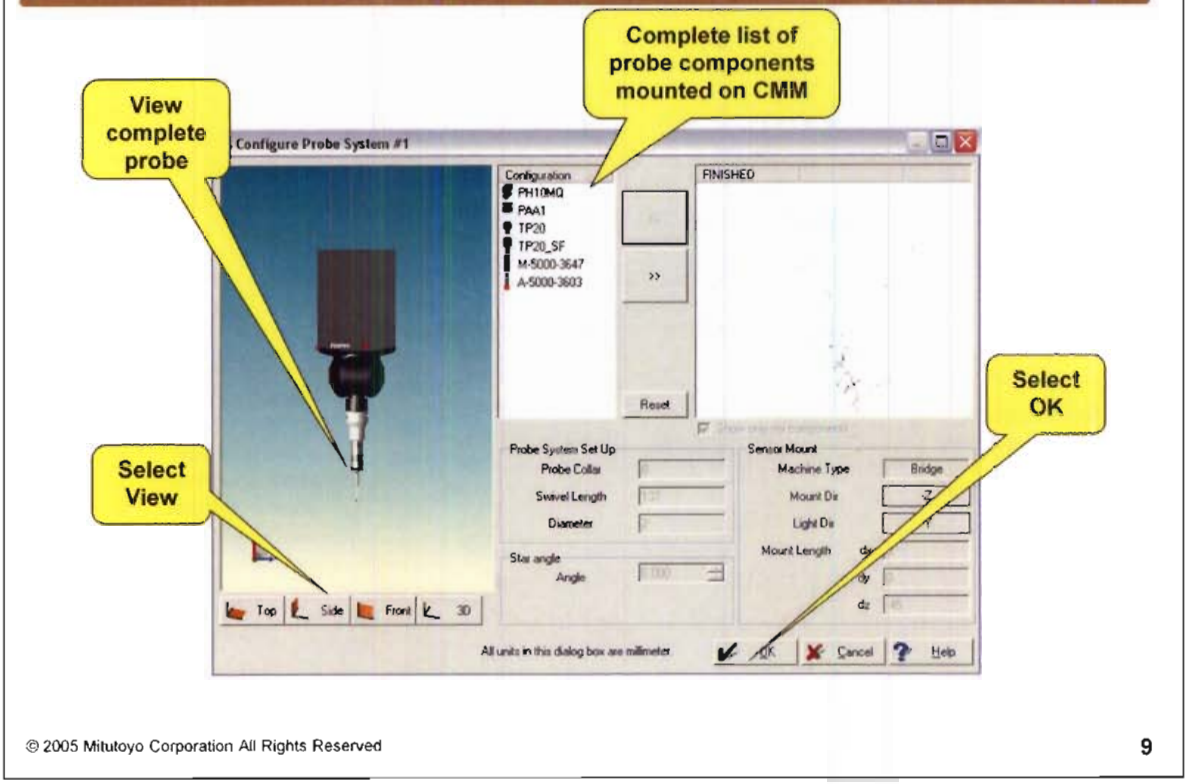
Configure probe system 4



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- Graphic should now show all the probe equipment mounted on the CMM.
- On a CNC CMM this graphic is used to calculate CNC motion if it is incorrect the Calibration could fail or crash.
- Select view.
- Rt click and drag to Zoom Lf click and drag to zoom click both and drag to pan.
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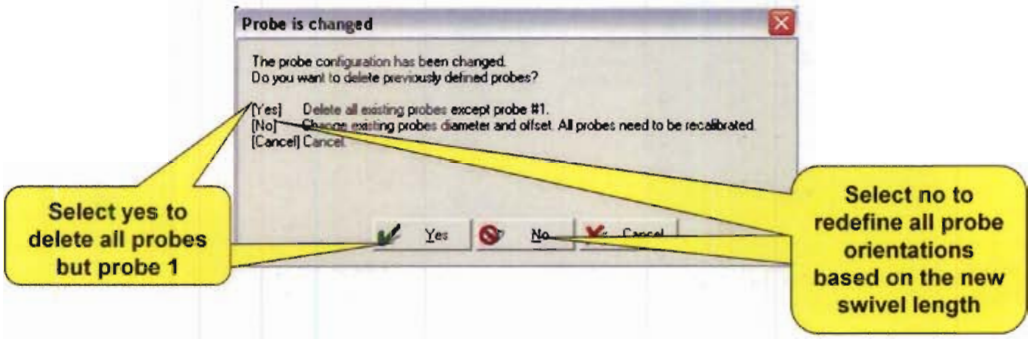
Configure probe system 8



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Define Probes 1

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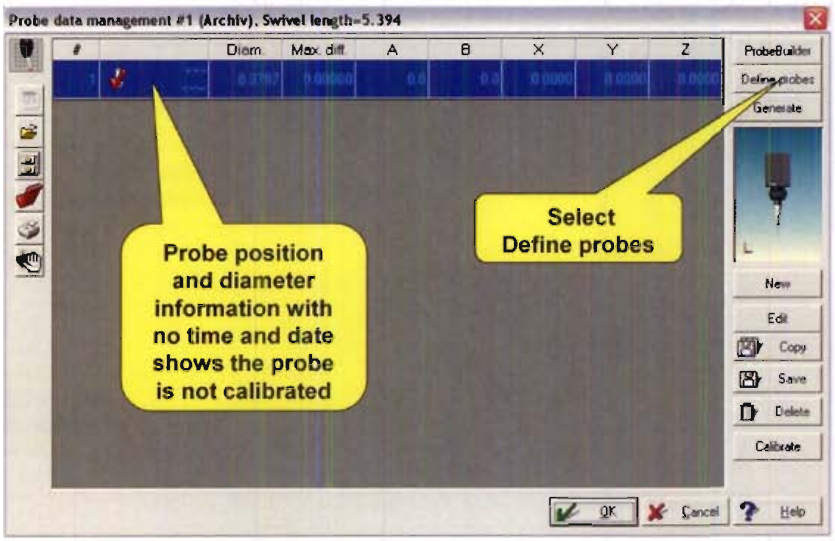

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- The first stylus (for a indexable probe head),will be A and B angle 0.
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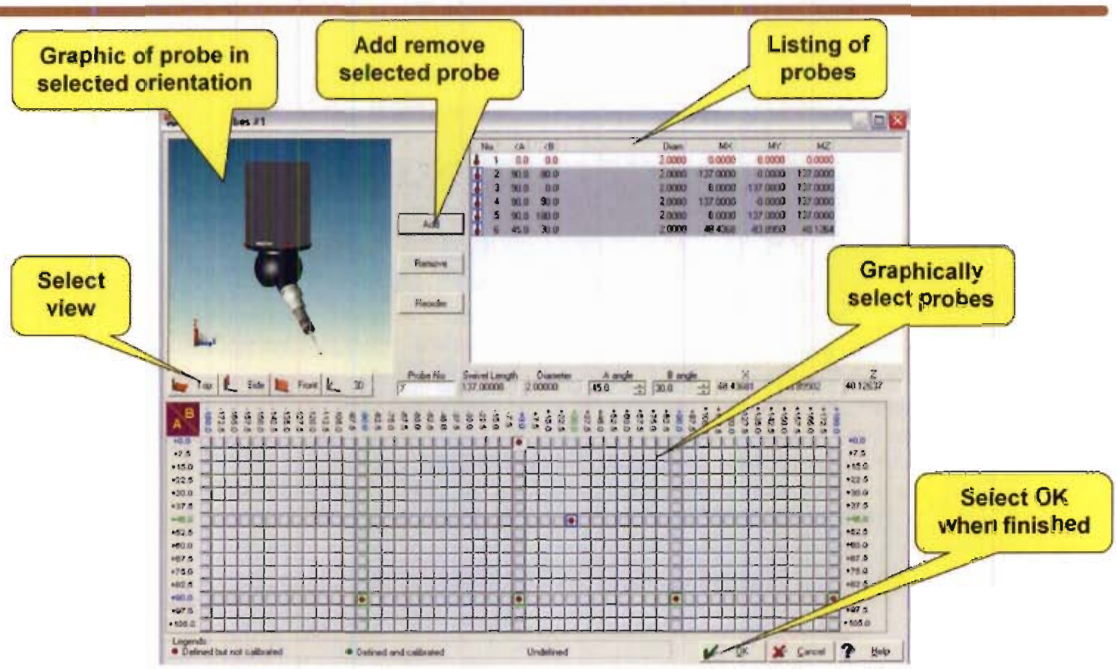
Define Probes 2



- The Probe Builder will define probe 1. You may now define additional probe orientations as necessary. Note: probe 1 must be at A 0, B 0.
- Windows selection methods: SHIFT, and CTRL may be used.
- Click on add or double click the probe in the selection window to add the selected probe to the list.
- The graphic will display the selected probe.
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Probe Calibration 1

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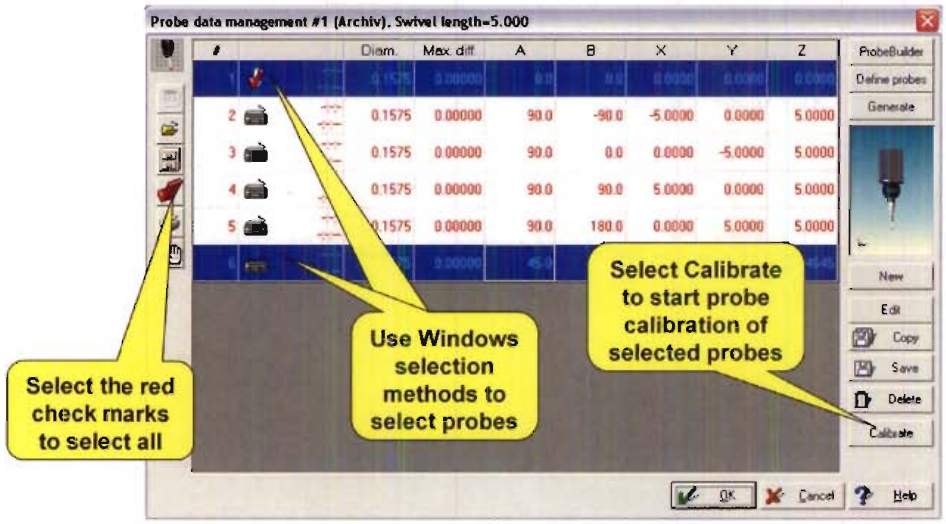

- To calibrate these probes, select **Checkmarks** to select all of the defined probes and then select **Calibrate.** Or use alternate Windows selection method to select specific probes.
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Probe Calibration 2

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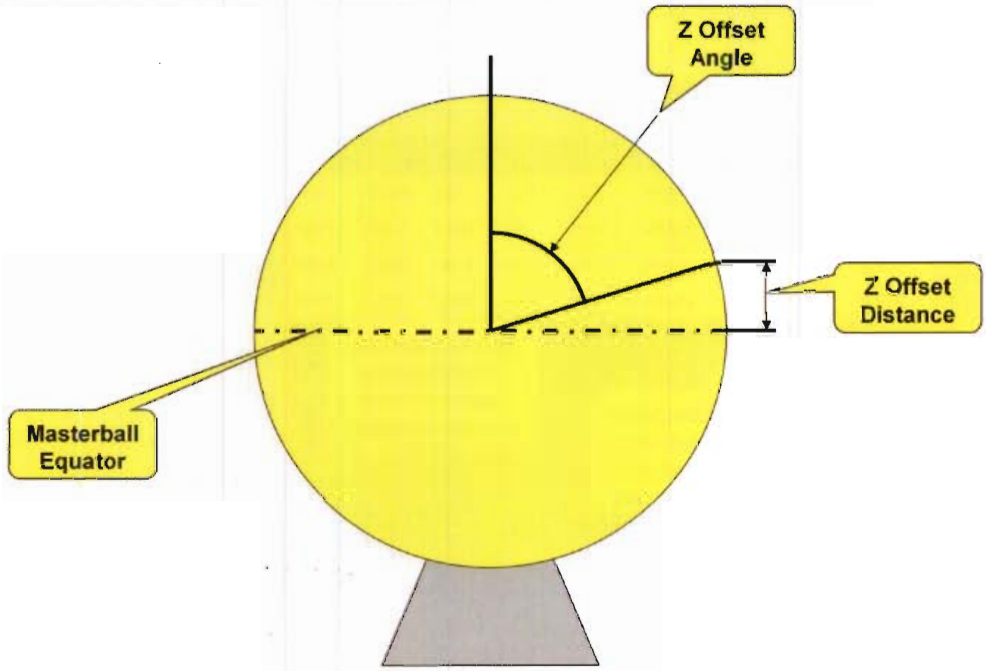

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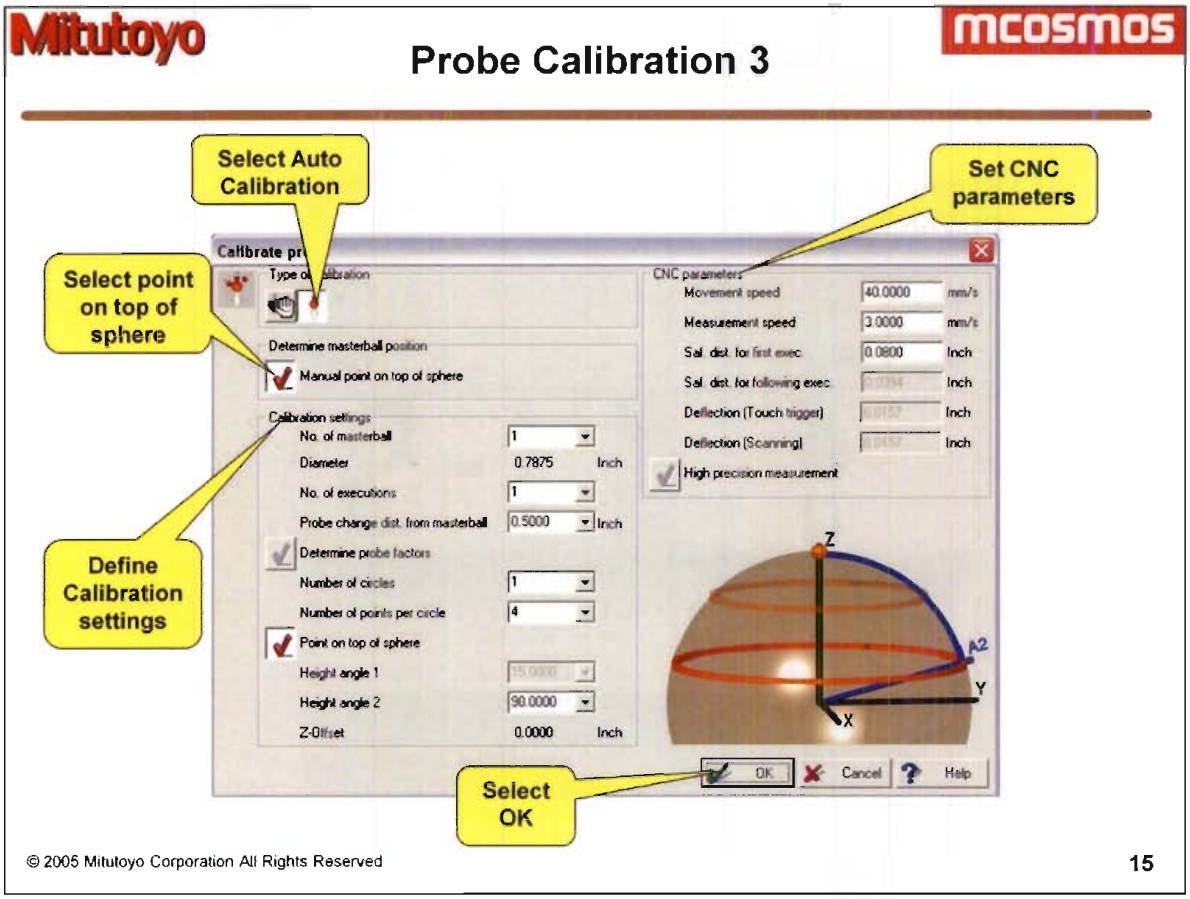
- To adjust the offset from the equator adjust height angle 2. The offset value will appear below.
- This is used for cylindrical styli with a spherical end and very small styli (smaller then 1 MM).



- Select Auto Calibration to automatically calibrate the selected probes.
- Set CNC parameters as shown CNC Parameters will be discussed latter. Note: to calibrate automatically here you need an automatic probe head.
- Select point on manual point on top of sphere. Otherwise the machine will use a defined masterball. Calibration defines the masterball.
- Define Calibration settings.
- For a scanning probe select Determine probe factors and high precision measurement. Scanning probes require 2 executions.
- See Disk styli calibration in the Knowledge base for Disk styli.
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Probe Calibration 4

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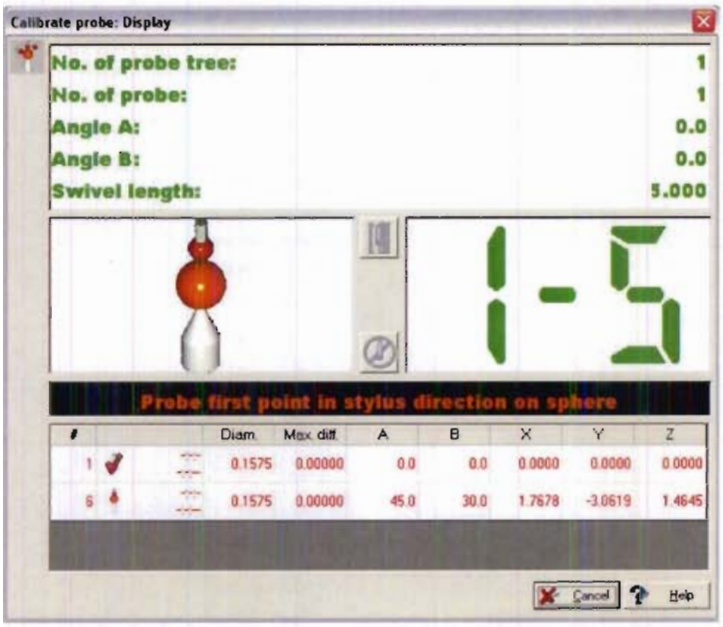

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- Measure I point on the top of the Masterball and the machine will calibrate the rest of the probes for a machine with an automatic probe. Manual probes must be calibrated manually or with a calibration program.
- To calibrate individual probes automatically Probe #1 must be included .
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Probe Calibration 5

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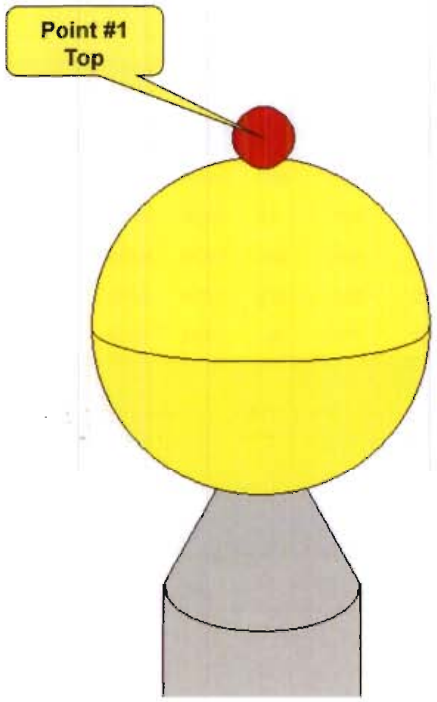

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Generate probe calibration program 1

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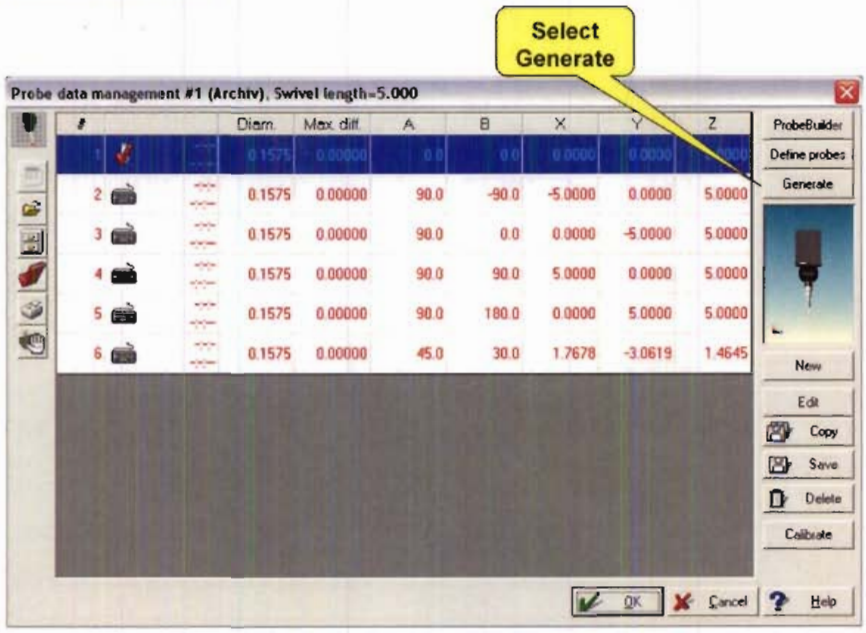

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- To Generate an Automatic calibration program for an indexable probe or a fixed star probe Select Generate
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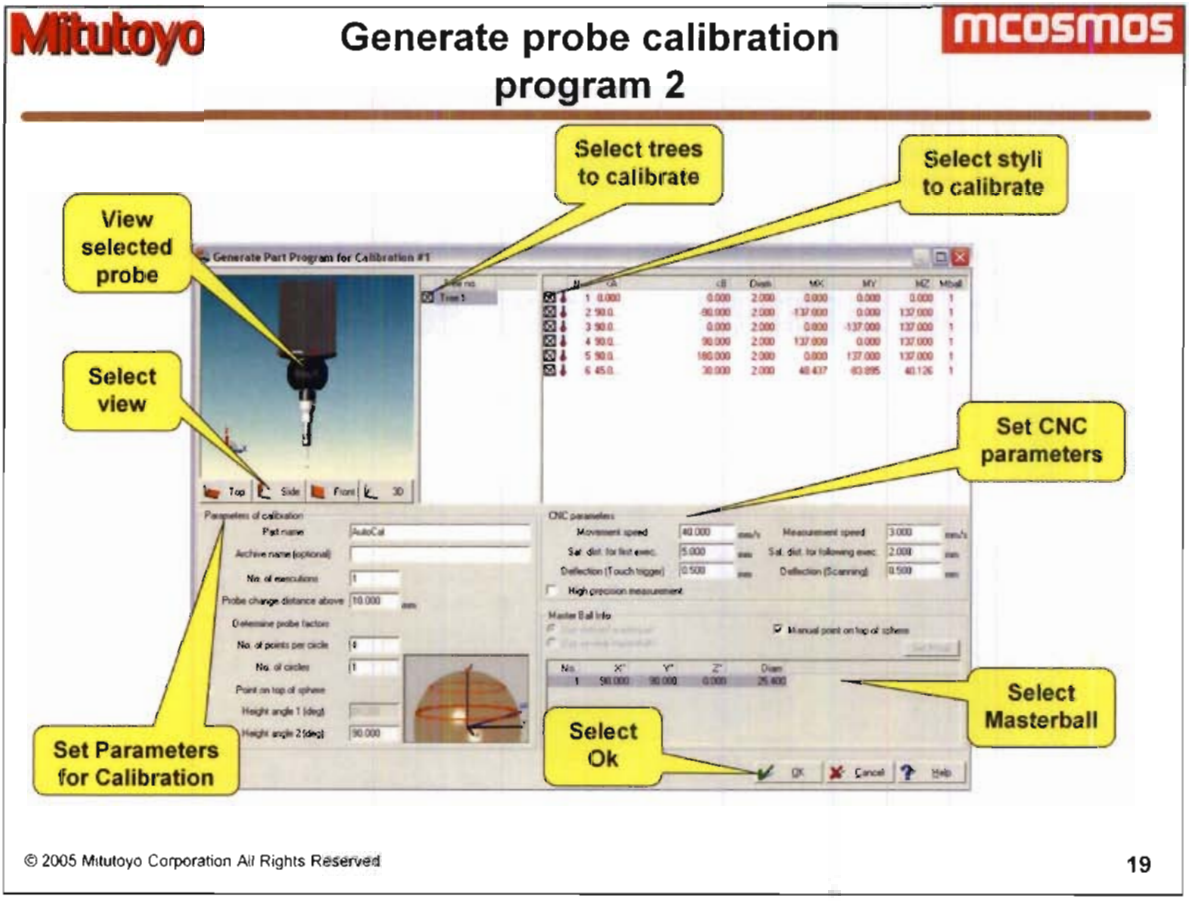

- Select trees to be calibrated.
- Select probes for each tree to be calibrated.
- View probe as selected / adjust view as required.
- Set CNC parameters.
- Select Masterball / Masterballs.
- Set Parameters of Calibration.
- Select OK and MCOSMOS will generate a calibration program placing the program in the active parts list.
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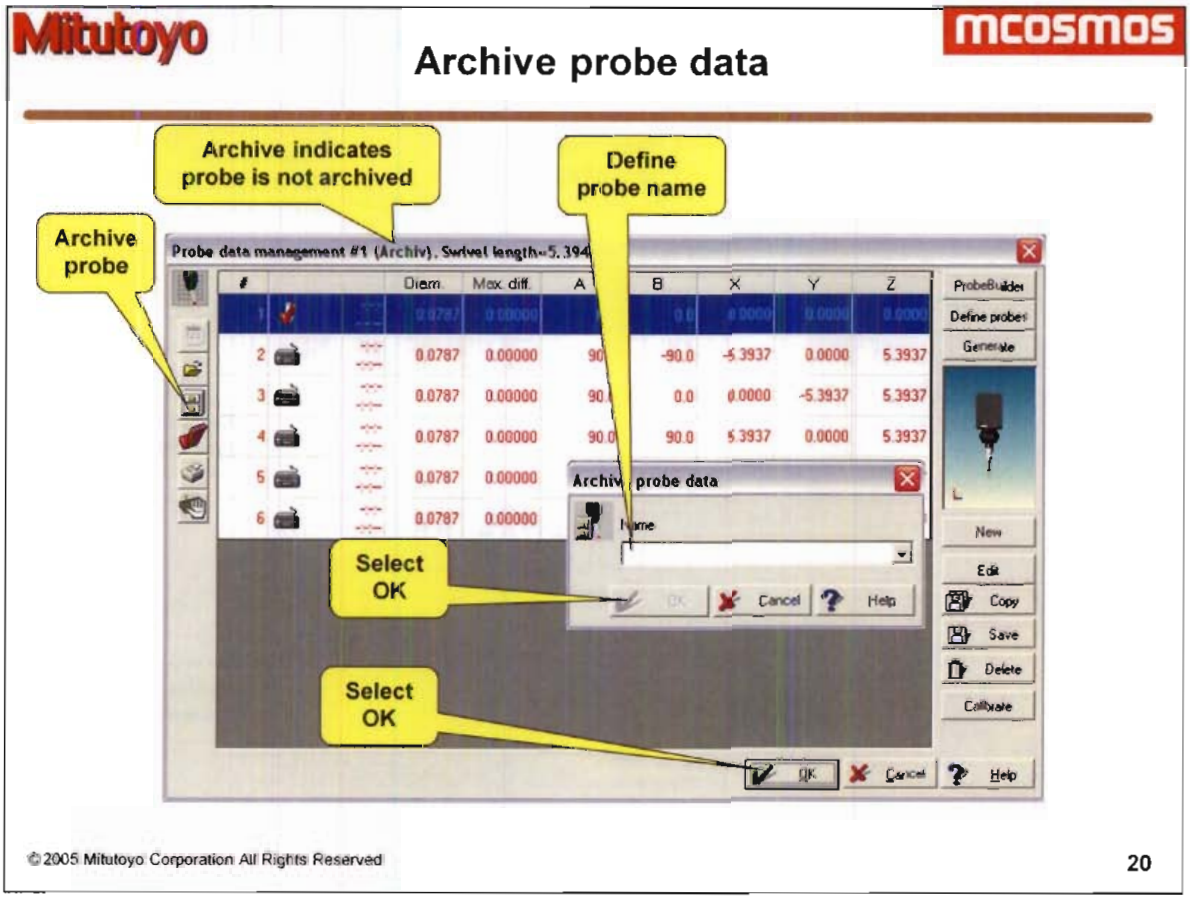

- After calibrating you may want to Archive the probe.
- Archiving the probe will create a file for retrieval at a later date with the probe as built, all of the defined orientations and the calibration data.
- Note: probes to be used should be re calibrated after loading from Archive.
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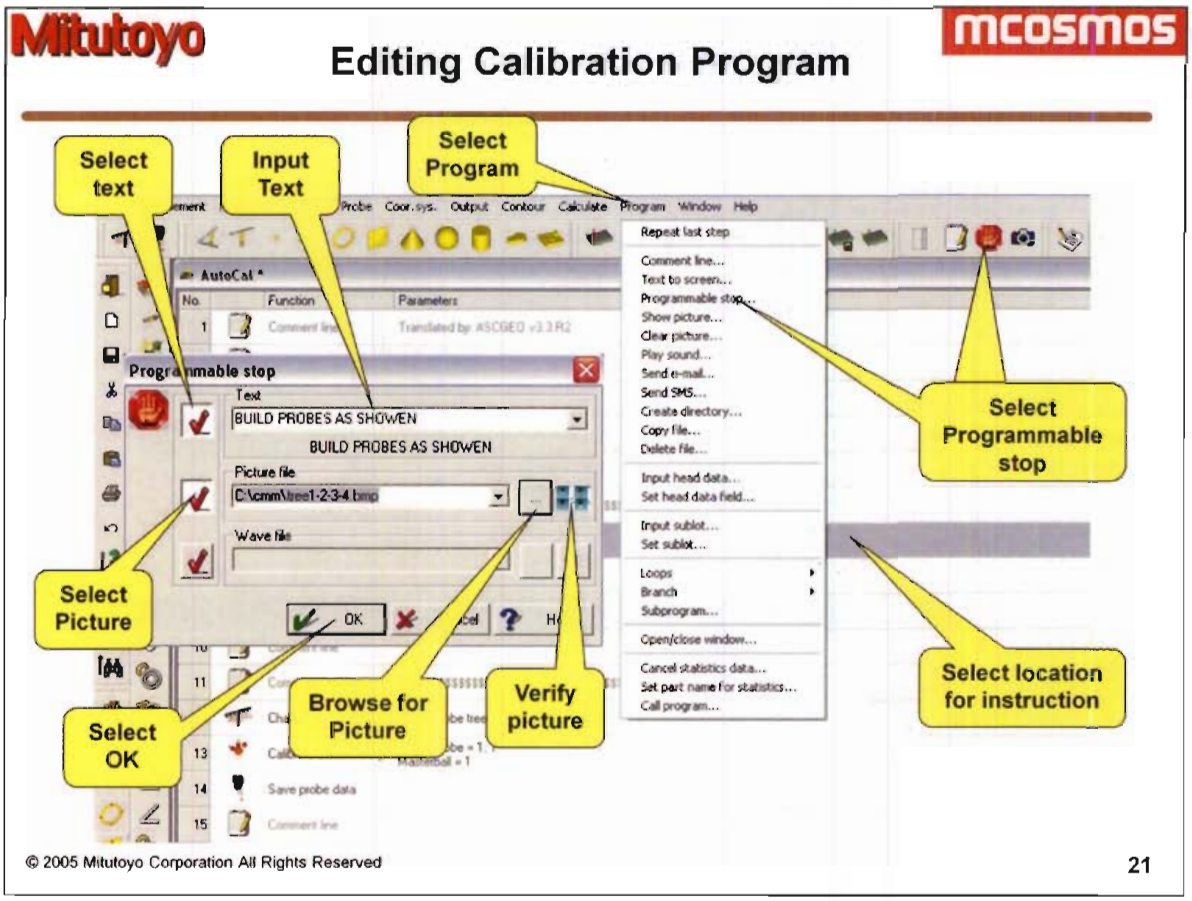

- Once a Probe Calibration program has been generated, it may be helpful to add instructions.
- From the part program editor select the line were you would like to insert (lines are inserted above the highlighted line) your instructions.
- Select Program.
- Select Programmable stop.
- Select the instruction type (s) with the check mark.
- Input text instructions, or brose for a picture or sound file as preferred.
- Select OK.
- If you have a manual probe changer repeat for each probe change.
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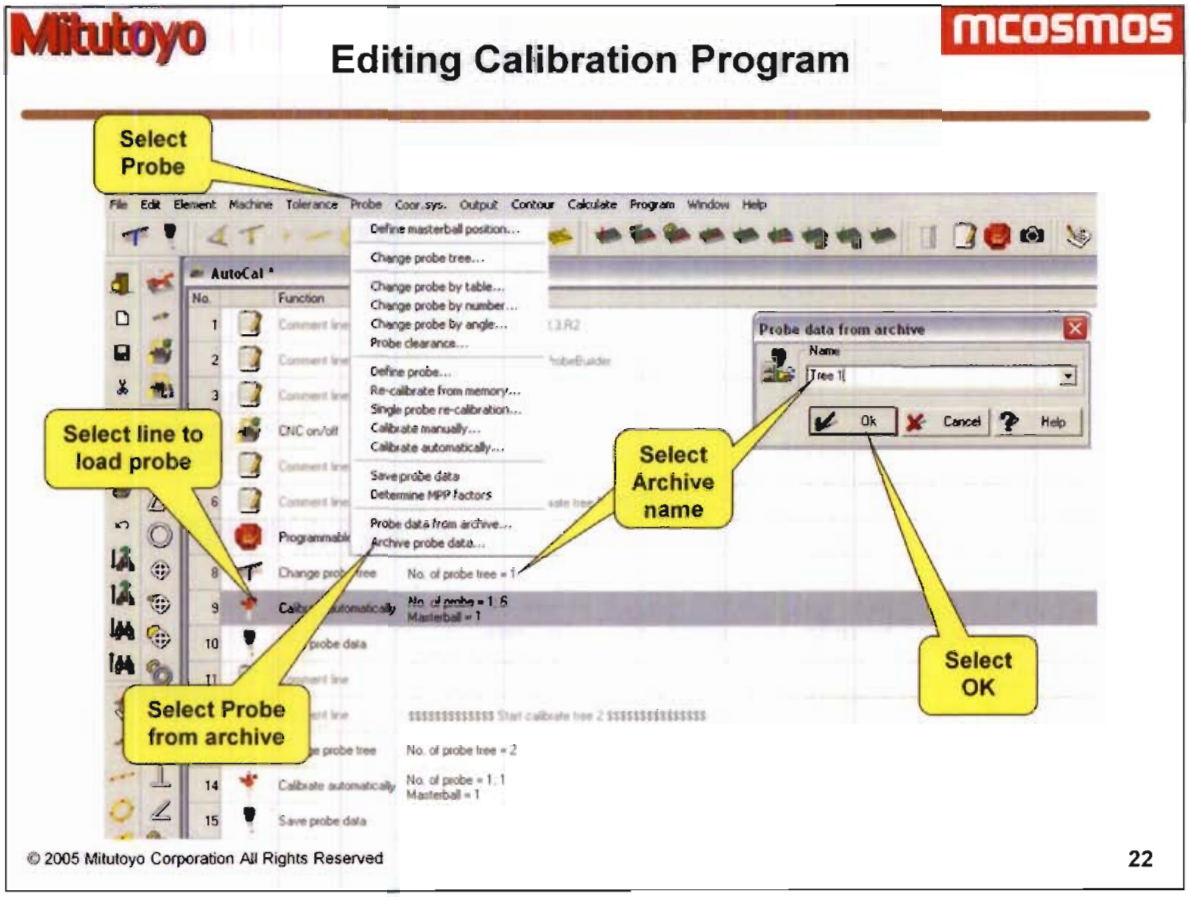

- A generated calibration program will calibrate the current probe.
- To make the correct probe the current probe load it from archive.
- Select the automatic calibration line in your program.
- Select Probe.
- Select Probe from Archive.
- Use the pull down to select the appropriate probe from archive.
- Select OK
- If multiple probe trees are to be calibrated repeat for each tree.
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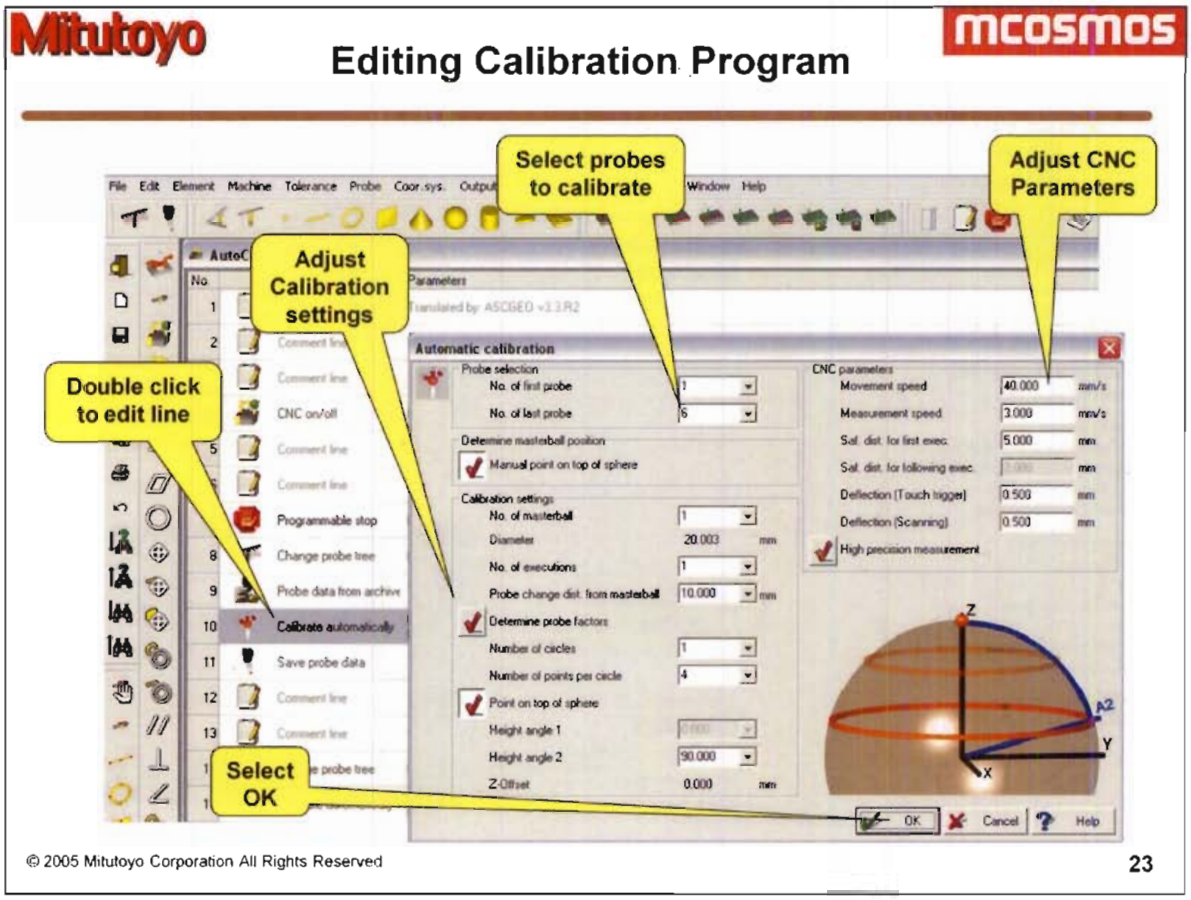

- If additional probe orientations are to be added.
- Archive that probe with the added probe orientations.
- Double click on the automatic calibration line.
- Change the number of probes to be calibrated.
- Adjust the Calibration settings as necessary.
- Adjust the CNC parameters as necessary.
- Select OK
- If multiple probe trees are to be calibrated repeat for each tree as necessary.
- Upon completion save the Calibration program and exit.
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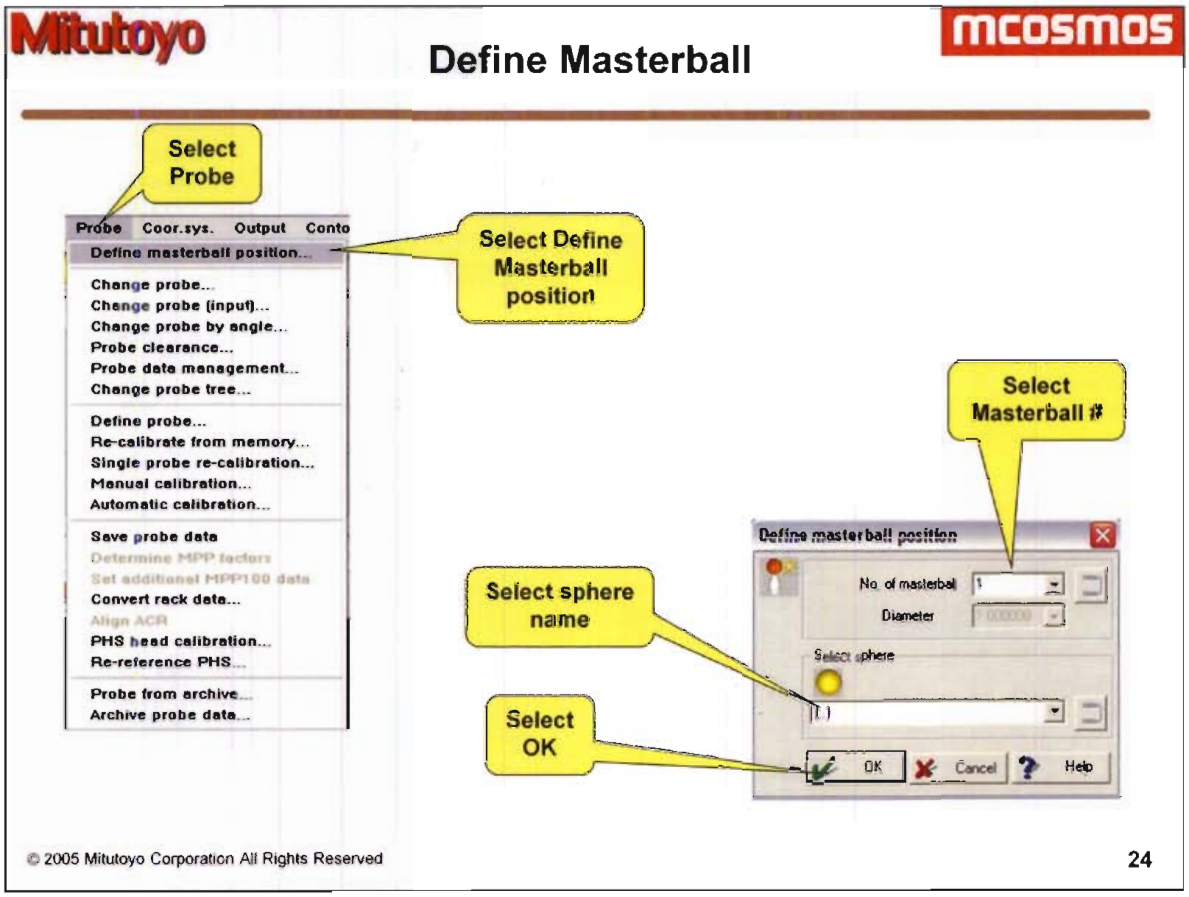

- Select Probe.
- Select Define masterball position.
- Select masterball #.
- Select a measured sphere that represents the masterball location.
- With multiple masterballs you must define their locations.
- With a defined master ball the calibration can be completely automatic no point on top of the master ball is required unless requested.
- This is only necessary for multiple masterballs and should be part of the calibration program. Normal calibration defines the masterball loction.
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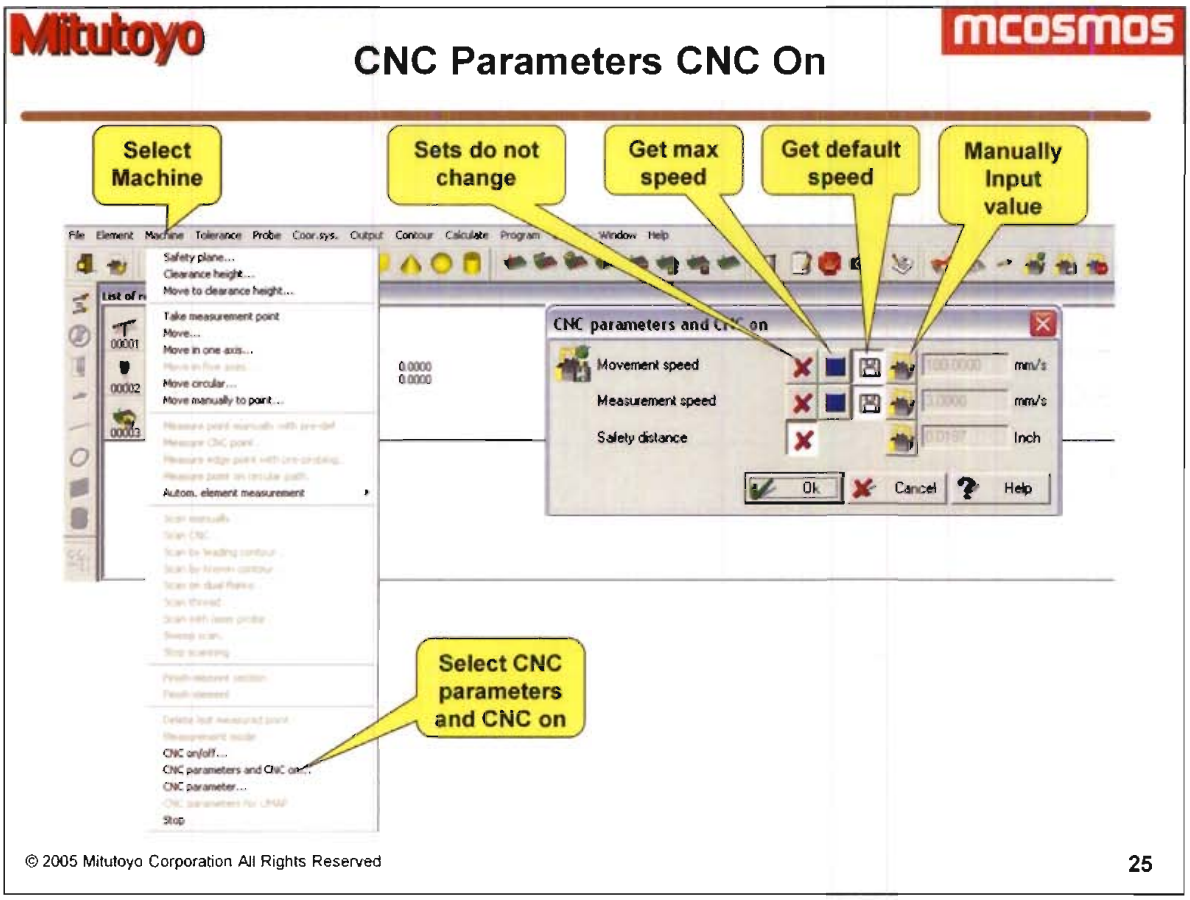

- This option is not recommended. It does not set Measurement Length, or Positioning Distance. These parameters if not set will remain as they were.
- They may have been adjusted in previous part programs causing your program to intermittently fail, crash, or run very slow .
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Setting CNC on / off

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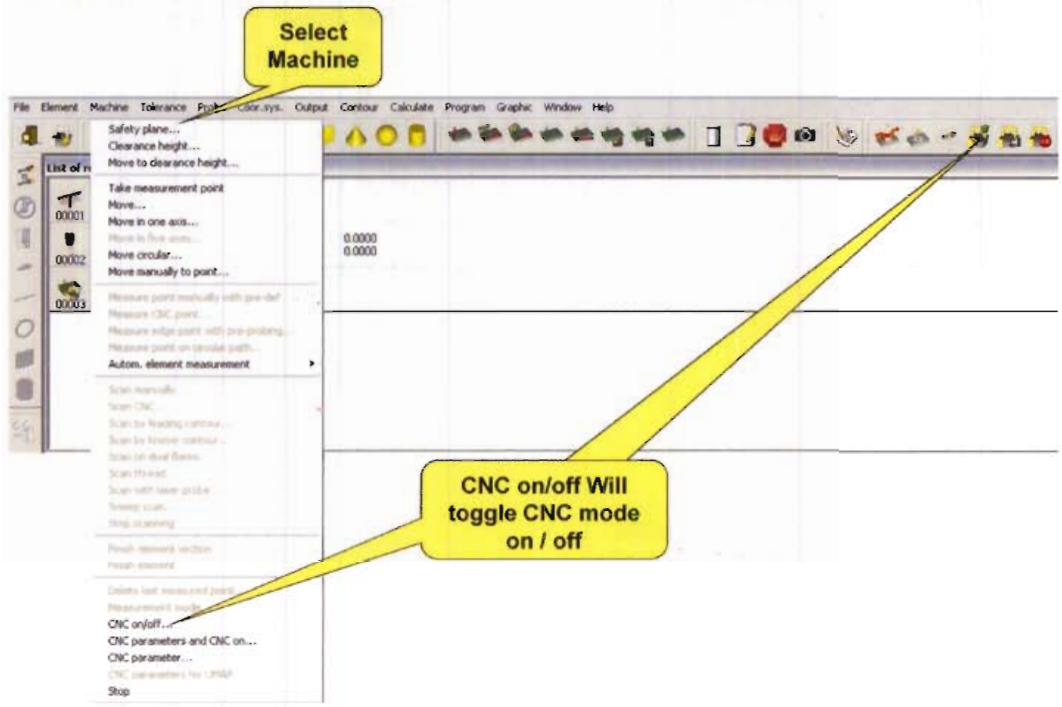

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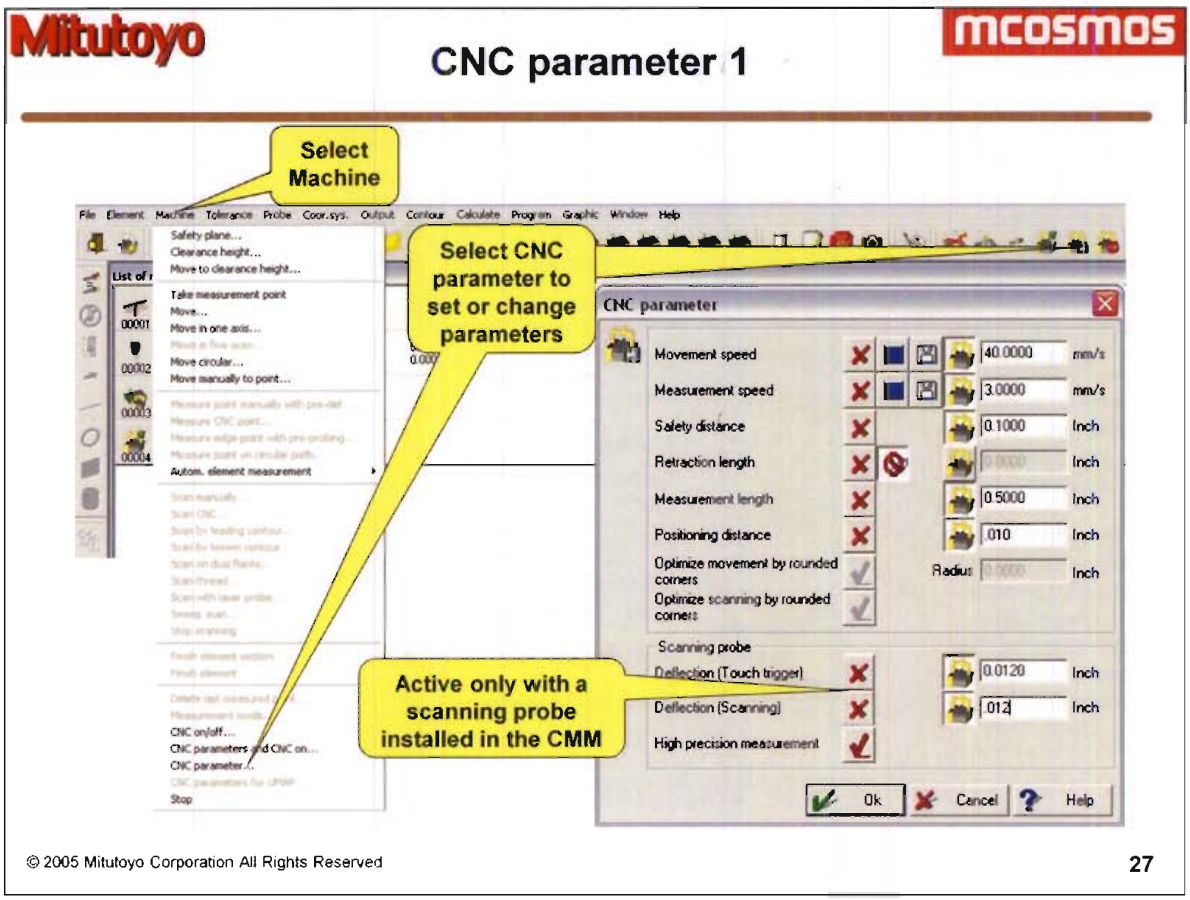

- Recommended settings :
  - Movement speed = 40 mm/s
  - Measurement speed = 3 mm/s Tp20, Sp25 6 mm/s Tp200
  - Safety distance = 1.5 to 2.5 mm / .060 to .100 Inch
    (Hole Dia – Probe Dia) /2 Max
  - Retraction length selec to set retraction equal to safety distance
  - Measurement length = 12.7mm/ .5 Inch 3 X Safety distance Min
  - Positioning distance = .25mm/ .010Inch/ 25% safety distance Max
- Once a part program has been written and proven, then adjust the movement speed as high as you feel comfortable.
- Set deflection for scanning and touch to 0.3 MM or .012 inch ½ of the total travel
  for SP25 probe Turn high precision on.
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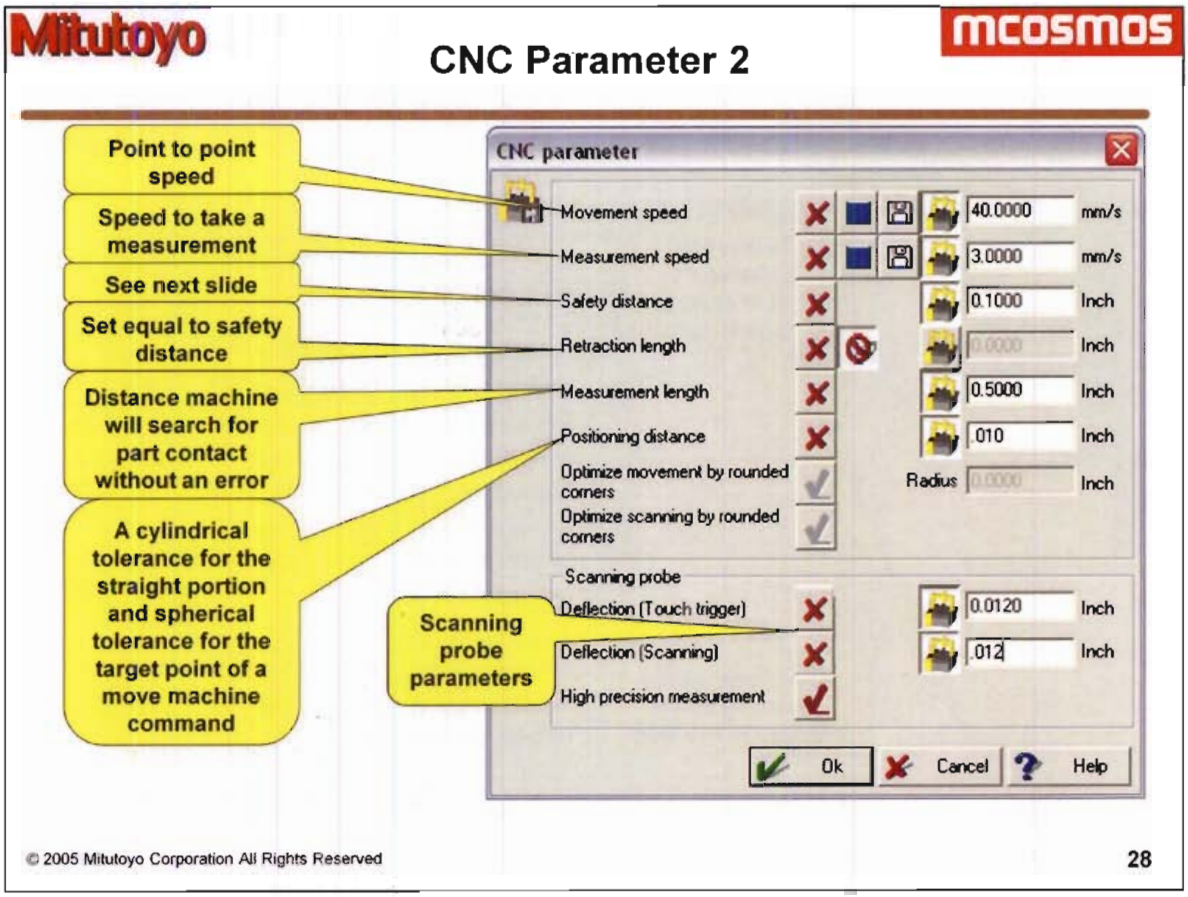

- Note: positioning distance has no effect on measurement moves, only on machine moves and program run time.
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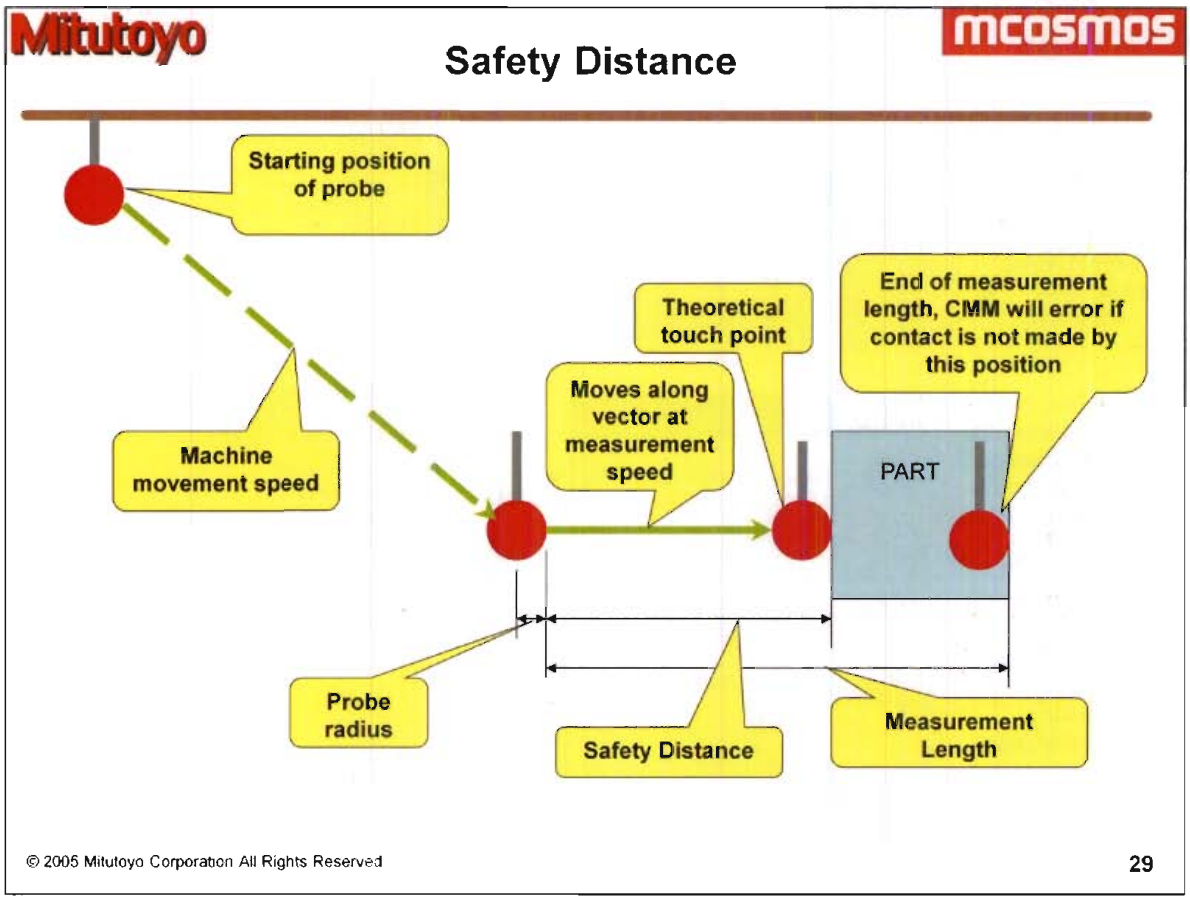
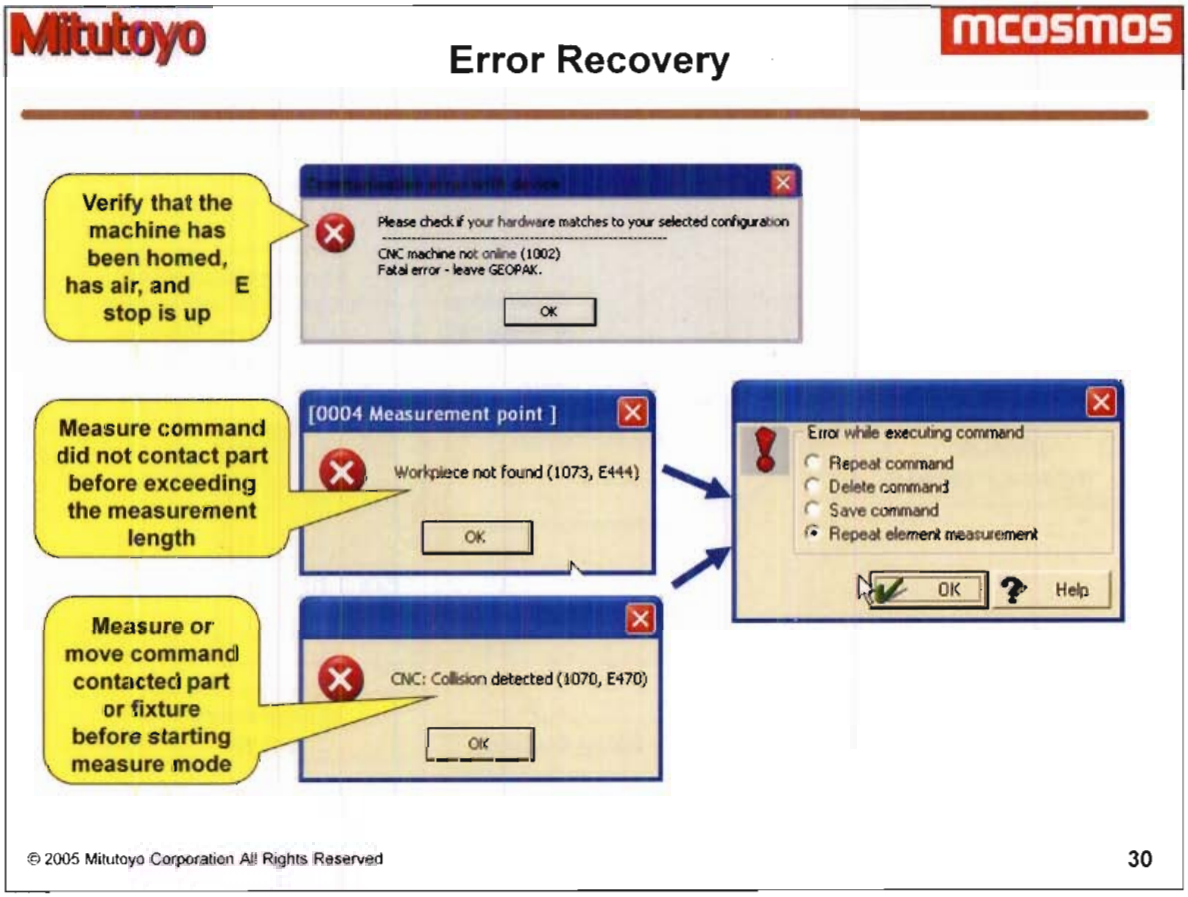


- Note: measurement length must be longer than the safety distance or the CMM will error before making contact with the part.



- You will encounter this error message should you attempt to launch the learn mode or repeat mode before the CMM has been sent home. Simply acknowledge, correct the problem ie no air, E stop is pressed or home the machine.
- For Workpiece not found or collision acknowledge and select 1 of the following
- Repeat command – deletes points collected with the failed tool and returns to learn mode.
- Delete command – removes command and returns to learn mode.
- Save Command – keeps the command in the program with out change.
- Repeat Element Measurement – deletes all data for the active feature and starts element measurement fresh.
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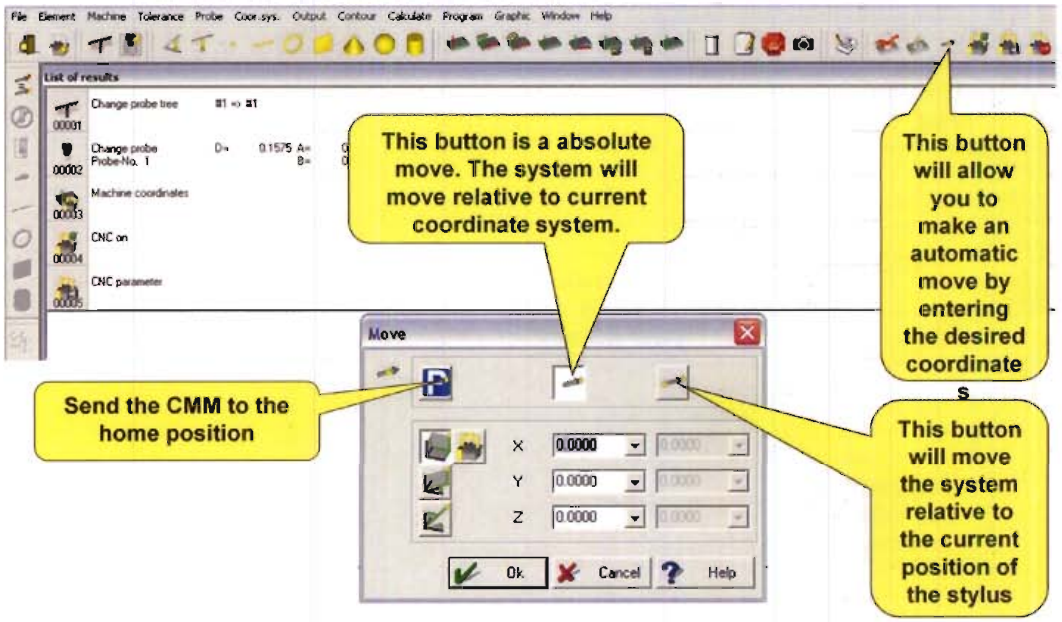
CNC: Movement



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- Note: It is also possible to record an automatic move by physically locating the stylus to desired location, then pressing the "GOTO" button on your joystick box. The current location will then be recorded and written into the program.
- You can also click on the picture of the CMM bringing the current position into the dialog then press OK. Or define a move to target.
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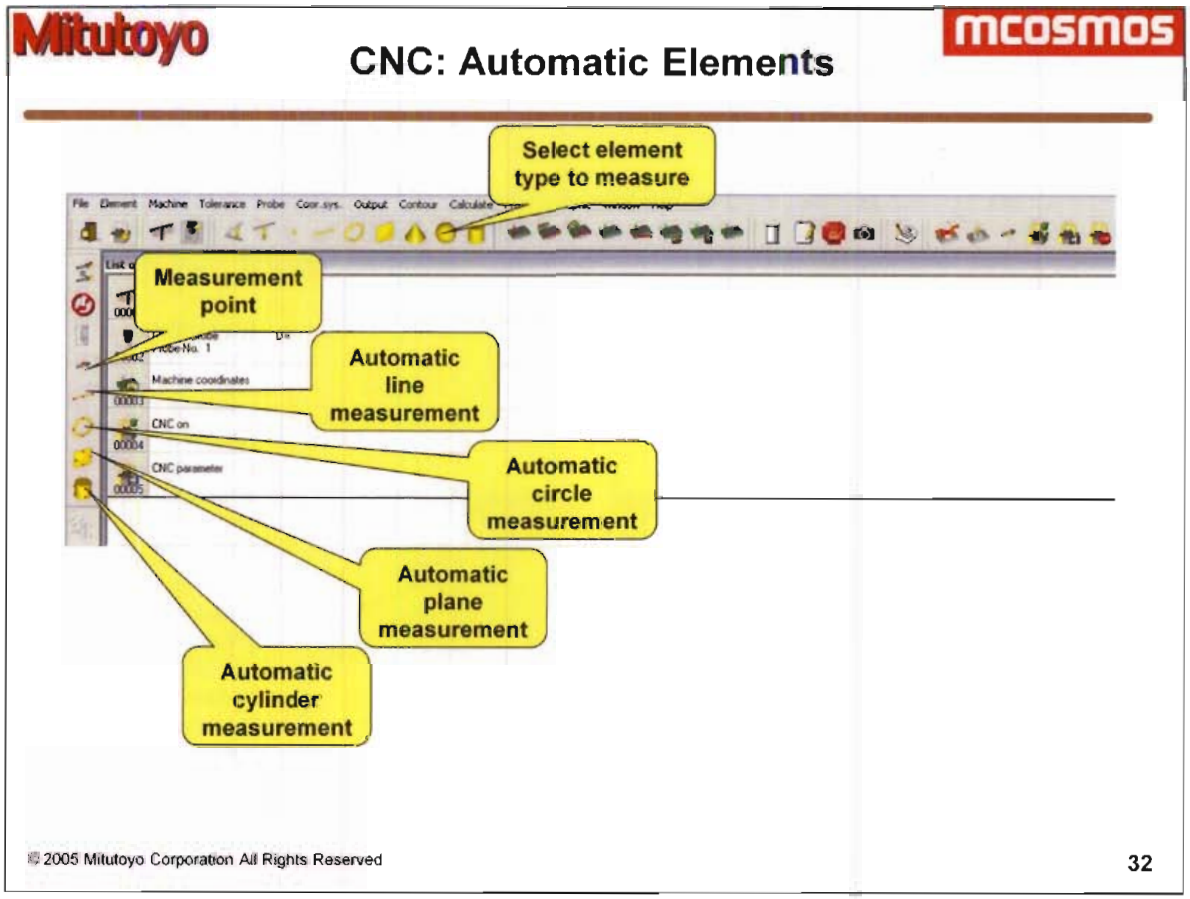

- Notice measurement tools are gray until you select a element type to measure.
- Automatic element functions may be accessed from the toolbar.
- You may run multiple automatic element measurement tools multiple times as is applicable for the selected element measurement.
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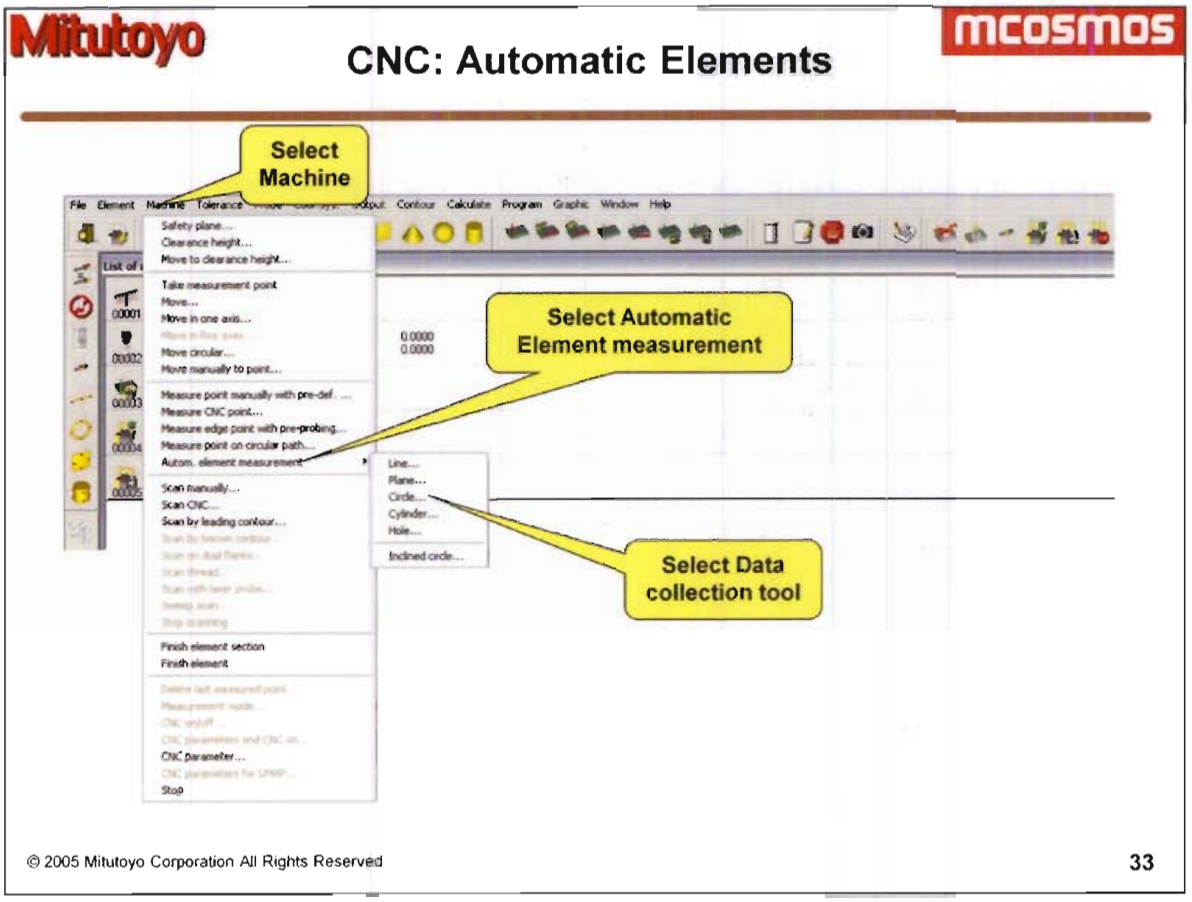

- Automatic element functions may be accessed from the menu.
- Select Machine then select Autom. element measurement.
- You may run multiple automatic element measurement tools multiple times as is applicable for the selected element measurement
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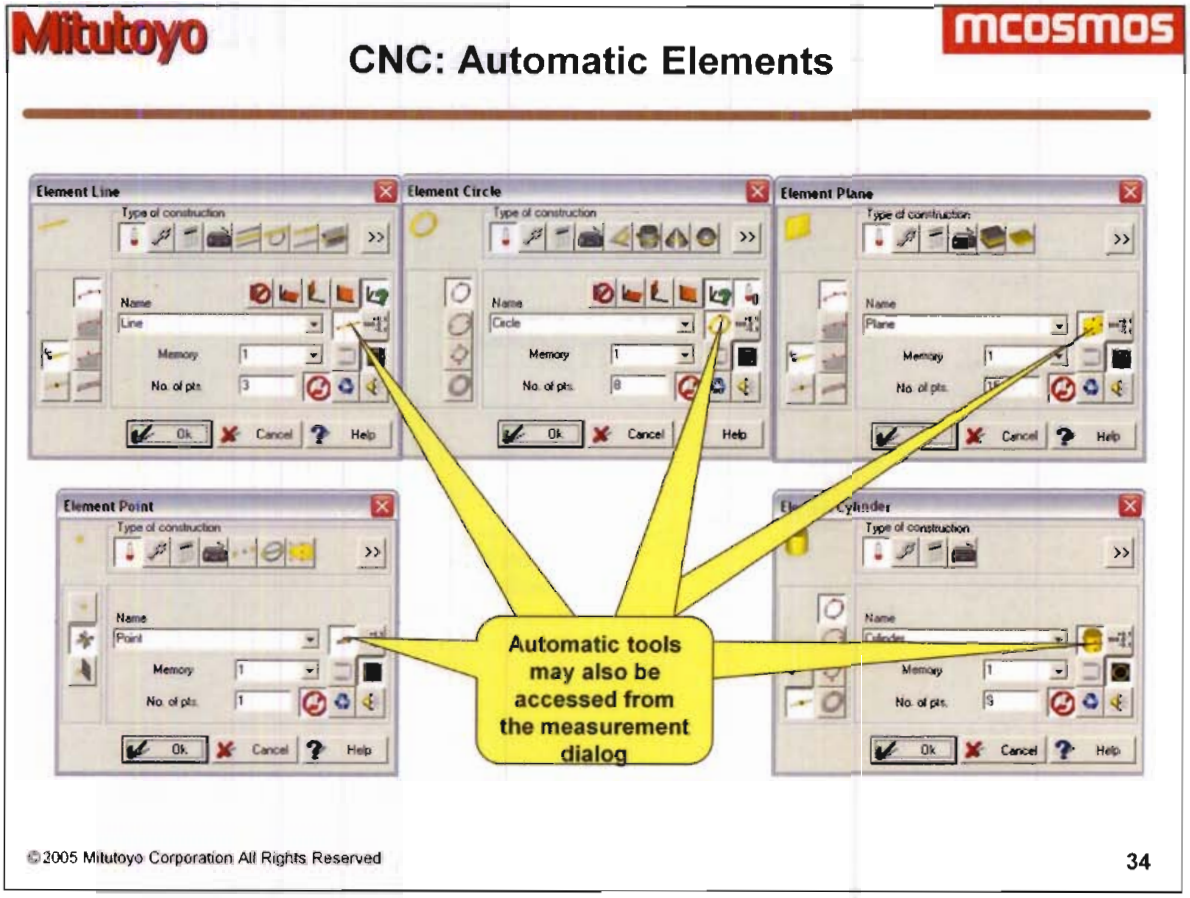
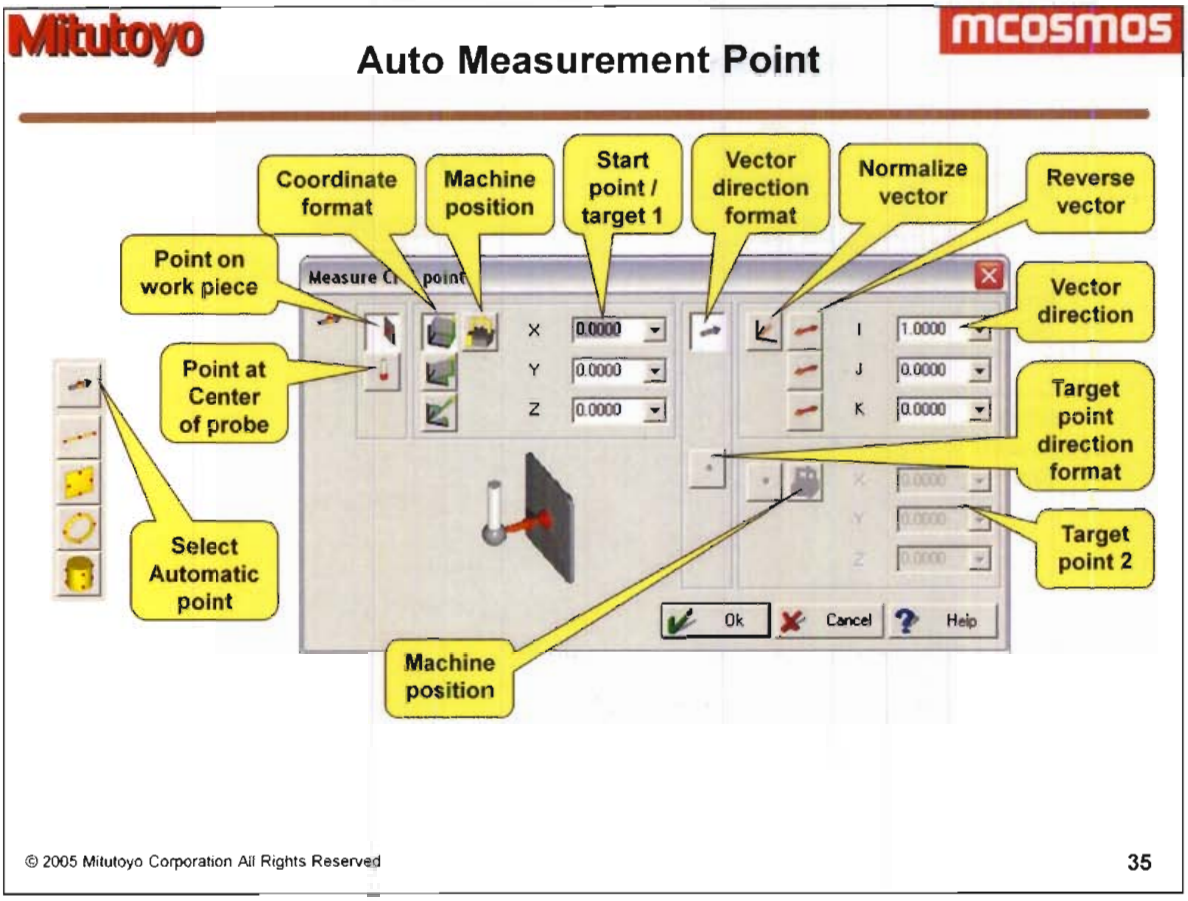


- To access Automatic element measurements you must have selected a feature to measure from the element toolbar.
- Automatic element functions may be accessed from the toolbar, menu or in the element measurement dialog.
- You may rum multiple automatic element measurement tools multiple times as is applicable for the selected element measurement



- Select a point at the probe center or on the work piece.
- Select a coordinate system format (Cartesian, Cylindrical, or spherical).
- Machine position allows you to apply the machine position to the start point/target1.
- If Machine position was not used then Define the start point/target1 .
- Choose Vector direction format or target point direction format.
- Vector direction format move the safety distance away from the target in the opposite direction of the vector then drives in the vector direction toward the start point/target1.
    - Normalize Vector will recalculate the vector to reduce it from an incorrect value.
    - Reverse Vector will change the sign, or quadrant of the vector per the format.
    - Vector direction in the format as defined in Input Characteristics.
- Target point direction will move to the start point/target1 then drive toward the target point2.
    - Target point2 defines the target point in this format.
    - Machine position allows you to apply the machine position to the target point2.
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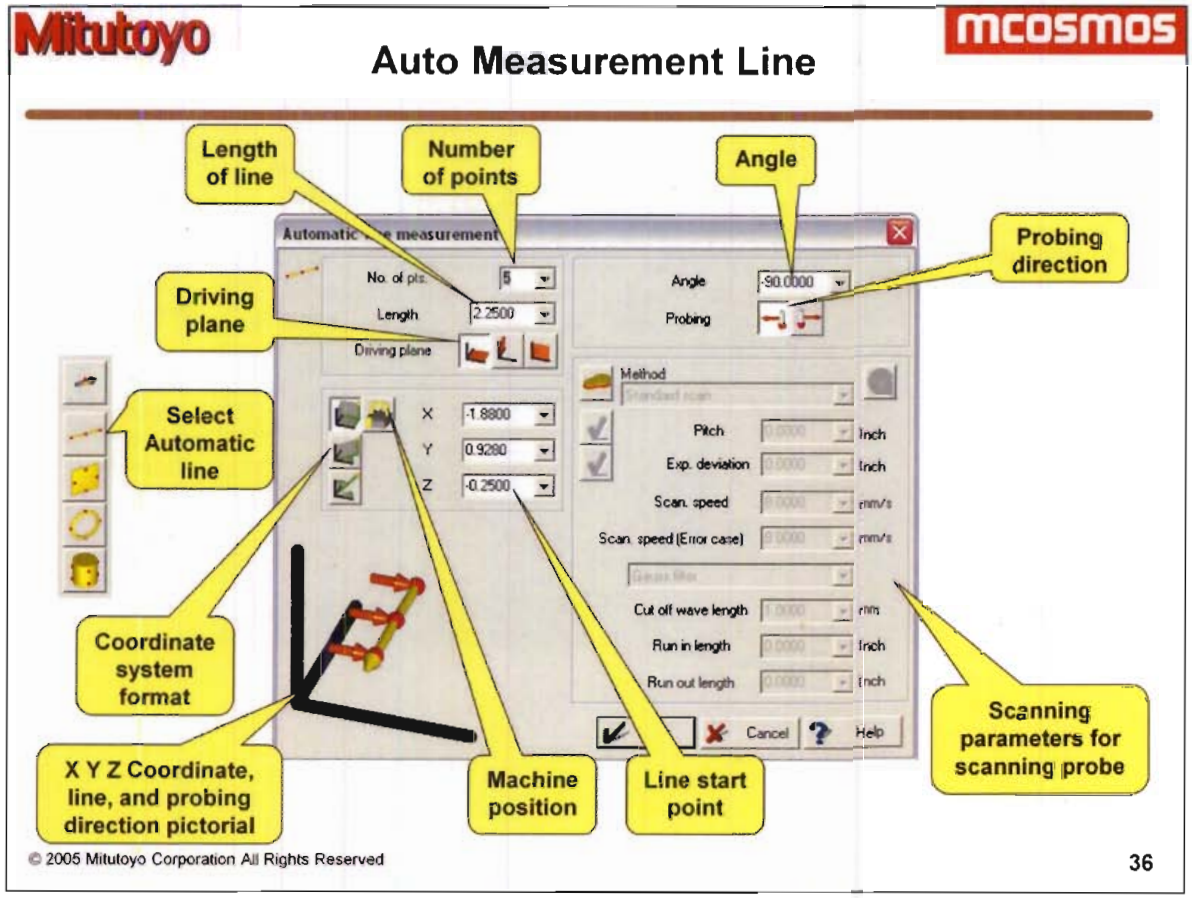

- Define the number of points to be collected along the line.
- Define the length of the line.
- Select the Driving Plane. The Driving Plane is the plane that contains the line and the approach direction.
- Select a coordinate system format (Cartesian, Cylindrical, or Spherical)
- Machine position allows you to apply the machine position to the line start point.
- Select an Angle in the driving plane to define the direction to collect the points on the line.
- Select the probing direction.
- View the pictorial to verify your line direction, and probing direction.
- If you are using a scanning probe set the scanning options.
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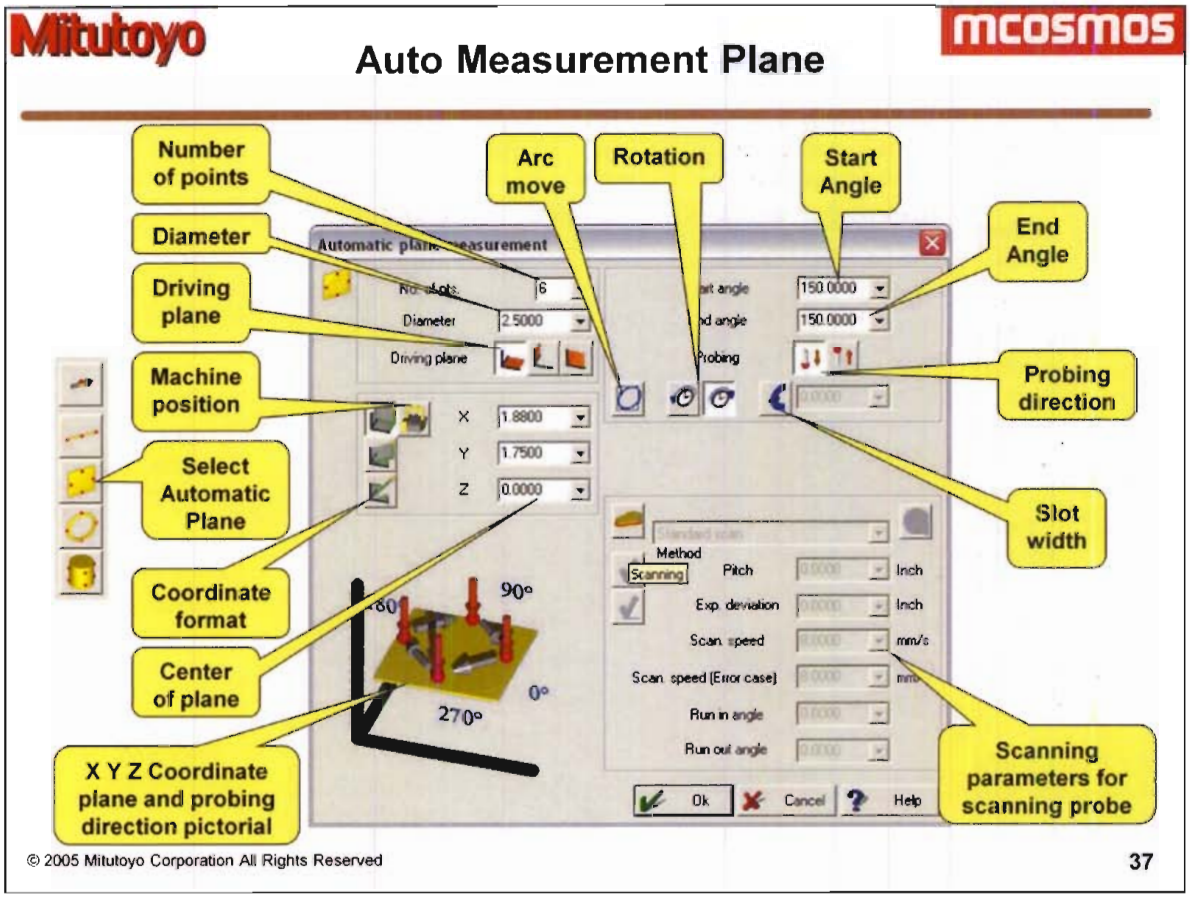
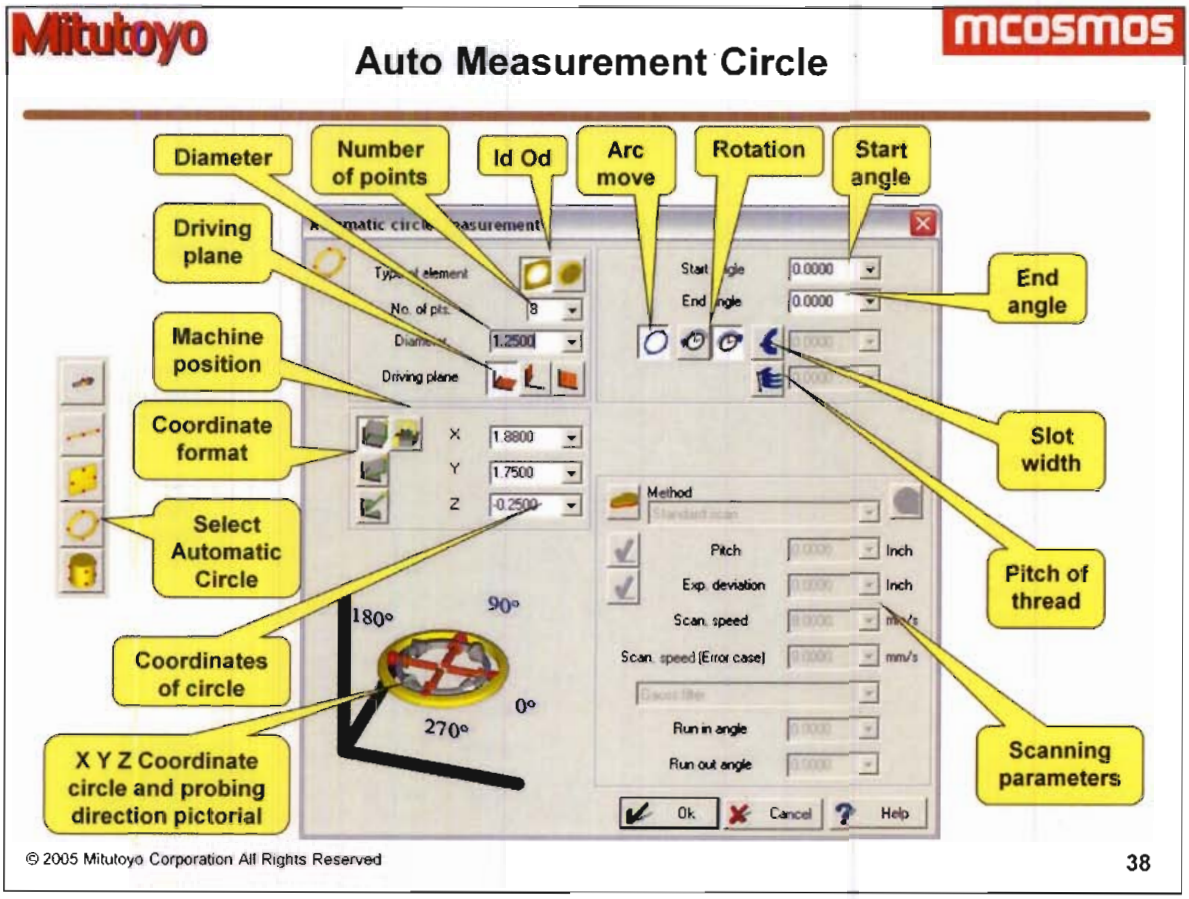
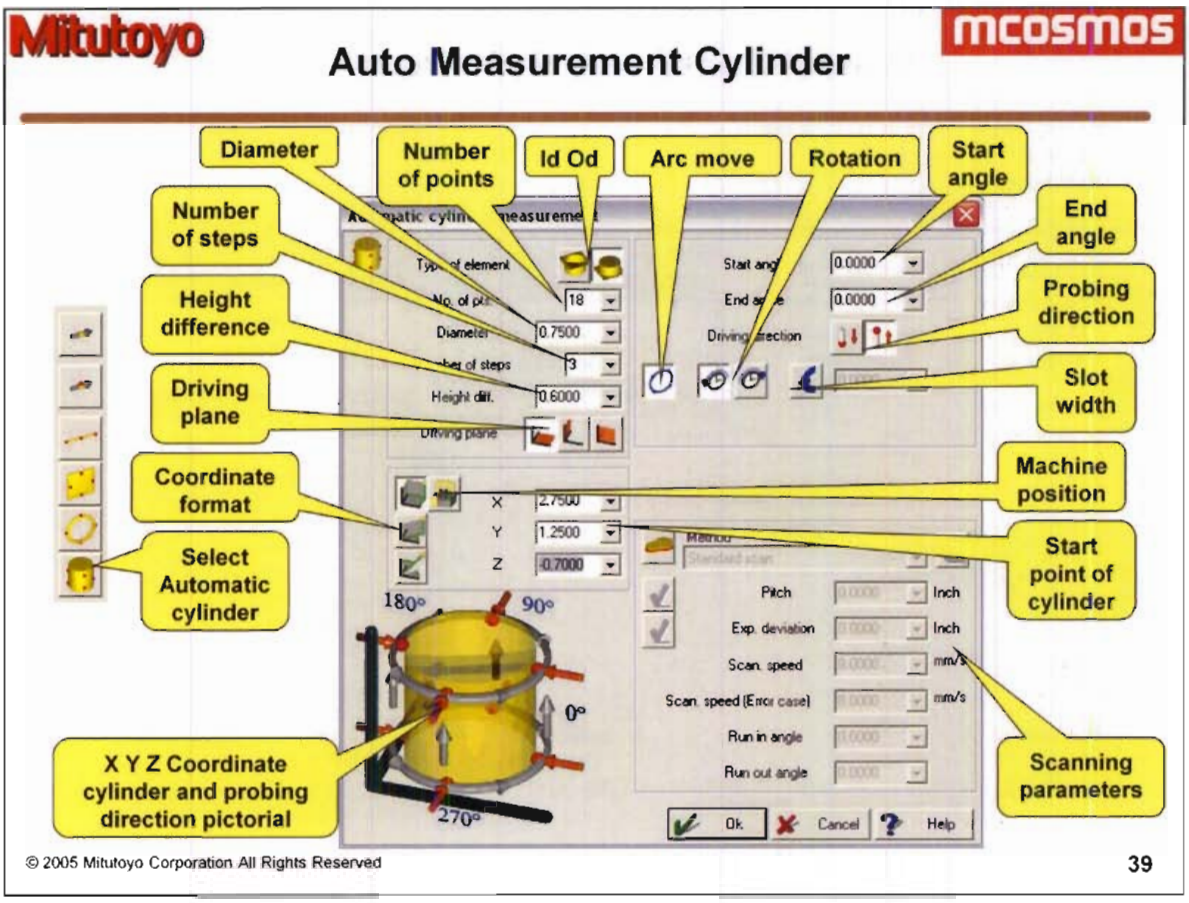


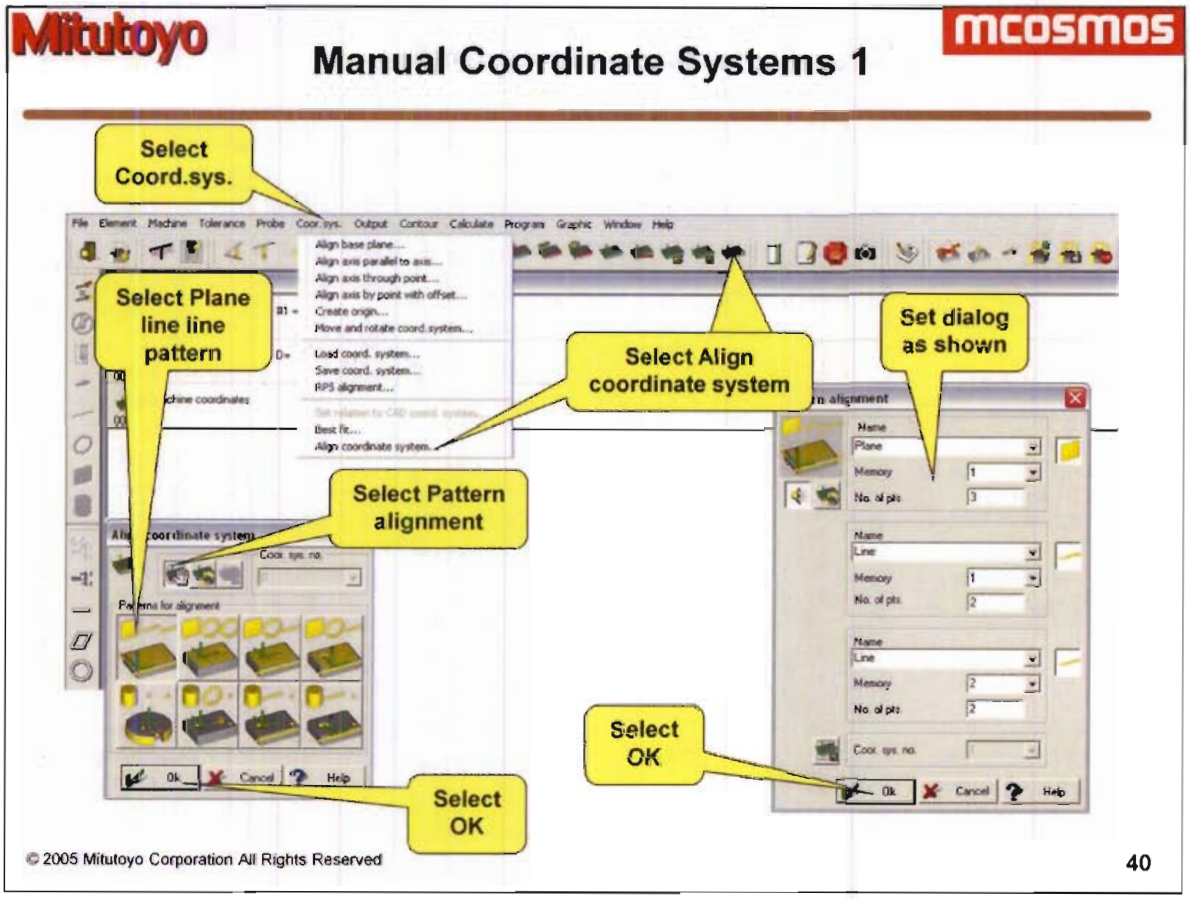
- Define the number of points to be measured in this sequence.
- Define the diameter that you want to collect the points at.
- Choose the driving plane to collect the points in.
- Choose a coordinate system format (Cartesian, Cylindrical, or spherical).
- Machine position allows you to apply the machine position to the plane center.
- If Machine position was not used then define a point at the center of the plane patern.
- Define the start and end angle for your plane.
  - If the start / end angle are equal the machine will collect 1 point at the start/end point and the balance equally spaced.
  - If the start / end angle are not equal the machine will collect 1 point at the start angle, 1 at the end angle, the balance equally spaced.
- Choose the probing direction (see the pictorial).
- Choose circular arc move if desired.
- Choose direction Clockwise / Counter Clockwise (see gray arrows in the pictorial).
- If your machine is incapable of Arc moves and you need a precise path select and define Slot width.
- If you are using a scanning probe set the scanning options.



- Choose ID or OD to correspond to the measurement task.
- Define the number of points to be measured in this sequence.
- Define the diameter that you want to collect the points at.
- Choose the driving plane in which to collect the points.
- Choose a coordinate system format (Cartesian, Cylindrical, or Spherical).
- Machine position allows you to apply the machine position to the circle position
- If Machine position is not used, define a point at the center of the diameter at depth.
- Define the start and end angle for your circle.
  - If the start / end angle are equal 1 point will be collected at the start/end point and the balance equally spaced.
  - If the start / end angle are not equal 1 point will be collected at the start angle, 1 at the end angle and the balance equally spaced.
- Choose circular arc move if desired.
- Choose direction Clockwise / Counter Clockwise (see gray arrows in the pictorial).
- If your machine is incapable of Arc moves and you need a precise path select and define Slot width.
- Choose and define pitch to spiral up or down to match the thread of a hole. Note: pitch is the size of 1 thread pitch.
- If you are using a scanning probe set the scanning options.



- Choose Id or OD to correspond to the measurement task.
- Define the number of points to be measured in this sequence.
- Define the diameter that you want to collect the points at.
- Define the number of steps (circles) in your cylinder.
- Choose the driving plane to collect the points in.
- Choose a coordinate system format (Cartesian, Cylindrical, or spherical).
- Machine position allows you to apply the machine position to the start point/target1.
- If Machine position is not used define a point at the center of the diameter at start depth.
- Define the height difference from one end to the other of the measured cylinder .
- If you are not measuring full cylinders you may use the circle tool multiple times to collect the data. This manner of data collection may help to avoid a crash should there be an obstacle.
- Choose the probing direction (see the pictorial bottom to top or top to bottom).
- Choose circular arc move if desired.
- Choose direction Clockwise / Counter Clockwise (see gray arrows in the pictorial).
- If your machine is incapable of Arc moves and you need a precise path, select and define Slot width.
- If you are using a scanning probe set the scanning options.



- This portion of the class will cover CNC motion and review tolerancing.
- To generate meaningful CNC motion you must know what the coordinate system is.
- We will create a manual (approximate) coordinate system on the part.
- This coordinate system should collect the least data possible.
- This coordinate system may not match your datum structure.
- This coordinate system only needs to let the machine know where the part is within about ½ your safety distance.
- Create this coordinate system using the plane line line pattern alignment on the front left hand corner of the part.
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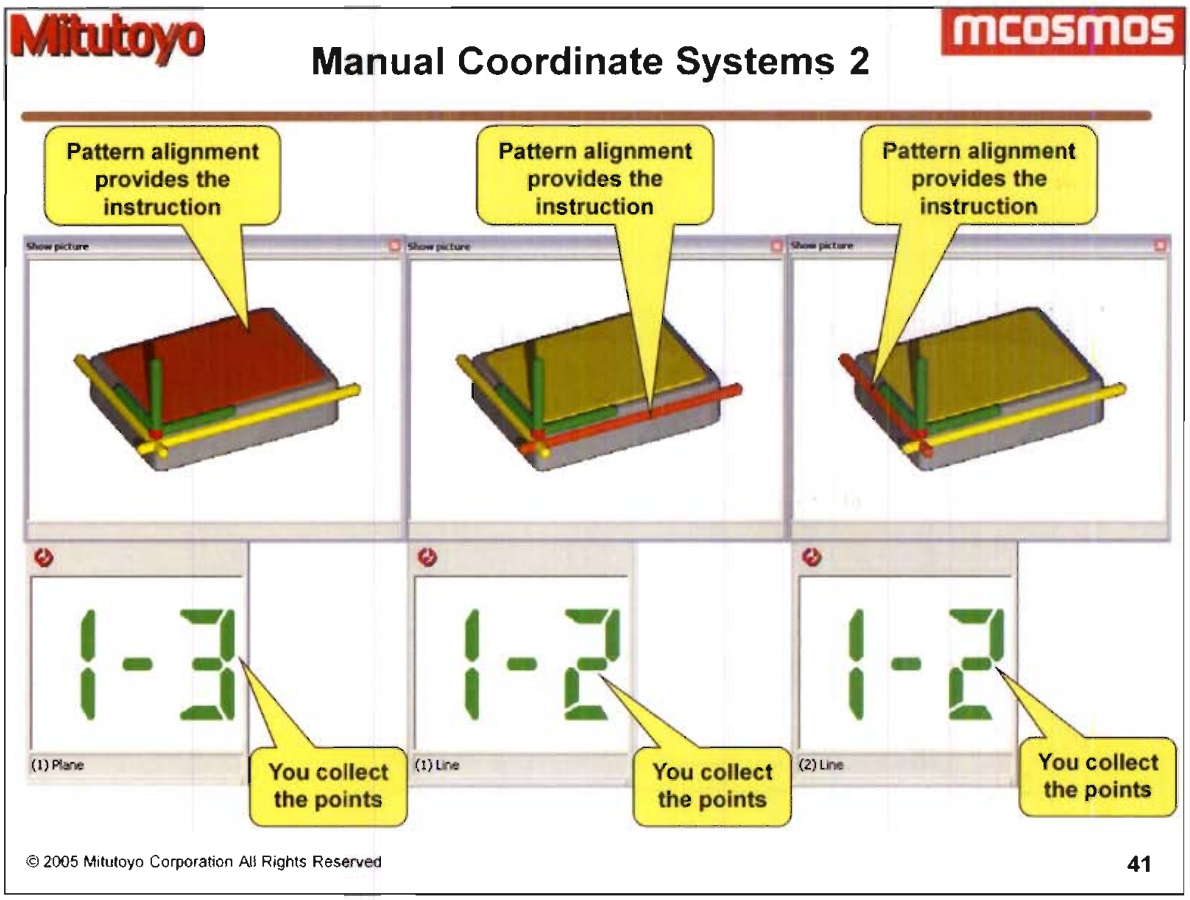

- Measure the features as instructed by the Pattern alignment.
- Upon completion leave the probe the retracted distance away from the last measured point.
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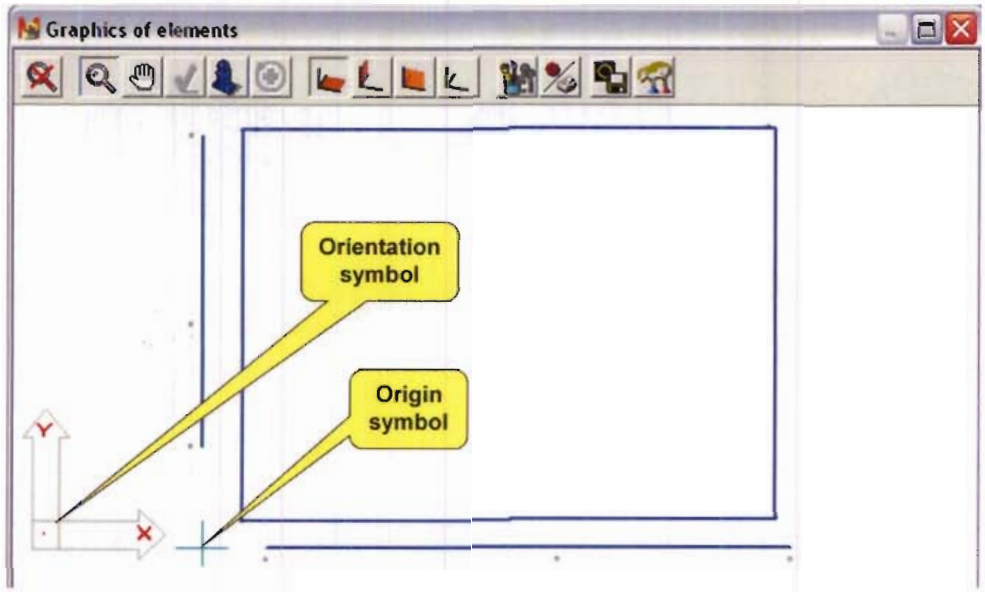
Verify Coordinate System 1



42

- The Graphics of elements shows the features measured.
- The features and their orientation in this window may be used to verify your coordinate system.
- It is always a good idea to verify your coordinate system.
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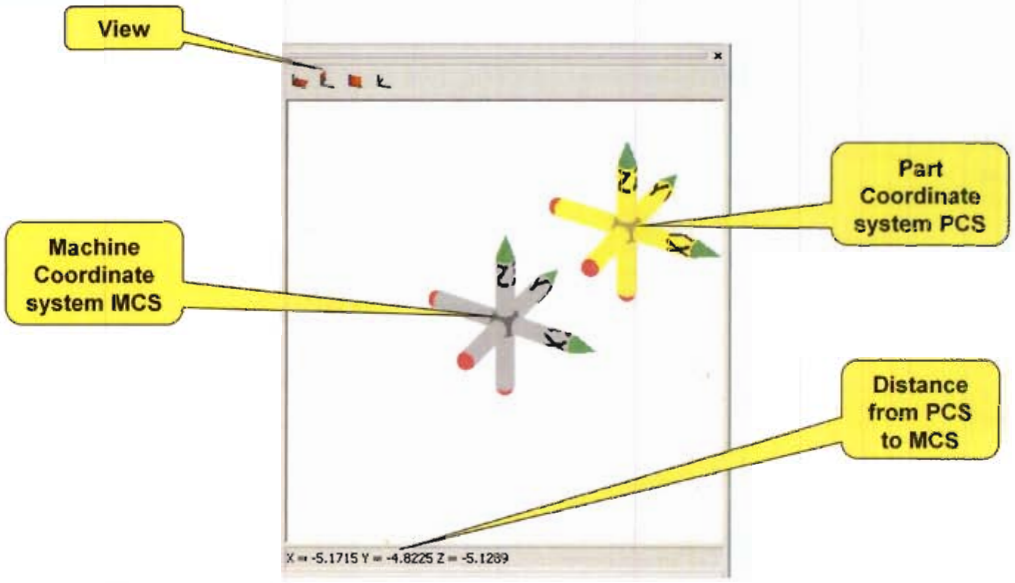
Verify Coordinate System 2



43

- The Display axis window is another way to verify your coordinate system.
- It is always a good idea to verify your coordinate system.
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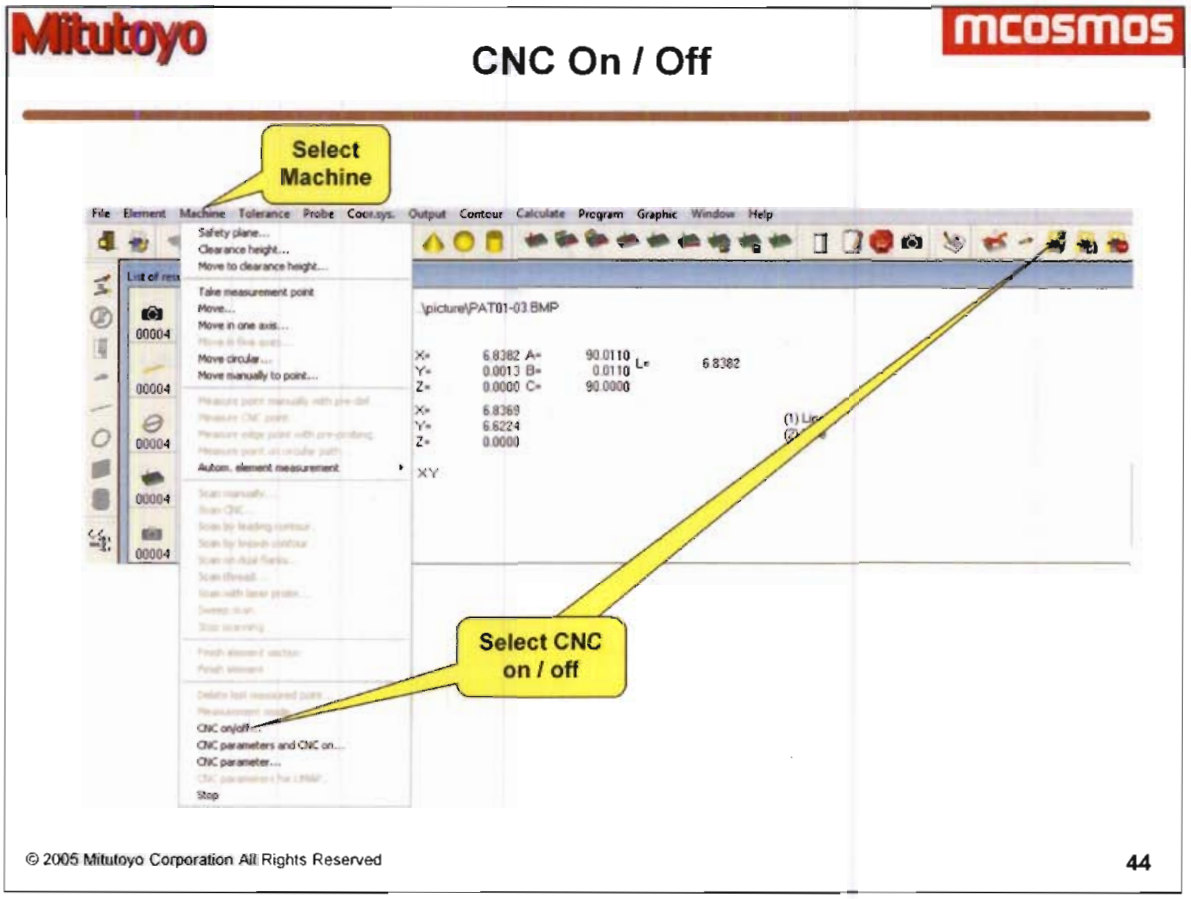
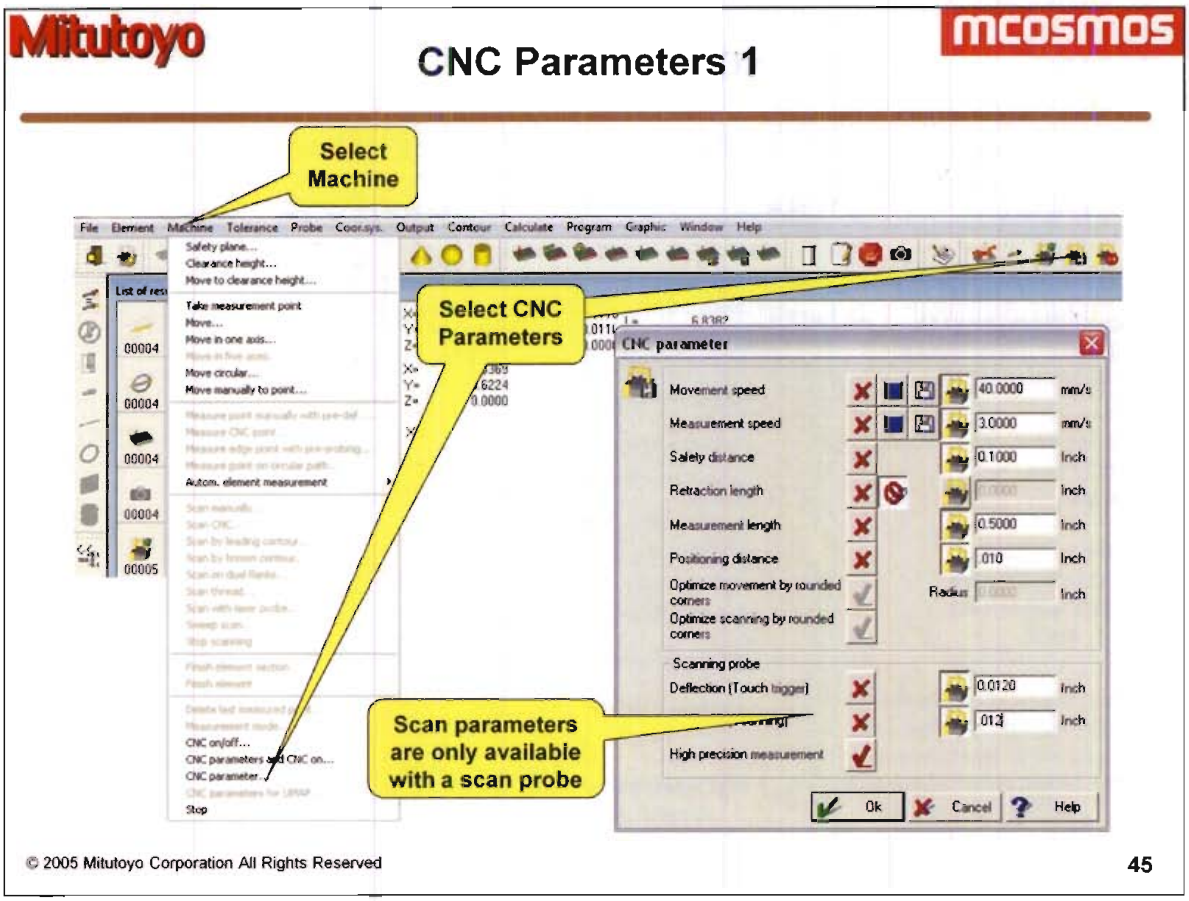
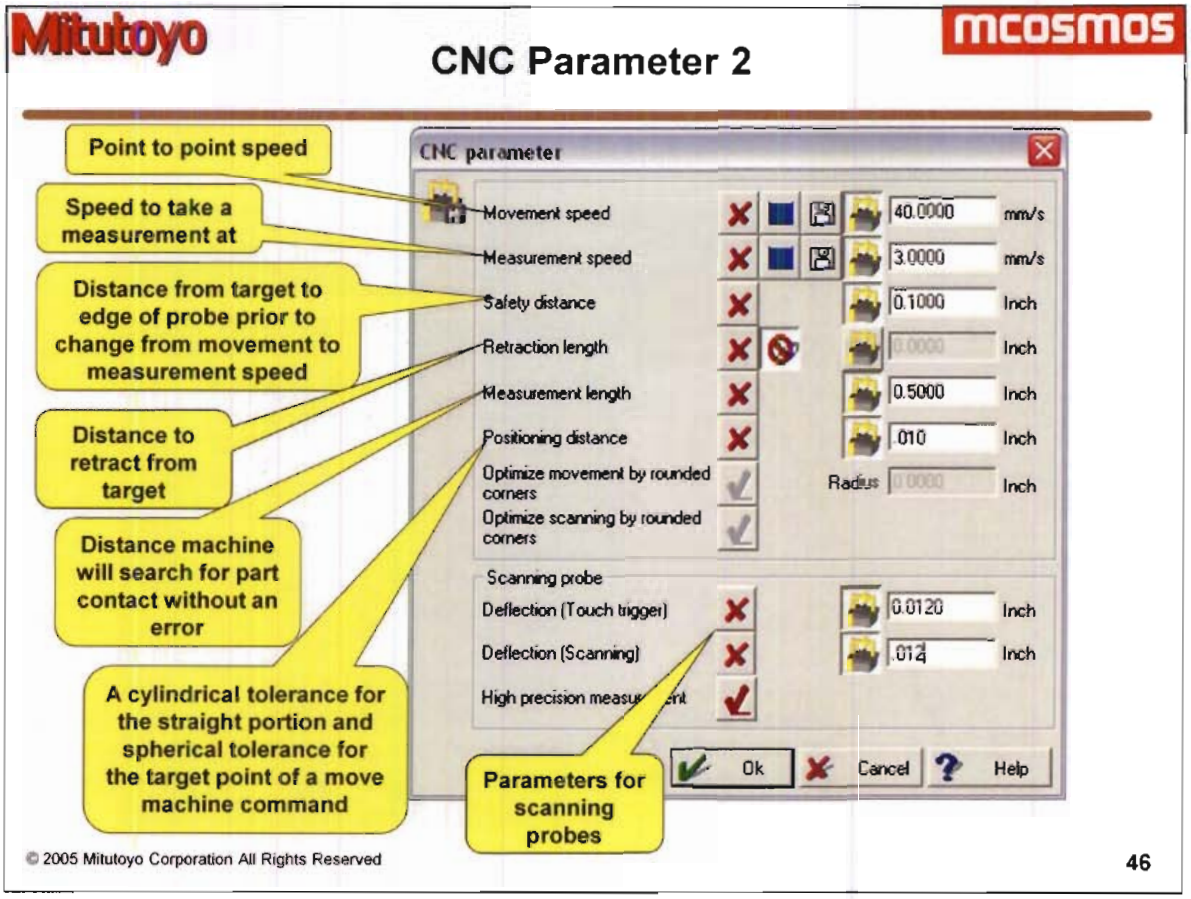


- CNC on off is a toggle to turn CNC motion on or off.
- Note: the machine will move to the home position without CNC motion turned on in the learn mode



- CNC Parameters allows you to set all of your parameters.
- It is preferred to use "CNC on/off" and "CNC parameters" rather then "CNC parameters and CNC on" as CNC parameters and CNC on will only allow you to set three of the parameters. Not setting all the parameters could cause your part program to crash, fail or run abnormally slow.



- Recommended settings :
  - Movement speed = 40 mm/s
  - Measurement speed = 3 mm/s Tp20, Sp25 6 mm/s Tp200 Tp7
  - Safety distance = 1.5 to 2.5 mm / .060 to .100 Inch
    (Hole Dia – Probe Dia) /2 Max
  - Measurement length = 12.7 mm / .5 Inch 3 X Safety distance Min
  - Positioning distance = .25 mm / .010 Inch / 25% safety distance Max
- Once a part program has been written and proven, then adjust the movement speed as high as you feel comfortable.
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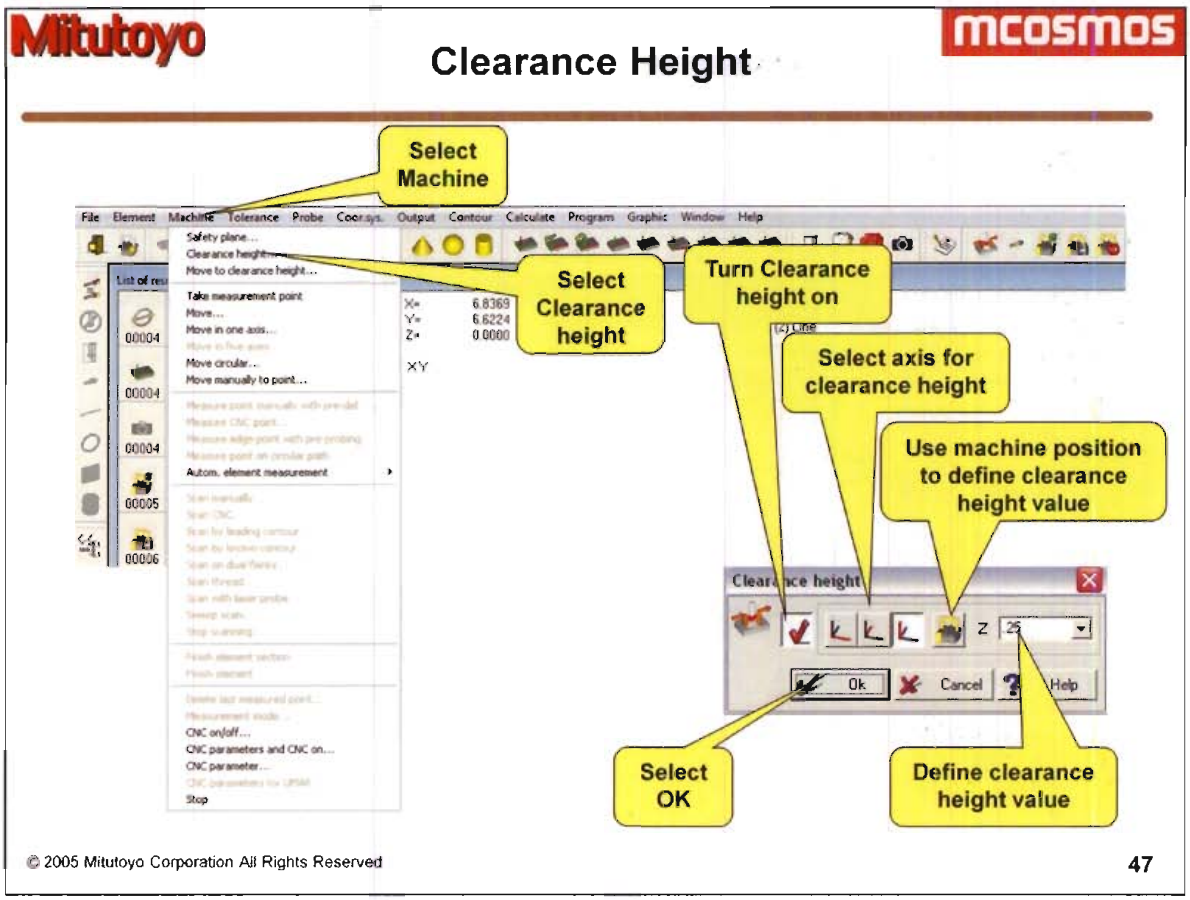

- Clearance height is a value in a particular axis that the machine will move to prior to a measurement.
- The machine will then move over the first point at the clearance height.
- The machine will measure the feature and return to clearance height.
- Clearance height may be turned on or off within an element measurement to streamline motion.
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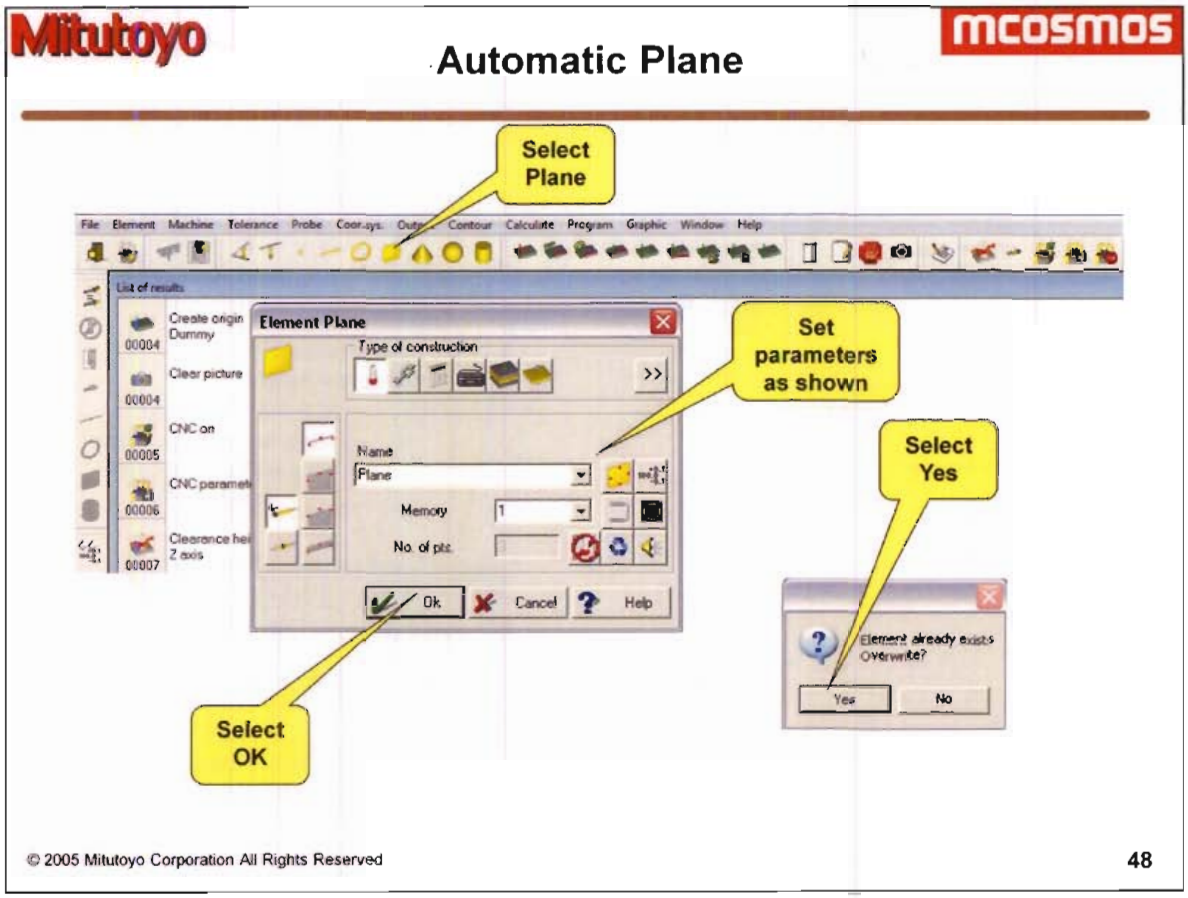

- We will follow the same steps as in manual measurement covered earlier in class but with automatic motion.
- Select Plane.
- Set the parameters as shown (auto finish, auto measure, and voices off).
- These settings will allow us to use multiple Automatic element measurement tools multiple times as is applicable.
- Select OK.
- We measured plane 1 in with the pattern alignment. It has served it's purpose. We should over write it to prevent confusion.
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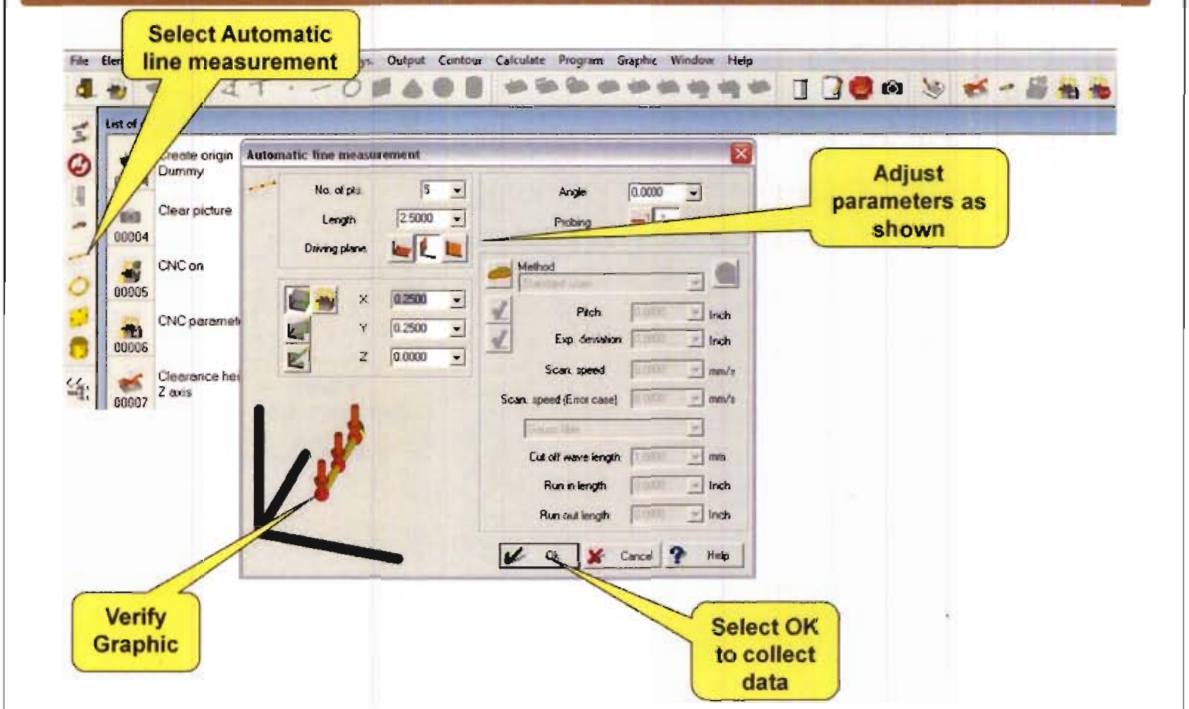
Collecting data on our Plane 1



49

- We will use the Automatic line measurement tool first.
- Set parameters as shown.
- We are measuring a plane as that was the element we selected.
- The Automatic line measurement tool describes data collection method not the element.
- We could use multiple line tools to create a grid on a rectangular part.
- Select OK to collect these points.
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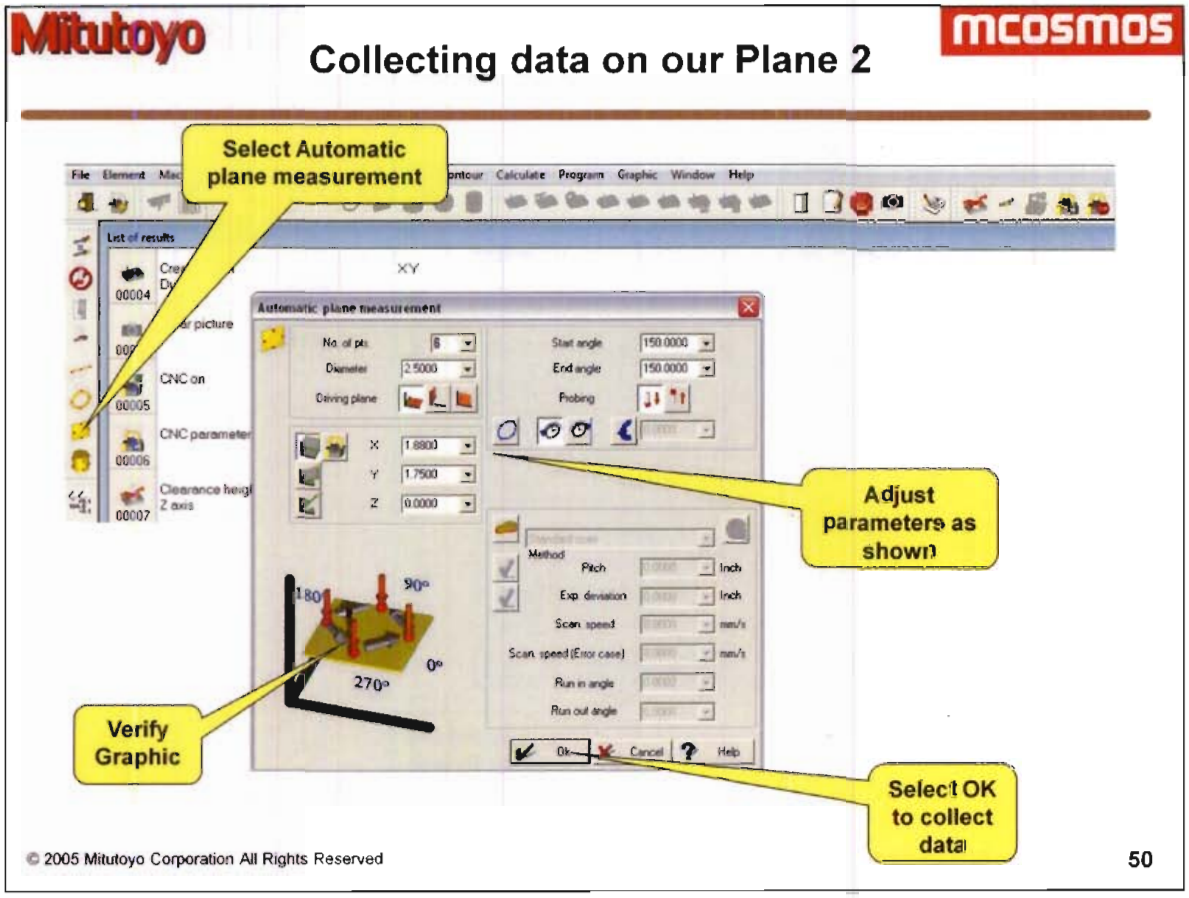

- We will use the Automatic plane measurement tool next.
- Adjust the tools to collect their data points in an efficient manor.
- Select OK to collect these points.
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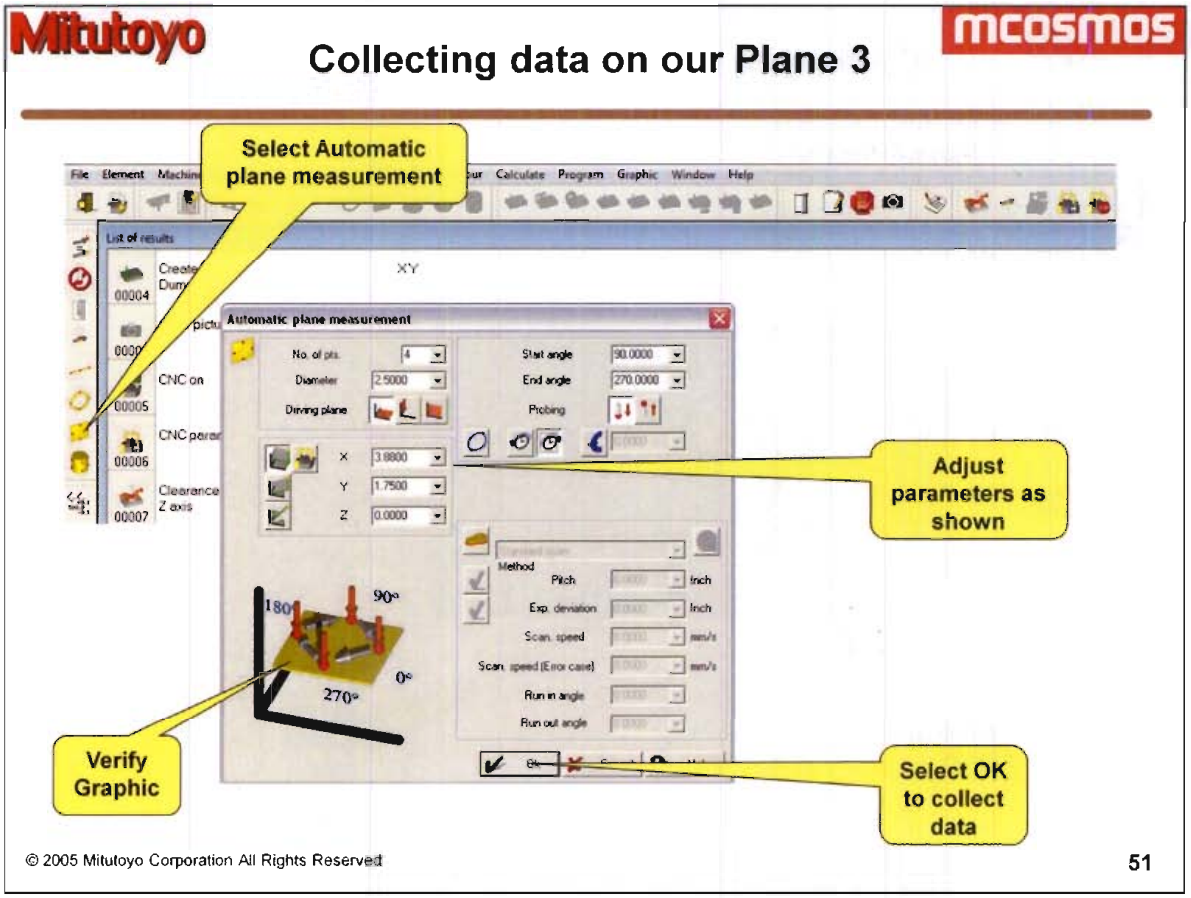

- We will run the Automatic plane measurement tool a second time at the other end of the part.
- Adjust parameters to skip duplicate points.
- Select OK to collect these points.
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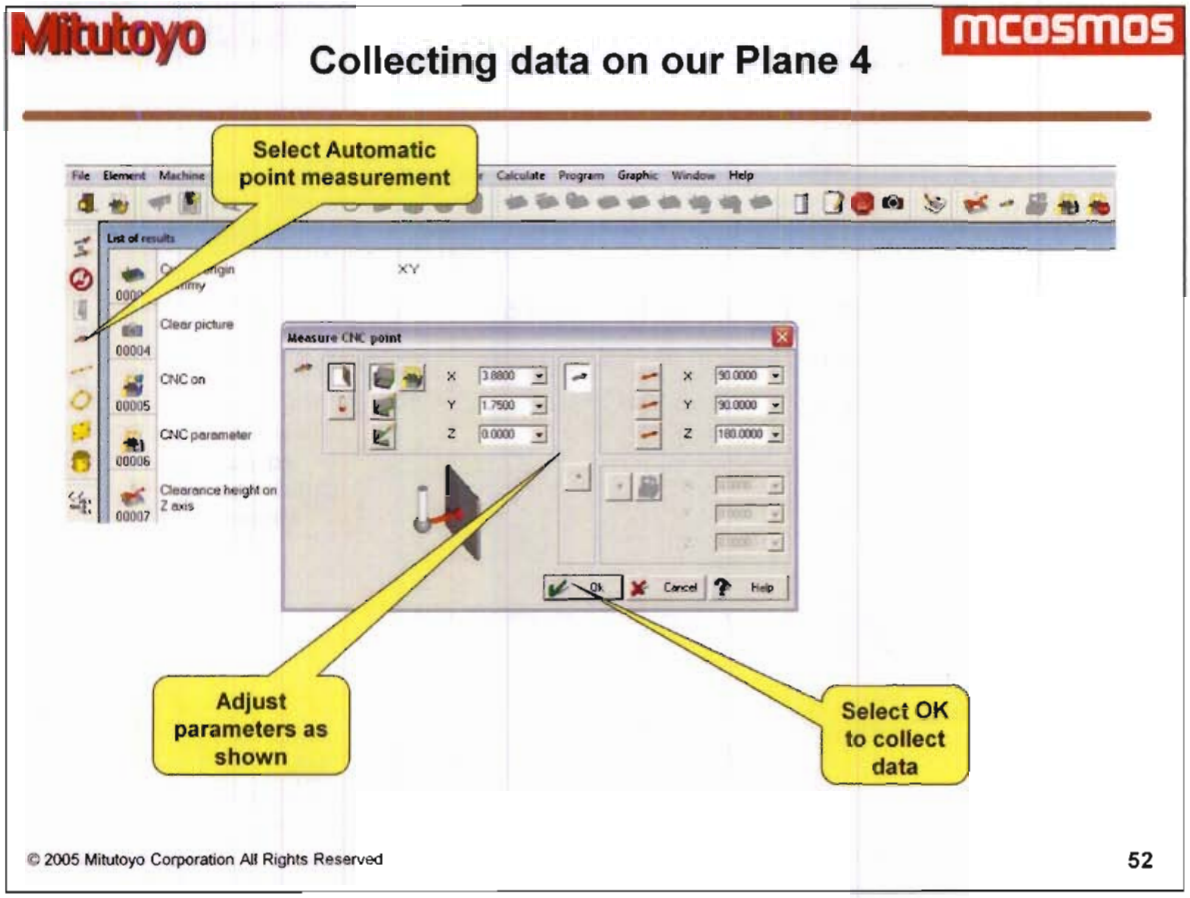

- We can use the Measurement point tool to fill in any places that may have been missed
- Adjust parameters as shown.
- Select OK to collect this point.
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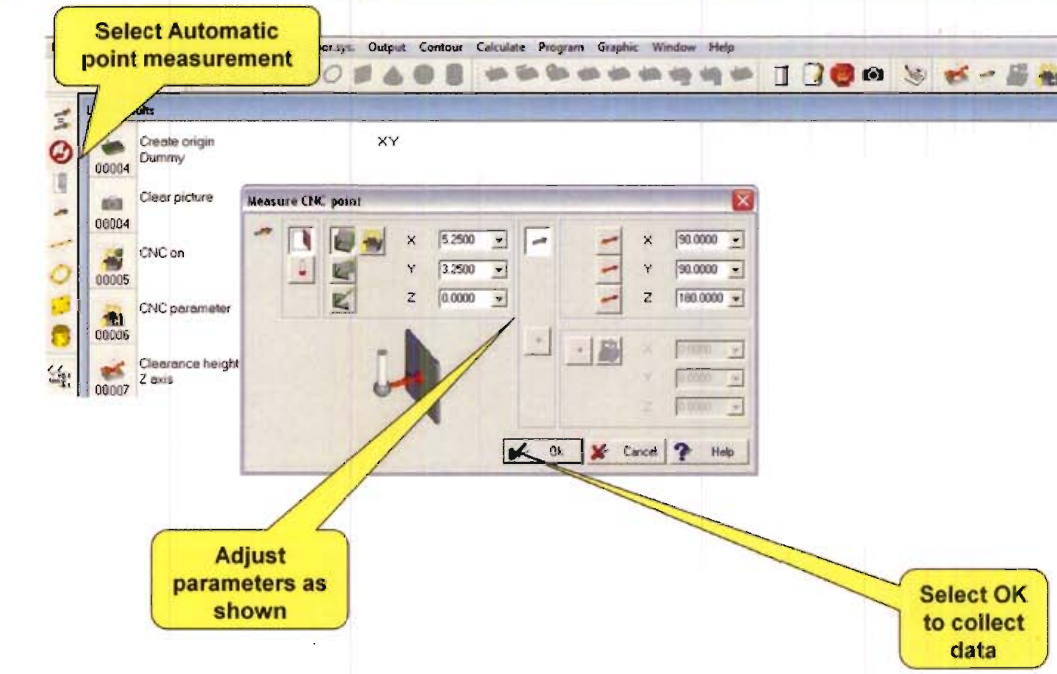
Collecting data on our Plane 5



53

- We started at one corner let's finish at the opposite corner.
- Adjust the location as the vector remains constant .
- Select OK to collect this point.
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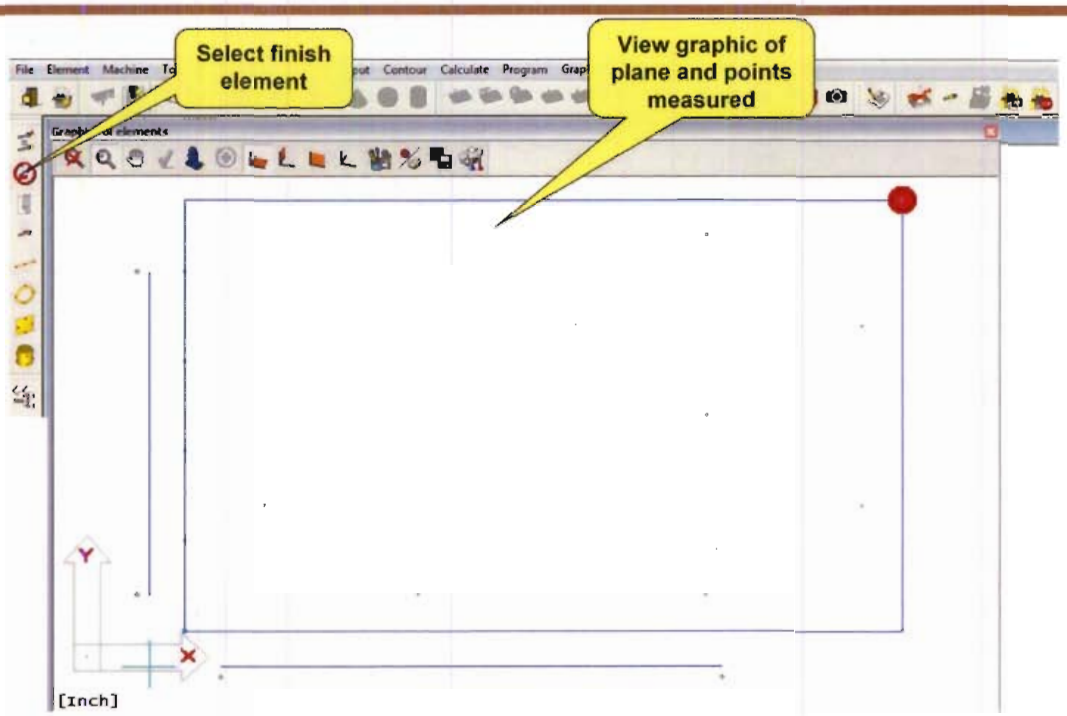
Finish Element



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- Once a sufficient number and distribution of data is reached finish the element.
- Quantity and distribution of points will very based on tolerance, method of manufacture and stability of product .
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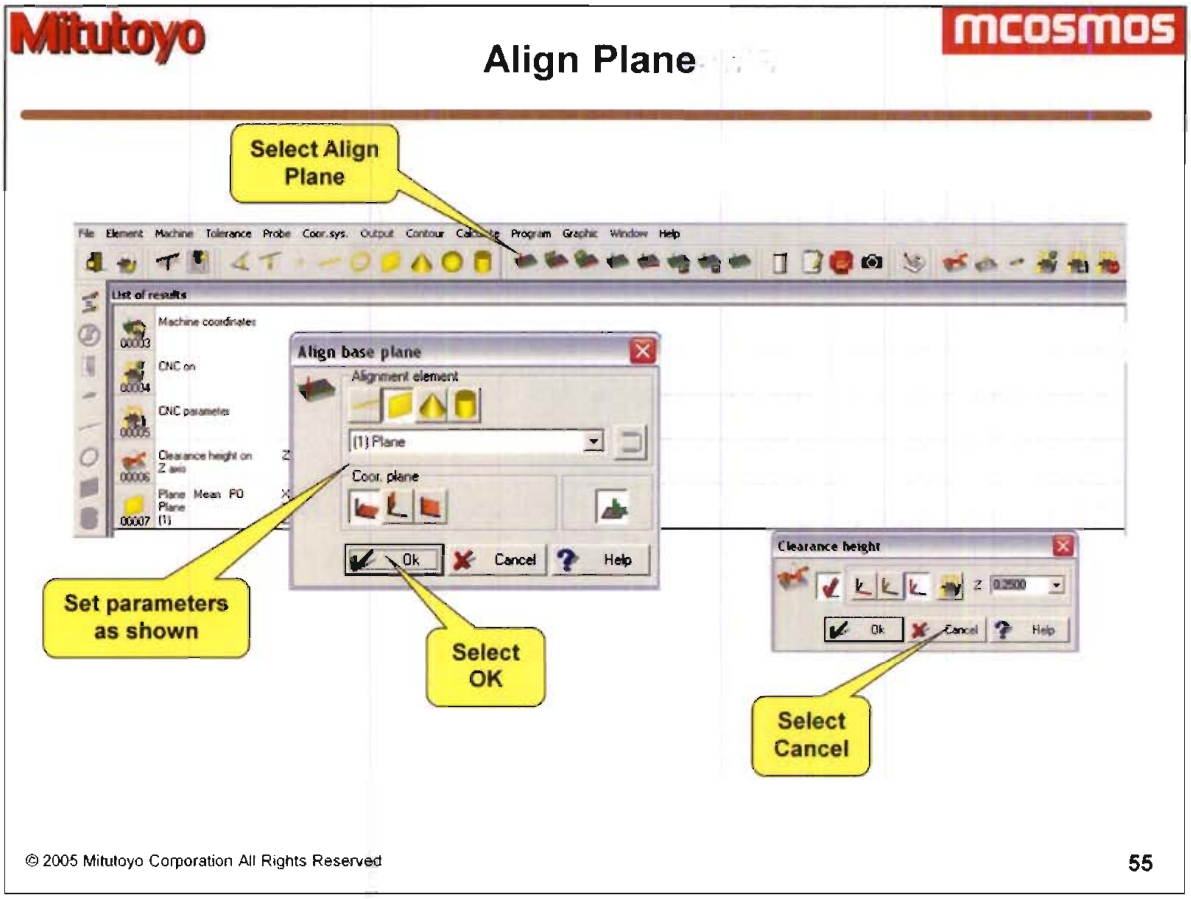
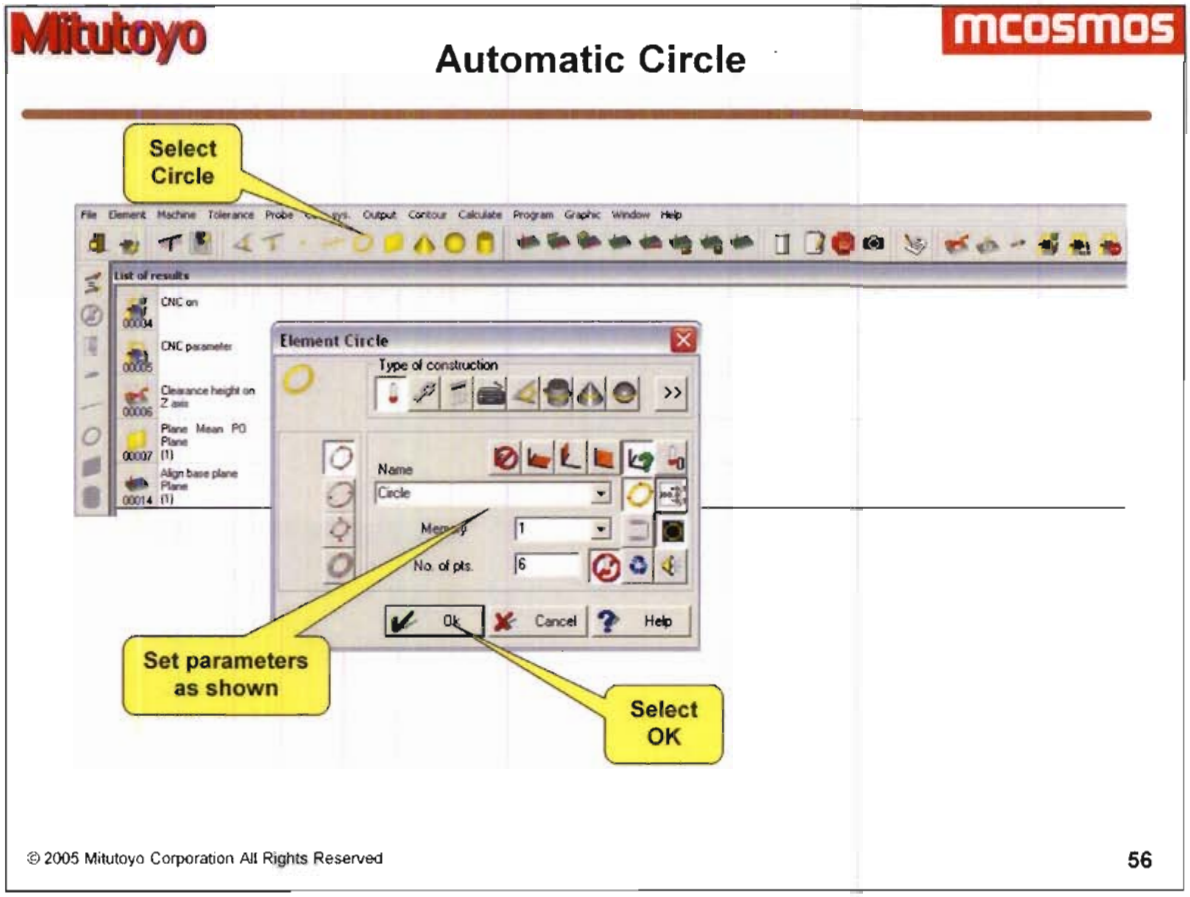
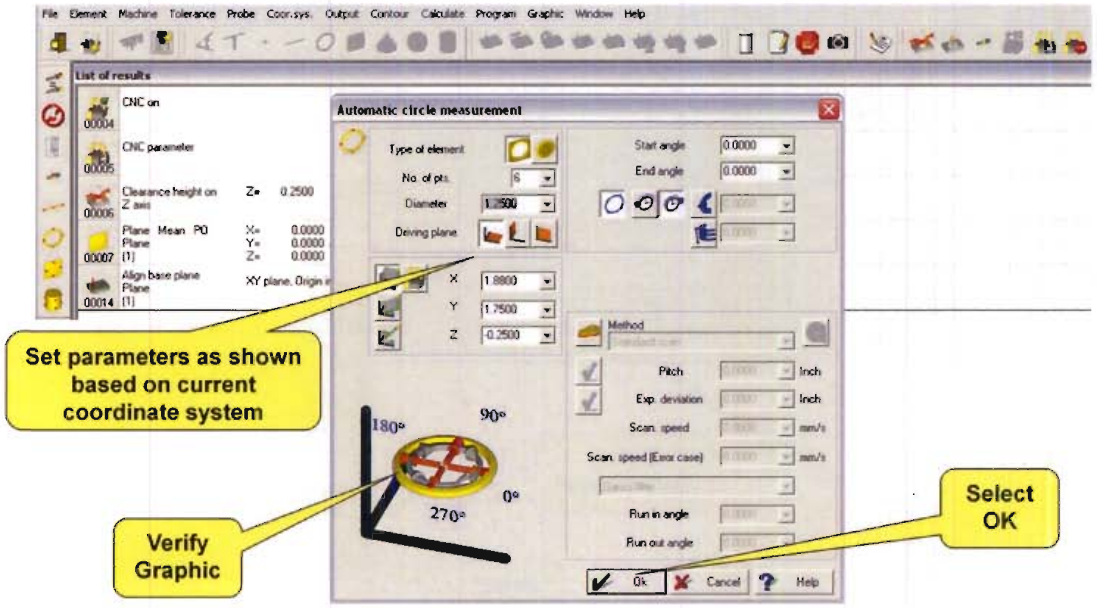


- Align your plane.
- After any alignment adjustment or probe change with Clearance height set you will be prompted to adjust your Clearance height.
- If Clearance height needs to be adjusted adjust it.
- If Clearance height is to remain the same you should cancel to avoid duplicate lines in your part program.



- The next step as you may recall is to create an origin.
- We will measure the 1.250 Dia. Datum –A- circle and create an origin.
- Select Circle.
- Set parameters as shown (Auto measure, Auto project, Tolerance).
- Select 6 points with Auto finish.
- When measuring features we should generally measure at least 1 more then the minimum number of points.
- With TP2 / TP20 we should measure a multiple of 3 points on circular features to average the lobbing error of the probe.
- With TP 200, tp7, sp25 a prime number of points is preferred as these probes have little or no lobbing error.
- With tighter tolerance, larger diameters and form tolerance more data should collected.
- Select OK.

Collecting data on a Circle



57

- Set the parameters as shown based on your current coordinate system.
- Verify the graphic.
- Select OK to collect these points.
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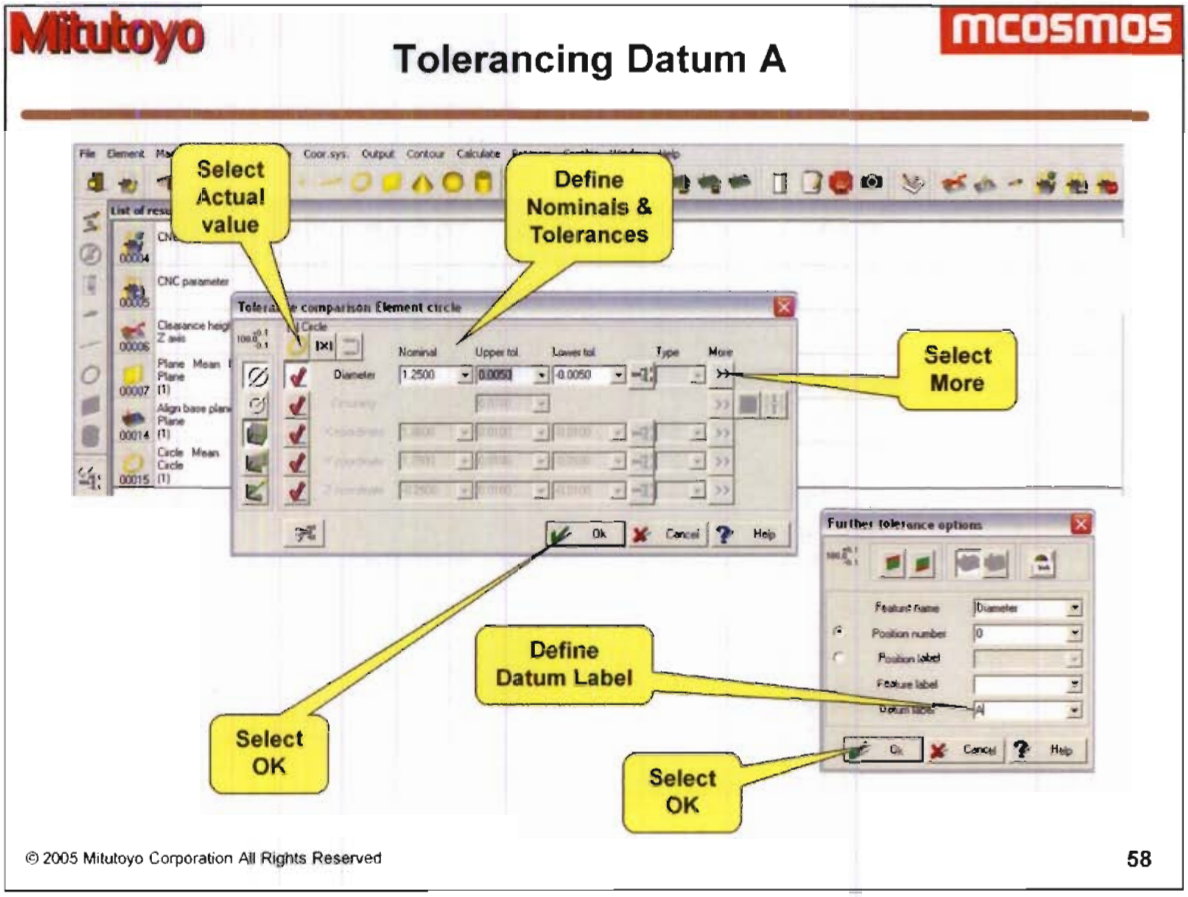

- Because you selected the tolerance icon in the measurement dialog a tolerance dialog will appear upon completion of the measurement.
- Select actual value. This will populate the nominal fields with the actual values rounded to a specified number of decimal places.
- Define the nominal and tolerance.
- Select More.
- Define the Datum label. Datum labels are used to store a MMC value of a feature to be used at a later time in MMC calculations.
- Press OK in the further tolerance options dialog.
- Press OK in the tolerance comparison dialog.
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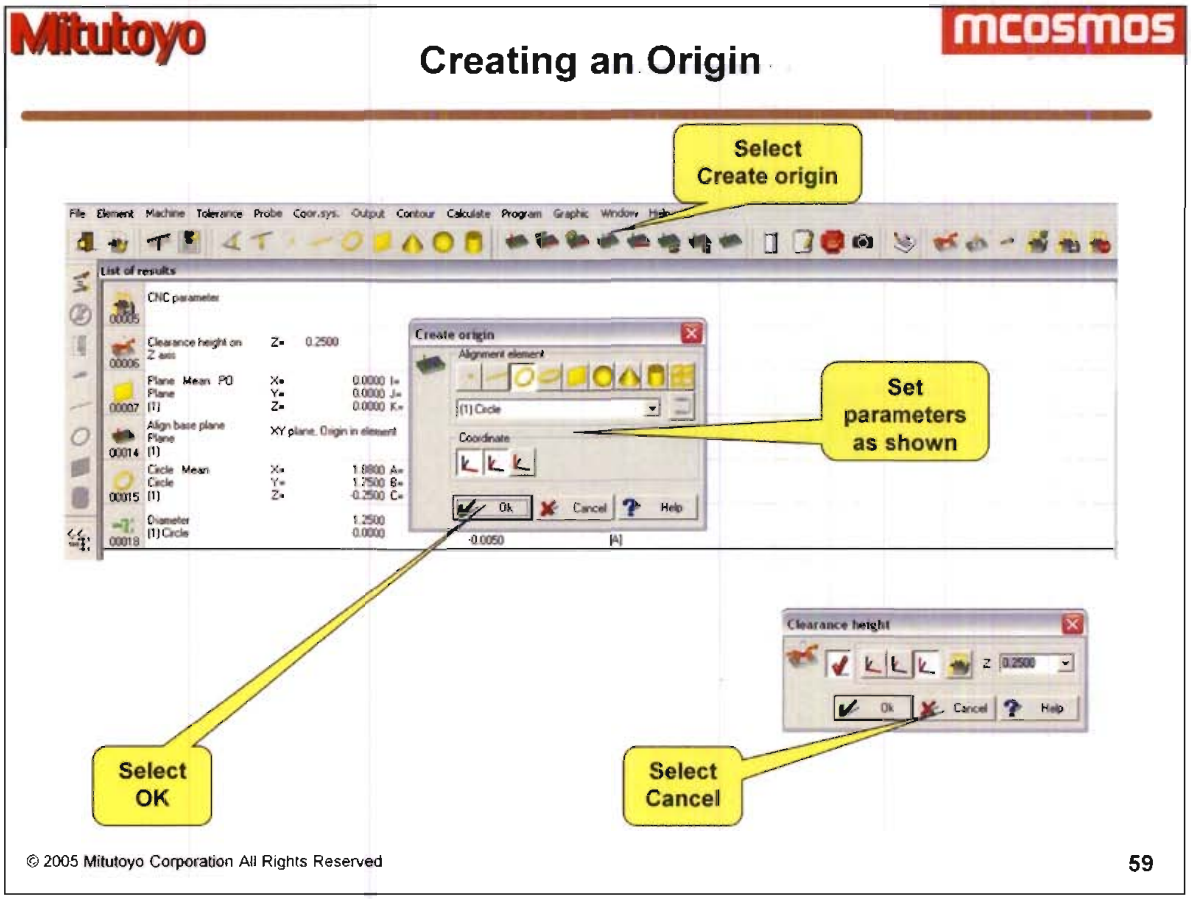

- Select Create origin tool.
- Set parameters as shown.
- Select OK.
- After any alignment adjustment or probe change with Clearance height set you will be prompted to adjust your Clearance height.
- If Clearance height needs to be adjusted adjust it.
- If Clearance height is to remain the same you should cancel to avoid duplicate lines in your part program
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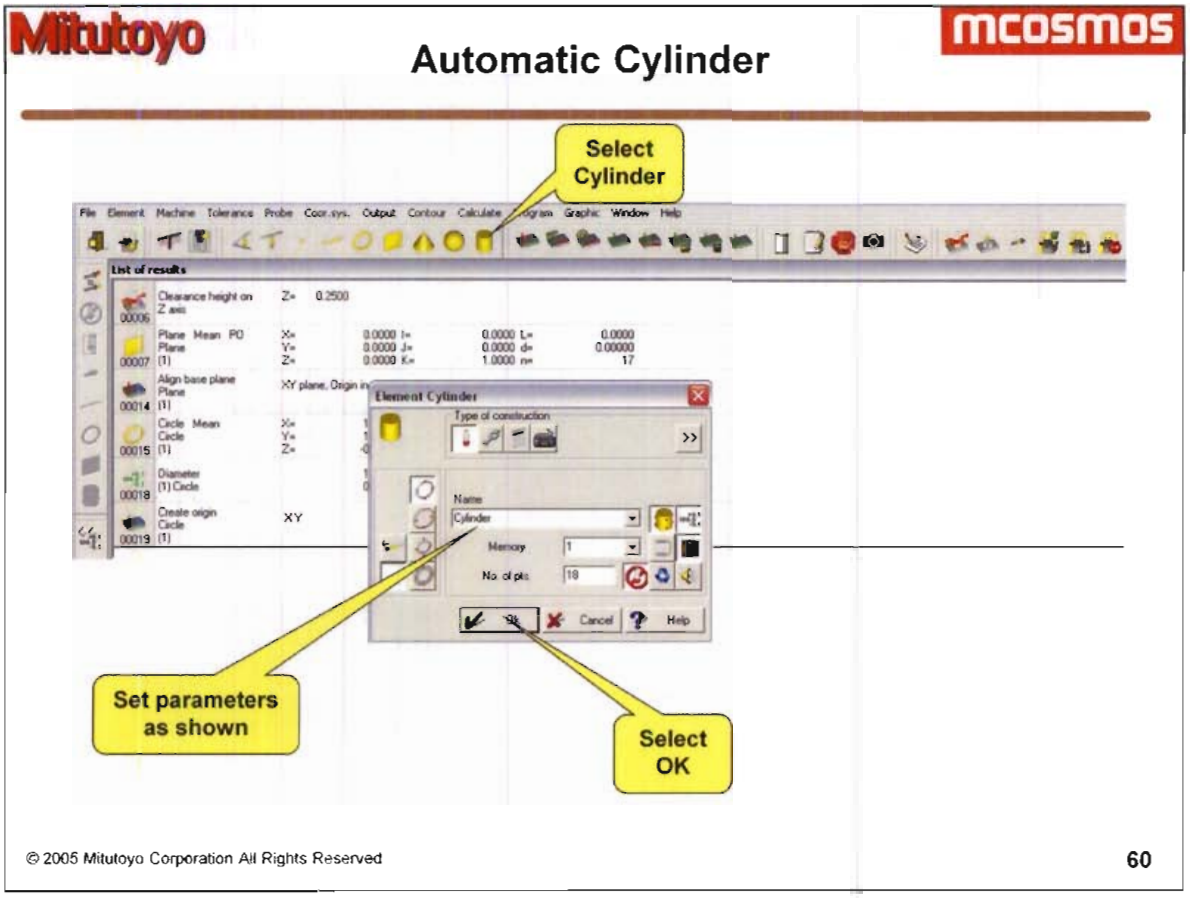

- The next feature we will measure is our cylinder.
- Select Cylinder.
- Set parameters as shown (Auto measure, Tolerance and Auto finish on).
- We will collect 18 points 6 points at each of 3 levels
- Select OK
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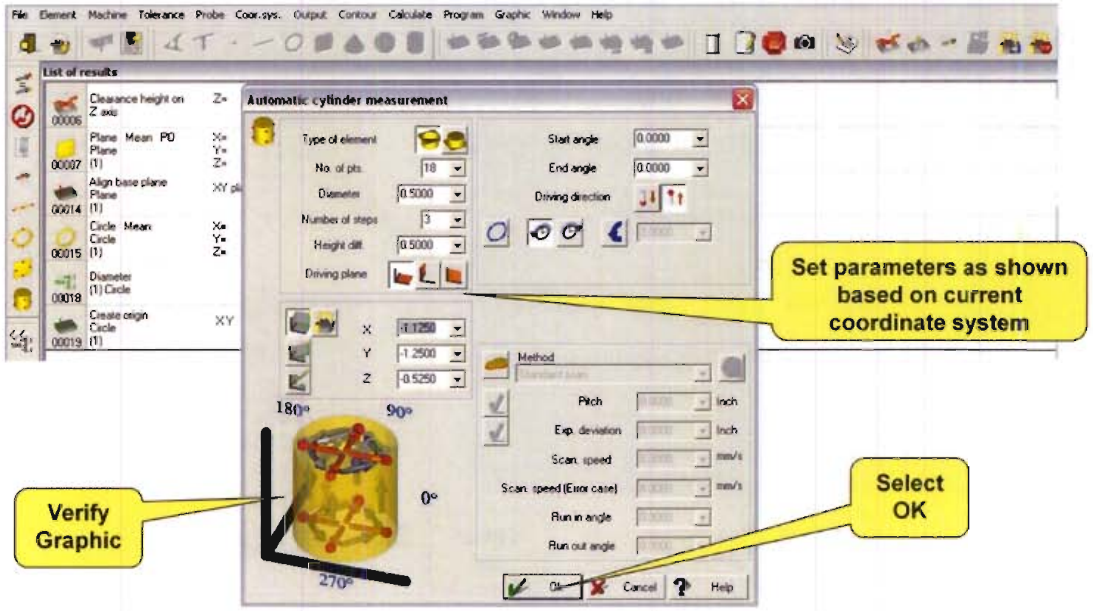
Collecting data on a Cylinder



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- Set the parameters as shown based on your current coordinate system.
- Height difference is a positive value over which data will be collected.
- Verify the graphic.
- Select OK to collect these points.
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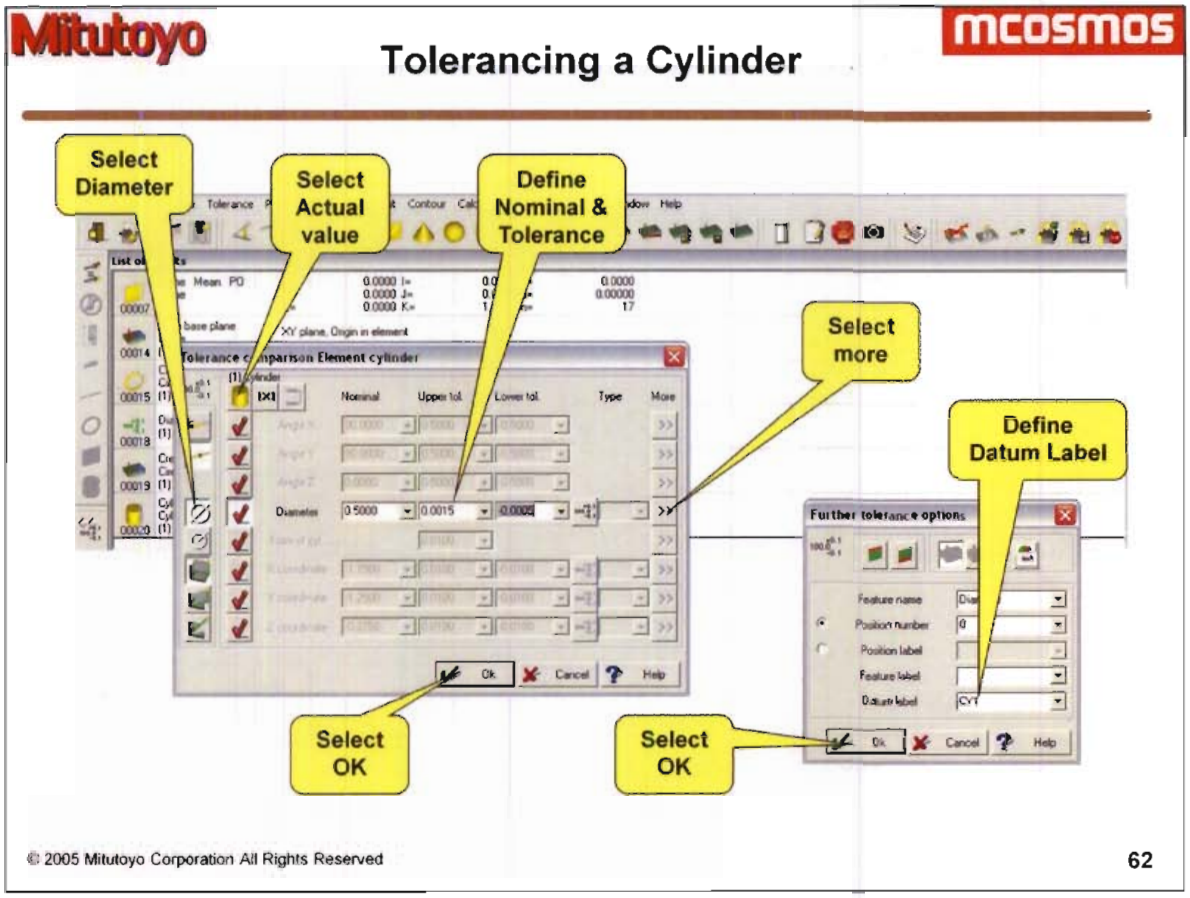

- The tolerance dialog will appear.
- Select Actual value.
- Select Diameter only as our coordinate system is not complete.
- Define Nominal & Tolerance.
- Select More.
- Define a Datum label.
- Press OK in the further tolerance options dialog.
- Press OK in the tolerance comparison dialog.
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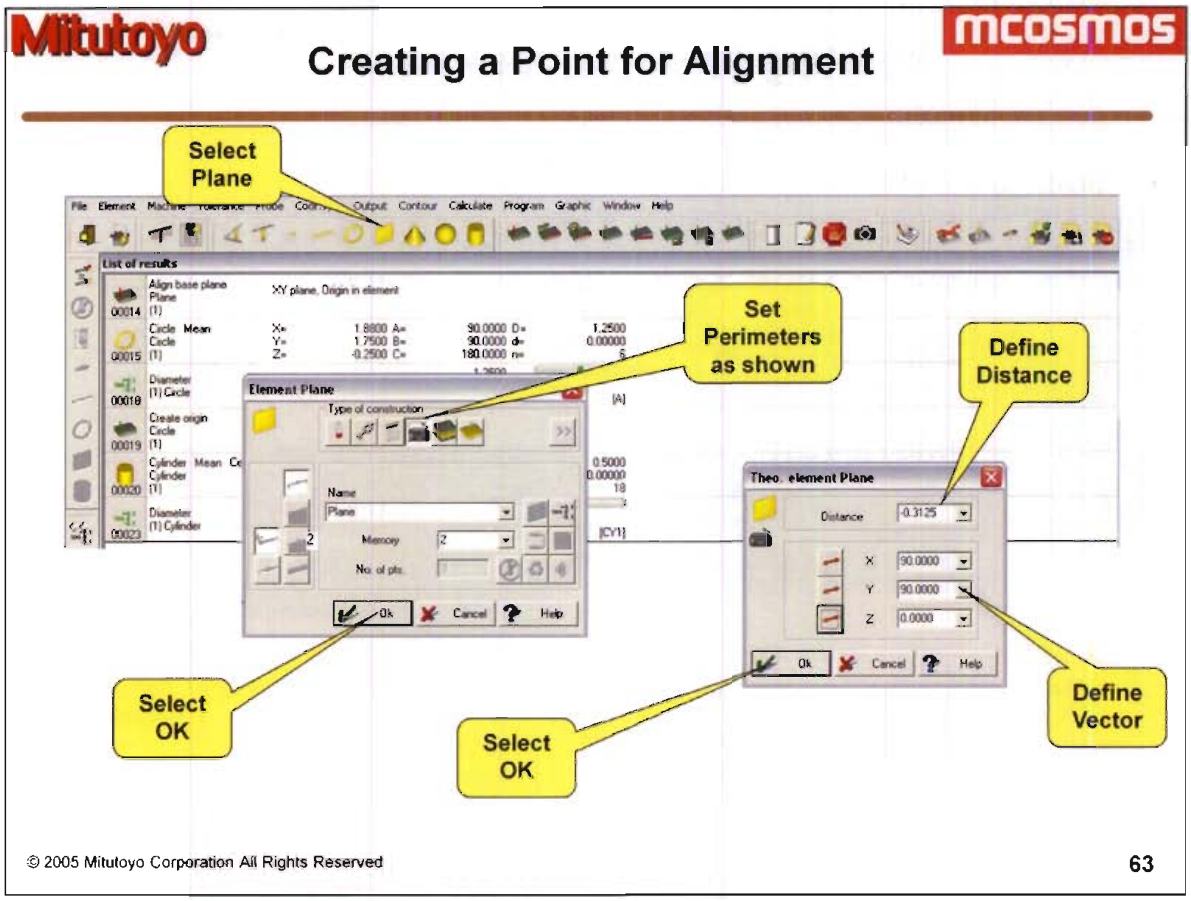

- To align our axis on this feature we must reduced it to a point. To achieve this we will intersect it with a plane half way down the feature.
- Select Plane.
- Set parameters as shown.
- Select OK.
- Define the distance from origin.
- Define the plane vector.
- Select OK.
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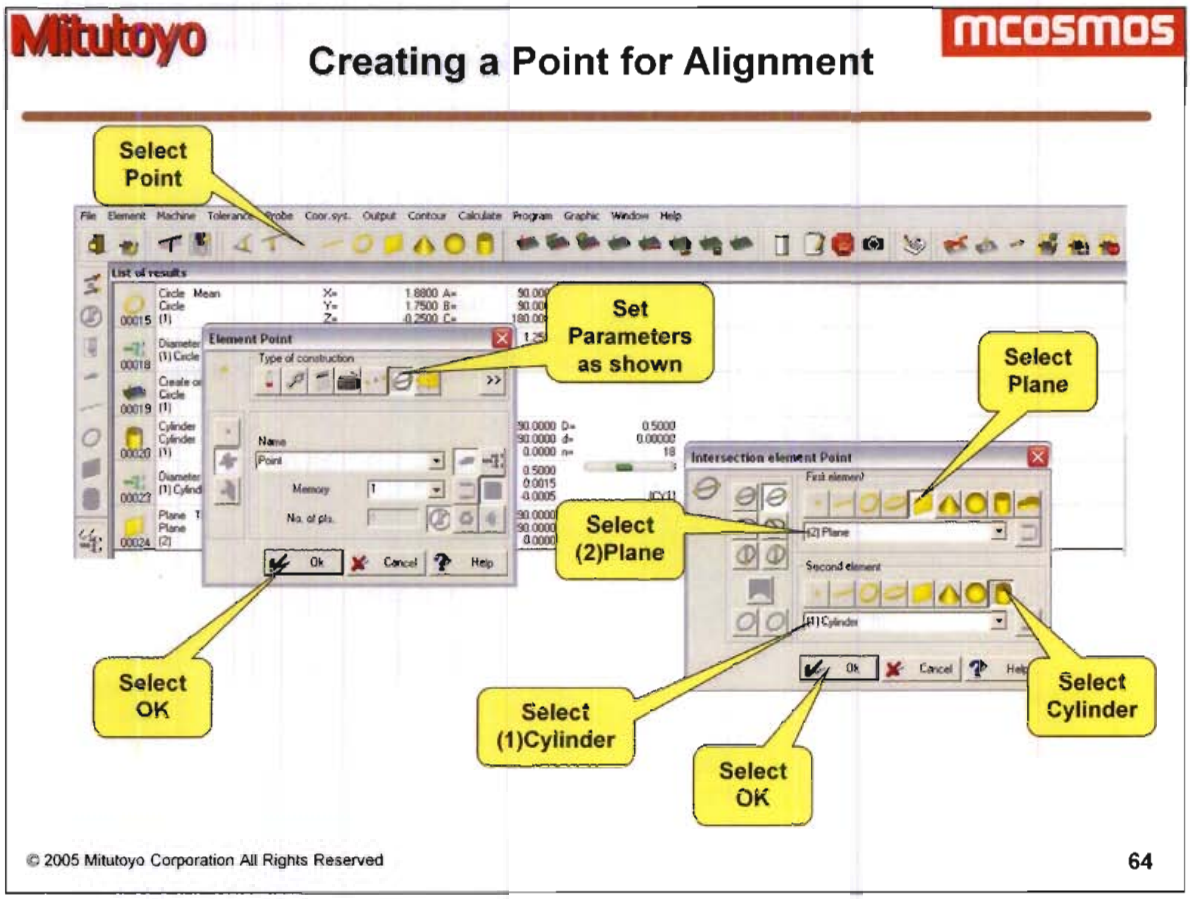

- Select Point to create an intersection point between the plane and cylinder.
- Set parameters as shown.
- Select OK.
- Select Plane for first element type.
- Select (2) plane.
- Select Cylinder for second element type.
- Select (1) Cylinder.
- Select OK.
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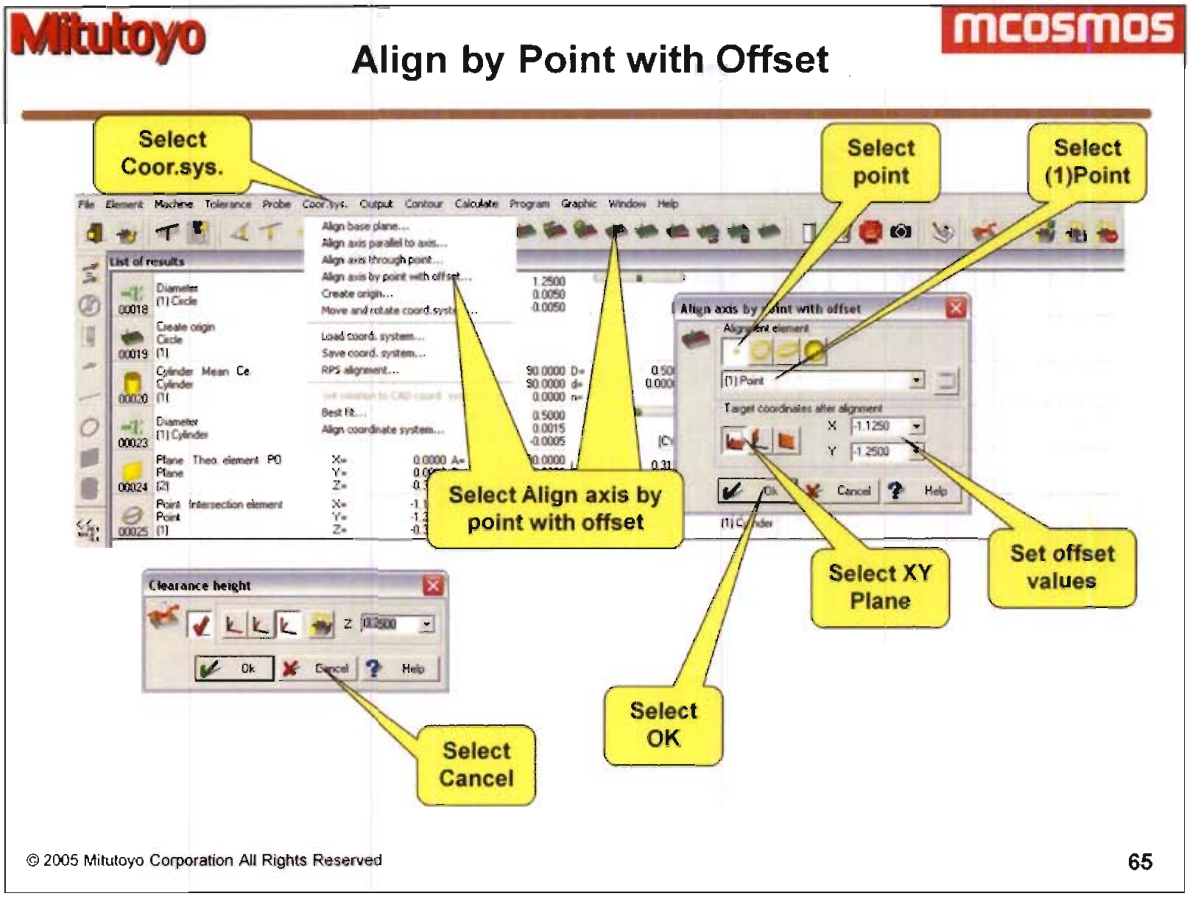
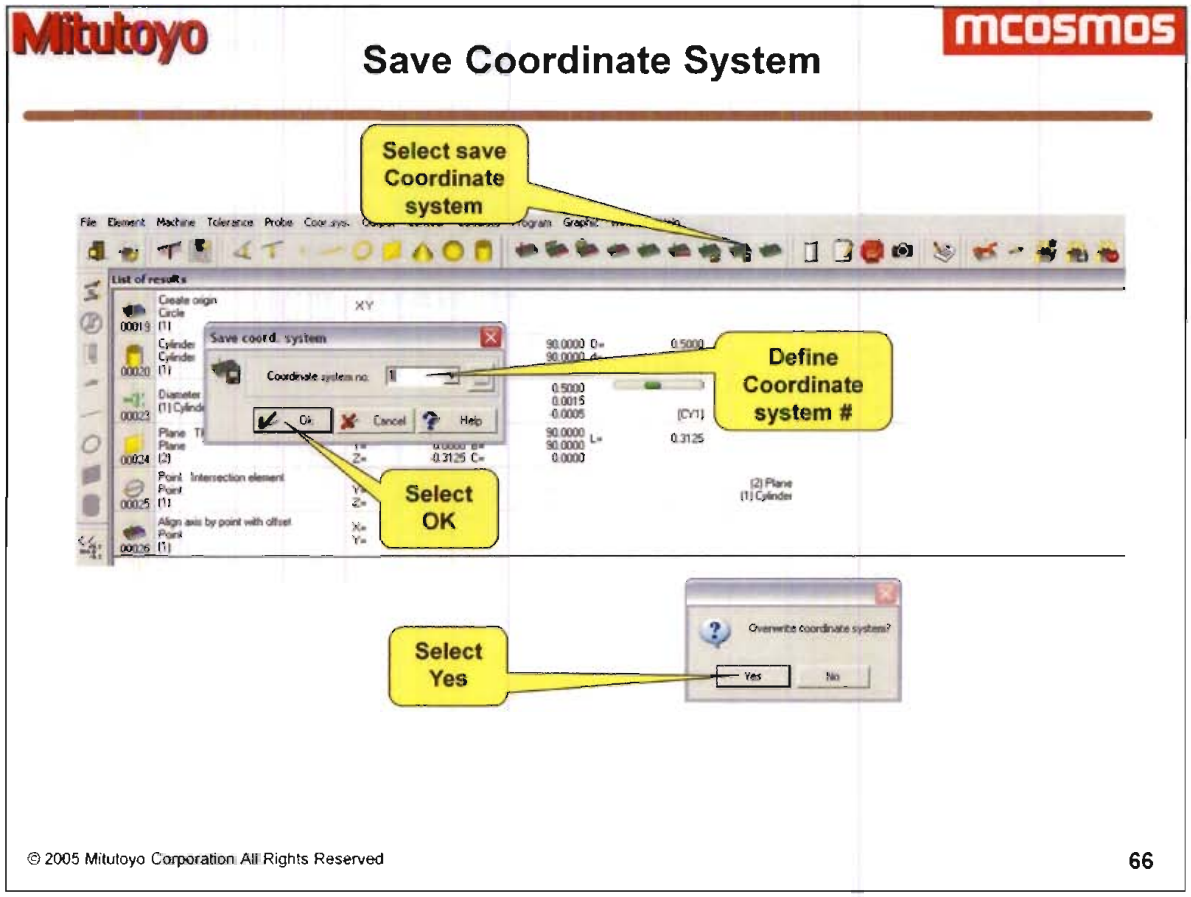


- Complete the coordinate system by aligning the Axis.
- Select Cord.sys menu. All alignment options are not on the toolbar.
- Select Align axis by point with offset.
- Select point as Alignment element.
- Select (1) Point.
- Set offset values from your print requirements .
- Select OK.
- After any alignment adjustment or probe change with Clearance height set you will be prompted to adjust your Clearance height.
- If Clearance height needs to be adjusted adjust it.
- If Clearance height is to remain the same you should cancel to avoid duplicate lines in your part program.
- _____



- Our coordinate system is complete it's a good idea to save it.
- Select save Coord. sys. .
- Define Coord.sys. # (1 to 9999).
- Select OK.
- If this coordinate system number has been used you will be prompted to Overwrite. In this case select yes.
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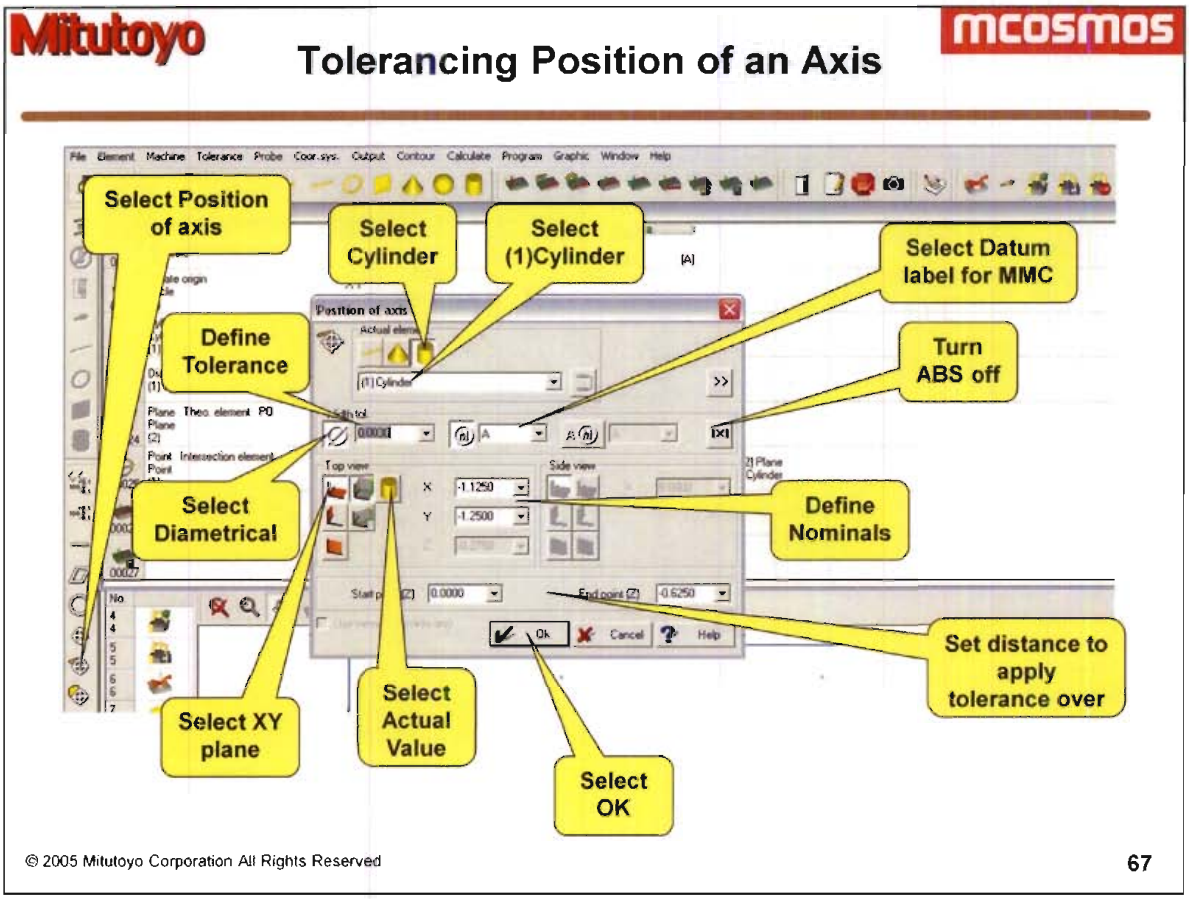
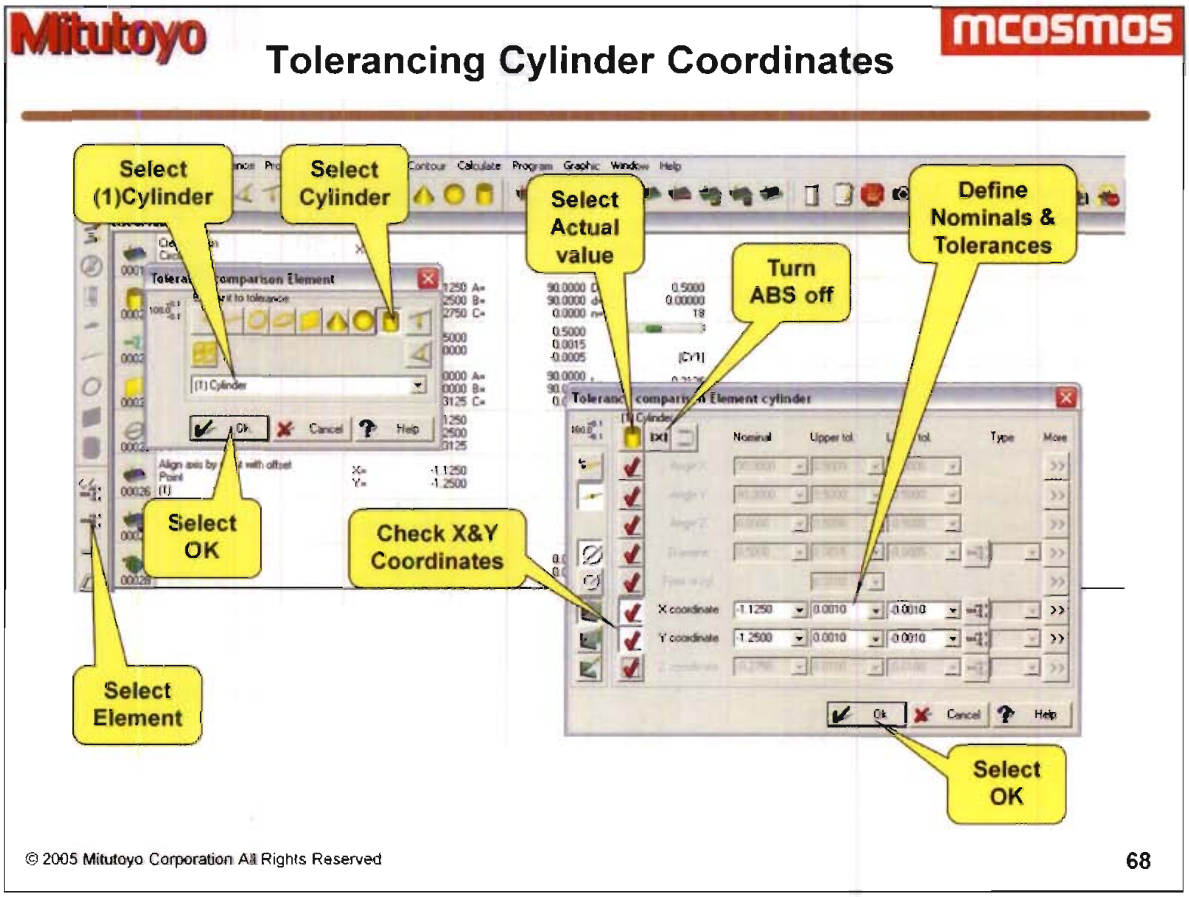


- To tolerance a Cylinder for True Position select Position of an axis.
- The position of an axis dialog will appear.
- Select Cylinder as the actual element type.
- Select (1) Cylinder in the pull down dialog. This selection can also be made in the graphics window.
- Define the tolerance.
- Select the datum label to apply MMC.
- Define the nominal location.
- Set the length of the feature to define the portion of the feature that the tolerance zone applies over.
- Select OK.
- _____
- _____



- Select Element from the tolerance tool bar.
- The Tolerance Comparison Element dialog will appear.
- Select cylinder as the element type.
- Select (1) Cylinder in the pull down dialog. This selection can also be made in the graphics window.
- The Tolerance comparison dialog will appear.
- Select the actual value.
- Select X & Y as the position tolerancing does not report the actual X & Y location.
- Define the Nominals & Tolerances.
- Select OK.
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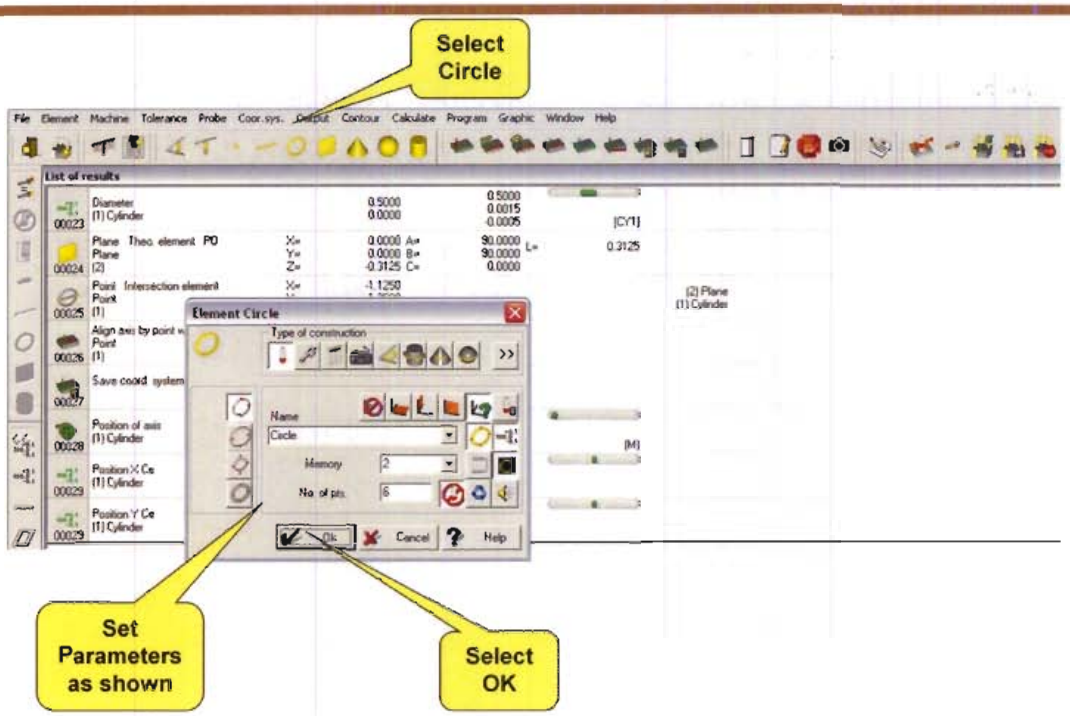
Automatic Circle



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- To tolerance the circles measure them Select Circle.
- Set parameters as shown (Auto measure Auto project Tolerance).
- Select OK.
- The Automatic circle measurement dialog will appear.
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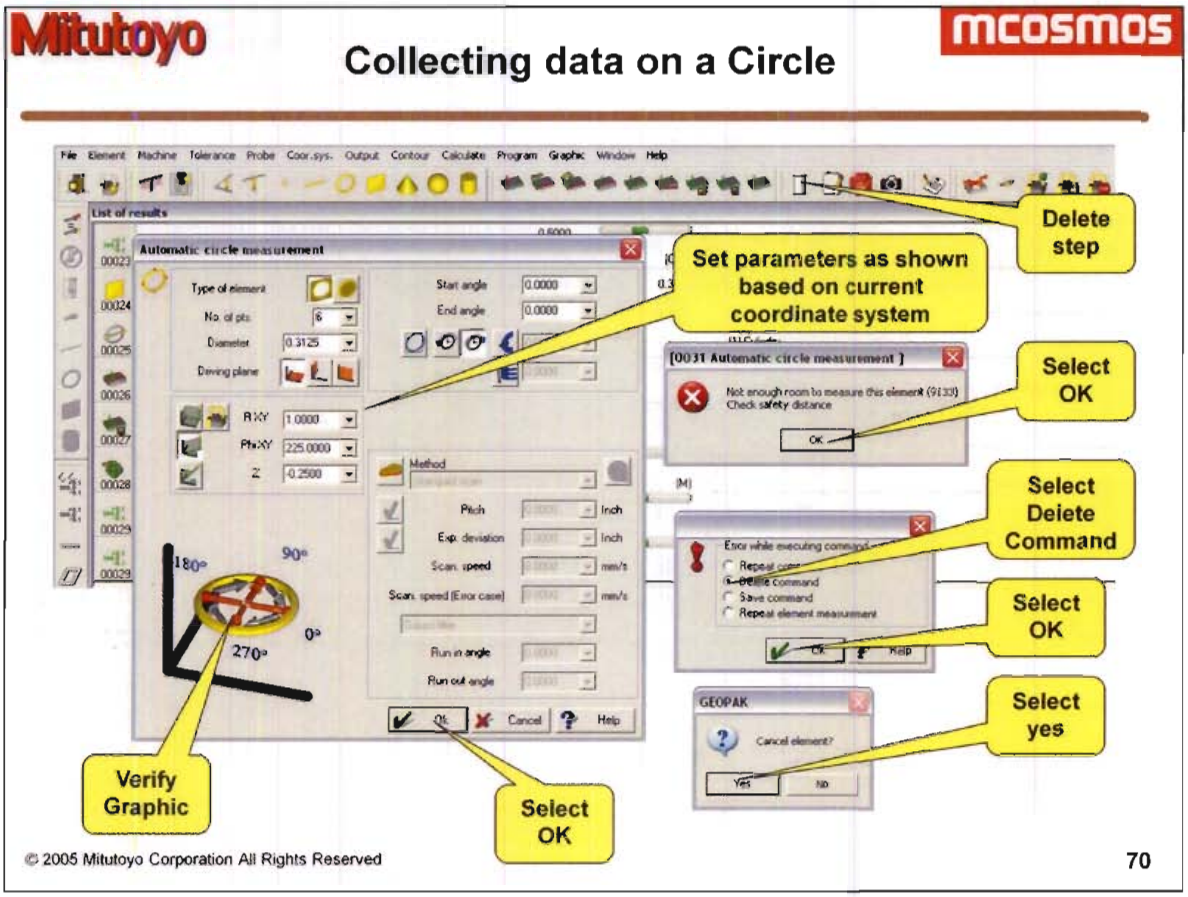
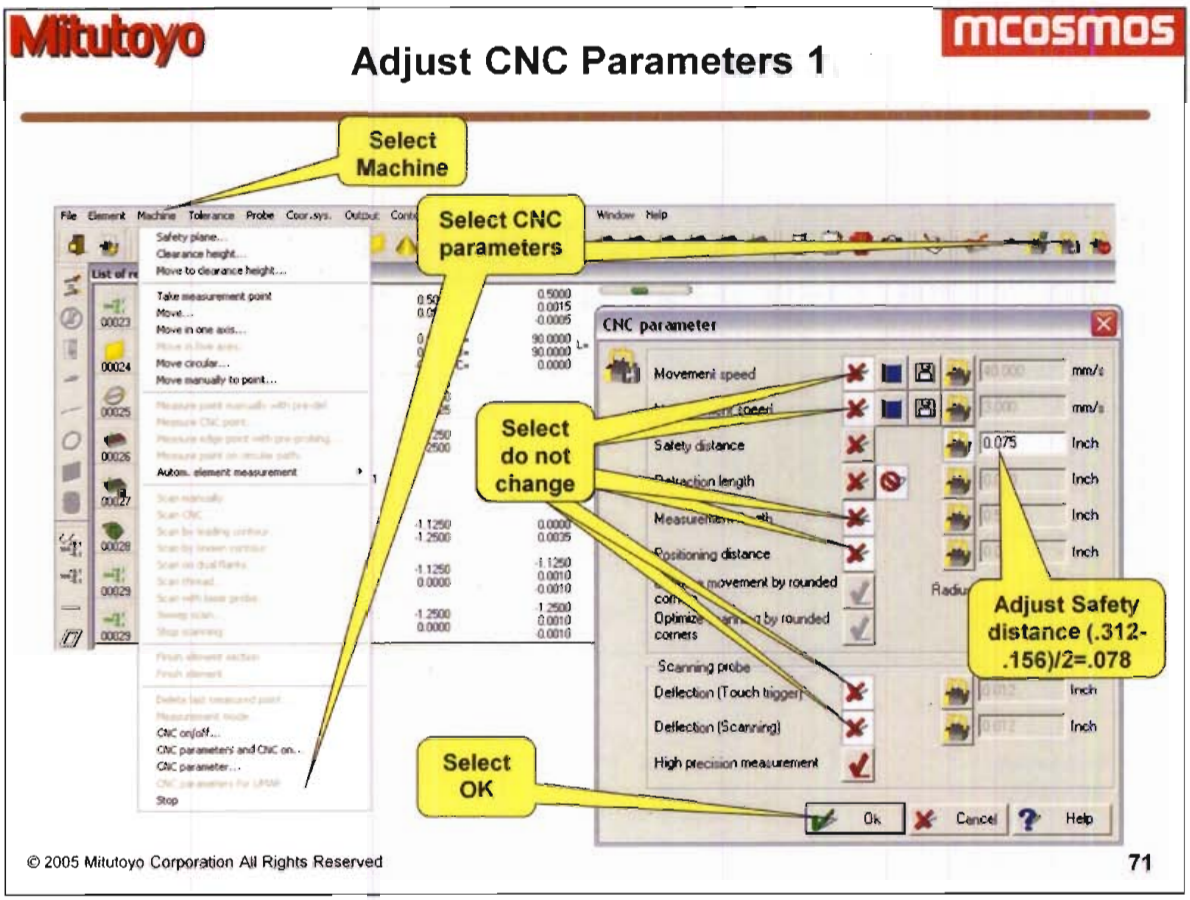


- Set parameters as shown. We will check the .3125 hole closest to the .500 dia hole it is at 225 or -135 they both have the same value.
- Verify the graphic.
- Select OK.
- We will receive the warning not enough room to measure this element.
- We can either lie about the diameter or correct the safety distance.
- Select OK
- Delete the command as we will correct the safety distance.
- Trash the last step (element circle) as you can nor correct the adjust CNC parameters within an element measurement
- _____
- _____
- _____
- _____



- We cannot enter CNC parameters with a measurement open.
- Close the measurement with the trash can or the red X in the measurement display.
- Select Yes to cancel the measurement.
- Select Machine.
- Select CNC Parameters.
- _____
- _____
- _____
- _____
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- _____

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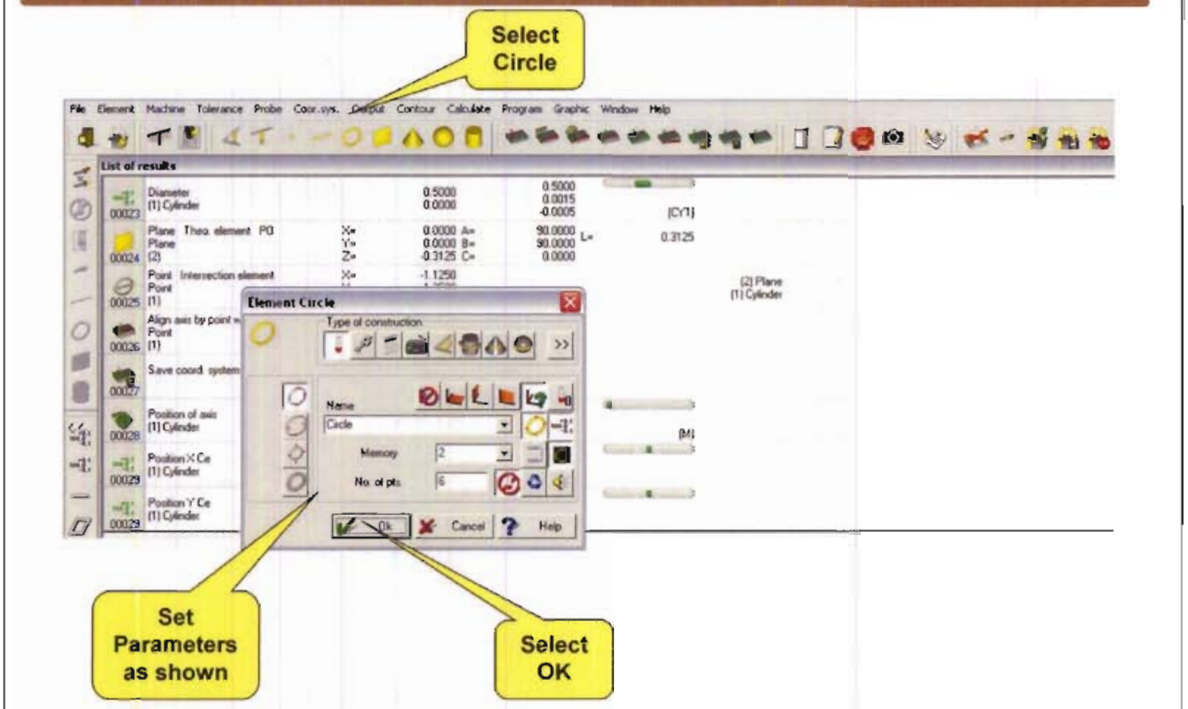
Automatic Circle



72

- To tolerance the circles measure them Select Circle.
- Set parameters as shown (Auto measure Auto project Tolerance).
- Select OK.
- The Automatic circle measurement dialog will appear.
- _____
- _____
- _____
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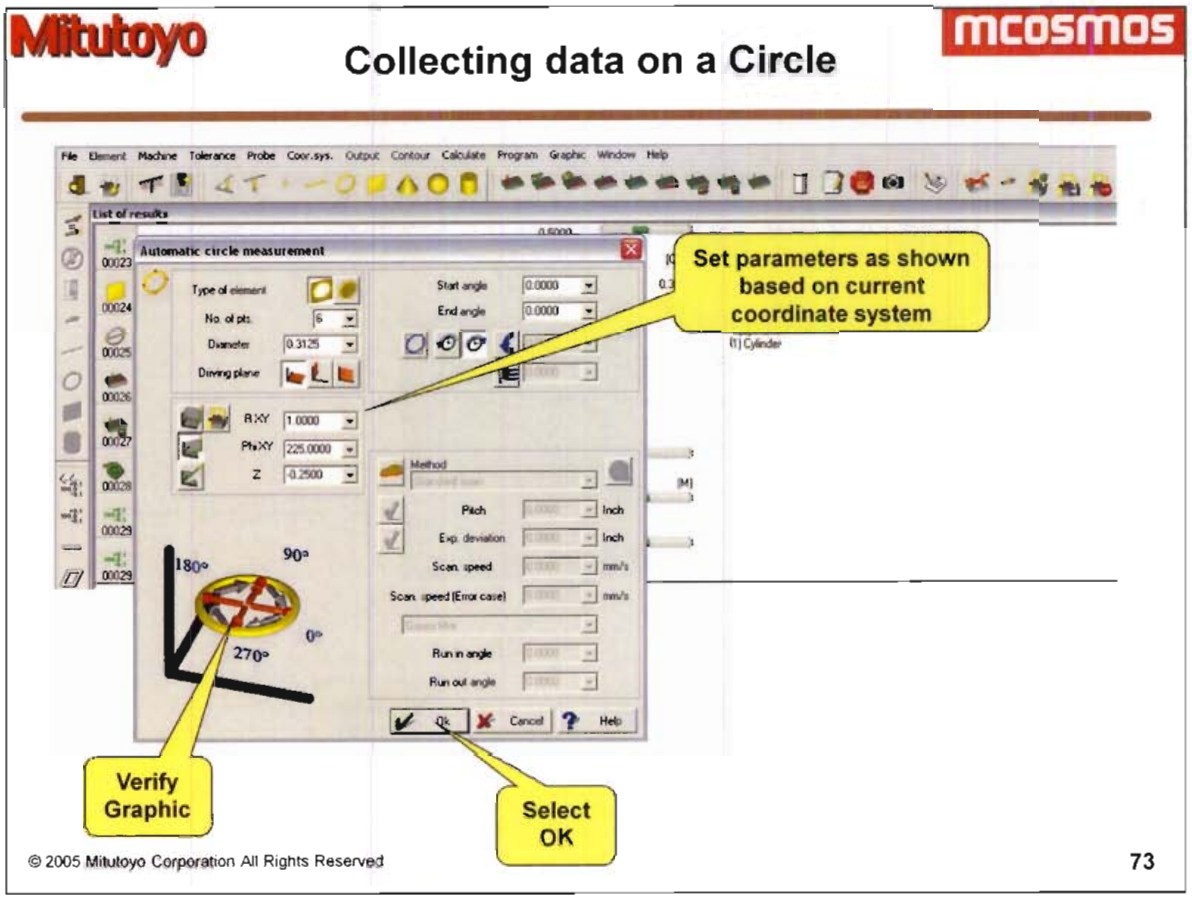
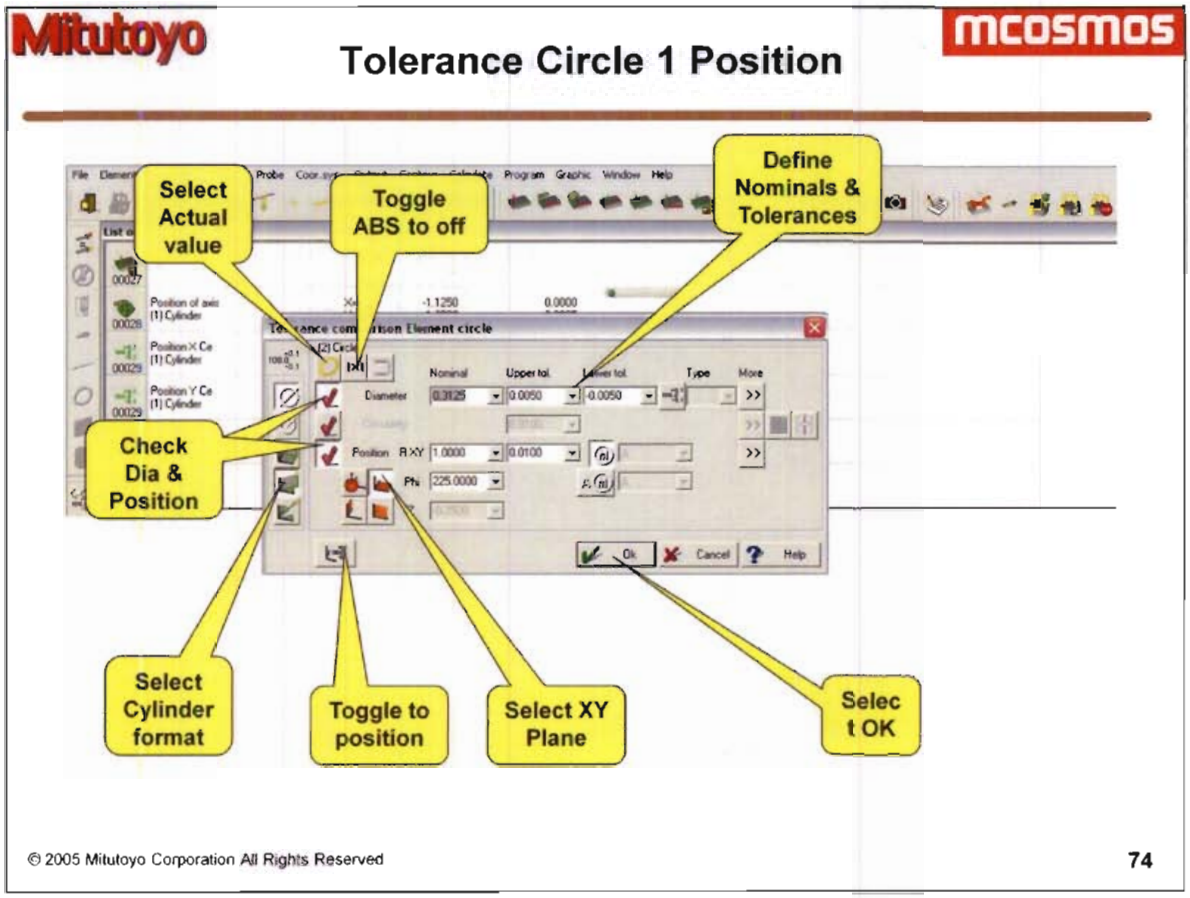
- _____



- Set parameters as shown. We will check the .3125 hole closest to the .500 dia hole it is at 225 or -135 they both have the same value.
- Verify the graphic.
- Select OK.
- We will receive the warning not enough room to measure this element.
- We can either lie about the diameter or correct the safety distance.
- Select OK
- Delete the command as we will correct the safety distance.
- Trash the last step (element circle) as you can nor correct the adjust CNC parameters within an element measurement
- _____
- _____
- _____
- _____



- Because the tolerance icon was selected the tolerance comparison dialog will appear.
- Toggle ABS to off.
- Toggle to position.
- Check Diameter and Position.
- Select Cylindrical format as that is the print requirement.
- Select actual value.
- Define Nominals & Tolerances.
- Select OK.
- _____
- _____
- _____
- _____

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Tolerance Circle 1 Coordinates

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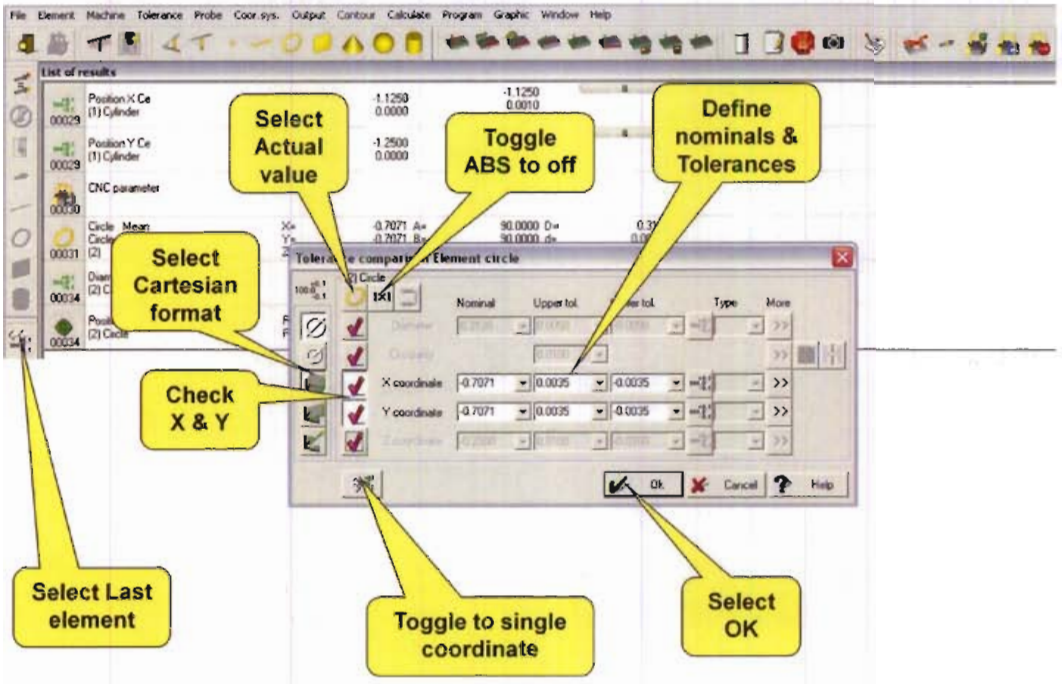
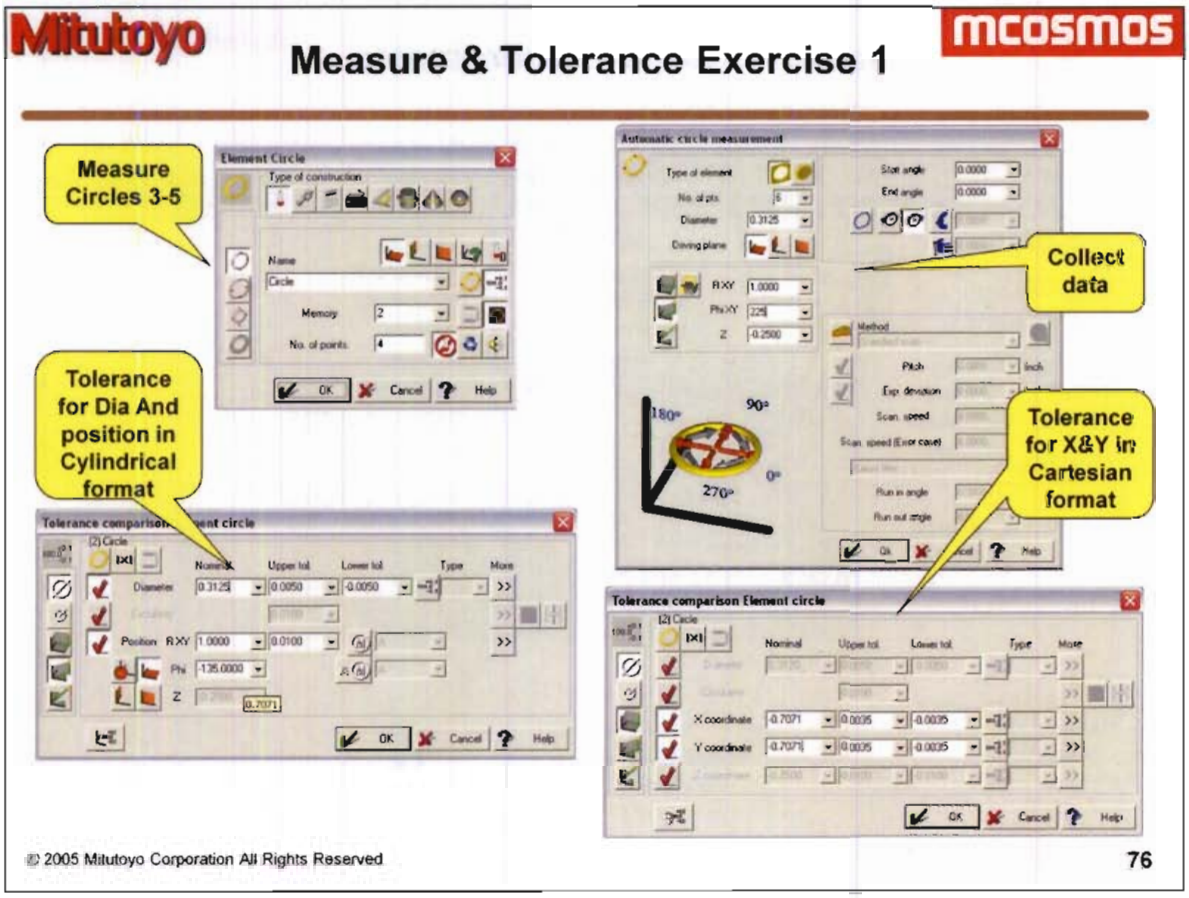


75

- The position tolerance was reported in a Cylindrical format to report B/P requirements. We should include X & Y values for shop use.
- Select Last element from the Tolerance toolbar.
- Toggle to Single coordinates.
- To calculate the X & Y coordinates select X & Y.
- Select Cylindrical format.
- Select Actual value.
- Define / adjust the nominals in Cylindrical format
- Select Cartesian format this will recalculate the Nominals in the Cartesian format.
- Verify nominals and tolerances.
- Select OK.
-



- Repeat the above steps for the other 3 holes in the bolt circle
- _____
- _____
- _____
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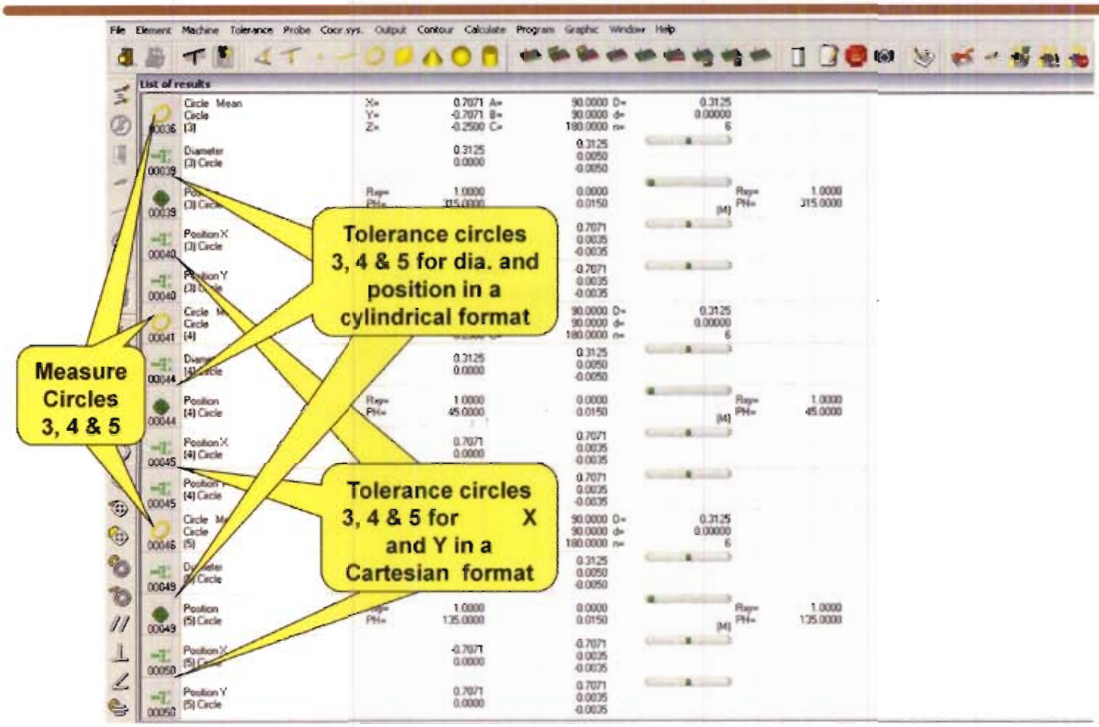
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Measure & Tolerance Exercise 1



77

- This is what the field for results should look like.
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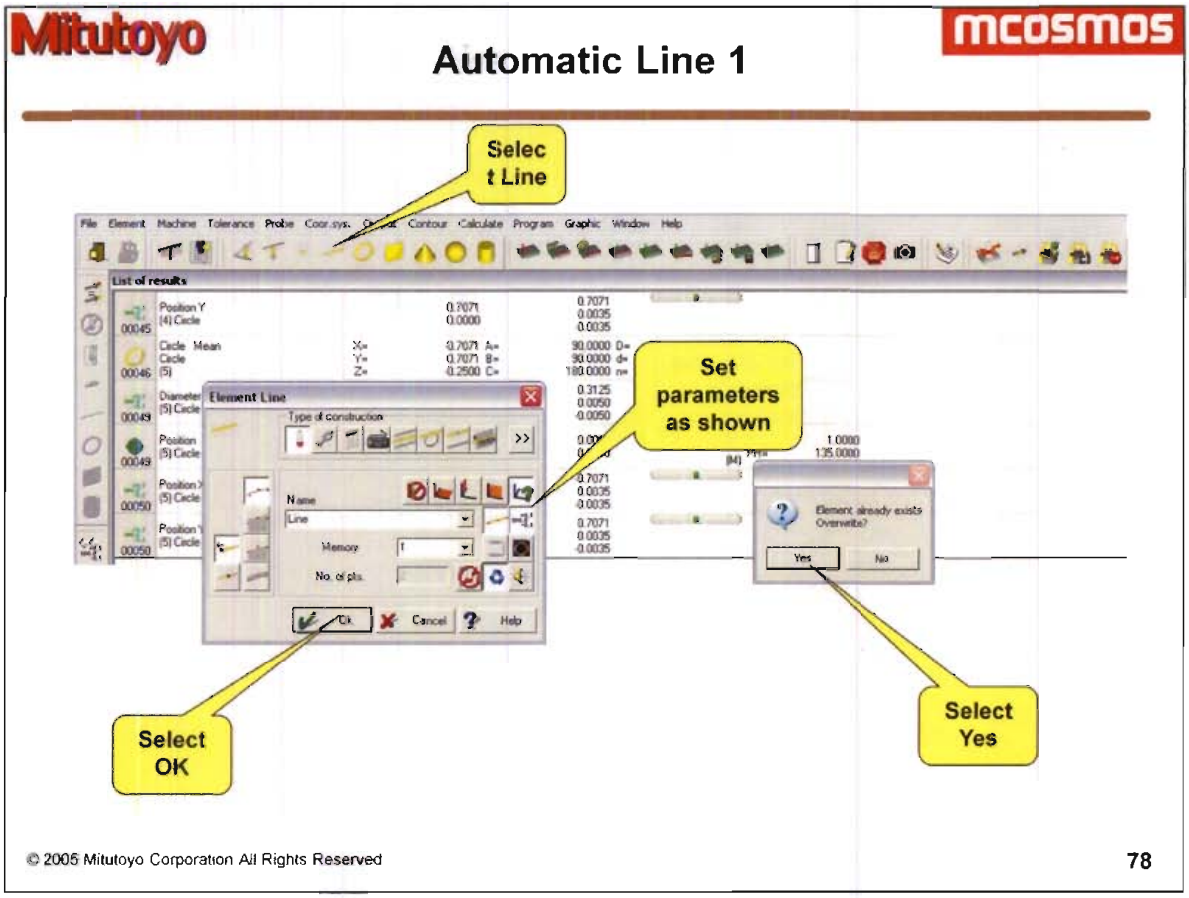
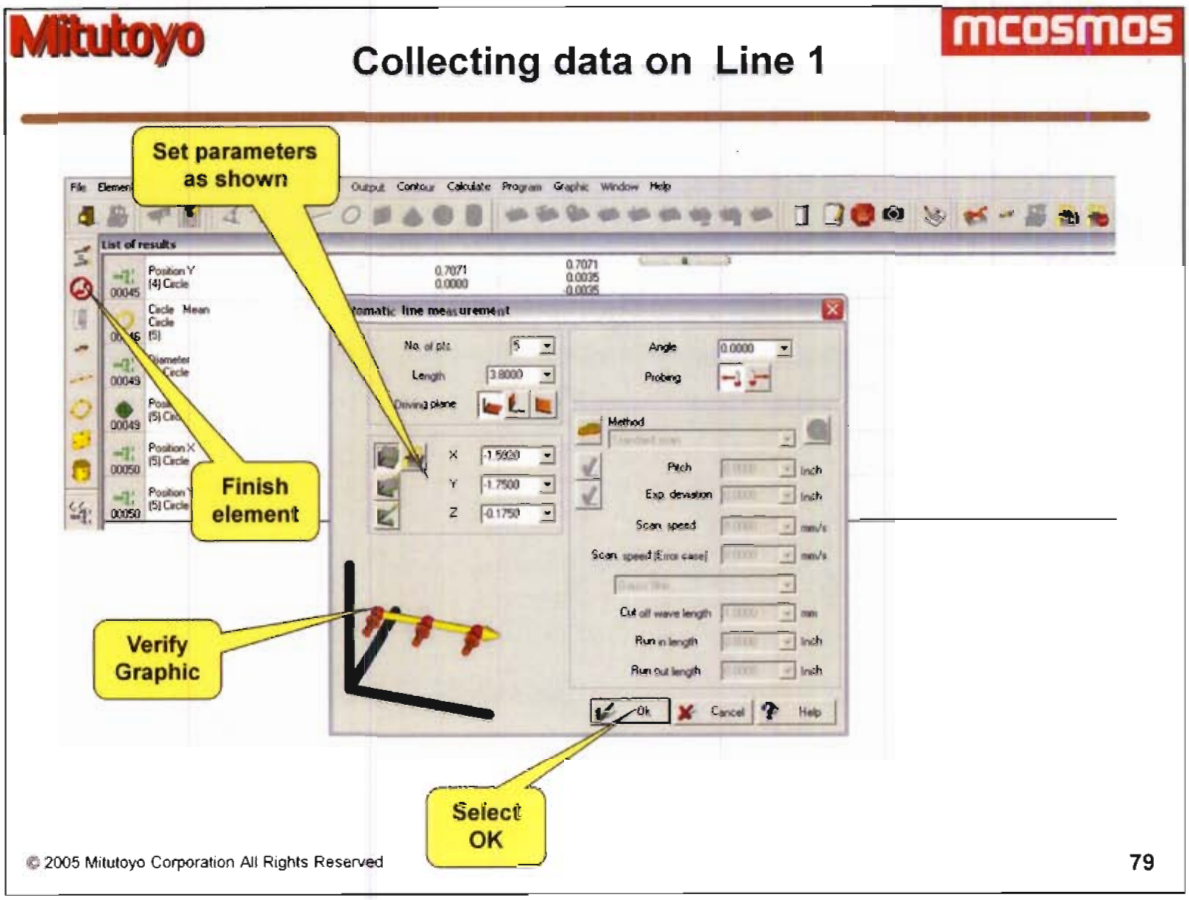
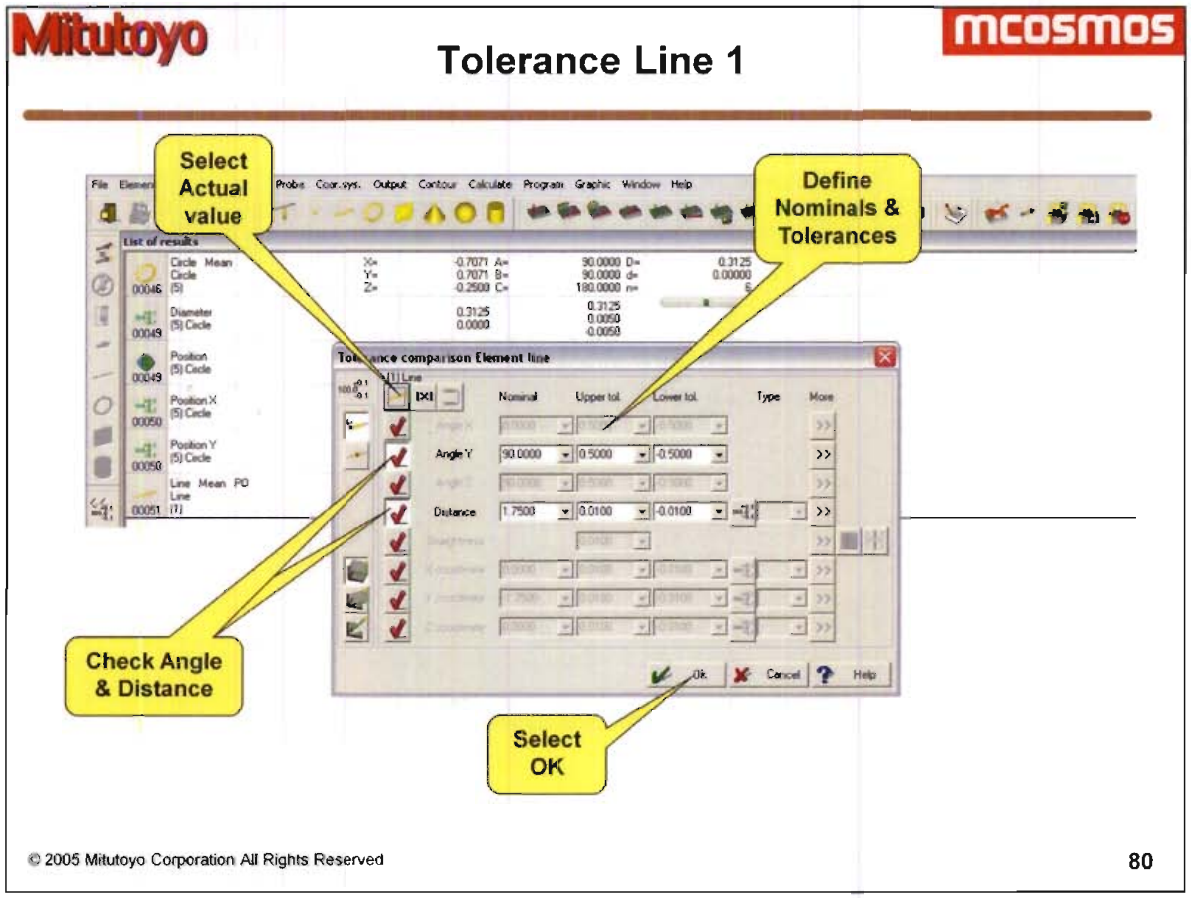


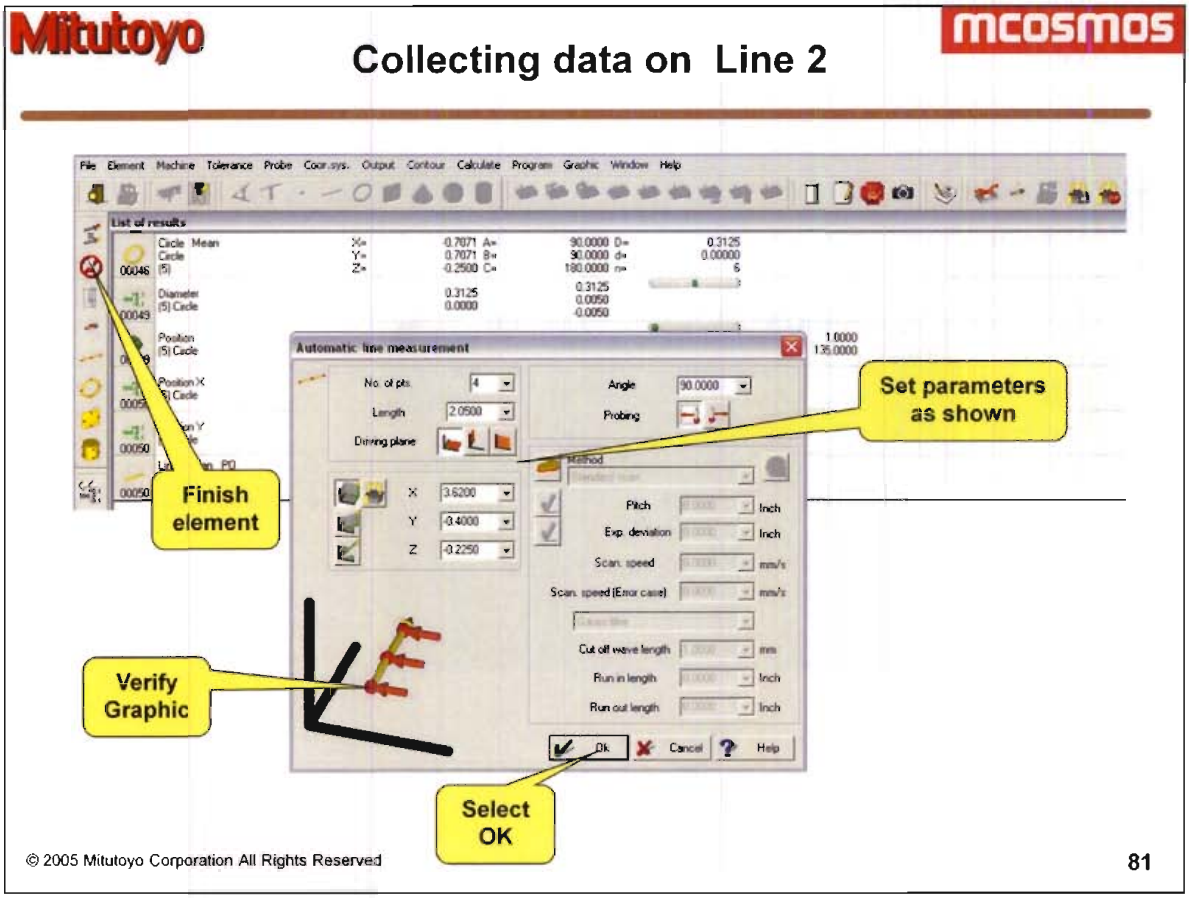
- Measure the lines around the periphery.
- Select Line.
- Set parameters as shown (Auto measure, Auto projection, Tolerance Auto repetition on and auto finish off).
- With Auto finish off we can easily change the number of points and tools used.
- Don't forget to overwrite the lines from your Pattern alignment.
- Select OK.
- Select Yes.
- _____
- _____
- _____
- _____
- _____
- _____



- Select the number of points to be measured on this line.
- Select the drive plane (the plane parallel to the line and the retraction direction for that line).
- Define the start point.
- The calculator found at start / all programs / accessories / calculator might be handy as it has copy past capability.
- Define Angle and probing direction.
- Select OK.
- Finish the element.
- _____
- _____
- _____
- _____



- Upon completion of measurement a tolerance dialog should open.
- Select Actual value.
- Check Angle, & Distance.
- Define Nominals & Tolerances.
- Select OK.
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____



- Select the number of points to be measured on this line.
- Select the drive plane (the plane parallel to the line and the retraction direction for that line).
- Define the start point.
- The calculator found at start / all programs / accessories / calculator might be handy as it has copy past capability.
- Define Angle and probing.
- Select OK.
- Finish the element.
- _____
- _____
- _____
- _____

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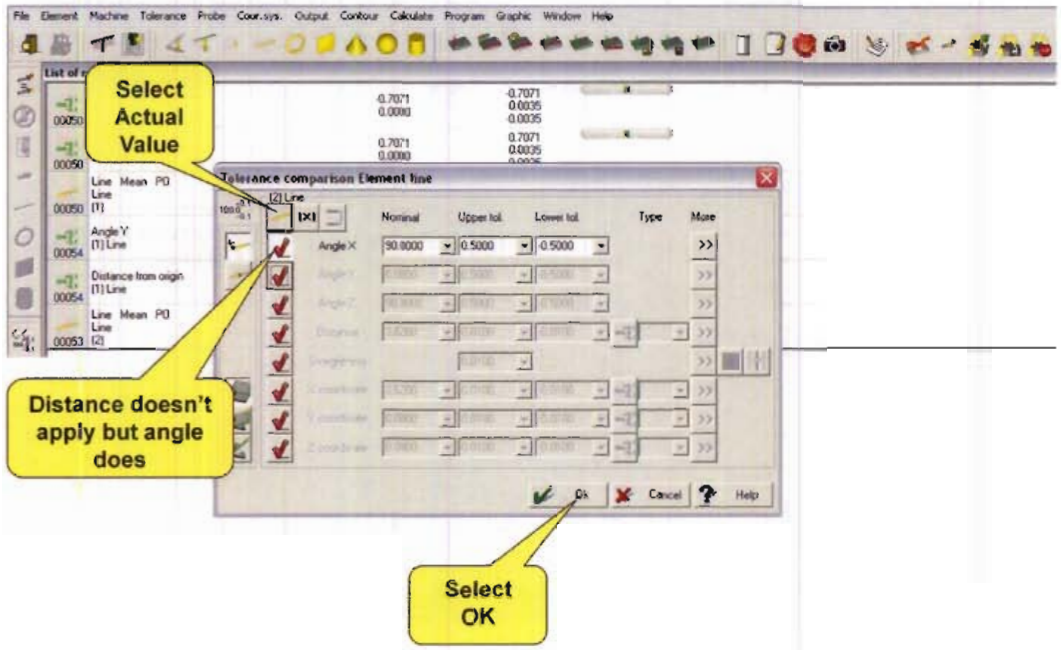
Tolerance Line 2



82

- Upon completion of measurement a tolerance dialog should open.
- Select Actual value.
- This value is not a B/P requirement. We will tolerance this feature later.
- Select Cancel.
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

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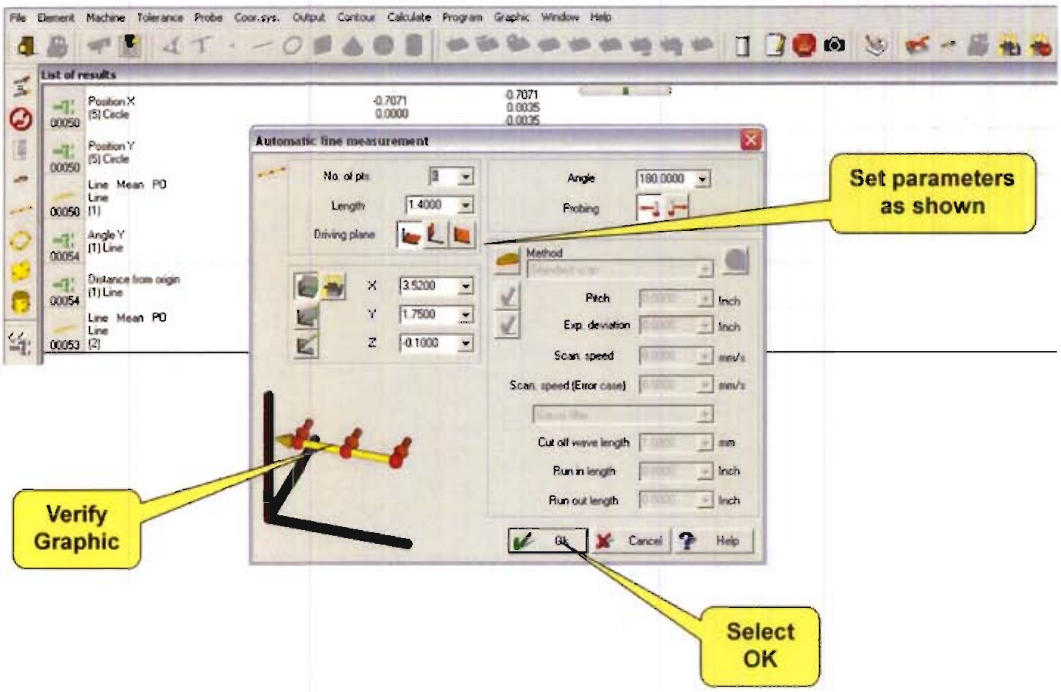
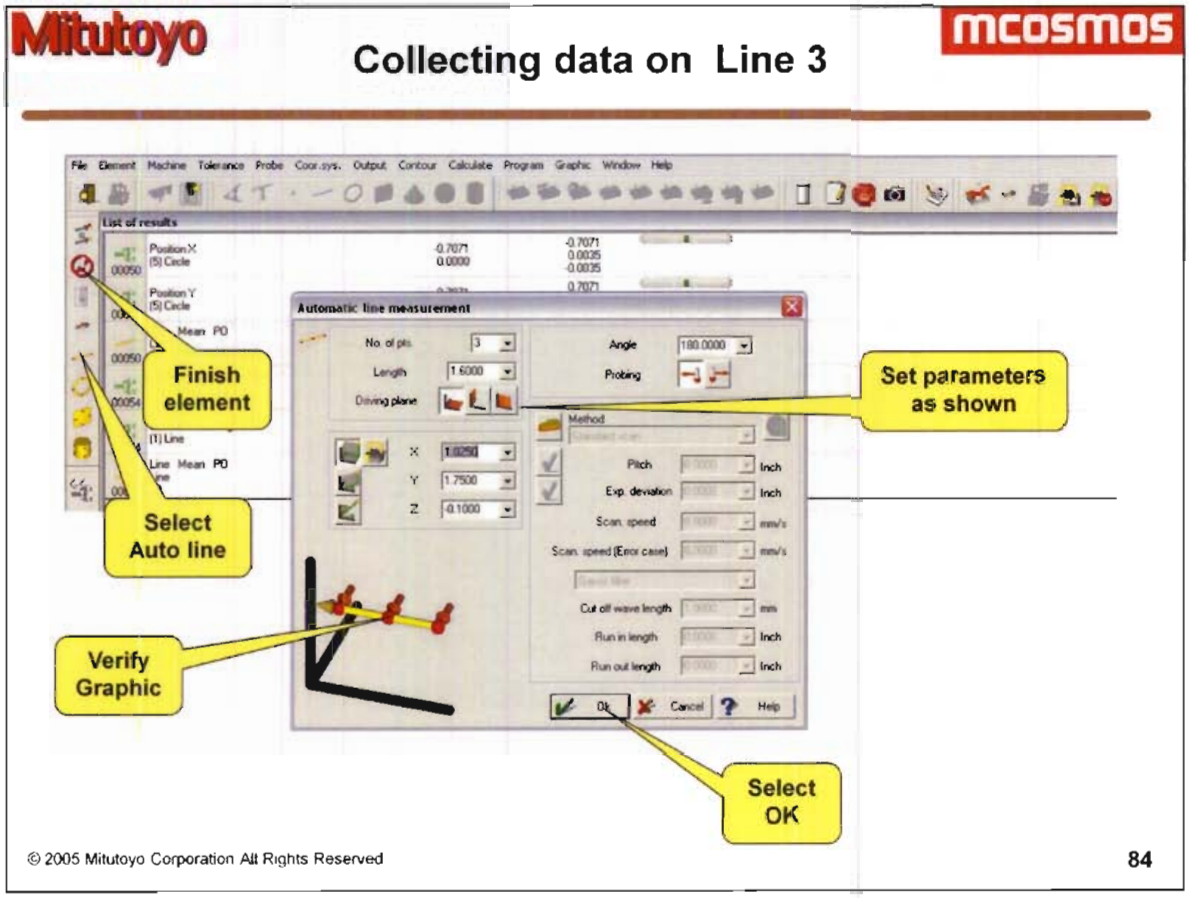
Collecting data on Line 3

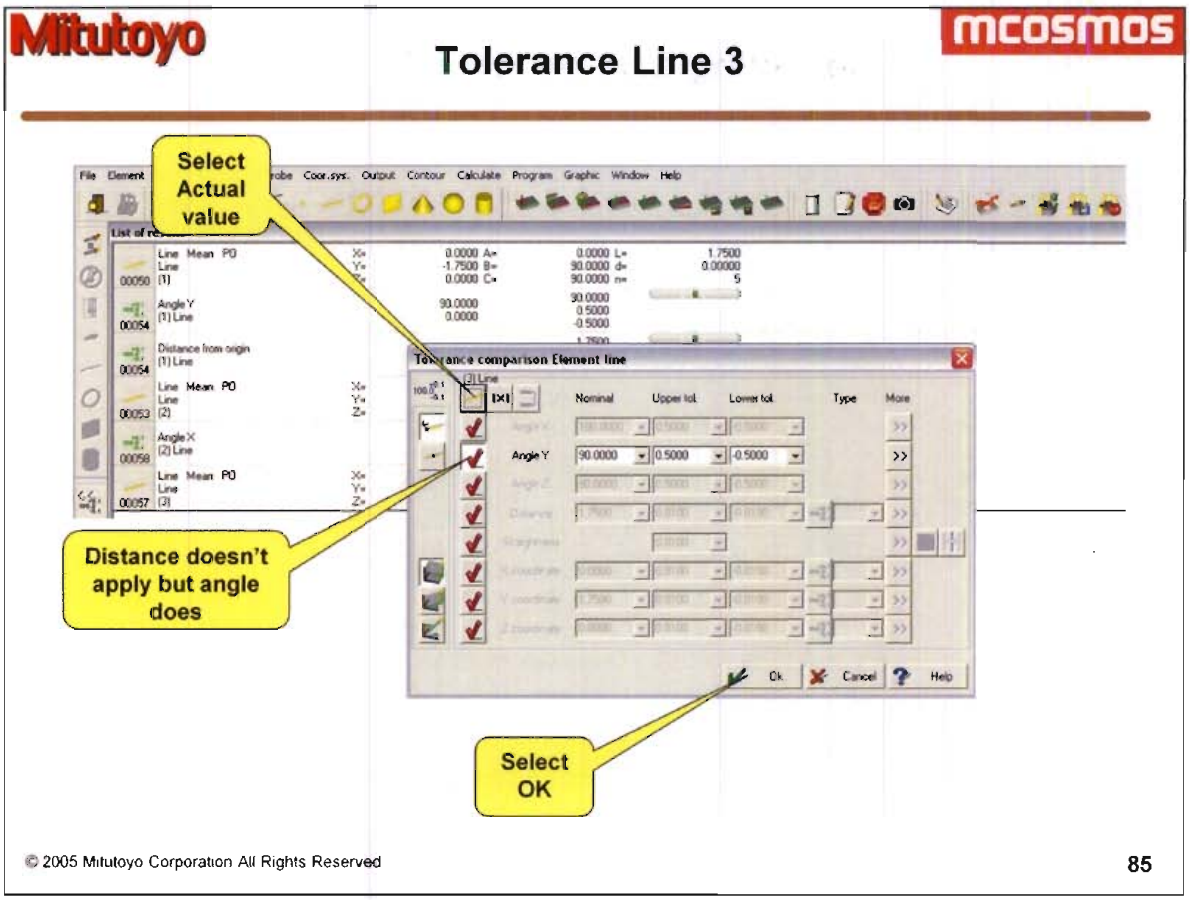


83

- This line is interrupted we will use the line tool 2 times to collect the data.
- Select the number of points to be measured on this portion of the line.
- Select the drive plane (a the plane parallel to the line and the retraction direction for that line.
- Define the start point.
- The calculator found at start / all programs / accessories / calculator might be handy as it has copy past capability.
- Define Angle and probing.
- Select OK.
- _____
- _____
- _____
- _____

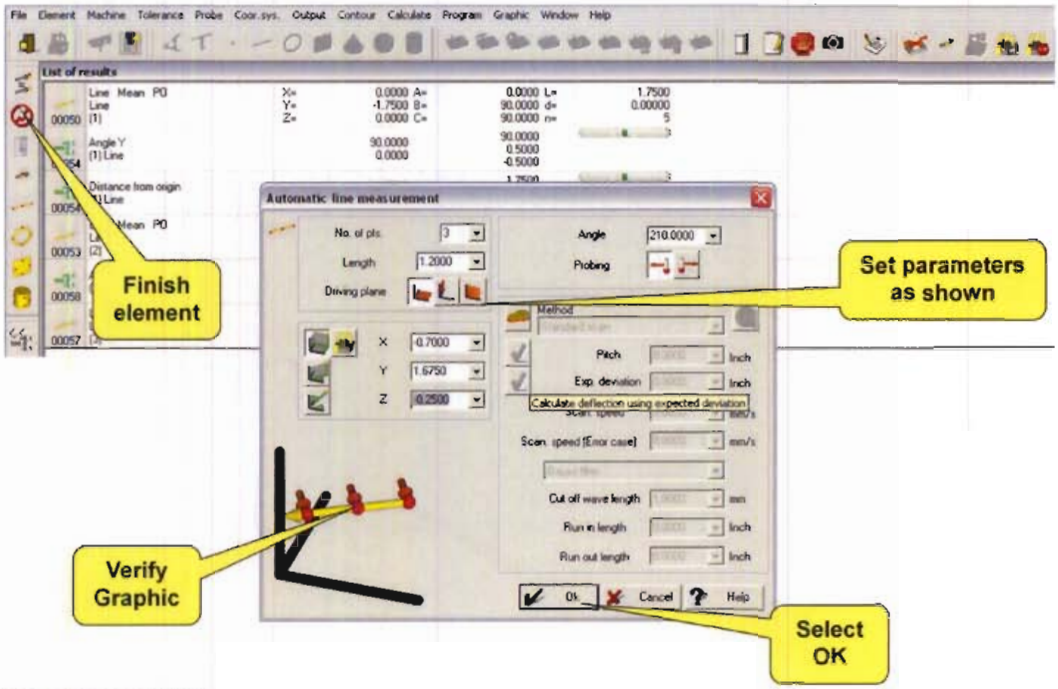


- Select the number of points to be measured on this portion of the line.
- Select the drive plane (a the plane parallel to the line and the retraction direction for that line.
- Define the start point.
- The calculator found at start / all programs / accessories / calculator might be handy as it has copy past capability.
- Define Angle and probing.
- Select OK.
- Finish the element.
- _____
- _____
- _____
- _____



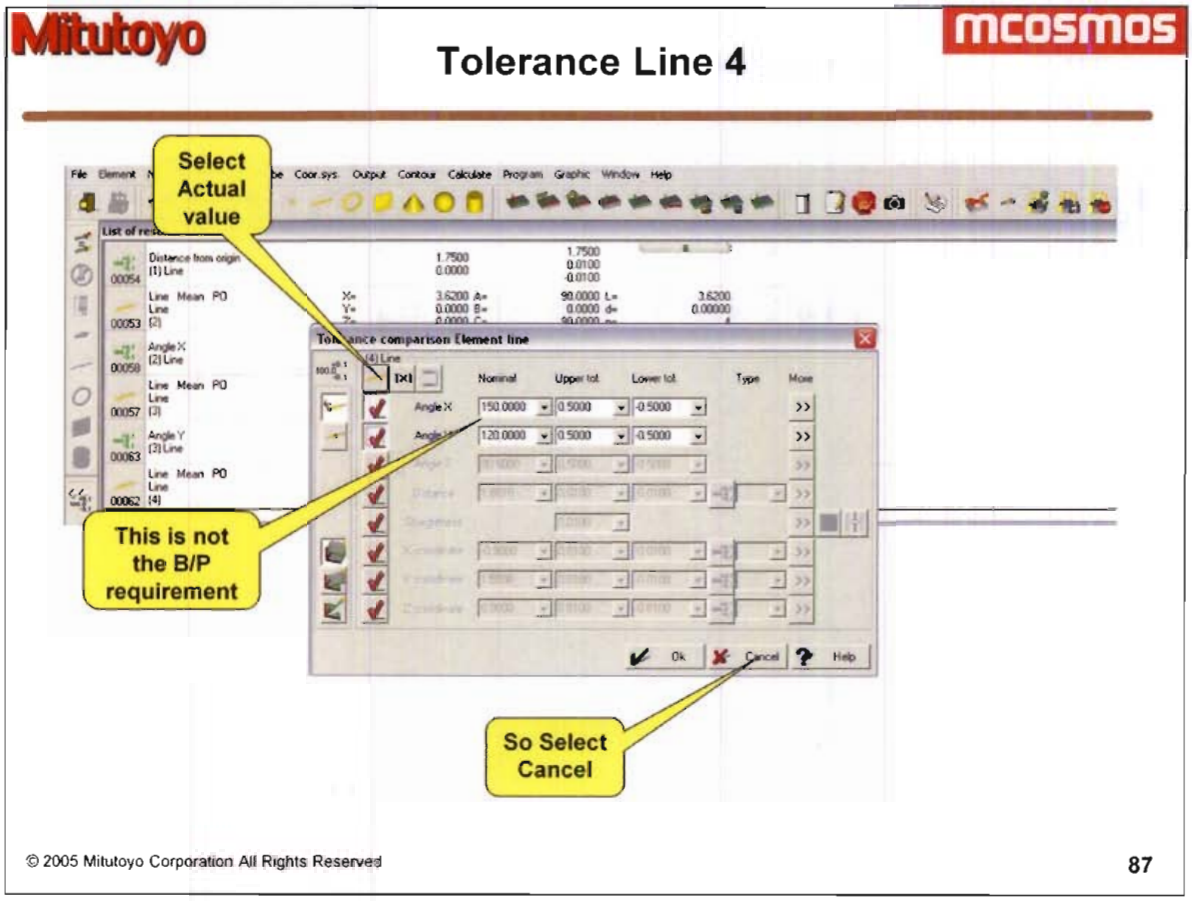
- Upon completion of measurement a tolerance dialog should open.
- Select Actual value.
- This value is not a B/P requirement. We will tolerance this feature later.
- Select Cancel.
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Collecting data on Line 4

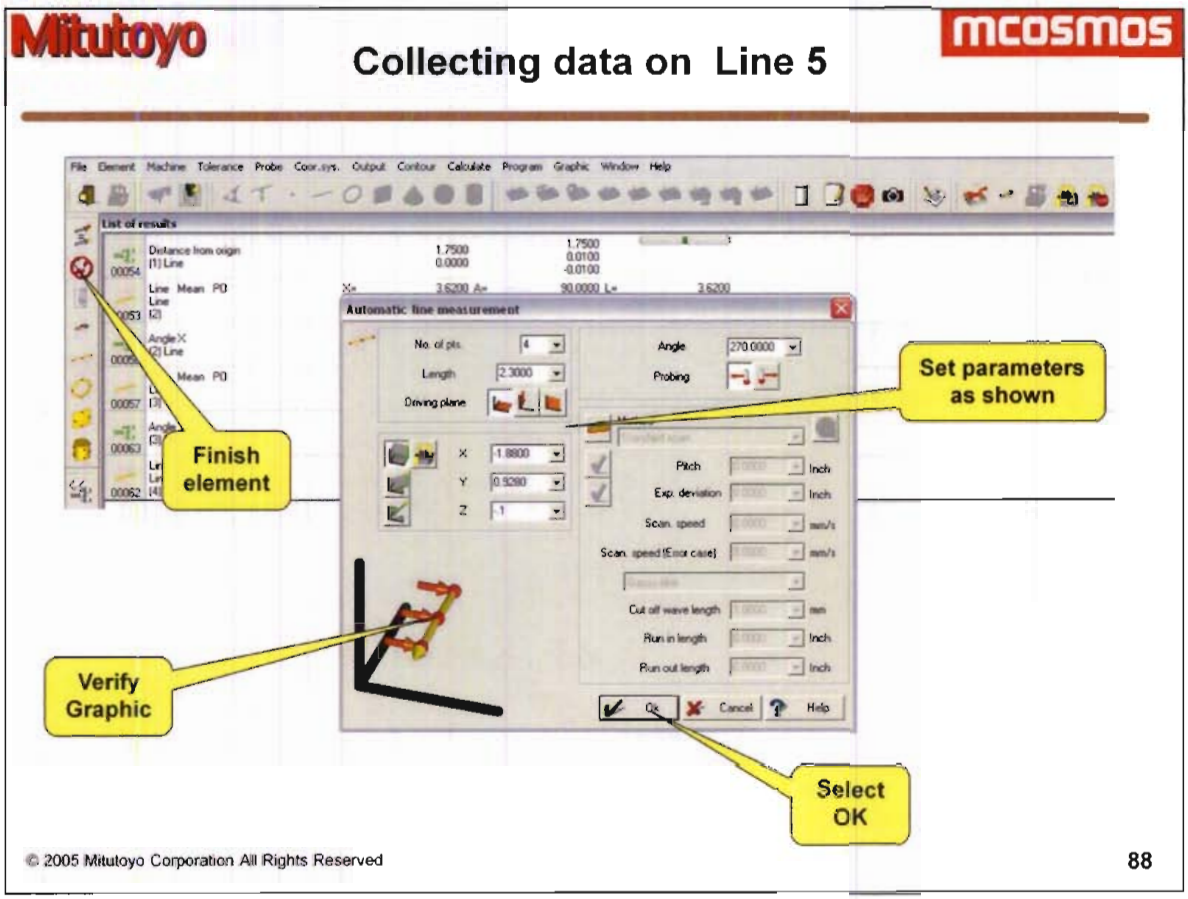


86

- Select the number of points to be measured on this line.
- Select the drive plane (a the plane parallel to the line and the retraction direction for that line.
- Define the start point.
- To avoid calculations place the probe approximately over the start point.
- Press position of machine to define the start point.
- Correct the Z axis location.
- Define Angle and probing.
- Select OK.
- Finish the element.
- _____
- _____
- _____
- _____



- Upon completion of measurement a tolerance dialog should open.
- Select Actual value.
- This value is not a B/P requirement. We will tolerance this feature later.
- Select Cancel.
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____



- Select the number of points to be measured on this line.
- Select the drive plane (a the plane parallel to the line and the retraction direction for that line.
- Define the start point.
- Define Angle and probing.
- Select OK.
- Finish the element.
- _____
- _____
- _____
- _____
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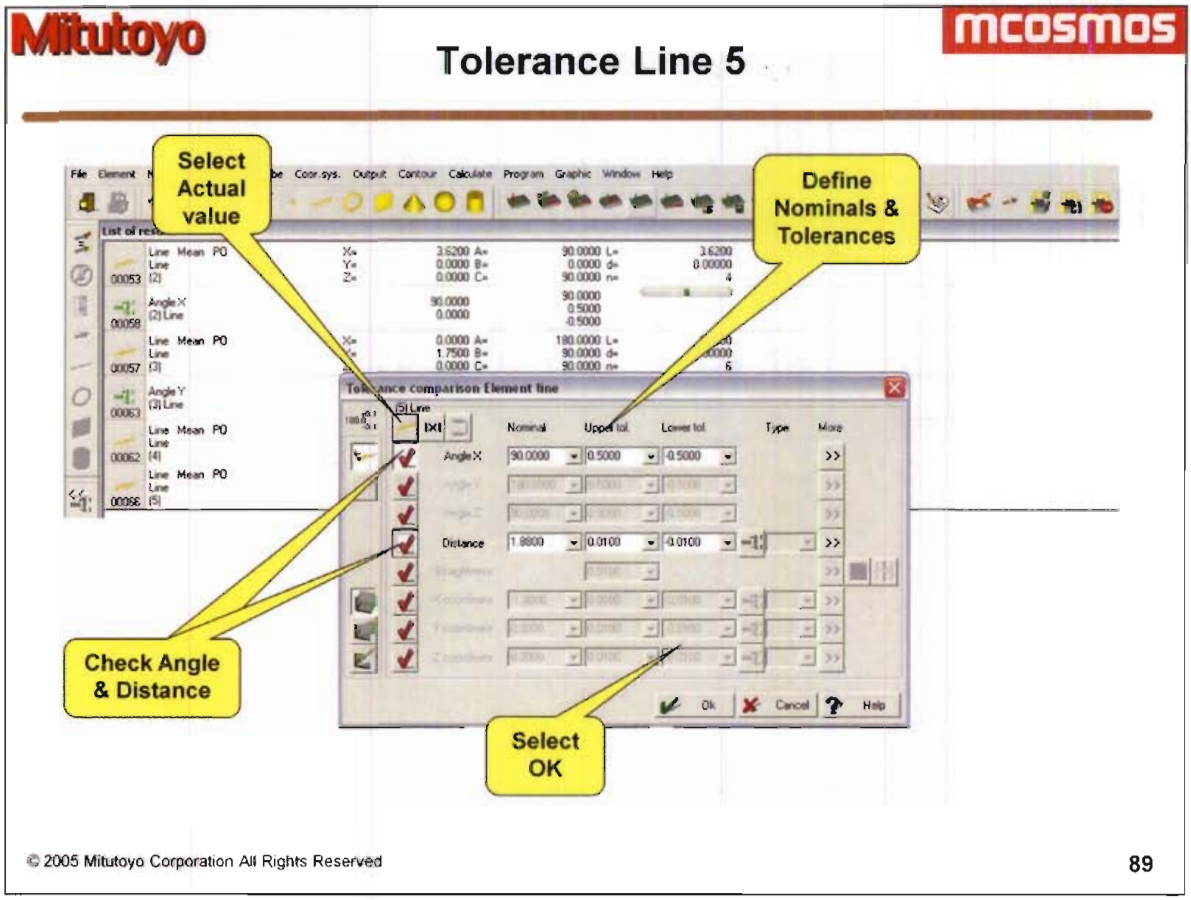
- _____



- Upon completion of measurement a tolerance dialog should open.
- Select Actual value.
- Check Angle, & Distance.
- Define Nominals & Tolerances.
- Prior to selecting OK in the tolerance dialog, Cancel the Automatic line measurement tool and the measurement display. Otherwise you will need to tolerance this line twice.
- Select OK.
- _____
- _____
- _____
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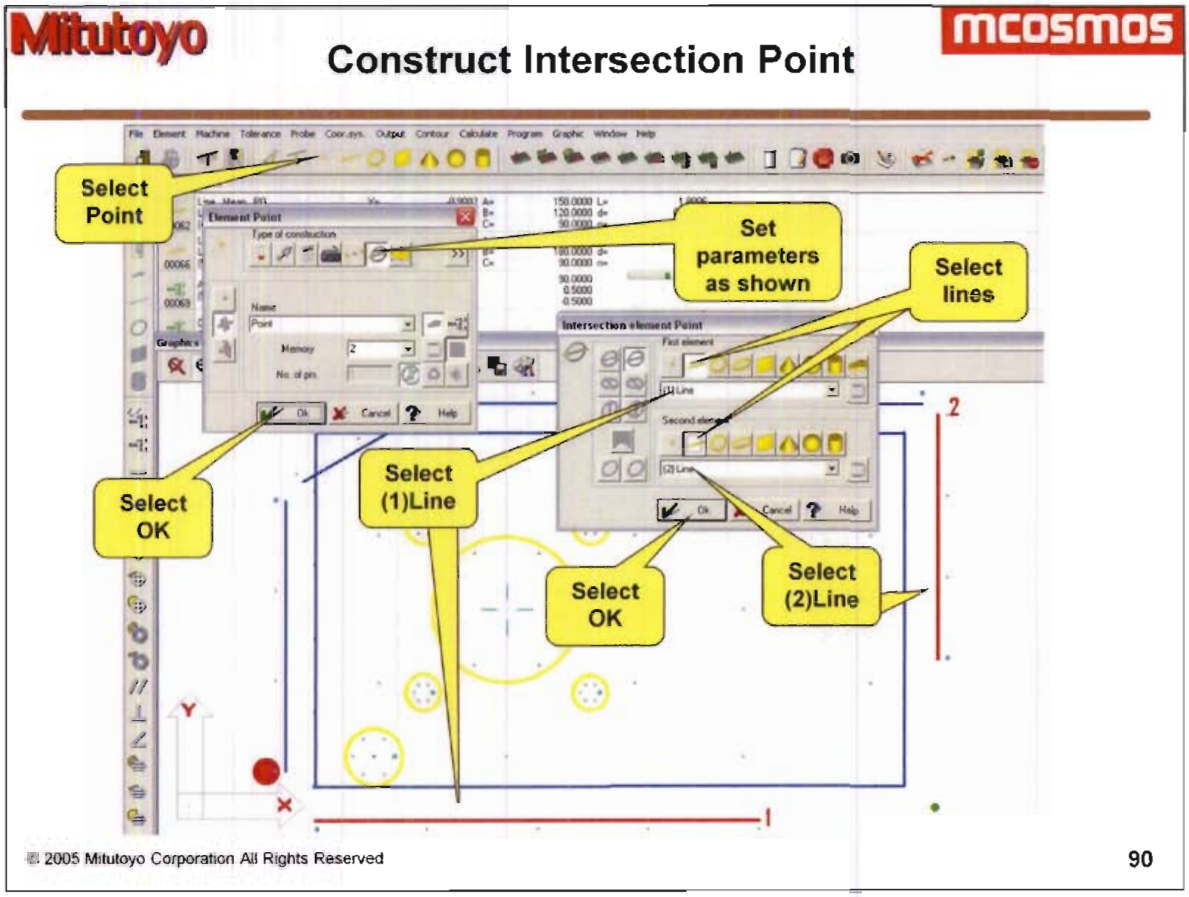
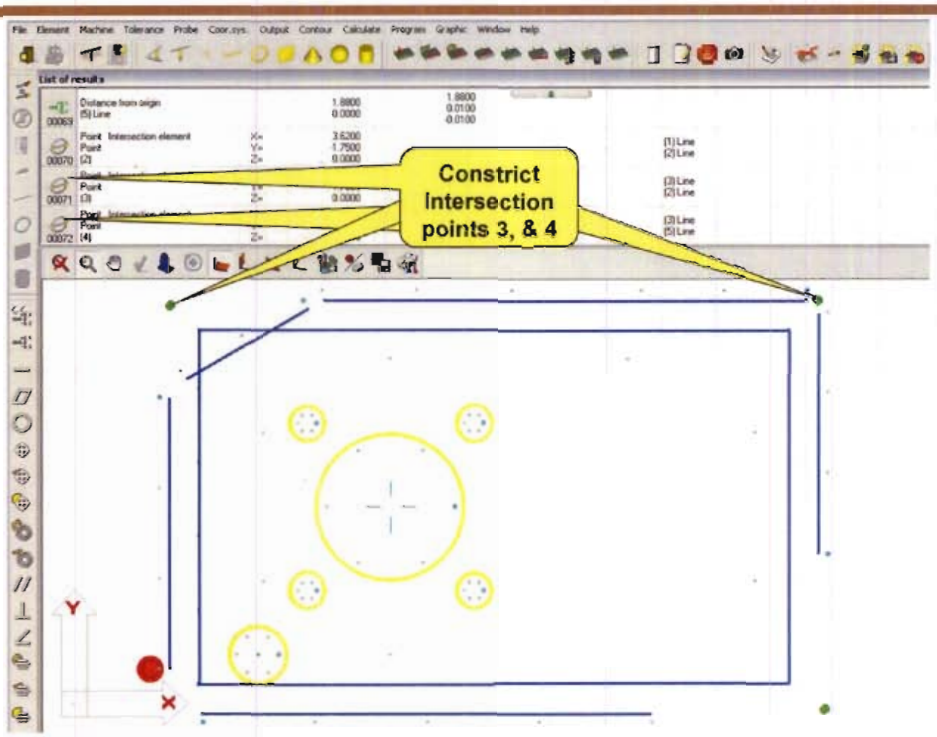
- _____



- To Tolerance the distance between 2 lines it is best to construct intersection points.
- Select Point.
- Set Parameters as shown.
- Select OK.
- The Intersection element dialog will appear Select Lines as element types.
- Select (1) Line and (2) Line.
- Select OK.
- Repeat with (2) Line & (3) Line, and (3)Line &(5) Line.
- _____
- _____
- _____
- _____

Construction Exercise



91

- Repeat with (2) Line & (3) Line, and (3)Line &(5) Line.
- _____
- _____
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- _____
- _____
- _____
- _____
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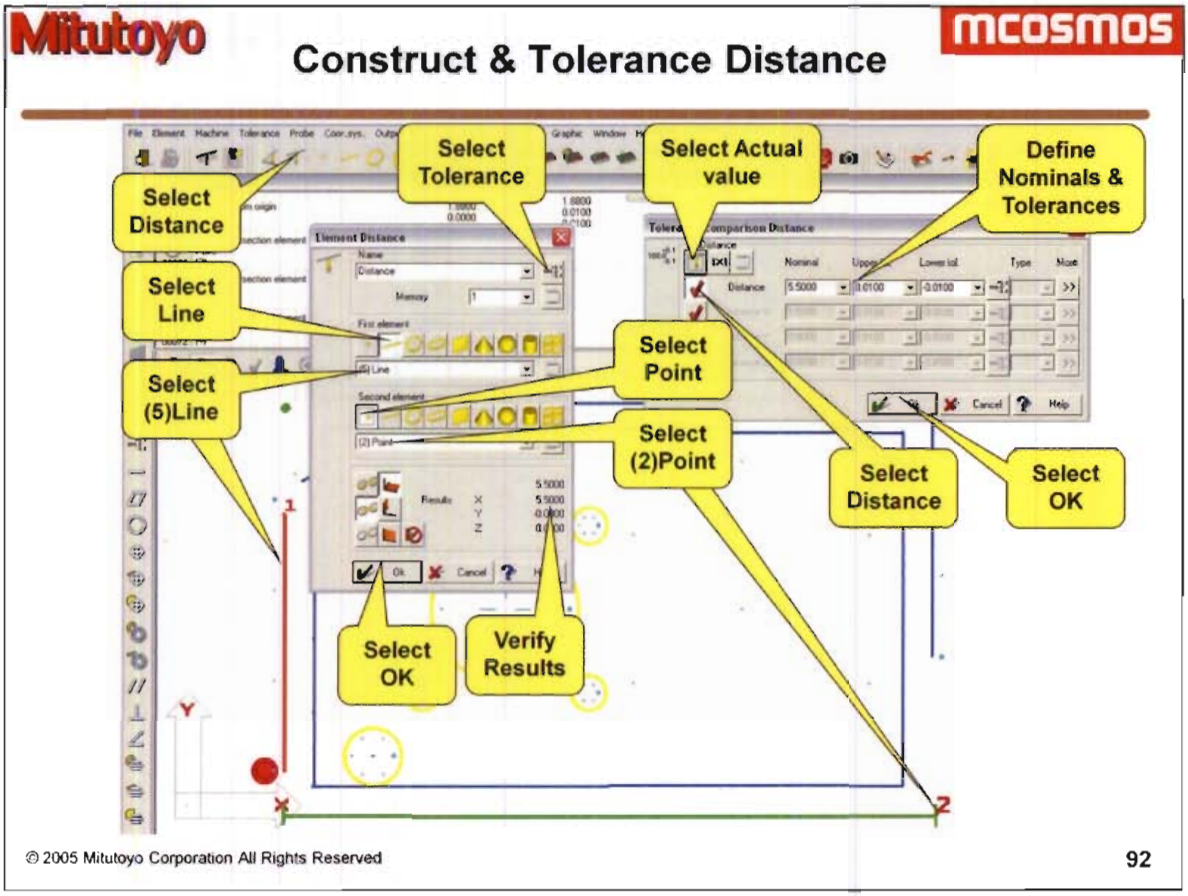
- _____
- _____
- _____
- _____



- Now you can construct & tolerance the distances Select Distance.
- Select Tolerance.
- Select Line and Point as Element type.
- Select (1) Line, and (3) Point.
- Select OK the Tolerance Distance Dialog will appear.
- Select Actual value.
- Check Distance.
- Define the Nominal and Tolerance.
- Select OK.
- Repeat with (1) Line & (4) Point, (5) Line & (2) Point, and (5) Line & (3) Point.
- _____
- _____

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Construct & Tolerance Distance Exorcize

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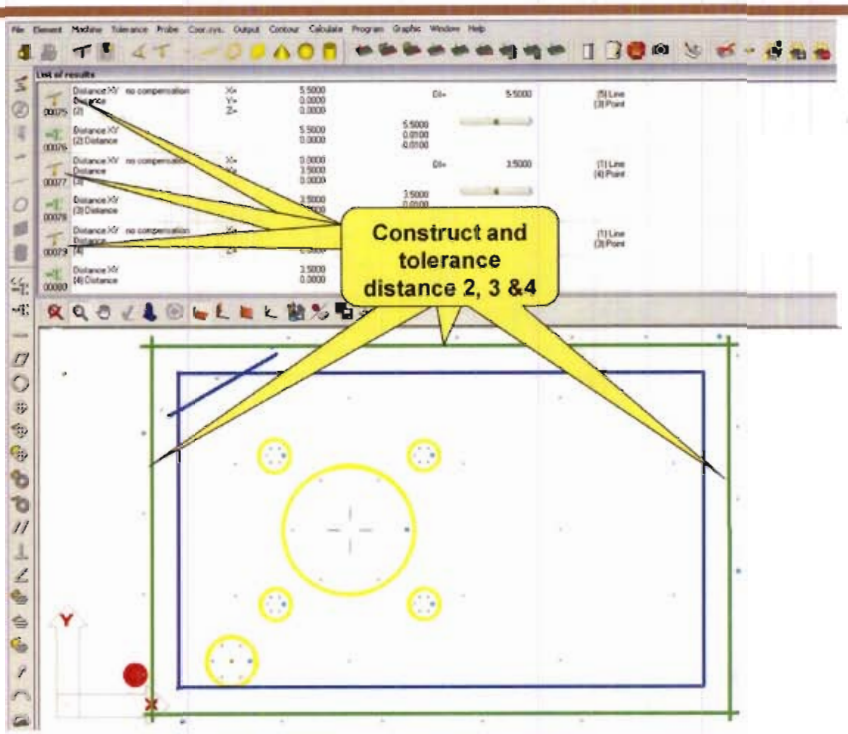

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- Repeat with (1) Line & (4) Point, (5) Line & (2) Point, and (5) Line & (3) Point.
- _____
- _____
- _____
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- _____
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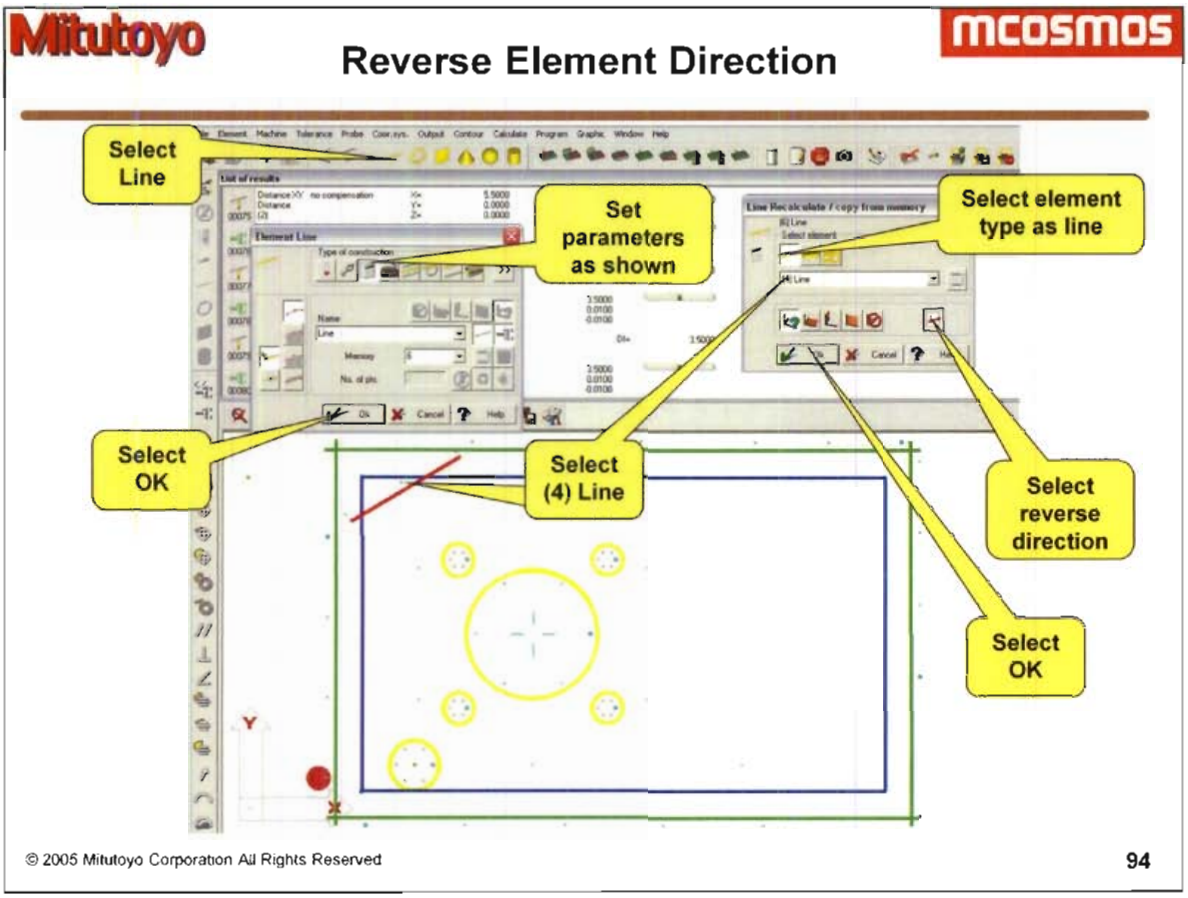
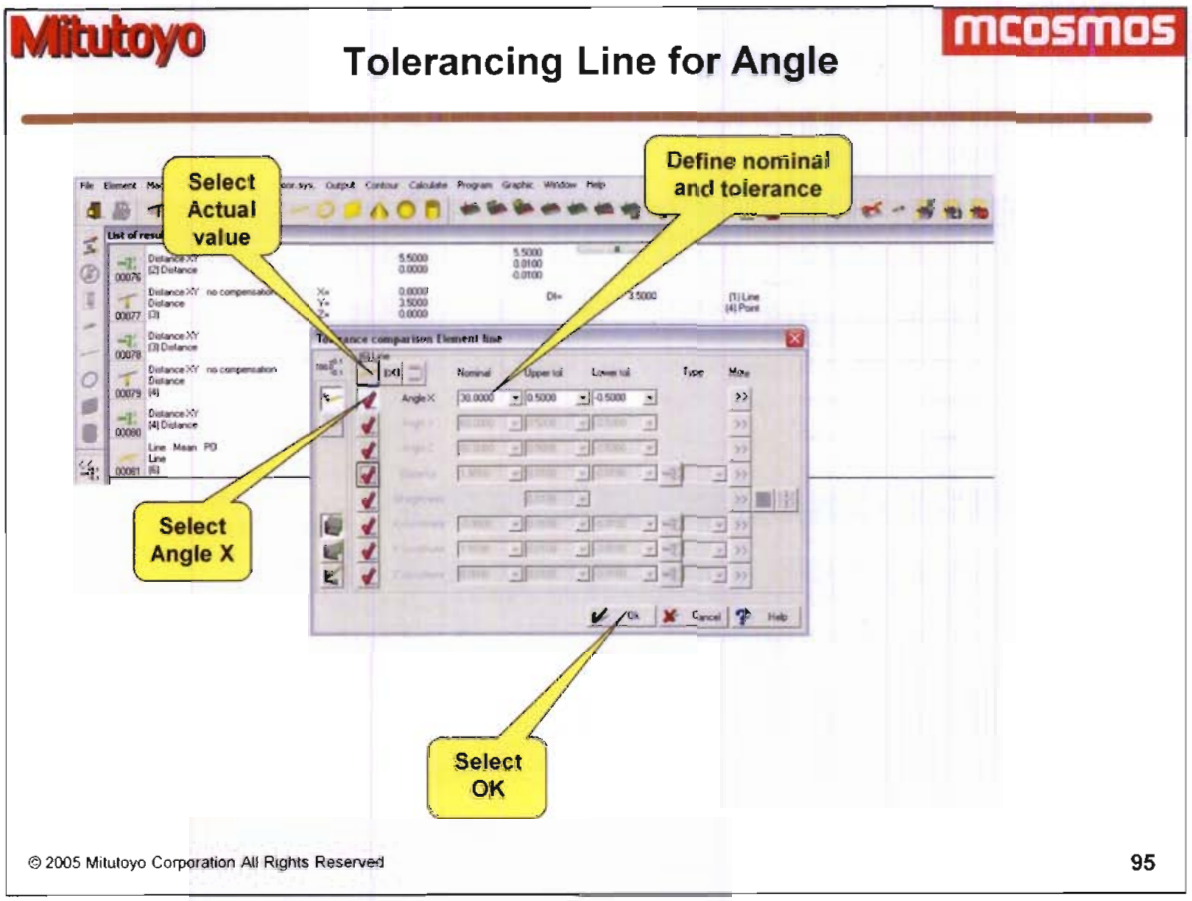
- _____
- _____



- When we measured (4) line the angle answers were not what the print required. To correct this we will reverse the direction of the line.
- Select Line.
- Set parameters as shown (memory recall).
- Select OK Line. Recalculate \ copy from memory dialog will appear
- Select line as element type.
- Select (4) line (the 30 deg line).
- Select reverse direction option.
- Select XY projection this option is not necessary but simplifies tolerancing.
- Select OK.
- _____
- _____
- _____



- Because we had tolerance selected a line tolerance dialog will open.
- Select Actual value.
- Select Angle X.
- Define nominal and tolerance .
- Select OK.
- _____
- _____
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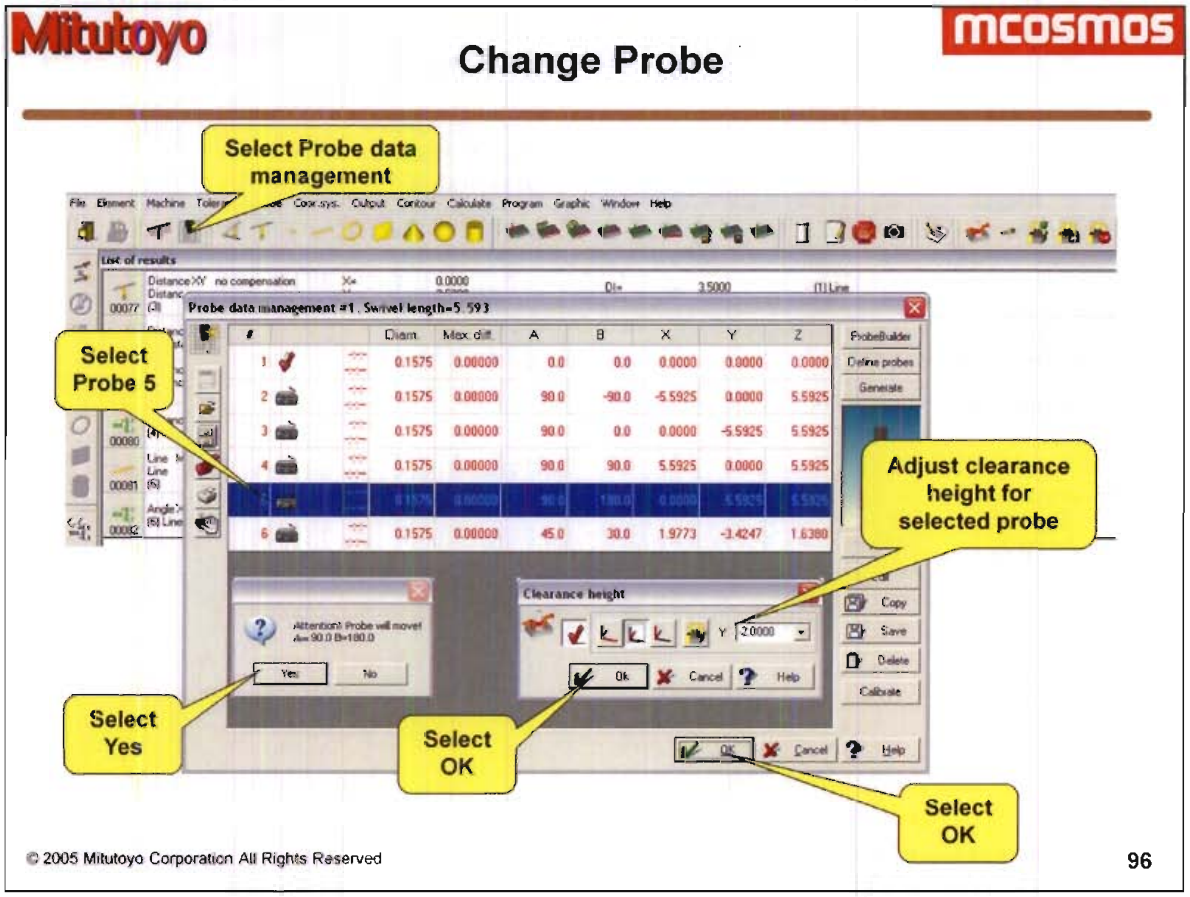

- We have now inspected all of the features that we inspected manually.
- On a CNC machine we inspect features on multiple sides of the part.
- To do so we need to change the probe. Select the change probe icon.
- Select the appropriate probe. In this case probe 5.
- Select OK
- You will be warned that the probe will move if safe select Yes.
- After any alignment adjustment or probe change with Clearance height set you will be prompted to adjust your Clearance height.
- If Clearance height needs to be adjusted adjust it.
- If Clearance height is to remain the same you should cancel to avoid duplicate lines in your part program.
- In this case we will change it to the Y axis and -2.000.
-

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Partial Circle

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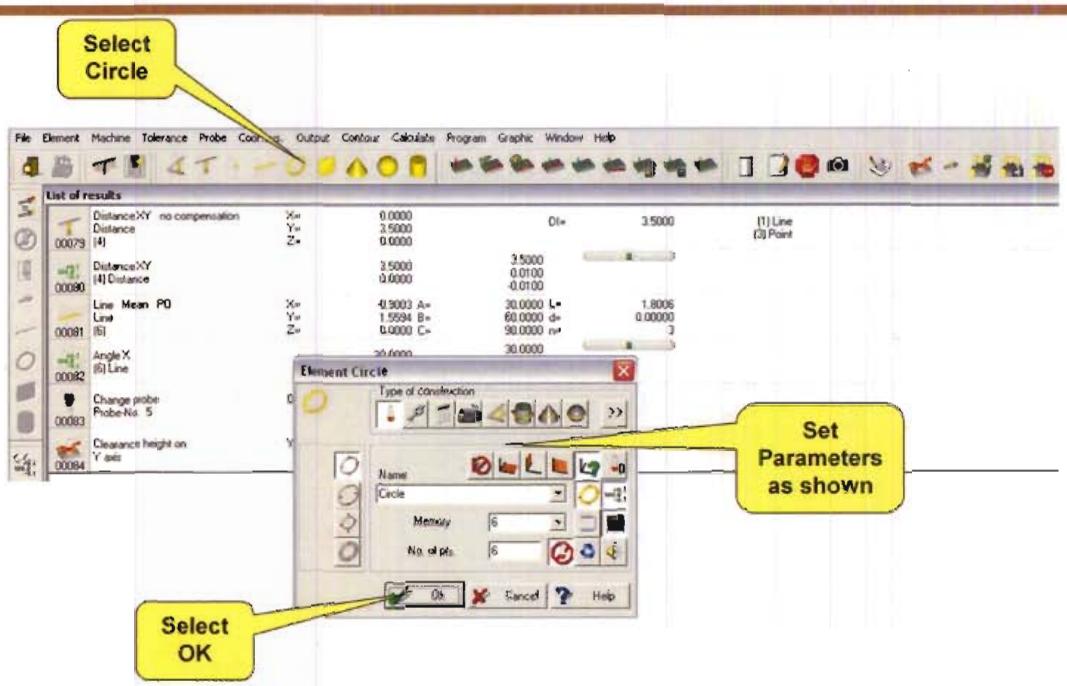

- We will now check 1 of the partial circles on the front of the part.
- Clearance height will take care of GOTO moves.
- Automatic projection will take care of projection.
- Set parameters as shown.
- Select OK.
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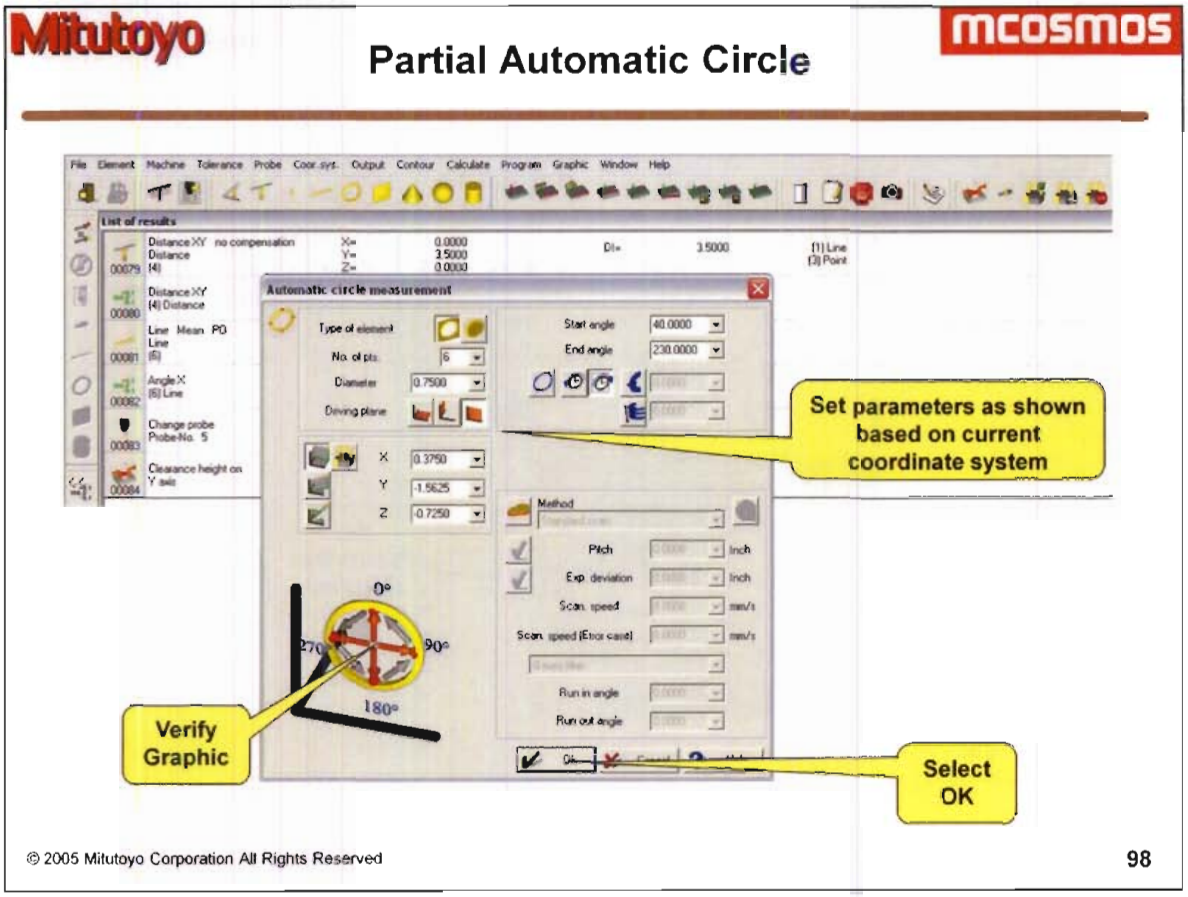
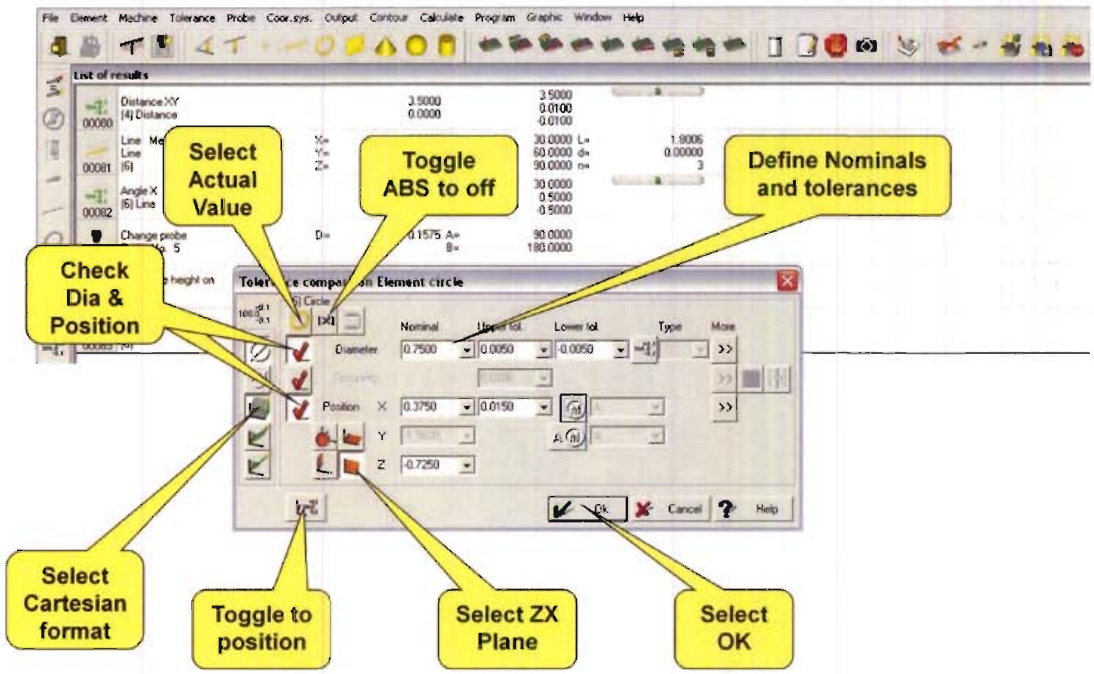
- _____



- Set the parameters as shown.
- Your Y axis value defines the measurement depth in the current coordinate system.
- Note the start angle allows for misallocation within tolerance.
- Verify Graphic.
- Select OK.
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Tolerance Circle 6 ZX Position



99

- If the dialog is not in position format toggle to position.
- Select Cartesian format.
- Select Actual Value.
- Select Diameter and Position with the red checkmarks.
- Select the ZX plane for tolerancing position .
- Define Nominals and tolerances.
- Select OK.
- _____
- _____
- _____
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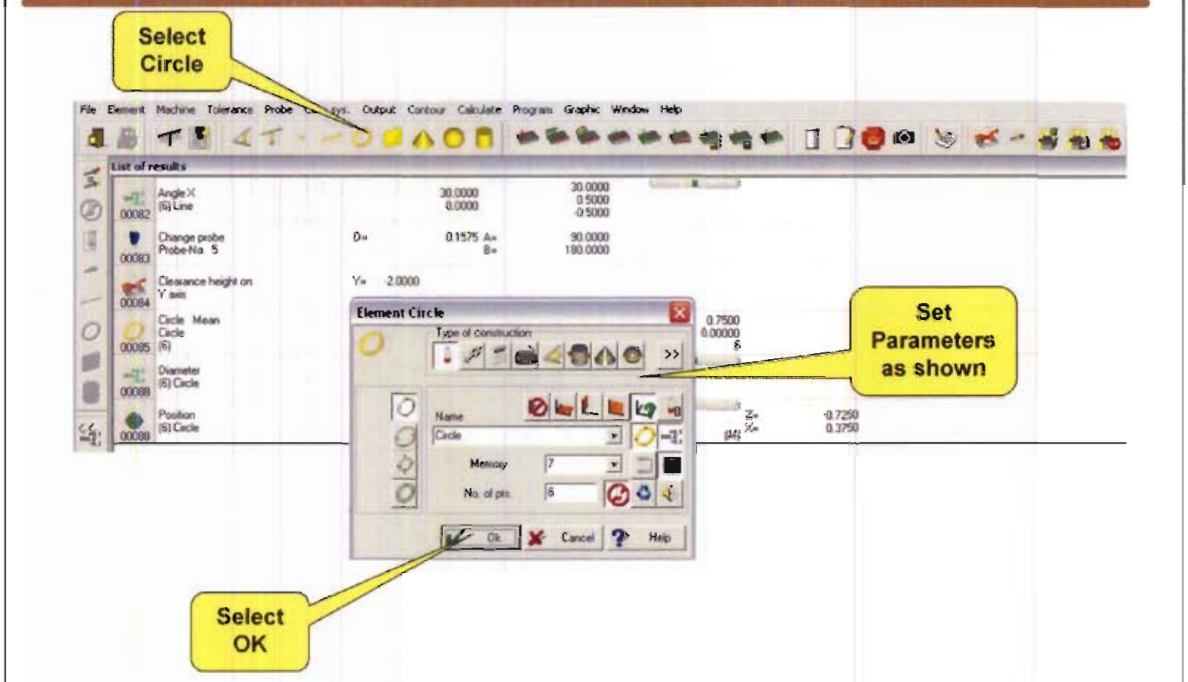
- _____
- _____

Partial Circle



- We will now check the second of the partial circles on the front of the part.
- Clearance height will take care of GOTO moves.
- Automatic projection will take care of projection.
- Set parameters as shown.
- Select OK.
-
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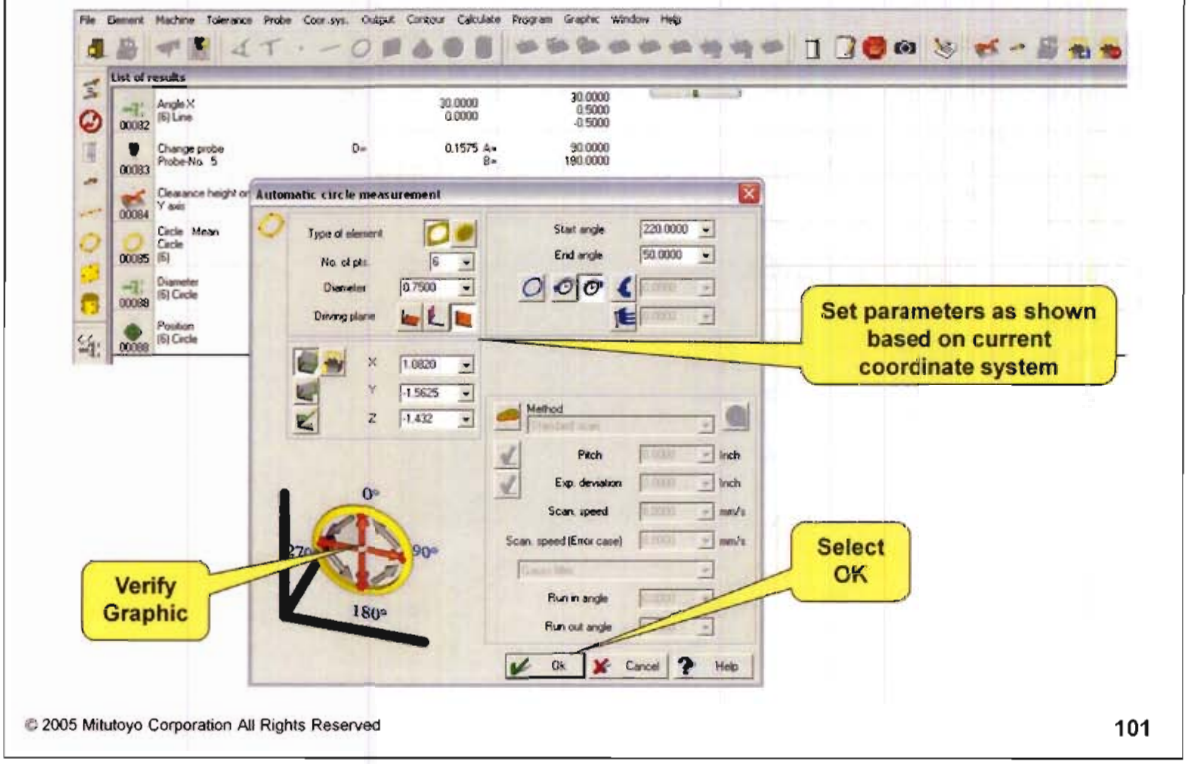
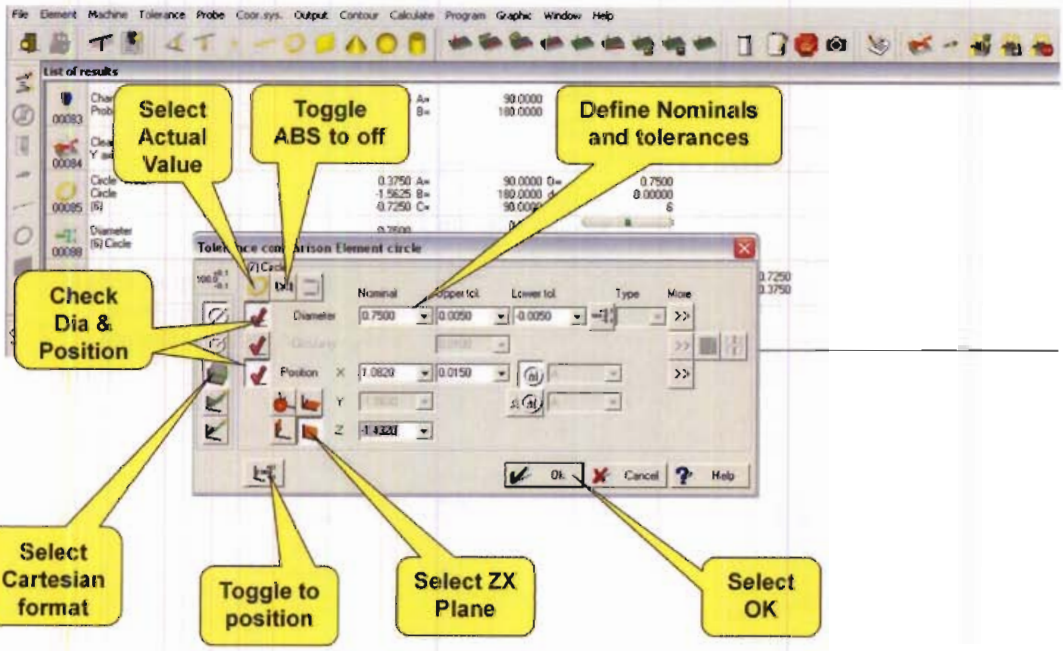
-
-
-

Partial Automatic Circle



- Set the parameters as shown.
- Your Y axis value defines the measurement depth in the current coordinate system.
- Note the start angle allows for misallocation within tolerance.
- Verify Graphic.
- Select OK.
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Tolerance Circle 6 ZX Position



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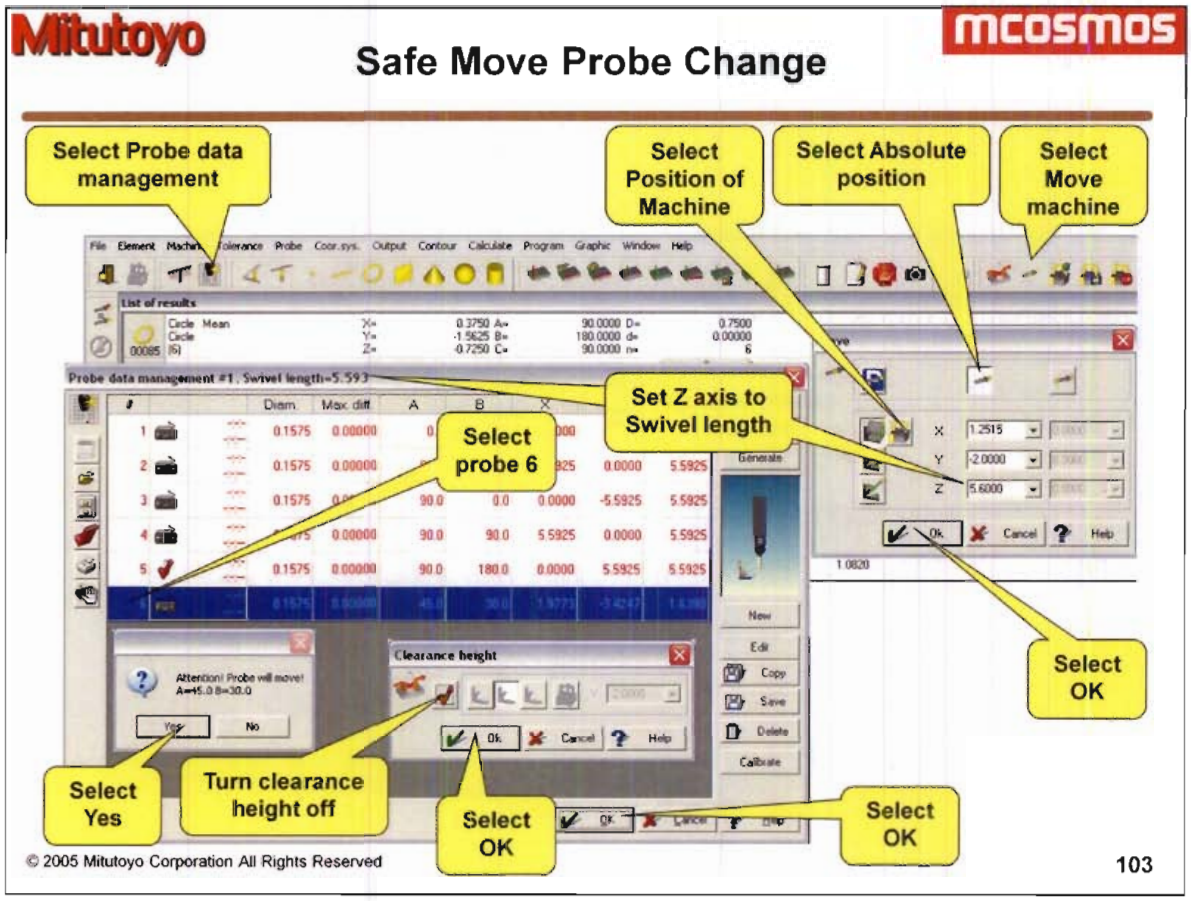
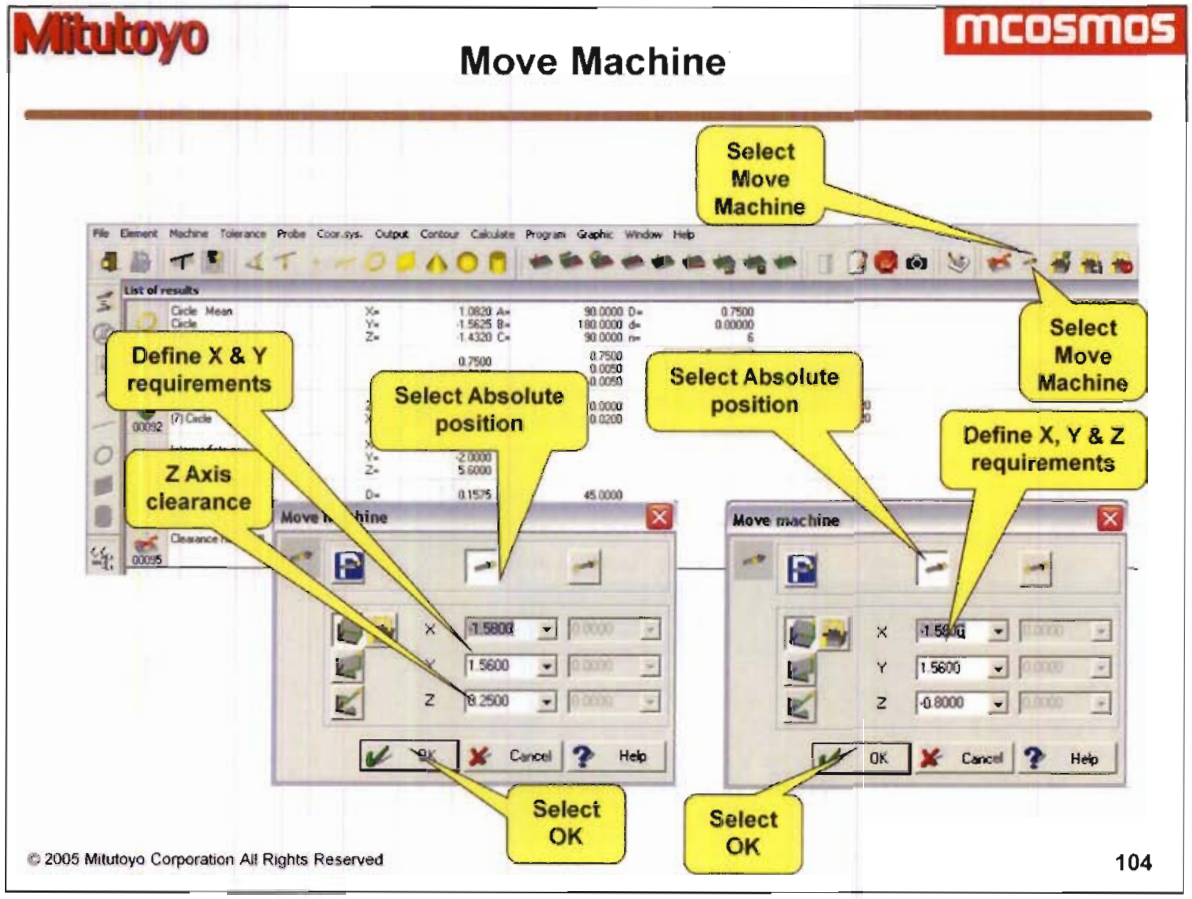
- If the dialog is not in position format toggle to position.
- Select Cartesian format.
- Select Actual Value.
- Select Diameter and Position with the red checkmarks.
- Select the ZX plane for tolerancing position .
- Define Nominals and tolerances.
- Select OK.
- _____
- _____
- _____
- _____
- _____
- _____



- If we change our probe here it may hit the table.
- We will make a safe move first. Select Move machine.
- Select Absolute position and position of machine.
- To find a safe location for a probe move select Change probe.
- Set the Z axis value to your swivel length.
- Select OK for the machine to move.
- Select the desired probe. In this case probe 6.
- Select OK
- Select Yes to allow the probe to move.
- Adjust clearance height as required. In this case turn clearance height cff.
- Select OK
- _____
- _____



- Our next topic is a Compound angle hole .
- Move the probe close to the hole.
- Move the probe to the hole entry (Pearce Point).
- _____
- _____
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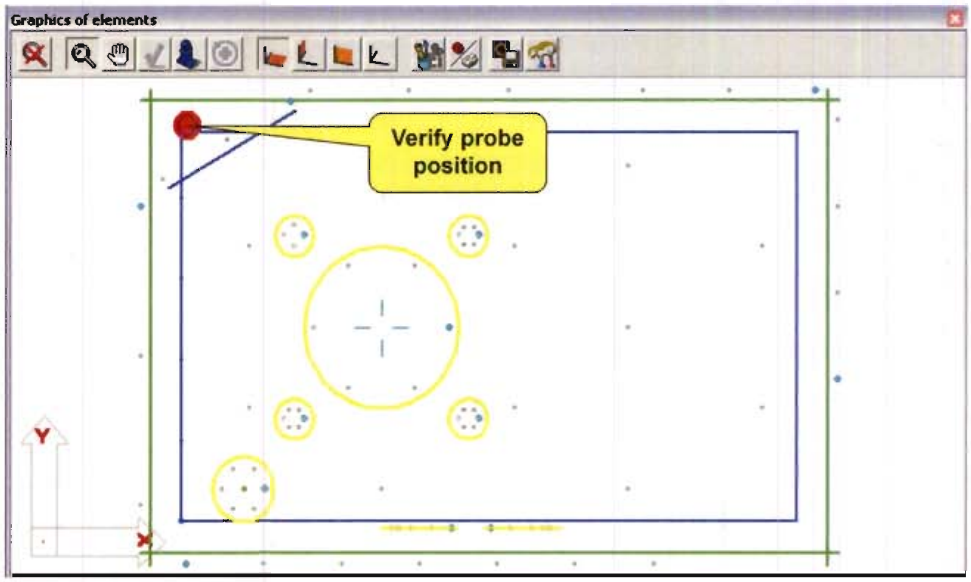
Verify Move

mcosmos



- Verify probe position graphically and on the machine.
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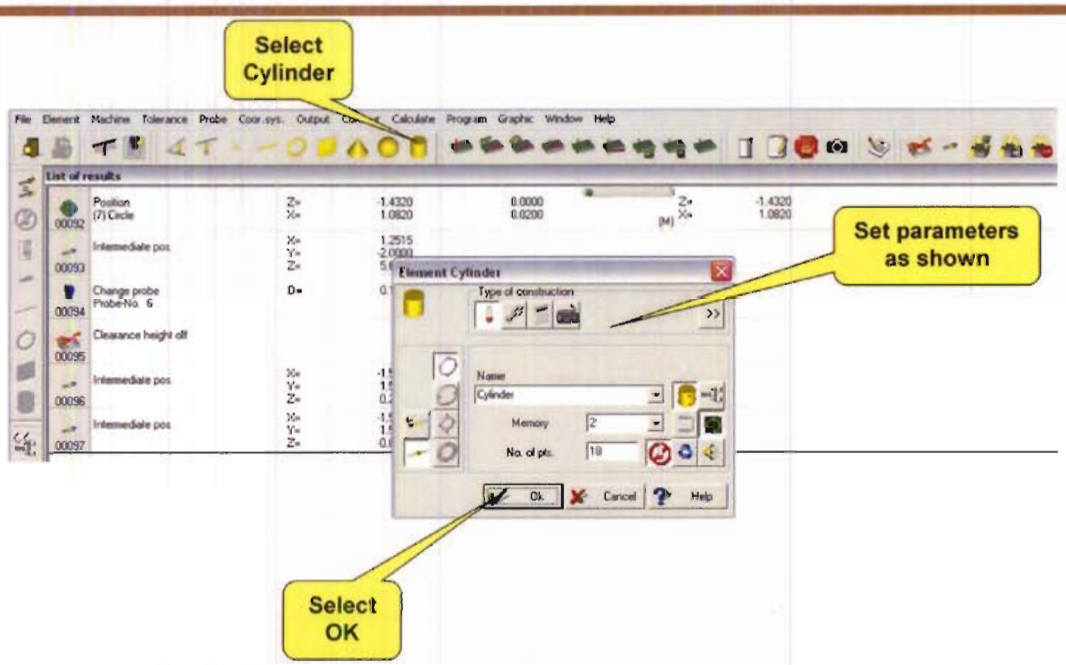
Cylinder at Compound Angle

mcosmos



106

- Select Cylinder.
- Set parameters as shown.
- Select OK.
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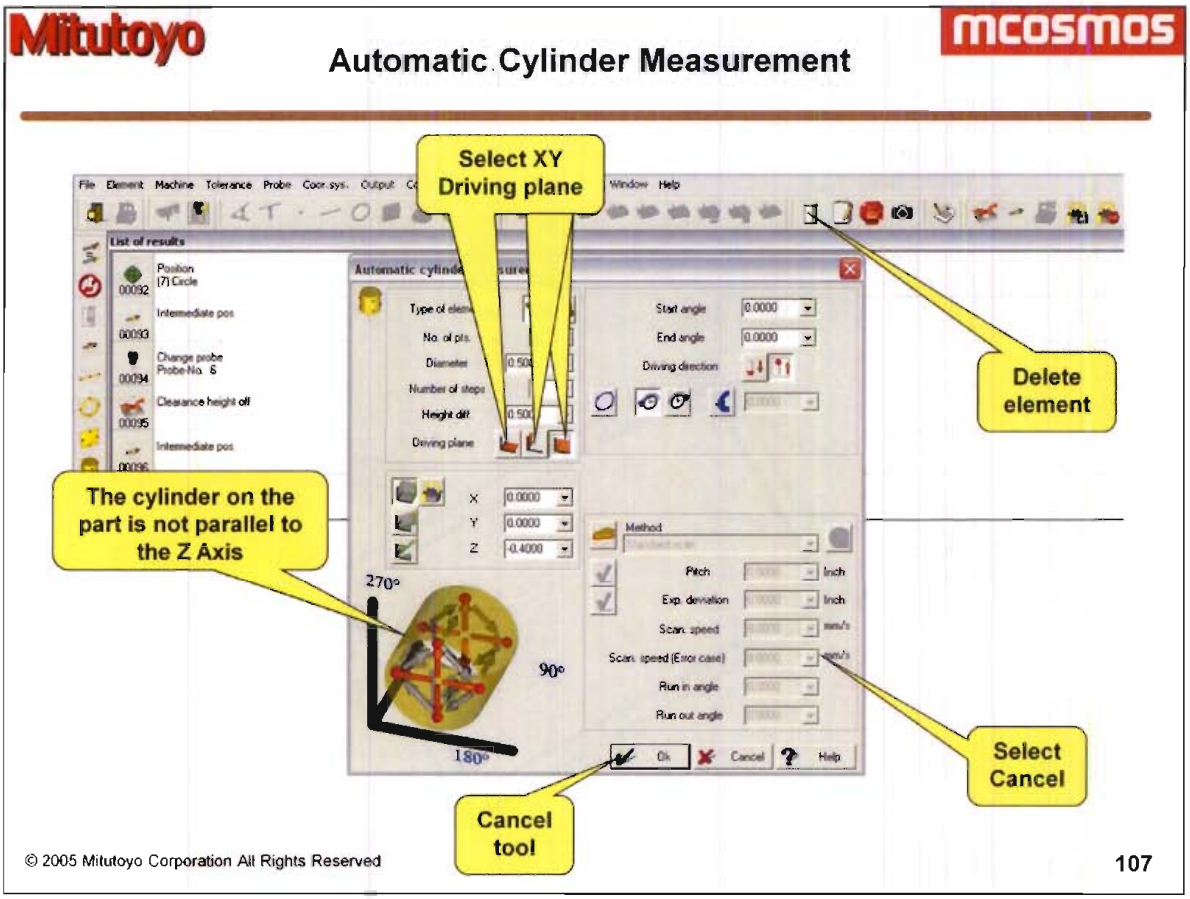

- Select XY Driving plane.
- Note: the axis of the cylinder on the part doesn't match the graphic.
- Select YZ Driving plane.
- Note: the axis of the cylinder on the part doesn't match the graphic.
- Select ZX Driving plane.
- Note: the axis of the cylinder on the part doesn't match the graphic.
- There for we can not use the Automatic Cylinder. So Cancel.
- That leaves Calculating points and vectors, or using the Joy stick
- Both poor choices. So cancel the element.
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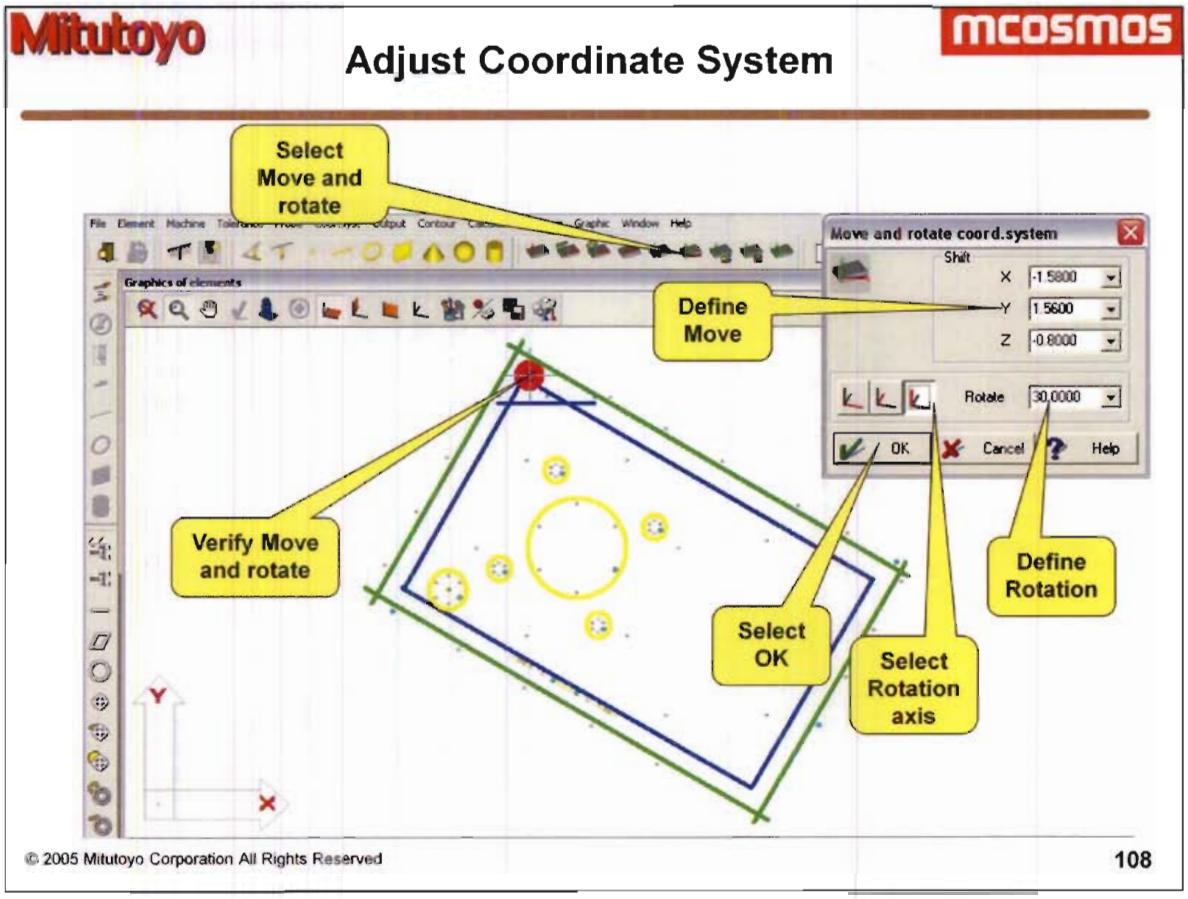

- We can move and rotate the part per the print requirements to make the theoretical axis of the hole parallel to our coordinate system.
- To move and rotate your coordinate system select Move and rotate.
- Define the move and rotate values based on the print requirements.
- Select OK.
- Use the Graphics of elements to verify the move and rotation.
- This may require multiple views.
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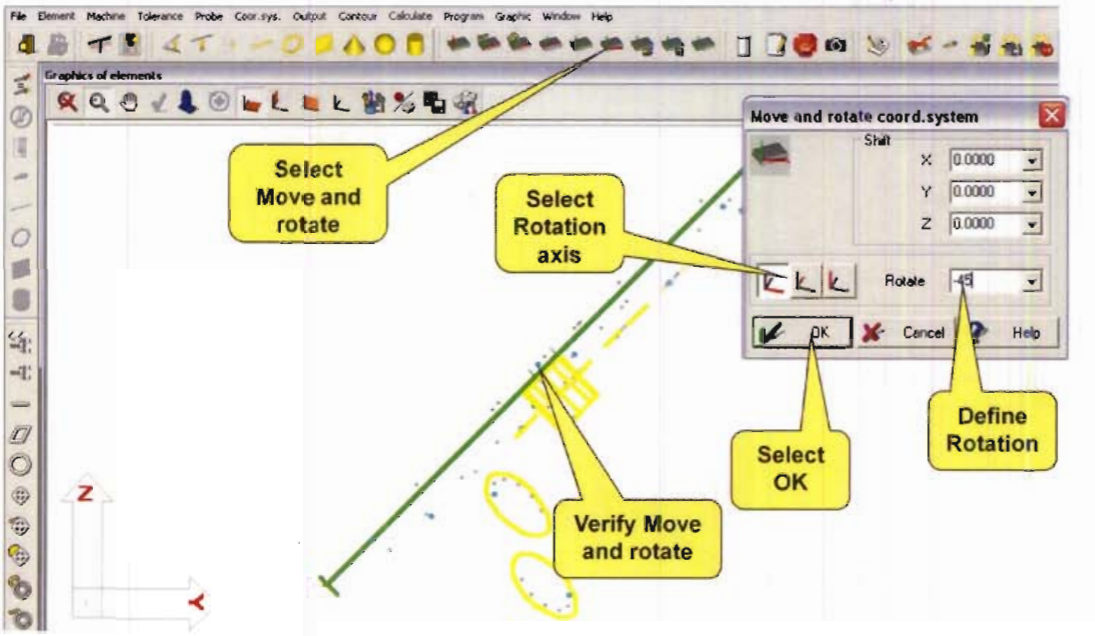
Adjust Coordinate System 2



109

- To rotate the 2nd axis of your coordinate system select Move and rotate.
- Select the 2nd axis Define the rotate value based on the print requirements.
- Select OK.
- Use the Graphics of elements to verify the move and rotation.
- This may require multiple views.`
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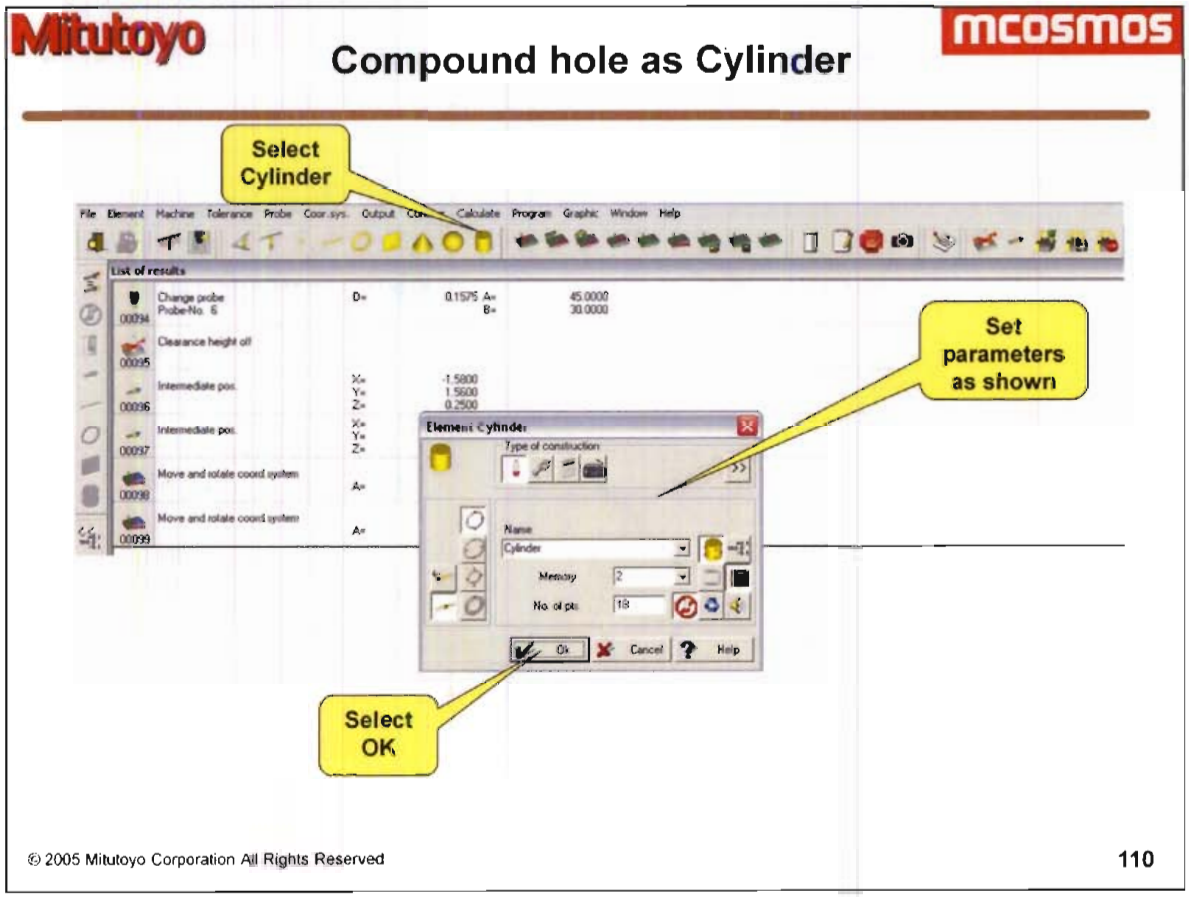

- Now with the coordinate system adjusted we can easily measure the cylinder.
- Select Cylinder from the toolbar.
- Set the parameters as shown.
- Select OK.
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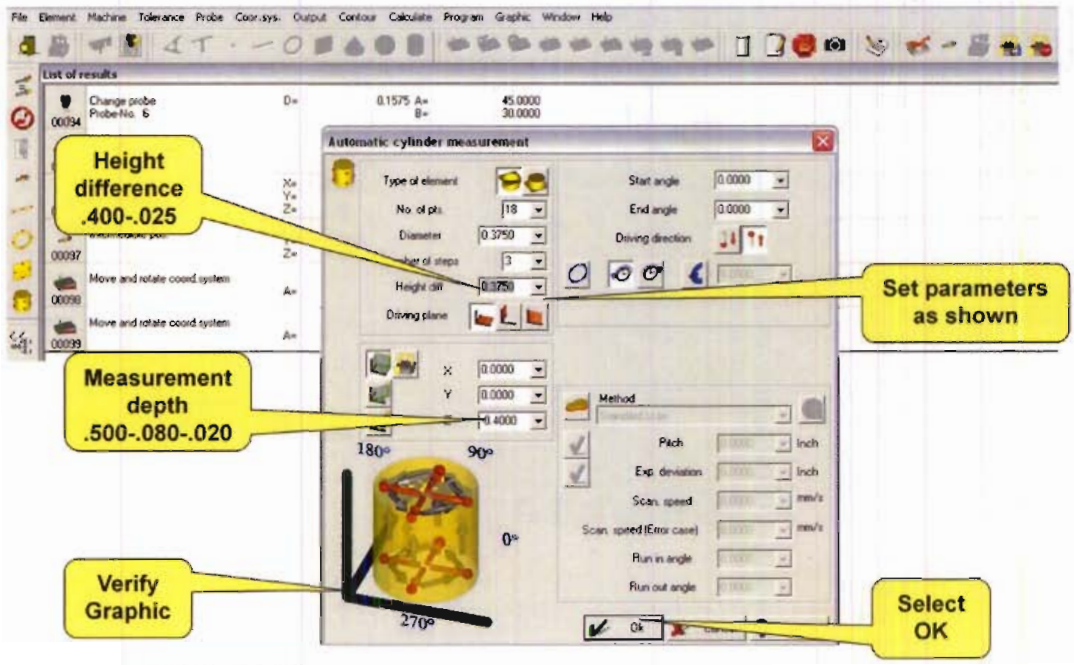
Compound hole as Cylinder



111

- Set the parameters as shown.
- The 3rd axis of the driving plane (Z axis) should be the lesser of, effective working length or the hole depth - probe radius - depth tolerance - a safety margin.
- Height deference is the distance from the measurement depth to the opposite end of the hole – a safety margin.
- We want to spread our points over the longest length possible to minimize projection errors.
- Select OK.
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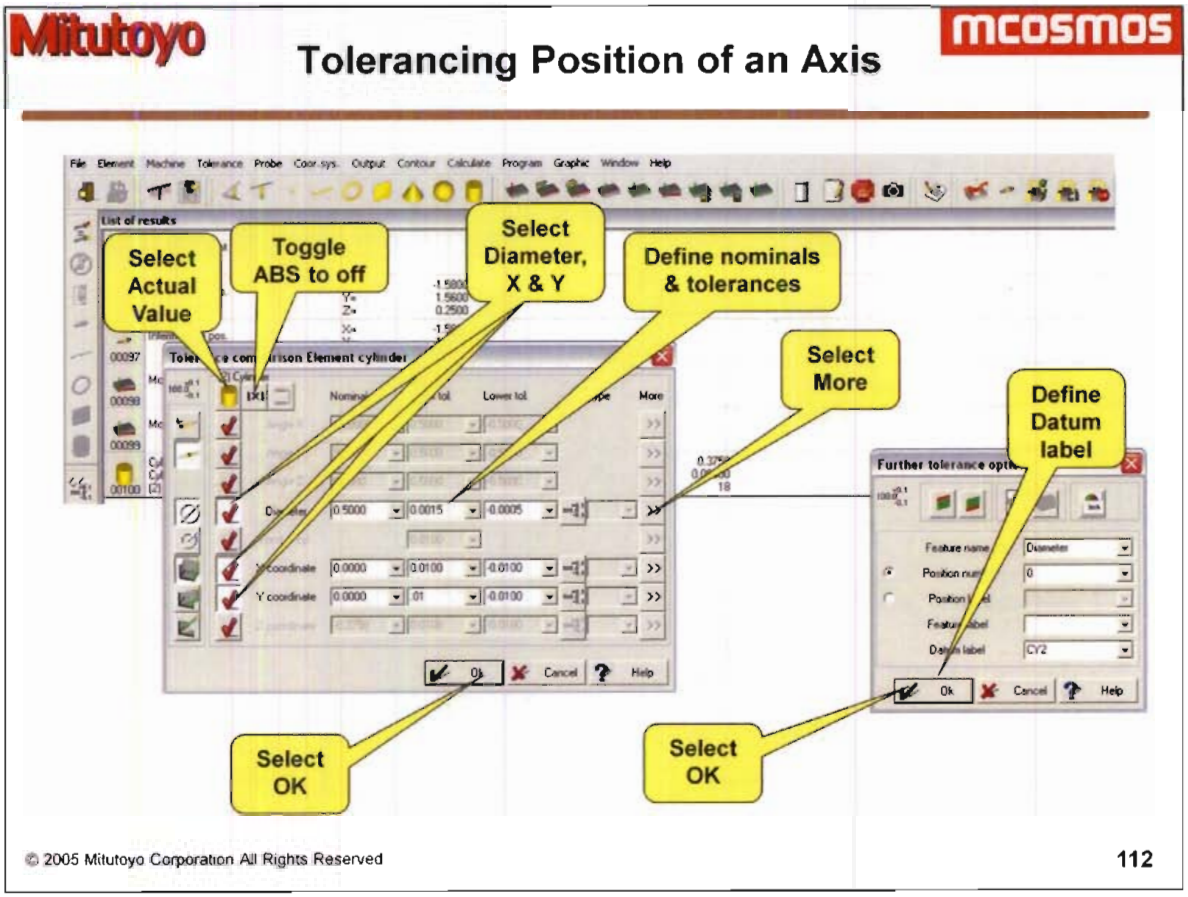

- The tolerance dialog will open.
- Select Actual values.
- Toggle Absolute value off.
- As we found earlier Position of an axis does not report the actual location of the feature.
- Select Diameter, X Coordinate and Y coordinate.
- Define nominals and tolerances.
- Select More tolerance options.
- Define a datum label. This is necessary should you apply MMC.
- Select OK in the More tolerance options dialog.
- Select OK in the tolerance dialog.
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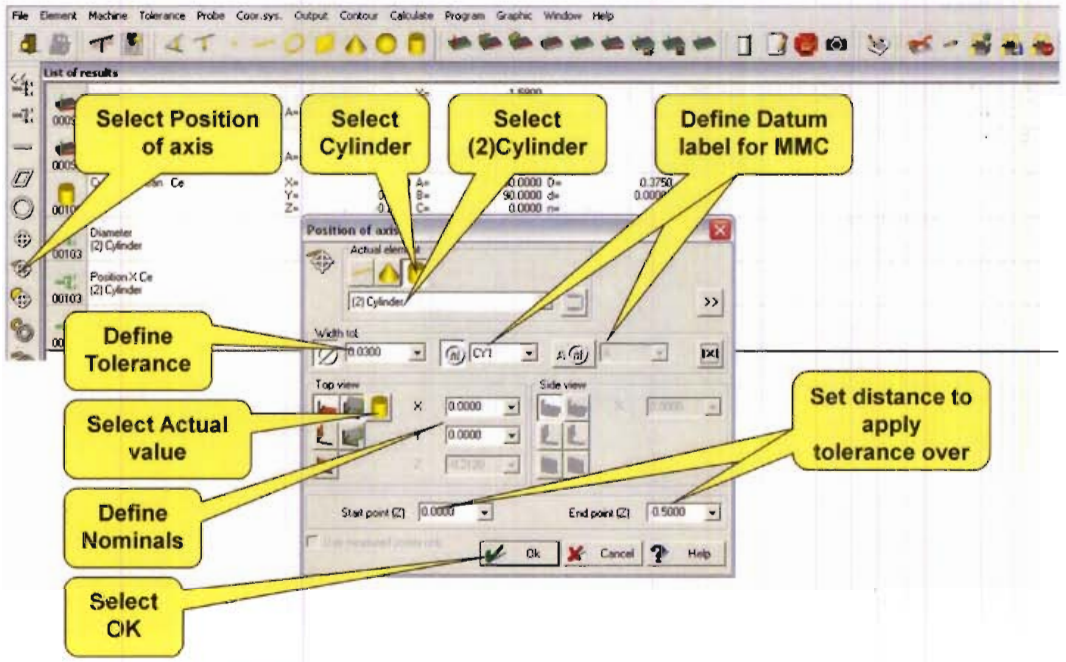
Tolerancing Position of an Axis



113

- To tolerance a Cylinder for True Position select Position of an axis.
- The position of an axis dialog will appear.
- Select Cylinder as the actual element type.
- Select (2) Cylinder in the pull down dialog. This selection can also be made in the graphics window.
- Define the tolerance.
- Select the datum label to apply MMC.
- Define the nominal location.
- Set the length of the feature to define the portion of the feature that the tolerance zone applies over.
- Select OK.
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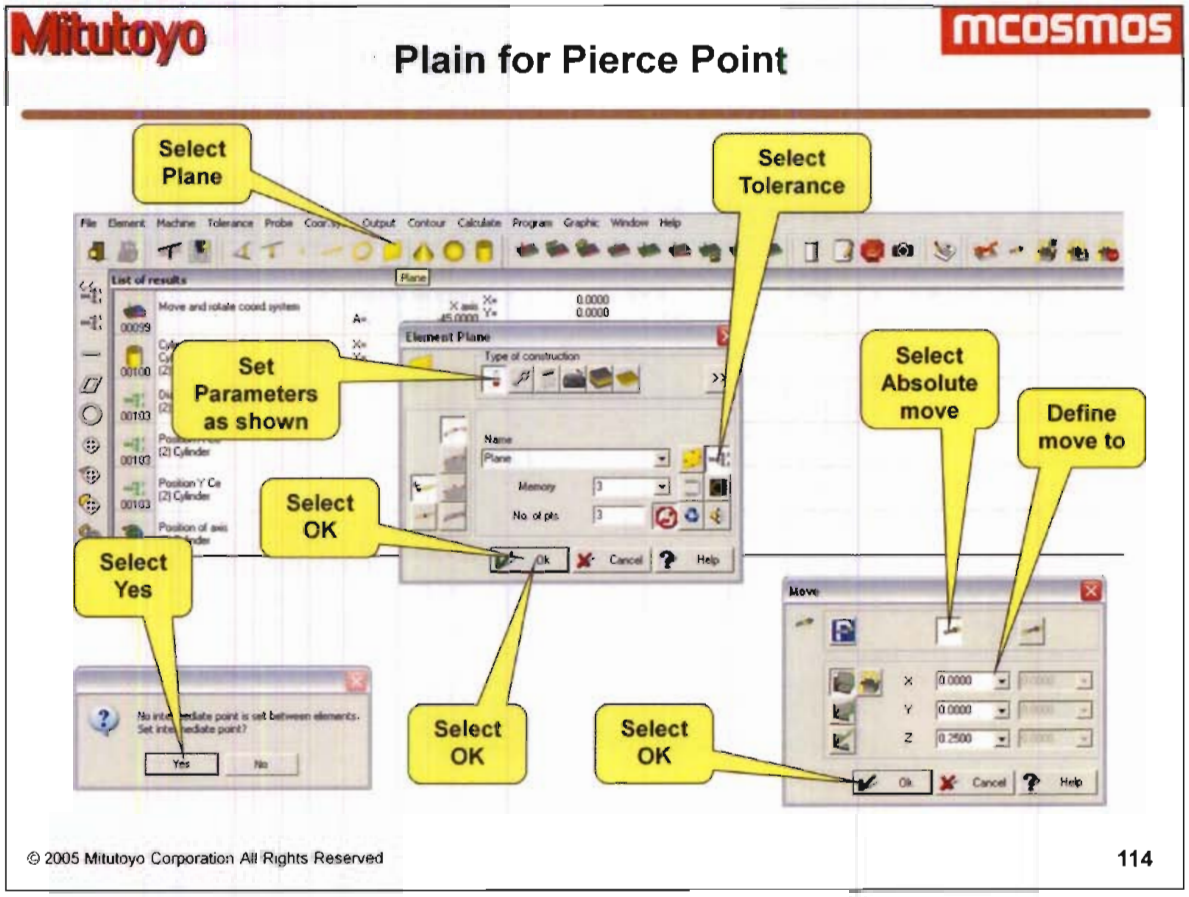
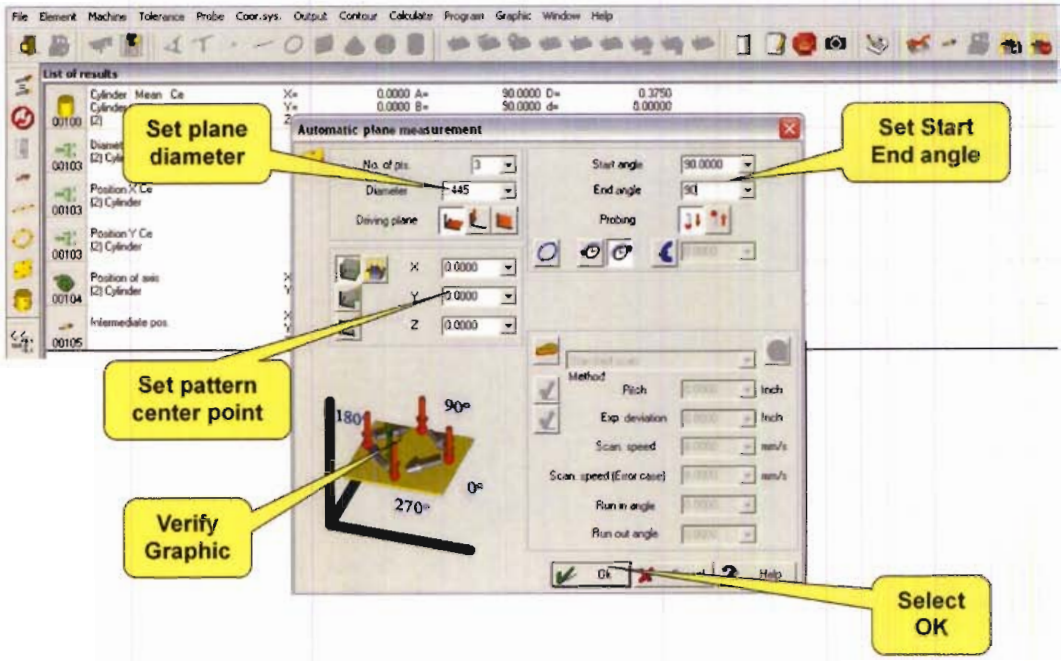


- The print requirement is for the pierce point.
- We will measure a plane and intersect it with the cylinder to collect the pierce point.
- Select Plane.
- Set parameters as shown.
- Be sure to set tolerancing to evaluate the profile of .010 of the plane.
- Select OK.
- When we select OK we are ask to set an intermediate point.
- We are ask this because we have turned clearance height off.
- Select Yes. As the machine will crash if we don't a move dialog opens.
- Select an absolute move.
- Define the move machine (Go To) point.
- Select OK in the move machine dialog.
- Select OK in the Element Plane dialog.

Automatic Plane Measurement



115

- Automatic Plane measurement dialog will open.
- Set diameter (hole dia. + tolerance of size + tolerance of position + edge brake + safety factor).
- Set pattern center point per the current coordinate system.
- Set stare end angle for maximum clearance.
- Verify graphic.
- Select OK.
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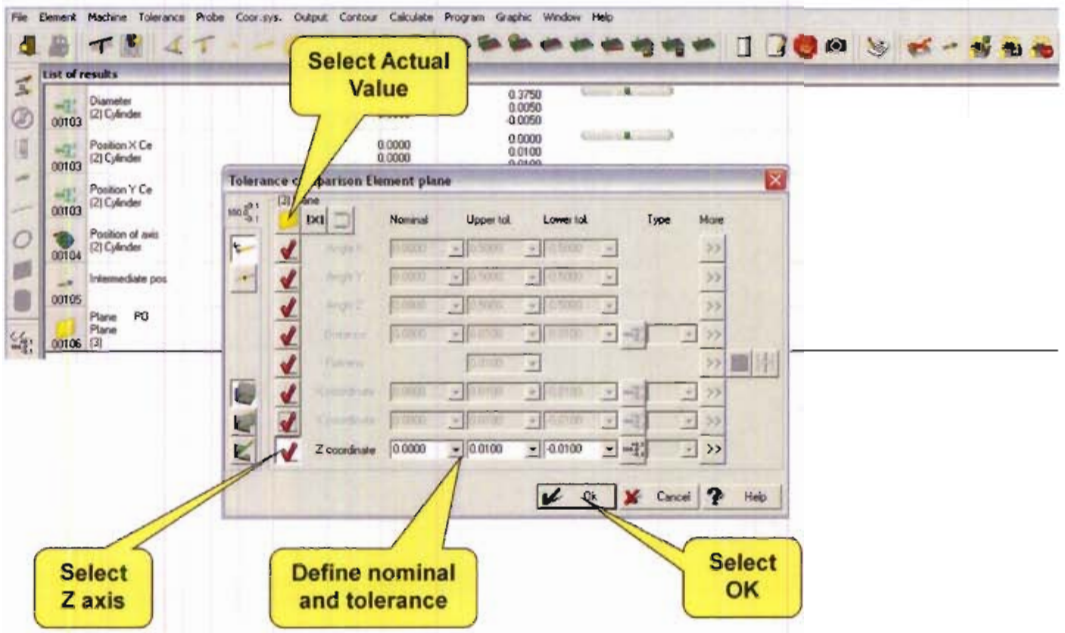
Profile of a Planer surface



116

- In this coordinate system the profile applies in the Z axis.
- We could tolerance distance but tolerancing the Z coordinate will provide a positive deviation relating to plus stock or a negative deviation relating to minus stock. Distance always shows a positive deviation.
- Define nominal (0) and tolerance (½ profile tolerance).
- Select OK.
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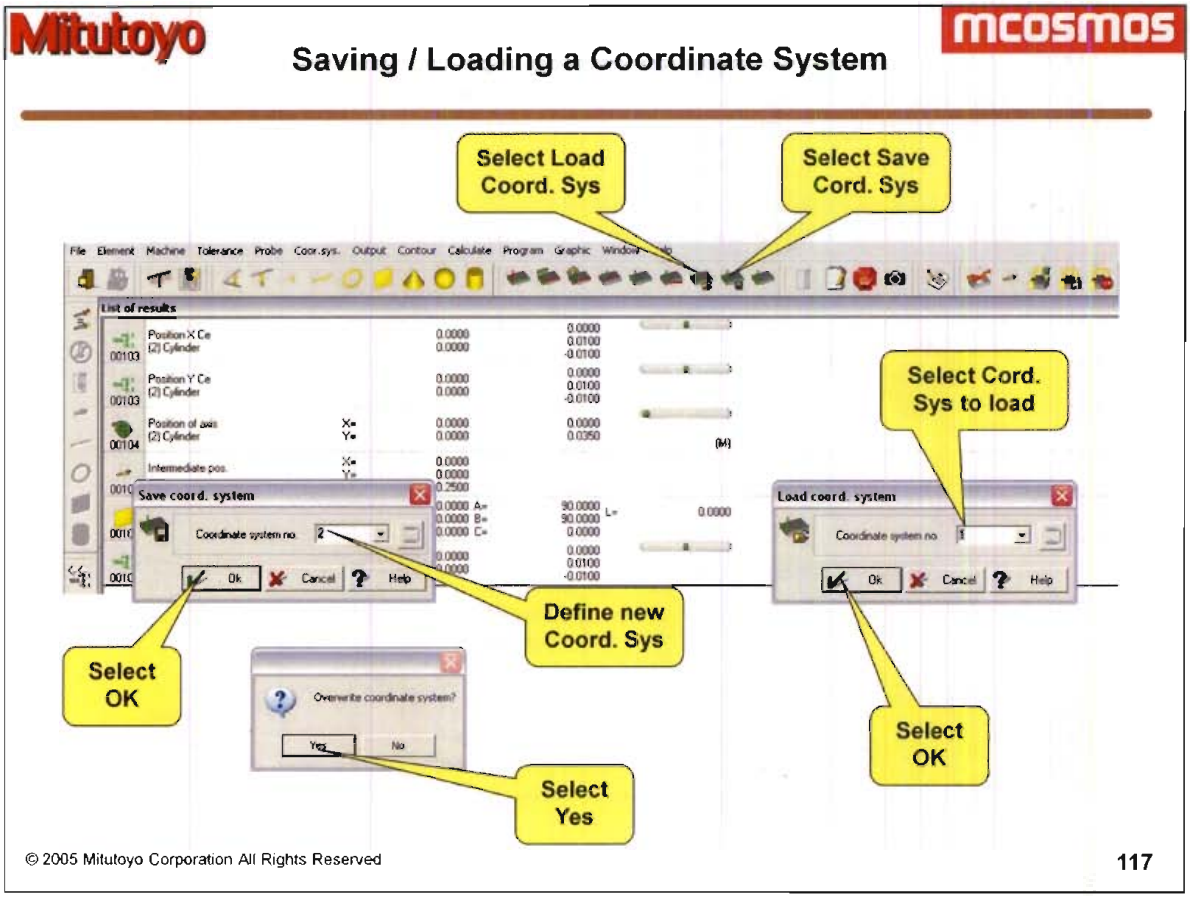

- To evaluate the pierce point we must load coordinate system 1.
- Prior to loading coordinate system 1 we should save the current coordinate system.
- Select save coordinate system.
- Define the coordinate system number (2).
- Select OK. If a coordinate system exists for the number you chose, you will be prompted to overwrite. Select yes.
- Select Load coordinate system.
- Select coordinate system 1.
- Select OK.
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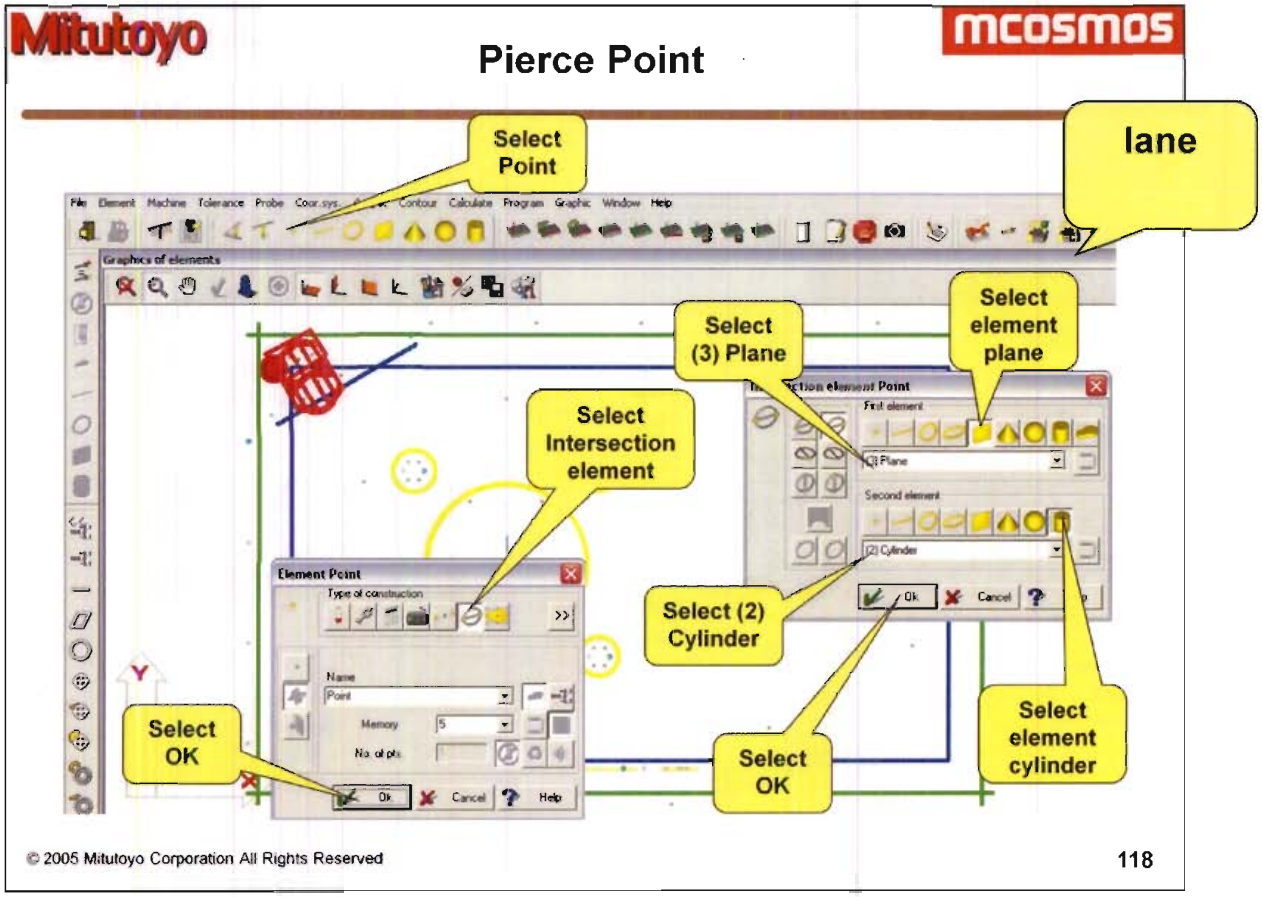

- We have measured and toleranced the features in the local coordinate system.
- This information is very helpful in providing information for corrections out on the machine.
- The print requirement is for the pierce point. An intersection between the Cylinder and Plane.
- To create the pierce point select Point.
- Select Intersection.
- Select OK.
- Select (3) Plane and (2) Cylinder.
- Select OK.
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Tolerance Pierce Point

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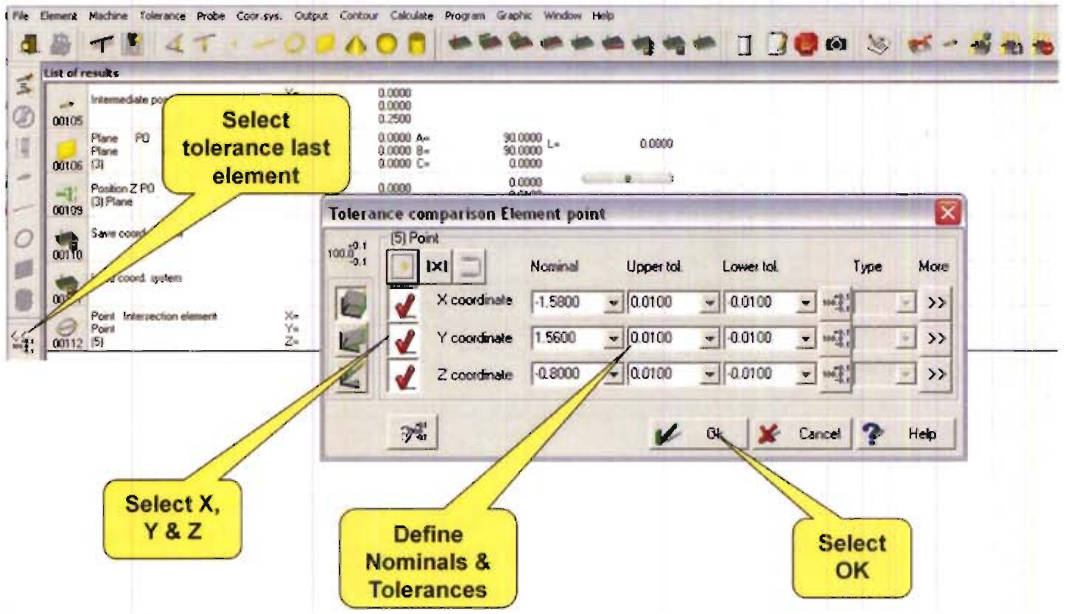

119

- Because we had the tolerance button pushed the tolerance dialog will appear.
- Define Nominals, and tolerances.
- Select OK.
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Local Vs Part Coordinate System

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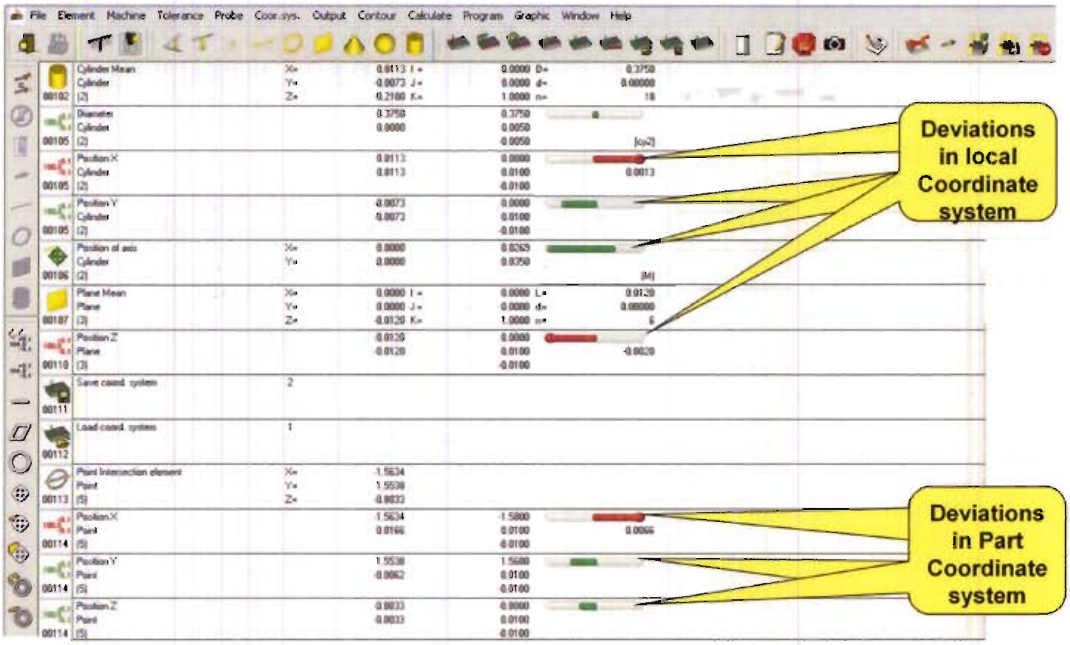
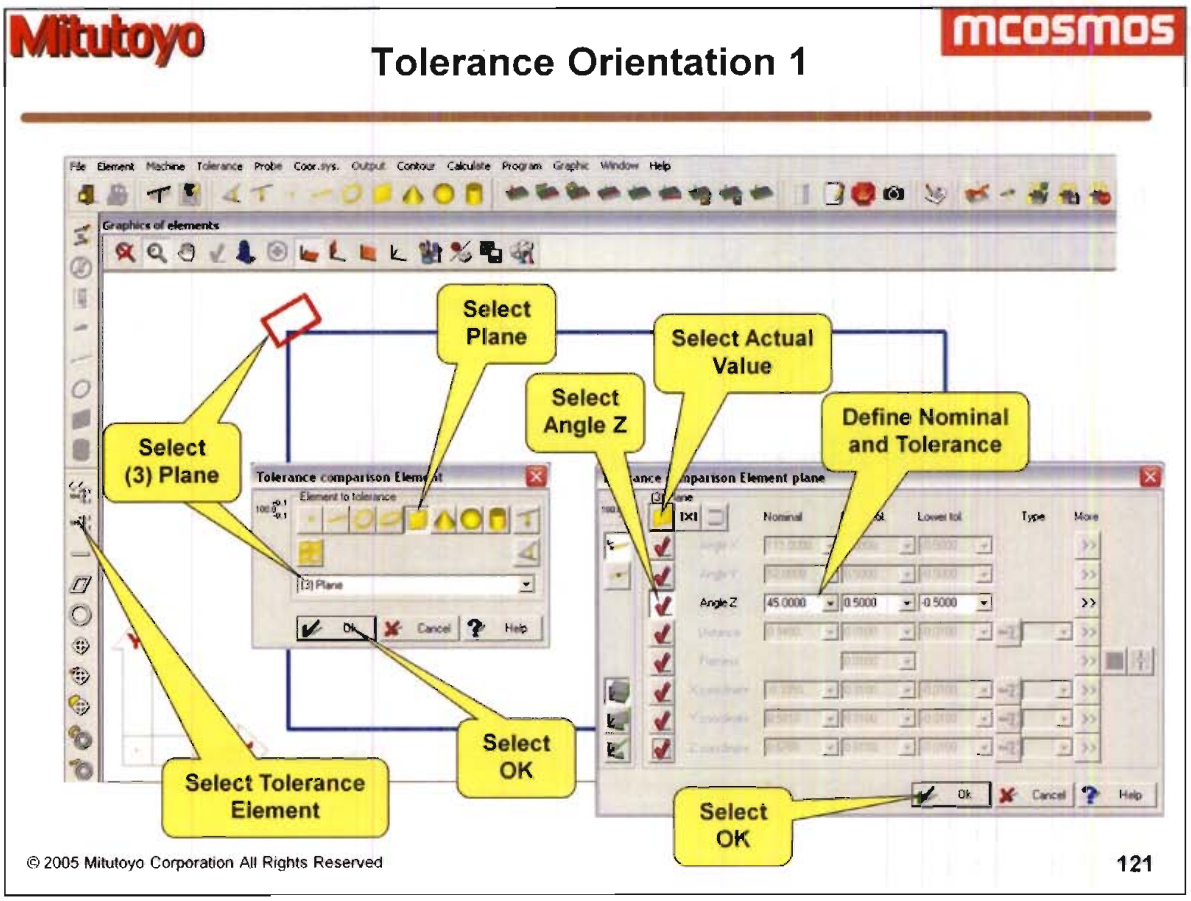


120

- If we review the results in the part coordinate system, and the local coordinate system we can see how the part coordinate system results may be misleading to the machinist making corrections.



- We have checked the feature and reported it's location.
- To report the orientation select Tolerance element.
- Select Plane.
- Select (3) Plane.
- Select OK.
- Select Actual value.
- Select Angle Z.
- Define Nominal and tolerance for this angle (45 Deg.).
- Select OK.
- To report the orientation select Tolerance element.
- Select Cylinder. As both features are not at exactly the same angle.
- Select (2) Cylinder.
- Select OK.
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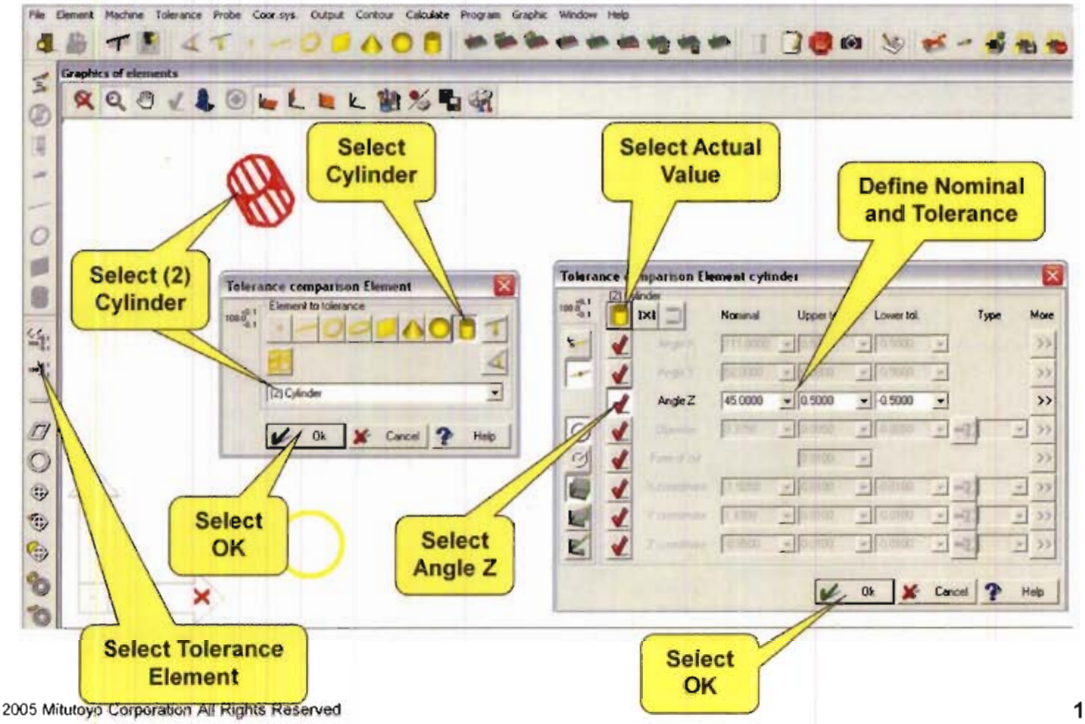
Tolerance Orientation 3



- To report the orientation select Tolerance element.
- Select Cylinder. As both features are not at exactly the same angle.
- Select (2) Cylinder.
- Select OK.
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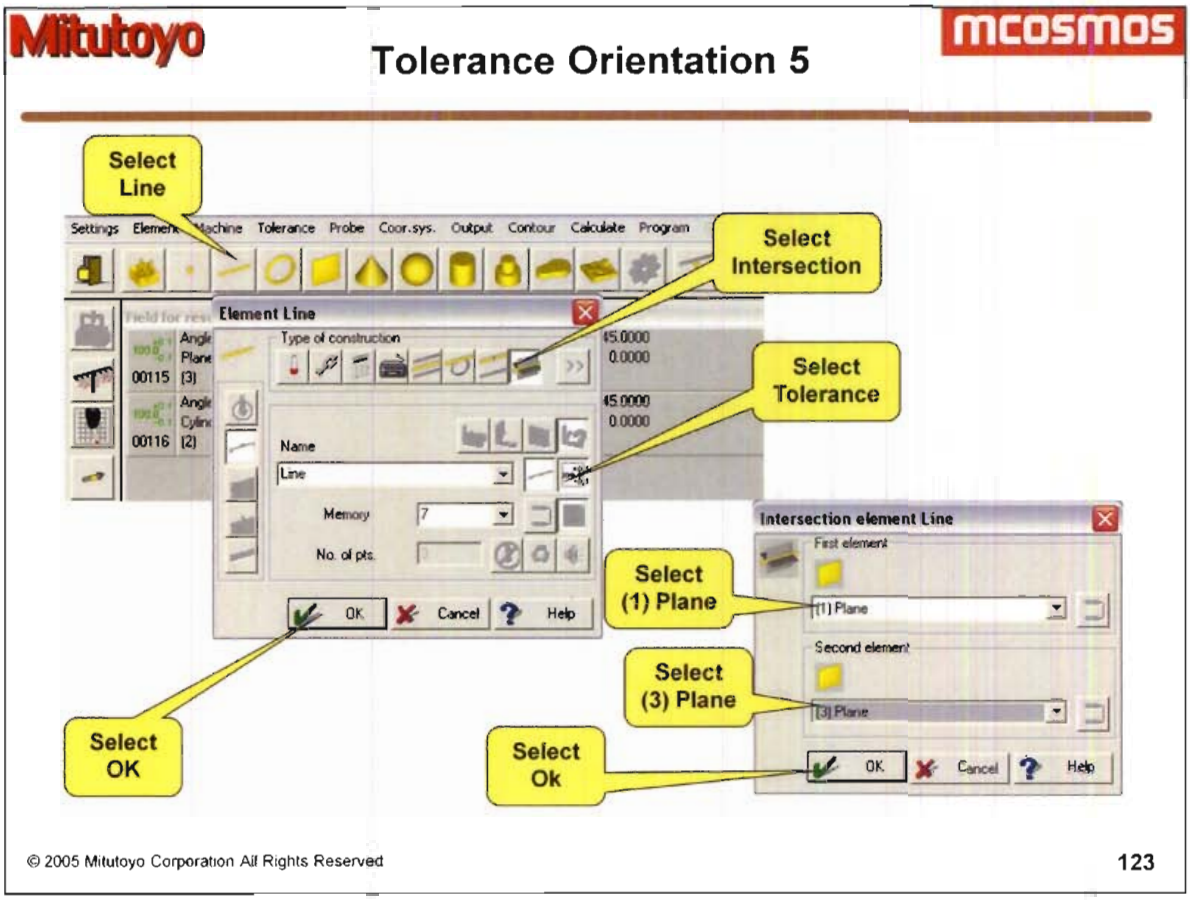

- We have evaluated both Elements for the 45 Deg. requirement.
- To measure the 30 deg requirement we will intersect the angle plane with the top plane and evaluate the resulting line.
- Select Line.
- Select Intersection and tolerance.
- Select OK.
- Select (1) Plane and (3) Plane.
- Select OK.
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Tolerance Orientation 6

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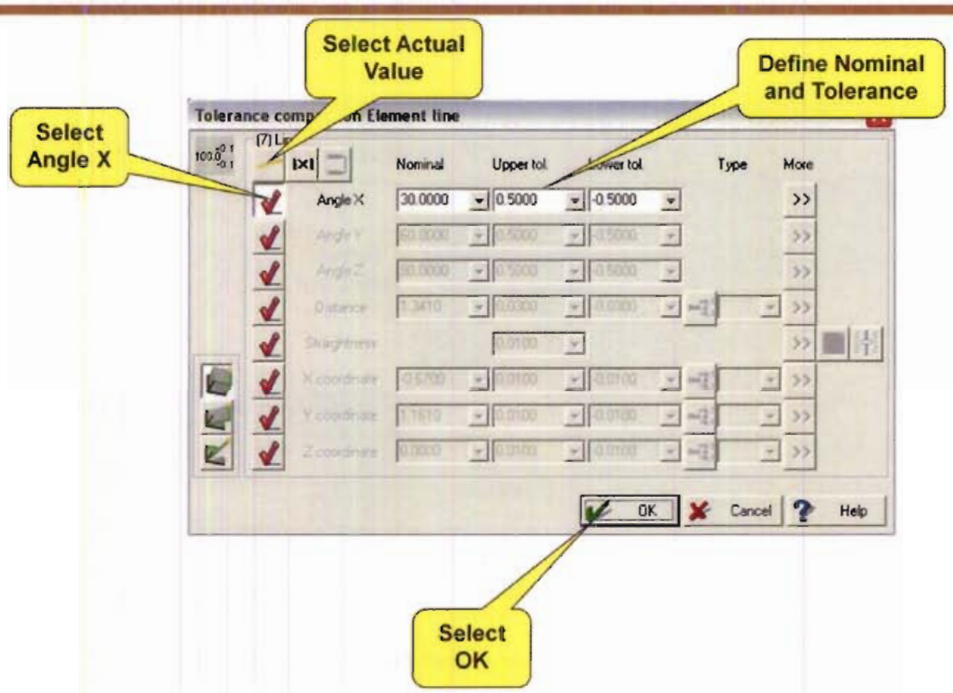

124

- Select Actual value.
- Select Angle X.
- Define Nominal and tolerance for this angle (30 Deg.).
- Select OK.
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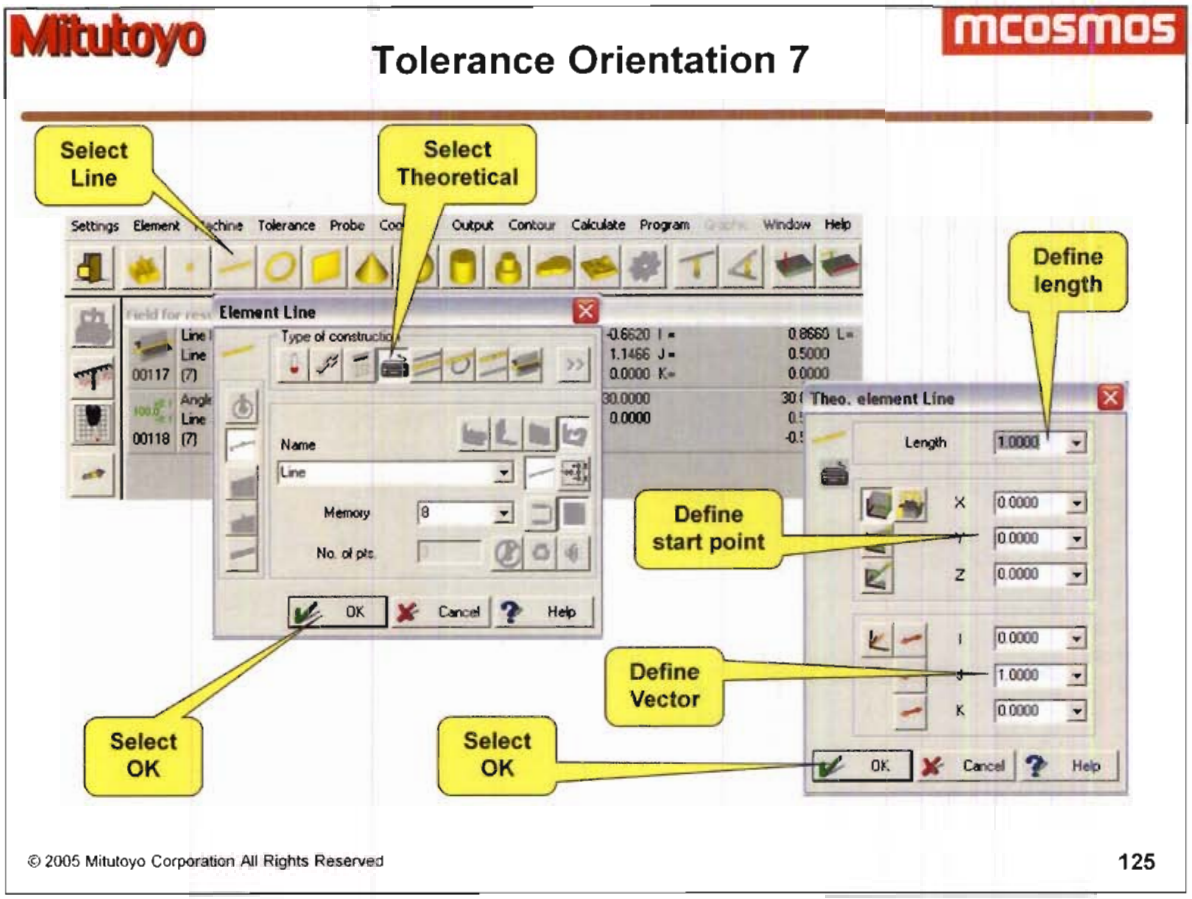

- The only angle left is the 30 deg angle for the Cylinder.
- The Cylinder should be 30 deg from the Y axis projected into the XY plane.
- We will create a line parallel to the Y axis.
- Select Line.
- Select Theoretical.
- Select OK.
- Define the length, start point and vector.
- Select OK.
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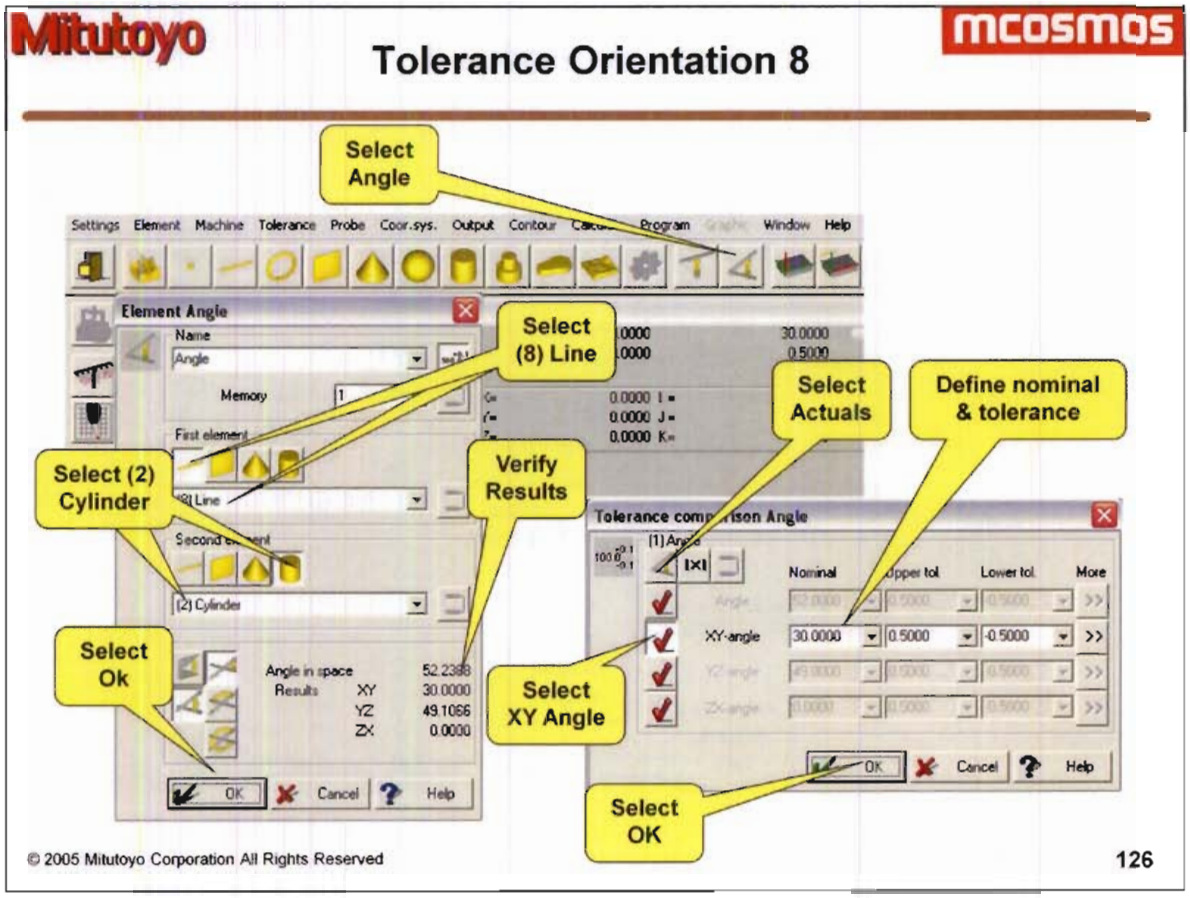

- Now that we have a line parallel to the X axis we can construct the angle.
- Select Element Angle.
- Select (8) Line.
- Select (2) Cylinder.
- Verify results.
- Select OK.
- Because we had tolerance selected a tolerance dialog will open.
- Select Actual value.
- Select XY Angle.
- Define nominal and tolerance.
- Select OK.
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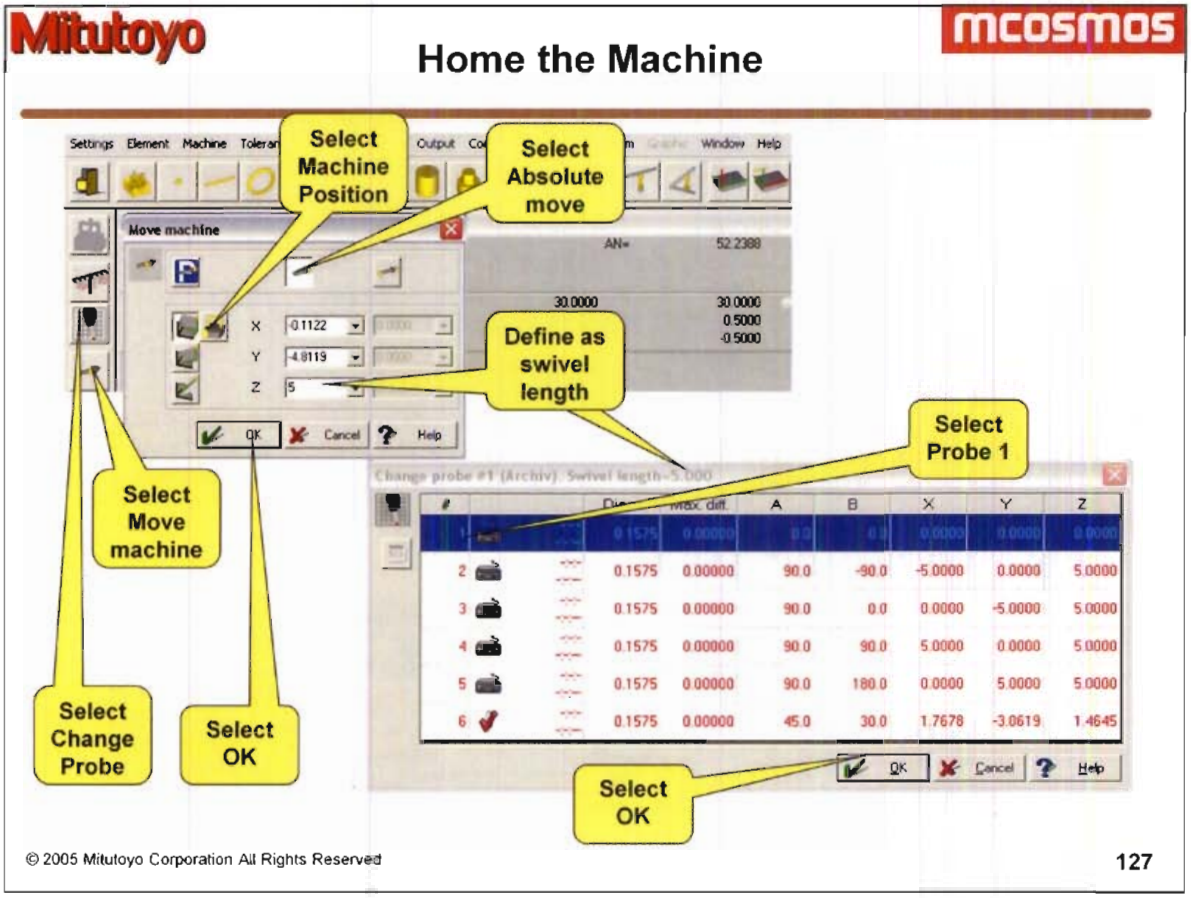

- We have now completed our inspection.
- To remove this part and load the next one it would be a good idea to clear the machine.
- Select Move machine.
- Select Absolute move.
- Select Machine Position.
- Define a safe z value to move to (swivel length).
- Select Change probe to obtain swivel length.
- Select OK in the Move machine dialog.
- Select Probe 1 in the Change probe dialog.
- Select OK in the Change probe dialog.
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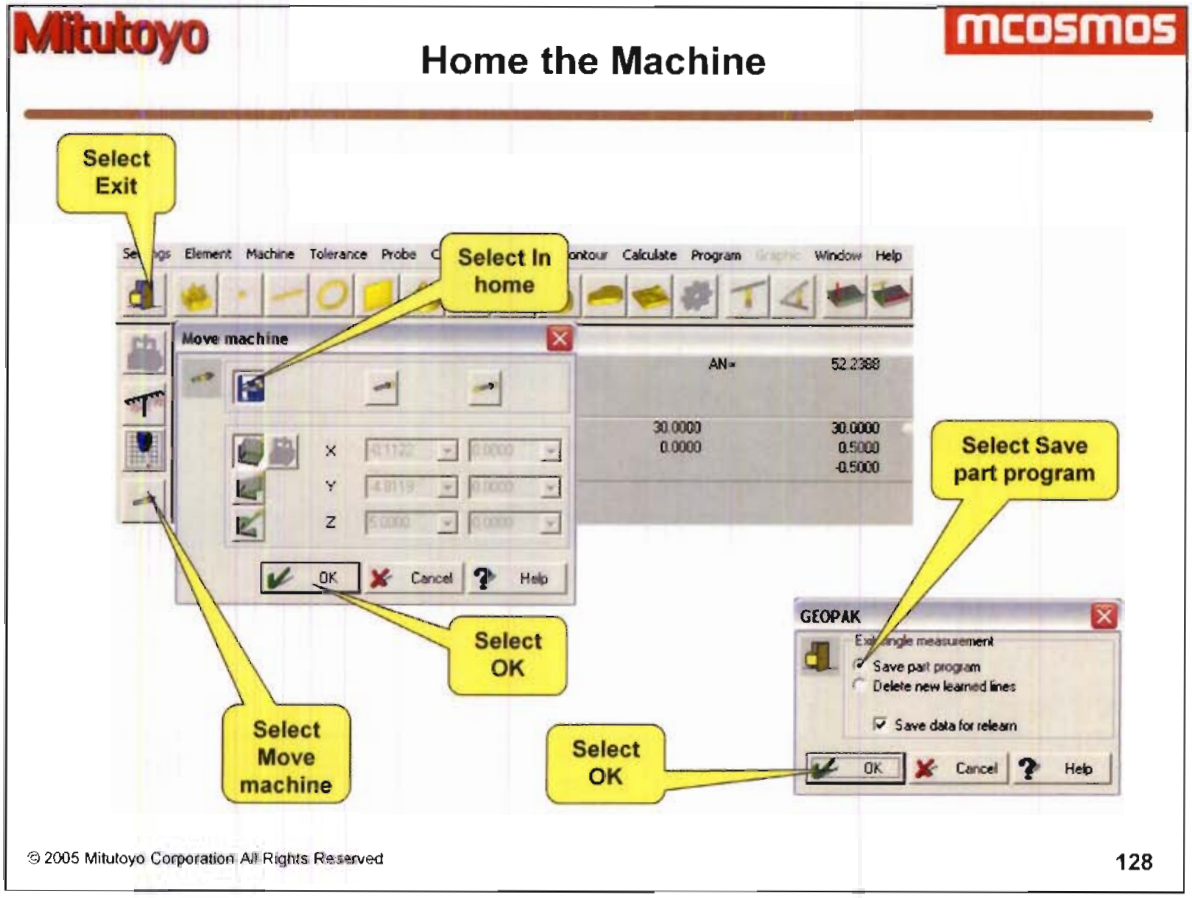

- We have cleared the probe from the part and Returned to probe #1.
- It is now safe to send the machine to the home position.
- Select Move machine.
- Select CMM in home position.
- Select OK.
- We are now done so select Exit.
- Select Save part program.
- It is not necessary to select save data for relearn as we will be editing the part program. Editing corrupts the relearn data.
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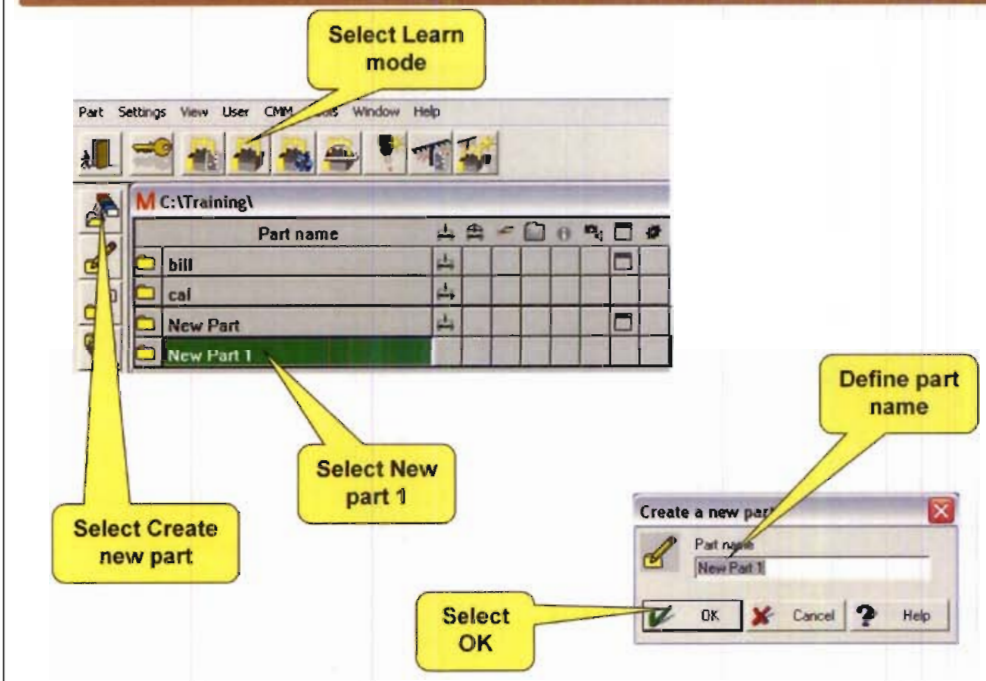
Manual to Fixture Based



129

- Select Create new part.
- Define new part name or except default.
- Select OK.
- Select the new part just created from the parts list.
- Select Learn mode.
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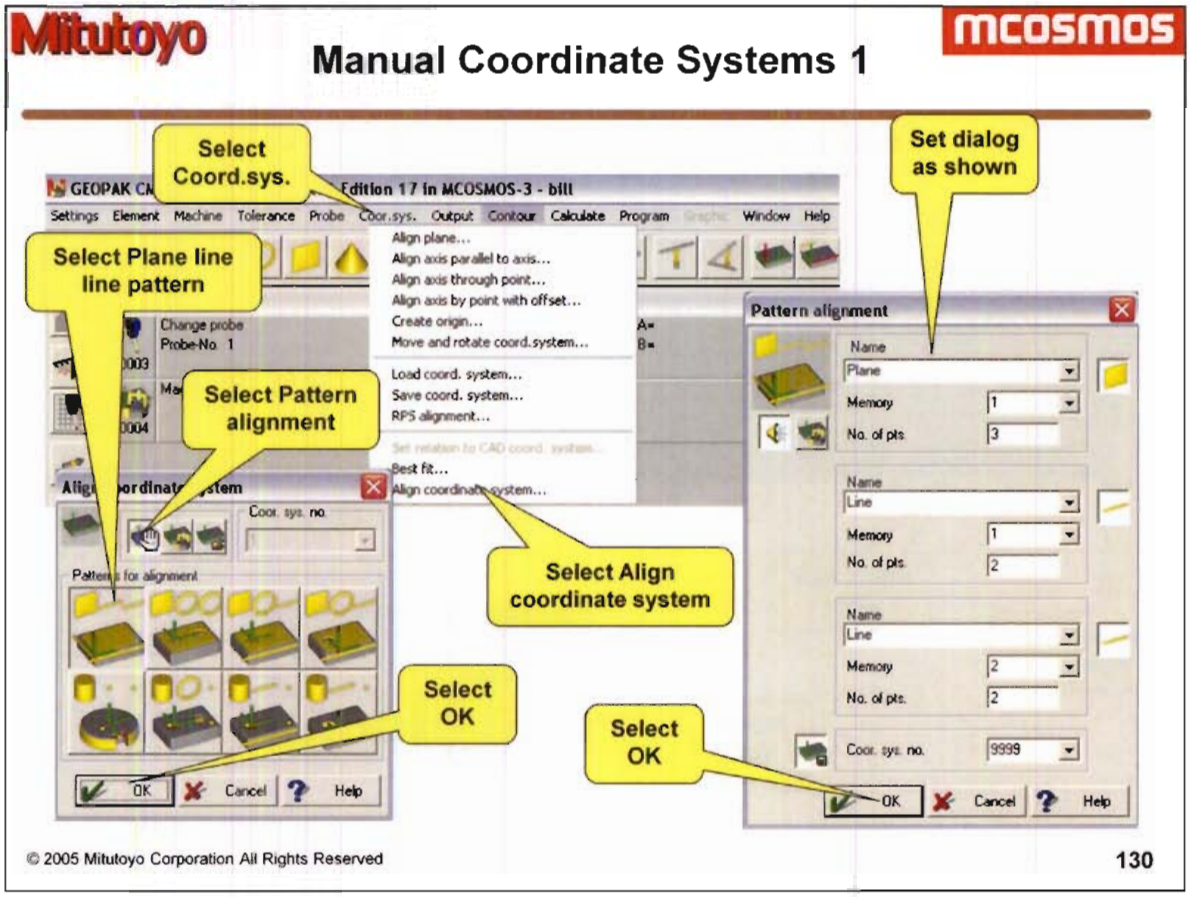

- We have already used the pattern alignments to create part coordinate systems.
- We will now create a coordinate system on our fixture.
- Select Coor.sys.
- Select Pattern alignment.
- Select OK.
- Define the number of points desired per element.
- Define FCS (Fixture Coordinate System) Number.
- Select OK.
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Manual Coordinate Systems 2

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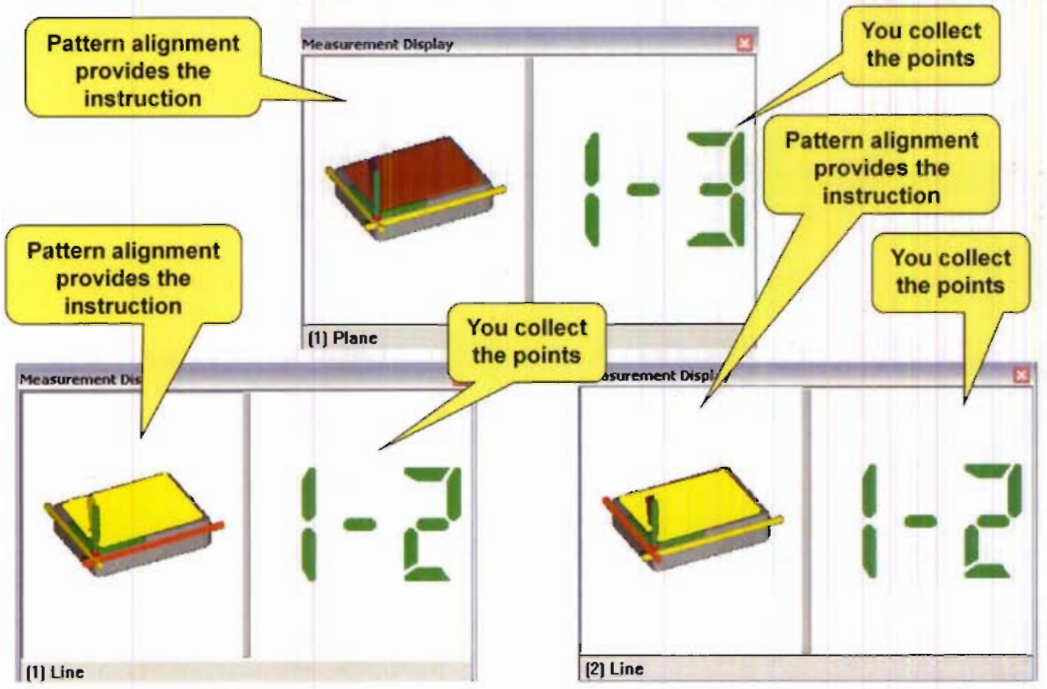

131

- Measure the features as instructed by the Pattern alignment.
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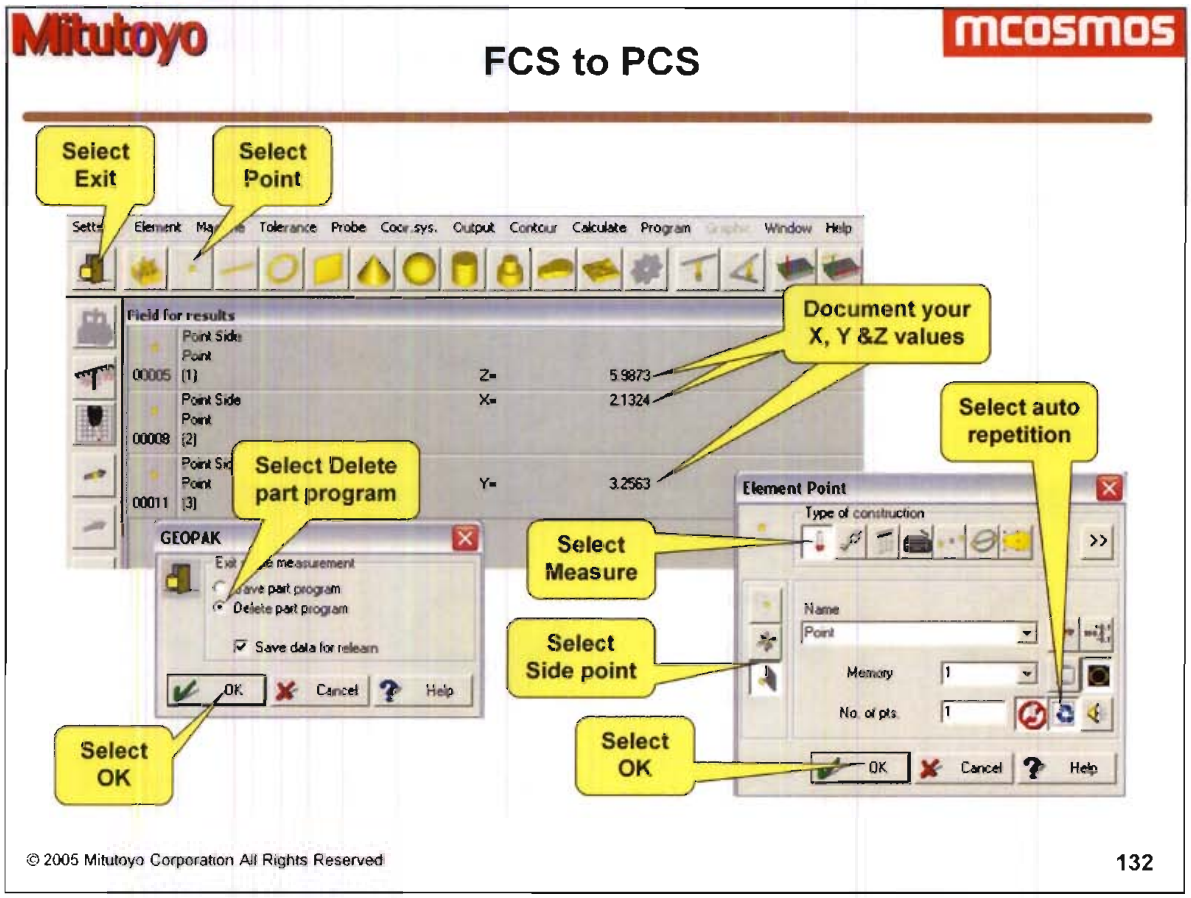

- Collect points on the surfaces that the initial coordinate system used.
- Select point.
- Select side point.
- Select auto repetition.
- Select OK.
- Collect a point in X, Y and Z axis.
- Cancel the measurement display.
- Document your findings rounded to 2 dismals is ok.
- Exit and delete the part program.
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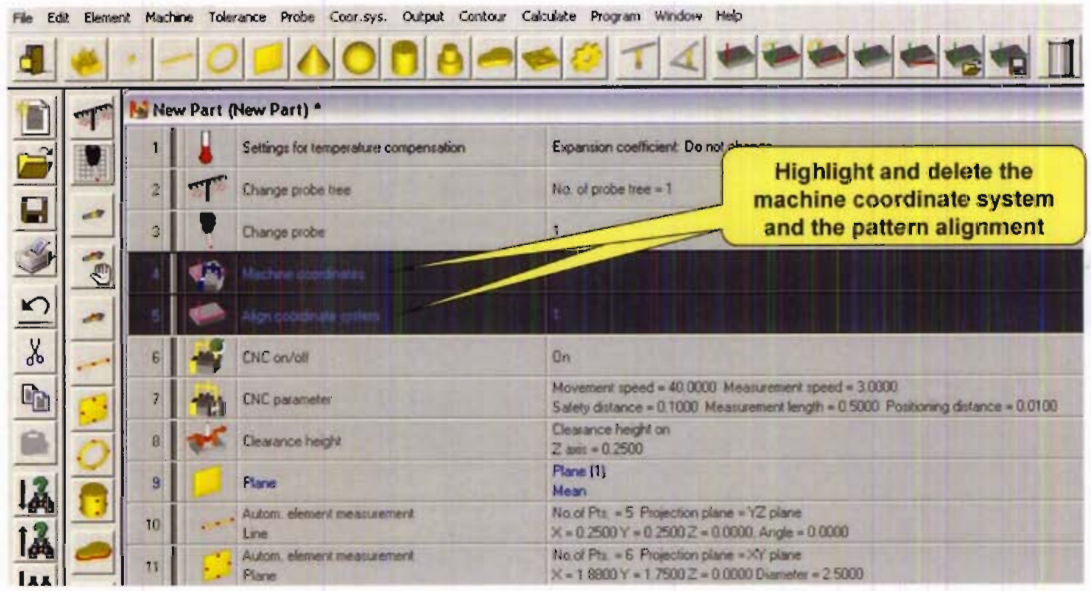
Editing to full CNC



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- To convert our part program from Manual / CNC remove the initial coordinate system and the pattern alignment.
- Highlight the Machine coordinate system and Align coordinate system lines.
- Delete these lines press the Scissors or Trash can tool or Delete key.
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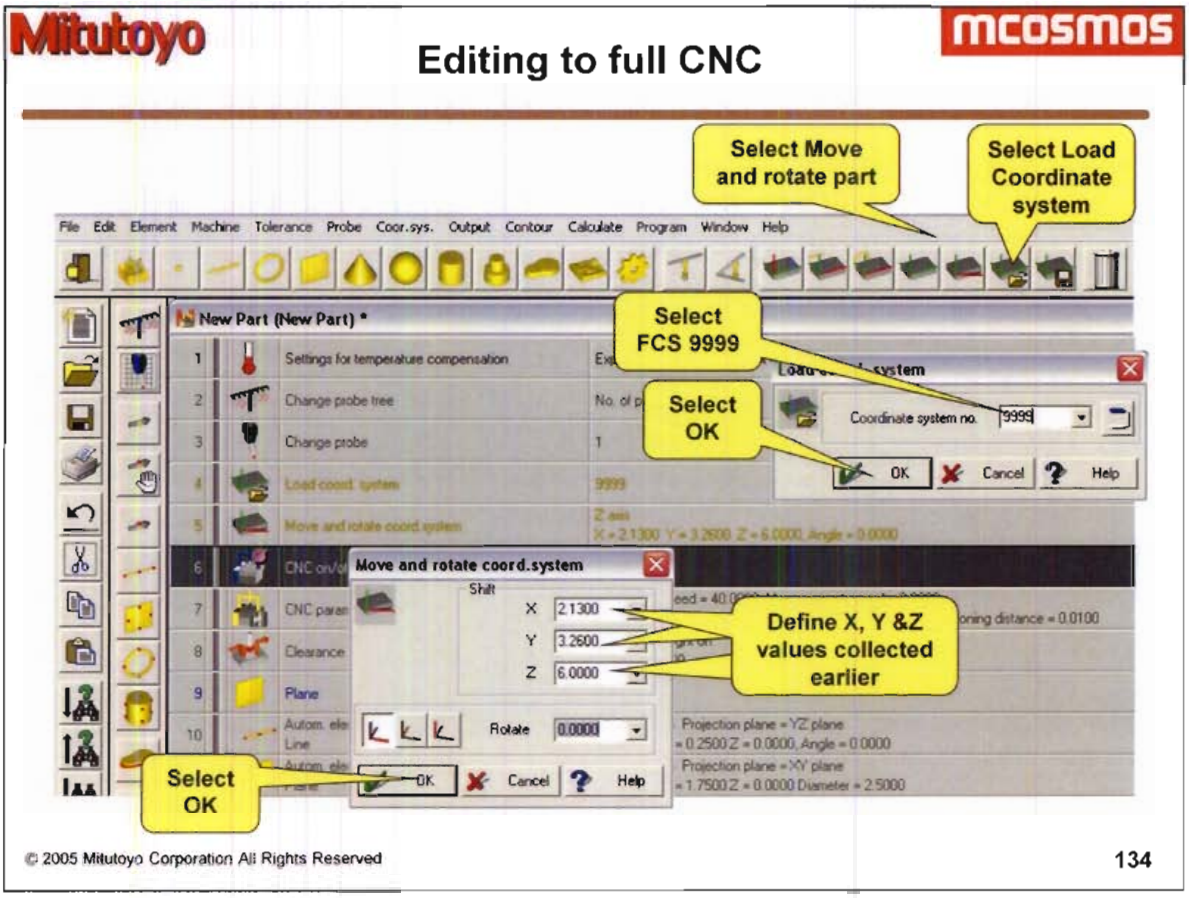

- Select Load coordinate system.
- Select 9999 (Your fixture coordinate system).
- Select OK.
- Select Move and rotate.
- Define the translation from the FCS to PCS (as measured earlier).
- Select OK.
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Editing to full CNC

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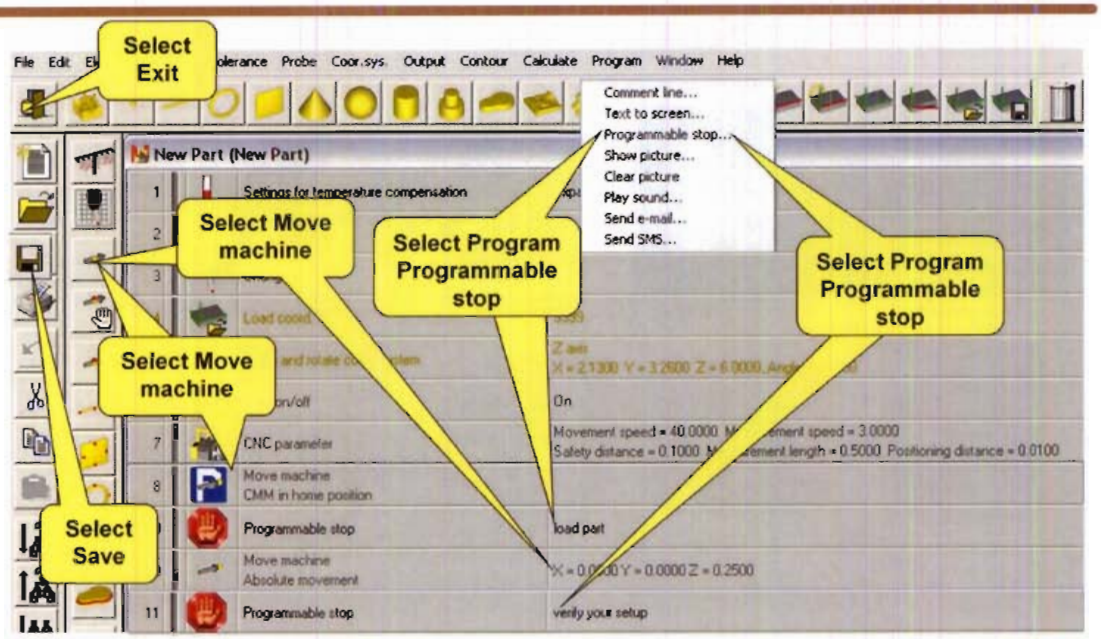

- To complete our part program we will add an in home command.
- We will provide instruction on loading the part.
- We will move the machine to a conspectus location relative to the part.
- We will allow the inspector to verify that the setup is correct.
- We should now save our program. Saving periodically is also advised.
- We are don you may exit and run your program.
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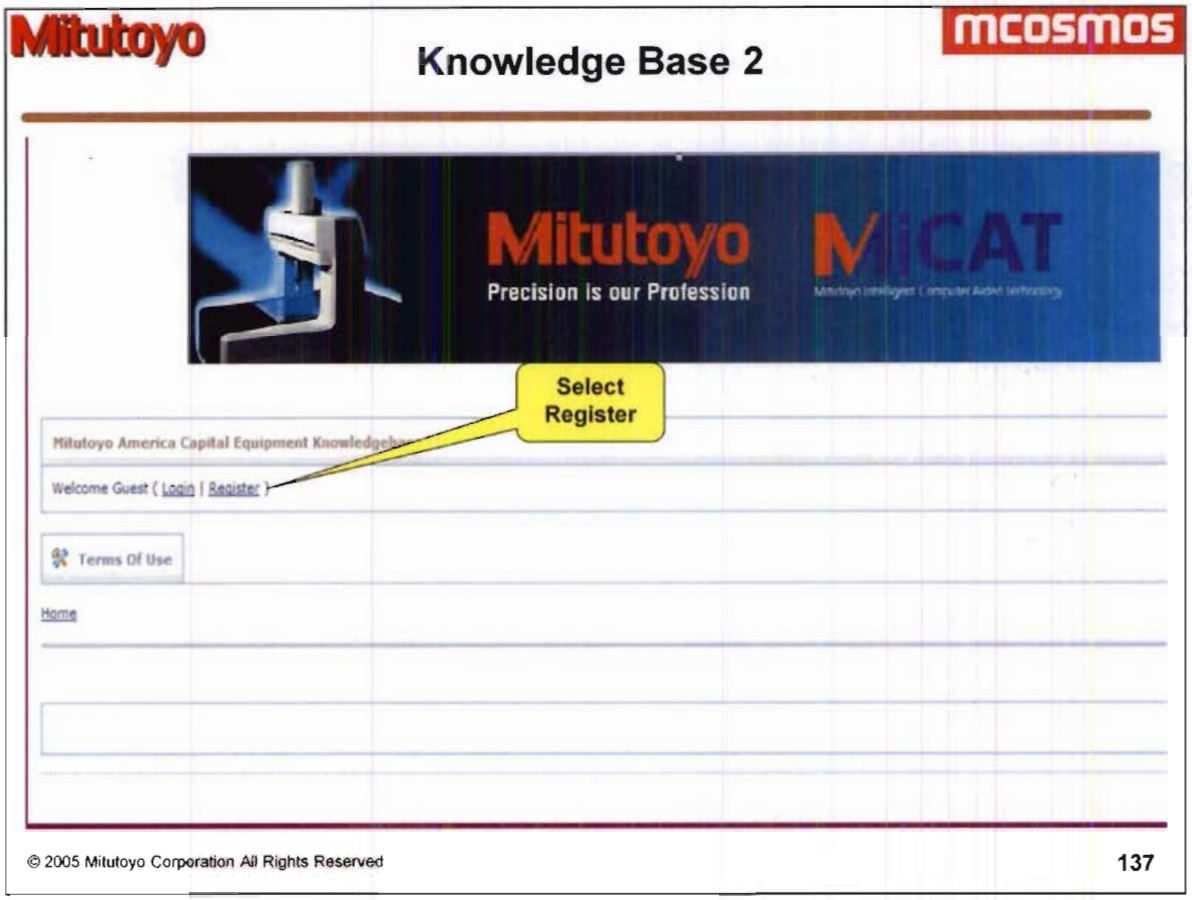
Knowledge Base 1

136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Knowledge Base 2
Mitutoyo
Precision is our Profession
MiCAT
Select Register
Mitutoyo America Capital Equipment Knowledgeba
Welcome Guest (Login | Register)
Terms Of Use
Home
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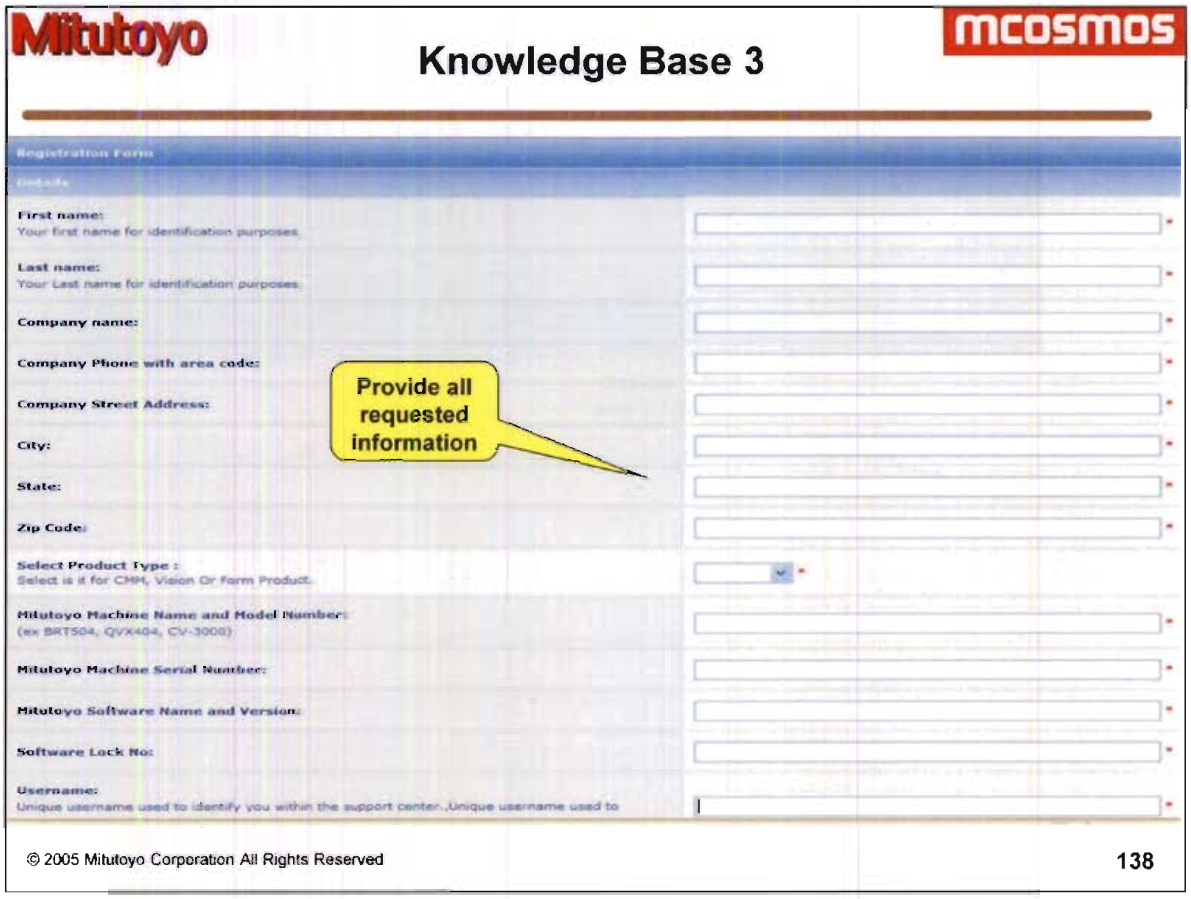
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mcosmos
Knowledge Base 3
Registration Form
Details
First name:
Your first name for identification purposes.
Last name:
Your Last name for identification purposes.
Company name:
Company Phone with area code:
Company Street Address:
City:
State:
Zip Code:
Select Product Type :
Select is it for CMM, Vision Or Form Product.
Mitutoyo Machine Name and Model Number:
(ex BRT504, QVX404, CV-3008)
Mitutoyo Machine Serial Number:
Mitutoyo Software Name and Version:
Software Lock No:
Username:
Unique username used to identify you within the support center.,Unique username used to
Provide all requested information
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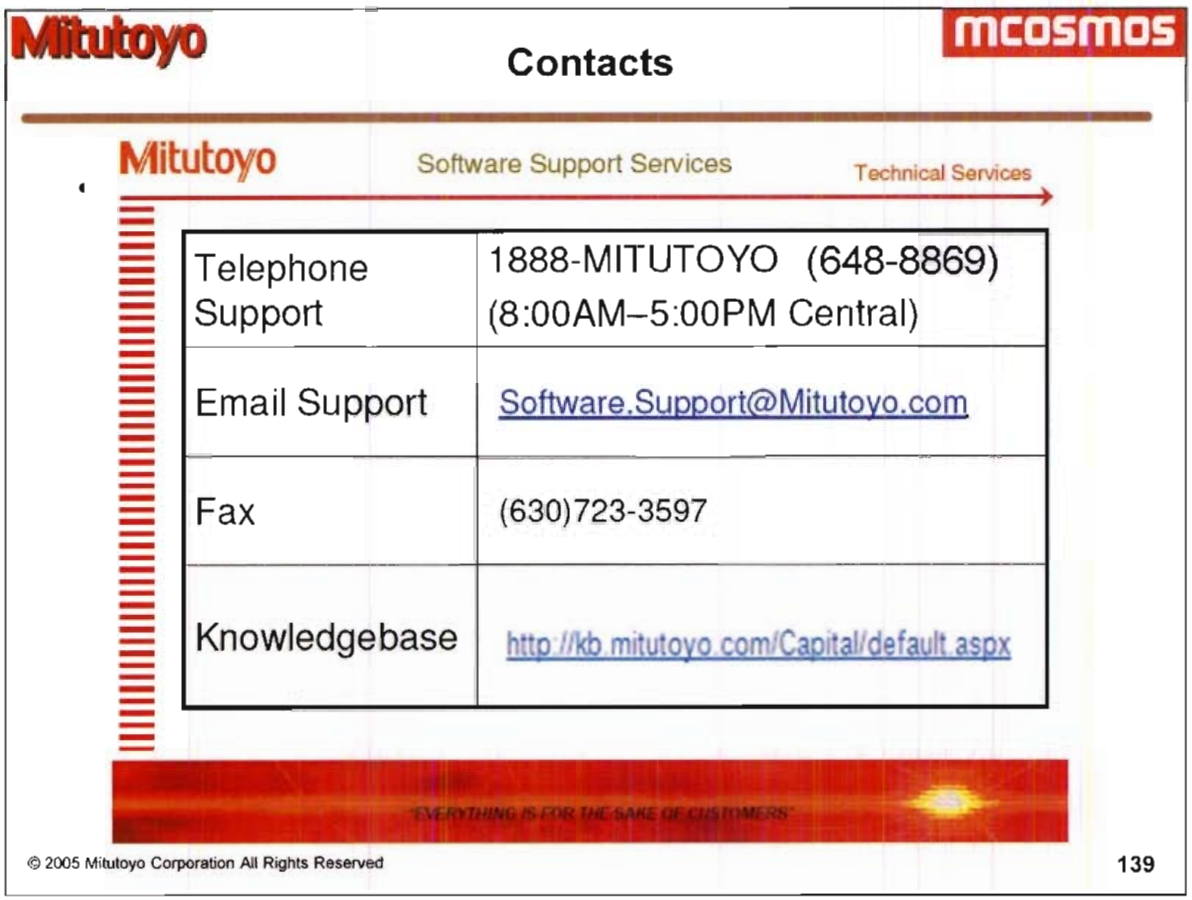

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