
INTERNATIONAL STANDARD



4997

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

Cold-reduced steel sheet of structural quality

Tôles en acier de construction laminées à froid

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Descriptors : iron and steel products, cold-rolled products, metal plates, metal sheets, structural steels, materials specifications, chemical composition, mechanical properties, mechanical tests, marking, dimensional tolerances, form tolerances.

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 4997 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in July 1976.

It has been approved by the member bodies of the following countries:

Australia	Germany	Romania
Belgium	India	South Africa, Rep. of
Brazil	Iran	Spain
Bulgaria	Italy	Sweden
Czechoslovakia	Korea, Rep. of	Switzerland
Canada	Mexico	Turkey
Denmark	Netherlands	United Kingdom
Egypt, Arab Rep. of	Norway	U.S.A.
Finland	Poland	U.S.S.R.
France	Portugal	

The member bodies of the following countries expressed disapproval of the document on technical grounds:

Austria
Hungary

Cold-reduced steel sheet of structural quality

1 SCOPE AND FIELD OF APPLICATION

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 the range of thicknesses of 0,36 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), or steels supplied to specified hardness, for example 1/4, 1/2 or 3/4 hard, etc.

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

2 REFERENCES

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.*

3 DEFINITIONS AND OTHER INFORMATION

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 :

- 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.

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 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.

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.

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.

5 DIMENSIONAL TOLERANCES

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

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.

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.

TABLE 2 – Mechanical properties¹⁾

Grade	R_{eL} min. N/mm ²	R_m min. (information only) N/mm ²	A min. % ²⁾		180° bend mandrel diameter ⁴⁾
			$L_o = 50$ mm	$L_o = 80$ mm	
CR220	220	300	22	20	1 a
CR250	250	330	20	18	2 a
CR320	320	400	16	14	2 a
CH550	550	3)	Not applicable	Not applicable	Not applicable

1) 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

2) Use either $L_o = 50$ mm or $L_o = 80$ mm.

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 82.

4) 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.

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.

7 MECHANICAL PROPERTY TESTS

7.1 Tensile test

The tensile test shall be carried out in accordance with the requirements of ISO 82 and ISO 86. 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, and 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/R 85 and ISO/R 87.

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

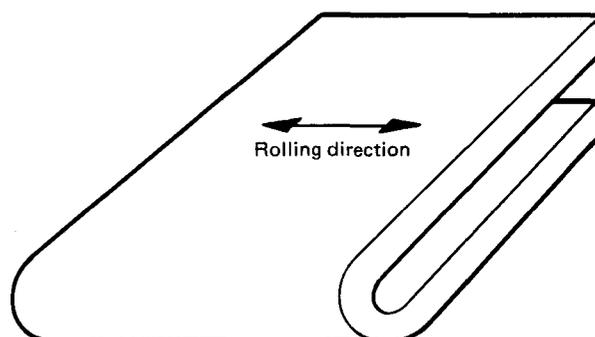


FIGURE 1 – Transverse bend test piece (after bending)

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 or range of acceptable inside diameters (I.D.) 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 adequately requirements under 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 material (for example, cold-reduced steel sheet, structural quality, grade CR220, class B);
- c) whether oiled or not oiled (see 3.5);
- 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 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 — 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. 3456, seat frame — unexposed, furnish report of mechanical properties, maximum lift 4 000 kg.

TABLE 3 – Thickness tolerances for coils¹⁾ and cut lengths
 (For grade CR320-increase the thickness tolerances by 20 % applying normal rounding-off procedures)

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
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
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
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
Over 1 800	–	0,12	0,13	0,14	0,16	0,19	0,21	0,24	0,26

- 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 – 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 % × 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

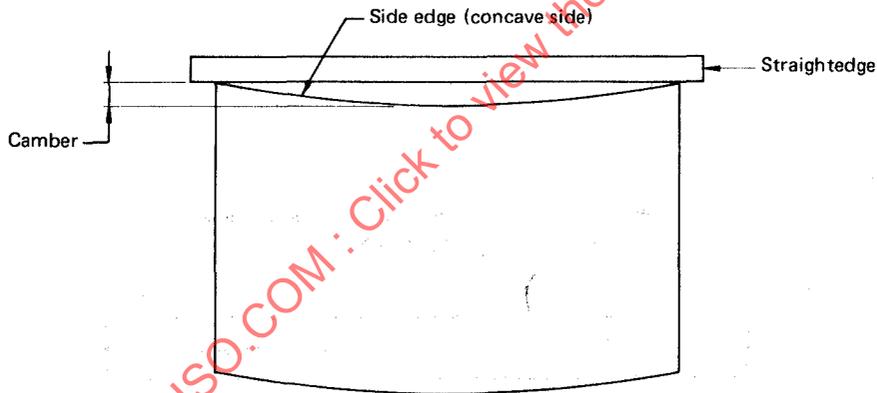


FIGURE 2 – Measurement of camber

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

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

TABLE 8 – Out-of-square¹⁾ tolerances for resquared²⁾ 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

- 1) See figure 3.
- 2) When measuring material to resquared tolerances, consideration may have to be given to extreme variations in temperature.

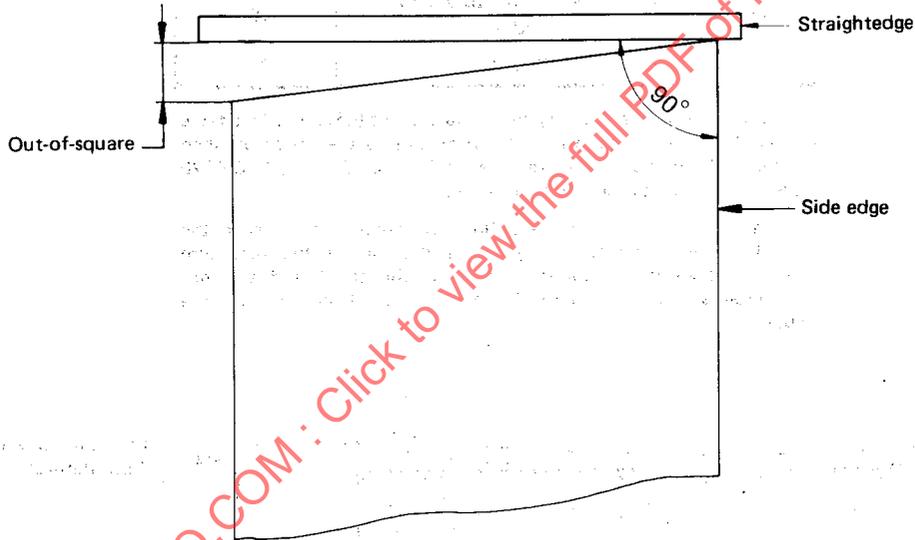


FIGURE 3 – Measurement of out-of-square

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.