

Standardisation of Magnetic Alloys and Steels : a worldwide collaborative effort

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The standardisation of magnetic materials allows assuring that the producers of cores for electric machines can rely on certified properties of available materials, for qualification. Both the standardisation of the materials and of their measurement techniques, are relevant for consistent reported material properties. The identified uncertainty of the values of magnetic, electrical, mechanical, thermal, insulation properties, is an important metrological topic. The continuous evolution towards higher energy efficient electrical equipment steers the development of higher performance materials, which need to be included in standards as they become available for machine integration. New proposed measurement techniques need to be tested for validity, which often implies worldwide round robin comparisons, with standardisation members from national metrological institutes, universities and industry. This very diverse international community brings insights from different backgrounds, which guarantees a scientific correct approach, relevant for the industry's progress.

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1. Introduction

The standardisation of magnetic materials and the measurement of their properties falls at the international level within the scope of the International Electrotechnical Commission (IEC) [1], whereas the materials standardised for their mechanical properties fall within the scope of ISO [2]. IEC handles different types of electric machines and materials in different Technical Committees (TC). As examples IEC TC 2 standardises Rotating machinery (motors and generators), TC 14 Power transformers, TC 51 Magnetic components, ferrite and magnetic powder materials, TC 68 Magnetic alloys and steels.

For the case of European standardisation, the measurement standards of magnetic materials are established in IEC and adopted as such by CENELEC into EU standards and their derived national standards, whereas the product standards are established in a dedicated CEN working group. [3]

Historically North America has relied mostly on the American Society for Testing and Materials (ASTM) standards, that have been incorporating SI units. Furthermore, ASTM has changed to an International organisation in 2001[4]. This implies notable differences in the categorisation, the measurement methods and the reporting of properties of magnetic materials, depending on whether the IEC or ASTM background is used. Other countries have their national standards, often adherent to the methodology of IEC. The international approach to standardisation does not imply that all initiatives are driven by an association of countries. As an example, the Verband der Automobilindustrie (VDA) initiative for the measurement of all relevant properties of electrical steels for automotive applications is quite relevant, as an initiative driven by a specific industry for clearer guidelines, in Germany [5].

2. Overview of recent standardisation results and ongoing discussions

The conference paper will in detail provide an overview of recently conducted and ongoing product and measurement standards new topics, updates, as well as round robin studies in the standardisation context. IEC TC 68 will be the main focus, but adjacent standardisation bodies' topics will be included.

For permanent magnets; new types were added in the classification standard. Beyond classis characterisation techniques are developed such as the pulsed field magnetometry, open circuit measurements using a superconducting magnet, elevated temperature measurement techniques, verification of the angle of magnetisation.

For grain-oriented electrical steels a new class of domain refined materials was added and associated Epstein and Single Sheet Testing is compared and further extended in application range. For non-oriented electrical steels upgrades for the use of the Epstein frame method as well as preparations for the introduction of Single Sheet Testing are ongoing.

For amorphous materials both a product and measurement standard have been defined.

References

- [1] <https://www.iec.ch>
- [2] <https://www.iso.org/standards.html>
- [3] <https://www.cenelec.eu>
- [4] <https://www.astm.org>
- [5] <https://www.vda.de/en>

Acknowledgments: All contributing laboratories and companies to the standardisation work are summarised on the websites of the referenced standardisation bodies.