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ROTOR TEMPERATURE MONITORING with WIRELESS BATTERY-FREE SENSORS

White Paper

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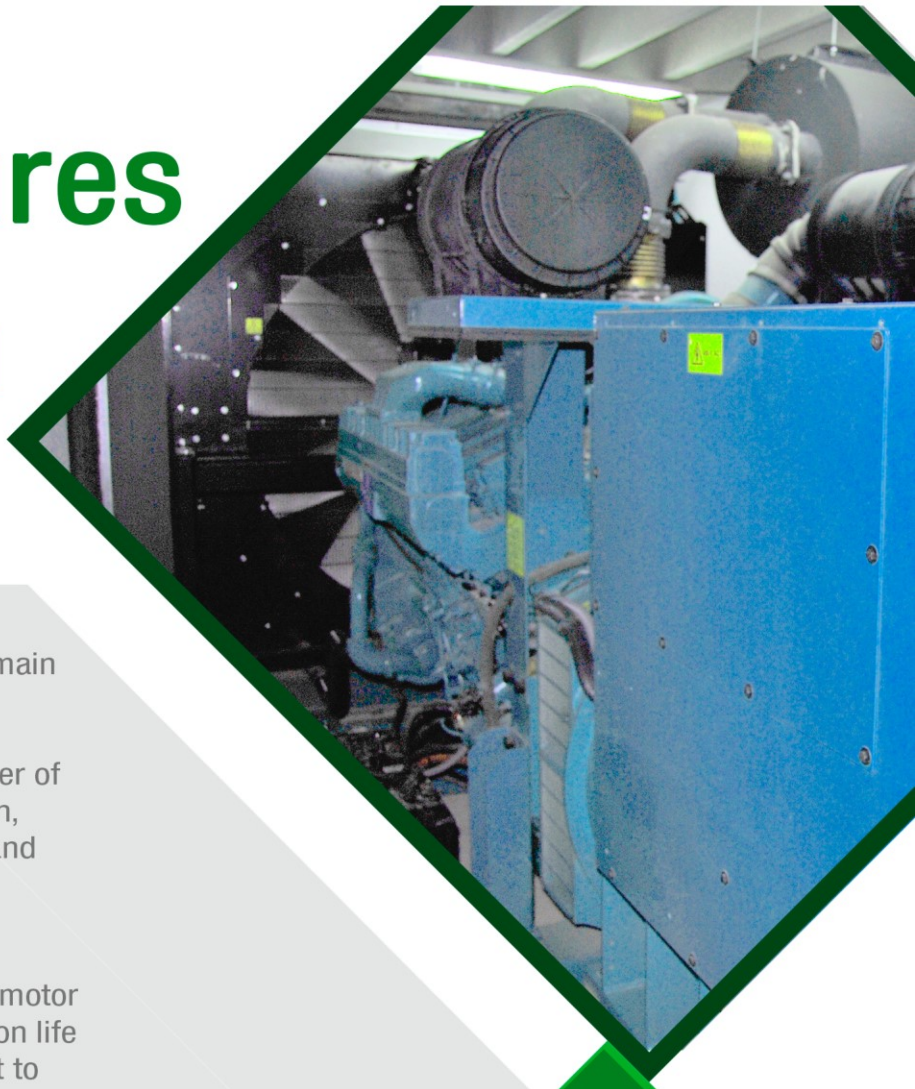

High temperatures are known as one of the main reasons why electric motors shut down, regardless of the type of motor. Unluckily, overheating is relatively common for a number of reasons – i.e.: overload, poor power condition, high effective service factor, frequent stops and starts or environmental reasons.

In induction electric motors and generators excessive heat causes rapid deterioration of motor winding insulation. As an estimation, insulation life is cut in half for every 10ºC of additional heat to the windings. As an example, if a motor that would normally last 20 years in regular service is running 40ºC above rated temperature, the motor would have a life of about 1 year.

In permanent magnet motors and generators, the issue is different but the cause is the same: high temperatures. High current or operating temperatures can cause the magnets in PMSM motors to lose their magnetic properties. Permanent magnets, once demagnetized, cannot recover, even if current or temperature returns to normal levels.

In both cases, manufacturers react by oversizing the design to minimize the risk and guarantee a long life of the motor. This is far from efficient and results from the inability of monitoring rotor temperature conditions reliably.

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Sensors as a source of data for motor maintenance

Maintenance of electric motors is generally based on indirect measurements – stator temperature to infer rotor hotspot temperature – and complex algorithms to make assumptions about real temperature in hot spots.

Some manufacturers use wireless sensors directly in the rotor during motor testing. This testing is carried out before shipping the motor to the customers to guarantee that performance adheres to specifications.

These wireless sensor solutions are fast and easy to install during testing. In comparison, using sensors to communicate over brush is a lot more complex and manufacturers will try to avoid it as much as possible.

Moreover, battery life is not an issue due to the short duration of these tests. This makes wireless sensor systems a good approach for direct measurement during the testing phase.

However, for long tests (durability tests for design purposes) and real operation standard wireless solutions are not optimal. Due to these wireless sensors requiring battery changes, motors have to be stopped when batteries are low or they must run without sensor data.

Pyros-0373-MKSWB contact temperature sensor

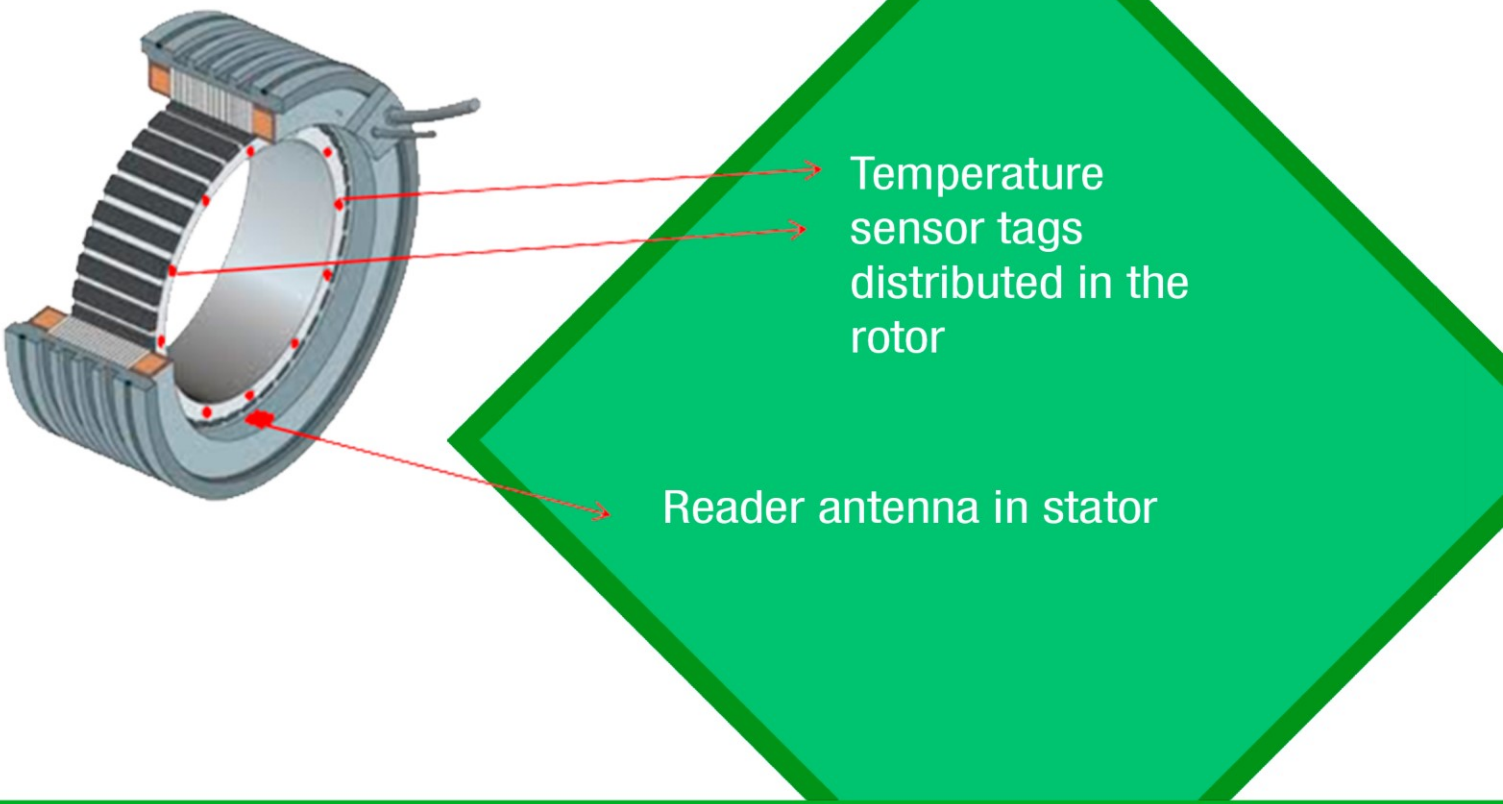
These wireless sensor solutions are fast and easy to install during testing

Real time wireless motor rotor monitoring

RFID based wireless and battery-free sensors are ideal for rotor monitoring systems. Temperature sensors such as thermistors can be placed directly into motor rotor hotspots to collect temperature data that can be processed to create a complete heat map of the rotor.

The wireless and battery-free system consists of an UHF RFID reader, reader antennas and sensor tags. The reader is fixed and can be placed even outside the motor. Reader antennas are placed in the stator and are responsible for RF field and signal creation. Sensor tags are placed on the rotor and harvest the energy from the RF field created by the reader antennas to take the measurements.

Once the battery-free system is correctly set up for the motor, the system will keep collecting data without ever requiring a battery change.



Improving motor life-cycle: from design to de-commissioning

Direct measurements from sensors in rotor provide benefits that apply to the complete life-cycle of the motor.

1. Design

Every engineer knows temperature is a key specification for motors. Engineers give a high priority to refrigeration systems on their designs as this will have a great impact in motor performance and service life.

Unluckily, engineers have to work with indirect data for their designs. They have little information from rotor hotspots due to the inability to source long, on-duty temperature data of their designs.

Having a set of objective data from the rotor after long test would allow them to improve their designs and increase motor efficiency and reduce costs by not having to oversize as much as they have to with indirect measurements.

2. Testing

Wireless sensors are already being used during testing by motor manufacturers for some tests. It provides great advantages in terms of time employed to set up the system when compared to brush based solutions.

However, these tests are limited to monitoring performance over short periods of time. Battery-free and wireless sensors allow manufacturers to run tests over long periods of time and process sensor data for information not only about on-duty specifications but also for performance over time.

3. Operation

This is the area with bigger potential for manufacturers and users of motors. Real time, on-duty condition monitoring with multiple sensing points allows for continuous temperature data over complete operation life of the motor. Processing this data will provide users with information not only for predictive maintenance – taking actions based on temperature profiles – but also to create comparisons between historical data and current temperature data.

As the sensors on the rotor have no batteries, there will be no downtimes associated to battery changes ever.

Prevent unexpected shutdowns and extend motor life by implementing wireless and battery-free sensors to get real time temperature monitoring of the motor rotor.

Real time, on-duty condition monitoring with multiple sensing points allows for continuous temperature data over complete operation life of the motor

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