Crack detection on forged parts

Induction thermography

FOERSTER

Test part

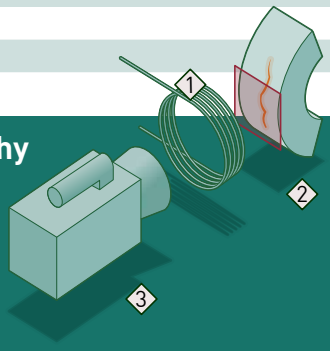
The test part is a forged steel shaft fork.

It is an automotive component that will be part of the steering mechanism. The stage is after forging and before machining.

The part is safety relevant. Currently all parts are inspected with magnetic particle inspection.

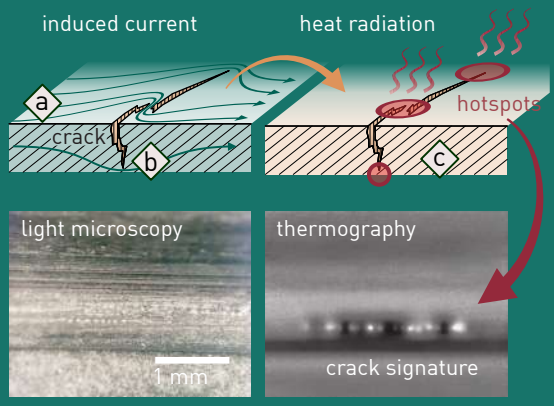
The test area is the fork part where cracks typically appear on the sides of the prongs. Cracks have no particular direction.

Induction Thermography



Induction thermography uses an induction coil (1) to produce currents in a conductive test part (2). The thermal response is monitored with an infrared camera (3).

Cracks constitute an obstacle for induced currents (a). This results in strong local variations in current density where the currents circumvent the crack (b). Areas of high current density become hotspots (c), low density area become heat sinks. The heat radiation is picked up by the camera and cracks manifest as beaded patterns on an induction thermography recording.



Results

Cracks can be be detected with induction thermography. An exemplary recording is shown below.

Crack signature patterns occur with a high intensity. Recordings are reproducible. Disruptive pattern may also occur.They originate from scale, chalk markings and the edges on the part geometry. None of the disruptive patterns are significant as compared to the crack pattern.

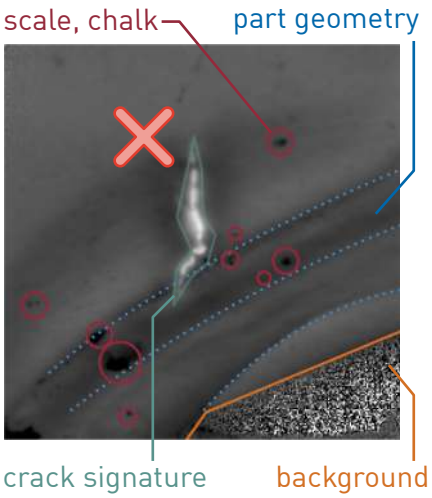
In comparison to magnetic particle testing, induction thermography performs significantly better. Crack patterns are much more pronounces in contrast in relation to disruptive patterns and noise. An automated image processing algorithm can easily be customised to find such patterns.

An application may still be challenging, when cracks with different directions and in different test areas on the part have to be detected. This might require several inspection steps with customised parameters and increase the complexity of an inspection. The detection limit has to be established with a statistically relevant sample size and a comparison to destructive metallographic inspections.

Photography

Magnetic Particle Inspection

Induction thermography



Conclusion

Cracks can be detected on the test part. An application appears feasible. Further studies are required to optimise the inspection and establish detection limits. ✓

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