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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Terms and nomenclature for cores made of magnetically soft ferrites – Part 3: Guidelines on the format of data appearing in manufacturers catalogues of transformer and inductor cores

Termes et nomenclature pour noyaux en matériaux ferrites magnétiquement doux – Partie 3: Lignes directrices relatives aux formats des données figurant dans les catalogues des fabricants de noyaux pour transformateurs et inductances

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

TERMS AND NOMENCLATURE FOR CORES MADE OF MAGNETICALLY SOFT FERRITES –

Part 3: Guidelines on the format of data appearing in manufacturers catalogues of transformer and inductor cores

FOREWORD

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International Standard IEC 60401-3 has been prepared IEC technical committee 51: Magnetic components and ferrite materials.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition of reliability in Clause 6.

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The text of this standard is based on the following documents:

FDIS	Report on voting
51/1106/FDIS	51/1121/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60401 series, published under the general title *Terms and nomenclature for cores made of magnetically soft ferrites*, can be found on the IEC website.

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

- reconfirmed,
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INTRODUCTION

For various reasons, a manufacturer may wish to publish in its catalogue typical data for material parameters as measured on test pieces. It is the object of this part of IEC 60401 to promote the comparability of such information in the area of soft ferrite materials.

Except for several specific property limits that should be given separately for each particular core, the properties described in this standard are material characteristics, intended to facilitate meaningful evaluation of ferrite materials. It should be recognized, however, that there is no direct relation between material characteristics as measured on test pieces and the corresponding parameters measured on other cores, made of the same material, because of differences in geometry and variation in production processes. Also, the extrapolation of material characteristics to other flux densities and other frequencies will not permit valid comparison of cores of different materials under these new conditions of operation.

It is therefore emphasized that it is impossible to design and specify a core on the basis of material properties published by a manufacturer in its catalogue, without due contact with that manufacturer. Also, the publication of material characteristics should not be considered as a guarantee for core properties; for this purpose, only the specification of that core should be used.

It is strongly recommended that, together with the material characteristics, manufacturers publish a note covering the two statements above on the limitations of this kind of information.

This standard further addresses the comparability of various grades of ferrite from different manufacturers by defining the baseline reliability and temperature performance that is inherent for all MnZn ferrite materials, and the limitations that exist when specifying related performance characteristics in ferrite cores.

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TERMS AND NOMENCLATURE FOR CORES MADE OF MAGNETICALLY SOFT FERRITES –

Part 3: Guidelines on the format of data appearing in manufacturers catalogues of transformer and inductor cores

1 Scope

This part of IEC 60401 gives guidelines for a uniform method of presentation for the properties of magnetically soft ferrite materials and measuring conditions under which they should be determined. It is intended for use in manufacturers' catalogues of transformer and inductor cores, in order to aid the comparability of such data. Additional guidance is given for users and manufacturers concerning testing and specification of reliability for ferrite cores and for devices using ferrite cores.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61332:2005, *Soft ferrite material classification*

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*

3 Measuring methods

The measuring methods should conform to the general procedures and precautions given in IEC 62044-1, IEC 62044-2 and IEC 62044-3. The test piece for the magnetic measurements should be a ring-core, preferably one of the sizes R10 to R36 in accordance with IEC TR 61604, and having corresponding A_e values within the range 8 mm^2 to 100 mm^2. Table 2 indicates recommended test conditions.

4 Table of material properties and measuring conditions

The conditions laid down in Table 2 have been chosen as representative of those that are in common use. This means that in the majority of cases the values now published by manufacturers will differ only slightly from the corresponding values at the measuring conditions given in Table 2. It is therefore expected that only small adjustments to existing catalogues will be required.

The following rules are recommended for the use of Table 2 by manufacturers:

a) properties not of importance for the application of the material in question should be omitted;

b) where for one property several measuring conditions are stated with one or more underlined, the conditions underlined shall be used and the rest are optional;

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c) if none of the measuring conditions is underlined, the choice is free and at least one shall be used;

d) values obtained under measuring conditions deviating from those specified in the table may be added to those required according to items b) and c) above.

5 Integrity of value

The following rules shown in Table 1 shall be applied for the property values given in Table 2. It is recommended to describe whether each value in a manufacturer's document is a "typical value" or a "limit value" for better understanding.

Table 1 – Rules for property values given in Table 2

Type of document	Typical value	Limit value
Table of material properties [a]	THD_F, Z_N, P_V	μ_i, B_s, $(\tan\delta)/\mu_i$, η_B, T_c, α_F, D_F
Property graph	All properties	
Table of (shaped) core properties		A_L, THD_F, Z_N, P_V
[a] Any other values in a table of material properties not specified here are to be given as "typical value".		

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Table 2 – Property values and measuring conditions *(1 of 2)*

Property - valid for test ring cores only sizes R10 to R36 (see Clause 3)	Symbol	Unit	Measuring conditions				
			Frequency kHz	Field strength kA/m	Peak flux density mT	Temperature (see Clause 4) °C	Footnotes
Initial permeability	μ_i		≤ 10		< 0,50	25	
Saturation magnetic flux density	B_s	mT	≤ 10	1,2 (μ_i > 1 000) 3 (1 000 ≥ μ_i>500) 10 (500 ≥ μ_i >100) 20 (100 ≥ μ_i)		25; 100 [k]	
Remanent flux density	B_r	mT	≤ 10			25; 100	a
Coercivity	H_c	A/m	≤ 10			25; 100	a
Losses at low flux density	$\tan\delta/\mu_i$				< 0,25	25	b
Hysteresis material constant	η_B	T^{-1}	10 (μ_i ≥ 500)		B_1 B_2 1,5 3,0	25	c
			100 (μ_i < 500)		0,3 1,2		
Curie temperature	T_c	°C	≤ 10		< 0,25		d
Relative temperature factor	α_F	10^{-6}/°C	≤ 10		< 0,25	between 25 and −40, −25, +5, +55, +85	e
(Mass) density	d_b	kg/m³					
Disaccommodation factor	D_F	10^{-6}	≤ 10		< 0,25	25; 40	d
Resistivity[l]	ρ	Ωm	DC			25	f
Total harmonic distortion factor	THD_F	dB	5		50	25	g
Normalized impedance	Z_N	Ω/m			< 0,25	25	d
The following properties are only valid for materials used for power applications							
Power loss (volume) density	P_v	kW/m³	25		200	100; Minimum loss temperature	h
			100		200		
			100		100		
			200		100		
			300		100		
			500		50		
			1 000		50		
			2 000		20		
			5 000		10		
			50		150	25; 100	i

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