INTERNATIONAL STANDARD

ISO 4997

Fourth edition
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Cold-reduced carbon steel sheet of structural quality

Tôles en acier au carbone laminées à froid, de qualité destinée à la construction

Reference number
ISO 4997:2007(E)

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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 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4997 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This fourth edition cancels and replaces the third edition (ISO 4997:1999), which has been technically revised.

Cold-reduced carbon steel sheet of structural quality

1 Scope

This International Standard applies to cold-reduced steel sheet of structural quality in grades CR220, CR250, CR320 and CH550, usually without the use of microalloying elements. The product is intended for structures that may include bolting, riveting and welding. It is generally used in the delivered condition for fabricating purposes, such as bending, forming or welding.

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

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

This International Standard does not cover steels designated as commercial quality or drawing qualities (covered in ISO 3574), cold-reduced carbon steel sheet according to hardness requirements (covered in ISO 5954), cold-reduced steel sheet of higher strength with improved formability (covered in ISO 13887), or cold-reduced steel sheet of high tensile strength and low yield point with improved formability (covered in ISO 14590).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6892, *Metallic materials — Tensile testing at ambient temperature*

ISO 16162, *Continuously cold-rolled steel sheet products — Dimensional and shape tolerances*

3 Terms and definitions

For the purposes of this document, the following terms and 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 compared to non-alloyed steels produced to equivalent strength levels

3.2
cold-reduced steel sheet (grades CR220, CR250 and CR320)
product obtained from hot-rolled descaled steel sheet by cold reducing to the required sheet thickness followed by annealing to recrystallize the grain structure

NOTE 1 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.

NOTE 2 CH550 is a product which has not been annealed after reduction to the specified thickness.

3.3
skin pass (except grade CH550)
light cold rolling of the product

NOTE 1 The purpose of skin passing is one or more of the following:

a) to minimize the appearance of coil breaks, stretcher strains and fluting;

b) to control the shape;

c) to obtain the required surface finish.

NOTE 2 Some increase in hardness and some loss in ductility will result from skin passing.

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. On request, the purchaser shall be informed of the steelmaking process being used.

4.2 Chemical composition

Table 1 — Chemical composition (heat analysis), %

Contents in percent

Grade	Class	Method of deoxidation	C max.	Mn max.	P max.	S max.
CR220	B	E or NE	0,15	Not applicable	0,035	0,035
	D	CS	0,15	Not applicable	0,035	0,035
CR250	B	E or NE	0,20	Not applicable	0,035	0,035
	D	CS	0,20	Not applicable	0,035	0,035
CR320	B	E or NE	0,20	1,50	0,035	0,035
	D	CS	0,20	1,50	0,035	0,035
CH550	Not applicable	Not applicable	0,20	1,50	0,035	0,035

E = Rimming

NE = Non-rimming

CS = Aluminum killed

NOTE 1 The nitrogen content is controlled; normally it should not exceed 0,009 % for E or NE steel or 0,015 % for CS steel.

NOTE 2 Class B steels are intended for use in welded structures or structural parts, subjected to normal loading conditions.

NOTE 3 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 — Limits on additional chemical elements

Contents in percent

Elements	Heat analysis max.	Product analysis max.
Cu [a]	0,20	0,23
Ni [a]	0,20	0,23
Cr [a, b]	0,15	0,19
Mo [a, b]	0,06	0,07
Nb [c]	0,008	0,018
V [c]	0,008	0,018
Ti [c]	0,008	0,018

[a] The sum of copper, nickel, chromium, and molybdenum shall not exceed 0,50 % on heat analysis. When one or more of these elements is specified, the sum does not apply; in which case, only the individual limits on the remaining elements will apply.

[b] The sum of chromium and molybdenum shall not exceed 0,16 % on heat analysis. When one or more of these elements are specified, the sum does not apply; in which case, only the individual limits on the remaining elements will apply.

[c] Analysis greater than 0,008 may be supplied after agreement between the producer and consumer.

4.3 Chemical analysis

4.3.1 Heat analysis

An analysis of each heat of steel shall be made by the manufacturer to determine compliance with the requirements given in Tables 1 and 2. When requested, the heat analysis shall be reported to the purchaser or his representative.

Each of the elements listed in Table 2 shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less that 0,02 %, the analysis may be reported at "$<$ 0,02 %".

4.3.2 Product analysis

A product 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 steels) are not technologically suited to product analysis.

For killed steels, the sampling method shall be agreed between the manufacturer and purchaser at the time of ordering. The product analysis tolerances shall be in accordance with Table 3.

Table 3 — Product analysis tolerances

Element	Maximum of specified element %	Tolerance over maximum specified percent
Carbon	$\leqslant$ 0,15	0,03
	$>$ 0,015 $\leqslant$ 0,40	0,04
Manganese	$\leqslant$ 0,60	0,03
	$>$ 0,60 $\leqslant$ 1,15	0,04
	$>$ 1,15 $\leqslant$ 1,65	0,05
Phosphorus	$\leqslant$ 0,04	0,01
Sulfur	$\leqslant$ 0,04	0,01

NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis.

4.4 Weldability

The 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. Proper identification of the part may include visual examination, prints or description, or a combination of these.

4.6 Mechanical properties

Except when ordered according to an identified specification, the mechanical properties shall be as given in Table 4, when they are determined on test pieces obtained in accordance with the requirements of Clause 8.

NOTE Prolonged storage of the sheet may cause a change in the mechanical properties (increase in hardness and a decrease in elongation) leading to an adverse effect on formability.

Table 4 — Mechanical properties

Grade	R_e [a] min.	R_m min.	A [b] min., %	
	N/mm^2	N/mm^2	$L_0 = 50$ mm	$L_0 = 80$ mm
CR220	220	300	22	20
CR250	250	330	20	18
CR320	320	400	16	14
CH550	550	[c]	Not applicable	Not applicable

R_e = yield stress - can be either R_{eL} or R_{eH}, but not both

R_{eL} = lower yield stress

R_{eH} = higher yield stress

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

1 N/mm^2 = 1 MPa

[a] The yield stress values can be measured by 0,5 % elongation proof stress (proof stress under load) or by 0,2 % offset when a definite yield phenomenon is not present.

[b] Use either $L_0 = 50$ mm or $L_0 = 80$ mm.

[c] For grade CH550, the yield point approaches the tensile strength and, since there is no hesitation in 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.

4.7 Surface quality

The products are supplied according to either surface quality A or B.

4.7.1 Surface quality A (unexposed)

Imperfections, such as pores, slight imperfections, small marks, minor scratches and slight colouring which do not affect the formability or the application of surface coatings are permitted.

4.7.2 Surface quality B (exposed)

The best surface shall be free of imperfections which might affect the uniform appearance of quality paint or an electrolytic coating (see 4.9). The other surface shall at least conform to surface quality A.

In the case of delivery of coil and slit coil, the percentage of defects may be greater than in the case of delivery in sheet or cut lengths. This should be taken into account by the purchaser and the percentage of admissible surface defects may be agreed upon at the time of the enquiry and order. Unless otherwise agreed, a single surface of the product shall comply with the specified requirements. The other surface shall be such that, during subsequent treatment, it does not have a deleterious effect on the best surface.

4.8 Surface finish

Cold-reduced steel sheet is normally produced with 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.

4.9 Suitability for surface coating

The products may be required for metallic coating by the hot dip coating or electrolytic coating process, or organic coating or another coating. When such a coating is intended, it shall be specified at the time of ordering.

4.10 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 shall be easily removable using degreasing chemicals. The product may be ordered not-oiled, if required, in which case, the supplier has a limited responsibility if oxidation occurs.

5 Dimensional tolerances

Dimensional tolerances applicable to cold-reduced steel sheet shall be as given in ISO 16162.

Restricted thickness tolerances are given in ISO 16162.

6 Tensile-test sampling

One representative sample for the tensile test, as specifed in Table 4, 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.

7 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 Retests

8.1 Machining and flaws

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

8.2 Elongation

If the percentage elongation of any test piece is less than that specified in Table 4, 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 gives results that do not conform to the requirements of this International Standard, two additional tests shall be carried out at random on the same lot. If both retests conform to the requirements of this International Standard, the lot shall be deemed acceptable. If one or both retests fails to conform to the requirements of this International Standard, the lot may be rejected.

9 Resubmission

The manufacturer may resubmit, for acceptance, the products that have been rejected during earlier inspection because of unsatisfactory properties after the rejected products have been subjected to a suitable treatment (selection, heat treatment, etc.) 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.

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 the final product or to subsequent appropriate processing.

Processing for shipment in coils does not afford the manufacturer the opportunity of readily observing or of removing imperfect portions, as can be carried out on the cut-length product.

11 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.

12 Coil size

When cold-reduced steel sheet is ordered in coils, a minimum or range of acceptable inside diameter(s) (ID) shall be specified. In addition, the maximum outside diameter (OD) and 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) manufacturer's name or identifying brand;

b) the number of this International Standard, i.e. ISO 4997;

c) the quality designation number;

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 the delivery requirements of this International Standard, enquiries and orders shall include the following information:

a) the number of this International Standard, i.e. ISO 4997:2007;

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

c) whether oiled or not oiled (see 4.10);

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

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

f) the report of the mechanical properties and/or the heat 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 Clause 11);

i) restricted thickness tolerances, if required (see Clause 5);

j) R_{eH} or R_{eL} shall be specified when required (see Table 4).

EXAMPLE International Standard ISO 4997:2007, cold-reduced steel sheet, structural quality, grade CR220 class B, normal thickness tolerances, 1 mm × 700 mm × 1 800 mm, 40 000 kg, for part No. 3456, seat frame-unexposed, furnish report of mechanical properties, maximum lift 4 000 kg.

Bibliography

[1] ISO 3574, *Cold-reduced carbon steel sheet of commercial and drawing qualities*

[2] ISO 5954, *Cold-reduced carbon steel sheet according to hardness requirements*

[3] ISO 13887, *Cold-reduced steel sheet of higher yield strength with improved formability*

[4] ISO 14590, *Cold-reduced steel sheet of high tensile strength and low yield point with improved formability*

[5] ASTM A 1008M, *Standard Specification for Steel, Sheet and Strip, Cold-Rolled, Carbon, Structural, High- Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability*[1)]

1) This standard may be reviewed for comparison with this ISO standard. The relationship between the standards may only be approximate; therefore, the respective standards should be consulted for actual requirements. Those who use these documents must determine which specifications address their needs.

ICS 77.140.50

Price based on 8 pages