INTERNATIONAL STANDARD

ISO 898-2

Third edition
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Mechanical properties of fasteners made of carbon steel and alloy steel —

Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread

Caractéristiques mécaniques des éléments de fixation en acier au carbone et en acier allié —

Partie 2: Écrous de classes de qualité spécifiées — Filetages à pas gros et filetages à pas fin

Reference number
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Contents

Page

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 898-2 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 12, *Fasteners with metric internal thread*.

This third edition cancels and replaces the second edition (ISO 898-2:1992) and ISO 898-6:1994, which have been technically revised.

ISO 898 consists of the following parts, under the general title *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*

— *Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread*

— *Part 5: Set screws and similar threaded fasteners with specified hardness classes — Coarse thread and fine pitch thread*

— *Part 7: Torsional test and minimum torques for bolts and screws with nominal diameters 1 mm to 10 mm*[1)]

1) It is intended that, upon revision, the main element of the title of Part 7 will be aligned with the main element of the title of Part 1.

Mechanical properties of fasteners made of carbon steel and alloy steel —

Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread

1 Scope

This part of ISO 898 specifies mechanical and physical properties of nuts with coarse thread and fine pitch thread made of carbon steel and alloy steel when tested at an ambient temperature range of 10 °C to 35 °C.

Nuts conforming to the requirements of this part of ISO 898 are evaluated at that ambient temperature range. It is possible that they do not retain the specified mechanical and physical properties at elevated and/or lower temperatures.

NOTE 1 Nuts conforming to the requirements of this part of ISO 898 have been used in applications ranging from –50 °C to +150 °C. It is the responsibility of users to consult an experienced fastener materials expert for temperatures outside the range of –50 °C to +150 °C and up to a maximum temperature of +300°C to determine appropriate choices for a given application.

NOTE 2 Information for the selection and application of steels for use at lower and elevated temperatures is given for instance in EN 10269, ASTM F2281 and in ASTM A320/A320M.

This part of ISO 898 is applicable to nuts:

a) made of carbon steel or alloy steel;

b) with coarse thread M5 ≤ D ≤ M39, and fine pitch thread M8×1 ≤ D ≤ M39×3;

c) with triangular ISO metric thread according to ISO 68-1;

d) with diameter/pitch combinations according to ISO 261 and ISO 262;

e) with specified property classes, including proof load;

f) with different nut styles: thin nuts, regular nuts and high nuts;

g) with minimum height $m \geq 0{,}45D$;

h) with a minimum outside diameter or width across flats $s \geq 1{,}45D$ (see Annex A);

i) able to mate with bolts, screws and studs with property classes according to ISO 898-1.

For hot dip galvanized nuts, see ISO 10684.

This part of ISO 898 does not specify requirements for properties such as:

— prevailing torque properties (see ISO 2320);

— torque/clamp force properties (see ISO 16047 for test method);

— weldability;

— corrosion resistance.

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 6157-2, *Fasteners — Surface discontinuities — Part 2: Nuts*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 16426, *Fasteners — Quality assurance system*

3 Symbols

For the purposes of this document, the following symbols apply.

D nominal thread diameter of the nut, in millimetres

d_h hole diameter of the grip, in millimetres

F load, in newtons

h thickness of the grip, in millimetres

m height of the nut, in millimetres

P pitch of the thread, in millimetres

s width across flats, in millimetres

4 Designation systems

4.1 Designation of nut styles

This part of ISO 898 specifies requirements for three styles of nuts according to their height:

— style 2: high nut with minimum height $m_{min} \approx 0{,}9D$ or $m_{min} > 0{,}9D$; see Table A.1;

— style 1: regular nut with minimum height $m_{min} \geq 0{,}8D$; see Table A.1;

— style 0: thin nut with minimum height $0{,}45D \leq m_{min} < 0{,}8D$.

4.2 Designation of property classes

4.2.1 General

The marking and labelling of nuts with property classes shall be as specified in Clause 10 for only those nuts which meet all applicable requirements of this part of ISO 898.

4.2.2 Regular nuts (style 1) and high nuts (style 2)

The symbol for property classes of regular nuts (style 1) and high nuts (style 2) consists of one number. It corresponds to the number to the left of the appropriate maximum property class of bolts, screws and studs with which they can be mated.

4.2.3 Thin nuts (style 0)

The symbol for property classes of thin nuts (style 0) consists of two numbers, specified in the following ways:

a) the first number is zero, indicating that the loadability of the nut is reduced in comparison with the loadability of a regular nut or a high nut according to 4.2.2 and therefore thread stripping can occur when overloaded;

b) the second number corresponds to 1/100 of the nominal stress under proof load on a hardened test mandrel, in megapascals.

4.3 Ranges of nominal diameters in relation to nut style and property class

The ranges of nominal diameters in relation to nut style and property class are as given in Table 1.

Table 1 — Ranges of nominal diameters in relation to nut style and property class

Property class	**Range of nominal diameters**, D		
	Regular nut (style 1)	High nut (style 2)	Thin nut (style 0)
04	—	—	M5 ≤ D ≤ M39 M8×1 ≤ D ≤ M39×3
05	—	—	M5 ≤ D ≤ M39 M8×1 ≤ D ≤ M39×3
5	M5 ≤ D ≤ M39 M8×1 ≤ D ≤ M39×3	—	—
6	M5 ≤ D ≤ M39 M8×1 ≤ D ≤ M39×3	—	—
8	M5 ≤ D ≤ M39 M8×1 ≤ D ≤ M39×3	M5 < D ≤ M39 M8×1 ≤ D ≤ M39×3	—
9	—	M5 ≤ D ≤ M39	—
10	M5 ≤ D ≤ M39 M8×1 ≤ D ≤ M16×1,5	M5 ≤ D ≤ M39 M8×1 ≤ D ≤ M39×3	—
12	M5 ≤ D ≤ M16	M5 ≤ D ≤ M39 M8×1 ≤ D ≤ M16×1,5	—

5 Design of bolt and nut assemblies

Explanations of basic design principles of nuts and loadability of bolted assemblies are given in Annex A.

Regular nuts (style 1) and high nuts (style 2) shall be mated with externally threaded fasteners according to Table 2. However, nuts of a higher property class may replace nuts of a lower property class.

Table 2 — Combination of regular nuts (style 1) **and high nuts** (style 2) **with bolt property classes**

Nut property class	Maximum property class of mating bolt, screw and stud
5	5.8
6	6.8
8	8.8
9	9.8
10	10.9
12	12.9/12.9

A decrease of thread stripping strength occurs for nuts with a fundamental deviation greater than zero for tolerance class 6H (such as hot dip galvanized nuts: 6AZ, 6AX). Thin nuts (style 0) have a reduced loadability compared to regular nuts or high nuts, and are not designed to provide resistance to thread stripping.

Thin nuts used as jam nuts should be assembled together with a regular nut or a high nut. In assemblies with jam nut, the thin nut is first tightened against the assembled parts and then the regular or high nut is tightened against the thin nut.

6 Materials

Table 3 specifies materials and heat treatment for the different property classes of nuts.

Nuts with coarse thread and property classes 05, 8 [regular nuts (style 1) with $D >$ M16], 10 and 12 shall be quenched and tempered.

Nuts with fine pitch thread and property classes 05, 6 (with $D >$ M16), 8 [regular nuts (style 1)], 10 and 12 shall be quenched and tempered.

The chemical composition shall be assessed in accordance with the relevant International Standards.

Table 3 — Steels

Thread	Property class		Material and nut heat treatment	Chemical composition limit (cast analysis %)[a]			
				C max.	Mn min.	P max.	S max.
Coarse thread	04[c]		Carbon steel[d]	0,58	0,25	0,060	0,150
	05[c]		Carbon steel, QT[e]	0,58	0,30	0,048	0,058
	5[b]		Carbon steel[d]	0,58	—	0,060	0,150
	6[b]		Carbon steel[d]	0,58	—	0,060	0,150
	8	High nut (style 2)	Carbon steel[d]	0,58	0,25	0,060	0,150
	8	Regular nut (style 1) $D \leq$ M16	Carbon steel[d]	0,58	0,25	0,060	0,150
	8[c]	Regular nut (style 1) $D >$ M16	Carbon steel, QT[e]	0,58	0,30	0,048	0,058
	9		Carbon steel[d]	0,58	0,25	0,060	0,150
	10[c]		Carbon steel, QT[e]	0,58	0,30	0,048	0,058
	12[c]		Carbon steel, QT[e]	0,58	0,45	0,048	0,058
Fine pitch thread	04[b]		Carbon steel[d]	0,58	0,25	0,060	0,150
	05[c]		Carbon steel, QT[e]	0,58	0,30	0,048	0,058
	5[b]		Carbon steel[d]	0,58	—	0,060	0,150
	6[b]	$D \leq$ M16	Carbon steel[d]	0,58	—	0,060	0,150
	6[b]	$D >$ M16	Carbon steel, QT[e]	0,58	0,30	0,048	0,058
	8	High nut (style 2)	Carbon steel[d]	0,58	0,25	0,060	0,150
	8[c]	Regular nut (style 1)	Carbon steel, QT[e]	0,58	0,30	0,048	0,058
	10[c]		Carbon steel, QT[e]	0,58	0,30	0,048	0,058
	12[c]		Carbon steel, QT[e]	0,58	0,45	0,048	0,058

QT = Quenched and tempered nuts.

"—" No limit specified.

[a] In case of dispute, the product analysis applies.

[b] Nuts of these property classes may be manufactured from free-cutting steel upon agreement between the purchaser and the manufacturer; in such a case, sulfur, phosphorus and lead are permissible with the following maximum contents: S: 0,34 %; P: 0,11 %; Pb: 0,35%.

[c] Alloying elements may be added, provided the mechanical properties required in Clause 7 are fulfilled.

[d] This may be quenched and tempered at the manufacturer's discretion.

[e] For materials of these property classes, there shall be sufficient hardenability to ensure a structure consisting of approximately 90 % martensite in the "as-hardened" condition before tempering in the threaded area of the nut as specified in Figure 3.

NOTE It is intended that national regulations for the restriction or prohibition of certain chemical elements be taken into account in the countries or regions concerned.

7 Mechanical properties

When tested by the methods specified in Clause 9, the nuts of the specified property class shall meet, at ambient temperature, the requirements for the proof load (see Tables 4 and 5) and for the hardness (see Tables 6 and 7), regardless of which tests are performed during manufacturing or final inspection.

For nuts which are not quenched and tempered, 9.2.4.2 additionally applies.

Table 4 — Proof load values for nuts with coarse thread

Thread *D*	Pitch *P*	Proof load [a], N Property class							
		04	05	5	6	8	9	10	12
M5	0,8	5 400	7 100	8 250	9 500	12 140	13 000	14 800	16 300
M6	1	7 640	10 000	11 700	13 500	17 200	18 400	20 900	23 100
M7	1	11 000	14 500	16 800	19 400	24 700	26 400	30 100	33 200
M8	1,25	13 900	18 300	21 600	24 900	31 800	34 400	38 100	42 500
M10	1,5	22 000	29 000	34 200	39 400	50 500	54 500	60 300	67 300
M12	1,75	32 000	42 200	51 400	59 000	74 200	80 100	88 500	100 300
M14	2	43 700	57 500	70 200	80 500	101 200	109 300	120 800	136 900
M16	2	59 700	78 500	95 800	109 900	138 200	149 200	164 900	186 800
M18	2,5	73 000	96 000	121 000	138 200	176 600	176 600	203 500	230 400
M20	2,5	93 100	122 500	154 400	176 400	225 400	225 400	259 700	294 000
M22	2,5	115 100	151 500	190 900	218 200	278 800	278 800	321 200	363 600
M24	3	134 100	176 500	222 400	254 200	324 800	324 800	374 200	423 600
M27	3	174 400	229 500	289 200	330 500	422 300	422 300	486 500	550 800
M30	3,5	213 200	280 500	353 400	403 900	516 100	516 100	594 700	673 200
M33	3,5	263 700	347 000	437 200	499 700	638 500	638 500	735 600	832 800
M36	4	310 500	408 500	514 700	588 200	751 600	751 600	866 000	980 400
M39	4	370 900	488 000	614 900	702 700	897 900	897 900	1 035 000	1 171 000

[a] For the application of thin nuts, it should be considered that the stripping load is lower than the proof load of a nut with full loadability (see Annex A).

Table 5 — Proof load values for nuts with fine pitch thread

Thread $D \times P$	Proof load [a], N Property class						
	04	05	5	6	8	10	12
M8×1	14 900	19 600	27 000	30 200	37 400	43 100	47 000
M10×1,25	23 300	30 600	44 200	47 100	58 400	67 300	73 400
M10×1	24 500	32 200	44 500	49 700	61 600	71 000	77 400
M12×1,5	33 500	44 000	60 800	68 700	84 100	97 800	105 700
M12×1,25	35 000	46 000	63 500	71 800	88 000	102 200	110 500
M14×1,5	47 500	62 500	86 300	97 500	119 400	138 800	150 000
M16×1,5	63 500	83 500	115 200	130 300	159 500	185 400	200 400
M18×2	77 500	102 000	146 900	177 500	210 100	220 300	—
M18×1,5	81 700	107 500	154 800	187 000	221 500	232 200	—
M20×2	98 000	129 000	185 800	224 500	265 700	278 600	—
M20×1,5	103 400	136 000	195 800	236 600	280 200	293 800	—
M22×2	120 800	159 000	229 000	276 700	327 500	343 400	—
M22×1,5	126 500	166 500	239 800	289 700	343 000	359 600	—
M24×2	145 900	192 000	276 500	334 100	395 500	414 700	—
M27×2	188 500	248 000	351 100	431 500	510 900	535 700	—
M30×2	236 000	310 500	447 100	540 300	639 600	670 700	—
M33×2	289 200	380 500	547 900	662 100	783 800	821 900	—
M36×3	328 700	432 500	622 800	804 400	942 800	934 200	—
M39×3	391 400	515 000	741 600	957 900	1 123 000	1 112 000	—

[a] For the application of thin nuts, it should be considered that the stripping load is lower than the proof load of a nut with full loadability, see Annex A.

Table 6 — Hardness properties for nuts with coarse thread

Thread D	Property class															
	04		05		5		6		8		9		10		12	
	Vickers hardness, HV															
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
M5 ≤ D ≤ M16	188	302	272	353	130	302	150	302	200	302	188	302	272	353	295[c]	353
M16 < D ≤ M39					146		170		233[a]	353[b]					272	
	Brinell hardness, HB															
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
M5 ≤ D ≤ M16	179	287	259	336	124	287	143	287	190	287	179	287	259	336	280[c]	336
M16 < D ≤ M39					139		162		221[a]	336[b]					259	
	Rockwell hardness, HRC															
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
M5 ≤ D ≤ M16	—	30	26	36	—	30	—	30	—	30	—	30	26	36	29[c]	36
M16 < D ≤ M39									—	36[b]					26	

Surface integrity shall be in accordance with ISO 6157-2.

Vickers hardness test is the reference method for acceptance (see 9.2.4).

[a] Minimum value for high nuts (style 2): 180 HV (171 HB).

[b] Maximum value for high nuts (style 2): 302 HV (287 HB; 30 HRC).

[c] Minimum value for high nuts (style 2): 272 HV (259 HB; 26 HRC).