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ROYAL CANADIAN AIR FORCE

TABLES AND FORMULAE

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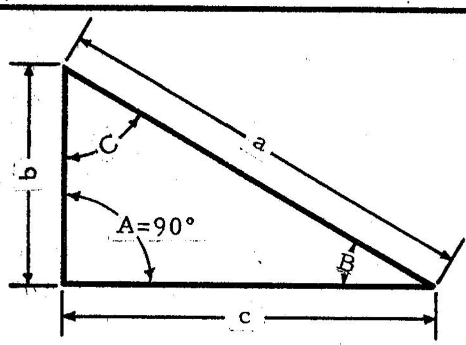
TABLES AND FORMULAE



As shown in the illustration, the sides of the right-angled triangle are designated a, b, and c. The angles opposite each of these sides are designated A, B and C, respectively.

Angle A, opposite the hypotenuse a is the right angle, and is therefore always one of the known quantities.

Sides and Angles Known	Formulae for Sides and Angles to be Found		
Sides a and b	$c=\sqrt{a^2-b^2}$	$\sin B=\frac{b}{a}$	$C=90^{\circ}-B$
Sides a and c	$b=\sqrt{a^2-c^2}$	$\sin C=\frac{c}{a}$	$B=90^{\circ}-C$
Sides b and c	$a=\sqrt{b^2+c^2}$	$\tan B=\frac{b}{c}$	$C=90^{\circ}-B$
Side a; angle B	$b=a \times \sin B$	$c=a \times \cos B$	$C=90^{\circ}-B$
Side a; angle C	$b=a \times \cos C$	$c=a \times \sin C$	$B=90^{\circ}-C$
Side b; angle B	$a=\frac{b}{\sin B}$	$c=b \times \cot B$	$C=90^{\circ}-B$
Side b; angle C	$a=\frac{b}{\cos C}$	$c=b \times \tan C$	$B=90^{\circ}-C$
Side c; angle B	$a=\frac{c}{\cos B}$	$b=c \times \tan B$	$C=90^{\circ}-B$
Side c; angle C	$a=\frac{c}{\sin C}$	$b=c \times \cot C$	$B=90^{\circ}-C$

Figure 1 Solution of Right-Angled Triangles

To Convert	Multiply By
Atmospheres to pounds per square inch	14.696
British Thermal Units to Centigrade Heat Units	0.5556
British Thermal Units to foot-pounds	778.4
British Thermal Units per minute to horsepower	0.023572
British Thermal Units per second to horsepower	1.41503
Centigrade Heat Units to British Thermal Units	1.8
Centigrade to Fahrenheit	$(^{o}C \times 9/5) + 32$
Centimetres to feet	0.0328
Cheval vapeur to kilowatts	0.7355
Cubic inches to Imperial gallons	0.003604
Cubic inches to litres	0.01639
Cubic inches to United States gallons	0.004329
Cubic metres to cubic yards	1.30795
Cubic yards to cubic metres	0.76455
Dynes to poundals	0.00007233
Fahrenheit to Centigrade	$(^{o}F - 32) \times 5/9$
Feet to centimetres	30.48
Feet per minute to miles per hour	0.0114
Feet per second to metres per minute	18.288
Foot-pounds to British Thermal Units	0.001285
Foot-pounds to Centigrade Heat Units	0.0007138
Foot-pounds per second to horsepower	0.0018
Imperial gallons to cubic inches	277.42
United States gallons to litres	3.785332
Grammes per litre to ounces per gallon	0.160354
Horsepower to British Thermal units per minute	42.42
Horsepower to British Thermal Units per second	0.707
Horsepower to kilogrammetres per second	76.04025
Inches of mercury to pounds per square inch	0.49117
Kilogrammes to pounds	2.205
Kilogrammes to tons	0.00098421

Figure 2 (Sheet 1 of 2) Table of Conversion Factors

To Convert	Multiply By
Kilogrammetres per second to cheval vapeur	0.0133
Kilogrammetres per second to horsepower	0.013151
Kilogrammes per square centimetre to millimetres of mercury	735.54
Kilometres (1000 metres) to feet	3280.8
Kilometres per litre to miles per United States gallon	2.3521
Kilowatts to cheval vapeur	1.35962
Litres to cubic inches	61.024
Litres to United States gallons	0.26417
Litres per kilometre to United States gallons per mile	0.4252
Metres per minute to feet per second	0.054664
Metres per second to miles per hour	2.23694
Miles per hour to feet per minute	88.0
Miles per hour to metres per second	0.44704
Millimetres of mercury (gauge) to kilogrammes per square centimetre	0.0013596
Ounces per gallon to grammes per litre	28.349527
Piezes to atmospheres	0.0098692
Pounds per square inch to atmospheres	0.0680
Pounds per square inch to inches of mercury	2.03596
Poundals to pounds weight	32.19
Poundals to dynes	13825.5
Poundals to Newtons	0.13825497
Square metres to square yards	1.19599
Square yards to square metres	0.83613
Ton miles to tonne kilometres	1.583
Tonne kilometres to ton miles	0.631
Tonne kilometres per litre to ton miles per gallon	2.868
Ton miles per gallon to tonne kilometres per litre	0.348
United States gallons to cubic inches	231.0
United States gallons to litres	3.785411
United States tons to tonnes (1000 kilogrammes)	0.907185
Long tons (2240 pounds) to tons	1.12

Figure 2 (Sheet 2 of 2) Table of Conversion Factors

Size	Decimal Equiv.	Size	Decimal Equiv.	Size	Decimal Equiv.	Size	Decimal Equiv.
1/2	.5000	17/64	.2656	22	.1570	50	.0700
31/64	.4844	G	.2610	5/32	.1562	51	.0670
15/32	.4687	F	.2570	23	.1540	52	.0635
29/64	.4531	1/4	.2500	24	.1520	1/16	.0625
7/16	.4375	D	.2460	25	.1495	53	.0595
29/64	.4219	C	.2420	26	.1470	54	.0550
Z	.4130	B	.2380	27	.1440	55	.0520
13/32	.4062	15/64	.2344	9/64	.1406	3/64	.0469
Y	.4040	A	.2340	28	.1405	56	.0465
X	.3970	1	.2280	29	.1360	57	.0430
25/64	.3906	2	.2210	30	.1285	58	.0420
W	.3860	7/32	.2187	1/8	.1250	59	.0410
V	.3770	3	.2130	31	.1200	60	.0400
3/8	.3750	4	.2090	32	.1160	61	.0390
U	.3680	5	.2055	33	.1130	62	.0380
23/64	.3594	6	.2040	34	.1110	63	.0370
T	.3580	13/64	.2031	35	.1100	64	.0360
S	.3480	7	.2010	7/64	.1094	65	.0350
11/32	.3437	8	.1990	36	.1065	66	.0330
R	.3390	9	.1960	37	.1040	67	.0320
Q	.3320	10	.1935	38	.1015	1/32	.0313
21/64	.3281	11	.1910	39	.0995	68	.0310
P	.3230	12	.1890	40	.0980	69	.0292
O	.3160	3/16	.1875	41	.0960	70	.0280
5/16	.3125	13	.1850	3/32	.0937	71	.0260
N	.3020	14	.1820	42	.0935	72	.0250
19/64	.2969	15	.1800	43	.0890	73	.0240
M	.2950	16	.1770	44	.0860	74	.0225
L	.2900	17	.1730	45	.0820	75	.0210
9/32	.2812	11/64	.1719	46	.0810	76	.0200
K	.2810	18	.1695	47	.0785	77	.0180
J	.2770	19	.1660	5/64	.0781	78	.0160
I	.2720	20	.1610	48	.0760	1/64	.0156
H	.2660	21	.1590	49	.0730	79	.0145
Fractional sizes are available in 1/64 increasing up to 1-3/4 dia.						80	.0135

Figure 3 Table of Twist Drill Sizes for Decimal Equivalents

Inch Fraction	Decimal Equiv.	Area Sq.In.	mm Equiv.	Inch Fraction	Decimal Equiv.	Area Sq.In.	mm Equiv.
1/64	.0156	.0002	.397	17/32	.5312	.2217	13.494
1/32	.0312	.0008	.794	35/64	.5469	.2349	13.891
3/64	.0469	.0017	1.191	9/16	.5625	.2485	14.288
1/16	.0625	.0031	1.587	37/64	.5781	.2625	14.684
5/64	.0781	.0048	1.984	19/32	.5937	.2769	15.081
3/32	.0937	.0069	2.381	39/64	.6094	.2916	15.478
7/64	.1049	.0094	2.778	5/8	.6250	.3068	15.875
1/8	.1250	.0123	3.175	41/64	.6406	.3223	16.272
9/64	.1406	.0154	3.572	21/32	.6562	.3382	16.669
5/32	.1562	.0192	3.969	43/64	.6719	.3545	17.065
11/64	.1719	.0232	4.366	11/16	.6875	.3712	17.462
3/16	.1875	.0276	4.762	45/64	.7031	.3883	17.859
13/64	.2031	.0324	5.159	23/32	.7187	.4057	18.256
7/32	.2187	.0376	5.556	47/64	.7344	.4235	18.653
15/64	.2344	.0431	5.953	3/4	.7500	.4418	19.050
1/4	.2500	.0491	6.350	49/64	.7656	.4604	19.447
17/64	.2656	.0553	6.747	25/32	.7812	.4794	19.844
9/32	.2812	.0621	7.144	51/64	.7969	.4987	20.241
19/64	.2969	.0692	7.540	13/16	.8125	.5185	20.637
5/16	.3125	.0767	7.937	53/64	.8281	.5386	21.034
21/64	.3281	.0845	8.334	27/32	.8437	.5591	21.431
11/32	.3437	.0928	8.731	55/64	.8594	.5800	21.828
23/64	.3594	.1014	9.128	7/8	.8750	.6013	22.225
3/8	.3750	.1105	9.525	57/64	.8906	.6229	22.622
25/64	.3906	.1198	9.922	29/32	.9062	.6450	23.019
13/32	.4062	.1296	10.319	59/64	.9219	.6675	23.416
27/64	.4219	.1398	10.716	15/16	.9375	.6903	23.812
7/16	.4375	.1503	11.112	61/64	.9531	.7134	24.209
29/64	.4531	.1612	11.509	31/32	.9687	.7371	24.606
15/32	.4687	.1726	11.906	63/64	.9844	.7610	25.003
31/64	.4844	.1842	12.303	1	1.0000	.7854	25.400
1/2	.5000	.1964	12.700	1-1/8	1.1250	.9940	
33/64	.5156	.2088	13.097		1.1300	1.0030	

Figure 4 Table of Decimal Equivalents and Areas

Screw Thread		Commercial Tap Drills*		Screw Thread		Commercial Tap Drills*	
Outside Diam. Pitch	Root Diam.	Size or Number	Equiv. Decimal	Outside Diam. Pitch	Root Diam.	Size or Number	Equiv. Decimal
1/16-64	0.0422	3/64	0.0469	20	0.3100	21/64	0.3281
72	0.0445	3/64	0.0469	24	0.3209	Q	0.3320
5/64-60	0.0563	1/16	0.0625	27	0.3269	R	0.3390
72	0.0601	52	0.0635	7/16-14	0.3447	U	0.3680
3/32-48	0.0667	49	0.0730	20	0.3726	25/64	0.3906
50	0.0678	49	0.0730	24	0.3834	X	0.3970
7/64-48	0.0823	43	0.0890	27	0.3894	Y	0.4040
1/8-32	0.0844	3/32	0.0937	1/2-12	0.3918	27/64	0.4219
-40	0.0925	38	0.1015	13	0.4001	27/64	0.4219
9/64-40	0.1081	32	0.1160	20	0.4351	29/64	0.4531
5/32-32	0.1157	1/8	0.1250	24	0.4459	29/64	0.4531
36	0.1202	30	0.1285	27	0.4519	15/32	0.4687
11/64-32	0.1313	9/64	0.1406	9/16-12	0.4542	31/64	0.4844
3/16-24	0.1334	26	0.1470	18	0.4903	33/64	0.5156
32	0.1469	22	0.1570	27	0.5144	17/32	0.5312
13/64-24	0.1490	20	0.1610	5/8-11	0.5069	17/32	0.5312
7/32-24	0.1646	16	0.1770	12	0.5168	35/64	0.5469
32	0.1782	12	0.1890	18	0.5528	37/64	0.5781
15/64-24	0.1806	10	0.1935	27	0.5769	19/32	0.5937
1/4-20	0.1850	7	0.2010	11/16-11	0.5694	19/32	0.5937
24	0.1959	4	0.2090	16	0.6063	5/8	0.6250
27	0.2019	3	0.2130	3/4-10	0.6201	21/32	0.6562
28	0.2036	3	0.2130	12	0.6418	43/64	0.6719
32	0.2094	7/32	0.2187	16	0.6688	11/16	0.6875
5/16-18	0.2403	F	0.2570	27	0.7019	23/32	0.7187
20	0.2476	17/64	0.2656	13/16-10	0.6826	23/32	0.7187
24	0.2584	I	0.2720	7/8-9	0.7307	49/64	0.7656
27	0.2644	J	0.2770	12	0.7668	51/64	0.7969
32	0.2719	9/32	0.2812	14	0.7822	13/16	0.8125
3/8-16	0.2938	5/16	0.3125	18	0.8028	53/64	0.8281

*These tap drill diameters allow approximately 75 percent of a full thread.

Figure 5 (Sheet 1 of 2) Table of Tap Drill Dizes for Unified and American Threads

Screw Thread		Commercial Tap Drills*		Screw Thread		Commercial Tap Drills*	
Outside Diam. Pitch	Root Diam.	Size or Number	Equiv. Decimal	Outside Diam. Pitch	Root Diam.	Size or Number	Equiv. Decimal
27	0.8269	27/32	0.8437	12	1.2668	1-19/64	1.2969
15/16- 9	0.7932	53/64	0.8281	1-1/2 - 6	1.2835	1-11/32	1.3437
1 - 8	0.8376	7/8	0.8750	12	1.3918	1-27/64	1.4219
12	0.8918	59/64	0.9219	1-5/8 - 5-1/2	1.3888	1-29/64	1.4531
14	0.9072	15/16	0.9375	1-3/4 - 5	1.4902	1-9/16	1.5625
27	0.9519	31/32	0.9687	1-7/8 - 5	1.6152	1-11/16	1.6875
1-1/8- 7	0.9394	63/64	0.9844	2 - 4-1/2	1.7113	1-25/32	1.7812
12	1.0168	1-3/64	1.0469	2-1/8 - 4-1/2	1.8363	1-29/32	1.9062
1-1/4- 7	1.0644	1-7/64	1.1094	2-1/4 - 4-1/2	1.9613	2-1/32	2.0312
12	1.1418	1-11/64	1.1719	2-3/8 - 4	2.0502	2-1/8	2.1250
1-3/8- 6	1.1585	1-7/32	1.2187	2-1/2 - 4	2.1752	2-1/4	2.2500

*These tap drill diameters allow approximately 75 percent of a full thread.

Figure 5 (Sheet 2 of 2) Table of Tap Drill Sizes for Unified and American Threads

Screw Size	Basic Major Diameter	No. of Threads		Tap Drill Size			
				Coarse		Fine	
		Coarse	Fine	No. or size	Dec.Equiv.	No. or size	Dec.Equiv.
0	0.0600		80			3/64	.047
1	0.0730	64	72	53	.060	53	.060
2	0.0860	56	64	50	.070	50	.070
3	0.0990	48	56	47	.079	45	.082
4	0.1120	40	48	43	.089	42	.094
5	0.1250	40	44	38	.102	37	.104
6	0.1380	32	40	36	.107	33	.113
8	0.1640	32	36	29	.136	29	.136
10	0.1900	24	32	25	.150	21	.159
12	0.2160	24	28	16	.177	14	.182

To find No. or size of screw, measure the diameter and divide by 12. The remainder is the screw number, e.g., 0. 164 diameter screw. Divide by 12. Result 13 and 8 remainder. This is a No. 8 screw. Reason: This is an arithmetical progression with base at .060 inch diameter for a number 0 screw. Other numbers increase by .013.

Figure 6 Table of Tap Drill Sizes for Machine Screws

Designation			External Thread Limits of Size							
				Major Diameter			Pitch Diameter[1]			
				Limits			Limits			
Size	Thds Per In.	Thread Symbol	Allow-ance	Max	Min	Toler-ance	Max	Min	Toler-ance	Min Dia meter Max[2]
1(.073)	64	NC-2A	0.0006	0.0724	0.0686	0.0038	0.0623	0.0603	0.0020	0.0532
2(.086)	56	NC-2A	0.0006	0.0854	0.0813	0.0041	0.0738	0.0717	0.0021	0.0635
3(.099)	48	NC-2A	0.0007	0.0983	0.0938	0.0045	0.0848	0.0825	0.0023	0.0727
4(.112)	40	NC-2A	0.0008	0.1112	0.1061	0.0051	0.0950	0.0925	0.0025	0.0805
5(.125)	40	NC-2A	0.0008	0.1242	0.1191	0.0051	0.1080	0.1054	0.0026	0.0935
6(.138)	32	NC-2A	0.0008	0.1372	0.1312	0.0060	0.1169	0.1141	0.0028	0.0989
8(.164)	32	NC-2A	0.0009	0.1631	0.1571	0.0060	0.1428	0.1399	0.0029	0.1248
10(.190)	24	NC-2A	0.0010	0.1890	0.1818	0.0072	0.1619	0.1586	0.0033	0.1379
1/4	20	UNC-2A	0.0011	0.2489	0.2408	0.0081	0.2164	0.2127	0.0037	0.1876
5/16	18	UNC-2A	0.0012	0.3113	0.3026	0.0087	0.2752	0.2712	0.0040	0.2431
3/8	16	UNC-2A	0.0013	0.3737	0.3643	0.0094	0.3331	0.3287	0.0044	0.2970
7/16	14	UNC-2A	0.0014	0.4361	0.4258	0.0103	0.3897	0.3850	0.0047	0.3485
1/2	13	UNC-2A	0.0015	0.4985	0.4876	0.0109	0.4485	0.4435	0.0050	0.4041
9/16	12	UNC-2A	0.0016	0.5609	0.5495	0.0114	0.5068	0.5016	0.0052	0.4587
5/8	11	UNC-2A	0.0016	0.6234	0.6113	0.0121	0.5644	0.5589	0.0055	0.5119
3/4	10	UNC-2A	0.0018	0.7482	0.7353	0.0129	0.6832	0.6773	0.0059	0.6255
7/8	9	UNC-2A	0.0019	0.8731	0.8592	0.0139	0.8009	0.7946	0.0063	0.7368
1	8	UNC-2A	0.0020	0.9980	0.9830	0.0150	0.9168	0.9100	0.0068	0.8446

[1] British: Effective Diameter.

[2] The minimum minor diameter may be determined by subtracting 0.6495p (=3/4H) from the minimum pitch diameter of the external thread.

Figure 7 Table of Threads - Class 2A, Coarse Thread Series, External Threads, Symbols UNC-2A and NC-2A

Designation			Internal Thread Limits of Size						
			Minor Diameter			Pitch Diameter[1]			Major Diameter Min[2]
			Limits		Tolerance	Limits		Tolerance	
Size	Thds Per In.	Thread Symbol	Min	Max		Min	Max		
1(.073)	64	NC-2B	0.0561	0.0623	0.0062	0.0629	0.0655	0.0026	0.0730
2(.086)	56	NC-2B	0.0667	0.0737	0.0070	0.0744	0.0772	0.0028	0.0860
3(.099)	48	NC-2B	0.0764	0.0845	0.0081	0.0855	0.0885	0.0030	0.0990
4(.112)	40	NC-2B	0.0849	0.0939	0.0090	0.0958	0.0991	0.0033	0.1120
5(.125)	40	NC-2B	0.0979	0.1062	0.0083	0.1088	0.1121	0.0033	0.1250
6(.138)	32	NC-2B	0.1042	0.1140	0.0098	0.1177	0.1214	0.0037	0.1380
8(.164)	32	NC-2B	0.1302	0.1389	0.0087	0.1437	0.1475	0.0038	0.1640
10(.190)	24	NC-2B	0.1449	0.1555	0.0106	0.1629	0.1672	0.0043	0.1900
1/4	20	UNC-2B	0.1959	0.2067	0.0108	0.2175	0.2223	0.0048	0.2500
5/16	18	UNC-2B	0.2524	0.2630	0.0106	0.2764	0.2817	0.0053	0.3125
3/8	16	UNC-2B	0.3073	0.3182	0.0109	0.3344	0.3401	0.0057	0.3750
7/16	14	UNC-2B	0.3602	0.3717	0.0115	0.3911	0.3972	0.0061	0.4375
1/2	13	UNC-2B	0.4167	0.4284	0.0117	0.4500	0.4565	0.0065	0.5000
9/16	12	UNC-2B	0.4723	0.4843	0.0120	0.5084	0.5152	0.0068	0.5625
5/8	11	UNC-2B	0.5266	0.5391	0.0125	0.5660	0.5732	0.0072	0.6250
3/4	10	UNC-2B	0.6417	0.6545	0.0128	0.6850	0.6927	0.0077	0.7500
7/8	9	UNC-2B	0.7547	0.7681	0.0134	0.8028	0.8110	0.0082	0.8750
1	8	UNC-2B	0.8647	0.8797	0.0150	0.9188	0.9276	0.0088	1.0000

[1] British: Effective Diameter.

[2] The maximum major diameter of the internal thread may be determined by adding 0.7039p (=11/12 H) to the maximum pitch diameter of the internal thread.

Figure 8 Table of Threads - Class 2B, Coarse Thread Series, Internal Threads, Symbols UNC-2B and NC-2B

Designation			External Thread Limits of Size						
			Major Diameter			Pitch Diameter[1]			
			Limits			Limits			
Size	Thds Per Inch	Thread Symbol	Max	Min	Toler-ance	Max	Min	Toler-ance	Minor Diameter Max[2]
1(.073)	64	NC-3A	0.0730	0.0692	0.0038	0.0629	0.0614	0.0015	0.0538
2(.086)	56	NC-3A	0.0860	0.0819	0.0041	0.0744	0.0728	0.0016	0.0641
3(.099)	48	NC-3A	0.0990	0.0945	0.0045	0.0855	0.0838	0.0017	0.0734
4(.112)	40	NC-3A	0.1120	0.1069	0.0051	0.0958	0.0939	0.0019	0.0813
5(.125)	40	NC-3A	0.1250	0.1199	0.0051	0.1088	0.1068	0.0019	0.0943
6(.138)	32	NC-3A	0.1380	0.1320	0.0060	0.1177	0.1156	0.0021	0.0997
8(.164)	32	NC-3A	0.1640	0.1580	0.0060	0.1437	0.1415	0.0022	0.1257
10(.190)	24	NC-3A	0.1900	0.1828	0.0072	0.1629	0.1604	0.0025	0.1389
1/4	20	UNC-3A	0.2500	0.2419	0.0081	0.2175	0.2147	0.0028	0.1887
5/16	18	UNC-3A	0.3125	0.3038	0.0087	0.2764	0.2734	0.0030	0.2443
3/8	16	UNC-3A	0.3750	0.3656	0.0094	0.3344	0.3311	0.0033	0.2983
7/16	14	UNC-3A	0.4375	0.4272	0.0103	0.3911	0.3876	0.0035	0.3499
1/2	13	UNC-3A	0.5000	0.4891	0.0109	0.4500	0.4463	0.0037	0.4056
9/16	12	UNC-3A	0.5625	0.5511	0.0114	0.5084	0.5045	0.0039	0.4603
5/8	11	UNC-3A	0.6250	0.6129	0.0121	0.5660	0.5619	0.0041	0.5135
3/4	10	UNC-3A	0.7500	0.7371	0.0129	0.6850	0.6806	0.0044	0.6273
7/8	9	UNC-3A	0.8750	0.8611	0.0139	0.8028	0.7981	0.0047	0.7387
1	8	UNC-3A	1.0000	0.9850	0.0150	0.9188	0.9137	0.0051	0.8466

[1] British: Effective Diameter.

[2] The minimum minor diameter may be determined by subtracting 0.6495p (=3/4H) from the minimum pitch diameter of the external thread.

Figure 9 Table of Threads - Class 3A, Coarse Thread Series, External Threads, Symbols UNC-3A and NC-3A

Designation			Internal Thread Limits of Size						
			Minor Diameter			Pitch Diameter[1]			
			Limits		Toler-ance	Limits		Toler-ance	Major Dia-meter Min[2]
Size	Thds Per Inch	Thread Symbol	Min	Max		Min	Max		
1(.013)	64	NC-3B	0.0561	0.0623	0.0062	0.0629	0.0648	0.0019	0.0730
2(.086)	56	NC-3B	0.0667	0.0737	0.0070	0.0744	0.0765	0.0021	0.0860
3(.099)	48	NC-3B	0.0764	0.0845	0.0081	0.0855	0.0877	0.0022	0.0990
4(.112)	40	NC-3B	0.0849	0.0939	0.0890	0.0958	0.0982	0.0024	0.1120
5(.125)	40	NC-3B	0.0979	0.1062	0.0083	0.1088	0.1113	0.0025	0.1250
6(.138)	32	NC-3B	0.1042	0.1140	0.0098	0.1177	0.1204	0.0027	0.1380
8(.164)	32	NC-3B	0.1302	0.1389	0.0087	0.1437	0.1465	0.0028	0.1640
10(.190)	24	NC-3B	0.1449	0.1555	0.0106	0.1629	0.1661	0.0032	0.1900
1/4	20	UNC-38	0.1959	0.2067	0.0108	0.2175	0.2211	0.0036	0.2500
5/16	18	UNC-3B	0.2524	0.2630	0.0106	0.2764	0.2803	0.0039	0.3125
3/8	16	UNC-3B	0.3073	0.3182	0.0109	0.3344	0.3387	0.0043	0.3750
7/16	14	UNC-3B	0.3602	0.3717	0.0115	0.3911	0.3957	0.0046	0.4375
1/2	13	UNC-3B	0.4167	0.4284	0.0117	0.4500	0.4548	0.0048	0.5000
9/16	12	UNC-3B	0.4723	0.4846	0.0120	0.5084	0.5135	0.0051	0.5625
5/8	11	UNC-3B	0.5266	0.5391	0.0125	0.5660	0.5714	0.0054	0.6250
3/4	10	UNC-3B	0.6417	0.6545	0.0128	0.6850	0.6907	0.0057	0.7500
7/8	9	UNC-3B	0.7547	0.7681	0.0134	0.8028	0.8089	0.0061	0.8750
1	8	UNC-3B	0.8647	0.8797	0.0150	0.9188	0.9254	0.0066	1.0000

[1] British: Effective Diameter.

[2] The maximum major diameter of the internal thread may be determined by adding 0.7930p (=11/12 H) to the maximum pitch diameter of the internal thread.

Figure 10 Table of Threads - Class 3B, Coarse Thread Series, Internal Threads, Symbols UNC-3B and NC-3B

Designation			External Thread Limits of Size							
				Major Diameter			Pitch Diameter[1]			
				Limits			Limits			
Size	Thds Per Inch	Thread Symbol	Allow-ance	Max	Min	Toler-ance	Max	Min	Toler-ance	Minor Dia-meter Max[2]
0 (.060)	80	NF-2A	0.0005	0.0595	0.0563	0.0032	0.0514	0.0496	0.0018	0.0442
1 (.073)	72	NF-2A	0.0006	0.0724	0.0689	0.0035	0.0634	0.0615	0.0019	0.0554
2 (.086)	64	NF-2A	0.0006	0.0854	0.0816	0.0038	0.0753	0.0733	0.0020	0.0662
3 (.099)	56	NF-2A	0.0007	0.0983	0.0942	0.0041	0.0867	0.0845	0.0022	0.0764
4 (.112)	48	NF-2A	0.0007	0.1113	0.1068	0.0045	0.0978	0.0954	0.0024	0.0857
5 (.125)	44	NF-2A	0.0007	0.1243	0.1195	0.0048	0.1095	0.1070	0.0025	0.0964
6 (.138)	40	NF-2A	0.0008	0.1372	0.1321	0.0051	0.1210	0.1184	0.0026	0.1065
8 (.164)	36	NF-2A	0.0008	0.1632	0.1577	0.0055	0.1452	0.1424	0.0028	0.1291
10 (.190)	32	NF-2A	0.0009	0.1891	0.1831	0.0060	0.1688	0.1658	0.0030	0.1508
1/4	28	UNF-2A	0.0010	0.2490	0.2425	0.0065	0.2258	0.2225	0.0033	0.2052
5/16	24	UNF-2A	0.0011	0.3114	0.3042	0.0072	0.2843	0.2806	0.0037	0.2603
3/8	24	UNF-2A	0.0011	0.3739	0.3667	0.0072	0.3468	0.3430	0.0038	0.3228
7/16	20	UNF-2A	0.0013	0.4362	0.4281	0.0081	0.4037	0.3995	0.0042	0.3749
1/2	20	UNF-2A	0.0013	0.4987	0.4906	0.0081	0.4662	0.4619	0.0043	0.4374
9/16	18	UNF-2A	0.0014	0.5611	0.5524	0.0087	0.5250	0.5205	0.0045	0.4929
5/8	18	UNF-2A	0.0014	0.6236	0.6149	0.0087	0.5875	0.5828	0.0047	0.5554
3/4	16	UNF-2A	0.0015	0.7485	0.7391	0.0094	0.7079	0.7029	0.0050	0.6718
7/8	14	UNF-2A	0.0016	0.8734	0.8631	0.0103	0.8270	0.8216	0.0054	0.7858
1	14	NF-2A	0.0017	0.9983	0.9880	0.0103	0.9519	0.9463	0.0056	0.9107
1	12	UNF-2A	0.0018	0.9982	0.9868	0.0114	0.9441	0.9382	0.0059	0.8960
1-1/8	12	UNF-2A	0.0018	1.1232	1.1118	0.0114	1.0691	1.0631	0.0060	1.0210
1-1/4	12	UNF-2A	0.0018	1.2482	1.2368	0.0114	1.1941	1.1879	0.0062	1.1460
1-3/8	12	UNF-2A	0.0019	1.3731	1.3617	0.0114	1.3190	1.3127	0.0063	1.2709
1-1/2	12	UNF-2A	0.0019	1.4981	1.4867	0.0114	1.4440	1.4376	0.0064	1.3959

[1] British: Effective Diameter.

[2] The minimum minor diameter may be determined by subtracting 0.6495p (=3/4 H) from the minimum pitch diameter of the external thread.

Figure 11 Table of Threads - Class 2A, Fine Thread Series, External Threads, Symbols UNF-2A and NF-2A

Designation			Internal Thread Limits of Size						
			Minor Diameter			Pitch Diameter[1]			
			Limits			Limits			
Size	Thds Per Inch	Thread Symbol	Min	Max	Toler-ance	Min	Max	Toler-ance	Major Dia-meter Min[2]
0 (.060)	80	NF-2B	0.0465	0.0514	0.0049	0.0519	0.0542	0.0023	0.0600
1 (.073)	72	NF-2B	0.0580	0.0635	0.0055	0.0640	0.0665	0.0025	0.0730
2 (.086)	64	NF-2B	0.0691	0.0753	0.0062	0.0759	0.0786	0.0027	0.0860
3 (.099)	56	NF-2B	0.0797	0.0865	0.0068	0.0874	0.0902	0.0028	0.0990
4 (.112)	48	NF-2B	0.0894	0.0968	0.0074	0.0985	0.1016	0.0031	0.1120
5 (.125)	44	NF-2B	0.1004	0.1079	0.0075	0.1102	0.1134	0.0032	0 1250
6 (.138)	40	NF-2B	0.1109	0.1186	0.0077	0.1218	0.1252	0.0034	0.1380
8 (.164)	36	NF-2B	0.1339	0.1416	0.0077	0.1460	0.1496	0.0036	0.1640
10 (.190)	32	NF-2B	0.1562	0.1641	0.0079	0.1697	0.1736	0.0039	0.1900
1/4	28	UNF-2B	0.2113	0.2190	0.0077	0.2268	0.2311	0.0043	0.2500
5/16	24	UNF-2B	0.2674	0.2754	0.0080	0.2854	0.2902	0.0048	0.3125
3/8	24	UNF-2B	0.3299	0.3372	0.0073	0.3479	0.3528	0.0049	0.3750
7/16	20	UNF-2B	0.3834	0.3916	0.0082	0.4050	0.4104	0.0054	0.4375
1/2	20	UNF-2B	0.4459	0.4537	0.0078	0.4675	0.4731	0.0056	0.5000
9/16	18	UNF-2B	0.5024	0.5106	0.0082	0.5264	0.5323	0.0059	0.5625
5/8	18	UNF-2B	0.5649	0.5730	0.0081	0.5889	0.5949	0.0060	0.6250
3/4	16	UNF-2B	0.6823	0.6908	0.0085	0.7094	0.7159	0.0065	0.7500
7/8	14	UNF-2B	0.7977	0.8068	0.0091	0.8286	0.8356	0.0070	0.8750
1	14	NF-2B	0.9227	0.9313	0.0088	0.9536	0.9609	0.0073	1.0000
1	12	UNF-2B	0.9098	0.9198	0.0100	0.9459	0.9535	0.0076	1.0000
1-1/8	12	UNF-2B	1.0348	1.0448	0.0100	1.0709	1.0787	0.0078	1.1250
1-1/4	12	UNF-2B	1.1598	1.1698	0.0100	1.1959	1.2039	0.0080	1.2500
1-3/8	12	UNF-2B	1.2848	1.2948	0.0100	1.3209	1.3291	0.0082	1.3750
1-1/2	12	UNF-2B	1.4098	1.4198	0.0100	1.4459	1.4542	0.0083	1.5000

[1] British: Effective Diameter.

[2] The maximum major diameter of the internal thread may be determined by adding 0.7939p (=11/12 H) to the maximum pitch diameter of the internal thread.

Figure 12 Table of Threads - Class 2B, Fine Thread Series, Internal Threads, Symbols UNF-2B and NF-2B

Designation			External Thread Limits of Size						
			Major Diameter			Pitch Diameter[1]			Minor Dia-meter Max[2]
			Limits		Toler-ance	Limits		Toler-ance	
Size	Thds Per Inch	Thread Symbol	Max	Min		Max	Min		
0 (.060)	80	NF-3A	0.0600	0.0568	0.0032	0.0519	0.0506	0.0013	0.0447
1 (.073)	72	NF-3A	0.0730	0.0695	0.0035	0.0640	0.0626	0.0014	0.0560
2 (.086)	64	NF-3A	0.0860	0.0822	0.0038	0.0759	0.0744	0.0015	.0668
3 (.099)	56	NF-3A	0.0990	0.0949	0.0041	0.0874	0.0858	0.0016	0.0771
4 (.112)	48	NF-3A	0.1120	0.1075	0.0045	0.0985	0.0967	0.0018	0.0864
5 (.125)	44	NF-3A	0.1250	0.1202	0.0048	0.1102	0.1083	0.0019	0.0971
6 (.138)	40	NF-3A	0.1380	0.1329	0.0051	0.1218	0.1198	0.0020	0.1073
8 (.164)	36	NF-3A	0.1640	0.1585	0.0055	0.1460	0.1439	0.0021	0.1299
10 (.190)	32	NF-3A	0.1900	0.1840	0.0060	0.1697	0.1674	0.0023	0.1517
1/4	28	UNF-3A	0.2500	0.2435	0.0065	0.2268	0.2243	0.0025	0.2062
5/16	24	UNF-3A	0.3125	0.3053	0.0072	0.2854	0.2827	0.0027	0.2614
3/8	24	UNF-3A	0.3750	0.3678	0.0072	0.3479	0.3450	0.0029	0.3239
7/16	20	UNF-3A	0.4375	0.4294	0.0081	0.4050	0.4019	0.0031	0.3762
1/2	20	UNF-3A	0.5000	0.4919	0.0081	0.4675	0.4643	0.0032	0.4387
9/16	18	UNF-3A	0.5625	0.5538	0.0087	0.5264	0.5230	0.0034	0.4943
5/8	18	UNF-3A	0.6250	0.6163	0.0087	0.5889	0.5854	0.0035	0.5568
3/4	16	UNF-3A	0.7500	0.7406	0.0094	0.7094	0.7056	0.0038	0.6733
7/8	14	UNF-3A	0.8750	0.8647	0.0103	0.8286	0.8245	0.0041	0.7874
1	14	NF-3A	1.0000	0.9897	0.0103	0.9536	0.9494	0.0042	0.9124
1	12	UNF-3A	1.0000	0.9886	0.0114	0.9459	0.9415	0.0044	0.8978
1-1/8	12	UNF-3A	1.1250	1.1136	0.0114	1.0709	1.0664	0.0045	1.0228
1-1/4	12	UNF-3A	1.2500	1.2386	0.0114	1.1959	1.1913	0.0046	1.1478
1-3/8	12	UNF-3A	1.3750	1.3636	0.0114	1.3209	1.3162	0.0047	1.2728
1-1/2	12	UNF-3A	1.5000	1.4886	0.0114	1.4459	1.4411	0.0048	1.3978

[1] British: Effective Diameter.

[2] The minimum minor diameter may be obtained by subtracting 0.6495p (=3/4 H) from the minimum pitch diameter of the external thread.

Figure 13 Table of Threads - Class 3A, Fine Thread Series, External Threads, Symbols UNF-3A and NF-3A

Designation			Internal Thread Limits of Size						
			Minor Diameter			Pitch Diameter[1]			
			Limits			Limits			
Size	Thds Per Inch	Thread Symbol	Min	Max	Toler-ance	Min	Max	Toler-ance	Major Dia-meter Min[2]
0 (.060)	80	NF-3B	0.0465	0.0514	0.0049	0.0519	0.0536	0.0017	0.0600
1 (.073)	72	NF-3B	0.0580	0.0635	0.0055	0.0640	0.0659	0.0019	0.0730
2 (.086)	64	NF-3B	0.0691	0.0753	0.0062	0.0759	0.0779	0.0020	0.0860
3 (.099)	56	NF-3B	0.0797	0.0865	0.0068	0.0874	0.0895	0.0021	0.0990
4 (.112)	48	NF-3B	0.0894	0.0968	0.0074	0.0985	0.1008	0.0023	0.1120
5 (.125)	44	NF-3B	0.1004	0.1079	0.0075	0.1102	0.1126	0.0024	0.1250
6 (.138)	40	NF-3B	0.1109	0.1186	0.0077	0.1218	0.1243	0.0025	0.1380
8 (.164)	36	NF-3B	0.1339	0.1416	0.0077	0.1460	0.1487	0.0027	0.1640
10 (.190)	32	NF-3B	0.1562	0.1641	0.0079	0.1697	0.1726	0.0029	0.1900
1/4	28	UNF-3B	0.2113	0.2190	0.0077	0.2268	0.2300	0.0032	0.2500
5/16	24	UNF-3B	0.2674	0.2754	0.0080	0.2854	0.2890	0.0036	0.3125
3/8	24	UNF-3B	0.3299	0.3372	0.0073	0.3479	0.3516	0.0037	0.3750
7/16	20	UNF-3B	0.3834	0.3916	0.0082	0.4050	0.4091	0.0041	0.4375
1/2	20	UNF-3B	0.4459	0.4537	0.0078	0.4675	0.4717	0.0042	0.5000
9/16	18	UNF-3B	0.5024	0.5106	0.0082	0.5264	0.5308	0.0044	0.5625
5/8	18	UNF-3B	0.5649	0.5730	0.0081	0.5889	0.5934	0.0045	0.6250
3/4	16	UNF-3B	0.6823	0.6908	0.0085	0.7094	0.7143	0.0049	0.7500
7/8	14	UNF-3B	0.7977	0.8068	0.0091	0.8286	0.8339	0.0053	0.8750
1	14	NF-3B	0.9227	0.9315	0.0088	0.9536	0.9590	0.0054	1.0000
1	12	UNF-3B	0.9098	0.9198	0.0100	0.9459	0.9516	0.0057	1.0000
1-1/8	12	UNF-3B	1.0348	1.0448	1.0100	1.0709	1.0768	0.0059	1.1250
1-1/4	12	UNF-3B	1.1598	1.1698	0.0100	1.1959	1.2019	0.0060	1.2500
1-3/8	12	UNF-3B	1.2848	1.2948	0.0100	1.3209	1.3270	0.0061	1.3750
1-1/2	12	UNF-3B	1.4098	1.4198	0.0100	1.4459	1.4522	0.0063	1.5000

[1] British: Effective Diameter.

[2] The maximum major diameter of the internal thread may be determined by adding 0.7939p (=11/12 H) to the maximum pitch diameter of the internal thread.

Figure 14 Table of Threads - Class 3B, Fine Thread Series, Internal Threads, Symbols UNF-3B and NF-3B

Gauge Number	B.& S.G. Brown and Sharpe Gauge	B.W.G. Birmingham Wire & Stubs Iron Wire Gauge	U.S.S.G. United States Standard Gauge	N.W.G. National Wire Gauge	M.W.G. Music Wire Gauge	S.W.G. British Imperial Standard Wire Gauge
	Material Applied To					
	Sheets: Aluminum, Brass, Copper; Wire: Brass, Copper	Tubing: Aluminum, Steel, Brass, Copper; Sheet: Spring Steel	Sheets: Steel, Terneplate	Wire: Steel, Spring Steel	Wire: Piano Wire	Sheets: Aluminum; Wire: All Wire (in England)
000000	.5800		.4688	.4615	.004	.464
00000	.5165	.500(1/2)	.4375	.4305	.005	.432
0000	.4600	.454	.4063	.3938	.006	.400
000	.4096	.425	.3750	.3625	.007	.372
00	.3648	.380	.3438	.3310	.008	.348
0	.3249	.340	.3125	.3065	.009	.324
1	.2893	.300	.2813	.2830	.010	.300
2	.2576	.284	.2656	.2625	.011	.276
3	.2294	.259	.2500	.2437	.012	.252
4	.2043	.238	.2344	.2253	.013	.232
5	.1819	.220	.2188	.2070	.014	.212
6	.1620	.203	.2031	.1920	.016	.192
7	.1443	.180	.1875	.1770	.018	.176
8	.1285	.165	.1719	.1620	.020	.160
9	.1144	.148	.1563	.1483	.022	.144
10	.1019	.134	.1406	.1330	.024	.128
11	.0907	.120	.1250	.1205	.026	.116
12	.0808	.109	.1094	.1055	.029	.104
13	.0720	.095	.0938	.0915	.031	.092
14	.0641	.083	.0781	.0800	.033	.080
15	.0571	.072	.0703	.0720	.035	.072
16	.0508	.065	.0625	.0625	.037	.064
17	.0453	.058	.0563	.0540	.039	.056

Figure 15 (Sheet 1 of 2) Table of Wire and Sheet Metal Gauges

Gauge Number	B.& S.G. Brown and Sharpe Gauge	B.W.G. Birmingham Wire & Stubs Iron Wire Gauge	U.S.S.G. United States Standard Gauge	N.W.G. National Wire Gauge	M.W.G. Music Wire Gauge	S.W.G. British Imperial Standard Wire Gauge
	Material Applied To					
	Sheets: Aluminum, Brass, Copper; Wire: Brass, Copper	Tubing: Aluminum, Steel, Brass, Copper; Sheet: Spring Steel	Sheets: Steel, Terneplate	Wire: Steel, Spring Steel	Wire: Piano Wire	Sheets: Aluminum; Wire: All Wire (in England)
18	.0403	.049	.0500	.0475	.041	.048
19	.0359	.042	.0438	.0410	.043	.040
20	.0320	.035	.0375	.0348	.045	.036
21	.0285	.032	.0344	.0317	.047	.032
22	.0253	.028	.0313	.0286	.049	.028
23	.0226	.025	.0281	.0258	.051	.024
24	.0201	.022	.0250	.0230	.055	.022
25	.0179	.020	.0219	.0204	.059	.020
26	.0159	.018	.0188	.0181	.063	.018
27	.0142	.016	.0172	.0173	.067	.0164
28	.0126	.014	.0156	.0162	.071	.0148
29	.0113	.013	.0141	.0150	.075	.0136
30	.0100	.012	.0125	.0140	.080	.0124
31	.0089	.010	.0109	.0132	.085	.0116
32	.0080	.009	.0102	.0128	.090	.0108
33	.0071	.008	.0094	.0118	.095	.0100
34	.0063	.007	.0086	.0104	.100	.0092
35	.0056	.005	.0078	.0095	.106	.0084
36	.0050	.004	.0070	.0090	.112	.0076
37	.0045		.0066	.0085	.118	.0068
38	.0040		.0063	.0080	.124	.0060
39	.0035			.0075	.130	.0052
40	.0031			.0070	.138	.0048

Figure 15 (Sheet 2 of 2) Table of Wire and Sheet Metal Gauges

Diam., Inches	Threads per Inch	Pitch, Inch	Depth of Thread, Inch	Full or Major Diam., Max.	Effective Diam., Max.	Minor Diam.	Tap Drill Diam., Inch
1/8	40	0.02500	0.01600	0.1250	0.1090	0.0930	0.0980
3/16	24	0.04167	0.02670	0.1875	0.1608	0.1341	0.1405
1/4	20	0.05000	0.03200	0.2500	0.2180	0.1860	0.1960
5/16	18	0.05556	0.03555	0.3125	0.2769	0.2414	1/4
3/8	16	0.06250	0.04000	0.3750	0.3350	0.2950	5/16
7/16	14	0.07143	0.04575	0.4375	0.3918	0.3460	23/64
1/2	12	0.08333	0.05335	0.5000	0.4466	0.3933	13/32
9/16	12	0.08333	0.05335	0.5625	0.5091	0.4558	15/32
5/8	11	0.09091	0.05820	0.6250	0.5668	0.5086	17/32
11/16*	11	0.09091	0.05820	0.6875	0.6293	0.5711	37/64
3/4	10	0.10000	0.06405	0.7500	0.6860	0.6219	41/64
13/16*	10	0.10000	0.06405	0.8125	0.7485	0.6844	45/64
7/8	9	0.11111	0.07115	0.8750	0.8039	0.7327	3/4
15/6*	9	0.11111	0.07115	0.9375	0.8664	0.7952	13/16
1	8	0.12500	0.08005	1.0000	0.9200	0.8399	55/64
1-1/8	7	0.14286	0.09150	1.1250	1.0335	0.9420	31/32
1-1/4	7	0.14286	0.09150	1.2500	1.1585	1.0670	1-3/32
1-3/8*	6	0.16667	0.10670	1.3750	1.2683	1.1616	1-3/16
1-1/2	6	0.16667	0.10670	1.5000	1.3933	1.2866	1-5/16
1-5/8*	5	0.20000	0.12806	1.6250	1.4969	1.3689	1-13/32
1-3/4	5	0.20000	0.12806	1.7500	1.6219	1.4939	1-33/64

*Sizes marked (*) not recommended for general use by British Standards Institution.

Tap drill diam. = major diam. - 1.1328 X pitch (to yield about 88% full thread form).

Figure 16 (Sheet 1 of 3) Table of British Standard Whitworth Threads

Diam., Inches	Threads per Inch	Pitch, Inch	Depth of Thread, Inch	Full or Major Diam., Max.	Effective Diam., Max.	Minor Diam.	Tap Drill Diam., Inch
1-7/8*	4-1/2	0.22222	0.14228	1.8750	1.7327	1.5904	1-5/8
2	4-1/2	0.22222	0.14228	2.0000	1.8577	1.7154	1-3/4
2-1/8*	4-1/2	0.22222	0.14228	2.1250	1.9827	1.8404	1-7/8
2-1/4	4	0.25000	0.16008	2.2500	2.0899	1.9298	1-31/32
2-3/8*	4	0.25000	0.16008	2.3750	2.2149	2.0548	2-3/32
2-1/2	4	0.25000	0.16008	2.5000	2.3399	2.1798	2-7/32
2-5/8*	4	0.25000	0.16008	2.6250	2.4649	2.3048	2-23/64
2-3/4	3-1/2	0.28571	0.18295	2.7500	2.5670	2.3841	2-7/16
2-7/8*	3-1/2	0.28571	0.18295	2.8750	2.6920	2.5091	2-9/16
3	3-1/2	0.28571	0.18295	3.0000	2.8170	2.6341	2-11/16
3-1/8*	3-1/2	0.28571	0.18295	3.1250	2.9420	2.7591	2-13/16
3-1/4	3-1/4	0.30769	0.19700	3.2500	3.0530	2.8560	
3-3/8*	3-1/4	0.30769	0.19700	3.3750	3.1780	2.9810	
3-1/2	3-1/4	0.30769	0.19700	3.5000	3.3030	3.1060	
3-5/8*	3-1/4	0.30769	0.19700	3.6250	3.4280	3.2310	
3-3/4	3	0.33333	0.21345	3.7500	3.5366	3.3231	
3-7/8*	3	0.33333	0.21345	3.8750	3.6616	3.4481	
4	3	0.33333	0.21345	4.0000	3.7866	3.5731	
4-1/8*	3	0.33333	0.21345	4.1250	3.9116	3.6981	
4-1/4*	2-7/8	0.34783	0.22270	4.2500	4.0273	3.8046	
4-3/8*	2-7/8	0.34783	0.22270	4.3750	4.1523	3.9296	

*Sizes marked (*) not recommended for general use by British Standards Institution.

Tap drill diam. = major diam. - 1.1328 X pitch (to yield about 88% full thread form).

Figure 16 (Sheet 2 of 3) Table of British Standard Whitworth Threads

Diameter, Inch	Threads per Inch	Pitch, Inch	Depth of Thread, Inch	Full or Major Diam., Max.	Effective Diam., Max.	Minor Diam.
4-1/2	2-7/8	0.34783	0.22270	4.5000	4.2773	4.0546
4-5/8*	2-7/8	0.34783	0.22270	4.6250	4.4023	4.1796
4-3/4*	2-3/4	0.36364	0.23285	4.7500	4.5172	4.2843
4-7/8*	2-3/4	0.36364	0.23285	4.8750	4.6422	4.4093
5	2-3/4	0.36364	0.23285	5.0000	4.7672	4.5343
5-1/4*	2-5/8	0.38095	0.24395	5.2500	5.0061	4.7621
5-1/2	2-5/8	0.38095	0.24395	5.5000	5.2561	5.0121
6	2-1/2	0.40000	0.25615	6.0000	5.7439	5.4877

*Sizes marked (*) not recommended for general use by British Standards Institution.

Tap drill diam. = major diam. - 1.1328 X pitch (to yield about 88% full thread form).

Figure 16 (Sheet 3 of 3) Table of British Standard Withworth Threads

British Association Number	Diameter		Pitch		Depth of Thread	Radius	Threads per Inch Approx.
	Millimetres	Inches	Millimetres	Inches	Inches	Inches	
0	6.0	0.2362	1.00	0.0394	0.0236	0.0072	25.4
1	5.3	0.2087	0.90	0.0354	0.0212	0.0064	28.2
2	4.7	0.1850	0.81	0.0319	0.0191	0.0058	31.4
3	4.1	0.1614	0.73	0.0287	0.0172	0.0052	34.8
4	3.6	0.1417	0.66	0.0260	0.0156	0.0047	38.5
5	3.2	0.1260	0.59	0.0232	0.0139	0.0042	43.0
6	2.8	0.1102	0.53	0.0209	0.0125	0.0038	47.9
7	2.5	0.0984	0.48	0.0189	0.0113	0.0034	52.9
8	2.2	0.0866	0.43	0.0169	0.0101	0.0031	59.1
9	1.9	0.0748	0.39	0.0154	0.0092	0.0028	65.1
10	1.7	0.0669	0.35	0.0138	0.0083	0.0025	72.6

Figure 17 Table of British Association Standard Threads

Diam., Inches	Threads per Inch	Pitch Inch	Depth of Thread, Inch	Major Diam.	Effective or Pitch Diam.	Minor Diam.	Tap Drill Size, Inch
3/16	32	0.03125	0.0200	0.1875	0.1675	0.1475	No.25
7/32	28	0.03571	0.0229	0.2188	0.1959	0.1730	No.16
1/4	26	0.03846	0.0246	0.2500	0.2254	0.2008	No.5
9/32	26	0.03846	0.0246	0.2812	0.2566	0.2320	B
5/16	22	0.04545	0.0291	0.3125	0.2834	0.2543	G
3/8	20	0.05000	0.0320	0.3750	0.3430	0.3110	O
7/16	18	0.05556	0.0356	0.4375	0.4019	0.3663	3/8
1/2	16	0.06250	0.0400	0.5000	0.4600	0.4200	27/64
9/16	16	0.06250	0.0400	0.5625	0.5225	0.4825	1/2
5/8	14	0.07143	0.0457	0.6250	0.5793	0.5336	35/64
11/16	14	0.07143	0.0457	0.6875	0.6418	0.5961	39/64
3/4	12	0.08333	0.0534	0.7500	0.6966	0.6432	21/32
13/16	12	0.08333	0.0534	0.8125	0.7591	0.7057	23/32
7/8	11	0.09091	0.0582	0.8750	0.8168	0.7586	25/32
1	10	0.10000	0.0640	1.0000	0.9360	0.8720	57/64
1-1/8	9	0.11111	0.0711	1.1250	1.0539	0.9828	1
1-1/4	9	0.11111	0.0711	1.2500	1.1789	1.1078	1-1/8
1-3/8	8	0.12500	0.0800	1.3750	1.2950	1.2150	1-15/16
1-1/2	8	0.12500	0.0800	1.5000	1.4200	1.3400	1-23/64
1-5/8	8	0.12500	0.0800	1.6250	1.5450	1.4650	1-31/64
1-3/4	7	0.14286	0.0915	1.7500	1.6585	1.5670	1-19/32
2	7	0.14286	0.0915	2.0000	1.9085	1.8170	1-27/32
2-1/4	6	0.16667	0.1067	2.2500	2.1433	2.0366	2-1/16
2-1/2	6	0.16667	0.1067	2.5000	2.3933	2.2866	2-5/16
2-3/4	6	0.16667	0.1067	2.7500	2.6433	2.5366	2-9/16
3	5	0.20000	0.1281	3.0000	2.8719	2.7438	2-3/4
3-1/4	5	0.20000	0.1281	3.2500	3.1219	2.9938	
3-1/2	4-1/2	0.22222	0.1423	3.5000	3.3577	3.2154	
3-3/4	4-1/2	0.22222	0.1423	3.7500	3.6077	3.4654	
4	4-1/2	0.22222	0.1423	4.0000	3.8577	3.7154	
4-1/4	4	0.25000	0.1601	4.2500	4.0899	3.9298	

Figure 18 Table of British Standard Fine Threads

Shore Scleroscope	Rockwell(1) C 150 Kg Load	Rockwell(1) B 100 Kg Load 1/16 Ball	Vickers Diamond Pyramid 50 Kg Load (2)	Brinell (3) 3000 Kg Load - 10 mm Ball Tungsten Carbide Ball	Brinell (3) 3000 Kg Load - 10 mm Ball Steel Ball	Tensile Strength 1000 lb. per sq.in.
	67		918	820	717	
	66		884	796	701	
	65		852	774	686	
	64		822	753	671	
84	63		793	732	656	
82	62		765	711	642	
81	61		740	693	628	
80	60		717	675	613	
78	59		694	657	600	
77	58		672	639	584	
76	57		650	621	574	
74	56	121.3	630	604	561	
73	55	120.8	611	588	548	
71	54	120.2	592	571	536	
70	53	119.6	573	554	524	283
69	52	119.1	556	538	512	273
67	51	118.5	539	523	500	264
66	50	117.9	523	508	488	256
65	49	117.4	508	494	476	246
63	48	116.8	493	479	464	237
62	47	116.2	479	465	453	231
61	46	115.6	465	452	442	221
59	45	115.0	452	440	430	215
58	44	114.4	440	427	419	208
57	43	113.8	428	415	408	201
56	42	113.3	417	405	398	194
54	41	112.7	406	394	387	188
53	40	112.1	396	385	377	181
52	39	111.5	386	375	367	176
51	38	110.9	376	365	357	170
50	37	110.4	367	356	347	165
48	36	109.7	357	346	337	160
47	35	109.1	348	337	327	155
46	34	108.5	339	329	318	150
45	33	107.8	330	319	309	147
44	32	107.1	321	310	301	142
43	31	106.4	312	302	294	139
42	30	105.7	304	293	286	136
41	29	105.0	296	286	279	132
40	28	104.3	288	278	272	129
39	27	103.7	281	271	265	126
38	26	102.9	274	264	259	123
37	25	102.2	267	258	253	120
36	24	101.5	261	252	247	118
36	23	100.8	255	246	241	115
35	22	100.2	250	241	235	112
34	21	99.5	245	236	230	110
33	20	98.9	240	231	225	107
32	19	98.1	235	226	220	104
32	18	97.5	231	222	215	103

Figure 19 (Sheet 1 of 2) Table of Hardness and Tensile Strength Co-ordination

Shore Scleroscope	Rockwell (1) C 150 Kg Load	Rockwell (1) B 100 Kg Load 1/16 Ball	Vickers Diamond Pyramid 50 Kg Load (2)	Brinell (3) 3000 Kg Load - 10 mm Ball Tungsten Carbide Ball	Brinell (3) 3000 Kg Load - 10 mm Ball Steel Ball	Tensile Strength 1000 lb. per sq.in.
32	17	96.9	227	218	210	102
31	16	96.2	223	214	206	100
30	15	95.5	219	210	201	99
30	14	94.9	215	206	197	97
30	13	94.1	211	202	193	95
29	12	93.4	207	199	190	93
29	11	92.6	203	195	186	91
29	10	91.8	199	191	183	90
29	9	91.2	196	187	180	89
28	8	90.3	192	184	177	88
27	7	89.7	189	180	174	87
26	6	89	186	177	171	85
26	5	88.3	183	174	168	84
26	4	87.5	179	171	165	83
26	3	87	177	169	162	82
25	2	86	173	165	160	81
25	1	85.5	171	163	158	80
	0	84.5	167	159	154	78
		83.2	162	153	150	76
		82	157	148	145	74
		80.5	153	144	140	72
		79	149	140	136	70
		77.5	143	134	131	68
		76	139	130	127	66
		74	135	126	122	64
		72	129	120	117	62
		70	125	116	113	60
		68	120	111	108	58
		66	116	107	104	56
		64	112	104	100	54
		61	108	100	96	52
		58	104	95	92	50
		55	99	91	87	48
		51	95	86	83	46
		47	91	83	79	44
		44	88	80	76	42
		39	84	76	72	40
		35	80	72	68	38
		30	76	67	64	36
		24	72	64	60	34
		20	69	61	57	32
		11	65	57	53	30
		0	62	54	50	28

(1) Rockwell C values below 20 and B values above 100 are not recommended for correlation; however, these values are sufficiently accurate to indicate the trend of relationship.

(2) Vickers values of 167 to 95 inclusive with 30 kg load; 91 to 62 inclusive with 10 kg load.

(3) Brinell tungsten carbide ball values 159 to 86 inclusive obtained with 1500 kg load; 83 to 54 inclusive with 500 kg load.

Figure 19 (Sheet 2 of 2) Table of Hardness and Tensile Strength Co-ordination

Bolt Size	Hole Sizes — For all components of the assembly, arranged from left to right in order of decreasing preference. Drilled: Oversize	Drilled: Clearance	Drilled: Close	Reamed: Standard Tolerance	Reamed: Close Tolerance	Spotface Sizes: Dia.	Spotface Sizes: Fillet Radius
#2		#43 (.089)					
#4		#31 (.120)				3/8	.031
#6	#25 (.149)	#27 (.144)				7/16	
#8	#16 (.177)	#18 (.169)	#19 (.166)				
*3/16		#11 (.191)	3/16	.1875 +.0005 -.0010		9/16	.062
#10	#7 (.201)	#10 (.193)	#12 (.189)	.1900 +.0005 -.0010	.1900(±.0005)		
1/4	5/16	F (.257)	1/4	.2500 +.0005 -.0010	.2500(±.0005)	5/8	
5/16	3/8	O (.316)	5/16	.3125 +.0005 -.0010	.3125(±.0005)	11/16	
3/8	7/16	V (.377)	3/8	.3750 +.0005 -.0010	.3750(±.0005)	13/16	
7/16		29/64	7/16	.4375 +.0005 -.0010	.4375(±.0005)	7/8	
1/2		33/64	1/2	.5000 +.0005 -.0010	.5000(±.0005)	1	

*AN23 is the only standard fastener of 3/16 size. Nearest standard size is #10

Figure 20 Table of Standard Bolt Hole Sizes

Material Commercial Designation	Hardness Temper	Brinell Hardness Number	Material Commercial Designation	Hardness Temper	Brinell Hardness Number
2S(pure aluminum)	O	23	24S	RT	116
	H	44	25S forging	O	80
3S	O	28		W	100
	H	55		T	90
14S forging	T	125	A51S forging	T	90
17S	O	45	57S	O	45
	T	100		H	85
	RT	110	65S	O	30
24S	O	42		T	95
	T	105	75S	T	168

Temper Code	
O	Annealed condition
H	Maximum commercial degree of work hardening
T	Fully heat-treated
RT	Heat-treated and cold worked
W	Quenched but not completely aged. W temper applies only to alloys requiring artificial aging to attain T condition

Figure 21 Table of Hardness Values for Aluminum Alloys

Values shown in Figure 22 (Sheet 2 of 2) are for dry (lubricant free) cadmium plated steel bolts and nuts. Stainless steel bolts and nuts must be used with anti-seize compound. Use column 3. Where torquing must be done through bolt head, use high value in tables. Where shear nuts are used, use column 3 regardless of bolt type. For joints sealed with synthetic rubber sheet or gasket material, use the following table:-

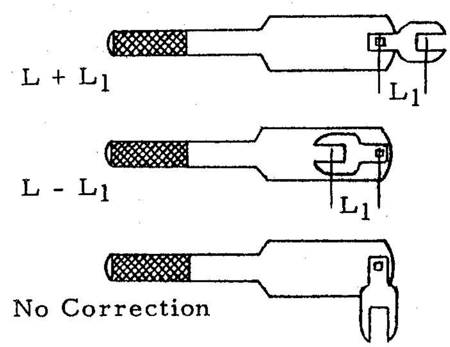
Bolt size	Torque (Inch-pounds)
No. 10	20-25
1/4	25-60
5/16	35-60

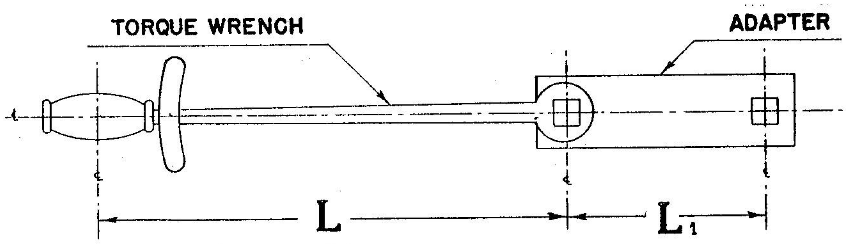
NOTE

A Torque wrench should never be used to loosen or back off a nut

NOTE

Many special aircraft tools are torque wrench adapters designed to be used with any of a number of standard torque wrenches. The mechanical value of these adapters must be considered in arriving at the correct dial reading to give the specified torque at the nut or bolt being tightened. To determine what torque wrench dial reading should be to indicate a specified torque value, the following equation is used.





$$\frac{\text{ACTUAL OR SPECIFIED TORQUE} \times L}{L + L_1} = \text{DIAL READING}$$

WHEN SUBSTITUTING VALUES IN FORMULA,
USE INCH UNITS THROUGHOUT TO OBTAIN ANSWER IN INCH POUNDS.
USE FOOT UNITS THROUGHOUT TO GET ANSWER IN FOOT POUNDS.

TORQUE READING CORRECTION FORMULA

If the adaptor is fitted at right angles to the torque wrench the use of the torque wrench formula is not required. When the adaptor is used in a straight line with the torque wrench and the torque arm is increased or decreased the use of the torque wrench conversion formula is mandatory.

Figure 22 (Sheet 1 of 2) (Issue 1) Table of Torque Values, Steel Nuts and Bolts, NF and NC Threads

Bolts Stud or Screw Size	Standard Nuts, Bolts and Screws AN3-20 And AN173-186 Series Bolts: Tension Nuts AN310 and AN365 (40,000 psi in bolt)	Standard Nuts, Bolts and Screws AN3-20 And AN173-186 Series Bolts: Shear Nuts AN320 and AN364 (60% of column 2)	High-Strength Nuts, Bolts And Screws NAS 333-340 NAS 144-158 MS 20004-20024 Series Bolts: Any Nut Except Shear Type	Maximum Allowable Tightening Torque: Tension Nuts AN310 and AN365 (90,000 psi in bolt)	Maximum Allowable Tightening Torque: Shear Nuts AN320 and AN364 (60% of column 5)	High Strength Bolts and Screws having 160000 PSI Strength: Tension 12 Point High Tensile Barrel Type etc Max Torque for 115000 PSI Bolt Loading
1	2	3	4	5	6	7
8-36	12 - 15	7 - 9	15 - 18	20	12	150
10-32	20 - 25	12 - 15	25 - 35	40	25	340
1/4-28	50 - 70	30 - 40	70 - 90	100	60	600
5/16-24	100 - 140	60 - 85	140 - 203	225	140	900
3/8-24	160 - 190	95 - 110	190 - 351	390	240	1400
7/16-20	450 - 500	270 - 300	500 - 756	840	500	2050
1/2-20	480 - 690	290 - 410	690 - 990	1,100	660	3100
9/16-18	800 - 1,000	480 - 600	1,000 - 1,440	1,600	960	5800
5/8-18	1,000 - 1,300	660 - 780	1,300 - 2,160	2,400	1,400	9000
3/4-16	2,300 - 2,500	1,300 - 1,500	2,500 - 4,500	5,000	3,000	13000
7/8-14	2,500 - 3,000	1,500 - 1,800	3,000 - 6,300	7,000	4,200	19000
1-14	3,700 - 5,500	2,200 - 3,300	5,500 - 9,000	10,000	6,000	32000
1-1/8-12	5,000 - 7,000	3,000 - 4,200	7,000 - 13,500	15,000	9,000	
1-1/4-12	9,000 - 11,000	5,400 - 6,600	11,000 - 22,500	25,000	15,000	
8-32	12 - 15	7 - 9	15 - 18	20	12	
10-24	20 - 25	12 - 15	25 - 35	35	21	
1/4-20	40 - 50	25 - 30	50 - 68	75	45	
5/16-18	80 - 90	48 - 55	90 - 144	160	100	
3/8-16	160 - 185	95 - 110	185 - 248	275	170	
7/16-14	235 - 255	140 - 155	255 - 428	475	280	
1/2-13	400 - 480	240 - 290	480 - 792	880	520	
9/16-12	500 - 700	300 - 420	700 - 990	1,100	650	
5/8-11	700 - 900	420 - 540	900 - 1,350	1,500	900	
3/4-10	1,150 - 1,600	700 - 950	1,600 - 2,250	2,500	1,500	
7/8-9	2,200 - 3,000	1,300 - 1,800	3,000 - 4,140	4,600	2,700	
1-8	3,700 - 5,000	2,200 - 3,000	5,000 - 6,840	7,600	4,500	
1-1/8-8	5,500 - 6,500	3,300 - 4,000	6,500 - 10,800	12,000	7,200	
1-1/4-8	6,500 - 8,000	4,000 - 5,000	8,000 - 14,000	16,000	10,000	

NOTE

Care must be exercised to insure that a purely axial force is applied on the installation or removal of the following recessed head screws: 8-36, 10-32, 8-32 and 10-24. The application of a non-axial load could result in failure.

Figure 22 (Sheet 2 of 2) (Issue 1) Table of Torque Values - Steel Nuts and Bolts - NF and NC Threads

Revised 30 Aug 62

NOTE

It is often advantageous to change a torque specification from inch-pounds to foot-pounds or from inch-pounds to inch-ounces or from inch-ounces to inch-grams.

If one remembers that this conversion is based on the fact that there are twelve inches to a foot, then it is evident that one foot-pound equals twelve inch-pounds and the following formulas may be written:-

$$\text{Foot-Pounds} \times 12 = \text{Inch-Pounds}$$
$$\text{Inch-Pounds} \div 12 = \text{Foot-Pounds}$$

Since there are sixteen ounces to a pound, the formulas for converting inch-pounds and inch-ounces are :-

$$\text{Inch-Pounds} \times 16 = \text{Inch-Ounces}$$
$$\text{Inch-Ounces} \div 16 = \text{Inch-Pounds}$$

Since there are 28.35 grams to an ounce, the formulas for converting inch-ounces and inch-grams are:-

$$\text{Inch-Ounces} \times 28.35 = \text{Inch-Grams}$$
$$\text{Inch-Grams} \div 28.35 = \text{Inch-Ounces}$$

The coefficients for bend allowance are computed from the bend allowance empirical formula. This formula, as the name implies, was developed by experimentation. The neutral axis was found to lie slightly inside the 1/2T, therefore, the formula (.01743R + .0078T) gives the bend allowance for 1° bend. The table gives the 1° bend allowances for certain given radii and thicknesses. These are multiplied by the bend angle (in degrees) to arrive at the total bend allowance.

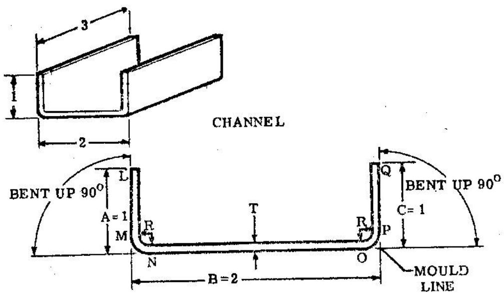
Values are for 1° bend. Values derived from formula:

$$B.A. = (.0078T + .01743R)N$$

N = No. of degrees
T = Metal thickness
R = Radius of bend

Example: T = .032, R = 1/8, angle = 90°

$$B.A. = .00243 \times 90 = .2187$$

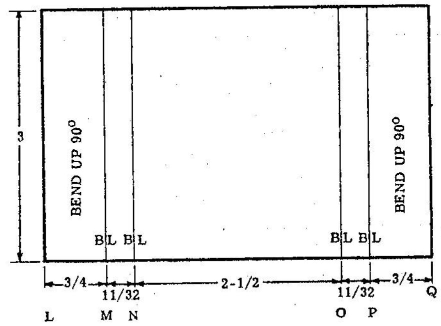


The mould lines (ML) indicate the point to which the dimension is given. The length of the channel will remain unchanged from flat pattern to finished part. On the other hand, the material necessary to make the channel web and the two flanges will not be the sum of their dimensions in the finished part, as it might at first seem, but rather, this developed length will be less than that sum, owing to the short cuts taken around the curved corners. The procedure for use of the formula is as follows:

1. Imagine that the length around the cross section of the channel is divided into sections according to the letters L, M, N, O, P, and Q. Length LM = 1 in, - R (radius of bend) - T (thickness of metal). If R = 3/16 and T = 1/16 (.064), then

LM = 1 in. - (3/16 in. + 1/16 in.) = 3/4 in.

Lay this length out along the metal as shown and draw the bend line (BL).



2. Next, for the length MN, called the bend allowance, refer to the bend allowance chart for 1° bend allowance and multiply it by the number of degrees of bend (90°). The chart gives .00377 for 3/16R and .064T; when multiplied by 90, we get .3393 or 11/32 (closest fraction) to the next bend line.

3. The web of the channel has two bends to be subtracted. Therefore it is 2 in. - 2 (T + R) or 2 in. - 1/2 in. = 1-1/2 in. from N to O. Repeat the first two operations in reverse order to complete the pattern.

Therefore, the developed length (sum LM + MN + NO + OP + PQ) equals 3.6726. Referring back, this is less than the sum of the dimensioned sides in Figure 6B.

Formed angles of open or closed bevels may be developed in the same manner except that the distance from the corner mould line to the bend line is found by the formula:

(T + R) x (the tangent of half the bent-up angle)

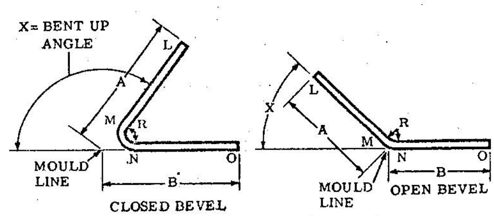


Figure 23 (Sheet 1 of 2) Bend Allowance Derivation - Bend Allowance Chart for 1° Angle

Radius of Bend	Metal Thickness									
	.020 .022	.023 .025	.028 .029	.031 .032	.038 .040	.050 .051	.063 .064	.081	.091 .094	.125 .129
1/32	00072	00073	00076	00079	00086	00094	00104	00117	00125	00154
1/16	00126	00128	00131	00135	00140	00149	00159	00172	00188	00209
3/32	00180	00183	00185	00188	00195	00203	00213	00226	00234	00263
1/8	00235	00237	00240	00243	00249	00258	00268	00281	00289	00317
5/32	00290	00292	00294	00297	00304	00312	00322	00335	00343	00372
3/16	00344	00346	00349	00352	00358	00367	00377	00390	00398	00426
7/32	00398	00401	00403	00406	00412	00421	00431	00444	00452	00481
1/4	00454	00455	00458	00461	00467	00476	00486	00500	00507	00535
9/32	00507	00510	00512	00515	00521	00530	00540	00553	00561	00590
5/16	00562	00564	00567	00570	00576	00584	00595	00608	00616	00644
11/32	00616	00619	00620	00624	00630	00639	00649	00662	00670	00699
3/8	00671	00673	00675	00679	00685	00693	00704	00717	00725	00753
13/32	00725	00728	00730	00733	00739	00748	00758	00771	00779	00808
7/16	00780	00782	00784	00767	00794	00802	00812	00826	00834	00862
15/32	00834	00836	00839	00842	00848	00857	00867	00853	00888	00917
1/2	00889	00891	00893	00896	00903	00911	00921	00935	00943	00971
17/32	00943	00945	00948	00951	00957	00966	00976	00989	00997	01025
9/16	00998	01000	01002	01005	01012	01020	01030	01044	01051	01080
19/32	01051	01054	01055	01058	01065	01073	01083	01098	01105	01133
5/8	01107	01109	01111	01114	01121	01129	01139	01152	01160	01189
21/32	01161	01163	01166	01170	01175	01183	01193	01207	01214	01245
11/16	01216	01218	01220	01223	01230	01238	01248	01261	01269	01298
23/32	01269	01272	01273	01276	01283	01291	01301	01316	01322	01351
3/4	01324	01327	01329	01332	01338	01347	01357	01370	01378	01407
25/32	01378	01381	01383	01386	01392	01401	01411	01425	01432	01461
13/16	01433	01436	01438	01441	01447	01456	01466	01479	01487	01516
27/32	01487	01490	01491	01494	01501	01509	01519	01534	01540	01569
7/8	01542	01545	01548	01550	01556	01565	01575	01588	01596	01625
29/32	01596	01600	01601	01604	01610	01619	01629	01643	01650	01679
15/16	01651	01654	01655	01657	01665	01674	01684	01697	01705	01734
31/32	01705	01708	01709	01712	01718	01727	01737	01752	01758	01787
1	01760	01763	01765	01768	01774	01783	01793	01806	01814	01834

Figure 23 (Sheet 2 of 2) Bend Allowance Derivation - Bend Allowance Chart for 1° Angle

Gauge	3S			24S		57S		65S			75S			14S		
	-0 Bent Cold	-H12 Bent Cold	-H16 Bent Cold	Bare And Clad -0 Bent Cold	Bare And Clad -T3 Bent Cold (inc. -T4)	-0 Bent Cold	-H34 Bent Cold	-0 Bent Cold	-T4 Bent Cold	-T6 Bent Cold	Bare And Clad -0 Bent Cold	Bare And Clad -W Bent Cold & -T6 Bent Hot	Clad Only -T6 Bent Cold	Bare And Clad -0 Bent Cold	Bare And Clad -T4 Bent Cold & -T6 Bent Hot	Clad Only -T6 Bent Cold
*.012	.03	.03	.03	.03	.06	.03	.03				.06	.09	.12	.06	.06	.06
.014	.03	.03	.03	.03	.06	.03	.03				.06	.09	.12	.06	.06	.06
*.016	.03	.03	.03	.03	.06	.03	.03				.06	.09	.12	.06	.06	.06
.018	.03	.03	.03	.03	.06	.03	.03				.06	.09	.12	.06	.06	.06
*.020	.03	.03	.03	.03	.06	.03	.03				.06	.09	.12	.06	.06	.06
.022	.03	.03	.03	.03	.06	.03	.06				.06	.09	.12	.06	.06	.06
.024	.03	.06	.06	.06	.06	.03	.06				.06	.09	.12	.06	.06	.09
*.025	.03	.06	.06	.06	.06	.03	.06	.03	.03	.06	.06	.09	.12	.06	.06	.09
.028	.06	.06	.06	.06	.06	.06	.06				.06	.12	.12	.06	.06	.09
*.032	.06	.06	.06	.06	.09	.06	.06	.03	.03	.06	.06	.12	.12	.06	.06	.12
.036	.06	.06	.06	.06	.09	.06	.06				.06	.16	.16	.06	.09	.12
*.040	.06	.06	.06	.06	.09	.06	.06	.06	.06	.09	.06	.16	.19	.06	.09	.16
.048	.06	.06	.06	.06	.12	.06	.09				.09	.19	.25	.09	.09	.19
*.051	.06	.06	.06	.06	.12	.06	.09	.06	.06	.09	.09	.19	.25	.09	.09	.19
.056	.06	.09	.09	.06	.16	.06	.09				.09	.22	.28	.09	.12	.28
.063	.06	.09	.09	.09	.16	.06	.09				.09	.25	.31	.12	.12	.31
*.064	.06	.09	.09	.09	.16	.06	.09	.06	.09	.12	.09	.25	.31	.12	.12	.31
.071	.09	.12	.12	.12	.22	.09	.12				.16	.28	.38	.12	.16	.38
*.072	.09	.12	.12	.12	.22	.09	.12				.16	.28	.38	.12	.16	.38
.080	.12	.12	.16	.12	.25	.12	.12				.19	.31	.44	.16	.16	.41

* = standard gauges.

T = thickness (gauge) of material.

Figure 24 (Sheet 1 of 2) Table of Minimum Bend Radii for Simple Bends in Aluminum Alloy Sheet and Plate

Gauge	3S			24S		57S		65S			75S			14S		
	-0 Bent Cold	-H12 Bent Cold	-H16 Bent Cold	Bare And Clad -0 Bent Cold	Bare And Clad -T3 Bent Cold (inc. -T4)	-0 Bent Cold	-H34 Bent Cold	-0 Bent Cold	-T4 Bent Cold	-T6 Bent Cold	Bare And Clad -0 Bent Cold	Bare And Clad -W Bent Cold & -T6 Bent Hot	Clad Only -T6 Bent Cold	Bare And Clad -0 Bent Cold	Bare And Clad -T4 Bent Cold & -T6 Bent Hot	Clad Only -T6 Bent Cold
*.081	.12	.12	.16	.12	.25	.12	.12	.09	.16	.19	.19	.31	.44	.16	.16	.41
.090	.12	.12	.19	.12	.28	.12	.19				.25	.38	.50	.16	.19	.47
*.091	.12	.12	.19	.12	.28	.12	.19	.09	.19	.22	.25	.38	.50	.16	.19	.47
.095	.12	.16	.25	.16	.31	.12	.19				.28	.41	.50	.19	.19	.47
.100	.14	.16	.25	.16	.34	.12	.19				.31	.41	.56	.19	.19	.50
*.102	.14	.16	.25	.16	.34	.12	.19	.16	.25	.28	.31	.41	.56	.19	.19	.50
.112	.16	.19	.25	.19	.41	.16	.19				.34	.44	.69	.19	.22	.56
*.125	.16	.19	.25	.19	.44	.16	.22	.16	.25	.28	.34	.50	.75	.25	.25	.63
.132				.22	.47	.16	.22				.41	.50	.81	.25	.34	.81
.140				.25	.50	.16	.22				.41	.56	.84	.25	.38	.84
*.156				.25	.56	.16	.22	.22	.38	.47	.47	.63	.94	.31	.41	.94
.160				.25	.56	.16	.22				.47	.69	.94	.31	.41	.94
.170				.31	.75	.16	.25				.50	.69	1.03	.31	.41	1.03
*.188				.34	.84	.16	.25	.22	.38	.47	.56	.75	1.12	.34	.47	1.16
.190				.34	.84	.16	.25				.56	.75	1.12	.34	.47	1.16
.212				.38	1.06						.63	.84	1.25	.38	.56	1.28
.224				.41	1.12						.69	.94	1.34	.41	.56	1.34
.250				.47	1.25			31	50	.63	.75	1.00	1.50			
Over 250				2T	5T			1-1/2 T	2T	2-1/2 T	3T	4T	6T			

* = standard gauges.

T = thickness (gauge) of material.

Figure 24 (Sheet 2 of 2) Table of Minimum Bend Radii for Simple Bends in Aluminum Alloy Sheet and Plate

Gauge	SAE 1010 Annealed, Bent Cold		SAE 1020 SAE 1025 SAE 1095 Annealed Bent Cold		SAE 4130 and NE 8630 (1)				Corrosion Resistant Steel			
					Normalized Bent Cold		Annealed Bent Cold		Annealed Bent Cold		1/2 Hard Bent Cold	
	90°	180°	90°	180°	90°	180°	90°	180°	90°	180°	90°	180°
.080			.12		.16				.09	.19	.19	.31
.083			.12	.19	.16	.25						
.090			.19		.19				.09	.19	.19	.31
.093					.19	.38	.09	.16				
.095			.19	.25	.19				.12		.22	
.100					.22				.12		.22	
.104	.12	.25										
.109			.19	.25	.22	.44	.12	.19				
.112			.19		.22				.12	.25	.25	.38
.119	.12	.25	.19	.25								
.120												
.125			.25		.25	.50	.12	.19	.12	.25	.25	.38
.132			.25						.19			
.134	.19	.38	.25	.38								
.140			.25						.19			
.156			.25	.38	.31	.63	.16	.25				
.160			.28		.31				.19			
.170			.31		.34				.19			
.188			.31	.38	.38	.75	.19	.28	.19	.38		
.190			.31		.38				.19			
.212			.38		.44				.22			
.224			.38		.47				.22			
.250			.38	.50	.50	1.00	.25	.38	.25	.50		
Over (2) .250			1-1/2T	2T	2-1/2T	1-1/2T	2T	1T	2T			

Notes: 1. The minimum bend radii for SAE.4130 are applicable to the following steels:-
- a. Normalized values shown in the Table - SAE.4135, SAE.4137, NE.8735 and NE.8740 all in the normalized and tempered condition.
- b. Annealed values shown in the Table - SAE.4135, SAE.4137, NE.8735 and NE.8740 all in the annealed condition.

2. T = material thickness.

Figure 25 (Sheet 1 of 2) Table of Minimum Bend Radii for Simple Bends in Steel Sheet and Plate

Gauge	SAE 1010 Annealed Bent Cold		SAE 1020 SAE 1025 SAE 1095 Annealed Bent Cold		SAE 4130 and NE 8630 (1)				Corrosion Resistant Steel			
					Normalized Bent Cold		Annealed Bent Cold		Annealed Bent Cold		1/2 Hard Bent Cold	
	90°	180°	90°	180°	90°	180°	90°	180°	90°	180°	90°	180°
.010											.03	.06
.012			.03		.06				.03	.03	.03	.06
.014			.03		.06				.03		.03	
.016			.03	.06	.06				.03	.03	.03	.06
.018	.03	.06	.03		.06				.03		.03	
.020			.03	.06	.06	.09			.03	.06	.06	.09
.022			.06		.06				.03		.06	
.024	.03	.06	.06		.06	.09			.03		.06	
.025			.06	.09	.06	.09			.03	.06	.06	.09
.028			.06		.06				.03		.06	
.030	.03	.06			.06	.09						
.032			.06	.09	.12				.03		.06	
.035	.06	.12	.06	.12	.12	.19						
.036	.06	.12	.06		.12				.06	.12	.12	.19
.040			.06		.12				.06	.12	.12	.19
.042			.06	.12	.12	.19						
.045									.06	.12	.12	.19
.048	.06	.12	.09		.12				.06		.12	
.049			.09	.12								
.050					.12	.19			.06	.12	.12	.19
.056					.12				.06		.12	
.060	.06	.12										
.063			.09		.12	.19			.06	.12	.12	.19
.065			.09	.12								
.071			.12		.16				.06		.16	
.072			.12	.19								
.075	.09	.19										
.078					.16	.25						

Figure 25 (Sheet 2 of 2) Table of Minimum Bend Radii for Simple Bends in Steel Sheet and Plate

Gauge	AMS 4900 90°	AMS 4901 90°	AMS 4908 90°	Gauge	AMS 4900 90°	AMS 4901 90°	AMS 4908 90°
.016	.06	.06	.12	.063	.16	.19	.28
.018	.06	.06	.12	.071	.16	.22	.38
.020	.06	.06	.12	.080	.22	.28	.41
.025	.06	.09	.12	.090	.25	.34	.47
.028	.06	.09	.16	.100	.25	.38	.50
.032	.09	.12	.16	.112	.28	.41	.56
.036	.09	.12	.16	.125	.34	.44	.63
.040	.09	.12	.19	.140	.38	.50	.66
.045	.09	.16	.19	.160	.41	.56	.81
.050	.12	.16	.22	.180	.47	.63	.90
.056	.12	.19	.25				

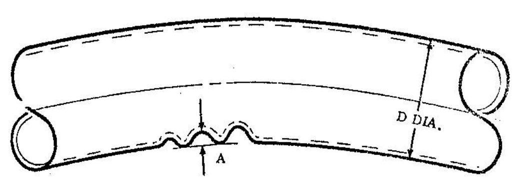
Figure 26 Table of Minimum Bend Radii for Simple Bends in Titanium Alloy Sheet

Gauge	QQ-M-44 Condition A Bent Cold	QQ-M-44 Condition H Bent Cold	QQ-M-44 Condition A Bent Cold	Gauge	QQ-M-54 Condition A Bent Cold	QQ-M-54 Condition H Bent Cold	QQ-M-54 Condition A Bent Cold
.012	.06	.12	.06	.071	.28	.75	.34
.014	.06	.16	.06	.080	.31	.81	.41
.016	.06	.16	.09	.090	.38	.94	.45
.018	.06	.19	.09	.095	.38	1.00	.47
.020	.09	.19	.12	.100	.41	1.00	.50
.022	.09	.22	.12	.112	.44	1.12	.56
.024	.09	.25	.12	.125	.50	1.25	.63
.028	.12	.28	.16	.132	.50	1.31	.69
.032	.12	.31	.16	.140	.56	1.41	.69
.036	.16	.38	.19	.160	.63	1.63	.81
.040	.16	.41	.22	.170	.69	1.75	.88
.048	.19	.47	.25	.190	.75	1.94	.94
.056	.22	.56	.28	.212	.88	2.12	1.06
.063	.25	.63	.31	.224	.88	2.25	1.12

Figure 27 Table of Minimum Bend Radii for Simple Bends in Magnesium Alloy Sheet

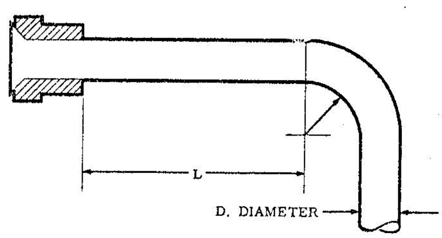
Outside Diameter of Tube inches	Minimum Bend Radii (Measure at Inside of Bend) - Inches							
	Annealed Aluminum Alloy		Heat Treated Aluminum Alloy		MIL-T-6845 Corr. Resistant Steel (1/6 Hard)		MIL-T-8504 Corr. Resistant Steel (Annealed)	
	Minimum Wall	Minimum Bend	Minimum Wall	Minimum Bend	Minimum Wall	Minimum Bend	Minimum Wall	Minimum Bend
3/16					0.020	5/8	0.020	5/8
1/4	0.035	5/8	0.035	5/8	0.020	5/8	0.020	3/4
5/16	0.035	5/8	0.035	5/8	0.020	5/8	0.020	3/4
3/8	0.049	3/4	0.049	3/4	0.028	3/4	0.028	1
1/2	0.049	1	0.065	1	0.035	1	0.035	1-1/4
5/8	0.049	1	0.065	1	0.049	1	0.035	1-1/2
3/4	0.049	1	0.083	1	0.049	1	0.028	1
1	0.049	1	0.083	2	0.065	2	0.028	1
1-1/4	0.049	1-1/4	0.083	3	0.065	3	0.028	1-1/4
1-1/2	0.049	1-1/2					0.028	1-1/2
1-3/4	0.049	1-3/4					0.028	1-3/4
2	0.049	2					0.028	2
2-1/2	0.049	2-1/2					0.035	2-1/2
3	0.049	3					0.035	3
3-1/2	0.049	3-1/2					0.035	3-1/2
4	0.064	4					0.035	4

Figure 28 Table of Minimum Bend Radii for Rigid Fluid Tubing



D Outside Diameter of Tube inches	A Depth Maximum inches
Up to 3/4	.005
1 to 1-3/4	.020
2 to 2-3/4	.030
3 to 3-3/4	.040
4 and over	.060

Figure 29 Table of Allowable Wrinkles in Rigid Fluid Tube Bends



Clearance for Single Flares	
D Outside Diameter of Tube inches	L Minimum inches
1/8 to 5/8	1
3/4 to 1	7/8
1-1/4 to 1-1/2	1
1-3/4 to 2	1-1/4

Figure 30 Table of Minimum Sleeve-to-Start-Bend Clearances on Rigid Fluid Tubing

Outside Diameter of Tube inches	Hose Assy. Size Dash No.	Thread Size of Fittings inches	57S-O Aluminum Alloy Tubing		MIL-T-6845 and AMS-5566 Stainless Steel Tubing		Flexible Hose Assemblies and 65S-T6 Aluminum Alloy Tubing	
			Minimum Torque in./lb.	Maximum Torque in./lb.	Minimum Torque in./lb.	Maximum Torque in./lb.	Minimum Torque in./lb.	Maximum Torque in./lb.
1/8	-2	5/16-24	20	25				
3/16	-3	3/8-24	25	35	90	140	30	70
1/4	-4	7/16-20	40	65	135	185	70	120
5/16	-5	1/2-20	60	80	180	230	70	120
3/8	-6	9/16-18	75	125	270	345	130	180
1/2	-8	3/4-16	150	250	450	525	300	400
5/8	-10	7/8-14	200	350	650	750	430	550
3/4	-12	1-1/16-12	300	500	900	1100	650	800
1	-16	1-5/16-12	500	700	1200	1400	900	1100
1-1/4	-20	1-5/8-12	600	900	1500	1800	1200	1450
1-1/2	-24	1-7/8-12	600	900	2000	2300	1550	1850
1-3/4	-28	2-1/4-12	700	1000	2600	2900	2000	2350
2	-32	2-1/2-12	800	1100	3200	3600	2500	2900

NOTE: These values apply regardless of fitting or nut material.

Figure 31 Table of Torque Values for Fittings with Straight Threads in Other than Oxygen Systems

Nominal Pipe Size inches	Minimum Torque Value in./lb.	Maximum Torque Value in./lb.
1/8	40	300
1/4	60	600
3/8	75	700
1/2	100	900
3/4	300	1600
1-	400	2200
1-1/4	500	2500

Note: These values apply regardless of fitting or nut material.

All fittings with tapered (pipe) threads shall be torqued as follows:

a. Torque to the minimum value specified, then continue to tighten until the fitting is correctly positioned, but do not exceed the maximum torque value specified.

b. If leakage develops, tighten one full turn further, but do not exceed the maximum torque value specified.

c. If leakage persists, reject the parts.

Figure 32 Table of Torque Values for Fittings with Tapered (Pipe) Threads in Other than Oxygen Systems

Tubing Size-inches	Torque Value-in. /lb.
5/16	100 - 125
3/8	125 - 150
1/2	125 - 150

If a torque wrench cannot be used, the coupling nut may be tightened 1/2 turn beyond the point of hand tightness for new lines or 1/3 turn beyond the point of hand tightness for used lines.

Figure 33 Table of Torque Values for Flared Tube Fittings in Oxygen Systems

Nominal Pipe Size Inches	Torque Value in. /lb.
1/8	*50 - 100
1/4	100 - 200

* The 1/8 inch tapered thread boss in the Type A-12 oxygen regulator (for connections to A-3 indicator) are not to be torqued above 50 inch-pounds.

Figure 34 Table of Torque Values for Aluminum and Bronze Fittings with Tapered (Pipe) Threads in Oxygen Systems

Sheet thickness	Diameter of Rivet							
	1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
0.014	44							
0.016	107							
0.018	121	173						
0.020	134	192						
0.025	168	240	321					
0.032	214	307	411	509				
0.036	241	346	463	572	688			
0.040	268	384	514	636	764			
0.045	302	432	578	716	860			
0.051	342	490	655	811	974	1,310		
0.064	429	614	822	1,020	1,220	1,640	2,070	
0.072	482	691	925	1,140	1,370	1,850	2,330	2,780
0.081	543	778	1,040	1,290	1,550	2,080	2,620	3,130
0.091	610	874	1,170	1,450	1,740	2,340	2,940	3,510
0.102	683	979	1,310	1,620	1,910	2,620	3,290	3,940
0.128	858	1,230	1,640	2,030	2,410	3,290	4,130	4,940
0.156	1,050	1,500	2,010	2,480	2,980	4,010	5,040	6,030
0.188	1,250	1,800	2,410	2,980	3,580	4,820	6,060	7,240
0.250	1,670	2,400	3,210	3,970	4,770	6,420	8,070	

Note: This table is based on a stress of 100,000 psi. For ratios of actual bearing strength to 100,000 psi for various aluminum alloy sheets, see Figure 37.

Figure 35 Table of Unit Bearing Strength of Sheets on Rivets

Plate Sizes	Size of Pins or Bolts												
	1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8	1/2	5/8	3/4	7/8	1
	Bearing strength of plate												
0.028	175	263	350										
0.035	219	328	438	547	656								
0.049	306	459	612	766	919	1,225							
0.058	362	544	725	906	1,087	1,450	1,812						
0.065	406	609	812	1,016	1,219	1,625	2,031						
0.072	450	675	900	1,125	1,350	1,800	2,250	2,700					
0.083	519	778	1,038	1,297	1,556	2,075	2,594	3,112					
0.095	594	891	1,188	1,484	1,781	2,375	2,969	3,563	4,750				
0.120	750	1,125	1,500	1,875	2,250	3,000	3,750	4,500	6,000	7,500			
3/16	1,172	1,758	2,344	2,930	3,516	4,688	5,859	7,031	9,375	11,719	14,063	16,406	18,750
1/4	1,563	2,344	3,125	3,906	4,688	6,250	7,813	9,375	12,500	15,625	18,750	21,875	25,000

Note: This table is based on a stress of 100,000 psi. For ratios of actual bearing strength to 100,000 psi for various aluminum alloy sheets, see Figure 37.

Figure 36 Table of Unit Bearing Strength of Sheets on Bolts and Pins

Material	Thickness	(Minimum guaranteed properties)				Ultimate Tensile Strength psi.
		K ultimate		K yield		
		e/D=2.0	e/D=1.5	e/D=2.0	e/D=1.5	
24S-T4 (heat-treated by user)	<0.250	1.18	0.93	0.64	0.56	62000
24S-T42 (heat-treated by user)	0.250-0.500	1.22	0.96	0.61	0.53	64000
	.501-1.000	1.18	0.93	0.61	0.53	62000
	1.001-2.000	1.14	0.90	0.61	0.53	60000
	2.001-3.000	1.06	0.84	0.61	0.53	56000
24S-T3	<0.250	1.24	0.98	0.79	0.69	65000
24S-T4	.250-0.500	1.24	0.98	0.74	0.64	65000
	.501-1.000	1.20	0.95	0.70	0.62	63000
	1.001-2.000	1.16	0.92	0.68	0.60	61000
24S-T36	≲0.500	1.33	1.05	0.96	0.84	70000
24S-T4 (coiled)	<0.250	1.18	0.93	0.64	0.56	62000
Clad 24S-T4(heat-treated by user)	<0.064	1.10	0.87	0.59	0.52	56000
	.064-0.249	1.16	0.92	0.61	0.53	59000
Clad 24S-T4(heat-treated by user)	.250-0.499	1.18	0.93	0.61	0.53	62000
	.500-1.000	1.14	0.90	0.58	0.50	60000
	1.001-2.000	1.10	0.87	0.58	0.50	58000
	2.001-3.000	1.03	0.81	0.58	0.50	54000
Clad 24S-T3	.010-0.063	1.14	0.90	0.73	0.64	60000
	.064-0.249	1.20	0.95	0.74	0.64	63000
Clad 24S-T4	.250-0.499	1.20	0.95	0.74	0.64	63000
	.500-1.000	1.16	0.92	0.67	0.59	61000
	1.001-2.000	1.12	0.89	0.64	0.56	59000
Clad 24S-T36	.019-0.063	1.20	0.95	0.88	0.77	63000
	.064-0.500	1.27	1.01	0.93	0.81	67000
Clad 24S-T4 (coiled)	.012-0.063	1.10	0.87	0.59	0.52	58000
	0.064	1.16	0.92	0.61	0.53	61000
Clad 24S-T6	<0.064	1.14	0.90	0.75	0.66	60000
	≥0.064	1.18	0.93	0.78	0.69	62000
Clad 24S-T81	<0.064	1.22	0.96	0.90	0.78	64000
	≥0.064	1.27	1.00	0.94	0.83	67000

For e/D values between 1.5 and 2.0 bearing factors may be obtained by linear interpolation (e=edge distance, D=hole diameter).

Figure 37 (Sheet 1 of 2) Table of Bearing Factors - Aluminum Alloy Sheet and Plate

Material	Thickness	(Minimum guaranteed properties)				Ultimate Tensile Strength psi.
		K ultimate		K yield		
		e/D-2.0	e/D=1.5	e/D=2.0	e/D=1.5	
Clad 24S-T84	<0.064	1.27	1.00	1.01	0.88	67000
	≯0.064	1.33	1.05	1.06	0.92	70000
Clad 24S-T86	<0.064	1.33	1.05	1.04	0.91	70000
	≯0.064	1.35	1.06	1.09	0.95	72000
75S-T6 (aged)	.016-0.039	1.44	1.14	1.06	0.92	76000
	.040-0.249	1.46	1.16	1.07	0.94	77000
	.250-0.500	1.46	1.16	1.07	0.94	77000
	.501-1.000	1.50	1.19	1.10	0.97	79000
	1.001-2.000	1.50	1.19	1.10	0.97	78000
Clad 75S-T6 (aged)	.016-0.039	1.33	1.05	0.98	0.85	70000
	.040-0.249	1.37	1.08	1.01	0.88	72000
	.250-0.499	1.37	1.08	1.01	0.88	72000
	.500-1.000	1.41	1.11	1.02	0.90	74000
	1.001-2.000	1.41	1.11	1.02	0.90	73000
Hardclad R301-T3 and Alclad 14S-T3	.020-0.039	1.06	0.84	0.64	0.56	
	.040-0.250	1.08	0.85	0.69	0.60	
Hardclad R301-T6 and Alclad 14S-T6	.020-0.039	1.20	0.94	0.90	0.78	64000
	.040-0.250	1.22	0.96	0.91	0.80	65000
52S-H32 (1/4H)		0.65	0.50	0.34	0.29	31000
52S-H34 (1/2H)		0.71	0.54	0.38	0.34	34000
52S-H36 (3/4H)		0.78	0.59	0.46	0.41	37000
52S-H38(H)		0.82	0.62	0.53	0.46	39000
61S-T4		0.63	0.48	0.26	0.22	30000
61S-T6		0.88	0.67	0.56	0.49	42000

For e/D values between 1.5 and 2.0 bearing factors may be obtained by linear interpolation (e=edge distance, D=hole diameter).

1. K = Ratio of actual bearing stress to 100,000 psi.

2. The tables of e/D=1.5 are given here for interest only. Edge distance should never be less than 2D. Use this table in conjunction with the Table of Unit Bearing Strength of Sheets on Rivets, and the Table of Unit Bearing Strengths of Sheets on Bolts and Pins.

3. < = Less than. ≮ = Not less than. ≯ = Not greater than.

Figure 37 (Sheet 2 of 2) Table of Bearing Factors - Aluminum Alloy Sheet and Plate

Species (common and botanical names) **Hardwoods (broad-leaved species) *Softwoods (conifers)	S.G. based on weight and volume when oven-dry	Weight at 12% moisture content	Shrinkage from green to oven-dry conditions based on dimensions when green		Static bending				Compression parallel to grain		Compression normal to grain stress at proportional limit	Side hardness load required to embed a 0.444 in. ball to 1/2 its diam.	Shear parallel to grain; maximum shearing stress	Tension normal to grain max. tensile strength
			Radial	Tangential	Stress at proportional limit	Modulus of rupture	Modulus of elasticity	Work to maximum load	Stress at proportional limit	Maximum crushing strength				
		lbs. per cu. ft.	Per-cent	Per-cent	psi	psi	1,000 psi	In-lb per cu in	psi	psi	psi	lbs.	psi	psi
**Ash, black (Fraxinus nigra)	.53	34	5.0	6.8	7,200	12,600	1,600	14.9	4,520	5,970	940	850	1,570	700
Ash, commercial (Fraxinus spp.)	.62	41	4.3	5.9	8,800	14,800	1,690	16.1	5,570	7,270	1,510	1,280	1,950	870
Basswood, American (Tilia glabra)	.40	26	6.6	9.3	5,900	8,700	1,460	7.2	3,800	4,730	450	410	990	350
Birch Alaska (Betula neoalaskana)	.59	38	6.5	9.9	7,700	13,600	1,900	13.9	5,290	7,450	820	830	1,400	660
Birch, paper (Betula papyrifera)	.60	38	6.3	8.6	6,900	12,300	1,590	16.0	3,610	5,690	740	910	1,210	
Birch (Betula spp.)	.68	44	7.0	8.5	10,100	16,700	2,070	19.8	6,200	8,310	1,250	1,340	2,010	930
Magnolia, southern (Magnolia grandiflora)	.53	35	5.4	6.6	6,800	11,200	1,400	12.8	3,420	5,460	1,060	1,020	1,530	740
Mahogany (Swietenia spp.)	.51		3.4	4.7	8,600	11,000	1,410	6.7		6,410	1,270	820	1,090	
Maple, soft	.51	37	3.7	7.9	8,000	12,200	1,510	11.4	4,570	6,190	1,150	880	1,750	500
Maple, hard	.67	44	4.8	9.4	9,400	15,700	1,820	16.3	5,350	7,770	1,780	1,440	2,300	670
Oak, commercial white and red (Quercus spp.)	.69	45	4.6	9.0	8,100	14,100	1,730	14.2	4,440	6,900	1,330	1,300	1,850	780
Walnut, black (Juglans nigra)	.56	38	5.2	7.1	10,500	14,600	1,680	10.7	5,780	7,580	1,250	1,010	1,370	690
Yellow poplar (Liriodendron tulipifera)	.43	28	4.0	7.1	6,100	9,200	1,500	6.8	3,550	5,290	580	450	1,100	520
*Cedar, Alaska (Chamaecyparis noothatensis)	.46	31	2.8	6.0	7,100	11,100	1,420	10.4	5,210	6,310	770	580	1,130	360
Douglas fir (Pseudotsuga taxifolia)	.51	34	5.0	7.8	8,100	11,700	1,920	8.6	6,450	7,420	910	670	1,140	300

Figure 38 (Sheet 1 of 2) Table of Strength and Related Properties of Aircraft Woods at 12 Percent Moisture Content

Species (common and botanical names)	S.G. based on weight and volume when oven-dry		Shrinkage from green to oven-dry conditions based on dimensions when green: Radial	Shrinkage from green to oven-dry conditions based on dimensions when green: Tangential	Static bending: Stress at proportional limit	Static bending: Modulus of rupture	Static bending: Modulus of elasticity	Static bending: Work to maximum load	Compression parallel to grain: Stress at proportional limit	Compression parallel to grain: Maximum crushing strength	Compression normal to grain stress at proportional limit	Side hardness load required to embed a 0.444 in. ball to 1/2 its diam.	Shear parallel to grain; maximum shearing stress	Tension normal to grain max. tensile strength
		lbs. per cu. ft.	Per-cent	Per-cent	psi	psi	1,000 psi	In-lb per cu in	psi	psi	psi	lbs.	psi	psi
Fir, California red (Abies magnifica)	.42	27	3.8	6.9	7,200	11,200	1,590	9.5		5,290	850	530	1,050	350
Fir, noble (Abies nobilis)	.40	26	4.5	8.3	6,600	10,100	1,580	8.8	4,960	5,550	640	410	980	220
Fir, Pacific silver (Abies amabilis)	.42	27	4.5	10.0	6,200	9,400	1,530	9.3	4,660	5,550	490	430	1,050	
Fir, white (Abies concolor)	.40	26	3.2	7.0	6,500	9,300	1,380	6.7	3,590	5,350	600	440	930	260
Hemlock, western (Tsuga heterophylla)	.44	29	4.3	7.9	6,800	10,100	1,490	7.5	5,340	6,210	680	580	1,170	310
Pine, eastern white (Pinus strobus)	.38	25	2.2	6.0	6,000	8,800	1,280	6.7	3,680	4,840	550	400	860	300
Pine, ponderosa (Pinus ponderosa)	.42	28	3.9	6.3	6,300	9,200	1,260	6.6	4,060	5,270	740	450	1,160	400
Pine, red (Pinus resinosa)	.51	34	4.6	7.2	9,400	12,500	1,800	10.0	5,330	7,340	830	580	1,230	490
Pine, sugar (Pinus lambertiana)	.38	25	2.9	5.6	5,700	8,000	1,200	5.5	4,140	4,770	590	380	1,050	350
Pine, western white (Pinus monticola)	.42	27	4.1	7.4	6,200	9,500	1,510	8.8	4,480	5,620	540	370	850	
Red cedar, western (Thuja plicata)	.34	23	2.5	5.1	5,300	7,700	1,120	5.8	4,360	5,020	610	350	860	220
Spruce (Picea spp.)	.40	28	4.1	7.4	6,700	10,100	1,510	8.8	4,500	5,650	650	500	1,120	360
White cedar, northern (Thuja occidentalis)	.32	22	2.1	4.9	4,900	6,500	800	4.8	2,630	3,960	380	320	850	240
White cedar, Port Orford (Chamaecyparis lawsoniana)	.44	29	4.6	6.9	7,700	11,300	1,730	9.1	5,890	6,470	760	560	1,080	400

(These are the average values of the properties based on extensive tests made at the U.S. Forest Products Laboratory and are not to be confused with the design values)

Figure 38 (Sheet 2 of 2) Table of Strength and Related Properties of Aircraft Woods at 12 Percent Moisture Content