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IMPROVE HOT MILL / COLD MILL THROUGHPUT

WITH MOTOR / GENERATOR ROTOR TEMPERATURE MONITORING

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Application: Improve Hot Mill / Cold Mill throughput with motor / generator rotor temperature monitoring

DC Motors and generators are rated to protect rotor armature windings from high temperatures that can damage the winding insulation. However, these ratings can limit the mill's production capacity, perhaps to unnecessarily low levels depending on how conservatively the equipment is rated and how conservatively production loading is applied. Recently, some mill operators have been improving production throughput without jeopardizing their drive equipment by employing an innovative new digital telemetry technology to directly measure rotor temperatures on their motors and generators.

For AC synchronous motor drives, the same rotor temperature monitoring techniques can be applied to temperature monitoring. In addition, ground fault detection and average field winding copper temperatures can provide even greater protection of the rotor, offering users a valuable predictive maintenance tool.

Industry: Steel, tin and aluminum metal production

Product: AT-7000 Motor Monitor

Parameters measured: Temperature --measured directly on the rotor winding via thermocouples or RTD's.

Additional useful measurements:

- Torque (via strain gage mounted on the rotor), Vibration (via ICP accelerometers)
- For AC Motors: Field Voltage and Current (allowing average rotor temperature calculation- important for motor restarts), and Ground Fault Resistance

Overview: Increasing the production output of drive motors and generators without monitoring the temperature of the rotors is asking for trouble. Failure to detect the overheating of a large motor or generator can result in insulation failure or even forging damage, requiring a $100,000 to $800,000 rebuild. New large motor replacements can cost from $250,000 to $2,000,000.

Stator-based indirect temperature monitoring does not adequately indicate rotor temperatures because of the differences in current density on the isolated field winding and the thermal insulation of the rotor.

Solution: Install RTD's or thermocouples on the surface of the rotor windings, or preferably embed them in the windings during a rewind (see www.flanderselectric.com). (Note: Any purchase of a new generator or motor, or rewind of an existing generator or motor should have RTD's or thermocouples installed. This is a small initial investment that ensures a future capability for effective rotor temperature monitoring.) The temperature signals are then available to be easily captured with on-rotor digital telemetry.

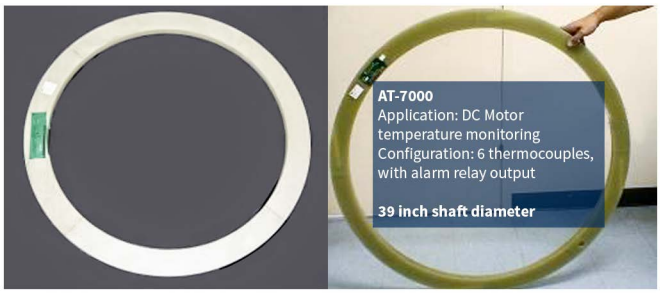
The AT-7000 Multi-channel Digital Telemetry System is highly EMI immune, providing an extremely effective method of continuously condition monitoring of the rotor to ensure safe/ reliable operation. The temperature data is measured at high sampling rates to properly capture the desired temperature information along with any high frequency noise signals that the sensors pick up. After transfer of the digital data off of the rotating shaft, the receiver then filters out the noise to provide high accuracy un-aliased temperature data with excellent signal integrity.

How it is applied: The AT-7000 telemetry system provides a robust multi-channel technique for retrieving sensor data in the following way:

1. A split clamp-collar of G10 glass laminate is mounted to the shaft. It is installed simply by tightening of two mounting bolts. This collar contains the telemetry measurement electronics and the input connectors for the on-rotor sensors.
2. Electric induction (delivered via a closely mounted stationary pickup coil) is used to wirelessly power the sensors and the rotating telemetry electronics. There are no batteries.
3. The RTD's, thermocouples, and any other sensor signals (torque, vibration, voltages, currents, and ground fault measurements) are amplified, anti-alias filtered and then digitized on-shaft to preserve the signal integrity.
4. The digital data from all of the sensors is serialized into a single high speed data stream, and transmitted to the stationary pickup loop that surrounds the shaft.
5. The data is transferred via coax to a remote receiver, where it is converted to high level analog outputs (4-20mA or 0 to 10volts) allowing easy input into any data acquisition system, or alternatively provided as RS-232 or Ethernet data.

Benefits include:

- **Real-time temperature reporting:** Continuous high speed temperature measurements are provided for active process feedback and for predictive maintenance/ statistical trending.
- **High Noise Immunity:** The telemetry measurement data is highly immune to EMI from the motors and generators, as well as from variable frequency drives and other noise sources.
- **No Dropout/ Interference:** The closely coupled digital data transfer
  -does not experience dropouts that are common in other wireless systems.
  -does not cross-talk interfere with other telemetry systems.
- **Low Maintenance:** The systems are not subject to wear/tear and noise issues typically seen by mechanical slip ring interfaces.
- **Torque and Vibration Stress Monitoring:** Excessive stresses on the rotor and drive spindle in steel mills can be real-time monitored in the same telemetry system through high speed sampling of strain gage and accelerometer sensor inputs.
- **Modular construction for multiple sensors**: The AT-7000 provides flexibility for a large variety and number of sensor inputs.



Transmitter telemetry collars for
>30” rotor diameters of large motors

Stationary pickup/induction loop shown around a large transmitter collar

AT 7000 Receiver providing individual analog signal and/or RS-232, Ethernet outputs

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