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INTERNATIONAL STANDARD

colour inside

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



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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

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

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- withdrawn,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

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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±5)°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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-121 and IEC 60050-221 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

4 General principles of AC measurements

4.1 General

Clause 4 specifies the general conditions for the determination of AC magnetic properties of electrical steel strip and sheet at power frequencies by means of a single sheet tester.

4.2 Principle of the single sheet tester method

The test specimen comprises a sample of ~~magnetic~~ electrical steel sheet and is placed ~~inside~~ in the center of two concentric windings:

– an exterior primary winding (magnetizing winding);

– an interior secondary winding (voltage winding).

The flux closure is made by a magnetic circuit consisting of two identical yokes, the cross-section of which is very large compared with that of the test specimen (see Figure 1).

~~To minimize the effects of pressure on the test specimen, the upper yoke shall be provided with a means of suspension which allows part of its weight to be counterbalanced in accordance with 3.2.1.~~

~~Care shall be taken to ensure that~~ The temperature changes of the specimen ~~are~~ shall be kept below a level likely to produce stress in the test specimen due to thermal expansion or contraction.