



**SLOVENSKI STANDARD**  
**oSIST prEN IEC 63300:2022**  
**01-marec-2022**

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**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

**iTeh STANDARD**  
**PREVIEW**

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

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**ICS:**

29.030	Magnetni materiali	Magnetic materials
29.100.10	Magnetne komponente	Magnetic components

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SECRETARIAT: Japan	SECRETARY: Mr Takeshi Abe
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 68	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
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TITLE:

**Test methods for electrical and magnetic properties of magnetic powder cores**

PROPOSED STABILITY DATE: 2028

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**TEST METHODS FOR ELECTRICAL AND MAGNETIC PROPERTIES OF  
MAGNETIC POWDER CORES**

## FOREWORD

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IEC 63300 has been prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials. It is an international standard.

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,

208 available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by  
209 IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

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

- 213 • reconfirmed,
- 214 • withdrawn,
- 215 • replaced by a revised edition, or
- 216 • amended.

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217

## INTRODUCTION

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

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

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

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237 **TEST METHODS FOR ELECTRICAL AND MAGNETIC PROPERTIES OF**  
 238 **MAGNETIC POWDER CORES**

239 **1 Scope**

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

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

249 **2 Normative references**

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

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

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

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

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

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

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

266 **3 Terms, definitions and symbols**

267 **3.1 Terms and definitions**

268 No terms and definitions are listed in this document.

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

- 271 • IEC Electropedia: available at <http://www.electropedia.org/>
- 272 • ISO Online browsing platform: available at <http://www.iso.org/obp>

273 **3.2 Symbols**

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

276  $f$  the frequency, in Hertz (Hz);

277

278  $T_s$  the cycle, in Second (s) ;

279  $B_m$  the peak value of effective magnetic flux density, in Tesla (T) ;

280  $H_m$  the peak value of effective magnetic field strength, in Ampere per meter (A/m) ;

281  $P_c$  the power loss absorbed by the core, in Watt (W) ;

- 282  $P_w$  the winding loss, in Watt (W) ;  
 283  $P_{cv}$  the power density absorbed by the core, in Watt per cubic meter (W/m<sup>3</sup>) ;  
 284  $A_e$  the effective cross-sectional area of the core, in square meter (m<sup>2</sup>) ;  
 285  $l_e$  the effective magnetic path length of the core, in meter (m) ;  
 286  $V_e$  the effective volume of the core, in cubic meter (m<sup>3</sup>) ;  
 287  $\varphi$  the phase, in Radian (rad) ;  
 288  $\Delta\varphi$  the phase shift absolute error, in Radian (rad) ;  
 289  $N_2$  the number of turns of the voltage sensing winding;  
 290  $\Delta T$  the temperature rise, in degree Celsius (°C) ;  
 291  $N_1$  the number of turns of the exciting winding;  
 292  $\mu_0$  the magnetic constant (the permeability of vacuum), approximately  $4 \times \pi \times 10^{-7}$  H/m;  
 293  $\mu_{ea}$  the effective amplitude permeability;  
 294  $\mu_{e\Delta}$  the effective incremental permeability.

## 295 **4 Instruments and equipment**

### 296 **4.1 General provision**

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

### 298 **4.2 Excitation source**

#### 299 **4.2.1 General provision**

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

#### 313 **4.2.2 Sinusoidal wave excitation source**

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

$$317 \quad B_m = \frac{\sqrt{2} \times U_{rms}}{2 \times \pi \times f \times A_e \times N_1} \quad (1)$$

318 where :

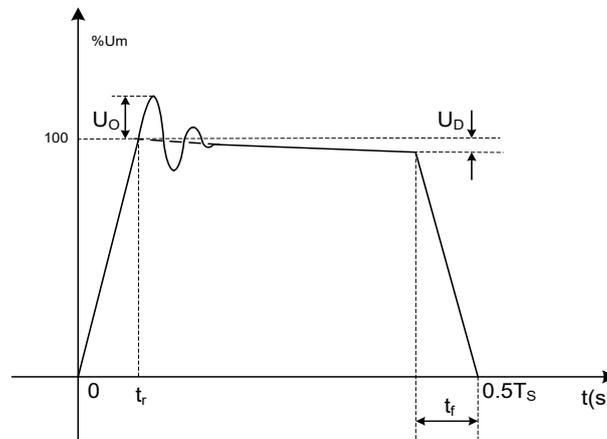
319  $U_{rms}$  is the RMS of excitation voltage, in Volt (V).

#### 320 **4.2.3 Square wave excitation source**

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

327

$$B_m = \frac{U_m}{4 \times f \times A_e \times N_1} \quad (2)$$



328

329 **Key**

330  $U_m$  peak pulse amplitude, the maximum value of an extrapolated smooth curve through the  
 331 top of the pulse, excluding any initial "spike" or "overshoot", the duration of which is less than  
 332 10 % of the pulse duration. in Volt (V). [Source: IEC61007:2020, 3.3]

333  $t_r$  pulse rise time334  $t_f$  pulse fall time335  $U_D$  droop336  $U_o$  overshoot

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Figure 1 – Figure of square waveform

338 **4.2.4 Calculation of magnetic flux density**

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

$$B_m = \frac{U}{4 \times f \times A_e \times N_1} \quad (3)$$

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

345 **4.3 Measuring equipment**346 **4.3.1 General provision**

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

351 **4.3.2 Voltmeter**

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