

What is Core Loss?

"Core Loss is a Waster of Energy and Destroyer of Motors"

Not all power applied to an electric motor is converted to work. Principal sources of energy waste include winding loss (I^2R), windage, friction, stray load loss and loss in stator, rotor and armature cores. Studies have shown that depending on load, core loss is the first or second leading cause of energy waste in rewound motors, and can account for 25% or more of motor inefficiency.

LEXSECO determined that the most important indication of core steel condition is the watts of electrical energy lost per pound (kilogram) of core steel when the core is excited to operating conditions. Common electrical grades of core steel have inherent Epstein test rated watts per pound (kilogram) losses ranging from 1 to 2 watts per pound (kilogram) depending upon application. This value is increased by as much as a factor of 1.5 to 2 once this steel is punched and assembled into motor cores. This increase may be attributed to a combination of lamination punching or stamping burrs, lamination thickness, Lamination clamping pressure, type of insulation coating used on the steel, heat treatment process used on punched laminations, lamination assembly method, silicon content and hardness of the steel, and heavy welds across the back of the core stacking.

Watts per pound (kilogram) core losses may be divided into hysteresis and eddy current losses. All cores experience some inherent loss. Increased loss results from physical damage or overheating during use or burnout of old windings. Core loss, dissipated in the form of heat, further degrades the core, causing greater core loss and more heat – a vicious cycle of rising operational inefficiency leading to premature motor failure. In DC armatures, core loss can cause commutator sparking and spotting, impeding motor performance.

A significant percentage of motors have core loss exceeding statistical acceptability. Some special types, such as hermetic refrigeration and traction motors, suffer especially high losses. Moreover, government efficiency mandates make detecting sources of energy loss increasingly important.

The critical importance of core testing has been acknowledged by preeminent technical authorities, such as the Engineering Committee of the Electrical Apparatus Service Association (EASA). EASA's Guidelines for Maintaining Motor Efficiency During Rebuilding require motor repairers to "Conduct a stator core test before and after stripping [the winding]." Core Testing reveals repairable problems. Testing before stripping avoids wasting time and money on a core which should be replaced, and verifies that stripping did not damage the core.

Why Test for Core Loss?

Core Loss Testing provides a quick and efficient method for determining core losses found in the core steel of stators, rotors, and armatures. LEXSECO recognized that core loss was a significant cause of wasted electrical energy that could be caused by overheating during operation or during winding burnout, as well as from physical damage. Core loss is second only to copper loss in motor windings as a cause of motor inefficiency. Core loss testing is the only method of determining if a motor is capable of operating at rated efficiency after rebuilding.

In developing the Core Loss Tester, LEXSECO performed thousands of tests on a wide range of motor and core types and created an extensive empirical test database. Moreover, LEXSECO studied and incorporated the electrical steel manufacturers' data used by the designers of electrical apparatus in arriving at output and performance characteristics.

Highest Metering Accuracy on the Market

The metering system is a key component in most industrial test equipment and should be specifically designed to address the application. LEXSECO's Flux Metering system is the result of decades of research in the field of core loss testing and advances in metering technology. It is an auto-ranging system, which measures actual lines of flux within the core at a very high sampling rate. It is certified traceable under the standards of the National Institute of Standards Technology (NIST) to be of the highest accuracy.



The system was designed specifically for core loss testing. It provides the most accurate metering available for testing a wide array of HP and frame characteristics. The accuracy specifications are presented as a percentage of the actual meter reading. The "% of reading" or "% of rdg" is a very significant term when used in conjunction with instrumentation specifications. It indicates how far the meter's reported reading can vary as a percentage of the reported reading from the actual.

The "% of rdg" must be compared to a more standard term "% of full scale" or "% of FS" in order to fully understand its significance. The term "% of FS" indicates how far the meter's reported reading can vary as a percentage of the largest reading the meter can display from the actual. Consider the following example of two watt meters (both meters have a five digit display and full scale = 10,000 watts) displaying 180 watts when testing a core:

- **Other Meters** (with an accuracy specification of $\pm 0.5\%FS$) The reading of 180W might actually be between 130 and 230W, a range of 100 watts.
- **LEXSECO's Flux Meter** (with accuracy specification of $\pm 0.25\% Rdg \pm .2$) The reading of 180W might actually be between 179.35 and 180.65 a range of **only 1.3 watts**.

Of all metering issues associated with the Core Loss Tester, the most difficult parameter to represent accurately is wattage, as it is derived from two separate measurements, voltage and current and their observed phase relationship. The above example illustrates how one specification can greatly affect your confidence in the reported results.

Calibration is easily addressed with our flux meter exchange program. The exchange metering system comes complete with traceable Certificate of Compliance certified in conformity with the National Institute of Standards and Technology (NIST). The Flux Metering System is a self-enclosed modular component, which provides for a quick removal and installation process. This program should help you conform to ISO 9001, EASA-Q, and other program standards that require regular and traceable calibration while maintaining your Core Loss Testing with little or no interruption.