Stator Core Condition Assessment

The stator cores of rotating electrical machines are composed of multiple stacked layers to minimize core (eddy current) losses. Shorting in two or more layers can lead to localized hot spots, which in a worst-case scenario, can cause a partial core meltdown and eventually complete damage to the machine. Regular testing can be a proper countermeasure to identify potential hot spots at an early stage. The two major test methods for this include *the ring flux test* and *the stray flux measurement*. The ring flux test is carried out at rated flux and thus requires a large amount of test equipment and a high effort to set it up. The localization of hot spots is then done with thermographic imaging.

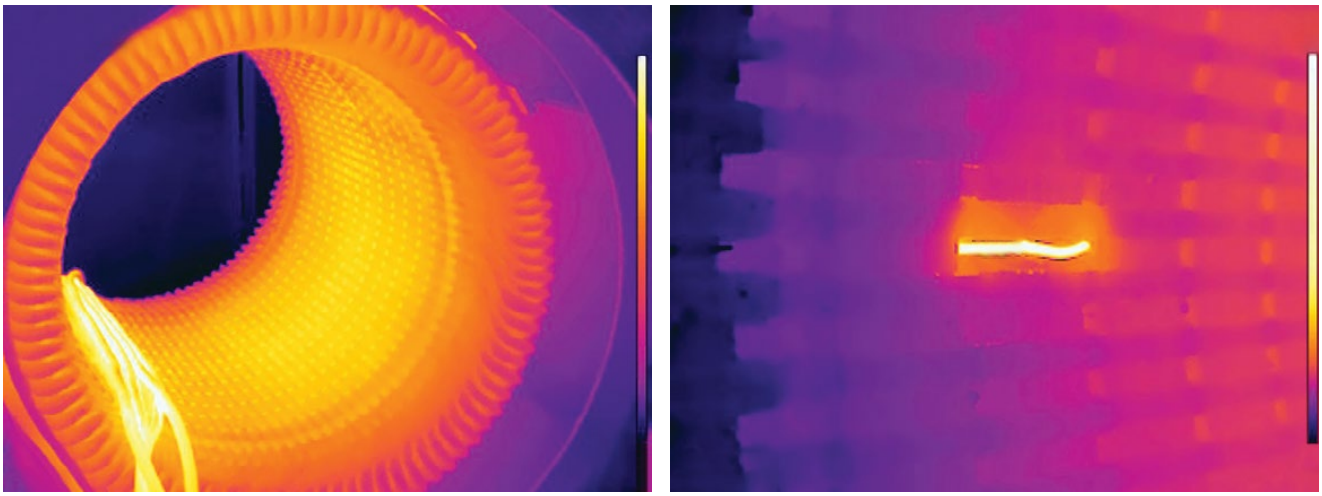

Figure 1: Left: Thermographic imaging during a ring flux test on a small motor. The current in the excitation wires is heating them up. Right: A simulated fault during the test.

As for on-site testing during maintenance, especially for larger machines, the effort of testing with rated flux is often too high and therefore not possible. Therefore, the stray flux measurement (also known as the electromagnetic imperfection measurement) is the choice.

The test is carried out with only a small percentage of rated flux, thus requiring less effort. The measurement is done with a Chattock coil. The excitation is performed similarly to the ring flux test with an auxiliary winding (Figure 1). As the excitation is only a few percent of the nominal flux, the cables are much smaller and flexible.

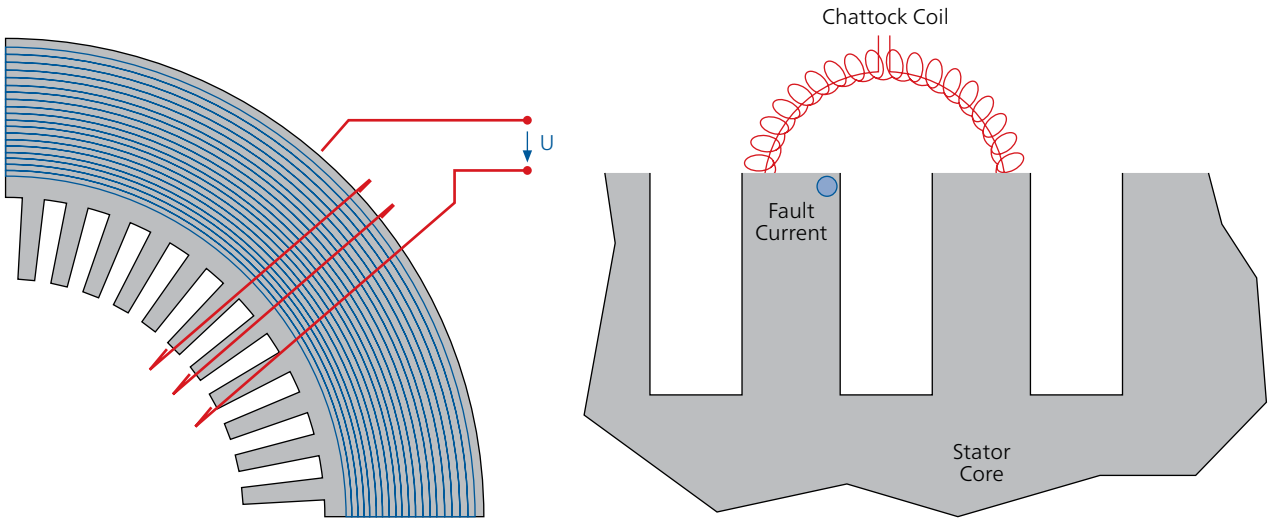

Figure 2: Left: Auxiliary winding and flux distribution within the stator core. Right: Faults are detected by a higher stray flux which is measured with a Chattock coil.

OMICRON's CPC 100 acts in this case as both the excitation source as well as the measurement device. With the Stator Core Measurement Upgrade Option, ease and efficiency of use in combination with an accurate measurement result in a reliable stator core assessment. The Chattock coil moves automatically on a rail, which ensures highly reproducible measurement results. After finishing the scan, the rail is placed onto the next slot. Strong magnets as well as a safety suspension prevent the rail from falling down.

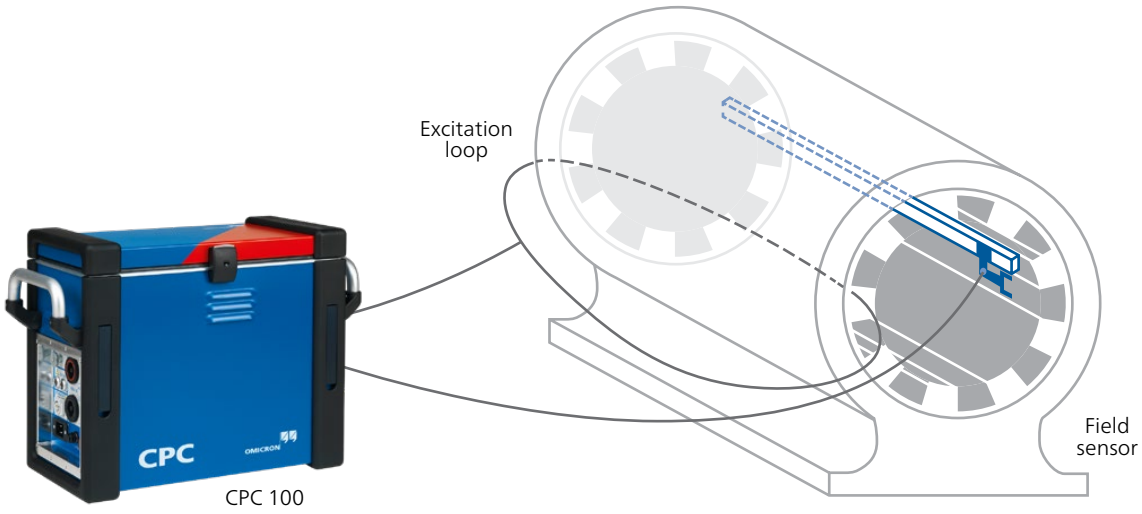

Figure 3. Test setup for a stator core imperfection detection test

A potential fault is indicated by a higher level (amplitude) of stray flux as well as a different angle to the injection of the measured voltage. Out of the latter one, a correlating current can be calculated. Within the industry, a limit of 100 mA for either the real part or the imaginary part of the current is commonly accepted. If higher values are reached, special attention should be paid to the spot. This can mean that either monitoring sensors are installed, the measurement interval is reduced, or a rated flux test is performed as a confirmation.

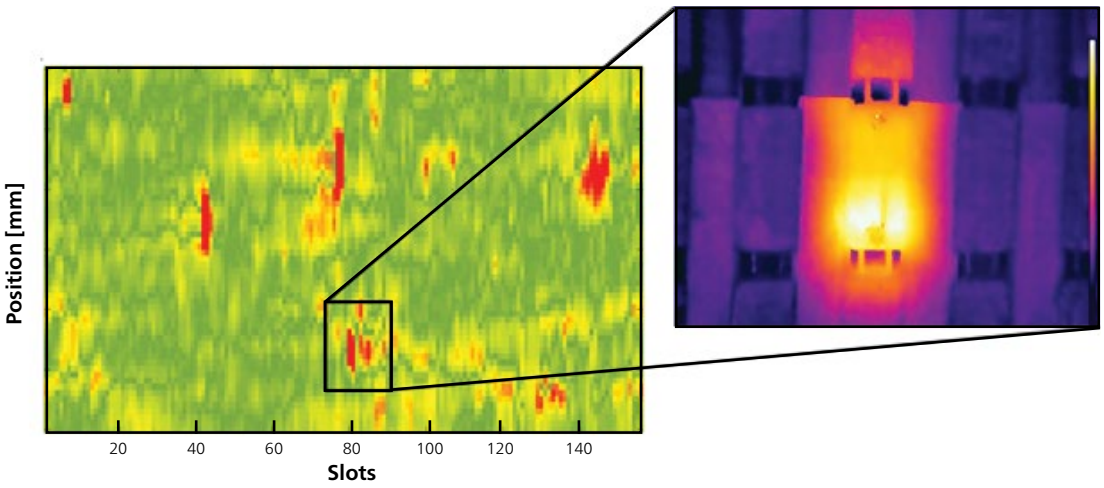

Figure 4. Comparison between a stray flux measurement of an entire stator and a section during a rated flux test on an old, decommissioned stator. The red areas indicate spots with fault currents higher than 100 mA measured during the stray flux measurement.

Before every measurement, the equipment is calibrated with a certain current using a calibration unit. This ensures comparable results and a system check before going to the Device Under Test (DUT).