EasyInspector
Installation & Operation Guide

Skylogiq Co., Ltd.

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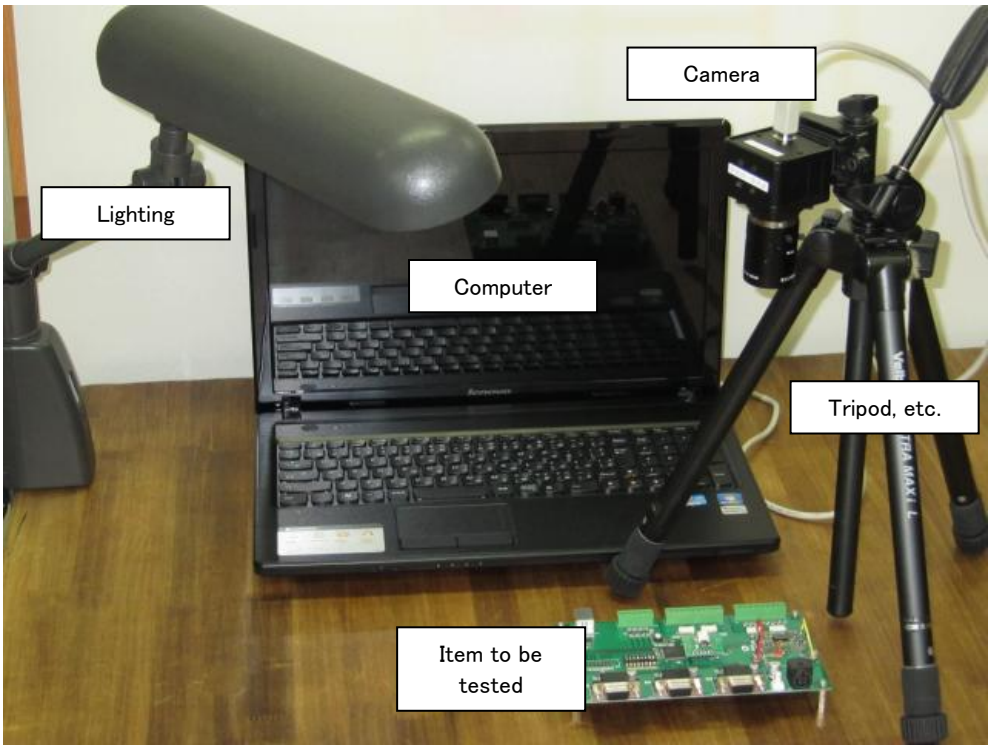
1 Preparation

Below are the things you will need to run inspections using the “EasyInspector” USB image inspection software.

- Computer
  - OS: Windows XP (SP2 and up), Vista, 7 – 32- or 64-bit version
    (Some cameras are not compatible with 64-bit or even when compatible may not be verified. It is recommended to check beforehand by using a loan camera and the evaluation version of the software.)
  - CPU Core 2 Duo 2.0Ghz or higher、Core i5 or higher
  - RAM 1GB or more
  - Equipped with at least two USB 2.0 ports (with USB license key, for connecting USB cameras)

- USB License Key (not necessary for the evaluation version)

- USB Camera
  (For details, please refer to the “Preparing the Camera” section below.)
- Lighting
  Normally, image testing can be done with just the lights of the room, but in some cases when test items have glossy material or the brightness of the test environment varies greatly, lighting equipment will be necessary.
- Jig for test items and cameras
  The jig is needed to set the test item and camera in the same positions.



2 Preparing the Camera

This is a guide for connecting a camera to EasyInspector and testing it.

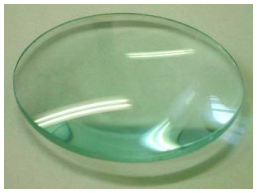
Purchasing Cameras

For a USB camera, Web cams can be bought at most household electronics stores. When purchasing, please observe the following points.

- It must be a USB camera
- Has a pixel count of 14 megapixels or less (Maximum pixel count varies with the grade of EasyInspector.)
- Supports DirectX9.0 standard (almost all new cameras are compatible)
- Output format should be one of the following:
  RGB24 , RGB32 , YUY2, UYVY
- Has a video output function of 640x480 or higher
- Low distortion (If using a Web cam on the market, choose one with a larger lens.)
- Has manually adjustable (fixed) focus (cameras with automatic focus are not suitable for image inspection)
- Has manually adjustable (fixed) exposure time

In addition, it is also possible to use industrial cameras, with the same selection criteria as above.
The price range is between 50,000 and 100,000 yen (depending on the pixel count), expensive when compared to web cams, but with sharp focus and little distortion, they are suitable for inspections which require a high degree of accuracy.
It is also possible to find them by searching the internet, but in case of doubt please consult us.

Purchasing Lenses



A web cam with many screws for focus adjustment can focus to within a few centimeters, but if it is unable to focus for close-up photography, try a convex lens. These can be purchased at home improvement stores or stationery shops. For industrial cameras, buy a high-performance lens with focus and aperture adjustment together when buying the camera. For industrial cameras, you can also choose a lens that magnifies like a microscope.

Installing the Cameras

Use the installation CD for the camera you purchased, and do what is necessary to use the USB camera with your computer. For camera installation methods, please follow the instruction manual for your respective camera.

Checking the Operation of a Camera Unit

Use the display software that came with the USB camera to verify that the camera can be used at 640x480.

Connecting a USB Camera to the Computer

Because USB cameras transfer a very large amount of information, plugging them into adjacent ports can cause the image display to slow down or even stop. For that reason, please follow the conditions below as closely as possible.

☆ Do not use a USB hub in the USB port where the camera is connected
☆ Leave empty ports adjacent to the port where the camera is connected

3 Installing EasyInspector

Downloading the Installer for the Evaluation Version of the Software

Follow the directions for downloading the installer for the evaluation version of the software at the web page :

http://www.skylogiq.co.jp/download/downloading/evaluation/index.html .

Installing the Evaluation Version of the Software

The installation method for the software evaluation version is different depending on whether your computer is connected to the internet.

A) If your Computer is Connected to the Internet

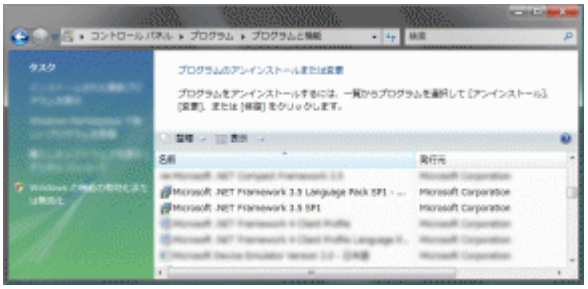
Please proceed to the “Starting the Easy Inspector Installer” procedure.

B) If your Computer is Not Connected to the Internet

Checking the Microsoft .Net Framework

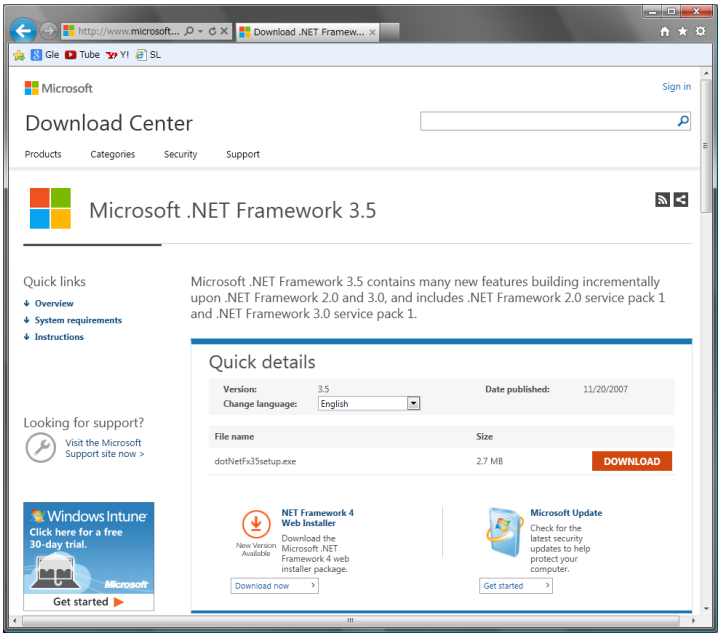
To run EasyInspector, you must have Microsoft`s freely distributed Microsoft .Net Framework 3.5 installed on your computer. Please check it in the following way.

Select “Start Menu” → “Control Panel” → “Uninstall Program (on XP: Add or Remove Programs)”, and verify whether “Microsoft .NET Framework 3.5” appears in the list.



If Microsoft .Net Framework does not appear in the list

You will need to download the Microsoft .Net Framework installer from the Microsoft homepage and install it.



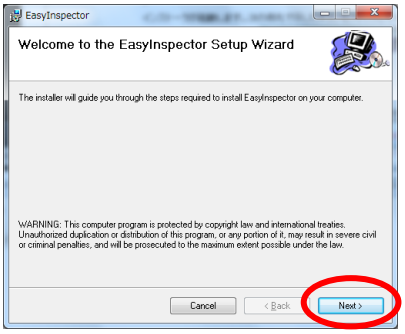
Microsoft .Net Framework 3.5 Installation

※ In addition, if you are using Windows 2000 SP4, you may need to first install Microsoft Installer 3.0, which can also be downloaded from the Microsoft homepage.

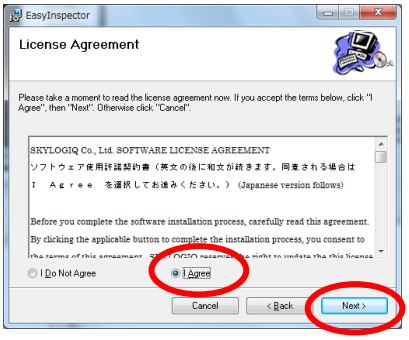
Starting the EasyInspector Installer

① Because the software evaluation version you downloaded is compressed, please decompress it using general decompression software. Then, in the decompressed folder, double click on Setup.exe.

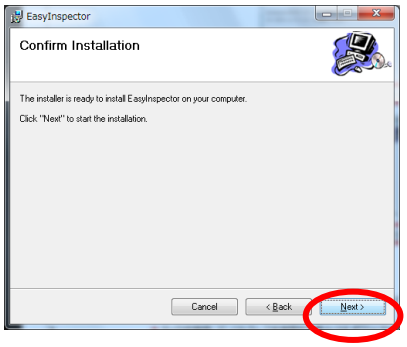
② The installer will start. Click on the button indicated in the red circle to begin the installation.



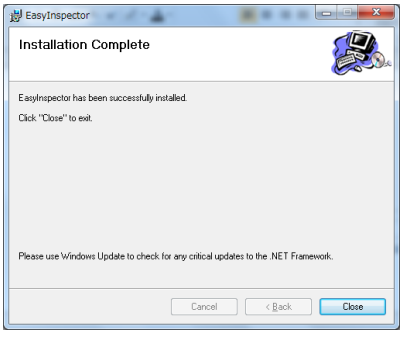
③ Read the license agreement thoroughly, and if you agree, click on “I Agree”.



④ The installation will begin. Please wait for a few moments until it finishes.



⑤ Installation of EasyInspector is complete.



4 Selecting the Test Items

There are multiple test items in EasyInspector.
Since the test items select differ depending on the test content and target object, please choose the closest options from those presented below.

Test Target	Test Item
Burrs, chipping, cracking, deformation, assembly condition, scratches, missing or faded letters, upside-down printing, typos, part numbers, etc.	“Compare with Master Image” under “Color Comparison Test”
Black/brown spots, burning, foreign body adhesion, contamination, reversed part insertion, part orientation, plating color detection, rust detection, wiring color difference detection, forgotten drilling, missing screws or parts, etc.	“Specified Color Presence Test” under “Color Comparison Test”
Product dimensions/angles (width, heights, etc.), gap detection, metal protrusion dimensions/angles, position verification, pressed product dimensions/ angles, record of liquid surface height, etc.	“Measurement/Angle Test”
Solder bridging, wire bonding, sheet count tests (paper, board, etc.), fiber count tests (cloth, etc.)	“Count / Pitch Test” under “Intensity Profile”
Bent pins, lead pitch of connectors, etc.	
Laser light spread, laser light intensity, LED brightness, etc.	“Beam Profiler” under “Intensity Profile”
Black/brown spots, burning, foreign body adhesion, black spots in plastic molding, carbides in plastic molding, white spots from dust, metal scratches, etc.	“Scratch/Spot Test”

License Type and Test Items

Test items and maximum USB camera pixel counts available in EasyInspector differ depending on the license type (grade).

Type / Item	EasyInspector 100	EasyInspector 200	EasyInspector 300	EasyInspector 310
Color Comparison Test	○	-	○	○
Dimension/Angle Test	-	○	○	○
Intensity Profile Test	-	-	-	○
Scratch/Spot Test	-	-	-	○
Pixel count of corresponding camera	80,000-300,000 pixels	80,000-300,000 pixels	80,000-1.3 mil. pixels	80,000-14 mil. pixels
Multiple camera connections	-	-	○	○

5 Using EasyInspector

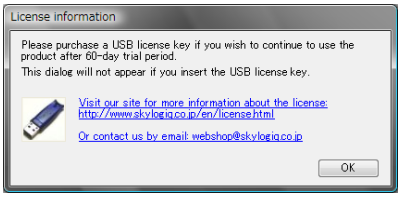
This section explains the flow from EasyInspector start-up and configuring settings up to testing.
It is possible to try out image inspection with Easy Inspector by using sample images that are independent of the test items. Since USB cameras and lighting are not needed, you can try it without worrying about them.

Starting EasyInspector

Double-click on the shortcut icon that was created on the desktop at the time of installation.

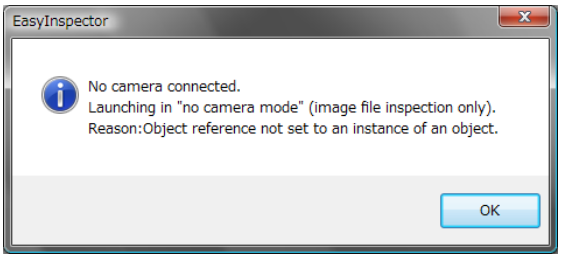
Evaluation Version Check Window

A window will appear to confirm that you are using the evaluation version. This window will appear at random times during use. When you purchase the license for the official version and insert the USB key into the computer, this window will no longer appear.



Non-connected Camera Check

If no camera is connected, the message at right will be displayed. Click OK.

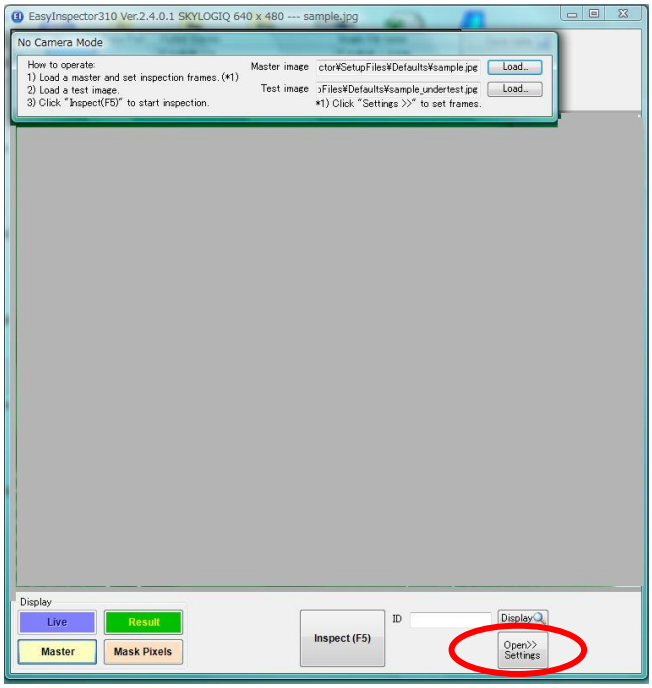


Operation Check with Sample Images (Color Test)

Main Screen

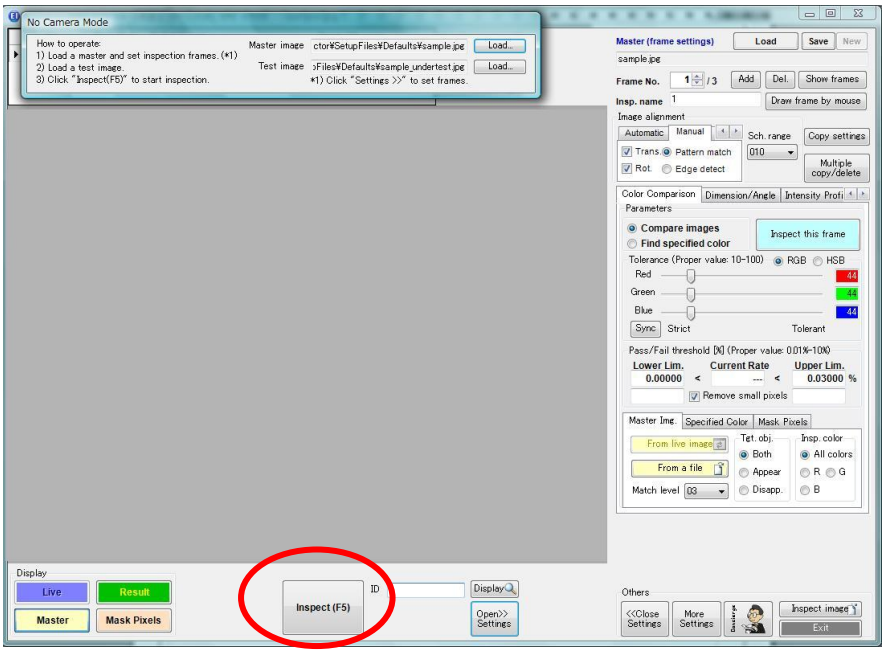
The Main Screen will appear.

Click on “Open>>Settings” in the lower right of the screen.



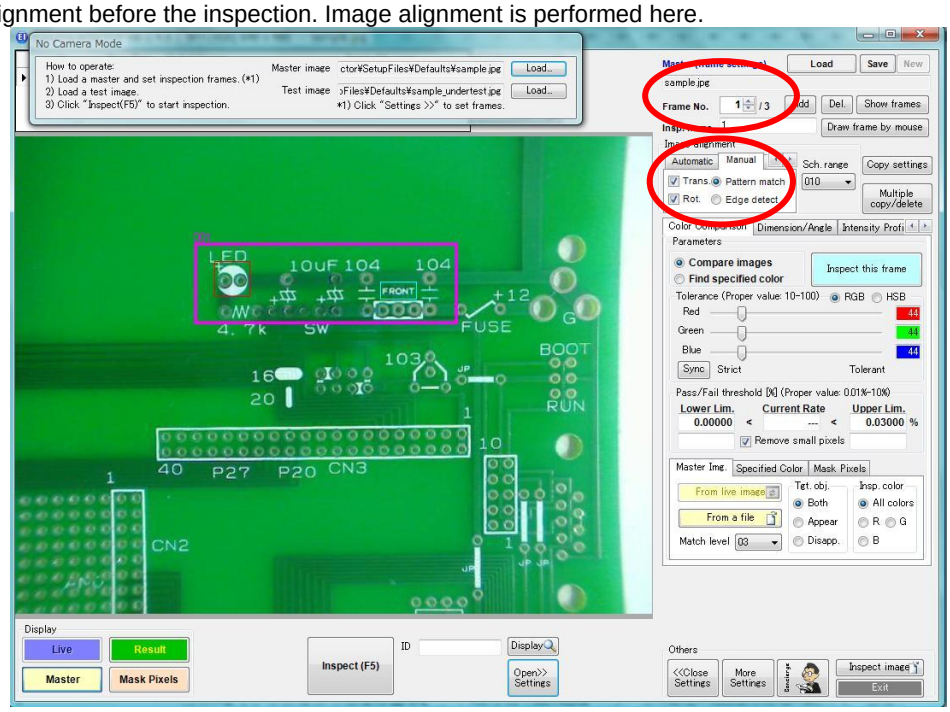
Running an Inspection (F5) (Component Test Sample)

Click on “Inspect (F5)” to try running an inspection. It will run an inspection by automatically reading a pre-installed sample master (non-defective product) image and target test images.

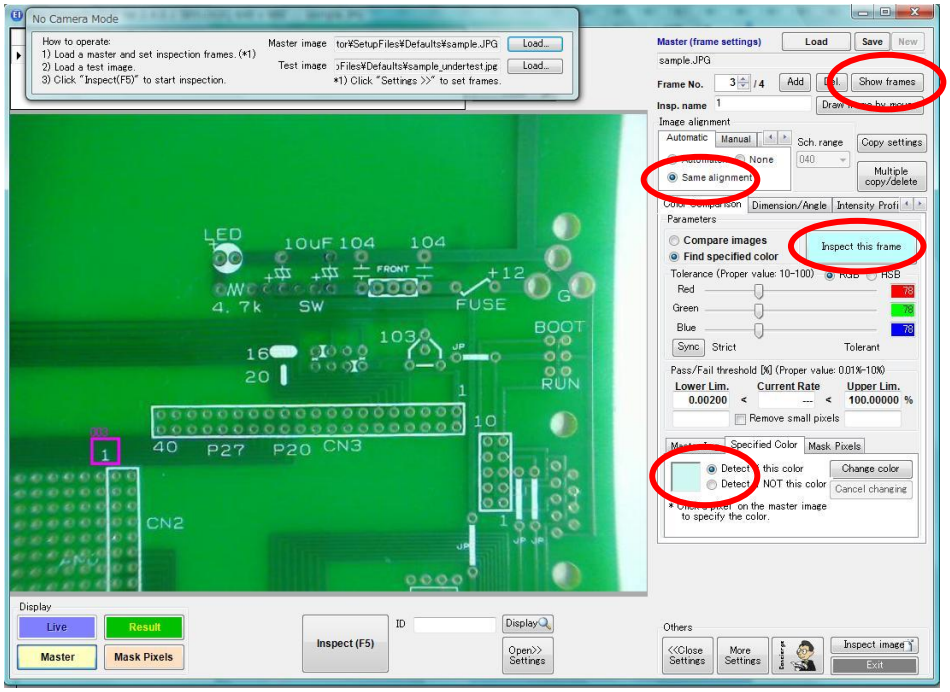


Checking Test Settings

In comparison with the Master Image (non-defective image), pre-defined areas of Frames 1 and 2 are compared with the master image according to the settings in order to detect areas that are different. When comparing with the master image, it is sometimes best to perform translational or rotational image alignment before the inspection. Image alignment is performed here.



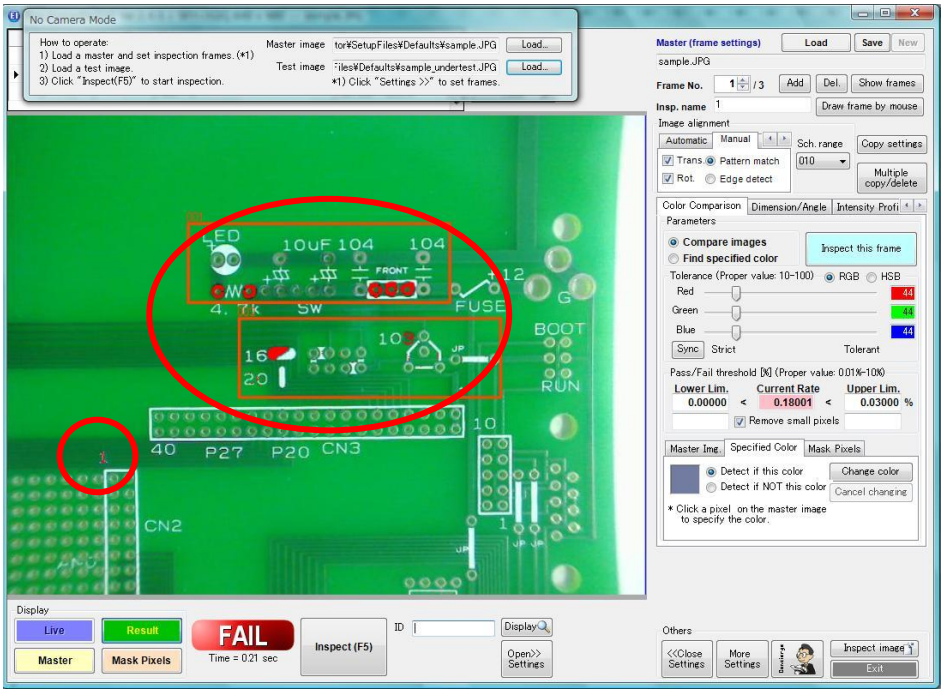
For frame 3, "Find specified color" is selected for the "Test range detection method", and test will pass inspection if the specified color (white) is detected within the frame. In this case, as long as the printed "1" in Frame 3 is detected somewhere within the frame, it doesn't matter if it is shifted slightly. For this purpose, the pre-inspection image alignment is set to "Same alignment", which means the same alignment as the previous image. (For detail, refer to the "Difference between 'Comparison with Master Image' and 'Specified Color Detection'" section below.) Clicking "Show frames" will display all the frames under current settings.

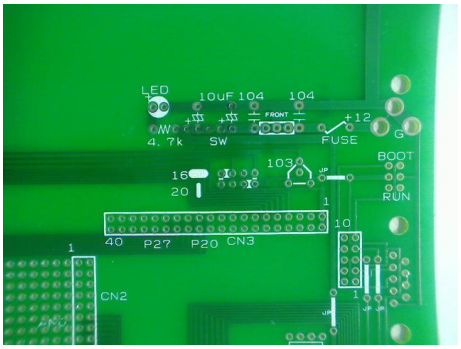


Running an Inspection

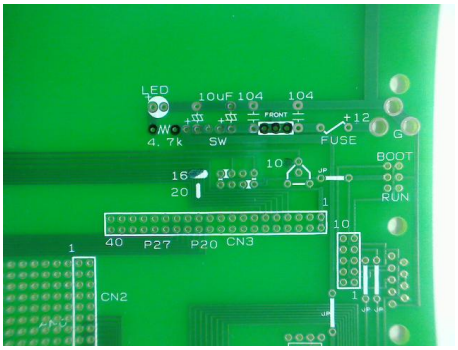
Try running an inspection by clicking "Inspect this frame".
It will automatically read and test the pre-installed sample master (non-defective product) image against the test image. After the inspection results are displayed on the screen, it will return to the previous screen.

Because the master image and test image are different as shown below, those differing areas are shown in red. In addition, due to the way frame 3 is set to detect white parts within the frame, the character "1" is detected.



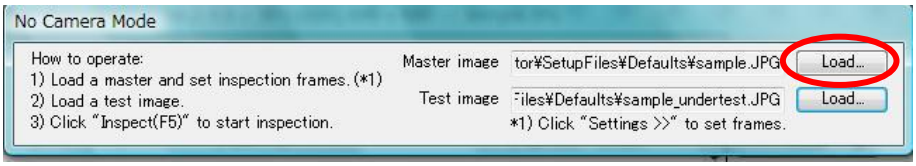


Master Image (non-defective item)

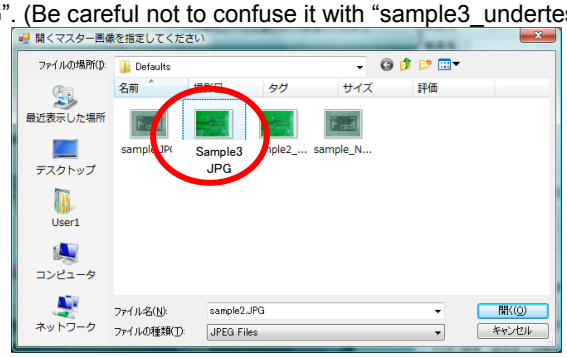


Test Image (with defective areas)

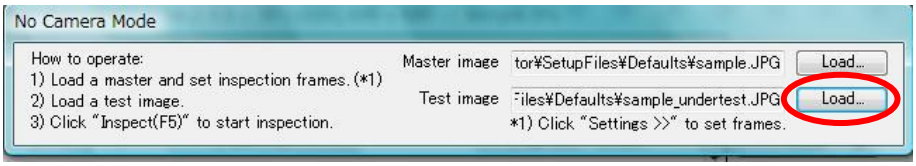
Let`s do an inspection by reading different pre-installed sample and test images (shape matching test).
First, we will read the master image. Click on Master Image "Load..." in the "No Camera Mode" window.



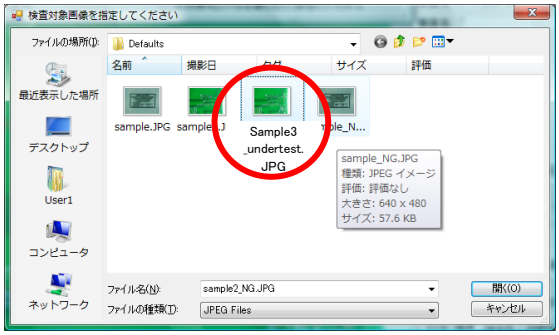
Open “sample3.JPG”. (Be careful not to confuse it with “sample3_undertest.JPG”.)



Next, click the Test Image “Load...” button in the “No Camera Mode” window.

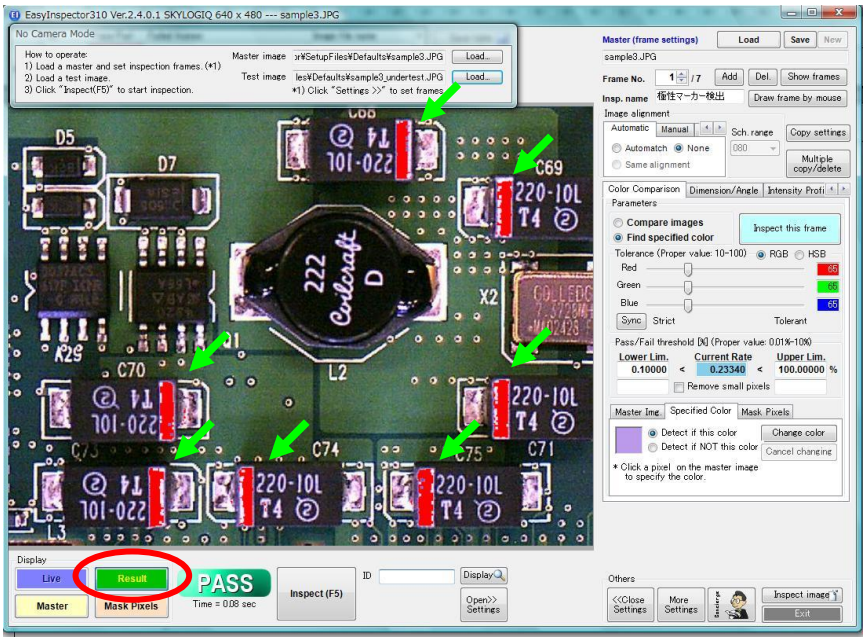


Open “sample3_undertest.JPG”. (Be careful not to confuse it with “sample3.JPG”.)

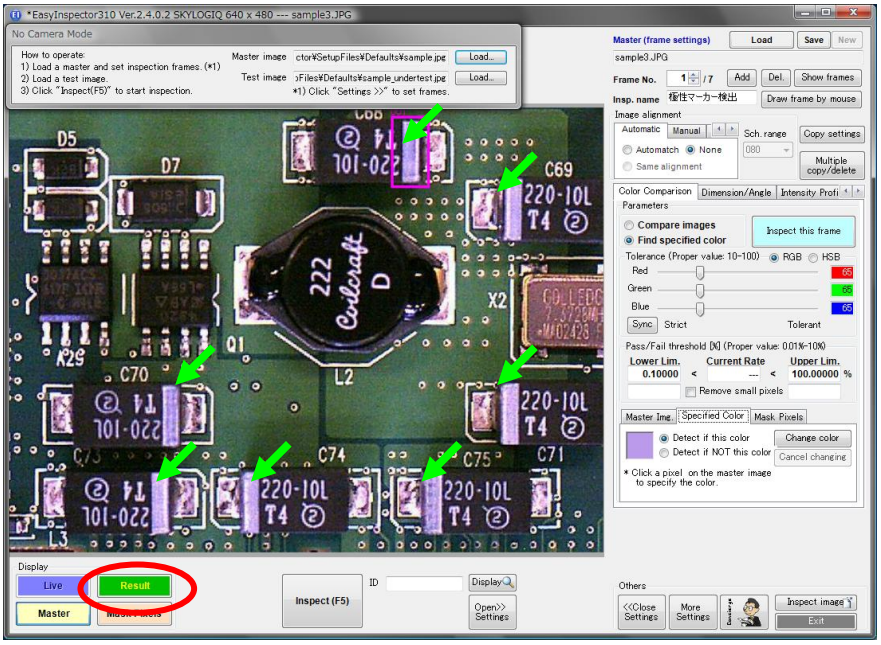


Checking the test image

Click on “Result” in the lower left to check the inspection result image.



This inspection is configured to detect the light purple color of a polarity marker (indicated by green arrows in the image below), so in the above image, the polarity marker areas are shown in red (detection areas). In cases where a condensor is missing or installed backwards, the specified color is not detected because there is no purple in the set frame (pink and green frame in the image below), so the inspection is judged to have failed.



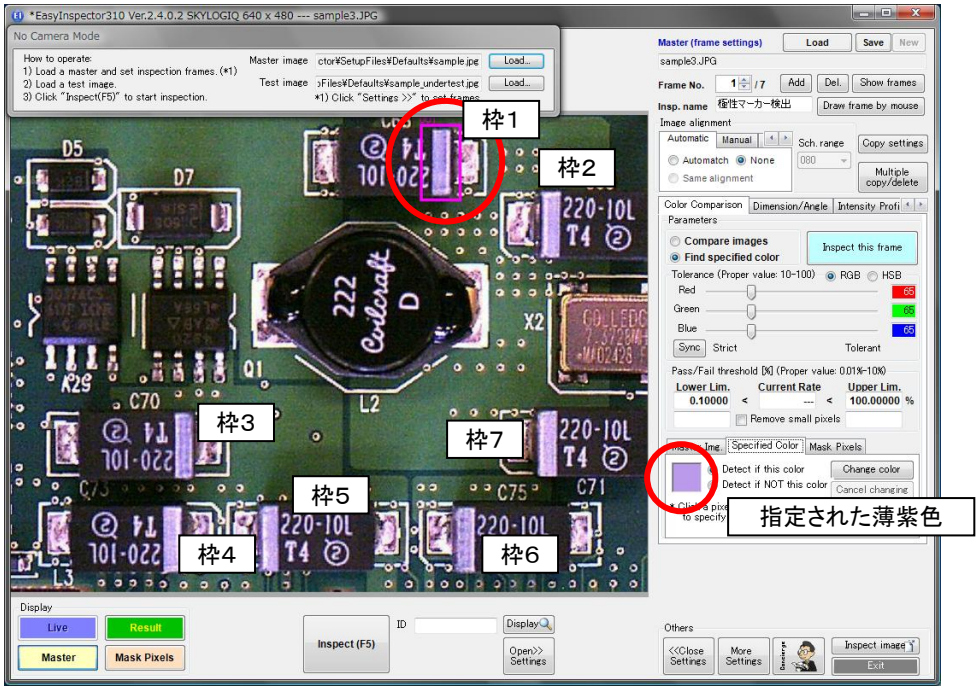
Checking Test Settings

Let`s check the test settings. When we are running real tests, configuring test settings will be a very important operation.
Test settings allow us to define the test area for each frame (pink and green rectangle in the image below). There is a number for each respective frame, and the software displays the test frame or frame number.

For each respective frame number, you can:

- set what kind of area is being detected in the image (settings for test frame position and size)
- select between “Master Image and Test Image Comparison” or “Specified Color Presence Detection”
- for “Master Image and Test Image Comparison”, set the allowable shift in position versus the non-defective image
- choose whether to remove small detection areas as noise
- set the tolerance for the pixel-by-pixel decision of whether the color is judged to be the same
- set the minimum area ratio for detected areas to pass or fail (those areas shown above in “Checking Test Results”)
- in the case of “Specified Color Presence Detection”, what color must be present within the frame (or what color must not be present there)

In this configuration, it will inspect a range (on either side of the chip) where each frame number must have a polarity marker (light purple bands on the chip). If the polarity markers are present as normal, the specified color will be detected and the inspection will be judged to have passed. If the chip is mounted backwards, the color of the polarity markers will not be found, and it will be judged to have failed.



Difference between “Comparison with Master Image” and “Specified Color Detection”

“Comparison with Master Image”

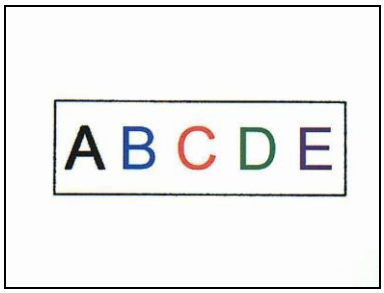
Inspection by comparison with the master image means that it performs a pixel-by-pixel comparison of the master image (non-defective item) and test image. The inspection will not pass unless both of the following conditions are met:

- the colors match
- the position matches

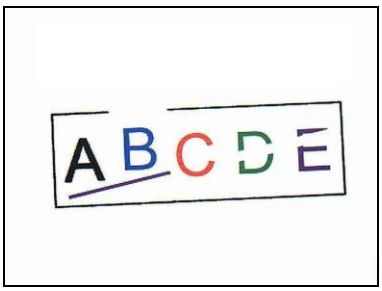
This means it can be used to detect shifts in printing, blurring, size and position discrepancies, breaking, and bending.

However, since positional shift can cause comparison with the master image to fail, a shift during camera and sample setup can significantly affect the inspection. For that reason, when the shift is large, it necessary either to improve the position sample accuracy at the time of imaging, or to use the position alignment feature this software provides. For information on matching image positions before inspection, please refer to the "Setting the Translational/Rotational Position Correction Box for the Master Image" section below.

Example (printing):

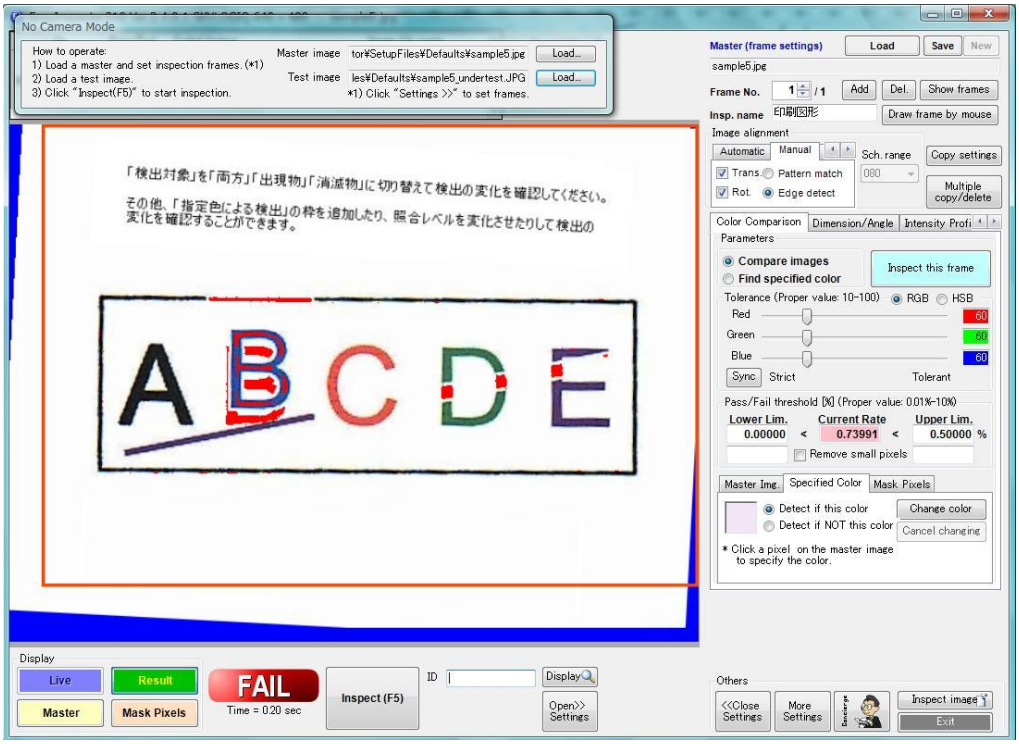


Master Image (non-defective)



Target Image (defective, shifted, slanted)

Test result: After correcting for shift and slant, a pixel-by-pixel comparison with the master will be conducted.


No Camera Mode
How to operate:
1) Load a master and set inspection frames. (*1)
2) Load a test image.
3) Click "Inspect(F5)" to start inspection.
Master image
Test image
Load...
*1) Click "Settings >>" to set frames.
「検出対象」を「両方」「出現物」「消滅物」に切り替えて検出の変化を確認してください。
その他、「指定色による検出」の枠を追加したり、照合レベルを変化させたりして検出の変化を確認することができます。
ABCDE
Master (frame settings)
Load
Save
New
sample5.jpg
Frame No.
Add
Del.
Show frames
Insp. name
印刷図形
Draw frame by mouse
Image alignment
Automatic
Manual
Sch. range
Copy settings
Trans.
Pattern match
Rot.
Edge detect
Multiple copy/delete
Color Comparison
Dimension/Angle
Intensity Profi
Parameters
Compare images
Find specified color
Inspect this frame
Tolerance (Proper value: 10-100)
RGB
HSB
Red
Green
Blue
Sync
Strict
Tolerant
Pass/Fail threshold [%] (Proper value: 0.01%-10%)
Lower Lim.
Current Rate
Upper Lim.
0.00000
0.73991
0.50000
Remove small pixels
Master Img.
Specified Color
Mask Pixels
Detect if this color
Detect if NOT this color
Change color
Cancel changing
* Click a pixel on the master image to specify the color.
Display
Live
Result
Master
Mask Pixels
FAIL
Time = 0.20 sec
Inspect (F5)
ID
Display
Open>> Settings
Others
<<Close Settings
More Settings
Inspect image
Exit

“Specified Color Presence Detection”

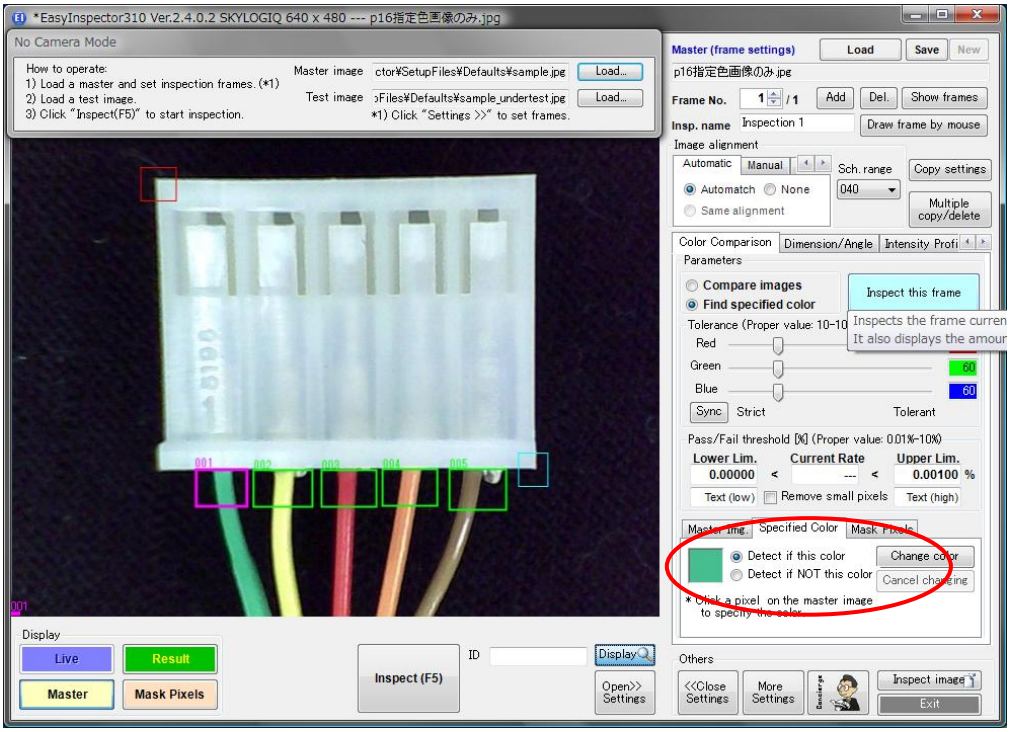
Unlike “Comparison with Master Image”, specified color detection makes a judgment based only on

- whether a specified color (or a color other than that specified) can be detected within the frame.

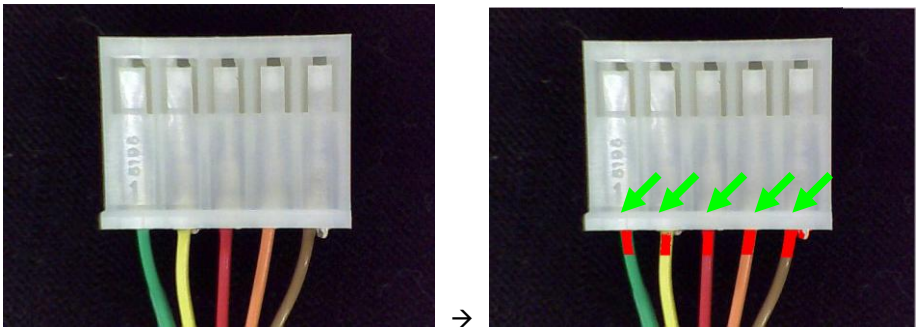
This means that, even if there is a position shift, the inspection will pass as long as the color can be found within the frame or, conversely, fail if a color other than the specified color is found within the frame. This judgment method is appropriate for checking for black spots, dirt, missing parts, foreign bodies, assembly status, etc.

Even if sample positioning at the time of imaging is somewhat inaccurate, in most cases it is not necessary to use the software’s position alignment function (pre-inspection image position matching.

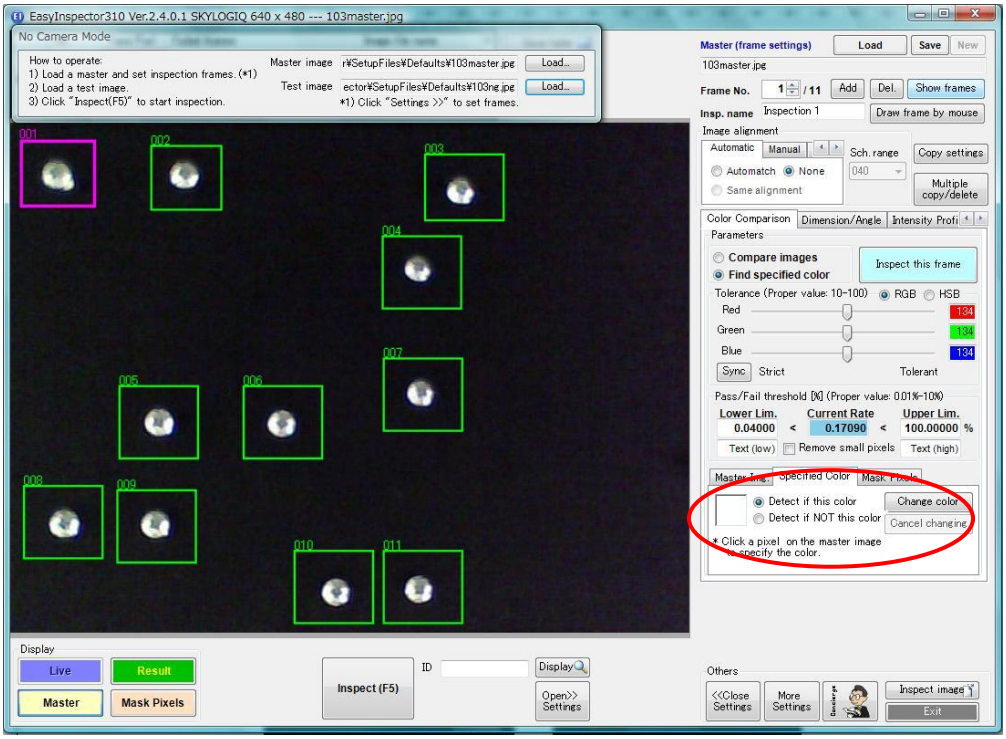
Example 1 (Detection of wire color difference): Inspection with a color specified for each frame
If a green wire is installed in the pink frame on the left, the inspection will pass. Similarly, yellow, red, orange, and brown are specified for each of the other respective frames, and it will check for those. As long as the wires are within their respective frame, it does not matter if they move around.



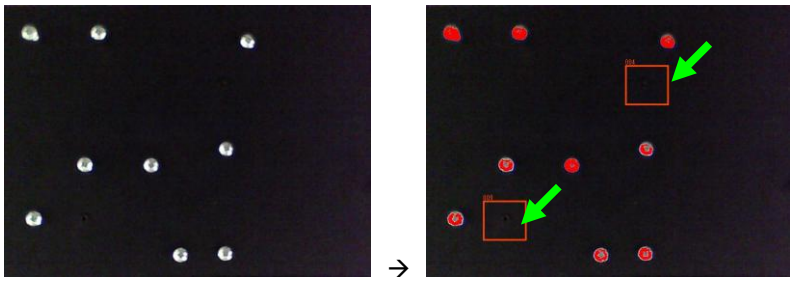
Test result：The red marks (in the right image) show that specified colors were correctly detected in their respective frames.



Example 2 (inspection for forgotten screws): Inspects for the presence of screws in 11 places. It inspects for the presence of each screw by detecting an area of white from the reflection off the screw.



Test result: It detected 9 screws, but did not detect two of the middle screws (right image).



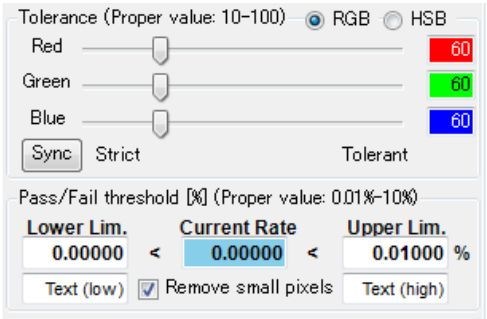
In addition, it can be adapted to a variety of test object by the using the settings below.

Test object	Detection method	Detection % for pass - ex.	Detection % for fail – ex.	Minimum	Maximum
Dirty or faded print	Comparison with master image	0.1 %	2.0 %	0 %	1 %
Part installed at a designated spot	Specified color detection (Inspect for designated part color)	2.0 %	0.1 %	1.0 %	100%
Foreign matter in powder or food product	Specified color detection (Inspect for color *other* than the powder/food color)	0.0 %	0.1 %	0 %	0.05%
Presence of cracks in glass	Specified color detection (Inspect for crack color (white)	0.0 %	0.1 %	0 %	0.05%

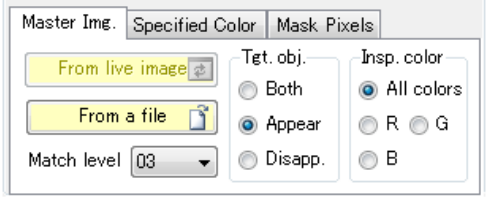
※Inspect both pass and fail items, take the media value and use it for the minimum or maximum of the "Pass/Fail Threshold".

Other Setting Items for Color Comparison Testing

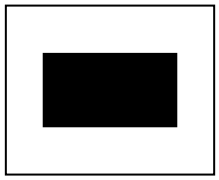
- “Match Level” : Setting mainly used when inspecting by comparison with master image. When set at a high value, it will not detect small position shifts between the master image and the test image (judgment occurs if there is no problem). For test items where the position may be somewhat different, set this number on the high side to reduce the impact of noise and shifting.
- “Remove small pixels” : Sometimes, the inspection detects a lot of noise areas with around 1 or 2 pixels. If this noise affects your test results, remove them by turning this checkbox on. This setting is mainly used with inspectiong by companison with master image.
- “Position alignment” : In inspection by comparison with the master image, positional shifting has a large impact on the inspection (see the “Difference ‘Comparison with master image’ and ‘Specified color detection’” section). By turning this checkbox on, you can correct position shift (translational or rotational). For details, see the “Setting the Translational/Rotational Position Correction Box for the Master Image” section.
- “Tolerance” (Color judgment tolerance range): You can set the tolerance with regard to the level of each color. Color tolerance is the range of color for judging whether a color matches the standard color (for comparison with master image, the color of each pixel in the frame; for specified color detection, the specified color). For each color component, it will be judged as a different color if it falls outside of the range by even 1 point. Accordingly, for inspection by comparison with the master image, if this value is set low (strict), even small difference in color will be judged as a different color, so the detection level is increased. Conversely, for inspection by specified color detection, if this value is set low, the range of color which will be judged as being the same is narrowed, thus decreasing the detection level.



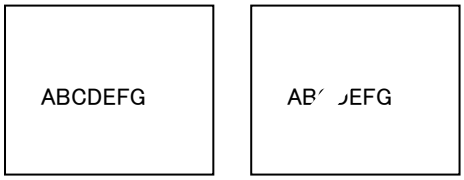
- “From live image” : Update the master image to the image currently captured by the camera.
- “From a file” : Open an existing master image and use it for the master image.
- “Save to file” : Save the currently displayed master image to a file.



- “Target object” : For inspection by comparison with master image, you can limit testing to things that appear (dust, cracks, etc.), or things that are absent (faded printing, etc.).

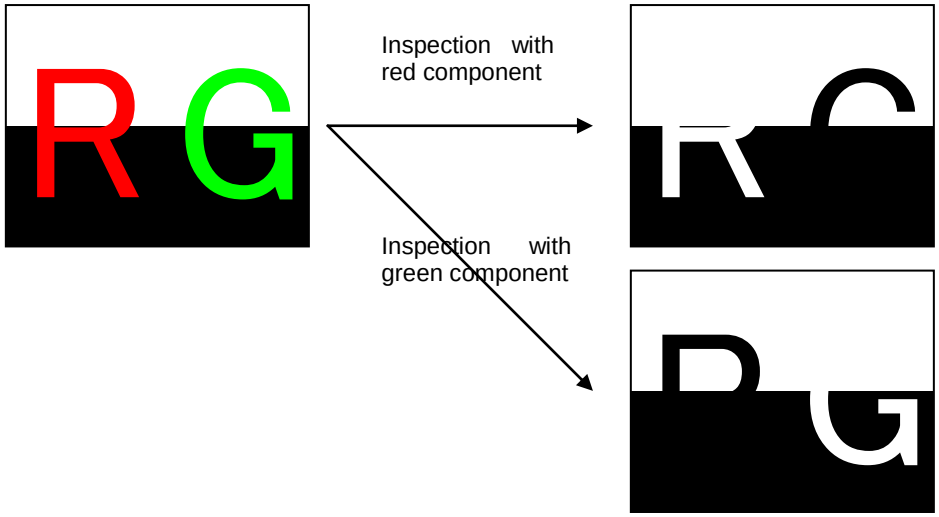


Example of things which appear (dust, cracks, etc.)



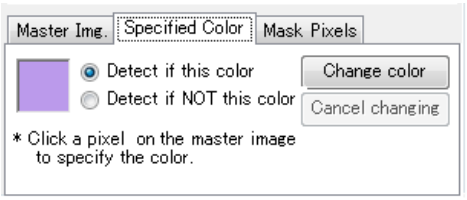
Example. of things which are absent (faded printing, etc.)

- “Test color” : For inspection by comparison with the master image, you can limit color components to be tested. This has the same effect as setting a maximum tolerance for color component other than the



limited color component. In the image above, when the background is white, an inspection for the red component will remove (ignore) the red parts for inspection. Conversely, when the background is black, the inspection will remove the parts which have no red component.

- “Detect if this color” : Detects the specified color. For example, to inspect for forgotten parts, the part color is specified, and it inspects for the presence or absence of parts, inspects to see whether the specified color is printed or not, inspects for cracks in glass, and so on. It detects things with a certain color, and if the color is present, the inspection is judged to have failed.



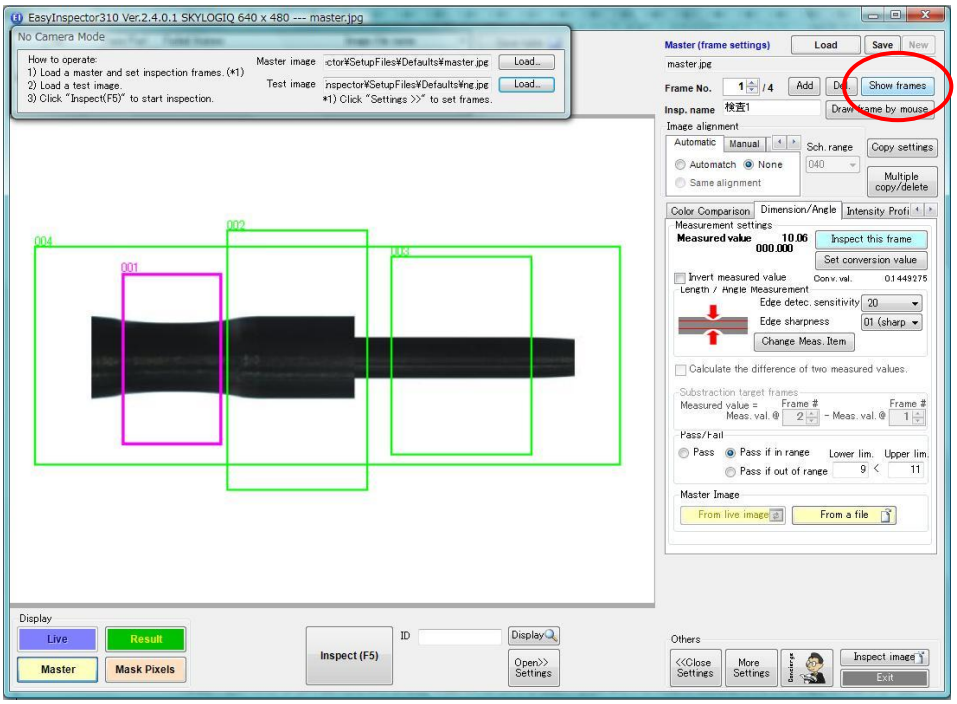
- For example, for rice or a powder or liquid, it is not possible to predict what color a foreign body might be. In this case, for rice, we use white as the specified color, and “detect if there is any color besides white” to detect foreign bodies.
- “Change color” : You can extract a specified color from the master image. After clicking this button, click on the color in the master image that you want to specify.

“Dimension/Angle Test”

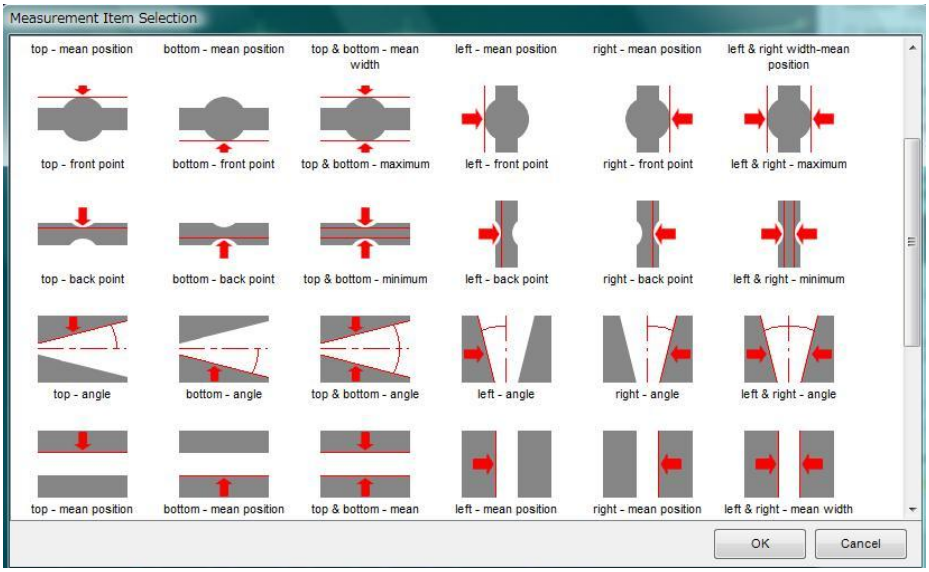
Now we will read a master image for dimensions/angles using the same procedure as “Reading and Inspecting a Sample Image (Shape matching test)”. The master image file name is “sample2.jpg”, and the test image file name is “sample2_undertest.jpg”. Click on “Inspect (F5)” and verify the dimension/angle measurement operation.

Checking Test Settings

When “Show frames” is clicked, it shows the positions of registered inspection frames. This sample is set to inspect the angle and width of metal processed parts.

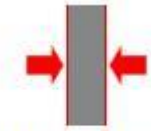
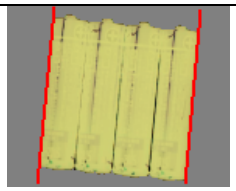
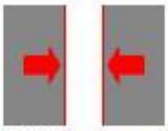
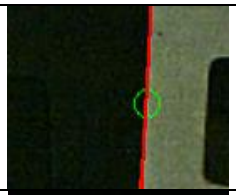
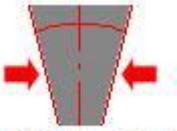
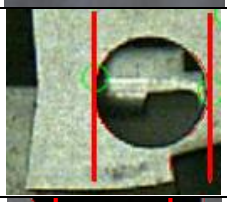
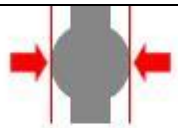
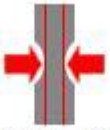


“Change Measurement Item” button : The measurement item sets the direction (top, bottom, left, right) from which the test area of each from will be examined, which change (white-to-black or black-to-white) will determine an edge, and what type of measurement will be conducted (angle, dimension, etc.). When you click on the “Change” button, measurement items are provided visually for you to choose from.



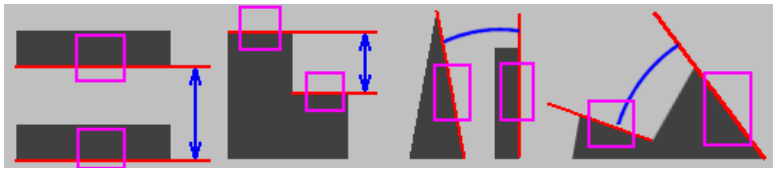
Exampe of item selection：

The examples below are selected from the above measurement items.

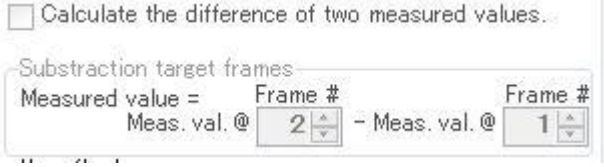
Measurement details	Image	Selected item
Width measurement (with bright background) ・Looking from the right and left sides, extracts the lines where it changes from the light background to the dark part.		 left & right width-mean position
Width measurement (with dark background) ・Looking from the right and left sides, extracts the lines where it changes from the dark background to the light part.		 left & right - mean width
Angle (with dark background) ・Looking from the left side, extract the line where it changes from the dark background to the light part		 left - angle
Angle opening (with light background) ・Looking from the right and left sides, extracts the 2 lines where it changes from a light background to dark.		 left & right - angle
Hole diameter (with light background) ・Looking from the right and left sides, extracts the most exterior points at which the light background changes to dark.		 left & right - maximum
Narrow part (with light background) ・Looking from the right and left sides, extracts the most interior points at which the light background changes to dark.		 left & right - minimum

Calculation of Relative Position and Angle

By checking “Calculate the difference of two measured values”, you can calculate and judge the relative position or angle of two frames which have already been measured. This setting can be used from frame 3.



For example, in frame 3, the position of the edge in frame 2 is calculate, with the edge in frame 1 as standard, and the judgment is set in the following way.

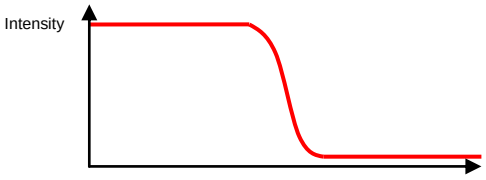


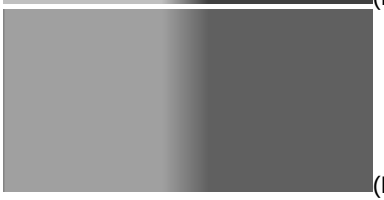
Settings for Sensitivity and Sharpness for Edge Detection

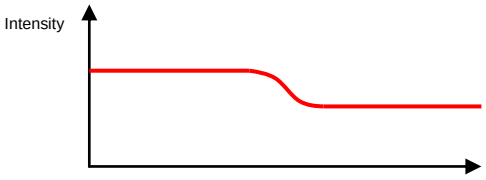
Edge detection sensitivity :

When you want to capture low-contract edges, set the sensitivity high (a low value). However, when sensitivity is set high, it is easier to detect parts (noise, etc.) which are not the actual edge. This value should be set to a value as low as possible without detecting noise (Because things detected as noise will be automatically removed during image processing, having some noise will not cause a problem.)

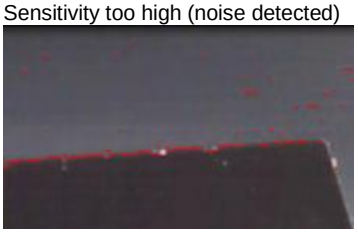
(High contract)



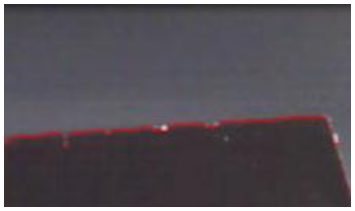

(Low contrast)



Sensitivity too high (noise detected)



Suitable value

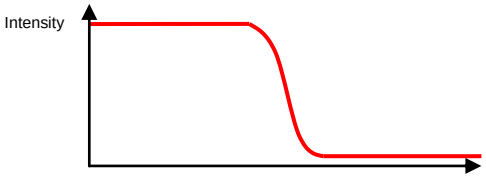


Sensitivity too low (edge not detected)

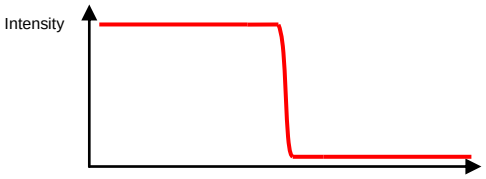
Target edge sharpness :

It is normally set to “01 (Sharp)”. If a focused edge cannot be captured and the edge position is wavy, it will be necessary to set a higher value for detection of a dull edge.

(Dull edge)



(Sharp edge)



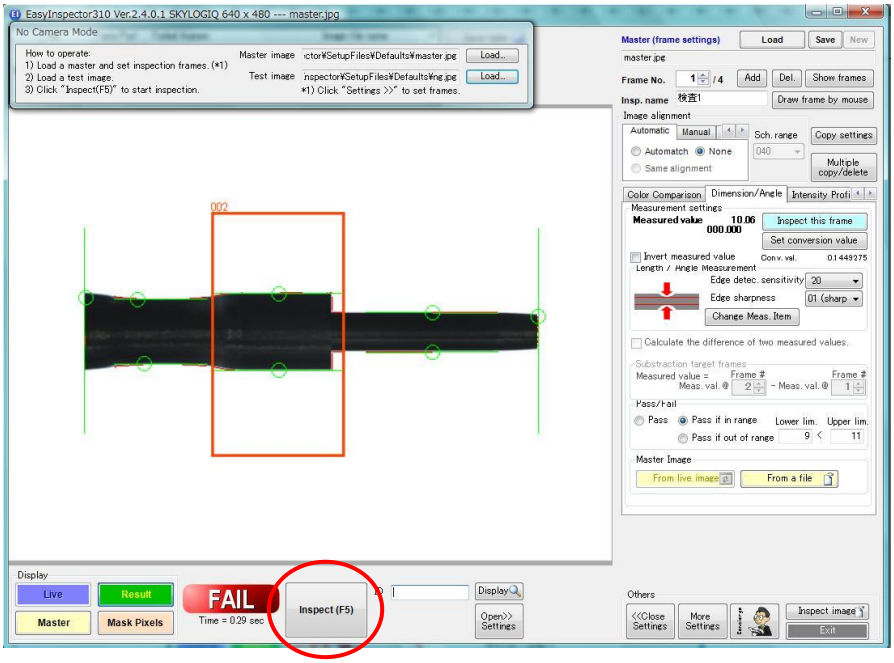
Difference in test results when a dull edge is detected :

When “Sharp” is selected, there is a degree of variation in the line.

When “Dull” is selected, the edge is smoother.

Running an Inspection

Click on “Inspect (F5)”. Edges detected in each frame will be displayed in red, and lines for requested measurements based on the edges will be displayed in green. (By clicking on “Inspect this frame”, you can inspect each frame individually. “Individual inspection” is useful for adjusting test settings.)

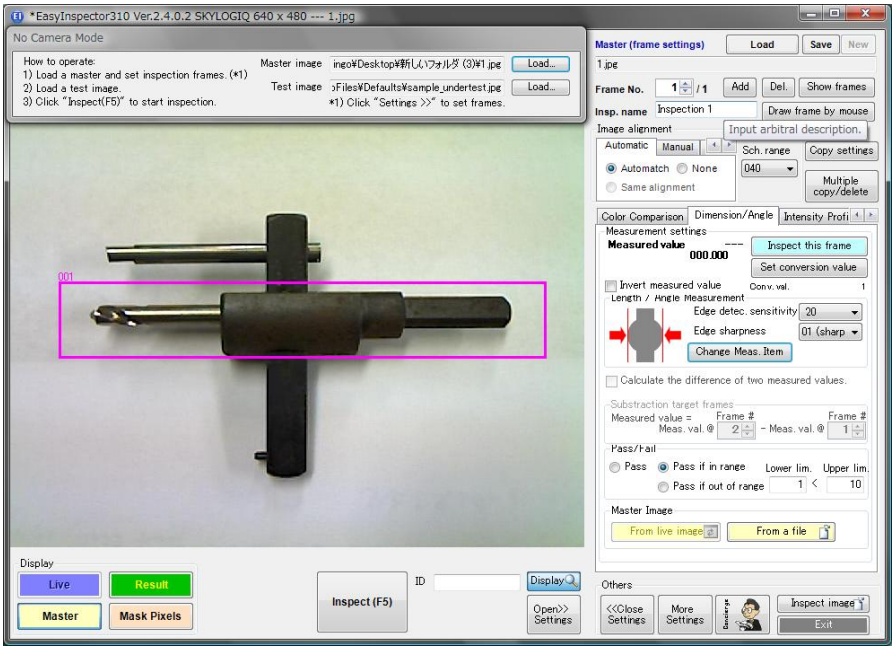


Length Calibration

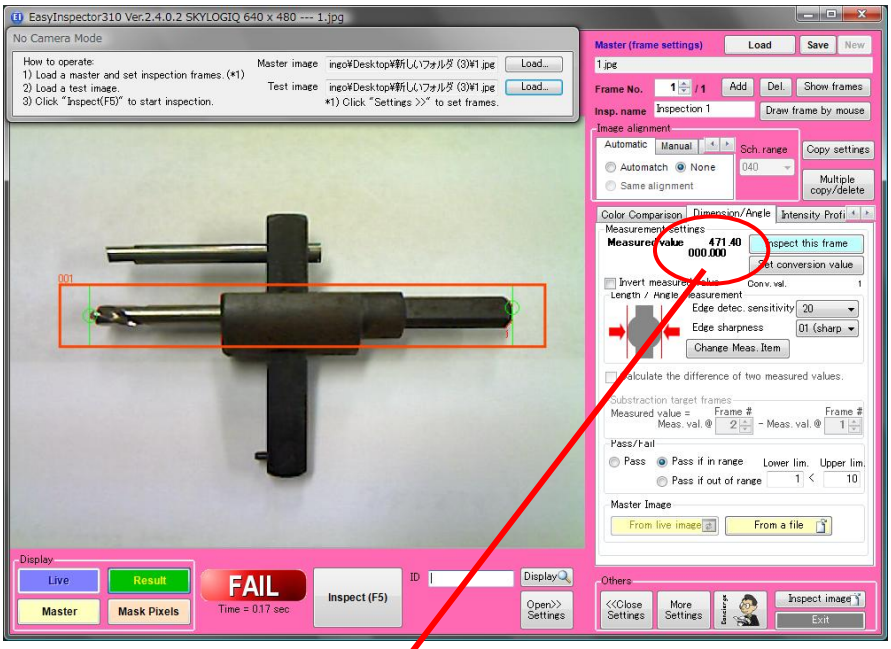
If length has not been calibrated, length is diplayed in pixels. If you want to convert this to mm or another unit, you need to calibrate length. By calibrating the length, you can set the length that corresponds to one pixel in the existing image capture, and test results will be displayed and judged in mm or another unit.

How to calibrate

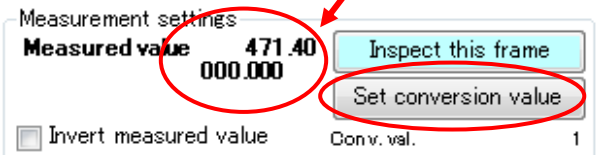
First, use a sample with a known length, and set it to measure that part.



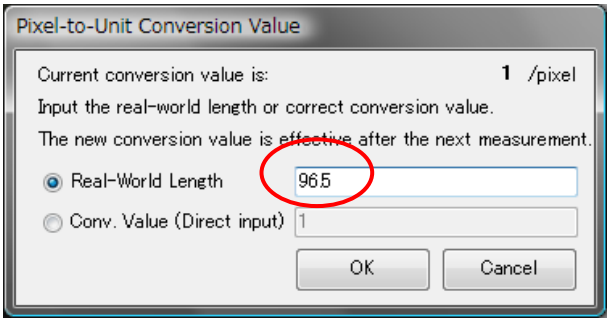
Run an inspection.



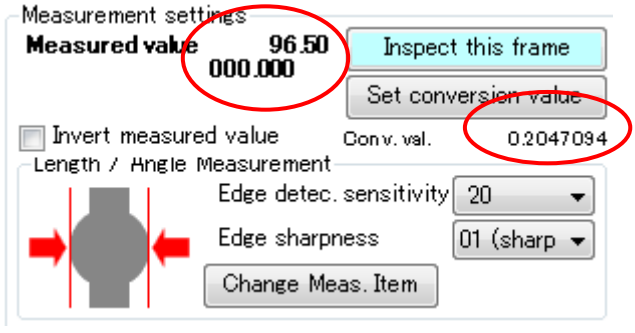
Before calibrating the length, length is shown in pixels (left-right width in the above image). Now click on "Set conversion value".



Input the Real-World Length. Here, we are using something with a known value of 96.5 mm. After inputting the value, click OK to close the box.



A conversion value of 0.2047094mm per pixel is calculated, and future measurements will be displayed and calculated in mm.

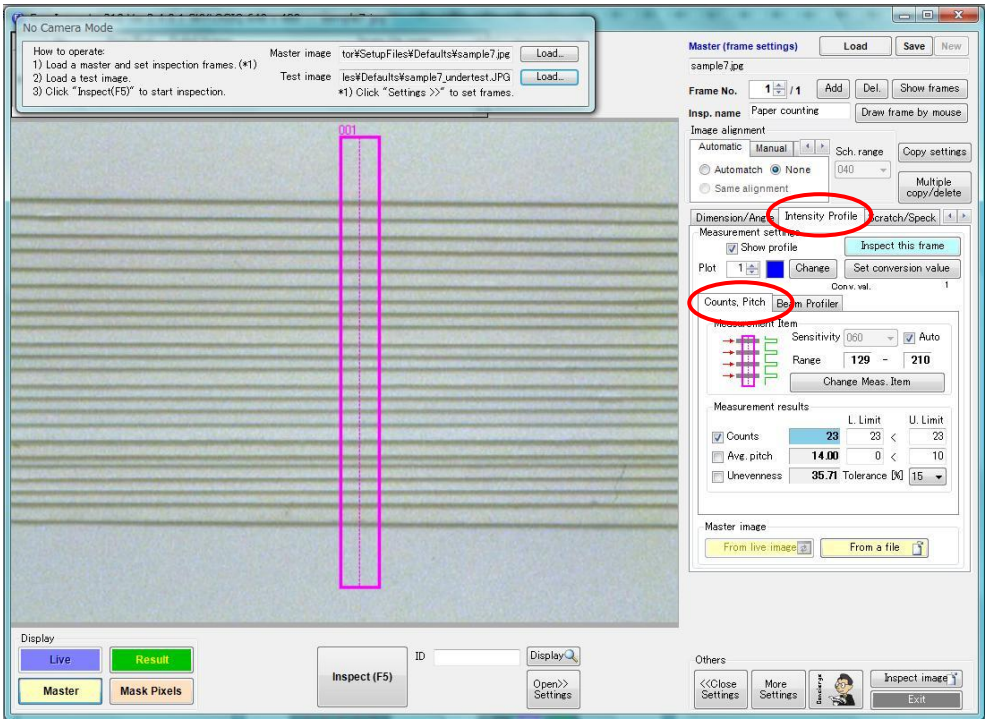


“Intensity Profile Test” Count/Pitch Test

Now we will read a master image for intensity profile tests using the same procedure as “Reading and Inspecting a Sample Image (Shape matching test)”. The master image file name is “sample7.jpg” and the target image file name is “sample7_undertest.jpg.” Click on “Inspect (F5)” and verify the count/pitch test operation.

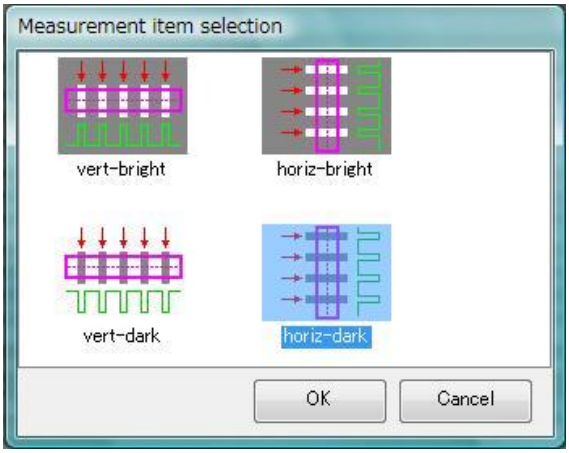
Checking Test Settings

This sample is set to inspect for horizontal line counting and gap variance.



“Change measurement item” button : Sets the test item for the testing range specified in the test frame. Select the line direction (vert./horiz.) and color change (white→black / black→white) from the following four patterns. Select the visual which is closest and click OK.

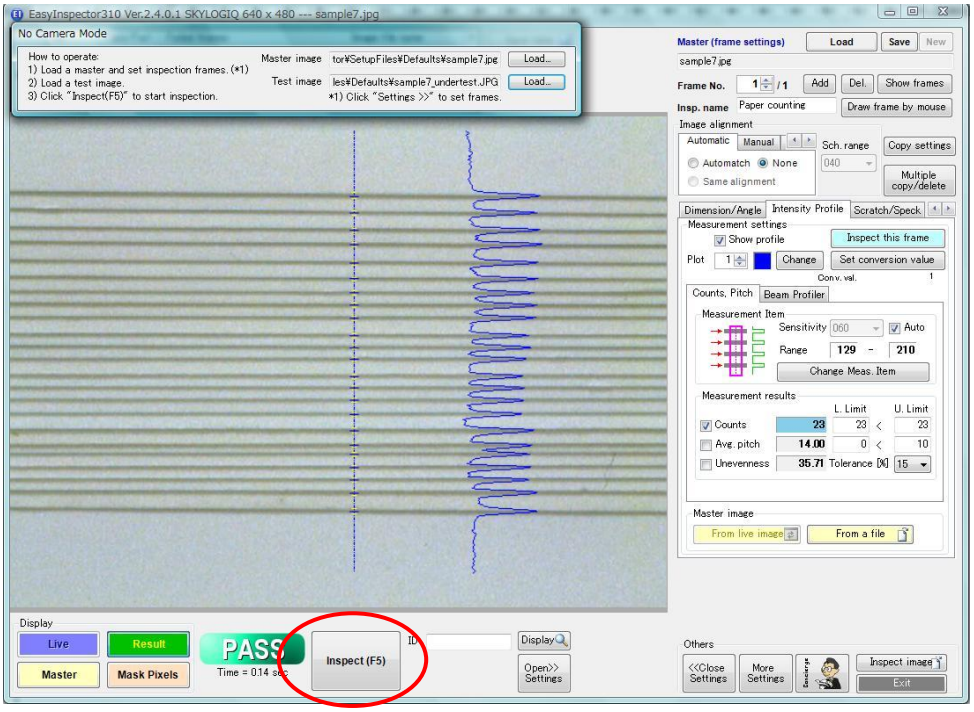
In the above example, “horiz-dark” is selected.



Running an Inspection

Click the “Inspect (F5)” button. Detected edges and intensity changes (intensity profile) will be each be shown in green. “Count” is selected to count the horizontal lines in the sample, but if you want to inspect intervals and gaps between the lines, you can select “Avg. pitch” or “Unevenness”.

※As with dimension/angle tests, you can calibrate the length.

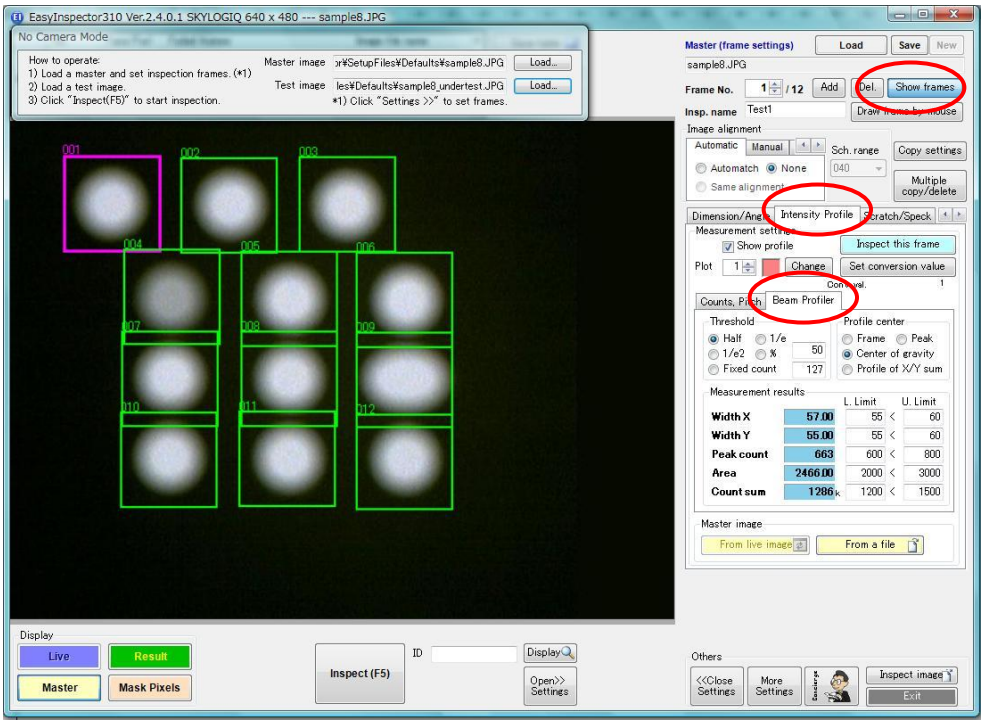


“Intensity Profile Test” Beam Profiler

Now we will read a master image for intensity profile tests using the same procedure as “Reading and Inspecting a Sample Image (Shape matching test)”. The master image file name is “sample8.jpg” and the target image file name is “sample8_undertest.jpg.” Click on “Inspect (F5)” and verify the beam profiler operation.

Checking Test Settings

When “Show frames” is clicked, it will display the position of registered test frames. This sample is configured to inspect the light-emission status of LEDs.



Description of Features

① Intensity profile Display

If you want to check the profile, put a check mark in “Show display”.

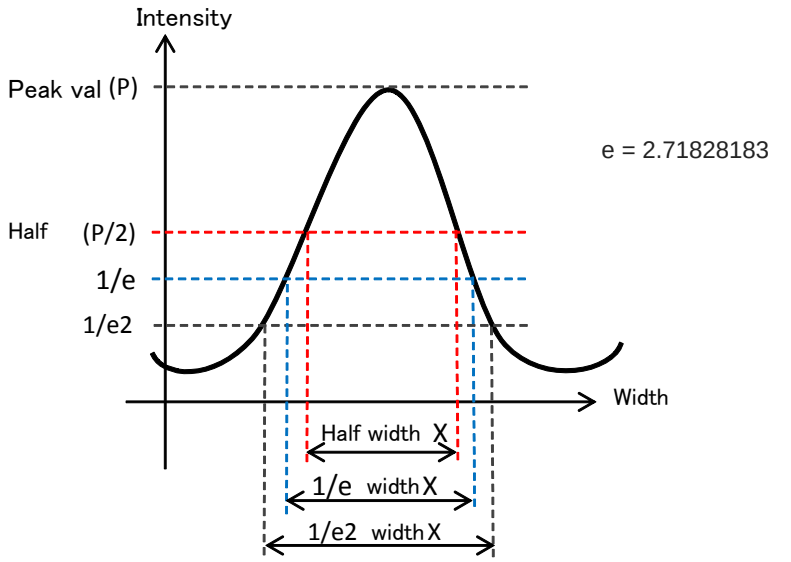
② Dimension Conversion Value Settings

The dimension conversion value provides a real-world length per pixel.

For details, please refer to “Length Calibration” in the “Dimension/Angle Test” section.

③ Threshold

Sets the threshold for matching with the test item`s intensity.
The brightest pixel in the frame is represented by the peak value.
When “%” is selected, please enter a value in the next frame.
When “Fixed count” is selected, please enter the direct value.
※You can check the peak value in “Peak count” under the measurement results after conducting an individual inspection.



④ Profile Center

Select the center position for the profile.
Selecting “Frame” sets the center position of the frame.
Selecting “Peak” sets the brightest pixel as the center position.
Selecting “Center of gravity” sets the place of best continuous intensity balance as the center position.
Selecting “Profile of X/Y sum” counts brightness within the frame, sets the center position according to the results of the calculation.

⑤ Test Results

Width X ： Values of intensity change in X width

Width Y ： Values of intensity change in Y width

(X and Y width are initially displayed in pixels, and displayed in mm if optional dimension conversion is used)

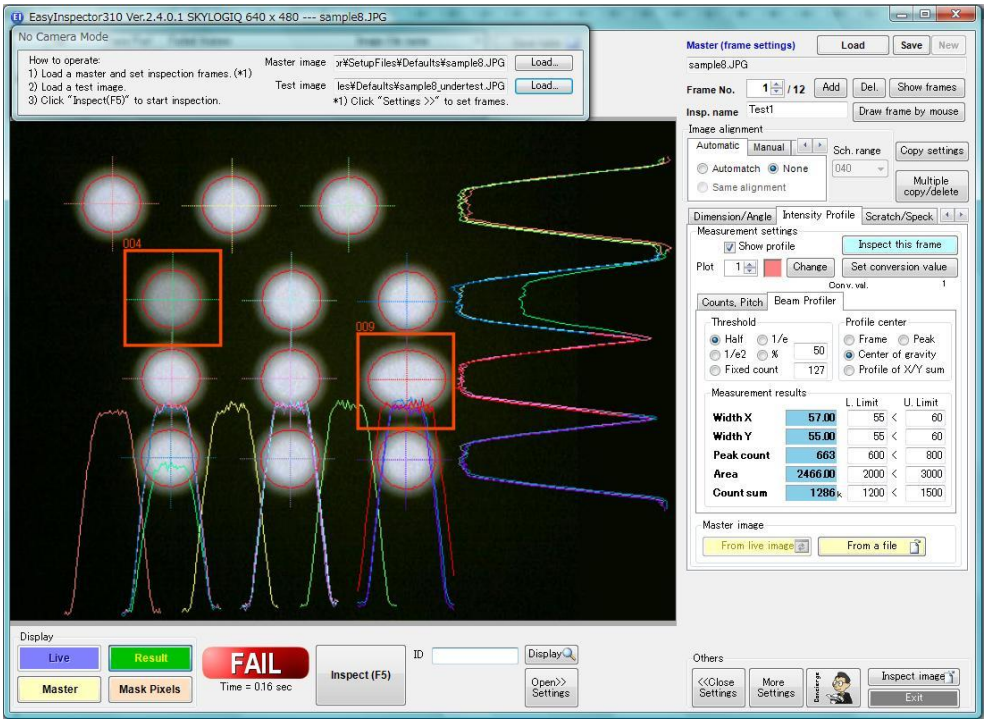
Peak count : Values of the brightest pixel position in the frame

Area : Values of area of intensity change within the frame

Count sum : Values of brightness within the frame

Running an Inspection

Click “Inspect (F5)”.

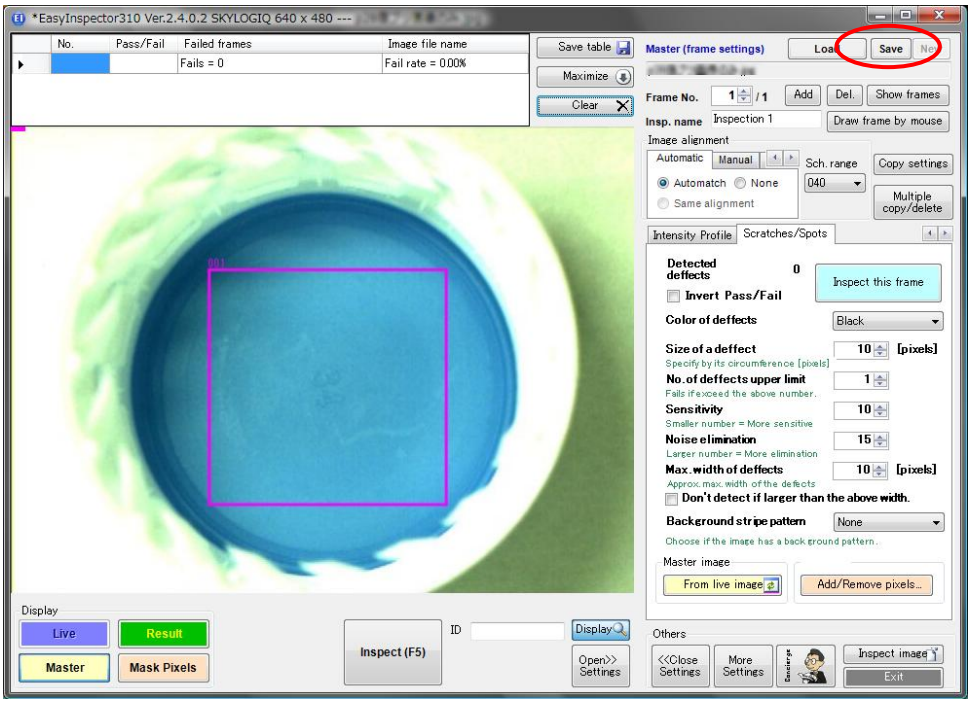


“Scratch/Spot Test”

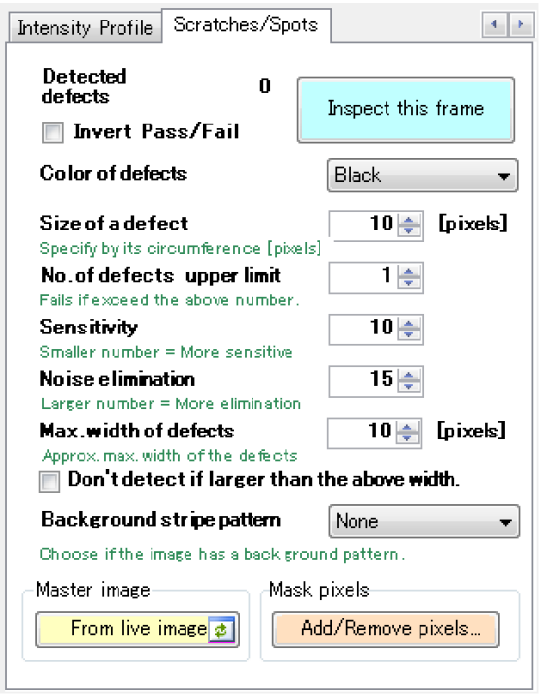
Now we will read a master image for scratch/spot profile tests using the same procedure as “Reading and Inspecting a Sample Image (Shape matching test)”. The master file name is “sample10.jpg”, and the test image file name is “sample10_undertest.jpg”. Click “Inspect (F5)” and verify the scratch/spot test operation.

Checking Test Settings

This same inspects for scratches or dirt inside plastic products (pet bottle caps).



Description of Features



① Defect Color

If the color of the scratches or dirt you want to detect is darker than the background, select “Black”. Conversely, if the color is lighter than the background, select “White”. In the sample, the background is light blue, so “Black” is selected.

② Defect Size

Set the size in pixels of the scratch or dirt you want to detect. If you don’t know the appropriate value for this, test an actual sample, then input the value displayed to the upper left of the target spot.

③ Maximum Number of Defects

If the test meets the set number of detected scratches or spots, it is judged to have failed.
The sample is set to fail if even one spot is detected, so “1” is selected.

④ Detection Sensitivity (Difference in Intensity)

If you are inspecting for dark scratches or spots on a light backgroud as in the sample (i.e., there is a difference in intensity), set the value high. Conversely, if you are detecting scratches or spots of a color similar to the background (no difference in intensity), set a low value.

⑤ Noise Elimination Level

If you want to detect all scratches or spots, even small ones, set a low value. Conversely, if you don’t want the test to fail for small scratches or spots, set a high value.

⑥ Maximum Width of Defects

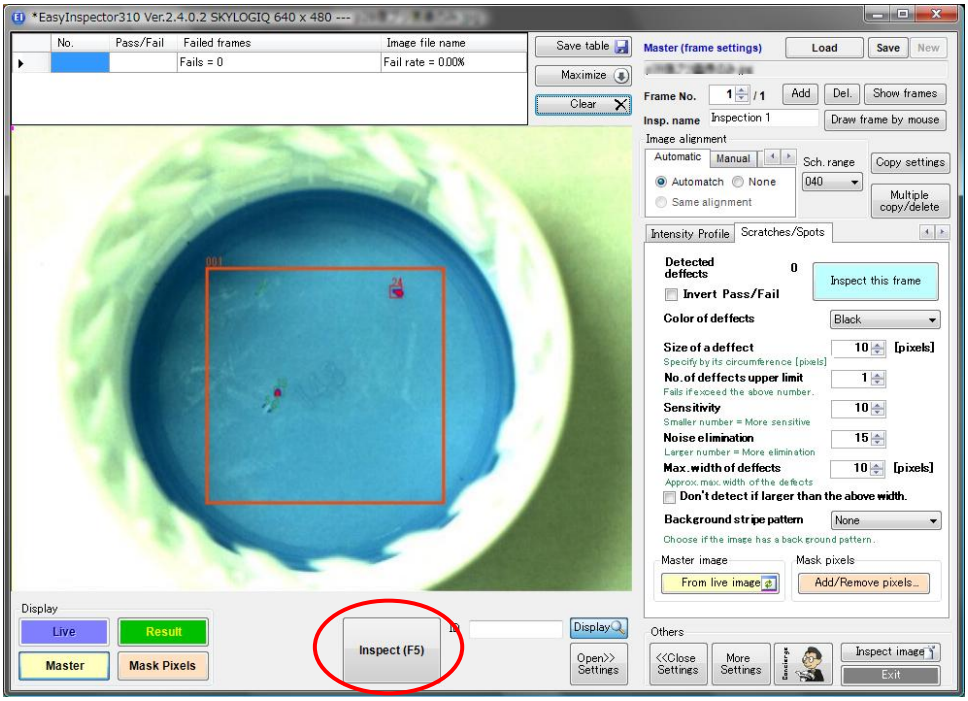
This sets the maximum width of the scratches or spots you want to detect, in pixels. When you put a check next to “Don’t detect if larger than the above width”, scratches and spots exceeding the setting value will not be detected.

⑦ Background Stripe Pattern

If the background has a pattern close to a vertical striped pattern, set this to “vertical stripe”. If it is close to a horizontal stripe pattern, set this to “horizontal stripe”.
If the pattern is complex, such as polka-dotted or checkered, you may not be able to inspect for scratches or spots.

Running an Inspection

Click “Inspect (F5)”. Detected scratches and spots will be displayed in orange. In the sample, two spots were detected.


*EasyInspector310 Ver.2.4.0.2 SKYLOGIQ 640 x 480 ---
No.
Pass/Fail
Failed frames
Image file name
Fails = 0
Fail rate = 0.00%
Save table
Maximize
Clear
Master (frame settings)
Load
Save
New
Frame No.
1 / 1
Add
Del.
Show frames
Insp. name
Inspection 1
Draw frame by mouse
Image alignment
Automatic
Manual
Automatch
None
Same alignment
Sch. range
040
Copy settings
Multiple copy/delete
Intensity Profile
Scratches/Spots
Detected deffects
0
Inspect this frame
Invert Pass/Fail
Color of deffects
Black
Size of a deffect
10
[pixels]
Specify by its circumference [pixels]
No. of deffects upper limit
1
Fails if exceed the above number.
Sensitivity
10
Smaller number = More sensitive
Noise elimination
15
Larger number = More elimination
Max. width of deffects
10
[pixels]
Approx. max. width of the deffects
Don't detect if larger than the above width.
Background stripe pattern
None
Choose if the image has a back ground pattern.
Master image
From live image
Mask pixels
Add/Remove pixels...
Display
Live
Result
Master
Mask Pixels
Inspect (F5)
Display
Open>> Settings
Others
<<Close Settings
More Settings
Inspect image
Exit

Tests Possible with a Digital Camera, when there is no USB Camera

In “No Camera Mode”, it is possible to run tests with images captured from a regular digital camera, using the following method.

- Take a picture with a digital camera
- Convert the saved image to 640x480 (JPEG or BMP)
- Use EasyInspector to read and inspect the image

Method:

★ Affix the digital camera firmly to a tripod, etc.
★ Take the master image (non-defective item), putting the item to be measured against a ruler or jig to avoid position shift.
★ Take the test item image (non-defective or defective item), positioning the item to be measure against the ruler or jig in the same way as you did for the master image.
★ Convert the two pictures you have taken into 640x480-pixel images (JPEG or BMP). For conversion, use image editing software such as “Paint”.
★ Click on Master image “Load...” and Test image “Load...” in the “No Camera Mode” tool window, and read the respective master and test target images, then press the “Inspect (F5)” button.
★ Change the test settings as necessary to find the optimal settings for inspection.

6 Running an Actual Test

Now it's time to connect the USB camera, start up EasyInspector, and run an image test. Please enjoy EasyInspector's testing capabilities by using the following procedures.

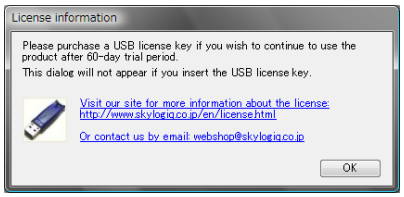
Checking Camera Connection and Operation

If the camera is disconnected, connect it to the computer and use the imaging software that came with your camera to confirm that can capture an image correctly.
If there is no problem, exit out of the camera's imaging software, and start EasyInspector.

Starting EasyInspector

Double-click on the shortcut icon that was created on the desktop at the time of installation.

Evaluation Version Check Window

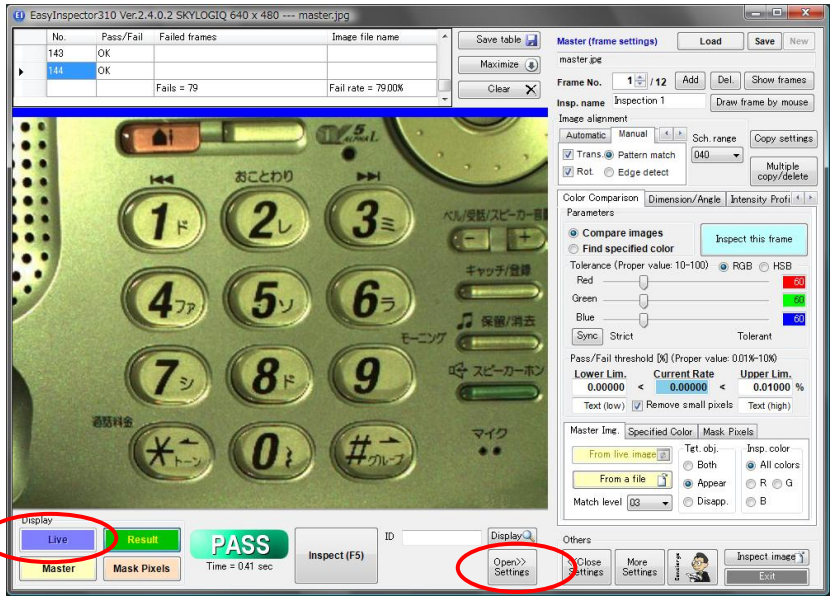


A window will appear to confirm that you are using the evaluation version. This window will appear at random times during use. When you purchase the license for the official version and insert the USB key into the computer, this window will no longer appear.

Master Image Capture and Configuration

※In this example, the camera is photographing an assembled product, but the capture target could also be a plastic product, metal part, painted item, food products, and so on. Photograph your target item.

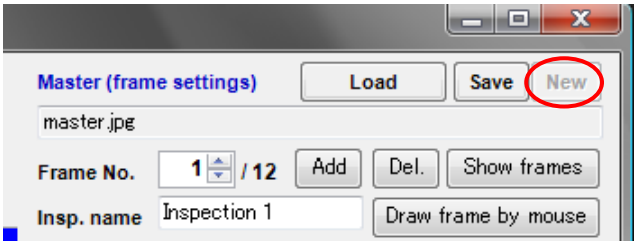
Click the “Open>>Settings” button at the bottom of the screen, and the settings area will be displayed.



Click “Open>>Settings”

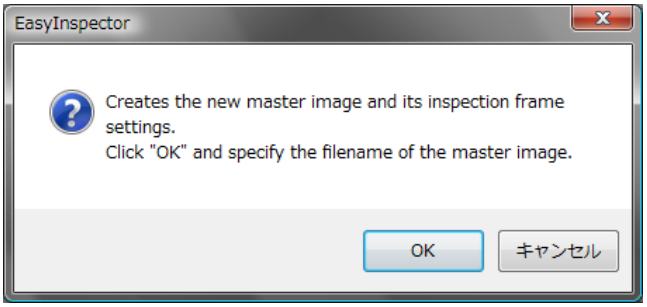
Set the camera position and focus on the test target item. If the image is not in the video, click on “Live”in the lower left of the screen. Steady the camera and test object with tape, etc., so that they will not move during the next series of operations. (If the camera or test object move, you may not be able to get good test results.)

Click on “Master” in the lower left of the screen. Now the pre-installed image will be displayed as the Master Image. Click on the “New” button in the upper right of the screen, and the currently captured image will be registered as the Master Image, displaying the initial setting values.

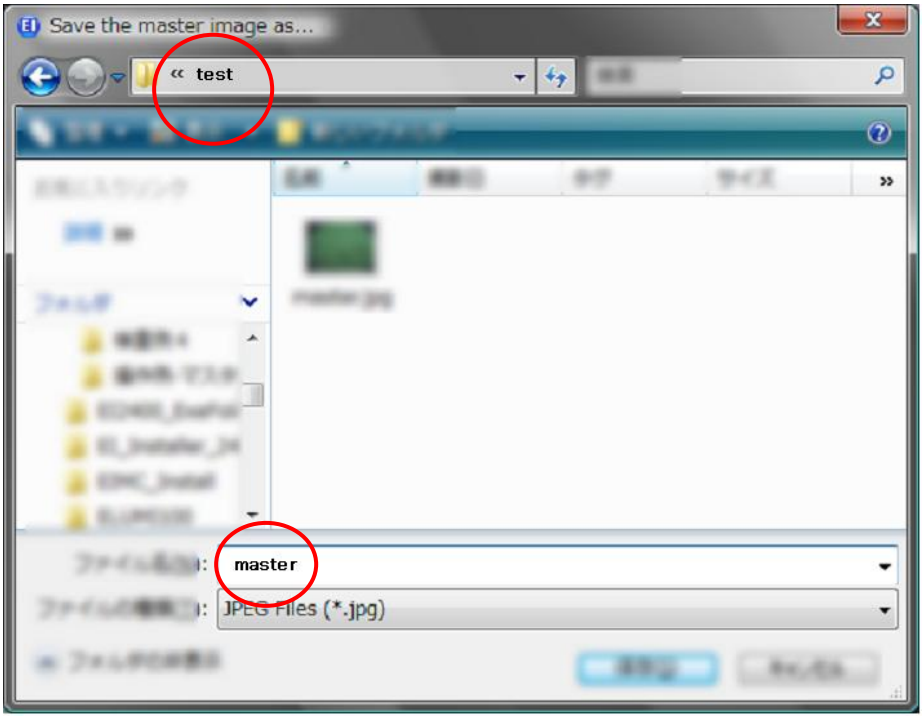


Click on the “New” button in the upper right of the screen.

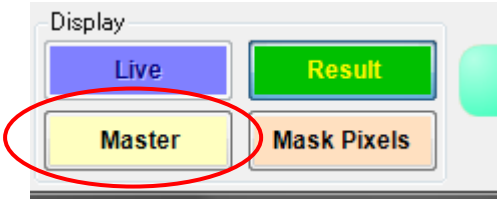
※ At start time, the content of the settings in the right-hand area of the screen are the settings read from the last Master Image. The first time you start up, it will be the sample file settings, but when you set a new Master Image, the configuration settings will be reset.



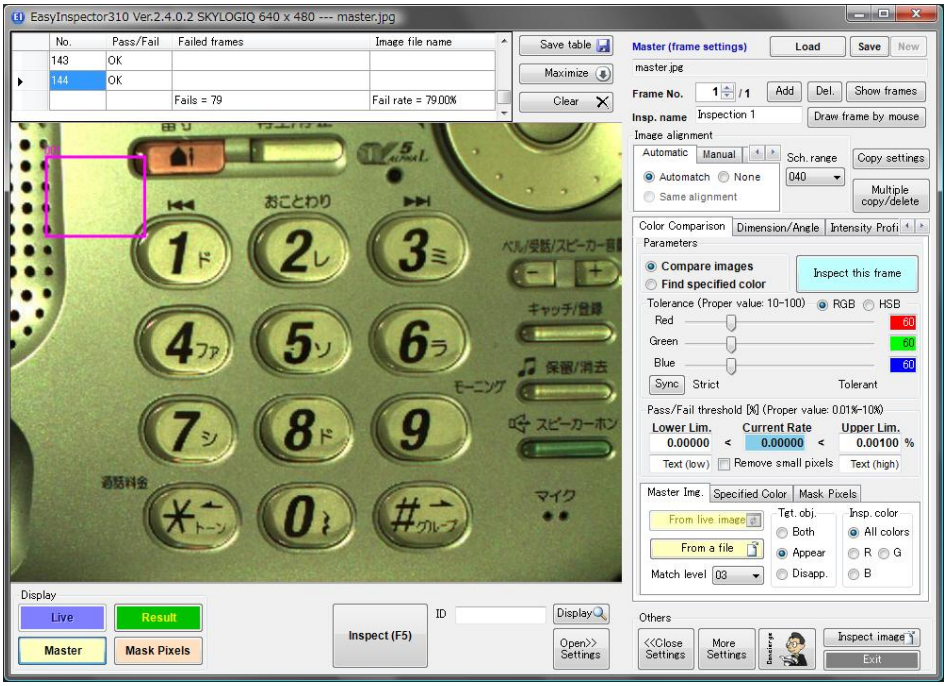
It will display “Creates the new master image and its inspection frame settings. Click “OK” and specify the filename of the master image.” Click “OK”.



Choose the destination folder, enter the filename and click “Save”.
In this example, “test” is selected as the folder, and “master” as the file name.



Clicking on the “Master” button in the lower left will display the Master Image on the screen.



Make sure the Master Image and Frame 001 are displayed in the upper left.

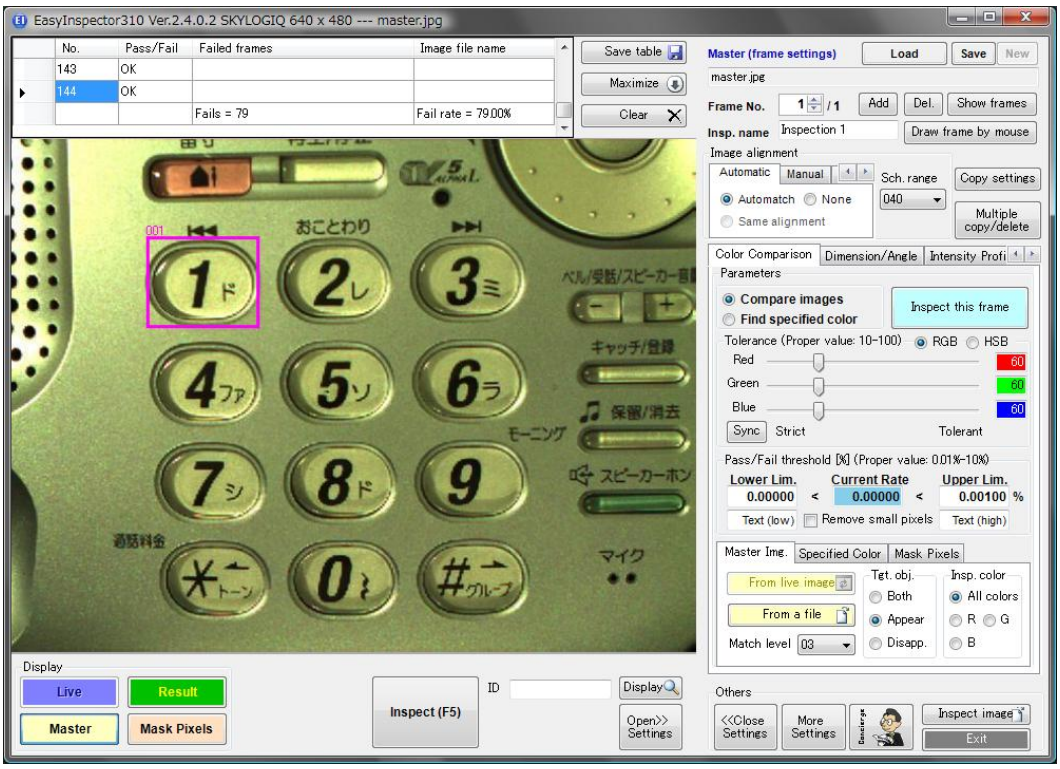
Settings for Test Frame 1

By creating frames, you can make use of various frame features.

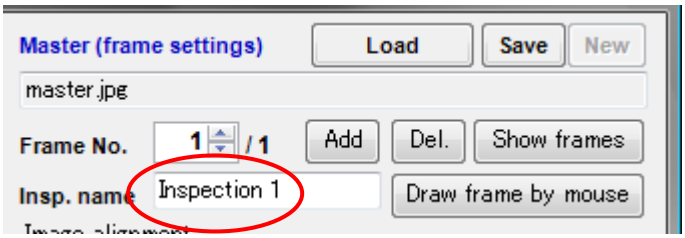
- ✧ Set the position of test areas
- ✧ Accurately correct for shifting of the Master and Test Object images (Alignment Feature)
- ✧ Specify formulas for calculating measurement value difference between two frames

(It is possible to define a maximum of 999 frames.)

Here, Frame 001 is set on the “1” key, Frame 002 is set on the “2” key, continuing up to Frame 012, corresponding to the number of keys.

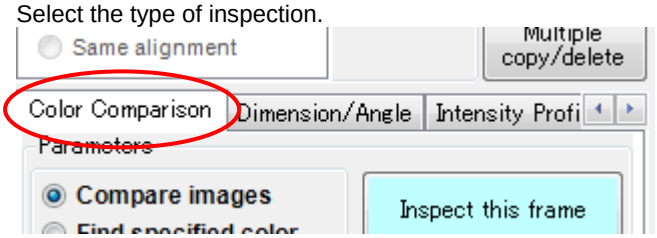


Clicking the “Display” button will display the full size image.



If necessary, you can specify an inspection name. This is initially set as “Inspection 1”.

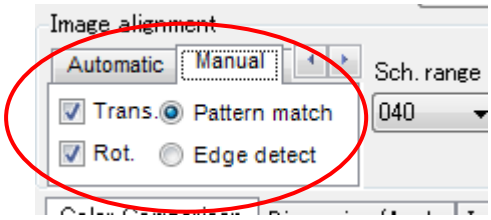
Select the type of inspection.



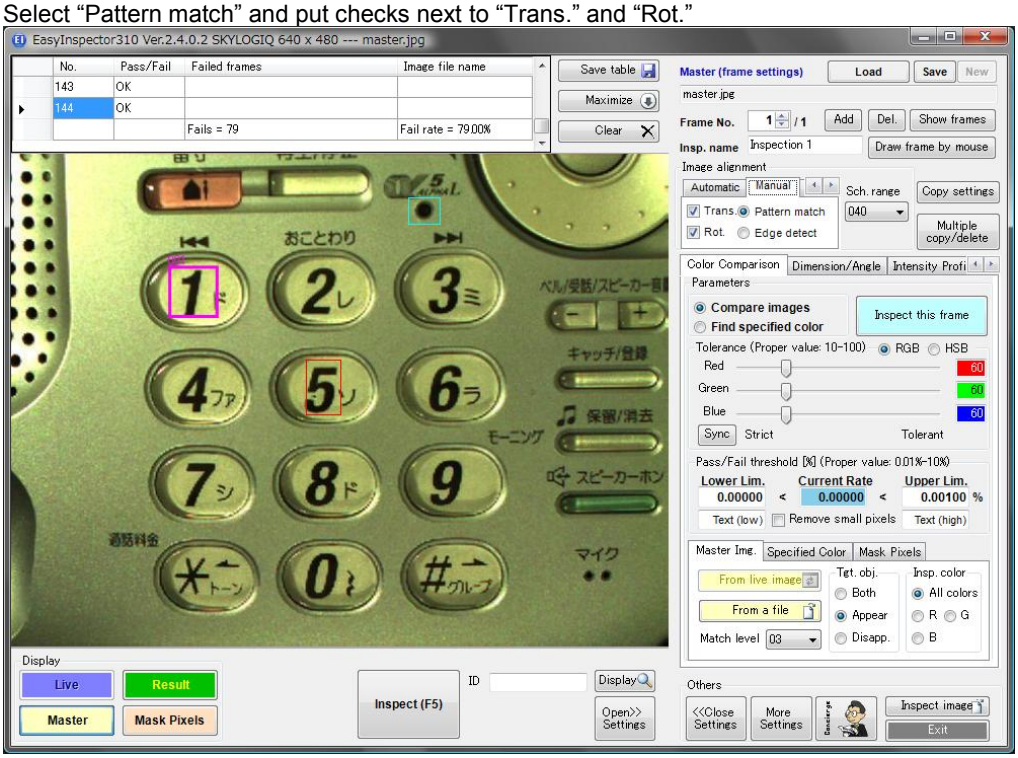
This inspection will be a comparison with the master image, so “Color Comparison” is selected.
※For EasyInspector100, only “Color Comparison” is available.

Image Alignment Settings

When the test object is placed in front of the camera, it can be shifted somewhat from the position in the Master Image. “Image Alignment” corrects this in the image, and each test frame is aligned so that a comparison with the master image can be conducted correctly.



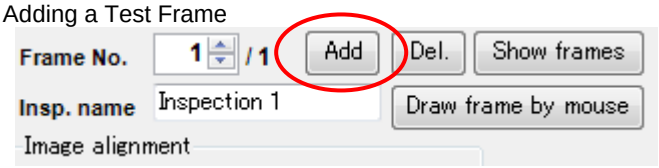
Click on the “Manual” tab under “Image alignment”. (The initial setting is on “Automatic”.)
Select “Pattern match” and put checks next to “Trans.” and “Rot.”



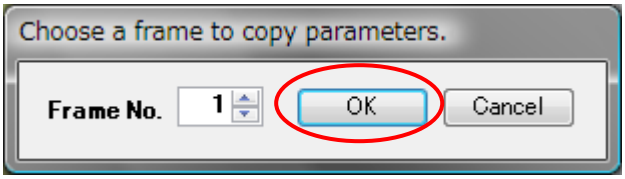
Red and light blue alignment frames will be displayed over the image.

Set the red alignment frame on a characteristic shape or letter as close as possible to the center of the image. Here, it has been set on the number “5” button.
Set the blue alignment frame on a characteristic shape or letter in a position as far as possible from the red alignment frame. (However, choose a point that will still be in image range even with the maximum image shift.) Here, it has been set on a black button in the upper right.

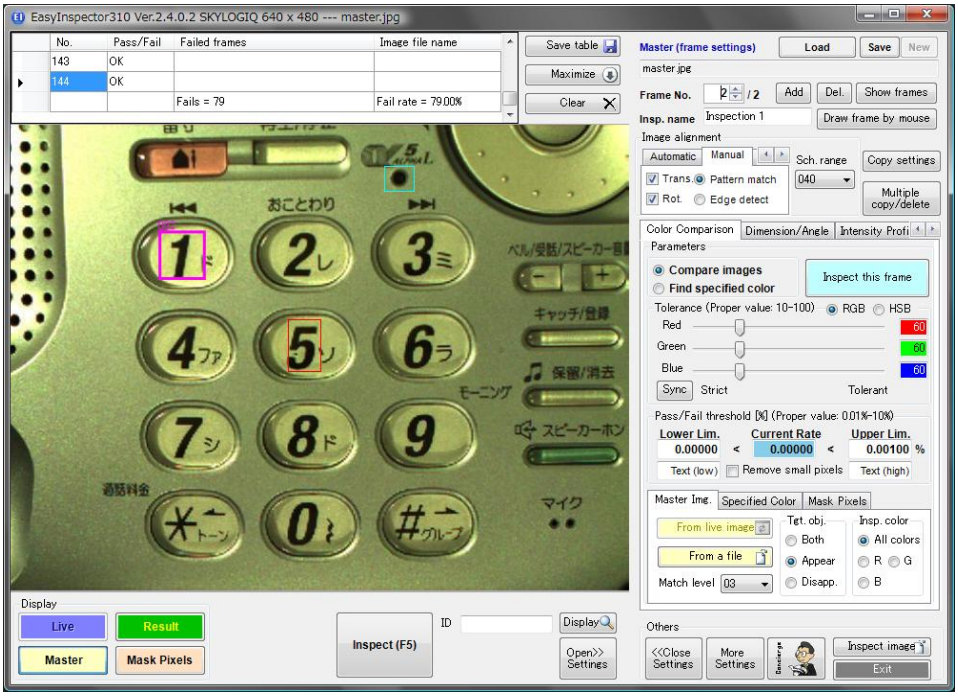
Adding a Test Frame



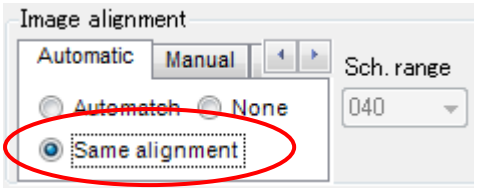
Click on the “Add” button in the upper right to create a second frame.



A window will be displayed for choosing a source frame from which to copy parameters. In this example, we will leave it on Frame 1, and click on “OK”.

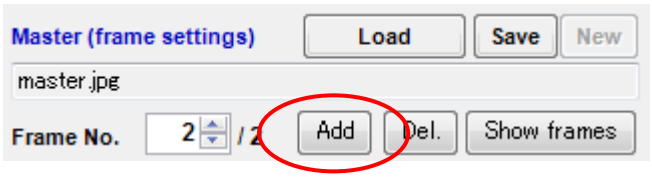


As with Frame 001, 3 frames will be displayed, in pink, red, and light blue.
Because the settings were copied from Frame 001, Frame 002 is created as an exact overlay of Frame 001. Move it to the area you want to be inspected for Frame 002. In this example, we will move it to the number “2” button.

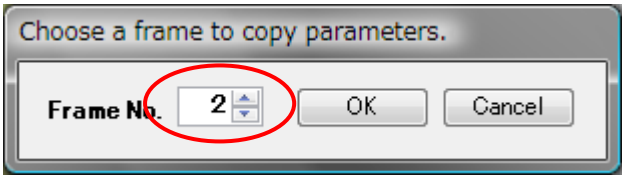


From Frame 002 on, instead of setting image alignment, you can use the same alignment for frame 001.

※If highly accurate alignment is needed, you can set alignment for each individual frame instead of using "Automatic"/"Same alignment".

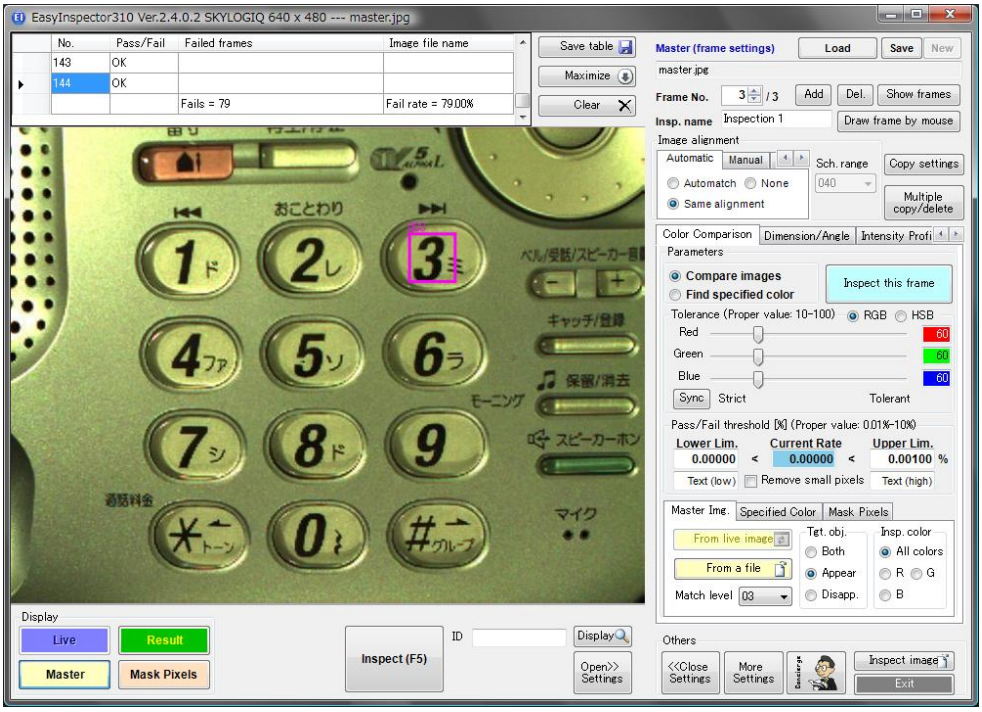


Click on "Add" in the upper right to create a third frame.

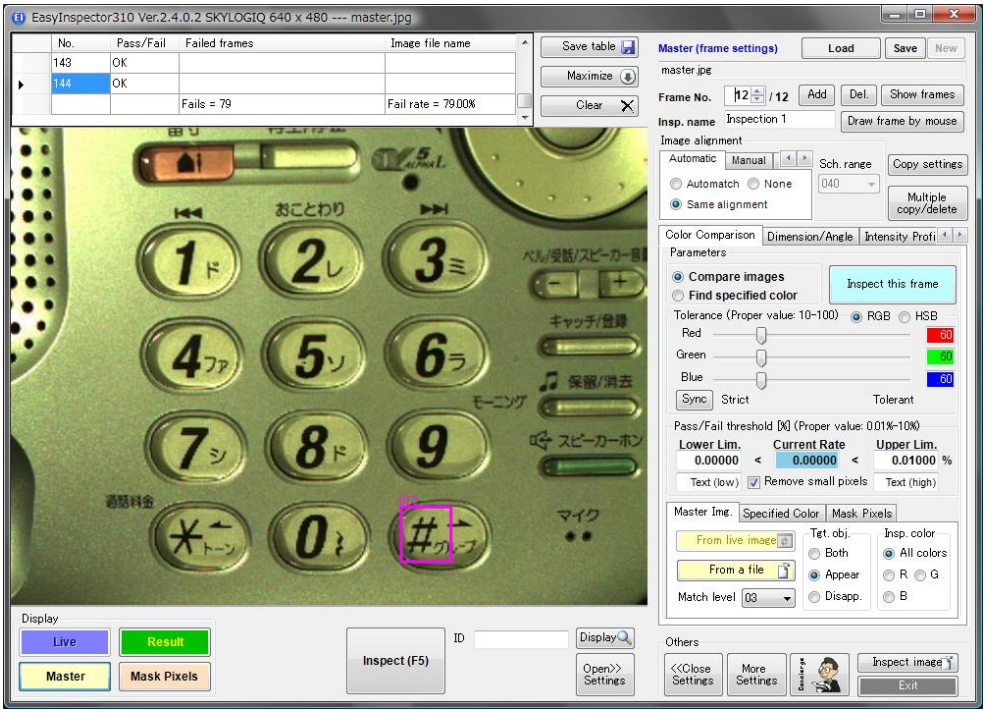


A window will be displayed for choosing a source frame from which to copy parameters. Here, we will specify Frame 2.

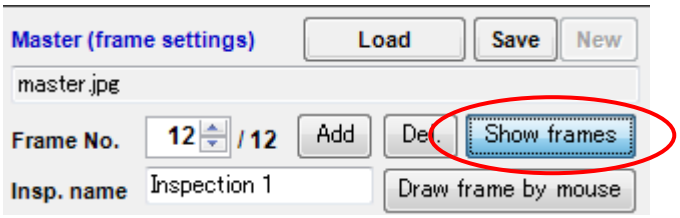
※because Frame 002's alignment is set on "Automatic"/"Same alignment"



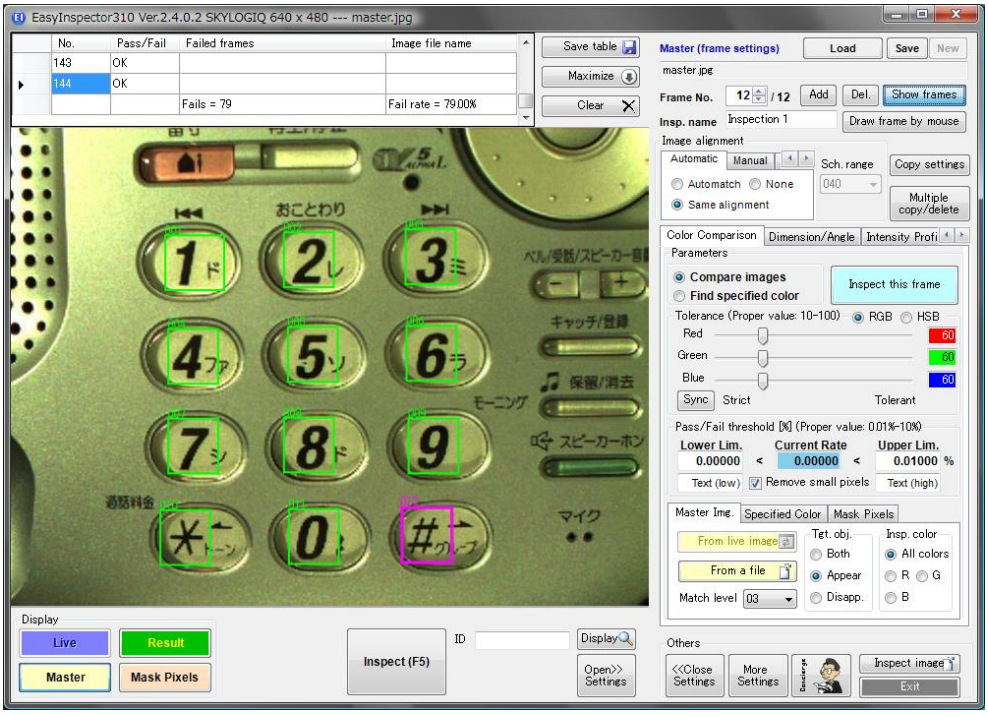
Move Frame 003 to the area you want to inspect.
Here, we will move it to the number "3" button.



Continue clicking the “Add” button and setting the frames on their inspection areas.
Here, we will set 12 frames on the 1 through # buttons.



Press the “Show frames” button, and make sure that each frame is displayed correctly.

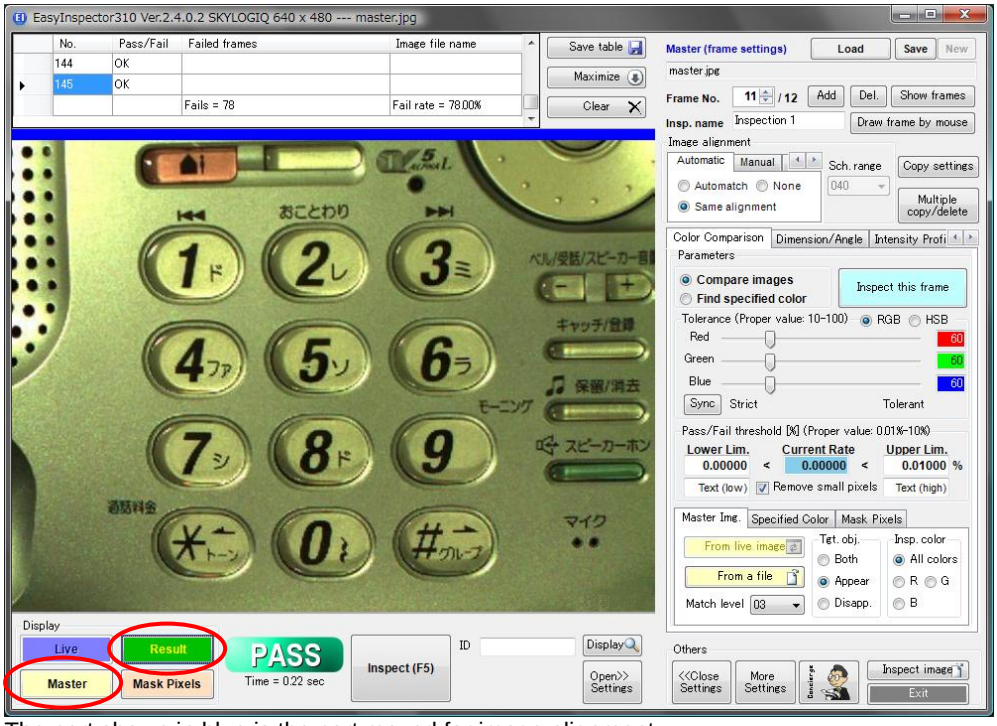


※Frames will only be displayed while the button is held down.

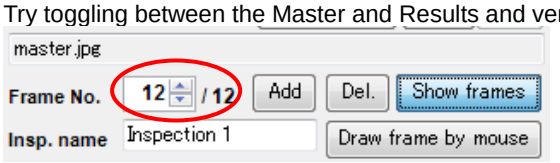
Test Item Settings

Click the “Inspect (F5)” button.

Click the “Result” button.

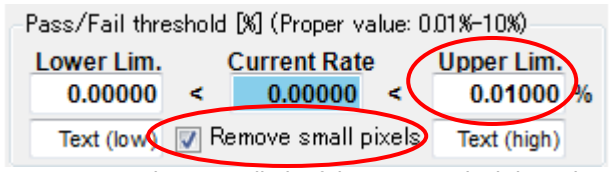


The part shown in blue is the part moved for image alignment.
Try toggling between the Master and Results and verify that the images are correctly aligned.



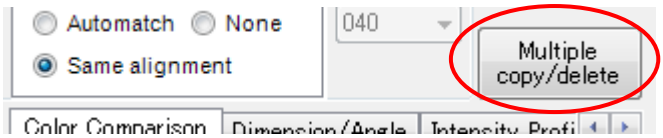
If an error is displayed (fail) for a frame which appears to be correct, the configuration settings need to be adjusted. Try adjusting them in the following way.

Choose the failing frame by using the frame number up/down buttons.

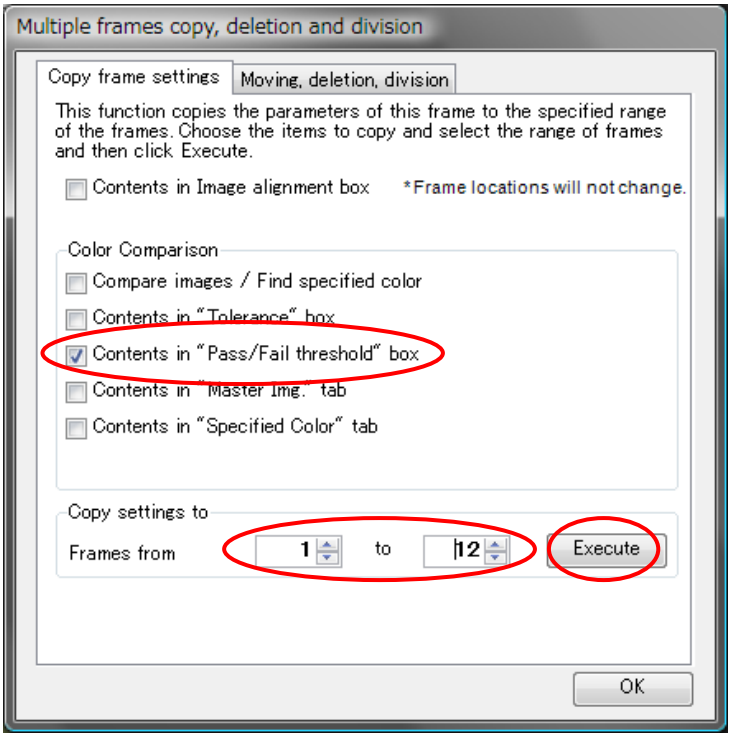


1.Increase the upper limit of the current pixel detection pass/fail threshold.
2.Put a check next to “Remove small pixels”
Do one or both of the above.
In this example, the upper limit is set to 0.01, and “Remove small pixels” is checked.

Click “Inspect this frame” to inspect the current frame and ensure that it passes.



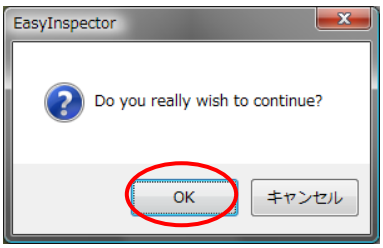
The above adjustments are only effective for the currently displayed frame. If you want to apply the settings to the other frames as well, click “Multiple copy/delete”.



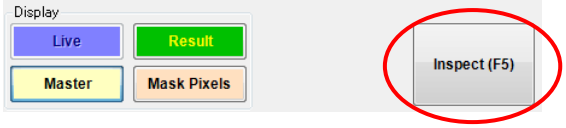
The settings screen will be displayed.

In this example, we want the “Pass/Fail threshold” contents to be applied to the other frames, so “Contents in ‘Pass/Fail threshold’ box” is checked.

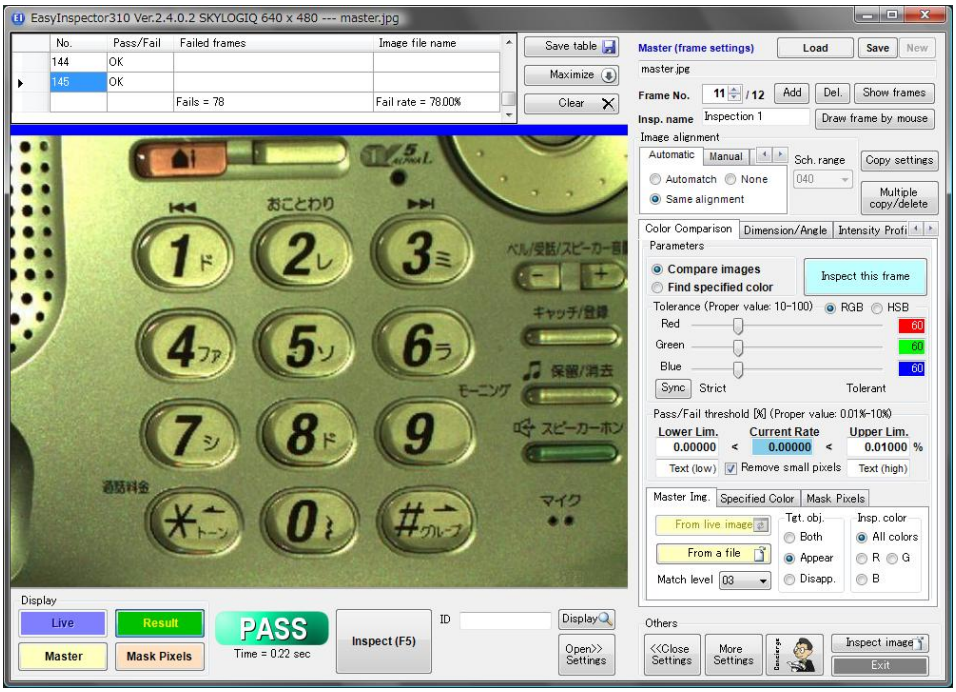
Set it copy settings to frames 1-12 and click “Execute”.
A dialog will appear asking, “Do you really wish to continue?” Click “OK”.



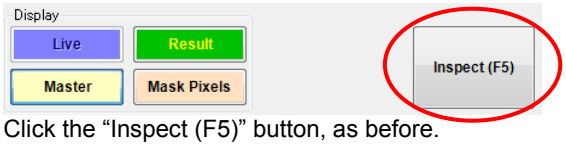
Click “OK” and the “Multiple frames copy/delete/division” window will close.



Click on “Inspect (F5)”.
If it displays “Pass”, the preparations for passing non-defective items is complete.



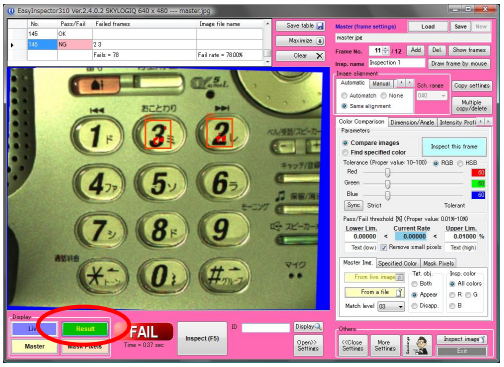
Now position a defective item.



Click the “Inspect (F5)” button, as before.

Click the “Result” button and verify the details.

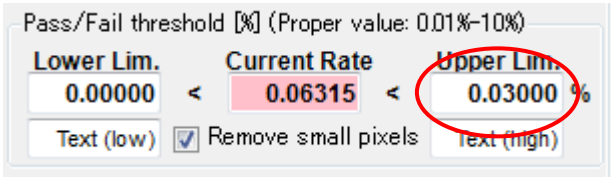
Failed frames will be displayed in orange, and the places where it differs from the master image will be displayed.



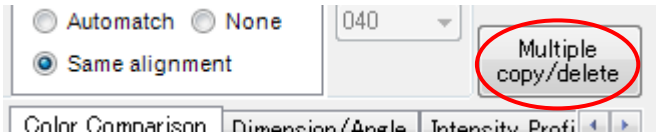
Toggle between Master and Result to verify that the alignment has been corrected.
In the image diplayed when “Result” is pressed, the blue area shows how much the image was moved for alignment.

Check results for Frame number “2”.
Use the frame number up/down buttons to display frame number 2, and check the “Current Rate” under “Pass/Fail threshold”.

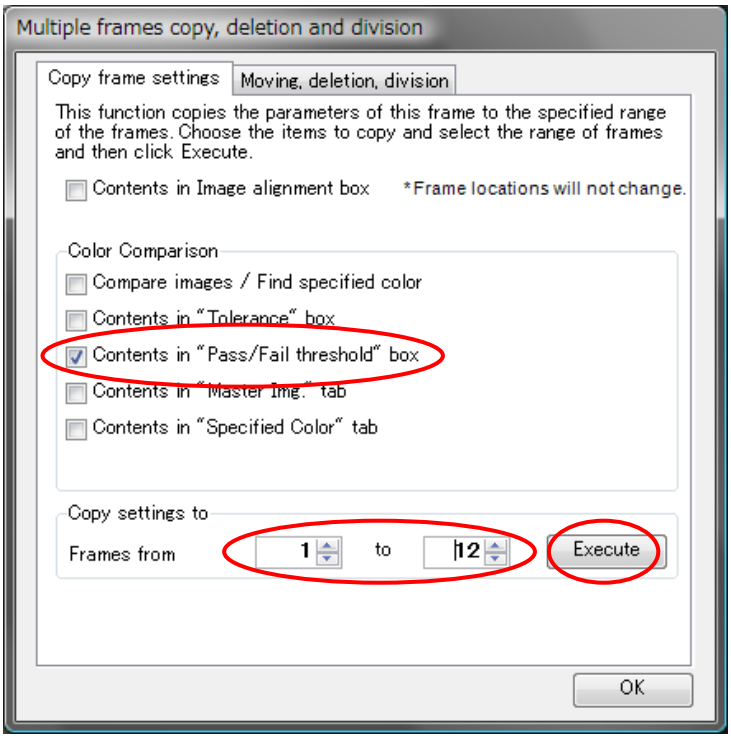
In this example, the area in Frame 2 detected as different from the master image comes to 0.06%.
The most stable level for detection is half of that, at 0.03.



Change the Upper Limit setting for Frame 2 to 0.03.



Press the “Multiple copy/delete” button, set the copy source frame to Frame 2, and click “OK”.



The multiple frame operation dialog box will be diaplayed. Input the following details.
Put a check next to “Contents in ‘Pass/Fail threshold’ box”.
In “Copy setting to”, set it for frames 1 to 12.
Click the “Execute” button.

Now fine tuning of setting values is complete.

Press “Inspect (F5)” and make sure that defective items are marked as “fail”.

※If defected items are not judged as “fail”, display the frame that should have originally failed, and check the “Current Rate” under Pass/Fail threshold.
Fine tune the “Upper Limit” of the Pass/Fail threshold.
For example, if the failed item is at 0.1%, the optimum setting would at half that, at 0.05%.

Saving

Click on the “Save” button in the upper right of the screen. It will display “Do you want to overwrite?”. Choose “Yes”.

Test Initialization

Position a test object sample. Press “Inspect (F5)” and the subsequent tests will continue.

Tips for Settings

This section explains some important points to remember when configuring test settings.

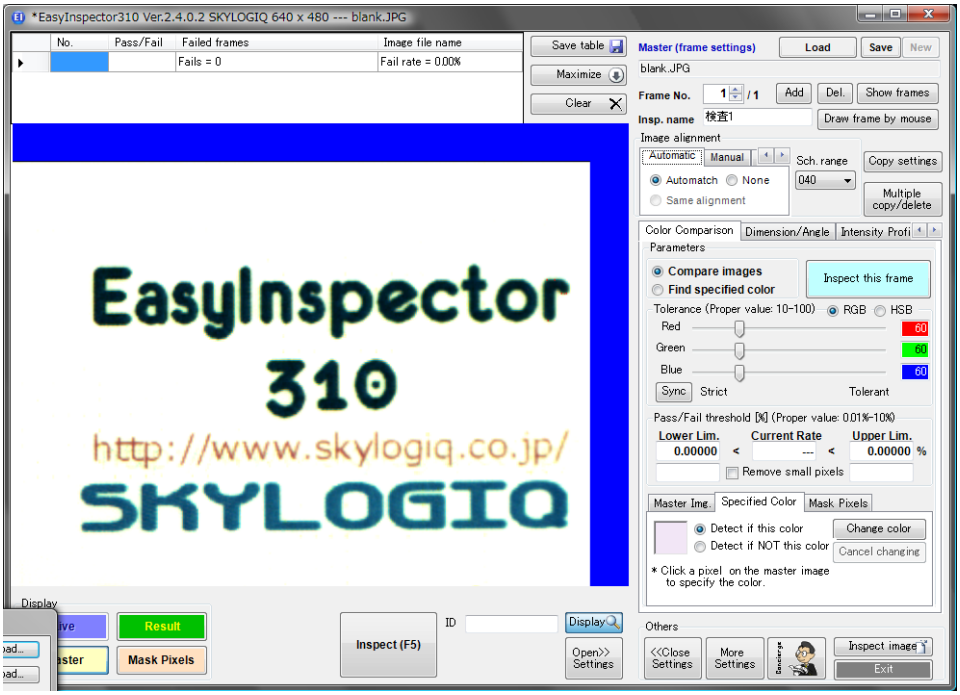
Settings in the Translational/Rotational Alignment Box for the Master Image

EasyInspector judges whether a test item passes or fails by comparing it with a Master Image (non-defective item image). “Translational/Rotation Alignment” is a feature that compares with the master image, and if the test image is somewhat rotated or shifted, it automatically moves it to match the master image. If you are able to use accurate jigs/rulers, or if you have a highly-accurate automatic positioning system, this alignment correction and configuration will not be necessary (Uncheck the “Trans.” and “Rot.” boxes.) In addition, when using “Specified Color Detection”, the specified color can be detected anywhere within the frame, so in many cases, the alignment correction and configuration is not necessary.

Correction via Automatch Image Matching

Under the “Automatic” tab, select “Automatch”.

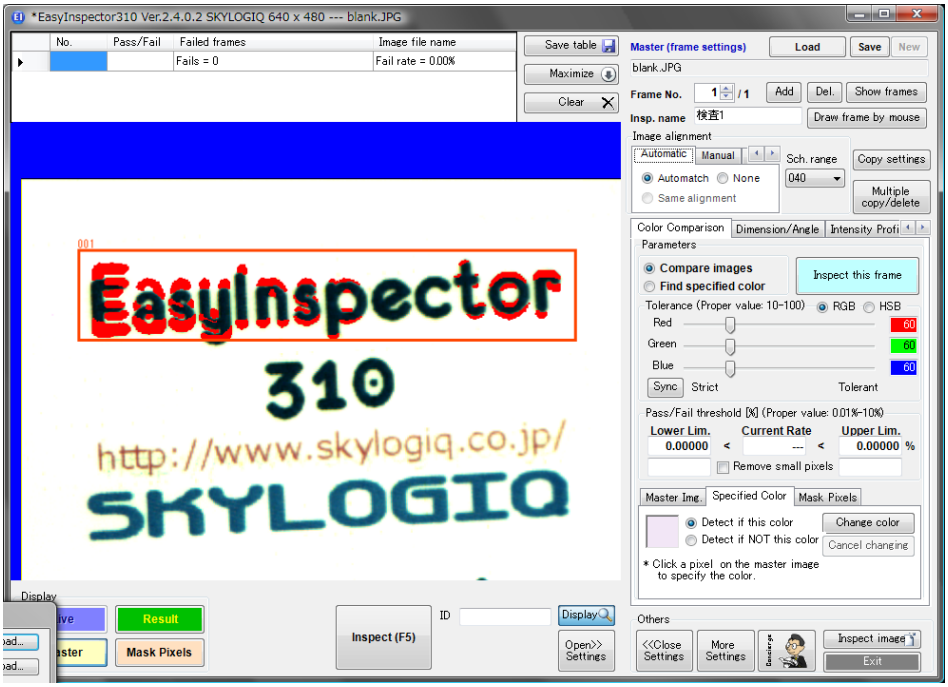
Select the Search range. Choose a Search range, in pixels, which is larger than the expected range for positional shift, but (to speed up the search) as small as possible. Click the light blue “Inspect this frame” button on the right side of the screen. Positional shift will be corrected (the area where the image was moved horizontally or vertically will be displayed in blue). The image will match the Master Image, so it will pass. To check whether image alignment has been conducted correctly, toggle between “Master” and “Result” by clicking the buttons in the lower left of the screen and compare them.



A Difficult Case for Automatch Position Alignment (Rotation)

Because “Automatch” is limited to correction for vertical/horizontal shift, when there is a rotational shift beyond translational shifting, as in the figure below, “Automatch” may be unable to perform alignment.

If you want to do alignment for rotational shift, you can do manual feature recognition, as in the “Manual – Pattern Match (Translation+Rotation) section below.



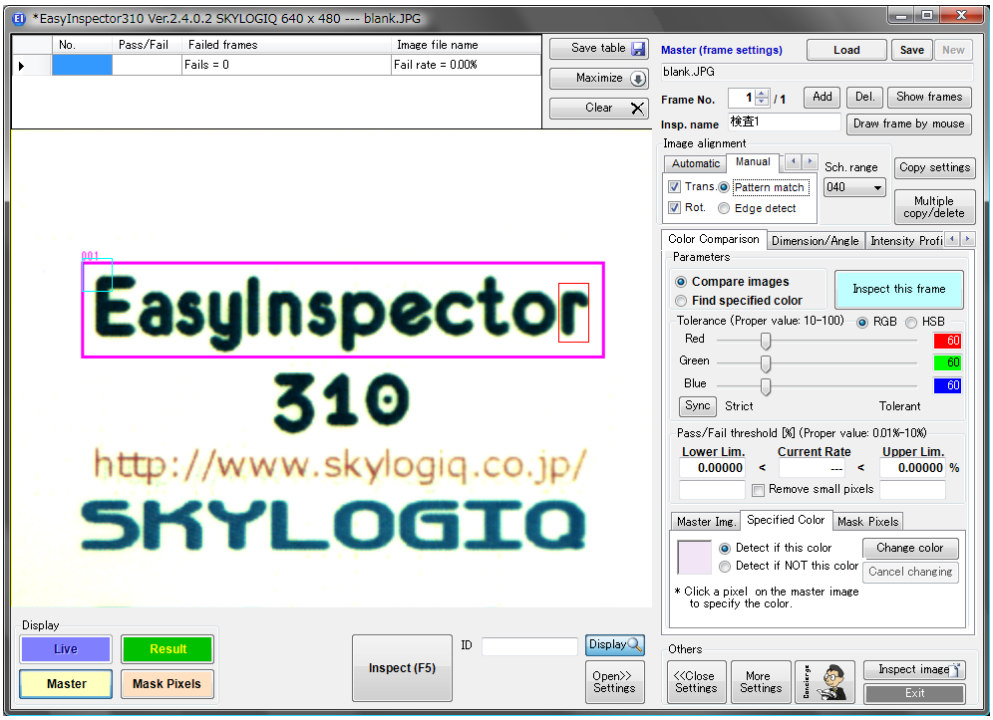
Manual – Pattern Match (Translation + Rotation)

Click on the “Manual” tab under “Image alignment”.

Click on “Pattern Match” and check the boxes next to “Trans.” and “Rot.”

Red and light blue frames for pattern match search will be displayed. Set each frame to a characteristic image (which does not exist in another part of the master image).

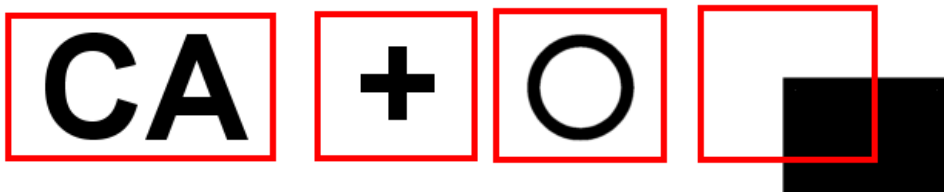
Here, the red and blue frames do not necessarily have to be set inside the inspection frame (pink), but the red frame should at least be set in or near the inspection frame, and the light blue frame should be set as far as possible from the red frame, in a horizontal direction.



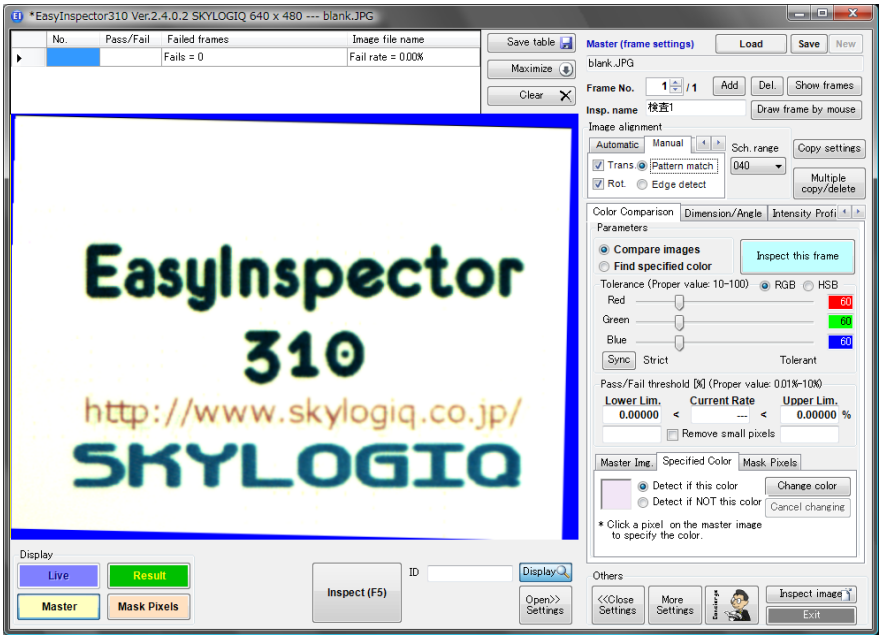
Suitable feature images for pattern matching (images for which translational shifting is detectable)

・Letters, symbols, angles, etc.

・If a large rotation correction is needed, select as circular a shape as possible, such as a hole or round shape.



Check the “Search range” and click the “Inspect this frame” button.
Translational and rotational alignment will be conducted (the area where the image was moved horizontally or vertically will be displayed in blue). The image will match the Master Image, and it will pass.
To check whether image alignment has been conducted correctly, toggle between “Master” and “Result” by clicking the buttons in the lower left of the screen and compare them.



Other Tips

For quick image alignment, consider:

- The Search range setting should be as small as possible
- Choose something small for the feature to be searched

However, in setting the Search range as small as possible, it is necessary for it to fit closely to an L-shaped bracket, etc., so that the expected positional shift range is small. Since “Automatch” alignment uses the inspection frame image (pink from 001 in this document) as the feature image, making the feature image small means making the inspection frame small. If you wish to have a small feature frame and a large inspection frame, use “Pattern match” under the “Manual” tab, so that you can set the feature and inspection frames separately.

Difference with “Automatch”

The previous item touched upon it, but “Automatch” uses the inspection frame image itself as the feature image. For that reason, the standard position for image alignment will always be the inspection frame’s position (it cannot be set to another position). For example, if you want to see the positional shift of a seal affixed to a circuit board, it is necessary to set the standard position to silkscreened letters on the circuit board, but set the inspection frame to the position where the seal is affixed. In this case “Automatch” cannot be used. Instead, you would need to use “Manual”—“Pattern match” to individually set the standard position for the circuit board and the inspection frame for the area where the seal is affixed.
In addition, “Automatch” does not perform correction for rotational shift.

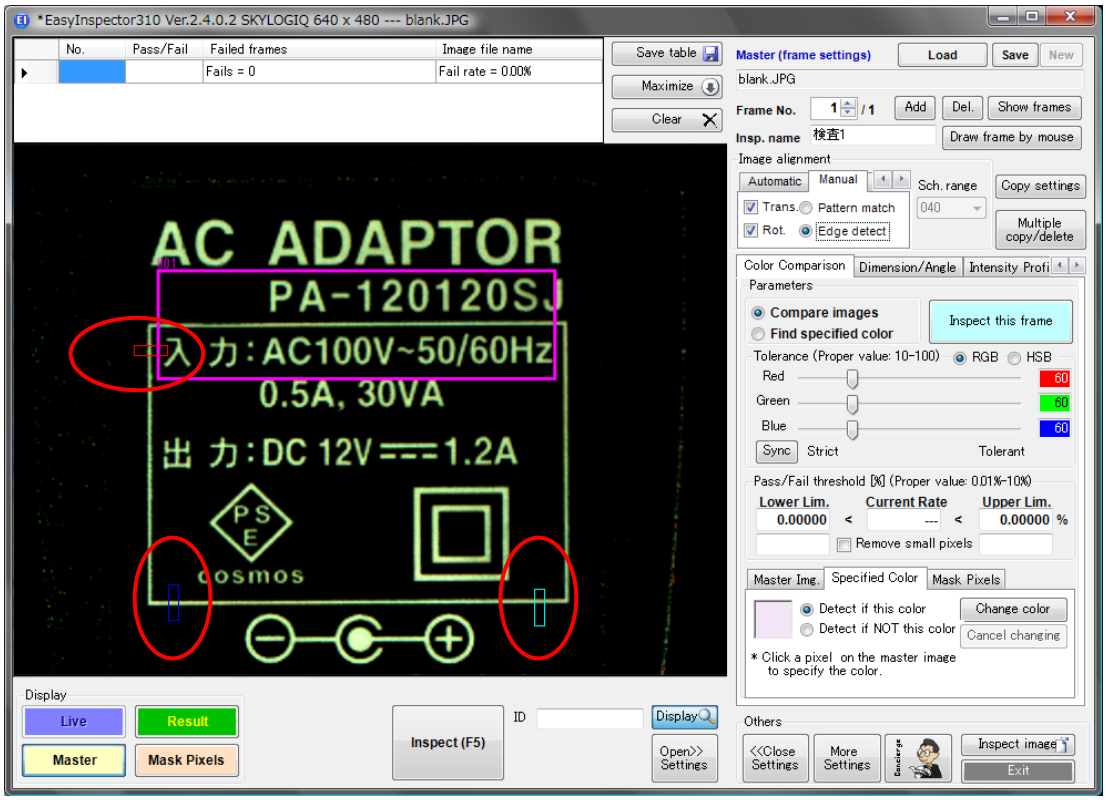
Making the area to inspect as large as possible:

Here, we have chosed a small area of the Master Image as the inspection frame, but setting the inspection frame as large as possible on the screen lowers the effect of noise data and can accurately judge between pass and fail.

"Manual" – Position Alignment with "Edge Detection"

Normally, image alignment is done with "Automatch" or "Manual"- "Pattern match", but if the image contains no characteristic markings (circles, plus signs, letters, etc.), image alignment can be done on the basis of vertical and horizontal lines alone. In the image below, it is configured to do image alignment by using the vertical and horizontal lines in the rectangular frames.

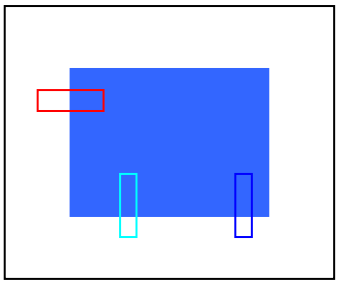
Image alignment is performed by detecting the respective edges of the black frame at the red, blue, and light blue frames.



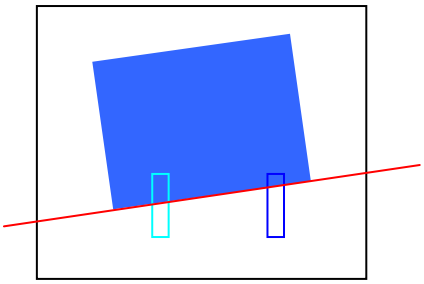
Position Alignment Sequence

The program uses the following sequence to perform translational and rotational alignment.

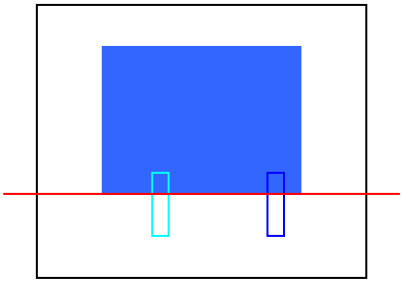
Master Image



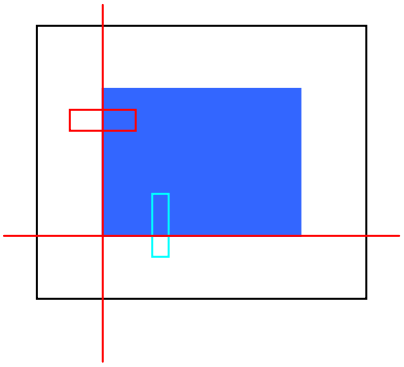
Target Image



The light blue and blue frames are used to make the target image's tilt match that of the master image (if the rotational alignment checkbox is checked)



The red and light blue frames are used to make the target image's translational position match that of the master image (if the translational alignment checkbox is checked)



Important points when setting the frames

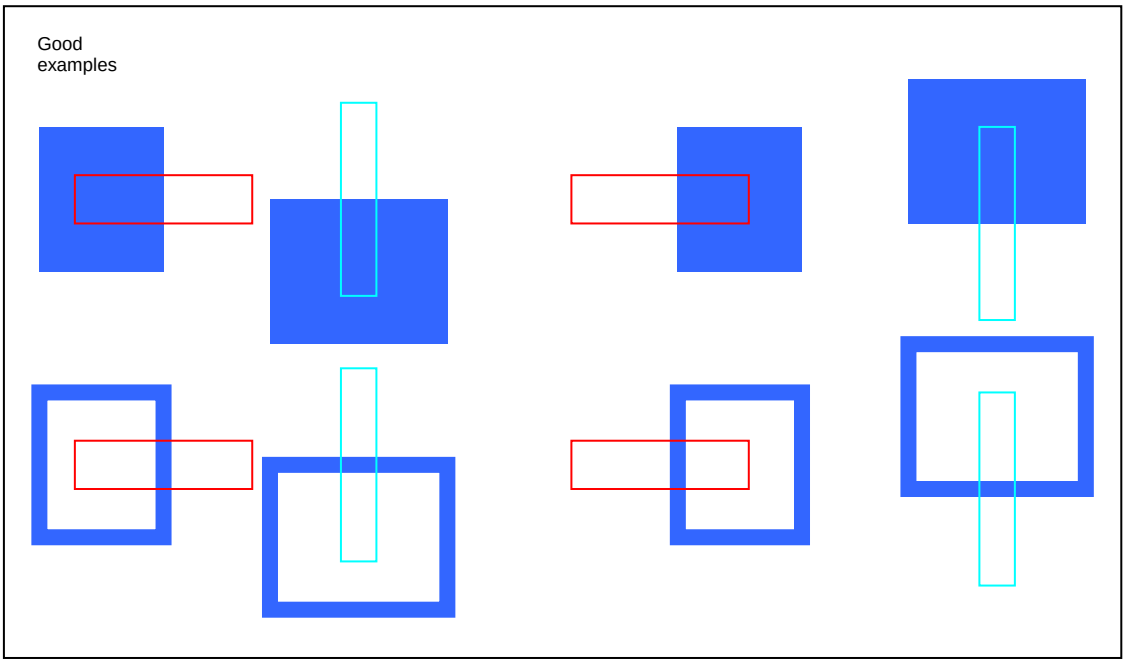
When the “Trans.” and “Rot.” checkboxes are checked, detection accuracy will vary depending on the frame settings. When setting the frames, take care regarding the following points:

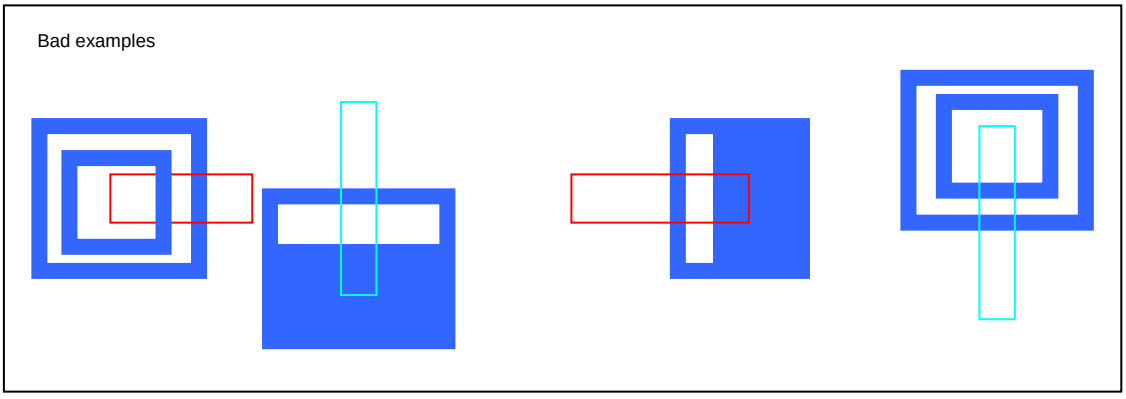
★ Set it so that a verticle line of the target image is in the red frame and a horizontal is in the blue and light blue frames.

★ Each frame’s size should be larger than the range of shifting of the target image (from the master image position)

★ As much as possible, set them on vertical or horizontal with a clearly define brightness/darkness.

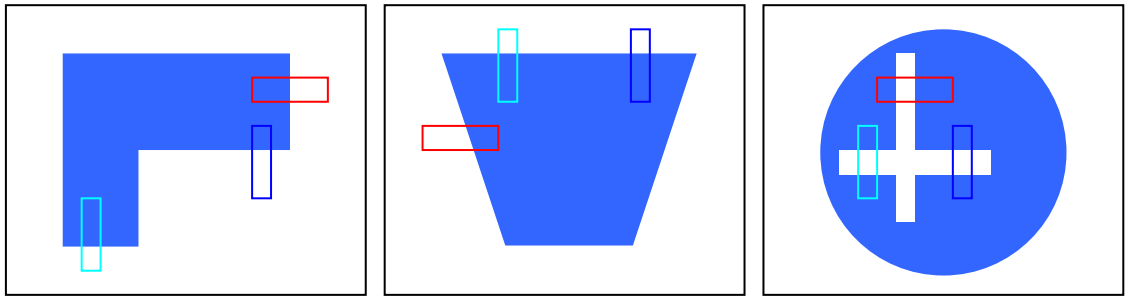
★ Being careful of the following points, don’t include more than one line in each frame.



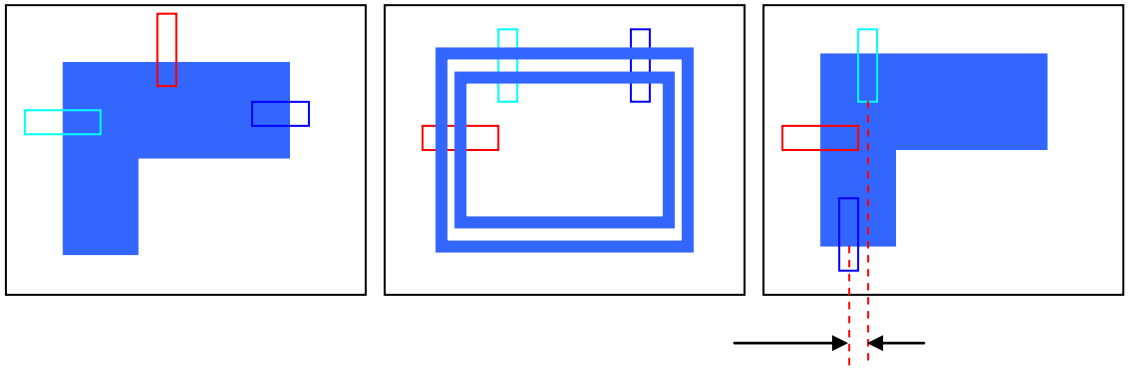


★ Also take note of the following points with regard to the position of the image.

Frame settings: Good examples



Frame settings: Bad examples



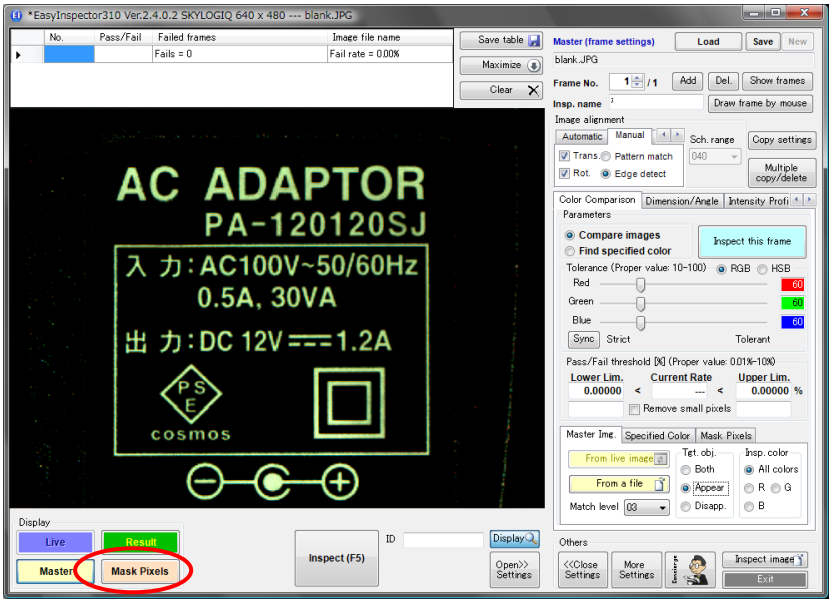
Left: The red frame contains a horizontal lines. The blue and light blue frames contain vertical lines.

Center: Frames each contain two lines.

Right: If the blue and light blue frames are too close horizontally, it may cause inaccuracy in rotational alignment.

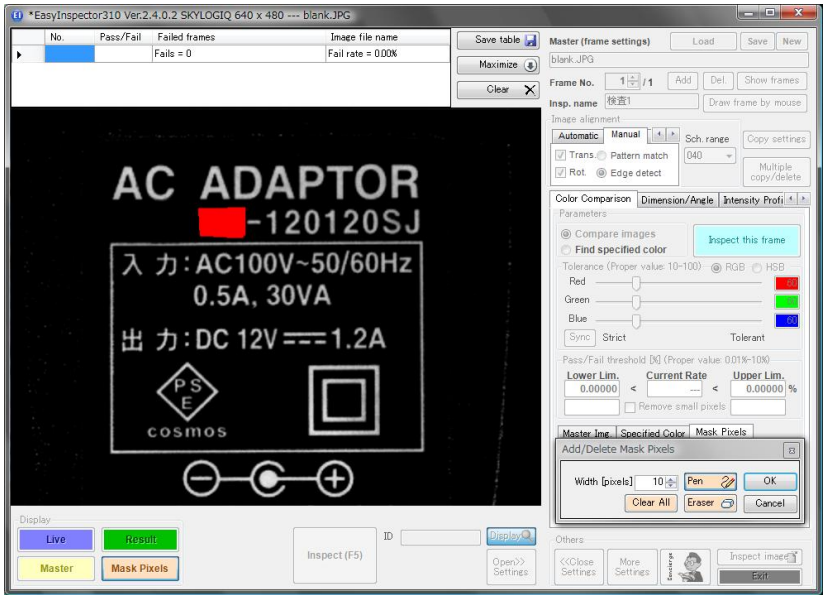
Mask Pixels Settings

“Mask Pixels” refers to an area excluded from the inspection frame. If there is an area you would like to exclude from the inspection frame, click on “Mask Pixels” in the lower left and paint over the part you would like to exclude from inspection in red. If there is no area you would like to exclude from inspection, you may skip this setting. To check the masked pixels, click on “Mask Pixels” in the lower left, and the masked pixels will be displayed. The master image is displayed in black and white, and the masked pixels are displayed in red. At initial start-up, mask pixels have not been set, so only the black and white master image will be displayed.



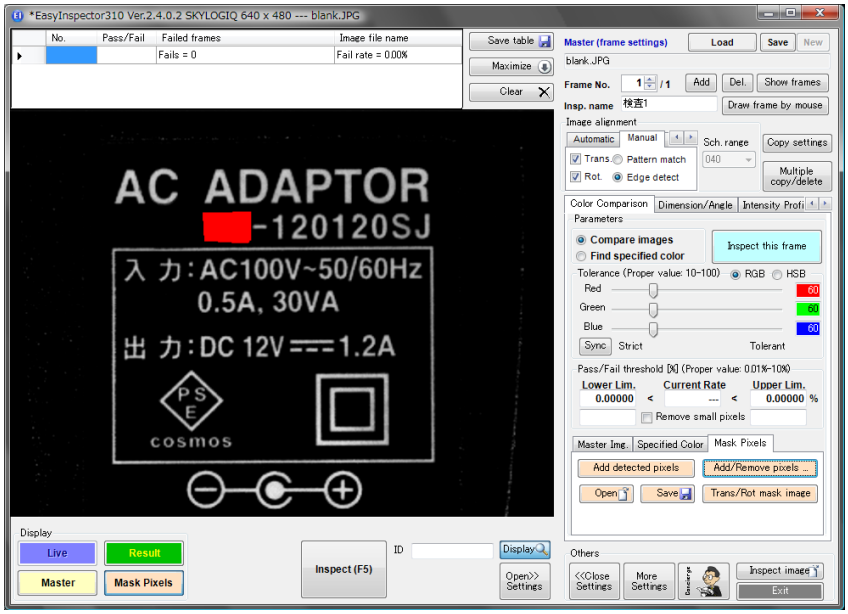
“Mask Pixels” display

Click on the “Mask Pixels” tab in the lower right, and then click on the “Add/Delete Pixels” button. The toolbox for drawing mask pixels will appear on the right. Toggle between the “Pen” and the “Eraser” to cover over the mask pixels. The pen and eraser line width can be set in “Width [pixels]”.



Painting over mask pixels

When you have finished painting over the mask pixels, click on “OK” in the toolbox to end editing.



After mask pixel settings are complete

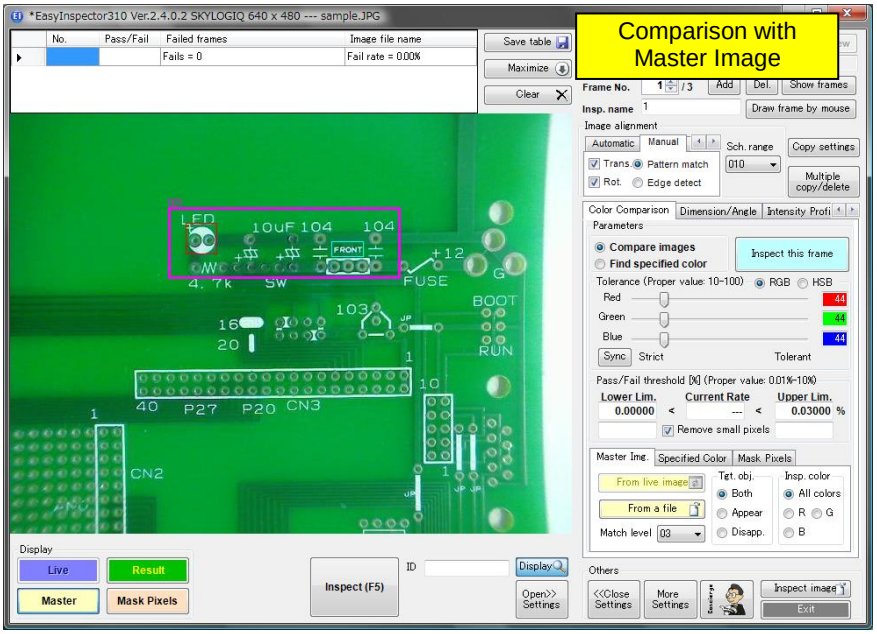
If the mask pixels area is curved or complicated, it is also possible to use any paint program to do the setting.

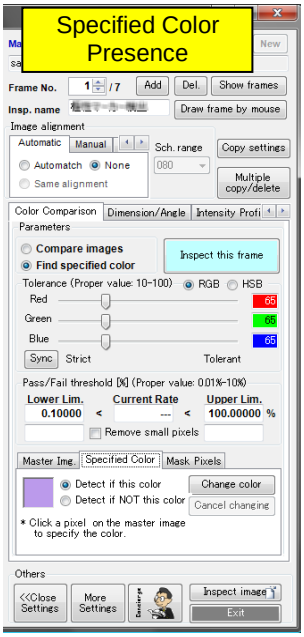
Procedure

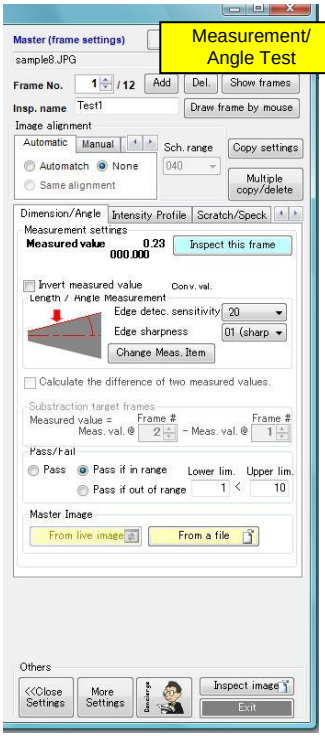
- Open the target master image (ex.: abc.jpg) in the paint program of your choice.
- Change the master image to black and white. However, keep it in 24-bit (True Color) to avoid color loss.
- Paint over the desired area in pure red (R=255, G=0, B=0).
- Save the image with a different file name. When saving it, save it as a “BITMAP” instead of a “JPEG”, and add “_mask” to the file name. For example, if the master image is abc.jpg, save it as abc_mask.bmp. Save it in the same folder as the master image.

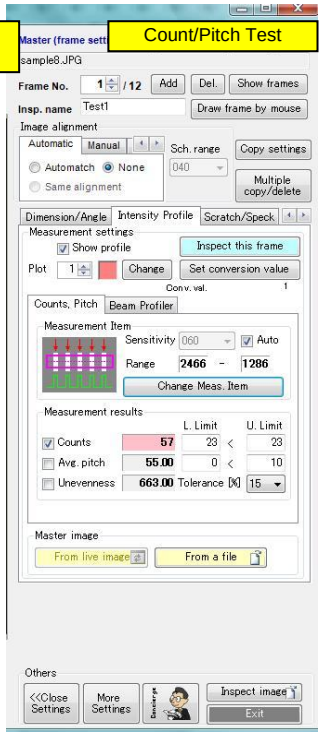
Description of Windows

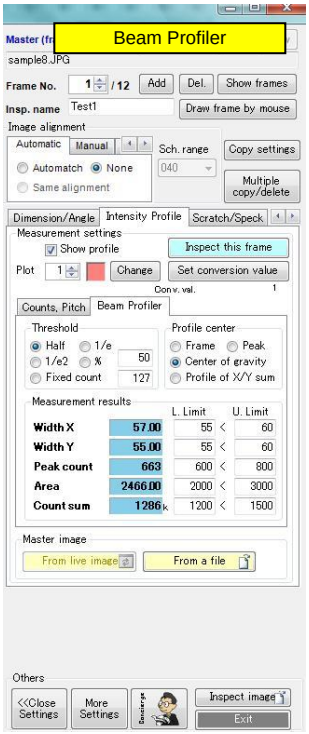
This section provides an explanation of each of the buttons, etc., found in the windows.

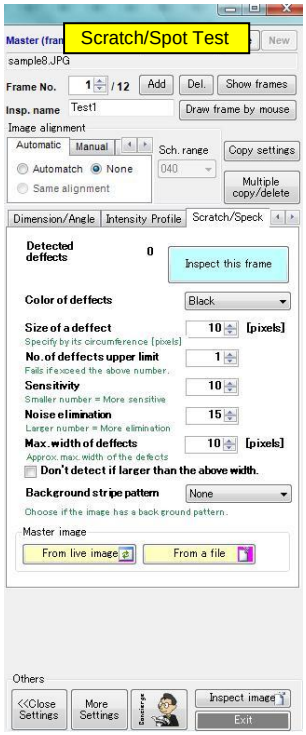








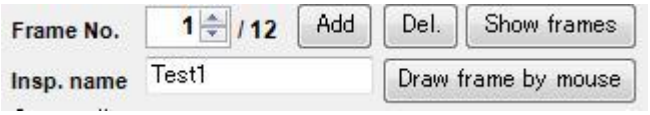




“Load”, “Save”, and “New” Buttons

- “Load” : Opens an existing master image and its associated inspection frame settings. For images which have never been opened in EasyInspector, there are no associated inspection frame settings, so one new frame will automatically be created when it opens. The file name of the open image is displayed below the buttons (sample8.jpg).
- “Save” : Saves the currently open master image and its associated inspection frame settings. The inspection frame settings are automatically saved in the same folder as the master image.
- “New” : Creates new master image and inspection frame settings files, taking the image currently displayed in the live monitor as the new master image. When this button is clicked, a screen will appear for you to specify the new master image file name and the folder where it will be stored. Specify the save destination.

Inspection Frame

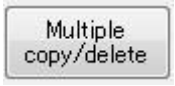


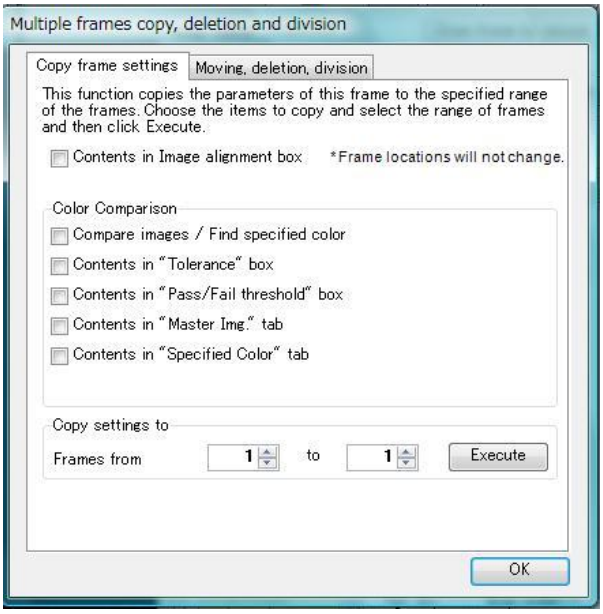
- “Frame No.” : Clicking on the up/down button changes the inspection frame to be displayed.
- “Add” : Click here to add a new inspection frame.
- “Del.” : Click here to delete the displayed frame settings.
- “Show frames” : When this button is held down, the positions of all currently configured frame are shown.
- “Draw frame by mouse” : Draws a frame with the mouse. When this button is clicked, the mouse cursor will change to crosshairs. Place the cursor in the upper left of the frame region you wish to set, hold down the left mouse button, drag down and to the right over the region, and release the button.
- “Insp. name” : You can specify and optional name/description for this frame setting.

Bulk Operation with Multiple Frames

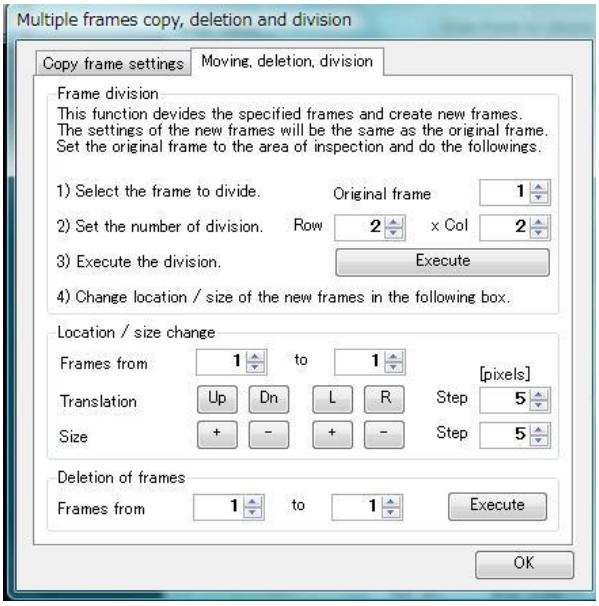
In this window, you can take the settings of a given inspection frame and apply them to another range of frames, and delete, divide, or move multiple frames.

Click the “Multiple copy/delete” button to make the window appear.



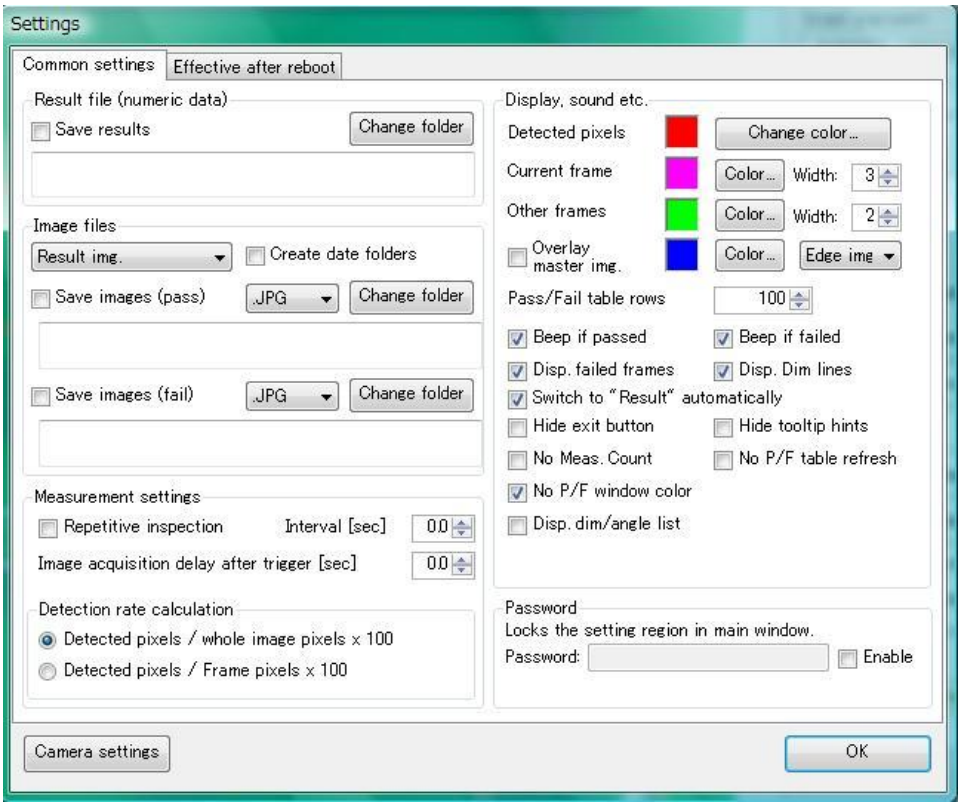


- Copy frame settings : Copies the settings of the currently displayed frame to the range of frames specified under “Copy settings to “. Check the items you want to copy and click the “Execute” button.



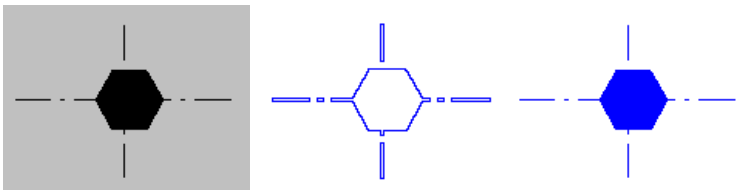
- “Moving, deletion, division” : Divides one frame horizontally or vertically into any number of multiple frames. The settings are pulled from the original frame to be divided. After selecting the frame to divide, set the number of divisions and click “Execute”.
- After division, “Location/size change” allows you to move and make size changes.
- If you want to delete multiple frames, set the range of target frames under “Deletion of frames” and click “Execute”.

Common settings window



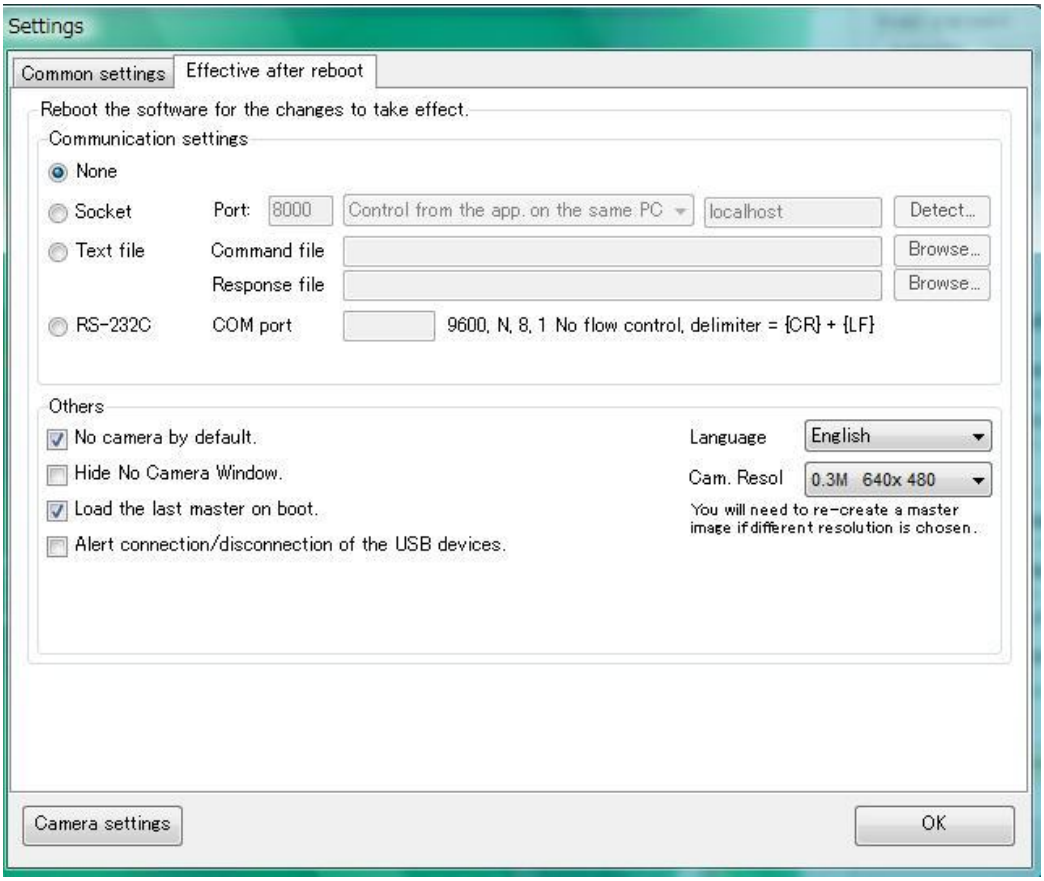
- "Result file" : For an inspection log, you can save an inspection pass/fail log of each inspection frame. If you want to activate this save function, check the box next to "Save results" and specify the save destination. Data will be saved in CSV format, and can be opened in Excel, etc.
- "Save images" : You can save the result images after inspections are judged to pass, fail, or both. If you want to activate this function, put a check in the box for pass, fail, or both. Then click on "Change folder" and specify the save destination folder(s). When "Result img." is selected, only the result image will be saved. If "Raw image" is selected, the image will be saved as captured. If "Result image + raw image" is selected, both will be saved. If "Create date folders" is checked, they will be saved into folders organized by date.
- "Repetitive inspection" : When "Inspect (F5)" is clicked, this will repeat inspections until the "STOP" button is pressed. You can set the period between inspections with "Interval [sec]".
- "Image acquisition delay after trigger" : If you are using an optional I/O unit to trigger inspections with a switch or light sensor, you may want to set a period of time to wait for the sample blur to clear up. In this case, use the delay setting. When this value is not set to 0, after the trigger, it will wait the specified time before capture.
- "Detection rate calculation" : Pixel detection rate has a direct effect of pass/fail judgment, but you can select the calculation method for this. ①"Detected pixels/whole image pixels x 100" : This is calculated by taking the *detected pixel count* (usually red pixels) and dividing by the *total pixel count of the image*. The denominator of the calculated value is a fixed value (number of pixels on the screen), so the calculated value does not depend on the size of the inspection frame. ②"Detected pixels/frame pixels x 100" : This is calculated by taking the *detected pixel count* (usually red pixels) and dividing by the *pixel count of each frame*. Because the denominator of the calculated value is variable (the pixel count of each inspection frame), a pass/fail reference value (%) may be needed depending on the size of the frame, but you can set the ratio for the frame size, and the setting value is easy to determine by feel (for example, if the entire inside of the frame is colored in, the calculated value will be 100%).

- “Detected pixel” display color ：Sets the display color for the image area detected in image inspection.
- “Current frame”/“Other frame” ：Sets the color and size for inspection frame display. You can configure the setting for the currently displayed frame number and for respective display settings for the frames desplayed when you press “Show frames”.
- “Overlay master img.” ：Overlays the master image onto the inspection result image. When “Edge img.” is selected, the edge lines of the master image are projected onto the result image. When “Binary img.” is selected, dark areas are filled in and superimposed on the image.
  Ex.：



Master image　　Edge image　　Binary image

- “Pass/fail table rows” ：Specifies the maximum number of rows to appear in the table displayed at the top of the main window. When it exceeds the maximum number of rows, the old data will be deleted sequentially.
- “Beep if passed/failed” : When the boxes are checked, different sounds will be made upon pass and fail respectively.
- “Disp. failed frames” ：Displays failed frames in the “Inspection Result” image.
- “Disp. dim lines” ：Displays the detected base lines during dimension/angle measurement.
- “Switch to ‘Result’ automatically” ： Automatically displays the “Inspection result” image after inspection.
- “Hide exit button” ：Hides the exit button so that the program cannot be accidentally closed when using external control, etc.
- “Hide tooltip hints” ：If tooltips are getting in the way, check this box.
- “No meas. count” ：When this box is checked, the inspection count will not be incremented
- “No P/F table refresh” ：If you are not using the pass/fail display in the lower left of the main window, you can check this box.
- “No P/F window color” ：Disables the feature which changes the window color in response to pass or fail during inspection.
- “Disp. dim/angle list” ：When doing dimension/angle inspection, this will display a separate window with a list showing the measurement location name, measurement results and inspection results.



To activate the above features, it is necessary to shut down and restart EasyInspector.

- Communication settings：Selects and configures communications to enable external control. When “Socket” is selected, EasyInspector will open the specified port and await commands via socket communication. Socket communication allows for EasyInspector to be controlled from another application on the same computer, or from a remote computer. When “Text file” is selected, EasyInspector access the specified file at regular time intervals and looks to read commands written there. It writes its responses in the “Response file”. You can down load sample programs for socket communication and text file communication (VB6.0, VB2005) from our homepage. When RS-232C is selected, it opens the port selected in “COM port” and awaits commands via 232C. For details on the commands, please refer to the “Communication Command List” instruction manual.
- No camera by default：If you are, for example, using “Inspect specified image file” to inspect images from another program and you will not be using the camera, you can check this box.
- Hide No Camera Window ：Checking this box will prevent the appearance of the “No Camera Window” which normally appears when a camera is not detected or when “No camera by default” is checked.
- Load the last master on boot ： Reads the last used master image when the software is booted up. If this box is unchecked, when the software boots up, it will load a blank master image called “Blank.jpg”.
- Language ： You can select Japanese or Chinese, in addition to English.
- Camera Resol.：You can choose from 0.1M (100,000 pixels) to 14M (14 million pixels). However, for EasyInspector100/200 selection is limited to 300,000 pixels, and for EasyInspector300 it is limited to 1.3 million pixels.