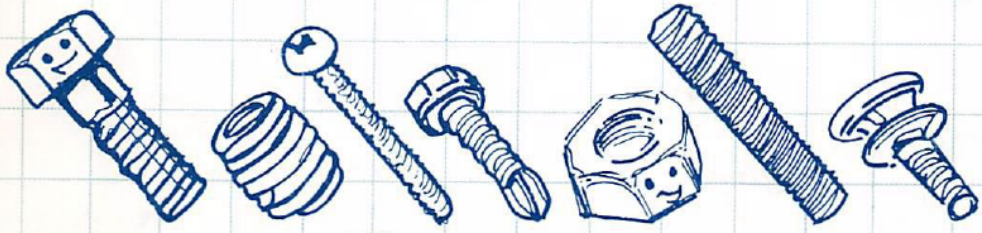
REFERENCE GUIDE TO STAINLESS, BRASS, SILICON BRONZE

Right-Off-The-Shelf®

I-N-S-T-A-N-T Stock®



400,000 Square Feet of Stainless, Brass, Silicon Bronze Inventory

STAR STAINLESS SCREW CO.

STAR STAINLESS SCREW CO.

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NEW PRODUCTS STOCKED BY STAINLESS STAN

SQUARE DRIVE SHEET METAL SCREWS

SELF-DRILLING SCREWS 410 BRIGHT HARDENED

DOMESTIC-MADE FASTENERS TO MS-AN-NAS-ASTM SPECS

With MS hex caps; ASTM heavy hex caps; a full line of MS-AN-NAS machine screws including drilled fillisters; MS-AN flat and lockwashers; MS socket caps; and MS-ASTM nuts.

LIMITS TO STAR QUALITY STANDARDS

STAR QUALITY STANDARDS are merely a guide to the commercial fasteners sold by Star. Star believes that the information contained in this catalog is correct and that Star's normal commercial fasteners meet the standards listed herein, but Star makes no representation or warranty on the accuracy of this information or that any particular batch of commercial fasteners from Star conforms in any or all respects to its Star Quality Standards nor does Star represent or warrant that its fasteners have been inspected by Star or that fasteners sold by Star meet government or other specs, unless specifically stated on Star's invoice and packing slip. Star believes that the great preponderance of its commercial fasteners meet Star Quality Standards stated herein, but Star states that the very nature of commercial fasteners is that batches differ, usually in small respects, causing variations from some standards. Star makes no warranty of merchantability or fitness for any particular purpose or any other warranty, express or implied.

STAR QUALITY STANDARDS

HEX HEAD CAP SCREWS

Hex Caps RIGHT-OFF-THE-SHELF® in 304, 316, silicon bronze, brass.
Full Thread Hex Caps - RIGHT-OFF-THE-SHELF® IN 304.
Stainless steel hex head cap screws are normally made of 304 or 316 material with the grade of material and manufacturer's marking stamped on the head. Stainless hex head cap screws without grade marking would generally be made of 18-8 material.
Nearly all silicon bronze hex head cap screws are made of 651 material with 651 stamped on the head.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS COLD-FORMED HEX HD. CAP SCREWS** Star Quality Standard A.10.30 B.10.30 C.10.30	A = 18-8 B = 304 C = 316	.10 = 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.	.30 = head and body dimensions to ANSI B18. 2.1 thread dimensions to class 2A fit, ANSI B1.1 thread length to ANSI B18.2.1 minimum - actual thread length may be longer. See chart below.
 **STAINLESS HOT FORGED HEX HD. CAP SCREWS** Star Quality Standard A.12.30 B.12.30 C.12.30	A = 18-8 B = 304 C = 316	.12 = 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.	
 **SILICON BRONZE COLD-FORMED HEX HEAD CAP SCREWS** Star Quality Standard D.24.54	D = 651 silicon bronze	.24 = tensile - 70,000-100,000 psi yield - 50,000-55,000 psi min. elongation - 8%-10% min. hardness - 70 Rockwell B min.	.54 = head and body dimensions to ANSI B18. 2.1 thread dimensions to class 2A fit, ANSI B1.1 thread length: see chart below.
 **BRASS COLD-FORMED HEX HEAD CAP SCREWS** Star Quality Standard G.32.54	G = commercial brass	.32 = tensile - 60,000 psi min. yield - 40,000 psi min. elongation - 20% min. hardness - 60 Rockwell B min.	

HEX CAPS - HEAD DIMENSIONS

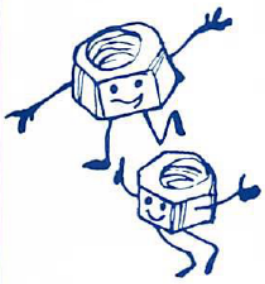
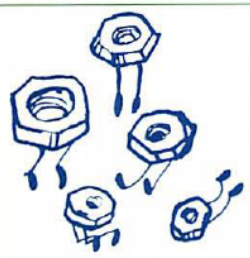
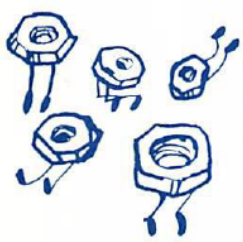
Hex Cap - ANSI B18.2.1	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
Maximum Across Flats	7/16	1/2	9/16	5/8	3/4	13/16	15/16	1-1/8	1-5/16	1-1/2	1-11/16	1-7/8	2-1/4
Head Height	5/32	13/64	15/64	9/32	5/16	23/64	25/64	15/32	35/64	19.64	11/16	25/32	15/16

THREAD LENGTHS - Hex Caps

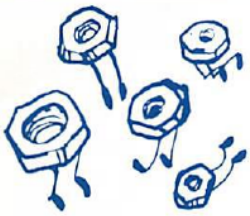
Stainless	Brass	Bronze
Up to and including 6" long: twice the diameter plus 1/4"; over 6" long: twice the diameter plus 1/2"; all hex caps may have an additional 1/4" to 3/8" thread, particularly on short lengths up to 1-1/2" and longer lengths over 4".	Same as stainless	Up to and including 4" long: full thread; over 4" long: may be full thread at option of manufacturer.

STAR QUALITY STANDARDS

HEX NUTS - RIGHT-OFF-THE-SHELF® -in stainless, silicon bronze, brass, machine screw nuts, finished, jam, heavy, heavy jam, small pattern.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS COLD-FORMED HEX NUTS** **Finished, jam, heavy, heavy jam** Star Quality Standard A.18.50 B.18.50 C.18.50	A = 18-8 B = 304 C = 316	.18 = 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. proof load - see chart on opposite page for 1/4" and up	.50 = thickness and width across flats to ANSI B18.2.2 thread dimensions to class 2B, ANSI B1.1
 **STAINLESS COLD-FORMED HEX MACHINE SCREW NUTS** Star Quality Standard A.18.58 C.18.58	A = 18-8 C = 316		.58 = thickness and width across flats to ANSI B18.6.3 thread dimensions to class 2B, ANSI B1.1
 **STAINLESS COLD-FORMED SMALL PATTERN NUTS** Star Quality Standard A.18.60	A = 18-8		.60 = thread dimensions to class 2B, ANSI B1.1 thickness and width across flats - see chart on opposite page
 **STAINLESS HOT-FORGED HEX NUTS** **Finished, jam, heavy, heavy jam** Star Quality Standard A.22.50 B.22.50 C.22.50	A = 18-8 B = 304 C = 316	.22 = tensile - 70,000 psi yield - 30,000 psi hardness - 70 Rockwell B min. reduction in area - 40% magnetic permeability - 2.0 max. proof load - see chart on opposite page	.50 = see stainless cold formed hex nuts above.
 **SILICON BRONZE COLD-FORMED HEX NUTS** **Finished, jam, heavy** Star Quality Standard D.26.50 E.26.50	D = 651 silicon bronze E = commercial bronze nearly all silicon bronze nuts are made from 651.	.26 = tensile - 70,000-100,000 psi proof load stress psi - 50 min. hardness - 60 Rockwell B min.	
 **SILICON BRONZE COLD-FORMED MACHINE SCREW NUTS** Star Quality Standard D.26.58 E.26.58			.58= see stainless hex machine screw nuts.

NUTS (continued)

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **BRASS COLD-FORMED OR MACHINED** Star Quality Standard G.34.50	G = commercial brass cold-formed nuts are generally made from alloy 270, while machined nuts are made from alloy 360.	.34 = cold formed brass fasteners tend to be at least 5%-10% higher than machined 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.	.50 = thickness and width across flats to ANSI B18.2.2 thread dimensions to class 2B, ANSI B1.1
 **BRASS COLD-FORMED OR MACHINED MACHINE SCREW NUTS** Star Quality Standard G.34.58			.58= thickness and width across flats to ANSI B18.6.3 thread dimensions to class 2B, ANSI B1.1
 **BRASS MACHINED KNURLED NUTS** Star Quality Standard G.34.46			.46 = see dimensions below.

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 ..... 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 - 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
Finished 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 FULL	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
Heavy -- 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	3-3/16	2-3/8	2-9/16	2-3/4	2-15/16	3-1/8	3-1/2	3-7/8
Thickness FULL	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 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

APPROX. MIN. PROOF LOAD – Stainless Finished Nuts, Coarse Thread

(Fine thd.-plus about 10%; Heavy Nuts-plus about 5%; Jam nuts-less about 50%)

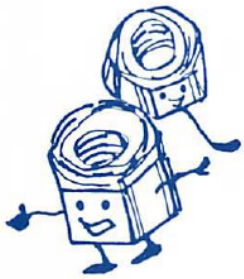
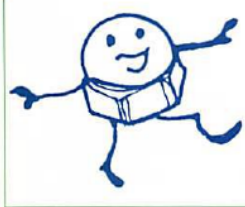
1/4	5/16	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
2,200	3,700	5,600	10,100	16,500	23,500	33,000	43,000	56,000	71,000	105,000

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

STAR QUALITY STANDARDS

NYLON INSERT NUTS - RIGHT-OFF-THE-SHELF® in 18-8; many sizes available in 316 and brass.
CAP NUTS - RIGHT-OFF-THE-SHELF® in 18-8; some sizes also available in 316 and brass.
WING NUTS - RIGHT-OFF-THE-SHELF® in 18-8; some sizes also available in 316 and brass.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS COLD-FORMED NYLON INSERT NUTS** Star Quality Standard H.10.52 J.10.52	H = 18-8 J = 316 nylon = 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 and is not affected by cold.	.10 = 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.	.52 = thread dimensions to class 2B, ANSI B1.1 thickness, height, width across flats - see chart below.
 **STAINLESS COLD FORMED CAP NUTS** Star Quality Standard A.10.58 C.10.58	A = 18-8 C = 316		.58 = thread dimensions to Class 2B, ANSI B1.1 width across flats and height - see chart below.
 **STAINLESS COLD-FORMED WING NUTS** Star Quality Standard A.10.60 C.10.60	A = 18-8 C = 316		.60 = thread dimensions to Class 2B, ANSI B1.1 wing span and thickness - see chart below.

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
Width Ac. Fl. Reg. & Thin NM, NE, NTM, NTE	.250	.250	.250	.250	.312	.344	.375	.438	.438	.500	.563	.625	.750	.875	.938	1.063	1.250	1.440	1.625	1.810	2.197
Height-Regular-NM, NE	.141	.141	.141	.141	.172	.234	.234	.313	.313	.344	.453	.453	.594	.640	.750	.875	.984	1.047	1.187	1.406	1.625
Height-Thin-NTM, NTE	-	-	.109	-	.125	.172	.172	-	.203	.250	.266	.313	.313	-	.391	.406	.468	.562	.656	.750	.812
Width Ac. Fl. - Heavy - NU, NTU	-	-	-	-	-	-	-	-	.500	.563	.687	.750	.875	-	1.06	1.125	1.440	1.627	1.814	2.000	2.380
Height-Heavy - NU	-	-	-	-	-	-	-	-	.375	.438	.547	.593	.703	-	.859	1.000	1.125	1.296	1.438	1.625	1.906
Height-Heavy Jam - NU	-	-	-	-	-	-	-	-	.281	.313	.406	.437	.531	-	.609	.703	.781	.906	-	1.093	1.296

DIMENSIONS - CAP NUTS (STAINLESS AND BRASS)

Diameter	4	6	8	10	12	1/4	5/16	3/8	7/16	1/2	5/8	3/4
Width Across Flats - Stainless	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. Stainless	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
Width Across Flats - Brass	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. Brass	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	2.62/2.76	.391

NUTS (continued)

SPECIAL LOCK NUTS WITH EXTERNAL LOCKWASHERS - RIGHT-OFF-THE-SHELF®
in 18-8 with 400 series washers.
COUPLING NUTS - RIGHT-OFF-THE-SHELF® IN 18-8.
SERRATED FLANGE NUTS - RIGHT-OFF-THE-SHELF® IN 18-8.
SQUARE NUTS - RIGHT-OFF-THE-SHELF® in 18-8.
plus CASTLE NUTS, FLEXLOC NUTS, TWO-WAY LOCK NUTS -- many sizes RIGHT-OFF-THE-SHELF®in 18-8.

DIMENSIONS - COUPLING NUTS

Diameter	10	1/4	5/16	3/8	1/2	5/8	3/4	7/8	1
Width Across Flats	3/8	3/8	7/16	1/2	5/8	7/8	1	1-1/4	1-3/8
Thickness	3/4	7/8	1	1-1/8	1-1/4	1-3/4	2	2-1/2	2-1/2

DIMENSIONS - SERRATED FLANGE NUTS

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

SPECIAL LOCK NUTS WITH EXT. LOCKWASHERS | COUPLING NUTS | SERRATED FLANGE NUTS | SQUARE NUTS | CASTLE NUTS | FLEXLOC NUTS

PLUS I-N-S-T-A-N-T STOCK® ON THUMB SCREWS

THUMB SCREWS - RIGHT-OFF-THE-SHELF® with and without shoulder in 18-8 and without shoulder in brass.
KNURLED THUMB SCREWS - RIGHT-OFF-THE-SHELF® in brass.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS COLD-FORMED THUMB SCREWS** Star Quality Standard A.20.46	A = 18-8	.20 = tensile - 100,000 psi min. approx. yield - 55,000 psi min. approx. hardness - 100 Rockwell B min. approx.	.66 = thread dimensions to class 2B, ANSi B1.1 other dimensions - see chart below
 **BRASS COLD-FORMED KNURLED THUMB SCREWS** Star Quality Standard G.34.66	G = commercial brass cold-formed brass is generally made from alloy 270 while machined brass is made from alloy 360.	.34 = Cold-formed brass fasteners tend to be at least 5%-10% higher than machined in tensile, yield and hardness, so cold-formed may 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.	

DIMENSIONS - Thumb Screws - Stainless and Brass

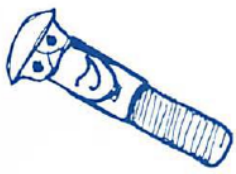
REGULAR NON-SHOULDER THUMB SCREWS						
Size	**6**	**8**	**10**	**1/4**	**5/16**	**3/8**
Head Diameter	3/8	15/32	9/16	23/32	7/8	1-3/32
Height Height	1/4	1/4	3/8	1/2	11/16	13/16
SHOULDER THUMB SCREWS						
Head Diameter	5/16	23/64	7/16	33/64	11/16	13/16
Head Height	11/32	25/64	15/32	19/32	3/4	15/16

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

STAR QUALITY STANDARDS

CARRIAGE BOLTS - RIGHT-OFF-THE-SHELF® in 18-8; some sizes stocked in 316, brass and silicon bronze.
LAG BOLTS - RIGHT-OFF-THE-SHELF® in 18-8.
SQUARE HEAD SET SCREWS - RIGHT-OFF-THE-SHELF® in 18-8.
SHOULDER BOLTS - RIGHT-OFF-THE-SHELF® in 18-8.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS COLD-FORMED CARRIAGE BOLTS** Star Quality Standard A.10.32 C.10.32	A = 18-8 C = 316	.10 = 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.	.32 = head and body dimensions to ANSI B18.5 thread dimensions to class 2A fit, ANSI B1.1 thread length: see chart below.
 **STAINLESS COLD-FORMED HEX LAG BOLTS** Star Quality Standard A.10.34	A = 18-8		.34 = head, body and thread dimensions to ANSI B18.2.1 thread length: see chart below.
 **STAINLESS SQUARE HEAD SET SCREWS CUP POINT** Star Quality Standard A.10.62	A = 18-8		.62 = thread dimensions to class 2A fit, ANSI B1.1 head and body dimensions to ANSI B18.6.2
 **STAINLESS HEX SOCKET SHOULDER BOLTS** Star Quality Standard A.40.44	A = 18-8	.40 = tensile - 70,000 psi min. yield - 30,000 psi min. hardness - 55 Rockwell B min.	.44= head, body and socket dimensions to ANSI B18.3 thread dimensions to class 3A fit, ANSI B1.1

DIMENSIONS - CARRIAGE BOLTS

ANSI B18.5	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 - SHOULDER BOLTS

ANSI B18.3 Nominal 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 - HEX LAG BOLTS

ANSI B18.2.1	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 - SQUARE HEAD SET SCREWS

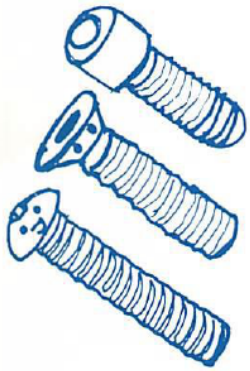
ANSI B18.6.2	1/4	5/16	3/8	1/2
Max. Width Ac. Fl. - Head	.250	.312	.375	.500
Max. Head Height	.196	.245	.293	.389

THREAD LENGTHS

	Stainless	Brass	Bronze
Carriage Bolts	Up to and including 4" long: full thread; over 4" long: may be full thread or have shoulder of 1"-2" or more, depending on manufacturer.	--	Usually full thread.
Lag Bolts	Usually threaded 60%-67% of length; short lengths of 1-1/2" or less may have 70%-90% or more thread.	--	--

STAR QUALITY STANDARDS

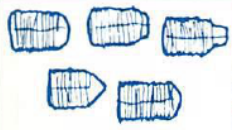
SOCKET CAPS - RIGHT-OFF-THE-SHELF® in 18-8. Many sizes stocked in 316 and silicon bronze.
SOCKET SETS - RIGHT-OFF-THE-SHELF® in 18-8. Cup Pt. Many sizes of cup pt. stocked in 316 and brass; some odd points stocked in 18-8.
FLAT SOCKETS, BUTTON SOCKETS - RIGHT-OFF-THE-SHELF® in 18-8; some sizes stocked in 316.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS COLD-FORMED SOCKET CAP SCREWS, FLAT SOCKET CAP SCREWS, BUTTON SOCKET CAP SCREWS** Star Quality Standard A.10.42 C.10.42	A = 18-8 C = 316	.10 = 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.	.42 = head, body and socket dimensions to ANSI B18.3 thread dimensions to class 3A fit, ANSI B1.1 thread length: see chart below. socket caps normally knurled heads except #2 dia. & below.
 **STAINLESS COLD-FORMED SOCKET SET SCREWS** Star Quality Standard A.10.44 C.10.44	A = 18-8 C = 316		.44= head, body and socket dimensions to ANSI B18.3 thread dimensions to class 3A fit, ANSI B1.1

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	.022	.028	.028	.040	.040	.050	.050	.062	.075	.100	.125	.150	.175	.200	.250	.300
C-Maximum	.033	.040	.047	.054	.061	.067	.074	.087	.102	.132	.172	.212	.252	.291	.371	.450
X-Nominal	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

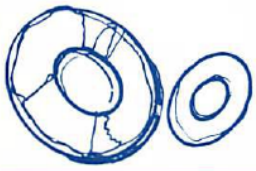
Diameter of Screw	2	4	5	6	8	10	1/4	5/16	3/8	7/16	1/2	5/8	3/4
Flat - Maximum Head Diameter	.197	.255	.281	.307	.359	.411	.531	.656	.781	.844	.937	1.188	1.438
Flat - Maximum Head Height	.064	.083	.090	.097	.112	.127	.161	.198	.234	.234	.251	.324	.396
Button - Maximum Head Diameter	.164	.213	-	.262	.312	.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	.3790

THREAD LENGTHS

	STAINLESS					BRASS	BRONZE
Socket caps	Usual thread length approximates minimum thread listed.					—	Usually full thread.
	Diameter	Min. Thread Length	Max. Thread Length	Diameter	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	Usually full thread.					—	—

STAR QUALITY STANDARDS

FLAT WASHERS - RIGHT-OFF-THE-SHELF® in 18-8, 316, silicon bronze, brass.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **FLAT WASHERS** Star Quality Standard A.14.46 C.14.46	A = 18-8 C = 316	.14 = washer faces should be flat, smooth and parallel. magnetic permeability - 2.0 max.	.46 = see dimensions below.
 **FLAT WASHERS** Star Quality Standard E.28.46	E = commercial bronze	.28 = washer faces should be flat, smooth and parallel.	
 **FLAT WASHERS** Star Quality Standard G.28.46	G = commercial bronze		

Domestic = WD

1-W-37-175

non standard

standard

FLAT WASHERS - Commercial - Stainless Steel

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	3/4	7/8	1	1-1/8	1-1/4	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	1-3/4	1-7/8	2	2	2-1/2	2-3/4	3-1/4	3-1/2	4
I.D.	.250	.281	.343	.406	.500	.531	.625	.687	.812	.812	.937	1.062	1.187	1.312	1.562	1.812	2.125
Nom. Thickness	.045	.045	.045	.045	.062	.062	.078	.078	.109	.109	.109	.12.5	.125	.125	.140	.140	.187

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	-	-
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	.091
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		

900 SERIES

Commercial and AN960C

certified

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 1/4	.500	.265	1/16
C416L 1/4	.500	.265	1/32
C516 5/16	.562	.328	1/16
C516L 5/16	.562	.328	1/32
C616 3/8	.625	.390	1/16
C616L 3/8	.625	.390	1/32
C716 7/16	.750	.453	1/16
C716L 7/16	.750	.453	1/32
C816C 1/2	.875	.516	1/16
C816L 1/2	.875	.516	1/32
C916 9/16	1.062	.578	1/16
C916L 9/16	1.062	.578	1/32
C1016 5/8	1.187	.641	1/16
C1016L 5/8	1.187	.641	1/32
C1216 3/4	1.312	.766	3/32
C1216L 3/4	1.312	.766	1/32
C1416 7/8	1.500	.890	3/32
C1616 1	1.750	1.016	3/32

800 SERIES

Commercial and MS15795

certified

SAE

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

Small Pattern Key Nuts = KSP

NAS Stainless 60mm

1-NAS-

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

WASHERS (continued)

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

Size	#6	#8	#10	#10	1/4	1/4	1/4	1/4	5/16	5/16	3/8	3/8	3/8	1/2	1/2	3/4
O.D.	5/8	3/4	11/16	1	11/16	1	1-1/4	1-1/2	1-1/4	1-1/2	1	1-1/4	1-1/2	1-1/2	2	2
I.D.	.149	.174	.203	.203	.281	.281	.281	.281	.343	.343	.406	.406	.406	.531	.531	.812
Nominal Thickness	.031	.040	.045	.045	.045	.045	.045	.062	.045	.062	.045	.045	.062	.062	.062	.125

PLUS OTHER WASHERS FROM STAR'S I-N-S-T-A-N-T STOCK®

LOCKWASHERS, MEDIUM - RIGHT-OFF-THE-SHELF® in 18-8, 316 and silicon bronze. Light, heavy and hi-collar stocked in 18-8.

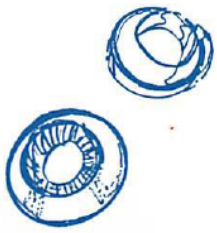
CUP WASHERS, FLANGE CUP WASHERS - RIGHT-OFF-THE-SHELF® in 18-8, brass and brass nickel plated.

BEVELLED WASHERS - RIGHT-OFF-THE-SHELF® in 18-8.

NEOPRENE BONDED WASHERS - RIGHT-OFF-THE-SHELF® in 18-8.

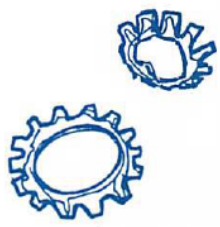
INTERNAL, EXTERNAL, EXT.-COUNTERSUNK - RIGHT-OFF-THE-SHELF® in 400, 410 and phosphorous bronze.

CUP WASHERS

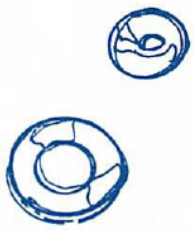


FLANGE CUPS

BEVELLED



INT-EXT COUNTERSUNK



NEOPRENE BONDED

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS MEDIUM SPRING LOCKWASHERS** Star Quality Standard A.16.48 C.16.48	A = 18-8 C = 316	.16 = hardness - 35 Rockwell C min. magnetic permeability - 2.0 max. washer should have capacity to compress flat and show definable rebound upon release.	.48 = dimensions to ANSI B18.21.1
 **SILICON BRONZE MEDIUM SPRING LOCKWASHERS** Star Quality Standard E.30.48	E = commercial bronze	.30 = hardness - 90 Rockwell B min. washer should have capacity to compress flat and show definable rebound upon release.	

LOCK WASHERS DIMENSIONS - Light, Medium (all metals where available)

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	.144	.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	1.647	1.838	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	.022	.020	.025	.025	.031	.031	.040	.047	.056	.062	.078	.094	.109	.125	.141	.156	.188	.219	.250	.281	.312	.344	.375

STAR QUALITY STANDARDS

SELF-DRILLING SCREWS - RIGHT-OFF-THE-SHELF® in Phillips and hex washer - 410 bright hardened, type BSD point high quality.

THREAD CUTTING SCREWS - RIGHT-OFF-THE-SHELF® in 410 and some 18-8, type F point.

T-U ROUND HEAD DRIVE SCREWS - RIGHT-OFF-THE-SHELF® in 18-8.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS SELF-DRILLING SCREWS - BSD** Star Quality Standard H.42.64	H = 410 bright hardened Note that bright hardening uses heat treatment without oxygen to cause hardness without oxides forming on the material surface.	.42 = hardness - 40 Rockwell C min.	.64 = body, thread, and point dimensions to ANSI B18.6.4

DIMENSIONS - Thread and Points - Self-Drilling Screws

	Threads Per In.	Max. Major Dia.	Max. 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)

PLUS A COMPLETE STOCK OF:

THREADED ROD - RIGHT-OFF-THE-SHELF® in 18-8, 304, 316 and brass in 2 ft, 3 ft, 6 ft and 12 ft lengths, depending on diameter.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS THREADED ROD** Star Quality Standard A.12.40 B.12.40 C.12.40	A = 18-8 B = 304 C = 316	.12 = 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.	.40 = thread dimensions to class 1A and 2A, ANSI B1.1

MISCELLANEOUS ITEMS - RIGHT-OFF-THE-SHELF® in 18-8

SLOTTED HEADLESS SET SCREWS

ELEVATOR BOLTS

KEY STOCK

NAILS

SHAFT COLLARS

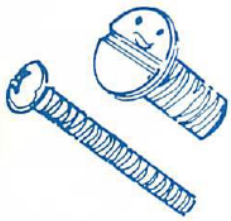
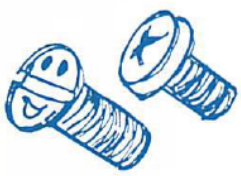
STAR QUALITY STANDARDS

MACHINE SCREWS - Phillips, Slotted, Hex RIGHT-OFF-THE-SHELF® in 18-8 with many sizes stocked in 316, brass and silicon bronze.

HEX SCREWS - Trimmed, indented RIGHT-OFF-THE-SHELF® in 18-8 and some sizes of 316.

SHEET METAL SCREWS - Phillips, slotted, hex washer, hex RIGHT-OFF-THE-SHELF® in 18-8

WOOD SCREWS - Phillips, slotted RIGHT-OFF-THE-SHELF® in 18-8 and brass; some sizes stocked in silicon bronze.

	RAW MATERIAL	PHYSICAL	DIMENSIONAL
 **STAINLESS COLD-FORMED MACHINE SCREWS Slotted, Phillips, Hex** Star Quality Standard A.10.36 C.10.36	A = 18-8 C = 316	.10 = 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.	.36 = head, body, slot and recess dimensions to ANSI B18.6.3 thread dimensions to class 2A fit, ANSI, B1.1 thread length: see chart below.
 **STAINLESS SHEET METAL T-A, T-B Slotted, Phillips, Indented Hex and Hex Washer, Square Drive** Star Quality Standard A.10.38	A = 18-8		.38 = slot and recess dimensions to ANSI B18.6.3 thread dimensions: see chart below.
 **BRASS COLD-FORMED MACHINE SCREWS** Star Quality Standard G.32.36	G = commercial brass	.32 = tensile - 55,000-65,000 psi min. yield - 30,000-50,000 psi min. elongation - 25% min. hardness - 55 Rockwell B min.	.36 = see stainless machine screws above.
 **BRASS AND STAINLESS COLD-FORMED WOOD SCREWS** Star Quality Standard A.10.56 G.32.56	A = 18-8 G = commercial brass Note that brass wood screws are normally made as cut thread while stainless are roll thread.	stainless = .10 (see above) brass = .32 (see above)	.56 = head, body, slot, recess and thread dimensions to ANSI B18.6.1 thread length: see chart below.

THREAD DIMENSIONS - SHEET METAL SCREWS Phillips, Slotted, Hex, Hex Washer, Square Drive

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

THREAD DIMENSIONS - 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 LENGTHS

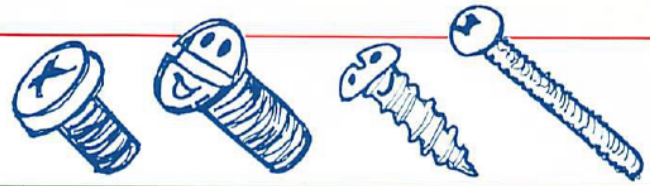
	Stainless	Brass	Bronze
Machine screws, including trimmed and indented hex heads	Up to and including 2" long: full thread; over 2" long: usually full thread but may have shoulder.	Same as stainless	Same as stainless
Sheet metal screws	Up to and including 2" long: full thread; over 2" long: usually 2" of thread with balance as shoulder, but sometimes full thread.	—	—
Wood screws	Usually threaded about 2/3 of length: short lengths may be full thread.	Same as stainless	Same as stainless

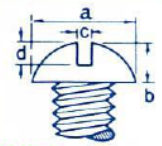
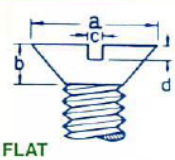
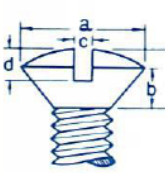
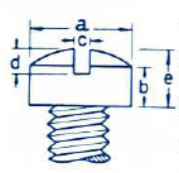
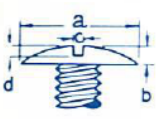
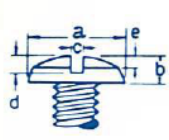
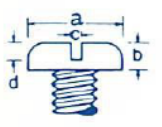
THREAD DIMENSIONS (Class 2A,2B,3A,3B ANSI B1.1)

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	.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

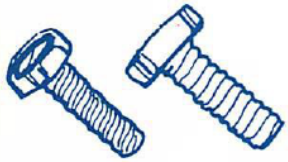
INTERNAL		Major Dia.		Minor Dia.
		Max.	Min.	Max.
0/80	2B	.0465	.0514	.0600
	3B	.0465	.0514	.0600
1/72	2B	.0580	.0635	.0730
	3B	.0580	.0635	.0730
2/56	2B	.0667	.0737	.0860
	3B	.0667	.0737	.0860
3/48	2B	.0764	.0845	.0990
	3B	.0764	.0845	.0990
4/40	2B	.0849	.0939	.1120
	3B	.0849	.0939	.1120
5/40	2B	.0979	.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	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

HEAD DIMENSIONS - Machine and Sheet Metal Screws - ANSI B18.6.3 Phillips, Slotted



Dia. of Screw . . . no. or in.		0	1	2	3	4	5	6	8	10	12	1/4	5/16	3/8
 ROUND	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
	C	.053	.061	.069	.078	.086	.095	.103	.120	.137	.153	.175	.216	.256
	D	.043	.051	.059	.067	.075	.083	.091	.107	.123	.139	.160	.198	.237
		.023	.026	.031	.035	.039	.043	.058	.054	.060	.067	.075	.084	.094
		.016	.019	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
		.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
 FLAT	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
	C	.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
		.023	.026	.031	.035	.039	.043	.048	.054	.060	.067	.075	.084	.094
		.016	.019	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
		.015	.109	.023	.027	.030	.034	.038	.045	.053	.060	.070	.088	.106
		.010	.012	.015	.017	.020	.022	.024	.029	.034	.039	.046	.058	.070
 OVAL	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
	C	.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
		.023	.026	.031	.035	.039	.043	.048.	.054	060	.067	.075	.084	.094
		.016	.109	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
	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
 FILLISTER	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
	C	.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
		.023	.026	.031	.035	.039	.043	.048	.054	.060	.067	.075	.084	.094
		.016	.109	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
		.025	.031	.037	.043	.048	.054	.060	.071	.083	.094	.109	.137	.164
	E	.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
 TRUSS	A	–	–	.194	.226	.257	.289	.321	.384	.448	.511	.573	.698	.823
	B	–	–	.180	.211	.241	.272	.303	.364	.425	.487	.546	.666	.787
	C	–	–	.053	.061	.069	.078	.086	.102	.118	.134	.150	.183	.215
	D	–	–	.044	.051	.059	.066	.074	.088	.103	.118	.133	.162	.191
		–	–	.031	.035	.039	.043	.048	.054	.060	.067	.075	.084	.094
		–	–	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
		–	–	.031	.036	.040	.045	.050	.058	.068	.077	.087	.106	.124
		–	–	.022	.026	.030	.034	.037	.045	.053	.061	.070	.085	.100
 BINDING	A	–	–	.181	.208	.235	.263	.290	.344	.399	.454	.525	.656	.788
	B	–	–	.171	.197	.223	.249	.275	.326	.378	.430	.498	.622	.746
	C	–	–	.046	.054	.063	.071	.080	.097	.114	.130	.153	.193	.234
	D	–	–	.041	.048	.056	.064	.071	.087	.102	.117	.138	.174	.211
		–	–	.031	.035	.039	.043	.048	.054	.060	.067	.075	.084	.094
		–	–	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
		–	–	.030	.036	.042	.048	.053	.065	.077	.089	.105	.134	.163
	E	–	–	.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
 PAN HEAD	A	–	–	.167	.193	.219	.245	.270	.322	.373	.425	.492	.615	.740
	B	–	–	.155	.180	.205	.231	.256	.306	.357	.407	.473	.594	.716
	C	–	–	.053	.060	.068	.075	.082	.096	.110	.125	.144	.178	.212
	D	–	–	.045	.051	.058	.065	.072	.085	.099	.112	.130	.162	.195
		–	–	.031	.035	.039	.043	.048	.054	.060	.067	.075	.084	.094
		–	–	.023	.027	.031	.035	.039	.045	.050	.056	.064	.072	.081
		–	–	.033	.037	.041	.045	.050	.058	.067	.077	.087	.109	.130
		–	–	.023	.027	.030	.032	.038	.043	.050	.060	.070	.092	.113

DIMENSIONS



HEX SCREWS: TRIMMED, INDENTED, HEX AND HEX WASHER

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

Length for Undercut Flat Screws

Dia.	0	2	4	6	8	10
Lgth.	1/8	1/8	3/16	3/16	1/4	5/16

DOMESTIC MADE FASTENERS - MS-AN- NAS-ASTM RIGHT-OFF-THE-SHELF®

To government and industry specs certified with complete paperwork from United States manufacturers.

HEX HEAD CAP SCREWS
- MS 35307
- MS 35308

MACHINE SCREWS

Phillips Pan
- MS51957
- MS 51958
- NAS 1635

Phillips Flat
- MS51959
- MS 51960

Phillips Flat100°
- MS24693C
- NAS 662C

Phillips Truss
- AN526C

Drilled Fillister
- MS35275
- MS 35276
- AN 500 AD
- AN 501 AD

FLAT WASHERS
- MS15795
- AN960C
- NAS620C

LOCK WASHERS
- MS35338

MACHINE SCREW NUTS
- MS35649
- MS35650

SOCKET CAP
- MS16995
- MS16996

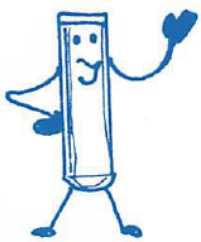
HEAVY HEX HEAD CAP SCREWS
- ASTM193 GRADE B8

FINISHED, HEAVY NUTS
- ASTM194 GRADE B 8, B8M

PLUS A COMPLETE LINE OF PINS FROM STAR'S I-N-S-T-A-N-T STOCK®

DOWEL PINS - RIGHT-OFF-THE-SHELF® in 18-8.
COTTER PINS - RIGHT-OFF-THE-SHELF® in 18-8.
ROLL PINS - RIGHT-OFF-THE-SHELF® in 420.

DOWEL PINS - Tolerance .0002 oversize; double chamber –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

Size	Max. Dia.	Min. Dia.	Double Shear Load
1/4	.2503	.2501	3550
5/16	.3128	.3126	5500
3/8	.3753	.3751	8000
1/2	.5003	.5001	14000

STAINLESS STAN'S EASY-TO-UNDERSTAND GLOSSARY OF STAINLESS, BRASS AND BRONZE FASTENERS

"A" SHEET METAL SCREWS — Sheet metal screws with (a) sharp-pointed ends; and (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 various "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 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 the 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 reduce to 125,000-150,000 psi, while 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 non-magnetic for practical purposes.

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 various 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.

"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.

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.

BRASS — The most common alloy of copper, brass is basically 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 F. 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.

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.

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.

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.

CONDITION A — Means that fasteners should be 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.

CREEP STRENGTH — A measure of 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 assembly 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 commerical 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 percent 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.

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.

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.

FIT — Normally referring to threads, fit is a measure for 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.

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 (see below) 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.

Metals listed first will corrode due to galvanic reaction before those at end of paragraph: magnesium, zinc, aluminum 1100, cadmium, aluminum 2024, steel and iron, lead, tin, brass, copper, bronze, monel, 304 and 316 stainless (passive), silver, titanium, graphite, gold.

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.

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 counter-clockwise.

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

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 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 non-magnetic.

A 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, pump parts under high stress. Martensitic stainless is magnetic, contains no nickel, loses toughness in very cold temperatures, and may have 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. Molybdenum helps reduce hardness and increase tensile strength at higher temperatures.

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.

NON-FERROUS — Metals without iron. Brass and silicon bronze are non-ferrous; stainless is often characterized as non-ferrous, but it is not non-ferrous.

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 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 the 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 stanless.

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 a finished fastener to over 1,850 degrees F. 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.**

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.

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.

EXTRA NOTES TO STAR QUALITY STANDARDS

Cleaning and Passivating.

The terms "cleaning" and "passivating" are used interchangeably and generically at Star to mean the removal of oil, grease, and metal particles left from the manufacturing process. A range of cleaning methods is used from dipping in mixtures of nitric, phosphoric and other acids to exposing cleaned fasteners to air for a period of time which allows a form of passive film to occur. When fasteners are sufficiently cleaned, it is impossible to identify the cleaning or passivating method that was used.

Physical Characteristics of Cold-Formed and Hot-Forged Stainless Austentic Fasteners.

Tensile and yield strength rise sharply during manufacturing when 300 series stainless is cold-formed, often 30%-50% higher than the minimum Star Quality Standard. However, hot-forged manufacturing does not cause a similar increase, so tensile and yield would be closer to the Star Quality Standard.

APPROXIMATE WEIGHTS PER M FOR 18-8 STAINLESS

(316 PLUS 1%; BRASS-PLUS 8%; SILICON BRONZE-PLUS 11%)

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	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 (blue) SOCKET SETS (red)

	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 (blue) CARRIAGE BOLTS (green) LAG BOLTS (red)

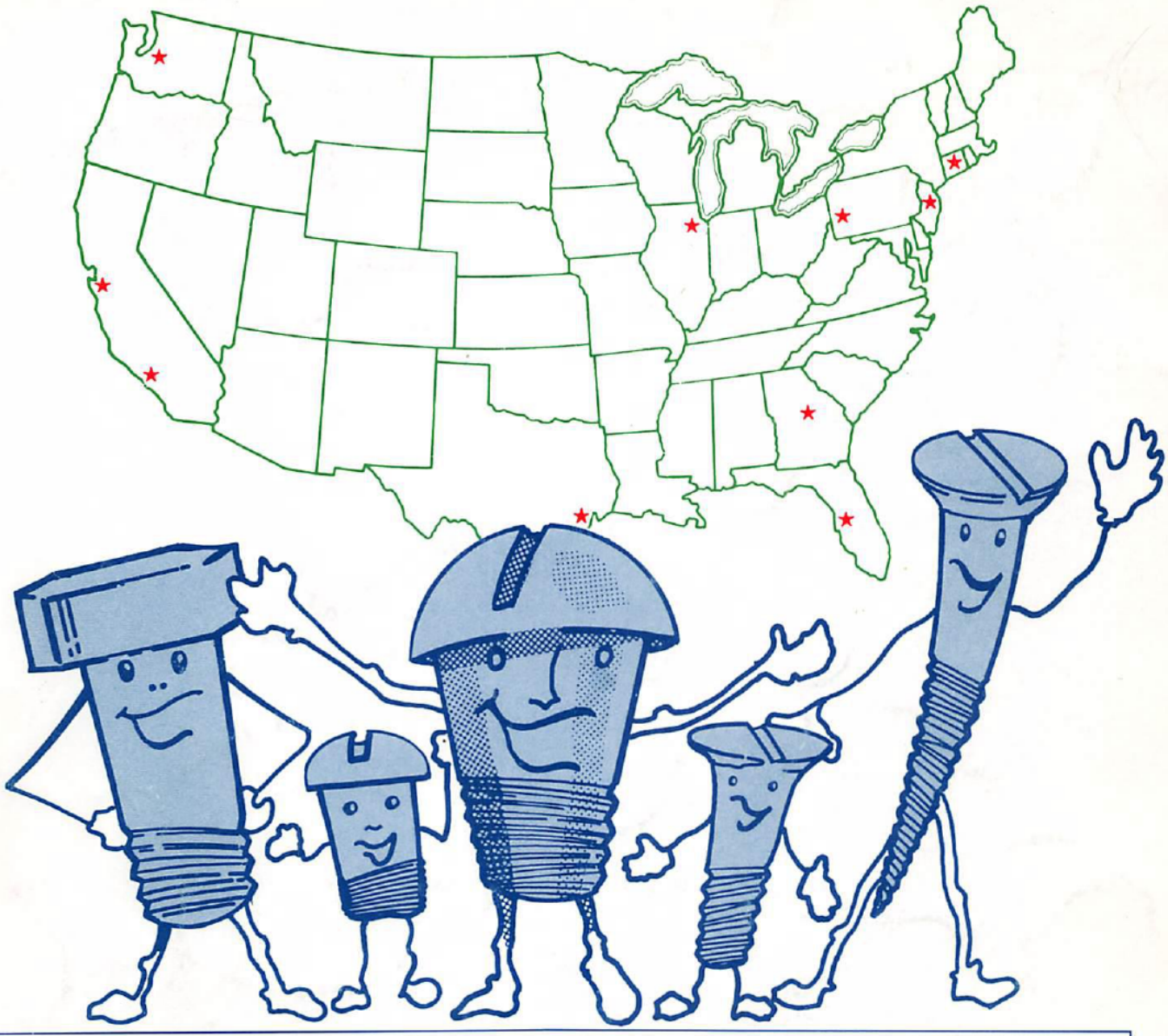
	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
1/2	13.4 12.7	20.5	33.5									
3/4	15.6 14.8	24.8 23.5	39.7 37.8	56.1	84.5							
1	18.7 17.8 17.5	29.2 27.7 27.5	45.9 43.6 41.7	64.4	95.5 90.7	157	252					
1-1/4	21.4 20.2 20.1	34.7 33.0 32.8	52.7 50.0 47.9	78.8	106 101	174	278					
1-1/2	25.1 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.	m/s Nuts Fin. 1/4" & Up	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

	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.	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	17-19%	8-10%	.08% 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.
XM7	17-19%	8-10%	.10%	2%	.045%	.03%		1%	3-4%			See 302HQ		Similar to 302HQ
303	17-10%	8-10%	.15%	.2%	.02%	.15 Min.		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	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	18-20%	8-12%	.03%	2%	.045%	.03%		1%			Slightly lower than 304 due to lower carbon content			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	16-18%	10-14%	.08%	2%	.045%	.03%	2-3%	1%			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.
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.)
310	24-26%	19-22%	.25%	2%	.045%	.035		1.5%				See 309		Similar to 309 at high temperatures; extra corrosion resistance to salt.
317	18-20%	11-15%	.08%	2%	.45%	.03%	3-4%	1%				See 309		High chromium and nickel with added molybdenum give greater tensile strength and corrosion resistance at high temperatures.
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.

	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 5% of stainless fasteners; magnetic; no nickel and high carbon content mean the lowest corrosion resistance among the different types of stainless.											Tensile and yield will increase sharply in martensitic stainless by heat treating.			
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 twoards 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.
FERRITIC STAINLESS: A few percent of stainless fasteners; magnetic; not hardenable by heat treatment; high chromium content helps corrosion resistance.														
405	11.5-14.5%		.08%	1%	.04%	.03%		1%		.1-3% Alum.	70,000-75,000	40,000-45,000	B65-B75	Low corrosion reisstance; added aluminum lowers tensile strength
430	16-18%		.12%	1%	.04%	.03%		1%				See 405		Most popular of ferritic stainless; higher carbon content adds strength; used for cold forming and hot forging but low machineability.
PRECIPITATION HARDENED STAINLESS, MONEL, AND ALUMINUM														
630	15.5-175%	3.5%	.07%	1%	.04%	.03%	1%		3-5%	Columbian & Tantalum - 15.4 5%	135,000	105,000	C28	Infrequently used; high corrosion resistance; strength and ductility in high and low temperatures due to solution annealing and hardening.
Monel 400		63-70%	.3%	2%		.5%				2.5%-Iron, .5%-Alum., .15% Sulf., remainder copper	80,000-125,000	40,000-70,000	B70	Most commonly used nickel-copper alloy for cold forming; excellent corrosion resistance in heat and salt water.
Aluminum 2024	.1%			.3-.9%		.5%			3.8-4.9%	.25% Zinc. 1.2-1.8% Magnesium, remainder Alum.	60,000 heat treated	50,000 heat treated	B60 heat treated	Most popular of aluminum alloys; needs heat treatment for strength.
BRASS AND BRONZE														
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	B55	Good machineability due to added lead; good for screw machine parts.
Commercial Brass									60-65%	35-40% Zinc. .05-.15 Lead	55,000	35,000	B60	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% Laad, .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.



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