IEC 60404-5

Edition 3.0 2015-04

REDLINE VERSION

colour inside

Magnetic materials –
Part 5: Permanent magnet (magnetically hard) materials – Methods of measurement of magnetic properties

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 17.220.20; 29.030

ISBN 978-2-8322-2643-8

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 3
INTRODUCTION 5
~~1 General~~ .....
1 Scope 6
2 Normative references 6
3 Terms and definitions 6
4 Electromagnet and conditions for magnetization 6
4.1 General 6
4.2 Geometrical conditions 8
4.3 Electromagnetic conditions 9
5 Test specimen 9
6 Determination of the magnetic flux density 10
7 Determination of the magnetic polarization 11
8 Measurement of the magnetic field strength 11
9 Determination of the demagnetization curve 12
9.1 General 12
9.2 Principle of determination of the demagnetization curve, test specimen magnetized in the electromagnet 12
9.3 Principle of determination of the demagnetization curve, test specimen magnetized in a superconducting coil or pulse magnetizer 13
10 Determination of the principal characteristics 14
10.1 ~~Magnetic remanence~~ Remanent flux density 14
10.2 $(BH)_{max}$ product 14
10.3 Coercivities H_{cB} and H_{cJ} 14
10.4 Determination of the recoil line and the recoil permeability 14
11 Reproducibility 15
12 Test report 15
Annex A (normative) Influence of the air-gap between the test specimen and the pole pieces 17
Annex B (informative) Influence of the ambient temperature on measurement results 18
Bibliography 19

Figure 1 – Demagnetization curve showing $(BH)_{max}$ point 7
Figure 2 – Schematic diagram of electromagnet 8
Figure 3 – Measuring circuit (schematic) 13
Figure 4 – Demagnetization curve and recoil loop 15
Figure A.1 – Air-gap 17

Table 1 – Reproducibility of the measurement of the magnetic characteristics of permanent magnet materials 15
Table A.1 – d/l ratios 17
Table B.1 – Temperature coefficients of B_r and H_{cJ} of permanent magnet materials 18

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MAGNETIC MATERIALS –

Part 5: Permanent magnet (magnetically hard) materials – Methods of measurement of magnetic properties

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

DISCLAIMER
This Redline version is not an official IEC Standard and is intended only to provide the user with an indication of what changes have been made to the previous version. Only the current version of the standard is to be considered the official document.

This Redline version provides you with a quick and easy way to compare all the changes between this standard and its previous edition. A vertical bar appears in the margin wherever a change has been made. Additions and deletions are displayed in red, with deletions being struck through.

International Standard IEC 60404-5 has been prepared by IEC technical committee 68: Magnetic alloys and steels.

This third edition cancels and replaces the second edition published in 1993 and Amendment 1:2007. This edition constitutes a technical revision.

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

- adaption of the measurement methods and test conditions to newly introduced magnetically hard materials with coercivity values H_{cJ} higher than 2 MA/m;
- update of the temperature conditions to allow the measurement of new materials with high temperature coefficients.

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

FDIS	Report on voting
68/497/FDIS	68/505/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 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

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

The previous edition of IEC 60404-5 was issued in October 1993 and amended in 2007. Since then, new applications of NdFeB sintered magnetic materials with intrinsic coercivity, H_{cJ}, higher than 2 MA/m for hybrid electric vehicles and fully electric vehicles have appeared. Thus, IEC TC68 decided in 2011 at their meeting in Ghent to revise IEC 60404-5.

For the measurement of the coercivity relating to polarization, H_{cJ}, at values higher than 2 MA/m and the measurement of magnetic properties at elevated temperatures, the methods described in the non-normative Technical Reports IEC TR 61807 and IEC TR 62331 can be considered.

The ambient temperature previously recommended was (23 ± 5) °C. However, for permanent magnet materials such as NdFeB and hard ferrites that have large temperature coefficients, it is strongly recommended that the ambient temperature should be controlled within this range to ± 1 °C or better. It is desirable to apply this temperature recommendation for other hard magnet materials. This recommendation was already included in IEC 60404-5:1993/AMD1:2007.

MAGNETIC MATERIALS –

Part 5: Permanent magnet (magnetically hard) materials – Methods of measurement of magnetic properties

~~1 General~~

1 Scope

The purpose of this part of IEC 60404 is to define the method of measurement of the magnetic flux density, magnetic polarization and the magnetic field strength and also to determine the demagnetization curve and recoil line of permanent magnet materials, such as those specified in IEC 60404-8-1 [1][1], the properties of which are presumed homogeneous throughout their volume.

The performance of a magnetic system is not only dependent on the properties of the permanent magnet material but also on the dimensions of the system, the air-gap and other elements of the magnetic circuit. The methods described in this part of IEC 60404 refer to the measurement of the magnetic properties in a closed magnetic circuit ~~simulating a ring~~.

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 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org)

[1] Numbers in square brackets refer to the Bibliography.

IEC 60404-5

Edition 3.0 2015-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Magnetic materials –
Part 5: Permanent magnet (magnetically hard) materials – Methods of measurement of magnetic properties

Matériaux magnétiques –
Partie 5: Aimants permanents (magnétiques durs) – Méthodes de mesure des propriétés magnétiques



IEC 60404-5:2015-04(en-fr)

CONTENTS

FOREWORD 3
INTRODUCTION 5
1 Scope 6
2 Normative references 6
3 Terms and definitions 6
4 Electromagnet and conditions for magnetization 6
4.1 General 6
4.2 Geometrical conditions 8
4.3 Electromagnetic conditions 8
5 Test specimen 9
6 Determination of the magnetic flux density 10
7 Determination of the magnetic polarization 10
8 Measurement of the magnetic field strength 11
9 Determination of the demagnetization curve 12
9.1 General 12
9.2 Principle of determination of the demagnetization curve, test specimen magnetized in the electromagnet 12
9.3 Principle of determination of the demagnetization curve, test specimen magnetized in a superconducting coil or pulse magnetizer 13
10 Determination of the principal characteristics 14
10.1 Remanent flux density 14
10.2 $(BH)_{\mathrm{max}}$ product 14
10.3 Coercivities H_{cB} and H_{cJ} 14
10.4 Determination of the recoil line and the recoil permeability 14
11 Reproducibility 15
12 Test report 15
Annex A (normative) Influence of the air-gap between the test specimen and the pole pieces 17
Annex B (informative) Influence of the ambient temperature on measurement results 18
Bibliography 19

Figure 1 – Demagnetization curve showing $(BH)_{\mathrm{max}}$ point 7
Figure 2 – Schematic diagram of electromagnet 8
Figure 3 – Measuring circuit (schematic) 13
Figure 4 – Demagnetization curve and recoil loop 15
Figure A.1 – Air-gap 17

Table 1 – Reproducibility of the measurement of the magnetic characteristics of permanent magnet materials 15
Table A.1 – d/l ratios 17
Table B.1 – Temperature coefficients of B_{r} and H_{cJ} of permanent magnet materials 18

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MAGNETIC MATERIALS –

Part 5: Permanent magnet (magnetically hard) materials – Methods of measurement of magnetic properties

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

International Standard IEC 60404-5 has been prepared by IEC technical committee 68: Magnetic alloys and steels.

This third edition cancels and replaces the second edition published in 1993 and Amendment 1:2007. This edition constitutes a technical revision.

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

- adaption of the measurement methods and test conditions to newly introduced magnetically hard materials with coercivity values H_{cJ} higher than 2 MA/m;
- update of the temperature conditions to allow the measurement of new materials with high temperature coefficients.

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

FDIS	Report on voting
68/497/FDIS	68/505/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 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

INTRODUCTION

The previous edition of IEC 60404-5 was issued in October 1993 and amended in 2007. Since then, new applications of NdFeB sintered magnetic materials with intrinsic coercivity, H_{cJ}, higher than 2 MA/m for hybrid electric vehicles and fully electric vehicles have appeared. Thus, IEC TC68 decided in 2011 at their meeting in Ghent to revise IEC 60404-5.

For the measurement of the coercivity relating to polarization, H_{cJ}, at values higher than 2 MA/m and the measurement of magnetic properties at elevated temperatures, the methods described in the non-normative Technical Reports IEC TR 61807 and IEC TR 62331 can be considered.

The ambient temperature previously recommended was (23 ± 5) °C. However, for permanent magnet materials such as NdFeB and hard ferrites that have large temperature coefficients, it is strongly recommended that the ambient temperature should be controlled within this range to ± 1 °C or better. It is desirable to apply this temperature recommendation for other hard magnet materials. This recommendation was already included in IEC 60404-5:1993/AMD1:2007.

MAGNETIC MATERIALS –

Part 5: Permanent magnet (magnetically hard) materials – Methods of measurement of magnetic properties

1 Scope

The purpose of this part of IEC 60404 is to define the method of measurement of the magnetic flux density, magnetic polarization and the magnetic field strength and also to determine the demagnetization curve and recoil line of permanent magnet materials, such as those specified in IEC 60404-8-1 [1][1], the properties of which are presumed homogeneous throughout their volume.

The performance of a magnetic system is not only dependent on the properties of the permanent magnet material but also on the dimensions of the system, the air-gap and other elements of the magnetic circuit. The methods described in this part of IEC 60404 refer to the measurement of the magnetic properties in a closed magnetic circuit.

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 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org)

1 Numbers in square brackets refer to the Bibliography.

SOMMAIRE

AVANT-PROPOS 21
INTRODUCTION 23
1 Domaine d'application 24
2 Références normatives 24
3 Termes et définitions 24
4 Electroaimant et conditions d'aimantation 24
4.1 Généralités 24
4.2 Conditions géométriques 26
4.3 Conditions électromagnétiques 26
5 Spécimen soumis aux essais 27
6 Détermination de l'induction magnétique 28
7 Détermination de la polarisation magnétique 29
8 Mesure de l'intensité du champ magnétique 29
9 Détermination de la courbe de désaimantation 30
9.1 Généralités 30
9.2 Principe de détermination de la courbe de désaimantation, avec un spécimen soumis aux essais aimanté dans l'électroaimant 30
9.3 Principe de détermination de la courbe de désaimantation, avec un spécimen soumis aux essais aimanté dans une bobine supraconductrice ou un banc d'aimantation à impulsion 31
10 Détermination des caractéristiques principales 32
10.1 Induction rémanente 32
10.2 Produit $(BH)_{max}$ 32
10.3 Champs coercitifs H_{cB} et H_{cJ} 32
10.4 Détermination de la droite de recul et de la perméabilité de recul 32
11 Reproductibilité 33
12 Rapport d'essai 34
Annexe A (normative) Influence de l'entrefer entre le spécimen soumis aux essais et les pièces polaires 35
Annexe B (informative) Influence de la température ambiante sur les résultats de mesure 36
Bibliographie 37

Figure 1 – Courbe de désaimantation montrant le point $(BH)_{max}$ 25
Figure 2 – Schéma de principe de l'électroaimant 26
Figure 3 – Circuit de mesure (schéma) 31
Figure 4 – Courbe de désaimantation et boucle de recul 33
Figure A.1 – Entrefer 35

Tableau 1 – Reproductibilité des mesures des caractéristiques magnétiques des matériaux pour aimants permanents 33
Tableau A.1 – Rapports d/l 35
Tableau B.1 – Coefficients de température de B_r et H_{cJ} de matériaux pour aimants permanents 36

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

_____

MATÉRIAUX MAGNÉTIQUES –

Partie 5: Aimants permanents (magnétiques durs) – Méthodes de mesure des propriétés magnétiques

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 60404-5 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 1993 et l'Amendement 1:2007. Cette édition constitue une révision technique.

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

- adaptation des méthodes de mesure et des conditions d'essai aux matériaux magnétiquement durs récemment introduits possédant un champ coercitif H_{cJ} supérieur à 2 MA/m;

- mise à jour des conditions de température, afin de permettre la mesure de nouveaux matériaux avec des coefficients de température élevés.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
68/497/FDIS	68/505/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée 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.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

INTRODUCTION

L'édition précédente de l'IEC 60404-5 a été publiée en octobre 1993 et modifiée en 2007. Depuis, de nouvelles applications des matériaux magnétiques au NdFeB fritté présentant un champ coercitif intrinsèque, H_{cJ}, supérieur à 2 MA/m destinés aux véhicules électriques hybrides et aux véhicules entièrement électriques sont apparues. Ainsi, lors de la réunion de Gand en 2011, le CE 68 de l'IEC a décidé de réviser l'IEC 60404-5.

Pour la mesure du champ coercitif se rapportant à la polarisation, H_{cJ}, de valeur supérieure à 2 MA/m et pour la mesure des propriétés magnétiques à des températures élevées, on peut utiliser les méthodes décrites dans les rapports techniques non normatifs IEC TR 61807 et IEC TR 62331.

Auparavant, la température ambiante recommandée était (23 ± 5) °C. Toutefois, pour les matériaux pour aimants permanents tels que le NdFeB et les ferrites dures de coefficients de température élevés, il est fortement recommandé que la température ambiante soit contrôlée dans les limites de cette plage avec une précision de ± 1 °C ou plus. Il est souhaitable d'appliquer cette recommandation de température pour d'autres matériaux pour aimants durs. Cette recommandation figurait déjà dans l'IEC 60404-5:1993/AMD1:2007.

MATÉRIAUX MAGNÉTIQUES –

Partie 5: Aimants permanents (magnétiques durs) – Méthodes de mesure des propriétés magnétiques

1 Domaine d'application

La présente partie de l'IEC 60404 a pour objectif de définir la méthode de mesure de l'induction magnétique, de la polarisation magnétique et l'intensité du champ magnétique, mais aussi de déterminer la courbe de désaimantation et la droite de recul des matériaux pour aimants permanents, comme ceux qui sont spécifiés dans l'IEC 60404-8-1 [1][1], dont les propriétés sont supposées homogènes dans tout leur volume.

Les performances d'un système magnétique ne dépendent pas seulement des propriétés du matériau pour aimant permanent, mais aussi des dimensions du système, de l'entrefer et des autres éléments du circuit magnétique. Les méthodes décrites dans la présente partie de l'IEC 60404 se rapportent aux mesures des propriétés magnétiques en circuit magnétique fermé.

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. 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 (toutes les parties), *Vocabulaire Électrotechnique International* (disponible sous: www.electropedia.org)

---

1 Les chiffres entre crochets se réfèrent à la Bibliographie.