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Electroplated coatings of tin — Specification and test methods

Dépôts électrolytiques d'étain — Spécifications et méthodes d'essai

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 2093 was prepared by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings*.

This second edition cancels and replaces the first edition (ISO 2093-1973), of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Electroplated coatings of tin — Specification and test methods

0 Introduction

This International Standard specifies requirements for electroplated coatings of tin on fabricated metal articles to protect them from corrosion and to facilitate soldering.

Attention is drawn to legislative requirements that exist in many countries for tin coatings used in the food industry.

Annex C gives additional information as guidance to the user.

It is essential that the purchaser should state the information itemized in 4.1 and, if appropriate, 4.2. Specifying ISO 2093 without this information is insufficient.

1 Scope and field of application

This International Standard specifies requirements for electroplated coatings of nominally pure tin on fabricated metal articles. The coatings may be dull or bright as electroplated or may be flow-melted by fusion after electroplating.

It does not apply to

- a) threaded components;
- b) tin-coated copper wire;
- c) coatings on sheet, strip or wire in unfabricated form, or on articles made from them;
- d) coatings on coil springs;
- e) coatings applied by chemical means (immersion, autocatalytic or "electroless");
- f) electroplating of steels with tensile strength greater than 1 000 MPa¹⁾ (or of corresponding hardness), because such steels are subject to hydrogen embrittlement (see 8.2).

2 References

ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method.*

ISO 2064, *Metallic and other non-organic coatings — Definitions and conventions concerning the measurement of thickness.*

ISO 2177, *Metallic coatings — Measurement of coating thickness — Coulometric method by anodic dissolution.*

ISO 2819, *Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion.*

ISO 2859, *Sampling procedures and tables for inspection by attributes.*²⁾

ISO 3497, *Metallic coatings — Measurements of coating thickness — X-ray spectrometric methods.*

ISO 3543, *Metallic and non-metallic coatings — Measurements of thickness — Beta backscatter method.*

ISO 3768, *Metallic coatings — Neutral salt spray test (NSS test).*

ISO 4519, *Electrodeposited metallic coatings and related finishes — Sampling procedures for inspection by attributes.*

ISO 6988, *Metallic and other non-organic coatings — Sulfur dioxide test with general condensation of moisture.*

IEC Publication 68-2-20, *Basic environmental testing procedures — Test T: Soldering.*

3 Definitions

For the purpose of this International Standard, the following definitions apply.

3.1 significant surface: The part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance.

(Definition taken from ISO 2064.)

3.2 flow-melting; fusing; flow-brightening; reflowing: A process by which a coating is melted in order to impart desirable properties such as brightness or improved solderability (see clause C.4).

1) 1 MPa = 1 N/mm²

2) At present at the stage of draft. (Revision of ISO 2859-1974.)

4 Information to be supplied by the purchaser to the electroplater

4.1 Essential information

The following information shall be supplied by the purchaser to the electroplater:

- a) the number of this International Standard;
- b) the nature of the basis material (see clause 5);
- c) the service condition number (see 7.1) or the classification code of the coating required (see 7.2);
- d) the significant surface of the article to be electroplated indicated, for example, by drawings or by the provision of suitably marked samples;
- e) the sampling procedure to be adopted (see clause 6);
- f) the positions where unavoidable contact marks and other defects are acceptable (see 10.1);
- g) the method of adhesion testing to be used (see 10.3).

4.2 Additional information

The following additional information may be required and, if so, shall be specified by the purchaser:

- a) any heat treatment required (see clause 8);
- b) any requirements for porosity testing (see 10.4);
- c) any requirement for solderability testing and the test methods and conditions to be applied (see 10.5);
- d) any special requirements for undercoats (see clause 9);
- e) a sample showing the required finish (see 10.1);
- f) any special pretreatment required;
- g) any specific requirements for the purity of the coating (see clauses 0 and C.5);
- h) any special packaging requirements for plated components;
- i) any special post-plating treatment.

5 Basis material

This International Standard specifies no requirements for the condition, finish or surface roughness of the basis material prior to electroplating (see C.2.1).

6 Sampling

Sampling procedures are specified in ISO 2859 and ISO 4519.

The method of sampling and acceptance levels shall be agreed between purchaser and supplier.

7 Classification

7.1 Service condition number

The service condition number indicates the severity of the service conditions in accordance with the following scale:

- 4: exceptionally severe — for example service outdoors in severe corrosive conditions or contact with food or drink where a complete cover of tin has to be maintained against corrosion and abrasion (see C.1.1).
- 3: severe — for example service outdoors in typical temperate conditions
- 2: moderate — for example service indoors with some condensation
- 1: mild — for example service indoors in dry atmospheres or applications where solderability is the primary requirement

NOTE — See 10.2, which gives guidance on the relation between service condition number and minimum thickness.

When specifying the service condition number or coating classification code, it should be noted that tin is susceptible to damage in abrasive environments or in those containing certain organic vapours. See also C.1.1.

7.2 Coating classification code

The coating classification code shall consist of four parts, the first two of which shall be separated by an oblique stroke, as follows:

a/b c d

where

- a** indicates the chemical symbol for the basis metal (or for the main constituent if an alloy);
- b** indicates the chemical symbol for the undercoat metal (or for the main constituent if an alloy) followed by a figure for its minimum coating thickness, in micrometres, and is omitted if no undercoat is required [see 4.2 d)];
- c** indicates the chemical symbol for tin, Sn, followed by a figure for its minimum thickness, in micrometres;
- d** indicates the surface finish, by the symbol **m** if the coating is matt, or **b** if it is bright electroplated or **f** if it is flow-melted.

An example is

Fe/Ni 2.5 Sn 5 f

which represents an iron or steel basis metal, with a 2,5 µm nickel undercoat, tin electroplated to a coating thickness of 5 µm and flow-melted.

8 Heat treatment of steel

8.1 Stress relief before electroplating

Severely cold-worked steel parts shall be stress relieved before electroplating by heating for 1 h at 190 to 220 °C.

The properties of some steels which have been carburized, flame-hardened or induction-hardened and subsequently ground would be impaired by this treatment and shall instead be stress relieved at a lower temperature, for example at 130 to 150 °C for not less than 5 h.

8.2 Hydrogen embrittlement relief after electroplating

Because diffusion of hydrogen through tin is very slow, heat treatment for hydrogen embrittlement relief after electroplating is impractical.

9 Requirements for undercoats

Undercoats may be necessary on certain basis materials for any of the following reasons:

- to prevent diffusion (see C.2.2 and C.2.3);
- to retain solderability (see C.2.2, C.2.3 and C.2.4);
- to ensure adhesion (see C.2.4 and C.2.5);
- to improve protection against corrosion.

Care should be taken to select an undercoat or undercoat system that will not confer undesirable properties such as embrittlement of the basis material or finished article. For example the use of highly stressed nickel should be avoided.

If the basis material is a copper alloy containing zinc as an alloying constituent, and solderable properties are required, a nickel or copper undercoat of minimum local thickness 2,5 µm is essential in addition to the specified coating thickness of tin (see C.2.3); such coatings may also be necessary to retain good appearance and adhesion.

If an undercoat is specified, its nature (see annex C) and minimum local thickness (see 10.2) shall be specified by the purchaser.

The thickness of the undercoat or undercoats shall be measured by the appropriate method specified in annex A.

10 Requirements for coatings

10.1 Appearance

When examined by the unaided eye or corrected vision the significant surfaces of the electroplated article shall be free from any visible defects such as blisters, pits, roughness, cracks or unelectroplated areas, and shall not be stained or discoloured.

The acceptability and positions of unavoidable contact marks and defects on non-significant surfaces shall be specified by the purchaser.

The finished article shall be clean and free from damage. The surface shall be of a smooth texture, free from nodules and, where fused, shall be free from dewetted areas.

If necessary, a sample showing the required finish shall be supplied or approved by the purchaser.

10.2 Thickness

Tin coatings are classified by thickness and for each service condition (see 7.1), minimum values are specified in the table (see also C.3.2).

The thickness of the coating shall be measured over a reference area (see ISO 2064) by the appropriate method given in annex A on any part of the significant surface that can be touched with a 20 mm diameter ball. In the case of articles having a significant surface area of 100 mm² or greater, the minimum thickness shall be regarded as the minimum value of local thickness. In the case of articles having a significant surface area of less than 100 mm², the minimum thickness shall be regarded as the minimum value of average thickness.

In the case of printed circuit boards with electroplated-through holes, the requirements shall apply to the surfaces within the holes, as well as to the areas that can be touched with a 20 mm diameter ball.

In the case of flow-melted coatings, the thickness requirements apply to the as-electroplated condition, prior to flow-melting. (See C.3.2., clause C.4 and annex A.)

Table — Coating thicknesses

Service condition number	Copper basis materials ¹⁾		Other basis materials ²⁾	
	(Partial) classification code	Minimum thickness	(Partial) classification code	Minimum thickness
		µm		µm
4	Sn 30	30	Sn 30	30
3	Sn 15	15	Sn 20	20
2	Sn 8	10	Sn 12	12
1	Sn 5	5	Sn 5	5

1) Attention is drawn to the essential requirement in clause 9 for undercoats on copper alloy basis materials that contain zinc as an alloying constituent.

2) See C.2.4 and C.2.5 regarding the need to undercoat certain basis materials.