

Cold rolled non-oriented electrical steel sheet and strip delivered in the fully processed state

The European Standard EN 10106 : 1995 has the status of a
British Standard

ICS 29.040.10; 77.140.50

Committees responsible for this British Standard

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- Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)
- British Steel Industry
- Department of Trade and Industry (National Physical Laboratory)
- Electricity Supply Industry in England and Wales
- Electronic Components Industry Federation
- GAMBICA (BEAMA Ltd.)
- Institute of Physics
- Rotating Electrical Machines Association (BEAMA Ltd.)
- Sunderland Polytechnic (Magnet Centre)
- Transmission and Distribution Association (BEAMA Ltd.)
- Wolfson Centre for Magnetic Technology
- Co-opted members

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Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
Foreword	2
Text of EN 10106	3

National foreword

This British Standard has been prepared by Technical Committee ISE/NFE/5 and is the English language version of EN 10106 : 1995, published by the European Committee for Standardization (CEN).

This British Standard supersedes BS 6404 : Section 8.4 : 1996 which is withdrawn. The essential part of annex D of BS 6404 : Section 8.4 : 1996 is contained in BS 6404 : Part 20 : 1996, *Resistance and temperature classification of insulation coatings*.

Cross-references

Publication referred to	Corresponding British Standard
	BS 4727 <i>Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms</i> Part 1: <i>Terms common to power, telecommunications and electronics</i>
IEC 50 (121) : 1978	Group 01 : 1983 <i>Fundamental terminology</i>
IEC 50 (221) : 1990	Group 07 : 1991 <i>Magnetic materials and components</i> BS 6404 : <i>Magnetic materials</i>
IEC 404-1 : 1979	Part 1 : 1984 <i>Classification</i>
IEC 404-2 : 1978 (Euronorm 118) ¹⁾	Part 2 : 1996 <i>Methods of measurement of the magnetic properties of electrical steel sheet and strip by means of an Epstein frame</i>
IEC 404-3 : 1992	Part 3 : 1992 <i>Methods of measurement of the magnetic properties of magnetic sheet and strip by means of a single sheet tester</i>
EN 10021 : 1993	BS EN 10021 : 1993 <i>General technical delivery requirements for steel and iron products</i>
EN 10027-1 : 1992	BS EN 10027 : <i>Designation systems for steel</i> Part 1 : 1992 <i>Steel names, principal symbols</i>
EN 10027-2 : 1992	Part 2 : 1992 <i>Steel numbers</i>
EN 10204 : 1991	BS EN 10204 : 1991 <i>Metallic products. Types of inspection documents</i>
EN 10251 ¹⁾	BS EN 10251 : <i>Magnetic materials. Methods of determination of the geometrical characteristics of electrical steel sheet and strip</i> ¹⁾

Compliance with a British Standard does not of itself confer immunity from legal obligations.

¹⁾ In preparation.

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Descriptors: Cold rolled products, metal plates, magnetic alloys, magnetic circuits, steels, classifications, designation, delivery, magnetic properties, geometric characteristics, physical properties, acceptance tests, quality

English version

Cold rolled non-oriented electrical steel sheet and strip delivered in the fully processed state

Tôles magnétiques à grains non orientés laminées à froid et livrées à l'état fini

Kaltgewalztes nichtkornorientiertes Elektroblech und -band im schlußgeglühten Zustand

This European Standard was approved by CEN on 1995-11-23. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by the Technical Committee ECISS/TC 24, Electrical steel and strip qualities — Qualities, dimensions, tolerances and specific tests, of which the secretariat 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 June 1996, and conflicting national standards shall be withdrawn at the latest by June 1996.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

	Page
Foreword	
1 Scope	3
2 Normative references	3
3 Definitions	3
4 Classification	3
5 Designation	3
6 General requirements	4
6.1 Production process	4
6.2 Form of supply	4
6.3 Delivery condition	4
6.4 Surface condition	4
6.5 Suitability for cutting	4
7 Technical requirements	4
7.1 Magnetic properties	4
7.2 Geometric characteristics and tolerances	5
7.3 Technological characteristics	6
8 Inspection and testing	6
8.1 General	6
8.2 Selection of samples	6
8.3 Preparation of test specimens	6
8.4 Test methods	7
8.5 Retests	7
9 Marking, labelling and packaging	7
10 Complaints	7
11 Information to be supplied by the purchaser	8
Annex A (informative) Non specified magnetic properties	11

1 Scope

This European Standard defines the grades of cold-rolled non-oriented electrical steel sheet and strip in nominal thicknesses of 0,35 mm, 0,50 mm, 0,65 mm and 1,00 mm. In particular, it specifies general requirements, the magnetic properties, geometric characteristics and tolerances, technological characteristics as well as the inspection procedure.

This European Standard applies to materials supplied in the fully annealed condition intended for the construction of magnetic circuits. It does not apply to semi-processed material.

These magnetic materials correspond to clause C.21 of IEC 404-1.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

IEC 50 (121)	<i>International Electrotechnical Vocabulary (IEV) — Chapter 121 : Electromagnetism</i>
IEC 50 (221)	<i>International Electrotechnical Vocabulary (IEV) Chapter 221 : Magnetic materials and components</i>
IEC 404-1	<i>Magnetic materials — Part 1 : Classification</i>
IEC 404-2	<i>Magnetic materials — Part 2 : Methods of measurement of magnetic, electrical and physical properties of magnetic sheet and strip</i>
IEC 404-3	<i>Magnetic materials — Part 3 : Methods of measurement of the magnetic properties of magnetic sheet and strip by means of a single sheet tester</i>
ISO 7799	<i>Metallic materials — Sheet and strip 3 mm thick or less — Reverse bend test</i>
EN 10021	<i>General technical delivery requirements for steel and steel products</i>

EN 10027-1	<i>Designation systems for steel — Part 1 : Steel names, principal symbols</i>
EN 10027-2	<i>Designation systems for steel — Part 2 : Numerical system</i>
EN 10204	<i>Metallic products — Types of inspection documents</i>
EN 10251	<i>Magnetic materials — Methods of determination of the geometrical characteristics of magnetic steel sheet and strip</i>
EURONORM 118 ¹⁾	<i>Methods for determination of magnetic characteristics of magnetic sheets by means of the 25 cm Epstein frame</i>

3 Definitions

The definitions of the principal terms relative to magnetic properties employed in this European Standard are given in IEC 50 (121) and IEC 50 (221). In addition, for the purposes of this European Standard, the following definitions apply:

3.1 edge camber

The greatest distance between a longitudinal edge of the sheet and the line joining the two extremities of the measured length of this edge.

3.2 flatness

Property of a sheet or a length of strip which is characterized by the wave factor, i.e. by the relationship of the height of the wave to its length.

3.3 number of bends

The number of alternate bends possible before the appearance in the base metal of the first crack visible to the naked eye; it constitutes an indication of the ductility of the material.

3.4 internal stresses

Stresses which are characterized by a deviation in relation to the line of cutting.

4 Classification

The grades covered by this European Standard are classified according to the value of maximum specific total loss in watts per kilogram and according to the nominal thickness of the material (0,35 mm, 0,50 mm, 0,65 mm and 1,00 mm).

5 Designation

5.1 For the steel grades covered by this European Standard, the steel names are allocated in accordance with EN 10027-1; the steel numbers are allocated in accordance with EN 10027-2.

¹⁾ Until this EURONORM is transformed into a European Standard, it can either be implemented or reference made to the corresponding national standards.

5.2 The steel name comprises the following in the order given:

- 1) the letter M for electrical steel;
- 2) one hundred times the specified value of maximum specific total loss at 1.5 T at 50 Hz, in watts per kilogram and corresponding to the nominal product thickness;
- 3) one hundred times the nominal thickness of the material, in millimetres;
- 4) the characteristic letter A for non-oriented electrical sheet or strip supplied in the fully processed state.

EXAMPLE: M250-35A for electrical non-oriented steel sheet or strip with a maximum specific total loss at 1,5 T of 2,50 W/kg at 50 Hz, a nominal thickness of 0,35 mm, supplied in the fully processed state.

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 material is supplied in bundles in the case of sheets and in coils in the case of strip.

The mass of bundles of sheets or of coils shall be agreed at the time of ordering.

The recommended value for the internal diameter of coils is approximately 500 mm.

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

Strip shall be of constant width and wound in such a way that the edges are superimposed in a regular manner and that 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 can occasionally exhibit welds or interleaves resulting from the removal of defective zones, subject to prior agreement between the parties. If necessary, marking of welds or interleaves may be agreed at the time of ordering.

For coils containing 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 material.

6.3 Delivery condition

The material can be supplied either without insulation or with insulation on one or both sides. If the material is supplied with insulation, the nature of the insulation, its properties, and the stacking factor and their verification shall be agreed at the time of ordering.

6.4 Surface condition

The surfaces shall be smooth and clean, free from grease and rust²⁾. Dispersed defects such as scratches, blisters, cracks, etc. are permitted if they are within the limits of thickness tolerances and if they are not detrimental to the correct use of the supplied material.

When an insulation coating is present on the surface of the material, it shall be sufficiently adherent so that the coating does not become detached during cutting operations. During the alternating bend test (see 8.4.3.2), the coating shall not be detached after a bend of 90°. If the coating becomes detached during the test, the piece from which the sample was taken shall be subjected to a shearing test. During this test, it shall not be admissible for large pieces of the coating to become detached; however, the slight chipping of this coating at the shearing edges shall be tolerated.

6.5 Suitability for cutting

The material shall be able to be cut or punched without causing premature wear of tools; it shall be able to be cut at any point and into the usual shapes, thus ensuring accurate working with the correct cutting tools. If there are special requirements with regard to a suitability test for cutting or punching, these shall be established by agreement between the manufacturer and the purchaser.

7 Technical requirements

7.1 Magnetic properties

The properties defined in 7.1.1 to 7.1.3 are applicable to products in the delivery conditions defined in 6.3. For coated products, the mass of the insulation coating shall be taken into account.

7.1.1 Magnetic polarization

The minimum specified values of magnetic polarization for magnetic field strengths H of 2 500 A/m, 5 000 A/m and 10 000 A/m shall be as given in table 2.

The magnetic polarization shall be determined in an alternating magnetic field (expressed as a peak value) at 50 Hz.

²⁾ This should not be confused with some colouration of the insulation coating inherent in the manufacturing process.

7.1.2 Specific total loss

The specified values of maximum specific total loss shall be as given in table 2. They apply:

- for the thicknesses 0,35 mm, 0,50 mm and 0,65 mm to aged test pieces (see 8.3.1),
- for the thickness 1,00 mm to non-aged test pieces.

In certain cases, the specified value of maximum specific total loss can be made the subject of agreement for longitudinal test pieces only, or for transverse test pieces only.

The values of the specific total loss are specified for a magnetic polarization of 1,5 T.

The test shall be made in an alternating magnetic field at 50 Hz.

Annex A gives, for guidance only, the maximum specific total loss for a magnetic polarization of 1,0 T at 50 Hz and for a magnetic polarization of 1,5 T at 60 Hz.

7.1.3 Anisotropy of loss

This is specified at a polarization of 1,5 T. The maximum permitted values shall be as specified in table 2.

7.2 Geometric characteristics and tolerances

7.2.1 Thickness

The nominal thicknesses of the material are 0,35 mm, 0,50 mm, 0,65 mm and 1,00 mm.

For thickness tolerance, a distinction is made between:

- the allowable tolerance on the nominal thickness within the same acceptance unit;
- the difference in thickness in a sheet or in a length of strip in a direction parallel to the direction of rolling;
- the difference in thickness in a direction perpendicular to the direction of rolling. This tolerance applies only to materials with a width greater than 150 mm.

At any point the allowable tolerance on the nominal thickness within the same acceptance unit shall be $\pm 8\%$ of the nominal value for the thickness 0,35 mm and 0,50 mm and $\pm 6\%$ of the nominal value for the thicknesses 0,65 mm and 1,00 mm. The additional thickness due to welds, with respect to the measured thickness of the steel sheet or strip shall not exceed 0,050 mm.

The difference in thickness in a sheet or in a length of strip (see 8.3.2) in a direction parallel to the direction of rolling shall not exceed 8 % for nominal thicknesses 0,35 mm and 0,50 mm, and 6 % for nominal thicknesses 0,65 mm and 1,00 mm.

The difference in thickness in a direction perpendicular to the direction of rolling shall not exceed 0,020 mm for thicknesses of 0,35 mm and 0,50 mm, and 0,030 mm for the thicknesses of 0,65 mm, and 1,00 mm, the measurements being made at least 30 mm from the edges. This tolerance applies only to materials with a width greater than 150 mm. For narrow strip, other agreements may be reached.

7.2.2 Width

The available nominal widths are less than or equal to 1 250 mm.

For the width tolerances a distinction is made between material supplied with edges in the as-rolled condition and material delivered with trimmed edges.

For materials supplied with trimmed edges, the tolerances of table 1 shall apply:

Table 1. Tolerances on nominal width	
Nominal width l (mm)	Tolerance (mm)
$l \leq 150$	$\left\{ \begin{array}{c} + 0,2 \\ 0 \end{array} \right.$
$150 < l \leq 300$	$\left\{ \begin{array}{c} + 0,3 \\ 0 \end{array} \right.$
$300 < l \leq 600$	$\left\{ \begin{array}{c} + 0,5 \\ 0 \end{array} \right.$
$600 < l \leq 1\,000$	$\left\{ \begin{array}{c} + 1,0 \\ 0 \end{array} \right.$
$1\,000 < l \leq 1\,250$	$\left\{ \begin{array}{c} + 1,5 \\ 0 \end{array} \right.$

NOTE. By agreement when ordering, the tolerances on the nominal width can be all minus values.

For materials supplied with as-rolled edges, the tolerances on nominal width should be the subject of agreement when ordering.

7.2.3 Length

The tolerance on length for sheets in relation to length ordered shall be $\left\{ \begin{array}{c} + 0,5 \\ 0 \end{array} \right. \%$, but with a maximum of + 6 mm.

7.2.4 Edge camber

The verification of edge camber applies only to material supplied with trimmed edges and width greater than 30 mm.

The edge camber shall not exceed for a measuring length of 1 m:

- 0,5 mm for a nominal width $l > 150$ mm,
- 1,0 mm for a nominal width l , such that $30 \text{ mm} < l \leq 150$ mm.

7.2.5 Flatness (wave factor)

The verification of flatness does not apply to material of width less than or equal to 100 mm. The wave factor (see 8.4.2.4), expressed as a percentage, shall not exceed 2.

7.2.6 Residual curvature

The verification of residual curvature does not apply to material of width less than or equal to 100 mm.

A requirement concerning residual curvature can be specified by agreement when ordering; in this case, the distance between the bottom edge of the test specimen and the supporting plate shall not exceed 35 mm for the products with thicknesses 0,35 mm, 0,50 mm and 0,65 mm. For the thickness 1,00 mm this distance shall be subject to an agreement between the supplier and the purchaser.

7.3 Technological characteristics

7.3.1 Density

The density of the material is not specified.

The conventional values of density used to calculate the magnetic properties and the stacking factor shall be as given in table 2.

7.3.2 Stacking factor

The minimum values shall be as specified in table 2 and only apply to non-insulated material.

7.3.3 Number of bends

The minimum number of bends shall be as specified in table 2. The values apply to test specimens cut perpendicular to the direction of rolling.

7.3.4 Internal stresses

The material shall be as far as possible free from internal stresses.

The verification of internal stresses does not apply to materials of width less than or equal to 150 mm. The measured gap shall not exceed 2 mm (see 8.3.3.3).

8 Inspection and testing

8.1 General

The material defined by this European Standard can be ordered with or without specific inspection in accordance with EN 10021. However, as a dispensation from EN 10021, in the case of an order without inspection, the manufacturer shall supply a certificate giving the specific total loss of the supplied material.

In the case of an order with specific inspection, the type of inspection document in accordance with EN 10204 shall be specified when ordering. In this case, the delivery is divided into acceptance units.

Each acceptance unit shall comprise 20 t or the remaining fraction thereof of the same grade and the same nominal thickness. Different acceptance units can be adopted by special agreement.

For coils of more than 20 t, each coil shall constitute an acceptance unit.

Except by special agreement, the same rules apply to the inspection of internal stress, adherence of surface insulation and tolerances of shape and dimensions.

8.2 Selection of samples

Test samples shall be taken from each acceptance unit.

The first internal turn and the last external turn of the coil shall be considered as wrapping and not representative of the quality of the remainder of the coil; the selection shall be made from the first external turn excluding the wrapping turn and outside any welding zones or interleaves.

In the case of sheets, the selection shall preferably be made from the upper part of the bundle.

By choosing a suitable order for the execution of the tests, the same sample shall serve to check the various properties.

8.3 Preparation of test specimens

8.3.1 Magnetic properties

For the measurement of magnetic polarization and specific total loss, the test specimen for the 25 cm Epstein frame shall consist of a minimum of 16 Epstein strips having the following dimensions:

- length 280 mm to 310 mm, the lengths being equal within a tolerance of $\pm 0,5$ mm
- width $30 \text{ mm} \pm 0,2$ mm.

Half the test strips shall be cut parallel to the direction of rolling and the other half perpendicular, giving an even distribution across the width of the material. The test strips shall be carefully cut without deformation. Punching shall be made only with well sharpened tools. The maximum tolerance between the direction of cutting in relation to the specified direction shall be $\pm 5^\circ$.

When the width of the material is insufficient for a sampling of test strips to be taken across the width, the test strips shall be taken in the direction of rolling only.

In the case of measurement of specific total loss on aged test pieces, these shall be heated at $225^\circ\text{C} \pm 5^\circ\text{C}$ for a duration of 24 h and shall be cooled to ambient temperature before testing.

8.3.2 Geometrical characteristics and tolerances

For the measurement of thickness, width, flatness, and edge camber, the test specimen shall consist of a sheet or a 2 m length of strip.

For the measurement of residual curvature, the test specimen shall consist of a sample 500 mm in length and of width equal to the delivery width of the sheet or strip.

8.3.3 Technological characteristics

8.3.3.1 Stacking factor

The test specimen shall consist of a least 16 strips of the same size; but in the case of a dispute, the test shall be made with 100 strips. They shall have a width of at least 20 mm and a surface area of at least $5\,000 \text{ mm}^2$, their widths being equal within a tolerance of $\pm 0,1$ mm as well as their lengths. The test strips shall be carefully deburred before the test.

8.3.3.2 Number of bends

Two test specimens at least 20 mm wide shall be cut perpendicular to the direction of rolling of the sheet, at a distance of at least 40 mm from the edge, and from the middle and outside any welding zones.

If the width of the material is not great enough for transverse test specimens of the prescribed length to be taken, the test specimens shall be taken in the direction of rolling. In this case, the values of table 2 also apply.

The test specimens shall be carefully cut, without deformation.

8.3.3.3 Internal stresses

The test specimen shall consist of a sheet or a length of strip of 2 m.

8.4 Test methods

For each specified property one test shall be carried out per acceptance unit. Unless otherwise specified, the tests shall be made at a temperature of $(23 \pm 5)^\circ\text{C}$.

8.4.1 Magnetic properties

8.4.1.1 Magnetic polarization and specific total loss

The test shall be made using a 25 cm Epstein frame in accordance with EURONORM 118.

NOTE. As an alternative to the Epstein Method, the single sheet tester described in IEC 404-3 may be used by agreement between the manufacturer and purchaser. In this case, the specified values obtained with the single sheet tester may also be subject to agreement.

8.4.1.2 Anisotropy of loss

The loss in watts per kilogram shall be measured separately on 16 Epstein test strips taken parallel and 16 Epstein test strips taken perpendicular to the direction of rolling.

The anisotropy of the loss T , (in percent) is calculated according to the following formula:

$$T = \frac{W_1 - W_2}{W_1 + W_2} \times 100$$

where

W_1 is the loss, in watts per kilogram, perpendicular to the direction of rolling;

W_2 is the loss, in watts per kilogram, parallel to the direction of rolling.

8.4.2 Geometrical characteristics and tolerances

8.4.2.1 Thickness

The measurement of thickness shall be made at any point located more than 30 mm from the edges. For materials of width less than 60 mm, the measurement of thickness shall be made along the longitudinal axis of the sheet. This measurement shall be made using a micrometer with a resolution of 0,001 mm.

8.4.2.2 Width

The width shall be measured perpendicular to the longitudinal axis of the product.

8.4.2.3 Edge camber

The edge camber shall be determined in accordance with EN 10251.

8.4.2.4 Flatness (wave factor)

The wave factor shall be determined in accordance with EN 10251.

8.4.2.5 Residual curvature

The residual curvature in the longitudinal direction of the strip shall be determined in accordance with EN 10251.

8.4.3 Technological characteristics

8.4.3.1 Stacking factor

The stacking factor shall be measured in accordance with IEC 404-2.

8.4.3.2 Number of bends

The test consists of bending the test specimen through 90° alternately to each side of its initial position, following the method of bending defined by ISO 7799. The radius of bending chosen shall be 5 mm.

A bend of 90° from the initial position with return to the initial position counts as one bend.

The test shall be stopped on the appearance in the base metal of the first crack visible to the naked eye. The last bend shall not be counted.

8.4.3.3 Internal stresses

The internal stresses shall be determined in accordance with EN 10251.

8.5 Retests

When a test does not give the specified result, this test shall be repeated on double the number of test specimens from other sheets of the acceptance unit or on other strips from coils. The delivery shall be considered to conform with the order if all results of additional tests are in accordance with the requirements of this standard.

After re-treatment, the manufacturer has the right to present again for test acceptance units which had not been found to comply with the order.

9 Marking, labelling and packaging

Marking, labelling and packaging of the products may be agreed at the time of ordering.

10 Complaints

Internal or external defects shall justify a complaint only if they are clearly prejudicial to the method of working or the judicious use of the material.

The purchaser shall give to the supplier the opportunity of convincing himself of the fairness of the claim by presenting the material in dispute and evidence for the complaint.

In all cases, the terms and conditions of complaints shall be made in accordance with EN 10021.

11 Information to be supplied by the purchaser

For materials to comply adequately with the requirements of this standard, the purchaser shall include the following information in his enquiry or order:

- a) quantity;
- b) type of product (strip or sheet);
- c) number of this European Standard (EN 10106);
- d) name or number of the steel (see 5.1);
- e) dimensions of sheets or strip required (including any limitations on the external diameter of a coil) (see 6.2);
- f) any limitation on the mass of a bundle of sheets or of a coil;
- g) any special requirements for marking of welds or interleaves (see 6.2);
- h) any requirement for insulation coating and its classification (see 6.3);
- i) the inspection procedure required including the nature of the related documents (see 8.1);
- j) any special requirement about single sheet testing (see 8.4.1).

Table 2. Technological and magnetic properties

Designation according to		Nominal thickness (mm)	Maximum specific total loss (W/kg) at 50 Hz at 1,5 T	Minimum magnetic polarization (T) ¹⁾ in an alternating magnetic field for a magnetic field strength (A/m)			Maximum anisotropy of loss (%)	Minimum stacking factor (mm)	Minimum number of bends	Conventional density (kg/dm ³)
EN 10027-1	EN 10027-2			2 500	5 000	10 000				
M235-35A	1.0890	0,35	2,35	1,49	1,60	1,70	± 17	0,95	2	7,60
M250-35A	1.0800		2,50	1,49	1,60	1,70	± 17		2	7,60
M270-35A	1.0801		2,70	1,49	1,60	1,70	± 17		2	7,65
M300-35A	1.0803		3,00	1,49	1,60	1,70	± 17		3	7,65
M330-35A	1.0804		3,30	1,49	1,60	1,70	± 17		3	7,65
M250-50A	1.0891	0,50	2,50	1,49	1,60	1,70	± 17	0,97	2	7,60
M270-50A	1.0806		2,70	1,49	1,60	1,70	± 17		2	7,60
M290-50A	1.0807		2,90	1,49	1,60	1,70	± 17		2	7,60
M310-50A	1.0808		3,10	1,49	1,60	1,70	± 14		3	7,65
M330-50A	1.0809		3,30	1,49	1,60	1,70	± 14		3	7,65
M350-50A	1.0810		3,50	1,50	1,60	1,70	± 12		5	7,65
M400-50A	1.0811		4,00	1,53	1,63	1,73	± 12		5	7,70
M470-50A	1.0812		4,70	1,54	1,64	1,74	± 10		10	7,70
M530-50A	1.0813		5,30	1,56	1,65	1,75	± 10		10	7,70
M600-50A	1.0814		6,00	1,57	1,66	1,76	± 10		10	7,75
M700-50A	1.0815	0,65	7,00	1,60	1,69	1,77	± 10	0,97	10	7,80
M800-50A	1.0816		8,00	1,60	1,70	1,78	± 10		10	7,80
M940-50A	1.0817		9,40	1,62	1,72	1,81	± 8		10	7,85
M310-65A	1.0892		3,10	1,49	1,60	1,70	± 15		2	7,60
M330-65A	1.0819		3,30	1,49	1,60	1,70	± 15		2	7,60
M350-65A	1.0820		3,50	1,49	1,60	1,70	± 14		2	7,60
M400-65A	1.0821		4,00	1,52	1,62	1,72	± 14		2	7,65
M470-65A	1.0823		4,70	1,53	1,63	1,73	± 12		5	7,65
M530-65A	1.0824		5,30	1,54	1,64	1,74	± 12		5	7,70
M600-65A	1.0825		6,00	1,56	1,66	1,76	± 10		10	7,75
M700-65A	1.0826	0,80	7,00	1,57	1,67	1,76	± 10	0,97	10	7,75
M800-65A	1.0827		8,00	1,60	1,70	1,78	± 10		10	7,80

Table 2. Technological and magnetic properties (continued)

Designation according to		Nominal thickness (mm)	Maximum specific total loss (W/kg) at 50 Hz at 1,5 T	Minimum magnetic polarization (T) ¹⁾ in an alternating magnetic field for a magnetic field strength (A/m)			Maximum anisotropy of loss (%)	Minimum stacking factor (mm)	Minimum number of bends	Conventional density (kg/dm ³)
EN 10027-1	EN 10027-2			2 500	5 000	10 000				
M1000-65A	1.0829		10,00	1,61	1,71	1,80	± 10		10	7,80
M600-100A	1.0893		6,00	1,53	1,63	1,72	± 10		2	7,60
M700-100A	1.0894		7,00	1,54	1,64	1,73	± 8		3	7,65
M800-100A	1.0895	1,00	8,00	1,56	1,66	1,75	± 6	0,98	5	7,70
M1000-100A	1.0896		10,00	1,58	1,68	1,76	± 6		10	7,80
M1300-100A	1.0897		13,00	1,60	1,70	1,78	± 6		10	7,80

¹⁾ It has been common practice for many years to give values of magnetic flux density. In fact the Epstein frame is used to determine magnetic polarization (intrinsic flux density) which is defined as:

$J = B - \mu_0 H$

where

J = magnetic polarization

B = magnetic flux density

μ_0 = magnetic constant : $4\pi \cdot 10^{-7} \text{ H.m}^{-1}$

H = magnetic field strength

in accordance with IEC 50 (121).

Annex A (informative)

Non-specified magnetic properties

Designation according to		Maximum specific total loss (W/kg)	
EN 10027-1	EN 10027-2	1,0 T at 50 Hz	1,5 T at 60 Hz
M235-35A	1.0890	0,95	2,97
M250-35A	1.0800	1,00	3,14
M270-35A	1.0801	1,10	3,36
M300-35A	1.0803	1,20	3,74
M330-35A	1.0804	1,30	4,12
M250-50A	1.0891	1,05	3,21
M270-50A	1.0806	1,10	3,47
M290-50A	1.0807	1,15	3,71
M310-50A	1.0808	1,25	3,95
M330-50A	1.0809	1,35	4,20
M350-50A	1.0810	1,50	4,45
M400-50A	1.0811	1,70	5,10
M470-50A	1.0812	2,00	5,90
M530-50A	1.0813	2,30	6,66
M600-50A	1.0814	2,60	7,53
M700-50A	1.0815	3,00	8,79
M800-50A	1.0816	3,60	10,06
M940-50A	1.0817	4,20	11,84
M310-65A	1.0892	1,25	4,08
M330-65A	1.0819	1,35	4,30
M350-65A	1.0820	1,50	4,57
M400-65A	1.0821	1,70	5,20
M470-65A	1.0823	2,00	6,13
M530-65A	1.0824	2,30	6,84
M600-65A	1.0825	2,60	7,71
M700-65A	1.0826	3,00	8,98
M800-65A	1.0827	3,60	10,26
M1000-65A	1.0829	4,40	12,77
M600-100A	1.0893	2,60	8,14
M700-100A	1.0894	3,00	9,38
M800-100A	1.0895	3,60	10,70
M1000-100A	1.0896	4,40	13,39
M1300-100A	1.0897	5,80	17,34

List of references

See national foreword.

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