Qualifying Electric Motors On-line

By Gary Herr • Demaria Electric Motor Services, Inc.

Demaria Electric Motor Services Inc., located in Wilmington, California, brings motor qualification to new levels by employing on-line monitoring to augment its use of handheld data collectors.

With the advent of on-line multi-parameter vibration systems typically used to monitor critical industrial machinery, such systems are easily adapted to the test cell environment. New and rebuilt electric motor test stands can utilize the benefits of LAN based on-line vibration data collection technology to assure industry standard quality control.

Electric motor repair has risen to a new level as faulty motors arrive at the repair facility and are tested to confirm mechanical or electrical problems. Spectral signatures are analyzed to determine incoming bearing condition, balance tolerance, even rotor bar condition. Subsequent repairs are performed and motor quality is confirmed as it runs on the test stand. Multi-parameter monitoring allows for analyzing all aspects of the motor frequency spectrum for quality assurance. Before and after repair reports are now available with a percent of change column to justify repairs and give credence to the customer's predictive maintenance program. Test data is archived for historical reference, giving proof to the condition of the operation of the motor upon shipment.

Demaria Electric Motor Services Inc. incorporated an on-line monitoring system to augment its use of handheld data collectors for motor qualification. The system consists of a SKF Condition Monitoring CMMA 320 Local Monitoring Unit (LMU), a 32 channel NEMA enclosed vibration monitor with a front panel switch assembly with BNC connectors to access buffered signals and tachometer speed pulses. The data acquisition device (DAD) is mounted on the wall next to the motor supply test panel, which can power motors up to 2 600 HP and up to 4 160 V. A hinged, 90 degree bend of conduit was fabricated and mounted on the motor test panel to allow for the transducers to swing freely over the motor under test with 6 m *(20 ft.)* of lead length.

Fig. 1. Both the SKF Local Monitoring Unit, a 32 channel NEMA enclosed vibration monitor, and the SKF Microlog portable data collector analyzer are used to confirm mechanical and electrical problems.

A BNC connector exists at the end of the conduit gland fitting to allow for an optical phase reference input. Six SKF integral lead accelerometers equipped with rare earth magnets are used for sensor inputs. System software allows for motor point configuration on a PC and downloaded to the DAD, which collects the data and communicates directly to the host computer via a two-wire LAN cable. Accelerometers are placed in horizontal, vertical and axial planes on both inboard and outboard bearings. Sixteen vibration points are collected on each motor with as fast a schedule as possible.

A complete set of data measurement points typically takes six minutes. Spectral signatures collected are 1 600 lines of resolution and two averages to allow for detailed frequency analysis. Horizontal parameters include peak velocity at 10X running speed of motor under test, peak acceleration at 100X running speed, acceleration enveloping and high frequency detection (HFD). Vertical and axial measurements include velocity and acceleration parameters. Velocity allows observation of 1X running speed balance condition, 2X line frequency electrical condition, lower order bearing condition, seal installation and rotor rub condition.

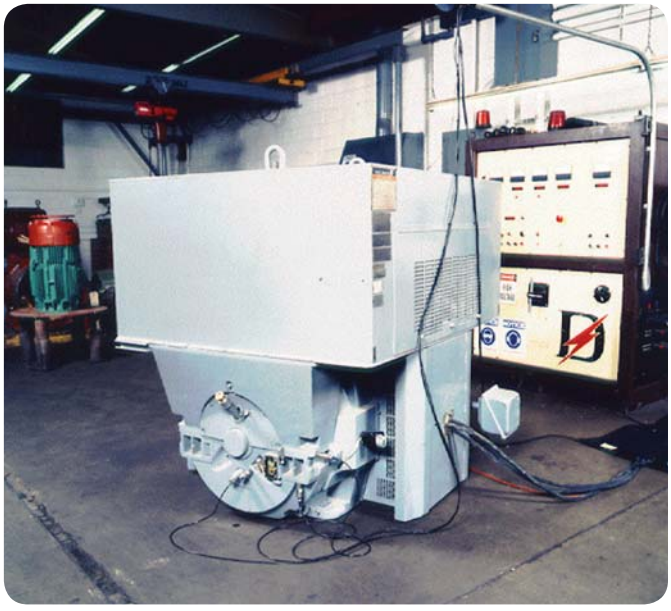
Acceleration gives an indication of higher order bearing frequencies and rotor bar frequencies. Envelope demodulation will certainly confirm a bearing problem as repetitive frequencies are accentuated. HFD offers a reliable indication of bearing installation quality, lubrication and metal-to-metal contact, as it offers a higher frequency overall measurement from sensor resonance, which acceleration spectra might not detect. Spectral Emitted Energy (SEE) technology is also used to confirm lubrication problems.

Motor test vibration data is sent directly to the analysts computer, running PRISM[4] for Windows software. Spectrums are updated continuously as the motor under test is exercised. Customers are often present to witness motor qualification. Overall live bars are often used to observe the real time aspects of the motor operation. Customers can sit in a comfortable noise-free environment and witness the operation of their motor running for as long as they see fit. Spectrums may be called upon demand or examined live with time waveforms. Rolling element bearing condition may be monitored using the software Frequency Analysis Module (FAM). BPFO, BPFI, BSF and FTF frequency overlays on the spectrum point out any bearing fault frequencies. Customer specifications may also be addressed to accommodate specific demands.

Rolling element bearing motors are typically run for 30 minutes to one hour. This allows for trend development to judge the integrity of the repair. Large journal bearing motors are run from one to two hours to allow for proper stabilization of bearing temperatures and to understand how heat influences the rotor balance condition. This condition will determine whether or not the rotor will be balanced in place at running speed. If this is the case, the motor may be balanced with the SKF Microlog handheld data collector at the motor. The motor may also be balanced utilizing the DAD's buffered outputs.

Fig. 2. Gary Herr, vibration analyst at Demaria Electric, uses the SKF Microlog balancing wizard to determine unbalance.

Fig. 3. Customers witness motor qualification in a comfortable noise-free environment, where spectrums are called upon demand or examined live with time waveforms.



Motors may also be monitored using existing eddy current probes, which accompany many large sleeve bearing motors and are easily interfaced with the system. Balancing may also be achieved with the eddy probe outputs. Phase data is a valuable tool to determine if indeed unbalance is the problem. Polar vector plots make it easy to track phase angle changes over time.

On-line system software is easily accessible to all in the motor shop. Mechanics in the shop utilize the system and are familiar with the implemented procedures. Motor parameters are derived according to running speed. Templates for a motor under test are easily created and downloaded to the DAD according to the job number.

The Add Machine module in the software has been customized for every different type of motor application. The operator of the system need only enter a four digit job number, motor RPM and press a key to create all the machinery point parameters. The database hierarchy is based on customer name with the motor shop reference job number residing within its respective set. Each motor point ID includes the motor job number. The software also allows for adding customer machine number, plant name, purchase order, etc. Notes may also be taken and saved to the particular motor dataset. The database is archived quarterly and a pre-programmed empty database with all customer hierarchy is used to start the process all over again. About 60 MB of data are collected each quarter.

Large motors (1 000 HP and higher) are typically followed out to the field for installation. Only one attribute of the DAD points needs to be changed to allow for downloading shop data motor points to a SKF Microlog data collector for on site data collection and baseline comparison. Motors are run on the base uncoupled to prove sound operation. After alignment, another set of data is collected for on-site baseline reference as well as the driven equipment. Data is often collected on a weekly basis (namely sleeve bearing motors) to ensure proper working condition.

The on-line system has proved to be an excellent insurance policy, as all motor test data is on file at the fingertips of the motor shop. If a vibration problem exits in the field, shop baseline data may be easily drawn upon. Many customers have motor vibration specifications, and the reporting capabilities of the software prove motor shop compliance.

Expert system PRISM^4 PRO is also used in conjunction with PRISM^4 software to provide before and after motor repair reports with analysis of incoming and outgoing condition. The system has certainly added credibility to the motor repair shop. Customer confidence is also an added value, as many also have a vibration monitoring program.

Fig. 4. Accelerometers are placed in horizontal, vertical and axial planes on both inboard and outboard bearings. Sixteen vibration points are collected on each motor with as fast a schedule as possible.

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