International Standard 5950

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

Continuous electrolytic tin-coated cold-reduced carbon steel sheet of commercial and drawing qualities

Tôles en acier au carbone laminées à froid, revêtues en continu d'un dépôt électrolytique d'étain, de qualité commerciale et pour emboutissage

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Descriptors : steels, unalloyed steels, cold rolled products, metal coatings, clad metals, tin coatings, designations, specifications, chemical composition, sampling, tests, mechanical tests, mechanical properties, tensile properties, hardness, dimensional tolerances, form tolerance, flatness.

Price based on 11 pages

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 5950 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in March 1978.

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

Austria	Ireland	South Africa, Rep. of
Belgium	Italy	Spain
Bulgaria	Japan	Sweden
Canada	Korea, Dem. P. Rep. of	Switzerland
Denmark	Korea, Rep. of	Turkey
Egypt, Arab Rep. of	Mexico	United Kingdom
France	Netherlands	USA
Germany, F. R.	Norway	USSR
India	Poland	
Iran	Romania	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
New Zealand

Printed in Switzerland

Continuous electrolytic tin-coated cold-reduced carbon steel sheet of commercial and drawing qualities

1 Scope and field of application

1.1 This International Standard applies to cold-reduced carbon steel sheet of commercial and drawing qualities coated in coil form by electro-deposition of tin. The product is commonly known as electrolytic tin-coated sheet and is used where solderability is desired, appearance is important, or a degree of corrosion resistance under specific conditions is advantageous. The coating mass may be specified in accordance with table 2. The coating is expressed as the total coating on both surfaces in grams per square metre. The coating mass specified should be compatible with the desired service life, thickness of the base metal and the forming requirements involved. A designation system (see 3.2) includes the coating designation, coating condition and quality.

1.2 Electrolytic tin-coated sheet[1] is normally produced in the range of thicknesses 0,50 to 0,85 mm inclusive and in widths of 600 mm to 1 050 mm in coil form and cut lengths.

NOTE — Approximate conversions to inches given in the annex, for information only.

1.3 Commercial quality electrolytic tin-coated sheet (quality 01) is intended for general fabricating purposes where sheet is used in the flat, or for bending or moderate forming.

1.4 Drawing quality electrolytic tin-coated sheet (qualities 02, 03, 04) is intended for drawing or severe forming. It is furnished to all requirements of this International Standard, or, with agreement where ordered, to fabricate an identified part in which case the mechanical properties in table 3 do not apply. Drawing qualities are identified as follows :

02 — Drawing quality

03 — Deep drawing quality

04 — Deep drawing quality special killed (non-ageing)

1.5 This International Standard does not cover tinplate and blackplate.

2 References

ISO 82, *Steel — Tensile testing.*

ISO/R 85, *Bend test for steel.*

ISO 86, *Steel — Tensile testing of sheet and strip less than* 3 mm *and not less than* 0,5 mm *thick.*

ISO/R 87, *Simple bend test of steel sheet and strip less than* 3 mm *thick.*

3 Definitions and other information

3.1 electrolytic tin-coated sheet : A product obtained by electrolytic deposition of tin on cold-reduced steel sheet on a continuous electrolytic tinning line to produce either tin-coated coils or tin-coated cut lengths.

3.2 Designation system

The as-produced electrolytic tin-coated sheet coatings are designated as SN, as shown in table 2. The coating mass designation follows the SN and three spaces are allocated for coating mass designation. If only two spaces are required, such as for designation 56, then the 56 is preceded by a "0" to fill the computer space and is shown as "056". Since this product is always skin-passed, the section in this designation system usually reserved for S or N will be used to indicate whether the tin has been reflowed or whether it is "matt" or not reflowed. (See 3.5 and 3.7.) Therefore the designations for this tin condition will be

BR : Bright reflowed, fused, melted

MA : Matt, dull, not reflowed, unmelted

The numbers 01, 02, 03 and 04 are common to other standards indicating the qualities of commercial, drawing, deep drawing, and deep drawing special killed. An example of a complete designation system, including coating, coating mass, coating

1) Some world markets define "electrolytic tinplate" as having a maximum thickness of 0,38 mm, in which case the thickness range for "electrolytic tin-coated sheet" will have a minimum of 0,38 mm.

condition and quality is SN056BR03. This is composed by combining the following :

SN : Tin coating

056 : Coating designation (see table 2)

BR : Bright; tin has been reflowed

03 : Deep drawing quality

3.3 skin pass : A light cold rolling of the cold-reduced and annealed sheet prior to electrotinning. The purposes of skin passing are one or more of the following :

a) to control surface smoothness and to improve appearance. This process may adversely affect the ductility of the base metal;

b) to minimize temporarily the occurrence of conditions known as stretcher strains (Lüder lines) or fluting during fabrication of finished parts;

c) to control shape.

3.4 Mill passivation

A passivating chemical or electrochemical treatment is applied to the surface of electrolytic tin-coated sheet to stabilize the plate surface characteristics compatible with a specific application.

3.5 Coating condition

The as-produced tin-coated sheet has a dull (matt) appearance. (See 3.2 and 3.7.) If it is heated to the melting point of tin, the tin reflows and has a bright (fused, melted) appearance. Some iron-tin alloy will also form at the steel surface interface during this heating process.

Normally "matt" finish sheet is produced from cold-reduced sheet having a "shot-blasted" surface, and "bright" finish sheet is produced from cold-reduced sheet having a "ground" roll surface. (See 3.7.) All tinning lines have strip thickness limits on bright finish sheet because of melting limitations.

3.6 Oiling

Electrolytic tin-coated sheet always has a lubricant film applied to both surfaces of the sheet as the last operation in the tinning line prior to shearing or coiling, to minimize abrasion.

3.7 Surface finish

Normally two surface finishes are produced for electrolytic tin-coated sheet. These surfaces are obtained by skin passing the strip on either shot-blasted or ground rolls. Shot-blasted rolls impart a rough (SBF) finish produced for *matt* (dull, unmelted, not reflowed) finish tin-coated sheet, while ground rolls impart a smooth (BR) finish produced for *bright* (reflowed, melted, fused) electrolytic tin-coated sheet. The required finish shall be specified at the time of ordering.

4 Conditions of manufacture

4.1 Steelmaking

The processes used in making the steel and in manufacturing electrolytic tin-coated sheet are left to the discretion of the producer. When requested, the purchaser shall be informed of the steelmaking process being used.

4.2 Chemical composition

The chemical composition (cast analysis) would not be expected to exceed the values given in table 1.

Table 1 — Chemical composition, %

Quality		C	Mn	P	S
Designation	Name	max.	max.*	max.*	max.
01	Commercial	0,15	0,60	0,05	0,05
02	Drawing	0,12	0,50	0,04	0,04
03	Deep drawing	0,10	0,45	0,03	0,03
04	Deep drawing special killed (non-ageing)	0,08	0,45	0,03	0,03

* Higher maximum required for certain applications subject to agreement.

4.3 Chemical analysis

4.3.1 Cast analysis

A cast analysis of each cast of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus, and sulphur. When requested, this analysis shall be reported to the purchaser or his representative.

4.3.2 Verification analysis

A verification analysis may be made by the purchaser to verify the specified analysis of the semi-finished or finished steel and shall take into consideration any normal heterogeneity. Non-killed steels (such as rimmed or capped) are not technologically suited to verification analysis. For killed steels, the sampling method and deviation limits shall be agreed upon between manufacturer and purchaser at the time of ordering.

4.4 Coating mass

The coating mass shall conform to the requirements presented in table 2 for the specific coating designation. The coating mass is the total amount of the tin, including both sides of the sheet, expressed in grams per square metre (g/m^2) of sheet. Methods checking that the material complies with this standard are given in 6.2.1 and 7.2.

4.5 Weldability

The product is suitable for welding if appropriate welding conditions are selected; however because of its excellent solderability, welding is seldom performed.

4.6 Application

Tin-coated steel shall be identified for fabrication by name of the part or by the intended application. Steel sheet of drawing qualities (02, 03 and 04) may be produced to make an identified part, which shall be previously agreed upon between manufacturer and purchaser. In this case, the part name, the details of fabrication and special requirements (freedom from stretcher strains, or fluting, coating performance requirements) shall be specified and the mechanical properties of table 3 do not apply.

4.7 Mechanical properties

Except when ordered to an identified part as explained in 4.6, at the time that the steel is made available for shipment the mechanical properties shall be as stated in table 3 when they are determined on test pieces obtained according to the requirements of 6.1 (mechanical tests). Prolonged storing of the sheet can cause changes in mechanical properties (increase in hardness and a decrease in elongation), leading to a decrease in drawability. To minimize this effect, quality 04 should be specified.

5 Dimensional tolerances

Dimensional tolerances applicable to electrolytic tin-coated steel sheet shall be as given in tables 4 to 12 inclusive.

6 Sampling

6.1 Mechanical tests

6.1.1 Tensile test

When ordered to mechanical properties, one representative sample for the tensile test required in table 3 shall be taken from each lot of sheet for shipment. A lot consists of 50 tonnes or less of sheet of the same quality rolled to the same thickness and condition.

6.1.2 Bend test (when specified)

One representative sample for the bend test (quality 01) shall be taken from each lot of sheet for shipment. A lot consists of all sheet of the same quality rolled to the same thickness and condition.

6.2 Coating tests

6.2.1 Mass of coating

The manufacturer shall make such tests and measurements as he deems necessary to ensure that the material produced complies with the values in table 2. The purchaser may verify the mass of coating by use of the following sampling method :

Three specimens shall be cut, one from the mid-width position, and one from each side not closer than 25 mm from the side edge. The minimum specimen area should be 2 000 mm^2.

7 Test methods

7.1 Mechanical tests

7.1.1 Tensile test (base metal)

The tensile test shall be carried out in accordance with ISO 82 and ISO 86. Transverse test pieces shall be taken mid-way between the centre and edge of the sheet as rolled. Because the tin coating is very thin, ends of test pieces are not usually required to have the tin removed prior to testing.

7.1.2 Bend test (when specifced)

The transverse bend piece (quality 01) shall withstand being bent in the direction as shown in figure 1 through 180°, without cracking on the outside of the bent portion, around the inside diameter as shown in table 3. The bend test shall be performed at ambient temperature and is described in ISO/R 85 and ISO/R 87. Small cracks on the edges of test pieces, and cracks which require magnification to be visible, shall be disregarded.

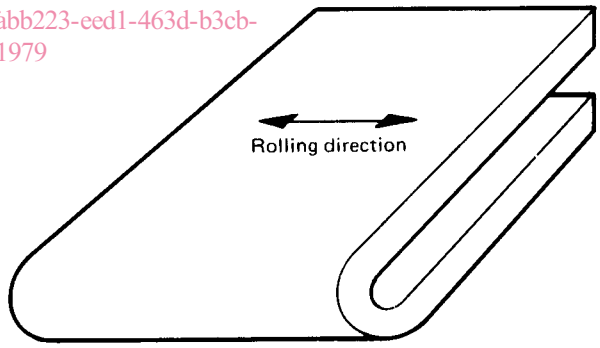

Figure 1 — Transverse bend test piece (after bending)

7.2 Coating tests

7.2.1 Triple spot test

The triple spot test result is the average coating mass found on the three specimens taken according to 6.2.1. The tin-coating mass may be determined by any of the recognized and accepted analytical methods.

7.2.2 Single spot test

The single spot test result shall be the minimum coating mass found on any one of the three pieces used for the triple spot test. Material which has been slit from wide coil shall be subject to a single spot test only.

8 Retests

If a test does not give the specified results, two more tests shall be taken at random from the same lot. Both retests shall conform to the requirements of this International Standard; otherwise, the lot may be rejected.

9 Resubmission

9.1 The manufacturer may resubmit for acceptance the products that have been rejected during earlier inspection because of unsatisfactory properties, after he has subjected them to a suitable treatment (selection, slitting) which, on request, will be indicated to the purchaser. In this case, the tests should be carried out as if they applied to a new batch.

9.2 The manufacturer has the right to present the rejected products to a new examination for compliance with the requirements for another grade.

10 Workmanship

The electrolytic tin-coated steel sheet in cut lengths shall be free from amounts of laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing. Processing for shipment in coils does not afford the manufacturer the opportunity to observe readily or to remove defective portions as can be carried out on the cut length product.

11 Inspection and acceptance

11.1 While not usually required for products covered by this International Standard, when the purchaser specifies that inspection and tests for acceptance be observed prior to shipment from the manufacturer's works, the manufacturer shall afford the purchaser's inspector all reasonable facilities to determine that the steel is being furnished in accordance with this International Standard.

11.2 Steel that is reported to be defective after arrival at the user's works shall be set aside, properly and correctly identified and adequately protected. The supplier shall be notified in order that he may properly investigate.

12 Coil size

When electrolytic tin-coated steel sheet is ordered in coils, a minimum or range of acceptable inside diameter (I.D.) shall be specified. In addition, the maximum outside diameter (O.D.) and maximum acceptable coil mass shall be specified.

13 Marking

Unless otherwise stated, the following minimuim requirements for identifying the steel shall be legibly stencilled on the top of each lift or shown on a tag attached to each coil or shipping unit :

a) the manufacturer's name or identifying brand;

b) the number of this International Standard;

c) designation (coating, coating mass, coating condition and quality of base metal);

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass.

14 Information to be supplied by the purchaser

To adequately specify requirements under this International Standard, inquiries and orders shall include the following information :

a) the number of this International Standard;

b) the name and designation of the material, for example electrolytic tin-coated sheet, 056 coating, bright commercial quality, SN056BR01 (see 1.3, 1.4 and 3.2);

c) the dimensions of product (the thickness includes the coating) and quantity required.

d) the finish, i.e. whether SBF or ground roll (see 3.7);

e) the application (name of part), if possible (see 4.6);

f) for drawing qualities (03 and 04), whether ordered to mechanical properties (see 4.7) or to fabricate an identified part (see 4.6);

g) coil size requirements (see clause 12);

h) whether a report of the cast analysis, is required (see 4.3.1);

i) details of fabrication or special requirements;

j) inspection and tests for acceptance prior to shipment from the producer's works, if required (see 11.1).

NOTE — A typical ordering description is as follows :

International Standard ISO 5950, Electrolytic tin-coated steel sheet, 056BR, commercial quality, designation SN056BR01, 0,7 × 1 200 mm × coil, 20 000 kg, to form cookie tins, ≠ 6201.

Table 2 — **Mass of coating** (total both sides)[1]

Coating designation	Nominal coating g/m²	Minimum coating mass limits	
		Triple spot test check limits g/m² (of sheet)	Single spot test check limits g/m² (of sheet)
SN056	5,6	3,7	2,8
SN112	11,2	7,3	5,6
SN168	16,8	11,0	8,2
SN224	22,4	14,6	11,0

1) Because of the many variables and changing conditions that are characteristic of continuous tin coating, the mass of coating is not always evenly divided between the two surfaces of a tin-coated sheet; neither is the tin coating evenly distributed from edge to edge. However, it can normally be expected that not less than 40 % of the single-spot check limit will be found on either surface.

Table 3 — **Mechanical properties**[1] (see 4.7)

Quality		R_m max.[2] N/mm²	A min. %[3]		180° bend mandrel diameter	Hardness, max.[4]	
Designation	Name		L_o = 50 mm	L_o = 80 mm		HRB	HR30 T
01	Commercial				0 (flat on itself)	5)	
02	Drawing	370	31	30		59	56
03	Deep drawing	350	35	34		53	52
04	Deep drawing special killed (non-ageing)	340	37	36		53	52

1) R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

HRB = hardness Rockwell B scale

HR30 T = hardness Rockwell 30 T scale

1 N/mm² = 1 MPa

2) Minimum tensile strength for qualities 02, 03 and 04 would normally be expected to be 270 N/mm². All tensile strength values are determined to the nearest 10 N/mm².

3) For material up to and including 0,6 mm in thickness the elongation values in the table shall be reduced by 1. Minimum elongation values on a gauge length of $L_o = 5{,}65\sqrt{S_o}$ may be the subject of agreement between the interested parties.

4) Equivalent Vickers hardness values are allowed by agreement between the producer and the purchaser at the time of ordering. By agreement between the producer and purchaser, no hardness requirements need apply. The hardness of sheet thinner than 0,6 mm shall be measured exclusively in compliance with HR30 T scale.

5) The hardness of qualitz 01 steel sheet is expected not to exceed the equivalent of Rockwell HRB 65 at the time it is made available for shipment.

Table 4 — Standard thickness tolerances for coils[1] and cut lengths

Unless otherwise stated on the order, the thickness tolerances for all qualities of electrolytic tin-coated steel sheet should be in accordance with table 4. When required, special tolerances may be the subject of agreement between the interested parties.

Values in millimetres

Specified widths	Thickness tolerances[2], over and under, for specified thicknesses		
	up to and including 0,6	over 0,6 up to and including 0,8	over 0,8
Up to and including 1 050	0,08	0,09	0,10

1) The thickness tolerances for sheets in coil form are the same as for sheets supplied in cut lengths but in cases where welds are present, the tolerances shall be double those given over a length of 15 m in the vicinity of the weld.

2) Thickness is measured at any point on the sheet not less than 40 mm from a side edge.

Table 5 — Width tolerances for coils and cut lengths, not resquared

Values in millimetres

Specified widths	Tolerance
Up to and including 750	$^{+5}_{0}$
Over 750 up to and including 1 050	$^{+7}_{0}$

Table 6 — Length tolerances for cut lengths, not resquared

Values in millimetres

Specified lengths	Tolerance
Up to and including 3 000	$^{+20}_{0}$
Over 3 000	$^{+30}_{0}$

Table 7 — Camber tolerances for coils and cut lengths, not resquared

Form	Camber tolerance
Cut lengths	0,4 % × length
Coils	20 mm in any 5 000 mm length

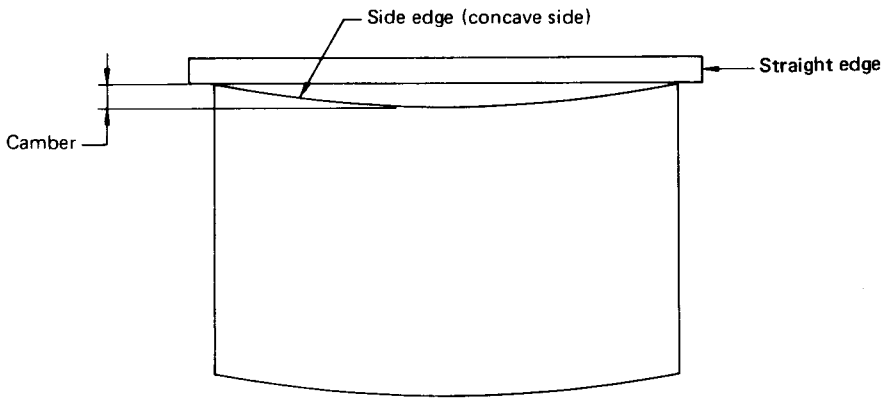

Figure 2 — Measurement of camber

Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straightedge.

Table 8 — Out-of-square tolerance for cut lengths, not resquared

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1,0 % × width

Table 9 — Out-of-square tolerances for resquared[1] material

Values in millimetres

Specified lengths	Specified widths	Out-of-square tolerance
Up to and including 3 000	All widths	$+\,^{2}_{0}$
Over 3 000	All widths	$+\,^{3}_{0}$

1) When measuring material to resquared tolerances, consideration may have to be given to extreme variations in temperature.

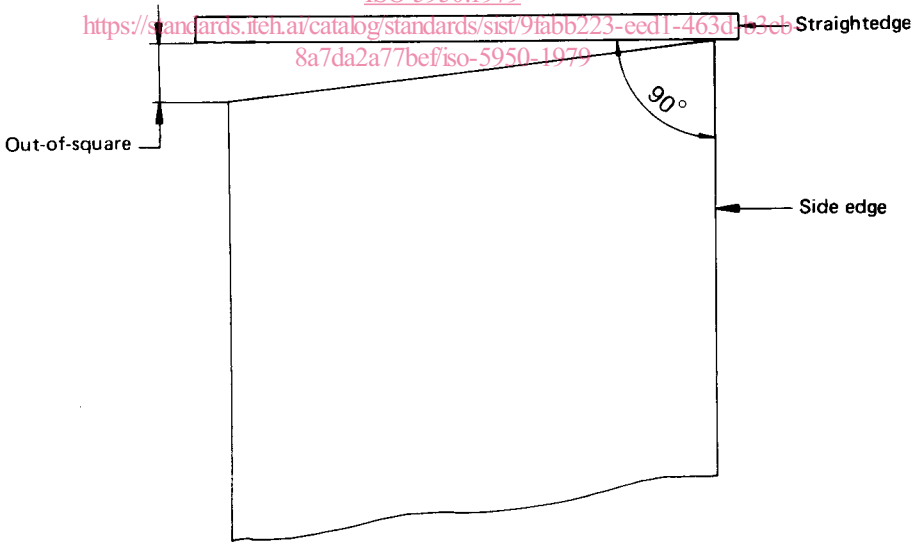

Figure 3 — Measurement of out-of-square

Out-of-square is the greatest deviation of an end edge from a straight line at right angles to a side and touching one corner, the measurement being taken as shown in figure 3. It can also be measured as one-half the difference between the diagonals of the cut length sheet.