

TORQUE-TENSION REFERENCE GUIDE



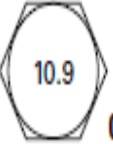

TORQUE-TENSION RELATIONSHIP FOR A307A, GRADE 5, 8 & 9 BOLTS

Nominal Dia. (in.)	Threads per inch	ASTM A307 Grade A					SAE J429 Grade 5					SAE J429 Grade 8					FNL Grade 9				
		Clamp Load (Lbs.)	Tightening Torque			Clamp Load (Lbs.)	Tightening Torque			Clamp Load (Lbs.)	Tightening Torque			Clamp Load (Lbs.)	Tightening Torque						
			K = 0.15	K = 0.17	K = 0.20		Ecoguard™	K = 0.15	K = 0.17		K = 0.20	Ecoguard™	K = 0.15		K = 0.17	K = 0.20	Ecoguard™	K = 0.15	K = 0.17	K = 0.20	
Coarse Thread Series																					
1/4	20	859	32 in-lbs	37 in-lbs	43 in-lbs	2029	61 in-lbs	76 in-lbs	86 in-lbs	10 1in-lbs	2864	86 in-lbs	107 in-lbs	122 in-lbs	143 in-lbs	3357	101 in-lbs	126 in-lbs	143 in-lbs	168 in-lbs	
5/16	18	1416	66	75	88	3342	125	157	178	209	4719	177	221	251	295	5531	207	259	294	346	
3/8	16	2092	10 ft-lbs	1 1 ft-lbs	13 ft-lbs	4940	19 ft-lbs	23 ft-lbs	26 ft-lbs	31 ft-lbs	6974	26 ft-lbs	33 ft-lbs	37 ft-lbs	44 ft-lbs	8174	31 ft-lbs	38 ft-lbs	43 ft-lbs	51 ft-lbs	
7/16	14	2870	16	18	21	6777	30	37	42	49	9568	42	52	59	70	11214	49	61	70	82	
1/2	13	3831	24	27	32	9046	45	57	64	75	12771	64	80	90	106	14969	75	94	106	125	
9/16	12	4912	35	39	46	11599	65	82	92	109	16375	92	115	130	154	19193	108	135	153	180	
5/8	11	6102	48	54	64	14408	90	113	128	150	20340	127	159	180	212	23840	149	186	211	248	
3/4	10	9030	85	96	113	21322	160	200	227	267	30101	226	282	320	376	35281	265	331	375	441	
7/8	9	12467	136	155	182	29436	258	322	365	429	41556	364	455	515	606	48707	426	533	604	710	
1	8	16355	204	232	273	38616	386	483	547	644	54517	545	681	772	909	63899	639	799	905	1065	
1-1/4	7	26166	409	463	545	53786	672	840	952	1121	87220	1090	1363	1545	1817	102229	1278	1597	1810	2130	
1-3/8	6	31182	536	607	715	64096	881	1102	1249	1469	103939	1429	1768	2025	2382	121826	1675	2094	2373	2792	
1-1/2	6	37942	711	806	949	77991	1170	1462	1657	1950	126473	1897	2371	2688	3162	148237	2224	2779	3150	3706	
Fine Thread Series																					
1/4	28					2319	70 in-lbs	87 in-lbs	99 in-lbs	116 in-lbs	3274	98 in-lbs	123 in-lbs	139 in-lbs	164 in-lbs	3837	115 in-lbs	144 in-lbs	163 in-lbs	192 in-lbs	
5/16	24					3702	139	174	197	231	5226	196	245	278	327	6125	230	287	325	383	
3/8	24					5599	21 ft-lbs	26 ft-lbs	30 ft-lbs	35 ft-lbs	7905	30 ft-lbs	37 ft-lbs	42 ft-lbs	49 ft-lbs	9265	35 ft-lbs	43 ft-lbs	49 ft-lbs	58 ft-lbs	
7/16	20					7568	33	41	47	55	10684	47	58	66	78	12523	55	68	78	91	
1/2	20					10197	51	64	72	85	14396	72	90	102	120	16873	84	105	120	141	
9/16	18					12940	73	91	103	121	18268	103	128	146	171	21412	120	151	171	201	
5/8	18					16317	102	127	144	170	23036	144	180	204	240	27000	169	211	239	281	
3/4	16					23776	178	223	253	297	33566	252	315	357	420	39343	295	369	418	492	
7/8	14					32479	284	355	403	474	45853	401	502	568	669	53743	470	588	666	784	
1	14					43343	433	542	614	722	61190	612	765	867	1020	71720	717	896	1016	1195	
1-1/4	12					59548	744	930	1055	1241	96565	1207	1509	1710	2012	113182	1415	1768	2004	2358	
1-3/8	12					72967	1003	1254	1421	1672	118324	1627	2034	2305	2712	138686	1907	2384	2701	3278	
1-1/2	12					87747	1316	1645	1865	2194	142292	2134	2668	3024	3557	166778	2502	3127	3544	4169	

ELECTRODEPOSITED ZINC & LUBRICATED PREVAILING-TORQUE ALL-METAL TYPE NUTS

Locknut Size	Threads per inch	Steel Hex Locknut						Steel Hex Flange Nut					
		Grade C			FNL Grade 9			Grade F			Grade G		
		Clamp Load (lbs.)	Tightening Torque		Clamp Load (lbs.)	Tightening Torque		Clamp Load (lbs.)	Tightening Torque		Clamp Load (lbs.)	Tightening Torque	
			min	max		min	max		min	max		min	max
Coarse Thread Series													
1/4	20	2864	93.1 in-lbs	144 in-lbs	3357	100.7 in-lbs	134.3 in-lbs	2029	76.1 in-lbs	96.4 in-lbs	2864	107.4 in-lbs	136 in-lbs
5/16	18	4719	192	251	5531	207	277	3342	157	198	4719	221	280
3/8	16	6974	28.3 ft-lbs	37 ft-lbs	8174	30.7 ft-lbs	40.9 ft-lbs	4940	23.2 ft-lbs	29.3 ft-lbs	6974	32.7 ft-lbs	41.4 ft-lbs
7/16	14	9568	45	59	11214	49	65	6777	37	47	9568	52	66
1/2	13	12771	69	90	14969	75	100	9046	57	72	12771	80	101
9/16	12	16375	100	130	19193	108	144	11599	82	103	16375	115	146
5/8	11	20340	138	180	23840	149	199	14408	113	143	20340	159	201
3/4	10	30101	245	320	35281	265	353	21322	200	253	30101	282	357
7/8	9	41556	394	515	48707	426	568						
1	8	54517	591	772	63899	639	852						
1-1/8	7	68695	837	1095	80516	906	1208						
1-1/4	7	87220	1181	1545	102229	1278	1704						
Fine Thread Series													
1/4	28	3274	90 in-lbs	130.9 in-lbs	3837	105.5 in-lbs	153.5 in-lbs						
5/16	24	5226	180	261	6125	211	306						
3/8	24	7905	27.2 ft-lbs	39.5 ft-lbs	9265	31.8 ft-lbs	46.3 ft-lbs						
7/16	20	10684	43	62	12523	50	73						
1/2	20	14396	66	96	16873	77	112						
9/16	18	18268	94	137	21412	110	161						
5/8	18	23036	132	192	27000	155	225						
3/4	16	33566	231	336	39343	270	393						
7/8	14	45853	368	535	53743	431	627						
1	14	61190	561	816	71720	657	956						
1-1/8	12	77015	794	1155	90268	931	1354						
1-1/4	12	96565	1106	1609	113182	1297	1886						

METRIC FASTENERS

Nominal Dia. (mm)	Pitch	 Class 4.6				 Class 8.8				 Class 10.9				 Class 12.9			
		Clamp Load (lbs)	Tightening Torque			Clamp Load (lbs)	Tightening Torque			Clamp Load (lbs)	Tightening Torque			Clamp Load (lbs)	Tightening Torque		
			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	18822	167	189	222	26934	239	270	318	31477	279	316	372
20	2.5	9286	91	104	122	23938	236	267	314	34256	337	382	449	40034	394	446	525
22	2.5	11509	125	141	166	29669	321	364	428	42457	460	521	613	49619	537	609	716
24	3	13372	158	179	211	34471	407	461	543	49329	582	660	777	57649	681	771	908
27	3	17428	232	262	309	44924	597	676	796	64288	854	968	1139	75132	998	1131	1331
30	3.5	21266	314	356	419	54819	809	917	1079	78448	1158	1312	1544	91680	1353	1534	1804
33	3.5	26310	427	484	570	67821	1101	1248	1468	97055	1576	1786	2101	113425	1842	2087	2455
36	4	30982	549	622	732	79866	1415	1603	1886	114291	2024	2294	2699	133569	2366	2681	3154

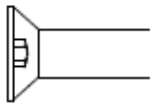
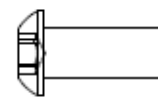


* Tightening Torque (in-lbs through M8; M10 & over ft-lbs)

A2 OR A4 METRIC STAINLESS STEEL FASTENERS

Nominal Dia. (mm)	Pitch	Torque (in-lbs through M8; M10 & over ft-lbs)	
		Dry	Lubricated
3	0.5	7.5 in-lbs.	7.0 in-lbs.
4	0.7	17.5	16.2
5	0.8	35.4	32.7
6	1	60.3	55.8
8	1.25	146.2	135.2
10	1.5	24.1 ft-lbs	22.3 ft-lbs
12	1.75	42.1	38.9
14	2	67.2	62.2
16	2	104	96
18	2.5	144	133
20	2.5	204	188
22	2.5	208	193
24	3	264	244

CAUTION: All material included in these charts 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.

ALLOY STEEL LOW HEAD SOCKET HEAD CAP SCREW

Nominal Size		Alloy Steel Socket Head Other Configurations Torque (in-lbs.)			
Size	Inch				
		Flat Head	Button Head	Shoulder Screw	Low-Head
#1	0.073	2.5	2	-	
#2	0.086	4.5	4	-	
#3	0.099	7	7	-	
#4	0.112	9	8.5	-	5
#5	0.125	13	13	-	9.5
#6	0.138	17	15	-	9.5
#8	0.164	32	30	-	19
#10	0.190	60	55	-	30.5
1/4	0.250	125	105	50	75
5/16	0.313	225	200	125	150
3/8	0.375	375	350	265	275
1/2	0.500	1100	950	470	600
5/8	0.625	1900	1700	1150	1300
3/4	0.750	3500	-	2000	-
7/8	0.875	5750	-	-	-
1	1.000	8000	-	-	-

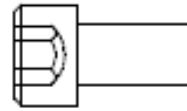
NOTES:

- 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 tensile strength.
- For A307A, J429 Grade 5 and 8, FNL Grade 9, EcoGuard™, A574, A193 B7, Class 4.6, 8.8, 10.9, and 12.9 externally thread fasteners and Prevailing Torque All-Metal Nut chart, the torque values were calculated from the formula $Torque = KDF$, where K is the estimated torque coefficient (for full details contact engineer@fastenal.com).
 $K = 0.12$ when using EcoGuard™ coated nut, bolt and washer
 $K = 0.15$ for "lubricated" conditions including EcoGuard™, some oil, tapping fluid, etc.
 $K = 0.17$ for some anti-seize, thread lockers, and some plain conditions
 $K = 0.20$ for zinc and dry conditions
 $K = 0.12$ is listed for A193 B7, which would be used for some general PTFE coatings
 When using zinc plated lubricated with wax prevailing torque lock nuts, the K value can vary between 0.12–0.18. Use Prevailing Torque All-Metal Nut chart if using this style of nut.
 D = Nominal Diameter
 F = Clamp Load
 For J429 Grade 5 and 8, FNL Grade 9, A574, Class 4.6, 8.8, 10.9 and 12.9, the clamp loads are listed at 75% of the proof loads specified by the standard. For A307 Grade A, 75% of 36,000 PSI is utilized. A193 B7 uses 75% of the yield strength. The prevailing torque lock nut clamp loads are listed at 75% of the proof loads specified for the appropriate grade bolt: Grade C – SAE J429 Grade 8, FNL Grade 9 – FNL Grade 9 bolt, Grade F – SAE J429 Grade 5, Grade G – SAE J429 Grade 8.

- With the exception of the F835 Countersunk and Button Head, Alloy Steel Socket Shoulder and Alloy Steel Low Head Socket Head Cap Screw, torque values for inch series charts up through and including 5/16-in diameter are in inch-pounds; diameters 3/8-in and larger are in foot-lbs. Torque values for metric fasteners up through and including M8 are in inch-pounds; diameters M10 and larger are in foot-lbs.
 - Torque values for F835 Countersunk and Button Head, Alloy Steel Socket Shoulder and Alloy Steel Low Head Socket Head Cap Screw are given for "as-received" screws in rigid joints when torqued with standard hex keys; all are listed in inch-pounds.
 - 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.
- CONVERSION FACTORS:**
 To convert inch-pounds (in-lbs) to Newton meters (Nm), multiply by 0.113
 To convert foot-pounds (ft-lbs) to Newton meters (Nm), multiply by 1.35
 To convert pounds (lbs) to Newtons (N), multiply by 4.448
 To convert inches (in) to millimetres (mm), multiply by 25.4
 Note: When using Zinc Plated (lubricated with wax) Top Lock Nuts, the K value can vary between 0.12-0.16.

ASTM A574 SOCKET HEAD CAP SCREWS

Nominal Size or Basic Screw Dia.		Threads per inch	Tensile Stress Area (sq. in.)	ASTM A574			
				Clamp Load (lbs)	Tightening Torque		
					K = 0.15	K = 0.17	K = 0.20
Coarse Thread Series							
#1	0.0730	64	0.0026	275	3.0 in-lbs	3.4 in-lbs	4.0 in-lbs
#2	0.0860	56	0.0037	388	5.0	5.7	6.7
#3	0.0990	48	0.00492	511	7.6	8.6	10.1
#4	0.1120	40	0.006	633	10.6	12.1	14.2
#5	0.1250	40	0.008	835	16	18	21
#6	0.1380	32	0.0091	954	20	22	26
#8	0.1640	32	0.014	1471	36	41	48
#10	0.1900	24	0.0175	1841	52	59	70
1/4	0.2500	20	0.0318	3341	125	142	167
5/16	0.3125	18	0.0524	5505	258	292	344
3/8	0.3750	16	0.0775	8136	38 ft-lbs	43 ft-lbs	51 ft-lbs
7/16	0.4375	14	0.1063	11162	61	69	81
1/2	0.5000	13	0.1419	14899	93	106	124
5/8	0.6250	11	0.226	22883	179	203	238
3/4	0.7500	10	0.3345	33864	317	360	423
7/8	0.8750	9	0.4617	46751	511	580	682
1	1.0000	8	0.6057	61332	767	869	1022
1-1/4	1.2500	7	0.9691	98123	1533	1738	2044
1-1/2	1.5000	6	1.4053	142282	2668	3023	3557
Fine Thread Series							
#0	0.0600	80	0.0018	189	1.7 in-lbs	1.9 in-lbs	2.3 in-lbs
#1	0.0730	72	0.0028	292	3.2	3.6	4.3
#2	0.0860	64	0.0039	413	5.3	6.0	7.1
#3	0.0990	56	0.0052	549	8.2	9.2	10.9
#4	0.1120	48	0.0066	693	11.7	13.2	15.5
#5	0.1250	44	0.0083	872	16	19	22
#6	0.1380	40	0.0101	1065	22	25	29
#8	0.1640	36	0.0147	1546	38	43	51
#10	0.1900	32	0.02	2099	60	68	80
1/4	0.2500	28	0.0364	3819	143	162	191
5/16	0.3125	24	0.0581	6097	286	324	381
3/8	0.3750	24	0.0878	9222	43 ft-lbs	49 ft-lbs	58 ft-lbs
7/16	0.4375	20	0.1187	12465	68	77	91
1/2	0.5000	20	0.16	16795	105	119	140
5/8	0.6250	18	0.256	26876	210	238	280
3/4	0.7500	16	0.373	39161	367	416	490
7/8	0.8750	14	0.5095	53495	585	663	780
1	1.0000	14	0.6799	71388	892	1011	1190
1-1/4	1.2500	12	1.0729	112659	1760	1995	2347
1-1/2	1.5000	12	1.581	166007	3113	3528	4150



ASTM A574

ASTM A193 B7



ASTM A193 B7

Nominal Dia.	Threads per inch	Clamp Load (lbs)	Tightening Torque			
			K=0.12 (ft-lbs.)	K = 0.15 (ft-lbs.)	K = 0.17 (ft-lbs.)	K = 0.20 (ft-lbs.)
			Coarse Thread Series			
1/4	20	2506	75.2 in-lbs	94 in-lbs	106.5 in-lbs	125.3 in-lbs
5/16	18	4129	155	194	219	258
3/8	16	6102	22.9 ft-lbs	28.6 ft-lbs	32.4 ft-lbs	38.1 ft-lbs
7/16	14	8372	37	46	52	61
1/2	13	11175	56	70	79	93
5/8	11	17798	111	139	158	185
3/4	10	26339	198	247	280	329
7/8	9	36362	318	398	451	530
1	8	47702	477	596	676	795
1-1/8	7	60108	676	845	958	1127
1-1/4	7	76318	954	1192	1351	1590
1-3/8	6	90947	1251	1563	1772	2084
1-1/2	6	110664	1660	2075	2352	2767
UN8 Thread Series						
1-1/8	8	62248	700 ft-lbs	875 ft-lbs	992 ft-lbs	1167 ft-lbs
1-1/4	8	78727	984	1230	1394	1640
1-3/8	8	97138	1336	1670	1892	2226
1-1/2	8	117483	1762	2203	2497	2937
Fine Thread Series						
1/4	28	2864	85.9 in-lbs	107.4 in-lbs	121.7 in-lbs	143.2 in-lbs
5/16	24	4573	171	214	243	286
3/8	24	6916	25.9 ft-lbs	32.4 ft-lbs	36.7 ft-lbs	43.2 ft-lbs
7/16	20	9349	41	51	58	68
1/2	20	12596	63	79	89	105
5/8	18	20157	126	157	178	210
3/4	16	29371	220	275	312	367
7/8	14	40121	351	439	497	585
1	14	53541	535	669	758	892
1-1/8	12	67388	758	948	1074	1264
1-1/4	12	84494	1056	1320	1496	1760
1-3/8	12	103534	1424	1779	2017	2373
1-1/2	12	124506	1868	2334	2646	3113

- If using API bolting requirements, refer to applicable API specification for tightening torque values.
- These recommendations are for non-gasketed metal-to-metal joints.

STAINLESS STEEL AND NON-FERROUS FASTENERS (INCH SERIES)

Nom Dia	Threads per inch	18-8 and 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