SKF Electric Motor Condition Monitoring

Powerful visibility into the health and performance of industrial motors and equipment
Maximize return on investment in the motors that drive your business
Why perform electrical tests on motors?

Industrial electric motors are the pervasive engines of commerce. They literally drive industrial output. They support physical plant infrastructure such as the offices and factory buildings throughout a given organization. From oilfield pumping stations to metal refineries, manufacturing production lines and building HVAC systems, motors drive the machinery and equipment that make businesses and organizations productive. These dependencies on motors make it critical for organizations to maintain their motorized equipment effectively and efficiently. They must do so while minimizing the cost and effort necessary to maximize the operational life and value of those motors and machinery.

Proactive electrical testing and monitoring of motors helps organizations minimize maintenance costs and reduce costly unplanned downtime. Industrial maintenance professionals have used electrical motor test equipment for decades. SKF Electric Motor Condition Monitoring (EMCM) delivers some of the most innovative, cost-effective solutions to help organizations around the world manage the condition of the electric motors and machinery they depend upon.

SKF’s electric motor test and monitoring equipment is designed for use by predictive maintenance (PdM), manufacturing and motor service and repair professionals. PdM professionals rely upon SKF’s electric motor test and monitoring solutions to provide crucial visibility into the condition of motor insulation and the machine’s motors drive. The solutions provide a powerful view that improves maintenance decisions and substantially reduces motor maintenance costs. Motor original equipment manufacturers (OEMs) use SKF’s static-state motor testing systems to ensure production motors meet their rigorous quality standards. Motor rebuilders and service shop personnel depend upon SKF motor analyzers to validate the rewinding and repair work they do is rock-solid, documented for quality assurance, and meets or exceeds their customers’ expectations.
**Why motors often fail prematurely**

Degraded insulation and worn or failed bearings are the leading causes of motor failure. There are two main types of insulation in a motor: winding (also known as turn-to-turn) insulation, and ground-wall insulation.

Dielectric strength of insulation is the ability to protect one electrified wire from arcing to another wire, or to ground (earth). The dielectric strength of motor insulation naturally degrades over time with normal use. However, when certain common conditions occur, insulation degradation can accelerate. Winding and ground-wall insulation are both prone to accelerated degradation under conditions such as excessive heat, which can be induced by over-loading, machine faults or poor power quality, among other issues. Contamination (e.g., chemicals or dust) and moisture also contribute to insulation degradation. Maintenance personnel need electrical test equipment to detect if any problems exist in a motor well before the motor would fail.

This visibility allows maintenance departments to schedule downtime for a motor's removal for repair or replacement. It also minimizes costs of motor replacement, because when a motor fails, the cost of a new motor is added to the costs of unplanned production downtime. These are just a few of the reasons why it is important to test and monitor motors with reliable electrical test and monitoring instruments.

**Proven static-state and dynamic-state motor test solutions from SKF**

SKF electrical motor test equipment enables detection of developing electric motor problems that vibration-only condition monitoring tools do not reveal. SKF static motor testing analyzers perform tests on motors while in a static, or powered-down state. These analyzers are the best in the industry at detecting and analyzing winding and ground-wall insulation weaknesses that would lead to premature motor failure. These instruments also find motor circuit problems that reduce motor performance and service life. SKF's world-renowned Baker-branded products find motor insulation problems in static-state motors so maintenance professionals can proactively plan replacements and repairs with a minimum impact on production and the bottom line.

SKF also designs and builds instruments that monitor motors in their dynamic (or operational) state. These analyzers help determine if a problem is electrical or mechanical in nature, and what the cause of a problem might be with a motor or the machine system it works within. They employ sophisticated technologies developed by SKF to identify problems across the motor-machine system, including assessment of the quality of power supplied to the system, the performance of the motor, and evaluation of load torque placed upon the motor.

Original equipment manufacturers of motors and motorized equipment use SKF quality control systems to ensure the products they build meet their stringent quality requirements before they are sold to customers.

These solutions employ proven, innovative technologies, and feature capabilities suited to the various needs of motor maintenance, repair and quality control professionals.
SKF Electric Motor Condition Monitoring solutions work to:

- Reduce electric motor maintenance costs
- Maximize motor and machine uptime
- Prevent unexpected motor failure and resulting losses
- Extend motor life and improve motor efficiency
- Improve motor and machine maintenance programs
Static-state motor analysis and monitoring
SKF’s world-renowned Baker motor analyzer products are high-voltage instruments that detect weaknesses and faults in motor insulation and circuitry. These portable predictive maintenance tools perform a comprehensive spectrum of tests to provide a clear, reliable view of a motor’s condition. This helps eliminate unplanned downtime while enhancing maintenance planning and decision-making.

**SKF Static Motor Analyzer – Baker AWA-IV Series**

SKF’s flagship Baker AWA-IV static motor analyzers are portable instruments designed to perform automated, repeatable, user-programmable tests that assess motor circuit and insulation strength. Specific tests and the sequence they are performed can be saved for any given motor. Different users, regardless of skill level, can perform the exact same tests and achieve the exact same results for a motor each time the motor gets tested over periods of weeks, months or years. All they need to do is connect to a motor in its powered-down static state, select that motor’s test in the analyzer’s software, and push a button to perform all of the pre-programmed tests. The analyzer saves the test data and produces clear, concise reports that identify issues that help maintenance professionals make informed decisions. Baker AWA-IV series analyzers are also used to assure the quality or reliability of new or rebuilt motors before they are placed in service.

This series of analyzers features a user-friendly touch-screen interface. The range of common tests it performs includes surge, polarization index (PI)/dielectric absorption (DA), DC hipot, meg-Ohm and winding resistance. Units are compliant with industry-standard IEEE and IEC specifications. Analyzers in this series perform at maximum test voltages ranging from 2 000 V on up to 12 000 V. These include Baker AWA-IV 2- and 4-kV models, and Baker AWA-IV 6- and 12-kV models, with a HO (high output) version of the 12 kV model designed to perform tests on large motors.

All Baker AWA-IV analyzers run on Microsoft Corp.’s Windows 7 Embedded® operating system, and can be connected to local-area computer networks (LANs) via wired Ethernet or wirelessly via an optional wireless network accessory. Test results can be saved and retrieved on the analyzer itself, or transferred to a personal computer or server for test report viewing and archival storage.

**SKF static motor analyzers save railway $100 000 per locomotive drive failure**

One of the largest railroads in the United States had a major problem with the variable-frequency drive (VFD) systems in the main-line locomotives it depends upon to move billions of dollars of freight annually. Maintenance crews were at a loss to accurately determine which of three traction motors integral to a given locomotive’s drive system was responsible for a recurrent string of costly failures. Each failure cost the rail company an average of US$100 000 in downtime, labor and traction motor replacement costs of rebuilding or replacing three traction motors.

The company used a Baker AWA-IV to perform a series of electrical tests on each of three traction motors with a known VFD failure problem. The tests enabled maintenance techs to zero in on one of the three motors, which was found to have insulation weakness that would ultimately lead to premature failure. This resolved the costly issue, enabling the railroad to save the US$100 000 average each time the problem cropped up. The Baker AWA-IV analyzer is now a cornerstone of this major railroad transportation company’s locomotive motor PdM program.
**SKF Static Motor Analyzer – Baker DX Series**

This line of portable static-state motor test equipment is the go-to electrical testing platform for motor rewind, repair and service shops around the globe. PdM professionals appreciate the Baker DX for its lightweight portability for performing motor tests in the field. The Baker DX series boasts more test capabilities than any previous generation of SKF static motor test equipment, and meets the rigorous needs of motor service and repair shops.

Baker DX series analyzers are available in configurations that provide just the motor, generator or coil test functions desired. Available models include simple power pack control units to fully-loaded analyzers that perform the full spectrum of insulation and circuit tests on AC and DC motors and their components.

Baker DX units offer a full spectrum of low and high-voltage test capabilities in models with maximum test voltages of 4000, 6000, 12000 and 15000 volts. Test options include:

- Partial discharge (PD)
- Surge (with error-area ratio analysis)
- Impedance
- Capacitance
- Phase angle
- Resistance
- Insulation resistance (IR)
- DC hipot/step voltage
- Dielectric absorption (DA) and polarization index (PI)
- Rotor influence check (RIC)

**Surveyor DX software**

Surveyor DX software is an optional Microsoft Windows-based software application that extends report generation and archival capabilities of the Baker DX to desktop and laptop personal computers. Users can export data from the analyzer to a PC to save test data, generate and print reports for record keeping and presentation to clients.

**SKF static motor analyzer power packs**

Larger motors often require test voltages higher than the 12 kV or 15 kV limits of the Baker AWA-IV and Baker DX series analyzers. SKF’s Baker power packs extend the test voltage capabilities of its analyzers up to 40000 volts. Baker PP30, Baker PP30A, Baker PP40 and Baker PP24 power packs are high-powered impulse generators designed for testing very large, high-voltage windings (usually greater than 3000 horsepower). The power packs perform both surge and DC/hipot tests when used with an SKF static motor analyzer as the controller and display. Like the Baker DX and Baker AWA-IV analyzers, Baker power packs comply with IEEE and IEC standards when testing motor windings and coils.
Static motor analyzer accessories

Baker ZTX low-impedance test accessory
This high-current surge test adapter enables bar-to-bar armature tests on very low impedance coils. The Baker ZTX reduces the voltage applied while increasing current to enable accurate tests on DC motor armatures as well as other low-impedance motor components.

ATF 5000 bar-to-bar armature test accessory
The ATF 5000 is a handheld fixture designed to work with Baker DX and Baker AWA-IV static motor analyzers in combination with the Baker ZTX (or with the Baker DX-15A, which has integrated ZTX technology). This fixture improves the speed, accuracy and ease of testing armatures bar-to-bar.

Other static motor test accessories
Additional static motor analyzer accessories include footswitches, safety lights, single- and three-phase test leads, plug-and-play printers and wireless network adapters (for Baker AWA-IV Windows 7 Embedded models only), and Windows PC report generation software.
Dynamic motor analyzers
Innovative, powerful motor-machine system monitoring

Maintenance teams often rely on SKF dynamic motor analyzers to confirm whether a problem with a motor-machine system is electrical or mechanical, and to provide critical information that leads to root-cause diagnostics when problems are identified.

SKF Dynamic Motor Analyzer – EXP4000
The portable EXP4000 is the latest in a line of innovative motor test equipment that is designed to gather diagnostic information from motors while they are in a dynamic, or operational state. After safe attachment to a motor through a motor control cabinet (MCC), via an SKF EP1000 connection at an MCC, or at the motor itself (connections at the motor are safely made ONLY when the motor is powered down for the connection), the EXP4000 gathers health and performance data on quality of power supplied to the motor, the motor itself and the load placed on the motor.

This visibility across the motor-machine system reduces guesswork around whether a problem’s root causes are mechanical or electrical. It also minimizes the time it takes to troubleshoot an issue. This makes the EXP4000 a powerful predictive maintenance and troubleshooting tool that can reduce costs of maintenance, extend the lives of motors, and ensure entire motor-machine systems are running at optimal performance. Performance and health trends are identifiable with data collected by the EXP4000, providing critical information about the root causes of underperforming or malfunctioning equipment. This in turn helps maintenance teams avoid costly unplanned downtime.

EXP4000 test domains include:
• Power quality
• Machine performance
• Current
• Spectrum
• Time waveforms
• Torque
• Variable frequency drives (VFDs)
• Continuous monitoring
• Transient analysis
• Vibration
• DC monitoring
• Efficiency

Dynamic motor analyzer accessories

Dynamic Motor Link – EP1000
The EP1000 is a permanent, safety-accessible connection to motors from the exterior at a motor control cabinet (MCC). Once installed, users can easily attach an EXP4000 to monitor motors with no need for the PPE required when opening an MCC. The EP1000 makes it unnecessary to connect at the motor itself. Monitoring motors via an EP1000 saves time and eliminates exposure to high voltage within an MCC and at the motor itself. Unlike connections made at the motor or without an EP1000, the motor does not need to be shut down to safely connect an EXP4000 for monitoring.

Bottling plant troubleshoots nagging motor problems with an SKF dynamic motor analyzer

Dozens of motors attached to variable-frequency drives (VFDs) at a Miller Coors bottling plant were running hot and failing prematurely. Maintenance engineers needed to identify the root causes, so they began monitoring the motors with an SKF EXP4000 dynamic motor analyzer.

The analyzer revealed high power distortions and inexplicably high voltage draws on motors that were not even loaded. By adjusting the pulse-width modulation (PWM) carrier frequencies to optimal levels, maintenance techs were able to minimize the number of overheated motors and premature motor failures. The company also realized average energy savings of roughly US$50 000 a year per motor.
SKF On-line Motor Analysis System – NetEP

Like the EXP4000, the NetEP monitors motors while they are operating (i.e., in a dynamic state). It assesses the quality of power supplied to a motor, the condition of the motor itself, and the load placed on the motor. Unlike the EXP4000, the NetEP is a stationary, network-connected system that continuously measures and monitors the three fundamental elements of a motor-machine system: the power source, the motor itself, and the machinery placing a load on the motor. The system allows maintenance professionals to monitor these conditions remotely, 24/7/365, from any location in the world with an Internet-connected desktop or laptop computer.

Each NetEP can continuously collect data from up to 32 motors over as many as seven different voltage busses. It acquires power quality data from each motor system every 60 seconds, and produces time waveforms once every hour for each attached motor. The resulting timeline of trend information provides a comprehensive continuous view of motor system operation.

The NetEP's standard computer network architecture enables maintenance managers, engineers and technicians to safely monitor motor health and performance from anywhere they can connect to the Internet. Route-based maintenance testing can be optimized by allowing personnel to focus just on the motors the NetEP identifies as having potential problems.

SKF online motor analysis system enables gas supplier to meet lucrative contract terms.

A global supplier of industrial gases faced several stringent performance requirements from a major petroleum refinery it was under contract with. If the vendor did not meet the terms of the contract, the gas supply company would be liable for any production losses. Uptime and performance reliability of its deployment of 30 large electric motors (which ranged in size from 500 to 1,000 horsepower) were critical to fulfillment of the contract.

The vendor's existing solution, which involved periodic monitoring of motors, was considered risky given the stakes, so it brought in SKF to install an SKF Online Motor Analysis System – NetEP to provide 24/7/365 continuous monitoring. The NetEP identified a major fault on its first day of operation, and has since allowed the gas vendor to secure uptime levels and meet its contract terms. The system proved to be so successful that the gas company planned several more installations to monitor motors in other operations with different customers.
Electric motor condition monitoring (EMCM) training

SKF seminars, training courses and conferences

SKF offers much more than traditional equipment training programs. SKF helps users of its electrical motor test equipment to optimize their motor predictive maintenance (PdM) repair/rebuild services. This training reduces cost while increasing throughput for increased returns on investment, revenue and profitability. Courses are conducted at our headquarters in Fort Collins, Colorado, or on-site at customer locations.

Common course and conference objectives range from basic electric motor theory and technology to advanced operational knowledge of SKF EMCM equipment.

Course attendees will be exposed to strategies that can help them:

• Boost productivity
• Make more informed decisions
• Become proficient at troubleshooting
• Extend maintenance intervals through increased knowledge
• Avoid costly downtime
• Increase efficiency of critical equipment

Contact SKF Electric Motor Condition Monitoring in Fort Collins, Colorado at +1 970 282 1200 for more information on seminar and training schedules and options.
Motor quality control testing

Motor quality control test systems
Motor quality control test systems from SKF are rugged, rack-style units that test motor stators and armatures in high-volume manufacturing environments. These time-tested, semi-customized units combine the most common electrical tests for motor manufacturing.

SKF Static Motor Analyzer – Baker WinAST
The Baker WinAST automated stator tester was developed for end-of-line quality-control testing in manufacturing of stators, coils, alternators, rotors, and other motor windings. It performs common in-process electrical tests with a semi-custom instrument, assembled to customer specifications.

- Hipot, surge, and temperature-compensated resistance test capabilities are standard.
- Rotation-direction testing is optional for testing stators and field coils. The WinAST system enables assembly managers to verify and detect trends within the manufacturing, enabling problems to be identified early.

A range of additional test capabilities are available with this semi-custom product – ask your SKF EMCM representative about your options.

Fixtures
A variety of single- and dual-station fixture designs are available for use with the Baker WinAST. Test fixtures are custom-built according to winding and physical specifications provided by a customer. All Baker WinAST testers include a standard control console, safety interlock switch, and alligator clip terminations (unless optional custom fixtures are requested). Foot switches and safety lighting options are also available.

SKF Static Motor Analyzer – Baker WinTATS
The Baker WinTATS traction armature test system, which features a ruggedized design built for the rigors of manufacturing environments, test electric motor armatures for new or rebuilt motors. This is a semi-custom product assembled from standard components to customer specifications. The system is a rack-mounted Windows computer-based analyzer with proprietary measurement circuits and a highly precise, optical-positioning armature indexing stand. Tests include DC and/or AC hipot tests, resistance test, and a low-voltage/high-current surge test to identify any issues prior to final assembly of a traction motor.

SKF motor quality control systems help railway meet high uptime requirements
A European railway company under contract to the British government needed to ensure its passenger rail system maintained stringent uptime requirements. This meant that its locomotives, which rely upon DC traction motors, needed to be rigorously maintained to minimize or reduce in-service failures. The company purchased a Baker WinTATS system to test its traction armatures during scheduled rebuilds, which helped it meet the high uptime terms of its contract. The company purchased additional Baker WinTATS systems as it expanded its business with the British government.
Service and support

Technical service and support

SKF Electric Motor Condition Monitoring provides world-class global technical support for its entire range of motor test and monitoring equipment. From routine calibrations to repairs and upgrades, SKF EMCM technicians will expertly service your equipment and return it quickly, in top condition. Should you need technical assistance for your SKF EMCM product, our technicians are available by phone or email to answer your questions and help you troubleshoot.

Contact the SKF Technical Support Group (TSG) at +1 800 523 7514 within the US or +1 858 496 3627 outside the US for more information on product service or for technical support of your SKF electric motor condition monitoring equipment.

SKF Product Support Plans

SKF EMCM offers product support plans to help protect equipment investments and extend product service lives. The EMCM product service plans are product-specific, and cover routine software upgrades and equipment calibrations, repairs and annual preventive maintenance. They provide fast, expedited service turnarounds, unlimited technical support, and (in the 48 contiguous U.S. states only) provide loan equipment for service that requires more than five days to complete. Contact your authorized SKF sales representative for more information, or call +1 970-282-1200 to learn more about how a product service plan can help protect the equipment you rely upon.
The Power of Knowledge Engineering

Combining products, people, and application-specific knowledge, SKF delivers innovative solutions to equipment manufacturers and production facilities in every major industry worldwide. Having expertise in multiple competence areas supports SKF Life Cycle Management, a proven approach to improving equipment reliability, optimizing operational and energy efficiency and reducing total cost of ownership.

These competence areas include bearings and units, seals, lubrication systems, mechatronics, and a wide range of services, from 3-D computer modelling to cloud-based condition monitoring and asset management services.

SKF’s global footprint provides SKF customers with uniform quality standards and worldwide product availability. Our local presence provides direct access to the experience, knowledge and ingenuity of SKF people.