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**Cold-reduced carbon steel strip with a  
maximum carbon content of 0,25 %**

*Feuillards en acier au carbone laminés à froid avec teneur maximale en  
carbone égale à 0,25 %*

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 6932 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This second edition cancels and replaces the first edition (ISO 6932:1986), which has been technically revised.

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# Cold-reduced carbon steel strip with a maximum carbon content of 0,25 %

## 1 Scope

1.1 This International Standard applies to cold-reduced carbon steel strip with a maximum carbon content of 0,25 %, furnished to two levels of closer tolerances than cold-reduced carbon steel sheet, with specific quality, specific hardness requirements or mechanical properties, specific edge and specific finish.

NOTE This International Standard does not apply to the product in narrow widths known as cold-reduced carbon steel sheet slit from wider widths (ISO 3574), nor does it include cold-reduced carbon steel strip with a carbon content over 0,25 % (ISO 4960).

1.2 Cold-reduced carbon steel strip is produced with a maximum of the specified carbon not exceeding:

- 0,15 % for material specified to mechanical properties;
- 0,25 % for material specified to temper (hardness) requirements.

1.3 This product is commonly produced in thicknesses of 6 mm and under, and in widths up to 600 mm, in coils and cut lengths.

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## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test Method*

ISO 6508-1:1999, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature*

ISO 7438:1985, *Metallic materials — Bend test*

### 3 Terms and definitions

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

#### 3.1

##### **cold-reduced carbon steel strip**

product manufactured from hot-rolled, descaled coils by cold reducing to the desired thickness on a single-stand mill or on a tandem mill consisting of several single stands in series

#### 3.2

##### **cold reduction**

process of reducing the thickness of the strip at room temperature whereby the amount of reduction is greater than that used for a **skin pass** (see 3.9)

#### 3.3

##### **aluminum killed**

steel which has been deoxidized with aluminum sufficient to prevent the evolution of gas during solidification

#### 3.4

##### **annealing**

process of heating to and holding at a suitable temperature and then cooling at a suitable rate, for such purposes as lowering hardness, facilitating cold working, producing a desired microstructure or obtaining desired mechanical, physical or other properties

##### 3.4.1

##### **box annealing**

annealing in a sealed container under conditions that minimize oxidation

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NOTE The strip is usually heated slowly to a temperature below the transformation range, but sometimes above or within it, and is then cooled slowly.

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##### 3.4.2

##### **continuous annealing**

annealing the strip in continuous strands through a furnace having a controlled atmosphere, followed by controlled cooling

#### 3.5

##### **normalizing**

heating to a suitable temperature above the transformation range and then cooling in air to a temperature substantially below the transformation range

NOTE In bright normalizing the furnace atmosphere is controlled to prevent oxidation of the strip surface.

#### 3.6

##### **temper**

designation by number or term to indicate the hardness as a minimum, as a maximum or as a range

NOTE The tempers are obtained by the selection and control of chemical composition, by amounts of cold reduction, by thermal treatment and by a skin pass.

#### 3.7

##### **dead soft**

condition describing annealed strip produced without definite control of stretcher-straining or fluting

NOTE It is suitable for drawing and other applications where such surface characteristics are not objectionable.

#### 3.8

##### **surface finish**

degree of smoothness or lustre of the strip

**3.9****skin pass**

light cold rolling of the product resulting in an increase in hardness and some loss in ductility

NOTE The purpose of skin passing is to minimize the appearance of coil breaks, stretcher strains and fluting, or to control shape, or to obtain the required surface finish.

**4 Conditions of manufacture****4.1 Physical properties**

Temper requirements according to Table 1 or mechanical properties according to Table 2 may be specified as included in this International Standard, but not both since there is no direct correlation.

**4.1.1** Cold-reduced carbon steel strip specified to mechanical properties is produced to the following commercial and drawing quality designations:

- CR21: commercial quality
- CR22: drawing quality
- CR23: deep drawing quality
- CR24: deep drawing quality aluminum killed

**4.1.2** Cold-reduced carbon steel strip specified to temper requirements is produced to the following temper designations:

- No. 1: (hard)
- No. 2: (half hard)
- No. 3: (quarter hard)
- No. 4: (skin-passed)
- No. 5: (dead soft)

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**4.2 Steelmaking**

The processes used in making the steel and in manufacturing cold-reduced carbon strip are left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steelmaking process being used.

Except for grade CR24, the deoxidation practice shall be at the discretion of the manufacturer unless otherwise agreed at the time of ordering.

Table 1 — Temper and hardness requirements for cold-reduced carbon steel strip

Temper	Thickness, <i>e</i> mm	Hardness			
		Rockwell B scale HRB	Rockwell R30T scale HR30T	Rockwell 15T scale HR15T	Vickers HV
No. 1 (hard)	$e \leq 0,36$	—	—	90 min.	185 min.
	$0,36 < e \leq 1,0$	—	76 min.	—	185 min.
	$e > 1,0$	84 min.	—	—	162 min.
No. 2 <sup>a</sup> (half-hard)	$e \leq 0,36$	—	—	83,5 to 88,5	125 to 165
	$0,36 < e \leq 1,0$	—	63,5 to 73,5	—	125 to 165
	$e > 1,0$	70 to 80	—	—	125 to 165
No. 3 <sup>a</sup> (quarter-hard)	$e \leq 0,36$	—	—	80 to 85	107 to 137
	$0,36 < e \leq 1,0$	—	56,5 to 66,5	—	107 to 137
	$e > 1,0$	60 to 75	—	—	107 to 137
No. 4 <sup>a,b</sup> (skin-passed)	$e \leq 0,36$	—	—	82 max.	116 max.
	$0,36 < e \leq 1,0$	—	60 max.	—	116 max.
	$e > 1,0$	65 max.	—	—	116 max.
No. 5 <sup>a,b</sup> (dead-soft)	$e \leq 0,36$	—	—	78,5 max.	100 max.
	$0,36 < e \leq 1,0$	—	53 max.	—	100 max.
	$e > 1,0$	55 max.	—	—	100 max.

<sup>a</sup> Rockwell and Vickers hardness values apply to aluminum-killed steels. For non-killed steel (rimmed or capped) or semi-killed steels, the values apply only at the time of shipment.

<sup>b</sup> Nos. 4 and 5 temper may be ordered with a carbon range of 0,15 % to 0,25 %. In each instance, the maximum hardness requirement is established by agreement.



Table 2 — Mechanical property requirements for cold-reduced carbon steel strip <sup>a</sup>

Quality designation	Condition of delivery <sup>b</sup>	$R_e$ max <sup>c</sup> N/mm <sup>2</sup>	$R_m$ <sup>d</sup> N/mm <sup>2</sup>	$A$ min %	
				$L_0 = 80$ mm <sup>e</sup>	$L_0 = 50$ mm
CR21	HK <sup>f</sup>	—	—	—	—
	TC	—	410 max.	28	32
	HK270	—	410 max.	28	32
	HK290	—	290 to 430	18	24
	HK390	—	390 to 540	—	—
	HK490	—	490 to 640	—	—
	HK590	—	590 to 740	—	—
	HK690	—	690 min.	—	—
CR22	TC	—	370 max.	32	35
	HK270	250	370 max.	32	35
	HK290	355	290 to 410	21	25
	HK390	—	390 to 510	5	13
	HK490	—	490 to 620	—	—
	HK590	—	590 min.	—	—
CR23	TC	—	350 max.	36	38
	HK270	225 <sup>g</sup>	350 max.	36	38
	HK290	325	290 to 390	23	27
	HK390	—	390 to 490	6	14
	HK490	—	490 to 600	—	—
	HK590	—	590 min.	—	—
CR24	TC	—	350 max.	36	38
	HK270	225 <sup>g</sup>	350 max.	36	38
	HK290	325	290 to 390	23	27
	HK390	—	390 to 490	6	14
	HK490	—	490 to 590	—	—
	HK590	—	590 to 690	—	—

<sup>a</sup> Longitudinal test pieces:

$R_e$  yield strength

$R_m$  tensile strength

$A$  percentage elongation after fracture

$L_0$  gauge length on test piece

$S_0$  original cross-sectional area of gauge length

1N/mm<sup>2</sup> = 1 MPa

<sup>b</sup> Conditions of delivery: HK, cold-reduced; TC, annealed; HK270, skin-passed; HK290 to HK690, cold-reduced various amounts.

<sup>c</sup> For thickness 0,7 mm and less the specified maximum yield strength values are increased by 20 N/mm<sup>2</sup>.

<sup>d</sup> Minimum tensile strength values for condition of delivery HK, TC and HK270 would normally be expected to be 270 N/mm<sup>2</sup>.

<sup>e</sup> Minimum elongation values are reduced by 2 % for thicknesses 0,5 mm to 0,7 mm inclusive and by 4 % for thicknesses less than 0,5 mm.

<sup>f</sup> There are no mechanical property requirements for this condition.

<sup>g</sup> For thicknesses 1,5 mm and greater the yield strength is 235 N/mm<sup>2</sup> maximum.

### 4.3 Chemical Composition

#### 4.3.1 General

The chemical composition (heat analysis) shall not exceed the values given in Tables 3 and 4.

#### 4.3.2 Heat analysis

A heat analysis of each heat of steel shall be made by the manufacturer to determine compliance with the requirements of Tables 3 and 4. When requested, at the time of ordering, this analysis shall be reported to the purchaser or his representative.

#### 4.3.3 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. Non-killed steels (such as rimmed or capped) are not technologically suited to product analysis. For killed steels, the sampling method and deviation limits shall be agreed upon between the interested parties at the time of ordering.

**Table 3 — Chemical composition (heat analysis)**

Values as percentages by mass

Temper or quality designation	Carbon (C) max.	Manganese (Mn) max.	Phosphorus (P) max.	Sulfur (S) max.
Temper Nos. 1,2,3	0,25	0,60	0,035	0,04
Temper Nos. 4,5	0,15	0,60	0,035	0,04
CR21	0,15	0,60	0,05	0,05
CR22	0,12	0,50	0,04	0,04
CR23	0,10	0,45	0,03	0,03
CR24	0,08	0,45	0,03	0,03

Table 4 — Limits on additional chemical elements <sup>a</sup>

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

<sup>a</sup> Each of the elements listed in this table shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less than 0,02 %, the analysis may be reported as "< 0,02 %".

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

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

<sup>d</sup> Heat analysis greater than 0,008 % may be supplied after agreement between producer and consumer.

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### 4.4 Weldability

This product is suitable for welding if appropriate welding conditions are selected. As carbon content increases above 0,15 %, spot welding becomes increasingly difficult.

### 4.5 Application

It is desirable that cold-reduced steel strip be identified for fabrication by the name of the part or by intended application, which shall be compatible with the temper or mechanical properties specified. Proper identification of the part may include visual examination, prints or description, or a combination of these.

### 4.6 Mechanical properties

#### 4.6.1 Hardness

When the temper designation is specified and at the time the steel is made available for shipment, the hardness shall be as stated in Table 1 when it is determined on test pieces obtained in accordance with the requirements of clause 6.

#### 4.6.2 Tensile properties

When the mechanical property designation is specified and at the time the steel is made available for shipment, the tensile properties shall be as stated in Table 2 when they are determined on test pieces obtained in accordance with the requirements of clause 6.

### 4.7 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.