

**BS ISO 4997:2015**



**BSI Standards Publication**

# **Cold-reduced carbon steel sheet of structural quality**

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**National foreword**

This British Standard is the UK implementation of ISO 4997:2015. It supersedes BS ISO 4997:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/109, Coated and Uncoated Flat Products to be Used for Cold Forming.

A list of organizations represented on this committee can be obtained on request to its secretary.

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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  
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## Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. [www.iso.org/directives](http://www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: [Foreword — Supplementary information](#).

The committee responsible for this document is ISO/TC 17, *TC Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This fifth edition cancels and replaces the fourth edition (ISO 4997:2007), which has been technically revised.

# Cold-reduced carbon steel sheet of structural quality

## 1 Scope

This International Standard applies to cold-reduced carbon 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 include bolting, riveting, and welding. It is generally used in the delivered condition for fabricating purposes, such as bending, forming, and welding.

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 documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. For dated references, only the edition cited applies. For undated references, the latest edition of the reference documents (including any amendments) applies.

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 16162, *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 element**

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 to entry: The 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 to entry: CH 550 is a product which has not been annealed after reduction to the specified thickness.

### 3.3

#### **skin pass**

<except grade CH 550> light cold rolling of the product

Note 1 to entry: The purpose of the 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 to entry: Some increase in hardness and some loss in ductility will result from skin passing.

### 3.4 lot

50 t or less of sheet of the same grade rolled to the same thickness and condition

## 4 Dimensions

4.1 The 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.

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

## 5 Conditions of manufacture

### 5.1 Steelmaking

Unless otherwise agreed by the interested parties, 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](#) and [Table 2](#).

**Table 1 — Chemical composition (heat analysis)**

Mass fractions in per cent

Grade	C max.	Mn max.	P max.	S max.
CR 220	0,15	1,20	0,035	0,035
CR 250	0,25	1,40	0,035	0,035
CR 320	0,25	1,50	0,035	0,035
CH 550	0,25	1,50	0,035	0,035

**Table 2 — Limits on additional chemical elements**

Mass fractions in per cent

Element	Heat analysis max.	Product analysis max.
Cu <sup>a</sup>	0,20	0,23
Ni <sup>a</sup>	0,20	0,23
Cr <sup>a, b</sup>	0,15	0,19
Mo <sup>a, b</sup>	0,06	0,07
Nb <sup>c</sup>	0,008	0,018

<sup>a</sup> The sum of copper, nickel, chromium, and molybdenum shall not exceed 0,50 % 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.

<sup>b</sup> 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.

<sup>c</sup> Heat analysis greater than 0,008 % can be supplied after agreement between the producer and consumer.



**Table 2 (continued)**

Element	Heat analysis max.	Product analysis max.
V <sup>c</sup>	0,008	0,018
Ti <sup>c</sup>	0,008	0,018

<sup>a</sup> The sum of copper, nickel, chromium, and molybdenum shall not exceed 0,50 % 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.

<sup>b</sup> 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.

<sup>c</sup> Heat analysis greater than 0,008 % can be supplied after agreement between the producer and consumer.

## 5.3 Chemical analysis

### 5.3.1 Heat analysis

An analysis of each heat of steel shall be made by the manufacturer in order to determine compliance with the requirements given in [Table 1](#) and [Table 2](#). On request, at the time of ordering, this 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.

### 5.3.2 Product analysis

A product analysis can be made by the purchaser to verify the specified analysis of the product and shall take into consideration any normal heterogeneity. 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 2](#) and [Table 3](#).

**Table 3 — Product analysis tolerance**

Mass fractions in per cent

Element	Maximum of specified element	Tolerance over maximum specified
C	≤0,15	0,03
	>0,15 to ≤0,40	0,04
Mn	≤0,60	0,03
	>0,60 to ≤1,15	0,04
	>0,15 to ≤1,65	0,05
P	≤0,04	0,01
S	≤0,04	0,01

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

## 5.4 Weldability

This product is normally suitable for welding if appropriate welding conditions are selected. When the mass fraction of carbon exceeds 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.

## 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, which shall be compatible with the grade specified. Proper identification of the part can include visual examination, prints or description, or a combination of these.

## 5.6 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 7](#).

**Table 4 — Mechanical properties**

Grade	$R_e^a$ min. N/mm <sup>2</sup>	$R_m$ min. N/mm <sup>2</sup>	$A^b$ min. %	
			$L_0 = 50$ 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 strength-can be either  $R_{eL}$  or  $R_{eH}$ , but not both  
 $R_{eL}$  = lower yield strength  
 $R_{eH}$  = upper yield strength  
 $R_m$  = tensile strength  
 $A$  = percentage elongation after fracture  
 $L_0$  = original gauge length of original test piece  
1 N/mm<sup>2</sup> = 1MPa  
a The yield strength can be measured by 0,5 % elongation proof strength (proof strength 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 strength approaches the tensile strength and, since there is no hesitation in the pointer or drop of the beam, the  $R_{eL}$  shall be taken as the strength at 0,5 % total elongation under load in accordance with ISO 6892-1.

## 5.7 Surface quality

### 5.7.1 General

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

### 5.7.2 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.

### 5.7.3 Surface quality B (exposed)

**5.7.3.1** The better of the two surfaces shall be free of imperfections, which might affect the uniform appearance of quality paint or an electrolytic coating (see [5.9](#)). The other surface shall at least conform to surface quality A.

**5.7.3.2** In the case of delivery of coil and slit coil, the percentage of defects can be greater than in the case of delivery in sheet or cut lengths. The purchaser should take this into account, and the percentage

of admissible surface defects can be agreed 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 better surface.

## 5.8 Surface finish

**5.8.1** 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.

**5.8.2** When cold-reduced steel sheet is deformed during fabrication, localized areas can roughen to some degree, and such affected portions of the part might require hand-finishing to prepare the surface for the intended application.

**5.8.3** By agreement at the time of the enquiry and order, ranges for surface roughness can be specified for specific end uses.

## 5.9 Suitability for surface coating

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

## 5.10 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 removed using degreasing chemicals. The product can be ordered not-oiled, if required, in which case, the supplier has limited responsibility if oxidation occurs.

## 6 Dimensional and shape tolerances

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

## 7 Tensile-test sampling

One representative sample for the tensile test, as required in [Table 4](#), shall be taken from each lot of sheet for shipment.

## 8 Tensile test

The tensile test shall be carried out in accordance with ISO 6892-1. Transverse test pieces shall be taken midway between the centre and the edge of the sheet as rolled.

## 9 Retests

### 9.1 Machining and flaws

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

### 9.2 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.

### 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 shall be rejected.

## 10 Resubmission

**10.1** The manufacturer can 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 lot.

**10.2** The manufacturer has the right to present the rejected products for fresh examination for compliance with the requirements for another grade.

## 11 Workmanship

**11.1** The surface condition shall be that normally obtained in a cold-reduced product.

**11.2** The steel sheet in cut lengths shall be free from quantities of laminations, surface flaws and other imperfections that are detrimental to the final product or to subsequent appropriate processing.

**11.3** 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. However, this does not relieve the manufacturer of responsibility to provide a product that meets the requirement for surface condition that is normally obtained in a cold-reduced 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 shall 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 the supplier can properly investigate.

## 13 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.

## 14 Marking

Unless otherwise stated, the following minimum requirements for identifying the steel sheet 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 4997:2014;

- c) quality designation;
- d) order number;
- e) product dimensions;
- f) report of the heat analysis and/or the mechanical properties, if required (see [5.3.1](#) and [5.6](#));
- g) mass.

## 15 Information to be provided by the purchaser

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

- a) the number of this International Standard, i.e. ISO 4997:2014;
- b) name, quality, and grade of the material (for example, cold-reduced steel sheet, structural quality, grade CR220, surface quality A);
- c) whether oiled or unoled (see [5.10](#));
- d) dimensions of the product and the quantity required;
- e) application (name of part) (see [5.5](#));
- f) report of the mechanical properties and/or the heat analysis, if required (see [5.3.1](#) and [5.6](#));
- g) limitations on masses and dimensions of individual coils or bundles, if applicable (see [Clause 13](#));
- h) inspection and tests for acceptance prior to shipment from the producer's works, if required (see [Clause 12](#));
- i) restricted dimensional tolerances, if required (see [Clause 6](#));
- j)  $R_{eH}$  or  $R_{eL}$  shall be specified when required (see [Table 4](#)).

EXAMPLE A typical ordering description is as follows:

ISO 4997:2014 nn cold-reduced steel sheet, structural quality, grade CR220, surface quality A, 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 A1008M, *Standard specification for steel, sheet and strip, cold-rolled, carbon, structural, high-strength, low-alloy, and high-strength low-alloy with improved formability*<sup>1)</sup>

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