MUDGE FASTENERS, INC.

STAINLESS STEEL
REFERENCE GUIDE

18-8, 316 & 410 STAINLESS

STANDARDS & NON-STANDARDS

IMPORT & DOMESTIC

INCH & METRIC

MUDGE FASTENERS, INC.
CALL OR TEXT
(951) 270-1360
EMAIL
SALES@MUDGEFASTENERS.COM

Head Dimensions

HEX CAPS - HEAD DIMENSIONS ASME B18.2.1

Diameter	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
Maximum Across Flats	7/16	1/2	9/16	5/8	3/4	13/16	15/16	1-1/8	1-5/16	1-1/2	1-11/16	1-7/8	2-1/4
Head Height	5/32	13/64	15/64	9/32	5/16	23/64	25/64	15/32	35/64	39/64	11/16	25/32	15/16

CARRIAGE BOLTS DIMENSIONS ASME B18.5

Diameter	10	1/4	5/16	3/8	1/2
Max. Head Diameter	.469	.594	.719	.844	.1094
Max. Head Height	.114	.145	.176	.208	.270
Max. Sq. Depth	.125	.156	.187	.219	.281
Max. Sq. Width	.199	.260	.324	.388	.515

HEX LAG BOLTS DIMENSIONS ASME B18.2.1

Diameter	1/4	5/16	3/8	1/2	5/8
Head Diameter Ac. Flats	7/16	1/2	9/16	3/4	15/16
Head Height	11/64	7/32	1/4	11/32	27/64
Threads Per Inch	10	9	7	6	5

SHOULDER BOLTS DIMENSIONS ASME B18.3

Diameter	1/4	5/16	3/8	1/2	5/8	3/4
Max. Shoulder Diameter	.248	.310	.373	.498	.623	.748
Max. Head Diameter	.375	.438	.562	.750	.875	1.000
Max. Head Height	.188	.219	.250	.312	.375	.500
Size of Hex Hole	.125	.156	.188	.250	.312	.375
Thread Size	10/24	1/4-20	5/16-18	3/8-16	1/2-13	5/8-11

SQUARE HEAD SET SCREWS DIMENSIONS ASME B18.6.2

Diameter	1/4	5/16	3/8	1/2
Max. Width Ac. Fl. - Head	.250	.312	.375	.500
Max. Head Height	.196	.245	.293	.389

SOCKET HEAD CAP SCREWS DIMENSIONS - ASME B18.3

Diameter of Screw	0	1	2	3	4	5	6	8	10	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
Maximum Head Diameter	.096	.118	.140	.161	.183	.205	.226	.270	5/16	3/8	15/32	9/16	21/32	3/4	15/16	1-1/8	1-5/16	1-1/2
Maximum Head Height	.060	.073	.086	.099	.112	.125	.138	.164	.190	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
Size of Hex Hole	.050	1/16	5/64	5/64	3/32	3/32	7/64	9/64	5/32	3/16	1/4	5/16	3/8	3/8	1/2	5/8	3/4	3/4

SOCKET SET SCREW DIMENSIONS - ASME B18.3

Diameter of Screw	0	1	2	3	4	5	6	8	10	1/4	5/16	3/8	7/16	1/2	5/8	3/4
Size of Hex Hole	.028	.035	.035	.050	.050	1/16	1/16	5/64	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8
Depth of Hex Hole	.050	.060	.060	.070	.070	.080	.080	.090	.100	.125	.156	.188	.219	.250	.312	.375
Max. Cup. Pt. Dia.	.033	.040	.047	.054	.061	.067	.074	.087	.102	.132	.172	.212	.252	.291	.371	.450
Cup Pt. Angle	118°	118°	118°	118°	118°	118°	118°	118°	118°	118°	118°	118°	118°	118°	118°	118°

FLAT AND BUTTON SOCKET CAP SCREWS DIMENSIONS - ASME B18.3

Diameter of Screw	2	4	5	6	8	10	1/4	5/16	3/8	7/16	1/2	5/8	3/4
Flat - Maximum Head Diameter	.197	.255	.281	.307	.359	.411	.531	.656	.781	.844	.937	1.188	1.438
Flat - Maximum Head Height	.064	.083	.090	.097	.112	.127	.161	.198	.234	.234	.251	.324	.396
Button - Maximum Head Diameter	.164	.213	-	.262	.312	.361	.437	.547	.656	-	.875	1.000	-
Button - Maximum Head Height	.046	.059	-	.073	.087	.101	.132	.166	.199	-	.265	.331	-
Flat and Button - Maximum Size Hex Hole	.051	.0635	.0791	.0791	.0952	.1270	.1587	.1900	.2217	-	.3160	.3790	.5000

DIMENSIONS - Thumb Screws - Stainless and Brass

REGULAR NON-SHOULDER THUMB SCREWS						
Size	**6**	**8**	**10**	**1/4**	**5/16**	**3/8**
Head Diameter	3/8	15/32	9/16	23/32	7/8	1-3/32
Height Height	1/4	1/4	3/8	1/2	11/16	13/16
SHOULDER THUMB SCREWS						
Head Diameter	5/16	23/64	7/16	33/64	11/16	13/16
Head Height	11/32	25/64	15/32	19/32	3/4	15/16

Trimmed and indented hex machine screws, hex and slotted hex washer sheet metal screws

Dia.	4	6	8	10
Max. Across Flats	.187	.250	.250	.312
Max. Head Height	.060	.093	.110	.120

DIMENSIONS - Knurled Thumb Screws - Brass

Size	4	6	8	10	1/4
Nom. Head Diameter	5/16	3/8	13/32	7/16	9/16
Nom. Head Height	9/32	9/32	5/16	21/64	3/8

Dimensions for Nuts

MACHINE SCREW NUT DIMENSIONS - ASME B18.2.2, and small pattern nuts

Diameter of Screw		0	1	2	3	4	5	6	8	10	12	1/4	5/16	3/8
Machine Screw	Width across Flats .....inches	5/32	5/32	3/16	3/16	1/4	5/16	5/16	11/32	3/8	7/16	7/16	9/16	5/8
	Thickness .....inches	3/64	3/64	1/16	1/16	3/32	7/64	7/64	1/8	1/8	5/32	3/16	7/32	1/4
SMALL PATTERN	Width across Flats	1/8	1/8	5/32	-	3/16	1/4	1/4	1/4	5/16	-	-	-	-
	Thickness .....inches	3/64	3/64	1/16	-	1/16	3/32	3/32	3/32	7/64	-	-	-	-
	Width across Flats	-	-	-	-	-	-	-	5/16	11/32	-	-	-	-
	Thickness .....inches	-	-	-	-	-	-	-	7/64	1/8	-	-	-	-

DIMENSIONS OF FINISHED, JAM, HEAVY, HEAVY JAM - ASME B18.2.2

	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-3/4	1-7/8	2	2-1/4	2-1/2
Fin. & Jam - Width Across Flats	7/16	1/2	9/16	11/16	3/4	7/8	15/16	1-1/8	1-5/16	1-1/2	1-11/16	1-7/8	2-1/16	2-1/4	2-7/16	2-5/8	2-13/16	3	3-3/8	3-3/4
Thickness Finished	7/32	17/64	21/64	3/8	7/16	31/64	35/64	41/64	3/4	55/64	31/32	1-1/16	1-11/64	1-9/32	1-25/64	1-1/2	1-39/64	1-23/32	1-59/64	2-9/64
Thickness JAM	5/32	3/16	7/32	1/4	5/16	5/16	3/8	27/64	31/64	35/64	39/64	23/32	25/32	27/32	-	31/32	-	1-3/32	1-13/64	1-29/64
Hvy. & Hvy. Jam - Width Across Flats	1/2	9/16	11/16	3/4	7/8	15/16	1-1/16	1-1/4	1-7/16	1-5/8	1-13/16	2	2-3/16	2-3/8	2-9/16	2-3/4	2-15/16	3-1/8	3-1/2	3-7/8
Thickness Heavy	15/64	19/64	23/64	27/64	31/64	35/64	39/64	47/64	55/64	63/64	1-7/64	1-7/32	1-11/32	1-15/32	1-19/32	1-23/32	1-27/32	1-31/32	2-13/64	2-29/64
Thickness Heavy Jam	11/64	13/64	15/64	17/64	19/64	21/64	23/64	27/64	31/64	35/64	39/64	23/32	25/32	27/32	29/32	31/32	1-1/32	1-3/32	1-13/64	1-29/64

DIMENSIONS - KNURLED NUTS - Brass

Size	4	6	8	10	1/4	5/16
Diameter	3/8	3/8	7/16	1/2	5/8	11/16
Height	1/4	1/4	5/16	21/64	3/8	13/32

DIMENSIONS - SERRATED FLANGE NUTS - ASME B18.2.2

Diameter	6	8	10	1/4	5/16	3/8	1/2
Max. Width Across Flats	.312	.344	.375	.438	.500	.562	.750
Max. Thickness	.171	.203	.219	.236	.283	.347	.458

DIMENSIONS - NYLON INSERT NUTS

Diameter	2	3	4	5	6	8	10	12	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
Max. Width Ac. Fl. NM and NE	.251	.251	.251	.251	.313	.345	.376	.439	.439	.502	.564	.627	.752	.877	.940	1.064	1.252	1.440	1.627	1.815	2.197
Height- NM and NE	.153	.153	.153	.153	.188	.239	.249	.328	.328	.359	.468	.468	.609	.656	.765	.890	.999	1.078	1.203	1.422	1.640
Height NTM and NTE	-	-	.125	-	.141	.188	.188	.218	.218	.265	.281	.328	.328	.374	.407	.421	.484	.578	.672	.765	.828
Max. Width Ac. Fl. - NTM and NTE	.251	.251	.251	.251	.313	.345	.376	.439	.439	.502	.564	.627	.741	.877	.940	1.06	1.25	1.44	1.62	1.81	2.19
Max. Width Ac. Fl. - Heavy - NTU	-	-	-	-	-	-	-	-	.502	.564	.690	.752	.877	-	1.06	1.25	1.440	1.627	1.814	2.008	2.384
Height-Heavy - NTU	-	-	-	-	-	-	-	-	.296	.328	.421	.453	.546	-	.624	.718	.796	.922	1.06	1.114	1.344
Height-Heavy - NU	-	-	-	-	-	-	-	-	.390	.453	.562	.579	.718	-	.874	1.015	1.140	1.312	1.469	1.672	1.953
Max. Width Ac. Fl. - Heavy - NU	-	-	-	-	-	-	-	-	.503	.566	.691	.754	.879	-	1.067	1.255	1.444	1.632	1.820	2.010	2.384

DIMENSIONS - CAP NUTS (STAINLESS, BRASS AND ALUMINUM)

	Diameter	4	6	8	10	12	1/4	5/16	3/8	7/16	1/2	5/8	3/4
Stainless	Width Across Flats	1/4	5/16	5/16	3/8	3/8	7/16	9/16	5/8	5/8	3/4	1	1-1/16
	Height Overall ± .010 in.	1/4	19/64	5/16	25/64	27/64	15/32	17/32	5/8	23/32	13/16	63/64	1-3/16
Brass and Aluminum	Width Across Flats	1/4	5/16	5/16	3/8	3/8	7/16	9/16	5/8	3/4	3/4	1	1-1/16
	Height Overall ± .010 in.	1/4	9/32	9/32	11/32	11/32	3/8	7/16	1/2	9/16	9/16	3/4	7/8

DIMENSIONS - WING NUTS (STAINLESS AND BRASS) ASME B18.6.9

Diameter	Wing Span Max/Min	Thickness (nom.)
4	.72/.59	.110
6	.91/.78	.140
8	.91/.78	.140
10	.91/.78	.140
1/4	1.10/.97	.180

Diameter	Wing Span Max/Min	Thickness (nom.)
5/16	1.25/1.12	.238
3/8	1.44/1.31	.238
1/2	1.94/1.81	.330
5/8	2.76/2.62	.391
3/4	2.76/2.62	.391

DIMENSIONS - COUPLING NUTS

Diameter	4/40	6/32	8/32	10/24-32	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
Width Across Flats	5/16	5/16	5/16	3/8	3/8	7/16	1/2	9/16	5/8	7/8	1	1-1/4	1-3/8	1-1/2	1-5/8	2
Length	7/16	1/2	1/2	3/4	7/8	1	1-1/8	1-1/4	1-1/4	1-3/4	2	2-1/2	2-1/2	3	3	3-1/2

MUDGE FASTENERS, INC.
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Dimensions for Flat Washers

FLAT WASHERS - Industrial - Stainless Steel 18-8 and 316

Note: Washer thickness may vary ± .007 depending on production run.

Size	#12	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-3/4	2
O.D.	9/16	5/8	3/4	7/8	1-1/8	1-1/4	1-3/8	1-1/2	1-7/8	2	2	2-1/2	2-3/4	3-1/4	3-1/4	3-1/2	4
I.D.	.250	.281	.343	.406	.500	.531	.625	.687	.812	.937	1.062	1.187	1.312	1.500	1.562	1.812	2.125
Nom. Thickness	.050	.050	.050	.050	.062	.062	.078	.078	.109	.109	.125	.125	.125	.140	.140	.140	.187

FENDER WASHERS AND WASHERS WITH UNUSUAL OUTSIDE DIAMETERS

Note: Washer thickness may vary ± .007 depending on production run.

	OD	ID	Thickness
#6	5/8	.149	.031
#8	3/4	.174	.040
#10	11/16	.203	.040
#10	3/4	.203	.040
#10	1	.203	.040
1/4	11/16	.281	.050
1/4	1	.281	.050
1/4	1-1/4	.281	.050
1/4	1-1/2	.281	.062
1/4	2	.281	.062
5/16	1	.343	.050
5/16	1-1/4	.343	.050
5/16	1-1/2	.343	.062
5/16	2	.343	.062
3/8	1	.406	.050
3/8	1-1/4	.406	.050
3/8	1-1/2	.406	.062
3/8	2	.406	.062
1/2	1-1/2	.531	.062
1/2	2	.531	.062
3/4	1-3/4	.812	.109

316 FLAT WASHERS SMALL SIZES

Size	4	6	8	10
O.D.	.312	.312	.375	.437
I.D.	.125	.156	.174	.203
Thickness	.031	.031	.031	.031

800 SERIES Industrial and MS15795

Bolt Size	I.D. Inches	O.D. Inches	Thickness Max.	Thickness Min.	Dash No.
0	.078	.187	.025	.016	–801
2	.093	.250	.025	.016	–802
4	.125	.250	.028	.017	–803
4	.125	.312	.040	.025	–804
6	.156	.312	.048	.027	–805
6	.156	.375	.065	.036	–806
8	.187	.375	.065	.036	–807
10	.218	.437	.065	.036	–808
10	.250	.562	.080	.051	–809
★1/4	.281	.625	.080	.051	–810
1/4	.312	.750	.080	.051	–811
★5/16	.343	.687	.080	.051	–812
5/16	.375	.875	.104	.064	–813
★3/8	.406	.812	.080	.051	–814
3/8	.437	1.000	.104	.064	–815
7/16	.468	.921	.080	.051	–816
7/16	.500	1.250	.104	.064	–817
★1/2	.531	1.062	.121	.074	–818
1/2	.562	1.375	.132	.086	–819
★5/8	.656	1.312	.121	.074	–820
5/8	.687	1.750	.160	.108	–821
★3/4	.812	1.500	.160	.108	–822
3/4	.812	2.000	.177	.122	–823
7/8	.937	1.750	.160	.108	–824
7/8	.937	2.250	.192	.136	–825
1	1.062	2.000	.160	.108	–826
1	1.062	2.500	.192	.136	–827
8	.188	.438	.065	.036	–841
★10	.219	.500	.065	.036	–842

★SAE

900 SERIES Industrial and AN960C

Size	O.D.	I.D.	Thick.
★ C2	.250	.099	1/32
C2L	.250	.099	1/64
★ C3	.250	.109	1/32
C3L	.250	.109	1/64
★ C4	.312	.125	1/32
C4L	.312	.125	1/64
★ C5	.438	.140	3/64
★ C6	.375	.149	1/32
C6L	.375	.149	1/64
★ C8	.375	.174	1/32
C8L	.375	.174	1/64
★ C10	.437	.203	1/16
C10L	.437	.203	1/32
C416	.500	.265	1/16
C416L	.500	.265	1/32
C516	.562	.328	1/16
C516L	.562	.328	1/32
C616	.625	.390	1/16
C616L	.625	.390	1/32
C716	.750	.453	1/16
C716L	.750	.453	1/32
C816	.875	.516	1/16
C816L	.875	.516	1/32
C916	1.062	.578	1/16
C916L	1.062	.578	1/32
C1016	1.187	.641	1/16
C1016L	1.187	.641	1/32
C1216	1.312	.766	3/32
C1216L	1.312	.766	1/32
C1416	1.500	.890	3/32
C1616	1.750	1.016	3/32

★Star Industrial Sizes

NAS Stainless

Size	0	2	3	3L	4	4L	5	5L	6	6L	8	8L	10	10L	416	416L
O.D.	.099	.149	.180	.180	.209	.209	.238	.238	.267	.267	.304	.304	.354	.354	.468	.468
I.D.	.063	.089	.102	.102	.115	.115	.128	.128	.143	.143	.169	.169	.195	.195	.255	.255
Thickness	.016	.016	.032	.016	.032	.016	.032	.016	.032	.016	.032	.016	.063	.032	.063	.032

FLAT WASHERS - Brass and Silicon Bronze

Size	I.D. Brass	O.D. Brass	Thickness Brass	Approx. Pieces Per Lb-Brass	O.D. Silicon Bronze	Thickness Silicon Bronze
2S	.099	.187	.020	7,600	-	-
3	.101	.250	.020	4,100	-	-
4	.120	.281	.025	2,600	-	-
5	.133	.281	.025	2,800	-	-
6S	.147	.312	.025	2,100	-	-
6L	.147	.375	.032	1,100	.375	.032
8S	.172	.375	.032	1,200	.375	.032
8L	.172	.437	.036	725	-	-
10S	.200	.437	.036	760	.437	.036
10L	.200	.500	.040	490	-	-
12S	.228	.500	.040	525	.500	.040
12L	.228	562	.040	400	-	-
1/4S	.260	.562	.040	420	-	-
1/4L	.260	.687	.051	200	.687	.040
16S	.281	.625	.040	340	-	-
16L	.281	.750	.062	135	-	-

Size	I.D. Brass	O.D. Brass	Thickness Brass	Approx. Pieces Per Lb-Brass	O.D. Silicon Bronze	Thickness Silicon Bronze
18S	.310	.687	.051	220	-	-
18L	.310	.875	.062	100	-	-
5/16S	.340	.750	.062	145	.750	.062
5/16L	.340	.875	.062	100	.875	.062
3/8S	.392	.875	.062	105	.875	.062
3/8L	.392	1.000	.081	60	1.000	.062
7/16	.500	1.125	.081	50	1.125	.062
1/2S	.562	1.250	.091	37	1.250	.078
1/2L	.562	1.375	.091	30	-	-
9/16	.625	1.500	.091	24	-	-
5/8S	.687	1.500	.102	23	1.500	.091
5/8L	.687	1.750	.102	16	-	-
3/4S	.812	1.875	.114	13	1.875	.102
3/4L	.812	2.000	.114	10	-	-
7/8	.937	2.250	.128	7.5	2.250	.114
1	1.062	2.500	.144	5.5	2.500	.128
1-1/8	1.187	2.750	.156	4.5		
1-1/4	1.312	3.000	.156	3.5		
1-1/2	1.562	3.500	.156	2.5		

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Type B Washers

NARROW TYPE B WASHERS

Size	ID	OD	Thickness	Star Part #
#2	.094	.188	.022-.028	1-WBN-2
#4	.125	.250	.028-.036	1-WBN-4
#6	.156	.312	.028-.036	1-WBN-6
#8	.188	.375	.036-.045	1-WBN-8
#10	.203	.406	.036-.045	1-WBN-10
1/4	.281	.500	.056-.071	1-WBN-25
5/16	.344	.625	.056-.071	1-WBN-31
3/8	.406	.734	.056-.071	1-WBN-37
1/2	.531	1.000	.056-.071	1-WBN-50
5/8	.656	1.250	.090-.112	1-WBN-62
3/4	.812	1.375	.090-.112	1-WBN-75
7/8	.938	1.469	.090-.112	1-WBN-87
1	1.062	1.750	.090-.112	1-WBN-100

REGULAR TYPE B WASHERS

Size	ID	OD	Thickness	Star Part #
#2	.094	.250	.028-.036	1-WBR-2
#4	.125	.375	.036-.045	1-WBR-4
#6	.156	.438	.036-.045	1-WBR-6
#8	.188	.500	.036-.045	1-WBR-8
#10	.203	.562	.036-.045	1-WBR-10
1/4	.281	.734	.056-.071	1-WBR-25
5/16	.344	.875	.056-.071	1-WBR-31
3/8	.406	1.000	.056-.071	1-WBR-37
1/2	.531	1.250	.090-.112	1-WBR-50
5/8	.656	1.750	.090-.112	1-WBR-62
3/4	.812	2.000	.090-.112	1-WBR-75
7/8	.938	2.250	.146-.174	1-WBR-87
1	1.062	2.500	.146-.174	1-WBR-100

WIDE TYPE B WASHERS

Size	ID	OD	Thickness	Star Part #
#4	.125	.438	.036-.045	1-WBW-4
#6	.156	.562	.036-.045	1-WBW-6
#8	.188	.625	.056-.071	1-WBW-8
#10	.203	.734	.056-.071	1-WBW-10
1/4	.281	1.000	.056-.071	1-WBW-25
5/16	.344	1.125	.056-.071	1-WBW-31
3/8	.406	1.250	.090-.112	1-WBW-37
1/2	.531	1.750	.090-.112	1-WBW-50
5/8	.656	2.250	1.46-.174	1-WBW-62
3/4	.812	2.500	1.46-.174	1-WBW-75
7/8	.938	2.750	1.46-.174	1-WBW-87
1	1.062	3.000	1.46-.174	1-WBW-100

Dimensions for Lockwashers and Dowel Pin Tolerances
Undercut Lengths for Flat Heads; Decimal and Metric Charts
Driver Size for Square Drive Screws

LOCK WASHERS DIMENSIONS - Light, Medium (all metals where available) Med. - ASME B18.21.1

Bolt Size . . . No. or Inc.		0	1	2	3	4	5	6	8	10	12	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Min. Inside Dia.		.062	.075	.088	.101	.114	.127	.141	.167	.193	.220	.252	.314	.377	.440	.502	.564	.628	.753	.878	1.003	1.129	1.254	1.379	1.504
LIGHT																									
Maximum O.D.		–	–	.165	.188	.202	.225	.239	.280	.323	.364	.489	.575	.678	.780	.877	.975	1.082	1.277	1.470	1.656	1.837	2.012	2.183	2.352
Section Size	Width In.	–	–	.030	.035	.035	.040	.040	.047	.055	.062	.107	.117	.136	.154	.170	.186	.201	.233	.264	.289	.314	.336	.356	.375
	Thick In.	–	–	.015	.020	.020	.025	.025	.031	.040	.047	.047	.056	.070	.085	.099	.113	.126	.153	.179	.202	.224	.244	.264	.282
MEDIUM																									
Maximum O.D.		.137	.150	.172	.195	.209	.236	.250	.293	.334	.377	.487	.583	.680	.776	.869	.965	1.072	1.264	1.455	1.652	1.847	2.028	2.210	2.409
Section Size	Width In.	.020	.022	.035	.040	.040	.047	.047	.055	.062	.070	.109	.125	.141	.156	.171	.188	.203	.234	.266	.297	.328	.359	.391	.422
	Thick In.	.017	.020	.020	.025	.025	.031	.031	.040	.047	.056	.062	.078	.094	.109	.125	.141	.156	.188	.219	.250	.281	.312	.344	.375

Dowel Pins - Tolerance .0002 oversize; double chamfer –45°

Size	Max. Dia.	Min. Dia.	Double Shear Load
1/16	.0628	.0626	220
3/32	.0941	.0939	500
1/8	.1253	.1251	900
3/16	.1878	.1876	2000
1/4	.2503	.2501	3550
5/16	.3128	.3126	5500
3/8	.3753	.3751	8000
1/2	.5003	.5001	14000

Note: 45° double Chamfer not applicable for 1/32 and 3/64 diameters, along with 1/16 dia. short lengths.

Length for Undercut Head on Flat Head Machine Screws

Diameter	0	2	4	6	8	10
Length	1/8	1/8	3/16	3/16	1/4	5/16

Driver for Square Drive Screws

Diameter	4	6	8-10	12-14	5/16
Driver	#0	#1	#2	#3	#4

METRIC - INCH CONVERSION CHART

Metric MM	2	2.5	3	4	5	6	8	10	12	14	16	18	20	22
Approx. Inch	5/64"	3/32"	1/8"	5/32"	3/16"	1/4"	5/16"	3/8"	1/2"	9/16"	5/8"	11/16"	3/4"	7/8"

Metric MM	25	30	35	40	45	50	60	70	80	90	100	120	140	160
Approx. Inch	1"	1-3/16"	1-3/8"	1-9/16"	1-3/4"	2"	2-3/8"	2-3/4"	3-3/16"	3-1/2"	4"	4-3/4"	5-1/2"	6-1/4"

DIMENSIONS - DECIMAL EQUIVALENTS

Fraction	Decimal	Fraction	Decimal	Fraction	Decimal	Fraction	Decimal	Fraction	Decimal	Fraction	Decimal	Fraction	Decimal	Fraction	Decimal
1/64"	.0156	9/64"	.1406	17/64"	.2656	25/64"	.3906	33/64"	.5156	41/64"	.6406	49/64"	.7656	57/64"	.8906
1/32"	.0312	5/32"	.1562	9/32"	.2812	13/32"	.4062	17/32"	.5312	21/32"	.6562	25/32"	.7812	29/32"	.9062
3/64"	.0468	11/64"	.1718	19/64"	.2968	27/64"	.4218	35/64"	.5468	43/64"	.6718	51/64"	.7968	59/64"	.9218
1/16"	.0625	3/16"	.1875	5/16"	.3125	7/16"	.4375	9/16"	.5625	11/16"	.6875	13/16"	.8125	15/16"	.9375
5/64"	.0781	13/64"	.2031	21/64"	.3281	29/64"	.4531	37/64"	.5781	45/64"	.7031	53/64"	.8281	61/64"	.9531
3/32"	.0937	7/32"	.2187	11/32"	.3437	15/32"	.4687	19/32"	.5937	23/32"	.7187	27/32"	.8437	31/32"	.9687
7/64"	.1093	15/64"	.2343	23/64"	.3593	31/64"	.4843	39/64"	.6093	47/64"	.7343	55/64"	.8593	63/64"	.9843
1/8"	.1250	1/4"	.2500	3/8"	.3750	1/2"	.5000	5/8"	.6250	3/4"	.7500	7/8"	.8750	1"	1.000

Metric Dimensions

HEX HEAD CAP SCREWS

DIN 931/933

	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
Across Flats	8	10	13	17	19	22	24	27	30	32	36
Head Height	3.35	3.85	5.15	6.22	7.32	8.62	9.82	11.28	12.28	13.78	14.78

		M2	M2.5	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
HEX NUTS DIN 934	Thickness	1.35	1.75	2.15	2.9	3.7	4.7	6.14	7.64	9.64	10.3	12.3	14.3	14.9	16.9	17.7
	Ac. Flats	4	5	5.5	7	8	10	13	17	19	22	24	27	30	32	36
NYLON INSERT DIN 985	Thickness	–	–	4	5	5	6	8	10	12	14	16	18.5	20		
	Ac. Flats	–	–	5.5	7	8	10	13	17	19	22	24	27	30		
JAM NUTS DIN 439	Thickness	0.95	1.35	1.55	1.95	2.45	2.9	3.7	4.7	5.7	6.42	7.42	8.42	9.1		
	Ac. Flats	4	5	5.5	7	8	10	13	17	19	22	24	27	30		

FLAT WASHERS DIN 125

	M2	M2.5	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
ID	2.2	2.7	3.2	4.3	5.3	6.4	8.4	10.5	13	15	17	19	21	23	25
OD	5	6.0	7	9	10	12	16	20	24	28	30	34	37	39	44
Thickness	0.3	0.5	0.5	0.8	1	1.6	1.6	2	2.5	2.5	3	3	3	3	4

LOCKWASHERS DIN 127

	M2	M2.5	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
ID	2.1	2.6	3.1	4.1	5.1	6.1	8.1	10.2	12.2	14.2	16.2	18.2	20.2	22.5	24.5
OD	4.4	5.1	6.2	7.6	9.2	11.8	14.8	18.1	21.1	24.1	27.4	29.4	33.6	35.9	40.0
Thickness	0.5	0.6	0.8	0.9	1.2	1.6	2.0	2.2	2.5	3.0	3.5	3.5	4.0	4.0	5.0

SOCKET CAP SCREWS DIN 912

	M2	M2.5	M3	M4	M5	M6	M8	M10	M12	M16	M20
Hd. Dia.	3.62	4.32	5.32	6.78	8.28	9.78	12.73	15.73	17.73	23.67	29.67
Hd. Ht.	1.86	2.36	2.86	3.82	4.82	5.7	7.64	9.64	11.57	15.57	19.48
Hex Soc. Ac. Fl.	1.15	2	2.5	3	4	5	6	8	10	14	17

		M2	M2.5	M3	M4	M5	M6	M8	M10
PHILLIPS PAN DIN 7985	Head Dia.	4	5	6	8	10	12	16	
	Head Ht.	1.6	2	2.4	3.1	3.8	4.6	6	
SLOTTED PAN DIN 85	Head Dia.	4	5	6	8	10	12	16	20
	Head Ht.	1.2	1.5	1.8	2.4	3	3.6	4.8	6
CHEESE DIN 84	Head Dia.	3.8	4.5	5.5	7	8.5	10	13	16
	Head Ht.	1.3	1.6	2	2.6	3.3	3.9	5	6
PHILLIPS/SLOTTED FLAT DIN 965/963	Head Dia.	3.8	4.7	5.6	7.5	9.2	11	14.5	18
	Head Ht.	1.2	1.5	1.65	2.2	2.5	3	4	5

METRIC PITCH

	Normal Coarse	Fine
M2	.4	
M2.5	.45	
M3	.5	
M4	.7	
M5	.8	
M6	1	
M8	1.25	1
M10	1.5	1
M12	1.75	1.5
M14	2	1.5
M16	2	1.5
M18	2.5	1.5
M20	2.5	1.5
M22	2.5	1.5
M24	3	2 or 1.5

		M3	M4	M5	M6	M8	M10	M12
FLAT SOCKET CAP SCREWS DIN 7991	Head Ht.	1.7	2.3	2.8	3.3	4.4	5.5	6.5
	Head Diameter	6	8	10	12	16	20	24
	Hex Soc. Ac. Fl.	2	2.5	3	4	5	6	8
BUTTON SOCKET CAP SCREWS DIN 7380	Head Ht.	1.65	2.2	2.75	3.3	4.4	5.5	6.6
	Head Diameter	5.7	7.6	9.5	10.5	14	17.5	21
	Hex Soc. Ac. Fl.	2	2.5	3.	4.	5.	6	8

Thread Information

CLASS OF THREAD FOR STAINLESS, BRASS, SILICON BRONZE AND ALUMINUM FASTENERS

2A - Hex Head Cap Screws, Machine Screws, Carriage Bolts, Square Head Set Screws, Slotted Headless Set Screws, Thumb Screws, normally Threaded Rod
2B - All Nuts
3A - Socket Cap Screws, Socket Set Screws, Flat Socket Cap Screws, Button Socket Cap Screws, Shoulder Bolts

THREAD LENGTHS FOR INDUSTRIAL FASTENERS

HEX HEAD CAP SCREWS

Stainless, Brass
Up to and including 6" long: min. thd. twice the diameter plus 1/4";
over 6" long; min. thd. twice the diameter plus 1/2";
all hex caps may have an additional 1/4" to 3/8" thread, particularly on short lengths up to 1-1/2" and long lengths over 4".

Silicon Bronze
Up to and including 4" long: full thread;
over 4" long: may be full thread at option of manufacturer.

Aluminum
1/4" through 1/2" diameter up to and including 1-1/2" long: full thread;
5/8" diameter up to and including 1-3/4" long: full thread; longer lengths than above at the option of the manufacturer.

CARRIAGE BOLTS

Stainless
Up to and including 4" long: full thread;
over 4" long: may be full thread or have shoulder of 1"-2" or more, at the option of the manufacturer.

HEX LAG BOLTS

Stainless
Usually threaded two-thirds of length; short lengths of 1-1/2" or less may have additional thread.

WOOD SCREWS

Stainless, Brass
Usually threaded about 2/3 of length: short lengths may be full thread.

MACHINE SCREWS

Stainless, Brass, Silicon Bronze
Up to and including 2" long: full thread;
over 2" long: usually full thread but may have shoulder.

SHEET METAL SCREWS

Stainless
Up to and including 2" long: full thread;
over 2" long: usually 2" of thread with balance as shoulder, but sometimes full thread.

THREADED SOCKET HEAD CAP SCREWS

Stainless
Usual thread length approximates maximum thread listed.

Dia.	Min. Thread Length	Max. Thread Length	Dia.	Min. Thread Length	Max. Thread Length
0	1/2"	5/8"	3/8	1-1/4"	2"
1,2,3	5/8"	7/8"	7/16	1-3/8"	2-1/4"
4,5	3/4"	1"	1/2	1-1/2"	2-1/2"
6	3/4"	1-1/8"	5/8	1-3/4"	3"
8	3/4"	1-1/4"	3/4	2"	3-1/2"
10	7/8"	1-3/8"	7/8	2-1/4"	3-3/4"
1/4	1"	1-1/2"	1	2-1/2"	4-1/2"
5/16	1-1/8"	1-3/4"			

Note: Yellow Woods stocks fully threaded 18/8 socket head cap screws.

FLAT AND BUTTON SOCKETS

Stainless
Usually full thread.

THREAD DIMENSIONS FOR SHEET METAL SCREWS AND WOOD SCREWS

SHEET METAL SCREWS

Size	Major Dia.	Minor Dia.	Threads Per In.
4A	.114-.110	.083-.078	24
4B,AB	.114-.110	.086-.082	24
6A	.141-.136	.102-.096	18
6B,AB	.139-.135	.104-.099	20
8A	.168-.162	.123-.116	15
8B,AB	.166-.161	.122-.116	18

Size	Major Dia.	Minor Dia.	Threads Per In.
10A	.194-.188	.133-.126	12
10B,AB	.189-.183	.144-.135	16
12A	.221-.215	.162-.155	11
12B,AB	.215-.209	.164-.157	14
14A	.254-.248	.185-.178	10
14B,AB	.246-.240	.192-.185	14

WOOD SCREWS

Size	Major Dia.	Minor Dia.	Threads Per In.
4	.116-.105	.100-.089	22
6	.142-.131	.122-.111	18
8	.168-.157	.145-.134	15

Size	Major Dia.	Minor Dia.	Threads Per In.
10	.194-.183	.164-.153	13
12	.220-.209	.189-.178	11
14	.246-.235	.211-.200	10

THREAD AND POINT INFORMATION FOR SELF-DRILLING SCREWS

		Max.	Max.	Length									
	Threads Per In.	Major Dia.	Minor Dia.	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2	2	2-1/2	3
6	20	.139	.104	#1	#2(.190)	#2(.190)	#2(.190)	#2(.190)					
8	18	.166	.122	#1	#2(.211)	#2(.211)	#2(.211)	#2(.211)	#2(.211)	#2(.211)			
10	16	.189	.141		#2(.211)	#3(.300)	#3(.300)	#3(.300)	#3(.300)	#3(.300)	#3(.300)		
12	14	.215	.164				#3(.353)	#3(.353)	#3(.353)	#3(.353)	#3(.353)	#3(.353)	#3(.353)
14	14	.246	.192				#3(.393)	#3(.393)	#3(.393)	#3(.393)	#3(.393)	#3(.393)	#3(.393)

Thread Dimensions (Class 2A, 2B, 3A, 3B ASME B1.1)

EXTERNAL		Major Dia.		Minor Dia.
		Max.	Min.	Max.
0/80	2A	.0595	.0563	.0446
	3A	.0600	.0568	.0451
1/72	2A	.0724	.0689	.0559
	3A	.0730	.0695	.0565
2/56	2A	.0854	.0813	.0642
	3A	.0860	.0819	.0648
3/48	2A	.0983	.0938	.0734
	3A	.0990	.0945	.0741
4/40	2A	.1112	.1061	.0814
	3A	.1120	.1069	.0822
5/40	2A	.1242	.1191	.0944
	3A	.1250	.1199	.0952
6/32	2A	.1372	.1312	.1000
	3A	.1380	.1320	.1008
8/32	2A	.1631	.1571	.1259
	3A	.1640	.1580	.1268
10/24	2A	.1890	.1818	.1394
	3A	.1900	.1828	.1404
10/32	2A	.1891	.1831	.1519
	3A	.1900	.1840	.1528
12/24	2A	.2150	.2078	.1654
	3A	.2160	.2088	.1664
1/4-20	2A	.2489	.2408	.1894
	3A	.2500	.2419	.1905
1/4-28	2A	.2490	.2425	.2064
	3A	.2500	.2435	.2074
5/16-18	2A	.3113	.3026	.2452
	3A	.3125	.3038	.2464
5/16-24	2A	.3114	.3042	.2618
	3A	.3125	.0353	.2629
3/8-16	2A	.3737	.3643	.2992
	3A	.3750	.3656	.3005
3/8-24	2A	.3739	.3667	.3243
	3A	.3750	.3678	.3254
7/16-14	2A	.4361	.4258	.3511
	3A	.4375	.4272	.3525
7/16-20	2A	.4362	.4281	.3767
	3A	.4375	.4294	.3780
1/2-13	2A	.4985	.4876	.4069
	3A	.5000	.4891	.4084
1/2-20	2A	.4987	.4906	.4392
	3A	.5000	.4919	.4405
9/16-12	2A	.5609	.5495	.4617
9/16-18	2A	.5611	.5524	.4950
5/8-11	2A	.6234	.6113	.5152
	3A	.6250	.6129	.5168
5/8-18	2A	.6236	.6149	.5575
3/4-10	2A	.7482	.7353	.6291
	3A	.7500	.7371	.6309
3/4-16	2A	.7485	.7391	.6740
7/8-9	2A	.8731	.8592	.7408
	3A	.8750	.8611	.7427
7/8-14	2A	.8734	.8631	.7884
1-8	2A	.9980	.9830	.8492
	3A	1.000	.9850	.8512
1-14	2A	.9983	.9880	.9132
1-1/8-7	2A	1.1228	1.1064	.9527
1-1/8-8	2A	1.1229	1.1079	.9741
1-1/4-7	2A	1.2478	1.2314	1.0777
1-1/4-8	2A	1.2479	1.2329	1.0991
1-1/2-6	2A	1.4976	1.4794	1.2992
1-1/2-8	2A	1.4978	1.4828	1.3490

INTERNAL		Major Dia.		Minor Dia.
		Max.	Min.	Max.
0/80	2B	.0465	.0514	.0600
	3B	.0465	.0514	.0600
1/72	2B	.0580	.0635	.0730
	3B	.0580	.0635	.0730
2/56	2B	.0667	.0737	.0860
	3B	.0667	.0737	.0860
3/48	2B	.0764	.0845	.0990
	3B	.0764	.0845	.0990
4/40	2B	.0849	.0939	.1120
	3B	.0849	.0939	.1120
5/40	2B	.0979	.1062	.1250
	3B	.0979	.1062	.1250
6/32	2B	.104	.114	.1380
	3B	.1040	.1140	.1380
8/32	2B	.130	.139	.1640
	3B	.1300	.1389	.1640
10/24	2B	.145	.156	.1900
	3B	.1450	.1555	.1900
10/32	2B	.156	.164	.1900
	3B	.1560	.1641	.1900
12/24	2B	.171	.181	.2160
	3B	.1710	.1807	.2160
1/4-20	2B	.196	.207	.2500
	3B	.1960	.2067	.2500
1/4-28	2B	.211	.220	.2500
	3B	.2110	.2190	.2500
5/16-18	2B	.252	.265	.3125
	3B	.2520	.2630	.3125
5/16-24	2B	.267	.277	.3125
	3B	.2670	.2754	.3125
3/8-16	2B	.307	.321	.3750
	3B	.3070	.3182	.3750
3/8-24	2B	.330	.340	.3750
	3B	.3300	.3372	.3750
7/16-14	2B	.360	.376	.4375
	3B	.3600	.3717	.4375
7/16-20	2B	.383	.395	.4375
	3B	.3830	.3916	.4375
1/2-13	2B	.417	.434	.5000
	3B	.4170	.4284	.5000
1/2-20	2B	.446	.457	.5000
	3B	.4460	.4537	.5000
9/16-12	2B	.472	.490	.5625
9/16-18	2B	.502	.515	.5625
5/8-11	2B	.527	.546	.6250
	3B	.5270	.5391	.6250
5/8-18	2B	.565	.578	.6250
3/4-10	2B	.642	.6563	.7500
	3B	.6420	.6545	.7500
3/4-16	2B	.682	.696	.7500
7/8-9	2B	.755	.778	.8750
	3B	.7550	.7681	.8750
7/8-14	2B	.798	.814	.8750
1-8	2B	.865	.890	1.000
	3B	.8650	.8797	1.000
1-14	2B	.92	.938	1.000
1-1/8-7	2B	.970	.998	1.1250
1-1/8-8	2B	.990	1.015	1.1250
1-1/4-7	2B	1.095	1.123	1.2500
1-1/4-8	2B	1.115	1.140	1.250
1-1/2-6	2B	1.320	1.350	1.5000
1-1/2-8	2B	1.365	1.390	1.5000

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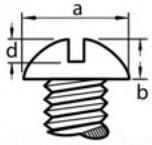
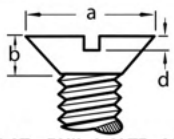
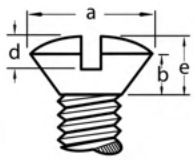
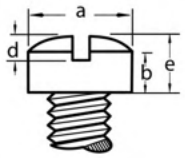
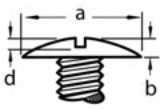
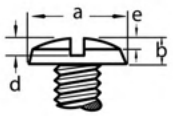
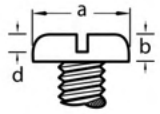
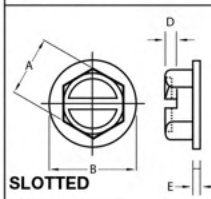
Head Dimensions – Phillips and Slotted Machine and Sheet Metal Screws

Head Dimensions ASME B18.6.3 **Thread Dimensions - Class 2A Fit, ASME B1.1 for machine screws**

Dia. of Screws ... no. or in.		0	1	2	3	4	5	6	8	10	12	1/4	5/16	3/8
	A	.113	.138	.162	.187	.211	.236	.260	.309	.359	.408	.472	.590	.708
		.099	.122	.146	.169	.193	.217	.240	.287	.334	.382	.443	.557	.670
	B	.053	.061	.069	.078	.086	.095	.103	.120	.137	.153	.175	.216	.256
		.043	.051	.059	.067	.075	.083	.091	.107	.123	.139	.160	.198	.237
	D	.039	.044	.048	.053	.058	.063	.068	.077	.087	.096	.109	.132	.155
ROUND - PHIL & SLTD.		.029	.033	.037	.040	.044	.047	.051	.058	.065	.073	.082	.099	.117
	A	.112	.137	.162	.187	.212	.237	.262	.312	.362	.412	.477	.597	.717
		.096	.120	.144	.167	.191	.215	.238	.285	.333	.380	.442	.556	.670
	B	.035	.043	.051	.059	.067	.075	.083	.100	.116	.132	.153	.191	.230
	D	.015	.019	.023	.027	.030	.034	.038	.045	.053	.060	.070	.088	.106
FLAT - PHIL & SLTD. 82°		.010	.012	.015	.017	.020	.022	.024	.029	.034	.039	.046	.058	.070
	A	.112	.137	.162	.187	.212	.237	.262	.312	.362	.412	.477	.597	.717
		.096	.120	.144	.167	.191	.215	.238	.285	.333	.380	.442	.556	.670
	B	.035	.043	.051	.059	.067	.075	.083	.100	.116	.132	.153	.191	.230
	D	.030	.038	.045	.052	.059	.067	.074	.088	.103	.117	.136	.171	.206
		.025	.031	.037	.043	.049	.055	.060	.072	.084	.096	.112	.141	.170
	E	.056	.068	.080	.092	.104	.116	.128	.152	.176	.200	.232	.290	.347
OVAL - PHIL & SLTD.		.041	.052	.063	.073	.084	.095	.105	.126	.148	.169	.197	.249	.300
	A	.096	.118	.140	.161	.183	.205	.226	.270	.313	.357	.414	.518	.622
		.083	.104	.124	.145	.166	.187	.208	.250	.292	.334	.389	.490	.590
	B	.043	.053	.062	.070	.079	.088	.096	.113	.130	.148	.170	.211	.253
		.038	.045	.053	.061	.069	.078	.086	.102	.118	.134	.155	.194	.233
	D	.025	.031	.037	.043	.048	.054	.060	.071	.083	.094	.109	.137	.164
		.015	.020	.025	.030	.035	.040	.045	.054	.064	.074	.087	.110	.133
	E	.055	.066	.083	.095	.107	.120	.132	.156	.180	.205	.237	.295	.355
FILLISTER - PHIL & SLTD.		.047	.058	.066	.077	.088	.100	.111	.133	.156	.178	.207	.262	.315
	A	–	–	.194	.226	.257	.289	.321	.384	.448	.511	.573	.698	.823
		–	–	.180	.211	.241	.272	.303	.364	.425	.487	.546	.666	.787
	B	–	–	.053	.061	.069	.078	.086	.102	.118	.134	.150	.183	.215
		–	–	.044	.051	.059	.066	.074	.088	.103	.118	.133	.162	.191
	D	–	–	.031	.036	.040	.045	.050	.058	.068	.077	.087	.106	.124
TRUSS - PHIL & SLTD.		–	–	.022	.026	.030	.034	.037	.045	.053	.061	.070	.085	.100
	A	–	–	.181	.208	.235	.263	.290	.344	.399	.454	.525	.656	.788
		–	–	.171	.197	.223	.249	.275	.326	.378	.430	.498	.622	.746
	B	–	–	.050	.059	.068	.078	.087	.105	.123	.141	.165	.209	.253
		–	–	.043	.052	.061	.069	.078	.095	.112	.130	.152	.194	.235
	D	–	–	.030	.036	.042	.048	.053	.065	.077	.089	.105	.134	.163
		–	–	.020	.025	.030	.035	.040	.050	.060	.070	.084	.108	.132
	E	–	–	.018	.022	.025	.029	.032	.039	.045	.052	.061	.077	.094
BINDING - PHIL & SLTD.		–	–	.013	.016	.018	.021	.024	.029	.034	.039	.046	.059	.071
	A	–	–	.167	.193	.219	.245	.270	.322	.373	.425	.492	.615	.740
		–	–	.155	.180	.205	.231	.256	.306	.357	.407	.473	.594	.716
	B	–	–	.053	.060	.068	.075	.082	.096	.110	.125	.144	.178	.212
		–	–	.045	.051	.058	.065	.072	.085	.099	.112	.130	.162	.195
	D	–	–	.031	.036	.040	.045	.050	.058	.068	.077	.087	.106	.124
PAN & SLTD.	–	–		.022	.026	.030	.034	.037	.045	.053	.061	.070	.085	.100
WIDTH OF SLOT -		.023	.026	.031	.035	.039	.043	.048	.054	.060	.067	.075	.084	.094
ALL HEADS		.016	.019	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
	A	–	–	–	–	.188	–	.250	.250	.312	.312	.375	.500	.562
		–	–	–	–	.181	–	.244	.244	.305	.305	.367	.489	.551
	B	–	–	–	–	.243	–	.328	.348	.414	.432	.520	.676	.780
		–	–	–	–	.225	–	.302	.322	.384	.398	.480	.624	.720
	D	–	–	–	–	.042	–	.053	.074	.080	.103	.111	.134	.168
		–	–	–	–	.025	–	.033	.052	.057	.077	.083	.100	.131
SLOTTED	E	–	–	–	–	.019	–	.025	.031	.031	.039	.050	.055	.068
HEX WASHER		–	–	–	–	.011	–	.015	.019	.019	.022	.030	.035	.037

Physical and Dimensional Specifications – Stainless

	Dimensional	Physical
18-8, 304, 316 **Hex head cap screws**	Head and body dimensions to ASME B18.2.1 Thread dimensions to class 2A fit, ASME B1.1 Thread length to ASME B18.2.1 minimum - actual thread length may be longer. See chart in catalog	Cold formed hex caps - tensile, yield and hardness increase sharply during cold-formed manufacturing of stainless. Figures below are approximate and are often much higher than shown. Tensile - 100,000-125,000 psi Yield - 55,000-75,000 psi Hardness - 100 Rockwell B Elongation - 30% Reduction in area - 40%
		Hot-forged hex caps - Tensile - 70,000 psi min. Yield - 30,000 psi min. Hardness - 70 Rockwell B min. Elongation - 30% min. Reduction in area - 40% min.
18-8, 304, 316 **Finished hex nuts -** **jam** **heavy** **heavy jam** **machine screw** **small pattern** **nylon insert** **cap** **wing**	Finished, jam, heavy, heavy jam - thickness and width across flats to ASME B18.2.2 Thread dimensions to class 2B, ASME B1.1	All cold-formed nuts - tensile, yield and hardness increase sharply during cold-formed manufacturing of stainless. Figures below are approximate and are often much higher than shown. Tensile - 100,000-125,000 psi Yield - 55,000-75,000 psi Hardness - 100 Rockwell B Elongation - 30% Reduction in area - 40%
	Machine screw nuts - thickness and width across flats to ASME B18.6.3 Thread dimensions to class 2B, ASME B1.1	All hot-forged nuts - Tensile - 70,000 psi Yield - 30,000 psi Hardness - 70 Rockwell B min. Reduction in Area - 40%
	Nylon insert, small pattern, cap, wing - thread dimensions to class 2B, ASME B1.1 Thickness, width across flats and other dimensions - see chart in catalog	Nylon insert - normally nylon 66 with resisting temperature of 256 degrees F., heat distortion at 360 degrees F. and melt-down at 480 degrees F. Nylon tensile increases with temperature decrease.
18-8, 316 **socket caps** **socket sets** **flat sockets** **button sockets** **square head sets** **slotted headless sets**	Socket caps, sets, flats, buttons - head, body and socket dimensions to ASME B18.3 Thread dimensions to class 3A fit, ASME B1.1 Thread lengths: see chart in catalog Socket caps normally knurled heads except #2 dia. & below.	Cold-formed - tensile, yield and hardness increase sharply during cold-formed manufacturing of stainless. Figures below are approximate and are often much higher than shown. Tensile - 100,000-125,000 psi Yield - 55,000-75,000 psi Hardness - 100 Rockwell B Soc. Sets may be lower Elongation - 30% Reduction in area - 40% Hot Forged Tensile - 70,000 PSI Min. Yield - 30,000 PSI Min. Hardness - 70 Rockwell B Min.
	Square set, slotted headless sets - head and body dimensions to ASME B18.6.2 Thread dimensions to class 2A, ASME B1.1	
18-8, 316 **machine screws** **sheet metal screws** **wood screws**	Machine screws - head, body, slot and recess dimensions to ASME B18.6.3 Thread dimensions to class 2A fit, ASME B1.1 Thread length: see chart in catalog	Tensile, yield and hardness increase sharply during cold-formed manufacturing of stainless. Figures below are approximate and are often much higher than shown. Tensile - 100,000-125,000 psi Yield - 55,000-75,000 psi Hardness - 100 Rockwell B Elongation - 30% Reduction in area - 40%
	Sheet metal screws - head, slot and recess dimensions to ASME B18.6.4. Stainless sheet metal screws are normally type A or type B, not type AB. Thread dimensions: see chart in catalog	
	Wood screws - Head, body, slot, recess and thread dimensions to ASME B18.6.1 Thread length: see chart in catalog	

Physical and Dimensional Specifications – Brass and Silicon Bronze

	Dimensional	Physical
Brass cold-formed or machined **hex head cap screws** **hex nuts** **knurled nuts** **machine screws** **wood screws** **knurled thumb screws** **Note that cold-formed brass is generally made from alloy 270 or commercial brass while machined brass is normally made from alloy 360.**	Hex caps - head and body dimensions to ASME B18.2.1 Thread dimensions to class 2A fit, ASME B1.1 Finished, jam nuts - thickness and width across flats to ASME B18.2.2 Thread dimensions to class 2B, ASME B1.1 M/S nuts - thickness and width across flats to ASME B18.6.3 Thread dimensions to class 2B, ASME B1.1 Knurled nuts - see dimensions in catalog Machine screws - head, body, slot and recess dimensions to ASME B18.6.3 Thread dimensions to class 2A, ASME B1.1 Thread length: see chart in catalog Wood screws - head, body, slot, recess and thread dimensions to ASME B18.6.1 Brass wood screws are normally made as cut thread Thread length: see chart in catalog Knurled thumb screws - thread dimensions to class 2B, ASME B1.1 Other dimensions - see chart in catalog	Cold-formed brass fasteners tend to be at least 5%-10% higher than machined fasteners in tensile, yield and hardness so cold-formed might fall towards the higher end of the range below. Tensile - 50,000-65,000 psi Yield - 30,000-50,000 psi Hardness - 40-75 Rockwell B min. Elongation - 10%-25%
Brass **flat washers**	See chart in catalog	Washers should be flat, smooth, and parallel
Silicon bronze **cold-formed hex head cap screws** **normally made from alloy 651 material.**	Head and body dimensions to ASME B18.2.1 Thread dimensions to class 2A fit, ASME B1.1 Thread length: see chart in catalog	Tensile - 70,000-100,000 psi Yield - 50,000-55,000 psi min. Elongation - 8%-10% min. Hardness - 70 Rockwell B min.
Silicon bronze **cold-formed hex nuts** **finished** **jam** **heavy** **machine screw** **normally made from alloy 651 material.**	Finished, jam heavy - thickness and width across flats to ASME B18.2.2 Thread dimensions to class 2B, ASME B1.1 Machine screw nuts - thickness and width across flats to ASME B18.6.3	Thread dimensions to class 2B, ASME B1.1 Tensile - 70,000-100,000 psi Proof load stress psi - 50 min. Hardness - 60 Rockwell B min.
Silicon bronze **flat washers** **lockwashers**	Flat - see chart in catalog Lock - dimensions to ASME B18.21.1	Flat - washer faces should be flat, smooth and parallel Lock - Hardness - 90 Rockwell B min. Washer should have capacity to compress flat and show definable rebound upon release

Physical and Dimensional Specifications – Stainless and Aluminum

	Dimensional	Physical
18-8, 316 **flat washers** **lockwashers**	Flat - see chart in catalog	Flat - washer faces should be flat, smooth and parallel
	Medium lock - dimensions to ASME B18.21.1	Lock - Hardness - 35 Rockwell C min. Washer should have capacity to compress flat and show definable rebound upon release
	Light lock - see chart in catalog	
18-8, 316 **carriage bolts** **hex lag bolts**	Carriage - head and body dimensions to ASME B18.5 Thread dimensions to class 2A fit, ASME B1.1 Thread length: see chart in catalog	Cold formed - tensile, yield and hardness increase sharply during cold-formed manufacturing of stainless. Figures below are approximate and are often much higher than shown. Tensile - 100,000-125,000 psi Yield - 55,000-75,000 psi Hardness - 100 Rockwell B Elongation - 30% Reduction in area - 40%
	Lag - head, body and thread dimensions to ASME B18.2.1 Thread length: see chart in catalog	
18-8 **shoulder bolts**	Head, body and socket dimensions to ASME B18.3 Thread dimensions to class 3A fit, ASME B1.1	Tensile - 70,000 psi min. Yield - 30,000 psi min. Hardness - 55 Rockwell B min.
18-8, 304, 316 **threaded rod**	Thread dimensions to class 1A or class 2A, ASME B1.1 Pressure applied in roll threading stainless rod causes the rod to elongate or stretch. As the rod stretches, the pitch diameter is reduced which may, in turn, reduce the thread class.	Tensile - 70,000 psi min. Yield - 30,000 psi min. Hardness - 70 Rockwell B min. Elongation - 30% min. Reduction in area - 40% min.
410 hardened with bright finish **self-drilling screws**	Body, thread, and point dimensions to ASME B18.6.4 Tensile - 180,000 psi heat-treated	Yield - 150,000 psi heat-treated Hardness - 40 Rockwell C min.
18-8, 304, 316 **MS-AN-NAS-ASTM Fasteners**	To government or consensus specification as required	To government or consensus specification as required
18-8, 316 (A2 & A4) **metric fasteners**	To DIN standard as required	To DIN standard as required
Aluminum **Hex Head Cap Screws** **Finished Nuts** **Machine Screws Nuts** **Flat Washers** **Lockwashers** **Threaded Rod**	Hex caps - head and body dimensions to ASME B18.2.1 Thread dimensions to class 2A fit, ASME B1.1 Thread length - see chart in catalog	Tensile, yield, and hardness vary sharply depending on the alloying metal mixed with aluminum and the type of heat treatment. Lowest tensile strength is 6061, with 2024 in the middle, and 7075 at the highest strength. Hardness is not considered an important specification in aluminum. The light weight of aluminum is its claim to fame. Tensile - 37,000-75,000 psi Yield - 30,000-50,000 psi Hardness - B40-B90 Elongation - 10%
	Finished nuts - thickness and width across flats to ASME B18.2.2 Thread dimensions to class 2B, ASME B1.1	
	Machine screw nuts - thickness and width across flats to ANSI B18.6.3 Thread dimensions to class 2B, ASME B1.1	
	Flat washers - see chart in catalog	
	Lockwashers - dimensions to ANSI B18.21.1	

Metric Fasteners

Stocking A2, A4 and Brass

- Carriage Bolts
- Dowel Pins
- Hex Heads
  - Partial Thread
  - Full Thread
- Screws
  - Combo Pan M/S (Slot/Phil)
  - Six Lobe Pans M/S
  - Six Lobe Flat M/S
  - Phil. Flat M/S
  - Phil. Oval M/S
  - Phil. Pan M/S
  - Sems Split L/W
  - Sems Ext Tooth
  - Sems Square Cone®
  - Slot Cheese D
  - Slot Flat M/S
  - Slot Pan M/S
- Threaded Rod

Nuts

- Cap Nuts
- Coupling Nuts
- Flange Nuts
- Flange Nylon Inserts
- Jam Nuts
- K-Locknuts
- Nylon Insert Nuts
- Regular Hex Nuts
- Wing Nuts

Washers

- Fender Washers
- Flat Washers
- High Collar L/W
- Serrated Int & Ext
- Split Lock Washers
- Tooth Washers Int & Ext

Socket Items

- Button Sockets
- Low Head Sockets
- Flat Sockets
- Socket Head Cap Screws
- Shoulder Bolts
- Set Screws
  - Cup Point
  - Flat Point
  - Cone Point
  - Knurled
  - Point Dog
  - Point

- Item with Green Dot also available in Brass
- Item with Red Dot also available in Type A4-316

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Approximate Weights Per M for 18-8 Stainless -

(316 plus 1%; Brass-Plus 8%; Silicon Bronze-Plus 11%; Aluminum-Minus 65%)

MACHINE SCREWS (top) SHEET METAL (bottom)

	2	4	6	8	10	12	1/4	5/16	3/8
1/4	.5 .5	.9 .9	1.6 1.4	2.7 2.4	4.1 3.7				
3/8	.7 .7	1.2 1.2	2.0 1.9	3.4 2.8	4.6 4.3	6.4 6.0	8.8		
1/2	.8 .8	1.5 1.4	2.3 2.2	3.8 3.4	5.2 4.8	7.2 6.4	10.8 9.3	19.6	30.2
5/8	.9	1.7 1.6	2.7 2.5	4.4 3.9	6.0 5.4	8.1 7.4	12.0 10.4	21.7	31.5
3/4	1.0	2.0 1.9	3.1 2.9	4.9 4.3	6.8 6.0	9.0 8.2	12.3 11.4	23.7	34.5
1	1.4	2.4 2.3	3.8 3.6	6.0 5.3	8.1 7.1	11.1 9.8	16.0 13.4	28.0	40.5
1-1/4		2.9	4.5 4.3	7.1 6.3	9.4 8.4	12.5 11.6	18.4 15.8	32.0	46.6
1-1/2		3.4	5.3 5.0	8.1 7.3	10.9 9.6	14.6 13.2	20.9 17.8	36.1	52.6
1-3/4			6.0 5.7	9.2 8.2	12.2 10.9	16.6 14.9	23.4 20.3	40.2	58.8
2			6.8 6.5	10.3 9.1	13.7 12.0	18.5 16.4	25.9 22.2	44.4	65.0
2-1/2			8.2	12.6 10.9	16.6 14.4	22.4 19.9	31.0 26.6	52.7	77.2
3			9.7	14.8 12.7	19.5 17.0	25.9 23.0	36.1 31.0	61.1	89.5

SOCKET CAPS (top) SOCKET SETS (bottom)

	2	4	6	8	10	1/4	5/16	3/8	1/2
3/16	.5 .2	.3	.4	.6	.7	1.3			
1/4	.6 .2	1.1 .4	1.7 .5	3.0 .8	1.0	1.6	2.2	3.7	
3/8	.7 .4	1.3 .6	2.3 .9	3.5 1.5	5.1 1.8	9.6 3.0	4.6	6.1	11.0
1/2	.9 .6	1.6 .9	2.8 1.2	4.3 2.0	5.8 2.4	10.6 4.2	18.4 6.7	30.6 9.4	16.0
5/8	1.0	1.9 1.1	3.0 1.6	4.8 2.6	6.6 3.2	12.0 5.6	20.5 8.7	33.2 12.0	21.4
3/4	1.2	2.1 1.4	3.5 2.0	5.5 3.1	7.3 3.8	13.4 6.9	22.7 10.8	36.3 17.1	76.7 26.0
1	1.5	2.6 1.8	4.4 2.8	6.7 4.5	9.5 5.3	15.5 9.2	26.6 14.8	42.3 21.8	89.1 37.2
1-1/4	2.0	3.1	5.1	7.8	11.0 6.7	17.8 11.9	32.0 19.3	49.1 27.0	98.2 49.0
1-1/2		3.8	6.1	9.0	12.7	21.8 14.8	36.3 23.9	58.5 33.2	110 61.0
1-3/4		4.2	7.5	10.4	14.7	23.1 17.0	41.9 27.0	65.8 40.3	128 75.0
2		4.8	8.2	11.6	15.2	25.6 19.8	46.7 31.5	74.2 46.0	141 80.5
2-1/2					18.9	30.5	56.2	89.9	168
3					24.1	35.5	67.6	106	198

HEX CAPS (top) CARRIAGE BOLTS (middle) LAG BOLTS (bottom)

	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
1/2	13.4 12.7	20.5	33.5									
3/4	15.6 14.8	24.8 23.5	39.7 37.8	56.1	84.5							
1	18.7 17.8 17.5	29.2 27.7 27.5	45.9 43.6 41.7	64.4	95.5 90.7	157	252					
1-1/4	21.4 20.2 20.1	34.7 33.0 32.8	52.7 50.0 47.9	78.8	106 101	174	278					
1-1/2	25.1 23.8 23.3	40.3 38.2 38.0	60.6 57.6 54.3	83.5	119 113 112	192	305	452	626			
1-3/4	28.6 27.1 26.2	45.8 43.4 42.9	68.4 64.9 60.8	94.0	133 125 124	212	323	489	674			
2	32.1 30.4 29.0	51.4 48.7 47.5	76.2 72.4 66.9	104.5	146 139 137	233	362	526	722			
2-1/2	39.3 37.4 34.6	62.4 59.1 56.5	92.0 87.5 79.6	125	174 165 160	276	426	610	823			
3	46.4 44.1 40.3	73.5 69.7 65.4	107 102 92.4	147	201 190 185	319	490	697	937	1230	1585	
3-1/2	53.5 50.7 45.9	84.5 81.9 74.0	123 117 106	168	229 217 207	363	554	784	1050	1370	1770	
4	60.6 57.3 51.2	95.7 91.0 82.7	138 131 119	189	257 244 231	405	618	871	1165	1520	1950	3000
4-1/2	67.7 64.0 57.4	107 101 91.8	154 145 132	210	284 270 254	448	682	958	1275	1660	2120	3250
5	74.8 70.1 62.8	118 112 100	169 159 144	231	312 295 279	492	746	1045	1390	1800	2300	3500
6	89.0 84.3 74.0	140 133 118	200 190 170	273	368 348 325	577	874	1220	1620	2100	2650	4000

Dia.	m/s Nuts Fin. 1/4" & Up	Jam Nuts	Heavy Nuts	Nylon Nuts	Cap	Wing	Flat Washers	Lock Washers	Threaded Rod
2	.4						.2	.1	
4	1.1			1.3	2.5		.4	.2	
6	2.1			2.6	4.6	4.0	.5	.3	3.5
8	2.8			4.0	4.6	7.7	.8	.5	5.5
10	3.3			5.1	8.3	7.7	1.2	.8	7.5
12	5.5			8.6			1.9	1.2	10.0
1/4	7.2	5.2	12.0	8.8	13.3	13.9	3.0	2.5	12.5
5/16	10.5	7.5	20.0	10.7	23.8	17.6	4.8	4.5	20.0
3/8	15.2	10.3	32.0	17.8	34.8	29.7	7.0	7.0	29.0

Dia.	Fin. Nuts	Jam Nuts	Heavy Nuts	Nylon Nuts	Cap	Wing	Flat Washers	Lock Washers	Threaded Rod
7/16	27.7	18.5	47.0	29.0	51.0	71.0	15.0	10.0	40.0
1/2	36.0	26.0	67.0	42.4	57.2	77.0	22.0	18.0	54.0
5/8	69.0	48.0	120	86.5	121	128	30.0	26.0	85.0
3/4	127	86.0	195	123			68.0	43.0	127
7/8	200	130	295	194			72.0	67.0	170
1	295	193	425	258			89.0	97.0	225
1-1/8	420	270	585				140	135	280
1-1/4	590	410	815				166	180	350
1-1/2	1000	690	1050				230	300	600

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"A" SHEET METAL SCREWS – Sheet metal screws with (a) sharp -pointed ends; (b) fewer threads per inch than type AB screws; and (c) deeper threads with better gripping power than type AB. The Industrial Fasteners Institute incorrectly labels type A an "obsolete" thread though it is universally preferred in 18-8 stainless over type AB, especially by the marine industry.

"AB" SHEET METAL SCREWS – Sheet metal screws with pointed ends similar to type-A screws and thread dimensions similar to type-B. Type AB screws are seldom used in stainless.

AN – Stands for Air Force-Navy.

ANSI – Stands for American National Standards Institute.

ASME – Stands for American Society of Mechanical Engineers.

ANSI/ASME NOMENCLATURE (B1.1 AND ALL) – The "B" numbers are standards set by ASME regarding various aspects of fasteners. The most common number, B1.1, deals with dimensions and thread tolerances; B1.2 with gages and their use; B1.3 with various systems for gaging threads; B1.7 with definitions of terms.

ASTM – Stands for American Society for Testing and Materials.

ASTM 193-194 – ASTM 193 are chemical and physical specifications for hex head cap screws, studs, and bolts made of steel and stainless steel. ASTM 194 refers to nuts. The commonly used stainless is called grade 8, referring to 304 material to certain specifications, and grade 8M referring to 316 material. The major differences between ASTM and commercial stainless fasteners are: (a) 304 material must be used for manufacturing grade 8, not simply 18-8; (b) ASTM 193-194 generally refers to heavy hex heads and heavy nuts, though semi-finished hex heads and finished nuts may be supplied with the permission of the buyer; (c) cold formed material will require carbide solution treatment or annealing to reduce hardness to meet ASTM requirements.

AGE HARDEN – To use modified heat treatments at various temperatures over a period of time to harden and strengthen a fastener.

AIRCRAFT QUALITY – Fasteners made with a particularly high level of attention in manufacture and inspection.

ALLOY STEEL – A mixture (or alloy) of ordinary steel added to other metals besides carbon with the specific purpose of attaining certain characteristics such as higher strength. A few exceptions to this definition exist, however, so that a chromium content above 4% is not considered alloy steel and above 12% is considered stainless steel.

ALUMINUM – The most abundant metal in the earth, aluminum is blueish and silvery-white, very light, malleable, and ductile with high heat and electrical conductivity. It is non-magnetic and one-third the weight of steel with good corrosion resistance against certain chemicals and acids but weak resistance against other elements such as sea water.

ANNEAL – To heat metal in order to lower its hardness. The term anneal refers to the heat treatment given all 300 series stainless and most 400 series stainless by a steel mill after the raw material has been completed but before fasteners are manufactured. Anneal also refers to the heat treatment given 400 series stainless fasteners after their manufacture (also called hardening and tempering) to lower hardness and increase toughness. For example, fasteners of 410 stainless may score over 200,000 psi after manufacture and be too brittle. By annealing at 1000 degrees F. tensile strength would decrease to 125,000-150,000 psi; annealing the same material to 500 de-grees F. would bring tensile to 160,000-190,000psi.

AUSTENITIC – Refers to 300 series stainless, the most popular of the stain-less alloys accounting for 85%-90% of stainless fasteners sold. Named for Sir Robert Williams Austen, an English metallurgist, austenitic stainless is a crystal structure formed by heating steel, chromium, and nickel to a high temperature where it forms the characteristics of 300 series stainless steel. An "AUSTENITE" is a molecular structure where 8 atoms of iron surround one atom of carbon, thus limiting the corrosive effects of the carbon. Austen-itic fasteners have the highest level of corrosion resistance in the stainless family, cannot be hardened by heat treatment, and are almost always non- magnetic. Sometimes heat and friction in cold-forming can cause austenitic stainless to take on slight magnetism, but the corrosion-resistant properties remain the same. The most popular of austenitic grades is known generically as "18-8 stain- less" and includes grades 302, 302HQ, 303, 304, 305, and XM-7. Typical industries using 18-8 fasteners include: food, dairy, wine, chemical, pulp and paper, pharmaceutical, boating, swimming pool, pollution control, electronic, medical and hospital equipment, computer, textile

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Type 316 stainless has added nickel and especially molybdenum. The molybdenum (called moly) sharply increases corrosion resistance to chlorides and sulfates, including sulfurous acids in the pulp industry. It has superior tensile strength at high temperatures compared to 18-8. Besides pulp and paper, typical industries using 316 are: photographic and other chemicals, ink, textile, bleach, rubber. Exotic metals in the 300 series include 309,310,317,321, and 347. With superior corrosion resistance at elevated temperatures, these metals are used for furnace parts, high temperature containers and processing equipment, aircraft parts such as collector rings, exhaust systems, and equipment for very corrosive compounds of sulfuric, nitric, citric, and lactic acids. Their usage compared to 18-8 and 316 is very low.

"B" – Referring to sheet metal screws, type-B indicates a blunt point with more threads per inch and smaller thread depth than type-A screws.

BEARING SURFACE – The part of a fastener such as the washer face of a nut or under the head of a machine screw that actually comes in contact with the part it fastens.

BEVEL – A small slant, usually describing a flat washer which is square and thicker on one side than the other. The slant of the bevelled washer can offset a slanted surface, so that a bolt going into the bevelled washer may be parallel to the floor or ground.

BINDER HEAD – Old term for pan head, "binder" has now come to mean "binding" head screws rather than pan.

BLANK – A fastener where one or two stages of manufacturing have been performed, but the fastener has not been finished.

BOLT VERSUS SCREW – Though some manuals spend pages trying to differentiate between a bolt and a screw, any difference is dubious at best and Star uses the terms interchangeably. For hex head, a bolt does not have a washer face under the head while a cap screw does.

BRASS – The most common alloy of copper, brass is about two-thirds copper, one-third zinc. It is non-magnetic with good strength and toughness, high electrical conductivity, and an attractive lustrous finish. It has good corrosion resistance but not in salt water. Brass is commonly used by the electrical and communications industries, builders hardware, and some marine applications.

BROACH – Using sharp edges to cut material and push it away, broach usually refers to the socket drive on socket screws.

CAPTIVE SCREW – Where the shoulder of a screw is perceptibly smaller in diameter than the threaded portion (technically the minor diameter or less).

CARBIDE PRECIPITATION – Carbon that breaks loose from its bond within the stainless solution when material is heated between 800-1400 degrees. Under severe corrosive conditions, it can result in extra oxidation and surface corrosion. See Solution Annealed.

CARBON – Adds strength to stainless steel, but also lowers corrosion resistance. The more carbon there is, the more chromium must be added, because carbon offsets 17 times its own weight in chromium to form carbides, thus reducing the chromium available for resisting corrosion.

CARBON STEEL – Ordinary steel with no significant additions besides carbon.

CERTIFICATE OF COMPLIANCE – A certification that a fastener meets the description or standard to which it was sold.

CHAMFER – A slight rounding on the end of a fastener or the edges of a hex nut for ease of assembly or smoother appearance.

CHEESE HEAD – Old term for fillister head in United States; similar to fillister in metric sizes.

CHROMIUM – A blue-white metal, chromium is the most important element providing corrosion resistance in stainless steel. By adding 12% chromium to ordinary steel, stainless steel is formed. Chromium offsets the corrosive effects of carbon found in steel and is the primary factor in the ability of stainless to form a passive film on its surface providing corrosion resistance.

CLASS 1A – Solution annealed in finished condition to meet ASTM A193 specification.

COARSE THREADS – Proponents of coarse threads claim: (a) coarse threads exhibit a better fatigue resistance; (b) coarse threads are more tolerant to handling and shipping; (c) coarse threads assemble and disassemble quicker and easier; (d) coarse threads tap better into brittle materials.

COLD FORMING or COLD HEADING or COLD WORKING – When fasteners are produced without heating or small heat below the recrystallization temperature (so the raw material bond of stainless remains unchanged) by pressing metal wire against various dies at high speed to form a fastener's head or basic shape. Cold working causes an increase in tensile strength and hardness (known as work hardening) and a decrease in ductility.

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CONDITION A – Means that fasteners are usually solution annealed.

CONDITION B – Means strain hardened to meet certain minimum tensile requirements.

COPPER – A reddish metal that is an excellent conductor of heat and electricity. It is malleable, ductile, and non-magnetic with low to average strength and good corrosion resistance. Brass and silicon bronze, composed mainly of copper, gain their strength from the addition of other metals, such as silicon.

CREEP STRENGTH – measure of A the resistance of fasteners to stress under elevated temperatures. At higher temperatures, a fastener can change in dimension under the same load, and that is called creep. Creep can cause the loosening of fasteners as temperature increases.

CREVICE CORROSION – Refers to joints and crevices in a fastener as-sembly where lack of oxygen caused by limited space or by surface grease prevents the passive film on stainless from forming.

CUT THREADING – Forming threads on a fastener by cutting away and actually removing the unneeded metal.

DEBURR –To remove chips, burrs, or other imperfections through a secondary operation such as grinding.

DISCONTINUITIES – A variety of small or large disfigurations in a fastener such as pits (slight depressions on the surface), toolmarks, voids (small cracks), laps, folds and seams (slightly bunched or folded material at corners of a fastener), and inclusions (a slight non-metallic impurity in the metal). Minor discontinuities are permissible in both commercial fasteners and those made to various MS and other specs.

DRAWING – Where raw material shaped like wire is pulled through a die to reduce its diameter to that needed for the particular fastener being manufactured.

DUCTILITY – The ability of a fastener to deform before breaking (for example, an elastic would be more ductile than a diamond). Ductility is a measurement similar to elongation.

"18-8" – 300 series stainless steel having approximately (not exactly) 18% chromium and 8% nickel. The term "18-8" is used interchangeably to characterize fasteners made of 302, 302HQ, 303, 304, 305, 384, XM7, and other variables of these grades with close chemical compositions. There is little overall difference in corrosion resistance among the 18-8 types, but slight differences in chemical composition do make certain grades more resistant than others against particular chemicals or atmospheres. "18-8" has superior corrosion resistance to 400 series stainless, is generally non-magnetic, and is hardenable only by cold working.

ELONGATION – Stretching a fastener to the point that it breaks. The per-cent of elongation at rupture (same as measure of ductility) is determined by dividing the total length after stretching to the original length. Elongation decreases as strength and hardness increase.

ELECTRICAL CONDUCTIVITY– Metals carry electric currents with varying capacities. As a relative guide to the conductivity of different metals, with electrolytic copper rated at 101 under the International Annealed Copper Standard, at 68 degrees F., 18-8 stainless rates is rated at 5; silicon bronze 651 at 12; and brass at 27.

ETCH – A chemical process that clean sand brightens aluminum after heat treatment.

EXTRUDING – When cold forming produces a fastener before threading with two different diameters. The portion with the larger diameter is the shoulder; the smaller portion will be roll threaded. In the extruding process, a manufacturer starts with raw material equal to the shoulder diameter and pushes part of it through a die, reducing the diameter of the portion which will later be roll threaded.

F593, F594 – F593 is a specification for stainless hex head cap screws; F594 is for stainless nuts. Compared to regular stainless fasteners, F593 and F594 call for: (a) tensile requirements about 20% higher than that of commercial 18-8 or stainless hex caps and nuts to MS specifications (MS35307-8, MS34649-50); (b) both a minimum and a maximum tensile and hardness requirements while commercial and MS fasteners do not have a maximum; (c) chemical requirements that are somewhat bizarre, eliminating many commonly used mixtures of 300 or 18-8 stainless while allowing others. The copper requirements of F593-4 permitting 3%-4% for some grades and no copper for others are senseless.

FATIGUE – Metal failure due to stresses that push first in one direction and then another. Fatigue Corrosion is caused by repeated stress in a corrosive atmosphere and is generally not associated with stainless.

FATIGUE STRENGTH – Measures the endurance of a fastener by showing the load it can accept without breaking under repeated load cycles.

FERRITIC – Comprising less than 5% of stainless fasteners, mainly type 430, it is magnetic and not hardenable by heat treatment. Though containing no nickel, ferritic stainless has a high chromium content providing greater corrosion resistance than martensitic stainless but much less than austenitic. It is mainly used by the automotive and building industries for decorative trim, architectural hardware, handrails, moldings on various products.

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FINE THREADS – Proponents of fine threads claim: (a) fine threads are stronger in tension because of their larger tensile stress area; (b) because of their larger minor diameters, fine threads develop higher torque and shear strengths; (c) fine threads tap better into thin walls and more easily into hard materials; (d) fine threads require less torque to develop equivalent preloads, since they offer more resistance to vibration.

FIT – Normally referring to threads, fit is a measure of the tightness of mating parts.

FRETTING CORROSION – Occurs when vibration causes a stainless fastener to continually rub against another surface, resulting in the passive oxide film on stainless rubbing off. Fretting corrosion might occur in high tensile fasteners such as martensitic stainless.

FULL BODY DIAMETER – When the shoulder of a fastener equals the outside or major diameter of the threaded portion.

GALLING (also called SEIZING) – When two metals or fasteners stick together and cannot be easily loosened. In tightening fasteners, for example, pressure builds on threads as metals rub against each other, and the passive film preventing corrosion on stainless may not form due to lack of oxygen. Heat contributes to galling caused by high speed fastener installation. A reduced wrench speed can help. Thread lubrication is the most effective treatment for galling.

GALVANIC CORROSION – An accelerated degree of corrosion occurring when two different metals are in contact with moisture, particularly sea water. All metals have what is termed a specific electric potential, so that low level electric current flows from one metal to another. A metal with a higher position in the galvanic series will corrode sacrificially rather than one with a lower position, meaning stainless, for example, will corrode before gold. The further apart the metals on the chart, the more electric current will flow and the more corrosion will occur. No serious galvanic action will occur by combining the same metals, only dissimilar ones. To prevent galvanic corrosion, use insulation, paint or coatings when separating dissimilar metals; or put the metal to be protected next to a metal which is not important in the assembly, so it can corrode sacrificially.

GIMLET POINT – A threaded cone point usually having a point angle of 45-50 degrees.

GRIP – The unthreaded part of a fastener.

HARDNESS - Normally stated in terms of Rockwell or Brinell scale of measurement, hardness shows resistance of a fastener to rough marks and abrasions, can indicate yield strength and brittleness, and has a direct relationship to tensile strength in alloy steel fasteners. However, for stainless, brass, and silicon bronze, the correlation between hardness and tensile or yield is tenuous with no definite relationship. Case-hardening uses surface heat treatment on ferrous material to cause a harder outside surface than the center. Through-hardening hardens the entire fastener. Bright hardening calls for heat treatment without oxygen, so no oxides are formed on the material surface.

HEADER POINT – A chamfer at the end of a fastener formed at the time of heading but before threading.

HEAT TREATMENT – Heating often combined with cooling at controlled temperatures in order to strengthen and harden a fastener.

HOT FORGING – Heating metal to red-hot temperatures or temperatures above the recrystallization point to soften it before shaping a fastener. Hot forging is primarily used when the diameter of the metal is too large for cold forming or the quantity required is too small to economically set up a cold-forming machine.

HYDROGEN EMBRITTLEMENT – Hydrogen trapped under the surface of a fastener can later cause ruptures. It is generally associated with carbon and alloy steels, not stainless. There may be no external signs of corrosion before a break occurs.

IFI – Stands for Industrial Fasteners Institute.

IN-PROCESS SAMPLING – Random samples of fasteners taken at different process points in the manufacture for testing conformance. ISO – Stands for International Organization for Standardization.

INTERGRANULAR CORROSION – A technical term describing corrosion at grain boundaries (various outside portions) of a fastener. It can occur when fasteners are heated above 800 degrees during use, such as welding, which changes the chromium-carbon bond in stainless, thus allowing increased oxidation and corrosion. To prevent intergranular corrosion, low carbon stainless should be used, or material should be annealed and quenched after exposure to elevated temperatures, so the carbon is put back into an austenitic stainless bond.

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JAM NUT – A thinner nut that is "jammed" against another nut to prevent loosening.

KNURL – A rough or decorative surface on part of a fastener.

LEAD – A heavy malleable ductile metal that increases machineability.

LEFT HAND THREAD – Opposite of commonly used fasteners. With left hand thread, a nut would be tightened on a bolt by turning it counterclockwise.

LIQUID PENETRANT TEST – Dipping fasteners into a dye and then viewing under ultraviolet light to look for cracks.

LOT – A particular size of fastener processed from the same raw material heat and same production process.

LOT SAMPLING – Random samples taken from the same lot of fasteners for quality inspection. Maximum lot size for inspection purposes should not exceed 250,000 pieces; thus, lots over 250,000 would require additional samples.

MS – Stands for Military Standards. The overriding characteristic of MS fasteners compared to commercial products is the extensive inspection and lot traceability for MS, guaranteeing the chemical, physical and dimensional qualities. While commercial fasteners may look similar and happen to pass many tests given MS products, the commercial fasteners lack the pedigree of guaranteed quality for chemical, physical and dimensional aspects that users who order MS fasteners rely on.

MACHINEABILITY – Same as free machining. Refers to the malleable characteristics of metal when cutting or forming on screw machines.

MAGNETISM – As related to stainless fasteners, 300 series stainless is non-magnetic in its raw material condition. Cold working can sometimes induce magnetism in 300 series, depending on the severity of cold working and chemical composition of the stainless. A rise in magnetism is related to an increase in tensile strength and work hardening caused by the heat and friction of cold forming and does not reduce corrosion resistance or cause any molecular change in austentic raw material. A higher portion of nickel can increase stability in stainless, thus decreasing work hardening and any possibilities of magnetism. Brass and silicon bronze are nonmagnetic. Many stainless specs including MS hex head cap screws allow 2.0 magnetic permeability which translates to low/ medium magnetism. Magnetic permeability of 1.0 translates to a very slight, glancing magnetism.

MAGNETIC PERMEABILITY - test simply determines the level of magnetism.

MAJOR DIAMETER – Largest or outside diameter of the screw threads.

MANGANESE – A non-magnetic metal which improves strength and hardness.

MARTENSITIC – Comprising approximately 5% of stainless fasteners, martensitic refers mainly to stainless types 410, 416, and 420. Named for Robert Martens, a German metallurgist, martensitic grades have a high carbon content which reduces corrosion resistance but allows a sharp increase in tensile strength after heat treatment. Because of its high tensile strength, martensitic stainless is used for highly stressed parts such as control rod mechanisms, valves, shafts and pump parts. Martensitic stainless is magnetic, contains no nickel, loses toughness in very cold temperatures, and may have a tendency to become brittle. Its corrosion resistance is not as good as austentic or ferritic stainless, so martensitic fasteners are used in mild atmospheres.

MILLED FROM BAR (also called MACHINING) – Made on a screw machine or lathe by cutting material away from the original piece of metal. It is used for manufacturing very large diameters which cannot be cold formed and for small quantities where it would not be economical to set up cold forming equipment. However, machining can interrupt the grain of metal causing a lessening in tensile and fatigue strength.

MINOR DIAMETER – The inside or smallest diameter of the screw threads.

MOLYBDENUM – Nicknamed moly, molybdenum is a metal added to 316 stainless steel, sharply increasing its corrosion resistance to chlorides and sulfates, especially various sulfurous acids in the pulp industry. Moly bdenum helps reduce hardness and increase tensile strength at higher temperatures. Molybdenum is also added to Marutex® selfdrilling screws made of 410 stainless to significantly increase corrosion resistance

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MONEL – Invented by the International Nickel Co. and composed basically of two-thirds nickel, one-third copper, monel has good strength, excellent corrosion resistance against salt water and in high temperatures, and is very expensive.

MUNTZ – A form of brass with about 60% copper.

NAVAL BRONZE (also called NAVAL BRASS) – Basic brass with a small addition of tin for added corrosion resistance against salt water.

NAS – Stands for National Aerospace Standards.

NICKEL – A metal added to 300 series stainless to provide corrosion resistance, increased strength in both high and low temperatures, and increased toughness in low temperatures. Nickel lowers the effects of work hardening, thus reducing traces of magnetism caused by cold forming and making material flow more freely in manufacturing. The addition of nickel to stain-less prevents stainless from becoming brittle at sub-zero temperatures and increases its high temperature properties.

NON-FERROUS – Metals without iron. Brass and silicon bronze are nonferrous; stainless is often characterized as non-ferrous, but that is not correct.

NYLON – Light and low in strength compared to metal fasteners, nylon is non-magnetic, good for insulation, and corrosion resistant against many chemicals.

OVEN HEAD – Old term for truss head.

PASSIVATING – A very confusing term, since the common usage has taken on a different meaning than the technical definition. In Star's experience, users (including engineers) of commercial fasteners seldom mean the old technical terminology. Technically, passivating is not cleaning but is a process of dipping fasteners into a nitric acid solution to rapidly form a chromium oxide on the surface of the material, creating a passive film that protects stainless from further oxidation (see Passive Film). The purpose of passivating is to remove both grease left from manufacturing and traces of steel particles which may have rubbed off manufacturing tools onto the fastener. In common commercial parlance (meaning non-military and aerospace), passivating means cleaning to users, and the terms "passivating" and "cleaning" are used interchangeably. A wide range of cleaning methods using different mixtures containing nitric, phosphoric and other acids or simply exposing cleaned stainless fasteners to air for a period of time will result in a "passivated" condition. For fasteners that have been properly cleaned, it is impossible to determine the method of cleaning or passivation that was used. AN/MS/NAS fasteners sold by Star have been cleaned, descaled, and passivated to the applicable engineering specifications.

PASSIVE FILM – The major characteristic of stainless is its ability to form a thin layer of protection called a "passive film" on its outside surface. This film results from a continual process of low-level oxidation, so oxygen from the atmosphere is needed for the passive film to exist. Once formed, it prevents further oxidation or corrosion from occurring. Even if chipped or scratched, a new passive film on stainless will form.

PHOSPHORUS – A non-metallic substance that lowers the rate of oxidation, thereby helping resist corrosion.

PICKLING – Removing surface impurities by using chemicals.

PILOT POINT – Similar to a "B" point, a pilot point is a small (perhaps ⅛"-¼") unthreaded blunt portion at the end of a sheet metal or drive screw.

PITCH – The distance between two adjacent threads measured at the outside diameter of the threads.

PITCH DIAMETER - Approximately in-between the major and minor diameters.

PITTING CORROSION – Pitting indicates deep corrosion in localized spots on a fastener. Dirt or grease on certain portions of a fastener may block oxygen from that surface, thus impeding the passive film which protects stainless from corrosion.

PRECIPITATION HARDENED STAINLESS STEEL – Type 630 stainless, little used, expensive and not sold as commercial products, it combines corrosion resistance of 300 series stainless with high tensile strength of 400 series.

PROOF LOAD – A test load that a fastener must undergo without showing significant deformation. It is usually 90% of yield strength.

QUENCH – To cool suddenly and rapidly after heating.

REDUCTION OF AREA – A measurement like elongation which is related to the tensile strength of a fastener. While elongation measures the length of a fastener stretched to its breaking point compared to its original length, reduction of area measures the diameter of a fastener just before breaking compared to its original diameter.

ROLL THREADING – Forming threads on a fastener by pushing or rolling dies against the fastener without any removal of metal. Roll threading, as opposed to cut threading, hardens the material making the threads stronger.

ROOT DIAMETER – Refers to the minor diameter on screws or the major diameter on nuts.

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SAE –– Stands for Society of Automotive Engineers
SCALE – A discoloring or oxidation on the surface of hot forged fasteners.
SCREW MACHINE – Cutting and removing material in order to form a fastener.
SECONDARY OPERATIONS – Less important than the major steps of heading or cold forming fasteners, secondary operations include grinding, polishing, drilling.
SEMI FINISHED HEX CAPS – The normally sold variety of stainless hex head cap screws, semi finished have the same dimensions as a finished fastener but with generally greater tolerances.
SHEAR STRENGTH – Measured by the push or pull against the side of a fastener until the fastener breaks (for example, moving an object continually against the side of a screw that is protruding from a wall). As a rule of thumb, shear strength is two-thirds of tensile strength. Double Shear Strength is applying a load against a fastener in two places causing the fastener to break into three pieces.

SILICON – A non-metallic substance that adds strength and toughness to copper to help form a bronze alloy.
SILICON BRONZE – An alloy made of 95%-98% copper plus a small amount of silicon added for strength. Small amounts of manganese and aluminum may also be added for strength, and lead may be added for machineability. Silicon bronze is non-magnetic with a high degree of thermal conductivity and high corrosion resistance against sea water, gases, and sewage. It is often used by the utilities industry for pole line hardware and switchgear equipment, mine sweeping, sewage disposal equipment, food machinery, marine applications, plumbing and liquid handling. Surprisingly, silicon bronze is only a low to moderate conductor of electricity, though it is a better conductor than stainless.

SOLUTION ANNEALED (same as CARBIDE SOLUTION ANNEALED) – A process of heating and removing carbide precipitants (carbon that has broken loose from its stainless steel solution) by heating raw material or a finished fastener to over 1,850 degrees and cooling it quickly, usually in water, so carbon content goes back into the stainless solution.
STAINLESS STEEL – With the addition of 12% chromium to iron, stainless steel is formed. The chromium protects the iron against most corrosion or red-colored rust; thus the term "stainless" steel. The ability of stainless to form a thin layer of protection on its outside surface, called a "passive film", is its most important characteristic in preventing corrosion (see Passive Film). The overriding purpose of stainless steel is to provide corrosion resistance against: (a) atmospheric conditions such as carbon dioxide, moisture, electrical fields, sulfur, salt, and chloride compounds; (b) natural and artificially produced chemicals (c) extremes of weather where cold temperatures cause brittleness and hot temperatures reduce strength and increase corrosion. For more information, see Austenitic, Martensitic, Ferritic, and Precipitation Hardening. When iron or ordinary steel are exposed to air, the oxygen in the air combines with iron to form iron oxide known as rust. When stainless steel is exposed to air or oxygen, a thin layer of film, chromium oxide, forms on the surface. If this film is broken, it will quickly reform if enough oxygen is present.
STAMPING – Punching out parts with dies, usually referring to flat washers
STOVE HEAD – Old term for truss head.
STRAIN HARDENED – To increase hardness and strength by (a) cold working of raw material by a steel mill or (b) cold forming by a fastener manufacturer. The standards for strain hardened material vary with different specifications. Cold forming by a fastener manufacturer can sharply increase tensile strength and hardness, so that ordinary material from a steel mill may often be used. However, fasteners that are milled from bar will decrease in strength and hardness, so that raw material would need to be strain hardened by a steel mill before milling the fasteners.

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Stainless Stan's MiniEncyclopedia

STRESS CORROSION – Occurs when corrosion causes a highly stressed part (one that is pushed to its maximum tensile strength) to crack. Except for heat treated 400 series stainless, stress corrosion does not normally apply to austenitic stainless, brass, or bronze, since these metals are relatively ductile and not normally used for high tensile operations.

SULFUR – A non-metallic substance found in large quantities by itself or combined with other elements to form sulfates and sulfides. It improves machineability and helps cool material and prevent galling, but its presence lowers the corrosion resistance of stainless.

TANTALUM – A gray ductile metal with a high melting point and excellent corrosion resistance against certain chemicals.

TAP – To put internal threads in a hole or in a nut.

TAP BOLT – Fully threaded bolt.

TEMPER – To heat material after hardening to a temperature of perhaps 1000 degrees F. and allow to cool naturally in order to soften material and make it less brittle. Or to heat to a lower temperature of possibly 500 degrees F. to relieve stress in metal without affecting the hardness.

TENSILE STRENGTH – A common measure to compare the strength of a fastener. It is the load needed to pull the fastener apart.

THREADS – Class 1 threads are a loose tolerance. Class 2 threads comprise 90% of stainless fasteners and are normal commercial tolerance. Class 3 threads have a stricter tolerance and tighter fit such as socket cap and set screws. No definite relationship exists between tensile strength and tightness or looseness of fit. The symbol "A" added to threads, such as 2A, means external threads (screws), and "B" means internal (nuts). With the exception of 1⁹⁄₃₂ diameter, which is extremely popular, coarse thread comprises 90-95% of hex head cap screws and hex nuts sold in 18-8 stainless, and perhaps 98% of other stainless items including machine screws and socket products. Coarse threads are deeper than fine threads with fewer threads per inch, so coarse threads may have greater protection against thread stripping, better tap in brittle materials, and better fatigue resistance, while fine threads may have better fit in thin-walled materials, higher torque strength, and increased tightness during vibration.

TIN – A malleable and ductile metal which increases strength, hardness and corrosion resistance against salt water when added to brass alloys.

TITANIUM – A silvery gray metal with high corrosion resistance against salt waters, chlorides, and many acids. It is strong, though lightweight, and very expensive.

TORQUE or TORSION STRENGTH – Torque is the force used in twisting, such as tightening a fastener. Torsion strength is the amount of force needed to twist a fastener apart. Both measures consider the amount of pressure applied to the fastener and the length of the wrench used in the application.

TOUGHNESS – A fastener's capacity to accept various impacts and shocks.

TUMBLING – To flip fasteners around like clothes in a dryer in order to clean fasteners and increase the shininess of stainless. Soap or a cleansing solution are often added.

UN, UNR – Indicates "unified" screw threads to "inch" dimensions used in the U.S. as distinguished from metric dimensions.

UNJ – A type of threads originating around the 1950's with a more rounded fit in order to prevent cracks, reduce loosening due to vibration and slightly increase strength. Possessing a tighter fit, UNJ thread depth is smaller than the usual UN standards with the minor diameter of external threads on screws and internal threads on nuts both increasing. UNJ is used in critical applications by the aerospace and automotive industries.

UNDERSIZE BODY OR REDUCED BODY DIAMETER – Where the shoulder of a fastener equals the pitch diameter or less, which means the shoulder is smaller than the outside diameter of the threads. It would indicate that a fastener was not extruded during its manufacture.

WASHER FACE – A circular rim on the underside of the head of a bolt or on one side of a nut with the purpose of providing a flat bearing surface for the bolt or nut to sit on. A smooth washer face takes away any burrs or imperfections caused by the manufacturing process.

WORK HARDENED – An increased level of hardness caused by cold forming fasteners. Too much work hardening may cause a slight degree of magnetism in austenitic stainless.

YIELD – The resistance to a load pulling on the middle of a fastener until the fastener shows permanent deformation.

YIELD STRENGTH – The amount of pressure required to cause permanent deformity.

	Chromium	Nickel	Max. Carbon	Max. Mangan.	Max. Phosph.	Max. Sulfur	Molybd.	Max. Silicon	Copper	Other Elements	Tensile	Yield	Approx. Hardness	Special Characteristics
300 SERIES AUSTENITIC STAINLESS: Accounts for 85%-90% of stainless fasteners; best corrosion resistance of stainless alloys; non-magnetic before cold working; low heat conductivity; good strength at higher temperatures; not hardenable by heat treatment.											**Tensile and yield will increase sharply in austenitic fasteners made by cold forming but may decrease in fasteners made by machining. Consequently, the range for tensile and yield is broad and depends largely on how fasteners are made. Grades commonly used for cold forming such as 302HQ, 304, and 316 may have much higher strength than other grades.**			
18-8 Also referred to as 300 Series or A-2	17-20% Usually 17-19%	8-13% Usually 8-10.5%	.08% Usually .03-05%	2%	.2% Usually .045%	.03-15% Usually .03%		1%	0-4% Usually 2%-3%		80,000-150,000 usual range. After cold work: 100,000-125,000 typical for 1/4-5/8 dia; 100,000 typical for 3/4-1" dia; 80,000-90,000 typical over 1" dia.	40,000 min. After cold work: 80,000-90,000 typical 1/4-5/8 dia.; 45,000-70,000 typical 3/4 & over dia.	B85-95	Most common designation for non-magnetic stainless fasteners; encompasses 30 to 40 various mixtures of 301, 302, 303, 304, 305 and XM7
302	17-19%	8-10%	.15%	2%	.045%	.03%		1%			90,000-125,000 Typical: 100,000	40,000 min. Typical: 50,000-70,000	B85-95	Higher carbon content than 302HQ or 304; ductile; often used in wire-typice products such as springs, screens, cables; common material for flat washers.
302HQ and XM7	17-19%	8-10%	.08%-302HQ .10%-XM7 Usually .02 or less	2%	.045%	.03%		1%	3-4%		80,000-140,000 usual range. After cold work: 100,000-120,000 typical for 1/4-5/8 dia; 100,000 typical for 3/4-1" dia; 80,000 typical over 1" dia.	40,000 min. After cold work: 80,000-90,000 typical 1/4-5/8 dia.; 45,000-65,000 typical 3/4 & over dia.	B85-95	Extra copper reduces work hardening during cold forming; commonly used for machine screws, metal scres, small nuts.
303	17-19%	8-10%	.15%	2%	.02%	.15 Min.	.6 Max.	1%			90,000-125,000	40,000 min.	B85-95	Good for machineability in products such as large nuts; not for cold forming; higher carbon and sulfur may lower corrosion resistance.
304 304L 304L is same as 304 with max. of .03% carbon	18-20%	8-10.5%	.08%	2%	.45%	.03%		1%			85,000-150,000 usual range. After cold work: 125,000 typical for 1/4-5/8 dia.; 100,000 typical for 3/4-1" dia.; 90,000 typical above 1" dia.	40,000 min. After cold work: 90,000 typical for 1/4-5/8 dia.; 50,000-70,000 typical for 3/4 & over dia.	B85-95	Most popular stainless for hex head cap screws; also frequently used for flat washers. Low carbon increases corrosion resistance and welding capacity.
305	17-19%	10.5-13%	.12%	2%	.045%	.03%		1%			See 302HQ			High nickel content lowers work hardening during severe cold forming and keeps parts non-magnetic.
316 Same as A-4 316L 316L is same as 316 with max. of .03% carbon	16-18%	10-14%	.08%	2%	.045%	.03%	2-3%	1%	May contain 1%-3%		85,000-140,000 usual range. After cold work: 120,000 typical for 1/4-5/8 dia.; 95,000 typical for 3/4-1" dia.; 80,000 typical above 1" dia.	40,000 min. After cold work: 80,000-90,000 typical for 1/4-5/8 dia.; 50,000-70,000 typical for 3/4 & over dia.	B85-95	Addition of molybdenum increases corrosion resistance to chloride and sulfides. Low carbon increases corrosion resistance and welding capacity.
309	22-24%	12-15%	.2%	2%	.045%	.03%		1%			100,000-120,000	60,000-80,000	B85-95	Higher chromium and nickel give better corrosion resistance at high temperatures (1900 deg. F.)
321	17-19%	9-12%	.08%	2%	.045%	.03%		1%		Titanium - 5 times carbon content	See 309			Titanium improves intergranular corrosion resistance, by avoiding carbide precipitation; good for intermittent heating applications and corrosion resistance to 1600 deg. F.
347	17-19%	9-13%	.08%	2%	.045%	.03%		1%		Columbian & Tantalum-10 times carbon.	See 309			Columbium and Tantalum give similar properties to 321.
Alloy 20	19%-21%	32.5%-35%	.06%	2.0%	.035%	.035%	2%-3%	1%	3%-4%	Columbian & Tantalum - 8 times carbon; 1% max.	100,000-150,000	65,000-135,000		Excellent resistance to sulfuric acid. Columbian helps resist carbide precipitation.
FERRITIC STAINLESS: A few percent of stainless fasteners; magnetic; not hardenable by heat treatment; high chromium content helps corrosion resistance.														
430	16-18%		.12%	1%	.04%	.03%		1%			70,000-75,000	40,000-45,000	B65-B75	Most popular of ferritic stainless; higher carbon content adds strength; used for cold forming and hot forging but low machineability.

	Chromium	Nickel	Max. Carbon	Max. Mangan.	Max. Phosph.	Max. Sulfur	Molybd.	Max. Silicon	Copper	Other Elements	Tensile	Yield	Approx. Hardness	Special Characteristics
400 SERIES MARTENSITIC STAINLESS: About 10% of stainless fasteners; magnetic; no nickel and high carbon content mean the lowest corrosion resistance among the different types of stainless. Used for elevated temperatures; can go to 1,100° F.														
400 Mixture Martensitic	11.5%-14%		.30% Usually .15-.30%	1.25% Usually 1%	.06% Usually .04%	.15% Usually .03%		1%			180,000-250,000 if heat treated	150,000-200,000 if heat treated	C34-C45	Often a mixture of different 400 materials, usually with carbon content towards high end of max, giving greater strength but lowering corrosion resistance.
410	11.5-13.5%		.15%	1%	.04%	.03%		1%			180,000 heat treated	150,000 heat treated	C34	Higher carbon content gives strength; most popular of the grades with 12% chrome; used in highly stressed conditions.
416	12-14%		.15%	1.25%	.06%	.15%		1%			See 410			Higher sulfur content helps machineability but lowers corrosion resistance.
420	12-14%		.30% Nom. 15% Min.	1%	.04%	.03%		1%			250,000 heat treated	200,000 heat treated	C45	Higher carbon gives greater strength but lowers corrosion resistance.
BRASS, BRONZE, COPPER and NICKEL COPPER: All brass and bronze are defined as copper alloy, since they contain at least 40% copper, while pure copper is defined as 99.3% minimum copper. With brass, zinc is the main alloying element. Regular bronze does not have a dominant alloying element while tin is the major alloy in phosphorous bronze internal-external lockwashers. Nickel Copper combines important ingredients of austenitic stainless and brass to give superior corrosion resistance with strength and toughness over a large range of temperatures.											**Due to high copper content, brass and bronze have low strength. They have excellent thermal and electrical conductivity, good corrosion resistance, and are non-magnetic.**			
Brass Alloy 270									65%	35% Zinc	70,000	45,000	B65	Good cold forming due to high copper content; also used for milled from bar nuts.
Brass Alloy 360									61.5%	3% Lead remainder Zinc	50,000	30,000	B50	Good machineability due to added lead; good for screw machine parts.
Commercial Brass									55-65%	35-42% Zinc. .05-3.5% Lead	50,000	30,000	B50	Easier to cold form as copper content increases; as copper content decreases, the metal becomes stronger and harder.
Bronze Alloy 651				.07%				2.0%	96.0% min.	.05% Lead max. 1.5% Zinc max.	70,000-80,000	35,000-45,000	B70-B75	Generally used for hex head cap screws.
Bronze Alloy 655		.06%		1.5%				3.8%	94.8% min.	.05% Lead max. 1.5% Zinc max.	See Bronze 651			Used for hot forged fasteners.
Commercial Bronze								2-4%	94-96%	.05-.8% Lead, .05-1.5% Zinc.	See Bronze 651			Addition of lead helps machineability.
Phosphorus Bronze					.3%				95%	5% Tin	60,000	35,000	B60	Tin increases strength; phosphorus helps against stress corrosion; excellent cold forming properties.
Naval Bronze									59-62%	.5-1% Tin, 2% Lead remainder Zinc	70,000	30,000	B65	Addition of tin gives better corrosion resistance against salt water.
Copper 110									99.9% min.		Used for flat washers, copper 110 has high electrical and thermal conductivity. Low tensile strength inhibits use for fasteners.			
Nickel Copper 400		63% min.	0.3%	2.0%		.024%		0.5%	28%-34%	2.5% Iron max.	70,000-130,000	30,000-60,000	60-RC25	Particularly high corrosion resistance with nearly 2/3 nickel and 1/3 copper. Marine and chemical industries are major users.
Nickel Copper K-500		63% min.	0.25%	1.5%		.01%		0.5%	27%-33%	2.0% Iron Max. 2.3%-3.15% Alum. .35%-.85% Titanium				Addition of aluminum and titanium adds strength and hardness.
ALUMINUM - Aluminum weights about one-third of steel, is non-magnetic with good electrical conductivity. Its strength-to-weight ratio is high. The "T" designation stands for heat-treated.											**Unalloyed aluminum has a tensile strength of only 13,000 psi. By alloying metals, its strength is sharply increased. Its number identifies the alloy: 2 for copper; 6 for magnesium and silicon; 7 for zinc.**			
Aluminum 2024 T-4 heat-treated	.1% Max.			.3-.9%				.5%	3.8-4.9%	.25% Zinc Max. .5% Iron Max. 1.2-1.8% Mag. .15% Titanium Max. remainder Alum.	55,000-70,000 heat treated	40,000 heat treated	B70-B85 heat treated	Most popular of aluminum alloys; uses copper as its principal alloying element; generally used for hex head cap screws and flat washers
Aluminum 6061 T-6 heat-treated	.04-.35%			.15%				.4-.8%	.15-.4%	.25% Zinc Max. .7% Iron Max. .08-1.2% Mag. .15% Titanium Max. remainder Alum.	37,000-52,000 heat treated	30,000 heat treated	B40-50 heat treated	Magnesium and silicon are the principal alloying elements; often used for hex nuts.
Aluminum 7075-T73 heat treated a variation, 7075-T6, is used for lockwashers	.18-.35%			.3%				.4%	1.2-2%	5.1-6.1% Zinc .5% Iron Max. 2.1-2.9% Mag. .2% Titanium Max. remainder Alum.	60,000-75,000 heat treated	50,000 heat treated	B80-90 heat treated	Much higher content of zinc and magnesium than other alloys; yield and hardness also higher