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Cold-rolled grain-oriented and non-oriented electrical steel strip (sheet)

冷轧取向和无取向电工钢带（片）

(IEC 60404-8-7:1998, Specification of individual materials - Cold-rolled grain-oriented electrical steel sheet and strip delivered in the fully-processed state; IEC 60404-8-4:1998, Specifications for individual materials - Cold-rolled non-oriented electrical steel sheet and strip delivered in the fully-processed state; MOD)

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Cold-rolled grain-oriented and non-oriented electrical steel strip (sheet)

1 Scope

This standard specifies the classification, designation, general requirements, technical requirements, inspection and testing, packaging, marking and quality certificates, of cold-rolled grain-oriented electrical steel strips (sheets), which have a nominal thickness of 0.23 mm, 0.27 mm, 0.30 mm, 0.35 mm, AND the cold-rolled non-oriented electrical steel strips (sheets), which have a nominal thickness of 0.35 mm, 0.50 mm, 0.65 mm.

This standard applies to cold-rolled grain-oriented and cold-rolled non-oriented electrical steel strips (sheets), which is supplied in full-process conditions AND used in magnetic circuit structures.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard; however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 228 Metallic materials - Tensile testing at ambient temperature (GB/T 228-2002, ISO 6894:1998, EQV)

GB/T 235 Metallic materials - Sheet and strip which has a thickness equal to or less than 3 mm - Repeated bending test method (GB/T 235-1988, ISO 7799:1985, MOD)

GB/T 247 General rule of package mark and certification for steel plates (sheets) and strips

GB/T 2522 Methods of test for the determination of surface insulation resistance and lamination factor of electric sheet and strip (GB/T 2522-2007, IEC 60404-11:1999, MOD)

GB/T 3655 Methods of measurement of the magnetic properties of electrical steel sheet and strip by means of an Epstein frame (GB/T 3655-2000, IEC 60404-2:1996, NEQ)

GB/T 9637 Electrotechnical terminology - Magnetic materials and components (GB/T 9637-2001, IEC 60050 (221):1990, EQV)

GB/T 13789 Magnetic sheet and strip - Methods of measurement of magnetic properties by means of a single sheet tester (GB/T 13789-1992, IEC 60404-3, EQV)

GB/T 17505 Steel and steel products General technical delivery requirements (GB/T 17505-1998, ISO 404:1992 (E), MOD)

GB/T 18253 Steel and steel products - Types of inspection documents (GB/T 18253-2000, ISO 10474:1991, MOD)

GB/T 19289 Methods of measurement of density, resistivity and stacking factor of electrical steel sheet and strip (GB/T 19289-2003, IEC 60404-13:1995, MOD)

3 Terms and definitions

The terms and definitions related to magnetic properties, which are established in GB/T 9637, as well as the following terms and definitions, apply to this standard.

3.1

Specific total loss

When the magnetic polarization intensity changes according to the sine law with time, its peak value is a certain calibration value, AND the change frequency is a certain calibration frequency, the power consumed by the iron core, per unit mass, is the specific total loss, in the unit of watts per kilogram (W/kg).

3.2

Magnetic polarization

From the demagnetization state of the core specimen, the magnetic polarization intensity changes according to the sine law, at the calibration frequency. When the peak value of the AC magnetic field reaches a certain calibration value, the peak value of the magnetic polarization intensity, as reached by the core specimen, in Tesla (T).

3.3

Edge camber

corresponding thickness;

4) For non-oriented electrical steel, which has a magnetic polarization intensity at 1.5T AND frequency at 50 Hz, the unit of watts per kilogram AND 100 times the maximum specific total loss of the product of the corresponding thickness.

For example:

30Q130 represents to ordinary-grade grain-oriented electrical steel, which has a nominal thickness of 0.30 mm AND a specific total loss P1.7/50 of 1.30 W/kg.

30QG110 represents a high-permeability grade grain-oriented electrical steel, which has a nominal thickness of 0.30 mm AND a specific total loss P1.7/50 of 1.10 W/kg.

50W400 represents a non-oriented electrical steel, which has a nominal thickness of 0.50 mm AND a specific total loss P1.5/50 of 4.0 W/kg.

6 General requirements

6.1 Production process

The production process and chemical composition of steel are determined by the manufacturer.

6.2 Form of supply

Steel strips are supplied in coils. Steel sheets are supplied in boxes.

The weight of the coil and box shall meet the order requirements.

The recommended inner diameter of the steel coil is 510 mm.

The weight of grain-oriented electrical steel coil is generally 2t ~ 3t. The weight of non-oriented electrical steel coil is generally not less than 3t.

The sheets, which make up each box, shall be stacked flat on the sides, approximately perpendicular to the upper surface.

The steel coils shall be coiled from steel strips of the same width; the sides of the coils shall be as straight as possible.

Steel coils shall be wound very tightly, so that they do not collapse under their own weight.

The steel strip may be spliced due to the removal of defects; the splicing place

shall not exceed 0.030 mm.

For materials, which have a width greater than 150 mm, the measured lateral thickness deviation shall not exceed 0.020 mm, at a minimum distance of 30 mm from the edge. For narrow strip, it requires signing a separate agreement.

7.2.1.1.2 Non-oriented electrical steel

For the allowable deviation of the nominal thickness, within the same acceptance batch, it shall not exceed ±0.028 mm of the nominal thickness, for materials, which have a thickness of 0.35 mm; it shall not exceed ±0.040 mm of the nominal thickness, for materials which have a thickness of 0.50 mm and 0.65 mm. The increase in the thickness, at the weld, shall not exceed 0.050 mm.

On a 2 m long steel strip or a steel sheet, which has a nominal thickness of 0.35 mm, the longitudinal thickness deviation shall not exceed 0.018 mm.

On a 2 m long steel strip or a steel sheet, which has a nominal thickness of 0.50 mm, the longitudinal thickness deviation shall not exceed 0.025 mm.

On a 2 m long steel strip or a steel sheet, which has a nominal thickness of 0.65 mm, the longitudinal thickness deviation shall not exceed 0.040 mm.

For materials, which have a nominal thickness of 0.35 mm and 0.50 mm, the lateral thickness deviation shall not exceed 0.020 mm. For materials, which have a nominal thickness of 0.65 mm, the lateral thickness deviation shall not exceed 0.030 mm. These deviations, which are tested at a minimum of 30 mm from the edge, are only applicable to materials, which have a width greater than 150 mm. For narrow strip, it requires signing additional agreements.

7.2.2 Width

The width of the material can be selected within the width range, which is specified by the manufacturer. It can be delivered in the state of trimming or un-trimming.

The allowable deviation of the electrical steel strip (sheet), which is delivered after trimming, shall be $^{+1.5}_{0}$ mm.

7.2.4 Edge camber

The testing of the edge camber of grain-oriented electrical steel is only applicable to materials, which have a width greater than 150 mm. The edge camber of material, which have a length of 2 m, shall not exceed 1.0 mm.

The testing of the edge camber of non-oriented electrical steel is only applicable to materials, which have a width greater than 30 mm. The edge camber of material, which has a length of 2 m, shall not exceed:

1.0 mm, when L > 150 mm; 2.0 mm, when 30 mm < L ≤ 150 mm.

7.2.5 Flatness (wave factor)

The inspection of flatness is applicable to materials, which have a width greater than 150 mm. The flatness of grain-oriented electrical steel shall not exceed 1.5%; the flatness of non-oriented electrical steel shall not exceed 2.0%.

7.2.6 Residual curvature

The inspection is carried out, only when the user has requirements for the residual curvature AND it is specified in the agreement. The inspection of residual curvature is applicable to materials, which have a width greater than 150 mm. The residual curvature of the steel sheet is determined, by testing the distance BETWEEN the bottom edge of the steel sheet AND the support plate, which shall not exceed 35 mm. The residual curvature of the steel coil shall comply with the order agreement.

7.2.7 Burr height

The measurement of the shearing burr height is only applicable to materials, which are delivered in the final use width. The shearing burr height of grain-oriented electrical steel shall not exceed 0.025 mm; the shearing burr height of non-oriented electrical steel shall not exceed 0.035 mm.

7.3 Process characteristics

7.3.1 Density

For the agreed density, which is used to calculate the magnetic properties and stacking factor, it is 7.65 kg/dm^3 for the grain-oriented electrical steel. The agreed density, of each designation of non-oriented electrical steel, shall meet the requirements of Table 3.

7.3.2 Stacking factor

The minimum stacking factor of grain-oriented electrical steel shall meet the requirements of Table 1 and Table 2. The minimum stacking factor of non-

8 Inspection and testing

8.1 Overview

When signing an order agreement in accordance with this standard, the agreement may contain clauses, which specify or not specify the inspection items, according to the electrical steel inspection standards in the cited documents. If there is no clause, which specify the inspection items, the manufacturer shall provide the maximum specific total loss and the minimum magnetic polarization value, of the materials supplied.

During ordering, when requires for designated inspection items, it shall clarify the inspection content involved in GB/T 18253.

Generally, one coil is used to form an acceptance batch. It is allowed to combine the steel strips of the same designation and the same nominal thickness, to form an acceptance batch.

Except for special agreements, the above requirements apply to the inspection of surface insulation resistance AND shape and size deviation.

When the product is supplied in the form of sub-coils, the test results on the original acceptance batch are applicable to the sub-coil.

8.2 Sampling

Test specimens shall be taken from each acceptance batch.

Magnetic specimens shall be taken from the beginning and the end of each coil.

The specimen shall be taken at a distance, not less than 3 m from the head and tail of the steel coil; meanwhile it shall avoid the welding seam and the strip splicing area. For steel sheet products, the specimens shall be selected first from the upper part of the bundle.

By rationally arranging the test sequence, the same set of specimens can be used to test multiple characteristics.

8.3 Preparation of specimen

8.3.1 Magnetic characteristics

When using a 25 cm Epstein square ring, to test the maximum specific total loss and minimum magnetic polarization intensity of the material, a set of specimens consists of 4 times the test pieces; the recommended weight is about 0.50 kg. The sampling method, dimension, dimensional deviation of the specimen, shall comply with the requirements of GB/T 3655. Before the test of

of each piece of specimen depends on the test method used; the width of the specimen, for Franklin method, is 50 mm.

For steel strips or steel sheets, which have a width of less than 600 mm, the size of the specimen, which is selected for checking the resistance of the insulating coating, shall conform to the order agreement.

According to the order agreement, the specimen may need to be heat treated, according to the conditions provided by the manufacturer, before testing.

8.3.4 Mechanical properties

The test of mechanical properties, of non-oriented electrical steel, shall be sampled in accordance with the provisions of GB/T 228.

8.4 Test method

For each characteristic specified, each acceptance batch shall be tested. Unless otherwise specified, the test shall be carried out at a temperature of (23 ± 5) °C.

8.4.1 Magnetic characteristics

The magnetic properties shall be tested, in accordance with the GB/T 3655 standard. Through agreement, it may also be tested in accordance with the GB/T 13789 standard; at this time, the test value shall also meet the requirements of Table 1, Table 2, Table 3.

For some electrical steels with refined magnetic domain, the test shall be performed, in accordance with the requirements of the manufacturer, using the single-piece method of GB/T 13789.

Note: The results, which are obtained by the two methods of GB/T 3655 and GB/T 13789, for the same material, will be different.

8.4.2 Geometrical characteristics and deviations

8.4.2.1 Thickness

The thickness of grain-oriented electrical steel shall be tested, at any place greater than 30 mm, from the edge of the steel sheet or strip.

The thickness of non-oriented electrical steel shall be tested, at any place greater than 30 mm (burrs 45 mm), from the edge of the steel strip or steel sheet.

The thickness test shall be carried out, by the use of a micrometer, which has an accuracy of 0.001 mm.

The insulation coating's resistance is tested, according to the GB/T 2522 standard.

8.4.4 Mechanical properties

The mechanical properties are tested according to GB/T 228 standard.

8.5 Reinspection

When the inspection result of a certain property does not meet the requirements of this standard, it shall take double quantity of specimens, for reinspection. The re-inspection shall be carried out in accordance with the GB/T 247 standard.

9 Packaging, marking, quality certificate

9.1 Packaging and marking

The packaging and marking of the steel strip (sheet) shall comply with the requirements of GB/T 247.

9.2 Quality certificate

Each batch of steel strips (sheets) submitted shall be accompanied by a quality certificate, which proves that the performance of the batch of steel strips (sheets), to be inspected, meets the requirements of this standard and the order contract. The terms of the quality certificate shall comply with the requirements of GB/T 247.

10 Objections

In all cases, the terms and conditions of the objection shall comply with the provisions of GB/T 17505.

11 Ordering information

The following information shall be provided, when ordering according to this standard:

a) Standard number;

b) Designation;

c) Product name (steel strip or steel sheet);

d) Quantity;

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