



DPC: 23 / 30431968 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 26 July 2023
Origin: International**Latest date for receipt of comments: 13 September 2023**

Project No. 2020/03515

Responsible committee: PEL/2 Rotating electrical machinery

Interested committees:

Title: BS EN IEC 60034-35 Rotating electrical machines

Part 35: Technical requirements for electrical sheet metal and strip metal used in electrical machines

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD.
THIS DRAFT IS NOT CURRENT BEYOND 13 September 2023

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <http://standardsdevelopment.bsigroup.com>

Responsible Committee Secretary: **Committee Service Centre (BSI)**
Direct tel: **020 8996 7009**
E-mail: csc@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

PROJECT NUMBER:

IEC 60034-35 ED1

DATE OF CIRCULATION:

2023-07-21

CLOSING DATE FOR COMMENTS:

2023-10-13

SUPERSEDES DOCUMENTS:

2/2005/NP, 2/2036A/RVN

IEC TC 2 : ROTATING MACHINERY

SECRETARIAT:

United Kingdom

SECRETARY:

Mr Charles Whitlock

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 68

PROPOSED HORIZONTAL STANDARD:

☐

Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC☐ ENVIRONMENT☐ QUALITY ASSURANCE☐ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (See AC/22/2007 or NEW GUIDANCE DOC).

TITLE:

Rotating electrical machines – Part 35: Technical requirements for electrical sheet metal and strip metal used in electrical machines

NOTE FROM TC/SC OFFICERS:

Copyright © 2023 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

CONTENTS

FOREWORD	4
1. Introduction	6
1.1. Influence of manufacturer on electromagnetic and mechanical properties	8
2. Scope	8
3. Guidance on the application of the standard.	8
4. Normative references	9
5. Terms and definitions	9
5.1. Magnetic core	9
5.2. Core packaging method	9
5.3. Stator core	9
5.4. Rotor core	9
5.5. Punching	9
5.6. Lasering	9
5.7. Specific total loss processing factor P_{SPF}	10
5.8. Magnetic field strength processing factor H_{PF}	10
5.9. Specific total loss P_s [W/kg]	10
5.10. Hysteresis power loss P_h [W/kg]	10
5.11. Eddy current losses P_e [W/kg]	10
5.12. Electrical sheet	10
5.13. Density ρ [kg/dm ³]	10
5.14. Fully- finished	10
5.15. Semi- finished	10
6. Designation of electrical steel material	11
7. Order details	11
7.1. Radioactive contamination	11
8. Quality	11
8.1. Strip edges	11
8.2. Welding seams	12
8.3. Cutting and punching properties	12
8.4. Grain size related separation factors G_{SFL} and G_{SFC}	12
8.5. Surface quality of sheet material	12
8.6. Permissible thickness deviations in the direction of rolling	12
8.7. Permissible thickness deviation across the direction of rolling	12
8.8. Permissible width deviation	13
8.9. Permissible length deviation	13
8.10. Edge camber	13
9. Permissible shape deviations	14
9.1. Internal stress	14
9.2. Wave factor	14
9.3. Residual Curvature	14
10. Magnetic and mechanical properties	14
10.1. Magnetic properties	14
10.1.1. Magnetic properties including tolerances standard types (A) - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 50 Hz; 0,35 mm and 0,50 mm	14

10.1.2.	Magnetic properties including tolerances standard types (A) - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 50 Hz; 0,65 mm	15
10.1.3.	Magnetic properties including tolerances standard types (A) - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 60 Hz; 0,35 mm and 0,50 mm	16
10.1.4.	Magnetic properties including tolerances standard types (A) - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 60 Hz; 0,65 mm	17
10.1.5.	Magnetic properties including tolerances standard types (A) - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 200 Hz; 0,35 mm and 0,50 mm	18
10.1.6.	Magnetic properties including tolerances standard types (A) - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 200 Hz; 0,65 mm	19
10.1.7.	Magnetic properties standard types (A)- magnetic field strength $\hat{H}$ at 50 Hz; 0,35 mm, 0,50 mm and 0,65 mm	20
10.1.8.	Magnetic properties including tolerances high permeability types HPA - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 50 Hz	21
10.1.9.	Magnetic properties including tolerances high permeability types HPA - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 60 Hz	21
10.1.10.	Magnetic properties including tolerances high permeability types HPA - losses for electrical steel and stator core package at $\hat{f}=1,5$ T, 200 Hz	22
10.1.11.	Magnetic properties high permeability types HPA - magnetic field strength	22
10.2.	Mechanical properties	23
10.2.1.	Allowable tolerance on nominal thickness within one acceptance unit	23
10.2.2.	Mechanical properties standard types (A)	23
10.2.3.	Mechanical properties high permeability types (HPA)	23
11.	Insulation.....	24
11.1.	General.....	24
11.2.	Insulation requirements.....	24
11.2.1.	Insulation layer thickness	24
11.2.2.	Insulation resistance	24
11.2.3.	Ripple and roughness	24
11.2.4.	Bonding strength	24
11.2.5.	Hardening.....	24
12.	Test certificates and characteristic curves	25
12.1.	Test methods for electromagnetic assessment.....	25
12.1.1.	Epstein sample according to IEC 60404-2	25
12.1.2.	Single sheet testing according to IEC 60404-3.....	25
12.2.	Test documentation	25
13.	Type labelling	25
14.	Terms of delivery	25
15.	Annex.....	26
A.1	Minimum details for factory certificate for electrical steel	26
A.2	Minimum details for factory certification for electrical sheet packages	27
A.3	Mechanical properties standard type (A)	28
A.4	Mechanical properties high permeability types (HPA).....	29
A.5	Magnetic properties standard types- magnetic field strength $\hat{H}$ at 50 Hz	29
A.6	Specific total loss P_s (sample characteristic).....	29
A.7	Samples core packaging method	30

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ROTATING ELECTRICAL MACHINES –

Part 35: Technical requirements for electrical sheet metal and strip metal used in electrical machines

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 60034-35 has been prepared by working group WG12 of IEC technical committee 2: Rotating machinery.

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/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.

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

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

The National Committees are requested to note that for this document the stability date is 20XX..

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

1. Introduction

The requirements for electrical steel to produce stator and rotor cores of modern rotating electrical machines have increased considerably due to current technological developments. The necessity for developing rotating electrical machines with increased efficiency is an example for this.

For rotating electrical machine manufacturers, this has made extended specifications regarding the characteristics of electrical steel inevitable. The purpose of this document is to standardise these additional requirements internationally.

Laminated electrical steel, as used in rotating electrical machines for the purpose of magnetic field conduction and magnetic field amplification, must meet defined magnetic and mechanical properties. As a main component of the electrical steel according to the present standard, carbon reduced iron is used, along with other alloying components - here mainly silicon.

In particular, the requirement for constant magnetic properties of the electrical sheet is a prerequisite for compliance with normative and statutory efficiency requirements of rotating electrical machines.

Due to the 360° rotating magnetic flux, electrical sheets for the most rotating electrical machines ideally have isotropic magnetic properties (there are exceptions). This desired, and currently not entirely achievable, material-specific isotropy leads to a desired, symmetrical behavior of the rotating electrical machine over the entire angle of rotation of the rotor.

The isotropic properties are mainly achieved by a disordered geometrical position of the texture-forming grains (crystallites) in the electrical steel sheet, whereby the electrical steel sheet properties are decisively determined by the multi-stage manufacturing process (steel production, materials used, hot strip, cold strip, annealing, surface coating, shaping).

As a result, the electrical steel sheets available on the market exhibit significant differences, despite uniform electrical steel sheet designations defined in standards.

The design of an electrical machine requires precise knowledge of the mechanical and magnetic properties of the available electrical sheets.

The individual alloying constituents (in particular Al and Si) and the microstructural properties (Figure 1-1) have a significant effect on the desired properties of electrical steel sheets because of the manufacturing process.

The magnetic polarization values and the total iron losses of the electrical steel sheet in the alternating magnetic field, which consist of the eddy current losses and the hysteresis losses, must be considered. The eddy current losses themselves can be further divided into "classical" eddy current losses and anomalous eddy current losses.

Since the individual loss components can in turn be an individual manufacturer characteristic, it is advisable to assess not only the total iron losses but also the hysteresis losses and the eddy current losses of the electrical steel sheet. Here, in turn, the grain size as a structural property of the electrical sheet is of interest, since it has a direct influence on the deteriorating, electromagnetic behavior after the forming process (e.g., by stamping). The goal of the user of electrical sheets for rotating electrical machines should therefore be to strive for properties of different electrical sheets that are as comparable as possible within a defined quality classification. Figure 1-2 shows different hysteresis characteristics for the 1st quadrant of the hysteresis characteristic curve of different materials with the same steel grade.

Microstructure of an electrical sheet is determined individually by the electrical sheet manufacturer and has, among other things, an influence on the electromagnetic quality changes caused by the subsequent machining process to produce a complete electrical sheet package for rotating electrical machines.

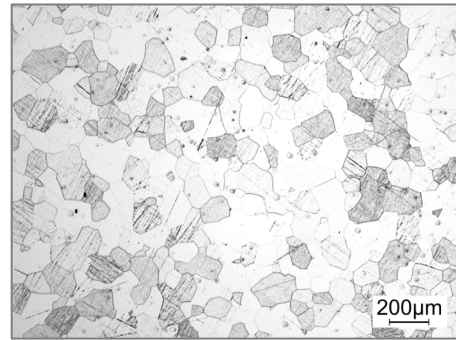


Figure 1-1 Microstructure electrical steel sheet (exemplary)

Electrical sheets can have different electromagnetic properties because of different manufacturing processes - even if they have identical steel names according to IEC 60404-8-4. The reason for this may be, for example, the use of different strategies to obtain the desired properties. This includes the alloying strategy and the manufacturing process.

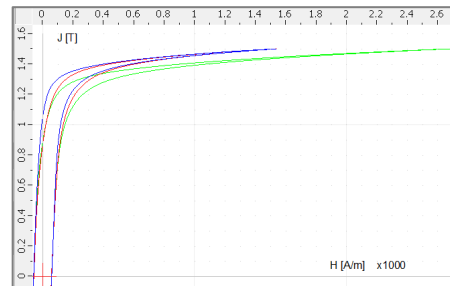


Figure 1-2 Hysteresis characteristics of 3 different electrical steels of the same grade (exemplary)

The electromagnetic properties change due to the necessary forming process to produce an electrical steel sheet package.

Due to individual manufacturing processes of the electrical steel strip, the electromagnetic properties of the complete electrical steel sheet package deviate.

Note: Different batches of the same grades can also cause deviations.

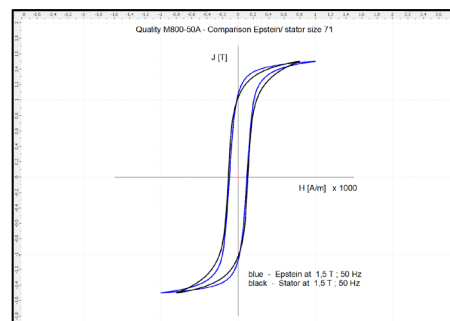


Figure 1-3 Comparison of hysteresis characteristics between Epstein test and stator core test (identical grade, exemplary)

1.1. Influence of manufacturer on electromagnetic and mechanical properties

Steel manufacturers, electrical sheet package manufacturers and annealing companies have a decisive influence on the electromagnetic and mechanical properties of electrical sheet packages.

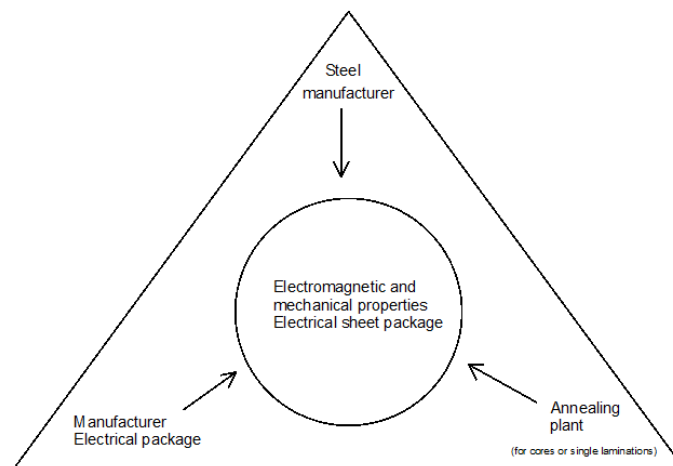


Figure 1-4 Influence on electromagnetic and mechanical properties Electric sheet package.

2. Scope

This part of the IEC 60034 series of standards establishes specific requirements for material that is intended to be used for the stator core or the rotor core of rotating electrical machines. The document applies in addition to IEC 60404- series. The document is addressed to the suppliers of the raw material (electrical sheet), to producers of electrical sheet packages (including a possible annealing treatment), to electric motor manufacturers as well as to users of electrical steel.

3. Guidance on the application of the standard.

This standard contains information regarding the requirements for non-grain-oriented electrical sheets for electrical machines.

The specifications concern, among other details, requirements for the electrical sheets regarding the specific, total losses as well as the magnetic field strengths at defined magnetic polarisation values.

These defaults are delimited by defined tolerance bands. The practically existing differences in properties are considered by 3 gradations (Range A, Range B, Range C) of the standardised tolerances. In addition, steel names, standardised thicknesses, specific total losses and magnetic field strengths may be agreed individually. These must be defined between the supplier and the customer.

Specification value tables containing a "Specific total loss processing factor" or a "Magnetic field strength processing factor" apply to the electrical sheet and to the electrical sheet package. These factors are used to describe any changes in the properties of the electrical steel compared to the finished electrical steel package and must be agreed between the supplier and the user of the electrical steel package. As a result, the electrical sheet package can be delivered with consistent, defined electromagnetic properties.