

TIGHTENING TORQUES FOR IMPERIAL (U.S.) BOLTS 80% of yield strength (Sy)

IMPERIAL (U.S.)		Diameter (in)		0.25	0.3125	0.375	0.4375	0.5	0.5625	0.625	0.75	0.875	1	1.125	1.25	1.375	1.5	1.625	1.75	1.875	2	2.25	2.5	2.75	3							
		NO. THREADS / IN (NC)		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"	2 3/4"	3"							
		STRESS AREA (As) in in ²		0.032	0.052	0.077	0.106	0.142	0.182	0.226	0.334	0.462	0.606	0.763	0.969	1.155	1.405	1.606	1.899	2.160	2.498	3.248	3.999	4.934	5.967							
C O A R S E	MATERIAL	Sy (KSI)	LUBR.	μ	TIGHTENING TORQUE in Lbs-ft Multiply by 1.356 to obtain N*m																											
					GRADE 1																											
					GRADE 2																											
T H T H	MATERIAL	Sy (KSI)	LUBR.	μ	TIGHTENING TORQUE in Lbs-ft Multiply by 1.356 to obtain N*m																											
					GRADE 5																											
					GRADE 5.2																											
R E A D	MATERIAL	Sy (KSI)	LUBR.	μ	TIGHTENING TORQUE in Lbs-ft Multiply by 1.356 to obtain N*m																											
					GRADE 7																											
					GRADE 8																											
F I N E	MATERIAL	Sy (KSI)	LUBRIFIC	μ	TIGHTENING TORQUE in Lbs-ft Multiply by 1.356 to obtain N*m																											
					ASTM A449																											
					ASTM A490																											
T H R E A D	MATERIAL	Sy (KSI)	LUBRIFIC	μ	TIGHTENING TORQUE in Lbs-ft Multiply by 1.356 to obtain N*m																											
					ASTM A36																											
					AISI 1045																											
A I S I	MATERIAL	Sy (KSI)	LUBRIFIC	μ	TIGHTENING TORQUE in Lbs-ft Multiply by 1.356 to obtain N*m																											
					AISI 4140																											
					ASTM A449																											

Lubrication : NL = Non-lubricated L = Lubricated or New

As = 0.7854 * (D - (0.9743/n))² D = bolt diameter, in in. F = % * Sy * As * 1000 (% = % of yield strength, generally 80%) C = F * μ * D = % * Sy * As * μ * D * 1000 / 12

As = stress area of bolt, in in² n = no. threads / in. F = tensile force, in Lbs C = TIGHTENING TORQUE, IN N*m

μ = Friction coefficient

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TIGHTENING TORQUES FOR METRIC BOLTS 80% of yield strength (Sy)

MÉTRIQUE	ABMS <small>CONCEPTION ET CALCULS MÉCANIQUES</small>	Diameter (mm)		6	8	10	12	14	16	18	20	22	24	27	30	33	36	39	42	45	48	52	56	60	64	68						
		M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M45	M48	M52	M56	M60	M64	M68								
		PITCH (mm)		1	1.25	1.5	1.75	2	2	2.5	2.5	2.5	3	3	3.5	3.5	4	4	4.5	4.5	5	5	5.5	5.5	6	6						
		STRESS AREA (As) In mm²		20	37	58	84	115	157	192	245	303	353	459	561	694	817	976	1121	1306	1473	1758	2030	2362	2676	3055						
		MATERIAL	Sy (MPa)	LUBR.	μ	TIGHTENING TORQUE in Lbs-ft													Multiply by 1.356 to obtain N*m													
S T A N D A R D	CLASS 4.6	240	NL	0.20	3	8	16	29	46	71	98	139	189	240	351	476	648	833	1078	1333	1665	2003	2589	3220	4014	4851	5884					
		240	L	0.15	3	6	12	21	34	53	74	104	142	180	263	357	486	625	808	1000	1248	1502	1942	2415	3010	3638	4413					
	CLASS 8.8	640	NL	0.20	9	22	44	76	122	189	262	370	504	639	937	1270	1729	2221	2874	3556	4439	5341	6904	8586	10704	12935	15691					
		640	L	0.15	7	17	33	57	92	142	196	277	378	479	703	953	1296	1665	2156	2667	3329	4005	5178	6439	8028	9701	11769					
	STAINLESS Class 50	210	NL	0.20	3	7	14	25	40	62	86	121	165	210	307	417	567	729	943	1167	1456	1752	2265	2817	3512	4244	5149					
		210	L	0.15	2	5	11	19	30	47	64	91	124	157	231	313	425	546	707	875	1092	1314	1699	2113	2634	3183	3862					
	STAINLESS Class 70	450	NL	0.20	6	16	31	54	86	133	184	260	N/A, See note 1																			
		250	NL	0.20	N/A, See note 1													197	250	366	496	675	867	1123	1389	1734	2086	2697	3354	4181	5053	6129
		450	L	0.15	5	12	23	40	64	100	138	195	N/A, See note 1																			
		250	L	0.15	N/A, See note 1													148	187	274	372	506	651	842	1042	1300	1565	2023	2515	3136	3789	4597
	STAINLESS Class 80	600	NL	0.20	9	21	41	72	114	177	245	347	473	599	878	1191	1621	2082	2694	3333	4161	5007	6472	8049	10035	12126	14711					
		600	L	0.15	6	16	31	54	86	133	184	260	354	449	659	893	1215	1561	2021	2500	3121	3755	4854	6037	7526	9095	11033					
ASTM A36	250	NL	0.20	4	9	17	30	48	74	102	144	197	250	366	496	675	867	1123	1389	1734	2086	2697	3354	4181	5053	6129						
	250	L	0.15	3	6	13	22	36	55	77	108	148	187	274	372	506	651	842	1042	1300	1565	2023	2515	3136	3789	4597						
AISI 1045	310	NL	0.20	4	11	21	37	59	92	127	179	244	309	454	615	837	1076	1392	1722	2150	2587	3344	4159	5185	6265	7600						
	310	L	0.15	3	8	16	28	44	69	95	134	183	232	340	461	628	807	1044	1292	1612	1940	2508	3119	3888	4699	5700						
	AISI 4140	420	NL	0.20	6	15	29	50	80	124	172	243	331	419	615	834	1134	1457	1886	2333	2913	3505	4531	5635	7024	8488	10297					
CLASS 10.9	940	NL	0.20	13	32	64	112	179	278	384	543	740	938	1376	1866	2539	3262	4221	5222	6519	7844	10140	12611	15721	18998	23047						
	940	L	0.15	10	24	48	84	134	209	288	407	555	704	1032	1399	1904	2446	3166	3917	4889	5883	7605	9458	11791	14249	17285						
CLASS 12.9	1100	NL	0.20	16	38	75	131	210	325	450	636	866	1098	1610	2183	2971	3817	4940	6111	7629	9179	11866	14757	18397	22232	26970						
	1100	L	0.15	12	29	56	98	157	244	337	477	650	824	1208	1637	2228	2863	3705	4583	5722	6884	8899	11068	13798	16674	20227						
		PITCH (mm)		0.75	1	1	1.25	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5						
		STRESS AREA (As) In mm²		22	39	64	92	125	167	216	272	333	401	514	642	784	940	1110	1294	1493	1810	2010	2301	2485	2851	3242						
		MATERIAL	Sy (MPa)	LUBR.	μ	TIGHTENING TORQUE in Lbs-ft													Multiply by 1.356 to obtain N*m													
F I N E P I T C H	CLASS 4.6	240	NL	0.20	4	9	18	31	49	76	110	154	208	273	393	546	733	958	1226	1539	1902	2460	2961	3649	4223	5167	6244					
		240	L	0.15	3	7	14	23	37	57	83	115	156	204	295	409	550	719	920	1155	1427	1845	2221	2737	3167	3876	4683					
	CLASS 8.8	640	NL	0.20	10	24	49	83	132	202	294	410	553	727	1049	1455	1954	2555	3269	4105	5073	6560	7895	9731	11260	13780	16650					
		640	L	0.15	7	18	37	63	99	152	220	308	415	545	787	1091	1465	1917	2452	3079	3804	4920	5921	7298	8445	10335	12487					
	STAINLESS Class 50	210	NL	0.20	3	8	16	27	43	66	96	135	182	238	344	477	641	838	1073	1347	1664	2153	2591	3193	3695	4521	5463					
		210	L	0.15	2	6	12	21	32	50	72	101	136	179	258	358	481	629	805	1010	1248	1614	1943	2395	2771	3391	4097					
	STAINLESS Class 70	450	NL	0.20	7	17	34	59	93	142	207	288	N/A, See note 1																			
		250	NL	0.20	N/A, See note 1													216	284	410	568	763	998	1277	1604	1981	2563	3084	3801	4398	5383	6504
		450	L	0.15	5	12	26	44	69	107	155	216	N/A, See note 1																			
		250	L	0.15	N/A, See note 1													162	213	307	426	572	749	958	1203	1486	1922	2313	2851	3299	4037	4878
	STAINLESS Class 80	600	NL	0.20	9	22	46	78	123	189	276	384	519	681	983	1364	1832	2396	3065	3849	4756	6150	7402	9123	10556	12919	15609					
		600	L	0.15	7	17	34	59	93	142	207	288	389	511	738	1023	1374	1797	2299	2886	3567	4613	5551	6842	7917	9689	11707					
ASTM A36	250	NL	0.20	4	9	19	33	51	79	115	160	216	284	410	568	763	998	1277	1604	1981	2563	3084	3801	4398	5383	6504						
	250	L	0.15	3	7	14	24	39	59	86	120	162	213	307	426	572	749	958	1203	1486	1922	2313	2851	3299	4037	4878						
AISI 1045	310	NL	0.20	5	11	24	40	64	98	142	199	268	352	508	705	946	1238	1584	1988	2457	3178	3824	4713	5454	6675	8065						
	310	L	0.15	4	9	18	30	48	73	107	149	201	264	381	529	710	928	1188	1491	1843	2383	2868	3535	4091	5006	6049						
	AISI 4140	420	NL	0.20	7	16	32	55	86	133	193	269	363	477	688	955	1282	1677	2146	2694	3329	4305	5181	6386	7389	9043	10926					
CLASS 10.9	940	NL	0.20	15	35	72	123	193	297	432	602	813	1067	1541	2137	2870	3753	4802	6030	7450	9635	11596	14292	16538	20239	24454						
	940	L	0.15	11	26	54	92	145	223	324	452	610	800	1156	1603	2152	2815	3601	4522	5588	7226	8697	10719	12404	15179	18341						
CLASS 12.9	1100	NL	0.20	17	41	84	143	226	347	505	705	951	1249	1803	2501	3358	4392	5619	7056	8718	11275	13570	16725	19353	23684	28617						
	1100	L	0.15	13	31	63	108	170	261	379	529	713	937	1352	1875	2519	3294	4214	5292	6539	8456	10178	12544	14515	17763	21462						

Lubrication: NL = Non-lubricated L = Lubricated or New $As = 0.7854 \cdot \pi \cdot (D - (0.9382 \cdot \text{Pitch}))^2$ D = bolt diameter, in in. $F = \% \cdot Sy \cdot As$ = % of yield strength, generally 80% $C = F \cdot \mu \cdot D = \% \cdot Sy \cdot \mu \cdot D / 1000$ Sy = yield strength, in MPa
 Note 1 : Stainless, class 70, Sy=250 MPa when D > 22mm As = stress area of bolt, in mm² P = Pitch in mm F = tensile force, in N C = TIGHTENING TORQUE IN N*m μ = friction coefficient

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