Hexagon Head Bolts/Screws

Metric Series—Physical Properties—Tightening Torques

Physical Properties :

Property Class			8.8				10.9	
Dimeter			≤ M 16		> M 16		all diameters	
Unit			N/mm²	Kgf/mm²	N/mm²	Kgf/mm²	M/mm²	Kgf/mm²
Tensile Strength, Min.			800	81.5	830	84.6	1040	106.0
Yield Strength, 0.2% offset Min.			640	65.2	660	67.2	940	95.8
Proof Lead Stress			580	59.1	600	61.2	830	84.6
Shear Strength, Min.			480	48.9	498	50.8	624	63.6
Hardness	Brinell	HB	219-285		242-319		295-362	
	Rockwell	HRC	20-30		23-34		31-39	
Elongation % on GL = $\sqrt{5.65A}$. A= Cross Sectional Area.			12% Min.				9% Min	

Recommended Tightening Torques and Induced Loads :

Thread Size	Stress Area mm²	Property Class 8.8				Property Class 10.9			
		Torque		Induced Load		Torque		Induced Load	
		Nm	Kgm.	N	Kgs.	NM	Kgm.	N	Kgs.
M4	8.78	3.0	0.30	3877	395	4.3	0.44	5695	580
M5	14.2	6.0	0.62	6361	648	8.9	0.91	9344	952
M6	20.1	10.3	1.05	9005	918	15.1	1.54	13230	1348
M8	36.6	25.0	2.54	16400	1671	37.0	3.73	24080	2455
M10	58.0	50.0	5.11	26360	2686	74.0	7.50	38700	3946
M12	84.3	87.0	8.90	38300	3905	128.0	13.08	56300	5735
(M14)	115.0	139.0	14.17	52300	5327	205.0	20.82	76800	7824
M16	157.0	214.0	21.82	72300	7375	315.0	32.06	106300	10832
(M18)	192.0	304.0	30.97	91200	9300	435.0	44.10	129900	13246
M20	245.0	431.0	43.91	116400	11868	615.0	62.54	165800	16903
(M22)	303.0	586.0	59.74	144000	14677	835.0	85.08	205100	20904
M24	353.0	745.0	75.94	167700	17100	1060.0	108.00	238700	24333
(M27)	459.0	1090.0	111.00	218100	22234	1550.0	158.00	310400	31640
M30	561.0	1480.0	150.00	266600	27175	2105.0	214.60	379400	38671
(M33)	694.0	2013.0	205.20	329800	33618	2865.0	292.00	469300	47839
M36	817.0	2586.0	263.60	388200	39576	3680.0	375.00	552500	56318
(M39)	976.0	3346.0	341.10	463800	47278	4760.0	485.40	660000	67278
M42	1120.0	4135.0	421.50	532200	54253	5880.0	599.80	757400	77205

Note :

The tightening torques calculated to induce approximate stresses as under in screw threads:

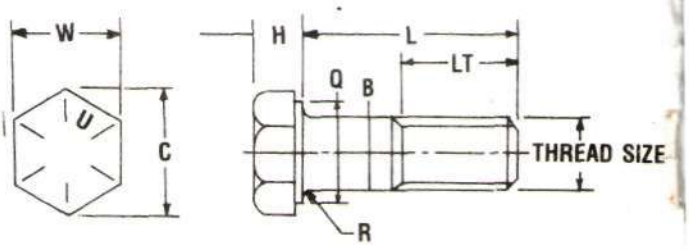
448 N/mm² for Property Class 8.8, dia ≤ M16
462 N/mm² for Property Class 8.8, dia > M16
658 N/mm² for Property Class 10.9.

Hexagon Head Bolts/Screws

Inch Series, UNC/UNF—Dimensions

Note :

1. The bolts and screws will generally conform to ANSI B 18.2.1 (Bolts/Screws made to ANSI B.18.2.1 will also generally conform to B.S.1768).
2. Threads will conform to class 2A of ANSI B1.1 or BS 1580 for Unified threads (Coarse Fine).
3. Material : Unbrako High grade carbon/alloy steel.
4. Heat Treatment : As per SAE grade 5 or 8 (Bolts/Screws made to SAE grade 5 and 8 will also generally conform to requirements of grade 'S' & 'V' of BS 1768 respectively.
5. Thread Length LT:
   LT1 for L ⩽ 6
   LT2 for L > 6
6. Screw lengths equal to or shorter than those listed in row 'LFT' will be threaded to head.
7. All dimensions are in inches.



Thread Size	Pitch		W Max.	C Min.	B Max.	H Nom.	R Min.	Q Min	Length of Thread			Length Range L
	UNC	UNF							LT1	LT2	LFT	
1/4"	20	28	0.4375	0.505	0.2500	0.158	0.015	0.411	3/4	-	1	1/2-2.1/4
5/16"	18	24	0.5000	0.577	0.3125	0.206	0.015	0.473	7/8	-	1.1/8	1/2-4
3/8"	16	24	0.5625	0.650	0.3750	0.238	0.015	0.535	1	-	1.1/4	1/2-4
7/16"	14	20	0.6250	0.722	0.4375	0.286	0.015	0.595	1.1/8	-	1.3/8	3/4-3.1/2
1/2"	13	20	0.7500	0.866	0.5000	0.318	0.015	0.720	1.1/4	1.1/2	1.1/2	3/4-3.1/2
5/8"	11	18	0.9375	1.083	0.6250	0.398	0.020	0.908	1.1/2	1.3/4	1.7/8	1-8
3/4"	10	16	1.1250	1.300	0.7500	0.473	0.020	1.090	1.3/4	2	2.1/8	1.1/2-8
7/8"	9	14	1.3125	1.515	0.8750	0.553	0.040	1.275	2	2.1/4	2.3/8	1.1/2-8
1"	8	12	1.5000	1.732	1.0000	0.617	0.060	1.463	2.1/4	2.1/2	2.5/8	1.1/2-8

Hexagon Head Bolts/Screws

Inch Series, UNC/UNF—Physical Properties—Tightening Torques:

Grade	Grade 5	Grade 8
Tensile Strength(Min)	120000 lbs/in^2	150000 lbs/in^2
	84.5Kgf/mm^2	105.4 Kgf/mm^2
Proof Load Stress	85000 lbs/in^2	120000 lbs/in^2
	59.9Kgf/mm^2	84.5 Kgf/mm^2
Elongation % on GL= 4 x Gauge Dia	14%	12%
Rockwell Hardness	RC 25-34	RC 33-39

Recommended Tightening Torques and Induced Loads UNC Thread

Thread Size	Stress Area	Grade 5		Grade 8	
		Torque	Induced Load	Torque	Induced Load
1/4"	0.0324	99.1	2086	140.	2948
5/16"	0.0532	203.4	3426	287.4	4841
3/8"	0.0786	360.5	5061	509.7	7152
7/16"	0.1078	577.1	6942	815.4	9809
1/2"	0.1438	879.6	9260	1243.2	13085
5/8"	0.2290	1705.2	14748	2409.5	20839
3/4"	0.3380	3020.0	21767	4267.6	30758
7/8"	0.4670	4868.5	30075	6878.7	42497
1"	0.6120	7291	39412	10302.9	55692

Recommended Tightening Torques and Induced Loads UNF Thread

Thread Size	Stress Area	Grade 5		Grade 8	
		Torque	Induced Load	Torque	Induced Load
1/4"	0.0368	112.5	2370	159.1	3349
5/16"	0.0587	224.4	3780	317.2	5341
3/8"	0.0887	406.6	5706	574.5	8063
7/16"	0.1198	641.3	7715	906.2	10902
1/2"	0.1612	986.2	10381	1393.5	14669
5/8"	0.2580	1921.1	16615	2715.0	23478
3/4"	0.375	3351.0	24150	4735.0	34125
7/8"	0.513	5326.5	33037	7557	46683
1"	0.667	7946.2	42955	11229	60697

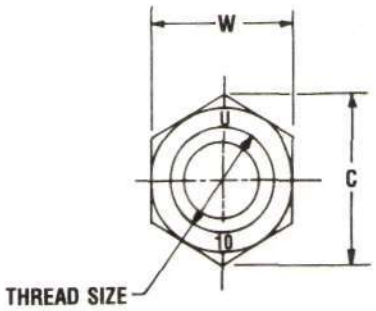
Note :
The tightening torques calculated to induce stress equal to approximately 70% of Yield Stress.

Hexagon Nuts

Metric Series–Dimensions–Physical Properties

Note :

1. The nuts will generally conform to IS : 1364, ISO 4032, DIN 934.
2. Threads will conform to class 6H of IS : 4218, Coarse Series.
3. Material & Heat Treatment
   To achieve mechanical properties of Property Class 8 or 10 of IS : 1367-VI.
4. Nuts of Property Class 8 are used with bolts of Property Class 8.8 Nuts of Property Class 10 are used with bolts of Property Class 10.9. (In general, nuts of a higher property class can replace nuts of a lower property class in a joint)
5. In Bolts/Nut assembly, tightening should be done by rotation of nut. Torque values as recommended in tables for bolts (p:5).
6. Sizes in brackets are non-preferred standards.
7. All dimensions are in millimeters.



Dimensions :

Thread size	Pitch	W Max.		C Min.		H Max.	
M4	0.7	7.0		7.66		3.20	
M5	0.8	8.0		8.79		4.00	4.70
M6	1.0	10.0		11.05		5.00	5.20
M8	1.25	13.0		14.38		6.50	6.80
M10	1.5	17.0	16.0	18.90	17.77	8.00	8.40
M12	1.75	19.0	18.0	21.10	20.03	10.00	10.80
(M14)	2.0	22.0	21.0	24.49	23.35	11.00	12.80
M16	2.0	24.0		26.75		13.00	14.80
(M18)	2.5	27.0		29.56		15.00	15.80
M20	2.5	30.0		32.95		16.00	18.00
(M22)	2.5	32.0	34.0	35.72	37.72	18.00	19.40
M24	3.0	36.0		39.55		19.00	21.50
(M27)	3.0	41.0		45.20		22.00	23.80
M30	3.5	46.0		50.85		24.00	25.60
(M33)	3.5	50.0		55.37		26.00	28.70
M36	4.0	55.0		60.79		29.00	31.00
(M39)	4.0	60.0		66.44		31.00	33.40
M42	4.5	65.00		72.09		34.00	

Dimension in accordance with revised standards–in the process of being implemented.

Identification Marking for new Across flat will be as Shown in the figure.

Physical Properties

Nut Size		Property Class 8					Property Class 10				
		Proof Load Stress	Hardness HV		Hardness HR		Proof Load Stress	Hardness HV		Hardness HRC	
Over	To	N/mm²	Min.	Max.	Min	Max.	N/mm²	Min.	Max.	Min.	Max.
	M4	800	170	302	HRB 87	HRC 30	1040	272	353	26	36
M4	M7	810	188		HRB 90		1040				
M7	M10	830					1040				
M10	M16	840					1050				
M16	M42	920	233	353	HRC 19	HRC 36	1060				

Quick Production Selection Guide

PRODUCT	TENSILE STRENGTH		SIZE RANGE				EQUIVALENT STANDARDS					
	Property Class		Diameter		Length							
	Psi. Min.	N/mm²	Metric	Inch*	Metric	Inch*	IS	ISO	DIN	BS	ANSI	JIS
Socket Head Cap Screws 	190000	1,300 (12.9)	M2 to M42	1/8 to 1"	6 to 300 mm	3/16" to 10"	2269	4762	912	4168 2470	B18.3.1M	B1176
Socket Countersunk Head Screws 	160000	1,050 (12.9)	M3 to M24	3/16" to 5/16"	6 to 60 mm	3/8" to 1.1/4"	6761	--	7991	4168 2470	B18.3.5M	--
Socket Button Head Cap Screws 	--	1,050 (12.9)	M3 to M12	--	6 to 50 mm	--	--	7380	9427	4168	B18.3.4M --	--
Socket Head Shoulder Screw 	--	(12.9)	M6 to M24	--	10 to 120 mm	--	--	7379	9841	4168	--	--
Socket Set Screws Knurled Cup 	Hardness HRc 45 Min.		M3 to M20	1/8" to 3/4"	3 to 85 mm	3/16" to 3"	6094	4026 4027 4028 4029	913 914 915 916	4168 2470	B18.3.6M	B1177
Durlok Bolt 	--	12.9	M6 to M20	--	12 to 100 mm	--	As Per Unbrako Specification					
Hex Wrenches 	Hardness HRc 47 Min.		1.5 to 32 mm	1/16" to 3/4"	--	--	3082	2936	911	4168 2470	B18.3.2M	B4648
Hex Head Bolts 	800/830 (8.8) 1,040 (10.9)	Grade R,S V	M4 to M42	1/4" to 2"	10 to 300 mm	1/2" to 12"	1364	4014 4017	931 933	1083 1768	B18.2.1	B1180
Hex Nuts 	Nut Grade 8/10	Nut Grade 8/5	M6 to M72	1/4" to 1-1/2"	--	--	1364	4032	934	1083 1768	B18.2.4.1M B18.2.2	B1181
High Strength Structural Bolts, Nuts, Washers 	Bolts 8.8/10.9 Nuts 8/10	--	M16 to M30	--	40 to 300 mm	--	3757 6623 6649	7412 4775 7415	6914 6915 6916	4395	B18.2.3.7M B18.2.4.6M	B1186
Stud With 2 Heavy nuts 	Stud B7 Nut 2H		M12-M56	1/2" to 2-1/4"	60 to 500 mm	2.1/4" to 27"					A193 A194	
Special Products 	--	800/830 (8.8) 1,040 (10.9)	M3 to M42	1/8" to 1"	6 to 410 mm	3/8" to 12"	As per customer specifications					

*Thread type in any of the following inch series : BSW, BA, UNC & UNF.
** Thread type in NPTF
Note : UNBRAKO standards meet, or in many instances, exceed the requirements of the standards listed.

Plating : No guarantee can be given for UNBRAKO products which have been plated by the users and / or outside plates, who may not have considered hydrogen embrittlement problem.

Thread Size Comparison

METRIC PRODUCTS						
SIZE	THREAD PITCH & T.P.I.				Major Dia	
	COARSE		FINE			
	PITCH (mm)	T.P.I.	PITCH (mm)	T.P.I.	mm	Inch
M3	0.50	51	–	–	3.00	0.118
M4	0.70	36	–	–	4.00	0.157
M5	0.80	32	–	–	5.00	0.197
M6	1.0	25	–	–	6.00	0.236
M8	1.25	20	1.00	25	8.00	0.315
M10	1.50	17	1.25	20	10.00	0.394
M12	1.75	14.5	1.25	20	12.00	0.472
(M14)	2.00	12.5	1.50	17	14.00	0.551
M16	2.00	12.5	1.50	17	16.00	0.630
(M18)	2.50	10	1.50	17	18.00	0.709
M20	2.50	10	1.50	17	20.00	0.787
(M22)	2.50	10	1.50	17	22.00	0.866
M24	3.00	8.5	2.00	13	24.00	0.945
(M27)	3.00	8.50	2.00	13	27.00	1.063
M30	3.50	7.25	2.00	13	30.00	1.181
(M33)	3.50	7.25	2.00	13	33.00	1.299
M36	4.00	6.40	3.00	8.5	36.00	1.417
(M39)	4.00	6.40	3.00	8.5	39.00	1.535
M42	4.50	5.60	3.00	8.5	42.00	1.653

UNIFIED INCH PRODUCTS			
SIZE	T.P.I.		Major Dia
	UNC	UNF	inch
#5	40	44	0.125
#6	32	40	0.138
#8	32	36	0.164
#10	24	32	0.190
1/4	20	28	0.250
5/16	18	24	0.313
3/8	16	24	0.375
1/2	13	20	0.500
5/8	11	18	0.625
3/4	10	16	0.750
7/8	9	14	0.875
1	8	12	1.000
1-1/8	7	12	1.125
1-1/4	7	12	1.250
1-1/2	6	12	1.500

B.S. INCH PRODUCTS					
SIZE	T.P.I.		Major Dia	T.P.I.	Major Dia
	BSW	BSF	inch	BA	inch
1/8	40	-	0.125		
5 BA				43.1	0.126
4 BA				38.5	0.142
3 BA	24	32	0.187	34.8	0.161
3/16					
2 BA				31.3	0.185
1 BA				28.2	0.209
1/4	20	26	0.250	25.4	0.236
0 BA					
5/16	18	22	0.313		
3/8	16	20	0.375		
7/16	14	18	0.438		
1/2	12	16	0.500		
5/8	11	14	0.625		
3/4	10	12	0.750		
7/8	9	11	0.875		
1	8	10	1.000		
1-1/8	7	9	1.125		
1-1/4	7	9	1.250		
1-1/2	6	8	1.500		

Note : Sizes in brackets are non-preferred standards

Plating : No guarantee can be given for UNBRAKO products which have been plated by the users and / outside plates, who may not have considered hydrogen embrittlement problem.

Comparison of Different Strength Grades

SAE	B.S.	IS 1.S.D. DIN	ULTIMATE TENSILE STRENGTH			HARDNESS		
			Tonnes/In^2 (Kgf/mm^2)	Newtons/mm^2 Min. (Kgf/mm^2)	Pounds/In^2 Min. (Kgf/mm^2)	BHN	HRb	HRc
		4.6		400 (40.8)		114 209	67 95	
GRADE 1					60,000 (42.3)	(121) (241)	70 100	
		4.8		420 (42.8)		124 209	71 95	
		5.6		500 (51.0)		147 209	79 95	
GRADE 2					74,000 (52.1)	(154) (241)	80 100	
		5.8		520 (53.0)		152 209	82 95	
	P		35/45 (55.2/71.0)			152 207		
		6.8		600 (61.2)		181 238	89 99	
	R		45/55 (71.0/86.8)			201 285		
	S		50/60 (78.9/94.7)			223 310		(20/33)
		8.8		800≤ M16 830> M16 (81.6) (84.6)		219/285 242/319		20/30 23/34
GRADE 5					1,20,000 (84.6)	(266) (318)		25/34
	T		55/65 (86.8/102.6)			248 335		(24/36)
	U		60/70 (94.7/110.5)			269 331		(28/36)
	V		65/75 (102.6/118.4)			293 370		(31/40)
GRADE 8					1,50,00 (105.7)	(311) (362)		33/39
		10.9		1,040 (106.0)		295 362		31/39
	W		70/80 (110.5/126.3)			311 375		(33/41)
	X		75/85 (118.4/134.2)			341 410		(37/44)
		12.9		1,220 (124.4)		353 412		38/44
	Y		80/90 (126.3/142.0)			363 429		(39/46)
	Z		100 Min (157.8)			444		(47)

Note : 1. : 1Kgf=9.81 Newtons 1Kgf/mm^2=1421.7 Psi 2. : Values in brackets are approximate conversions