EN 103051-1

Steel tubes for precision applications – Technical delivery conditions

1 Scope

This part of EN 10219 specifies tolerances for cold formed welded circular, square and rectangular 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 x 500 mm
Rectangular: Outside dimensions up to 500 mm x 300 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 B.
Dimensions and sectional properties for a limited range of sizes are given in Annex C.
Technical delivery conditions are specified in EN 10219-1.
NOTE The designation of the sections' major axis (yy) and its minor axis (zz) align with the axis designation used for structural design in the structural Eurocodes.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.
EN 10219-1:2006, *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 European Standard, the terms and definitions given in EN 10219-1:2006 apply.

4 Symbols

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

Table 1 — Symbols and definitions

Symbol	Unit	Definition
A	cm^2	Cross-sectional area
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
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	The 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
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
R	mm	External corner radius of a square or rectangular hollow section
T	mm	Specified 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
$\backslash$ ° Angle between adjacent sides of a square or rectangular hollow section

5 Information to be obtained by the manufacturer

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 type of length, length range or length (see Table 4).
b) The dimensions (see Clause 8).
NOTE This information is included in the list of information to be obtained by the manufacturer contained in EN 10219-1.

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.

6.3 Additional tolerances for out-of-roundness, accidental eccentricity and dimples may be applied to tubes of diameter ≥ 900 mm and D/T ≥ 50 when they are to be used as bearing piles or primary elements in combined walls in accordance with ENV 1993-5. In order for these additional tolerances to be applied the fabrication tolerance quality class, A, B, or C should be agreed. See Annex A.

Table 2 — Tolerances on shape and mass

Characteristic	**Circular hollow sections**	**Square and rectangular hollow sections**
Outside dimensions (D, B and H)	± 1 % with a minimum of ± 0,5 mm and a maximum of ±1 0 mm	
Side length mm	Tolerance	
H, B <100	± 1 % with a minimum of ± 0,5 mm	
100 δ H, B δ 200	± 0,8 %	
H,B > 200	± 0,6 %	
Thickness (T)	For D δ 406,4 mm:	
T δ 5 mm	± 10 %	
T > 5 mm	± 0,5 mm	
For D > 406,4 mm:		
± 10 % with a maximum of ± 2 mm		
T δ 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
Squareness of side (⟍)
— 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
Mass per unit length (M) □} 6 % on individual delivered lengths
a Where the diameter to thickness ratio exceeds 100 the tolerance on out-of-roundness shall be agreed.
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 δ 6 1,6T to 2,4T
6 < T δ 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 δ 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 ε 4 000 $^{50}_{0}$ + mm
<6 000 $^{50}_{0}$ + mm
6 000 δ L δ 10 000 $^{15}_{0}$ + mm
Exact length b $^{+}_{0}$ 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 bead for submerged arc welded hollow sections
Dimensions in millimetres
Thickness, T Maximum weld bead height
δ14,2 3,5
>14,2 4,8

7 Measurement of size and shape

7.1 General

All external dimensions, including out-of-roundness, shall be measured at a distance from the end of the

hollow section of not less than D for circular sections, B for square sections or H for rectangular sections, with a minimum of 100 mm.

7.2 Outside dimensions

For circular hollow sections the diameter (D) shall be measured either directly, e.g. using a calliper gauge, or 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.

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 equation, but see Annex A for piling tube.

$$(\%) = \max \square \min \cdot 100$$

D

$O\ D\ D$

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:

$_1 \cdot 100\%;\ _2 \cdot 100\%;\ _1 \cdot 100\%;\ _2 \cdot 100\%$

H

x

H

x

B

x

B

x

where B and H are the dimensions of the sides containing the concavity x_1 or the convexity x_2.

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 $\backslash$ as shown in Figure 3.

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.

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.

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.

7.8.3 The twist 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

7.9 Straightness

The deviation from straightness (e) of the total length of a hollow section shall be measured at the point of maximum departure of the hollow section from a straight line connecting its two ends, as shown in Figure 7 where L is the manufacturer's delivered length. The percentage deviation from straightness shall be calculated as follows:

·100%

L

e

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.

e

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 B.

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

Annex A
(informative)
Additional tolerances for piling tube

A.1 General

This annex contains guidance on additional tolerances that can be applied to tubes when they are to be used as bearing piles or primary elements in combined walls in accordance with ENV 1993-5. These requirements are generally relevant to tubes of diameter ≥ 900 mm and D/T ≥ 100.

For verification of tubular piles subject to shell buckling, ENV 1993-5: Piling refers to ENV 1993-1-6. Shell buckling is partly governed by geometrical imperfections of the shell due to out-of-roundness, accidental eccentricity and dimples. ENV 1993-1-6 specifies limits for each of these geometrical imperfections, based on the concept of fabrication quality classes. Details of how to assess out-of-roundness, accidental eccentricity and dimples, and the recommended maximum permitted values for each fabrication quality class, are given in A.2, A.3 and A.4.

NOTE 1 See ENV 1993-1-6 for further details of fabrication tolerance quality classes, their design implications and for definitions and use of symbols.

NOTE 2 The values of certain parameters, given in Tables A.1, A.2 and A.3 may be subject to change by national application of ENV 1993-1-6. Nationally determined parameters will be given in the relevant National Annex of ENV 1993-1-6.

A.2 Out of roundness tolerance

Out-of-roundness of a tubular pile is assessed in terms of the parameter U_r the difference between the maximum and minimum values of the measured internal diameter, relative to the nominal inside diameter, see Figure A.1, given by:

U_r =
nom
max min
d
d □ d
Where:
| d_{max} is the maximum measured internal diameter;
| d_{min} is the minimum measured internal diameter;
| d_{nom} is the nominal inside diameter ($d = D – 2T$, see B.2).
An appropriate number of diameters should be measured in order to identify the maximum and minimum values.

The out-of-roundness parameter U_r should satisfy the condition:
U_r δ $U_{r, max}$
where:
$U_{r, max}$ is the maximum permitted value for the out-of-roundness parameter.
Recommended values for each fabrication tolerance quality class are given in Table A.1.

Table A.1 — Maximum permitted values for out-of-roundness parameter $U_{r, max}$
Dimensions in mm

Diameter range		
d ≤ 500	**500 < d < 1250**	**1250 ≤ d**
Fabrication tolerance quality class	**Description**	**Value of U_r max [a]**
Class A	Excellent	0,14	0,007+0,0093 (1,25 - d)	0,007
Class B	High	0,02	0,010+0,0133 (1,25 - d)	0,01
Class C	Normal	0,03	0,015+0,020 (1,25 - d)	0,015

[a] The values of this parameter may be subject to change by national application of ENV 1993-1-6. If in doubt, reference should be made to the relevant National Annex of ENV 1993-1-6.

A.3 Accidental eccentricity tolerance

Accidental eccentricity, the unintentional eccentricity due to misalignment of the tube walls at horizontal joints, is assessed in terms of the parameter U_e given by:
U_e =
T
E_a

The accidental eccentricity e_a should satisfy the condition:
e_a ≤ $e_{a, max}$
where:
$e_{a, max}$ is the maximum permitted accidental eccentricity.
Recommended values for each fabrication tolerance quality class are given in Table A.2.
The accidental eccentricity parameter U_e should satisfy the condition:
U_e δ $U_{e, max}$
where:
$U_{e, max}$ is the maximum permitted value for the accidental eccentricity parameter.
Recommended values for each fabrication tolerance quality class are given in Table A.2.

Table A.2 — Maximum permitted values for accidental eccentricity parameter $U_{e, max}$ and for accidental

eccentricity $e_{a,\,max}$
Dimensions in mm
Fabrication
tolerance quality
class
Description $U_{e,\,max}$ a $e_{a,\,max}$
a
Class A Excellent 0,14 2
Class B High 0,2 3
Class C Normal 0,3 4
a The values of these parameters may be subject to change by national application of ENV 1993-1-6. If in doubt, reference should be made to the relevant National Annex of ENV 1993-1-6.

A.4 Dimple tolerance

The depth of initial dimples in the tube wall w_o is measured, in both the meridontal and circumferential directions, using a measurement gauge, see Figure A.3, of length l_g where:

a) meridontally and circumferentially $l_g = 4\sqrt{rT}$

b) across welds $l_g = 25\,T$ but $l_g \leq 500$ mm

The gauge used for meridontal measurements should be straight but that used for measurements in the circumferential direction should have a radius of curvature r where:

$r =$

2

$(D \square T)$

NOTE For joints involving tubes of different thicknesses, it is recommended to refer to ENV 1993-1-6.

The level of initial dimples in the wall of the tubular pile is assessed in terms of the dimple tolerance parameter U_d given by:

$U_d =$

g

o

l

w

The dimple tolerance parameter U_d should satisfy the condition:

$U_d \leq U_{d,\,max}$

where:

$U_{d,\,max}$ is the maximum permitted value for the dimple tolerance parameter.

Recommended values for each fabrication tolerance class are given in Table A.3.

Table A.3 — Maximum permitted values for dimple tolerance parameter $U_{d,\,max}$
Dimensions in mm
Fabrication
tolerance
quality class
Description $U_{d,\,max}$
Class A Excellent 0,006
Class B High 0,01
Class C Normal 0,016
a The values of this parameter may be subject to change by national application of ENV 1993-1-6. If in doubt, reference should be made to the National Annex of ENV 1993-1-6.

Annex B
(normative)

Formulae for the calculation of sectional properties

B.1 General
Tables C.1, C.2 and C.3 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 its minor axis (zz) align with the axis designation used for structural design in the structural Eurocodes. This is a change from previous axis designations.

B.2 Circular hollow sections
The sectional properties for circular hollow sections in Table C.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
10_3
D
$As = \square$
(m2/m)

Cross-sectional area $( )$
2
2 2
$4 \cdot 10$
$A = \square D \square d$
(cm2)
Mass per unit length $M = 0{,}785 \cdot A$ (kg/m)

Second moment of area $( )$
4
4 4
$64 \cdot 10$
$I = \square D \square d$
(cm4)
Radius of gyration
A
$i = I$
(cm)

Elastic section modulus
D
$W\ 2I\ 10$
el
$= \cdot$
(cm3)
Plastic section modulus

3
3 3
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$W = D \square d$
(cm3)
Torsional inertia constant
(polar moment of inertia)
$I I_t = 2$ (cm4)
Torsional modulus constant $C_t = 2W_{el}$ (cm3)

B.3 Rectangular, or square, hollow sections

The sectional properties for square hollow sections in Table C.2 and for rectangular hollow sections in Table C.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 δ 6 mm 2,0 T (mm)
for thicknesses > 6 mm δ 10 mm 2,5 T (mm)
for thicknesses > 10mm 3,0 T (mm)
Internal corner radius (r_i) for calculation is:
for thicknesses δ 6 mm 1,0 T (mm)
for thicknesses > 6 mm and δ 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 ( )s 3 o o 4
10
$A = 2 H + B \square r + \square r$
(m2/m)

Cross-sectional area ( ) ( )( )
2
2
i
2
o
10
$2T\ B\ H\ 2T\ 4\ r\ r$
A
$+ \square \square \square \square$
$=$
$\square$
(cm2)
Mass per unit length M = 0,785A (kg/m)
Second moment of area
Major axis
I_{yy}

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(cm4)
Radius of gyration
Major axis
i_{yy} =
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(cm)
Minor axis
i_{zz} =
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(cm)
Elastic section modulus
Major axis
$W_{el\ yy}$ =
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Minor axis

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Plastic section modulus

Major axis

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Torsional modulus constant

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(For minor axis substitute *B* for *H*.)
Major axis
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$h = 2[(B - T) + (H - T)] - 2R_c(4 - \square)$ (mm)
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Annex C
(normative)

Sectional properties for a limited range of standard sizes

Table C.1 — Nominal dimensions and sectional properties of a limited range of circular hollow sections (see Figure C.1)

Specified outside diameter	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 tonne
D	T	M	A	I	i	W_{el}	W_{pl}	L_t	C_t	A_s	
mm	mm	kg/m	cm2	cm4	cm	cm3	cm3	cm4	cm3	m2/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
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

Specified outside diameter
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

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per tonne

D	*T*	*M*	*A*	*I*	*i*	W_{el}	W_{pl}	L_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
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	1129	162	0,439	50,5
139,7	6,3	20,7	26,4	589	4,72	84,3	112	1177	169	0,439	48,2
139,7	8,0	26,0	33,1	720	4,66	103	139	1441	206	0,439	38,5
139,7	10,0	32,0	40,7	862	4,60	123	169	1724	247	0,439	31,3
168,3	3,0	12,2	15,6	532	5,85	63,3	82,0	1065	127	0,529	81,8
168,3	4,0	16,2	20,6	697	5,81	82,8	108	1394	166	0,529	61,7
168,3	5,0	20,1	25,7	856	5,78	102	133	1712	203	0,529	49,7
168,3	6,0	24,0	30,6	1009	5,74	120	158	2017	240	0,529	41,6
168,3	6,3	25,2	32,1	1053	5,73	125	165	2107	250	0,529	39,7
168,3	8,0	31,6	40,3	1297	5,67	154	206	2595	308	0,529	31,6
168,3	10,0	39,0	49,7	1564	5,61	186	251	3128	372	0,529	25,6
177,8	4,0	17,1	21,8	825	6,15	92,8	121	1650	186	0,559	58,3
177,8	5,0	21,3	27,1	1014	6,11	114	149	2028	228	0,559	46,9
177,8	6,0	25,4	32,4	1196	6,08	135	177	2392	269	0,559	39,3
177,8	6,3	26,6	33,9	1250	6,07	141	185	2499	281	0,559	37,5
177,8	8,0	33,5	42,7	1541	6,01	173	231	3083	347	0,559	29,9
177,8	10,0	41,4	52,7	1862	5,94	209	282	3724	419	0,559	24,2
177,8	12,0	49,1	62,5	2159	5,88	243	330	4318	486	0,559	20,4
177,8	12,5	51,0	64,9	2230	5,86	251	342	4460	502	0,559	19,6
193,7	4,0	18,7	23,8	1073	6,71	111	144	2146	222	0,609	53,4
193,7	5,0	23,3	29,6	1320	6,67	136	178	2640	273	0,609	43,0
193,7	6,0	27,8	35,4	1560	6,64	161	211	3119	322	0,609	36,0
193,7	6,3	29,1	37,1	1630	6,63	168	221	3260	337	0,609	34,3
193,7	8,0	36,6	46,7	2016	6,57	208	276	4031	416	0,609	27,3
193,7	10,0	45,3	57,7	2442	6,50	252	338	4883	504	0,609	22,1
193,7	12,0	53,8	68,5	2839	6,44	293	397	5678	586	0,609	18,6
193,7	12,5	55,9	71,2	2934	6,42	303	411	5869	606	0,609	17,9
219,1	4,0	21,2	27,0	1564	7,61	143	185	3128	286	0,688	47,1
219,1	5,0	26,4	33,6	1928	7,57	176	229	3856	352	0,688	37,9
219,1	6,0	31,5	40,2	2282	7,54	208	273	4564	417	0,688	31,7
219,1	6,3	33,1	42,1	2386	7,53	218	285	4772	436	0,688	30,2
219,1	8,0	41,6	53,1	2960	7,47	270	357	5919	540	0,688	24,0
219,1	10,0	51,6	65,7	3598	7,40	328	438	7197	657	0,688	19,4
219,1	12,0	61,3	78,1	4200	7,33	383	515	8400	767	0,688	16,3
219,1	12,5	63,7	81,1	4345	7,32	397	534	8689	793	0,688	15,7
244,5	5,0	29,5	37,6	2699	8,47	221	287	5397	441	0,768	33,9
244,5	6,0	35,3	45,0	3199	8,43	262	341	6397	523	0,768	28,3
244,5	6,3	37,0	47,1	3346	8,42	274	358	6692	547	0,768	27,0
244,5	8,0	46,7	59,4	4160	8,37	340	448	8321	681	0,768	21,4
244,5	10,0	57,8	73,7	5073	8,30	415	550	10150	830	0,768	17,3
244,5	12,0	68,8	87,7	5938	8,23	486	649	11880	972	0,768	14,5
244,5	12,5	71,5	91,1	6147	8,21	503	673	12300	1006	0,768	14,0
273,0	5,0	33,0	42,1	3781	9,48	277	359	7562	554	0,858	30,3
273,0	6,0	39,5	50,3	4487	9,44	329	428	8974	657	0,858	25,3
273,0	6,3	41,4	52,8	4696	9,43	344	448	9392	688	0,858	24,1
273,0	8,0	52,3	66,6	5852	9,37	429	562	11700	857	0,858	19,1
273,0	10,0	64,9	82,6	7154	9,31	524	692	14310	1048	0,858	15,4
273,0	12,0	77,2	98,4	8396	9,24	615	818	16790	1230	0,858	12,9
273,0	12,5	80,3	102	8697	9,22	637	849	17400	1274	0,858	12,5
323,9	5,0	39,3	50,1	6369	11,3	393	509	12740	787	1,02	25,4
323,9	6,0	47,0	59,9	7572	11,2	468	606	15150	935	1,02	21,3
323,9	6,3	49,3	62,9	7929	11,2	490	636	15860	979	1,02	20,3
323,9	8,0	62,3	79,4	9910	11,2	612	799	19820	1224	1,02	16,0
323,9	10,0	77,4	98,6	12160	11,1	751	986	24320	1501	1,02	12,9
323,9	12,0	92,3	118	14320	11,0	884	1168	28640	1768	1,02	10,8
323,9	12,5	96,0	122	14850	11,0	917	1213	29690	1833	1,02	10,4
355,6	5,0	43,2	55,1	8464	12,4	476	615	16930	952	1,12	23,1

Specified outside diameter

Specified

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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 tonne
D	T	M	A	I	i	W_{el}	W_{pl}	L_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
355,6	6,0	51,7	65,9	10070	12,4	566	733	20140	1133	1,12	19,3
355,6	6,3	54,3	69,1	10550	12,4	593	769	21090	1186	1,12	18,4
355,6	8,0	68,6	87,4	13200	12,3	742	967	26400	1485	1,12	14,6
355,6	10,0	85,2	109	16220	12,2	912	1195	32450	1825	1,12	11,7
355,6	12,0	102	130	19140	12,2	1076	1417	38280	2153	1,12	9,83
355,6	12,5	106	135	19850	12,1	1117	1472	39700	2233	1,12	9,45
355,6	16,0	134	171	24660	12,0	1387	1847	49330	2774	1,12	7,46
355,6	20,0	166	211	29800	11,9	1676	2255	59580	3351	1,12	6,04
406,4	6,0	59,2	75,5	15130	14,2	745	962	30260	1489	1,28	16,9
406,4	6,3	62,2	79,2	15850	14,1	780	1009	31700	1560	1,28	16,1
406,4	8,0	78,6	100	19870	14,1	978	1270	39750	1956	1,28	12,7
406,4	10,0	97,8	125	24480	14,0	1205	1572	48950	2409	1,28	10,2
406,4	12,0	117	149	28940	14,0	1424	1867	57870	2848	1,28	8,57
406,4	12,5	121	155	30030	13,9	1478	1940	60060	2956	1,28	8,24
406,4	16,0	154	196	37450	13,8	1843	2440	74900	3686	1,28	6,49
406,4	20,0	191	243	45430	13,7	2236	2989	90860	4472	1,28	5,25
406,4	25,0	235	300	54700	13,5	2692	3642	109400	5384	1,28	4,25
457,0	6,0	66,7	85,0	21620	15,9	946	1220	43240	1892	1,44	15,0
457,0	6,3	70,0	89,2	22650	15,9	991	1280	45310	1983	1,44	14,3
457,0	8,0	88,6	113	28450	15,9	1245	1613	56900	2490	1,44	11,3
457,0	10,0	110	140	35090	15,8	1536	1998	70180	3071	1,44	9,07
457,0	12,0	132	168	41560	15,7	1819	2377	83110	3637	1,44	7,59
457,0	12,5	137	175	43150	15,7	1888	2470	86290	3776	1,44	7,30
457,0	16,0	174	222	53960	15,6	2361	3113	107900	4723	1,44	5,75
457,0	20,0	216	275	65680	15,5	2874	3822	131400	5749	1,44	4,64
457,0	25,0	266	339	79420	15,3	3475	4671	158800	6951	1,44	3,75
457,0	30,0	316	402	92170	15,1	4034	5479	184400	8068	1,44	3,17
508,0	6,0	74,3	94,6	29810	17,7	1174	1512	59620	2347	1,60	13,5
508,0	6,3	77,9	99,3	31250	17,7	1230	1586	62490	2460	1,60	12,8
508,0	8,0	98,6	126	39280	17,7	1546	2000	78560	3093	1,60	10,1
508,0	10,0	123	156	48520	17,6	1910	2480	97040	3820	1,60	8,14
508,0	12,0	147	187	57540	17,5	2265	2953	115100	4530	1,60	6,81
508,0	12,5	153	195	59760	17,5	2353	3070	119500	4705	1,60	6,55
508,0	16,0	194	247	74910	17,4	2949	3874	149800	5898	1,60	5,15
508,0	20,0	241	307	91430	17,3	3600	4766	182900	7199	1,60	4,15
508,0	25,0	298	379	111000	17,1	4367	5837	221800	8734	1,60	3,36
508,0	30,0	354	451	129200	16,9	5086	6864	258400	10170	1,60	2,83
610,0	6,0	89,4	114	51920	21,4	1702	2189	103900	3405	1,92	11,2
610,0	6,3	93,8	119	54440	21,3	1785	2296	108900	3570	1,92	10,7
610,0	8,0	119	151	68550	21,3	2248	2899	137100	4495	1,92	8,42
610,0	10,0	148	188	84850	21,2	2782	3600	169700	5564	1,92	6,76
610,0	12,0	177	225	100800	21,1	3305	4292	201700	6611	1,92	5,65

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610,0 12,5 184 235 104800 21,1 3435 4463 209000 6869 1,92 5,43
610,0 16,0 234 299 131800 21,0 4321 5647 263600 8641 1,92 4,27
610,0 20,0 291 371 161500 20,9 5295 6965 323000 10590 1,92 3,44
610,0 25,0 361 459 196900 20,7 6456 8561 393800 12910 1,92 2,77
610,0 30,0 429 547 230500 20,5 7557 10100 461000 15110 1,92 2,33
711,0 6,0 104 133 82570 24,9 2323 2982 165100 4645 2,23 9,59
711,0 6,3 109 139 86590 24,9 2436 3129 173200 4871 2,23 9,13
711,0 8,0 139 177 109200 24,9 3071 3954 218300 6141 2,23 7,21
711,0 10,0 173 220 135300 24,8 3806 4914 270600 7612 2,23 5,78
711,0 12,0 207 264 161000 24,7 4529 5864 322000 9057 2,23 4,83
711,0 12,5 215 274 167300 24,7 4707 6099 334700 9415 2,23 4,64
711,0 16,0 274 349 211000 24,6 5936 7730 422100 11870 2,23 3,65
711,0 20,0 341 434 259400 24,4 7295 9552 518700 14590 2,23 2,93
711,0 25,0 423 539 317400 24,3 8927 11770 634700 17850 2,23 2,36
711,0 30,0 504 642 372800 24,1 10490 13920 745600 21000 2,23 1,98
762,0 6,0 112 143 101800 26,7 2672 3429 20360 5345 2,39 8,94
762,0 6,3 117 150 106800 26,7 2803 3598 213600 5605 2,39 8,52
762,0 8,0 149 190 134700 26,7 3535 4548 269400 7070 2,39 6,72
762,0 10,0 185 236 167000 26,6 4384 5655 334100 8768 2,39 5,39
762,0 12,0 222 283 198900 26,5 5219 6751 397700 10440 2,39 4,51

Specified outside diameter
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 tonne

D T M A I i W_{el} W_{pl} L_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
762,0 12,5 231 294 206700 26,5 5426 7023 413500 10900 2,39 4,33
762,0 16,0 294 375 261000 26,4 6850 8906 522000 13700 2,39 3,40
762,0 20,0 366 466 321100 26,2 8427 11000 642200 16860 2,39 2,73
762,0 25,0 454 579 393500 26,1 10327 13580 786900 20650 2,39 2,20
762,0 30,0 542 690 462900 25,9 12148 16080 925700 24300 2,39 1,85
813,0 8,0 159 202 163900 28,5 4032 5184 327800 8064 2,55 6,30
813,0 10,0 198 252 203400 28,4 5003 6448 406700 10010 2,55 5,05
813,0 12,0 237 302 242200 28,3 5959 7700 484500 11930 2,55 4,22
813,0 12,5 247 314 251900 28,3 6196 8011 503700 12400 2,55 4,05
813,0 16,0 314 401 318200 28,2 7828 10170 636400 15660 2,55 3,18
813,0 20,0 391 498 392000 28,0 9641 12600 783800 19280 2,55 2,56
813,0 25,0 486 619 480900 27,9 11829 15530 961700 23660 2,55 2,06
813,0 30,0 579 738 566400 27,7 13933 18400 1133000 27870 2,55 1,73
914,0 8,0 179 228 233700 32,0 5113 6567 467300 10230 2,87 5,59
914,0 10,0 223 284 290200 32,0 6349 8172 580300 12700 2,87 4,49
914,0 12,0 267 340 345890 31,9 7569 9764 691800 15140 2,87 3,75
914,0 12,5 278 354 359700 31,9 7871 10160 719400 15740 2,87 3,60

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914,0 16,0 354 451 455100 31,8 9959 12900 910300 19920 2,87 2,82
914,0 20,0 441 562 561500 31,6 12286 15990 1123000 24570 2,87 2,27
914,0 25,0 548 698 690300 31,4 15105 19760 1381000 30210 2,87 1,82
914,0 30,0 654 833 814800 31,3 17829 23450 1630000 35660 2,87 1,53
1016,0 8,0 199 253 321800 35,6 6334 8129 6436000 12670 3,19 5,03
1016,0 10,0 248 316 399900 35,6 7871 10120 799700 15740 3,19 4,03
1016,0 12,0 297 378 477000 35,5 9389 12100 954000 18780 3,19 3,37
1016,0 12,5 309 394 496100 35,5 9766 12590 992300 19530 3,19 3,23
1016,0 16,0 395 503 628500 35,4 12372 16000 1257000 24740 3,19 2,53
1016,0 20,0 491 626 776300 35,2 15282 19840 1553000 30560 3,19 2,04
1016,0 25,0 611 778 956000 35,0 18821 24560 1912000 37640 3,19 1,64
1016,0 30,0 729 929 1130000 34,9 22251 29180 2261000 44500 3,19 1,37
1067,0 10,0 261 332 463900 37,4 8693 11170 927600 17390 3,35 3,84
1067,0 12,0 312 398 553420 37,3 10373 13360 1107000 20750 3,35 3,20
1067,0 12,5 325 414 575700 37,3 10790 13900 1151000 21580 3,35 3,08
1067,0 16,0 415 528 729600 37,2 13676 17680 1459000 27350 3,35 2,41
1067,0 20,0 516 658 901800 37,0 16903 21930 1804000 33810 3,35 1,94
1067,0 25,0 642 818 1111000 36,9 20831 27150 2223000 41660 3,35 1,56
1067,0 30,0 767 977 1315000 36,7 24646 32270 2630000 49290 3,35 1,30
1168,0 10,0 286 364 609800 40,9 10443 13410 1220000 20890 3,67 3,50
1168,0 12,0 342 436 728100 40,9 12467 16040 1456000 24930 3,67 2,92
1168,0 12,5 356 454 757400 40,9 12969 16690 1515000 25940 3,67 2,81
1168,0 16,0 455 579 960800 40,7 16452 21240 1922000 32900 3,67 2,20
1168,0 20,0 566 721 1189000 40,6 20353 26360 2377000 40710 3,67 1,77
1168,0 25,0 705 898 1467000 40,4 25115 32670 2933000 50230 3,67 1,42
1219,0 10,0 298 380 694000 42,7 11387 14620 1388000 22770 3,83 3,35
1219,0 12,0 357 455 828700 42,7 13597 17480 1657000 27190 3,83 2,80
1219,0 12,5 372 474 862200 42,7 14146 18200 1724000 28290 3,83 2,69
1219,0 16,0 475 605 1094000 42,5 17951 23260 2188000 35900 3,83 2,11
1219,0 20,0 591 753 1354000 42,4 22217 28760 2708400 44440 3,83 1,69
1219,0 25,0 736 938 1672000 42,2 27430 35650 3344000 54860 3,83 1,36

Table C.2 — Nominal dimensions and sectional properties of a limited range of square hollow sections (see Figure C.2)

Specified side dimension | **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 tonne**

B T M A I i W_{el} W_{pl} L_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
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
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 1163 175 0,446 37,9
120 10,0 31,8 40,6 777 4,38 129 162 1376 203 0,437 31,4
120 12,0 35,8 45,7 806 4,20 134 174 1518 219 0,418 27,9
120 12,5 36,9 47,0 817 4,17 136 178 1551 223 0,416 27,1

Specified side dimension
Specified thickness

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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 tonne

B	T	M	A	I	i	W_{el}	W_{pl}	L_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
140	4,0	16,8	21,3	652	5,52	93,1	108	1023	140	0,546	59,7
140	5,0	20,7	26,4	791	5,48	113	132	1256	170	0,543	48,3
140	6,0	24,5	31,2	920	5,43	131	155	1479	198	0,539	40,8
140	6,3	25,4	32,3	941	5,39	134	160	1550	205	0,533	39,4
140	8,0	31,4	40,0	1127	5,30	161	194	1901	248	0,526	31,8
140	10,0	38,1	48,6	1312	5,20	187	230	2274	291	0,517	26,2
140	12,0	43,4	55,3	1398	5,03	200	253	2567	322	0,498	23,1
140	12,5	44,8	57,0	1425	5,00	204	259	2634	329	0,496	22,3
150	4,0	18,0	22,9	808	5,93	108	125	1265	162	0,586	55,5
150	5,0	22,3	28,4	982	5,89	131	153	1554	197	0,583	44,9
150	6,0	26,4	33,6	1146	5,84	153	180	1833	230	0,579	37,9
150	6,3	27,4	34,8	1174	5,80	156	185	1922	239	0,573	36,6
150	8,0	33,9	43,2	1412	5,71	188	226	2364	289	0,566	29,5
150	10,0	41,3	52,6	1653	5,61	220	269	2839	341	0,557	24,2
150	12,0	47,1	60,1	1780	5,44	237	298	3231	380	0,538	21,2
150	12,5	48,7	62,0	1817	5,41	242	306	3321	389	0,536	20,5
150	16,0	58,7	74,8	2009	5,18	268	351	3830	440	0,518	17,0
160	4,0	19,3	24,5	987	6,34	123	143	1541	185	0,626	51,9
160	5,0	23,8	30,4	1202	6,29	150	175	1896	226	0,623	42,0
160	6,0	28,3	36,0	1405	6,25	176	206	2239	264	0,619	35,4
160	6,3	29,3	37,4	1442	6,21	180	213	2349	275	0,613	34,1
160	8,0	36,5	46,4	1741	6,12	218	260	2897	334	0,606	27,4
160	10,0	44,4	56,6	2048	6,02	256	311	3490	395	0,597	22,5
160	12,0	50,9	64,9	2224	5,86	278	346	3997	443	0,578	19,6
160	12,5	52,6	67,0	2275	5,83	284	356	4114	455	0,576	19,0
160	16,0	63,7	81,2	2546	5,60	318	413	4799	520	0,558	15,7
180	4,0	21,8	27,7	1422	7,16	158	182	2210	237	0,706	45,9
180	5,0	27,0	34,4	1737	7,11	193	224	2724	290	0,703	37,1
180	6,0	32,1	40,8	2037	7,06	226	264	3223	340	0,699	31,2
180	6,3	33,3	42,4	2096	7,03	233	273	3383	354	0,693	30,0
180	8,0	41,5	52,8	2546	6,94	283	336	4189	432	0,686	24,1
180	10,0	50,7	64,6	3017	6,84	335	404	5074	515	0,677	19,7
180	12,0	58,5	74,5	3322	6,68	369	454	5865	584	0,658	17,1
180	12,5	60,5	77,0	3406	6,65	378	467	6050	600	0,656	16,5
180	16,0	73,8	94,0	3887	6,43	432	550	7178	698	0,638	13,6
200	4,0	24,3	30,9	1968	7,97	197	226	3049	295	0,786	41,2
200	5,0	30,1	38,4	2410	7,93	241	279	3763	362	0,783	33,2
200	6,0	35,8	45,6	2833	7,88	283	330	4459	426	0,779	27,9
200	6,3	37,2	47,4	2922	7,85	292	341	4682	444	0,773	26,8
200	8,0	46,5	59,2	3566	7,76	357	421	5815	544	0,766	21,5
200	10,0	57,0	72,6	4251	7,65	425	508	7072	651	0,757	17,6
200	12,0	66,0	84,1	4730	7,50	473	576	8230	743	0,738	15,2
200	12,5	68,3	87,0	4859	7,47	486	594	8502	765	0,736	14,6

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200 16,0 83,8 107 5625 7,26 562 706 10210 901 0,718 11,9
220 5,0 33,2 42,4 3238 8,74 294 340 5038 442 0,863 30,1
220 6,0 39,6 50,4 3813 8,70 347 402 5976 521 0,859 25,3
220 6,3 41,2 52,5 3940 8,66 358 417 6277 543 0,853 24,3
220 8,0 51,5 65,6 4828 8,58 439 516 7815 668 0,846 19,4
220 10,0 63,2 80,6 5782 8,47 526 625 9533 804 0,837 15,8
220 12,0 73,5 93,7 6487 8,32 590 712 11150 922 0,818 13,6
220 12,5 76,2 97,0 6674 8,29 607 735 11530 951 0,816 13,1
220 16,0 93,9 120 7812 8,08 710 881 13970 1129 0,798 10,7
250 5,0 38,0 48,4 4805 9,97 384 442 7443 577 0,983 26,3
250 6,0 45,2 57,6 5672 9,92 454 524 8843 681 0,979 22,1
250 6,3 47,1 60,0 5873 9,89 470 544 9290 711 0,973 21,2
250 8,0 59,1 75,2 7229 9,80 578 676 11600 878 0,966 16,9
250 10,0 72,7 92,6 8707 9,70 697 822 14200 1062 0,957 13,8
250 12,0 84,8 108 9859 9,55 789 944 16690 1226 0,938 11,8
250 12,5 88,0 112 10160 9,52 813 975 17280 1266 0,936 11,4
250 16,0 109 139 12050 9,32 964 1180 21150 1520 0,918 9,18
260 6,0 47,1 60,0 6405 10,3 493 569 9970 739 1,02 21,2
260 6,3 49,1 62,6 6635 10,3 510 591 10480 772 1,01 20,4

Specified side dimension
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 tonne

B T M A I i W_{el} W_{pl} L_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

260 8,0 61,6 78,4 8178 10,2 629 734 13090 955 1,01 16,2
260 10,0 75,8 96,6 9865 10,1 759 894 16040 1156 0,997 13,2
260 12,0 88,6 113 11200 9,96 862 1028 18880 1337 0,978 11,3
260 12,5 91,9 117 11550 9,93 888 1063 19550 1381 0,976 10,9
260 16,0 114 145 13740 9,73 1057 1289 23990 1663 0,958 8,77
300 6,0 54,7 69,6 9964 12,0 664 764 15430 997 1,18 18,3
300 6,3 57,0 72,6 10340 11,9 689 795 16220 1042 1,17 17,5
300 8,0 71,6 91,2 12800 11,8 853 991 20310 1293 1,17 14,0
300 10,0 88,4 113 15520 11,7 1035 1211 24970 1572 1,16 11,3
300 12,0 104 132 17770 11,6 1184 1402 29510 1829 1,14 9,65
300 12,5 108 137 18350 11,6 1223 1451 30600 1892 1,14 9,30
300 16,0 134 171 22080 11,4 1472 1774 37840 2299 1,12 7,46
350 8,0 84,2 107 20680 13,9 1182 1366 32560 1787 1,37 11,9
350 10,0 104 133 25190 13,8 1439 1675 40130 2182 1,36 9,61
350 12,0 123 156 29050 13,6 1660 1949 47600 2552 1,34 8,16
350 12,5 127 162 30050 13,6 1717 2020 49390 2642 1,34 7,86
350 16,0 159 203 36510 13,4 2086 2488 61480 3238 1,32 6,28
400 10,0 120 153 38220 15,8 1911 2214 60430 2892 1,56 8,35

400 12,0 141 180 44320 15,7 2216 2587 71840 3395 1,54 7,07
400 12,5 147 187 45880 15,7 2294 2683 74600 3518 1,54 6,81
400 16,0 184 235 56150 15,5 2808 3322 93280 4336 1,52 5,43

Table C.3 — Nominal dimensions and sectional properties of a limited range of rectangular hollow sections (see Figure C.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
B	H	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	W_{elyy}	W_{elzz}	$W_{pl\,yy}$	$W_{pl\,zz}$	L_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
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	2,0	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
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
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

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

$B \cdot H$ T M A I_{yy} I_{zz} i_{yy} i_{zz} W_{elyy} W_{elzz} $W_{pl\,yy}$ $W_{pl\,zz}$ L_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
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
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

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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 1008 536 5,35 3,90 134 107 169 128 1206 182 0,466 36,1
150 100 10,0 33,4 42,6 1162 614 5,22 3,80 155 123 199 150 1426 211 0,457 29,9
150 100 12,0 37,7 48,1 1207 642 5,01 3,65 161 128 215 163 1573 229 0,438 26,5
150 100 12,5 38,9 49,5 1225 651 4,97 3,63 163 130 220 166 1606 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
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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 1001 335 5,46 3,16 125 83,7 163 100 882 150 0,446 37,9
160 80 10,0 31,8 40,6 1146 380 5,32 3,06 143 95,0 191 117 1031 172 0,437 31,4
160 80 12,0 35,8 45,7 1171 391 5,06 2,93 146 97,8 204 125 1111 183 0,418 27,9
160 80 12,5 36,9 47,0 1185 396 5,02 2,90 148 98,9 208 127 1129 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 1124 452 6,53 4,14 125 90,4 154 103 1045 154 0,543 48,3
180 100 6,0 24,5 31,2 1310 524 6,48 4,10 146 105 181 120 1227 179 0,539 40,8
180 100 6,3 25,4 32,3 1335 536 6,43 4,07 148 107 186 124 1283 185 0,533 39,4
180 100 8,0 31,4 40,0 1598 637 6,32 3,99 178 127 226 150 1565 222 0,526 31,8
180 100 10,0 38,1 48,6 1859 736 6,19 3,89 207 147 268 177 1859 260 0,517 26,2
180 100 12,0 43,4 55,3 1965 782 5,96 3,76 218 156 292 194 2073 285 0,498 23,1
180 100 12,5 44,8 57,0 2001 796 5,92 3,74 222 159 300 199 2122 290 0,496 22,3
200 100 4,0 18,0 22,9 1200 411 7,23 4,23 120 82,2 148 91,7 985 142 0,586 55,5
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200 100 6,0 26,4 33,6 1703 577 7,12 4,14 170 115 213 132 1417 200 0,579 37,9
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200 100 10,0 41,3 52,6 2444 818 6,82 3,94 244 164 318 195 2154 292 0,557 24,2
200 100 12,0 47,1 60,1 2607 876 6,59 3,82 261 175 350 215 2414 322 0,538 21,2
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200 120 4,0 19,3 24,5 1353 618 7,43 5,02 135 103 164 115 1345 172 0,626 51,9
200 120 5,0 23,8 30,4 1649 750 7,37 4,97 165 125 201 141 1652 210 0,623 42,0
200 120 6,0 28,3 36,0 1929 874 7,32 4,93 193 146 237 166 1947 245 0,619 35,4
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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

$B \cdot H$ T M A I_{yy} I_{zz} i_{yy} i_{zz} W_{elyy} W_{elzz} $W_{pl\,yy}$ $W_{pl\,zz}$ L_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

200 120 8,0 36,5 46,4 2386 1079 7,17 4,82 239 180 298 209 2507 308 0,606 27,4

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250 150 5,0 30,1 38,4 3304 1508 9,28 6,27 264 201 320 225 3285 337 0,783 33,2
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250 150 6,3 37,2 47,4 4001 1825 9,18 6,20 320 243 391 276 4078 412 0,773 26,8
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250 150 10,0 57,0 72,6 5825 2634 8,96 6,02 466 351 582 409 6121 602 0,757 17,6
250 150 12,0 66,0 84,1 6458 2925 8,77 5,90 517 390 658 463 7088 684 0,738 15,2
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250 150 16,0 83,8 106,8 7660 3453 8,47 5,69 613 460 805 566 8713 823 0,718 11,9
260 180 5,0 33,2 42,4 4121 2350 9,86 7,45 317 261 377 294 4695 426 0,863 30,1
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300 200 16,0 109 139 15620 8340 10,6 7,75 1041 834 1319 1000 19220 1442 0,918 9,18
350 250 6,0 54,7 69,6 12460 7458 13,4 10,3 712 597 843 671 14550 967 1,18 18,3
350 250 6,3 57,0 72,6 12920 7744 13,3 10,3 738 620 876 698 15290 1010 1,17 17,5
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350 250 10,0 88,4 113 19410 11590 13,1 10,1 1109 927 1335 1062 23500 1522 1,16 11,3
350 250 12,0 104 132 22200 13260 13,0 10,0 1268 1061 1544 1229 27750 1770 1,14 9,65
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350 250 16,0 134 171 27580 16430 12,7 9,81 1576 1315 1954 1554 35500 2220 1,12 7,46
400 200 8,0 71,6 91,2 18970 6517 14,4 8,45 949 652 1173 728 15820 1133 1,17 14,0
400 200 12,5 108 137 27100 9260 14,1 8,22 1355 926 1714 1062 23600 1644 1,14 9,30
400 200 16,0 134 171 32550 11060 13,8 8,05 1627 1106 2093 1294 28930 1984 1,12 7,46
400 300 8,0 84,2 107 25120 16210 15,3 12,3 1256 1081 1487 1224 31180 1747 1,37 11,9
400 300 10,0 104 133 30610 19730 15,2 12,2 1530 1315 1824 1501 38410 2132 1,36 9,61
400 300 12,0 123 156 35280 22750 15,0 12,1 1764 1516 2122 1747 45530 2492 1,34 8,16
400 300 12,5 127 162 36490 23520 15,0 12,0 1824 1568 2198 1810 47240 2580 1,34 7,86
400 300 16,0 159 203 44350 28540 14,8 11,9 2218 1902 2708 2228 58730 3159 1,32 6,28

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