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**Magnetic materials –
Part 3: Methods of measurement of the magnetic properties of electrical steel
strip and sheet by means of a single sheet tester**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MAGNETIC MATERIALS –

Part 3: Methods of measurement of the magnetic properties of electrical steel strip and sheet by means of a single sheet tester

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 IEC 60404-3:1992+AMD1:2002+AMD2:2009 CSV. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60404-3 has been prepared by IEC technical committee 68: Magnetic alloys and steels. It is an International Standard.

This third edition cancels and replaces the second edition published in 1992, Amendment 1:2002 and Amendment 2:2009. This edition constitutes a technical revision.

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

- a) Annex A was revised. The method of determining the yokes' lamination resistance was added to Annex A;
- b) Annex B of the consolidated version of 2010 referred to calibration of the SST using the Epstein method. It was cancelled;
- c) Annex B (new), Annex C and Annex D were revised, they are for information only;
- d) Annex C was modified taking account of the new situation regarding P and R grades;
- e) Annex D was amended by addition of Clause D.4 on the numerical air flux compensation.

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

Draft	Report on voting
68/699/CDV	68/710/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. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

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MAGNETIC MATERIALS –

Part 3: Methods of measurement of the magnetic properties of electrical steel strip and sheet by means of a single sheet tester

1 ~~Object and field of application~~ Scope

This part of IEC 60404 is applicable to grain-oriented and non-oriented electrical steel strip and sheet for measurement of AC magnetic properties at power frequencies.

The object of this document is to define the general principles and the technical details of the measurement of the magnetic properties of ~~magnetic sheets~~ electrical steel strip and sheet by means of a single sheet tester (SST).

~~This part of IEC 60404 is applicable at power frequencies to:~~

~~a) grain-oriented magnetic sheet and strip:~~

~~for the measurement between 1,0 T and 1,8 T of:~~

~~— specific total loss;~~

~~— specific apparent power;~~

~~— r.m.s. value of the magnetic field strength;~~

~~for the measurement up to peak values of magnetic field strength of 1 000 A/m of:~~

~~— peak value of the magnetic polarization;~~

~~— peak value of the magnetic field strength.~~

~~b) non-oriented magnetic sheet and strip:~~

~~for the measurement between 0,8 T and 1,5 T of:~~

~~— specific total loss;~~

~~— specific apparent power;~~

~~— r.m.s. value of excitation current;~~

~~for the measurement up to peak values of magnetic field strength of 10 000 A/m of:~~

~~— peak value of the magnetic polarization;~~

~~— peak value of the magnetic field strength.~~

The single sheet tester is applicable to test specimens obtained from ~~magnetic sheets and strips of any quality~~ electrical steel strips and sheets of any grade. The AC magnetic characteristics are determined for sinusoidal induced voltages, for specified peak values of the magnetic polarization, for specific peak values of the magnetic field strength and for a specified frequency.

The measurements are made at an ambient temperature of $(23\pm 5)^\circ\text{C}$ on test specimens which have first been demagnetized.

NOTE Throughout this document, the quantity "magnetic polarization" is used as defined in ~~IEC 60050(901)~~ IEC 60050-221. In some standards of the IEC 60404 series, the quantity "magnetic flux density" was used.

In order to support the long-term reliability of the performance of this set up and to understand better the relationship between the Epstein method and the SST method, the informative Annexes B and C, respectively, have been included.

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 – Part 221: Magnetic materials and components*

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

IEC 60404-13, *Magnetic materials – Part 13: Methods of measurement of resistivity, density and stacking factor of electrical steel strip and sheet*

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Magnetic materials –

Part 3: Methods of measurement of the magnetic properties of electrical steel strip and sheet by means of a single sheet tester

Matériaux magnétiques –

Partie 3: Méthodes de mesure des caractéristiques magnétiques des bandes et tôles magnétiques en acier à l'aide de l'essai sur tôle unique

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IEC 60404-13, *Magnetic materials – Part 13: Methods of measurement of resistivity, density and stacking factor of electrical steel strip and sheet*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

MATÉRIAUX MAGNÉTIQUES –

Partie 3: Méthodes de mesure des caractéristiques magnétiques des bandes et tôles magnétiques en acier à l'aide de l'essai sur tôle unique

AVANT-PROPOS

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L'IEC 60404-3 a été établie par le comité d'études 68 de l'IEC: Matériaux magnétiques tels qu'alliages et aciers. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la première édition parue en 1992, l'Amendement 1:2002 et l'Amendement 2:2009. Cette édition constitue une révision technique.

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

- a) l'Annexe A a été révisée. La méthode de détermination de la résistance des bandes des culasses a été ajoutée à l'Annexe A;
- b) l'Annexe B de l'édition consolidée de 2010 faisait référence à l'étalonnage du SST à l'aide de la méthode Epstein. Elle a été annulée;

- c) l'Annexe B (nouvelle), l'Annexe C et l'Annexe D ont été révisées et sont seulement informatives;
- d) l'Annexe C a été modifiée compte tenu de la nouvelle situation concernant les qualités P et R;
- e) l'Annexe D a été amendée par ajout de l'Article D.4 relatif à la compensation numérique du flux d'air.

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

Projet	Rapport de vote
68/699/CDV	68/710/RVC

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

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

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

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- reconduit,
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MATÉRIAUX MAGNÉTIQUES –

Partie 3: Méthodes de mesure des caractéristiques magnétiques des bandes et tôles magnétiques en acier à l'aide de l'essai sur tôle unique

1 Domaine d'application

La présente partie de l'IEC 60404 s'applique aux bandes et tôles magnétiques en acier à grains orientés et à grains non orientés pour le mesurage des caractéristiques magnétiques en courant alternatif aux fréquences industrielles.

Le présent document a pour objet de définir les principes généraux et les détails techniques pour le mesurage des caractéristiques magnétiques des bandes et tôles magnétiques en acier à l'aide de l'essai sur tôle unique (SST, *Single Sheet Tester*).

L'essai sur tôle unique s'applique aux éprouvettes prélevées à partir de bandes et de tôles magnétiques en acier de toute qualité. Les caractéristiques magnétiques en courant alternatif sont déterminées pour des tensions induites sinusoïdales, pour les valeurs de crête spécifiées de la polarisation magnétique, pour les valeurs de crête spécifiques de l'intensité du champ magnétique et pour une fréquence spécifiée.

Les mesurages sont effectués à la température ambiante de (23 ± 5) °C sur des éprouvettes qui ont été au préalable désaimantées.

NOTE Dans le présent document, la grandeur "polarisation magnétique" est utilisée conformément à la définition de l'IEC 60050-221. Dans certaines normes de la série IEC 60404, la grandeur "induction magnétique" a été utilisée.

Afin de soutenir la fiabilité à long terme des performances de cette configuration et de mieux comprendre la relation entre la méthode Epstein et la méthode SST, les annexes informatives B et C, ont été respectivement, ajoutées.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils 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 – Partie 221: Matériaux et composants magnétiques*

IEC 60404-13, *Matériaux magnétiques – Partie 13: Méthodes de mesure de la résistivité, de la masse volumique et du facteur de foisonnement des bandes et tôles en acier électrique*