
International Standard



6316

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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 institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6316 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in June 1981.

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It has been approved by the member bodies of the following countries :

Austria	Iran	Spain
Belgium	Italy	Sweden
Bulgaria	Kenya	Switzerland
Canada	Korea, Dem. P. Rep. of	Tanzania
China	Korea, Rep. of	Turkey
Czechoslovakia	Netherlands	United Kingdom
Egypt, Arab Rep. of	New Zealand	USA
France	Norway	USSR
Germany, F. R.	Romania	
India	South Africa, Rep. of	

The member body of the following country expressed disapproval of the document on technical grounds :

Japan

Hot-rolled steel strip of structural quality

1 Scope and field of application

1.1 This International Standard applies to hot-rolled steel strip of structural quality in the grades and classes listed in tables 1 and 2, usually 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 rolled on a narrow strip mill.

1.2 This product is commonly produced in the range of thicknesses of 0,65 to 12 mm inclusive and widths to 600 mm exclusive in coils and cut lengths.

1.3 This International Standard does not cover strip steels designated as commercial quality or drawing qualities (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 References

ISO 82, *Steel — Tensile testing.*

ISO/R 85, *Bend test for steel.*

ISO 86, *Steel — Tensile testing of sheet and strip less than 3 mm and not less than 0,5 mm thick.*

ISO/R 87, *Simple bend testing of steel sheet and strip less than 3 mm thick.*

ISO 148, *Steel — Charpy impact test (V-notch).*

3 Definitions and other information

3.1 microalloying elements : Elements, such as niobium, vanadium, titanium, etc., added singly or in combination to ob-

tain higher strength levels combined with better formability, weldability and toughness as compared with non-alloyed steels produced to equivalent strength levels.

3.2 hot-rolled steel strip : A product obtained usually by rolling heated steel (billet or slab) through a continuous-type mill to the required strip thickness and tolerances.

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.

Descaling may also be performed by mechanical means such as grit blasting. Some change in properties may result from descaling.

As a deterrent to rusting, a coating of oil is usually applied to hot-rolled descaled steel strip, but strip may be furnished not oiled if required. The oil is not intended as a 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.

3.4 mill-edge : A normal side edge produced without any definite contour in hot rolling.

Mill-edges may contain some irregularities such as cracked or torn edges or thin (feathered) edges. A square mill edge can be produced by hot-edge rolling (with the corners not as a square as square edge bar).

3.5 edge trimmed : A normal edge obtained by shearing, slitting or trimming a mill-edge product.

Normal processing does not necessarily provide a definite positioning of the slitting burr.

3.6 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.

4 Conditions of manufacture

4.1 Steelmaking

The processes used in making the steel 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.

4.2 Chemical composition

The chemical composition (cast analysis) shall not exceed the values given in table 1.

4.3 Chemical analysis

4.3.1 Cast analysis

A cast analysis of each cast of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus and sulphur. On request, this analysis shall be reported to the purchaser or his representative.

4.3.2 Verification analysis

A verification 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. Non-killed steels (such as rimmed or capped) are not technologically suited to verification analysis. For killed steels, the sampling method and deviation limits shall be agreed upon between the manufacturer and the purchaser at the time of ordering.

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

4.5 Application

It is desirable that hot-rolled steel strip 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.

4.6 Mechanical properties

At the time that the steel is made available for shipment, the mechanical properties shall be as stated in table 2 when they are determined on test pieces obtained in accordance with the requirements of clause 7.

5 Dimensional tolerances

Dimensional tolerances applicable to hot-rolled steel strip of structural quality shall be as given in tables 3 to 8 inclusive.

6 Sampling

6.1 Tensile test

One representative sample for the tensile test required in table 2 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.

6.2 Bend test (when specified)

One representative sample for the bend test shall be taken from each lot of strip for shipment. A lot consists of all strip of the same grade and class rolled to the same thickness and condition.

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Table 1 – Chemical composition (cast analysis), %

Grade	Class ^{3) 4)}	Method of deoxidation ^{1) 2)}	C max.	Mn max.	Si max.	P max.	S max.
HR235	B	E or NE	0,18	Not applicable	Not applicable	0,050	0,050
	D	CS	0,17	Not applicable	Not applicable	0,040	0,040
HR275	B	E or NE	0,21	Not applicable	Not applicable	0,050	0,050
	D	CS	0,20	Not applicable	Not applicable	0,040	0,040
HR355	B	NE	0,22	1,60	0,55	0,050	0,050
	D	CS	0,20				

1) E = Rimming
NE = Non-rimming
CS = Special killed

2) The nitrogen content is controlled; normally, it should not exceed 0,009 % for E or NE steel or 0,015 % for CS steel.

3) Class B steels are intended for use in welded structures or structural parts, subjected to normal loading conditions.

4) Class D steels are 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.

7 Mechanical property tests

7.1 Tensile test

The tensile test shall be carried out in accordance with ISO 82 and ISO 86. Longitudinal test pieces shall be used.

7.2 Bend test (when specified)

The transverse bend test piece shall withstand being bent through 180°, in the direction as shown in figure 1, around an inside diameter as shown in table 2, without cracking on the outside of the bent portion. The bend test shall be carried out at ambient temperature and as specified in ISO/R 85 and ISO/R 87.

Small cracks on the edges of test pieces and cracks which require magnification to be visible shall be disregarded.

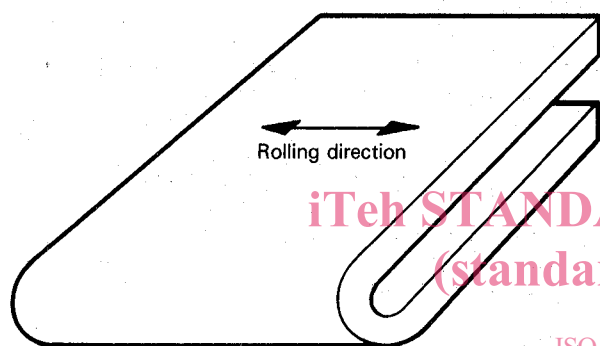


Figure 1 — Transverse bend test piece (after bending)

7.3 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 specimen shall be in the longitudinal direction and the test shall be carried out in accordance with ISO/R 148 for the Charpy V-notch test.

8 Retests

8.1 Machining and flaws

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

8.2 Elongation

If the percentage elongation of any test piece is less than that specified in table 2 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 may be rejected.

Table 2 — Mechanical properties¹⁾

Grade	R_e min. ²⁾ N/mm ²	R_m min. (information only) N/mm ²	A min. % ^{3) 5)}				180° ⁴⁾ bend mandrel diameter
			$e < 3$		$3 \leq e \leq 6$		
			$L_o = 50$ mm	$L_o = 80$ mm	$L_o = 5,65 \sqrt{S_o}$	$L_o = 50$ mm	
HR235	235	330	20	18	23	22	2a
HR275	275	370	17	15	20	18	3a
HR355	355	450	15	13	19	16	3a

- 1) R_e = yield strength
- R_m = tensile strength
- A = percentage elongation after fracture
- L_o = gauge length on test piece
- S_o = original cross-sectional area of gauge length
- e = thickness of bend test piece
- a = thickness of steel strip, in millimetres
- 1 N/mm² = 1 MPa

- 2) 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.
- 3) For thicknesses up to 3 mm, use either $L_o = 50$ mm or $L_o = 80$ mm. For thicknesses 3 mm inclusive to 6 mm inclusive, use $L_o = 5,65 \sqrt{S_o}$ or $L_o = 50$ 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.
- 4) The bend test is carried out only when specified (see 7.2). The bend mandrel diameters in table 2 are for test pieces prepared for laboratory testing. Conditions during fabrication may be more severe, and may not simulate those during laboratory testing.
- 5) For material over 6 mm in thickness, values for bend and elongation are subject to agreement between the manufacturer and the purchaser.

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 to a new examination for compliance with the requirements for another grade or class.

10 Workmanship

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

The steel strip in cut lengths shall be free from amounts of 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 defective portions as can be carried out on the cut length product.

11 Inspection and acceptance

11.1 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.

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 manufacturer shall be notified in order that he may properly investigate.

12 Coil size

When hot-rolled steel strip is ordered in coils, a minimum or range of acceptable inside diameters (I.D.) shall be specified. In addition, the maximum outside diameter (O.D.) 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 adequately requirements under this International Standard, inquiries and orders shall include the following information :

- a) the number of this International Standard;
- b) the name, quality, grade and class of the material (for example, hot-rolled steel strip, 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 4.4 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 4.6 and 4.3.1);
- j) limitations on masses and dimensions of individual coils and bundles, if applicable (see clause 12);
- k) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see 11.1).

NOTE — A typical ordering description is as follows :

ISO 6316, hot-rolled steel strip, structural quality, Grade HR235, Class D, 3 × 200 × 1 600 mm, 40 000 kg, for Part No 2 345. roof support, mill edge, furnish report of mechanical properties, maximum lift 1 000 kg.

Table 3 – Thickness tolerances for coils¹⁾ and cut lengths in Grades HR235 and HR275 (including descaled strip, coils)
Values in millimetres

Specified widths	Thickness tolerances ²⁾ , over and under, for specified thicknesses							
	< 1,5	> 1,5 < 2,0	> 2,0 < 4,0	> 4,0 < 5,0	> 5,0 < 6,0	> 6,0 < 8,0	> 8,0 < 10,0	> 10,0 < 12,0
> 10 < 100	0,12	0,14	0,15	0,16	0,17	0,18	0,19	—
> 100 < 600	0,14	0,16	0,17	0,18	0,19	0,20	0,22	0,27

- 1) The values specified do not apply to the uncropped ends of a mill-edge coil within 7 m inclusive of both ends.
- 2) Thickness is measured at any point on the strip not less than 20 mm from a side edge for mill-edge strip and not less than 10 mm from a side edge for edge-trimmed strip. Measurement shall not be made on top of the shear burr.

Table 3A – Thickness tolerances for coils¹⁾ and cut lengths for Grade HR355 (including descaled material)
Values in millimetres

Specified widths	Thickness tolerances ²⁾ , over and under, for specified thicknesses							
	< 1,5	> 1,5 < 2,0	> 2,0 < 4,0	> 4,0 < 5,0	> 5,0 < 6,0	> 6,0 < 8,0	> 8,0 < 10,0	> 10,0 < 12,0
> 10 < 100	0,13	0,15	0,17	0,18	0,19	0,20	0,21	—
> 100 < 600	0,15	0,18	0,19	0,20	0,21	0,22	0,24	0,30

- 1) The values specified do not apply to the uncropped ends of a mill-edge coil within 7 m inclusive of both ends.
- 2) Thickness is measured at any point on the strip not less than 20 mm from a side edge for mill-edge strip and not less than 10 mm from a side edge for edge-trimmed strip. Measurement shall not be made on top of the shear burr.

Table 4 – Width tolerances, over and under²⁾ for coils and cut lengths (including descaled material), mill edge
Values in millimetres

Specified widths	Tolerances ^{1) 2)}
Up to and including 50	0,8
Over 50 up to and including 100	1,2
Over 100 up to and including 200	1,6
Over 200 up to and including 400	2,0
Over 400 up to 600 exclusive	2,5

- 1) The values specified do not apply to the uncropped ends for a mill-edge coil within 7 m inclusive of both ends.
- 2) By agreement, material can be ordered to all plus tolerances, in which case the value in the table is doubled.

Table 5 – Width tolerances, over and under, for hot-rolled steel strip (including descaled strip) edge trimmed, not resquared coils and cut lengths
Values in millimetres

Specified widths	Tolerances ¹⁾	
	Up to and including 3	Over 3
Up to and including 100	0,3	0,4
Over 100 up to and including 200	0,5	0,6
Over 200 up to and including 400	0,7	0,8
Over 400 up to 600 exclusive	0,9	1,0

- 1) By agreement, material can be ordered to all plus tolerances, in which case the value in the table is doubled.

Table 6 – Length tolerances for hot-rolled steel strip (including descaled strip), not resquared
Values in millimetres

Specified lengths	Tolerance over, nothing under ¹⁾
	Specified widths up to 600 exclusive
Up to and including 1 500	25
Over 1 500 up to and including 3 000	30
Over 3 000 up to and including 6 000	40
Over 6 000 up to and including 9 000	65
Over 9 000 up to and including 12 000	85
Over 12 000	100

- 1) Closer tolerances are subject to agreement.

Table 7 — Camber tolerances for coils and cut lengths (including descaled material)

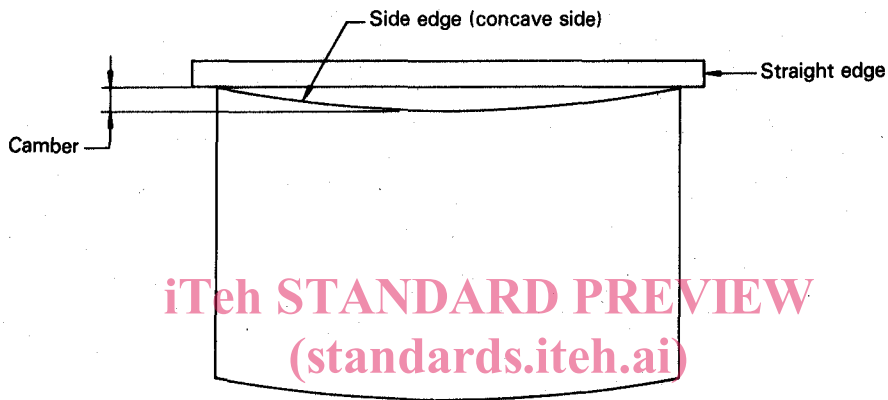
Values in millimetres

Form	Camber tolerances ^{1) 2)}
Coils and	20 for widths > 10 < 40 in any 2 000 length
Cut lengths	10 for widths > 40 < 600 in any 2 000 length

1) In those cases where it is not practical to measure the tolerance as given in the table, the following formula may be used :

$$\text{New tolerance} = \frac{(\text{non-standard } l)^2}{(\text{standard } l)^2} \times \text{tolerance in table 7}$$

2) The values do not apply to the uncropped ends of a mill-edge coil within 7 m inclusive of both ends.



ISO 6316:1982
Figure 2 — Measurement of camber
<https://standards.iteh.ai/catalog/standards/sist/512192ec-617a-4c82-965d-c7b77abb2b7a/iso-6316-1982>

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

Table 8 — Flatness tolerances of hot-rolled strip

It has not been practicable to formulate flatness tolerances for hot-rolled steel strip.