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Structural steels —

Part 4: Technical delivery conditions for high yield strength quenched and tempered structural steel plates and wide flats

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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, *Steels*, Subcommittee SC 3, *Steels for construction purposes*.

This second edition cancels and replaces the first edition (ISO 630-4:2012), which has been technically revised. The main changes compared to the previous edition are as follows:

— modification of the title to integrate wide flats;

— integration of wide flats in the text;

— applicable thickness ranges have been added in the scope;

— extension of applicable thicknesses for S890Q and S960Q;

— addition of quality F for grade S960Q;

— additional terms and definitions concerning heat treatments have been deleted because ISO 4885 is in normative references of ISO 630-1;

— list of options has been updated as part has been integrated in ISO 630-1;

— the formula for CEV has been deleted because given in ISO 630-1;

— test units have been updated;

— in Tables, the designation concerning thickness have been changed into “nominal thickness”;

— order of listing chemical elements has been updated for grades of Annex A in accordance with ISO 6306;

— the content of the document has been updated to harmonize with all parts of ISO 630.

A list of all parts in the ISO 630 series can be found on the ISO website.

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.

Structural steels —

Part 4: Technical delivery conditions for high yield strength quenched and tempered structural steel plates and wide flats

1 Scope

This document specifies qualities for high-yield-strength quenched and tempered structural steels. It applies to steel plates and wide flats rolled on a reversing mill which are used in the quenched and tempered condition and normally intended for welded or bolted structures.

This document covers 10 grades and 5 qualities. Grades S460Q, S500Q, S550Q, S620Q, S690Q, S890Q and S960Q are covered in Annex A. Grades SG460Q, SG500Q, and SG700Q are covered in Annex B. Not all grades are available in all qualities, and some qualities have Charpy V-notch requirements.

The steels specified in this document are applicable to hot-rolled flat products with a minimum nominal thickness of 3 mm and a maximum nominal thickness of 200 mm for grades S460Q, S500Q, S550Q, S620Q and S690Q, a maximum nominal thickness of 125 mm for grades S890Q and S960Q, a maximum nominal thickness of 100 mm for grades SG460Q and SG500Q and a maximum nominal thickness of 150 mm for grade SG700Q.

This document does not include the following structural steels, some of which are covered by other International Standards:

— Sheet and strip — refer to ISO TC 17/SC 12, Continuous mill flat rolled products;

— Tubular products — refer to ISO TC 5/SC 1, Steel tubes.

NOTE 1 Lists of standards covered by ISO/TC 17/SC 12 and ISO/TC 5/SC 1 are available on the ISO website.

NOTE 2 In all parts of ISO 630, the term of "thickness" is considered as "nominal thickness", unless otherwise stated.

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 630-1, *Structural steels — Part 1: General technical delivery conditions for hot-rolled products*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 630-1 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
fine-grain steel
steel with fine-grain structure with an equivalent index of grain size ≥ 6 determined in accordance with ISO 643

Note 1 to entry: See 6.1.

4 Classification and designation

4.1 Classification

The steel grades specified in this document shall be classified as unalloyed or alloy steels.

4.2 Designation (grades and qualities)

This document specifies 10 steel grades. Grades S460Q, S500Q, S550Q, S620Q, S690Q, S890Q and S960Q are covered in Annex A. Grades SG460Q, SG500Q, and SG700Q are covered in Annex B.

Each grade is available in up to 5 qualities. These grades and qualities differ in their specified mechanical properties and impact energy requirements:

— Quality A: no impact test;

— Quality C: impact testing at 0 °C;

— Quality D: impact testing at −20 °C;

— Quality E: impact testing at −40 °C;

— Quality F: impact testing at −60 °C.

4.3 Normative annexes

The requirements of Annex A or Annex B are to be regarded separately. Each annex is independent of the other without combining in any way.

5 Information to be supplied by the purchaser

5.1 Mandatory information

The information that shall be supplied by the purchaser at the time of the order is specified in ISO 630-1.

5.2 Options

The options of ISO 630-1 may apply. In addition, the following options may apply to products according to this document. If the purchaser does not indicate a wish to implement any of these options at the time of the order, the products shall be supplied in accordance with the basic specification (see 5.1).

1) Testing of tensile and impact properties at a frequency per each plate and wide flat as heat-treated.

2) On special request of the purchaser, the manufacturer shall inform the purchaser at the time of the order which of the alloying elements appropriate to the steel grade required will be deliberately added to the material to be delivered and reported in the heat analysis.

3) On special request of the purchaser, the manufacturer shall inform the purchaser at the time of the order which of the alloying elements appropriate to the steel grade required will be deliberately added to the material to be delivered and reported in the product analysis. The product analysis shall be carried out at an agreed frequency when specified at the time of the order.

6 Requirements

6.1 Steelmaking process

See ISO 630-1.

If a special steelmaking process has been specified, this shall be reported in the inspection document.

The steels shall contain sufficient amount of nitrogen-binding elements and have a fine-grain structure.

The steels specified in this specification shall be fully killed.

6.2 Delivery condition

The products covered by this document are delivered in the quenched and tempered condition. The delivery condition is indicated in the inspection document.

6.3 Chemical composition

6.3.1 Heat analysis

The chemical composition determined by heat analysis shall conform with the values specified in Table A.1 or Table B.1.

6.3.2 Product analysis

The product analysis of grades S460Q, S500Q, S550Q, S620Q, S690Q, S890Q and S960Q shall comply with the values given in Table A.2.

The permitted deviations on analysis of grades SG460Q, SG500Q, and SG700Q, relative to the values for heat analysis, are given in Table B.2.

6.3.3 Carbon equivalent value

The maximum carbon equivalent value (CEV) requirements for Annex A grades are given in Table A.3 and for Annex B grades in Table B.3.

6.4 Mechanical properties

6.4.1 Tensile properties

The tensile properties at room temperature shall comply with the values specified in Table A.4 or Table B.4.

6.4.2 Charpy V-notch impact properties

The impact properties of Charpy V-notch test pieces shall comply with the values specified in Table A.5 or Table B.5. The orientation of the specimens shall be longitudinal, unless a transverse orientation is agreed between the purchaser and manufacturer (see 5.2, ISO 630-1 and the values in Table A.6).

6.5 Surface condition

See ISO 630-1.

6.6 Internal soundness

See ISO 630-1.

6.7 Dimensions, tolerances on dimensions and shape, mass

See ISO 630-1.

7 Inspection

Specific inspection shall be required for all grades. Refer to ISO 630-1.

8 Sampling – Frequency of testing

8.1 Verification

The verification of mechanical properties shall be by heat.

8.2 Test units

8.2.1 Annex A

The test unit shall contain products of the same form, grade, quality, delivery condition and thickness range as specified in Table A.4 for the yield strength and shall be by heat and:

— 60 tonnes or part thereof.

8.2.2 Annex B

The test unit shall be taken on each plate and wide flat as heat treated.

9 Test methods

See ISO 630-1.

10 Marking

See ISO 630-1.

Annex A
(normative)

Steel grades S460Q, S500Q, S550Q, S620Q, S690Q, S890Q and S960Q: Chemical composition and mechanical properties

Table A.1 — Chemical composition % by mass (heat analysis) [a]

Designation		C	Si	Mn	P	S	Cr	Ni	Mo	N	B	Cu	Nb	Ti	V	Zr
Grade	Quality	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.[b]	% max.[b]	% max.[b]	% max.[b]
All grades	D	0,20	0,80	1,70	0,025	0,015	1,50	4,0	0,70	0,015	0,005 0	0,50	0,06	0,05	0,12	0,15
	E, F				0,020	0,010										

[a] Depending on the thickness of the product and the manufacturing conditions, the manufacturer may add to the steel one or several alloying elements up to the maximum values given in order to obtain the specified properties (see 6.3.1).

[b] There shall be at least 0,015 % of a grain-refining element present. Aluminium is also one of these elements. The minimum content of 0,015 % applies to soluble aluminium, this value is regarded as attained if the total aluminium content is at least 0,018 %; in case of dispute, the soluble aluminium content shall be determined.

Table A.2 — Chemical composition % by mass (product analysis) [a] based on Table A.1

Designation		C	Si	Mn	P	S	Cr	Ni	Mo	N	B	Cu	Nb	Ti	V	Zr
Grade	Quality	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.	% max.[b]	% max.[b]	% max.[b]	% max.[b]
All grades	D	0,22	0,86	1,80	0,030	0,017	1,60	4,1	0,74	0,016	0,006 0	0,55	0,07	0,07	0,14	0,17
	E, F				0,025	0,012										

[a] Depending on the thickness of the product and the manufacturing conditions, the manufacturer may add to the steel one or several alloying elements up to the maximum values given in order to obtain the specified properties (see 6.3.2).

[b] There shall be at least 0,010 % of a grain-refining element present. Aluminium is also one of these elements. The minimum content of 0,010 % applies to soluble aluminium, this value is regarded as attained if the total aluminium content is at least 0,013 %; in case of dispute, the soluble aluminium content shall be determined.

Table A.3 — Maximum CEV based on the heat analysis

Designation		Maximum CEV in % for nominal product thickness, mm			
Grade	Quality	≤ 50	>50 ≤ 100	>100 ≤ 125	>125 ≤ 200
S460Q	D, E, F	0,47	0,48	0,50	0,50
S500Q	D, E, F	0,47	0,70	0,70	0,70
S550Q	D, E, F	0,65	0,77	0,83	0,83
S620Q	D, E, F	0,65	0,77	0,83	0,83
S690Q	D, E, F	0,65	0,77	0,83	0,83
S890Q	D, E, F	0,72	0,82	0,83	—
S960Q	D, E, F	0,82	0,85	0,85	—

Table A.4 — Tensile properties at room temperature

Designation		Nominal thickness mm								
		≥ 3 ≤ 50	>50 ≤ 100	>100 ≤ 125	>125 ≤ 200	≥ 3 ≤ 50	>50 ≤ 100	>100 ≤ 125	>125 ≤ 200	≥3 ≤ 200
		Minimum yield strength, R_{eH} [a, c]				**Tensile strength, R_m** [a]				**Minimum elongation after fracture $L_0 = 5{,}65\sqrt{S_0}$**
Grade	**Quality**	MPa [b]				MPa [b]				%
S460Q	D, E, F	460	440	400		550 to 720		500 to 670		17
S500Q	D, E, F	500	480	440		590 to 770		540 to 720		17
S550Q	D, E, F	550	530	490		640 to 820		590 to 770		16
S620Q	D, E, F	620	580	560		700 to 890		650 to 830		15
S690Q	D, E, F	690	650	630		770 to 940	760 to 930	710 to 900		14
S890Q	D, E, F	890	830	830	—	940 to 1 100	880 to 1 100	880 to 1 100	—	11
S960Q	D, E, F	960	850	850	—	980 to 1 150	900 to 1 100	900 to 1 100	—	10

[a] For plates and wide flats with widths ≥600 mm, the direction transverse to the rolling direction applies.

[b] 1 MPa = 1 N/mm^2.

[c] If R_{eH} is not pronounced, refer to ISO 630-1.

Table A.5 — Longitudinal charpy V-notch properties [a]

Designation		Minimum impact energy, J at test temperature [b], °C			
Grade	**Quality**	0	−20	−40	−60
S460Q S500Q S550Q S620Q S690Q S890Q S960Q	D	40	30	—	—
S460Q S500Q S550Q S620Q S690Q S890Q S960Q	E	50	40	30	—
S460Q S500Q S550Q S620Q S690Q S890Q S960Q	F	60	50	40	30

[a] For nominal thicknesses ≤12 mm, see ISO 630-1

[b] Unless otherwise specified, the testing temperature for each quality is the lowest available with a specified energy value.

Table A.6 — Transverse Charpy V-notch properties [a, c]

Designation		Minimum energy, J at test temperature [b],°C			
Grade	**Quality**	0	−20	−40	−60
S460Q S500Q S550Q S620Q S690Q S890Q S960Q	D	30	27	—	—
S460Q S500Q S550Q S620Q S690Q S890Q S960Q	E	35	30	27	—
S460Q S500Q S550Q S620Q S690Q S890Q S960Q	F	40	35	30	27

[a] For nominal thicknesses ≤ 12 mm, see ISO 630-1.

[b] Unless otherwise specified, the testing temperature for each quality is the lowest available with a specified energy value.

[c] See 5.2.