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**Structural steels — Cold-formed, welded,  
structural hollow sections — Dimensions  
and sectional properties**

*Aciers de construction — Profils creux pour la construction soudés formés à  
froid — Dimensions et caractéristiques du profil*

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4019 was prepared by Technical Committee ISO/TC 5, *Ferrous metal pipes and metallic fittings*, Subcommittee SC 1, *Steel tubes*.

This second edition cancels and replaces the first edition (ISO 4019:1982), which has been technically revised.

Annex A forms a normative part of this International Standard.

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# Structural steels — Cold-formed, welded, structural hollow sections — Dimensions and sectional properties

## 1 Scope

This International Standard specifies the tolerances for cold-formed, welded, structural hollow steel sections that are circular, square or rectangular, and gives the dimensions and sectional properties for a range of standard sizes.

NOTE For technical delivery requirements, see ISO 10799.

## 2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 10799:2001, *Structural steels — Cold-formed, welded, structural hollow sections — Technical delivery requirements*.

## 3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 10799 apply.

## 4 Symbols

Symbols used in this International Standard are given in Table 1.

## 5 Information to be supplied by the purchaser

The following mandatory information, taken from this International Standard, shall be supplied by the purchaser at the time of enquiry and ordering:

- a) the type of length, and the length or length range (see Table 4);
- b) 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 10799:2001, 5.1.

Table 1 — Symbols

Symbol	Unit	Definition
$A$	cm <sup>2</sup>	Cross-sectional area
$A_s$	m <sup>2</sup> /m	Surface area per metre 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
$e$	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

## 6 Tolerances

Tolerances on the dimensions and mass of cold-formed hollow sections shall not exceed the values given in Table 2 for shape and mass, Table 3 for external corner profiles, Table 4 for length and, in the case of submerged-arc-welded hollow sections, Table 5 for the height of the internal and external weld beads.

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	
		Side length, mm	Tolerance
Outside dimensions ( $D$ , $B$ and $H$ )	$\pm 1\%$ , with a minimum of $\pm 0,5$ mm and a maximum of $\pm 10$ mm.	$H, B < 100$	$\pm 1\%$ , with a minimum of $\pm 0,5$ mm
		$100 \leq H, B \leq 200$	$\pm 0,8\%$
		$H, B > 200$	$\pm 0,6\%$
Thickness, $T$	For $D \leq 406,4$ mm: $T \leq 5$ mm: $\pm 10\%$ $T > 5$ mm: $\pm 0,50$ mm For $D > 406,4$ mm $\pm 10\%$ with a maximum of $\pm 2$ mm	$T \leq 5$ mm: $\pm 10\%$ $T > 5$ mm: $\pm 0,50$ mm	
Out-of-roundness, $O$	2 % for hollow sections having a diameter to thickness ratio not exceeding 100 <sup>a</sup>	—	
Concavity/convexity <sup>b</sup>	—	Max. 0,8 %, with a minimum of 0,5 mm	
Squareness of sides	—	$90^\circ \pm 1^\circ$	
External corner profile	—	See Table 3	
Twist, $V$	—	2 mm plus 0,5 mm/m length	
Straightness	0,20 % of total length	0,15 % of total length	
Mass, $M$ , per unit length	$\pm 6\%$ on individual lengths		

<sup>a</sup> Where the diameter to thickness ratio exceeds 100, the tolerance on out-of-roundness shall be agreed.

<sup>b</sup> The tolerance on convexity and concavity is independent of the tolerance on outside dimensions.

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Table 3 — External corner profile

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Thickness $T$ mm	External corner profile $C_1$ , $C_2$ or $R^a$ mm
$T \leq 6$	$1,6 T$ to $2,4 T$
$6 < T \leq 10$	$2,0 T$ to $3,0 T$
$T > 10$	$2,4 T$ to $3,6 T$

<sup>a</sup> The sides need not be tangential to the corner arcs.

Table 4 — 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	$\geq 4 000$	+50 mm 0
Exact length	$< 6 000$	+5 mm 0
	$\geq 6 000$ to $\leq 10 000$	+15 mm 0
	$> 10 000$	+5 mm+1 mm/m 0

<sup>a</sup> The purchaser shall indicate in the enquiry and order the type of length required and the length or length range as appropriate.

Table 5 — Tolerance on height of internal and external weld bead for submerged-arc-welded hollow sections

Thickness $T$ mm	Maximum weld bead height mm
$\leq 14,2$	3,5
$> 14,2$	4,8

## 7 Measurement of size and shape

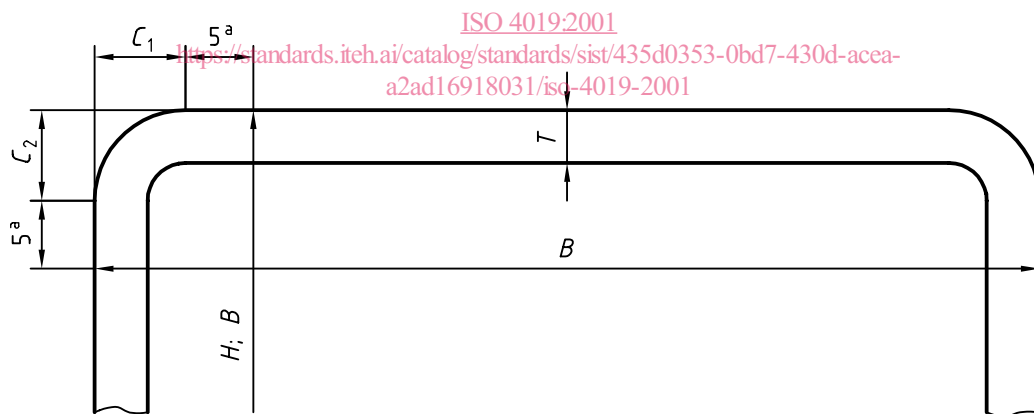
### 7.1 General

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 and  $H$  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.



Dimensions in millimetres

<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 dimensions  $B$ ,  $H$  and  $T$  for square or rectangular hollow sections

### 7.3 Thickness

The thickness  $T$  shall be measured at a position of 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 out-of-roundness,  $O$ , of a circular hollow section shall be calculated, as a percentage, 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 as follows:

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

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

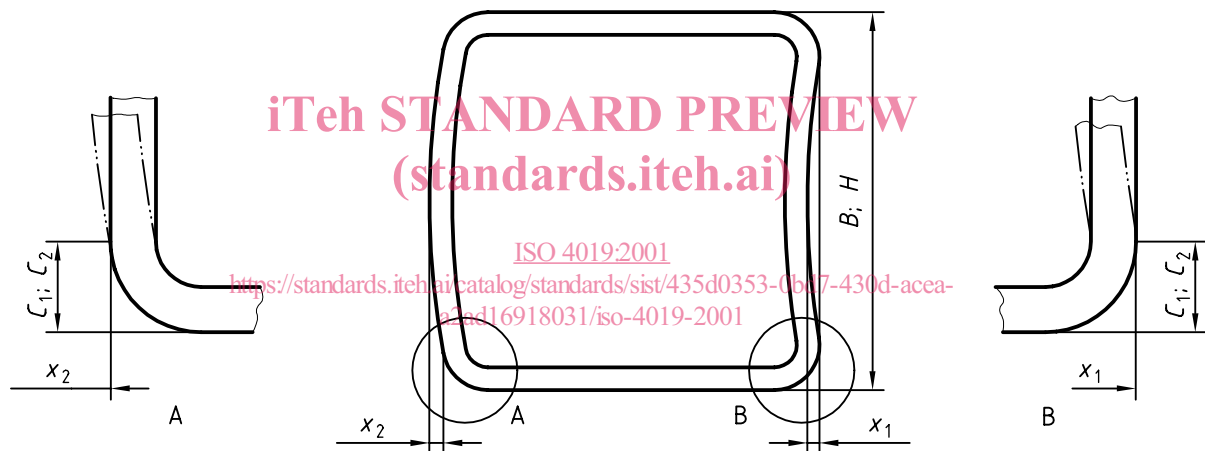
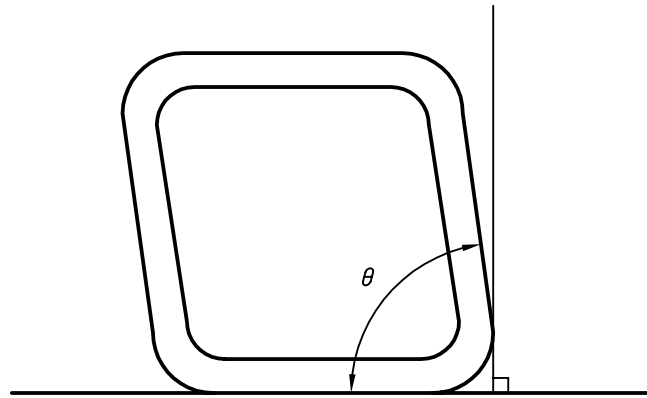


Figure 2 — Measurement of concavity/convexity of square or rectangular hollow sections

## 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.



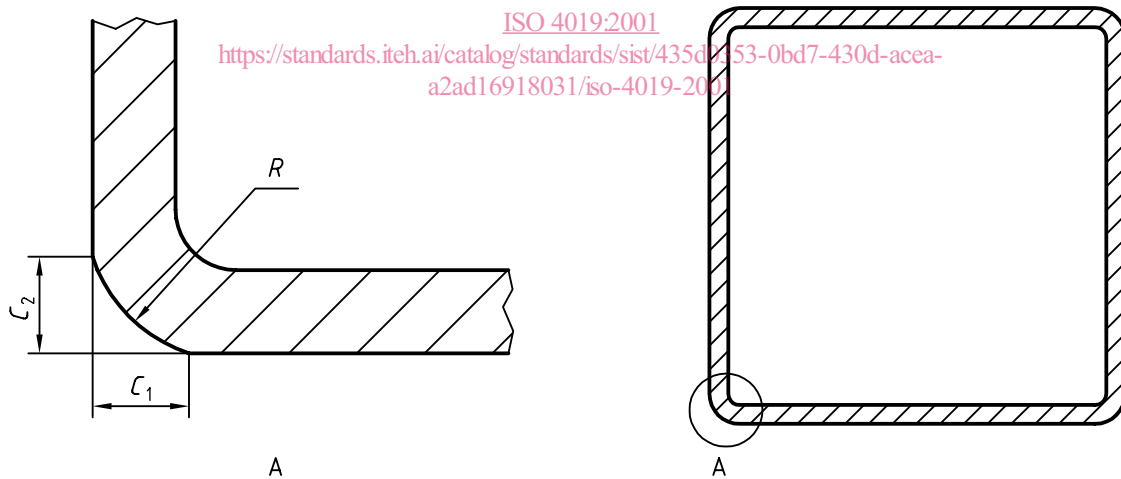
<sup>a</sup> Deviation from squareness =  $90^\circ - \theta$

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

**7.7 External corner profile**

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

- a) Measure the external corner radius  $R$ . Use a radius gauge or other suitable device.
- b) Measure the length of the external corner profile ( $C_1$  and  $C_2$  in Figure 4).



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

**7.8 Twist**

The total twist,  $V$ , in a square or rectangular hollow section shall be determined in accordance with a) or b), at the discretion of the manufacturer.

- a) 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).

- b) Measure  $V$  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).  $V$  is the difference between the values  $V_1$  (see Figure 6) measured at each end of the section.

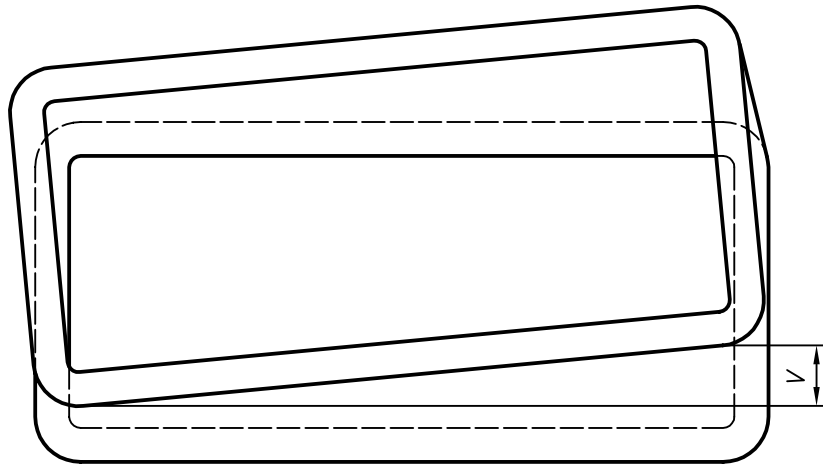
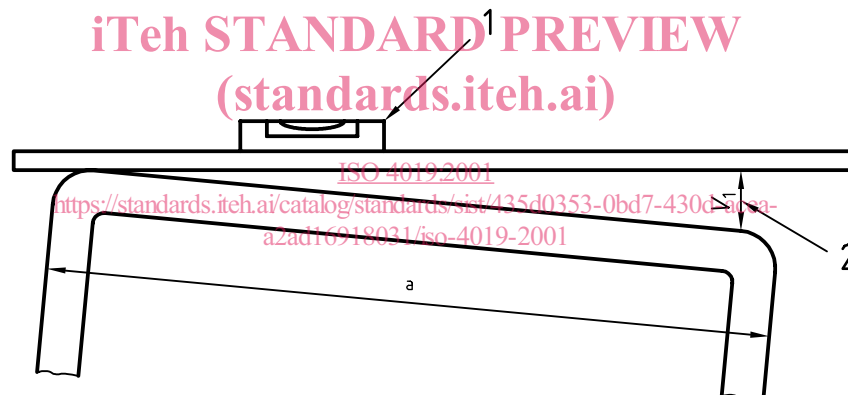


Figure 5 — Total twist of square or rectangular hollow sections



**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 section from a straight line connecting its two ends, as shown in Figure 7. The percentage deviation from straightness shall be calculated as follows:

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

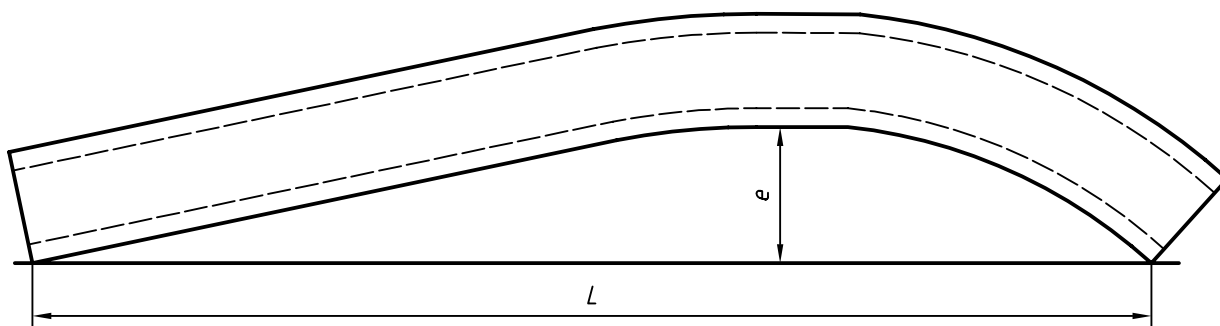


Figure 7 — Measurement of deviation from straightness

## 8 Dimensions and sectional properties

The nominal-section dimensions and sectional properties for a range of cold-formed, structural hollow section sizes are given in Table 6 for circular sections, Table 7 for square sections and Table 8 for rectangular sections. The sectional properties were calculated from the formulae given in annex A. Other sizes and thicknesses may be available.

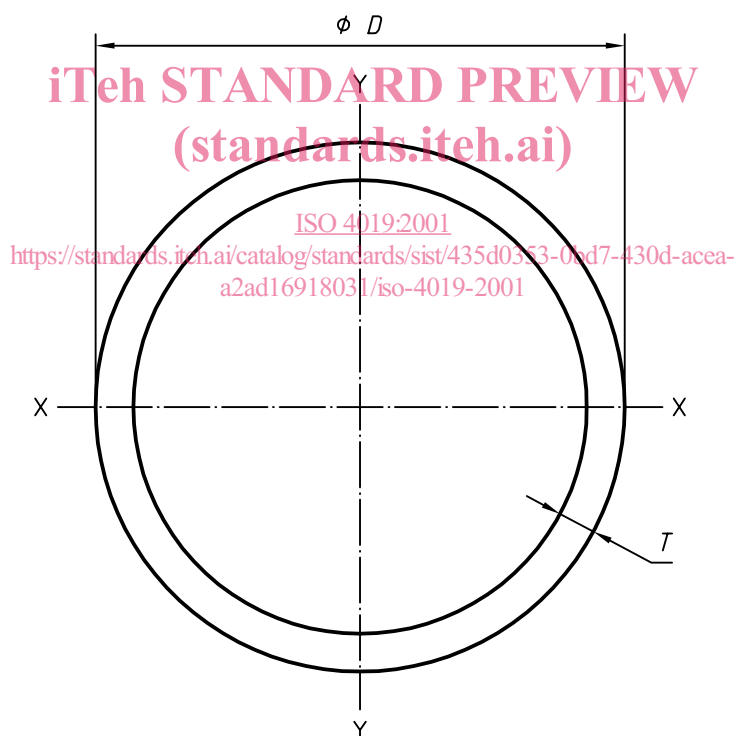


Figure 8 — Circular hollow section (see Table 6)