

The tightening torque

There is at present no method for direct measurement of the clamping force in a screw joint in practical production. This means in practice that, despite the uncertainty, the tightening torque is the only value usable for deciding the quality of screw joints. Screws are usually rated for a specific tightening torque with regard to size and tensile strength (bolt grade). This torque has generally been calculated to give a tension in the screw of approximately 60% of its tensile strength. At first sight this seems to provide a good margin for variations in tightening torque and yet result in proper clamping. However, considering the distribution of forces applied to the screw, it is obvious that even moderate variations in torque might lead to a joint that comes apart by itself or an over-tightening situation with screw breakage if thread conditions are not fully under control.

Another decisive factor in the tightening process is the torque rate, which is the turning angle from snug level to the rated tightening torque of the screw. A hard joint where the screw is short and the pieces being fastened together are rigid and tight requires only a fraction of a turn to reach the final torque, whereas a soft joint where the screw is long and/or there are resilient components such as spring washers or gaskets may require several full turns to reach its final prestress. It follows that the energy required to tighten a soft joint is greater than for a hard joint.

Recommendations

Recommended max tightening torque (Nm) for untreated lightly oiled screws, (friction coefficient = 0.125) Metric coarse thread.

Thread	3.6	3.6	4.6	5.8	8.8	10.9	12.9
M1.6	0.05	0.065	0.086	0.11	0.17	0.24	0.29
M2	0.10	0.13	0.17	0.22	0.35	0.49	0.58
M2.2	0.13	0.17	0.23	0.29	0.46	0.64	0.77
M2.5	0.20	0.26	0.35	0.44	0.70	0.98	1.20
M3	0.35	0.46	0.61	0.77	1.20	1.70	2.10
M3.5	0.55	0.73	0.97	1.20	1.90	2.70	3.30
M4	0.81	1.10	1.40	1.80	2.90	4.00	4.90
M5	0.60	2.20	2.95	3.60	5.70	8.10	9.70
M6	2.80	3.70	4.90	6.10	9.80	14.0	17.0

Table 1

The torques correspond to approximately 62% of tensile stress.

Note: If a screw locking element is included, increase torque by 10% for plastic insert and 20% for mechanical locking (prevailing nut).

Recommended tightening torque for thread rolling screws, Taptite®, Swageform® etc.

Recommended tightening torque for thread forming screw – ST (sheet metal screw).

Thread	Torque Nm
M3	1.4
M4	3.2
M5	6.5
M6	11
M8	26
M10	52
M12	91

Thread	Torque Nm
ST 2.2 (B2)	0.2
ST 2.9 (B4)	1.0
ST 3.5 (B6)	1.8
ST 4.2 (B8)	2.9
ST 4.8 (B10)	4.2
ST 5.5 (B12)	6.7
ST 6.3 (B14)	9.1

Table 2 and 3

Case-hardened, threadforming screws for metal. M thread. Recommended values apply to the strength of the screw (the joint may be weaker).

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