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Cold-reduced Electrolytic Tinplate

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Foreword

This Standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This Standard replaces GB/T 2520-2008, Cold-reduced Electrolytic Tinplate. Compared with GB/T 2520-2008, the major technical changes are as follows:

-- the thickness of single cold-reduced products in the application scope is modified into 0.14 mm ~ 0.80 mm (see Chapter 1; Chapter 1 of Edition 2008);

-- the classification method is modified, the passivation method is modified into the surface treatment method and the method of no treatment is added (see Table 1; Table 1 of Edition 2008);

-- the definition of “chemical treated electrolytic tinplate” is deleted (see 3.7 of Edition 2008);

-- the solutions for chemical passivation and electrochemical passivation intrusion are modified (see 3.7 and 3.8; 3.8 and 3.9 of Edition 2008);

-- the content “Other thickness increments of advancement may also be used for the nominal thickness as agreed on by the supplier and the purchaser” (see 6.1.1);

-- the types and chemical compositions of black plate steels of cold-reduced electrolytic tinplate are added; the method standards for the testing of chemical compositions are added simultaneously in the normative references (see Article 2 and Table 2);

-- the requirements for the black plates, and the limits of poisonous or harmful elements, of tin coating of the tinplate which is used to make containers (containing or not containing organic coating) in direct contact with foods, pharmaceuticals, beverages and so on, are added (7.1.3 and 7.3.5);

-- the provisions on the minimum average tin coating weight when an order is placed in accordance with the tin coating weight not specified, are added (7.3.1);

-- the requirement “the rounding interval of the value of single point test on each surface is 0.05 g/m2” (see 7.3.3);

-- the surface condition of double cold-reduced products, S, is added (see Table 8);

-- the provision that the equipment measuring hardness shall be provided with a diamond anvil block, is added (see 8.5);

-- Annex B “Spring-back Test Method” is modified (see Annex B; Annex B of Edition 2008);

-- Annex E “Precautions for Use of Tinplate” is added;

Cold-reduced Electrolytic Tinplate

1 Application Scope

This Standard specifies the classification and codes, ordering content, dimensions, shapes, weights and tolerances, technical requirements, test methods, inspection rules, packaging, marking and quality certification of cold-reduced electrolytic tinplate.

This Standard applies to single cold-reduced electrolytic tinplate of nominal thickness 0.14 mm ~ 0.80 mm and double cold-reduced electrolytic tinplate of nominal thickness 0.12 mm ~ 0.36 mm (hereinafter referred to as tinplate).

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition dated applies to this document. For undated references, the latest edition of the referenced documents (including all amendments) applies to this Standard.

GB/T 222, *Permissible Tolerances for Chemical Composition of Steel Products*

GB/T 223.4, *Iron, Steel and Alloy – Determination of Manganese Content – Potentiometric or Visual Titration Method*

GB/T 223.5, *Steel and Iron – Determination of Acid-soluble Silicon and Total Silicon Content – Reduced Molybdosilicate Spectrophotometric Method*

GB/T 223.9, *Iron, Steel and Alloy – Determination of Aluminium Content – Chrom Azurol S Photometric Method*

GB/T 223.11, *Iron, Steel and Alloy – Determination of Chromium Content – Visual Titration or Potentiometric Titration Method*

GB/T 223.18, *Methods for Chemical Analysis of Iron, Steel and Alloy – The Sodium Thiosulfate Separation Iodimetric Method for the Determination of Copper Content*

GB/T 223.23, *Iron, Steel and Alloy – Determination of Nickel Content – The Dimethylglyoxime Spectrophotometric Method*

GB/T 223.26, *Iron, Steel and Alloy – Determination of Molybdenum Content – The Thiocyanate Spectrophotometric Method*

GB/T 223.29, *Iron Steel and Alloy – Determination of Lead Content – Carrier Precipitation-Xylenol Orange Spectrophotometric Method*

GB/T 223.31, *Iron Steel and Alloy – Determination of Arsenic Content – Distillation-*

Molybdenum Blue Spectrophotometric Method

GB/T 223.57, *Methods for Chemical Analysis of Iron,Steel And Alloy – The Extraction-Absorption Catalytic Polarographic Method for the Determination of Cadmium Content*

GB/T 223.59, *Iron, Steel and Alloy – Determination of Phosphorus Content – Bismuth Phosphomolybdate Blue Spectrophotometric Method and Antimony Phosphomolybdate Blue Spectrophotometric Method*

GB/T 223.60, *Methods for Chemical Analysis of Iron, Steel and Alloy – The Perchloric Acid Dehydration Gravimetric Method for the Determination of Silicon Content*

GB/T 223.63, *Methods for Chemical Analysis of Iron, Steel and Alloy – The Sodium (Potassium) Periodate Photometric Method for the Determination of Manganese Content*

GB/T 223.64, *Iron, Steel and Alloy – Determination of Manganese Content – Flame Atomic Absorption Spectrometric Method*

GB/T 228.1, *Metallic Materials – Tensile Testing – Part 1: Method of Test at Room Temperature*

GB/T 230.1, *Metallic Materials – Rockwell Hardness Test – Part 1: Test Method (Scales A, B, C, D, E, F, G, H, K, N, T)*

GB/T 247, *General Rule of Package, Mark and Certification for Steel Plates (Sheets) and Strips*

GB/T 708, *Dimension, Shape, Weight, and Tolerance for Cold-Rolled Steel Plate*

GB/T 728-2010, *Ingot Tin*

GB/T 1838, *Test Methods of Tin Coating Mass for Electrolytic Tinplate*

GB/T 4336, *Carbon and Low-alloy Steel – Determination of Multi-element Contents – Spark Discharge Atomic Emission Spectrometric Method (Routine Method)*

GB/T 8170, *Rules of Rounding off for Numerical Values and Expression and Judgement of Limiting Values*

GB/T 17505, *Steel and Steel Products – General Technical Delivery Requirements*

GB/T 20066, *Steel and Iron – Sampling and Preparation of Samples for the Determination of Chemical Composition*

GB/T 20123, *Steel and Iron – Determination of Total Carbon and Sulfur Content Infrared Absorption Method after Combustion in an Induction Furnace (Routine Method)*

continuous annealing; CA

The process in which cold-reduced steel strip is annealed in the unfolding state and controlled atmosphere, in accordance with the set cycles of time and temperature.

3.7

chemical passivation

Steel strip is immersed in a chemical solution after electrolytic tinning and treated by chemical passivation without electrifying.

3.8

electrochemical passivation

Steel strip is immersed in a chemical solution after electrolytic tinning and treated by cathodic electrochemical passivation by electrifying.

3.9

low chromate passivation

One type of chemical passivation treatment, including the target value of the chromate content in the surface passivation film controlled below 1.5 mg/m^2.

3.10

K plate

Tin plate which features good corrosion resistance and whose tin coating weight shall not be lower than 5.6/2.8 g/m^2. Its target value shall meet the following requirements after the four special tests including pickle lag value (PLV), iron solution value (ISV), tin crystal size (TCS) and alloy-tin couple (ATC):

a) PLV ≤ 10 S;

b) TCS ≤ grade 9;

c) ISV ≤ 20 μg;

d) ATC ≤ 0.12 μA/cm2.

3.11

J plate

Tin plate which features good corrosion resistance and whose tin coating weight shall not be lower than 5.6/2.8 g/m^2. Its target value shall meet the following requirements of 3.10 after the three special tests including pickle lag value (PLV), iron solution value

degree code, annealing method code and code DI.

EXAMPLE D T-2.5 CA DI

4.2.3 For the tinplate used for manufacturing plain surface (coating weight more than 5.6/2.8 g/m^2) food cans for acidic contents, i.e. K plate, the black plate steel grade is usually steel grade L. Its designation consists of black plate steel grade L, temper degree code, annealing method code and code K.

4.2.4 For tinplate used for manufacturing food cans for mushroom and others which require low-chromium passivation treatment, the black plate steel grade is usually steel grade MR or L. Its designation consists of black plate steel grade MR or L, temper degree code, annealing method code and code LCr.

EXAMPLE MR T-2.5 CA LCr.

5 Ordering Content

The contract or order placed in accordance with this Standard shall include the following content:

a) product name (tinplate);

b) a reference to this Standard;

c) designation;

d) dimensions (thickness, width, length or inner diameter and so on);

e) tin coating weight code;

f) surface treatment method;

g) differentially coating marking method;

h) edge shape;

i) packaging method;

j) purpose;

k) number of sheets or weight;

l) others.

6 Dimensions, Shapes, Weights and Tolerances

6.1 Dimensions

Key

1—skewness;

2—straight edge (line);

3—longitudinal edge (length) of tinplate.

Figure 1 – Measurement of Skewness

6.3.2 Camber

The camber shall not be greater than 1 mm on any 1 000 mm length.

6.3.3 Roughness

The roughness only applies to steel plate. The roughness shall not be greater than 3 mm on any 1 000 mm length.

6.4 Tolerances for edge shapes and dimensions and shapes of WL tinplate

The tolerances for edge shapes, dimensions and shapes of WL tinplate shall be as agreed on by the supplier and the purchaser during ordering.

6.5 Others

Other dimensions, shapes, weights and tolerances shall be as specified in GB/T 708.

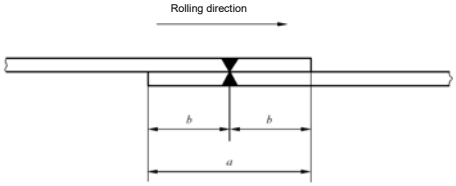
6.6 Welding lines in steel strips

6.6.1 In each roll of steel strips, the total number of welding lines on any 10 000 mm length shall not be greater than 3.

6.6.2 The welding lines in steel strips shall be marked by punching and affixed with signs visible to the eyes. For example, a flexible label is inserted in the place of welding line. Other marking methods may also be used as agreed on by the supplier and the purchaser.

6.6.3 The thickness of welding lines shall not be greater than 1.5 times of the nominal thickness of steel strips.

6.6.4 The total overlap joint length of welding lines *a* shall not be greater than 10 mm; the free overlap joint length *b* shall not be greater than 5 mm, as shown in Figure 2.



Key

	M	Matte surface	

7.5 Surface treatment method

After electrolytic tinning, tinplate usually requires surface treatment. The methods for surface treatment includes chemical passivation, electrochemical passivation, low chromium passivation and no treatment. Both chemical passivation and electrochemical passivation are capable of improving the resistance to oxidation of the surface and improving the paintability and printability of the surface. If the surface treatment method is not specified during ordering, then use electrochemical passivation treatment.

7.6 Surface oiling

Tinplate shall be coated with oil on the tin coating. The oils for coating include CSO, DOS, DOS-A, DOS-P, ATBC and so on. Unless agreed otherwise, usually DOS oil is used.

7.7 Surface quality

7.7.1 The surface of tin coating shall be free from the defects which harm its usability, such as pinholes, scars, pits, wrinkles, rusts and so on, but the deficiencies which cause no harm to its usability are allowed, such as slight inclusions, scratches, indentations and oil marks and so on.

7.7.2 For steel strips, it is impossible to cut off the defective part of steel strips, so steel strips are allowed to be delivered with defects, but the length of the defective part shall not exceed 8% of the total length of each roll.

7.8 Raw material tin

The raw material tin used for the electrolytic tinning of tinplate shall be as specified in the provisions for the designation Sn99.90 in GB/T 728-2010; and the mass fraction of lead content shall not be greater than 0.010 0%.

8 Test Methods

8.1 The dimensions and shapes of tinplate shall be measured with appropriate tools.

8.2 The thickness measuring position is any point not less than 10 mm from both sides of tinplate.

8.3 The appearance of tinplate is examined by visual inspection.

8.4 The tensile test shall be as specified in Method B of GB/T 228.1-2010. In order to improve the repeatability of the measuring results, crosshead displacement control

4—bending mandrel (Φ25.4 mm);

5—bending roll;

6—forming arm.

Figure B.1 – Spring-back Tester

B.3.2 Test procedures

B.3.2.1 Measure the thickness of samples, accurate to 0.001 mm.

B.3.2.2 Insert the samples into the spring-back tester, tighten the clamp screws with appropriate pressure and mount the samples in the test position.

B.3.2.3 Swing the forming arm smoothly to make the samples bend 180° around the mandrel.

B.3.2.4 Rapidly make the forming arm return to the original position, directly observe, read and record the spring-back angle along samples, and then dismount samples.

B.3.2.5 See Formula (B.1) for the relationship between the specified plastic elongation strength and the thickness of the samples and the spring-back angle:

$$\frac{\theta}{180}=3\left[\frac{R_e\times r}{E\times t}\right]-4\left[\frac{R_e\times r}{E\times t}\right]^3 \qquad \text{(B.1)}$$

where,

R_e—specified plastic elongation strength, i.e. $R_{p0.2}$, in MPa;

E—longitudinal elasticity modulus (Young modulus), in MPa;

θ—spring-back angle, in °;

r—radius of curvature, in mm;

t—thickness of samples, in mm.

B.4 Others

This method may also be used for measurement if the user requires the spring-back angle.

Annex E

(Informative)

Precautions for Use of Tinplate

E.1 With the passage of time, the tin in the surface of tinplate reacts with the oxygen in the air, so the tin oxidation film will increase, which will degrade the surface characteristics of tinplate and its usability for the user. It is suggested that is be used before the following dates recommended:

a) for the tinplate without surface passivation treatment, it is suggested that it be used within 3 months after the date of manufacture;

b) for the tinplate with chemical passivation and low-chromium passivation treatment, it is suggested it be used within 6 months after the date of manufacture.

NOTE It is suggested that the products which goes beyond the time limits, be used by the user after testing.

E.2 The surface of tinplate tends to dew and be affected with damp under the environmental conditions such as large temperature differences, moisture circumstances and low temperature. It is suggested the user install dew alarm apparatus and take the measures and packages to prevent dew and damp during use, in order to prevent losses caused by the damp of tinplate because of dew.

Annex F

(Normative)

Determination of Lead Content in the Coating of Tinplate

F.1 Principle for measurement

Use the samples as the positive pole and dissolve the tin coating of the samples in the hydrochloric acid electrolyte through a certain ampere density. Because of the differences in the potentials of the free tin of tinplate, alloy tin and steel base relative to the reference electrode, so by recording the change of potential along with time during the dissolution process of the tin coating of samples, the times for the full dissolution of the free tin coating and total tine coating may be obtained respectively, then the time and electric quantity consumed for the dissolution of the tin coating is calculated and then the tin coating weight is calculated in accordance with Faraday's Law; the lead content in the electrolyte is determined using the atomic absorption spectrometric method or inductively coupled plasma atomic emission spectrometric method, i.e. the lead content in the tin coating of tinplate is determined.

F.2 Apparatus

F.2.1 Electrolyzer: including the constant current source and the recording instrument which is capable of recording the curve of potential changing along with time.

F.2.2 Calomel electrodes and platinum wire electrodes.

F.2.3 Atomic absorption spectrometer or inductively coupled plasma optical emission spectrometer.

F.3 Major reagents and appliances

F.3.1 Hydrochloric acid (guaranteed reagent, 2 mol/l).

F.3.2 Sulphuric acid (guaranteed reagent, 4.5 mol/l).

F.3.3 Hydrobromic acid (guaranteed reagent, 10%).

F.3.4 Hydrochloric acid (guaranteed reagent, 10%).

F.3.5 Pb standard stock solution (1.000 g/l).

F.3.6 Pb standard solution (8 μg/ml): absorb 8 ml of Pb standard stock solution (1.000 g/l) to pour into a 1 000-ml volumetric flask and use distilled water to dilute to the scale.

F.3.7 Coating for sealing (yellow coating).

F.3.8 Vernier calipers.

t_2—total tin dissolution time.

Figure F.4 – Electrolytic Curve

F.4.3 Determination of lead content in electrolyte using the atomic absorption spectrometric or the inductively coupled plasma atomic emission spectrometric method

After the electrolysis of several samples, rinse the electrodes, collect the electrolyte, rinsing fluid and the rinsing fluid for the sample plates in a 300-ml beaker. Place the beaker on an electric furnace for heating until the solution in the beaker is less than 25 ml.

Tin evaporation operation: add 2 ml of sulphuric acid (4.5 mol/l) in the beaker, heat until the solution is about 5 ml, add 5 ml of hydrobromic acid (10%), continue heating to evaporate tin until the residual in the beaker is a white solid residual and does not give out white smoke, take down the beaker for cooling, add 10 ml of hydrochloric acid (10%) after cooling, and heat at low temperature to dissolve the white solid residual in the beaker until the solution becomes transparent.

NOTE When the atomic absorption spectrometer is used to determine the lead content in the electrolyte, the tin evaporation operation is required; when the inductively coupled plasma optical emission spectrometer is used to determine the lead content in the electrolyte, the tin evaporation operation may be omitted.

Take down the beaker after cooling and add dropwise to the scale in a 25-ml volumetric flask. Use the atomic absorption spectrometer or the inductively coupled plasma optical emission spectrometer to determine the absorbance of the Pb calibration curve solution and the electrolyte of samples, and calculate the absolute content C (in μg) of lead in the electrolyte.

Conduct blank tests while testing the samples in accordance with the operating procedures: add 30 ml of hydrochloric acid (2 mol/l) in a 300-ml beaker and obtain the blank value C_0 (in μg) in accordance with the above-mentioned procedures.

Calculate the lead content (in mg/kg) in the tin coating of tinplate in accordance with the absolute content C (in μg) and blank value C_0 of lead in the electrolyte and the total mass m_t (in mg) of the tin coating.

F.4.4 Preparation of Pb calibration curve solution

Add 40 ml of hydrochloric acid (10%) in six 100-ml volumetric flasks respectively, add Pb standard solution (8 μg/ml) respectively in accordance with Table F.1 and add distilled water dropwise to 100 ml.

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