

(Technical Data)
Table of Diameter of Screw Low Hole (Low Anchor)

1. Meter coarse thread

Nominal size of thread	Minimum dimensions		Maximum dimensions	
	Grade 2, Grade 3	Grade 2	Grade 2	Grade 3
M 1 x 0.25	0.73	0.78	-	-
M 1.1 x 0.25	0.83	0.89	-	-
M 1.2 x 0.25	0.93	0.98	-	-
M 1.4 x 0.3	1.08	1.14	-	-
M 1.6 x 0.35	1.22	1.32	-	-
M 1.7 x 0.35	1.33	1.42	-	-
M 1.8 x 0.35	1.42	1.52	-	-
M 2 x 0.4	1.57	1.67	-	-
M 2.2 x 0.45	1.71	1.84	-	-
M 2.3 x 0.4	1.87	1.97	-	-
M 2.5 x 0.45	2.01	2.14	-	-
M 2.6 x 0.45	2.12	2.23	-	-
M 3 x 0.5	2.46	2.60	2.64	-
M 3.5 x 0.6	2.85	3.01	3.05	-
M 4 x 0.7	3.24	3.42	3.47	-
M 4.5 x 0.75	3.69	3.88	3.92	-
M 5 x 0.8	4.13	4.33	4.38	-
M 6 x 1	4.92	5.15	5.22	-
M 7 x 1	5.92	6.15	6.22	-
M 8 x 1.25	6.65	6.91	6.98	-
M 9 x 1.25	7.65	7.91	7.98	-
M 10 x 1.5	8.38	8.68	8.75	-
M 11 x 1.5	9.38	9.68	9.75	-
M 12 x 1.75	10.11	10.44	10.53	-
M 14 x 2	11.84	12.21	12.31	-
M 16 x 2	13.84	14.21	14.31	-
M 18 x 2.5	15.29	15.74	15.85	-
M 20 x 2.5	17.29	17.74	17.85	-
M 22 x 2.5	19.29	19.74	19.85	-
M 24 x 3	20.75	21.25	21.38	-
M 27 x 3	23.75	24.25	24.38	-
M 30 x 3.5	26.21	26.77	26.92	-
M 33 x 3.5	29.21	29.77	29.92	-
M 36 x 4	31.67	32.27	32.42	-
M 39 x 4	34.67	35.27	35.42	-
M 42 x 4.5	37.13	37.80	37.98	-
M 45 x 4.5	40.13	40.80	40.98	-
M 48 x 5	42.59	43.30	43.49	-

2. Meter fine thread

Nominal size of thread	Minimum dimensions		Maximum dimensions	
	Grade 2, Grade 3	Grade 2	Grade 2	Grade 3
M 2.5 x 0.35	2.12	2.22	-	-
M 3 x 0.35	2.62	2.72	-	-
M 3.5 x 0.35	3.12	3.22	-	-
M 4 x 0.5	3.46	3.60	3.64	-
M 4.5 x 0.5	3.96	4.10	4.14	-
M 5 x 0.5	4.46	4.60	4.64	-
M 5.5 x 0.5	4.96	5.10	5.14	-
M 6 x 0.75	5.19	5.38	5.42	-
M 7 x 0.75	6.19	6.38	6.42	-
M 8 x 1	6.92	7.15	7.22	-
M 8 x 0.75	7.19	7.38	7.42	-
M 9 x 1	7.92	8.15	8.22	-
M 9 x 0.75	8.19	8.38	8.42	-
M 10 x 1.25	8.65	8.91	8.98	-
M 10 x 1	8.92	9.15	9.22	-
M 10 x 0.75	9.19	9.38	-	-
M 11 x 1	9.92	10.15	10.22	-
M 11 x 0.75	10.19	10.38	10.42	-
M 12 x 1.5	10.38	10.68	10.75	-
M 12 x 1.25	10.65	10.91	10.98	-
M 12 x 1	10.92	11.15	11.22	-
M 14 x 1.5	12.38	12.68	12.75	-
M 14 x 1	12.92	13.15	13.22	-
M 15 x 1.5	13.38	13.68	13.75	-
M 15 x 1	13.92	14.15	14.22	-

Nominal size of thread	Minimum dimensions		Maximum dimensions	
	Grade 2, Grade 3	Grade 2	Grade 2	Grade 3
M 16 x 1.5	14.38	14.68	14.75	-
M 16 x 1	14.92	15.15	15.22	-
M 17 x 1.5	15.38	15.68	15.75	-
M 17 x 1	15.92	16.15	16.22	-
M 18 x 2	15.84	16.21	16.31	-
M 18 x 1.5	16.38	16.68	16.75	-
M 18 x 1	16.92	17.15	17.22	-
M 20 x 2	17.84	18.21	18.31	-
M 20 x 1.5	18.38	18.68	18.75	-
M 20 x 1	18.92	19.15	19.22	-
M 22 x 2	19.84	20.21	20.31	-
M 22 x 1.5	20.38	20.68	20.75	-
M 22 x 1	20.92	21.15	21.22	-
M 24 x 2	21.84	22.21	22.31	-
M 24 x 1.5	22.38	22.68	22.75	-
M 24 x 1	22.92	23.15	23.22	-
M 25 x 2	22.84	23.21	23.31	-
M 25 x 1.5	23.38	23.68	23.75	-
M 25 x 1	23.92	24.15	24.22	-
M 26 x 1.5	24.38	24.68	24.75	-
M 27 x 2	24.84	25.21	25.31	-
M 27 x 1.5	25.38	25.68	25.75	-
M 27 x 1	25.92	26.15	26.22	-
M 28 x 2	25.84	26.21	26.31	-
M 28 x 1.5	26.38	26.68	26.75	-
M 28 x 1	26.92	27.15	27.22	-
M 30 x 3	26.75	27.25	27.38	-
M 30 x 2	27.84	28.21	28.31	-
M 30 x 1.5	28.38	28.68	28.75	-
M 30 x 1	28.92	29.15	29.22	-
M 32 x 2	29.84	30.21	30.31	-
M 32 x 1.5	30.38	30.68	30.75	-
M 33 x 3	29.75	30.25	30.38	-
M 33 x 2	30.84	31.21	31.31	-
M 33 x 1.5	31.38	31.68	31.75	-
M 35 x 1.5	33.38	33.68	33.75	-
M 36 x 3	32.75	33.25	33.38	-
M 36 x 2	33.84	34.21	34.31	-
M 36 x 1.5	34.38	34.68	34.75	-
M 38 x 1.5	36.38	36.68	36.75	-
M 39 x 3	35.75	36.25	36.38	-
M 39 x 2	36.84	37.21	37.31	-
M 39 x 1.5	37.38	37.68	37.75	-
M 40 x 3	36.75	37.25	37.38	-
M 40 x 2	37.84	38.21	38.31	-
M 40 x 1.5	38.38	38.68	38.75	-
M 42 x 4	37.67	38.27	38.42	-
M 42 x 3	38.75	39.25	39.38	-
M 42 x 2	39.84	40.21	40.31	-
M 42 x 1.5	40.38	40.68	40.75	-
M 45 x 4	40.67	41.27	41.42	-
M 45 x 3	41.75	42.25	42.38	-
M 45 x 2	42.84	43.21	43.31	-
M 45 x 1.5	43.38	43.68	43.75	-
M 48 x 4	43.67	44.27	44.42	-
M 48 x 3	44.75	45.25	45.38	-
M 48 x 2	45.84	46.21	46.31	-
M 48 x 1.5	46.38	46.68	46.75	-
M 50 x 3	46.75	47.25	47.38	-
M 50 x 2	47.84	48.21	48.31	-
M 50 x 1.5	48.38	48.68	48.75	-

(Technical Data)
Correct Tightening Axial Force and Correct Tightening Torque for Bolts

■ The tightening tension and fatigue limit when clamping with bolts

- The calculation of the correct tightening torque when tightening bolts is to be within the elastic region, and a maximum of 70% of the standard yield strength under the Torque Method.
- The fatigue limit from repeated loads on the bolt should not exceed the allowable value.
- The flange of a bolt or nut should not be sunk into the clamped surface.
- The surface to be clamped should not be damaged through the tightening of bolts.

The Torque Method, the Torque Gradient Method, the Turn-of-Nut Method, and the Stretch Measurement Method can all be used as the method of bolt tightening, but the Torque Method is relatively simple and is widely used.

■ Calculation of the tightening axial force and tightening torque

The relationship of the tightening axial force F_f is expressed in formula (1) k : torque coefficient
 $F_f = 0.7 \times y \times A_s \dots (1)$ d : nominal bolt diameter [cm]
 The tightening torque T_{fA} , is expressed in formula (2) Q : tightening coefficient
 $T_{fA} = 0.35K(1 + 1/Q) \cdot y \cdot A_s \cdot d \dots (2)$ y : yield strength (112 kgf / mm² when strength category is 12.9)
 A_s : effective bolt area [mm²]

■ Calculation Example

The correct torque and axial force is required to clamp two pieces of soft steel (strength category of 12.9) with a socket head cap screw M6 in a lubricated state.

- The correct torque is shown using formula (2) $T_{fA} = 0.35K(1 + 1/Q) \cdot y \cdot A_s \cdot d$
 $= 0.35 \cdot 0.17(1 + 1/1.4)112 \cdot 20.1 \cdot 0.6$
 $= 138 \text{ kgf} \cdot \text{cm}$
- The correct axial tension is shown using formula (1) $F_f = 0.7 \times y \times A_s$
 $= 0.7 \times 112 \times 20.1$
 $= 1576 \text{ kgf}$

■ Torque coefficient by combining the surface treatment of the bolt, the surface to be clamped, and the female screw. ■ The standard values of tightening coefficient Q

Bolt Surface treatment	Torque coefficient k	Combining	
		Material of surface to be clamped (a)	Material of female screw (b)
Lubricant	0.145	SCM - FC	FC - FC SUS - FC
	0.155	S10C - FC	SCM - S10C SCM - SCM FC - S10C FC - SCM
	0.165	SCM - SUS	FC - SUS AL - FC SUS - S10C SUS - SCM SUS - SUS
	0.175	S10C - S10C	S10C - SCM S10C - SUS AL - S10C AL - SCM
	0.185	SCM - AL	FC - AL AL - SUS
	0.195	S10C - AL	SUS - AL
Steel bolts Black oxide coating	0.215	AL - AL	
	0.25	S10C - FC	SCM - FC FC - FC
Lubricated	0.35	S10C - SCM	SCM - SCM FC - S10C FC - SCM AL - FC
	0.45	S10C - S10C	SCM - S10C AL - S10C AL - SCM
Not lubricated	0.55	SCM - AL	FC - AL AL - AL

S10C: Non heat-treated steel SCM: Heat-treated steel (35HRC) FC: Cast iron (FC200) AL: Aluminum SUS: Stainless (SUS304)

Tightening coefficient Q	Tightening method	Surface state		Lubrication state
		Bolt	Nut	
1.25	Torque wrench	Manganese phosphate		
1.4	Torque wrench	Non-treated or phosphate	Non-treated or phosphate	Lubricated or MoS ₂ paste
	Ratchet wrench			
1.6	Impact wrench			
1.8	Torque wrench	Non-treated or phosphate	Non-treated	Not lubricated
	Ratchet wrench			

Expressing strength categories

Example $\frac{12.9}{10.9}$
 Yield strength : 90% of the minimum tensile strength
 The minimal tensile strength is 1220N / mm² { 124kgf / mm² }
 Yield strength : 90% of the minimum tensile strength
 The minimal tensile strength is 1040N / mm² { 106kgf / mm² }

■ Initial tightening strength and torque

Bolt size	Effective bolt area As mm ²	Strength category											
		12.9			10.9			8.8			4.8		
		Yield load kgf	Initial tightening strength kgf	Tightening torque kgf · cm	Yield load kgf	Initial tightening strength kgf	Tightening torque kgf · cm	Yield load kgf	Initial tightening strength kgf	Tightening torque kgf · cm	Yield load kgf	Initial tightening strength kgf	Tightening torque kgf · cm
M 3 x 0.5	5.03	563	394	17	482	338	15	328	230	10	175	122	5
M 4 x 0.7	8.78	983	688	40	842	589	34	573	401	23	305	213	12
M 5 x 0.8	14.2	1590	1113	81	1362	953	69	927	649	47	493	345	25
M 6 x 1	20.1	2251	1576	138	1928	1349	118	1313	919	80	697	488	43
M 8 x 1.25	36.6	4099	2869	334	3510	2457	286	2390	1673	195	1270	889	104
M10 x 1.5	58	6496	4547	663	5562	3894	567	3787	2651	386	2013	1409	205
M12 x 1.75	84.3	9442	6609	1160	8084	5659	990	5505	3853	674	2925	2048	358
M14 x 2	115	12880	9016	1840	11029	7720	1580	7510	5257	1070	3991	2793	570
M16 x 2	157	17584	12039	2870	15056	10539	2460	10252	7176	1670	5448	3814	889
M18 x 2.5	192	21504	15053	3950	18413	12889	3380	12922	9045	2370	6662	4664	1220
M20 x 2.5	245	27440	19208	5600	23496	16447	4790	16489	11542	3360	8502	5951	1730
M22 x 2.5	303	33936	23755	7620	29058	20340	6520	20392	14274	4580	10514	7360	2360
M24 x 3	353	39536	27675	9680	33853	23697	8290	23757	16630	5820	12249	8574	3000

- (Notes) • Tightening conditions : The use of a torque wrench (lubrication, torque coefficient k= 0.17, tightening coefficient Q= 1.4)
 • The torque coefficient changes depending on conditions of use, so please use this table as an indication only.
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