



NSAI
Standards

Irish Standard
I.S. EN 60404-8-1:2015

Magnetic materials - Part 8-1: Specifications for individual materials - Magnetically hard materials

I.S. EN 60404-8-1:2015

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:

EN 60404-8-1:2015

Published:

2015-05-29

*This document was published
under the authority of the NSAI
and comes into effect on:*

2015-06-16

ICS number:

NOTE: If blank see CEN/CENELEC cover page

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

EUROPEAN STANDARD

EN 60404-8-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2015

ICS 29.030; 17.220.20

English Version

**Magnetic materials - Part 8-1: Specifications for individual
materials - Magnetically hard materials
(IEC 60404-8-1:2015)**

Matériaux magnétiques - Partie 8-1: Spécifications pour
matériaux particuliers - Matériaux magnétiquement durs
(IEC 60404-8-1:2015)

Magnetische Werkstoffe - Teil 8-1: Anforderungen an
einzelne Werkstoffe - Hartmagnetische Werkstoffe
(Dauermagnete)
(IEC 60404-8-1:2015)

This European Standard was approved by CENELEC on 2015-05-01. 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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 68/495/FDIS, future edition 3 of IEC 60404-8-1, prepared by IEC/TC 68 "Magnetic alloys and steels" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60404-8-1:2015.

The following dates are fixed:

- latest date by which the document has to be implemented at (dop) 2016-02-01
national level by publication of an identical national
standard or by endorsement
- latest date by which the national standards conflicting with (dow) 2018-05-01
the document have to be withdrawn

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

Endorsement notice

The text of the International Standard IEC 60404-8-1:2015 was approved by CENELEC as a European Standard without any modification.

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When 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.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050	series	International electrotechnical vocabulary	-	-
IEC 60404-5	-	Magnetic materials - Part 5: Permanent magnet (magnetically hard) materials - Methods of measurement of magnetic properties	-	-

This page is intentionally left blank



IEC 60404-8-1

Edition 3.0 2015-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Magnetic materials –

Part 8-1: Specifications for individual materials – Magnetically hard materials

Matériaux magnétiques –

**Partie 8-1: Spécifications pour matériaux particuliers – Matériaux
magnétiquement durs**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2015 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 60 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.



IEC 60404-8-1

Edition 3.0 2015-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Magnetic materials –

Part 8-1: Specifications for individual materials – Magnetically hard materials

Matériaux magnétiques –

Partie 8-1: Spécifications pour matériaux particuliers – Matériaux magnétiquement durs

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.220.20; 29.030

ISBN 978-2-8322-2429-8

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

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	7
4 Types of materials and their applications.....	7
5 Classification.....	8
5.1 General.....	8
5.2 Principal magnetic properties	8
5.3 Additional magnetic properties.....	9
6 Chemical composition.....	10
7 Densities	10
8 Designation	10
9 Mode of shipment and dimensions	10
10 Testing.....	10
10.1 Extent of testing.....	10
10.2 Testing methods	10
11 Grounds for rejection	11
12 Description of tables of standard properties.....	11
12.1 Magnetically hard alloys.....	11
12.1.1 Aluminium-nickel-cobalt-iron-titanium alloys (AlNiCo)	11
12.1.2 Chromium-iron-cobalt alloys (CrFeCo).....	12
12.1.3 Iron-cobalt-vanadium-chromium alloys (FeCoVCr).....	12
12.1.4 Rare earth-cobalt alloys (RECo).....	13
12.1.5 Rare earth-iron-boron alloys (REFeB).....	14
12.2 Magnetically hard ceramics (magnetically hard ferrites)	14
12.2.1 Chemical composition	14
12.2.2 Manufacturing method	15
12.2.3 Sub-classification	15
12.2.4 Magnetic properties and densities.....	15
12.2.5 Dimensional tolerances	15
12.3 Bonded magnets.....	15
12.3.1 General	15
12.3.2 Chemical composition	15
12.3.3 Manufacturing method.....	16
12.3.4 Sub-classification	16
12.3.5 Magnetic properties and densities	17
12.3.6 Dimensional tolerances	17
13 Irreversible demagnetization behaviour	17
13.1 General.....	17
13.2 General definition of demagnetization field strength H_D	18
13.3 Simplified definition of demagnetization field strength H_D	18
14 Tables 10 to 23.....	20
Annex A (informative) Physical data and mechanical reference values of AlNiCo, CrFeCo, FeCoVCr, SmCo, NdFeB, hard ferrite and bonded SmFeN magnets	34

Bibliography	36
Figure 1 – Graphic representation of $B(H)$ and $J(H)$ demagnetization and recoil curves	19
Figure 2 – Simplified evaluation of $B(H)$ and $J(H)$ demagnetization and recoil curves	20
Table 1 – Classification of magnetically hard materials	8
Table 2 – Magnetic properties — Symbols and units	9
Table 3 – Additional magnetic properties — Symbols and units	9
Table 4 – Chemical compositions of AlNiCo alloys (% mass fraction)	11
Table 5 – Chemical compositions of CrFeCo alloys (% mass fraction)	12
Table 6 – Chemical compositions of FeCoVCr alloys (% mass fraction)	12
Table 7 – Chemical compositions of RECo alloys (% mass fraction)	13
Table 8 – Chemical compositions of REFeB alloys (% mass fraction)	14
Table 9 – Chemical compositions of REFeN alloys for bonded magnet (% mass fraction)	16
Table 10 – Magnetic properties and densities of AlNiCo magnets	21
Table 11 – Magnetic properties and densities of CrFeCo and FeCoVCr magnets	22
Table 12 – Magnetic properties and densities of RECo magnets	23
Table 13 – Magnetic properties and densities of REFeB magnets	24
Table 14 – Magnetic properties and densities of hard ferrites	25
Table 15 – Magnetic properties and densities of isotropic AlNiCo alloys with organic binder	26
Table 16 – Magnetic properties and densities of RECo alloys with organic binder	27
Table 17 – Magnetic properties and densities of isotropic REFeB alloys with organic binder	28
Table 18 – Magnetic properties and densities of isotropic and anisotropic hard ferrites with organic binder	29
Table 19 – Magnetic properties and densities of anisotropic REFeN alloys with organic binder	30
Table 20 – Dimensional tolerances (as cast or as sintered) of magnets made from AlNiCo alloys	31
Table 21 – Dimensional tolerances of cold rolled strips of FeCoVCr and CrFeCo alloys with a maximum thickness of 6 mm and maximum width of 125 mm	32
Table 22 – Dimensional tolerances of the diameter of cold drawn wires and bars of FeCoVCr and CrFeCo alloys	32
Table 23 – Dimensional tolerances on magnets made from hard ferrites	33
Table A.1 – Physical data and mechanical reference values of AlNiCo, CrFeCo, FeCoVCr, SmCo, NdFeB, hard ferrite and bonded SmFeN magnets	35

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MAGNETIC MATERIALS –

Part 8-1: Specifications for individual materials – Magnetically hard materials

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 60404-8-1 has been prepared by IEC technical committee 68: Magnetic alloys and steels.

This third edition cancels and replaces the second edition published in 2001 and Amendment 1:2004. This edition constitutes a technical revision.

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

- a) recently developed anisotropic Sm-Fe-N bonded magnets are included;
- b) high energy ferrites with La and Co as substituents are included.

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

FDIS	Report on voting
68/495/FDIS	68/503/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

This third edition of IEC 60404-8-1 includes the recently developed anisotropic Sm-Fe-N bonded magnets and high energy ferrites with La and Co as substituents which have become established in permanent magnet applications. It also includes corrections to the second edition in order to improve consistency with IEC 60404-5. The squareness of the demagnetization curve is introduced through the quantity H_D .

MAGNETIC MATERIALS –

Part 8-1: Specifications for individual materials – Magnetically hard materials

1 Scope

This part of IEC 60404 specifies minimum values for the principal magnetic properties of, and dimensional tolerances for, technically important magnetically hard materials (permanent magnets).

For information purposes only, this part of IEC 60404 provides values for the densities of the materials and the ranges of their chemical compositions.

NOTE Some additional physical data and mechanical reference values concerning the magnetic materials are given in Table A.1 for information and comparison purposes.

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: www.electropedia.org)

IEC 60404-5, *Magnetic materials – Part 5: Permanent magnet (magnetically hard) materials – Methods of measurement of magnetic properties*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-121 [1], IEC 60050-151 [2] and IEC 60050-221 [3] apply.¹

4 Types of materials and their applications

Permanent magnetic materials, also designated as magnetically hard materials, are classified in IEC 60404-1 [4] as Class R (magnetically hard alloys), Class S (magnetically hard ceramics) and Class U (bonded magnets).

Permanent magnets have a coercivity relating to the magnetic polarization greater than 1 kA/m. After being magnetized to saturation they produce a material-dependent specific magnetic energy, which can be used in static or dynamic magnetic circuit applications.

Permanent magnetic materials are used in nearly every area of daily life. They perform coupling, modulating, or regulating functions in equipment and devices based on electromagnetic principles, for example in measuring instruments, motors, generators and

¹ Numbers in square brackets refer to the Bibliography.

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- Looking for additional Standards? Visit Intertek Inform Infostore
 - Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation
-