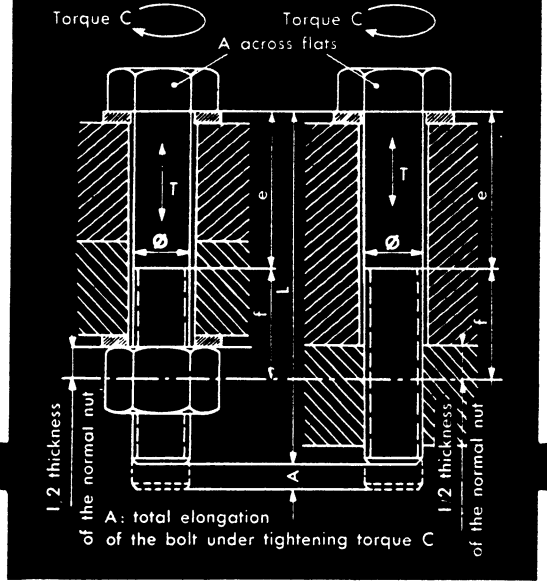


elongations of standard bolts (international standard threads) subjected to the tightening torques and bolt tensions recommended in the table on the opposite page

The following elongations have been calculated subject to the same conditions as were applied in preparing the table on the opposite page, i. e. : use of three-fourths of the elastic limit of bolts, for a coefficient of friction of 0.12, corresponding to bolts which are **mounted greased,** and carefully manufactured from the standpoint of condition of the surfaces and the geometric standards used in production.
To obtain the elongations representing the elastic limit of bolts, multiply the following elongations by 1.33.

	Soft Steel Bolts AFNOR RATING C 20 Breaking Stress : 45 kg/mm² Elastic Limit : 25 kg/mm²	Semi-Hard Steel Bolts AFNOR RATING C35 Breaking Stress : 65 kg/mm² Elastic Limit : 32 kg/mm²	Hard Steel Bolts AFNOR RATING C45 Breaking Stress : 75 kg/mm² Elastic Limit : 38 kg/mm²	Heat treated Hard Steel Bolts AFNOR RATING C45 Breaking Stress : 90 kg/mm² Elastic Limit : 65 kg/mm²	Heat treat. Nickel Chrome Steel Bol. AFNOR RATING 16 N C 6 Breaking Stress : 130 kg/mm² Elastic Limit : 90 kg/mm²
Elongations of the threaded part (machine-made and rolled bolts). Elongations indicated for a threaded part 100 mm on length, whatever the diameter of the bolt. A_1	mm 0,09	mm 0,12	• mm 0,14	mm 0,24	mm 0,34
Average elongations of the smooth part of machine-made bolts. Elongations indicated for a smooth part 100 mm in length, whatever the diameter of the bolt. A_2	0,06	0,08	• 0,09	0,16	0,22
Average elongations of the smooth part of rolled bolts. Elongations indicated for a smooth part 100 mm in length, whatever the diameter of the bolt. A_3	0,07	0,09	• 0,11	0,18	0,25

calculating the elongation of a bolt subjected to a given tightening torque

The elongations are proportional to the tightening torques; they vary according to the quality of the steel and according to the section of the bolt (that is why the elongations indicated above differ, depending on whether the part is threaded or smooth, machine-made or rolled); furthermore, they are proportional to the length of the bolt (the values indicated above are for 100 millimeters). To ascertain the elongation of a bolt as an absolute value, you need only compute two successive rules of three for the threaded part and the smooth part, and add together the two values obtained.

Example : A diameter 12 IS bolt of hard steel, untreated. Length of the useful threaded part f = 25 mm.
Length of the smooth part under the bolt head e = 30 mm.

A - ELONGATION OF THE THREADED PART

Machine-made or rolled bolt (cf. line A_1).
The table indicates, for 4.2 mkg and for a threaded part 100 mm in length, an elongation of 0.14 mm (cf. black dots above).
At a torque of 3 mkg and for a threaded part 100 mm in length, the elongation would be $\frac{0.14 \times 3}{4.2} = 0.10$ mm.

At a torque of 3 mkg and for a threaded part 25 mm in length, the elongation would be $\frac{0.10 \times 25}{100} = 0.025$ mm.

The bolt and screw tightening torque indications shown in these tables are the result of calculations and tests carried out by the Engineering Bureau of the FACOM Company.

B - ELONGATION OF THE SMOOTH PART

a) Machine-made bolt (cf. line A_2).
The table indicates, for 4.2 mkg and for a smooth part 100 mm in length, an elongation of 0.09 mm (cf. black dots above).
At a torque of 3 mkg and for a smooth part 100 mm in length, the elongation would be $\frac{0.09 \times 3}{4.2} = 0.064$ mm.

At a torque of 3 mkg and for a smooth part 30 mm in length, the elongation would be $\frac{0.064 \times 30}{100} = 0.0193$ mm.

b) Rolled bolt (cf. line A_3).
The table indicates, for 4.2 mkg and for a smooth part 100 mm in length, an elongation of 0.11 mm (cf. black dots above).
At a torque of 3 mkg and for a smooth part 100 mm in length, the elongation would be $\frac{0.11 \times 3}{4.2} = 0.078$ mm.

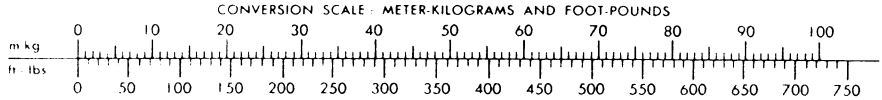
At a torque of 3 mkg and for a smooth part 30 mm in length, the elongation would be $\frac{0.078 \times 30}{100} = 0.0235$ mm.

C - TOTAL ELONGATION

a) Machine-made bolt - At a tightening torque of 3 mkg, the diameter 12 IS bolt (f = 25, e = 30) of untreated hard steel would have a total elongation of 0.025 + 0.0193 = 0.044 mm.

b) Rolled bolt - At a tightening torque of 3 mkg, the diameter 12 IS bolt (f = 25,e = 30) of untreated hard steel would have a total elongation of 0.025 + 0.0235 = 0.048 mm.

CONVERSION SCALE : METER-KILOGRAMS AND FOOT-POUNDS



Example : 20 m kg = 145 ft-lbs
100 ft-lbs = 13,8 m kg

TS 2 - torque tables

Table of tightening torques recommended for standard bolts and screws.

tightening torque and bolt tension recommended for standard bolts (international standard threads)

The tightening torques and bolt tension indications listed below are based on use of 75 % of the elastic limit of bolts for a coefficient of friction of 0.12, corresponding to bolts which are **mountend greased,** and carefully manufactured from the standpoint of condition of the surfaces and the geometric standards used in production. These loads are an exact indication of the **normal** tightening twist which can be applied to bolts, and may be used to determine the practical amount of tightening torque, in terms of the torque wrench being used.
To determine the tightening torque and bolt tension which represents the elastic limit of bolts, multiply the figures in the table below by 1.33.

Torque Capacity of FACOM Torque Wrenches								Standard Bolt Dimensions (I.S. Threads)			TYPE OF BOLTS									
											Soft Steel Bolts AFNOR Rating C20 Breaking Stress : 45 kg/mm² Elastic Limit : 25 kg/mm²		Semi-Hard Steel Bolts AFNOR Rating C35 Breaking Stress : 65 kg/mm² Elastic Limit : 32 kg/mm²		Hard Steel Bolts AFNOR Rating C45 Breaking Stress : 75 kg/mm² Elastic Limit : 38 kg/mm²		Heat Treated Hard Steel Bolts AFNOR Rating C45 Breaking Stress : 90 kg/mm² Elastic Limit : 65 kg/mm²		Heat Treated Nickel Chrome Steel Bolts AFNOR Rating 16NC6 Breaking Stress : 130 kg/mm² Elastic Limit : 90 kg/mm²	
R 200	J 200	S 200	S 203	S 203 with S 214	S 203 with K 214	K 200	M 200	Bolt Diameter	Thread Pitch	Bolt Head Dimensions Across Flats	Recommended Tightening Torque	Bolt Tension Developed	Recommended Tightening Torque	Bolt Tension Developed	Recommended Tightening Torque	Bolt Tension Developed	Recommended Tightening Torque	Bolt Tension Developed	Recommended Tightening Torque	Bolt Tension Developed
0 to 2 mkg	0 to 10 mkg	0 to 25 mkg	0 to 20 mkg	0 to 40 mkg	0 to 60 mkg	0 to 80 mkg	0 to 250 mkg	⌀ in mm	P in 1/100 mm	A in mm	C in mkg	T in kg	C in mkg	T in kg	C in mkg	T in kg	C in mkg	T in kg	C in mkg	T in kg
								4	75	7	0,09	128	0,12	164	0,14	194	0,23	340	0,33	460
								5	90	8	0,17	206	0,22	265	0,27	315	0,46	535	0,63	740
								6	100	10	0,32	310	0,41	400	0,49	470	0,84	805	1,16	1 120
								7	100	12	0,55	456	0,71	585	0,84	690	1,45	1 180	2,00	1 640
								8	125	14	0,80	575	1,03	740	1,22	870	2,10	1 500	2,90	2 060
								9	125	16	1,20	770	1,54	990	1,82	1 170	3,10	2 000	4,30	2 760
								10	150	17	1,58	915	2,03	1 170	2,40	1 390	4,10	2 380	5,70	3 300
								11	150	19	2,20	1 170	2,80	1 500	3,35	1 780	5,70	3 050	7,90	4 200
								12	175	21	2,77	1 330	3,55	1 700	• 4,20	• 2 020	7,20	3 450	10,00	4 800
								14	200	23	4,35	1 840	5,55	2 350	6,60	2 790	11,30	4 800	15,60	6 600
								16	200	26	6,80	2 550	8,70	3 250	10,40	3 880	17,70	6 600	24,50	9 200
								18	250	29	9,30	3 070	11,90	3 950	14,20	4 670	24,20	8 000	33,50	11 000
								20	250	32	13,20	3 980	16,90	5 100	20,00	6 000	34,50	10 400	47,50	14 300
								22	250	35	18,00	5 050	23,00	6 450	27,40	7 700	47,00	13 100	65,00	18 200
								24	300	38	22,60	5 800	29,00	7 400	34,40	8 800	59,00	15 100	81,00	20 800
								27	300	42	33,50	7 650	43,00	9 800	51,00	11 600	87,00	19 900	120,00	27 500
								30	350	46	45,00	9 200	57,50	11 800	68,50	14 000	117,00	24 000	162,00	33 000
								33	350	50	61,00	11 500	78,00	14 800	93,00	17 500	159,00	30 000	220,00	41 500
								36	400	54	80,00	13 500	102,00	17 300	122,00	20 500	208,00	35 000	288,00	48 500
								39	400	58	102,00	16 500	130,00	21 000	155,00	25 000	265,00	43 000	356,00	59 000
								42	450	63	126,00	18 800	152,00	24 000	194,00	28 500	330,00	48 700	460,00	67 500
								45	450	67	158,00	22 000	202,00	28 200	240,00	33 500	410,00	57 300	570,00	79 500
								48	500	71	190,00	24 700	242,00	31 600	286,00	37 600	490,00	64 200	675,00	89 000
								52	500	77	245,00	29 900	313,00	38 000	372,00	45 300	635,00	77 500	880,00	107 000

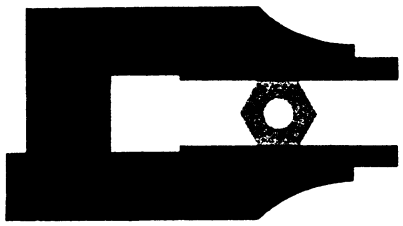
computing the tension developed by a given torque and, conversely, computing the torque needed to develop a given tension

Whatever the type of bolt used and for a given bolt diameter, there is a definite ratio between the tension developed and the tightening torque applied. A simple *rule of three* will give us the tension in terms of the torque, using the figures in the table which correspond to the bolt diameter.

Example : Diameter 12 IS. bolt of hard untreated steel.
The table indicates for 4 mkg 2 a bolt tension of 2020 kg (see black dotted figures above).
The bolt tension developed by applying 3 mkg of torque would be $\frac{2020 \times 3}{4,2} = 1440$ kg.

Conversely, the torque which would produce a bolt tension of 1500 kg would be $\frac{4,2 \times 1500}{2\,020} = 3,12$ mkg.

TS 1 - torque specification table - Table showing tightening torques specified by automobile manufacturers.



comparative table

when ordering your FACOM wrenches always specify the dimensions across flats

METRIC SYSTEM

Dimensions across flats (mm)	Diameter of Bolt									
	France		Germany		Sweden				Norway Denmark	
	Afnor		Din		Sms					
	NF-E-27311 February 1930	PN-E-27311 March 1959	Metric	Whitworth	Metric Small	Metric Large	Whitworth Small	Whitworth Large	Metric	Whitworth
mm	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts
3										
3,2		1,6								
3,5			1,7							
4	2,5	2	2		2,3				1,7	
4,5			2,3		2,6				2	
5	3	2,5	2,6		3				2,3	
5,5		3	3						2,6	
6	3,5	3,5	3,5	1/8	3,5	3			3	
7	4 4,5	4	4		4	3,5			3,5	
8	5	5			5	4			4	
9	5,5		5	3/16		5			5	
10	6	6	6		6					
11		7	7	1/4	7	6	1,4		6 7	1,4
12	7				8					
13		8					5/16	1,4		
14	8		8	5/16		8			8	5/16
15					10		3,8	5,16		
16	9									
17	10	10	10	3/8		10			9 10	
18					12		7/16	3,8		
19	11	12	12	7/16					11	7/16
20										
21	12				14		1/2	7,16		
22		14	14	1/2		12 14			12 14	1/2
23	14							1,2		
24		16	16		16		5/8			
25										
26	16									
27		18	18	5/8	18	16			16	5/8
28							3/4	5/8		
29	18									
30		20	20		20					
32	20	22	22	3/4	22	18 20			18 20	3/4

ENGLISH SYSTEM

Dimensions across flats		Diameter of Bolt: Great Britain			Dimensions across flats		Diameter of Bolt: Great Britain U.S.A.-Canada						
		BSW	BSF BSW	BA			Unified System BS 192-1954						
		Original Whitworth BS-28 and 190	Small hexagon BS-1083	BS-57			Heavy Series		Regular Series		Special Series Bolts and Nuts		
Inches	mm	Bolts and Nuts	Bolts and Nuts	Bolts and Nuts	Inches	mm	Bolts	Nuts	Bolts	Nuts	Screws	Machine-made Nuts	Standard Nuts
0,117	2,97			10									
0,131	3,33			9									
0,152	3,86			8									
0,172	4,37			7									
0,193	4,90			6	3/16	4,76					4	4	
0,220	5,59			5									
0,248	6,30			4	1/4	6,35					6 8	6	4
0,282	7,16			3									
0,297	7,54				5/16	7,94					10	8 10	6
0,324	8,23			2	11/32	8,73							8
0,338	8,64	1/8	3/16										
0,365	9,27			1	3/8	9,53							10
0,413	10,44		7/32	0									
0,445	11,30	3/16	1/4		7/16	11,11			1/4	1/4		1/4	1/4
					1/2	12,7			5/16	5/16		5/16	
0,525	13,33	1/4	5/16		9/16	14,29			3,8	3/8		3,8	5/16
0,600	15,24	5,16	3/8										
					5/8	15,88			7,16				3/8
					11/16	17,46				7/16			
0,710	18,03	3,8	7,16		3/4	19,05			1,2	1,2			
0,820	20,83	7/16	1,2										
					13/16	20,64			9/16				
					7/8	22,23	1/2	1/2		9/16			
0,920	23,34	1,2	9/16		15/16	23,81			5,8	5/8			
1,010	25,65	9/16	5/8		1	25,4							
					1 1/16	26,99	5/8	5/8					
1,100	27,94	5/8	11/16		1 1/8	28,58			3/4	3/4			
1,200	30,48	11/16	3/4										
					1 1/4	31,75	3/4	3/4					

AMERICAN SYSTEM

Dimensions across flats		Diameter of Bolt: U. S. A. American Standard								
		Heavy Series		Regular Series		Light Series	Square Head Screws	Square Head Long Bolt	Special Nuts
Inches	mm	Bolts	Nuts	Bolts	Nuts	Nuts	Screws	Bolts	Nuts
3/32	2,38								
1/8	3,17								
5/32	3,97								0 1
3/16	4,76								2 3
7/32	5,56								
1/4	6,35						1/4		4
9/32	7,14								
5/16	7,94						5/16	10	5 6
11/32	8,73								8
3/8	9,53			1/4			3/8	1/4	10
13/32	10,32								
7/16	11,11				1/4	1/4	7/16		12 14
1/2	12,7		1/4	5/16		5/16	1/2	5/16	
9/16	14,29			3/8	5/16	3/8	9/16	3/8	5/16
19/32	15,08		5/16						
5/8	15,88			7/16	3/8	7/16	5/8	7/16	3/8
11/16	17,46		3/8						
3/4	19,05			1/2	7,16	1,2	3/4	1/2	
25/32	19,84		7/16						
13/16	20,64				1/2				
7/8	22,23	1/2	1/2	9/16	9,16	9/16	7/8	9/16	
15/16	23,81	9/16	9/16	5/8		5/8		5/8	
1	25,4				5/8		1		
1 1/16	26,99	5/8	5/8			3/4			
1 1/8	28,58			3/4	3/4		1 1/8	3/4	
1 3/16	30,16								
1 1/4	31,75	3/4	3/4			7/8	1 1/4		