FOOTPOUND-FORCE TO KILOPONDMETER

1 Footpound = 0,13825 kpm

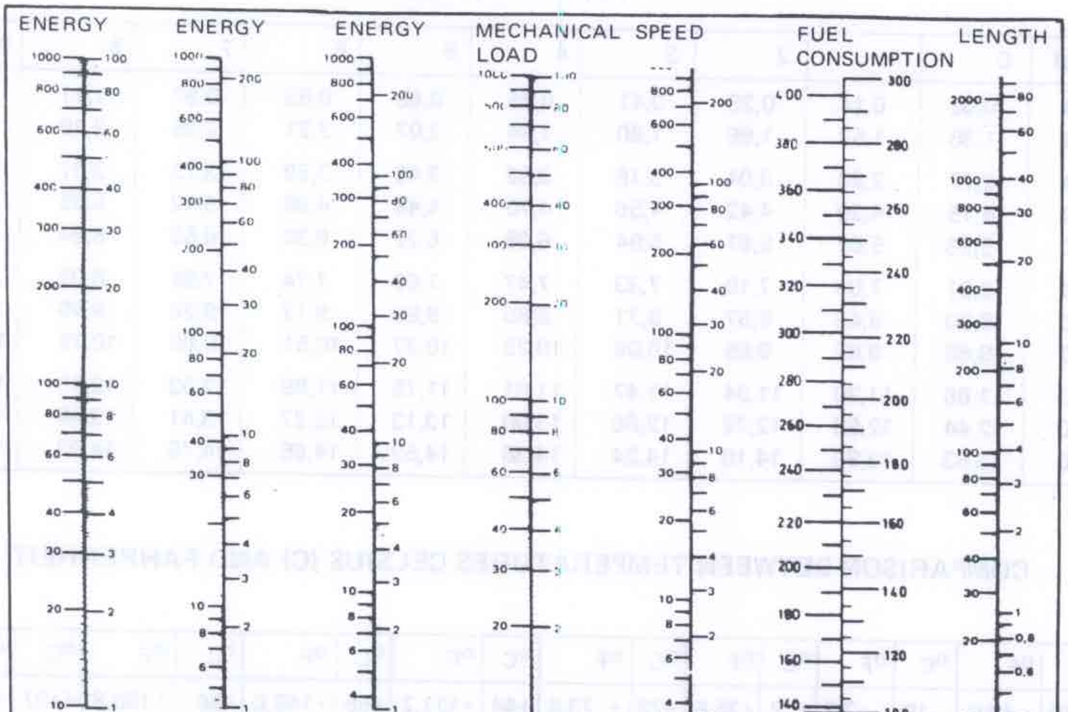
ft.lbf	0	1	2	3	4	5	6	7	8	9
0	0,00	0,14	0,28	0,41	0,55	0,69	0,83	0,97	1,11	1,24
10	1,38	1,52	1,66	1,80	1,94	2,07	2,21	2,35	2,49	2,63
20	2,77	2,90	3,04	3,18	3,32	3,46	3,59	3,73	3,87	4,01
30	4,15	4,29	4,42	4,56	4,70	4,48	4,98	5,12	5,25	5,39
40	5,53	5,67	5,81	5,94	6,08	6,22	6,36	6,50	6,64	6,77
50	6,91	7,05	7,19	7,33	7,47	7,60	7,74	7,88	8,02	8,16
60	8,30	8,43	8,57	8,71	8,85	8,99	9,12	9,26	9,40	9,54
70	9,68	9,82	9,95	10,09	10,23	10,37	10,51	10,65	10,78	10,92
80	11,06	11,20	11,34	11,47	11,61	11,75	11,89	12,03	12,17	12,30
90	12,44	12,58	12,72	12,86	13,00	13,13	13,27	13,41	13,55	13,69
100	13,83	13,96	14,10	14,24	14,38	14,52	14,65	14,79	14,93	15,07

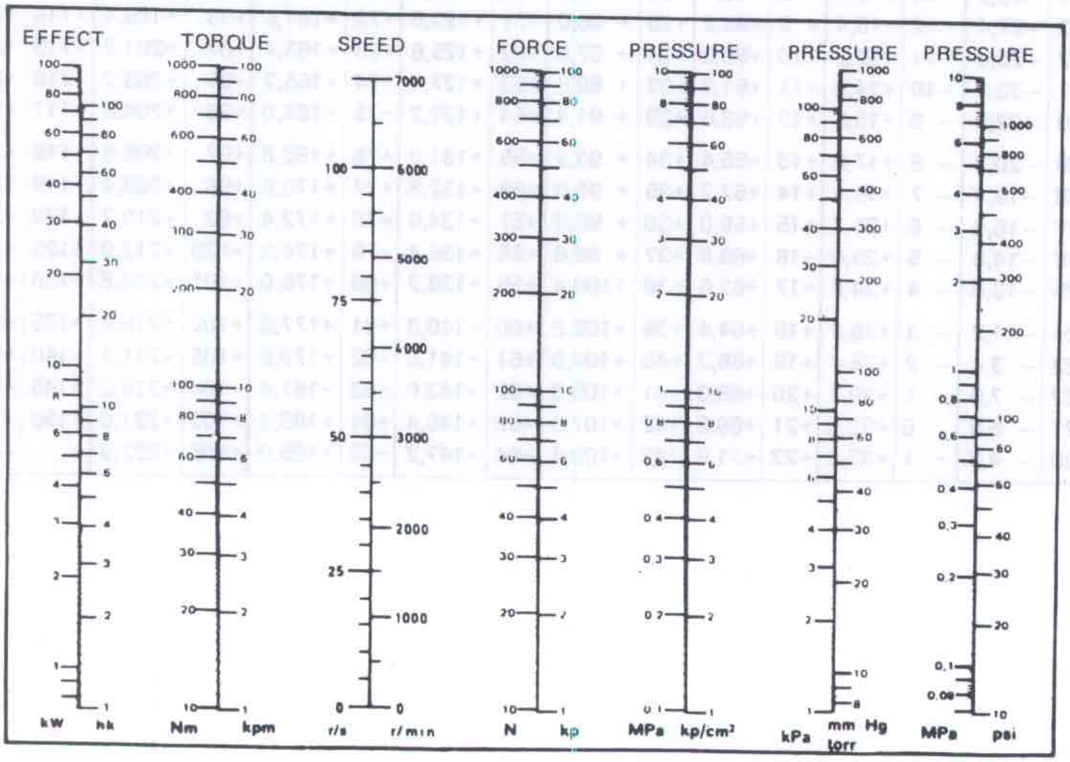
COMPARISON BETWEEN TEMPERATURES CELSIUS (C) AND FAHRENHEIT (F)

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
−40	−40,0	−19	− 2,2	+ 2	+35,6	+23	+ 73,4	+44	+111,2	+65	+149,0	+86	+186,8
−39	−38,2	−18	− 0,4	+ 3	+37,4	+24	+ 75,2	+45	+113,0	+66	+150,8	+87	+188,6
−38	−36,4	−17	+ 1,4	+ 4	+39,2	+25	+ 77,0	+46	+114,8	+67	+152,6	+88	+190,4
−37	−34,6	−16	+ 3,2	+ 5	+41,0	+26	+ 78,8	+47	+116,6	+68	+154,4	+89	+192,2
−36	−32,8	−15	+ 5,0	+ 6	+42,8	+27	+ 80,6	+48	+118,4	+69	+156,2	+90	+194,0
−35	−31,0	−14	+ 6,8	+ 7	+44,6	+28	+ 82,4	+49	+120,2	+70	+158,0	+91	+195,8
−34	−29,2	−13	+ 8,6	+ 8	+46,4	+29	+ 84,2	+50	+122,0	+71	+159,8	+92	+197,6
−33	−27,4	−12	+10,4	+ 9	+48,2	+30	+ 86,0	+51	+123,8	+72	+161,6	+93	+199,4
−32	−25,6	−11	+12,2	+10	+50,0	+31	+ 87,8	+52	+125,6	+73	+163,4	+94	+201,2
−31	−23,8	−10	+14,0	+11	+51,8	+32	+ 89,6	+53	+127,4	+74	+165,2	+95	+203,2
−30	−22,0	− 9	+15,8	+12	+53,6	+33	+ 91,4	+54	+129,2	+75	+167,0	+96	+204,8
−29	−20,2	− 8	+17,6	+13	+55,4	+34	+ 93,2	+55	+131,0	+76	+168,8	+97	+206,6
−28	−18,4	− 7	+19,4	+14	+57,2	+35	+ 95,0	+56	+132,8	+77	+170,6	+98	+208,4
−27	−16,6	− 6	+21,2	+15	+59,0	+36	+ 96,8	+57	+134,6	+78	+172,4	+99	+210,2
−26	−14,8	− 5	+23,0	+16	+60,8	+37	+ 98,6	+58	+136,4	+79	+174,2	+100	+212,0
−25	−13,0	− 4	+24,8	+17	+62,6	+38	+100,4	+59	+138,2	+80	+176,0	+101	+213,8
−24	−11,2	− 3	+26,6	+18	+64,4	+39	+102,2	+60	+140,0	+81	+177,8	+102	+215,6
−23	− 9,4	− 2	+28,4	+19	+66,2	+40	+104,0	+61	+141,8	+82	+179,6	+103	+217,4
−22	− 7,6	− 1	+30,2	+20	+68,0	+41	+105,8	+62	+143,6	+83	+181,4	+104	+219,2
−21	− 5,8	0	+32,0	+21	+69,8	+42	+107,6	+63	+145,4	+84	+183,2	+105	+221,0
−20	− 4,0	+ 1	+33,8	+22	+71,6	+43	+109,4	+64	+147,2	+85	+185,0	+106	+222,8

°C	°F
+107	+224,6
+108	+226,4
+109	+228,2
+110	+230,0
+111	+231,8
+112	+233,6
+113	+235,4
+114	+237,2
+115	+239,0
+116	+240,8
+117	+242,6
+118	+244,4
+119	+246,2
+120	+248,0
+125	+257,0
+130	+266,0
+135	+275,0
+140	+284,0
+145	+293,0
+150	+302,0
−	−

CONVERSION SCALES





FREEZING AND BOILING POINTS FOR ANTI-FREEZE FLUIDS

$$\text{Volume percent} = \frac{\text{Quantity of anti-freeze fluid} \times 100}{\text{entire capacity of radiator}}$$

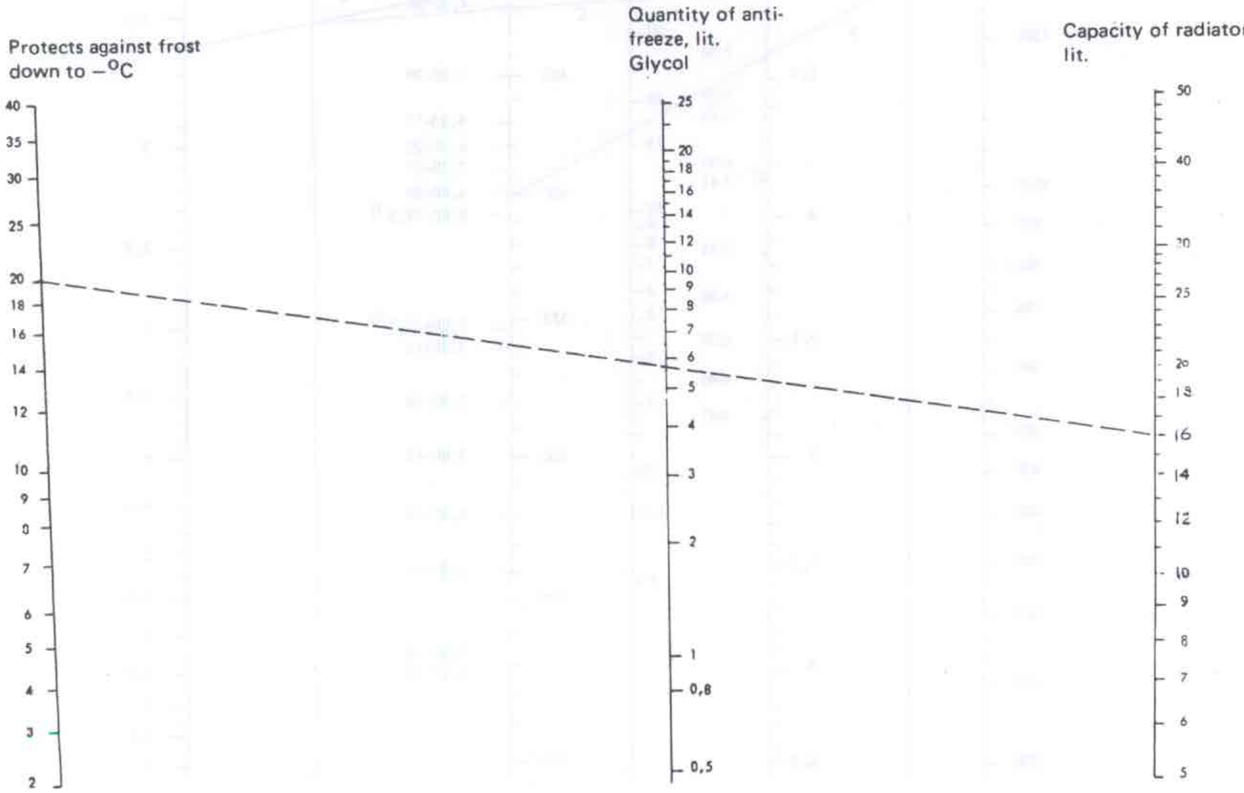
$$\text{Quantity anti-freeze fluid} = \frac{\text{Volume percent} \times \text{entire capacity of radiator}}{100}$$

Volume percent	Density		Freezing point °C		Boiling point °C	
	Glycol	Glycerin	Glycol	Glycerin	Glycol	Glycerin
10	1,012	1,026	−4	−2	+ 101	+ 101
20	1,027	1,052	−9	−7	+ 202	+ 102
30	1,041	1,078	−15	−12	+ 103	+ 103
40	1,055	1,104	−24	−19	+ 104	+ 104
50	1,068	1,130	−37	−27	+ 106	+ 105
60	1,077	1,156	−56	−37	+ 110	+ 108

The correct amount of anti-freeze fluid required for a certain temperature can easily be obtained with the help of the nomogram below. The Nomogram does not give exact values in certain extreme cases. The values obtained are, however, sufficiently accurate for this purpose.

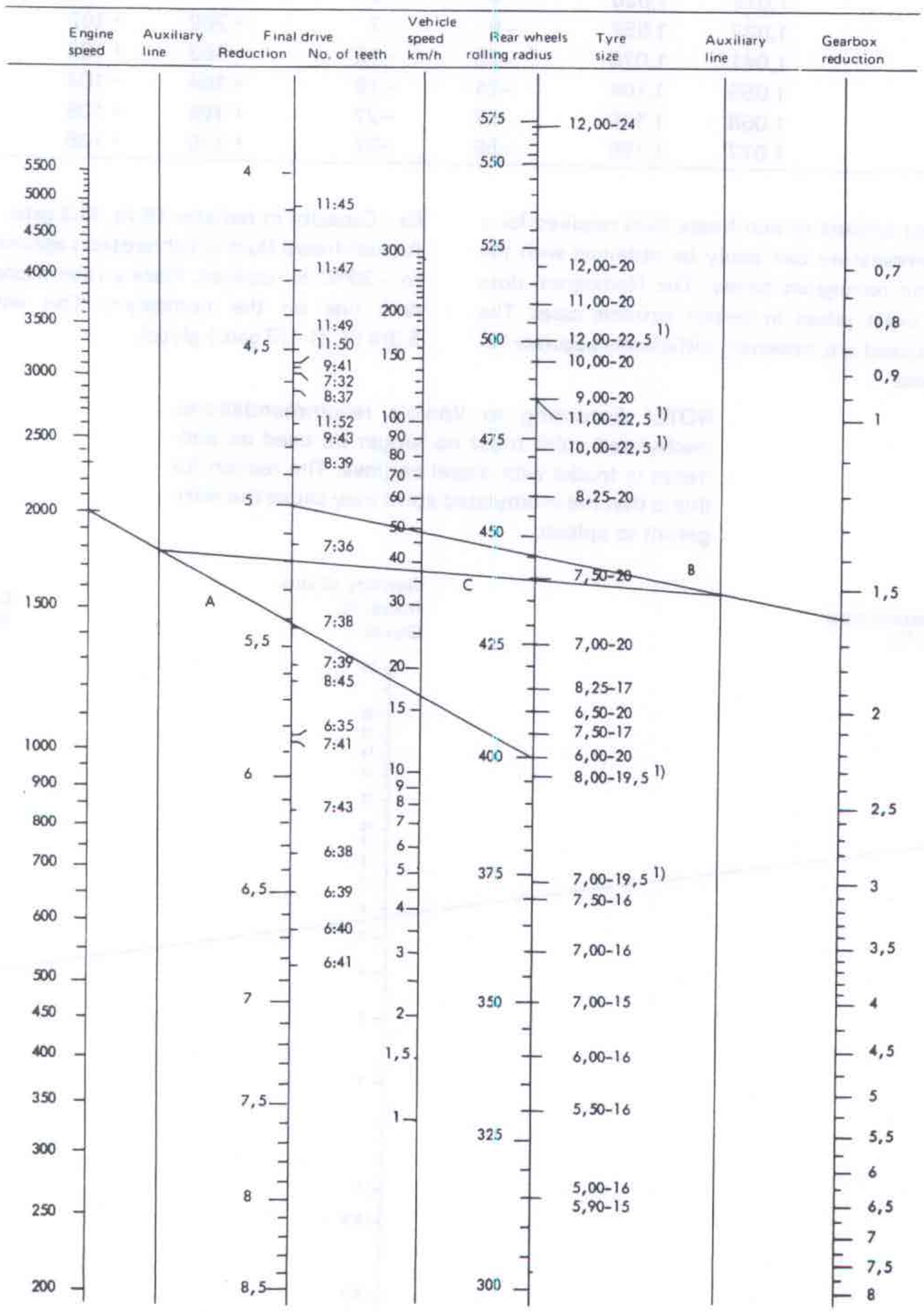
Ex.: Capacity of radiator 16 lit. (3.3 gals). An anti-freeze fluid which protects against frost down to −20°C is required. Place a ruler according to the dash line on the nomogram. This will give you 5 3/4 lit. (1 1/3 gals.) glycol.

NOTE! According to Volvo's recommendations, methylated spirit must no longer be used as anti-freeze in trucks with diesel engines. The reason for this is that the methylated spirit may cause the refrigerant to splash.

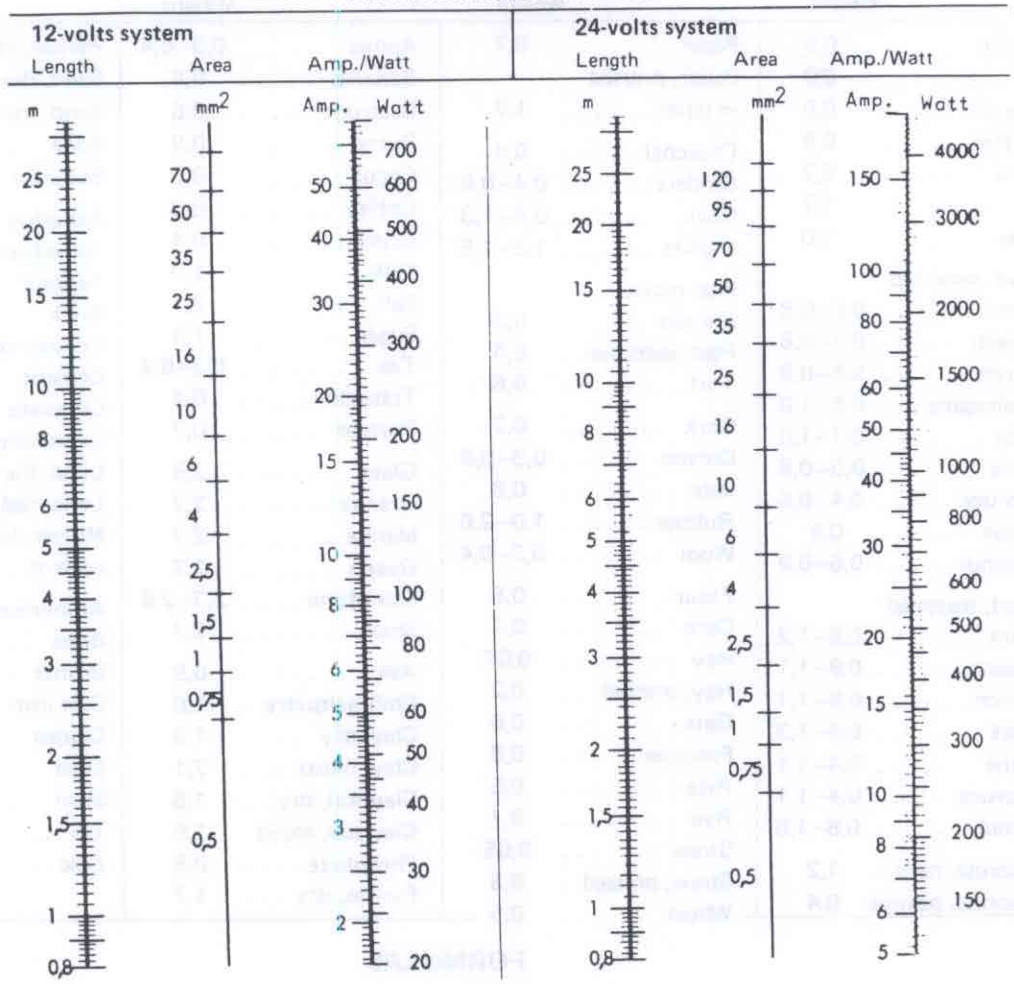


VEHICLE SPEED NOMOGRAM

Vehicle speed is indicated in km/h, as a function of the engine revolutions per minute, the rolling radius for the rear wheels in mm, the rear axle reduction and the gearbox reduction. Use of the nomogram implies that the engine is sufficiently powerful, i.e., tractive effort is greater than driving resistance. Example: given; engine speed 200 rev/min, tyre size 6.00–20, rear axle reduction 5.00:1 and gearbox reduction 1.6:1. Sort: vehicle speed. First draw the line A from engine speed 2000 to tyre size 6.00–20. Then draw the line B from rear axle reduction 5 to gearbox reduction 1.6. Finally join the line C where both the auxiliary lines intersect the A and B lines. The sought vehicle speed is where the C line cuts the speed scale, in this case, 38 km/h.



NOMOGRAM SHOWING CONNECTION BETWEEN CABLE LENGTH, CABLE AREA AND AMPERAGE/WATTAGE



AVERAGE RETARDATION AT DIFFERENT SPEEDS

Speed km/h	m/sec.	Retadation m/sec² 1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0	5,5	6,0	6,5	7,0	8,0
		Braking distance in metres												
10	2,8	2,5	1,9	1,5	1,3	1,1	1,0	0,9	0,8	0,7	0,6	0,6	0,5	0,5
15	4,2	5,8	4,3	3,5	2,9	2,5	2,2	1,9	1,7	1,6	1,4	1,3	1,2	1,1
20	5,5	10,3	7,7	6,1	5,1	4,4	3,8	3,4	3,1	2,8	2,5	2,4	2,2	2,1
25	6,9	16,1	12,0	9,7	8,0	6,9	6,0	5,4	4,8	4,4	4,0	3,7	3,4	3,2
30	8,3	23,1	17,3	13,9	11,5	9,9	8,7	7,7	6,9	6,3	5,8	5,3	4,9	4,5
35	9,7	31,4	23,5	18,9	15,7	13,4	11,8	10,5	9,4	8,6	7,8	7,2	6,7	6,2
40	11,1	41,1	30,8	24,6	20,5	17,6	15,4	13,7	12,3	11,2	10,3	9,5	8,8	8,1
45	12,4	52,1	38,6	31,3	25,8	22,1	19,3	17,2	15,5	14,0	12,9	11,9	11,0	9,1
50	13,9	64,1	48,2	38,5	32,1	27,5	24,1	21,4	19,3	17,5	16,1	14,8	13,8	12,9
55	15,3	77,9	58,2	46,7	38,8	33,3	29,1	25,9	23,3	21,2	19,4	17,9	16,6	15,4
60	16,6	92,5	69,2	55,5	46,2	39,6	34,6	30,8	27,7	25,2	23,1	21,3	19,8	17,4
65	18,0	109,0	81,2	65,2	54,1	46,4	40,6	36,1	32,5	29,5	27,1	24,8	23,3	22,0
70	19,4	126,0	94,1	75,7	62,7	53,7	47,0	41,8	37,6	34,2	31,4	28,9	26,9	24,8
75	20,8	145,0	108,0	86,4	72,0	61,9	54,0	48,0	43,2	39,4	36,0	33,4	30,8	27,3
80	22,2	164,0	123,0	98,6	81,8	70,2	61,4	54,6	49,1	44,7	40,9	37,8	35,1	31,0
85	23,6	185,8	139,0	111,5	92,9	79,6	69,6	61,9	55,7	50,6	46,4	42,8	39,8	34,8
90	25,0	208,0	155,0	12,50	104,0	88,7	77,6	69,0	62,1	56,5	51,8	47,8	43,6	39,0
95	26,4	232,0	174,0	139,0	116,0	99,4	87,0	77,3	69,6	63,2	57,9	53,5	49,7	43,5
100	27,7	258,0	192,0	155,0	128,0	109,0	95,8	85,1	76,6	69,6	63,9	58,9	54,7	49,0
110	30,4	312,0	232,0	187,0	154,0	134,0	116,0	103,0	92,6	84,2	77,2	71,3	66,2	61,9
120	33,3	370,0	277,0	222,0	185,0	159,0	139,0	123,0	111,0	110,0	92,6	85,4	79,3	69,4
130	36,1	434,0	326,0	261,0	217,0	186,0	163,0	145,0	130,0	118,0	108,0	100,0	93,1	81,5
140	38,3	504,0	368,0	302,0	252,0	216,0	189,0	163,0	151,0	134,0	126,0	113,0	108,0	94,4

WEIGHTS IN TON/m³ [1)]

	Weight
Fuel oil	0,9
Ice	0,9
Lube oil	0,9
Paraffin	0,8
Petrol	0,7
Tar	1,2
Water	1,0
Wood, seasoned	
Elm	0,6–0,8
Beech	0,7–0,8
Birch	0,5–0,8
Mahogany	0,6–1,0
Oak	0,7–1,0
Pine	0,3–0,8
Spruce	0,4–0,6
Teak	0,9
Walnut	0,6–0,8
Wood, seasoned	
Elm	0,8–1,2
Beech	0,9–1,1
Birch	0,8–1,1
Oak	0,9–1,3
Pine	0,4–1,1
Spruce	0,4–1,1
Walnut	0,8–1,0
Masonite, hard	1,2
Masonite, porous	0,4

	Weight
Paper	0,7
Paper, pressed in bales	1,2
Charcoal	0,4
Cinders	0,4–0,5
Coal	0,8–1,3
Lignite	1,2–1,5
Peat moss, pressed	0,3
Peat, seasoned	0,4
Turf	0,6
Cork	0,2
Cotton	0,3–0,6
Jute	0,6
Rubber	1,0–2,0
Wool	0,2–0,4
Flour	0,5
Corn	0,7
Hay	0,07
Hay, pressed	0,2
Oats	0,6
Potatoes	0,8
Rice	0,5
Rye	0,7
Straw	0,05
Straw, pressed	0,3
Wheat	0,8

	Weight
Apples	0,3–0,4
Bananas	0,4
Beetroot	0,6
Butter	0,9
Cocoa	0,5
Coffee	0,6
Copra	0,4
Milk	1,0
Salt	2,1
Sugar	1,6
Tea	0,3–0,4
Tobacco	0,4
Turnips	0,7
Glass	2,6
Granite	2,7
Marble	2,7
Quarts	2,7
Sandstone	2,3–2,6
Shale	2,7
Ash	0,9
Chile saltpetre	1,0
Clay, dry	1,6
Clay, moist	2,1
Clay soil, dry	1,5
Clay soil, moist	1,9
Phosphate	0,8
Pyrites, dry	1,7

	Weight
Pyrites, moist	2,1
Sand, dry	1,6
Sand, moist	2,0
Soda	0,7–0,8
Soil, dry	1,6
Asbestos	2,1–2,8
Asbestos board	1,2
Asphalt	1,5
Brick	2,0
Cellular concrete	0,7
Cement	1,5–2,0
Concrete	1,8–2,5
Light concrete	0,3–1,8
Lime, burnt	0,9–1,3
Lime, slaked	1,1–1,3
Mortar, lime & cement	1,7–2,1
Aluminium	2,7
Brass	8,4
Bronze	8,7
Cast iron	7,6
Copper	8,9
Lead	11,3
Steel	7,8
Tin	7,3
Zinc	7,0

FORMULAS

Calculating speed:

$$\text{Speed (m/s)} = \frac{\text{Distance (m)}}{\text{Time (s)}}$$

$$\text{Speed (km/h)} = \frac{\text{Speed (r/s x tyre circumference, m) x 3.6}}{\text{Gearbox red. x rear axle red.}}$$

$$\text{Km/h} = \text{m/s} \times 3.6$$

$$\text{m/s} = \frac{\text{km/h}}{3.6}$$

Calculating the working output:

$$\text{Engine output (kW)} = \frac{\text{Tractive effort (N) x speed (Km/h)}}{3600}$$

$$\text{Engine output (kW)} = \frac{\text{Torque (Nm) x speed (r/s)}}{159{,}24}$$

$$\text{Engine output (hp)} = \frac{\text{Tractive effort (kp) x speed (km/h)}}{270}$$

$$\text{Horsepower (hp)} = \frac{\text{Nm/sec}}{7{,}65} = \frac{\text{kp/sec}}{75} = \frac{\text{kilowatt (kW)}}{0{,}736}$$

[1)] Certain materials are not indicated in density but are included in the natural composition freight in question.

Calculating the torque:

$$\text{Torque (Nm)} = \frac{159{,}24 \times \text{Engine output (kW)}}{\text{Speed (r/s)}}$$

Calculating the tractive effort: (Concerns driving at altitude of up to 300 metres above see level. When driving at very high altitude, consideration must be given to output losses due to the lower barometric height. Minus approx. 10% at 1000 metres difference in altitude.)

$$\text{Tractive effort (N)} = \frac{\text{Efficiency } (=0{,}80\text{–}0{,}84) \times \text{Torque (Nm)} \times \text{Gearbox red.} \times \text{rear axle red.}}{\text{Tyre rolling radius (m)}}$$

Calculating hill climbing ability:

$$100 \times \text{Gradient (\%)} = \frac{\text{Tractive effort (N)}}{\text{Train weight (ton)}} - \text{rolling resistance (N/ton)}$$

Rolling resistance for different types of roads:

First-class concrete road	Rm 100 N/ton
Concrete road	Rm 120 N/ton
Hard gravel road, asphalt road	Rm 150 N/ton
Averagely good gravel road	Rm 200 N/ton
Loose earth road	Rm 300–400 N/ton

Calculating air resistance:

$$\text{Air resistance (N)} = 0.5 \times \bar{C}_D \times A \times \varrho \times v^2$$

$\bar{C}_D$ = Air flow coefficient (technical meas. value) where side winds have been taken into consideration

A = Area (m^2) overall width x overall height

ϱ = Air density (kg/m^3)

v^2 = Speed x speed (m/s)

Conversion for fuel consumption:

$$\text{Lit/mile} = \frac{28{,}25}{\text{miles/imp. gallon}} = \frac{23{,}52}{\text{miles/US gallon}}$$

$$\text{Miles/imp. gallon} = \frac{28{,}25}{\text{lit/mil}}$$

$$\text{Miles/Us gallon} = \frac{23{,}52}{\text{lit/mil}}$$

Converting temperatures:

$$\text{Celsius degrees (°C)} = \frac{(\text{Fahrenheitdegrees (°F)} - 32) \times 5}{9}$$

$$\text{Fahrenheit degrees (°F)} = \frac{(\text{Celsius degrees (°C)}) \times 9}{5} + 32$$

Calculating electricity:

$$\text{Wattage (W)} = \text{Voltage (V)} \times \text{Current (A)}$$

$$\text{Amperage (A)} = \frac{\text{Wattage (W)}}{\text{Voltage}}$$

$$\text{Amperage (A)} = \frac{\text{Voltage (V)}}{\text{Resistance } (\Omega = \text{Ohm})}$$

$$\text{Voltage (V)} = \text{Resistance } (\Omega) \times \text{Amperage (A)}$$

Voltage (V)	=	$\frac{\text{Output (W)}}{\text{Current (A)}}$
Resistance (Ω)	=	$\frac{\text{Voltage (V)}}{\text{Current (A)}}$
Cable resistance (Ω)	=	$\frac{\text{Spec. resistance (}\Omega\text{ m) x Length (M)}}{\text{Cable crossectional area (m}^2\text{)}}$

Calculating pressure:

Pressure (N/m² = pascal)	=	$\frac{\text{force (N)}}{\text{area (m}^2\text{)}}$
Pressure (kp/cm²)	=	$\frac{\text{force (kp)}}{\text{area (cm}^2\text{)}}$

Calculating area of a circle:

circle area (m^2)	= 0.785 x diam. (m) x diam. (m)
circle circumference	= 3.14 x diam. (m)

Calculating density:

$$\text{Density (kg/cm}^3\text{)} = \frac{\text{Absolute weight (kg)}}{\text{Volume (m}^3\text{)}}$$

METRICAL THREADS

General

Metrical threads have designation M. For threads with coarse pitch up to an outer diameter of 68 mm (coarse threads), the letter M shall be followed with the outer diameter (in mm), e.g., M30.

Fine pitch threads have an M together with the outer diameter separated from the pitch by an x, e.g., M30 x 1.5.

A complete thread designation also includes the tolerance. The tolerance designation is added to the thread designation separated by the – sign, e.g., M40–6 g or M30 x 1.5–6 g.

Torque

The table below gives the torques for screws (and corresponding nuts) of strength class D 80 for screw assemblies not requiring any special requirements.

The torques are those achieved by using a torque wrench for instance with an accuracy within ±30%. The figures apply if nothing else is indicated in the production instructions.

M-coarse thread

Thread	Torque in Nm	Torque in kpm
M 6	10–6	1–0,6
M 8	25–15	2,5–1,5
M 10	51–31	5,1–3,1
M 12	90–55	9–5,5
M 14	140–90	14–9
M 16	230–140	23–14
M 18	300–190	30–19
M 20	440–270	44–27
M 22	600–370	60–37
M 24	750–45	75–45

M-fine thread

Thread	Torque in Nm	Torque in kpm
M 6x0,75	12–7	1,2–0,7
M 8x1	28–17	2,8–1,7
M 10x1	55–33	5,5–3,3
M 12x1,25	110–70	11–7
M 14x1,5	160–100	16–10
M 16x1,5	250–150	25–15
M 18x1,5	350–220	35–22
M 20x1,5	480–300	48–30
M 22x1,5	650–400	65–40
M 24x2	900–550	90–55

The tables below give screws (and corresponding nuts) of strength class D 80 in *heavily stressed* bolting or bolting important in another way.

The values are adapted for tightening with tools with an accuracy within ±10%. These values must always be indicated in the production documentation.

M-coarse thread

Thread	Torque In Nm	Torque in kpm
M 6	–	
M 8	–	
M 10	51–41	5,1–4,1
M 12	90–70	9–7
M 14	140–110	14–11
M 16	230–180	23–18
M 18	300–250	30–25
M 20	440–350	44–35
M 22	600–480	60–48
M 24	750–600	75–60

M-fine thread

Thread	Torque in Nm	Torque in kpm
M 6x0,75	–	–
M 8x1	–	–
M 10x1	55–45	5,5–4,5
M 12x1,25	110–90	11–9
M 14x1,5	160–130	16–13
M 16x1,5	250–200	25–20
M 18x1,5	350–280	35–28
M 20x1,5	480–380	48–38
M 22x1,5	650–500	65–50
M 24x2	900–750	90–75

The values in the table below refer to screws (and corresponding nuts) of strength class D 60 in *normal* bolting without any particular demands.

The values are adapted for tightening with tools with an accuracy within ±30% and apply unless otherwise indicated.

Thread	Max. torque			
	Cross-slotted screws		Other types	
	Nm	Kpm	Nm	Kpm
M 3,5	0,6	0,06	1	0,1
M 4	1,5	0,15	2	0,2
M 5	2	0,2	3	0,3
M 6	4	0,4	7	0,7
M 8	9	0,9	15	1,5
M 10	18	1,8	30	3
M 12	30	3	50	5

UNIFIED THREADS

General

Unified threads have the following designations:

coarse threads	UNC
fine threads	UNFUNF
extra fine threads	UNEF
construction threads	UN

Torque

The tables overleaf contain values for screws (and corresponding nuts) of strength class D 80 in *normal* bolting without special demands.

The values below are adapted for tightening with tools with an accuray within ±30%. They apply unless otherwise indicated in the production documentation.

UNC-thread

Thread	Torque in Nm	Torque in kpm
1/4–20	11–7	1,1–0,7
5/16–18	22–14	2,2–1,4
3/8–16	41–25	4,1–2,5
7/16–14	67–40	6,7–4
1/2–13	100–60	10–6
9/16–12	150–90	15–9
5/8–11	210–130	21–13
3/4–10	370–230	37–23
7/8–9	600–370	60–37
1–8	900–550	90–55

UNF-thread

Thread	Torque in Nm	Torque in kpm
1/4–28	13–8	1,3–0,8
5/16–24	27–17	2,7–1,7
3/8–24	50–30	5–3
7/16–20	80–45	8–4,5
1/2–20	120–75	12–7,5
9/16–18	180–110	18–11
5/8–18	250–150	25–15
3/4–16	440–270	44–27
7/8–14	700–430	70–43
1–12	1000–600	100–60

The tables below contain values concerning screws (and corresponding nuts) of strength class D 80 in *heavily stressed* bolting or bolting important in any other way.

The values are adapted for tightening with tools with an accuracy within ±10%. These values must always be indicated in the production documentation.

UNF-thread

Thread	Torque in Nm	Torque in kpm
1/4–20	–	–
5/16–18	–	–
3/8–16	41–33	4,1–3,3
7/16–14	67–55	6,7–5,5
1/2–13	100–80	10–8
9/16–12	150–120	15–12
5/8–11	210–170	21–17
3/4–10	370–300	37–30
7/8–9	600–480	60–48
1–8	900–750	90–75

UNF-thread

Thread	Torque in Nm	Torque in kpm
1/4–28	–	–
5/16–24	–	–
3/8–24	50–40	5–4
7/16–20	80–65	8–6,5
1/2–20	120–100	12–10
9/16–18	180–140	18–14
5/8–18	250–200	25–20
3/4–16	440–350	44–35
7/8–14	700–550	70–55
1–12	1000–800	100–80

The values in the tables to the right concern screws (and corresponding nuts) of strength class D 60 in *normal* bolting without special demands.

The values are adapted for tightening with tools with an accuracy within ±30% and apply unless otherwise indicated.

Thread UNC	Max. torque			
	Cross-slotted screw		Other types	
	Nm	Kpm	Nm	Kpm
Nr. 6	0,6	0,06	1	0,1
Nr. 8	1,5	0,15	2	0,2
Nr. 10	2	0,2	3	0,3
Nr. 12	3	0,3	5	0,5
1/4	4	0,4	7	0,7
5/16	9	0,9	15	1,5
3/8	18	1,8	30	3
7/16	30	3	50	5