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Structural steels — Structural steels for building with improved seismic resistance — Technical delivery conditions

Aciers de construction — Aciers de construction à résistance améliorée aux séismes — Conditions techniques de livraison

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 24314 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 3, *Steels for structural purposes*.

Structural steels — Structural steels for building with improved seismic resistance — Technical delivery conditions

1 Scope

This International Standard specifies qualities for seismic-purpose structural steels. This International Standard applies to steel plates with thicknesses of 6 mm or over and up to 125 mm, wide flats and hot-rolled sections, which are used in the as-delivered condition and normally intended for bolted, riveted or welded structures [1)].

It does not include the following steels, certain of which are covered by other International Standards, namely:

— structural steels (ISO 630);

— steels for general engineering purposes (ISO 1052);

— high-yield-strength flat steel products (ISO 4950-1, ISO 4950-2 and ISO 4950-3);

— high-yield-strength steel bars and sections (ISO 4951-1, ISO 4951-2 and ISO 4951-3);

— structural steels with improved atmospheric corrosion resistance (ISO 4952);

— high-yield-strength steel plates and wide flats for cold forming (ISO 6930-1 and ISO 6930-2).

2 Normative references

The following referenced documents are indispensable for the application 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 404:1992, *Steel and steel products — General technical delivery requirements*

ISO 657-1, *Hot-rolled steel sections — Part 1: Equal-leg angles — Dimensions*

ISO 657-2, *Hot-rolled steel sections — Part 2: Unequal-leg angles — Dimensions*

ISO 657-5, *Hot-rolled steel sections — Part 5: Equal-leg angles and unequal-leg angles — Tolerances for metric and inch series*

ISO 657-11, *Hot-rolled steel sections — Part 11: Sloping flange channel sections (Metric series) — Dimensions and sectional properties*

1) For precautions to be taken when welding, see the guide for the welding and weldability of C-Mn and C-Mn micro-alloy steels published by Sub-commission IX-G of the International Welding Institute (document ISS/IIWI 843-87).

ISO 657-14, *Hot-rolled steel sections — Part 14: Hot-finished structural hollow sections — Dimensions and sectional properties*

ISO 657-15, *Hot-rolled steel sections — Part 15: Sloping flange beam sections (Metric series) — Dimensions and sectional properties*

ISO 657-16, *Hot-rolled steel sections — Part 16: Sloping flange column sections (metric series) — Dimensions and sectional properties*

ISO 657-18, *Hot-rolled steel sections — Part 18: L sections for shipbuilding (metric series) — Dimensions, sectional properties and tolerances*

ISO 657-19, *Hot-rolled steel sections — Part 19: Bulb flats (metric series) — Dimensions, sectional properties and tolerances*

ISO 657-21, *Hot-rolled steel sections — Part 21: T-sections with equal depth and flange width — Dimensions*

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

ISO 6892, *Metallic materials — Tensile testing at ambient temperature*

ISO 6929, *Steel products — Definitions and classification*

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

ISO 7778:1983, *Steel plate with specified through-thickness characteristics*

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*

3 Terms and definitions

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

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

3.2
thermomechanical rolling
rolling 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 Subsequent heating above 580 °C may lower the strength values. If temperatures above 580 °C are needed, reference should be made to the supplier.

NOTE 2 Thermomechanical rolling leading to the delivery condition “thermomechanically rolled” can include processes with an increasing cooling rate with or without tempering, including self-tempering but excluding direct quenching or quenching and tempering.

4 General requirements

4.1 Steel-making process

Unless otherwise agreed at the time of enquiry and order, the steel-making process is left to the discretion of the manufacturer.

4.2 Delivery condition

The products are generally delivered in the as-rolled condition, with the exception of grade S460S which is normally produced using a thermomechanical rolling operation. For all other grades, unless otherwise agreed, all delivery conditions other than thermomechanical rolling are allowed at the manufacturer's discretion. When agreed upon between the purchaser and the manufacturer, thermomechanical rolling can be applied to any grade.

4.3 Surface conditions

The products shall have a smooth surface corresponding to the rolling process used ; they shall not have any defects that are prejudicial to their subsequent processing or appropriate use. By agreement, alternative requirements may be specified, such as ISO 7788 for plates and wide flats, ISO 20723 for sections and ISO 9443 for bars. Other and/or more requirements than those reported in International Standards may be specified as well.

4.4 Shape, dimensions, mass and tolerances

The shape, dimensions and mass of product and the tolerance thereof shall be in accordance with the following standards. Other size shapes are acceptable, if agreed between the purchaser and the manufacturer.

ISO 657-1, *Hot-rolled steel sections — Part 1: Equal-leg angles — Dimensions*

ISO 657-2, *Hot-rolled steel sections — Part 2: Unequal-leg angles — Dimensions*

ISO 657-5, *Hot-rolled steel sections — Part 5: Equal-leg angles and unequal-leg angles — Tolerances for metric and inch series*

ISO 657-11, *Hot-rolled steel sections — Part 11: Sloping flange channel sections (Metric series) — Dimensions and sectional properties*

ISO 657-14, *Hot-rolled steel sections — Part 14: Hot-finished structural hollow sections — Dimensions and sectional properties*

ISO 657-15, *Hot-rolled steel sections — Part 15: Sloping flange beam sections (Metric series) — Dimensions and sectional properties*

ISO 657-16, *Hot-rolled steel sections — Part 16: Sloping flange column sections (metric series) — Dimensions and sectional properties*

ISO 657-18, *Hot-rolled steel sections — Part 18: L sections for shipbuilding (metric series) — Dimensions, sectional properties and tolerances*

ISO 657-19, *Hot-rolled steel sections — Part 19: Bulb flats (metric series) — Dimensions, sectional properties and tolerances*

ISO 657-21, *Hot-rolled steel sections — Part 21: T-sections with equal depth and flange width — Dimensions*

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

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

See also Annex B

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 7452:2002, Table 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 1 or Table 2 of this International Standard, shall be specified at the time of enquiry or order.

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

Table 1 — Tolerances on flange thickness of H-section (Class A)

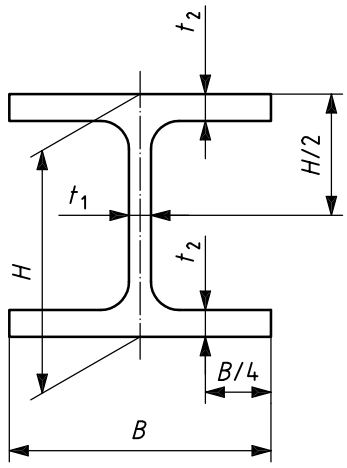
Dimensions in millimetres

Thickness (t_2)	**Tolerance**
$6 \leqslant t_2 < 16$	$^{+1,7}_{-0,3}$
$16 \leqslant t_2 < 40$	$^{+2,3}_{-0,7}$
$40 \leqslant t_2 \leqslant 100$	$^{+2,5}_{-1,5}$
$100 < t_2 \leqslant 125$	[a]
[a] Subject to agreement between purchaser and manufacturer.	

Table 2 — Tolerances on flange thickness for H-section (Class B)

Dimensions in millimetres

Thickness (t_2)	**Tolerance**
$6 \leqslant t_2 < 10$	$^{+2,0}_{-1,0}$
$10 \leqslant t_2 < 20$	$^{+2,5}_{-1,5}$
$20 \leqslant t_2 < 30$	$^{+2,5}_{-2,0}$
$30 \leqslant t_2 < 40$	$^{+2,5}_{-2,5}$
$40 \leqslant t_2 < 60$	$^{+3,0}_{-3,0}$
$60 \leqslant t_2$	$^{+4,0}_{-4,0}$



Key

B width
H height
t_1 web thickness
t_2 flange thickness

Figure 1 — Dimensions of H-section

5 Characteristics of types, grades and qualities

5.1 Chemical composition

5.1.1 Cast (heat) analysis

The maximum values of the composition limits for ladle analysis are given in Table 3.

5.1.2 Product analysis

Table 4 gives the permissible deviations on analysis relative to the values for cast (heat) analysis which are given in Table 3.

Table 3 — Chemical composition

Grade	Thickness e mm	C % max.	Si % max	Mn %	P % max.	S % max.	Cu % max.	Ni % max.	Cr % max.	Mo % max.
S235S	$6 \leqslant e < 50$	0,20	0,35	0,50 to 1,40	0,030	0,045	0,60	0,45	0,35	0,15
	$50 \leqslant e \leqslant 125$	0,22								
S325S	$6 \leqslant e < 50$	0,18	0,55	0,50 to 1,60	0,030	0,045	0,60	0,45	0,35	0,15
	$50 \leqslant e \leqslant 125$	0,20								
S345S	$6 \leqslant e < 50$	0,23	0,55	0,50 to 1,60	0,030	0,045	0,60	0,45	0,35	0,15
	$50 \leqslant e \leqslant 125$									
S460S	$6 \leqslant e < 50$	0,18	0,55	0,50 to 1,60	0,030	0,045	0,60	0,45	0,35	0,15
	$50 \leqslant e \leqslant 125$	0,20								
The sum of niobium, vanadium and titanium shall not exceed 0,15 %.										
NOTE 1 If agreed between the purchaser and the manufacturer, the limitations of alloying elements other than those given in Table 4 can be applied.										
NOTE 2 If agreed between the purchaser and the manufacturer, the lower limit of a maximum sulfur content can be applied.										

Table 4 — Permissible deviation for the product analysis relative to the specified cast (heat) analysis (refer to 6.4.4.1)

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

5.1.3 Carbon equivalent or parameter crack measurement (Pcm)

5.1.3.1 Carbon equivalent

A maximum value of carbon equivalent (CEV) based on the cast (heat) analysis, shall be as given in Table 5. The carbon-equivalent value, expressed as a percentage, shall be determined using the following formula:

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

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 C can be applied as the formula of carbon equivalent and maximum value of carbon equivalent in place of Table 5 and Formula 1.

Table 5 — Maximum value of carbon equivalent

Grade	Maximum value of carbon equivalent %	
	50 mm or under in thickness	over 50 mm, up to and including 125 mm in thickness
S235S	0,35	0,35
S325S	0,46	0,48
S345S	0,45	0,47
S460S	0,47	0,49
The applicable thickness is t_2 in the case of H-sections.		

5.1.3.2 Parameter crack measurement

A maximum value of parameter crack measurement (Pcm) may be applied, instead of the maximum value of carbon equivalent subjected to the agreement between the purchaser and supplier. In this case, the maximum value of parameter crack measurement shall be as given in Table 6. The value of parameter crack measurement shall be calculated from the following formula by using the cast (heat) analysis values obtained by the procedure in 6.4.4.

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

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 6 — Maximum value of parameter crack measurement

Grade	Maximum value of parameter crack measurement %
S235S	0,26
S325S	0,29
S345S	0,28
S460S	0,30

5.1.4 Carbon equivalent or parameter crack measurement (Pcm) for thermomechanically rolled steel products

The maximum carbon-equivalent value for the thermomechanically rolled steel products by agreement between the purchaser and supplier shall be as given in Table 7.

Table 7 — Maximum value of carbon equivalent when thermomechanically rolled process is used

Grade	Maximum value of carbon equivalent %	
	Up to and including 50 mm in thickness	Over 50 mm to 125 mm inclusive in thickness
S325S	0,37	0,39
S345S	0,39	0,39
S460S	0,44	0,47
The applicable thickness is t_2 in the case of H-sections.		

Furthermore, the maximum value of parameter crack measurement 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 8.

Table 8 — Maximum value of parameter crack measurement when thermomechanically rolled process is used

Grade	Maximum value of parameter crack measurement %	
	Up to and including 50 mm in thickness	Over 50 mm to 125 mm inclusive in thickness
S325S	0,24	0,26
S345S	0,26	0,26
S460S	0,28	0,30

5.2 Mechanical properties

The steels, in the delivery condition defined in 4.2, shall comply with the mechanical properties specified in Tables 9 and 10 when these are determined on test pieces prepared in accordance with 6.4.

For the product 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 9 — Mechanical properties — Yield strength, tensile strength, yield strength to tensile strength ratio and elongation

Grade	Yield strength N/mm² [a]				Tensile strength N/mm²	Yield strength to tensile strength ratio % [b]				Elongation %
	Thickness of steel product [c] mm					Thickness of steel product [c] mm				
	$6 \leqslant t < 12$	$12 \leqslant t < 16$	$16 \leqslant t \leqslant 40$	$40 < t \leqslant 125$		$6 \leqslant t < 12$	$12 \leqslant t < 16$	$16 \leqslant t \leqslant 40$	$40 < t \leqslant 125$	$L_0 = 5{,}65\sqrt{S_0}$
S235S	235 to 355	235 to 355	235 to 355	215 to 335	400 to 510	—	80 max.	80 max.	80 max.	21
S325S	325 to 445	325 to 445	325 to 445	295 to 415	490 to 610		80 max.	80 max.	80 max.	20
S345S	345 to 450	345 to 450	345 to 450	345 to 450	450 min.	85 max.	85 max.	85 max.	85 max.	19
S460S	460 to 580	460 to 580	440 to 560	420 to 540	520 to 700	90 max.	90 max.	90 max.	90 max.	16

[a] 1 N/mm² = 1 MPa.

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

[c] For the H-section, the dimension t_2 in Tables 1 and 2 shall be applied.

Table 10 — Charpy absorption energy

Grade	Test temperature °C	Impact energy J
S235S	0	27 min.
S325S		
S345S		
S460S		
The product over 12 mm in thickness shall be tested in accordance with 6.4.2. The Charpy absorption energy, in this case, shall be expressed by the average of measured values of three test pieces. If the purchase order of H-sections requires the Charpy V-notch test from the centreline of the web, the test temperature shall be 20 °C.		

6 Inspection and testing

6.1 General

Rolled products covered by this International Standard may be subject to an inspection and testing in accordance with the conditions specified in 8.3 of ISO 404:1992, relating to the mechanical properties and chemical analysis of the product. Verification of the chemical composition of the products is only carried out by agreement at the time of enquiry and order. Inspection and testing shall be carried out in accordance with 6.2 to 6.5, unless otherwise agreed when ordering.

6.2 Test unit

6.2.1 General

The verification of mechanical properties shall be per cast (heat).

6.2.2 Tensile tests

A test unit shall contain products of the same form, grade and delivery condition, and be from the same thickness range in accordance with Table 9.

For a test unit not exceeding 50 t, one tensile test shall be carried out.

For a test unit exceeding 50 t, two tensile tests shall be carried out.

6.2.3 Impact tests

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

For a test unit not exceeding 50 t, one impact test shall be carried out.

For a test unit exceeding 50 t, two impact tests shall be carried out.

The impact test shall be sampled on the thickest product of the test unit

Three test pieces shall be taken from the sample.

6.3 Position and orientation of test sample (see ISO 377)

6.3.1 Plates and wide flats of width 600 mm or over

The test sample shall be taken a quarter-width from a side edge.

a) The longitudinal axes of the tensile test piece shall be perpendicular to the direction of rolling.

b) The longitudinal axes of the impact test piece shall always be parallel to the direction of rolling.

6.3.2 Sections, girders and wide flats of width less than 600 mm

The longitudinal axes of the test pieces shall be parallel to the direction of rolling. However, if agreed, the transverse test piece may be used for wide flats of widths between 450 mm and 600 mm.

For sections, unless an alternative location for the Charpy V-notch sample is required in the purchase order, the test samples shall be taken such that the axis of the test piece is 1/3 from the outer edge of the half-flange (see ISO 6929, H- and U- sections,) or of the flange (for other sections) or, for the small sections, as near as possible to this position (see Figure A.1). For the tapered-flange sections, the test samples may be taken at the outer 1/4 position of the web. When it is unfeasible to take a test piece from the specified position, the sampling should be performed as close to the aforementioned position as possible.

6.4 Test methods — Type of test pieces

6.4.1 Tensile test

See ISO 6892.

Normally the test piece used shall be a proportional prismatic or cylindrical test piece and have an original gauge length, L_0, given by the formula:

$$L_0 = 5.65\sqrt{S_0}$$

where S_0 is the original cross-sectional area of the gauge length.

A non-proportional test piece with fixed original gauge length may be used. In this case, reference shall be made to the conversion table in ISO 2566-1.

In case of dispute, only the results obtained on a proportional test piece shall be taken into consideration.

The yield strength specified in Table 9 is the upper yield strength R_{eH}. If the yield phenomenon is not visible, either the 0,2 % proof strength ($R_{p0,2}$) or the 0,5 % proof strength (total elongation) ($R_{t0,5}$) shall be determined.

The specification of the material is complied with in this respect if either value satisfies the specified value of yield strength. In cases of dispute, the 0,2 % proof strength shall be determined.

6.4.2 Impact test

6.4.2.1 The impact test shall normally be carried out on products having a thickness more than 12 mm. Unless otherwise required in the purchase order, the test piece shall be machined so that the face nearest to the rolled surface is not more than 2 mm from it.

For products of thickness greater than 40 mm, the test piece shall be taken in such a way that its axis is positioned at 1/4 of the thickness from the surface.

If the purchase order requires the test piece from the centreline of the web of sections, for the products over 50 mm thickness, the test piece shall be taken at 1/4 of the thickness from the inside surface of the flange.

The notch shall be perpendicular to the rolled surface. If agreed at the time of ordering, impact tests may be carried out on products having a thickness less than 12 mm: the dimensions of the test pieces shall be in accordance with the requirements of ISO 148-1, i.e. 10 mm × 7,5 mm or 10 mm × 5 mm, or shall correspond to 10 mm × t (t being the product thickness) and reduced proportionally to the sub-size specimen.

The specified energy values are given in Table 10.

6.4.2.2 The test shall be carried out using a V-notch test piece supported at both ends (see ISO 148-1), the value to be taken into account being the average of the results obtained from three test pieces cut adjacent to each other from the same product, unless there are reasons for a retest (refer to 6.4.6).

6.4.3 Through-thickness characteristics test

The test method for the through-thickness characteristics shall be as given in ISO 7778.

6.4.4 Chemical analysis

6.4.4.1 If a product analysis is specified on the order, one sample shall be taken per cast, unless otherwise specified on the order.

The samples may be taken from the test pieces used to check the mechanical properties, or from the full thickness of the product at the same place as the test pieces. In case of dispute, only the analysis of material from the full thickness of the product shall be taken into consideration.

For the selection and preparation of samples for chemical analysis, the requirements of ISO 14284 shall be applied.

6.4.4.2 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 between the parties concerned.

6.4.5 Invalid test results

Test results which are due to improper sampling and/or preparation of test pieces and/or to tests carried out improperly shall be considered invalid.

6.4.6 Retest

If, during inspection, a test does not give the required results, additional tests, unless otherwise agreed, may be carried out as follows.

a) Tensile test

   Procedures defined in 8.3.4.3.2 “Non-sequential tests” of ISO 404:1992 shall apply.

b) Impact test

   The assessment of the impact test result shall be made following a sequential method as described in 8.3.4.3.3 of ISO 404:1992, and if retests are necessary, they shall be carried out according to 8.3.4.3.3 of ISO 404:1992.

c) Through-thickness characteristics test

   The procedure defined in 7.3 of ISO 7778:1983 shall apply.

6.5 Inspection documents

The type of inspection documents required shall be chosen among those defined in ISO 10474 and specified in the order. If the product is heat treated, the delivery condition should be included in the inspection document.

7 Sorting and reprocessing

The requirement of Clause 9 of ISO 404:1992 shall apply.

8 Non-destructive tests

If agreed at the time of ordering, the plates and wide flats shall be tested by means of the ultrasonic examination method. The details of the test methods and the acceptance criteria shall be agreed upon at the time of enquiry and order.

Other than the above, if the purchaser requires non-destructive tests to check the soundness of the products by means of ultrasonic, magnetic or liquid-penetrant examination methods, these tests shall be agreed upon at the time of enquiry and order. This agreement shall include details of the test methods and an interpretation of the results.

9 Marking

Unless otherwise agreed at the time of ordering, products shall bear the following marks:

a) the identification symbols for the grade of the steel;

b) name or brand of the manufacturer;

c) symbol of non-destructive testing:

   1) UT for ultrasonic testing;

   2) MT for magnetic testing;

   3) PT for penetrant testing;

d) symbol of heat treatment:

   The symbol of heat treatment shall be marked;

   1) N for normalizing;

   2) Q for quench and temper;

   3) TM for thermomechanical rolling.

   When another heat treatment is applied, the symbol of heat treatment shall be agreed between the purchaser and manufacturer.

e) if necessary, symbols, letters or numbers which relate the inspection document, test pieces and products to each other.

In the case of products of small unit mass which are consigned in bundles, the above information may be marked on a tag securely attached to each bundle (or it may be marked on the upper plate).

10 Order

The order shall specify:

— if a particular steel-making process is required (4.1);

— if the purchaser wishes to be informed of the steel-making process (the choice of process being left to the manufacturer) (4.1);

— if a particular delivery condition is required (4.2);

— if repair by welding is not permitted (4.3);

— whether Table 1 or 2 is required (4.4);

— if product analysis is required (5.1.2) and the number of samples is required (6.4.4.1);

— if the formula of carbon equivalent and maximum carbon-equivalent value is required (5.1.3.1, Annex C);

— if the maximum parameter crack measurement (Pcm) value is required (5.1.3.2);

— if the carbon equivalent or parameter crack measurement (Pcm) for thermomechanically rolled steel products is required (5.1.4);

— if through-thickness characteristics “Class Z25” in accordance with ISO 7778 is required (5.2);

— if impact tests for products less than 12 mm thick are required (6.4.2.1);

— if a retest is not permitted (6.4.6);

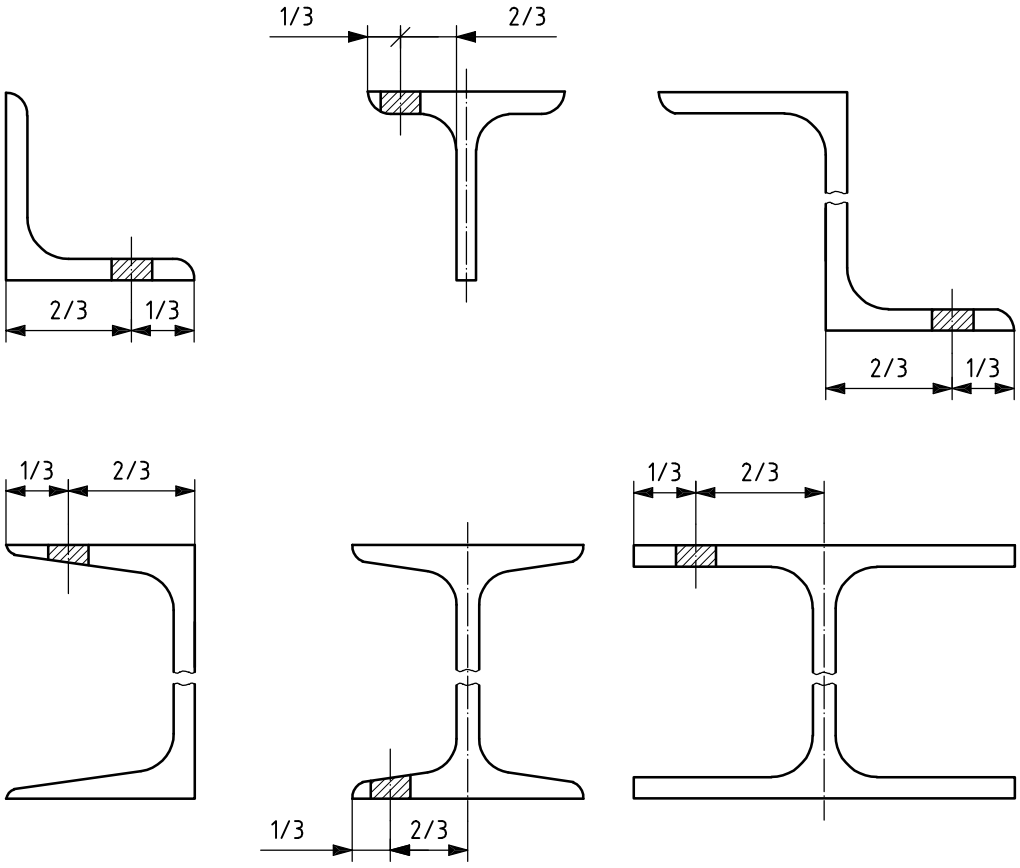
— if non-destructive tests are required (Clause 8);

— if other types of marking are required (Clause 9).

Points that are not specified shall not be taken into account by the manufacturer.

Annex A
(normative)

Position and orientation of test pieces



position of test pieces

Figure A.1 — Position and orientation of test pieces

NOTE For the tapered-flange sections, the test samples may be taken at the outer position of the web (see 6.3.2)

Annex B
(normative)

Dimensions and sectional properties of H-sections

B.1 Dimensional tolerances

The dimensional tolerances of H-sections are specified in Tables B.1 and B.2. At the time of enquiry or order, Tables B.1 or B.2 shall be specified. If agreed between the purchaser and the manufacturer, other dimensional tolerances can be applied. Tolerances on mass may be agreed at the time of the enquiry or order.

B.2 Shapes and dimensions of H-sections

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

NOTE JIS G 3192, ASTM A6M, DIN 1025-1, DIN 1025-2, DIN 1025-3, DIN 1025-4 and DIN 1025-5 include the shapes of H-sections.

Table B.1 — Dimensional tolerance of H-section

Dimensions in millimetres

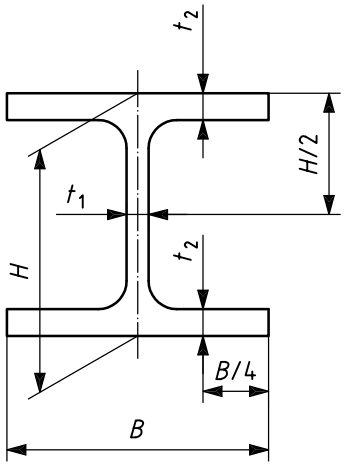
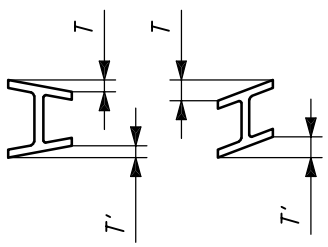
Division and dimension		Tolerance	Remarks
Width (B)	$B < 100$	$\pm$ 2,0	
	$100 \leqslant B < 200$	$\pm$ 2,5	
	$200 \leqslant B$	$\pm$ 3,0	
Height (H)	$H < 400$	$\pm$ 2,0	
	$400 \leqslant H < 600$	$\pm$ 3,0	
	$600 \leqslant H$	$\pm$ 4,0	
Web thickness (t_1)	$t_1 < 16$	$\pm$ 0,7	
	$16 \leqslant t_1 < 25$	$\pm$ 1,0	
	$25 \leqslant t_1 < 40$	$\pm$ 1,5	
	$40 \leqslant t_1$	$\pm$ 2,0	
Length (L)	$L \leqslant 7\,000$	+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)	$H \leqslant 300$	$T+T' \leqslant 0{,}01\ B$, minimum 1,5 mm	
	$300 < H$	$T+T' \leqslant 0{,}012\ B$, minimum 1,5 mm	

Table B.1 (*continued*)

Dimensions in millimetres

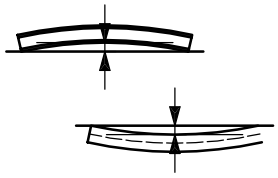
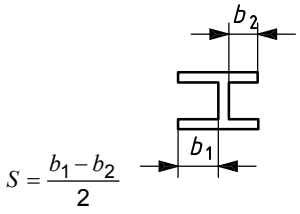
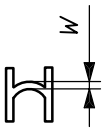
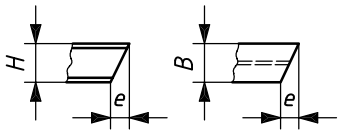
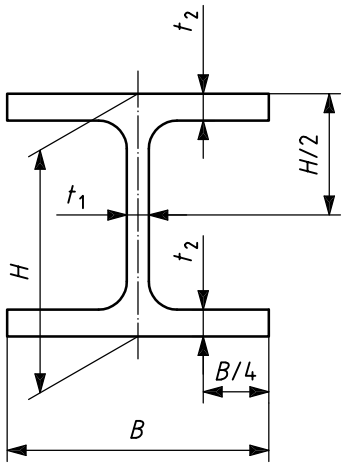
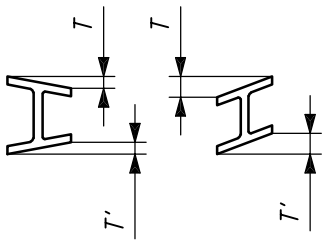
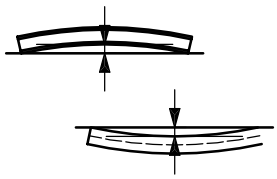
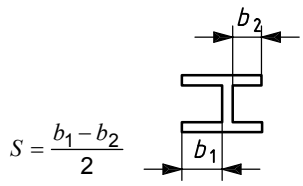
Division and dimension		Tolerance	Remarks
Straightness	$H \leqslant 300$	$\leqslant 0{,}015\ L$	
	$300 < H$	$\leqslant 0{,}010\ L$	
Eccentricity (S)	$H \leqslant 300$ or $B \leqslant 200$	$\pm 2{,}5$	
	$300 < H$ or $200 < B$	$\pm 3{,}5$	
Concavity of web (W)	$H < 400$	2,0	
	$400 \leqslant H < 600$	2,5	
	$600 < H$	3,0	
Sectional squareness (e)	$e \leqslant 0{,}016\ B$ or $e \leqslant 0{,}016\ H$	minimum 3,0	

Table B.2 — Dimensional tolerances of H-section

Dimensions in millimetres

Division and dimension		Tolerance	Remarks
Width (B)	$B \leqslant 110$	+4,0 −1,0	
	$110 < B \leqslant 210$	+4,0 −2,0	
	$210 < B \leqslant 325$	+4,0 −4,0	
	$325 < B$	+6,0 −5,0	
Height (H)	$H \leqslant 180$	+3,0 −2,0	
	$180 < H \leqslant 400$	+4,0 −2,0	
	$400 < H \leqslant 700$	+5,0 −3,0	
	$700 < H$	+5,0 −5,0	
Web Thickness (t_1)	$t_1 < 7$	± 0,7	
	$7 \leqslant t_1 < 10$	± 1,0	
	$10 \leqslant t_1 < 20$	± 1,5	
	$20 \leqslant t_1 < 40$	± 2,0	
	$40 \leqslant t_1 < 60$	± 2,5	
	$60 \leqslant t_1$	± 3,0	
Length (L)		± 50 +100 mm where minimum lengths are requested.	
Squareness (T)	$B \leqslant 110$	1,5	
	$110 < B$	2 % of B (max 6,5 mm)	
Straightness	$80 < H \leqslant 180$	0,30 % of L	
	$180 < H \leqslant 360$	0,15 % of L	
	$360 < H$	0,1 % of L	
Eccentricity (S)	where $t_2 < 40$ $B \leqslant 110$ $110 < B \leqslant 325$ $325 < B$	 2,5 3,5 5,0	
	where $40 \leqslant t_2$ $110 < B \leqslant 325$ $325 < B$	 5,0 8,0	

Annex C
(normative)

The formula of carbon equivalent and the maximum carbon-equivalent value

C.1 Scope

If agreed between the purchaser and the manufacturer, the formula of carbon equivalent in this annex can be applied. In this case, Table C.1 shall be applied as the maximum carbon-equivalent value.

If agreed between the purchaser and the manufacturer, Table C.1 and Formula C.1 in Clause C.2 can be applied as the formula of carbon equivalent and maximum value of carbon equivalent, in place of Table 5 and Formula 1 in 5.1.3.1.

C.2 Carbon equivalent

A maximum value of carbon equivalent (CEV), based on the cast (heat) analysis, shall be as given in Table C.1. The carbon equivalent, expressed as a percentage, shall be determined using the following formula:

$$\text{CEV} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Si}}{24} + \frac{\text{Ni}}{40} + \frac{\text{Cr}}{5} + \frac{\text{Mo}}{4} + \frac{\text{V}}{14} \qquad \text{(C.1)}$$

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.

Table C.1 — Maximum value of carbon equivalent

Grade	Maximum value of carbon equivalent %	
	50 mm or under in thickness	over 50 mm, up to and including 125 mm in thickness
S235S	0,36	0,36
S325S	0,44	0,46
S345S	0,43	0,45
S460S	0,45	0,47
The applicable thickness is t_2 in the case of H-sections.		

C.3 Carbon equivalent of steel products which is processed by thermomechanical rolling

A maximum value of carbon equivalent of steel products which is processed by thermomechanical rolling, based on cast (heat) analysis is given in Table C.2.

Table C.2 — Maximum value of carbon equivalent when thermomechanically rolled process is used

Grade	Maximum value of carbon equivalent %	
	50 mm or under in thickness	over 50 mm, up to and including 125 mm in thickness
S325S	0,38	0,40
S345S	0,39	0,39
S460S	0,44	0,47

Bibliography

[1] ISO 630, *Structural steels — Plates, wide flats, bars, sections and profiles*

[2] ISO 1052, *Steels for general engineering purposes*

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

[4] ISO 4950-1, *High yield strength flat steel products — Part 1: General requirements*

[5] ISO 4950-2, *High yield strength flat steel products — Part 2: Products supplied in the normalized or controlled rolled condition*

[6] ISO 4950-3, *High yield strength flat steel products — Part 3: Products supplied in the heat-treated (quenched + tempered) condition*

[7] ISO 4951-1, *High yield strength steel bars and sections — Part 1: General delivery requirements*

[8] ISO 4951-2, *High yield strength steel bars and sections — Part 2: Delivery conditions for normalized, normalized rolled and as-rolled steels*

[9] ISO 4951-3, *High yield strength steel bars and sections — Part 3: Delivery conditions for thermomechanically-rolled steels*

[10] ISO 4952, *Structural steels with improved atmospheric corrosion resistance*

[11] ISO 6930-1, *High yield strength steel plates and wide flats for cold forming — Part 1: Delivery conditions for thermomechanically-rolled steels*

[12] ISO 6930-2, *High yield strength steel plates and wide flats for cold forming — Part 2: Delivery conditions for normalized, normalized rolled and as-rolled steels*

[13] ISO 9443, *Heat-treatable and alloy steels — Surface quality classes for hot-rolled round bars and wire rods — Technical delivery conditions*

[14] ISO 20723, *Structural steels — Surface condition of hot rolled sections — Delivery requirements*

[15] JIS G 3192, *Dimensions, mass and permissible variations of hot rolled steel sections*

[16] ASTM A6/A6M, *Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling*

[17] DIN 1025-1, *Hot rolled I-beams — Part 1: Narrow flange I-beams, I-serie — Dimensions, masses, sectional properties*

[18] DIN 1025-2, *Hot rolled I-beams — Part 2: Wide flange I-beams, IPB-serie; dimensions, masses, sectional properties*

[19] DIN 1025-3, *Hot rolled I-beams — Part 3: Wide flange I-beams, light pattern, IPBl — serie; dimensions, masses, sectional properties*

[20] DIN 1025-4, *Hot rolled I-beams — Part 4: Wide flange I-beams, heavy pattern, IPBv-serie; dimensions, masses, sectional properties*

[21] DIN 1025-5, Hot rolled I-beams — Part 5: *Medium flange I-beams, IPE-serie; dimensions, masses, sectional properties*

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Price based on 20 pages