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May 1974

Hollow Sections for Structural Steel Engineering

Hot Formed Square and Rectangular Steel Tubes

Dimensions, Weights, Permissible Deviations, Static Values

DIN 59 410

Hohlprofile für den Stahlbau; warmgefertigte quadratische und rechteckige Stahlrohre; Masse, Gewichte, zulässige Abweichungen, statische Werte

Dimensions in mm

1 Scope

This Standard applies to seamless or welded hot formed square or rectangular hollow steel sections in the dimensions according to Tables 1 and 2, made of the steels quoted in Section 4, used primarily for structural steel engineering.

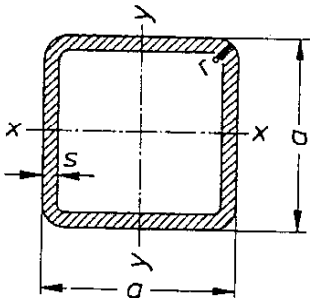

Figure 1.

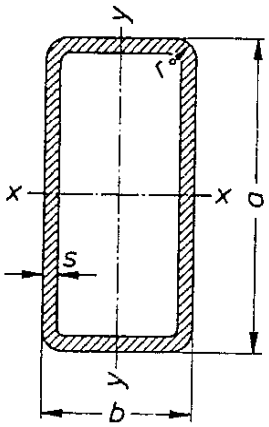

Figure 2.

2 Designation

Designation of a square hollow section with side lengths a = 80 mm and wall thickness s = 4.5 mm made of a steel with the code number RSt 37-2 resp. material number 1.0114:

Hollow section 80 x 80 x 4.5 DIN 59 410 — RSt 37-2
or Hollow section 80 x 80 x 4.5 DIN 59 410 — 1.0114

Designation of a rectangular hollow section with side lengths a = 100 mm and b = 60 mm as well as wall thickness s = 5.6 mm made of a steel with the code number St 52-3 resp. material number 1.0841:

Hollow section 100 x 60 x 5.6 DIN 59 410 — St 52-3
or Hollow section 100 x 60 x 5.6 DIN 59 410 — 1.0841

Continued on pages 2 to 5
Explanations on page 5

3 Dimensions and permissible deviations on dimension and form

3.1 Cross-section

3.1.1 Square and rectangular hollow sections according to this Standard are supplied with the dimensions according to Tables 1 and 2.

Table 1. Dimensions and static values of hot formed square hollow steel sections

Nominal dimension a	Wall thickness s	Cross-section F	Weight G	Surface area U	Static values [1] for bending axis [2] x — x = y — y			for torsion [3]	
					J_x	W_x	i_x	J_t	W_t
		cm²	kg/m	m²/m	cm⁴	cm³	cm	cm⁴	cm³
40	2,9	4,23	3,32	0,155	9,66	4,83	1,51	15,0	7,97
	4,0	5,62	4,41	0,153	12,1	6,05	1,47	19,0	10,3
50	2,9	5,39	4,23	0,195	19,8	7,94	1,92	30,7	12,9
	4,0	7,22	5,67	0,193	25,4	10,1	1,87	39,5	16,9
60	2,9	6,55	5,14	0,235	35,5	11,8	2,33	54,5	18,9
	4,0	8,82	6,93	0,233	45,9	15,3	2,28	71,2	25,1
	5,0	10,8	8,47	0,231	54,1	18,0	2,24	84,5	30,2
70	3,2	8,46	6,64	0,275	62,7	17,9	2,72	96,3	28,5
	4,0	10,4	8,18	0,273	75,3	21,5	2,69	116	34,8
	5,0	12,8	10,0	0,271	89,6	25,6	2,65	139	42,2
80	3,6	10,9	8,55	0,314	106	26,4	3,11	162	42,0
	4,5	13,4	10,5	0,312	127	31,7	3,08	196	51,3
	5,6	16,4	12,9	0,310	151	37,6	3,03	234	61,9
90	3,6	12,3	9,68	0,354	153	34,0	3,52	234	53,7
	4,5	15,2	11,9	0,352	185	41,0	3,48	284	65,8
	5,6	18,6	14,6	0,350	220	49,0	3,44	341	79,7
100	4,0	15,2	12,0	0,393	233	46,6	3,91	357	73,7
	5,0	18,8	14,7	0,391	281	56,3	3,87	433	90,2
	6,3	23,3	18,3	0,389	339	67,8	3,82	525	111
120	4,5	20,5	16,1	0,469	452	75,3	4,70	702	120
	5,6	25,1	19,7	0,467	544	90,6	4,65	852	146
	6,3	28,0	22,0	0,465	598	99,7	4,62	942	163
140	5,6	29,6	23,3	0,547	885	126	5,47	1380	202
	7,1	37,0	29,0	0,543	1080	154	5,40	1690	250
	8,8	45,0	35,3	0,539	1280	182	5,33	2030	302
160	6,3	37,7	29,6	0,618	1460	183	6,23	2330	297
	8,0	47,0	36,9	0,613	1780	222	6,15	2880	368
	10,0	57,4	45,1	0,606	2100	263	6,05	3470	446
180	6,3	42,8	33,6	0,698	2120	236	7,05	3360	379
	8,0	53,4	41,9	0,693	2590	288	6,97	4160	471
	10,0	65,4	51,4	0,686	3090	343	6,87	5040	574
200	6,3	47,8	37,5	0,778	2960	296	7,86	4660	472
	8,0	59,8	46,9	0,773	3620	362	7,78	5780	588
	10,0	73,4	57,6	0,766	4340	434	7,69	7020	718
220	6,3	52,8	41,5	0,858	3980	362	8,68	6250	574
	8,0	66,2	52,0	0,853	4890	445	8,60	7770	717
	10,0	81,4	63,9	0,846	5890	535	8,50	9470	878
260	7,1	70,5	55,4	1,02	7450	573	10,3	11660	907
	8,8	86,4	67,8	1,01	8980	691	10,2	14200	1110
	11,0	106	83,6	1,00	10830	833	10,1	17350	1360
280 [4]	8,0	85,4	67,0	1,09	10430	745	11,0	16350	1180
	10,0	105	82,8	1,09	12650	903	11,0	20060	1450
	12,5	130	102	1,08	15220	1090	10,8	24460	1780
320 [4]	10,0	121	95,3	1,25	19240	1200	12,6	30300	1920
	12,5	150	118	1,24	23270	1450	12,5	37080	2360
	16,0	188	148	1,23	28430	1780	12,3	46030	2940
360 [4]	10,0	137	108	1,41	27790	1540	14,2	43540	2450
	12,5	170	133	1,40	33740	1870	14,1	53430	3010
	16,0	214	168	1,39	41450	2300	13,9	66580	3770
400 [4]	12,5	190	149	1,56	46970	2350	15,7	73980	3750
	16,0	239	188	1,55	57950	2900	15,6	92470	4700
	20,0	294	231	1,53	69400	3470	15,4	112400	5750

[1] The static values were calculated with the following rounding radius r as a function of the side length a: $1.0 \cdot s$ with $a \leq 100$ mm, $1.4 \cdot s$ with $a > 100 \leq 140$ mm, $2.0 \cdot s$ with $a > 140$ mm.

[2] J = moment of inertia, W = section modulus, i = radius of gyration.

[3] J_t = St. Venant twist inertia, W_t = torsional moment of resistance.

[4] Enquiries should be made to the manufacturer as to whether these hollow sections can be supplied.

Table 2. Dimensions and static values of hot formed rectangular hollow steel sections

Nominal dimensions $a \times b$	Wall thickness s	Cross-section F_2	Weight G	Surface area U	Static values [1] for bending axis [2] x – x			y – y			for torsion [3]	
					J_x	W_x	i_x	J_y	W_y	i_y	J_t	W_t
		cm^2	kg/m	m^2/m	cm^4	cm^3	cm	cm^4	cm^3	cm	cm^4	cm^3
50 × 30	2,9	4,23	3,32	0.155	13,4	5,36	1,78	5,88	3,92	1,18	12,9	7,39
	4,0	5,62	4,41	0,153	16,9	6,75	1,73	7,25	4,83	1,14	16,2	9,54
60 × 40	2,9	5,39	4,23	0,195	26,0	8,67	2,20	13,7	6,83	1,59	28,0	12,3
	4,0	7,22	5,67	0,193	33,3	11,1	2,15	17,3	8,65	1,55	35,9	16,1
70 × 40	2,9	5,97	4,69	0,215	38,1	10,9	2,53	15,7	7,83	1,62	34,9	14,4
	4,0	8,02	6,30	0,213	49,2	14,1	2,48	19,9	9,95	1,58	44,9	19,0
80 × 40	2,9	6,55	5,14	0,235	53,1	13,3	2,85	17,7	8,83	1,64	42,0	16,6
	4,0	8,82	6,93	0,233	69,0	17,3	2,80	22,5	11,3	1,60	54,2	21,9
	5,0	10,8	8,47	0,231	81,7	20,4	2,75	26,2	13,1	1,56	63,6	26,2
90 × 50	3,2	8,46	6,64	0,275	89,7	19,9	3,26	35,5	14,2	2,05	79,8	26,0
	4,0	10,4	8,18	0,273	108	24,0	3,22	42,3	16,9	2,02	95,9	31,6
	5,0	12,8	10,0	0,271	129	28,7	3,18	49,9	19,9	1,98	114	38,2
100 × 50	3,6	10,2	7,98	0,294	129	25,8	3,56	42,9	17,2	2,05	102	32,2
	4,5	12,5	9,83	0,292	155	31,0	3,52	50,9	20,4	2,02	122	39,1
	5,6	15,3	12,0	0,290	184	36,8	3,47	59,4	23,8	1,97	144	46,9
100 × 60	3,6	10,9	8,55	0,314	146	29,1	3,66	65,2	21,7	2,45	141	39,1
	4,5	13,4	10,5	0,312	176	35,1	3,62	77,9	26,0	2,41	169	47,7
	5,6	16,4	12,9	0,310	209	41,8	3,57	91,8	30,6	2,37	201	57,4
120 × 60	4,0	13,5	10,6	0,350	247	41,1	4,27	82,7	27,6	2,47	199	51,9
	5,0	16,6	13,0	0,348	296	49,3	4,22	98,2	32,7	2,43	239	63,1
	6,3	20,5	16,1	0,345	354	59,0	4,16	116	38,6	2,38	286	76,6
140 × 80	4,0	16,7	13,1	0,430	438	62,5	5,12	183	45,7	3,31	408	82,6
	5,0	20,6	16,2	0,428	529	75,6	5,07	220	55,0	3,27	496	101
	6,3	25,5	20,0	0,425	639	91,3	5,01	263	65,8	3,21	601	124
160 × 90	4,5	21,2	16,6	0,485	715	89,4	5,81	293	65,1	3,72	672	119
	5,6	25,9	20,4	0,481	858	107	5,75	350	77,7	3,67	814	145
	7,1	32,2	25,3	0,476	1030	129	5,67	418	92,9	3,60	991	179
180 × 100	5,6	29,3	23,0	0.541	1240	137	6,50	496	99,1	4,11	1150	184
	7,1	36,4	28,6	0,536	1500	167	6,41	597	119	4,05	1410	227
	8,8	44,2	34,7	0,530	1760	196	6,32	696	139	3,97	1680	272
200 × 120	6,3	37,7	29,6	0,618	2010	201	7,30	910	152	4,91	2030	277
	8,0	47,0	36,9	0,613	2440	244	7,21	1100	183	4,84	2490	342
	10,0	57,4	45,1	0,606	2890	289	7,10	1290	216	4,75	2990	414
220 × 120	6,3	40,2	31,6	0,658	2540	231	7,95	992	165	4,97	2320	305
	8,0	50,2	39,4	0,653	3100	281	7,85	1200	200	4,89	2850	378
	10,0	61,4	48,2	0,646	3680	335	7,74	1410	236	4,80	3420	458
260 × 140	6,3	47,8	37,5	0,778	4260	328	9,44	1630	233	5,85	3800	426
	8,0	59,8	46,9	0,773	5220	402	9,35	1990	284	5,77	4700	530
	10,0	73,4	57,6	0,766	6260	481	9,23	2370	339	5,68	5690	646
260 × 180	6,3	52,8	41,5	0,858	5070	390	9,80	2880	320	7,39	5820	554
	8,0	66,2	52,0	0,853	6240	480	9,71	3540	393	7,31	7220	692
	10,0	81,4	63,9	0,846	7510	578	9,60	4240	472	7,22	8790	846
280 × 180 [4]	7,1	62,0	48,7	0,896	6730	481	10,4	3410	379	7,42	7210	669
	8,8	75,9	59,6	0,890	8100	578	10,3	4090	454	7,34	8740	815
	11,0	93,2	73,2	0,882	9720	695	10,2	4890	543	7,24	10620	995
280 × 220 [4]	8,0	75,8	59,5	0,973	8650	618	10,7	5970	543	8,88	11180	921
	10,0	93,4	73,3	0,966	10460	747	10,6	7210	656	8,79	13670	1130
	12,5	115	90,1	0,957	12540	896	10,5	8620	784	8,67	16600	1380
320 × 180 [4]	8,8	82,9	65,1	0,970	11230	702	11,6	4600	511	7,45	10550	935
	10,0	93,4	73,3	0,966	12510	782	11,6	5110	568	7,40	11800	1050
	12,5	115	90,0	0,957	14990	937	11,4	6090	677	7,29	14280	1280
320 × 220 [4]	8,8	89,9	70,6	1,05	12930	808	12,0	7270	661	8,99	14810	1150
	10,0	101	79,6	1,05	14430	902	11,9	8090	736	8,93	16610	1300
	12,5	125	97,9	1,04	17360	1080	11,8	9700	882	8,82	20120	1590
360 × 220 [4]	10,0	109	85,9	1,13	19210	1070	13,3	8980	816	9,06	19640	1470
	12,5	135	106	1,12	23170	1290	13,1	10780	980	8,94	23920	1800
	16,0	169	132	1,11	28190	1570	12,9	13030	1180	8,79	29460	2230
400 × 260 [4]	11,0	137	108	1,28	30330	1520	14,9	15610	1200	10,7	32930	2130
	14,2	174	137	1,27	37610	1880	14,7	19280	1480	10,5	41300	2680
	17,5	211	166	1,26	44440	2220	14,5	22680	1740	10,4	49350	3230

[1] to [4] see Table 1

3.1.2 The permissible deviations from the side lengths a and b are ± 1% of the nominal dimension.

3.1.3 The permissible deviations from the wall thickness s (see also Section 7.1) are:

± 10% of the nominal wall thickness in the case of square hollow sections with side lengths up to 100 x 100 as well as rectangular hollow sections with side lengths up to 120 x 60,

± 12.5% of the nominal wall thickness in the case of hollow sections with larger side lengths.

3.1.4 The deviation from rectangularity may not exceed ± 1°.

3.1.5 The values in Table 3 apply for the permissible rounding radius r.

Table 3. Permissible rounding radius r

Nominal dimension a over	up to	Rounding radius r maximum
–	140	$2{,}5 \cdot s$
140	400	$3{,}0 \cdot s$

3.1.6 The camber t of the four side faces of the hollow sections may not exceed the values according to Table 4 (see Section 7.3).

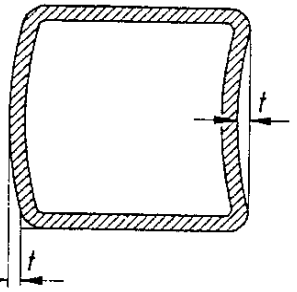

Figure 3.

Table 4. Permissible camber of the side faces

Nominal dimensions a, b over	up to	Camber t maximum
–	100	0,8
100	140	1,0
140	220	1,5
220	400	2,0

3.2 Straightness

The deviation from the straightness q may not exceed $0.002 \cdot l$ (see Section 7.3).

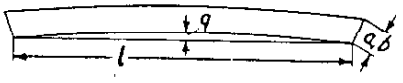

Figure 4.

3.3 Twist

The twist v may not exceed the values according to Table 5 (see Section 7.4).

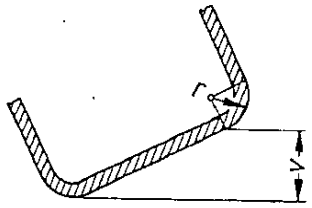

Figure 5.

Table 5. Permissible twist

Length l over	up to	Twist v maximum
–	3000	$0{,}0015 \cdot l$
3000	8000	$0{,}001 \cdot l$
8000	–	$0{,}00075 \cdot l$

4 Material

Hollow sections according to this Standard are manufactured preferably from steel grades according to DIN 17100.

The desired steel grade should be given in the designation.

5 Weight and permissible weight deviations

5.1 The weight given in Tables 1 and 2 is calculated from the cross-section on the basis of a density of 7.85 kg/dm³.

5.2 The permissible weight deviations may not exceed

$^{+\ 10}_{-\ 7{,}5}$ % for the complete quantity supplied (in the case of supply of quantities of at least 10 t),

± 10 % for each length of hollow section.

5.2.1 The weight deviation in this sense is the difference between the weight actually supplied and the weight calculated from the weight data as given in Tables 1 and 2 and (where manufacturing lengths are ordered) the number of metres supplied or (where fixed or exact lengths are ordered) the number of metres ordered.

6 Mode of delivery

6.1 The length data according to Table 6 applies for delivery of hollow sections.

6.2 Where hollow sections are ordered by weight, the length may vary between the maximum and minimum dimensions of the agreed range for manufacturing lengths.

Table 6. Length and permissible deviations

Type of length	Length		Details of order for the length
	Range	Perm. dev.	
Manufacturing length	6000 to 16000 [1]	[1]	None
Fixed length	≧ 2000	± 500	Required fixed length in mm
Exact length	≧ 2000 ≦ 6000	+ 10 0	Required exact length in mm
	> 6000	+ 15 0	

[1] The required range of manufacturing lengths should be agreed when ordering. 90 % of the hollow sections supplied must fall within this length range; 10 % may be shorter but must not be less than 75 % of the agreed lower limit of the length range.

6.3 Example of order

100 t of hollow section with the side lengths a = 100 mm and b = 60 mm as well as wall thickness s = 5.6 mm made of steel with the code number RSt 37-2 resp. material number 1.0114 in manufacturing lengths:

100 t Hollow section 100 x 60 x 5.6 DIN 59 410 — RSt 37-2

or

100 t Hollow section 100 x 60 x 5.6 DIN 59 410 — 1.0114

7 Testing for accuracy to size

7.1 The wall thickness s shall be tested outside the area of the permissible rounding radius r according to Table 3.

7.2 The camber f shall be determined on the basis of the data in Fig. 3.

7.3 The dimension q shall be measured over the total length of the hollow section for testing the straightness.

7.4 The twist v shall be determined according to the data in Fig. 5. It can be measured at any point of the hollow section. For the measurement, the hollow section must be horizontal and, in the case of rectangular sections, must be lying on the longer side.

Explanations

The present first issue of DIN 59 410 is intended to provide standardization of the conditions for producing and using hollow sections for structural steel engineering. The dimension specifications of hot formed products will be followed shortly by a corresponding standard for cold formed hollow steel sections.

The denomination "hollow section" has been and remains a point of contention in the discussions. The manufacturers were in favour of standardizing this definition, which is also in general use in a similar sense abroad and is already contained in international specifications, for example in ISO/R 630 — General structural steels. The hollow sections must comply with the same conditions as apply to other structural steel sections (e.g. channel, beam or angle). Round tubes on the other hand have predominantly to meet other requirements, for example regarding tightness and ability to withstand internal pressure. The issuing of separate standards for the two types of product suggested that different denominations would be desirable. On the other hand, there were objections to a denomination based solely on the intended application but not distinguishable by any feature in the product itself. Nor was there any general agreement with the proposal to designate in principle in the future hollow bodies with non-round cross-section as "hollow sections" and hollow bodies with round cross-section as "tubes", because such a regulation would be contrary to other provisions or customs. Thus, for example, in the non-ferrous metal industry, the definition "hollow section" is applied only to products of non-uniform thickness across the cross-section, whilst hollow bodies of the type described in DIN 59 410 are regarded as tubes (section tubes). Similarly, the manufacturers of precision tubes were not prepared to adopt the denomination hollow sections for products used outside the structural steel industry. Finally, there was agreement on a compromise to use both definitions, i.e. "hollow sections" and "tubes", in the title of the standard but it was clearly understood that, in the long term, preference would have to be given to one particular denomination only. This question will therefore have to be discussed again on the occasion of a later issue of the standard, taking into account any international regulations that have been met by that time.

DIN 59 410 contains 52 square and 60 rectangular hollow sections. On the basis of information from the producers, it is not at the present time possible or reasonable to pick out specially preferred nominal dimensions. The hollow sections listed in Tables 1 and 2 with Footnote 4, having side lengths ≧ 280 mm do not form part of the normal supply range of manufacturers and therefore enquiries should be made with the manufacturers as to the possibilities of supplying them.

The provisions relating to permissible deviations on dimension and form have been brought into line with the data for other sections for structural engineering and also for tubes. An investigation will be made for the next issue as to whether a reduction in the permissible deviations from the wall thickness (Section 3.1.3) is possible and whether an additional specification on the difference between the maximum and minimum wall thickness within the same cross-section can be introduced.