MotorDoc LLC

Doing what everyone else just talks about

CASE STUDY: 400HP, 1800 RPM, 4000 VOLT MOTOR NO LOAD WITH EMPOWER™

During a training session at a motor repair shop we ran the EMPATH™ and EMPOWER™ systems side-by-side to see what we could observe concerning an electric motor that had just arrived from a repair customer. The motor was a GE, 400 hp, 1785 RPM, 4000 volt motor with 6318 and 6315 bearings (Figure 1). As with all of our repair shop users – they know that the EMPATH and EMPOWER systems have the resolution necessary to test motors at no load, uncoupled and full voltage. There was no notification from the customer as to the reason for the repair.

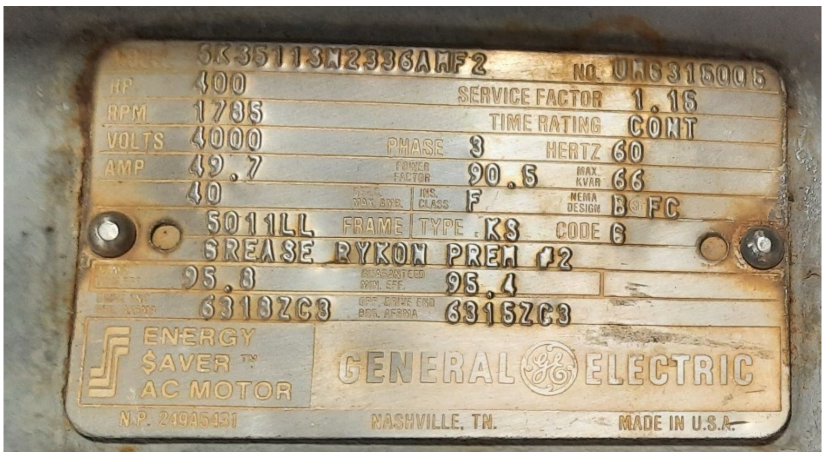

Figure 1: Electric Motor Nameplate

Figure 2: Motor being set up in test area.

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Data collection with the EMPATH ESA system took about 48 seconds to collect three phases of voltage and current from the CTs and PTs at the back of the test panel then another 10 seconds to analyze the data using a 12 kHz sample rate. The EMPOWER MCSA system, while having a slightly greater resolution across the 5 kHz (300,000 CPM) spectrum of >0.009 Hz, takes 120 seconds to collect data and another 120 seconds to run special prognostic algorithms for speed, energy with current only, emissions and driven equipment with a 44.1 kHz, 24 bit sample rate.

Figure 3: EMPATH data collection upper right and laptop with the EMPOWER hanging over the door of the back of the test panel controls.

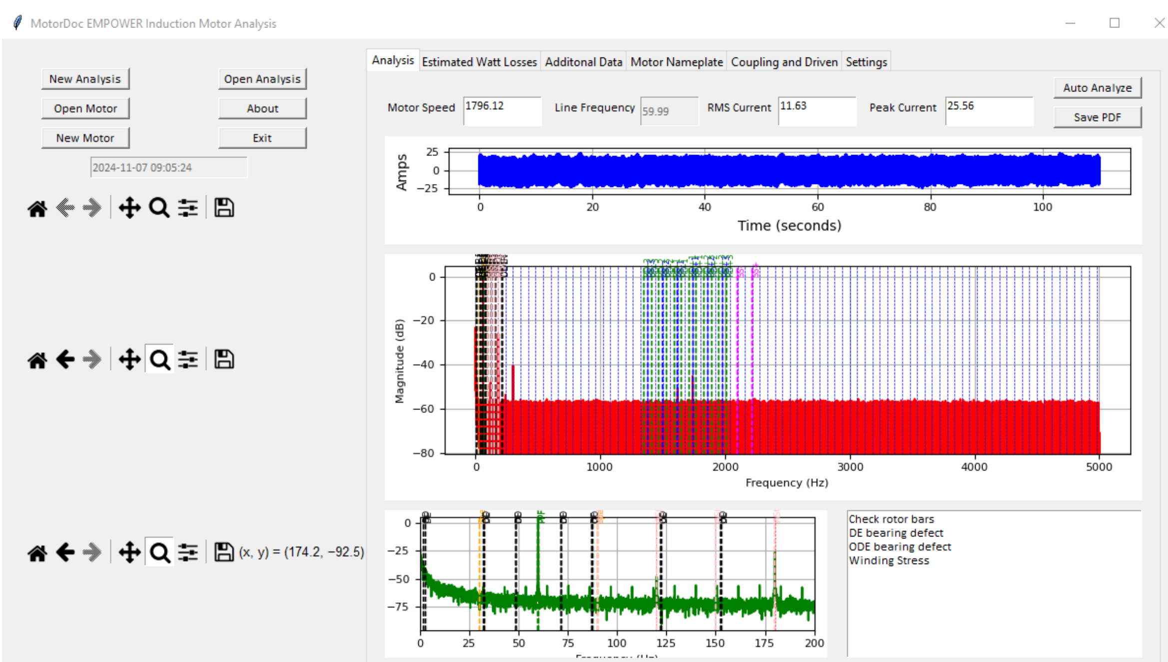

Figure 4: EMPOWER main page following auto-analysis. Black lines are bearing indicators.

Figure 4 shows the results of the auto-analysis including the detection of running speed normally accurate to 0.01 RPM. The analysis identified pole pass frequency (check rotor bars), both bearings, and winding stress. The winding stress is not overly surprising due to the type of soft start used by the test center.

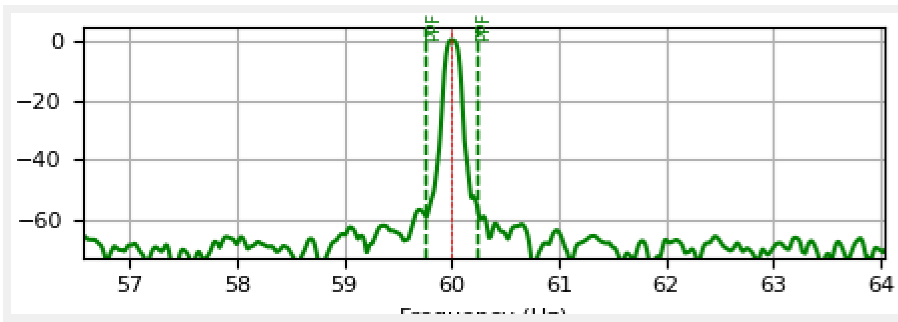

Figure 5: PPF on the unloaded motor at full voltage and uncoupled. Data collected through a 225:1 current transformer.

In Figure 5 you can see the PPF lines fall on small peaks on either side of line frequency. This would indicated the potential for high resistance rings if this is a copper rotor bar or casting voids in a cast aluminum or copper rotor.

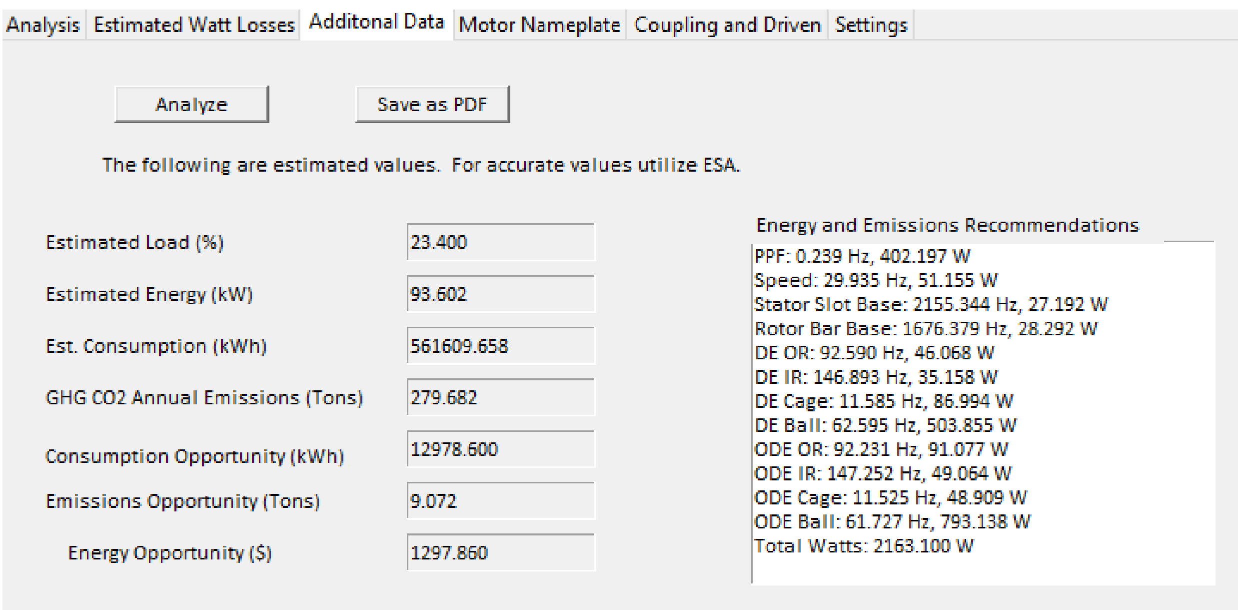

Figure 6: Additional Data screen - the energy analysis.

Figure 6 is the energy analysis of the motor based upon 6000 hours of operation at that load and $0.10/kWh. The operating time and cost are randomly selected for demonstration. However, the Energy and Emissions Recommendations output identifies the frequencies and losses associated with each component. Of importance is noting the DE and ODE ball losses (these are in watts) and the losses associated with the rotor catch. The others bearing components are also a little heightened, as well. This would most likely indicate dry bearings or some other type of lubrication issue – which often show as high losses in ball and/or cage frequencies. Normally bearing losses are measured in a few tens of watts.

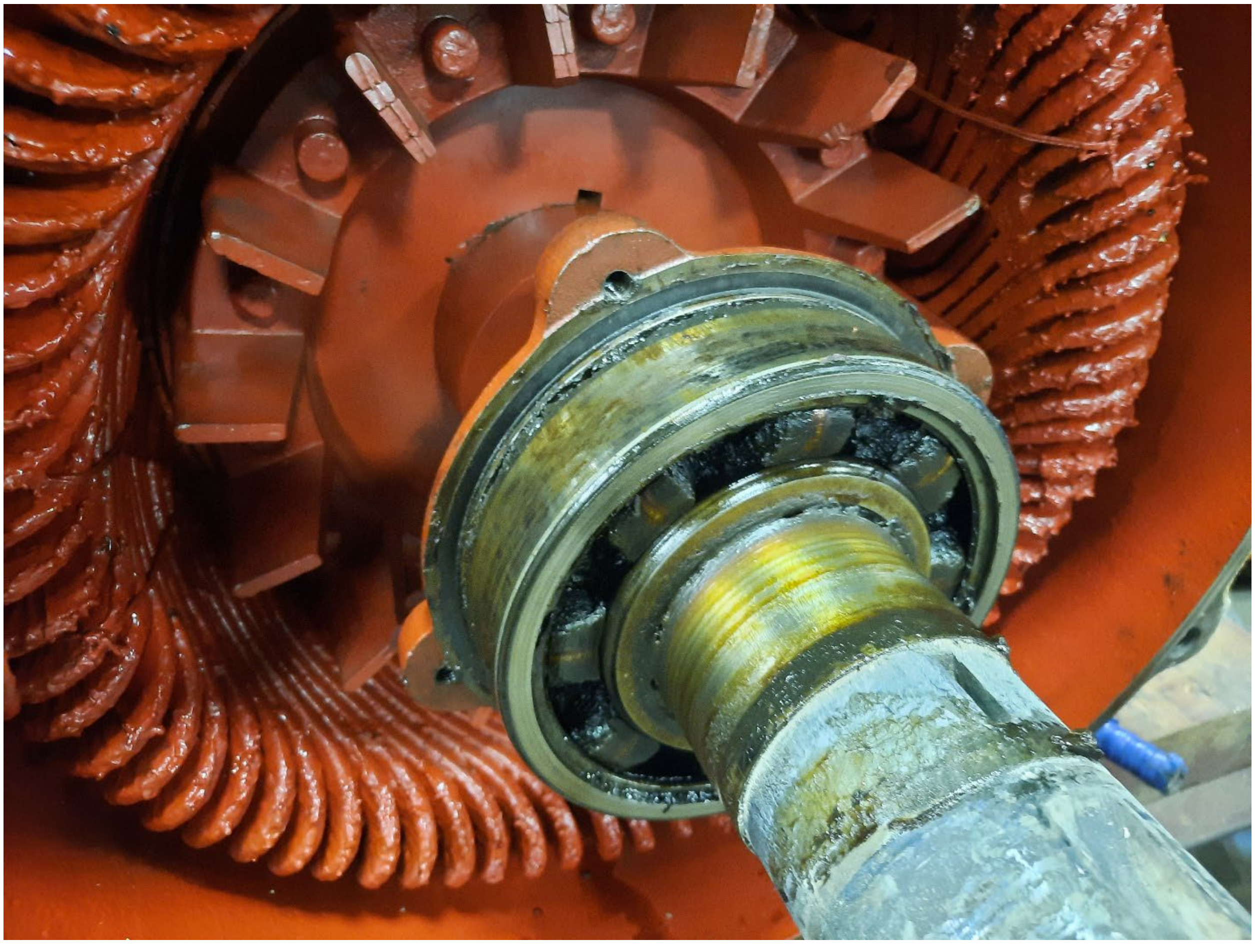

Figure 7: Drive end bearing and rotor once the end shield was removed.

As can be seen in Figure 7, the grease is caked in the drive end bearing and the rotor is a caste aluminum. There is also some wear appearing on the outside of the bearing race. At the bottom of the image under the bearing is oil, as the oil separated from the grease. Figure 8 is of the opposite drive end bearing indicating similar findings.

Figure 9 shows the housing of the drive end shield and the grease, including visual indications that two separate greases were used. Often when grease incompatibility occurs the oil separates from the soap and the bearing is no longer being properly lubricated. The vibration system being used during the test did not indicate any issues. The winding stress indicator is from the type of soft start being used and the PPF peaks are due to the type of rotor and suspect rotor casting voids.

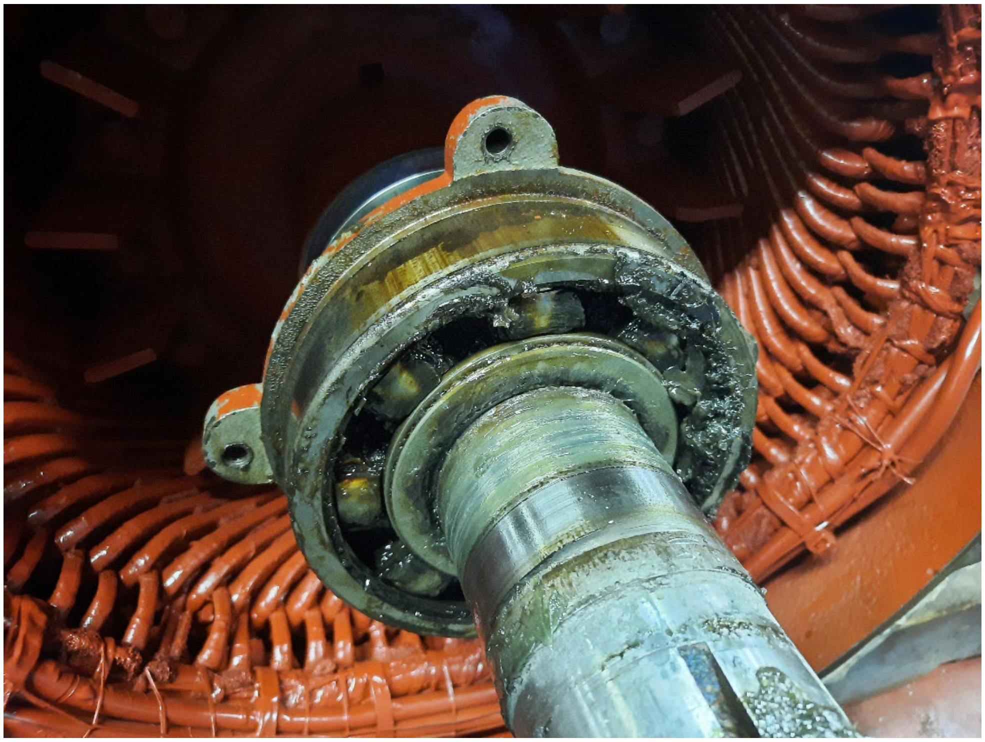

Figure 8: Opposite Drive End bearing grease and fretting on the outer race. Grease is caking and oil separating.

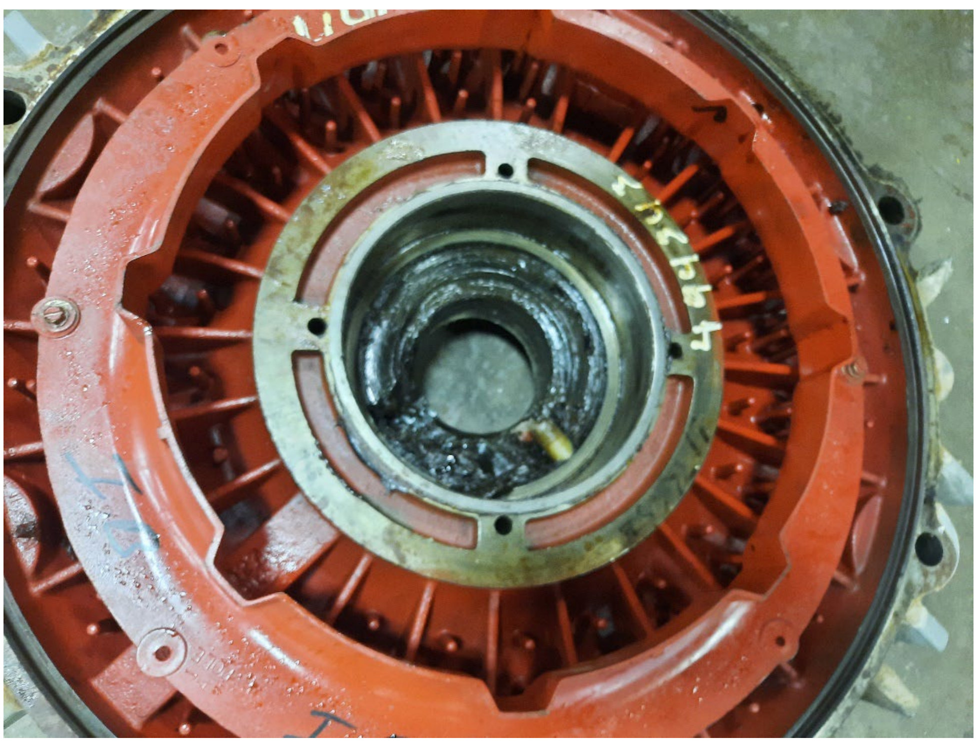

Figure 9: Drive end housing showing wear but also a discoloring of the grease compared to the yellowish that is in the bottom right. The grease in both housings show that two separate greases were used.

For more information and a quotation on the EMPOWER or EMPATH systems, contact MotorDoc LLC at info@motordocllc.com.

MotorDoc is a registered trademark of MotorDoc LLC, EMPOWER stands for the Electric Motor Performance Optimization Waveform Evaluation and Recognition system, which analyzes from a single phase of current, and EMPATH is the Electric Motor Performance Analysis Tool Hardware system.

MotorDoc LLC can be found at the following websites:

www.motordoc.com

www.empathcms.com

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