
International Standard



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● Double cold-reduced electrolytic tinplate — Part 1 : Sheet

Fer-blanc électrolytique laminé à froid par double réduction — Partie 1 : Feuilles

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Foreword

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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.

International Standard ISO 4977/1 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in March 1983.

It has been approved by the member bodies of the following countries :

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No member body expressed disapproval of the document.

Double cold-reduced electrolytic tinplate — Part 1 : Sheet

1 Scope and field of application

This part of ISO 4977 specifies the characteristics of double cold-reduced electrolytic tinplate sheet in low carbon cold-reduced mild steel. It applies to products in nominal thicknesses from 0,14 mm up to and including 0,29 mm according to mechanical properties classification.

It does not apply to double cold-reduced tinplate in coils or to single cold-reduced tinplate or to material described commercially as tinned sheets, steel sheets, blackplate or electrolytic chromium/chromium oxide coated steel (ECCS).

2 References

ISO/R 1024, *Rockwell superficial hardness test (N and T scales) for steel*.

ISO 6892, *Metallic materials — Tensile testing*.

3 Definitions

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

3.1 double cold-reduced electrolytic tinplate : Low carbon mild steel sheet coated on both surfaces with tin, applied by electro-deposition, the steel base of which has received a second major cold reduction following annealing.

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

3.3 consignment : A quantity of double cold-reduced tinplate of the same dimensions and quality made available for despatch at the same time.

4 Conditions of manufacture and utilization

4.1 The methods of manufacture of double cold-reduced tinplate are the province of the producer.

4.2 The methods of using double cold-reduced tinplate are the province of the user.

4.3 The tin used for the coating shall have a purity of not less than 99,75 %.

4.4 The chemical composition of the steel may be agreed upon between the producer and the purchaser provided that it is consistent with this part of ISO 4977 (see clause 15).

4.5 At the time that it is made available by the producer and under normal conditions of transport and storage, double cold-reduced tinplate is suitable for surface treatments such as established lacquering and printing operations. Appropriate grades are suitable for folding, bending and assembly work such as joint forming, soldering and welding, but caution is necessary when considering certain applications due to the ductility and directional properties of double cold-reduced tinplate. The purchaser's order requirements shall be consistent with the end use of the product.

4.6 Surface finishes

Double cold-reduced electrolytic tinplate is customarily supplied with a finish imparted to the strip by use of ground work rolls in the final stages of double reduction and by a flow-brightened tin coating. The product may also be available with an unmelted tin coating.

4.7 Surface treatments

4.7.1 Passivation treatment

Passivation is a chemical or electrochemical treatment applied to the surface of electrolytic tinplate to produce a surface of improved resistance to discolouration and superior lacquering and printing quality. The usual procedure is cathodic treatment in a solution of sodium dichromate [see 15d)].

4.7.2 Oiling

Normally the surface of electrolytic tinplate has applied to it a very thin coating of an oil which is suitable for food packaging [see 15a)].

NOTES

1 When ordering double cold-reduced tinplate, it is recommended that the purpose for which the double cold-reduced tinplate is intended be stated. Double cold-reduced tinplate is relatively less ductile (when compared with single-reduced products) and has very distinct directional properties.

When double cold-reduced tinplate is used for built-up can bodies, it is essential that the rolling direction should be around the circumference of the can so as to minimize the hazard of flange cracking. In such cases it is imperative that the rolling direction be clearly designated on the contract.

2 It is recommended that, if requested, the producer supply to the purchaser such details of the steel making process as may assist the purchaser in his efficient use of the material. It is further recommended that the purchaser be informed of any alterations in the method of manufacture which will significantly affect the properties of the purchased product. Similarly it is recommended that the purchaser informs the producer of modifications to the fabrication methods which will significantly affect the way in which the purchased product is used.

5 Material grading

5.1 Double cold-reduced electrolytic tinplate, standard grade

Standard grade double-cold-reduced electrolytic tinplate represents the normal production of lines employing the usual inspection and classification procedures. In normal conditions of storage and use, standard grade double cold-reduced electrolytic tinplate permits lacquering and printing over the entire surface.

NOTES

1 The surface appearance of double cold-reduced electrolytic tinplate is different from and not so consistent as that of single cold-reduced electrolytic tinplate.

2 Double cold-reduced electrolytic tinplate, second grade, is available in certain countries. It represents the best sheets rejected from the standard grade but may contain sheets exhibiting surface imperfections, tinning defects and shape and other defects to a minor extent (but not pinholes or off-thickness material). Suitability for lacquering and printing over the entire surface is not guaranteed.

6 Tin-coating masses

6.1 Expression of tin-coating masses

Tin-coating masses shall be expressed in grams per square metre (g/m²).

6.2 Double cold-reduced electrolytic tinplate, equally coated

A number of coating masses are specified as shown in table 1.

Table 1 — Coating masses for double cold-reduced tinplate, equally coated

Designation ¹⁾	Nominal coating mass, ¹⁾ g/m ²		Minimum average coating mass (see 6.4), g/m ²
	Per surface	Total both surfaces	Total both surfaces
E 2,8/2,8	2,8	5,6	4,9
E 5,6/5,6	5,6	11,2	10,5
E 8,4/8,4	8,4	16,8	15,7
E 11,2/11,2	11,2	22,4	20,2

1) The conventional designation corresponds to the nominal coating mass on each surface of the tinplate.

6.3 Double cold-reduced electrolytic tinplate, differentially coated

A number of coating masses are specified in table 2.

Table 2 — Coating masses for double cold-reduced tinplate, differentially coated

Designation ¹⁾	Nominal coating mass, ¹⁾ g/m ²		Minimum average coating mass (see 6.4), g/m ²	
	Heavily coated surface	Lightly coated surface	Heavily coated surface	Lightly coated surface
D 5,6/2,8	5,6	2,8	4,75	2,25
D 8,4/2,8	8,4	2,8	7,85	2,25
D 8,4/5,6	8,4	5,6	7,85	4,75
D 11,2/2,8	11,2	2,8	10,1	2,25
D 11,2/5,6	11,2	5,6	10,1	4,75

1) The conventional designation corresponds to the nominal coating mass on each surface of the tinplate.

6.4 The average value of the coating masses of the sample selected to represent a consignment in accordance with clause 9 and tested in accordance with clause 10 shall not be lower than the appropriate minimum average coating mass specified in tables 1 or 2.

NOTES

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

2 In practice, the producer aims to apply the nominal coating mass, the minimum average coating mass values only occasionally being encountered.

6.5 Marking of differentially coated double reduced tinplate

In order to distinguish material having differential coatings, the sheet should be marked on one surface which, by agreement, can be either the lightly or the heavily coated surface. In all cases, both the surface to be marked and the surface which is to be piled uppermost should be clearly designated on the contract by the purchaser. Generally the marking system should be made on the heavier coated surface in the form of dull straight continuous parallel lines about 1 mm wide (see annex A). If the marking is on the lighter coated surface, then at least alternate lines should be interrupted, or geometrical patterns may be used.

7 Mechanical properties

7.1 No test or group of tests has been developed that adequately predicts all the factors affecting the fabricating performance of double-cold reduced electrolytic tinplate, the primary consideration being that the plate shall perform satisfactorily for the stated end use. Designations for mechanical properties arranged in generally ascending levels of strength are shown in table 3, though it is not technologically appropriate to define these to exacting limits.

7.2 The tensile test (see clause B.1 in annex B) or, when agreed between the producer and the purchaser, the springback test (see clause B.2 in annex B) or the Rockwell superficial hardness test (see clause B.3 in annex B) shall be used for evaluation of mechanical properties. The samples shall be selected in accordance with clause 8. Average values and not individual values shall be considered.

7.3 The purchaser shall select the classification he requires from table 3 and the producer shall aim to meet the values specified as appropriate.

Table 3 — Mechanical properties

Classification	Proof stress (0,2 % non-proportional elongation ¹⁾ longitudinal, N/mm ²	Rockwell hardness HR 30T
DR 550 (DR 8)	550 ± 70	73 ± 3
DR 620 (DR 9)	620 ± 70	76 ± 3
DR 660 (DR 9M)	660 ± 70	77 ± 3

1) The term tensile yield strength (0,2 % offset) is used in the USA and Canada.

8 Dimensional requirements

8.1 Thickness

8.1.1 Nominal thickness

Double cold-reduced electrolytic tinplate ordered in metric thicknesses is normally available in any nominal thickness which is a multiple of 0,01 mm from 0,14 mm up to and including 0,29 mm.

8.1.2 The producer shall aim to produce the thickness ordered.

8.1.3 Determination of thickness

8.1.3.1 The average thickness of the consignment may be determined by weighing whole sheets, or by direct measurement using a micrometer. When the weighing technique is used, the mass of each whole sheet is determined, its area is measured, and the thickness determined by applying the formula given in 8.1.3.2.

The mass of the sheet shall be determined to a precision of 2 g and the dimensions of the sheet shall be measured to a precision of 0,5 mm. The thickness shall be stated to the nearest 0,001 mm.

If the average thickness of a consignment is to be determined by direct measurement, a hand operated spring loaded micrometer shall be used. It shall be accurate to 0,001 mm. The measurement of thickness shall be carried out at least 10 mm from the trimmed edge.

In any case of dispute, retesting of thickness by the weighing method only shall be employed.

NOTE — It is recommended that when a micrometer is used it 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.

8.1.3.2 Thickness shall be calculated by applying the formula

$$d = \frac{m}{S \times 0,00785}$$

where

d is the thickness of the sheet, in millimetres;

m is the mass of the sheet, in grams;

S is the actual area of the sheet in square millimetres.

8.1.3.3 For determining the variation of thickness within a sheet, using the specimens Y (see figure 3), either the weighing or the direct measurement technique may be employed. If the former, the thickness of each of the specimens Y shall be determined by weighing the specimen, measuring the area and applying the formula given in 8.1.3.2 above.

The mass of the specimens shall be determined to a precision of 0,01 g or better, and the dimensions of the specimen shall be measured to a precision of 0,1 mm. The thickness shall be to the nearest 0,001 mm.

If the variation in thickness is determined by direct measurement, the micrometer to be used shall be as defined in 8.1.3.1 and the specimen Y (see figure 3) shall be measured at two locations. The thickness shall be stated to the nearest 0,001 mm.