
British Standard

Magnetic materials

Part 8. Individual materials

Section 8.4 Specification for cold-rolled, non-oriented magnetic steel sheet and strip delivered in the finally annealed state

Matériaux magnétiques

Partie 8. Matériaux particuliers

Section 8.4 Bandes et tôles magnétiques à grains non orientés, laminées à froid livrées à l'état recuit fini — Spécifications

Magnetische Werkstoffe

Teil 8. Einzelne Werkstoffe

Abschnitt 8.4 Elektroblech und -band aus Stahl, kaltgewalzt, nicht kornorientiert, schlußgeglüht

Foreword

This Section of BS 6404 : Part 8 has been prepared under the direction of the Iron and Steel and Non-ferrous Metals Standards Committees. It is based on IEC Publication 404-8 : 4*, prepared by the International Electrotechnical Commission (IEC).

Cold-rolled, non-oriented grades of magnetic steel sheet and strip delivered in the finally annealed state were previously covered by BS 601 : Part 1 together with non-oriented, non-alloyed and alloyed grades of magnetic steel sheet and strip delivered in the semi-processed state.

NOTE. BS 601 : Part 1 refers to silicon-free steel and steel with silicon contents up to 3.5 %. For the purposes of this standard, these categories are referred to as non-alloyed and alloyed steels respectively.

Non-oriented, non-alloyed grades of magnetic steel sheet and strip delivered in the semi-processed state are now the subject of BS 6404 : Section 8.3, whilst the alloyed grades delivered in the semi-processed state are the subject of BS 6404 : Section 8.2.

BS 601 : Part 1 also specified requirements and classification of insulating coatings which will not be included in IEC Publication 404-8-4. This information is included in this standard in the form of an appendix which can be amended when current international standardization work on insulating coatings has been completed. IEC 404-8-4 includes a nominal thickness of 0.47 mm to cover requirements principally for the American market. This thickness is not included in this standard.

With the publication of BS 6404 : Section 8.4, BS 601 : Part 1 : 1973 is now fully superseded and is withdrawn.

The following Parts of BS 6404 have been published or are being prepared for publication.

- Part 1 Classification
- Part 2 Methods of measurement of magnetic, electrical and physical properties of magnetic sheet and strip
- Part 3 Methods of measurement of specific total losses of magnetic sheet and strip by means of a single sheet tester
- Part 4 Methods of measurement of the d.c. magnetic properties of solid steels
- Part 5 Methods of measurement of the magnetic properties of magnetically hard (permanent magnet) materials
- Part 7 Method of measurement of the coercivity of magnetic materials in an open magnetic circuit
- Part 8 Individual materials
Section 8.2 Specification for cold-rolled, magnetic, non-oriented, alloyed steel strip delivered in the semi-processed state
Section 8.3 Specification for cold-rolled, magnetic, non-oriented, non-alloyed steel strip delivered in the semi-processed state.

Additional parts and sections of IEC Publication 404 have been or will be published and are expected to provide a basis for additional Parts and Sections of this British Standard.

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

* In preparation.

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Specification

1 Scope

This Section of BS 6404 : Part 8 specifies requirements for the magnetic properties and the geometric characteristics and tolerances of grades of cold-rolled, magnetic, non-oriented steel sheet and strip delivered in the finally annealed state. It applies to nominal thicknesses of 0.35, 0.50 and 0.65 mm and nominal widths up to and including 1250 mm. It also specifies the requirements for insulating coatings which can be applied to the surfaces of the sheet and strip when requested by the purchaser.

It applies to isotropic (non-oriented) material corresponding to that given in clause C21 of BS 6404 : Part 1 : 1984, intended for the construction of magnetic circuits and for use at industrial frequencies.

This Section also specifies inspection and sampling procedures, preparation of test specimens and test methods to be used.

NOTE. The titles of the publications referred to in this Section are listed on the inside back cover.

2 Definitions

For the purposes of this Section of BS 6404 : Part 8, the definitions given in BS 4727 : Part 1 : Group 07 apply, together with the following.

NOTE. Reference may also be made to IEC Publication 50, Chapter 901 for the definitions of the principal terms relating to the magnetic properties.

2.1 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.

NOTE. The number of bends constitutes an indication of the ductility of the material.

2.2 internal stress. The deviation in relation to the line of cutting.

2.3 deviation from flatness (wave factor). The relation of the height of a wave to its length (see figure 1).

2.4 residual curvature. The permanent curvature in the direction of rolling present in a coil in the delivery condition (see figure 2).

2.5 edge camber. The greatest distance between one longitudinal edge of a length of strip and the line joining the two ends of the measured length corresponding to this edge (see figure 3).

3 Designation

3.1 For the purposes of this Section of BS 6404 : Part 8, material is classified according to the maximum specific total loss in watts per kilogram at 1.5 T and 50 Hz, and according to the nominal thickness of the product (0.35, 0.50 or 0.65 mm).

3.2 The designation shall comprise the following in the order given:

- (a) 100 times the specified maximum specific total loss,

in watts per kilogram, at 1.5 T and 50 Hz;

- (b) 100 times the nominal thickness of the material in millimetres;

- (c) the letter 'A';

- (d) one-tenth of the frequency in hertz at which the magnetic properties are specified, i.e. 5 for a frequency of 50 Hz.

Example. 270-35-A 5 for material with a maximum specific total loss at 1.5 T of 2.70 W/kg at 50 Hz and a nominal thickness of 0.35 mm.

4 Information to be supplied by the purchaser

4.1 General

The purchaser shall state the following in the enquiry or order:

- (a) the number of this British Standard, i.e. BS 6404 : Section 8.4, the type of material and the designation (see clause 3);
- (b) the dimensions of the strip required, including any limitations on the external diameter of a coil;
- (c) the quantity required, including any limitations on the mass of a bundle of sheets or of a coil;
- (d) whether uninsulated or insulated material on one or two sides is required and, if insulated, its type and classification (see appendix D);
- (e) the level of inspection if required, in accordance with ISO 404 (see clause 12).

4.2 Options

There are a number of options incorporated in this Section. In the event that the purchaser does not indicate his wish to implement any of these options and specify his requirements at the time of the enquiry and order, the supplier shall assume that there are no special requirements in respect of the following:

- (a) the marking of junction welds, repair welds and interleaves (see note 2 to clause 5)
- (b) a suitability test with regard to punching and shearing requirements (see note 5 to clause 5)
- (c) the percentage limit of ageing (see note 1 to 7.2)
- (d) specific total loss on longitudinal or transverse test pieces (see note 2 to 7.2)
- (e) the difference in thickness in a direction perpendicular to the direction of rolling (see note 2 to 8.1)
- (f) negative width tolerances (see note 1 to table 3)
- (g) residual curvature (see 8.5)
- (h) the acceptance unit (see note 1 to 11.1)
- (i) ageing treatment for testing (see A.1)
- (j) the method for the determination of magnetic flux density (see note to A.2.1)
- (k) the resistance value of the insulating coating when tested by the method described in chapter VIII of BS 6404 : Part 2 : 1985 (see D.2.3).

5 Form of supply

5.1 Sheets, supplied in bundles, shall be stacked such that their edges are superimposed in a regular manner.

5.2 Strip of constant width, supplied in coils, shall be coiled in such a way that the edges are superimposed in a regular manner and that the side faces of the coil are substantially flat. The coils shall be wound sufficiently tightly to ensure that they do not collapse under their own mass.

5.3 In the case of coils containing welds or interleaves, each part of the strip shall be of the same grade.

5.4 The edges of parts welded together shall not be so much out of alignment as to exceed the tolerances for width and edge camber specified in 8.2 and 8.6.

5.5 The material shall be capable of being cut at any point and in the usual shapes thus assuring precise working with appropriate tools in good condition.

NOTES to clause 5.

NOTE 1. The preferred value for the internal diameter of a coil is approximately 500 mm.

NOTE 2. Coils may contain junction butt welds made between hot-rolled coils prior to cold-rolling. Similarly, coils may contain butt welds or interleaves resulting from the removal of defective zones after final cold rolling. If necessary, the marking of welds or interleaves may be agreed between the supplier and the purchaser.

NOTE 3. The material can be delivered either without insulation or with insulation on one or both sides.

NOTE 4. The material should not cause excessive wear of tools.

NOTE 5. If there are special requirements with regard to a suitability test for punching or shearing, these should be subject to agreement between the supplier and the purchaser.

6 Surface condition

The surfaces of both uninsulated and insulated material shall be smooth and clean, and free from dust, grease and rust.

NOTE. Isolated imperfections such as scratches, blisters, cracks, etc. are acceptable if the thickness remains within the tolerance limits (see 8.1).

7 Magnetic properties

7.1 Magnetic flux density

The minimum magnetic flux density for field strengths H of 2500, 5000 and 10 000 A/m shall be calculated using the values of conventional density given in table 1 and, when tested in accordance with A.2.1, shall be as given in table 1.

7.2 Specific total loss

The maximum specific total loss (in W/kg) at a magnetic flux density of 1.5 T and a frequency of 50 Hz shall be calculated using the values of conventional density given in table 1 and, when tested in accordance with A.2, shall be as given in table 1. The values given in table 1 shall apply to:

(a) aged test specimens, for the thicknesses 0.35 and 0.50 mm; and

(b) non-aged test specimens, for the thickness 0.65 mm.

NOTE 1. The percentage limit of ageing may be the subject of agreement between the supplier and the purchaser.

NOTE 2. The values specified in table 1 refer to samples taken in accordance with A.1 with half the test strips cut parallel with the rolling direction and the other half cut perpendicular to the rolling direction. In certain particular cases, the specified maximum specific total loss may be the subject of agreement for longitudinal test pieces only or for transverse test pieces only.

NOTE 3. Table 1 gives indicative values for specific total loss for a magnetic flux density of 1 T for information.

NOTE 4. Indicative values for specific total loss at a frequency of 60 Hz are given in table 2 for information.

7.3 Anisotropy of loss

Anisotropy of loss at a flux density of 1.5 T shall be as specified in table 1, when tested in accordance with A.2.2.

8 Dimensions and tolerances

8.1 Thickness

NOTE 1. The nominal thicknesses of the material are 0.35, 0.50 and 0.65 mm (see clause 1).

The tolerance on the nominal thickness shall be $\pm 10\%$ of the nominal value for the thickness of 0.35 mm and $\pm 8\%$ of the nominal value for the thicknesses 0.50 mm and 0.65 mm, when measured in accordance with appendix B.

The difference in thickness within a sheet or a length of coil of 2 m, in a direction parallel to the direction of rolling, shall not exceed 10 % of the nominal value for the thickness 0.35 mm, and 8 % of the nominal value for the thicknesses 0.50 mm and 0.65 mm, when measured in accordance with appendix B.

For widths greater than 150 mm, the difference in thickness in a direction perpendicular to the direction of rolling shall not exceed 0.020 mm for the thicknesses of 0.35 mm and 0.50 mm, and 0.030 mm for the thickness of 0.65 mm, when measured in accordance with appendix B, the measurements being taken at least 40 mm from the edges.

NOTE 2. For widths up to and including 150 mm, tolerances for the difference in thickness in a direction perpendicular to the direction of rolling may be available subject to agreement between the supplier and the purchaser.

In the case of material containing welds, the additional thickness due to the weld shall not exceed 0.050 mm.