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**Non-oriented magnetic steel
sheet and strip**

ICS 29.030

Descriptors : magnetic alloys, magnetic materials, sheet materials, strips, magnetic circuits, mechanical testing, electrical testing, insulating coatings

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently **JIS C 2552 : 1986** is replaced with **JIS C 2552 : 2000**.

At this revision **IEC 60404-8-4 : 1998** *Magnetic materials—Part 8-4 : Specifications for individual materials—Cold-rolled non-oriented electrical steel sheet and strip delivered in the fully-processed state* was used as the basis for conformity with International Standard.

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In the event of any doubts arising as to the contents,
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Non-oriented magnetic steel sheet and strip

Introduction This Japanese Industrial Standard has been prepared based on IEC 60404-8-4 *Magnetic materials—Part 8-4 : Specifications for individual materials—Cold-rolled non-oriented electrical steel sheet and strip delivered in the fully-processed state* published in 1998 as the second edition in such a manner, that provisions traditionally specified in JIS for non-oriented magnetic steel sheet and strip have been revised and specified in this text, while the items specified in the corresponding International Standard IEC 60404-8-4 have been employed as the annex without any modification on the technical contents.

1 Scope This Japanese Industrial Standard covers non-oriented magnetic steel sheet and strip coated with insulating film on both sides (hereafter referred to as “steel strip”), and especially specifies their magnetic characteristics, dimensions and shapes and tolerances thereon.

Note : The International Standard corresponding to this Standard is given below.

IEC 60404-8-4 : 1998 *Magnetic materials—Part 8-4 : Specifications for individual materials—Cold-rolled non-oriented electrical steel sheet and strip delivered in the fully-processed state*

2 Normative references The following standard contains provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent edition of the standard indicated below shall be applied.

JIS C 2550 *Test methods for magnetic steel sheet and strip*

3 Definitions For the purpose of this Standard, the definitions on magnetic characteristics specified in JIS C 2550 shall apply. Other definitions shall be as follows:

- a) **edge camber** The edge camber means the curving to right and left from the rolling direction and expressed by the maximum clearance when the reference line is applied to one edge along the rolling direction.
- b) **flatness** The flatness of a steel strip is expressed by the ratio of the height of the side waving to the wave length.
- c) **number of bends** The number of bends is expressed by the number of bends before the appearance of the first crack visible to the naked eye in the base metal of the test specimen when the specimen is subjected to bends to opposite side alternately.

4 Classification

4.1 Classification of steel strips Steel strips are classified according to the nominal thickness (0.35, 0.50 and 0.65 mm), and guaranteed iron loss and guaranteed magnetic flux density, and expressed by the appropriate symbol. Classification of steel strips is specified in Table 1 and the symbolization is specified in Fig. 1.

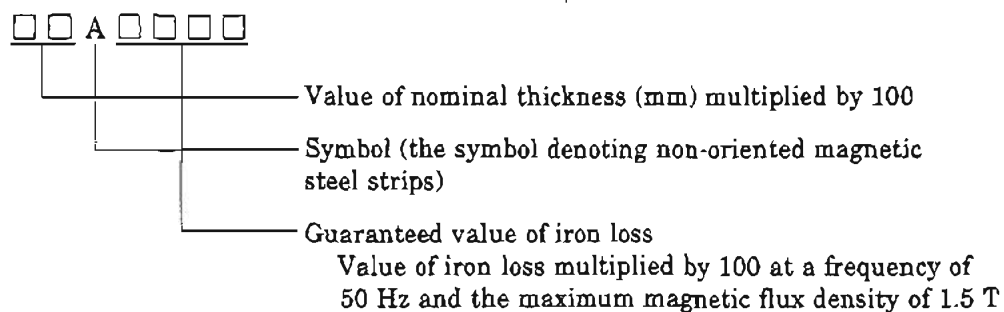
Table 1 Class, iron loss, magnetic flux density and minimum number of repeatable bends

Class	Nominal thickness mm	Density kg/dm ³	Iron loss W/kg W _{15/50}	Magnetic flux density T B ₅₀	Minimum number of repeatable bends
35A210	0.35	7.60	2.10 max.	1.60 min.	2
35A230		7.60	2.30 max.	1.60 min.	2
35A250		7.60	2.50 max.	1.60 min.	2
35A270		7.65	2.70 max.	1.60 min.	2
35A300		7.65	3.00 max.	1.60 min.	3
35A360		7.65	3.60 max.	1.61 min.	3
35A440		7.70	4.40 max.	1.64 min.	3
50A230	0.50	7.60	2.30 max.	1.60 min.	2
50A250		7.60	2.50 max.	1.60 min.	2
50A270		7.60	2.70 max.	1.60 min.	2
50A290		7.60	2.90 max.	1.60 min.	2
50A310		7.65	3.10 max.	1.60 min.	3
50A350		7.65	3.50 max.	1.60 min.	5
50A400		7.65	4.00 max.	1.61 min.	5
50A470		7.70	4.70 max.	1.62 min.	10
50A600		7.75	6.00 max.	1.65 min.	10
50A700		7.80	7.00 max.	1.68 min.	10
50A800		7.80	8.00 max.	1.68 min.	10
50A1000		7.85	10.00 max.	1.69 min.	10
50A1300		7.85	13.00 max.	1.69 min.	10
65A800	0.65	7.80	8.00 max.	1.66 min.	10
65A1000		7.80	10.00 max.	1.68 min.	10
65A1300		7.85	13.00 max.	1.69 min.	10
65A1600		7.85	16.00 max.	1.69 min.	10

Notes 1 The density is used for calculation of cross sectional area of test piece.

2 Iron loss W_{15/50} means the iron loss when the frequency is 50 Hz and the maximum magnetic flux density is 1.5 T.

3 Magnetic flux density B₅₀ means the magnetic flux density at a magnetic field strength of 5 000 A/m.

**Fig. 1 Symbolization of classes**

Example : 35A250 denotes a non-oriented magnetic steel strip of 0.35 mm in thickness with a guaranteed iron loss at a frequency of 50 Hz and a maximum magnetic flux density of 1.5 T not exceeding 2.5 W/kg.

4.2 Classification of insulating films Insulating films are classified as shown in Table 2.

Note : The insulating film of a steel strip shall not be deteriorated by insulating varnishes, transformer oils, machine oils, etc. and shall be in good contact with the steel strip.

Table 2 Classification of insulating films

Symbol	Kind of insulating film
CS-1	Inorganic material
CS-2	Semi-organic material

5 Characteristics and tolerances

5.1 Iron loss and magnetic flux density The iron loss and the magnetic flux density shall be as specified in Table 1, when the tests of 7.1 and 7.2.1 are carried out.

5.2 Dimensions and shapes and tolerances thereon The dimensions and shapes of steel strips shall be as follows:

5.2.1 Thickness The nominal thicknesses of steel strips are 0.35, 0.50 and 0.65 mm. The measurement of thickness shall be carried out in accordance with 7.2.2 a), and the tolerances and deviation on thickness shall be as stated following a) to c).

- The tolerance on thickness and the deviation of thickness in lateral direction shall be as specified in Table 3. The deviation of thickness in lateral direction of steel strip means the difference between the maximum thickness and the minimum thickness measured along the lateral direction on a steel strip excluding the portions within 15 mm from its both edges.
- The deviation of thickness in longitudinal direction of a steel sheet cut from a steel strip shall not exceed 8 % of the nominal thickness in the case of a nominal thickness 0.35 mm or 0.50 mm, or 6 % of the nominal thickness in the case of a nominal thickness 0.65 mm. The deviation of thickness in longitudinal direction of a steel sheet means the difference between the maximum thickness and the minimum thickness measured on a steel sheet excluding the portions within 15 mm from the edges.
- As for the thickness of welded part, the difference in thickness between the welded part and the normal part shall not exceed 0.1 mm.

5.2.2 Width The available widths of steel strips are less than or equal to 1 250 mm. The measurement of width of steel strip shall be carried out in accordance with 7.2.2 a), and the tolerance applicable to the width of steel strip delivered with its milled edges removed shall be as stated in Table 3. The tolerance on the as-rolled width of steel strip shall be determined between the parties concerned with acceptance.

Notes 1 The tolerance on width may be determined in minus side subject to the agreement between the parties concerned with acceptance.

Example : For a width not exceeding 150 mm $\begin{matrix} 0 \\ -0.3 \end{matrix}$

2 Milled edge means the as-rolled edge.

Table 3 Dimensional tolerances

Width w mm	Nominal thickness mm	Tolerance on thickness %	Deviation of thickness in lateral direction mm	Tolerance on width mm
$w \leq 150$	0.35	± 10	0.02 max.	+0.3 0
	0.50	± 8	0.03 max.	
	0.65	± 8	0.03 max.	
$150 < w \leq 500$	0.35	± 10	0.02 max.	+0.5 0
	0.50	± 8	0.03 max.	
	0.65	± 8	0.03 max.	
$500 < w \leq 1\,000$	0.35	± 10	0.02 max.	+1.5 0
	0.50	± 8	0.03 max.	
	0.65	± 8	0.04 max.	
$1\,000 < w$	0.35	± 10	0.03 max.	+1.5 0
	0.50	± 8	0.04 max.	
	0.65	± 8	0.04 max.	

5.2.3 Length The tolerance on length of a steel sheet cut from a steel strip shall be +0.5 % and -0 %, but with a maximum of +6 mm.

5.2.4 Cutting burr The cutting burr shall be checked on a steel strip delivered as slitted, and shall not exceed 0.035 mm when measured in accordance with 7.2.2 b).

5.2.5 Shapes The shapes of steel strip shall be as stated below.

- a) Normally one coil shall consist of one strip. When two or more strips are wound into a coil, the length of one strip shall, as a rule, be not less than 200 m.

A welded strip is regarded as one length so far as the welding does not affect practical use.

- b) The inside diameter of a coil of steel strip shall be 500 mm to 520 mm.
- c) **Flatness** The flatness of steel strip with a width 100 mm or more shall be measured in accordance with 7.2.2 c) and the results shall be 2 % or less.
- d) **Residual curvature** Residual curvature shall be not more than 35 mm when measured in accordance with 7.2.2 d). Provided that, this test is applied to a steel strip with a width of 100 mm or more when agreed at the time of ordering.
- e) **Edge camber** The edge camber of steel strip with a width exceeding 75 mm shall be measured in accordance with 7.2.2 e) and the result shall be 1.0 mm or less per 2 m.

5.3 Other materiality characteristics Other materiality characteristics of steel strips shall be as stated below.

5.3.1 Density Unless otherwise agreed, the density which is the base of calculation for the measurements of magnetic characteristics and stacking factor shall be as stated in Table 1.

5.3.2 Stacking factor The stacking factor of steel strips shall be as given in Table 4 when measured in accordance with 7.2.3.

Table 4 Stacking factor

Nominal thickness mm	Stacking factor %
0.35	95.0 min.
0.50	96.0 min.
0.65	97.0 min.

5.3.3 Tensile strength and elongation The tensile strength and elongation tests of steel strips shall, if necessary, be subject to the agreement between the parties concerned with acceptance. The tests, when carried out, shall be made in accordance with 7.2.4.

5.3.4 Number of repeated bends The minimum number of repeated bends of steel strips shall be measured in accordance with 7.2.5 and the number so measured shall be as stated in Table 1. The stated value is applicable for a test piece cut perpendicular to the rolling direction.

6 Appearance There shall be no rusts, cracks, peel off of coated film nor other defects detrimental to service when the appearance of steel strips is checked in accordance with 7.2.6. However, some abnormal parts as welded part are excluded. In such a case the decision is subject to the agreement between the parties concerned with acceptance.

7 Tests

7.1 Sampling of test specimens At least one set of test specimens shall be sampled from each coil of the same final annealing. However, for the items which may vary for each product unit delivered, the test specimen shall be so sampled that the quality of each product is guaranteed.

7.2 Test methods Test methods of steel strip shall be as follows:

7.2.1 Tests for iron loss and magnetic flux density Tests for iron loss and magnetic density shall be as follows:

- The test specimens shall be taken in accordance with 5 and 7.2.1 of JIS C 2550. Unless otherwise specified, one half of the specimens shall be taken in the rolling direction and the other half shall be taken in perpendicular to the rolling direction (traverse).

- b) Test conditions shall be as stated in 7.1 of JIS C 2550.
- c) Tests for iron loss and magnetic flux density shall be carried out in accordance with 7.2 of JIS C 2550.

7.2.2 Dimensions, shapes and tolerances thereon Tests for dimensions and shapes shall be as follows:

- a) **Thickness and width** Measurements of thickness and width shall be carried out in accordance with 6.1 of JIS C 2550.
- b) **Cutting burr** Measurement of cutting burr shall be carried out in accordance with 6.2 of JIS C 2550.
- c) **Flatness** Measurement of flatness shall be carried out in accordance with 6.3 of JIS C 2550.
- d) **Residual curvature** Measurement of residual curvature shall be carried out in accordance with 6.4 of JIS C 2550.
- e) **Edge camber** Measurement of edge camber shall be carried out in accordance with 6.5 of JIS C 2550.

7.2.3 Stacking factor test Stacking factor test shall be as follows:

- a) The test specimens shall be taken in accordance with 8.1 of JIS C 2550.
- b) The test shall be carried out in accordance with 8.2 of JIS C 2550.

7.2.4 Tests for tensile strength and elongation Tests for tensile strength and elongation shall be as follows:

- a) The test specimens shall be taken in accordance with 10.1.1 of JIS C 2550.
- b) The tests shall be carried out in accordance with 10.1.2 of JIS C 2550.

7.2.5 Test for number of bends Test for number of bends shall be as follows:

- a) The test specimens shall be taken in accordance with 10.2.1 of JIS C 2550.
- b) The test shall be carried out in accordance with 10.2.2 of JIS C 2550.

7.2.6 Appearance test Existence of scratch, surface conditions, existence of peeling off of coated film, etc. shall be checked on the appearance visually and so on.

8 Inspections In the inspections, the following requirements shall be satisfied:

- a) The iron loss and magnetic flux density shall comply with 5.1.
- b) The dimensions and shapes shall comply with 5.2.
Inspection for edge camber shall be made only when specified.
- c) The inspection for stacking factor shall be carried out only when specified, and the results shall comply with 5.3.2.