INTERNATIONAL STANDARD

ISO 11950

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Cold-reduced electrolytic chromium/chromium oxide-coated steel

Fer chromé électrolytique laminé à froid

Reference number
ISO 11950:1995(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 11950 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 9, *Tinplate and blackplate*.

It cancels and replaces ISO 8110-1:1988 and ISO 8111-1:1988.

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

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Cold-reduced electrolytic chromium/chromium oxide-coated steel

1 Scope

This International Standard specifies requirements for single and double cold-reduced electrolytic chromium/chromium oxide-coated steel (ECCS) in the form of sheets or coils for subsequent cutting into sheets.

Single-reduced ECCS 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 ECCS 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 D 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 chromium/chromium oxide-coated steel (ECCS): Low-carbon mild steel sheet or coil, electrolytically treated to produce on both surfaces a duplex film of metallic chromium adjacent to the steel substrate with a top layer of hydrated chromium oxide or hydroxide .

3.2 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.

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

3.4 standard grade ECCS: 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.

3.5 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.

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

3.7 finish: Appearance of the surface of ECCS, governed by the surface characteristics of the steel base which result from controlled preparation of the work rolls during the final stages of rolling.

3.7.1 shot blast finish: Finish resulting from the use of temper-mill work rolls that have been shot blasted.

3.7.2 smooth finish: Finish resulting from the use of temper-mill work rolls that have been ground to a high degree of polish.

3.7.3 stone finish: Finish 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.

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

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

3.10 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.

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

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

3.13 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.

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

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

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

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

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

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

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

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

3.22 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 ECCS, the finish required (see 6.2.1);

d) 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 and welding. 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) for double-reduced ECCS, with a stone surface finish (see 6.2.2);

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

c) for coils, they shall be dispatched with their cores vertical and an internal diameter of 420 mm (see 15.1);

d) 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 15.2);

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

f) with a coating of DOS or BSO (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 ECCS is used.

NOTE 2 When ordering cold-reduced ECCS, the purpose of manufacture for which the material is intended should be stated. When double cold-reduced ECCS is used for built-up can bodies, the rolling direction should be around the circumference of the can so as to minimize the hazard of flange cracking. In such cases, the direction of rolling should be clearly designated on the contract.

5 Designation

5.1 Single-reduced ECCS

For the purposes of this International Standard, single-reduced ECCS 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 ECCS 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 3.7);

f) the dimensions, in millimetres:

— for coils, strip thickness x width,

— for sheets, thickness x width x length.

EXAMPLE

Single cold-reduced ECCS sheet, in accordance with this International Standard, of steel grade TH61 + CE, continuously annealed (CA), stone finish, with a thickness of 0,22 mm, a width of 800 mm and a length of 900 mm shall be designated:

ECCS sheet ISO 11950 - TH61+CE - CA - stone - 0,22 x 800 x 900.

5.2 Double-reduced ECCS

For the purposes of this International Standard, the mechanical properties in which double-reduced ECCS 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 ECCS 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 dimensions, in millimetres:

— for coils, strip thickness x width,

— for sheets, thickness x width x length.

EXAMPLE

Double cold-reduced ECCS coil, in accordance with this International Standard, of steel grade TH620+SE, continuously annealed (CA), with a thickness of 0,18 mm and a width of 750 mm shall be designated:

ECCS coil ISO 11950 - T620+CE - CA - 0,18 x 750.

6 Manufacturing features

6.1 Manufacture

The methods of manufacture ECCS 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 ECCS.

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 ECCS.

6.2 Finish

6.2.1 Single-reduced ECCS

Single cold-reduced ECCS can be supplied with either a smooth, stone or shot blast finish, and the finish required shall be specified at the time of ordering [see 4.1 c)].

6.2.2 Double-reduced ECCS

Double cold-reduced ECCS is usually supplied with a stone surface finish (see 3.7.3).

NOTE 4 Special surface finishes may be available and should be agreed upon at the time of ordering.

6.3 Oiling

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

ECCS 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 f)], DOS (dioctyl sebacate) or BSO (butyl stearate oil) 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 ECCS manufactured is in accordance with the requirements of this International Standard.

However, the production of ECCS coils in continuous-strip mill operations does not afford the opportunity for removal of all ECCS 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 5 Items c) and d) in 3.4 cannot be verified by specific tests and should be the subject of a special agreement between the producer and user.

If, when processing ECCS 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 3.4, when sampled as described in 12.2.

7 Specific requirements

Standard grade ECCS shall comply with the appropriate requirements of clauses 8 to 11.

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 12.

Coils shall be dispatched as described in 15.1 and sheets shall be packaged as described in 15.2.

8 Chromium/chromium in oxide coating mass

The minimum and maximum average values of coating mass of the samples selected in accordance with clause 12 shall be as given in table 1, when tested as described in 13.2. No individual value shall be less than 30 mg/m^2, for metallic chromium and 5 mg/m^2 for chromium in the oxides.

NOTE 6 The total is made up of chromium metal and chromium in oxides. The amounts of each are determined separately.

Table 1 — Average chromium/chromium in oxide coating mass

Form of chromium	Average coating mass on each surface, mg/m^2	
	Minimum	Maximum
Metallic chromium	50	140
Chromium in oxides	7	35

9 Mechanical properties

9.1 General

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

Other mechanical properties will significantly influence the performance of ECCS 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 7 By agreement, the type of annealing for ECCS, i.e. BA or CA (see 3.5 or 3.6) may be specified when ordering.

9.2 Single-reduced ECCS

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

9.3 Double-reduced ECCS

The proof stress shall be as given in table 3, when tested as described in 13.3.

NOTE 8 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 13.3 is used.

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.

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

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

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

NOTE 9 Other geometrical features may be present in sheets cut from cold-reduced ECCS supplied in cold form, 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. Total 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 12, 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.

10.2.3 Thickness

10.2.3.1 General

The transverse thickness profile shall be measured using the micrometer method described in 13.1.2. All other thicknesses shall be determined by the weighing method (see 13.1.1) 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 13.1.1, on the sample sheets selected in accordance with 12.1, 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 13.1.1, 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 13.1.2, shall not differ from the actual centre thickness of the sheet by more than 8 %.

10.2.4 Edge camber of coils

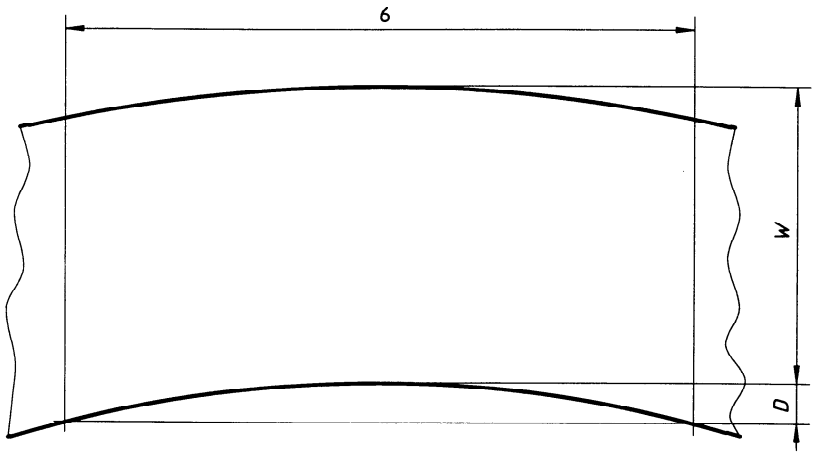
Edge camber is the maximum deviation (in the plane of the sheet) of an edge from a straight line forming a chord to its extremities (see figure 1).

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 12.2.2, 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 13.1.2. All other thicknesses shall be determined by the weighing method (see 13.1.1) 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 12.2.2, 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 13.1.1 on the sample sheets selected in accordance with 12.2.2, 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 13.1.1, 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 13.1.2, 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 side 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 %.

11 Joints within a coil

11.1 General

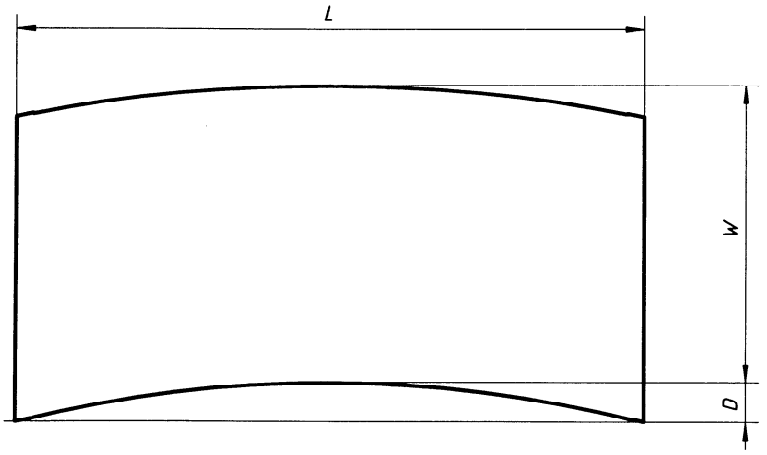
The producer shall ensure continuity of the coils within the limits of the lengths ordered, if necessary by means of electrically welded joints made after cold reduction. Requirements relating to the numbers, locations and dimensions of the joints permitted within a coil are given in 11.2 to 11.4.

11.2 Number of joints

The number of joints in a coil shall not exceed three in lengths of 10 000 m.

11.3 Location of joints

The location of each joint in a coil shall be indicated clearly.

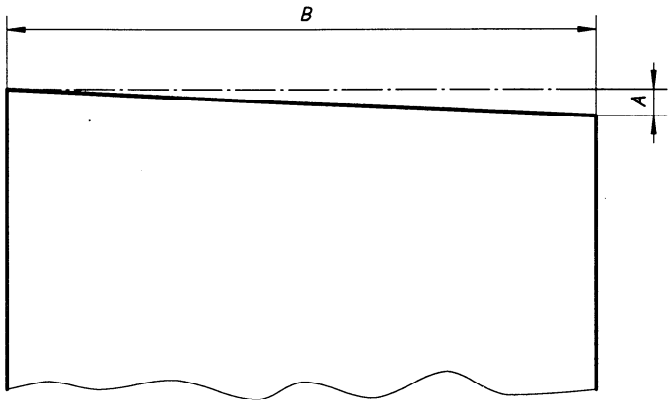


L: length of chord

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

NOTE 12 The location of each joint may be indicated, for example by the insertion of a piece of non-rigid material and punched holes. However, alternative methods may be agreed between the producer and purchaser at the time of enquiry and order.

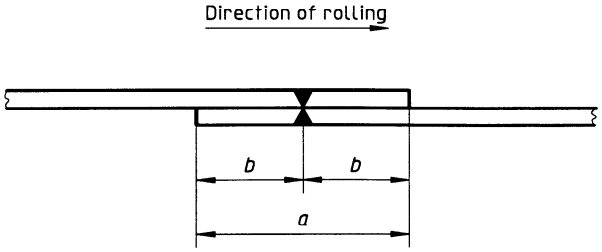
11.4 Dimensions of joints

11.4.1 Thickness

The total thickness of any joint shall not exceed three times the nominal thickness of the material forming the joint.

11.4.2 Overlap

In any lap joint, the total length of overlap shall not exceed 10 mm. The free overlap shall not exceed 5 mm (see figure 4).



a: total length of overlap

b: free overlap

Figure 4 — Joint overlap

12 Sampling

12.1 Coils

12.1.1 General

When tests are carried out to assess compliance with the requirements for coating mass (see clause 8), tolerances on dimensions and shape (see clause 10) and mechanical properties (see clause 9), samples of the ECCS coil shall be selected in accordance with 12.1.2.

After the coils in a consignment have been cut into rectangular or scrolled sheets, the sheets deemed not to be of standard grade ECCS shall be excluded. The standard grade sheets that remain shall be sampled on the basis of units of strip 750 m in length, in accordance with 12.1.2.3.

NOTE 13 Because the samples have to be cut from coils in the consignment, the taking of samples is usually carried out by the purchaser during his normal shearing operation.

The purchaser shall allow the producer, or his representatives, to be present during the sampling and subsequent testing and to be able to confirm that the identities of the samples and test pieces correspond with the coils in the consignment supplied.

12.1.2 Selection of samples

12.1.2.1 Lots and units

For the purpose of sampling, each consignment of coils shall be considered as one lot.