

Fastener Technical Reference

Torque-Tension Relationship for ASTM A574 Socket Head Cap Screws

Caution: All material included in this chart is advisory only, and its use by anyone is voluntary. In developing this information, Fastenal has made a determined effort to present its contents accurately. Extreme caution should be used when using a formula for torque/tension relationships. Torque is only an indirect indication of tension. Under/over tightening of fasteners can result in costly equipment failure or personal injury.

Nominal Dia.	threads per inch	Unified Coarse Thread Series			Fine Thread Series					
		Clamp Load (lbs)	Tightening Torque			Clamp Load (lbs)	Tightening Torque			
			K = 0.15 (ft.-lbs.)	K = 0.165 (ft.-lbs.)	K = 0.20 (ft.-lbs.)		threads per inch	K = 0.15 (ft.-lbs.)	K = 0.165 (ft.-lbs.)	K = 0.20 (ft.-lbs.)
1/4	20	3341	10	11	14	28	3819	12	13	16
5/16	18	5505	22	24	29	24	6097	24	26	32
3/8	16	8136	38	42	51	24	9222	43	48	58
7/16	14	11162	61	67	81	20	12465	68	75	91
1/2	13	14899	93	102	124	20	16795	105	115	140
5/8	11	22883	179	197	238	18	25916	202	223	270
3/4	10	33864	317	349	423	16	37762	354	389	472
7/8	9	46751	511	562	682	14	51584	564	621	752
1	8	61332	767	843	1022	14	68839	860	947	1147
1 1/4	7	98123	1533	1686	2044	12	108636	1697	1867	2263

The torque values can only be achieved if nut (or tapped hole) has a proof load greater than or equal to the bolt's minimum ultimate tensile strength.
 Clamp load calculated as 75% of the proof load for socket head cap screws as specified in ASTM A574.
 Torque values calculated from formula T=KDF, where
 K = 0.15 for "lubricated", K = 0.165 is the "as received", and K = 0.20 for "dry" conditions
 D = Nominal Diameter
 F = Clamp Load
 Note: When using Zinc Plated (lubricated with wax) Top Lock Nuts, the K value can vary between 0.12-0.16.

Torque Values for Stainless Steel and Non-Ferrous Fasteners (inch series)

Nom Dia.	Threads per inch	18-8 & 316 Stainless Steel		Silicon Bronze	Monel	Brass	2024-T4 Aluminum
		Dry	Lubricated				
Coarse Thread Series							
2	56	2.5 in-lbs	2.3 in-lbs	2.3 in-lbs	2.5 in-lbs	2.0 in-lbs	1.4 in-lbs
4	40	5.4	4.9	4.8	5.3	4.3	2.9
5	40	8.0	7.2	7.1	7.8	6.3	4.2
6	32	10.0	9.0	8.9	9.8	7.9	5.3
8	32	18.4	16.5	18.4	20.2	16.2	10.8
10	24	26.6	24.0	21.2	25.9	18.6	13.8
1/4	20	63.6	57.3	68.8	85.3	61.5	45.6
5/16	18	131	118	123	149	107	80
3/8	16	19.4 ft-lbs	17.4 ft-lbs	18.3 ft-lbs	22.2 ft-lbs	16.0 ft-lbs	11.9 ft-lbs
7/16	14	31.0	27.9	29.1	35.6	26.4	19.0
1/2	13	47	43	40	48.7	35.2	26
5/8	11	94	85	86	111	76	60
3/4	10	125	113	118	153	104	82
7/8	9	202	182	178	231	159	124
1	8	303	273	265	344	235	184
Fine Thread Series							
2	64	2.7 in-lbs	2.4 in-lbs	2.8 in-lbs	3.1 in-lbs	2.5 in-lbs	1.7 in-lbs
4	48	5.9	5.3	6.1	6.7	5.4	3.6
5	44	8.3	7.5	8.7	9.6	7.7	5.1
6	40	11.2	10.1	11.2	12.3	9.9	6.6
8	36	19.3	17.4	20.4	22.4	18.0	12.0
10	32	30.4	27.4	29.3	34.9	25.9	19.2
1/4	28	73	65	87	106	77	57
5/16	24	145	131	131	160	116	86
3/8	24	22.0 ft-lbs	19.8 ft-lbs	20.0 ft-lbs	24.5 ft-lbs	17.7 ft-lbs	13.1 ft-lbs
7/16	20	34.6	31.2	30.9	37.6	27.3	20.2
1/2	20	53	48	42	51	37	27
5/8	18	107	96	96	123	85	67
3/4	16	140	126	115	149	102	80
7/8	14	223	201	177	230	158	124
1	14	340	306	240	311	212	166

Stainless Steel and Non-Ferrous are suggested maximum torque values based on actual lab testing. Stainless steel fasteners tend to gall while being tightened. The risk of galling or thread seizing can be reduced by: using lubrication, tightening fasteners with low RPMs and without interruptions, applying only light pressure, and avoiding prevailing torque lock nuts when possible. Torque values up through and including 5/16-in series are in inch-pounds. All other torque values are in foot-pounds.

Torque-Tension Relationship for Metric Fasteners

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Nominal Dia. (mm)	Pitch	4.6			8.8			10.9			12.9						
		Clamp Load (lbs)	Tightening Torque (in-lbs through M8; M10 & over ft-lbs)			Clamp Load (lbs)	Tightening Torque (in-lbs through M8; M10 & over ft-lbs)			Clamp Load (lbs)	Tightening Torque (in-lbs through M8; M10 & over ft-lbs)			Clamp Load (lbs)	Tightening Torque (in-lbs through M8; M10 & over ft-lbs)		
			K = 0.15	K = 0.17	K = 0.20		K = 0.15	K = 0.17	K = 0.20		K = 0.15	K = 0.17	K = 0.20		K = 0.15	K = 0.17	K = 0.20
4	0.7	333	7.9 in-lbs	8.9 in-lbs	10.5 in-lbs	858	20.3 in-lbs	23 in-lbs	27 in-lbs	1228	29 in-lbs	32.9 in-lbs	38.7 in-lbs	1436	33.9 in-lbs	38.4 in-lbs	45.2 in-lbs
5	0.8	538	15.9	18.0	21.2	1387	40.9	46.4	54.6	1985	58.6	66.4	78.1	2319	68.5	77.6	91.3
6	1	763	27.0	30.7	36.1	1968	69.7	79.0	92.9	2816	99.8	113.1	133.0	3291	116.6	132.1	155.4
7	1	1095	45.3	51.3	60.3	2822	116.6	132.2	155.5	4039	167	189	223	4720	195	221	260
8	1.25	1389	65.6	74.4	87.5	3580	169.1	191.6	225.4	5123	242	274	323	5987	283	320	377
10	1.5	2200	10.8 ft-lbs	12.3 ft-lbs	14.4 ft-lbs	5671	27.9 ft-lbs	31.6 ft-lbs	37.2 ft-lbs	8115	39.9 ft-lbs	45.2 ft-lbs	53.2 ft-lbs	9484	46.7 ft-lbs	52.9 ft-lbs	62.2 ft-lbs
12	1.75	3197	18.9	21.4	25.2	8240	48.7	55.1	64.9	11792	69.6	78.9	92.8	13781	81.4	92.2	108.5
14	2	4379	30.2	34.2	40.2	11289	77.8	88.1	103.7	16154	111.3	126.1	148.4	18879	130.0	147.4	173.4
16	2	5943	47	53	62	15320	121	137	161	21924	173	196	230	25622	202	229	269
18	2.5	7301	65	73	86	19471	172	195	230	26934	239	270	318	31477	279	316	372
20	2.5	9286	91	104	122	24763	244	276	325	34256	337	382	449	40034	394	446	525
22	2.5	11509	125	141	166	30692	332	377	443	42457	460	521	613	49619	537	609	716
24	3	13372	158	179	211	35659	421	477	561	49329	582	660	777	57649	681	771	908
27	3	17428	232	262	309	46474	617	700	823	64288	854	968	1139	75132	998	1131	1331
30	3.5	21266	314	356	419	56709	837	949	1116	78448	1158	1312	1544	91680	1353	1534	1804
33	3.5	26310	427	484	570	70160	1139	1291	1519	97055	1576	1786	2101	113425	1842	2087	2455
36	4	30982	549	622	732	82620	1463	1658	1951	114201	2024	2294	2699	133569	2366	2681	3154

The torque values can only be achieved if nut (or tapped hole) has a proof load greater than or equal to the bolt's minimum ultimate tensile strength.
 Clamp loads estimated as 75% of proof load for specified bolts.
 Torque values calculated from formula T=KDF where; K=0.15 for "lubricated" condition, K=0.17, K=0.20 for plain and dry condition

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