INTERNATIONAL STANDARD

**ISO 6317**

Third edition
2008-06-01

# Hot-rolled carbon steel strip of commercial and drawing qualities

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

Reference number
ISO 6317:2008(E)

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Published in Switzerland

# Foreword

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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 6317 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This third edition cancels and replaces the second edition (ISO 6317:2000), which has been technically revised.

# Hot-rolled carbon steel strip of commercial and drawing qualities

## 1 Scope

**1.1** This International Standard specifies requirements for 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 the surface is of prime importance. This product is commonly 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 condition, or for bending, moderate forming and welding operations. It is commonly produced in the range of thicknesses 0,65 mm to 12 mm inclusive, and widths up 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 mm to 12 mm inclusive, and widths up to 600 mm exclusive, in coils and cut lengths. Drawing quality strip is furnished according 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 aluminum killed

**1.4** 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 meet the requirements of this International Standard.

## 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*

## 3 Definitions

For the purposes of this document, the following terms and definitions apply.

**3.1**
**aluminum killed**
steel which has been deoxidized with aluminum sufficiently to prevent the evolution of gas during solidification

**3.2**
**hot-rolled steel strip**
product obtained usually 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 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 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 This product is normally supplied oiled.

**3.4**
**skin pass**
light cold rolling of the product

NOTE 1 The purpose of the skin pass is one or more of the following:

a) to minimize the appearance of coilbreaks, stretcher strains and fluting;

b) to control the shape;

c) to obtain the required surface finish.

NOTE 2 Some increase in hardness and some loss in ductility will result from skin passing.

**3.5**
**mill edge**
normal side edge without any definite contour produced in hot rolling.

NOTE 1 Mill edges may contain some irregularities, such as cracked or torn edges or thin (feathered) edges.

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

**3.6**
**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

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 (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 fraction in percent

| Quality | | C | Mn | P | S |
|---|---|---|---|---|---|
| Designation | Name | max. | max. | max. | max. |
| HR1 | Commercial | 0,12 | 0,60 | 0,030 | 0,030 |
| HR2 | Drawing | 0,10 | 0,45 | 0,030 | 0,030 |
| HR3 | Deep drawing | 0,08 | 0,40 | 0,020 | 0,030 |
| HR4 | Deep drawing aluminum killed | 0,08 | 0,35 | 0,020 | 0,025 |

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

Mass fraction in percent

| Elements | Heat analysis max. | Product analysis max. |
|---|---|---|
| Cu [a] | 0,20 | 0,23 |
| Ni [a] | 0,20 | 0,23 |
| Cr [a, b] | 0,15 | 0,19 |
| Mo [a, b] | 0,06 | 0,07 |
| Nb [c] | 0,008 | 0,018 |
| V [c] | 0,008 | 0,018 |
| Ti [c] | 0,008 | 0,018 |

[a] 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.

[b] 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.

[c] Analysis greater than 0,008 % may be supplied after agreement between the producer and consumer.

## 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 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.

### 4.3.2 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. For killed steels, the sampling method and deviation limits 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**

| Element | Maximum of specified element<br>% | Tolerance over maximum specified<br>% |
|---|---|---|
| Carbon | $\leqslant$ 0,12 | 0,03 |
| Manganese | $\leqslant$ 0,60 | 0,03 |
| Phosphorus | $\leqslant$ 0,03 | 0,01 |
| Sulfur | $\leqslant$ 0,03 | 0,01 |
| NOTE The maximum tolerance in this table is the allowable excess over the specified requirements, and not the heat analysis. | | |

### 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

Hot-rolled steel strip should be identified for fabrication by the name of the part or by the intended application. Hot-rolled steel strip (HR1, 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, the part name, details of fabrication, and special requirements shall be specified and the mechanical properties in Table 4 do not apply.

### 4.6 Mechanical properties

Except when ordered according 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 4 when they are determined on test pieces obtained in accordance with the requirements of Clause 6.

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 drawabillity. To minimize this effect, quality HR4 should be specified.

### 4.7 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.

### 4.8 Oiling

As a deterrent to rusting, a coating of oil is usually applied to the product. The oil is not intended as a drawing or forming lubricant and should be easily removable with degreasing chemicals. The product 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 strip shall be in accordance with Table 5 and Tables 7 to 10 inclusive.

Restricted thickness tolerances are given in Table 6.

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

## 6 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 designation, rolled to the same thickness and condition.

## 7 Test methods

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 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 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 may 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 (e.g. 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.

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 on a hot-rolled product 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 such 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 provide the purchaser's inspector with 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, identified and 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 diameters (ID) shall be specified. In addition, the maximum outside diameter (OD) and the maximum acceptable coil mass shall be specified.

**Table 4 — Mechanical properties**

| **Quality** | | $R_m$ max. [a] MPa | $A$ % min. [b] | | | |
|---|---|---|---|---|---|---|
| | | | $e < 3$ | | $3 \geqslant e \leqslant 6$ | |
| **Designation** [c] | **Name** | | $L_o = 80$ mm | $L_o = 50$ mm | $L_o = 5{,}65\sqrt{S_o}$ | $L_o = 50$ mm |
| HR1 [d] | Commercial | 440 | 23 | 24 | 28 | 29 |
| HR2 | Drawing | 420 | 25 | 26 | 30 | 31 |
| HR3 | Deep drawing | 400 | 28 | 29 | 33 | 34 |
| HR4 | Deep drawing aluminum killed | 380 | 31 | 32 | 36 | 37 |

$R_m$ = tensile strength

$A$ = percentage elongation after fracture

$L_o$ = gauge length of original test piece

$S_o$ = original cross-sectional area of gauge length

$e$ = thickness of steel strip, in millimetres

1 MPa = 1N/mm$^2$

[a] The minimum tensile strength for qualities HR1, HR2, HR3 and HR4 would normally be expected to be 270 N/mm$^2$. Where the minimum tensile strength is required, the value of 270 N/mm$^2$ may be specified. All tensile strength values are determined to the nearest 10 N/mm$^2$.

[b] For thicknesses up to 3 mm, use either $L_o = 50$ mm or $L_o = 80$ mm. For thicknesses of 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.

[c] Refer to 4.5 (application).

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

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

a) a reference to this International Standard, i.e. ISO 6317;

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 according 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 3.3);

g) the type of edge (see 3.5 and 3.6);

h) whether skin passing is required (see 3.4);

i) the report of the heat analysis, if required (see 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 Clause 11).

NOTE Typical ordering descriptions are as follows:

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

**Table 5 — Normal thickness tolerances for hot-rolled steel strip (including descaled strip) coils and cut lengths**

Values in millimetres

| Specified widths | Thickness tolerances, over and under, for specified thicknesses [a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $\leqslant 1{,}5$ | $1{,}5 < e \leqslant 2$ | $2 < e \leqslant 4$ | $4 < e \leqslant 5$ | $5 < e \leqslant 6$ | $6 < e \leqslant 8$ | $8 < e \leqslant 10$ | $10 < e \leqslant 12$ |
| $> 10 < 100$ | $\pm 0{,}12$ | $\pm 0{,}14$ | $\pm 0{,}15$ | $\pm 0{,}16$ | $\pm 0{,}17$ | $\pm 0{,}18$ | $\pm 0{,}19$ | — |
| $\geqslant 100 < 600$ | $\pm 0{,}14$ | $\pm 0{,}16$ | $\pm 0{,}17$ | $\pm 0{,}18$ | $\pm 0{,}19$ | $\pm 0{,}20$ | $\pm 0{,}22$ | $\pm 0{,}27$ |

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

[a] 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-sheared strip. Measurements shall not be made on top of the shear burr.

**Table 6 — Restrictive thickness tolerances for hot-rolled steel strip (including descaled strip) and cut lengths**

Values in millimetres

| Specified widths | Thickness tolerances, over and under, for specified thicknesses [a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $e \leqslant 1{,}5$ | $1{,}5 < e \leqslant 2$ | $2 < e \leqslant 4$ | $4 < e \leqslant 5$ | $5 < e \leqslant 6$ | $6 < e \leqslant$ | $8 < e \leqslant 10$ | $10 < e \leqslant 12$ |
| $> 10 < 100$ | $\pm 0{,}09$ | $\pm 0{,}10$ | $\pm 0{,}11$ | $\pm 0{,}12$ | $\pm 0{,}13$ | $\pm 0{,}14$ | $\pm 0{,}14$ | — |
| $\geqslant 100 < 600$ | $\pm 0{,}10$ | $\pm 0{,}12$ | $\pm 0{,}13$ | $\pm 0{,}14$ | $\pm 0{,}14$ | $\pm 0{,}15$ | $\pm 0{,}17$ | $\pm 0{,}20$ |

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

[a] 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. Measurements shall not be made on top of the shear burr.

**Table 7 — Width tolerances, over and under, for hot-rolled steel strip (including descaled strip), mill edge coils and cut lengths**

Values in millimetres

| Specified widths | Tolerances |
|---|---|
| $\leqslant 50$ | $\pm 0{,}8$ |
| $> 50 \leqslant 100$ | $\pm 1{,}2$ |
| $> 100 \leqslant 200$ | $\pm 1{,}6$ |
| $> 200 \leqslant 400$ | $\pm 2{,}0$ |
| $> 400 < 600$ | $\pm 2{,}5$ |

NOTE 1 The values specified do not apply to the uncropped ends for a mill-edge coil within 7 m inclusive of both ends.

NOTE 2 By agreement, material can be ordered to all plus tolerances, in which case the value in this table is doubled.

**Table 8 — Width tolerances, over and under, for hot-rolled steel strip (including descaled strip), edge trimmed coils and cut lengths**

Values in millimetres

| Specified widths | Tolerances [a] | |
|---|---|---|
| | Specified thicknesses | |
| | ⩽ 3 | > 3 |
| ⩽ 100 | ± 0,3 | ± 0,4 |
| > 100 ⩽ 200 | ± 0,5 | ± 0,6 |
| > 200 ⩽ 400 | ± 0,7 | ± 0,8 |
| > 400 < 600 | ± 0,9 | ± 1,0 |
| NOTE For resquared material more restrictive tolerances are subject to negotiation. | | |
| [a] By agreement, material can be ordered to all plus tolerances, in which case, the value in this table is doubled. | | |

**Table 9 — Length tolerances for hot-rolled steel strip (including descaled strip)**

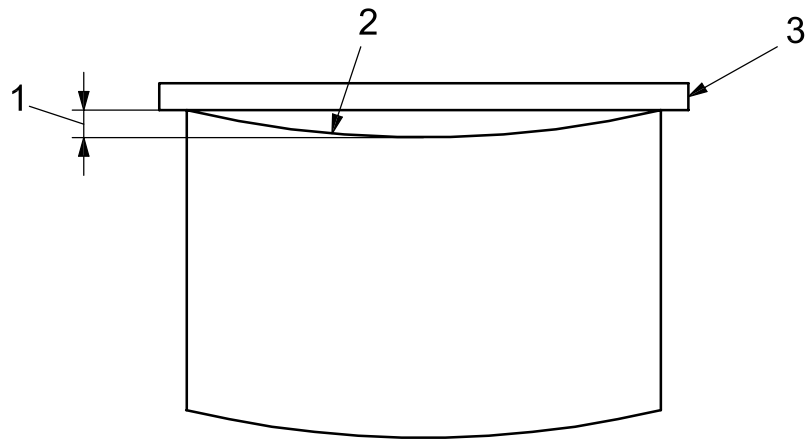
Values in millimetres

| Specified lengths | Tolerance over, nothing under |
|---|---|
| | Specified widths |
| | < 600 |
| ⩽ 1 500 | ± 25 |
| > 1 500 ⩽ 3 000 | ± 30 |
| > 3 000 ⩽ 6 000 | ± 40 |
| > 6 000 ⩽ 9 000 | ± 65 |
| > 9 000 ⩽ 12 000 | ± 85 |
| > 12 000 | ± 100 |
| NOTE For resquared material, more restrictive tolerances are subject to negotiation. | |

**Table 10 — Camber tolerances for hot-rolled steel strip (including descaled strip)**

Values in millimetres

| Form | Camber tolerance [a, b] |
|---|---|
| Coils and Cut lengths | 20 for widths $> 10 \leqslant 40$ in any 2 000 length |
| | 10 for widths $> 40 < 600$ in any 2 000 length |
| NOTE 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. | |
| [a] In those cases where it is not practical to measure the tolerance as given in this table, the following formula may be used: $\text{New tolerance} = \frac{(\text{Non-standard length})^2 \times \text{Tolerance in Table 10}}{(\text{Standard length})^2}$ [b] The values do not apply to the uncropped ends of a mill-edge coil within 7 m inclusive of both ends. | |




**Key**

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

**Figure 1 — Measurement of camber**

# Bibliography

[1] ASTM A 749/A 749M, *Standard Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot Rolled, General Requirements for*[1)]

1) This standard may be reviewed for comparison with this International Standard. The relationship between the standards may only be approximate; therefore, the respective standards should be consulted for actual requirements. Those who use these documents must determine which specifications address their needs.

**ICS 77.140.50**

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