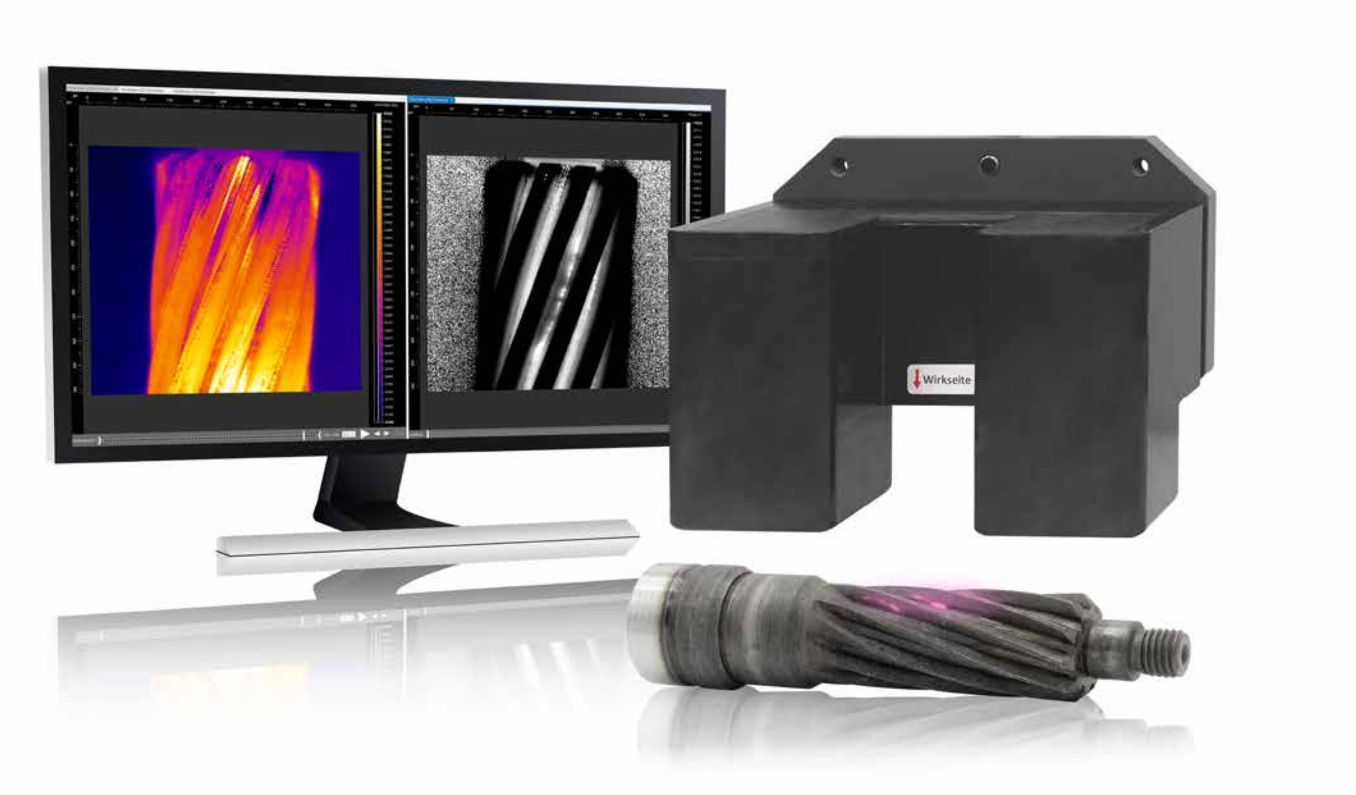
DEFECTOVISION CT

FOERSTER

Non-destructive and contact-free crack detection
for components with complex geometries



Highlights

- Fully automatable, contact-free, and non-destructive crack detection
- Suitable for open cracks, pores, heat treatment cracks, forging laps, welding defects, etc.
- Can be used on rough, uneven surfaces and surfaces coated with water or oil
- For asymmetric geometries, concave profiles, and small test areas
- Low heating required
- Testing in less than 1 second

Testing of complex geometry components made easy

Parts with complicated shapes have certain test areas that are difficult or impossible to access with eddy current probes. Often, the only remaining method for crack detection was magnetic particle inspection. With induction thermography, FOERSTER now offers a new, automatable solution for component testing. This method is suitable for the examination of semi-finished products as well as complexly shaped components.

Induction thermography allows for a contact-free crack detection on metallic components with complex geometries. A current induced into the workpiece generates localized hotspots at the defects in the material. These hotspots can be detected through their heat radiation with an infrared camera.

Crack detection with induction thermography

Operating principle

Induction thermography is a non-destructive and contact-free procedure for the detection of surface cracks on conductive materials. The eddy currents produced by an induction coil are locally distorted by cracks in the material surface. Accordingly, temperature surges - so-called hotspots - occur in the corresponding positions. With the help of a thermal imaging camera, defects are thus made visible.

Fig. 1: System setup

A typical system consists of an infrared camera, an inductor (Fig. 1) including a generator for high-power pulses (without illustration). The inductor is positioned such that a magnetic field pulse induces currents in the test area, heating the part by a few degrees Celsius. Simultaneously the camera is recording the same area. The camera captures the heat radiation, which is emitted as infrared light, and creates a temperature image of the surface.

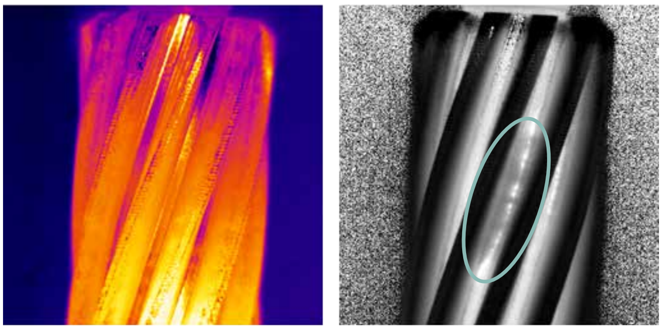


Fig. 2: Comparison of a pinion in infrared (left) and with induction thermography (right) where a crack is visible in the gear root.

The thermal recording analysis

If there are defects (e.g. cracks) in the test area, the induced current is deviated and is locally displaced or squeezed (Fig. 3a). Consequently, those locations in the part are heated stronger (Fig. 3b). When such hotspots form directly at the surface, they emit heat radiation and are visible to the camera. The heat from hotspots within the material can also reach the surface through the heat conduction of the material. However, the range into the material is limited by the penetration depth of the induction.

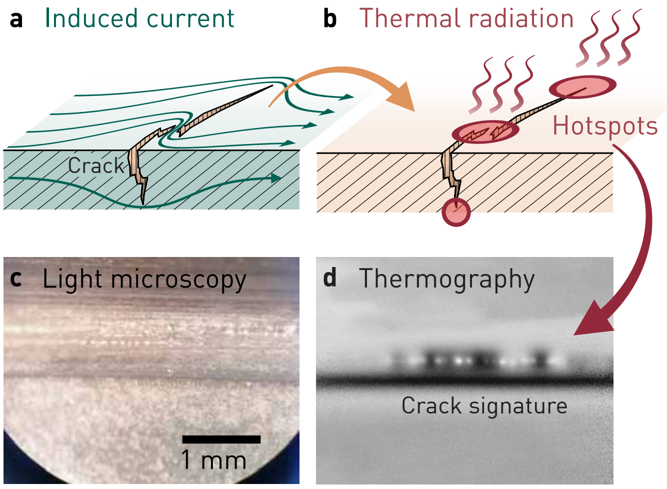


Fig. 3: Operating principle and imaging

The thermal recordings are analyzed with video and image processing algorithms. On a thermography recording (Fig. 3d), the hotspots leave a crack signature similar to a string of pearls. In contrast, other surface features, such as roughness and scratches, are suppressed. This way cracks can be detected that would be difficult or impossible to distinguish in a conventional photo (compare Fig. 3c). The high contrast and characteristic shape of cracks in induction thermography images allows for reliable algorithmic detection and enables the full automation of the procedure right up to a sorting result.

Typical test parts

Induction thermography offers a particular advantage on components that have special structural properties, such as threading, gearing, blades or profiles. Suitable parts are often forged, sintered, produced in additive manufacturing, or sometimes formed. Further advantages ensue on special surface conditions. For example, with the use of induction thermography, pores and cracks in welding seams can also be efficiently detected without disruptive effect.

External gearings
Thermography can allow the inspection of the full gear profile, including roots, flanks and end faces.

Internal gearings
Under certain circumstances, internal gear profiles are also accessible.

Cams
Hardening cracks running along the circumference can be efficiently detected.

Forged parts
Defects, such as forging laps, can occur in various areas. With thermography, many of these areas can be covered with the same test procedure.

Formed sheet metal
Cracks that occur on the bends can be detected. However, thermography cannot efficiently cover large test areas.

Welding seams
Cracks, pores and incomplete fusions are visible with minimal interference.

Sintered parts
Creases on the parts are particularly prone to crack. Such defects are accessible with thermography. However, very deep creases may also pose a challenge for this method.

Turbine blades
Thermography is suitable for cutting-edge materials and flexible enough to handle very complex geometries.

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