INTERNATIONAL STANDARD

ISO 3574

Third edition
1999-06-01

Cold-reduced carbon steel sheet of commercial and drawing qualities

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

Reference number
ISO 3574:1999(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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 3574 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products.*

This third edition cancels and replaces the second edition (ISO 3574:1986) which has been technically revised.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

Cold-reduced carbon steel sheet of commercial and drawing qualities

1 Scope

1.1 This International Standard applies to cold-reduced carbon steel sheet of commercial and drawing qualities. 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.

1.3 Drawing quality sheet (CR2, CR3, CR4, CR5) 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 of 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 3 do not apply. Drawing qualities are identified as follows:

— CR2 – Drawing quality

— CR3 – Deep drawing quality

— CR4 – Deep drawing quality aluminum killed (non-ageing)

— CR5 – Extra deep drawing quality (stabilized interstitial free)

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

2 Normative Reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, this publication do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 6892:1999, *Metallic materials – Tensile testing at ambient temperature.*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply:

3.1
cold-reduced steel sheet
product obtained from hot-rolled descaled steel sheet by cold reducing to the required sheet thickness followed by annealing to recrystallize the grain structure

3.2
skin pass
final light cold rolling of cold-reduced and annealed sheet

3.3
camber
greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straightedge

3.4
out-of-square
greatest deviation of an end edge from a straight line at right angles to a side and touching one corner, the measurement being taken as shown in Figure 2, also measurable as one-half the difference between the diagonals of the cut length sheet

4 Other Information

4.1 Cold-reduced steel sheet

This product is normally supplied skin passed (see 4.2) but may be supplied annealed last (ie. without a skin pass), if specified by the purchaser on his order.

4.2 Skin pass

The purpose of skin passing is one or more of the following:

a) to temporarily minimize the appearance of coil breaks, stretcher strains (Lüders lines) or fluting during fabrication of finished parts;

b) to obtain the required surface finish suitable for ordinary decorative painting;

c) to control the shape.

Some increase in hardness and some loss in ductility will result from skin passing.

4.3 Strain ageing

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:

a) surface markings from stretcher strains (Lüders lines) or fluting when the steel is formed;

b) 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 six 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 six months can be achieved by the supply of skin-passed non-ageing steels. Grades CR4 or CR5 shall be specified in such cases where Lüder's lines are not acceptable and where roller levelling is not possible.

4.4 Surface condition

The condition of the surface of cold-reduced steel sheet of drawing qualities (CR2, CR3, CR4 and CR5) 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 slight pitting, small markings, light scratches, and a light discoloration. The surface of sheet for exposed parts shall be reasonably free of these conditions. Unless otherwise agreed, only one side is inspected.

4.5 Surface Finish

Cold-reduced steel sheet is normally produced in a matte 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.

4.6 Oiling

As a deterrent to rusting, a coating of oil is usually applied to the product. The oil is not intended as a drawing or forming lubricant and should be easily removable with degreasing chemicals. The product may be ordered not oiled, if required, in which case, the supplier has limited responsibility if oxidation occurs.

5 Conditions of manufacture

5.1 Steelmaking

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

5.2 Chemical Composition

The chemical composition (heat analysis) shall not exceed the values given in Table 1.

5.3 Chemical analysis

5.3.1 Heat Analysis

An analysis of each heat of steel shall be made by the manufacturer to determine the percentage by mass of carbon, manganese, phosphorus and sulfur. When requested, this analysis shall be reported to the purchaser or to his representative.

5.3.2 Verification analysis

A verification analysis may be made by the purchaser to verify the specified analysis of the semi-finished or finished steel and shall take into consideration any normal heterogeneity. Non-killed steels (such as rimmed or capped) are not technologically suited to verification analysis.

For killed steels, the sampling method and deviation limits shall be agreed between the manufacturer and purchaser at the time of ordering.

Table 1 — Chemical composition (heat analysis)

Content in percent by mass

Quality		C	Mn [a]	P	S	Ti
		max	max	max	max	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 aluminum killed (non-ageing)	0,08	0,45	0,03	0,03	
CR5	Extra deep drawing [b] (stabilized interstitial free)	0,02	0,25	0,02	0,02	0,3

[a] Titanium may be replaced totally or partially by niobium or vanadium. Carbon and nitrogen shall be completely stabilized.

[b] By agreement, the manganese, phosphorus and sulfur maxima may be adjusted.

5.4 Weldability

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

5.5 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, CR4, CR5) may be produced to make an identified part within a properly established breakage allowance, which shall be previously agreed between the manufacturer and purchaser. In this case, the part name, the details of fabrication, and special requirements (i.e. exposed or unexposed, freedom from stretcher strain or fluting) shall be specified and the mechanical properties of Table 3 do not apply.

5.6 Mechanical properties

Except when ordered to an identified part as explained in 5.5, the mechanical properties shall be as given in Table 3, when they are determined on test pieces obtained in accordance with the requirements of clause 8.

The values specified in table 3 are applicable for the periods indicated in Table 2 from the time that the steel is available for shipment.

Table 2 — Applicable period for values specified in Table 3

Designation	Period
CR2	8 days
CR3	8 days
CR4	6 months
CR5	6 months

6 Dimensional tolerances

Dimensional tolerances applicable to cold-reduced steel sheet shall be as given in tables 4 to 12 inclusive.

Restricted thickness tolerances are given in Table 5.

7 Tensile test sampling

One representative sample for the tensile test required in Table 3 shall be taken from each lot of sheet for shipment. A lot consists of 50 t or less of sheet of the same designation rolled to the same thickness and condition.

8 Tensile test

The tensile test shall be carried out in accordance with ISO 6892. Transverse test pieces shall be taken midway between the centre and edge of the sheet as rolled.

9 Retests

9.1 Machining and flaws

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

9.2 Elongation

If the percentage elongation of any test piece is less than that specified in Table 3 and if any part of the fracture is outside the middle half of the gauge length as scribed before the test, the test shall be discarded and a retest shall be carried out.

9.3 Additional tests

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

10 Resubmission

The manufacturer may resubmit for acceptance the products that have been rejected during earlier inspection because of unsatisfactory properties, after he has subjected them to a suitable treatment (selection, heat treatment), which, on request, will be indicated to the purchaser. In this case, tests shall be carried out as if they applied to a new batch.

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

11 Workmanship

11.1 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 readily observe or to remove defective portions as can be carried out on the cut length product.

11.2 CR2, CR3, CR4, CR5

The surface condition of sheets of drawing qualities for exposed or unexposed parts shall be as specified in 4.4.

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

12 Inspection and acceptance

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.

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.

13 Coil Size

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

14 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, i.e. ISO 3574;

c) the quality designation number;

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass.

15 Information to be supplied by the purchaser

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

a) reference to this International Standard, i.e. ISO 3574;

b) the name and quality of the material, (see 1.2 and 1.3);

c) the dimensions of the product and quantity required;

d) the application (name of part), and whether it is an exposed or unexposed part (see 5.5);

e) for drawing qualities CR2, CR3, CR4 and CR5, any special requirements for surface finish, when required (see 4.4 and 4.5);

f) for drawing qualities CR2, CR3, CR4 and CR5, whether ordered to mechanical properties or to fabricate an identified part (see 5.5 and 5.6);

g) whether oiled (see 4.6);

h) annealed last, if required (see 4.1);

i) report of heat analysis, if required (see 5.3.1);

j) grip or entry marks location;

k) limitations on mass and dimensions of individual coils or bundles, if applicable (see clause 13);

l) inspection and tests for acceptance prior to shipment from the producer's works, if required (see clause 12).

EXAMPLE 1: ISO 3574, cold-reduced steel sheet, commercial quality CR1, normal thickness tolerance, 1 mm × 1 000 mm × 2 000 mm, 10 000 kg to be used for warehouse resale, oiled, report of heat analysis required, maximum lift mass 4 000 kg.

Example 2: ISO 3574, cold-reduced steel sheet, drawing quality CR2, normal thickness tolerance, 1 mm × 700 mm × 1 800 mm, 50 000 kg unexposed part, ordered to mechanical properties, oiled, furnish report of heat analysis required, maximum lift mass 4 000 kg.

Table 3 — Mechanical property requirements for cold rolled steel sheet [a]

Quality		R_e max. N/mm²	R_m max.[b] N/mm²	A [c] min. %		$\bar{r}$ [d,e]	$\bar{n}$ [d,f]
Designation	Name			L_0 = 80 mm	L_0 = 50 mm		
CR1	Commercial [g]	280	410	27	28	—	—
CR2	Drawing	240	370	30	31	—	—
CR3	Deep drawing	220	350	34	35	—	—
CR4	Deep drawing aluminum killed (non-aging)	210	350	36	37	—	—
CR5	Extra deep drawing (stabilized interstitial free)	190	350	38	38	1,7 min.	0,22 min.

a R_e yield stress
R_m tensile strength
A percentage elongation after fracture
L_0 gauge length on test piece
$\bar{r}$ plastic strain ratio (index of drawability of the product)
$\bar{n}$ tensile strain hardening exponent (index of stretchability of the product)

b 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. For design purposes, the lower limit for R_e may be assumed to be 140 N/mm² for grades CR1, CR2, CR3 and CR4 and 120 N/mm² for grade CR5.

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

d $\bar{r}$ and $\bar{n}$ values are only applicable to thicknesses $\geqslant$ 0,5 mm. For thicknesses > 2,0 mm, the $\bar{r}$ value is reduced by 0,2.

e $\bar{r}$ can also be written as bar r.

f $\bar{n}$ can also be written as bar n.

g Mechanical properties are not generally done on commercial quality products and the values in this Table are for information only.

Table 4 — Normal thickness tolerances for coils and cut lengths

Values in millimetres

Specified width	Thickness tolerance [a,b], for specified thickness									
	⩽ 0,4	>0,4 ⩽ 0,6	> 0,6 ⩽ 0,8	> 0,8 ⩽ 1,0	> 1,0 ⩽ 1,2	> 1,2 ⩽ 1,6	> 1,6 ⩽ 2,0	> 2,0 ⩽ 2,5	> 2,5 ⩽ 3,0	> 3,0 ⩽ 4,0
600 ⩽ 1 200	± 0,04	± 0,05	± 0,07	± 0,08	± 0,09	± 0,11	± 0,13	± 0,15	± 0,18	± 0,20
> 1 200 ⩽1 500	± 0,05	± 0,06	± 0,08	± 0,09	± 0,10	± 0,12	± 0,14	± 0,16	± 0,19	± 0,21
> 1 500 ⩽1 800	—	± 0,08	± 0,09	± 0,10	± 0,12	± 0,14	± 0,16	± 0,18	± 0,21	± 0,23

a The thickness tolerances for sheet in coil form are the same as for sheet 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.

b Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

Table 5 — Restricted thickness tolerances for coils and cut lengths

Values in millimetres

Specified width	Thickness tolerance [a,b], for specified thickness									
	⩽ 0,4	> 0,4 ⩽ 0,6	> 0,6 ⩽ 0,8	> 0,8 ⩽ 1,0	> 1,0 ⩽ 1,2	> 1,2 ⩽ 1,6	> 1,6 ⩽ 2,0	> 2,0 ⩽ 2,5	> 2,5 ⩽ 3,0	> 3,0 ⩽ 4,0
600 ⩽ 200	± 0,025	± 0,035	± 0,04	± 0,045	± 0,055	± 0,07	± 0,08	± 0,10	± 0,11	± 0,12
> 1 200 ⩽ 1 500	± 0,035	± 0,045	± 0,05	± 0,06	± 0,07	± 0,08	± 0,09	± 0,11	± 0,12	± 0,13
> 1 500 ⩽ 1 800	—	± 0,05	± 0,05	± 0,06	± 0,07	± 0,08	± 0,09	± 0,11	± 0,12	± 0,13

a The thickness tolerances for sheet in coil form are the same as for sheet 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.

b Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

Table 6 — Width tolerances for coils and cutlengths, not resquared

Values in millimetres

Specified width	Tolerance
⩽ 1 200	+5 0
> 1 200 ⩽ 1 500	+7 0
>1 500	+9 0

Table 7 — Length tolerances for cut lengths, not resquared

Values in millimetres

Specified length	Tolerance
⩽ 3 000	+20 0
> 3 000 ⩽ 6 000	+30 0
> 6 000	+0,5 % × length 0

Table 8 — Camber tolerances for coils and cut lengths, not resquared

Form	Camber tolerance
Cut length	0,4 % × length
Coils	20 mm in any 5 000 mm length
NOTE See Figure 1.	

Table 9 — Out-of-square tolerance for cut lengths, not resquared

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1% × width

Table 10 — Out-of square tolerances for resquared material

Values in millimetres

Specified length	Specified width	Out-of-square tolerance
⩽ 3 000	⩽ 1 200	+2 0
	> 1 200	+3 0
> 3 000	All widths	+3 0
NOTE 1 See Figure 2. NOTE 2 When measuring material to resquared tolerances, consideration may have to be given to extreme variations in temperature.		

Table 11 — Standard flatness tolerances for cut lengths

Values in millimetres

Specified thickness	Specified Width	Flatness tolerance [a]
⩽ 0,7	⩽ 1 200	15
	> 1 200 ⩽ 1 500	18
	> 1 500	22
> 0,7 ⩽ 1,2	⩽ 1 200	12
	> 1 200 ⩽ 1 500	15
	> 1 500	19
> 1,2	⩽ 1 200	10
	> 1 200 ⩽ 1 500	12
	> 1 500	17

NOTE This table also applies to sheet cut to length from coils by the customer when agreed upon flattening procedures are performed.

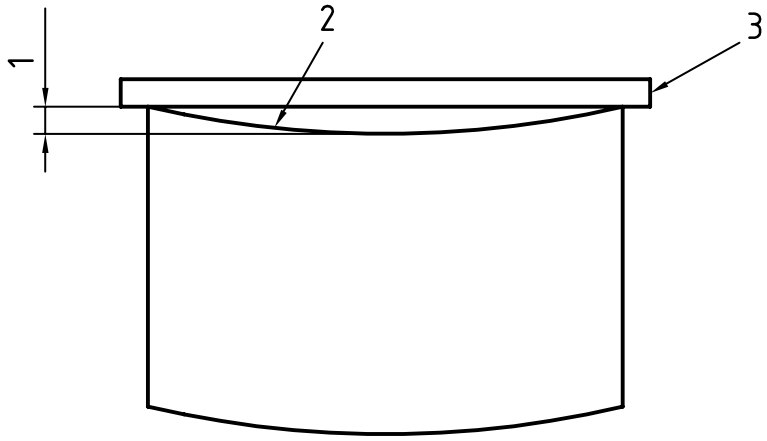
[a] Maximum deviation from a flat horizontal surface. With the sheet lying under its own weight on a flat surface, the maximum distance between the lower surface of the sheet and the flat horizontal surface is the maximum deviation from flatness (see Figure 3).

Table 12 — Restricted flatness tolerances for cut lengths

Values in millimetres

Specified thickness	Specified Width	Flatness tolerance [a]
⩽ 0,7	⩽1 200	6
	> 1 200 ⩽ 1 500	7
	>1 500	8
> 0,7 ⩽ 1,2	⩽ 1 200	5
	> 1 200 ⩽ 1 500	6
	> 1 500	7
> 1,2	⩽ 1 200	4
	> 1 200 ⩽ 1 500	5
	> 1 500	6

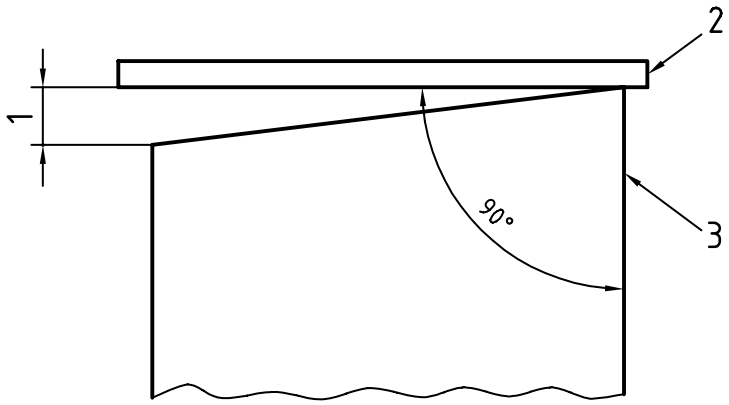
[a] Maximum deviation from a flat horizontal surface. With the sheet lying under its own weight on a flat surface, the maximum distance between the lower surface of the sheet and the flat horizontal surface is the maximum deviation from flatness (see Figure 3).



Key

1 Edge camber
2 Side edge (concave side)
3 Straightedge

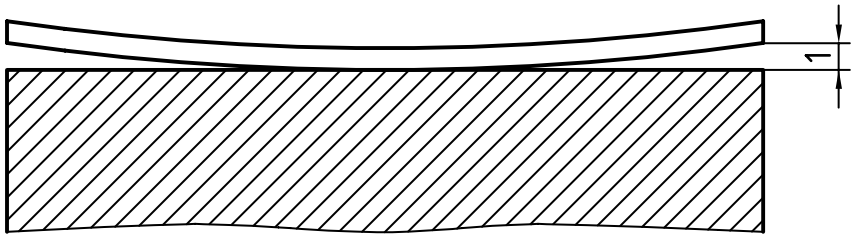
Figure 1 — Measurement of camber



Key

1 Out-of-square
2 Straightedge
3 Side edge

Figure 2 — Measurement of out-of-square



Key

1 Maximum deviation from flatness

Figure 3 — Measurement of flatness

Bibliography

[1] ISO 10113:1991, *Metallic materials — Sheet and strip — Determination of plastic strain ratio.*

[2] ISO 10275:1993, *Metallic materials — Sheet and strip — Determination of tensile strain hardening exponent.*

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