C/ Bizkargi, 6 – POL. SARRIKOLA
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Technical data sheet

Title	Mechanical properties of fasteners made from carbon steels and alloy steels. Part 1 Bolts, screws and studs.
Standard	UNE-EN ISO 898-1

1.- Purpose and field of application.

This part of the standard specifies the mechanical properties of the bolts, screws and studs made from carbon steel and alloy steel when they are tested at an ambient temperature interval of 10ºC to 35ºC.

This part of the standard is applicable to bolts, screws and studs:

- With coarse pitch thread M-1.6 to M39 and with fine pitch thread M8X1 to M39X3
- With ISO triangular thread, in accordance with the ISO 68-1 standard
- With diameter/pitch combinations in accordance with the ISO 261 and ISO 262 standards
- With thread tolerances in accordance with the ISO 965-1, ISO 965-2 and ISO 965-4 standards
- Made from carbon steel and alloy steel

It is not applicable to grub screws and similar threaded fasteners not subjected to tensile forces (see the ISO 898-5 standard)

It does not specify requirements for characteristics such as:

- Weldability
- Resistance to corrosion
- Capacity to withstand temperatures above +300ºC (+250ºC for 10.9) or below -50ºC
- Shear strength
- Fatigue strength

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2- Chemical composition.

The designation system for the classes of bolts, screws and studs is shown in table 1.

Quality class	Materials and treatments	Chemical composition limits (control analysis) % (m/m)					Tempering temperature
		C		P	S	B	[a]C
		Min	Max	Max	Max	Max	Min
4.6	Carbon steel and carbon steel with additives	--	0.55	0.05	0.06	Unspecified	--
4.8							
5.6		0.13					
5.8		--					
6.8		0.15					
8.8	Hardened and tempered carbon steel with additives (for example, B, Mn or Cr)	0.15	0.40	0.025	0.025	0.003	425
	Hardened and tempered carbon steel	0.25	0.55				
	Hardened and tempered alloy steel	0.20					
9.8	Hardened and tempered carbon steel with additives (for example, B, Mn or Cr)	0.15	0.40	0.025	0.025	0.003	425
	Hardened and tempered carbon steel	0.25	0.55				
	Hardened and tempered alloy steel	0.20					
10.9	Hardened and tempered carbon steel	0.25	0.55	0.025	0.025	0.003	425
	Hardened and tempered carbon steel with additives (for example, B, Mn or Cr)	0.20					
	Hardened and tempered alloy steel						
12.9	Hardened and tempered alloy steel	0.30	0.50	0.025	0.025	0.003	425
12.9	Hardened and tempered carbon steel with additives (for example, B, Mn, Cr or Mo)	0.28					380

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3- Mechanical and physical properties of the bolts, screws and studs.

When tested using the methods described in chapter 8, at ambient temperature, the bolts, screws and studs must have the mechanical and physical properties indicated in the table.

No.	Mechanical and physical properties		Quality class 4.6	4.8	5.6	5.8	6.8	8.8 d=< 16 mm	8.8 d>16 mm	9.8 D=<16 Mm	10.9	12.9
1	Tensile strength Rm, MPa	nom.	400		500		600	800		900	1000	1200
		min.	400	420	500	520	600	800	830	900	1040	1220
2	Lower yield strength, ReL, MPa	nom.	240	--	300	--	--	--	--	--	--	--
		min.	240	--	300	--	--	--	--	--	--	--
3	Conventional yield strength at 0.2% Rp0.2, MPa	nom.	--	--	--	--	--	640	640	720	900	1080
		min.	--	--	--	--	--	640	660	720	940	1100
4	Conventional yield strength at 0.0048d for entire fasteners, Rpf, MPa	nom.	--	320	--	400	480	--	--	--	--	--
		min.	--	340	--	420	480	--	--	--	--	--
5	Tension under test load, Sp, MPa	nom.	225	310	280	380	440	580	600	650	830	970
	Ratio of the tension under test load Sp,nom/ReL,min or Sp,nom/Rp0.2min or Sp,nom/Rpf,min		0.94	0.91	0.93	0.90	0.92	0.91	0.91	0.90	0.88	0.88
6	Percent elongation after Breakage for machined test tubes, A%	min.	22	--	20	--	--	12	12	10	9	8
7	Percentage reduction of the section after breakage for machined test tubes, A%	min.	--					52		48	48	44
8	Elongation after breakage for entire fasteners, Af.	min.	--	0.24	--	0.22	0.20	--	--	--	--	--
9	Strength of the head		Without breakage									
10	Vickers Hardness, HV F>=98N	min	120	130	155	160	190	250	255	290	320	385
		max.	220				250	320	335	360	380	435
No.	Mechanical and physical properties		Quality class 4.6	4.8	5.6	5.8	6.8	8.8		9.8 D=<16 Mm	10.9	12.9
11	Brinell Hardness, HB F=30 D	min.	114	124	147	152	181	245	250	286	316	380
		max.	209				238	316	331	355	375	429
12	Rockwell Hardness, HRB	min.	67	71	79	82	89	--				

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		max.	95.0		99.5	--				
	Rockwell Hardness, HRC	min.	--			22	23	28	32	39
		max.	--			32	34	37	39	44
13	Surface hardness, HV 0.3	max.	--			--			390	435
14	No carburisation	max.	--			h			h	H
15	Height of the non-decarburised zone of the threaded area, E, mm	min.	--			1/2 H1			2/3H1	3/4H1
	Depth of the complete decarburisation of the thread, G, mm	max.	--			0,015				
16	Reduction of the hardness after the second tempering, HV		--			20				
17	Breaking torque, MB, Nm	min.	--			In accordance with the ISO 898-7 standard				
18	Impact resistance,Kv, J	min.	--	27	--	27	27	27	27	
19	Surface integrity in accordance with		ISO 6157-1							ISO 6157-3

h The surface hardness must not be over 30 Vickers points above the measured hardness of the base metal of the fastener when the two measurements are taken with HV 0.3 (see 9.11).

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4- Tensile rupture minimum loads. Coarse pitch ISO metric thread.

Thread[a] (d)	Nominal strength area $A_{s,nom}$[b] mm2	Quality Class								
		4.6	4.8	5.6	5.8	6.8	8.8	9.8	10.9	12.9
		Tensile rupture minimum load ($A_{s,nom}$x$R_{m,min}$), N								
M3	5.03	2 010	2 110	2 510	2 620	3 020	4 020	4 530	5 230	6 140
M3.5	6.78	2 710	2 850	3 390	3 530	4 070	5 420	6 100	7 050	8 270
M4	8.78	3 510	3 690	4 390	4 570	5 270	7 020	7 900	9 130	10 700
M5	14.2	5 680	5 960	7 100	7 380	8 520	11 350	12 800	14 800	17 300
M6	20.1	8 040	8 440	10 000	10 400	12 100	16 100	18 100	20 900	24 500
M7	28.9	11 600	12 100	14 400	15 000	17 300	23 100	26 000	30 100	35 300
Thread[a] (d)	Nominal strength area $A_{s,nom}$[b] mm2	Quality Class								
		4.6	4.8	5.6	5.8	6.8	8.8	9.8	10.9	12.9
		Tensile rupture minimum load ($A_{s,nom}$x$R_{m,min}$), N								
M8	36.6	14 600	15 400	18 300	19 000	22 000	29 200	32 900	38 100	44 600
M10	58	23 200	24 400	29 000	30 200	34 800	46 400	52 200	60 300	70 800
M12	84.3	33 700	35 400	42 200	43 800	50 600	67 400[c]	75 900	87 700	103 000
M14	115	46 000	48 300	57 500	59 800	69 000	92 000[c]	104 000	120 000	140 000
M16	157	62 800	65 900	78 500	81 600	94 000	125 000[c]	141 000	163 000	192 000
M18	192	76 800	80 600	96 000	99 800	115 000	159 000	--	200 000	234 000
M20	245	98 000	103 000	122 000	127 000	147 000	203 000	--	255 000	299 000
M22	303	121 000	127 000	152 000	158 000	182 000	252 000	--	315 000	370 000
M24	353	141 000	148 000	176 000	184 000	212 000	293 000	--	367 000	431 000
M27	459	184 000	193 000	230 000	239 000	275 000	381 000	--	477 000	560 000
M30	561	224 000	236 000	280 000	292 000	337 000	466 000	--	583 000	684 000
M33	694	278 000	292 000	347 000	361 000	416 000	576 000	--	722 000	847 000
M36	817	327 000	343 000	408 000	425 000	490 000	678 000	--	850 000	997 000
M39	976	390 000	410 000	488 000	508 000	586 000	810 000	--	1020 000	1200 000

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5- Test loads. Coarse pitch ISO metric thread.

Thread[a] (d)	Nominal strength area $A_{s,nom}$[b] mm2	Quality Class								
		4.6	4.8	5.6	5.8	6.8	8.8	9.8	10.9	12.9
		Test load ($A_{s,nom}$xS_p), N								
M3	5.03	1 130	1 560	1 410	1 910	2 210	2 920	3 270	4 180	4 880
M3.5	6.78	1 530	2 100	1 900	2 580	2 980	3 940	4 410	5 630	6 580
M4	8.78	1 980	2 720	2 460	3 340	3 860	5 100	5 710	7 290	8 520
M5	14.2	3 200	4 400	3 980	5 400	6 250	8 230	9 230	11 800	13 800
M6	20.1	4 520	6 230	5 630	7 640	8 840	11 600	13 100	16 700	19 500
M7	28.9	6 500	8 960	8 090	11 000	12 700	16 800	18 800	24 000	28 000
Thread[a] (d)	Nominal strength area $A_{s,nom}$[b] mm2	Quality Class								
		4.6	4.8	5.6	5.8	6.8	8.8	9.8	10.9	12.9
		Test load ($A_{s,nom}$xS_p), N								
M8	36.6	8 240	11 400	10 200	13 900	16 100	21 200	23 800	30 400	35 500
M10	58	13 000	18 000	16 200	22 000	25 500	33 700	37 700	48 100	56 300
M12	84.3	19 000	26 100	23 600	32 000	37 100	48 900[c]	54 800	70 000	81 800
M14	115	25 900	35 600	32 200	43 700	50 600	66 700[c]	74 800	95 500	112 000
M16	157	35 300	48 700	44 000	59 700	69 100	91 000[c]	102 000	130 000	152 000
M18	192	43 200	59 500	53 800	73 000	84 500	115 000	--	159 000	186 000
M20	245	55 100	76 000	68 600	93 100	108 000	147 000	--	203 000	238 000
M22	303	68 200	93 900	84 800	115 000	133 000	182 000	--	252 000	294 000
M24	353	79 400	109 000	98 800	134 000	155 000	212 000	--	293 000	342 000
M27	459	103 000	142 000	128 000	174 000	202 000	275 000	--	381 000	445 000
M30	561	126 000	174 000	157 000	213 000	247 000	337 000	--	466 000	544 000
M33	694	156 000	215 000	194 000	264 000	305 000	416 000	--	576 000	673 000
M36	817	184 000	253 000	229 000	310 000	359 000	490 000	--	678 000	792 000
M39	976	220 000	303 000	273 000	371 000	429 000	586 000	--	810 000	947 000