
**Hot-finished structural hollow sections of
non-alloy and fine grain steels —**

**Part 1:
Technical delivery conditions**

*Profils creux de construction finis à chaud, en acier non allié ou à grains
fins —*

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ISO 12633-1:2011

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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.

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 12633-1 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 1, *Steel tubes*.

This first edition cancels and replaces ISO 630-2:2000, of which it constitutes a minor revision. In particular, better grouping of several documents by subject area and minor editorial improvements have been carried out. In addition, reference number ISO 630-2 has been utilized for a new subject: technical delivery conditions for structural steels for general purposes.

ISO 12633 consists of the following parts, under the general title *Hot-finished structural hollow sections of non-alloy and fine grain steels*:

- *Part 1: Technical delivery conditions*
- *Part 2: Dimensions and sectional properties*

Hot-finished structural hollow sections of non-alloy and fine grain steels —

Part 1: Technical delivery conditions

1 Scope

This part of ISO 12633 specifies the technical delivery requirements for hot-finished hollow sections of circular, square or rectangular form. It is applicable to hollow sections formed hot with or without subsequent heat treatment or formed cold with subsequent heat treatment to obtain equivalent metallurgical conditions to those obtained in the hot-formed product. Fine grain steels are generally delivered in the normalized condition.

The grades, chemical composition and mechanical properties for non-alloy steels and fine grain steels are given in Annexes A and B, respectively.

NOTE 1 For the requirements for tolerances, dimensions and sectional properties, see ISO 12633-2.

NOTE 2 For the technical delivery requirements of hot-rolled structural steels in other product forms, e.g. plates, wide strip, flats, bars and other structural sections, see ISO 630-1 and ISO 630-2.

NOTE 3 For cold-formed structural hollow sections, see ISO 10799-1 and ISO 10799-2.

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

ISO 643, *Steels — Micrographic determination of the apparent grain size*

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

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

ISO 6892-2, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature*

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

ISO 10474:1991, *Steel and steel products — Inspection documents*

ISO 12633-1:2011(E)

ISO 10893-2, *Non-destructive testing of steel tubes — Part 2: Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections*

ISO 10893-3, *Non-destructive testing of steel tubes — Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections*

ISO 10893-6, *Non-destructive testing of steel tubes — Part 6: Radiographic testing of the weld seam of welded steel tubes for the detection of imperfections*

ISO 10893-11, *Non-destructive testing of steel tubes — Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections*

ISO 12633-2, *Hot-finished structural hollow sections of non-alloy and fine grain steels — Part 2: Dimensions and sectional properties*

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

ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding*

ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

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3 Terms and definitions

ISO 12633-1:2011

For the purposes of this document, the following terms and definitions apply: <https://standards.iteh.ai/en/standards/ISO/ISO-12633-1-2011>
7F-4689-b93e-602d2a1f4493/iso-12633-1-2011

3.1

tube

hollow long product open at both ends of any cross-sectional shape

3.2

structural hollow section

tube intended to be used for structural purposes

3.3

normalizing rolling

rolling process in which the final deformation is carried out in a certain temperature range leading to a material condition equivalent to that obtained after normalizing so that the specified values of the mechanical properties are retained even after normalizing

4 Classification and designation

4.1 Classification

4.1.1 Within the steel grades of the non-alloy steels given in Annex A, three qualities JR, J0, and J2 are specified. These qualities differ with respect to specified impact requirements, method of deoxidation, and limits on values of various elements, with particular reference to sulfur and phosphorus, and inspection and testing requirements.

4.1.2 Within the steel grades of the fine grain steels given in Annex B, two qualities, N and NL, are specified. These differ in respect of the carbon, sulfur and phosphorus content and low-temperature impact properties.

4.2 Designations

4.2.1 For non-alloy steel structural hollow sections, the steel designation consists of:

- a reference to this part of ISO 12633, i.e. ISO 12633-1:2011;
- the capital letter S for structural steel;
- the indication of the minimum specified yield strength for thicknesses ≤ 16 mm, expressed in newtons per square millimetre (N/mm²);
- the capital letters JR for the qualities with specified impact properties at room temperature;
- the capital letter J and a number 0 or 2 for the qualities with specified impact properties at 0 °C and –20 °C respectively;
- the capital letter H to indicate hollow sections.

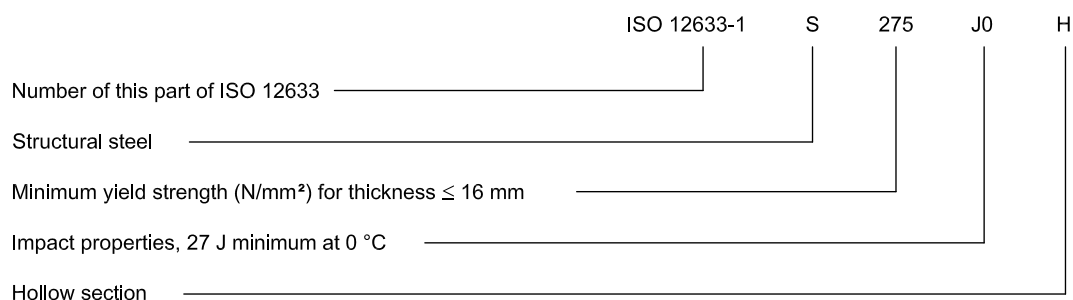
4.2.2 For fine grain steel structural hollow sections, the steel designation consists of:

- a reference to this part of ISO 12633, i.e. ISO 12633-1:2011;
- the capital letter S for structural steel;
- the indication of the minimum specified yield strength for thicknesses ≤ 16 mm, expressed in newtons per square millimetre (N/mm²);
- the capital letter N to indicate normalized or normalized rolled (see 6.4);
- the capital letter L for the qualities with specified minimum values of impact energy at a temperature of –50 °C;
- the capital letter H to indicate hollow sections.

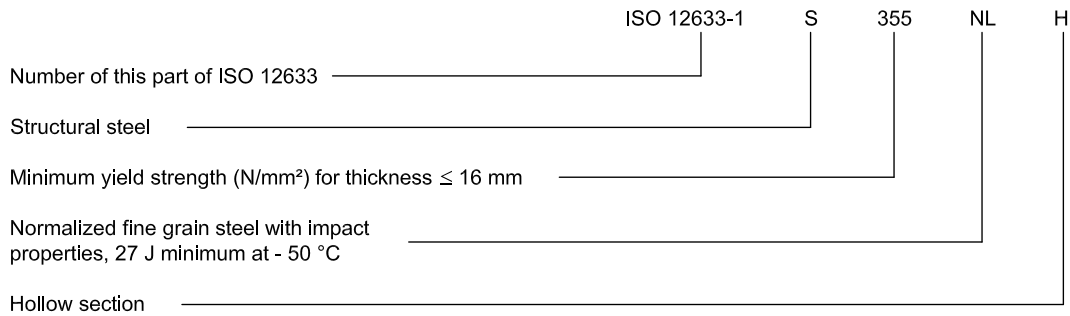
4.2.3 For modification of the designations in case of special delivery conditions, see 6.4.

4.2.4 The steel shall be designated as illustrated by the following examples:

EXAMPLE 1



EXAMPLE 2



NOTE Steel names used in this part of ISO 12633 differ from those in ISO/TS 4949.

5 Information to be supplied by the purchaser

5.1 Mandatory information

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

- a) the quantity (mass or total length or number);
- b) the type of length and length range or length (see ISO 12633-2);

- c) details of the product form:

HFCHS = hot-finished circular hollow sections;

HFRHS = hot-finished square or rectangular hollow sections;

- d) the steel designation (see 4.2);
- e) the dimensions (see ISO 12633-2);
- f) the options required (see 5.2);
- g) the type of inspection document required (see 7.2 and Tables 2 and 3).

5.2 Options

A number of options are specified in this part of ISO 12633; they are listed in this subclause with the appropriate clause references. In the event that the purchaser does not indicate his/her wish to implement any of these options at the time of enquiry and order, the products shall be supplied in accordance with the basic specification (see 5.1).

- a) Option 1: product analysis shall be carried out (see 6.5.1).
- b) Option 2: a maximum carbon equivalent value (CEV) in accordance with Table A.2 shall be provided for non-alloy grades (see 6.5.2).
- c) Option 3: the Cr, Cu, Mo, Ni, Ti and V cast analysis contents shall be reported in the inspection certificate or inspection report for non-alloy grades (see 6.5.2).
- d) Option 4: a maximum carbon equivalent value in accordance with Table B.2 shall be provided for fine grain steels S275 and S355 (see 6.5.3).

- e) Option 5: the cast analysis limits for grade S460 (see 6.5.3) shall be:
- 1) $V + Nb + Ti \leq 0,22 \%$; and
 - 2) $Mo + Cr \leq 0,30 \%$.
- f) Option 6: impact properties of quality J0 and JR shall be verified by test. This option applies only when products are ordered with specific inspection and testing (see 6.6.4).
- g) Option 7: the material shall be suitable for hot dipped galvanized coating (see 6.7.2).
- h) Option 8: weld repairs to the body of non-alloy structural steel hollow sections shall not be permitted (see 6.8.4).
- i) Option 9: specific inspection and testing for non-alloy grades of qualities JR and J0 shall be applied (see 7.1.1).

5.3 Example

Quantity and type of length (see ISO 12633-2)	10 t	12 m approximate + option 1 from ISO 12633-2	Product form	HFRHS -	ISO 12633-1 -	S355J0H -	100 × 100 × 8 -	Option 6, 9 :	3.1.B
Number of this part of ISO 12633	<p style="color: red; font-weight: bold; font-size: 1.2em;">iTeh STANDARD PREVIEW (standards.iteh.ai)</p> <p style="color: red; font-size: 0.8em;">ISO 12633-1:2011</p> <p style="color: red; font-size: 0.7em;">https://standards.iteh.ai/catalog/standards/sist/987faa08-fe7f-4689-b93e-602d2a1f4493/iso-12633-1-2011</p>								
Steel grade									
Size and thickness (see ISO 12633-2)									
Options 6 and 9 from this part of ISO 12633									
Type of inspection document selected from ISO 10474									

6 Requirements

6.1 General

Structural hollow sections of non-alloy steels shall comply with the requirements of Annex A; structural hollow sections of fine grain steels shall comply with the requirements of Annex B.

6.2 Steel manufacturing process

6.2.1 The steel manufacturing process shall be at the discretion of the steel producer.

6.2.2 For the non-alloy structural steels given in Annex A, the method of deoxidation shall be as given in Table A.1.

6.2.3 For the fine grain steels given in Annex B, the method of deoxidation shall be as given in Table B.1.

6.2.4 The fine grain steels given in Annex B shall have a ferritic grain size equal to or finer than 6 when measured in accordance with ISO 643.

6.3 Structural hollow section manufacturing process

6.3.1 Structural hollow sections shall be manufactured by a seamless or by a welding process. Welded sections manufactured by a continuous process shall not include welds used for joining lengths of the flat rolled-strip prior to forming the hollow section, except as permitted in 9.4.3.

6.3.2 Electric welded hollow sections are normally supplied without trimming the internal weld bead.

6.3.3 For quality assurance requirements, see ISO 404. If the purchaser specifies quality assurance, an appropriate International Standard, such as ISO 9001, can be used.

6.4 Delivery conditions

6.4.1 The hollow sections shall be delivered in the following conditions:

- qualities JR, J0 and J2: hot-finished;
- qualities N and NL: normalized (normalized includes normalized rolled).

6.4.2 It may be necessary for seamless hollow sections with a wall thickness above 16 mm or when *TID* is greater than 0,15 to apply accelerated cooling after austenitizing to achieve the intended structure or liquid quenching and tempering to achieve the mechanical properties. The decision shall be left to the discretion of the manufacturer, but shall be stated to the purchaser at the time of enquiry and order. Hollow sections treated in such a way shall be designated in the following ways:

- a) for accelerated cooling: by the steel name supplemented by the symbol "+DC";
- b) for quenching and tempering:
 - 1) by the steel name supplemented by the symbol "+QT" in the case of non-alloy steels;
 - 2) by a modified steel name for which the letter N is replaced with Q in cases of fine grain steels, e.g. S460QLH.

Details of the special delivery conditions shall be given in the inspection document and the product shall be marked in accordance with the above-mentioned stipulations.

NOTE Cold-formed hollow sections with subsequent heat treatment to obtain equivalent metallurgical conditions to those obtained by normalizing rolling are deemed to meet the requirements of this part of ISO 12633.

6.5 Chemical composition

6.5.1 The cast analysis reported by the steel producer shall apply and shall comply with the requirements of Tables A.1 and B.1.

Option 1 (see 5.2): a product analysis shall be carried out for hollow sections supplied with specific inspection and testing.

The permissible deviations of the product analysis from the specified-limits cast analysis are given in Table 1.

Table 1 — Permissible deviations of the product analysis from the specified limits of the cast analysis

Element	Permissible maximum content in the cast analysis	Permissible deviation of the product analysis from specified limits for the cast analysis
	mass fraction %	mass fraction %
C ^a	≤ 0,20	+0,02
	> 0,20	+0,03
Si	≤ 0,60	+0,05
Mn	non-alloy ≤ 1,60	+0,10
	fine grain ≤ 1,70	−0,05 +0,10
P	non-alloy ≤ 0,045	+0,010
	fine grain ≤ 0,035	+0,005
S	non-alloy ≤ 0,045	+0,010
	fine grain ≤ 0,030	+0,005
Nb	≤ 0,060	+0,010
V	≤ 0,20	+0,02
Ti	≤ 0,03	+0,01
Cr	≤ 0,30	+0,05
Ni	≤ 0,80	+0,05
Mo	≤ 0,10	+0,03
Cu	≤ 0,35	+0,04
	0,35 < Cu ≤ 0,70	+0,07
N	≤ 0,025	+0,002
Al _{Total}	≥ 0,020	−0,005

^a For S235JRH for thicknesses less than or equal to 16 mm, the permissible deviation is 0,04 % C, and for thicknesses greater than 16 mm and less than or equal to 40 mm, the permissible deviation is 0,05 % C.

When a CEV is required it shall be determined from the cast analysis using the formula:

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

6.5.2 For non-alloy steel products, the following additional requirements may be requested at the time of enquiry and order for products supplied with specific inspection and testing (see 7.1).

Option 2 (see 5.2): the CEV in accordance with Table A.2.

Option 3 (see 5.2): the recording on the inspection certificate or inspection report of the Cr, Cu, Mo, Ni, Ti and V content (cast analysis).

6.5.3 For fine grain steel hollow sections, the following additional requirements may be requested at the time of enquiry and order.

Option 4 (see 5.2): the CEV for steel grades S275 and S355 in accordance with Table B.2.

Option 5 (see 5.2): for steel grade S460, the following limits for the cast analysis:

$$V + Nb + Ti \leq 0,22 \% \quad \text{and} \quad Mo + Cr \leq 0,30 \%$$

A maximum CEV may be agreed between the purchaser and manufacturer as an alternative to option 5.

6.6 Mechanical properties

6.6.1 Under the inspection and testing conditions as specified in Clause 7 and in the delivery condition as specified in 6.4, the mechanical properties shall comply with the relevant requirements of Tables A.3 and B.3.

Stress relief annealing at more than 580 °C or for over 1 h may lead to deterioration of the mechanical properties. If the purchaser intends to stress relief anneal the products at higher temperatures or for longer times, the minimum values of the mechanical properties after such a treatment should be agreed at the time of the enquiry and order.

6.6.2 For impact tests, standard V-notch test pieces (see ISO 148-1) shall be used. If the nominal product thickness is not sufficient for the preparation of standard test pieces, the test shall be carried out using test pieces of width less than 10 mm, but not less than 5 mm. The minimum average values given in Tables A.3 and B.3 shall be reduced in direct proportion to the actual width of the test piece to that of the standard test piece.

Impact tests are not required for nominal thickness less than 6 mm.

6.6.3 For fine grain steel hollow sections in thicknesses which do not permit impact test pieces of width greater than or equal to 5 mm to be taken, the ferritic grain size (see 6.3.2) shall be verified by the method described in ISO 643.

When aluminium is used as the grain refining element, the grain size requirement shall be deemed to be fulfilled if the cast analysis shows the aluminium content to be not less than 0,020 % total aluminium or alternatively 0,015 % acid soluble aluminium. In these cases verification of the grain size is not required.

6.6.4 Subject to the limitations of 6.6.2:

- a) the impact properties of structural hollow sections of steel qualities J2, N and NL shall be verified;
- b) the impact properties of structural hollow sections of steel qualities JR and J0 are not verified.

Option 6 (see 5.2): the purchaser may request at the time of enquiry and order, for products supplied with specific inspection and testing (see option 9), that the impact properties be verified.

6.7 Technological properties

6.7.1 Weldability

The steels specified in this part of ISO 12633 shall be suitable for welding by all appropriate welding processes.

NOTE 1 With increasing product thickness, increasing strength level and increasing carbon equivalent level, the occurrence of cold cracking in the welded zone forms the main risk. Cold cracking is caused by the following factors in combination:

- the amount of diffusible hydrogen in the weld metal;
- a brittle structure of the heat affected zone;
- significant tensile stress concentrations in the welded joint.

NOTE 2 When using recommendations as laid down in any relevant standard, the recommended welding conditions and the various welding ranges of the steel grades can be determined depending on the product thickness, the applied welding energy, the design requirements, the electrode efficiency, the welding process and the weld metal properties.