

# INTERNATIONAL STANDARD

# ISO 10384

Second edition  
2001-12-15

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## Hot-rolled carbon steel sheet as defined by chemical composition

*Tôles en acier au carbone laminées à chaud définies par leur composition  
chimique*

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10384 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This second edition cancels and replaces the first edition (ISO 10384:1992) which has been technically revised.



# Hot-rolled carbon steel sheet as defined by chemical composition

## 1 Scope

1.1 This International Standard applies to continuously hot-rolled carbon steel sheet as defined by chemical composition. The product is generally used in the heat-treated condition after hot or cold working, press forming or cutting by the customer. For example, the product is used for general machinery such as sprocket wheels, chain links, washers, knife blades, agricultural implements, etc.

NOTE 1 Hot-rolled sheet up to but not including 3 mm in thickness is commonly known as "sheet". Hot-rolled sheet 3 mm and over in thickness is commonly known as either "sheet" or "plate".

NOTE 2 Steel sheet that is to be subjected to subsequent rerolling is not covered by this International Standard.

1.2 Hot-rolled carbon steel sheet based on chemical composition is manufactured from killed steel of chemical composition listed in Table 1. It is usually produced in the range of thickness 0,8 mm to 12,5 mm inclusive, and widths 600 mm and over, in coils and cut lengths.

1.3 Hot-rolled carbon sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 643:—<sup>1)</sup>, *Steels — Micrographic determination of the apparent grain size*

ISO 3887:—<sup>2)</sup>, *Steels — Determination of depth of decarburization*

ISO 4967:1998, *Steel — Determination of content of nonmetallic inclusions — Micrographic method using standard diagrams*

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6508-1:1999, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

ISO 14284:1996, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*

1) To be published. (Revision of ISO 643:1983)

2) To be published. (Revision of ISO 3887:1976)

### 3 Terms and definitions

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

#### 3.1

##### **hot-rolled steel sheet**

product obtained by rolling heated steel through a continuous-type strip mill to the required sheet thickness and tolerances

NOTE The product has a surface covered with oxide or scale resulting from the hot-rolling operation.

#### 3.2

##### **hot-rolled descaled steel sheet**

hot-rolled steel sheet from which oxide or scale has been removed, usually by pickling in an acid solution

NOTE Descaling may also be performed by appropriate mechanical means.

#### 3.3 edges

##### 3.3.1

##### **mill edge**

normal edge without any definite contour produced in hot-rolling

NOTE Mill edges may contain some irregularities such as cracked or torn edges or thin (feathered) edges.

##### 3.3.2

##### **sheared edge**

normal edge obtained by shearing, slitting or trimming a mill edge product

NOTE Normal processing does not necessarily provide a definite positioning of the slitting burr.

#### 3.4

##### **resquared**

attempt to approach a true 90° angle at the shear cut on steel sheet for which tighter than standard width, length, camber or out-of-square tolerances are required and which typically necessitates an additional shearing operation after the sheet has been cut to length from a coil

NOTE "Resquared" is referred to as "restricted" in some areas of the world.

### 4 Conditions of manufacture

#### 4.1 Steelmaking

The processes used in making the steel and in manufacturing hot-rolled sheet are left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steelmaking process used.

#### 4.2 Chemical composition

The chemical composition (heat analysis) shall comply with the values given in Tables 1 and 2.

Table 1 — Chemical composition (heat analysis) %

Steel grade	C	Si <sup>a</sup>	Mn	P max.	S max.
S08C	0,10 max.	0,15 – 0,35	0,50 max.	0,030	0,035
S10C	0,08 – 0,13	0,15 – 0,35	0,30 – 0,60	0,030	0,035
S15C	0,13 – 0,18	0,15 – 0,35	0,30 – 0,60	0,030	0,035
S20C	0,18 – 0,23	0,15 – 0,35	0,30 – 0,60	0,030	0,035
S25C	0,22 – 0,28	0,15 – 0,35	0,30 – 0,60	0,030	0,035
S30C	0,27 – 0,33	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S35C	0,32 – 0,38	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S38C	0,35 – 0,41	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S40C	0,37 – 0,43	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S43C	0,40 – 0,46	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S45C	0,42 – 0,48	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S48C	0,45 – 0,51	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S50C	0,47 – 0,53	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S53C	0,50 – 0,56	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S55C	0,52 – 0,58	0,15 – 0,35	0,60 – 0,90	0,030	0,035
S58C	0,55 – 0,61	0,15 – 0,35	0,60 – 0,90	0,030	0,035

<sup>a</sup> The silicon may be supplied within the limits agreed upon at the time of inquiry and ordering.

Table 2 — Limits on additional chemical elements

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

NOTE Each of the elements listed in this table should be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less than 0,02 %, the analysis may be reported as "< 0,02 %".

<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 may be supplied after agreement between producer and consumer.

### 4.3 Chemical analysis

#### 4.3.1 Heat analysis

A heat analysis of each heat of steel shall be made by the manufacturer to determine the percentage by mass of all elements listed in Tables 1 and 2. On request, this analysis shall be reported to the purchaser or his representative.

#### 4.3.2 Product analysis

A product analysis may be made by the purchaser to verify the specified analysis of the product and shall take into consideration any normal heterogeneity.

The permissible deviations between the specified heat analysis and the product analysis are shown in Table 3.

Table 3 — Permissible deviations for product analysis

Element	Limit, or maximum of specified element <i>L</i> %	Permissible deviation %
C	$L \leq 0,15$	+ 0,03 - 0,02
	$0,15 < L \leq 0,40$	+ 0,04 - 0,03
	$0,40 < L \leq 0,61$	+ 0,05 - 0,03
Si	$L \leq 0,35$	$\pm 0,05$
Mn	$L \leq 0,60$	$\pm 0,03$
	$0,60 < L \leq 0,90$	$\pm 0,04$
P	$L \leq 0,030$	$\pm 0,01$
S	$L \leq 0,035$	$\pm 0,01$

The sampling method shall be in accordance with ISO 14284. The requirements not specified in ISO 14284 shall be agreed upon by the manufacturer and purchaser at the time of ordering.

#### 4.4 Application

It is desirable that the specified product be identified for fabrication by name of the part or by intended application. Proper identification of the part may include visual examination, prints or description or a combination of these.

#### 4.5 Mechanical properties and other tests

**4.5.1** Tensile strength and elongation of the product are not generally specified because the product is subjected to heat treatment after delivery.

**4.5.2** The purchaser may request the following tests for the product. In this case, test items, sampling and test method, if an appropriate International Standard has not been published. Criteria of acceptance or rejection shall be agreed upon by the manufacturer and purchaser at the time of ordering.

- a) Depth of decarburization, see ISO 3887.
- b) Content of non-metallic inclusions, see ISO 4967.
- c) Austenitic grain size, see ISO 643.
- d) Hardness, see ISO 6507-1 or ISO 6508-1.
- e) Microscopic structure.

#### 4.6 Descaling

If mechanical means are used for descaling, some increase in hardness and some loss of ductility may result.

The purchaser should state whether descaling is required.

#### 4.7 Surface condition

Oxide or scale on hot-rolled steel sheet is subject to variations in thickness, adherence and colour. Removal of the oxide or scale by pickling or blast cleaning may disclose surface imperfections not readily visible prior to this operation. Also, after drawing, imperfections may be visible which were not apparent in the flat sheet.

#### 4.8 Oiling

As a deterrent to rusting, a coating of oil is usually applied to hot-rolled descaled steel sheet. However, sheet may be furnished not oiled if required. The oil is not intended as a drawing or forming lubricant and should be easily removable using degreasing chemicals. Hot-rolled descaled steel sheet may be ordered unoled, if required, in which case, the supplier has limited responsibility if oxidation occurs.

### 5 Dimensional tolerances

5.1 Dimensional tolerances applicable to hot-rolled steel sheet are given in Tables 4 to 13 inclusive.

5.2 Restricted thickness tolerances are given in Table 6.

### 6 Workmanship

The surface condition shall be that normally obtained in a hot-rolled product.

The material cut in lengths shall be free from lamination, 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 removing imperfect portions as can be carried out on the cut length product.

### 7 Inspection and acceptance

7.1 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 supplied in accordance with this International Standard.

7.2 Steel that is reported to be defective after arrival at the user's works shall be set aside, correctly identified and adequately protected. The supplier shall be notified in order that he may conduct a proper investigation.

### 8 Coil size

When the product 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.

### 9 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.

## 10 Information to be supplied by the purchaser

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

- a) the number of this International Standard, i.e. ISO 10384;
- b) the name and grade of the material (e.g. hot-rolled carbon steel sheet for machinery grade S40C);
- c) the dimensions of the product and the quantity required;
- d) the application or name of the part, if possible (see 4.4);
- e) whether pickling (see 3.2) or descaling by grit or shot blasting (see 4.6) is required (material so specified will be oiled unless ordered unoled, (see 4.8);
- f) the type of edge (see 3.3);
- g) the report of the heat analysis, if required (see 4.3.1);
- h) limitations on masses and dimensions of individual coils and bundles, if applicable (see clause 8);
- i) inspection and tests for acceptance prior to shipment to the manufacturer's works, if required (see 7.1).

NOTE A typical ordering description is as follows:

International Standard ISO 10384, hot-rolled, carbon steel sheet for machinery S40C, normal thickness tolerances, 3 mm × 1 200 mm × 2 400 mm, 10 000 kg, to be used for washer, mill edge, furnish report of heat analysis, maximum lift mass 4 000 kg.

## 11 Report

When so agreed between the manufacturer and the purchaser at the time of ordering, the manufacturer shall submit the following information:

- a) the heat analysis (see 4.3.1);
- b) the results of the test items requested by the purchaser (see 4.5.2);
- c) the steelmaking process (see 4.1);
- d) the product dimensions;
- e) the mass;
- f) the delivery conditions;
- g) the lot number enabling raw materials to be traced to melting.

**Table 4 — Normal thickness tolerances for hot-rolled sheet (including descaled sheet) coils and cut lengths of grades S08C to S20C**

Values in millimetres

Specified width	Thickness tolerances, for specified thicknesses									
	≥ 0,8	> 1,5	> 2,0	> 2,5	> 3,0	> 4,0	> 5,0	> 6,0	> 8,0	> 10,0
	≤ 1,5	≤ 2,0	≤ 2,5	≤ 3,0	≤ 4,0	≤ 5,0	≤ 6,0	≤ 8,0	≤ 10,0	≤ 12,5
> 600 ≤ 1 200	± 0,15	± 0,17	± 0,18	± 0,20	± 0,22	± 0,24	± 0,26	± 0,29	± 0,32	± 0,35
> 1 200 ≤ 1 500	± 0,17	± 0,19	± 0,21	± 0,22	± 0,24	± 0,26	± 0,28	± 0,30	± 0,33	± 0,36
> 1 500 ≤ 1 800	—	± 0,21	± 0,23	± 0,24	± 0,26	± 0,28	± 0,29	± 0,31	± 0,34	± 0,37
> 1 800	—	—	± 0,25	± 0,26	± 0,27	± 0,29	± 0,31	± 0,35	± 0,40	± 0,43

NOTE 1 The tolerance values specified do not apply to the uncropped ends for a total length, *l*, of a mill edge coil. The total length *l* is calculated using the following formula:

$$\text{total length, } l, \text{ in metres} = \frac{90}{\text{Thickness in millimetres}} \text{ provided that the result was not greater than 20 m, inclusive of both ends.}$$

NOTE 2 Thickness is measured at any point on the sheet not less than 40 mm from a side edge. Measurement on a mill edge sheet nearer to an edge than 40 mm and on a sheared edge sheet nearer to an edge than 25 mm, and tolerance values, shall be subject to agreement between the manufacturer and purchaser.

**Table 5 — Thickness tolerances for hot-rolled sheet steel (including descaled sheet) coils and cut lengths of grades S25C à S58C**

Values in millimetres

Specified width	Thickness tolerances, for specified thicknesses									
	≥ 0,8	> 1,5	> 2,0	> 2,5	> 3,0	> 4,0	> 5,0	> 6,0	> 8,0	> 10,0
	≤ 1,5	≤ 2,0	≤ 2,5	≤ 3,0	≤ 4,0	≤ 5,0	≤ 6,0	≤ 8,0	≤ 10,0	≤ 12,5
> 600 ≤ 1 200	± 0,17	± 0,19	± 0,20	± 0,22	± 0,24	± 0,26	± 0,29	± 0,32	± 0,35	± 0,39
> 1 200 ≤ 1 500	± 0,19	± 0,21	± 0,23	± 0,24	± 0,26	± 0,29	± 0,31	± 0,33	± 0,36	± 0,40
> 1 500 ≤ 1 800	—	± 0,23	± 0,25	± 0,26	± 0,29	± 0,31	± 0,32	± 0,34	± 0,37	± 0,41
> 1 800	—	—	± 0,28	± 0,29	± 0,30	± 0,32	± 0,34	± 0,39	± 0,44	± 0,47

NOTE 1 The tolerance values specified do not apply to the uncropped ends for a total length, *l*, of a mill edge coil. The total length *l* is calculated using the following formula:

$$\text{total length, } l, \text{ in metres} = \frac{90}{\text{Thickness in millimetres}} \text{ provided that the result was not greater than 20 m, inclusive of both ends.}$$

NOTE 2 Thickness is measured at any point on the sheet not less than 40 mm from a side edge. Measurement on a mill edge sheet nearer to an edge than 40 mm and on a sheared edge sheet nearer to an edge than 25 mm, and tolerance values, shall be subject to agreement between the manufacturer and purchaser.

**Table 6 — Restricted thickness tolerances for hot-rolled sheet steel (including descaled sheet), coils and cut lengths of grades S08C to S20C**

Values in millimetres

Specified width	Thickness tolerance, for specified thickness									
	≥ 0,8 ≤ 1,5	> 1,5 ≤ 2,0	> 2,0 ≤ 2,5	> 2,5 ≤ 3,0	> 3,0 ≤ 4,0	> 4,0 ≤ 5,0	> 5,0 ≤ 6,0	> 6,0 ≤ 8,0	> 8,0 ≤ 10,0	> 10,0 ≤ 12,5
> 600 ≤ 1 200	± 0,10	± 0,13	± 0,14	± 0,15	± 0,17	± 0,19	± 0,21	± 0,23	± 0,26	± 0,28
> 1 200 ≤ 1 500	± 0,12	± 0,14	± 0,15	± 0,17	± 0,18	± 0,21	± 0,22	± 0,24	± 0,26	± 0,29
> 1 500 ≤ 1 800	—	± 0,14	± 0,17	± 0,19	± 0,21	± 0,22	± 0,23	± 0,25	± 0,27	± 0,30
> 1 800	—	—	± 0,20	± 0,21	± 0,22	± 0,23	± 0,25	± 0,28	± 0,32	± 0,36

NOTE 1 The values specified do not apply to the uncropped ends for a total length,  $l$ , of a mill edge coil. The total length  $l$  would be calculated using the following formula:

$$\text{total length, } l, \text{ in metres} = \frac{90}{\text{Thickness in millimetres}} \text{ provided that the result was not greater than 20 mm.}$$

NOTE 2 Thickness is measured at any point on the sheet not less than 25 mm from a sheared edge and 40 mm from a mill edge. Points closer than these are subject to negotiation.

**Table 7 — Width tolerances for coils and cut lengths (including descaled material), mill edge**

Values in millimetres

Specified width	Tolerance
≤ 1 500	+ 20 0
> 1 500	+ 25 0

NOTE The values specified do not apply to the uncropped ends for a total length,  $l$ , of a mill edge coil. The total length  $l$  would be calculated using the formula:

$$\text{total length, } l, \text{ in metres} = \frac{90}{\text{Thickness in millimetres}} \text{ provided that the result was not greater than 20 m.}$$

**Table 8 — Width tolerances for coils and cut lengths  
(including descaled material), sheared edge, not resquared**

Values in millimetres

Specified width	Tolerance
≤ 1 200	+ 3 0
> 1 200 and ≤ 1 500	+ 5 0
> 1 500	+ 6 0
NOTE For resquared material more restrictive tolerances are subject to negotiation.	

**Table 9 — Length tolerances for cut lengths  
(including descaled material), not resquared**

Values in millimetres

Specified length	Tolerance
≤ 2 000	+ 10 0
> 2 000 and ≤ 8 000	+ 0,5 0 % × length
> 8 000	+ 40 0
NOTE For resquared material more restrictive tolerances are subject to negotiation.	

**Table 10 — Camber tolerances for coils and cut lengths  
(including descaled material), not resquared**

Form	Camber tolerance
Coils	25 mm in any 5 000 mm length
Cut lengths	0,5 % × length
NOTE 1 For resquared material more restrictive tolerances are subject to negotiation.	
NOTE 2 The values specified do not apply to the uncropped ends of a mill edge coil for a total length of 7 m.	
NOTE 3 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 (see Figure 1).	

**Table 11 — Out-of-square tolerance for cut lengths  
(including descaled material), not resquared**

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1 % × width
NOTE 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 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.	
NOTE 2 For resquared material more restrictive tolerances are subject to negotiation.	