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**Hot-rolled steel strip of structural  
quality**

*Feuillards laminés à chaud en acier de construction*

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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 6316 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 6316:2008), which has been technically revised.

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# Hot-rolled steel strip of structural quality

## 1 Scope

**1.1** This International Standard specifies requirements for hot-rolled steel strip of structural quality in the grades and classes listed in Table 1, usually without the use of microalloying elements. This 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. It is commonly rolled on a narrow strip mill.

**1.2** This International Standard does not cover steels designated as commercial quality or drawing quality (covered in ISO 6317) or steels intended for boilers or pressure vessels, or steels to be rerolled 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 for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the reference 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*

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## 3 Terms and definitions

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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 with equivalent strength levels

### 3.2

#### **hot-rolled steel strip**

product obtained by rolling heated steel (billet or slab) through a continuous-type mill to the required strip thickness, tolerances and other attributes set in this International Standard

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 strip**

hot-rolled steel strip from the surface of 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 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 side edge without any definite contour produced in hot rolling

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

Note 2 to entry: A square mill edge can be produced by hot-edge rolling (with the corners not as square as a square-edge bar).

**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 definitive positioning of the slitting burr.

**4 Dimensions**

**4.1** This product shall be produced in thicknesses from 0,65 mm to 12 mm inclusive and widths up to 600 mm exclusive, in coils and cut lengths.

**4.2** Hot-rolled steel strip can also be rolled on a wide continuous mill and slit into narrower coils. However, all attributes of the finished product shall meet the requirements of this International Standard.

**5 Conditions of manufacture**

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**5.1 Steelmaking**

Unless otherwise agreed by the interested parties, the processes used in steelmaking and in manufacturing hot-rolled strip 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**

Unless otherwise agreed by the interested parties, the chemical composition (heat analysis) shall be as agreed upon between the interested parties at the time of ordering. The ranges or limits shall be in accordance with the requirements of Tables 1 and 2 for the designation specified.

**Table 1 — Chemical composition (heat analysis)**

Mass fractions in percent

Grade	Class <sup>a</sup>	Method of deoxidation <sup>b,c</sup>	C max.	Mn max.	Si max.	P max.	S max.
HR235	D	CS	0,17	1,20	0,25	0,035	0,035
HR275	D	CS	0,20	1,20	0,25	0,035	0,035
HR355	D	CS	0,20	1,60	0,55	0,035	0,035

<sup>a</sup> Class D steels are intended for use in 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.

<sup>b</sup> CS = aluminum killed.

<sup>c</sup> The mass fraction of nitrogen is controlled; normally it should not exceed 0,015 % for CS steel.

**Table 2 — Limits on additional chemical elements**

Mass fractions in percent

Elements	Heat analysis	Product analysis
	max.	max.
Cu <sup>a</sup>	0,20	0,23
Ni <sup>a</sup>	0,20	0,23
Cr <sup>ab</sup>	0,15	0,19
Mo <sup>ab</sup>	0,06	0,07
Nb <sup>c</sup>	0,008	0,018
V <sup>c</sup>	0,008	0,018
Ti <sup>c</sup>	0,008	0,018

<sup>a</sup> The sum of copper, nickel, chromium and molybdenum shall not exceed 0,50 % on heat analysis. When one or more of these elements is/are specified, the sum does not apply; in which case, only the individual limits on the remaining elements apply.

<sup>b</sup> The sum of chromium and molybdenum shall not exceed 0,16 % on heat analysis. When one or more of these elements is/are specified, the sum does not apply; in which case, only the individual limits on the remaining elements apply.

<sup>c</sup> Analysis greater than 0,008 % may be supplied after agreement between the producer and purchaser.

### 5.3 Chemical analysis

#### 5.3.1 Heat analysis

An analysis of each heat of steel shall be made by the manufacturer to determine compliance with the requirements of Tables 1 and 2. When requested at the time of ordering, this analysis shall be reported to the purchaser or his representative. Each of the elements listed in Table 1 shall be included in the report of the heat analysis. If one or more of the elements in Table 2 is/are specified, the analysis shall be reported.

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#### 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 shall take into consideration any normal heterogeneity. The product analysis tolerances shall be in accordance with Table 3.

### 5.4 Weldability

This produce shall be capable of being welded where welding conditions are specified. For un-descaled steel, it may be necessary to remove the scale or oxide, depending upon the welding method.

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

### 5.5 Application

Hot-rolled steel strip should be identified for fabrication by the name of the part or by the intended application, which shall be compatible with the grade and class specified.

### 5.6 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 6.

5.7 Surface condition

Oxide or scale on hot-rolled steel strip 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 strip.

5.8 Oiling

As a deterrent to rusting, a coating of oil may be applied to the product. Any oil shall not be intended as a drawing or forming lubricant and shall be easily removed using degreasing chemicals. On request, the manufacturer shall advise the purchaser which type of oil has been used. The product may be ordered not oiled, if required, in which case the supplier shall have limited responsibility if oxidation occurs.

Table 3 — Product analysis tolerances

Mass fractions in percent

Element	Maximum of specified element	Tolerance over maximum specified
Carbon	> 0,15 to ≤ 0,20	0,04
Manganese	> 1,15 to ≤ 1,60	0,05
Silicon	> 0,30 to ≤ 0,55	0,05
Phosphorus	≤ 0,035	0,01
Sulfur	≤ 0,035	0,01

NOTE The above maximum tolerance is the allowable excess over the specified requirements, and not the heat analysis.

Table 4 — Mechanical properties

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Grade	$R_e$ min. <sup>a</sup>	$R_m$ min. (for information only)	% min. <sup>b,c</sup>			
	MPa	MPa	$e < 3$		$3 \geq e > 6$	
			$L_0 = 50$ mm	$L_0 = 80$ mm	$L_0 = 5,65 \sqrt{S_0}$	$L_0 = 50$ mm
HR235	235	330	20	18	23	22
HR275	275	370	17	15	20	18
HR355	355	450	15	13	19	16

$R_e$  yield strength  
 $R_m$  tensile strength  
 $A$  percentage elongation after fracture  
 $L_0$  gauge length of original test piece  
 $S_0$  original cross-sectional area of gauge length  
 $e$  thickness of steel sheet, in millimetres  
 1 MPa = 1 N/mm<sup>2</sup>

<sup>a</sup> The yield strength can be measured either by 0,5 % total elongation proof stress  $R_{t0,5}$  (proof stress under load) or by 0,2 % offset  $R_{p0,2}$  when a definite yield phenomenon is not present.  
<sup>b</sup> 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 either  $L_0 = 5,65 \sqrt{S_0}$  or  $L_0 = 50$  mm. In case of dispute, however, only the results obtained on a proportional test piece will be valid for material 3 mm and over in thickness.  
<sup>c</sup> For material over 6 mm in thickness, values for elongation are subject to agreement between the manufacturer and purchaser.



## 6 Dimensional and shape tolerances

Dimensional and shape tolerances applicable to hot-rolled steel strip of structural quality shall be as given in Table 5 and Tables 7 to 10 inclusive.

Restrictive thickness tolerances are given in Table 6.

It has not been found practicable to formulate flatness and out-of-square tolerances for hot-rolled steel strip.

## 7 Sampling

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

## 8 Test methods

### 8.1 Tensile test

The tensile test shall be carried out in accordance with ISO 6892-1. Longitudinal test pieces shall be taken at the 1/4 point (halfway between the edge and mid-width).

### 8.2 Impact test

While not usually specified, if so agreed at the time of ordering, impact tests may be specified for material over 6 mm in thickness. The test piece shall be in the longitudinal direction and the test shall be a Charpy V-notch test carried out in accordance with ISO 148-1.

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## 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 substituted.

### 9.2 Elongation

If the percentage elongation of any test piece is less than that specified in Table 4, or 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 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 may be rejected.

## 10 Resubmission

The manufacturer may resubmit, for acceptance, the products that have been rejected during earlier inspection because of unsatisfactory properties, after they have been subjected to a suitable retreatment (e.g. 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.