Baker WinAST Electric Motor Quality Control System

Megger

Power on

Baker WinAST
Electric Motor Quality Control System

Introduction

Megger Baker Instruments designs and manufactures electric motor test systems for original equipment manufacturers (OEMs) that help ensure their motors and coils meet or exceed the quality expectations OEMs set with their customers.

Baker's motor quality control (QC) systems include the Baker WinAST automated stator tester, the Baker HV WinAST and the Baker WinTATS traction armature test system. Each incorporates the most effective electric motor test processes into a single automated instrument, and can be customized to meet the specific testing needs of a given manufacturer.

Baker WinAST

The Baker WinAST is a semi-custom, fully-automated, high-volume electric motor testing unit that can test thousands of motors, generators or coils per day, depending upon the size and types of motors, or the testing fixtures used.

This automated stator tester is used to test AC motors ranging in size from fractional hp up to 5,000 hp. It is also designed to test DC motors up to about 1,500 hp. Manufacturers of motor windings, stators, coils, alternators, and rotors use the Baker WinAST to avoid shipping dead-on-arrival (DOA) motors, or products that prematurely fail or malfunction after being placed in service.

The Baker WinAST can be configured with a range of additional test capabilities to meet the rigorous quality assurance testing standards required by motor OEMs.

Every Baker WinAST is built to each customer's specifications using proven, reliable standard components in a cabinet-style rack design.

The Baker motor tester brand was built upon a reputation for quality and innovation. The Baker WinAST has more than 25 years of innovation built into it, and continues to provide motor OEMs with reliable quality assurance testing.

Automated testing

The Baker WinAST features a Windows-based application with an intuitive, menu-driven user interface. The system automates and controls tests, analysis and reports that are configured to meet the specific needs of a manufacturer.

Unlike other volume manufacturing test approaches, this system does not require a master winding to perform routine production tests, nor does an operator need to set test voltages or pass/fail limits when production is switched to another motor model.

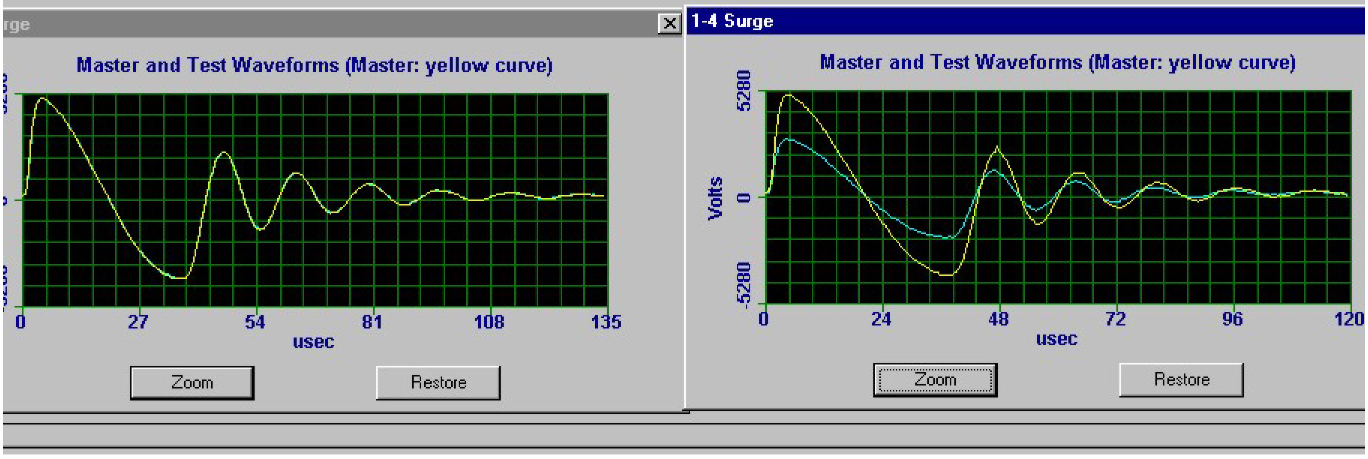
All test parameters are programmed into a master, "known-good" data file, an operation that can be performed in minutes. When a master file is created, the

The Baker WinAST is a time-tested quality control system for OEM motor manufacturers that is proven to last for many years of rigorous use.

t Results

Test Time 2/15/2001 10:12:22

Test Name	Parameter	Result	Upper Limit	Actual Value	Lower Limit	Test Voltage (V)	Graph
Hipot	Total Current (mA)	Pass	15.000	10.237	0.100	3500	
Hipot	Arc	Pass					
Resistance	Resistance (Ohm)	Pass	0.2625	0.2470	0.2375		
Resistance	Balance Error (%)	Pass	10.0	3.14			
Resistance	Resistance (Ohm)	Pass	0.2415	0.2378	0.2185		
Resistance	Balance Error (%)	Pass	10.0	0.72			
Resistance	Resistance (Ohm)	Pass	0.2415	0.2337	0.2185		
Resistance	Balance Error (%)	Pass	10.0	2.42			
Surge	EAR (%)	Fail	20	45.53		5000	Click to View
Surge	EAR (%)	Pass	20	2.26		5000	Click to View
Surge	EAR (%)	Fail	20	38.66		5000	Click to View



The WinAST rapidly compares multiple surge waveforms against a reference waveform for quality assurance testing of a given production motor.

user is prompted for all necessary information about a given product to be tested, and when complete, the file is permanently stored on the system's hard drive.

Testing is automatically sequenced according to the master file. Data is saved in XML format for compatibility with common databases. This ability to store so much data helps users adhere to ISO quality standards.

AC and DC hipot tests

The Baker WinAST uses micro-arc detection in both AC and DC hipot tests to detect any breakdowns to ground (the only proven method to accurately detect any such faults). It also performs a hipot test between phases to locate weak phase to phase insulation, and it has a capacitive compensation capability, which allows it to measure the resistive portion of any current leakage rather than the total leakage current. The Baker WinAST also performs a DC hipot test to check the integrity of the insulation system with high DC voltage.

Surge test

The instrument uses a high-voltage impulse test to detect any faults with insulation between turns, coils, and phases of the winding. Surge tests also detect other faults that change the inductance of a winding, such as any improperly annealed lamination steel, or reversed coils. The Baker WinAST uses a line-to-line method to analyze faults. It compares differences in waveforms and calculates the percentage difference relative to the saved master waveform.

Resistance test

The Baker WinAST resistance test can detect erroneous turn counts, poor connections, inaccurate lead labels and incorrect wire sizes. With the use of Kelvin connections, low-resistance winding tests are accurate and repeatable.

Resistance measurements are corrected for temperature to the equivalent resistance value at 25° C or to a customer-specified temperature.

Inductance test

The inductance test is another means of evaluating the motor circuit to ensure quality control. It detects shorts, opens, imbalances and reversed coils. It provides a numerical value of a tested winding to compare to expected inductance values. This test can be preformed using two or up to twelve leads.

Rotation-direction test

A rotation-direction test, which is an option for stator testing and for detecting misconnections, uses both induction and Hall-effect sensors.

Auxiliary relay matrix

The auxiliary relay matrix automatically connects stator leads for surge and rotation-direction tests. It accommmdates different winding configurations, including:

- wye
- delta
- high voltage
- low voltage
- part winding start
- double delta

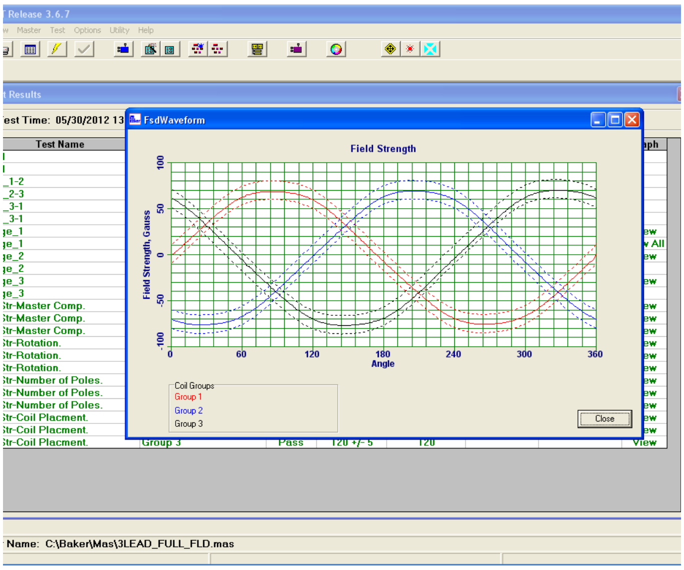
Field map test

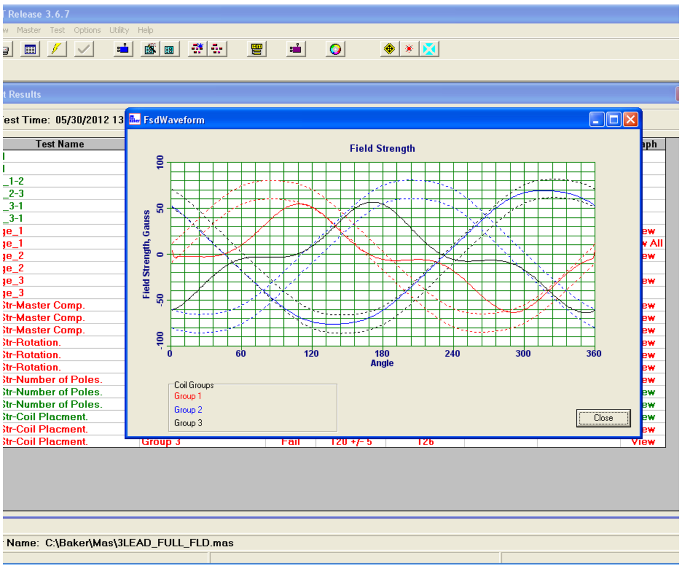
The Baker WinAST captures and analyzes stator field maps for the number of poles, rotation direction, symmetry, absolute amplitude and relative coil placement angle. The system detects mislabled leads, misplaced coils, turn and pole counts and rotation direction problems using customized probes inserted into a stator bore.

Data management

Raw test data and pass/fail counts are stored on the Baker WinAST's hard disk drive, in XML format, which makes it easy to use in commonly-used database programs such as Microsoft Excel or Access.

Data can be easily transferred to other computers via Ethernet or USB connections, or other portable or networked storage devices.

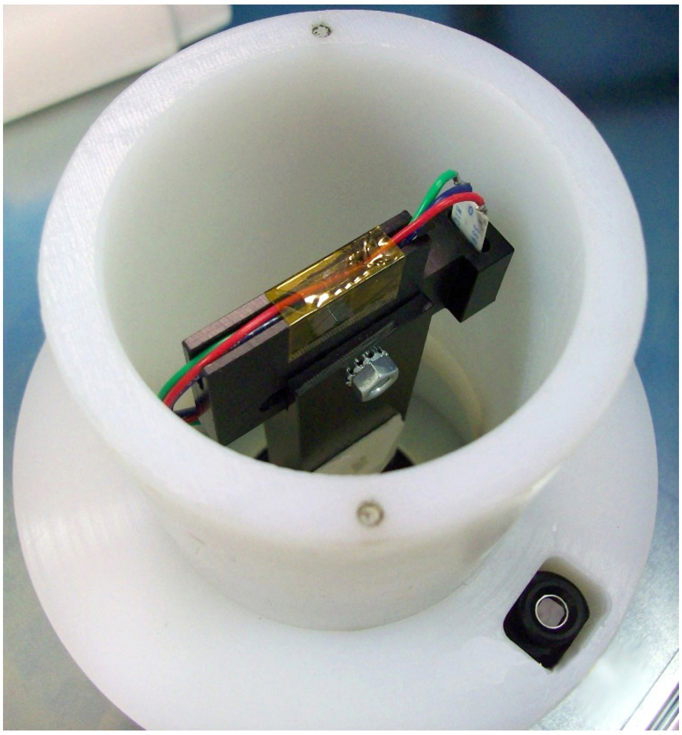




Examples of bad (top image) and good (bottom image) magnetic field map waveforms and limits for a production motor.

Baker HV WinAST

A high-voltage version of the Baker WinAST is available for conducting tests on low-inductance form coils and motor stators of more than 500 kW, or more than 575 V AC. For specific information about high-voltage system configurations, please contact Megger at baker.sales@megger.com.



Baker WinAST field map test accessory

Built to last

The Baker WinAST is designed for many years of rugged industrial use. When recalibration is required, the instrument can be calibrated on-site with adjustments to software coefficients via a simple menu (and using ISO procedures).

All Baker WinAST testers have a standard control console, safety interlock switch, and alligator clip terminations (unless an optional test fixture is ordered). A wide variety of single and dual station fixtures is available. In addition, test fixtures can be custom built to specifications.

Customized configurations

Please contact Megger (baker.sales@megger.com) for information on specific configurations or specifications. Every Baker WinAST system is a unique solution, and can be tailored to meet a wide spectrum of specific application needs.

More information on the Surge Test

It has long been known that most insulation failures in electric motors occur between phases, turns and layers rather than to ground. This is because the ground insulation system is usually much more robust than the rest of the insulation system. So as mechanical wear and high voltage transients age the insulation system, it is not surprising that the ground insulation lasts longer.

The high voltage impulse test is necessary to verify the integrity of insulation system components which can not be tested by the hipot test. It is capable of detecting insulation problems between turns, layers and phases of a winding which can not be detected with low voltage tests such as resistance or inductance. To perform this test, one end of a coil is grounded while a high voltage impulse is applied to the other end. The fast rise time impulse creates a voltage distribution across the coil as shown in Figure 1 which is similar to the effect of transients occurring in normal operation. The voltage distribution causes a turn to turn voltage differential which exposes weaknesses in the winding insulation. Weak insulation will break down causing a micro-arc.

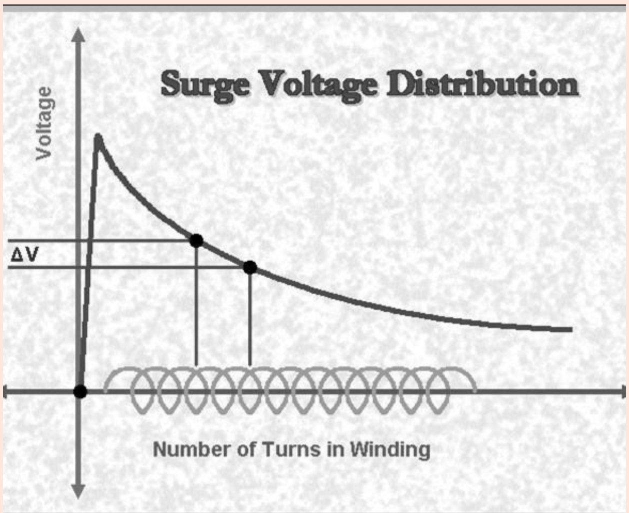


Figure 1: Initial impulse voltage distribution in a coil

The impulse is generated by rapidly discharging a capacitor into the coil which acts essentially like an inductor. The RLC circuit response to the impulse is an exponentially decaying sinusoidal waveform which is dependent on the inductance and losses in the winding as well as the internal capacitance and losses in the tester.

A breakdown in the winding insulation changes the inductance and losses on the coil thereby changing the test waveform. By comparing the waveform from a good coil with the waveforms from test coils, the user can detect problems in the test coils. A short always causes lower inductance and greater losses. There is a left shift in the test waveform as shown in Figure 2. The difference between a good waveform and a test waveform can be mathematically computed as a percentage for pass/fail analysis.

There is no industry standard method for analyzing the impulse waveform. The WinAST calculates the differential area between the curves.

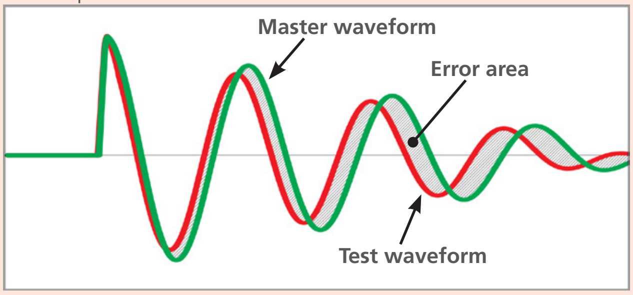


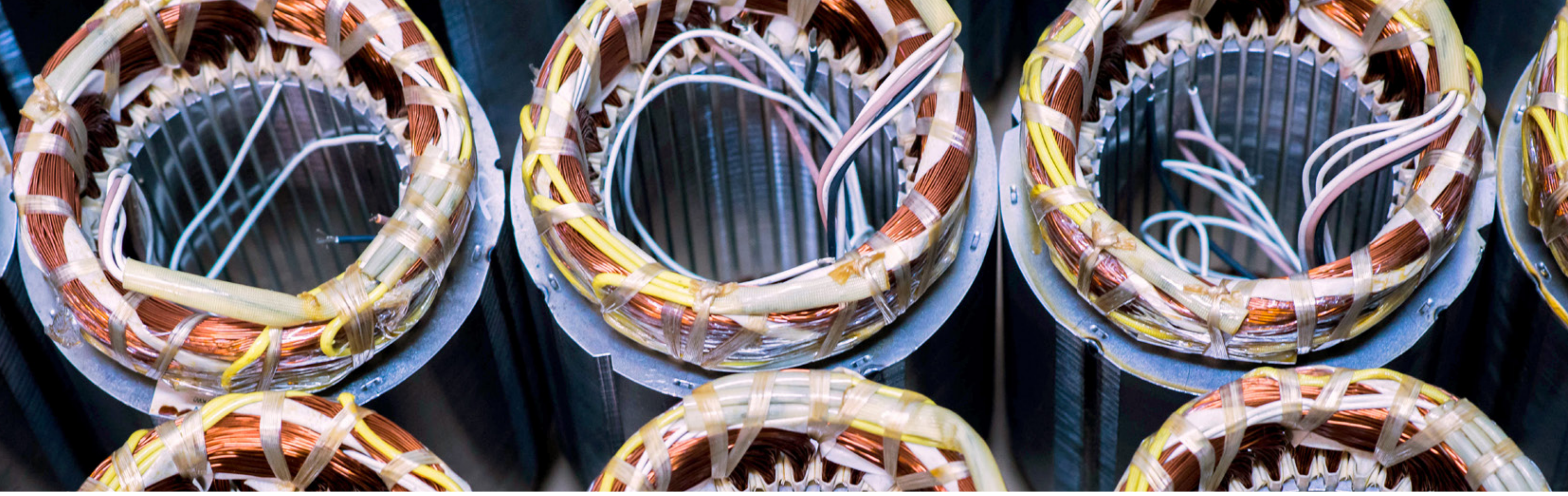
Figure 2: A mathematical percent error is calculated for the difference between a good and a shorted coil

Impulse waveforms in multiphase stators can be compared to check for balance. In many three phase stators the phases should be balanced. But, in some concentric machine-wound stators, the phases are naturally imbalanced.

For most measured parameters it is possible to obtain a statistical average and use that average to adjust the pass/fail parameters over time. With the surge test, this is difficult. However, the WinAST is able to digitize waveforms from multiple good windings to obtain an average Master waveform. This average can be obtained from windings taken from several winding machine setups or with different batches of steel cores.

Because the impulse waveform is primarily a function of winding inductance, other types of faults can be detected as well. Anything which affects the winding inductance or losses will change the impulse waveform. A winding with a reversed coil can be detected if it is coupled to another coil. Differences in the core material affect the impulse response.

Usually the impulse test is performed on electrical windings prior to assembly into the final product. This is important because rotors and steel housings significantly increase the losses in the winding thereby decreasing the fault detection sensitivity.



Baker WinAST specifications

Computer

Windows 7-based, with Ethernet, USB, video and serial port connections

Peripherals

- Display: high-resolution LCD screen
- Printer: optional desktop and label maker
- Keyboard and mouse

DC hipot

- Voltage: programmable 100 to 5 000 V DC in 50 V DC increments, 3% accuracy
- Current: 100 mA maximum, 1 mA resolution, programmable pass/fail in 1 mA increments
- Duration: programmable in one-second increments

AC hipot

- Voltage: programmable 100 to 3 500 V AC in 50 V AC increments, 50/60 Hz, 60 V A or 300 V A, ±5% accuracy
- Current: 100 mA/40 mA/13 mA/5 mA resolution, arc detection for improved fault detection, ±5% accuracy
- Duration: programmable in one-second increments
- Leakage current method installed: total or absolute leakage current

Resistance

- Auto-ranging
- 3,5 digit resolution
- 0,4% of full-scale accuracy in each range
- 0,2% of full-scale repeatability
- Kelvin leads and contacts for bar-to-bar testing
- Ambient temperature normally compensated 25 °C or user defined
- Infrared temperature sensing (optional)

Resistance Change	Current
10 mΩ – 20 mΩ	2 A
20 mΩ – 200 mΩ	2 A
200 mΩ – 2 Ω	200 mA
2 Ω - 20 Ω	20 mA
20 Ω – 200 Ω	2 mA
200 Ω – 2 kΩ	2 mA
2 kΩ – 20 kΩ	2 mA
20 kΩ – 200 kΩ	0.2 mA

Inductance

- 5-digit resolution
- Frequency range: 30 Hz – 1 000 Hz
- Kelvin leads

Baker WinAST inductance (typical)

1 µH - 10 µH	4%
10 µH - 100 µH	2%
100 µH - 10 mH	1%
10 mH - 100 mH	2%
100 mH - 200 mH	5%

High voltage impulse (surge)

- Voltage: programmable 500 to 5 000 V peak in 50 V increments
- 3% EAR repeatability
- Pulse energy: 0,5 J maximum
- Discharge capacitor: 0,04 mF
- Load: Greater than 100 mH
- Digitizing rate: 5, 10 or 20 M sample/second
- Programmable pass/fail percentage limit based on the error-area ratio (EAR) calculation

Rotation direction

- Senses clockwise or counter-clockwise rotation direction in windings
- Hall sensor effect method
- Single- and multi-phase motor options

Power requirements

- Input voltage: 115 V AC maximum (230 V AC available), 46 to 67 Hz
- Power consumption: 8 A
- Overcurrent protection: two-pole magnetic circuit breaker

Temperature compensation

- Ambient: standard
- Infra red: optional

Options

- PLC interface package
- Barcode scanner
- Additional leads (up to 12)
- AC hipotInductance
- Test fixtures

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