International Standard 8839

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Mechanical properties of fasteners — Bolts, screws, studs and nuts made of non-ferrous metals

Caractéristiques mécaniques des éléments de fixation — Boulons, vis, goujons et écrous en métaux non ferreux

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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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8839 was prepared by Technical Committee ISO/TC 2, *Fasteners*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Mechanical properties of fasteners — Bolts, screws, studs and nuts made of non-ferrous metals

1 Scope and field of application

This International Standard specifies the mechanical properties of bolts, screws, studs and nuts

— with nominal thread diameters, d, from M1,6 to M39 inclusive;

— with metric ISO thread in accordance with ISO 261;

— made of copper and copper alloys or aluminium and aluminium alloys.

It does not apply to bolts, screws, studs and nuts with special property requirements such as

— corrosion resistance;

— electrical conductivity.

2 References

ISO 1, *Standard reference temperature for industrial length measurements.*

ISO 209, *Wrought aluminium and aluminium alloys — Chemical composition of wrought products (per cent).* [1)]

ISO 261, *ISO general purpose metric screw threads — General plan.*

ISO 426/1, *Wrought copper-zinc alloys — Chemical composition and forms of wrought products — Part 1: Non-leaded and special copper-zinc alloys.*

ISO 426/2, *Wrought copper-zinc alloys — Chemical composition and forms of wrought products — Part 2: Leaded copper-zinc alloys.*

ISO 427, *Wrought copper-tin alloys — Chemical composition and forms of wrought products.*

ISO 428, *Wrought copper-aluminium alloys — Chemical composition and forms of wrought products.*

ISO 898/1, *Mechanical properties of fasteners — Part 1: Bolts, screws and studs.* [2)]

ISO 898/2, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values.*

ISO 898/7, *Mechanical properties of fasteners — Part 7: Torque test for bolts and screws with thread sizes from* M1 *to* M10. [3)]

ISO 1187, *Special wrought copper alloys — Chemical composition and forms of wrought products.*

ISO 1337, *Wrought copper (having minimum copper contents of* 99,85 %) *— Chemical composition and forms of wrought products.*

3 Designation system and materials

Table 1 lists the symbols for the material to be used in the designation and for marking purposes (see clause 7); reference is made to the relevant International Standard.

Table 1 — Symbols for materials

Symbol	Designation of material	Relevant International Standard
CU1	Cu-ETP or Cu-FRHC	ISO 1337
CU2	CuZn37	ISO 426/1
CU3	CuZn39Pb3	ISO 426/2
CU4	CuSn6	ISO 427
CU5	CuNi1Si	ISO 1187
CU6	CuZn40Mn1Pb	—
CU7	CuAl10Ni5Fe4	ISO 428
AL1	AlMg3	ISO 209
AL2	AlMg5	ISO 209
AL3	AlSi1MgMn	ISO 209
AL4	AlCu4MgSi	ISO 209
AL5	AlZnMgCu 0,5	—
AL6	AlZn5,5MgCu	ISO 209

Bolts, screws, studs and nuts made of non-ferrous metals shall be designated in accordance with following example:

Designation of a hexagon head bolt ISO 4014 - M12 × 80 made of CuZn37 (see table 1 for appropriate material symbol):

Hexagon head bolt ISO 4014 - M12 × 80 - CU2

1) At present at the stage of draft. (Revision of ISO/R 209-1971.)

2) At present at the stage of draft. (Revision of ISO 898/1-1978.)

3) At present at the stage of draft.

4 Mechanical properties

When tested at the standard reference temperature of 20 °C (see ISO 1) using the methods described in clause 6, the bolts, screws, studs and nuts shall have the mechanical properties set out in table 2.

NOTE — In case of high forming operations (e.g. special parts), the mechanical properties should be agreed between the customer and the supplier.

5 Mechanical properties to be tested

Table 3 specifies which tests shall be carried out on bolts, screws, studs and nuts. Other tests shall be subject to agreement between the customer and the supplier.

Table 2 — Mechanical properties

Material		Nominal thread diameter d	Tensile strength R_m min.	Stress at permanent set limit $R_{p0,2}$ min.	Percentage elongation after fracture A min.
Symbol	Designation		N/mm²	N/mm²	%
CU1	Cu-ETPor Cu-FRHC	$d \leqslant$ M39	240	160	14
CU2	CuZn37	$d \leqslant$ M6	440	340	11
		M6 $< d \leqslant$ M39	370	250	19
CU3	CuZn39Pb3	$d \leqslant$ M6	440	340	11
		M6 $< d \leqslant$ M39	370	250	19
CU4	CuSn6	$d \leqslant$ M12	470	340	22
		M12 $< d \leqslant$ M39	400	200	33
CU5	CuNi1Si	$d \leqslant$ M39	590	540	12
CU6	CuZn40Mn1Pb	M6 $< d \leqslant$ M39	440	180	18
CU7	CuAl10Ni5Fe4	M12 $< d \leqslant$ M39	640	270	15
AL1	AlMg3	$d \leqslant$ M10	270	230	3
		M10 $< d \leqslant$ M20	250	180	4
AL2	AlMg5	$d \leqslant$ M14	310	205	6
		M14 $< d \leqslant$ M36	280	200	6
AL3	AlSi1MgMn	$d \leqslant$ M6	320	250	7
		M6 $< d \leqslant$ M39	310	260	10
AL4	AlCu4MgSi	$d \leqslant$ M10	420	290	6
		M10 $< d \leqslant$ M39	380	260	10
AL5	AlZnMgCu 0,5	$d \leqslant$ M39	460	380	7
AL6	AlZn5,5MgCu	$d \leqslant$ M39	510	440	7

Table 3 — Mechanical properties to be tested

Nominal thread diameter d	Test(s) to be carried out on	
	bolts, screws and studs	nuts
$d \leqslant$ M5	Tensile test Breaking torque test	Proof load test
$d >$ M5	Tensile test (also, if required, stress at permanent set limit and percentage elongation after fracture)	

6 Test methods

6.1 Tensile test applicable to bolts, screws and studs

In general for tensile testing, a full size bolt, screw or stud shall be used and the test shall be carried out as specified in ISO 898/1. For minimum breaking loads, see table 4.

For testing the stress at permanent set limit, $R_{p0,2}$, and the percentage elongation after fracture, machined test pieces shall be used and the test shall be carried out as specified in ISO 898/1.

Table 4 — Minimum breaking loads

Nominal thread diameter d	Pitch of the thread P	Nominal stress area A_s	Symbols for materials												
			CU1	CU2	CU3	CU4	CU5	CU6	CU7	AL1	AL2	AL3	AL4	AL5	AL6
			Minimum breaking loads[1] $A_s \times R_m$												
	mm	mm^2	N												
M3	0,5	5,03	1 210	2 210	2 210	2 360	2 970	—	—	1 360	1 560	1 610	2 110	2 310	2 570
M3,5	0,6	6,78	1 630	2 980	2 980	3 190	4 000	—	—	1 830	2 100	2 170	2 850	3 120	3 460
M4	0,7	8,78	2 110	3 860	3 860	4 130	5 180	—	—	2 370	2 720	2 810	3 690	4 040	4 480
M5	0,8	14,2	3 410	6 250	6 250	6 670	8 380	—	—	3 830	4 400	4 540	5 960	6 530	7 240
M6	1	20,1	4 820	8 840	8 840	9 450	11 860	—	—	5 430	6 230	6 430	8 440	9 250	10 250
M7	1	28,9	6 940	10 690	10 690	13 580	17 050	12 720	—	7 800	8 960	8 960	12 140	13 290	14 740
M8	1,25	36,6	8 780	13 540	13 540	17 200	21 590	16 100	—	9 880	11 350	11 350	15 370	16 840	18 670
M10	1,5	58,0	13 920	21 460	21 460	27 260	34 220	25 520	—	15 660	17 980	17 980	24 360	26 680	29 580
M12	1,75	84,3	20 230	31 190	31 190	39 620	49 740	37 090	—	21 080	26 130	26 130	32 030	38 780	42 990
M14	2	115	27 600	42 550	42 550	46 000	67 850	50 600	73 600	28 750	35 650	35 650	43 700	52 900	58 650
M16	2	157	37 680	58 090	58 090	62 800	92 630	69 080	100 500	39 250	43 960	48 670	59 660	72 220	80 070
M18	2,5	192	46 080	71 040	71 040	76 800	113 300	84 480	122 900	48 000	53 760	59 520	72 960	88 320	97 920
M20	2,5	245	58 800	90 650	90 650	98 000	144 500	107 800	156 800	61 250	68 600	75 950	93 100	112 700	124 900
M22	2,5	303	72 720	112 100	112 100	121 200	178 800	133 300	193 900	—	84 840	93 930	115 100	139 400	154 500
M24	3	353	84 720	130 600	130 600	141 200	208 300	155 300	225 900	—	98 840	109 400	134 100	162 400	180 000
M27	3	459	110 200	169 800	169 800	183 600	270 800	202 000	293 800	—	128 500	142 300	174 400	211 100	234 100
M30	3,5	561	134 600	207 600	207 600	224 400	331 000	246 800	359 000	—	157 100	173 900	213 200	258 100	286 100
M33	3,5	694	166 600	256 800	256 800	277 600	—	305 400	444 200	—	194 300	215 100	263 700	319 200	353 900
M36	4	817	196 100	302 300	302 300	326 800	—	359 500	522 900	—	228 800	253 300	310 500	375 800	416 700
M39	4	976	234 200	361 100	361 100	390 400	—	429 400	624 600	—	—	302 600	370 900	449 000	497 800

1) For nuts, proof load.

6.2 Torsional strength test

In general for torsional strength testing, a full size bolt or screw shall be used and the test shall be carried out as described in ISO 898/7. The accuracy of the measuring device shall lie within ± 7 % of the minimum breaking torque to be tested. The bolt or screw shall meet the minimum breaking torque laid down in table 5.

6.3 Proof load test applicable to nuts

For proof load testing of nuts the method described in ISO 898/2 shall be used. The nuts shall meet the proof loads which are equal to the minimum breaking loads of the respective bolts, screws or studs laid down in table 4.

7 Marking

7.1 Symbols

Marking symbols are given in table 1.

7.2 Identification

Identification marking is required for bolts, screws, studs and nuts as laid down in ISO 898/1 and ISO 898/2.

Table 5 — Minimum breaking torque

Nominal thread diameter d	Symbols for materials										
	CU1	CU2	CU3	CU4	CU5	AL1	AL2	AL3	AL4	AL5	AL6
	Minimum breaking torque										
	N · m										
M1,6	0,06	0,10	0,10	0,11	0,14	0,06	0,07	0,08	0,1	0,11	0,12
M2	0,12	0,21	0,21	0,23	0,28	0,13	0,15	0,16	0,2	0,22	0,25
M2,5	0,24	0,45	0,45	0,5	0,6	0,27	0,3	0,3	0,43	0,47	0,5
M3	0,4	0,8	0,8	0,9	1,1	0,5	0,6	0,6	0,8	0,8	0,9
M3,5	0,7	1,3	1,3	1,4	1,7	0,8	0,9	0,9	1,2	1,3	1,5
M4	1	1,9	1,9	2	2,5	1,1	1,3	1,4	1,8	1,9	2,2
M5	2,1	3,8	3,8	4,1	5,1	2,4	2,7	2,8	3,7	4	4,5