BS ISO 20805:2011

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Hot-rolled steel sheet in coils of higher yield strength with improved formability and heavy thickness for cold forming

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National foreword

This British Standard is the UK implementation of ISO 20805:2011. It supersedes BS ISO 20805:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/109, Coated and Uncoated Flat Products to be Used for Cold Forming.

A list of organizations represented on this committee can be obtained on request to its secretary.

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BS ISO 20805:2011

INTERNATIONAL STANDARD

ISO 20805

Second edition
2011-05-01

Hot-rolled steel sheet in coils of higher yield strength with improved formability and heavy thickness for cold forming

Tôles fortes en acier laminées à chaud à limite d'élasticité et aptitude au formage accrues, en bobines, pour formage à froid

Reference number
ISO 20805:2011(E)

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Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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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 20805 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Contunuous mill flat rolled products*.

This second edition cancels and replaces the first edition (ISO 20805:2005), which has been technically revised.

INTERNATIONAL STANDARD ISO 20805:2011(E)

Hot-rolled steel sheet in coils of higher yield strength with improved formability and heavy thickness for cold forming

1 Scope

1.1 This International Standard applies to continuous hot-rolled steel sheet of higher yield strength with improved formability. The steel is killed, made according to a fine-grain practice and has a suitable chemical composition, which includes microalloying elements, to provide improved formability. The steel can be treated to achieve inclusion control. The product is intended for applications where parts are to be fabricated requiring better formability than is provided by normal high-yield-strength steel sheet. It is generally used in the as-delivered condition. This product is commonly produced on a wide strip mill.

Because of the combination of higher strength and improved formability, it is possible to obtain savings in mass along with better weldability (see 4.4).

1.2 This product is commonly produced in the range of thicknesses greater than 6 mm to 25 mm, and widths of 600 mm and over, in coils. Hot-rolled sheet less than 600 mm wide can be slit from wide sheet and will be considered as sheet.

1.3 This International Standard does not cover steels intended for boilers or pressure vessels, or steels designated as commercial quality, drawing quality or structural quality, 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 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 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.

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
product obtained by rolling heated steel (billet or slab) through a continuous-type mill to the required strip 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 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 Normal processing does not necessarily provide a definite positioning of the slitting burr.

3.4
mill edge
normal edge produced 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.

3.5
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 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.

4.2 Chemical composition

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

4.2.2 The steel covered by this International Standard shall contain microalloying elements. The chemical composition may be agreed between the interested parties at the time of enquiry and ordering.

Table 1 — Chemical analysis (heat analysis)

All grades	Carbon	Manganese	Phosphorus	Sulfur
	0,15 max., %	1,65 max., %	0,025 max., %	0,030 max., %
As the form of sulfide inclusions may have a certain influence on the cold-forming properties of the products, the manufacturers may, at their discretion, influence the form of inclusions by adding certain elements, such as Ce or Ca, or may choose a very low sulfur content for these steels. These steels shall also contain one or more of the following elements: vanadium, titanium or niobium. When used singly or in combination, these elements shall be present at a minimum level of 0,005 %. Other alloying elements may be present, but are not required.				

Table 2 — Limits on additional chemical elements

Copper, max., %	Heat analysis	0,20
	Product analysis	0,23
Nickel, max., %	Heat analysis	0,20
	Product analysis	0,23
Chromium, max., %	Heat analysis	0,15
	Product analysis	0,19
Molybdenum, max., %	Heat analysis	0,06
	Product analysis	0,07

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 of carbon, manganese, phosphorus and sulfur, and the contents of other elements giving the specified mechanical strength and formability. 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. For killed steels, 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 3.

Table 3 — Product analysis tolerances (mass fraction)

Element	Maximum of specified element %	Tolerance over maximum specified %
Carbon	≤0,15	0,03
Manganese	>1,15 to ≤1,65	0,05
Phosphorus	≤0,025	0,010
Sulfur	≤0,030	0,010
NOTE The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis. For example, for all grades in this International Standard, the following product analysis values are within these tolerances: C 0,18 %, Mn 1,70 %, P 0,035 %, S 0,040 %.		

4.4 Weldability

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

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 given in Table 4, when they are determined on test pieces in accordance with the requirements of Clause 6. Any additional property requirements specified or required are subject to agreement between the interested parties at the time of enquiry and ordering.

Table 4 — Mechanical properties

Grade	R_e min.[a] MPa	R_m min. MPa	A[b] min. % $L_o = 5{,}65\sqrt{S_o}$	A[b] min. % $L_o = 50$ mm for sheet thickness 6 mm ≤ L_o ≤ 12 mm	12 mm < L_o ≤ 19 mm	19 mm < L_o ≤ 25 mm
325	325	410	19	21	24	26
355	355	420	18	20	23	25
420	420	480	15	17	19	21
490	490	540	12	13	16	17
560	560	610	9	10	12	13

R_e is the yield strength;

R_{eH} is the upper yield stress;

R_{eL} is the lower yield stress;

R_m is the tensile strength;

A is the percentage elongation after fracture;

L_o is the gauge length on the test piece;

S_o is the original cross-sectional area of gauge length, in square millimetres;

1 MPa = 1 N/mm^2

[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 stress (proof stress 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.

4.7 Surface condition

The 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.

The steel shall be supplied as-rolled (3.2) or descaled (3.3) and oiled, as requested by the purchaser at the time of enquiry and ordering. If neither condition is specified, the delivery will be as-rolled.

4.8 Oiling

The 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. 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 of the type of oil that 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.

5 Dimensional and shape tolerances

5.1 Dimensional tolerances applicable to hot-rolled steel sheet in coils of structural quality and heavy thickness shall be in accordance with Tables 5 and 6. These tolerances also apply to descaled material.

5.2 Camber shall not exceed 25 mm in any 5 000 mm of length (see Figure 1).

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

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

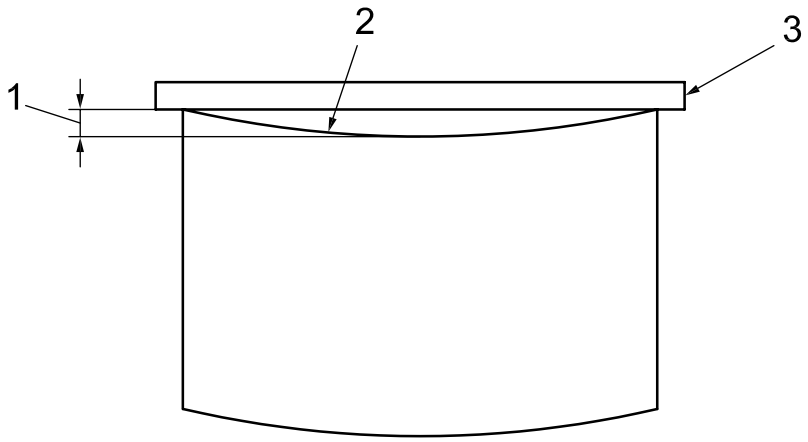
Dimensions and tolerances in millimetres

Specified widths	Thickness tolerances for specified thicknesses[a]				
	$6{,}00 < t \leq 8{,}00$	$8{,}00 < t \leq 10{,}00$	$10{,}00 < t \leq 12{,}50$	$12{,}50 < t \leq 16{,}00$	$16{,}00 < t \leq 25{,}00$
$> 600 \leq 1\,200$	±0,29	±0,32	±0,35	±0,38	±0,40
$> 1\,200 \leq 1\,500$	±0,30	±0,33	±0,36	±0,39	±0,42
$> 1\,500 \leq 1\,800$	±0,31	±0,34	±0,37	±0,40	±0,44
$> 1\,800$	±0,35	±0,40	±0,43	±0,48	±0,50
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: $\text{Length, } l\text{, in metres} = \frac{90}{\text{Thickness in millimetres}}$ provided that the result was not greater than 20 m inclusive of both ends.					
[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 material.					

Table 6 — Width tolerances for heavy-thickness hot-rolled sheet in coils

Dimensions and tolerances in millimetres

Specified widths	Mill edges		Sheared edges	
$> 600 \leq 1\,200$	+28	–0	+5	–0
$> 1\,200 \leq 1\,500$	+38	–0	+6	–0
$> 1\,500 \leq 1\,800$	+45	–0	+8	–0
$> 1\,800$	+50	–0	+10	–0



Key

1 edge camber
2 side edge (concave side)
3 straight edge

Figure 1 — Measurement of camber

6 Sampling — Tensile test

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 tonnes or less of sheet of the same designation rolled to the same thickness and condition.

7 Mechanical property tests

7.1 Tensile test

The tensile test shall be carried out in accordance with ISO 6892-1. Transverse test pieces shall be taken mid-way between the centre and edge of the sheet as-rolled.

7.2 Impact test

While not usually specified, if so agreed at the time of ordering, impact tests may be specified for material ordered according to this International Standard. The test piece shall be taken in the longitudinal direction and the test shall be carried out in accordance with ISO 148-1. Material less than 11 mm in thickness will result in sub-size impact tests.

8 Retests

8.1 Machining and flaws

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

8.2 Elongation

If the percentage of 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.

8.3 Additional tests

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

9 Resubmission

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 should be carried out as if they applied to a new batch.

The manufacturer has the right to present the rejected products to a new examination for compliance with the requirements for another grade.

10 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 laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing.

Processing for shipment in coils does not afford the manufacturer the opportunity to observe readily or to remove imperfect portions, as can be carried out on the cut-length product.

11 Inspection and acceptance

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 furnished in accordance with this International Standard.

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 manufacturer 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 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 stenciled on the top of each lift, or shown on a tag attached to each coil or shipping unit:

a) manufacturer's name or identifying brand;

b) a reference to this International Standard, i.e. ISO 20805:2011;

c) the grade designation;

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass;

h) the bundle/coil number;

i) production date.

14 Information to be supplied by the purchaser

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

a) a reference to this International Standard, i.e. ISO 20805:2011;

b) the name, quality and grade of the material (for example, hot-rolled steel sheet, higher yield strength with improved formability, grade HSF 355);

c) the dimensions of the product and the quantity required;

d) the application (name of part) if possible (see 4.4 and 4.5);

e) whether pickling or descaling by grit or shot blasting is required (material so specified will be oiled unless ordered not oiled) (see 3.3);

f) the type of edge (see 3.4 and 3.5);

g) whether cropped ends are required;

h) the report of the mechanical properties and/or the cast 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) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see Clause 11);

k) if necessary, additional requirements (see 4.6).

An example of a typical ordering description is as follows:

> ISO 20805:2011 hot-rolled steel sheet of higher yield strength with improved formability, grade HSF 355, 1 200 mm × 2 440 mm × coil, 40 000 kg, for Part No. 54321, pickled and oiled (DO), edge trimmed, furnish report of mechanical properties, maximum coil 15 000 kg, ID 760 mm, OD 1 850 mm.

Bibliography

[1] ASTM A1018/A1018M, *Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength*[1)]

1) This document is recognized by ISO/TC 17/SC 12 as covering a subject similar to that of this International Standard. This information is given for the convenience of users of this International Standard and constitutes neither an endorsement of the document by TC 17/SC 12 or ISO, nor a statement regarding its degree of equivalence with this International Standard.

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