

INTERNATIONAL STANDARD

ISO
4977-2

First edition
1988-10-15



INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Double cold-reduced electrolytic tinplate —

Part 2 : Coil for subsequent cutting into sheets

Fer blanc électrolytique laminé à froid par double réduction —

Partie 2 : Bobines destinées à être découpées en feuilles

Reference number
ISO 4977-2:1988 (E)



Documents
Document Sharing Hub

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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 4977-2 was prepared by Technical Committee ISO/TC 17, *Steel*.

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.

ISO 4977 consists of the following parts, under the general title *Double cold-reduced electrolytic tinplate*:

- *Part 1 : Sheet*
- *Part 2 : Coil for subsequent cutting into sheets*

Annexes A, B and C form an integral part of this part of ISO 4977.

Double cold-reduced electrolytic tinplate —

Part 2 :

Coil for subsequent cutting into sheets

1 Scope and field of application

This part of ISO 4977 specifies requirements for double cold-reduced electrolytic tinplate that is supplied in coils for subsequent cutting into sheet by the purchaser. It applies to tinplate strip in nominal widths of 500 mm and greater and in nominal thicknesses that are in multiples of 0,01 mm from 0,14 mm up to and including 0,29 mm. Manufacturing conditions may restrict the maximum coil widths available in certain thicknesses.

It has not been possible, in preparing this first edition of ISO 4977-2, to specify mandatory requirements for mechanical properties. Test data are still limited and there are fundamental questions concerning what are the most relevant and reliable tests for evaluating the mechanical properties of double reduced tinplate. For guidance purposes, information is given in annex A on the levels of proof stress and hardness to be expected in practice; procedures for sampling and testing are recommended for the determination of these properties.

2 References

ISO 1024, *Metallic materials — Hardness test — Rockwell superficial test (scales 15N, 30N, 45N, 15T, 30T and 45T)*.¹⁾

ISO 6892, *Metallic materials — Tensile testing*.

3 Definitions

For the purpose of this part of ISO 4977, the following definitions apply.

3.1 anvil effect : The effect which a hard anvil can produce on the numerical hardness value obtained when a hardness test is performed on very thin sheet supported on such an anvil.

3.2 bulk package; bulk : A multiple packaging unit comprising a pallet (see 3.10), the tinplate and packaging material.

3.3 coil : A rolled flat strip product which is wound into regularly superimposed laps so as to form a coil with almost flat sides.

3.4 consignment : A quantity of coils of the same specification made available for despatch at the same time.

3.5 double cold-reduced differentially coated electrolytic tinplate : Double cold-reduced electrolytic tinplate, one surface of which carries a heavier tin coating than the other.

3.6 double cold-reduced electrolytic tinplate : Electrolytic tinplate, the steel base of which has received a second major cold-reduction following annealing.

3.7 electrolytic tinplate : Low-carbon mild steel sheet or strip coated on both surfaces with tin that is applied in continuous electrolytic operation using anodes of at least 99,75 % tin, in a plating bath.

3.8 feather edge : Variation in thickness, characterized by a reduction in thickness close to the edges, at right angles to the rolling direction.

3.9 line inspection : The final inspection of the finished product performed by instruments and/or by visual examination at normal line speeds.

3.10 pallet : Base platform on which a tinplate coil is stacked to facilitate transportation.

¹⁾ To be published.

3.11 rolling width : The width of the strip perpendicular to the rolling direction. When the strip is sheared into sheets, the shorter edges of the sheet are not necessarily parallel to the rolling width.

3.12 standard grade tinplate : Material in sheet form which does not contain any of the following :

- a) pinholes, i.e. any perforation through the whole thickness of the plate;
- b) areas of thickness outside the tolerance range specified in 9.4;
- c) significant surface defects which render the material unsuitable for the intended use;
- d) significant damage or shape related defects which render the material unsuitable for the intended use.

4 Information to be supplied by the purchaser

4.1 General

The following information shall be given on the enquiry and order to assist the manufacturer in supplying the correct material :

- a) a description of the material required, i.e. standard grade double cold-reduced electrolytic tinplate in coil;
- b) reference to this part of ISO 4977;
- c) the quantity, expressed on an area basis, and the dimensions of the tinplate required. The area in square metres is calculated as the product of the supplier's indicated length of the coiled strip and its ordered nominal width;
- d) the designation for the required mechanical properties of the tinplate and the tin coating masses on the two surfaces (see clause 5);

NOTE — Certain classifications are suitable for shaping operations, such as stamping, drawing, folding, beading and bending and assembly work such as joint forming, soldering and welding although soft soldering is impracticable and welding is only recommended if, prior to welding, removal of the coating layer is efficiently undertaken at surfaces comprising the weld area. The end use should be borne in mind when the classification is selected.

- e) if the strip is to be used for scroll shearing, the maximum acceptable lateral weave (see 9.6);
- f) the maximum outside diameter and mass of coils which can be handled;
- g) any further special requirements.

4.2 Options

In the event that the purchaser does not indicate his wish to implement any of the options included in this part of ISO 4977

and does not specify his requirements at the time of the enquiry and order, the product shall be supplied on the following basis :

- a) with a stone surface finish (see 6.2);
- b) with surface passivation treatment using cathodic sodium dichromate;
- c) with the location of each joint indicated by a piece of non-rigid material (see 10.3);
- d) with differential tin coatings indicated on the heavier coated surface by continuous parallel lines spaced at 75 mm intervals (see clause 12);
- e) with the cores of the coils vertical (see clause 15).

4.3 Additional information

In addition to the information in 4.1 and 4.2, the purchaser may wish to provide further information to the supplier to ensure that the order requirements are consistent with the end use of the product.

The purchaser shall inform the supplier of any modifications to his fabrication operations that will significantly affect the way in which the tinplate is used.

NOTE — When ordering double cold-reduced tinplate, the purpose of manufacture for which the tinplate is intended should be stated. It should be noted that double cold-reduced tinplate is relatively less ductile than single cold-reduced tinplate and has very distinct directional properties, so for some uses, for example for built-up can bodies, the direction of rolling should be stated. When double cold-reduced tinplate is used for built-up can bodies, the rolling direction should be around the circumference of the can so as to minimize the hazard of flange cracking.

5 Designations

For the purposes of this part of ISO 4977, the following designations apply.

5.1 Mechanical property classifications

The levels of mechanical properties with which double cold-reduced tinplate is supplied are designated in terms of the nominal 0,2 % proof stress, as shown in table 1.

Table 1 — Mechanical property classifications

Classification	Nominal 0,2 % proof stress N/mm ²
DR 550	550
DR 620	620
DR 660	660

5.2 Coating mass designations

The coating masses, and their combinations, with which tinplate is supplied are designated by the letters E (for equally coated) and D (for differentially coated) followed by numbers representing the nominal coating mass for each surface of the tinplate. Examples are shown in table 2.

Table 2 — Examples of tinplate designations

Tinplate	Designation
Tinplate with a nominal proof stress of 550 N/mm ² and equal tin coatings of 2,8 g/m ² for each surface	DR 550, E 2,8/2,8
Tinplate with a nominal proof stress of 620 N/mm ² and differential tin coatings of 8,4 g/m ² for one surface and 5,6 g/m ² for the other	DR 620, D 8,4/5,6

6 Manufacture, finish and defects

6.1 Manufacture

The methods of manufacture of tinplate are left to the discretion of the manufacturer and are not specified in this part of ISO 4977.

The purchaser shall be informed if an alteration is made to the method of manufacture that will affect the properties of the purchased tinplate.

NOTE — It is recommended that the manufacturer supplies to the purchaser such details of the manufacturing process as may assist the purchaser in his efficient use of the tinplate.

6.2 Finish

Double cold-reduced tinplate is usually supplied with a stone surface finish characterized by a directional pattern, imparted to the strip by the use of ground work rolls in the final stages of the second reduction operation, and by a flow-brightened tin coating. It may also be available with other surface finishes.

The surface of electrolytic tinplate is normally subjected to a passivation treatment and to oiling. Passivation, produced either by a chemical treatment or by an electrochemical treatment, gives a surface with an improved resistance to oxidation and improved suitability for lacquering and printing. The usual passivation procedure is a cathodic treatment in a solution of sodium dichromate.

NOTE — Under normal conditions of transport and storage, double cold-reduced electrolytic tinplate should be suitable for surface treatments such as established lacquering and printing operations.

6.3 Defects

The producer is expected to employ his normal quality control and line inspection procedures to ensure that the tinplate manufactured is in accordance with the requirements of this part of ISO 4977. However, the production of tinplate coils in continuous strip mill operations does not afford the opportunity for removal of all tinplate that does not comply with the requirements of this part of ISO 4977.

At the time of shearing, sheets not conforming to the standard grade shall be set aside by the purchaser or his agent.

If the amount of sheets set aside exceeds 15 %, the coil shall be deemed not to comply with this part of ISO 4977.

NOTE — Items c) and d) in 3.12 cannot be verified by specific tests and should be the subject of special agreement between producer and user.

If, when processing a double cold-reduced tinplate coil, the purchaser (or his agent) encounters recurring defects which in his opinion seem excessive, it is essential — where practicable — that he stops processing the coil and advises the supplier.

The purchaser is expected to have adequate handling, roller levelling and shearing equipment and to take reasonable care during these operations.

7 General requirements

Double cold-reduced electrolytic tinplate supplied in coils shall comply with the requirements of clauses 8 to 12.

When tests are carried out to verify compliance with the requirements of clauses 8 and 9, sample sheets shall be selected from consignments in accordance with clause 13.

For the determinations of coating mass and mechanical properties, test specimens shall be taken from the sample sheets in accordance with 14.1 and shall be tested in accordance with 14.2.

NOTE — No sampling or testing requirements are specified in this part of ISO 4977 for verifying that any oil coating applied to the coils is suitable for food packaging in accordance with clause 11.

The method of dispatching tinplate coils shall be in accordance with clause 15.

8 Tin coating mass

The average coating mass, on each surface, shall be expressed in grams per square metre (g/m²). The lowest value specified in this part of ISO 4977 shall be 1 g/m² on each surface, and no upper limit is specified.

Whatever the coating mass used, the tolerance shall be as indicated in table 3, and the mass per unit area for equally and differentially coated coils respectively is determined on specimens taken from samples selected in accordance with clause 13 and tested in accordance with 14.2.

NOTE — For both equally coated and differentially coated tinplates, individual specimens of the sample may show tin coatings as low as, for example, 80 % of the minimum average coating mass, but it is emphasized that isolated specimens have no representative value in relation to the consignment under consideration.

Table 3 — Minimum average tolerances on tin coating masses

Nominal coating mass for each surface (g/m ²)	Minimum average tolerance for each surface (g/m ²)
> 1,0 and < 1,5	– 0,25
> 1,5 and < 2,8	– 0,30
> 2,8 and < 4,1	– 0,35
> 4,1 and < 7,6	– 0,50
> 7,6 and < 10,1	– 0,65
> 10,1	– 0,90

9 Tolerances on dimensions and shape

9.1 Introduction

Tolerances on dimensions (i.e. coil length, strip width and thickness) and shape (i.e. edge camber, lateral weave) are specified in 9.2 to 9.6, together with appropriate methods of measurement.

Other geometrical features may be present in sheets cut from double cold-reduced electrolytic tinplate supplied in coil, such as :

burr : metal displaced beyond the plane of the surface of the sheet by shearing action;

edge wave : an intermittent vertical displacement occurring at the sheet edge when the sheet is laid on a flat surface;

centre buckle (full centre) : an intermittent vertical displacement or wave in the sheet occurring other than at the edges;

longitudinal bow (line bow) : residual curvature in the sheet along the direction of rolling;

transverse bow (cross bow) : curvature of the sheet such that the distance between its edges parallel to the rolling direction is less than the sheet width.

Although it is not possible at present to specify methods of measuring or to specify limits for these geometrical features, certain of which are subject to the equipment employed by the purchaser, the producer should endeavour to keep the occurrence and magnitude of burr, edge wave, centre buckle and transverse bow to a minimum. He should also endeavour to minimize the variation of the longitudinal bow.

9.2 Coil length

The difference between the actual length and the producer's indicated length, measured on any single coil, shall not exceed $\pm 3\%$.

The accumulated difference between the actual lengths and the producer's indicated lengths, measured on at least 100 coils, shall not exceed $\pm 0,1\%$.

NOTE — The purchaser normally verifies the length of a coil by multiplying the average length of the sheets sheared from the coil by the number of sheets obtained and adding the accumulated lengths of any other portions of the coil as received. The average length of the sheets sheared from the coil is normally determined by measuring the lengths of at least ten sheets, taken at random, to an accuracy of 0,2 mm. Coil lengths may be measured by other methods, provided that the method adopted is acceptable to both the producer and the purchaser.

9.3 Width

9.3.1 Width measurement

The width of each sample sheet shall be measured to the nearest 0,5 mm. The width shall be measured across the centre of the sheet, at right angles to the rolling direction, with the sheet lying on a flat surface.

9.3.2 Width tolerance

The width, measured by the method given in 9.3.1 on each sample sheet selected in accordance with clause 13, shall be not less than the ordered width and shall not exceed the ordered width by more than 3 mm.

9.4 Thickness

9.4.1 Thickness determinations

9.4.1.1 General

Thickness shall be determined either by the weighing method described in 9.4.1.2, or by direct measurement using the micrometer method described in 9.4.1.3.

In cases of dispute and for all retests, the weighing method shall be the referee method.

However the transverse thickness profile shall be measured using the micrometer method (see 9.4.1.3).

9.4.1.2 Weighing method

9.4.1.2.1 Determine the thickness of each sample sheet as follows :

- Weigh the sheet to obtain the mass to the nearest 2 g.
- Measure the length and width of the sheet to the nearest 0,5 mm and calculate the area.
- Calculate the thickness of the sheet, to the nearest 0,001 mm, using the following formula :

$$\text{thickness (mm)} = \frac{\text{mass (g)}}{\text{area (mm}^2\text{)} \times 0,007\,85 \text{ (g/mm}^3\text{)}}$$

9.4.1.2.2 To determine the average thickness for a consignment, calculate the arithmetic mean of the calculated thicknesses of all the sample sheets representing the consignment.

9.4.1.2.3 To determine the variation of thickness within each sample sheet, take two specimens Y (see figure 1) from the sheet. Weigh each specimen to the nearest 0,01 g, measure the length and width of each specimen to the nearest 0,1 mm, and calculate the thickness of each specimen to the nearest 0,001 mm using the formula given in 9.4.1.2.1 c).

9.4.1.3 Micrometer method

9.4.1.3.1 Determine the thickness of each sample sheet by direct measurement using a hand-operated, spring-loaded micrometer which permits readings to 0,001 mm. Measure the thickness to an accuracy of 0,001 mm, at least 10 mm from the trimmed edge of the sheet.

NOTE — It is recommended that the micrometer should have a ball-ended shank anvil of approximately 3 mm diameter, a curved surface base anvil of approximately 25 mm radius and a face diameter of approximately 13 mm.