Cold formed welded structural hollow sections of non-alloy and fine grain structural steel

Part 2: Tolerances, dimensions and sectional properties
English version of DIN EN 10219-2

DIN EN 10219-2

ICS 77.140.75

Supersedes DIN 59411, July 1978 edition.

Descriptors: Hollow sections, structural steelwork, tolerances.

Kaltgefertigte geschweißte Hohlprofile für den Stahlbau aus unlegierten Baustählen und aus Feinkornbaustählen – Teil 2: Grenzabmaße, Maße und statische Werte

European Standard EN 10219-2 : 1997 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been prepared by ECISS/TC 10.

The responsible German body involved in its preparation was the *Normenausschuß Eisen und Stahl* (Steel and Iron Standards Committee), Technical Committee *Hohlprofile*.

Amendments

DIN 59411, July 1978 edition, has been superseded by the specifications of EN 10219-2. The scope of the standard has been extended to cover circular sections of diameters 21,3 to 1219 mm (cf. table 6). Specifications for concavity and convexity have been included.

Previous edition

DIN 59411: 1978-07.

EN comprises 38 pages.

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EUROPEAN STANDARD
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EN 10219-2

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English version

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Part 2: Tolerances, dimensions and sectional properties

Profils creux soudés pour la construction finis à froid en aciers de construction non alliés et à grains fins – Partie 2: Tolérances, dimensions et caractéristiques du profil

Kaltgefertigte geschweißte Hohlprofile für den Stahlbau aus unlegierten Baustählen und aus Feinkornbaustählen – Teil 2: Grenzabmaße, Maße und statische Werte

This European Standard was approved by CEN on 1997-06-22.

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Contents

Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 10 "Structural steels - Qualities", the secretariat of which is held by NNI.

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 February 1998, and conflicting national standards shall be withdrawn at the latest by February 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This Part of this European Standard specifies the tolerances for cold formed welded circular, square and rectangular structural hollow sections and gives the dimensions and sectional properties for a range of standard sizes.

For the technical delivery requirements see EN 10219-1.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 10219-1 Cold formed welded structural hollow sections of non-alloy and fine grain steels
Part 1: Technical delivery conditions

3 Definitions

See EN 10219 - 1

4 Symbols

Symbols used in this standard are given in table 1.

Table 1: Symbols

Symbol	Unit	Definition
A	cm^2	Cross-sectional area
A_s	m^2/m	Superficial area per metre length
B	mm	Nominal length of side of square hollow section. Nominal length 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	Nominal 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	Nominal length 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	Nominal thickness.
V	mm	Total measured twist.
V_1	mm	Twist measured at one end of a section.

Table 1: Symbols (concluded)

Symbols	Unit	Definitions
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
xx	-	Axis of cross-section, major axis of a rectangular hollow section
yy	-	Axis of cross-section, minor axis of a rectangular hollow section
θ	Degrees	Angle between adjacent sides of a square or rectangular hollow section

5 Information to be supplied by the purchaser

The following mandatory information from this Part of this European Standard shall be supplied by the purchaser at the time of enquiry and order.

a) The type of length and the 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 supplied by the purchaser contained in clause 5.1 of EN 10219-1.

6 Tolerances

6.1 Tolerances on the dimensions and mass of cold formed hollow sections shall not exceed the values given in table 2 for shape and mass, table 3 for external corner profiles, table 4 for length and 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.

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 dimension

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 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 longer side length from the end of the section.

7.4 Out-of-roundness

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

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

7.5 Concavity and convexity

The concavity (x_1) or the convexity (x_2) of the sides of a square or rectangular hollow section shall be measured as shown in figure 2.

The percentage concavity or convexity shall be calculated as follows:

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

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

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.

7.7 External Corner Profile

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

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

7.7.2 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

The twist (V) in a square or rectangular hollow section shall be determined in accordance with 7.8.1 or 7.8.2 at the discretion of the manufacturer.

7.8.1 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 a horizontal surface (see figure 5) shall be measured.

7.8.2 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 section.

7.9 Straightness

The deviation from straightness (e) of the total length of a hollow section shall be measured at the point of maximum departure of the hollow section from a straight line connecting its two ends as shown in figure 7. The percentage deviation from straightness shall be calculated as follows:-

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

8 Dimensions and sectional properties

The nominal section dimensions and sectional properties for a range of standard sizes of cold formed structural hollow section are given in table 6 for circular sections, table 7 for square sections and table 8 for rectangular sections. The sectional properties were calculated from the formulae given in annex A.

NOTE: Other sizes and thicknesses may be available by agreement with the manufacturer.

Table 2: Tolerances

<table>
<tr><td>Characteristic</td><td>Circular hollow sections</td><td colspan="2">Square and rectangular hollow sections</td></tr>
<tr><td rowspan="4">Outside dimensions (D, B and H)</td><td rowspan="4">± 1 % with a minimum of
± 0,5 mm and a maximum of ± 10 mm.</td><td>Side length
mm</td><td>Tolerance</td></tr>
<tr><td>H,B < 100</td><td>± 1 % with a minimum of ± 0,5 mm</td></tr>
<tr><td>100 ≤ H,B ≤ 200</td><td>± 0,8 %</td></tr>
<tr><td>H,B > 200</td><td>± 0,6 %</td></tr>
<tr><td>Thickness (T)</td><td>For D ≤ 406,4 mm
T ≤ 5 mm: ± 10 %
T > 5 mm: ± 0,50 mm
For D > 406,4 mm
± 10 % with a maximum of ± 2 mm</td><td colspan="2">T ≤ 5 mm: ± 10 %
T > 5 mm: ± 0,50 mm</td></tr>
<tr><td>Out-of-roundness (O)</td><td>2 % for hollow sections having a diameter to thickness ratio not exceeding 100[1)]</td><td colspan="2">-</td></tr>
<tr><td>Concavity/Convexity[2)]</td><td>-</td><td colspan="2">max 0,8 % with a minimum of 0,5 mm</td></tr>
<tr><td>Squareness of Side</td><td>-</td><td colspan="2">90 ° ± 1°</td></tr>
<tr><td>External Corner Profile</td><td>-</td><td colspan="2">See table 3</td></tr>
<tr><td>Twist (V)</td><td>-</td><td colspan="2">2 mm plus 0,5 mm/m length.</td></tr>
<tr><td>Straightness</td><td>0,20 % of total length</td><td colspan="2">0,15 % of total length</td></tr>
<tr><td>Mass (M)</td><td colspan="3">± 6 % on individual lengths</td></tr>
<tr><td colspan="4">[1)] Where the diameter to thickness ratio exceeds 100 the tolerance on out-of-roundness shall be agreed.

[2)] The tolerance on convexity and concavity is independent of the tolerance on outside dimensions.</td></tr>
</table>

Table 3: External corner profile

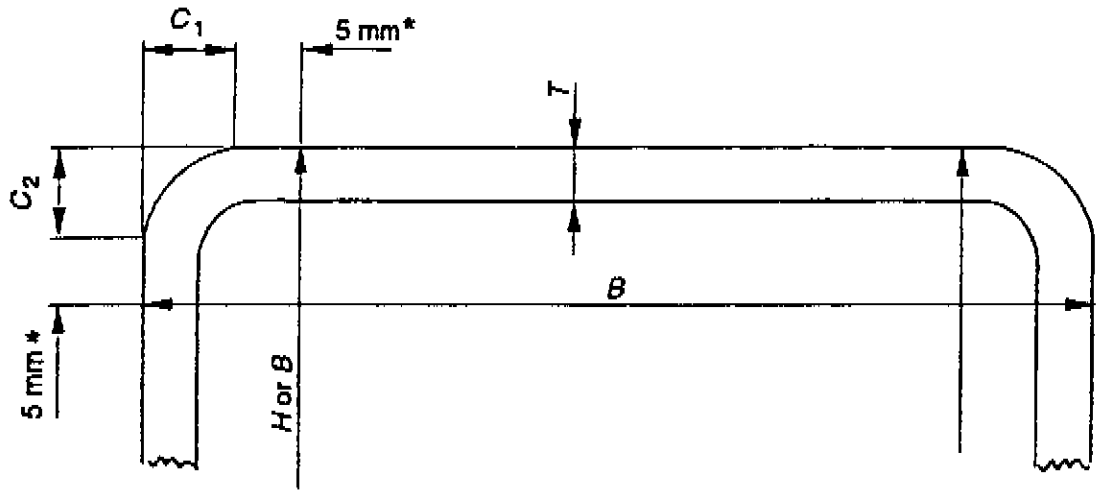
Thickness T mm	External corner profile C_1, C_2, or R[1] mm
$T \leq 6$	1,6T to 2,4T
$6 < T \leq 10$	2,0T to 3,0T
$10 < T$	2,4T to 3,6T
[1] The sides need not be tangential to the corner arcs.	

Table 4: Tolerances on length[1]

Type of length	Range in mm	Tolerance
Random length	4000 to 16000 with a range of 2000 per order item.	10 % of sections supplied may be below the minimum for the ordered range but not less than 75 % of the minimum of the range.
Approximate length	≥ 4000	+ 50 mm 0
Exact length	< 6000	+ 5 mm 0
	≥ 6000 to ≤ 10 000	+ 15 mm 0
	> 10 000	+ 5 mm + 1mm/m 0
[1] The purchaser shall indicate in the enquiry and order the type of length required and the length range or length required.		

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

Thickness (T)	Maximum weld bead height mm
≤ 14,2	3,5
> 14,2	4,8



* 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

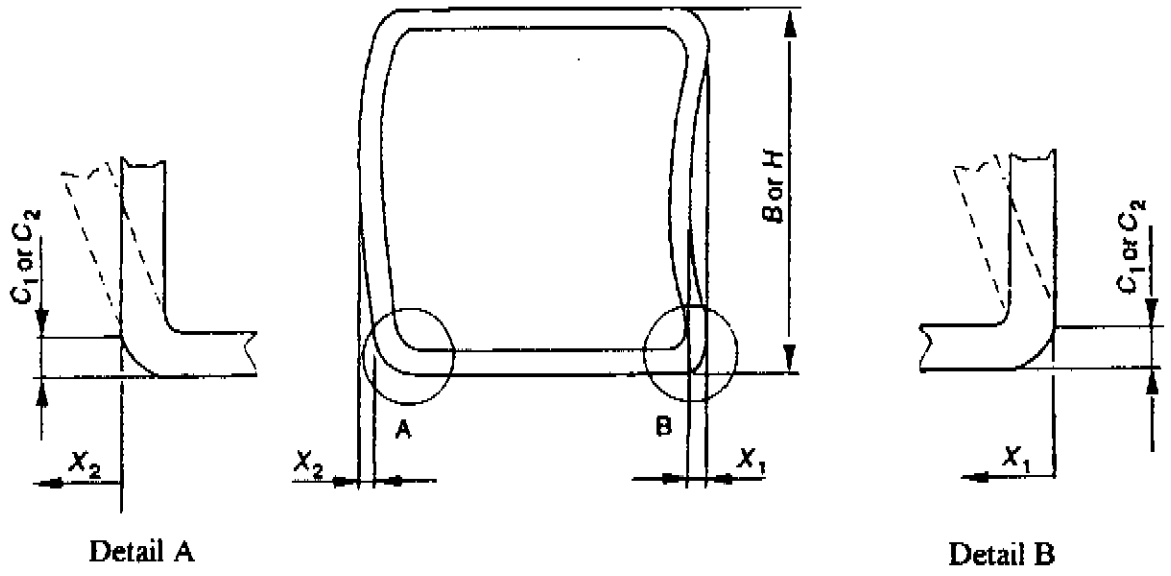
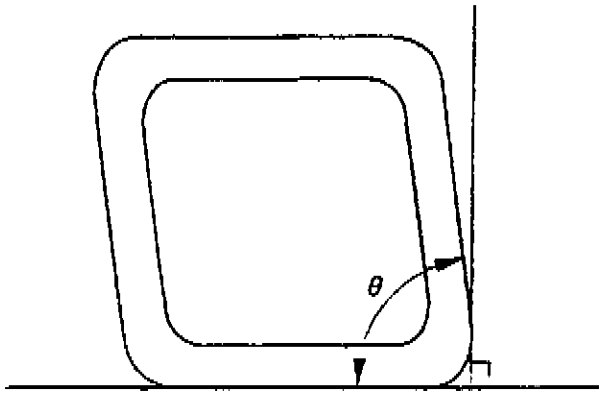
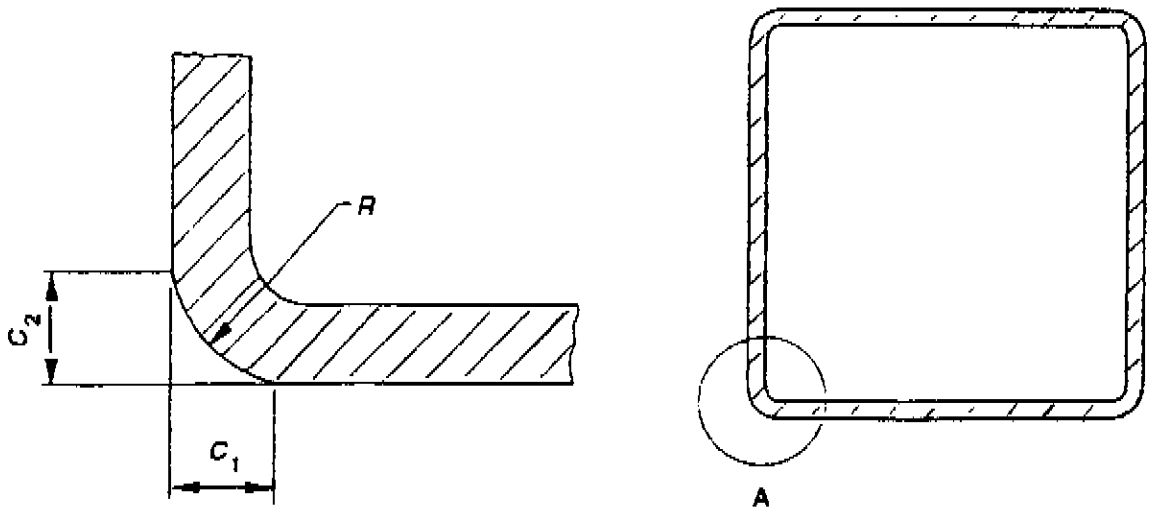


Figure 2: Measurement of concavity/convexity of square or rectangular hollow sections



Deviation from squareness = 90°- θ

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



Detail A

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

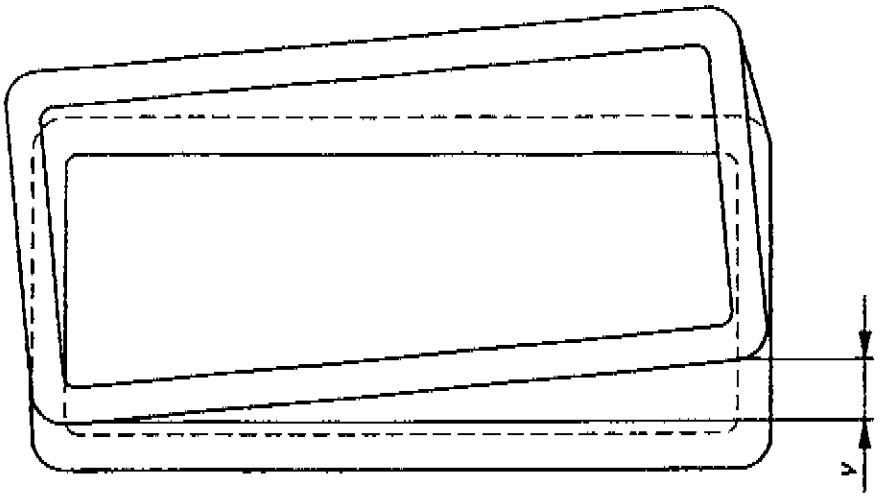


Figure 5: Twist of square or rectangular hollow sections

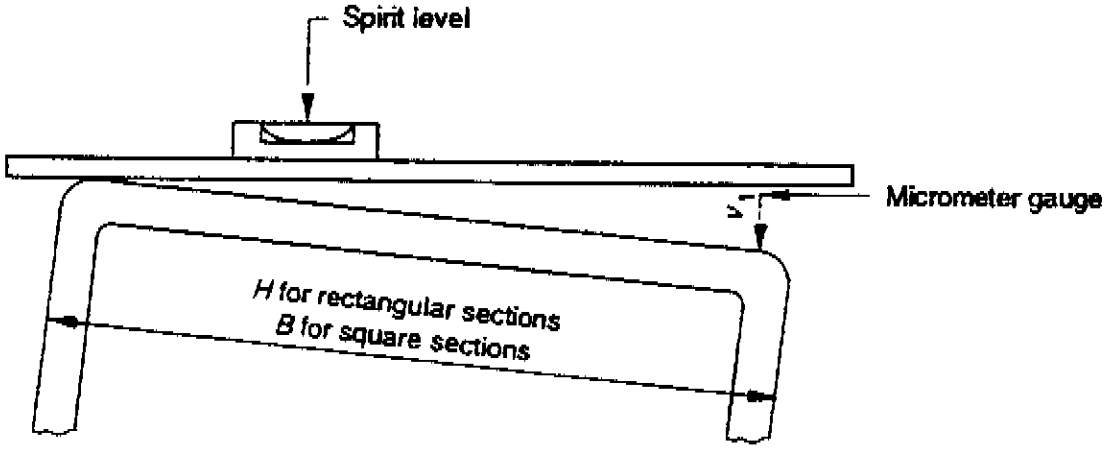


Figure 6: Measurement of twist

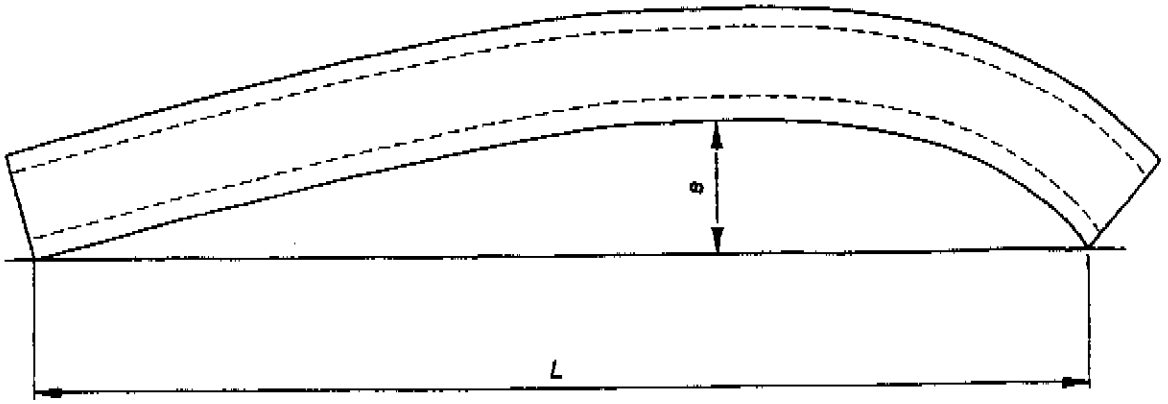


Figure 7: Measurement of deviation from straightness

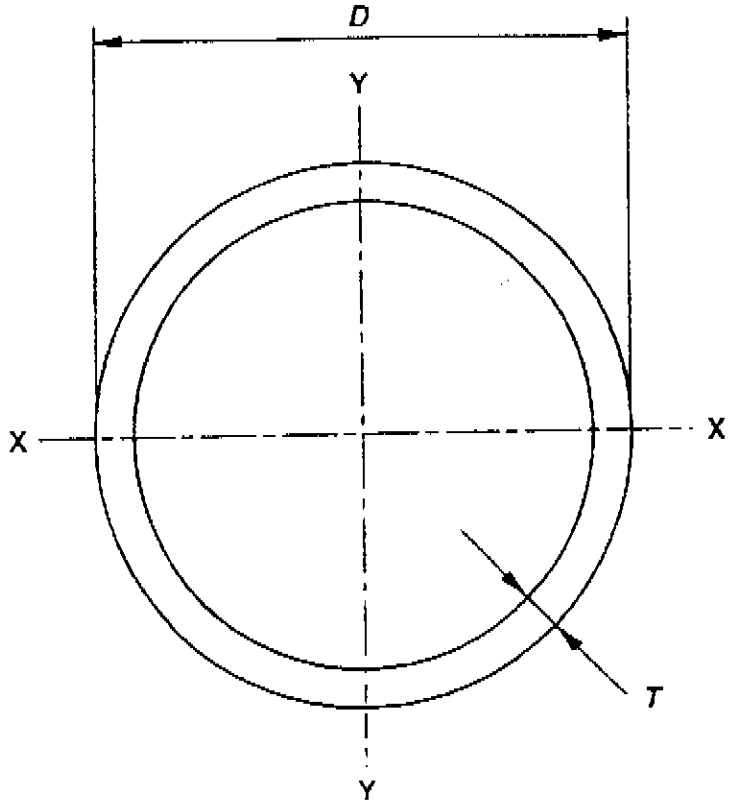


Figure 8: Circular hollow section (see table 6)

Table 6: Nominal dimensions and sectional properties of circular hollow sections
(see figure 8)

Outside Diameter	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
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	0,0669	1050
21,3	2,5	1,16	1,48	0,664	0,671	0,623	0,889	1,33	1,25	0,0669	863
21,3	3,0	1,35	1,72	0,741	0,656	0,696	1,01	1,48	1,39	0,0669	739
26,9	2,0	1,23	1,56	1,22	0,883	0,907	1,24	2,44	1,81	0,0845	814
26,9	2,5	1,50	1,92	1,44	0,867	1,07	1,49	2,88	2,14	0,0845	665
26,9	3,0	1,77	2,25	1,63	0,852	1,21	1,72	3,27	2,43	0,0845	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

Table 6: Nominal dimensions and sectional properties of circular hollow sections (continued)

Outside Diameter	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
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
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	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	1064	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

Table 6: Nominal dimensions and sectional properties of circular hollow sections (continued)

Outside Diameter	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
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
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	58,5
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

Table 6: Nominal dimensions and sectional properties of circular hollow sections (continued)

Outside Diameter	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
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
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	10146	830	0,768	17,3
244,5	12,0	68,8	87,7	5938	8,23	486	649	11877	972	0,768	14,5
244,5	12,5	71,5	91,1	6147	8,21	503	673	12295	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	11703	857	0,858	19,1
273,0	10,0	64,9	82,6	7154	9,31	524	692	14308	1048	0,858	15,4
273,0	12,0	77,2	98,4	8396	9,24	615	818	16792	1230	0,858	12,9
273,0	12,5	80,3	102	8697	9,22	637	849	17395	1274	0,858	12,5
323,9	5,0	39,3	50,1	6369	11,3	393	509	12739	787	1,02	25,4
323,9	6,0	47,0	59,9	7572	11,2	468	606	15143	935	1,02	21,3
323,9	6,3	49,3	62,9	7929	11,2	490	636	15858	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	12158	11,1	751	986	24317	1501	1,02	12,9
323,9	12,0	92,3	118	14320	11,0	884	1168	28639	1768	1,02	10,8
323,9	12,5	96,0	122	14847	11,0	917	1213	29693	1833	1,02	10,4
355,6	5,0	43,2	55,1	8464	12,4	476	615	16927	952	1,12	23,1
355,6	6,0	51,7	65,9	10071	12,4	566	733	20141	1133	1,12	19,3
355,6	6,3	54,3	69,1	10547	12,4	593	769	21094	1186	1,12	18,4
355,6	8,0	68,6	87,4	13201	12,3	742	967	26403	1485	1,12	14,6
355,6	10,0	85,2	109	16223	12,2	912	1195	32447	1825	1,12	11,7
355,6	12,0	102	130	19139	12,2	1076	1417	38279	2153	1,12	9,83
355,6	12,5	106	135	19852	12,1	1117	1472	39704	2233	1,12	9,45
355,6	16,0	134	171	24663	12,0	1387	1847	49326	2774	1,12	7,46
355,6	20,0	166	211	29792	11,9	1676	2255	59583	3351	1,12	6,04
406,4	6,0	59,2	75,5	15128	14,2	745	962	30257	1489	1,28	16,9
406,4	6,3	62,2	79,2	15849	14,1	780	1009	31699	1560	1,28	16,1
406,4	8,0	78,6	100	19874	14,1	978	1270	39748	1956	1,28	12,7
406,4	10,0	97,8	125	24476	14,0	1205	1572	48952	2409	1,28	10,2
406,4	12,0	117	149	28937	14,0	1424	1867	57874	2848	1,28	8,57

Table 6: Nominal dimensions and sectional properties of circular hollow sections (continued)

Outside Diameter	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
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
406,4	12,5	121	155	30031	13,9	1478	1940	60061	2956	1,28	8,24
406,4	16,0	154	196	37449	13,8	1843	2440	74898	3686	1,28	6,49
406,4	20,0	191	243	45432	13,7	2236	2989	90864	4472	1,28	5,25
406,4	25,0	235	300	54702	13,5	2692	3642	109404	5384	1,28	4,25
457,0	6,0	66,7	85,0	21618	15,9	946	1220	43236	1892	1,44	15,0
457,0	6,3	70,0	89,2	22654	15,9	991	1280	45308	1983	1,44	14,3
457,0	8,0	88,6	113	28446	15,9	1245	1613	56893	2490	1,44	11,3
457,0	10,0	110	140	35091	15,8	1536	1998	70183	3071	1,44	9,07
457,0	12,0	132	168	41556	15,7	1819	2377	83113	3637	1,44	7,59
457,0	12,5	137	175	43145	15,7	1888	2470	86290	3776	1,44	7,30
457,0	16,0	174	222	53959	15,6	2361	3113	107919	4723	1,44	5,75
457,0	20,0	216	275	65681	15,5	2874	3822	131363	5749	1,44	4,64
457,0	25,0	266	339	79415	15,3	3475	4671	158830	6951	1,44	3,75
457,0	30,0	316	402	92173	15,1	4034	5479	184346	8068	1,44	3,17
508,0	6,0	74,3	94,6	29812	17,7	1174	1512	59623	2347	1,60	13,5
508,0	6,3	77,9	99,3	31246	17,7	1230	1586	62493	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	57536	17,5	2265	2953	115072	4530	1,60	6,81
508,0	12,5	153	195	59755	17,5	2353	3070	119511	4705	1,60	6,55
508,0	16,0	194	247	74909	17,4	2949	3874	149818	5898	1,60	5,15
508,0	20,0	241	307	91428	17,3	3600	4766	182856	7199	1,60	4,15
508,0	25,0	298	379	110918	17,1	4367	5837	221837	8734	1,60	3,36
508,0	30,0	354	451	129173	16,9	5086	6864	258346	10171	1,60	2,83
610,0	6,0	89,4	114	51924	21,4	1702	2189	103847	3405	1,92	11,2
610,0	6,3	93,8	119	54439	21,3	1785	2296	108878	3570	1,92	10,7
610,0	8,0	119	151	68551	21,3	2248	2899	137103	4495	1,92	8,42
610,0	10,0	148	188	84847	21,2	2782	3600	169693	5564	1,92	6,76
610,0	12,0	177	225	100814	21,1	3305	4292	201627	6611	1,92	5,65
610,0	12,5	184	235	104755	21,1	3435	4463	209509	6869	1,92	5,43
610,0	16,0	234	299	131781	21,0	4321	5647	263563	8641	1,92	4,27
610,0	20,0	291	371	161490	20,9	5295	6965	322979	10589	1,92	3,44
610,0	25,0	361	459	196906	20,7	6456	8561	393813	12912	1,92	2,77
610,0	30,0	429	547	230476	20,5	7557	10101	460952	15113	1,92	2,33
711,0	6,0	104	133	82568	24,9	2323	2982	165135	4645	2,23	9,59

Table 6: Nominal dimensions and sectional properties of circular hollow sections (continued)

Outside Diameter	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
D	T	M	A	I	i	W_{el}	W_{pl}	I_t	C_t	A_x	
mm	mm	kg/m	cm^2	cm^4	cm	cm^3	cm^3	cm^4	cm^3	m^2/m	m
711,0	6,3	109	139	86586	24,9	2436	3129	173172	4871	2,23	9,13
711,0	8,0	139	177	109162	24,9	3071	3954	218324	6141	2,23	7,21
711,0	10,0	173	220	135301	24,8	3806	4914	270603	7612	2,23	5,78
711,0	12,0	207	264	160991	24,7	4529	5864	321981	9037	2,23	4,83
711,0	12,5	215	274	167343	24,7	4707	6099	334686	9415	2,23	4,64
711,0	16,0	274	349	211040	24,6	5936	7730	422080	11873	2,23	3,65
711,0	20,0	341	434	259351	24,4	7295	9552	518702	14591	2,23	2,93
711,0	25,0	423	539	317357	24,3	8927	11770	634715	17854	2,23	2,36
711,0	30,0	504	642	372790	24,1	10486	13922	745580	20973	2,23	1,98
762,0	6,0	112	143	101813	26,7	2672	3429	203626	5345	2,39	8,94
762,0	6,3	117	150	106777	26,7	2803	3598	213555	5605	2,39	8,52
762,0	8,0	149	190	134683	26,7	3535	4548	269366	7070	2,39	6,72
762,0	10,0	185	236	167028	26,6	4384	5655	334057	8768	2,39	5,39
761,0	12,0	222	283	198855	26,5	5219	6751	397710	10439	2,39	4,51
762,0	12,5	231	294	206731	26,5	5426	7023	413462	10852	2,39	4,33
762,0	16,0	294	375	260973	26,4	6850	8906	521947	13699	2,39	3,40
762,0	20,0	366	466	321083	26,2	8427	11014	642166	16855	2,39	2,73
762,0	25,0	454	579	393461	26,1	10327	13584	786922	20654	2,39	2,20
762,0	30,0	542	690	462853	25,9	12148	16084	925706	24297	2,39	1,85
813,0	8,0	159	202	163901	28,5	4032	5184	327801	8064	2,55	6,30
813,0	10,0	198	252	203364	28,4	5003	6448	406728	10006	2,55	5,05
813,0	12,0	237	302	242235	28,3	5959	7700	484469	11918	2,55	4,22
813,0	12,5	247	314	251860	28,3	6196	8011	503721	12392	2,55	4,05
813,0	16,0	314	401	318222	28,7	7828	10165	636443	15657	2,55	3,18
813,0	20,0	391	498	391909	28,0	9641	12580	783819	19282	2,55	2,56
813,0	25,0	486	619	480856	27,9	11829	15529	961713	23658	2,55	2,06
813,0	30,0	579	738	566374	27,7	13933	18402	1132748	27866	2,55	1,73
914,0	8,0	179	228	233651	32,0	5113	6567	467303	10225	2,87	5,59
914,0	10,0	223	284	290147	32,0	6349	8172	580294	12698	2,87	4,49
914,0	12,0	267	340	345890	31,9	7569	9764	691779	15137	2,87	3,75
914,0	12,5	278	354	359708	31,9	7871	10159	719417	15742	2,87	3,60
914,0	16,0	354	451	455142	31,8	9959	12904	910284	19919	2,87	2,82
914,0	20,0	441	562	561461	31,6	12286	15987	1122922	24572	2,87	2,27

Table 6: Nominal dimensions and sectional properties of circular hollow sections (concluded)

Outside Diameter	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
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
914,0	25,0	548	698	690317	31,4	15105	19763	1380634	30211	2,87	1,82
914,0	30,0	654	833	814775	31,3	17829	23453	1629550	35658	2,87	1,53
1016,0	8,0	199	253	321780	35,6	6334	8129	643560	12668	3,19	5,03
1016,0	10,0	248	316	399850	35,6	7871	10121	799699	15742	3,19	4,03
1016,0	12,0	297	378	476985	35,5	9389	12097	953969	18779	3,19	3,37
1016,0	12,5	309	394	496123	35,5	9766	12588	992246	19532	3,19	3,23
1016,0	16,0	395	503	628479	35,4	12372	16001	1256959	24743	3,19	2,53
1016,0	20,0	491	626	776324	35,2	15282	19843	1552648	30564	3,19	2,04
1016,0	25,0	611	778	956086	35,0	18821	24595	1912173	37641	3,19	1,64
1016,0	30,0	729	929	1130352	34,9	22251	29175	2260704	44502	3,19	1,37
1067,0	10,0	261	332	463792	37,4	8693	11173	927585	17387	3,35	3,84
1067,0	12,0	312	398	553420	37,3	10373	13357	1106840	20747	3,35	3,20
1067,0	12,5	325	414	575666	37,3	10790	13900	1151332	21581	3,35	3,08
1067,0	16,0	415	528	729606	37,2	13676	17675	1459213	27352	3,35	2,41
1067,0	20,0	516	658	901755	37,0	16903	21927	1803509	33805	3,35	1,94
1067,0	25,0	642	818	1111355	36,9	20831	27149	2222711	41663	3,35	1,56
1067,0	30,0	767	977	1314864	36,7	24646	32270	2629727	49292	3,35	1,30
1168,0	10,0	286	364	609843	40,9	10443	13410	1219686	20885	3,67	3,50
1168,0	12,0	342	436	728050	40,9	12467	16037	1456101	24933	3,67	2,92
1168,0	12,5	356	454	757409	40,9	12969	16690	1514818	25939	3,67	2,81
1168,0	16,0	455	579	960774	40,7	16452	21235	1921547	32903	3,67	2,20
1168,0	20,0	566	721	1188632	40,6	20353	26361	2377264	40707	3,67	1,77
1168,0	25,0	705	898	1466717	40,4	25115	32666	2933434	50230	3,67	1,42
1219,0	10,0	298	380	694014	42,7	11387	14617	1388029	22773	3,83	3,35
1219,0	12,0	357	455	828716	42,7	13597	17483	1657433	27193	3,83	2,80
1219,0	12,5	372	474	862181	42,7	14146	18196	1724362	28291	3,83	2,69
1219,0	16,0	475	605	1094091	42,5	17951	23157	2188183	35901	3,83	2,11
1219,0	20,0	591	753	1354155	42,4	22217	28755	2708309	44435	3,83	1,69
1219,0	25,0	736	938	1671873	42,2	27430	35646	3343746	54860	3,83	1,36

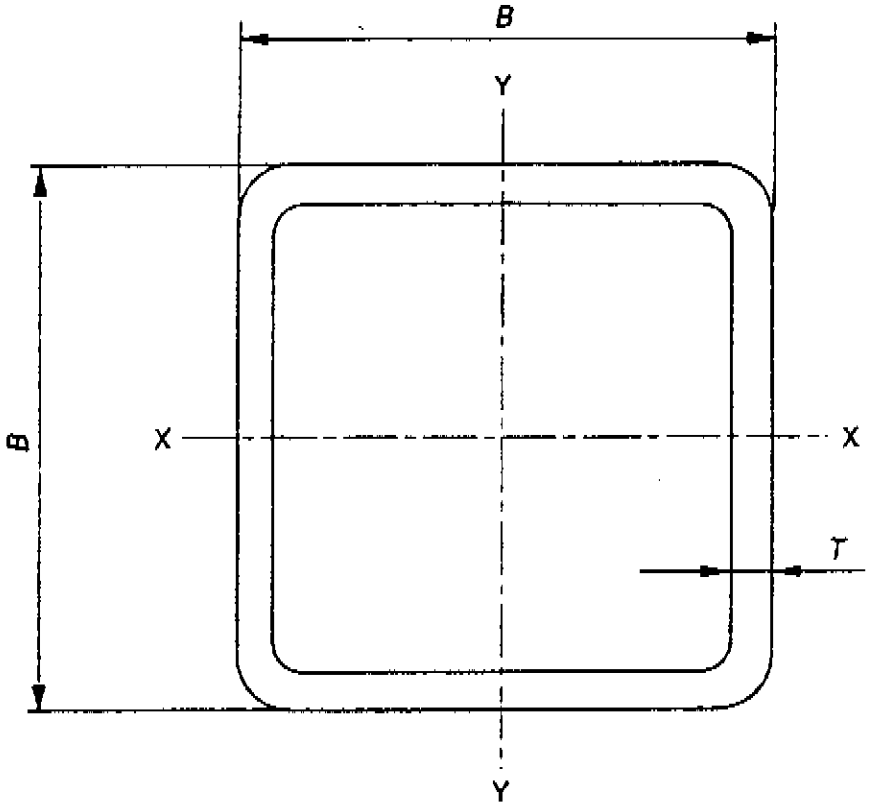


Figure 9: Square hollow section (see table 7)

Table 7: Nominal dimensions and sectional properties of square hollow sections
(see figure 9)

Size	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
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	29,0	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

Table 7: Nominal dimensions and sectional properties of square hollow sections (continued)

Size	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
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	70,7
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	209	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	1561	223	0,416	27,1
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

Table 7: Nominal dimensions and sectional properties of square hollow sections
(continued)

Size	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^3	cm^4	m^2/m	m
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	0,490	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	184	1922	239	0,573	36,6
150	8,0	33,9	43,2	1417	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	33,9	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

Table 7: Nominal dimensions and sectional properties of square hollow sections (continued)

Size	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
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	4740	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
200	16,0	83,8	107	5625	7,26	567	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	11149	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	13971	1179	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	11598	878	0,966	16,9
250	10,0	72,7	92,6	8707	9,70	697	822	14197	1062	0,957	13,8
250	12,0	84,8	108	9859	9,55	789	944	16691	1226	0,938	11,8
250	12,5	88,0	112	10161	9,52	813	975	17283	1266	0,936	11,4
250	16,0	109	139	12047	9,32	964	1180	21146	1520	0,918	9,18
260	6,0	47,1	60,0	6405	10,3	493	569	9970	799	1,02	21,2
260	6,3	49,1	62,6	6635	10,3	510	591	10475	772	1,01	20,4
260	8,0	61,6	78,4	8178	10,2	629	734	13087	955	1,01	16,2
260	10,0	75,8	96,6	9865	10,1	759	894	16035	1156	0,997	13,2
260	12,0	88,6	113	11200	9,96	862	1028	18878	1337	0,978	11,3
260	12,5	91,9	117	11548	9,93	888	1063	19553	1381	0,976	10,9
260	16,0	114	145	13739	9,73	1057	1289	23986	1663	0,958	8,77

Table 7: Nominal dimensions and sectional properties of square hollow sections (concluded)

Size	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
300	6,0	54,7	69,6	9964	12,0	664	764	15434	997	1,18	18,3
300	6,3	57,0	72,6	10342	11,9	689	795	16218	1042	1,17	17,5
300	8,0	71,6	91,2	12801	11,8	853	991	20312	1293	1,17	14,0
300	10,0	88,4	113	15519	11,7	1035	1211	24966	1572	1,16	11,3
300	12,0	104	132	17767	11,6	1184	1402	29514	1829	1,14	9,65
300	12,5	108	137	18348	11,6	1223	1451	30601	1892	1,14	9,30
300	16,0	134	171	22076	11,4	1472	1774	37837	2299	1,12	7,46
350	8,0	84,2	107	20681	13,9	1182	1366	32557	1787	1,37	11,9
350	10,0	104	133	25189	13,8	1439	1675	40127	2182	1,36	9,61
350	12,0	123	156	29054	13,6	1660	1949	47598	2552	1,34	8,16
350	12,5	127	162	30045	13,6	1717	2020	49393	2642	1,34	7,86
350	16,0	159	203	36511	13,4	2086	2488	61481	3238	1,32	6,28
400	10,0	120	153	38216	15,8	1911	2214	60433	2892	1,56	8,35
400	12,0	141	180	44319	15,7	2216	2587	71843	3395	1,54	7,07
400	12,5	147	187	45877	15,7	2294	2683	74598	3518	1,54	6,81
400	16,0	184	235	56154	15,5	2808	3327	93279	4336	1,52	5,43

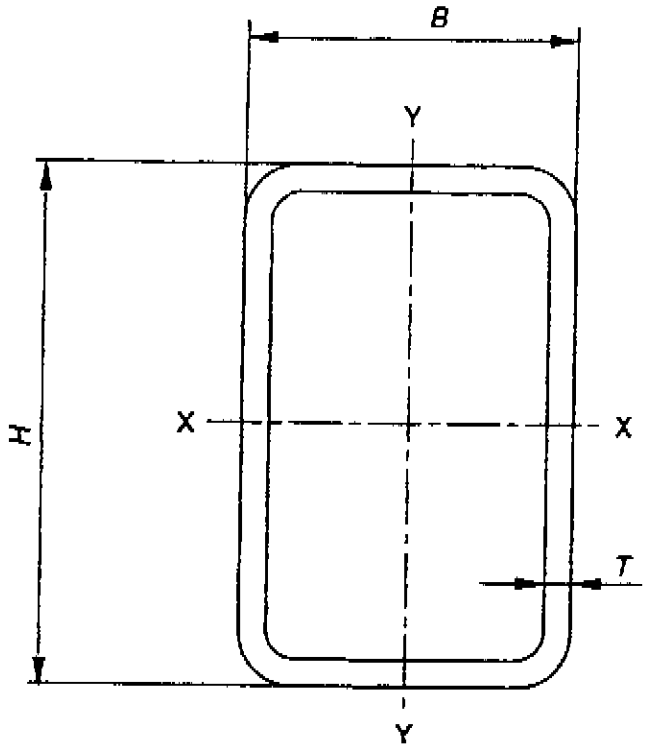


Figure 10: Rectangular hollow section (see table 8)

Table 8: Nominal dimensions and sectional properties of rectangular hollow sections (see figure 10)

Size		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	x B	T	M	A	I_{xx}	I_{yy}	i_{xx}	i_{yy}	Wel_{xx}	Wel_{yy}	Wpl_{xx}	Wpl_{yy}	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
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	8,77	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	10,7	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

Table 8: Nominal dimensions and sectional properties of rectangular hollow sections (continued)

Size		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
H x	B	T	M	A	I_{xx}	I_{yy}	i_{xx}	i_{yy}	Wel_{xx}	Wel_{yy}	Wpl_{xx}	Wpl_{yy}	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	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
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	490	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

Table 8: Nominal dimensions and sectional properties of rectangular sections (continued)

Size		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
H x	B	T	M	A	I_{xx}	I_{yy}	i_{xx}	i_{yy}	$W_{el,xx}$	$W_{el,yy}$	$W_{pl,xx}$	$W_{pl,yy}$	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
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	868	453	5,43	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
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	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
200	100	5,0	22,3	28,4	1459	497	7,17	4,19	146	99,4	181	112	1206	172	0,583	44,9
200	100	6,0	26,4	33,6	1703	577	7,12	4,14	170	115	213	132	1417	200	0,579	37,9
200	100	6,3	27,4	34,8	1759	591	7,06	4,17	174	118	219	135	1483	208	0,573	36,6
200	100	8,0	33,9	43,2	2091	705	6,95	4,04	209	141	267	165	1811	250	0,566	29,5
200	100	10,0	41,1	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
200	100	12,5	48,7	62,0	2659	892	6,55	3,79	266	178	359	221	2474	329	0,536	20,5
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
200	120	6,3	29,3	37,4	1976	898	7,27	4,90	198	150	244	172	2040	255	0,613	34,1

Table 8: Nominal dimensions and sectional properties of rectangular hollow sections
(continued)

Size		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
H	B	T	M	A	I_{yy}	I_{zz}	i_{yy}	i_{zz}	$W_{el,yy}$	$W_{el,zz}$	$W_{pl,y}$	$W_{pl,z}$	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
200	120	8,0	36,5	46,4	2386	1079	7,17	4,82	239	180	298	209	2507	308	0,606	27,4
200	120	10,0	44,4	56,6	2806	1262	7,04	4,72	281	210	356	250	3007	364	0,597	22,5
200	120	12,0	50,9	64,9	3031	1368	6,84	4,59	303	228	395	278	3419	406	0,578	19,6
200	120	12,5	52,6	67,0	3099	1397	6,80	4,57	310	233	406	285	3514	416	0,576	19,0
250	150	5,0	30,1	38,4	3304	1508	9,28	6,27	264	201	320	225	3285	337	0,783	33,2
250	150	6,0	35,8	45,6	3886	1768	9,23	6,23	311	236	378	266	3886	396	0,779	27,9
250	150	6,3	37,2	47,4	4001	1825	9,18	6,20	320	243	391	276	4078	412	0,773	26,8
250	150	8,0	46,5	59,2	4886	2219	9,08	6,12	391	296	482	340	5050	504	0,766	21,5
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	2975	8,77	5,90	517	390	658	463	7088	684	0,738	15,2
250	150	12,5	68,3	87,0	6633	3002	8,73	5,87	531	400	678	477	7315	704	0,736	14,6
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
260	180	6,3	41,2	52,5	5013	2856	9,77	7,38	386	317	463	361	5844	523	0,853	24,3
260	180	8,0	51,5	65,6	6145	3493	9,68	7,29	473	388	575	446	7267	642	0,846	19,4
260	180	10,0	63,2	80,6	7363	4174	9,56	7,20	566	464	694	540	8850	772	0,837	15,8
260	180	12,0	73,5	93,7	8245	4679	9,38	7,07	634	520	790	615	10328	884	0,818	13,6
260	180	12,5	76,2	97,0	8482	4812	9,35	7,04	652	535	815	635	10676	911	0,816	13,1
260	180	16,0	93,9	120	9979	5614	9,11	6,85	763	624	977	749	12890	1079	0,798	10,7
300	100	6,0	35,8	45,6	4777	842	10,2	4,30	318	168	411	188	2403	306	0,779	27,9
300	100	6,3	37,2	47,4	4907	868	10,2	4,28	327	174	425	194	2515	318	0,773	26,8
300	100	8,0	46,5	59,2	5978	1045	10,0	4,20	399	209	523	238	3080	385	0,766	21,5
300	100	10,0	57,0	72,6	7106	1224	9,90	4,11	474	245	631	285	3681	455	0,757	17,6
300	100	12,0	66,0	84,1	7808	1343	9,64	4,00	521	269	710	321	4177	508	0,738	15,2
300	100	12,5	68,3	87,0	8010	1374	9,59	3,97	534	275	737	330	4292	521	0,736	14,6
300	100	16,0	83,8	107	9157	1543	9,26	3,80	610	309	865	386	4939	592	0,718	11,9
300	150	6,0	40,5	51,6	6074	2080	10,8	6,35	405	277	500	309	4988	479	0,879	24,7
300	150	6,3	42,2	53,7	6266	2150	10,8	6,32	418	287	517	321	5234	499	0,873	23,7
300	150	8,0	52,8	67,2	7684	2623	10,7	6,25	512	350	640	396	6491	617	0,866	18,9
300	150	10,0	64,8	82,6	9209	3125	10,6	6,15	614	417	776	479	7879	733	0,857	15,4
300	150	12,0	75,4	96,1	10298	3498	10,4	6,03	687	466	883	546	9153	837	0,838	13,3
300	150	12,5	78,1	99,5	10594	3595	10,3	6,01	706	479	912	563	9452	862	0,836	12,8
300	150	16,0	96,4	123	12387	4174	10,0	5,83	826	557	1092	673	11328	1015	0,818	10,4
300	200	6,0	45,2	57,6	7370	3962	11,3	8,29	491	396	588	446	8115	651	0,979	22,1
300	200	6,3	47,1	60,0	7624	4104	11,3	8,27	508	410	610	463	8524	680	0,973	21,2
300	200	8,0	59,1	75,2	9389	5042	11,2	8,19	626	504	757	574	10627	838	0,966	16,9
300	200	10,0	72,7	92,6	11313	6058	11,1	8,09	754	606	921	698	12987	1012	0,957	13,8
300	200	12,0	84,8	108	12788	6854	10,9	7,96	853	685	1056	801	15236	1167	0,938	11,8
300	200	12,5	88,0	112	13179	7060	10,8	7,94	879	706	1091	828	15768	1204	0,936	11,4
300	200	16,0	109	139	15617	8340	10,6	7,75	1041	834	1319	1000	19223	1442	0,918	9,18

Table 8: Nominal dimensions and sectional properties of rectangular hollow sections
(Concluded)

Size		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
H x B		T	M	A	I_{xx}	I_{yy}	i_{xx}	i_{yy}	$W_{el,xx}$	$W_{el,yy}$	$W_{pl,xx}$	$W_{pl,yy}$	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	6,0	54,7	69,6	12457	7458	13,4	10,3	712	597	843	671	14554	967	1,18	18,3
350	250	6,3	57,0	72,6	12923	7744	13,3	10,3	738	620	876	698	15291	1010	1,17	17,5
350	250	8,0	71,6	91,2	16001	9573	13,2	10,2	914	766	1092	869	19136	1253	1,17	14,0
350	250	10,0	88,4	113	19407	11588	13,1	10,1	1109	927	1335	1062	23500	1522	1,16	11,3
350	250	12,0	104	132	22197	13261	13,0	10,0	1268	1061	1544	1229	27749	1770	1,14	9,65
350	250	12,5	108	137	22922	13690	12,9	9,99	1310	1095	1598	1272	28764	1830	1,14	9,30
350	250	16,0	134	171	27580	16434	12,7	9,81	1576	1315	1954	1554	35497	2220	1,12	7,46
400	200	8,0	71,6	91,2	18974	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	23594	1644	1,14	9,30
400	200	16,0	134	171	32547	11056	13,8	8,05	1627	1106	2093	1294	28928	1984	1,12	7,46
400	300	8,0	84,2	107	25122	16212	15,3	12,3	1256	1081	1487	1224	31179	1747	1,37	11,9
400	300	10,0	104	133	30609	19776	15,2	12,2	1530	1315	1824	1501	38407	2132	1,36	9,61
400	300	12,0	123	156	35284	22747	15,0	12,1	1764	1516	2122	1747	45527	2492	1,34	8,16
400	300	12,5	127	162	36489	23517	15,0	12,0	1824	1568	2198	1810	47237	2580	1,34	7,86
400	300	16,0	159	203	44350	28535	14,8	11,9	2218	1902	2708	2228	58730	3159	1,32	6,28

Annex A (normative)

Formulae for calculation of section properties

Tables 6, 7 and 8 of this standard give nominal sectional properties for a range of standard sizes of cold formed hollow sections. The nominal sectional properties of other sizes and thickness of structural hollow sections supplied to the requirements of this standard shall be calculated using the formulae given below.

A.1 Circular hollow sections

The sectional properties for circular hollow sections in table 6 are calculated from the following geometric properties using the formulae given below

Nominal outside diameter	(D)	[mm]
Nominal thickness	(T)	[mm]
Nominal 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 remain valid

Superficial area per metre length	$A_s = \frac{\pi D}{10^3}$	[m^2/m]
Cross-sectional area	$A = \frac{\pi (D^2 - d^2)}{4 \times 10^2}$	[cm^2]
Mass per unit length	$M = 0{,}785 \times A$	[kg/m]
Second moment of area	$I = \frac{\pi (D^4 - d^4)}{64 \times 10^4}$	[cm^4]
Radius of gyration	$i = \sqrt{\frac{I}{A}}$	[cm]
Elastic section modulus	$W_{el} = \frac{2I \times 10}{D}$	[cm^3]
Plastic section modulus	$W_{pl} = \frac{D^3 - d^3}{6 \times 10^3}$	[cm^3]

Torsional inertia constant (polar moment of inertia)	$I_t = 2I$	[cm^4]
Torsional modulus constant	$C_t = 2W_{el}$	[cm^3]

A.2 Rectangular, including square, hollow sections

The sectional properties for square hollow sections in table 7 and for rectangular hollow sections in table 8 are calculated from the following geometric properties using the formulae given below

Nominal length of side of a square hollow section or shorter side of a rectangular hollow section	(B)	[mm]
Nominal length of the longer side of a rectangular hollow section	(H)	[mm]
Nominal thickness	(T)	[mm]

Nominal external corner radius (r_o) for calculation is:

for thickness less than or equal to 6 mm	2,0 T	[mm]
for thicknesses more than 6 mm and less than or equal to 10 mm	2,5 T	[mm]
for thicknesses more than 10 mm	3,0 T	[mm]

Nominal internal corner radius (r_i) for calculation is:

for thicknesses less than or equal to 6 mm	1,0 T	[mm]
for thicknesses more than 6 mm and less than or equal to 10 mm	1,5 T	[mm]
for thicknesses more than 10 mm	2,0 T	[mm]

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

Superficial area per metre length

$$A_s = \frac{2}{10^3}(H + B - 4r_o + \pi\, r_o) \qquad [m^2/m]$$

Cross-sectional area

$$A = \frac{2T(B+H-2T)-(4-\pi)(r_o^2-r_i^2)}{10^2} \qquad [cm^2]$$

Mass per unit length

$$M = 0{,}785A \qquad [\text{kg/m}]$$

Second moment of area

Major axis

$$I_{xx} = \frac{1}{10^4}\left[\frac{BH^3}{12} - \frac{(B-2T)(H-2T)^3}{12} - 4(I_{zz} + A_z h_z^2) + 4(I_{\xi\xi} + A_\xi h_\xi^2)\right] \qquad [cm^4]$$

Minor axis

$$I_{yy} = \frac{1}{10^4}\left[\frac{HB^3}{12} - \frac{(H-2T)(B-2T)^3}{12} - 4(I_{zz} + A_z h_z^2) + 4(I_{\xi\xi} + A_\xi h_\xi^2)\right] \qquad [cm^4]$$

Radius of gyration

Major axis

$$i_{xx} = \sqrt{\frac{I_{xx}}{A}} \qquad [cm]$$

Minor axis

$$i_{yy} = \sqrt{\frac{I_{yy}}{A}} \qquad [cm]$$

Elastic section modulus

Major axis

$$W_{el\,xx} = \frac{2I_{xx}}{H}(\times 10) \qquad [cm^3]$$

Minor axis

$$W_{el,yy} = \frac{2I_{yy}}{B}(\times 10) \qquad [cm^3]$$

Plastic section modulus

Major axis

$$W_{pl,zz} = \frac{1}{10^3}\left[\frac{BH^2}{4} - \frac{(B-2T)(H-2T)^2}{4} - 4(A_z h_z) + 4(A_\xi h_\xi)\right] \qquad (cm^3)$$

Minor axis

$$W_{pl,yy} = \frac{1}{10^3}\left[\frac{HB^2}{4} - \frac{(H-2T)(B-2T)^2}{4} - 4(A_z h_z) + 4(A_\xi h_\xi)\right] \qquad [cm^3]$$

Torsional inertia constant

$$I_t = \frac{1}{10^4}\left[T^3\frac{h}{3} + 2\,KA_h\right] \qquad [cm^4]$$

Torsional modulus constant

$$C_t = 10\left[\frac{I_t}{T + K/T}\right] \qquad [cm^3]$$

where

$$A_z = \left(1 - \frac{\pi}{4}\right)r_o^2 \qquad [mm^2]$$

$$A_\xi = \left(1 - \frac{\pi}{4}\right)r_i^2 \qquad [mm^2]$$

$$h_z = \frac{H}{2} - \left(\frac{10-3\pi}{12-3\pi}\right)r_o$$

[mm] Major axis

(for minor axis substitute B for H)

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

[mm] Major axis

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

$$I_{zz} = \left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{3(12 - 3\pi)} \right) r_o^4 \qquad [\text{mm}^4]$$

$$I_{yy} = \left(\frac{1}{3} - \frac{\pi}{16} - \frac{1}{3(12 - 3\pi)} \right) r_i^4 \qquad [\text{mm}^4]$$

$$h = 2[\,(B - T) + (H - T)] - 2R_C\,(4 - \pi) \qquad [\text{mm}]$$

$$A_h = (B - T)(H - T)] - R_C^2(4 - \pi) \qquad [\text{mm}^2]$$

$$K = \frac{2A_h T}{h} \qquad [\text{mm}^2]$$

$$R_c = \frac{r_o + r_i}{2} \qquad [\text{mm}]$$