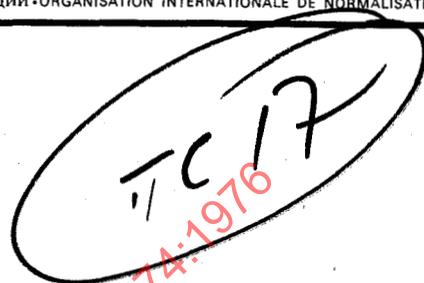

INTERNATIONAL STANDARD



3574

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION



Cold-reduced carbon steel sheet of commercial and drawing qualities

Tôles en acier au carbone laminées à froid, de qualité commerciale et pour emboutissage

First edition – 1976-10-15

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Descriptors: iron and steel products, cold-rolled products, metal plates, carbon steels, cupping, specifications, chemical composition, mechanical properties, mechanical tests, dimensions, tolerances (mechanics).

Price based on 13 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3574 was drawn up by Technical Committee ISO/TC 17, *Steel*, and was circulated to the Member Bodies in April 1975.

It has been approved by the Member Bodies of the following countries :

Belgium	Iran	Spain
Brazil	Ireland	Sweden
Bulgaria	Italy	Switzerland
Canada	Japan	Turkey
Czechoslovakia	Korea, Dem. P. Rep. of	United Kingdom
Denmark	Mexico	U.S.A.
Finland	Netherlands	U.S.S.R.
France	New Zealand	Yugoslavia
Germany	Romania	
Hungary	South Africa, Rep. of	

The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
Austria

Cold-reduced carbon steel sheet of commercial and drawing qualities

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard applies to cold-reduced carbon steel sheet of commercial and drawing qualities. It is suitable for applications where surface is of prime importance.

1.2 Commercial quality sheet (CR1) is intended for general fabricating purposes where sheet is used in the flat or for bending, moderate forming, and welding operations. It is produced in thicknesses of 0,36 mm and thicker (commonly produced up to 4 mm) and in widths of 600 mm and over in coils and cut lengths.

NOTE – Approximate conversions into inches are given in the annex for information only.

1.3 Drawing quality sheet (CR2, CR3, CR4) is intended for drawing or severe forming, including welding. It is produced in thicknesses of 0,36 mm and thicker (commonly produced up to 4 mm) and in widths 600 mm and wider in coils and cut lengths. Drawing quality sheet shall be furnished to all the requirements of this International Standard, or, by agreement when ordered, to fabricate an identified part, in which case the mechanical properties of table 2 do not apply. Drawing qualities are identified as follows :

CR2 : Drawing quality

CR3 : Deep drawing quality

CR4 : Deep drawing quality special killed (non-ageing)

1.4 Cold-reduced sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

2 REFERENCES

ISO/R 80, *Rockwell hardness test (B and C scales) for steel.*

ISO/R 81, *Vickers hardness test for steel (Load 5 to 100 kgf).*

ISO 82, *Steel – Tensile testing.*

ISO/R 85, *Bend test for steel.*

ISO 86, *Steel – Tensile testing of sheet and strip less than 3 mm and not less than 0,5 mm thick.*

ISO/R 87, *Simple bend testing of steel sheet and strip less than 3 mm thick.*

ISO/R 1024, *Rockwell superficial hardness test (N and T scales) for steel.*

3 DEFINITIONS AND OTHER INFORMATION

3.1 cold-reduced steel sheet : A product obtained from hot-rolled descaled steel sheet by cold-reducing to the required sheet thickness followed by annealing to recrystallize the grain structure. This product is normally supplied skin passed (see 3.2) but may be supplied annealed last (i.e. without a skin pass), if specified by the purchaser on his order.

3.2 skin pass : A final light cold rolling of cold-reduced and annealed sheet. The purposes of skin passing are one or more of the following :

- to minimize temporarily the occurrence of the condition known as stretcher strain (Lüder's lines) or fluting during fabrication of finished parts;
- to obtain required surface finish suitable for ordinary decorative painting;
- to control the shape.

Cold-reduced sheet in qualities CR1, CR2 and CR3, supplied in the skin-passed condition, tends to strain-age and this may lead to the following :

- surface markings from stretcher strain (Lüder's lines) or fluting when the steel is formed;
- deterioration in ductility.

Because of these factors, it is essential that the period between final processing at the mill and fabrication be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Stocking of such steels for extended periods of time should be avoided; for optimum performance the period should not exceed 6 weeks.

For skin-passed sheet in qualities CR1, CR2 and CR3 and with due regard to the foregoing precautions, reasonable freedom can be achieved by effective roller levelling immediately prior to fabrication at the purchaser's plant. Freedom from stretcher strain and fluting for a period of 6 months can be achieved by the supply of skin-passed non-ageing steels. Grade CR4 shall be specified in such cases where Lüder's lines are not acceptable and where roller levelling is not possible.

3.3 Surface condition

The condition of the surface of cold-reduced steel sheet of drawing qualities (CR2, CR3 and CR4) is not required to be the same for unexposed parts as it is for exposed parts.

Surface condition of sheet for unexposed parts may contain pores, some light pitting, small markings, light scratches, and a light discoloration. The surface of sheet for exposed parts is reasonably free of these conditions. Unless otherwise agreed, only one side is inspected.

3.4 Surface finish

Cold-reduced steel sheet is normally produced in a matt finish, dull in appearance, which is suitable for ordinary decorative painting but is not recommended for electroplating.

When cold-reduced steel sheet is deformed during fabrication, localized areas may roughen to some degree and such affected portions of the part may require hand-finishing to prepare the surface for the intended application.

3.5 Oiling

As a deterrent to rusting, a coating of oil is usually applied to cold-reduced steel sheet, but sheet may be furnished not oiled if required. The oil is not intended as a drawing or forming lubricant and should be easily removable with degreasing chemicals.

4 CONDITIONS OF MANUFACTURE

4.1 Steelmaking

The processes used in making the steel and in manufacturing cold-reduced sheet are left to the discretion of the manufacturer. When requested, the purchaser shall be informed of the steelmaking process being used.

4.2 Chemical composition

The chemical composition (cast analysis) shall not exceed the values given in table 1.

TABLE 1 — Chemical composition (cast analysis), %

Quality		C max.	Mn max.	P max.	S max.
Designation	Name				
CR1	Commercial	0,15	0,60	0,05	0,05
CR2	Drawing	0,12	0,50	0,04	0,04
CR3	Deep drawing	0,10	0,45	0,03	0,03
CR4	Deep drawing special killed (non-ageing)	0,08	0,45	0,03	0,03

4.3 Chemical analysis

4.3.1 Cast analysis

A cast analysis of each cast of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus, and sulphur. On request, this analysis shall be reported to the purchaser or his representative.

4.3.2 Verification analysis

A verification analysis may be made by the purchaser to verify the specified chemical composition of the semi-finished or finished steel and shall take into consideration any normal heterogeneity. Non-killed steels (such as rimmed or capped) are not technologically suited to verification analysis. For killed steels, the sampling method and deviation limits shall be agreed upon between the interested parties at the time of ordering.

4.4 Weldability

This product is normally suitable for welding if appropriate welding conditions are selected.

4.5 Application

It is desirable that cold-reduced steel sheet be identified for fabrication by name of the part or by the intended application. Cold-reduced steel sheet of drawing qualities (CR2, CR3 and CR4) may be produced to make an identified part within a properly established breakage allowance, which shall be previously agreed upon between the interested parties. In this case, part name, details of fabrication, and special requirements (exposed or unexposed, freedom from stretcher strains or fluting) shall be specified and the mechanical properties of table 2 do not apply.

4.6 Mechanical properties

Except when ordered to an identified part as explained in 4.5, the mechanical properties shall be as stated in table 2, when they are determined on test pieces obtained in accordance with the requirements of clause 7.

The values specified are applicable for the periods indicated below from the time that the steel is available for shipment.

Quality	Period
CR2	8 days
CR3	8 days
CR4	6 months

TABLE 2 – Mechanical properties¹⁾ (see 4.6)

Quality		R_m , max. ²⁾ N/mm ²	A min. % ³⁾		180° bend mandrel diameter		Hardness, max. ⁴⁾	
Designation	Name		$L_o = 80$ mm	$L_o = 50$ mm	$e < 3$	$e > 3$	HRB	HR30 T
CR1	Commercial	–	–	–	0 (flat on itself)	1a	Note 5)	–
CR2	Drawing	370	30	31	–	–	57	55
CR3	Deep drawing	350	34	35	–	–	53	52
CR4	Deep drawing special killed (non-ageing)	340	36	37	–	–	50	50

1) R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

S_o = original cross-sectional area of gauge length

e = thickness of steel sheet, in millimetres

a = thickness of bend test piece

1 N/mm² = 1 MPa

HRB = hardness Rockwell B scale

HR30 T = hardness Rockwell 30 T scale

2) Minimum tensile strength for qualities CR2, CR3 and CR4 would normally be expected to be 270 N/mm². All tensile strength values are determined to the nearest 10 N/mm².

3) For material up to and including 0,6 mm in thickness, the elongation values in the table shall be reduced by 1. Minimum elongation values on a gauge length of $L_o = 5,65 \sqrt{S_o}$ may be the subject of agreement between the interested parties.

4) Equivalent Vickers hardness values are allowed on agreement between the interested parties at the time of ordering. By agreement between the interested parties, no hardness requirements need apply. The hardness of sheet thinner than 0,6 mm shall be measured exclusively in compliance with the HR30 T scale.

5) The hardness of quality CR1 steel sheet is expected not to exceed the equivalent of Rockwell HRB 65 at the time it is made available for shipment.

5 DIMENSIONAL TOLERANCES

Dimensional tolerances applicable to cold-reduced steel sheet shall be as given in tables 3 to 12 inclusive. When required, special tolerances on thickness (table 4) and flatness (table 11) are to be the subject of agreement between the interested parties.

6 SAMPLING

6.1 Tensile and hardness tests

One representative sample for the tensile test (that is also to be used for the hardness test) required in table 2 shall be taken from each lot of sheet for shipment. A lot consists of 50 tonnes or less of sheet of the same quality rolled to the same thickness and condition.

6.2 Bend test

One representative sample for the bend test (only applicable to CR1) shall be taken from each lot of sheet for shipment.

A lot consists of all sheet of the same quality rolled to the same thickness and condition.

7 MECHANICAL TESTS

7.1 Tensile test

The tensile test shall be carried out in accordance with ISO 82 or ISO 86. Transverse test pieces shall be taken midway between the centre and edge of the sheet as rolled.

7.2 Bend test (applicable to CR1 only)

The transverse bend test piece shall withstand being bent through 180°, in the direction shown in figure 1 and around an inside diameter as given in table 2, without cracking on the outside diameter of the bent portion. The bend test is to be carried out at ambient temperature and as described in ISO/R 85 and ISO/R 87.

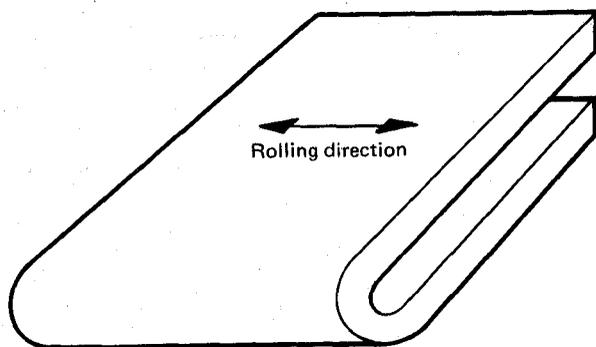


FIGURE 1 – Transverse bend test piece (after bending)

7.3 Hardness test

The hardness test shall be carried out as described in ISO/R 80, ISO 81 or ISO 1024 on the test pieces specified in 7.1.

8 WORKMANSHIP

8.1 Commercial quality CR1

The surface condition should be that normally obtained in a cold-reduced product.

The steel sheet in cut lengths shall be free from amounts of laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing.

Processing for shipment in coils does not afford the manufacturer opportunity to observe readily or to remove defective portions as can be carried out on the cut length product.

8.2 Drawing qualities CR2, CR3, CR4

The surface condition of sheets of drawing qualities for exposed or unexposed parts shall be as specified in 3.3.

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.

9 INSPECTION AND ACCEPTANCE

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

9.2 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.

10 COIL SIZE

When cold-reduced steel sheet is ordered in coils, a minimum or range of acceptable inside diameter (I.D.) shall be specified. In addition, the maximum outside diameter (O.D.) and the maximum acceptable coil mass shall be specified.

11 MARKING

Unless otherwise stated, the following minimum requirements for identifying the steel shall be legibly stencilled on the top of each lift or shown on a tag attached to each coil or shipping unit :

- a) the manufacturer's name or identifying brand;
- b) the number of this International Standard;
- c) the quality designation;
- d) the order number;
- e) the product dimensions;
- f) the lot number;
- g) the mass.

12 INFORMATION TO BE PROVIDED BY THE PURCHASER

To specify adequately the requirements under this International Standard, inquiries and orders shall include the following information :

- a) the number of this International Standard;
- b) the name and quality of the material (for example, cold-reduced steel sheet, deep-drawing quality CR3) (see 1.2 and 1.4);
- c) the dimensions of the product and quantity required;
- d) the special thickness tolerances, if required (see table 4);
- e) the application (name of part) and whether it is an exposed or unexposed part (see 4.5);
- f) for drawing qualities CR2, CR3 and CR4, any special requirements for surface finish, when required (see 3.4);
- g) for drawing qualities CR2, CR3 and CR4, whether ordered to mechanical properties or to fabricate an identified part (see 4.5 and 4.6);
- h) whether oiled or not oiled (see 3.5);
- i) annealed last, if required (see 3.1);
- j) the report of the cast analysis, if required (see 4.3.1);

k) limitations on masses and dimensions of individual coils or bundles, if applicable (see clause 10);

l) inspection and tests for acceptance prior to shipment from the producer's works, if required (see 9.1).

NOTE – Typical ordering descriptions are as follows :

1) International Standard ISO 3574 cold-reduced steel sheet

commercial quality CR1, 1 × 1 000 × 2 000 mm, 10 000 kg, to be used for warehouse resale, oiled, furnish report of cast analysis, maximum lift mass 4 000 kg.

2) International Standard ISO 3574 cold-reduced steel sheet drawing quality CR2, 1 × 700 × 1 800 mm, 50 000 kg, unexposed part, ordered to mechanical properties, oiled, furnish report of cast analysis, maximum lift mass 4 000 kg.

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TABLE 3 – Standard thickness tolerances for coils¹⁾ and cut lengths

Unless otherwise stated on the order, the thickness tolerances for all qualities of steel shall be in accordance with table 3. When required, special tolerances in accordance with table 4 shall be the subject of agreement.

Values in millimetres

Specified widths	Thickness tolerances ²⁾ , over and under, for specified thicknesses									
	up to and including 0,4	over 0,4 up to and including 0,6	over 0,6 up to and including 0,8	over 0,8 up to and including 1,0	over 1,0 up to and including 1,2	over 1,2 up to and including 1,6	over 1,6 up to and including 2,0	over 2,0 up to and including 2,5	over 2,5 up to and including 3,0	over 3,0 up to and including 4
600 up to and including 1 200	0,07	0,08	0,09	0,10	0,12	0,14	0,16	0,18	0,20	0,23
Over 1 200 up to and including 1 500	0,08	0,09	0,10	0,11	0,13	0,15	0,17	0,20	0,23	0,25
Over 1 500 up to and including 1 800	—	0,10	0,11	0,13	0,14	0,17	0,19	0,22	0,23	0,27
Over 1 800	—	0,12	0,13	0,14	0,16	0,19	0,21	0,24	0,26	0,29

1) The thickness tolerances for sheets in coil form are the same as for sheets supplied in cut lengths, but in cases where welds are present, the tolerances shall be double those given over a length of 15 m in the vicinity of the weld.

2) Thickness is measured at any point on the sheet not less than 40 mm from a side edge.

TABLE 4 – Special thickness tolerances for coils¹⁾ and cut lengths

Unless otherwise stated on the order, the thickness tolerances for all qualities of steel shall be in accordance with table 3. When required, special tolerances in accordance with table 4 shall be the subject of agreement.

Values in millimetres

Specified widths	Thickness tolerances ²⁾ , over and under, for specified thicknesses									
	up to and including 0,4	over 0,4 up to and including 0,6	over 0,6 up to and including 0,8	over 0,8 up to and including 1,0	over 1,0 up to and including 1,2	over 1,2 up to and including 1,6	over 1,6 up to and including 2,0	over 2,0 up to and including 2,5	over 2,5 up to and including 3,0	over 3,0 up to and including 4
600 up to and including 1 200	0,040	0,045	0,055	0,065	0,075	0,090	0,110	0,125	0,140	0,165
Over 1 200 up to and including 1 500	0,045	0,055	0,065	0,075	0,085	0,110	0,125	0,140	0,155	0,180
Over 1 500 up to and including 1 800	—	—	0,075	0,085	0,100	0,120	0,140	0,155	0,170	0,190
Over 1 800	—	—	0,080	0,095	0,105	0,135	0,150	0,165	0,185	0,200

1) The thickness tolerances for sheets in coil form are the same as for sheets supplied in cut lengths, but in cases where welds are present, the tolerances shall be double those given over a length of 15 m in the vicinity of the weld.

2) Thickness is measured at any point on the sheet not less than 40 mm from a side edge.

TABLE 5 – Width tolerances for coils¹⁾ and cut lengths, not required

Values in millimetres

Specified widths	Tolerance ¹⁾
Up to and including 1 200	+ 5 0
Over 1 200 up to and including 1 500	+ 7 0
Over 1 500	+ 9 0

1) Tolerances for sheet over 4 mm thick shall be the subject of agreement.

TABLE 6 – Length tolerances for sheet, not required

Values in millimetres

Specified lengths	Tolerance
Up to and including 3 000	+ 20 0
Over 3 000 up to and including 6 000	+ 30 0
Over 6 000	+ 0,5 % 0

TABLE 7 – Camber tolerances for coils and cut lengths, not required

Values in millimetres

Form	Camber tolerance
Coils	20 mm in any 5 000 mm length
Cut lengths	0,4 % X length

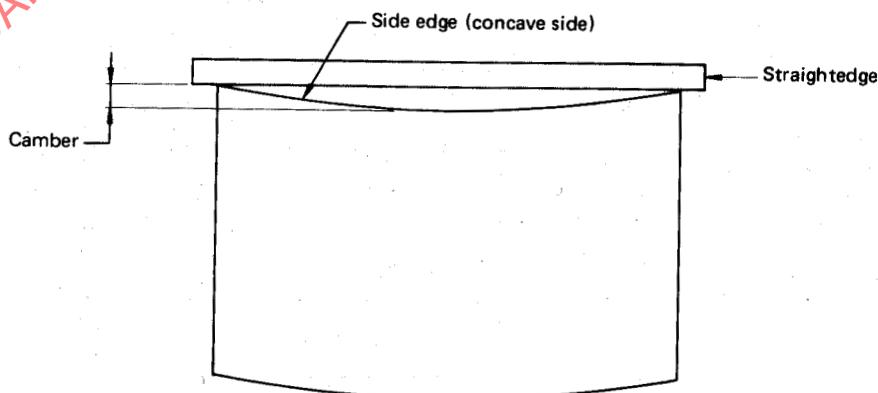


FIGURE 2 – Measurement of camber

Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straightedge.

TABLE 8 – Out-of-square tolerance for cut lengths, not resquared

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1,0 % X width

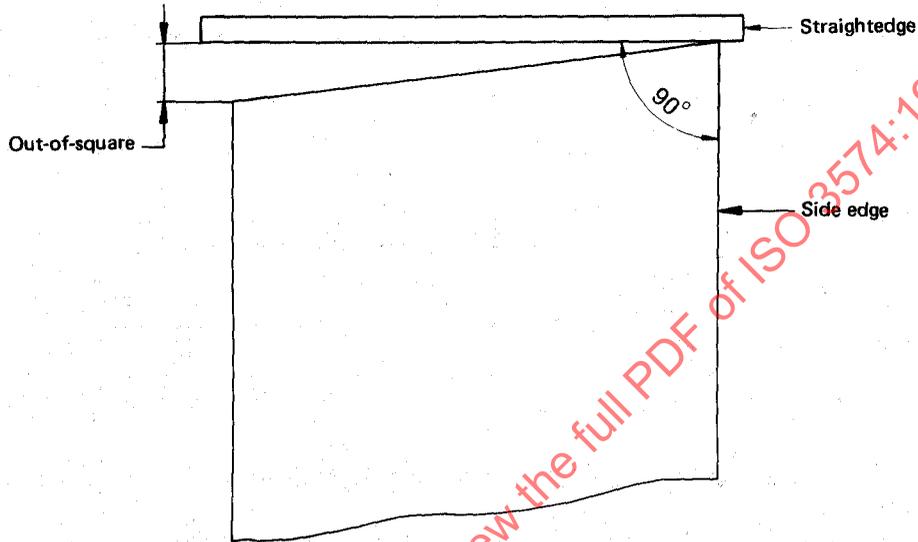


FIGURE 3 – Measurement of out-of-square

Out-of-square is the greatest deviation of an edge from a straight line at right angles to a side and touching one corner, the measurement being taken as shown in figure 3. It can also be measured as one-half the difference between the diagonals of the cut length sheet.

TABLE 9 – Out-of-square¹⁾ tolerances for resquared²⁾ sheet

Values in millimetres

Specified lengths	Specified widths	Out-of-square tolerance
Up to and including 3 000	Up to and including 1 200	+ 2 0
	Over 1 200	+ 3 0
Over 3 000	All widths	+ 3 0

1) See figure 3.

2) When measuring material to resquared tolerances, consideration may have to be given to extreme variations in temperature.

TABLE 10 – Standard flatness tolerances for cut lengths¹⁾²⁾

Values in millimetres

Specified thicknesses	Specified widths	Flatness tolerance ³⁾
Up to and including 0,7	Up to and including 1 200	15
	Over 1 200 up to and including 1 500	18
	Over 1 500	22
Over 0,7 up to and including 1,2	Up to and including 1 200	12
	Over 1 200 up to and including 1 500	15
	Over 1 500	19
Over 1,2	Up to and including 1 200	10
	Over 1 200 up to and including 1 500	12
	Over 1 500	17

- 1) This table does not apply to full hard sheet or sheet produced to hardness ranges.
- 2) This table also applies to sheet cut to length from coils by the customer when adequate flattening procedures are performed.
- 3) Maximum deviation from a flat horizontal surface. With the sheet lying under its own weight on a flat surface, the maximum distance between the lower surface of the sheet and the flat horizontal surface is the maximum deviation from flatness (see figure 4).

TABLE 11 – Special flatness tolerances for cut lengths roller levelled or stretcher levelled

Values in millimetres

Specified thicknesses	Specified widths	Flatness tolerance ¹⁾
Up to and including 0,7	Up to and including 1 200	6
	Over 1 200 up to and including 1 500	7
	Over 1 500	8
Over 0,7 up to and including 1,2	Up to and including 1 200	5
	Over 1 200 up to and including 1 500	6
	Over 1 500	7
Over 1,2	Up to and including 1 200	4
	Over 1 200 up to and including 1 500	5
	Over 1 500	6

- 1) Maximum deviation from a flat horizontal surface. With the sheet lying under its own weight on a flat surface, the maximum distance between the lower surface of the sheet and the flat horizontal surface is the maximum deviation from flatness (see figure 4).

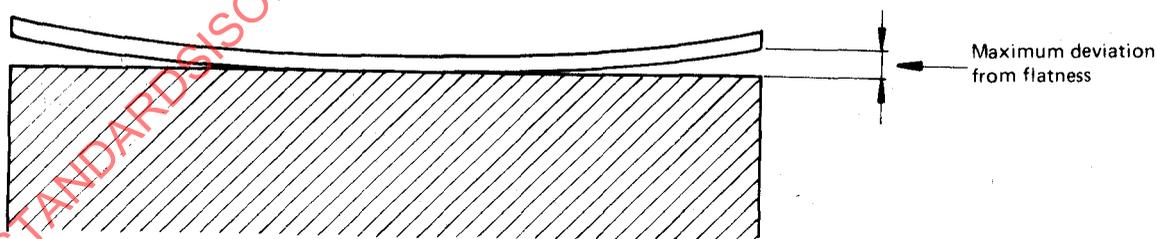


FIGURE 4 – Measurement of flatness

When cold-reduced sheet is specified to stretcher-levelled standards of flatness and not resquared, the allowances over specified dimensions in width and length given in table 12 apply. Under these conditions, the allowance for width and length are added by the manufacturer to the specified width and length and the tolerances given in tables 5 and 6 apply on the basis of the new size established. The camber tolerances in table 7 do not apply.

When sheet is not to have grip or entry marks within the specified length, the purchaser shall specify "grip or entry marks outside specified length". When sheet may have grip or entry marks within the specified length, the purchaser shall specify "grip or entry marks inside specified length".

TABLE 12 – Width and length allowances¹⁾ for sheet, stretcher levelled

Values in millimetres

Specified lengths	Allowances over specified dimensions		
	Widths	Lengths	
		Grip or entry marks outside specified length	Grip or entry marks inside specified length
Up to and including 3 000	19	100	75
Over 3 000 up to and including 4 000	25	100	75
Over 4 000	32	125	100

1) Allowances for sheet exceeding 6 mm thickness or length exceeding 5 000 mm shall be the subject of agreement.