INTERNATIONAL STANDARD

ISO 5950

Fourth edition
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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 qualités commerciale et pour emboutissage

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

This fourth edition cancels and replaces the third edition (ISO 5950:2000), 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 can 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 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.

NOTE 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.

1.3 Commercial-quality electrolytic tin-coated sheet (quality 01) is intended for general fabricating purposes where sheet is used in the flat state, 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, the mechanical properties in Table 5 do not apply. Drawing qualities are identified as follows:

02 Drawing quality

03 Deep drawing quality

04 Deep drawing quality aluminum killed (non-ageing)

1.4.1 Interstitial free steel (IF Steel) can be applied in orders of 02, 03 and 04, provided that the customer is informed of the substitution and that related shipping documents reflect the actual material shipped.

1.5 This International Standard does not cover tinplate and blackplate.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 16162, *Continuously cold-rolled steel sheet products — Dimensional and shape tolerances*

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 electro-tinning

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
aluminum killed
steel which has been deoxidized with aluminum 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 4. 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 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 aluminum killed.

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

— SN: Tin coating,

— 056: Coating designation (Table 4),

— 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 (heat analysis) shall not exceed the values given in Tables 1 and 2.

Table 1 — Chemical composition (heat analysis)

Mass fractions in percent

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 [b]	0,10	0,50	0,03	0,035
03	Deep drawing [b]	0,08	0,45	0,02	0,03
04	Deep drawing aluminum killed [b] (non-ageing)	0,06	0,45	0,02	0,03

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

[b] If interstitial free (IF Steel) is to be applied to 02, 03 and 04 orders, the values of 0,15 % maximum Ti and 0,10 % maximum Nb and V are acceptable to ensure that the carbon and nitrogen are fully stabilized.

Table 2 — Limits on additional chemical elements

Elements [a]	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 is specified, the sum does not apply; in which case, only the individual limits on the remaining elements will apply.

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

[d] For stabilized steels, the maximum for titanium is 0,15 %, and the maximum for each of niobium and vanadium is 0,10 %, to ensure that the carbon and nitrogen are fully stabilized.

5.3 Chemical analysis

5.3.1 Heat analysis

A heat analysis of each heat of steel shall be made by the manufacturer 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 his representative.

Each of the elements listed in Table 2 shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less that 0,02 %, the analysis may be reported at "< 0.02 %".

5.3.2 Product analysis

A product 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 suitable for verification analysis.

For killed steels, the sampling method and deviation limits shall be agreed between the manufacturer and purchaser at the time of ordering. The product analysis tolerances shall be in accordance with Table 3.

Table 3 — Product analysis tolerances

Element	Maximum of specified element %	Tolerance over maximum specified %
Carbon	⩽ 0,15	0,03
Manganese	⩽ 0,60	0,03
Phosphorus	⩽ 0,04	0,01
Sulfur	⩽ 0,04	0,01
NOTE The maximum tolerance in this table is the allowable excess over the specified requirement and not the heat analysis.		

5.4 Coating mass

The coating mass shall conform to the requirements presented in Table 4 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 for checking that the material complies with this International Standard are given in 7.2 and 8.2.

Table 4 — 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)
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
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 (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 (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 by the 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 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 5 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 5 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 5 — Mechanical properties

Quality		R_m max. [a]	A min. [b] %	
Designation	Name	MPa	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 aluminum killed (non-ageing)	340	37	36

R_m tensile strength
A percentage elongation after fracture
L_o gauge length of original test piece
1 MPa = 1 N/mm^2

[a] The minimum tensile strength for qualities 02, 03 and 04 would normally be expected to be 270 MPa. All tensile strength values are determined to the nearest 10 MPa.

[b] For material up to and including 0,6 mm in thickness, the elongation values in this table shall be reduced by 1.

[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 surfaces of the sheet as the last operation in the tinning line prior to shearing or coiling, to minimize abrasion. The oil is not intended as a drawing or forming lubricant and should be easily removable with degreasing chemicals.

6 Dimensional tolerances

Dimensional tolerances applicable to cold-reduced steel sheet shall be as given in ISO 16162.

Restricted thickness tolerances are given in ISO 16162.

7 Sampling

One representative sample for the tensile test required 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 designation rolled to the same thickness and condition.

7.1 Tensile test

If the order specifies mechanical properties, one representative sample for the tensile property test required in Table 5 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 deemed necessary to ensure that the material produced complies with the values given in Table 4. 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, the 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 according to 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.

9 Retests

9.1 Machining and flaws

If any test piece shows defective machining or develops flaws, it shall be discarded and another test piece substituted.

9.2 Additional tests

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

10 Resubmission

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, heat treatment), which, on request, will be indicated to the purchaser. In this case, tests shall be carried out as if they applied to a new batch.

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

11 Workmanship

The surface condition shall be that normally obtained in this product.

The electrolytic tin-coated sheet in cut lengths shall be free from 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.

12 Inspection and acceptance

12.1 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 provide the purchaser's inspector with all reasonable facilities to determine that the steel is being furnished in accordance with this International Standard.

12.2 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.