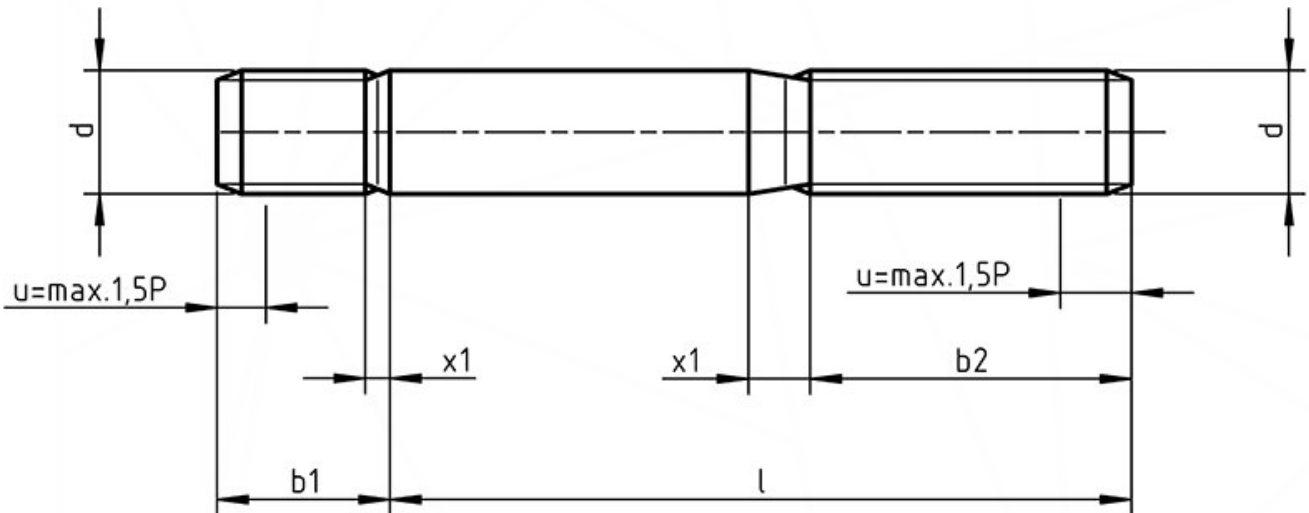


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Legend:

l - length of bolt
d - the nominal diameter of the thread
u - thread run
b1 - length of thread stud ends
b2 - thread length nut end

Makings:

Steel: 5,8,8,8,10,9
Stainless: A2,A4
Plastic: -
Non Ferrous: -
Thread: Sk6, Nut side 6g

Notes:

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TABLE 1: ACCORDING TO DIN 939

Thread d	M4	M5	M6	(M7)	M8	M10	M12	(M14)	M16	(M18)	M20	(M22)	M24
	-	-	-	-	-	M8x1	M10x1,25	M12x1,25	(M14x1,5)	M16x1,5	(M18x1,5)	M20x1,5	(M22x1,5)
-	-	-	-	-	-	-	M12x1,5	-	-	-	-	-	-
b1	5	6,5	7,5	9	10	12	15	18	20	22	25	28	30
b2 l<125mm	14	16	18	20	22	26	30	34	38	42	46	50	54
b2 125>l<200mm	20	22	24	26	28	32	36	40	44	48	52	56	60
b2 l>200mm	-	-	-	-	-	45	49	53	57	61	65	69	73
x1	1,75	2	2,5	2,5	3,2	3,8	4,3	5	5	6,3	6,3	6,3	7,5
x2	0,9	1	1,25	1,25	1,6	1,9	2,2	2,5	2,5	3,2	3,2	3,2	3,8
l js 15	Weight (7,85/dm ³) per 1000 units, in kg												
12													
14													
16													
18													
20	2,03												
22	2,23	3,65											
25	2,52	4,11	5,85										
28	2,82	4,57	6,52	9,49									
30	3,02	4,88	6,96	10,1	13,1								
35	3,51	5,65	8,07	11,6	15,1	24,2							
40	4,01	6,42	9,18	13,1	17	27,2	41						
45		7,19	10,2	14,6	19	30,3	45,4	64					
50		7,96	11,4	16,1	21	33,3	49,9	70	94,9				
55			12,5	17,7	22,9	36,4	54,3	76,1	103	130			
60			13,6	19,2	24,9	39,5	58,8	82,1	111	140	180		
65				20,7	26,9	42,6	63,2	88,2	119	150	192	242	
70				22,2	28,9	45,7	67,6	94,2	126	160	205	257	305
75					30,8	48,8	72,1	100	134	170	217	272	323
80					32,8	51,8	76,5	106	142	180	229	287	341
85						54,9	81	112	150	190	241	302	358
90						58	85,4	118	158	199	254	317	376
95						61,1	89,8	124	166	210	266	332	394
100						64,2	94,3	130	174	220	279	346	412
110							103	143	190	240	303	376	447
120							112	155	205	260	328	406	483
130								167	221	280	353	436	518
140								179	237	300	377	466	554
150									253	320	402	496	589
160									269	340	427	525	625
170										360	451	555	660
180										380	476	585	696
190											501	615	731
200											525	645	767

Thread d	(M27)	M30	(M33)	M36	(M39)	M42	(M45)	M48	(M52)
	(M27x2)	M30x2	(M33x2)	M36x3	(M39x3)	M42x3	(M45x3)	M48x3	(M52x3)
b1	35	38	42	45	50	52	58	60	65
b2 l<125mm	60	66	72	78	84	90	96	102	110
b2 125>l<200mm	66	72	78	84	90	96	102	108	116
b2 l>200mm	79	85	91	97	103	109	115	121	129
x1	7,5	9	9	10	10	11	11	12,5	12,5
x2	3,8	4,5	4,5	5	5	5,5	5,5	6,3	6,3
l js 15	Weight (7,85/dm ³) per 1000 units, in kg								
50									
55									
60									
70									
75	430								
80	452								
85	475	591							
90	497	619	776						
95	520	646	810						
100	542	674	843	1011					
110	587	730	910	1091	1326				
120	632	785	977	1171	1420	1647	1963		
130	677	841	1045	1251	1514	1756	2088	2364	
140	722	896	1112	1331	1607	1865	2213	2506	3027
150	767	952	1179	1411	1701	1973	2338	2648	3794
160	812	1007	1246	1490	1795	2082	2462	2790	3360
170	857	1062	1313	1570	1889	2191	2587	2932	3527
180	902	1118	1380	1650	1982	2300	2712	3074	3694
190	947	1173	1447	1730	2076	2408	2837	3216	3861
200	992	1229	1515	1810	2170	2517	2962	3358	4027
220	1082	1340	1649	1970	2358	2735	3211	3642	4361
240	1172	1450	1784	2130	2545	2952	3461	3927	4694
260	1262	1562	1918	2289	2733	3170	3711	4211	5028
280	1352	1672	2052	2449	2920	3387	3961	4495	5361
300		1784	2186	2609	3108	3605	4210	4779	5694
320			2321	2769	3295	3822	4460	5063	6028
340			2455	2929	3483	4040	4710	5347	6361
360				3088	3670	4257	4959	5631	6695
380					3858	4475	5209	5915	7028
400					4045	4692	5459	6199	7362

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Chemical Composition and Tempering

According to NEN-EN-ISO 898-1:2013 this table specifies limits for the chemical composition of steels and minimum tempering temperatures for the different property classes of bolts, screws and studs. The chemical composition shall be assessed in accordance with the relevant International Standards. For fasteners that have to be hot dip galvanized, the additional material requirements given in ISO 10684 apply.

TABLE 2: CHEMICAL COMPOSITION AND TEMPERING

Property class	Material and heat treatment	Chemical composition limit (cast analysis, %) ^a					Tempering temperature °C min
		C		P	S	B ^b	
		min.	max.	max.	max.	max.	
4.6 ^{c,d}	Carbon steel or carbon steel with additives	-	0,55	0,050	0,060	Not specified	-
4.8 ^d							
5.6 ^d		0,13	0,55	0,050	0,060		
5.8 ^d		-	0,55	0,050	0,060		
6.8 ^d		0,15	0,55	0,050	0,060		
8.8 ^f	Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered or	0,15 ^e	0,40	11,2	2,4	0,003	425
	Carbon steel quenched and tempered or	0,25	0,55	0,025	0,025		
	Alloy steel quenched and tempered ^g	0,20	0,55	0,025	0,025		
9.8 ^f	Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered or..	0,15 ^e	0,40	0,025	0,025	0,003	425
	Carbon steel quenched and tempered or	0,25	0,55	0,025	0,025		
	Alloy steel quenched and tempered ^g	0,20	0,55	0,025	0,025		
10.9 ^f	Carbon steel with additives (e.g. Boron or Mn or Cr) quenched and tempered or..	0,20 ^e	0,55	0,025	0,025	0,003	425
	Carbon steel quenched and tempered or..	0,25	0,55	0,025	0,025		
	Alloy steel quenched and tempered ^g	0,20	0,55	0,025	0,025		
12.9 ^{h,i}	Alloy steel quenched and tempered ^g	0,30	0,50	0,025	0,025	0,003	425
12.9 ^{h,i}	Carbon steel with additives (e.g. Boron or Mn or Cr or Molybdenum) quenched and tempered	0,28	0,50	0,025	0,025	0,003	425

a) In case of dispute, the product analysis applies. **b)** Boron content can reach 0,005 %, provided non-effective boron is controlled by the addition of titanium and/or aluminium. **c)** For cold forged fasteners of property classes 4.6 and 5.6, heat treatment of the wire used for cold forging or of the cold forged fastener itself may be necessary to achieve required ductility. **d)** Free cutting steel is allowed for these property classes with the following maximum sulfur, phosphorus and lead contents: S: 0,34 %; P: 0,11 %; Pb: 0,35 %. **e)** In case of plain carbon boron steel with a carbon content below 0,25 % (cast analysis), the minimum manganese content shall be 0,6 % for property class 8.8 and 0,7 % for property classes 9.8 and 10.9. **f)** For the materials of these property classes, there shall be a sufficient hardenability to ensure a structure consisting of approximately 90 % martensite in the core of the threaded sections for the fasteners in the "as-hardened" condition before tempering. **g)** This alloy steel shall contain at least one of the following elements in the minimum quantity given: chromium 0,30 %, nickel 0,30 %, molybdenum 0,20 %, vanadium 0,10 %. Where elements are specified in combinations of two, three or four and have alloy contents less than those given above, the limit value to be applied for steel class determination is 70 % of the sum of the individual limit values specified above for the two, three or four elements concerned. **h)** Fasteners manufactured from phosphated raw material shall be dephosphated before heat treatment; the absence of white phosphorus enriched layer shall be detected by a suitable test method. **i)** Caution is advised when the use of property class 12.9/12.9 is considered. The capability of the fastener manufacturer, the service conditions and the wrenching methods should be considered. Environments can cause stress corrosion cracking of fasteners as processed as well as those coated.

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Mechanical and physical properties of steel Metric Coarse fasteners

The Mechanical and physical properties according to NEN-EN-ISO 898-1:2013 The bolts, screws and studs of the specified property classes shall, at ambient temperature, meet all the applicable mechanical and physical properties in accordance with the tables regardless of which tests are performed during manufacturing or final inspection. For specific details consult NEN-EN-ISO 898-1:2013

TABLE 3: MECHANICAL AND PHYSICAL PROPERTIES OF STEEL FOR METRIC COARSE FASTENERS

No.	Mechanical or physical property	Property class										
		4.6	4.8	5.6	5.8	6.8	8.8		9.8	10.9	12.9/ 12.9	
								d _≤ 16 mm ^a	d _{>} 16 mm ^b	d _≤ 16 mm		
1	Tensile strength, R _m , MPa	nom. ^c	400		500		600	800		900	1 000	1 200
		min.	400	420	500	520	600	800	830	900	1 040	1 220
2	Lower yield strength, R _{eL} ^d , MPa	nom. ^c	240	—	300	—	—	—	—	—	—	—
		min.	240	—	300	—	—	—	—	—	—	—
3	Stress at 0,2 % non-proportional elongation, R _{p0,2} ^e , MPa	nom. ^c	—	—	—	—	—	640	640	720	900	1 080
		min.	—	—	—	—	—	640	660	720	940	1 100
4	Stress at 0,0048d non-proportional elongation for full-size fasteners, R _{pf} ^f , MPa	nom. ^c	—	320	—	400	480	—	—	—	—	—
		min.	—	340 ^e	—	420 ^e	480 ^e	—	—	—	—	—
5	Stress under proof load, S _p ^g , MPa	nom. ^c	225	310	280	380	440	580	600	650	830	970
		Proof strength ratio: S _{p,nom} /R _{eL,min} or S _{p,nom} /R _{p0,2,min} or S _{p,nom} /R _{pf,min}	0,94	0,91	0,93	0,9	0,92	0,91	0,91	0,9	0,88	0,88
6	Percentage elongation after fracture for machined test pieces, A, %	min.	22	—	20	—	—	12	12	10	9	8
7	Percentage reduction of area after fracture for machined test pieces, Z, %	min.	—					52		48	48	44
8	Elongation after fracture for full-size fasteners, Af min. (see also Annex C)	min.	—	0,24	—	0,22	0,2	—	—	—	—	—
9	Head soundness	No fracture										
10	Vickers hardness HV F ≥ 98 N	min.	120	130	155	160	190	250	255	290	320	385
		max.	220 ^g					250	320	335	360	380
11	Brinell hardness, HBW F = 30 D ²	min.	114	124	147	152	181	245	250	286	316	380
		max.	209 ^g					238	316	331	355	375

Table 3 (continued)

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No.	Mechanical or physical property	Property class										
		4.6	4.8	5.6	5.8	6.8	8.8		3.05	10.9	12.9/ 12.9	
12	Rockwell hardness. HRB	min.	67	71	79	82	89	—				
		max.	95,0 ^a				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	Non-carburization. HV 0.3	max.	—					h		h	h	
15	Height of non-decarburized thread zone. E. mm	min.	—					1/2 H ₁		2/3 H ₁	3/4 H ₁	
	Depth of complete decarburization in the thread. G. mm	max.	—					0.015				
16	Reduction of hardness after retempering. HV	min.	—					20				
17	Breaking torque. M _g . Nm	min.	—					in accordance with ISO 898-7				
18	Impact strength. KV i j. J	min.	—		27	—		27	27	27	27	—
19	Surface integrity in accordance with	min.	ISO 6157-II									ISO 6157-3

a) Values do not apply to structural bolting. **b)** For structural bolting $d \geq M12$ **c)** Nominal values are specified only for the purpose of the designation system for property classes. See Clause 5. **d)** In cases where the lower yield strength. ReL. cannot be determined, it is permissible to measure the stress at 0.2 % non-proportional elongation Rp0.2. **e)** For the property classes 4.8, 5.8 and 6.8, the values for Rp_f.min are under investigation. The values at the time of publication of this part of ISO 898 are given for calculation of the proof stress ratio only. They are not test values. **f)** Proof loads are specified in original ISO 898-1:2013. **g)** Hardness determined at the end of a fastener shall be 250 HV, 238 HB or 99.5 HRB maximum. **h)** Surface hardness shall not be more than 30 Vickers points above the measured base metal hardness of the fastener when determination of both surface hardness and base metal hardness are carried out with HV 0.3 **i)** Values are determined at a test temperature of -20 °C. **j)** Applies to $d \geq 16$ mm. **k)** Value for KV is under investigation. **l)** Instead of ISO 6157-1, ISO 6157-3 may apply by agreement between the manufacturer and the purchaser.

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Minimum Ultimate Tensile loads

According to NEN-EN-ISO 898-1:2013 the minimum ultimate tensile loads are applicable for coarse pitch thread.

TABLE 4: MINIMUM ULTIMATE TENSILE LOADS FOR STEEL METRIC COARSE FASTENERS

Thread ^a _d	Nominal stress area As,nom ^b mm ²	Property class								
		4.6	4.8	5.6	5.8	6.8	8.8	9.8	10.9	12.9/12.9
Minimum ultimate tensile load, Fm,min (As,nom × Rm,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
M8	36,6	14 600 ^c	15 400	18 300 ^c	19 000	22 000	29 200 ^c	32 900	38 100 ^c	44 600
M10	58	23 200 ^c	24 400	29 000 ^c	30 200	34 800	46 400 ^c	52 200	60 300 ^c	70 800
M12	84,3	33 700	35 400	42 200	43 800	50 600	67 400 ^d	75 900	87 700	103 000
M14	115	46 000	48 300	57 500	59 800	69 000	92 000 ^d	104 000	120 000	140 000
M16	157	62 800	65 900	78 500	81 600	94 000	125 000 ^d	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	—	1 020 000	1 200 000

a) Where no thread pitch is indicated in a thread designation, coarse pitch is specified. b) To calculate As,nom, see 9.1.6.1. in ISO 898-1:2013 c) For fasteners with thread tolerance 6az in accordance with ISO 965-4 subject to hot dip galvanizing, reduced values in accordance with ISO 10684:2004, Annex A, apply. d) For structural bolting 70 000 N (for M12), 95 500 N (for M14) and 130 000 N (for M16).

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