# INSPEC METROLOGY SOFTWARE

*FOR MANUAL SYSTEMS*




MICRO•VU

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## Warranty Statement

Micro-Vu Corporation warrants it products for a period of one year.

Customer alterations to the computer configuration may void the warranty. Changes to the operating system, hardware, or software may cause intermittent interruption or failure of operation.

Micro-Vu continues to make changes to InSpec in order to enhance the product. In order to provide customers the value afforded by these enhancements, Micro-Vu may release software versions incorporating these features without documenting them in this manual.

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## Document History

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# Table of Contents

# CHAPTER 1 INTRODUCTION TO THE SYSTEM

Micro-Vu's InSpec metrology software provides powerful, on-screen measuring functions reaching well beyond the realm of a measuring digital readout. Integrating the software with video measuring stages, Micro-Vu has created truly powerful Measuring Centers™.

A Micro-Vu Measuring Center™ includes the following items:

- InSpec for Windows 32-bit Metrology Software.
- Precision measuring stage.
- High-resolution CCD camera and Monitor.
- Profile and surface lighting (axial lighting optional)
- Computer system

## What is InSpec for Windows

InSpec for Windows is a true 32-bit Metrology software application. InSpec was designed with Microsoft Foundation Classes so that it is simple and intuitive to learn if you are familiar with any other Windows application such as Word or Excel. You also get the benefit of long file names, more memory, and smooth application integration. The application is designed specifically for three-axis Measuring Centers™.

InSpec supports many types of geometric features and operations. A feature may be an edge, height, hole, radius, or one of many other geometric characteristics on a part. When a feature is measured, InSpec calculates the position, size, and form of the feature.

InSpec is easy to program. InSpec uses a "teach" style programming where a program is automatically written for you as you measure a part. These programs can be saved onto the computer hard drive or a removable disk. Programs can be opened and rerun later. With DXF, IGES, Gerber, and Excellon files, you can import features into InSpec and create programs even faster.

InSpec records measurements automatically. After measuring a part, you can browse through the measurement data and video tools used to capture the data. You compute distances and construct new features from measured features. The data can be saved and used in spreadsheets or SPC software to track production trends.

InSpec measures features using a few or many data points. A minimum number of data points are required for each type of feature based on geometry. For example, a line requires a minimum of two points. It is

simple to use additional points if desired. Just press the multi-point icon and enter additional points. Using additional points will yield greater accuracy and repeatability.

InSpec lets you construct features by bisecting, intersecting, or using the center locations of other features in a program. New features can be constructed from existing ones. When Constructions have more than one solution, a construction dialog will appear to help you select the correct construction. With a line intersecting a circle there are two intersection points. InSpec would automatically display a dialog to help you select the correct point.

Easily set and align to datum features. Alignment functions include level, skew, and set origin. Leveling, skewing, and setting the origin define what is known as the part coordinate system. InSpec supports multiple coordinate systems giving the user the flexibility to set several zero points, alignments, or datum features in a single part program. In digital readout (DRO) terminology, this is analogous to having several absolute and incremental datum features on one part.

Add on-screen instructions for users. InSpec offer user prompts. Messages can be entered and will be displayed when a part is measured. Use the prompts to guide the user through the program or to request data from the user, such as the lot number, date, or operator ID number.

## The Measuring Machine

The stage is a precision electromechanical assembly that sends precise X, Y, and Z position data to the measuring software. When the stage is moved, linear encoders output the incremental displacement to the computer.

Three-Axis Measuring: The part to be measured is placed or fixtured on the measuring stage and viewed by the camera from above. The measuring stage (or the camera above on some systems) moves so that the desired area of the part is in the camera view. Left to right motion is called the X-axis. Similarly, motion front to back is called the Y-axis. The camera moves up and down in the vertical, or Z-axis, in order to measure heights and to focus on the part. Because measurements can be taken in the X-, Y-, and Z-axes, we call this type of system a three-axis measuring machine.

Stage Movement: The stage and camera are moved using hand wheels or on motorized systems with a joystick.

### Starting Up Your Measuring Center™

After the system has been properly installed, you will be able to run InSpec and take measurements.

Turn on the computer.

Turn on the machine.

Double-click on the InSpec icon on the Desktop to open InSpec.

### Shutting Down Your Measuring Center™

When you are shutting down the system, start with software.

Save your program if necessary.

Close InSpec

Turn off the machine.

Shutdown Windows.

Shutdown the computer.

## Technical Support

If you have questions that are not answered in this manual, you should contact your local Micro-Vu Dealer. Your Micro-Vu Dealer is not only well versed with InSpec for Windows, but your local dealer may be familiar with your application and be able to solve your problem quickly.

You may also contact Micro-Vu directly for technical support

PHONE: 707.838.6272

FAX: 707.838.3985

EMAIL: support@microvu.com

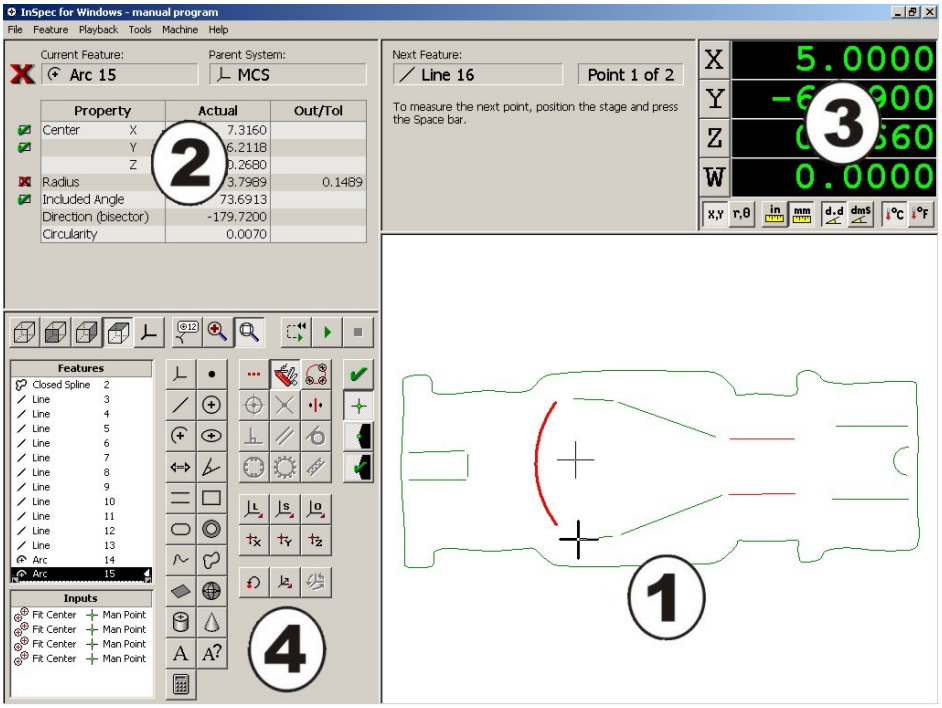
Regardless of whom you contact, you need to have the following information ready:

Machine type, size, and serial number; Software version and operating system; and detailed information on the problem that you are experiencing.

# CHAPTER 2 INSPEC'S USER INTERFACE

Combined with a number of pop-up windows and pull down menus, the layout provides an easy-to-understand yet powerful interface. This chapter will discuss the four of the five sections of the interface. The Program section is discussed in the following chapter.

1. The **Schematic Window** displays a graphic representation of the part.
2. The **Feature Summary** displays information about the current feature.
3. The **Status Section** displays the current stage position and units.
4. The **Program Section** displays the features in the current program and icons used to create a program.




## Schematic Window

InSpec draws a diagram of the programmed features in the top left section of the screen. Right click options and colors simplify identification and selection of features.

Within the Schematic window you can use the mouse to select single or multiple features. Use Windows conventions such as holding the Control

key down to select multiple features and click and drag to select features within a the selection area.

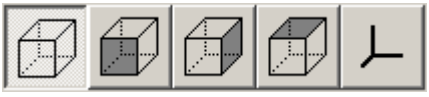
Colors are used to help the user distinguish selected and tolerances features. Features are normally drawn using thin green lines. Thick green lines designate the "selected" feature(s). Magenta indicates that the mouse is currently hovering over the feature. Red indicates that the feature is incomplete or out of tolerance.

### Current Stage Position

Thin gray crosshairs indicate the current stage position relative to the displayed part. When you run a program, a second set of crosshairs is displayed showing the position of the next feature. This is especially helpful at the beginning of a program or when measuring manual points.

### Schematic Views

InSpec offers five standard views of the part schematic. Operators can choose between the perspective, XZ, YZ, XY, and PCS views.



The perspective view rotates the schematic for a view from above the front right corner of the stage.

The XZ, YZ, and XY views are relative to the machine coordinate system (MCS). As the icons depict, these show the front, right, and top view of the part as it lays on the stage. For example, the top view will show a tilted schematic of the part if the part is not aligned to the stage axis.

The part coordinate system (PCS) view shows the schematic relative to current coordinate system, which is the system of the current feature. Program may have many different origins, skews, and levels.

### Schematic Zoom

Customers use Micro-Vu systems to measure a variety of parts. Some lager parts have small features. InSpec provides zoom capabilities in the schematic so that you can view the relative position of these features.

Use the Fit and Zoom Icons directly below the schematic window to zoom in on smaller features and zoom out to see the entire schematic.

 Use the Zoom-In icon toggles between the "Zoom" state and the "Pick" state. When the button is pressed, the mouse cursor will show a magnifying glass when the mouse is in the schematic window. To zoom in on features, click-and-drag a window around the area you would like to enlarge.

When the button is "up", the mouse cursor will be an arrow allowing the user to select features.

 The Zoom-Out icon incrementally decreases the zoom so that you can make slight increases to the field of view.

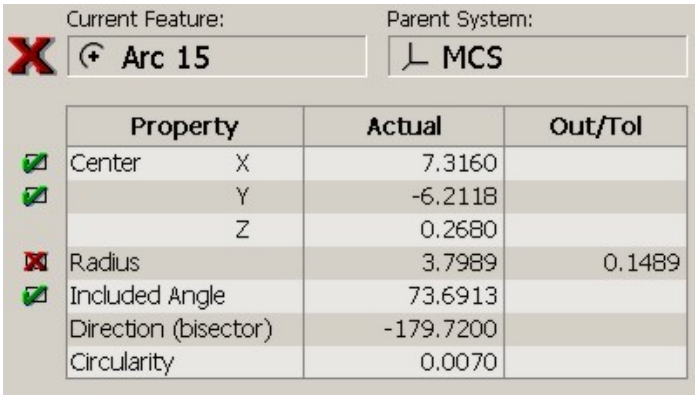
 The Zoom-Fit icon will change the schematic zoom to display all of the features in the program and the location of the current stage position. Note that if the camera location is not near the part and the part is relatively small, then the part features will appear small on the screen.

**Tags**

 The Tags icon allows the user to mark selected features on the schematic. This makes it easier for the user to locate specific features. A feature's Tag displays the number or name of the feature. The user may select a group of features from the Features list and change the tag status for all of the selected features at one time. When a feature is renamed the feature's name is displayed in place of its number.

## Feature Summary

The Feature Summary is displayed at the top of the screen. InSpec displays the name, system, measured values, and condition of tolerances for the current feature in the Feature View. Green check marks, red Xs, and yellow rulers indicate the status of the feature. A feature may be in tolerance or out of tolerance, or there may be a problem with a tool or with the measurement. Smaller green checks and red Xs will appear next to feature characteristics that are toleranced indicating that the individual characteristics are in or out of tolerance. The summary updates immediately when another feature is selected. The arrow on the right side of the Features List indicates which is the current feature.

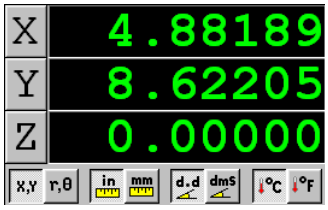



Many feature types have eight or more characteristics that may be displayed, toleranced, and exported. You can choose which characteristics are displayed for each feature type. Select Configure Summary from the Tools menu to customize the display of feature characteristics.

## Status Section

The top right section of the InSpec screen is dedicated to status settings, including position, units, and lighting.

The digital readout (DRO) appears in the top-right corner of the screen. This counter shows the X-Y-Z position or R-Theta-Z position of the crosshairs. The icons below the DRO allow the user to move the stage and specify the units of measurement.



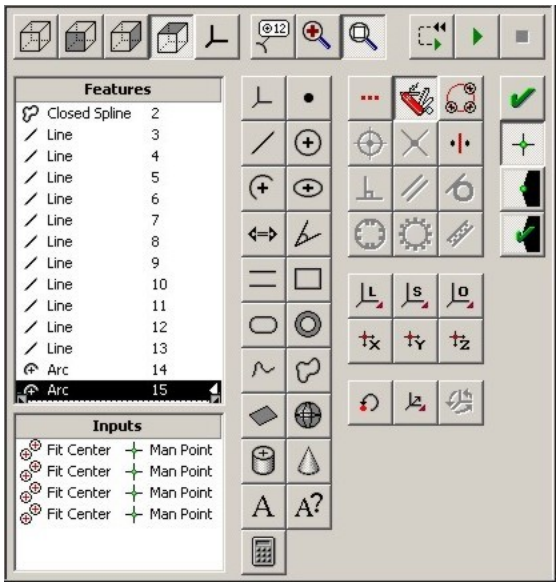

### Displayed Units

The buttons below the DRO allow the user to specify the units and type of coordinate system. Units can be selected and saved with each program.

The first pair toggles the system between X-Y-Z and R-Theta-Z formats, Cartesian and Polar formats. The next pair set the linear units, inches or millimeters. The next pair of buttons toggles angular values between decimal and degrees:minutes:seconds. The last two buttons toggle the temperature units.

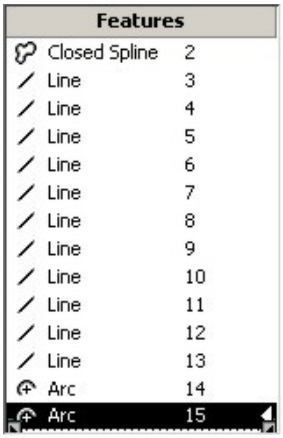
# CHAPTER 3 THE PROGRAM INTERFACE

Information about your part program is displayed in the lower left corner of the screen. The features and inputs are listed on the left with the programming icons just to the right. This view will vary in appearance depending on monitor resolution.




## Features List

The Features list displays a list of the features in the program. Features are added to the list as you measure them the first time. In run mode, the program will be played back in the order that the features appear in the list.

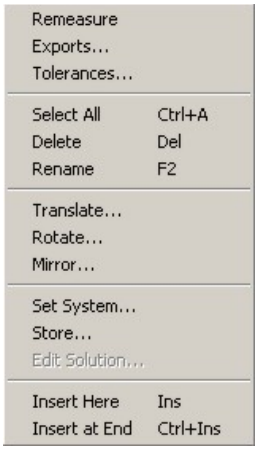


A feature is usually some entity on a part that can be measured. InSpec can measure several types of features including arcs, angles, circles, distances, ellipses, lines, o-rings, and points. Features are measured from data points or constructed from other features. There are also text, prompt, part separators, and temperature features.

A triangle on the right of the Features list indicates which is the “current feature.” The “current selection” of features is highlighted. Multiple features can be selected using the SHIFT and CTRL keys. Operations, such as deleting, setting tolerances, or copying, are applied to the current selection of features.

## Features Context Menu

Right clicking on a feature in the Features list will bring up the following menu:




This menu provides the following functions:

- Remeasure – Recapture data for the selected feature(s).
- Exports – Open an Exports dialog box to select export characteristics.
- Tolerances… – Open a Tolerance dialog to set tolerance values for the selected feature(s).
- Select All – Select all features in the program.
- Delete – Delete the selected feature(s).
- Rename … – Change the name of the current feature.
- Translate … – Copy or Move selected feature(s) in X, Y, and Z.

- Rotate… – Copy or Move selected feature(s) around the system origin.
- Mirror… – Copy or Move selected feature(s) across the X- or Y-axis.
- Set System – Relate selected feature(s) to a different coordinate system.
- Store… – Name and Save a feature for use in other programs.
- Edit Solution … - Change some geometric constructions.
- Edit Text… - Change the content of a Text feature.
- Insert Here – Place the insertion bar in front of the current feature.
- Insert at End – Place the insertion bar after the last feature.

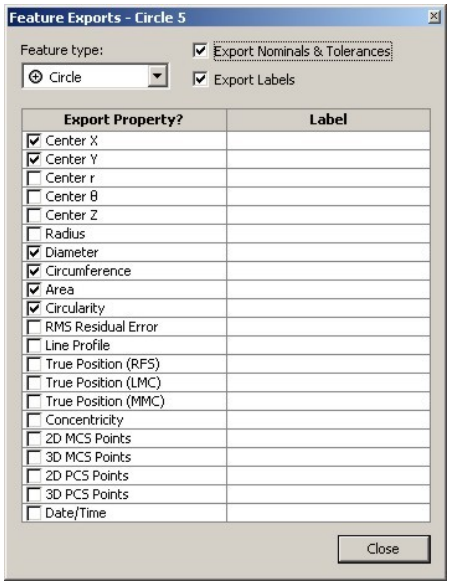
**Remeasure**

This command is useful to quickly retake a measurement or to verify that the position of a translated feature is correct without rerunning the entire program. Select the feature(s) of interest and then select Remeasure.

**Exports**

InSpec allows you to select individual characteristics of each feature to be exported to a data file. You can select a single feature or a group of features when setting the characteristics to be exported.

The export dialog box is a “pin up” box that remains on the screen as you select other features and set exports. Use the “X” in the top right to close the dialog.




To open the Feature Exports dialog box, first select the desired features in either the schematic or the Features list. Right click on the features and select Exports from the context menu. The F4 hot key will also open up the Feature Exports dialog.

Check the boxes for the properties and options you want to use. When you select multiple feature types such as a group of lines, circles, and points, use the “Feature Type” drop down menu in the top left where, you select one type of feature at a time.

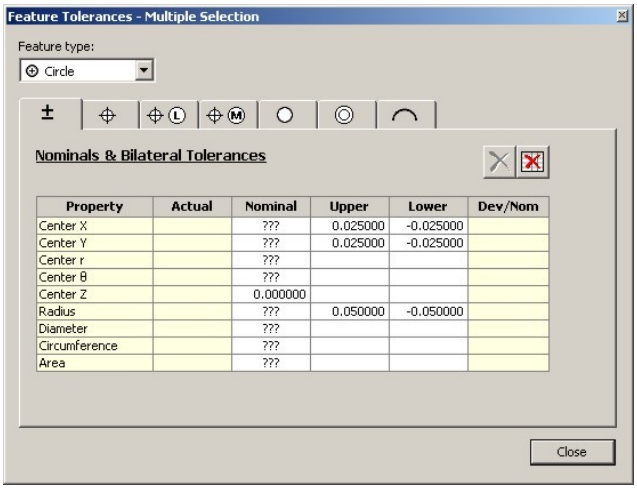
- Export with Labels – This toggle allows the user to include labels with the exported data, such as “Circle 10: Diameter.”
- Export Nominals and Tolerances – This toggle will include tolerance values if available, for each of the selected properties.
- Property – These check boxes allow the user to specify which characteristics of the selected features are to be exported.
- Label – InSpec allows you to customize labels for exported data. If Export with Labels is checked, InSpec will include a label with the export data. If no label is entered, then a default label is created from the feature name followed by the property. The label is in quotes to facilitate use in spreadsheet and SPC software i.e. “Circle 1: Center X.”

**Tolerances**

InSpec has the ability to do bilateral, form, and positional tolerances. Tolerances can be applied to a single feature or to a block of features.

For a single feature, the tolerance dialog box will display the available tolerances for the selected feature type, as well as nominal values and calculated deviations from tolerances.

For a block of features, the dialog will only display the available tolerances for the feature type. Nominal values will typically have question marks (???) indicating that the values for the selected block of features are different. A number appears in the nominal column if all of the features have the same value, for example all of the features have the same Z-height.




The tolerance dialog box is a “pin-up” box that remains on the screen as you select other features and set tolerances. Access the tolerance window through the Features Context Menu or by using the F3 hot key.

### Select All

This option can be used to pick all of the features in a program. You may want to use this so that you can immediately tolerance features or delete all features to start a new program.

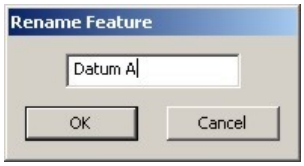
### Delete

This is one of the most used features. When programming, you often find a better way to measure a feature or change you mind after selecting a feature type. When you use “delete,” InSpec assumes that you mean it and does not ask for confirmation.

### Rename

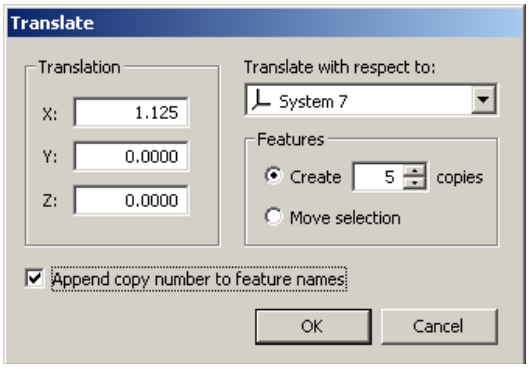
InSpec automatically names features with a number. The name can be changed to an alphanumeric phrase of up to 32 characters. The name

is used in the program, summary, reports, and tags. No two features in the same program can have the same name. A dialog box will appear and allow you to enter your own name for the feature. The hot key for the Rename dialog box is F2.




**Translate**

The Translate command in the Features Context Menu allows the user to move or copy-and-paste the selected feature or multiple features. To transform features, first select the group of features and then select Translate from the Features Context Menu.



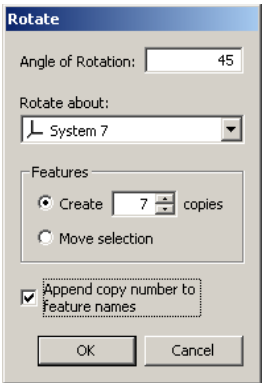

At the top of the Translate menu box, first select the base system for the translation. The base system will default to the coordinate system used by the first feature selected. The default system will not be appropriate for every case.

After selecting the proper system, enter the values for the translation. You have the choice of making copies which will be separated by the given translation interval, or moving the selected feature(s). The selected feature(s) will be copied or moved when you click on OK. Remember that these features have not been measured. It is often helpful to test the locations of copied features by immediately remeasuring them.

By checking the *Append copy number to feature names* box InSpec will add _# to the end of each feature name (including the source feature). For example, when Circle 1 is translated two times the result is Circle 1_1, Circle 1_2, and Circle 1_3.

### Rotate

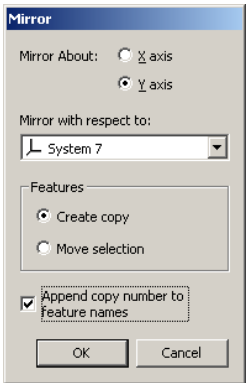
The Rotate command in the Features Context Menu allows the user to rotate a feature or multiple features in a program around the current system origin. This simplifies the programming of gear teeth, bolt hole patterns and other symmetric arrangements of features. To transform multiple features, select the group of features and then select Rotate from the Features Context Menu. Enter the angle of rotation and whether to move the original features or create a number of copies.




Checking *Append copy number to feature names* will add # to the end of each feature name (including the source feature). For example, when Bolt Hole 1 is rotated to create 3 copies, the result will be Bolt Hole 1_1, Bolt Hole 1_2, Bolt Hole 1_3, and Bolt Hole 1_4.

### Mirror

The Mirror command in the Features Context Menu allows the user to flip a feature or multiple features in a program across the X- or Y-axis. This simplifies the programming of symmetric features. In the Mirror dialog box, select the axis to mirror across and whether to move the original features or create a copy.



The *Append copy number to feature names* check box will add _# to the end of each feature (including the source feature). For example, the result of making a mirrored copy of Line 4 would change the original feature to Line 4_1 and create Line 4_2.

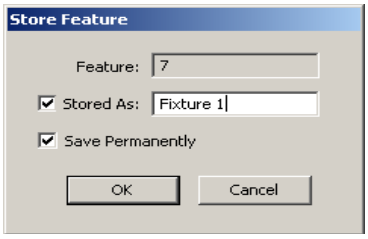
### Set System

Set System gives the user flexibility for taking measurements relative to different coordinate systems. Users will find that although they wrote a program to measure a feature relative to one coordinate system, they may want to know the location relative to a different system or to second system.

### Store Feature

InSpec software allows features to be stored in memory, so you can use them in other programs.

Storing a Feature is simple. First, Create a feature. Then choose *Store* from the Features Context Menu (right click on the feature name). The following dialog will appear:

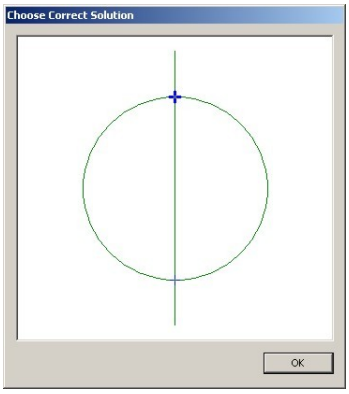



Check the box next to *Store As* and enter a unique name. By checking the *Store Permanently* box you will save the feature permanently. If you do not check the box, the feature will be saved only for the current session of InSpec and will be deleted when InSpec is closed.

Stored Features are often used to save the location of a Fixture. After a fixture has been measured, subsequent inspection programs can begin with a “Recalled” system that brings the data into the current program.

### Edit Solution

There are a number of constructions that have multiple solutions. For instance a line may intersect with a circle in two locations. When you program a part a dialog box will pop up and allow you to select the correct solution. However if the wrong solution was selected, the Edit Solution option can be used to view and select the correct construction. The bold crosshairs show the selected construction point.




**Edit Text**

This option will allow you to edit existing text in a Text and Prompt type features. The dialog will give you the options to accept, reset, and cancel any changes.

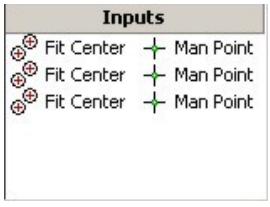
This feature is convenient for exporting text to a data file, especially for cases where the text does not change very often. For instance, if you measured twenty samples per lot, the text message may say "LOT #7909." This could be exported with the data. For the next lot of twenty samples, you could Edit Text to change the number. This would be more convenient than using a Prompt feature that requires user input for each run.

**Insert Here / Insert at End**

The Insert features allow you to add features or copy features to rearrange the order that the features are measured. The insertion bar will be placed above the selected feature when you choose Insert Here, or at the end of the list when you select Insert at End.

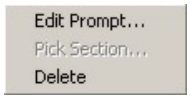
## Inputs List

The Inputs list, located below the Features list, displays the individual components used to create the current feature. These entries tell how a feature was measured and which features were used for data points. Inputs can be selected, edited, and deleted individually.



### Inputs Context Menu

Right clicking on an Input brings up the following menu:




This menu lets you do the following to the Input:

- Edit Prompt… – Displays a dialog box where you add and edit a prompt for the selected Input. The prompts usually are used to instruct the operator where to place the current tool.
- Pick Section... – Allows editing of splines that have been used as inputs.
- Delete – Allows deletion of the current Input.

# CHAPTER 4 FEATURE ICONS

As with most Windows applications, icons are essential components of the program. Icons provide easy access to the most commonly used features of a program. Most of the icons in InSpec are located between the program list and the camera window. This location minimizes mouse movement required for programming and running parts. Color themes and grouping are used to help the user differentiate the functions of the feature, construction, tool, and playback icons.

When creating a program, the icons will change from active and inactive states to indicate that the icon is usable or not allowed. The constructions are restricted to the applicable features.

### Feature Icons

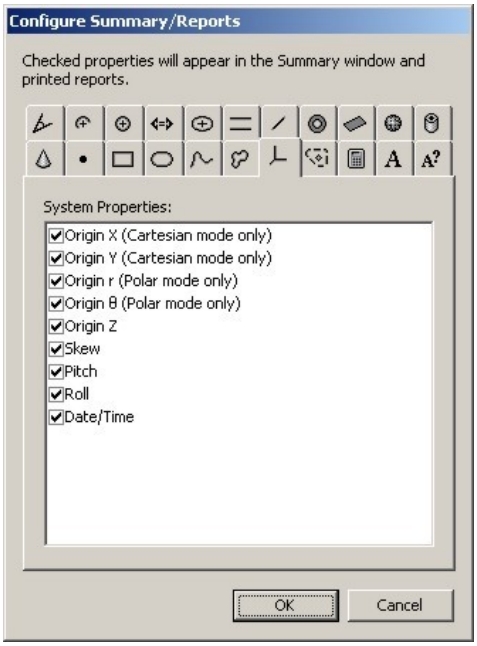
Feature icons are grouped on the left, closest to the program list. They are composed of black symbols on a gray background.

Feature icons represent the features that can be added to a program. Click on an icon and it will appear in the Feature Window. The F5 hot key creates a new feature of the same type as the last feature in the program.

Each feature type, such as a point, line, or circle, has a set of data characteristics. The following feature descriptions list the data characteristics for each feature type. The data charateristics that are displayed in the feature summary can be customized using the Configure Summary option under the Tools menu.

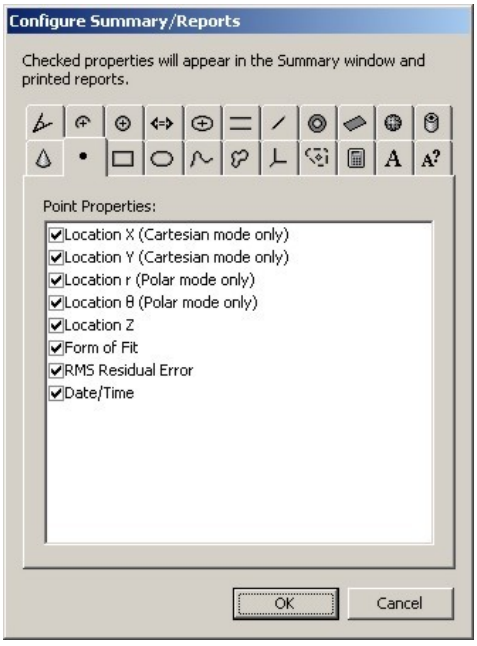
## System

Use the System icon to create a coordinate system. Use systems to orient the X-Y plane, align the counting direction to direction of the part, and zero the counter for an axis. After selecting the system icon a few of the “construction” icons will be active including System Level, System Skew, and System Origin. Select the appropriate construction and then select an existing feature or use a tool as an input.



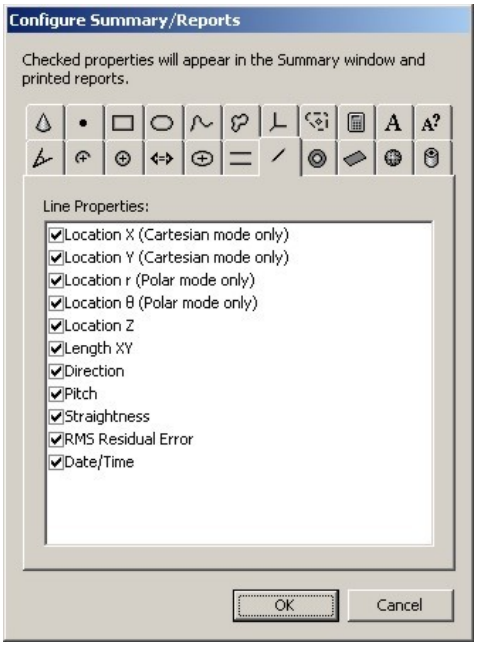
## Point

The Point feature is used to identify an X-Y-Z location. Points can be used to identify starting positions in a program, intersections of lines, arcs, and circles. When used with a focus tool, a point can establish a Z height. Points can also be used to identify the center of a feature or the midpoint of multiple features. For the midpoint between two points, create a Point, use the More Inputs icon, and select the two points.



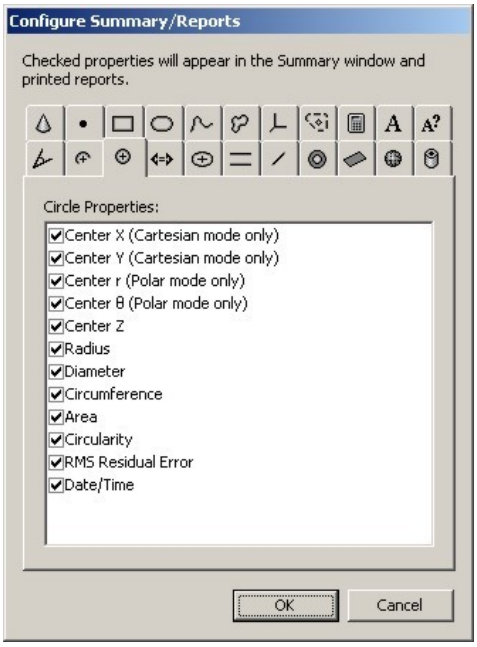
## Line

Lines are most often used to identify edges on a part. A Line feature has a direction in the current X-Y plane and is centered on an X-Y-Z location. Lines can also be created from multiple features, such as a series of circles in a row or a series of points as with the teeth of a rack or saw blade. You may also construct a line between existing features by clicking those features. The center location, direction, length, and straightness are some of the features that are automatically displayed in Summary Dialog box.



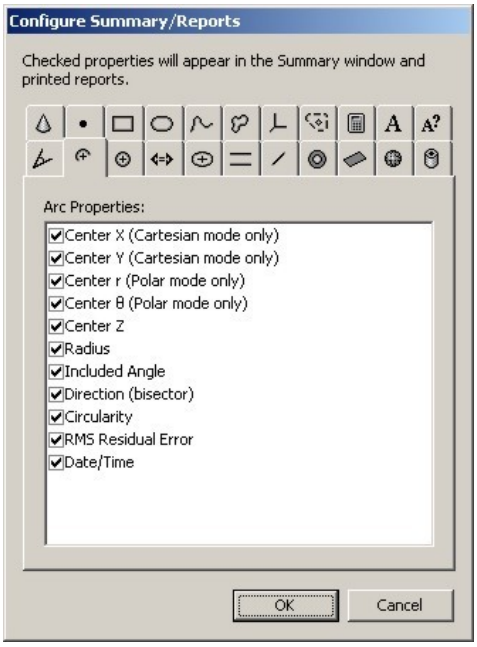
## Circle

Circle measures the location and diameter of a circle. To measure a Circle, click circle and (to use more than three points, click on More Inputs) choose a tool. Enter three (or more) points on the circle. The diameter and the center locations are displayed in the Summary Dialog box. A circle is drawn in the Schematic Window.



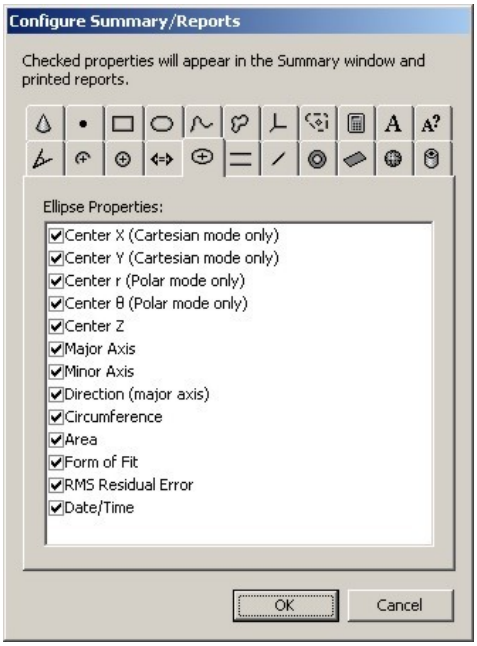
## Arc

An Arc feature determines the radius and center X-Y-Z location. To measure an arc, click on arc and (to use more than three points, click on More Inputs) choose appropriate tool. Enter 3 points (or more) on the arc. The radius and center locations are displayed in the Summary Dialog box. An arc is drawn in the Schematic Window.



## Ellipse

Ellipse measures the location, size, and orientation of an ellipse. To measure an ellipse, click Ellipse and (to use more than five points, click on More Inputs) choose a tool. Enter five (or more) points on the ellipse. The major axis, minor axis, and the location of the center are displayed in the Summary Dialog box. An ellipse is drawn in the Schematic Window.

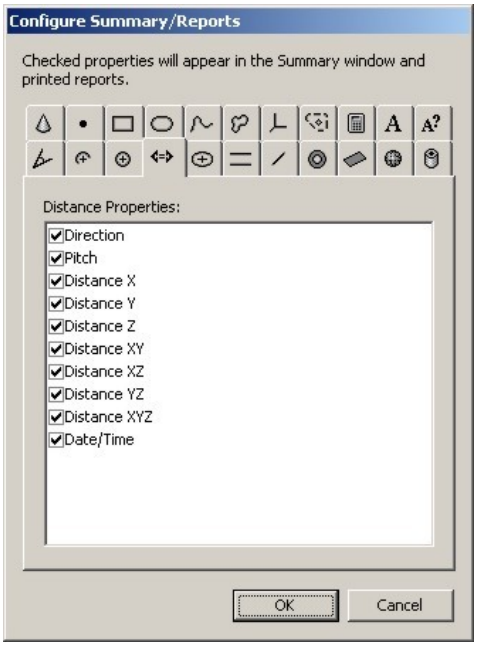


## Distance

Distance measures the path length between two points or features. Distance features are drawn as dashed lines in the schematic window. This way they can be differentiated from the physical features such as sides and edges.

Distances calculate the length between the center points of selected features unless one or both of the features are lines. A distance between a line and another feature will measure length of the normal of the line to the center of the other feature. A distance between two lines will measure the length of the normal of the first line to the center of the second line. This allows measurement of the distance to a line without requiring a system skew.

To determine a distance between two features, click of the Distance icon, then click on two features from the Features list. The 3D distance, 2D distance, X component, Y component, and Z component (height) will be displayed in the Feature Summary.

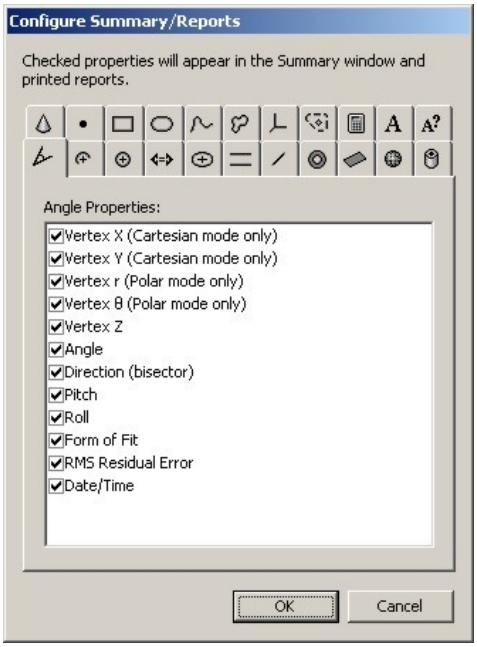


## Angle

The Angle feature allows you to measure the size of an angle and the location of the vertex.

To measure an angle, click on Angle, choose the appropriate tool and enter the four points. Enter two points on one line, and then enter two points on the other line. To use more than four points click on More Inputs and enter more than four points on the two lines. To create an angle from two existing lines in your program, select the Angle icon, select the Intersect icon, and then select the two lines from the program list or schematic display. To find the angle between three features, select the "center" feature twice.

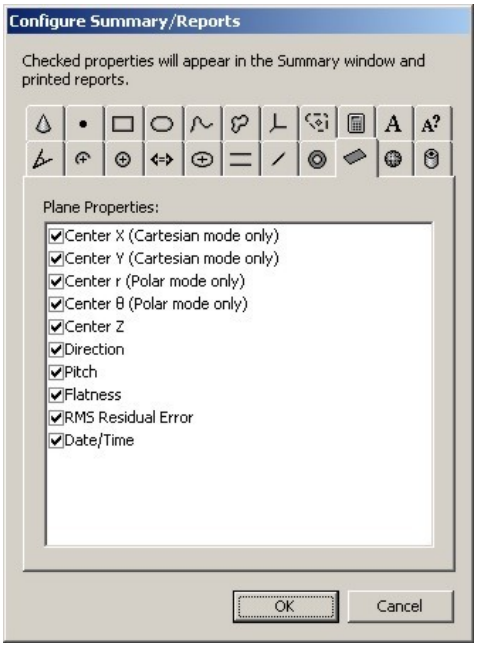
The angle and vertex location are displayed in Summary Dialog box. An angle is drawn in the Schematic Window.



## Plane

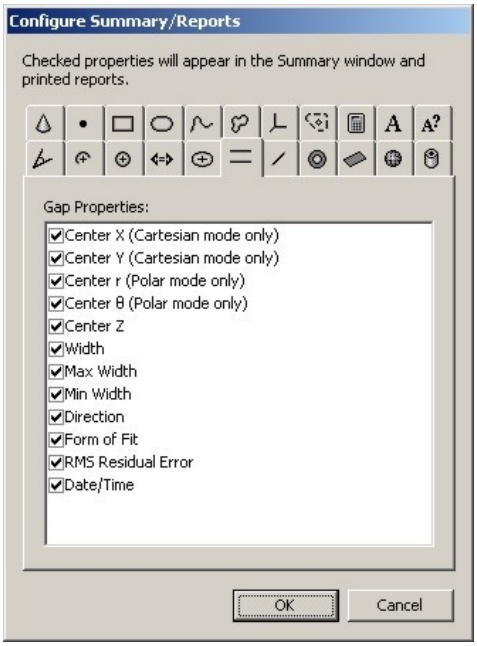
A Plane can be created using a minimum of three points. In most cases focus points will be used to establish a plane. Planes have a center position based on the inputs, a direction that is normal to the plane, and a flatness value when more than three points or features are used as inputs. Distance measurements originate from the X-Y-Z center of the plane.

To create a plane, select the Plane feature icon, and then create three or more focus points on the part surface. The focus points will appear as inputs for the plane. Use More Inputs for more accurate results.



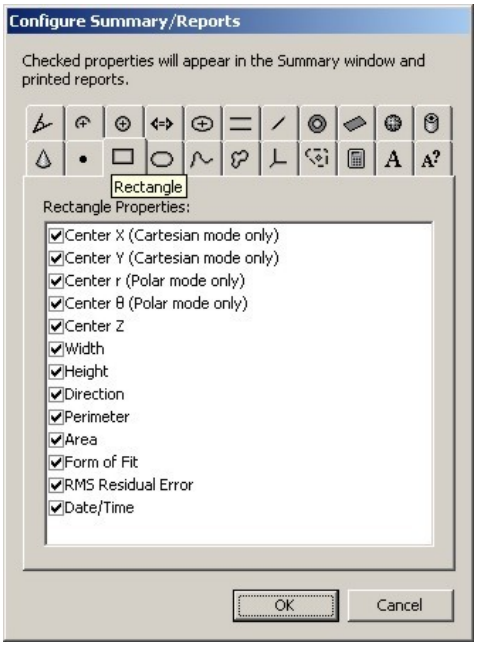
 **Gap**

A Gap is the perpendicular distance between a line and the center of another feature. A gap will have a center position, width, and direction. A gap can be created using a minimum of three points; the first two points construct a line and a perpendicular distance is measured to the third point. The gap can also be create between existing features such as two lines, a line and point, three points, a line and a circle, etc.



## Rectangle

A Rectangle reports the length, width, and center location. It can be defined with five points, a line and three points, or a combination of lines and points. Use the More Inputs button to include additional points in the feature calculation.

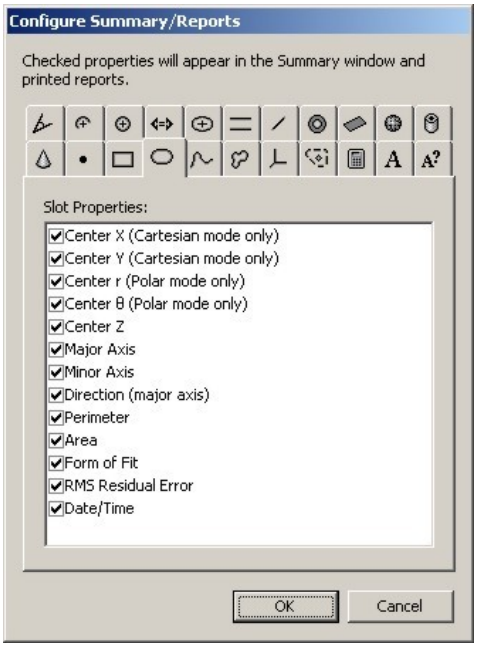


## Slot

The Slot feature in InSpec is defined as having rounded ends of equal diameter as the width. A slot has a center location, major and minor axes, and direction.

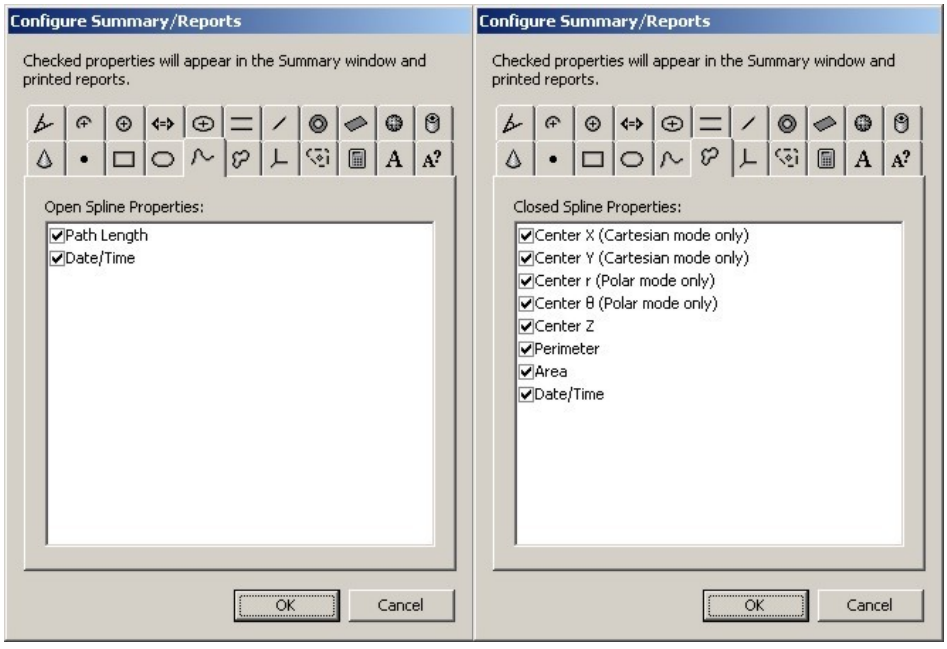
A minimum of five data points is required to create a slot. When using points, the first two points must be placed on one side of the slot. Place the third point on the radius at one end of the slot, the fourth point on the radius on the other end of the slot, and the fifth on the side opposite of the first two points.

More points are recommended for better measurements. However, two points must be on one side of the slot, one point must be on the opposite side of the slot, and one point must be on each of the two radii. Slots can also be constructed from measured features or created using arc and line F-Scan tools.



## Splines

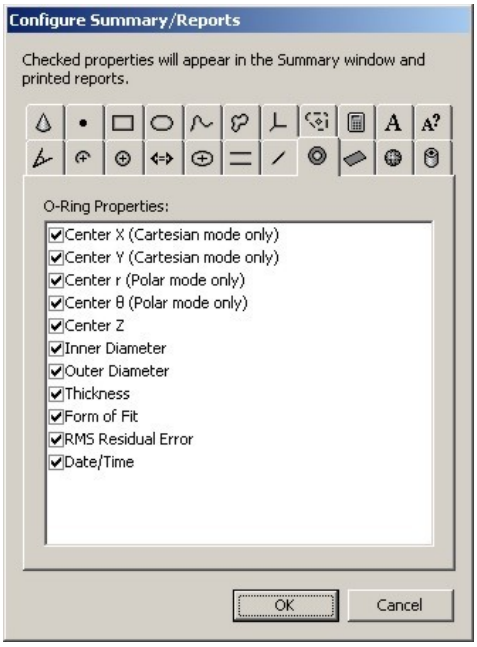
The Open and Closed Splines allows you to measure continuous path lengths, perimeters, and areas of irregular features. InSpec uses the NURBS (Non-Uniform Rational B-Spline) definition of the spline. Data points are fit by a third order polynomial. Create corners by entering the same point twice.



## O-Ring

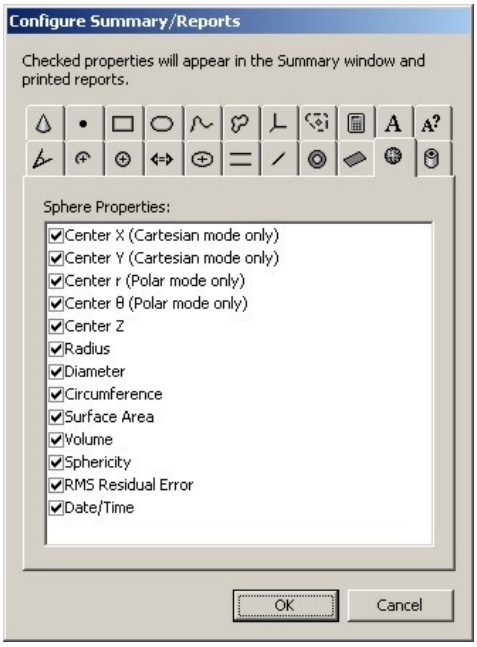
Given a minimum of six points, the O-ring feature calculates an ID, OD, and average thickness for the data points. When additional points are included, the feature calculates the freeform o-ring condition. This allows a flexible ring to be measured in an out-of-round state and produce the same diameter as in its round state.

As with any feature, more data points will produce a better characterization of the feature. The recommended number of point pairs depends on the roundness of the part. For a metal washer, four point pairs might be adequate. But for a rubber band, twenty or more point pairs may be necessary.



## Sphere

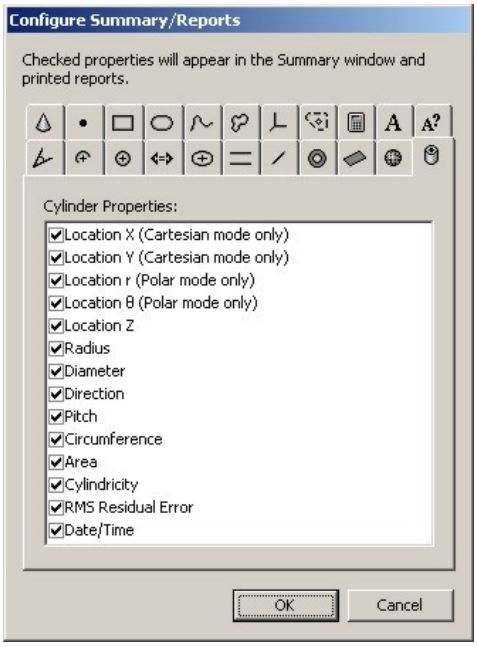
A sphere has a center position, diameter, surface area, and volume. A minimum of four points is required to create a sphere. These points cannot be in the same plane. Therefore, a sphere such as a ball bearing can be measured using three points around the circular profile and a point on top, but not from four points around the circular profile.



## Cylinder

A cylinder is defined by a circle projected along an axis. Like a line, a cylinder extends infinitely in the direction of the axis. A cylinder requires a minimum of five points. These points cannot be in the same plane. In addition, five points is a minimum; more points are highly recommended.

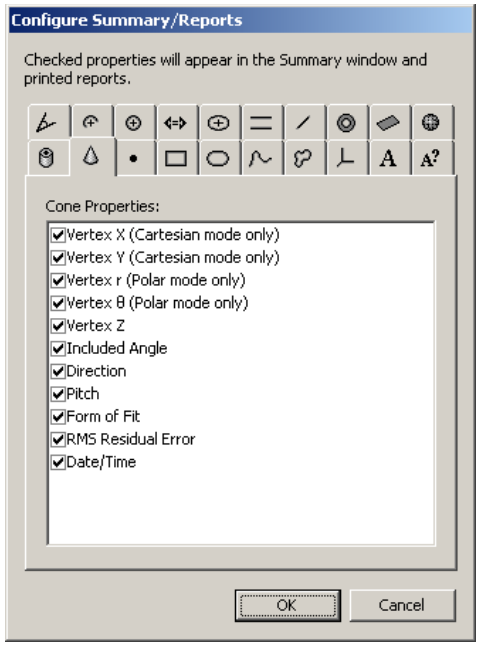
InSpec will fit a cylinder through the entered points. The points entered may possibly fit multiple cylinders. InSpec will assume that your cylinder is roughly aligned to one of the axes. As more points are entered, your cylinder will be better defined. Seven points with three near each end defining a circle and one point somewhere in the middle will consistently define a cylinder with relatively few points.



## Cone

A cone is defined by a vertex point and an angle. A cone extends infinitely from the vertex but only the measured volume is displayed. A cone requires a minimum of six points. These points cannot be in the same plane. Six points is a minimum, and more points are recommended for better measurements.

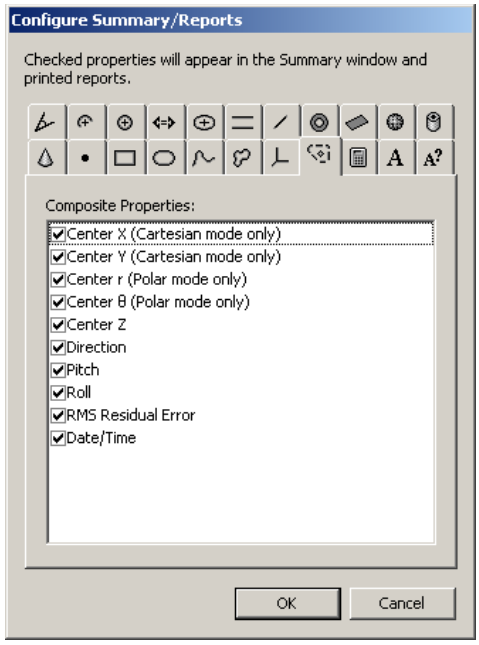
InSpec will fit a cone through the entered points. The points entered may possibly fit multiple cones. As more points are entered, the cone will be better defined. Use three points to define a circle near each end and one point somewhere in the middle. This will consistently define a cone with relatively few points.



## Composite Feature

The Composite feature allows you to combine multiple features into one. A group of holes or an edge consisting of several blended arcs and lines may be evaluated as one feature for position or profile.

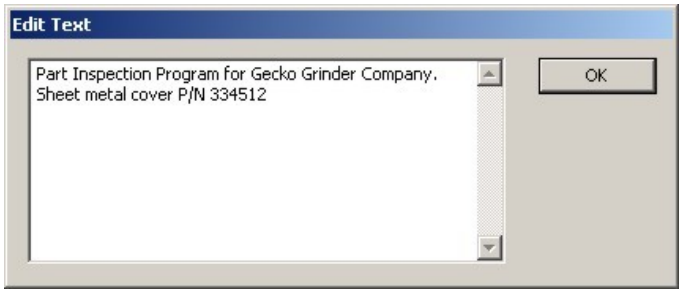
The profile tolerance of a Composite feature has the unique ability to be evaluated with or without a datum reference. Without a datum reference, the profile is evaluated in the same manner as an overlay on an optical comparator. The profile is free to rotate and translate to fit the features.



## Text

The Text feature is useful for adding notes to a program or exporting additional information, such as the company name, lot numbers, operator's name, and comments. The text and feature label can be exported.

The text will not be displayed when the part program runs. It can be edited before or after the program runs. It is convenient to use the Text feature for data that you want to export but that will also remain the same for a period of time. Use prompts for data, such as serial number and cavity number that will change with each run of the program.

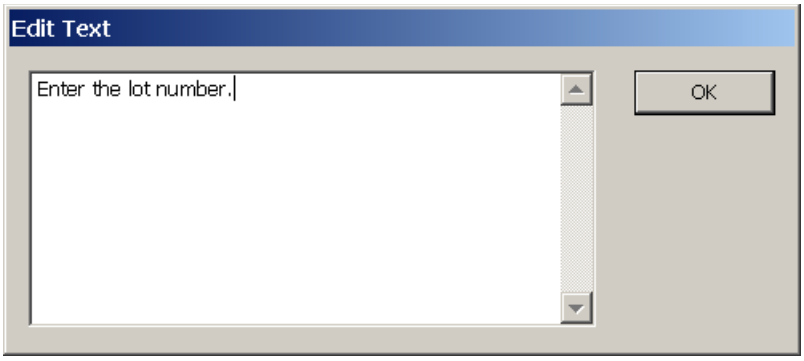


## Prompt

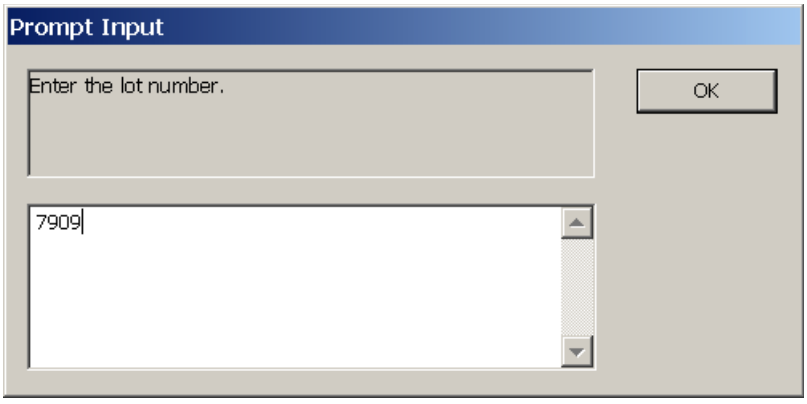
The Prompt feature asks the operator for input to enter information each time that a program runs. The Prompt label, text, and entered value can be exported.

The Prompt includes a text message to instruct the operator what to enter. Use prompts for values that change for each run, such as serial number, mold cavity number, and the time of measurement.

Click on the Prompt Icon to create a Prompt Feature. Enter the message portion of the Prompt in the Edit Text box.



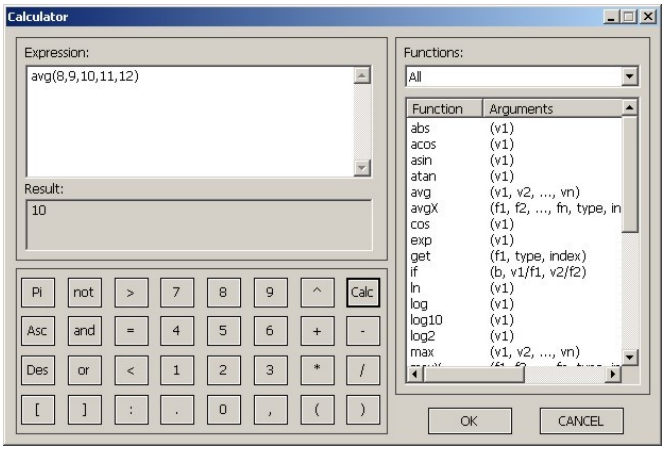

When the program is run, it will display the programmed Prompt allowing the user to enter text.




You may re-edit the Prompt text after it has been created by right clicking the Prompt feature in the Feature list and selecting Edit Text.

## Calculator

The Calculator feature has the ability to perform mathematical, trigonometric, and statistical computations. The result of the Calculator can be given a nominal value and toleranced.




To program, click on Calculator, and choose a function from the Functions Menu. Listed next to each function is a list of the expected arguments for each computation. Enter inputs that correspond to the expected arguments by pointing and clicking with the mouse, or by typing on the keyboard (the Calculator is case sensitive). When you are finished, click 'OK'.

| ***Name*** | ***Arguments*** | ***Example*** |
|---|---|---|
| tan | (v1) | tan([25].AngInt) |
| max | (v1,v2,...vn) | max([1].Dia,[2].Dia,[3].Dia) |
| maxX | (f1,f2,...fn,type,index) | maxX([1],[2],[3],[4],Dia,Nom) |
| if | (b,v1/f1,v2/f2) | if([Circle 2].Dia>5.125,1,0) |

The two main arguments used in the calculator are *feature (f1, f2, ...)* and *value (v1, v2, ...)*.

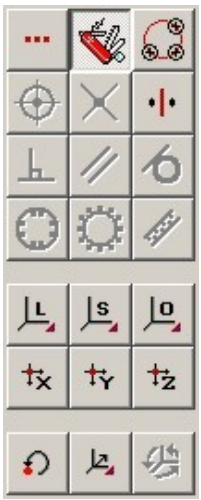
A value is represented by a feature name, type, and an index – each separated by a period. A single value of a circle's measured diameter would appear in the calculator as: *[Circle 14].Dia.Act.* The default index is "Act", which allows you to reduce *min([circle 14].Dia.Act,[circle 15].Dia.Act,)* to *min([circle 14].Dia,[circle 15].Dia)*.

A feature is represented by square brackets around the name of the feature as it appears in InSpec, (e.g. [Datum A]).

When a function is followed by a capital X (maxX, avgX,...), it means that the calculator will be evaluating the same type and index for each of the features listed. This allows you to program quicker by not entering the type and index for each feature. A colon can be used as a shorthand way to program sequential features. Therefore, *maxX([1],[2],[3],[4],[5],[6],Dia,DevNom)* can be reduced to *maxX([1]:[6],Dia,DevNom)*.

# CHAPTER 5 CONSTRUCTION ICONS

Construction icons are used to define how data from one feature is used to construct another. The icons use black with red accents on a gray background. Valid constructions are accented and invalid constructions are grayed out. InSpec determines which constructions are valid based on the current feature type.



**More Inputs**

InSpec allows the operator to use many points or a few points to create features. The More Inputs button acts as a toggle. When it is “up”, the minimum number of points for the current feature is used. When it is “down,” additional points are allowed.

Normally, a circle requires three points. With More Inputs “down,” more that three points can be used to measure the circle. The additional data provides a better characterization of size, location, and form of the circle. Just click on the icon to switch between minimum inputs and multiple points modes.

Multiple points also works with feature scan tools. In “Multipoint” mode, a circle can be created using arc feature scan tools. Similarly, a long line can be measured using feature scan line tools. Although these features do not fit completely in the image window, data from the entire feature edge can be gathered using multiple feature scan tools at different locations on the feature.

 **Auto**

The utility knife icon is used to toggle Quick Fit mode on and off. Normally the button is down and you will be using it. The most common events are preprogrammed into Quick Fit mode to minimize mouse movement and button clicks. Special constructions can be created by explicitly selecting other icons.

For example, if you create a system feature and then select a line, Quick fit will automatically skew to the line. Click again on a point or circle and Quick Fit will set the system origin to the point or circle.

 **Fit To Center**

Fit to Center uses the center position of the selected existing feature or tool to create a new feature. In many cases, Quick Fit mode will automatically use Fit to Center. For special constructions, select Fit to Center to explicitly use the center of a feature.

Use Fit to Center to find the diameter of a bolt pattern. Create a circle feature. Select Fit to Center, and then pick circles from the feature list that represent the holes. The schematic will show a best-fit circle through the circles.

 **Fit Points**

Although you do not see an icon for Fit Points, you will see it used in the Inputs list as you construct features. This is usually the default construction used by InSpec in Auto mode

Fit Points indicates that data from vision tools is being used to construct the feature. Several F-Scan radius tools may be used to measure a complete circle. Or four lines may be measured and then fit to create a rectangle feature. Similarly you may fit the data of two lines and two radii to create a slot.

 **Centered**

The centered construction is used to construct circles or arcs. The circle or arc will require only two inputs: one feature or tool to locate the center of the new circle or arc and a second feature or tool on the circumference on the new circle or arc. This creates a circle centered on the first feature with a radius equal to the distance between the first and second input.

 **Intersect**

Intersect creates a point that lies where two features cross. To create an intersection point between two lines, select the point feature icon, then the intersect icon. Select the two lines to be intersected from the Features list or graphics window. The lines do not have to cross on the schematic. InSpec will project lines to construct the intersection point.

A line intersects with a circle at two intersection points. InSpec will display a small diagram of the two choices and allow the operator to select the correct point. Other constructions will have multiple solutions, such as the intersection of a circle and ellipse that may have four possible points. In each case, InSpec will display the intersection points and allow the operator to select the correct solution.

 **Bisect**

Bisect is a construction used to create a line or a point that lies exactly in between two other features. The most common use is creating a line that bisects two other lines. To use this bisect construction first create a new line feature. Select the Bisect icon and pick the two lines you want to bisect from the feature list or schematic.

You can select either of the two bisect solutions provided: one line that bisects the angle of the two lines, or a line at the vertex of the included angle that is perpendicular to the first.

 **Perpendicular**

Use the perpendicular construction to create a line that is perpendicular to another feature (typically another line). This is a construction not a measurement. This allows you to create a line that makes an exact 90-degree angle with the selected line or feature.

Create a line, select the perpendicular icon, select the reference line, and then select another feature to set the location of the line.

For example, a part has a hole located close to an edge and the drawing sets the minimum distance from the edge to the hole. After measuring the edge and the hole, create a line perpendicular to the edge through the hole. This will create a line that intersects the holes at the closest and furthest point to the edge. The closest and furthest measurements can be taken from these points to the edge.

 **Parallel**

Use the parallel construction to create a line that is parallel to another feature (typically another line). This is a construction not a measurement. This allows you to create a line that has the same direction as the selected line or feature. Use it the same as the perpendicular construction above.

 **Tangent**

The Tangent constraint is used when constructing circles or lines.

A line tangent to two circles has four possible solutions, so a multiple solutions dialog will be displayed allowing the preferred solution to be selected. The chosen solution will be used when the program is rerun.

A line tangent to a circle or ellipse is supported. The other input must be a single Fit Center. The two solutions will be displayed so that the desired solution can be chosen.

A circle will require that one point is tangent to a line. You may construct a circle that is tangent to one, two or even three lines provided that the circle is fully constrained by its other inputs.

You may begin a circle feature that is Centered On a Point and the construct it Tangent to an existing line or one created using an FScan line tool.

 **Circumscribed**

The Circumscribed constraint is used to construct circles.

The circle will require the standard inputs for any circle. This can be the field of view circle, profile circle, or any combination of best edges, first edges, and closest edge.

This creates a circle that utilizes three points from the data set to construct the smallest circle that encompasses all of the data points.

 **Inscribed**

The Inscribed constraint is used to construct circles.

The circle will require the standard inputs for any circle. This can be the field of view circle, profile circle, or any combination of best edges, first edges, and closest edge.

This creates a circle that utilizes three points from the data set to construct the largest circle that fits inside all of the data points.

 **Minimum Zone**

The Zone constraint is used to construct circles and arcs.

The circle will require the standard inputs for any circle. This can be the field of view circle, profile circle, or any combination of best edges, first edges, and closest edge.

A circle is created by allowing the center position to float and by minimizing the zone between two concentric circles that bound the measured data points.

 **System Level**

System Level allows InSpec to accurately relate features in planes that are not parallel to the focal plane of the stage. Level requires three inputs such as focus points on the surface or a single reference to a plane. After using System Level, the X-Y plane will be parallel to the selected plane. Note that the Z direction will be normal to the selected plane but will not be zeroed to the plane. Use Z-origin to set the Z value to zero.

 **System Skew**

The System Skew orients the X and Y counting directions of the program to that of the part. This allows parts to be measured without aligning the part to the axes of the stage. Skew will adjust the X- or Y-axis to a line on the part. Select System, then Skew, and then a line. To skew to the center of two holes, first measure the holes using two Circle features. Then create a line between the holes and skew to the line.

 **Skew X and Skew Y**

Unless specified, the skew will align the closer of the X- or Y-axis to the selected line. To specify an X or Y skew, select the X or Y origin buttons immediately after selecting Skew, and then select the line. This becomes especially important when skewing to a feature that is oriented 40º-50º from the current coordinate system. This forces the skew to select the rotate the selected axis, X or Y, to the direction of the line. It is important to remember that lines have direction. A line that connects

points 1 and 2 will have the opposite direction of a line that connects points 2 and 1.

 **System Origin**

The System Origin creates a datum zero X, Y, and Z on a designated feature or location. To set an origin, select the System Origin icon, and select a feature from the instructions list or schematic. If the previous feature was another system, you will need to select the System icon first to begin a new system.

 **X – Origin**

There are circumstances where the X origin must be set separately from the Y or Z. Select the System X icon and then select a feature from the instructions list or schematic or select a point in the camera window.

 **Y – Origin**

There are circumstances where the Y origin must be set separately from the other axes. Select the System Y icon and then select a feature from the instructions list or schematic or select a point in the camera window.

 **Z – Origin**

There are circumstances where the Z origin must be set separately from the other axes. Select the System Z icon and use a focus point in the camera window or select a feature from the instructions list or schematic.

 **Recall Feature**

Recall is usually used to “recall” the home position of the stage (REFSYS, a permanent stored feature) as the data point for the first system in a part program. Once the program has established an X-Y-Z origin, the program has a reference point to use and can begin searching for the next feature.

Recall is often used to create systems at the beginning of a program, but it is capable of much more. Recall can be used with any feature type. It allows the data points of the recalled feature to be used to construct the current feature.

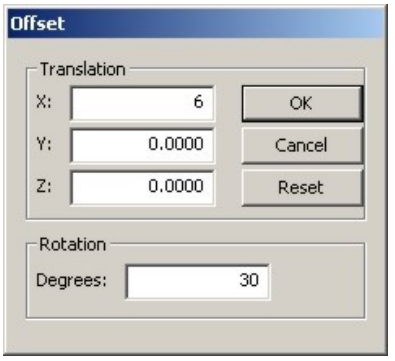
## Move Point

The Move Point enables the operator to move the stage to a particular location without making a measurement. This allows the user to guide the lens around the part to prevent collisions. It can also be used to move the part forward or camera back to ease loading and unloading of parts.

## Offset

This gives ability to offset and rotate a construction (such as a coordinate system) by a nominal value.

To offset a feature, create the feature first, and then click on the Offset icon. Enter the translation distances and rotation angle (counterclockwise is positive). Click on OK when you are done and the feature will be displayed on the graphic portion of the schematic.




## Working Plane

This feature is used to simplify measurements of three-dimensional objects. The working plane is only available for system features. The button toggles the working plane between XY, XZ, and YZ. The working plane feature operates the same as leveling to a plane. However, instead of creating the plane with points, constructing the plane, and then leveling, it takes only one or two click to change to the XZ and YZ working plane. The change appears in the Inputs section of the program list.

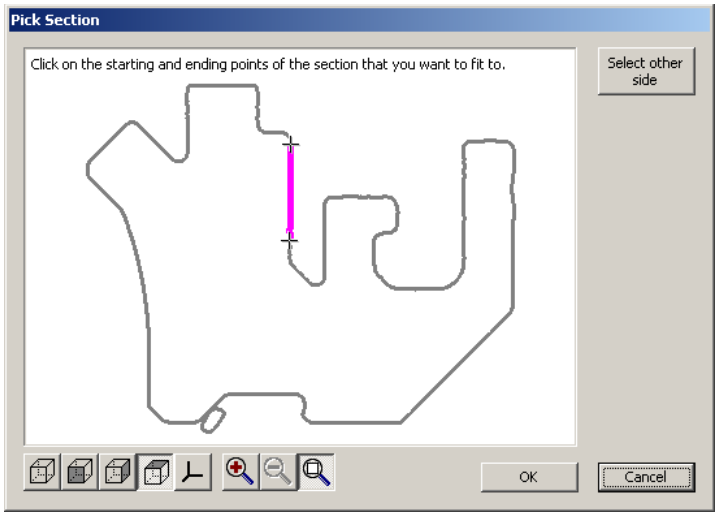
For example, you may want to measure the diameter of a soda can that is lying on its side. Create three focus points on the top of the can. Then assuming the can is lying in the X direction, create a system feature and use the working plane icon to change to the YZ working plane. Watch the DRO when you move the stage. The axes have changed so that the X&Y PCS are the Y&Z of the MCS. Z of the PCS is

X of the MCS. Now create a radius and use the three focus points. InSpec projects the points into the YZ plane, which is now the working plane and calculates the radius of the can.

### Fit Section

Fit Section is a term used to dissect an open or closed spline into separate entities. Using Fit Section, a spine of a slot could be separated into two lines and two arcs. Then the straightness or parallelism or the lines or the position or circularity of the arcs could be evaluated.

Fit section is an Auto function. If you create a new line, arc, or angle and select an existing spline as an input, InSpec will open the Pick Section dialog. Select data from the dialog and continue with the construction of your feature.



# CHAPTER 6 OTHER ICONS

 **Make Point**

The Make Point icon allows the operator to enter a point at the crosshairs. This functions the same as the footswitch and spacebar. A data point is added to the inputs of the current feature in the program list.

## Playback Icons

The Playback icons allow the user to start from the beginning, stop, and continue the playback of a part program.

 **Run**

The Run icon starts the current measurement program from the top of the Features list. Manual points and features measured to create the first system will require operator input.

 **Continue**

The Continue icon restarts the measurement after the process has been paused or stopped. Continue starts the program from the current feature and progresses down the program list. This allows the user to stop the program, skip features, and restart the measurement process if needed.

 **Stop**

The Stop icon will stop the measurement of a program. While stopped, measured features can be checked and remeasured if needed. Use Continue to restart the measurement process.

## Schematic Icons

Customers use Micro-Vu systems to measure a variety of parts. Some lager parts have small features. InSpec provides zoom capabilities in the schematic so that you can view the relative position of these features.

Use the Fit and Zoom Icons directly below the Schematic window to zoom in on smaller features and zoom out to see the entire Schematic.

 **Zoom-In**

Use the Zoom-In icon toggles between the “Zoom” state and the “Pick” state. When the button is pressed, the mouse cursor will show a magnifying glass when the mouse is in the Schematic window. To zoom in on features, click-and-drag a window around the area you would like to enlarge.

When the button is “up,” the mouse cursor will be an arrow allowing the user to select features.

 **Zoom-Out**

The Zoom-Out icon incrementally decreases the zoom so that you can make slight increases to the field of view.

 **Zoom to Fit**

The Zoom-Fit icon will change the Schematic zoom to display all of the features in the program and the location of the current stage position. Note that if the camera location is not near the part and the part is relatively small, then the part features will appear small on the screen.

 **Tags**

The Tags icon allows the user to mark selected features on the Schematic. This makes it easier for the user to locate specific features. The user may select a group of features from the Features list and change the tag status for all of the selected features at one time. A feature’s Tag displays the number or name of the feature. When a feature is renamed the feature’s name is displayed in place of its number.

# CHAPTER 7 EDGE DETECTOR SYSTEMS

This section applies ONLY to systems with profile edge detection.

Profile edge detection uses an optical sensor to determine when an edge has been crossed. An edge is any light to dark or dark to light change that crossed a preset threshold.

Profile edge detection allows you to determine the location of the edge without lining up the crosshairs. As the crosshairs pass over the edge, the edge detector locks in the coordinates of the threshold. Edge detection can improve repeatability between operators. The edge detector uses the same threshold each time, whereas different operators will often spot an edge in different locations.

## Edge Detector Modes

Icons for Edge Detector Modes are grouped next to the schematic window. The icons are black with green accents on a gray background. Each icon represents a different mode: Edge Detector Off, Auto Edge Detection, and Edge Deetection Confirm.

 **Edge Off**

With the edge detection off, an edge detector system does not look for edges. With edge off, the operator visually determines the location of a feature. The operator simply aligns the crosshairs with the point on the part and enters a point.

 **Auto**

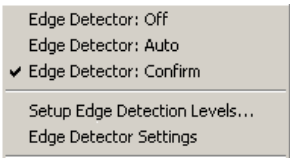
The Auto Edge mode enters a point every time an edge is crossed. InSpec will beep to notify the operator that a point has been entered.

### Confirm Mode

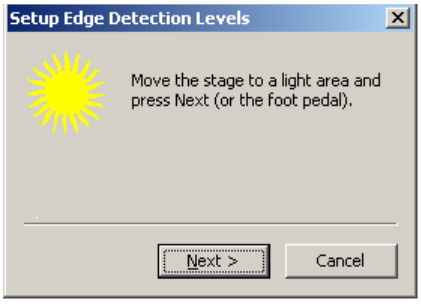
Confirm mode is like Auto edge with the exception that InSpec waits for the operator to confirm the edge. When an edge is crossed, InSpec will beep. The operator must then press the spacebar, foot pedal, or enter button to enter this edge. The confirm mode prevents dust or incorrect edges from being entered by mistake.

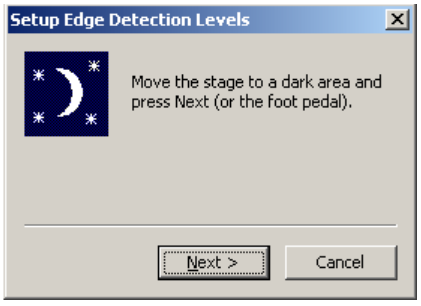
## Edge Detector Calibration

Options in the Machine Menu allow you to select between different edge detector modes and set edge detection levels.



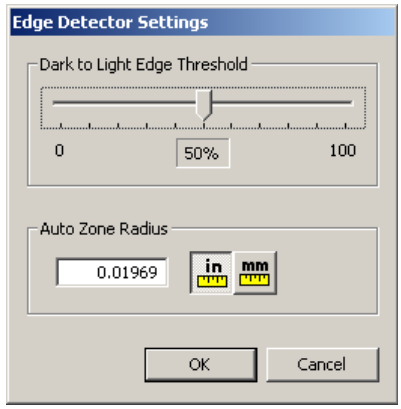

To calibrate the edge detector, select Setup Edge Detection Levels. Follow the dialog boxes to enter light and dark levels.




## Edge Detector Settings

In the Machine menu, you can choose Edge Detector settings. This dialog allows you to change the edge threshold and the zone radius.




## Edge Threshold

*The dark to light edge threshold can be changed. This adjusts where an edge detector capture an edge. This should not be changed unless you test the edge detection on a known artifact. Tall or translucent parts may require adjustments to the edge threshold for the most accurate measurements.*

## Auto Zone Radius

*The auto zone radius works with the edge detector in Auto mode. InSpec uses the zone radius limit where edge points are taken. When you run a program, InSpec creates a zone around the target point. The size of the zone is set by the zone radius. Although you will hear beeps as InSpec crosses edges, InSpec will not use the edge unless it is within the zone.*

*If a circle is created with points at 2, 4, and 10 o'clock, then the operator must return to these same locations when running the program in auto-edge mode.*

# CHAPTER 8 BEGINNING TO MEASURE

Micro-Vu's InSpec software provides an easy-to-use, point-and-click style to create measurement programs. InSpec records the stage position for each point as you "teach."

Not only are programs easy to create, they are also easy to edit. Because of the Feature/Input structure of the program created in InSpec, the user is allowed to go back and change individual steps of the program.

When you open InSpec, the Schematic window, features list, and inputs list will be empty. As you teach InSpec the features on a part, the features will appear in the Schematic and be listed in the features list. The individual points used to create each feature will appear in the inputs list. You can save and open files from the File menu as you do in other Windows based programs.

## Measuring the Sample Part

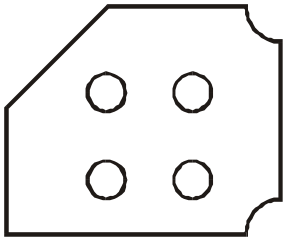
The following section shows step-by-step, icon-by-icon, how to measure a few features on the sample part. Follow along step-by-step. Some of the steps are explained as they occur. Others are better explained later in the manual. You should be familiar with the basic Windows operations and the InSpec user interface before beginning.

### Preparation

- Turn on the computer and machine.
- Double click the InSpec icon to start InSpec.
- Set the zoom to the lowest magnification. Using low magnification makes moving the stage easier for a beginner and allows you to view more of the part at one time.
- Set the profile lighting to 10-20% and turn the other lighting off.

## Beginning a Program

- Place the sample part on the stage as shown.

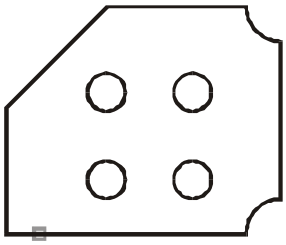


The first step in measuring a part is to align the part with the measuring system. Some parts can be placed on the measuring stage in such a way that they are aligned with the X and Y travel of the stage. Many parts, however, cannot be aligned as such.

Fortunately, InSpec can compensate for this with the Skew feature.

In this example, we want to align the measurement system to the bottom edge of the part.

- Select Skew  using the mouse.



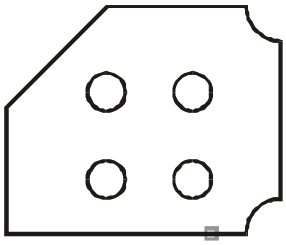
- Move the stage to align the bottom edge of the part (near one corner) with the crosshairs.

This position is shown in the figure above by a small square.

- Press the foot switch to enter that point. If you do not have a foot switch you can press the spacebar on the computer keyboard.

Skew requires two points on a line, so we must enter one more point.

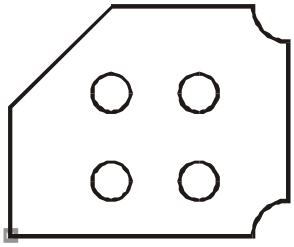
- Move to another point on the bottom edge of the part, this time near the other corner. Press the foot switch again.



This completes the Skew alignment. InSpec now knows how the part is aligned on the stage. All our measurements will now be referenced to this alignment. As you move the crosshairs along the bottom edge of the part, the Y value should remain close to zero.

### Zeroing the origin

Now let's "zero" the DRO. This is the same as setting the origin or a datum on the part. This will set a point on the part to be X=0 and Y=0. In this example, we want to set the origin to the bottom left corner of the part.



- Move the crosshairs to the bottom left corner of the part.
- Click on the X and Y buttons on the DRO or the x-origin and y-origin icons to indicate that you want to create a zero point.
- Then press the foot switch or space bar or Make Point icon to enter the point.

**The foot switch, space bar, and Make Point icon have the same function of accepting the data point at the crosshairs.**

X and Y are now set to zero at the lower left corner of the part. All dimensions in this example will be referenced to this point.

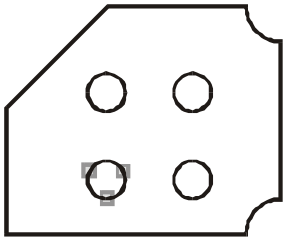
Notice that a System appears in the Feature list on the left side of the screen. A coordinate system has been "programmed." A coordinate system is composed of an X, Y, Z origin (these may be set separately), an alignment or skew, and a level. Level is not used in this example and is assumed to be parallel with the top of the stage or measuring surface.

### Measuring a diameter

There are four holes in the sample part. Let's measure the diameters of these holes. Later we will find the distance between them.

- Select  , the Circle feature icon.
- Move the stage to align the crosshairs to the edge of the hole.

A circle requires at least three points. See the figure.



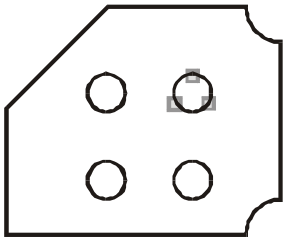
- Press the foot switch to enter the point.

InSpec now needs two more points.

- Move the stage and enter two more points on the hole with the foot switch.

After the last point was entered, several things happen. First, the Circle will be drawn in the Schematic window. The Feature Summary window will display the diameter as well as the X and Y coordinates of the center. These coordinates are the distance from the datum point (lower left corner) to the center of the diameter. Features are drawn in the Schematic window as they are measured. They are given a label, which is a number generated by InSpec.

- Now measure another hole in the part. Refer to the figure below. Select Circle and enter three points using the foot switch.



Notice that the information on the Schematic and Feature Summary windows are updated for the new feature.

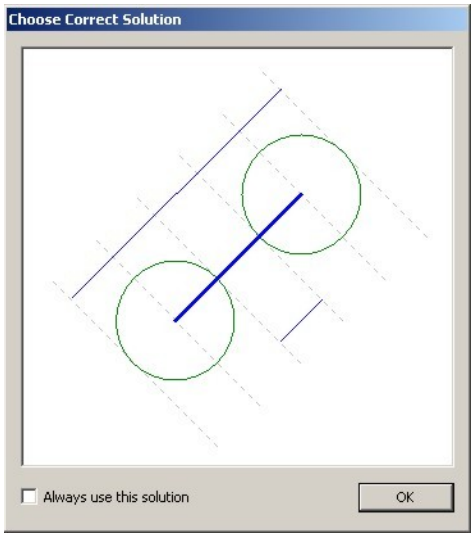
**Hole to hole center distance**

We can find the distance between the two holes or any two features.

- Select the Distance icon  .
- Then select the two diameters with the mouse.

There are a couple of ways to select features for input. Click the mouse on the feature name in the Features list, or click on the feature label or the feature itself in the Schematic window.

- If prompted, select one of three possible solutions: minimum, centers, or maximum distance. This is an optional prompt that can be set to a default solution.

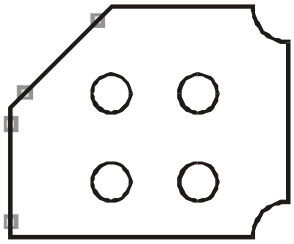



A Distance feature is added to the Features list and the distance between the two centers is shown in the Feature Summary. The Feature summary will typically display the X, Y, and XY components of the distance. The distance will be displayed in the Schematic window as a bold line because it is the current selected feature. If you select one of the other features, you will see that a dashed line will represent the distance.

**Measuring an angle**

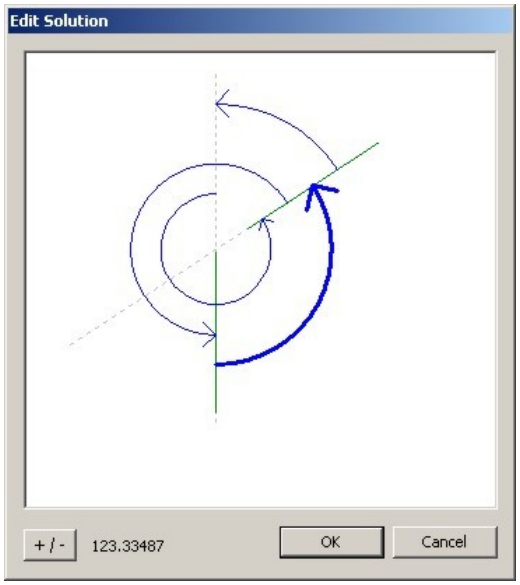
Now we will measure the angle on the top left side of the sample part. An angle measurement requires four points, two on each leg of the angle. You can also intersect two lines to create an angle.

- Select the Angle icon  .
- Move to a point on the first line of the angle, far away from the vertex. (The vertex is the point of the angle where the two lines intersect.) See the figure below.



- Press the foot switch to enter the two points on the vertical side.
- Now enter two points on the second line.

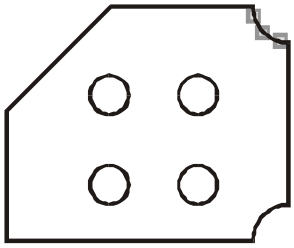
Once you have entered enough inputs, InSpec will display a dialog box to help choose the angle of interest. Just click on the correct angle and then on OK.




The angle will be displayed in the Schematic Window. The angle and location of the vertex are shown in the feauter summary. Remember that the X and Y position of the vertex is referenced from the datum at the lower left corner of the part.

### Measuring an Arc

Next we will measure the radius of an arc on the top right of the part.



An arc, like a circle , requires a minimum of three points. However, more than three points can be used for greater accuracy.

- Select the Arc icon  .
- Enter three points on the curve using the foot switch, space bar, or Enter Point button when the crosshairs is positioned on the edge.

The radius and position of the center of the Arc will be displayed in the Feature Summary.

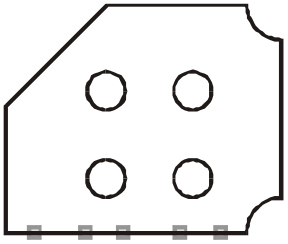
You can also expand the Feature Summary list Result Window using the mouse. Place the mouse pointer over the Feature Result Window and click the left mouse button. This is the same as pressing the Tab key on the computer keyboard. To remove this expanded window, click the left mouse button again.

**Measuring a multi-point line**

Although each feature has a minimum number of inputs, you will get better results using more inputs. The more data InSpec has about the part, the better the measurements will be.

Now measure a Line using five points instead of two.

- Select the Line icon  with the mouse.
- Then select the More Inputs icon  . Notice that the More Inputs button acts as a toggle. When it is pressed, features can use More Inputs; when it is up, features use the minimum number of inputs.
- Enter the first two points along the bottom edge of the part as shown in the figure. Notice that a short line is drawn in the Schematic after the second point is entered.



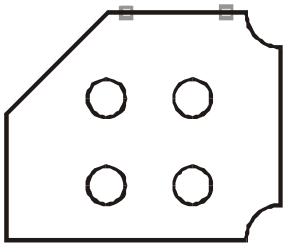
- Enter three more points. Notice that the line is extended as you enter the additional points.

- Now press the More Inputs icon  again to return to the minimum inputs mode.

**Distance between lines**

Let's measure the line at the top of the part and then take the distance between the top and bottom line to this top line. This will give the overall Y dimension of the part.

- Select Line icon  again.
- Enter two points on the top edge of the part.



Now that you have the top and bottom line, you can find the distance between the two lines using the Distance feature.

- Select the Distance icon  .
- Select the top and bottom lines from the Features list or from the Schematic.

Notice that when the mouse hovers over a feature in the Schematic, the feature changes color.

### Saving the Program

What really makes InSpec useful is the ability to save and retrieve measurement programs. This saves time when the part needs to be Inspected the next time. Measurement routines are documented and operators make the same measurements in the same order.

- Select Save or Save As from the File menu.
- Give the file a name such as “Tutorial” at the File Name prompt and then click on Save.

The default directory for saving and opening a file is C:/InSpec Documents.

- Select New from the File menu to start another program.

In an effort to simplify the user interface, InSpec only allows one program to be active at a time. Tutorial will no longer be open. If you selected New and did not save the program, the program is GONE. If that was not what was intended, you get to practice on the tutorial again.

### Loading and Running a Program

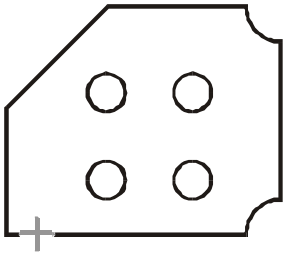
Opening an InSpec program is just like opening a program or document in most other Windows software.

- Click on File to display the File Menu.
- Select Open from the list of options.
- Browse through the file listing directories to find Tutorial.
- Click on Tutorial and then on Open, or double click on the file name.

The Features list and graphic will load. InSpec is ready for you to place a part on the stage and begin measuring. In the Run Mode, you are guided through measuring the part. All you need to do is move the stage and press the foot switch.

- Click on the Run Icon  to run the program and follow through the program.

The current feature will be displayed in the program list. Large gray crosshairs appear on the Part Drawing in the Schematic Window. These crosshairs are showing where on the part to take the next point. See the figure.

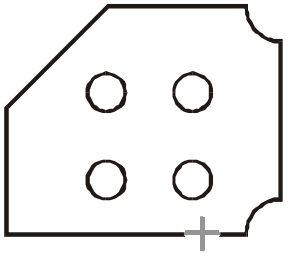


Later in the program, after a system is created, a second smaller crosshairs will appear. The second crosshairs will show the current camera position in relation to the part. It will appear only after the origin (X=0, Y=0) is established.

- Move to the bottom edge of the part near the corner, as shown. Looking at the video monitor, not the computer monitor, align the crosshairs with the part and press the foot switch.

This corresponds to measuring the first point in the Skew calibration. The large crosshairs now move to the next point on the part.

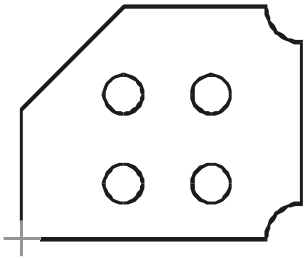
Note: The term “computer monitor” refers to the monitor where the InSpec Software is displayed. The term “video monitor” refers to the measuring system's closed-circuit monitor where the image of the part is displayed.



- Move to the second point (a point on the bottom edge near the other corner) and press the foot switch.

The Skew is completed and the part is aligned.

You will now be prompted to take measure the point where X and Y are set to zero. Notice that the large crosshairs move to the corner of the part.



- Move to the bottom left corner of the part as shown and press the foot switch.
- The X- and Y-axes are now zero at this point.

Now that the Skew alignment and X and Y datum have been set, the small crosshairs appear in the Schematic Window.

The small crosshairs show the current stage position in relation to the part being measured. As you move the measuring stage, the small crosshairs will move.

The rest of the measurements are even easier. Move the X- and Y-axes to align the small crosshairs and large crosshairs. Then the edge for the next point will appear on the video monitor. Make fine adjustments while looking at the video monitor. Enter the point with the space bar, foot pedal, or point entry button.

The large crosshairs in the Schematic Window are on the edge of the lower left circle.

- Move the stage to align the smaller black crosshairs with the larger gray crosshairs while looking at the computer monitor.
- Look over at the video monitor and align the camera crosshairs to the edge of the hole.
- Press the foot switch.

The large crosshairs move to the next point. Repeat these steps to measure the remaining points on the hole and the points on the remaining features.

The measured values appear in the Feature Summary as you make the measurements.

# CHAPTER 9 HOW TO MEASURE YOUR PARTS

InSpec for Windows provides a powerful metrology software package while keeping the user interface simple. With the previous example you can see that it is easy to measure the sample part, but now how do you measure other parts.

Considering the diversity of our customers and their parts, it is a challenge to write a “How To” manual that will explain how to measure every part. This section provides some “typical” measurements examples and programming tips. By applying the concepts in this chapter, you will have a good foundation to build a program for measuring “any” part. Keep these steps in mind when creating a part program.

- Plan your measurements
- Set light levels
- Stay in focus
- Create a coordinate system
- Measure features

## Planning a Program

The first step to writing a program is to identify the features that you need to and can measure with the Micro-Vu system. Proper planning can save you time programming and running parts.

The next step is to look at the part and identify the order in which you need to take the measurements. For example, you need to measure datum features before you can measure other features that relate to the datum features. Also consider the order of features to minimize long moves of more that a few inches. For example, you can measure the perimeter features of the sample part and then do a distance between the features instead of measuring the left side followed by the right and then the top followed by the bottom of the part.

An InSpec program will not display the position crosshairs until an initial coordinate system is created. This system is typically created from the datum features on a part. The initial coordinate system information tells InSpec where the part is located on the machine and how the part is aligned. After establishing the initial coordinate system, InSpec knows the stage position and can place a crosshairs on the Schematic Window as a reference to the operator. Later in the program, additional coordinate systems can be added.

## Plan your Measurements

Planning your measurements will save you programming time and shorten the overall run time of the program. Ask yourself the following questions.

How is the part going to be held in place?

Although the system is not motorized, the part can still slide on the stage. This would create errors in measurements. Secure parts with clay or clips.

How you are going to build the initial system? What features are needed to start the program? Can you use the RefSys?

What measurement order will minimize move time between features? This is a relatively minor issue except on large parts.

## Selecting Light Levels

Lighting can have a large impact on image quality and edge definition. When selecting lighting, it is important to make edges appear as crisp as possible. Sharp edges will produce more repeatable and more likely to work on the next part that may not have the same surface finish.

The best way for beginners to learn proper lighting is to look at a variety of parts and try different lighting. The best words of advice are “Not too little, not too much” and “experiment.”

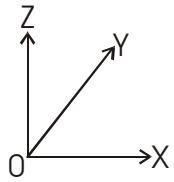
**Coaxial Light** or “Through the Lens Light” (OPTIONAL). In a video system, coaxial light refers to an illumination source that is parallel to the optical axis. This is usually achieved with a right angle beam-splitter between the lens and the camera.

**Profile Light** Illumination that originates from behind (under) a part directed upwards toward the lens/camera system. This lighting technique is very good for illuminating flat parts.

**Surface Light** or “Ring Light.” In this application, surface light refers to illumination from above the part. The light is reflected off the surface of the piece. Usually, surface lighting is some form of ring light around the lens.

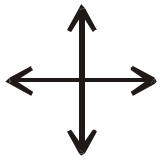
## Creating a Coordinate System

The purpose of the initial system is to give your program a place to start. It tells the program the location and the orientation of the part on the machine. Your initial system is the cornerstone of your program. With a reliable initial system, your program will require few if any changes.




Systems are very important. If the location of the origin is incorrect, the error will be present on any locations of features. If the skew is inaccurate, an error will be present and increase the further a feature is located from the origin. A bulletproof system will have a precise ORIGIN in X, Y, and Z and a precise SKEW.

Before creating the initial system, take a good look at your parts and prints. You need to find a feature with LOCATION and a feature with ORIENTATION. These features are often the datum features on the prints, but other features may be used.



LOCATION

The initial system needs a starting point on the part. The LOCATION feature(s) tell the program where the part is located on the machine. This XY position needs to be repeatable from one part to the next but does not have to be the same as the datum as described on the part print. Good examples include a point at the intersection of two lines and the center of a circle. Bad examples are the center of a line or a point on a curve.

ORIENTATION

The initial system needs to know how the part is aligned and what direction the X- and Y-axes are aligned. The ORIENTATION feature(s) tell InSpec how the part is skewed on the stage. Again, this alignment needs to be repeatable from one part to the next but does not have to be the same as the datum as described on the part print. Good examples include a line, which can be an edge on the part, or a line between two holes. Any feature that has “direction” can be used.

Skew – Length Matters

When picking the features that will be used for the skew of a system, keep in mind that length does matter. A longer line will have the less angular error than a short line. For instance, if you measure a line and use only 0.100" of an edge, then a deviation of less than 0.0002" in the Y direction from end to end translates to an angular error of 0.1º. That doesn’t seem like much. But if you now measure a hole 4" from the origin along the X-axis, you will have a 0.007" deviation in the Y position due to the sine error.

The deviation of less than 0.0002" over a line of 4" would produce a much better skew reference with an angular error of less than 0.003º.

The skew of the coordinate system can have a large affect on measurements, especially of larger parts. Skew to long lines created with multiple points to reduce errors.

## Creating a Feature

The icons between the instruction list and the camera window are divided into three main sections. On the left are the features. Feature icons are the types of entries that can appear in the instruction list. To create a feature, select the icon for the feature you want.

Select from point, line, circle, arc, distance, angel, ellipse, rectangle, slot, gap, spline, o-ring, and system.

Selecting a feature icon will place a feature in the instruction list. InSpec uses a “closed” feature architecture that requires the feature to be completed or deleted before allowing the user to work on another feature. You must provide enough points to construct the current line, circle, or rectangle before you can begin the next arc, point, or distance.

## Using Magnification

The zoom lens gives the Micro-Vu system the flexibility to easily located parts as well as to accurately measure very small features. For the best focus repeatability, use high magnification with a 2X multiplier. If the parts do not require height measurements or viewing very small features, most users prefer to use lower magnification. At lower magnification more of the part can be seen.

Furthermore, at lower magnification, the depth of field is greater. With a greater depth of field, a surface can vary in Z and still appear to be in focus.

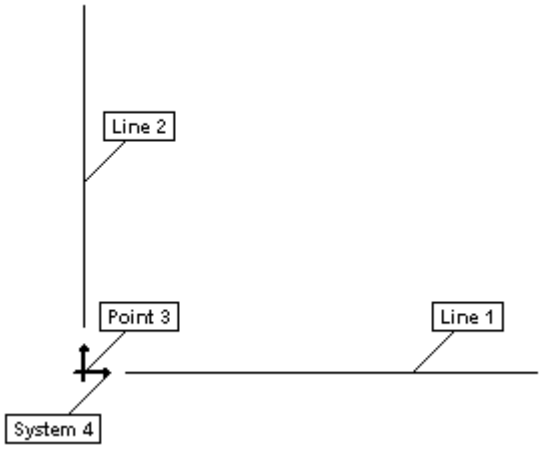
# CHAPTER 10 APPLICATION TIPS

InSpec for Windows is an incredibly flexible metrology software package. It is used by customers measuring sheet metal panels with tolerances of +/- 0.020" as well as customers measuring fiber optic connectors with tolerances of +/- 0.000020". Parts vary in size, shape, weight, material, and texture. The objective of the InSpec software is to provide an easy-to-use metrology solution that meets most customers' needs.

Considering the diversity of our customers and their parts, it is a challenge to write a "How To" manual that will explain how to measure every part. This section provides some "typical" measurements examples and programming tips. By applying the concepts in this chapter, you will have a good foundation to build a program for measuring "any" part.

## Making an Initial System

The following steps outline how to create a simple initial system at the bottom left corner of the sample part. These steps provide a well defined location and orientation of the part. This example is repeated with icons and pictures in the next section, Measuring the Sample Part.




- Place the sample part on the machine.
- Set the profile lighting to 10%. Set the other lights to 0%.
- Set the magnification to the lowest setting.
- Position the stage so that you can see the bottom left corner of the part on the screen. Make sure that the part is in focus.

- Select the Line feature icon.
- Place two points on the bottom edge of the part to create a horizontal line.

This will create feature Line 1.

- Place two points on the left edge of the part to create a vertical line.

This will create feature Line 2.

- Select the Point feature icon.
- Click on Line 1 and Line 2 to create a point at the intersection of the two lines.

After you selected the point feature and clicked on the two lines, the Auto contruction mode assumed that that you wanted the intersection of the two lines. If you had wanted a point at the center of one of the lines, you would have to select the Fit Center construction first.

Now you have a Point that has a well defined LOCATION and a line that has DIRECTION.

- Select the Skew icon.
- Click on the horizontal line. The system will be aligned to the horizontal line.
- Select the System icon.
- Select the Origin icon.
- Click on the Point. The system will be “zeroed” to the point.

In this example, you could also have selected the system icon and then clicked on the point and then one of the lines. When a System feature is being created, the Auto construction will automatically use a line as a skew and a point as an XYZ origin point.

## More Simple Programs

After you are comfortable with the steps above, read through and practice the following programming tips.

### Same Sample Part, New Origin

Because InSpec is so flexible, there are ofter more ways than one to locate a feature or make a measurement. Using the Sample Part again, use the following steps to make another system with the origin at the center of the bottom left circle and skewed to the bottom edge.

- Set the profile lighting to 10%. Set the other lights to 0%.
- Set the magnification to the lowest setting.
- Position the stage so that you can see the bottom left corner of the part on the screen.
- Select the Line feature icon.
- Place two points on the bottom edge of the part to create a horizontal line.
- Select the Circle feature icon.
- Place three points on a circle.
- Select the Skew icon.
    - Click on the horizontal line. The system will be aligned to the horizontal line.
    - Select the System icon.
    - Click on the Circle.
    - Add a few additional features and run the program.

## Building A Bulletproof System

As mentioned earlier, coordinate systems are very important to ensure the accuracy of your measurements. A bulletproof system will have a precise ORIGIN in X, Y, and Z and a precise SKEW.

InSpec does not limit the number of systems in a program. You can use a simple initial system to get the program started. This will display the second set of crosshairs to help lead the operator through the program. Then measure some additional features to define the system better.

## Parts with Concentric Features

The geometry of some parts allows the user to use some tricks. For instance, many customers measure round parts with concentric features. Because of the geometry of the part and some assumptions that the parts will be fairly close to the nominal values, an initial system can be created with only an Origin. The system skew will not be important because of the symmetry of the part. For these parts you can use a manual point at the center of the part or a tangent point line of a circle located with one of the crosshair lines. These points are easy for the operator to identify and can give the system enough information to locate the other features on the part.

## Diameters on Tapered Parts

Measuring the diameter at a nominal distance from the end:

Example: measure the diameter 4" from the end of the part. The print calls for a 1.00" diameter +/-0.05". Put the system at the end of the part, and skew to the centerline of the taper. Create points at (4,1,0) and (4,-1,0) using the point offset. Create a line between the two points. Create intersection points with the line and the top and bottom edges of the taper. Take the distance between the two intersection points. Set the tolerance of the y distance to be 1.00 +/-0.05".

Measuring the location where a ring gage would fits on a taper:

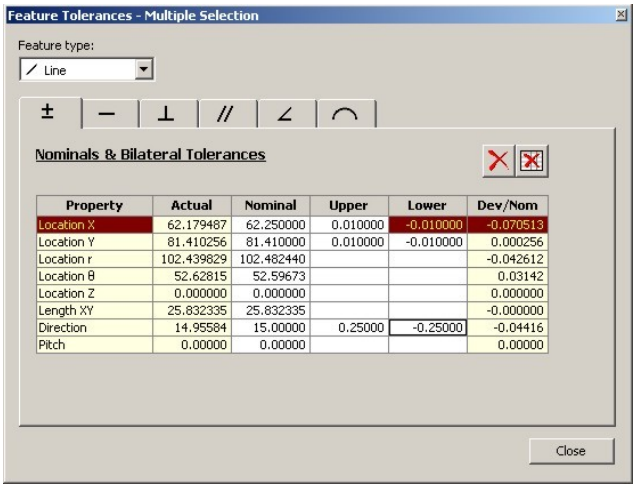
Example: Measure where the diameter is 1". The print calls for a location of 4" +/- 0.01". Put the system at the end of the taper, skew to the centerline of the taper. Create points at (3.5,0.5,0) and (4.5,0.5,0) using the point offset. Create a line between the two points. Intersect the line with the line on the top edge of the taper. The x location of the point is the location of the 1" diameter. Set the tolerance of the x position to be 4.00 +/-0.01".

# CHAPTER 11 SETTING FEATURE TOLERANCES

With InSpec you can set bilateral, form, true position, and profile tolerances, including tolerances using reference features. Once values have been entered, InSpec will display a green check mark or a red “X” in the feature summary window to indicate that the feature is in tolerance or not.

Tolerances can be applied to a single feature or to a block of features.

InSpec allows feature tolerances to be added to individual features in your programs. In a single dialog box, InSpec will display the pertinent information of the selected feature with regards to the tolerances.




| Property | Actual | Nominal | Upper | Lower | Dev/Nom |
|---|---|---|---|---|---|
| Location X | 62.179487 | 62.250000 | 0.010000 | -0.010000 | -0.070513 |
| Location Y | 81.410256 | 81.410000 | 0.010000 | -0.010000 | 0.000256 |
| Location r | 102.439829 | 102.482440 | | | -0.042612 |
| Location θ | 52.62815 | 52.59673 | | | 0.03142 |
| Location Z | 0.000000 | 0.000000 | | | 0.000000 |
| Length XY | 25.832335 | 25.832335 | | | -0.000000 |
| Direction | 14.95584 | 15.00000 | 0.25000 | -0.25000 | -0.04416 |
| Pitch | 0.00000 | 0.00000 | | | 0.00000 |

If a block of features is selected, the dialog will display the pertinent information for the selected feature type indicated in the top left of the box.

## Types of Tolerances

### ± Nominal Values

Nominal values include basic size and location tolerances.

### Position RFS

Nominal values define the location of a feature. The true position RFS sets a diametric tolerance zone for the position of the feature. The tolerance is independent of size of the feature.

###  Position MMC

Nominal values define the location of a feature. The true position MMC sets a diametric tolerance zone that increases as the feature deviates from its maximum material condition. The tolerance is dependent on the size of the feature.

###  Position LMC

Nominal values define the location of a feature. The true position LMC sets a diametric tolerance zone that increases as the feature deviates from its least material condition. The tolerance is dependent on the size of the feature.

###  Straightness

Straightness is a form tolerance with the condition that the element of a surface or an axis is a straight line. The tolerance is determined by placing a zone about the line where all the points must lie.

###  Circularity

Circularity is a form tolerance with the condition that all the points lie equidistant from a center (used to determine how round a circle is). The tolerance is determined by placing two concentric circles about the center where all the points must lie.

###  Flatness

Flatness is a form tolerance where the surface has all points in one plane. The tolerance is determined by placing two parallel planes about the desired plane where all points must lie.

###  Perpendicularity

Perpendicularity is an orientation tolerance with the condition that a surface, plane, or axis is at a right angle to another. The tolerance is determined by two parallel lines constructed perpendicular to a datum or an axis. The data points must lie between the constructed lines. The gap distance between the constructed lines is the perpendicularity value.

###  Parallelism

Parallelism is an orientation tolerance with the condition that a surface, plane, or axis is equidistant at all point to another. The tolerance is determined by two parallel lines constructed parallel to a datum or an axis. The data points must lie between the constructed lines. The gap distance between the constructed lines is the parallelism value.

###  Angularity

Angularity is an orientation tolerance with the condition that a surface, center plane, or an axis is at a specified angle from a datum plane or axis. The tolerance is determined by two parallel lines constructed at the specified angle relative to a datum or an axis. The data points must lie between the constructed lines. The gap distance between the constructed lines is the angularity value.

###  Concentricity

Concentricity is where all the data points are congruent about an axis or another feature. The tolerance is determined by placing a circle about the axis or the center of a feature where all of the data points of the second feature must lie. In other words, it tells how close are the centers of two features.

###  Profile of a Line

Profile of a line establishes a two-dimensional tolerance zone around a nominal feature. The value of this bilateral tolerance is determined by doubling the distance from the nominal feature to the maximum data point. Nominal values for the feature must be entered. The current system acts as the datum references. If there are no datum references, create the feature, set a system origin on the feature, create duplicate feature, and tolerance the duplicate feature.

###  Profile of a Surface

Profile of a Surface establishes a three -dimensional tolerance zone around a nominal feature. The value of this bilateral tolerance is determined by doubling the distance from the nominal feature to the maximum data point. Nominal values must be entered for the feature. The current system acts as the datum references.

## Entering Tolerances

If the feature is not already selected, select the feature you wish to tolerance from the Features list or from the Schematic window.

Next, right click with the mouse and select Tolerances from the options.

The Feature Tolerances dialog box will display the feature's bilateral tolerances. Bilateral tolerances are the basic position and size characteristics of the feature.

You may enter values in the Nominal and tolerance columns. These cells will normally have a white background. However, if the characteristic is out of tolerance, the cell will have a red background. The values in the other columns are computed and cannot be edited.

### Entering Form Tolerances

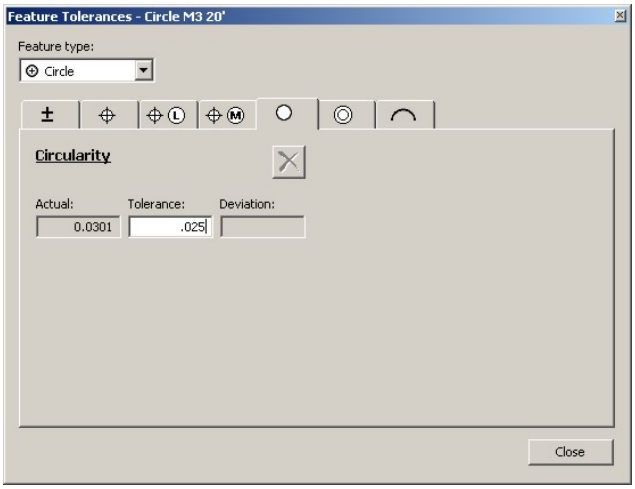
Form tolerances include circularity, flatness, and straightness.

First, if the feature is not already selected, select the feature you wish to tolerance from the Schematic window.

Next, you will need to bring up the appropriate Form tolerance.

Dialog. This can be achieved by either clicking on the desired form tolerance button from the Tolerance Tool Bar or by selecting the desired form tolerance from the Tolerance menu from the Features Context Menu.

The following is a Form Dialog (Circularity):




Use the tab key or the mouse to maneuver around the dialog.

- Feature Type – Displays the feature being toleranced.
- Actual – Displays the measured values.

- Tolerance – The tolerance zone.
- Deviation – Displays the difference between the Actual and the Nominal.

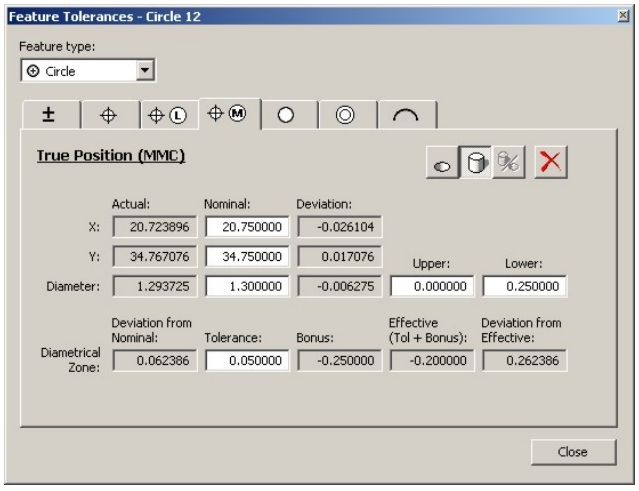
If you are applying the tolerance to a group of circles, the Actual value will remain blank. If multiple values already exist, question marks, "???", will appear in the tolerance box.

### Entering True Position Tolerances

True Position tolerances include RFS, MMC, and LMC.

After you select the feature(s) you wish to tolerance, select Tolerances… from the Features Context Menu.

Select the appropriate positional tolerance from the tabs in the Tolerance Dialog Box.




For TP MMC and TP LMC a bonus will be calculated and applied during the evaluation.

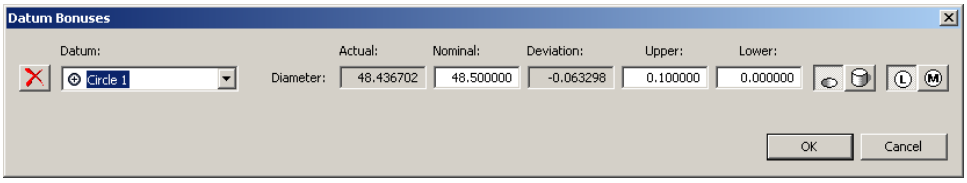
The following is the dialog for TP MMC for a single feature:

Use the tab key or the mouse to maneuver around the dialog.

- Icons – Use the icons on the right to specify it the feature is a hole or boss.
- Actual – Displays the measured values.
- Nominal – Displays the nominal value. This number must be entered.
- Deviation – Displays the difference between the Actual and the Nominal.

- Deviation from Nominal – The true location from nominal based on a diametrical zone.
- Tolerance – The tolerance zone.
- Bonus – An increase in the tolerance based on the feature departing from its MMC size.
- Effective (Tolerance + Bonus) – The effective tolerance zone considering the bonus.
- Deviation from effective – How far off the hole or boss is from the Effective Tolerance Zone.

In addition to its LMC or MMC bonus, a feature can have a datum bonus applied to its tolerance. If the datum of a feature has a LMC or MMC tolerance, the bonus from the datum can also be added to the effective tolerance of the feature. When you click on the Datum Bonus icon, the following window appears:

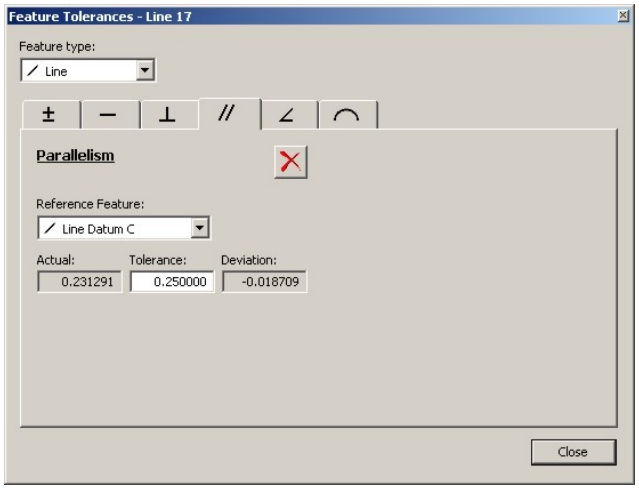



Fill in information as you did for the LMC and MMC scenarios above. When you click *OK* the bonus will automatically apply to the feature tolerance.

### Tolerances the require Reference Features

Some ANSI Y14.5 tolerances, including angularity, concentricity, perpendicularity, and parallelism, are dependent upon a datum feature. For these tolerances, an additional combo box will appear allowing you to select the reference feature.

Following is an example for parallelism using Datum C as the reference feature.




You can use the tab key or the mouse to maneuver around the dialog.

- Feature Type – Displays the feature type being toleranced. If you have selected multiple feature types, use the pull-down box to switch feature types.
- Reference Feature – Displays the feature being referenced to determine the tolerance.
- Actual – Displays the measured value.
- Tolerance – Displays the nominal value. This number must be entered.
- Deviation – Displays the difference between the Actual and Tolerance.

# CHAPTER 12 SETTING EXPORT PROPERTIES

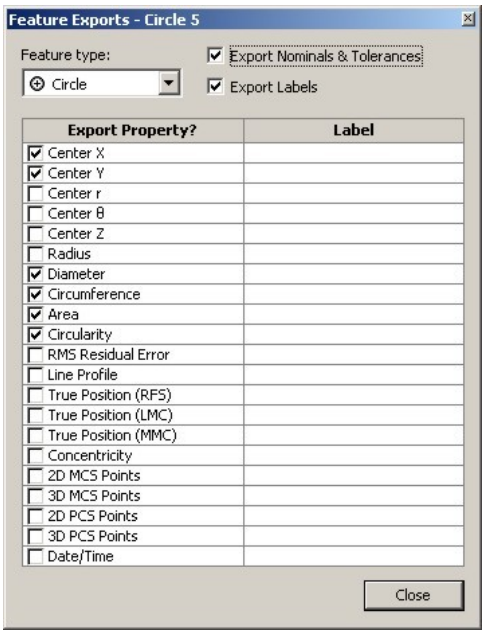
Each measured feature type has six or more exportable properties. A distance as seen below has seven properties. In addition, you can export the Nominal & Tolerances and Labels for each property. InSpec allows you to select individual export properties for each feature and save them into the part program.

## Feature Exports

The Feature Exports dialog boxes have been designed to be simple to use and understand.

Setting export properties for features can be performed on an individual feature or a group of features. To setup the properties to be exported for a single feature, right click on a feature and select Exports from the Features List context menu.

A dialog box similar to the one below will be displayed with the feature name at the top.



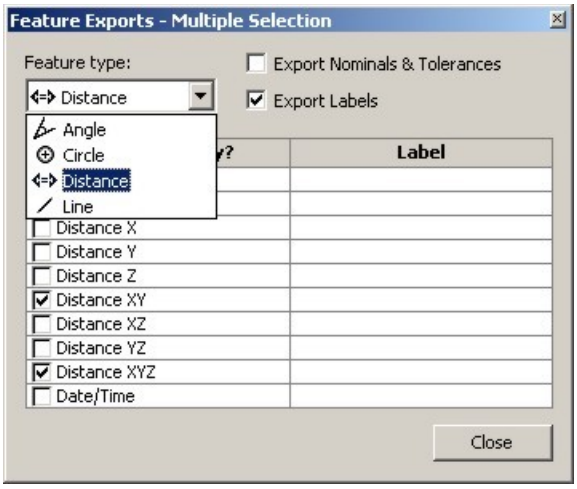

- Export Nominals & Tolerances – This option will automatically include tolerance information if available for each of the selected properties.

- Export with Label – This option allows the user to include labels with exported data. The default label is the feature name followed by the property, the whole label is in quotes, i.e. “Circle 1: Center X.”

- Export Property – Click on the check boxes to specify which properties are to be exported.
- Label – These cells are used to create custom labels for each export property. If Export Labels is checked and the Export Property is checked, InSpec will check for and export the custom label with the property's value. If a custom label is not entered, the default label will be exported.

## Multiple Feature Exports

Export properties can be set for a block of features. After selecting multiple features in the Features list, right click on a selected feature and select Exports. This will display the Multiple Selection dialog box.




There are two differences between the individual and multiple selection dialog boxes. First, the dialog box headers changes to indicate that you have selected multiple features.

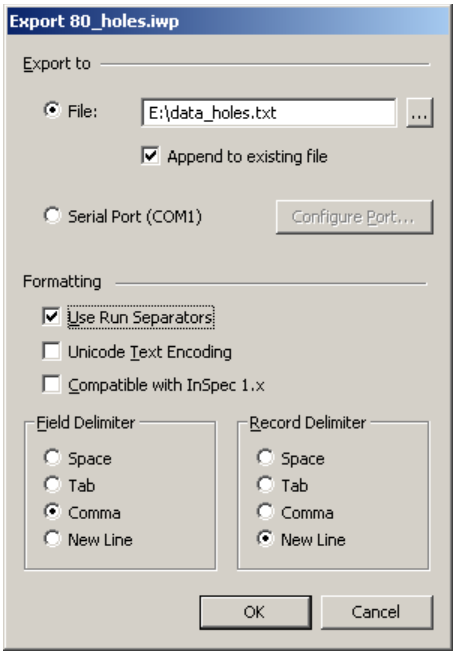
Second, InSpec displays a drop down list under Feature Type when a group of features with different feature types has been selected. InSpec separates the feature types for you, so you can assign the appropriate export properties.

For example, you may have a program with a mixture of points, lines, and circles, but you are only interested in the diameters of the holes. You can select all the features in you feature list (Ctrl+A), right click and select Exports, choose Circle from the Feature Type drop down menu, and the check the Diameter box. Now all of the diameters are ready to be exported.

# Exporting Data

InSpec allow you to manually or automatically export data.

To manually send data to a file or port, select **Export** under the **File** menu.




### Export To

With the manual export, you can send data to a file or a data port. Use the File or Serial Port radio buttons to make your selection.

When exporting to a file, you must enter a data file name and location. Use the button with three dots to browse through directories. Check the **Append to Existing File** if you want to add data to the end of an existing file. If the box is not checked, InSpec will replace existing data with new data.

When exporting to a Serial Port, the Configure Port button will become active and allow you to adjust port settings.

### Formatting

- Run Separators – This toggle enables :BEGIN and :END markers to be included with the export data.
- Unicode Text Encoding – If you want to export text, prompts, or labels that contain Unicode characters, you must check this box.

This setting will be helpful if you are not using the US-English character set.

- Compatible with InSpec 1.x – The export order of some tolerance fields has changed since InSpec Version 1.x. Check this option to use the order used in 1.XX. The different orders are shown in the Appendix A.

**Delimiter**

- Field Delimiter – Select the separation character to go between feature data. (Line 1 data [,] Arc 2 data [,] Circle 3 data [,] …)
- Record Delimiter – Select the separation character to go between feature property data. (Arc 2:Center X [,] Arc 2:Center Y [,] Arc 2;Diameter [,] …)

For automatic reporting using **Playback Options …** under the **Tools** menu, refer to the section on Automated Reporting for more information.

**Output Format**

The different types of tolerances have different fields to export. The typical order for data is:

[Label.] Actual, [Nominal, PlusTol, MinusTol, DevNom, DevTol]

The Label is optional and must be checked in the Feature Exports dialog to be exported. Exporting the nominal and tolerances is also an option in the Feature Exports dialog. Samples are shown in the appendix.

**Part Separators**

The part separator is a special feature type used to format your data. It exports a Carriage Return / Line Feed (CR/LF) when it is reached in a program. This can help manage exported data for a program that measures multiple parts. Select **Insert** from the **Feature** menu, and then select **Part Separator** to insert a new Part Separator feature in the part program.

Many users place an array of parts on the stage; let's use an example of 5 paper clips in a row in a fixture. After creating a program for the first clip, set the radii and distances to export using comma or tab delimiters. Using Translate and selecting 4 copies 1" apart, the program can measure all five clips.

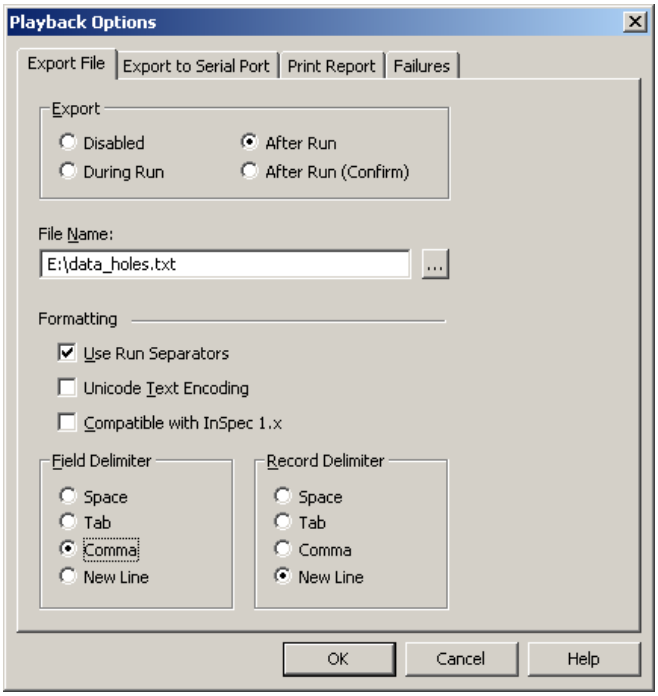
When exported, the data for the five clips would be strung together on one line. This can be difficult to handle.

By adding a part separator at the end of the measurements for each clip, the data for each part would be on a separate line. With each part on a separate line, it is easier to import the data into SPC and spreadsheet software.

# CHAPTER 13 REPORTING DATA

InSpec does more than measure parts and display data. It provides options to automatically print, save, and transmit data. There are also tool and tolerance "failure" modes that can be activated. These tasks can be saved with each program.

These options are accessed from **Playback Options …** under the **Tools** menu.




## Export File Parameters

After properties of the features have been selected for exporting, you are ready to send the data to a file. The export file will be a text file (*.txt).

Manual exporting can be performed by selecting **Export** from the **File** menu.

Automatic Exporting can be performed by selected **Playback Options …** from the **Tools** menu. The dialog box above will appear. Automatic Exporting appends data to the end of the designated file every time the program is run.

- Export– Use the radio buttons to select when you want the data exported, Disabled (off, no export), During Run, After Run, and After

Run Confirm. During Run sends data as each feature is measured. This can help when an SPC program is monitoring the data file. After Run waits until all features are measured and Confirm will prompt the user before sending data.

- File – Enter a data file name and location. Use the button with three dots to browse through directories. Data will be automatically appended to an existing file.

**Formatting**

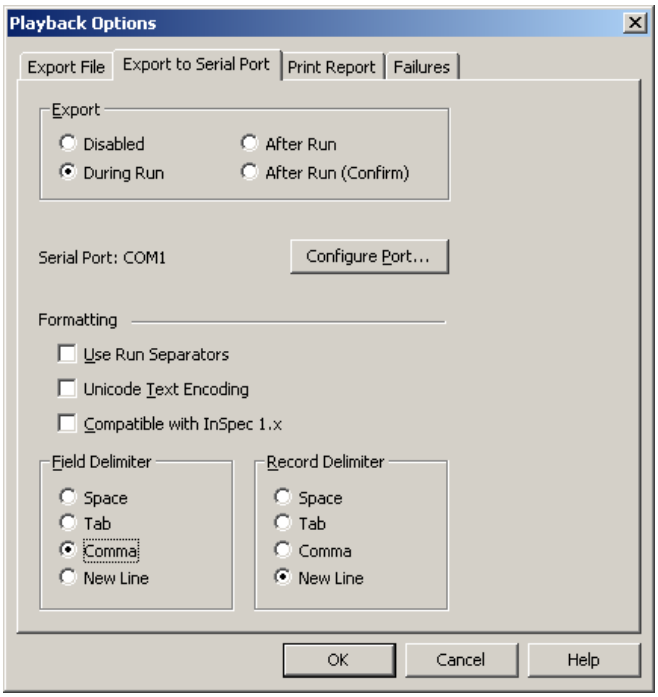
- Run Separators – This toggle enables :BEGIN and :END markers to be included with the export data.
- Unicode Text Encoding – If you want to export text, prompts, or labels that contain Unicode characters, you must check this box. This setting will be helpful if you are not using the US-English character set.
- Compatible with InSpec 1.xx – The export order of some tolerance fields has changed since InSpec Version 1.xx. Check this option to use the order used in 1.xx. Refer to the appendix for examples of 1.xx and 2.xx outputs.

**Delimiter**

- Field Delimiter – Select the separation character to go between feature data. (Line 1 data [,] Arc 2 data [,] Circle 3 data [,] …)
- Record Delimiter – Select the separation character to go between feature property data. (Arc 2:Center X [,] Arc 2:Center Y [,] Arc 2;Diameter [,] …)

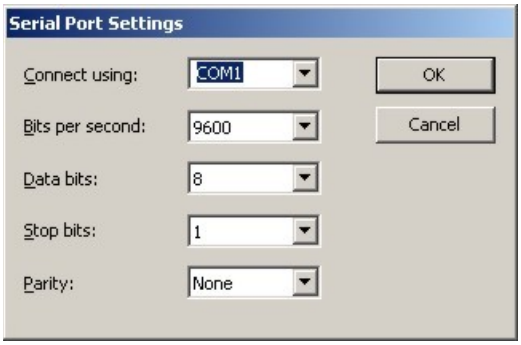
The export delimiter types set in this dialog are applied for both the manual and automatic export.

## Serial Export Parameters




When the data is exported, the format, and the delimiters have the same options as described for exporting to a file.

However the export to serial dialog has an additional button to configure the serial port settings. Set the port, bits, stops, and parity to match the settings of the receiving device.

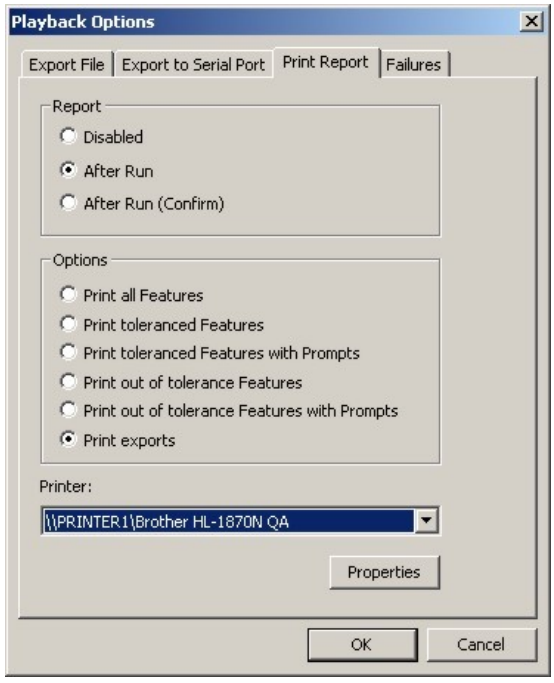



## Printing

Printing can be automated at the end of each program or at any time by selecting Print from the File menu. There are four options regarding

which data to print: All Features, Toleranced Features, Out of Tolerance Features, or Features marked for Export.

Each report has a header that gives the program title, date and time, units, and column headings. The page number will be printed at the bottom of the page.



**Print all Features** will print all of the features in the following format:

Program: Untitled  Date: Wed Jul 11 2001  Time: 19:03:07
Units: in, dec deg

| Feature | Actual | Nominal | Plus (+) | Minus (-) | Dev/Nom | Out/Tol |
|---|---|---|---|---|---|---|
| Point 1 | [MCS] | | | | | |
| Location X | 8.42826 | 8.42826 | | | 0.00000 | |
| Location Y | 4.81317 | 4.81317 | | | 0.00000 | |
| Location Z | 0.00000 | 0.00000 | | | 0.00000 | |
| Line 2 | [MCS] | | | | | |
| Location X | 9.53428 | 9.53428 | | | 0.00000 | |
| Location Y | 4.95616 | 4.95616 | | | 0.00000 | |
| Length XY | 1.60711 | 1.60711 | | | 0.00000 | |
| Direction | 3.4392 | 3.4392 | | | 0.0000 | |
| Straightness | 0.02380 | | | | | |
| Line 3 | [MCS] | | | | | |
| Location X | 8.35943 | 8.35943 | | | 0.00000 | |
| Location Y | 3.78869 | 3.78869 | | | 0.00000 | |
| Length XY | 1.74427 | 1.74427 | | | 0.00000 | |
| Direction | -90.0636 | -90.0636 | | | 0.0000 | |
| Straightness | 0.10773 | | | | | |
| Point 4 | [MCS] | | | | | |
| Location X | 8.36065 | 8.36065 | | | 0.00000 | |
| Location Y | 4.88562 | 4.88562 | | | 0.00000 | |
| Location Z | 0.00000 | 0.00000 | | | 0.00000 | |
| System 5 | [MCS] | | | | | |
| Origin X | 8.42826 | 8.42826 | | | 0.00000 | |
| Origin Y | 4.81317 | 4.81317 | | | 0.00000 | |
| Skew | -0.0636 | -0.0636 | | | 0.0000 | |
| Angle 6 | [System 5] | | | | | |
| Vertex X | 0.27173 | 0.25000 | 0.01000 | 0.01000 | 0.02173 | 0.01173 |
| Vertex Y | -0.37651 | -0.36324 | | | -0.01327 | |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |
| Angle 7 | [System 5] | | | | | |
| Vertex X | 0.27266 | 0.25000 | 0.01000 | 0.01000 | 0.02266 | 0.01266 |
| Vertex Y | -0.75918 | -0.74866 | | | -0.01052 | |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |
| Angle 8 | [System 5] | | | | | |
| Vertex X | 0.26179 | 0.25000 | 0.01000 | 0.01000 | 0.01179 | 0.00179 |
| Vertex Y | -1.20454 | -1.19008 | | | -0.01445 | |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |
| Angle 9 | [System 5] | | | | | |
| Vertex X | 0.25231 | 0.25000 | 0.01000 | 0.01000 | 0.00231 | |
| Vertex Y | -1.64955 | -1.61881 | | | -0.03074 | |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |

Selecting **Print toleranced Features** will only print those features that have toleranced characteristics in the following format:

Program: Untitled
Units: in, deg

Date: Wed Jul 11 2001 Time: 19:01:09

| Feature | Actual | Nominal | Plus (+) | Minus (-) | Dev/Nom | Out/Tol |
|---|---|---|---|---|---|---|
| Angle 6 | [System 5] | | | | | |
| Vertex X | 0.27173 | 0.25000 | 0.01000 | 0.01000 | 0.02173 | 0.01173 |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |
| Angle 7 | [System 5] | | | | | |
| Vertex X | 0.27266 | 0.25000 | 0.01000 | 0.01000 | 0.02266 | 0.01266 |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |
| Angle 8 | [System 5] | | | | | |
| Vertex X | 0.26179 | 0.25000 | 0.01000 | 0.01000 | 0.01179 | 0.00179 |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |
| Angle 9 | [System 5] | | | | | |
| Vertex X | 0.25231 | 0.25000 | 0.01000 | 0.01000 | 0.00231 | |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |
| Angle 10 | [System 5] | | | | | |
| Vertex X | 0.26010 | 0.25000 | 0.01000 | 0.01000 | 0.01010 | 0.00010 |
| Angle | 60.0000 | 60.0000 | 2.0000 | 2.0000 | 0.0000 | |
| Point 24 | [System 5] | | | | | |
| Location X | 4.09107 | 4.09107 | 0.01000 | 0.01000 | 0.00000 | |
| Point 25 | [System 5] | | | | | |
| Location X | 4.99783 | 4.99783 | 0.01000 | 0.01000 | 0.00000 | |
| Point 26 | [System 5] | | | | | |
| Location X | 5.98164 | 5.98164 | 0.01000 | 0.01000 | 0.00000 | |
| Point 27 | [System 5] | | | | | |
| Location X | 6.84698 | 6.84698 | 0.01000 | 0.01000 | 0.00000 | |

Selecting **Print out of tolerance Features** will only print those features that are out of tolerance, in the following format:

Program: Untitled
Units: in, deg

Date: Wed Jul 11 2001 Time: 18:59:48

| Feature | Actual | Nominal | Plus (+) | Minus (-) | Dev/Nom | Out/Tol |
|---|---|---|---|---|---|---|
| Angle 6 | [System 5] | | | | | |
| Vertex X | 0.27173 | 0.25000 | 0.01000 | 0.01000 | 0.02173 | 0.01173 |
| Angle 7 | [System 5] | | | | | |
| Vertex X | 0.27266 | 0.25000 | 0.01000 | 0.01000 | 0.02266 | 0.01266 |
| Angle 8 | [System 5] | | | | | |
| Vertex X | 0.26179 | 0.25000 | 0.01000 | 0.01000 | 0.01179 | 0.00179 |
| Angle 10 | [System 5] | | | | | |
| Vertex X | 0.26010 | 0.25000 | 0.01000 | 0.01000 | 0.01010 | 0.00010 |

The **Print Exports** option will use the same format. It will only print feature properties that are marked for export.

Another Print option under the File menu is Print Schematic. This option will print the features (and Tags if present) in the Schematic Window. It is useful to display tags and print the Schematic to help document Inspection procedures.

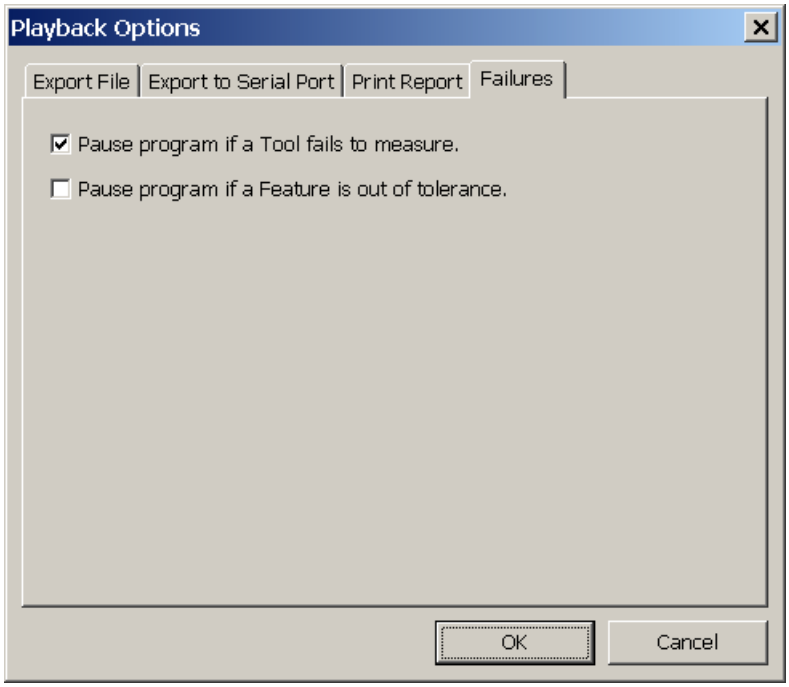
## Handling Failures

The **Tool Failure Mode** and **Tolerance Failure Mode** each provide three options: stop, wait for the user, and continue. These options can save you time measuring parts.

For instance, use the “skip and continue” tool failure mode if you need to leave the machine unattended. InSpec will run the entire program and allow you to fix “failed” tools when you return. InSpec will check to see if the feature is needed to create a system. If it is, the InSpec will automatically pause and wait for the user.

If the user will be monitoring the system while running the program, it is best to use the “pause and wait for user” tool fail mode.

The “stop the program” tolerance failure mode can be used to stop after the first out of tolerance measurement. The operator can go to the next part without spending additional time on a rejected part.



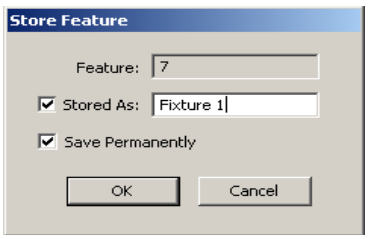
# CHAPTER 14 ADVANCED FUNCTIONS

InSpec for Windows includes advanced features that allow features to be shared between programs, generate reports generated automatically, and customize the displayed of measurements.

## Stored Features

InSpec software allows features to be stored in memory. Once stored, they can be used in other programs.

Storing a Feature is very simple. Create a system from measured features. Select the system that you want to store and choose Store Feature from the Features Context Menu. The following dialog will appear:



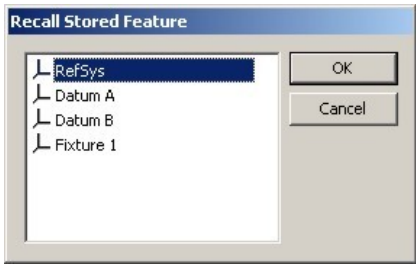

Check the box next to *Store As* and enter a unique name. The name can be any combination of letters and numbers. Unless the *Save Permanently* box is checked, the feature will only be saved for the current session of InSpec and will be lost when the software is closed. If saved permanently, the feature will remain until manually removed via Tools – Stored Features.

### Using a Stored Feature

Once a feature has been stored, it can be recalled as input for another feature.

- Select a feature icon such as a System.
- Select the Recall icon  .

The following Dialog will appear with a list of available stored features.

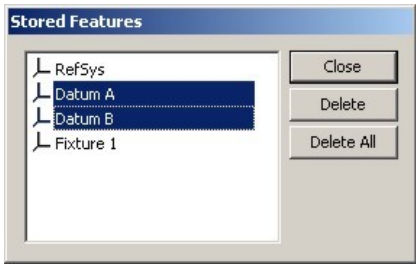



- Select a stored feature with a double click on the stored feature's name or with one click on the stored feature's name and a second on OK.

In most cases, Stored features are used as a coordinate system at the beginning of a program. For example, suppose you have the corner of a fixture saved as an external angle called "FX1." The first step in your program might be to set a system origin (X, Y, and Z) to a Stored feature. By doing so, you automatically have your initial coordinate system measured when you load the program.

### Clearing Stored Features from memory

If you want to clear existing Stored Features from memory, from the Tools Menu choose Stored Features… The following dialog will appear:




You will have the options to Close the dialog box, delete a stored feature, or Delete all of the stored features. RefSys will appear in the list and cannot be removed.

### REFSYS Home Position

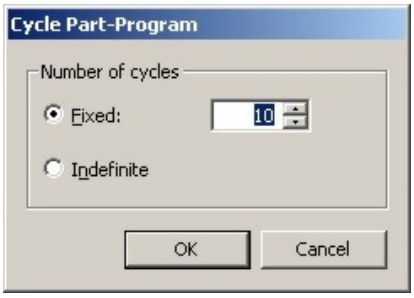
REFSYS is a stored feature with an origin at the lower front left corner of the stage volume and skew of the X-axis. This entry will always be present in the Recall Feature dialog box.

To use REFSYS in a program, start a new program with a system and recall REFSYS from the list of stored features. Then begin a part program.

## Cycling a Program

The Cycle option under the Playback Menu is similar to the Run icon. However, Cycle will continue to rerun a program for a fixed number of runs or indefinitely. This can be useful for running several of the same part in a single fixture, gathering repeatability data when used with auto-export, and for demonstrating to customers and suppliers.

After writing a program, simply select Cycle from the Program Menu. Select the number of time to run the program, or select indefinite to run the program continuously. At any, time the program may be interrupted with the Stop button.




## Importing CAD Files

InSpec for Windows is capable of importing DXF, Excellon, Iges, and Gerber format files. These formats are the most popular CAD file types and most CAD programs can export in one of these formats. (Note: Import translators are optional and may not be included. Contact your local dealer for assistance.)

Features in the CAD files are loaded and converted to features in an InSpec file. InSpec allows the operator to create an origin from the imported unmeasured features and then “convert to initial system.” After setting appropriate lighting and magnification, InSpec will “convert import inputs” to automatically create points for all of the features. In less than a minute you can create a program.

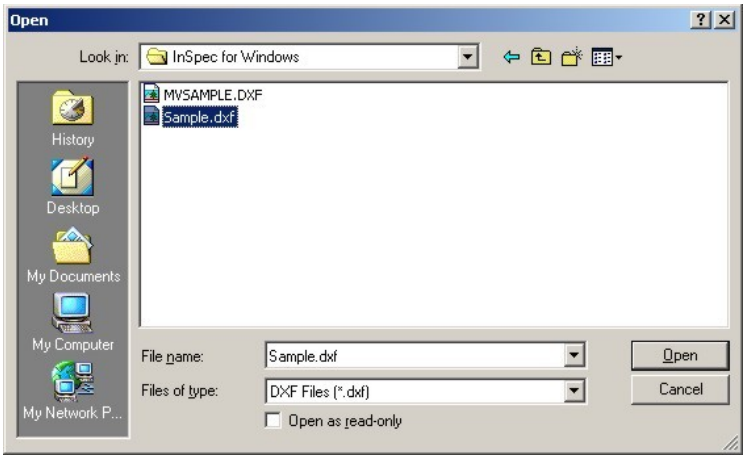
### Importing a DXF File

The import process is very similar for all file types. Here is an example DXF file from the sample part in the InSpec for Windows directory.

The Import process begins with opening a CAD file. After the user specifies conversion units, the features in the file are converted to InSpec features. The operator creates an initial coordinate system, and then sets the zoom and lighting. Then the part is ready to be measured.

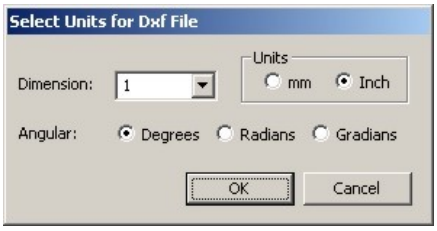
To begin, select Import from the File menu.

You will be prompted to enter the name of the import file. Near the bottom of the dialog box you can select the file type, DXF, Excellon, etc., you are about to import.




Select the file you would like to import and click on Open.

After you have selected the import file, you will be prompted to select the scale factor of the CAD file and the linear and angular units. The default dimension factor is one, i.e. a one to one scale factor. The default angular units are degrees.




Select the correct units for the CAD file, and click on OK.

At this point, InSpec for Windows will convert each of the CAD file features into InSpec features. A list of the features will be displayed and a diagram of the part will be drawn in the Schematic window.

The next step in the conversion process is to set up an initial system for the part using features from the CAD file. In many cases, you will intersect two lines to create a point. The point will become system origin (0,0,0) and one of the lines will be used for the system skew alignment.

**Create a system from the imported file**

In this example, create a point at the intersection of the left vertical line and the bottom horizontal line. Set the XYZ Origin on the point set the Skew to the bottom horizontal line. The new system will be used as the initial system for the program.

**After creating the system, select the Continue button in the Import – System Construction message box.**


InSpec will make copies of the features used to create the initial system, in this case two lines, and a point, and place them at the beginning of the program list. Line 1, Line 2, and Point 1 in this example create the new initial system, System 2.

InSpec will create the individual points for each feature. The original inputs of the imported features were labeled “IMPORT.” After clicking on Continue, the import wizard creates Manual Points. Three points will be created for each arc and diameter, two points for each line, and a single point for any imported points. The file conversion is complete and you can now run the program.

At this point the program is just like any other that you have created. You can add and delete features. You can edit and save the program. You can verify that the program has been imported properly by viewing tolerances. The tolerance dialog box will show the nominal locations of features. These numbers should match the numbers in the DXF file.

### Run the program

To play back the program, click on the Run button.

You will be prompted to measure the features used to create the initial coordinate system. It is helpful to turn on Tags for initial features to help the user locate the initial features.

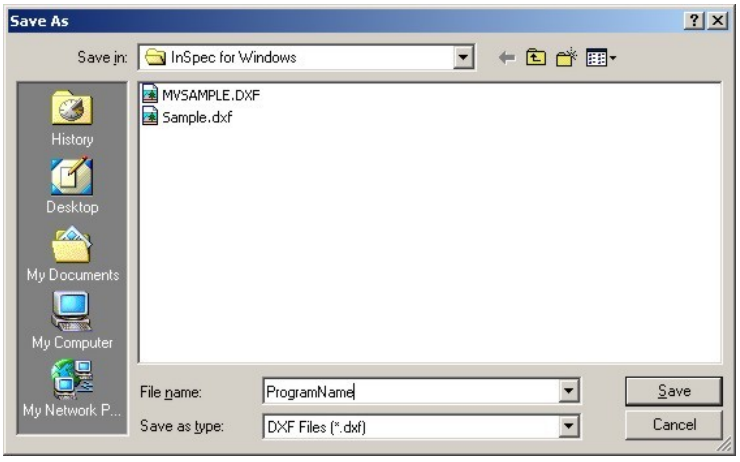
After measuring the initial features, InSpec will be able to create the initial system and display the camera location crosshairs. Enter points and adjust magnification and lighting as needed.

## Exporting DXF Files

InSpec for Windows currently allows the user to export DXF format files. DXF is a most popular CAD file type that most CAD programs can accept.

The Export process begins by measuring a part with InSpec. Then, select Export DXF from the File menu.

You will be prompted to enter the name of the export file.



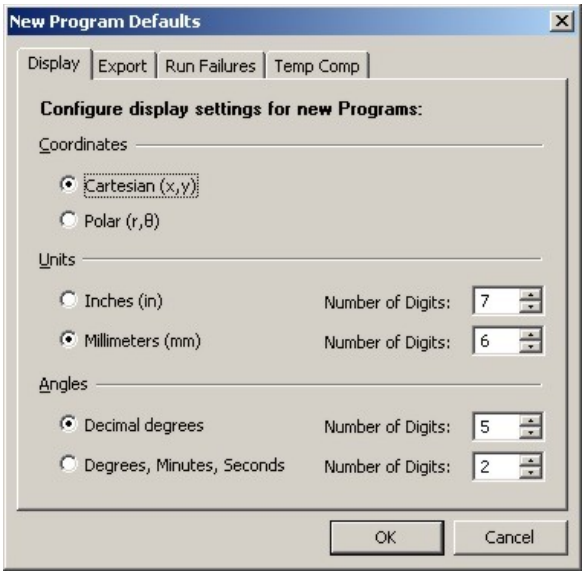

Enter a file name at the prompt and click on Save. By default, InSpec will add the DXF extension to the file name.

## New Program Defaults

Program defaults set parameters for NEW programs. The tabs at the top of the window divide four sets of parameters: display, export, run failures, and temperature compensation.

### Display Defaults

The system type, linear, and angular parameters are set in the display tab. Standard rounding is used when displaying data. The Number of Digits refers to the number of places to the right of the decimal point.



### Export Defaults

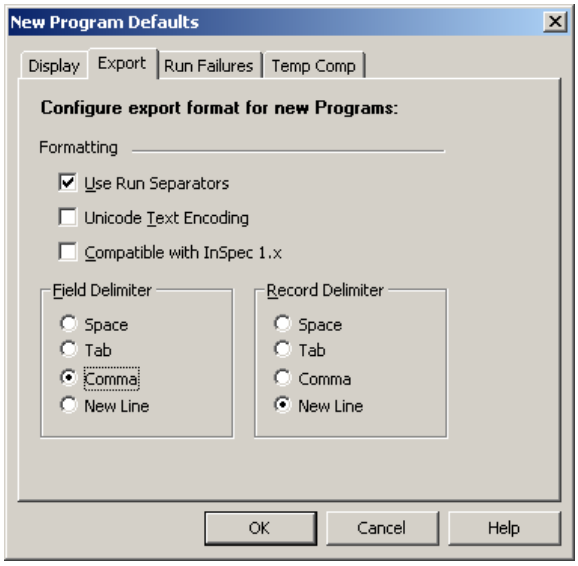
The export delimiter types set in this dialog are applied for both the manual and automatic export.

### Formatting

- Run Separators – This toggle enables :BEGIN and :END markers to be included with the export data.
- Unicode Text Encoding – If you want to export text, prompts, or labels that contain Unicode characters, you must check this box. This setting will be helpful if you are not using the US-English character set.
- Compatible with InSpec 1.x – The export order of some tolerance fields has changed since InSpec Version 1.x. Check this option to use the order used in 1.XX. The different orders are shown in the appendix.

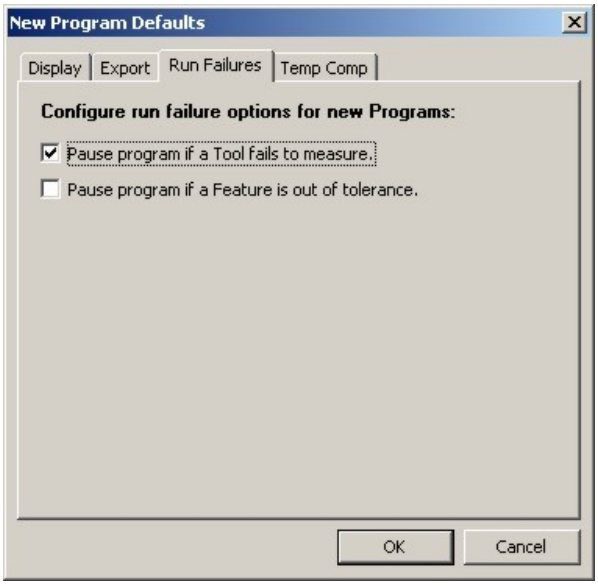
### Delimiter

- Field Delimiter – Select the separation character to go between feature data.
- Record Delimiter – Select the separation character to go between feature property data.



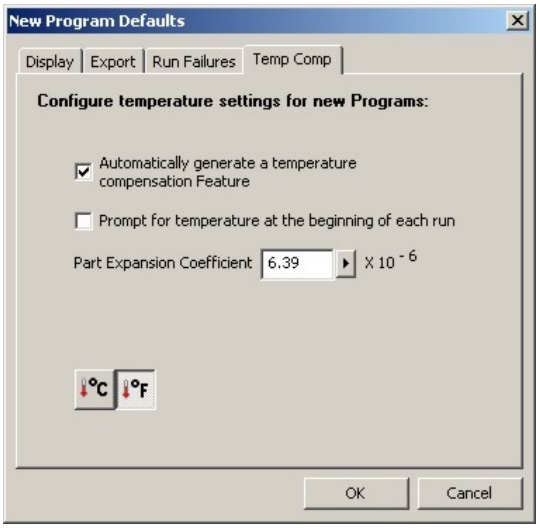
### Run Failures

Run Failures sets the conditions for stopping a program. Depending on the application and program, the operator may want the system to run completely through the program or stop and wait for the operator if a tool fails or a feature is out of tolerance. With long programs, it is more convenient to allow the program to run to the end than to sit and watch for problems. The operator can start a program and return after all features have been processed. Features that were out of tolerance or unmeasured can then edited, updated, or fixed when the operator returns. In other cases, it may be more convenient to have the operator monitor a long program because tools can be immediately fixed. Or if one dimension is out of tolerance, then the operator can stop the program, discard the bad part, and start on the next part.



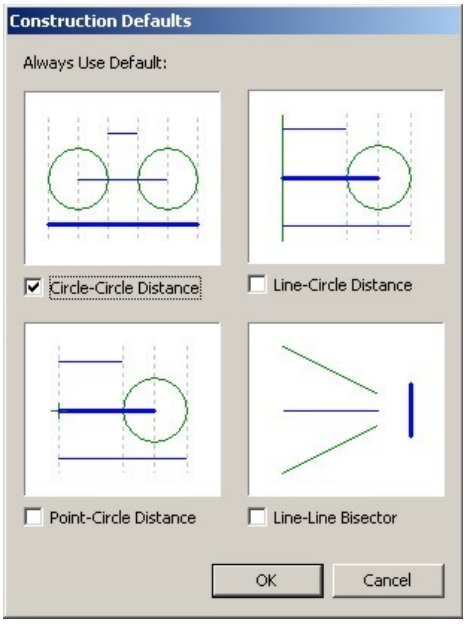

### Temperature Compensation

Temperature compensation can provide the additional accuracy required for a tight tolerance or be removed to provide a simplified interface. The settings allow a temperature feature to be added to beginning of each program and to the request the temperature at the bezginning of each run. Consider using temperature compensation for large parts and very long programs with 1000s of features. The basic premise of any temperature compensation is that the machine, the room, and the part have settled to equilibrium. If there are large temperature swings (>+/- 2º), then the temperature variation will have more of an affect than the compensation.



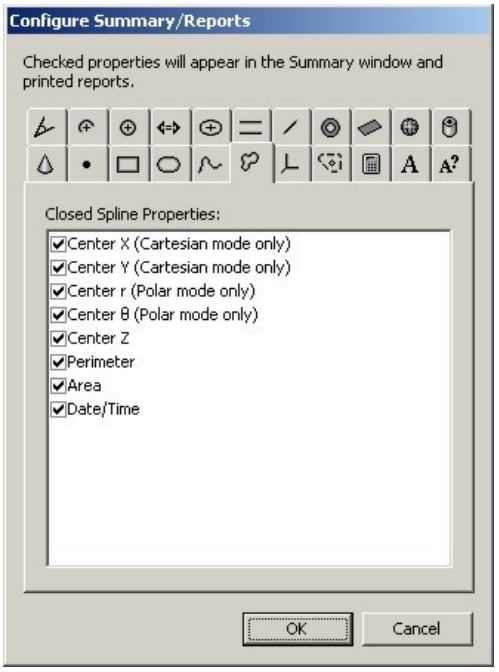

## Construction Defaults

Because Micro-Vu measurement systems are used to measure everything from precision ball bearings and computer chips to rubber hoses and coat hangers, we have tried to make the software powerful yet simple. The Construction Defaults give the operator a means to customize some of the functionality. The distance between two circles can be the minimum, center-to-center, or maximum distance. The same options are available for a circle to a line or a circle to a point. There are two options for a line bisecting two lines, a line along the bisecting angle and its perpendicular.



### Configure Summary

The characteristics in the Summary Window and printouts are controlled in Configure Summary. These settings are saved with each program. As shown earlier in the manual, the display of individual characteristics for each feature type may be turned on and off. Select the feature type from the tabs at the top of the dialog. Then check the boxes of the characteristics you would like displayed.




### Configure Audio

InSpec gives you the option to change its audio settings. If you are using the joystick and are far away from the computer, you can run the sound through external speakers and increase the volume.

# CHAPTER 15 PASSWORD PROTECTION

### Overview

InSpec Metrology Software includes multi-level password protection to protect the integrity of part programs and results. Security levels can be configured per group or per individual.

To activate or make changes to the password protection, run ConfigUsers.exe from the InSpec installation directory. InSpec is typically installed at C:\ProgramFiles\MicroVuCorporation\InSpec for Windows.

From ConfigUsers.exe you can setup new users accounts, modify existing users accounts, and modify individual and group privileges.

### Privileges

The password protection has nine categories of privileges.

**Run part-programs** – The ability to load and run programs.

**Edit/Save part-programs** – The ability to modify tolerances, exports, zone sizes, add features, delete features, … and to be able to save the changes.

**Edit part-program defaults** – The ability to change the units, readout digits, temperature compensation, … that are used for the startup.

**Calibrate stage/volume** – The ability to calibrate the stage and the volume.

**Verify stage calibration** –The ability to verify the stage calibration.

**Calibrate optics/zoom range** – The ability to calibrate the optics and to determine the zoom range.

**Tune machine** – The ability to adjust the motion control parameters.

**Edit hardware configuration** – The ability to modify the configuration of the encoder counts, the camera, and stage settings.

**Configure user/passwords** – The ability to add, modify, and remove users, groups, and passwords.

### Groups

A group is assigned a set of privileges. There are three predefined groups.

**Administrators** – all privileges.

**Programmers** – all privileges except for setting up passwords, calibrating, tuning, or modifying the machine.

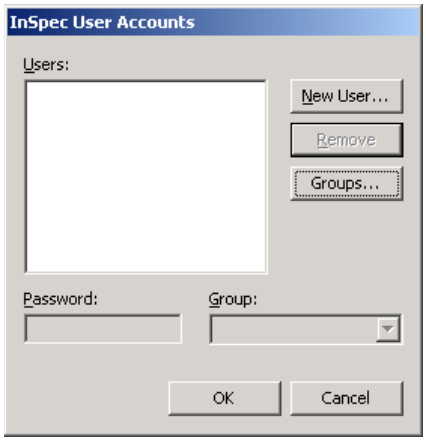
**Operators** – only running programs and verifying the stage privileges.

InSpec gives you the flexibility to create other groups as needed and modify existing ones.

### Setting Up User Accounts

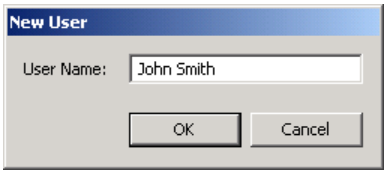
Run ConfigUsers.exe to view the InSpec User Accounts dialog. Your initial options allow you to create new users or modify group properties.

*If password protection has already been activated, you will need to log in with Configure User/Passwords privileges.*




### New User…

Clicking on New User from the InSpec User Accounts Dialog brings up the dialog below.

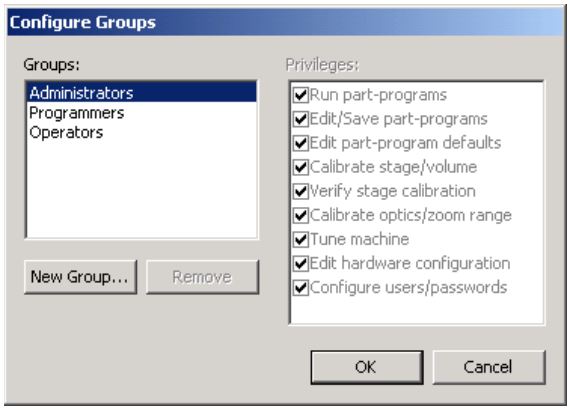



Enter the user name or ID and click OK to close the dialog. You will be returned to the InSpec User Accounts dialog with the cursor in the Password cell.

You may enter a password and select a group for the new user. You may leave the password field blank if you do not wish to use one. Leaving the password blank for “Operators” can make account management easier.

### Groups

Clicking on Groups from the InSpec User Accounts Dialog brings up the dialog below.



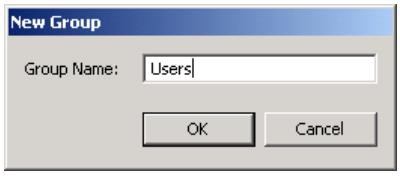

The Configure Groups dialog allows you to set up New Groups, Remove Groups, and edit privileges for your groups. You cannot edit or remove the default groups.

*If password protection has already been activated, you will need to log in with Configure User/Passwords privileges.*

To add a group, select the New Group button. To remove a group, select the group to be removed and then click on Remove button. To edit Privileges, add a group and check the desired Privileges for the account. Click OK when finished to close Configure Groups and go back to the InSpec User Accounts dialog.

### New Groups

Clicking on New Group button from the Configure Groups Dialog brings up the dialog below.




Enter the name of the new Group desired and click OK to close the dialog. Then select Privileges from the list on the right.

### Modifying User Passwords and Groups

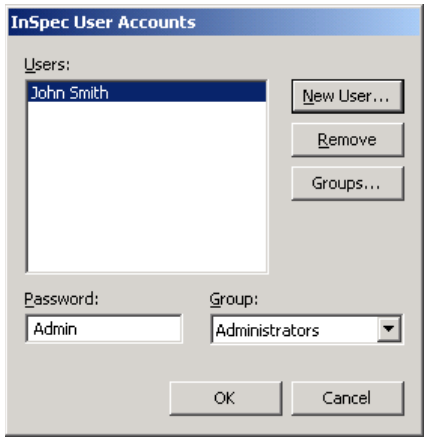
To modify a user password, select the User name from the list in the InSpec User Accounts dialog.

To change a Password, type in the new password.

To change a Group, select the desired group from the list.

To remove a user, select the user to be removed and then click on the Remove button.

Click OK when finished or select another User to make additional changes.




### Using Password Protection

If password protection has been set, the following Log On to InSpec dialog will appear when entering InSpec, ConfigUser, and Tuning programs.


The User name will default to the last User who entered the system. Use the arrow on the right to view a list of user names.

Select your User name, enter your Password, and click OK.

If the wrong password is entered the dialog will close and InSpec will not open. If your name is not in this list, then contact an administrator so that your name can be added. If you cannot perform certain functions, then you probably do not have the proper privileges. Ask an administrator regarding privileges.

# CHAPTER 16 CALIBRATION AND VERIFICATION

An increasing variety of industries are using Micro-Vu Precision Measuring Systems to Inspect parts more efficiently. Many parts being manufactured are becoming smaller and the tolerances on parts are continually becoming tighter.

Using the latest technology Micro-Vu can build machines that are mechanically more accurate than ever before. Micro-Vu recommends that your -Vu machine is calibrated annually. Depending on use and environment, it may be necessary to verify and calibrate more often to maintain peak performance.

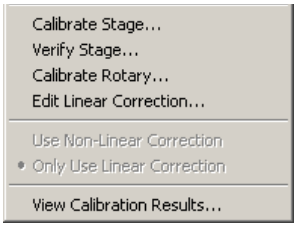
## Environmental Calibration Requirements

To get the best results, use the following criteria during the calibration or verification of a machine.

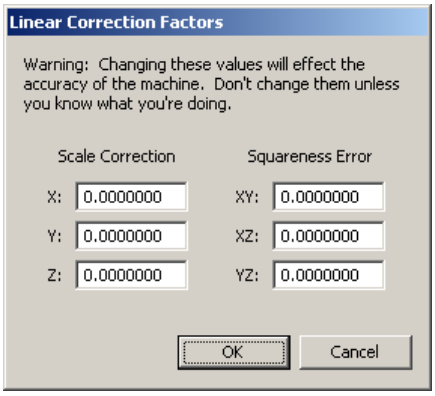
- Allow the machine to reach equilibrium with the room temperature. This may take up to two days depending on the size of the machine.
- Operate the machine in a temperature stable environment. The actual temperature is not as critical as the fluctuation range. For large, high accuracy machines, the temperature must be stable to +/-0.1 degrees. For typical measurements, the temperature should not fluctuate by more than +/-1 degree during the calibration.
- Locate the machine away from outside windows, fans and air ducts.
- Take temperature readings at the machine.

## Calibration Functions

InSpec includes calibration functions under the Machine menu. The options to Calibrate and Verify the Stage require a Micro-Vu Calibration and Verification Grid. Using the grid will provide the best calibration. Systems can be calibrated with other instruments and tools.



The Edit Linear Correction option allows the user to manually adjust linear and squareness compensation. To protect calibrations from unauthorized users, consider using password protection.




## Calibration and Verification System

Since the early 1990s, Micro-Vu has produced a Calibration and Verification (C/V) System that includes a glass calibration grid and software. This C/V System allows you to perform a calibration and verification quickly, easily, and as often as needed.

The calibration and verification software is included with InSpec for Windows. A glass calibration grid can be purchased from your local Micro-Vu distributor. The glass calibration grid is created with a photo-emulsion process. “Nodes” are placed at 0.5" vertical and horizontal increments on glass. This provides more than 150 data points on the smallest grid size. The center locations of the nodes are measured and the positions are written to a data file. The name of the data file matches the serial number of the grid.

When a calibration is performed, the C/V System compares the values in the data file to the values measured. The differences are computed and used to create compensation values to improve the machine performance.

**Features of the C/V System:**

1. A means to improve the accuracy of machines beyond any other means of calibration in less time.
2. A calibration procedure that automatically calculates compensation values to correct for mechanical misalignments.
3. A simple verification procedure that determines whether or not the machine is within specification.

4. A system that can be used on all Micro-Vu Measuring Centers™.
5. Calibration data that is traceable to N.I.S.T.

**Grid Maintenance**

Grids should always be stored in a protective case. This protects the photo-emulsion from dirt and scratches and protects the glass from breaking. The photo-emulsion is relatively fragile. Use gloves and avoid touching the surface of the grid to prevent fingerprints. Do not use clay, wax, or tape on the top surface of the grid.

**Do not use glass cleaner or any other liquids**.

If a grid gathers too much dust or otherwise becomes dirty, it should be cleaned. To do this, gently wipe its surface with a soft dry cloth, tissue, or a soft brush similar to the types used by photographers to clean negatives.

## Stage Calibration

The Stage Calibration is a pre-programmed routine that measures the locations of the nodes on the calibration grid. Prior to running the Stage Calibration, the machine must be par-centric, par-focal, and leveled. The Z-axis must be perpendicular and linear. The camera must be parallel to Z. The methods for the above are explained in the Micro-Vu Calibration Guide or the machine manual for your specific machine.

In addition, temperature effects must be considered. Unless disabled, the temperature compensation dialog appears when InSpec is opened. For the best results, maintain a room temperature of 20ºC (68ºF) +/- 0.1º during the calibration. Greater fluctuations will affect the calibration results. Over 24", each 0.1º can contribute one half micron (0.000020") of error.

Allow time for the grid to “soak” to room temperature. Even holding a grid can change its temperature. For best results, minimize touching the grid during soak, calibration, and verification.

**To perform a Stage Calibration:**

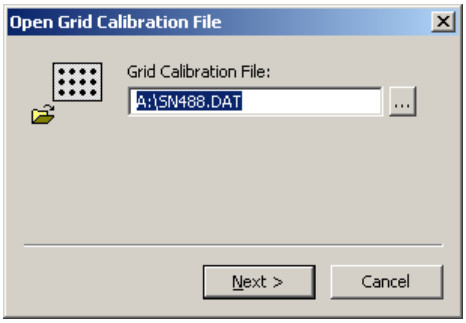
Place the calibration grid, serial number up, on the stage with the principal node at the front left corner. The grid can actually be place in any orientation with the nodes up. It is often more convenient to orient the grid with the serial number facing the operator. When using a grid that is larger than the stage, make sure that the grid will not make contact with the machine and surrounding objects during the calibration.

Affix the grid to stage with clay or clips so that the grid does not move. The photo-emulsion is relatively fragile. Use gloves and avoid touching the surface of the grid to prevent fingerprints. Do not use clay, wax, or tape on the surface of the grid.

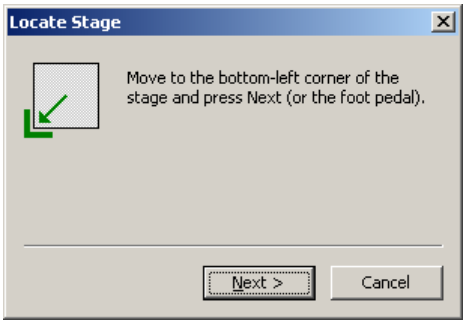
Confirm that the grid is secure and that all nodes are visible.

Select Calibrate from the Machine menu, and then choose Calibrate Stage.

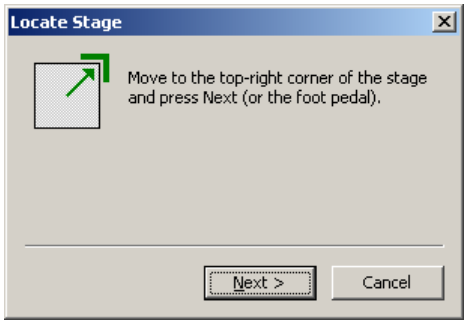
The first of a series of dialog boxes will prompt the operator for a grid data file. A grid data file is paired with each C/V grid. Type in the name of the file, or use the "…" button to search for a file.



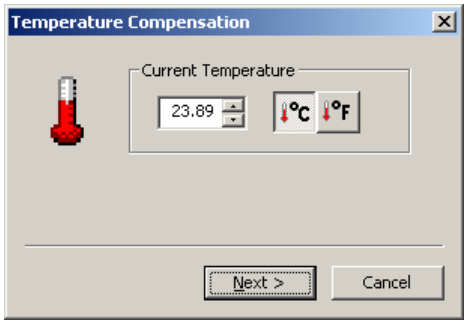

After providing the file name and selecting "Next," the operator will be prompted to locate a corner of the stage. Move the stage back and to the right so that the camera is viewing the near left corner.



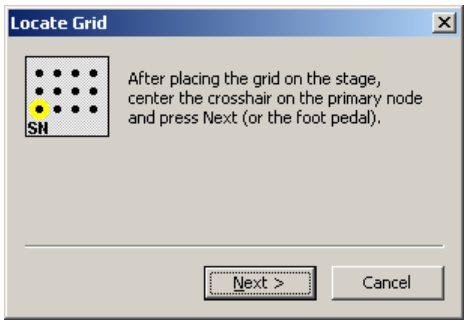

The **first time** the system is calibrated, the software needs to determine the useable measurement area. To do this it will prompt the operator to locate the opposite corner of the stage. Move the stage forward and to the left so the camera is above the back right corner of the measurement area. If the volume was previously entered, InSpec will skip the following step.




After the measurement area has been established, follow the on-screen instructions. Go to the principal node near the serial number, center the crosshairs on the node, and enter a point.




The first point on the Primary node provided information about the grid origin point.



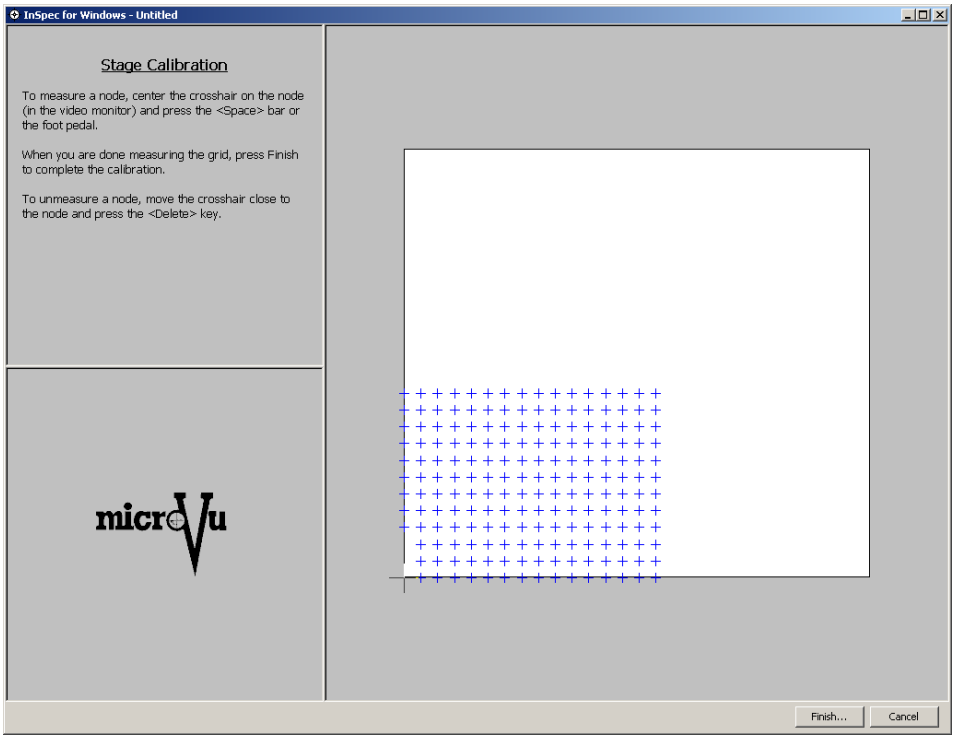

Next, enter a point on a “secondary” node. Move to a node in the same row, center the crosshairs on the node, and enter the point.

The second point provided information for the skew of the grid.

Now, InSpec can display the layout of nodes on the grid and display black crosshairs that show the current location of the camera.

The grid is displayed in relation to the measurement area. If the measurement area is very large relative to the size of the grid, InSpec will show a zoom view in the lower left where the Micro-Vu logo is usually displayed.

If you do not see the grid pattern, the volume may have been set incorrectly. Start the calibration over after checking the volume and counting directions.

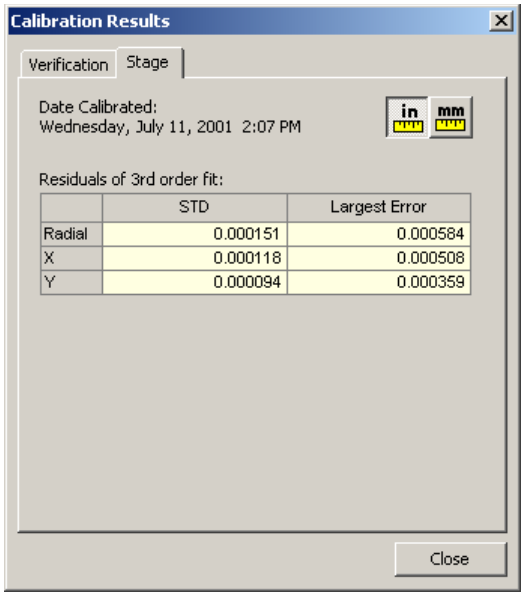



Now begin entering node positions. As nodes are entered, the blue crosshairs on the screen change to blue boxes. If a point was entered by mistake, position the crosshairs near the problem node and press delete.

The calibration may recommend multiple placements of the grid for best results. The number of placements will also depend on the size of the machine. Grid placements should overlap each other and overlap the edges of the stage for best results.

If you choose another placement of the grid, you will be prompted again for the primary and secondary nodes.

The Stage Calibration Results will appear at the end of the calibration and can be viewed later from the option in the Machine menu. Results provide the standard deviation and largest error for radial, X, and Y measurements. Refer to the Digital readout for the units. After reviewing the data, select Continue to return to the InSpec screen.




## Stage Verification

The Stage Verification process measures nine nodes on the C/V grid. Then the measured distances are compared to the distances calculated from the calibrated locations. The verification will display the nominal, measured, and error values for the distances as well as the largest and RMS errors. The largest error should be compared to the machine's accuracy specification. The RMS error is the uncertainty. The results can be displayed in Metric or English units.

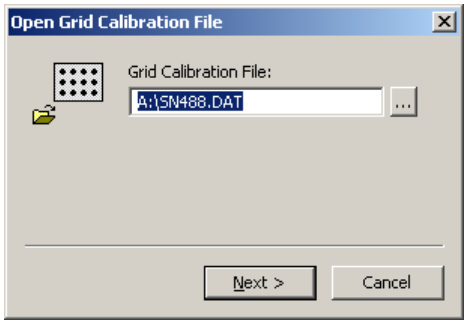
Place the calibration grid, serial number up, on the stage with the principal node at the front left corner. The grid can actually be placed in any orientation with the nodes up. It is often more convenient to orient the grid with the serial number facing the operator. When using a grid that is larger than the stage, make sure that the grid will not make contact with the machine and surrounding objects during the calibration.

Affix the grid to the stage with clay or clips so that the grid does not move. The photo-emulsion is relatively fragile. Use gloves and avoid touching the surface of the grid to prevent fingerprints. Do not use clay, wax, or tape on the surface of the grid.

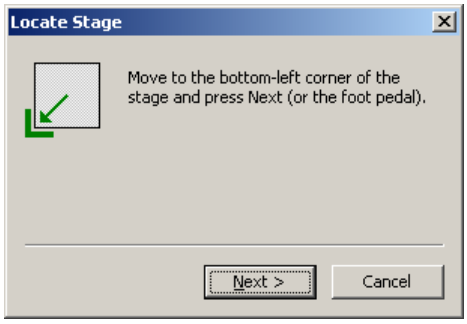
Confirm that the grid is secure and that all nodes are visible.

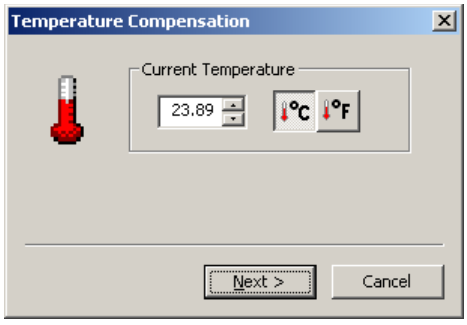
Select Calibrate from the Machine menu, and then choose Calibrate Stage.

The first of a series of dialog boxes will prompt the operator for a grid data file. A grid data file is paired with each C/V grid. Type in the name of the file, or use the "…" button to search for a file.

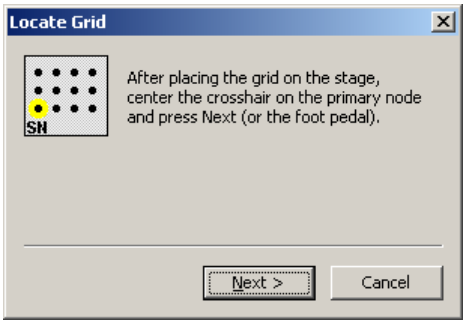



After providing the file name and selecting "Next," the operator will be prompted to locate a corner of the stage. Move the stage back and to the right so that the camera is viewing the near left corner.

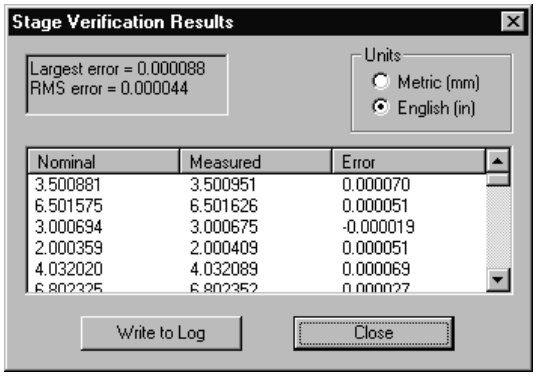



- InSpec will instruct the operator to measure the (9) nine nodes that best cover the stage. If you do not see the grid pattern, the volume may have been set incorrectly. Start the calibration over after checking the volume and counting directions.




- The **Verify Stage Calibration** results will appear and can be viewed directly from the Tool Menu – Calibration Option. Columns display the nominal, measured, and error values for individual distances. The largest and RMS errors are displayed at the top. The results can be saved to a data file.
- After reviewing the data, select Close to return to InSpec.




**Largest error:** This is the largest error measured in X , Y, or X-Y.

**RMS error:** This value represents the uncertainty of the verification measurements.

If the largest error is greater than the original manufacturer's accuracy specifications, then repeat the verification process. First, make sure that the grid is secure on the machine. During this second run, watch to ensure that there is no debris on the grid. (If there is some debris, clean it off and start over.) If the second run also has a larger than acceptable error, perform a calibration. After completing the calibration, check it by rerunning the Verification.

If a calibration has been run and the largest error still exceeds the original manufacturer's accuracy specifications, then the machine may require servicing. Contact your local dealer or Micro-Vu for assistance. The machine may still be used with this calibration knowing that a maximum error of measurement is this verified value.

## Data Files

There are three data files related to calibration. Keep backups of these files on a floppy or a separate computer to prevent loss of calibration data.

Each grid has an accompanying data file named with the serial number. For example grid number 302 has a data file named SN302.DAT. This file contains the information about the grid that makes it traceable to NIST during the stage calibration and verification processes.

The stage calibration creates a file named StageCal.DAT. This file contains the compensation values for the machine. If the computer should ever fail, reinstalling the InSpec and the StageCal.DAT file would return the system to an operational and calibrated state.

The stage verification creates a file called StageVer.DAT. This file contains the measured data and nominal data for the last verification. This file may be required for quality assurance to track the status of the gage. Create a text file on disk by selecting the “Write to Log” button in the Stage Verification Results dialog box.

## Effects of Temperature

The non-linear calibration corrects the machine for non-linearity at the time of calibration. The calibration remains valid as long as the temperature cycle is kept small and around the calibrated temperature. Large temperature excursions may cause mechanical distortions that produce time dependent errors. This random effect can invalidate a calibration and require the machine to be re-calibrated.

Seasonal temperature shifts of the machine’s environment may be another reason for re-calibration. If necessary, calibrate the machine for each seasonal temperature change. Large, granite-based systems may require a day or more of soak time to settle to equilibrium if the room temperature changes by more than a few degrees.

## Temperature Compensation

The Temperature Compensation dialog will be one of the first windows a user will notice when opening InSpec. A temperature and humidity controlled room combined with temperature compensation will provide the highest accuracy. This feature can be disabled where temperature compensation is not required.

Using temperature compensation, InSpec can correctly compute the sizes of and distances between features at a temperature other than the recommended operating temperature. The standard operating

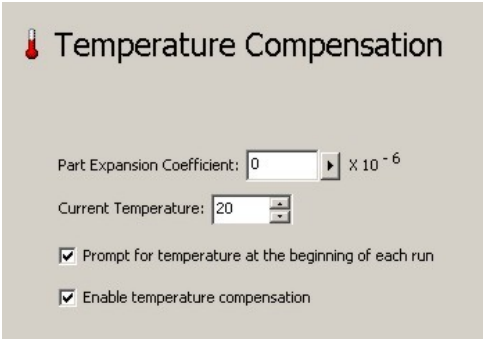
temperature is 20ºC (68ºF). Temperature compensation is designed for static temperature conditions. Using any equipment for measurement in a dynamic temperature environment will have inaccuracies.

When you enter InSpec, the software will initialize and display a Temperature Compensation dialog window. The user may change values or select “Done” to accept the current settings.

- The part and stage have separate entries for the **coefficient of expansion**. The default is 0 for No Part Correction, as this will give the actual measurement at the current temperature. Clicking on the arrow next to the part correction value will display expansion coefficients for different materials for the current units of temperature. The coefficient of expansion for the stage is set by Micro-Vu and should not be changed.

| | |
|---|---|
| Zero Expansion Material | 0 |
| Aluminum | 25 |
| Brass (Yellow) | 18.9 |
| Copper | 16.6 |
| Glass (heat-resistant) | 3.0 |
| Glass (soft) | 9.0 |
| Iron (Cast) | 12.0 |
| Nickel | 13 |
| Platinum | 9.0 |
| Steel (Hardened) | 11.5 |
| Steel (Carbon) | 11.3 |
| Zinc | 35 |

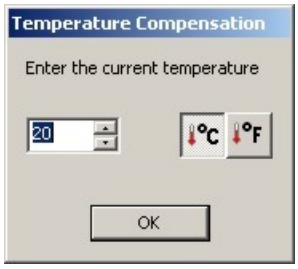
- The current room **Temperature** should be entered for accurate temperature compensation. The last temperature value used will be displayed. It is assumed that the machine and parts to be measured have had sufficient time to soak to this temperature.
- At the bottom of the dialog window, one check box allows the user to show the dialog window at the beginning of each run. A second check box allows the user to apply or remove temperature compensation to the part program. Select units of temperature ºC or ºF under the X-Y-Z digital readout.



### Temperature Compensation Feature Type

The Temperature Compensation feature can be included to prompt the operator for current temperature. This feature can only be placed at the beginning of the program and has no exportable characteristics.

Under controlled environmental conditions, measurement accuracy will be improved with temperature compensation. The effects of temperature compensation are most noticeable on high accuracy measurements of large parts. Room temperature and part handling must also be considered for measurements.



# GLOSSARY

This section presents the meanings of some technical terms as they relate to InSpec Metrology Software.

**ASCII** (American Standard Code for Information Interchange) A standard format for representing data in a computer.

**Baud Rate** The speed at which data is transmitted and received over an electronic interface.

**Cartesian Coordinates** A method of representing a location or position using a set of ordered numbers X and Y. The X coordinate is the distance from the origin (datum) to the position in the X-axis direction. The Y coordinate is the distance from the origin to the position in the Y-axis direction. The X-axis coordinate is normally positive to the right of the origin and negative to the left. The Y-axis coordinate is normally positive above the origin and negative below.

**Coordinate System** A coordinate system is a system for denoting locations in X and Y coordinates. A coordinate system consists of an origin (X = 0, Y = 0) and a direction (skew angle). InSpec uses two types of coordinate systems, the **M**achine **C**oordinate **S**ystem, and **P**art **C**oordinate **S**ystem.

**Depth of Field** The physical distance in the optical axis that can be considered in focus at the same time.

**Edge Detection** In a video system, edge detection refers to the ability to accurately and repeatability find the physical location of a part's features from the video image.

**Feature** A feature is a geometric characteristic of the part being measured. In InSpec, features (like line, radius, angle, etc.) automatically become program steps.

**Field of View** The physical size that can be imaged by the camera.

**Fixture** In this manual, a fixture is simply a part holding device used for orientation and to keep the part from moving during the Inspection process.

**Form** A measure of how a feature's shape deviates from a perfect feature shape. For a line, form is the straightness of the line. A perfectly straight line has zero form error. For a radius or diameter, form is roundness.

**Icon** A small picture on the computer monitor that represents a function. For example, clicking the mouse on a icon in the feature toolbar begins the process of creating a new feature.

**Latched Point** A point is "latched" after the profile edge detector has captured an edge. This "latched" point can then be entered into a geometric calculation by pressing the [spacebar]. In the manual tool (when the large blue crosshairs are displayed) the current location of the stage is always the latched point.

**Light, Coaxial** or "Through the Lens" Lighting. In a video system, coaxial light refers to an illumination source that is parallel to the optical axis. This is usually achieved with a right angle beam-splitter between the lens and the camera.

**Light, Profile** Illumination that travels from behind (or under) a part towards the lens/camera system. This lighting technique is very good for illuminating flat parts but tends to create shadows in thicker pieces.

**Light, Surface** In this application, surface light refers to illumination from above the part. The light is reflected off the surface of the piece. Usually, surface lighting is some form of ring light around the lens.

**Magnification, Optical** The image size at the camera divided by the object size. This is the number printed on the lens elements.

**Magnification, Video** The image size on the video monitor divided by the object size. Most of this magnification is due to the camera chip to monitor magnification. This number will increase as the size of the monitor increases. The apparent magnification increases without giving any more image resolution or field of view.

**MCS** (Machine Coordinate System) The machine coordinate system is the system of X and Y coordinates defined by the measuring stage. This means that the point (X = 0, Y = 0) is the point where the measuring stage was when the system was turned on or the location of index marks. There is no skew factor since the X- and Y-axes are lines up with the travel of the measuring stage. The MCS is never changed while using InSpec. When you zero the X- and Y-axes on the DRO, the PCS changes, not the MCS.

**Metrology** The science of measurement.

**Parity** A method of error detection used in RS232 communications. Parity can be EVEN, ODD, SPACE, MARK, or most commonly NONE.

**Pixel** (Picture Element) When a video input is digitized, the image is broken up into many discrete pieces called pixels. By using many pixels in an area, sub-pixel repeatability of edge detection can be achieved through statistical methods.

**Polar Coordinates** A method of representing a location using a radius (distance) and angle from the origin. The angle is zero degrees if the radius is aligned with the positive X-axis. The angle increased in the counter-clockwise direction.

**PCS** (Part Coordinate System) The part coordinate system is the system of X and Y coordinates you are using to measure the part. It consists of a zero location for X, a zero location for Y, and a skew direction. The part coordinate system is different than the machine coordinate system. If the part being measured is not square to the measuring stage, you must use the skew function to compensate. This sets up a part coordinate system. You may use several part coordinate systems to measure on part if necessary.

**RS232** (Radio Signal 232) This is a standard method for sending and receiving data with computers.

**Sigma** A measure of how well a set of data points define a feature with perfect shape. Technically it is the standard deviation of the data points to the measured feature.

**Skew** A method for measuring a part that is not aligned with the X- and Y-axes of the measuring stage. Aligning a coordinate system with the part does this.

**Structure** In this manual, structure refers to the presence of information (contrast, detail, “graininess”) in the video image. The Measuring Center™ uses this information to perform the automatic focus.

**Tool** A routine that completes a task, often returning useful data to the part program. Features can contain one or more tools.

**Vertex** The point at which the sides of an angle (or two lines) intersect.

# APPENDIX A: EXPORT FORMATS

Different types of tolerances have different fields. The order of fields exported for each type of tolerance is shown below using the comma delimited format. Labels and nominals are optional fields.

### InSpec 2.XX – Data Exporting

Dimensions (i.e. Center X, Diameter, Width, etc)

*[Label, ]Actual[, Nominal, PlusTol, MinusTol, DevNom, DevTol]*

RMS Residual Error

*[Label, ]Actual*

Form Tolerances (i.e. Straightness, Circularity, Flatness, "Form of Fit")

*[Label, ]Actual[, Zone, DevTol]*

Reference-Feature Tolerances (i.e. Parallelism, Perpendicularity, Angularity, Concentricity)

*[Label, ]Actual[, Zone, DevTol]*

True Position Tolerance (i.e. RFS)

*[Label, ]Actual[, Zone, DevTol, $X_{ACTUAL}$, $Y_{ACTUAL}$, $X_{NOMINAL}$, $Y_{NOMINAL}$]*

True Position Tolerance (i.e. MMC/LMC)

*[Label, ]Actual[, Zone, DevTol, $X_{ACTUAL}$, $Y_{ACTUAL}$, $X_{NOMINAL}$, $Y_{NOMINAL}$, Bonus]*

### InSpec 1.XX – Data Exporting

In Version 1.XX of InSpec, the Zone tolerance preceded the Actual value. Customers who upgraded from the 1.XX version can use the “Version1.XX” check box on the export option to continue using this format.

Dimensions (i.e. Center X, Diameter, Width, etc)

*[Label, ]Actual[, Nominal, PlusTol, MinusTol, DevNom, DevTol]*

Form Tolerances (i.e. Straightness, Circularity, Flatness)

*[Label, Zone, ]Actual[, DevTol]*

Reference-Feature Tolerances (i.e. Parallelism, Perpendicularity, Angularity, Concentricity)

*[Label, Zone, ]Actual[, DevTol]*

True Position Tolerance (i.e. RFS)

*[Label, Zone, ]Actual[, DevTol, $X_{ACTUAL}$, $Y_{ACTUAL}$, $X_{NOMINAL}$, $Y_{NOMINAL}$]*

True Position Tolerance (i.e. MMC/LMC)

*[Label, Zone, ]Actual[, DevTol, $X_{ACTUAL}$, $Y_{ACTUAL}$, $X_{NOMINAL}$, $Y_{NOMINAL}$, Bonus]*

# APPENDIX B: EXTERNAL LINKS TO INSPEC

The installation of InSpec metrology software includes an executable file called ISCMD.EXE. This file allows users to sends commands to InSpec from external script files or integration software.

This allows you to easily create your own operator interface that runs an InSpec part program.

You can create an interface that has pictures of your parts or that interfaces with Excel or SPC software. With a single click your interface could open and run and inspection program, look for the data file to be created and then have a robot load and unload parts.

Currently the following commands are supported:

iscmd /run *filename*

iscmd /run *filename* /nowait

iscmd /halt

The /run command tells InSpec to open and run the specified program file. The script file will not continue past the /run line until the part program has completed its measurements.

With the optional /nowait flag present, the script file will continue to the next line of the script file immediately after InSpec starts the part program.

The /halt command tells InSpec to stop the running program.

This command can be used when a program has been started with the

/run /nowait command.

iscmd.exe handles only one command per call.

iscmd.exe returns a non-zero value when it is unable to successfully send a command to InSpec (either InSpec isn't running or it doesn't recognize the command line arguments).

# APPENDIX C: LANGUAGE SUPPORT IN INSPEC

InSpec, by default, selects a language based on the current language of the Windows operating system.

When a Multilingual user Interface (MUI) pack is installed InSpec will choose its language based on the Windows user account's language. Each user account may have a different language associated with it.

You may also set (or override) the language in inspec.ini.

Create a [Language] header in the inspec.ini file using one of the UserInterface codes listed below. InSpec will ignore entries that begin with a semicolon. This is a convenient way to change between languages.

Here is a typical language entry in the inspec.ini file:

[Language]

UserInterface=German

;UserInterface=English

The three-letter international code or the name as listed below can be used to specify the language.

| | | | |
|---|---|---|---|
| ENU | English | KOR | Korean |
| FRA | French | CHS | Chinese - Simplified |
| ITA | Italian | CHT | Chinese - Traditional |
| ESP | Spanish - Castilian | CHS | Chinese |
| ESM | Spanish - Mexican | CSY | Czech |
| ESM | Spanish | BRA | Portuguese - Brazilian |
| DES | German - Swiss | PTG | Portuguese |
| DEU | German | HUN | Hungarian |

# Alphabetical Index