

Work Inspection Camera

RICOH SC-20

Collection of tips by application

[Screw Tightening]

*This document introduces tips for setting up SC-20 for inspecting screw-tightening work. Since actual conditions at the work site may vary depending on the shape, texture, color, ambient light, etc., the contents of this document are for reference only and the most appropriate adjustments should be made at the actual work site.

Tips 1 Work Inspection Flow

Q : What is the work inspection process for SC-20?

A : For each checkpoint, the degree of conformity of the shape (or color in the case of color recognition) with the master image is measured by image recognition, and if they match, it is judged as OK. The setup work can be repeated to find the optimal settings while repeatedly testing the judgment, thereby preventing misjudgment.

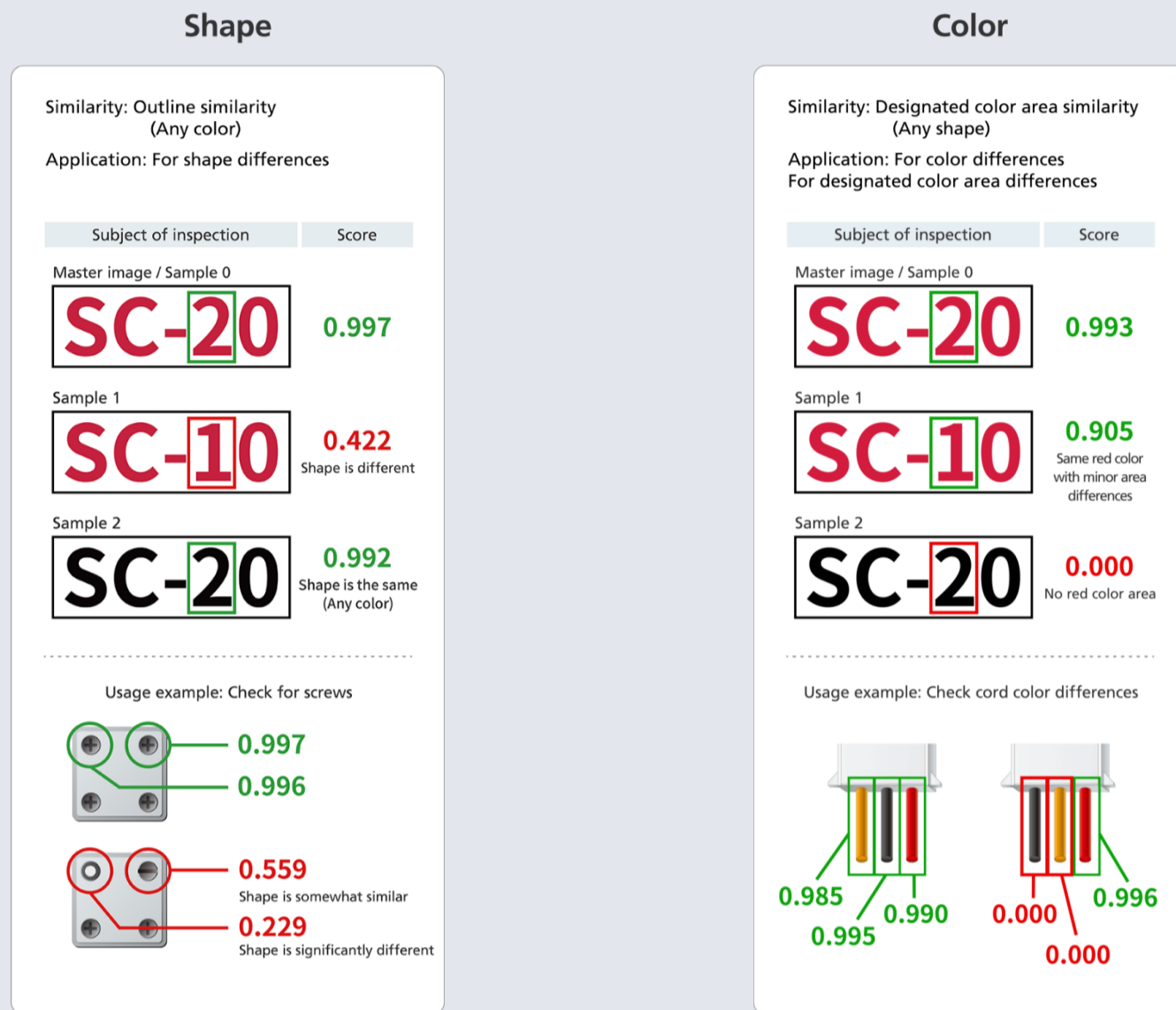
■■■ Glossary ■■■

Checkpoint	Actual inspection points. For example, in the case of screw tightening work, the screw point is the checkpoint.
Test	<p>Function to test the judgment. Click the thumbnail image of the checkpoint on the right side of the standby screen and click the "Test" button in the dialog to test.</p> 
Score	This is a numerical value of the shape matching (or color matching in the case of color recognition) with the master image. A score of 1.00 is assigned when there is a 100% match with the master image.

Tips 2 Logic for Judgment

Q : What logic is used to calculate scores for "shape" and "color" recognition, respectively?

A : In the "Shape" check method, the image to be inspected is binarized, and the degree of agreement is calculated by comparing only the shape of the outline (color differences have no effect). The "Color" check method compares the area of the color specified in the "Specified Area" to calculate the degree of matching (shape differences have no effect).



Tips 3 Checkpoint size

Q : How large should the checkpoint be?

A : When specifying checkpoint, the size of the area to be surrounded is important. Perform a "test" of the judgment before and after the work to be inspected, respectively, and set the size to which the score difference is the largest.

■■■ This is the trick ! ■■■

Trick①	Basically, set the minimum size according to the size (shape) of the object to be inspected. If other items are included, the score will also reflect the size of the items, and therefore, the difference in score tends to be less pronounced.	
Trick②	If the score varies with the minimum size and the judgment is not stable, please try a slightly larger enclosure. Since SC-20 is a high-definition product, the scores may be skewed depending on the way the light hits the object or the condition of the object. In such cases, including the area around the object to be inspected in the checkpoints will stabilize the score difference and make it effective.	
Trick③	If the inspected object is too large to fit in the specified size of checkpoint, please specify a characteristic point of the inspected object (a point where there is a clear difference between before and after work). <ul style="list-style-type: none"> ● The maximum specified size of checkpoints is 500 (pixel) x 500 (pixel). ● The minimum checkpoint size is 50 (pixel) x 50 (pixel). 	

Tips 4 Parameter Setting for Checkpoint

Q : Do I need to set parameters for checkpoint?

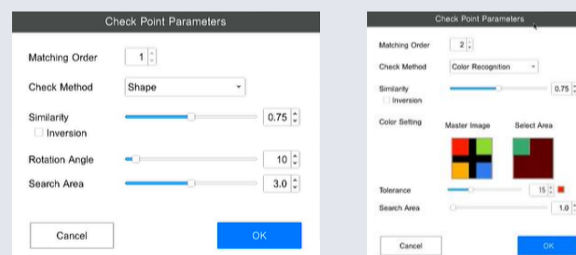
A : The accuracy and speed of judgment can be improved by adjusting the parameters of each checkpoint.
There are three parameters to adjust: "Similarity," "Rotation Angle," and "Search Range".

■■■ Glossary ■■■

Similarity	Set how much the score (shape matching with master image (color matching in case of color recognition)) is acceptable for judgment, and the lower limit for OK.
Rotation Angle	Set the acceptable range for judgment when the inspection target is rotating, from $\pm 1^\circ$ to $\pm 180^\circ$. This parameter is especially important for screw tightening work.
Search Range	Set the width of the search range when locating the inspection target. The equivalent checkpoint width is set to 1.0, and the larger the number, the wider the search range.

■■■ This is the trick ! ■■■

Trick①	The best value for " Similarity " is based on the results of the test. For example, if the test results are [Before: 0.37] and [After: 0.98], set any value in between. The closer the set value is to the pre-work value, the more lenient the judgment will be, and the closer it is to the post-work value, the more severe the judgment will be.
Trick②	The " Rotation angle " value should be set to [45] ($\pm 45^\circ$) for screw tightening operations, since there are variations in the rotation state of screws after the operation.
Trick③	If the value of " Search Range " is set too small, it may not be possible to locate the inspection target, so first test with the default value [3.0]. If there are objects of similar shape near the object to be inspected, adjust the value smaller if necessary. For three-dimensional objects such as screws, set the value to [1.2] or higher.
Trick④	<u>If there are different-colored items,</u> two checkpoints can be set for the same inspection target, and the check method can be set to "shape" and "color" matching to prevent misjudgment.



Tips 5 Anchor Point

Q : Why is it necessary to set an Anchor Point

A : To specify the location of the object (product) to be assembled and one anchor point from which to search for checkpoints.
Since the setting of the anchor point affects the speed at which the inspection starts and the accuracy of the judgment, we recommend making optimal adjustments here as well.

*When using a positioning mechanism for the object (product) to be assembled (e.g., a jig to place the product in a fixed location), setting of an anchor point is not required.

■ ■ ■ This is the trick ! ■ ■ ■

Trick①	Specifying a position as close as possible to each checkpoint reduces errors in relative position to the checkpoint and improves search accuracy.
Trick②	As with checkpoint, the Anchor Point is searched for by comparison with the master image through image recognition. Therefore, specify areas where the shape is unique and no similar shape exists. <ul style="list-style-type: none">● The maximum specified size of an Anchor Point is 700 (pixel)x700 (pixel).● The minimum specified size for an Anchor Point is 50 (pixel)x50 (pixel).
Trick③	Please specify a part of a shape that includes straight lines, not a circular object. If you specify a circular object, the orientation of the object's installation will be incorrectly recognized, resulting in a large error in the relative position to the checkpoint.

Tips 6 Anchor Point ROI

Q : What is the Anchor Point ROI ?

A : In order to search for the Anchor Point quickly and improve processing speed, the search can be focused on the area specified in the "Anchor Point ROI" instead of the entire screen.

*If you do not set an Anchor Point, you do not need to set a search area.

■ ■ ■ This is the trick ! ■ ■ ■

Trick①	Specify a range so that the Anchor Point is in the center of the search area.
Trick②	Specify a range wider than the Anchor Point (About 3 times larger). If the range is too large, the search area will expand and processing speed will decrease.

