International Standard 6932

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

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

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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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6932 was prepared by Technical Committee ISO/TC 17, *Steel.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

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

1 Scope and field of application

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.

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 exclusive, in coils and cut lengths.

1.4 Temper requirements according to table 2 or mechanical properties according to table 3 may be specified as included in this International Standard, but not both since there is no direct correlation.

1.4.1 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 special killed (non-ageing)

1.4.2 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)

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

2 References

ISO/R 1024, *Rockwell superficial hardness test (N and T scales) for steel.*

ISO 6507/1, *Metallic materials — Hardness test — Vickers test — Part 1 :* HV 5 *to* HV 100.

ISO 6508, *Metallic materials — Hardness test — Rockwell test — Scales* A, B, C, E, F, G, H.[1)]

ISO 6892, *Metallic materials — Tensile testing.*

ISO 7438, *Metallic materials — Bend test.*

3 Definitions

3.1 cold-reduced carbon steel strip : A 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. Sometimes an anneal is used at some intermediate thickness to facilitate further cold reduction or to obtain desired temper and mechanical properties in the finished strip.

3.2 cold reduction : The process of reducing the thickness of the strip at room temperature.

The amount of reduction is greater than that used for a skin pass (see 3.7).

3.3 annealing : The process of heating to and holding at a suitable temperature and then cooling at a suitable rate, for

1) At present at the stage of draft. (Revision of ISO/R 80-1968 and ISO 2713-1973.)

such purposes as lowering hardness, facilitating cold working, producing a desired microstructure, or obtaining desired mechanical, physical, or other properties.

3.3.1 box annealing : Annealing in a sealed container under conditions that minimize oxidation.

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

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

3.4 normalizing : Heating to a suitable temperature above the transformation range and then cooling in air to a temperature substantially below the transformation range.

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

3.5 temper : A designation by number or term to indicate the hardness as a minimum, as a maximum, or as a range.

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.

3.6 dead soft : Annealed strip produced without definite control of stretcher-straining or fluting. It is suitable for drawing and other applications where such surface characteristics are not objectionable.

3.7 skin pass : A light cold rolling of annealed steel strip.

3.8 surface finish : The degree of smoothness or lustre of the strip.

4 Other information

4.1 Skin pass

The purpose of skin passing is one or more of the following :

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

b) to obtain the required surface finish;

c) to affect hardness or other mechanical properties or to improve flatness (shape).

4.2 Oiling

As a deterrent to rusting, a coating of oil is usually applied to cold-reduced carbon 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.

5 Conditions of manufacture

5.1 Steelmaking

5.1.1 General

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.

5.1.2 Deoxidation

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

5.2 Chemical composition

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

NOTE — In all carbon steels small quantities of residual elements may be unavoidably retained from raw materials used in the manufacture of the steel, e.g. copper, nickel, molybdenum and chromium. Such elements are considered as incidental and are not required to be determined.

Table 1 — Chemical composition (cast 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

5.3 Chemical analysis

5.3.1 Cast analysis

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

5.3.2 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 between the manufacturer and purchaser at the time of ordering.

5.4 Weldability

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

5.5 Application

It is desirable that cold-reduced carbon steel strip be identified for fabrication by the name of the part or by the 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.

5.6 Mechanical properties

5.6.1 Hardness

When the temper designation is specified, the hardness shall be as stated in table 2 at the time the steel is made available for shipment.

5.6.2 Tensile properties

When the mechanical property designation is specified, the tensile properties shall be as stated in table 3 at the time the steel is made available for shipment.

Table 2 — Temper and hardness requirements for cold-reduced carbon steel strip

Temper	Thickness, *e* (mm)	Hardness			
		Hardness Rockwell B scale	Hardness Rockwell 30 T scale	Hardness Rockwell 15 T scale	Hardness Vickers
		HRB	HR 30 T	HR 15 T	HV
No. 1 (hard)	*e* < 0,36	—	—	90 min.	185 min.
	0,36 < *e* < 1,0	—	76 min.	—	185 min.
	e > 1,0	84 min.	—	—	162 min.
No. 2[1] (half-hard)	*e* < 0,36	—	—	83,5 to 88,5	125 to 165
	0,36 < *e* < 1,0	—	63,5 to 73,5	—	125 to 165
	e > 1,0	70 to 80	—	—	125 to 165
No. 3[1] (quarter-hard)	*e* < 0,36	—	—	80 to 85	107 to 137
	0,36 < *e* < 1,0	—	56,5 to 66,5	—	107 to 137
	e > 1,0	60 to 75	—	—	107 to 137
No. 4[1)2)] (skin-passed)	*e* < 0,36	—	—	82 max.	116 max.
	0,36 < *e* < 1,0	—	60 max.	—	116 max.
	e > 1,0	65 max.	—	—	116 max.
No. 5[1)2)] (dead-soft)	*e* < 0,36	—	—	78,5 max.	100 max.
	0,36 < *e* < 1,0	—	53 max.	—	100 max.
	e > 1,0	55 max.	—	—	100 max.

1) Rockwell and Vickers hardness values apply to special killed (non-ageing) steels. For non-killed steel (rimmed or capped) or semi-killed steels the values apply only at the time of shipment.

2) 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.

5.7 Edges

The desired edge number shall be specified as in 5.7.1 to 5.7.6.

5.7.1 No. 1 edge

A prepared edge of a specified contour (round or square), which is produced when a very accurate width is required or when an edge condition suitable for electroplating is required, or both.

5.7.2 No. 2 edge

A natural mill edge carried through the cold rolling from the hot-rolled carbon steel strip without additional processing of the edge.

5.7.3 No. 3 edge

An approximately square edge, produced by slitting, on which the burr is not eliminated. Normal coiling or piling does not necessarily provide a definite positioning of the slitting burr.

Table 3 — Mechanical property requirements for cold-reduced carbon steel strip[1)]

Quality designation	Condition of delivery[2)]	R_e max.[3)]	R_m[4)]	A min. (%)	
		N/mm²	N/mm²	L_o = 80 mm[5)]	$L_o = 5{,}65\sqrt{S_o}$ (3 mm and over)
CR21	HK[6)]	—	—	—	—
	TC	—	410 max.	28	32
	HK 270	—	410 max.	28	32
	HK 290	—	290 to 430	18	24
	HK 390	—	390 to 540	—	—
	HK 490	—	490 to 640	—	—
	HK 590	—	590 to 740	—	—
	HK 690	—	690 min.	—	—
CR22	TC	—	370 max.	32	35
	HK 270	250	370 max.	32	35
	HK 290	355	290 to 410	21	25
	HK 390	—	390 to 510	5	13
	HK 490	—	490 to 620	—	—
	HK 590	—	590 min.	—	—
CR23	TC	—	350 max.	36	38
	HK 270	225[7)]	350 max.	36	38
	HK 290	325	290 to 390	23	27
	HK 390	—	390 to 490	6	14
	HK 490	—	490 to 600	—	—
	HK 590	—	590 min.	—	—
CR24	TC	—	350 max.	36	38
	HK 270	225[7)]	350 max.	36	38
	HK 290	325	290 to 390	23	27
	HK 390	—	390 to 490	6	14
	HK 490	—	490 to 590	—	—
	HK 590	—	590 to 690	—	—

1) Longitudinal test pieces.
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
1 N/mm² = 1 MPa.

2) Conditions of delivery : HK, cold-reduced; TC, annealed; HK270, skin-passed; HK290 to HK690, cold-reduced various amounts.

3) For thicknesses 0,7 mm and less the specified maximum yield strength values are increased by 20 N/mm².

4) Minimum tensile strength values for condition of delivery HK, TC and HK270 would normally be expected to be 270 N/mm².

5) Minimum elongation values are reduced by 2 % for thicknesses 0,5 to 0,7 mm inclusive and by 4 % for thicknesses less than 0,5 mm.

6) There are no mechanical property requirements for this condition.

7) For thicknesses 1,5 mm and greater the yield strength is 235 N/mm² maximum.

5.7.4 No. 4 edge

A rounded edge produced by edge rolling either the natural edge of hot-rolled carbon steel strip or slit-edge material. This edge is produced when the width tolerances and edge condition are not as exacting as for No. 1 edge.

5.7.5 No. 5 edge

An approximately square edge produced from slit-edge material on which the burr is eliminated, usually by rolling or filing.

5.7.6 No. 6 edge

A square edge produced by edge rolling the natural edge of hot-rolled carbon steel strip or slit-edge material. This edge is produced when the width tolerance and edge condition are not as exacting as for the No. 1 edge.

5.8 Surface finish

The finish is specified normally as one of 5.8.1 to 5.8.4.

5.8.1 No. 1 or matt (dull) finish

A finish without lustre, produced by rolling on rolls toughened by mechanical, electrical or chemical means. This finish is especially suitable for lacquer or paint adhesion, and is beneficial in aiding drawing operations by reducing the contact friction between the die and the strip.

5.8.2 No. 2 or regular bright finish

A finish produced by rolling on rolls having a moderately smooth finish. It is suitable for many requirements, but not generally applicable to bright plating.

5.8.3 No. 3 or best bright finish

A finish generally of high lustre, produced by selective rolling practices, including the use of specially prepared rolls. This is a high quality finish and is particularly suited for bright plating. The production of this finish requires extreme care in processing and extensive inspection.

5.8.4 No. 4 or mirror finish

A finish of special high lustre, produced on specially polished rolls mainly for highly decorative plating purposes. The production of this finish requires extreme care in processing and extensive inspection.

6 Dimensional tolerances

Dimensional tolerances applicable to cold-reduced carbon steel strip shall be as given in tables 5 to 10 inclusive. When required, special tolerances shall be as agreed between the manufacturer and the purchaser.

The tolerance on flatness for cut to length cold-reduced carbon steel strip shall be a maximum of 10 mm in any 1 000 mm of length. Any further requirements for flatness shall be agreed between the manufacturer and purchaser at the time or ordering. The tolerance on flatness is taken to be the greatest difference between the cut length resting on a plane horizontal base and a measuring rule laid in the direction of the longitudinal axis.

7 Sampling

7.1 Hardness or tensile test

One representative sample for the hardness or tensile test required in table 2 or table 3 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 temper or mechanical properties.

7.2 Bend test

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 designation rolled to the same thickness and temper or mechanical properties.

8 Mechanical property tests

8.1 Hardness test

The hardness test shall be carried out in accordance with ISO/R 1024, ISO 6507/1 or ISO 6508 as applicable.

8.2 Tensile test

The tensile test shall be carried out in accordance with ISO 6892.

8.3 Bend test

The bend test piece shall withstand being bent as shown in table 4, without cracking on the outside of the bent portion. The bend test shall be carried out at ambient temperature and in accordance with ISO 7438.

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

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 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 shall be deemed to have failed.

10 Resubmission

10.1 The manufacturer may resubmit for acceptance the products that have failed 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.

Tests shall be carried out as if they apply to a new batch.

10.2 The manufacturer has the right to present the failed products to a new examination for compliance with the requirements for another temper, edge or finish.

11 Workmanship

The surface condition shall be that normally obtained in a cold-reduced product as specified in 5.8.

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 opportunity to observe readily or to remove defective portions as can be carried out on the cut length product.

12 Inspection and acceptance

12.1 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.

12.2 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.

13 Coil size

When cold-reduced carbon 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.

14 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 and temper or mechanical property designation;

d) the order number;

e) the product dimensions;

f) the lot number;

g) the mass.

15 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, quality and temper or mechanical property designation (see 1.2 to 1.4 and table 4);

c) the type of edge (see 5.7);

d) the type of finish (see 5.8);

e) the dimensions of the product and quantity required;

f) the application (name of part), if possible (see 5.5);

g) the report of the cast analysis, if required (see 5.3.1);

h) limitations on mass and dimensions of individual coils or bundles, if applicable (see clause 13);

i) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see 12.1);

j) steelmaking process (see 5.1.1);

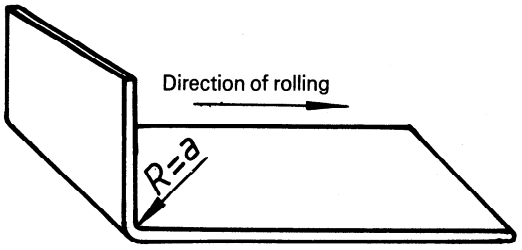
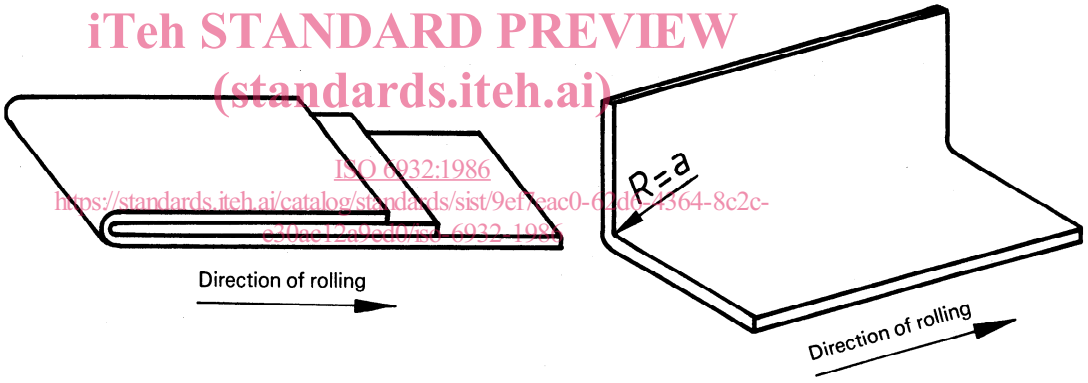
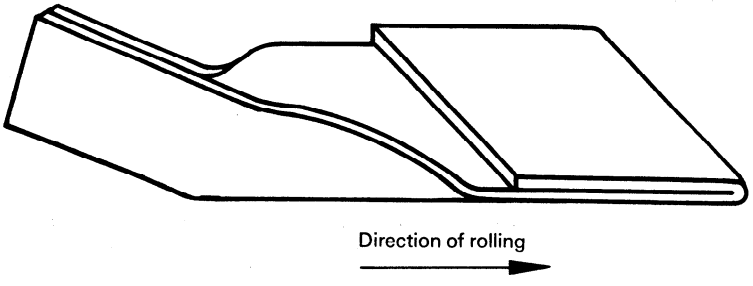
k) N or F tolerances (see table 5).

NOTE — Typical ordering descriptions are as follows :

EXAMPLE 1 : ISO 6932, cold-reduced carbon steel strip, CR21, TC, No. 3 edge, No. 1 finish, 1,30 mm × 66,5 mm × 2 500 mm, 10 000 kg, to be used for cruise control field plate, oiled, maximum bundle mass 250 kg, maximum lift mass 1 000 kg.

EXAMPLE 2 : ISO 6932, cold-reduced carbon steel strip, aluminium killed, No. 4 temper, No. 3 edge, No. 1 finish, 1,90 mm × 92 mm coil, 6 000 kg, to be used for hinge strap. Coils 400 mm minimum I.D., 1 500 mm maximum O.D., maximum lift mass 1 200 kg.

Table 4 — Bend test requirements, for cold-reduced carbon steel strip

Temper or condition of delivery	Bend test requirements
No. 1 (hard) HK HK490 HK590 HK690	No requirement
No.2 (half-hard) HK390	90° longitudinal bend around a radius of a[1)] 
No. 3 (quarter-hard) HK290	180° longitudinal bend over one thickness and a 90° transverse bend around a radius of a[1)] 
No. 4 (skin-passed) No. 5 (dead-soft) HK270 TC	180° flat bend in either longitudinal or transverse direction 

1) a is the thickness of the bend test piece.