INTERNATIONAL STANDARD

ISO 9445-1

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Continuously cold-rolled stainless steel — Tolerances on dimensions and form —

Part 1: Narrow strip and cut lengths

Acier inoxydable laminé à froid en continu — Tolérances sur les dimensions et la forme —

Partie 1: Bandes étroites et feuillards coupés à longueur

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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 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 9445-1 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 4, *Heat treatable and alloy steels*.

This first edition of ISO 9445-1, together with ISO 9445-2, cancels and replaces ISO 9445:2002, the contents of which have been technically revised and separated into two parts.

ISO 9445 consists of the following parts, under the general title *Continuously cold-rolled stainless steel — Tolerances on dimensions and form*:

— *Part 1: Narrow strip and cut lengths*

— *Part 2: Wide strip and plate/sheet*

Continuously cold-rolled stainless steel — Tolerances on dimensions and form —

Part 1: Narrow strip and cut lengths

1 Scope

This part of ISO 9445 specifies the tolerances on dimensions and form for continuously cold-rolled stainless steel narrow strip, in thicknesses of up to and including 3 mm and in rolling widths of less than 600 mm. It also applies to cut lengths taken from such strip.

Narrow strip and cut lengths with widths of less than 600 mm, which are manufactured from wide strip by longitudinal slitting, are covered in ISO 9445-2.

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 6929, *Steel products — Definitions and classification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6929 apply.

4 Information to be supplied by the purchaser

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for products under this specification. Such requirements to be considered include, in the order listed, but are not limited to, the following:

a) the type of delivery [see 5.2 a) and 5.2 b)];

b) the number of this International Standard, i.e. ISO 9445-1;

c) the thickness in millimetres (if necessary accurate to two decimal places) and, if required, including the relevant code letter (F or P) for a fine or precision tolerance;

d) the width in millimetres and, if required, including the relevant code letter (F or P) for a fine or precision tolerance;

e) the code letter R where a restricted tolerance on edge camber is required;

f) for cut lengths, the length in millimetres and, if a special tolerance is required, the code letter S;

g) for cut lengths, the code letters FS where a special tolerance is required for flatness (see Clause 12);

h) any special requirement for edge condition (see 5.3).

EXAMPLE 1 Cold-rolled narrow strip according to this part of ISO 9445 with a specified thickness of 0,25 mm, precision thickness tolerance (P), with a specified width of 250 mm, precision tolerance on width (P), and with restricted tolerance on edge camber (R).

Cold-rolled narrow strip ISO 9445-1 – 0,25P x 250P-R

EXAMPLE 2 Cold-rolled cut lengths according to this part of ISO 9445 with a specified thickness of 1,00 mm, fine thickness tolerance (F), width 40 mm, fine width tolerance (F), restricted tolerance on edge camber R, length 1 000 mm, special tolerance on length (S), special tolerance on flatness (FS) and rounded edges.

Cold-rolled cut lengths ISO 9445-1 – 1,00F x 40F-R x 1000S-FS, rounded edges

4.2 In the absence of information in the order concerning special requirements for tolerances on dimension, shape and edge condition [see 4.1 c), d), e), f), g) and h)], flat products covered by this part of ISO 9445 will be delivered according to the basic specifications of this part of ISO 9445, i.e. with normal tolerances.

5 Type of delivery and delivery conditions

5.1 General

In the absence of agreements at the time of enquiry and order concerning special requirements for the delivery conditions given in 5.3, flat products covered by this part of ISO 9445 will be delivered according to the basic specifications of this part of ISO 9445.

5.2 Type of delivery

Flat products according to this part of ISO 9445 can be supplied as

a) cold-rolled narrow strip (strip in rolled widths less than 600 mm);

b) cut lengths from cold-rolled narrow strip [cut from cold-rolled narrow strip according to item 5.2 a)].

5.3 Delivery conditions of cold-rolled narrow strip and products obtained from cold-rolled narrow strip

5.3.1 Cold-rolled narrow strip and cut lengths obtained from cold-rolled narrow strip are usually supplied with cut edges. These products will have burrs caused by cutting. If there are special requirements for these edges, corresponding agreements shall be made on ordering. In this case, the strip is deemed to be cut almost free of burrs if the height of the burr is less than 10 % of the product thickness.

5.3.2 By special agreement and depending on the technical equipment of the supplier, cold-rolled narrow strip and cut lengths obtained from cold-rolled narrow strip can be delivered with special edges, e.g. deburred or rounded edges.

6 Tolerances on thickness for cold-rolled narrow strip and products obtained from cold-rolled narrow strip

The tolerances on thickness are given in Table 1.

Table 1 — Tolerances on specified thickness for cold-rolled narrow strip and cut lengths obtained from cold-rolled narrow strip

Dimensions in millimetres

Specified thickness	Tolerance on specified thickness for nominal width of								
	$w < 125$			$125 \leqslant w < 250$			$250 \leqslant w < 600$		
t	Normal	Fine (F)	Precision (P)	Normal	Fine (F)	Precision (P)	Normal	Fine (F)	Precision (P)
0,05[a] $\leqslant t <$ 0,10	± 0,10 t	± 0,06 t	± 0,04 t	± 0,12 t	± 0,10 t	± 0,08 t	± 0,15 t	± 0,10 t	± 0,08 t
0,10 $\leqslant t <$ 0,15	± 0,010	± 0,008	± 0,006	± 0,015	± 0,012	± 0,008	± 0,020	± 0,015	± 0,010
0,15 $\leqslant t <$ 0,20	± 0,015	± 0,010	± 0,008	± 0,020	± 0,012	± 0,010	± 0,025	± 0,015	± 0,012
0,20 $\leqslant t <$ 0,25	± 0,015	± 0,012	± 0,008	± 0,020	± 0,015	± 0,010	± 0,025	± 0,020	± 0,012
0,25 $\leqslant t <$ 0,30	± 0,017	± 0,012	± 0,009	± 0,025	± 0,015	± 0,012	± 0,030	± 0,020	± 0,015
0,30 $\leqslant t <$ 0,40	± 0,020	± 0,015	± 0,010	± 0,025	± 0,020	± 0,012	± 0,030	± 0,025	± 0,015
0,40 $\leqslant t <$ 0,50	± 0,025	± 0,020	± 0,012	± 0,030	± 0,020	± 0,015	± 0,035	± 0,025	± 0,018
0,50 $\leqslant t <$ 0,60	± 0,030	± 0,020	± 0,014	± 0,030	± 0,025	± 0,015	± 0,040	± 0,030	± 0,020
0,60 $\leqslant t <$ 0,80	± 0,030	± 0,025	± 0,015	± 0,035	± 0,030	± 0,018	± 0,040	± 0,035	± 0,025
0,80 $\leqslant t <$ 1,00	± 0,030	± 0,025	± 0,018	± 0,040	± 0,030	± 0,020	± 0,050	± 0,035	± 0,025
1,00 $\leqslant t <$ 1,20	± 0,035	± 0,030	± 0,020	± 0,045	± 0,035	± 0,025	± 0,050	± 0,040	± 0,030
1,20 $\leqslant t <$ 1,50	± 0,040	± 0,030	± 0,020	± 0,050	± 0,035	± 0,025	± 0,060	± 0,045	± 0,030
1,50 $\leqslant t <$ 2,00	± 0,050	± 0,035	± 0,025	± 0,060	± 0,040	± 0,030	± 0,070	± 0,050	± 0,035
2,00 $\leqslant t <$ 2,50	± 0,050	± 0,035	± 0,025	± 0,070	± 0,045	± 0,030	± 0,080	± 0,060	± 0,040
2,50 $\leqslant t \leqslant$ 3,00	± 0,060	± 0,045	± 0,030	± 0,070	± 0,050	± 0,035	± 0,090	± 0,070	± 0,045

NOTE By agreement, the tolerances may alternatively be totally + or totally − or unevenly distributed. In any case, the total range of the tolerance shall remain as in the table.

[a] For thicknesses below 0,05 mm, the values for the tolerances are to be agreed at the time of enquiry and order.

7 Tolerances on width for cold-rolled narrow strip and products obtained from cold-rolled narrow strip

The tolerances on width are given in Table 2.

Table 2 — Tolerances on width for cold-rolled narrow strip and cut lengths obtained from cold-rolled narrow strip

Dimensions in millimetres

Specified thickness	Specified width											
	$w \leqslant 40$			$40 < w \leqslant 125$			$125 < w \leqslant 250$			$250 < w < 600$		
t	Normal	Fine (F)	Precision (P)	Normal	Fine (F)	Precision (P)	Normal	Fine (F)	Precision (P)	Normal	Fine (F)	Precision (P)
$t < 0{,}25$	$^{+0{,}17}_{0}$	$^{+0{,}13}_{0}$	$^{+0{,}10}_{0}$	$^{+0{,}20}_{0}$	$^{+0{,}15}_{0}$	$^{+0{,}12}_{0}$	$^{+0{,}25}_{0}$	$^{+0{,}20}_{0}$	$^{+0{,}15}_{0}$	$^{+0{,}50}_{0}$	$^{+0{,}50}_{0}$	$^{+0{,}40}_{0}$
$0{,}25 \leqslant t < 0{,}50$	$^{+0{,}20}_{0}$	$^{+0{,}15}_{0}$	$^{+0{,}12}_{0}$	$^{+0{,}25}_{0}$	$^{+0{,}20}_{0}$	$^{+0{,}15}_{0}$	$^{+0{,}30}_{0}$	$^{+0{,}22}_{0}$	$^{+0{,}17}_{0}$	$^{+0{,}60}_{0}$	$^{+0{,}50}_{0}$	$^{+0{,}40}_{0}$
$0{,}50 \leqslant t < 1{,}00$	$^{+0{,}25}_{0}$	$^{+0{,}22}_{0}$	$^{+0{,}15}_{0}$	$^{+0{,}25}_{0}$	$^{+0{,}22}_{0}$	$^{+0{,}17}_{0}$	$^{+0{,}40}_{0}$	$^{+0{,}25}_{0}$	$^{+0{,}20}_{0}$	$^{+0{,}70}_{0}$	$^{+0{,}60}_{0}$	$^{+0{,}50}_{0}$
$1{,}00 \leqslant t < 1{,}50$	$^{+0{,}25}_{0}$	$^{+0{,}22}_{0}$	$^{+0{,}15}_{0}$	$^{+0{,}30}_{0}$	$^{+0{,}25}_{0}$	$^{+0{,}17}_{0}$	$^{+0{,}50}_{0}$	$^{+0{,}30}_{0}$	$^{+0{,}22}_{0}$	$^{+1{,}0}_{0}$	$^{+0{,}70}_{0}$	$^{+0{,}60}_{0}$
$1{,}50 \leqslant t < 2{,}50$	—	—	—	$^{+0{,}40}_{0}$	$^{+0{,}25}_{0}$	$^{+0{,}20}_{0}$	$^{+0{,}60}_{0}$	$^{+0{,}40}_{0}$	$^{+0{,}25}_{0}$	$^{+1{,}0}_{0}$	$^{+0{,}80}_{0}$	$^{+0{,}60}_{0}$
$2{,}50 \leqslant t \leqslant 3{,}00$	—	—	—	$^{+0{,}50}_{0}$	$^{+0{,}30}_{0}$	$^{+0{,}25}_{0}$	$^{+0{,}60}_{0}$	$^{+0{,}40}_{0}$	$^{+0{,}25}_{0}$	$^{+1{,}2}_{0}$	$^{+1{,}0}_{0}$	$^{+0{,}80}_{0}$

NOTE By agreement, the tolerance may alternatively be either equally ± or all -. In both cases, the total range of the tolerance shall remain as in the table above.

8 Preferred coil inner diameters for cold-rolled narrow strip

The inside diameter of the coil should be decided by mutual agreement. Preferred inside diameters of coils are approximately 300 mm, 400 mm, 500 mm and 600 mm with a limitation for the diameter 300 mm which is not usually available for strip thicknesses above 2,0 mm.

9 Tolerances on length for cut lengths obtained from cold-rolled narrow strip

The tolerances on length are given in Table 3.

Table 3 — Length tolerances for cut lengths obtained from cold-rolled narrow strip

Dimensions in millimetres

Specified length	Tolerances	
l	Normal	Special (S)
$l \leqslant 2\,000$	$^{+3}_{0}$	$^{+1{,}5}_{0}$
$2\,000 < l \leqslant 4\,000$	$^{+5}_{0}$	$^{+2}_{0}$

10 Tolerances on edge camber for cold-rolled narrow strip and cut lengths obtained from cold-rolled narrow strip

The edge camber tolerances are given in Table 4. These tolerances do not apply to material supplied in the work-hardened condition, for which any requirement shall be agreed between manufacturer and purchaser.

Table 4 — Tolerances on edge camber for cold-rolled narrow strip and cut lengths obtained from cold-rolled narrow strip

Dimensions in millimetres

Specified width w	Edge camber tolerances[a] for measuring lengths			
	1 000	2 000	1 000	2 000
	Normal		Restricted (R)	
$10 \leqslant w < 25$	4	16	1,5	6
$25 \leqslant w < 40$	3	12	1,25	5
$40 \leqslant w < 125$	2	8	1,0	4
$125 \leqslant w < 600$	1,5	6	0,75	3

[a] If applicable, both measuring lengths shall be used.

11 Tolerances on squareness for cut lengths obtained from cold-rolled narrow strip

The out-of-squareness for cut lengths obtained from cold-rolled narrow strip in widths of 250 mm and above shall not exceed 0,5 % of the actual width of the product.

For cut lengths obtained from cold-rolled narrow strip in widths less than 250 mm, the value is to be agreed at the time of enquiry and order.

12 Tolerances on flatness for cut lengths obtained from cold-rolled narrow strip

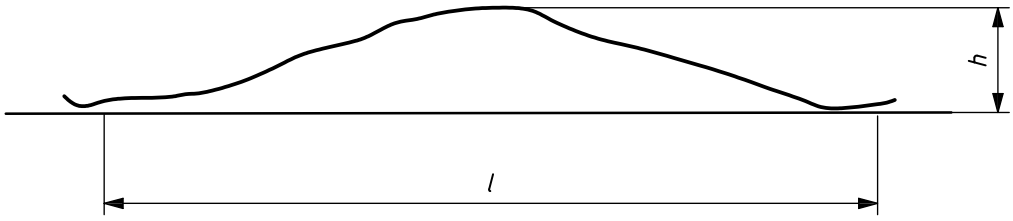
The flatness tolerance for cut lengths obtained from cold-rolled narrow strip shall not exceed 6 mm for normal cases and 4 mm where a special tolerance (FS) is required.

This requirement does not apply to material supplied in the work hardened condition and in the condition 2D (cold rolled, heat treated, pickled).

13 Edge waviness tolerances for cold-rolled strip

For skin-passed or stretch-levelled cold-rolled narrow strip, the waviness of the edges, i.e. the ratio of wave height (h) to wave length (l) shall be maximum 0,03 for specified thicknesses up to 1,00 mm and maximum 0,02 for specified thicknesses over 1,00 mm (see Figure 1).

This requirement does not apply to material supplied in the work hardened condition and in the condition 2D (cold rolled, heat treated, pickled).



Key

h/l = waviness

Figure 1 — Edge waviness tolerances for cold-rolled strip

14 Form of coils

The coils delivered according to this part of ISO 9445 shall be tightly wound, as round as possible and with straight edges. Gradual displacement of the edge of the strip to one side shall not exceed 35 mm in the case of trimmed (slit) edges and 70 mm in the case of mill (as rolled) edges.

15 Ordered format for cut lengths

When ordering, an agreement may be made that the ordered format be contained in every piece supplied. In this case, the tolerances on width, length, edge camber and out-of-squareness shall be agreed at the time of enquiry and order.

16 Measurement of thickness for cold-rolled narrow strip and cut lengths obtained from cold-rolled narrow strip

The thickness may be measured at any arbitrarily chosen point on the product at least 10 mm from the edges. For widths up to and including 20 mm, it shall be measured at the centre of the product width.

When ordering fine (F) or precision (P) thickness tolerances, it can be agreed that the permissible deviations from thickness shall be maintained over the whole width of the product.

17 Measurement of width

The width is measured perpendicularly to the rolling direction of the product.

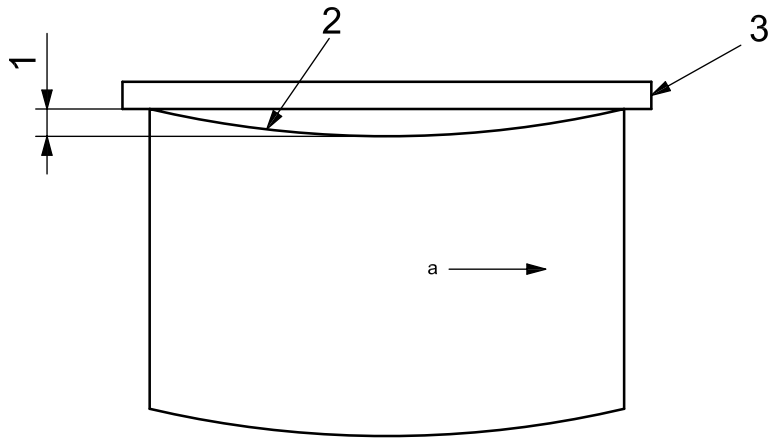
18 Measurement of length

The length of cut lengths is measured along the rolling direction of the product.

19 Measurement of edge camber

19.1 Edge 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 (see Figure 2).

19.2 Edge camber is not normally measured by the manufacturer, unless compliance is in doubt. If edge camber is measured, this shall be done at a minimum distance of 3 laps from the end of the coil for cold-rolled narrow strip.



Key

1 edge camber

2 side edge (concave side)

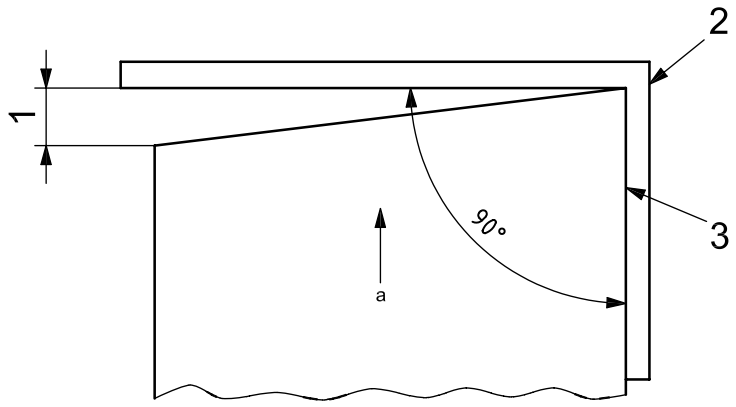
3 straight edge

a Rolling direction.

Figure 2 — Measurement of edge camber

20 Measurement of squareness

20.1 Out-of-squareness is the greatest deviation of an end edge from a straight edge of a square placed at right angles to a side and touching one corner (see Figure 3).



Key

1 out-of-squareness

2 square

3 side edge

a Rolling direction.

Figure 3 — Measurement of out-of-squareness

20.2 The out-of-squareness is not normally measured by the manufacturer, unless compliance is in doubt.

21 Measurement of flatness and waviness

21.1 Flatness tolerances can be measured in the following ways:

a) Maximum deviation from a flat horizontal surface. With the product lying under its own mass on a flat surface, the maximum deviation from flatness is the maximum distance between the lower surface of the product and the flat horizontal surface.

b) To measure the flatness, the product shall be laid on an approximately flat surface. Deviation with respect to flatness shall be taken as the greatest distance between the product and a straight-edge placed upon it. The straight-edge should be either 1 000 mm or 2 000 mm long. It may be placed on the product at any position and in any direction. Only the position of the points of contact of product and straight-edge shall be taken into account.

Unless otherwise agreed, the choice of the measurement method is left to the manufacturer.

21.2 The measurement of waviness is only made on edges.

21.3 Flatness and waviness are not normally measured by the manufacturer, unless compliance is in doubt.

ICS 77.140.20; 77.140.50

Price based on 8 pages