
High yield strength steel plates and wide flats for cold forming — Delivery conditions

*Produits plats en acier à haute limite d'élasticité pour formage à
froid — Conditions de livraison*

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Published in Switzerland

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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.

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 voluntary nature of standards, 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.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 3, *Steels for structural purposes*.

This second edition cancels and replaces ISO 6930-1:2001 and ISO 6930-2:2004, which have been technically revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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High yield strength steel plates and wide flats for cold forming — Delivery conditions

1 Scope

This document specifies the requirements for weldable high yield strength plates and wide flats for cold forming.

It does not apply to weldable structural steels, whether or not of special quality, which are covered by other International Standards, namely:

- structural steels: ISO 630 (all parts);
- high yield strength flat steel products: ISO 4950-1, ISO 4950-2 and ISO 4950-3;
- hot-rolled steel sheet of higher yield strength with improved formability: ISO 5951;
- sheet and strip: refer to ISO/TC 17, *Steel*, SC 12, *Continuous mill flat rolled products*;
- tubular products; refer to ISO/TC 5, *Ferrous metal pipes and metallic fittings*, SC 1, *Steel tubes*.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

ISO 404, *Steel and steel products — General technical delivery requirements*

ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels*

ISO 4885, *Ferrous materials — Heat treatments — Vocabulary*

ISO 4948-1, *Steels — Classification — Part 1: Classification of steels into unalloyed and alloy steels based on chemical composition*

ISO 4948-2, *Steels — Classification — Part 2: Classification of unalloyed and alloy steels according to main quality classes and main property or application characteristics*

ISO/TS 4949, *Steel names based on letter symbols*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 6929, *Steel products — Vocabulary*

ISO 7438, *Metallic materials — Bend test*

ISO 7452, *Hot-rolled steel plates — Tolerances on dimensions and shape*

ISO 7788, *Steel — Surface finish of hot-rolled plates and wide flats — Delivery requirements*

ISO 9034, *Hot-rolled structural steel wide flats — Tolerances on dimensions and shape*

ISO/TR 9769, *Steel and iron — Review of available methods of analysis*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*

ISO 17577, *Steel — Ultrasonic testing of steel flat products of thickness equal to or greater than 6 mm*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6929 and ISO 4885 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 wide flat

flat product of width over 150 mm up to and including 1 250 mm and thickness generally over 4 mm, supplied in lengths, i.e. not coiled, and the edges are square, i.e. hot-rolled on all four sides (or in box passes)

4 Dimensions and tolerances

4.1 General

This document applies to plates and wide-flats, hot-rolled on reversing mills, of a thickness ≤ 20 mm for grades specified in [Annexes A](#) and [B](#) and of a thickness between 4 mm and 50 mm (inclusive) for grades specified in [Annex C](#).

4.2 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

- a) the quantity required;
- b) the type of product;
- c) the nominal dimensions and tolerances on dimensions and shape of the product;
- d) the number of this document, i.e. ISO 6930;
- e) the steel name (grade);
- f) all required options;
- g) inspection document to be issued.

5 Classification and designation

5.1 Classification

The steel grades specified in this document shall be classified as non-alloy or alloy quality steels in accordance with ISO 4948-1, ISO 4948-2 and ISO/TS 4949 depending on the steel-grade chemical composition and heat treatment condition.

5.2 Designation

Designation shall be carried out in accordance with ISO/TS 4949.

This document specifies twenty (20) steel grades.

Grades S260NC, S315NC, S355NC, and S420NC are specified in [Annex A](#).

Grades S315MC, S355MC, S420MC, S460MC, S500MC, S550MC, S600MC, S650MC, S700MC, S900MC and S960MC are specified in [Annex B](#).

Grades S345, S415, S485, S550 and S690 are specified in [Annex C](#).

5.3 Using [Annexes A, B and C](#)

The requirements of [Annexes A, B and C](#) shall be regarded separately. Each is independent of the other without combining in any way.

6 Technical requirements

6.1 Steelmaking process

Unless otherwise specified at the time of the order, the steelmaking process is left to the discretion of the manufacturer. On request, the purchaser shall be informed of the steelmaking process to be used.

6.2 Method of deoxidation

The steels shall be fully killed and have a fine grain practice containing sufficient amounts of nitrogen binding elements.

6.3 Production process

Unless otherwise specified at the time of the order, the production process is left to the discretion of the manufacturer.

6.4 Delivery condition

Products of grades S260NC, S315NC, S355NC and S420NC are supplied in the normalized or normalized rolled delivery condition.

Products of grades S315MC, S355MC, S420MC, S460MC, S500MC, S550MC, S600MC, S650MC, S700MC, S900MC and S960MC are supplied in the thermomechanically rolled delivery condition.

Plates and wide flats shown in [Annex C](#) are supplied in the as-rolled, normalized, or thermomechanically rolled delivery condition.

6.5 Chemical composition

6.5.1 Heat analysis

The chemical composition in % mass fraction determined by heat analysis shall conform to the values specified in [Tables A.1, B.1](#) or [C.1](#)

6.5.2 Product analysis tolerances

If requested by the purchaser at the time of the order, a product analysis shall be carried out.

The permissible deviations for the product analysis in relation to the heat analysis of grades S260NC, S315NC, S355NC and S420NC shall conform to the values given in [Table A.2](#).

The permissible deviations for the product analysis in relation to the heat analysis of grades S315MC, S355MC, and S420MC, S460MC, 500MC, S550MC, S600MC, S650MC, S700MC, S900MC and S960MC shall conform to the values given in [Table B.2](#).

The product analysis of grades S345, S415, S485, S550 and S690 shall conform to the values given in [Table C.2](#).

6.6 Dimensions tolerances and surface condition

Product dimensions tolerances and surface condition shall be in accordance with ISO 7452, ISO 7788 and ISO 9034.

6.7 Internal soundness

By agreement, ultrasonic requirements together with the conditions of their verification shall be specified at the time of the order in accordance with ISO 17577.

7 Mechanical properties

7.1 Tensile properties

The tensile properties at room temperature shall conform to the values specified in [Tables A.3](#), [B.3](#) or [C.3](#).

7.2 Impact properties

If agreed upon at the time of order, the impact energy value shall be verified for products with nominal thickness ≥ 6 mm at -20 °C and shall meet a minimum average value of 40 J, or at -40 °C and shall meet a minimum average value of 27 J based on full size (10 mm $\times$ 10 mm) test piece (see [8.4.2](#)). If the thickness is not sufficient for the preparation of full-size impact test pieces, test pieces of smaller thickness shall be taken and the applicable values shall be decreased proportionally.

This subclause is only applicable to [Annexes A](#) and [B](#).

7.3 Technical properties

7.3.1 Weldability

The steels are weldable by all the appropriate processes when following the rules of technology.

A maximum value of the carbon equivalent value (CEV) based on the heat analysis can be agreed upon at the time of enquiry and order. The CEV shall be determined using [Formula \(1\)](#):

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \quad (1)$$

7.3.2 Bending and cold-edging ability

The products of steel grades according to [Annexes A](#) and [B](#) are suitable for cold forming.

Mandatory bending radii at 180° values are in [Tables A.3](#) and [B.3](#).

As an option, other bending radii according to [Table B.4](#) can be agreed at the time of the order.

8 Inspection and testing

8.1 General

The product covered by this document shall be the subject of specific inspection and testing in accordance with ISO 404.

8.2 Test unit

8.2.1 Product analysis

The verification of product analysis shall be per heat.

8.2.2 Mechanical properties

A test unit shall contain products of the same form, grade and delivery condition.

For [Annexes A](#) and [B](#), by heat, 40 t or part thereof.

For [Annex C](#), by heat, 50 t or part thereof.

8.3 Position and orientation of sample

The sample product can be any product within the test unit.

- For plates and wide flats, the samples shall be taken approximately midway between the edge and centre line of the products.

The following samples shall be taken from one sample product of each test unit:

- for grades according to [Annex A](#), one sample for tensile testing in the longitudinal direction in the case of product widths <600 mm and in the transverse direction in the case of product widths ≥600 mm. One sample for bend testing in the transverse direction;
- for grades according to [Annex B](#), one sample for tensile testing in the longitudinal direction and in the transverse direction for the bend test;
- for grades according to [Annexes A](#) and [B](#), one sample sufficient for one set of six impact test pieces (if an impact test is agreed at the time of the order).

8.4 Preparation

Preparation of samples shall be carried out in accordance with ISO 377 for mechanical testing and ISO 14284 for chemical analysis.

8.4.1 Tensile test pieces

The requirements of ISO 6892-1 shall apply.

Test pieces may be non-proportional but in cases of dispute proportional test pieces having a gauge length $L_0 = 5,65\sqrt{S_0}$ shall be used.

8.4.2 Impact test pieces

V-notch test pieces shall be machined and prepared in accordance with ISO 148-1. In addition, the following shall apply:

- a) for nominal thickness >12 mm, the standard 10 mm × 10 mm test pieces shall be machined in such a way that one side is not further away than 2 mm from a rolled surface;

- b) for nominal thickness ≤ 12 mm, when test pieces with reduced thicknesses are used, the minimum thickness shall be ≥ 6 mm (see 7.2).

8.5 Testing

8.5.1 Tensile Test

The tensile test shall be carried out in accordance with ISO 6892-1. The manufacturer may choose between Method A or B.

For specified yield strength in Tables A.3 or B.3, the upper yield strength (R_{eH}) shall be determined.

If a yield phenomenon is not present, the 0,2 % proof strength ($R_{p0,2}$) shall be determined.

If a non-proportional test piece is used for products with a thickness ≥ 3 mm, the percentage elongation value obtained shall be converted to the value for a gauge length $L_0 = 5,65\sqrt{S_0}$ using the conversion tables given in ISO 2566-1.

8.5.2 Impact test

If specified at the time of order, the impact test shall be carried out in accordance with ISO 148-1 using the 2 mm striker.

The average value of the three test results shall meet the specified requirement. One individual value may be below the minimum average value specified, provided that it is not less than 70 % of that value.

Three additional test pieces shall be taken from the same sample in accordance with 8.3 and tested in any one of the following cases:

- if the average of three impact values is lower than the minimum average value specified;
- if the average value meets the specified requirement, but two individual values are lower than the minimum average value specified;
- if any one value is lower than 70 % of the minimum average value specified.

The average value of the six tests shall not be less than the minimum average value specified. Not more than two of the individual values may be lower than the minimum average value specified and not more than one may be lower than 70 % of this value.

8.5.3 Bend test

The bend test shall be carried out in accordance with ISO 7438. Both rolled surfaces shall remain on the test piece.

8.5.4 Product analysis

In case of dispute about analytical methods, the chemical composition shall be determined in accordance with a reference method of International Standards listed in ISO/TR 9769. If no standard exists, the method to be used shall be agreed upon by the parties concerned.

8.6 Retests

If, during inspection, a test does not give the required result, additional retests in accordance with ISO 404 shall be carried out.

9 Inspection documents

The type of inspection documents with respect to specific inspection and testing shall be chosen from those defined in ISO 10474 and specified in the order.

10 Sorting and reprocessing

The requirements of ISO 404 shall apply.

11 Marking

The products shall be marked durably and readably in an accessible and visible place with the information given in [Table 1](#). The method of marking and the material of marking shall, unless otherwise agreed, be at the manufacturer's discretion. It is permissible to supply products in securely tied bundles. In this case, the marking shall be on a label or tag attached to the bundle.

Table 1 — Marking of the products

Marking of	Symbol ^a	Marking of	Symbol ^a
Manufacturer's name, trademarks or logo	+	Direction of rolling ^b	(+)
The number of this document	(+)	Nominal thickness	(+)
Steel name (grade)	+	Nominal dimensions other than thickness	(+)
Type of finish	(+)	Inspector's mark	+ ^c
Identification number ^d	+ ^e	Purchaser's order No.	(+)
^a +: the marking shall be applied; (+): the marking shall be applied if so agreed, or at the manufacturer's discretion. ^b The direction of rolling is normally obvious from the shape of the product and the position of the marking. Marking may be longitudinally applied by roller stamping or it may be placed near to one end of the piece and transverse to the rolling direction. A specific separate indication of the principal rolling direction will not normally be required, but may be requested by the purchaser. ^c The inspector's mark may be omitted if the relevant inspector can be identified in another way. ^d The numbers or letters used for identification shall allow the product(s) to be related to the relevant inspection certificate or inspection report. ^e This shall permit the traceability of the heat number.			

Annex A

(normative)

Chemical composition and mechanical properties of normalized and normalized rolled steels for steel grades S260NC, S315NC, S355NC and S420NC

Table A.1 — Chemical composition (heat analysis)

Grades	C % max.	Mn % max.	Si % max.	P % max.	S % max. ^a	Al _{total} % min. ^b	Nb % max. ^c	V % max. ^c	Ti % max. ^c
S260NC	0,16	1,20	0,50	0,025	0,020	0,015	0,09	0,10	0,15
S315NC	0,16	1,40	0,50	0,025	0,020	0,015	0,09	0,10	0,15
S355NC	0,18	1,60	0,50	0,025	0,015	0,015	0,09	0,10	0,15
S420NC	0,20	1,60	0,50	0,025	0,015	0,015	0,09	0,10	0,15

^a If agreed upon at the time of order, the sulfur content shall be decreased to a maximum value of 0,010 %.

^b If agreed upon at the time of order, the minimum content of total aluminium does not apply when other grain-refining elements are present in sufficient quantity.

^c The sum of niobium, vanadium, titanium contents shall be a maximum of 0,22 %.

Table A.2 — Permissible deviations for the product analysis in relation to the specified heat analysis

Element	Specified limits %	Permissible deviation %
C	≤0,20	+0,02
Mn	≤1,65	+0,10
Si	≤0,55	+0,05
P	≤0,025	+0,005
S	≤0,020	+0,002
Al _{total}	≥0,015	-0,005
Nb	≤0,09	+0,01
V	≤0,10	+0,02
Ti	≤0,15	+0,01

Table A.3 — Mechanical properties

Grade	Thickness mm	Minimum yield strength R_{eH} MPa ^{a,d}	Tensile strength R_m MPa ^{a,d}	Minimum percentage elongation at fracture A % ^a , Nominal thickness in mm ≥ 4 $L_0 = 5,65 \sqrt{S_0}$	Bending at 180° minimum mandrel diameter ^{b,c}
S260 NC	≤ 20	260	370 to 490	30	0 t
S315 NC		315	430 to 550	27	0,5 t
S355 NC		355	470 to 610	25	0,5 t
S420 NC		420	530 to 670	23	0,5 t

^a The values for the tensile test apply to longitudinal test pieces for product widths <600 mm and to transverse test pieces for product widths ≥ 600 mm.

^b The values for the bend test apply to transverse test pieces.

^c t = thickness in mm of test piece for bend test.

^d 1 MPa = 1 N/mm².

Annex B (normative)

Chemical composition and mechanical properties of thermomechanically rolled steels for steel grades S315MC, S355MC, S420MC, S460MC, S500MC, S550MC, S600MC, S650MC, S700MC, S900MC and S960MC

Table B.1 — Chemical composition (heat analysis)

Grades	C % max.	Mn % max.	Si % max.	P % max.	S % max.	Al _{total} ^c % min.	Nb % max.	V % max.	Ti % max.	Mo % max.	B % max.
S315MC	0,12	1,30	0,50	0,025	0,020 ^a	0,015	0,09 ^b	0,20 ^b	0,15 ^b	–	–
S355MC	0,12	1,50	0,50	0,025	0,020 ^a	0,015	0,09 ^b	0,20 ^b	0,15 ^b	–	–
S420MC	0,12	1,60	0,50	0,025	0,015 ^a	0,015	0,09 ^b	0,20 ^b	0,15 ^b	–	–
S460MC	0,12	1,60	0,50	0,025	0,015 ^a	0,015	0,09 ^b	0,20 ^b	0,15 ^b	–	–
S500MC	0,12	1,70	0,50	0,025	0,015 ^a	0,015	0,09 ^b	0,20 ^b	0,15 ^b	–	–
S550MC	0,12	1,80	0,50	0,025	0,015 ^a	0,015	0,09 ^b	0,20 ^b	0,15 ^b	–	–
S600MC	0,12	1,90	0,50	0,025	0,015 ^a	0,015	0,09 ^b	0,20 ^b	0,22 ^b	0,50	0,005
S650MC	0,12	2,00	0,60	0,025	0,015 ^a	0,015	0,09 ^b	0,20 ^b	0,22 ^b	0,50	0,005
S700MC	0,12	2,10	0,60	0,025	0,015 ^a	0,015	0,09 ^b	0,20 ^b	0,22 ^b	0,50	0,005
S900MC	0,20	2,20	0,60	0,025	0,010	0,015	0,09	0,20	0,25	1,00	0,005
S960MC	0,20	2,20	0,60	0,025	0,010	0,015	0,09	0,20	0,25	1,00	0,005

^a If agreed at the time of the order, the sulfur content shall be a maximum value of 0,010 %.

^b The sum of niobium, vanadium, and titanium contents shall be a maximum of 0,22 %.

^c If agreed upon at the time of order, the minimum content of total aluminium does not apply when other grain-refining elements are present in sufficient quantity.

Table B.2 — Permissible deviations for the product analysis in relation to the specified heat analysis

Element	Specified limits %	Permissible deviation %
C	≤0,20	+0,02
Mn	≤2,20	+0,10
Si	≤0,60	+0,05
P	≤0,025	+0,005
S	≤0,020	+0,002
Al _{total}	≥0,015	–0,005
Nb	≤0,09	+0,01
V	≤0,20	+0,02
Ti	≤0,25	+0,01
Mo	≤1,00	+0,05
B	≤0,005	+0,001

Table B.3 — Mechanical properties

Grade	Thickness, mm	Minimum yield strength R_{eH} MPa ^{a,e}	Tensile strength R_m MPa ^{a,e}	Minimum percentage elongation at fracture A % ^a Nominal thickness in mm ≥ 4 $L_0 = 5,65 \sqrt{S_0}$	Bending at 180° minimum mandrel diameter ^{b,c}
S315MC	≤ 20	315	390 to 510	24	0 t
S355MC	≤ 20	355	430 to 550	23	0,5 t
S420MC	≤ 20	420	480 to 620	19	0,5 t
S460MC	≤ 20	460	520 to 670	17	1 t
S500MC	≤ 16	500	550 to 700	14	1 t
S550MC	≤ 16	550	600 to 760	14	1,5 t
S600MC	≤ 16	600	650 to 820	13	1,5 t
S650MC	≤ 16	650 ^d	700 to 880	12	2 t
S700MC	≤ 16	700 ^d	750 to 950	12	2 t
S900MC	≤ 10	900	930 to 1 200	8	8 t
S960MC	≤ 10	960	980 to 1 250	7	9 t

^a The values for the tensile test apply to longitudinal test pieces.

^b The values for the bend test apply to transverse test pieces.

^c t = thickness in mm of test piece for bend test.

^d For thicknesses >8 mm the minimum yield strength can be 20 MPa^e lower.

^e 1 MPa = 1 N/mm².

Table B.4 — Minimum inside bend radii for cold forming

Grade	Minimum inside bend radii for bend angle 90° mm	
	$4 < t \leq 6$	$t > 6$
S315MC	0,5 t	1,0 t
S355MC	0,5 t	1,0 t
S420MC	1,0 t	1,5 t
S460MC	1,0 t	1,5 t
S500MC	1,5 t	2,0 t
S550MC	1,5 t	2,0 t
S600MC	1,5 t	2,0 t
S650MC	2,0 t	2,5 t
S700MC	2,0 t	2,5 t
S900MC	4,0 t	4,5 t
S960MC	4,5 t	5,0 t