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Magnetni materiali - 8-11. del: Specifikacije za posamezne materiale - Amorfn trak na osnovi železa, dobavljen kot polizdelek

Magnetic materials - Part 8-11: Specifications for individual materials - Fe-based amorphous strip delivered in the semi-processed state

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TITLE:

Magnetic materials - Part 8-11: Specifications for individual materials - Fe-based amorphous strip delivered in the semi-processed state

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MAGNETIC MATERIALS –

**Part 8-11: Specifications for individual materials –
Fe-based amorphous strip delivered in the semi-processed state**

FOREWORD

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This international Standard IEC 60404-8-11 introduces grades of Fe-based amorphous strip material specified according to the maximum specific total loss under given magnetic polarizations. Moreover, it specifies also the minimum stacking factor of the strip.

This document has been prepared by IEC technical committee 68: Magnetic alloys and steels.

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

FDIS	68
68/XX/FDIS	68/XX/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 website 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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

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The National Committees are requested to note that for this publication the stability date is 2021.

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

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INTRODUCTION

131 Fe-based amorphous strip is regarded as a promising material to reduce energy loss in
132 transformer cores and, consequently, to help mitigate global warming.

133 The Fe-based amorphous strip is produced by a rapidly-solidifying, direct-casting process. The
134 strip is intended primarily for the construction of wound cores of transformers for commercial
135 power frequency (50 Hz and 60 Hz) applications.

136 After appropriate heat treatment, the strip exhibits a significantly lower value of specific total
137 loss in comparison to grain-oriented electrical steel strip for the same applications. It is
138 associated with low hysteresis loss due to low magnetic anisotropy and with low eddy current
139 loss due to high resistivity and low material thickness.

140 This document introduces grades of the material specified according to the maximum specific
141 total loss under given magnetic polarizations. Moreover, it specifies also the minimum stacking
142 factor of the strip.

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MAGNETIC MATERIALS –

Part 8-11: Specifications for individual materials – Fe-based amorphous strip delivered in the semi-processed state

1 Scope

This part of IEC 60404 defines the grades of Fe-based amorphous strip delivered in the semi-processed state, i.e. without final heat treatment, of nominal thickness 0,025 mm. Other nominal thicknesses in the range from 0,020 mm to 0,030 mm may be specified by agreement between the manufacturer and the purchaser. In particular, it gives general requirements, magnetic properties, geometric characteristics, tolerances and technological characteristics, as well as inspection procedures.

This document applies to the rapidly-solidified Fe-based amorphous strip supplied in coils with as-cast edges and intended for the construction of magnetic circuits.

The grades are grouped into two classes:

- conventional grades;
- high permeability grades.

They correspond to Class I1 of IEC 60404-1.

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/>

IEC 60404-1, *Magnetic materials – Part 1: Classification*

IEC 60404-9, *Magnetic materials – Part 9: Methods of determination of the geometrical characteristics of magnetic steel sheet and strip*

IEC 60404-16, *Magnetic materials – Part 16: Methods of measurement of magnetic properties of Fe-based amorphous strip by means of a single sheet tester*

ISO 404, *Steel and steel products – General technical delivery requirements*

ISO 10474, *Steel and steel products – Inspection documents*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-121, IEC 60050-221, IEC 60404-9, and the following apply.

3.1 strip tear ductility

ductility which is characterized by a ductility code that is classified by the number of brittle spots when a strip of a length corresponding to two times the casting roll circumference is torn in a direction parallel to the casting direction

3.2**casting roll**

spinning chilled roll on which molten alloy is ejected and a rapidly-solidified strip is produced

3.3**brittle spots**

areas of strip which show the following brittleness when being torn through; shatter, fracture, diverting the path or direction of the tear by approximately 6 mm or more, or a piece of the material comes free from the strip

4 Classification

The grades covered by this document are classified according to the value of maximum specific total loss in watts per kilogram at a peak magnetic polarization of 1,3 T and 50 Hz, according to the value of minimum stacking factor and according to the nominal thickness of the strip in mm.

5 Designation

The material name complies with the following in the order given:

- 1) the letters AM for Fe-based amorphous material;
- 2) one hundred times the specified value of maximum specific total loss at a peak magnetic polarization of 1,3 T and 50 Hz, in watts per kilogram;
- 3) one thousand times the nominal thickness of the strip, in millimetres;
- 4) the characteristic letter;
 - S for conventional grades;
 - P for high permeability grades;
- 5) one tenth of the frequency 50 Hz, i.e. 5;
- 6) one hundred times the specified value of the minimum stacking factor.

EXAMPLE AM10-25S5-84 for Fe-based amorphous strip of conventional grade with a maximum specific total loss at 1,3 T of 0,10 W/kg at 50 Hz, a nominal thickness of 0,025 mm and a minimum stacking factor of 0,84, supplied in the semi-processed state.

6 General requirements**6.1 Production process**

The production process of the strip and its chemical composition are left to the discretion of the manufacturer.

6.2 Form of supply

The strip is supplied in coils. A coil shall be a single-ply spool which is a continuous single strip wound on a spool hub, or a multi-ply spool which is a number of strips simultaneously wound on a spool hub.

The mass of the coils shall be agreed between the manufacturer and the purchaser at the time of enquiry and order.

The recommended value for the internal diameter of spool hubs is approximately 406 mm. The outside diameter of coils should be at least 600 mm and should not exceed 1 120 mm.

Strip shall be of constant width and wound in such a manner that the edges are superimposed in a regular manner and the side faces of the coil are substantially flat.

227 Irregular deviations from flatness and/or the size and the number of voids or openings in the
228 coil shall be agreed between the manufacturer and the purchaser at the time of enquiry and
229 order.

230 Coils shall be sufficiently tightly wound in order that they do not loosen under their own weight.

231 In the case of coils of multi-ply spools, strips may exhibit single-ply joints if agreed between the
232 manufacturer and the purchaser at the time of enquiry and order. The shape of strip ends at the
233 joint may be agreed between the manufacturer and the purchaser at the time of enquiry and
234 order.

235 The edges of parts jointed together shall not be so much out of alignment as to affect the
236 further processing of the strip.

237 6.3 Delivery condition

238 Fe-based amorphous strip is usually supplied without an insulating coating. An oxide layer is
239 formed naturally on the strip surface during manufacture of the strip.

240 6.4 Surface condition

241 The surfaces shall be smooth and clean, free from grease and rust. No continuous indication of
242 oxide shall be visible along the surfaces or edges of the strip.

243 The surfaces and edges shall have no wrinkles, dimples, cracks, folds, flakes, or other defects
244 that would make the strip unsuitable for the fabrication of wound cores. Dispersed
245 imperfections such as minor rusts, slight coloration, small pinholes, shallow dimples, etc. are
246 permitted if they are not detrimental to the correct use of the supplied strip.

247 The strip shall have no needle-like holes exceeding 7,0 mm in length. The strip shall have no
248 more than eight needle-like holes aligned in the direction of casting of the strip in any 25 mm
249 segment.

250 The strip edge shall have no slivers, nicks or feathers with a maximum dimension exceeding
251 4,0 mm.

252 6.5 Suitability for cutting

253 The strip shall be suitable for cutting straight at any point when appropriate cutting tools are
254 used.

255 7 Technical requirements

256 7.1 Magnetic properties

257 7.1.1 Reference condition

258 The properties defined in 7.1.2 and 7.1.3 shall apply only to test specimens in the reference
259 condition which is obtained by the following magnetic annealing.

260 The test specimens shall be subjected to the magnetic annealing in a d.c. magnetic field
261 directed parallel to the direction of casting, at least 1 600 A/m in strength and at a temperature
262 in accordance with the specification of the manufacturer.

263 The magnetic annealing shall be maintained for 2 h at the temperature and maintained until the
264 temperature falls to 200 °C.

265 NOTE 1 The magnetic annealing releases stress and induces magnetic anisotropy in the casting direction.