

# HANDOUT 17 PROPERTIES OF TUBING

## MECHANICAL PROPERTIES OF SHELBY SEAMLESS TUBING—ROUND

Size O.D. inches	Thickness		Weight per foot, pounds W	Area of metal square inches A	Moment of Inertia I	Section modulus S=I/y	Radius of gyration $r = \sqrt{I/A}$	Diameter, weight, area, and properties of corresponding solid rounds
	Decimal of inch	B.W.G. or fraction'						
1/4	.028	22	.0664	.0195	.0001	.0009	.0791	D = 1/4" W = .167 A = .0491
	.035	20	.0804	.0236	.0001	.0011	.0770	
	.049	18	.1052	.0309	.0001	.0013	.0731	
	.065	16	.1284	.0377	.0002	.0015	.0693	
5/16	.028	22	.0852	.0250	.0002	.0016	.1010	D = 5/16" W = .261 A = .0767
	.035	20	.1039	.0305	.0002	.0019	.0988	
	.049	18	.1382	.0405	.0003	.0023	.0947	
	.065	16	.1722	.0505	.0004	.0026	.0904	
3/8	.028	22	.1038	.0305	.0004	.0024	.1230	D = 3/8" W = .375 A = .1105
	.035	20	.1271	.0374	.0005	.0029	.1208	
	.049	18	.1706	.0502	.0007	.0036	.1166	
	.065	16	.2152	.0633	.0008	.0042	.1120	
	.072	15	.2330	.0685	.0008	.0044	.1101	
	.083	14	.2588	.0761	.0009	.0047	.1073	
	.095	13	.2841	.0836	.0009	.0049	.1045	
	.109	12	.3097	.0911	.0009	.0050	.1016	
7/16	.028	22	.1226	.0360	.0007	.0034	.1451	D = 7/16" W = .511 A = .1503
	.035	20	.1506	.0443	.0009	.0041	.1428	
	.049	18	.2036	.0598	.0011	.0052	.1384	
	.065	16	.2589	.0761	.0014	.0062	.1337	
	.083	14	.3147	.0924	.0015	.0070	.1287	
	.095	13	.3480	.1022	.0016	.0074	.1257	
	.109	12	.3830	.1125	.0017	.0077	.1224	
	.120	11	.4075	.1197	.0017	.0079	.1200	
1/2	.028	22	.1411	.0415	.0011	.0046	.1671	D = 1/2" W = .667 A = .1963 I = .0031 S = .0123 r = .125
	.035	20	.1738	.0511	.0013	.0055	.1648	
	.049	18	.2360	.0694	.0018	.0071	.1604	
	.065	16	.3020	.0888	.0021	.0086	.1555	
	.072	15	.3291	.0968	.0023	.0091	.1534	
	.083	14	.3696	.1087	.0025	.0098	.1503	
	.095	13	.4109	.1209	.0026	.0105	.1471	
	.109	12	.4552	.1339	.0028	.0110	.1435	
	.120	11	.4870	.1433	.0028	.0114	.1409	
	.134	10	.5238	.1541	.0029	.0117	.1378	
	.156	5/32	.5731	.1687	.0030	.0120	.1335	
	.188	3/16	.6264	.1841	.0031	.0122	.1288	
5/8	.028	22	.1785	.0525	.0023	.0075	.2113	D = 5/8" W = 1.043 A = .3068 I = .0075 S = .0240 r = .1562
	.035	20	.2205	.0649	.0028	.0091	.2090	
	.049	18	.3014	.0887	.0037	.0119	.2044	
	.065	16	.3888	.1144	.0045	.0145	.1993	
	.083	14	.4805	.1413	.0053	.0170	.1939	
	.095	13	.5377	.1582	.0057	.0183	.1904	
	.109	12	.6007	.1767	.0061	.0197	.1865	
	.120	11	.6472	.1904	.0064	.0205	.1835	
	.134	10	.7027	.2067	.0067	.0214	.1799	
	.156	5/32	.7814	.2301	.0070	.0224	.1746	
	.188	3/16	.8774	.2577	.0073	.0233	.1682	
	.219	7/32	.9496	.2793	.0074	.0238	.1631	
3/4	.028	22	.2159	.0635	.0041	.0110	.2554	D = 3/4" W = 1.502 A = .4418 I = .0155 S = .0414 r = .1875
	.035	20	.2673	.0786	.0050	.0134	.2530	
	.049	18	.3668	.1079	.0067	.0178	.2484	
	.065	16	.4755	.1399	.0083	.0221	.2433	
	.083	14	.5913	.1739	.0098	.0262	.2376	
	.095	13	.6646	.1955	.0107	.0285	.2340	
	.109	12	.7462	.2195	.0116	.0309	.2299	
	.120	11	.8074	.2375	.0122	.0326	.2267	
	.134	10	.8816	.2593	.0129	.0344	.2229	
	.156	5/32	.9897	.2915	.0137	.0366	.2170	
	.188	3/16	1.128	.3313	.0145	.0388	.2096	
	.250	1/4	1.335	.3927	.0153	.0409	.1976	

MECHANICAL PROPERTIES—SHELBY AIRCRAFT TUBING—ROUND—Continued  
 STANDARD SIZES AS LISTED IN ARMY-NAVY AERONAUTICAL DESIGN STANDARDS—REVISED OCT. 1, 1942

Outside diameter inches	Thickness		Weight per foot, pounds W	Area of metal square inches A	Moment of Inertia I	Section modulus S=I/y	Radius of gyration r= $\sqrt{I/A}$
	Decimal of inch	B.W.G. or fraction					
1	.035	20	.3607	.1061	.0123	.0247	.3414
	.049	18	.4977	.1464	.0166	.0332	.3367
	.058	17	.5835	.1716	.0191	.0382	.3337
	.065	16	.6491	.1909	.0210	.0419	.3314
	.083	14	.8129	.2391	.0253	.0507	.3255
	.095	13	.9182	.2701	.0280	.0559	.3217
	.120	11	1.128	.3318	.0327	.0654	.3140
	.158	$\frac{5}{32}$	1.406	.4142	.0381	.0762	.3033
	.188	$\frac{3}{16}$	1.630	.4786	.0415	.0831	.2948
	.219	$\frac{7}{32}$	1.827	.5369	.0441	.0883	.2868
	.250	$\frac{1}{4}$	2.003	.5890	.0460	.0920	.2795
$1\frac{1}{16}$	.049	18	.5306	.1560	.0201	.0378	.3588
	.065	16	.6928	.2037	.0254	.0479	.3534
	.095	13	.9821	.2888	.0341	.0642	.3437
	.109	12	1.111	.3265	.0376	.0708	.3393
	.120	11	1.209	.3553	.0401	.0755	.3359
	.156	$\frac{5}{32}$	1.511	.4449	.0470	.0885	.3251
$1\frac{1}{8}$	.028	22	.3280	.0964	.0145	.0258	.3879
	.035	20	.4074	.1199	.0178	.0317	.3856
	.049	18	.5631	.1656	.0240	.0427	.3808
	.058	17	.6609	.1944	.0277	.0493	.3777
	.065	16	.7359	.2165	.0305	.0542	.3755
	.072	15	.8097	.2382	.0332	.0590	.3732
	.083	14	.9237	.2717	.0371	.0660	.3696
	.095	13	1.045	.3074	.0411	.0731	.3657
	.120	11	1.288	.3789	.0485	.0863	.3578
	.156	$\frac{5}{32}$	1.614	.4755	.0572	.1017	.3469
	.188	$\frac{3}{16}$	1.881	.5522	.0630	.1121	.3380
$1\frac{3}{16}$	.219	$\frac{7}{32}$	2.119	.6228	.0676	.1202	.3296
	.250	$\frac{1}{4}$	2.338	.6872	.0711	.1265	.3217
	.028	22	.3469	.1020	.0172	.0289	.4101
	.049	20	.5961	.1753	.0284	.0479	.4029
	.065	16	.7796	.2292	.0362	.0610	.3975
	.083	14	.9795	.2880	.0442	.0744	.3916
$1\frac{1}{4}$	.095	13	1.109	.3261	.0490	.0828	.3877
	.109	12	1.256	.3693	.0542	.0914	.3833
	.120	11	1.369	.4024	.0581	.0978	.3798
	.035	20	.4542	.1336	.0247	.0385	.4297
	.049	18	.6285	.1849	.0334	.0534	.4250
	.058	17	.7384	.2172	.0387	.0619	.4219
	.065	16	.8228	.2420	.0426	.0682	.4196
	.095	13	1.172	.3447	.0579	.0926	.4097
	.109	12	1.328	.3907	.0642	.1027	.4052
	.120	11	1.448	.4260	.0688	.1100	.4018
	.134	10	1.597	.4698	.0742	.1187	.3974
$1\frac{5}{16}$	.156	$\frac{5}{32}$	1.823	.5369	.0819	.1310	.3906
	.188	$\frac{3}{16}$	2.132	.6259	.0910	.1457	.3814
	.219	$\frac{7}{32}$	2.411	.7087	.0984	.1575	.3727
	.250	$\frac{1}{4}$	2.670	.7854	.1043	.1669	.3644
	.065	16	.8864	.2547	.0497	.0757	.4417
	.120	11	1.529	.4496	.0807	.1230	.4238
$1\frac{3}{8}$	.156	$\frac{5}{32}$	1.928	.5676	.0966	.1472	.4125
	.188	$\frac{3}{16}$	2.259	.6627	.1078	.1642	.4032
	.219	$\frac{7}{32}$	2.559	.7517	.1169	.1781	.3944
	.035	20	.5009	.1473	.0331	.0481	.4739
	.049	18	.6939	.2041	.0449	.0653	.4691
	.058	17	.8158	.2400	.0521	.0758	.4661
$1\frac{7}{16}$	.065	16	.9094	.2675	.0575	.0837	.4637
	.083	14	1.145	.3369	.0706	.1027	.4577
	.095	13	1.299	.3820	.0787	.1144	.4538
	.120	11	1.608	.4731	.0940	.1367	.4457
	.156	$\frac{5}{32}$	2.031	.5983	.1129	.1642	.4344
	.188	$\frac{3}{16}$	2.383	.6995	.1263	.1838	.4250
	.219	$\frac{7}{32}$	2.704	.7846	.1375	.2000	.4160
	.250	$\frac{1}{4}$	3.004	.8836	.1467	.2134	.4075
	.049	18	.7269	.2137	.0516	.0718	.4912
	.095	13	1.363	.4007	.0907	.1262	.4758
	.156	$\frac{5}{32}$	2.138	.6289	.1310	.1822	.4564
.250	$\frac{1}{4}$	3.172	.9327	.1717	.2389	.4291	

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 STANDARD SIZES AS LISTED IN ARMY-NAVY AERONAUTICAL DESIGN STANDARDS—REVISED OCT. 1, 1942

Outside diameter inches	Thickness		Weight per foot, pounds W	Area of metal square inches A	Moment of inertia I	Section modulus S=I/y	Radius of gyration $r = \sqrt{I/A}$	
	Decimal of inch	B.W.G. or fraction						
1 1/2	.035	20	.5476	.1611	.0432	.0577	.5181	
	.042	19	.6540	.1924	.0512	.0682	.5157	
	.049	18	.7593	.2234	.0589	.0785	.5133	
	.058	17	.8932	.2628	.0684	.0912	.5102	
	.065	16	.9962	.2930	.0756	.1008	.5079	
	.072	15	1.098	.3230	.0825	.1101	.5055	
	.083	14	1.256	.3695	.0931	.1241	.5018	
	.095	13	1.426	.4193	.1039	.1388	.4979	
	.120	11	1.769	.5202	.1248	.1664	.4897	
	.156	5/32	2.239	.6596	.1508	.2011	.4782	
	.188	3/16	2.634	.7731	.1698	.2265	.4687	
	.219	7/32	2.996	.8805	.1859	.2479	.4595	
	.250	1/4	3.338	.9817	.1994	.2659	.4507	
	1 9/16	.065	18	1.040	.3058	.0859	.1099	.5300
.083		14	1.312	.3858	.1059	.1355	.5239	
.095		13	1.489	.4380	.1184	.1516	.5199	
.156		5/32	2.344	.6903	.1728	.2211	.5003	
.188		3/16	2.761	.8099	.1950	.2496	.4906	
.250		1/4	3.338	1.0799	.2637	.3245	.4941	
1 5/8	.035	20	.5943	.1748	.0553	.0680	.5623	
	.049	18	.8248	.2428	.0754	.0928	.5575	
	.058	17	.9707	.2855	.0878	.1080	.5544	
	.065	16	1.083	.3186	.0971	.1195	.5520	
	.083	14	1.367	.4021	.1199	.1475	.5460	
	.095	13	1.552	.4566	.1341	.1651	.5420	
	.120	11	1.929	.5674	.1617	.1990	.5388	
	.156	5/32	2.447	.7209	.1966	.2419	.5222	
	.188	3/16	2.885	.8467	.2224	.2737	.5125	
	.219	7/32	3.289	.9664	.2446	.3011	.5031	
	.250	1/4	3.671	1.0799	.2637	.3245	.4941	
	1 3/4	.035	20	.6411	.1886	.0694	.0793	.6065
		.049	18	.8902	.2618	.0948	.1083	.6016
		.058	17	1.048	.3083	.1104	.1262	.5986
.065		16	1.170	.3441	.1223	.1398	.5962	
.083		14	1.478	.4347	.1514	.1730	.5901	
.095		13	1.679	.4939	.1697	.1939	.5861	
.109		12	1.910	.5619	.1900	.2171	.5815	
.120		11	2.089	.6145	.2052	.2345	.5779	
.156		5/32	2.656	.7823	.2507	.2866	.5661	
.188		3/16	3.138	.9204	.2849	.3256	.5563	
.219		7/32	3.581	1.0523	.3147	.3596	.5468	
.250		1/4	4.005	1.1781	.3405	.3892	.5376	
1 7/8		.049	18	.9556	.2811	.1172	.1251	.6458
		.058	17	1.126	.3311	.1368	.1459	.6427
	.065	16	1.257	.3696	.1516	.1617	.6403	
	.083	14	1.589	.4673	.1880	.2005	.6342	
	.095	13	1.806	.5312	.2110	.2251	.6302	
	.109	12	2.056	.6047	.2367	.2524	.6256	
	.120	11	2.249	.6616	.2559	.2730	.6219	
	.156	5/32	2.864	.8436	.3141	.3350	.6101	
	.188	3/16	3.387	.9940	.3581	.3820	.6002	
	.219	7/32	3.873	1.1382	.3974	.4238	.5908	
	.250	1/4	4.339	1.2763	.4312	.4600	.5813	
	2	.035	20	.7345	.2161	.1043	.1043	.6948
		.049	18	1.021	.3003	.1430	.1430	.6900
		.058	17	1.203	.3538	.1670	.1670	.6869
.065		16	1.343	.3951	.1851	.1851	.6845	
.072		15	1.483	.4361	.2029	.2029	.6821	
.083		14	1.699	.4999	.2300	.2300	.6784	
.095		13	1.933	.5686	.2588	.2588	.6744	
.109		12	2.201	.6475	.2904	.2904	.6697	
.120		11	2.409	.7087	.3144	.3144	.6660	
.134		10	2.670	.7855	.3437	.3437	.6614	
.156		5/32	3.072	.9050	.3873	.3873	.6542	
.188		3/16	3.638	1.0678	.4431	.4431	.6442	
.219		7/32	4.166	1.2241	.4928	.4928	.6344	
.250		1/4	4.673	1.3744	.5369	.5369	.6250	