



Tightening Torque Guide (Figures are based in ft., lbs. unless noted*)

Size	Grade 5 N.C. Plain	Grade 5 N.C. Plated	Grade 5 N.F. Plain	Grade 5 N.F. Plated	Grade 8 N.C. Plain	Grade 8 N.C. Plated	Grade 8 N.F. Plain	Grade 8 N.F. Plated
1/4	8 ft. lbs.	76 in. lbs.*	10 ft. lbs.	87 in. lbs.*	12 ft. lbs.	9 ft. lbs.	14 ft. lbs.	10 ft. lbs.
5/16	17 ft. lbs.	13 ft. lbs.	19 ft. lbs.	14 ft. lbs.	25 ft. lbs.	18 ft. lbs.	27 ft. lbs.	20 ft. lbs.
3/8	31 ft. lbs.	23 ft. lbs.	35 ft. lbs.	26 ft. lbs.	44 ft. lbs.	33 ft. lbs.	49 ft. lbs.	37 ft. lbs.
7/16	50 ft. lbs.	37 ft. lbs.	55 ft. lbs.	41 ft. lbs.	70 ft. lbs.	52 ft. lbs.	78 ft. lbs.	58 ft. lbs.
1/2	76 ft. lbs.	57 ft. lbs.	85 ft. lbs.	64 ft. lbs.	106 ft. lbs.	80 ft. lbs.	120 ft. lbs.	90 ft. lbs.
9/16	109 ft. lbs.	82 ft. lbs.	122 ft. lbs.	91 ft. lbs.	153 ft. lbs.	115 ft. lbs.	172 ft. lbs.	129 ft. lbs.
5/8	150 ft. lbs.	112 ft. lbs.	170 ft. lbs.	128 ft. lbs.	212 ft. lbs.	159 ft. lbs.	240 ft. lbs.	180 ft. lbs.
3/4	266 ft. lbs.	200 ft. lbs.	297 ft. lbs.	223 ft. lbs.	376 ft. lbs.	282 ft. lbs.	420 ft. lbs.	315 ft. lbs.
7/8	430 ft. lbs.	322 ft. lbs.	474 ft. lbs.	355 ft. lbs.	606 ft. lbs.	454 ft. lbs.	668 ft. lbs.	501 ft. lbs.
1	644 ft. lbs.	483 ft. lbs.	705 ft. lbs.	529 ft. lbs.	909 ft. lbs.	682 ft. lbs.	955 ft. lbs.	746 ft. lbs.
1-1/8	794 ft. lbs.	596 ft. lbs.	890 ft. lbs.	668 ft. lbs.	1288 ft. lbs.	966 ft. lbs.	1444 ft. lbs.	1083 ft. lbs.
1-1/4	1120 ft. lbs.	840 ft. lbs.	1241 ft. lbs.	930 ft. lbs.	1817 ft. lbs.	1363 ft. lbs.	2012 ft. lbs.	1509 ft. lbs.
1-3/8	1470 ft. lbs.	1102 ft. lbs.	1672 ft. lbs.	1254 ft. lbs.	2382 ft. lbs.	1787 ft. lbs.	2712 ft. lbs.	2034 ft. lbs.
1-1/2	1950 ft. lbs.	1462 ft. lbs.	2194 ft. lbs.	1645 ft. lbs.	3161 ft. lbs.	2371 ft. lbs.	3557 ft. lbs.	2668 ft. lbs.

Based on IFI 5th edition technical data N-12/N-16, using equation (1) and a torque coefficient, K=0.20 for non plated steel fasteners and K=0.15 for plated fasteners. These figures represent an estimate of torque (torque being the measurement of friction, not tension) required to induce a given preload (clamp load) in a bolt for non-critical applications only. For critical or special applications where greater control is desired this should be experimentally determined. This applies to washer faced or double chamfered hex nuts (or bolts, if bolt is torqued) having a width across flats of approximately 1.5 times the nominal diameter and having threads free of interference.

Because of the many interrelated variables that directly or indirectly affect friction, such as surface texture, type of coating or finish, lubrication, speed of tightening, human error, etc., it is important to experience as much as +/- 25% deviation in preload (clamp load) with the use of a torque wrench.

CAUTION: LUBRICATED FASTENERS (PLATED OR OTHERWISE) ARE TO BE TORQUED AT A LOWER VALUE (LUB. COLUMN), OTHERWISE EXCESSIVE CLAMPLOADS AND FAILURE DURING INSTALLATION WILL RESULT. USERS OF THIS CHART ASSUME FULL RESPONSIBILITY OF APPLICATION.

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U.S./Metric Conversion Equivalents

Quantity	To Convert		Multiply By	To Convert		Multiply By
	Into	Into		Into	Into	
Length	Inch (in.)	Millimeter (mm)	25.4	mm	Inch	0.03937
	Feet (ft.)	Millimeter (mm)	304.8	mm	Feet	0.00328
Area	Square Inch (sq. in.)	Square Millimeter (sq. mm)	645.16	sq. mm	sq. in.	0.00155
Volume	Gallon	Liter	3.785	Liter	Gal.	0.2642
	Cubic Inch	Cubic Centimeter	16.3871			
	Cubic Foot	Cubic Meter	0.0283			
Force	Pound (lb.)	Newton (N)	4.448	N	lb.	0.2248
Pressure	Pound/sq. in. (psi)	Pascal (Pa)	6895	MPa	psi	145.1
		Mega Pascal (MPa)	0.006895			
Torque	Inch Pound (in. lb.)	Newton Meter (N m)	0.113	N m	in.- lb.	8.851
	Foot Pound (ft. lb.)	Newton Meter (N m)	1.356	N m	ft.-lb.	0.738

Other common conversions: 1N = 1 kg • m/s² - 1 Pa = 1 N/m² - 1 MPa = 1N/mm²

Example: To convert length to mm, multiply total inches by 25.4

Fraction/Decimal/Metric

Fraction	Decimal	Millimeter	Fraction	Decimal	Millimeter	Fraction	Decimal	Millimeter
1/64	.015625	0.397	23/64	.359375	9.128	45/64	.703125	17.859
1/32	.03125	0.794	3/8	.375	9.525	23/32	.71875	18.256
	.0394	1.0	25/64	.390625	9.92	47/64	.734375	18.653
3/64	.046875	1.191		.3937	10.0		.7480	19.0
1/16	.0625	1.587	13/32	.40625	10.319	3/4	.75	19.053
5/64	.078125	1.984	27/64	.421875	10.716	49/64	.765625	19.447
	.0787	2.0		.4331	11.0	25/32	.78125	19.844
3/32	.09375	2.381	7/16	.4375	11.113		.7874	20.0
7/64	.109375	2.778	29/64	.453125	11.509	51/64	.796875	20.241
	.1181	3.0	15/32	.46875	11.906	13/16	.8125	20.638
1/8	.125	3.175		.4724	12.0		.8268	21.0
9/64	.140625	3.572	31/64	.484375	12.303	53/64	.828125	21.034
5/32	.15625	4.0	1/2	.5	12.700	27/32	.84375	21.431
11/64	.171875	4.366		.5118	13.0	55/64	.859375	21.828
	.1575	4.0	33/64	.515625	13.097		.8661	22.0
3/16	.1875	4.763	17/32	.53125	13.494	7/8	.875	22.225
	.1969	5.0	35/64	.546875	13.891	57/64	.890625	22.622
13/64	.203125	5.159		.5512	14.0		.9055	23.0
7/32	.21875	5.556	9/16	.5625	14.288	29/32	.90625	23.019
15/64	.234375	5.953	37/64	.578125	14.684	59/64	.921875	23.416
	.2362	6.0		.5906	15.0	15/16	.9375	23.813
1/4	.25	6.350	19/32	.59375	15.081		.9449	24.0
17/64	.265625	6.747	39/64	.609375	15.478	61/64	.953125	24.209
	.2756	7.0	5/8	.625	15.875	31/32	.96875	24.606
9/32	.28125	7.144		.6299	16.0		.9843	25.0
19/64	.296875	7.541	41/64	.640625	16.272	63/64	.984375	25.003
5/16	.3125	7.938	21/32	.65625	16.669	1	1.0	25.4
	.3150	8.0		.6693	17.0			
21/64	.328125	8.334	43/64	.671875	17.066			
11/32	.34375	8.731	11/16	.6875	17.463			



Tightening Torques For Metric Bolts, Screws And Nuts

Ref: Manufacturer's Catalog

Failure of threaded fasteners due to over-tightening can occur by bold shank fracture or by stripping of the nut and/or bolt's thread. A bolt or screw assembled with a nut of the appropriate class is intended to provide an assembly capable of being tightened to the bolt proof load without thread stripping occurring.

The torque value to be set for a particular size of screw is dependent upon:

- 1) Material of the screw
- 2) Parent material (steel, non-ferrous metal or plastic)
- 3) Whether the screw is untreated or plated
- 4) Whether the screw is dry or lubricated
- 5) The depth of the thread

Tables below are given for informational use only. The exact torque values are found by tests based upon work experience.

TIGHTENING TORQUES - Untreated Screw (Black Finish) FRICTION Coefficient 0.14

Property Class	Torque Ma	NOMINAL DIAMETER - COARSE THREAD																		
		M 3	M 4	M 5	M 6	M 7	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24	M 27	M 30	M 33	M 36	M 39
5.6	Nm	0.60	1.37	2.70	4.6	7.6	11	22	39	62	95	130	184	250	315	470	635	865	1111	1440
	ft. lb.	0.44	1.01	1.99	3.3	5.6	8.1	16	28	45	70	95	135	184	232	346	468	637	819	1062
8.8	Nm	1.37	3.10	6.15	10.5	17.5	26	51	89	141	215	295	420	570	725	1070	1450	1970	2530	3290
	ft. lb.	1.01	2.29	4.54	7.7	12.9	19	37	65	103	158	217	309	420	534	789	1069	1452	1865	2426
10.9	Nm	1.92	4.40	8.65	15	25	36	72	125	198	305	420	590	800	1020	1510	2050	2770	3560	4620
	ft. lb.	1.42	3.25	6.38	11	18.4	26	53	92	146	224	309	435	590	752	1113	1511	2042	2625	3407
12.9	Nm	2.30	5.25	10.4	18	29	43	87	150	240	365	500	710	960	1220	1810	2450	3330	4280	5550
	ft. lb.	1.70	3.87	7.6	13	21.3	31	64	110	177	269	368	523	708	899	1334	1806	2455	3156	4093

Property Class	Torque Ma	NOMINAL DIAMETER - FINE THREAD								
		M8 x 1	M10 x 1.25	M 12 x 1.25	M 14 x 1.5	M 16 x 1.5	M 18 x 1.5	M 20 x 1.5	M22 x 1.5	M 24 x 2
8.8	Nm	27	52	95	150	225	325	460	610	780
	ft. lb.	19	38	70	110	165	239	339	449	575
10.9	Nm	38	73	135	210	315	460	640	860	1100
	ft. lb.	28	53	99	154	232	339	472	634	811
12.9	Nm	45	88	160	250	380	550	770	1050	1300
	ft. lb.	33	64	118	184	280	405	567	774	958

TIGHTENING TORQUES - Electrically Zinc Plated FRICTION Coefficient 1.25

Property Class	Torque Ma	NOMINAL DIAMETER - COARSE THREAD																		
		M 3	M 4	M 5	M 6	M 7	M 8	M 10	M 12	M 14	M 16	M 18	M 20	M 22	M 24	M 27	M 30	M 33	M 36	M 39
5.6	Nm	0.56	1.28	2.50	4.3	7.1	10.5	21	36	58	88	121	171	230	295	435	590	800	1030	1340
	ft. lb.	0.41	0.94	1.84	3.1	5.2	7.7	15	26	42	64	89	126	169	217	320	435	590	759	988
8.8	Nm	1.28	2.90	5.75	9.9	16.5	24	48	83	132	200	275	390	530	675	995	1350	1830	2360	3050
	ft. lb.	0.94	2.14	4.24	7.3	12.1	17.7	35	61	97	147	202	287	390	497	733	995	1349	1740	2249
10.9	Nm	1.80	4.10	8.10	14	23	34	67	117	185	285	390	550	745	960	1400	1900	2580	3310	4290
	ft. lb.	1.33	3.02	5.97	10.3	16.9	25	49	86.2	136	210	287	405	549	708	1032	1401	1902	2441	3163
12.9	Nm	2.15	4.95	9.70	16.5	27	40	81	140	220	340	470	660	890	1140	1680	2280	3090	3980	5150
	ft. lb.	1.59	3.65	7.15	12.1	19.9	29	59	103	162	250	346	486	656	840	1239	1681	2278	2935	3798

Property Class	Torque Ma	NOMINAL DIAMETER - FINE THREAD								
		M8 x 1	M10 x 1.25	M 12 x 1.25	M 14 x 1.5	M 16 x 1.5	M 18 x 1.5	M 20 x 1.5	M22 x 1.5	M 24 x 2
8.8	Nm	25	49	88	140	210	305	425	570	720
	ft. lb.	18	36	64	103	154	224	313	420	531
10.9	Nm	35	68	125	195	295	425	600	800	1000
	ft. lb.	25	50	92	143	217	313	442	590	737
12.9	Nm	42	82	150	235	350	510	720	960	1200
	ft. lb.	30	60	110	173	258	376	531	708	885

PLEASE NOTE CONVERSION FACTOR: ONE Nm = .7375 Foot Pound

One Foot Pound = 1.355818 Nm



Tightening Torques (Cont.) For Metric Socket Head Cap Screws

TIGHTENING TORQUES DATA

Nominal Size And Thread Pitch	Recommended Tightening Torque (N-m)
M1.6 x 0.35	0.34
M2 x 0.4	0.69
M2.5 x 0.45	1.43
M3 x 0.5	2.48
M4 x 0.7	5.85
M5 x 0.8	12.0
M6 x 1.0	20.3
M8 x 1.25	48.8
M10 x 1.50	97.5
M12 x 1.75	165
M14 x 2.00	265
M16 x 2.0	413
M20 x 2.5	8.25
M24 x 3.0	1425
M30 x 3.5	2775
M36 x 4.0	4875

NOTE: Tables are given for informational use only.
The exact torque values are found by tests based upon
work experience.

Stainless Steel Metric Socket Head Cap Screws

MECHANICAL PROPERTIES OF THREADED TO THE HEAD STAINLESS STEEL METRIC SOCKET HEAD CAP SCREWS

Nominal Size And Thread Pitch	Recommended Tightening Torque (N-m)
M1.6 x 0.35	0.18
M2 x 0.4	0.37
M2.5 x 0.45	0.76
M3 x 0.5	1.31
M4 x 0.7	3.10
M5 x 0.8	6.36
M6 x 1.0	10.8
M8 x 1.25	25.9
M10 x 1.50	51.7
M12 x 1.75	87.5

Metric Shoulder Screws

MECHANICAL PROPERTIES

Nominal Shoulder Diameter (mm)	Nominal Thread Size (mm)	Tightening Torque** (N-m)
6.5	M5 - 0.8	6.9
8	M6 - 1.0	12
10	M8 - 1.25	28
13	M10 - 1.5	56
16	M12 - 1.75	99
20	M16 - 2.0	250
25	M20 - 2.5	400

**Torque to tighten screw with key, not by turning nut.
These torques apply to standard black screws in rigid joints,
when torqued with standard hex keys or bits.

Metric Button Head And Flat Countersunk Head Socket Cap Screws

TIGHTENING TORQUE - N-m

Nominal Size And Thread Pitch MM	Button Head		Flat Countersunk Head
	Hex Key Size (mm)	Max Tightening Torque (N m)	Max Tightening Torque (N m)
M3 x 0.5	2	1.25	1.85
M4 x 0.7	2.5	2.9	3.4
M5 x 0.8	3	5.9	6.9
M6 x 1.0	4	10	12
M8 x 1.25	5	24	28
M10 x 1.50	6	48	56
M12 x 1.75	8	84	99
M16 x 2.0	10	207	246
M20 x 2.5	12	—	400

Torque to tighten screw with key, not by turning nut.
These torques apply to standard black screws in rigid joints,
when torqued with standard hex keys or bits.

Metric Socket Set Screws

AXIAL HOLDING POWER OF CUP POINT SET SCREWS (ALLOY STEEL)

Nominal Size And Thread Pitch (mm)	Tightening Torque (N-m)
1.6	0.1
2	0.2
2.5	0.6
3	1.0
4	2.1
5	4.7
6	7.7
8	17.8
10	35
12	55
16	125
20	250
24	425

Ref: Manufacturer's Catalog

Failure Of Threaded Fasteners Due To Over - Tightening Can Occur By Bolt Shank
Fracture Or By Stripping Of The Nut And / Or Bolts Thread, A Bolt Or Screw
Assembled With A Nut Of The Appropriate Class Is Intended To Provide An
Assembly Capable Of Being Tightened To The Bolt Proof Load Without Thread
Stripping Occurring.

The Torque Value To Be Set For A Particular Size Of Screw Is Dependent On: (1)
Material Of The Screw (2) Parent Material (Steel, Non - Ferrous Metal Or Plastic)
(3) Whether The Screw Is Untreated Or Plated (4) Whether The Screw Is Dry Or
Lubricated (5) The Depth Of The Thread

Tables Below Are Given For Informational Use Only. The Exact Torque Values Are
Founded By Tests Based Upon Work Experience