

## Flange Bolt-Up Bolting Torque Tables

The torque tables are built on specific assumptions regarding bolt and nut factor. Before using a given torque table, these assumptions should be verified to insure they are appropriate for the specific application.

Even if all assumptions are appropriate, results may vary depending on actual conditions. Many factors induce scatter in the results or increase the inherent variability in the bolting process. These include variations in the nut factor; bolt, flange and nut condition; equipment calibration and condition; perpendicularity of the bolt, nut and flange; etc.

The values in the tables are based on the equation:

$$S = \frac{Fkd}{12}$$

T = Torque value, (ft-lbs)

F = Bolt pre-load, (lbs)

k = Nut Factor based on lubricant used

d = Nominal bolt diameter, (in.)



The nut factor is not the coefficient of friction.

It is an experimentally derived constant that includes the impact of friction.

ft-lbs to nm = 0.737562149277

nm to ft-lbs = 1.3558179

**Table 1 / Torque FT-LBS - ASTM A193 and ASTM A320 Grade B8, CL2 Stud Bolts**

BOLT DIA	Torque FT-LBS		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	16	36	52
9/16	23	53	75
5/8	31	73	104
3/4	55	129	184
7/8	71	166	237
1	107	249	356
1 1/8	127	297	424
1 1/4	179	417	596

1 1/8	127	297	424
1 1/4	179	417	596
1 3/8	186	435	622
1 1/2	246	574	821
1 9/16	168	392	560
1 5/8	191	445	636
1 3/4	240	561	801
1 7/8	298	696	994
2	366	853	1219
2 1/4	529	1234	1762
2 1/2	733	1709	2442
2 3/4	986	2300	3285
3	1289	3008	4297

**Table 1 / Torque FT-LBS** - ASTM A193 and ASTM A320 Grade B8, CL2 Stud Bolts

<b>Table 1 / Torque Nm</b> - ASTM A193 and ASTM A320 Grade B8, CL2 Stud Bolts			
BOLT DIA	Torque Nm		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	22	49	71
9/16	31	72	102
5/8	42	99	141
3/4	75	175	249
7/8	96	225	321
1	145	338	483
1 1/8	172	403	575
1 1/4	243	565	808
1 3/8	252	590	843
1 1/2	334	778	1112

1 <sup>3</sup> / <sub>8</sub>	252	590	843
1 <sup>1</sup> / <sub>2</sub>	334	778	1113
1 <sup>9</sup> / <sub>16</sub>	228	531	759
1 <sup>5</sup> / <sub>8</sub>	259	603	862
1 <sup>3</sup> / <sub>4</sub>	325	761	1086
1 <sup>7</sup> / <sub>8</sub>	404	944	1348
2	496	1157	1653
2 <sup>1</sup> / <sub>4</sub>	717	1673	2389
2 <sup>1</sup> / <sub>2</sub>	994	2317	3311
2 <sup>3</sup> / <sub>4</sub>	1337	3118	4454
3	1748	4078	5826

**Table 1 / Torque Nm** - ASTM A193 and ASTM A320 Grade B8, CL2 Stud Bolts

**Notes:**

- Bolting torque to develop 50% Bolt Yield Stress at Nut Factor, K=0.16
- This Table is applicable to Never-Seize paste and Fel-Pro lubricant, K=0.16.
- The above Table is applicable only for ASTM A320 Grade B8, Class 2 and A193 Grade B8, Class 2 Stud Bolts. These are 304 SS material.
- The torque values are approved for spiral wound graphite and PTFE filled gaskets, graphite sheet gaskets GHE and GHR types, ring joint, double jacketed and Camprofile gaskets.
- The Final Torque Value accounts for 10% bolt relaxation.
- The yield strength for strain-hardened bolts varies with diameter. Torque values for bolts greater than 1<sup>1</sup>/<sub>2</sub> in. diameter are based on 30 ksi yield strength.

**Table 1A / Torque FT-LBS** - Cold Service ASTM A193 and ASTM A320 Grade B8, CL2 Stud Bolts

BOLT DIA	Torque FT-LBS		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	22	51	73
9/16	32	74	105
5/8	44	102	145
3/4	57	133	188

5/8	44	102	145
3/4	77	180	257
7/8	100	232	332
1	149	348	498
1 1/8	178	415	593
1 1/4	250	584	834
1 3/8	261	609	870
1 1/2	345	804	1149
1 9/16	235	549	784
1 5/8	267	624	891
1 3/4	336	785	1121
1 7/8	418	974	1392
2	512	1194	1706
2 1/4	740	1727	2467
2 1/2	1026	2393	3419
2 3/4	1380	3219	4599
3	1805	4211	6015

**Table 1A / Torque FT-LBS** - Cold Service ASTM A193 and ASTM A320 Grade B8, CL2 Stud Bolts

<b>Table 1A / Torque Nm</b> - Cold Service ASTM A193 and ASTM A320 Grade B8, CL2 Stud Bolts			
BOLT DIA	Torque Nm		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	30	69	99
9/16	43	100	142
5/8	60	138	197
3/4	104	244	348
7/8	136	315	450

7/8	136	315	450
1	202	472	675
1 1/8	241	563	804
1 1/4	339	792	1131
1 3/8	354	826	1180
1 1/2	468	1090	1558
1 9/16	319	744	1063
1 5/8	362	846	1208
1 3/4	456	1064	1520
1 7/8	567	1321	1887
2	694	1619	2313
2 1/4	1003	2341	3345
2 1/2	1391	3244	4636
2 3/4	1871	4364	6235
3	2447	5709	8155

**Table 1A / Torque Nm** - Cold Service ASTM A193 and ASTM A320 Grade B8, CL2 Stud Bolts

**Notes:**

- Bolting torque to develop 70% Bolt Yield Stress at Nut Factor, K=0.16
- This Table is applicable to Never-Seize paste and Fel-Pro lubricant, K=0.16.
- The above Table is applicable only for ASTM A320 Grade B8, Class 2 and A193 Grade B8, Class 2 Stud Bolts. These are 304 SS material.
- The torque values are approved for spiral wound graphite and PTFE filled gaskets, graphite sheet gaskets GHE and GHR types, ring joint, double jacketed and Camprofile gaskets.
- The Final Torque Value accounts for 10% bolt relaxation.
- The yield strength for strain-hardened bolts varies with diameter. Torque values for bolts greater than 1 1/2 in. diameter are based on 30 ksi yield strength.

**Table 2 / Torque FT-LBS** - ASTM 193 Grade B7 and ASTM 193 Grade B16 Stud Bolts

BOLT DIA	Torque FT-LBS		
	30% Initial	70%	100% Final

BOLT DIA	Torque FT-LBS		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	17	39	55
9/16	24	55	80
5/8	33	77	110
3/4	59	137	195
7/8	93	217	310
1	140	325	465
1 1/8	205	480	685
1 1/4	288	672	960
1 3/8	391	915	1305
1 1/2	518	1208	1725
1 9/16	588	1372	1960
1 5/8	668	1558	2225
1 3/4	840	1960	2800
1 7/8	1044	2436	3480
2	1280	2985	4265
2 1/4	1850	4315	6165
2 1/2	2565	5985	8550
2 3/4	3121	7282	10400
3	4080	9520	13600

**Table 2 / Torque FT-LBS - ASTM 193 Grade B7 and ASTM 193 Grade B16 Stud Bolts**

<b>Table 2 / Torque Nm - ASTM 193 Grade B7 and ASTM 193 Grade B16 Stud Bolts</b>			
BOLT DIA	Torque Nm		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	23	53	75

1/2	23	53	75
9/16	33	75	108
5/8	45	104	149
3/4	80	186	264
7/8	126	294	420
1	190	441	630
1 1/8	278	651	929
1 1/4	390	911	1302
1 3/8	530	1241	1769
1 1/2	702	1638	2339
1 9/16	797	1860	2657
1 5/8	906	2112	3017
1 3/4	1139	2657	3796
1 7/8	1415	3303	4718
2	1735	4047	5783
2 1/4	2508	5850	8359
2 1/2	3478	8115	11592
2 3/4	4232	9873	14101
3	5532	12907	18439
<b>Table 2 / Torque Nm - ASTM 193 Grade B7 and ASTM 193 Grade B16 Stud Bolts</b>			

**Notes:**

- Bolting torque to develop 50% Bolt Yield Stress at Nut Factor, K=0.16
- This Table is applicable to Never-Seize paste and Fel-Pro lubricant, K=0.16.
- The above Table is applicable only for ASTM A320 Grade L7, A193 Grade B7 and A193 Grade B16 Stud Bolts.
- The torque values are approved for spiral wound graphite and PTFE filled gaskets, graphite sheet gaskets GHE and GHR types, ring joint, double jacketed and Camprofile gaskets with graphite and PTFE lining.
- The Final Torque Value accounts for 10% bolt relaxation.
- This Table is not acceptable for PTFE coated Stud Bolts and nuts, for these refer to Table 5.

refer to Table 5.

Table 2A / Torque FT-LBS - Cold Service ASTM A320 Grade L7 Stud Bolts			
BOLT DIA	Torque FT-LBS		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	23	54	76
9/16	33	77	110
5/8	46	107	152
3/4	81	189	270
7/8	131	305	436
1	196	457	653
1 1/8	287	671	958
1 1/4	404	943	1348
1 3/8	854	1279	1828
1 1/2	725	1689	2413
1 9/16	824	1922	2746
1 5/8	935	2183	3118
1 3/4	1177	2747	3924
1 7/8	1461	3410	4871
2	1792	4180	5972
2 1/4	2590	6044	8635
2 1/2	3590	8376	11966

Table 2A / Torque FT-LBS - Cold Service ASTM A320 Grade L7 Stud Bolts

Table 2A / Torque Nm - Cold Service ASTM A320 Grade L7 Stud Bolts			
BOLT DIA	Torque Nm		
	30% Initial	70%	100% Final



BOLT DIA	Torque Nm		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	31	73	103
9/16	45	104	149
5/8	62	145	206
3/4	110	256	366
7/8	178	414	591
1	266	620	885
1 1/8	389	910	1299
1 1/4	548	1279	1828
1 3/8	1158	1734	2478
1 1/2	983	2290	3272
1 9/16	1117	2606	3723
1 5/8	1268	2960	4227
1 3/4	1596	3724	5320
1 7/8	1981	4623	6604
2	2430	5667	8097
2 1/4	3512	8195	11707
2 1/2	4867	11356	16224

**Table 2A / Torque Nm - Cold Service ASTM A320 Grade L7 Stud Bolts**

**Notes:**

- Bolting torque to develop 70% Bolt Yield Stress at Nut Factor, K=0.16
- This Table is applicable to Never-Seize paste and Fel-Pro lubricant, K=0.16.
- The above Table is applicable only for ASTM A320 Grade L7.
- The torque values are approved for spiral wound graphite and PTFE filled gaskets, graphite sheet gaskets GHE and GHR types, ring joint, double jacketed and Camprofile gaskets with graphite and PTFE lining.
- The Final Torque Value accounts for 10% bolt relaxation.
- This Table is not acceptable for PTFE coated Stud Bolts and nuts, for these refer to Table 5A.

**Table 3 / Torque FT-LBS** - Use only with A193 B8, CL1 Bolts at 540°C - 650°C on uninsulated flanges

BOLT DIA	Torque FT-LBS		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	5	10	15
9/16	5	15	20
5/8	10	20	25
3/4	15	35	50
7/8	25	55	80
1	35	90	125
1 1/8	50	125	175
1 1/4	75	175	250
1 3/8	100	235	335
1 1/2	135	315	450
1 9/16	150	350	500
1 5/8	170	400	575
1 3/4	215	505	725
1 7/8	270	630	900
2	330	770	1100
2 1/4	475	1115	1590
2 1/2	660	1540	2200
2 3/4	885	2065	2950
3	1160	2705	3865

**Table 3 / Torque FT-LBS** - Use only with A193 B8, CL1 Bolts at 540°C - 650°C on uninsulated flanges

**Table 3 / Torque Nm** - Use only with A193 B8, CL1 Bolts at 540°C - 650°C on uninsulated flanges

	Torque Nm
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uninsulated flanges			
BOLT DIA	Torque Nm		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	7	14	20
9/16	7	20	27
5/8	14	27	34
3/4	20	47	68
7/8	34	75	108
1	47	122	169
1 1/8	68	169	237
1 1/4	102	237	339
1 3/8	136	319	454
1 1/2	183	427	610
1 9/16	203	475	678
1 5/8	230	542	780
1 3/4	292	685	983
1 7/8	366	854	1220
2	447	1044	1491
2 1/4	644	1512	2156
2 1/2	895	2088	2983
2 3/4	1200	2800	4000
3	1573	3667	5240

**Table 3 / Torque Nm** - Use only with A193 B8, CL1 Bolts at 540°C - 650°C on  
uninsulated flanges

**Notes:**

- Bolting torque to develop 45% Bolt Yield Stress at Nut Factor, K=0.16
- This Table is applicable to Never-Seize paste and Fel-Pro lubricant, K=0.16.
- The above Table is applicable only for ASTM A193 Grade B8, Class 1 Stud Bolts for use in temperatures above 1000°F (540°C), and up to and including 1200°F (650°C), installed on uninsulated flanges. The values are based on yield strength at ambient temperature.
- The torque values are approved for spiral wound graphite filled gaskets.

1200°F (650°C), installed on uninsulated flanges. The values are based on yield strength at ambient temperature.

- The torque values are approved for spiral wound graphite filled gaskets, graphite sheet gaskets GHE and GHR types, ring joint, double jacketed and Camprofile gaskets with graphite lining.
- The Final Torque Value accounts for 10% bolt relaxation.

Table 4 / Torque FT-LBS - Use only with 6061-T6 Aluminium flanges			
BOLT DIA	Torque FT-LBS		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	10	15	25
9/16	10	25	35
5/8	15	35	50
3/4	25	60	90
7/8	40	100	140
1	65	150	215
1 1/8	95	220	315
1 1/4	130	305	440
1 3/8	175	415	595
1 1/2	230	540	770
1 9/16	265	620	885
1 5/8	300	700	1000
1 3/4	375	875	1250
1 7/8	465	1085	1550
2	565	1320	1885
2 1/4	815	1900	2715
2 1/2	1125	2625	3750
2 3/4	1500	3515	5020
3	1970	4595	6565

3	1970	4595	6565
Table 4 / Torque FT-LBS - Use only with 6061-T6 Aluminium flanges			

Table 4 / Torque Nm - Use only with 6061-T6 Aluminium flanges			
BOLT DIA	Torque Nm		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	14	20	34
9/16	14	34	47
5/8	20	47	68
3/4	34	81	122
7/8	54	136	190
1	88	203	292
1 1/8	129	298	427
1 1/4	176	414	597
1 3/8	237	563	807
1 1/2	312	732	1044
1 9/16	359	841	1200
1 5/8	407	949	1356
1 3/4	508	1186	1695
1 7/8	630	1471	2102
2	766	1790	2556
2 1/4	1105	2576	3681
2 1/2	1525	3559	5084
2 3/4	2034	4766	6806
3	2671	6230	8901
Table 4 / Torque Nm - Use only with 6061-T6 Aluminium flanges			

Notes:

**Notes:**

- Bolting torque to develop 25,000 PSI Bolt Stress at Nut Factor, K=0.16
- This Table is applicable to Never-Seize paste and Fel-Pro lubricant, K=0.16.
- The above Table is applicable for all Stud Bolts listed in Doc No... Do not use at temperatures exceeding 350°F (175°C).
- The torque values are approved for gaskets with a low seating stress such as elastomer gaskets.

**Table 5 / Torque FT-LBS - PTFE coated ASTM A193 B7 & ASTM 193 B16 Stud Bolts**

BOLT DIA	Torque FT-LBS		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	12	29	41
9/16	18	41	59
5/8	24	57	82
3/4	43	101	145
7/8	70	163	233
1	105	245	350
1 1/8	154	359	513
1 1/4	217	505	722
1 3/8	294	685	979
1 1/2	388	905	1292
1 9/16	441	1030	1471
1 5/8	501	1169	1670
1 3/4	631	1471	2102
1 7/8	783	1827	2610
2	960	2240	3199
2 1/4	1388	3238	4626
2 1/2	1923	4487	6410
2 3/4	2341	5462	7802

2 1/4	2341	5462	7802
3	3061	7143	10204

**Table 5 / Torque FT-LBS** - PTFE coated ASTM A193 B7 & ASTM 193 B16 Stud Bolts

BOLT DIA	Torque Nm		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	16	39	56
9/16	24	56	80
5/8	33	77	111
3/4	58	137	197
7/8	95	221	316
1	142	332	475
1 1/8	209	487	696
1 1/4	294	685	979
1 3/8	399	929	1327
1 1/2	526	1227	1752
1 9/16	598	1396	1994
1 5/8	679	1585	2264
1 3/4	856	1994	2850
1 7/8	1062	2477	3539
2	1302	3037	4337
2 1/4	1882	4390	6272
2 1/2	2607	6084	8691
2 3/4	3174	7405	10578
3	4150	9685	13835

**Table 5 / Torque Nm** - PTFE coated ASTM A193 B7 & ASTM 193 B16 Stud

5	4150	9085	15855
<b>Table 5 / Torque Nm</b> - PTFE coated ASTM A193 B7 & ASTM 193 B16 Stud Bolts			

**Notes:**

- Bolting torque to develop 50% Bolt Yield Stress at Nut Factor, K=0.12
- This Table is applicable for PTFE coated bolts with K=0.12.
- The above Table is applicable only for A193 Grade B7 and A193 Grade B16 Stud Bolts.
- The torque values are approved for spiral wound graphite and PTFE filled gaskets, graphite sheet gaskets GHE and GHR types, ring joint, double jacketed and Camprofile gaskets with graphite and PTFE lining.
- The Final Torque Value accounts for 10% bolt relaxation.

<b>Table 5A / Torque FT-LBS</b> - Cold Service PTFE coated ASTM A320 Grade L7 Stud Bolts			
BOLT DIA	Torque FT-LBS		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	17	40	57
9/16	25	58	83
5/8	34	80	114
3/4	61	142	203
7/8	98	229	327
1	147	343	490
1 1/8	216	503	719
1 1/4	303	707	1011
1 3/8	411	959	1371
1 1/2	543	1267	1809
1 9/16	618	1441	2059
1 5/8	702	1637	2339
1 3/4	883	2060	2943
1 7/8	1096	2557	3653
2	1344	3135	4479



2	1344	3135	4479
2¼	1943	4533	6476
2½	2692	6282	8974

**Table 5A / Torque FT-LBS** - Cold Service PTFE coated ASTM A320 Grade L7 Stud Bolts

**Table 5A / Torque Nm** - Cold Service PTFE coated ASTM A320 Grade L7 Stud Bolts

BOLT DIA	Torque Nm		
	30% Initial Torque	70% Torque	100% Final Torque
1/2	23	54	77
9/16	34	79	113
5/8	46	108	155
3/4	83	193	275
7/8	133	310	443
1	199	465	664
1⅛	293	682	975
1¼	411	959	1371
1⅜	557	1300	1859
1½	736	1718	2453
1 <sup>9</sup> / <sub>16</sub>	838	1954	2792
1⅝	952	2219	3171
1¾	1197	2793	3990
1⅞	1486	3467	4953
2	1822	4250	6073
2¼	2634	6146	8780
2½	3650	8517	12167

**Table 5A / Torque Nm** - Cold Service PTFE coated ASTM A320 Grade L7 Stud Bolts

Bolts
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**Notes:**

- Bolting torque to develop 70% Bolt Yield Stress at Nut Factor,  $K=0.12$
- This Table is applicable for PTFE coated bolts with  $K=0.12$ .
- The above Table is applicable only for ASTM A320 Grade L7.
- The torque values are approved for spiral wound graphite and PTFE filled gaskets, graphite sheet gaskets GHE and GHR types, ring joint, double jacketed and Camprofile gaskets with graphite and PTFE lining.
- The Final Torque Value accounts for 10% bolt relaxation.