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ISO 630-6

Second edition
2023-11

Structural steels —

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

Aciers de construction —

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

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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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 4, *Steels for structural purposes*.

This second edition cancels and replaces the first edition (ISO 630-6:2014), which has been technically revised.

The main changes are as follows:

— steel grades and qualities have been updated in the scope with the addition of a new grade (SA390) and four qualities (D, D+, E and E+);

— the maximum nominal thickness for plate has been changed from 125 mm to 150 mm;

— the specification of delivery conditions has been added to the scope to align with other parts of the ISO 630 series;

— the list of normative references has been updated;

— some terms and definitions concerning heat treatments have been deleted because they are already included in 630-1;

— four qualities (D, D+, E and E+) have been added to 4.2;

— in the tables, the designations concerning thickness have been changed to “nominal thickness”;

— specified values for SA390 have been added to Tables 1, 3, 4, 5, 6, 7 and 8;

— four new qualities (D, D+, E and E+) have been added to Table 8

— the layout of Table 3, 4, 5, 6, B.1, and B.2 has been updated.

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

1 Scope

This document specifies qualities for steels for seismic-proof improved structural use. It is applicable to steel plates rolled on a reversing mill, wide flats, hot-rolled sections, which are used in the as-rolled condition, with the exception of grade SA440, which is normally produced using quenched and tempered or thermomechanical controlled process and normally intended for welded or bolted structures.

This document covers 5 steel grades and 7 qualities. Grades SA235, SA325, SA345, SA390 and SA440 are covered. 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 plates, wide flats, and sections with a minimum nominal thickness of 6 mm and a maximum nominal thickness of 150 mm for steel plates, and a maximum nominal thickness of 140 mm for wide flats and hot-rolled sections.

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

— sheet and strip, e.g. ISO 4995 or ISO 4996;

— tubular products. e.g. ISO 12633-1, ISO 12633-2.

NOTE The term "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*

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 630-1 apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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 5 steel grades— Grades SA235, SA325, SA345, SA390 and SA440. Each grade is available in up to 7 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.

— Quality D: impact testing at –20 °C.

— Quality D+: impact testing at –20 °C and through-thickness characteristics testing.

— Quality E: impact testing at –40 °C.

— Quality E+: impact testing at –40 °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 may apply. In addition, the following options may apply.

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 may 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 may 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 may be carried out at an agreed frequency when specified at the time of the order.

6 Requirements

6.1 Steel-making process

The steel making process shall be in accordance with ISO 630-1.

6.2 Delivery condition

The products covered by this document 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 controlled process. 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 controlled process is not allowed at the manufacturer's discretion. When agreed upon between the purchaser and the manufacturer, thermomechanical controlled process may be applied to any grade.

6.3 Chemical composition

6.3.1 Heat analysis

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

Table 1 — Chemical composition % by mass (heat analysis)

Grade	Nominal thickness[a] t mm	C % max.	Si % max.	Mn %	P % max.	S[b] % max.	Cu % max.	Ni % max.	Cr % max.	Mo % max.	Nb + V + Ti % max.
SA235	$6 \le t < 50$	0,20	0,35	0,50 to 1,50	0,030	0,045	0,60	0,45	0,35	0,15	0,15
	$50 \le t \le 150$	0,22									
SA325	$6 \le t < 50$	0,18	0,55	0,50 to 1,65	0,030	0,045	0,60	0,45	0,35	0,15	0,15
	$50 \le t \le 150$	0,20									
SA345	$6 \le t < 50$	0,23	0,55	0,50 to 1,65	0,030	0,045	0,60	0,45	0,35	0,15	0,15
	$50 \le t \le 150$										
SA390	$6 \le t \le 150$	0,20	0,55	0,50 to 1,65	0,030	0,045	0,60	0,45	0,35	0,15	0,15
SA440	$6 \le t < 50$	0,18	0,55	0,50 to 1,65	0,030	0,045	0,60	0,45	0,35	0,15	0,15
	$50 \le t \le 150$	0,20									

If agreed between the purchaser and the manufacturer, the limitations of alloying elements other than those given may be applied.

[a] For the H-section, the dimension t_2 (flange thickness) in Figure 1 shall apply.

[b] If agreed between the purchaser and the manufacturer, the lower limit of a maximum sulfur content may be applied.

6.3.2 Product analysis

The permissible deviations of product analysis shall conform with the values given in Table 2. See 5.2.

Table 2 — Permitted deviation for the product analysis relative to the specified heat analysis

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 value (CEV) or parameter crack measurement (P_{CM})

6.3.3.1 Carbon equivalent value (CEV)

The carbon equivalent value (C_{EV}) requirements shall be as given in Table 3.

The carbon equivalent value (C_{EV}) shall be determined using the IIW (International Institute for Welding) formula, given as Formula (1):

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

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

Table 3 — CEV based on the heat analysis

Grade	Nominal thickness[a] t mm	Maximum C_{EV} %
SA235	$6 \le t \le 50$	0,35
	$50 < t \le 150$	0,35
SA325	$6 \le t \le 50$	0,46
	$50 < t \le 150$	0,48
SA345	$6 \le t \le 50$	0,45
	$50 < t \le 150$	0,47
SA390	$6 \le t \le 50$	0,45
	$50 < t \le 150$	0,47
SA440	$6 \le t \le 50$	0,47
	$50 < t \le 150$	0,49

[a] For the H-section, the dimension t_2 (flange thickness) in Figure 1 shall apply.

6.3.3.2 Parameter crack measurement (P_{CM})

If agreed between the purchaser and manufacturer, the value of parameter crack measurement requirements (P_{CM}) shown in Table 4 may be used instead of the CEV. For determining the P_{CM}, the heat analysis value and Formula (2) 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 (2) shall be used for calculation and reported, regardless of whether those elements are intentionally added or not.

Table 4 — P_{CM} based on the heat analysis

Grade	Nominal thickness[a] t mm	Maximum P_{CM} %
SA235	$6 \le t \le 150$	0,26
SA325	$6 \le t \le 150$	0,29
SA345	$6 \le t \le 150$	0,28
SA390	$6 \le t \le 150$	0,28
SA440	$6 \le t \le 150$	0,30
[a] For the H-section, the dimension t_2 (flange thickness) in Figure 1 shall apply.		

6.3.4 Carbon equivalent value (CEV) or parameter crack measurement (P_{CM}) for steel products by thermomechanical controlled process

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

Table 5 — Maximum CEV based on the heat analysis for steel products by thermomechanical controlled process

Grade	Nominal thickness[a] t mm	Maximum C_{EV} %
SA325	$6 \le t \le 50$	0,37
	$50 < t \le 150$	0,39
SA345	$6 \le t \le 50$	0,39
	$50 < t \le 150$	0,39
SA390	$6 \le t \le 50$	0,40
	$50 < t \le 150$	0,43
SA440	$6 \le t \le 50$	0,44
	$50 < t \le 150$	0,47
[a] For the H-section, the dimension t_2 (flange thickness) in Figure 1 shall apply.		

Furthermore, the maximum value of parameter crack measurement (P_{CM}) may be used 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 P_{CM} based on the heat analysis for steel products by thermomechanical controlled process

Grade	Nominal thickness[a] t mm	Maximum P_{CM} %
SA325	$6 \leq t \leq 50$	0,24
	$50 < t \leq 150$	0,26
SA345	$6 \leq t \leq 150$	0,26
SA390	$6 \leq t < 50$	0,26
	$50 < t \leq 150$	0,27
SA440	$6 \leq t \leq 50$	0,28
	$50 < t \leq 150$	0,30

[a] For the H-section, the dimension t_2 (flange thickness) in Figure 1 shall apply.

6.4 Mechanical properties

6.4.1 Tensile properties

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

6.4.2 Charpy V-notch impacts test

The impact properties of Charpy V-notch test pieces shall conform 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).

If required for H-sections, the Charpy V-notch test is sampled from a location between the surface and the centreline of the flange. The test temperature shall be +20 °C.

6.4.3 Through thickness characteristics

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

Table 7 — Mechanical properties at room temperature

Grade	Nominal thickness [c] mm	Yield strength R_{eH} [d] MPa[a]	Tensile strength R_m MPa[a]	Maximum yield strength to tensile strength ratio [b] %	Minimum elongation % $L_0 = 5{,}65\sqrt{S_0}$
SA235	$6 \le t < 12$	235 to 355	400 to 510	—	21
	$12 \le t < 40$	235 to 355		80	
	$40 \le t \le 150$	215 to 335			
SA325	$6 \le t < 12$	325 to 445	490 to 610	—	20
	$12 \le t < 40$	325 to 445		80	
	$40 \le t \le 150$	295 to 415			
SA345	$6 \le t \le 150$	345 to 450	450 min.	85	19
SA390	$6 \le t < 12$	390 to 510	510 to 660	85	19
	$12 \le t < 40$	390 to 510			
	$40 \le t \le 150$	370 to 490			
SA440	$6 \le t < 16$	460 to 580	520 to 700	90	16
	$16 \le t < 40$	440 to 560			
	$40 \le t \le 150$	420 to 540			

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/mm^2.

[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 Figure 1 shall apply.

[d] If R_{eH} is not pronounced, proof strength shall be in accordance with ISO 630-1.

Table 8 — Charpy V-notch energy

Grade	Quality	Test temperature [a] °C	Impact energy J
SA235 SA325 SA345 SA390 SA440	C, C+	0	27 min.
	D, D+	−20	
	E, E+	−40	

[a] If required for H-sections, the Charpy V-notch test is sampled from a location between the surface and the centreline of the flange. The test temperature shall be +20 °C.

6.5 Surface conditions

The surface conditions shall be in accordance with ISO 630-1.

6.6 Internal soundness

The internal soundness shall be in accordance with ISO 630-1.

6.7 Dimensions, tolerances on dimensions and shape, mass

The dimensions, tolerances on dimensions and shape, mass shall be in accordance with ISO 630-1.

The shapes and dimensions tolerances of H-sections shall be in accordance with 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, Class B, shall apply.

b) The tolerances on thickness for the steel wide flats: ISO 9034, Class B, shall apply.

c) The tolerance on flange thickness for the H-section: Table 9 or Table 10 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 the H-section (Class A)

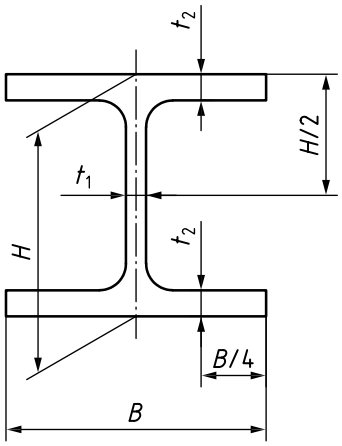
Dimensions in millimetres

Nominal 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 the H-section (Class B)

Dimensions in millimetres

Nominal 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



Key

B width
H height
t_1 web thickness
t_2 flange thickness

Figure 1 — Dimensions of the H-section

7 Inspection

Specific inspection shall be in accordance with ISO 630-1 for all grades.

8 Sampling — Frequency of testing

8.1 Verification

The verification of mechanical properties shall be by heat. Verification by lot shall be by agreement between the purchaser and the manufacturer.

8.2 Test units

8.2.1 Tensile tests

The test unit shall contain products of the same form, grade, quality, and delivery condition, and of the same thickness range as specified in Table 7 for the yield strength and shall be taken by heat:

— 50 tons or part thereof.

8.2.2 Impact tests

The test unit shall contain products of the same form, grade, quality, and delivery condition and shall be taken by heat:

— 50 tons or part thereof.

The impact test shall be sampled on the thickest product of the test unit. Three test pieces shall be taken from the sample.

8.2.3 Through-thickness characteristics test

The test unit for the through-thickness characteristics shall be in accordance with ISO 7778.

9 Test methods

The test methods shall be in accordance with ISO 630-1.

The test method for the through-thickness characteristics shall be in accordance with ISO 7778.

10 Marking

The marking shall be in accordance with ISO 630-1.

Annex A
(normative)

Shapes and dimensions tolerances of H-sections

Shapes and dimensions of H-sections shall be specified at the order stage.

The dimensional tolerances of H-sections are specified in Tables A.1 and A.2. At the order stage, Tables A.1 or A.2 shall be specified. If agreed between the purchaser and the manufacturer, other dimensional tolerances may be used, e.g. JIS G 3192 and, ASTM A6M, EN 10025-1, EN 10025-2, EN 10025-3, EN 10025-4 and EN 10025-5 include the shapes of H-sections.

Tolerances on mass may be agreed at the time of order.

Table A.1 — Shapes and dimensions tolerances of H-sections

Dimensions in millimetres

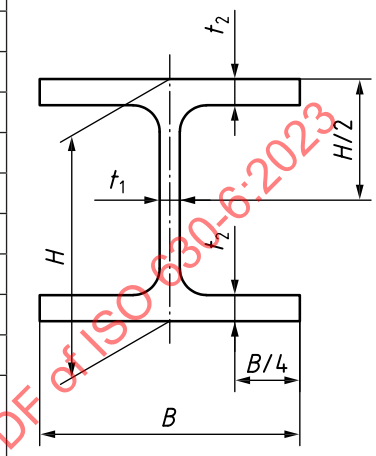
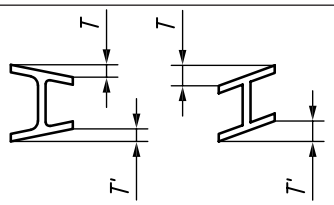
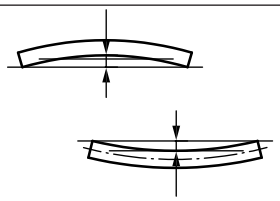
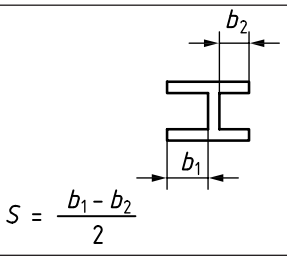
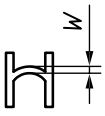
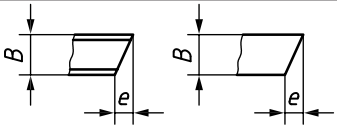
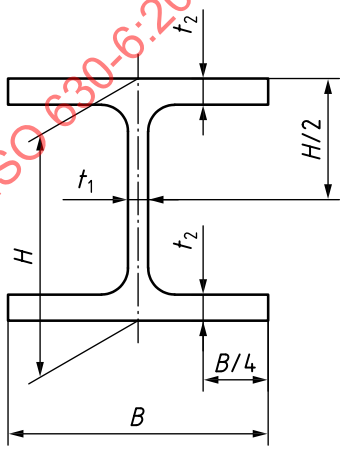
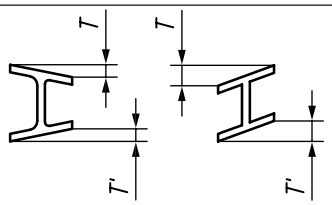
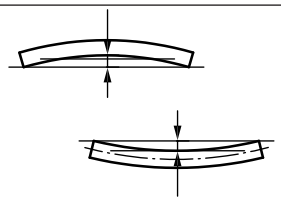
Division and dimension		Tolerance	Remarks
Width (B)	$B < 100$	±2,0	
	$100 \leq B < 200$	±2,5	
	$200 \leq B$	±3,0	
Height (H)	$H < 400$	±2,0	
	$400 \leq H < 600$	±3,0	
	$600 \leq H$	±4,0	
Web thickness (t_1)	$t_1 < 16$	±0,7	
	$16 \leq t_1 < 25$	±1,0	
	$25 \leq t_1 < 40$	±1,5	
	$40 \leq t_1$	±2,0	
Length (L)	$L \leq 7\,000$	+40,0	
	$7\,000 < L$	Add 5 mm to the plus-side tolerance given in the above column for every 1 000 mm increase in length or its fraction	
Squareness (T)	$H \leq 300$	T, $T' \leq 0{,}01\ B$ or 1,5 mm, whichever is smaller	
	$300 < H$	T, $T' \leq 0{,}012\ B$ or 1,5 mm, whichever is smaller	
Straightness	$H \leq 300$	$\leq 0{,}015\ L$	
	$300 < H$	$\leq 0{,}010\ L$	
Eccentricity (S)	$H \leq 300$ or $B \leq 200$	±2,5	
	$300 < H$ or $200 < B$	±3,5	
Concavity of web (W)	$H < 400$	2,0	
	$400 \leq H < 600$	2,5	
	$600 \leq H$	3,0	
Sectional squareness (e)	–	$e \leq 0{,}016\ B$, $e \leq 0{,}016\ H$ or 3,0 mm, whichever is the smallest	

Table A.2 — Shapes and dimensions tolerances of H-sections

Dimensions in millimetres

Division and dimension		Tolerance	Remarks
Width (B)	$B \leq 110$	+4,0 −1,0	
	$110 < B \leq 210$	+4,0 −2,0	
	$210 < B \leq 325$	+4,0 −4,0	
	$325 < B$	+6,0 −5,0	
Height (H)	$H \leq 180$	+3,0 −2,0	
	$180 < H \leq 400$	+4,0 −2,0	
	$400 < H \leq 700$	+5,0 −3,0	
	$700 < H$	+5,0 −5,0	
Web thickness (t_1)	$t_1 < 7$	±0,7	
	$7 \leq t_1 < 10$	±1,0	
	$10 \leq t_1 < 20$	±1,5	
	$20 \leq t_1 < 40$	±2,0	
	$40 \leq t_1 < 60$	±2,5	
	$60 \leq t_1$	±3,0	
Length (L)	–	±50 +100 mm where minimum lengths are requested.	
Squareness (T)	$B \leq 110$	1,5	
	$110 < B$	2 % of B (max. 6,5 mm)	
Straightness	$80 < H \leq 180$	0,30 % of L	
	$180 < H \leq 360$	0,15 % of L	
	$360 < H$	0,1 % of L	