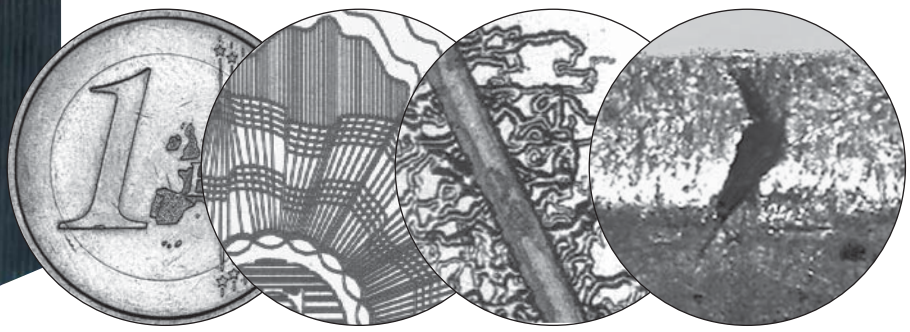
Figure 1: Line scan camera sensor head for direct bright-field illumination
Both the light source and the camera are coaligned on the object for direct bright-field illumination. Glossy surfaces parallel to the sensor reflect most of the light back to the camera and so appear as bright areas, while surfaces with a structure and bevelled edges appear dark. Figure 2 illustrates the use of direct bright-field illumination in the analysis of a one euro coin.

Special developments

Line scan cameras with integrated bright-field illumination

A novel development in automated surface inspection and analysis



Imprint testing *Microembossing* *Paint damage* *Crack detection*

High-contrast image acquisition of structured objects; making the invisible visible
Illumination and image acquisition techniques that are well adapted to the object properties emphasize the object features of interest. Elaborate image processing algorithms are avoided.

In microscopy, the application of sophisticated illumination techniques for the enhancement of specific object features has been routine for a long time. It is well known that the quality of the image is crucially dependent upon the type of illumination as well as the performance of the lens. Incident light microscopy techniques, such as bright-field and dark-field illumination or directed and diffuse illumination, have been used since the 19th century for examining the crystal structure of metallic and other surfaces.

Line scan sensor heads by **Schäfter+ Kirchhoff** combine all of the essental features - the line scan camera, the measuring objective and LED bright-field illumination - in a ruggedized unit, highly suited for industrial applications. The LED illumination is aligned precisely with the camera lens and provides a service life of years.

The modular structure of the line scan camera sensor heads promotes their use in numerous surface and texture analysis tasks. Figure 1 depicts a 4096-pixel sensor head with a resolution of 8 µm and a 33 mm field of view. A sensor head with 8000+ pixels was developed for ice core scanning, providing a resolution of 5 µm for a 41 mm field of view (see page 53). The working distance in each case is 50 mm.

Directed bright-field illumination is ideally suited for surface inspection and, by using high contrast, reveals damage normally invisible to the human eye. Subsequent image and data processing steps are speeded up substantially by having the best possible imaging methods.

Directed bright-field illumination

Principle of the method

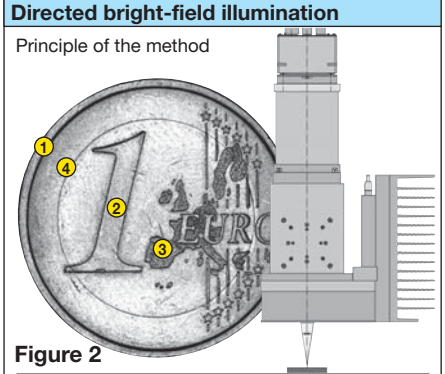
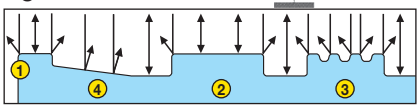


Figure 2



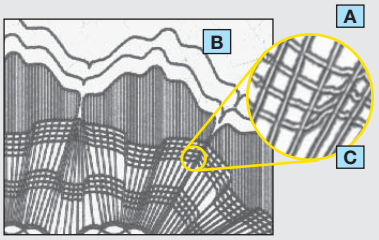
① The edges of the minted coin are angled both inwardly and outwardly.
Vertically directed light is mainly scattered and only a part is reflected back to the sensor.
The edges are reproduced dimly.

② The margin and embossed design are at right angles to the illumination source, reflecting most incident light back to the sensor and appearing as bright surfaces.

③ Continental Europe and the British Isles have a distinctively patterned surface that scatters most of the incident light. This pattern produces a largely dark field with bright punctuated highlights.

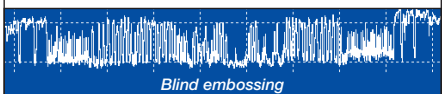
④ The background between these raised areas exhibits an angled depression which is rendered as a surface with gray tones.

Application: Blind embossing
Making the invisible visible



A An identity card with unnoticeable blind embossing illuminated diffusely: no significant textures from the surface are visible.
B Using directed bright-field illumination: detailed imaging rich in contrast reveals the blind embossing.
C Magnified portion of B.

The edges of the embossed grooves scatter the directed illumination and are seen as two parallel dark lines. The flat surface and the groove channel directly reflect the light and are seen as bright areas in the image.



Blind embossing
Oscilloscope display of line signal

Application: Paint damage
Scratching under the surface

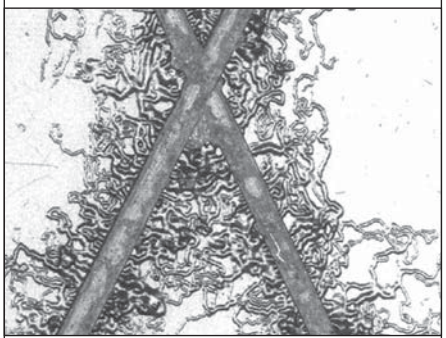
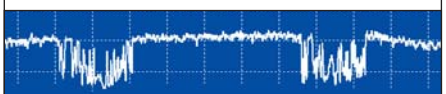


Figure 4: Varnished aluminum test plate with filiform corrosion along two scratches

Varnished car body sheets made from high alloy aluminum are sensitive to filiform corrosion and varnish infiltration originating from minute scratches.
Directed bright-field illumination reveals the full extent of the filiform infiltration as regions of high contrast. Automatic evaluation of the test object uses digital image processing to find the optimum imaging conditions.



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Application: Surface inspection

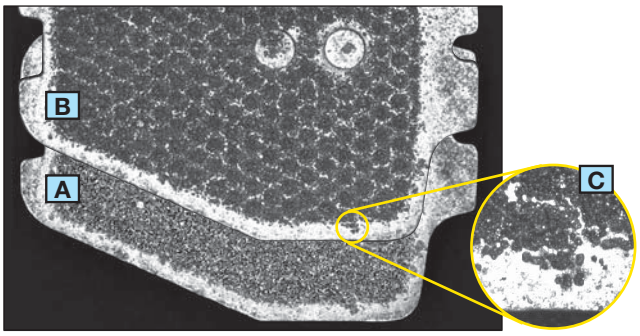


Figure 5: Disc brakepad with sintered surface
A Diffuse illumination B Bright-field illumination C Example of a fault

Images A and B were taken using the identical line scan camera and coordinates but differing only in the type of illumination used. By using directed bright-field illumination B, the sinter particle clusters and fault areas can be clearly recognized in the inspected region.
Image C is a magnification of the fault in the sintered coating of the brakepad.

Application: Inspection of overall geometry and blade edges

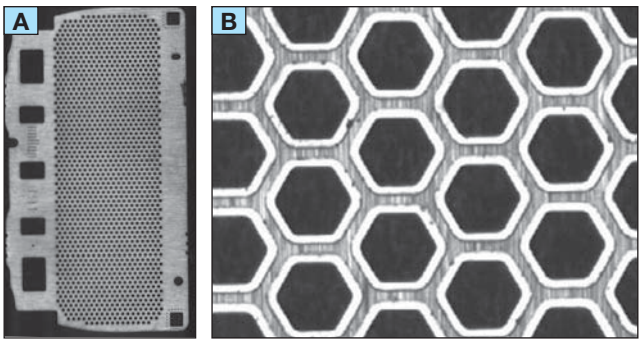
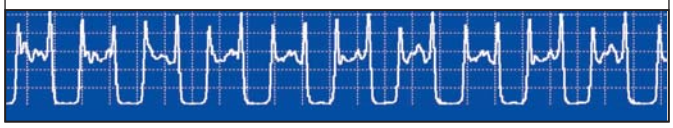
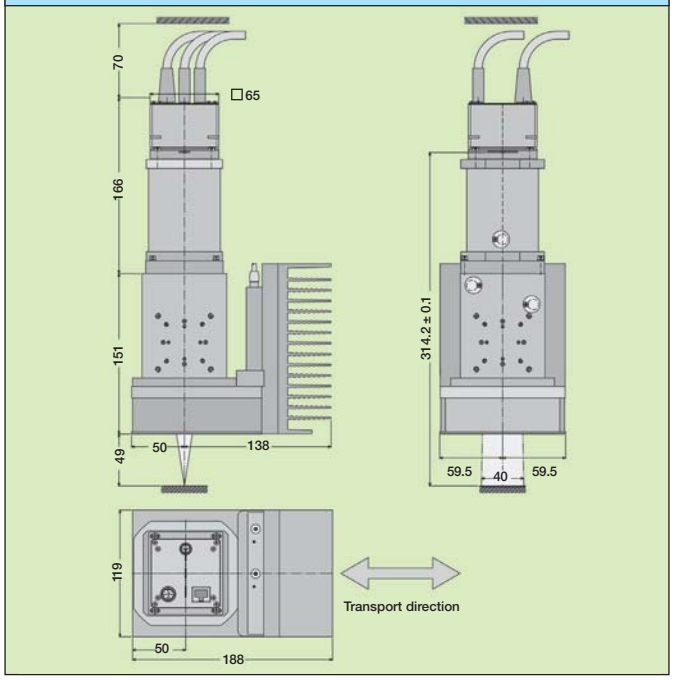


Figure 6: Shaving foil from an electric razor
A Shaving foil pictured under bright-field illumination
B Magnified portion of A

The hexagonal dark areas are holes in the flexible 3D shaving foil. The bright edges are the flat cutting edges, which are interspersed with a contiguous gray area that delineates the depressed surface of the metal foil.



Dimensions



Application
Crack inspection of cold-extruded parts

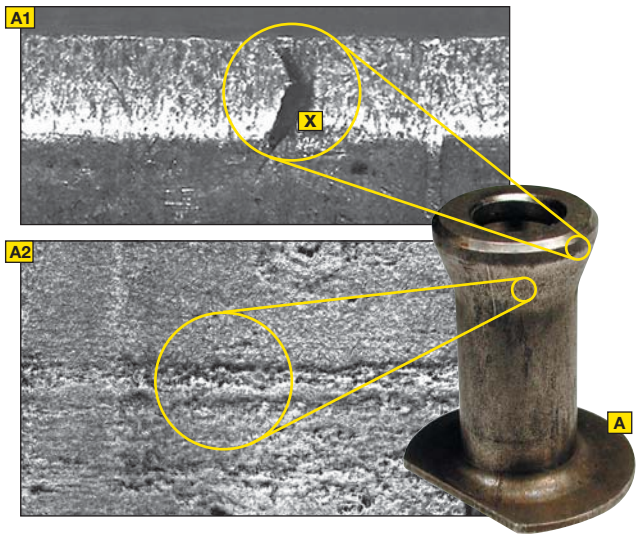


Figure 7: Extruded object and magnified inspection area
A Extruded object
A1 Surface scan of the extruded edge; camera C1
X Crack in the outer surface
A2 Surface scan showing texture of the pressed contour; camera C2

- 100% control of critical areas of components manufactured in round-the-clock processes
- Custom-designed specialist editions are our speciality
- Line scan camera with integrated bright-field illumination
- The final system and protective casings are carefully designed to conform to the minimum space available
- The robust camera covers and casings are resistant to dirt and scratches – in high quality sapphire look

All components are specially designed and assembled for the demanding environments found in industrial production

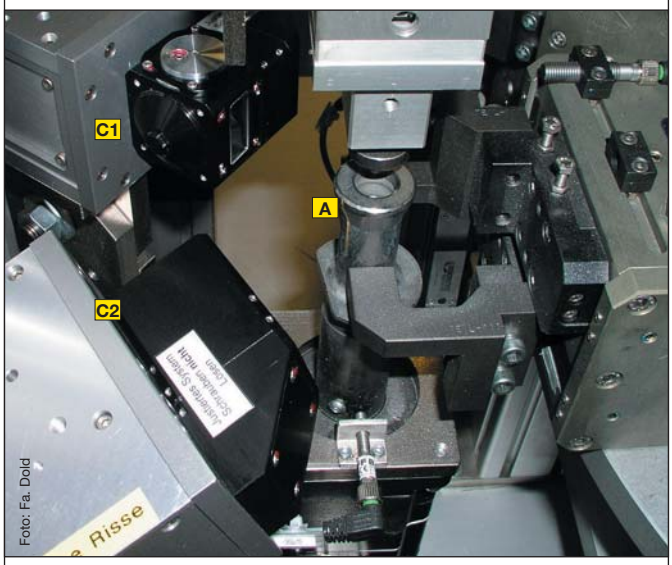


Figure 8: Inspection assembly with cameras and transport system
A Measured object (cold-extruded component)
C1 Camera, horizontally mounted, checks the surface of upper lip A1
C2 Camera, angled mounting, checks the conical area A2