INTERNATIONAL STANDARD

ISO 5950

Third edition
2000-06-15

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

Reference number
ISO 5950:2000(E)

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Printed in Switzerland

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 5950 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This third edition cancels and replaces the second edition (ISO 5950:1991), which has been technically revised.

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

1 Scope

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 and coating mass may be specified. 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 (clause 4) includes the coating designation, coating condition and quality.

1.2 Electrolytic tin-coated sheet[1)] is normally produced in thicknesses from 0,50 mm to 0,85 mm and widths of 600 mm to 1 050 mm, in coils and cut lengths.

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 according to the requirements of this International Standard or, with agreement where ordered, to fabricate an identified part, in which case mechanical properties do not apply. Drawing qualities are identified as follows:

— 02 drawing quality;

— 03 deep drawing quality;

— 04 deep drawing quality aluminum killed (non-ageing).

1.5 This International Standard does not cover tinplate and blackplate.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature.*

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.

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
electrolytic tin-coated sheet
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
skin pass
light cold rolling of the cold-reduced and annealed sheet prior to electrotinning

NOTE The purposes of skin passing are one or more of the following:

a) to minimize the appearance of coilbreaks, stretcher strains and fluting;

b) to control the shape;

c) to obtain the required surface finish.

An increase in hardness and some loss in ductility will result from skin passing.

3.3
aluminium killed
steel which has been deoxidized with aluminium sufficient to prevent the evolution of gas during solidification

4 Designation system

The as-produced electrolytic tin-coated sheet coatings are designated as SN, as shown in Table 3. 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 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 where the tin has been reflowed or whether it is “matt” or not reflowed (see 5.7 and 5.10). Therefore the designations for this tin condition are as follows:

— 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 aluminum killed.

EXAMPLE SN056BR03 is a complete designation, including coating, coating mass, coating condition and quality signifying:

— SN: tin coating

— 056: coating designation (see Table 3)

— BR: bright (tin has been reflowed)

— 03: deep drawing quality

5 Conditions of manufacture

5.1 Steelmaking

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

5.2 Chemical composition

The chemical composition of the steel (heat analysis) would not be expected to exceed the values given in Tables 1 and 2.

Table 1 — Chemical composition (heat analysis)

Quality		C	Mn	P	S
Designation	Name	% max.	% max. [a]	% max. [a]	% max.
01	Commercial	0,15	0,60	0,03	0,035
02	Drawing	0,12	0,50	0,03	0,035
03	Deep drawing	0,10	0,45	0,02	0,03
04	Deep drawing aluminum killed (non-ageing)	0,08	0,45	0,02	0,03

[a] Higher maximum required for certain applications subject to agreement.

Table 2 — Limits on additional chemical elements [a]

Element	Heat analysis % max.	Product analysis % max.
Cu [b]	0,20	0,23
Ni [b]	0,20	0,23
Cr [b, c]	0,15	0,19
Mo [b, c]	0,06	0,07
Nb [d]	0,008	0,018
V [d]	0,008	0,018
Ti [d]	0,008	0,018

[a] Each of the elements listed in this table shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less than 0,02 %, the analysis may be reported as "< 0,02 %".

[b] The sum of copper, nickel, chromium and molybdenum shall not exceed 0,50 % on heat analysis. When one or more of these elements are specified, the sum shall not apply, in which case only the individual limits on the remaining elements shall apply.

[c] The sum of chromium and molybdenum shall not exceed 0,16 % on heat analysis. When one or more of these elements are specified, the sum shall not apply, in which case only the individual limits on the remaining elements shall apply.

[d] Heat analyses greater than 0,008 % may be supplied upon agreement between producer and consumer.

5.3 Chemical analysis

5.3.1 Heat analysis

A heat analysis of each heat of steel shall be made by the manufacturer in order to determine compliance with the requirements of Tables 1 and 2. When requested, at the time of ordering, this analysis shall be reported to the purchaser or to his representative.

5.3.2 Product analysis

A product analysis may be made by the purchaser in order 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 product analysis. For killed steels, the sampling method and deviation limits shall be agreed upon between manufacturer and purchaser at the time of ordering.

5.4 Coating mass

The coating mass shall conform to the requirements presented in Table 3 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 International Standard are given in 7.2 and 8.2.

Table 3 — Mass of coating (total both sides)

Coating designation	**Nominal coating**	**Minimum coating mass limits**	
		Triple spot test check limits	**Single spot test check limits**
	g/m^2	g/m^2 (of sheet)	g/m^2 (of sheet)
SN56	5,6	3,7	2,8
SN112	11,2	7,3	5,6
SN168	16,8	11	8,2
SN224	22,4	14,6	11
NOTE 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.			

5.5 Weldability

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

5.6 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.

5.7 Coating condition

The as-produced tin-coated sheet has a dull (matt) appearance (see clause 4 and 5.10). 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 “ground” roll surfaces (see 5.10). All tinning lines have strip thickness limits on bright finish sheet because of melting limitations.

5.8 Application

Tin-coated steel shall be identified for fabrication using the name of the part or intended application. Steel sheet of drawing quality (02, 03 and 04) may be produced to make an identified part, which shall be previously agreed upon between manufacturer and purchaser. In such a 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 4 do not apply.

5.9 Mechanical properties

Except when ordering an identified part, as explained in 5.8, at the time that the steel is made available for shipment, the mechanical properties shall be as stated in Table 4 when they are determined on test pieces obtained according to the requirements of 7.1 (mechanical tests). Prolonged storing of the sheet can cause changes in mechanical properties (increase in hardness and decrease in elongation), leading to a decrease in drawability. To minimize this effect, quality 04 should be specified.

Table 4 — Mechanical properties

Quality		R_m max. [a]	A min. [b]	
Designation	Name	N/mm^2	L_o = 50 mm	L_o = 80 mm
01	Commercial [c]	–	–	–
02	Drawing	370	31	30
03	Deep drawing	350	35	34
04	Deep drawing aluminium killed (non-ageing)	340	37	36

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

S_o = initial cross-sectional area of gauge length

1 N/mm^2 = 1 MPa

[a] Minimum tensile strength for qualities 02, 03 and 04 would normally be expected to be 270 N/mm^2. All tensile strength values are determined to the nearest 10 N/mm^2.

[b] 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.

[c] The hardness of quality 01 steel sheet is expected not to exceed the equivalent of Rockwell HRB65 at the time it is made available for shipment.

5.10 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.

5.11 Oiling

Electrolytic tin-coated sheet always has a lubricant film applied to both its surfaces as the last operation in the tinning line prior to shearing or coiling, in order to minimize abrasion. The oil is not intended as a drawing or forming lubricant and should be easily removable using degreasing chemicals.

6 Dimensional tolerances

Dimensional tolerances applicable to electrolytic tin-coated sheet shall be as given in Tables 5 to 13 inclusive. Restricted tolerances are given in Tables 6 and 13.

Table 5 — Standard thickness tolerances for coils and cut lengths

Values in millimetres

Specified widths	Thickness tolerances [a] for specified thicknesses		
	$\geqslant 0{,}5 \leqslant 0{,}6$	$> 0{,}6 \leqslant 0{,}8$	$> 0{,}8$
$\geqslant 600 \leqslant 1\,050$	$\pm 0{,}05$	$\pm 0{,}07$	$\pm 0{,}08$
NOTE 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. NOTE 2 Unless otherwise stated on the order, the thickness tolerances for all qualities of electrolytic tin-coated steel sheet should be in accordance with this Table.			
[a] Thickness is measured at any point on the sheet not less than 25 mm from a side edge.			

Table 6 — Restricted thickness tolerances for coils and cut lengths

Values in millimetres

Specified widths	Thickness [a] tolerances, for specified thicknesses		
	$\geqslant 0{,}5 \leqslant 0{,}6$	$> 0{,}6 \leqslant 0{,}8$	$> 0{,}8$
$\geqslant 600 \leqslant 1\,050$	$\pm 0{,}025$	$\pm 0{,}035$	$\pm 0{,}040$
NOTE 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.			
[a] Thickness is measured at any point on the sheet not less than 25 mm from a side edge.			

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

Values in millimetres

Specified widths	Tolerance
⩽ 750	$^{+5}_{0}$
> 750 ⩽ 1 050	$^{+7}_{0}$
NOTE For resquared material more restrictive tolerances are subject to negotiation.	

Table 8 — Length tolerances for cut lengths, not resquared.

Values in millimetres

Specified length	Tolerance
⩽ 3 000	$^{+20}_{0}$
> 3 000 ⩽ 6 000	$^{+30}_{0}$
> 6 000	$^{+0,5\ \% \times \text{length}}_{0}$
NOTE For resquared material more restrictive tolerances are subject to negotiation	

Table 9 — Camber tolerances for coils and cut lengths, not resquared

Form	Camber tolerance
Coils	20 mm in any 5 000 mm length
Cut lengths	0,4 % × length
NOTE 1 Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straight edge as shown in Figure 1.	
NOTE 2 For resquared material more restrictive tolerances are subject to negotiation.	

Table 10 — Out-of-square tolerance for cut lengths, not resquared

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1% × width
NOTE 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 as shown in Figure 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.	

Table 11 — Out-of square tolerances for resquared material

Values in millimetres

Specified length	Specified width	Out-of-square tolerance
⩽ 3 000	All widths	$^{+2}_{0}$
> 3 000	All widths	$^{+3}_{0}$
NOTE 1 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 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.		
NOTE 2 When measuring material to resquared tolerances, consideration may have to be given to extreme variations in temperature.		

Table 12 — Standard flatness tolerances for cut lengths

Values in millimetres

Specified thicknesses	Specified widths	Flatness tolerance [a]
⩽ 0,7	⩽ 1 050	15
> 0,7 ⩽ 0,85	⩽ 1 050	12
NOTE This table also applies to sheet cut to length from coil by the customer when agreed upon flattening procedures are performed.		
[a] Maximum deviation from a flat horizontal surface. With the sheet lying under its own weight on a flat surface, the maximum distance between the lower surface of the sheet and the flat horizontal surface is the maximum deviation from flatness as shown in Figure 3.		

Table 13 — Restricted flatness tolerances for cut lengths

Values in millimeters

Specified thicknesses	Specified widths	Flatness tolerance [a]
⩽ 0,7	⩽ 1 050	6
> 0,7 ⩽ 0,85	⩽ 1 050	5

[a] Maximum deviation from a flat horizontal surface. With the sheet lying under its own weight on a flat surface, the maximum distance between the lower surface of the sheet and the flat horizontal surface is the maximum deviation from flatness as shown in Figure 3.

7 Sampling

7.1 Tensile test

If the order specifies mechanical properties, one representative sample for the tensile property test given in Table 4 shall be taken from each lot of sheet for shipment. A lot consists of 50 t or less of sheet of the same quality rolled to the same thickness and condition.

7.2 Tests for 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 given Table 3. 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 shall be 2 000 mm^2.

8 Test methods

8.1 Tensile test (base metal)

The tensile test shall be carried out in accordance with ISO 6892. 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.

8.2 Coating tests

8.2.1 Triple spot test

The triple spot test result is the average coating mass found on the three specimens taken in accordance with 7.2. The tin coating mass may be determined by any of the recognized and accepted analytical methods.

8.2.2 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.