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

**Part 2:  
Dimensions and sectional properties**

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

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*Partie 2: Dimensions et caractéristiques du profil*

ISO 12633-2:2011

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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 12633-2 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 1, *Steel tubes*.

This first edition of ISO 12633-2 cancels and replaces ISO 657-14:2000, 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.

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 2: Dimensions and sectional properties

### 1 Scope

This part of ISO 12633 specifies the tolerances for hot-finished circular, square and rectangular structural hollow sections, and gives the dimensions and sectional properties for a range of standard sizes.

NOTE For the technical delivery requirements, see ISO 12633-1.

### 2 Normative reference

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 12633-1, *Hot-finished structural hollow sections of non-alloy and fine grain steels — Part 1: Technical delivery conditions* <https://standards.iteh.ai/catalog/standards/sist/d7ba836a-24d9-4987-9884-3a549a547af4/iso-12633-2-2011>

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12633-1 apply.

### 4 Symbols

For the purposes of this document, the symbols given in Table 1 apply.

Table 1 — Symbols

Symbol	Unit	Definition
$A$	cm <sup>2</sup>	Cross-sectional area
$A_s$	m <sup>2</sup> /m	Surface area per unit length
$B$	mm	Nominal length of side of a square hollow section Nominal length of the shorter side of a rectangular hollow section
$C_1; C_2$	mm	Length of external corner profile of a square or rectangular hollow section
$C_t$	cm <sup>3</sup>	Torsional-modulus constant
$D$	mm	Nominal outside diameter of a circular hollow section
$D_{max}; D_{min}$	mm	Maximum and minimum outside diameter of a circular hollow section, measured in the same plane

Table 1 (continued)

Symbol	Unit	Definition
$e$	mm	Deviation from straightness
$H$	mm	Nominal length of the longer side of a rectangular hollow section
$I$	cm <sup>4</sup>	Second moment of area
$I_t$	cm <sup>4</sup>	Torsional-inertia constant (polar moment of inertia for circular hollow sections only)
$i$	cm	Radius of gyration
$L$	mm	Length
$M$	kg/m	Mass per unit length
$O$	%	Out-of-roundness
$R$	mm	External corner radius of a square or rectangular hollow section
$T$	mm	Nominal thickness
$V$	mm	Total twist
$V_1$	mm	Twist measured at one end of a section
$W_{el}$	cm <sup>3</sup>	Elastic section modulus
$W_{pl}$	cm <sup>3</sup>	Plastic section modulus
$x_1$	mm	Concavity of a side of a square or rectangular hollow section
$x_2$	mm	Convexity of a side of a square or rectangular hollow section
XX	—	Axis of cross-section: major axis of a rectangular hollow section
YY	—	Axis of cross-section: minor axis of a rectangular hollow section
$\theta$	Degrees	Angle between adjacent sides of a square or rectangular hollow section

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## 5 Information to be supplied by the purchaser

### 5.1 Mandatory information

The following information from this part of ISO 12633 shall be supplied by the purchaser at the time of enquiry and order:

- the type of length, and the length or the length range (see Table 3);
- the dimensions (see Clause 8).

NOTE This information is included in the list of information to be supplied by the purchaser contained in 5.1 of ISO 12633-1:—.

### 5.2 Options

One option is specified in this part of ISO 12633. In the event that the purchaser does not indicate his wish to implement this option at the time of enquiry or order, the products shall be supplied in accordance with the basic specification (see 5.1).

Option 1: the tolerance on approximate length shall be  ${}^{+150}_0$  mm (see Table 3).

## 6 Tolerances

**6.1** Tolerances on the dimensions and mass of hot-finished hollow sections shall not exceed the values given in Table 2 for shape and mass, Table 3 for length and, in the case of submerged-arc-welded hollow sections, Table 4 for the height of the internal and external weld bead.

**6.2** The internal corners of square and rectangular hollow sections shall be rounded.

NOTE The internal corner profile is not specified.

**Table 2 — Tolerances**

Characteristic	Circular hollow sections	Square and rectangular hollow sections
Outside dimensions ( $D$ , $B$ , $H$ )	$\pm 1$ %, with a minimum of $\pm 0,5$ mm and a maximum of $\pm 10$ mm	$\pm 1$ %, with a minimum of $\pm 0,5$ mm
Thickness, $T$	– 10 % <sup>ab</sup>	
Out-of-roundness, $O$	2 % for hollow sections having a diameter to thickness ratio not exceeding 100 <sup>c</sup>	—
Concavity/convexity <sup>d</sup>	—	1 %
Squareness of sides	—	$90^\circ \pm 1^\circ$
External corner profile ( $C_1$ , $C_2$ or $R$ ) <sup>e</sup>	—	$3T$ maximum at each corner
Twist, $V$	—	2 mm plus 0,5 mm/m length
Straightness	0,2 % of total length	
Mass per unit length, $M$	$\pm 6$ % on individual lengths <sup>f</sup>	
<p><sup>a</sup> The positive deviation is limited by the tolerance on mass.</p> <p><sup>b</sup> For seamless sections, thicknesses 10 % less than, but not more than 12,5 % less than, the nominal thickness may occur in smooth transition areas, but not over more than 25 % of the circumference.</p> <p><sup>c</sup> Where the diameter to thickness ratio exceeds 100, the tolerance on out-of-roundness shall be agreed.</p> <p><sup>d</sup> The tolerance on convexity and concavity is independent of the tolerance on outside dimensions.</p> <p><sup>e</sup> The sides need not be tangential to the corner arcs.</p> <p><sup>f</sup> The positive tolerance on the mass per unit length of seamless hollow sections shall be 8 %.</p>		

**Table 3 — Tolerances on length<sup>a</sup>**

Type of length	Range mm	Tolerance
Random length	4 000 to 16 000 with a range of 2 000 per order item	10 % of sections supplied may be below the minimum for the ordered range but not less than 75 % of the minimum of the range
Approximate length	4 000 to 16 000	$\pm 500$ mm <sup>b</sup>
Exact length	$\geq 2\ 000$ to 6 000	$^{+10}_0$ mm
	$\geq 6\ 000$	$^{+15}_0$ mm
<p><sup>a</sup> The purchaser shall indicate in the enquiry and order the type of length required and the length range or length as appropriate.</p> <p><sup>b</sup> Option 1 (see 5.2): the tolerance on the approximate length shall be <math>^{+150}_0</math> mm.</p>		

**Table 4 — Tolerance on height of internal and external weld bead for submerged-arc-welded hollow sections**

Thickness <i>T</i> mm	Maximum weld bead height mm
≤ 14,2	3,5
> 14,2	4,8

**7 Measurement of size and shape**

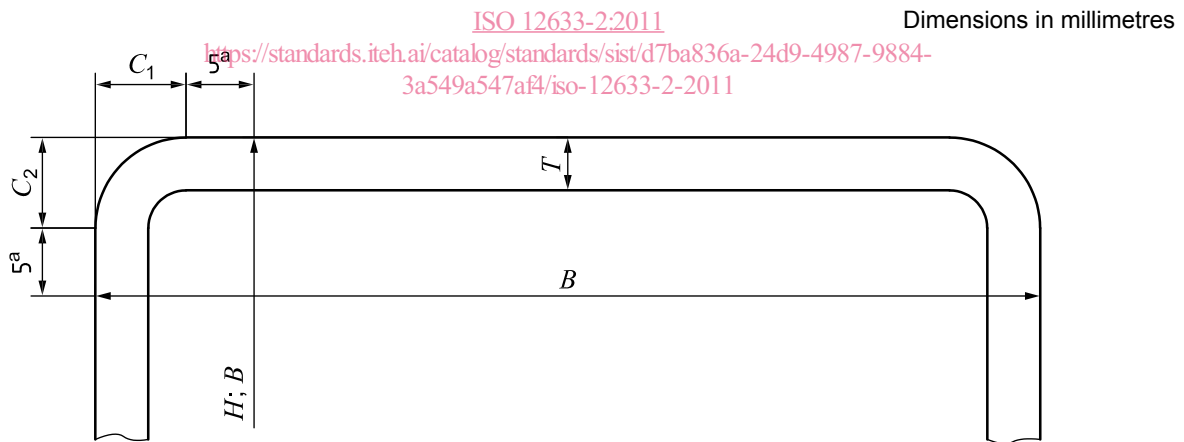
**7.1 General**

All external dimensions, including out-of-roundness, shall be measured at a distance from the end of the hollow section of not less than *D* for circular sections, *B* for square sections or *H* for rectangular sections, with a minimum of 100 mm.

**7.2 Outside dimensions**

For circular hollow sections, the diameter, *D*, shall be measured. A calliper gauge, circumference tape or other suitable device may be used at the discretion of the manufacturer.

Dimensions *B* and *H* shall be measured at a position within 5 mm from the start of the external corner profile as shown in Figure 1.



<sup>a</sup> This dimension is a maximum when measuring *B* or *H* and a minimum when measuring *T*.

**Figure 1 — Limiting cross-sectional positions for measuring the dimensions *B*, *H* and *T* for square or rectangular hollow sections**

**7.3 Thickness**

The thickness, *T*, of welded hollow sections shall be measured at a position not less than  $2T$  from the weld.

The limiting cross-sectional positions for measuring the thickness of square and rectangular hollow sections are shown in Figure 1.

NOTE Thickness is normally measured within a distance of half the outside diameter or half the longer side length from the end of the section.



## 7.4 Out-of-roundness

The percentage out-of-roundness,  $O$ , of a circular hollow section shall be calculated from the following equation:

$$O = \frac{D_{\max} - D_{\min}}{D} \times 100$$

## 7.5 Concavity and convexity

The concavity,  $x_1$ , or the convexity  $x_2$ , of the sides of a square or rectangular hollow section shall be measured as shown in Figure 2.

The percentage concavity or convexity shall be calculated using the following:

$$\frac{x_1}{B} \times 100; \frac{x_2}{B} \times 100; \frac{x_1}{H} \times 100; \frac{x_2}{H} \times 100$$

where  $B$  and  $H$  are the lengths of the sides containing the concavity,  $x_1$ , or the convexity,  $x_2$ .

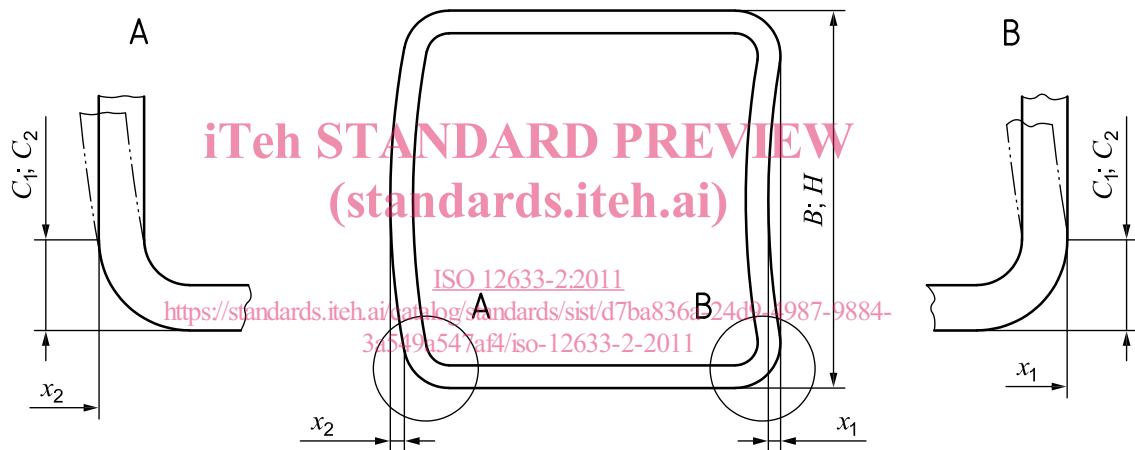
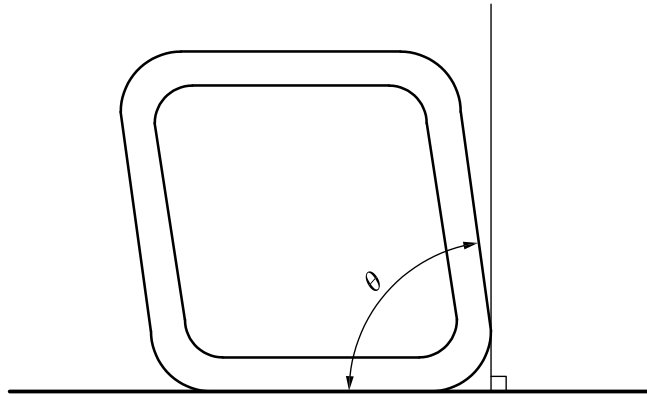


Figure 2 — Measurement of concavity/convexity of square or rectangular hollow sections

## 7.6 Squareness of sides

The deviation from squareness of the sides of a square or rectangular hollow section is defined as the difference between  $90^\circ$  and  $\theta$  as shown in Figure 3.



Deviation from squareness =  $90^\circ - \theta$

**Figure 3 — Squareness of sides of square or rectangular hollow sections**

**7.7 External corner profile**

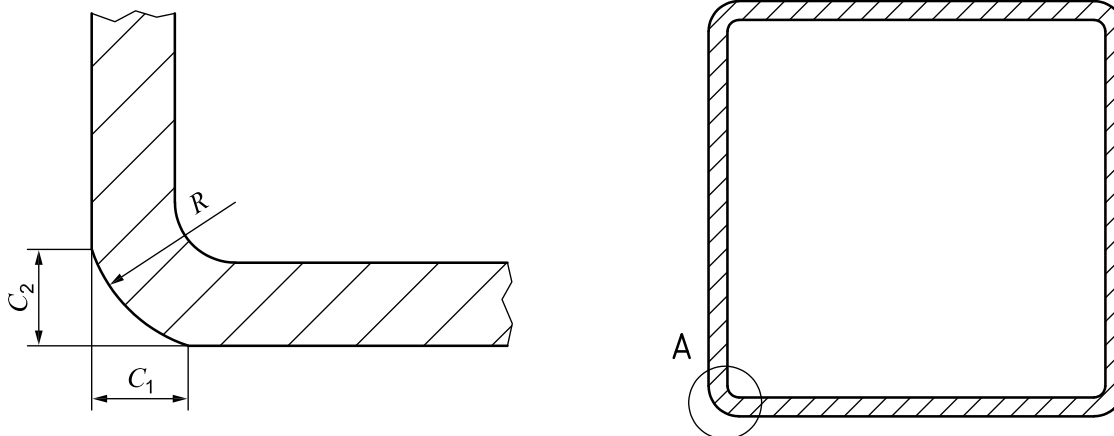
**7.7.1** The external corner profile of a square or rectangular hollow section shall be measured in accordance with 7.7.2 or 7.7.3 at the discretion of the manufacturer.

**7.7.2** Measure the external corner radius, *R*. Use a radius gauge or other suitable device.

**7.7.3** Measure the length of the external corner profile (*C*<sub>1</sub> and *C*<sub>2</sub> in Figure 4).

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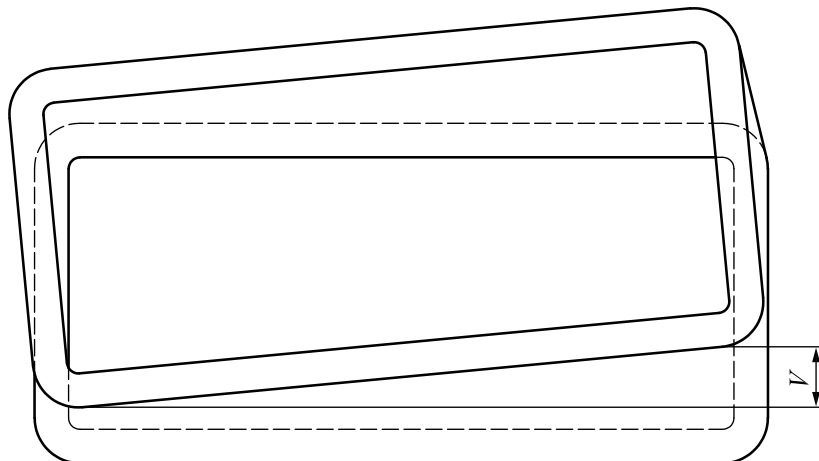
**Figure 4 — External corner profile of square or rectangular hollow sections**

**7.8 Twist**

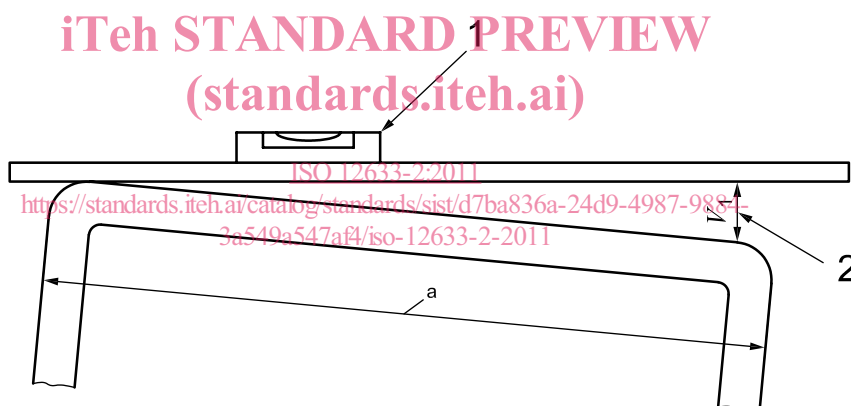
**7.8.1** The total twist, *V*, in a square or rectangular hollow section shall be determined in accordance with 7.8.2 or 7.8.3 at the discretion of the manufacturer.

**7.8.2** Place the hollow section on a horizontal surface with one side at one end pressed flat against the surface. At the opposite end of the hollow section, determine the difference, *V*, in the height of the two lower corners from a horizontal surface (see Figure 5).

**7.8.3** Measure the total twist,  $V$ , with a spirit level and micrometer (screw) gauge or other suitable device. The reference length of the spirit level shall be the distance between the intersection of the flat sides and the external corner profile (see Figure 6). The total twist,  $V$ , is the difference between the values  $V_1$  (see Figure 6) measured at each end of the hollow section.



**Figure 5 — Total twist of square or rectangular hollow sections**



**Key**

- 1 spirit level
- 2 micrometer gauge
- <sup>a</sup>  $H$  for rectangular sections,  $B$  for square sections.

**Figure 6 — Measurement of twist**

## 7.9 Straightness

The deviation from straightness,  $e$ , of the total length of a hollow section shall be measured at the point of maximum departure of the hollow section from a straight line connecting its two ends as shown in Figure 7. The percentage deviation from straightness shall be calculated using the following:

$$\frac{e}{L} \times 100 \%$$

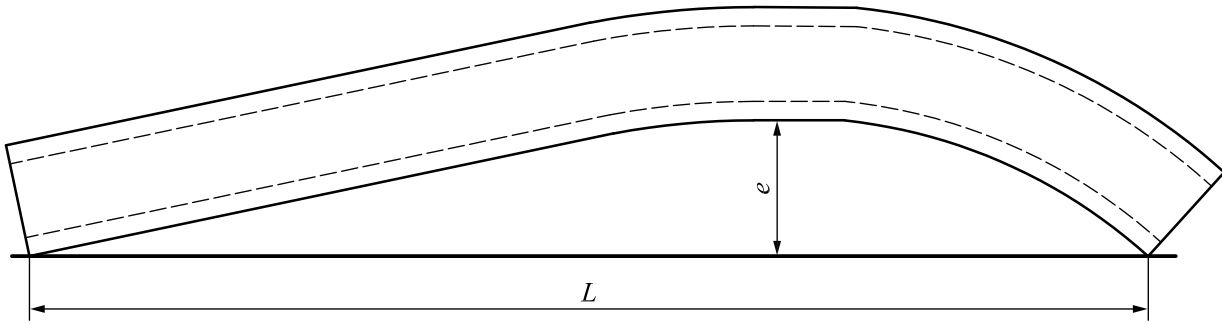
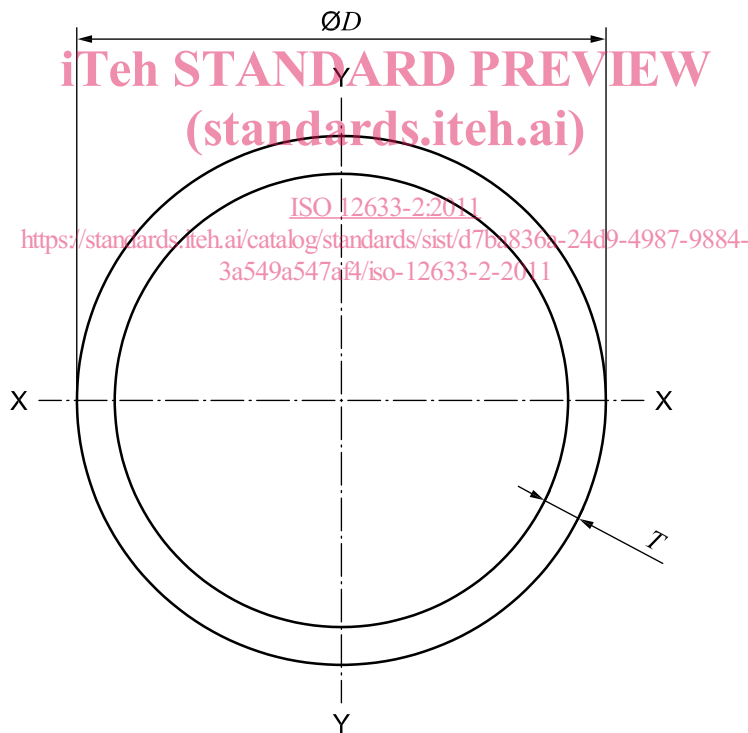


Figure 7 — Measurement of deviation from straightness

### 8 Dimensions and sectional properties

The nominal section dimensions and sectional properties for a range of sizes of hot-finished structural hollow sections are given in Table 5 for circular sections (see Figure 8), Table 6 for square sections and Table 7 for rectangular sections. The sectional properties were calculated from the formulae given in Annex A. Other sizes and thicknesses may be available.



NOTE See Table 5.

Figure 8 — Circular hollow section