

INTERNATIONAL STANDARD

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10384

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Hot-rolled carbon steel sheet for machinery

Tôles laminées à chaud en acier au carbone pour outillage

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ISO 10384:1992

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Reference number
ISO 10384:1992(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 10384 was prepared by Technical Committee ISO/TC 17, *Steel*, Sub-Committee SC 12, *Continuous mill flat rolled products*.

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Hot-rolled carbon steel sheet for machinery

1 Scope

1.1 This International Standard applies to continuously hot-rolled carbon steel sheet for machinery. 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.

NOTES

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".

2 Steel sheet that is to be subjected to subsequent re-rolling is not covered by this International Standard.

1.2 Hot-rolled carbon steel sheet for machinery shall be manufactured from killed steel of chemical composition listed in table 1. It is usually produced in the range of thickness 1,6 mm to 12,5 mm inclusive, and widths 600 mm and over, in coils and cut lengths.

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

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 377-2:1989, *Selection and preparation of samples and test pieces of wrought steels — Part 2: Samples for the determination of the chemical composition.*

ISO 643:1983, *Steels — Micrographic determination of the ferritic or austenitic grain size.*

ISO 3887:1976, *Steel, non-alloy and low-alloy — Determination of depth of decarburization.*

ISO 4967:1979, *Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams.*

ISO 6507-1:1982, *Metallic materials — Hardness test — Vickers test — Part 1: HV 5 to HV 100.*

ISO 6508:1986, *Metallic materials — Hardness test — Rockwell test (scales A - B - C - D - E - F - G - H - K).*

3 Definitions

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

3.1 hot-rolled steel sheet: A product obtained by rolling heated steel through a continuous-type strip mill to the required sheet thickness and tolerances. 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. Descaling may also be performed by appropriate mechanical means.

3.3 mill edge: A normal side edge without any definite contour produced in hot-rolling. Mill edges may contain some irregularities such as cracked or torn edges or thin (feathered) edges.

3.4 edge trimmed: A normal edge obtained by shearing, slitting, or trimming a mill edge product.

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

4 Other information concerning surface preparation

4.1 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.

4.2 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.

4.3 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 with degreasing chemicals.

5 Conditions of manufacture

5.1 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.

5.2 Chemical composition

The chemical composition (cast analysis) shall comply with table 1.

5.3 Chemical analyses

5.3.1 Cast analysis

A cast analysis of each cast of steel shall be made by the manufacturer to determine the percentage by mass of carbon, silicon, manganese, phosphorus and sulfur. On request, this analysis shall be reported to the purchaser or his representative.

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Table 1 — Chemical composition (cast analysis)

Steel grade	Chemical composition [% (m/m)] ¹⁾				
	C	Si	Mn	P max.	S max.
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

1) The percentage by mass of Cu, Ni, Cr and Ni + Cr shall not exceed 0,30 %, 0,20 %, 0,20 % and 0,35 % respectively.

5.3.2 Product analysis

A product analysis may be made by the purchaser to verify the specified analysis of the semi-finished or finished steel and this shall take into consideration any normal heterogeneity.

The permissible deviations between the specified cast analysis and the product analysis are shown in table 2.

Table 2 — Permissible deviations for product analysis

Element	Limit, or maximum of specified element, L [%]	Permissible deviations [%]
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 377-2. The requirements not specified in ISO 377-2 are to be agreed upon by the manufacturer and purchaser at the time of ordering.

5.4 Application

It is desirable that hot-rolled steel sheet be identified for fabrication by the name of the part or by the intended application.

5.5 Mechanical properties and other tests

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

5.5.2 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, and criteria of acceptance or rejection shall be agreed upon by the manufacturer and purchaser at the time of ordering.

- Depth of decarburization.
- Content of non-metallic inclusions.
- Austenitic grain size.
- Hardness.
- Microscopic structure.

6 Dimensional tolerances

Dimensional tolerances applicable to hot-rolled steel sheet are given in tables 3 to 10 inclusive.

7 Measurement of dimensions

Figures 1 to 3 illustrate the measurement of edge camber, out-of-square and flatness, respectively.

7.1 Edge camber

Edge 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).

7.2 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 2. It can also be measured as one-half of the difference between the diagonals of the cut length of sheet.

Table 3 — Thickness tolerances for coils and cut lengths of grades S10C to S20C

Values in millimetres

Specified widths		Thickness tolerance for specified thicknesses									
over	up to and including	up to and including 2,0	over 2,0 up to and including 2,5	over 2,5 up to and including 3,0	over 3,0 up to and including 4,0	over 4,0 up to and including 5,0	over 5,0 up to and including 6,0	over 6,0 up to and including 8,0	over 8,0 up to and including 10,0	over 10,0 up to and including 12,5	
600	1 200	0,18	0,19	0,21	0,23	0,25	0,27	0,32	0,35	0,38	
1 200	1 500	0,20	0,22	0,23	0,25	0,27	0,29	0,33	0,36	0,40	
1 500	1 800	0,22	0,24	0,25	0,27	0,29	0,30	0,34	0,37	0,41	

NOTES

1 The tolerance values specified do not apply to the uncropped ends for a length, *l*, of a mill edge coil.

l is calculated using the following formula:

$$\text{Length } l \text{ in metres} = \frac{90}{\text{Thickness in millimetres}}$$

provided that the result was not greater than 20 m, inclusive of both ends.

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

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Table 4 — Thickness tolerances for coils and cut lengths of grades S25C to S58C

Values in millimetres

Specified widths		Thickness tolerance for specified thicknesses									
over	up to and including	up to and including 2,0	over 2,0 up to and including 2,5	over 2,5 up to and including 3,0	over 3,0 up to and including 4,0	over 4,0 up to and including 5,0	over 5,0 up to and including 6,0	over 6,0 up to and including 8,0	over 8,0 up to and including 10,0	over 10,0 up to and including 12,5	
600	1 200	0,20	0,21	0,23	0,25	0,28	0,30	0,36	0,40	0,44	
1 200	1 500	0,22	0,24	0,25	0,28	0,30	0,32	0,37	0,41	0,45	
1 500	1 800	0,24	0,26	0,28	0,30	0,32	0,33	0,39	0,42	0,46	

NOTES

1 The tolerance values specified do not apply to the uncropped ends for a length, *l*, of a mill edge coil.

l is calculated using the following formula:

$$\text{Length } l \text{ in metres} = \frac{90}{\text{Thickness in millimetres}}$$

provided that the result was not greater than 20 m, inclusive of both ends.

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

Table 5 — Width tolerances for hot-rolled steel sheet (including descaled sheet), mill edge coils and cut lengths

Values in millimetres

Specified widths		Tolerance ¹⁾
over	up to and including	
	1 200	+30 0
1 200	1 500	+35 0
1 500	1 800	+40 0

1) The values specified do not apply to the uncropped ends for a length, *l*, of a mill edge coil.

l is calculated using the following formula:

$$\text{Length, } l, \text{ in metres} = \frac{90}{\text{Thickness in millimetres}}$$

provided that the result was not greater than 20 m, inclusive of both ends.

Table 8 — Edge camber tolerances for hot-rolled steel sheet (including descaled sheet), which is not required

Form	Edge camber tolerance ¹⁾
Cut lengths	0,5 % × length
Coils	25 mm in any 5 000 mm length

1) The tolerance values do not apply to the uncropped ends of mill edge coil within 7 m, inclusive of both ends.

Table 9 — Out-of-square tolerance for hot-rolled steel sheet in cut lengths, not required

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1,0 % × width

Table 10 — Standard flatness tolerances for hot-rolled steel sheet (including descaled sheet) and cut lengths

Values in millimetres

Specified thicknesses		Specified widths		Flatness tolerances ^{1), 2)}
over	up to and including	over	up to and including	
2	2		1 200	36
			1 500	48
		1 500		56
2			1 200	29
			1 500	38
		1 500		48

1) These tolerances are only applicable to sheet up to and including 5 000 mm in length. Tolerances for sheet having a length exceeding 5 000 mm are subject to agreement between the manufacturer and purchaser. This table also applies to sheet cut to length from coil by the customer, when adequate flattening procedures are performed.

2) Maximum deviation from a flat horizontal surface. With the sheet lying under its own mass on a flat surface, the maximum distance between the lower surface of the sheet and the flat horizontal surface is the maximum deviation from flatness. (See figure 3.)

Table 6 — Width tolerances for hot-rolled steel sheet (including descaled sheet), cut edge, coils which are not required and cut lengths

Values in millimetres

Specified widths		Tolerance
over	up to and including	
	1 200	+6 0
1 200	1 500	+8 0
1 500	1 800	+10 0

Table 7 — Length tolerances for hot-rolled steel sheet (including descaled sheet) which is not required

Values in millimetres

Specified widths		Tolerance
over	up to and including	
	3 000	+20 0
3 000	6 000	+30 0
6 000		+0,5×length 0

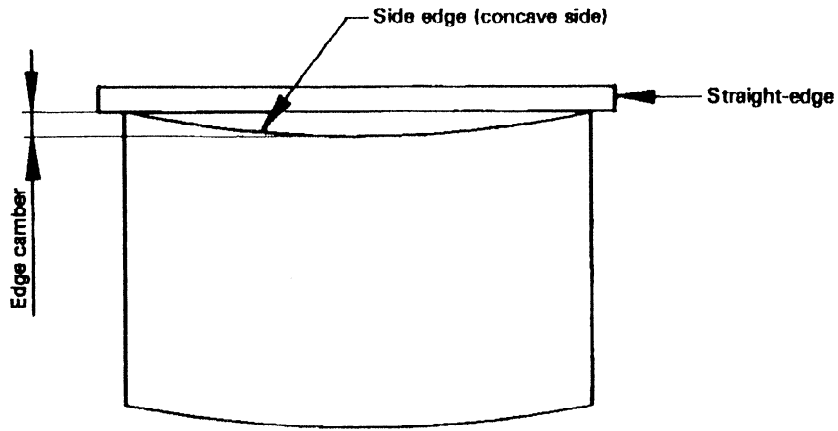


Figure 1 — Measurement of edge camber

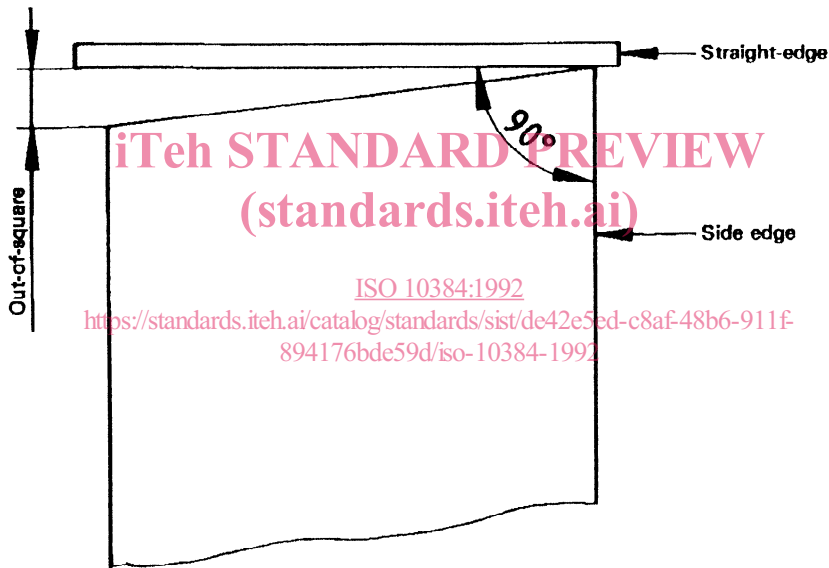


Figure 2 — Measurement of out-of-square

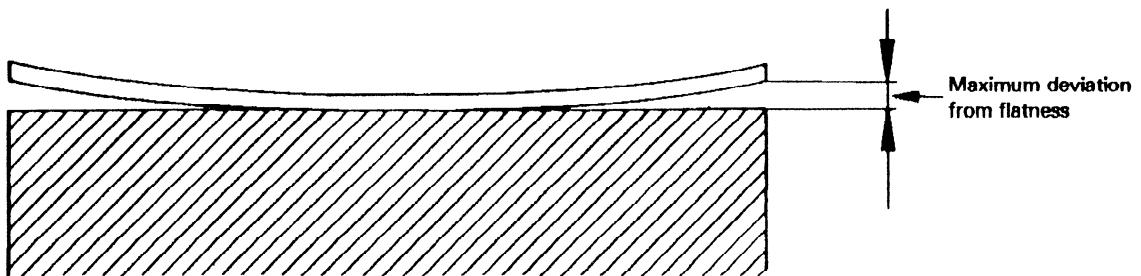


Figure 3 — Measurement of flatness

8 Workmanship

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

The steel sheet in cut lengths shall be free from marks of laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing.

Processing for shipment in coils does not allow the manufacturer to readily observe or remove defective portions as on cut length products.

9 Inspection and acceptance

9.1 Although 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.

9.2 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.

10 Coil size

When hot-rolled steel sheet is ordered in coils, a minimum internal diameter, D_{int} , or range of acceptable internal diameters shall be specified. In addition, the maximum external diameter, D_{ext} , and the maximum acceptable coil mass shall be specified.

11 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:

- the manufacturer's name or identifying brand;
- the number of this International Standard;
- the quality designation;
- the order number;
- the product dimensions;
- the lot number;

- the mass.

12 Information to be supplied by the purchaser

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

- the number of this International Standard;
- the name and grade of the material (e.g. hot-rolled carbon steel sheet for machinery grade S40C, see 1.2);
- the dimensions of the product and the quantity required;
- the application or name of the part, if possible (see 5.4);
- whether pickling (see 3.2) or descaling by grit or shot blasting (see 4.1) is required (material so specified will be oiled unless ordered not oiled, see 4.3);
- the type of edge (see 3.3 and 3.4);
- the report of the cast analysis, if required (see 5.3.1);
- limitations on masses and dimensions of individual coils and bundles, if applicable (see clause 10);
- inspection and tests for acceptance prior to shipment to the manufacturer's works, if required (see 9.1);

A typical ordering description is as follows:

International Standard ISO 10384, hot-rolled, carbon steel sheet for machinery S40C, 3 mm × 1 200 mm × 2 440 mm, 10 000 kg, to be used for washer, mill edge, furnish report of cast analysis, maximum lift mass 4 000 kg.

13 Report

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

- the cast analysis (see 5.3.1);
- the results of the test items requested by the purchaser (see 5.5.2);
- the steelmaking process (5.1);