International Standard ISO 6317

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Hot-rolled carbon steel strip of commercial and drawing qualities

Feuillards en acier au carbone laminés à chaud de qualité commerciale et pour emboutissage

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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 6317 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in June 1981.

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

Austria	Iran	Spain
Belgium	Italy	Sweden
Bulgaria	Japan	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	

No member body expressed disapproval of the document.

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Hot-rolled carbon steel strip of commercial and drawing qualities

1 Scope and field of application

1.1 This International Standard applies to hot-rolled carbon steel strip of commercial and drawing qualities.

NOTE — Steel strip that is to be subjected to subsequent rerolling is not covered by this International Standard.

Hot-rolled steel strip is suitable for many applications where the presence of oxide or scale, or normal surface imperfections disclosed after removal of oxide or scale, are not objectionable. It is not suitable for applications where surface is of prime importance. This product is rolled on a narrow strip mill.

1.2 Commercial quality strip (HR1) is intended for general fabrication purposes where strip is used in the flat or for bending, moderate forming, and welding operations. It is commonly produced in the range of thicknesses 0,65 to 12 mm inclusive, and widths to 600 mm exclusive, in coils and cut lengths.

1.3 Drawing quality strip (HR2, HR3, HR4) is intended for drawing or severe forming, including welding. It is commonly produced in the range of thicknesses 0,65 to 12 mm inclusive, and widths to 600 mm exclusive, in coils and cut lengths. Drawing quality strip is furnished to all the requirements of this International Standard or, by agreement when ordered, to fabricate an identified part, in which case the mechanical properties in table 2 do not apply. Specific drawing qualities are identified as follows :

HR2 Drawing quality

HR3 Deep drawing quality

HR4 Deep drawing quality special killed.

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.*

3 Definitions and other information

3.1 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.

3.2 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 increase in hardness and some loss of ductility 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 drawing or forming lubricant and should be easily removable with degreasing chemicals.

3.3 skin pass : A light cold-rolling of hot-rolled steel strip or hot-rolled descaled steel strip.

The purposes of skin passing are one or more of the following :

a) to minimize temporarily the occurence of the condition known as stretcher strain (Lüder's lines) or fluting during fabrication of finished parts;

b) to minimize the appearance of coil breaks;

c) to control the shape.

Some increase in hardness and some loss of ductility will result from skin passing.

3.4 mill edge : A normal side edge without any definite contour produced 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 square as a 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 or 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.

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.

Table 1 — Chemical composition (cast analysis), %

Quality		C	Mn	P	S
Designation	Name	max.	max.	max.	max.
HR1	Commercial	0,15	0,60	0,05	0,05
HR2	Drawing	0,12	0,50	0,04	0,04
HR3	Deep drawing	0,10	0,45	0,03	0,03
HR4	Deep drawing special killed	0,08	0,45	0,03	0,03

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.

4.5 Application

It is desirable that hot-rolled steel strip be identified for fabrication by name of the part or by the intended application. Hot-rolled steel strip of drawing qualities (HR2, HR3, HR4) may be produced to make an identified part within a properly established breakage allowance which shall be previously agreed upon between the interested parties. In this case, part name, details of fabrication, and special requirements such as freedom from stretcher strains or from fluting shall be specified and the mechanical properties in table 2 do not apply.

4.6 Mechanical properties

Except when ordered to an identified part, as explained in 4.5, at the time that the steel is made available for shipment, the mechanical properties shall be as given in table 2 when they are determined on test pieces obtained in accordance with the requirements of clause 7.

Prolonged storage of the strip can cause a change in the mechanical properties (increase in hardness and a decrease in elongation), leading to a decrease in drawability. To minimize this effect, quality HR4 should be specified.

5 Dimensional tolerances

Dimensional tolerances applicable to hot-rolled strip 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 designation rolled to the same thickness and condition.

6.2 Bend test

One representative sample for the bend test (applicable only to HR1) shall be taken from each lot of strip for shipment. A lot consists of all strip 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 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.

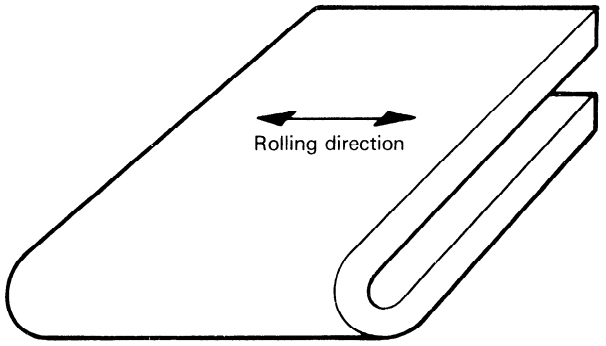

Figure 1 — Transverse bend test piece (after bending)

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.

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 quality.

10 Workmanship

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

Table 2 — Mechanical properties[1] (see 4.6)

Quality		R_m max.[2]	A min. %[3] [4]				180° bend mandrel diameter	
			$e < 3$		$3 < e < 6$			
Designation	Name	N/mm²	$L_o = 80$ mm	$L_o = 50$ mm	$L_o = 5{,}65\sqrt{S_o}$	$L_o = 50$ mm	$e < 3$	$3 < e < 6$
HR1	Commercial	—	—	—	—	—	1a	2a
HR2	Drawing	430	25	26	28	29	—	—
HR3	Deep drawing	370	28	29	32	33		
HR4	Deep drawing special killed	390	28	29	32	33	—	—

1) 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 steel strip in millimetres
a = thickness of bend test piece
1 N/mm² = 1 MPa

2) Minimum tensile strength for qualities HR2, HR3 and HR4 would normally be expected to be 270 N/mm². All tensile strength values are determined to the nearest 10 N/mm².

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) For material over 6 mm in thickness, values for bend and elongation are subject to agreement between the manufacturer and the purchaser.

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 such 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 supplier 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 diameter (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 quality designation;

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 the requirements of this International Standard, inquiries and orders shall include the following information :

a) the number of this International Standard;

b) the name and quality of the material (for example, hot-rolled steel strip, deep drawing quality HR3) (see 1.2 and 1.3);

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

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

e) for drawing qualities HR2, HR3 and HR4, whether ordered to mechanical properties or to fabricate an identified part (see 4.5 and 4.6);

f) whether pickling or descaling by grit or shot blasting is required (material so specified will be oiled unless ordered not oiled) (see 3.2);

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

h) whether skin passing is required (see 3.3);

i) the report of the cast analysis, if required (see 4.3.1);

k) limitations on masses and dimensions of individual coils and bundles, if applicable (see clause 12);

m) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see 11.1).

NOTE — Typical ordering descriptions as follows :

1 ISO 6317, hot-rolled steel strip, commercial quality HR1, 3 × 200 × 1 600 mm, 10 000 kg to be used for warehouse resale, edge trimmed, furnish report of cast analysis, maximum lift mass 1 000 kg.

2 ISO 6317, hot-rolled steel strip, deep drawing quality HR3, 2,5 × 300 mm × coil, 50 000 kg ordered to mechanical properties, pickled and oiled, mill edge, coils 600 mm minimum I.D., 1 500 mm maximum O.D., maximum coil mass 3 000 kg.

Table 3 — Thickness tolerances for hot-rolled steel strip (including descaled strip) coils[1] and cut lengths

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 4 — Width tolerances, over and under[2] for hot-rolled steel strip (including descaled strip), mill-edge coils and cut lengths

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]	
	Specified thicknesses	
	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 hot-rolled steel strip (including descaled strip) not resquared

Values in millimetres

Form	Camber tolerance[1) 2)]
Coils and Cut lengths	20 for widths ⩾ 10 < 40 in any 2 000 length
	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.

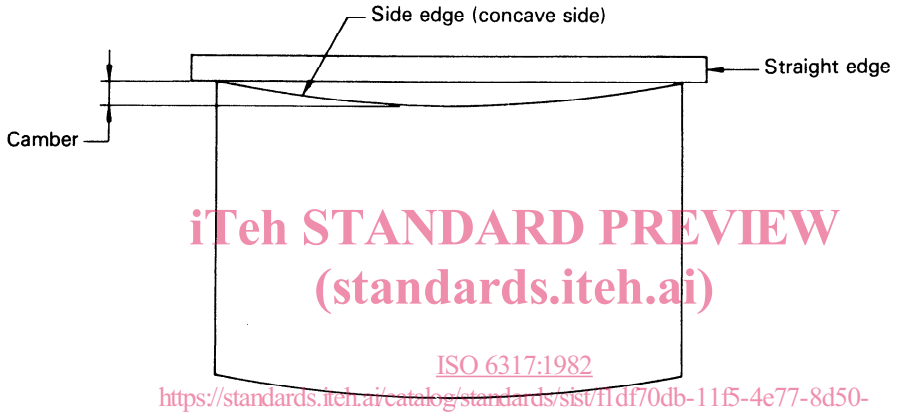

Figure 2 — Measurement of camber

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 steel strip

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