International Standard ISO 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

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Descriptors : steels, unalloyed steels, iron-and steel products, sheet metal, specifications, chemical composition, mechanical properties, mechanical tests, dimensional tolerances.

Price based on 9 pages

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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 3574 was prepared by Technical Committee ISO/TC 17, *Steel*.

This second edition cancels and replaces the first edition (ISO 3574-1976), table 4 of which has been technically revised.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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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.

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

ISO 6507/1, *Metallic materials - Hardness test — Vickers test — Part 1 :* HV5 *to* HV100.

ISO 6508, *Metallic materials — Rockwell test — Scales* A, B, C, E, F, G, H.[1)]

ISO 6892, *Metallic materials — Tensile testing.*

ISO 7438, *Metallic materials — Bend test.*

3 Definitions

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.

3.2 skin pass : A final light cold rolling of cold-reduced and annealed 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 (i.e. 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 minimize temporarily the occurrence of the condition known as stretcher strain (Lüder's 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.

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 strain (Lüder's 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 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

1) At present at the stage of draft. (Revision of ISO/R 80-1968 and ISO 2713-1973.)

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.

4.3 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 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.

4.4 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.

4.5 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.

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

5.3 Chemical analysis

5.3.1 Cast analysis

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

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 the 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 between the manufacturer and purchaser. In this case, part name, details of fabrication, and special requirements (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.

Table 1 — Chemical composition (cast analysis)

Values as percentages by mass

Quality		Carbon (C) max.	Manganese (Mn) max.	Phosphorus (P) max.	Sulfur (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

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

Table 3 — Mechanical property requirements for cold-reduced carbon steel sheet[1)]

Quality		R_m max.[2)] N/mm²	A min. %[3)]		180° bend mandrel diameter		Hardness[4)] max.	
Designation	Name		L_o = 80 mm	L_o = 50 mm	e < 3	e > 3	HRB	HR 30 T
CR1	Commercial	—	—	—	0 (Flat on itself)	a	—[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, in millimetres, of steel sheet
a : thickness of bend test piece
HRB : hardness Rockwell B scale
HR 30 T : hardness Rockwell 30T scale
1 N/mm² = 1 MPa

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 HR 30 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.

6 Dimensional tolerances

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

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 allowances 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".

7 Sampling

7.1 Tensile and hardness tests

One representative sample for the tensile test (that is also to be used for the hardness test) required in table 3 shall be taken from each lot of sheet for shipment. A lot consists of 50 t or less of sheet of the same quality rolled to the same thickness and condition.

7.2 Bend test

One representative sample for the bend test (applicable only 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.

8 Mechanical property tests

8.1 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.

8.2 Bend test (applicable only to CR1)

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 3, without cracking on the outside of the bent portion. The bend test shall be carried out at ambient temperature and in accordance with ISO 7438.

Small cracks on the edges of test pieces, and cracks not visible to the naked eye, shall be disregarded.

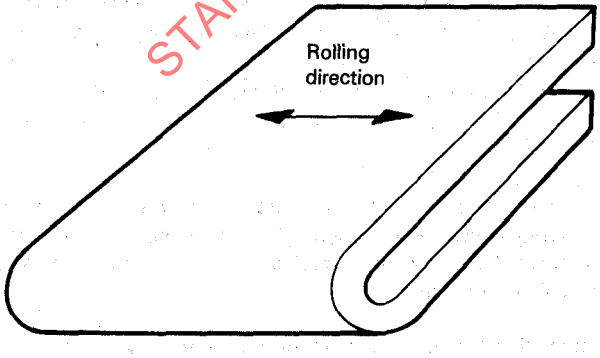

Figure 1 — Transverse bend test piece (after bending)

8.3 Hardness test

The hardness test shall be carried out in accordance with ISO/R 1024, ISO 6507/1 or ISO 6508 on the test pieces specified in 8.1.

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 more 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

10.1 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. Tests shall be carried out as if they apply to a new batch.

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

11.2 Drawing qualities CR2, CR3, CR4

The surface condition of sheets of drawing qualities for exposed or unexposed parts shall be as specified in 4.3.

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.

12 Inspection and acceptance

12.1 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.

12.2 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.

13 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.

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;

c) the quality designation;

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass.

15 Information to be supplied by the purchaser

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

a) the number of this International Standard;

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 and CR4, any special requirements for surface finish, when required (see 4.4);

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

g) whether oiled (see 4.5);

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

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

j) grip or entry marks location (see clause 6);

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 manufacrurer's works, if required (see 12.1).

NOTE — Typical ordering descriptions are as follows :

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

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

Table 4 — Thickness tolerances for cold-reduced steel sheet, for coils[1] and cut lengths

Values in millimetres

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

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 25 mm from a side edge. (Values to be taken nearer than 25 mm are subject of negotiation between the purchaser and supplier.)

Table 5 — Width tolerances for cold-reduced steel sheet, for coils and cut lengths, not resquared

Values in millimetres

Specified width, b	Tolerance[1]
$b \leqslant 1\,200$	$^{+\ 5}_{\ 0}$
$1\,200 < b \leqslant 1\,500$	$^{+\ 7}_{\ 0}$
$b > 1\,500$	$^{+\ 9}_{\ 0}$

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

Table 6 — Length tolerances for cold-reduced steel sheet, not resquared

Specified length, l	Tolerance
$l \leqslant 3\,000$ mm	$^{+\ 20}_{\ 0}$ mm
$3\,000 < l \leqslant 6\,000$ mm	$^{+\ 30}_{\ 0}$ mm
$l > 6\,000$ mm	$^{+\ 0,5\ \%\ \times\ l}_{\ 0}$

Table 7 — Camber[1] tolerances for cold-reduced steel sheet, not resquared

Form	Camber tolerance
Cut length, l	0,4 % × l
Coil	20 mm in any 5 000 mm length

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

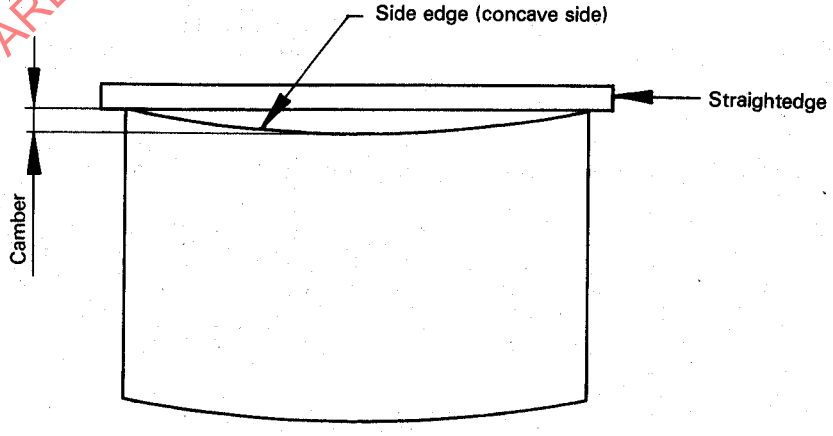

Figure 2 — Measurement of camber

Table 8 — Out-of-square tolerances for cold-reduced steel sheet, for cut lengths, not resquared

Dimensions	Out-of-square tolerance[1]
All thicknesses and all sizes	1,0 % × b[2]

1) 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.

2) b is the width.

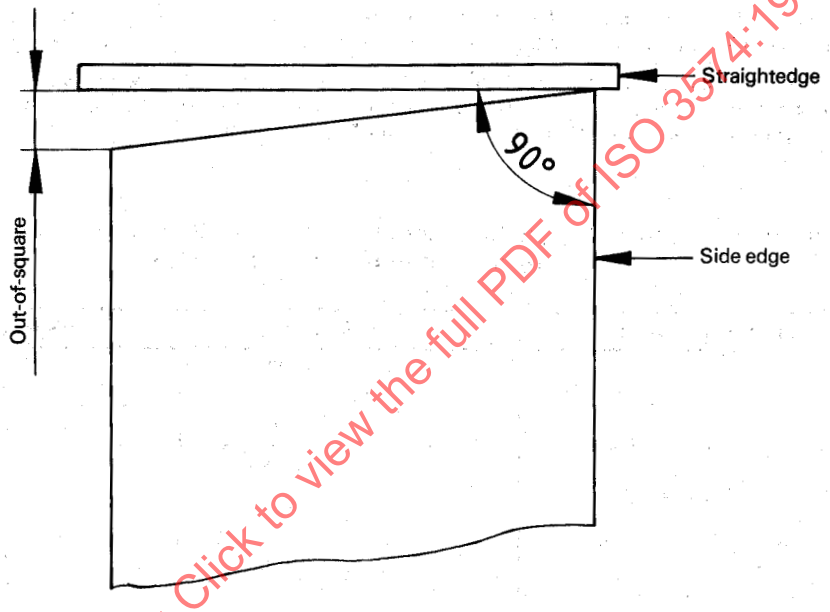

Figure 3 — Measurement of out-of-square

Table 9 — Out-of-square[1] width, and length tolerances for cold-reduced steel sheet, resquared[2]

Values in millimetres

Specified length, l	Specified width, b	Tolerance
l < 3 000	b < 1 200	2
	b > 1 200	3
l > 3 000	All widths	3

1) See figure 3.

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