INTERNATIONAL STANDARD

ISO 630-6

First edition
2014-09-15

Structural steels —

Part 6: Technical delivery conditions for seismic-improved structural steels for building

Aciers de construction —

Partie 6: Conditions techniques de livraison pour aciers de construction améliorés sismiques pour bâtiment

Reference number
ISO 630-6:2014(E)

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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).

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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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 17, *Steels*, Subcommittee SC 3, *Steels for structural purposes*.

This first edition of ISO 630-6 cancels and replaces ISO 24314:2006, of which it constitutes a technical revision.

ISO 630 consists of the following parts, under the general title *Structural steels*:

— *Part 1: General technical delivery conditions for hot rolled products*

— *Part 2: Technical delivery conditions for non alloy structural steels for general purpose*

— *Part 3: Technical delivery conditions for fine grain structural steels*

— *Part 4: Technical delivery conditions for high yield strength quenched and tempered structural steels*

— *Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance*

— *Part 6: Technical delivery conditions for seismic-proof improved structural steels for building*

Structural steels —

Part 6: Technical delivery conditions for seismic-improved structural steels for building

1 Scope

This part of ISO 630 specifies qualities for seismic-proof improved structural steels. This part of ISO 630 applies to steel plates with thicknesses of 6 mm or over and up to 125 mm, wide flats and hot-rolled sections up to 140 mm, which are used in the usual delivery conditions as given in 6.2 and normally intended for welded or bolted structures.

This part of ISO 630 does not include the following structural steels, certain 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.

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

ISO 7452:2013, *Hot-rolled steel plates — Tolerances on dimensions and shape*

ISO 7778, *Through-thickness characteristics for steel products*

ISO 9034:1987, *Hot-rolled structural steel wide flats — Tolerances on dimensions and shape*

3 Terms and definitions

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

3.1
as-rolled
steel without any special rolling and/or heat treatment condition

3.2
normalized
steel produced by heating to a suitable temperature above the transformation range and then cooling in air to a temperature substantially below the transformation range

3.3
quenching
operation which consists of cooling a ferrous product more rapidly than in still air from a high temperature above Ac_1

Note 1 to entry: Ac_1 is the temperature at which austenite begins to form during heating.

3.4
tempering
heat treatment applied to a ferrous product, generally after quench hardening, or another heat treatment to bring the properties to the required level, and consisting of heating to specific temperatures (< Ac1) and soaking for an appropriate duration followed by cooling at an appropriate rate

Note 1 to entry: Additionally, the following may apply: processes of direct quenching plus tempering.

3.5
thermomechanical processed
steel rolled with a process in which the final deformation is carried out in a certain temperature range leading to a material condition with certain properties which cannot be achieved or repeated by heat treatment alone

Note 1 to entry: Hot forming or post weld heat treatment above 580 °C may lower the strength values and should not be performed. Flame straightening may be applied in accordance with relevant technical recommendations.

Note 2 to entry: Thermomechanical rolling can include processes with an increasing cooling rate with or without tempering including self-tempering but excluding direct quenching and quenching and tempering.

Note 3 to entry: In some publications the term “Thermomechanical Control Process” is also used.

4 Classification and designation

4.1 Classification

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

4.2 Grades and Qualities

This document specifies four (4) steel grades— Grades SA235, SA325, SA345, and SA440. Each grade is available in up to three (3) qualities.

— Quality A: no impact testing

— Quality C: impact testing at 0 °C

— Quality C+: impact testing at 0 °C and through-thickness characteristics testing

5 Information to be supplied by 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 apply. In addition, the following options apply to products according to this part of ISO 630. 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).

a) Testing of impact properties in the transverse direction using Charpy V-notch test pieces in accordance with ISO 630-1.

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

c) 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.

d) 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.

e) Through thickness characteristics “Class 25” in accordance with ISO 7778 (see 6.4.3).

6 Requirements

6.1 Steel-making process

See ISO 630-1.

6.2 Delivery condition

The products are generally delivered in the as-rolled condition, with the exception of grade SA440 which is normally produced using quenched and tempered or a thermomechanical rolling operation. For all other grades, unless otherwise agreed, the as rolled condition, normalized rolled, normalized or quenched and tempered condition are allowed at the manufacturer’s discretion. The thermomechanical rolling is not allowed at the manufacturer’s discretion. When agreed upon between the purchaser and the manufacturer, thermomechanical rolling may be applied to any grade.

6.3 Chemical composition

6.3.1 Heat analysis

The chemical composition determined by heat analysis shall comply with the specified value in Table 1.

6.3.2 Product analysis

The permissible deviations of product analysis shall comply with the values given in Table 2.

Table 1 — Chemical composition (heat analysis)

Grade	**Thickness** *t* mm	**C** % max.	**Si** % max	**Mn** %	**P** % max.	**S** % max.	**Cu** % max.	**Ni** % max.	**Cr** % max.	**Mo** % max.	**Nb + V + Ti** % max.
SA235	6 ≤ t < 50	0,20	0,35	0,50 to 1,50	0,030	0,045	0,60	0,45	0,35	0,15	0,15
	50 ≤ t ≤140	0,22									
SA325	6 ≤ t < 50	0,18	0,55	0,50 to 1,65	0,030	0,045	0,60	0,45	0,35	0,15	0,15
	50 ≤ t ≤140	0,20									
SA345	6 ≤ t < 50	0,23	0,55	0,50 to 1,65	0,030	0,045	0,60	0,45	0,35	0,15	0,15
	50 ≤ t ≤140										
SA440	6 ≤ t < 50	0,18	0,55	0,50 to 1,65	0,030	0,045	0,60	0,45	0,35	0,15	0,15
	50 ≤ t ≤ 140	0,20									
If agreed between the purchaser and the manufacturer, the limitations of alloying elements other than those given may be applied. If agreed between the purchaser and the manufacturer, the lower limit of a maximum sulfur content may be applied.											

Table 2 — Permitted deviation for the product analysis relative to the specified heat analysis (see 5.2)

Element	Specified limits %	Permitted deviation %
C	≤0,23	+0,03
Si	≤0,55	+0,05
Mn	≥0,50; ≤1,65	+0,10, −0,10
P	≤0,030	+0,005
S	≤0,045	+0,005
Cu	≤0,60	+0,07
Ni	≤0,45	+0,05
Cr	≤0,35	+0,05
Mo	≤0,15	+0,03
Nb + V + Ti	≤0,15	+0,02

6.3.3 Carbon equivalent (CEV) or parameter crack measurement (P_{CM})

6.3.3.1 Carbon equivalent (CEV)

The carbon equivalent value requirements are given in Table 3. For determining the CEV, the heat analysis value and the following International Institute for Welding (IIW) formula shall be used:

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

In this respect, all the elements designated in the formula shall be used for calculation and reported, regardless of whether those elements are intentionally added or not.

If agreed between the purchaser and the manufacturer, Annex B may be applied for the formula of carbon equivalent and maximum value of carbon equivalent in place of Table 3 and Formula (1).

Table 3 — Maximum value of carbon equivalent

Grade	Maximum value of carbon equivalent %	
	$t \leq 50$ mm	$50 < t \leq 140$ mm
SA235	0,35	0,35
SA325	0,46	0,48
SA345	0,45	0,47
SA440	0,47	0,49
The applicable thickness is t_2 in the case of H-sections (see Table 10).		

6.3.3.2 Parameter crack measurement (P_{CM})

If agreed between the purchaser and manufacturer, the value of parameter crack measurement requirements shown in Table 4 may be applied instead of CEV. For determining the P_{CM}, the heat analysis value and the following formula shall be used:

$$P_{CM} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B \quad (2)$$

In this respect, all the elements designated in the formula shall be used for calculation and reported, regardless of whether those elements are intentionally added or not.

Table 4 — Maximum value of parameter crack measurement

Grade	Maximum value of parameter crack measurement %
SA235	0,26
SA325	0,29
SA345	0,28
SA440	0,30

6.3.4 Carbon equivalent (CEV) or parameter crack measurement (P_{CM}) for thermomechanically rolled steel products

The maximum carbon equivalent value for the thermomechanically rolled steel products by agreement between the purchaser and manufacturer shall be as given in Table 5.

Table 5 — Maximum value of carbon equivalent when thermomechanically rolled process is used

Grade	Maximum value of carbon equivalent %	
	$t \leq 50$ mm	$50 < t \leq 140$ mm
SA325	0,37	0,39
SA345	0,39	0,39
SA440	0,44	0,47
The applicable thickness is t_2 in the case of H-sections.		

Furthermore, the maximum value of parameter crack measurement (P_{CM}) may be applied, instead of the maximum value of carbon equivalent subjected to the agreement between the purchaser and supplier. The maximum value of parameter crack measurement, in this case, shall be as given in Table 6.

Table 6 — Maximum value of parameter crack measurement when thermomechanically rolled process is used

Grade	Maximum value of parameter crack measurement %	
	$t \leq 50$ mm	$50 < t \leq 140$ mm
SA325	0,24	0,26
SA345	0,26	0,26
SA440	0,28	0,30

6.4 Mechanical properties

6.4.1 Tensile properties

The tensile properties at room temperature shall comply with the values specified in Table 7.

6.4.2 Charpy V-notch impact tests

The impact properties of Charpy V-notch test pieces shall comply with the values specified in Table 8. The orientation of the specimens shall be longitudinal unless a transverse orientation is agreed between the purchaser and manufacturer (see 5.2 and ISO 630-1).

6.4.3 Through thickness characteristics

For products 16 mm or over in thickness, the requirement of through-thickness characteristics "Class Z25" in accordance with ISO 7778 may be applied by agreement between the purchaser and supplier.

Table 7 — Mechanical properties — Yield strength, tensile strength, yield strength to tensile strength ratio and elongation

Grade	Yield strength MPa[a]				Tensile strength MPa	Yield strength to tensile strength ratio %[b]				Elongation %
	Thickness of steel product[c] mm					Thickness of steel product[c] mm				$L_0 = 5{,}65\sqrt{S_0}$
	6 ≤ t < 12	12 ≤ t < 16	16 ≤ t < 40	40 ≤ t ≤ 140		6 ≤ t < 12	12 ≤ t < 16	16 ≤ t < 40	40 ≤ t ≤ 140	
SA235	235 to 355	235 to 355	235 to 355	215 to 335	400 to 510	—	80 max.	80 max.	80 max.	21
SA325	325 to 445	325 to 445	325 to 445	295 to 415	490 to 610	—	80 max.	80 max.	80 max.	20
SA345	345 to 450	345 to 450	345 to 450	345 to 450	450 min.	85 max.	85 max.	85 max.	85 max.	19
SA440	460 to 580	460 to 580	440 to 560	420 to 540	520 to 700	90 max.	90 max.	90 max.	90 max.	16

For plate and wide flats with widths ≥600 mm, the values apply for direction transverse to the rolling direction. For wide flats with widths <600 mm and sections, the values apply for the direction parallel to the rolling direction.

[a] 1 MPa = 1 N/mm².

[b] If agreed between the purchaser and the manufacturer, the yield strength to tensile strength ratio other than that specified in this table may be specified.

[c] For the H-section, the dimension t_2 (flange thickness) in Tables 9 and 10 shall be applied in this table.

Table 8 — Charpy V-notch energy

Grade	Quality	Test temperature °C	Impact energy J
SA235	C, C+	0	27 min.
SA325			
SA345			
SA440			

For H-sections, the Charpy V-notch test is sampled from the centreline of the web; the test temperature shall be +20 °C.

6.5 Surface conditions

See ISO 630-1.

6.6 Internal soundness

See ISO 630-1.

6.7 Dimensions and tolerances on dimensions, shape, and mass

See ISO 630-1.

See also Annex A

In this case, unless otherwise agreed between the purchaser and the manufacturer, the following requirements shall also be satisfied.

a) The tolerances on thickness for the steel plates: ISO 7452:2013, Table B.2, Class B, shall be applied.

b) The tolerances on thickness for the steel wide flats: ISO 9034:1987, Table 1, Class B, shall be applied.

c) The tolerance on flange thickness for the H-sections: Table 9 or Table 10 of this part of ISO 630 shall be specified at the time of enquiry or order.

The dimensions of the H-section are given in Figure 1.

Table 9 — Tolerances on flange thickness of H-section (Class A)

Dimensions in millimetres

Thickness (t_2)	Tolerance
$6 \leq t_2 < 16$	+1,7 −0,3
$16 \leq t_2 < 40$	+2,3 −0,7
$40 \leq t_2 < 100$	+2,5 −1,5
$100 \leq t_2 \leq 140$	a

a Subject to agreement between purchaser and manufacturer.

Table 10 — Tolerances on flange thickness for H-section (Class B)

Dimensions in millimetres

Thickness (t_2)	Tolerance
$6 \leq t_2 < 10$	+2,0 −1,0
$10 \leq t_2 < 20$	+2,5 −1,5
$20 \leq t_2 < 30$	+2,5 −2,0
$30 \leq t_2 < 40$	+2,5 −2,5
$40 \leq t_2 < 60$	+3,0 −3,0
$60 \leq t_2$	+4,0 −4,0