

# Bolt torque *chart.*

Recommended **tightening torque** for common bolts — Grade 5/8 imperial and Grade 8.8/10.9/12.9 metric. Dry, lubricated, and anti-seize values. Derived from the standard K-factor formula  $T = K \times D \times P$ .

## The chart

SIZE	GRADE	DRY (K=0.20)	LUBRICATED (K=0.15)	ANTI-SEIZE (K=0.10)
1/4-20	Grade 5	8 ft·lbf	6 ft·lbf	5 ft·lbf
5/16-18	Grade 5	17 ft·lbf	13 ft·lbf	10 ft·lbf
3/8-16	Grade 5	30 ft·lbf	23 ft·lbf	17 ft·lbf
7/16-14	Grade 5	50 ft·lbf	38 ft·lbf	28 ft·lbf
1/2-13	Grade 5	75 ft·lbf	57 ft·lbf	43 ft·lbf
9/16-12	Grade 5	110 ft·lbf	83 ft·lbf	62 ft·lbf
5/8-11	Grade 5	150 ft·lbf	113 ft·lbf	85 ft·lbf
3/4-10	Grade 5	270 ft·lbf	203 ft·lbf	152 ft·lbf
7/8-9	Grade 5	435 ft·lbf	326 ft·lbf	245 ft·lbf
1-8	Grade 5	650 ft·lbf	488 ft·lbf	366 ft·lbf
1/4-20	Grade 8	12 ft·lbf	9 ft·lbf	6 ft·lbf

SIZE	GRADE	DRY (K=0.20)	LUBRICATED (K=0.15)	ANTI-SEIZE (K=0.10)
5/16-18	Grade 8	24 ft·lbf	18 ft·lbf	13 ft·lbf
3/8-16	Grade 8	43 ft·lbf	32 ft·lbf	24 ft·lbf
7/16-14	Grade 8	70 ft·lbf	53 ft·lbf	40 ft·lbf
1/2-13	Grade 8	105 ft·lbf	79 ft·lbf	60 ft·lbf
9/16-12	Grade 8	155 ft·lbf	116 ft·lbf	87 ft·lbf
5/8-11	Grade 8	210 ft·lbf	158 ft·lbf	118 ft·lbf
3/4-10	Grade 8	375 ft·lbf	281 ft·lbf	211 ft·lbf
7/8-9	Grade 8	610 ft·lbf	458 ft·lbf	343 ft·lbf
1-8	Grade 8	910 ft·lbf	683 ft·lbf	512 ft·lbf
M4 × 0.7	8.8	3 N·m	2 N·m	2 N·m
M5 × 0.8	8.8	6 N·m	5 N·m	4 N·m
M6 × 1.0	8.8	11 N·m	8 N·m	6 N·m
M8 × 1.25	8.8	26 N·m	20 N·m	15 N·m
M10 × 1.5	8.8	53 N·m	40 N·m	30 N·m
M12 × 1.75	8.8	92 N·m	69 N·m	52 N·m
M14 × 2.0	8.8	146 N·m	110 N·m	83 N·m
M16 × 2.0	8.8	229 N·m	172 N·m	129 N·m
M20 × 2.5	8.8	447 N·m	335 N·m	252 N·m
M4 × 0.7	10.9	4 N·m	3 N·m	2 N·m

SIZE	GRADE	DRY (K=0.20)	LUBRICATED (K=0.15)	ANTI-SEIZE (K=0.10)
M5 × 0.8	10.9	8 N·m	6 N·m	5 N·m
M6 × 1.0	10.9	15 N·m	11 N·m	8 N·m
M8 × 1.25	10.9	36 N·m	27 N·m	20 N·m
M10 × 1.5	10.9	75 N·m	56 N·m	42 N·m
M12 × 1.75	10.9	130 N·m	98 N·m	73 N·m
M14 × 2.0	10.9	207 N·m	155 N·m	116 N·m
M16 × 2.0	10.9	321 N·m	241 N·m	181 N·m
M20 × 2.5	10.9	628 N·m	471 N·m	353 N·m
M4 × 0.7	12.9	5 N·m	4 N·m	3 N·m
M5 × 0.8	12.9	10 N·m	7 N·m	5 N·m
M6 × 1.0	12.9	17 N·m	13 N·m	10 N·m
M8 × 1.25	12.9	43 N·m	32 N·m	24 N·m
M10 × 1.5	12.9	88 N·m	66 N·m	49 N·m
M12 × 1.75	12.9	152 N·m	114 N·m	86 N·m
M14 × 2.0	12.9	243 N·m	182 N·m	136 N·m
M16 × 2.0	12.9	376 N·m	282 N·m	212 N·m
M20 × 2.5	12.9	736 N·m	552 N·m	414 N·m

**About the values.** Torque is the indirect way to achieve a target bolt tension. The K-factor depends on thread finish, lubrication, and washer condition — values shown are typical, not absolute. For critical joints,

use a tension-indicating method (direct-tension washer, strain gauge, or yield-point method) rather than torque alone.

## Common applications

USE CASE	TYPICAL BOLT	NOTE
Automotive lug nut	1/2-20 or M14	Always check vehicle manufacturer spec – varies 80–150 ft·lbf
Engine cylinder head	M10–M12 stretch bolt	Torque-to-yield (TTY); use the angle method, not just torque
Bicycle stem bolt	M5 or M6	Typically 5–8 N·m. Over-torque cracks carbon parts
Bicycle pedal	9/16" or M14	30–35 ft·lbf typical
Furniture assembly bolt	M6 or M8	Hand-tight + 1/4 turn; particleboard threads strip easily
Structural steel connection	3/4-10 A325	Slip-critical: turn-of-nut or DTI washer, not torque

## Common pitfalls

- **Lubrication changes torque ~30%.** A dry-spec bolt over-torqued because someone added oil will snap. A lubed bolt under-torqued because spec was for lubed will loosen.
- **Used bolts have different friction.** Re-used fasteners may need different torque. Critical joints should use new fasteners.

- **Galvanized and stainless are different.** Galvanized increases friction (~20%); stainless tends to gall and seize. Use anti-seize on stainless.
- **Torque ≠ tension.** Even with perfect technique, torque-to-tension correlation has ±25% scatter. For mission-critical joints, measure tension directly.
- **Bolt grade matters more than size.** A Grade 8 1/4" bolt holds more than a Grade 2 3/8" bolt. Check the head markings.

## Common questions

### Why does my torque spec say 'lubricated' or 'dry'?

About 90% of applied torque is consumed by friction (between threads and under the bolt head); only ~10% actually produces clamping force. Lubrication reduces friction, so the same torque produces more preload. A dry torque spec applied to a lubricated bolt can overstretch it by 30-50% and break it. Always match your bolt condition to the spec.

### What torque should I use if I don't have a spec?

For grade 5 (or class 8.8) bolts in steel, a reasonable rule of thumb is  $T = 0.2 \times D \times \text{proof-load-force}$ , with T in lb·ft, D in inches, and force in lbf. For a 1/2-13 grade 5 bolt (D = 0.5 in, proof load ~12,030 lbf),  $T \approx 0.2 \times 0.5 \times 12,030 / 12 = 100$  lb·ft. Always cross-check against a published table; rules of thumb are starting points, not specs.

## Can I reuse a bolt that's been torqued before?

It depends on whether it was torqued into the yield range (most aerospace and engine bolts) or below yield (most general fasteners). Yield-tightened bolts plastically deform and should never be reused. Standard fasteners torqued below their proof load can usually be reused 2-3 times — but inspect for thread damage, stretching, or corrosion before reuse.

## What's the difference between proof load and yield strength?

Proof load is the highest load a bolt can take without permanent deformation; yield strength is the load at which deformation starts. Proof load is typically set at 90% of yield to give a safety margin. Bolt grades (5, 8, 10.9, 12.9) are categorized by proof load, not yield, because proof is what matters for repeated use.

## Why are anti-seize compounds problematic for torque specs?

Most anti-seize compounds (copper, nickel, moly-disulfide) reduce friction so much that standard torque specs over-tighten the bolt. If you must use anti-seize, reduce the torque by 20-30% or use a torque-angle method instead. Some manufacturers explicitly forbid anti-seize on critical bolts because of this.

## Sources

- **Methodology:** ISO 16047 — Fasteners, torque/clamp force testing.
- **Imperial values:** SAE J429 (bolt grades) cross-referenced with Machinery's Handbook 31st ed.
- **Metric values:** ISO 898-1 (mechanical properties) cross-referenced with Machinery's Handbook.

- **K-factor formula:**  $T = K \times D \times P$ , where T = torque, K = friction factor, D = nominal diameter, P = clamp load (typically 75% of proof load).

**Disclaimer.** Torque values are guidelines, not specifications. For any joint where failure has consequences (structural, automotive, machinery), use the manufacturer's torque spec, not a general chart.