

1 The F-360° inspection system records objects from different directions in free fall using several cameras. This is how 100 percent of the object surface is captured in a single recording process.

2 Even components with complex shapes – such as this test part made of aluminum – can be examined for desired coatings and undesired impurities in free fall.

## F-360° INSPECTION SYSTEM DETECTING COATINGS AND IMPURITIES IN FREE FALL

The requirements regarding the surface quality of semi-finished products continue to increase. Especially the assurance of purity or desired coating properties is becoming more and more important. In many cases, the component even needs to be tested from all sides, which so far is only possible with an additional handling step, since the components are always transported on a carrier or a conveyor belt. Suitable inspection systems thus encounter two great challenges: On the one hand, the variety of components increases handling costs. On the other hand, the requirement to qualify the entire surface of all parts in the production confronts automatic image processing with almost unsolvable problems. That is why the new F-360° inspection system follows a completely new approach: It inspects the entire component surface in free fall – entirely without handling, with a simultaneous image recording of the component from all sides.

### Fluorescence measurement in free fall

The F-360° inspection system inspects the entire surface of components and bulk material such as forming, stamping, forging or cast parts completely from all sides (fig. 1). The object falls through an opening into the system, where it is detected by a light barrier. A time trigger switches several UV-LEDs that illuminate the object in a suitable volume from all sides. Simultaneously, several cameras record the object from different directions. This is how 100 percent of the object surface is recorded in a single process step. Organic substances fluoresce under UV-lighting in the visible wavelength range and can be detected by the cameras spatially resolved and with high sensitivity. Impurities such as oil drops and residual filmic coatings are characterized quantitatively. Layer thickness or mass coverage can be exactly specified. While fluorescence is being measured

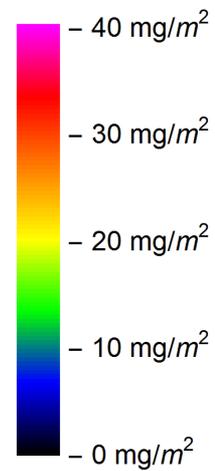
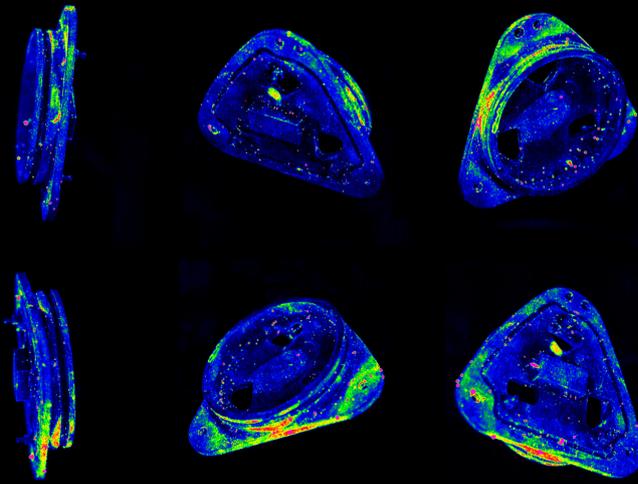
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red, images of the object are recorded that capture its orientation. Based on these images, a type recognition is carried out via CAD data matching. A mapping of both procedures allows the local assignment of the fluorescence signals and thus the imaging representation of the organic substances on the object surface (fig. 3).

### Simple and intuitive analysis

The system provides the results to the operator in simple analyzable form. Faulty areas can be recognized quickly and intuitively, so that a suitable reaction can take place in the production cycle. Since the system also detects surface characteristics such as discolorations or cracks, it provides a complete analysis of the entire object surface: Aside from local quantitative high-resolution measurement of coatings or film-type contaminations, F-360° also detects defects.

With the F-360° inspection system, an "accept/reject" conclusion with regard to

the specific object and requirements can be made within one second. The criteria for this can be adapted to specific objects and adjusted for different surface properties. In addition, the automated analysis of the measuring results can be restricted to selected parts of the object surface, so that only surface areas that are relevant for the component assessment, such as sealing surfaces or joining surfaces, are examined.

### No handling – simple integration

A decisive advantage of the F-360° inspection system is that no laborious handling is needed to test the surface. The process of feeding objects into the system is handled in a simple and universal way. In addition, the system itself can inspect all kinds of components. There is practically no restriction with respect to complexity of components (fig. 2). The surface only needs to be optically accessible. Even with a high diversity of parts, no mechanical adjustment is necessary, which is usually complex and

**3** The F-360° system detects organic substances such as film-type contaminations or particles using fluorescence. Matching the measurement values with the CAD component data allows the imaging representation of impurities on the object – from all sides.

expensive. All that needs to be done is to input new CAD data for the new components – there is no need to retrofit the F-360° inspection system for new parts.

Given a cycle speed of up to two objects per second – including complete inspection and analysis of the results – the system can also easily be integrated into a production process. There are hardly any limits to the variety of requirements that the F-360° can meet: The cleanliness of clean room and vacuum components as well as the partial purity for joining, adhesion or sealing surfaces can be characterized, as can the completeness of coated friction and protection layers for which the layer thickness needs to be measured.

### Inspect-360° free fall system

Inspect 360°, another free fall solution from Fraunhofer IPM, tests the component geometry and surface defects on components.

#### Typical system properties

Detection limit (according to BAM K009 lubricating oil)	10 mg/m <sup>2</sup>
Spatial resolution of the imaging procedure	100 μm
Cycle times	Approx. 0,5s
Recorded object sizes with current version (adjustable for larger components)	Up to 10 x 10 x 10 cm <sup>3</sup>

All specifications and features are subject to modification without notice.