

**STAINLESS STEEL & NON  
FERROUS RESOURCE GUIDE**

**PRECISION SCREW PRODUCTS, INC.**

1215 KARL COURT  
SUITE 205

WAUCONDA, IL 60084

PHONE: (847) 526-2184 FAX: (847) 526-7921

800-286-BOLT (2658)

[www.precisionsscrewprod.com](http://www.precisionsscrewprod.com)

# QUALITY ASSURANCE PROMISE

Our Quality Assurance Manual is the cornerstone of our Quality Program. It sets the guidelines for inspection procedures, gaging, documentation, and calibration schedules. It provides concrete structure for our program, insuring TIMELESS CONTINUITY. We will be pleased to send you a copy of our Quality Assurance Manual upon your request.



In addition to our own IN-HOUSE quality program, we continually audit our manufacturer's operations and procedures, many of whom use STATISTICAL PROCESS CONTROL.

Precision Screw Products can furnish Dimensional Inspection Reports, Physical and Chemical Reports, and Certificates of Compliance upon request.

## **Our Product Line**

### **18-8, 304, 316, 410, 420, Silicon Bronze, Brass, Aluminum, Nickel-Copper, Copper, Phosphorous Bronze**

Hex Head Cap Screws and Full Thread Hex  
Trimmed Hex Head Caps  
ASTM A193 Grade 8 Heavy Hex Cap Screws  
ASTM F593 Hex Head Caps  
Indented Hex Machine Screws

Carriage Bolts  
Hex Lag Bolts  
Shoulder Bolts  
Elevator Bolts  
Penta Head Bolts  
Hanger Bolts  
Sidewalk Bolts

Machine & Finished Nuts  
Jam, Heavy Jam, & Heavy Nuts  
Small Pattern, Castle, Knurled Nuts  
K-L, Flex Loc, High Crown Cap, Castle Nuts  
Nylon Insert Nuts - Thin, NTU, NU, NE, NTM, NM  
Waxed Nylon Inserts, Center Lock  
Cap, Wing, Coupling, Square, Serrated Flange, T-Nuts  
Left Hand Jam & Finished, Small Pat K-L Nuts  
ASTM A194 Gr 8 Fin, Heavy Nuts  
ASTM F594 Finished Nuts

Slotted, Phillips, Sq. Dr. Sheet Metal Screw T-A & B  
Slotted, Phillips, Square Drive Machine Screws  
Slotted/Phillips Combo Pan M/S & S/M/S  
Slotted, Phillips, Square, Frearson Wood Screws  
SEMS Machine Screws

Flat, Fender, SAE Flat Washers  
Cup, Flange Cup, Neoprene Bonded Washers  
Belleville, Bevelled Washers  
Light, Medium, Heavy, High Collar Lockwashers  
Int, Ext, Ext Ctsk Lockwashers

Socket Caps and Low Head Sockets  
Socket Sets - Various Points  
Square Head Sets  
Flat, Button, Flange Button Sockets

Thumb, Shoulder, Knurled Screws  
Threaded Rod  
Key, Round Stock  
Roll, Cotter, Dowel Pins  
Deck Screws, Rivets  
Shaft Collars, Bits  
Drive Screws, Pipe Plugs  
U-Bolts, Eye Bolts  
Pin-In Buttons, Flats, Spanners  
Self-Drilling Screws

Metric - Hex Caps - Full & Partial Thread  
Nuts, Jam, Nylon Inserts, Cap, Wing Nuts  
Flat, Fender, Lockwashers, Int-Ext Lockwashers  
Socket Caps, Socket Sets, Button, Flat Sockets  
Dowel Pins, Threaded Rod  
Machine Screws

Black Oxide Fasteners  
Patched Fasteners  
Chrome-Plated Fasteners  
Nickel-Plated Fasteners

# HEAD DIMENSIONS

## HEX CAPS - HEAD DIMENSIONS ANSI 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	19/64	11/16	25/32	15/16

## DIMENSIONS - CARRIAGE BOLTS ANSI 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

## DIMENSIONS - HEX LAG BOLTS ANSI 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

## DIMENSIONS - SHOULDER BOLTS ANSI 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

## DIMENSIONS - SQUARE HEAD SET SCREWS ANSI 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 - ANSI 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 - ANSI 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 - ANSI 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
Head 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 - ANSI B18.6.3, 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 .....	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 .....	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 .....	3/64	3/64	1/16	-	1/16	3/32	3/32	3/32	7/64	-	-	-	-
	Width across Flats .....	-	-	-	-	-	-	-	5/16	11/32	-	-	-	-
	Thickness .....	-	-	-	-	-	-	-	7/64	1/8	-	-	-	-

## DIMENSIONS OF FINISHED, JAM, HEAVY, HEAVY JAM - ANSI 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 - ANSI 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	.563	.627	.752	.877	.940	1.064	1.252	1.440	1.627	1.815	2.197
Height - NM and NE	.081	.081	.081	.081	.103	.140	.140	.225	.225	.250	.335	.324	.464	.469	.593	.742	.790	.825	.930	1.125	1.313
Height - NTM and NTE	-	-	.075	-	.090	.110	.110	.125	.125	.158	.150	.225	.190	.225	.255	.288	.340	.405	.500	.523	.565
Max. Width Ac. Fl. - NTM and NTE	.251	.281	.251	.251	.313	.345	.376	.439	.439	.502	.546	.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	-	-	-	-	-	-	-	.194	.212	.251	.316	.360	-	.428	.488	.535	.600	.625	.720	.810	
Height - Heavy - NU	-	-	-	-	-	-	-	.290	.335	.392	.464	.544	-	.677	.790	.883	1.000	-	1.250	1.413	
Max. Width Ac. Fl. - Heavy - NU	-	-	-	-	-	-	-	.503	.566	.691	.754	.879	-	1.067	1.255	1.444	1.632	1.820	2.008	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)

Diameter	Wing Span Max/Min	Thickness (nom.)
4	.72/.59	.125
6	.72/.59	.125
8	.91/.78	.171
10	.91/.78	.171
1/4	1.10/.97	.187

Diameter	Wing Span Max/Min	Thickness (nom.)
5/16	1.25/1.12	.238
3/8	1.49/1.31	.250
1/2	1.94/1.81	.350
5/8	2.31/2.24	.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

# 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
3/4	2	.812	.125

## 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

## 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	.032	.016	.032	.032

★PSP Industrial Sizes

## 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	-	-

# 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. - ANSI 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			
<b>LIGHT</b>																											
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 Width In.	-	-	.030	.035	.035	.040	.040	.047	.055	.062	.107	.117	.136	.154	.170	.186	.201	.233	.264	.289	.314	.336	.356	.375			
Size Thick In.	-	-	.015	.020	.020	.025	.025	.031	.040	.047	.047	.056	.070	.085	.099	.113	.126	.153	.179	.202	.224	.244	.264	.282			
<b>MEDIUM</b>																											
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	1.647	1.838	2.028	2.210	2.409			
Section 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			
Size 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

### 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

	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
<b>DIN 931/933</b>											
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

## HEX NUTS DIN 934

	M2	M2.5	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
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

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	24.1	21.1	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

## PHILLIPS PAN DIN 7985

	M2	M2.5	M3	M4	M5	M6	M8	M10
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

## FLAT SOCKET CAP SCREWS DIN 7991

	M3	M4	M5	M6	M8	M10	M12
Head Ht.	1.7	2.3	2.8	3.3	4.4	5.5	6.5
Head Ac. Fl.	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 Ac. Fl.	5.7	7.6	9.5	10.5	14	17.5	21
Hex Soc. Ac. Fl.	2	2.5	3.	4.	5.	6	8

## 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



# 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 option of 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 option of 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.

### 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"			

### 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

	Threads Per In.	Max. Major Dia.	Max. Minor Dia.	Length										
				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)	#3(.353)
14	14	.246	.192				#3(.393)	#3(.393)	#3(.393)	#3(.393)	#3(.393)	#3(.393)	#3(.393)	#3(.393)

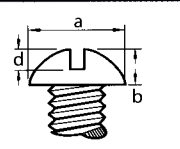
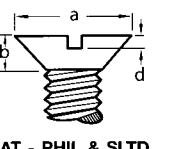
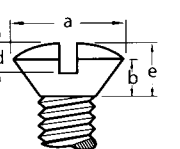
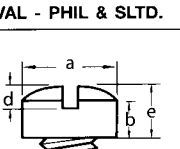
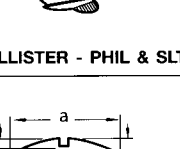
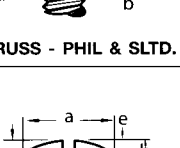
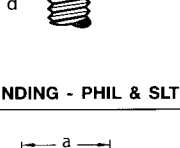
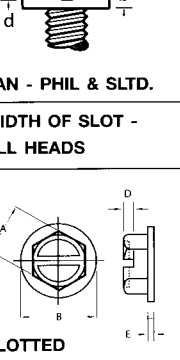
# Thread Dimensions [Class 2A, 2B, 3A, 3B ANSI B1.1]

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	.3053	.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

# Physical and Dimensional Specifications - Stainless

## Head Dimensions ANSI B18.6.3 Thread Dimensions - Class 2A Fit, ANSI 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	
 <b>ROUND - PHIL &amp; SLTD.</b>	A	.113	.138	.162	.187	.211	.236	.260	.309	.359	.408	.472	.590	.708
	B	.099	.122	.146	.169	.193	.217	.240	.287	.334	.382	.443	.557	.670
	D	.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
		.029	.033	.037	.040	.044	.047	.051	.058	.065	.072	.082	.099	.117
 <b>FLAT - PHIL &amp; SLTD.</b>	A	.119	.146	.172	.199	.225	.252	.279	.332	.385	.438	.507	.635	.762
	B	.099	.123	.147	.171	.195	.220	.244	.292	.340	.389	.452	.568	.685
	D	.035	.043	.051	.059	.067	.075	.083	.100	.116	.132	.153	.191	.230
	D	.026	.033	.040	.048	.055	.062	.069	.084	.098	.112	.131	.165	.200
		.015	.019	.023	.027	.030	.034	.038	.045	.053	.060	.070	.088	.106
		.010	.012	.015	.017	.020	.022	.024	.029	.034	.039	.046	.058	.070
 <b>OVAL - PHIL &amp; SLTD.</b>	A	.119	.146	.172	.199	.225	.252	.279	.332	.385	.438	.507	.635	.762
	B	.099	.123	.147	.171	.195	.220	.244	.292	.340	.389	.452	.568	.685
	D	.035	.043	.051	.059	.067	.075	.083	.100	.116	.132	.153	.191	.230
	D	.026	.033	.040	.048	.055	.062	.069	.084	.098	.112	.131	.165	.200
	E	.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
		.056	.068	.080	.092	.104	.116	.128	.152	.176	.200	.232	.290	.347
		.041	.052	.063	.073	.084	.095	.105	.126	.148	.169	.197	.249	.300
 <b>FILLISTER - PHIL &amp; SLTD.</b>	A	.096	.118	.140	.161	.183	.205	.226	.270	.313	.356	.414	.518	.622
	B	.083	.104	.124	.145	.166	.187	.208	.250	.292	.334	.389	.490	.590
	D	.045	.053	.062	.070	.079	.088	.096	.113	.130	.148	.170	.211	.253
	D	.037	.045	.053	.061	.069	.078	.086	.102	.118	.134	.155	.194	.233
	E	.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
		.059	.071	.083	.095	.107	.120	.132	.156	.180	.205	.237	.295	.355
		.043	.055	.066	.077	.088	.100	.111	.133	.156	.178	.207	.262	.315
 <b>TRUSS - PHIL &amp; SLTD.</b>	A	-	-	.194	.226	.257	.389	.321	.384	.448	.511	.573	.698	.823
	B	-	-	.180	.211	.241	.272	.303	.364	.425	.487	.546	.666	.787
	D	-	-	.053	.061	.069	.078	.086	.102	.118	.134	.150	.183	.215
	D	-	-	.044	.051	.059	.066	.074	.088	.103	.118	.133	.162	.191
		-	-	.031	.036	.040	.045	.050	.058	.068	.077	.087	.106	.124
		-	-	.022	.026	.030	.034	.037	.045	.053	.061	.070	.085	.100
 <b>BINDING - PHIL &amp; SLTD.</b>	A	-	-	.181	.208	.235	.263	.290	.344	.399	.454	.525	.656	.788
	B	-	-	.171	.197	.223	.249	.275	.326	.378	.430	.498	.622	.746
	D	-	-	.050	.054	.068	.078	.087	.105	.123	.141	.165	.209	.253
	D	-	-	.043	.059	.061	.069	.078	.095	.112	.130	.152	.194	.235
	E	-	-	.030	.036	.042	.048	.053	.065	.077	.089	.105	.134	.163
		-	-	.024	.029	.034	.039	.044	.054	.064	.074	.088	.112	.136
		-	-	.018	.022	.025	.029	.032	.039	.045	.052	.061	.077	.094
		-	-	.013	.016	.018	.021	.024	.029	.034	.039	.046	.059	.071
 <b>PAN - PHIL &amp; SLTD.</b>	A	-	-	.167	.193	.219	.245	.270	.322	.373	.425	.492	.615	.740
	B	-	-	.155	.180	.205	.231	.256	.306	.357	.407	.473	.594	.716
	D	-	-	.053	.060	.068	.075	.082	.096	.110	.125	.144	.178	.212
	D	-	-	.045	.051	.058	.065	.072	.085	.099	.112	.130	.162	.195
		-	-	.033	.037	.041	.045	.050	.058	.067	.077	.087	.109	.130
		-	-	.023	.027	.030	.032	.038	.043	.050	.060	.070	.092	.113
<b>WIDTH OF SLOT - ALL HEADS</b>		.023	.026	.031	.035	.039	.042	.048	.054	.060	.067	.075	.084	.094
		.016	.019	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
 <b>SLOTTED HEX WASHER</b>	A	-	-	-	-	.188	-	.250	.250	.312	.312	.375	.500	.562
	B	-	-	-	-	.181	-	.244	.244	.305	.305	.367	.489	.551
	D	-	-	-	-	.243	-	.328	.348	.414	.432	.520	.676	.780
	D	-	-	-	-	.225	-	.302	.322	.384	.398	.480	.624	.720
	E	-	-	-	-	.042	-	.053	.074	.080	.103	.111	.134	.168
		-	-	-	.025	-	.033	.052	.057	.077	.083	.100	.131	
		-	-	-	.019	-	.025	.031	.031	.039	.050	.055	.068	
		-	-	-	.011	-	.015	.019	.019	.022	.030	.035	.037	

# Physical and Dimensional Specifications - Brass and Silicon Bronze

	Dimensional	Physical
<b>Brass cold-formed or machined</b>  <b>hex head cap screws</b> <b>hex nuts</b> <b>knurled nuts</b> <b>machine screws</b> <b>wood screws</b> <b>knurled thumb screws</b>  <b>Note that cold-formed brass is generally made from alloy 270 while machined brass is normally made from alloy 360.</b>	Hex caps - head and body dimensions to ANSI B18.2.1 Thread dimensions to class 2A fit, ANSI B1.1	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 - 55,000-65,000 psi min. Yield - 35,000-50,000 psi min. Hardness - 55-75 Rockwell B min. Elongation - 10%-25% min.
	Finished, jam nuts - thickness and width across flats to ANSI B18.2.2 Thread dimensions to class 2B, ANSI B1.1	
	M/S nuts - thickness and width across flats to ANSI B18.6.3 Thread dimensions to class 2B, ANSI B1.1	
	Knurled nuts - see dimensions in catalog	
	Machine screws - head, body, slot and recess dimensions to ANSI B18.6.3 Thread dimensions to class 2A, ANSI B1.1 Thread length: see chart in catalog	
	Wood screws - head, body, slot, recess and thread dimensions to ANSI 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, ANSI B1.1 Other dimensions - see chart in catalog	
<b>Brass flat washers</b>	See chart in catalog	Washers should be flat, smooth, and parallel
<b>Silicon bronze</b>  <b>cold-formed hex head cap screws</b>  <b>normally made from alloy 651 material.</b>	Head and body dimensions to ANSI B18.2.1 Thread dimensions to class 2A fit, ANSI 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.
<b>Silicon bronze</b>  <b>cold-formed hex nuts finished</b> <b>jam heavy machine screw</b>  <b>normally made from alloy 651 material.</b>	Finished, jam heavy - thickness and width across flats to ANSI B18.2.2 Thread dimensions to class 2B, ANSI B1.1  Machine screw nuts - thickness and width across flats to ANSI B18.6.3	Thread dimensions to class 2B, ANSI B1.1  Tensile - 70,000-100,000 psi Proof load stress psi - 50 min. Hardness - 60 Rockwell B min.
<b>Silicon bronze</b>  <b>flat washers</b> <b>lockwashers</b>	Flat - see chart in catalog	Flat - washer faces should be flat, smooth and parallel
	Lock - dimensions to ANSI B18.21.1	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
<b>18-8, 316</b> <b>flat washers</b> <b>lockwashers</b>	Flat - see chart in catalog	Flat - washer faces should be flat, smooth and parallel  Magnetic permeability - 2.0 max.
	Medium lock - dimensions to ANSI B18.21.1	Lock - Hardness - 35 Rockwell C min. Magnetic permeability - 2.0 max. Washer should have capacity to compress flat and show definable rebound upon release
	Light lock - see chart in catalog	
<b>18-8, 316</b> <b>carriage bolts</b> <b>hex lag bolts</b>	Carriage - head and body dimensions to ANSI B18.5  Thread dimensions to class 2A fit, ANSI 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% Magnetic permeability - 2.0 max.
	Lag - head, body and thread dimensions to ANSI B18.2.1  Thread length: see chart in catalog	
<b>18-8</b> <b>shoulder bolts</b>	Head, body and socket dimensions to ANSI B18.3  Thread dimensions to class 3A fit, ANSI B1.1	Tensile - 70,000 psi min. Yield - 30,000 psi min. Hardness - 55 Rockwell B min.
<b>18-8, 304, 316</b> <b>threaded rod</b>	Thread dimensions to class 1A or class 2A, ANSI 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. Magnetic permeability - 2.0 max.
<b>410 hardened with bright finish</b> <b>self-drilling screws</b>	Body, thread, and point dimensions to ANSI B18.6.4 Tensile - 180,000 psi heat-treated	Yield - 150,000 psi heat-treated Hardness - 40 Rockwell C min.
<b>18-8, 304, 316</b> <b>MS-AN-NAS-ASTM</b> <b>Fasteners</b>	To government or consensus specification as required	To government or consensus specification as required
<b>18-8, 316 (A2 &amp; A4)</b> <b>metric fasteners</b>	To DIN standard as required	To DIN standard as required
<b>Aluminum</b> <b>Hex Head Cap Screws</b> <b>Finished Nuts</b> <b>Machine Screws Nuts</b> <b>Flat Washers</b> <b>Lockwashers</b> <b>Threaded Rod</b>	Hex caps - head and body dimensions to ANSI B18.2.1  Thread dimensions to class 2A fit, ANSI 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. 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 ANSI B18.2.2  Thread dimensions to class 2B, ANSI B1.1	
	Machine screw nuts - thickness and width across flats to ANSI B18.6.3  Thread dimensions to class 2B, ANSI B1.1	
	Flat washers - see chart in catalog	
	Lockwashers - dimensions to ANSI B18.21.1	



**"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 degrees F. would bring tensile to 160,000-190,000 psi.

**AUSTENITIC** – Refers to 300 series stainless, the most popular of the stainless 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. Austenitic 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 stainless" 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.

Type 316 stainless has added nickel and especially molybdenum. The molybdenum (called moly) sharply increases corrosion resistance to chlorides and sulfates, including sulfuric 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 PSP 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.



**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.

**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 traces of 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 austenitic 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 non-magnetic. 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 austenitic 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 sulfuric acids in the pulp industry. Molybdenum helps reduce hardness and increase tensile strength at higher temperatures. Molybdenum is also added to Marutex® self-drilling screws made of 410 stainless to significantly increase corrosion resistance.

**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 stainless 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 non-ferrous; 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 PSP 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 PSP 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 1/8"-1/4") 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.

**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.

**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 10/32 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
<p><b>300 SERIES AUSTENITIC STAINLESS:</b> 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.</p>														
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. 80,000-90,000 typical 1/4-5/8 dia.; 45,000-70,000 typical for 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-type products such as springs, screens, cables, common material for flat washers.
302HQ and XM7	17-19%	8-10%	.08%-.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 for 3/4 & over dia.	B85-95	Extra copper reduces work hardening during cold forming; commonly used for machine screws, metal screws, 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	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.
304L is same as 304 with max. of .03% carbon														
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	16-18%	10-14%	.08%	2%	.045%	.03%	2-3%	1%	May contain 1%-3%		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.	85,000-140,000 usual After cold work: 80,000-90,000 typical for 1/4-5/8 dia.; 50,000-70,000 typical for 3/4 & over dia.	40,000 min.	B85-95 Addition of molybdenum increases corrosion resistance to chloride and sulfides.
316L is same as 316 with max. of .03% carbon														
309	22-24%	12-15%	2%	2%	.045%	.03%		1%			100,000-120,000	60,000-80,000	B85-95	Low carbon increases corrosion resistance and welding capacity.
321	17-19%	9-12%	.08%	2%	.045%	.03%		1%		Titanium - 5 times carbon content		See 309		Higher chromium and nickel give better corrosion resistance at high temperatures (1900 deg. F.)
347	17-19%	9-13%	.08%	2%	.045%	.03%		1%		Columbian & Tantalum - 10 times carbon.		See 309		Titanium improves intergranular corrosion resistance, by avoiding carbide precipitation; good for intermittent heating applications and corrosion resistance to 1600 deg. F.
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		Columbian and Tantalum give similar properties to 321.
														Excellent resistance to sulfuric acid. Columbian helps resist carbide precipitation.
<p><b>FERRITIC STAINLESS:</b> A few percent of stainless fasteners; magnetic; not hardenable by heat treatment; high chromium content helps corrosion resistance.</p>														
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.