
Hot-rolled steel sheet of structural quality

Tôles en acier de construction laminées à chaud

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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

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This sixth edition cancels and replaces the fifth edition (ISO 4995:2008), which has been technically revised.

Hot-rolled steel sheet of structural quality

1 Scope

This International Standard applies to hot-rolled steel sheet of structural quality in the grades listed in [Table 1](#), usually prepared without the use of microalloying elements. The product is intended for structural purposes where particular mechanical properties are required. It is generally used in the delivered condition and is intended for bolted, riveted, or welded structures. This product is produced on a wide strip mill, not a plate mill.

This International Standard does not cover steels intended for boilers or pressure vessels, steels designated as commercial quality or drawing quality (covered in ISO 3573^[1]), steels to be re-rolled to cold-reduced products, or steels designated as weathering steels, having increased atmospheric corrosion resistance.

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 referenced document (including any amendments) applies.

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

ISO 13976, *Hot-rolled steel sheet in coils of structural quality and heavy thickness*

ISO 16160, *Hot-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

element, such as niobium, vanadium, titanium, 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

product obtained by rolling heated steel through a continuous-type or reversing-type wide strip-mill to the required sheet thickness, the product having a surface covered with oxide or scale resulting from the hot-rolling operation

3.3

hot-rolled descaled steel sheet

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

Note 1 to entry: Descaling may also be performed by mechanical methods such as grit blasting. Some change in properties can result from descaling.

3.4

edges

3.4.1

mill edge

normal side edge without any definite contour produced in hot rolling

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

3.4.2

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.

3.5

aluminum killed

steel which has been deoxidized with aluminum is sufficient to prevent the evolution of gas during solidification

3.6

lot

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

4 Dimensions

4.1 This product is commonly produced in thicknesses from 1,6 mm to 6 mm and in widths of 600 mm and over, in coils and cut lengths.

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

NOTE 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".

5 Conditions of manufacture

5.1 Steelmaking

Unless otherwise agreed 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](#).

5.3 Chemical analysis

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, at the time of ordering, this analysis shall be reported to the purchaser or the purchaser's 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 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 sampling method shall be agreed upon between the interested parties at the time of ordering. The product analysis tolerances shall be in accordance with [Table 2](#) and [Table 3](#).

Table 1 — Chemical composition (heat analysis)

Mass fractions in per cent

Grade	C max.	Mn max.	Si max.	P max.	S max.
HR235	0,17	1,20	Not applicable	0,035	0,035
HR275	0,20	1,20	Not applicable	0,035	0,035
HR355	0,20	1,50	0,55	0,035	0,035

Table 2 — Limits on additional chemical elements^a

Mass fractions in per cent

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

^a Each of the elements listed in this table 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 %”.

^b 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.

^c 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.

^d Heat analysis greater than 0,008 % may be supplied upon agreement between producer and consumer.

Table 3 — Product analysis tolerances

Mass fractions in per cent

Element	Maximum of specified element	Tolerance over maxi- mum specified
C	0,21	0,04
Mn	1,50	0,05
P	0,035	0,010
S	0,035	0,010
Si	0,55	0,05

NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis. For example, for Grade HR355, the following product analysis values are within these tolerances: C 0,24 %, Mn 1,55 %, P 0,045 %, S 0,045 %, Si 0,60 %.

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 of Clause 7.

5.5 Application

It is desirable that hot-rolled steel sheet 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.

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. As the carbon content increases above 0,15 %, spot welding becomes increasingly difficult.

Table 4 — Mechanical properties

Grade ^a	R _e min. ^b MPa		R _m min. (information only) MPa	A min. % ^c			
	R _{eH}	R _{eL}		e < 3		3 ≤ e ≤ 6	
				L ₀ = 50 mm	L ₀ = 80 mm	L ₀ = 5,65√S ₀	L ₀ = 50 mm
HR235	235	215	330	20	18	23	22
HR275	275	255	370	17	15	20	18
HR355	355	335	450	15	13	19	16
R _e	yield strength						
R _{eH}	upper yield strength						
R _{eL}	lower yield strength						
R _m	tensile strength						
A	percentage elongation after fracture						
e	thickness of steel sheet, in mm						
L ₀	original gauge length on test piece						
S ₀	original cross-sectional area of gauge length						
1 MPa = 1 N/mm ²							
^a Formerly designated as grades Fe37, Fe44, and Fe52. ^b Either R _{eH} or R _{eL} shall be specified, but not both. The measured value shall meet the minimum requirement. The yield strength values 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. ^c For thicknesses up to 3 mm, use either L ₀ = 50 mm or L ₀ = 80 mm. For thicknesses of 3 mm to 6 mm, use L ₀ = 5,65√S ₀ or L ₀ = 50 mm. In case of dispute, only the results obtained on a 50 mm test piece will be valid.							

5.7 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 grit blasting might disclose surface imperfections not readily visible prior to this operation.

5.8 Oiling

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 forming lubricant and shall be easily removed using degreasing chemicals. On request, the manufacturer shall advise the purchaser of the type of oil used. Hot-rolled descaled sheet may 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 hot-rolled steel sheet of structural quality shall be as given in ISO 16160. These tolerances also apply to descaled material. Tolerances on coiled material with thicknesses over 6 mm shall be as given in ISO 13976.

7 Tensile test sampling

One representative sample for the tensile test 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 edge of the sheet as rolled.

9 Retests

9.1 Machining and flaws

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

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 tests shall conform to the requirements of this International Standard; otherwise the lot shall be rejected.

10 Resubmission

10.1 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 (for example: selection, heat treatment, etc.) which, on request, will be indicated to the purchaser. In this case, tests shall be carried out as if they are 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.