ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 898/II

MECHANICAL PROPERTIES OF FASTENERS

NUTS WITH SPECIFIED PROOF LOAD VALUES

1st EDITION

March 1969

For each individual country the only valid standard is the national standard of that country.

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BRIEF HISTORY

The ISO Recommendation R 898/II, *Mechanical properties of fasteners – Nuts with specified proof load values,* was drawn up by Technical Committee ISO/TC 2, *Bolts, nuts and accessories,* the Secretariat of which is held by the Deutscher Normenausschuss (DNA).

Work on this question led, in 1966, to the adoption of a Draft ISO Recommendation.

In September 1967, this Draft ISO Recommendation (No. 1297) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Austria	Iran	South Africa, Rep. of
Belgium	Israel	Spain
Canada	Italy	Sweden
Chile	Japan	Switzerland
Czechoslovakia	Korea, Rep. of	Turkey
Denmark	Netherlands	U.A.R.
Finland	New Zealand	United Kingdom
Germany	Norway	U.S.A.
Greece	Poland	U.S.S.R.
Hungary	Portugal	Yugoslavia
India	Romania	

One Member Body opposed the approval of the Draft :

France

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in March 1969, to accept it as an ISO RECOMMENDATION.

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MECHANICAL PROPERTIES OF FASTENERS

NUTS WITH SPECIFIED PROOF LOAD VALUES

1. SCOPE

This ISO Recommendation specifies the mechanical properties of nuts.*

It applies to nuts

— with nominal thread diameters up to and including 39 mm ($1\frac{1}{2}$ in),

— of any triangular ISO-thread and with diameters and pitches according to ISO Recommendations R 68, R 262 and R 263,

with specific mechanical requirements,

— of any shape provided that the width across flats or outside diameter of the nut is not less than 1.45 d,

— with effective heights of thread greater than or equal to 0.6 d,

— made of carbon steel or alloy steel.

It does not apply to nuts requiring special properties such as

— weldability,

— corrosion resistance,

— ability to withstand temperatures above + 300 °C or below – 50 °C.

NOTE. – Nuts made from free-cutting steel should not be used above + 250 °C.

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* See also ISO Recommendation R 898/I, *Mechanical properties of fasteners – Bolts, screws and studs*, and ISO Recommendation R 898/III, *Mechanical properties of fasteners – Marking of bolts, screws, studs and nuts*.

2. DESIGNATION SYSTEM

The property classes of nuts are designated by the numbers 4, 5, 6, 8, 10, 12 and 14 as shown in Table 1.

For metric series nuts, the designation number is equal to one-tenth of the specified proof load stress in kilogrammes-force per square millimetre. This proof load stress corresponds to the minimum tensile strength of a bolt or screw with which the nut 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 nuts, the designation number is significant only to the extent that increasing designation numbers indicate increasing proof load stress values.

TABLE 1 – Designation of property classes in relation to
proof load stress

Property class		4	5	6	8	10	12	14
Proof load stress S_p	kgf/mm²	40	50	60	80	100	120	140
	1000 lbf/in²	60	75	90	120	150	180	200

NOTE. – The figures shown for 1000 lbf/in² are rounded values and not exact conversions; they should be applied to nuts with inch series threads only.

3. RAW MATERIALS

Nuts should be made of steel conforming to the chemical composition limits specified in Table 2.

TABLE 2 – Limits of chemical composition

Property class	Chemical composition limits (check analysis)			
	Carbon max. %	Manganese min. %	Phosphorus max. %	Sulphur max. %
4 *, 5 * and 6 *	0.50	...	0.110	0.150
8	0.58	0.30	0.060	0.150
10 **	0.58	0.30	0.048	0.058
12 ** and 14 **	0.58	0.45	0.048	0.058

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* Free-cutting steel may be used only by special agreement between customer and supplier. In such cases the following maximum sulphur, phosphorus and lead contents respectively are permissible :

sulphur	0.34 %
phosphorus	0.12 %
lead	0.35 %

** Alloying elements may be added if necessary to develop the mechanical properties of the nuts.

4. MECHANICAL REQUIREMENTS

TABLE 3 — Mechanical requirements

Mechanical requirements		Property class							Application
		4	5	6	8	10	12	14	
Proof load stress S_p	kgf/mm²	40	50	60	80	100	120	140	All nuts, other than those excepted by agreement between customer and supplier*
	1000 lbf/in²	60	75	90	120	150	180	200	
Brinell Hardness HB max.		302	302	302	302	353	353	375	All nuts
Rockwell Hardness HRC max.		30	30	30	30	36	36	39	All nuts

* Metric series nuts with specified proof load in excess of 35 000 kgf or inch series nuts with specified proof loads in excess of 110 000 lbf may be exempted from proof load testing. Such nuts should meet minimum hardness requirements as determined between customer and supplier.

TABLE 4 – Proof load values – coarse thread, ISO metric series

Nominal thread diameter mm	Pitch of the thread mm	Nominal stress area of test mandrel A_s mm²	Property class of nut						
			4	5	6	8	10	12	14
			Proof load $(A_s \times S_p)$* kgf						
1.6	0.35	1.27	51	63.5	76.0	100	125	150	175
2	0.4	2.07	83	103	120	165	205	250	290
2.5	0.45	3.39	135	170	200	270	340	400	470
3	0.5	5.03	200	250	300	400	500	600	700
3.5	0.6	6.78	270	340	405	540	680	815	950
4	0.7	8.78	350	440	525	700	875	1 050	1 230
5	0.8	14.2	570	710	850	1 140	1 420	1 700	1 990
6	1	20.1	800	1 000	1 200	1 600	2 000	2 400	2 800
7	1	28.9	1 150	1 450	1 730	2 300	2 900	3 470	4 000
8	1.25	36.6	1 450	1 830	2 200	2 900	3 650	4 300	5 100
10	1.5	58.0	2 300	2 900	3 500	4 600	5 800	6 950	8 100
12	1.75	84.3	3 350	4 210	5 050	6 700	8 400	10 000	11 800
14	2	115	4 600	5 750	6 900	9 200	11 500	13 800	16 100
16	2	157	6 300	7 850	9 400	12 600	15 700	18 800	22 000
18	2.5	192	7 700	9 600	11 500	15 400	19 200	23 000	26 900
20	2.5	245	9 800	12 200	14 700	19 600	24 500	29 400	34 300
22	2.5	303	12 100	15 100	18 200	24 200	30 300	36 400	42 500
24	3	353	14 100	17 600	21 200	28 200	35 300	42 300	49 400
27	3	459	18 400	23 000	27 600	36 700	45 900	55 000	64 300
30	3.5	561	22 400	28 000	33 600	44 800	56 100	67 300	78 500
33	3.5	694	27 800	34 700	41 600	55 500	69 400	83 300	97 000
36	4	817	32 700	40 800	49 000	65 300	81 700	98 000	114 400
39	4	976	39 000	48 800	58 500	78 000	97 600	117 000	136 700

* The proof load is calculated by multiplying the proof load stress by the nominal stress area of corresponding male thread. The nominal stress area A_s is calculated as follows :

$$A_s = \frac{\pi}{4}\left(\frac{d_2 + d_3}{2}\right)^2$$

where

d_2 is the basic pitch diameter, and

d_3 is the minor diameter : $d_3 = d_1 - \frac{H}{6}$

where

d_1 is the basic minor diameter, and

H is the height of fundamental triangle for the thread.

TABLE 5 — Proof load values — fine thread, ISO metric series

Nominal thread diameter mm	Pitch of the thread mm	Nominal stress area of test mandrel A_s mm²	Property class of nut						
			4	5	6	8	10	12	14
			Proof load $(A_s \times S_p)$* kgf						
8	1	39.2	1 570	1 960	2 350	3 100	3 900	4 700	5 500
10	1.25	61.2	2 400	3 060	3 700	4 900	6 100	7 350	8 550
12	1.25	92.1	3 700	4 600	5 500	7 400	9 200	11 000	12 900
14	1.5	125	5 000	6 250	7 500	10 000	12 500	15 000	17 500
16	1.5	167	6 700	8 350	10 000	13 400	16 700	20 000	23 400
18	1.5	216	8 600	10 800	12 900	17 200	21 600	25 800	30 200
20	1.5	272	10 900	13 600	16 300	21 800	27 200	32 600	38 000
22	1.5	333	13 300	16 600	20 000	26 600	33 300	40 000	46 600
24	2	384	15 400	19 200	23 000	30 700	38 400	46 000	53 800
27	2	496	19 900	24 800	29 800	39 700	49 600	59 500	69 500
30	2	621	24 800	31 000	37 300	49 700	62 100	74 500	87 000
33	2	761	30 400	38 000	45 600	60 800	76 100	91 400	106 500
36	3	865	34 600	43 200	51 900	69 200	86 500	104 000	121 000
39	3	1030	41 500	51 900	61 800	82 500	103 000	124 000	144 000

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* The proof load is calculated by multiplying the proof load stress by the nominal stress area of corresponding male thread. The nominal stress area A_s is calculated as follows :

$$A_s = \frac{\pi}{4}\left(\frac{d_2 + d_3}{2}\right)^2$$

where

d_2 is the basic pitch diameter, and

d_3 is the minor diameter : $d_3 = d_1 - \frac{H}{6}$

where

d_1 is the basic minor diameter, and

H is the height of fundamental triangle for the thread.