Hot finished structural hollow sections of non-alloy and fine grain structural steel

Part 2: Tolerances, dimensions and sectional properties
English version of DIN EN 10210-2

DIN EN 10210-2

ICS 77.140.75

Supersedes DIN 59410, May 1974 edition.

Descriptors: Hollow sections, structural steelwork, tolerances.

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

European Standard EN 10210-2 : 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DIN 59410, May 1974 edition, has been superseded by the specifications of EN 10210-2. The scope of the standard has been extended to cover circular sections of diameters 21,3 to 1 219 mm (cf. table 5).

Previous edition

DIN 59410: 1974-05.

EN comprises 38 pages.

Bearbeitet: Normung

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EN 10210-2

August 1997

ICS 77.140.70; 91.080.10

Descriptors: Hollow sections, structural steelwork, tolerances.

English version

Hot finished structural hollow sections of non-alloy and fine grain structural steels

Part 2: Tolerances, dimensions and sectional properties

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

Warmgefertigte 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.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the 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

The European Standard has been prepared by the Technical Committee ECISS/TC 10 "Structural steels - Qualities", the secretariat of which was 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 hot finished 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 10210-1.

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 10210-1 Hot finished structural hollow sections of non-alloy and fine grain structural steels Part 1: Technical delivery requirements'.

3 Definitions

See EN 10210 - 1.

4 Symbols

Symbols used in this standard are given in table 1.

Table 1: Symbols used in this European Standard

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.

continued

Table 1: Symbols used in this European Standard (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

5.1 Mandatory information

The following 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 3).

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 10210-1.

5.2 Options

One option is specified in this Part of this European Standard. In the event that the purchaser does not indicate his wish to implement this option at the time of enquiry of order, the supplier shall supply in accordance with the basic specification.

2.1 The tolerance on approximate length shall be $^{0}_{+150}$ mm (see table 3).

6 Tolerances

6.1 Tolerances on the dimensions and mass of hot finished hollow sections shall not exceed the values given in table 2 for shape and mass, table 3 for length and table 4 for the height of the internal and external weld bead of submerged arc welded hollow sections.

6.2 The internal corners of square and rectangular hollow sections shall be rounded.

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 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 are shown in figure 1.

7.3 Thickness

The thickness (T) of welded hollow sections shall be measured at a position not less than 2T from the weld.

The limiting cross-sectional positions for measuring the thickness of square and rectangular hollow sections are shown in figure 1.

NOTE: Thickness is normally measured within a distance of half the outside diameter or half the 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 hollow 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 hot finished structural hollow section are given in table 5 for circular sections, table 6 for square sections and table 7 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

Characteristic	Circular Hollow Sections	Square and Rectangular Hollow Sections
Outside dimensions (D, B, H)	± 1 % with a minimum of ± 0,5 mm and a maximum of ± 10 mm.	± 1 % with a minimum of ± 0,5 mm
Thickness (T)	- 10 % [1) 2)]	
Out-of-roundness (O)	2 % for hollow sections having a diameter to thickness ratio not exceeding 100 [3)]	-
Concavity/Convexity[4)]	-	1 %
Squareness of side	-	90 ° ± 1°
External corner profile (C_1 C_2 or R)[5)]	-	3T maximum at each corner
Twist (V)	-	2 mm plus 0,5 mm/m length.
Straightness	0.2 % of total length	
Mass (M)	± 6 % on individual lengths[6)]	

[1)] The positive deviation is limited by the tolerance on mass.

[2)] For seamless sections thicknesses of less than 10 % but not less than 12,5 % of the nominal thickness may occur in smooth transition areas over not more than 25 % of the circumference.

[3)] Where the diameter to thickness ratio exceeds 100 the tolerance on out-of-roundness shall be agreed.

[4)] The tolerance on convexity and concavity is independent of the tolerance on outside dimensions.

[5)] The sides need not be tangential to the corner arcs.

[6)] The positive tolerance on the mass of seamless hollow sections shall be 8 %.

Table 3: Tolerances on length[1)]

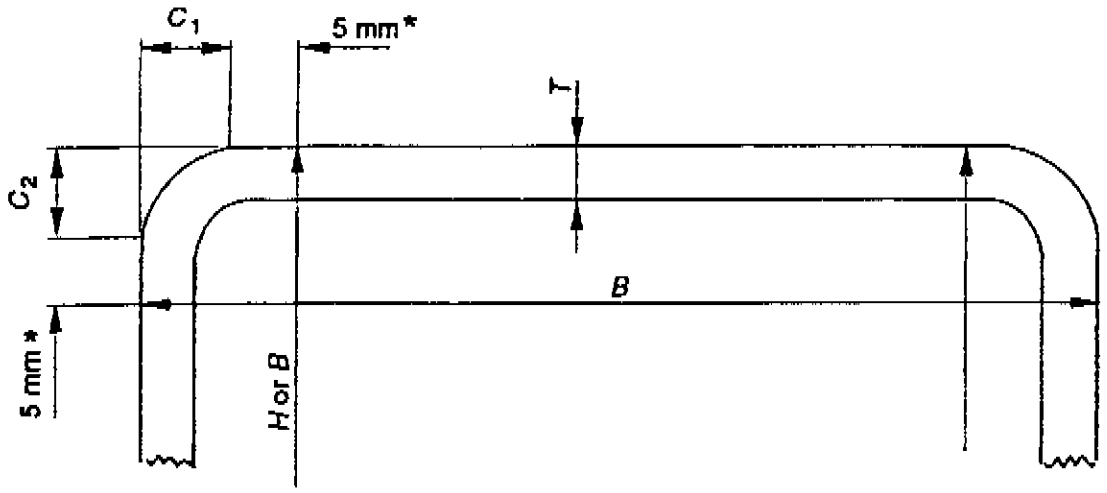
Type of length		
Random length	4000 to 16000 with a range of 2000 per order item.	10 % of sections supplied may be below the minimum for the ordered range but not less than 75 % of the minimum of the range.
Approximate length	4000 to 16000	± 500 mm[2)]
Exact length	≥ 2000 to 6000 > 6000	+ 10 mm 0 + 15 mm 0

[1)] The purchaser shall indicate in the enquiry and order the type of length required and the length range or length as appropriate.

[2)] Option 2.1. The tolerance on approximate length shall be $^{0}_{+150}$ mm (see 5.2)

Table 4: Tolerance on height of internal and external weld bead for submerged arc-welded hollow sections

Thickness (T) mm	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

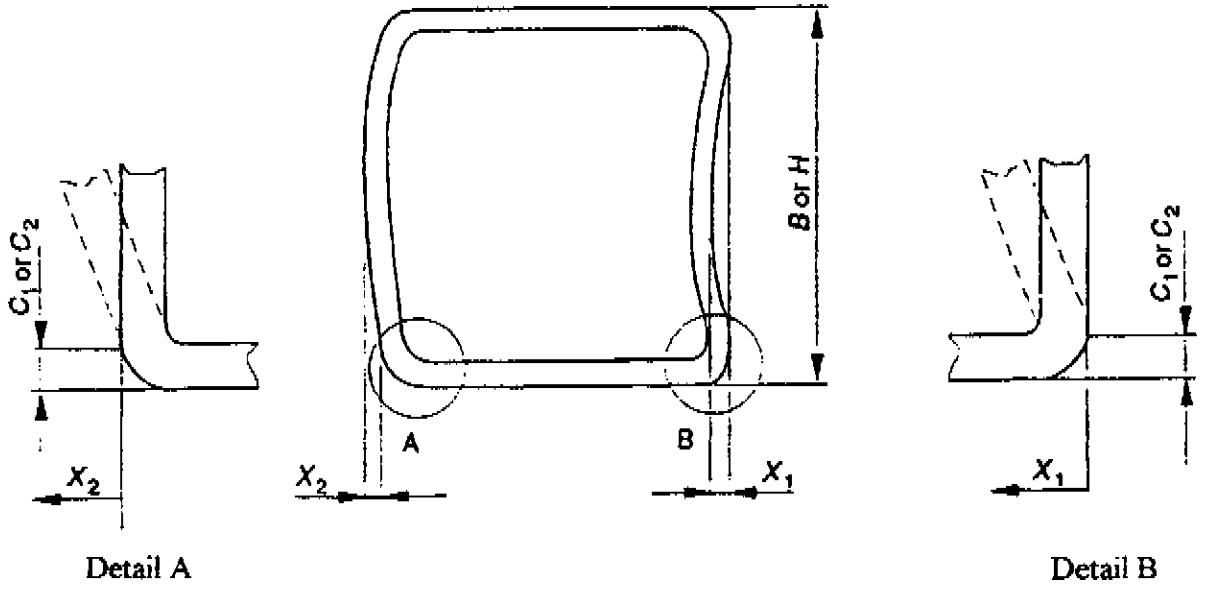
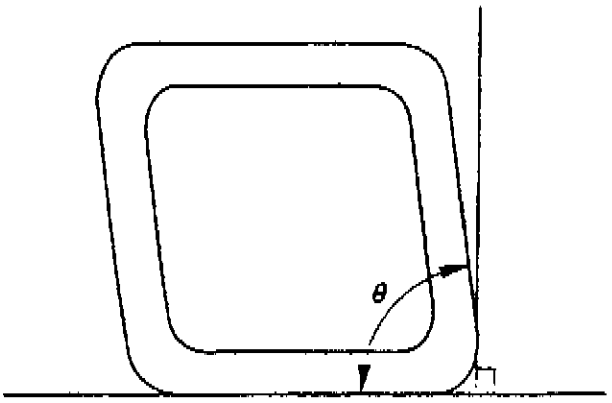
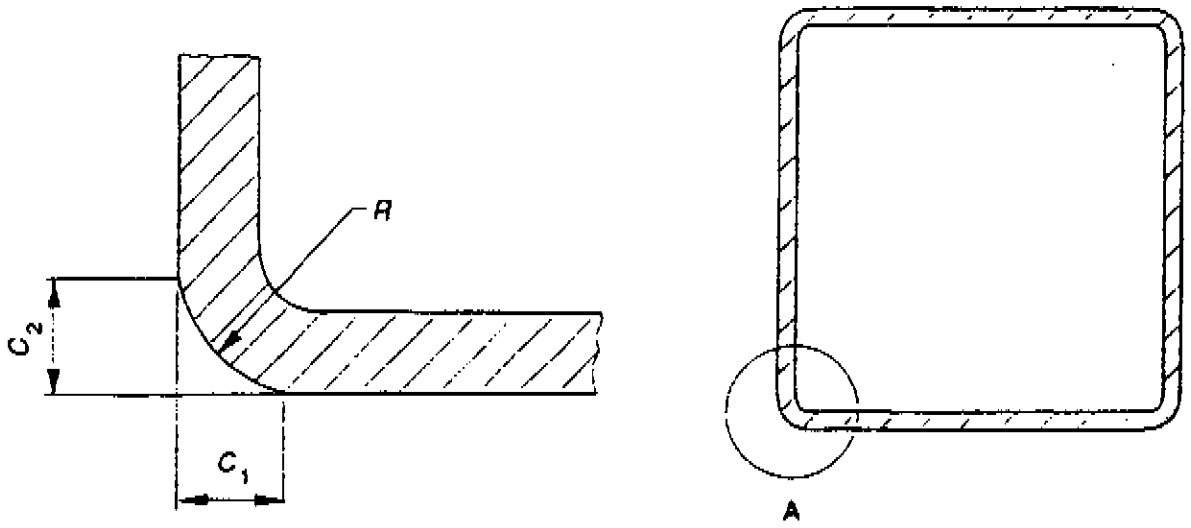


Figure 2: Measurement of concavity/convexity of square or rectangular hollow sections



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

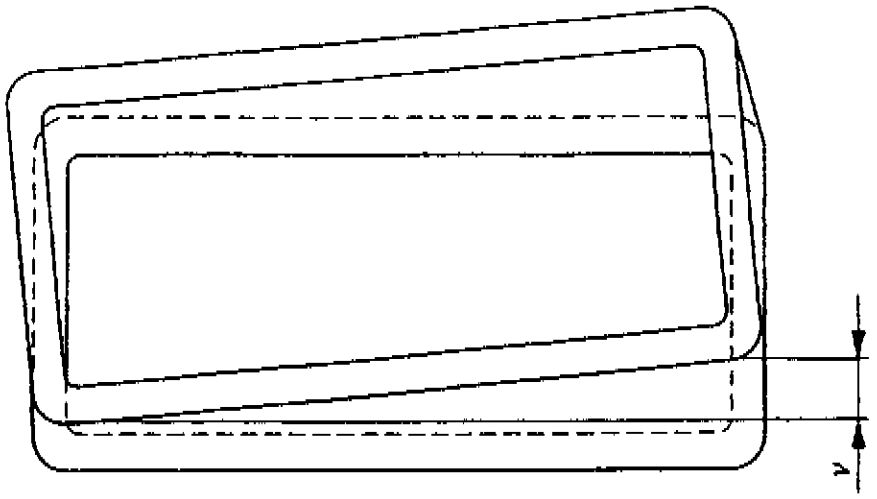


Figure 5: Twist of square or rectangular hollow sections

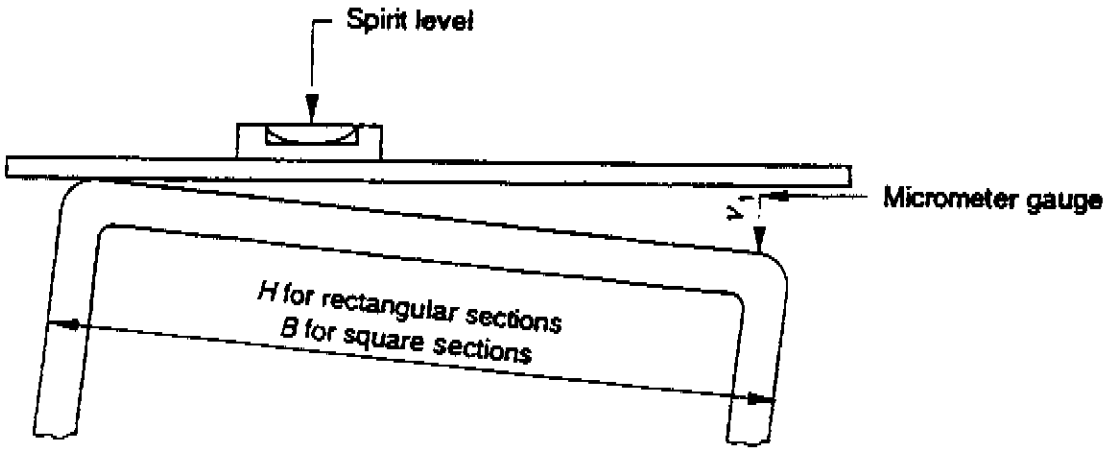


Figure 6: Measurement of twist

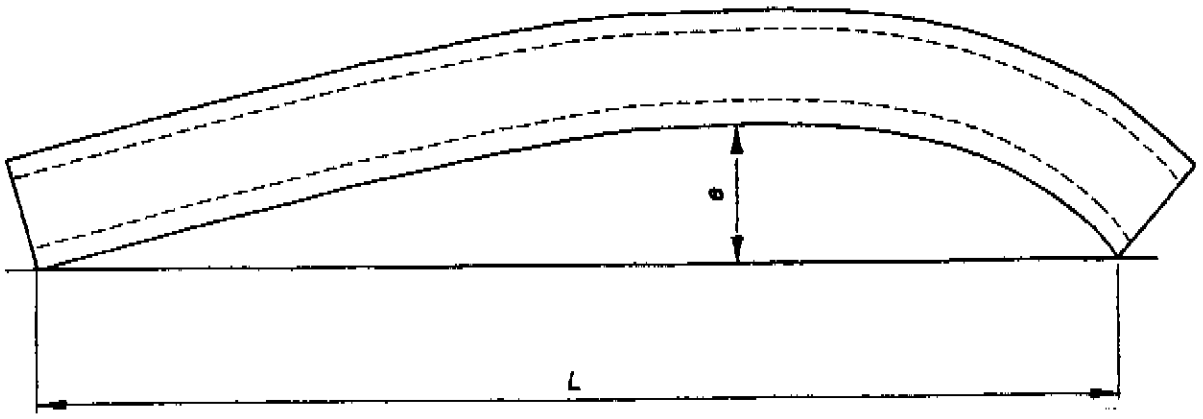


Figure 7: Measurement of deviation from straightness

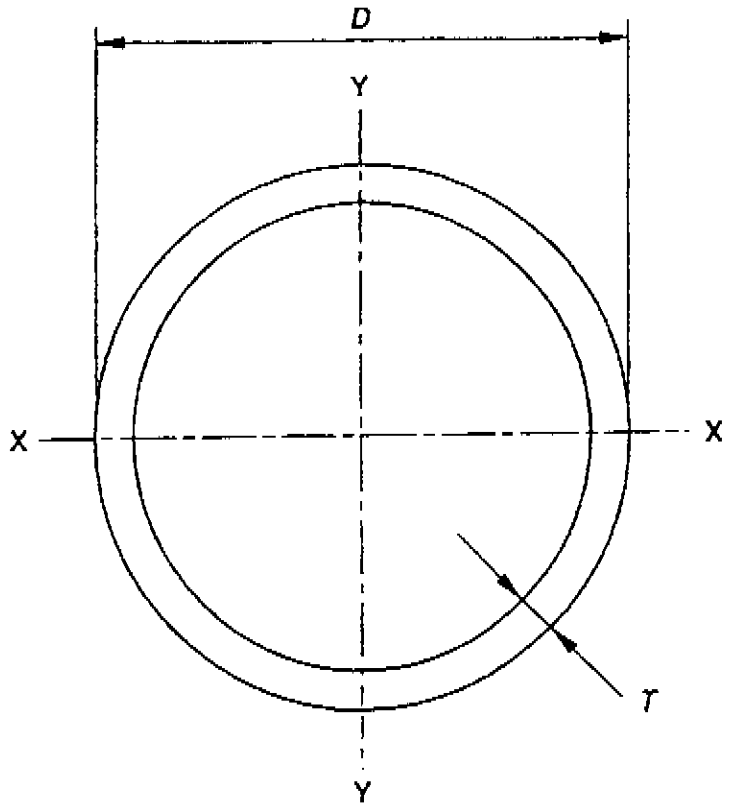


Figure 8: Circular hollow section (see table 5)

Table 5: 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	2,3	1,08	1,37	0,629	0,677	0,590	0,834	1,26	1,18	0,0669	928
21,3	2,6	1,20	1,53	0,681	0,668	0,639	0,915	1,36	1,28	0,0669	834
21,3	3,2	1,43	1,82	0,768	0,650	0,722	1,06	1,54	1,44	0,0669	700
26,9	2,3	1,40	1,78	1,36	0,874	1,01	1,40	2,71	2,07	0,0845	717
26,9	2,6	1,56	1,98	1,48	0,864	1,10	1,54	2,96	2,20	0,0845	642
26,9	3,2	1,87	2,38	1,70	0,846	1,27	1,81	3,41	2,53	0,0845	535
33,7	2,6	1,99	2,54	3,09	1,10	1,84	2,52	6,19	3,67	0,106	501
33,7	3,2	2,41	3,07	3,60	1,08	2,14	2,99	7,21	4,28	0,106	415
33,7	4,0	2,93	3,73	4,19	1,06	2,49	3,55	8,38	4,97	0,106	341
42,4	2,6	2,55	3,25	6,46	1,41	3,05	4,12	12,9	6,10	0,133	392
42,4	3,2	3,09	3,94	7,62	1,39	3,59	4,93	15,2	7,19	0,133	323
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	2,6	2,93	3,73	9,78	1,62	4,05	5,44	19,6	8,10	0,152	341
48,3	3,2	3,56	4,53	11,6	1,60	4,80	6,52	23,2	9,59	0,152	281
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	2,6	3,70	4,71	19,7	2,04	6,52	8,66	39,3	13,0	0,189	270
60,3	3,2	4,51	5,74	23,5	2,02	7,78	10,4	46,9	15,6	0,189	222
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	2,6	4,71	6,00	40,6	2,60	10,7	14,1	81,2	21,3	0,239	212
76,1	3,2	5,75	7,33	48,8	2,58	12,8	17,0	97,6	25,6	0,239	174
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
88,9	3,2	6,76	8,62	79,2	3,03	17,8	23,5	158	35,6	0,279	148
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	3,2	7,77	9,89	120	3,48	23,6	31,0	240	47,2	0,319	129
101,6	4,0	9,63	12,3	146	3,45	28,8	38,1	293	57,6	0,319	104

Table 5: 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
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
101,6	8,0	18,5	23,5	260	3,32	51,1	70,3	519	102	0,319	54,2
101,6	10,0	22,6	28,8	305	3,26	60,1	84,2	611	120	0,319	44,3
114,3	3,2	8,77	11,2	172	3,93	30,2	39,5	345	60,4	0,359	114
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
114,3	10,0	25,7	32,8	450	3,70	78,7	109	899	157	0,359	38,9
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
139,7	12,0	37,8	48,1	990	4,53	142	196	1980	283	0,439	26,5
139,7	12,5	39,2	50,0	1020	4,52	146	203	2040	292	0,439	25,5
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
168,3	12,0	46,3	58,9	1810	5,54	215	294	3620	430	0,529	21,6
168,3	12,5	48,0	61,2	1868	5,53	222	304	3737	444	0,529	20,8
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

Table 5: 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
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	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
193,7	16,0	70,1	89,3	3554	6,31	367	507	7109	734	0,609	14,3
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
219,1	16,0	80,1	102	5297	7,20	483	661	10590	967	0,688	12,5
219,1	20,0	98,2	125	6261	7,07	572	795	12520	1143	0,688	10,2
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	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
244,5	16,0	90,2	115	7533	8,10	616	837	15066	1232	0,768	11,1
244,5	20,0	111	141	8957	7,97	733	1011	17914	1465	0,768	9,03
244,5	25,0	135	172	10517	7,81	860	1210	21034	1721	0,768	7,39

Table 5: 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
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
273,0	16,0	101	129	10707	9,10	784	1058	21414	1569	0,858	9,86
273,0	20,0	125	159	12798	8,97	938	1283	25597	1875	0,858	8,01
273,0	25,0	153	195	15127	8,81	1108	1543	30254	2216	0,858	6,54
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	15145	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
323,9	16,0	121	155	18390	10,9	1136	1518	36780	2271	1,02	8,23
323,9	20,0	150	191	22139	10,8	1367	1850	44278	2734	1,02	6,67
323,9	25,0	184	235	26400	10,6	1630	2239	52800	3260	1,02	5,43
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
355,6	25,0	204	260	35677	11,7	2007	2738	71353	4013	1,12	4,91
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

Table 5: 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	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
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
406,4	30,0	278	355	63224	13,3	3111	4259	126447	6223	1,28	3,59
406,4	40,0	361	460	78186	13,0	3848	5391	156373	7696	1,28	2,77
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	22634	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
457,0	40,0	411	524	114949	14,8	5031	6977	229898	10061	1,44	2,43
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

Table 5: 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
508,0	30,0	354	451	129173	16,9	5086	6864	258346	10171	1,60	2,83
508,0	40,0	462	588	162188	16,6	6385	8782	324376	12771	1,60	2,17
508,0	50,0	565	719	190885	16,3	7515	10330	381770	15030	1,60	1,77
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
610,0	40,0	562	716	292333	20,2	9585	13017	584666	19169	1,92	1,78
610,0	50,0	691	880	347570	19,9	11396	15727	695140	22791	1,92	1,45
711,0	6,0	104	133	82568	24,9	2323	2982	165135	4645	2,23	9,59
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	9057	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
711,0	40,0	662	843	476242	23,8	13396	18031	952485	26793	2,23	1,51
711,0	50,0	815	1038	570317	23,4	16043	21888	1140623	32085	2,23	1,23
711,0	60,0	963	1227	655583	23,1	18441	25500	1311166	36882	2,23	1,04
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

Table 5: 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
762,0	10,0	185	236	167028	26,6	4384	5655	334057	8768	2,39	5,39
762,0	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	260972	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
762,0	40,0	712	907	593011	25,6	15565	20875	1186021	31129	2,39	1,40
762,0	50,0	878	1118	712207	25,2	18693	25389	1424414	37386	2,39	1,14
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	251960	28,3	6196	8011	503721	12392	2,55	4,05
813,0	16,0	314	401	318222	28,2	7828	10165	636443	15657	2,55	3,18
813,0	20,0	391	498	391909	28,0	9641	12580	783819	19287	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
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

Table 5: 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
1016,0	20,0	493	626	776324	35,2	15282	19843	1557648	30564	3,19	2,04
1016,0	25,0	611	778	956086	35,0	18821	24557	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

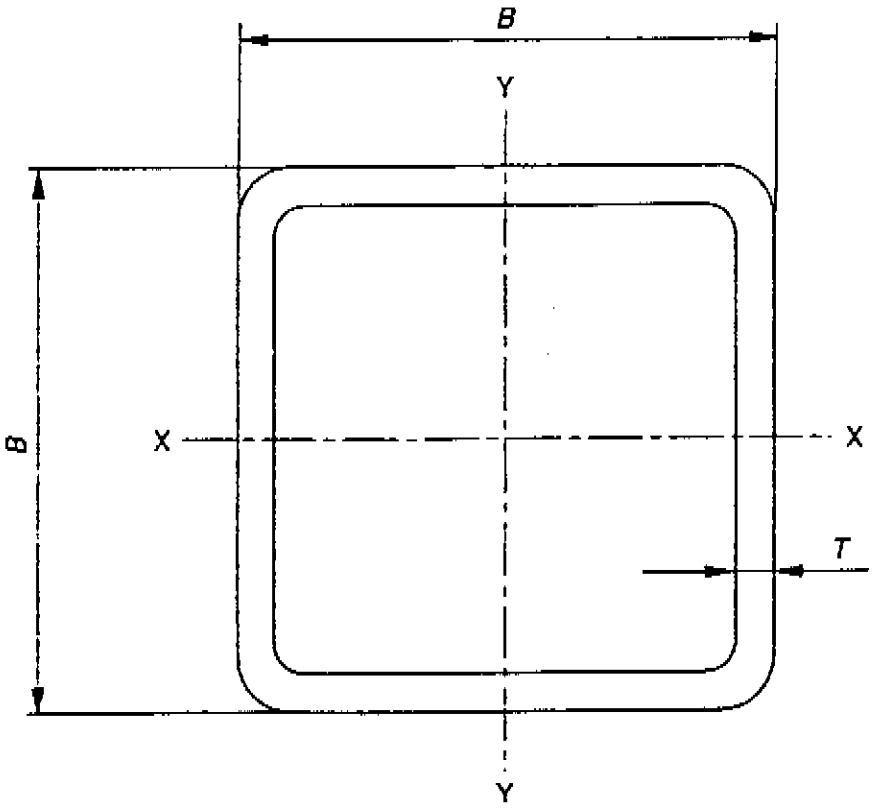


Figure 9: Square hollow section (see table 6)

Table 6: 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	1.10	1.40	0.739	0.727	0,739	0,930	1,22	1,07	0,0748	912
20	2,5	1.32	1.68	0,835	0,705	0,835	1.08	1,41	1,20	0,0736	757
25	2,0	1,41	1,80	1,56	0,932	1.25	1,53	2,52	1,81	0,0948	709
25	2,5	1,71	2,18	1,81	0,909	1,44	1,82	2,97	2,08	0.0936	584
25	3,0	2,00	2,54	2,00	0,886	1,60	2,06	3.35	2,30	0,0923	501
30	2,0	1,72	2,20	2,84	1,14	1,89	2,29	4,53	2,75	0,115	580
30	2,5	2,11	2,68	3,33	1,11	2,22	2,74	5,40	3,22	0,114	475
30	3,0	2,47	3.14	3,74	1,09	2,50	3,14	6,16	3,60	0,112	405
40	2,5	2,89	3,68	8,54	1,52	4,27	5,14	13,6	6,22	0,154	346
40	3,0	3,41	4,34	9,78	1,50	4,89	5,97	15,7	7,10	0,152	293
40	4,0	4,39	5,59	11,8	1,45	5,91	7,44	19,5	8,54	0,150	228
40	5,0	5,28	6,73	13,4	1,41	6,68	8,66	22,5	9,60	0,147	189
50	2,5	3,68	4,68	17,5	1,93	6,99	8,29	27,5	10,2	0,194	272
50	3,0	4,35	5.54	20,2	1,91	8,08	9,70	32,1	11,8	0,192	230
50	4,0	5.64	7.19	25.0	1,86	9,99	12,3	40,4	14,5	0,190	177
50	5,0	6,85	8,73	28,9	1,82	11.6	14.5	47.6	16.7	0,187	146
50	6,0	7,99	10,2	32.0	1,77	12.8	16,5	53,6	18,4	0,185	125
50	6,3	8,31	10,6	32,8	1,76	13.1	17.0	55.2	18,8	0,184	120
60	2,5	4,46	5,68	31.1	2,34	10.4	12.2	48.5	15,2	0,234	224
60	3,0	5,29	6,74	36.2	2,32	12.1	14,3	56,9	17,7	0,232	189
60	4,0	6,90	8.79	45,4	2,27	15,1	18,3	72.5	22.0	0,230	145
60	5.0	8,42	10,7	53.3	2,23	17,8	21,9	86,4	25,7	0,227	119
60	6,0	9,87	12.6	59,9	2,18	20.0	25,1	98,6	28,8	0,225	101
60	6,3	10,3	13,1	61.6	2.17	20.5	26,0	102	29,6	0,224	97,2
60	8,0	12,5	16,0	69,7	2,09	23,2	30,4	118	33,4	0,219	79.9
70	3,0	6,24	7,94	59,0	2,73	16.9	19,9	92.2	24,8	0,272	160
70	4,0	8,15	10,4	74,7	2,68	21.3	25.5	118	31.2	0,270	123
70	5.0	9.99	12.7	88,5	2,64	25,3	30,8	142	36,8	0,267	100
70	6,0	11,8	15,0	101	2.59	28.7	35,5	163	41,6	0,265	85.1
70	6,3	12,3	15,6	104	2,58	29,7	36,9	169	42,9	0,264	81.5

Table 6: 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
70	8,0	15,0	19,2	120	2,50	34,2	43,8	200	49,2	0,259	66,5
80	3,0	7,18	9,14	89,8	3,13	22,5	26,3	140	33,0	0,312	139
80	4,0	9,41	12,0	114	3,09	28,6	34,0	180	41,9	0,310	106
80	5,0	11,6	14,7	137	3,05	34,2	41,1	217	49,8	0,307	86,5
80	6,0	13,6	17,4	156	3,00	39,1	47,8	252	56,8	0,305	73,3
80	6,3	14,2	18,1	162	2,99	40,5	49,7	262	58,7	0,304	70,2
80	8,0	17,5	22,4	189	2,91	47,3	59,5	312	68,3	0,299	57,0
90	4,0	10,7	13,6	166	3,50	37,0	43,6	260	54,2	0,350	93,7
90	5,0	13,1	16,7	200	3,45	44,4	53,0	316	64,8	0,347	76,1
90	6,0	15,5	19,8	230	3,41	51,1	61,8	367	74,3	0,345	64,4
90	6,3	16,2	20,7	238	3,40	53,0	64,3	382	77,0	0,344	61,6
90	8,0	20,1	25,6	281	3,32	62,6	77,6	459	90,5	0,339	49,8
100	4,0	11,9	15,2	232	3,91	46,4	54,4	361	68,2	0,390	83,9
100	5,0	14,7	18,7	279	3,86	55,9	66,4	439	81,8	0,387	68,0
100	6,0	17,4	22,2	323	3,82	64,6	77,6	513	94,3	0,385	57,5
100	6,3	18,2	23,2	336	3,80	67,1	80,9	534	97,8	0,384	54,9
100	8,0	22,6	28,8	400	3,73	79,9	98,2	646	116	0,379	44,3
100	10,0	27,4	34,9	462	3,64	92,4	116	761	133	0,374	36,5
120	5,0	17,8	22,7	498	4,68	83,0	97,6	777	122	0,467	56,0
120	6,0	21,2	27,0	579	4,63	96,6	115	911	141	0,465	47,2
120	6,3	22,2	28,2	603	4,62	100	120	950	147	0,464	45,1
120	8,0	27,6	35,2	726	4,55	121	146	1160	176	0,459	36,2
120	10,0	33,7	42,9	852	4,46	142	175	1382	206	0,454	29,7
120	12,0	39,5	50,3	958	4,36	160	201	1578	230	0,449	25,3
120	12,5	40,9	52,1	982	4,34	164	207	1623	236	0,448	24,5
140	5,0	21,0	26,7	807	5,50	115	135	1253	170	0,547	47,7
140	6,0	24,9	31,8	944	5,45	135	159	1475	198	0,545	40,1
140	6,3	26,1	33,3	984	5,44	141	166	1540	206	0,544	38,3
140	8,0	32,6	41,6	1195	5,36	171	204	1892	249	0,539	30,7

Table 6: 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
140	10,0	40,0	50,9	1416	5,27	202	246	2272	294	0,534	25,0
140	17,0	47,0	59,9	1609	5,18	230	284	2616	333	0,529	21,3
140	12,5	48,7	62,1	1653	5,16	236	293	2696	342	0,528	20,5
150	5,0	22,6	28,7	1002	5,90	134	156	1550	197	0,587	44,3
150	6,0	26,8	34,2	1174	5,86	156	184	1828	230	0,585	37,3
150	6,3	28,1	35,8	1223	5,85	163	192	1909	240	0,584	35,6
150	8,0	35,1	44,8	1491	5,77	199	237	2351	291	0,579	28,5
150	10,0	43,1	54,9	1773	5,68	236	286	2832	344	0,574	23,2
150	12,0	50,8	64,7	2023	5,59	270	331	3272	391	0,569	19,7
150	12,5	52,7	67,1	2080	5,57	277	342	3375	402	0,568	19,0
150	16,0	65,2	83,0	2430	5,41	324	411	4026	467	0,559	15,3
160	5,0	24,1	30,7	1225	6,31	153	178	1892	226	0,627	41,5
160	6,0	28,7	36,6	1437	6,27	180	210	2233	264	0,625	34,8
160	6,3	30,1	38,3	1499	6,26	187	220	2333	275	0,624	33,3
160	8,0	37,6	48,0	1831	6,18	229	272	2880	335	0,619	26,6
160	10,0	46,3	58,9	2186	6,09	273	329	3478	398	0,614	21,6
160	12,0	54,6	69,5	2502	6,00	313	382	4028	454	0,609	18,3
160	12,5	56,6	72,1	2576	5,98	322	395	4158	467	0,608	17,7
160	16,0	70,2	89,4	3078	5,82	379	476	4988	546	0,599	14,2
180	5,0	27,3	34,7	1765	7,13	196	227	2718	290	0,707	36,7
180	6,0	32,5	41,4	2077	7,09	231	269	3215	340	0,705	30,8
180	6,3	34,0	43,3	2168	7,07	241	281	3361	355	0,704	29,4
180	8,0	42,7	54,4	2661	7,00	296	349	4162	434	0,699	23,4
180	10,0	52,5	66,9	3193	6,91	355	424	5048	518	0,694	19,0
180	12,0	62,1	79,1	3677	6,82	409	494	5873	595	0,689	16,1
180	12,5	64,4	82,1	3790	6,80	421	511	6070	613	0,688	15,5
180	16,0	80,2	102	4504	6,64	500	621	7343	724	0,679	12,5
200	5,0	30,4	38,7	2445	7,95	245	283	3756	362	0,787	32,9
200	6,0	36,2	46,2	2883	7,90	288	335	4449	426	0,785	27,6

Table 6: 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	A_s	
mm	mm	kg/m	cm^2	cm^4	cm	cm^3	cm^3	cm^4	cm^3	m^2/m	m
200	6,3	38,0	48,4	3011	7,89	301	350	4653	444	0,784	26,3
200	8,0	47,7	60,8	3709	7,81	371	436	5778	545	0,779	21,0
200	10,0	58,8	74,9	4471	7,72	447	531	7031	655	0,774	17,0
200	12,0	69,6	88,7	5171	7,64	517	621	8208	754	0,769	14,4
200	12,5	72,3	92,1	5336	7,61	534	643	8491	778	0,768	13,8
200	16,0	90,3	115	6394	7,46	639	785	10340	927	0,759	11,1
220	6,0	40,0	51,0	3875	8,72	352	408	5963	521	0,865	25,0
220	6,3	41,9	53,4	4049	8,71	368	427	6240	544	0,864	23,8
220	8,0	52,7	67,2	5002	8,63	455	532	7765	669	0,859	19,0
220	10,0	65,1	82,9	6050	8,54	550	650	9473	807	0,854	15,4
220	12,0	77,2	98,3	7023	8,45	638	762	11091	933	0,849	13,0
220	12,5	80,1	102	7254	8,43	659	789	11481	963	0,848	12,5
220	16,0	100	128	8749	8,27	795	969	14054	1156	0,839	10,0
250	6,0	45,7	58,2	5752	9,94	460	531	8825	681	0,985	21,9
250	6,3	47,9	61,0	6014	9,93	481	556	9238	712	0,984	20,9
250	8,0	60,3	76,8	7455	9,86	596	694	11525	880	0,979	16,6
250	10,0	74,5	94,9	9055	9,77	724	851	14106	1065	0,974	13,4
250	12,0	88,5	113	10556	9,68	844	1000	16567	1237	0,969	11,3
250	12,5	91,9	117	10915	9,66	873	1037	17164	1279	0,968	10,9
250	16,0	115	147	13267	9,50	1061	1280	21138	1546	0,959	8,67
260	6,0	47,6	60,6	6491	10,4	499	576	9951	740	1,02	21,0
260	6,3	49,9	63,5	6788	10,3	522	603	10417	773	1,02	20,1
260	8,0	62,8	80,0	8423	10,3	648	753	13006	956	1,02	15,9
260	10,0	77,7	98,9	10242	10,2	788	924	15932	1159	1,01	12,9
260	12,0	92,2	117	11954	10,1	920	1087	18729	1348	1,01	10,8
260	12,5	95,8	122	12365	10,1	951	1127	19409	1394	1,01	10,4
260	16,0	120	153	15061	9,91	1159	1394	23942	1689	0,999	8,30
300	6,0	55,1	70,2	10080	12,0	672	772	15407	997	1,18	18,2
300	6,3	57,8	73,6	10547	12,0	703	809	16136	1043	1,18	17,3
300	8,0	72,8	92,8	13128	11,9	875	1013	20194	1294	1,18	13,7

Table 6: 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	10,0	90,2	115	16026	11,8	1068	1246	24807	1575	1,17	11,1
300	12,0	107	137	18777	11,7	1252	1470	29249	1840	1,17	9,32
300	12,5	112	142	19442	11,7	1296	1525	30333	1904	1,17	8,97
300	16,0	141	179	23850	11,5	1590	1895	37622	2325	1,16	7,12
350	8,0	85,4	109	21129	13,9	1207	1392	32384	1789	1,38	11,7
350	10,0	106	135	25884	13,9	1479	1715	39886	2185	1,37	9,44
350	12,0	126	161	30435	13,8	1739	2030	47154	2563	1,37	7,93
350	12,5	131	167	31541	13,7	1802	2107	48934	2654	1,37	7,62
350	16,0	166	211	38942	13,6	2225	2630	60990	3264	1,36	6,04
400	10,0	122	155	39128	15,9	1956	2260	60092	2895	1,57	8,27
400	12,0	145	185	46130	15,8	2306	2679	71181	3405	1,57	6,90
400	12,5	151	192	47839	15,8	2392	2782	73906	3530	1,57	6,63
400	16,0	191	243	59344	15,6	2967	3484	92442	4362	1,56	5,24
400	20,0	235	300	71535	15,4	3577	4247	112489	5237	1,55	4,25

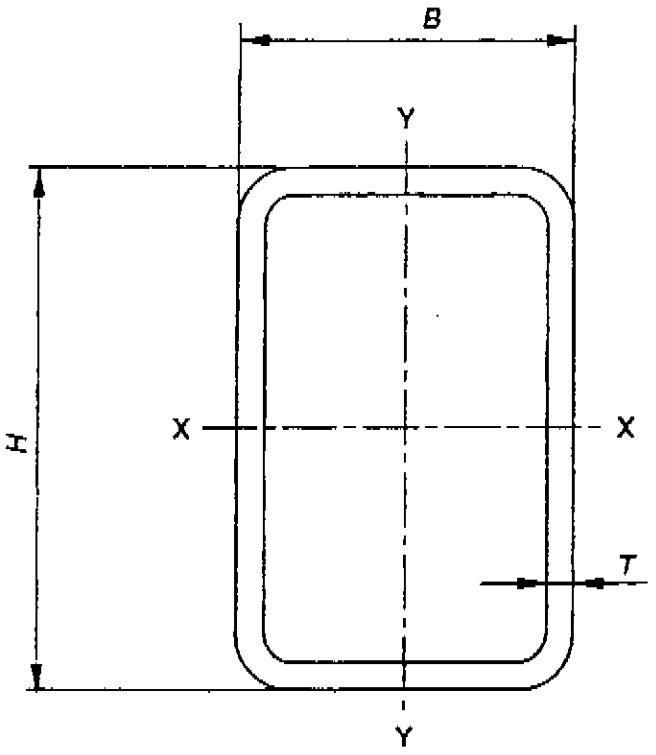


Figure 10: Rectangular hollow section (see table 7)

Table 7: 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	Torsional modulus constant	Superficial area per metre length	Nominal length per tonne
H	B	T	M	A	I_y	I_z	i_y	i_z	$W_{el,y}$	$W_{el,z}$	$W_{pl,y}$	$W_{pl,z}$	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
50	25	2,5	2,69	3,43	10,4	3,39	1,74	0,994	4,16	2,71	5,33	3,22	8,47	4,61	0,144	371
50	25	3,0	3,17	4,04	11,9	3,83	1,72	0,973	4,76	3,06	6,18	3,71	9,64	5,20	0,142	315
50	30	2,5	2,89	3,68	11,8	5,22	1,79	1,19	4,73	3,48	5,92	4,11	11,7	5,73	0,154	346
50	30	3,0	3,41	4,34	13,6	5,94	1,77	1,17	5,43	3,96	6,88	4,76	13,5	6,51	0,152	293
50	30	4,0	4,39	5,59	16,5	7,08	1,72	1,13	6,60	4,72	8,59	5,88	16,6	7,77	0,150	228
50	30	5,0	5,28	6,73	18,7	7,89	1,67	1,08	7,49	5,26	10,0	6,80	19,0	8,67	0,147	189
60	40	2,5	3,68	4,68	22,8	12,1	2,21	1,60	7,61	6,03	9,32	7,02	25,1	9,73	0,194	272
60	40	3,0	4,35	5,54	26,5	13,9	2,18	1,58	8,82	6,95	10,9	8,19	29,2	11,2	0,192	230
60	40	4,0	5,64	7,19	32,8	17,0	2,14	1,54	10,9	8,52	13,8	10,3	36,7	13,7	0,190	177
60	40	5,0	6,85	8,73	38,1	19,5	2,09	1,50	12,7	9,77	16,4	12,2	43,0	15,7	0,187	146
60	40	6,0	7,99	10,2	42,3	21,4	2,04	1,45	14,1	10,7	18,6	13,7	48,2	17,3	0,185	125
60	40	6,3	8,31	10,6	43,4	21,9	2,02	1,44	14,5	11,0	19,2	14,2	49,5	17,6	0,184	120
80	40	3,0	5,29	6,74	54,2	18,0	2,84	1,63	13,6	9,00	17,1	10,4	43,8	15,3	0,232	189
80	40	4,0	6,90	8,79	68,2	22,2	2,79	1,59	17,1	11,1	21,8	13,2	55,2	18,9	0,230	145
80	40	5,0	8,42	10,7	80,3	25,7	2,74	1,55	20,1	12,9	26,1	15,7	65,1	21,9	0,227	119
80	40	6,0	9,87	12,6	90,5	28,5	2,68	1,50	22,6	14,2	30,0	17,8	73,4	24,2	0,225	101
80	40	6,3	10,3	13,1	93,3	29,2	2,67	1,49	23,3	14,6	31,1	18,4	75,6	24,8	0,224	97,2
80	40	8,0	12,5	16,0	106	32,1	2,58	1,42	26,5	16,1	36,5	21,2	85,8	27,4	0,219	79,9
90	50	3,0	6,24	7,94	84,4	33,5	3,26	2,05	18,8	13,4	23,2	15,3	76,5	22,4	0,277	160
90	50	4,0	8,15	10,4	107	41,9	3,21	2,01	23,8	16,8	29,8	19,6	97,5	28,0	0,270	123
90	50	5,0	9,99	12,7	127	49,2	3,16	1,97	28,3	19,7	36,0	23,5	116	32,9	0,267	100
90	50	6,0	11,8	15,0	145	55,4	3,11	1,92	32,2	22,1	41,6	27,0	133	37,0	0,265	85,1
90	50	6,3	12,3	15,6	150	57,0	3,10	1,91	33,3	22,8	43,2	28,0	138	38,1	0,264	81,5
90	50	8,0	15,0	19,2	174	64,6	3,01	1,84	38,6	25,8	51,4	32,9	160	43,2	0,259	66,5
100	50	3,0	6,71	8,54	110	36,8	3,58	2,08	21,9	14,7	27,3	16,8	88,4	25,0	0,292	149
100	50	4,0	8,78	11,2	140	46,2	3,53	2,03	27,9	18,5	35,2	21,5	113	31,4	0,290	114
100	50	5,0	10,8	13,7	167	54,3	3,48	1,99	33,3	21,7	42,6	25,8	135	36,9	0,287	92,8
100	50	6,0	12,7	16,2	190	61,2	3,43	1,95	38,1	24,5	49,4	29,7	154	41,6	0,285	78,8
100	50	6,3	13,3	16,9	197	63,0	3,42	1,93	39,4	25,2	51,3	30,8	160	42,9	0,284	75,4
100	50	8,0	16,3	20,8	230	71,7	3,33	1,86	46,0	28,7	61,4	36,3	186	48,9	0,279	61,4
100	60	3,0	7,18	9,14	124	55,7	3,68	2,47	24,7	18,6	30,2	21,2	121	30,7	0,312	139
100	60	4,0	9,41	12,0	158	70,5	3,63	2,43	31,6	23,5	39,1	27,3	156	38,7	0,310	106
100	60	5,0	11,6	14,7	189	83,6	3,58	2,38	37,8	27,9	47,4	32,9	188	45,9	0,307	86,5
100	60	6,0	13,6	17,4	217	95,0	3,53	2,34	43,4	31,7	55,1	38,1	216	52,1	0,305	73,3
100	60	6,3	14,2	18,1	225	98,1	3,52	2,33	45,0	32,7	57,3	39,5	224	53,8	0,304	70,2
100	60	8,0	17,5	22,4	264	113	3,44	2,25	52,8	37,8	68,7	47,1	265	62,2	0,299	57,0
120	60	4,0	10,7	13,6	249	83,1	4,28	2,47	41,5	27,7	51,9	31,7	201	47,1	0,350	93,7
120	60	5,0	13,1	16,7	299	98,8	4,23	2,43	49,9	32,9	63,1	38,4	242	56,0	0,347	76,1
120	60	6,0	15,5	19,8	345	113	4,18	2,39	57,5	37,5	73,6	44,5	279	63,8	0,345	64,4
120	60	6,3	16,2	20,7	358	116	4,16	2,37	59,7	38,8	76,7	46,3	290	65,9	0,344	61,6
120	60	8,0	20,1	25,6	425	135	4,08	2,30	70,8	45,0	92,7	55,4	344	76,6	0,339	49,9
120	60	10,0	24,3	30,9	488	152	3,97	2,21	81,4	50,5	109	64,4	396	86,1	0,334	41,2

Table 7: 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}	Wel_{yy}	Wel_{zz}	Wpl_{yy}	Wpl_{zz}	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm^2	cm^4	cm^4	cm	cm	cm^3	cm^3	cm^3	cm^3	cm^4	cm^3	m^2/m	m
120	80	4,0	11,9	15,2	303	161	4,46	3,25	50,4	40,2	61,2	46,1	330	65,0	0,390	83,9
120	80	5,0	14,7	18,7	365	193	4,42	3,21	60,9	48,2	74,6	56,1	401	77,9	0,387	68,0
120	80	6,0	17,4	22,2	423	222	4,37	3,17	70,6	55,6	87,3	65,5	468	89,6	0,385	57,5
120	80	6,3	18,2	23,2	440	230	4,36	3,15	73,3	57,6	91,0	68,2	487	92,9	0,384	54,9
120	80	8,0	22,6	28,8	525	273	4,27	3,08	87,5	68,1	111	82,6	587	110	0,379	44,3
120	80	10,0	27,4	34,9	609	313	4,18	2,99	102	78,1	131	97,3	688	126	0,374	36,5
140	80	4,0	13,2	16,8	441	184	5,12	3,31	62,9	46,0	77,1	52,2	411	76,5	0,430	75,9
140	80	5,0	16,3	20,7	534	221	5,08	3,27	76,3	55,3	94,3	63,6	499	91,9	0,427	61,4
140	80	6,0	19,3	24,6	621	255	5,03	3,22	88,7	63,8	111	74,4	583	106	0,425	51,8
140	80	6,3	20,2	25,7	646	265	5,01	3,21	92,3	66,2	115	77,5	607	110	0,424	49,6
140	80	8,0	25,1	32,0	776	314	4,93	3,14	111	78,5	141	94,1	733	130	0,419	39,9
140	80	10,0	30,6	38,9	908	362	4,83	3,05	130	90,5	168	111	862	150	0,414	32,7
150	100	4,0	15,1	19,2	607	324	5,63	4,11	81,0	64,8	97,4	73,6	660	105	0,490	66,4
150	100	5,0	18,6	23,7	739	392	5,58	4,07	98,5	78,5	119	90,1	807	127	0,487	53,7
150	100	6,0	22,1	28,2	862	456	5,53	4,02	115	91,2	141	106	946	147	0,485	45,2
150	100	6,3	23,1	29,5	898	474	5,52	4,01	120	94,8	147	110	986	153	0,484	43,2
150	100	8,0	28,9	36,8	1087	569	5,44	3,94	145	114	180	135	1203	183	0,479	34,7
150	100	10,0	35,3	44,9	1282	665	5,34	3,85	171	133	216	161	1432	214	0,474	28,4
150	100	12,0	41,4	52,7	1450	745	5,25	3,76	193	149	249	185	1633	240	0,469	24,2
150	100	12,5	42,8	54,6	1488	763	5,22	3,74	198	153	256	190	1679	246	0,468	23,3
160	80	4,0	14,4	18,4	617	207	5,77	3,35	76,5	51,7	94,7	58,3	493	88,1	0,470	69,3
160	80	5,0	17,8	22,7	744	249	5,72	3,31	93,0	62,3	116	71,1	600	106	0,467	56,0
160	80	6,0	21,2	27,0	868	288	5,67	3,27	108	72,0	136	83,3	701	122	0,465	47,2
160	80	6,3	22,2	28,2	903	299	5,66	3,26	113	74,8	142	86,8	730	127	0,464	45,1
160	80	8,0	27,6	35,2	1091	356	5,57	3,18	136	89,0	175	106	883	151	0,459	36,2
160	80	10,0	33,7	42,9	1284	411	5,47	3,10	161	103	209	125	1041	175	0,454	29,7
160	80	12,0	39,5	50,3	1449	455	5,37	3,01	181	114	240	142	1175	194	0,499	25,3
160	80	12,5	40,9	52,1	1485	465	5,34	2,99	186	116	247	146	1204	198	0,448	24,5
180	100	4,0	16,9	21,6	945	379	6,61	4,19	105	75,9	128	85,2	852	127	0,550	59,0
180	100	5,0	21,0	26,7	1153	460	6,57	4,15	128	92,0	157	104	1047	154	0,547	47,7
180	100	6,0	24,9	31,8	1350	536	6,52	4,11	150	107	186	123	1224	179	0,545	40,1
180	100	6,3	26,1	33,3	1407	557	6,50	4,09	156	111	194	128	1277	186	0,544	38,3
180	100	8,0	32,6	41,6	1713	671	6,42	4,07	190	134	239	157	1560	224	0,539	30,7
180	100	10,0	40,0	50,9	2036	787	6,32	3,93	226	157	288	188	1862	263	0,534	25,0
180	100	12,0	47,0	59,9	2320	886	6,22	3,85	258	177	333	216	2130	296	0,529	21,3
180	100	12,5	48,7	62,1	2385	908	6,20	3,82	265	182	344	223	2191	303	0,528	20,5

Table 7: 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_y	I_z	i_y	i_z	Wel_y	Wel_z	Wpl_y	Wpl_z	I_t	C_t	A_s	
mm	mm	mm	kg/m	cm²	cm⁴	cm⁴	cm	cm	cm³	cm³	cm³	cm³	cm⁴	cm³	m²/m	m
200	100	4,0	18,2	23,2	1223	416	7,26	4,24	122	83,2	150	92,8	983	142	0,590	54,9
200	100	5,0	22,6	28,7	1495	505	7,21	4,19	140	101	185	114	1204	172	0,587	44,3
200	100	6,0	26,8	34,2	1754	589	7,16	4,15	175	118	218	134	1414	200	0,585	37,3
200	100	6,3	28,1	35,8	1829	613	7,15	4,14	183	123	228	140	1475	208	0,584	35,6
200	100	8,0	35,1	44,8	2234	739	7,06	4,06	223	148	282	172	1804	251	0,579	28,5
200	100	10,0	43,1	54,9	2664	869	6,96	3,98	266	174	341	206	2156	295	0,574	23,2
200	100	12,0	50,8	64,7	3047	979	6,86	3,89	305	196	395	237	2469	333	0,569	19,7
200	100	12,5	52,7	67,1	3136	1004	6,84	3,87	314	201	408	245	2541	341	0,568	19,0
200	100	16,0	65,2	83,0	3678	1167	6,66	3,72	368	229	491	290	2982	391	0,559	15,3
200	120	6,0	28,7	36,6	1980	892	7,36	4,94	198	149	242	169	1942	245	0,625	34,8
200	120	6,3	30,1	38,3	2065	929	7,34	4,92	207	155	253	177	2028	255	0,624	33,3
200	120	8,0	37,6	48,0	2529	1128	7,26	4,85	253	188	313	218	2495	310	0,619	26,6
200	120	10,0	46,3	58,9	3026	1337	7,17	4,76	303	223	379	263	3001	367	0,614	21,6
200	120	12,0	54,6	69,5	3472	1520	7,07	4,68	347	253	440	305	3461	417	0,609	18,3
200	120	12,5	56,6	72,1	3576	1562	7,04	4,66	358	260	455	314	3569	428	0,608	17,7
250	150	6,0	36,2	46,2	3965	1796	9,27	6,24	317	239	385	270	3877	396	0,785	27,6
250	150	6,3	38,0	48,4	4143	1874	9,25	6,22	331	250	402	283	4054	413	0,784	26,3
250	150	8,0	47,7	60,8	5111	2298	9,17	6,15	409	306	501	350	5021	506	0,779	21,0
250	150	10,0	58,8	74,9	6174	2755	9,08	6,06	494	367	611	426	6090	605	0,774	17,0
250	150	12,0	69,6	88,7	7154	3168	8,98	5,98	572	422	715	497	7088	695	0,769	14,4
250	150	12,5	72,3	92,1	7387	3265	8,96	5,96	591	435	740	514	7326	717	0,768	13,8
250	150	16,0	90,3	115	8879	3873	8,79	5,80	710	516	906	625	8868	849	0,759	11,1
260	180	6,0	40,0	51,0	4942	2804	9,85	7,42	380	312	454	353	5554	502	0,865	25,0
260	180	6,3	41,9	53,4	5166	2929	9,83	7,40	397	325	475	369	5810	524	0,864	23,8
260	180	8,0	52,7	67,2	6390	3608	9,75	7,33	492	401	592	459	7221	644	0,859	19,0
260	180	10,0	65,1	82,9	7741	4351	9,66	7,24	595	483	724	560	8798	775	0,854	15,4
260	180	12,0	77,2	98,3	8990	5034	9,57	7,16	692	559	849	656	10285	895	0,849	13,0
260	180	12,5	80,1	102	9290	5196	9,54	7,13	715	577	879	679	10643	924	0,848	12,5
260	180	16,0	100	128	11245	6231	9,38	6,98	865	692	1081	831	12993	1106	0,839	10,0

Table 7: 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_{yy}	I_{zz}	i_{yy}	i_{zz}	Wel_{yy}	Wel_{zz}	Wpl_{yy}	Wpl_{zz}	I_t	C	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
300	200	6,0	45,7	58,2	7486	4013	11,3	8,31	499	401	596	451	8100	651	0,985	21,9
300	200	6,3	47,9	61,0	7829	4193	11,3	8,29	522	419	624	472	8476	681	0,984	20,9
300	200	8,0	60,3	76,8	9717	5184	11,3	8,22	648	518	779	589	10562	840	0,979	16,6
300	200	10,0	74,5	94,9	11819	6278	11,2	8,13	788	628	956	721	12908	1015	0,974	13,4
300	200	12,0	88,5	113	13797	7294	11,1	8,05	920	729	1124	847	15137	1178	0,969	11,3
300	200	12,5	91,9	117	14273	7537	11,0	8,02	952	754	1165	877	15677	1217	0,968	10,9
300	200	16,0	115	147	17390	9109	10,9	7,87	1159	911	1441	1080	19252	1468	0,959	8,67
350	250	6,0	55,1	70,2	12616	7538	13,4	10,4	721	603	852	677	14529	967	1,18	18,2
350	250	6,3	57,8	73,6	13203	7885	13,4	10,4	754	631	892	709	15215	1011	1,18	17,3
350	250	8,0	72,8	92,8	16449	9798	13,3	10,3	940	784	1118	888	19027	1254	1,18	13,7
350	250	10,0	90,2	115	20102	11937	13,2	10,2	1149	955	1375	1091	23354	1525	1,17	11,1
350	250	12,0	107	137	23577	13957	13,1	10,1	1347	1117	1624	1286	27513	1781	1,17	9,32
350	250	12,5	112	142	24419	14444	13,1	10,1	1395	1156	1685	1334	28526	1842	1,17	8,97
350	250	16,0	141	179	30011	17654	12,9	9,93	1715	1412	2095	1655	35325	2246	1,16	7,12
400	200	8,0	72,8	92,8	19562	6660	14,5	8,47	978	666	1203	743	15735	1135	1,18	13,7
400	200	10,0	90,2	115	23914	8084	14,4	8,39	1196	808	1480	911	19259	1376	1,17	11,1
400	200	12,0	107	137	28059	9418	14,3	8,30	1403	942	1748	1072	22622	1602	1,17	9,37
400	200	12,5	112	142	29063	9738	14,3	8,28	1453	974	1813	1111	23438	1656	1,17	8,97
400	200	16,0	141	179	35738	11824	14,1	8,13	1787	1182	2256	1374	28871	2010	1,16	7,12
450	250	8,0	85,4	109	30082	12142	16,6	10,6	1337	971	1622	1081	27083	1629	1,38	11,7
450	250	10,0	106	135	36895	14819	16,5	10,5	1640	1185	2000	1331	33284	1986	1,37	9,44
450	250	12,0	126	161	43434	17359	16,4	10,4	1930	1389	2367	1572	39260	2324	1,37	7,93
450	250	12,5	131	167	45026	17973	16,4	10,4	2001	1438	2458	1631	40719	2406	1,37	7,62
450	250	16,0	166	211	55705	22041	16,2	10,2	2476	1763	3070	2029	50545	2947	1,36	6,04
500	300	10,0	122	155	53762	24439	18,6	12,6	2150	1629	2595	1826	52450	2696	1,57	8,22
500	300	12,0	145	185	63446	28736	18,5	12,5	2538	1916	3077	2161	62039	3167	1,57	6,90
500	300	12,5	151	192	65813	29780	18,5	12,5	2633	1985	3196	2244	64389	3281	1,57	6,63
500	300	16,0	191	243	81783	36768	18,3	12,3	3271	2451	4005	2804	80329	4044	1,56	5,24
500	300	20,0	235	300	98777	44078	18,2	12,1	3951	2939	4885	3408	97447	4842	1,55	4,25

Annex A (normative)

Formulae for calculation of sectional properties

Tables 5, 6 and 7 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 6 and for rectangular hollow sections in table 7 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 for calculation is:	($r_o = 1,5$ T)	[mm]
Nominal internal corner radius for calculation is:	($r_i = 1,0$ 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

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

Second moment of area

Major axis

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

Minor axis

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

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

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

Minor axis

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

Torsional inertia constant

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

Torsional modulus constant

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

where

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

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

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

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

[mm^4]

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

[mm^4]

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

[mm]

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

[mm^2]

$$K = \frac{2A_h T}{h}$$

[mm^2]

$$R_c = \frac{r_o + r_i}{2}$$

[mm]