# Corrosion Inspector

## Measurement and evaluation of corrosion phenomena on coated test plates


- Test plate size max. 100 mm x 200 mm
- Scan velocity 250 mm/s
- Resolution 0.04 mm
- Automatic and interactive measurement of corrosion phenomena ( area, width, filament length, delamination, multi-impact)

**SKan-CI Version 3.0**

03/2017

Schäfter+Kirchhoff GmbH

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## SK-LASM-80-40-49-J01

# Corrosion Inspector - Scanning and Imaging

**with variable illumination for bright-field and dark-field**

Filiform corrosion is a special corrosion phenomena that often affects coated aluminum and low alloy steels. The corrosion creeps between the metal and the coating, typically in the shape of fine filaments.
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 0.04 mm.
The coaxial 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 takes 2 -3 seconds. Including documentation in an image and Excel sheet, the test process for a sample plate is completed in 5 seconds.

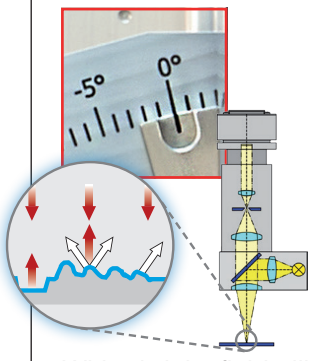
## Automatic evaluation procedure

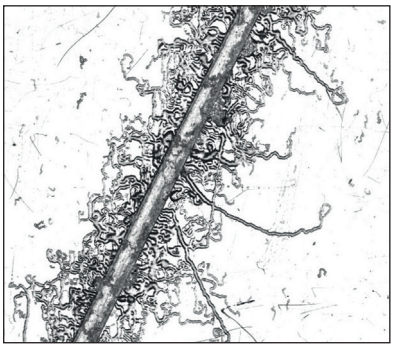
Step 1: Clamp the test plate onto the sample table.
Step 2: Choice of illumination by adjusting the sensor head angle: 0° for bright-field, -15° to + 15° for dark-field illumination.
Step 3: Scanning and evaluation.
Step 4: Export the results.


## Corrosion Inspector Hardware SK-LASM-80-49-40-J01

1. **Line scan camera SK2048GSD-L**
2. **Illumination unit LBH146-01-640-V-140-49**
3. **Adapter console, rotatable, -15° ... + 15°**
4. **Translation unit SK8030-200-JE**

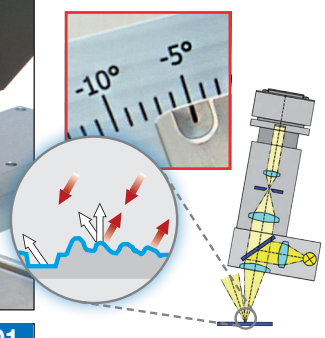
## Bright-field illumination (Sensor Head Angle 0°)

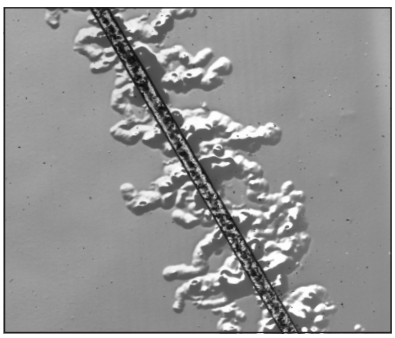


With bright-field illumination, the incident light is perpendicular to the test plate. Horizontal surfaces reflect the most light into the camera and appear bright. The incident light reflected from steep structures or edges is not captured and these appear dark. This is ideal for the evaluation of filiform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



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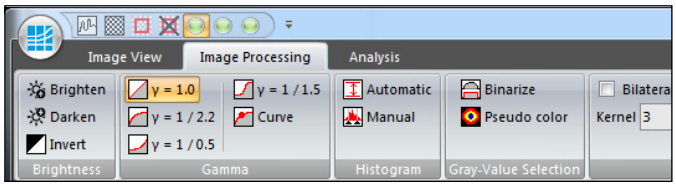
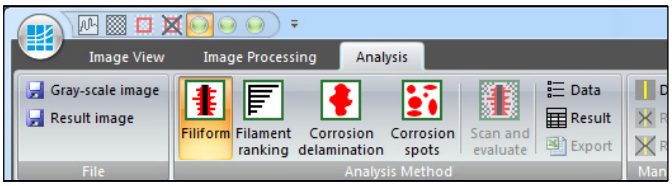
## Software SKan-CI 3.0

# Corrosion Inspector - Measurement and Evaluation



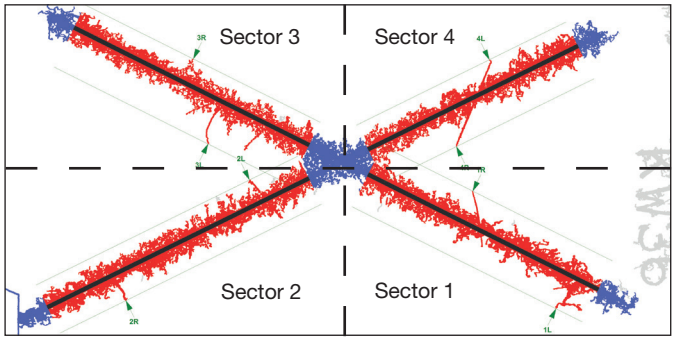

**Software functions SKan-CI 3.0:**

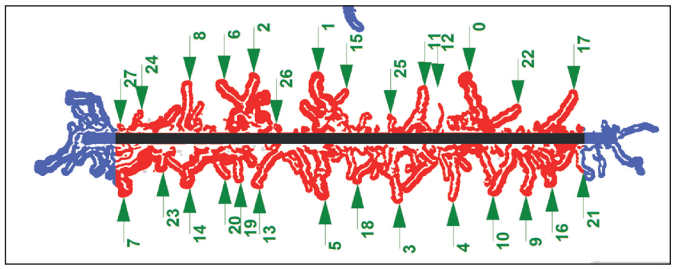
- Control of camera, lighting and motor stage
- Variable scan lengths, measuring in ROIs,
- Image processing, contrast enhancement, zoom,
- Corrosion measurement and evaluation
- Result image, original image, merged image (png)
- Data export to ExcelTM, LibreOffice Calc

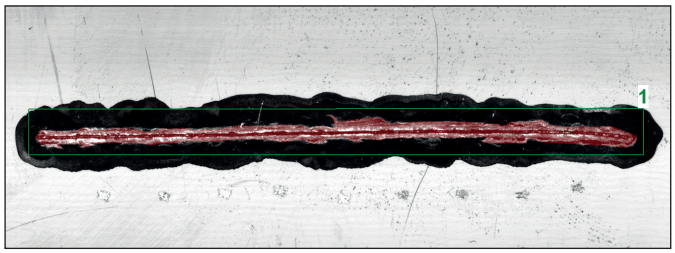
**Corrosion evaluations:**

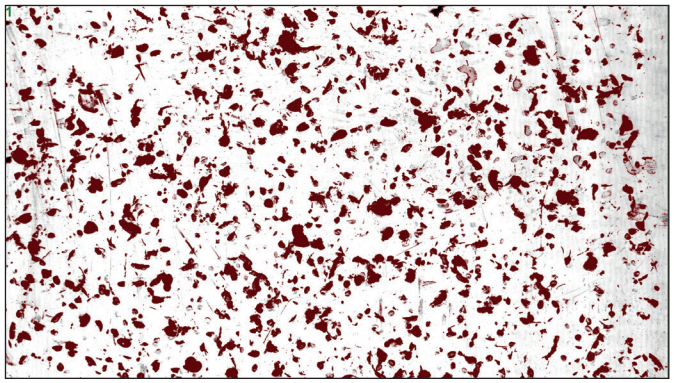
- Filiform corrosion according to ISO21227-4
- Delamination and corrosion acc. to ISO 4628-8
- Testing of stone impact resistance, ISO 20567-1
- Mean underfloating width UF (Daimler)
- Counting of all filaments, maximum length l, r
- Evaluation according to GSB (F, H)

## Measurements and evaluations (extract)







### Filiform
- Evaluation according ISO 21227-4
- Average width of underfilm corr. UF

**Measured values:**

A = area of underfilm corrosion along the scribe line ($mm^2$)
Am = average corrosion area per scribe lenght unit, $Am_L$, $Am_R$ ($mm^2$/cm)
$L_l$,$L_r$= longest filament on left/right of scribe (mm)
UF = (d - d0) /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 = length of scribe line (mm), H = occurence frequency
F = indicator of filiform corrosion attack

### Delamination and Corrosion
- Evaluation according to ISO 4628-8
- Total corrosion area minus scribe line ($mm^2$)

**Measured values:**

$A_d$ = delamination area ($mm^2$), D = delamination extent
$A_c$ = corrosion area ($mm^2$), C = corrosion extent

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

**Measured values:**

$A_D$ = damaged area, absolute ($mm^2$),
$A_R$ = damaged area, relative to the total area (%),
KW= indicator for degree of damage (0.5 - 5.0)
- size classification
- frequency of occurence of objects of a size class
- evaluation in gray value classes
- pseudo color representation of gray value classes

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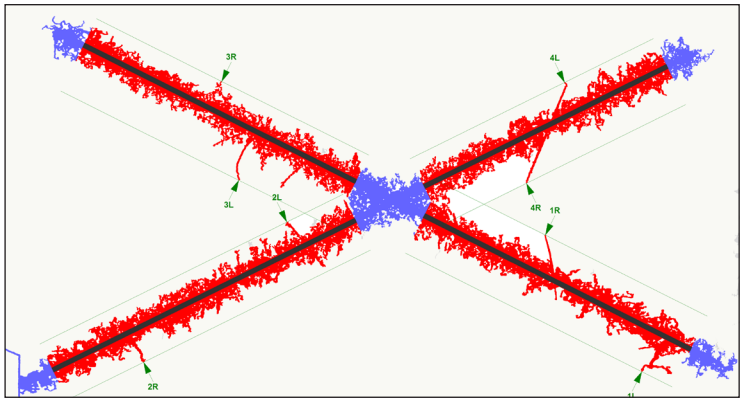
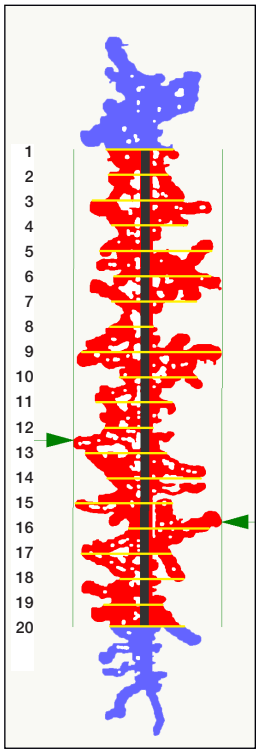
## Results and Reports

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.



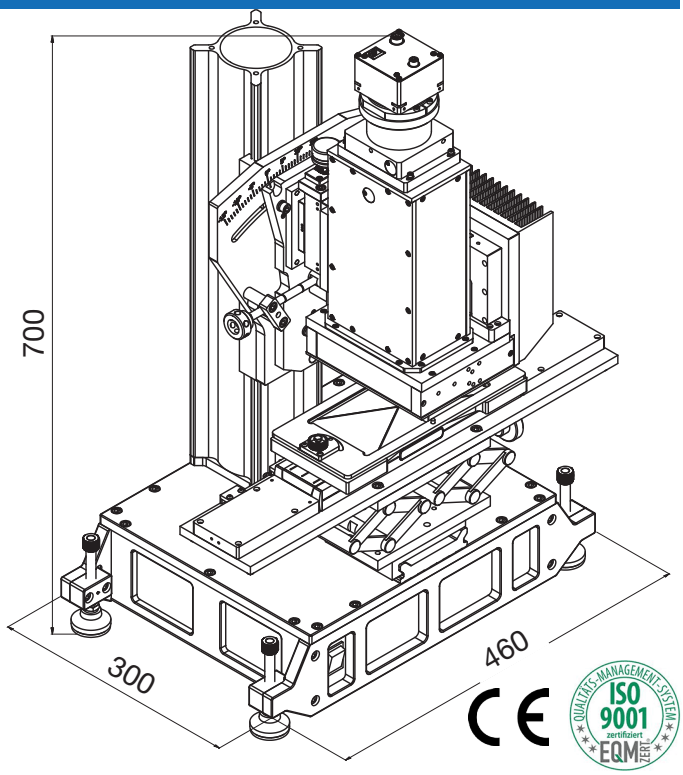

Filiform Analysis — Automotive
Order: A416682
Exposure time: 1000 h
Operator: Joe Doe

| 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

| **Corrosion Inspector SKan-CI** | |
|---|---|
| Total measurement time | max. 5 s (in automatic mode) |
| **Sensor** | **SK2048GSD+LED-80-49** |
| Measurement area | max. 80 mm x 200 mm |
| Free Working Distance | 49 mm |
| Resolution | 0.04 mm/pixel (= 25 pixel/mm) |
| Depth of focus | +/–1.2 mm (2z = 2.4 mm for k = 8) |
| Line scan camera | SK2048GSD-L |
| Number of pixel, size | 2048, 14 µm x 14 µm |
| Line frequency | max. 14.3 kHz |
| Characteristics | Anti-Blooming, Integration Control |
| Interface | Gigabit Ethernet |
| Operating temperature | +5 ... +45°C |
| **Illumination** | **LBH146-01-640-V-140-49** |
| LED line light | 640 nm +/–20 nm |
| Interface | RS232, software controlled |
| Adapter console | rotatable, +/–15° |
| **Translation unit** | **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 |
| **Total system** | |
| Power supply | voltage: 110–240 V AC<br>power consumption: max. 90 W |
| Interface to the PC | 1x Gigabit Ethernet |
| Dimensions (W x D x H) | 460 mm x 300 mm x 700 mm |
| Weight | 34.0 kg |




| Order information Article | Corrosion Inspector |
|---|---|
| **SK-LASM-80-40-49-J01** | **Scanner hardware**, sensor head and translation unit included |
| **SKan-CI** | **Software package**<br>Controlling of the camera, illumination, and the translation unit, measurement and evaluation, export and report functions |
| **SKan-CI-LIC** | **Second license,** for offline evaluation of stored images |



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