INTERNATIONAL STANDARD ISO 2320

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Prevailing-torque type steel hexagon locknuts — Mechanical and performance properties

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FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2320 was drawn up by Technical Committee ISO/TC 2, *Bolts, nuts and accessories.*

It was approved in October 1971 by the Member Bodies of the following countries :

Austria	Ireland	Romania
Belgium	Italy	South Africa, Rep. of
Canada	Japan	Spain
Czechoslovakia	Korea, Rep. of	Sweden
Egypt, Arab Rep. of	Netherlands	Switzerland
Finland	New Zealand	Thailand
Germany	Norway	Turkey
Hungary	Poland	United Kingdom
India	Portugal	U.S.S.R.

The Member Body of the following country expressed disapproval of the document on technical grounds :

France

Printed in Switzerland

Prevailing-torque type steel hexagon locknuts — Mechanical and performance properties

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the mechanical and performance requirements for prevailing-torque type steel hexagon locknuts

- with nominal thread diameters up to and including 39 mm (1 1/2 in);
- with specific strength requirements;
- with dimensions in conformity with ISO 2358 and ISO 2359.

It does not apply to locknuts requiring special properties such as

- weldability;
- corrosion resistance;
- ability of all-metal locknuts to withstand temperatures above + 300 °C, or locknuts with non-metallic inserts to withstand temperatures above + 100 °C, or any locknut to withstand temperatures below − 50 °C.

2 REFERENCES

ISO/R 79, *Brinell hardness test for steel.*

ISO/R 80, *Mechanical properties of fasteners.*

ISO/R 898, *Mechanical properties of fasteners.*

ISO/R 965, *ISO general purpose metric screw threads.*

ISO 1192, *ISO inch screw threads — Tolerances.* (At present at the stage of Draft : No. 784.)

ISO 2358, *Prevailing-torque type steel hexagon locknuts — Metric series.*

ISO 2359, *Prevailing-torque type steel hexagon locknuts — Inch series.*

3 DEFINITION

prevailing-torque type locknut : A nut which is frictionally resistant to rotation due to a self-contained prevailing-torque feature, and not because of a compressive load developed against the bearing surface of the locknut. ("Locknut" is a generic term used to identify the internally threaded products covered in this International Standard. The term "locknut" is not intended to imply an indefinite permanency of fixture.)

4 DESIGNATION

The property classes of locknuts are designated by the numbers 6, 8, 10 and 12 as shown in Table 1.

TABLE 1 — **Designation system**

Property class	Proof load stress S_p		Brinell hardness	Rockwell hardness	Nominal locknut size (thread size)	
Designation	N/mm²	1 000 lbf/in²	HB	HRC	mm	in
6	600	90	302 max.	30 max.	3 to 39	No. 4 to 1 1/2
8	800	120	302 max.	30 max.	3 to 39	No. 4 to 1 1/2
10	1 000	150	255 to 353	24 to 36	3 to 16	No. 4 to 5/8
			270 to 353	26 to 36	18 to 39	3/4 to 1 1/2
12	1 200	180	285 to 353	28 to 36	3 to 16	No. 4 to 5/8
			315 to 353	32 to 36	18 to 39	3/4 to 1 1/2

Each property class of locknut is suggested for use with bolts having specified tensile strengths as given in Table 2.

TABLE 2 – **Nut/bolt assemblies**

Property class of the nut	6	8	10[1]	12[1]
Property class of the mating bolt	6.6/6.8/6.9	6.6/6.8/6.9/8.8	10.9	12.9

1) If, in exceptional circumstances, it is necessary to combine this quality class locknut with a bolt of a lower grade, the locking characteristics may be significantly altered.

For metric series locknuts, the designation number is equal to one-hundredth of the specified proof load stress in newtons per square millimetre. This proof load stress corresponds to the minimum tensile strength of a bolt or screw with which the locknut should be assembled, so as to ensure the loading capacity of the bolted connection up to the minimum tensile strength of the bolt.

For inch series locknuts, the designation number is significant only to the extent that increasing designation numbers indicate increasing proof load stress values.

5 MECHANICAL AND PERFORMANCE REQUIREMENTS

5.1 Materials and processes

5.1.1 *Material*

Locknuts shall be made of carbon or alloy steel of a grade adequate for the locknut to meet the mechanical and performance requirements of this International Standard. The prevailing-torque element of insert design locknuts may be of a material other than steel.

5.1.2 *Heat treatment*

Class 6 locknuts need not be heat treated. Class 8 locknuts may be heat treated as necessary, and class 10 and 12 locknuts shall be heat treated to meet the mechanical and performance requirements of this International Standard. Case hardening is not allowed for any property class.

5.1.3 *Finish*

Locknuts may be furnished plain (bare metal) or with a protective coating (electrodeposited plating or chemical conversion coating) as specified by the user.

All locknuts shall be provided with a supplementary lubricant if necessary to meet the stated performance requirements without galling and shall be clean and dry to the touch.

The performance of locknuts which are furnished with a protective coating shall not deteriorate when the locknuts are stored indoors for a period of 6 months.

In cases where locknuts are given a protective coating following delivery to the purchaser, the locknut producer shall not be held responsible for failure of the locknut to meet dimensional, mechanical, or performance requirements traceable to plating or coating practice.

5.1.4 *Hydrogen embrittlement*

Electroplated or phosphate-coated heat-treated class 10 and 12 locknuts shall be suitably treated as soon as practicable after plating or coating to avoid hydrogen embrittlement.

5.2 Mechanical requirements

5.2.1 *Proof load*

Locknuts shall withstand the proof loads specified in Tables 3 to 10 for the applicable class when tested as specified in 6.1.

5.2.2 *Hardness*

Locknuts shall have a hardness conforming to the limits specified for the applicable class in Table 1 when tested as specified in 6.2.

5.3 Performance requirements

5.3.1 *Prevailing torque*

The prevailing torque developed by locknuts during their first installation, or any subsequent installation or removal, shall not exceed the maximum first installation torque specified for the applicable class in Tables 3 to 10 when tested as specified in 6.3. In addition, the maximum and minimum prevailing torques developed by locknuts during their first and fifth removals shall not be less than the respective "highest" and "lowest" reading removal torques specified in Tables 3 to 10 when tested as specified in 6.3.

5.3.1.1 DEFINITION

prevailing torque developed by a locknut: The torque necessary to rotate the locknut on its mating externally threaded component, with the torque being measured while the locknut is in motion, and with no axial load in the mating component.

TABLE 3 – **Clamp load and prevailing torque – ISO metric series – Coarse thread – Property classes 6 and 8**

Nominal thread diameter	Pitch of the thread	Proof load N Property class		Clamp load N Property class		Prevailing torque				
						First installation	First removal		Fifth removal	
							Highest reading	Lowest reading	Highest reading	Lowest reading
mm	mm	6	8	6	8	N.m max.	N.m min.	N.m min.	N.m min.	N.m min.
3	0.5	3 000	4 000	1 800	2 200	0.45	0.12	0.06	0.08	0.04
4	0.7	5 250	7 000	3 150	3 800	0.9	0.18	0.09	0.12	0.06
5	0.8	8 500	11 400	5 000	6 200	1.6	0.29	0.14	0.23	0.1
6	1	12 000	16 000	7 200	8 800	3	0.45	0.2	0.30	0.15
7	1	17 300	23 000	10 500	12 600	4.5	0.65	0.3	0.45	0.2
8	1.25	22 000	29 000	13 000	16 600	6	0.85	0.4	0.6	0.3
10	1.5	35 000	46 000	20 600	25 400	10.5	1.5	0.7	1	0.5
12	1.75	50 500	67 000	30 000	36 700	15.5	2.3	1	1.6	0.8
14	2	69 000	92 000	40 000	50 200	23.5	3.3	1.5	2.3	1
16	2	94 000	126 000	56 000	68 500	31.5	4.5	2	3	1.5
18	2.5	115 000	154 000	68 000	84 000	42	6	3	4.2	2
20	2.5	147 000	196 000	87 000	107 000	54	7.5	3.5	5.3	2.5
22	2.5	182 000	242 000	108 000	132 000	67.5	9.5	4.5	6.5	3
24	3	212 000	282 000	126 000	154 000	80	11.5	5.5	8	4
27	3	276 000	367 000	164 000	200 000	94	13.5	6.5	10	5
30	3.5	336 000	448 000	200 000	245 000	108	16	8	12	6
33	3.5	416 000	555 000	248 000	303 000	122	18	9	14	7
36	4	490 000	653 000	291 000	356 000	136	20.5	10	16	8
39	4	585 000	780 000	348 000	426 000	150	22.5	11	18	9

NOTE – The clamp load for property classes 6 and 8 is equal to 85 % of the proof load for bolt classes 6.9 and 8.8 respectively, as specified in ISO/R 898, Part I.

Proof load values for nut classes 6 and 8 respectively are as specified in ISO/R 898, Part II.

Nuts too large for proof load testing shall meet the maximum hardness condition and a minimum hardness to be agreed between the purchaser and the supplier.

TABLE 4 – *Clamp load and prevailing torque – ISO metric series – Coarse thread –* **Property classes 10 and 12**

Nominal thread diameter	Pitch of the thread	Proof load N Property class		Clamp load N Property class		Prevailing torque				
						First installation	First removal		Fifth removal	
							Highest reading	Lowest reading	Highest reading	Lowest reading
mm	mm	10	12	10	12	N.m max.	N.m max.	N.m min.	N.m min.	N.m min.
3	0.5	5 000	6 000	3 000	3 600	0.6	0.15	0.07	0.1	0.05
4	0.7	8 750	10 500	5 200	6 200	1.2	0.22	0.1	0.15	0.07
5	0.8	14 200	17 000	8 400	10 200	2.1	0.35	0.15	0.3	0.15
6	1	20 000	24 000	11 900	14 300	4	0.55	0.25	0.4	0.2
7	1	29 000	34 700	17 200	20 600	6	0.85	0.4	0.6	0.3
8	1.25	36 500	43 000	21 700	26 100	8	1.15	0.6	0.8	0.4
10	1.5	58 000	69 500	34 500	41 300	14	2	1	1.4	0.7
12	1.75	84 000	100 000	50 000	60 000	21	3.1	1.5	2.1	1
14	2	115 000	138 000	68 000	82 000	31	4.4	2	3	1.5
16	2	157 000	188 000	93 000	112 000	42	6	3	4.2	2
18	2.5	192 000	230 000	114 000	136 000	56	8	4	5.5	2.5
20	2.5	245 000	294 000	145 000	175 000	72	10.5	5	7	3.5
22	2.5	303 000	364 000	180 000	216 000	90	13	6.5	9	4,5
24	3	353 000	423 000	210 000	251 000	106	15	7.5	10.5	5
27	3	459 000	550 000	274 000	327 000	123	17	8.5	12	6
30	3.5	561 000	673 000	333 000	400 000	140	19	9.5	14	7
33	3.5	694 000	833 000	412 000	494 000	160	21.5	10.5	15.5	7.5
36	4	817 000	980 000	485 000	582 000	180	24	12	17.5	8.5
39	4	976 000	1 170 000	580 000	695 000	200	26.5	13	19.5	9.5

NOTE – The clamp load for property classes 10 and 12 is equal to 75 % of the proof load for bolt classes 10.9 and 12.9 respectively, as specified in ISO/R 898, Part I.

Proof load values for nut classes 10 and 12 respectively are as specified in ISO/R 898, Part II.

Nuts too large for proof load testing shall meet the maximum hardness condition and a minimum hardness to be agreed between the purchaser and the supplier.

TABLE 5 – **Clamp load and prevailing torque – ISO metric series – Fine thread – Property classes 6 and 8**

Nominal thread diameter	Pitch of the thread	Proof load N Property class		Clamp load N Property class		Prevailing torque				
						First installation	First removal		Fifth removal	
							Highest reading	Lowest reading	Highest reading	Lowest reading
mm	mm	6	8	6	8	N.m min.	N.m min.	N.m min.	N.m min.	N.m min.
8	1	23 500	31 000	14 000	17 100	6	0.85	0.4	0.6	0.3
10	1.25	37 000	49 000	21 800	26 700	10.5	1.5	0.7	1	0.5
12	1.25	55 000	74 000	32 800	40 200	15.5	2.3	1	1.6	0.8
14	1,5	75 000	100 000	44 500	54 500	23.5	3.3	1.5	2.3	1
16	1.5	100 000	134 000	59 500	73 000	31.5	4.5	2	3	1.5
18	1.5	129 000	172 000	77 500	94 500	42	6	3	4.2	2
20	1.5	163 000	218 000	96 700	118 000	54	7.5	3.5	5.3	2.5
22	1.5	200 000	266 000	118 000	146 000	67.5	9.5	4.5	6.5	3
24	2	230 000	307 000	136 000	187 000	80	11.5	5.5	8	4
27	2	298 000	397 000	177 000	217 000	94	13.5	6.5	10	5
30	2	373 000	497 000	221 000	271 000	108	16	8	12	6
33	2	456 000	608 000	271 000	333 000	122	18	9	14	7
36	3	519 000	692 000	308 000	378 000	136	20.5	10	16	8
39	3	618 000	825 000	367 000	450 000	150	22.5	11	18	9

NOTE – The clamp load for property classes 6 and 8 is equal to 75 % of the proof load for bolt classes 6.9 and 8.8 respectively, as specified in ISO/R 898, Part I.

Proof load values for nut classes 6 and 8 respectively are as specified in ISO/R 898, Part II.

Nuts too large for proof load testing shall meet the maximum hardness condition and a minimum hardness to be agreed between the purchaser and the supplier.

TABLE 6 – **Clamp load and prevailing torque – ISO metric series – Fine thread – Property classes 10 and 12**

Nominal thread diameter	Pitch of the thread	Proof load N Property class		Clamp load N Property class		Prevailing torque				
						First installation	First removal		Fifth removal	
							Highest reading	Lowest reading	Highest reading	Lowest reading
mm	mm	10	12	10	12	N.m max.	N.m min.	N.m min.	N.m min.	N.m min.
8	1	39 000	47 000	23 200	27 900	8	1.15	0.6	0.8	0.4
10	1.25	61 000	73 000	36 400	43 500	14	2	1	1.4	0.7
12	1.25	92 000	110 000	54 700	65 000	21	3.1	1.5	2.1	1
14	1.5	125 000	150 000	74 200	89 000	31	4.4	2	3	1.5
16	1.5	167 000	200 000	99 000	119 000	42	6	3	4.2	2
18	1.5	216 000	258 000	128 000	154 000	56	8	4	5.5	2.5
20	1.5	272 000	326 000	161 000	194 000	72	10.5	5	7	3.5
22	1.5	333 000	400 000	198 000	237 000	90	13	6.5	9	4.5
24	2	384 000	460 000	228 000	275 000	106	15	7.5	10.5	5
27	2	496 000	595 000	295 000	353 000	123	17	8.5	12	6
30	2	621 000	745 000	369 000	372 000	140	19	9.5	14	7
33	2	761 000	914 000	453 000	542 000	160	21.5	10.5	15.5	7.5
36	3	865 000	1 040 000	513 000	617 000	180	24	12	17.5	8.5
39	3	1 030 000	1 240 000	612 000	785 000	200	26.5	13	19.5	9.5

NOTE – The clamp load for property classes 10 and 12 is equal to 75 % of the proof load for bolt classes 10.9 and 12.9 respectively, as specified in ISO/R 898, Part I.

Proof load values for nut classes 10 and 12 respectively are as specified in ISO/R 898, Part II.

Nuts too large for proof load testing shall meet the maximum hardness condition and a minimum hardness to be agreed between the purchaser and the supplier.

TABLE 7 – **Clamp load and prevailing torque – ISO inch series – Coarse thread – Property classes 6 and 8**

Nut size and threads per inch	Proof load lbf Property class		Clamp load lbf Property class		Prevailing torque				
					First installation	First removal		Fifth removal	
	6	8	6	8	max.	Highest reading min. lbf.in	Lowest reading min. lbf.in	Highest reading min. lbf.in	Lowest reading min. lbf.in
					lbf.in				
No. 4 – 40	540	720	250	380	3	1	0.5	0.5	0.2
No. 6 – 32	820	1 100	370	580	6	1.5	0.5	1	0.5
No 8 – 32	1 250	1 700	580	900	9	2	1	1.5	0.5
No. 10 – 24	1 550	2 100	720	1 100	13	2.5	1	2	1
No. 12 – 24	2 200	2 900	1 000	1 550	20	3.5	1.5	2.5	1
1/4 – 20	2 900	3 800	1 300	2 000	30	5	2.5	3.5	1.5
5/16 – 18	4 700	6 300	2 150	3 350	60	8	4	5.5	2.5
3/8 – 16	7 000	9 300	3 200	4 950	80	12	5	8.5	4
7/16 – 14	9 550	12 800	4 400	6 800	100	17	7.5	12	5
1/2 – 13	12 800	17 000	5 850	9 050	150	22	10	15	7.5
					lbf.ft				
9/16 – 12	16 400	21 800	7 550	11 600	17	30	15	21	10
5/8 – 11	20 400	27 200	9 300	14 500	25	39	17.5	27	12.5
3/4 – 10	30 100	40 100	13 800	21 300	35	58	25	41	20
7/8 – 9	41 600	55 500	11 400	29 500	50	88	40	62	30
1 – 8	54 500	72 800	15 000	38 700	70	120	60	84	40
1 1/8 – 7	68 700	91 700	18 900	48 600	75	150	70	105	50
1 1/4 – 7	87 100	116 000	24 000	61 800	85	188	90	132	60
1 3/8 – 6	104 000	139 000	28 700	73 600	100	220	110	154	70
1 1/2 – 6	126 000	169 000	34 800	89 600	110	260	130	182	90

NOTE – Clamp loads for class 6 locknuts, in sizes up to and including 3/4 inch are equal to 75 % of the proof loads specified for class 5.8 bolts, and in sizes over 3/4 inch, are equal to 75 % of the proof loads specified for class 4.6 bolts. Clamp loads for class 8 locknuts are equal to 75 % of the proof loads specified for class 8.8 bolts.

Proof load values for nut classes 6 and 8 respectively are as specified in ISO/R 898, Part II.

Nuts too large for proof load testing shall meet the maximum hardness condition and a minimum hardness to be agreed between purchaser and supplier.

TABLE 8 – **Clamp load and prevailing torque – ISO inch series – Coarse thread – Property classes 10 and 12**

Nut size and threads per inch	Proof load lbf Property class		Clamp load lbf Property class		Prevailing torque				
					First installation	First removal		Fifth removal	
						Highest *reading* min.	Lowest *reading* min.	Highest *reading* min.	Lowest *reading* min.
	10	12	10	12	max.	lbf.in	lbf.in	lbf.in	lbf.in
					lbf.in				
No. 4 – 40	910	1 100	550	630	4	1	0.5	0.5	0.2
No 6 – 32	1 350	1 650	810	950	8	2	1	1	0.5
No. 8 – 32	2 100	2 500	1 250	1 450	12	2.5	1	2	1
Nos 10 – 24	2 600	3 150	1 550	1 800	17	3.5	1.5	2.5	1
No. 12 – 24	3 650	4 350	2 200	2 550	27	4.5	2	3	1.5
1/4 – 20	4 750	5 700	2 850	3 300	40	6	3	4.5	2
5/16 – 18	7 850	9 450	4 700	5 500	80	10,5	5	7.5	3
3/8 – 16	11 600	14 000	6 950	8 100	110	16	7.5	11.5	5
7/16 – 14	16 000	19 000	9 600	11 300	135	23	10	16	7.5
					lbf.ft				
1/2 – 13	21 300	25 600	12 800	14 900	17	30	15	20	10
9/16 – 12	27 300	32 800	16 400	19 100	25	40	20	28	12.5
5/8 – 11	33 900	40 700	20 300	23 700	35	52	25	36	15
3/4 – 10	50 100	60 200	30 100	35 000	45	78	35	54	25
7/8 – 9	69 300	83 200	41 600	48 500	70	117	50	82	40
1 – 8	91 000	109 000	54 600	63 500	90	160	80	112	50
1 1/8 – 7	115 000	137 000	69 000	80 000	100	200	100	140	70
1 1/4 – 7	145 000	174 000	87 000	102 000	110	250	120	176	80
1 3/8 – 6	173 000	208 000	104 000	121 000	135	293	140	205	100
1 1/2 – 6	211 000	253 000	127 000	177 000	150	346	170	242	120

NOTE – Clamp loads for classes 10 and 12 locknuts are equal to 75 % of the proof loads specified for bolts classes 10.9 and 12.9.

Proof load values for nut classes 10 and 12 respectively are as specified in ISO/R 898, Part II.

Nuts too large for proof load testing shall meet the maximum hardness condition and a minimum hardness to be agreed between the purchaser and the suplier.