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ISO 2320

Fifth edition 2015-12-01

Fasteners — Prevailing torque steel nuts — Functional properties

Fixations — Écrous autofreinés en acier — Caractéristiques fonctionnelles



ISO 2320:2015(E)



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ISO copyright office Ch. de Blandonnet 8 • CP 401 CH-1214 Vernier, Geneva, Switzerland Tel. +41 22 749 01 11 Fax +41 22 749 09 47 copyright@iso.org www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 2, Fasteners, Subcommittee SC 12, Fasteners with metric internal thread.

This fifth edition cancels and replaces the fourth edition (ISO 2320:2008), which has been technically revised. The following changes have been made:

- property class 9 has been deleted;
- prevailing torques for nuts M3 and M4 have been moved to Annex C;
- in the test fixture, the thread protrusion through the prevailing torque feature has been changed to 3 to 5 pitches;
- the reference surface condition for the test bolt has been specified in accordance with ISO 16047 (plain surface, uncoated and degreased, unless otherwise agreed);
- the determination of the prevailing-off torque has been changed from the upper value to the minimum value (new point 5 in <u>Figure 2</u>), which changes the acceptance conditions;
- other editorial revisions.

Fasteners — Prevailing torque steel nuts — Functional properties

1 Scope

This International Standard specifies the functional properties for prevailing torque steel nuts when tested at an ambient temperature range of +10 °C to +35 °C. It includes a combined test method to determine the prevailing torque properties and the torque/clamp force properties at the same time.

It applies to prevailing torque all metal type nuts and prevailing torque non-metallic insert type nuts:

- with triangular ISO thread in accordance with ISO 68-1;
- with diameter/pitch combination in accordance with ISO 261 and ISO 262;
- with coarse pitch thread M5 to M39 or with fine pitch thread M8 × 1 to M39 × 3;
- with thread tolerances in accordance with ISO 965-2;
- with mechanical properties in accordance with ISO 898-2;

Prevailing torque values specified in this standard are based on laboratory test conditions.

NOTE 1 Actual prevailing torques in practical application can vary.

NOTE 2 All metal type nuts conforming to the requirements of this International Standard are used in applications ranging from -50 °C to +150 °C.

NOTE 3 Non-metallic insert type nuts conforming to the requirements of this International Standard are used in applications ranging from -50 °C to +120 °C.

WARNING — Temperatures outside the ambient temperature range can influence the functional properties (torque/clamp force and prevailing torque properties), see Annex A.

2 Normative references

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

ISO 273, 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 with specified property classes — Coarse thread and fine pitch thread

ISO 898-2, Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and 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 16047:2005, 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 nut

nut which is not free-running on a mating thread by virtue of a self-contained prevailing torque feature, and which provides 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 without clamp force

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 without clamp force

3.4

prevailing-off torque

torque to rotate after backing off the nut until the removal of the clamp force 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 and/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 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.

- D nominal diameter, in millimetre
- d₄ diameter of the hole of the fixture, in millimetre
- F_P proof load, in newton
- F₆₅ lower load limit for the evaluation of the coefficient of total friction at 65 % of F_P, in newton
- F₇₅ upper load limit for the evaluation of the coefficient of total friction at 75 % of F_P, in newton
- F_{80} test clamp force (shut-down force for the tightening process) at 80 % of F_{P} , in newton
- P pitch of the thread, in millimetre
- T_{Fv} prevailing-on torque, in newton metre
- $T_{\rm Fd}$ prevailing-off torque, in newton metre
- T_{65} lower torque limit for the evaluation of the coefficient of total friction at F_{65} , in newton metre
- T_{75} upper torque limit for the evaluation of the coefficient of total friction at F_{75} , in newton metre

 T_{80} test torque corresponding to 80 % of the proof load, in newton metre (see <u>Tables 1</u> to <u>7</u>)

 μ_{tot} coefficient of total friction

5 Thread

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

- a) 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 functional requirements.

7 Mechanical properties of prevailing torque nuts

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

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

8 Functional requirements for prevailing torque properties

The prevailing-on torque shall not exceed the value specified for the applicable nut in Tables 1 to 7.

The prevailing-off torque shall exceed the value specified for the applicable nut in Tables 1 to 7.

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

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

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

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

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

Thread D D×P		Clamp force for evaluation of total friction coefficient $\mu_{\mathrm{tot}}{}^{\mathrm{b}}$		Prevailing torque Nm			
	Test clamp force F ₈₀ a N	Upper limit F75° N	Lower limit F65 ^d N	1 st installation $T_{\text{Fv,max}}^{\text{e}}$	$\begin{array}{c} \mathbf{1^{st}removal} \\ T_{\mathrm{Fd,min}} \end{array}$	5 th removal T _{Fd,min}	
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		0.05	0.6	
M8×1	11 920	11 175	9 685	- 6	0,85	0,6	
M10	17 600	16 500	14 300				
M10×1,25	18 640	17 475	15 145	10,5	1,5	1	
M10×1	19 600	18 375	15 925]			
M12	25 600	24 000	20 800				
M12×1,5	26 800	25 125	21 775	15,5	2,3	1,6	
M12×1,25	28 000	26 250	22 750				
M14	34 960	32 775	28 405		3,3		
M14×1,5	38 000	35 625	30 875	24		2,3	
M16	47 760	44 775	38 805	32	4.5		
M16×1,5	50 800	47 625	41 275		4,5	3	
M18	58 400	54 750	47 450				
M18×1,5	65 360	61 275	53 105	42	6	4,2	
M20	74 480	69 825	60 515		7,5		
M20×1,5	82 720	77 550	67 210	54		5,3	
M22	92 080	86 325	74 815				
M22×1,5	101 200	94 875	82 225	- 68	9,5	6,5	
M24	107 280	100 575	87 165				
M24×2	116 720	109 425	94 835	80	11,5	8	
M27	139 520	130 800	113 360	0.1	40 =		
M27×2	150 800	141 375	122 525	94	13,5	10	
M30	170 560	159 900	138 580	460	4.5		
M30×2	188 800	177 000	153 400	108	16	12	
M33	210 960	197 775	171 405	400	40		
M33×2	231 360	216 900	187 980	122	18	14	
M36	248 400	232 875	201 825	455			
M36×3	262 960	246 525	213 655	136	21	16	
M39	296 720	278 175	241 085	450	9.5		
M39×3	313 120	293 550	254 410	150	23	18	

The clamp force for property class 04 nuts is equal to 80 % of the proof load of property class 04 specified in ISO 898-2 for nuts with 5 mm $\leq D \leq$ 39 mm.

b See <u>Annex B</u>.

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

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

Thread	Test clamp force			Prevailing torque Nm			
D D×P	F ₈₀ a N	Upper limit F75 ^c N	Lower limit $F_{65}{}^{ m d}$ N	1 st installation $T_{\text{Fv,max}}^{\text{e}}$	$T_{\mathrm{Fd,min}}$	5 th removal T _{Fd,min}	
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		0.0	
M8×1	15 680	14 700	12 740	8	1,15	0,8	
M10	23 200	21 750	18 850				
M10×1,25	24 480	22 950	19 890	14	2	1,4	
M10×1	25 760	24 150	20 930				
M12	33 760	31 650	27 430				
M12×1,5	35 200	33 000	28 600	21	3,1	2,1	
M12×1,25	36 800	34 500	29 900				
M14	46 000	43 125	37 375	31	4,4		
M14×1,5	50 000	46 875	40 625			3	
M16	62 800	58 875	51 025	42	6		
M16×1,5	66 800	62 625	54 275			4,2	
M18	76 800	72 000	62 400		8		
M18×1,5	86 000	80 625	69 875	56		5,5	
M20	98 000	91 875	79 625		10,5	_	
M20×1,5	108 800	102 000	88 400	72		7	
M22	121 200	113 625	98 475			_	
M22×1,5	133 200	124 875	108 225	90	13	9	
M24	141 200	132 375	114 725				
M24×2	153 600	144 000	124 800	106	15	10,5	
M27	183 600	172 125	149 175	100			
M27×2	198 400	186 000	161 200	123	17	12	
M30	224 400	210 375	182 325		-10		
M30×2	248 400	232 875	201 825	140	19	14	
M33	277 600	260 250	225 550	4.00	24.5		
M33×2	304 400	285 375	247 325	160	21,5	15,5	
M36	326 800	306 375	265 525	4			
M36×3	346 000	324 375	281 125	180	24	17,5	
M39	390 400	366 000	317 200	0.00	25 -		
M39×3	412 000	386 250	334 750	200	26,5	19,5	

The clamp force for property class 05 nuts is equal to 80 % of the proof load of property class 05 specified in ISO 898-2 for nuts with 5 mm $\leq D \leq$ 39 mm.

b See <u>Annex B</u>.

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.

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

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

Thread	Test clamp force	Clamp force for evaluation of total friction coefficient $\mu_{ ext{tot}}^{ ext{b}}$		Prevailing torque Nm			
D D×P	F ₈₀ a N	Upper limit F75 ^c N	Lower limit F ₆₅ d N	1 st installation $T_{\rm Fv,max}^{\rm e}$	$T_{\mathrm{Fd,min}}^{\mathrm{st}}$	5 th removal T _{Fd,min}	
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	0.05	0.6	
M8×1	11 920	11 175	9 685	6	0,85	0,6	
M10	17 600	16 500	14 300				
M10×1,25	18 640	17 475	15 145	10,5	1,5	1	
M10×1	19 600	18 375	15 925				
M12	25 600	24 000	20 800				
M12×1,5	26 800	25 125	21 775	15,5	2,3	1,6	
M12×1,25	28 000	26 250	22 750				
M14	34 960	32 775	28 405	- 24	3,3	2.2	
M14×1,5	38 000	35 625	30 875			2,3	
M16	47 760	44 775	38 805	- 32	4.5	22 45	
M16×1,5	50 800	47 625	41 275		4,5	3	
M18	58 400	54 750	47 450		6		
M18×1,5	65 680	61 575	53 365	42		4,2	
M20	74 480	69 825	60 515		7,5	7.5	
M20×1,5	82 400	77 250	66 950	54		5,3	
M22	92 000	86 250	74 750				
M22×1,5	100 800	94 500	81 900	68	9,5	6,5	
M24	107 200	100 500	87 100				
M24×2	116 800	109 500	94 900	80	11,5	8	
M27	113 600	106 500	92 300	6.	40.5		
M27×2	123 200	115 500	100 100	94	13,5	10	
M30	139 200	130 500	113 100	400	4-5	- 10	
M30×2	153 600	144 000	124 800	108	16	12	
M33	172 000	161 250	139 750	400	40		
M33×2	188 800	177 000	153 400	122	18	14	
M36	202 400	189 750	164 450	4.7.			
M36×3	214 400	201 000	174 200	136	21	16	
M39	242 400	227 250	196 950				
M39×3	255 200	239 250	207 350	150	23	18	

The clamp force for property class 5 nuts is equal to 80 % of the proof load of property class 5.8 specified in ISO 898-1 for bolts

b See <u>Annex B</u>.

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

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

Thread	Test clamp force			Prevailing torque Nm				
D D×P	F ₈₀ a N	Upper limit F ₇₅ c N	Lower limit F ₆₅ d N	1 st installation T _{Fv,max} e	$T_{\rm Fd,min}$	5 th removal T _{Fd,min}		
М5	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	,	0.05	0.6		
M8×1	13 760	12 900	11 180	6	0,85	0,6		
M10	20 400	19 125	16 575					
M10×1,25	21 520	20 175	17 485	10,5	1,5	1		
M10×1	22 720	21 300	18 460	1				
M12	29 680	27 825	24 115					
M12×1,5	31 040	29 100	25 220	15,5	2,3	1,6		
M12×1,25	32 400	30 375	26 325					
M14	40 480	37 950	32 890	24	3,3			
M14×1,5	44 000	41 250	35 750			2,3		
M16	55 280	51 825	44 915		4,5	4.5		
M16×1,5	58 800	55 125	47 775	32		3		
M18	67 600	63 375	54 925		6			
M18×1,5	76 000	71 250	61 750	42		4,2		
M20	86 400	81 000	70 200		7,5			
M20×1,5	96 000	90 000	78 000	54		5,3		
M22	106 400	99 750	86 450					
M22×1,5	116 800	109 500	94 900	- 68	9,5	6,5		
M24	124 000	116 250	100 750					
M24×2	135 200	126 750	109 850	80	11,5	8		
M27	161 600	151 500	131 300		10.5			
M27×2	174 400	163 500	141 700	94	13,5	10		
M30	197 600	185 250	160 550	400	4.5			
M30×2	218 400	204 750	177 450	108	16	12		
M33	244 000	228 750	198 250	45-	4-			
M33×2	268 000	251 250	217 750	122	18	14		
M36	287 200	269 250	233 350	45-				
M36×3	304 800	285 750	247 650	136	21	16		
M39	343 200	321 750	278 850	150	9.5			
M39×3	362 400	339 750	294 450	150	23	18		

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

b See <u>Annex B</u>.

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 <u>Annex B</u>.

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

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

Thread	Test clamp force			Prevailing torque Nm				
D D×P	F ₈₀ a N	Upper limit F ₇₅ c N	Lower limit F ₆₅ ^d N	$\mathbf{1^{st}}$ installation $T_{\mathrm{Fv,max}^{\mathrm{e}}}$	$T_{\mathrm{Fd,min}}$	5 th removal T _{Fd,min}		
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		0.05	0.6		
M8×1	18 160	17 025	14 755	6	0,85	0,6		
M10	26 960	25 275	21 905					
M10×1,25	28 400	26 625	23 075	10,5	1,5	1		
M10×1	29 920	28 050	24 310	1				
M12	39 120	36 675	31 785					
M12×1,5	40 880	38 325	33 215	15,5	2,3	1,6		
M12×1,25	42 720	40 050	34 710					
M14	53 360	50 025	43 355	24	3,3	2.2		
M14×1,5	58 000	54 375	47 125			2,3		
M16	72 800	68 250	59 150		4,5	4.5	4.5	
M16×1,5	77 520	72 675	62 985	32		3		
M18	92 000	86 250	74 750	40	6			
M18×1,5	104 000	97 500	84 500	42		4,2		
M20	117 600	110 250	95 550		7,5			
M20×1,5	130 400	122 250	105 950	54		5,3		
M22	145 600	136 500	118 300					
M22×1,5	160 000	150 000	130 000	68	9,5	6,5		
M24	169 600	159 000	137 800					
M24×2	184 000	172 500	149 500	80	11,5	8		
M27	220 000	206 250	178 750	0.	40.5			
M27×2	238 400	223 500	193 700	94	13,5	10		
M30	269 600	252 750	219 050	400	4-5	- 10		
M30×2	298 400	279 750	242 450	108	16	12		
M33	332 800	312 000	270 400	45-	4-			
M33×2	365 600	342 750	297 050	122	18	14		
M36	392 000	367 500	318 500	45-				
M36×3	415 200	389 250	337 350	136	21	16		
M39	468 800	439 500	380 900	150	0.0			
M39×3	494 400	463 500	401 700	150	23	18		

The clamp force for property class 8 nuts is equal to 80 % of the proof load of property class 8.8 specified in ISO 898-1 for bolts.

b See <u>Annex B</u>.

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

Table 6 — Test clamp force and prevailing torques for prevailing torque nuts of property class 10

Thread	Test clamp force			Prevailing torque Nm			
D D×P	F ₈₀ a N	Upper limit F ₇₅ c N	Lower limit F ₆₅ d N	$\begin{array}{c} \mathbf{1^{st}installation} \\ T_{\mathrm{Fv,max}} \mathbf{e} \end{array}$	$\begin{array}{c} \mathbf{1^{st}removal} \\ T_{\mathrm{Fd,min}} \end{array}$	5 th removal T _{Fd,min}	
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		1.15	0.0	
M8×1	26 000	24 375	21 125	8	1,15	0,8	
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	
M12×1,25	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		6		
M16×1,5	111 200	104 250	90 350	42		4,2	
M18	127 200	119 250	103 350		8		
M18×1,5	143 200	134 250	116 350	56		5,5	
M20	162 400	152 250	131 950		10,5	10.5	_
M20×1,5	180 800	169 500	146 900	72		7	
M22	201 600	189 000	163 800		13	42	
M22×1,5	220 800	207 000	179 400	90		9	
M24	234 400	219 750	190 450	101			
M24×2	255 200	239 250	207 350	106	15	10,5	
M27	304 800	285 750	247 650	400	4=		
M27×2	329 600	309 000	267 800	123	17	12	
M30	372 800	349 500	302 900	440	40		
M30×2	412 000	386 250	334 750	140	19	14	
M33	460 800	432 000	374 400	460	24.5		
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	0.00	24.5		
M39×3	684 000	641 250	555 750	200	26,5	19,5	

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

b See <u>Annex B</u>.

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.

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

Table 7 — Test clamp force and prevailing torques for prevailing torque nuts of property class 12

Thread	Test clamp force	Clamp force for evaluation of total friction coefficient $\mu_{\mathrm{tot}}{}^{\mathrm{b}}$		Prevailing torque Nm				
D D×P	F ₈₀ a N	Upper limit F75 ^c N	Lower limit F ₆₅ ^d N	1 st installation T _{Fv,max} e	$T_{\mathrm{Fd,min}}$	5 th removal T _{Fd,min}		
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		4.45			
M8×1	30 400	28 500	24 700	8	1,15	0,8		
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	1				
M12	65 440	61 350	53 170		3,1			
M12×1,5	68 400	64 125	55 575	21		2,1		
M12×1,25	71 440	66 975	58 045	1				
M14	89 600	84 000	72 800		4.4	4.4	4.4	_
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		10,5	10.5	_	
M20×1,5	211 200	198 000	171 600	72		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			40.5		
M24×2	297 600	279 000	241 800	106	15	10,5		
M27	356 000	333 750	289 250	400	4-			
M27×2	384 800	360 750	312 650	123	17	12		
M30	435 200	408 000	353 600	140	140 19			
M30×2	481 600	451 500	391 300	140		14		
M33	538 400	504 750	374 400	4.00	0.4 =			
M33×2	590 400	553 500	479 700	160	21,5	15,5		
M36	633 600	594 000	514 800	15-				
M36×3	671 200	629 250	545 350	180	24	17,5		

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

b See Annex B.

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

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

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

Thread	Test clamp force	Clamp force for evaluation of total friction coefficient $\mu_{\mathrm{tot}}{}^{\mathrm{b}}$		Prevailing torque Nm		
D D×P	F ₈₀ a N	Upper limit F75 ^c N	Lower limit F ₆₅ d N	1 st installation T _{Fv,max} e	$1^{ ext{st}}$ removal $T_{ ext{Fd,min}}$	5 th removal T _{Fd,min}
M39	757 600	710 250	615 550	200	26.5	10.5
M39×3	799 200	749 250	649 350	200	26,5	19,5

- The clamp force for property class 12 nuts is equal to 80 % of the proof load of property class 12.9 specified in ISO 898-1 for bolts.
- b See Annex B.
- 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 values of prevailing torque for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum prevailing torques shall be 50 % of the values.

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 in accordance with ISO 898-2. 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, 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 for acceptance.

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.

NOTE Any nut used in the prevailing torque test (see 9.3) may be used for the proof load test, as long as the nut threads are not damaged.

9.3 Prevailing torque test

9.3.1 General

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

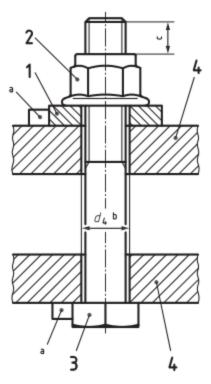
a) the functional properties (prevailing torques developed by the nut);

b) the torque/clamp force properties tested in accordance with ISO 16047.

9.3.2 Test apparatus

For test apparatus, see ISO 16047. In addition, the accuracy of prevailing torque measurement shall be \pm 5 % of the value measured.

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 with thread tolerance class 6g
- 4 test fixture including load cell
- d₄ diameter of the hole of the test fixture
- 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, fine series.
- c 3 to 5 pitches.

Figure 1 — Test setup and nut when seated

9.3.3 Test parts

For reference bolt/screw and reference test bearing plate/test washer, see ISO 16047. The reference test bearing plate/test washer shall be of type HH, unless otherwise agreed. With the exception of the test mandrel, reference parts shall be used only once.

In case of dispute, the surface condition of the reference test bolt/screw and test bearing plate/washer shall be in accordance with ISO 16047, i.e. plain surface, uncoated and degreased, unless otherwise agreed.

The property class of the test bolt/screw shall be chosen in accordance with Table 8.

Any nut used in the proof load test (see 9.2) shall not be used for the prevailing torque test.

Table 8 — 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						
10	≥ 10.9						
12	12.9						

9.3.4 Test procedure

9.3.4.1 First removal test

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 in accordance with Figure 1.

The nut to be tested is engaged by hand on the bolt/screw thread until the prevailing torque feature is in contact with the bolt/screw. The end of the test bolt/screw shall not protrude through the nut before testing. The threaded length for tightening shall be three to five pitches in accordance with 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 specified in Tables 1 to 7. 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} .

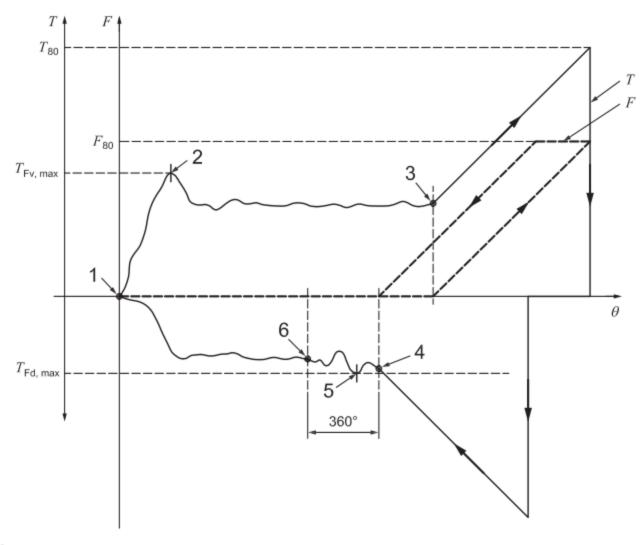
The seating point (see point 3 in Figure 2) shall be determined. Between point 1 and point 3, the prevailing-on torque, $T_{\text{Fv,max}}$, (see point 2 in Figure 2) shall be measured. It shall not exceed the values $T_{\text{Fv,max}}$ specified in Tables 1 to 7.

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 4 in Figure 2). The maximum prevailing-off torque, $T_{\rm Fd,max}$, occurring while the nut is rotated through the next 360° of rotation (see point 5 in Figure 2) shall be measured. This torque shall be equal to, or higher than, the 1st removal prevailing torque value, $T_{\rm Fd,min}$, specified in Tables 1 to 7. Point 6 corresponds to the angular position of point 4 minus 360°.

The nut is then disassembled until the initial angular position is reached again (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.



Key

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

Figure 2 — Torque/clamp force/angle curve

9.3.4.2 Fifth removal test

For determination of the values for the 5^{th} removal, the procedure in 9.3.4.1 shall be performed four more times between point 1 and point 3 only.

During the 5th removal, the maximum prevailing-off torque occurring while the nut is being rotated through 360° shall be measured in accordance with <u>Figure 2</u>. This torque shall be equal to, or higher than, the 5th removal prevailing torque value as specified in <u>Tables 1</u> to <u>7</u>.

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.

9.3.5 Test report

See ISO 16047 for the test report content. A reference to this International Standard, i.e. ISO 2320, 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 influence on prevailing torques of nuts with nonmetallic insert

The use of prevailing torque nuts with non-metallic insert at or near the temperature limits of -50 °C and +120 °C can reduce the prevailing torque capability and can require the use of an adequate non-metallic material.

This annex specifies a comparative test to show the influence of temperature on the prevailing torque properties. This test may be agreed between customer and supplier, if appropriate.

There is no direct relation between the result of this test and the performance of the nut under actual service conditions.

NOTE It is strongly recommended to develop a test procedure considering actual service conditions, see also ISO 16047:2005, Clause 9.

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

The assembly shall be placed in a chamber at +120 °C, unless otherwise agreed. 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, unless otherwise agreed. After 1 h, it shall be removed from the chamber to recover naturally to ambient temperature.

With the assembly at ambient temperature, the prevailing-off torque shall be measured between point 4 and point 6 in accordance with 9.3.4.1.

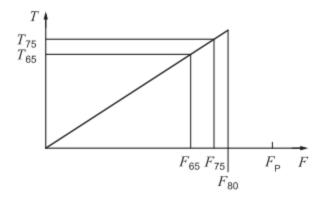
The maximum prevailing-off torque measured shall not be lower than the relevant values specified in <u>Tables 1</u> to <u>T</u>, unless otherwise agreed.

Annex B (informative)

Principles 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 in the range of 65 % to 75 % of the proof load value.

The coefficient of friction, μ_{tot} , is calculated as the mean of the coefficients of friction in the range of 65 % to 75 %.



Key

F_P proof load

F₆₅ lower load limit for the evaluation of the coefficient of total friction at 65 % of F_P

F₇₅ upper load limit for the evaluation of the coefficient of total friction at 75 % of F_P

F₈₀ test clamp force (shut-down value 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}

Annex C

(informative)

Test clamp force and prevailing torques for prevailing torque nuts M3 and M4 in property classes 8 and 10

See Tables C.1 and C.2.

Table C.1 — Test clamp force and prevailing torques for prevailing torque nuts of property class 8

Thread	Test clamp force	Clamp force for evaluation of total friction coefficient $\mu_{tot}{}^{b}$		Prevailing torque Nm		
D	F ₈₀ a N	Upper limit F75 ^c N	Lower limit F ₆₅ d N	1 st installa- tion T _{Fv,max} e	1 st removal T _{Fd,min}	5 th removal T _{Fd,min}
М3	2 336	2 190	1 898	0,43	0,12	0,08
M4	4 080	3 825	3 315	0,90	0,18	0,12

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 specified in ISO 898-1.

b See <u>Annex B</u>.

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.

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.

Table C.2 — Test clamp force and prevailing torques for prevailing torque nuts of property class 10

Thread D	Test clamp force F ₈₀ a N	Clamp force for evaluation of total friction coefficient $\mu_{\mathrm{tot}}{}^{\mathrm{b}}$		Prevailing torque Nm			
		Upper limit F75 ^c N	Lower limit $F_{65}^{ m d}$ N	$\mathbf{1^{st}}$ installation $T_{\mathrm{Fv,max}}^{\mathrm{e}}$	1 st removal T _{Fd,min}	5 th removal	
М3	3 344	3 135	2 717	0,60	0,15	0,10	
M4	5 832	5 468	4 739	1,20	0,22	0,15	

- b See <u>Annex B</u>.
- 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.
- 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.

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 specified in ISO 898-1.

Bibliography

- $[1] \hspace{0.5cm} \textbf{ISO 68-1, ISO general purpose screw threads} \textit{Basic profile} \textit{Part 1: Metric screw threads}$
- [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

