INTERNATIONAL STANDARD

ISO 11949

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Cold-reduced electrolytic tinplate

Fer-blanc électrolytique laminé à froid

Reference number
ISO 11949:1995(E)

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 voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11949 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 9, *Tinplate and blackplate*.

It cancels and replaces ISO 1111-1:1983, ISO 1111-2:1983, ISO 4977-1:1984 and ISO 4977-2:1988.

Annexes A and B form an integral part of this International Standard. Annexes C, D and E are for information only.

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Cold-reduced electrolytic tinplate

1 Scope

This International Standard specifies requirements for single and double cold-reduced low-carbon mild steel electrolytic tinplate in the form of sheets or coils for subsequent cutting into sheets.

Single-reduced tinplate is specified in nominal thicknesses that are multiples of 0,005 mm, from 0,17 mm up to and including 0,49 mm. Double-reduced tinplate is specified in nominal thicknesses that are multiples of 0,005 mm, from 0,14 mm up to and including 0,29 mm.

This International Standard applies to coils and sheets cut from coils in nominal minimum widths of 500 mm.

Annex E lists the relevant clauses for the selected product.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1024:1989, *Metallic materials — Hardness test — Rockwell superficial test (scales 15N, 30N, 45N, 15T, 30T and 45T).*

ISO 6892:1984, *Metallic materials — Tensile testing.*

3 Definitions

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

3.1 electrolytic tinplate: Low-carbon mild steel sheet or coil coated on both surfaces with tin that is applied in continuous electrolytic operation.

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

3.3 single cold-reduced: Term used to describe those products where the steel substrate has been reduced to the desired thickness in a cold-reduction mill and subsequently annealed and temper rolled.

3.4 double cold-reduced: Term used to describe those products in which the steel base has had a second major reduction after annealing.

3.5 standard grade tinplate: Material in sheet form which is the product of line inspection. It is suitable, under normal conditions of storage, for established lacquering and printing over the entire surface of the sheet and does not contain any of the following:

a) pinholes, i.e. any perforation through the whole thickness of the material;

b) thickness outside the tolerance range specified in 10.3;

c) surface defects which render the material unsuitable for the intended use;

d) damage or shape-related defects which render the material unsuitable for the intended use.

3.6 second grade tinplate: Material which represents the best sheets rejected from the standard grade but may contain sheets exhibiting defects in surface appearance and shape of limited extent. Suitability for established lacquering and printing over the entire surface of the sheet is not assured.

3.7 batch annealed; box annealed (BA): Annealed by the process in which the cold-reduced strip is annealed in tight coil form, within a protective atmosphere, for a predetermined time-temperature cycle.

3.8 continuously annealed (CA): Annealed by the process in which cold-reduced coils are unwound and annealed in strip form within a protective atmosphere.

3.9 finish: Surface appearance of tinplate, determined by the surface characteristics of the steel base together with the conditioning of the tin coating which can be either flow-melted or unflow-melted.

3.9.1 bright finish: Finish resulting from the use of temper-mill work rolls that have been ground to a high degree of polish together with a flow-melted or unflow-melted tin coating.

3.9.2 stone finish: Finish on flow-melted tinplate characterized by a directional pattern, resulting from the use of final-mill work rolls that have been ground to a lower degree of polish than those used for the smooth finish, together with a flow-melted tin coating.

3.9.3 silver finish: Finish resulting from the use of temper-mill work rolls that have been shot blasted, together with a flow-melted tin coating.

3.9.4 matt finish: Finish resulting from the use of temper-mill work rolls that have been shot blasted, together with an unflow-melted tin coating.

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

3.11 longitudinal bow; line bow: Residual curvature in the strip remaining along the direction of rolling.

3.12 transverse bow; cross bow: Mode of curvature in the sheet such that the distance between its edges parallel to the direction of rolling is less than the sheet width.

3.13 centre buckle; full centre: Intermittent vertical displacement or wave in the strip occurring other than at the edges.

3.14 edge wave: Intermittent vertical displacement occurring at the strip edge when the strip is laid on a flat surface.

3.15 feather edge; transverse thickness profile: Variation in thickness, characterized by a reduction in thickness close to the edges, at right angles to the direction of rolling.

3.16 burr: Metal displaced beyond the plane of the surface of the strip by shearing action.

3.17 rolling width: Width of the strip perpendicular to the direction of rolling.

3.18 consignment: Quantity of material of the same specification made available for dispatch at the same time.

3.19 bulk package; bulk: Packaging unit comprising a base platform or pallet, the sheets and packaging material. (See pallet.)

3.20 pallet: Base platform on which a coil is placed to facilitate ready transportation.

3.21 stillage platform: Base platform on which sheets are stacked to facilitate packing and ready transportation.

3.22 sample unit: 750 m of coil cut into sheets, for the purposes of sampling.

3.23 line inspection: Final inspection of the finished product performed by instruments and/or visual examination at normal production-line speeds.

3.24 anvil effect: 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.

4 Information to be supplied by the purchaser

4.1 General

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

a) the designation as given in clause 5 excluding the annealing code, unless a specific type of annealing is required;

b) the quantity, expressed on an area or mass basis;

c) for single-reduced tinplate, the finish required (see 6.2.1);

d) marking requirements for differentially coated tinplate (see clause 12);

e) any further special requirements.

NOTE 1 Appropriate classifications are suitable for shaping operations such as stamping, drawing, folding, beading and bending, and assembly work such as joint forming, soldering and welding. However, for tin coatings less than 2,8 g/m^2, high-speed soft soldering cannot be guaranteed. Welding, for coatings less than 1,4 g/m^2, cannot be guaranteed. The end use should be borne in mind when the classification is selected.

4.2 Options

In the event that the purchaser does not indicate his wish to implement any of the options included in this International Standard 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 cathodic surface passivation treatment using a dichromate salt of an alkali metal (see 6.3);

b) where differential tin coatings are ordered, the heavier coated surface shall be indicated by continuous parallel lines spaced at 75 mm intervals (see clause 12);

c) for double-reduced tinplate, with a stone surface finish (see 6.2.2);

d) for coils, the location of each joint shall be indicated by a piece of non-rigid material and punched holes (see 11.3);

e) for coils, they shall be dispatched with their cores vertical and an internal diameter of 420 mm or 508 mm (see 16.1);

f) for sheets, the direction of the runners of the stillage platform is at the discretion of the producer but shall be consistent within a consignment (see 16.2);

g) for sheets, the rolling width shall be either of the two specified dimensions (see note 2);

h) with a coating of DOS (see 6.3).

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 2 When ordering double cold-reduced tinplate, the purpose of manufacture for which the material 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 direction of rolling should be around the circumference of the can so as to minimize the hazard of flange cracking.

5 Designation

5.1 Single-reduced tinplate

For the purposes of this International Standard, single-reduced tinplate is designated in terms of a temper classification based on the Rockwell HR30Tm hardness values given in table 2.

Single-reduced material covered by this International Standard shall be designated by the following characteristics in the given sequence:

a) a description of the material (either tinplate coil or sheet);

b) the number of this International Standard;

c) the temper designation in accordance with table 2;

d) the type of annealing used by the manufacturer (see 9.1);

e) the type of finish (see 3.9);

f) the coating masses and their combinations, E (for equally coated) or D (for differentially coated), together with numbers representing the nominal coating mass on each surface (see clause 12);

g) the dimensions, in millimetres:

— for coils, strip thickness × width;

— for sheets, thickness × width × length.

EXAMPLE

Single cold-reduced tinplate sheet, in accordance with this International Standard, of steel grade TH61+SE (tinplated coating), continuously annealed (CA), stone finish, equally coated with a coating mass of 2,8 g/m^2, with a thickness of 0,22 mm, a width of 800 mm and a length of 900 mm shall be designated:

Tinplate sheet ISO 11949 - TH61+SE - CA - stone - E 2,8/2,8 - 0,22 × 800 × 900.

5.2 Double-reduced tinplate

For the purposes of this International Standard, the mechanical properties in which double-reduced tinplate complying with this International Standard is supplied are designated in terms of a system of mechanical property classifications based on 0,2 % proof stress given in table 3.

Double-reduced material covered by this International Standard shall be designated by the following characteristics in the given sequence:

a) a description of the material (either tinplate coil or sheet);

b) the number of this International Standard;

c) the mechanical property designation (see table 3);

d) the type of annealing used by the manufacturer (see 9.1);

e) the coating masses and their combinations, E (for equally coated) or D (for differentially coated), together with numbers representing the nominal coating mass on each surface (see clause 12);

f) the dimensions, in millimetres:

— for coils, strip thickness × width;

— for sheets, thickness × width × length.

EXAMPLE

Double cold-reduced tinplate coil, in accordance with this International Standard, of steel grade T620+SE, continuously annealed (CA), differentially coated with coating masses of 8,4 g/m² and 5,6 g/m², with a thickness of 0,18 mm and a width of 750 mm shall be designated:

Tinplate coil ISO 11949 - T620+SE - CA - D 8,4/5,6 - 0,18 × 750.

6 Manufacturing features

6.1 Manufacture

The purity of tin used to produce the coating shall be not less than 99,85 % (*m/m*).

The methods of manufacture of tinplate are the province of the manufacturer and are not specified in this International Standard.

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

NOTE 3 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

6.2.1 Single-reduced tinplate

Single cold-reduced tinplate can be supplied with either a bright, silver, stone or matt finish, and the finish required shall be specified at the time of ordering [see 4.1 c)].

The appearance is governed by

a) the surface characteristics of the steel base which principally result from controlled preparation of the work rolls used during the final stages of temper rolling;

b) the mass of the coating applied;

c) whether the tin layer is flow-melted or unflow-melted.

6.2.2 Double-reduced tinplate

Double cold-reduced tinplate is usually supplied with a stone surface finish and a flow-brightened tin coating.

6.3 Passivation and oiling

The surface of electrolytic tinplate is normally subjected to a passivation treatment and to oiling. Passivation, produced either by a chemical or an electrochemical treatment, gives a surface with an improved resistance to oxidation and improved suitability for lacquering and printing. Unless otherwise agreed at the time of ordering [see 4.2 a)], the usual passivation procedure is a cathodic treatment in a solution of a dichromate salt of an alkali metal.

Under normal conditions of transport and storage, electrolytic tinplate shall be suitable for surface treatments such as established lacquering and printing operations.

Tinplate coils and sheets are supplied with an oil coating. The oil shall be one that is recognized (i.e. by the relevant national or international authority) as being suitable for food packaging. Unless otherwise agreed at the time of ordering [see 4.2 h)], DOS (dioctyl sebacate) shall be used.

6.4 Defects

6.4.1 Coils

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 International Standard.

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 International Standard.

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

The quantity of sheets complying with this International Standard shall be at least 90 % of any one coil.

NOTE 4 Items c) and d) in 3.5 cannot be verified by specific tests and should be the subject of a special agreement between the producer and user.

If, when processing 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 inspection facilities, and to take reasonable care during these operations.

6.4.2 Sheets

Sheets shall not contain any defects as defined in 3.5, when sampled as described in 13.2.

7 Specific requirements

Standard grade tinplate shall comply with the appropriate requirements of clauses 8 to 12.

When tests are carried out to verify compliance with the requirements of clauses 8 to 10, sample sheets shall be selected from consignments in accordance with clause 13.

Coils shall be dispatched as described in 16.1 and sheets shall be packaged as described in 16.2.

8 Tin coating mass

The coating mass, on each surface, shall be expressed in grams per square metre. The lowest value specified in this International Standard shall be 1 g/m² on each surface, and no upper limit is specified. Values of preferred coating masses are 1,0 g/m², 1,5 g/m², 2,0 g/m², 2,8 g/m², 4,0 g/m², 5,0 g/m², 5,6 g/m², 8,4 g/m² and 11,2 g/m².

Whatever the coating mass used, the tolerance shall be as indicated in table 1, and the mass per unit area for equally and differentially coated tinplate is determined on test pieces taken from samples selected in accordance with clause 13 and tested in accordance with 14.2. In cases of dispute, the reference method given in annex A shall be used.

NOTE 5 For both equally coated and differentially coated tinplate, the individual test pieces 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 test pieces have no representative value in relation to the consignment under consideration.

Table 1 — Tolerances on tin coating masses

Ranges of mass (m) per surface g/m²	Permissible deviation for sample average from nominal coating mass g/m²
$1,0 \leqslant m < 1,5$	− 0,25
$1,5 \leqslant m < 2,8$	− 0,30
$2,8 \leqslant m < 4,1$	− 0,35
$4,1 \leqslant m < 7,6$	− 0,50
$7,6 \leqslant m < 10,1$	− 0,65
$10,1 \leqslant m$	− 0,90

9 Mechanical properties

9.1 General

For the purposes of this International Standard, single-reduced tinplate is classified into temper grades based on Rockwell HR30Tm hardness values and double-reduced tinplate classification is based on the 0,2 % proof stress properties.

Other mechanical properties will significantly influence the performance of tinplate in processing, and the subsequent intended end use will vary depending on the steel type and the methods of casting, annealing and temper rolling employed.

NOTE 6 By agreement, the type of annealing for tinplate, i.e. BA or CA (see 3.7 or 3.8) may be specified when ordering.

9.2 Single-reduced tinplate

The hardness values for single-reduced tinplate shall be as given in table 2, when tested as described in D.3.

9.3 Double-reduced tinplate

The proof stress shall be as given in table 3, when tested as described in 14.3.

NOTES

7 For routine testing, the proof stress may be determined using the springback test as described in annex B. However, in cases of dispute, the method described in 14.3 is used.

8 Annex D gives hardness values for information.

10 Tolerances on dimensions and shape

10.1 General

Tolerances on dimensions (i.e. thickness and linear dimensions) and shape (i.e. edge camber, out-of-squareness, lateral weave) are specified in 10.2 and 10.3, together with appropriate methods of measurement.

NOTE 9 Other geometrical features may be present, such as burr, edge wave, centre buckle, longitudinal bow and transverse bow. This International Standard does not specify methods of measurement and does not 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.

10.2 Coils

10.2.1 Length

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

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

NOTE 10 The purchaser normally verifies the length of strip in 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 purchaser.

10.2.2 Width

The width of each sample sheet, selected in accordance with clause 13, 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 direction of rolling, with the sheet lying on a flat surface. The measured width shall be not less than the ordered width and shall not exceed the ordered width by more than 3 mm.

Table 2 — Hardness values (HR30Tm) for single-reduced tinplate

Steel grade (previous designation)	$e \leqslant 0{,}21$		$0{,}21 < e \leqslant 0{,}28$		$e > 0{,}28$	
	Nominal	Range for sample average	Nominal	Range for sample average	Nominal	Range for sample average
TH50+SE (T50)	53 max.		52 max.		51 max.	
TH52+SE (T52)	53	± 4	52	± 4	51	± 4
TH55+SE (T55)	56	± 4	55	± 4	54	± 4
TH57+SE (T57)	58	± 4	57	± 4	56	± 4
TH61+SE (T61)	62	± 4	61	± 4	60	± 4
TH65+SE (T65)	65	± 4	65	± 4	64	± 4

NOTES

1 It is important to distinguish HR30Tm from HR30T, the former denoting that depressions on the under surface of the test piece are permitted (cf. ISO 1024).

2 e is the thickness, in millimetres.

Table 3 — Proof stress values of double-reduced tinplate

Steel grade (previous designation)	Average 0,2 % proof stress	
	Nominal N/mm²	Permitted range N/mm²
T550+SE (DR550)	550	480 to 620
T580+SE (DR580)	580	510 to 650
T620+SE (DR620)	620	550 to 690
T660+SE (DR660)	660	590 to 730
T690+SE (DR690)	690	620 to 760

10.2.3 Thickness

10.2.3.1 General

The transverse thickness profile shall be measured using the micrometer method described in 14.1.2. All other thicknesses shall be determined by the weighing method (see 14.1.1) or by direct measurement using the micrometer method. However, in cases of dispute and for all retests, except for the transverse thickness profile, the weighing method shall be used.

10.2.3.2 Individual sheets

When shearing a coil, sheets shall be eliminated if they deviate from the nominal thickness by more than ± 8,5 %.

10.2.3.3 Average thickness of a consignment

The average thickness of a consignment, determined by the weighing method described in 14.1.1, on the sample sheets selected in accordance with 13.1, shall not deviate from the ordered nominal thickness by more than

a) ± 2,5 % for consignments comprising more than 15 000 m; or

b) ± 4 % for consignments comprising 15 000 m or less.

10.2.3.4 Thickness variation across the width

The thickness of each of the two individual test pieces, determined in accordance with 14.1.1, shall not deviate from the actual average thickness of the whole sheet by more than 4 %.

10.2.3.5 Feather edge (transverse thickness profile)

The minimum thickness, when measured by the micrometer method described in 14.1.2, shall not differ from the actual centre thickness of the sheet by more than 8 %.

10.2.4 Edge camber of coils

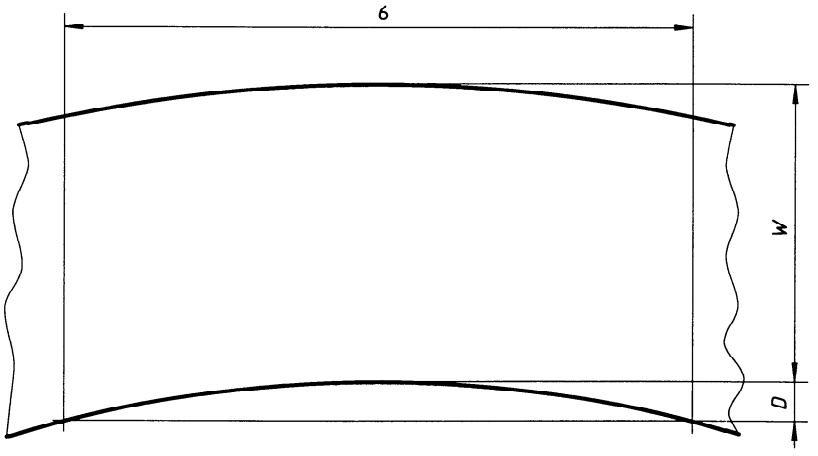
Edge camber is the maximum deviation (in the plane of the sheet) of an edge from a straight line forming a chord to its extremities (see figure 1).

The edge camber expressed as a percentage of the chord length, is calculated using the following formula:

$$\text{Edge camber} = \frac{\text{Deviation } (D)}{\text{Length of chord (6 m)}} \times 100$$

The edge camber, measured over a distance (chord length) of 6 m, shall not exceed 0,1 % (i.e. 6 mm).

Dimensions in metres



W: rolling width

D: deviation from a straight line

Figure 1 — Edge camber of coils

10.2.5 Lateral weave (short pitch camber) of coils

Lateral weave is the deviation of a mill-trimmed edge from a straight line lying in the same plane and forming a chord to it over a relatively short distance.

The lateral weave, measured over a chord length of 1 m, shall not exceed 1,0 mm when measured prior to shearing.

NOTE 11 If the coil is used for scroll shearing, the permissible values should be agreed upon between the manufacturer and purchaser.

10.3 Sheets

10.3.1 Linear dimensions of sheets

Each sample sheet shall be such that a rectangle of the ordered dimensions can fit into it. To determine the linear dimensions, lay each sample sheet, selected in accordance with 13.2.2, on a flat surface and measure the length and width to the nearest 0,5 mm across the centre of the sheet.

The dimensions of each sample sheet shall be not less than the ordered dimensions and neither dimension shall exceed the ordered dimension by more than 3 mm.

10.3.2 Thickness of sheets

10.3.2.1 General

The transverse thickness profile shall be measured using the micrometer method described in 14.1.2. All other thicknesses shall be determined by the weighing method (see 14.1.1) or by direct measurement using the micrometer method. However, in cases of dispute and for all retests, except for the transverse thickness profile, the weighing method shall be used.

10.3.2.2 Individual sheets

The thickness of each of the individual sample sheets, selected from a consignment in accordance with 13.2.2, shall not deviate from the ordered nominal thickness by more than ± 8,5 %.

10.3.2.3 Average thickness of a consignment

The average thickness of a consignment, determined by the weighing method described in 14.1.1 on the sample sheets selected in accordance with 13.2.2 shall not deviate from the ordered nominal thickness by more than

a) ± 2,5 % for a consignment of more than 20 000 sheets; or

b) ± 4 % for a consignment of 20 000 sheets or less.

10.3.2.4 Tolerances on local thickness within a sheet (crown)

The thickness of each of the two individual test pieces, determined by the weighing method described in 14.1.1, shall not deviate from the actual average thickness of the whole sheet by more than 4 %.

10.3.2.5 Feather edge (transverse thickness profile)

The minimum thickness, when measured by the micrometer method described in 14.1.2, shall not differ from the actual centre thickness of the sheet by more than 8 %.

10.3.3 Edge camber of sheets

Edge camber is the maximum deviation (in the plane of the sheet) of an edge from a straight line forming a chord to it (see figure 2).

The edge camber, expressed as a percentage of the chord length, is calculated using the following formula:

$$\text{Edge camber} = \frac{\text{Deviation } (D)}{\text{Length of chord } (L)} \times 100$$

For each sample sheet, the edge camber shall not exceed 0,15 %.

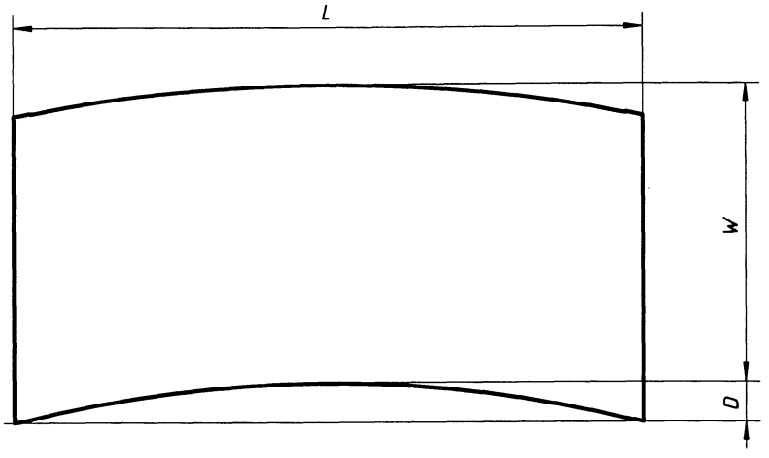
10.3.4 Out-of-squareness of sheets

Out-of-squareness is the deviation of an edge from a straight line drawn at a right angle to the other edge of the sheet, touching one corner and extending to the opposite edge (see figure 3).

The out-of-squareness, expressed as a percentage, is calculated using the following formula:

$$\text{Out-of-squareness} = \frac{\text{Deviation } (A)}{\text{Sheet dimension } (B)} \times 100$$

For each sheet in the sample, the out-of-squareness shall not exceed 0,20 %.

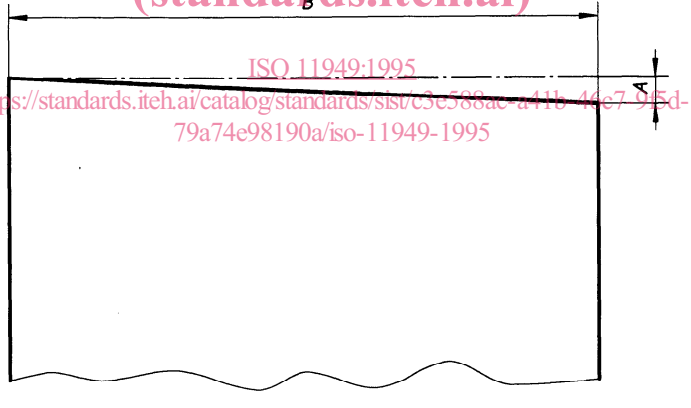


L: length of chord

W: rolling width

D: deviation from a straight line

Figure 2 — Edge camber of sheet



A: deviation

B: length or width of the sheet measured at a right angle to an edge

Figure 3 — Out-of-squareness of sheets