Coercivity measurements of complex-shaped soft magnetic parts according to IEC 60404-7:2019

Markus Kuhnt[a]

[1]*Independent Researcher, GERMANY.*

Coercivity is a key property of soft magnetic materials, sensitive to structural changes, and crucial for quality control in the industry. Standardized measurement techniques were first outlined in IEC 60404-7:1982, including methods like vibrating coil magnetometers. The standard was revised in 2019 to reflect new findings and introduced the vibration sample magnetometer. However, the updated EN IEC 60404-7:2020 is not yet globally implemented, leading to uncertainty about compliance. This work provides an overview of the changes and remaining challenges.

Keywords: Coercivity; magnetic measurements; Standardization

1. Introduction

Coercivity is not only one of the most fundamental properties of a soft magnetic material, but it is also very sensitive to structural changes of the material. Thus, since the introduction of the first coercimeters the measurement of the coercivity has become an important tool for the industry in quality control [1].

Due to the continued success the coercivity measurement techniques were first standardized in IEC 60404-7:1982 [2]. This standard has included the vibrating coil magnetometer [2,3], coercimeters with magnetic sensors near the sample as well as those with magnetic sensors outside the magnetizing coil [1,2].

After decades of only minor changes (e.g. in EU being integrated in EN 10330 [4,5]), a fully revised version was published in 2019. It reflected new findings in these measurements methods and also introduced the vibration sample magnetometer in an informative appendix [6]. However, even though it has been adapted as EN IEC 60404-7:2020 [7], not in all countries the new standard has yet been implemented worldwide. Among the users of these standards this results in a state of insecurity which method is in compliance with the new standard and what is the roadmap for introducing the standard on a national level.
In this work, we will not only give an overview over the most significant changes, but also will give an outlook about remaining challenges.

2. Results and discussion

The standard introduces some major changes. Among the most prominent are the following two:

The standard now only applies to samples with a coercivity from 0.2 A/m to 160 kA/m. This reflects that for samples with higher coercivites other techniques are more suitable than those described in the standard.

Reflecting experimental findings that especially for very soft magnetic materials all measurement methods are affected significantly by the shape of the sample, the standard also introduces further restrictions on measuring complex shaped samples with coercivities smaller than 40 A/m. According to the new standard only measurement method type B shall be used, which has the smallest error due to the larger distance between sample and sensor.

In conclusion, the new standards includes some new regulations reflecting the experimental findings in the industry in the last decades.

However,we may point out that the standard still lacks a section about conformity to this standard can be achieved. Without such an information, a manufacturer can declare conformity, even if he only partially complies with this standard. Stricter regulations about conformity might help to understand discrepancies between measurement equipment according to the standard better and in the end result in better quality assurance in the magnetic industry in the future.

References

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