
**Hot-rolled steel sheet in coils of
structural quality and heavy thickness**

Tôles fortes en acier de construction laminées à chaud en bobines

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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.

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

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see the following URL: <http://www.iso.org/iso/foreword.html>

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

This third edition cancels and replaces the second edition (ISO 13976:2005), which has been technically revised.

Hot-rolled steel sheet in coils of structural quality and heavy thickness

1 Scope

This document applies to hot-rolled carbon/manganese steel sheet in coils of structural quality without the use of microalloying elements. It is generally used in the delivered condition and is intended for bolted, riveted or welded structures. The product is produced on a wide sheet mill.

The product is intended for structural purposes where particular mechanical properties are required.

The steel sheet is produced in a number of grade designations designed to be compatible with differing application requirements.

This document does not cover steels intended for boilers or pressure vessels, or steels designated as commercial quality or drawing qualities, or steels rolled to cold-reduced products, or steels designated as weathering steels, having increased atmospheric corrosion resistance, or those products rolled on a plate mill.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

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 with non-alloyed steel produced to equivalent strength levels

3.2

hot-rolled steel sheet in coils

steel sheet in coil form manufactured through hot-rolling process where the material was heated before rolling to achieve the required sheet thickness and tolerances

Note 1 to entry: The product has a surface covered with oxide or scale resulting from the hot-rolling operation.

3.3 hot-rolled descaled steel sheet in coils

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

Note 1 to entry: Descaling can also be performed by mechanical means such as grit blasting. Some increase in hardness and some loss of ductility can result from descaling.

Note 2 to entry: This product is normally supplied oiled.

3.4 mill edge

normal edge produced without any definite contour produced in hot-rolling

Note 1 to entry: Mill edges can contain some irregularities such as cracked or torn edges on thin (feathered) edges.

3.5 sheared edge

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

Note 1 to entry: Normal processing does not necessarily provide a definite positioning of the slitting burr.

3.6 lot

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

3.7 edge camber

edge camber is the greatest deviation of a side from a straight line, the measurement being taken on the concave side with a straight edge

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4 Dimensions

Hot-rolled steel sheet in coils of structural quality and heavy thickness is produced in the range of thicknesses greater than 6 mm to 25 mm, and widths of 600 mm and over, in coils.

5 Conditions of manufacture

5.1 Steelmaking

Unless otherwise agreed upon by the interested parties, 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 being used.

5.2 Chemical composition

The chemical composition (heat analysis) shall conform to the requirements given in [Tables 1](#) and [2](#).

Table 1 — Chemical composition (heat analysis)

Mass fractions in percent

Grade	C max.	Mn max.	P max.	S max.	Si max.	N max.
HR185	0,16	1,5	0,030	0,035	0,40	0,015
HR235	0,18	1,5	0,030	0,035	0,40	0,015
HR275	0,18	1,5	0,030	0,035	0,40	0,015
HR295	0,21	1,5	0,030	0,035	0,55	0,015
HR325	0,18	1,6	0,030	0,035	0,55	0,015
HR355	0,22	1,5	0,030	0,035	0,55	0,015

Table 2 — Limits on additional chemical elements

Mass fractions in percent

Element	Cu ^a max.	Ni ^a max.	Cr ^{ab} max.	Mo ^{ab} max.	Nb max.	V ^c max.	Ti max.
Heat analysis	0,20	0,20	0,15	0,06	0,008	0,008 ^c	0,008
Product analysis	0,23	0,23	0,19	0,07	0,018	0,018	0,018

^a The sum of copper, nickel, chromium and molybdenum shall not exceed 0,50 % on the 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 is specified, the sum does not apply, in which case only the individual limits on the remaining elements will apply.

^c Where residual V levels greater than 0,008 % occur due to high levels of V in natural ores, such material may be supplied after agreement between the manufacturer and purchaser.

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5.3 Chemical analysis

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5.3.1 Heat analysis

An analysis of each heat shall be made by the manufacturer in order to determine compliance with the requirements given in [Tables 1](#) and [2](#). On request, a report of the heat analysis shall be made available to the purchaser or the purchaser's representative. Each of the elements listed in [Tables 1](#) and [2](#) shall 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 %".

5.3.2 Product analysis

A product analysis may be made by the purchaser in order to verify the specified analysis of the product and shall take into consideration any normal heterogeneity. The product analysis tolerances shall be in accordance with [Tables 2](#) and [3](#).

Table 3 — Product analysis tolerances

Mass fractions in percent

Element	Maximum or range of specified element	Tolerance over maximum specified
C	> 0,15 to ≤ 0,22	0,04
Mn	> 1,15 to ≤ 1,6	0,05
P	≤ 0,030	0,010
S	≤ 0,035	0,010
Si	> 0,40 to ≤ 0,55	0,05
N	≤ 0,015	0,005

NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis. For example: for Grade HR295, the following product analysis values are within these tolerances: C 0,25 %, Mn 1,55 %, P 0,040 %, S 0,045 %, Si 0,60 %, N 0,020 %.

5.4 Mechanical properties

At the time that the steel is made available for shipment, the mechanical properties shall be as stated in [Table 4](#), when they are determined on test pieces obtained in accordance with the requirements in [Clause 7](#).

5.5 Application

It is desirable that the specified product be identified for fabrication by the name of the part or by the intended application.

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

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5.6 Weldability

This product is normally suitable for welding when appropriate welding conditions are selected. For non-descaled steel, it may be necessary to remove the scale or oxide depending upon the welding method.

NOTE When the mass fraction of carbon exceeds 0,15 %, spot welding becomes increasingly difficult.

5.7 Surface condition

Designation AR describes the as-rolled 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.

5.8 Oiling

Designation DO describes the descaled and oiled condition. As a deterrent to rusting, a coating of oil is usually applied to hot-rolled descaled steel sheet, but sheet may be furnished not oiled if required. The oil is not intended as a drawing or 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. Hot-rolled descaled steel sheet may be ordered not oiled, if required, in which case the supplier has limited responsibility if oxidation occurs.

NOTE If AR and DO are omitted, it means that the delivery will be as-rolled.

5.9 Dimensional and shape tolerances

5.9.1 Dimensional and shape tolerances applicable to hot-rolled steel sheet in coils of structural quality heavy thickness shall be as specified in [Tables 5](#) and [6](#). These tolerances also apply to descaled material.

5.9.2 Edge camber shall not exceed 25 mm in any 5 000 mm of length (see Figure 1).

Table 4 — Mechanical properties

Grade	R_e^a min. MPa ^c	R_m min. MPa ^c	A^b min, %			
			$L_o = 5,65\sqrt{S_o}$	$L_o = 50$ mm for sheet thickness		
				$6 < e \leq 12$ mm	$12 < e \leq 19$ mm	$19 < e \leq 25$ mm
HR185	185	290	19	20	23	26
HR235	235	400	19	20	23	26
HR275	275	410	16	17	20	22
HR295	295	470	15	16	19	21
HR325	325	490	15	16	19	21
HR355	355	490	15	16	19	21

R_e = yield strength – can be either R_{eL} or R_{eH} not both;
 R_{eL} = lower yield strength, R_{eH} = high yield strength;
 R_m = tensile strength;
 A = percentage elongation after fracture;
 L_o = gauge length of original test piece;
 S_o = original cross-sectional area of gauge length;
 e = thickness of steel sheet, in millimetres.

^a Either R_{eH} or R_{eL} shall be measured and either value shall meet the minimum requirement. The yield strength values can be measured by 0,5 % total elongation proof strength (proof strength under load) or by 0,2 % offset when a definite yield phenomenon is not present.

^b In case of dispute, only the results obtained on a 50 mm test piece will be valid.

^c 1 MPa = 1 N/mm²

Table 5 — Thickness tolerances for heavy thickness hot-rolled sheet (including descaled) in coils

Dimensions and tolerances in millimetres

Specified widths	Specified thicknesses ^a				
	$6,00 < e \leq 8,00$	$8,00 < e \leq 10,00$	$10,00 < e \leq 12,50$	$12,50 < e \leq 16,00$	$16,00 < e \leq 25,00$
$600 < w \leq 1\ 200$	±0,29	±0,32	±0,35	±0,38	±0,40
$1\ 200 < w \leq 1\ 500$	±0,30	±0,33	±0,36	±0,39	±0,42
$1\ 500 < w \leq 1\ 800$	±0,31	±0,34	±0,37	±0,40	±0,44
$w > 1\ 800$	±0,35	±0,40	±0,43	±0,48	±0,50

w = width;
 e = thickness of steel sheet, in millimetres;

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

$$l = \frac{90}{e} \text{ metres}$$

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

^a Thickness is measured at any point on the sheet not less than 40 mm from a side edge for mill edge material and not less than 25 mm from the edge for sheared edge material.