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Inductive sensors based on eddy currents

eddyNCDT

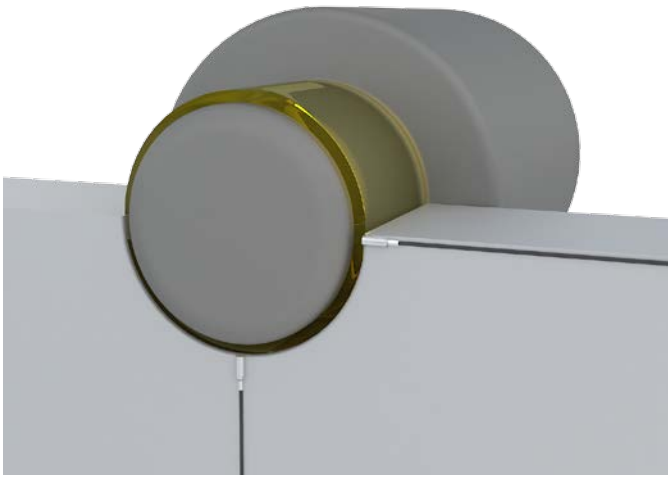
Measuring the bearing gap in wind turbines

The terms "Predictive Maintenance", "Industry 4.0" and "Condition Monitoring" are meanwhile given high importance. The future need for early predictions about failure of a machine and its components is increasing. The aim is to proactively intervene before any major damage occurs. Targeted monitoring using modern sensor technology reduces maintenance and servicing costs. Proactive monitoring based on sensor technology is already being used in production processes and continues in test benches and real-time monitoring during turbine operation. For example, wind turbines typically have two main bearings in which the rotor shaft runs. Due to safety and cost reasons, wind turbines require 24/7 monitoring.

Monitoring the bearing gap between the bearing surface and the drive shaft is one of the primary objectives. An oil film in the lubricating gap prevents direct contact between the bearing surface and the shaft. Improved sliding properties of the bearing increase the turbine's effectiveness while prolonging its service life. The sliding properties mainly depend on the width of the bearing gap. Based on the size of the bearing gap, different conclusions can be drawn. This is because when the gap width is reduced, less oil covers the bearing surface and the component wear increases. This would lead to high temperatures, rapid wear and to bearing damage. In the worst case, the plant comes to a standstill which results in high service costs.

To date, bearing gaps were measured during standstill based on a tactile principle. Therefore, long inspection intervals were required, which in turn, may increase the risk of a complete plant failure. Moreover, these deliberate stoppages intended for measuring and inspection purposes cause considerable additional costs. Micro-Epsilon acquires the measurement values during plant operation, thereby enabling reliable, cost-saving real-time analysis.

This measurement task is performed with the inductive eddyNCDT 3005 measuring system based on eddy currents. It includes a sensor with a measuring range up to 6 mm, which is permanently connected to the controller via a 1 m long cable. As the system is oil-tight both on the front and rear side, it is ideally suited to this application even when typical oil pressures reach 1 to 2 bar in the bearing. The eddyNCDT 3005 inductive system is already being used in wind turbines to analyze and optimize the maintenance intervals of wind turbines. In addition, the data acquired in the test bench throughout the design period can be taken into account and used for dimensioning purposes of new components. The sensors can be used in the test bench and in high volume applications for Condition Monitoring. Serial use offers major advantages as the sensor technology can already be aligned and precisely adjusted during installation and initial operation.



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The output analog signals can be directly fed into a PLC and used, for example, to check their compliance with predefined limit values (MAX/MIN values). Furthermore, the measured results can be evaluated via external software. Special features such as linearity calibration and temperature compensation from Micro-Epsilon enable the calibration of sensors for diverse materials, shapes and different installation positions.

Requirements for the measurement system

- Typ. measuring ranges 2 - 6 mm
- Measurement uncertainty: 10 µm
- Frequency response <1 kHz
- Pressure resistant (front and rear)
- Temperature compensation up to 150 °C

Ambient conditions

- Shaft rotation speed 10-20 rpm
- Measurement immersed in oil
- Oil pressure (front and rear) 1 - 2 bar
- High temperatures up to 150 °C

System design

- Measuring system:
  - Electronics: DT3005 (LC)
  - Unshielded sensor with a measuring range of 6 mm
  - Sensor cable 1 m
  - Supply and signal cable : PC10/5, 10 m

- Installation:
  - Clamping flange for electronics Ø12
  - Sensor screwed and secured

Advantages

- Improved performance and service life of components
- Avoidance of unscheduled downtime thanks to preventive maintenance
- Optimized maintenance intervals
- Increases operational safety