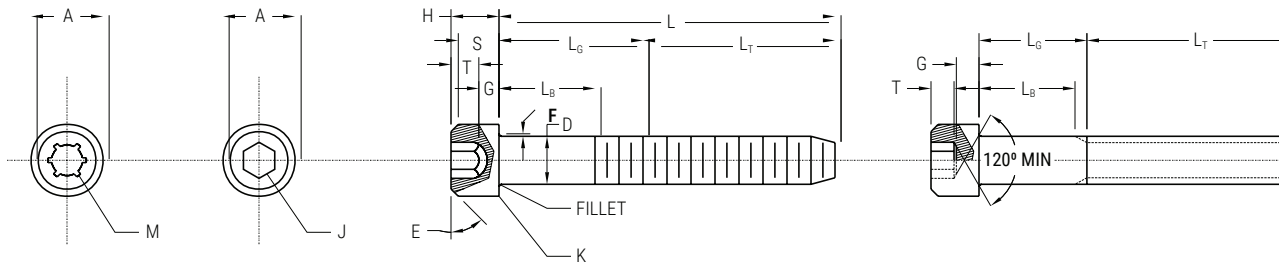


TABLE 1. AMERICAN NATIONAL STANDARD HEXAGON AND SPLINE SOCKET HEAD CAP SCREWS (1960 SERIES) (ANSI B18.3-1982)



Nominal Size	Body Diameter		Head Diameter		Head Height		Spline Socket Size	Hex. Socket Size		Fillet Ext.	Key Engagement*
	Max	Min	Max	Min	Max	Min	Nom	Nom		Max	
	D		A		H		M	J		F	
0	0.0600	0.0568	0.096	0.091	0.060	0.057	0.060	0.050		0.007	0.025
1	0.0730	0.0695	0.118	0.112	0.073	0.070	0.072	1/16	0.062	0.007	0.031
2	0.0860	0.0822	0.140	0.134	0.086	0.083	0.096	5/64	0.078	0.008	0.038
3	0.0990	0.0949	0.161	0.154	0.099	0.095	0.096	5/64	0.078	0.008	0.044
4	0.1120	0.1075	0.183	0.176	0.112	0.108	0.111	3/32	0.094	0.009	0.051
5	0.2250	0.1202	0.205	0.198	0.125	0.121	0.111	3/32	0.094	0.010	0.057
6	0.1380	0.1329	0.226	0.218	0.138	0.234	0.133	7/64	0.109	0.010	0.064
8	0.1640	0.2585	0.270	0.262	0.164	0.159	0.168	9/64	0.141	0.012	0.077
10	0.1900	0.1840	0.312	0.303	0.190	0.185	0.183	5/32	0.156	0.014	0.090
1/4	0.2500	0.2435	0.375	0.365	0.250	0.244	0.216	3/16	0.188	0.014	0.120
5/16	0.3125	0.3053	0.469	0.457	0.312	0.306	0.291	1/4	0.250	0.017	0.151
3/8	0.3750	0.3678	0.562	0.550	0.375	0.368	0.372	5/16	0.312	0.020	0.182
7/16	0.4375	0.4294	0.656	0.642	0.438	0.430	0.454	3/8	0.375	0.023	0.213
1/2	0.5000	0.4919	0.750	0.735	0.500	0.492	0.454	3/8	0.375	0.026	0.245
5/8	0.6250	0.6163	0.938	0.921	0.625	0.616	0.595	1/2	0.500	0.032	0.307
3/4	0.7500	0.7406	1.125	1.107	0.750	0.740	0.620	5/8	0.625	0.039	0.370
7/8	0.8750	0.8647	1.312	1.293	0.875	0.864	0.698	3/4	0.750	0.044	0.432
1	1.0000	0.9886	1.500	1.479	1.000	0.988	0.790	3/4	0.750	0.050	0.495

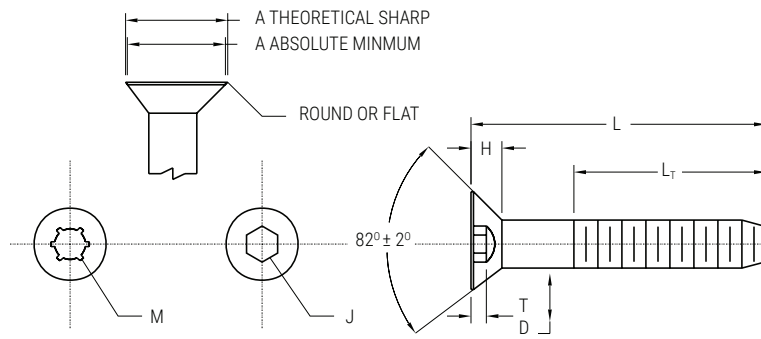
TABLE 1. AMERICAN NATIONAL STANDARD HEXAGON AND SPLINE SOCKET HEAD CAP SCREWS (1960 SERIES) (ANSI B18.3-1982)

Nominal Size	Body Diameter		Head Diameter		Head Height		Spline Socket Size	Hex. Socket Size		Fillet Ext.	Key Engagement*
	Max	Min	Max	Min	Max	Min	Nom	Nom	Max		
	D		A		H		M	J		F	T
1 1/8	1.1250	1.1086	1.688	1.665	1.125	1.111	–	7/8	0.875	0.055	0.557
1 1/4	1.2500	1.2336	1.875	1.852	1.250	1.236	–	7/8	0.875	0.060	0.620
1 3/8	1.3750	1.3568	2.062	2.038	1.375	1.360	–	1	1.000	0.065	0.682
1 1/2	1.5000	1.4828	2.250	2.224	1.500	1.485	–	1	1.000	0.070	0.745
1 3/4	1.7500	1.7295	2.625	2.597	1.750	1.734	–	1 1/4	1.250	0.080	0.870
2	2.0000	1.9780	3.000	2.970	2.000	1.983	–	1 1/2	1.500	0.090	0.995
2 1/4	2.2500	2.2280	3.375	3.344	2.250	2.232	–	1 3/4	1.750	0.100	1.120
2 1/2	2.5000	2.4762	3.750	3.717	2.500	2.481	–	1 3/4	1.750	0.110	1.245
2 3/4	2.7500	2.7262	4.125	4.090	2.750	2.730	–	2	2.000	0.120	1.370
3	3.0000	2.9762	4.500	4.464	3.000	2.979	–	2 1/4	2.250	0.130	1.495
3 1/4	3.2500	3.2262	4.875	4.837	3.250	3.228	–	2 1/4	2.250	0.140	1.620
3 1/2	3.5000	3.4762	5.250	5.211	3.500	3.478	–	2 3/4	2.750	0.150	1.745
3 3/4	3.7500	3.7262	5.625	5.584	3.750	3.727	–	2 3/4	2.750	0.160	1.870
4	4.0000	3.9762	6.000	5.958	4.000	3.976	–	3	3.000	0.170,	1.995

* Key engagement depths are minimum.

All dimensions in inches. The body length LB of the screw is the length of the unthreaded cylindrical portion of the shank. The length of thread, LT, is the distance from the extreme point to the last complete (full form) thread. Standard length increments for screw diameters up to 1 in. are 1/16 in. for lengths 1/8 through 1/4 in., 1/8 in. for lengths 1/4 through 1 in., 1/4 in. for lengths 1 through 3 1/2 in., 1/2 in. for lengths 3 1/2 through 7 in., 1 in. for lengths 7 through 10 in. and for diameters over 1 in. are 1/2 in. for lengths 1 through 7 in., 1 in. for lengths 7 through 10 in. and 2 in. for lengths over 10 in. Heads may be plain or knurled, and chamfered to an angle E of 30 to 45 degrees with the surface of the flat. The thread conforms to the Unified Standard with radius root, Class 3A, UNRC and UNRF for screw sizes No. 0 through 1 in. inclusive, Class 2A, UNRC and UNRF for over 1 in. through 1 1/2 in. inclusive, and Class 2A UNRC for sizes larger than 1 1/2 in. For manufacturing details not shown, including materials, see American National Standard ANSI B18.3-1982.

TABLE 2. AMERICAN NATIONAL STANDARD HEXAGON AND SPLINE SOCKET FLAT COUNTERSUNK HEAD CAP SCREWS (ANSI B 18.3-1982)



Nominal Size	Body Diameter		Head Diameter		Head Height	Spline Socket Size	Hexagon Socket Size	Key Engagement*
	Max	Min	Theoretical Sharp	Abs. Min.	Reference	Nom	Nom	
			Max					
	D		A		H	M	J	
0	0.0600	0.0568	0.138	0.117	0.044	0.048	0.035	0.025
1	0.0730	0.0695	0.168	0.143	0.054	0.060	0.050	0.031
2	0.0860	0.0822	0.197	0.168	0.064	0.060	0.050	0.038
3	0.0990	0.0949	0.226	0.193	0.073	0.072	1/16	0.044
4	0.1120	0.1075	0.255	0.218	0.083	0.072	1/16	0.055
5	0.1250	0.1202	0.281	0.240	0.090	0.096	5/64	0.061
6	0.1380	0.1329	0.307	0.263	0.097	0.096	5/64	0.066
8	0.1640	0.1585	0.359	0.311	0.112	0.111	3/32	0.076
10	0.1900	0.1840	0.411	0.359	0.127	0.145	1/8	0.087
1/4	0.2500	0.2435	0.531	0.480	0.161	0.183	5/32	0.111
5/16	0.3125	0.3053	0.656	0.600	0.198	0.216	3/16	0.135
3/8	0.3750	0.3678	0.781	0.720	0.234	0.251	7/32	0.159
7/16	0.4375	0.4294	0.844	0.781	0.234	0.291	1/4	0.159
1/2	0.5000	0.4919	0.938	0.872	0.251	0.372	5/16	0.172
5/8	0.6250	0.6163	1.188	1.112	0.324	0.454	3/8	0.220
3/4	0.7500	0.7406	1.438	1.355	0.396	0.454	1/2	0.220
7/8	0.8750	0.8647	1.688	1.604	0.468	—	9/16	0.248
1	1.0000	0.9886	1.938	1.841	0.540	—	5/8	0.297
1 1/8	1.1250	1.1086	2.188	2.079	0.611	—	3/4	0.325
1 1/4	1.2500	1.2336	2.438	2.316	0.683	—	7/8	0.358
1 3/8	1.3750	1.3568	2.688	2.553	0.755	—	7/8	0.402
1 1/2	1.5000	1.4818	2.938	2.791	0.827	—	1	0.435

* Key engagement depths are minimum.

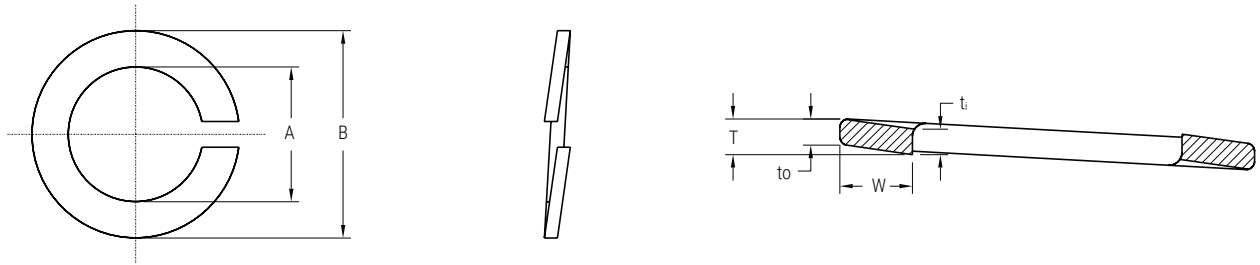
The body of the screw is the unthreaded cylindrical portion of the shank where not threaded to the head; the shank being the portion of the screw from the point of juncture of the conical bearing surface and the body to the flat of the point. The length of thread LT is the distance measured from the extreme point to the last complete (full form) thread.

Standard length increments of No. 0 through 1-in. sizes are: 1/16 in. for nominal screw lengths of 1/8 through 1/4 in., 1/8 in. for lengths of 1/4 through 1 in., 1/4 in. for lengths of 1 in. through 3 1/2 in., 1/2 in. for lengths of 3 1/2 through 7 in., and 1 in. for lengths of 7 through 10 in., inclusive. For screw sizes over 1 in., length increments are: 1/2 in. for nominal screw lengths of 1 in. through 7 in., 1 in. for lengths of 7 through 10 in., and 2 in. for lengths over 10 in.

Threads shall be Unified external threads with radius root; Class 3A UNRC and UNRF series for sizes No. 0 through 1 in. and Class 2A UNRC and UNRF series for sizes over 1 in. to 1 1/2 in., incl.

For manufacturing details not shown, including materials, see American National Standard ANSI B18 3-1982.

TABLE 3. AMERICAN NATIONAL STANDARD HELICAL SPRING LOCK WASHERS (ANSI B18.21.1-1972)



Nominal Washer Size	Inside Diameter, A		Regular*			Heavy†			Extra Duty‡			
	Max	Min	O.D., B Max: ¶	Section Width, W	Section Thickness, T§	O.D., B Max: ¶	Section Width, W	Section Thickness, T§	O.D., B Max: ¶	Section Width, W	Section Thickness, T§	
No. 2	0.086	0.094	0.088	0.172	0.035	0.020	0.182	0.040	0.025	0.208	0.053	0.027
No. 3	0.099	0.107	0.101	0.195	0.040	0.025	0.209	0.047	0.031	0.239	0.062	0.034
No. 4	0.112	0.120	0.114	0.209	0.040	0.025	0.223	0.047	0.031	0.253	0.062	0.034
No. 5	0.125	0.133	0.127	0.236	0.047	0.031	0.252	0.055	0.040	0.300	0.079	0.045
No. 6	0.138	0.148	0.141	0.250	0.047	0.031	0.266	0.055	0.040	0.314	0.079	0.045
No. 8	0.164	0.174	0.167	0.293	0.055	0.040	0.307	0.062	0.047	0.375	0.096	0.057
No. 10	0.190	0.200	0.193	0.334	0.062	0.047	0.350	0.070	0.056	0.434	0.112	0.068
No. 12	0.216	0.227	0.220	0.377	0.070	0.056	0.391	0.077	0.063	0.497	0.130	0.080
1/4	0.250	0.262	0.254	0.489	0.109	0.062	0.491	0.110	0.077	0.535	0.132	0.084
5/16	0.311	0.326	0.317	0.586	0.125	0.078	0.596	0.130	0.097	0.622	0.143	0.108
3/8	0.375	0.390	0.380	0.683	0.141	0.094	0.691	0.145	0.115	0.741	0.170	0.123
7/16	0.438	0.455	0.443	0.779	0.156	0.109	0.787	0.160	0.133	0.839	0.186	0.143
1/2	0.500	0.518	0.506	0.873	0.171	0.125	0.883	0.176	0.151	0.939	0.204	0.162
9/16	0.518	0.582	0.570	0.971	0.188	0.141	0.981	0.193	0.170	1.041	0.223	0.182
0.562	0.625	0.650	0.635	1.079	0.203	0.156	1.093	0.210	0.189	1.157	0.242	0.202
11/16	0.688	0.713	0.698	1.176	0.219	0.172	1.192	0.227	0.207	1.258	0.260	0.221
3/4	0.750	0.775	0.760	1.271	0.234	0.188	1.291	0.244	0.226	1.361	0.279	0.241
3/16	0.812	0.843	0.824	1.367	0.250	0.203	1.391	0.262	0.246	1.463	0.298	0.261
7/8	0.875	0.905	0.887	1.464	0.266	0.219	1.494	0.281	0.266	1.576	0.322	0.285
15/16	0.938	0.970	0.950	1.560	0.281	0.234	1.594	0.298	0.284	1.688	0.345	0.308
1	1.000	1.042	1.017	1.661	0.297	0.250	1.705	0.319	0.306	1.799	0.366	0.330
1 1/16	1.062	1.107	1.080	1.756	0.312	0.266	1.808	0.338	0.326	1.910	0.389	0.352
1 1/8	1.125	1.172	1.144	1.853	0.328	0.281	1.909	0.356	0.345	2.019	0.411	0.375
1 13/16	1.188	1.237	1.208	1.950	0.344	0.297	2.008	0.373	0.364	2.124	0.431	0.396
1 1/4	1.250	1.302	1.271	2.045	0.359	0.312	2.113	0.393	0.384	2.231	0.452	0.417
1 5/16	1.312	1.366	1.334	2.141	0.375	0.328	2.211	0.410	0.403	2.335	0.472	0.438

TABLE 3. AMERICAN NATIONAL STANDARD HELICAL SPRING LOCK WASHERS (ANSI B18.21.1-1972)

Nominal Washer Size		Inside Diameter, A		Regular*			Heavy†			Extra Duty‡		
		Max	Min	O.D., B Max: ¶	Section Width, W	Section Thickness, T§	O.D., B Max: ¶	Section Width, W	Section Thickness, T§	O.D., B Max: ¶	Section Width, W	Section Thickness, T§
1 3/8	1.375	1.432	1.398	2.239	0.391	0.344	2.311	0.427	0.422	2.439	0.491	0.458
1 7/16	1.438	1.497	1.462	2.334	0.406	0.359	2.406	0.442	0.440	2.540	0.509	0.478
1 1/2	1.500	1.561	1.525	2.430	0.422	0.375	2.502	0.458	0.458	2.638	0.526	0.496

All dimensions are given in inches.

* ormerly designated Medium Helical Spring Lock Washers.

† Not recommended for new applications.

‡ Formerly designated Extra Heavy Helical Spring Lock Washers.

¶ The maximum outside diameters specified allow for the commercial tolerances on cold-drawn wire.

T § = mean section thickness = $(t_i + t_o) \div 2$

TABLE 4. AMERICAN NATIONAL STANDARD TYPE A PLAIN WASHERS PREFERRED SIZES (ANSI B18.22.1-1965, R1975)**

Nominal Washer Size***		Series	Inside Diameter			Outside Diameter			Thickness		
			Basic	Tolerance		Basic	Tolerance		Basic	Max.	Min.
				Plus	Minus		Plus	Minus			
-	-	-	0.078	0.000	0.005	0.188	0.000	0.005	0.020	0.025	0.016
-	-	-	0.094	0.000	0.005	0.250	0.000	0.005	0.020	0.025	0.016
-	-	-	0.125	0.008	0.005	0.312	0.008	0.005	0.032	0.040	0.025
No. 6	0.138	-	0.156	0.008	0.005	0.375	0.015	0.005	0.049	0.065	0.036
No. 8	0.164	-	0.188	0.008	0.005	0.438	0.015	0.005	0.049	0.065	0.036
No. 10	0.190	-	0.219	0.008	0.005	0.500	0.015	0.005	0.049	0.065	0.036
3/16	0.188	-	0.250	0.015	0.005	0.562	0.015	0.005	0.049	0.065	0.036
No. 12	0.216	-	0.250	0.015	0.005	0.562	0.015	0.005	0.065	0.080	0.051
1/4	0.250	N	0.281	0.015	0.005	0.625	0.015	0.005	0.065	0.080	0.051
1/4	0.250	W	0.312	0.015	0.005	0.734*	0.015	0.007	0.065	0.080	0.051
5/16	0.312	N	0.344	0.015	0.005	0.688	0.015	0.007	0.065	0.080	0.051
5/16	0.312	W	0.375	0.015	0.005	0.875	0.030	0.007	0.083	0.104	0.064
3/8	0.375	N	0.406	0.015	0.005	0.812	0.015	0.007	0.065	0.080	0.051
3/8	0.375	W	0.438	0.015	0.005	1.000	0.030	0.007	0.083	0.104	0.064
7/16	0.438	N	0.469	0.015	0.005	0.922	0.015	0.007	0.065	0.080	0.051
7/16	0.438	W	0.500	0.015	0.005	1.250	0.030	0.007	0.083	0.104	0.064
1/2	0.500	N	0.531	0.015	0.005	1.062	0.030	0.007	0.095	0.121	0.074
1/2	0.500	W	0.562	0.015	0.005	1.375	0.030	0.007	0.109	0.132	0.086
9/16	0.562	N	0.594	0.015	0.005	1.156*	0.030	0.007	0.095	0.121	0.074
9/16	0.562	W	0.625	0.015	0.005	1.469*	0.030	0.007	0.109	0.132	0.086
5/8	0.625	N	0.656	0.030	0.007	1.312	0.030	0.007	0.095	0.121	0.074
5/8	0.625	W	0.688	0.030	0.007	1.750	0.030	0.007	0.134	0.160	0.108
3/4	0.750	N	0.812	0.030	0.007	1.469	0.030	0.007	0.134	0.160	0.108
3/4	0.750	W	0.812	0.030	0.007	2.000	0.030	0.007	0.148	0.177	0.122
7/8	0.875	N	0.938	0.030	0.007	1.750	0.030	0.007	0.134	0.160	0.108
7/8	0.875	W	0.938	0.030	0.007	2.250	0.030	0.007	0.165	0.192	0.136
1	1.000	N	1.062	0.030	0.007	2.000	0.030	0.007	0.134	0.160	0.108
1	1.000	W	1.062	0.030	0.007	2.500	0.030	0.007	0.165	0.192	0.136
1 1/8	1.125	N	1.250	0.030	0.007	2.250	0.030	0.007	0.134	0.160	0.108
1 1/8	1.125	W	1.250	0.030	0.007	2.750	0.030	0.007	0.165	0.192	0.136
1 1/4	1.250	N	1.375	0.030	0.007	2.500	0.030	0.007	0.165	0.192	0.136
1 1/4	1.250	W	1.375	0.030	0.007	3.000	0.030	0.007	0.165	0.192	0.136

TABLE 4. AMERICAN NATIONAL STANDARD TYPE A PLAIN WASHERS PREFERRED SIZES (ANSI B18.22.1-1965, R1975)**

Nominal Washer Size***		Series	Inside Diameter			Outside Diameter			Thickness		
			Basic	Tolerance		Basic	Tolerance		Basic	Max.	Min.
				Plus	Minus		Plus	Minus			
1 3/8	1.375	N	1.500	0.030	0.007	2.750	0.030	0.007	0.165	0.192	0.136
1 3/8	1.375	W	1.500	0.045	0.010	3.250	0.045	0.010	0.180	0.213	0.153
1 1/2	1.500	N	1.625	0.030	0.007	3.000	0.030	0.007	0.165	0.192	0.136
1 1/2	1.500	W	1.625	0.045	0.010	3.500	0.045	0.010	0.180	0.213	0.153
1 5/8	1.625	–	1.750	0.045	0.010	3.750	0.045	0.010	0.180	0.213	0.153
1 3/4	1.750	–	1.875	0.045	0.010	4.000	0.045	0.010	0.180	0.213	0.153
1 7/8	1.875	–	2.000	0.045	0.010	4.250	0.045	0.010	0.180	0.213	0.153
2	2.000	–	2.125	0.045	0.010	4.500	0.045	0.010	0.180	0.213	0.153
2 1/4	2.250	–	2.375	0.045	0.010	4.750	0.045	0.010	0.220	0.248	0.193
2 1/2	2.500	–	2.625	0.045	0.010	5.000	0.045	0.010	0.238	0.280	0.210
2 3/4	2.750	–	2.875	0.065	0.010	5.250	0.065	0.010	0.259	0.310	0.228
3	3.000	–	3.125	0.065	0.010	5.500	0.065	0.010	0.284	0.327	0.249

All dimensions are in inches.

* The 0.734-in., 1.156-in., and 1.469-in. outside diameters avoid washers which could be used in coin operated devices.

** Preferred sizes are for the most part from series previously designated “Standard Plate” and “SAE.” Where common sizes exist in the two series, the SAE size is designated “N” (narrow) and the Standard Plate “W” (wide). These sizes as well as all other sizes of Type A Plain Washers are to be ordered by ID, OD, and thickness dimensions.

*** Nominal washer sizes are intended for use with comparable nominal screw or bolt sizes.

TABLE 5. MACHINABILITY – SURFACE CUTTING SPEEDS

Surface cutting speeds given below are approximate and are intended as a guide in calculating the proper speed for the part in hand. The figures are average for the general run of parts and are based on the use of high-speed cutting tools. Any extraordinary features in the part to be made should be taken into consideration and speeds altered accordingly.

For the carbon and alloy grades listed, the figures are based on cold-drawn bars in the as-drawn condition, except when it is noted that the grade is annealed.

Surface cutting speeds for hot rolled as-rolled bars and hot rolled heat treated bars are not available, since the machining qualities of these bars vary according to hardness, microstructure, condition of the surface, etc.

For the stainless steels and super alloys listed, all grades are annealed or solution annealed except where otherwise indicated.

CARBON STEELS		
Grade	Surface Feet per Minute	Rating*
1015	120	72%
1018	130	78%
1020	120	72%
1022	130	78%
1030	115	70%
1040	105	64%
1042	105	64%
1050	90	54%
1095	70	42%
1117	150	91%
1137	120	72%
1141	115	70%
1141 Ann.	135	81%
1144	125	76%
1144 Ann.	140	85%
1212	165	100%
1213	225	136%
12L14	280	170%
1215	225	136%
1144 Hi Stress	130	79%
Stressproof	140	83%
Fatigue-proof	134	80%
Leaded Grade A	325	193%
Ledloy A, La-Led	325	193%
Leaded Grade AX,AY,AZ	420	250%
Ledloy AZ, La-Led X	420	250%

ALLOY STEELS		
Grade	Surface Feet per Minute	Rating*
2355 Ann.	115	70%
4130 Ann.	120	72%
4140 Ann.	110	66%
4142 Ann.	110	66%
41L42 Ann.	127	77%
4150 Ann.	100	60%
4150 Resul. Heat Treat	65	40%
4330 Mod. Ann.	95	59%
4340 Ann.	95	57%
4340 Mod. (300M) Ann.	95	57%
4620	110	66%
4820 Ann.	80	49%
52100 Ann.	65	40%
6150 Ann.	100	60%
8620	110	66%
86L20	127	77%
9310 Ann.	85	51%
D6AC Ann.	50	30%
"e.t.d." 150	125	75%
H-11 Ann.	49	29%
HS 220-18 Ann.	85	51%
Nitriding #3 135 Mod. Ann.	76	45%

TABLE 5. MACHINABILITY – SURFACE CUTTING SPEEDS

STAINLESS & SUPER ALLOYS					
Grade	Surface Feet per Minute	Rating"	Grade	Surface Feet per Minute	Rating"
302	75	45%	431	75	45%
303	130	78%	440A	75	45%
303MA	135	82%	440B&C	65	40%
304	75	45%	15-5 Condition A	80	48%
304L	75	45%	Condition H1150	90	55%
316	75	45%	Condition H1150M	125	76%
321	60	36%	17-4 Condition A	80	48%
347	60	36%	Nitronic 50 (22-13-5)	50	21%
410	90	54%	A286 Aged	55	33%
416	180	110%	Hastelloy X	32	19%
420	75	45%	Maraging 18 Ni 250	50	30%
430	90	54%			
430F	150	91%			

TABLE 6. HARDNESS CONVERSION NUMBERS FOR STEEL

BRINELL 3000 kg. Load 10 mm. Ball		ROCKWELL				SHORE SCLEROSCOPE	TENSILE STRENGTH psi (Approx.)
Diameter	Hardness Number	A Scale	B Scale	C Scale	15-N Scale		
2.25	745	84.1	–	65.3	92.3	91	–
2.30	712		–	–	–	–	–
2.35	682	82.2	–	61.7	91.0	84	–
2.40	653	81.2	–	–	–	81	–
2.45	627	80.5	–	–	–	79	–
2.50	601	79.8	–	57.3	89.0	77	–
2.55	578	79.1	–	56.0	88.4	75	–
2.60	555	78.4	–	54.7	87.8	73	298000
2.65	534	77.8	–	53.5	87.2	71	288000
2.70	514	76.9	–	52.1	86.5	70	274000
2.75	495	76.3	–	51.0	85.9	68	264000
2.80	477	75.6	–	49.6	85.3	66	252000
2.85	461	74.9	–	48.5	84.7	65	242000
2.90	444	74.2	–	47.1	84.0	63	230000
2.95	429	73.4	–	45.7	83.4	61	219000
3.00	415	72.8	–	44.5	82.8	59	212000
3.05	401	72.0	–	43.1	82.0	58	202000
3.10	388	71.4	–	41.8	81.4	56	193000
3.15	375	70.6	–	40.4	80.6	54	184000
3.20	363	70.0	–	39.1	80.0	52	177000
3.25	352	69.3	110.0	37.9	79.3	51	170000
3.30	341	68.7	109.0	36.6	78.6	50	163000
3.35	331	68.1	108.5	35.5	78.0	48	158000
3.40	321	67.5	108.5	34.3	77.3	47	152000
3.45	311	66.9	107.5	33.1	76.7	46	147000
3.50	302	66.3	107.0	32.1	76.1	45	143000
3.55	293	65.7	106.0	30.9	75.5	43	139000
3.60	285	65.3	105.5	29.9	75.0		136000
3.65	277	64.6	104.5	28.8	74.4	41	131000
3.70	269	64.1	104.0	27.6	73.7	40	128000
3.75	262	63.6	103.0	26.6	73.1	39	125000
3.80	255	63.0	102.0	25.4	72.5	38	121000
3.85	248	62.5	101.0	24.2	71.7	37	118000
3.90	241	61.8	100.0	22.8	70.9	36	114000
3.95	235	61.4	99.0	21.7	70.3	35	111000

TABLE 6. HARDNESS CONVERSION NUMBERS FOR STEEL

BRINELL 3000 kg. Load 10 mm. Ball		ROCKWELL				SHORE SCLEROSCOPE	TENSILE STRENGTH psi (Approx.)
Diameter	Hardness Number	A Scale	B Scale	C Scale	15-N Scale		
4.00	229	60.8	98.2	20.5	69.7	34	109000
4.05	223	98.2	97.3	18.8			104000
4.10	217	–	96.4	17.5	–	33	103000
4.15	212	–	95.5	16.0	–		100000
4.20	207	–	94.6	15.2	–	32	99000
4.25	201	–	93.8	13.8	–	31	97000
4.30	197	–	92.8	12.7	–	30	94000
4.35	192	–	91.9	11.5	–	29	92000
4.40	187	–	90.7	10.0	–		90000
4.45	183	–	90.0	9.0	–	28	89000
4.50	179	–	89.0	8.0	–	27	88000
4.55	174	–	87.8	6.4	–		86000
4.60	170	–	86.8	5.4	–	26	84000
4.65	167	–	86.0	4.4	–		83000
4.70	163	–	85.0	3.3	–	25	82000
4.80	156	–	82.9	0.9	–		80000
4.90	149	–	80.8	–	–	23	–
5.00	143	–	78.7	–	–	22	–
5.10	137	–	76.4	–	–	21	–
5.20	131	–	74.0	–	–		–
5.30	126	–	72.0	–	–	20	–
5.40	121	–	69.8	–	–	19	–
5.50	116	–	67.6	–	–	18	–
5.60	111	–	65.7	–	–	15	–

ROCKWELL							BRINELL 500 kg. Load 10 mm. Ball
B Scale	F Scale	15-T Scale	30-T Scale	E Scale	H Scale	A Scale	
74	99.0	–	66.0	–	–	46.0	118
72	98.0	84.0	65.0	–	–	45.0	114
70	97.0	83.5	63.5	99.5	–	44.0	110
68	95.5	–	62.0	98.0	–	43.0	107
66	94.5	82.0	60.5	97.0	–	42.0	104
64	93.5	81.5	59.5	95.5		41.5	101
62	92.0	–	58.0	94.5		40.5	98
60	91.0	–	56.5	93.0	–	39.5	95
58	90.0	79.5	55.0	92.0	–	38.5	92
56	89.0	79.0	54.0	90.5	–		90

TABLE 6. HARDNESS CONVERSION NUMBERS FOR STEEL

ROCKWELL							BRINELL 500 kg. Load 10 mm. Ball
B Scale	F Scale	15-T Scale	30-T Scale	E Scale	H Scale	A Scale	
54	87.5	–	52.5	89.5	–	37.0	87
52	86.5	77.5	51.0	88.0	–	36.0	85
50	85.5	77.0	49.5	87.0	–	35.0	83
48	84.5	–	48.5	85.5	–	34.5	81
46	83.5	75.5	47.0	84.5	–	33.5	–
44	82.0	75.0	45.5	83.5	–	32.5	78
42	81.0		44.0	82.0	–	31.5	76
40	79.5	73.5	43.0	81.0	–	–	–
38	78.5	73.0	41.5	79.5	–	30.0	73
36	77.5		40.0	78.5	100.0	29.5	–
34	76.5	71.5	38.5	77.0	99.0	28.0	70
32	75.0	71.0	37.5	76.0	98.5	27.5	–
30	74.0	70.5	36.0	75.0	–	26.5	67
28	73.0	–	34.5	73.5	97.0	25.5	66
26	72.0	69.0	33.0	72.5	–	24.5	65
24	70.5	68.5	32.0	71.0	95.5	24.0	–
22	69.5	–	30.5	70.0	95.0	23.0	–
20	68.5	–	29.0	68.5	–	22.0	–
18	67.0	66.5	27.5	67.5	93.5	–	–
16	66.0	66.0	26.0	66.5	–	20.5	–
14	65.0	–	25.0	65.0	92.0	–	–
12	64.0	64.5	23.5	64.0	91.5	–	–
10	63.0	64.0	22.0	62.5	90.5	–	57
8	61.5	63.5	20.5	61.5	90.0	–	–
6	60.5	–	19.5	60.5	–	–	–
4	59.5	62.0	18.0	59.0	88.5	–	–
2	58.0	61.5	16.5	58.0	–	–	54
0	57.0	–	15.0	57.0	87.0	–	53

TABLE 6. HARDNESS CONVERSION NUMBERS FOR STEEL

ROCKWELL HARDNESS			
Scale	Major Load, Kg.	Indenter	Use of Scale
A	60	Diamond cone	Extremely hard material such as tungsten carbide or hard sheet material too thin for heavy load.
B	100	1/16" ball	Materials of B 0 to B 100 hardness.
C	150	Diamond cone	Materials of C 20 to C 100 hardness.
E	100	1/8" ball	Very soft materials such a bearing metals.
F	60	1/16" ball	Very soft materials such a bearing metals.
H	60	1/8" ball	Very soft materials such a bearing metals.

ROCKWELL SUPERFICIAL HARDNESS SCALES			
15-N	15	Diamond cone	Materials comparable in hardness of C 20 to C 70.
15-T	15	1/16" ball	Materials comparable in hardness of B 0 to B 100.
30-T	30	1/16" ball	Materials comparable in hardness of B 0 to B 100.

TABLE 7. SHEET GAUGES

Gauge No.	STEEL SHEETS		GALVANIZED		STAINLESS STEEL SHEETS			ALUMINUM SHEETS	
	Weights Lbs. Per Square Foot	Thickness in Inches	Weights Lbs. Per Square Foot	Thickness in Inches	Wt., Lbs. Per Sq. Ft.		Approx. Thickness in lathes	Weights Lbs. Per Sq. Ft. (1100)	Thickness in Inches
					Straight Chromium (400 Series)	Chromium Nickel (400 Series)			
38	0.25000	0.0060	–	–	–	–	–	0.0558	0.0039
37	0.26562	0.0064	–	–	–	–	–	0.0627	0.0044
36	0.28125	0.0067	–	–	–	–	–	0.0705	0.00500
35	0.31250	0.0075	–	–	–	–	–	0.0791	0.0056
34	0.34375	0.0082	–	–	–	–	–	0.0888	0.00630
33	0.37500	0.0090	–	–	–	–	–	0.0998	0.00701
32	0.40625	0.0097	0.56250	0.0134	0.3708	0.3780	0.010	0.1121	0.00795
31	0.43750	0.0105	0.59375	0.0142	0.4506	0.4594	0.011	0.1259	0.00893
30	0.50000	0.0120	0.65625	0.0157	0.5150	0.5250	0.013	0.1410	0.0100
29	0.56250	0.0135	0.71875	0.0172	0.5794	0.5906	0.014	0.1593	0.0113
28	0.62500	0.0149	0.78125	0.0187	0.6438	0.6562	0.016	0.1777	0.0126
27	0.68750	0.0164	0.84375	0.0202	0.7081	0.7218	0.017	0.2002	0.0142
26	0.75000	0.0179	0.90625	0.0217	0.7725	0.7875	0.019	0.2242	0.0159
25	0.87500	0.0209	1.03125	0.0247	0.9013	0.9187	0.022	0.2524	0.0179
24	1.0000	0.0239	1.15625	0.0276	1.0300	1.0500	0.025	0.2834	0.0201
23	1.1250	0.0269	1.28125	0.0306	1.1587	1.1813	0.028	0.3187	0.0226
22	1.2500	0.0299	1.40625	0.0336	1.2875	1.3125	0.031	0.3567	0.0253
21	1.3750	0.0329	1.53125	0.0366	1.4160	1.4437	0.034	0.4019	0.0285
20	1.5000	0.0359	1.65625	0.0396	1.5450	1.5750	0.038	0.4512	0.0320
19	1.7500	0.0418	1.90625	0.0456	1.8025	1.8375	0.044	0.5062	0.0359
18	2.0000	0.0478	2.15625	0.0516	2.0600	2.1000	0.050	0.5682	0.0403
17	2.2500	0.0538	2.40625	0.0575	2.3175	2.3625	0.056	0.6387	0.0453
16	2.5000	0.0598	2.65625	0.0635	2.5750	2.6250	0.063	0.7163	0.0508
15	2.8125	0.0673	2.96875	0.0710	2.8968	2.9531	0.070	0.8051	0.0571
14	3.1250	0.0747	3.28125	0.0785	3.2187	3.2812	0.078	0.9038	0.0641
13	3.7500	0.0897	3.90625	0.0934	3.8625	3.9375	0.094	1.015	0.0720
12	4.3750	0.1046	4.53125	0.1084	4.5063	4.5937	0.109	1.139	0.0808
11	5.0000	0.1196	5.15625	0.1233	5.1500	5.2500	0.125	1.279	0.0907
10	5.6250	0.1345	5.78125	0.1382	5.7937	5.9062	0.141	1.437	0.1019
9	6.2500	0.1495	6.40625	0.1532	6.4375	6.5625	0.156	1.613	0.1144
8	6.8750	0.1644	7.03125	0.1681	7.0813	7.2187	0.172	1.812	0.1285

TABLE 7. SHEET GAUGES

Gauge No.	STEEL SHEETS		GALVANIZED		STAINLESS STEEL SHEETS			ALUMINUM SHEETS	
	Weights Lbs. Per Square Foot	Thickess in Inches	Weights Lbs. Per Square Foot	Thickess in Inches	Wt., Lbs. Per Sq. Ft.		Approx. Thickness in lathes	Weights Lbs. Per Sq. Ft. (1100)	Thickess in Inches
					Straight Chromium (400 Series)	Chromium Nickel (400 Series)			
7	7.5000	0.1793	–	–	–	–	–	2.035	0.1443
6	8.1250	0.1943	–	–	–	–	–	2.284	0.1620
5	8.7500	0.2092	–	–	–	–	–	2.565	0.1819
4	9.3750	0.2242	–	–	–	–	–	2.881	0.2043
3	10.000	0.2391	–	–	–	–	–	3.235	0.2294

TABLE 8. MILLIMETERS CONVERTED TO DECIMAL AND FRACTIONAL INCHES

Milimeters	Fractional Decimal Inches	Inches (to nearest 64th)	Milimeters	Fractional Decimal Inches	Inches (to nearest 64th)	Milimeters	Fractional Decimal Inches	Inches (to nearest 64th)
1	0.0394	3/64	34	1.339	1 11/32	67	2.638	2 41/64
2	0.0787	5/64	35	1.378	1 3/8	68	2.677	2 43/64
3	0.1181	1/6	36	1.417	1 21/64	69	2.717	2 23/32
4	0.1575	5/32	37	1.457	1 29/64	70	2.756	2 3/4
5	0.1969	13/64	38	1.496	1 1/2	71	2.795	2 51/64
6	0.2362	15/64	39	1.535	1 11/32	72	2.835	2 53/64
7	0.2756	9/32	40	1.575	1 37/64	73	2.874	2 7/8
8	0.3150	5/16	41	1.614	1 39/64	74	2.913	2 29/32
9	0.3543	23/64	42	1.654	1 21/32	75	2.953	2 61/64
10	0.3937	26/64	43	1.693	1 11/16	76	2.992	2 63/64
11	0.4331	7/16	44	1.732	1 47/64	77	3.031	3 1/32
12	0.4724	15/32	45	1.772	1 49/64	78	3.071	5/64
13	0.5118	33/64	46	1.811	1 13/16	79	3.110	7/64
14	0.5512	35/64	47	1.850	1 27/32	80	3.150	5/32
15	0.5906	19/32	48	1.890	1 57/64	81	3.189	3/16
16	0.6299	5/8	49	1.929	1 59/64	82	3.228	3 15/64
17	0.6693	43/64	50	1.969	1 31/32	83	3.268	3 17/64
18	0.7087	45/64	51	2.008	2 1/64	84	3.307	3 5/16
19	0.7480	3/4	52	2.047	2 3/64	85	3.346	3 11/32
20	0.7874	25/32	53	2.087	2 3/32	86	3.386	3 25/64
21	0.8268	53/64	54	2.126	2 1/8	87	3.425	3 27/64
22	0.8661	55/64	55	2.165	2 11/64	88	3.465	3 15/32
23	0.9055	29/32	56	2.205	2 13/64	89	3.504	3 1/2
24	0.9449	15/16	57	2.244	2 1/4	90	3.543	3 35/64
25	0.9843	63/64	58	2.283	2 9/32	91	3.583	3 37/64
26	1.024	1 1/32	59	2.323	2 21/64	92	3.622	3 5/8
27	1.063	1 1/16	60	2.362	2 23/64	93	3.661	3 21/32
28	1.102	1 7/64	61	2.402	2 13/32	94	3.701	3 45/64
29	1.142	1 9/64	62	2.441	2 7/16	95	3.740	3 47/64
30	1.181	1 3/16	63	2.480	2 31/64	96	3.780	3 25/32
31	1.220	1 7/32	64	2.520	2 33/64	97	3.819	3 13/16
32	1.260	1 17/64	65	2.559	2 9/16	98	3.858	3 55/64
33	1.299	1 19/64	66	2.598	2 19/32	99	3.898	3 57/64
–	–	–	–	–	–	100	3.937	3 15/16

TABLE 9. CONVERSION FACTORS

Milimeters	Fractional Decimal Inches	Inches (to nearest 64th)
Acceleration	1 m/s ²	= 4.252 x 10 ¹ ft/h ²
Area	1 m ²	= 1550.0 in ²
–	–	= 10.764 ft ²
Degree (angle)	1 radian	= 57.471 degree
Energy	1 J	= 9.4787 x 10 ⁻⁴ Btu
–	1 kcal	= 3.968 Btu
Force	1 N	= .22481 lbf
Heat Flux	1 W/m ²	= .3171 Btu/h•ft ²
Heat Transfer Coefficient	1 W/m ² •K	= 0.17612 Btu/h•ft ² . °F
Heat Transfer Rate	1W	= 3.4123 Btu/h
Length	1 m	= 39.370 in
–	–	= 3.2808 ft
Mass	1 kg	= 2.2046 lbm
–	1 lbm	= 16 oz
Mass Density	1 kg/m ³	= .062428 lbm/ft ³
Pressure and Stress	1 N/m ²	= .020886 lbf /ft ²
–	–	= 1.4504 x 10 ⁻⁴ lbf /in ²
–	–	= 4.015 x 10 ⁻³ inH ₂ O
–	–	= 2.953 x 10 ⁻⁴ inHg
–	1.1033 x 10 ⁵ N/m ²	= 1 standard atmosphere
–	1 x 10 ⁵ N/m ²	= 1 bar
Temperature	1 K	= (5/9) °R
–	–	= (5/9) (°F + 459.67)
–	–	= °C + 273.15
Temperature Difference	1 K	= 1 °C
–	–	= (9/5) °R = (9/5) °F
Thermal Conductivity	1 W/m•K	= .57782 Btu/h•ft• °F
Thermal Resistance	1 K/W	= .52750° F/h•Btu
Volume	1 m ³	= 6.1023 X 10 ⁴ in ³
–	–	= 35.314 ft ³
–	–	= 264.17 gal
Volume Flow Rate	1 m ³ /s	= 1.2713 x 10 ⁵ ft ³ /h
–	–	= 2.1189 x 10 ³ ft ³ /min
–	–	= 1.5850 x 10 ⁴ gal/min

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