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Influence of normal-compressed stresses on measurement precision of toroidal and oval nanocrystalline cut cores used for metering

***Abstract**. The following paper presents the analysis of influence on measurement precision due to change of magnetic properties of nanocrystalline wound cut cores caused by normal-compressed stresses. Two types of nanocrystalline cut cores were examined: toroidal core and oval core. The mass, path length and cross section of both cores were identical but the shape of cores was different. The same range of normal-compressed stresses force was applied on cores and the significantly different results were obtained.*

Keywords: nanocrystalline magnetic cores, current transformers, magnetic measurements

Introduction

Increasing needs in terms of precision, accuracy and electrical quantities measurement affects on equipment manufacturers to find technological improves. In recent years, the use of nanocrystalline magnetic cores in current and voltage transformers has radically increased. It is caused by increasing demand for current (CT) and voltage (VT) transformers with high class of measurement. New and modern solution in CT's devices is using the nanocrystalline cut cores and making the measuring element separable. This type of construction allows to install the CT without disconnecting the conductor with current what reduces the mounting time and make the process much more simple. Very important aspect is the force applied to the core. Assembling two half-parts of CT, results in normal-compressed force (perpendicular to cut surfaces) acting on magnetic core [1, 2]. The force distribution is different for toroidal and oval cores that have been examined.

Experimental setup and results

Two types of nanocrystalline magnetic cut cores that can be used in separable CT were examined. Toroidal core as a classic solution for CT applications and wound oval core which can be applied when there is limited space or when the current conductor has a rectangular shape. Both cores under consideration had the same magnetic path length (550 mm), mass (1.4 kg) and cross section (360 mm^2) and the only difference between them was the shape. The carried out thermomagnetic treatment, the cutting and polishing process were identical for both core types [3]. The specialized support for precise assembling half-parts of the core was built. Device is able to evaluate the torque (Nm) that corresponds to normal-compressed stresses (N) acting on magnetic core. The magnetic relative permeabilities of two examined nanocrystalline cores are presented in Fig. 1.

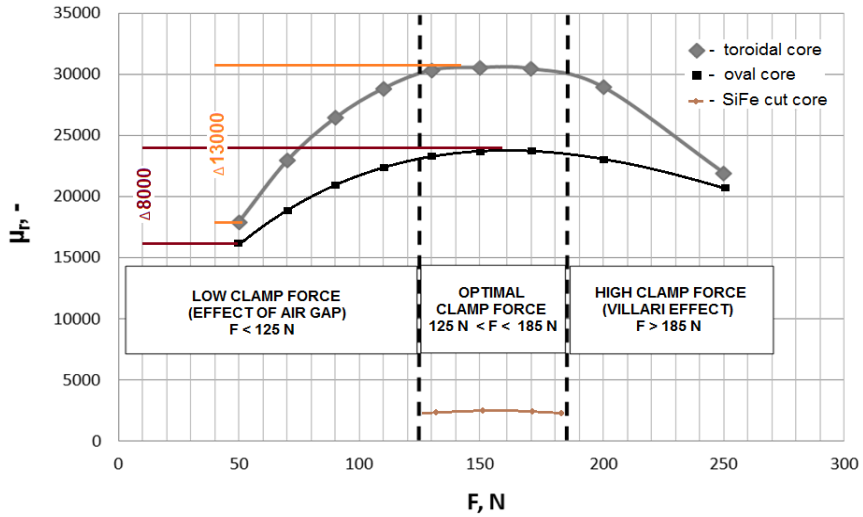

Fig.1. Magnetic relative permeabilities at magnetic field strength H=1 A/m dependency on clamping force from 50 to 250 N of nanocrystalline toroidal and oval cut cores (own measurement data).

Summary

Presented in the abstract results of magnetic cut cores examination, confirms higher applicability level of oval core to be used in high precision CT. Oval cut core has a less sensitivity on normal-compressed stresses than toroidal cut core. This fact results in that oval core shows less degradation of magnetic properties caused by clamping force. Independently of CT's casing construction which should provide sufficient protection against high clamping force, the oval cut core is a better option than a toroidal cut core.

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