
Hot-rolled steel sheet of structural quality

Tôles en acier de construction laminées à chaud

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 2.

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

ISO 4995 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This fifth edition cancels and replaces the fourth edition (ISO 4995:2001), which has been technically revised.

Hot-rolled steel sheet of structural quality

1 Scope

1.1 This International Standard applies to hot-rolled steel sheet of structural quality in the grades and classes 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.

1.2 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.

1.3 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”.

1.4 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 referenced documents are indispensable for the application 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 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, *Continuously 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 and tolerances

NOTE The product has 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 Descaling may also be performed by mechanical methods such as grit blasting. Some change in properties can result from descaling.

3.4

mill edge

normal side edge without any definite contour produced in hot rolling

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

3.5

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.

4 Conditions of manufacture

4.1 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.

4.2 Chemical composition

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

4.3 Chemical analysis

4.3.1 Heat analysis

A heat analysis of each heat of steel shall be made by the manufacturer in order to determine the content 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 in order to verify the specified analysis of the product and shall take into consideration any normal heterogeneity. Non-killed steels (such as rimmed or capped) are not technologically suited to product analysis. For killed steel, 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 Tables 2 and 3.

Table 1 — Chemical composition (heat analysis)

Mass fractions in percent

Grade	Class ^{a, b}	Method of deoxidization ^{c, d}	C max.	Mn max.	Si max.	P max.	S max.
HR235	B	E or NE	0,18	1,20	Not applicable	0,035	0,035
	D	CS	0,17	1,20		0,035	0,035
HR275	B	E or NE	0,21	1,20	Not applicable	0,035	0,035
	D	CS	0,20	1,20		0,035	0,035
HR355	B	NE	0,21	1,50	0,55	0,035	0,035
	D	CS	0,20			0,035	0,035

^a Class B steels are intended for use in welded structures or structural parts subjected to normal loading conditions.

^b Class D steels are intended to be used for welded structures or structural parts where, owing to loading conditions and the general design of the structure, a high resistance to brittle fracture is necessary.

^c E = rimming; NE = non-rimming; CS = aluminium killed.

^d The nitrogen content is controlled; normally, it should not exceed 0,009 % for E or NE steels or 0,015 % for CS steels.

Table 2 — Limits on additional chemical elements ^a

Mass fractions in percent

Element	Heat analysis max.	Product analysis max.
Cu ^b	0,20	0,23
Ni ^b	0,20	0,23
Cr ^{b, c}	0,15	0,19
Mo ^{b, c}	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 percent

Element	Maximum of specified element	Tolerance over maximum specified
Carbon	0,21	0,04
Manganese	1,50	0,05
Phosphorus	0,035	0,010
Sulfur	0,035	0,010
Silicon	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, class B, the following product analysis values are within these tolerances: C 0,25 %, Mn 1,55 %, P 0,045 %, S 0,045 %, Si 0,60 %.

4.4 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.

4.5 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.

4.6 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.

Table 4 — Mechanical properties

Grade ^a	R_e min. ^b MPa		R_m min. (information only) MPa	A min. % ^c			
				$e < 3$ mm		$3 \text{ mm} \leq e \leq 6$ mm	
	R_{eH}	R_{eL}		$L_o = 50$ mm	$L_o = 80$ mm	$L_o = 5,65\sqrt{S_o}$	$L_o = 50$ 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 millimetres L_o = gauge length on test piece S_o = 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 stress values can be measured by 0,5 % elongation proof stress (proof stress under load) or by 0,2 % offset when a definite yield phenomenon is not present. ^c For thicknesses up to 3 mm, use either $L_o = 50$ mm or $L_o = 80$ mm. For thicknesses of 3 mm to 6 mm, use $L_o = 5,65\sqrt{S_o}$ or $L_o = 50$ mm. In case of dispute, only the results obtained on a 50 mm test piece will be valid.							

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

4.8 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 removable 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.

5 Dimensional tolerances

Dimensional 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.

6 Sampling

One representative sample for the tensile test required in Table 4 shall be taken from each lot of sheet for shipment. A lot consists of 50 t or less of sheet of the same grade and class rolled to the same thickness and condition.

7 Mechanical property tests

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.

8 Retests

8.1 General

If a test does not give the specified results, two more tests shall be taken at random on the same lot. Both retests shall conform to the requirements of this International Standard; otherwise, the lot shall be rejected.

8.2 Machining and flaws

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

8.3 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 Resubmission

9.1 The manufacturer may resubmit for acceptance the products that have been rejected during earlier inspection because of unsatisfactory properties, after he has subjected them to a suitable treatment (selection, heat treatment), which, on request, will be indicated to the purchaser. In this case, the tests shall be carried out as if they applied to a new batch.

9.2 The manufacturer has the right to present the rejected products for fresh examination for compliance with the requirements for another grade or class.

10 Workmanship

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

10.2 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.

10.3 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.

11 Inspection and acceptance

11.1 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 furnished in accordance with this International Standard.

11.2 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 he may properly investigate.

12 Coil size

When hot-rolled steel sheet is ordered in coils, a minimum inside diameter (ID) or a range of acceptable inside diameters shall be specified. In addition, the maximum outside diameter (OD) and the maximum acceptable coil mass shall be specified.

13 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 grade and class designations;
- d) the order number;
- e) the product dimensions;
- f) the lot number;
- g) the mass.

14 Information to be supplied by the purchaser

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

- a) reference to this International Standard, i.e. ISO 4995:2008;
- b) the name, quality, grade and class of the material (e.g. hot-rolled steel sheet, structural quality, grade HR235, class D);
- c) the dimensions of the product and the quantity required;
- d) the application (name of part) if possible (see 4.5);
- e) whether pickling or descaling by grit or shot blasting is required (see 3.3); material so specified will be oiled unless ordered not oiled (see 4.8);
- f) the type of edge required (see 3.4 and 3.5);
- g) whether cropped ends are required;
- h) the report of the mechanical properties and/or the heat analysis, if required (see 4.3.1 and 4.6);
- i) limitations on masses and dimensions of individual coils and bundles, if applicable (see Clause 12);
- j) the inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see 11.1);
- k) specification of either R_{eH} or R_{eL} (see Table 4, footnote b).

EXAMPLE A typical ordering description is as follows:

ISO 4995:2008, hot-rolled steel sheet, structural quality, grade HR235, class D, 3 mm × 1 200 mm × 2 440 mm, 40 000 kg, for part No. 2 345, roof support, mill edge, furnish report of mechanical properties, maximum lift 4 000 kg.