Orca Bolts

STEEL

Useful Information

Steels (BS EN ISO 898-1:2009)

Property class	Material and heat treatment	Chemical composition limits (cast analysis, %) [a]					Tempering temperature
		C		P	S	B [b]	°C
		min.	max.	max.	max.	max.	min.
4.6 [c, d]	Carbon steel or carbon steel with additives	–	0,55	0,050	0,060	Not specified	–
4.8 [d]							
5.6 [c]		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	0,15 [e]	0,40	0,025	0,025	0,003	425
	or Carbon steel quenched and tempered	0,25	0,55	0,025	0,025		
	or 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	0,15 [e]	0,40	0,025	0,025	0,003	425
	or Carbon steel quenched and tempered	0,25	0,55	0,025	0,025		
	or 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	0,20 [e]	0,55	0,025	0,025	0,003	425
	or Carbon steel quenched and tempered	0,25	0,55	0,025	0,025		
	or Alloy steel quenched and tempered [g]	0,20	0,55	0,025	0,025		
12.9 [f, h, i]	Alloy steel quenched and tempered [g]	0,30	0,50	0,025	0,025	0,003	425
12.9 [f, 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	380

a In case of dispute, the product analysis applies.

b Boron content can reach 0,005 %, provided that non-effective boron is controlled by 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 sulphur, phosphorus and lead contents: sulphur 0,34 %; phosphorus 0,11 %; lead 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 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 shown above for the two, three or four elements concerned.

h A metallographically detectable white phosphorus enriched layer is not permitted for property class 12.9/12.9. It 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 may cause stress corrosion cracking of fasteners as processed as well as those coated.

Mechanical and Physical Properties of Bolts, Screws and Studs (BS EN ISO 898-1:2009)

No.	Mechanical or physical property		Property class									
			4.6	4.8	5.6	5.8	6.8	8.8 $d \leq 16$ mm [a]	8.8 $d > 16$ mm [b]	9.8 $d \leq 16$ mm	10.9	12.9/12.9
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, $R_{p0,2}$, MPa	nom. [c]	–	–	–	–	–	640	640	720	900	1 080
		min.	–	–	–	–	–	640	660	720	940	1 100
4	Stress at 0,0048 d non-proportional elongation for full-size fasteners, R_{pf}, MPa	nom. [c]	–	320	–	400	480	–	–	–	–	–
		min.	–	340 [e]	–	420 [e]	480 [e]	–	–	–	–	–
5	Stress under proof load, S_p [f], MPa	nom.	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	0,90	0,92	0,91	0,91	0,90	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, A_f (see also Annex C)	min.	–	0,24	–	0,22	0,20	–	–	–	–	–
9	Head soundness		No fracture									
10	Vickers hardness, HV $F \geq 98$ N	min.	120	130	155	160	190	250	255	290	320	385
		max.	220 [g]				250	320	335	360	380	435
11	Brinell hardness, HBW $F = 30\ D^2$	min.	114	124	147	152	181	238	242	276	304	366
		max.	209 [g]				238	304	318	342	361	414
12	Rockwell hardness, HRB	min.	67	71	79	82	89	–				
		max.	95,0 [g]				99,5	–				
	Rockwell hardness, HRC	min.	–					22	23	28	32	39
		max.	–					32	34	37	39	44
13	Surface hardness, HV 0,3	max.	–					h			h, i	h, j
14	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				
15	Reduction of hardness after retempering, HV	max.	–					20				
16	Breaking torque, M_B, N·m	min.	–					in accordance with ISO 898-7				
17	Impact strength, K_V [k, l], J	min.	–		27		–	27	27	27	27	m
18	Surface integrity in accordance with		ISO 6157-1 [n]									ISO 6157-3

a Values do not apply for structural bolting.
b For structural bolting *d* B 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 R_{eL} cannot be determined, it is permissible to measure the stress at 0,2 % non-proportional elongation $R_{p0,2}$
e For the property classes 4.8, 5.8 and 6.8 the values for $R_{pf\ min}$ are under investigation. The present values are given for calculation of the proof stress ratio only. They are not test values.
f Proof loads are specified in Tables 5 and 7.
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 core hardness of the fastener when determination of both surface hardness and core hardness are carried out with HV 0,3.
i Any increase in hardness at the surface which indicates that the surface hardness exceeds 390 HV is not acceptable.
j Any increase in hardness at the surface which indicates that the surface hardness exceeds 435 HV is not acceptable.
k Values are determined at a test temperature of -20 °C, see 9.14.
l Applies to *d* B 16 mm.
m Value for K_v is under investigation.
n Instead of ISO 6157-1, ISO 6157-3 may apply by agreement between the manufacturer and the purchaser.

Minimum Ultimate Tensile Loads - ISO Metric Coarse Pitch Thread (BS EN ISO 898-1:2009)

Thread [a] d	Nominal stress area $A_{s,nom}$ [b] mm²	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, $F_{m\,min}$ ($A_{s,\,nom}$ 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
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 $A_{s,nom}$, see 9.1.6.1.
[c] For fasteners with thread tolerance 6az according to 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).

Proof Loads - ISO Metric Coarse Pitch Thread (BS EN ISO 898-1:2009)

Thread [a] d	Nominal stress area $A_{s,nom}$ [b] mm²	Property class 4.6	4.8	5.6	5.8	6.8	8.8	9.8	10.9	12.9/12.9
		Proof load, F_p ($A_{s,nom}$ x $S_{p,nom}$), 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
M8	36,6	8 240 [c]	11 400	10 200 [c]	13 900	16 100	21 200 [c]	23 800	30 400 [c]	35 500
M10	58	13 000 [c]	18 000	16 200 [c]	22 000	25 500	33 700 [c]	37 700	48 100 [c]	56 300
M12	84,3	19 000	26 100	23 600	32 000	37 100	48 900 [d]	54 800	70 000	81 800
M14	115	25 900	35 600	32 200	43 700	50 600	66 700 [d]	74 800	95 500	112 000
M16	157	35 300	48 700	44 000	59 700	69 100	91 000 [d]	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

[a] Where no thread pitch is indicated in a thread designation, coarse pitch is specified.
[b] To calculate $A_{s,nom}$, see 9.1.6.1.
[c] For fasteners with thread tolerance 6az according to ISO 965-4 subject to hot dip galvanizing, reduced values in accordance with ISO 10684:2004, Annex A, apply.
[d] For structural bolting 50 700 N (for M12), 68 800 N (for M14) and 94 500 N (for M16).

Chemical Composition of Steel Nuts (BS 4190:2001)

Strength grade designation	Chemical composition limits (check analysis)		
	Carbon max. %	Phosphorus max. %	Sulfur max. %
4 and 6 (see note)	0.50	0.110	0.150
8	0.58	0.060	0.150
10	0.58	0.048	0.058

NOTE 1 Free cutting steel may be used only by special agreement between the purchaser and the supplier. In such cases, the following maximum phosphorus, sulfur and lead contents are permissible: phosphorus, 0.12 %, sulfur, 0.34 %, lead, 0.35 %.
NOTE 2 Alloying elements may be added if necessary to develop the mechanical properties of the nuts stipulated in Table 14.

Proof Loads for Steel Nuts (Coarse Pitch Series) (BS 4190:2001)

Nominal size of nut	Tensile stress area of bolt	Strength grade designation				
		4	6	8	10	12
		Stress under proof load N/mm²				
		400	600	800	1 000	1 200
mm	mm²	Proof load N				
M5	14.2	5 680	8 500	11 400	14 800	17 000
M6	20.1	8 040	12 000	16 000	20 000	24 000
M8	36.6	14 600	22 000	29 000	36 500	43 000
M10	58.0	23 200	35 000	46 000	58 000	69 500
M12	84.3	33 700	50 500	67 000	84 000	100 000
M16	157	62 800	94 000	125 000	157 000	188 000
M20	245	98 000	147 000	196 000	245 000	294 000
M22	303	121 000	182 000	242 000	303 000	364 000
M24	353	141 000	212 000	282 000	353 000	423 000
M27	459	184 000	276 000	367 000	459 000	550 000
M30	561	224 000	336 000	448 000	561 000	673 000
M33	694	278 000	416 000	555 000	694 000	833 000
M36	817	327 000	490 000	653 000	817 000	980 000
M39	976	390 000	585 000	780 000	976 000	1 170 000
M42	1 120	448 000	672 000	896 000	1 120 000	1 340 000
M45	1 300	520 000	780 000	1 400 000*	1 300 000	1 560 000
M48	1 470	588 000	882 000	1 180 000	1 470 000	1 760 000
M52	1 760	704 000	1 060 000	1 410 000	1 760 000	2 110 000
M56	2 030	812 000	1 220 000	1 620 000	2 030 000	2 440 000
M60	2 360	944 000	1 420 000	1 890 000	2 360 000	2 830 000
M64	2 680	1 072 000	1 610 000	2 140 000	2 680 000	3 220 000
M68	3 060	1 224 000	1 840 000	2 450 000	3 060 000	3 670 000

NOTE 1 Proof load = stress under proof load x tensile stress area divided by 1 000.
NOTE 2 For stress under proof load, see Table 16.
NOTE 3 Nuts with a specified proof load above 500 000 N may be exempted from proof load testing; see clause 18 and Table 14.

*may due to typing error in BS 4190

Chemical Composition of Steel Nuts (BS 3692:2001)

Strength grade designation	Chemical composition limits (check analysis)			
	Carbon max. %	Manganese min. %	Phosphorus max. %	Sulfur max. %
4, 5 and 6 (See notes)	0.50	–	0.110	0.150
8	0.58	0.30	0.060	0.150
10 and 12 (See notes)	0.58	0.45	0.048	0.058

NOTE 1 Free cutting steel may be used only by special agreement between the purchaser and the supplier. In such cases, the following maximum phosphorus, sulfur and lead contents are permissible:
Phosphorus, 0.12 %; Sulfur, 0.34 %; Lead, 0.35 %.

NOTE 2 Alloying elements may be added if necessary to develop the mechanical properties of the nuts stipulated in clause 15.

Proof Loads for Steel Nuts (Coarse Pitch Series) (BS 3692:2001)

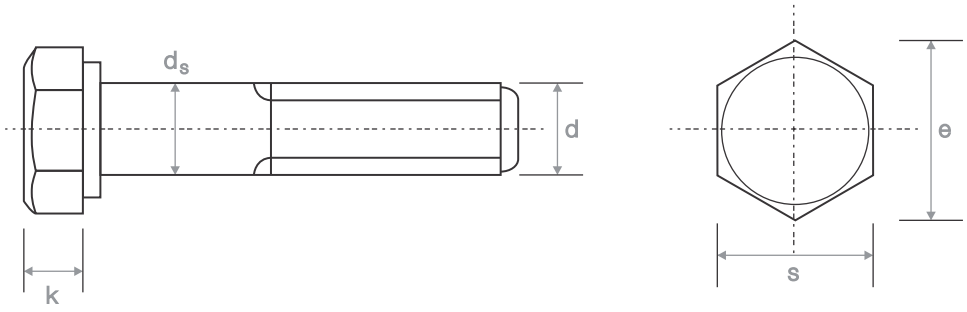
Nominal size of nut	Tensile stress area of bolt	Strength grade designation					
		4	5	6	8	10	12
		Stress under proof load N/mm²					
		400	500	600	800	1 000	1 200
mm	mm²	Proof load N					
M1.6	1.27	510	640	760	1 020	1 270	1 520
M2	2.07	830	1 030	1 240	1 650	2 070	2 480
M2.5	3.39	1 360	1 700	2 030	2 710	3 390	4 070
M3	5.03	2 010	2 520	3 020	4 000	5 000	6 000
M4	8.78	3 510	4 400	5 250	7 000	8 750	10 500
M5	14.2	5 680	7 100	8 500	11 400	14 200	17 000
M6	20.1	8 040	10 000	12 000	16 000	20 000	24 000
M8	36.6	14 600	18 300	22 000	29 000	36 500	43 000
M10	58.0	23 200	29 000	35 000	46 000	58 000	69 500
M12	84.3	33 700	42 100	50 500	67 000	84 000	100 000
M14	115	46 000	57 500	69 000	92 000	115 000	138 000
M16	157	62 800	78 500	94 000	125 000	157 000	188 000
M18	192	76 800	98 000	115 000	154 000	192 000	230 000
M20	245	98 000	122 000	147 000	196 000	245 000	294 000
M22	303	121 000	151 000	182 000	242 000	303 000	364 000
M24	353	141 000	175 000	212 000	282 000	353 000	423 000
M27	459	184 000	230 000	276 000	367 000	459 000	550 000
M30	561	224 000	280 000	336 000	448 000	561 000	673 000
M33	694	278 000	347 000	416 000	555 000	694 000	833 000
M36	817	327 000	408 000	490 000	653 000	817 000	980 000
M39	976	390 000	488 000	585 000	780 000	976 000	1 170 000
M42	1 120	448 000	560 000	672 000	896 000	1 120 000	1 340 000
M45	1 300	520 000	650 000	780 000	1 040 000	1 300 000	1 560 000
M48	1 470	588 000	735 000	882 000	1 180 000	1 470 000	1 760 000
M52	1 760	704 000	880 000	1 060 000	1 410 000	1 760 000	2 110 000
M56	2 030	812 000	1 015 000	1 220 000	1 620 000	2 030 000	2 440 000
M60	2 360	944 000	1 180 000	1 420 000	1 890 000	2 360 000	2 830 000
M64	2 680	1 072 000	1 340 000	1 610 000	2 140 000	2 680 000	3 220 000
M68	3 060	1 224 000	1 530 000	1 840 000	2 450 000	3 060 000	3 670 000

NOTE 1 Proof load = Stress under proof x tensile stress area of bolt

NOTE 2 For stress under proof load, see Table 9.

NOTE 3 Nuts with a specified proof load above 500 000 N force may be exempted from proof load testing, see clause 14 and Table 9.

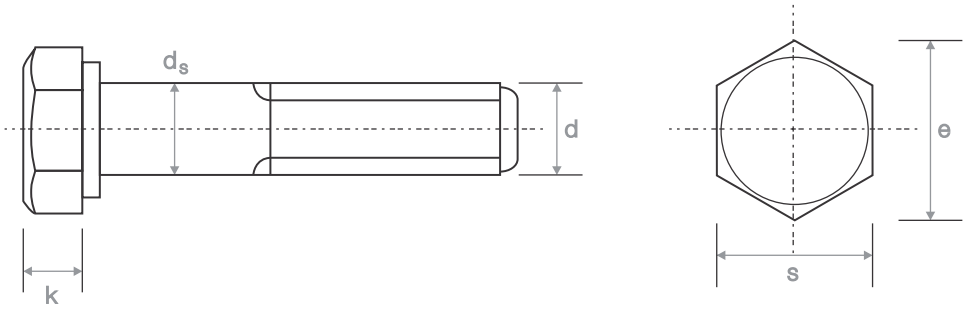
DIMENSIONAL COMPARISON - HEXAGON HEAD SCREWS / BOLTS (M6-M20)



nominal size and thread diameter	specification	width across flats		width across corners		height of head		diameter of unthreaded shank	
d		s		e		k		d_s	
		min	max	min	max	min	max	min	max
M6	DIN 931	9.78	10	11.05	-	3.85	4.15	5.82	6
	DIN 933	9.78	10	11.05	-	3.85	4.15	-	-
	BS 4190	9.64	10.00	10.89	11.5	3.625	4.375	5.52	6.48
	BS 3692	9.78	10.0	11.05	11.5	3.85	4.15	5.82	6.0
M8	DIN 931	12.73	13	14.38	-	5.15	5.45	7.78	8
	DIN 933	12.73	13	14.38	-	5.15	5.45	-	-
	BS 4190	12.57	13.00	14.20	15.0	5.125	5.875	7.42	8.58
	BS 3692	12.73	13.0	14.38	15.0	5.35	5.65	7.78	8.0
M10	DIN 931	16.73	17	18.9	-	6.22	6.58	9.78	10
	DIN 933	16.73	17	18.9	-	6.22	6.56	-	-
	BS 4190	16.57	17.00	18.72	19.6	6.55	7.45	9.42	10.58
	BS 3692	16.73	17.0	18.9	19.6	6.82	7.18	9.78	10.0
M12	DIN 931	18.67	19	21.1	-	7.32	7.68	11.73	12
	DIN 933	18.67	19	21.1	-	7.32	7.68	-	-
	BS 4190	18.48	19.00	20.88	21.9	7.55	8.45	11.30	12.70
	BS 3692	18.67	19.0	21.10	21.9	7.82	8.18	11.73	12.0
M16	DIN 931	23.67	24	26.75	-	9.82	10.18	15.73	16
	DIN 933	23.67	24	26.75	-	9.82	10.18	-	-
	BS 4190	23.16	24.00	26.17	27.7	9.55	10.45	15.30	16.70
	BS 3692	23.67	24.0	26.75	27.7	9.82	10.18	15.73	16.0
M20	DIN 931	29.67	30	33.53	-	12.28	12.72	19.67	20
	DIN 933	29.67	30	33.53	-	12.28	12.72	-	-
	BS 4190	29.16	30.00	32.95	34.6	12.10	13.90	19.16	20.84
	BS 3692	29.67	30.0	33.53	34.6	12.785	13.215	19.67	20.0

unit in mm

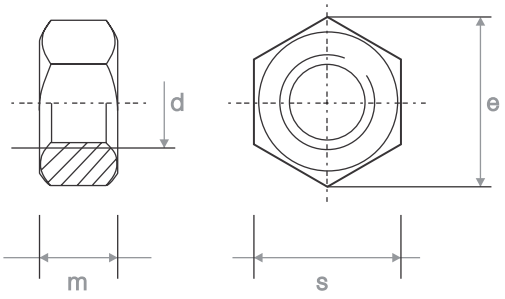
DIMENSIONAL COMPARISON - HEXAGON HEAD SCREWS / BOLTS (M24-M39)



nominal size and thread diameter	specification	width across flats		width across corners		height of head		diameter of unthreaded shank	
d		s		e		k		d_s	
		min	max	min	max	min	max	min	max
M24	DIN 931	35.38	36	39.98	-	14.78	15.22	23.67	24
	DIN 933	35.38	36	39.98	-	14.78	15.22	-	-
	BS 4190	35.00	36.00	39.55	41.6	14.10	15.90	23.16	24.84
	BS 3692	35.38	36.0	39.98	41.6	14.785	15.215	23.67	24.0
M27	DIN 931	40	41	45.2	-	16.65	17.35	26.48	27
	DIN 933	40	41	45.2	-	16.65	17.35	-	-
	BS 4190	40.00	41.00	45.20	47.3	16.10	17.90	26.16	27.84
	BS 3692	40.38	41.0	45.63	47.3	16.785	17.215	26.67	27.0
M30	DIN 931	45	46	50.85	-	18.28	19.12	29.48	30
	DIN 933	45	46	50.85	-	18.28	19.12	-	-
	BS 4190	45.00	46.00	50.85	53.1	17.95	20.05	29.16	30.84
	BS 3692	45.38	46.0	51.28	53.1	18.74	19.26	29.67	30.0
M33	DIN 931	49	50	55.37	-	20.58	21.42	32.38	33
	DIN 933	49	50	55.37	-	20.58	21.42	-	-
	BS 4190	49.00	50.00	55.37	57.7	19.95	22.05	32.00	34.00
	BS 3692	49.38	50.0	55.80	57.7	20.74	21.26	32.61	33.0
M36	DIN 931	53.8	55	60.79	-	22.08	22.92	35.38	36
	DIN 933	53.8	55	60.79	-	22.08	22.92	-	-
	BS 4190	53.80	55.00	60.79	63.5	21.95	24.05	35.00	37.00
	BS 3692	54.26	55.0	61.31	63.5	22.74	23.26	35.61	36.0
M39	DIN 931	58.8	60	66.44	-	24.58	25.42	38.38	39
	DIN 933	58.8	60	66.44	-	24.58	25.42	-	-
	BS 4190	58.80	60.00	66.44	69.3	23.95	26.05	38.00	40.00
	BS 3692	59.26	60.0	66.96	69.3	24.74	25.26	38.61	39.0

unit in mm

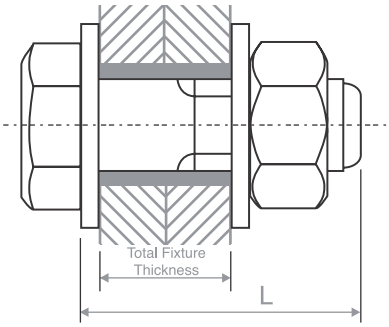
DIMENSIONAL COMPARISON - HEXAGON NUTS (M6-M39)



nominal size and thread diameter	specification	width across flats		width across corners		Thickness	
d		s		e		m	
		min	max	min	max	min	max
M6	DIN 934	9.78	10	11.05	-	4.7	5
	BS 4190	9.64	10.00	10.89	11.50	4.625	5.375
	BS 3692	9.78	10.00	11.05	11.50	4.70	5.00
M8	DIN 934	12.73	13	14.38	-	6.14	6.5
	BS 4190	12.57	13.00	14.20	15.00	6.125	6.875
	BS 3692	12.73	13.00	14.38	15.00	6.14	6.50
M10	DIN 934	16.73	17	18.9	-	7.64	8
	BS 4190	16.57	17.00	18.72	19.60	7.55	8.45
	BS 3692	16.73	17.00	18.90	19.60	7.64	8.00
M12	DIN 934	18.67	19	21.1	-	9.64	10
	BS 4190	18.48	19.00	20.88	21.90	9.55	10.45
	BS 3692	18.67	19.00	21.10	21.90	9.64	10.00
M16	DIN 934	23.67	24	26.75	-	12.3	13
	BS 4190	23.16	24.00	26.17	27.70	12.45	13.55
	BS 3692	23.67	24.00	26.75	27.70	12.57	13.00
M20	DIN 934	29.16	30	32.95	-	14.9	16
	BS 4190	29.16	30.00	32.95	34.60	15.45	16.55
	BS 3692	29.67	30.00	33.53	34.60	15.57	16.00
M24	DIN 934	35	36	39.55	-	17.7	19
	BS 4190	35.00	36.00	39.55	41.60	18.35	19.65
	BS 3692	35.38	36.00	39.98	41.60	18.48	19.00
M27	DIN 934	40	41	45.2	-	20.7	22
	BS 4190	40.00	41.00	45.20	47.30	21.35	22.65
	BS 3692	40.38	41.00	45.63	47.30	21.48	22.00
M30	DIN 934	45	46	50.85	-	22.7	24
	BS 4190	45.00	46.00	50.85	53.10	23.35	24.65
	BS 3692	45.38	46.00	51.28	53.10	23.48	24.00
M33	DIN 934	49	50	55.37	-	24.7	26
	BS 4190	49.00	50.00	55.37	57.70	25.35	26.65
	BS 3692	49.38	50.00	55.80	57.70	25.48	26.00
M36	DIN 934	53.8	55	60.79	-	27.4	29
	BS 4190	53.80	55.00	60.79	63.50	28.35	29.65
	BS 3692	54.26	55.00	61.31	63.50	28.48	29.00
M39	DIN 934	58.8	60	66.44	-	29.4	31
	BS 4190	58.80	60.00	66.44	69.30	30.20	31.80
	BS 3692	59.26	60.00	66.96	69.30	30.38	31.00

unit in mm

CALCULATION OF SCREW / BOLT LENGTH

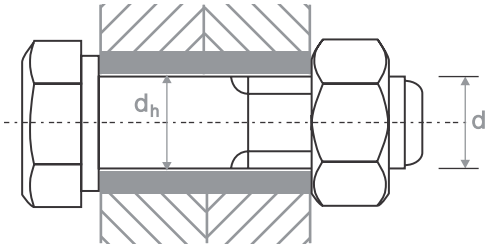


Bolt Length: Total Fixture Thickness + Maximum Thickness of Components + Thread Clearance
(The calculated values have to be rounded off to the next larger standardized length.)

nominal size and thread diameter	specification	maximum nuts thickness	maximum flat washer thickness (BS 4320A)	thread clearance (2 pitch)	thickness of 1 nut, 2 flat washers (BS 4320A) & thread clearance (2 pitch)
M6	BS 4190	5.375	1.8	2	10.98
	BS 3692	5.00	1.8	2	10.60
M8	BS 4190	6.875	1.8	2.5	12.98
	BS 3692	6.50	1.8	2.5	12.60
M10	BS 4190	8.45	2.2	3	15.85
	BS 3692	8.00	2.2	3	15.40
M12	BS 4190	10.45	2.7	3.5	19.35
	BS 3692	10.00	2.7	3.5	18.90
M16	BS 4190	13.55	3.3	4	24.15
	BS 3692	13.00	3.3	4	23.60
M20	BS 4190	16.55	3.3	5	28.15
	BS 3692	16.00	3.3	5	27.60
M24	BS 4190	19.65	4.3	6	34.25
	BS 3692	19.00	4.3	6	33.60
M27	BS 4190	22.65	4.3	6	37.25
	BS 3692	22.00	4.3	6	36.60
M30	BS 4190	24.65	4.3	7	40.25
	BS 3692	24.00	4.3	7	39.60
M33	BS 4190	26.65	5.6	7	44.85
	BS 3692	26.00	5.6	7	44.20
M36	BS 4190	29.65	5.6	8	48.85
	BS 3692	29.00	5.6	8	48.20
M39	BS 4190	31.80	6.6	8	53.00
	BS 3692	31.00	6.6	8	52.20

unit in mm

CLEARANCE HOLES FOR SCREWS AND BOLTS



Thread diameter d	Clearance hole d_h Series: fine	medium	coarse
1	1.1	1.2	1.3
1.2	1.3	1.4	1.5
1.4	1.5	1.6	1.8
1.6	1.7	1.8	2
1.8	2	2.1	2.2
2	2.2	2.4	2.6
2.5	2.7	2.9	3.1
3	3.2	3.4	3.6
3.5	3.7	3.9	4.2
4	4.3	4.5	4.8
4.5	4.8	5	5.3
5	5.3	5.5	5.8
6	6.4	6.6	7
7	7.4	7.6	8
8	8.4	9	10
10	10.5	11	12
12	13	13.5	14.5
14	15	15.5	16.5
16	17	17.5	18.5
18	19	20	21
20	21	22	24
22	23	24	26
24	25	26	28
27	28	30	32
30	31	33	35
33	34	36	38
36	37	39	42
39	40	42	45

Thread diameter d	Clearance hole d_h Series: fine	medium	coarse
42	43	45	48
45	46	48	52
48	50	52	56
52	54	56	62
56	58	62	66
60	62	66	70
64	66	70	74
68	70	74	78
72	74	78	82
76	78	82	86
80	82	86	91
85	87	91	96
90	93	96	101
95	98	101	107
100	104	107	112
105	109	112	117
110	114	117	122
115	119	122	127
120	124	127	132
125	129	132	137
130	134	137	144
140	144	147	155
150	155	158	165

The following tolerance fields are given for information only, for use where it is desirable to specify tolerances:
fine series: H12
medium series: H13
coarse series: H14
In cases where it is necessary to avoid interference between the edge of the hole and the underhead fillet of the bolt, a chamfer is recommended.

unit in mm

Test clamp force and prevailing torques for prevailing torque type nuts of property class 8 (BS EN ISO 2320:2008)

Thread d P	Test clamp force F_{80} [a] N	Clamp force for evaluation of total friction coefficient μ_{tot} [b]		Prevailing torque N m		
		Upper limit F_{75} [c] N	Lower limit F_{65} [d] N	1st installation $T_{Fv,max}$ [e]	1st removal $T_{Fd,min}$ [f]	5th removal $T_{Fd,min}$ [f]
M3	2 336	2 190	1 898	0,43	0,12	0,08
M4	4 080	3 825	3 315	0,9	0,18	0,12
M5	6 584	6 173	5 350	1,6	0,29	0,2
M6	9 280	8 700	7 540	3	0,45	0,3
M7	13 440	12 600	10 920	4,5	0,65	0,45
M8	16 960	15 900	13 780	6	0,85	0,6
M8x1	18 160	17 025	14 755			
M10	26 960	25 275	21 905	10,5	1,5	1
M10x1,25	28 400	26 625	23 075			
M10x1	29 920	28 050	24 310			
M12	39 120	36 675	31 785	15,5	2,3	1,6
M12x1,5	40 880	38 325	33 215			
M12x1,25	42 720	40 050	34 710			
M14	53 360	50 025	43 355	24	3,3	2,3
M14x1,5	58 000	54 375	47 125			
M16	72 800	68 250	59 150	32	4,5	3
M16x1,5	77 520	72 675	62 985			
M18	92 000	86 250	74 750	42	6	4,2
M18x1,5	104 000	97 500	84 500			
M20	117 600	110 250	95 550	54	7,5	5,3
M20x1,5	130 400	122 250	105 950			
M22	145 600	136 500	118 300	68	9,5	6,5
M22x1,5	160 000	150 000	130 000			
M24	169 600	159 000	137 800	80	11,5	8
M24x2	184 000	172 500	149 500			
M27	220 000	206 250	178 750	94	13,5	10
M27x2	238 400	223 500	193 700			
M30	269 600	252 750	219 050	108	16	12
M30x2	298 400	279 750	242 450			
M33	332 800	312 000	270 400	122	18	14
M33x2	365 600	342 750	297 050			
M36	392 000	367 500	318 500	136	21	16
M36x3	415 200	389 250	337 350			
M39	468 800	439 500	380 900	150	23	18
M39x3	494 400	463 500	401 700			

NOTE The evaluation of results from the prevailing torque test by statistical process control methods (SPC) has no statistical relevance.

a The clamp force for property class 8 nuts is equal to 80 % of the proof load of property class 8.8 bolts. Proof loads for bolts are given in ISO 898-1.
b See Annex B.
c The value of the upper limit of the clamp force is equal to 75 % of the proof load, see Annex B.
d The value of the lower limit of the clamp force is equal to 65 % of the proof load, see Annex B.
e The prevailing torques for first assembly apply for all metal type nuts only. For prevailing torque non-metallic insert type nuts, the maximum torques shall be 50 % of the values.
f Values in this table are required for testing performed under laboratory acceptance test conditions. Utilization of this type of fastener is application dependent and performance for parts may vary in normal use. It is recommended that additional testing of complete joints, using production components, be performed when there are questions of product performance.

Proof load, clamp load and prevailing-torques (coarse pitch series) property class 8 (BS 4929-1:1973)

Nominal size and thread diameter d	Pitch of thread u	Tensile stress area (A_s)	Clamp load	Proof load	Prevailing-torque				
					First installation max.	First removal		Fifth removal	
						Highest reading min.	Lowest reading min.	Highest reading min.	Lowest reading min
	mm	mm^2	N	N	Nm	Nm	Nm	Nm	Nm
M3	0.5	5.03	–	–	–	–	–	–	–
M4	0.7	8.78	3 726	6 864	0.9	0.18	0.09	0.12	0.06
M5	0.8	14.2	6 080	11 200	1.6	0.29	0.14	0.23	0.10
M6	1.0	20.1	8 630	15 690	3.0	0.45	0.2	0.30	0.15
M8	1.25	36.6	16 280	28 440	6.0	0.85	0.4	0.60	0.3
M10	1.5	58.0	24 900	45 110	10.5	1.5	0.7	1.0	0.5
M12	1.75	84.3	36 000	65 705	15.5	2.3	1.0	1.6	0.8
(M14)	2	115	49 230	90 220	23.5	8.3*	1.5	2.3	1.0
M16	2	157	67 180	123 564	31.5	4.5	2.0	3.0	1.5
M20	2.5	245	104 930	192 210	54.0	7.5	3.5	5.3	2.5
(M22)	2.5	303	129 450	237 320	67.5	9.5	4.5	6.5	3.0
M24	3.0	353	151 020	276 550	80.0	11.5	5.5	8.0	4.0
(M27)	3.0	459	196 130	360 000	94.0	13.5	6.5	10.0	5.0
M30	3.5	561	240 260	439 340	108	16.0	8.0	12.0	6.0
(M33)	3.5	694	297 140	542 270	122	18.0	9.0	14.0	7.0
M36	4.0	817	349 120	640 370	136	20.5	10.0	16.0	8.0

NOTE 1 Sizes shown in brackets are non-preferred.

NOTE 2 Clamp loads equal 75% of proof loads specified for grade 8.8 bolts or screws in BS 3692 (ISO/R 898).

Clamp load = stress under proof load x tensile stress area x $\frac{75}{100}$

for 8.8 bolts or screws = 571 x A_s x $\frac{75}{100}$N

* May due to typing error in BS 4929-1