



BSI Standards Publication

Hot finished steel structural hollow sections

Part 2: Tolerances, dimensions and sectional properties

Botop Steel

bsi.

<https://www.botopsteelpipe.com>

EUROPEAN STANDARD

EN 10210-2

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2019

ICS 77.140.75

Supersedes EN 10210-2:2006

English Version

Hot finished steel structural hollow sections - Part 2: Tolerances, dimensions and sectional properties

Profils creux de construction finis à chaud en aciers -
Partie 2 : Tolérances, dimensions et caractéristiques de
section

Warmgefertigte Hohlprofile für den Stahlbau - Teil 2:
Grenzabmaße, Maße und statische Werte

This European Standard was approved by CEN on 20 March 2019.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword	3
1 Scope	4
2 Normative references	4
3 Terms and definitions	4
4 Symbols	4
5 Information to be obtained by the manufacturer	6
6 Tolerances	6
7 Measurement of size and shape	8
8 Dimensions and sectional properties	13
Annex A (normative) Formulae for the calculation of sectional properties	14
A.1 General	14
A.2 Circular hollow sections	14
A.3 Rectangular, including square, hollow sections	15
A.4 Elliptical hollow sections	17
Annex B (normative) Sectional properties for a limited range of standard sizes	19

European foreword

This document (EN 10210-2:2019) has been prepared by Technical Committee CEN/TC 459 “ECISS - European Committee for Iron and Steel Standardization”¹, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2019, and conflicting national standards shall be withdrawn at the latest by November 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 10210-2:2006.

The main changes with respect to the previous edition are listed below:

- a) paragraph 5.2 two options were added;
- b) in Table 2 the mass tolerances were changed;
- c) Figure 2 was updated;
- d) for Tables B.1, B.2 and B.3 larger sizes and wall thicknesses were added;
- e) standard was editorially revised.

This standard consists of the following parts:

- EN 10368, *Steel structural hollow sections — General (Characteristics, evaluation of conformity and marking)* (in preparation)
- EN 10210-1, *Hot finished steel structural hollow sections — Part 1: Technical delivery conditions*
- EN 10210-2, *Hot finished steel structural hollow sections — Part 2: Tolerances, dimensions and sectional properties*
- EN 10210-3, *Hot finished steel structural hollow sections — Part 3: Technical delivery conditions for mechanical engineering purposes* (in preparation)

It forms part of a series of standards on hollow sections together with EN 10219-1 to EN 10219-3.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

¹ Through its subcommittee SC 3 “Structural steels other than reinforcements” (secretariat: DIN)

1 Scope

This document specifies tolerances for hot finished circular, square, rectangular and elliptical structural hollow sections, manufactured in wall thicknesses up to 120 mm, in the following size ranges:

- Circular: Outside diameters up to 2 500 mm;
- Square: Outside dimensions up to 800 mm × 800 mm;
- Rectangular: Outside dimensions up to 750 mm × 500 mm;
- Elliptical: Outside dimensions up to 500 mm × 250 mm.

The formulae for calculating sectional properties of sections manufactured to the dimensional tolerances of this standard, to be used for the purposes of structural design, are given in Annex A.

Dimensions and sectional properties for a limited range covering the more common sizes are given in Annex B.

NOTE The designation of the sections' major axis (yy) and minor axis (zz) aligns with the axis designation used for structural design in the structural Eurocodes.

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.

EN 10210-1, *Hot finished structural hollow sections of non-alloy and fine grain steels — Part 1: Technical delivery conditions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10210-1 apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Symbols

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

Table 1 — Symbols and definitions

Symbol	Unit	Definition
A	cm ²	Cross-sectional area
A_m	mm ²	Area of the surface delimited by the perimeter at mid-thickness
A_s	m ² /m	Superficial area per metre length
B	mm	Specified side dimension of a square hollow section. Specified dimension of the shorter side of a rectangular

Symbol	Unit	Definition
		hollow section. Specified outside dimension of an elliptical section on its minor axis
C_1/C_2	mm	Length of corner region of a square or rectangular hollow section
C_t	cm ³	Torsional modulus constant
D	mm	Specified 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	Specified dimension of the longer side of a rectangular hollow section. Specified outside dimension of an elliptical section on its major axis
I	cm ⁴	Second moment of area
I_t	cm ⁴	Torsional inertia constant (polar moment of inertia in the case of circular hollow sections only)
i	cm	Radius of gyration
L	mm	Length
M	kg/m	Mass per unit length
O	%	Out-of-roundness
P	mm	External perimeter of an elliptical hollow section
R	mm	External corner radius of a square or rectangular hollow section
T	mm	Specified thickness
U	mm	Perimeter of an elliptical hollow section at mid-thickness
V	mm	Total measured twist
V_1	mm	Twist measured at one end of a section
W_{el}	cm ³	Elastic section modulus
W_{pl}	cm ³	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
yy	—	Axis of cross-section, major axis of a rectangular hollow section
zz	—	Axis of cross-section, minor axis of a rectangular hollow section
θ	°	Angle between adjacent sides of a square or rectangular hollow section

5 Information to be obtained by the manufacturer

5.1 Mandatory information

The following mandatory information from this part of EN 10210 shall be obtained by the manufacturer at the time of enquiry and order:

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

NOTE This Information is included in the list of information to be obtained by the manufacturer contained in EN 10210-1.

5.2 Options

Options are specified in this part of EN 10210. In the event that the purchaser does not indicate a wish to implement one of these options at the time of enquiry and order, the manufacturer shall supply in accordance with the basic specification.

- Option 2.1 The tolerance on approximate length shall be $+150_0$ mm (see Table 3).
- Option 2.2 Tolerance of external corner radius of 2T maximum at each corner.
- Option 2.3 Out-of-roundness tolerances for diameter to thickness ratio exceeding 100 (see Table 2, footnote d).

6 Tolerances

6.1 Tolerances shall not exceed the values given in Table 2 for shape, straightness and mass, Table 3 for manufacturer's delivered length and Table 4 for the height of the internal and external weld bead of submerged arc welded hollow sections.

6.2 The internal corners of square and rectangular hollow sections shall be rounded, except in the case of EW sections for a corner containing the weld, should the weld be located in the corner region.

NOTE The internal corner profile is not specified.

Table 2 — Tolerances on shape, straightness and mass

Characteristic	Circular sections	hollow	Square and rectangular sections	and hollow sections	Elliptical sections	hollow
Outside dimensions (D , B , H)	±1 % with a minimum of ± 0,5 mm and a maximum of ± 10 mm		±1 ^a % with a minimum of ± 0,5 mm			
Thickness (T)	- 10 % ^{b c}					
Out-of-roundness (O)	2 % for hollow sections having a diameter to thickness ratio not exceeding 100 ^d		—			
Concavity/Convexity (x_1 , x_2) ^e	—		1 %		—	
Squareness of side (θ)	—		90° ± 1°		—	
External corner profile (C_1 , C_2 or R) ^f	—		3T maximum at each corner		—	
Twist (V)	—		2 mm ^a plus 0,5 mm/m length			
Straightness (e)	0,2 ^a % of total length and 3 mm over any 1 m length					
Mass (M)	- 6 %/+ 8 % on individual delivered lengths					
<p>^a For elliptical hollow sections of sizes $H < 250$ mm, the permitted tolerance is twice the value given in this table.</p> <p>^b The positive deviation is limited by the tolerance on mass.</p> <p>^c For seamless sections thicknesses of less than 10 % but not less than 12,5 % of the nominal thickness may occur in smooth transition areas over not more than 25 % of the circumference.</p> <p>^d When the diameter to thickness ratio exceeds 100, application of tolerance on out-of-roundness is not required, unless specifically agreed (see 5.2).</p> <p>^e The tolerance on convexity and concavity is independent of the tolerance on outside dimensions.</p> <p>^f The sides need not be tangential to the corner arcs.</p>						

Table 3 — Tolerances on manufacturer's delivered length

Dimensions in millimetres

Type of length ^a	Range of length or length <i>L</i>	Tolerance
Random length	$4\ 000 \leq L \leq 16\ 000$ with a range of 2 000 per order item	10 % of sections supplied may be below the minimum for the ordered range but not shorter than 75 % of the minimum range length
Approximate length	$4\ 000 \leq L \leq 16\ 000$	± 500 mm ^b
Exact length	$2\ 000 \leq L \leq 6\ 000$ $6\ 000 < L$ ^c	$^{+10}_0$ mm $^{+15}_0$ mm

^a The manufacturer shall establish at the time of enquiry and order the type of length required and the length range or length.

^b Option 3.1 the tolerance on approximate length is $^{+150}_0$ mm.

^c Common lengths available are 6 m and 12 m.

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

Dimensions in millimetres

Thickness, <i>T</i>	Maximum weld bead height
$\leq 14,2$	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 or *H* for rectangular and elliptical sections, with a minimum of 100 mm.

7.2 Outside dimensions

For circular hollow sections the diameter (*D*) and for elliptical hollow sections the outside dimensions (*B* and *H*) shall be measured either directly, e.g. using a calliper gauge, or for circular tubes by circumference tape at the discretion of the manufacturer.

The limiting cross-sectional positions for measuring *B* and *H* for square and rectangular hollow sections are shown in Figure 1.

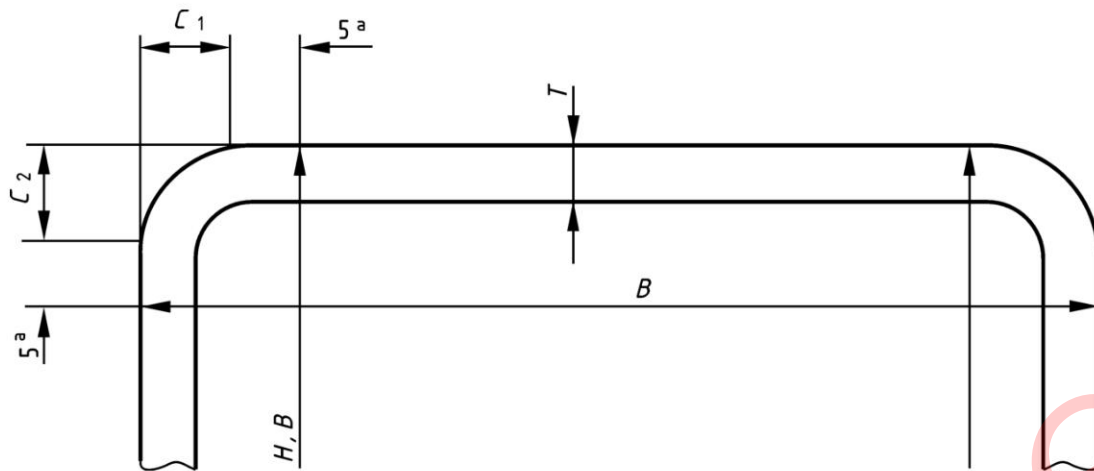
7.3 Thickness

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 dimension of the longer side from the end of the section.

Dimensions in millimetres



Key

^a 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

7.4 Out-of-roundness

The out-of-roundness (O) of a circular hollow section shall be calculated from the following formula:

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

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 dimensions of the sides containing the concavity x_1 or the convexity x_2 .

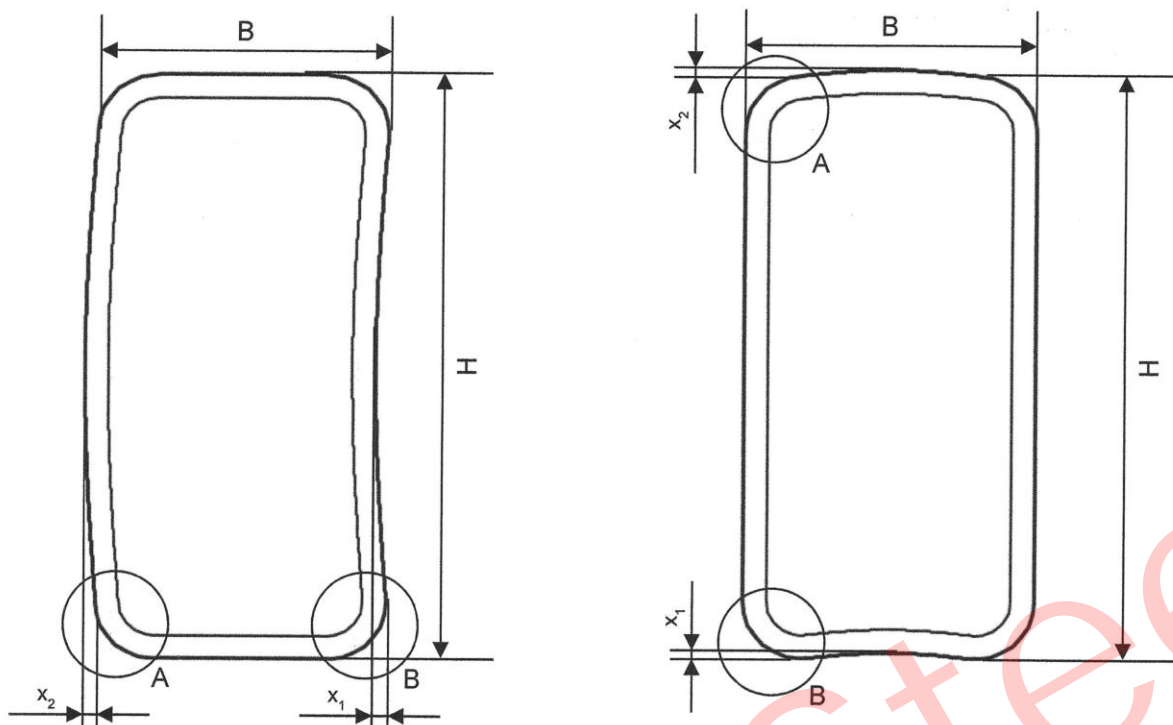


Figure 2 — Measurement of concavity/convexity of square or rectangular hollow sections

7.6 Squareness of sides

The deviation from squareness of the sides of a square or rectangular hollow section shall be measured as the difference between 90° and θ as shown in Figure 3.

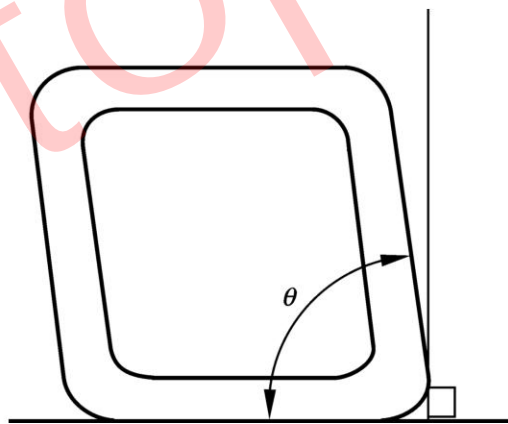


Figure 3 — Squareness of sides of square or rectangular hollow sections

7.7 External corner profile

7.7.1 The external corner profile of a square or rectangular hollow section shall be measured according to 7.7.2 or 7.7.3 at the discretion of the manufacturer.

7.7.2 The corner arc shall be measured with a radius gauge.

7.7.3 The distance between the intersection of the flat side and the corner arc and the intersection of the projections of the flat sides to the corner (C_1 and C_2 in Figure 4) shall be measured.

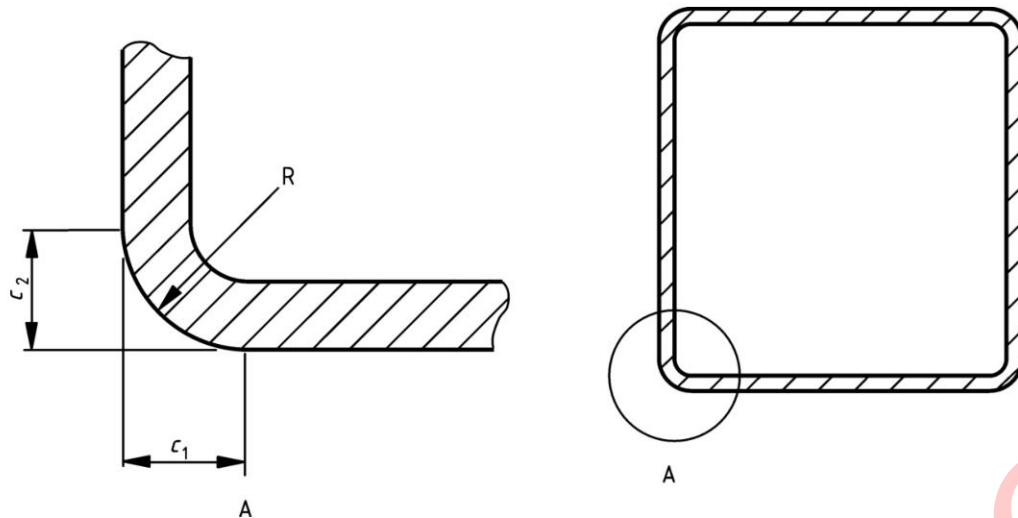


Figure 4 — Outside corner profile of square or rectangular hollow sections

7.8 Twist

7.8.1 The 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. The twist (V) in an elliptical hollow section shall be determined in accordance with 7.8.4.

7.8.2 The hollow section shall be placed on a horizontal surface with one side at one end pressed flat against the surface. At the opposite end of the hollow section, the difference in height of the two lower corners from the horizontal surface (see Figure 5) shall be determined.

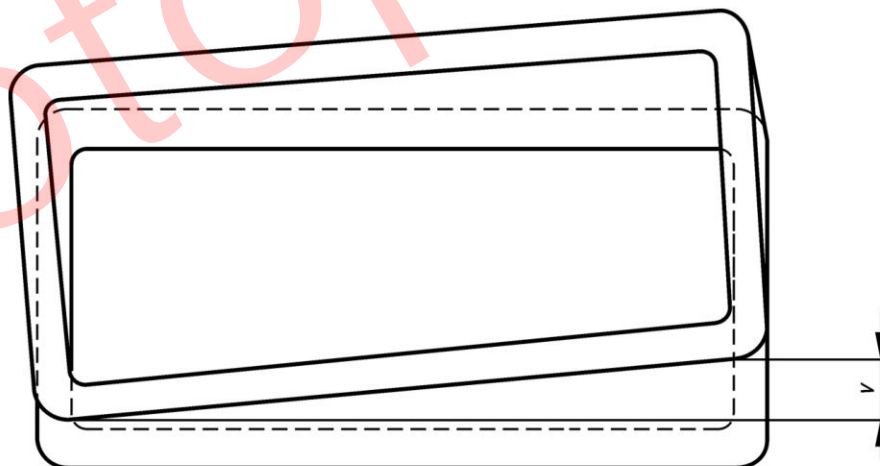
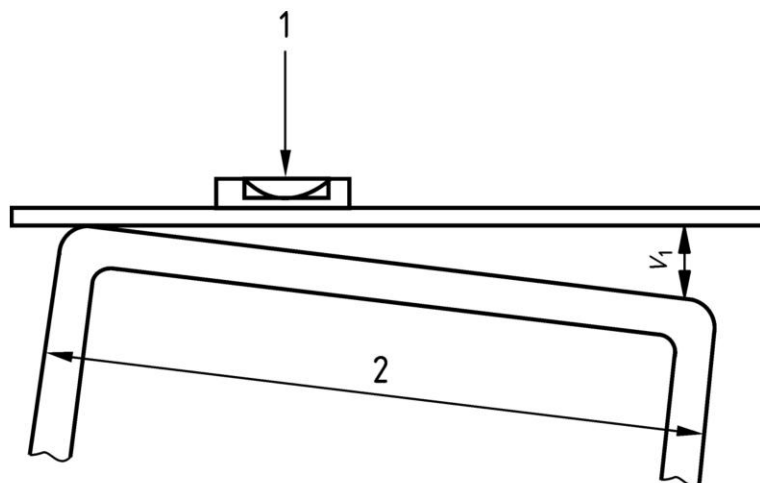


Figure 5 — Twist of square or rectangular hollow sections

7.8.3 The twist of square and rectangular hollow sections shall be measured with a spirit level and micrometer gauge (screw). The reference length of the spirit level shall be the distance between the intersection of the flat sides and the corner arcs (see Figure 6). The twist V is the difference between the values V_1 (see Figure 6) measured at each end of the hollow section.

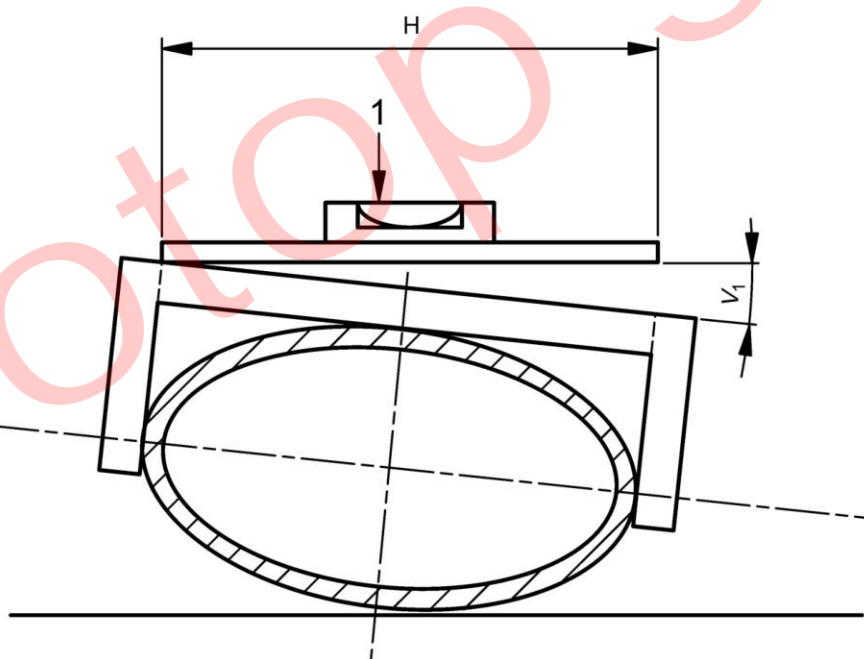


Key

- 1 spirit level
- 2 H for rectangular sections, B for square sections

Figure 6 — Measurement of twist on square or rectangular hollow sections

7.8.4 The twist of elliptical hollow sections shall be measured with a spirit level and micrometer gauge (screw). The reference length of the spirit level shall be the dimension of the sections major axis (H). The twist V is the difference between the values V_1 (see Figure 7) measured at each end of the hollow section.



Key

- 1 spirit level

Figure 7 — Measurement of twist of elliptical hollow sections

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 8 where L is the manufacturer's delivered length. The percentage deviation from straightness shall be calculated as follows:

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

In addition the local deviation (e) from straightness of a hollow section, measured at any point along its length from a straight line length L of 1 m, shall be not more than 3 mm.

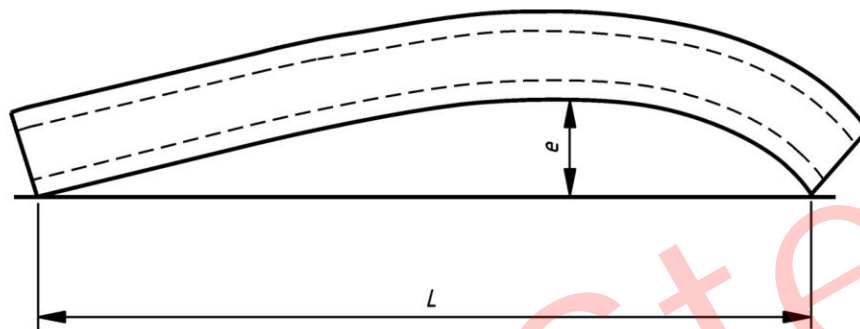


Figure 8 — Measurement of deviation from straightness

8 Dimensions and sectional properties

The nominal sectional properties of hollow sections within the scope of this part of EN 10210 and manufactured to the dimensional tolerances of this standard, required for the purposes of structural design, shall be calculated in accordance with Annex A.

The sectional properties for a limited range of standard sizes of hot finished circular, square, rectangular and elliptical hollow sections are given in Table B.1 for circular sections, Table B.2 for square sections, Table B.3 for rectangular sections and Table B.4 for elliptical sections. These sectional properties were calculated from the formulae given in Annex A.

NOTE Not all sizes and thicknesses shown in Tables B.1, B.2, B.3 and B.4 are available from all manufacturers and the user is recommended to check availability. Other sizes and thicknesses within the scope of this standard may be available.

Annex A (normative)

Formulae for the calculation of sectional properties

A.1 General

Tables B.1, B.2, B.3 and B.4 of this standard give nominal sectional properties for a limited range of sizes of hot finished hollow sections. The nominal sectional properties of hollow sections supplied to the requirements of this standard shall be calculated using the formulae given below.

NOTE The designation of the sections' major axis (yy) and minor axis (zz) aligns with the axis designation used for structural design in the structural Eurocodes. This is a change from previous axis designations.

A.2 Circular hollow sections

The sectional properties for circular hollow sections in Table B.1 are calculated using the formulae given below.

Specified outside diameter	(D)	(mm)
Specified thickness	(T)	(mm)
Inside diameter	$(d = D - 2T)$	(mm)

These parameters, which characterize the shape of circular hollow sections, may vary within the tolerances allowed by this standard and the sectional properties still remain valid.

Superficial area per metre length	$A_s = \frac{\pi D}{10^3}$	(m ² /m)
-----------------------------------	----------------------------	---------------------

Cross-sectional area	$A = \frac{\pi (D^2 - d^2)}{4 \times 10^2}$	(cm ²)
----------------------	---	--------------------

Mass per unit length	$M = 0,785 \times A$	(kg/m)
----------------------	----------------------	--------

Second moment of area	$I = \frac{\pi (D^4 - d^4)}{64 \times 10^4}$	(cm ⁴)
-----------------------	--	--------------------

Radius of gyration	$i = \sqrt{\frac{I}{A}}$	(cm)
--------------------	--------------------------	------

Elastic section modulus	$W_{el} = \frac{2I \times 10}{D}$	(cm ³)
-------------------------	-----------------------------------	--------------------

Plastic section modulus	$W_{pl} = \frac{D^3 - d^3}{6 \times 10^3}$	(cm ³)
-------------------------	--	--------------------

Torsional inertia constant (polar moment of inertia)	$I_t = 2I$	(cm ⁴)
---	------------	--------------------

Torsional modulus constant	$C_t = 2W_{el}$	(cm ³)
----------------------------	-----------------	--------------------

A.3 Rectangular, including square, hollow sections

The sectional properties for square hollow sections, in Table B.2, and for rectangular hollow sections, in Table B.3, are calculated using the formulae given below.

Specified side dimension of a square hollow section or shorter side of a rectangular hollow section (B) (mm)

Specified dimension of the longer side of a rectangular hollow section (H) (mm)

Specified thickness (T) (mm)

External corner radius (r_o) for calculation is: $(r_o = 1,5T)$ (mm)

Internal corner radius (r_i) for calculation is: $(r_i = 1,0T)$ (mm)

These parameters, which characterize the geometric shape of rectangular, including square, hollow sections, may vary within the tolerances allowed by this standard and the sectional properties still remain valid.

Superficial area per metre length $A_s = \frac{2}{10^3} (H + B - 4r_o + \pi r_o)$ (m²/m)

Cross-sectional area $A = \frac{2T(B + H - 2T) - (4 - \pi)(r_o^2 - r_i^2)}{10^2}$ (cm²)

Mass per unit length $M = 0,785A$ (kg/m)

Second moment of area

Major axis $I_{yy} = \frac{1}{10^4} \left[\frac{BH^3}{12} - \frac{(B - 2T)(H - 2T)^3}{12} - 4(I_g + A_g h_g^2) + 4(I_{\xi\xi} + A_{\xi} h_{\xi}^2) \right]$ (cm⁴)

Minor axis $I_{zz} = \frac{1}{10^4} \left[\frac{HB^3}{12} - \frac{(H - 2T)(B - 2T)^3}{12} - 4(I_g + A_g h_g^2) + 4(I_{\xi\xi} + A_{\xi} h_{\xi}^2) \right]$ (cm⁴)

Radius of gyration

Major axis $i_{yy} = \sqrt{\frac{I_{yy}}{A}}$ (cm)

Minor axis $i_{zz} = \sqrt{\frac{I_{zz}}{A}}$ (cm)

Elastic section modulus

Major axis $W_{el yy} = \frac{2I_{yy}}{H} \times 10$ (cm³)

Minor axis $W_{el zz} = \frac{2I_{zz}}{B} \times 10$ (cm³)

Plastic section modulus

Major axis $W_{pl,yy} = \frac{1}{10^3} \left[\frac{BH^2}{4} - \frac{(B-2T)(H-2T)^2}{4} - 4(A_g h_g) + 4(A_\xi h_\xi) \right]$ (cm³)

Minor axis $W_{pl,zz} = \frac{1}{10^3} \left[\frac{HB^2}{4} - \frac{(H-2T)(B-2T)^2}{4} - 4(A_g h_g) + 4(A_\xi h_\xi) \right]$ (cm³)

Torsional inertia constant $I_t = \frac{1}{10^4} \left[T^3 \frac{h}{3} + 2KA_h \right]$ (cm⁴)

Torsional modulus constant $C_t = 10 \left[\frac{I_t}{T + K/T} \right]$ (cm³)

Where

$A_g = \left(1 - \frac{\pi}{4} \right) r_o^2$ (mm²)

$A_\xi = \left(1 - \frac{\pi}{4} \right) r_i^2$ (mm²)

Major axis $h_g = \frac{H}{2} - \left(\frac{10-3\pi}{12-3\pi} \right) r_o$ (mm)

(For minor axis substitute *B* for *H*.)

Major axis $h_\xi = \frac{H-2T}{2} - \left(\frac{10-3\pi}{12-3\pi} \right) r_i$ (mm)

(For minor axis substitute *B* for *H*.)

$I_g = \left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{3(12-3\pi)} \right) r_o^4$ (mm⁴)

$I_{\xi\xi} = \left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{3(12-3\pi)} \right) r_i^4$ (mm⁴)

$h = 2[(B-T) + (H-T)] - 2R_c(4-\pi)$ (mm)

$A_h = (B-T)(H-T) - R_c^2(4-\pi)$ (mm)

$K = \frac{2A_h T}{h}$ (mm²)

$R_c = \frac{r_o + r_i}{2}$ (mm)

A.4 Elliptical hollow sections

The sectional properties for elliptical hollow sections in Table B.4 are calculated using the formulae given below.

Specified outside dimension of an elliptical section on its major axis (H) (mm)

Specified outside dimension of an elliptical section on its minor axis (B) (mm)

Specified thickness (T) (mm)

These parameters, which characterize the geometric shape of elliptical hollow sections, may vary within the tolerances allowed by this standard and the sectional properties still remain valid.

Superficial area per meter length $A_s = \frac{P}{10^3}$ (m²/m)

Cross sectional area $A = \frac{\pi [HB - (H - 2T)(B - 2T)]}{4 \times 10^2}$ (cm²)

Mass per unit length $M = 0,785 A$ (kg/m)

Second moment of area

Major axis $I_{yy} = \frac{[BH^3 - (B - 2T)(H - 2T)^3] \frac{\pi}{64}}{10^4}$ (cm⁴)

Minor axis $I_{zz} = \frac{[HB^3 - (H - 2T)(B - 2T)^3] \frac{\pi}{64}}{10^4}$ (cm⁴)

Radius of gyration

Major axis $i_{yy} = \sqrt{\frac{I_{yy}}{A}}$ (cm)

Minor axis $i_{zz} = \sqrt{\frac{I_{zz}}{A}}$ (cm)

Elastic section modulus

Major axis $W_{el yy} = \frac{20 I_{yy}}{H}$ (cm³)

Minor axis $W_{el zz} = \frac{20 I_{zz}}{B}$ (cm³)

Plastic section modulus

Major axis $W_{pl yy} = \frac{[H^2 B - (H - 2T)^2 (B - 2T)]}{6 \times 10^3}$ (cm³)

Minor axis

$$W_{plzz} = \frac{\left[B^2 H - (B - 2T)^2 (H - 2T) \right]}{6 \times 10^3} \quad (\text{cm}^3)$$

Torsional inertia constant

$$I_t = \frac{1}{10^4} \left[\frac{4A_m^2 T}{U} + \frac{UT^3}{3} \right] \quad (\text{cm}^4)$$

Torsional modulus constant

$$C_t = \frac{10I_t}{T + \left(\frac{2A_m}{U} \right)} \quad (\text{cm}^3)$$

where

$$A_m = \frac{\pi(H - T)(B - T)}{4} \quad (\text{mm}^2)$$

$$P = \frac{\pi}{2}(H + B) \left(1 + 0,25 \left(\frac{H - B}{H + B} \right)^2 \right) \quad (\text{mm})$$

$$U = \frac{\pi}{2}(H + B - 2T) \left(1 + 0,25 \left(\frac{H - B}{H + B - 2T} \right)^2 \right) \quad (\text{mm})$$

Annex B
(normative)

Sectional properties for a limited range of standard sizes

Table B.1 — Dimensions and sectional properties of a limited range of circular hollow sections (see Figure B.1)

Specified outside diameter	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>D</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
21,3	2,3	1,08	1,37	0,629	0,677	0,590	0,834	1,26	1,18	0,067	928
	2,6	1,20	1,53	0,681	0,668	0,639	0,915	1,36	1,28	0,067	834
	3,2	1,43	1,82	0,768	0,650	0,722	1,06	1,54	1,44	0,067	700
26,9	2,3	1,40	1,78	1,36	0,874	1,01	1,40	2,71	2,02	0,085	717
	2,6	1,56	1,98	1,48	0,864	1,10	1,54	2,96	2,20	0,085	642
	3,2	1,87	2,38	1,70	0,846	1,27	1,81	3,41	2,53	0,085	535
33,7	2,6	1,99	2,54	3,09	1,10	1,84	2,52	6,19	3,67	0,106	501
	3,2	2,41	3,07	3,60	1,08	2,14	2,99	7,21	4,28	0,106	415
	4,0	2,93	3,73	4,19	1,06	2,49	3,55	8,38	4,97	0,106	341
42,4	2,6	2,55	3,25	6,46	1,41	3,05	4,12	12,9	6,10	0,133	392
	3,2	3,09	3,94	7,62	1,39	3,59	4,93	15,2	7,19	0,133	323
	4,0	3,79	4,83	8,99	1,36	4,24	5,92	18,0	8,48	0,133	264
	5,0	4,60	5,90	10	1,33	4,90	7,04	20,9	9,90	0,130	217
48,3	2,6	2,93	3,73	9,8	1,62	4,05	5,44	19,6	8,10	0,152	341
	3,2	3,56	4,53	11,6	1,60	4,80	6,52	23,2	9,59	0,152	281
	4,0	4,37	5,57	13,8	1,57	5,70	7,87	27,5	11,4	0,152	229
	5,0	5,34	6,80	16,2	1,54	6,69	9,42	32,3	13,4	0,152	187
	6,3	6,50	8,30	19	1,50	7,80	11,20	37,5	15,5	0,150	153
60,3	2,6	3,70	4,71	19,7	2,04	6,52	8,66	39,3	13,0	0,189	270
	3,2	4,51	5,74	23,5	2,02	7,78	10,4	46,9	15,6	0,189	222
	4,0	5,55	7,07	28,2	2,00	9,34	12,7	56,3	18,7	0,189	180
	5,0	6,82	8,69	33,5	1,96	11,1	15,3	67,0	22,2	0,189	147
	6,3	8,40	10,7	39	1,92	13,1	18,45	79,0	26,2	0,190	119
76,1	2,6	4,71	6,00	40,6	2,60	10,7	14,1	81,2	21,3	0,239	212
	3,2	5,75	7,33	48,8	2,58	12,8	17,0	97,6	25,6	0,239	174
	4,0	7,11	9,06	59,1	2,55	15,5	20,8	118	31,0	0,239	141

Specified outside diameter	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>D</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	5,0	8,77	11,2	70,9	2,52	18,6	25,3	142	37,3	0,239	114
	6,3	10,8	13,8	85	2,48	22,3	30,78	169,6	44,6	0,240	92
	8,0	13,4	17,1	101	2,42	26,4	37,27	201,2	52,9	0,240	74
88,9	3,2	6,76	8,62	79,2	3,03	17,8	23,5	158	35,6	0,279	148
	4,0	8,38	10,7	96,3	3,00	21,7	28,9	193	43,3	0,279	119
	5,0	10,3	13,2	116	2,97	26,2	35,2	233	52,4	0,279	96,7
	6,3	12,8	16,3	140	2,93	31,5	43,1	280	63,1	0,279	77,9
	8,0	16,0	20,3	168	2,87	37,8	52,53	335,9	75,6	0,280	62,7
	10,0	19,5	24,8	196	2,81	44,1	62,59	392,0	88,2	0,280	51
101,6	3,2	7,77	9,89	120	3,48	23,6	31,0	240	47,2	0,319	128,8
	4,0	9,63	12,3	146	3,45	28,8	38,1	293	57,6	0,319	103,9
	5,0	11,9	15,2	177	3,42	34,9	46,7	355	69,9	0,319	84,0
	6,3	14,8	18,9	215	3,38	42,3	57,3	430	84,7	0,319	67,5
	8,0	18,5	23,5	260	3,32	51,1	70,3	519	102	0,319	54,2
	10,0	22,6	28,8	305	3,26	60,1	84,2	611	120	0,319	44,3
	12,5	27,5	35,0	354	3,18	69,7	99,89	708,1	139,4	0,320	36
114,3	3,2	8,77	11,2	172	3,93	30,2	39,5	345	60,4	0,359	114,1
	4,0	10,9	13,9	211	3,90	36,9	48,7	422	73,9	0,359	91,9
	5,0	13,5	17,2	257	3,87	45,0	59,8	514	89,9	0,359	74,2
	6,3	16,8	21,4	313	3,82	54,7	73,6	625	109	0,359	59,6
	8,0	21,0	26,7	379	3,77	66,4	90,6	759	133	0,359	47,7
	10,0	25,7	32,8	450	3,70	78,7	109	899	157	0,359	38,9
	12,5	31,4	40,0	526	3,63	92,0	130,19	1 051,3	184,0	0,360	32
139,7	4,0	13,4	17,1	393	4,80	56,2	73,7	786	112	0,439	74,7
	5,0	16,6	21,2	481	4,77	68,8	90,8	961	138	0,439	60,2
	6,3	20,7	26,4	589	4,72	84,3	112	1 177	169	0,439	48,2
	8,0	26,0	33,1	720	4,66	103	139	1 441	206	0,439	38,5
	10,0	32,0	40,7	862	4,60	123	169	1 724	247	0,439	31,3
	12,5	39,2	50,0	1 020	4,52	146	203	2 040	292	0,439	25,5
168,3	4,0	16,2	20,6	697	5,81	83	108	1 394	166	0,529	61,7
	5,0	20,1	25,7	856	5,78	102	133	1 712	203	0,529	49,7
	6,3	25,2	32,1	1 053	5,73	125	165	2 107	250	0,529	39,7
	8,0	31,6	40,3	1 297	5,67	154	206	2 595	308	0,529	31,6
	10,0	39,0	49,7	1 564	5,61	186	251	3 128	372	0,529	25,6

Specified outside diameter	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>D</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	12,5	48,0	61,2	1 868	5,53	222	304	3 737	444	0,529	20,8
	16,0	60,1	76,6	2 244	5,41	267	372	4 488	533	0,530	16,6
177,8	5,0	21,3	27,1	1 014	6,11	114	149	2 028	228	0,559	46,9
	6,3	26,6	33,9	1 250	6,07	141	185	2 499	281	0,559	37,5
	8,0	33,5	42,7	1 541	6,01	173	231	3 083	347	0,559	29,9
	10,0	41,4	52,7	1 862	5,94	209	282	3 724	419	0,559	24,2
	12,5	51,0	64,9	2 230	5,86	251	342	4 460	502	0,559	19,6
	16,0	63,8	81,3	2 687	5,75	302	420	5 375	605	0,560	15,7
193,7	5,0	23,3	29,6	1 320	6,67	136	178	2 640	273	0,609	43,0
	6,3	29,1	37,1	1 630	6,63	168	221	3 260	337	0,609	34,3
	8,0	36,6	46,7	2 016	6,57	208	276	4 031	416	0,609	27,3
	10,0	45,3	57,7	2 442	6,50	252	338	4 883	504	0,609	22,1
	12,5	55,9	71,2	2 934	6,42	303	411	5 869	606	0,609	17,9
	14,2	62,9	80,1	3 245	6,37	335	458	6 491	670	0,609	15,9
	16,0	70,1	89,3	3 554	6,31	367	507	7 109	734	0,609	14,3
	20,0	85,7	109,1	4 171	6,18	431	606	8 341	861	0,610	11,7
219,1	5,0	26,4	33,6	1 928	7,57	176	229	3 856	352	0,688	37,9
	6,3	33,1	42,1	2 386	7,53	218	285	4 772	436	0,688	30,2
	8,0	41,6	53,1	2 960	7,47	270	357	5 919	540	0,688	24,0
	10,0	51,6	65,7	3 598	7,40	328	438	7 197	657	0,688	19,4
	12,5	63,7	81,1	4 345	7,32	397	534	8 689	793	0,688	15,7
	14,2	71,8	91,4	4 820	7,26	440	597	9 640	880	0,688	13,9
	16,0	80,1	102	5 297	7,20	483	661	10 590	967	0,688	12,5
	20,0	98,2	125	6 261	7,07	572	795	12 520	1 143	0,688	10,2
244,5	5,0	29,5	37,6	2 699	8,47	221	287	5 397	441	0,768	33,9
	6,3	37,0	47,1	3 346	8,42	274	358	6 692	547	0,768	27,0
	8,0	46,7	59,4	4 160	8,37	340	448	8 321	681	0,768	21,4
	10,0	57,8	73,7	5 073	8,30	415	550	10 150	830	0,768	17,3
	12,5	71,5	91,1	6 147	8,21	503	673	12 300	1 006	0,768	14,0
	14,2	80,6	102,7	6 837	8,16	559	754	13 670	1 119	0,768	12,4
	16,0	90,2	115	7 533	8,10	616	837	15 070	1 232	0,768	11,1
	20,0	110,7	141	8 957	7,97	733	1 011	17 910	1 465	0,768	9,0
	25,0	135	172	10 520	7,81	860	1 210	21 030	1 721	0,768	7,39
273,0	5,0	33,0	42,1	3 781	9,48	277	359	7 562	554	0,858	30,3

Specified outside diameter	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>D</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	6,3	41,4	52,8	4 696	9,43	344	448	9 392	688	0,858	24,1
	8,0	52,3	66,6	5 852	9,37	429	562	11 700	857	0,858	19,1
	10,0	64,9	82,6	7 154	9,31	524	692	14 310	1 048	0,858	15,4
	12,5	80,3	102	8 697	9,22	637	849	17 400	1 274	0,858	12,5
	14,2	90,6	115	9 695	9,16	710	952	19 390	1 421	0,858	11,0
	16,0	101	129	10 710	9,10	784	1 058	21 410	1 569	0,858	9,9
	20,0	125	159	12 800	8,97	938	1 283	25 600	1 875	0,858	8,0
	25,0	153	195	15 130	8,81	1 108	1 543	30 250	2 216	0,858	6,5
	30,0	180	229	17 162	8,66	1 257	1 780	34 324	2 515	0,860	5,6
323,9	5,0	39,3	50,1	6 369	11,3	393	509	12 740	787	1,02	25,4
	6,3	49,3	62,9	7 929	11,2	490	636	15 860	979	1,02	20,3
	8,0	62,3	79,4	9 910	11,2	612	799	19 820	1 224	1,02	16,0
	10,0	77,4	98,6	12 160	11,1	751	986	24 320	1 501	1,02	12,9
	12,5	96,0	122	14 850	11,0	917	1 213	29 690	1 833	1,02	10,4
	14,2	108,5	138	16 600	11,0	1 025	1 363	33 200	2 050	1,02	9,2
	16,0	121	155	18 390	10,9	1 136	1 518	36 780	2 271	1,02	8,23
	20,0	150	191	22 140	10,8	1 367	1 850	44 280	2 734	1,02	6,67
	25,0	184	235	26 400	10,6	1 630	2 239	52 800	3 260	1,02	5,43
30,0	222	283	32 095	10,7	1 946	2 707	64 190	3 892	1,04	4,5	
355,6	6,3	54,3	69,1	10 550	12,4	593	769	21 090	1 186	1,12	18,4
	8,0	68,6	87,4	13 200	12,3	742	967	26 400	1 485	1,12	14,6
	10,0	85,2	109	16 220	12,2	912	1 195	32 450	1 825	1,12	11,7
	12,5	106	135	19 850	12,1	1 117	1 472	39 700	2 233	1,12	9,45
	14,2	120	152	22 230	12,1	1 250	1 656	44 460	2 500	1,12	8,36
	16,0	134	171	24 660	12,0	1 387	1 847	49 330	2 774	1,12	7,46
	20,0	166	211	29 790	11,9	1 676	2 255	59 580	3 351	1,12	6,04
	25,0	204	260	35 680	11,7	2 007	2 738	71 350	4 013	1,12	4,91
	30,0	241	307	41 011	11,6	2 307	3 189	82 023	4 613	1,12	4,2
406,4	6,3	62,2	79,2	15 850	14,1	780	1 009	31 700	1 560	1,28	16,1
	8,0	78,6	100	19 870	14,1	978	1 270	39 750	1 956	1,28	12,7
	10,0	97,8	125	24 480	14,0	1 205	1 572	48 950	2 409	1,28	10,2
	12,5	121	155	30 030	13,9	1 478	1 940	60 060	2 956	1,28	8,24
	14,2	137	175	33 690	13,9	1 658	2 185	67 370	3 315	1,28	7,28
	16,0	154	196	37 450	13,8	1 843	2 440	74 900	3 686	1,28	6,49

Specified outside diameter	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>D</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	20,0	191	243	45 430	13,7	2 236	2 989	90 860	4 472	1,28	5,25
	25,0	235	300	54 700	13,5	2 692	3 642	109 400	5 384	1,28	4,25
	30,0	278	355	63 220	13,3	3 111	4 259	126 500	6 223	1,28	3,59
	40,0	361	460	78 190	13,0	3 848	5 391	156 000	7 696	1,28	2,77
457,0	6,3	70,0	89,2	22 650	15,9	991	1 280	45 310	1 983	1,44	14,3
	8,0	88,6	113	28 450	15,9	1 245	1 613	56 900	2 490	1,44	11,3
	10,0	110	140	35 090	15,8	1 536	1 998	70 180	3 071	1,44	9,07
	12,5	137	175	43 150	15,7	1 888	2 470	86 290	3 776	1,44	7,30
	14,2	155	198	48 460	15,7	2 121	2 785	96 930	4 242	1,44	6,45
	16,0	174	222	53 960	15,6	2 361	3 113	107 900	4 723	1,44	5,75
	20,0	216	275	65 680	15,5	2 874	3 822	131 400	5 749	1,44	4,64
	25,0	266	339	79 420	15,3	3 475	4 671	158 800	6 951	1,44	3,75
	30,0	316	402	92 170	15,1	4 034	5 479	184 300	8 068	1,44	3,17
	40,0	411	524	115 000	14,8	5 031	6 977	229 900	10 060	1,44	2,43
508,0	6,3	77,9	99,3	31 250	17,7	1 230	1 586	62 490	2 460	1,60	12,8
	8,0	98,6	126	39 280	17,7	1 546	2 000	78 560	3 093	1,60	10,1
	10,0	123	156	48 520	17,6	1 910	2 480	97 040	3 820	1,60	8,14
	12,5	153	195	59 760	17,5	2 353	3 070	119 500	4 705	1,60	6,55
	14,2	173	220	67 200	17,5	2 646	3 463	134 400	5 291	1,60	5,78
	16,0	194	247	74 910	17,4	2 949	3 874	149 800	5 898	1,60	5,15
	20,0	241	307	91 430	17,3	3 600	4 766	182 900	7 199	1,60	4,15
	25,0	298	379	111 000	17,1	4 367	5 837	221 800	8 734	1,60	3,36
	30,0	354	451	129 200	16,9	5 086	6 864	258 400	10 170	1,60	2,83
	40,0	462	588	162 200	16,6	6 385	8 782	324 400	12 770	1,60	2,17
	50,0	565	719	190 900	16,3	7 515	10 530	381 800	15 030	1,60	1,77
610,0	6,3	93,8	119	54 440	21,3	1 785	2 296	108 900	3 570	1,9	10,7
	8,0	119	151	68 550	21,3	2 248	2 899	137 100	4 495	1,9	8,42
	10,0	148	188	84 850	21,2	2 782	3 600	169 700	5 564	1,9	6,76
	12,5	184	235	104 800	21,1	3 435	4 463	209 600	6 869	1,9	5,43
	14,2	209	266	118 000	21,1	3 869	5 042	236 000	7 738	1,9	4,79
	16,0	234	299	131 800	21,0	4 321	5 647	263 600	8 641	1,9	4,27
	20,0	291	371	161 500	20,9	5 295	6 965	323 000	10 590	1,9	3,44
	25,0	361	459	196 900	20,7	6 456	8 561	393 800	12 910	1,9	2,77
	30,0	429	547	230 500	20,5	7 557	10 100	461 000	15 110	1,9	2,33

Specified outside diameter	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>D</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	40,0	562	716	292 300	20,2	9 585	13 020	585 000	19 170	1,9	1,78
	50,0	691	880	347 600	19,9	11 400	15 720	69 5000	22 790	1,9	1,45
711,0	6,3	109	139	86 590	24,9	2 436	3 129	173 000	4 871	2,23	9,13
	8,0	139	177	109 200	24,9	3 071	3 954	218 000	6 141	2,23	7,21
	10,0	173	220	135 300	24,8	3 806	4 914	270 600	7 612	2,23	5,78
	12,5	215	274	167 300	24,7	4 707	6 099	334 700	9 415	2,23	4,64
	14,2	244	311	188 700	24,6	5 309	6 895	377 500	10 620	2,23	4,10
	16,0	274	349	211 000	24,6	5 936	7 730	422 100	11 870	2,23	3,65
	20,0	341	434	259 400	24,4	7 295	9 552	518 700	14 590	2,23	2,93
	25,0	423	539	317 400	24,3	8 927	11 770	634 700	17 850	2,23	2,36
	30,0	504	642	372 800	24,1	10 490	13 920	745 600	20 970	2,23	1,98
	40,0	662	843	476 200	23,8	13 400	18 030	952 500	26 790	2,23	1,51
	50,0	815	1038	570 300	23,4	16 040	21 890	1 141 000	32 090	2,23	1,23
60,0	963	1227	655 600	23,1	18 440	25 500	1 311 000	36 890	2,23	1,04	
762,0	6,3	117	150	106 800	26,7	2 803	3 598	213 600	5 605	2,39	8,52
	8,0	149	190	134 700	26,7	3 535	4 548	269 400	7 070	2,39	6,72
	10,0	185	236	167 000	26,6	4 384	5 655	334 100	8 768	2,39	5,39
	12,5	231	294	206 700	26,5	5 426	7 023	413 500	10 850	2,39	4,33
	14,2	262	334	233 000	26,4	6 120	7 940	467 000	12 300	2,39	3,82
	16,0	294	375	261 000	26,4	6 850	8 906	522 000	13 700	2,39	3,40
	20,0	366	466	321 100	26,2	8 427	11 010	642 200	16 860	2,39	2,73
	25,0	454	579	393 500	26,1	10 330	13 580	786 900	20 650	2,39	2,20
	30,0	542	690	462 900	25,9	12 150	16 080	925 700	24 300	2,39	1,85
	40,0	712	907	593 000	25,6	15 570	20 870	1 186 000	31 130	2,39	1,40
50,0	878	1 118	712 200	25,2	18 690	25 390	1 424 000	37 390	2,39	1,14	
813,0	8,0	159	202	163 900	28,5	4 032	5 184	327 800	8 064	2,55	6,30
	10,0	198	252	203 400	28,4	5 003	6 448	406 800	10 010	2,55	5,05
	12,5	247	314	251 900	28,3	6 196	8 011	503 700	12 390	2,55	4,05
	14,2	280	356	284 000	28,2	6 990	9 060	569 000	14 000	2,55	3,57
	16,0	314	401	318 200	28,2	7 828	10 170	636 400	15 660	2,55	3,18
	20,0	391	498	391 900	28,0	9 641	12 580	783 800	19 280	2,55	2,56
	25,0	486	619	480 900	27,9	11 830	15 530	961 700	23 660	2,55	2,06
	30,0	579	738	566 400	27,7	13 930	18 400	1 132 800	27 870	2,55	1,73
914,0	8,0	179	228	233 700	32,0	5 113	6 567	467 300	10 230	2,87	5,59

Specified outside diameter	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>D</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
1 016,0	10,0	223	284	290 500	32,0	6 349	8 172	580 300	12 700	2,87	4,49
	12,5	278	354	359 700	31,9	7 871	10 160	719 400	15 740	2,87	3,60
	14,2	315	401	406 000	31,8	8 890	11 500	813 000	17 800	2,87	3,17
	16,0	354	451	455 100	31,8	9 959	12 900	910 300	19 920	2,87	2,82
	20,0	441	562	561 500	31,6	12 290	15 990	1 123 000	24 570	2,87	2,27
	25,0	548	698	690 320	31,4	15 100	19 760	1 381 000	30 210	2,87	1,82
	30,0	654	833	814 800	31,3	17 830	23 450	1 630 000	35 660	2,87	1,53
1 016,0	8,0	199	253	321 800	35,6	6 334	8 129	643 600	12 670	3,19	5,03
	10,0	248	316	399 900	35,6	7 871	10 120	799 700	15 740	3,19	4,03
	12,5	309	394	496 100	35,5	9 766	12 590	992 250	19 530	3,19	3,23
	14,2	351	447	561 000	35,4	11 000	14 300	1 120 000	22 100	3,19	2,85
	16,0	395	503	628 480	35,4	12 370	16 000	1 257 000	24 740	3,19	2,53
	20,0	491	626	776 300	35,2	15 280	19 840	1 553 000	30 560	3,19	2,04
	25,0	611	778	956 100	35,0	18 820	24 560	1 912 000	37 640	3,19	1,64
1 067,0	10,0	261	332	463 800	37,4	8 693	11 170	927 500	17 390	3,35	3,84
	12,5	325	414	575 670	37,3	10 790	13 900	1 151 000	21 580	3,35	3,08
	14,2	369	470	651 000	37,2	12 200	15 700	1 300 000	24 400	3,35	2,71
	16,0	415	528	729 610	37,2	13 680	17 680	1 459 000	27 350	3,35	2,41
	20,0	516	658	901 800	37,0	16 900	21 930	1 804 000	33 810	3,35	1,94
	25,0	642	818	1 111 000	36,9	20 830	27 150	2 223 000	41 660	3,35	1,56
	30,0	767	977	1 315 000	36,7	24 650	32 270	2 630 000	49 290	3,35	1,30
1 168,0	10,0	286	364	609 800	40,9	10 440	13 410	1 220 000	20 890	3,67	3,50
	12,5	356	454	757 400	40,9	12 970	16 690	1 515 000	25 940	3,67	2,81
	14,2	404	515	856 700	40,8	14 670	18 910	1 713 000	29 340	3,67	2,47
	16,0	455	579	960 800	40,7	16 450	21 240	1 922 000	32 900	3,67	2,20
	20,0	566	721	1 189 000	40,6	20 350	26 360	2 377 000	40 710	3,67	1,77
	25,0	705	898	1 467 000	40,4	25 120	32 670	2 933 000	50 230	3,67	1,42
1 219,0	10,0	298	380	694 000	42,7	11 390	14 620	1 388 000	22 770	3,83	3,35
	12,5	372	474	862 200	42,7	14 150	18 200	1 724 000	28 290	3,83	2,69
	14,2	422	537	975 300	42,6	16 000	20 610	1 951 000	32 000	3,83	2,37
	16,0	475	605	1 094 000	42,5	17 950	23 160	2 188 000	35 900	3,83	2,11
	20,0	591	753	1 354 000	42,4	22 220	28 760	2 708 000	44 440	3,83	1,69
	25,0	736	938	1 672 000	42,2	27 430	35 650	3 344 000	54 860	3,83	1,36

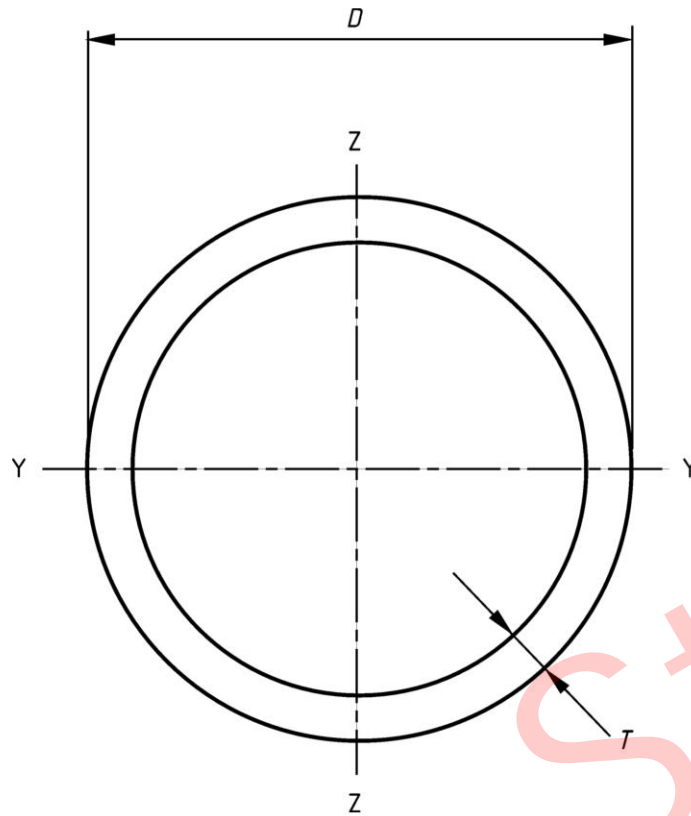


Figure B.1 — Circular hollow section

**Table B.2 — Dimensions and sectional properties of a limited range of square hollow sections
(see Figure B.2)**

Specified side dimension	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>B</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
40	2,6	3,00	3,82	8,80	1,52	4,40	5,31	14,0	6,41	0,153	334
	3,2	3,61	4,60	10,2	1,49	5,11	6,28	16,5	7,42	0,152	277
	4,0	4,39	5,59	11,8	1,45	5,91	7,44	19,5	8,54	0,150	228
	5,0	5,28	6,73	13,4	1,41	6,68	8,66	22,5	9,60	0,147	189
50	2,6	3,81	4,86	18,0	1,93	7,21	8,58	28,4	10,6	0,193	262
	3,2	4,62	5,88	21,2	1,90	8,49	10,2	33,8	12,4	0,192	217
	4,0	5,64	7,19	25,0	1,86	9,99	12,3	40,4	14,5	0,190	177
	5,0	6,85	8,73	28,9	1,82	11,6	14,5	47,6	16,7	0,187	146
	6,3	8,31	10,6	32,8	1,76	13,1	17,0	55,2	18,8	0,184	120
60	2,6	4,63	5,90	32,2	2,34	10,7	12,6	50,2	15,7	0,233	216
	3,2	5,62	7,16	38,2	2,31	12,7	15,2	60,2	18,6	0,232	178
	4,0	6,90	8,79	45,4	2,27	15,1	18,3	72,5	22,0	0,230	145
	5,0	8,42	10,7	53,3	2,23	17,8	21,9	86,4	25,7	0,227	119
	6,3	10,3	13,1	61,6	2,17	20,5	26,0	102	29,6	0,224	97,2
	8,0	12,5	16,0	69,7	2,09	23,2	30,4	118	33,4	0,219	79,9
70	3,2	6,63	8,4	62,3	2,72	17,8	21,0	97,6	26,1	0,272	151
	4,0	8,15	10,4	74,7	2,68	21,3	25,5	118	31,2	0,270	123
	5,0	9,99	12,7	88,5	2,64	25,3	30,8	142	36,8	0,267	100
	6,3	12,3	15,6	104	2,58	29,7	36,9	169	42,9	0,264	81,5
	8,0	15,0	19,2	120	2,50	34,2	43,8	200	49,2	0,259	66,5
80	3,2	7,63	9,72	95	3,13	23,7	27,9	148	34,9	0,312	131
	4,0	9,41	12,0	114	3,09	28,6	34,0	180	41,9	0,310	106
	5,0	11,6	14,7	137	3,05	34,2	41,1	217	49,8	0,307	86,5
	6,3	14,2	18,1	162	2,99	40,5	49,7	262	58,7	0,304	70,2
	8,0	17,5	22,4	189	2,91	47,3	59,5	312	68,3	0,299	57,0
	10,0	21,1	26,9	214	2,82	53,5	69,3	360	76,8	0,294	47,3
90	4,0	10,7	13,6	166	3,50	37,0	43,6	260	54,2	0,350	93,7
	5,0	13,1	16,7	200	3,45	44,4	53,0	316	64,8	0,347	76,1
	6,3	16,2	20,7	238	3,40	53,0	64,3	382	77,0	0,344	61,6
	8,0	20,1	25,6	281	3,32	62,6	77,6	459	90,5	0,339	49,9
	10,0	24,3	30,9	322	3,23	71,6	91,3	536	103	0,334	41,2
100	4,0	11,9	15,2	232	3,91	46,4	54,4	361	68,2	0,390	83,9
	5,0	14,7	18,7	279	3,86	55,9	66,4	439	81,8	0,387	68,0

Specified side dimension	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>B</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	6,3	18,2	23,2	336	3,80	67,1	80,9	534	97,8	0,384	54,9
	8,0	22,6	28,8	400	3,73	79,9	98,2	646	116	0,379	44,3
	10,0	27,4	34,9	462	3,64	92,4	116	761	133	0,374	36,5
	12,5	33,0	42,1	522	3,52	104	135	879	150	0,368	30,3
120	5,0	17,8	22,7	498	4,68	83,0	97,6	777	122	0,467	56,0
	6,3	22,2	28,2	603	4,62	100	120	950	147	0,464	45,1
	8,0	27,6	35,2	726	4,55	121	146	1 160	176	0,459	36,2
	10,0	33,7	42,9	852	4,46	142	175	1 382	206	0,454	29,7
	12,5	40,9	52,1	982	4,34	164	207	1 623	236	0,448	24,5
	16,0	50,1	63,8	1 116	4,18	186	244	1 891	267	0,439	20,0
140	5,0	21,0	26,7	807	5,50	115	135	1 253	170	0,547	47,7
	6,3	26,1	33,3	984	5,44	141	166	1 540	206	0,544	38,3
	8,0	32,6	41,6	1 195	5,36	171	204	1 892	249	0,539	30,7
	10,0	40,0	50,9	1 416	5,27	202	246	2 272	294	0,534	25,0
	12,5	48,7	62,1	1 653	5,16	236	293	2 696	342	0,528	20,5
	14,2	54,4	69,3	1 790	5,08	256	322	2 950	369	0,523	18,4
	16,0	60,1	76,6	1 920	5,01	274	350	3 200	394	0,519	16,6
	17,5	64,7	82,5	2 010	4,94	287	371	3 380	412	0,515	15,4
	20,0	72,0	91,7	2 130	4,82	304	403	3 630	436	0,508	13,9
	25,0	85,0	108	2 275	4,85	325	451	3 988	464	0,496	11,8
150	6,3	28,1	35,8	1 223	5,85	163	192	1 909	240	0,584	35,6
	8,0	35,1	44,8	1 491	5,77	199	237	2 351	291	0,579	28,5
	10,0	43,1	54,9	1 773	5,68	236	286	2 832	344	0,574	23,2
	12,5	52,7	67,1	2 080	5,57	277	342	3 375	402	0,568	19,0
	14,2	58,9	75,0	2 262	5,49	302	377	3 707	436	0,563	17,0
	16,0	65,2	83,0	2 430	5,41	324	411	4 026	467	0,559	15,3
	17,5	70,2	89,5	2 550	5,34	340	437	4 270	490	0,555	14,2
	20,0	78,3	99,7	2 740	5,24	365	476	4 620	521	0,548	12,8
	25,0	92,9	118,3	2 951	4,99	393	537	5 131	562	0,536	10,8
160	5,0	24,1	30,7	1 225	6,31	153	178	1 892	226	0,627	41,5
	6,3	30,1	38,3	1 499	6,26	187	220	2 333	275	0,624	33,3
	8,0	37,6	48,0	1 831	6,18	229	272	2 880	335	0,619	26,6
	10,0	46,3	58,9	2 186	6,09	273	329	3 478	398	0,614	21,6
	12,5	56,6	72,1	2 576	5,98	322	395	4 158	467	0,608	17,7
	14,2	63,3	80,7	2 809	5,90	351	436	4 579	508	0,603	15,8

Specified side dimension	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>B</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	16,0	70,2	89,4	3 028	5,82	379	476	4 988	546	0,599	14,2
	17,5	75,7	96,5	3 190	5,75	399	507	5 300	575	0,595	13,2
	20,0	84,6	108	3 420	5,63	428	554	5 760	615	0,588	11,8
	25,0	101	128	3 748	5,41	469	631	6 469	670	0,576	9,9
180	5,0	27,3	34,7	1 765	7,13	196	227	2 718	290	0,707	36,7
	6,3	34,0	43,3	2 168	7,07	241	281	3 361	355	0,704	29,4
	8,0	42,7	54,4	2 661	7,00	296	349	4 162	434	0,699	23,4
	10,0	52,5	66,9	3 193	6,91	355	424	5 048	518	0,694	19,0
	12,5	64,4	82,1	3 790	6,80	421	511	6 070	613	0,688	15,5
	14,2	72,2	92,0	4 154	6,72	462	566	6 711	670	0,683	13,8
	16,0	80,2	102	4 504	6,64	500	621	7 343	724	0,679	12,5
	17,5	86,7	110	4 770	6,57	530	664	7 830	765	0,675	11,5
	20,0	97,1	124	5 160	6,46	573	730	8 580	825	0,668	10,3
	25,0	116	148	5 748	6,23	639	842	9 787	916	0,656	8,6
200	5,0	30,4	38,7	2 445	7,95	245	283	3 756	362	0,787	32,9
	6,3	38,0	48,4	3 011	7,89	301	350	4 653	444	0,784	26,3
	8,0	47,7	60,8	3 709	7,81	371	436	5 778	545	0,779	21,0
	10,0	58,8	74,9	4 471	7,72	447	531	7 031	655	0,774	17,0
	12,5	72,3	92,1	5 336	7,61	534	643	8 491	778	0,768	13,8
	14,2	81,1	103	5 872	7,54	587	714	9 417	854	0,763	12,3
	16,0	90,3	115	6 394	7,46	639	785	10 340	927	0,759	11,1
	17,5	97,7	124	6 790	7,39	679	842	11 060	983	0,755	10,2
	20,0	110	140	7 390	7,27	739	930	12 180	1 070	0,748	9,12
	25,0	132	168	8 355	7,05	835	1 083	14 064	1 200	0,736	7,6
220	6,3	41,9	53,4	4 049	8,71	368	427	6 240	544	0,864	23,8
	8,0	52,7	67,2	5 002	8,63	455	532	7 765	669	0,859	19,0
	10,0	65,1	82,9	6 050	8,54	550	650	9 473	807	0,854	15,4
	12,5	80,1	102	7 254	8,43	659	789	11 480	963	0,848	12,5
	14,2	90,1	115	8 007	8,35	728	879	12 770	1 060	0,843	11,1
	16,0	100	128	8 749	8,27	795	969	14 050	1 156	0,839	10,0
	17,5	109	138	9 320	8,20	847	1 040	15 070	1 230	0,835	9,20
	20,0	122	156	10 200	8,09	927	1 150	16 660	1 340	0,828	8,18
	25,0	148	188	11 648	7,87	1 059	1 354	19 417	1 524	0,816	6,8

Specified side dimension	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
<i>B</i>	<i>T</i>	<i>M</i>	<i>A</i>	<i>I</i>	<i>i</i>	<i>W_{el}</i>	<i>W_{pl}</i>	<i>I_t</i>	<i>C_t</i>	<i>A_s</i>	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
250	6,3	47,9	61,0	6 014	9,93	481	556	9 238	712	0,984	20,9
	8,0	60,3	76,8	7 455	9,86	596	694	11 530	880	0,979	16,6
	10,0	74,5	94,9	9 055	9,77	724	851	14 110	1 065	0,974	13,4
	12,5	91,9	117	10 920	9,66	873	1 037	17 160	1 279	0,968	10,9
	14,2	103	132	12 090	9,58	967	1 158	19 140	1 413	0,963	9,67
	16,0	115	147	13 270	9,50	1 061	1 280	21 140	1 546	0,959	8,67
	17,5	125	159	14 190	9,43	1 140	1 380	22 730	1 650	0,955	7,99
	20,0	141	180	15 310	9,23	1 230	1 530	25 240	1 810	0,948	7,09
	25,0	171	218	18 050	9,09	1 444	1 816	29 728	2 084	0,936	5,8
260	6,3	49,9	63,5	6 788	10,3	522	603	10 420	773	1,02	20,1
	8,0	62,8	80,0	8 423	10,3	648	753	13 010	956	1,02	15,9
	10,0	77,7	98,9	10 240	10,2	788	924	15 930	1 159	1,01	12,9
	12,5	95,8	122	12 370	10,1	951	1 127	19 410	1 394	1,01	10,4
	14,2	108	137	13 710	10,0	1 055	1 259	21 660	1 542	1,00	9,27
	16,0	120	153	15 060	9,9	1 159	1 394	23 940	1 689	1,00	8,30
	17,5	131	166	16 120	9,84	1 240	1 500	25 770	1 810	0,995	7,65
	20,0	147	188	17 700	9,71	1 360	1 670	28 650	1 980	0,988	6,79
	25,0	179	228	20 614	9,50	1 586	1 985	33 834	2 290	0,976	5,6
300	6,3	57,8	74	10 550	12,0	703	809	16 140	1 043	1,18	17,3
	8,0	72,8	93	13 130	11,9	875	1 013	20 190	1 294	1,18	13,7
	10,0	90,2	115	16 030	11,8	1 068	1 246	24 810	1 575	1,17	11,1
	12,5	112	142	19 440	11,7	1 296	1 525	30 330	1 904	1,17	8,97
	14,2	126	160	21 640	11,6	1 442	1 708	33 940	2 114	1,16	7,95
	16,0	141	179	23 850	11,5	1 590	1 895	37 620	2 325	1,16	7,12
	17,5	153	194	25 610	11,5	1 710	2 050	40 590	2 490	1,15	6,55
	20,0	172	220	28 370	11,4	1 890	2 290	45 320	2 750	1,15	5,80
	25,0	211	268	33 278	11,1	2 219	2 737	53 998	3 215	1,14	4,7
350	8,0	85,4	109	21 130	13,9	1 207	1 392	32 380	1 789	1,38	11,7
	10,0	106	135	25 880	13,9	1 479	1 715	39 890	2 185	1,37	9,44
	12,5	131	167	31 540	13,7	1 802	2 107	48 930	2 654	1,37	7,62
	14,2	148	189	35 210	13,7	2 012	2 364	54 880	2 957	1,36	6,76
	16,0	166	211	38 940	13,6	2 225	2 630	60 990	3 264	1,36	6,04
	17,5	180	229	41 932	13,5	2 396	2 845	65 939	3 508	1,36	5,6
	20,0	204	260	46 680	13,4	2 670	3 190	73 900	3 900	1,35	4,91
	25,0	250	318	55 315	13,2	3 161	3 845	88 749	4 595	1,34	4,00

Specified side dimension	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area	Radius of gyration	Elastic section modulus	Plastic section modulus	Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
B	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
400	10,0	122	155	39 130	15,9	1 956	2 260	60 090	2 895	1,57	8,22
	12,5	151	192	47 840	15,8	2 392	2 782	73 910	3 530	1,57	6,63
	14,2	170	217	53 530	15,7	2 676	3 127	83 030	3 942	1,56	5,87
	16,0	191	243	59 340	15,6	2 967	3 484	92 440	4 362	1,56	5,24
	17,5	208	264	64 034	15,6	3 202	3 775	100 102	4 699	1,56	4,8
	20,0	235	300	71 540	15,4	3 577	4 247	112 500	5 237	1,55	4,25
	25,0	289	368	85 384	15,2	4 269	5 141	135 854	6 223	1,54	3,46

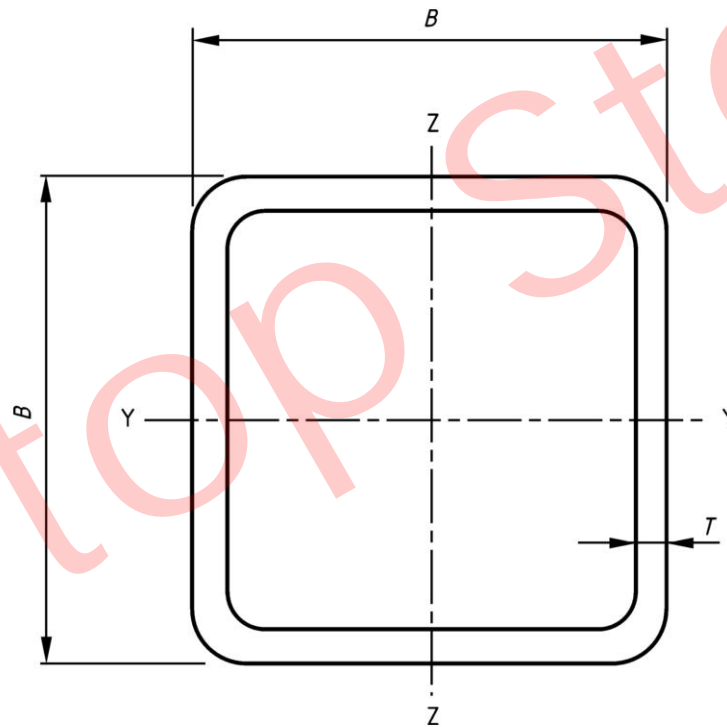


Figure B.2 — Square hollow section

Table B.3 — Dimensions and sectional properties of a limited range of rectangular hollow sections (see Figure B.3)

Specified side dimensions	Specified thickness T	Mass per unit length M	Crosssectional area A	Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant I_t	Torsional modulus constant C_t	Superficial area per metre length A_s	Nominal length per ton
				I_{yy}	I_{zz}	i_{yy}	i_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$				
$H \times B$	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$	I_t	C_t	A_s	
mm	mm	kg/m	cm ²	cm ⁴	cm ⁴	cm	cm	cm ³	cm ³	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
50	30	3,00	3,82	12,2	5,38	1,79	1,19	4,87	3,58	6,12	4,25	12,1	5,90	0,15	334
	30	3,61	4,60	14,2	6,20	1,76	1,16	5,68	4,13	7,25	5,00	14,2	6,80	0,15	277
	30	4,39	5,59	16,5	7,08	1,72	1,13	6,60	4,72	8,59	5,88	16,6	7,77	0,15	228
	30	5,28	6,73	18,7	7,89	1,67	1,08	7,49	5,26	10,0	6,80	19,0	8,67	0,15	189
60	40	3,81	4,86	23,6	12,4	2,20	1,60	7,86	6,22	9,65	7,26	25,9	10,04	0,19	262
	40	4,62	5,88	27,8	14,6	2,18	1,57	9,27	7,29	11,5	8,64	30,8	11,74	0,19	217
	40	5,64	7,19	32,8	17,0	2,14	1,54	10,9	8,52	13,8	10,3	36,7	13,71	0,19	177
	40	6,85	8,73	38,1	19,5	2,09	1,50	12,7	9,77	16,4	12,2	43,0	15,71	0,19	146
80	40	8,31	10,6	43,4	21,9	2,02	1,44	14,5	11,0	19,2	14,2	49,5	17,64	0,18	120
	40	5,62	7,16	57,2	18,9	2,83	1,63	14,3	9,5	18,0	11,0	46,2	16,08	0,23	178
	40	6,90	8,79	68,2	22,2	2,79	1,59	17,1	11,1	21,8	13,2	55,2	18,90	0,23	145
	40	8,42	10,7	80,3	25,7	2,74	1,55	20,1	12,9	26,1	15,7	65,1	21,85	0,23	119
90	40	10,3	13,1	93,3	29,2	2,67	1,49	23,3	14,6	31,1	18,4	75,6	24,84	0,22	97,2
	40	12,5	16,0	106	32,1	2,58	1,42	26,5	16,1	36,5	21,2	85,8	27,45	0,22	79,9
	40	14,9	18,9	115	33,7	2,47	1,33	28,8	16,9	41,3	23,5	92,5	28,9	0,214	67,3
	40	17,1	21,7	119	33,7	2,34	1,25	29,8	16,8	44,8	24,7	94,0	28,8	0,209	58,6
90	50	6,63	8,44	89,1	35,3	3,25	2,04	19,8	14,1	24,6	16,2	80,9	23,58	0,27	151
	50	8,15	10,4	107	41,9	3,21	2,01	23,8	16,8	29,8	19,6	97,5	28,02	0,27	123
	50	9,99	12,7	127	49,2	3,16	1,97	28,3	19,7	36,0	23,5	116	32,86	0,27	100
	50	12,3	15,6	150	57,0	3,10	1,91	33,3	22,8	43,2	28,0	138	38,06	0,26	81,5

Specified side dimensions	Specified thickness T	Mass per unit length M	Crosssectional area		Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant I_t	Torsional modulus constant C_t	Superficial area per metre length A_s	Nominal length per ton
			A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$					
50	8,0	15,0	19,2	174	64,6	3,01	1,84	38,6	25,8	51,4	32,9	160	43,21	0,26	66,5	
	10,0	18,0	22,9	194	70,2	2,91	1,75	43,0	28,1	59,3	37,4	179	47,1	0,254	55,6	
50	12,5	21,3	27,1	208	73,2	2,77	1,64	46,2	29,3	66,5	41,1	192	49,2	0,248	47,1	
	3,2	7,13	9,08	116	38,8	3,57	2,07	23,2	15,5	28,9	17,7	93,4	26,38	0,29	140	
50	4,0	8,78	11,2	140	46,2	3,53	2,03	27,9	18,5	35,2	21,5	113	31,40	0,29	114	
	5,0	10,8	13,7	167	54,3	3,48	1,99	33,3	21,7	42,6	25,8	135	36,91	0,29	92,8	
50	6,3	13,3	16,9	197	63,0	3,42	1,93	39,4	25,2	51,3	30,8	160	42,89	0,28	75,4	
	8,0	16,3	20,8	230	71,7	3,33	1,86	46,0	28,7	61,4	36,3	186	48,89	0,28	61,4	
50	10,0	19,6	24,9	259	78,4	3,22	1,77	51,8	31,4	80,0	41,4	209	53,6	0,274	51,1	
	12,5	23,2	29,6	281	82,3	3,08	1,67	56,3	32,9	80,7	45,8	226	56,4	0,268	43,1	
60	3,2	7,63	9,72	131	58,8	3,67	2,46	26,2	19,6	32,0	22,4	129	32,36	0,31	131	
	4,0	9,41	12,0	158	70,5	3,63	2,43	31,6	23,5	39,1	27,3	156	38,74	0,31	106	
60	5,0	11,6	14,7	189	83,6	3,58	2,38	37,8	27,9	47,4	32,9	188	45,86	0,31	86,5	
	6,3	14,2	18,1	225	98,1	3,52	2,33	45,0	32,7	57,3	39,5	224	53,81	0,30	70,2	
60	8,0	17,5	22,4	264	113	3,44	2,25	52,8	37,8	68,7	47,1	265	62,17	0,30	57,0	
	10,0	21,1	26,9	299	126	3,33	2,16	59,9	42,1	80,2	54,4	304	69,3	0,294	47,3	
60	12,5	25,2	32,1	329	136	3,21	2,06	65,9	45,2	91,6	61,2	336	74,8	0,288	39,7	
	4,0	10,7	13,6	249	83,1	4,28	2,47	41,5	27,7	51,9	31,7	201	47,10	0,35	93,7	
60	5,0	13,1	16,7	299	98,8	4,23	2,43	49,9	32,9	63,1	38,4	242	55,95	0,35	76,1	
	6,3	16,2	20,7	358	116	4,16	2,37	59,7	38,8	76,7	46,3	290	65,94	0,34	61,6	
60	8,0	20,1	25,6	425	135	4,08	2,30	70,8	45,0	92,7	55,4	344	76,64	0,34	49,9	
	10,0	24,3	30,9	488	152	3,97	2,21	81,4	50,5	109	64,4	396	86,13	0,33	41,2	

Specified side dimensions	Specified thickness T mm	Mass per unit length M kg/m	Crosssectional area		Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant I_t cm ⁴	Torsional modulus constant C_t cm ³	Superficial area per metre length A_s m ² /m	Nominal length per ton m
			A cm ²	I_{yy} cm ⁴	I_{zz} cm ⁴	i_{yy} cm	i_{zz} cm	$W_{el,yy}$ cm ³	$W_{el,zz}$ cm ³	$W_{pl,yy}$ cm ³	$W_{pl,zz}$ cm ³					
60	12,5	29,1	37,1	546	165	3,84	2,11	91,1	54,9	126	73,1	442	93,8	0,328	34,4	
																80
80	5,0	14,7	18,7	365	193	4,42	3,21	60,9	48,2	74,6	56,1	401	77,88	0,39	68,0	
																80
80	8,0	22,6	28,8	525	273	4,27	3,08	87,5	68,1	111	82,6	587	110	0,38	44,3	
																80
80	12,5	33,0	42,1	692	349	4,05	2,88	115	87,4	153	113	789	141	0,368	30,3	
																80
80	4,0	13,2	16,8	441	184	5,12	3,31	62,9	46,0	77,1	52,2	411	77	0,43	75,9	
																80
80	6,3	20,2	25,7	646	265	5,01	3,21	92,3	66,2	115	77,5	607	110	0,42	49,6	
																140
80	10,0	30,6	38,9	908	362	4,83	3,05	130	90,5	168	111	862	150	0,41	32,7	
																80
80	14,2	41,0	52,3	1 110	430	4,62	2,87	159	107	215	140	1 070	179	0,403	24,4	
																100
100	5,0	18,6	23,7	739	392	5,58	4,07	98,5	78,5	119	90,1	807	127	0,49	53,7	
																100
100	8,0	28,9	36,8	1 087	569	5,44	3,94	145	113,9	180	135	1 203	183	0,48	34,7	
																100
100	12,5	42,8	54,6	1 488	763	5,22	3,74	198	152,6	256	190	1 679	246	0,47	23,3	
																100

Specified side dimensions	Specified thickness T mm	Mass per unit length M kg/m	Crosssectional area		Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant I_t cm ⁴	Torsional modulus constant C_t cm ³	Superficial area per metre length A_s m ² /m	Nominal length per ton m
			A cm ²	I_{yy} cm ⁴	I_{zz} cm ⁴	i_{yy} cm	i_{zz} cm	$W_{el,yy}$ cm ³	$W_{el,zz}$ cm ³	$W_{pl,yy}$ cm ³	$W_{pl,zz}$ cm ³					
160	100	52,6	67,0	1 710	862	5,05	3,59	228	172	304	223	1 950	278	0,459	19,0	
	80	14,4	18,4	612	207	5,77	3,35	76,5	51,7	94,7	58,3	493	88	0,47	69,3	
	80	17,8	22,7	744	249	5,72	3,31	93,0	62,3	116	71,1	600	106	0,47	56,0	
	80	22,2	28,2	903	299	5,66	3,26	113	74,8	142	86,8	730	127	0,46	45,1	
	80	27,6	35,2	1 091	356	5,57	3,18	136	89,0	175	106	883	151	0,46	36,2	
	80	33,7	42,9	1 284	411	5,47	3,10	161	103	209	125	1 041	175	0,45	29,7	
	80	40,9	52,1	1 485	465	5,34	2,99	186	116	247	146	1 204	198	0,45	24,5	
	80	45,5	57,9	1 600	492	5,25	2,91	200	123	270	159	1 300	210	0,443	22,0	
	80	50,1	63,8	1 700	514	5,16	2,84	212	128	292	170	1 370	220	0,439	20,0	
	80	16,9	21,6	945	379	6,61	4,19	105	75,9	128	85,2	852	127	0,55	59,0	
180	100	21,0	26,7	1 153	460	6,57	4,15	128	92,0	157	104	1 042	154	0,55	47,7	
	100	26,1	33,3	1 407	557	6,50	4,09	156	111	194	128	1 277	186	0,54	38,3	
	100	32,6	41,6	1 713	671	6,42	4,02	190	134	239	157	1 560	224	0,54	30,7	
	100	40,0	50,9	2 036	787	6,32	3,93	226	157	288	188	1 862	263	0,53	25,0	
	100	48,7	62,1	2 385	908	6,20	3,82	265	182	344	223	2 191	303	0,53	20,5	
	100	54,4	69,3	2 590	974	6,11	3,75	288	195	378	244	2 390	326	0,523	18,4	
	100	60,1	76,6	2 780	1 030	6,02	3,67	309	207	411	264	2 560	346	0,519	16,6	
	100	64,7	82,5	2 910	1 070	5,94	3,61	324	215	437	278	2 690	359	0,515	15,4	
	100	18,2	23,2	1 223	416	7,26	4,24	122	83	150	93	983	142	0,59	54,9	
	100	22,6	28,7	1 495	505	7,21	4,19	149	101	185	114	1 204	172	0,59	44,3	
200	100	28,1	35,8	1 829	613	7,15	4,14	183	123	228	140	1 475	208	0,58	35,6	
	100	35,1	44,8	2 234	739	7,06	4,06	223	148	282	172	1 804	251	0,58	28,5	

Specified side dimensions	Specified thickness T	Mass per unit length M	Crosssectional area		Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant I_t	Torsional modulus constant C_t	Superficial area per metre length A_s	Nominal length per ton
			A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$					
100	10,0	43,1	54,9	2 664	869	6,96	3,98	266	174	341	206	2 156	295	0,57	23,2	
	12,5	52,7	67,1	3 136	1 004	6,84	3,87	314	201	408	245	2 541	341	0,57	19,0	
100	16,0	65,2	83,0	3 678	1 147	6,66	3,72	368	229	491	290	2 982	391	0,56	15,3	
100	17,5	70,2	89,5	3 870	1 190	6,58	3,65	387	239	523	307	3 140	407	0,555	14,2	
100	20,0	78,3	99,7	4 140	1 250	6,44	3,55	414	251	570	331	3 350	429	0,548	12,8	
100	25,0	92,9	118	4 501	1 317	6,17	3,34	450	263	645	366	3 615	452	0,536	10,8	
120	25,0	1 011	128	5 272	2 171	6,41	4,11	527	361	733	490	5 378	598	0,576	9,9	
120	6,3	30,1	38,3	2 065	929	7,34	4,92	207	155	253	177	2 028	255	0,62	33,3	
120	8,0	37,6	48,0	2 529	1 128	7,26	4,85	253	188	313	218	2 495	310	0,62	26,6	
120	10,0	46,3	58,9	3 026	1 337	7,17	4,76	303	223	379	263	3 001	367	0,61	21,6	
120	12,5	56,6	72,1	3 576	1 562	7,04	4,66	358	260	455	314	3 569	428	0,61	17,7	
220	14,2	63,3	80,7	3 910	1 690	6,96	4,58	391	282	503	346	3 920	464	0,603	15,8	
120	16,0	70,2	89,4	4 220	1 810	6,87	4,50	422	302	550	377	4 250	497	0,599	14,2	
120	17,5	75,7	96,5	4 460	1 900	6,80	4,44	446	317	586	400	4 500	521	0,595	13,2	
120	20,0	84,6	108	4 790	2 020	6,67	4,33	479	337	642	435	4 860	555	0,588	11,8	
120	25,0	109	138	6 869	2 402	7,05	4,17	624	400	866	537	6 217	574	0,616	9,2	
150	6,3	38,0	48,4	4 143	1 874	9,25	6,22	331	250	402	283	4 054	413	0,78	26,3	
150	8,0	47,7	60,8	5 111	2 298	9,17	6,15	409	306	501	350	5 021	506	0,78	21,0	
150	10,0	58,8	74,9	6 174	2 755	9,08	6,06	494	367	611	426	6 090	605	0,77	17,0	
150	12,5	72,3	92,1	7 387	3 265	8,96	5,96	591	435	740	514	7 326	717	0,77	13,8	
150	14,2	81,1	103	8 141	3 576	8,87	5,88	651	477	823	570	8 102	784	0,76	12,3	
150	16,0	90,3	115	8 879	3 873	8,79	5,80	710	516	906	625	8 868	849	0,76	11,1	

Specified side dimensions	Specified thickness T mm	Mass per unit length M kg/m	Crosssectional area		Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant I_t cm ⁴	Torsional modulus constant C_t cm ³	Superficial area per metre length A_s m ² /m	Nominal length per ton m
			A cm ²	I_{yy} cm ⁴	I_{zz} cm ⁴	i_{yy} cm	i_{zz} cm	$W_{el,yy}$ cm ³	$W_{el,zz}$ cm ³	$W_{pl,yy}$ cm ³	$W_{pl,zz}$ cm ³					
150	17,5	97,7	124	9 450	4 100	8,71	5,74	756	546	972	669	9 460	899	0,755	10,2	
	20,0	110	140	10 310	4 430	8,59	5,63	824	590	1070	736	10 370	971	0,748	9,12	
150	25,0	132	168	11 696	4 930	8,34	5,41	936	657	1254	850	11 856	1 083	0,736	7,57	
140	6,3	38,0	48,4	4 355	1 660	9,49	5,86	335	237	411	267	3 803	399	0,784	26,3	
140	7,1	42,68	54,2	4 842	1 839	9,45	5,82	372	263	459	298	4 234	442	0,782	23,5	
140	8,0	47,7	60,8	5 373	2 032	9,40	5,78	413	290	511	331	4 704	488	0,779	21,0	
140	8,8	52,2	66,5	5 831	2 197	9,37	5,75	449	314	557	360	5 111	527	0,777	19,2	
140	10,0	58,8	74,9	6 490	2 432	9,31	5,70	499	347	624	402	5 698	584	0,774	17,0	
140	11,0	64,3	81,9	7 017	2 617	9,26	5,65	540	374	678	436	6 169	628	0,772	15,6	
140	12,5	72,3	92,1	7 767	2 876	9,18	5,59	597	411	756	485	6 841	690	0,768	13,8	
140	14,2	81,2	103	8 560	3 144	9,10	5,52	658	449	840	537	7 555	754	0,763	12,3	
140	16,0	90,3	115	9 337	3 400	9,01	5,44	718	486	925	588	8 257	815	0,759	11,1	
140	17,5	97,7	124	9 936	3 592	8,93	5,37	764	513	992	629	8 800	862	0,755	10,2	
140	20,0	110	140	10 838	3 872	8,81	5,26	834	553	1 097	691	9 619	930	0,748	9,12	
180	6,3	41,9	53,4	5 166	2 929	9,83	7,40	397	325	475	369	5 810	524	0,86	23,8	
180	8,20	52,7	67,2	6 390	3 608	9,75	7,33	492	401	592	459	7 221	644	0,86	19,0	
180	10,0	65,1	82,9	7 741	4 351	9,66	7,24	595	483	724	560	8 798	775	0,85	15,4	
180	12,5	80,1	102	9 299	5 196	9,54	7,13	715	577	879	679	10 640	924	0,85	12,5	
180	14,2	90,1	115	10 280	5 719	9,46	7,06	791	635	980	755	11 820	1 016	0,84	11,1	
180	16,0	100	128	11 250	6 231	9,38	6,98	865	692	1 081	831	12 990	1 106	0,84	9,97	
180	17,5	109	138	12 000	6 620	9,31	6,92	923	736	1 160	892	13 920	1 180	0,835	9,20	
180	20,0	122	156	13 150	7 220	9,19	6,81	1 010	802	1 290	986	15 350	1 280	0,828	8,18	

260

Specified side dimensions	Specified thickness T mm	Mass per unit length M kg/m	Crosssectional area		Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant I_t cm ⁴	Torsional modulus constant C_t cm ³	Superficial area per metre length A_s m ² /m	Nominal length per ton m
			A cm ²	I_{yy} cm ⁴	I_{zz} cm ⁴	i_{yy} cm	i_{zz} cm	$W_{el,yy}$ cm ³	$W_{el,zz}$ cm ³	$W_{pl,yy}$ cm ³	$W_{pl,zz}$ cm ³					
180	25,0	149	188	15 071	8 172	8,95	6,59	908	1 152	1 152	1 448	17 814	1 448	0,816	6,77	
	6,3	47,9	61,0	7 829	4 193	11,3	8,29	419	472	472	681	8 476	681	0,98	20,9	
200	8,0	60,3	76,8	9 717	5 184	11,3	8,22	648	589	589	840	10 560	840	0,98	16,6	
	10,0	74,5	94,9	11 820	6 278	11,2	8,13	788	721	721	1 015	12 910	1 015	0,97	13,4	
200	12,5	91,9	117	14 270	7 537	11,0	8,02	952	877	877	1 217	15 680	1 217	0,97	10,9	
	14,2	103	132	15 830	8 328	11,0	7,95	833	978	978	1 343	17 460	1 343	0,96	9,7	
200	16,0	115	147	17 390	9 109	10,9	7,87	911	1 080	1 080	1 468	19 250	1 468	0,96	8,67	
	17,5	125	159	18 620	9 720	10,80	7,81	972	1 160	1 160	1 570	20 680	1 570	0,955	7,99	
200	20,0	141	180	20 520	10 650	10,69	7,70	1 070	1 290	1 290	1 710	22 910	1 710	0,948	7,09	
	25,0	171	218	23 808	12 209	10,44	7,48	1 587	1 520	1 520	1 964	26 861	1 964	0,936	5,836	
250	6,3	57,8	73,6	13 200	7 885	13,4	10,4	754	892	709	1 011	15 220	1 011	1,18	17,3	
	8,0	72,8	92,8	16 450	9 798	13,3	10,3	940	1 118	888	1 254	19 030	1 254	1,18	13,7	
250	10,0	90,2	115	20 100	11 940	13,2	10,2	1 149	1 375	1 091	1 525	23 350	1 525	1,17	11,1	
	12,5	112	142	24 420	14 440	13,1	10,1	1 395	1 685	1 334	1 842	28 530	1 842	1,17	8,97	
250	14,2	126	160	27 200	16 050	13,0	10,0	1 554	1 887	1 492	2 044	31 890	2 044	1,16	7,95	
	16,0	141	179	30 010	17 650	12,9	9,93	1 715	2 095	1 655	2 246	35 330	2 246	1,16	7,12	
250	17,5	153	194	32 250	18 926	12,9	9,87	1 843	2 263	1 785	2 406	38 083	2 406	1,16	6,55	
	20,0	172	220	35 780	20 910	12,76	9,76	2 040	2 530	1 990	2 660	42 470	2 660	1,15	5,80	
200	8,0	72,8	92,8	19 560	6 660	14,5	8,47	978	1 203	743	1 135	15 740	1 135	1,18	13,7	
	10,0	90,2	115	23 910	8 084	14,4	8,39	1 196	1 480	911	1 376	19 260	1 376	1,17	11,1	
200	12,5	112	142	29 060	9 738	14,3	8,28	1 453	1 813	1 111	1 656	23 440	1 656	1,17	8,97	
	14,2	126	160	32 380	10 780	14,2	8,21	1 619	2 032	1 242	1 834	26 140	1 834	1,16	7,95	

Specified side dimensions	Specified thickness T mm	Mass per unit length M kg/m	Crosssectional area		Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant I_t cm ⁴	Torsional modulus constant C_t cm ³	Superficial area per metre length A_s m ² /m	Nominal length per ton m
			A cm ²	I_{yy} cm ⁴	I_{zz} cm ⁴	i_{yy} cm	i_{zz} cm	$W_{el,yy}$ cm ³	$W_{el,zz}$ cm ³	$W_{pl,yy}$ cm ³	$W_{pl,zz}$ cm ³					
200	16,0	141	179	35 740	11 820	14,1	8,13	1 787	1 182	2 256	1 374	2 010	28 870	2 010	1,16	7,12
	17,5	153	194	34 812	12 640	14,1	8,06	1 921	1 264	2 437	1 481	2 148	31 053	2 148	1,16	6,55
250	20,0	172	220	42 630	13 900	13,9	7,95	2 130	1 390	2 730	1 650	2 360	34 490	2 360	1,15	5,80
	25,0	211	268	50 175	16 063	13,68	7,74	2 509	1 606	3 266	1 958	2 732	40 659	2 732	1,14	4,75
450	8,0	85,4	109	30 080	12 140	16,6	10,6	1 337	971	1 622	1 081	1 629	27 080	1 629	1,38	11,7
	10,0	106	135	36 900	14 820	16,5	10,5	1 640	1 185	2 000	1 331	1 986	33 280	1 986	1,37	9,44
250	12,5	131	167	45 030	17 970	16,4	10,4	2 001	1 438	2 458	1 631	2 406	40 720	2 406	1,37	7,62
	14,2	148	189	50 320	20 000	16,3	10,3	2 236	1 600	2 759	1 827	2 675	45 580	2 675	1,36	6,76
500	16,0	166	211	55 710	22 040	16,2	10,2	2 476	1 763	3 070	2 029	2 947	50 550	2 947	1,36	6,04
	17,5	180	229	60 035	23 665	16,2	10,2	2 668	1 893	3 323	2 192	3 163	54 549	3 163	1,36	5,55
300	20,0	204	260	66 930	26 220	16,1	10,1	2 970	2 100	3 730	2 450	3 500	60 950	3 500	1,35	4,90
	25,0	250	318	79 536	30 759	15,8	9,83	3 535	2 461	4 499	2 941	4 107	72 736	4 107	1,34	4,00
300	10,0	122	155	53 760	24 440	18,6	12,6	2 150	1 629	2 595	1 826	2 696	52 450	2 696	1,57	8,22
	12,5	151	192	65 810	29 780	18,5	12,5	2 633	1 985	3 196	2 244	3 281	64 390	3 281	1,57	6,63
300	14,2	170	217	73 700	33 250	18,4	12,4	2 948	2 216	3 593	2 519	3 660	72 240	3 660	1,56	5,87
	16,0	191	243	81 780	36 770	18,3	12,3	3 271	2 451	4 005	2 804	4 044	80 330	4 044	1,56	5,24
300	17,5	208	264	88 311	39 592	18,3	12,2	3 532	2 639	4 341	3 035	4 353	86 885	4 353	1,56	4,82
	20,0	235	300	98 780	44 080	18,2	12,1	3 951	2 939	4 885	3 408	4 842	97 450	4 842	1,55	4,25
300	25,0	289	368	118 187	52 245	18,0	11,9	4 727	3 483	5 920	4 112	5 733	117 216	5 733	1,54	3,46

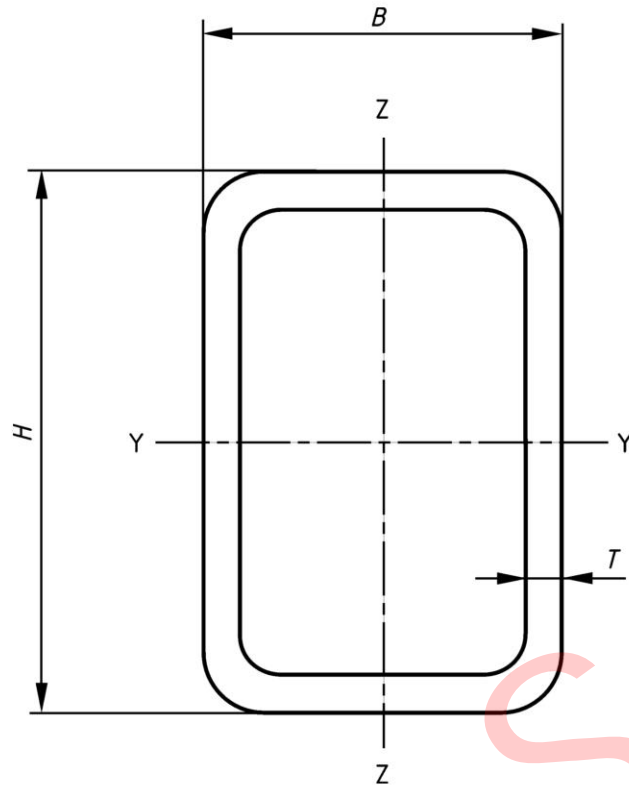


Figure B.3 — Rectangular hollow section

Table B.4 — Dimensions and sectional properties of elliptical hollow sections (see Figure B.4)

Specified dimensions	Specified thickness	Mass per unit length	Cross-sectional area	Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
				I_{yy}	I_{zz}	I_{yy}	I_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$				
$H \times B$	T	M	A	I_{yy}	I_{zz}	I_{yy}	I_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$	I_t	C_t	A_s	
mm	mm	kg/m	cm ²	cm ⁴	cm ⁴	cm	cm	cm ³	cm ³	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
60	3,2	6,85	8,7	123	41,4	3,76	2,18	20,5	13,8	28,7	17,6	124	30,8	0,291	146
60	4,0	8,48	10,8	150	49,9	3,73	2,15	25,1	16,6	35,3	21,5	150	36,9	0,291	118
60	5,0	10,5	13,4	182	59,7	3,69	2,12	30,4	19,9	43,2	26,2	180	43,9	0,291	95,4
60	6,0	12,4	15,8	212	68,6	3,66	2,08	35,4	22,9	50,7	30,5	208	50,1	0,291	80,5
60	8,0	16,2	20,6	266	83,7	3,59	2,02	44,3	27,9	64,7	38,4	256	60,4	0,291	61,8
75	4,0	10,7	13,6	301	101	4,70	2,72	40,1	26,9	56,1	34,4	303	60,1	0,364	93,4
75	5,0	13,3	16,9	367	122	4,66	2,69	48,9	32,5	68,9	42,0	367	72,2	0,364	75,4
75	6,0	15,8	20,1	430	141	4,63	2,65	57,3	37,7	81,3	49,3	426	83,2	0,364	63,5
75	6,3	16,5	21,0	448	147	4,62	2,64	59,7	39,1	84,9	51,5	443	86,3	0,364	60,6
75	8,0	20,6	26,3	546	176	4,56	2,59	72,8	46,8	105	62,9	533	102	0,364	48,5
75	10,0	25,3	32,2	649	204	4,49	2,52	86,6	54,5	126	75,1	625	118	0,364	39,6
90	6,0	19,1	24,3	761	253	5,59	3,22	84,6	56,2	119	72,6	760	125	0,436	52,4
90	8,0	25,1	31,9	974	318	5,52	3,16	108	70,6	154	93,3	961	155	0,436	39,9
90	10,0	30,8	39,3	1 169	375	5,46	3,09	130	83,3	187	112	1 139	182	0,436	32,4
100	6,3	22,3	28,4	1 103	368	6,23	3,60	110	73,5	155	94,7	1 105	163	0,485	44,8
100	8,0	28,0	35,7	1 358	446	6,17	3,54	136	89,3	193	117	1 347	197	0,485	35,7
100	10,0	34,5	44,0	1 637	529	6,10	3,47	164	106	235	141	1 605	232	0,485	29,0
100	12,5	42,4	54,0	1 954	619	6,02	3,39	195	124	284	169	1 889	269	0,485	23,6
110	6,0	23,5	30,0	1 421	476	6,88	3,99	129	86,6	181	111	1 429	193	0,533	42,5
110	8,0	31,0	39,5	1 832	606	6,81	3,92	167	110	235	143	1 824	244	0,533	32,3

Specified dimensions	Specified thickness	Mass per unit length	Crosssectional area	Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
				I_{yy}	I_{zz}	I_{yy}	I_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$				
$H \times B$	T	M	A	I_{yy}	I_{zz}	I_{yy}	I_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$	I_t	C_t	A_s	
mm	mm	kg/m	cm ²	cm ⁴	cm ⁴	cm	cm	cm ³	cm ³	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	110	38,2	48,7	2 215	722	6,74	3,85	201	131	287	174	2 183	288	0,533	26,2
	125	26,9	34,2	2 109	711	7,85	4,56	169	114	235	144,5	2 130	254,5	0,606	37,2
	125	28,2	35,9	2 205	742	7,84	4,55	176	119	246	151	2 224	265	0,606	35,5
250	125	35,4	45,1	2 732	909	7,78	4,49	219	145	307	188	2 734	323	0,606	28,2
	125	43,8	55,8	3 316	1 090	7,71	4,42	265	174	376	228	3 288	385	0,606	22,8
	125	51,9	66,2	3 864	1 254	7,64	4,35	309	201	442	267	3 798	440	0,606	19,3
	125	53,9	68,7	3 996	1 292	7,63	4,34	320	207	458	276	3 918	453	0,606	18,5
300	150	42,8	54,5	4 813	1 616	9,39	5,44	321	215	449	275	4 846	481	0,727	23,4
	150	53,0	67,5	5 872	1 950	9,32	5,37	391	260	551	336	5 867	577	0,727	18,9
	150	65,5	83,4	7 120	2 334	9,24	5,29	475	311	674	409	7 047	686	0,727	15,3
	150	82,5	105	8 731	2 809	9,12	5,17	582	374	837	503	8 529	818	0,727	12,1
320	160	45,8	58,3	5 877	1 978	10,0	5,82	367	247	513	315	5 928	553	0,776	21,8
	160	56,7	72,3	7 181	2 393	9,97	5,75	449	299	631	385	7 192	665	0,776	17,6
	160	67,5	86,0	8 422	2 779	9,90	5,69	526	347	745	453	8 375	769	0,776	14,8
	160	78,0	99,4	9 604	3 137	9,83	5,62	600	392	855	517	9 483	863	0,776	12,8
400	200	57,6	73,4	11 690	3 966	12,6	7,35	584	397	811	500	11 860	890	0,969	17,4
	200	71,5	91,1	14 340	4 829	12,5	7,28	717	483	1 001	615	14 470	1 079	0,969	14,0
	200	85,2	109	16 910	5 646	12,5	7,21	845	565	1 186	726	16 960	1 257	0,969	11,7
	200	88,6	113	17 530	5 843	12,5	7,19	877	584	1 232	753	17 560	1 299	0,969	11,3
	200	98,7	126	19 370	6 416	12,4	7,14	968	642	1 366	832	19 310	1 422	0,969	10,1
480	240	86,3	110	25 170	8 529	15,1	8,81	1 049	711	1 457	897	25 510	1 594	1,16	11,6
	240	103	131	29 750	10 010	15,1	8,74	1 240	835	1 730	1 062	30 010	1 865	1,16	9,71

Specified dimensions	Specified thickness	Mass per unit length	Crosssectional area	Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia constant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
				I_{yy}	I_{zz}	I_{yy}	I_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$				
$H \times B$	T	M	A	I_{yy}	I_{zz}	I_{yy}	I_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,yy}$	$W_{pl,zz}$	I_t	C_t	A_s	
mm	mm	kg/m	cm ²	cm ⁴	cm ⁴	cm	cm	cm ³	cm ³	cm ³	cm ³	cm ⁴	cm ³	m ² /m	m
	240	119	152	34 190	11 430	15,0	8,67	1 425	953	1 997	1 222	34 320	2 121	1,16	8,37
	250	90,0	115	28 540	9 682	15,8	9,19	1 142	775	1 585	976	28 950	1 739	1,21	11,1
500	250	112	142	35 030	11 790	15,7	9,10	1 401	943	1 956	1 201	35 330	2 108	1,21	8,95
	250	142	180	43 710	14 550	15,6	8,98	1 748	1 164	2 459	1 501	43 740	2 586	1,21	7,06

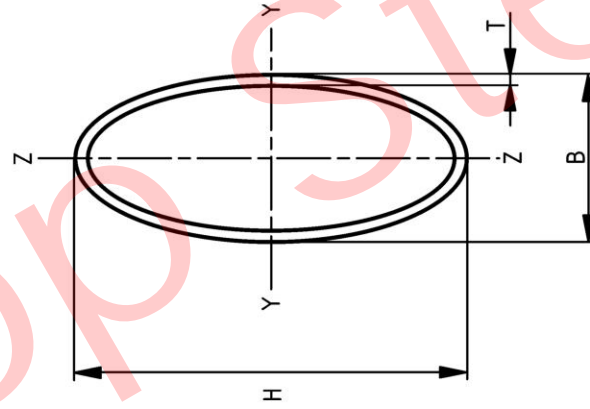


Figure B.4 — Elliptical hollow section

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.
- Standards purchased in hard copy format:
 - A British Standard purchased in hard copy format is for personal or internal company use only.
 - It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services

Tel: +44 345 086 9001

Email (orders): orders@bsigroup.com

Email (enquiries): cservices@bsigroup.com

Subscriptions

Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.

<https://www.botopsteelpipe.com>