

# Corrosion Inspector Color

Measurement and evaluation of corrosion phenomena on coated test plates



- Color scanner system
- Test panel size max. 100 mm x 200 mm
- Resolution 22 microns / mm
- Automatic and interactive measurement of corrosion phenomena ( area, width, filament length, delamination, multi-impact)

SKan-CI Version 3.3

10/2018

# SK-LASM-C-90-22-J010

## Corrosion Inspector – Scanning and Imaging

Color scanner with variable illumination for bright-field and dark-field

During the development of coating systems with improved corrosion resistance as well as for quality control of coated components, a large number of coated test plates is produced. These plates are scribed and then weathered in special climate chambers to start the corrosion. Conventionally, the resulting corrosion phenomena are then manually and visually evaluated, often using a magnification glass with an integrated scale, a very tedious work, which is error-prone and subjective.

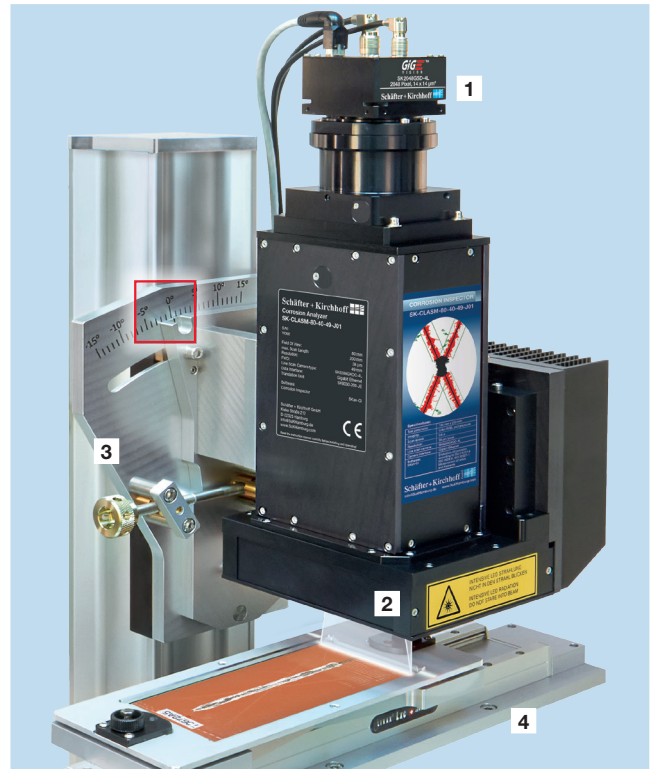


The Corrosion Inspector scans a standardized test plate in 0.8 seconds with an optical resolution of 22 microns / pixel.

The coaxial line illumination, either as a bright field or as a dark field, ensures the high contrast image of the corrosion structures. The software

automatically detects the shape, length and corrosion area and evaluates it according to the relevant standards.

The system was developed for rapid and objective corrosion evaluations with high sample throughput. The automatic evaluation including documentation in an image and Excel sheet takes 5 seconds. The system proceeds color and monochrome grayscale images.



### Corrosion Inspector Hardware SK-LASM-C-90-22-J010

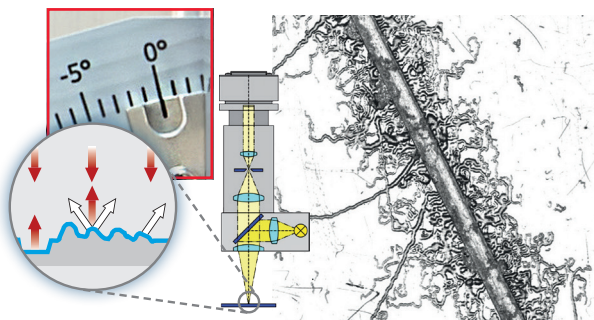
- 1 Color line scan camera 3 x 4080 pixels (RGB)
- 2 Illumination unit LBH146-01-500K-V-140-49
- 3 Adapter console, rotatable, -15° ... + 15°
- 4 Translation unit SK8030-200-JE

### Automatic evaluation procedure

- Step 1: Clamp the test plate onto the sample table.
- Step 2: Choice of illumination by adjusting the sensor head angle: 0° for bright-field, -15° to + 15° for dark-field illumination.
- Step 3: Scanning and evaluation.
- Step 4: Export the results.

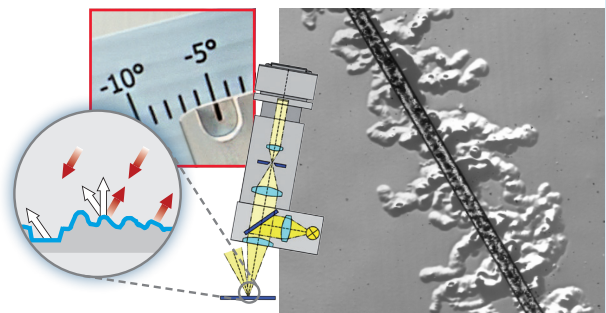
### Bright-field illumination (Sensor Head Angle 0°)

With bright-field illumination, the incident light is perpendicular to the test plate. Horizontal surfaces reflect the most light into the camera and appear bright. The incident light reflected from steep structures or edges is not captured and these appear dark. This is ideal for the evaluation of filiform corrosion, as the finest filaments and faults are revealed at high contrast.



### Dark-field illumination (Sensor Head Angle -15°..+15°)

Dark-field illumination with a sensor head angle of -15° to +15° provides good imaging results at corrosion areas with shallow ramped edges. These appear bright, while flat areas are mapped dark. Typical of the dark field illumination is the relief-like imaging of surface structures.

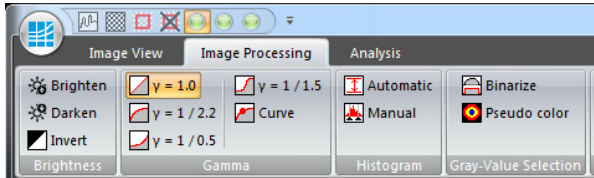




# Corrosion Inspector – Software SKan-CI 3.3

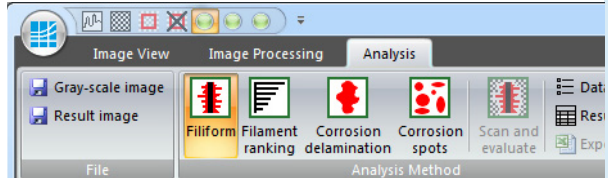
## Software functions SKan-CI 3.3:

- Control of camera, lighting and motor stage
- Variable scan lengths, measuring in ROIs,
- Image processing, contrast enhancement, zoom,
- Corrosion measurement and evaluation
- Result image, original image, merged image (png)
- Data export to Excel<sup>TM</sup>, LibreOffice Calc



## Corrosion evaluations:

- Filiform corrosion according to ISO21227-4
- Delamination and corrosion acc. to ISO 4628-8
- Testing of stone impact resistance, ISO 20567-1
- Average underfilm width UF
- Counting of all filaments, maximum length l, r
- Evaluation according to GSB, ACT II, Qualicoat



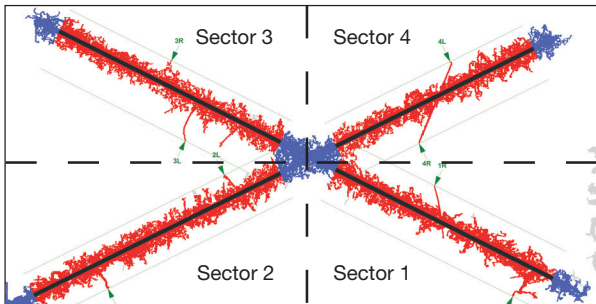
## Measurements and evaluations (extract)



**Filiform**  
 - Evaluation according ISO 21227-4  
 - Mean width of filiform corrosion (UF)

### Measured values:

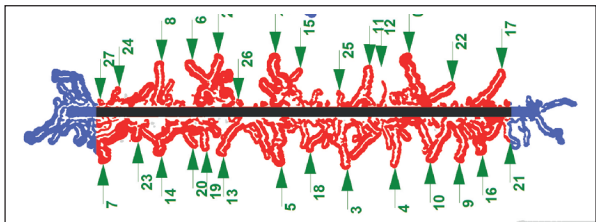
- A = area of corrosion along the scribe line (mm<sup>2</sup>)
- Am = average corrosion area per scribe length unit, Am<sub>L</sub>, Am<sub>R</sub> (mm<sup>2</sup>/cm)
- L<sub>L</sub>, L<sub>R</sub> = longest filament on left/right of scribe (mm)
- UF = (d - d<sub>0</sub>) / 2; 20 equidistant measuring points



**Filament counting**  
 - Ranking of filament lengths  
 - Evaluation acc. GSB: H= Z / L, F= l \* H

### Measured values:

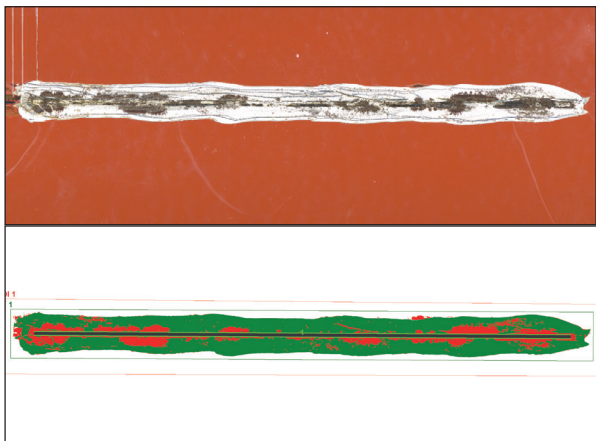
- l = average length (mm), Z = number of filaments
- L = scribe length (mm), H = occurrence frequency
- F = indicator of filiform corrosion attack



**Delamination and Corrosion (ISO 4628-8)**  
 - Automatic red rust detection, color analysis  
 - Separation of delamination area

### Measured values:

- D = delamination extent (mm)
  - C = corrosion extent (mm)
  - Ad = delamination area (mm<sup>2</sup>)
  - Ac = corrosion area (mm<sup>2</sup>)
  - Al = scribe area (mm<sup>2</sup>)
  - l = scribe length (mm)
- $$D = \frac{Ad - Al}{2} \cdot \frac{1}{l}$$
- $$C = \frac{Ac - Al}{2} \cdot \frac{1}{l}$$



### Result image

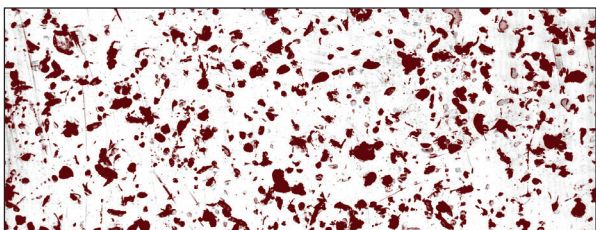
green: area of delamination, red: area of corrosion



**Corrosion sites**  
 - evaluation of multi-impact acc. ISO 20567-1  
 - degree of blistering acc. ISO 4628-2

### Measured values:

- A<sub>D</sub> = damaged area, absolute (mm<sup>2</sup>),
- A<sub>R</sub> = damaged area, relative to the total area (%),
- KW = rating of the affected areas (0.5 - 5.0)



# Results and Reports – Technical Data

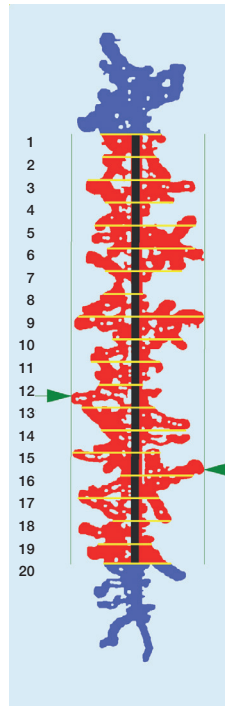
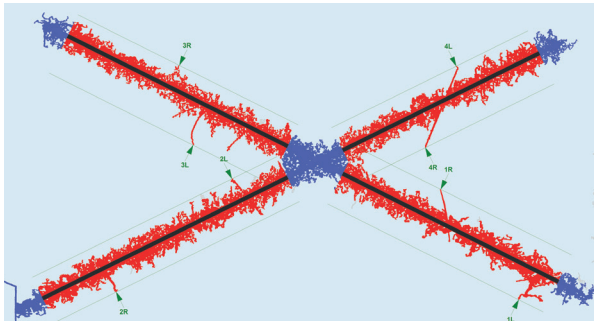
Results

## Results and Reports

Immediately after the measurement, the software displays the results graphically and numerically on the monitor.

The corrosion surface is marked in red. The measured filaments are indicated by green arrows. Areas that are excluded from the measurement, at the scribe ends, and in the crossing area of a X pattern are marked in blue.

The operator enters the process data via a comfortable dialog. The program saves the result image together with the original image and an Excel or Calc table in the selected folder.



Filiform Analysis      Automotive  
 Order:                    A416682  
 Exposure time:        1000 h  
 Operator:                Joe Doe

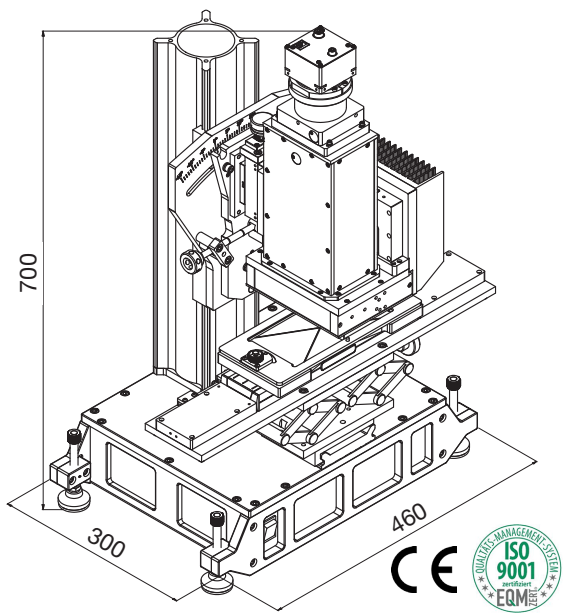
Sample ID:	1	Pattern:
Remark:	D	Date: 28.02.2017
Measuring point	Sector 1 [mm]	
1	5,66	
2	4,84	
3	7,62	
4	6,29	
5	9,34	
6	8,01	
7	6,67	
8	3,48	
9	11,72	
10	6,33	
11	6,05	
12	6,76	
13	7,81	
14	7,73	
15	8,13	
16	6,95	
17	7,66	
18	5,31	
19	4,73	
20	6,41	
Total	137,50	
d (Total / 20)	6,88	
d - d0	5,88	
UF	2,94	

Technical Data

## Order information Article Corrosion Inspector

- Order Code** SK-LASM-C-90-22-J010  
**Scanner hardware**, sensor head and translation unit included
- Order Code** SKan-CI  
**Software package**, Controlling of the camera, illumination, and the translation unit, measurement and evaluation, export and report functions
- Order Code** SKan-CI-LIC  
**Second license**, for offline evaluation of stored images

## Dimensions



## Technical Data

Corrosion Inspector Color	
Total measurement time	max. 5 s (in automatic mode)
<b>Sensor</b>	SK12240GKOC+LED-500K-90-22-49
Measurement area	max. 90 mm x 200 mm
Free Working Distance	49 mm
Resolution	22 µm/pixel (= 45 pixel/mm)
Depth of focus	+/-1.2 mm (2z = 2.4 mm for k = 8)
Line scan camera	SK12240GKOC-4L
Number of pixel, size	3 x 4080 (RGB), 10 µm x 10 µm
Line frequency	max. 7.2 kHz
Characteristics	Anti-Blooming, Integration Control
Interface	Gigabit Ethernet
Operating temperature	+5 ... +45°C
<b>Illumination</b>	LBH146-01-500K-V-140-49
LED line light	5000K (white)
Interface	RS232, software controlled
Adapter console	rotatable, +/-15°
<b>Translation unit</b>	SK8030-200-JE
Drive	mono block linear motor, resolution 1 µm
Scan length	max. 200 mm
Scan velocity	max. 250 mm/s
Object carrier	height adjustable table, lift range 40 mm
Test plate holder	length and depth stopper, press-in frame
<b>Total system</b>	
Power supply	voltage: 110-240VAC power consumption: max. 90W
Interface to the PC	1x Gigabit Ethernet
Dimensions (WxDxH)	460 mm x 300 mm x 700 mm
Weight	34.0 kg