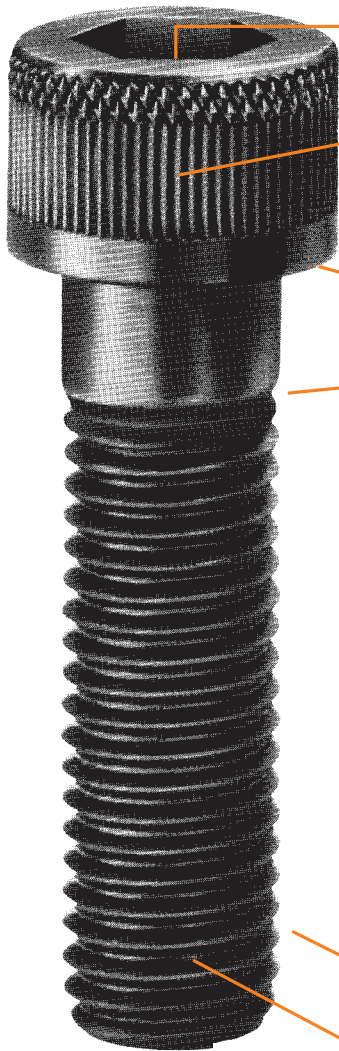


SOCKET HEAD CAP SCREWS

Why Socket Screws? . . . Why UNBRAKO ■ "Profile" of Extra Strength

PROFILE OF EXTRA STRENGTH

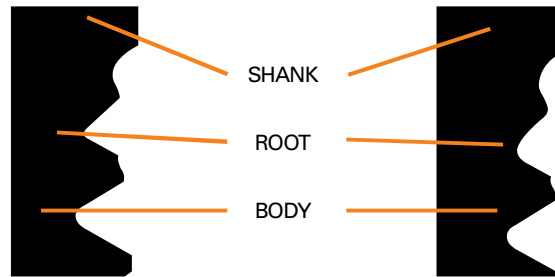


Deep, accurate socket for high torque wrenching. Knurls for easier handling. Marked for easier identification.

Head with increased bearing area for greater loading carrying capacity. Precision forged for symmetrical grain flow, maximum strength.

Elliptical fillet doubles fatigue life at critical head-shank juncture.

"3-R" (radiused-root runout) increases fatigue life in this critical head-shank juncture.

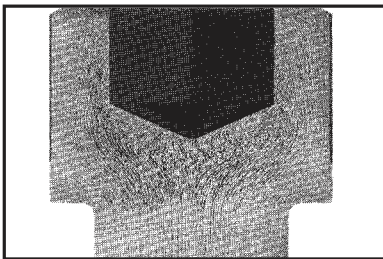


CONVENTIONAL THREAD RUNOUT – Note sharp angle at root where high stress concentration soon develops crack which penetrates into body of the screw.

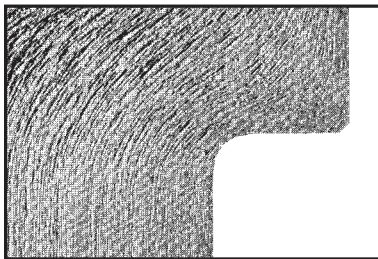
UNBRAKO "3-R" (RADIUSED ROOT RUNOUT) THREAD – Controlled radius of runout root provides a smooth form that distributes stress and increases fatigue life of thread run-out as a much as 300% in certain sizes.

Fully formed radiused thread increases fatigue life 100% over flat root thread forms.

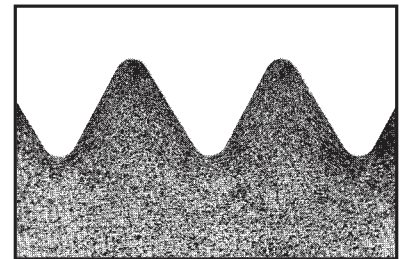
Controlled heat treatment produces maximum strength without brittleness.



Accurate control of socket depth gives more wrench engagement than other screws, permits full tightening without cracking or reaming the socket, yet provides ample metal in the crucial fillet area for maximum head strength.

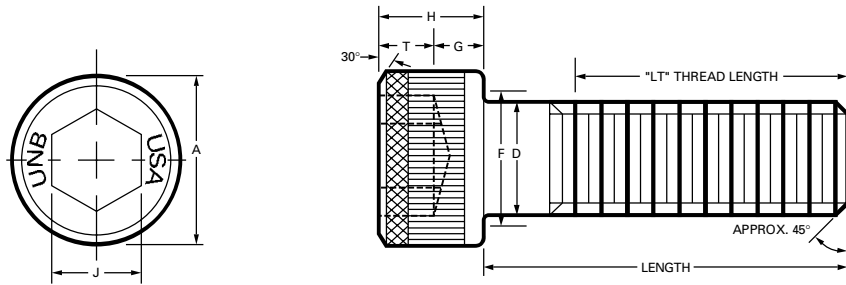


Controlled head forging, uniform grain flow, unbroken flow lines; makes heads stronger; minimizes failure in vital fillet area; adds to fatigue strength.



Contour-following flow lines provide extra shear strength in threads, resist stripping and provide high fatigue resistance. The large root radius UNBRAKO socket screw development doubles fatigue life compared to flat root thread forms.

SOCKET HEAD CAP SCREWS ■ 1960 Series ■ Dimensions ■ Mechanical Properties



Head markings may vary slightly depending on manufacturing practice. Diamond knurls, UNBRAKO, and UNB are recognized identifications for 1/4" diameter and larger.

DIMENSIONS

nom. size	basic screw dia.	threads per inch		A		D		G	T	H		J	F		LT
		UNRC	UNRF	head diameter		body diameter		min.	min.	head height		nom.	fillet diameter		basic
				max.	min.	max.	min.			max.	min.		max.	min.	
#0	.060	-	80	.096	.091	.060	.0568	.020	.025	.060	.057	.050	.074	.051	.500
#1	.073	64	72	.118	.112	.073	.0695	.025	.031	.073	.070	.062	.087	.061	.625
#2	.086	56	64	.140	.134	.086	.0822	.029	.038	.086	.083	.078	.102	.073	.625
#3	.099	48	56	.161	.154	.099	.0949	.034	.044	.099	.095	.078	.115	.084	.625
#4	.112	40	48	.183	.176	.112	.1075	.038	.051	.112	.108	.094	.130	.094	.750
#5	.125	40	44	.205	.198	.125	.1202	.043	.057	.125	.121	.094	.145	.107	.750
#6	.138	32	40	.226	.218	.138	.1329	.047	.064	.138	.134	.109	.158	.116	.750
#8	.164	32	36	.270	.262	.164	.1585	.056	.077	.164	.159	.141	.188	.142	.875
#10	.190	24	32	.312	.303	.190	.1840	.065	.090	.190	.185	.156	.218	.160	.875
1/4	.250	20	28	.375	.365	.250	.2435	.095	.120	.250	.244	.188	.278	.215	1.000
5/16	.312	18	24	.469	.457	.3125	.3053	.119	.151	.312	.306	.250	.347	.273	1.125
3/8	.375	16	24	.562	.550	.375	.3678	.143	.182	.375	.368	.312	.415	.331	1.250
7/16	.437	14	20	.656	.642	.4375	.4294	.166	.213	.437	.430	.375	.484	.388	1.375
1/2	.500	13	20	.750	.735	.500	.4919	.190	.245	.500	.492	.375	.552	.446	1.500
9/16	.562	12	18	.843	.827	.5625	.5538	.214	.265	.562	.554	.438	.6185	.525	1.625
5/8	.625	11	18	.938	.921	.625	.6163	.238	.307	.625	.616	.500	.689	.562	1.750
3/4	.750	10	16	1.125	1.107	.750	.7406	.285	.370	.750	.740	.625	.828	.681	2.000
7/8	.875	9	14	1.312	1.293	.875	.8647	.333	.432	.875	.864	.750	.963	.798	2.250
1	1.000	8	12	1.500	1.479	1.000	.9886	.380	.495	1.000	.988	.750	1.100	.914	2.500
1	1.000	-	14*	1.500	1.479	1.000	.9886	.380	.495	1.000	.988	.750	1.100	.914	2.500
1 1/8	1.125	7	12	1.688	1.665	1.125	1.1086	.428	.557	1.125	1.111	.875	1.235	1.023	2.812
1 1/4	1.250	7	12	1.875	1.852	1.250	1.2336	.475	.620	1.250	1.236	.875	1.370	1.148	3.125
1 3/8	1.375	6	12	2.062	2.038	1.375	1.3568	.523	.682	1.375	1.360	1.000	1.505	1.256	3.437
1 1/2	1.500	6	12	2.250	2.224	1.500	1.4818	.570	.745	1.500	1.485	1.000	1.640	1.381	3.750
1 3/4	1.750	5	12	2.625	2.597	1.750	1.7295	.665	.870	1.750	1.734	1.250	1.910	1.609	4.375
2	2.000	4 1/2	12	3.000	2.970	2.000	1.9780	.760	.995	2.000	1.983	1.500	2.180	1.843	5.000
2 1/4	2.250	4 1/2	12	3.375	3.344	2.250	2.2280	.855	1.120	2.250	2.232	1.750	2.450	2.093	5.625
2 1/2	2.500	4	12	3.750	3.717	2.500	2.4762	.950	1.245	2.500	2.481	1.750	2.720	2.324	6.250
2 3/4	2.750	4	12	4.125	4.090	2.750	2.7262	1.045	1.370	2.750	2.730	2.000	2.990	2.574	6.875
3	3.000	4	12	4.500	4.464	3.000	2.9762	1.140	1.495	3.000	2.979	2.250	3.260	2.824	7.500

Performance data listed are for standard production items only. Non-stock items may vary due to variables in methods of manufacture. It is suggested that the user verify performance on any non-standard parts for critical applications.

* 1-14 is UNRS (special) standard thread form.

SOCKET HEAD CAP SCREWS

1960 Series ■ Dimensions ■ Mechanical Properties ■ Application Data

NOTES

Material: ASTM A574 – alloy steel
ASTM F837 – stainless steel

Dimensions: ANSI/ASME B18.3

Hardness: Alloy Steel – Rc 38-43
Stainless Steel – Rb 80 – Rc 33

Concentricity: Body to head O.D. – within 2% of body diameter T.I.R. or .006 T.I.R. whichever is greater. Body to hex socket – (sizes through 1/2") – within 3% of body diameter T.I.R. or .005 T.I.R. whichever is greater; (sizes over 1/2" – within 6% of body diameter).

The plane of the bearing surface shall be perpendicular to the axis of the screw within a maximum deviation of 1°.

For body and grip lengths see pages 8 and 9.

Thread Class: #0 through 1" dia. – 3A; over 1" dia. – 2A.

Typical values for test specimens:

Alloy Steel Stainless Steel

Elongation in 2 inches: 10% min. 10% min.

Reduction of area: 35% min. 30% min.

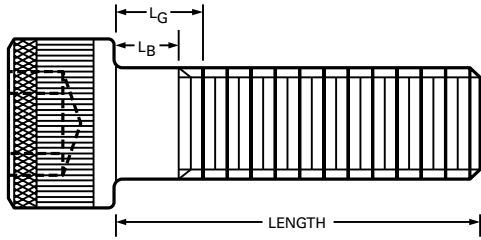
MECHANICAL PROPERTIES

nom. size	ALLOY STEEL						STAINLESS STEEL								
	tensile strength pounds		tensile strength psi min.	yield strength psi min.	single shear strength of body lbs. min.	recommended seating torque* in-lbs		tensile strength pounds		tensile strength	tensile strength	single shear strength	recommended seating torque* in-lbs		
	UNRC	UNRF				UNRC	UNRF	plain	plain				UNRC	UNRF	plain
			plain	plain	plain					plain					
#0	–	342	190,000	170,000	320	–	3	–	171	95,000	30,000	130	–	1.3	
#1	499	528	190,000	170,000	475	5	5	250	264	95,000	30,000	190	2.0	2.3	
#2	702	749	190,000	170,000	660	7	8	352	374	95,000	30,000	260	3.8	4	
#3	925	994	190,000	170,000	875	12	13	463	497	95,000	30,000	350	5.7	6	
#4	1,150	1,260	190,000	170,000	1,120	18	19	574	628	95,000	30,000	440	8.0	9	
#5	1,510	1,580	190,000	170,000	1,400	24	25	756	789	95,000	30,000	550	12	14	
#6	1,730	1,930	190,000	170,000	1,700	34	36	864	964	95,000	30,000	670	15	17	
#8	2,660	2,800	190,000	170,000	2,400	59	60	1,330	1,400	95,000	30,000	850	28	29	
#10	3,330	3,800	190,000	170,000	3,225	77	91	1,660	1,900	95,000	30,000	1,280	40	45	
1/4	6,050	6,910	190,000	170,000	5,600	200	240	3,020	3,460	95,000	30,000	2,200	95	110	
5/16	9,960	11,000	190,000	170,000	8,750	425	475	4,980	5,510	95,000	30,000	3,450	170	190	
3/8	14,700	16,700	190,000	170,000	12,600	750	850	7,360	8,350	95,000	30,000	4,470	300	345	
7/16	20,200	22,600	190,000	170,000	17,100	1,200	1,350	10,100	11,300	95,000	30,000	6,760	485	545	
1/2	27,000	30,400	190,000	170,000	22,350	1,850	2,150	13,500	15,200	95,000	30,000	8,840	750	850	
9/16	32,800	36,500	180,000	155,000	28,300	2,500	2,700	17,300	19,300	95,000	30,000	11,200	920	1,050	
5/8	40,700	46,100	180,000	155,000	34,950	3,400	3,820	21,500	24,300	95,000	30,000	13,800	1,270	1,450	
3/4	60,200	67,100	180,000	155,000	47,700	6,000	6,800	31,700	35,400	95,000	30,000	19,850	2,260	2,520	
7/8	83,100	91,700	180,000	155,000	64,000	8,400	9,120	44,000	48,400	95,000	30,000	27,100	3,790	4,180	
1	109,000	119,000	180,000	155,000	84,800	12,500	13,200	57,600	63,000	95,000	30,000	35,300	5,690	6,230	
1	–	122,000	180,000	155,000	107,000	–	13,900								
1-1/8	137,000	154,000	180,000	155,000	214,000	14,900	16,600								
1-1/4	175,000	193,000	180,000	155,000	132,500	25,000	27,000								
1-3/8	208,000	237,000	180,000	155,000	160,000	33,000	35,000								
1-1/2	253,000	285,000	180,000	155,000	190,500	43,500	47,000								
1-3/4	342,000	394,000	180,000	155,000	259,500	71,500	82,500								
2	450,000	521,000	180,000	155,000	339,000	108,000	125,000								
2-1/4	585,000	664,000	180,000	155,000	429,000	155,000	186,000								
2-1/2	720,000	828,000	180,000	155,000	530,000	215,000	248,000								
2-3/4	888,000	1,006,000	180,000	155,000	641,000	290,000	330,000								
3	1,074,000	1,204,000	180,000	155,000	763,000	375,000	430,000								

*Seating torques for alloy steel calculated in accordance with VDI 2230, "Systematic Calculation of High Duty Bolted Joints," to induce approximately 120,000 PSI in the screw threads through 0.500-inch diameter, and 115,000 PSI over 0.500-inch diameter. Seating torques for stainless steel are calculated to induce approximately 40,000 PSI stress. Values are for plain screws. For cadmium plated screws, multiply recommended seating torque by .75; for zinc plated screws multiply by 1.40. See note, page 1.

See Technical Guidelines section for additional information on torques, installation, and hole preparation.

SOCKET HEAD CAP SCREWS ■ 1960 Series ■ Body and Grip Lengths



LENGTH TOLERANCES

diameter	up to 1" incl.	over 1" to 2 1/2" incl.	over 2 1/2" to 6" incl.	over 6"
#0 thru 3/8 incl.	-.03	-.04	-.06	-.12
7/16 to 3/4 incl.	-.03	-.06	-.08	-.12
7/8 to 1-1/2 incl.	-.05	-.10	-.14	-.20
over 1 1/2		-.18	-.20	-.24

BODY and GRIP LENGTHS

length	#0		#1		#2		#3		#4		#5		#6		#8		#10		#14	
	L_G	L_B	L_G	L_B	L_G	L_B	L_G	L_B	L_G	L_B	L_G	L_B	L_G	L_B	L_G	L_B	L_G	L_B	L_G	L_B
3/4	.250	.187																		
7/8	.250	.187	.250	.172	.250	.161	.250	.146												
1	.500	.437	.250	.172	.250	.161	.250	.146	.250	.125	.250	.125								
1 1/4	.750	.687	.625	.547	.625	.536	.625	.521	.250	.125	.250	.125	.500	.344	.375	.219	.375	.167		
1 1/2			.875	.797	.875	.786	.875	.771	.750	.625	.750	.625	.500	.344	.375	.219	.375	.167	.500	.250
1 3/4					1.125	1.036	1.125	1.021	.750	.625	.750	.625	1.000	.844	.875	.719	.875	.667	.500	.250
2							1.375	1.271	1.250	1.125	1.250	1.125	1.000	.844	.875	.719	.875	.667	1.000	.750
2 1/4											1.250	1.125	1.500	1.344	1.375	1.219	1.375	1.167	1.000	.750
2 1/2											1.750	1.625	1.500	1.344	1.375	1.219	1.375	1.167	1.500	1.250
2 3/4													2.000	1.844	1.875	1.719	1.875	1.667	1.500	1.250
3															1.875	1.719	1.875	1.667	2.000	1.750
3 1/4															2.375	2.219	2.375	2.167	2.000	1.750
3 1/2																	2.375	2.167	2.500	2.250
3 3/4																	2.875	2.667	2.500	2.250
4																			3.000	2.750
4 1/4																			3.000	2.750
4 1/2																			3.500	3.250
4 3/4																			3.500	3.250
5																			4.000	3.750
5 1/4																			4.000	3.750
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SOCKET HEAD CAP SCREWS

1960 Series ■ Body and Grip Lengths

L_G is the maximum grip length and is the distance from the bearing surface to the first complete thread.

L_B is the minimum body length and is the length of the unthreaded cylindrical portion of the shank.

Thread length for the sizes up to and including 1" diameter shall be controlled by the grip length and body length as shown in the table.

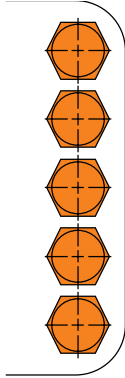
For sizes larger than 1" the minimum complete thread length shall be equal to the basic thread length, and the

total thread length including imperfect threads shall be basic thread length plus five pitches. Lengths too short to apply formula shall be threaded to head. Complete threads shall extend within two pitches of the head lengths above the heavy line on sizes up to and including 5/8" diameter. Larger diameters shall be threaded as close to the head as practicable.

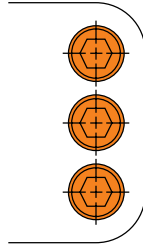
Screws of longer lengths than those tabulated shall have a thread length conforming to the formula for sizes larger than 1".

	5/16		3/8		7/16		1/2		9/16		5/8		3/4		7/8		1	
	L _G	L _B	L _G	L _B	L _G	L _B	L _G	L _B	L _G	L _B	L _G	L _B	L _G	L _B	L _G	L _B	L _G	L _B
	.625	.347	.500	.187														
	.625	.347	.500	.187	.625	.268												
	1.125	.847	1.000	.687	.625	.268	.750	.365										
	1.125	.847	1.000	.687	1.125	.768	.750	.365	.875	.458	.750	.295						
	1.625	1.187	1.500	1.187	1.125	.768	.750	.365	.875	.458	.750	.295						
	1.625	1.347	1.500	1.187	1.625	1.268	1.500	1.115	.875	.458	.750	.295	1.000	.500				
	2.125	1.847	2.000	1.687	1.625	1.268	1.500	1.115	1.625	1.208	1.500	1.045	1.000	.500	1.000	.444		
	2.125	1.847	2.000	1.687	2.125	1.768	1.500	1.115	1.625	1.208	1.500	1.045	1.000	.500	1.000	.444	1.000	.375
	2.625	2.347	2.500	2.187	2.125	1.768	2.250	1.865	1.625	1.208	1.500	1.045	1.000	.500	1.000	.444	1.000	.375
	2.625	2.347	2.500	2.187	2.625	2.268	2.250	1.865	2.375	1.958	2.250	1.795	2.000	1.500	1.000	.444	1.000	.375
	3.125	2.847	3.000	2.687	2.625	2.268	2.250	1.865	2.375	1.958	2.250	1.795	2.000	1.500	2.000	1.444	1.000	.375
	3.125	2.847	3.000	2.687	3.125	2.768	3.000	2.615	2.375	1.958	2.250	1.795	2.000	1.500	2.000	1.444	2.000	1.375
	3.625	3.347	3.500	3.187	3.125	2.768	3.000	2.615	3.125	2.708	3.000	2.545	2.000	1.500	2.000	1.444	2.000	1.375
	3.625	3.347	3.500	3.187	3.625	3.268	3.000	2.615	3.125	2.708	3.000	2.545	3.000	2.500	2.000	1.444	2.000	1.375
	4.125	3.847	4.000	3.687	3.625	3.268	3.750	3.365	3.125	2.708	3.000	2.545	3.000	2.500	3.000	2.444	2.000	1.375
	4.125	3.847	4.000	3.687	4.125	3.768	3.750	3.365	3.875	3.458	3.750	3.295	3.000	2.500	3.000	2.444	3.000	2.375
	4.625	4.347	4.500	4.187	4.125	3.768	3.750	3.365	3.875	3.458	3.750	3.295	3.000	2.500	3.000	2.444	3.000	2.375
	4.625	4.347	4.500	4.187	4.625	4.268	4.500	4.115	3.875	3.458	3.750	3.295	4.000	3.500	3.000	2.444	3.000	2.375
	5.125	4.847	5.000	4.687	4.625	4.268	4.500	4.115	4.625	4.208	4.500	4.045	4.000	3.500	4.000	3.444	3.000	2.375
			5.000	4.687	5.125	4.768	4.500	4.115	4.625	4.208	4.500	4.045	4.000	3.500	4.000	3.444	4.000	3.375
			5.500	5.187	5.125	4.768	5.250	4.865	4.625	4.208	4.500	4.045	4.000	3.500	4.000	3.444	4.000	3.375
			5.500	5.187	5.625	5.268	5.250	4.865	5.375	4.958	5.250	4.795	5.000	4.500	4.000	3.444	4.000	3.375
			6.000	5.687	5.625	5.268	5.250	4.865	5.375	4.958	5.250	4.795	5.000	4.500	5.000	4.444	4.000	4.375
					6.125	5.768	6.000	5.615	5.375	4.958	5.250	4.795	5.000	4.500	5.000	4.444	5.000	4.375
					6.125	5.768	6.000	5.615	6.125	5.708	6.000	5.545	5.000	4.500	5.000	4.444	5.000	4.375
					6.625	6.268	6.000	5.615	6.125	5.708	6.000	5.545	6.000	5.500	5.000	4.444	5.000	4.375
					7.125	6.768	7.000	6.615	6.875	6.458	6.750	6.295	6.000	5.500	6.000	5.444	5.000	5.375
					7.625	7.268	7.000	6.615	6.875	6.458	6.750	6.295	7.000	6.500	6.000	5.444	5.000	5.375
							8.000	7.615	7.625	7.208	7.750	7.295	7.000	6.500	7.000	6.444	7.000	6.375
							8.000	7.615	7.625	7.208	7.750	7.295	8.000	7.500	7.000	6.444	7.000	6.375
									9.125	8.708	9.250	8.795	9.000	8.500	8.000	7.444	8.000	7.375
									10.125	9.708	10.250	9.795	10.000	9.000	9.000	8.444	9.000	8.375
													11.000	10.500	10.000	9.444	10.000	9.375
													12.000	11.500	11.000	10.444	11.000	10.375
													13.000	12.500	12.000	11.444	12.000	11.375
															13.000	12.444	13.000	12.375
															14.000	13.444	14.000	13.375
															15.000	14.444	15.000	14.375
																16.000	15.375	
																17.000	16.375	

FEWER HOLES TO DRILL AND TAP



three screws do the work of five



old method

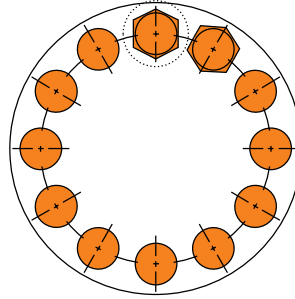
5-3/8-16 screws @
120,000 psi tensile
85,000 psi yield =
 $5 \times 85,000 \times .0775 =$
33,000 lbs. max. load

UNBRAKO method

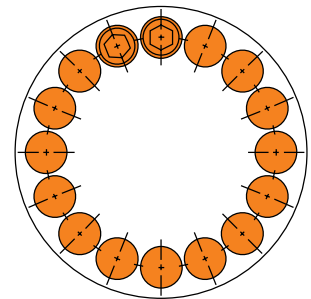
3-3/8-16 screws @
190,000 psi tensile
170,000 psi yield =
 $3 \times 170,000 \times .0775 =$
39,000 lbs. max. load

COMPACT SPACING

clearance for socket wrench



no wrench clearance necessary



old method

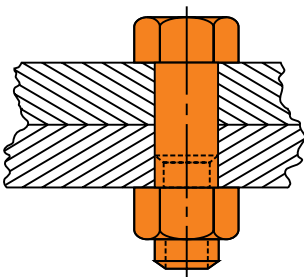
12-3/4-16 hexagon
head screws @
120,000 psi tensile
strength
Total strength =
537,000 lbs.

UNBRAKO method

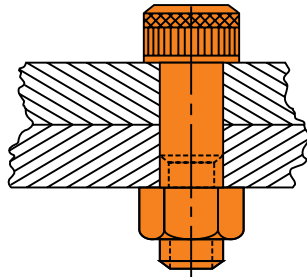
16-3/4-16 socket head
cap
screws @ 180,000 psi
tensile strength
Total strength =
1,074,200 lbs.

HIGH TENSILE AND YIELD STRENGTH

ordinary bolts



socket head cap screws



old method

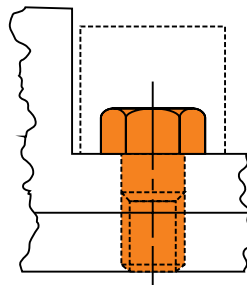
120,000 psi. 1/2-20 bolt
tensile = 19,200 lbs.
yield = 13,600 lbs.

UNBRAKO method

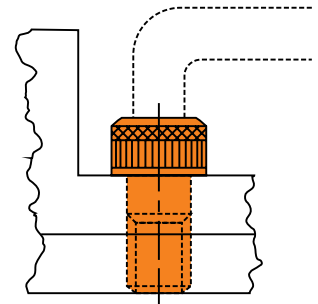
190,000 psi 1/2-20
UNBRAKO
tensile = 30,400 lbs.
yield = 27,200 lbs.
**Extra UNBRAKO joint
strength:**
tensile – 58% increase
yield – 100% increase

HIGH SHEAR STRENGTH

ordinary bolts



socket head cap screws



old method

120,000 psi. 1/2-20 bolt
Shear strength =
14,100 lbs.

UNBRAKO method

190,000 psi. 1/2-20
UNBRAKO
Shear strength =
22,400 lbs.
**Extra UNBRAKO shear
strength = 8,300 lbs.
less wrenching space
needed**