



**SLOVENSKI STANDARD  
SIST EN IEC 63300:2024**

**01-januar-2024**

---

**Preskusne metode za električne in magnetne lastnosti jeder iz magnetnega prahu**

Test methods for electrical and magnetic properties of magnetic powder cores

Prüfverfahren für elektrische und magnetische Eigenschaften magnetischer Pulverkerne

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

**Ta slovenski standard je istoveten z: EN IEC 63300:2023**

---

**ICS:**

29.030	Magnetni materiali	Magnetic materials
29.100.10	Magnetne komponente	Magnetic components

**SIST EN IEC 63300:2024**

**en**



EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN IEC 63300**

August 2023

ICS 29.030; 29.100.10

English Version

Test methods for electrical and magnetic properties of magnetic  
powder cores  
(IEC 63300:2023)

Méthodes d'essai des propriétés électriques et  
magnétiques des noyaux en poudre magnétique  
(IEC 63300:2023)

Prüfverfahren für elektrische und magnetische  
Eigenschaften magnetischer Pulverkerne  
(IEC 63300:2023)

This European Standard was approved by CENELEC on 2023-08-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

<https://standards.iteh.ai>  
SIST EN IEC 63300:2024

<https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024>



European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

**EN IEC 63300:2023 (E)****European foreword**

The text of document 51/1419/CDV, future edition 1 of IEC 63300, prepared by IEC/TC 51 "Magnetic components, ferrite and magnetic powder materials" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 63300:2023.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2024-05-01
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-08-01

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

**Endorsement notice**

The text of the International Standard IEC 63300:2023 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 61007:2020 NOTE Approved as EN IEC 61007:2020 (not modified)

IEC 62044 (series) NOTE Approved as EN 62044 (series)

IEC 62044-1 NOTE Approved as EN 62044-1

IEC 62044-2 NOTE Approved as EN 62044-2

IEC 62044-3 NOTE Approved as EN 62044-3

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cencenelec.eu](http://www.cencenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 63182-2	-	Magnetic powder cores - Guidelines on dimensions and the limits of surface irregularities - Part 2: Ring-cores	EN IEC 63182-2	-

iTeh Standards  
(<https://standards.iteh.ai>)  
Document Preview

[SIST EN IEC 63300:2024](https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024)

<https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024>





IEC 63300

Edition 1.0 2023-06

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**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 Standards  
(<https://standards.itih.ai>)  
Document Preview

[SIST EN IEC 63300:2024](https://standards.itih.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024)

<https://standards.itih.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024>

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 29.030, 29.100.10

ISBN 978-2-8322-7139-1

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references .....	9
3 Terms, definitions, abbreviated terms and symbols.....	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	9
3.3 Symbols.....	10
4 Instruments and equipment.....	10
4.1 General provisions.....	10
4.2 Excitation source .....	10
4.2.1 General provisions.....	10
4.2.2 Sinusoidal wave excitation source .....	11
4.2.3 Square wave excitation source .....	11
4.2.4 Calculation of magnetic flux density.....	12
4.3 Measuring equipment.....	12
4.3.1 General provisions.....	12
4.3.2 Voltmeter.....	12
4.3.3 Data acquisition unit .....	13
4.4 Sensor.....	13
4.4.1 Sampling resistor.....	13
4.4.2 Current transformer.....	13
4.5 Other descriptions.....	14
4.5.1 Intermediate connector.....	14
4.5.2 Thermostat .....	14
5 Sample.....	14
5.1 Magnetic core.....	14
5.2 Winding .....	14
5.2.1 Winding conditions .....	14
5.2.2 Dual winding.....	15
5.2.3 Single winding.....	15
5.3 Mounting of sample.....	16
5.4 Parameters of sample.....	16
6 Measuring conditions.....	16
6.1 Relation to practice .....	16
6.2 Effective parameters.....	17
6.3 Magnetic state of measurement .....	17
7 Test methods for power loss.....	17
7.1 Summary .....	17
7.2 AC power method .....	18
7.3 DC power method .....	18
7.4 Calorimetric method.....	18
8 Test methods for effective permeability.....	18
8.1 Summary .....	18
8.2 Large signal AC method.....	19
8.3 Impedance method .....	19



8.4	Pulse method.....	19
9	Test method for effective complex permeability .....	19
10	Test method for quality factor ( $Q$ ) .....	20
11	Verification of measurement accuracy .....	20
Annex A	(informative) AC power method.....	21
A.1	Overview.....	21
A.2	Basic circuit diagram.....	21
A.3	Measuring device.....	22
A.3.1	High frequency excitation source .....	22
A.3.2	Exciting winding $N_1$ and voltage sensing winding $N_2$ .....	22
A.3.3	Sensing resistor $R$ .....	22
A.3.4	Data collector .....	22
A.4	Test steps .....	22
A.5	Measuring principle.....	22
A.6	Error analysis.....	23
A.7	Matters to consider .....	24
A.7.1	Measurement error .....	24
A.7.2	Deduction of the winding loss .....	24
A.8	Specific test methods.....	24
A.8.1	B-H analyzer method .....	24
A.8.2	Power analyzer method .....	24
A.8.3	Capacitive reactive compensation method .....	24
A.9	Measurement for quality factor ( $Q$ ).....	26
Annex B	(informative) DC power method.....	27
B.1	Overview.....	27
B.2	Basic circuit diagram.....	27
B.3	Measuring device.....	27
B.3.1	DC voltage source $U_i$ .....	27
B.3.2	DC/AC inverter .....	27
B.3.3	Exciting winding $N_1$ .....	27
B.3.4	DC ammeter and DC voltmeter for measuring the average value .....	28
B.4	Test steps .....	28
B.5	Measuring principle.....	28
B.6	Matters to consider .....	29
B.6.1	Inverter loss.....	29
B.6.2	Deduction of winding loss .....	29
Annex C	(informative) Calorimetric method .....	30
C.1	Overview.....	30
C.2	Basic circuit diagram.....	30
C.3	Measuring device.....	30
C.3.1	Excitation source .....	30
C.3.2	Temperature sensor .....	30
C.3.3	Thermal insulated container.....	30
C.3.4	Thermal medium.....	31
C.3.5	Sample .....	31
C.4	Test steps .....	31
C.5	Measuring principle.....	31
C.6	Matters to consider .....	32

C.7	Specific test methods	32
C.7.1	Calibration calorimetric method	32
C.7.2	Comparative calorimetric method	33
Annex D	(informative) Large signal AC method	35
D.1	Overview	35
D.2	Basic circuit diagram	35
D.3	Measuring device	36
D.3.1	High-frequency excitation source	36
D.3.2	Exciting winding $N_1$ and voltage sensing winding $N_2$	36
D.3.3	Sampling resistor R	36
D.3.4	Data collector	36
D.4	Test steps	36
D.5	Measuring principle	37
D.6	Matters to consider	37
Annex E	(informative) Impedance method	38
E.1	Overview	38
E.2	Basic circuit diagram	38
E.3	Measuring device	38
E.3.1	Impedance analyzer or LCR meter	38
E.3.2	Exciting winding $N_1$	38
E.4	Test steps	39
E.5	Measuring principle	39
E.6	Matters to consider	39
Annex F	(informative) Pulse method	40
F.1	Overview	40
F.2	Basic circuit diagram	40
F.3	Measuring device	40
F.3.1	Sampling resistor R	40
F.3.2	Switch S	40
F.3.3	Exciting winding $N_1$	41
F.3.4	Capacitor C	41
F.4	Test steps	41
F.5	Measuring principle	41
F.6	Matters to consider	42
Annex G	(informative) Method of verification and criteria for judgment	43
Annex H	(informative) Imposing of DC bias on the core	46
H.1	Overview	46
H.2	Matters to consider	48
Annex I	(informative) References	49
I.1	Overview	49
I.2	Effect of rise time of square wave excitation on the core loss	49
I.3	Phase error limit	50
I.4	Derivation of Formula (8)	51
I.5	SRF consideration of the sample	52
Bibliography		54
Figure 1	– Figure of square waveform	12

Figure A.1 – Diagram of AC power method .....	21
Figure A.2 – Circuit diagram of reactive power compensation of capacitor .....	25
Figure A.3 – Phasor diagram of reactive power compensation of capacitor .....	26
Figure B.1 – Diagram of DC meter method.....	27
Figure C.1 – Diagram of the calorimetric method .....	30
Figure C.2 – Diagram of the calibration calorimetric method .....	33
Figure C.3 – Diagram of the comparative calorimetric method.....	34
Figure D.1 – Diagram of large signal AC method.....	35
Figure E.1 – Diagram of impedance method.....	38
Figure F.1 – Diagram of pulse method .....	40
Figure F.2 – Exciting voltage and current waveform on the exciting winding.....	42
Figure G.1 – Diagram of air-core inductor .....	44
Figure H.1 – Diagram of imposition of DC bias.....	47
Figure I.1 – Square wave excitation source.....	50
Figure I.2 – Diagram of the ratio error and phase error .....	50
Figure I.3 – Equivalent circuit model of sample .....	52
Table 1 – Comparisons of measuring methods for power loss .....	17
Table I.1 – Example for $k$ , $\alpha$ , $\beta$ and other parameters .....	50
Table I.2 – Example of core losses error with different $t_r$ .....	50
Table I.3 – Example of core losses measuring error and ratio error for the phase error.....	51
Table I.4 – Example of $\Delta L$ at different frequencies .....	53

## Document Preview

[SIST EN IEC 63300:2024](https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024)

<https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

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:

Draft	Report on voting
51/1419/CDV	51/1436/RVC

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

**IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## iTeh Standards (<https://standards.iteh.ai>) Document Preview

[SIST EN IEC 63300:2024](https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024)

<https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024>

## 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 magnetic powder core is much smaller, and the magnetizing current is very large, so the required excitation source will have 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  $90^\circ$ , and this results in great difficulties to obtain accurate measurements of power loss.

The IEC 62044 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 the IEC 62044 series cannot fully meet the measurement requirements for magnetic properties of magnetic powder cores. It is therefore useful 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 powder cores are introduced in this document, in addition to some modifications for the traditional power test methods. Also, an air core inductor with single winding or dual windings is introduced in the document 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.

**iTeh Standards**  
**(<https://standards.iteh.ai>)**  
**Document Preview**

[SIST EN IEC 63300:2024](https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024)

<https://standards.iteh.ai/catalog/standards/sist/cfdbdb8b-3f99-45aa-a8cc-65667751e8a0/sist-en-iec-63300-2024>