SLOVENSKI STANDARD
oSIST prEN IEC 63300:2022

01-marec-2022

Preskusne metode za električne in magnetne lastnosti jeder iz magnetnega prahu

Test methods for electrical and magnetic properties of magnetic powder cores

Méthodes d'essai des propriétés électriques et magnétiques des noyaux en poudre magnétique

Ta slovenski standard je istoveten z: **prEN IEC 63300:2022**

ICS:

29.030	Magnetni materiali	Magnetic materials
29.100.10	Magnetne komponente	Magnetic components

oSIST prEN IEC 63300:2022 **en**

51/1401/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 63300 ED1	
DATE OF CIRCULATION: 2022-01-14	CLOSING DATE FOR VOTING: 2022-04-08
SUPERSEDES DOCUMENTS: 51/1368/CD, 51/1379/CC	

IEC TC 51 : MAGNETIC COMPONENTS, FERRITE AND MAGNETIC POWDER MATERIALS	
SECRETARIAT: Japan	SECRETARY: Mr Takeshi Abe
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 68	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT	☐ QUALITY ASSURANCE ☐ SAFETY
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TITLE:

Test methods for electrical and magnetic properties of magnetic powder cores

PROPOSED STABILITY DATE: 2028

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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TEST METHODS FOR ELECTRICAL AND MAGNETIC PROPERTIES OF MAGNETIC POWDER CORES

FOREWORD

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The text of this International Standard is based on the following documents:

FDIS	Report on voting
51/XX/FDIS	51/XX/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Magnetic powder cores have the characteristics of low relative permeability, high saturated flux density and low loss. Therefore, compared with ungapped ferrite, the equivalent impedance of a sample of the magnetic powder core is much smaller, and the magnetizing current is very large, so the required excitation source needs both high frequency and high-power capacity, which is difficult to obtain in practice. Moreover, the impedance angle of a magnetic powder core under test is very close to 90°, and this results in great difficulties to obtain accurate measurements of power loss.

The IEC 62044 standard series provides measuring methods of magnetic properties at low and high excitation levels for magnetic cores made of magnetic oxides or metallic powders. However, the methods introduced in IEC 62044 cannot fully meet the measurement requirements for magnetic properties of magnetic powder cores. So, it is necessary to have a standard for suitable measuring methods for the magnetic properties of magnetic powder cores.

New test methods with pulse wave excitation and DC power method that account for the characteristics of magnetic power cores are introduced in this standard, in addition to some modifications for the traditional test methods. Also, ideally an air core inductor with single winding or dual windings is introduced in the standard to verify or calibrate the accuracy of test methods for magnetic properties of magnetic powder cores, because of the linear properties of an air core inductor.

TEST METHODS FOR ELECTRICAL AND MAGNETIC PROPERTIES OF MAGNETIC POWDER CORES

1 Scope

This standard provides the test methods for the electrical and magnetic properties of magnetic powder cores used for inductive components in electronics equipment, switch-mode power supplies and power conversion equipment, and introduces measuring principles, scope of application and matters needing attention for each method.

The parameters used to characterize the magnetic powder cores include: inductance factor, effective permeability, complex relative permeability, temperature coefficient of permeability, frequency coefficient of permeability, DC bias characteristic, power loss, and quality factor. This standard is the basis for determining the characteristic parameters of magnetic powder cores.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited is applicable to this document. For undated references, the latest edition of the referenced document (including any amendments) to applies.

IEC 60050, *International Electrotechnical Vocabulary (IEV)-Chapter 221: Magnetic materials and components*

IEC 61007, *Transformers and inductors for use in electronic and telecommunication equipment - Measuring methods and test procedures*

IEC 62044-1, *Cores made of soft magnetic materials-Measuring methods - Part 1: Generic specification*

IEC 62044-2, *Cores made of soft magnetic materials-Measuring methods - Part 2: Magnetic properties at low excitation level*

IEC 62044-3, *Cores made of soft magnetic materials-Measuring methods - Part 3: Magnetic properties at high excitation level*

IEC 63182-2, *Magnetic powder cores – Guidelines on dimensions and the limits of surface irregularities – Part 2: Ring-cores*

3 Terms, definitions and symbols

3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Symbols

All the formulas in this standard use basic SI units. When multiples or sub-multiples are used, the appropriate power of 10 shall be introduced.

f the frequency, in Hertz (Hz);

T_S the cycle，in Second (s) ;
B_m the peak value of effective magnetic flux density, in Tesla (T) ;
H_m the peak value of effective magnetic field strength, in Ampere per meter (A/m) ;
P_c the power loss absorbed by the core, in Watt (W) ;

P_w the winding loss, in Watt (W) ;
P_{cv} the power density absorbed by the core, in Watt per cubic meter (W/m^3) ;
A_e the effective cross-sectional area of the core, in square meter (m^2) ;
l_e the effective magnetic path length of the core, in meter (m) ;
V_e the effective volume of the core, in cubic meter (m^3) ;
φ the phase, in Radian (rad) ;
$\Delta\varphi$ the phase shift absolute error, in Radian (rad) ;
N_2 the number of turns of the voltage sensing winding;
ΔT the temperature rise, in degree Celsius (°C) ;
N_1 the number of turns of the exciting winding;
μ_0 the magnetic constant (the permeability of vacuum), approximately $4 \times \pi \times 10^{-7}$ H/m;
μ_{ea} the effective amplitude permeability;
$\mu_{e\Delta}$ the effective incremental permeability.

4 Instruments and equipment

4.1 General provision

A suitable circuit (in annexes) and instruments shall be chosen for measuring.

4.2 Excitation source

4.2.1 General provision

The properties of magnetic powder cores provided by manufacturers are generally based on sinusoidal wave excitation source, because that is the most repeatable and easily replicated measurement. Applications include many diverse non-sinusoidal conditions, and therefore methods for testing with other waveshapes are needed for specific cases. Sine wave basic data is most useful as a common point of reference for characterizing materials, comparing materials, correlating testing between labs, and setting clear specification limits. Excitation sources in this standard include sinusoidal wave and square wave sources. Note that the waveform of a voltage source (setting the magnetic flux density) does not necessarily match the waveform of the associated current (since the magnetic field strength follows according to the inductive properties of the device under test.) Likewise, the waveform of a current source (setting the magnetic field strength) does not necessarily match the waveform of the associated voltage (from the induced flux density). The excitation source shall have low internal impedance, with frequency and amplitude stable to within ±0,1% during measurement.

4.2.2 Sinusoidal wave excitation source

When sinusoidal wave excitation is specified, the total harmonic content of the excitation source shall be less than 1%. When the excitation voltage is sinusoidal, the magnetic flux density is calculated as in formula (1).

$$B_{\mathrm{m}} = \frac{\sqrt{2} \times U_{\mathrm{rms}}}{2 \times \pi \times f \times A_{\mathrm{e}} \times N_1} \qquad (1)$$

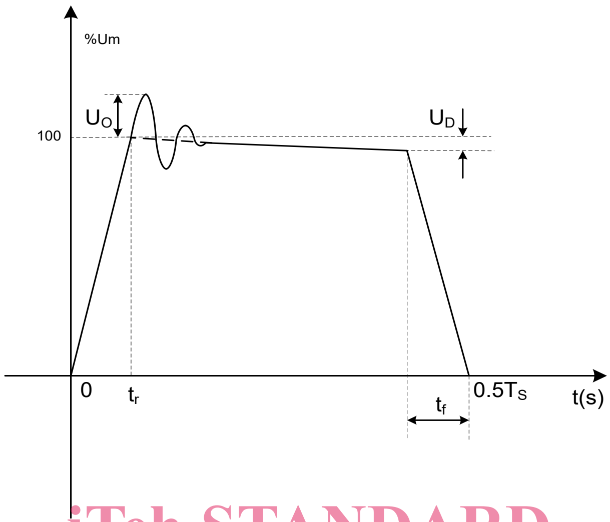
where :

U_{rms} is the RMS of excitation voltage, in Volt (V).

4.2.3 Square wave excitation source

When the square wave (the PWM waveform with 0,5 duty cycle) excitation is specified, as shown in Figure 1 (the negative half wave is the same as the positive half wave in shape), the overshoot U_O shall be less than 5% of the peak pulse amplitude U_m, the droop U_D shall be less than 2% of the peak pulse amplitude U_m, the pulse rise time t_r and pulse fall time t_f shall be less than 1% of the cycle of the square wave. When the excitation voltage is square, the magnetic flux density is calculated as in formula (2).

$$B_{\mathrm{m}} = \frac{U_{\mathrm{m}}}{4 \times f \times A_{\mathrm{e}} \times N_1} \quad (2)$$



Key

U_{m} peak pulse amplitude, the maximum value of an extrapolated smooth curve through the top of the pulse, excluding any initial "spike" or "overshoot", the duration of which is less than 10 % of the pulse duration. in Volt (V). [Source: IEC61007-2020, 3.3]

t_{r} pulse rise time
t_{f} pulse fall time
U_{D} droop
U_{O} overshoot

Figure 1 – Figure of square waveform

4.2.4 Calculation of magnetic flux density

In general, the magnetic flux density with arbitrary AC waveform exciting voltage can be calculated as in formula (3).

$$B_{\mathrm{m}} = \frac{U}{4 \times f \times A_{\mathrm{e}} \times N_1} \quad (3)$$

U is the average rectification value (ARV) of arbitrary AC waveform exciting voltage, in Volt (V).

4.3 Measuring equipment

4.3.1 General provision

Voltage meter or voltage-measuring equipment shall be of high internal impedance. In order to reduce measurement error, probes shall be of high input impedance. Additionally, the bandwidth of voltage meter or voltage-measuring equipment shall cover the frequency of harmonics whose amplitude is 1% of the amplitude of fundamental wave.

4.3.2 Voltmeter

In order to measure RMS, average value and peak value of the excitation voltage accurately, a voltmeter with accuracy of 0.2 % is recommended.