IEC 60404-6

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INTERNATIONAL STANDARD

colour inside

Magnetic materials –
Part 6: Methods of measurement of the magnetic properties of magnetically soft metallic and powder materials at frequencies in the range 20 Hz to ~~200~~ 100 kHz by the use of ring specimens

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60404-6 has been prepared by IEC technical committee 68: Magnetic alloys and steels.

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

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

a) adaption to modern measurement and evaluation methods, in particular the introduction of the widely spread digital sampling method for the acquisition and evaluation of the measured data;
b) limitation of the frequency range up to 100 kHz;
c) deletion of Clause 7 of the second edition that specified the measurement of magnetic properties using a digital impedance bridge;
d) addition of a new Clause 7 on the measurement of the specific total loss by the wattmeter method, including an example of the application of the digital sampling method;
e) addition of an informative annex on the technical details of the digital sampling technique for the determination of magnetic properties.

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

FDIS	Report on voting
68/595/FDIS	68/600/RVD

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

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

A list of all parts in the IEC 60404 series, published under the general title *Magnetic materials*, can be found on the IEC website.

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

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The contents of the corrigendum of November 2018 have been included in this copy.

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

~~INTRODUCTION~~

~~This edition of IEC 60404-6 has been prepared by WG2 in the TC68 maintenance programme of publications. The d.c. measurements in the first edition of this standard are now covered in IEC 60404-4 and Amendment 1 to that standard. This edition of IEC 60404-6 includes measurements on magnetically soft powder materials. Since measurements on these materials at high frequencies employ some of the techniques used to measure magnetic components, there has been active collaboration with IEC TC51. IEC TC51 recently started to publish the new IEC 62044 series which will be composed of four parts. IEC 62044-3 presents methods of measurement of magnetic properties at high excitation levels appropriate to various ferrite core applications, whereas this edition of IEC 60404-6 covers the requirements of material measurements excluding ferrites, so that the two standards do not overlap.~~

MAGNETIC MATERIALS –

Part 6: Methods of measurement of the magnetic properties of magnetically soft metallic and powder materials at frequencies in the range 20 Hz to ~~200~~ 100 kHz by the use of ring specimens

1 Scope

This part of IEC 60404 specifies methods for the measurement of AC magnetic properties of soft magnetic materials, other than electrical steels and soft ferrites, in the frequency range 20 Hz to ~~200~~ 100 kHz. The materials covered by this part of IEC 60404 include those speciality alloys listed in IEC 60404-8-6, amorphous and nano-crystalline soft magnetic materials, pressed and sintered and metal injection moulded parts such as are listed in IEC 60404-8-9, cast parts and magnetically soft composite materials.

The object of this part is to define the general principles and the technical details of the measurement of the magnetic properties of magnetically soft materials by means of ring methods. For materials supplied in powder form, a ring test specimen is formed by the appropriate pressing method for that material.

~~DC magnetic measurements on magnetically soft materials shall be~~ The measurement of the DC magnetic properties of soft magnetic materials is made in accordance with the ring method of IEC 60404-4. The determinations of the magnetic characteristics of magnetically soft components ~~shall be~~ are made in accordance with IEC 62044-3.

NOTE IEC 62044-3:2000 specifies methods for the measurement of AC magnetic characteristics of magnetically soft components in the frequency range up to 10 MHz.

Normally, the measurements ~~shall be~~ are made at an ambient temperature of (23 ± 5) °C on ~~ring~~ test specimens which have first been magnetized, then demagnetized. Measurements can be made over other temperature ranges by agreement between ~~supplier and purchaser~~ parties concerned.

2 Normative references

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.

IEC 60050-121, *International Electrotechnical Vocabulary – Part 121: Electromagnetism*

IEC 60050-221, *International Electrotechnical Vocabulary – Chapter 221: Magnetic materials and components*

IEC 60404-2~~:1996~~, *Magnetic materials – Part 2: Methods of measurement of the magnetic properties of electrical steel sheet and strip by means of an Epstein frame*

IEC 60404-4~~:1995~~, *Magnetic materials – Part 4: Methods of measurement of d.c. magnetic properties of iron and steel*
~~Amendment 1:2000~~

IEC 60404-8-6~~:1999~~, *Magnetic materials – Part 8-6: Specifications for individual materials – Soft magnetic metallic materials*

IEC 60404-8-9~~:1994~~, *Magnetic materials – Part 8: Specifications for individual materials – Section 9: Standard specification for sintered soft magnetic materials*

IEC 62044-3~~:2000~~, *Cores made of soft magnetic materials – Measuring methods – Part 3: Magnetic properties at high excitation level~~s~~*

ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement~~, 1993~~ (GUM:1995)*

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Matériaux magnétiques –
Partie 6: Méthodes de mesure des propriétés magnétiques des matériaux métalliques et des matériaux en poudre magnétiquement doux, aux fréquences comprises entre 20 Hz et 100 kHz, sur des éprouvettes en forme de tore

IEC 60404-6:2018-05(en-fr)

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IEC 60404-8-9, *Magnetic materials – Part 8: Specifications for individual materials – Section 9: Standard specification for sintered soft magnetic materials*

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MATÉRIAUX MAGNÉTIQUES –

Partie 6: Méthodes de mesure des propriétés magnétiques des matériaux métalliques et des matériaux en poudre magnétiquement doux, aux fréquences comprises entre 20 Hz et 100 kHz, sur des éprouvettes en forme de tore

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La Norme internationale IEC 60404-6 a été établie par le comité d'études 68 de l'IEC: Matériaux magnétiques tels qu'alliages et aciers.

Cette troisième édition annule et remplace la deuxième édition parue en 2003. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) adaptation aux méthodes modernes de mesure et d'évaluation, notamment l'introduction de la méthode d'échantillonnage numérique largement répandue pour l'acquisition et l'évaluation des données mesurées;

b) limitation de la gamme de fréquences à 100 kHz;

c) suppression de l'Article 7 de la deuxième édition qui spécifiait la mesure des propriétés magnétiques à l'aide d'un pont d'impédance numérique;

d) ajout d'un nouvel Article 7 sur la mesure des pertes totales massiques par la méthode du wattmètre, y compris un exemple d'application de la méthode d'échantillonnage numérique;

e) ajout d'une annexe informative concernant les détails de la technique d'échantillonnage numérique pour déterminer les propriétés magnétiques du matériau.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
68/595/FDIS	68/600/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de la présente Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60404, publiées sous le titre général *Matériaux magnétiques*, peut être consultée sur le site web de l'IEC.

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MATÉRIAUX MAGNÉTIQUES –

Partie 6: Méthodes de mesure des propriétés magnétiques des matériaux métalliques et des matériaux en poudre magnétiquement doux, aux fréquences comprises entre 20 Hz et 100 kHz, sur des éprouvettes en forme de tore

1 Domaine d'application

La présente partie de l'IEC 60404 spécifie les méthodes à utiliser pour mesurer les propriétés magnétiques en courant alternatif des matériaux magnétiques doux autres que les aciers électriques et les ferrites doux, aux fréquences comprises entre 20 Hz et 100 kHz. Les matériaux couverts par la présente partie de l'IEC 60404 incluent les alliages de spécialité répertoriés dans l'IEC 60404-8-6, les matériaux magnétiques doux amorphes et nanocristallins, les pièces compressées frittées et les pièces moulées par injection de métal répertoriées dans l'IEC 60404-8-9, ainsi que les pièces moulées et les matériaux composites magnétiquement doux.

L'objet de la présente partie est de définir les principes généraux et les détails techniques de la mesure des propriétés magnétiques des matériaux magnétiquement doux au moyen des méthodes du tore. Pour les matériaux livrés sous forme de poudre, une éprouvette d'essai en forme d'anneau est réalisée à l'aide de la méthode de compression appropriée pour le matériau considéré.

La mesure des propriétés magnétiques en courant continu des matériaux magnétiquement doux est réalisée selon la méthode du tore de l'IEC 60404-4. Les déterminations des propriétés magnétiques des composants magnétiquement doux sont réalisées selon l'IEC 62044-3.

NOTE L'IEC 62044-3:2000 spécifie les méthodes à utiliser pour mesurer les propriétés magnétiques en courant alternatif des composants magnétiquement doux, aux fréquences allant jusqu'à 10 MHz.

Normalement, les mesures sont réalisées à une température ambiante de (23 ± 5) °C sur des éprouvettes d'essai qui ont été dans un premier temps aimantées, puis désaimantées. Des mesures peuvent être réalisées pour d'autres plages de températures, sous réserve d'un accord entre les parties concernées.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-121, *Vocabulaire Electrotechnique International – Partie 121: Electromagnétisme*

IEC 60050-221, *Vocabulaire Electrotechnique International – Chapitre 221: Matériaux et composants magnétiques*

IEC 60404-2, *Matériaux magnétiques – Partie 2: Méthodes de mesure des propriétés magnétiques des tôles et bandes magnétiques en acier au moyen d'un cadre Epstein*

IEC 60404-4, *Matériaux magnétiques – Partie 4: Méthodes de mesure en courant continu des propriétés magnétiques du fer et de l'acier*

IEC 60404-8-6, *Matériaux magnétiques – Partie 8-6: Spécifications pour matériaux particuliers — Matériaux métalliques magnétiquement doux*

IEC 60404-8-9, *Matériaux magnétiques – Partie 8: Spécifications pour matériaux particuliers – Section 9: Spécification des matériaux magnétiques doux frittés*

IEC 62044-3:2000, *Noyaux en matériaux magnétiques doux – Méthodes de mesure – Partie 3: Propriétés magnétiques à niveau élevé d'excitation*

ISO/IEC Guide 98-3, *Incertitude de mesure – Partie 3: Guide pour l'expression de l'incertitude de mesure (GUM:1995)*