



Application Software for Industrial Vision Systems

# NeuroCheck 6.1 Training Course (Part II)



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# Preliminary remarks

This training course will acquaint you with the operation of the NeuroCheck software and present you the many fields of application in detail. It will guide you step by step through configuring automatic visual inspection applications. The Training Course manual is suitable for self study but also as a supporting document in a seminar.

## Content

The NeuroCheck Training Course consists of two manuals. You'll find the first part in the manual "Training Course I". Since the second part is based on the first one, it is necessary to work through the first part of the training course before the second.

The first part has the following content:

- Chapter 1 *Introduction* explains the basic concepts and most important terms of the NeuroCheck software.
- Chapter 2 *Working with Check Routines* describes how to create and configure check routines as the central element of the visual inspection application.
- Chapter 3 *Configuration of Image Capture* shows how to integrate a digital camera into NeuroCheck and to transmit captured images to NeuroCheck.
- Chapter 4 *Presence Verification* illustrates how to verify the presence of objects using NeuroCheck.
- Chapter 5 *Automated Inspection* demonstrates how to control NeuroCheck in automatic mode externally.

The second part of the training course, this manual, is structured as follows:

- Chapter 6 *Gauging* describes how to measure the dimensions of objects and the distances between objects in NeuroCheck.
- Chapter 7 *Configuration of Automatic Mode* explains how to adjust the controls and looks of automatic mode.
- Chapter 8 *Position Adjustment* deals with the compensation of object position changes.
- Chapter 9 *Data Input and Output* shows how to output results measured with NeuroCheck and how to set target values dynamically for NeuroCheck.
- Chapter 10 *Troubleshooting* tells you how to diagnose problems when executing NeuroCheck.

We wish you fun reading the manual and success with your work with the NeuroCheck software!

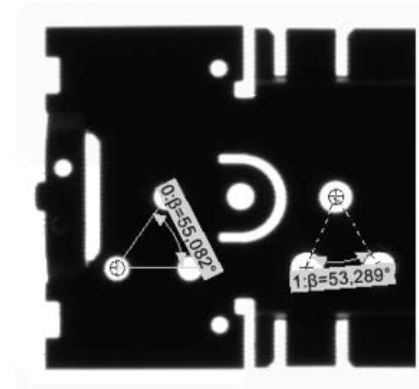
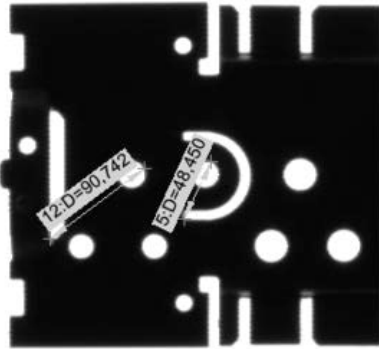


## 6. Gauging

One of the most important applications for vision systems is the contactless gauging of workpieces. Both the geometric properties of individual objects can be gauged but also the geometric relations between objects.

In this chapter you'll learn how to use NeuroCheck

- to gauge the distance between objects
- to compare the measured values to target values
- to gauge objects with an accuracy better than one pixel
- to create object edges as individual objects, approximate them with lines and measure their orientation towards each other
- to convert measured values into metric units



## 6.1 Gauging distances between two objects

### Goal

You want to ensure that the holes' width and distance from the edge of the cover plate we are using as an example are correct.

### Result

You can gauge geometric properties of individual objects with NeuroCheck and also the distance between objects.

### Solution

1



Create a new check routine with the description "Gauging" and the comment "Gauging distances and widths". Change the headline and description of the check to "Gauge distances and widths" and "Checks the holes' width and their distance to the edge". Add the check functions **Transfer Image** and **Define ROIs** to the check. Select the file *Cover\_Plate\_01\_OK.bmp* as image. Define two ROIs in the parameter dialog of the check function **Define ROIs**. The first should reach into the cover plate from the left without protruding over the upper or lower edge. The second one should cover the holes to the left completely without protruding over the cover plate.

2

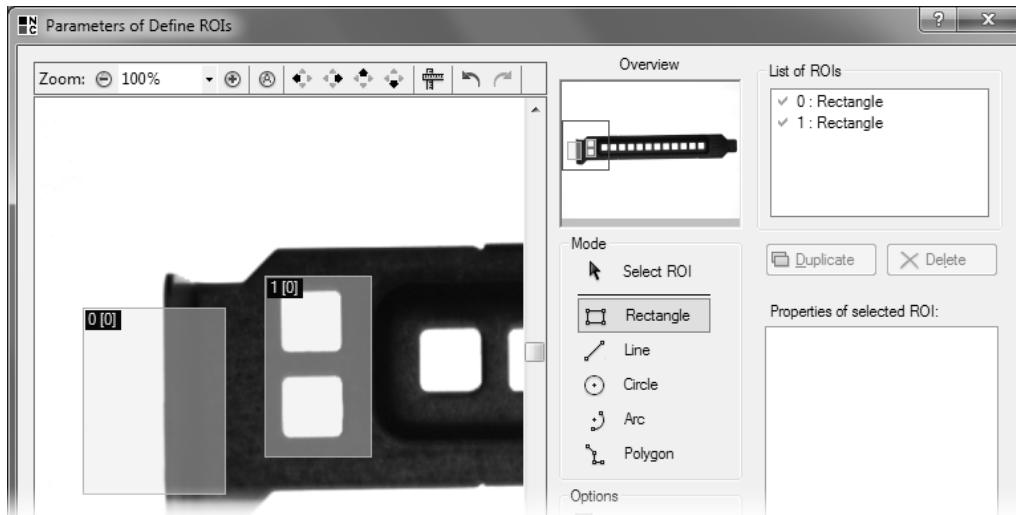


Add the check functions **Determine Threshold** and **Create ROIs by Thresholding**. In the parameter dialog of the check function **Create ROIs by Thresholding** select for **Object color Light** to look for the light holes on the dark cover plate and to look for the light background around the cover plate. In this case it's easier to create part of the background as auxiliary object than to create the left edge of the real object.

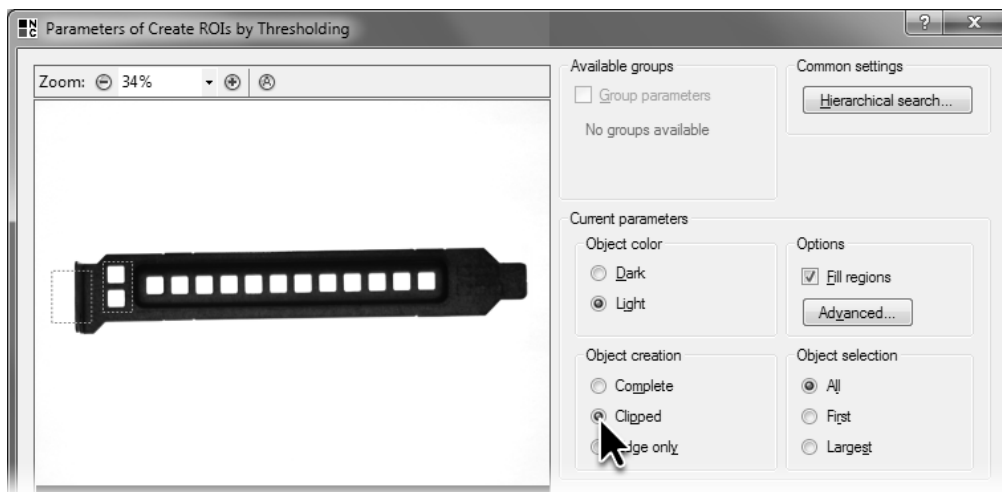
For only a part of the background to be created as an auxiliary object, select for **Object creation** the option **Clipped**. Thus the objects are cut off at the border of the search area.



## 6.1. Gauging distances between two objects



- 1 In the parameter dialog of **Define ROIs** define an ROI on the left edge of the cover plate and a second ROI over the two left holes.



- 2 As operating mode for **Object creation** select the option **Clipped** for the created ROIs to be limited by the search areas.

3



Execute the check function **Create ROIs by Thresholding**. Both holes are bordered by a transition from light to dark while the auxiliary object is only bordered by a transition from light to dark on the right side, and the other three sides are limited by the borders of the search area.

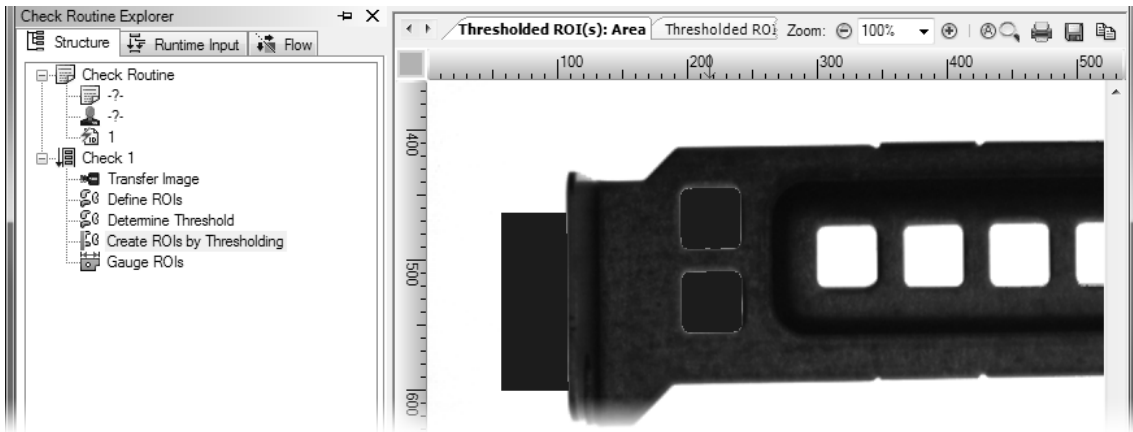
4



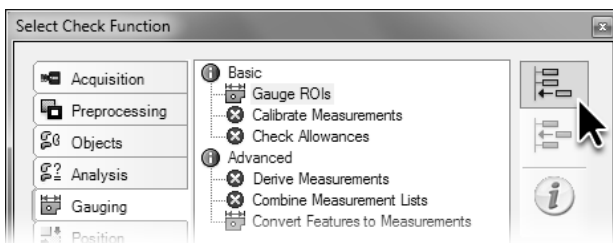
Add the check function **Gauge ROIs** from the **Gauging** group to the check.



## 6.1. Gauging distances between two objects



- 3 The background on the left edge of the cover plate is bordered on three sides by the search area and only on the right side by the object edge.



- 4 Add the check function **Gauge ROIs** to the check.

**5** Open the parameter dialog of the added check function **Gauge ROIs**. The parameter dialog shows a list of **Defined measurements**, which is empty at first. To define a new measurement, click the **New...** button.



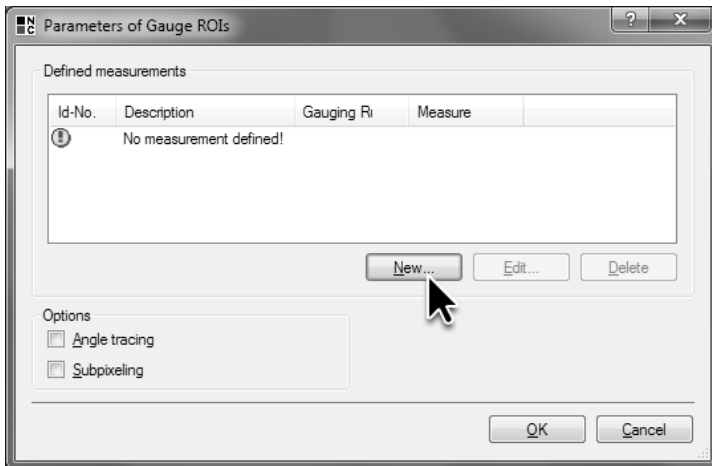
**6** On the first page of the **Gauging Wizard** you can select the ROIs you want to gauge. To gauge the distance between the left edge and the upper hole, click the two ROIs in the image view.



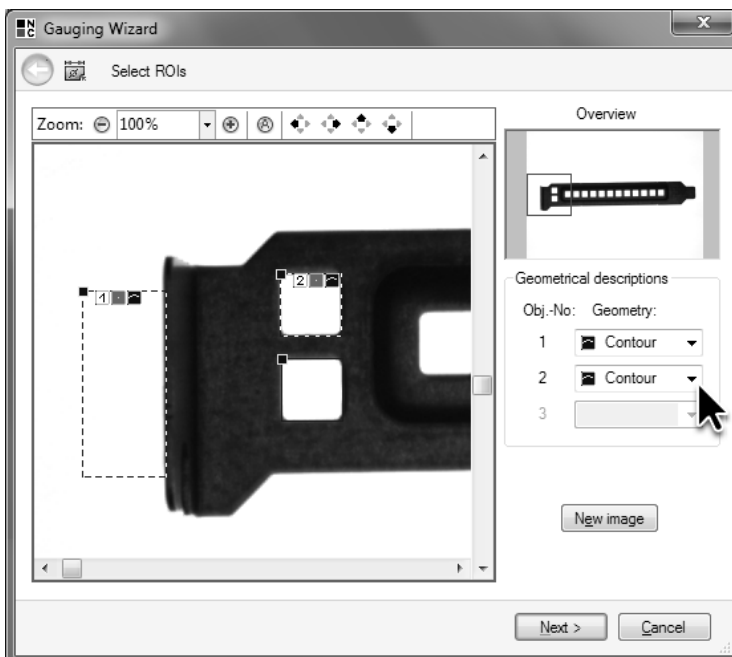
Select from **Geometrical descriptions** the **Contour** geometry for the two ROIs. The **Contour** geometry means that the object's border is used for gauging. The **Point** geometry is not suitable in this case since then the object's center is the basis for gauging, and it contains no information about the left edge of the cover plate.

Click the **Next** button to switch to the next page of the **Gauging Wizard**.

## 6.1. Gauging distances between two objects



- 5 Click the **New...** button to define a new measurement.



- 6 Select the two ROIs whose distance you want to gauge on the first page of the **Gauging Wizard** and choose for both the **Contour** geometry.

- 7 On the second page of the **Gauging Wizard** the gauging rule is selected. **Distance, minimal contour-contour** is the default. This **Gauging rule** determines the smallest distance between the two objects in any direction. Leave this setting unchanged. Enter a description of the measurement in the input field **Text**, e.g. "Distance from upper hole to left edge".

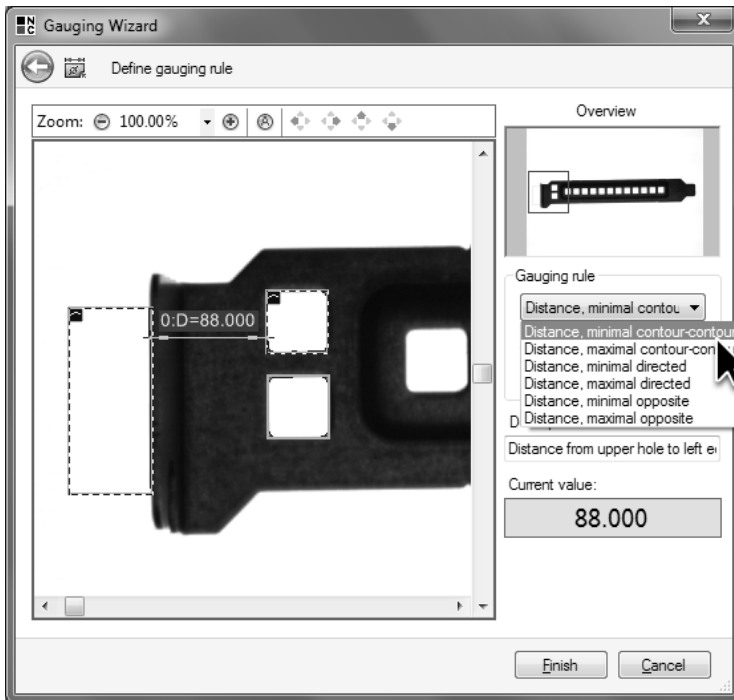
The field **Current value** displays a preview of the measured value. Because of a different binary threshold, this value can be slightly different for you.

Click the **Finish** button to close the **Gauging Wizard**.

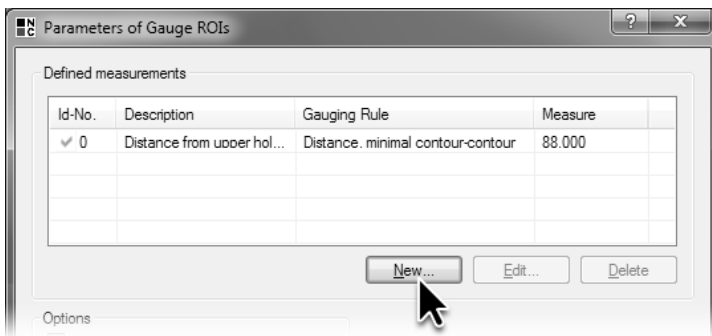
- 8 The newly defined measurement is listed in the parameter dialog of the check function **Gauge ROIs**.

Click the **New...** button to define the measurement for gauging the distance between the edge and the bottom hole in the same way.


## 6.1. Gauging distances between two objects



- 7 For the **Gauging rule** select **Distance, minimal contour-contour** to gauge the distance between edge and hole.

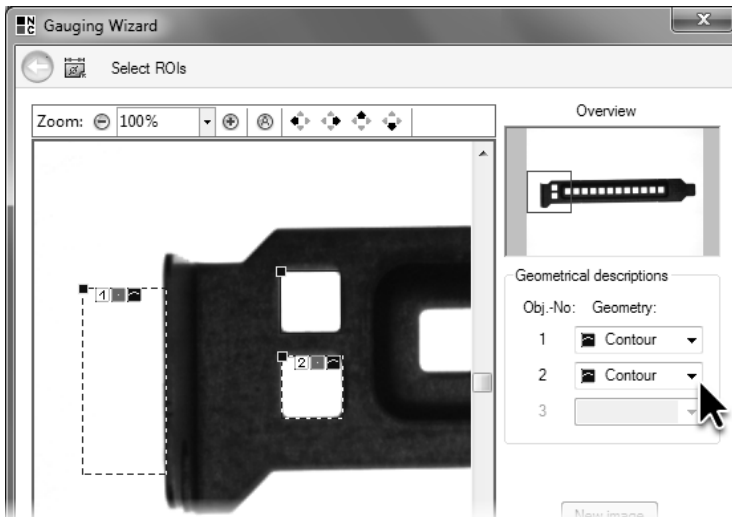


- 8 Click the **New...** button to define another measurement for gauging the distance between the bottom hole and the edge.

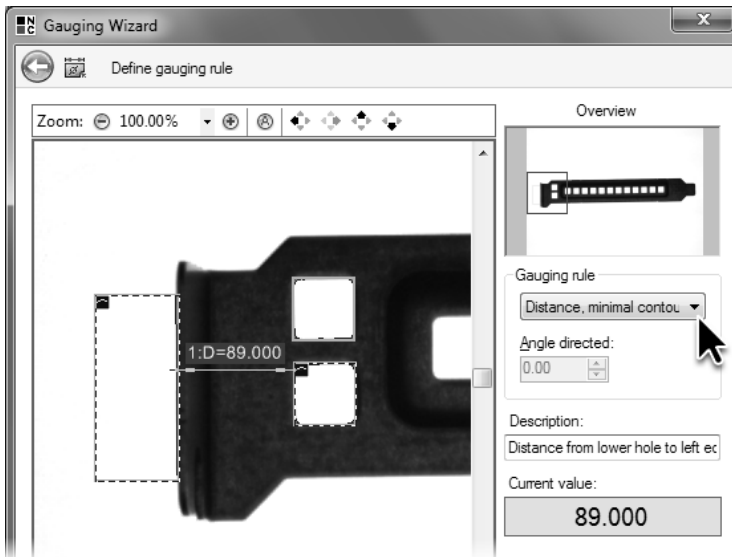
- 9  On the first page of the **Gauging Wizard** select the auxiliary object and the bottom hole. For both objects select the geometry **Contour**.
- 10 On the second page of the **Gauging Wizard**, leave the **Gauging rule** set to **Distance, minimal contour-contour** and for **Text** enter a description of the measurement, e.g "Distance from lower hole to left edge". Afterwards close the **Gauging Wizard**.



## 6.1. Gauging distances between two objects



- 9 Select the two ROIs whose distance you wish to gauge and select **Contour** for both as geometry.



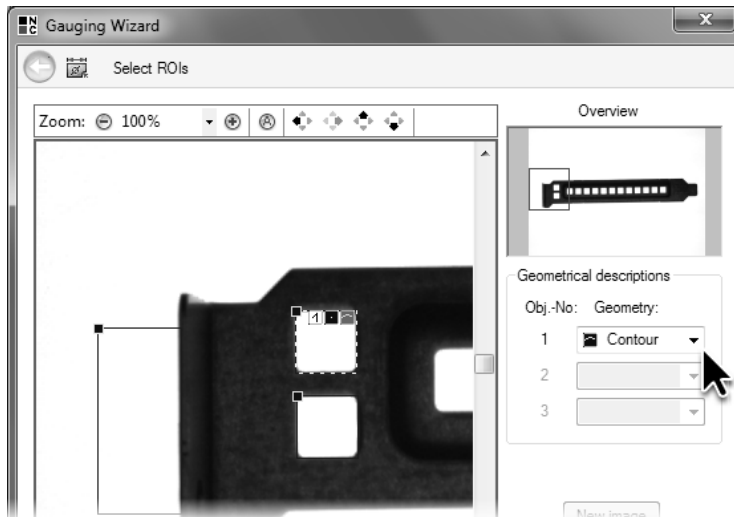
- 10 Select **Distance, minimal contour-contour** as gauging rule.

**11** In the **Gauge ROIs** parameter dialog click again the **New...** button to define a measurement for gauging the width of the top hole. On the first page of the **Gauging Wizard** select only the top hole as an object. Since the center of the object contains no information about its size, you have to select **Contour** for geometry. Click **Next** to select the gauging rule.

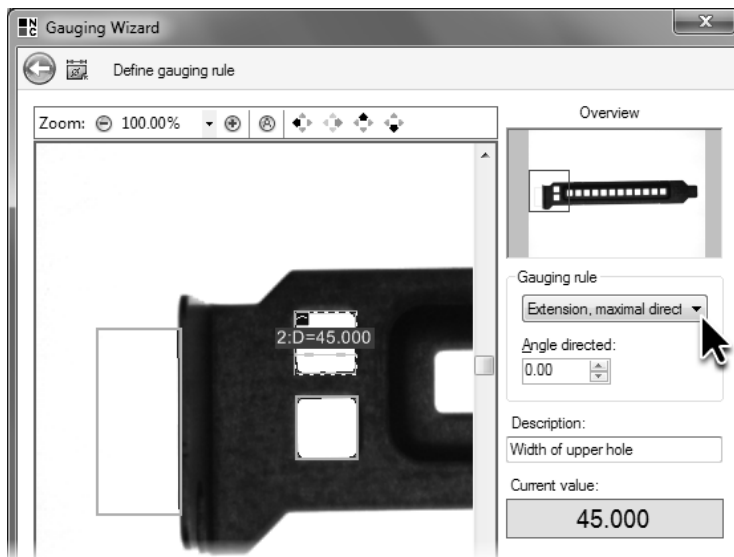
**12** The **Gauging rule** for determining the width of the object is **Extension, maximal directed**. Angle direction determines whether you are gauging the width or height of an object. Set the angle direction in the input field **Angle direction**. To gauge the dimension horizontally, i.e. the width, set angle direction to "0".

Enter the description "Width of upper hole" and click the **Finish** button.

## 6.1. Gauging distances between two objects



- 11 Select the ROI describing the upper hole and select **Contour** as geometry to gauge the hole's width.



- 12 As gauging rule select **Extension, maximal directed** and keep **Angle direction** at 0°.

**13** Likewise define a measurement for gauging the width of the bottom hole. The **Defined measurements** list displays the four configured measurements. Then close the parameter dialog of **Gauge ROIs** by clicking the **OK** button.

**14** Execute the check function and split the result view.

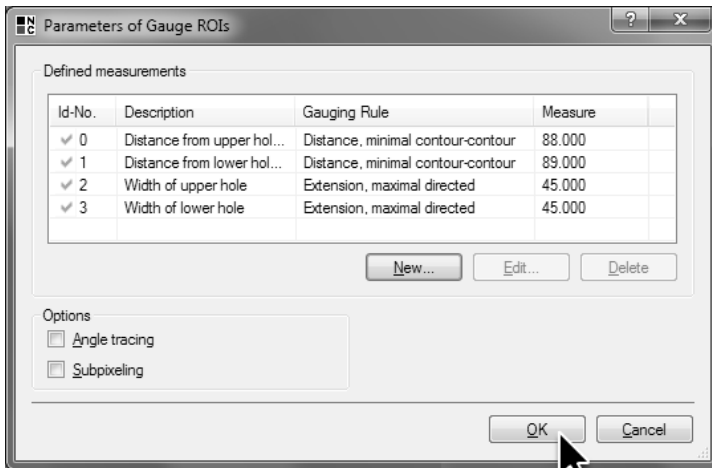


In the **Result** tab the measurements and their identification numbers, their measured values, their descriptions and their gauging rules are listed. Because of differing binary thresholds, the values you measure can differ from the ones depicted here.

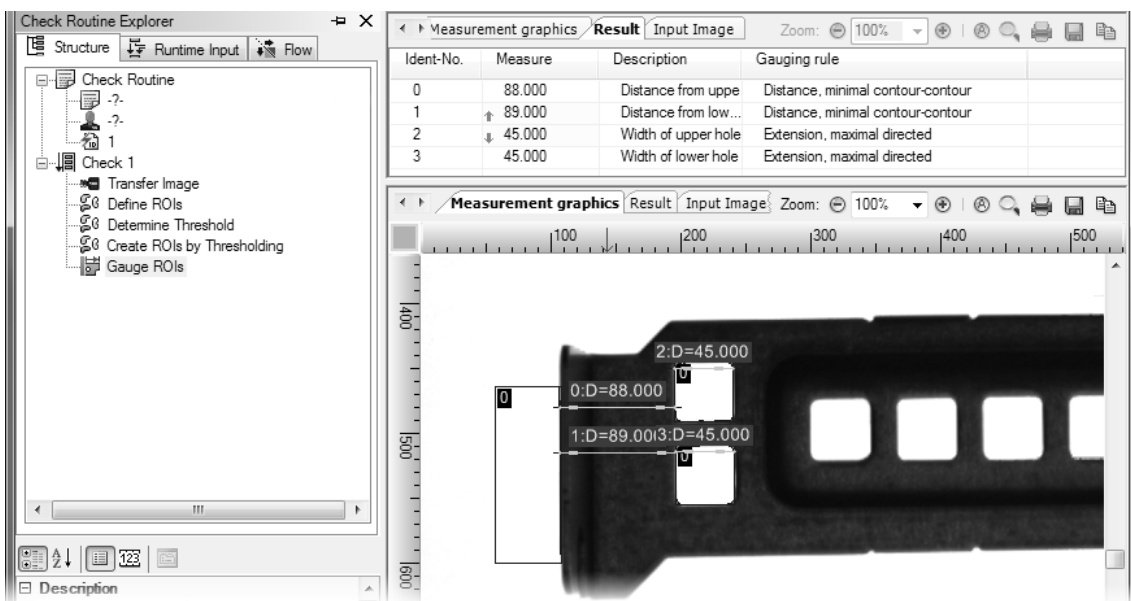


In the result view **Measurement graphics** you can see the measurements drawn into the image. The green boxes above the dimension arrowheads contain information about the identification number of the measurement and the value measured.

## 6.1. Gauging distances between two objects



- 13 The parameter dialog of the check function **Gauge ROIs** lists all defined measurements.



- 14 The **Result** tab displays the results and gauging rules in a table. The **Measurement graphics** tab of the result view displays the measurements graphically in the image.

15



Frequently, the purpose of gauging is to compare the measured values to predefined target values. Therefore, add the check function **Check Allowances** from the **Gauging** group to the check.

16



Open the target value dialog of the check function **Check Allowances**. The list **Allowance specification** of the target value dialog shows the measurements from the measurement list. To enable verification of the first measurement "Distance from upper hole to left edge", select the check box in the corresponding row.

The group field Allowance for measurement no. 0 now shows the target value and the allowance for the first measurement. You can now enter the target value of "88" into the input field **Nominal value**, which corresponds to the measured value in pixels.

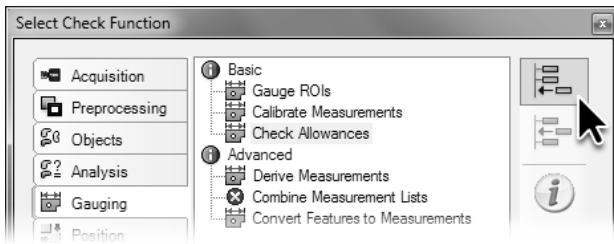
Enter an allowance of "3" in the input field **Upper allowance** and an allowance of "-3" in the input field **Lower allowance**. For the lower limit of values allowed to be smaller than the target value, the value for the lower allowance must be negative.

Since for **Method** the option **Absolute** has been selected, the allowances will be shown in pixels. Else they would be displayed as percentage of the target value.

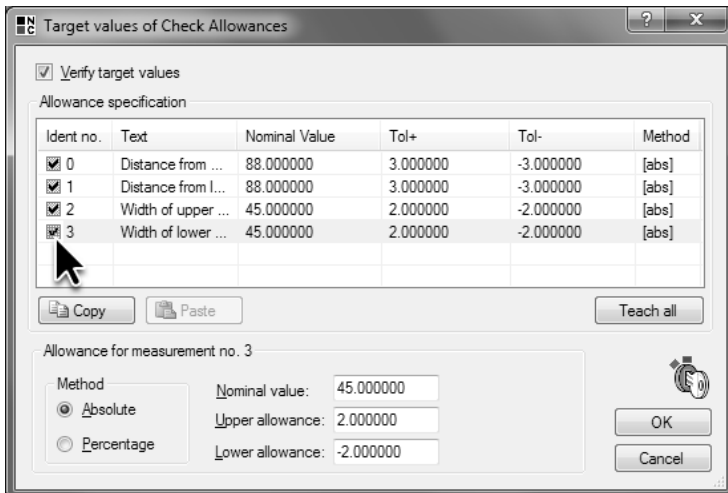
Enable the target value verification for the measurement "Distance from lower hole to left edge" and enter the same target value and the same allowances as you did for the previous measurement.

Enable the target value verification for the measurements "Width of upper hole" and "Width of lower hole". For the target value enter "45" and for the allowances "2" and "-2".

## 6.1. Gauging distances between two objects



- 15 Add the check function **Check Allowances** to the check.



- 16 In the target value dialog of the check function **Check Allowances** the target values and the upper and lower allowances are configured for every measurement.

**17** Close the target value dialog by clicking **OK** and execute the check function.



✓ The measurements are drawn into the image in the **Measurement graphics** tab of the split result view. In the table of the **Measurement list** tab the actual values, target values and allowances are listed. Since all four measurements are within the predefined allowances, the rows in the table are checked and the actual values are highlighted in green.

**18** Open the parameter dialog of the check function **Transfer image**, click the **Browse...** button and select the image file `Cover_Plate_05_NOK_Wrong_Distance.bmp`. Close the selection and the parameter dialog and execute check function **Check Allowances**.

✗ In this image the punched holes are further to the right than allowed. Therefore the distances between the holes and the left edge are outside the allowance. The **Measurement graphics** tab of the result view displays the measurements outside the allowances in red, and in the table of the **Measurement list** tab, the rows are marked with a yellow cross within a red circle and the actual values are highlighted in red to visualize the deviation from the target value.

In this case the check function **Check Allowances** displays a target value failure which aborts the check and displays the result of the check as *not O.K.*



## 6.1. Gauging distances between two objects

The screenshot shows the 'Check Routine Explorer' on the left, listing steps like 'Check Routine', 'Transfer Image', 'Define ROIs', etc. The main window is split into two tabs: 'Measurement graphics' and 'Measurement list'. The 'Measurement list' tab displays a table with the following data:

Ident-No.	Text	Measure	Nominal Val	Tol+	Tol-	Method
0	Distance from ...	88.000	88.000	3.000	-3.000	[abs]
1	Distance from ...	89.000	88.000	3.000	-3.000	[abs]
2	Width of upper ...	45.000	45.000	2.000	-2.000	[abs]
3	Width of lower hole	45.000	45.000	2.000	-2.000	[abs]

The 'Measurement graphics' tab shows a graphical view of a part with dimensions: 0:D=88.000, 1:D=89.000, 2:D=45.000, and 3:D=45.000. The measurements are highlighted in green.

- 17 In the **Measurement graphics** tab of the result view, measurements within the configured allowances are highlighted in green. In the **Measurement list** tab, these measurements are highlighted in green.

The screenshot shows the 'Check Routine Explorer' on the left. The main window is split into two tabs: 'Measurement graphics' and 'Measurement list'. The 'Measurement list' tab displays a table with the following data:

Ident-No.	Text	Measure	Nominal Val	Tol+	Tol-	Method
0	Distance from ...	108.000	88.000	3.000	-3.000	[abs]
1	Distance from ...	108.000	88.000	3.000	-3.000	[abs]
2	Width of upper ...	45.000	45.000	2.000	-2.000	[abs]
3	Width of lower hole	46.000	45.000	2.000	-2.000	[abs]

The 'Measurement graphics' tab shows a graphical view of a part with dimensions: 0:D=108.000, 1:D=108.000, 2:D=44.000, and 3:D=44.000. The measurements are highlighted in red.

- 18 Measurements outside the configured allowances are drawn or highlighted in red.

## 6.2 Gauging with sub-pixel precision

### Goal

You want to gauge measurements with an accuracy better than one pixel and gauging should be independent of the selected binary threshold.

### Result

You will be able to configure gauging with sub-pixel precision in NeuroCheck.

### Solution

1



Duplicate the check from the previous section and rename the copy "Gauging with sub-pixel accuracy". As a description you can enter "Gauging of distance with higher accuracy and independent of selected binary threshold". Execute the check function **Transfer Image**.

The edge of the cover plate is usually not exactly situated on the border between two pixels but somewhere within one pixel. To determine the exact position of the edge, a sub-pixel computation evaluates the gray value distribution on the edge. To illustrate the principle of sub-pixel computation, please open the image analysis tool. Right-click the image in the result view and then select **Open in Image Analysis Tool** from the context menu.

2

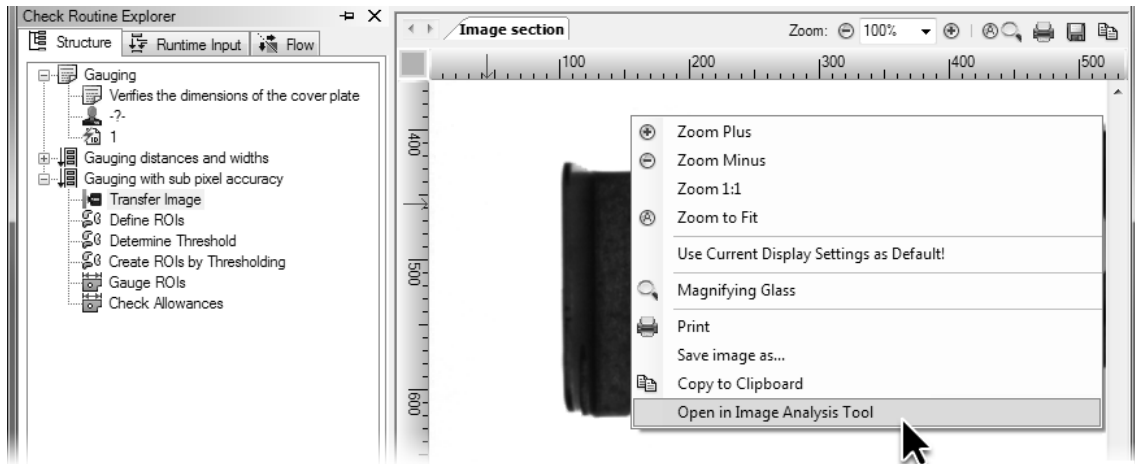


Among other things, you can use the **Image Analysis Tool** to analyze images for feasibility studies and to create images for the documentation of inspection stations.

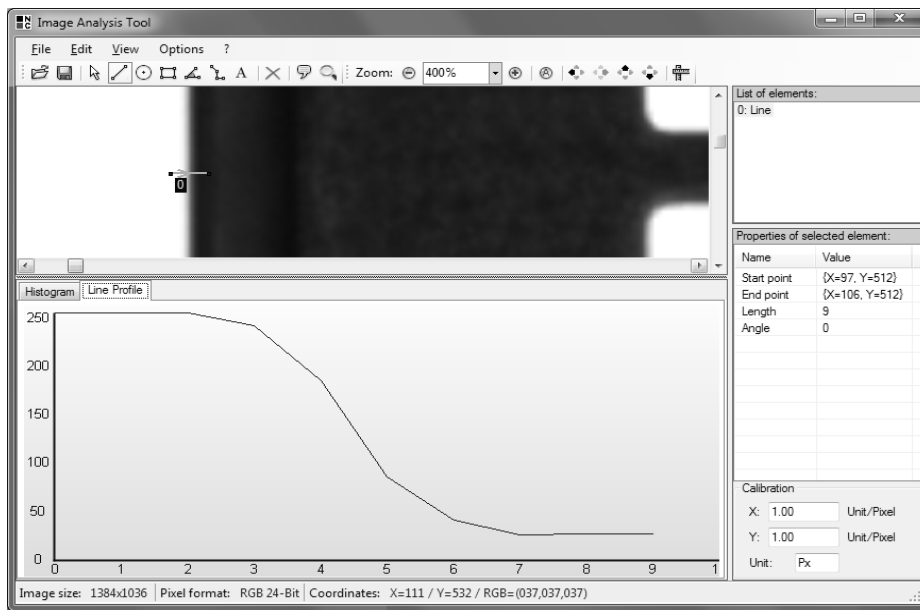
Select line geometry and define a line in the image running from the background over any edge onto the cover plate. Select the **Line Profile** tab to see the gray value profile along the line you selected. The exact distribution of the gray value profile depends on the position, the length and the direction of the line, but in principle it will correspond to the one depicted on the opposite page.

From the depicted gray value profile you can see that the transition from background - the pixels on the left with high gray values - to the cover plate - the pixels on the right with the low gray values - is distributed across several pixels and not precisely between two pixels. On the depicted gray value profile, from the discernible gradual transition from the light background pixels on the left side of the profile to the dark cover plate pixels on the right side of the profile, the position of the edge can be interpolated with an accuracy of better than a pixel. The interpolation of the edge position is called sub-pixel computation.


## 6.2. Gauging with sub-pixel precision



- 1 Right-click the result view to open the image in the **Image Analysis Tool**.




- 2 The transition between cover plate and background is distributed over several camera pixels, which is used for determining the position of the edge with sub-pixel precision.

-  Close the **Image Analysis Tool** and open the **Gauge ROIs** parameter dialog. To be able to use gauging with sub-pixel precision, enable the check box **Subpixeling**. This determines the position of the edges, between which the distance will be determined, with sub-pixel computation.



Then close the dialog by clicking **OK**.

-  Execute the check function **Gauge ROIs**. The distances of the holes to the edge are now displayed with decimals since now the distance has been computed between positions calculated with sub-pixel precision.



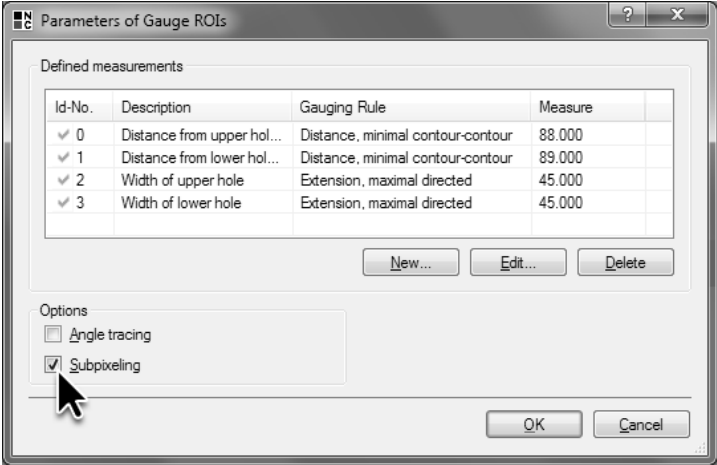
If sub-pixel computation isn't enabled, the check function **Gauge ROIs** computes the measurements exclusively based on ROIs and does not evaluate the images. Therefore, the measured values depend on object creation, especially on brightness and binary threshold.

If the sub-pixel computation is enabled, the check function **Gauge ROIs** computes the position from the gray value profile and thereby also evaluates the image information. Therefore, the gauging results are largely independent of, for example, the defined binary threshold, thus limited changes in brightness do not have an effect upon the gauging result.

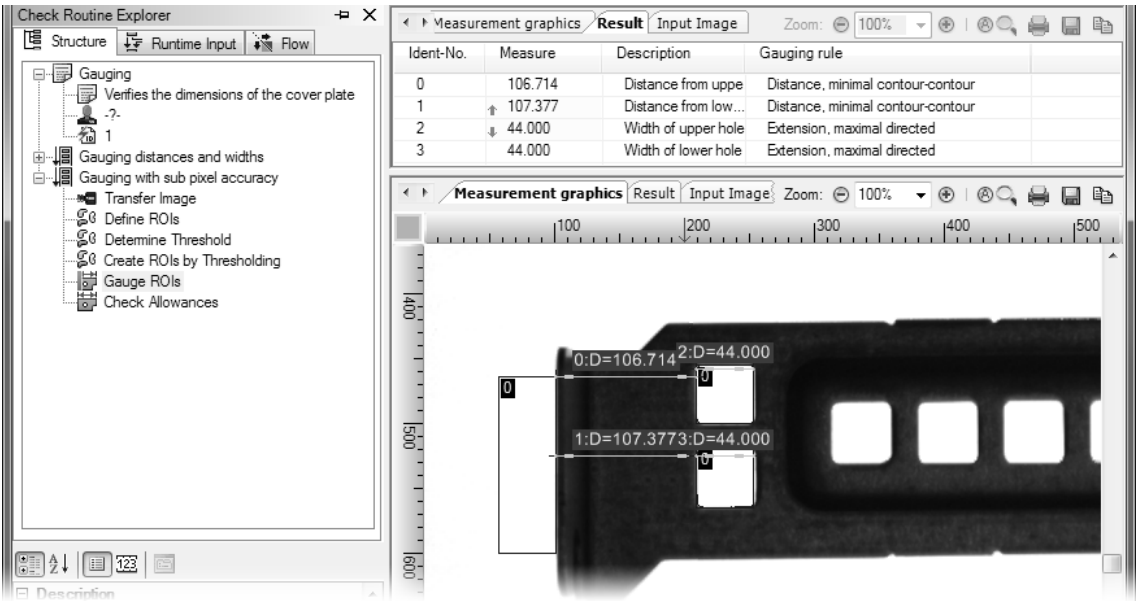


Please note that under real conditions a higher precision than 1/10 pixel is usually unattainable.

6.2. Gauging with sub-pixel precision



3 Enable the **Subpixeling**, option to compute more precise and threshold-independent gauging results.



4 Because of sub-pixel computation the distances of the holes from the edge are gauged with sub-pixel precision.

## 6.3 Gauging parallel edges


### Goal

You want to ensure that the cover plate has the correct height, and upper and lower edges don't show any larger defects.


### Result


You will be able to create object edges in NeuroCheck as discrete objects, use them to calculate regression lines and measure their respective positions.


### Solution

-  1 Duplicate one of the two checks created in this chapter. Rename the copy "Gauging of parallel edges". As a description you can enter "Gauging of the height of the cover plate and check of the upper and lower edge". As image source of the check function **Transfer image** select the file `Cover_Plate_01_OK.bmp`. Delete the two check functions **Gauge ROIs** and **Check Allowances**.

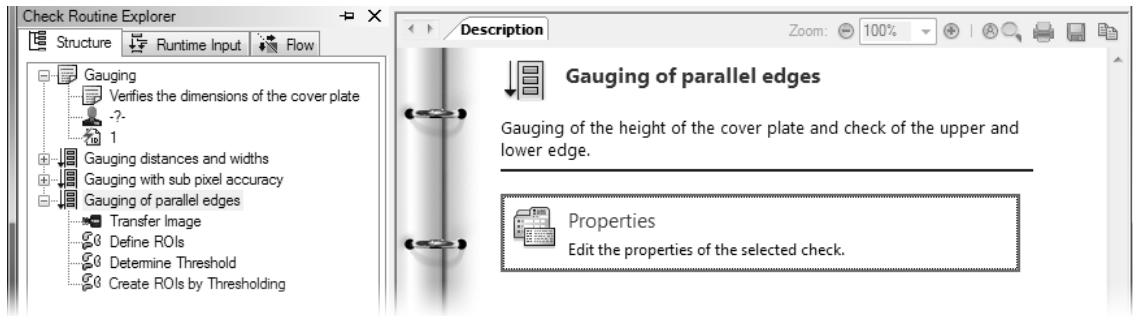
The approach from the first section to create the background as a construction object would lead to inaccurate results because of the small indentations. Instead, we can utilize our knowledge that the upper and lower edges of the cover plate form a line to suppress the effect of the indentations. For this, the edges must be created as objects.

-  2 Open the parameter dialog of **Define ROIs**. Select the two ROIs from the **List of ROIs** and delete them by clicking the **Delete** button.

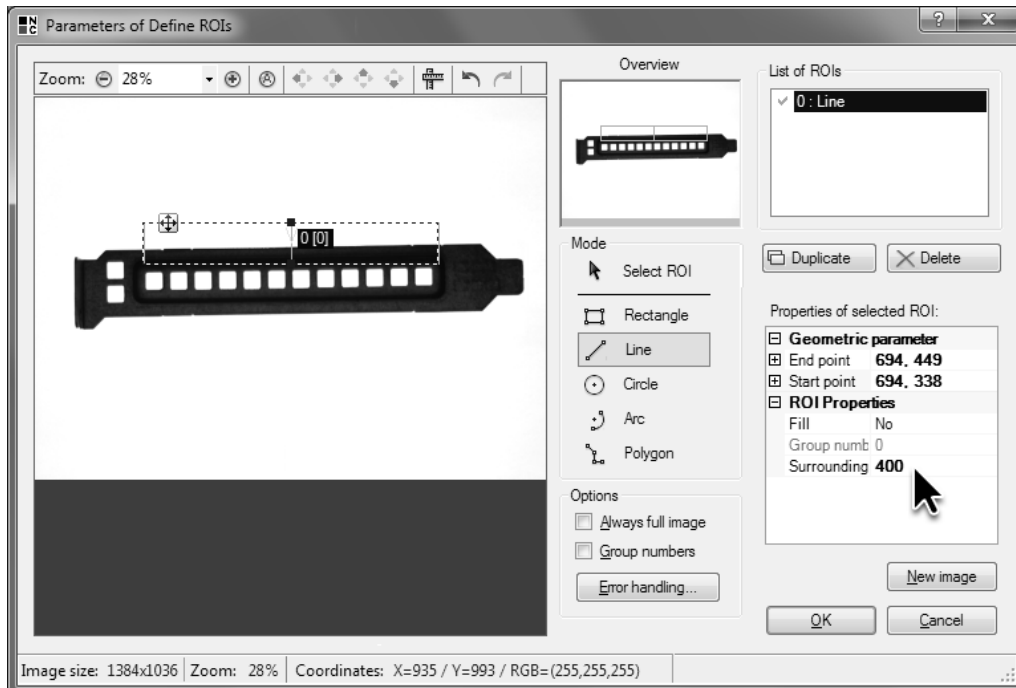
-  Select **Line** mode since it is not possible to search for edges with an ROI of the type **Rectangle**. Click the background above the cover plate approximately in the middle and drag the mouse vertically down onto the cover plate while keeping the mouse button pressed. Let go of the mouse button above the holes. You will see an arrow pointing from the background into the cover plate.

-  Select the line from the **List of ROIs** and enter the value 400 into the **Properties of selected ROIs** table in row **Surrounding**. A dotted-line rectangle is drawn into the image marking the line and its surrounding area. If the surrounding area protrudes over the straight area of the cover plate or is not completely above the holes, move the line by clicking the depicted icon and keeping the left mouse button pressed.


### 6.3. Gauging parallel edges



- 1 Duplicate the check and delete the last two checks.



- 2 Define an ROI of the type **Line** and set 400 for the **Surrounding** of the ROI.

- 3**  Once more select **Line** mode, click the background below the cover plate approximately in the middle and drag the mouse vertically up onto the cover plate while keeping the mouse button pressed. Let go of the mouse button below the holes. You will see an arrow pointing from the background into the cover plate.

Select the line from the **List of ROIs** and enter the value 400 into the **Properties of selected ROIs** table in row **Surrounding**. If the surrounding area protrudes over the straight area of the cover plate or is not completely below the holes, move the line.

Exit the parameter dialog by clicking **OK**.

- 4**  Open the parameter dialog of the **Create ROIs by Thresholding** check function. From the **Object creation** list select the **Edge only** option to search the upper and lower edge of the cover plate.

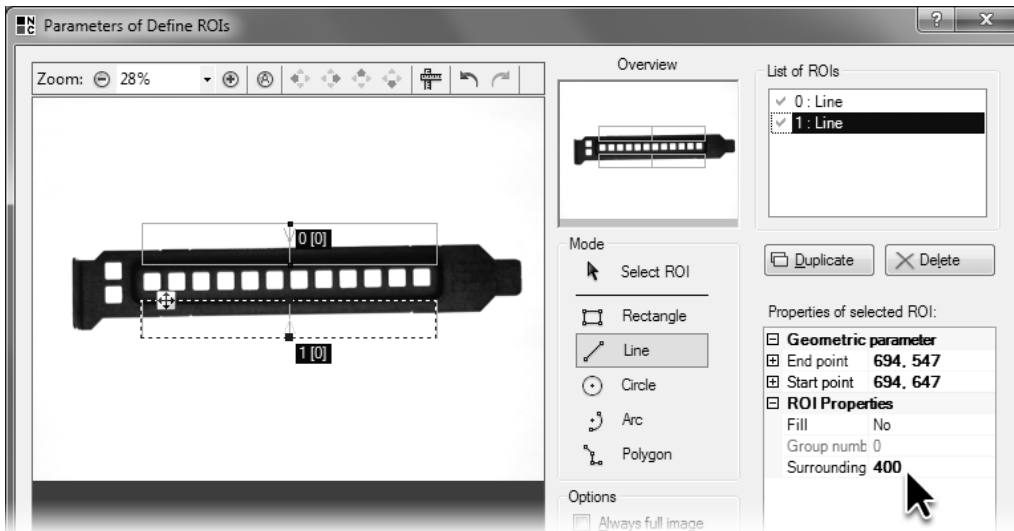
With this setting, the transition to the color defined in **Object color** is searched for along the line. The search takes place in the direction of the arrow depicted in the parameter dialog of the **Define ROIs** check function.

Since the arrows are pointing from a white background into the black cover plate, select as **Object color** the option **Dark**.

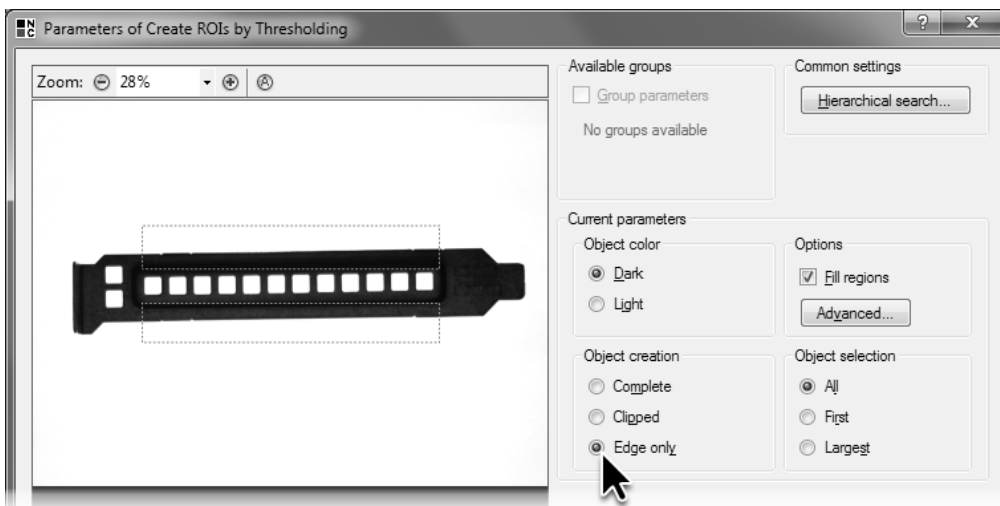
Click the **OK** button to close the parameter dialog.



### 6.3. Gauging parallel edges



- 3 Define another ROI of the type **Line**, also with 400 for the surrounding area.



- 4 Select the option **Edge only** for object creation so only the upper and lower edge of the cover plate will be created as objects.

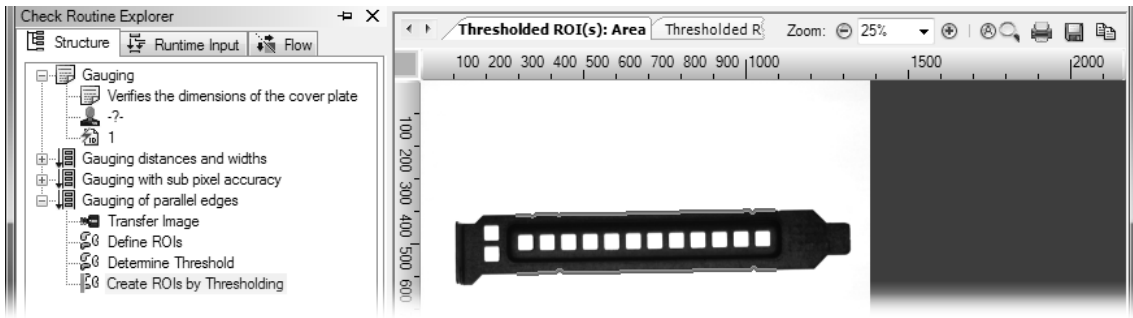
**5** Execute the check function **Create ROIs by Thresholding**. On the upper and lower edge of the cover plate you can see a pixel-wide ROI (on the image opposite they've been drawn thicker for illustration purposes). The created ROIs end at the defined surrounding area of the search lines.



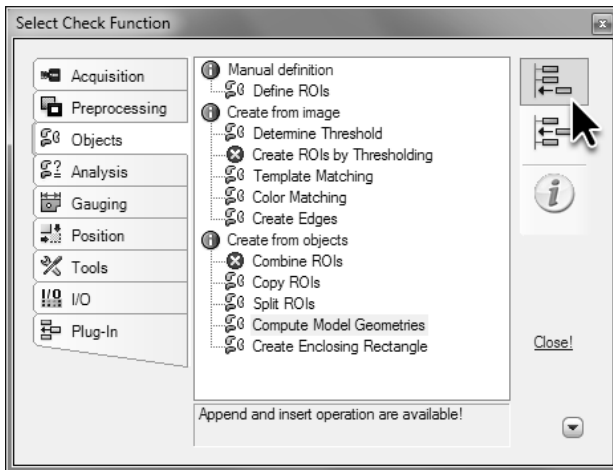
**6** The binary created ROIs are not lines but follow the contour of the cover plate including the indentations. To minimize the indentations' influence on the gauging, add the check function **Compute Model Geometries** from the **Objects** group to the check.




### 6.3. Gauging parallel edges





- 5 The created objects are depicted as one-pixel-wide ROIs above and below the cover plate.

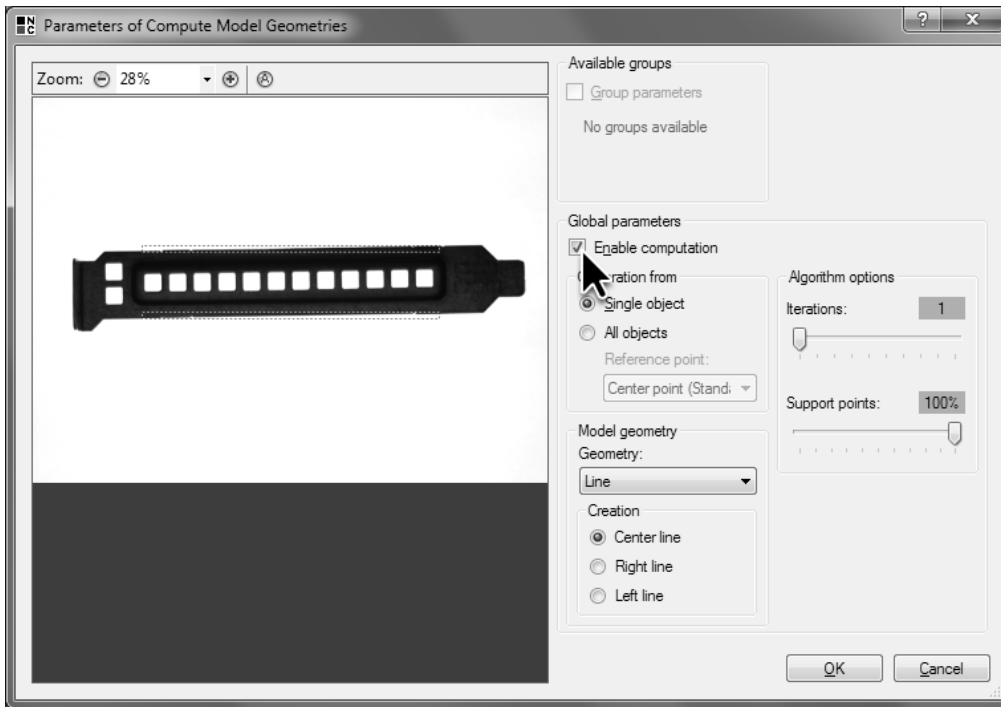


- 6 Add the check function **Compute Model Geometries** to the check.

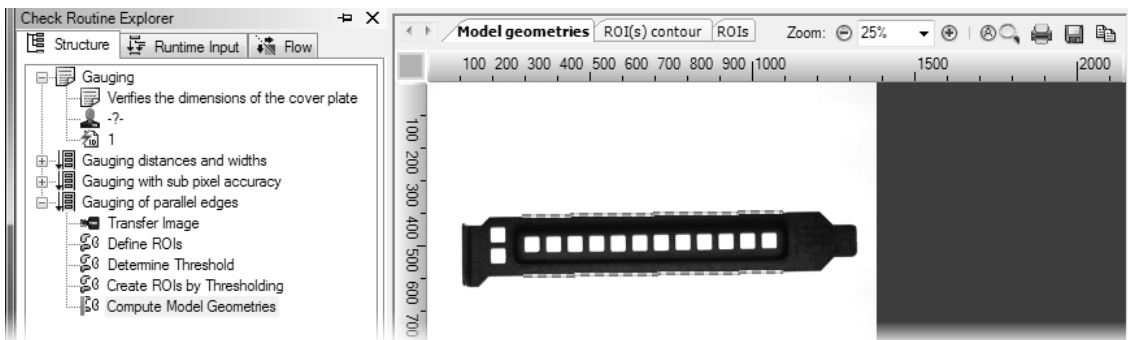
 Open the parameter dialog of the check function **Compute Model Geometries** and check **Enable computation** to compute model geometries. Leave the other settings at their defaults and close the parameter dialog by clicking the **OK** button.

  
 Execute the check function **Compute Model Geometries**. The ROIs on the upper and lower edge of the cover plate have been replaced by dotted regression lines (on the image opposite they've been drawn thicker for illustration purposes). These regression lines do not follow the indentations. Since the model computation is based on all points of the created ROIs, the indentations have virtually no influence on position and direction of the regression lines.

Because of the model geometry computation using all points of the created ROIs, the position and direction of model geometries and the measurements based upon them are sub-pixel precise.



7 Activate computation of model geometries to replace the created contours with lines.



8 The computed regression lines are depicted as dotted lines in the result view.

9

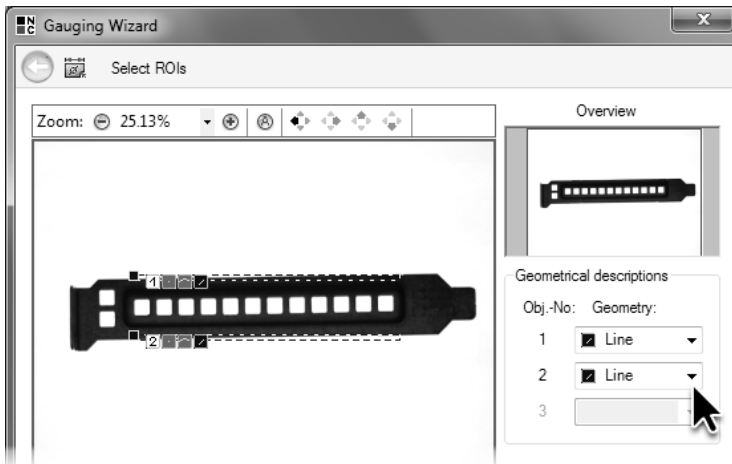


Add the check routines **Gauge ROIs** and **Check Allowances** to the check and open the parameter dialog of the check function **Gauge ROIs**. Click the **New...** button to define a new measurement. On the first page of the **Gauging Wizard**, select the two regression lines and select **Line** geometry for both objects. Click the **Next** button to switch to the next page.

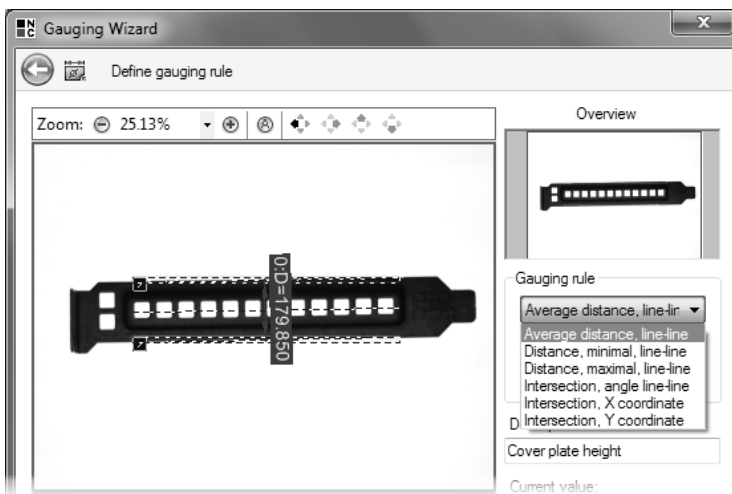
10

On the second page of the **Gauging Wizard**, keep the default gauging rule set to **Average distance, line-line** to gauge the height of the cover plate. Enter the **Text** "Cover plate height". Click the **Finish** button to close the **Gauging Wizard**.

### 6.3. Gauging parallel edges



9 In the Gauging Wizard select the two edges opposite each other and select **Line** geometry.

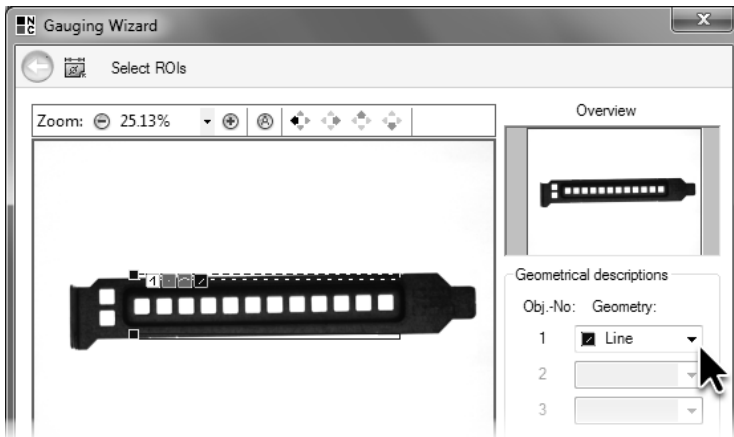


10 Select the gauging rule **Average distance, line-line** to gauge the height of the cover plate.

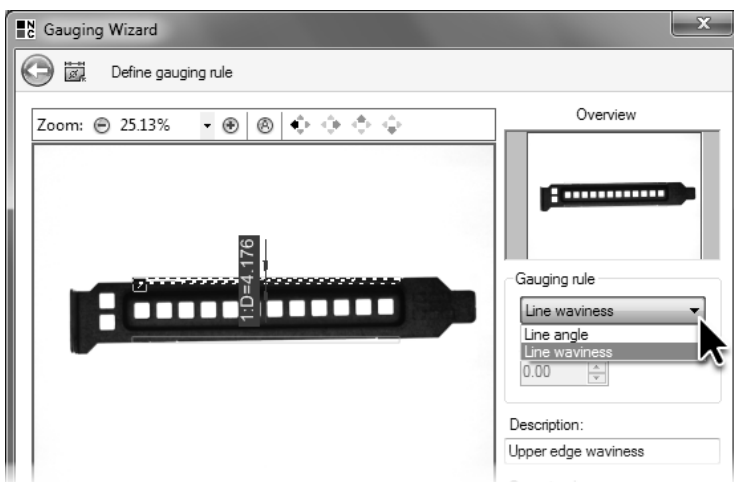
- 11** Click the **New...** button to define another measurement. Select the regression line describing the upper edge of the cover plate. Select **Line** geometry and click the **Next** button to switch to the next page of the **Gauging Wizard**.
- 12** Select **Line waviness** as **Gauging rule**. With line waviness, for each point of the contour used for computing the regression line, the distance to the regression line is calculated. The sum of the greatest distances on both sides of the regression line gives the waviness. In this case, the waviness is a measure for the size of the indentations in the upper edge of the cover plate. Enter the **Text** "Upper edge waviness" and click the **Finish** button.



### 6.3. Gauging parallel edges



11 Select the ROI on the upper edge of the cover plate and select **Line** geometry.



12 Select the gauging rule **Line waviness** to check the upper edge of the cover plate for indentations.

- 13** Likewise define a measurement for determining the waviness of the lower edge.

Then close the **Gauge ROIs** parameter dialog by clicking the **OK** button.

- 14** Open the **Check Allowances** target value dialog and enable checking of the measurement "Cover plate height". For the target value enter "180" and for the allowances "+3" and "-3".



Enable the inspection of the measurements "Upper edge waviness" and "Lower edge waviness". Enter the target value "0" each, since ideally the deviation from the line is zero. Since the waviness cannot be a negative value, enter "0" for the **Lower Allowance**. Enter "6" for the **Upper Allowance**.

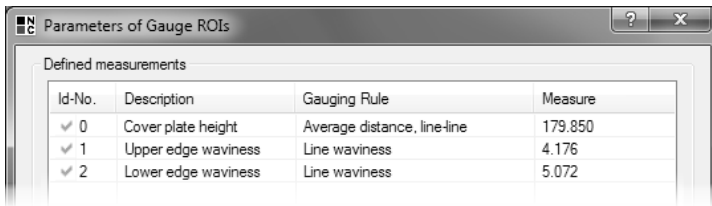
Close the dialog by clicking **OK**.

- 15** Execute the check function **Check Allowances**. In the result view you can see both regression lines and several auxiliary lines created for the gauging operation, furthermore the measured waviness and distance.

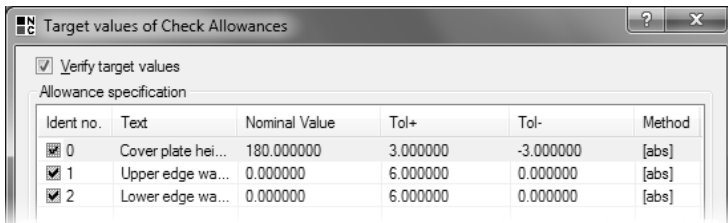


- 16** Execute the check using the image `Cover_Plate_06_NOK_Nodge.bmp`. Significant indentations on the upper edge result in a target value failure.

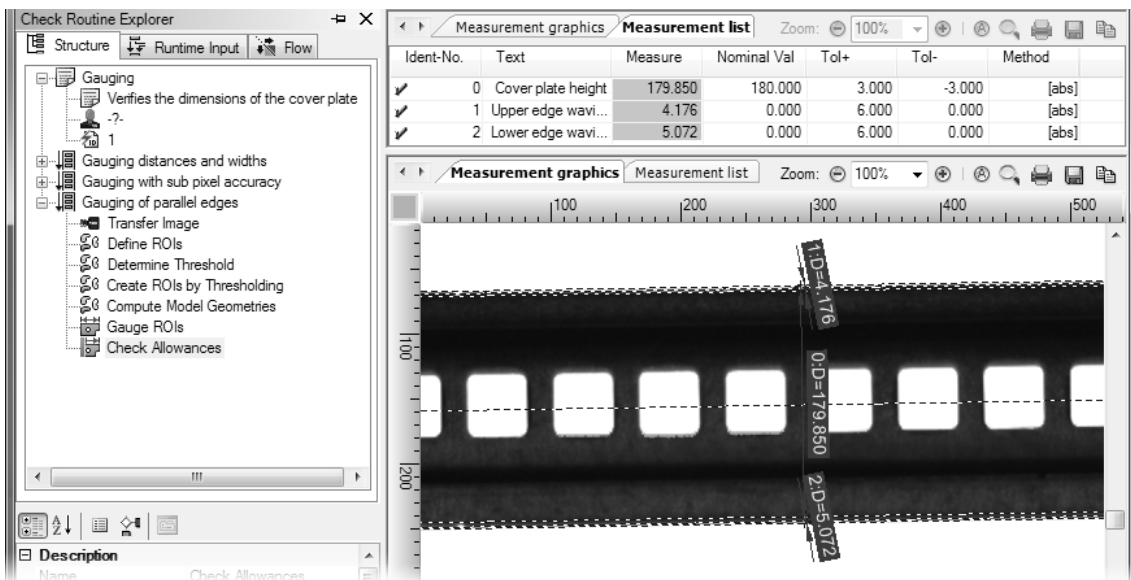




- 13 The three defined measurements are displayed in the **Gauge ROIs** parameter dialog.



- 14 Enter the target values and allowances for the height of the cover plate and the edge quality in the **Check Allowances** target value dialog.



- 15 The measurements are displayed in the result view together with the auxiliary lines necessary for gauging.

## 6.4 Calibration to metric measurements





### Goal

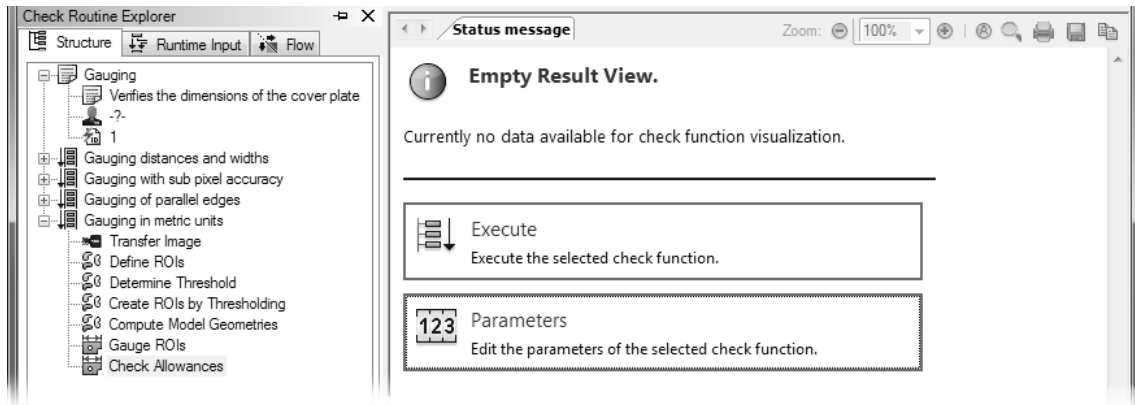
You want to convert pixel-based measurement to metric measurements.

### Result

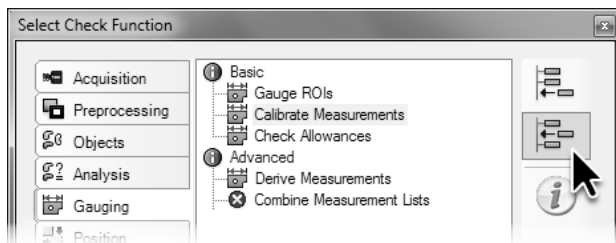
You will be able to determine the conversion factor between image pixels and real-world measurements, and you will know how to convert measurements using this factor.

### Solution

-  1 Duplicate the check "Gauging of parallel edges" you created in the previous section. Rename the copy "Gauging in metric units". Enter "The gauging results are calibrated to metric measurements" as description. As image source of the check function **Transfer image** select the file `Cover_Plate_01_OK.bmp`. Select the check function **Check Allowances**.
-  2 Open the check function selection dialog and select the measurement group. Select the check function **Calibrate Measurements**. Insert the check function into the check before the check function **Check Allowances** by clicking on the depicted icon.  

-  3 Open the parameter dialog of the newly inserted check function.



- 1 Select the check function **Check Allowances** to insert a new check function before it.



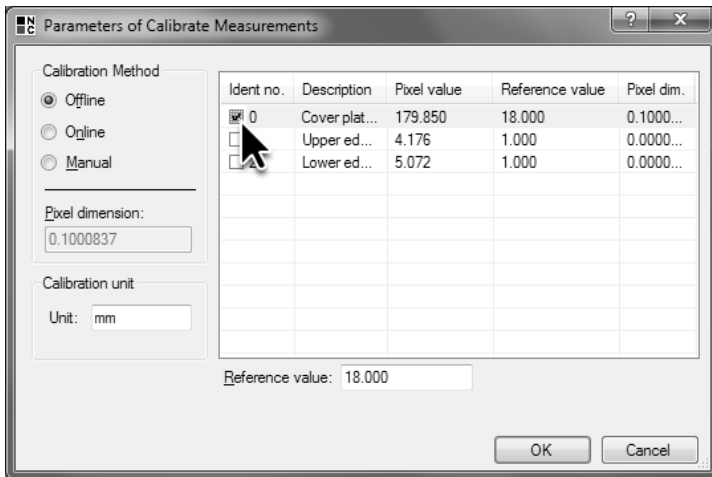
- 2 Insert the check function **Calibrate Measurements** into the check.

- 3 For the **Calibration Method** select the option **Offline**. Upon closing the parameter dialog by clicking **OK**, the calibration factor is calculated by dividing the value from the **Reference value** column for the activated value by the currently measured value from the **Pixel value** column. This calibration factor is calculated once and used in every execution for multiplying the measured values of all measurements to convert them to metric values.

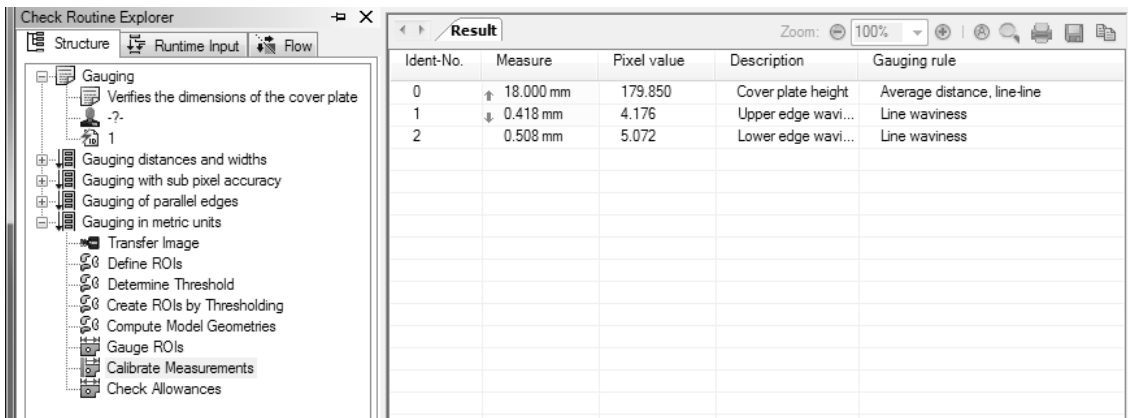
Enable the measurement "Cover plate height" and enter in the input field **Reference value** the height of the cover plate in millimeters: 18. Enter "mm" in the input field **Unit** as abbreviation for the measurement unit used for calibration.

Click the **OK** button to determine the calibration factor and close the parameter dialog. Please make sure that you use an image for the computation of the calibration factor, for which the real measurements used for computation match the configured reference values exactly. Save images you used for calibration to be able to use them for recalibration at a later time.



- 4 Execute the check function **Calibrate Measurements**. The result view will show "18 mm" as height measurement. The measurements for waviness are calibrated using the same factor and the values are around 0.5 mm.



- 3 In **Offline** mode, the calibration factor is calculated from the selected measurements upon closing the parameter dialog.



- 4 Upon execution of the check functions, all measurements are converted with the determined calibration factor.

-   
 5 The target values and allowances that are checked in the check function **Check Allowances** must be entered in metric values, i.e. adjusted to the calibrated results. Open the target value dialog of the check function and change the target value for *Cover plate height* to 18 mm and the allowances to +0.3 mm and -0.3 mm. For both waviness measurements change the upper allowance to 0.6 mm. Execute the check function. In both tabs of the result view, the calibrated measurements are checked and visualized.



## 6.4. Calibration to metric measurements

The screenshot displays the 'Check Routine Explorer' software interface. On the left, a tree view shows the 'Check Allowances' routine. The main window is divided into two panes. The top pane, titled 'Measurement list', contains a table with the following data:

Ident-No.	Text	Measure	Nominal Val	Tol+	Tol-	Method
0	Cover plate height	18.000 mm	18.000 mm	0.300 mm	-0.300 mm	[abs]
1	Upper edge wavi...	0.418 mm	0.000 mm	0.600 mm	0.000 mm	[abs]
2	Lower edge wavi...	0.508 mm	0.000 mm	0.600 mm	0.000 mm	[abs]

The bottom pane, titled 'Measurement graphics', shows a grayscale image of a cover plate with a grid overlay. A vertical measurement line is drawn across the image, with a label indicating the measured value: 'I.D.=0.418mm, O.D.=18.000mm, Z.P.D.=0.508mm'. The image also features a horizontal scale at the top ranging from 0 to 500 and a vertical scale on the left ranging from 0 to 200.

- 5 After calibrating the measurements, the target values and allowances can be entered using metric values in **Check Allowances**.



## 7. Configuration of Automatic Mode

One of NeuroCheck's special strengths is the freely configurable user interface for automatic inspection. You can design this user interface interactively, without programming.

In this chapter you'll learn how to

- create a process view to visualize the results of an inspection
- modify message texts of checks
- select the functions of a control panel menu
- configure the control panel and the control panel menu



## 7.1 Designing the process view

### Goal

You want to visualize gauging results for the station operator in automatic mode.

### Result

You will be able to configure a process view and you will know the most important windows of the process view and their essential settings.

### Solution

The process view is the window in NeuroCheck automatic mode, in which results, measured values and images of a check routine can be visualized. To tailor the process view optimally to a check routine, the check routine whose results you want to visualize must be open in NeuroCheck.

1



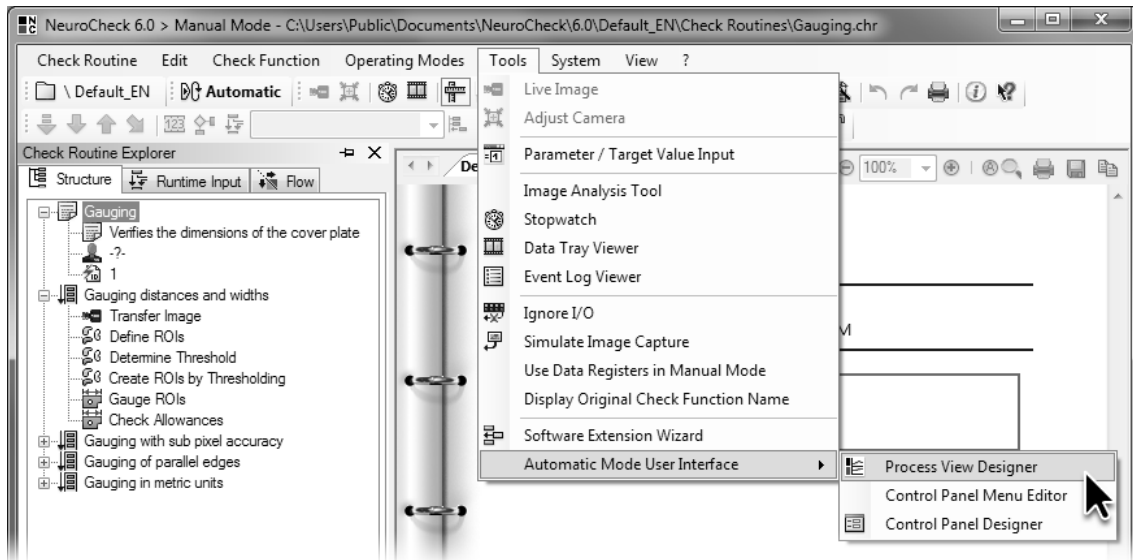
123

To create a process view for the check routine `Gauging.chr`, which you created in the previous chapter, open the check routine. Make sure that in the check *Gauging distance and widths* the check function **Transfer Image** uses the two files `Cover_Plate_01_OK.bmp` and `Cover_Plate_05_NOK_Wrong_Distance.bmp` as image sources.



Select **Automatic Mode User Interface** from the **Tools** menu and then the subentry **Process View Designer**. The **Process View Designer** is a dialog for creating process views in an interactive graphical way.

## 7.1. Designing the process view

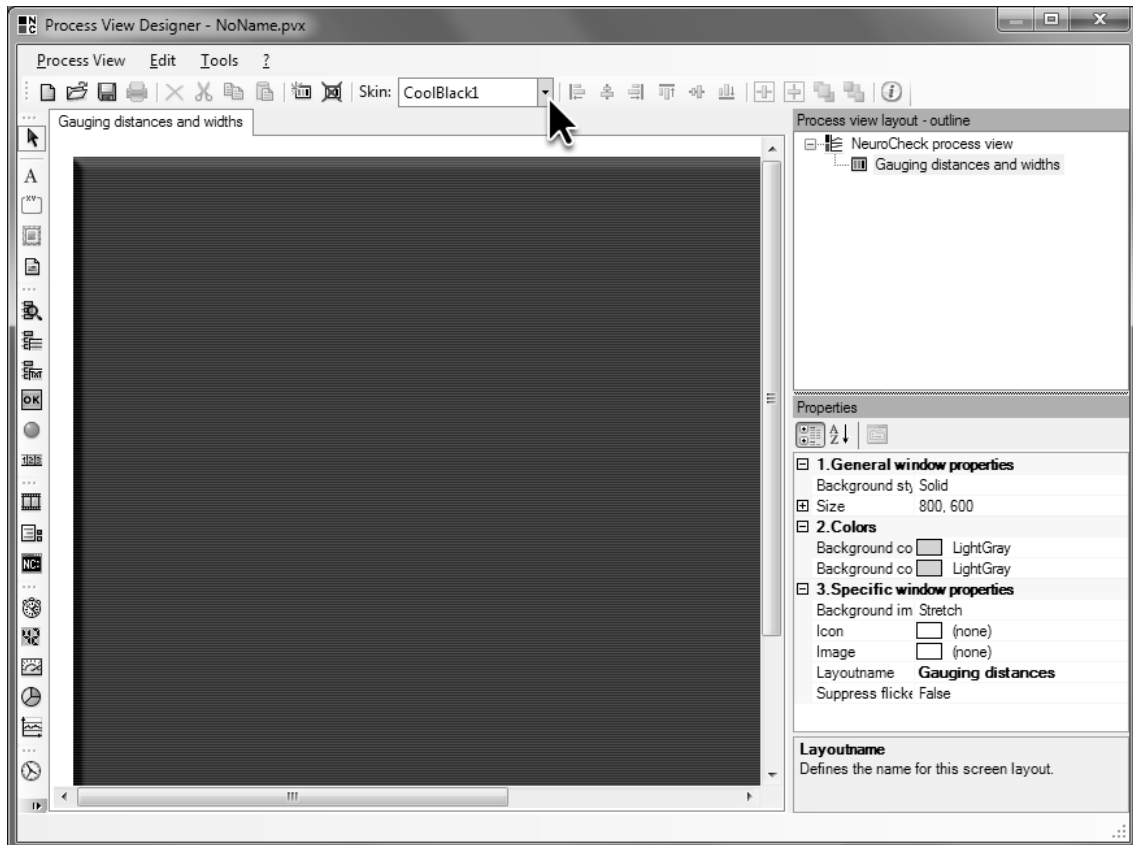


- 1 Open the **Process View Designer** to create a process view.

- 2 From the drop down menu **Skin** select the style **CoolBlack1** to determine the colors and borders of the window. The new style causes the background of the screen layout to change to a dark striped pattern. One screen layout equals one page of the process view.

In the **Properties** table, click in the right column of the **Layout name** row. Behind the automatically created name of the screen layout **Screen Layout 1** the cursor is blinking. Delete the name and enter the new name "Gauging distances". The name you entered appears as name of the tab in the process view.

## 7.1. Designing the process view



- 2 Set **Skin** to **CoolBlack1**. This will give the process view an appealing look. Change the **Headline** of the screen layout to "Gauging distances".

- 3 Click the depicted icon on the icon bar to enter a headline for the screen layout. Click on the screen layout, and draw a window of the **Text label** type by dragging the mouse keeping the left mouse button pressed. Let go of the mouse button as soon as the window has the right size. To get an impression of the completely configured process view, go to picture 15 on page 69.

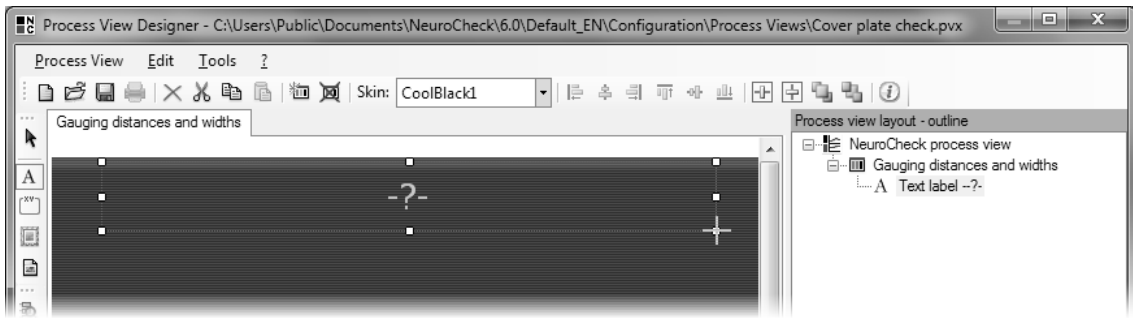
A

You can change the window size by clicking on an edge or corner and dragging while keeping the left mouse button pressed, reducing or enlarging the window. You can change the window's position by clicking in the window and dragging the mouse while keeping the mouse button pressed.

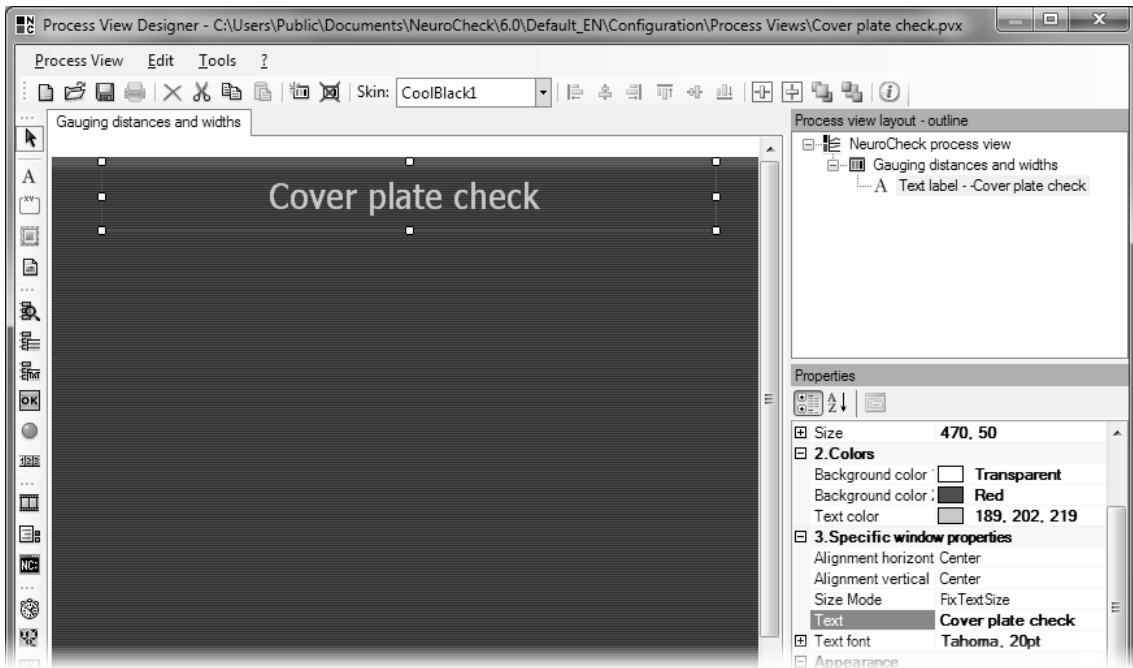
- 4 In the **Properties** table click the right column of the **Text** row. In the **Properties** table you can configure the parameters of the selected window. Replace the text with "Cover plate check". The text is displayed as title of the screen layout.






## 7.1. Designing the process view



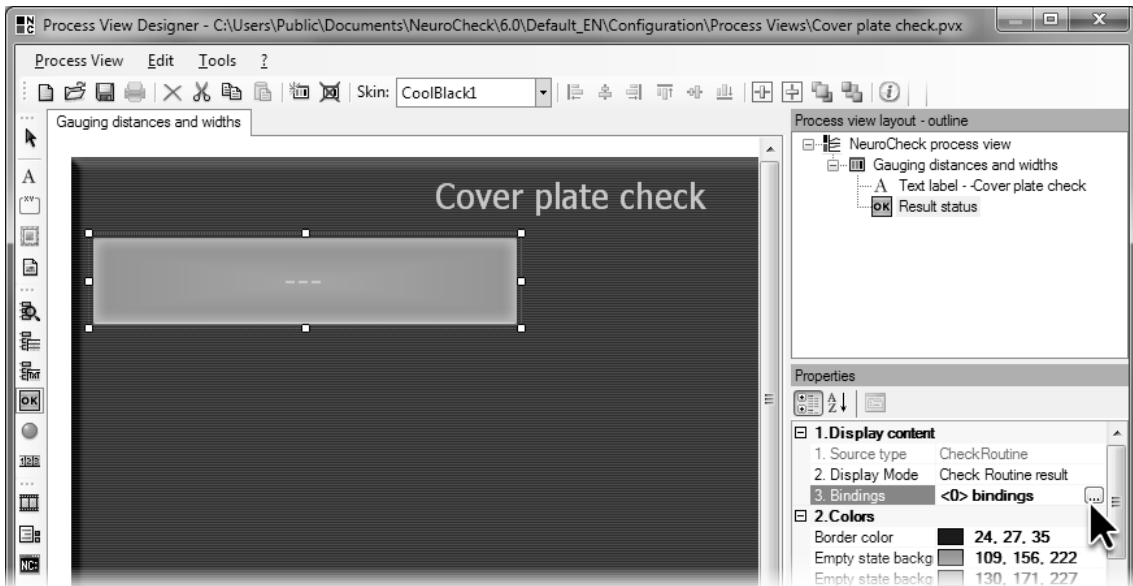
- 3 Draw a window of the **Text label** type as title in the screen layout.



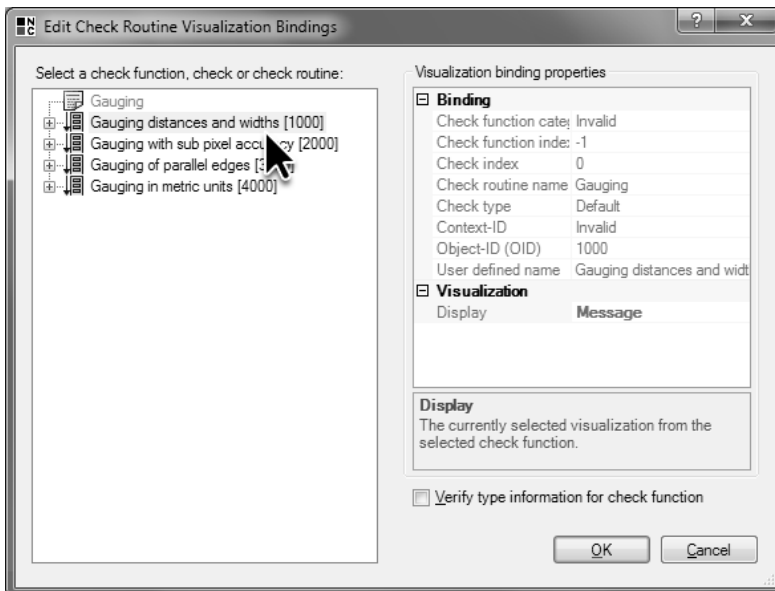
- 4 Enter a title for the process view in the **Text** row of the **Properties** table.

- 5**  Click the depicted icon on the icon bar and, in the screen layout, draw a window of the **Result status** type that visualizes the result of the check routine, a check or a check function.
-  In the **Properties** table click the right column of the **Bindings** row. Click the depicted button to link the window to a check result.
- 6**  In the tree view of the **Edit Check Routine Visualization Bindings** dialog, select the *Gauging distances and widths* check. The **Result View** window displays the result of the selected check. Click **OK** to close the **Edit Check Routine Visualization Bindings** dialog.

## 7.1. Designing the process view



- 5 Draw a window of the **Result status** type in the screen layout.



- 6 Select the check *Gauging distances and widths* to display its results.

7



Click the depicted icon on the icon bar and, in the screen layout, draw a window of the **Check function image** type that visualizes the result image of a check function.



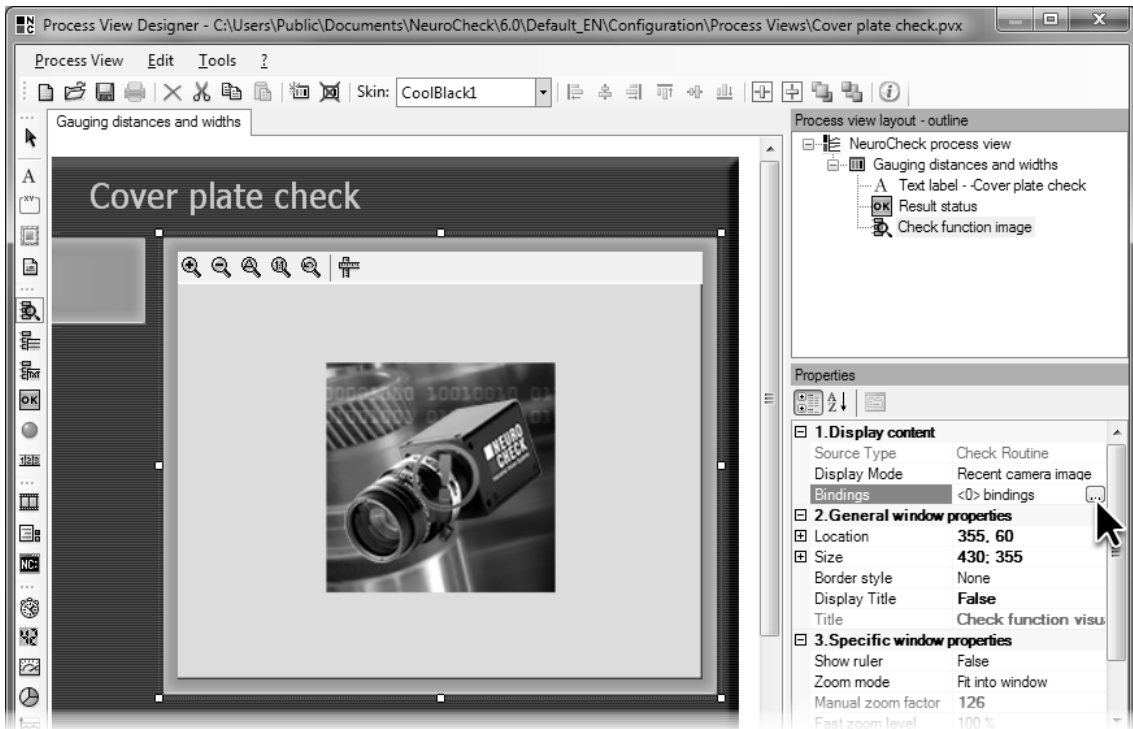
In the **Properties** table click the depicted button in the right column of the **Bindings** row to link the window to the result image of a check function.

8

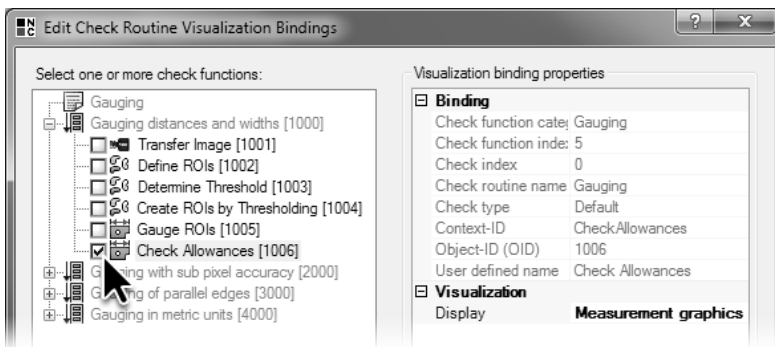


In the tree view of the **Edit Check Routine Visualization Bindings** dialog, expand the *Gauging distances and widths* check by clicking the depicted icon. Select the check function **Check Allowances** to display the content of the **Measurement graphics** tab of the result view in the **Check function image** window. Click **OK** to close the **Edit Check Routine Visualization Bindings** dialog.

## 7.1. Designing the process view



- 7 Draw a window of the **Check function image** type in screen layout.



- 8 Select the check function **Check Allowances** to display measurement graphics.

9



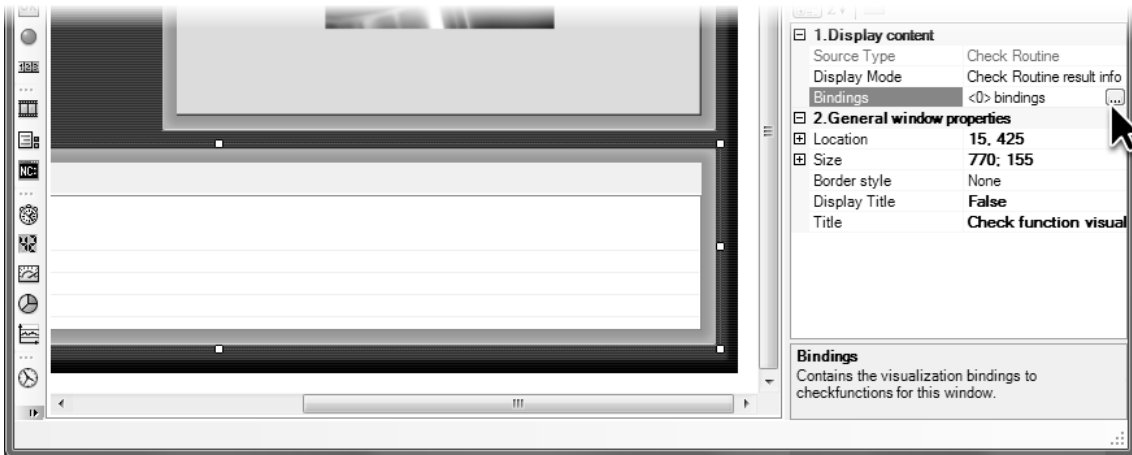
Click the depicted icon on the icon bar and, in the screen layout, draw a window of the **Check function visualization list** type that displays the result table of a check function. Link the window to the check function **Check Allowances** from the *Gauging distances and widths* check like you did with the previous window. The window **Check function visualization list** displays the content of the **Result** tab of the result view.

10

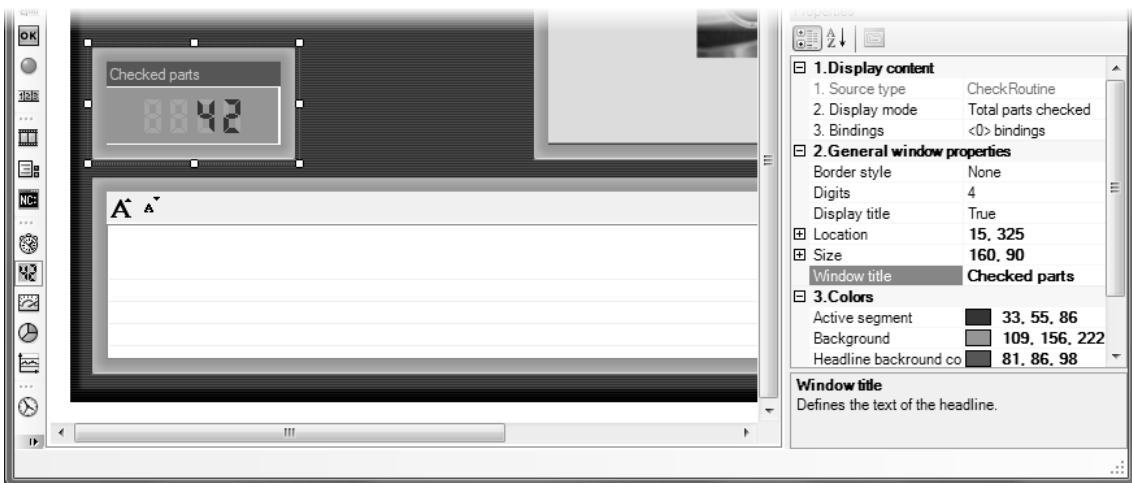


Click the depicted icon on the icon bar and, in the screen layout, draw a window of the **Counter** type that visualizes the number of pieces inspected. In the **Properties table** click the right column in the **Window title** row and replace the text with "Checked parts".

## 7.1. Designing the process view



- 9 Draw a window of the **Check function visualization list** type in the screen layout to visualize the gauging results.



- 10 Draw a window of the **Counter** type in the screen layout to display the number of pieces inspected.

11



Click the depicted icon on the icon bar and, in the screen layout, draw another window of the **Counter** type in the screen layout. Click the right column of the **Display content** row in the **Properties table** and select **Check time** mode to visualize the average execution time of the check routine. In the row **Window title** enter the text "Average check time".

12



Click the depicted icon on the icon bar and, in the screen layout, draw a window of the **Chart** type that visualizes the distribution of the results. By default, the **Chart** window displays both the share of work pieces that is okay, and the share of work pieces that resulted in an error or where one of the predefined target values were violated.



In the **Properties table** click the right column of the **Caption visible** row and select **No** so the title of the window is not displayed anymore. You've just finished creating your first process view.

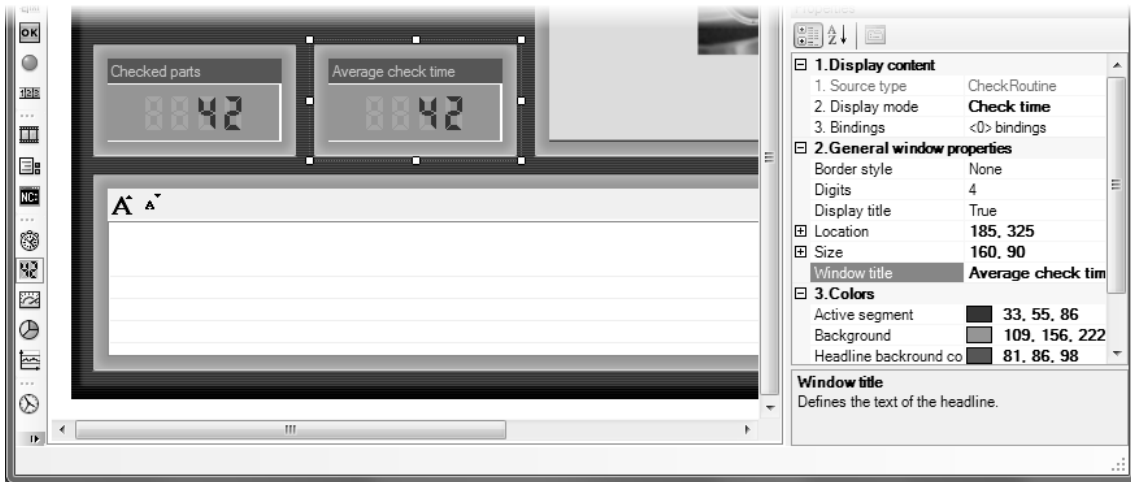
Select **Save as...** from the **Process View** menu. The **Save as...** dialog displays the sub-directory `\Configuration\Process Views\` of the project directory. Save the process view in the sub-directory using the file name "Cover plate check".



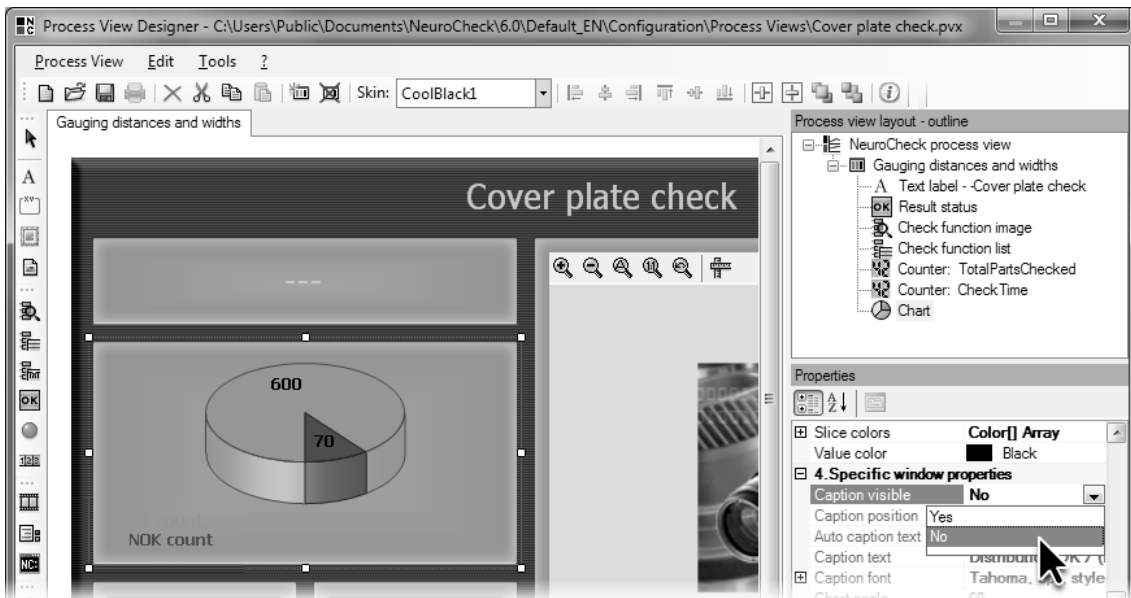
Click on the depicted button to close the **Process View Designer**.



## 7.1. Designing the process view



- 11 Draw another window of the **Counter** type in the screen layout to display the average execution time of the check.



- 12 Draw a window of the **Chart** type in the screen layout to visualize the ratio of O.K. parts to not O.K. parts.

13



For the process view to be displayed and updated in automatic mode, it has to be linked to the check routine. For this, in the **Check Routine Explorer** right-click the entry of the check routine *Gauging*. Select **Properties** from the context menu.

Since the process view can be especially optimized for visualizing the results of a check routine, the process view is linked to a check routine. Modifying a check routine usually entails a change of the displayed process view.

14



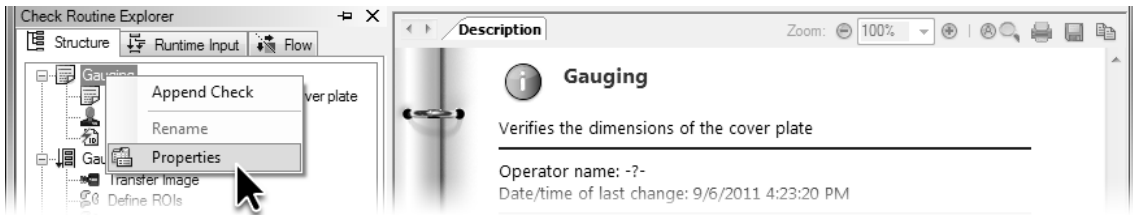
In the tree view of the **Check routine properties** dialog, click the depicted icon in front of **Automatic mode** to expand the sub-entries. In the tree view select **Process View** to link the check routine to the process view.

Select the **User defined process view** option and click the **Open** button to select the process view.

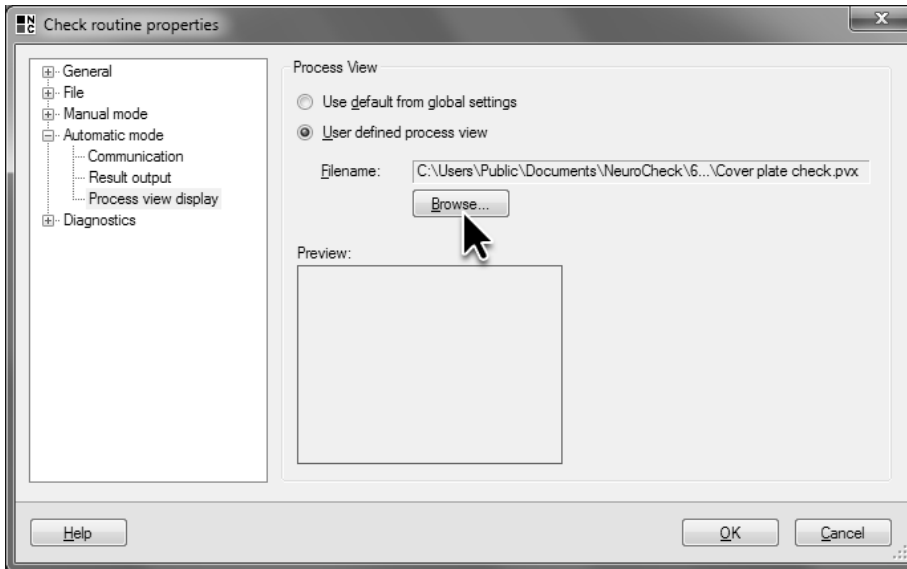
In the **Load Process View** dialog select the designed process view `Cover_plate_check.pvx` and click the **Open** button to close the dialog.

Then close the **User defined process view** dialog by clicking the **OK** button.


For the checks *Gauging with sub-pixel precision*, *Gauging of parallel edges* and *Gauging with metric measurements* not to yield *not O.K.* results, parameterize the check functions **Transfer Image** of these three check thus that only the image `Cover_Plate_01_OK.bmp` is loaded.



- 13 Select **Properties** from the context menu of the check routine.




- 14 Select **User defined process view** and then click **Open...** to select the created process view.

- 15** Switch to automatic mode by selecting **Automatic mode** in the **Operating modes** menu or by clicking the depicted icon. Next to the Control Panel the Process View you created is now displayed. If you don't want to display the process view, either click the *F5* button in the **Control Panel**, click *F5: Process View Show* in the LCD display of the **Control Panel**, or press the  key.



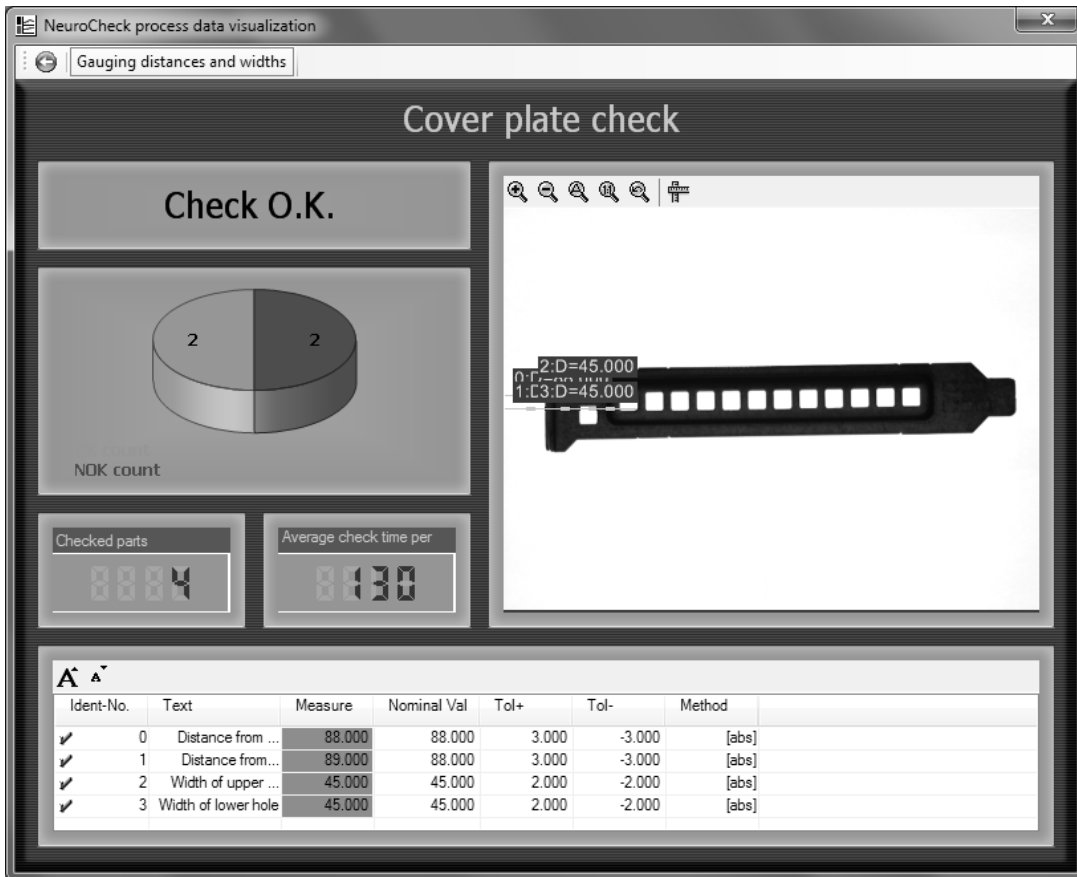
Please note that both the entries of the LCD display and the assigned hot keys depend on the current configuration. The depicted entries and keyboard assignments are the default configuration after installing NeuroCheck.

Make sure that **Control Panel** is the active window. Activate automatic mode by either clicking the *F3* button in the **Control Panel** or *F3: Start Automatic* in the LCD display of the **Control Panel**, or by pressing the  key.

A warning appears that the image is read from file, acknowledge by clicking **No**.

At the remote station of the virtual fieldbus, set bit 0 to cause the check routine to be executed once. For each execution of the check routine, the results are visualized in the windows of the **Process View**.

Alternately the results of the cover plate that is O.K., and of the cover plate that is not O.K. are displayed. The displayed results, measured values and images are taken from the check functions and checks that were selected in the **Process View Designer**.



- 15 In automatic mode, the check routine results are displayed in the process view.

## 7.2 Configuration of check result

### Goal

You want to adapt the messages displayed in the result window to the inspection.

### Result

You will be able to configure messages of check results.

### Solution

1



Switch back to manual mode. Select the check *Gauge distances and widths* in the **Check Routine Explorer**. Right-click the check and select **Properties** from the context menu. Click the depicted icon in front of the entry **Automatic mode** in the tree view to expand the sub-entries, and select **Result View**.



The messages configured on this page are displayed in the **Result View** window of the Process view which is linked to this check. Modify the text in the input field **Status message** in the group field **Result OK** to "Distances + Widths OK". This text will always be displayed in the **Result output** window if the inspection result is *O.K.*



Modify the text in the input field **Status message** in the group field **Result not OK** to "Failure". This text will always be displayed in the **Result output** window if a failure occurred during check execution.

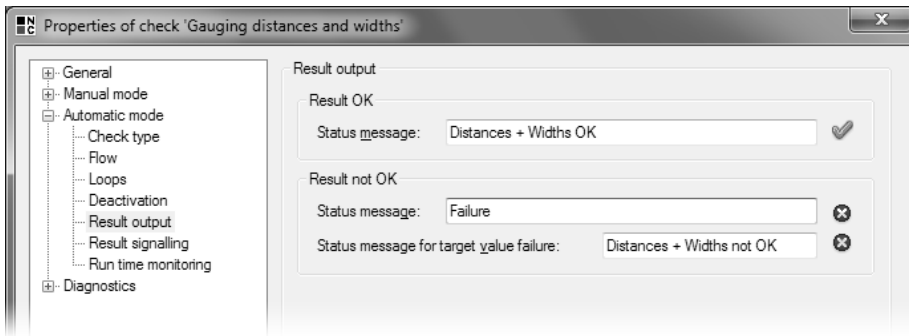


Modify the text in the input field **Status message** in the group field **Result not OK** to "Distances + Widths not OK". This text will always be displayed in the **Result output** window, if the value determined by the check deviates from the configured target value.

2



Switch to automatic mode and execute the check routine several times. In the **Result output** window of the process view the modified messages will be displayed depending on the check result.



- 1 Use the check's properties to determine the messages to be displayed in automatic mode.



- 2 In automatic mode the text you have entered will be displayed in the result view linked to the check. The message displayed will change depending on the check result.

## 7.3 Creation of a control panel menu

### Goal

You want to select the functions to be available as menu entries in automatic mode, and you want to adapt the names displayed for the functions.


### Result


You will be able to create your own Control Panel Menu (abbreviated to menu), link function keys to functions, and to configure NeuroCheck in such a way that it will use the menu created by you.

### Solution



- 1 Switch back to manual mode. From the **Tools** menu select **Automatic Mode User Interface ► Control Panel Menu Editor**. The **Control Panel Menu Editor** dialog is used for creating and modifying Control Panel Menus.

The Control Panel Menu determines the menu functions available in NeuroCheck in automatic mode irrespective of the selected check routine. Therefore, it is irrelevant for the creation of a Control Panel Menu what check routine is currently loaded. For the same reason the Control Panel Menu remains the same even if the check routine is changed.

-  In the **Menu Structure Outline** select **F2 –**. In the input table **Menu item properties** click the right column of the **Function** row.

-  Click the depicted icon to determine the function linked to the **F2** key. Select the function **Automatic Start** so you will be able to activate automatic mode.

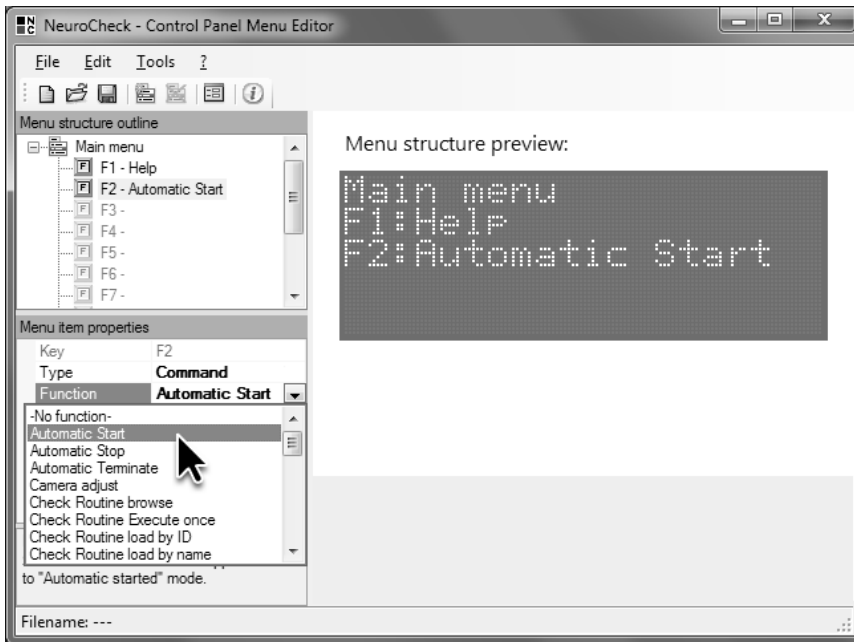
- 2 In the same way, link the **F3** key to the function **Automatic Stop** to be able to deactivate automatic mode, and the **F4** key to **Manual Mode** to be able to switch back to manual mode from automatic mode.

-   Please make sure that any menu you create contains the functions **Manual Mode** and **Automatic Stop** since otherwise it won't be possible to enter an inactive automatic mode state or to switch into manual mode.

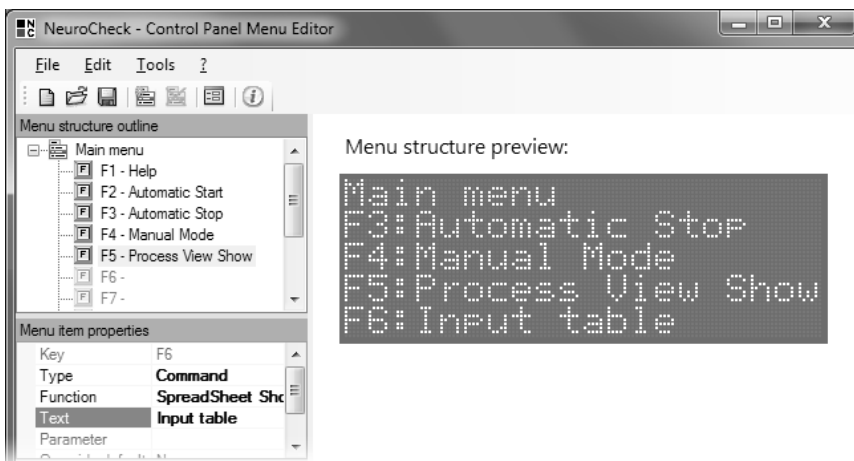
-  Link the **F5** key to the function **Process View Show** to be able to open the process view again if it has been closed.

-  Click the right column of the row **Text** and enter "Process View Show".







- 1 In the **Control Panel Menu Editor** link the **F2** key to the function **Automatic Start**.



- 2 Link the **F3**, **F4** and **F5** key to the functions **Automatic Stop**, **Manual Mode** and **Process View Show** respectively.

 Link the  key to the function **Spreadsheet Show** to open the dialog for setting parameters and target values, which you will hear more about in another chapter.



Click the right column of the row **Text** and enter "Input table".



Select **Save as...** from the **File** menu. The **Save Menu** dialog displays the sub-directory `\Configuration\Control Panel Menus\` of the project directory. Use this sub-directory to save the menu as "Training Course".



Click on the depicted button to close the **Control Panel Editor**.



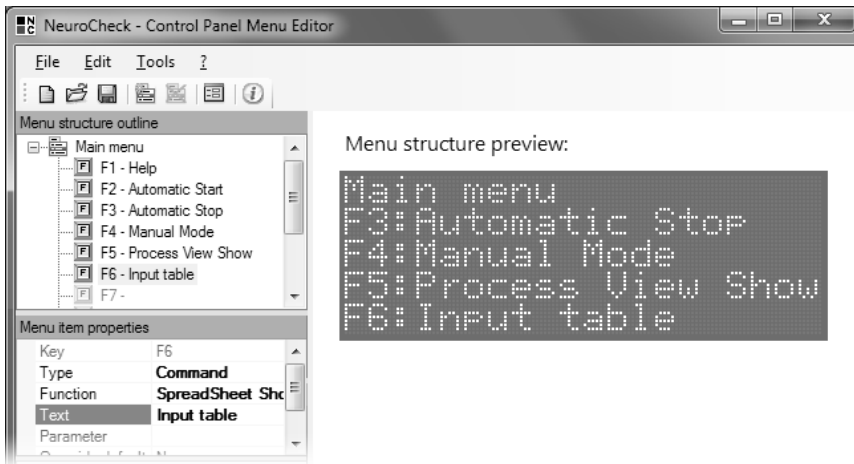
From the **System** menu select **Software Settings** to configure NeuroCheck to use the newly created menu in automatic mode.



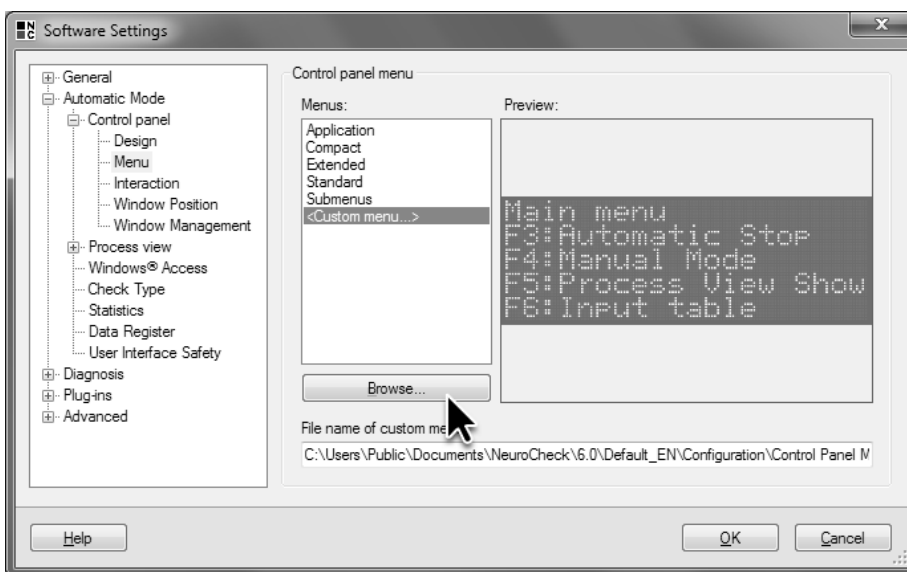
The **Software Settings** dialog is the central dialog for the configuration of all settings referring to the software as a whole. Since the Control Panel Menu is independent of the check routine, its selection is part of the NeuroCheck configuration. Click the depicted icon in front of **Automatic Mode** to expand the sub-entries. Then click the same icon in front of **Control Panel** to expand its sub-entries. Select **Menu**. On this page you can select the menu being used by NeuroCheck in automatic mode.

Select **<Custom menu...>** to choose a custom-defined menu. Click the **Browse...** button and select the menu `Training Course.mnux`. Close the **Open** dialog by clicking the **Open** button.





Click the **OK** button to close the **Software Settings** dialog.



- 3 Link the **F6** key to the function **Spreadsheet Show** and change the text to "Input table".



- 4 In the **Software Settings** dialog go to **Automatic mode** ► **Control Panel** ► **Menu** and select the created menu.

-  **5** Switch to automatic mode. The LCD display of the **Control Panel** displays the functions and messages of the menu you created. The commands linked to the keys  and  are displayed in the LCD display of the **Control Panel** after you have moved the selection down by pressing the  key repeatedly.

### 7.3. Creation of a control panel menu



- 5 In automatic mode, the newly created menu is used.

## 7.4 Selection of a control panel

### Goal

You want to use a Control Panel with a different appearance.

### Result

You will be able to select the Control Panel being used in automatic mode.

### Solution

- 1 Switch back to manual mode. Select **Software Settings** from the **System** menu to open the **Software Settings** dialog. Both the item **Automatic mode** and the item **Control Panel** are expanded since the last settings were made on the **Menu** page. Select **Design** directly above to select the Control Panel used by NeuroCheck in automatic mode.

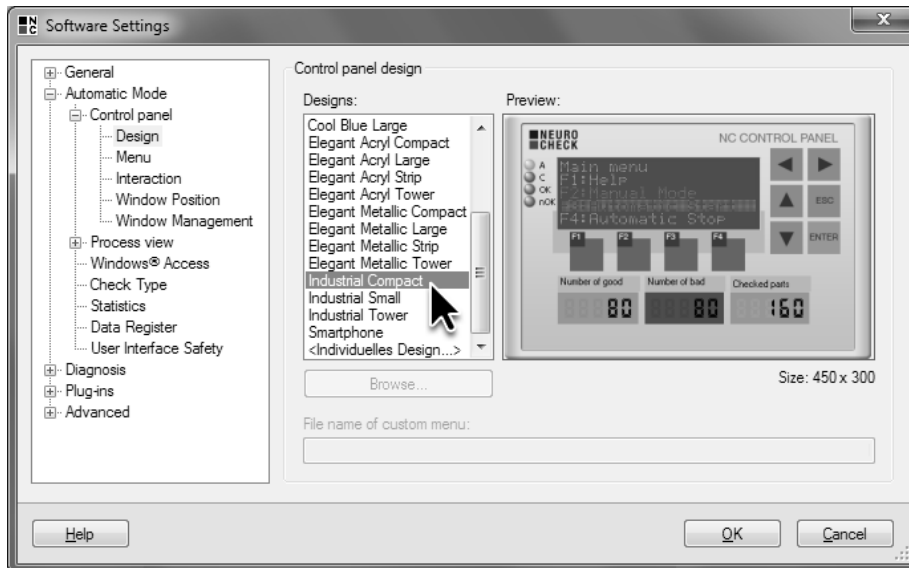
Like the Control Panel Menu, the Control Panel is part of the NeuroCheck configuration. The selection of the Control Panel takes place in the **Software Settings** dialog and is independent of the current check routine. After an inspection type change both the Control Panel and Control Panel Menu remain unchanged.

Select **Industrial Compact**. The **Preview** window shows the newly selected Control Panel. Click the **OK** button to close the **Software Settings** dialog.

- 2 Switch to automatic mode. The new Control Panel is displayed. The LCD display continues to show the functions and messages of the menu you created since the design and the menu of the Control Panel are independent of each other.

Apart from the numerous pre-defined Control Panels, you can use the **Control Panel Designer** to create your own Control Panels. Operation and functionality of the **Control Panel Designer** correspond largely to the operation of the **Process View Designer**.

## 7.4. Selection of a control panel



- 1 In the **Software Settings** dialog, go to the page **Automatic mode** ► **Control Panel** ► **Design** and select the Control Panel **Industrial Compact**.



- 2 In automatic mode, the selected Control Panel is used. When changing the Control Panel the menu remains unchanged.





## 8. Position Adjustment

To present work pieces in exactly the same way in front of the camera is rarely attainable. ROIs have to be positioned very precisely, especially for gauging tasks. To compensate for the variation in object positions in front of the camera and to position the ROI in the right spot, NeuroCheck offers a function for position adjustment.

In this chapter you'll learn how to

- compensate the offset of objects
- import and expand checks from other check routines
- modify the input data connections of check functions
- compensate the rotation of objects



## 8.1 Compensation of offsets

### Goal

You want to perform the gauging from chapter 6.1 (*Gauging distances between two objects*) for cover plates that are located in various positions in front of the camera.

### Result

You will be able to configure automatic position adjustment and to modify input data assignment.

### Solution

Position adjustment in NeuroCheck requires three steps: The first step determines the current position of the object. The determination of the position is relative to the position of the object in the reference image. In the second step, the required ROIs, e.g., for a gauging task, are manually defined. These ROIs are arranged to match their position to the reference image. In the third step, the manually defined ROIs are adjusted according to the position determined in the first step thus putting them in the right position in the current image. Afterwards the usual evaluation can take place such as gauging.

1



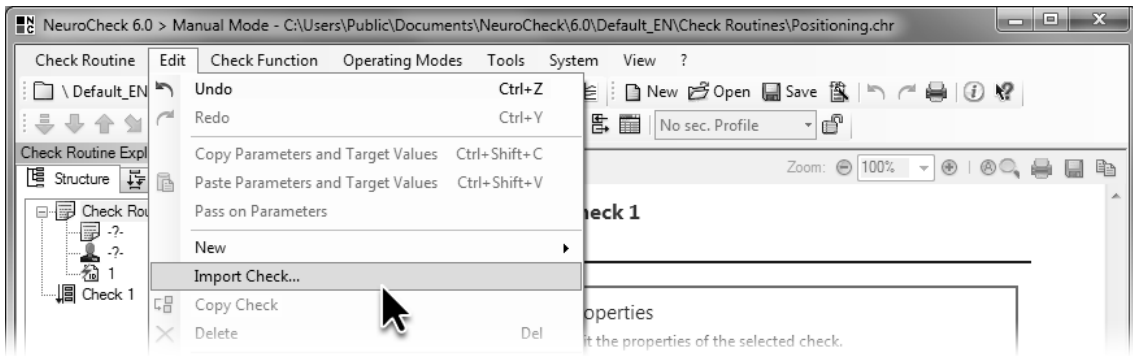
Create a new check routine with the description "Positioning" and the comment "Gauging cover plate with position adjustment". Import the check created in chapter 6.1 (*Gauging distances between objects*). In the **Edit** menu select **Import Check...** In the **Load Check Routine File** dialog, select the check routine *Gauging.chr* and click the **OK** button to close the dialog.

2

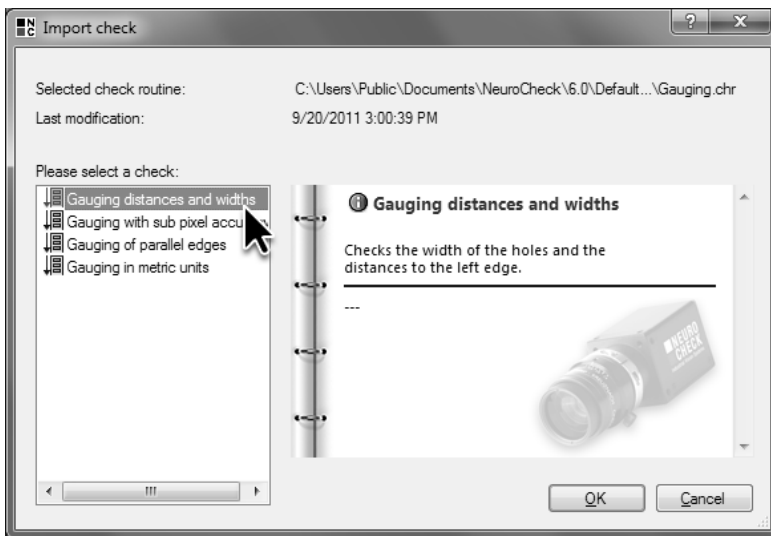


In the **Import check** dialog, select from the **Please select a check** list the check *Gauging distances and widths*. In the right side view you can see the check's properties. Close the dialog by clicking **OK**.





The imported check can only work if the object is optimally positioned. For differing object positions as in image *Cover\_Plate\_03\_OK\_Moved.bmp* the inspection fails since the ROIS are no longer on the left edge and above the holes in the cover plate.



1 In the **Edit** menu select **Import check**.



2 In the **Import check** dialog select the check you would like to import.


-  **3** The imported check is displayed in the check routine explorer. Change the name of the check to "*Gauging distances and widths with positioning*". Remove the empty check **Check 1** that was automatically created with the check routine.
-   
  
 **4** To simplify navigation in the imported check, add comment check functions. The comment check function has no evaluation functionality and serves only to structure and comment a check. Select the check function **Define ROIs** and open the **Check function selection** dialog. From the **Tools** category, select the check function **Comment** and click the depicted button twice to add two comment check functions.
- 5** Select the check function **Determine Threshold** and add two more **Comment** check functions. Change the names of the four comment check functions. From top to bottom enter the following names and comments: "1st step: Determine the current position", "2nd step: Define the ROIs for gauging", "3rd step: Move defined ROIs", and "Further processing: Gauging".

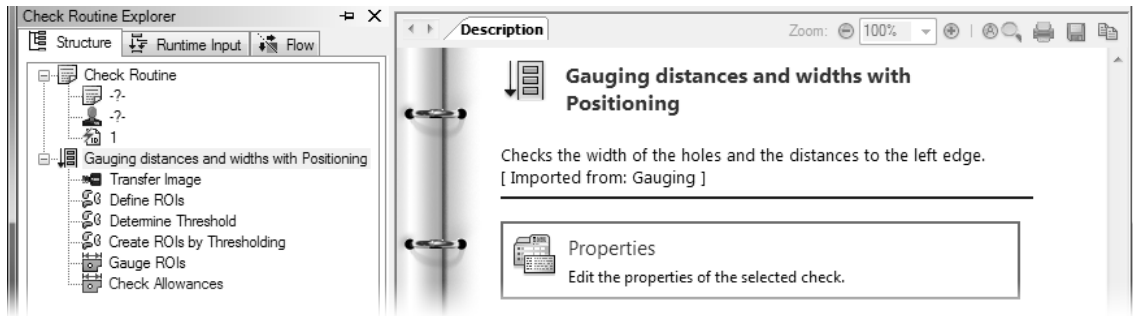
Below the comment *2nd step: ...* you'll find the check function **Define ROIs**. By importing the checks, you have already taken care of the second step of the position adjustment. The further evaluation is already completely configured so you only have to add the first and third step.



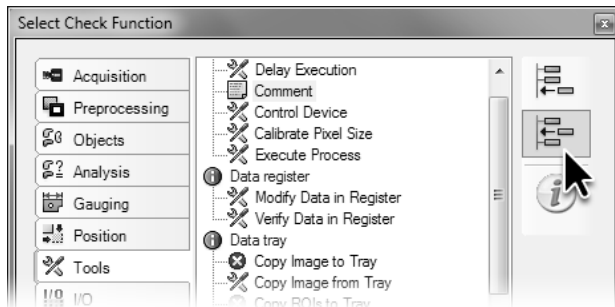
The following explanations require that the comment check functions are in the right place. Therefore, compare the depicted check function sequence to the one you created.

In the first step, the position of the cover plate is determined. For this the entire cover plate is searched for and created by thresholding. This first step in position adjustment usually consists of several check functions, in this case it consists of all check functions necessary for the creation of ROIs by thresholding.

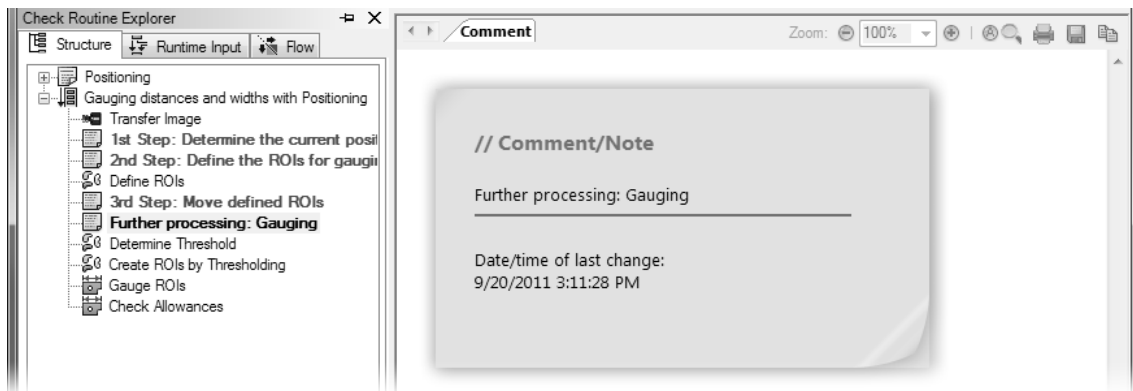
-  Since the determination of the position and the manual definition of ROIs must be referring to the same image, open the parameter dialog of the check function **Transfer Image** and select the image `Cover_Plate_01_OK.bmp`. In chapter 6.1 (*Gauging distances between objects*) the ROIs for this image were defined.










3 Delete the automatically created empty check and change the name of the imported check.

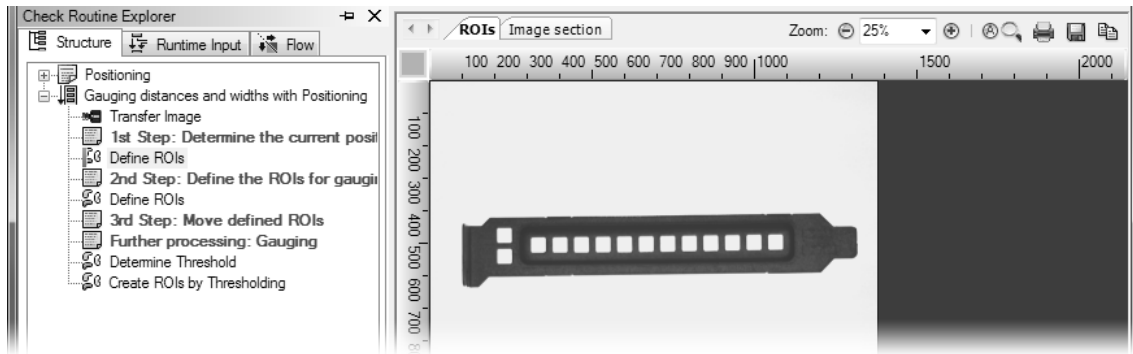


4 Insert two check functions **Comment** before the check function **Define ROIs** and two after.

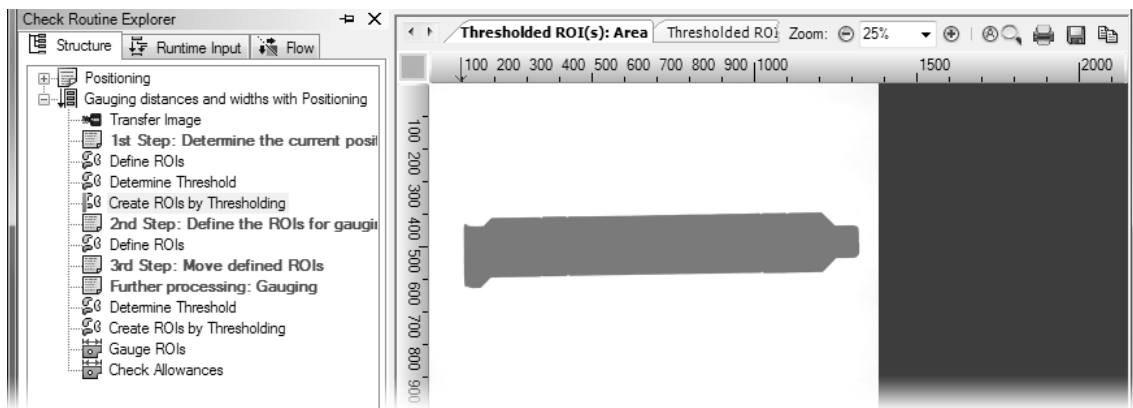


5 The comment check functions structure the check in the steps of position adjustment.

- 6** Select comment check function *2nd step: ...* and insert a new check function **Define ROIs** by selecting this check function type from the **Check function selection** dialog and clicking the depicted icon.
-   
  

- Open the parameter dialog of the newly inserted check function **Define ROIs**, create a rectangle, right-click into the rectangle and select **Full image** from the context menu. The ROI now comprises the entire image. The cover plate is thus found at any position in the image. Click the **OK** button to close the parameter dialog.
- 7** Again, select comment check function *2nd step: ...*, from the **Check function selection** dialog, select the check function **Determine Threshold** and add the check function by clicking the depicted button.
-   

- You can leave the parameters of the newly inserted check function unchanged since the created threshold separates the cover plate and background sufficiently well.
-   

- Again, select comment check function *2nd step: ...* and insert before it the check function **Create ROIs by Thresholding** by clicking the depicted button in the **Check function selection** dialog. You can leave the parameters of this check function unchanged as well since the cover plate is a black object on a white background.



- 6 Insert a new check function **Define ROIs** in front of the comment check function  
*2nd step: ....*



- 7 Insert a new check function **Determine Threshold** and a new check function **Create ROIs by Thresholding** before the comment check function *2nd step: ....*

- 8 Again, select comment check function *2nd step: ...* and open the **Check function selection** dialog. From the **Position** group, select the check function **Determine Position of ROIs** and add it to the check by clicking the depicted icon.



The check function **Determine Position of ROIs** determines the position of ROIs in the image with regard to a reference position. Instead of parameterizing - which you know from other check functions - this check function requires teaching the reference position.

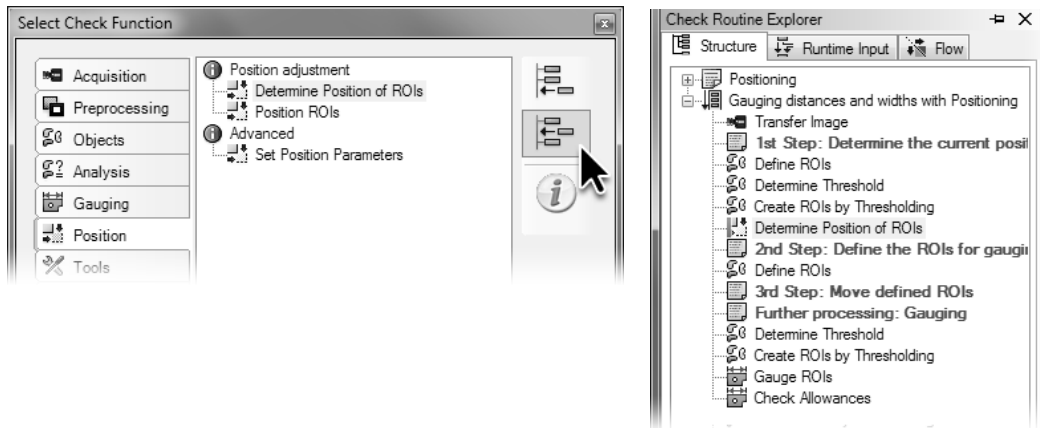
- 123 Open the parameter dialog of the check function **Determine Position of ROIs** and click the **Teach...** button to open the **Positioning wizard**.

- 9 On the first page of the **Positioning wizard** select the position modification you want to correct. Since the cover plate is moved in the direction of X and Y in some images but not rotated, we only have to compensate offsets in the direction of X and Y. Therefore, activate the check boxes **X offset** and **Y offset**.

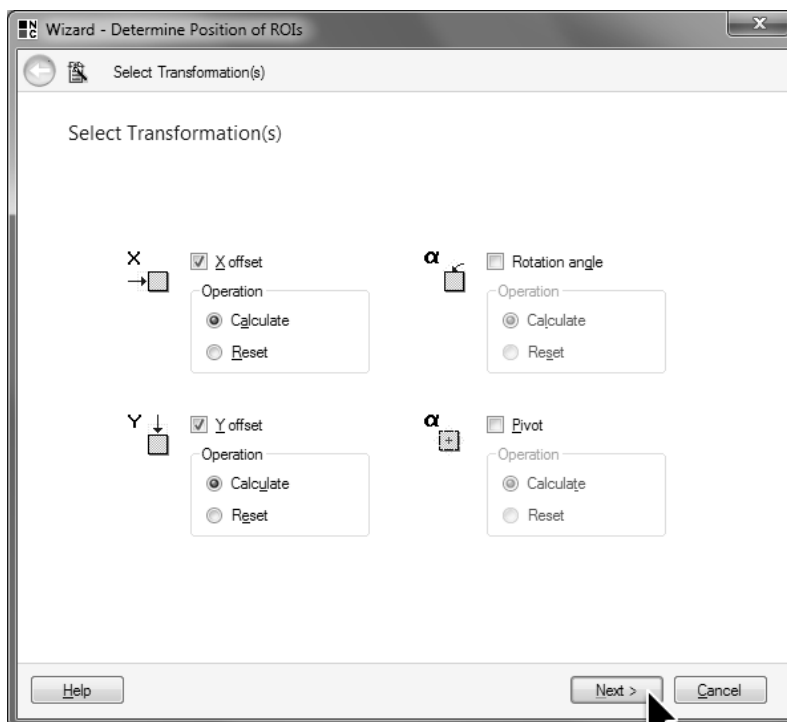
Click the **Next** button to switch to the next page of the **Wizard - Determine Position of ROIs**.



## 8.1. Compensation of offsets



- 8 Insert a new check function **Determine Position of ROIs** before the comment check function *2nd step: ....*



- 9 Enable the check boxes X offset and Y offset to compensate position offsets.

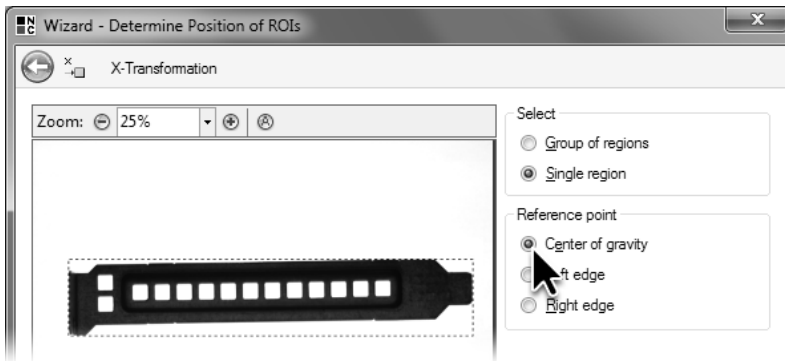
- 10 On the **X Offset** page of the **Wizard - Determine Position of ROIs** you can select how to determine the position in X direction. Since the cover plate was created as a whole and its shape does not change, we recommend selecting from the **Reference point** group the **Center of gravity** option.

Click the **Next** button to switch to the third page of the **Wizard - Determine Position of ROIs**.

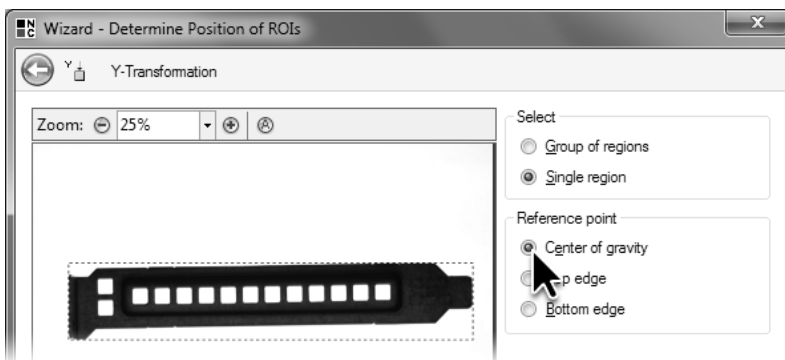
- 11 On the **Y Offset** page of the **Wizard - Determine Position of ROIs** you can select how to determine the position in Y direction. Select here **Center of gravity**, too.

Click the **Finish** button to determine the coordinates of the reference position and to return to the parameter dialog.

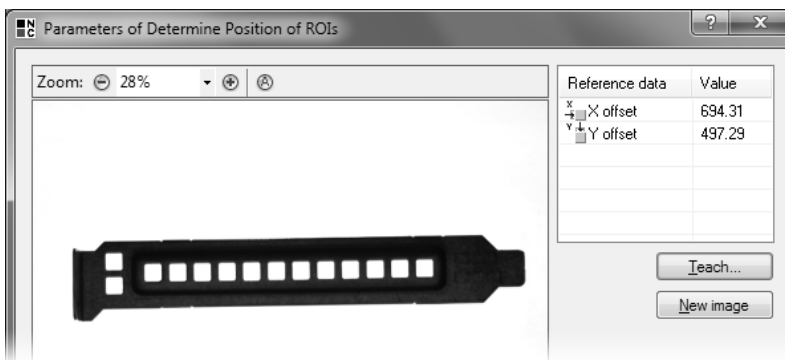
- 12 In the parameter dialog of the check function **Determine Position of ROIs** the coordinates determined for the current input data are displayed in the table. Exit the parameter dialog by clicking the **OK** button to confirm these coordinates as reference position for the offset compensation.



- 10 Select **Center of gravity** as reference point for determining the offset in the X direction.



- 11 Select **Center of gravity** as reference point for determining the offset in the Y direction.



- 12 The parameter dialog displays the reference values for the offset compensation.

**13**



Execute the check function **Determine Position of ROIs**. The **Positioning data** tab of the result view displays the difference between the position of the current ROIs and the reference position. Since the reference position has been taught using the current ROIs, the difference both in the direction of X and Y is zero.

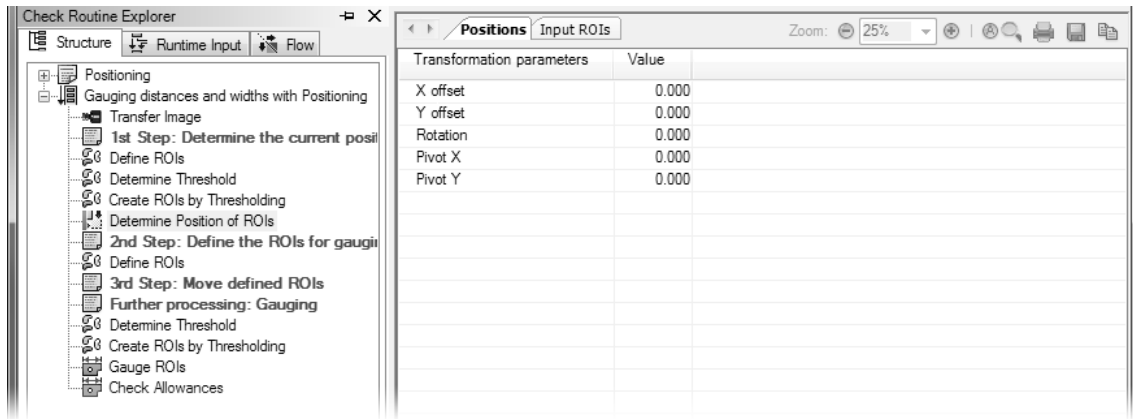
Thus the first step of position compensation - determining the position of the current object in the image - is completed. You have already imported the second step - defining ROIs for further evaluation - completely configured.

**14**

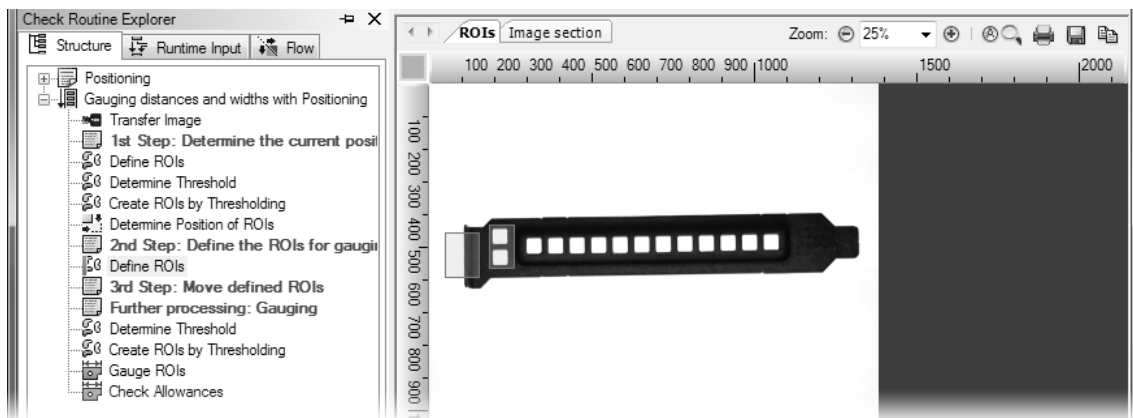


Execute the imported check function **Define ROIs** to verify that the ROIs were defined correctly with respect to the reference image.



## 8.1. Compensation of offsets

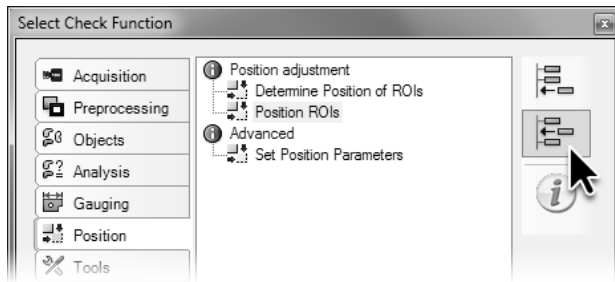


13 For the image we used to teach the reference values, the offset for the reference values is zero.

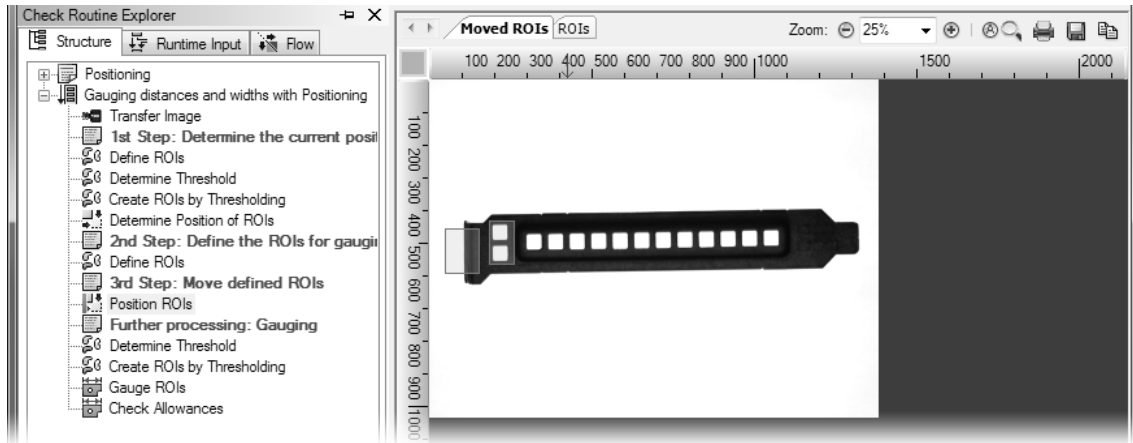


14 The defined ROIs have to be in the correct position in the reference image.


- 15** The third step of position adjustment is changing the position of the defined ROIs. This will be done by the check function **Position ROIs**.
-  Select comment check function *Further evaluation: ...* and in the **Check function selection** dialog from the **Position** group, select the check function **Position ROIs**. Click the depicted button to insert the check function between the comment check functions *3rd step: ...* and *Further evaluation: ....*
- 16** Execute the check function **Position ROIs**. There will be no change in the **Moved ROIs** tab of the result view since no position adjustment is necessary for the reference image.
-  Open the parameter dialog of the check function **Transfer Image** and select the image *Cover\_Plate\_03\_OK\_Moved.bmp*. In this image the cover plate is in a different position so you can observe the effects of the position adjustment. Close the parameter dialog by clicking the **OK** button.






- 15 Insert the check function **Position ROIs** to adjust the position of the ROIs.



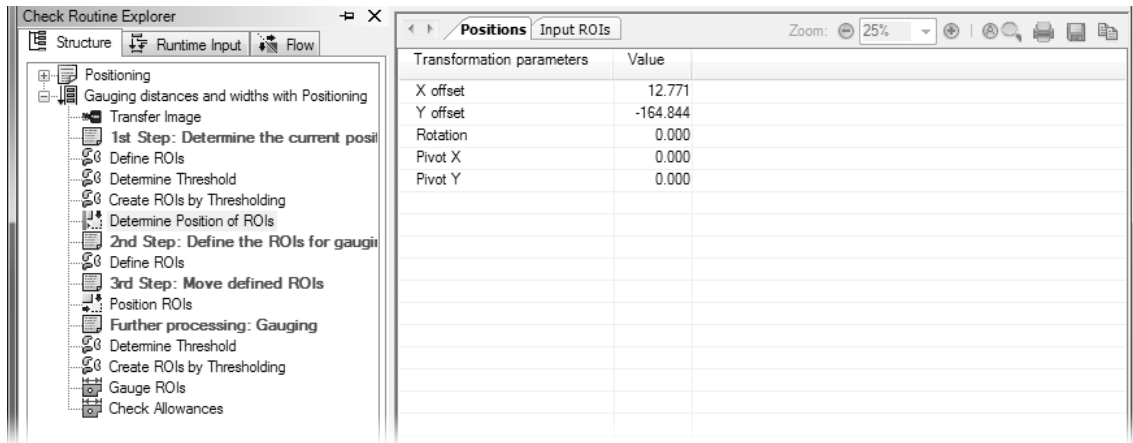
- 16 During teaching, the check function **Position ROIs** does not change the position of the ROIs.

-  17 Execute the check function **Determine Position of ROIs**. In the **Positions** tab of the result view, the differences between the reference position and the position in the current image are displayed.

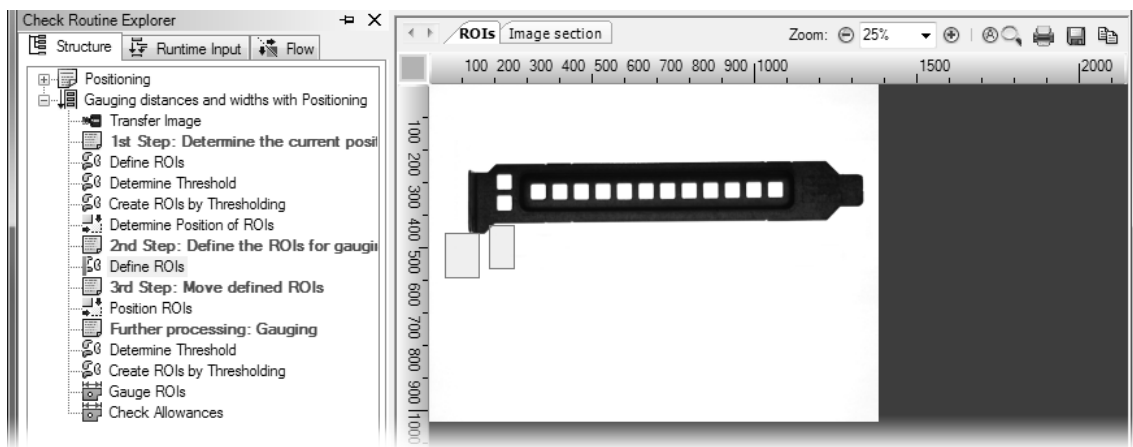

-  18 Execute the check function **Define ROIs**. As you can see in the result view, the defined ROIs are not in the correct position for the current image.







- 17 The check function **Determine Position of ROIs** measures the offset of the cover plate's position in the image.



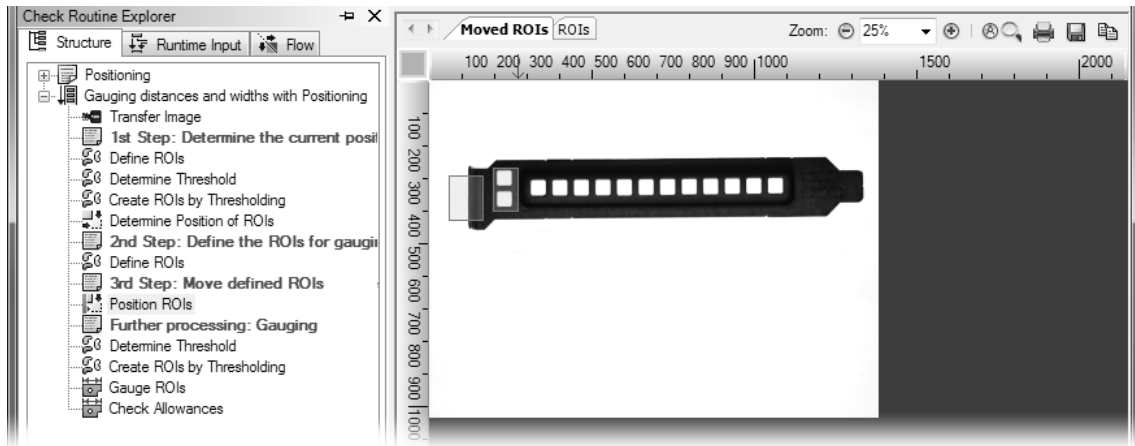
- 18 The position of the defined ROIs must be adjusted.



Execute the check function **Position ROIs**. This check function moves the defined ROIs by the difference computed in the check function **Determine Position of ROIs** so the ROIs end up in the correct position for the current image as displayed in the result view on the **Moved ROIs** tab.


Images, ROIs, histograms and measurement lists are exchanged in NeuroCheck using data objects. When inserting or adding a check function, it is automatically determined what data object the check function uses. This setting remains unchanged when adding further check functions.

The two check functions following the check function **Position ROIs** and the comment check function *Further evaluation: ...*, the check functions **Determine Threshold** and **Determine ROIs by Thresholding** therefore continue to use the non-adjusted ROIs. For these check functions to use the adjusted ROIS, the data objects used must be changed in the **Runtime Input Data** assignment of the check functions.




19 The position of the defined ROIs must be adjusted.

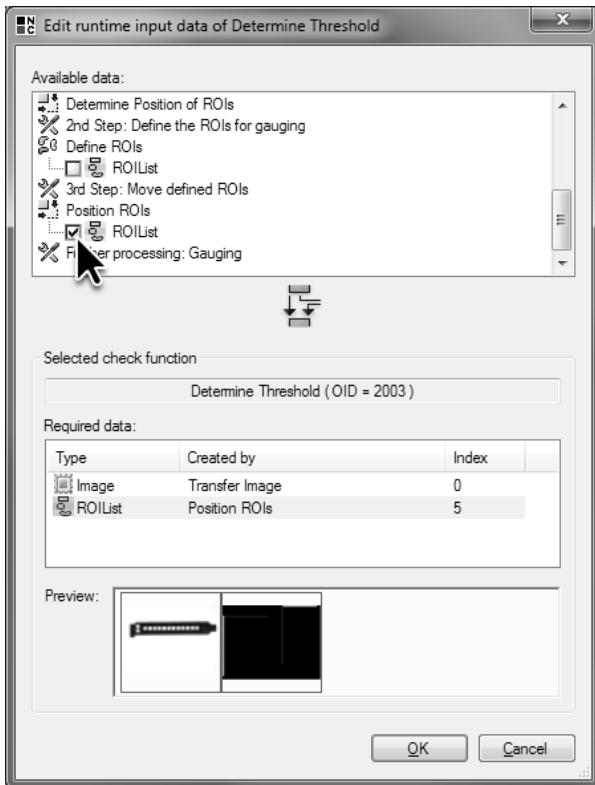
 20 Right-click the check function **Determine Threshold**. Select **Runtime Input Data** from the context menu.

 In the **Edit runtime input data** dialog from the **Required data** list select **ROI List**. In the tree view **Available data**, the check box in front of the sub-item **ROI List** of the check function **Define ROIs**, which is located below the comment *2nd step: ...*, is enabled. This means that for computing the histogram and the threshold the list of ROIs from this check function is used which contains the uncorrected ROIs.



In the tree view **Available data** enable the check box in front of the sub-item **ROI List** of the check function **Position ROIs**. Now for computing the histogram and the threshold, the check function **Determine Threshold** does not use the ROIs manually defined in the check function **Define ROIs** as input data objects but the ROIs determined by the check function **Position ROIs** with the adjusted positions.

Exit the dialog by clicking **OK**.

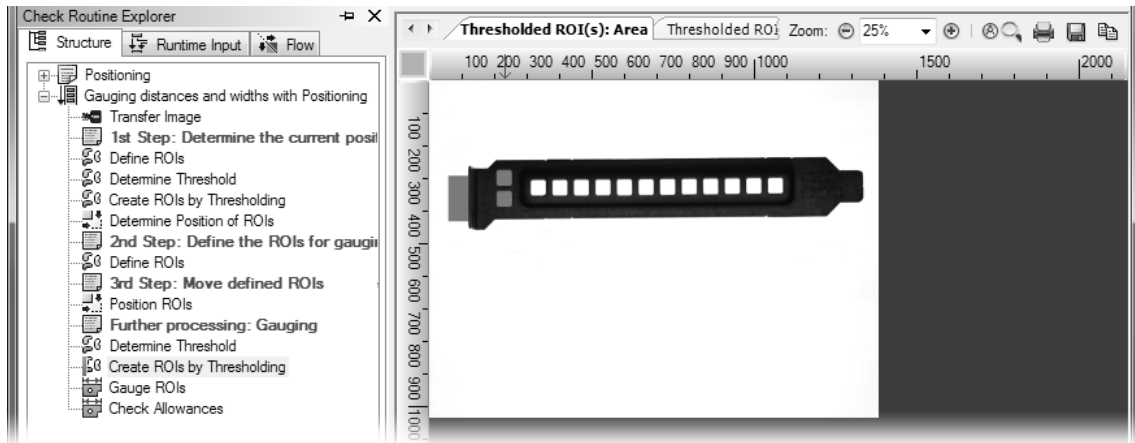
 Change the **Runtime input data** of the check function **Determine ROIs by Thresholding** in the same way so this check function also uses the adjusted ROIs as input data objects.



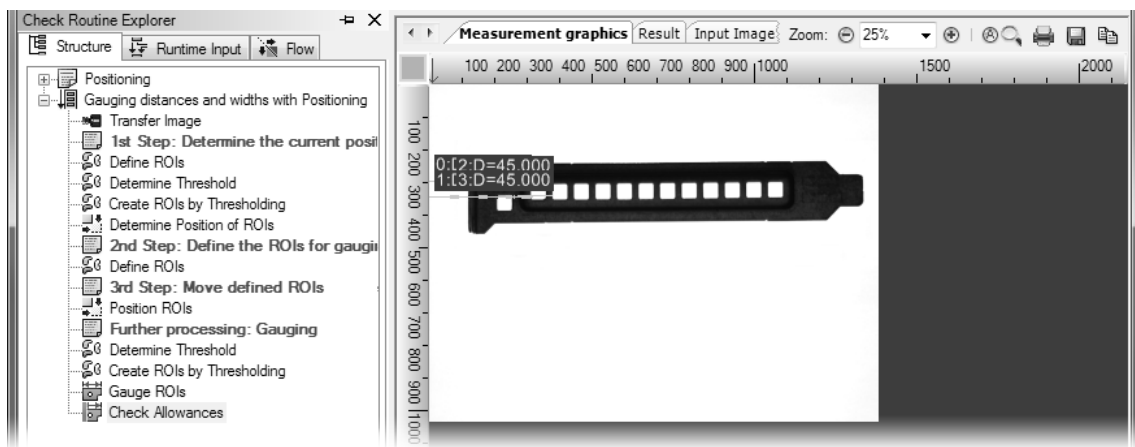
- 20 The input data assignment of the two imported check functions **Determine Threshold** and **Determine ROIs by Thresholding** must be changed so the ROIs are used whose position were changed.

-  **21** Execute the check function **Create ROIs by Thresholding**. The auxiliary object on the left edge of the cover plate and the two holes are found and created.
-  **22** Further evaluation can take place without changing the configuration since the following check functions use the ROIs determined by thresholding and are therefore independent of the position adjustment of the manually defined ROIs.

Thus the check has been amended with the position adjustment. Offsets of the X and Y position of the cover plate can be compensated and the gauging carried out.



- 21 After position adjustment both the background and the holes are found even if the cover plate position has changed.



- 22 After position adjustment, the width and the distance between the holes can be measured.

## 8.2 Compensation of rotation

### Goal

You want to gauge cover plates that are rotated with respect to the horizontal.

### Result

You will know how to configure the rotation compensation and to trace the angle for gauging.

### Solution



Duplicate the check from the previous section and change the name to "Gauge distances and width with rotation compensation". To compensate rotation, the orientation must also be determined during position determination. For this the position data including the data necessary for rotation compensation are taught again. Open the **Transfer Image** parameter dialog and select the image `Cover_Plate_01_OK.bmp`, which is the reference image for the position adjustment and the determination of the ROIs.



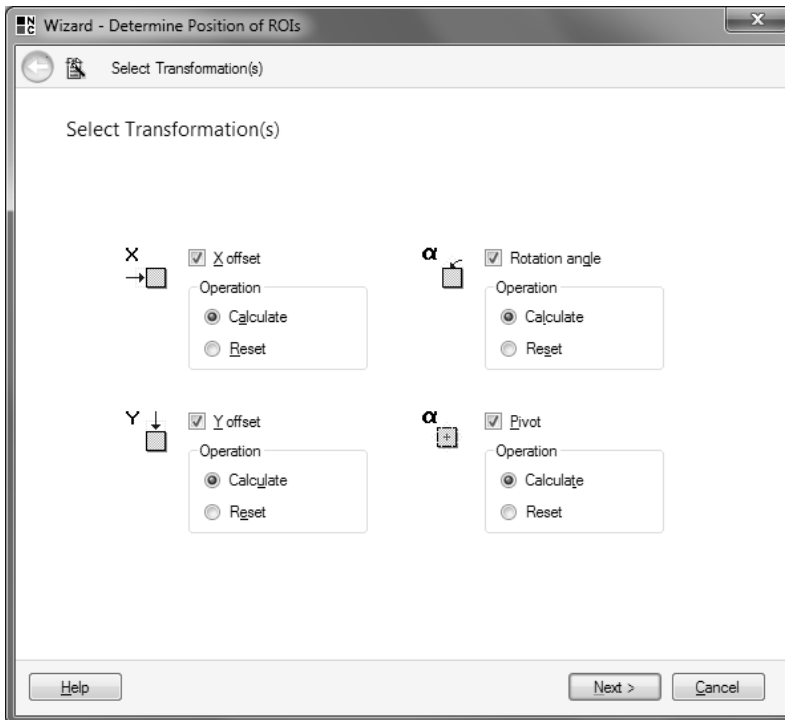
Open the parameter dialog of the check function **Determine Position of ROIs** and click the **Teach** button to open the Positioning wizard.



On the first page of the **Wizard - Determine Position of ROIs** enable all four check boxes: **X offset**, **Y offset**, **Rotation angle** and **Pivot**.

Click the **Next** button several times to reach the **Rotation** page.



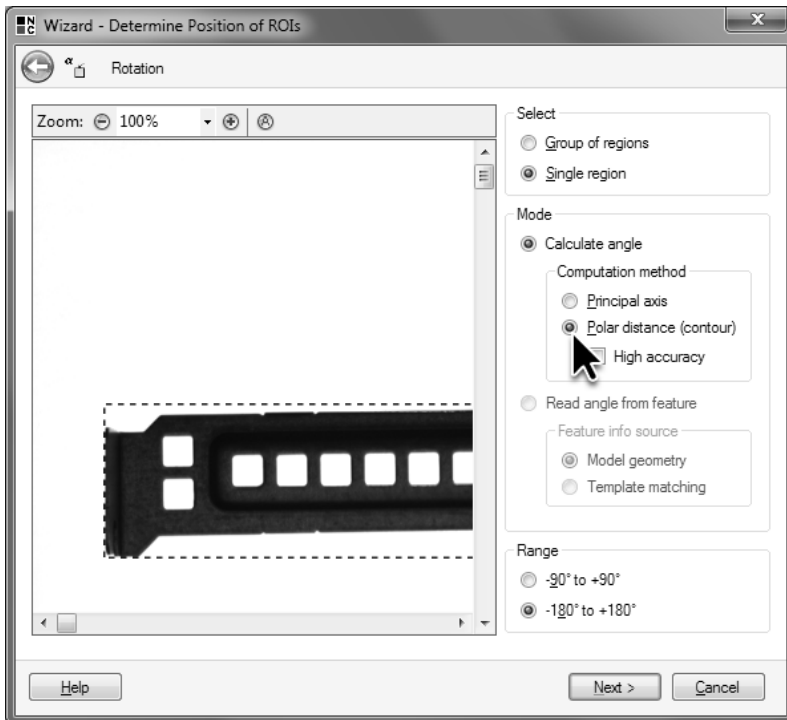


- 1 To compensate the object's rotation, the **Rotation angle** and the **Pivot** must be determined during teaching.

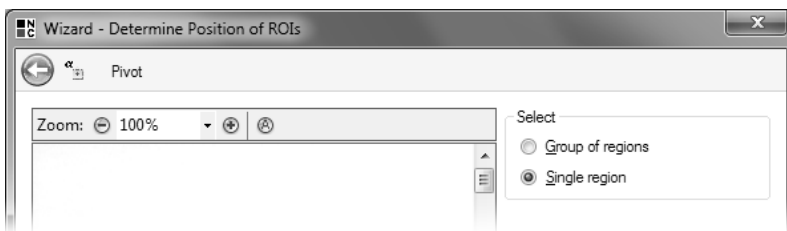
- 2 As calculation method for the angle determination, select **Polar distance (Contour)**. This method uses more computational resources than the **Principal axis** method and yields more precise results.

Click the **Next** button to switch to the **Pivot** page.

- 3 To compensate the rotation, apart from the angle of rotation, the point around which the object is rotated must be determined. This point is the pivot. In this case the center of the cover plate is the pivot. Since the cover plate is an individual object, leave the default settings and close the **Wizard - Determine Position of ROIs** by clicking the **Finish** button.




2 The option **Polar distance (Contour)** offers a more precise determination of the **Rotation angle**.



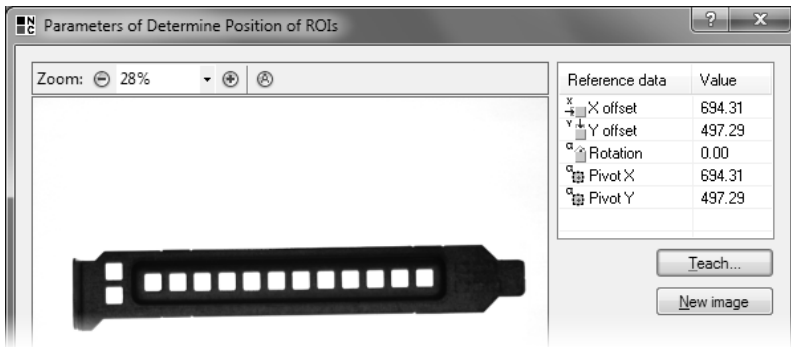
3 Determine the **Pivot** from a single ROI.

4 In the parameter dialog the reference values for the **X Offset** and **Y Offset**, the **Rotation** and the **Pivot X** and **Pivot Y** are displayed. Click the **OK** button to close the parameter dialog.

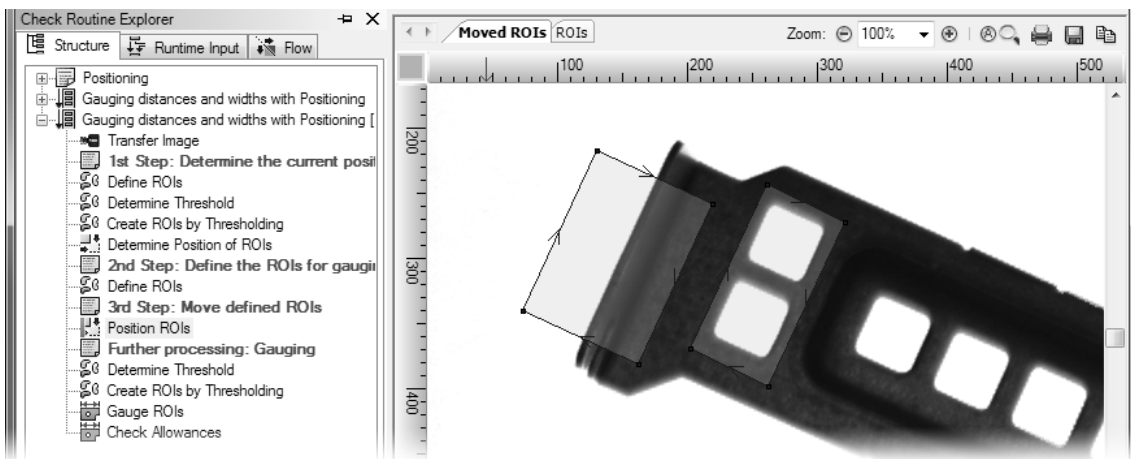
 Open the **Transfer Image** parameter dialog and select the image `Cover_Plate_07_OK_Rotated.bmp`, in which the ROI is rotated.

5 Execute the check function **Position ROIs**. The ROIs are positioned above the holes and the left edge of the cover plate.







4 The parameter dialog displays the reference values for the offsets, the angle and the pivot.



5 The position of the ROIs is also compensated for rotated objects.

- 6**  Execute the check function **Gauge ROIs**. For a rotated cover plate, gauging the **Extension, maximal directed** does not correspond to the width of the holes. To be able to gauge the width for rotated cover plates, the angle direction must also be compensated.
- 7**  For this open the parameter dialog of the check function **Gauge ROIs** and enable **Angle tracing**. By selecting this option the angle for gauging is automatically corrected by the determined angle of rotation.

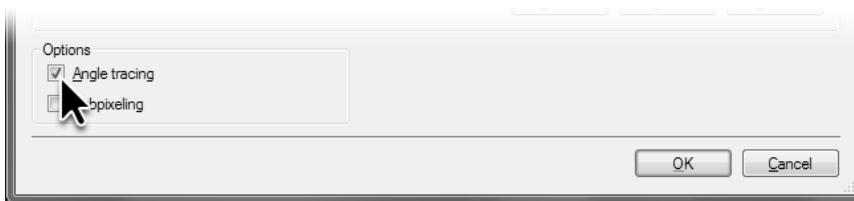
Close the parameter dialog by clicking the **OK** button.

## 8.2. Compensation of rotation

Ident-No.	Measure	Description	Gauging rule
0	87.727	Distance from upper	Distance, minimal contour-contour
1	↑ 88.102	Distance from lower	Distance, minimal contour-contour
2	↓ 51.000	Width of upper hole	Extension, maximal directed
3	51.000	Width of lower hole	Extension, maximal directed

The screenshot shows two windows. The top window, 'Check Routine Explorer', displays a tree view of measurement steps. The bottom window, 'Measurement graphics', shows a zoomed-in view of a part with four measurement lines. The dimensions are: 0:D=87.727, 1:D=88.102, 2:D=51.000, and 3:D=51.000. The part is rotated, and the measurements are taken along the axes of the holes.

6 Gauging the holes' width takes place in the wrong direction.



7 Enable the check box **Angle tracing** to be able to gauge the holes' width even for rotated objects.



Execute the check function. Gauging the **Extension, maximal directed** corresponds to the width of the holes. The compensation of the rotation is completely configured.



## 8.2. Compensation of rotation

Ident-No.	Measure	Description	Gauging rule
0	87.727	Distance from upper	Distance, minimal contour-contour
1	88.102	Distance from lower	Distance, minimal contour-contour
2	46.517	Width of upper hole	Extension, maximal directed
3	46.517	Width of lower hole	Extension, maximal directed

8 With the traced angle, the width of the holes is gauged.



## 9. Data Input and Output

The values measured with NeuroCheck often have to be saved for further evaluation or archiving in files, or transferred to a different computer. Likewise, parameters and target values must also be adjusted to work piece changes during automatic mode, either via manual input by the operator, by modifying a configuration file or by transferring data from one computer to another.

In this chapter you'll learn how to

- save measuring results determined by NeuroCheck to a file
- enter target values manually via keyboard during automatic mode



Data type	Value	Source	Min	Max
Integer	140	Keyboard	0	3600
Integer	500	Keyboard	0	3600
String	34BCFESM	Ethernet	-	-
String	34BCMEPT	Ethernet	-	-
Float	44.000	File	48.00	48.00
Float	125.930	Field bus	120.00	150.00
Float	128.000	Field bus	0.00	255.00
Float	12.000	None	-	-
Float	634.738	None	-	-

## 9.1 Write gauging results to file

### Goal

You want to save the data measured with the check routine `Gauging.chr` and the check routine **Gauge ROIs** to file.

### Result

You will be able to integrate a Data Format Converter, create pins and register cells, and connect check function results to register cells.

### Solution

Open the check routine `Gauging.chr` you created in chapter 6 (*Gauging*). In this section we will write the gauging results of the check *Gauge distances and widths* to a CSV file (CSV: short for Comma Separated Values, a file format for saving simple tables).

Result output takes place in two steps: In the first step, the result is copied to a register cell and buffered there right after it has been determined by a check function. After the check routine has been executed completely, the result from the register cell is sent to a pin and appended to the file in the second step.

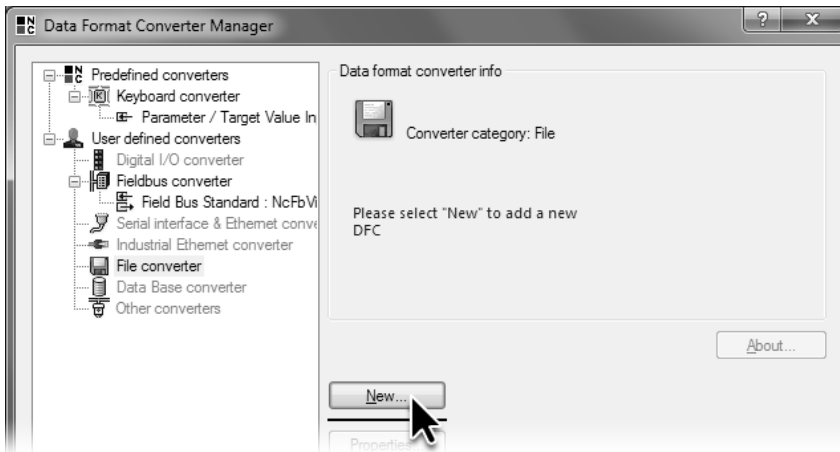
To create this transmission path between check routine and file, we recommend working in the opposite direction of the data transfer since when creating a new register cell, the pin to which the results are transferred should already exist.



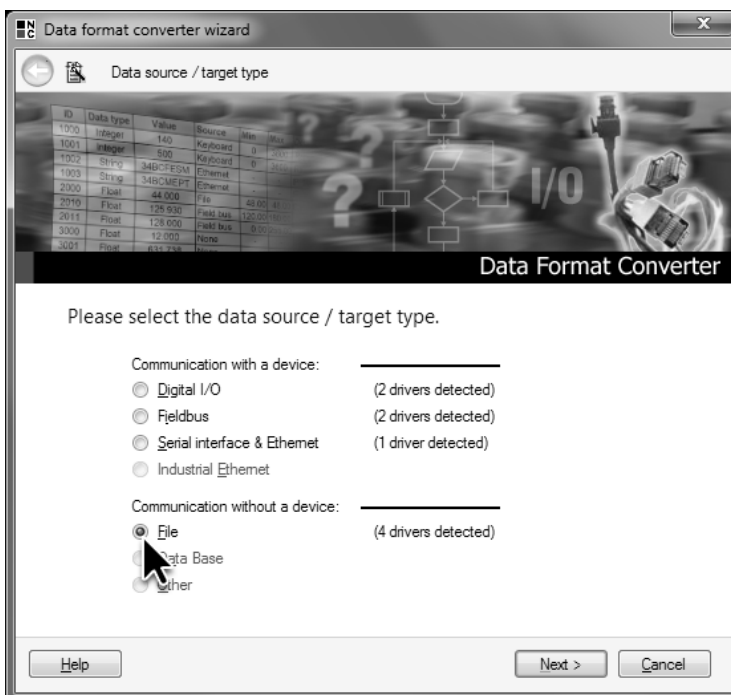
For the input and output of data NeuroCheck offers maximum flexibility to meet a multitude of requirements. Because of this flexibility a rather large number of settings must be configured. This makes the configuration of data output appear rather time-consuming even for simple cases such as this one.

- 1** Pins are provided by the Data Format Converter. Open the **Data Format Converter Manager** in the **System** menu by selecting **Data Format Converter Manager** to integrate a new converter. Click the **New...** button.
- 2** On the first page of the **Data Format Converter Wizard** select **File** since you want to write the gauging results to a file. Click the **Next** button to switch to the next page of the wizard.

## 9.1. Write gauging results to file



- 1 Click **New...** in the **Data Format Converter Manager** to integrate a new converter.



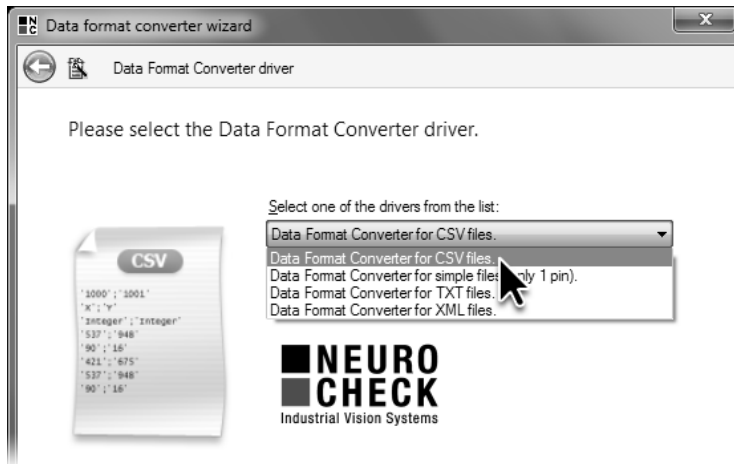
- 2 In the **Data Format Converter Wizard** select **File** to integrate a file converter.

- 3 From the selection box on the second page of the **Data Format Converter Wizard** select the converter driver **Data Format Converter for CSV files**. Converters created by this driver enable data input and output via CSV files. Click the **Next** button to switch to the next page of the wizard.
- 4 On the third page of the **Data Format Converter Wizard** select **Output file**. Click the **Browse...** button to create the output file.

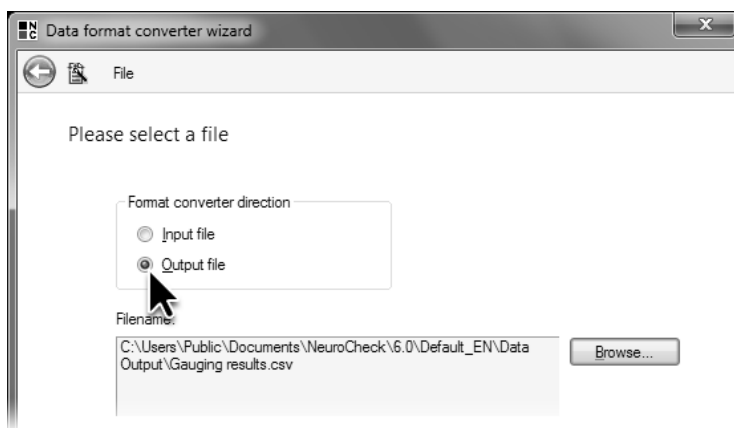
The **Select file** dialog opens in the `Data Output` folder in the project directory. Create a new file "Gauging results" and close the dialog by clicking **Open**.

Create the new converter by clicking **Finish**.




## 9.1. Write gauging results to file



- 3 Select the converter driver **Data Format Converter for CSV files**.



- 4 Select **Output file** because the converter is to be used for data output.

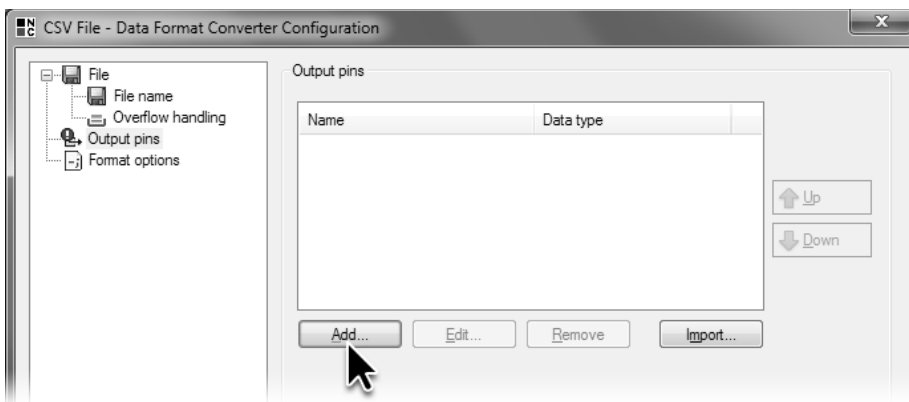
-  **5** The **Data Format Converter Manager** will display a warning that the new converter does not provide any pins. While the converter for communication via fieldbus that you encountered in chapter 5 (*Automated Inspection*) provides pins automatically, the pins for the data output converter have to be defined first. Click the **Properties...** button.
-  **6** In the **CSV File – Data Format Converter Configuration** select **Output pins** from the tree view and click the **Add...** button to create new pins. For converters writing results to files, a pin is the connection between a result and an entry in the file. In the CSV converter this corresponds to the entry of one column in the CSV file.
- 7** You can define the properties of the new pin in the **Pin configuration** dialog. Enter "Upper distance" in the **Name** field. The pin will be listed with this name in the pin selection dialogs.
-  Gauging results are always floating point values, therefore select **Floating point number** as **Data type**. To output results, the data type of the result determined by NeuroCheck must be identical to the data type of the pin used for data output.



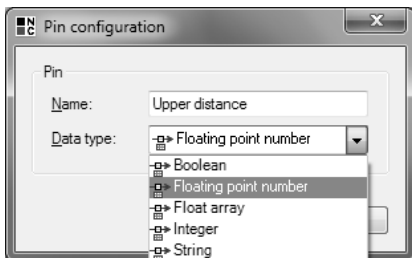
## 9.1. Write gauging results to file



- 5 After integration of the converter, a warning is displayed that no pin has been defined. Click the **Properties** button to define new pins.



- 6 Select the **Output pins** page to edit the list of defined pins.



- 7 Name the pin "Upper distance" and select **Floating point number** as data type.

- 8** Add three more pins "Lower distance", "Upper width" and "Lower width" for the output of further results. From the **Data type** selection box select **Floating point number** for each pin.



Click the **OK** button to close the **CSV File – Data Format Converter Configuration** dialog.

This opens a dialog inquiring whether you want to create the file for the result output right away or when the first result is being written. Click the **Yes** button to create the file at once.

Then close the **Data Format Converter Manager** by clicking **OK**.

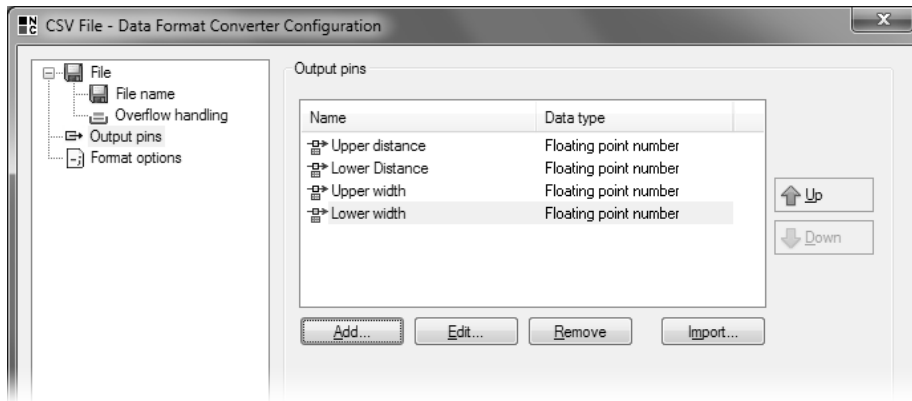
Since the pins exist, you can now create the register cells and connect them to the pins, building up the transmission path between check function and file.

- 9** You can create register cells in the **Data Register Manager**. In the **System** menu select **Data Register Manager**. Switch to the **Output register** page which displays an empty list since no output register cells have been created yet.

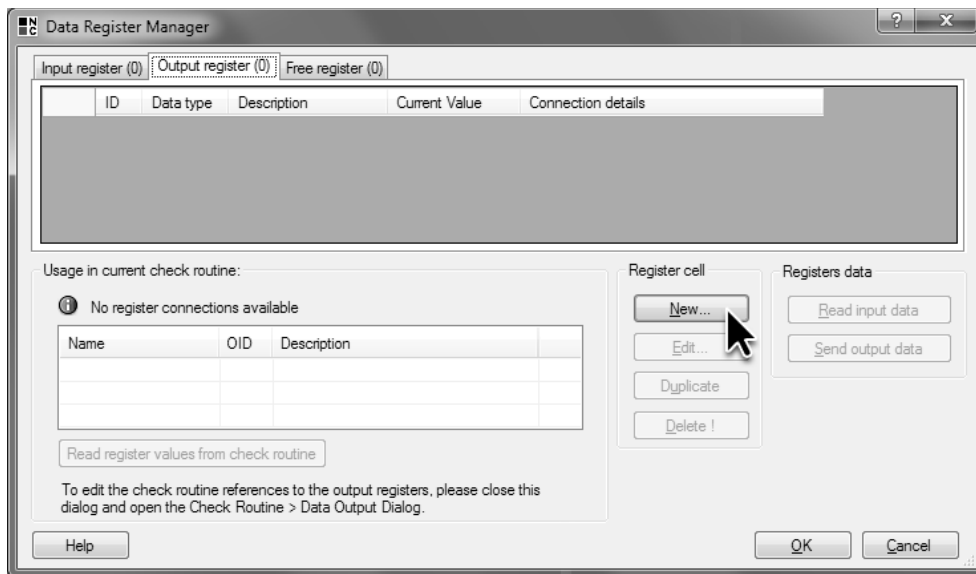


Click the **New...** button to create a new register cell for buffering a result.

## 9.1. Write gauging results to file



- 8 Create three more pins of the data type **Floating point number**.



- 9 In the **Data Register Manager** click the **New...** button to create a new register cell for buffering a result.

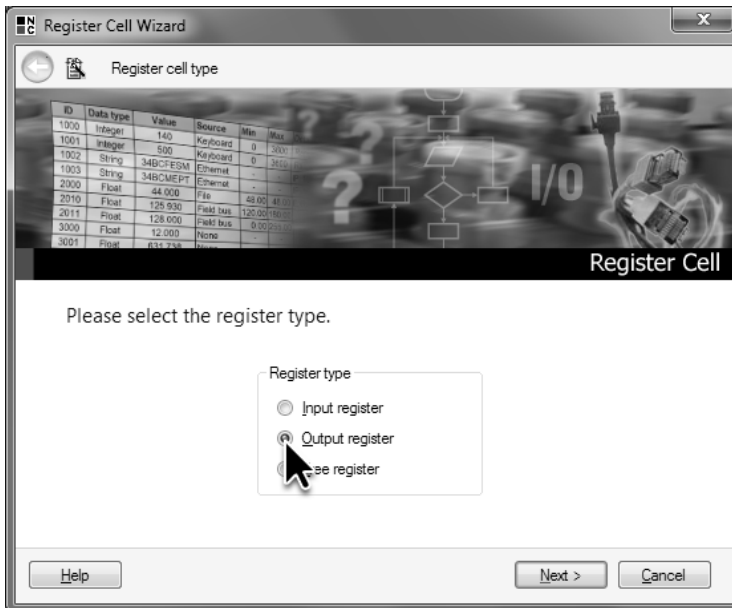
- 10 For the register cell to be usable for buffering results, it must be a cell of the output register. On the first page of the **Register Cell Wizard** select **Output register**. Click the **Next** button to switch to the next page of the wizard.
- 11 From the **Data type** selection box select **Floating point number** since the gauging results are floating point values and the register cells must have the same **Data type** as the results.

By default the field **Register ID** shows the smallest unused number between 2000 and 2999. The **Register ID** is used for identifying the register cell within NeuroCheck. Therefore, the **Register ID** must be unique and, like the **Data type**, it cannot be changed subsequently. Keep the default setting.

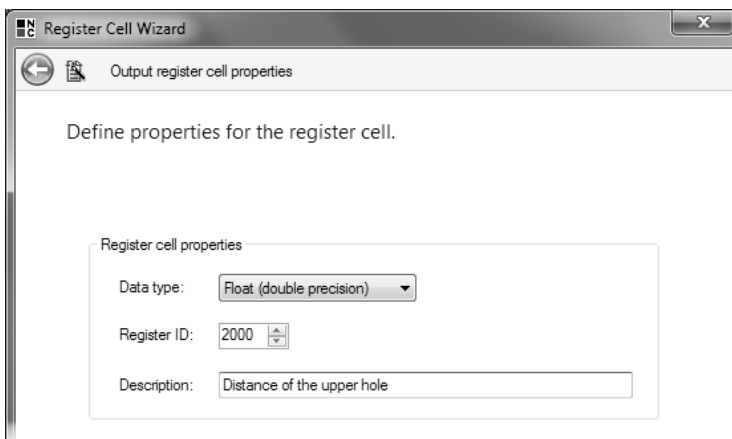
In the **Description** field enter the name with which the register cell will appear in the selection dialogs. Unlike the **Register ID** and the **Data type**, the **Description** can be modified later. As **Description** for this register cell enter "Distance of the upper hole".

Click the **Next** button to switch to the next page of the wizard.

## 9.1. Write gauging results to file



- 10 On the first page of the **Register Cell Wizard** select the **Output register** option for the new register cell.



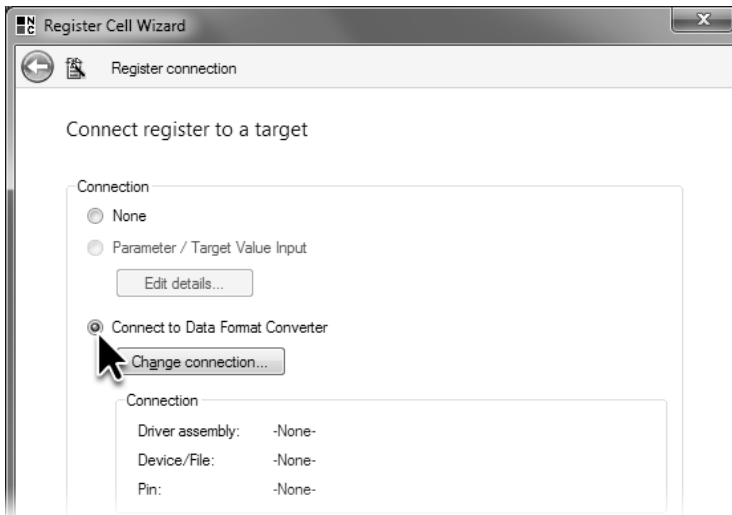
- 11 On the second page of the **Register Cell Wizard** select the data type **Floating point number** and enter a description for the register cell. Keep the default ID value suggested by NeuroCheck.

**12** On the third page of the **Register Cell Wizard** select **Connect to Data Format Converter** for the result being buffered in this register cell to be transferred to a pin after the check routine has been executed. To select the pin the result will be transferred to, click the **Change connection...** button.

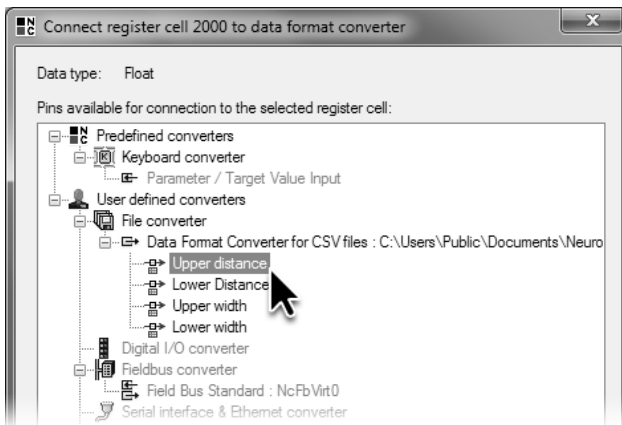
**13** You have already encountered the **Connect register cell 2000 to data format converter** dialog in chapter 5 (*Automated Inspection*). In this case, only data pins are listed in the list of available pins. The process pins provided by the fieldbus converter are not listed since register cells can only be connected to data pins not to process pins. Select the pin *Upper distance* as output target for the register cell. Exit the dialog by clicking **OK**.

Click the **Next** button to switch to the last page of the wizard.

## 9.1. Write gauging results to file



- 12** On the third page of the **Register Cell Wizard** select **Connect to Data Format Converter** to transfer the result from the register cell to a converter pin.



- 13** In the **Connect register cell 2000 to data format converter** dialog, select the pin you want to use for the output of the register cell values.

- 14 On the last page of the **Register Cell Wizard**, the settings are summarized: The new register cell is a cell of the **Output register** of the **Floating point number** type with the **Register Cell ID** *2000* and the **Description** *Distance of the upper hole*. The cell is connected to a file converter pin.

Click the **Finish** button to close the wizard.

- 15 In the **Data Register Manager** the newly created register cell is listed on the **Output register** page with the set properties.

To create three register cells for the other gauging results, duplicate the created register cell. Select the created register cell and click the **Duplicate** button three times. The copies are of the same data type as the original and their register cell ID is set automatically. Please note that these two properties cannot be changed subsequently.

Click twice (don't double-click!) in the row *2001* the column **Description** and enter "Distance of the lower hole".

In the same row click in the **Connection details** column the link **None**.

Connect the register cell in the **Connect register cell 2001 to data format converter** dialog to the pin *Lower distance*.

Close the **Connect register cell 2001 to data format converter** dialog by clicking **OK**.

In the same way change the description for the register cell in the row *2002* to "Width of the upper hole" and connect the register cell to the pin *upper width*.

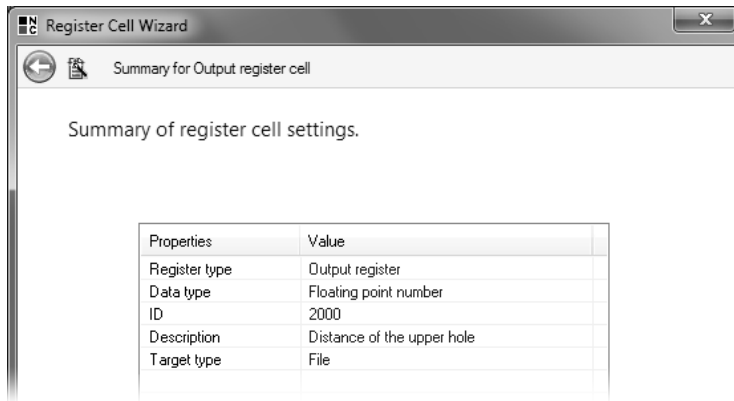
Then, in row *2003* change the description of the register cell to "Width of the lower hole" and connect it to the pin *lower width*.

Close the **Data Register Manager** by clicking **OK**.

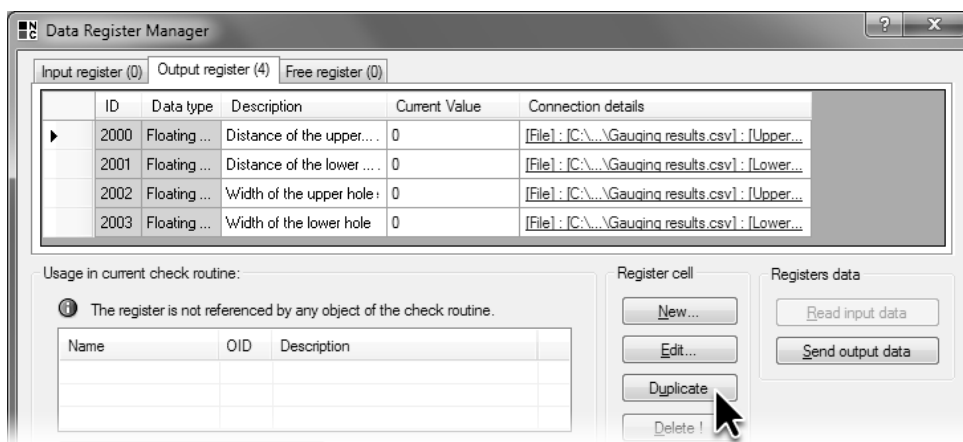
The transmission path for the results is almost complete. The register cells for buffering results have been created. The register cells are connected to pins so buffered results can be transferred to the already created pins after execution of the check routine. The pins determine how results are written to the file.



## 9.1. Write gauging results to file



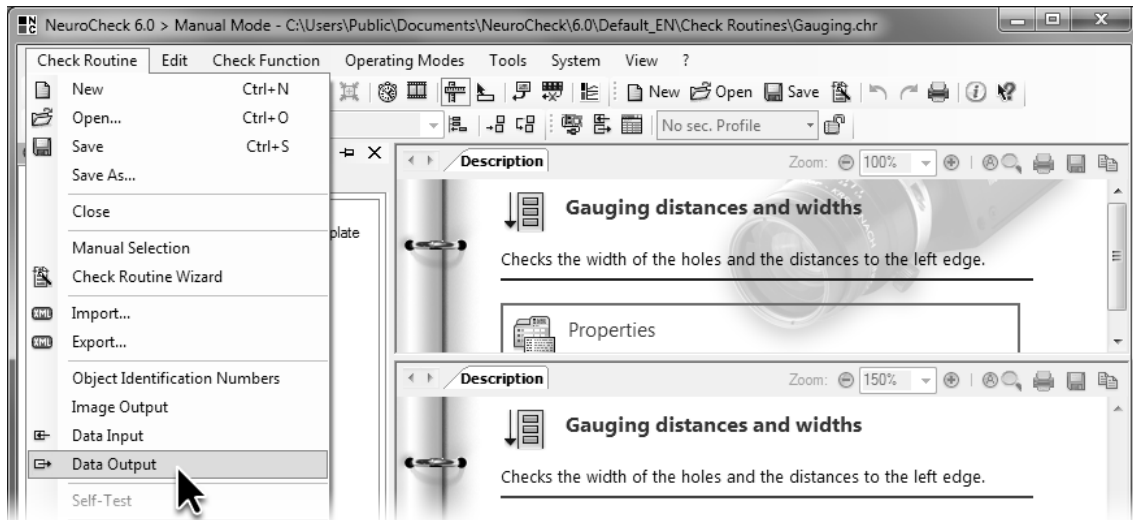
- 14 On the last page of the **Register Cell Wizard**, the configured properties of the new register cell are summarized.



- 15 In the **Data Register Manager** duplicate the newly created register cells three times, and change the description and connection of the new register cells.

- 16 The last link in the transmission path is the connection between the check function results and the register cells. To connect them, select from the **Check routine** menu the **Data Output** item.

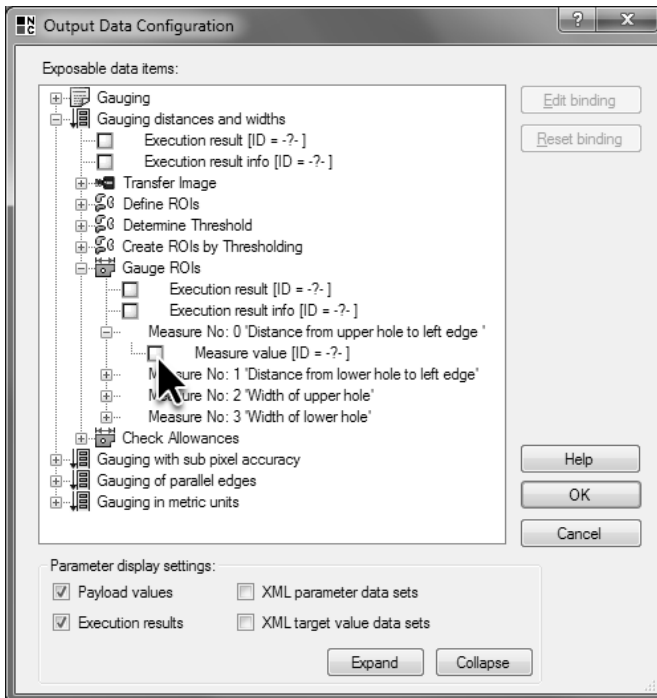
## 9.1. Write gauging results to file



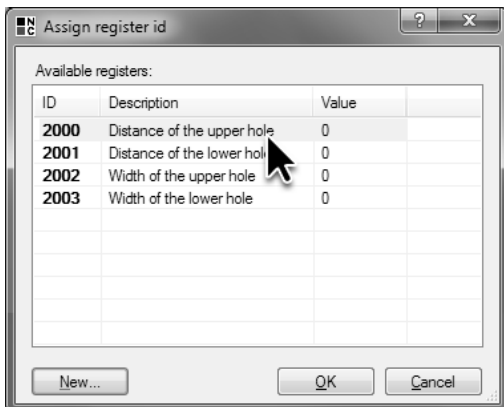
- 16 From the **Check routine** menu, select **Data Output** to connect the check function results to the register cells.

- 17** The **Output Data Configuration** dialog shows the entire tree structure of the current check routine. To output the gauging results of the holes' distances and widths, click the depicted symbol next to the check *Gauge distances and widths* to expand it. In the same way expand the check function **Gauge ROIs** and then the measurement *Distance from upper hole to left edge*. Enable the check box in front of **Measure value** to output the gauging result of the selected measurement.
- 18** In the **Assign Register ID** dialog you can select the cell from the **Available registers** list where you want to buffer the gauging result for output. Select the cell *Distance to the upper hole* to connect it to the gauging result from *Distance from upper hole to left edge*. Close the dialog by clicking **OK**.

## 9.1. Write gauging results to file



**17** In the **Output Data Configuration** dialog select the result you want to be output.



**18** In the **Assign register ID** select the register cell where you want to buffer the result.

- 19 Likewise, connect the gauging result *Distance from lower hole to left edge* to the register cell *Distance of the lower hole*, the gauging result of the measurement *Width of upper hole* to the register cell *Width of the upper hole*, and the gauging result of the measurement *Width of lower hole* to the register cell *Width of the lower hole*.

Close the **Output Data Configuration** dialog by clicking the **OK** button.

Save the check routine to save the settings you made in the **Output Data Configuration** dialog. The pins and register cells are part of the NeuroCheck system configuration and will be saved automatically to the NeuroCheck configuration file upon closing the **Data Format Converter Manager** and the **Data Register Manager**.

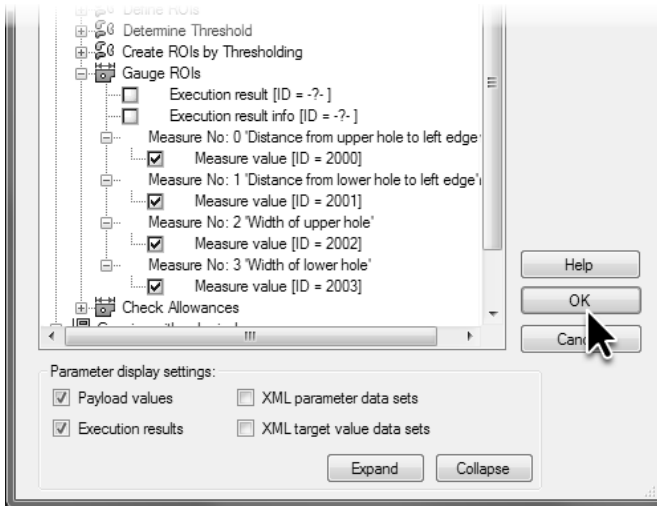
- ▶ The transmission path for the output of results from the check routine to the file is now complete. You can now output some results. Since data output is only executed automatically in automatic mode, switch to automatic mode and execute the check routine several times.
- 20 Use the Windows Explorer to navigate in the project directory into the sub-folder `Data Output`. Open the file `Gauging results.csv` with a spreadsheet such as Microsoft Excel or a text editor like Notepad. The spreadsheet columns correspond to the pins, i.e. result values. From the third row on, each row corresponds to one execution of the check routine in automatic mode.



Usually, the output of results only takes place in automatic mode. Therefore, no new row is added to the CSV file when the check is executed in manual mode.

Apart from the output of gauging results to files, NeuroCheck allows you output of gauging results via other communication hardware such as fieldbus or Ethernet. For this the corresponding data pins must be created in the respective Data Format Converter, and the register cells must be connected to these pins. Please note that the automatically integrated converter for digital I/O does not support the creation of data pins. Therefore, for result output use the converter **Digital I/O Advanced**.

## 9.1. Write gauging results to file



- 19 Enable output for further results and connect them to the corresponding register cells.

Gauging results.csv - Microsoft Excel

	A	B	C	D	E
1	'Upper distance'	'Lower Distance'	'Upper width'	'Lower width'	
2	'Float'	'Float'	'Float'	'Float'	
3	'88'	'89'	'45'	'45'	
4	'108'	'108'	'44'	'44'	
5	'88'	'89'	'45'	'45'	
6	'108'	'108'	'44'	'44'	
7					

- 20 The results written to the CSV file can be displayed in a spreadsheet such as Microsoft Excel.

## 9.2 Manual setting of target values in automatic mode

### Goal

You want to be able to change target values manually during automatic operation to adjust the inspection to various batches.

### Result

You will be able to link parameters and target values using the **Parameter /Target Value Input** dialog, and to use the **Parameter /Target Value Input** dialog.

### Solution

In the check routine `Gauging.chr`, for which you configured saving gauging results in the previous section, you want to set the target value and allowances for the distance of the holes from the left edge in automatic mode. Setting the target values or parameters is done the same way as the output of gauging results. In the case of **Parameter /Target Value Input**, a dialog for manually entering target values or parameters during automatic mode, no device or Data Format Converter is necessary since the input of values from the **Parameter /Target Value Input** dialog takes place directly into the register cells.

The values are buffered in these register cells until the check function is executed. Right before execution, the check function reads the target values or parameters from the register cells, and uses them instead of the values configured in the parameter dialog.

1



Therefore, the first step is to create register cells for buffering target values. For this, in the **System** menu select **Data Register Manager** or click the depicted icon. Go to the **Input register** page to create the new register cells.

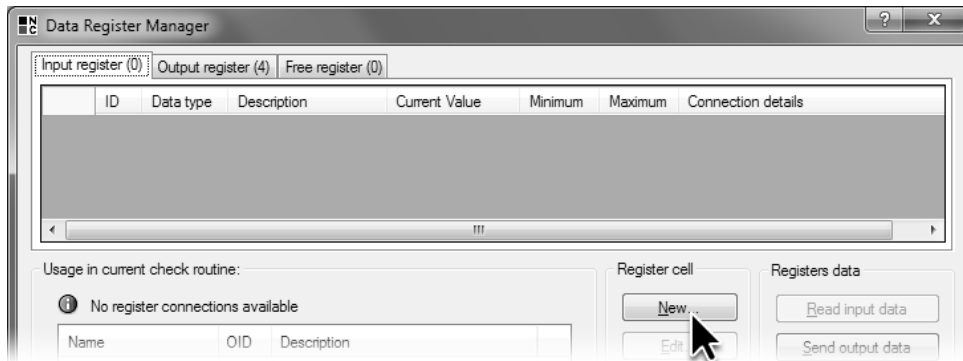
2

Click the **New...** button. Select **Input register** from the first page of the **Register Cell Wizard** and click **Next** to switch to the second page of the wizard.

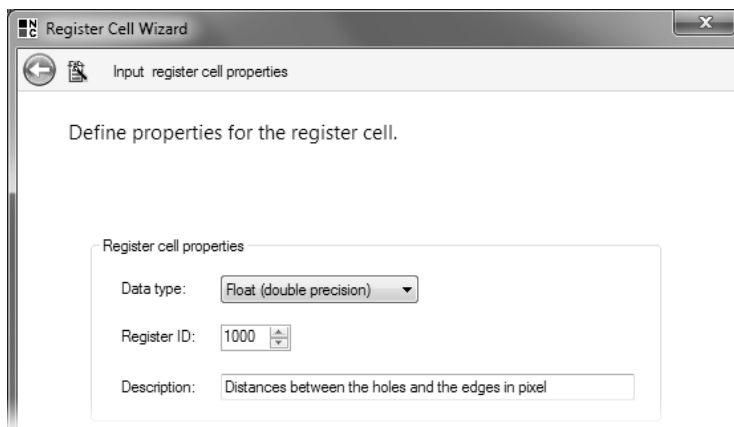
From the **Data type** selection box select **Floating point number**, keep the automatically created value in the **Register Cell ID** field and enter "Distance between the holes and the edges in pixel" as **Description**. Click the **Next** button to switch to the third page of the wizard.



## 9.2. Manual setting of target values in automatic mode



- 1 In the **Data Register Manager** click the **New...** button to define new register cells.



- 2 On the second page of the **Register Cell Wizard** select the **Floating point number** data type corresponding to the target value data type, keep the default **ID** and enter a **Description** for the new register cell.

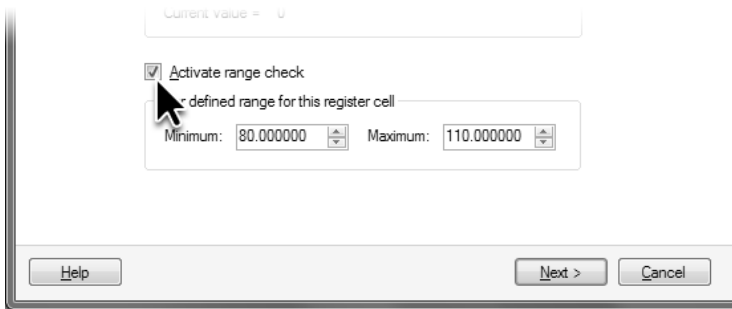
- 3 Enable the check box **Activate range check** so that only values within a given range can be entered. For **Minimum** enter "80" as minimum admissible value and for **Maximum** "110" as maximum admissible value. Click the **Next** button to switch to the fourth page of the wizard.
- 4 Select the **Parameter /Target Value Input** option from the **Connection** group. Thus the register cell is not connected to a converter but to the parameter / target value input. Unlike converters the parameter / target value input has no pins but is selected as a whole.

Click the **Edit details...** button to enter instructions for the operator.

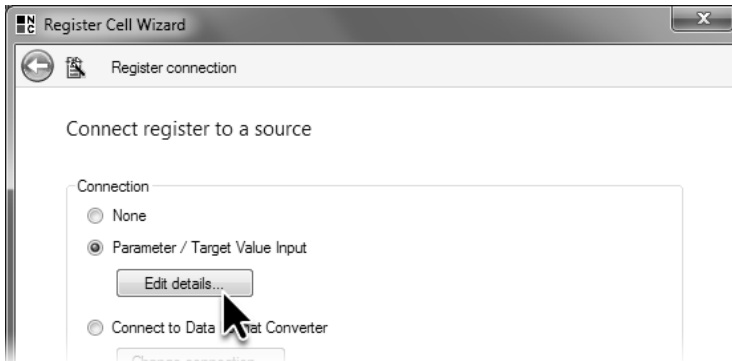
- 5 In the **Details to be displayed in Parameter /Target Value Input** dialog, enter instructions for the operator in the **Comment** field such as: "Change this value if the nominal distance between the left edge and the hole is changed." Click **OK** to close the dialog.

Click **Next** to get to the last page of the wizard, then click the **Finish** button to close the wizard.

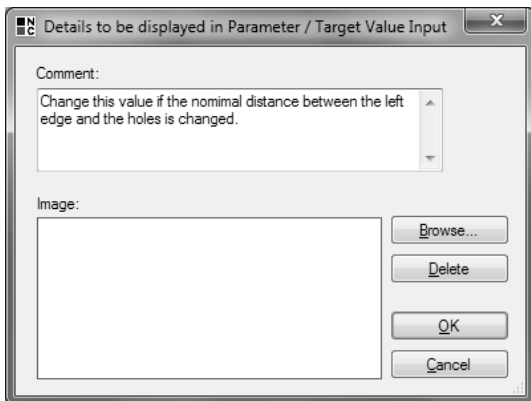
## 9.2. Manual setting of target values in automatic mode



- 3 Enable the value range check to discover input errors.



- 4 Select **Parameter /Target Value Input** to enable target value settings.



- 5 Enter a **Comment** explaining the meaning of the input value to the operator.

- 6 Copy the new register cell twice by clicking **Duplicate**. Select the first copy and click **Edit...** to open the **Register Cell Wizard**.

A warning message will open informing us that the current value of this register cell does not comply with the range defined. Click **OK** to acknowledge this message. We will take care of this later on.

- 7 You can change the properties of the register cells in the **Register Cell Wizard**. As description for the register cell enter "Lower allowance for distance between holes in pixel".

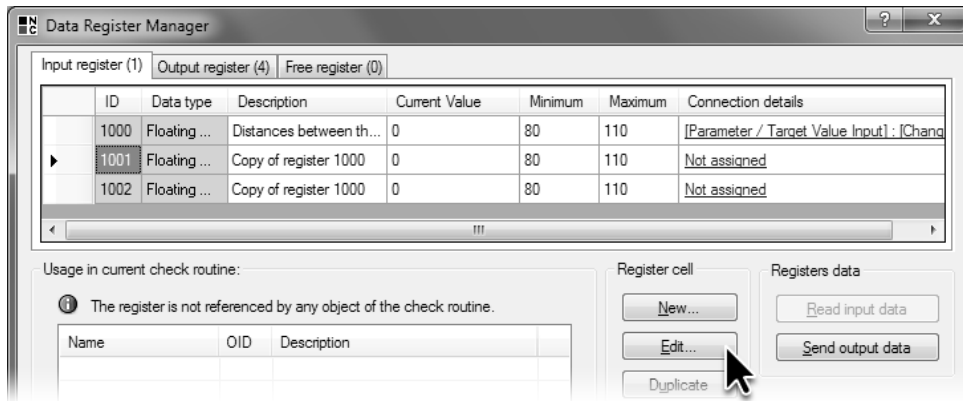
Change the permissible value range to -10 to 0.

Connect the register cell to the **Parameter / target value input**.

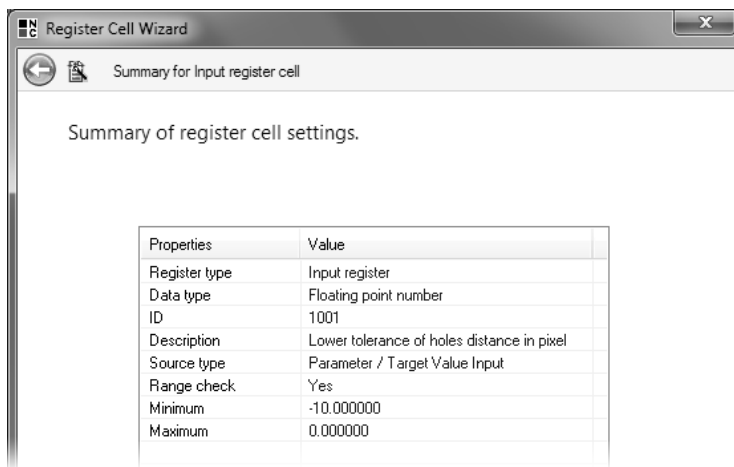
In the **Comment** field of the **Details to be displayed in Parameter /Target Value Input** dialog enter: "Lower the value to increase quality standard. Use negative values."

Exit the dialog by clicking **OK**. Exit the wizard by clicking **Finish**.

## 9.2. Manual setting of target values in automatic mode



- 6 Select the duplicated register cells and click **Edit....**



- 7 In the **Register Cell Wizard** change the **Description**, the **Value** range and the **Comment** of the edited register cell.

**8** Select the second copy and click **Edit...**

Again, a warning message opens. Click **OK** to acknowledge it.

In the **Register Cell Wizard** enter "Upper allowance for distance between holes in pixel" as description.

Change the permissible value range to 0 to 10.


Connect the register cell to the parameter / target value input.

In the **Comment** field of the **Details to be displayed in Parameter /Target Value Input** dialog enter: "Lower the value to increase quality standard. Use positive values."

Exit the dialog by clicking **OK**. Exit the wizard by clicking **Finish**.

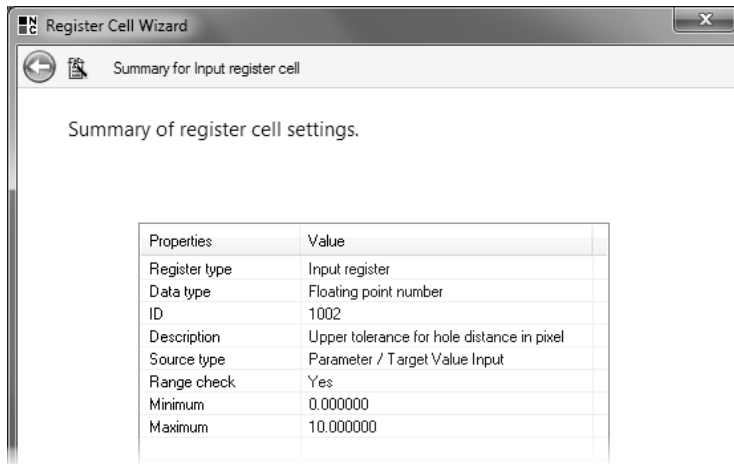
After all three required register cells have been created and connected to **Parameter /Target Value Input**, close the **Data Register Manager** by clicking **OK**.

**9** In the next step we have to make sure that the entered target values are used during check routine execution. First, make sure that the check routine `Gauging.chr` is open. From the **Check routine** menu select **Data Input**.

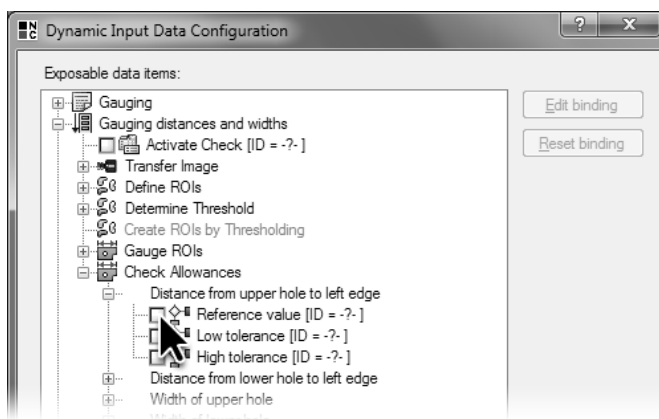
 You can select target values and parameters to be read from the input register in automatic mode in the **Data Input Configuration** dialog. Enlarge the check *Gauge distances and widths*, the check function **Check Allowances** within, and the measurement *Distance of the upper hole to the edge*.

Enable the check box in front of **Reference value** to use the value of a register cell as reference value.

## 9.2. Manual setting of target values in automatic mode



- 8 Change the second duplicated register cell in the **Register Cell Wizard** as well.



- 9 From the **Check routine** menu select **Data Input** and in the **Dynamic Input Data Configuration** dialog select the target value you want to change in automatic mode.

- 10 In the **Assign register ID** dialog the created register cells of the input register with the correct data type are displayed. Select the register cell *Distance between the holes in pixel* to use its value as reference value for the measurement *Distance from upper hole to left edge*.

Exit the dialog by clicking **OK**.

- 11 Enable the check box **Low tolerance** and connect the entry to the register cell *Lower tolerance of holes distance in pixels*. Enable the check box **High tolerance** and connect the entry to the register cell *Upper tolerance of holes distance in pixels*.

From now on the values from the register cells are used for the reference value and the allowances of the measurement *Distance from upper hole to left edge*. The same values are to be used for the inspection of the *Distance from lower hole to left edge* measurement.

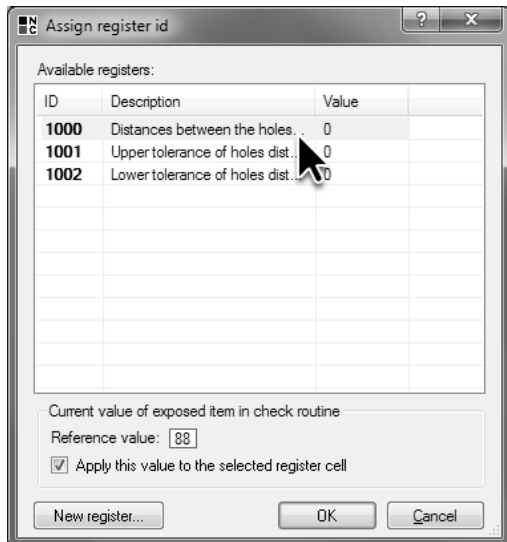
- 12 For this, expand this measurement in the **Dynamic Input Data Configuration** dialog. Enable the three check boxes and connect them to the corresponding register cells.

Close the **Data Input Configuration** dialog by clicking **OK**. Setting the target values via **Parameter /Target Value Input** is now completely configured.

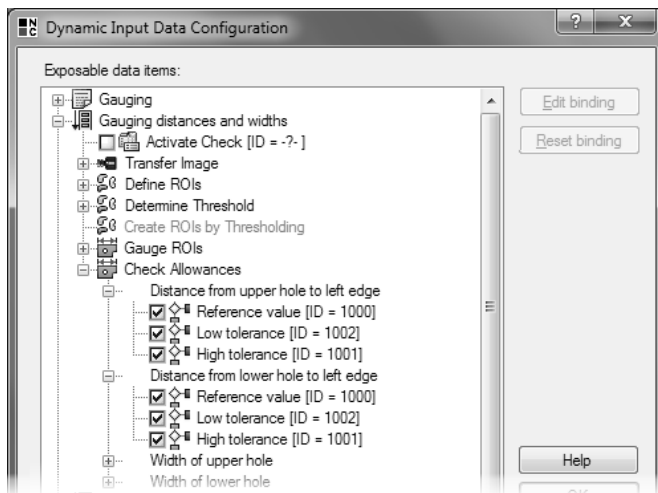
Save the check routine and thus the connection of the target values to the register cells. The register cells and their configuration are part of the NeuroCheck system configuration and they are saved automatically upon closing the **Data Register Manager**.



## 9.2. Manual setting of target values in automatic mode



- 10 Select the register cell from which to get the target value.



- 11 Select the other target values you want to use in automatic mode and connect them to the corresponding register cells.

**12**



Switch into automatic mode to use and test the defined target values via **Parameter /Target Value Input**. Start automatic mode and execute the check routine several times.



In the process view in the **Check function visualization list** the measured values are displayed in the **Measure** column. The values for the target value and both allowances from the register cells are displayed in the **Nominal value, Tol+** and **Tol-** columns with the depicted icon. The target values and allowances configured in the parameter dialog are displayed in the **Target value, Tol+** and **Tol-** columns without the depicted icon.

Since you haven't entered any values for **Parameter /Target Value Input**, the values from the registers and those entered in the target value dialog are the same.

In chapter 7.3 (*Creation of a Control Panel Menu*) opening the **Parameter /Target Value Input** dialog has been linked to the **F6** key. Press this key or click *F6: Input table* in the LCD matrix. This command is only executed if there is no start signal for NeuroCheck.

**13**



The **Parameter /Target Value Input** dialog opens. In the **Data view** table the register cells connected to this dialog are listed on the *Gauge distances and widths* page.

Select row *Distance between the edges from hole in pixels*. On the right side of the dialog, the description you entered for the value of this register cell is displayed.

Click the **New Value** column to enter a new reference value. Enter "95". Press the **Enter** key to close the entry.



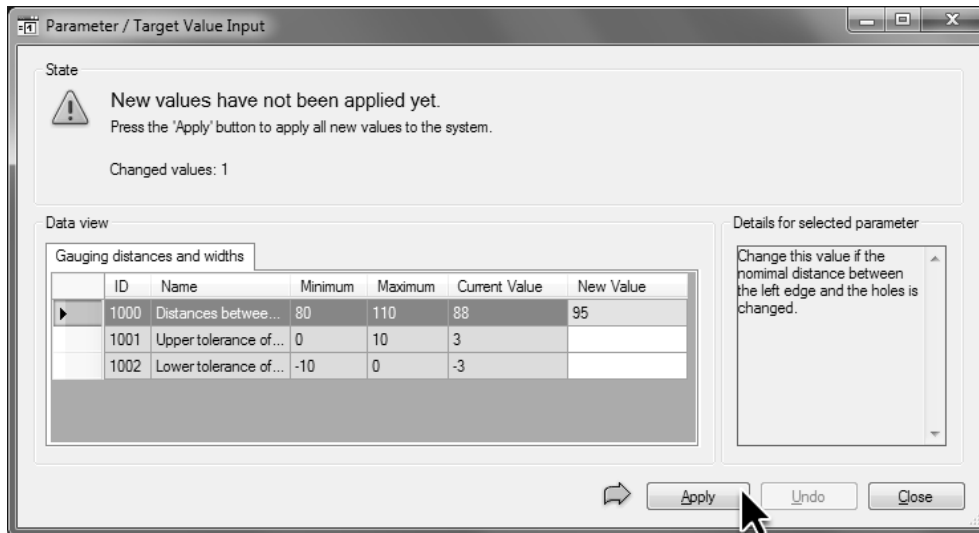
Next to the **Apply** button a green arrow is flashing to show that a new value has been entered but hasn't been transferred to the register cell.

To transfer the value to the register cell, click **Apply**.


## 9.2. Manual setting of target values in automatic mode

Ident-No.	Text	Measure	Nominal V	Tol+	Tol-	Nominal Val	Tol+	Tol-	Method
✓ 0	Distance from ...	88.000	88.000	3.000	-3.000	88.000	3.000	-3.000	[abs]
✓ 1	Distance from...	89.000	88.000	3.000	-3.000	88.000	3.000	-3.000	[abs]
✓ 2	Width of upper ...	45.000	45.000	2.000	-2.000	45.000	2.000	-2.000	[abs]
✓ 3	Width of lower hole	45.000	45.000	2.000	-2.000	45.000	2.000	-2.000	[abs]

- 12 The **Check function visualization list** in the process view displays the target values saved in the register cell and the target values configured in the target value dialog.



- 13 After entering a new value, a green arrow flashes next to the **Apply** button.

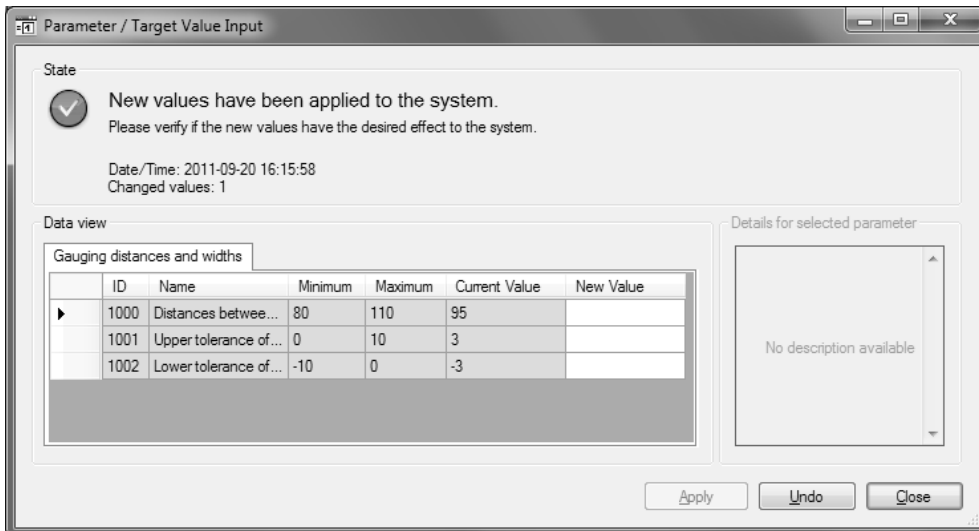
- 14 In the **Status** group of the **Parameter /Target Value Input** dialog it is indicated when the values are adopted. The **New value** column is now empty while the entered and now adopted value "95" is displayed in the **Current value** column.
- 15 Execute the check routine again. In the **Check function visualization list** the new value can be found in the **Target value** column with the depicted icon, both in the *Distance from upper hole to left edge* row and the *Distance from lower hole to left edge* row since both measurements are connected to the same register cell.  

- ⊗ Since the difference between the measured value and the target value is greater than the allowance, the result is *not OK*.

You changed the target value for the distance between the left edge and the holes during automatic mode.

By the way, the **Parameter /Target Value Input** dialog can stay open during execution of a check routine.

You can define parameters in the same way. Furthermore, it is possible for data input, as it is for data output, to receive values from files or communication hardware such as fieldbus or Ethernet. For this the corresponding data pins must be created in the respective converter, and the register cells must be connected to these pins. Please note that the automatically integrated converter for digital I/O does not support the creation of data pins. Therefore, for defining parameters and target values use the converter **Digital I/O Advanced**.

## 9.2. Manual setting of target values in automatic mode



- 14 The **Parameter /Target Value Input** shows that the values have been adopted.

Ident-No.	Text	Measure	Nominal V	Tol+	Tol-	Nominal Val	Tol+	Tol-	Method
0	Distance from ...	88.000	95.000	3.000	-3.000	88.000	3.000	-3.000	[abs]
1	Distance from...	89.000	95.000	3.000	-3.000	88.000	3.000	-3.000	[abs]
2	Width of upper ...	45.000	45.000	2.000	-2.000	45.000	2.000	-2.000	[abs]
3	Width of lower hole	45.000	45.000	2.000	-2.000	45.000	2.000	-2.000	[abs]

- 15 The **Check function visualization list** of the process view displays the modified target values.

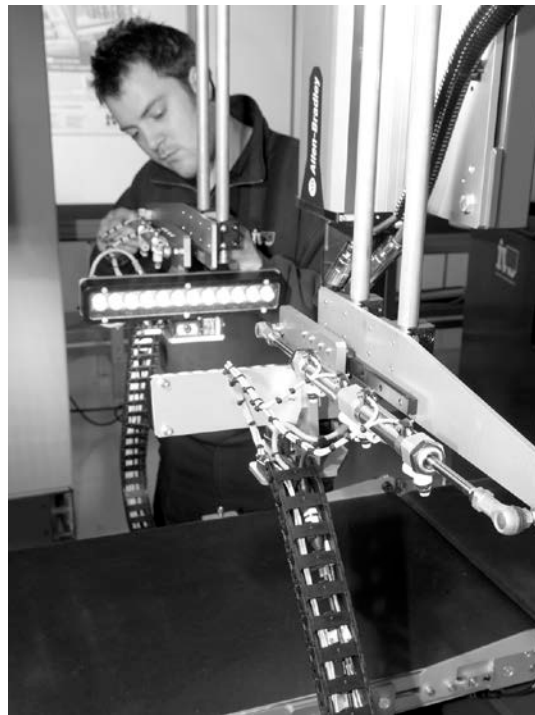


# 10. Troubleshooting

In automated vision inspection systems analyzing errors and problems in case of an incident is of great importance. NeuroCheck will support you in many ways.

In this chapter you'll learn how to

- save the images automatically whose inspection yielded *not OK* (rejected parts)
- trace the configuration changes of NeuroCheck



## 10.1 Configuration of error image storage

### Goal

You want to save the images automatically for which the NeuroCheck evaluation yielded *not OK* to review them subsequently and, if necessary, optimize the inspection.

### Result

You will be able to configure the saving of error images.

### Solution

Open the check routine `Gauging.chr` you created in chapter 6 (*Gauging*). In this section we will configure the saving of error images in such a way that the image of the first check *Gauging distances and widths* is saved if the result of the check is *not OK*.

Saving images and also saving error images is configured in the **Image Output – Configuration Dialog**. To open the dialog, select from the **Check routine** menu the item **Image Output**.

- 1 In the **Image Output – Configuration Dialog** go to the **Error images** page. For the automatic saving of images NeuroCheck uses image output jobs. On the **Error images** page the image output jobs are listed and configured which are carried out if the result is *not OK*.

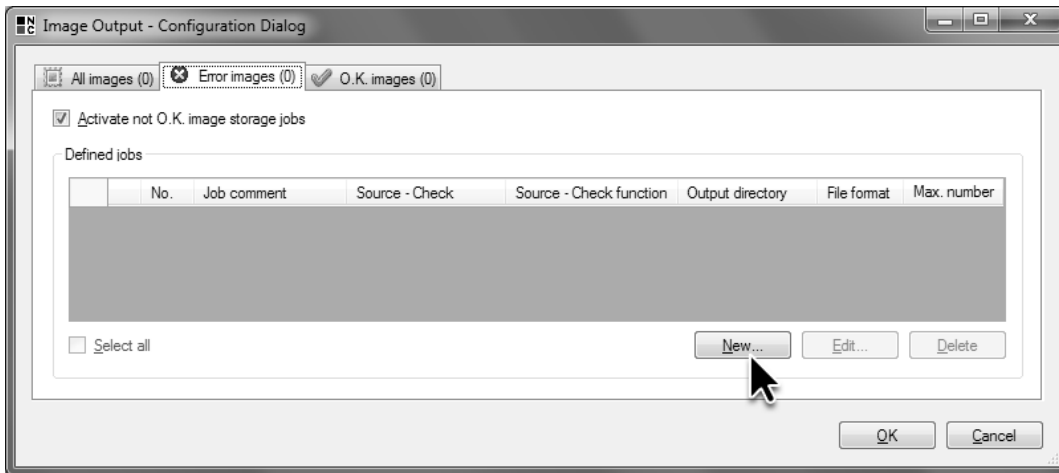
Click the **New...** button to define a new image output job.

- 2 On the first page of the **Image Output Job Wizard** you can select when to save the images. Keep the setting **Error images** so that images with the evaluation result *not OK* can be saved.

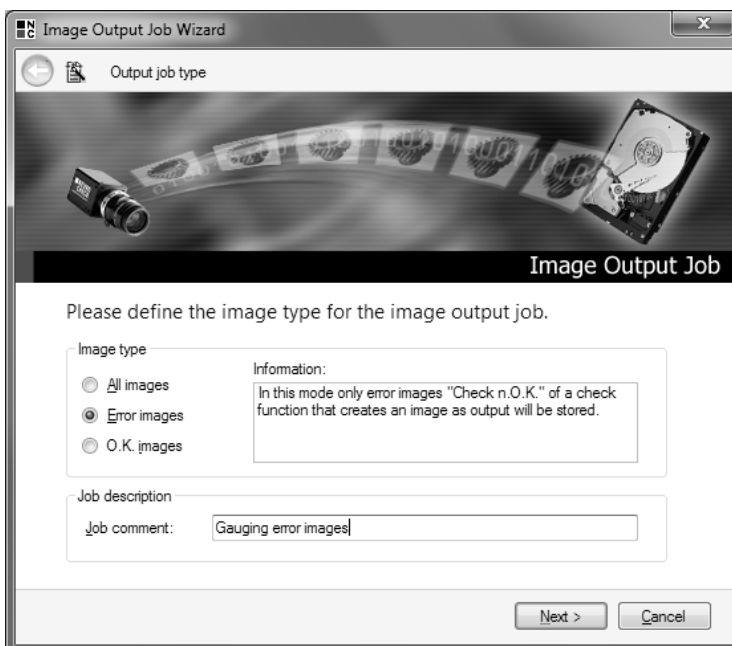
In the **Job comment** field enter a name for the image output job, in this case for example "Gauging error images".

Click the **Next** button to switch to the next page of the wizard.






1 The **Image Output – Configuration Dialog** displays the configured image output jobs.



2 On the first page of the **Image Output Job Wizard** enter a name for the image output job and select the image output job type.

- 3  The second page of the **Image Output Job Wizard** displays the entire structure of the check routine. Click the depicted icon in front of the check *Gauging distances and widths* to expand it. In this check select the check function **Transfer Image**. In case the result of the check *Gauging distances and widths* is not OK, the image created by **Transfer Image** will be saved.

Click the **Next** button to switch to the next page of the wizard.

- 4 On the third page of the wizard, the field **Directory** displays the folder where the error images are saved. By default this is the sub-directory `\Image Output\Error Images\` in the project directory.

The first part of the file name that is used for the error image to be saved, is defined in the text field **Fixed text**. Enter "Error images\_".

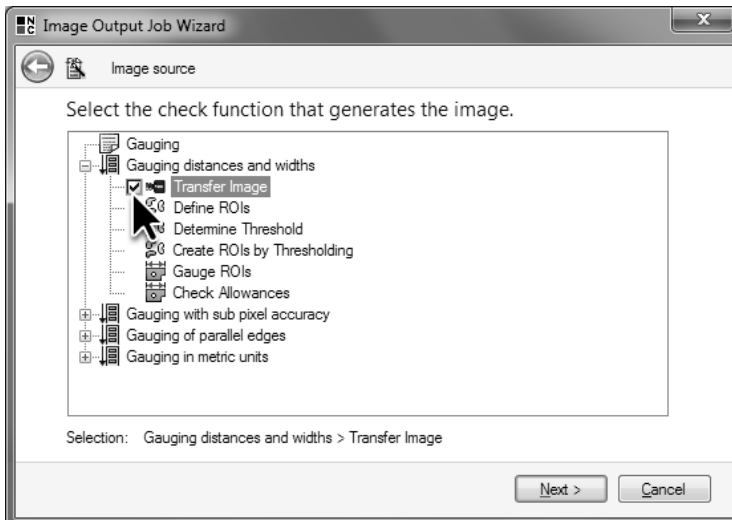
The second part of the file name consists of a sequential number or the date and time of saving. In the latter case select **Append date and time**.

Leave the **Max. numbers of files** setting at 99. This setting causes the first image to be deleted when the hundredth image is saved to prevent the error images from taking up too much space on the hard drive.

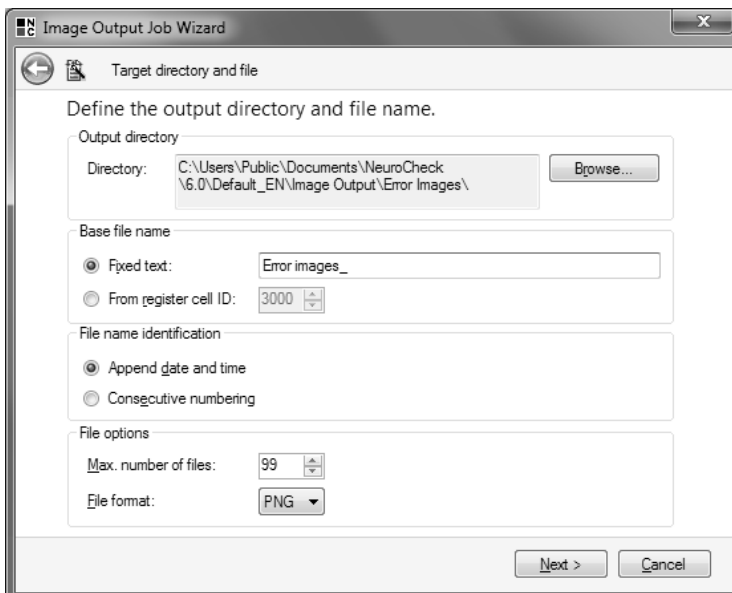
As **File format** select **PNG**. As opposed to the JPG format, this file format has the advantage that the content is not changed when the image data is compressed. Subsequent reconstruction of the inspection is only possible with unchanged image data!

Click the **Next** button to switch to the next page of the wizard.

## 10.1. Configuration of error image storage



- 3 On the second page of the **Image Output Job Wizard** select the source of the images to be saved.



- 4 On the third page of the **Image Output Job Wizard** you can configure the image file properties.

- 5 On the fourth page of the **Image Output Job Wizard** you can define more information to be saved with the image. You can save this information in the Exchangeable Image File header (shortened to Exif header) of the image file or draw it as a text row directly into the image.

When saving it to the Exif header, the image data remains unchanged since the additional information is saved in a separate part of the image file. This method is only available for saving images as TIFF or JPG files.

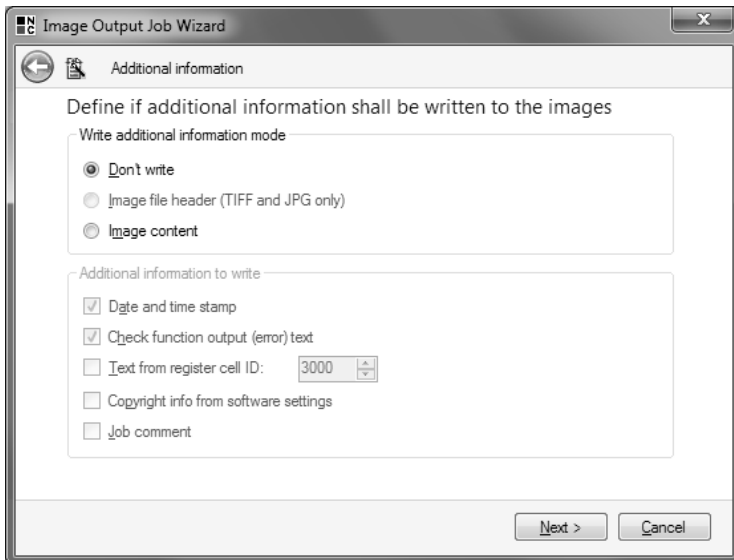


If you draw the information directly into the image, you are changing the image content which may make it difficult to reconstruct the inspection later on precisely. This option is always available irrespective of the image data type.

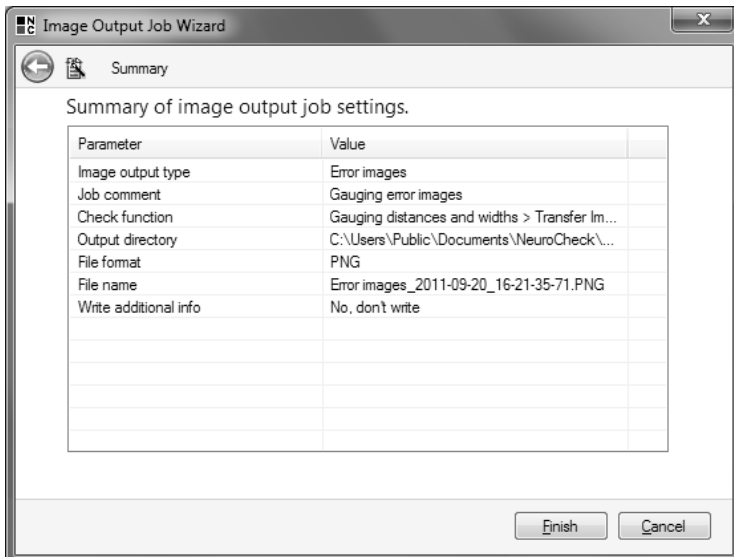
With images in the PNG format, additional information cannot be saved in the Exif header. So as not to change the image content, do not change the option **Don't write**.

Click the **Next** button to switch to the last page of the wizard.

- 6 The last page of the wizard summarizes the settings made. If the settings are all right, click **Finish** to close the wizard and have the image output job created.



- 5 You can configure if and what further information is to be saved in an image on the fourth page of the **Image Output Job Wizard**.




- 6 On the last page of the **Image Output Job Wizard** the settings you made are displayed in an overview.

- 7 The **Image Output – Configuration Dialog** on the **Error images** page lists the newly created image output job in **Defined jobs**. The columns of the table display the settings just made in the wizard.

For the images to be saved, make sure the superior check box **Activate not O.K. image storage jobs** is enabled and also the check box in the row of the created job from the **Defined jobs** list.

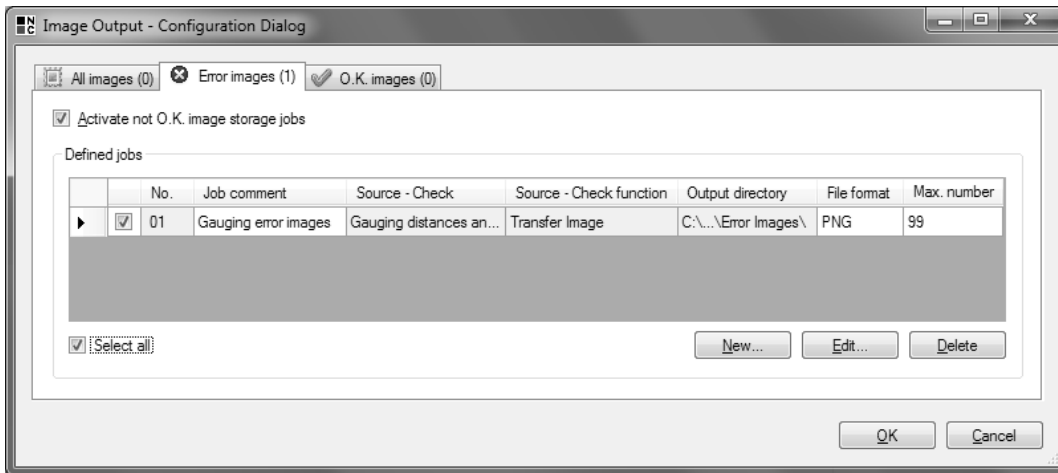
Close the dialog by clicking **OK**. The error image storage has been completely configured for the current check routine.

To check the configuration make sure that in the check *Gauge distances and widths* the check function **Transfer image** will load both images for which the inspection result is *OK* and images for which the result is *not OK*. Of course, saving and analyzing error images is only reasonable, if the check function **Transfer image** gets the images from a camera and not from file.

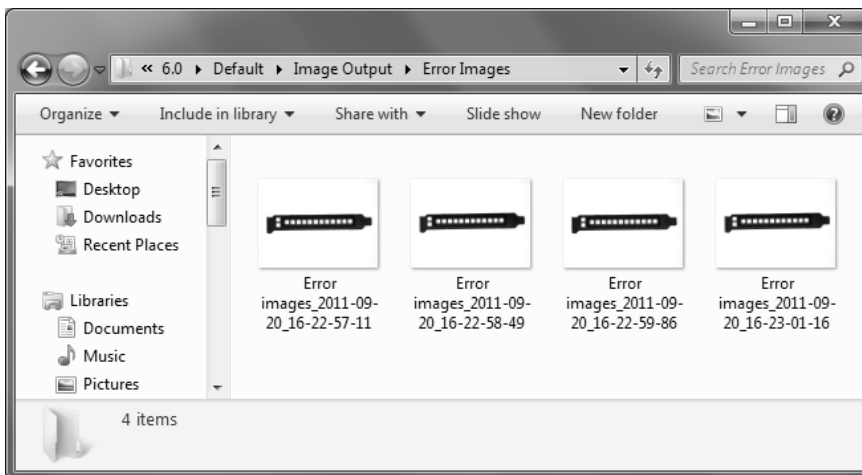
-  Switch to automatic mode and execute the check routine several times.

- 8 Use the Windows Explorer to navigate into the project directory and its sub-directory `\Image Output\Error Images\`. Each time the evaluation of the check yields *not OK*, the input image including date and time in its name is saved to this directory.

## 10.1. Configuration of error image storage



- 7 The newly created image output job is listed in the **Image Output – Configuration Dialog** on the **Error images** page.



- 8 If the result of the check yields *not OK*, the image is saved to the `\Image Output\Error Images\` folder of the project directory.

## 10.2 The event data base

### Goal

You want to know what settings have been changed in NeuroCheck and the check routines.

### Result

You will get to know the event log viewer and you will know how to display individual event categories.

### Solution



In the **Tools** menu select **Event Log Viewer**.



The **NeuroCheck – Event Log Viewer – Current System** dialog displays all changes made in check routines and system configuration in the upper half of the right column. These changes are listed as **Audit trail**. In addition, **Errors, Warnings** and **Informations** are listed.



Select a row from the list of events. In the **Event properties** field more information on this event is displayed. The field **Event details** shows more information on the event which can be helpful for the analysis. By clicking **Copy** you can copy the information displayed in **Event properties** to the clipboard to include it in an e-mail.

To analyze the event data base of a different station, go to the **File** menu and select **Import**. From the **Open** dialog select the event data base file you would like to analyze. You will find the event data base file in the project directory, `\System Output\` folder. The file is called `EventLog.dat`.

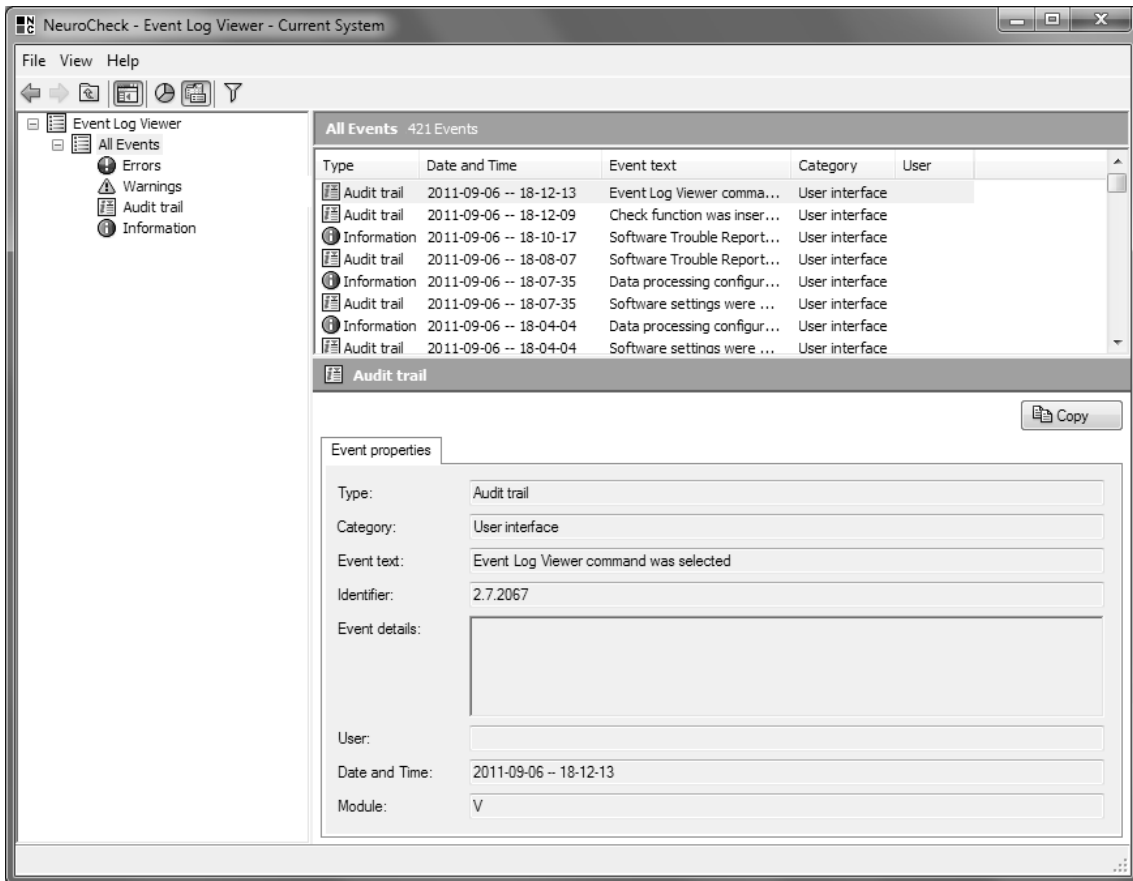
### End of Training Course

With a glimpse of the **Event Log Viewer** you have reached the end of our training course. You will now have a good idea on how to create vision inspection systems for automated manufacturing using NeuroCheck.



It is not possible to show the entire NeuroCheck functionality in this manual. You will find a comprehensive description of the capabilities of NeuroCheck in the user manual.





- 1 In the event log viewer you can trace changes made in the NeuroCheck configuration and check routines.