

Properties of Soft Magnetic Materials under Operational Stress Levels up to 650 MPa and their Measurement using Open Circuit Techniques

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When using soft magnetic materials in harsh environments such as an embedded starter/generator in a gas turbine, it is necessary to measure their properties with these conditions produced, where possible, in the laboratory. The DC hysteresis loops of strip geometry samples, 500 mm long, 20 mm wide and 0.3 to 0.6 mm thick, were measured in a permeameter in accordance with the IEC standard[1]. The tensile stress experienced in a high speed electrical machine was applied using a horizontal Instron machine in 50 MPa steps up to the yield strength. The full paper will show results for 6 types of soft magnetic material and contrast and compare the behaviour observed. The results will show that the optimum material for an application is dependent on the expected tensile stress.

For AC properties an open circuit measurement method has been adopted since the removal of the high permeability yoke used in [1] makes it simpler to obtain the required temperature and lowers the inductance of the magnetising solenoid so that the necessary magnetic field strengths can be reached at the operating frequencies required. In Figure 1 the change in the BH curve as the distance from the surface of the material to the H sensor increases is shown. Also shown is the BH curve obtained by extrapolating back to the field at the surface using this measured sensitivity to distance.

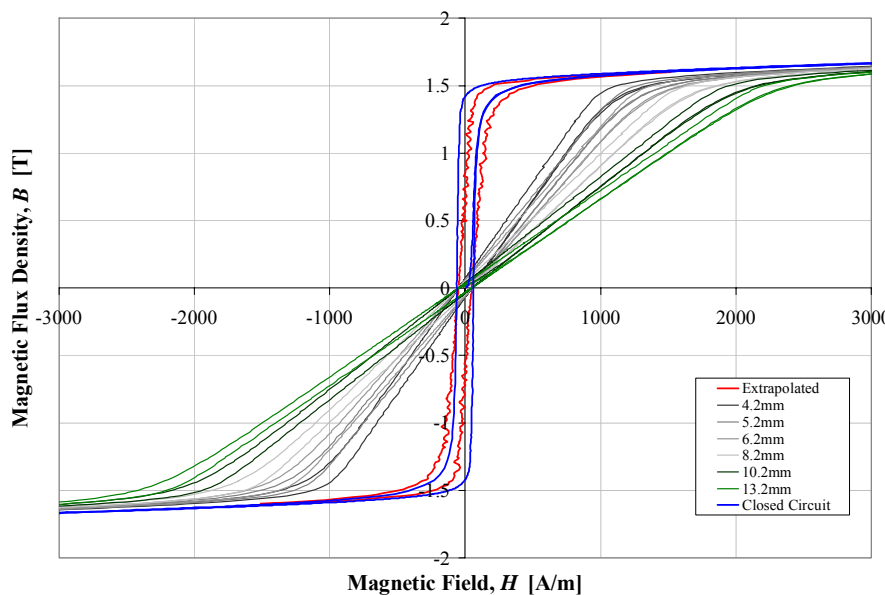


Figure 1. Change in the measured BH curve at increasing distance from the surface and extrapolation (red curve) back to the surface field.

In this paper details of this demagnetisation correction procedure and resulting measurement uncertainties will be presented.

[1] IEC Standard 60404 part 4, “Methods of measurement of d.c magnetic properties of iron and steel.”