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Orientirana elektropločevina in trakovi, dobavljeni v končnem žarjenem stanju

Grain-oriented electrical steel strip and sheet delivered in the fully processed state

Kornorientiertes Elektrobund und -blech im schlussgeglühten Zustand

Bandes et tôles en acier électrique à grains orientés livrées à l'état fini

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Ploščati jekleni izdelki in
polizdelki

Flat steel products and semi-
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Kornorientiertes Elektroband und -blech im
schlussgeglühten Zustand

This European Standard was approved by CEN on 24 July 2022.

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[SIST EN 10107:2022](https://standards.iteh.ai/catalog/standards/sist/cc88b0aa-e241-4f81-b1db-a66a22751c31/sist-en-10107-2022)

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 10107:2022) has been prepared by Technical Committee CEN/TC 459 “ECISS – European Committee for Iron and Steel Standardization”¹, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2023, and conflicting national standards shall be withdrawn at the latest by March 2023.

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

This document supersedes EN 10107:2014.

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

- insertion of a third class of electrical steels for magnetic domain refined high permeability grades;
- introduction of the Single Sheet Testing (SST) method as reference measurement method for this third class of material together with a conversion factor for transposition of the SST measurement results to the Epstein measurement results;
- update of the electrical steel range to take account of the current offers and demands of grades.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

¹ Through its sub-committee SC 8 “Steel sheet and strip for electrical applications” (secretariat: DIN).

Introduction

The insertion of a third class of electrical steels for magnetic domain refined high permeability grades is the main reason of this revision. Most of the technologies of magnetic domain refinement result in material that does not withstand the stress relief annealing after cutting without changing the magnetic properties (i.e. the specific total loss). In the case of this material, the Epstein method according to EN 60404-2, requiring the annealing of the Epstein strip samples, is not suitable. Therefore, the Single Sheet Tester (SST) method specified in IEC 60404-3 is employed.

The introduction of the SST as the reference measurement method for these magnetic domain refined high permeability grades was preceded by intense discussions within IEC/TC 68.

The specific total loss measured by use of the SST specified in IEC 60404-3 tends to be larger than the value measured by the use of Epstein frame in accordance with EN 60404-2. The magnetic polarization at $H = 800 \text{ A/m}$ measured by use of the SST tends to be a little lower than the value measured by the use of Epstein frame.

The significant difference between Epstein and SST loss results made it necessary to introduce a Conversion Factor, F_c , applied to the SST results. This Conversion Factor is to create continuity in the quality characteristics ratio of conventional grain-oriented electrical steel grades and of high permeability grades (Epstein related loss values) to the magnetic domain refined high permeability grades (SST related loss values), particularly over the transition zone between these grades. Otherwise, it might be confusing to the users of this specification standard that the higher quality materials measured by the SST method are listed with seemingly higher values of the specific total loss, compared with the lower Epstein values measured on the lower quality grades.

Considerations of the widely spread grades of grain-oriented electrical steel led to the consented value of $F_c = 0,925$ to be applied to the loss values at 1,7 T measured by the SST method.

The magnetic polarization for $H = 800 \text{ A/m}$ is the value taken from the SST measurement without conversion to an equivalent Epstein value.

Consequently, the magnetic domain refined high permeability grades have been listed in a new Table 3 as a new class of grain-oriented electrical steel strip and sheet.

1 Scope

This document defines the steel grades of grain-oriented electrical steel strip and sheet in nominal thicknesses of 0,20 mm, 0,23 mm, 0,27 mm, 0,30 mm and 0,35 mm. In particular, it gives general requirements, magnetic properties, geometric characteristics, tolerances and technological characteristics, as well as inspection procedures.

This document applies to Goss textured grain-oriented electrical steel strip and sheet supplied in the final annealed condition in coils or sheets and intended for the construction of magnetic circuits.

The grades are grouped into three classes:

- conventional grades;
- high permeability grades;
- magnetic domain refined high permeability grades.

They correspond to Class C22 of IEC 60404-1.

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.

EN 10021, *General technical delivery conditions for steel products*

EN 10204, *Metallic products - Types of inspection documents*

EN 10251, *Magnetic materials - Methods of determination of the geometrical characteristics of electrical steel sheet and strip*

EN 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*

EN IEC 60404-11, *Magnetic materials - Part 11: Methods of measurement of the surface insulation resistance of electrical steel strip and sheet*

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

EN ISO 7799, *Metallic materials - Sheet and strip 3 mm thick or less - Reverse bend test (ISO 7799)*

IEC 60050-121, *International electrotechnical vocabulary — Part 121: Electromagnetism*

IEC 60050-221, *International electrotechnical vocabulary — Part 221: Magnetic materials and components*

IEC 60404-3, *Magnetic materials — Part 3: Methods of measurement of the magnetic properties of electrical steel strip and sheet by means of a single sheet tester*

EN 10107:2022 (E)**3 Terms and definitions**

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

3.1
edge camber
greatest distance between a longitudinal edge of a length of strip or a sheet and the line joining the two extremities of the measured length of this edge

3.2
edge wave
wave factor
variations of flatness of a length of strip or a sheet taking a form of waves at the slit edge of the product

Note 1 to entry: The edge wave is characterized by the wave factor which is the relation of the height of the wave to its length, expressed as a percentage.

[SOURCE: IEC 60404-9:2018, 3.1]

3.3
residual curvature
variations of flatness of a length of strip or a sheet taking a permanent curvature in the rolling direction of the product

[SOURCE: IEC 60404-9:2018, 3.2]

3.4
number of bends
counts of alternate bending in the reverse bend test prior to the appearance of the first crack in the base metal of the specimen visible to the naked eye or prior to when sudden failure occurs by fracture

[SOURCE: IEC/TR 63114:2018, 3.2]

3.5
deviation from the shearing line
internal stress
greatest distance between corresponding points on the two sheared edges of a length of strip or a sheet sheared in the middle of the width, in parallel to the rolling direction of the product, which characterizes the internal stress of the materials

4 Classification and designation

4.1 Classification

The steel grades covered by this this document are classified according to the value of maximum specific total loss in watts per kilogram and according to the nominal thickness of the product² (0,20 mm, 0,23 mm, 0,27 mm, 0,30 mm and 0,35 mm).

4.2 Designation

The steel name comprises the following in the order given:

- a) the letter M for electrical steel;
- b) one hundred times the specified value of maximum specific total loss at 1,7 T and 50 Hz, in watts per kilogram;
- c) one hundred times the nominal thickness of the product, in millimetres;
- d) the characteristic letter:
 - S for conventional grades;
 - P for high permeability grades;
 - R for magnetic domain refined high permeability grades.

EXAMPLE M120-30S for conventional grain-oriented electrical steel strip or sheet with a maximum specific total loss of 1,20 W/kg at 1,7 T and 50 Hz, and a nominal thickness of 0,30 mm, supplied in the fully processed state.

5 Information to be supplied by the purchaser

5.1 General

For material to comply adequately with the requirements of this document, the purchaser shall include the following information in his enquiry and order:

5.2 Mandatory information

- a) the quantity;
- b) the type of product: strip or sheet;
- c) the number of this document, i.e. EN 10107;
- d) the steel name or number (see 4.2);
- e) the dimensions of sheets or strips required, including any limitations on the external diameter of a coil (see 6.2 and 7.2.2);
- f) any limitations on the mass of a coil or a bundle of sheets (see 6.2);

² In the rest of the document, the word “product” is used to mean “strip and sheet”.

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- g) the inspection procedure required including the nature of the related documents (see 8.1);
- h) whether or not the product can be delivered in a magnetic domain refined state by any technology (heatproof or non-heatproof).

5.3 Options

A number of options are specified in this document and listed below. If the purchaser does not indicate this wish to implement one of these options, the products shall be supplied in accordance with the basis specification of this document (see 5.1):

- 1) permissibility of welds and its marking (see 6.2);
- 2) compatibility between fluid and coating (see 6.4);
- 3) plus tolerances for nominal width (see Table 3, footnote a);
- 4) requirement concerning residual curvature (see 7.2.6);
- 5) requirement concerning the minimum insulation coating resistance (see 7.3.5);
- 6) acceptance unit other than 3 t (see 8.1);
- 7) test temperature other than $(23 \pm 5) ^\circ\text{C}$ (see 8.4.1);
- 8) alternative method for determination of magnetic properties (see 8.4.2);
- 9) marking of the products (see Clause 9).

6 General requirements**6.1 Production process**

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

6.2 Form of supply

The product shall be supplied in coils in the case of strip and in bundles in the case of sheets.

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

The recommended value for the internal diameter of coils is approximately 508 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.

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

Strip may exhibit welds or interleaves resulting from the removal of defective zones if agreed between the manufacturer and the purchaser at the time of enquiry and order. If necessary, the marking of welds or interleaves may be agreed between the manufacturer and the purchaser at the time of enquiry and order.

For coils containing repair welds or interleaves, each part of the strip shall be of the same grade.

The edges of parts welded together shall not be so much out of alignment as to affect the further processing of the product.

Sheets which make up each bundle shall be stacked so that the side faces are substantially flat and approximately perpendicular to the top face.

6.3 Delivery condition

Cold-rolled grain-oriented electrical steel products are usually supplied with an insulating coating on both sides. This coating generally consists of an EC-5-G coating on an EC-2 coating in accordance with EN 10342. Other types of coating exist which are used only when particularly specified.

6.4 Surface condition

The surfaces shall be smooth and clean, free from grease and rust³. Dispersed defects such as scratches, blisters, cracks, etc. are only permitted if they are within the limits of the tolerances on thickness and if they are not detrimental to the correct use of the supplied product.

The insulation coating present on the surface of the product shall be sufficiently adherent so that it does not become detached during core manufacturing operations or heat treatment under conditions specified by the supplier.

If the product is to be immersed in a fluid, an agreement between the manufacturer and the purchaser, initiated by the purchaser, should be reached to ensure compatibility between the fluid and the coating.

6.5 Suitability for cutting

The product shall be suitable for cutting accurately into the usual shapes at any point when appropriate cutting tools are used.

7 Technical requirements

7.1 Magnetic properties

7.1.1 General

The properties defined in 7.1.2 and 7.1.3 shall apply to products in the delivery condition defined in 6.3 and to the aged condition defined in 8.3.1.1 and 8.3.1.2.

The Epstein strips shall receive a stress relief heat treatment after cutting under conditions specified by the manufacturer.

The single sheet test specimens shall not be heat treated.

7.1.2 Magnetic polarization

The specified minimum values of peak magnetic polarization at the peak magnetic field strength of 800 A/m at 50 Hz shall be as given in Tables 1 to 3.

7.1.3 Specific total loss

The specified values of maximum specific total loss at 50 Hz shall be as given in Tables 1 to 3.

7.1.4 Magnetic properties of magnetic domain refined grades

The magnetic properties⁴ are measured in accordance with the SST method of IEC 60404-3.

³ Not to be confused with some coloration of the insulating coating inherent to the manufacturing process.

⁴ The specific total loss measured by use of the SST specified in IEC 60404-3 tends to be larger than the value measured by the use of Epstein frame in accordance with EN 60404-2. The magnetic polarization at H=800 A/m measured by use of the SST tends to be a little lower than the value measured by the use of Epstein frame.