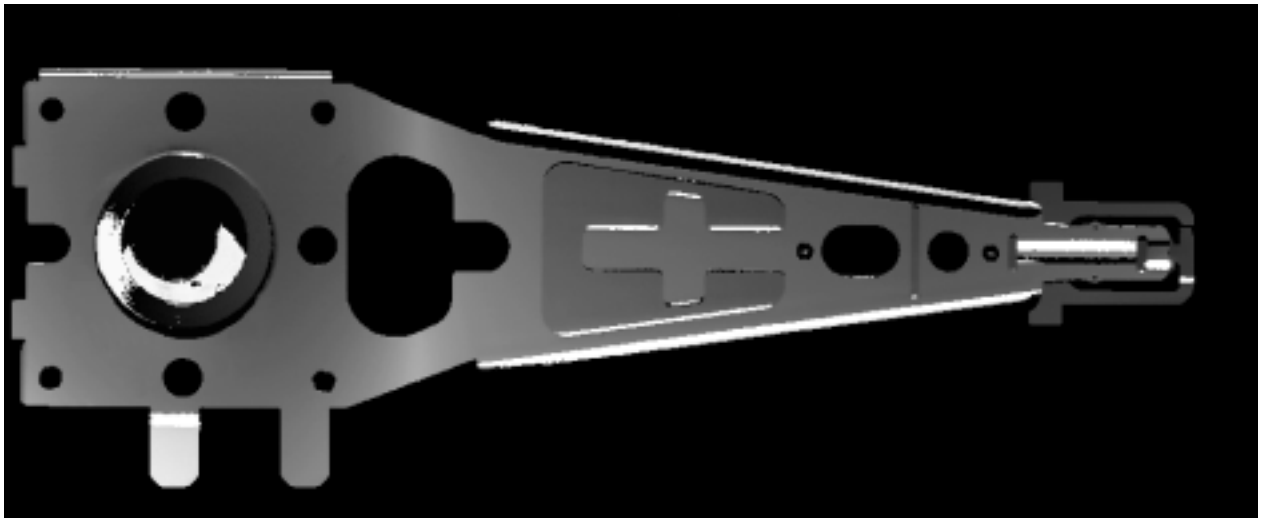
PPT VISION, Inc.
PPT861 Inspection System
User Documentation



Hard Drive Suspension Assembly
Component Inspector Manual

PPT Publication #843-0087 (Rev A)

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- The version number of all PPT VISION software and hardware you are running.
- The version number of Microsoft Windows™ you are running.

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Hard Drive Suspension Assembly Component Inspector

This manual serves as a supplement to your PPT861 Inspection System Users Manual (Publication # 843-0076). It contains procedures and other information for using the hard drive suspension assembly component (HDSAC) Inspector that is built in to your Inspection System.

Use the instructions in this manual to set up and modify inspections to be performed with your PPT861 Inspection System and to edit the part descriptions used for each part to be tested.

Overview of Setup Procedures

Suppose that you are preparing your PPT861 Inspection System to perform inspection runs on a new part (or a part that will be contained in a new fixture mount). You need to create a new recipe along with the corresponding part description, and you may need a new map to specify the fixture that will be used. (See “Using the Map Editor” in Chapter 7 of the users manual for information on creating the recipe, map, and part description.)

Assuming that the part description already defines the inspections to be performed, you will still want to make sure that the inspection runs work properly on the new parts. In particular, it is important that the parts are located properly within the acquired images and that the measurements used for each inspection are taken at the proper points of each test part.

Follow these steps

1. Install the part(s) into the desired fixture on the Inspection System mounting plate.

   Follow the instructions that you and PPT VISION, Inc. have developed for your specific installation.

2. Perform an inspection run.

Tip: If you click **OK**, you will lose the chance to observe the acquired images through the **Setup** screen. If this happens, perform another inspection run before continuing with step 4.

3. Check the inspection results displayed on the Inspection Manager main screen. (The results may help you decide which part to use as the basis for setting up the part.)

4. Select **Setup** ➡ **Inspections** from the Inspection Manager’s menu bar.

   The Inspections Setup window appears, as shown in Figur e1.

5. Click the **Use Part** arrow and select the desired part.

6. Click 

.

   The Inspection Setup Properties screen appears, as shown in Figure2. This screen displays the actual image of the selected part acquired during the inspection run.

7. Follow the instructions in the following sections to set up or modify existing inspections for this part:
   - Setting the Locate Parameters
   - Creating Point to Plane Inspections
   - Creating Angle Inspections
   - Creating Profile Measurements

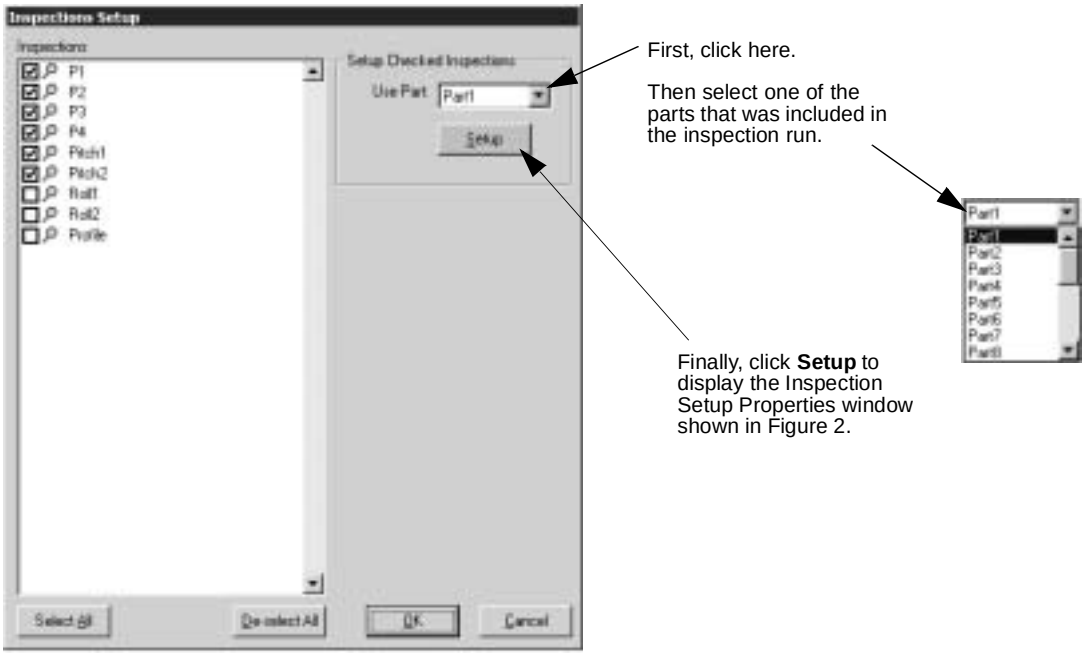


Figure 1: Inspections Setup Window

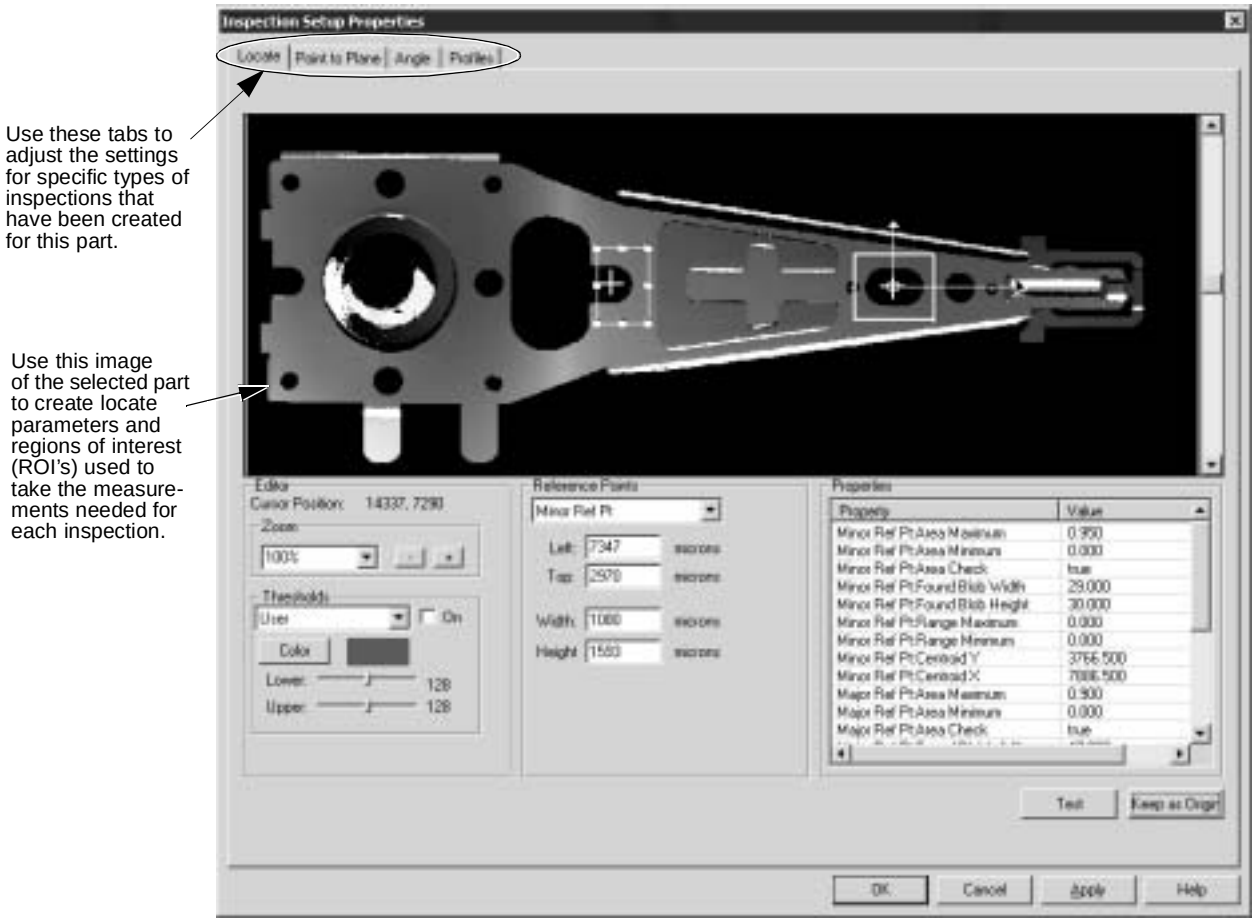


Figure 2: Inspection Setup Properties Screen

Setting the Locate Parameters

The locate parameters allow the PPT861 Inspection System to locate the part within each acquired image. By specifying a few key components on the part, the Inspection System can recognize the part, determine its orientation in the fixture, and apply a point of origin to be used in locating areas where measurements are to be taken.

You will need to set the locate parameters when setting up a new part for testing or when beginning to test a part using a different fixture.

Follow these steps

1. Perform an inspection run, then display the Inspection Setup Properties screen for one of the parts included in the inspection run. (See “Overview of Setup Procedures” on page2.)
2. When the Inspection Setup Properties screen appears, click the **Locate** tab to select it.

   See Figure 3 and the following table for information about the **Locate** tab.

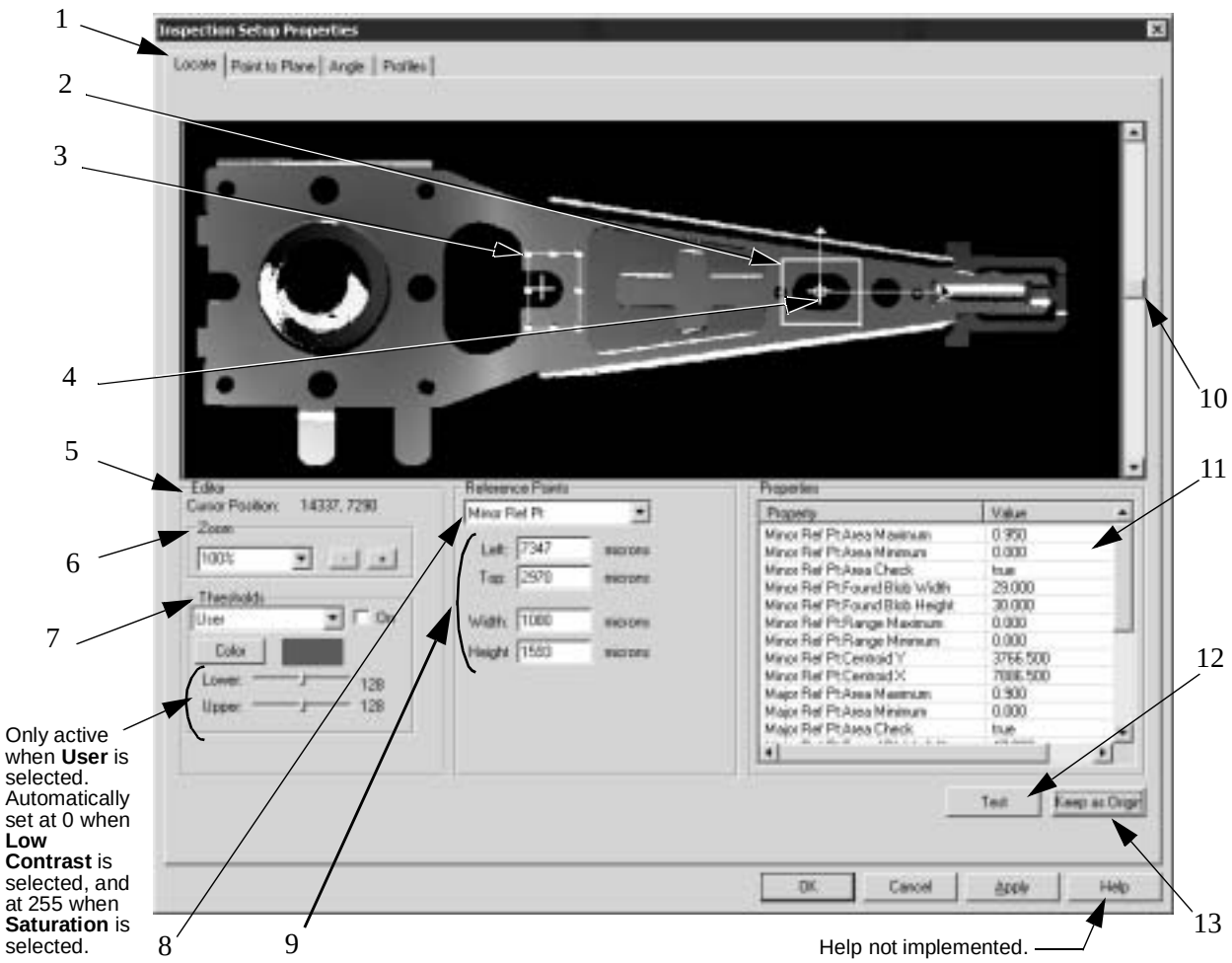


Figure 3: Setting the Locate Parameters

Figure 4: Part Origin

No.	Name:	Description:
1	Locate tab	Allows you to set the locate parameters for this part.
2	Major reference point ROI	You will set the size and position of this rectangle in step 5 of this procedure. The major reference point is used to locate the X and Y axes of the part.
3	Minor reference point ROI	You will set the size and position of this rectangle in step 6 of this procedure. The minor reference point is used to determine the rotation of the part's acquired image.
4	Part origin (see Figure 4)	The origin point with X and Y axes is calculated as a result of this procedure. Once set, this origin will be automatically placed on each image acquired of this part type.
5	Cursor position	Indicates the location of the cursor within the part image. The origin point (0,0) is at the top-left corner of the image.
6	Zoom controls	Use these controls to change the magnification of the displayed part image. You may want to zoom out to view the entire part, or zoom in to help you place one of the ROI's more accurately. Click the zoom arrow and choose one of the pre-selected zoom settings or use the + and - buttons to zoom in or out incrementally.

7	Thresholds	Use these controls to change the appearance of the displayed part image using any of the following methods:
		• Click the Thresholds arrow and select the desired setting:
		  • **User**: Sets all pixels in the image whose grey scale lies between the lower and upper values to the color that is selected. (Set using the Lower and Upper sliders.)
		  • **Low Contrast**: Sets all low contrast pixels in the image to the color that is selected. (Low contrast pixels are those that have a "0" value and are not getting enough light to the 3D scan head.)

Tip: Thresholds provide a useful way of checking the grey scale value of any point on the displayed part image. Set Thresholds to **User**, and select the On check box. Then set the Lower and Upper threshold settings to a very narrow range (for example, Lower = 50 and Upper = 60). This changes all points on the part display whose gray scale value is between 50 and 60 to the selected color, making them visually distinctive.

No.	Name:	Description:
	Thresholds (continued)	• **Saturation**: Sets all saturated pixels in the image to the color that is selected. (Saturated pixels are those that have a “255” value and send too much light to the 3D scan head.) Select the **On** check box for the new setting to take effect. • Click Color to select a different color for the threshold. Use the **Lower** and **Upper** sliders to set the Z-height range (only available when User is the threshold.)
8	Reference Points	Click the Reference Point arrow and select either the major or minor reference point. The selected area will be highlighted on the displayed part image and can be moved or resized as needed.
9	Coordinate and size fields	The **Left** and **Top** boxes indicate the position of the top-left corner of the currently selected ROI with respect to the image origin. (The image origin is the top-left corner of the image.) The **Width** and **Height** boxes indicate the size of the currently selected ROI. You can move and resize the ROI by typing new values.
10	Part image scroll bars	If you have zoomed in so that you cannot see the entire displayed part (see item #6, Zoom controls above), use these scroll bars to view any desired area on the image.
11	Properties	Each property appearing here is specified in the part description called by the recipe when performing the most recent inspection run. Some of the displayed values (for example, maximum and minimum allowable values) were entered into the part description as permanent entries, while others are actual measurements recorded on this particular part during the inspection run. To add, remove, or edit these properties, you need to make the changes to the part description. (See “Editing Part Descriptions” on page 30.)

Tip: You can move or resize the selected reference point either by clicking and moving it with the trackball, or by typing different numbers into the **Left**, **Top**, **Width**, and **Height** fields.

No.	Name:	Description:
12	Test button	After setting up your major and minor areas (see steps 3 and 4 below), click Test to perform a test that checks the specified areas against the actual part image. If the test passes, an origin point (displayed as red cross-hairs) is automatically placed inside the major and minor reference points. If the test fails, the reference points must be moved and/or resized.
13	Keep as Origin button	If the Test passes, click Keep as Origin to save the origin as the standard for this part. This will move the yellow cross-hair to the part origin. Once done, all other ROI's in the remaining tabs (Point to Plane, Angle, and Profiles) will be referenced from this point.

3. Identify two features on the part that you wish to use as the major and minor reference points. Keep the following considerations in mind:
   - Avoid background reflections, which can give false Z-height readings.
   - Select features that won't move considerably from one component to another.
   - Select features that have good contrast from other features around them.

4. Set up the major reference point's ROI, as follows:

   a) Click the Reference Point arrow and select **Major Ref Pt**.

   b) Move and resize the major reference point to fit around the first feature you have selected. You can do this either by grabbing and dragging the ROI directly on the displayed part image, or by entering the appropriate numbers in the **Left**, **Top**, **Width**, and **Height** boxes.

5. Set up the minor reference point's ROI, using the same general process described in step 4:

   a) Click the Reference Point arrow and select **Minor Ref Pt**.

   b) Move and resize the minor reference point to fit around the second feature you have selected. Use the same method you followed in step 4b above.

6. Click Test.

   Red cross-hairs should appear in both ROI's. This will indicate that the test result passes.

Note: If the test does not pass, you should try moving and/or resizing one or both ROI's.

7. When the test passes and the location of the part origin looks fine, click Keep as Origin.
8. The yellow part origin will move to the red cross-hair in the major reference point ROI. All ROI's you create in the following sections will be referenced from this location.
9. Click **OK** to return to the Inspections Setup window. (See Figure 1.)
10. Click **OK** to return to the Inspection Manager main screen.
11. Finally, you must save the currently open recipe in order to preserve the changes you have made to the associated part description:

    a) Select **File** ➡ **Save Recipe as** from the Inspection Manager's menu bar.

    The Save Recipe File As window appears, as shown in Figure 5.

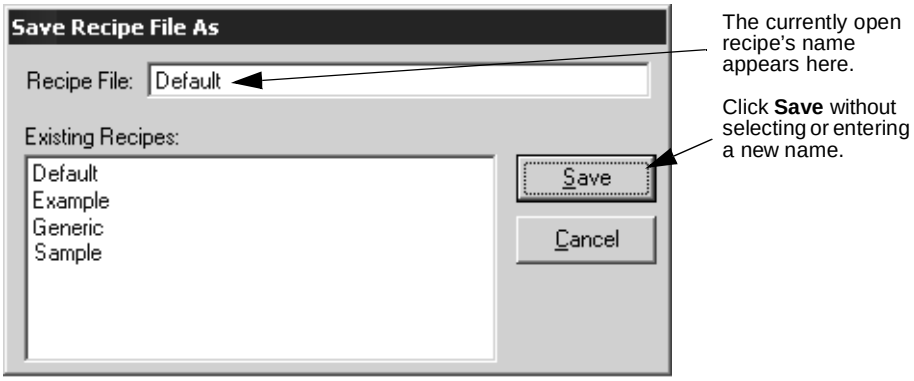


Figure 5: Save Recipe As Window

    b) Click **Save** *without* changing the name of the recipe.

    c) Click **Yes** when the warning appears, asking if you are certain that you want to save the changes.

    The major and minor reference point ROI's and the new origin point are now saved into the part description and will be used whenever an inspection run is performed using this recipe.

Setting up HDSAC Inspections and Measurements

Once you have set the part origin point by using the “Setting the Locate Parameters” procedure, you should check the regions of interest (ROI’s) that have been set for each inspection to be performed on this part. Even if the ROI’s have been previously sized and positioned, they may need to be adjusted due to the changed location of the part origin.

Inspections are created and stored within the part description to be used when running inspections on the desired part. Use the following procedures to adjust the ROI’s used to take the measurements that provide results for the following types of inspections:

- Point to Plane inspections
- Angle inspections
- Profile lines

Specifying Point to Plane Inspection Measurements

A part description can specify any number of point to plane inspections to be performed on the images acquired during inspection runs. A point to plane inspection requires the following elements to be set up (see Figur e6):

- One plane – You will position and size four ROI’s that result in three points through which a hypothetical plane passes. (Two of the ROI’s are combined to form one point.)
- One point – You will place one additional ROI that forms the point to be measured.

When the inspection is performed, the hypothetical plane will be extended so that it passes over or under (or through) the specified point. The shortest distance from the point to the plane’s surface will then be calculated and reported. If the distance from the point to the plane is within the specified distance tolerance, the part passes the inspection. If the distance is greater than the tolerance allows, the part fails.

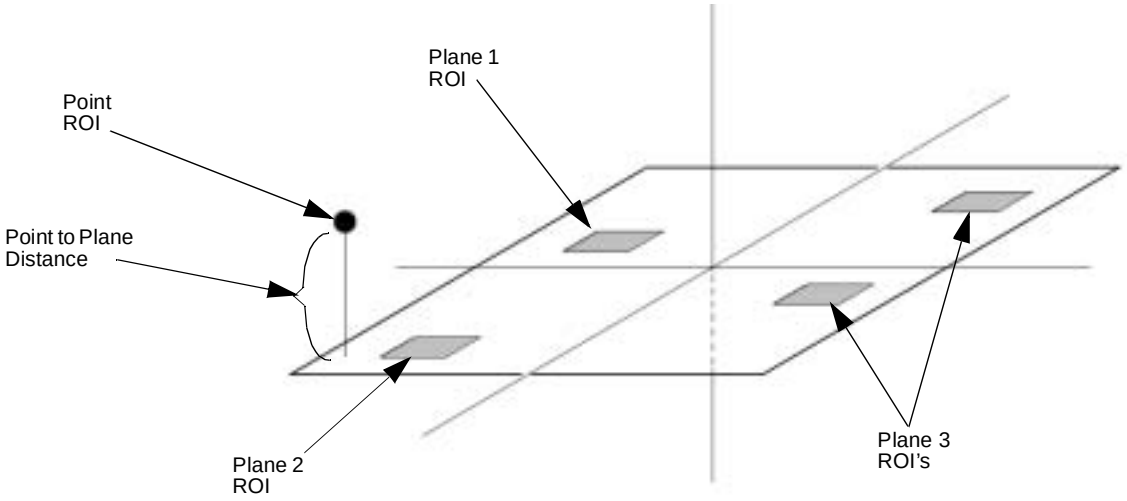


Figure 6: Distance from a Point to a Hypothetical Plane

Note: Perform the following steps to make adjustments to an inspection that is already specified in the relevant part description. Adding or deleting an inspection, or making other changes to the inspection, require that you open the part description and make the changes directly. See "Editing Part Descriptions" on page 30.

Follow these steps

1. Perform an inspection run, then display the Inspection Setup Properties screen for one of the parts included in the inspection run. (See "Overview of Setup Procedures" on page2.)

2. When the Inspection Setup Properties screen appears, click the **Point to Plane** tab to select it.

   See Figure 7 and the following table for information about the **Point to Plane** tab.

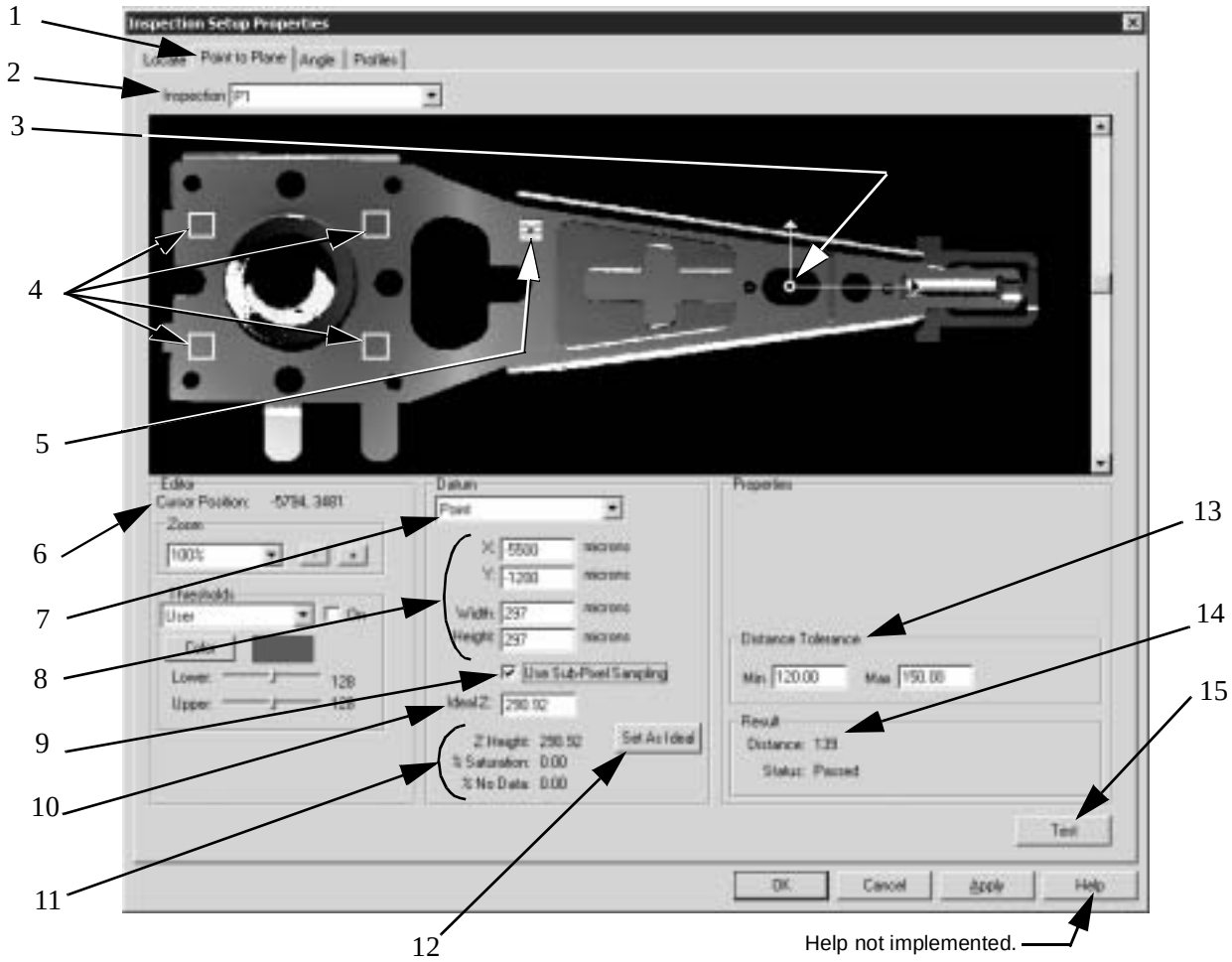


Figure 7: Creating Point to Plane Inspections

No.	Name:	Description:
1	Point to Plane tab	Select this tab to set the parameters for all point to plane inspections that have been created for this part.
2	Inspection	Click the Inspection arrow for a dropdown list of all point to plane inspections that have been created for this part. When you select an inspection from the list, the displayed part image and data reflects that exact part on the last performed inspection run.
3	Part origin (see Figure 8)	This is the origin point that was set up using the “Setting the Locate Parameters” procedure in this manual. The locations of all ROI’s for this part are relative to this point of origin.

Figure 8: Part Origin

No.	Name:	Description:
4	Plane ROI's	You will set the size and position of these four rectangles in step 5 of this procedure. These four ROI's form the plane, the distance from which the point (item #5 below) is measured.
5	Point ROI	You will set the size and position of this rectangle in step 6 of this procedure. Conducting the selected point to plane inspection will result in the calculation of this point's distance from the plane set with the four plane ROI's (item #4 above).
6	Editor controls and fields	Use these fields and controls to view the cursor coordinates and to change the appearance of the displayed part image: **Cursor Position**: Indicates the current position of the cursor as you move the trackball over the image. The X and Y coordinates shown are relative to the part origin's (0,0) location. **Zoom**: Use to increase or decrease the magnification of the displayed part image. (See item #6 on page 5 for more details.) **Thresholds**: Use these controls to change the appearance of the displayed part image and to check for areas on the part that fall within a specified range of gray scale values. (See item #7 on page 5 for more details.)
7	Point to Plane Datum	Click the Datum arrow and select the ROI you want to work with. The selected area will be highlighted on the displayed part image and can be moved or resized as needed.
8	Coordinate and size fields	The **X** and **Y** fields indicate the position of the center of the currently selected ROI with respect to the part origin (item #3 above). The **Width** and **Height** fields indicate the size of the currently selected ROI. You can move and resize the ROI by typing new values directly into these fields.

Tip: You can also move or resize the selected ROI by clicking on it and moving it with your PC's trackball.

No.	Name:	Description:
9	Use Sub-Pixel Sampling	Specifies the method used to calculate a Z-height value from the defined ROI's: Leave the box unchecked to use the average of all gray level values within the ROI. (See "Gray Level Average" on page34.) Select this box to fit the ROI's pixels to a plane, then find the value of that plane at the center of the ROI. (See "Gray Level Plane Fit" on page35.)
10	Ideal Z	In step 5d of this procedure, you will enter a value of 200 in this field. Then, click Test and go back and set each ROI to the calculated Z-height as "ideal."
11	Test data fields	These fields help when selecting ROI placements. It is desirable to have minimal % Saturation and % No Data values for each ROI you have created: Z Height – The calculated Z-height of the selected ROI. % Saturation – The percent of Z-height values in the selected ROI that are saturated (have values of 255 and send too much data to the 3D scan head to be useful). % No Data – The percent of Z-height values in the selected ROI that are low contrast (have values of 0 and do not send enough data to the 3D scan head to be useful).
12	Set as Ideal button	After clicking Test and obtaining acceptable results, click Set as Ideal to place the actual obtained Z-height value into the Ideal Z field (item #10 above).

No.	Name:	Description:
13	Distance Tolerance	Displays your settings for where the point should be located relative to the plane. This data is contained in the part description, but you can change it by typing new values directly into these fields. Entering a negative number in either of these fields means that it is acceptable for the point to lie below the plane's surface, while a positive number means that it is acceptable for the point to lie above the plane's surface. For example, entering a **Min** value of -70 and a **Max** value of 100 means that the point can be as much as 70 micrometers μ (m) below the plane or as much as 100 micrometers (μm) above the plane, and still be acceptable.
14	Result fields	After clicking Test, these fields indicate the measured distance between the point and the plane you have set up, and whether the test passed, failed, or could not be completed.
15	Test button	Click to test the current setup of the point to plane ROI's for the selected inspection. Check the Result field (item #14 above) and the test data fields for the results of the test.

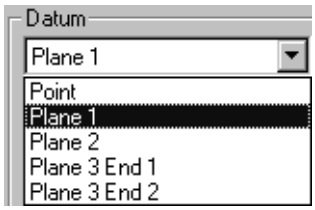
3. Select the point to plane inspection whose properties you want to change by clicking the Inspections arrow and selecting the desired inspection from the dropdown list that appears.

Tip: Use the **Zoom** and **Thresholds** controls to change the appearance of the displayed part image. See item #'s 6 and 7 in the table on page 5.

Note: Each of the inspections appearing in the dropdown list displayed in step 3 is contained in the part description used with the currently open recipe. If you want to create, delete, or perform additional edits on the part description, see "Editing Part Descriptions" on page 30.

4. Identify the locations that specify the plane and the point to be measured. Keep the following considerations in mind:
   - Avoid background reflections, which can give false Z-height readings.
   - The reference plane should be as close as possible to the measurement points.
   - Use subpixel sampling if needed to obtain more desirable results.
   - Consider the type of surface finish for setting reference plane ROI's.
   - ROI's should have low % Saturation and low % No Data readings.

5. Resize and reposition the four ROI's used to define the plane portion of this point to plane inspection:



   a) Click the Datum arrow and select **Plane 1.**

Note: As you select each ROI in these steps, the corresponding rectangular ROI on the displayed part image becomes selected and has control handles around its perimeter.

   b) Move and resize the ROI to fit around the first location you have selected. You can do this either by grabbing and dragging the ROI directly on the displayed part image or by entering the appropriate numbers in the **X**, **Y**, **Width**, and **Height** fields.

   c) If you wish to use sub-pixel sampling, select the Use Sub-Pixel Sampling box.

   d) As a starting point, enter 200 in the Ideal Z field.

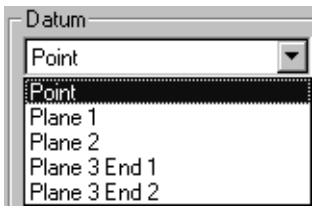
      After setting up all the ROI's and testing the setup, you will re-enter the actual Ideal Z setting in this field.

   e) Repeat steps a – d, selecting **Plane 2** from the Datum list.

   f) Repeat steps a – d, selecting first **Plane 3 End 1** and then **Plane 3 End 2** from the Datum list.

Note: These two ROI's (**Plane 3 End 1** and **Plane 3 End 2**) are combined and averaged to create a single point that is used to form the third and final point of the hypothetical plane.

6. Resize and reposition the single ROI used to define the point portion of this point to plane inspection:



   a) Click the Datum arrow and select **Point**.

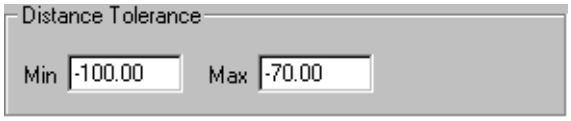
   b) Move and resize this ROI to fit around the second location you have selected to define the plane surface. Use the same method described in step 5.

   c) If you wish to use sub-pixel sampling, select the Use Sub-Pixel Sampling box.

   d) As a starting point, enter 200 in the Ideal Z field.

      After setting up all the ROI's and testing the setup, you will re-enter the actual Ideal Z setting in this field.

7. The current pass/fail criteria for this inspection are displayed in the Distance Tolerance fields. Enter new values, if necessary:



   The Minimum and Maximum Distance Tolerance fields indicate the range of distances that the point to plane measurement must fall within in order to pass the inspection. Negative values (–) indicate that the point lies below the plane, and positive values (+) indicate that the point lies above the plane.

8. Once all ROI's have been set up and the pass/fail criteria specified, click Test to perform the selected inspection on the currently displayed part image.

Tip: You may want to display the part image and perform this test (step 9) for several known good (or known bad) parts to ensure that the ROI's are set properly.

9. Review the Result field.

   Assuming the current part is good, the Distance field display should be within the specified tolerance, and the Status should read **Passed**. If the test result fails, you may need to move or resize one or more of the ROI's to ensure that a good plane surface is created.

10. When the test result looks good, you can update the entry in each ROI's Ideal Z field:

    a) Note the new value displayed in the Z Height field.

    b) Click Set as Ideal to enter the actual Z-height measurement into the Ideal Z field.

    c) Click the Datum arrow and (one at a time) select the remaining four ROI's and click Set as Ideal so that each has the new Ideal Z entry.

Tip: Clicking **Cancel** closes the Inspection Setup Properties screen without giving you the chance to save the changes made to the part description.

11. Click **OK** to return to the Inspections Setup window. (See Figure 1.)

12. Click **OK** to return to the Inspection Manager main screen.

13. The changes you have made have changed the part description. To make permanent changes, you must save the currently open recipe:

    a) Select **File** ➡ **Save Recipe as** from the Inspection Manager's menu bar.

    The Save Recipe File As window appears, as shown in Figure 9.

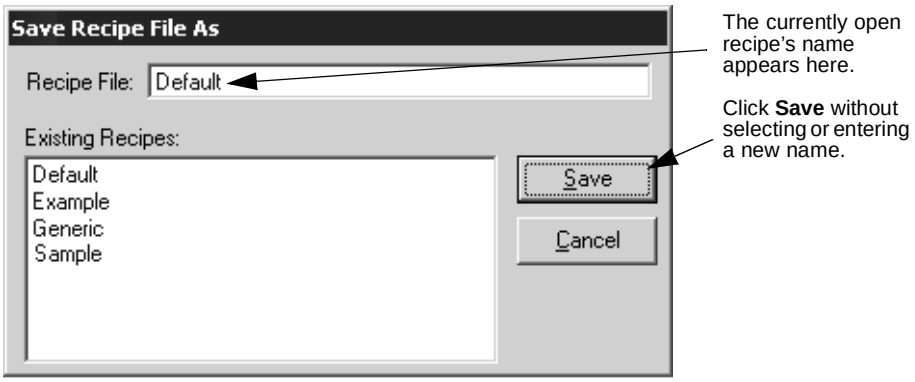


Figure 9: Save Recipe As Window

b) Click **Save** *without* changing the name of the recipe.

c) Click **Yes** when the warning appears, asking if you are certain that you want to save the changes.

The plane and point ROI's are now saved with the part description and will be used whenever an inspection run is performed using this recipe.

Specifying Angle Inspection Measurements

A part description can specify any number of angle inspections to be performed on the images acquired during inspection runs. For HDSAC component testing, the most common types of angle measurements are pitch and roll. Typical placement of the ROI's for pitch and roll type measurements is illustrated in both Figur e10 and Figur e11.

Tip: Actual placement of the ROI's is determined by the features and geometry of the part to be tested. The ROI's do not need to be positioned in an orderly fashion as they are shown in Figure 10 and Figure 11.

An angle inspection requires the following elements:

- One plane – You will position and size three ROI's through which a hypothetical plane passes.
- One vector – You will position and size two vector ROI's that form a vector (a straight line) that intersects the hypothetical plane at some point.

When the inspection is performed, the hypothetical plane and the vector will be extended so that they intersect. The angle at which the vector intersects the plane is calculated and reported. If the calculated angle is within the specified tolerance, the part passes the inspection. If the angle is greater than the tolerance allows, the part fails.

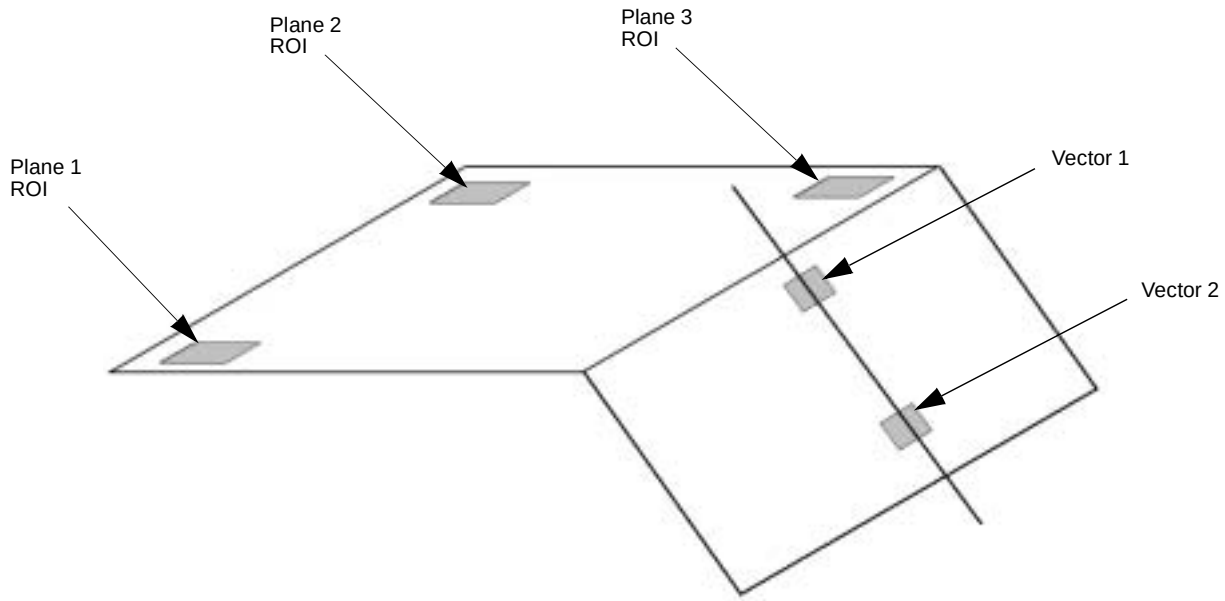


Figure 10: Vector ROI's Positioned to Measure Pitch Angle

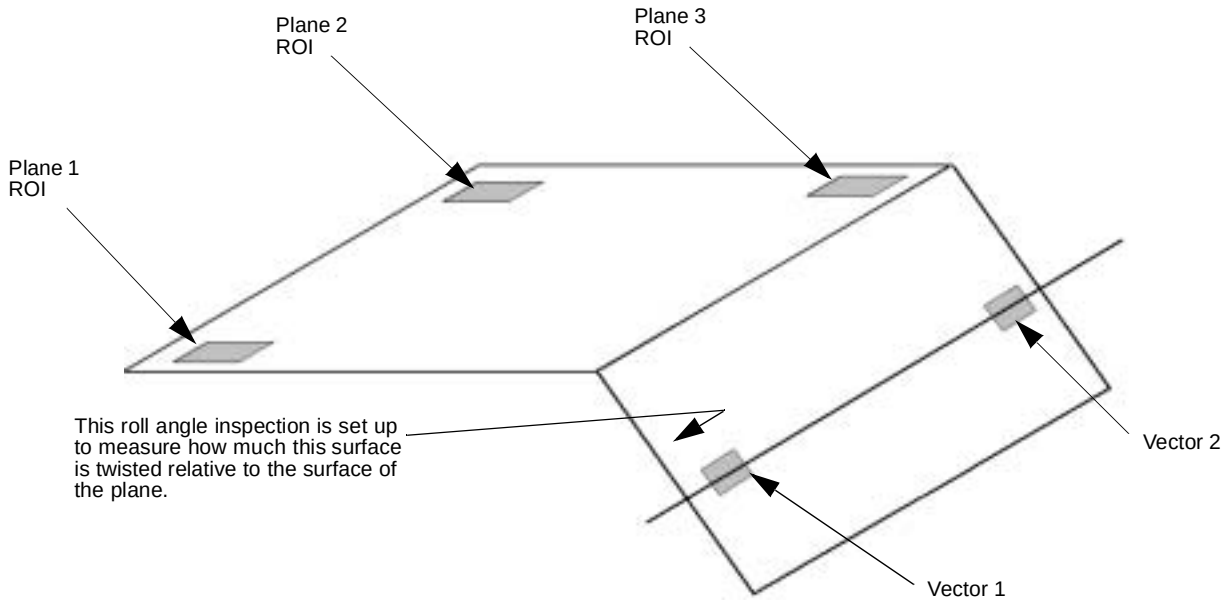


Figure 11: Vector ROI's Positioned to Measure Roll Angle

Note: Perform the following steps to make adjustments to an inspection that is already specified in the relevant part description. Adding or deleting an inspection or making other changes to the inspection require that you change the part description. See "Editing Part Descriptions" on page 30.

Follow these steps

1. Perform an inspection run, and then display the Inspection Setup Properties screen for one of the parts included in the inspection run. (See “Overview of Setup Procedures” on page2.)
2. When the Inspection Setup Properties screen appears, click the **Angle** tab.

   See Figure 12 and the following table for information about the **Angle** tab.

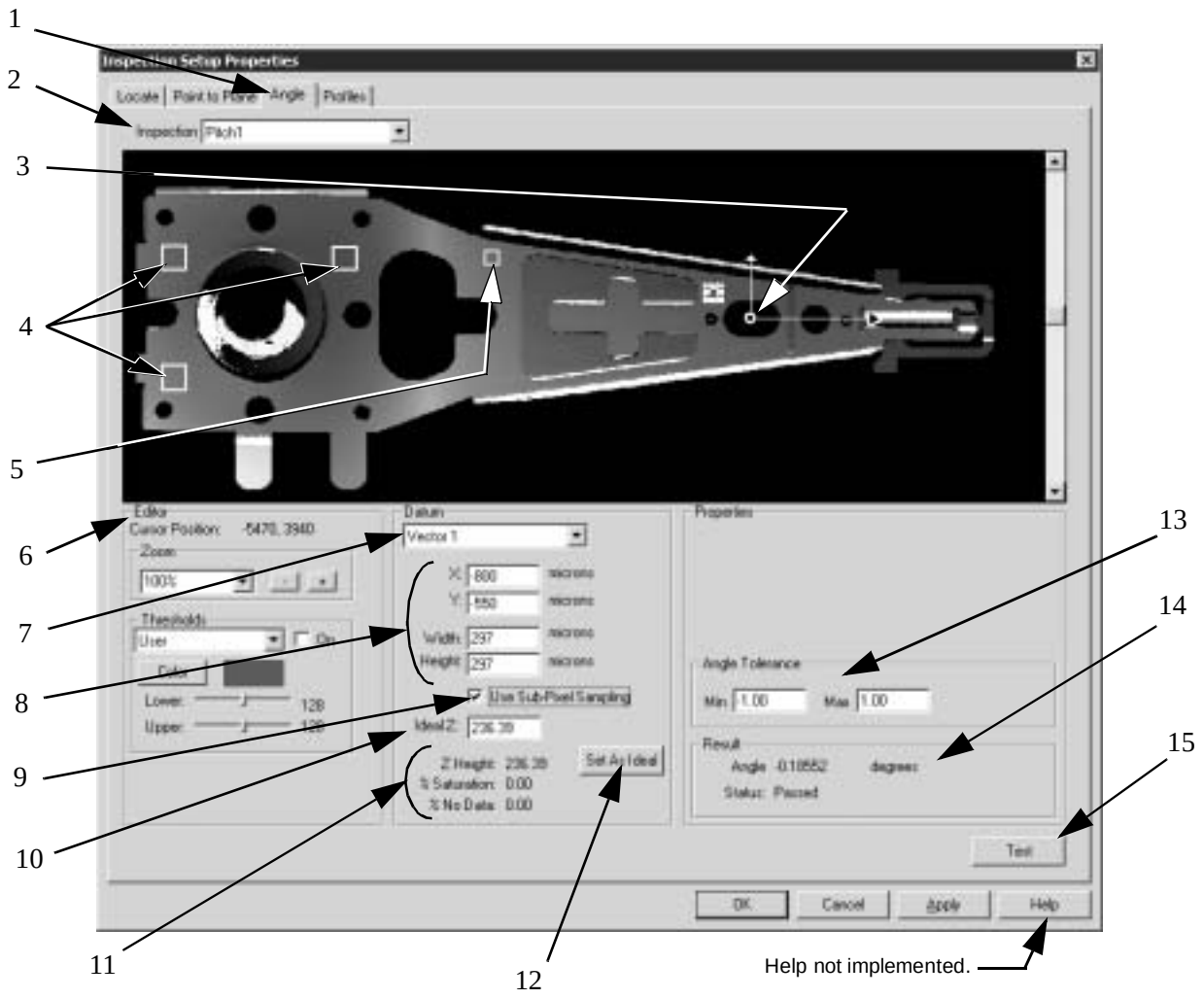


Figure 12: Creating Angle Inspections

No.	Name:	Description:
1	Angle tab	Select this tab to set the parameters for all point to plane inspections that have been created for this part.

Figure 13: Part Origin

No.	Name:	Description:
2	Inspection	Click the Inspection arrow for a list of all angle inspections that have been created for this part. When you select an inspection from the list, the displayed part image and data reflects that exact part on the last performed inspection run.
3	Part origin (see Figure 13)	This is the origin point that was set up using the "Setting the Locate Parameters" procedure in this manual. The locations of all ROI's for this part are relative to this point of origin.
4	Plane ROI's	You will set the size and position of these three rectangles in step 5 of this procedure. These three ROI's form the plane that is intersected by the line created by the vector ROI's (item #5 below).
5	Vector ROI's	You will set the size and position of these two rectangles in step 6 of this procedure. Conducting the selected angle inspection will result in the calculation of a line that passes through both vector points and intersects the plane defined by the three plane ROI's (item #4 above).
6	Editor controls and fields	Use these fields and controls to view the cursor coordinates and to change the appearance of the displayed part image: **Cursor Position**: Indicates the current position of the cursor as you move the trackball over the image. The X and Y coordinates shown are relative to the part origin's (0,0) location. **Zoom**: Use to increase or decrease the magnification of the displayed part image. (See item #6 on page 5 for more details.) **Thresholds**: Use these controls to change the appearance of the displayed part image and to check for areas on the part that fall within a specified range of gray scale values. (See item #7 on page 5 for more details.)
7	Angle Datum	Click Datum arrow and select the ROI you want to work with. The selected area will be highlighted on the displayed part image and can be moved or resized as needed.

Tip: You can also move or resize the selected ROI by clicking on it and moving it with your PC's trackball.

No.	Name:	Description:
8	Coordinate and size fields	The **X** and **Y** fields indicate the position of the center of the currently selected ROI with respect to the part origin (item #3 above). The **Width** and **Height** fields indicate the size of the currently selected ROI. You can move and resize the ROI by typing new values directly into these fields.
9	Use Sub-Pixel Sampling	Specifies the method used to calculate a Z-height value from the defined ROI's: Do not select this if you want to use the average of all gray level values within the ROI. (See "Gray Level Average" on page 34.) Select Use Sub-Pixel Sampling to fit the ROI's pixels to a plane, and then find the value of that plane at the center of the ROI. (See "Gray Level Plane Fit" on page35.)
10	Ideal Z	In step 5d of this procedure, you will enter a value of 200 in this field. Then, click Test, and go back and set each ROI to the calculated Z-height as ideal.
11	Test data fields	These fields help when selecting ROI placements. It is desirable to have minimal % Saturation and % No Data values for each ROI you have created: Z Height – The calculated Z-height of the selected ROI. % Saturation – The percent of Z-height values in the selected ROI that are saturated (have values of 255 and send too much data to the 3D scan head to be useful). % No Data – The percent of Z-height values in the selected ROI that are low contrast (have values of 0 and do not send enough data to the 3D scan head to be useful).
12	Set as Ideal button	After clicking Test and obtaining acceptable results, click Set as Ideal to place the actual obtained Z-height value into the Ideal Z field (item #10 above).

No.	Name:	Description:
13	Angle Tolerance	Displays your settings for the acceptable range of angles at which the vector may intersect the plane. This data is contained in the part description, but you can change it by typing new values directly into these fields. Entering a negative or a positive number for either tolerance is acceptable. For example, entering a **Min** value of -10 and a **Max** value of 5 means that the vector must cross the plane's surface downward at no more than a 10 degree angle, or upward at no more than a 5 degree angle in order to pass the inspection.
14	Result fields	After clicking Test, these fields indicate the measured angle between the vector and the plane you have set up, and whether the test passed, failed, or could not be completed.
15	Test button	Click Test to test the current setup of the angle ROI's for the selected inspection. Check the Result fields (item #14 above) and the test data fields (item #11 above) for the results of the test.

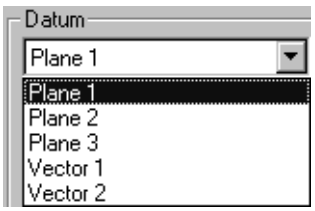
3. Select the angle inspection whose properties you want to change by clicking the Inspections arrow and selecting the desired inspection.

Tip: Use the **Zoom** and **Thresholds** controls to change the appearance of the displayed part image. See items 6 and 7 in the table on page 5.

Note: Each of the inspections appearing in the dropdown list displayed in step 3 is contained in the part description used with the currently open recipe. If you want to create, delete, or perform additional edits on the part description, see "Editing Part Descriptions" on page 30.

4. Identify the locations on the part that you wish to use to specify the vector and the plane to be used in the selected inspection. Keep the following considerations in mind:
   - Avoid background reflections, which can give false Z-height readings.
   - The reference plane should be as close as possible to the measurement points.
   - Use subpixel sampling if needed to obtain more desirable results.
   - Consider the type of surface finish for setting reference plane ROI's.
   - ROI's should have low % Saturation and low % No Data readings.

5. Resize and reposition the three ROI's used to define the plane portion of this angle inspection:



   a) Click the Datum arrow and select **Plane 1**.

Note: As you select each ROI in these steps, the corresponding rectangular ROI on the displayed part image becomes selected and has control handles around its perimeter.

   b) Move and resize the ROI to fit around the first location you have selected. You can do this either by grabbing and dragging the ROI directly on the displayed part image, or by entering the appropriate numbers in the **X**, **Y**, **Width**, and **Height** fields.

   c) If you wish to use sub-pixel sampling, select the Use Sub-Pixel Sampling box.

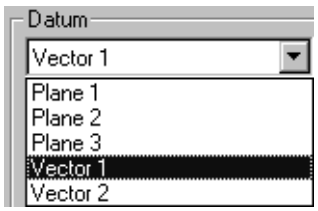
   d) As a starting point, enter 200 in the Ideal Z field.

      After setting up all the ROI's and testing the setup, you will re-enter the actual Ideal Z setting in this field.

   e) Repeat steps a – d, selecting **Plane 2** from the Datum list.

   f) Repeat steps a – d, first selecting **Plane 3** from the Datum list.

6. Resize and reposition the two ROI's used to define the vector portion of this angle inspection:



   a) Click the Datum arrow and select **Vector 1**.

   b) Move and resize this ROI to fit around the first location you have selected to define the vector. Use the same method described in step 5.

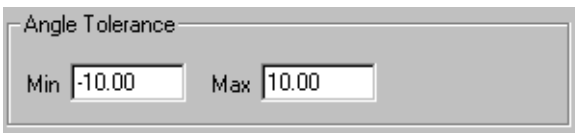
   c) If you wish to use sub-pixel sampling, select the Use Sub-Pixel Sampling box.

   d) Repeat steps a – c, selecting **Vector 2** from the Datum list.

   e) As a starting point, enter 200 in the Ideal Z field.

      After setting up all the ROI's and testing the setup, you will re-enter the actual Ideal Z setting in this field.

7. The current pass/fail criteria for this inspection are displayed in the Angle Tolerance fields. Enter new values (in degrees), if necessary:



The Minimum and Maximum Angle Tolerance fields indicate the range of angles that the angle measurement must fall within in order to pass the inspection. Negative values (-) indicate that the Vector lies downward from the plane, and positive values (+) indicate that the Vector lies upward from the plane.

8. Once all ROI's have been set up and the pass/fail criteria specified, click Test to perform the selected inspection on the currently displayed part image.

Tip: You may want to display the part image and perform this test (step 9) for several known good (or known bad) parts to ensure that the ROI's are set properly.

9. Review the Result field.

   Assuming the current part is good, the Angle field display should be within the specified tolerance, and the Status should read **Passed**. If the test result fails, you may need to move or resize one or more of the ROI's to ensure that a good plane surface is created and that the vector intersects the plane properly.

10. When the test result looks good, you can update the entry in each ROI's Ideal Z field:

    a) Note the new value displayed in the Z Height field.

    b) Click Set as Ideal to enter the actual Z-height measurement into the Ideal Z field.

    c) Click the Datum arrow, select the remaining four ROI's (one at a time), and click Set as Ideal so that each has the new Ideal Z entry.

Tip: Clicking **Cancel** closes the Inspection Setup Properties screen without giving you the chance to save the changes made to the part description.

11. Click **OK** to return to the Inspections Setup window. (See Figure 1.)

12. Click **OK** to return to the Inspection Manager main screen.

13. The changes you have made in performing this procedure have resulted in changes being made to the part description. To make permanent changes, you must save the currently open recipe:

    a) Select **File** ➡ **Save Recipe as** from the Inspection Manager's menu bar.

    The Save Recipe File As window appears, as shown in Figure 14.

Figure 14: Save Recipe As Window

b) Click **Save** *without* changing the name of the recipe.

c) Click **Yes** when the warning appears, asking if you are certain that you want to save the changes.

The plane and vector ROI's are now saved into the part description and will be used whenever an inspection run is performed using this recipe.

Creating Profile Measurements

A part description can contain any number of profile measurements to be taken along the surface of each part tested. A profile consists of a number of Z-height measurements taken along a straight line on the part's surface.

Note that a profile measurement is slightly different than the other inspections described in this manual. The difference is that the part neither passes nor fails the profile measurement – the data is merely recorded and reported onscreen and/or in the results file.

A profile measurement requires only one element (the profile line itself) to be set up with a specified number of measurement points spaced equally along the length of the line (see Figur e6):

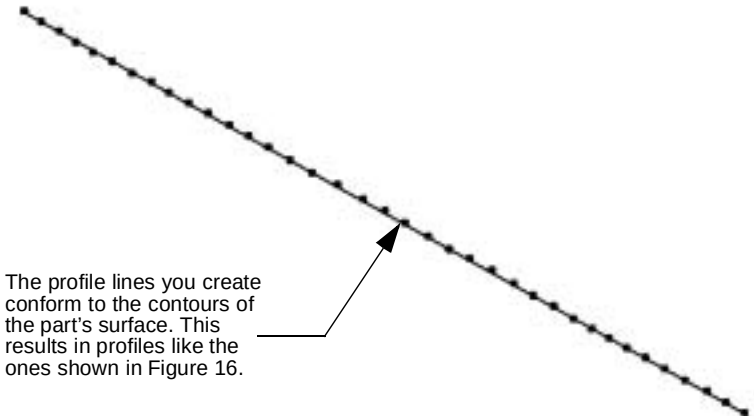


Figure 15: Profile Line with Defined Measurement Points

When the inspection is performed, a series of Z-height measurements are taken along the length of the profile line. The results are reported, most often by creating the appropriate control box to the Inspection Manager main screen, as shown in Figure 16:

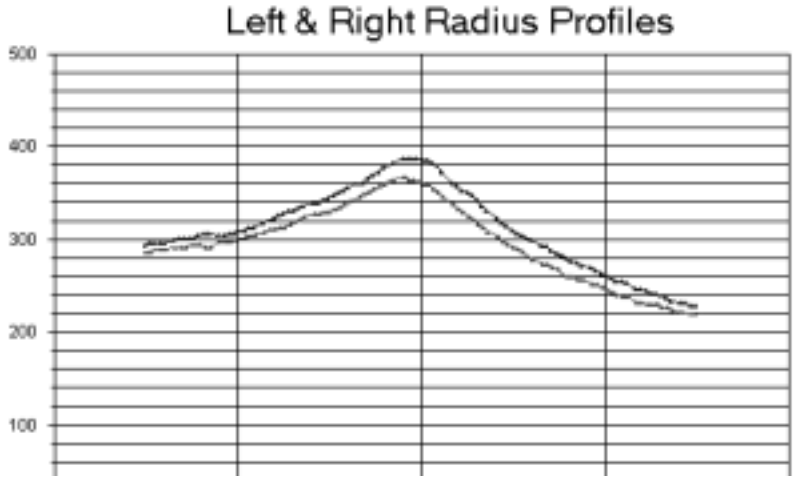


Figure 16: Typical Profile Chart (displayed on Inspection Manager main screen)

Note: Perform the following steps to make adjustments to a profile measurement that is already specified in the relevant part description. Adding or deleting a profile measurement or making other changes to the profile require that you change the part description. See “Editing Part Descriptions” on page 30.

Follow these steps

1. Perform an inspection run, and then open the Inspection Setup Properties screen for one of the parts included in the inspection run. (See “Overview of Setup Procedures” on page2.)
2. When the Inspection Setup Properties screen appears, click the **Profile** tab.

   See Figure 17 and the following table for information about the **Profile** tab.

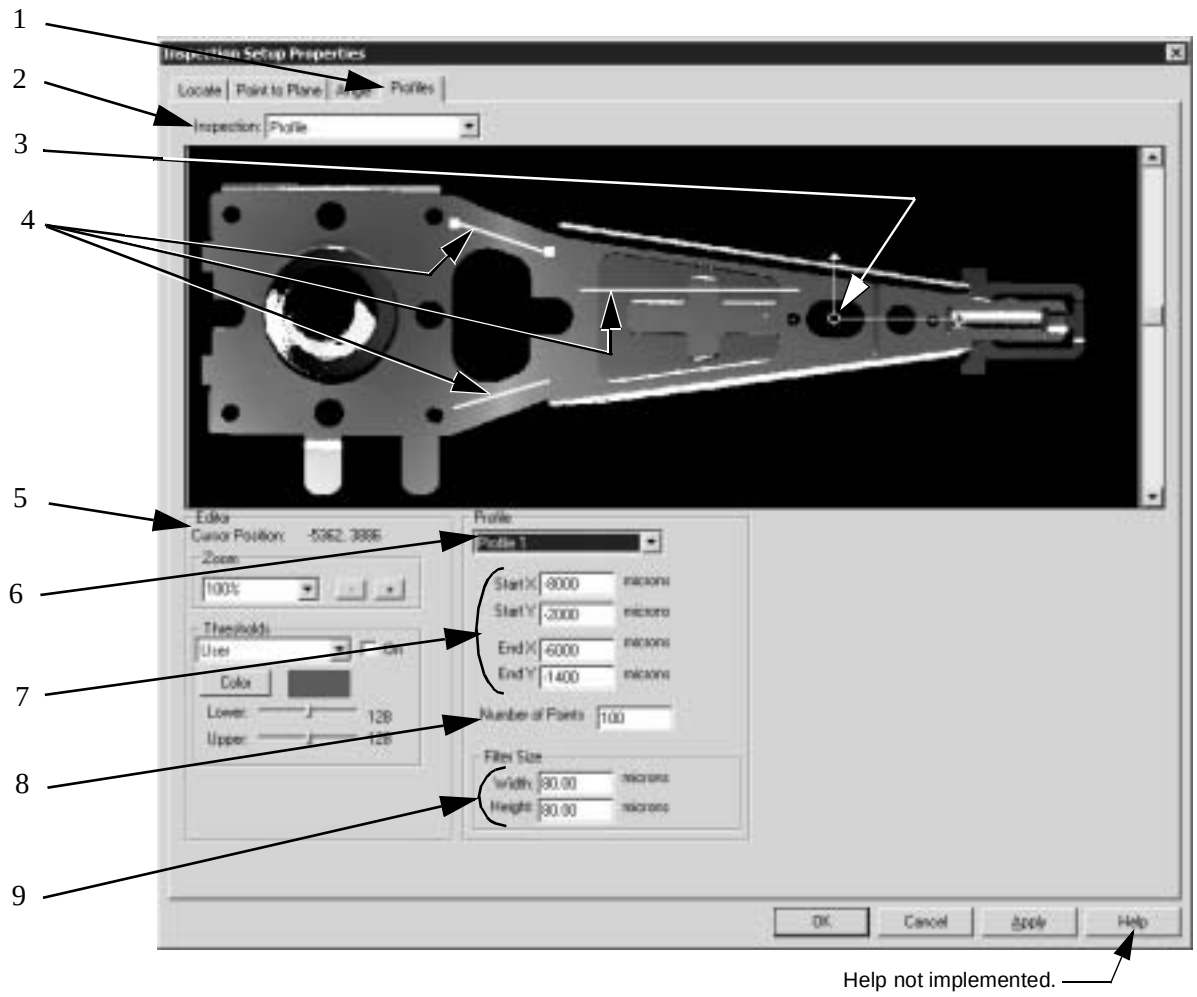


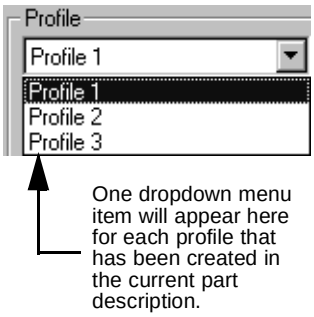
Figure 17: Creating Profile Measurements

No.	Name:	Description:
1	Profiles tab	Select this tab to set the parameters for all profile measurements that have been created for this part.
2	Inspection	Clicking the Inspection arrow displays a dropdown list of all profile inspections that have been created for this part. When you select a profile from the list, the set of three profile lines displayed are the ones set up for the selected profile measurement.
3	Part origin	This is the origin point that was set up using the “Setting the Locate Parameters” procedure in this manual. The locations of all profile lines for this part are relative to this point of origin.

No.	Name:	Description:
4	Profile lines	You will set the size and position of three profile lines for each profile you want to generate, in step 5 of this procedure. Each profile line results in a separate set of profile data being generated during each inspection run.
5	Editor controls and fields	Use these fields and controls to view the cursor coordinates and to change the appearance of the displayed part image: **Cursor Position**: Indicates the current position of the cursor as you move the trackball over the image. The X and Y coordinates shown are relative to the part origin's (0,0) location. **Zoom**: Use to increase or decrease the magnification of the displayed part image. (See item #6 on page 5 for more details.) **Thresholds**: Use these controls to change the appearance of the displayed part image and to check for areas on the part that fall within a specified range of gray scale values. (See item #7 on page 5 for more details.)
6	Profile Datum	Click the Datum arrow and select the profile you want to work with. The selected line will be highlighted on the displayed part image and can be moved or resized as needed.
7	Coordinate and size fields	The entries in these fields indicate the location of the starting points and end points of the currently selected profile line with respect to the part origin (item #3 above): • Start X and Start Y–These two fields provide the location of the profile line's starting point. • End X and End Y–These two fields provide the location of the profile line's ending point. You can move and resize the selected profile line by typing new values directly into these fields or by grabbing and dragging them with your trackball.

Tip: Be sure to note which endpoint of the profile line is the **Start** and which is the **End**. Make sure your onscreen control and your profile line are set up so that the data results are displayed in an easy-to-read fashion.

No.	Name:	Description:
8	Number of Points	Enter the number of points that you want to be placed (evenly spaced) along the profile line. An X, Y, and Z measurement will be taken at each point during each inspection run. The minimum allowable entry is 3, and the maximum is 1024.
9	Filter Size	Enter the distance (in microns) defining a rectangle around each measurement point. Each pixel within the rectangle will contribute to calculating the mean Z value that will be reported for every measurement point on the profile line.



3. Click the Profile arrow and select the profile whose properties you wish to change.

   The selected profile line is highlighted with control handles on the displayed part image, and the data appearing in the Profile fields relates specifically to the selected profile line.

4. Adjust the profile line's starting and ending position and its length, making sure that the line's **Start** and **End** points are oriented correctly. Use either of the following methods:
   - Grab and drag the profile with your trackball.
   - Type numbers into the coordinate and size fields (item #7 in the table above).

5. Enter the desired number of measurement points that you want to be spread along the profile line.

6. Enter the desired filter size width and height.

   The filter size determines how many separate pixels will be used in calculating a mean Z-height value to be reported for each measurement point along the profile line. (See item #7 in the table below Figure 17.)

Tip: Clicking **Cancel** closes the Inspection Setup Properties screen without giving you the chance to save the changes made to the part description.

7. Click **OK** to return to the Inspections Setup window. (See Figure 1.)

8. Click **OK** to return to the Inspection Manager main screen.

9. The changes you have made in performing this procedure have resulted in changes being made to the part description. To make these changes permanent, you must save the currently open recipe:

   a) Select **File** ➡ **Save Recipe as** from the Inspection Manager's menu bar.

   The Save Recipe File As window appears, as shown in Figure 18.

Figure 18: Save Recipe As Window

b) Click the **Save** button *without* changing the name of the recipe.

c) Click **Yes** when the warning appears, asking if you are certain that you want to save the changes.

The newly created profile lines are now saved into the part description and will be used whenever an inspection run is performed using this recipe file.

Editing Part Descriptions

When you create a recipe, its corresponding part description is automatically created at the same time. For example, if you save a recipe with the name **SamplePart_NewFixture.rcp**, the following part description would automatically appear in the Part folder on your PC: **SamplePart_NewFixture_Part.xml**.

Although the part descriptions are created automatically, one for each recipe, and the editing takes place by performing the procedures contained in this manual, there are several reasons why you might need to open a part description and edit its contents manually.

- Adding new measurements to the part description
- Deleting measurements from the part description
- Editing measurements or other part description information that cannot be accessed through the Inspection Setup Properties screen

⏩ Follow these steps

1. Open the part description to be edited:

   a) Using Windows Explorer go to the following directory:

   C:\Program Files\PPT Vision\PPT861\Part

   The Part folder appears, as shown in Figure 19.

b) Double-click the desired part description (or right-click it and select **Edit** from the menu that appears).

The part description opens using the Microsoft XML Notepad application installed on your PPT861 Inspection System's PC. (See Figure 20.)

Double-click a part description to open it. Remember that the part description's name corresponds to its associated recipe. For example, the part description named **Default_Part.xml** is paired with the recipe named **Default.rcp**

Figure 19: Folder Containing all Part Descriptions

Double-click a folder (or click its **+** or **–** symbol) to expand or contract its contents.

Each item's entered value is displayed here, in line with its title in the Structure column.

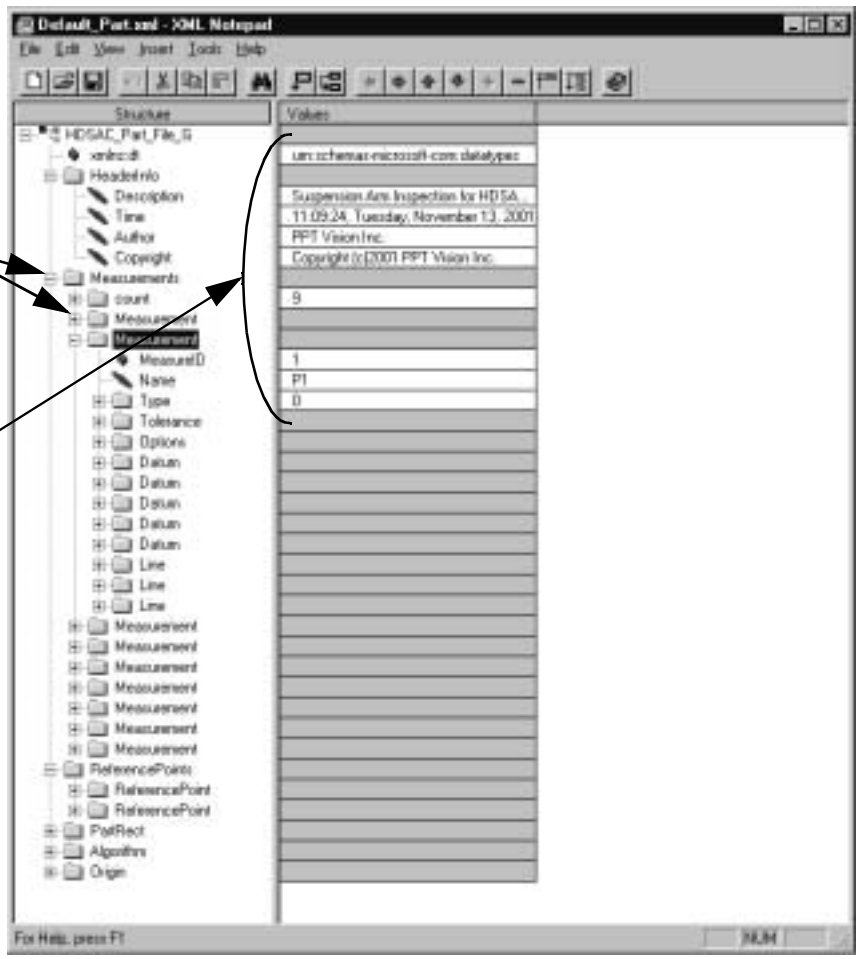


Figure 20: Part Description

Tip: Be sure to save the part description after making any changes to the part description. See step 7 on the next page.

2. Perform the following steps as needed to
   - Name a measurement (step 3).
   - Set the measurement type (step 4).
   - Add a measurement (step 5).
   - Delete a measurement (step 6).
   - Move a measurement in the tree (step 7).

3. To name a measurement:

   a) Open the Measurements folder.

   b) Open the specific Measurement that you want to rename.

   c) Enter the desired measurement name into the Name entry field. Be sure to follow these naming rules:
      - Acceptable characters: ‘a – z’, ‘A – Z’, ‘0 – 9’, ‘_’
      - The first character of the name must be a letter.

4. Setting the measurement type:

   a) Open the Measurements folder.

   b) Open the specific Measurement whose type you wish to verify.

   c) Enter the MeasureID entry that reflects the desired type of measurement as follows:

      0 = point to plane inspection

      1 = angle inspection

      2 = profile measurement

5. Adding a measurement:

CAUTION!
Do not use the Duplicate button on the XML Notepad toolbar. Doing so causes the new part description to be corrupt and you will have to start over.

   a) Open the Measurements folder.

   b) Select a measurement folder that is similar to the measurement you want to create.

   c) Select **Edit** ➡ **Copy** from XML Notepad’s main menu bar.

   d) Select the main Measurements folder. This ensures that the new measurement will be created in the proper location.

   e) Select **Edit** ➡ **Paste** from XML Notepad’s main menu bar.

      The new measurement will be placed at the bottom of the list of existing measurements.

   f) Enter the new part description’s name into the Name entry field. Follow the naming rules listed in step 3d above.

g) Go to the Count folder's entry field and increment the current number by 1. (For example, if the Count field reads **9** before creating the new measurement, change it to **10**.)

6. Deleting a measurement:

   a) Open the Measurements folder.

   b) Select the specific Measurement that you want to delete.

   c) Select **Edit ➡ Delete** from XML Notepad's main menu bar.

   d) Go to the Count folder's entry field and decrement the current number by 1. (For example, if the Count field reads **9** before creating the new measurement, change it to **8**.)

7. Moving a measurement in the tree:

   a) Open the Measurements folder.

   b) Select the specific Measurement that you want to move.

   c) Use the up and down arrows on the XML Notepad toolbar to place the measurement in the desired position.

8. Select **File ➡ Save** from XML Notepad's main menu bar to save the changes you have made to the part description.

Technical Notes and Questions

The following sections provide additional technical details regarding inspection setups using the Hard Drive Suspension Assembly Components Inspector.

How is a Single Point Calculated from a Rectangular Region of Interest (ROI)?

In setting up each of the HDSAC inspections and measurements described in this manual, you created a number of rectangular ROI's. Each of these ROI's results in the calculation of a single Z-height value that is then used in the creation of a plane, point, or vector. Understanding how this calculation takes place will help you decide where to place each ROI and how large or small each one should be.

This production of a single point from a number of pixel values is accomplished using one of these two methods, depending on the type of inspection or measurement you are setting up and the options you select while doing so:

- **Gray Level Average**
  This is the method used for calculating one point to represent an entire ROI, if you do not select the Use Sub-Pixel Sampling check box when specifying point to plane or angle inspections. The process is performed as follows

1. First, the system determines the gray scale value of each individual pixel in the ROI by adding the pixels, and then dividing by the total number of pixels in the ROI.

2. The resulting mean gray scale value is then used to generate a single Z-height value to be used for this entire ROI.

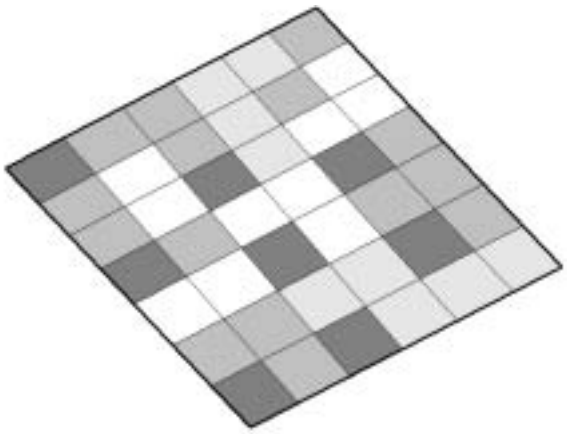


Figure 21: A 7x6 Pixel ROI

- **Gray Level Plane Fit**
  This is the method used for calculating one point to represent an entire ROI if you select the Use Sub-Pixel Sampling check box when specifying point to plane or angle inspections. The process is performed as follows:

1. The X and Y pixel locations along with the Z (gray level value) of each pixel are used to determine an equation of a plane for that ROI.
2. The Z value at the center of the plane is then used as the Z-height measurement for that entire ROI.

How Big is a Pixel?

Pixel size is determined strictly by the resolution of the camera. The PPT861 Inspection System's camera renders each pixel from a 20 x 20 micron square.

How Many Levels of Gray-Scale can be Translated into Z-Height Values?

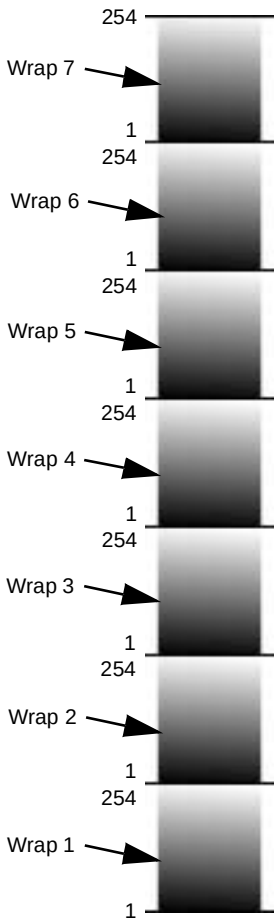


Figure 22: The 7-Wrap Set of Gray Scales

The PPT861 Inspection System distinguishes 254 different shades of gray, assigning each a value from 1 (almost black) to 254 (almost white). One complete set of gray scale values is called a wrap, and the camera is capable of stacking up seven wraps, as shown in Figur e22.

(Actually, the true range of values is 0 to 255. However, the value 0 is not used since it contains no data at all, and 255 is not used because it contains too much data to be useful.)

Having seven layers of wraps, one on top of another, is allows the PPT861 Inspection System to record measurements of physical points whose height difference is too great to measure within one wrap. For example, if one point is located at Z-height 115 in wrap 4 and a second point is located at Z-height 210 in wrap 5, there is more than one wrap of gray scales in between them. The height difference between these two points would be difficult to calculate if the Inspection System were not able to take measurements from adjoining wraps.

Note, however, is that there are still only 254 distinguishable shades of gray to work with. Z-height 27 in wrap one has the exact same gray scale value as does Z-height 27 in wrap 7. The PPT861 Inspection System's image processing algorithms recognize which wrap (relative to the origin point) each point falls within.

Document Revision History

Rev	Date	Description
A	January 2002	Used with PPT861 Software Version 2.1.0