INTERNATIONAL STANDARD

ISO 14590

Third edition
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Cold-reduced steel sheet of high tensile strength and low yield point with improved formability

Tôles en acier laminées à froid à haute résistance à la traction et faible limite d'élasticité, et aptitude au formage accrue

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This third edition cancels and replaces the second edition (ISO 14590:2005), which has been technically revised.

Cold-reduced steel sheet of high tensile strength and low yield point with improved formability

1 Scope

This International Standard applies to cold-reduced steel sheet of two types that are commercially available in the world. Type 1 represents steels that are produced to mechanical properties only and Type 2 represents steels that are produced to both chemical and mechanical properties. Bake hardening steels are included in both types.

This International Standard does not cover steels designated as commercial quality or drawing qualities (covered in ISO 3574), steels of structural quality (covered in ISO 4997) or steels of higher strength with improved formability (covered in ISO 13887).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

ISO 16162, *Cold-rolled steel sheet products — Dimensional and shape tolerances*

3 Terms and definitions

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

3.1
bake hardenable steel
highly formable steel that, subsequent to cold working, has been subjected to a low-temperature heat treatment, such as that used for paint baking (170 °C to 200 °C), in order to effect a significant increase in its yield strength, primarily due to carbon ageing

3.2
cold-reduced steel sheet
product obtained from hot-rolled descaled steel sheet by cold-reducing to the required sheet thickness followed by annealing to recrystallize the grain structure

3.3
dual-phase steel
steel whose thermal processing has resulted in a multi-phase structure that includes one or more low-temperature transformation products, thus providing for improved formability at higher strength levels

3.4
skin pass
light cold-rolling of the product

Note 1 to entry: The purpose of the skin passing is one or more of the following: to minimize the appearance of coil breaks, stretcher strains and fluting; to control the shape; and to obtain the required surface finish.

Note 2 to entry: Some increase in hardness and some decrease of ductility will result from skin passing.

3.5
ageing
change in steel properties with the passage of time

Note 1 to entry: Ageing may result in a change in yield strength and a corresponding decrease in ductility during storage. Ageing always has a negative effect on formability. The redevelopment of a definite yield point phenomenon as a result of ageing can result in a renewed susceptibility to surface imperfections, such as stretcher strain marks (Lüder's Lines) and fluting when the steel is formed. To avoid these adverse outcomes, it is essential that the period between final processing at the producing mill and fabrication be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Effective roller levelling immediately prior to fabrication can achieve reasonable freedom from stretcher strain marks.

3.6
lot
up to a specified quantity of steel sheet of the same designation rolled to the same thickness and grade

3.7
Type 1
cold-reduced steel sheet (3.2) specified to mechanical properties only

3.8
Type 2
cold-reduced steel sheet (3.2) specified to both mechanical properties and chemical composition

3.9
preliminary strain load
F_{WH}
load (kgf or N) of work hardening reached when the preliminary strain elongation specified in the tensile test is reached

Note 1 to entry: Preliminary strain elongation herein shall be 2 %.

Note 2 to entry: to entry: Refer to Figure A.2.

3.10
strain ageing yield load
F_{SA}
load (kgf or N) at yielding measured during the tensile testing of the specimen after it has been strained and heat-treated at 170 °C for 20 min

Note 1 to entry: Refer to Figure A.1.

3.11
BH amount
O_{BH}
value (kgf/mm^2 or N/mm^2) obtained by dividing the value (kgf or N) derived by subtracting the preliminary strain load, F_{WH}, from the strain ageing yield load, F_{SA}, of the test piece parallel portion original area (mm^2) before the preliminary strain

4 Dimensions

Cold-reduced steel sheet of high tensile strength and low yield point with improved formability is produced in thicknesses from 0,25 mm to 3,2 mm and in widths of 600 mm and over in coils and cut lengths. Product less than 600 mm wide, slit from wide sheet, will be considered as sheet.

5 Conditions of manufacture

5.1 Steelmaking

Unless otherwise agreed upon by the interested parties, the processes used in making the steel and in manufacturing cold-reduced steel sheet are left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steelmaking process being used.

5.2 Chemical composition

The chemical composition (heat analysis) shall conform to the requirements given in Tables 1 and 2.

Table 1 — Chemical composition for Type 2 (heat analysis)

Mass fractions in percent

Grade[a]	C max.	Si max.	Mn max.	P max.	S max.
SS220	0,10	0,50	1,00	0,100	0,030
SS260	0,10	0,50	1,50	0,120	0,030
SS300	0,15	0,50	1,50	0,140	0,030
DP250	0,10	0,70	2,00	0,030	0,030
DP280	0,12	0,70	2,50	0,030	0,030
DP300	0,14	1,40	2,00	0,080	0,030
DP350	0,14	1,40	2,50	0,100	0,030
DP400	0,18	1,40	2,50	0,030	0,030
DP600	0,20	1,40	3,00	0,030	0,030
BH180	0,04	0,50	0,70	0,060	0,030
BH220	0,08	0,50	0,70	0,080	0,030
BH260	0,08	0,50	0,70	0,100	0,030
BH300	0,10	0,50	0,70	0,120	0,030

NOTE Micro-alloying elements can be added.

[a] SS = structural steel;
DP = dual phase;
BH = bake hardening.

Table 2 — Limits on additional chemical elements for Type 2

Mass fractions in percent

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

NOTE 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 %.

[a] 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 apply.

[b] 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 apply.

[c] Heat analysis greater than 0,008 % may be supplied after agreement between the producer and purchaser.

5.3 Chemical analysis

5.3.1 Heat analysis

An analysis of each heat of steel shall be made by the manufacturer to determine compliance with the requirements of Tables 1 and 2. On request, a report of the heat analysis shall be made available to the purchaser or the purchaser's representative. Each of the elements listed in Tables 1 and 2 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 %".

5.3.2 Product analysis

A product analysis may be made by the purchaser in order to verify the specified analysis of the product and shall take into consideration any normal heterogeneity. The product analysis tolerances shall be in accordance with Tables 2 and 3.

Table 3 — Product analysis tolerances

Mass fractions in percent

Element	Range/maximum of specified element	Tolerance
C	≤0,15 >0,15 to ≤0,40	0,03 0,04
Si	>0,30 to ≤0,60 >0,60	0,05 0,06
Mn	>0,60 to ≤1,15 >1,15 to ≤1,70 >1,70	0,04 0,05 Subject to negotiation
P	≤0,04 >0,04	0,01 Not applicable
S	≤0,06	0,01

NOTE 1 This table applies to Type 2 Grades SS, DP and BH.

NOTE 2 The above maximum tolerance is the allowable excess over the specified requirement and not the heat analysis. For example, for Grade DP350, the following product analysis values are within these tolerances: C 0,17; Mn 1,04; P not applicable; S 0,04 and Si 0,55.

5.4 Mechanical properties

Type 1 and Type 2 steels shall satisfy the mechanical properties shown, respectively, in Tables 4 and 5 when they are determined in accordance with the requirements of Clauses 6 and 7. On request, a report of the mechanical properties shall be made to the purchaser.

NOTE Prolonged storage of the sheet can result in ageing, leading to an adverse effect on formability.

Table 4 — Mechanical properties for Type 1

Grade[a]	R_{eL}[b] N/mm², min.	O_{BH}[c] N/mm², min.	R_m[d] N/mm², min.	A min, %[e]	
				L_o = 50 mm	L_o = 80 mm
175YL	175	—	340	31	29
205YL	205	—	370	29	27
235YL	235	—	390	27	25
265YL	265	—	440	23	21
295YL	295	—	490	21	19
325YL	325	—	540	18	17
355YL	355	—	590	15	14
225YY	225	—	490	22	20
245YY	245	—	540	19	18
265YY	265	—	590	16	15
365YY	365	—	780	12	11
490YY	490	—	980	5	4
185YH	185	30	340	31	29

NOTE 1 MPa = 1 N/mm².

[a] YL = forming/drawing use;
YY = dual phase;
YH = bake hardening.

[b] R_{eL} = lower yield strength.

[c] O_{BH} = see 3.11.

[d] R_m = tensile strength.

[e] A = percentage elongation after fracture.