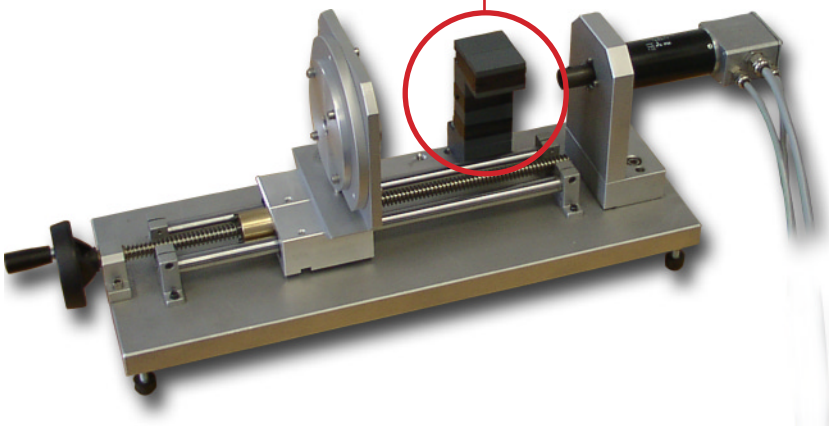
Case History - Rotor Tester



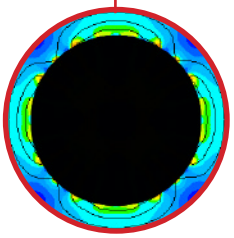
Abstract

A testing unit has been developed to scan the strength and distribution of a magnetic field generated by permanent magnets mounted on the rotor of an electric motor.

Problem and Task

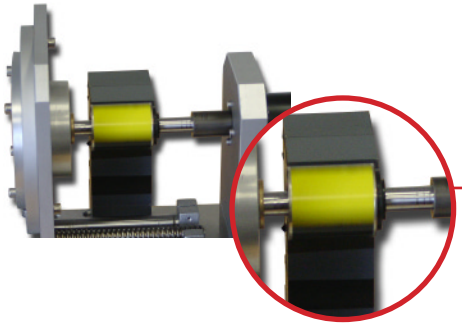
Rotors with permanent magnets built into electric motors can be a source of malfunction when the field strengths of the magnets mounted differ from each other. The unequal distribution of these opposing forces results in non-alignment which interferes with the concentricity of the motor and ultimately leads to its destruction. For this reason each rotor produced needs to be checked with regard to the equal distribution of its magnetic field, so that it can be integrated into the production process.

The test unit to be developed must scan and evaluate the rotor within a period of not longer than 30 seconds. There must be accurate and reliable determination of the maximum field strength in each sector,as well as of the integrated field of the sector, i.e.the entire flux of the sector.



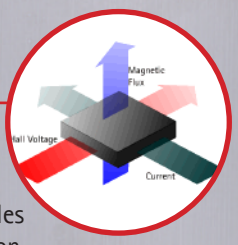
The mechanical basis

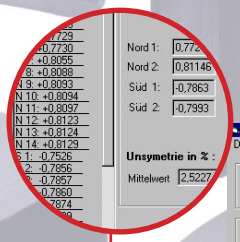
The rotor to be tested should be canned with a sensor or a set of sensors. The sensors should be in a fixed position while the rotor revolves. This arrangement of sensors can be either vertical or horizontal (see photo).

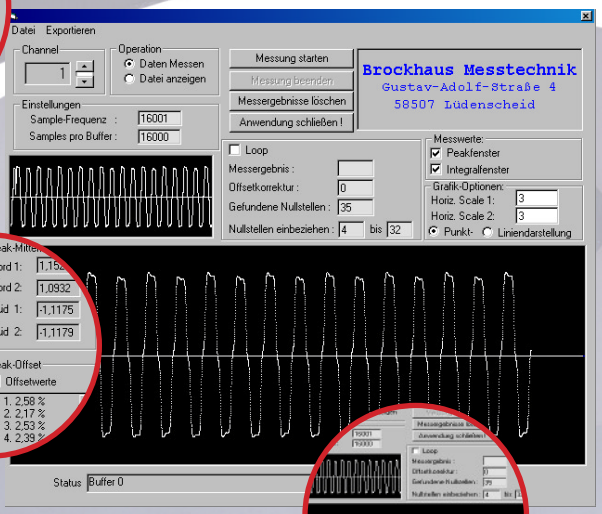


The Sensor

Hall sensors provide the best performance in the scanning of magnetic fields.
The function of a Hall sensor is based on the physical principle of the Hall effect named after its discoverer E.H.Hall: It means that a voltage is generated transversely to the direction in which the current flows in an electric conductor (the Hall voltage), when a magnetic field is applied perpendicular to the conductor. In a semi-conductive platelet the Hall voltage is generated by the effect of an external magnetic field acting perpendicular to the direction of the current. The Hall voltage is then directly related to the strength of the magnetic field. Measuring the hall voltage provides a direct measurement with regard to the strength of the magnetic field. In order to scan the distribution not only across the circumference but also across the entire length of the rotor a set of hall sensors is installed, thus providing a mean value of the field strength in the z-direction. The signals of the Hall sensors are digitalized at 16 bit resolution.







The Software

The software developed obtains the measured voltages and displays both the integrated values of the field strength of the appropriate sector and the peak values. All field sectors and their peaks are displayed on the screen. Additionally the distribution is shown as a graph, $F_{Field} = f(\varphi)$ The measurement can be saved in the software 's own format, or alternatively in MS Excel® format or as an ASCII file for further data processing.

Further developments and applications

Due to the modular design the test unit can be used for any type of rotor. A modification i.e. moving the sensor to the inside, will allow this application to be extended to include stators fitted with permanent magnets.

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