47

INTERNATIONAL STANDARD

ISO 4997

Second edition
1991-04-15

Cold-reduced steel sheet of structural quality

Tôles en acier de construction laminées à froid

Reference number
ISO 4997:1991(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 4997 was prepared by Technical Committee ISO/TC 17, *Steel*.

This second edition cancels and replaces the first edition (ISO 4997:1978), table 3 of which has been technically revised and the annex deleted.

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Cold-reduced steel sheet of structural quality

1 Scope

1.1 This International Standard applies to cold-reduced steel sheet of structural quality in grades CR220, CR250, CR320 and CH550 in the classes included in table 1, usually without the use of microalloying elements. The product is intended for structural purposes where particular mechanical properties are required. It is generally used in the delivered condition for fabricating purposes, such as bending, forming or welding.

1.2 This product is commonly produced in thicknesses from 0,36 mm to less than 3 mm and in widths of 600 mm and over, in coils and cut lengths.

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

1.4 This International Standard does not cover steels designated as commercial quality or drawing qualities (covered in ISO 3574[1]), or steels supplied to specified hardness, for example 1/4, 1/2 or 3/4 hard, etc.

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 6892:1984, *Metallic materials — Tensile testing.*

ISO 7438:1985, *Metallic materials — Bend test.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 microalloying elements: Elements, such as niobium, vanadium, titanium, etc., added singly or in combination to obtain higher strength levels combined with better formability, weldability, and toughness as compared to non-alloyed steels produced to equivalent strength levels.

3.2 cold-reduced steel sheet (grades CR220, CR250 and CR320): A product obtained from hot-rolled descaled steel sheet by cold reducing to the required thickness (full hard) followed by annealing to recrystallize the grain structure. This annealed product is normally supplied skin passed (see 3.3) but may be supplied annealed last (i.e. without a skin pass), if specified by the purchaser on his order.

CH550 is a product which has not been annealed after reduction to the specified thickness.

3.3 skin pass (except grade CH550): A final light cold rolling of cold-reduced, annealed steel sheet. The purposes of skin passing are 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 required surface finish suitable for ordinary decorative painting;

c) to control the shape.

1) ISO 3574:1986, *Cold-reduced carbon steel sheet of commercial and drawing qualities.*

4 Conditions of manufacture

4.1 Steelmaking

Unless otherwise agreed upon, the processes used in making the steel and in manufacturing cold-reduced steel sheet are left to the discretion of the manufacturer. On request, 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.

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 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 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. As the carbon content increases above 0,15 %, spot welding becomes increasingly difficult. Because the heat of welding might have a significant effect on lowering the strength of grade CH550, this grade is not recommended for welding.

4.5 Application

It is desirable that cold-reduced steel sheet be identified for fabrication by the name of the part or by the intended application, which shall be compatible with the grade and class specified.

Table 1 — Chemical composition (cast analysis), %

Grade	Class	Method of deoxidation	C max.	Mn max.	P max.	S max.
CR220	B	E or NE	0,15	Not applicable	0,050	0,050
	D	CS	0,15	Not applicable	0,040	0,040
CR250	B	E or NE	0,20	Not applicable	0,050	0,050
	D	CS	0,20	Not applicable	0,040	0,040
CR320	B	E or NE	0,20	1,50	0,050	0,050
	D	CS	0,20	1,50	0,040	0,040
CH550	Not applicable	Not applicable	0,20	1,50	0,050	0,050

NOTES

1 E = Rimming

NE = Non-rimming

CS = Special killed

2 The nitrogen content is controlled; normally it should not exceed 0,009 % for E or NE steel or 0,015 % for CS steel.

3 Class B steels are intended for use in welded structures or structural parts, subjected to normal loading conditions.

4 Class D steels are to be used for structures or structural parts where, owing to loading conditions and the general design of the structure, a high resistance to brittle fracture is necessary.

4.6 Mechanical properties

At the time that the steel is made available for shipment, 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.

4.7 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.

4.8 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 forming lubricant and shall be easily removable with degreasing chemicals. On request, the manufacturer shall advise the purchaser which type of oil has been used.

5 Dimensional tolerances

Dimensional tolerances applicable to cold-reduced steel sheet of structural quality shall be as given in table 3 to table 9 inclusive.

6 Sampling

6.1 Tensile test

One representative sample for the tensile 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 grade and class rolled to the same thickness and condition.

6.2 Bend test (when specified)

One representative sample for the bend test shall be taken from each lot of sheet for shipment. A lot consists of all sheet of the same grade and class rolled to the same thickness and condition.

Table 2 — Mechanical properties

Grade	R_{eL} min. N/mm²	R_m min. (information only) N/mm²	A min. % [1]		180° bend mandrel diameter[2]
			L_o = 50 mm	L_o = 80 mm	
CR220	220	300	22	20	1a
CR250	250	330	20	18	2a
CR320	320	400	16	14	2a
CH550	550	[3]	Not applicable	Not applicable	Not applicable

R_{eL} = lower yield stress

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

a = thickness of bend test piece

1 N/mm² = 1 MPa

1) Use either L_o = 50 mm or L_o = 80 mm.

2) The bend test is performed only when specified (see 7.2). The bend test radii in table 2 are for test pieces prepared for laboratory testing. Conditions during fabrication may be more severe and not simulate those during laboratory testing.

3) For grade CH550 the yield point approaches the tensile strength and since there is no hesitation of the pointer or drop of the beam, the lower yield stress (R_{eL}) shall be taken as the stress at 0,5 % total elongation under load in accordance with ISO 6892.

7 Mechanical property tests

7.1 Tensile test

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

7.2 Bend test (when specified)

The transverse bend test piece shall withstand being bent through 180°, in the direction as shown in figure 1, around an inside diameter as given in table 2, without cracking on the outside of the bent portion. The bend test shall be carried out at ambient temperature and as specified in ISO 7438.

Small cracks on the edges of test pieces and cracks which require magnification to be visible shall be disregarded.

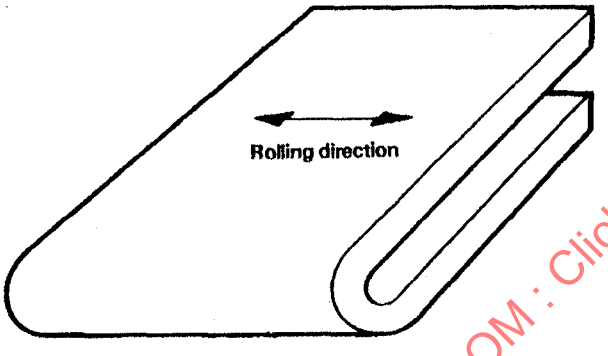


Figure 1 — Transverse bend test piece (after bending)

8 Retests

8.1 Machining and flaws

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

8.2 Elongation

If the percentage elongation of any test piece is less than that specified in table 2 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.

8.3 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.

9 Resubmission

9.1 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.

In this case, the tests shall be carried out as if they applied to a new batch.

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

10 Workmanship

The surface condition shall 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 the opportunity to observe readily or to remove defective portions as can be carried out on the cut length product.

11 Inspection and acceptance

11.1 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.

11.2 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 manufacturer shall be notified in order that he may properly investigate.

12 Coil size

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

13 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 grade and class designations;

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass.

14 Information to be supplied by the purchaser

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

a) the number of this International Standard;

b) the name, quality, grade and class of the material (for example, cold-reduced steel sheet, structural quality, grade CR220 class B);

c) whether oiled or not oiled (see 4.8);

d) the dimensions of the product and the quantity required;

e) the application (name of part) if possible (see 4.4 and 4.5);

f) the report of the mechanical properties and/or the cast analysis (see 4.6 and 4.3.1), if required;

g) limitations on masses and dimensions of individual coils and bundles, if applicable (see clause 12);

h) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see 11.1).

NOTE 1 A typical ordering description is as follows:

International Standard 4997, cold-reduced steel sheet, structural quality, grade CR220 class B, 1 × 700 × 1 800 mm, 40 000 kg, for part No. 3 456, seat frame — unexposed, furnish report of mechanical properties, maximum lift 4 000 kg.

Table 3 — Thickness tolerances for coils and cut lengths

Values in millimetres

Specified widths	Thickness tolerances[1) 2) 3)], over and under, for specified thicknesses								
	0,36 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
600 up to and including 1 200	0,05	0,06	0,08	0,09	0,10	0,12	0,14	0,17	0,20
Over 1 200 up to and including 1 500	0,06	0,07	0,09	0,10	0,11	0,13	0,15	0,18	0,21
Over 1 500 up to and including 1 800	—	0,09	0,10	0,11	0,13	0,15	0,18	0,20	0,23
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.									

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

2) For grade CR320, increase the thickness tolerances by 10 % by applying normal rounding off procedures.

3) For grade 550, the thickness tolerances should be agreed upon between the manufacturer and the purchaser.

Table 4 — Width tolerances for coils and cut lengths, not resquared

Values in millimetres

Specified widths	Tolerance
Up to and including 1 200	$^{+5}_{0}$
Over 1 200 up to and including 1 500	$^{+7}_{0}$
Over 1 500	$^{+9}_{0}$

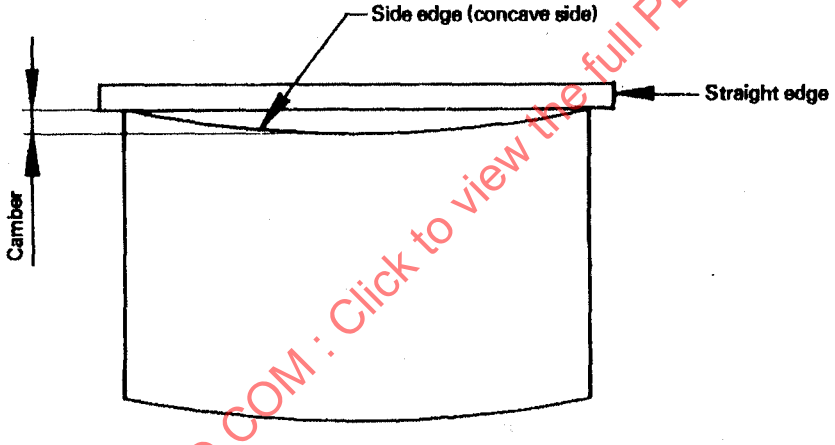
Table 5 — Length tolerances for cut lengths, not resquared

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	$^{+0,5\ \%\ \times\ \text{length}}_{0}$

Table 6 — Camber tolerances for coils and cut lengths, not resquared

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



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.

Figure 2 — Measurement of camber

Table 7 — Out-of-square tolerance for cut lengths, not resquared

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

Table 8 — Out-of-square tolerances for resquared material

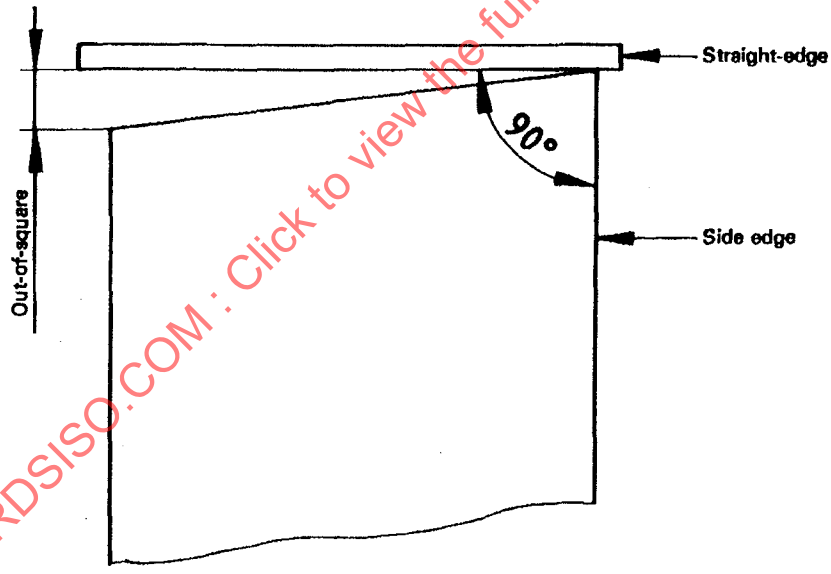
Values in millimetres

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	$^{+3}_{0}$

NOTES

1 See figure 3.

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



Out-of-square is the 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 3. It can also be measured as one-half the difference between the diagonals of the cut length sheet.

Figure 3 — Measurement of out-of-square