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Cold formed welded steel structural hollow sections - Part 2: Tolerances, dimensions and sectional properties

Profils creux de construction soudés, formés à froid en aciers - Partie 2 : Tolérances, dimensions et caractéristiques du profil

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

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

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European foreword

This document (EN 10219-2:2019) 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of an identical text or by endorsement, at the latest by November 2019, and conflicting national standards shall be withdrawn at the latest by November 2019.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 10219-2:2006.

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

a) elliptical hollow sections were added;

b) Annex A concerning the additional tolerances for piling tubes was removed;

c) subclause 5.2 was added with one option;

d) in Table 3 the length tolerances for exact length were changed;

e) in 7.1 one paragraph was added;

f) 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 10219-1, *Cold formed welded steel structural hollow sections - Part 1: Technical delivery conditions*

— EN 10219-2, *Cold formed welded steel structural hollow sections - Part 2: Tolerances, dimensions and sectional properties*

— EN 10219-3, *Cold formed welded 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 10210-1 to EN 10210-3.

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.

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[1] Through its subcommittee SC 3 "Structural steels other than reinforcements" (secretariat: DIN)

1 Scope

This document specifies tolerances for cold formed welded circular, square, rectangular and elliptical structural hollow sections, manufactured in wall thicknesses up to 40 mm, in the following size ranges:

— circular: Outside diameters up to 2 500 mm;

— square: Outside dimensions up to 500 mm × 500 mm;

— rectangular: Outside dimensions up to 500 mm × 300 mm;

— elliptical: Outside dimensions up to 480 mm × 240 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 of 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 10219-1, *Cold formed welded 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 10219-1 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 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

Symbol	Unit	Definition
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 10219 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 4);

NOTE This information is included in the list of information to be obtained by the manufacturer contained in EN 10219-1.

5.2 Options

An option is specified in this part of EN 10219. In the event that the purchaser does not indicate a wish to implement this at the time of enquiry and order, the manufacturer shall supply in accordance with the basic specification.

Option 2.1 Out-of-roundness tolerances for diameter to thickness ratio exceeding 100 (see Table 2, footnote a).

6 Tolerances

6.1 Tolerances shall not exceed the values given in Table 2 for shape and mass, Table 3 for external corner profiles, Table 4 for manufacturer's delivered length and Table 5 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.

NOTE The internal corner profile is not specified.

Table 2 — Tolerances on shape, straightness and mass

Characteristic	Circular hollow sections	Square and rectangular hollow sections		Elliptical hollow section
		Side length mm	Tolerance	
Outside dimensions (D, B and H)	±1 % with a minimum of ± 0,5 mm and a maximum of ± 10 mm	H, $B < 100$	±1 % with a minimum of ± 0,5 mm	±1 % with a minimum of ± 0,5 mm
		$100 \leq H$, $B \leq 200$	±0,8 %	
		H, $B > 200$	±0,6 %	
Thickness (T)	For $D \leq 406{,}4$ mm: $T \leq 5$ mm ± 10 % $T > 5$ mm ± 0,5 mm For $D > 406{,}4$ mm: ±10 % with a maximum of ± 2 mm	$T \leq 5$ mm ± 10 % $T > 5$ mm ± 0,5 mm		$T \leq 5$ mm ± 10 % $T > 5$ mm ± 0,5 mm
Out-of-roundness (O)	2 % for hollow sections having a diameter to thickness ratio not exceeding 100 [a]	—		—
Concavity/convexity (x_1, x_2) [b]	—	Max. 0,8 % with a minimum of 0,5 mm		—

Characteristic	Circular hollow sections	Square and rectangular hollow sections		Elliptical hollow section
		Side length mm	Tolerance	
Squareness of side (θ)	—	90° ± 1°		—
External corner profile (C_1, C_2 or R)	—	See Table 3		—
Twist (V)	—	2 mm plus 0,5 mm/m length		—
Straightness (e)	0,20 % of total length and 3 mm over any 1 m length	0,15 % of total length and 3 mm over any 1 m length		0,20 % of total length and 3 mm over any 1 m length
Mass per unit length (M)	±6 % on individual delivered lengths			

a When the diameter to thickness ratio exceeds 100, application of tolerance on out-of-roundness is not required, unless specifically agreed (see 5.2).

b The tolerance on convexity and concavity is independent of the tolerance on outside dimensions.

Table 3 — Tolerances on external corner profiles

Dimensions in millimetres

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

a The sides need not be tangential to the corner arcs.

Table 4 — Tolerances on manufacturer's delivered length

Dimensions in millimetres

Type of length [a]	Range of length or length L	Tolerance
Random length	4 000 < L ≤ 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	$^{+50}_{0}$ mm
Exact length [b]	< 6 000	$^{+10}_{0}$ mm
	6 000 ≤ L ≤ 10 000	$^{+15}_{0}$ mm
	> 10 000	$^{+5}_{0}$ mm +1 mm/m

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

[b] Common lengths available are 6 m and 12 m.

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

Dimensions in millimetres

Thickness, T	Maximum weld bead height
≤ 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.

All dimensional and shape tolerances indicated in Tables 2, 3 and 5 shall be verified according to a procedure fixed by the manufacturer.

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) 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.

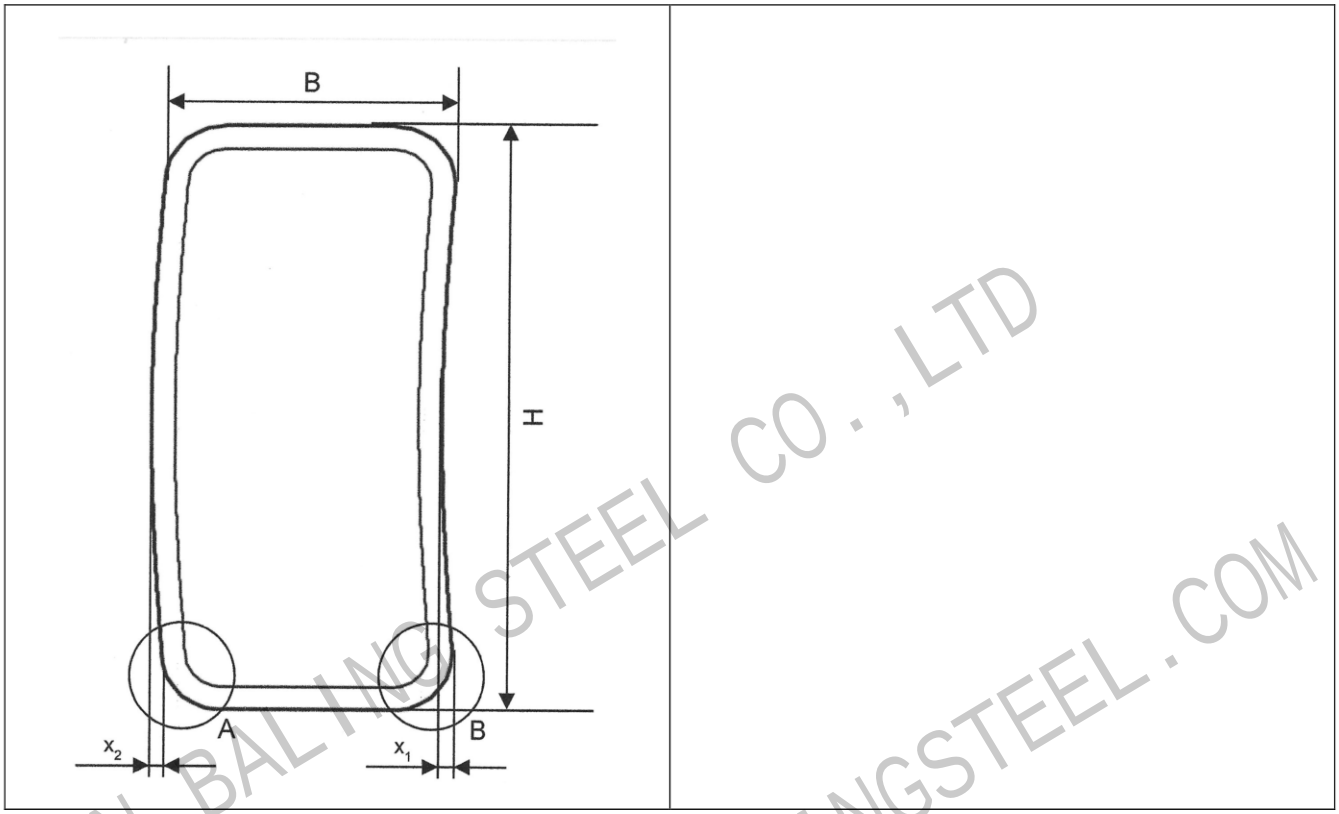


Figure 2 — Measurement of concavity/convexity of square or rectangular hollow sections

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.

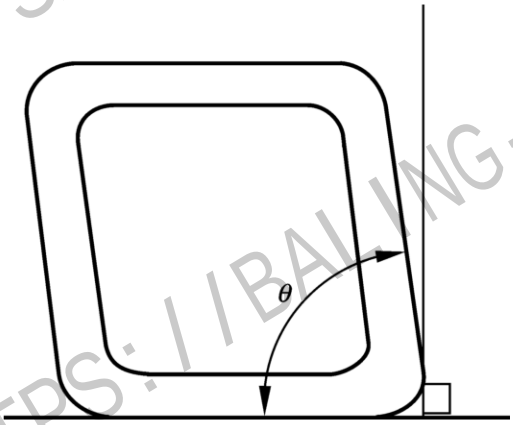


Figure 3 — Squareness of sides of square or rectangular hollow sections

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.

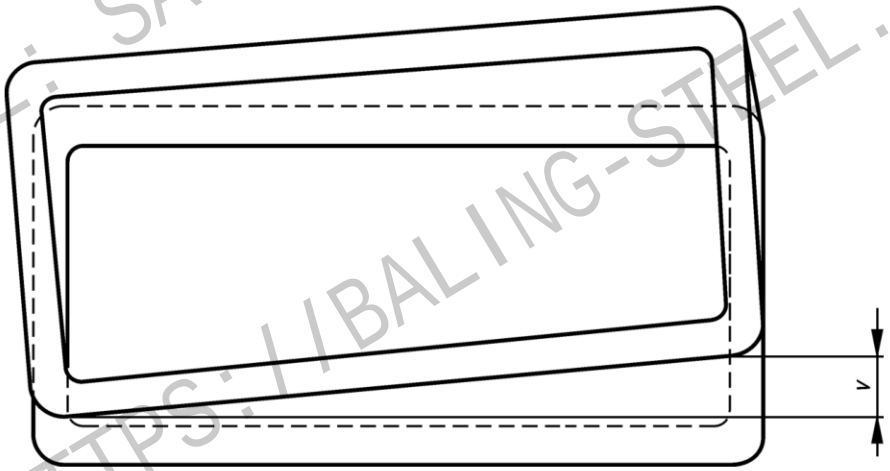
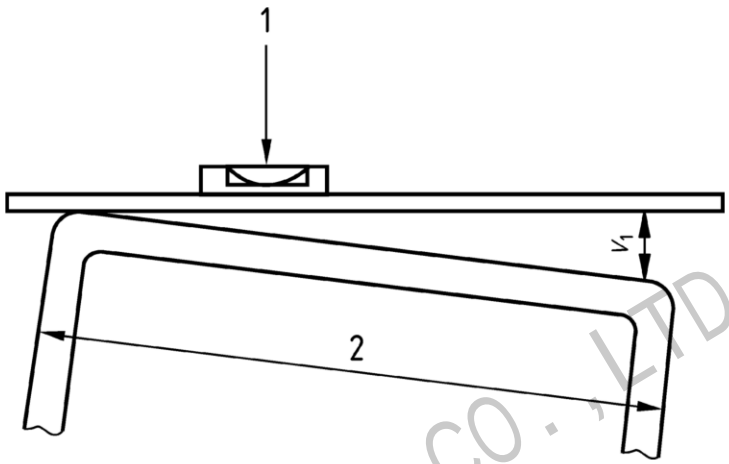


Figure 5 — Twist of square or rectangular hollow sections

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.



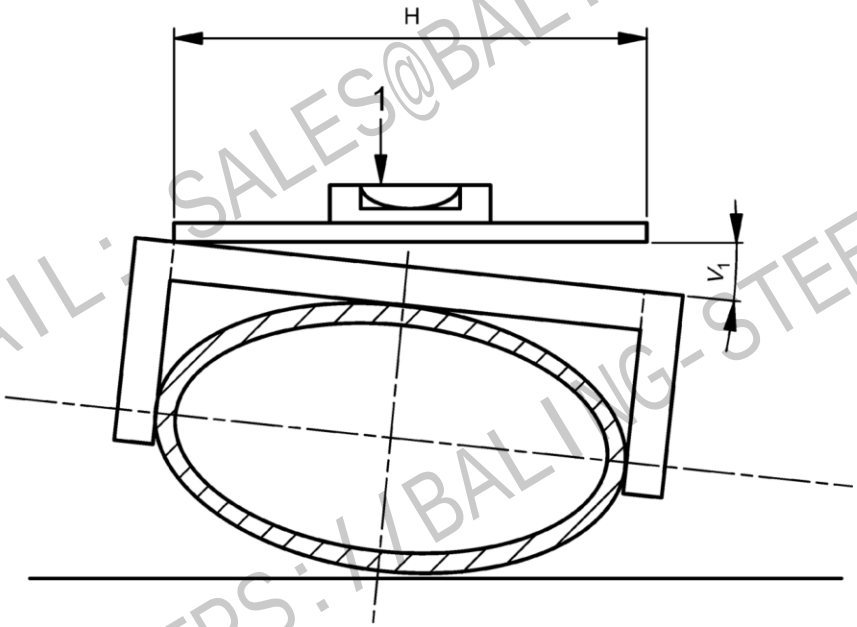
Key

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 10219 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 cold formed 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 hollow 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 cold formed 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	$A = \frac{\pi\left(D^2 - d^2\right)}{4 \times 10^2}$	(cm^2)
Mass per unit length	$M = 0{,}785 \times A$	(kg/m)
Second moment of area	$I = \frac{\pi\left(D^4 - d^4\right)}{64 \times 10^4}$	(cm^4)
Radius of gyration	$i = \sqrt{\frac{I}{A}}$	(cm)
Elastic section modulus	$W_{\text{el}} = \frac{2I \times 10}{D}$	(cm^3)
Plastic section modulus	$W_{\text{pl}} = \frac{D^3 - d^3}{6 \times 10^3}$	(cm^3)
Torsional inertia constant (polar moment of inertia)	$I_t = 2I$	(cm^4)
Torsional modulus constant	$C_t = 2W_{\text{el}}$	(cm^3)

A.3 Rectangular or 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:

for thicknesses ≤ 6 mm	2,0 T	(mm)
for thicknesses > 6 mm ≤ 10 mm	2,5 T	(mm)
for thicknesses > 10mm	3,0 T	(mm)

Internal corner radius (r_i) for calculation is:

for thicknesses ≤ 6 mm	1,0 T	(mm)
for thicknesses > 6 mm and ≤ 10 mm	1,5 T	(mm)
for thicknesses > 10 mm	2,0 T	(mm)

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

Superficial area per metre length

$$A_s = \frac{2}{10^3}\left(H + B - 4r_o + \pi r_o\right) \quad (m^2/m)$$

Cross-sectional area

$$A = \frac{2T\left(B + H - 2T\right) - \left(4 - \pi\right)\left(r_o^{\,2} - r_i^{\,2}\right)}{10^2} \quad (cm^2)$$

Mass per unit length

$$M = 0{,}785A \quad (kg/m)$$

Second moment of area

Major axis

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

Minor axis

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

Radius of gyration

Major axis

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

Minor axis

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

Elastic section modulus

Major axis

$$W_{\text{el yy}} = \frac{2I_{\text{yy}}}{H} \times 10 \quad (\text{cm}^3)$$

Minor axis

$$W_{\text{el zz}} = \frac{2I_{\text{zz}}}{B} \times 10 \quad (\text{cm}^3)$$

Plastic section modulus

Major axis

$$W_{\text{pl yy}} = \frac{1}{10^3}\left[\frac{BH^2}{4} - \frac{(B-2T)(H-2T)^2}{4} - 4\left(A_{\text{g}}h_{\text{g}}\right) + 4\left(A_{\xi}h_{\xi}\right)\right] \quad (\text{cm}^3)$$

Minor axis

$$W_{\text{pl zz}} = \frac{1}{10^3}\left[\frac{HB^2}{4} - \frac{(H-2T)(B-2T)^2}{4} - 4\left(A_{\text{g}}h_{\text{g}}\right) + 4\left(A_{\xi}h_{\xi}\right)\right] \quad (\text{cm}^3)$$

Torsional inertia constant

$$I_{\text{t}} = \frac{1}{10^4}\left[T^3\frac{h}{3} + 2KA_{\text{h}}\right] \quad (\text{cm}^4)$$

Torsional modulus constant

$$C_{\text{t}} = 10\left[\frac{I_{\text{t}}}{T + K/T}\right] \quad (\text{cm}^3)$$

Where

$$A_{\text{g}} = \left(1 - \frac{\pi}{4}\right)r_{\text{o}}^2 \quad (\text{mm}^2)$$

$$A_{\xi} = \left(1 - \frac{\pi}{4}\right)r_{\text{i}}^2 \quad (\text{mm}^2)$$

Major axis

$$h_{\text{g}} = \frac{H}{2} - \left(\frac{10 - 3\pi}{12\text{-}3\pi}\right)r_{\text{o}} \quad (\text{mm})$$

(For minor axis substitute B for H.)

Major axis

$$h_{\xi} = \frac{H - 2T}{2} - \left(\frac{10 - 3\pi}{12\text{-}3\pi}\right)r_{\text{i}} \quad (\text{mm})$$

(For minor axis substitute B for H.)

$$I_{\text{g}} = \left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{3(12 - 3\pi)}\right)r_{\text{o}}^4 \quad (\text{mm}^4)$$

$$I_{\xi\xi} = \left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{3(12 - 3\pi)}\right)r_{\text{i}}^4 \quad (\text{mm}^4)$$

$$h = 2[(B - T) + (H - T)] - 2R_{\text{c}}(4 - \pi) \quad (\text{mm})$$

$$A_{\text{h}} = (B - T)(H - T)] - R_{\text{c}}^2(4 - \pi) \quad (\text{mm})$$

$$K = \frac{2A_{\text{h}}T}{h} \quad (\text{mm}^2)$$

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

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

$$A_s = \frac{P}{10^3} \quad \text{(m}^2\text{/m)}$$

Cross sectional area

$$A = \frac{\pi\left[HB - \left(H - 2T\right)\left(B - 2T\right)\right]}{4 \times 10^2} \quad \text{(cm}^2\text{)}$$

Mass per unit length

$$M = 0{,}785\,A \quad \text{(kg/m)}$$

Second moment of area

Major axis

$$I_{yy} = \frac{\left[BH^3 - \left(B - 2T\right)\left(H - 2T\right)^3\right]\frac{\pi}{64}}{10^4} \quad \text{(cm}^4\text{)}$$

Minor axis

$$I_{zz} = \frac{\left[HB^3 - \left(H - 2T\right)\left(B - 2T\right)^3\right]\frac{\pi}{64}}{10^4} \quad \text{(cm}^4\text{)}$$

Radius of gyration

Major axis

$$i_{yy} = \sqrt{\frac{I_{yy}}{A}} \quad \text{(cm)}$$

Minor axis

$$i_{zz} = \sqrt{\frac{I_{zz}}{A}} \quad \text{(cm)}$$

Elastic section modulus

Major axis

$$W_{elyy} = \frac{20I_{yy}}{H} \quad \text{(cm}^3\text{)}$$

Minor axis

$$W_{elzz} = \frac{20I_{zz}}{B} \quad \text{(cm}^3\text{)}$$

Plastic section modulus

Major axis

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

Minor axis

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

Torsional inertia constant

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

Torsional modulus constant

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

where

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

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

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

Annex B
(normative)

Sectional properties for a limited range of standard sizes

Table B.1 — Nominal 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	Super-ficial area per metre length	Nominal length per tonne
D	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
21,3	2,0	0,95	1,21	0,571	0,686	0,536	0,748	1,14	1,07	0,067	1050
21,3	2,5	1,16	1,48	0,664	0,671	0,623	0,889	1,33	1,25	0,067	863
21,3	3,0	1,35	1,72	0,741	0,656	0,696	1,01	1,48	1,39	0,067	739
26,9	2,0	1,23	1,56	1,22	0,883	0,907	1,24	2,44	1,81	0,085	814
26,9	2,5	1,50	1,92	1,44	0,867	1,07	1,49	2,88	2,14	0,085	665
26,9	3,0	1,77	2,25	1,63	0,852	1,21	1,72	3,27	2,43	0,085	566
33,7	2,0	1,56	1,99	2,51	1,12	1,49	2,01	5,02	2,98	0,106	640
33,7	2,5	1,92	2,45	3,00	1,11	1,78	2,44	6,00	3,56	0,106	520
33,7	3,0	2,27	2,89	3,44	1,09	2,04	2,84	6,88	4,08	0,106	440
42,4	2,0	1,99	2,54	5,19	1,43	2,45	3,27	10,4	4,90	0,133	502
42,4	2,5	2,46	3,13	6,26	1,41	2,95	3,99	12,5	5,91	0,133	407
42,4	3,0	2,91	3,71	7,25	1,40	3,42	4,67	14,5	6,84	0,133	343
42,4	4,0	3,79	4,83	8,99	1,36	4,24	5,92	18,0	8,48	0,133	264
48,3	2,0	2,28	2,91	7,81	1,64	3,23	4,29	15,6	6,47	0,152	438
48,3	2,5	2,82	3,60	9,46	1,62	3,92	5,25	18,9	7,83	0,152	354
48,3	3,0	3,35	4,27	11,0	1,61	4,55	6,17	22,0	9,11	0,152	298
48,3	4,0	4,37	5,57	13,8	1,57	5,70	7,87	27,5	11,4	0,152	229
48,3	5,0	5,34	6,80	16,2	1,54	6,69	9,42	32,3	13,4	0,152	187
60,3	2,0	2,88	3,66	15,6	2,06	5,17	6,80	31,2	10,3	0,189	348
60,3	2,5	3,56	4,54	19,0	2,05	6,30	8,36	38,0	12,6	0,189	281
60,3	3,0	4,24	5,40	22,2	2,03	7,37	9,86	44,4	14,7	0,189	236
60,3	4,0	5,55	7,07	28,2	2,00	9,34	12,7	56,3	18,7	0,189	180
60,3	5,0	6,82	8,69	33,5	1,96	11,1	15,3	67,0	22,2	0,189	147
76,1	2,0	3,65	4,66	32,0	2,62	8,40	11,0	64,0	16,8	0,239	274
76,1	2,5	4,54	5,78	39,2	2,60	10,3	13,5	78,4	20,6	0,239	220
76,1	3,0	5,41	6,89	46,1	2,59	12,1	16,0	92,2	24,2	0,239	185

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	Super-ficial area per metre length	Nominal length per tonne
D	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
76,1	4,0	7,11	9,06	59,1	2,55	15,5	20,8	118	31,0	0,239	141
76,1	5,0	8,77	11,2	70,9	2,52	18,6	25,3	142	37,3	0,239	114
76,1	6,0	10,4	13,2	81,8	2,49	21,5	29,6	164	43,0	0,239	96,4
76,1	6,3	10,8	13,8	84,8	2,48	22,3	30,8	170	44,6	0,239	92,2
88,9	2,0	4,29	5,46	51,6	3,07	11,6	15,1	103	23,2	0,279	233
88,9	2,5	5,33	6,79	63,4	3,06	14,3	18,7	127	28,5	0,279	188
88,9	3,0	6,36	8,10	74,8	3,04	16,8	22,1	150	33,6	0,279	157
88,9	4,0	8,38	10,7	96,3	3,00	21,7	28,9	193	43,3	0,279	119
88,9	5,0	10,3	13,2	116	2,97	26,2	35,2	233	52,4	0,279	96,7
88,9	6,0	12,3	15,6	135	2,94	30,4	41,3	270	60,7	0,279	81,5
88,9	6,3	12,8	16,3	140	2,93	31,5	43,1	280	63,1	0,279	77,9
101,6	2,0	4,91	6,26	77,6	3,52	15,3	19,8	155	30,6	0,319	204
101,6	2,5	6,11	7,78	95,6	3,50	18,8	24,6	191	37,6	0,319	164
101,6	3,0	7,29	9,29	113	3,49	22,3	29,2	226	44,5	0,319	137
101,6	4,0	9,63	12,3	146	3,45	28,8	38,1	293	57,6	0,319	104
101,6	5,0	11,9	15,2	177	3,42	34,9	46,7	355	69,9	0,319	84,0
101,6	6,0	14,1	18,0	207	3,39	40,7	54,9	413	81,4	0,319	70,7
101,6	6,3	14,8	18,9	215	3,38	42,3	57,3	430	84,7	0,319	67,5
114,3	2,5	6,89	8,78	137	3,95	24,0	31,3	275	48,0	0,359	145
114,3	3,0	8,23	10,5	163	3,94	28,4	37,2	325	56,9	0,359	121
114,3	4,0	10,9	13,9	211	3,90	36,9	48,7	422	73,9	0,359	91,9
114,3	5,0	13,5	17,2	257	3,87	45,0	59,8	514	89,9	0,359	74,2
114,3	6,0	16,0	20,4	300	3,83	52,5	70,4	600	105	0,359	62,4
114,3	6,3	16,8	21,4	313	3,82	54,7	73,6	625	109	0,359	59,6
114,3	8,0	21,0	26,7	379	3,77	66,4	90,6	759	133	0,359	47,7
139,7	3,0	10,1	12,9	301	4,83	43,1	56,1	602	86,2	0,439	98,9
139,7	4,0	13,4	17,1	393	4,80	56,2	73,7	786	112	0,439	74,7
139,7	5,0	16,6	21,2	481	4,77	68,8	90,8	961	138	0,439	60,2
139,7	6,0	19,8	25,2	564	4,73	80,8	107	1 129	162	0,439	50,5
139,7	6,3	20,7	26,4	589	4,72	84,3	112	1 177	169	0,439	48,2
139,7	8,0	26,0	33,1	720	4,66	103	139	1 441	206	0,439	38,5
139,7	10,0	32,0	40,7	862	4,60	123	169	1 724	247	0,439	31,3
168,3	3,0	12,2	15,6	532	5,85	63,3	82,0	1 065	127	0,529	81,8
168,3	4,0	16,2	20,6	697	5,81	82,8	108	1 394	166	0,529	61,7

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	Super-ficial area per metre length	Nominal length per tonne
D	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
168,3	5,0	20,1	25,7	856	5,78	102	133	1 712	203	0,529	49,7
168,3	6,0	24,0	30,6	1 009	5,74	120	158	2 017	240	0,529	41,6
168,3	6,3	25,2	32,1	1 053	5,73	125	165	2 107	250	0,529	39,7
168,3	8,0	31,6	40,3	1 297	5,67	154	206	2 595	308	0,529	31,6
168,3	10,0	39,0	49,7	1 564	5,61	186	251	3 128	372	0,529	25,6
177,8	4,0	17,1	21,8	825	6,15	92,8	121	1 650	186	0,559	58,3
177,8	5,0	21,3	27,1	1 014	6,11	114	149	2 028	228	0,559	46,9
177,8	6,0	25,4	32,4	1 196	6,08	135	177	2 392	269	0,559	39,3
177,8	6,3	26,6	33,9	1 250	6,07	141	185	2 499	281	0,559	37,5
177,8	8,0	33,5	42,7	1 541	6,01	173	231	3 083	347	0,559	29,9
177,8	10,0	41,4	52,7	1 862	5,94	209	282	3 724	419	0,559	24,2
177,8	12,0	49,1	62,5	2 159	5,88	243	330	4 318	486	0,559	20,4
177,8	12,5	51,0	64,9	2 230	5,86	251	342	4 460	502	0,559	19,6
193,7	4,0	18,7	23,8	1 073	6,71	111	144	2 146	222	0,609	53,4
193,7	5,0	23,3	29,6	1 320	6,67	136	178	2 640	273	0,609	43,0
193,7	6,0	27,8	35,4	1 560	6,64	161	211	3 119	322	0,609	36,0
193,7	6,3	29,1	37,1	1 630	6,63	168	221	3 260	337	0,609	34,3
193,7	8,0	36,6	46,7	2 016	6,57	208	276	4 031	416	0,609	27,3
193,7	10,0	45,3	57,7	2 442	6,50	252	338	4 883	504	0,609	22,1
193,7	12,0	53,8	68,5	2 839	6,44	293	397	5 678	586	0,609	18,6
193,7	12,5	55,9	71,2	2 934	6,42	303	411	5 869	606	0,609	17,9
219,1	4,0	21,2	27,0	1 564	7,61	143	185	3 128	286	0,688	47,1
219,1	5,0	26,4	33,6	1 928	7,57	176	229	3 856	352	0,688	37,9
219,1	6,0	31,5	40,2	2 282	7,54	208	273	4 564	417	0,688	31,7
219,1	6,3	33,1	42,1	2 386	7,53	218	285	4 772	436	0,688	30,2
219,1	8,0	41,6	53,1	2 960	7,47	270	357	5 919	540	0,688	24,0
219,1	10,0	51,6	65,7	3 598	7,40	328	438	7 197	657	0,688	19,4
219,1	12,0	61,3	78,1	4 200	7,33	383	515	8 400	767	0,688	16,3
219,1	12,5	63,7	81,1	4 345	7,32	397	534	8 689	793	0,688	15,7
244,5	5,0	29,5	37,6	2 699	8,47	221	287	5 397	441	0,768	33,9
244,5	6,0	35,3	45,0	3 199	8,43	262	341	6 397	523	0,768	28,3
244,5	6,3	37,0	47,1	3 346	8,42	274	358	6 692	547	0,768	27,0
244,5	8,0	46,7	59,4	4 160	8,37	340	448	8 321	681	0,768	21,4
244,5	10,0	57,8	73,7	5 073	8,30	415	550	10 150	830	0,768	17,3

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	Super-ficial area per metre length	Nominal length per tonne
D	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
244,5	12,0	68,8	87,7	5 938	8,23	486	649	11 880	972	0,768	14,5
244,5	12,5	71,5	91,1	6 147	8,21	503	673	12 300	1 006	0,768	14,0
273,0	5,0	33,0	42,1	3 781	9,48	277	359	7 562	554	0,858	30,3
273,0	6,0	39,5	50,3	4 487	9,44	329	428	8 974	657	0,858	25,3
273,0	6,3	41,4	52,8	4 696	9,43	344	448	9 392	688	0,858	24,1
273,0	8,0	52,3	66,6	5 852	9,37	429	562	11 700	857	0,858	19,1
273,0	10,0	64,9	82,6	7 154	9,31	524	692	14 310	1 048	0,858	15,4
273,0	12,0	77,2	98,4	8 396	9,24	615	818	16 790	1 230	0,858	12,9
273,0	12,5	80,3	102	8 697	9,22	637	849	17 400	1 274	0,858	12,5
323,9	5,0	39,3	50,1	6 369	11,3	393	509	12 740	787	1,02	25,4
323,9	6,0	47,0	59,9	7 572	11,2	468	606	15 150	935	1,02	21,3
323,9	6,3	49,3	62,9	7 929	11,2	490	636	15 860	979	1,02	20,3
323,9	8,0	62,3	79,4	9 910	11,2	612	799	19 820	1 224	1,02	16,0
323,9	10,0	77,4	98,6	12 160	11,1	751	986	24 320	1 501	1,02	12,9
323,9	12,0	92,3	118	14 320	11,0	884	1 168	28 640	1 768	1,02	10,8
323,9	12,5	96,0	122	14 850	11,0	917	1 213	29 690	1 833	1,02	10,4
355,6	5,0	43,2	55,1	8 464	12,4	476	615	16 930	952	1,12	23,1
355,6	6,0	51,7	65,9	10 070	12,4	566	733	20 140	1 133	1,12	19,3
355,6	6,3	54,3	69,1	10 550	12,4	593	769	21 090	1 186	1,12	18,4
355,6	8,0	68,6	87,4	13 200	12,3	742	967	26 400	1 485	1,12	14,6
355,6	10,0	85,2	109	16 220	12,2	912	1 195	32 450	1 825	1,12	11,7
355,6	12,0	102	130	19 140	12,2	1076	1 417	38 280	2 153	1,12	9,83
355,6	12,5	106	135	19 850	12,1	1 117	1 472	39 700	2 233	1,12	9,45
355,6	16,0	134	171	24 660	12,0	1 387	1 847	49 330	2 774	1,12	7,46
355,6	20,0	166	211	29 800	11,9	1 676	2 255	59 580	3 351	1,12	6,04
406,4	6,0	59,2	75,5	15 130	14,2	745	962	30 260	1 489	1,28	16,9
406,4	6,3	62,2	79,2	15 850	14,1	780	1 009	31 700	1 560	1,28	16,1
406,4	8,0	78,6	100	19 870	14,1	978	1 270	39 750	1 956	1,28	12,7
406,4	10,0	97,8	125	24 480	14,0	1 205	1 572	48 950	2 409	1,28	10,2
406,4	12,0	117	149	28 940	14,0	1 424	1 867	57 870	2 848	1,28	8,57
406,4	12,5	121	155	30 030	13,9	1 478	1 940	60 060	2 956	1,28	8,24
406,4	16,0	154	196	37 450	13,8	1 843	2 440	74 900	3 686	1,28	6,49
406,4	20,0	191	243	45 430	13,7	2 236	2 989	90 860	4 472	1,28	5,25
406,4	25,0	235	300	54 700	13,5	2 692	3 642	109 400	5 384	1,28	4,25

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	Super-ficial area per metre length	Nominal length per tonne
D	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
457,0	6,0	66,7	85,0	21 620	15,9	946	1 220	43 240	1 892	1,44	15,0
457,0	6,3	70,0	89,2	22 650	15,9	991	1 280	45 310	1 983	1,44	14,3
457,0	8,0	88,6	113	28 450	15,9	1 245	1 613	56 900	2 490	1,44	11,3
457,0	10,0	110	140	35 090	15,8	1 536	1 998	70 180	3 071	1,44	9,07
457,0	12,0	132	168	41 560	15,7	1 819	2 377	83 110	3 637	1,44	7,59
457,0	12,5	137	175	43 150	15,7	1 888	2 470	86 290	3 776	1,44	7,30
457,0	16,0	174	222	53 960	15,6	2 361	3 113	107 900	4 723	1,44	5,75
457,0	20,0	216	275	65 680	15,5	2 874	3 822	131 400	5 749	1,44	4,64
457,0	25,0	266	339	79 420	15,3	3 475	4 671	158 800	6 951	1,44	3,75
457,0	30,0	316	402	92 170	15,1	4 034	5 479	184 400	8 068	1,44	3,17
508,0	6,0	74,3	94,6	29 810	17,7	1 174	1 512	59 620	2 347	1,60	13,5
508,0	6,3	77,9	99,3	31 250	17,7	1 230	1 586	62 490	2 460	1,60	12,8
508,0	8,0	98,6	126	39 280	17,7	1 546	2 000	78 560	3 093	1,60	10,1
508,0	10,0	123	156	48 520	17,6	1 910	2 480	97 040	3 820	1,60	8,14
508,0	12,0	147	187	57 540	17,5	2 265	2 953	115 100	4 530	1,60	6,81
508,0	12,5	153	195	59 760	17,5	2 353	3 070	119 500	4 705	1,60	6,55
508,0	16,0	194	247	74 910	17,4	2 949	3 874	149 800	5 898	1,60	5,15
508,0	20,0	241	307	91 430	17,3	3 600	4 766	182 900	7 199	1,60	4,15
508,0	25,0	298	379	111 000	17,1	4 367	5 837	221 800	8 734	1,60	3,36
508,0	30,0	354	451	129 200	16,9	5 086	6 864	258 400	10 170	1,60	2,83
610,0	6,0	89,4	114	51 920	21,4	1 702	2 189	103 900	3 405	1,92	11,2
610,0	6,3	93,8	119	54 440	21,3	1 785	2 296	108 900	3 570	1,92	10,7
610,0	8,0	119	151	68 550	21,3	2 248	2 899	137 100	4 495	1,92	8,42
610,0	10,0	148	188	84 850	21,2	2 782	3 600	169 700	5 564	1,92	6,76
610,0	12,0	177	225	100 800	21,1	3 305	4 292	201 700	6 611	1,92	5,65
610,0	12,5	184	235	104 800	21,1	3 435	4 463	209 000	6 869	1,92	5,43
610,0	16,0	234	299	131 800	21,0	4 321	5 647	263 600	8 641	1,92	4,27
610,0	20,0	291	371	161 500	20,9	5 295	6 965	323 000	10 590	1,92	3,44
610,0	25,0	361	459	196 900	20,7	6 456	8 561	393 800	12 910	1,92	2,77
610,0	30,0	429	547	230 500	20,5	7 557	10 100	461 000	15 110	1,92	2,33
711,0	6,0	104	133	82 570	24,9	2 323	2 982	165 100	4 645	2,23	9,59
711,0	6,3	109	139	86 590	24,9	2 436	3 129	173 200	4 871	2,23	9,13
711,0	8,0	139	177	109 200	24,9	3 071	3 954	218 300	6 141	2,23	7,21
711,0	10,0	173	220	135 300	24,8	3 806	4 914	270 600	7 612	2,23	5,78

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	Super-ficial area per metre length	Nominal length per tonne
D	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
711,0	12,0	207	264	161 000	24,7	4 529	5 864	322 000	9 057	2,23	4,83
711,0	12,5	215	274	167 300	24,7	4 707	6 099	334 700	9 415	2,23	4,64
711,0	16,0	274	349	211 000	24,6	5 936	7 730	422 100	11 870	2,23	3,65
711,0	20,0	341	434	259 400	24,4	7 295	9 552	518 700	14 590	2,23	2,93
711,0	25,0	423	539	317 400	24,3	8 927	11 770	634 700	17 850	2,23	2,36
711,0	30,0	504	642	372 800	24,1	10 490	13 920	745 600	21 000	2,23	1,98
762,0	6,0	112	143	101 800	26,7	2 672	3 429	20 360	5 345	2,39	8,94
762,0	6,3	117	150	106 800	26,7	2 803	3 598	213 600	5 605	2,39	8,52
762,0	8,0	149	190	134 700	26,7	3 535	4 548	269 400	7 070	2,39	6,72
762,0	10,0	185	236	167 000	26,6	4 384	5 655	334 100	8 768	2,39	5,39
762,0	12,0	222	283	198 900	26,5	5 219	6 751	397 700	10 440	2,39	4,51
762,0	12,5	231	294	206 700	26,5	5 426	7 023	413 500	10 900	2,39	4,33
762,0	16,0	294	375	261 000	26,4	6 850	8 906	522 000	13 700	2,39	3,40
762,0	20,0	366	466	321 100	26,2	8 427	11 000	642 200	16 860	2,39	2,73
762,0	25,0	454	579	393 500	26,1	10 327	13 580	786 900	20 650	2,39	2,20
762,0	30,0	542	690	462 900	25,9	12 148	16 080	925 700	24 300	2,39	1,85
813,0	8,0	159	202	163 900	28,5	4 032	5 184	327 800	8 064	2,55	6,30
813,0	10,0	198	252	203 400	28,4	5 003	6 448	406 700	10 010	2,55	5,05
813,0	12,0	237	302	242 200	28,3	5 959	7 700	484 500	11 930	2,55	4,22
813,0	12,5	247	314	251 900	28,3	6 196	8 011	503 700	12 400	2,55	4,05
813,0	16,0	314	401	318 200	28,2	7 828	10 170	636 400	15 660	2,55	3,18
813,0	20,0	391	498	392 000	28,0	9 641	12 600	783 800	19 280	2,55	2,56
813,0	25,0	486	619	480 900	27,9	11 829	15 530	961 700	23 660	2,55	2,06
813,0	30,0	579	738	566 400	27,7	13 933	18 400	1 133 000	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
914,0	10,0	223	284	290 200	32,0	6 349	8 172	580 300	12 700	2,87	4,49
914,0	12,0	267	340	345 890	31,9	7 569	9 764	691 800	15 140	2,87	3,75
914,0	12,5	278	354	359 700	31,9	7 871	10 160	719 400	15 740	2,87	3,60
914,0	16,0	354	451	455 100	31,8	9 959	12 900	910 300	19 920	2,87	2,82
914,0	20,0	441	562	561 500	31,6	12 286	15 990	1 123 000	24 570	2,87	2,27
914,0	25,0	548	698	690 300	31,4	15 105	19 760	1 381 000	30 210	2,87	1,82
914,0	30,0	654	833	814 800	31,3	17 829	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	6 436 000	12 670	3,19	5,03
1 016,0	10,0	248	316	399 900	35,6	7 871	10 120	799 700	15 740	3,19	4,03

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	Super-ficial area per metre length	Nominal length per tonne
D	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
1 016,0	12,0	297	378	477 000	35,5	9 389	12 100	954 000	18 780	3,19	3,37
1 016,0	12,5	309	394	496 100	35,5	9 766	12 590	992 300	19 530	3,19	3,23
1 016,0	16,0	395	503	628 500	35,4	12 372	16 000	1 257 000	24 740	3,19	2,53
1 016,0	20,0	491	626	776 300	35,2	15 282	19 840	1 553 000	30 560	3,19	2,04
1 016,0	25,0	611	778	956 000	35,0	18 821	24 560	1 912 000	37 640	3,19	1,64
1 016,0	30,0	729	929	1 130 000	34,9	22 251	29 180	2 261 000	44 500	3,19	1,37
1 067,0	10,0	261	332	463 900	37,4	8 693	11 170	927 600	17 390	3,35	3,84
1 067,0	12,0	312	398	553 420	37,3	10 373	13 360	1 107 000	20 750	3,35	3,20
1 067,0	12,5	325	414	575 700	37,3	10 790	13 900	1 151 000	21 580	3,35	3,08
1 067,0	16,0	415	528	729 600	37,2	13 676	17 680	1 459 000	27 350	3,35	2,41
1 067,0	20,0	516	658	901 800	37,0	16 903	21 930	1 804 000	33 810	3,35	1,94
1 067,0	25,0	642	818	1 111 000	36,9	20 831	27 150	2 223 000	41 660	3,35	1,56
1 067,0	30,0	767	977	1 315 000	36,7	24 646	32 270	2 630 000	49 290	3,35	1,30
1 168,0	10,0	286	364	609 800	40,9	10 443	13 410	1 220 000	20 890	3,67	3,50
1 168,0	12,0	342	436	728 100	40,9	12 467	16 040	1 456 000	24 930	3,67	2,92
1 168,0	12,5	356	454	757 400	40,9	12 969	16 690	1 515 000	25 940	3,67	2,81
1 168,0	16,0	455	579	960 800	40,7	16 452	21 240	1 922 000	32 900	3,67	2,20
1 168,0	20,0	566	721	1 189 000	40,6	20 353	26 360	2 377 000	40 710	3,67	1,77
1 168,0	25,0	705	898	1 467 000	40,4	25 115	32 670	2 933 000	50 230	3,67	1,42
1 219,0	10,0	298	380	694 000	42,7	11 387	14 620	1 388 000	22 770	3,83	3,35
1 219,0	12,0	357	455	828 700	42,7	13 597	17 480	1 657 000	27 190	3,83	2,80
1 219,0	12,5	372	474	862 200	42,7	14 146	18 200	1 724 000	28 290	3,83	2,69
1 219,0	16,0	475	605	1 094 000	42,5	17 951	23 260	2 188 000	35 900	3,83	2,11
1 219,0	20,0	591	753	1 354 000	42,4	22 217	28 760	2 708 400	44 440	3,83	1,69
1 219,0	25,0	736	938	1 672 000	42,2	27 430	35 650	3 344 000	54 860	3,83	1,36

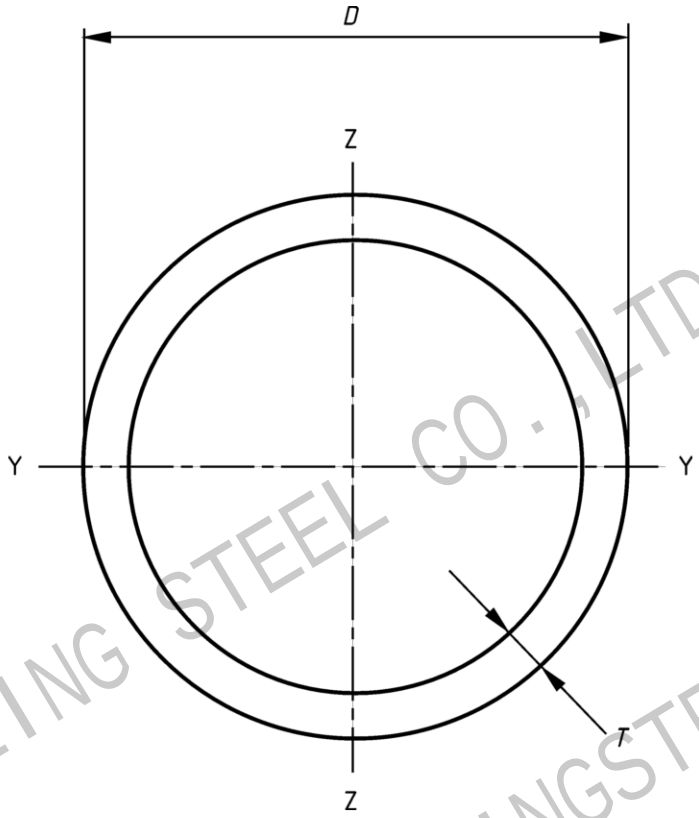


Figure B.1 — Circular hollow section

Table B.2 — Nominal 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 tonne
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
20	2,0	1,05	1,34	0,692	0,720	0,692	0,877	1,21	1,06	0,0731	953
25	2,0	1,36	1,74	1,48	0,924	1,19	1,47	2,53	1,80	0,0931	733
25	2,5	1,64	2,09	1,69	0,899	1,35	1,71	2,97	2,07	0,0914	610
25	3,0	1,89	2,41	1,84	0,874	1,47	1,91	3,33	2,27	0,0897	529
30	2,0	1,68	2,14	2,72	1,13	1,81	2,21	4,54	2,75	0,113	596
30	2,5	2,03	2,59	3,16	1,10	2,10	2,61	5,40	3,20	0,111	492
30	3,0	2,36	3,01	3,50	1,08	2,34	2,96	6,15	3,58	0,110	423
40	2,0	2,31	2,94	6,94	1,54	3,47	4,13	11,3	5,23	0,153	434
40	2,5	2,82	3,59	8,22	1,51	4,11	4,97	13,6	6,21	0,151	355
40	3,0	3,30	4,21	9,32	1,49	4,66	5,72	15,8	7,07	0,150	303
40	4,0	4,20	5,35	11,1	1,44	5,54	7,01	19,4	8,48	0,146	238

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 tonne
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
50	2,0	2,93	3,74	14,1	1,95	5,66	6,66	22,6	8,51	0,193	341
50	2,5	3,60	4,59	16,9	1,92	6,78	8,07	27,5	10,2	0,191	278
50	3,0	4,25	5,41	19,5	1,90	7,79	9,39	32,1	11,8	0,190	236
50	4,0	5,45	6,95	23,7	1,85	9,49	11,7	40,4	14,4	0,186	183
50	5,0	6,56	8,36	27,0	1,80	10,8	13,7	47,5	16,6	0,183	152
60	2,0	3,56	4,54	25,1	2,35	8,38	9,79	39,8	12,6	0,233	281
60	2,5	4,39	5,59	30,3	2,33	10,1	11,9	48,7	15,2	0,231	228
60	3,0	5,19	6,61	35,1	2,31	11,7	14,0	57,1	17,7	0,230	193
60	4,0	6,71	8,55	43,6	2,26	14,5	17,6	72,6	22,0	0,226	149
60	5,0	8,13	10,4	50,5	2,21	16,8	20,9	86,4	25,6	0,223	123
60	6,0	9,45	12,0	56,1	2,16	18,7	23,7	98,4	28,6	0,219	106
60	6,3	9,55	12,2	54,4	2,11	18,1	23,4	100	28,8	0,213	105
70	2,5	5,17	6,59	49,4	2,74	14,1	16,5	78,5	21,2	0,271	193
70	3,0	6,13	7,81	57,5	2,71	16,4	19,4	92,4	24,7	0,270	163
70	4,0	7,97	10,1	72,1	2,67	20,6	24,8	119	31,1	0,266	126
70	5,0	9,70	12,4	84,6	2,62	24,2	29,6	142	36,7	0,263	103
70	6,0	11,3	14,4	95,2	2,57	27,2	33,8	163	41,4	0,259	88,3
70	6,3	11,5	14,7	93,8	2,53	26,8	33,8	168	42,1	0,253	86,7
80	3,0	7,07	9,01	87,8	3,12	22,0	25,8	140	33,0	0,310	141
80	4,0	9,22	11,7	111	3,07	27,8	33,1	180	41,8	0,306	108
80	5,0	11,3	14,4	131	3,03	32,9	39,7	218	49,7	0,303	88,7
80	6,0	13,2	16,8	149	2,98	37,3	45,8	252	56,6	0,299	75,7
80	6,3	13,5	17,2	149	2,94	37,1	46,1	261	57,9	0,293	74,0
80	8,0	16,4	20,8	168	2,84	42,1	53,9	307	66,6	0,286	61,1
90	3,0	8,01	10,2	127	3,53	28,3	33,0	201	42,5	0,350	125
90	4,0	10,5	13,3	162	3,48	36,0	42,6	261	54,2	0,346	95,4
90	5,0	12,8	16,4	193	3,43	42,9	51,4	316	64,7	0,343	77,9
90	6,0	15,1	19,2	220	3,39	49,0	59,5	368	74,2	0,339	66,2
90	6,3	15,5	19,7	221	3,35	49,1	60,3	382	76,2	0,333	64,6
90	8,0	18,9	24,0	255	3,25	56,6	71,3	456	88,8	0,326	53,0
100	3,0	8,96	11,4	177	3,94	35,4	41,2	279	53,2	0,390	112
100	4,0	11,7	14,9	226	3,89	45,3	53,3	362	68,1	0,386	85,2
100	5,0	14,4	18,4	271	3,84	54,2	64,6	441	81,7	0,383	69,4
100	6,0	17,0	21,6	311	3,79	62,3	75,1	514	94,1	0,379	58,9

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 tonne
B	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
100	6,3	17,5	22,2	314	3,76	62,8	76,4	536	97,0	0,373	57,3
100	8,0	21,4	27,2	366	3,67	73,2	91,1	645	114	0,366	46,8
100	10,0	25,6	32,6	411	3,55	82,2	105	750	130	0,357	39,1
100	12,0	28,3	36,1	408	3,36	81,6	110	794	136	0,338	35,3
100	12,5	29,1	37,0	410	3,33	82,1	111	804	137	0,336	34,4
120	3,0	10,8	13,8	312	4,76	52,1	60,2	488	78,2	0,470	92,3
120	4,0	14,2	18,1	402	4,71	67,0	78,3	637	101	0,466	70,2
120	5,0	17,5	22,4	485	4,66	80,9	95,4	778	122	0,463	57,0
120	6,0	20,7	26,4	562	4,61	93,7	112	913	141	0,459	48,2
120	6,3	21,4	27,3	572	4,58	95,3	114	955	146	0,453	46,7
120	8,0	26,4	33,6	677	4,49	113	138	1 163	175	0,446	37,9
120	10,0	31,8	40,6	777	4,38	129	162	1 376	203	0,437	31,4
120	12,0	35,8	45,7	806	4,20	134	174	1 518	219	0,418	27,9
120	12,5	36,9	47,0	817	4,17	136	178	1 551	223	0,416	27,1
140	4,0	16,8	21,3	652	5,52	93,1	108	1 023	140	0,546	59,7
140	5,0	20,7	26,4	791	5,48	113	132	1 256	170	0,543	48,3
140	6,0	24,5	31,2	920	5,43	131	155	1 479	198	0,539	40,8
140	6,3	25,4	32,3	941	5,39	134	160	1 550	205	0,533	39,4
140	8,0	31,4	40,0	1 127	5,30	161	194	1 901	248	0,526	31,8
140	10,0	38,1	48,6	1 312	5,20	187	230	2 274	291	0,517	26,2
140	12,0	43,4	55,3	1 398	5,03	200	253	2 567	322	0,498	23,1
140	12,5	44,8	57,0	1 425	5,00	204	259	2 634	329	0,496	22,3
150	4,0	18,0	22,9	808	5,93	108	125	1 265	162	0,586	55,5
150	5,0	22,3	28,4	982	5,89	131	153	1 554	197	0,583	44,9
150	6,0	26,4	33,6	1 146	5,84	153	180	1 833	230	0,579	37,9
150	6,3	27,4	34,8	1 174	5,80	156	185	1 922	239	0,573	36,6
150	8,0	33,9	43,2	1 412	5,71	188	226	2 364	289	0,566	29,5
150	10,0	41,3	52,6	1 653	5,61	220	269	2 839	341	0,557	24,2
150	12,0	47,1	60,1	1 780	5,44	237	298	3 231	380	0,538	21,2
150	12,5	48,7	62,0	1 817	5,41	242	306	3 321	389	0,536	20,5
150	16,0	58,7	74,8	2 009	5,18	268	351	3 830	440	0,518	17,0
160	4,0	19,3	24,5	987	6,34	123	143	1 541	185	0,626	51,9
160	5,0	23,8	30,4	1 202	6,29	150	175	1 896	226	0,623	42,0
160	6,0	28,3	36,0	1 405	6,25	176	206	2 239	264	0,619	35,4

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 tonne
B	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
160	6,3	29,3	37,4	1 442	6,21	180	213	2 349	275	0,613	34,1
160	8,0	36,5	46,4	1 741	6,12	218	260	2 897	334	0,606	27,4
160	10,0	44,4	56,6	2 048	6,02	256	311	3 490	395	0,597	22,5
160	12,0	50,9	64,9	2 224	5,86	278	346	3 997	443	0,578	19,6
160	12,5	52,6	67,0	2 275	5,83	284	356	4 114	455	0,576	19,0
160	16,0	63,7	81,2	2 546	5,60	318	413	4 799	520	0,558	15,7
180	4,0	21,8	27,7	1 422	7,16	158	182	2 210	237	0,706	45,9
180	5,0	27,0	34,4	1 737	7,11	193	224	2 724	290	0,703	37,1
180	6,0	32,1	40,8	2 037	7,06	226	264	3 223	340	0,699	31,2
180	6,3	33,3	42,4	2 096	7,03	233	273	3 383	354	0,693	30,0
180	8,0	41,5	52,8	2 546	6,94	283	336	4 189	432	0,686	24,1
180	10,0	50,7	64,6	3 017	6,84	335	404	5 074	515	0,677	19,7
180	12,0	58,5	74,5	3 322	6,68	369	454	5 865	584	0,658	17,1
180	12,5	60,5	77,0	3 406	6,65	378	467	6 050	600	0,656	16,5
180	16,0	73,8	94,0	3 887	6,43	432	550	7 178	698	0,638	13,6
200	4,0	24,3	30,9	1 968	7,97	197	226	3 049	295	0,786	41,2
200	5,0	30,1	38,4	2 410	7,93	241	279	3 763	362	0,783	33,2
200	6,0	35,8	45,6	2 833	7,88	283	330	4 459	426	0,779	27,9
200	6,3	37,2	47,4	2 922	7,85	292	341	4 682	444	0,773	26,8
200	8,0	46,5	59,2	3 566	7,76	357	421	5 815	544	0,766	21,5
200	10,0	57,0	72,6	4 251	7,65	425	508	7 072	651	0,757	17,6
200	12,0	66,0	84,1	4 730	7,50	473	576	8 230	743	0,738	15,2
200	12,5	68,3	87,0	4 859	7,47	486	594	8 502	765	0,736	14,6
200	16,0	83,8	107	5 625	7,26	562	706	10 210	901	0,718	11,9
220	5,0	33,2	42,4	3 238	8,74	294	340	5 038	442	0,863	30,1
220	6,0	39,6	50,4	3 813	8,70	347	402	5 976	521	0,859	25,3
220	6,3	41,2	52,5	3 940	8,66	358	417	6 277	543	0,853	24,3
220	8,0	51,5	65,6	4 828	8,58	439	516	7 815	668	0,846	19,4
220	10,0	63,2	80,6	5 782	8,47	526	625	9 533	804	0,837	15,8
220	12,0	73,5	93,7	6 487	8,32	590	712	11 150	922	0,818	13,6
220	12,5	76,2	97,0	6 674	8,29	607	735	11 530	951	0,816	13,1
220	16,0	93,9	120	7 812	8,08	710	881	13 970	1 129	0,798	10,7
250	5,0	38,0	48,4	4 805	9,97	384	442	7 443	577	0,983	26,3
250	6,0	45,2	57,6	5 672	9,92	454	524	8 843	681	0,979	22,1

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 tonne
B	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_s	
mm	mm	kg/m	cm²	cm⁴	cm	cm³	cm³	cm⁴	cm³	m²/m	m
250	6,3	47,1	60,0	5 873	9,89	470	544	9 290	711	0,973	21,2
250	8,0	59,1	75,2	7 229	9,80	578	676	11 600	878	0,966	16,9
250	10,0	72,7	92,6	8 707	9,70	697	822	14 200	1 062	0,957	13,8
250	12,0	84,8	108	9 859	9,55	789	944	16 690	1 226	0,938	11,8
250	12,5	88,0	112	10 160	9,52	813	975	17 280	1 266	0,936	11,4
250	16,0	109	139	12 050	9,32	964	1 180	21 150	1 520	0,918	9,18
260	6,0	47,1	60,0	6 405	10,3	493	569	9 970	739	1,02	21,2
260	6,3	49,1	62,6	6 635	10,3	510	591	10 480	772	1,01	20,4
260	8,0	61,6	78,4	8 178	10,2	629	734	13 090	955	1,01	16,2
260	10,0	75,8	96,6	9 865	10,1	759	894	16 040	1 156	0,997	13,2
260	12,0	88,6	113	11 200	9,96	862	1 028	18 880	1 337	0,978	11,3
260	12,5	91,9	117	11 550	9,93	888	1 063	19 550	1 381	0,976	10,9
260	16,0	114	145	13 740	9,73	1 057	1 289	23 990	1 663	0,958	8,77
300	6,0	54,7	69,6	9 964	12,0	664	764	15 430	997	1,18	18,3
300	6,3	57,0	72,6	10 340	11,9	689	795	16 220	1 042	1,17	17,5
300	8,0	71,6	91,2	12 800	11,8	853	991	20 310	1 293	1,17	14,0
300	10,0	88,4	113	15 520	11,7	1 035	1 211	24 970	1 572	1,16	11,3
300	12,0	104	132	17 770	11,6	1 184	1 402	29 510	1 829	1,14	9,65
300	12,5	108	137	18 350	11,6	1 223	1 451	30 600	1 892	1,14	9,30
300	16,0	134	171	22 080	11,4	1 472	1 774	37 840	2 299	1,12	7,46
350	8,0	84,2	107	20 680	13,9	1 182	1 366	32 560	1 787	1,37	11,9
350	10,0	104	133	25 190	13,8	1 439	1 675	40 130	2 182	1,36	9,61
350	12,0	123	156	29 050	13,6	1 660	1 949	47 600	2 552	1,34	8,16
350	12,5	127	162	30 050	13,6	1 717	2 020	49 390	2 642	1,34	7,86
350	16,0	159	203	36 510	13,4	2 086	2 488	61 480	3 238	1,32	6,28
400	10,0	120	153	38 220	15,8	1 911	2 214	60 430	2 892	1,56	8,35
400	12,0	141	180	44 320	15,7	2 216	2 587	71 840	3 395	1,54	7,07
400	12,5	147	187	45 880	15,7	2 294	2 683	74 600	3 518	1,54	6,81
400	16,0	184	235	56 150	15,5	2 808	3 322	93 280	4 336	1,52	5,43

Figure B.2 — Square hollow section

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

Specified side 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	Superficial area per metre length		Nominal length per tonne
H ×	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	cm³	cm³	cm³	cm⁴	cm³	m²/m	m
40	20	2,0	1,68	2,14	4,05	1,34	1,38	0,793	2,02	1,34	2,61	1,60	3,45	2,36	0,113	596
40	20	2,5	2,03	2,59	4,69	1,54	1,35	0,770	2,35	1,54	3,09	1,88	4,06	2,72	0,111	492
40	20	3,0	2,36	3,01	5,21	1,68	1,32	0,748	2,60	1,68	3,50	2,12	4,57	3,00	0,110	423
50	30	2,0	2,31	2,94	9,54	4,29	1,80	1,21	3,81	2,86	4,74	3,33	9,77	4,84	0,153	434
50	30	2,5	2,82	3,59	11,3	5,05	1,77	1,19	4,52	3,37	5,70	3,98	11,7	5,72	0,151	355
50	30	3,0	3,30	4,21	12,8	5,70	1,75	1,16	5,13	3,80	6,57	4,58	13,5	6,49	0,150	303
50	30	4,0	4,20	5,35	15,3	6,69	1,69	1,12	6,10	4,46	8,05	5,58	16,5	7,71	0,146	238
60	40	2,0	2,93	3,74	18,4	9,83	2,22	1,62	6,14	4,92	7,47	5,65	20,7	8,12	0,193	341
60	40	2,5	3,60	4,59	22,1	11,7	2,19	1,60	7,36	5,87	9,06	6,84	25,1	9,72	0,191	278
60	40	3,0	4,25	5,41	25,4	13,4	2,17	1,58	8,46	6,72	10,5	7,94	29,3	11,2	0,190	236
60	40	4,0	5,45	6,95	31,0	16,3	2,11	1,53	10,3	8,14	13,2	9,89	36,7	13,7	0,186	183
60	40	5,0	6,56	8,36	35,3	18,4	2,06	1,48	11,8	9,21	15,4	11,5	42,8	15,6	0,183	152
70	50	2,0	3,56	4,54	31,5	18,8	2,63	2,03	8,99	7,50	10,8	8,58	37,5	12,2	0,233	281
70	50	2,5	4,39	5,59	38,0	22,6	2,61	2,01	10,9	9,04	13,2	10,4	45,8	14,7	0,231	228
70	50	3,0	5,19	6,61	44,1	26,1	2,58	1,99	12,6	10,4	15,4	12,2	53,6	17,1	0,230	193
70	50	4,0	6,71	8,55	54,7	32,2	2,53	1,94	15,6	12,9	19,5	15,4	68,1	21,2	0,226	149
70	50	5,0	8,13	10,4	63,5	37,2	2,48	1,90	18,1	14,9	23,1	18,2	80,8	24,6	0,223	123
80	40	2,0	3,56	4,54	37,4	12,7	2,87	1,67	9,34	6,36	11,6	7,17	30,9	11,0	0,233	281
80	40	2,5	4,39	5,59	45,1	15,3	2,84	1,65	11,3	7,63	14,1	8,72	37,6	13,2	0,231	228
80	40	3,0	5,19	6,61	52,3	17,6	2,81	1,63	13,1	8,78	16,5	10,2	43,9	15,3	0,230	193
80	40	4,0	6,71	8,55	64,8	21,5	2,75	1,59	16,2	10,7	20,9	12,8	55,2	18,8	0,226	149

Specified side 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	Superficial area per metre length		Nominal length per tonne
H	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	cm³	cm³	cm³	cm⁴	cm³	m²/m	m
80	40	5,0	8,13	10,4	75,1	24,6	2,69	1,54	18,8	12,3	24,7	15,0	65,0	21,7	0,223	123
80	60	2,0	4,19	5,34	49,5	31,9	3,05	2,44	12,4	10,6	14,7	12,1	61,2	17,1	0,273	239
80	60	2,5	5,17	6,59	60,1	38,6	3,02	2,42	15,0	12,9	18,0	14,8	75,1	20,7	0,271	193
80	60	3,0	6,13	7,81	70,0	44,9	3,00	2,40	17,5	15,0	21,2	17,4	88,3	24,1	0,270	163
80	60	4,0	7,97	10,1	87,9	56,1	2,94	2,35	22,0	18,7	27,0	22,1	113	30,3	0,266	126
80	60	5,0	9,70	12,4	103	65,7	2,89	2,31	25,8	21,9	32,2	26,4	136	35,7	0,263	103
90	50	2,0	4,19	5,34	57,9	23,4	3,29	2,09	12,9	9,35	15,7	10,5	53,4	15,9	0,273	239
90	50	2,5	5,17	6,59	70,3	28,2	3,27	2,07	15,6	11,3	19,3	12,8	65,3	19,2	0,271	193
90	50	3,0	6,13	7,81	81,9	32,7	3,24	2,05	18,2	13,1	22,6	15,0	76,7	22,4	0,270	163
90	50	4,0	7,97	10,1	103	40,7	3,18	2,00	22,8	16,3	28,8	19,1	97,7	28,0	0,266	126
90	50	5,0	9,70	12,4	121	47,4	3,12	1,96	26,8	18,9	34,4	22,7	116	32,7	0,263	103
100	40	2,5	5,17	6,59	79,3	18,8	3,47	1,69	15,9	9,39	20,2	10,6	50,5	16,8	0,271	193
100	40	3,0	6,13	7,81	92,3	21,7	3,44	1,67	18,5	10,8	23,7	12,4	59,0	19,4	0,270	163
100	40	4,0	7,97	10,1	116	26,7	3,38	1,62	23,1	13,3	30,3	15,7	74,5	24,0	0,266	126
100	40	5,0	9,70	12,4	136	30,8	3,31	1,58	27,1	15,4	36,1	18,5	87,9	27,9	0,263	103
100	50	2,5	5,56	7,09	91,2	31,1	3,59	2,09	18,2	12,4	22,7	14,0	75,4	21,5	0,291	180
100	50	3,0	6,60	8,41	106	36,1	3,56	2,07	21,3	14,4	26,7	16,4	88,6	25,0	0,290	152
100	50	4,0	8,59	10,9	134	44,9	3,50	2,03	26,8	18,0	34,1	20,9	113	31,3	0,286	116
100	50	5,0	10,5	13,4	158	52,5	3,44	1,98	31,6	21,0	40,8	25,0	135	36,8	0,283	95,4
100	50	6,0	12,3	15,6	179	58,7	3,38	1,94	35,8	23,5	46,9	28,5	154	41,4	0,279	81,5
100	50	6,3	12,5	15,9	176	58,2	3,32	1,91	35,1	23,3	46,9	28,6	158	42,1	0,273	79,9
100	60	2,5	5,96	7,59	103	46,9	3,69	2,49	20,6	15,6	25,1	17,7	103	26,2	0,311	168

Specified side 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	Superficial area per metre length		Nominal length per tonne
H	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	cm³	cm³	cm³	cm⁴	cm³	m²/m	m
100	60	3,0	7,07	9,01	121	54,6	3,66	2,46	24,1	18,2	29,6	20,8	122	30,6	0,310	141
100	60	4,0	9,22	11,7	153	68,7	3,60	2,42	30,5	22,9	37,9	26,6	156	38,7	0,306	108
100	60	5,0	11,3	14,4	181	80,8	3,55	2,37	36,2	26,9	45,6	31,9	188	45,8	0,303	88,7
100	60	6,0	13,2	16,8	205	91,2	3,49	2,33	41,1	30,4	52,5	36,6	216	51,9	0,299	75,7
100	60	6,3	13,5	17,2	203	90,9	3,44	2,30	40,7	30,3	52,8	36,9	223	53,0	0,293	74,0
100	80	2,5	6,74	8,59	127	90,2	3,84	3,24	25,4	22,5	30,0	25,8	166	35,7	0,351	148
100	80	3,0	8,01	10,2	149	106	3,82	3,22	29,8	26,4	35,4	30,4	196	41,9	0,350	125
100	80	4,0	10,5	13,3	189	134	3,77	3,17	37,9	33,5	45,6	39,2	254	53,4	0,346	95,4
100	80	5,0	12,8	16,4	226	160	3,72	3,12	45,2	39,9	55,1	47,2	308	63,7	0,343	77,9
100	80	6,0	15,1	19,2	258	182	3,67	3,08	51,7	45,5	63,8	54,7	357	73,0	0,339	66,2
100	80	6,3	15,5	19,7	259	183	3,62	3,04	51,8	45,7	64,6	55,4	371	75,0	0,333	64,6
120	60	2,5	6,74	8,59	161	55,2	4,33	2,53	26,9	18,4	33,2	20,6	133	31,7	0,351	148
120	60	3,0	8,01	10,2	189	64,4	4,30	2,51	31,5	21,5	39,2	24,2	156	37,1	0,350	125
120	60	4,0	10,5	13,3	241	81,2	4,25	2,47	40,1	27,1	50,5	31,1	201	47,0	0,346	95,4
120	60	5,0	12,8	16,4	287	96,0	4,19	2,42	47,8	32,0	60,9	37,4	242	55,8	0,343	77,9
120	60	6,0	15,1	19,2	328	109	4,13	2,38	54,7	36,3	70,6	43,1	280	63,6	0,339	66,2
120	60	6,3	15,5	19,7	327	109	4,07	2,35	54,5	36,4	71,2	43,7	289	65,1	0,333	64,6
120	60	8,0	18,9	24,0	375	124	3,95	2,27	62,6	41,3	84,1	51,3	340	75,0	0,326	53,0
120	80	3,0	8,96	11,4	230	123	4,49	3,29	38,4	30,9	46,2	35,0	255	50,8	0,390	112
120	80	4,0	11,7	14,9	295	157	4,44	3,24	49,1	39,3	59,8	45,2	331	64,9	0,386	85,2
120	80	5,0	14,4	18,4	353	188	4,39	3,20	58,9	46,9	72,4	54,7	402	77,8	0,383	69,4
120	80	6,0	17,0	21,6	406	215	4,33	3,15	67,7	53,8	84,3	63,5	469	89,4	0,379	58,9

Specified side 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	Superficial area per metre length		Nominal length per tonne
H	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	cm³	cm³	cm³	cm⁴	cm³	m²/m	m
120	80	6,3	17,5	22,2	408	217	4,28	3,12	68,1	54,3	85,6	64,7	488	92,1	0,373	57,3
120	80	8,0	21,4	27,2	476	252	4,18	3,04	79,3	62,9	102	76,9	584	108	0,366	46,8
140	80	4,0	13,0	16,5	430	180	5,10	3,30	61,4	45,1	75,5	51,3	412	76,5	0,426	77,0
140	80	5,0	16,0	20,4	517	216	5,04	3,26	73,9	54,0	91,8	62,2	501	91,8	0,423	62,6
140	80	6,0	18,9	24,0	597	248	4,98	3,21	85,3	62,0	107	72,4	584	106	0,419	53,0
140	80	6,3	19,4	24,8	603	251	4,93	3,19	86,1	62,9	109	74,0	609	109	0,413	51,4
140	80	8,0	23,9	30,4	708	293	4,82	3,10	101	73,3	131	88,4	731	129	0,406	41,8
150	100	4,0	14,9	18,9	595	319	5,60	4,10	79,3	63,7	95,7	72,5	662	105	0,486	67,2
150	100	5,0	18,3	23,4	719	384	5,55	4,05	95,9	76,8	117	88,3	809	127	0,483	54,5
150	100	6,0	21,7	27,6	835	444	5,50	4,01	111	88,8	137	103	948	147	0,479	46,1
150	100	6,3	22,4	28,5	848	453	5,45	3,98	113	90,5	140	106	992	152	0,473	44,6
150	100	8,0	27,7	35,2	1 008	536	5,35	3,90	134	107	169	128	1 206	182	0,466	36,1
150	100	10,0	33,4	42,6	1 162	614	5,22	3,80	155	123	199	150	1 426	211	0,457	29,9
150	100	12,0	37,7	48,1	1 207	642	5,01	3,65	161	128	215	163	1 573	229	0,438	26,5
150	100	12,5	38,9	49,5	1 225	651	4,97	3,63	163	130	220	166	1 606	233	0,436	25,7
160	80	4,0	14,2	18,1	598	204	5,74	3,35	74,7	50,9	92,9	57,4	494	88,0	0,466	70,2
160	80	5,0	17,5	22,4	722	244	5,68	3,30	90,2	61,0	113	69,7	601	106	0,463	57,0
160	80	6,0	20,7	26,4	836	281	5,62	3,26	105	70,2	132	81,3	702	122	0,459	48,2
160	80	6,3	21,4	27,3	846	286	5,57	3,24	106	71,4	135	83,3	732	126	0,453	46,7
160	80	8,0	26,4	33,6	1 001	335	5,46	3,16	125	83,7	163	100	882	150	0,446	37,9
160	80	10,0	31,8	40,6	1 146	380	5,32	3,06	143	95,0	191	117	1 031	172	0,437	31,4
160	80	12,0	35,8	45,7	1 171	391	5,06	2,93	146	97,8	204	125	1 111	183	0,418	27,9

Specified side 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	Superficial area per metre length		Nominal length per tonne
H	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	cm³	cm³	cm³	cm⁴	cm³	m²/m	m
160	80	12,5	36,9	47,0	1 185	396	5,02	2,90	148	98,9	208	127	1 129	185	0,416	27,1
180	100	4,0	16,8	21,3	926	374	6,59	4,18	103	74,8	126	84,0	854	127	0,546	59,7
180	100	5,0	20,7	26,4	1 124	452	6,53	4,14	125	90,4	154	103	1 045	154	0,543	48,3
180	100	6,0	24,5	31,2	1 310	524	6,48	4,10	146	105	181	120	1 227	179	0,539	40,8
180	100	6,3	25,4	32,3	1 335	536	6,43	4,07	148	107	186	124	1 283	185	0,533	39,4
180	100	8,0	31,4	40,0	1 598	637	6,32	3,99	178	127	226	150	1 565	222	0,526	31,8
180	100	10,0	38,1	48,6	1 859	736	6,19	3,89	207	147	268	177	1 859	260	0,517	26,2
180	100	12,0	43,4	55,3	1 965	782	5,96	3,76	218	156	292	194	2 073	285	0,498	23,1
180	100	12,5	44,8	57,0	2 001	796	5,92	3,74	222	159	300	199	2 122	290	0,496	22,3
200	100	4,0	18,0	22,9	1 200	411	7,23	4,23	120	82,2	148	91,7	985	142	0,586	55,5
200	100	5,0	22,3	28,4	1 459	497	7,17	4,19	146	99,4	181	112	1 206	172	0,583	44,9
200	100	6,0	26,4	33,6	1 703	577	7,12	4,14	170	115	213	132	1 417	200	0,579	37,9
200	100	6,3	27,4	34,8	1 739	591	7,06	4,12	174	118	219	135	1 483	208	0,573	36,6
200	100	8,0	33,9	43,2	2 091	705	6,95	4,04	209	141	267	165	1 811	250	0,566	29,5
200	100	10,0	41,3	52,6	2 444	818	6,82	3,94	244	164	318	195	2 154	292	0,557	24,2
200	100	12,0	47,1	60,1	2 607	876	6,59	3,82	261	175	350	215	2 414	322	0,538	21,2
200	100	12,5	48,7	62,0	2 659	892	6,55	3,79	266	178	359	221	2 474	329	0,536	20,5
200	120	4,0	19,3	24,5	1 353	618	7,43	5,02	135	103	164	115	1 345	172	0,626	51,9
200	120	5,0	23,8	30,4	1 649	750	7,37	4,97	165	125	201	141	1 652	210	0,623	42,0
200	120	6,0	28,3	36,0	1 929	874	7,32	4,93	193	146	237	166	1 947	245	0,619	35,4
200	120	6,3	29,3	37,4	1 976	898	7,27	4,90	198	150	244	172	2 040	255	0,613	34,1
200	120	8,0	36,5	46,4	2 386	1 079	7,17	4,82	239	180	298	209	2 507	308	0,606	27,4

Specified side 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	Superficial area per metre length		Nominal length per tonne
H	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	cm³	cm³	cm³	cm⁴	cm³	m²/m	m
200	120	10,0	44,4	56,6	2 806	1 262	7,04	4,72	281	210	356	250	3 007	364	0,597	22,5
200	120	12,0	50,9	64,9	3 031	1 368	6,84	4,59	303	228	395	278	3 419	406	0,578	19,6
200	120	12,5	52,6	67,0	3 099	1 397	6,80	4,57	310	233	406	285	3 514	416	0,576	19,0
250	150	5,0	30,1	38,4	3 304	1 508	9,28	6,27	264	201	320	225	3 285	337	0,783	33,2
250	150	6,0	35,8	45,6	3 886	1 768	9,23	6,23	311	236	378	266	3 886	396	0,779	27,9
250	150	6,3	37,2	47,4	4 001	1 825	9,18	6,20	320	243	391	276	4 078	412	0,773	26,8
250	150	8,0	46,5	59,2	4 886	2 219	9,08	6,12	391	296	482	340	5 050	504	0,766	21,5
250	150	10,0	57,0	72,6	5 825	2 634	8,96	6,02	466	351	582	409	6 121	602	0,757	17,6
250	150	12,0	66,0	84,1	6 458	2 925	8,77	5,90	517	390	658	463	7 088	684	0,738	15,2
250	150	12,5	68,3	87,0	6 633	3 002	8,73	5,87	531	400	678	477	7 315	704	0,736	14,6
250	150	16,0	83,8	106,8	7 660	3 453	8,47	5,69	613	460	805	566	8 713	823	0,718	11,9
260	180	5,0	33,2	42,4	4 121	2 350	9,86	7,45	317	261	377	294	4 695	426	0,863	30,1
260	180	6,3	41,2	52,5	5 013	2 856	9,77	7,38	386	317	463	361	5 844	523	0,853	24,3
260	180	8,0	51,5	65,6	6 145	3 493	9,68	7,29	473	388	573	446	7 267	642	0,846	19,4
260	180	10,0	63,2	80,6	7 363	4 174	9,56	7,20	566	464	694	540	8 850	772	0,837	15,8
260	180	12,0	73,5	93,7	8 245	4 679	9,38	7,07	634	520	790	615	10 330	884	0,818	13,6
260	180	12,5	76,2	97,0	8 482	4 812	9,35	7,04	652	535	815	635	10 680	911	0,816	13,1
260	180	16,0	93,9	120	9 923	5 614	9,11	6,85	763	624	977	759	12 890	1079	0,798	10,7
300	100	6,0	35,8	45,6	4 777	842	10,2	4,30	318	168	411	188	2 403	306	0,779	27,9
300	100	6,3	37,2	47,4	4 907	868	10,2	4,28	327	174	425	194	2 515	318	0,773	26,8
300	100	8,0	46,5	59,2	5 978	1 045	10,0	4,20	399	209	523	238	3 080	385	0,766	21,5
300	100	10,0	57,0	72,6	7 106	1 224	9,90	4,11	474	245	631	285	3 681	455	0,757	17,6

Specified side 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	Superficial area per metre length		Nominal length per tonne
H	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	cm³	cm³	cm³	cm⁴	cm³	m²/m	m
300	100	12,0	66,0	84,1	7 808	1 343	9,64	4,00	521	269	710	321	4 177	508	0,738	15,2
300	100	12,5	68,3	87,0	8 010	1 374	9,59	3,97	534	275	732	330	4 292	521	0,736	14,6
300	100	16,0	83,8	107	9 157	1 543	9,26	3,80	610	309	865	386	4 939	592	0,718	11,9
300	150	6,0	40,5	51,6	6 074	2 080	10,8	6,35	405	277	500	309	4 988	479	0,879	24,7
300	150	6,3	42,2	53,7	6 266	2 150	10,8	6,32	418	287	517	321	5 234	499	0,873	23,7
300	150	8,0	52,8	67,2	7 684	2 623	10,7	6,25	512	350	640	396	6 491	612	0,866	18,9
300	150	10,0	64,8	82,6	9 209	3 125	10,6	6,15	614	417	776	479	7 879	733	0,857	15,4
300	150	12,0	75,4	96,1	10 300	3 498	10,4	6,03	687	466	883	546	9 153	837	0,838	13,3
300	150	12,5	78,1	99,5	10 590	3 595	10,3	6,01	706	479	912	563	9 452	862	0,836	12,8
300	150	16,0	96,4	123	12 390	4 174	10,0	5,83	826	557	1 092	673	11 330	1 015	0,818	10,4
300	200	6,0	45,2	57,6	7 370	3 962	11,3	8,29	491	396	588	446	8 115	651	0,979	22,1
300	200	6,3	47,1	60,0	7 624	4 104	11,3	8,27	508	410	610	463	8 524	680	0,973	21,2
300	200	8,0	59,1	75,2	9 389	5 042	11,2	8,19	626	504	757	574	10 630	838	0,966	16,9
300	200	10,0	72,7	92,6	11 310	6 058	11,1	8,09	754	606	921	698	12 990	1 012	0,957	13,8
300	200	12,0	84,8	108	12 790	6 854	10,9	7,96	853	685	1 056	801	15 240	1 167	0,938	11,8
300	200	12,5	88,0	112	13 180	7 060	10,8	7,94	879	706	1 091	828	15 770	1 204	0,936	11,4
300	200	16,0	109	139	15 620	8 340	10,6	7,75	1 041	834	1 319	1 000	19 220	1 442	0,918	9,18
350	250	6,0	54,7	69,6	12 460	7 458	13,4	10,3	712	597	843	671	14 550	967	1,18	18,3
350	250	6,3	57,0	72,6	12 920	7 744	13,3	10,3	738	620	876	698	15 290	1 010	1,17	17,5
350	250	8,0	71,6	91,2	16 000	9 573	13,2	10,2	914	766	1 092	869	19 140	1 253	1,17	14,0
350	250	10,0	88,4	113	19 410	11 590	13,1	10,1	1 109	927	1 335	1 062	23 500	1 522	1,16	11,3
350	250	12,0	104	132	22 200	13 260	13,0	10,0	1 268	1 061	1 544	1 229	27 750	1 770	1,14	9,65

Specified side 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	Superficial area per metre length		Nominal length per tonne
H	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	I_t	C_t	A_s	
mm	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
350	250	12,5	108	137	22 920	13 690	12,9	9,99	1 310	1 095	1 598	1 272	28 770	1 830	1,14	9,30
350	250	16,0	134	171	27 580	16 430	12,7	9,81	1 576	1 315	1 954	1 554	35 500	2 220	1,12	7,46
400	200	8,0	71,6	91,2	18 970	6 517	14,4	8,45	949	652	1 173	728	15 820	1 133	1,17	14,0
400	200	12,5	108	137	27 100	9 260	14,1	8,22	1 355	926	1 714	1 062	23 600	1 644	1,14	9,30
400	200	16,0	134	171	32 550	11 060	13,8	8,05	1 627	1 106	2 093	1 294	28 930	1 984	1,12	7,46
400	300	8,0	84,2	107	25 120	16 210	15,3	12,3	1 256	1 081	1 487	1 224	31 180	1 747	1,37	11,9
400	300	10,0	104	133	30 610	19 730	15,2	12,2	1 530	1 315	1 824	1 501	38 410	2 132	1,36	9,61
400	300	12,0	123	156	35 280	22 750	15,0	12,1	1 764	1 516	2 122	1 747	45 530	2 492	1,34	8,16
400	300	12,5	127	162	36 490	23 520	15,0	12,0	1 824	1 568	2 198	1 810	47 240	2 580	1,34	7,86
400	300	16,0	159	203	44 350	28 540	14,8	11,9	2 218	1 902	2 708	2 228	58 730	3 159	1,32	6,28

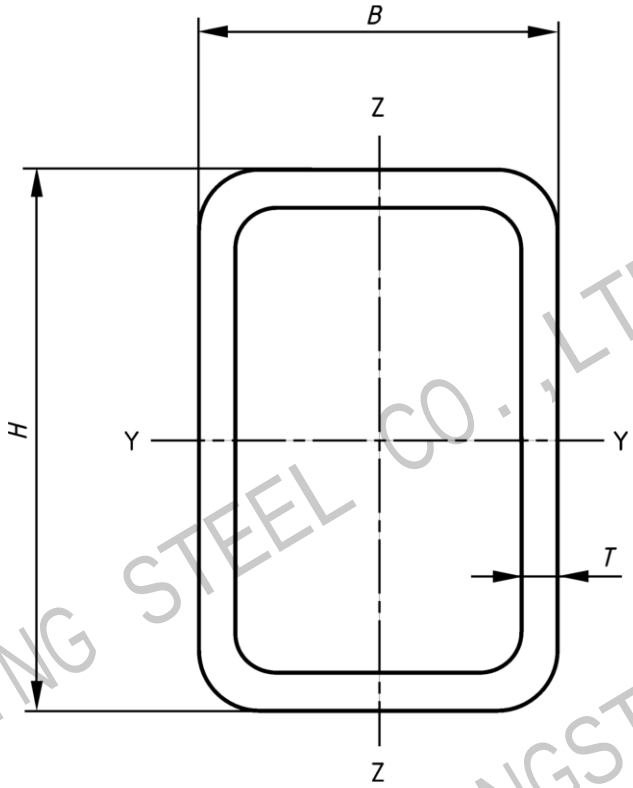


Figure B.3 — Rectangular hollow section

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 con_stant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
H × 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	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	Cm³	cm³	cm³	cm⁴	cm³	m²/m	m
120	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
120	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
120	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
120	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
150	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
150	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
150	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
150	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
150	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
150	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
180	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
180	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
180	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
200	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
200	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
200	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
200	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
220	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
220	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	Cross-sectional area	Second moment of area		Radius of gyration		Elastic section modulus		Plastic section modulus		Torsional inertia con_stant	Torsional modulus constant	Superficial area per metre length	Nominal length per ton
H × 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	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	Cm³	cm³	cm³	cm⁴	cm³	m²/m	m
220	110	10,0	38,2	48,7	2 215	722	6,74	3,85	201	131	287	174	2 183	288	0,533	26,2
250	125	6,0	26,9	34,2	2 109	711	7,85	4,56	169	114	235	144,5	2 130	254,5	0,606	37,2
250	125	6,3	28,2	35,9	2 205	742	7,84	4,55	176	119	246	151	2 224	265	0,606	35,5
250	125	8,0	35,4	45,1	2 732	909	7,78	4,49	219	145	307	188	2 734	323	0,606	28,2
250	125	10,0	43,8	55,8	3 316	1 090	7,71	4,42	265	174	376	228	3 288	385	0,606	22,8
250	125	12,0	51,9	66,2	3 864	1 254	7,64	4,35	309	201	442	267	3 798	440	0,606	19,3
250	125	12,5	53,9	68,7	3 996	1 292	7,63	4,34	320	207	458	276	3 918	453	0,606	18,5
320	160	8,0	45,8	58,3	5 877	1 978	10,0	5,82	367	247	513	315	5 928	553	0,776	21,8
320	160	10,0	56,7	72,3	7 181	2 393	9,97	5,75	449	299	631	385	7 192	665	0,776	17,6
320	160	12,0	67,5	86,0	8 422	2 779	9,90	5,69	526	347	745	453	8 375	769	0,776	14,8
400	200	8,0	57,6	73,4	11 690	3 966	12,6	7,35	584	397	811	500	11 860	890	0,969	17,4
400	200	10,0	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
400	200	12,0	85,2	109	16 910	5 646	12,5	7,21	845	565	1 186	726	16 960	1 257	0,969	11,7
400	200	12,5	88,6	113	17 530	5 843	12,5	7,19	877	584	1 232	753	17 560	1 299	0,969	11,3
480	240	10,0	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
480	240	12,0	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

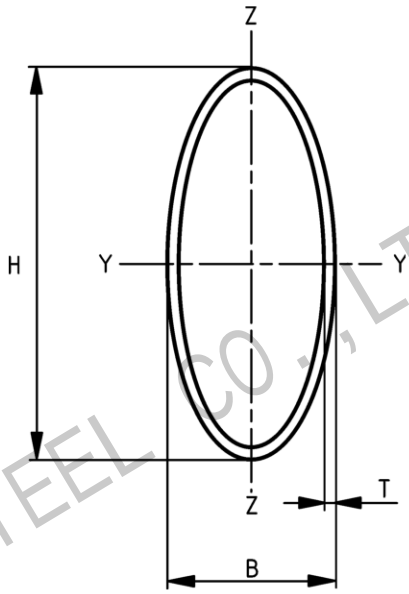


Figure B.4 — Elliptical hollow section

Bibliography

[1] EN 1993-1-6, *Eurocode 3 — Design of steel structures — Part 1-6: Strength and Stability of Shell Structures*

[2] EN 1993-5, *Eurocode 3 — Design of steel structures — Part 5: Piling*