
**Prevailing torque type steel nuts —
Mechanical and performance properties**

Écrous autofreinés en acier — Caractéristiques mécaniques et performances



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 2320 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 1, *Mechanical properties of fasteners*.

This fourth edition cancels and replaces the third edition (ISO 2320:1997), which has been technically revised. It also incorporates the Technical Corrigendum ISO 2320:1997/Cor.1:2006.

Prevailing torque type steel nuts — Mechanical and performance properties

1 Scope

This International Standard specifies the mechanical and performance properties for prevailing torque type steel nuts when tested at an ambient temperature range of +10 °C to +35 °C. It includes a single test to determine the prevailing torque properties (performance properties) and/or the torque/clamp force properties.

This International Standard applies to prevailing torque all metal type nuts and prevailing torque non-metallic insert type nuts:

- a) with triangular ISO thread according to ISO 68-1;
- b) with diameter/pitch combination according to ISO 261 and ISO 262;
- c) with coarse pitch thread M3 to M39 and mechanical properties according to ISO 898-2;
- d) with fine pitch thread M8×1 to M39×3 and mechanical properties according to ISO 898-6;
- e) within the temperature range of –50 °C to +150 °C for prevailing torque all metal type nuts;

NOTE 1 See Clause 7, paragraph 3.

- f) within the temperature range of –50 °C to +120 °C for prevailing torque non-metallic insert type nuts.

NOTE 2 See Clause 7, paragraph 4.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 273:1979, *Fasteners — Clearance holes for bolts and screws*

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs*

ISO 898-2, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread*

ISO 898-6, *Mechanical properties of fasteners — Part 6: Nuts with specified proof load values — Fine pitch thread*

ISO 965-2, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose external and internal screw threads — Medium quality*

ISO 16047, *Fasteners — Torque/clamp force testing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16047 and the following apply.

- 3.1 prevailing torque type nut**
nut which is not free-running on a mating thread by virtue of a self-contained prevailing torque feature, and which provides a degree of resistance to rotation independent of clamping or compression forces
- 3.2 prevailing torque developed by the nut**
torque necessary to rotate the nut on its mating externally threaded component and with no axial force in the mating component
- 3.3 prevailing-on torque**
torque to rotate the nut on its mating externally threaded component with the torque measured while the nut is in motion and with no clamp force
- 3.4 prevailing-off torque**
torque to rotate after backing off the nut until the removal of the clamp force in the externally threaded component in the following 360° rotation of the nut
- 3.5 prevailing torque all metal type nut**
nut which has a one piece or a multiple piece metal construction and derives its prevailing torque characteristics from a controlled distortion of the nut thread and/or body or from metallic insert(s)
- 3.6 prevailing torque non-metallic insert type nut**
nut which has a multiple piece construction and derives its prevailing torque characteristics from insert(s) of non-metallic material located and retained in the nut
- 3.7 seating point**
point in the tightening process where clamp force first appears

4 Symbols

For the purpose of this International Standard, the following symbols apply together with those defined in ISO 16047.

Symbol Designation

d	nominal diameter
d_4	diameter of the hole of the fixture
F_P	proof load
F_{65}	lower load limit for the evaluation of the coefficient of total friction at 65 % of F_P
F_{75}	upper load limit for the evaluation of the coefficient of total friction at 75 % of F_P
F_{80}	test clamp force (shut-down force for the tightening process) at 80 % of F_P
P	pitch of the thread
T_{FV}	prevailing-on torque, in newton metres

T_{Fd}	prevailing-off torque, in newton metres
T_{65}	lower torque limit for the evaluation of the coefficient of total friction at F_{65}
T_{75}	upper torque limit for the evaluation of the coefficient of total friction at F_{75}
T_{80}	test torque corresponding to 80 % of the proof load, in newton metres (see Tables 1 to 8)
μ_{tot}	coefficient of total friction

5 Thread

Threads for prevailing torque type nuts shall be in accordance with ISO 965-2 except for the prevailing torque feature:

- for prevailing torque non-metallic insert type nuts, the GO gauge shall be suitable for free installation (by hand) until it is seated against the prevailing torque feature;
- for prevailing torque all metal type nuts, the GO gauge shall be suitable for free installation (by hand) to one pitch at least.

6 Lubrication

At the option of the manufacturer a lubricant may be applied to the manufacturing lot to fulfil the performance requirements.

7 Mechanical properties of prevailing torque type nuts

The mechanical properties of prevailing torque type nuts shall conform to ISO 898-2 or ISO 898-6.

With regard to proof load, the test method specified in 9.2 shall apply.

For prevailing torque all metal type nuts, users should consult an experienced fastener materials expert for temperatures outside the range of -50 °C to $+150\text{ °C}$ to determine appropriate choices for a given application.

For prevailing torque non-metallic insert type nuts, use at or near the temperature limits of -50 °C and $+120\text{ °C}$ may reduce the prevailing torque capability and may require the use of an adequate non-metallic material. Users should consult an experienced fastener materials expert for temperatures outside the range of -50 °C to $+120\text{ °C}$ to determine appropriate choices for a given application.

8 Performance requirements for prevailing torque properties

The prevailing-on torque shall not exceed the value specified for the applicable nut in Tables 1 to 8.

The prevailing-off torque shall exceed the value specified for the applicable nut in Tables 1 to 8.

For delivery inspection, the 1st installation/removal test applies, unless otherwise agreed.

For initial type testing and in case of dispute, a 5th removal test shall also be applied unless otherwise agreed.

Prevailing torque performance decreases as a function of the number of reuses; the consumer should take into consideration the consequences of the decreased performance before any reuse of the nut.

By request of the customer, a temperature resistance test for prevailing torque non-metallic insert type nuts as given in Annex A may be carried out.

Paragraphs 3 and 4 of Clause 7 also apply to performance requirements.

Table 1 — Test clamp force and prevailing torques for prevailing torque type nuts of property class 04

Thread <i>d P</i>	Test clamp force F_{80}^a N	Clamp force for evaluation of total friction coefficient		Prevailing torque		
		μ_{tot}^b		N·m		
		Upper limit F_{75}^c N	Lower limit F_{65}^d N	1st installation $T_{Fv,max}^e$	1st removal $T_{Fd,min}^f$	5th removal $T_{Fd,min}^f$
M3	1 528	1 433	1 242	0,43	0,12	0,08
M4	2 672	2 505	2 171	0,9	0,18	0,12
M5	4 320	4 050	3 510	1,6	0,29	0,2
M6	6 112	5 730	4 966	3	0,45	0,3
M7	8 800	8 250	7 150	4,5	0,65	0,45
M8	11 120	10 425	9 035	6	0,85	0,6
M8×1	11 920	11 175	9 685			
M10	17 600	16 500	14 300	10,5	1,5	1
M10×1,25	18 640	17 475	15 145			
M10×1	19 600	18 375	15 925			
M12	25 600	24 000	20 800	15,5	2,3	1,6
M12×1,5	26 800	25 125	21 775			
M12×1,25	28 000	26 250	22 750			
M14	34 960	32 775	28 405	24	3,3	2,3
M14×1,5	38 000	35 625	30 875			
M16	47 760	44 775	38 805	32	4,5	3
M16×1,5	50 800	47 625	41 275			
M18	58 400	54 750	47 450	42	6	4,2
M18×1,5	65 360	61 275	53 105			
M20	74 480	69 825	60 515	54	7,5	5,3
M20×1,5	82 720	77 550	67 210			
M22	92 080	86 325	74 815	68	9,5	6,5
M22×1,5	101 200	94 875	82 225			
M24	107 280	100 575	87 165	80	11,5	8
M24×2	116 720	109 425	94 835			
M27	139 520	130 800	113 360	94	13,5	10
M27×2	150 800	141 375	122 525			
M30	170 560	159 900	138 580	108	16	12
M30×2	188 800	177 000	153 400			
M33	210 960	197 775	171 405	122	18	14
M33×2	231 360	216 900	187 980			
M36	248 400	232 875	201 825	136	21	16
M36×3	262 960	246 525	213 655			
M39	296 720	278 175	241 085	150	23	18
M39×3	313 120	293 550	254 410			

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

^a The clamp force for property class 04 nuts is equal to 80 % of the proof load of property class 04 nuts for 3 mm ≤ *d* ≤ 39 mm. Proof loads for nuts are given in ISO 898-2 and ISO 898-6.

^b See Annex B.

^c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.

^d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.

^e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.

^f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

Table 2 — Test clamp force and prevailing torques for prevailing torque type nuts of property class 05

Thread <i>d P</i>	Test clamp force F_{80}^a N	Clamp force for evaluation of total friction coefficient		Prevailing torque N·m		
		μ_{tot}^b		1st installation $T_{Fv,max}^e$	1st removal $T_{Fd,min}^f$	5th removal $T_{Fd,min}^f$
		Upper limit F_{75}^c N	Lower limit F_{65}^d N			
M3	2 000	1 875	1 625	0,6	0,15	0,1
M4	3 520	3 300	2 860	1,2	0,22	0,15
M5	5 680	5 325	4 615	2,1	0,35	0,24
M6	8 000	7 500	6 500	4	0,55	0,4
M7	11 600	10 875	9 425	6	0,85	0,6
M8	14 640	13 725	11 895	8	1,15	0,8
M8×1	15 680	14 700	12 740			
M10	23 200	21 750	18 850	14	2	1,4
M10×1,25	24 480	22 950	19 890			
M10×1	25 760	24 150	20 930			
M12	33 760	31 650	27 430	21	3,1	2,1
M12×1,5	35 200	33 000	28 600			
M12×1,25	36 800	34 500	29 900			
M14	46 000	43 125	37 375	31	4,4	3
M14×1,5	50 000	46 875	40 625			
M16	62 800	58 875	51 025	42	6	4,2
M16×1,5	66 800	62 625	54 275			
M18	76 800	72 000	62 400	56	8	5,5
M18×1,5	86 000	80 625	69 875			
M20	98 000	91 875	79 625	72	10,5	7
M20×1,5	108 800	102 000	88 400			
M22	121 200	113 625	98 475	90	13	9
M22×1,5	133 200	124 875	108 225			
M24	141 200	132 375	114 725	106	15	10,5
M24×2	153 600	144 000	124 800			
M27	183 600	172 125	149 175	123	17	12
M27×2	198 400	186 000	161 200			
M30	224 400	210 375	182 325	140	19	14
M30×2	248 400	232 875	201 825			
M33	277 600	260 250	225 550	160	21,5	15,5
M33×2	304 400	285 375	247 325			
M36	326 800	306 375	265 525	180	24	17,5
M36×3	346 000	324 375	281 125			
M39	390 400	366 000	317 200	200	26,5	19,5
M39×3	412 000	386 250	334 750			

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

a The clamp force for property class 05 nuts is equal to 80 % of the proof load of property class 05 nuts for $3 \text{ mm} \leq d \leq 39 \text{ mm}$. Proof loads for nuts are given in ISO 898-2 and ISO 898-6.

b See Annex B.

c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.

d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.

e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.

f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

Table 3 — Test clamp force and prevailing torques for prevailing torque type nuts of property class 5

Thread <i>d P</i>	Test clamp force F_{80}^a N	Clamp force for evaluation of total friction coefficient μ_{tot}^b		Prevailing torque N·m		
		Upper limit F_{75}^c N	Lower limit F_{65}^d N	1st installation $T_{Fv,max}^e$	1st removal $T_{Fd,min}^f$	5th removal $T_{Fd,min}^f$
M3	1 528	1 433	1 242	0,43	0,12	0,08
M4	2 672	2 505	2 171	0,9	0,18	0,12
M5	4 320	4 050	3 510	1,6	0,29	0,2
M6	6 112	5 730	4 966	3	0,45	0,3
M7	8 800	8 250	7 150	4,5	0,65	0,45
M8	11 120	10 425	9 035	6	0,85	0,6
M8×1	11 920	11 175	9 685			
M10	17 600	16 500	14 300	10,5	1,5	1
M10×1,25	18 640	17 475	15 145			
M10×1	19 600	18 375	15 925			
M12	25 600	24 000	20 800	15,5	2,3	1,6
M12×1,5	26 800	25 125	21 775			
M12×1,25	28 000	26 250	22 750			
M14	34 960	32 775	28 405	24	3,3	2,3
M14×1,5	38 000	35 625	30 875			
M16	47 760	44 775	38 805	32	4,5	3
M16×1,5	50 800	47 625	41 275			
M18	58 400	54 750	47 450	42	6	4,2
M18×1,5	65 680	61 575	53 365			
M20	74 480	69 825	60 515	54	7,5	5,3
M20×1,5	82 400	77 250	66 950			
M22	92 000	86 250	74 750	68	9,5	6,5
M22×1,5	100 800	94 500	81 900			
M24	107 200	100 500	87 100	80	11,5	8
M24×2	116 800	109 500	94 900			
M27	113 600	106 500	92 300	94	13,5	10
M27×2	123 200	115 500	100 100			
M30	139 200	130 500	113 100	108	16	12
M30×2	153 600	144 000	124 800			
M33	172 000	161 250	139 750	122	18	14
M33×2	188 800	177 000	153 400			
M36	202 400	189 750	164 450	136	21	16
M36×3	214 400	201 000	174 200			
M39	242 400	227 250	196 950	150	23	18
M39×3	255 200	239 250	207 350			

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

a The clamp force for property class 5 nuts is equal to 80 % of the proof load of property class 5.8 bolts for $3 \text{ mm} \leq d \leq 24 \text{ mm}$, and 80 % of the proof load of property class 4.8 bolts for $d > 24 \text{ mm}$. Proof loads for bolts are given in ISO 898-1.

b See Annex B.

c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.

d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.

e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.

f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

Table 4 — Test clamp force and prevailing torques for prevailing torque type nuts of property class 6

Thread <i>d P</i>	Test clamp force F_{80}^a N	Clamp force for evaluation of total friction coefficient μ_{tot}^b		Prevailing torque N·m		
		Upper limit F_{75}^c N	Lower limit F_{65}^d N	1st installation $T_{Fv,max}^e$	1st removal $T_{Fd,min}^f$	5th removal $T_{Fd,min}^f$
M3	1 768	1 658	1 437	0,43	0,12	0,08
M4	3 088	2 895	2 509	0,9	0,18	0,12
M5	5 000	4 688	4 063	1,6	0,29	0,2
M6	7 072	6 630	5 746	3	0,45	0,3
M7	10 160	9 525	8 255	4,5	0,65	0,45
M8	12 880	12 075	10 465	6	0,85	0,6
M8×1	13 760	12 900	11 180			
M10	20 400	19 125	16 575	10,5	1,5	1
M10×1,25	21 520	20 175	17 485			
M10×1	22 720	21 300	18 460			
M12	29 680	27 825	24 115	15,5	2,3	1,6
M12×1,5	31 040	29 100	25 220			
M12×1,25	32 400	30 375	26 325			
M14	40 480	37 950	32 890	24	3,3	2,3
M14×1,5	44 000	41 250	35 750			
M16	55 280	51 825	44 915	32	4,5	3
M16×1,5	58 800	55 125	47 775			
M18	67 600	63 375	54 925	42	6	4,2
M18×1,5	76 000	71 250	61 750			
M20	86 400	81 000	70 200	54	7,5	5,3
M20×1,5	96 000	90 000	78 000			
M22	106 400	99 750	86 450	68	9,5	6,5
M22×1,5	116 800	109 500	94 900			
M24	124 000	116 250	100 750	80	11,5	8
M24×2	135 200	126 750	109 850			
M27	161 600	151 500	131 300	94	13,5	10
M27×2	174 400	163 500	141 700			
M30	197 600	185 250	160 550	108	16	12
M30×2	218 400	204 750	177 450			
M33	244 000	228 750	198 250	122	18	14
M33×2	268 000	251 250	217 750			
M36	287 200	269 250	233 350	136	21	16
M36×3	304 800	285 750	247 650			
M39	343 200	321 750	278 850	150	23	18
M39×3	362 400	339 750	294 450			

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

a The clamp force for property class 6 nuts is equal to 80 % of the proof load of property class 6.8 bolts. Proof loads for bolts are given in ISO 898-1.

b See Annex B.

c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.

d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.

e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.

f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

Table 5 — Test clamp force and prevailing torques for prevailing torque type nuts of property class 8

Thread <i>d P</i>	Test clamp force F_{80}^a N	Clamp force for evaluation of total friction coefficient μ_{tot}^b		Prevailing torque N·m		
		Upper limit F_{75}^c N	Lower limit F_{65}^d N	1st installation $T_{Fv,max}^e$	1st removal $T_{Fd,min}^f$	5th removal $T_{Fd,min}^f$
		M3	2 336	2 190	1 898	0,43
M4	4 080	3 825	3 315	0,9	0,18	0,12
M5	6 584	6 173	5 350	1,6	0,29	0,2
M6	9 280	8 700	7 540	3	0,45	0,3
M7	13 440	12 600	10 920	4,5	0,65	0,45
M8	16 960	15 900	13 780	6	0,85	0,6
M8×1	18 160	17 025	14 755			
M10	26 960	25 275	21 905	10,5	1,5	1
M10×1,25	28 400	26 625	23 075			
M10×1	29 920	28 050	24 310			
M12	39 120	36 675	31 785	15,5	2,3	1,6
M12×1,5	40 880	38 325	33 215			
M12×1,25	42 720	40 050	34 710			
M14	53 360	50 025	43 355	24	3,3	2,3
M14×1,5	58 000	54 375	47 125			
M16	72 800	68 250	59 150	32	4,5	3
M16×1,5	77 520	72 675	62 985			
M18	92 000	86 250	74 750	42	6	4,2
M18×1,5	104 000	97 500	84 500			
M20	117 600	110 250	95 550	54	7,5	5,3
M20×1,5	130 400	122 250	105 950			
M22	145 600	136 500	118 300	68	9,5	6,5
M22×1,5	160 000	150 000	130 000			
M24	169 600	159 000	137 800	80	11,5	8
M24×2	184 000	172 500	149 500			
M27	220 000	206 250	178 750	94	13,5	10
M27×2	238 400	223 500	193 700			
M30	269 600	252 750	219 050	108	16	12
M30×2	298 400	279 750	242 450			
M33	332 800	312 000	270 400	122	18	14
M33×2	365 600	342 750	297 050			
M36	392 000	367 500	318 500	136	21	16
M36×3	415 200	389 250	337 350			
M39	468 800	439 500	380 900	150	23	18
M39×3	494 400	463 500	401 700			

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

- a The clamp force for property class 8 nuts is equal to 80 % of the proof load of property class 8.8 bolts. Proof loads for bolts are given in ISO 898-1.
- b See Annex B.
- c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.
- d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.
- e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.
- f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

Table 6 — Test clamp force and prevailing torques for prevailing torque type nuts of property class 9

Thread <i>d P</i>	Test clamp force F_{80}^a N	Clamp force for evaluation of total friction coefficient μ_{tot}^b		Prevailing torque N·m		
		Upper limit F_{75}^c N	Lower limit F_{65}^d N	1st installation $T_{Fv,max}^e$	1st removal $T_{Fd,min}^f$	5th removal $T_{Fd,min}^f$
M3	2 616	2 453	2 126	0,43	0,12	0,08
M4	4 568	4 283	3 712	0,9	0,18	0,12
M5	7 384	6 923	6 000	1,6	0,29	0,2
M6	10 480	9 825	8 515	3	0,45	0,3
M7	15 040	14 100	12 220	4,5	0,65	0,45
M8	19 040	17 850	15 470	6	0,85	0,6
M8×1	20 400	19 125	16 575			
M10	30 160	28 275	24 505	10,5	1,5	1
M10×1,25	31 840	29 850	25 870			
M10×1	33 520	31 425	27 235			
M12	43 840	41 100	35 620	15,5	2,3	1,6
M12×1,5	45 840	42 975	37 245			
M12×1,25	47 920	44 925	38 935			
M14	59 840	56 100	48 620	24	3,3	2,3
M14×1,5	64 960	60 900	52 780			
M16	81 600	76 500	66 300	32	4,5	3
M16×1,5	87 200	81 750	70 850			

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

a The clamp force for property class 9 nuts is equal to 80 % of the proof load of property class 9.8 bolts. Proof loads for bolts are given in ISO 898-1.

b See Annex B.

c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.

d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.

e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.

f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

Table 7 — Test clamp force and prevailing torques for prevailing torque type nuts of property class 10

Thread <i>d P</i>	Test clamp force F_{80}^a N	Clamp force for evaluation of total friction coefficient μ_{tot}^b		Prevailing torque N·m		
		Upper limit F_{75}^c N	Lower limit F_{65}^d N	1st installation $T_{Fv,max}^e$	1st removal $T_{Fd,min}^f$	5th removal $T_{Fd,min}^f$
M3	3 344	3 135	2 717	0,6	0,15	0,1
M4	5 832	5 468	4 739	1,2	0,22	0,15
M5	9 440	8 850	7 670	2,1	0,35	0,24
M6	13 360	12 525	10 855	4	0,55	0,4
M7	19 200	18 000	15 600	6	0,85	0,6
M8	24 320	22 800	19 760	8	1,15	0,8
M8×1	26 000	24 375	21 125			
M10	38 480	36 075	31 265			
M10×1,25	40 640	38 100	33 020	14	2	1,4
M10×1	42 800	40 125	34 775			
M12	56 000	52 500	45 500			
M12×1,5	58 480	54 825	47 515	21	3,1	2,1
M12v1,25	61 120	57 300	49 660			
M14	76 400	71 625	62 075			
M14×1,5	83 200	78 000	67 600	31	4,4	3
M16	104 000	97 500	84 500			
M16×1,5	111 200	104 250	90 350	42	6	4,2
M18	127 200	119 250	103 350			
M18×1,5	143 200	134 250	116 350	56	8	5,5
M20	162 400	152 250	131 950			
M20×1,5	180 800	169 500	146 900	72	10,5	7
M22	201 600	189 000	163 800			
M22×1,5	220 800	207 000	179 400	90	13	9
M24	234 400	219 750	190 450			
M24×2	255 200	239 250	207 350	106	15	10,5
M27	304 800	285 750	247 650			
M27×2	329 600	309 000	267 800	123	17	12
M30	372 800	349 500	302 900			
M30×2	412 000	386 250	334 750	140	19	14
M33	460 800	432 000	374 400			
M33×2	505 600	474 000	410 800	160	21,5	15,5
M36	542 400	508 500	440 700			
M36×3	574 400	538 500	466 700	180	24	17,5
M39	648 000	607 500	526 500			
M39×3	684 000	641 250	555 750	200	26,5	19,5

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

a The clamp force for property class 10 nuts is equal to 80 % of the proof load of property class 10.9 bolts. Proof loads for bolts are given in ISO 898-1.

b See Annex B.

c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.

d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.

e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.

f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

Table 8 — Test clamp force and prevailing torques for prevailing torque type nuts of property class 12

Thread <i>d P</i>	Test clamp force F_{80}^a N	Clamp force for evaluation of total friction coefficient μ_{tot}^b		Prevailing torque N·m		
		Upper limit F_{75}^c N	Lower limit F_{65}^d N	1st installation $T_{Fv,max}^e$	1st removal $T_{Fd,min}^f$	5th removal $T_{Fd,min}^f$
		M3	3 904	3 660	3 172	0,6
M4	6 816	6 390	5 538	1,2	0,22	0,15
M5	11 040	10 350	8 970	2,1	0,35	0,24
M6	15 600	14 625	12 675	4	0,55	0,4
M7	22 400	21 000	18 200	6	0,85	0,6
M8	28 400	26 625	23 075	8	1,15	0,8
M8×1	30 400	28 500	24 700			
M10	45 040	42 225	36 595			
M10×1,25	47 520	44 550	38 610	14	2	1,4
M10×1	50 160	47 025	40 755			
M12	65 440	61 350	53 170			
M12×1,5	68 400	64 125	55 575	21	3,1	2,1
M12×1,25	71 440	66 975	58 045			
M14	89 600	84 000	72 800			
M14×1,5	96 800	90 750	78 650	31	4,4	3
M16	121 600	114 000	98 800			
M16×1,5	129 600	121 500	105 300	42	6	4,2
M18	148 800	139 500	120 900			
M18×1,5	168 000	157 500	136 500	56	8	5,5
M20	190 400	178 500	154 700			
M20×1,5	211 200	198 000	171 600	72	10,5	7
M22	235 200	220 500	191 100			
M22×1,5	258 400	242 250	209 950	90	13	9
M24	273 600	256 500	222 300			
M24×2	297 600	279 000	241 800	106	15	10,5
M27	356 000	333 750	289 250			
M27×2	384 800	360 750	312 650	123	17	12
M30	435 200	408 000	353 600			
M30×2	481 600	451 500	391 300	140	19	14
M33	538 400	504 750	374 400			
M33×2	590 400	553 500	479 700	160	21,5	15,5
M36	633 600	594 000	514 800			
M36×3	671 200	629 250	545 350	180	24	17,5
M39	757 600	710 250	615 550			
M39×3	799 200	749 250	649 350	200	26,5	19,5

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

a The clamp force for property class 12 nuts is equal to 80 % of the proof load of property class 12.9 bolts. Proof loads for bolts are given in ISO 898-1.

b See Annex B.

c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.

d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.

e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.

f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

9 Test method

9.1 General

The nuts shall be tested as received.

9.2 Proof load test

The proof load test shall be carried out according to ISO 898-2 or ISO 898-6. Additionally, the following applies.

The nut to be tested shall be assembled on a test bolt (see 9.3) or on a hardened steel mandrel. The maximum prevailing torque to assemble the nut through 360° rotation shall be recorded after the first full thread has passed through the prevailing torque feature and assembly continues until three full threads protrude through the nut. For referee test purposes, a hardened steel mandrel shall be used for prevailing torque non-metallic insert type nuts and a test bolt shall be used for prevailing torque all metal type nuts. The maximum prevailing torque occurring during the assembly of the nut on the test bolt or mandrel shall be recorded after the first full form thread has passed through the prevailing torque feature.

A load equal to the specified proof load for the nut, as specified in ISO 898-2 or ISO 898-6, shall be applied through the test bolt or mandrel against the nut-bearing surface in an axial direction and shall be held for 15 s. The nut shall resist this load without thread stripping or rupture. The proof load test is decisive.

The maximum prevailing torque occurring during disassembly of the nut after a half-turn to full disengagement measured with the nut in motion shall not exceed the recorded maximum prevailing torque during assembly.

9.3 Prevailing torque test

9.3.1 General

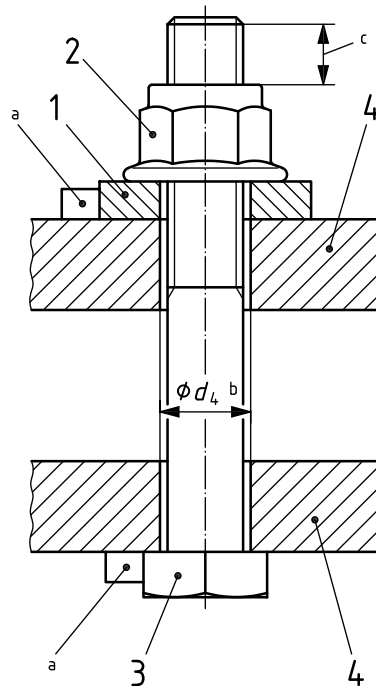
The purpose of this test method is to obtain simultaneously on the prevailing torque type nuts:

- a) the performance properties (prevailing torques developed by the nut);
- b) the torque/clamp force properties tested according to ISO 16047, when agreed between the manufacturer and the purchaser.

9.3.2 Test apparatus

For test apparatus, see ISO 16047.

For the test setup, see Figure 1. Test apparatus shall not generate clamp force during prevailing torque testing.

**Key**

- 1 test-bearing plate/washer
- 2 nut to be tested
- 3 test bolt/screw
- 4 load cell

d_4 diameter of the hole of the fixture

a Test-bearing plate or test washer and bolt head shall be fixed by suitable means to prevent rotation and shall be aligned.

b d_4 shall be in accordance with ISO 273:1979, fine series.

c 4 to 7 pitches.

Figure 1 — Test setup and nut when seated

9.3.3 Test parts

For test bolts/screws and test plate/washer, see ISO 16047. The test bolt and test washer surface finish shall be in accordance with ISO 16047, plain surface uncoated and degreased, unless otherwise agreed. The test washer shall be of type HH, unless otherwise agreed. With the exception of the test mandrel, test parts shall be used only once.

The property class of the test bolt/screw shall be chosen according to Table 9.

Table 9 — Property classes for the test bolt/screw

Nut to be tested	Corresponding test bolt/screw
Property class	
04	≥8.8
5	≥8.8
05	≥10.9
6	≥8.8
8	≥8.8
9	≥9.8
10	≥10.9
12	12.9

9.3.4 Test procedure

This test can be realized automatically on an appropriate testing device or manually with adequate hand tools like torque wrenches and load cells, see 9.3.2.

In case of dispute, the automatic mode applies.

Torque/clamp force testing conditions are specified in ISO 16047.

The test bolt/screw is placed in the testing device such that the protrusion through the prevailing torque feature of the nut after seating is according to Figure 1.

The nut to be tested is engaged by hand on the bolt/screw thread until the prevailing torque feature is engaged. The end of the test bolt/screw shall not protrude through the nut before testing. The threaded length for tightening shall be four to seven pitches according to Figure 1.

The starting point of the installation phase corresponds to the start-up of the tightening device (see point 1 in Figure 2).

The rotation shall be continuous and uniform from point 1 until the test clamp force, F_{80} , is reached. Values for F_{80} are given in Tables 1 to 8. Torque at clamp force F_{75} shall be recorded and evaluated.

NOTE The F_{80} value provides the shut-down signal for the test device to ensure precise evaluation at F_{75} .

The seating point (see point 2 in Figure 2) shall be determined. Between point 1 and point 2, the prevailing-on torque, $T_{Fv,max}$, shall be measured (see Tables 1 to 8).

The nut is then rotated off by the application of a reverse torque until the clamp force in the test bolt/screw is reduced to zero (see point 3 in Figure 2). The prevailing-off torque, $T_{Fd,min}$, occurring while the nut is rotated through the next 360° of rotation (see point 4 in Figure 2) shall be measured (see Tables 1 to 8). Point 4 corresponds to the angular position of point 3 minus 360°.

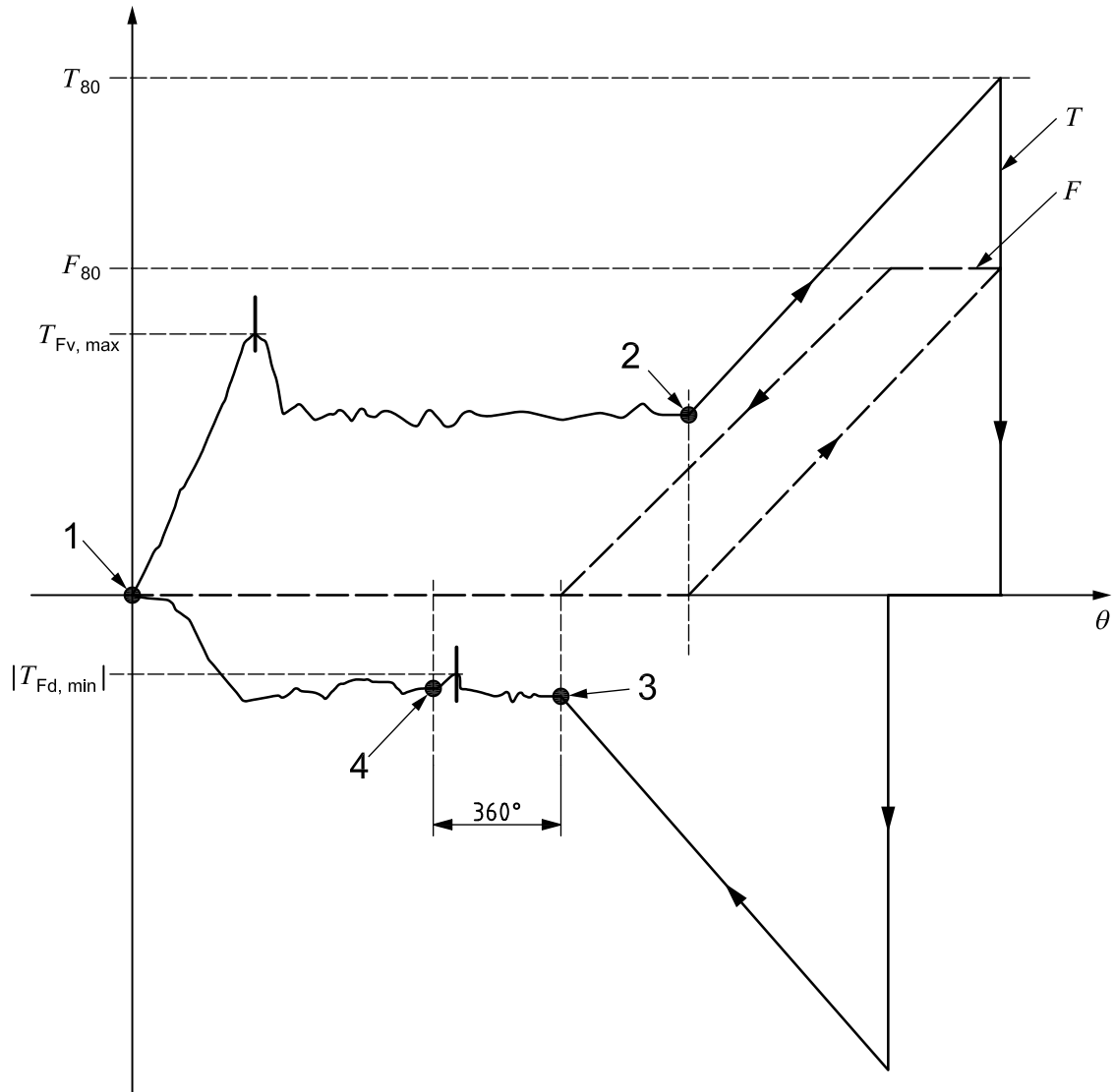
The nut is then disassembled until the initial angular position has reached the starting point (see point 1).

During the removal of the nut, the rotating shall be continuous and uniform from the test clamp force, F_{80} , to point 1.

After the complete removal of the nut, the nut and bolt threads shall not be damaged. In case of dispute, the test bolt shall accept the appropriate ring gauge.

For determination of the values for the 5th removal, the above procedure will be performed four more times between point 1 and point 2 only.

During the 5th removal, the prevailing-off torque occurring while the nut is being rotated through the first 360° shall be measured. This torque shall be equal to, or higher than, the 5th removal prevailing torque value as specified in Tables 1 to 8.



Key

- | | | |
|-----------------|---|--|
| F clamp force | 1 | point where prevailing-on torque occurs first and measurement of T_{FV} starts |
| T torque | 2 | seating point, end of measurement of T_{FV} |
| θ angle | 3 | no contact with the test plate/ washer, beginning of measurement of T_{Fd} |
| | 4 | end of measurement of T_{Fd} |

Figure 2 — Torque/clamp force/angle curve

9.3.5 Test report

See ISO 16047 for an outline of the test report content. A reference to this International Standard shall be included in the test report.

The prevailing-on torque, T_{FV} , and the prevailing-off torque, T_{Fd} , (and, if required, the temperature resistance test result for prevailing torque non-metallic insert type nuts) shall be included in the test report.

Annex A (normative)

Temperature resistance of prevailing torque non-metallic insert type nuts

The specifications given in this annex may be agreed between customer and supplier, if appropriate.

At ambient temperature (10 °C to 35 °C), the nut shall be assembled on to a test bolt until four to seven full threads protrude through the top of the nut but no clamp force is induced.

The assembly shall be placed in a chamber at +120 °C; after 1 h, it shall be removed from the chamber to cool naturally to ambient temperature.

The assembly shall then be placed in a chamber at –50 °C; after 1 h, it shall be removed from the chamber to recover naturally to ambient temperature.

With the assembly at ambient temperature, the prevailing torque test according to the test procedure given in 9.3.4 shall be carried out, disregarding the prevailing-on torque and clamp force. The prevailing torques measured at the first and the fifth removal shall not be lower than the relevant values specified in Tables 1 to 8.

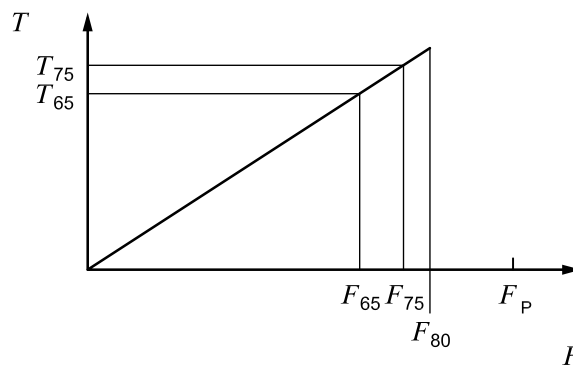
Upon agreement between customer and supplier, the temperature range may be modified to suit application requirements.

Annex B (informative)

Basis for the evaluation of the total coefficient of friction, μ_{tot}

The tightening process runs up to a test clamp force of 80 % of the proof load of the mating bolt. For evaluation of the coefficient of friction, μ_{tot} , the clamp force is determined at 65 % and 75 % of the proof load value.

The coefficient of friction, μ_{tot} , is calculated as the mean of the coefficient of friction at the upper limit and at the lower limit.



Key

- F_P proof load
- F_{65} lower load limit for the evaluation of the coefficient of total friction at 65 % of F_P
- F_{75} upper load limit for the evaluation of the coefficient of total friction at 75 % of F_P
- F_{80} test clamp force (shut-down force for the tightening process) at 80 % of F_P
- T_{65} lower torque limit for the evaluation of the coefficient of total friction at F_{65}
- T_{75} upper torque limit for the evaluation of the coefficient of total friction at F_{75}

Figure B.1 — Principles for evaluation of the coefficient of friction, μ_{tot}

Bibliography

- [1] ISO 68-1, *ISO general purpose screw threads — Basic profile — Part 1: Metric screw threads*
- [2] ISO 261, *ISO general purpose metric screw threads — General plan*
- [3] ISO 262, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts*

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