

ENGLISH / METRIC UNITS

SECTION 240

**HALLIBURTON
TECHNICAL DATA**

**CALCULATIONS,
FORMULAE
AND
SLURRY TABLES**

HALLIBURTON

Copyright © 1985, 1999, 2001
Halliburton Company

ALL RIGHTS RESERVED

ENGLISH/METRIC UNITS

SECTION 240

TABLE OF CONTENTS

Lengths, Areas, and Volumes	4
Geometrical Relationships	5
Weights and Measures	6
TVD from MD for Deviated Wells	7
Cosine Table	8
Horizontal Tanks	9
Pipe Capacity	10, 11
Volume and Height	10, 11
Balanced Plugs	12
Displacement	13
Buoyancy	13
Stretch Data for Drill Pipe, Tubing, and Casing	14, 15
Slack-Off Data for Tubing and Drill Pipe	16
Effect of Temperature on Steel	17
Hydrostatic Pressure	18
Hydrostatic Pressure and Fluid Weight	19-21
Effect of Water on Mud Weight	22
Mud Weight Adjustment with Barite or Water	23
Velocity & Hydraulic Horsepower	24, 25
Absolute Volume Factors for Materials in Solution	26
Slurry Density, Water Requirements, and Yield Calculations	27, 28
Slurry Tables	29-52
Flow Calculations	53, 54
Table for Sand Plugs	55-56

ENGLISH/METRIC UNITS**TABLE OF CONTENTS
(continued)**

Depth Conversion Table	57
Volume Conversion Table	58
Compressive Strength Conversion Table	59
Temperature Conversion Table	60-62
Conversion Percent Salt	63
Physical Properties	
of Sodium Chloride Solutions	64
of Calcium Chloride Solutions	65
of Potassium Chloride Solutions	66
API Gravity Conversion Table	67
API Gravity of Oil	68
Metric Conversion Factors	69
Classified List of Units	70-84
Conversion Constants	85
Conversion Charts	86-90

ENGLISH/METRIC UNITS

USEFUL DATA TO CALCULATE LENGTHS, AREAS AND VOLUMES

1. Linear Measurements (Length):

To find the circumference of a circle multiply the diameter by 3.1416.

To find the diameter of a circle divide the circumference by 3.1416.

The radius of a circle is one-half the diameter.

2. Square Measurement (Area):

To find the area of a square multiply the length by the width.

To find the area of a rectangle multiply the length by the width.

To find the area of a circle multiply one-half the diameter by one-half the diameter and multiply the answer by 3.1416, or diameter x diameter x .7854.

To find the vertical surface area of a cylinder standing on its end multiply the circumference by its vertical height.

To find the surface area of a sphere multiply the circumference by the diameter.

3. Cubic Measurement (Volume, capacity and displacement):

To find the volume of a cube or rectangular solid multiply the length by the height and multiply the answer by the width.

To find the volume, capacity or displacement of a square or rectangular tank multiply the length by the height, then multiply the answer by the width.

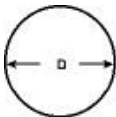
To find the volume, capacity or displacement of a cylinder multiply the area of its end by its height.

To find the volume, capacity or displacement of a sphere or spherical tank multiply one-half of its diameter by the surface area and divide the answer by three.

ENGLISH/METRIC UNITS

GEOMETRICAL RELATIONSHIPS

CIRCLE:



AREA = $0.7854 \times D^2$

SPHERE:



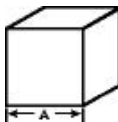
SURFACE AREA = $3.14 \times D^2$

ELLIPSE:



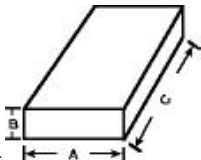
AREA = $0.7854 \times A \times B$

CUBE:



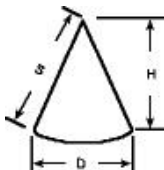
(ALL SIDES EQUAL)
SURFACE AREA = $6 \times A^2$

RECTANGULAR PARALLELOPIPED:



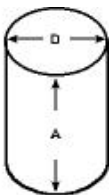
SURFACE AREA = $2 \times (AB + BC + CA)$

CONE:



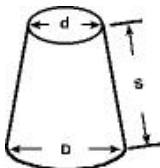
SURFACE AREA = $1.57 \times D \times S$
VOLUME = $\frac{3.14 \times D^2 \times H}{12}$

CYLINDER:



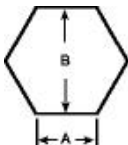
1. HOLLOW
SURFACE AREA = $3.14 \times D \times A$
VOLUME = $D^2 \times A \times .7854$
2. SOLID
SURFACE AREA = $3.14 \times D \times A + 1.57 \times D^2$
VOLUME = $D^2 \times A \times .7854$

FRUSTRUM OF CONE:



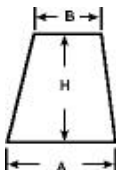
SURFACE AREA = $1.57 \times (D+d) \times S$

HEXAGON:



AREA = $\frac{3}{2} \times A \times B$

TRAPEZOID:



AREA = $\frac{1}{2} \times (A + B) \times H$

ENGLISH/METRIC UNITS

WEIGHTS AND MEASURES

1 U.S. gal equals	{	231 Cu. In. – 3785.4 cm ³ .
		0.1337 Cu. Ft. – .00379 m ³ .
		0.0238 bbls. – 3.785 L.
1 U.S. gal. water at 20°C. (68°F.) weighs 8.33 Lbs. – 3.778 kg.		
1 Imperial or English gal. equals ...		277.420 Cu. In. – 4.54596 L.
1 Imperial gal. of water weighs		10 Lbs. – 4.535924 kg.
1 Square Foot equals		144 square In. – .092903 m ² .
1 Cubic Inch equals	{	.0043291 Gals. – .016387 L.
		.0005787 Cu. Ft. – .000016 m ³ .
1 Cubic Foot equals	{	1728 Cu. In.–.02832.4 cm ³ .
		7.4805 U.S. Gal.–28.32 L.
		0.1781 bbls.–28.32 L.
1 cu. ft. water at 20°C. (68°F.) weighs .		62.31 Lbs.–28.263341 kg.
1 cu. ft. salt water(4.6%) weighs		64.3 Lbs.–29.165989 kg.
1 cu. ft. Saturated Salt Water weighs ..		74.7 Lbs.–33.8335 kg.
1 Standard Barrel equals		31.5 U.S. Gals.–119.2379 L.
1 Barrel of Oil equals	{	42 Gals.–158.98386 L.
		9702 Cu. In.–158987.6 cm ³ .
		5.6146 Cu. Ft.–.159 m ³ .
1 cu. in. of water weighs03606 Lbs.–.01636 kg.
12 cu. in. of water weighs433 Lbs.–.1964 kg.

A pressure of one lb. per sq. in. is exerted by a column of water 2.3110 feet high, or 27.73 inches high, at 20°C. (68°F.).

A pressure of 1 kPa is exerted by a column of water .102 meters high at 20°C.

A column of water, at 20°C (68°F.) one foot high presses on the base with a force of .433 lbs. per square inch.

A column of water, at 20°C (68°F.) one foot high presses on the base with a force of 9.807 kPa.

To find the pressure in lbs. per sq. in. of a column of water multiply the height of the column in feet by .433.

To find the pressure in kPa of a column of water multiply the height of the column in meters by 9.807.

To find the capacity of a mud pit per inch (mm) of depth multiply the length by the width in feet (m), which gives the area in square feet (m²), then multiply by the depth in feet (m), which gives total capacity of pit in Cu.Ft. (m³). Now divide the depth in inches (mm) to get Cu. Ft. per In. (m³) of depth. If it is desired to convert the cubic feet (m³/mm) into gallons (L) multiply by 7.48 (1000).

Doubling the inside diameter of a pipe increases its capacity four times.

Friction of liquids in pipe increases as the square of the velocity.

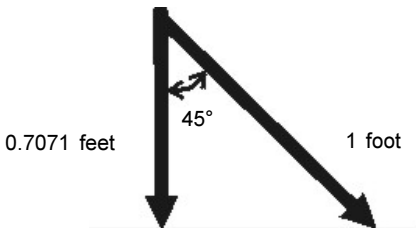
A horsepower is equivalent to raising 33,000 Lbs. 1 foot per minute, or 745.6999 W.

Steam rising from water at its boiling point has a pressure of 14.7 psi (101.34 kPa) at sea level.

ENGLISH/METRIC UNITS

DEVIATED WELL CALCULATIONS

The cosine is the ratio of the True Vertical Depth (TVD) compared to the Measured Depth (MD). For example the Cosine (COS) of a 45 degree angle is 0.7071. This means for every foot of measured depth the true vertical depth is only 0.7071 feet.

**Example:**

A well is deviated from the surface at a 30 degree angle. The MD is 800 feet. If the well is loaded with 11.4 lb/gal drilling fluid what is the hydrostatic pressure at the TD?

$$\text{COS } 30 = 0.8660$$

$$800 \text{ ft} \times 0.8660 \times 0.5922 \text{ psi/ft} = 410.2762 \text{ psi}$$

ENGLISH/METRIC UNITS

DEVIATED WELL CALCULATIONS

COSINE TABLE

Degree	Cosine	Degree	Cosine	Degree	Cosine
1	0.9998	31	0.8572	61	0.4848
2	0.9994	32	0.8480	62	0.4695
3	0.9986	33	0.8387	63	0.4540
4	0.9976	34	0.8290	64	0.4384
5	0.9962	35	0.8192	65	0.4226
6	0.9945	36	0.8090	66	0.4067
7	0.9925	37	0.7986	67	0.3907
8	0.9903	38	0.7880	68	0.3746
9	0.9877	39	0.7771	69	0.3584
10	0.9848	40	0.7660	70	0.3420
11	0.9816	41	0.7547	71	0.3256
12	0.9781	42	0.7431	72	0.3090
13	0.9744	43	0.7314	73	0.2924
14	0.9703	44	0.7193	74	0.2756
15	0.9659	45	0.7071	75	0.2588
16	0.9613	46	0.6947	76	0.2419
17	0.9563	47	0.6820	77	0.2250
18	0.9511	48	0.6691	78	0.2079
19	0.9455	49	0.6561	79	0.1908
20	0.9397	50	0.6428	80	0.1736
21	0.9336	51	0.6293	81	0.1564
22	0.9272	52	0.6157	82	0.1392
23	0.9205	53	0.6018	83	0.1219
24	0.9135	54	0.5878	84	0.1045
25	0.9063	55	0.5736	85	0.0872
26	0.8988	56	0.5592	86	0.0698
27	0.8910	57	0.5446	87	0.0523
28	0.8829	58	0.5299	88	0.0349
29	0.8746	59	0.5150	89	0.0175
30	0.8660	60	0.5000	90	0.0000

ENGLISH UNITS

CALCULATING CONTENTS OF HORIZONTAL CYLINDRICAL TANKS

First calculate the depth ratio (D) by dividing the depth of water or other fluid in the tank in inches (h) by the diameter of the tank in inches (d).

Opposite this value for the depth ratio (D) in the following table you will find the percentage of the total capacity of the tank. Multiplying the capacity of the tank by this percentage gives the contents of the tank for that fluid depth.

D	Percent of Capacity	D	Percent of Capacity	D	Percent of Capacity
.02	.004799	.34	.299762	.66	.700238
.04	.013480	.36	.324061	.68	.724271
.06	.024509	.38	.348667	.70	.747702
.08	.037501	.40	.373539	.72	.770805
.10	.052025	.42	.398525	.74	.79348
.12	.067979	.44	.423749	.76	.815334
.14	.085114	.46	.449132	.78	.836923
.16	.103234	.48	.464560	.80	.857654
.18	.122421	.50	.500000	.82	.877579
.20	.14346	.52	.525440	.84	.896766
.22	.163077	.54	.550868	.86	.914886
.24	.184466	.56	.576251	.88	.932021
.26	.206502	.58	.601475	.90	.947975
.28	.229195	.60	.626461	.92	.962499
.30	.252298	.62	.651333	.94	.975491
.32	.275729	.64	.675939	.96	.986520
				.98	.995201



$$D = \frac{h}{d}$$

Example: Find contents of tank 60" in diameter (d) which has 24" of water in it. Tank is 10 feet long. (Capacity of tank is 1469 gal.)

$D = \frac{24}{60} = .40$ and from table, the percent of capacity is .373539.

Contents = 1469 x .373539 = 550.62 gal.

ENGLISH UNITS

EQUATIONS FOR CALCULATING
CAPACITY OF PIPE

$$\text{Barrels per lineal foot} = .0009714 \times D^2$$

$$\text{Lineal feet per barrel} = \frac{1029.4}{D^2}$$

$$\text{Cubic feet per lineal foot} = .005454 \times D^2$$

$$\text{Lineal feet per cubic foot} = \frac{183.35}{D^2}$$

$$\text{Gallons per lineal foot} = .0408 \times D^2$$

$$\text{Lineal feet per gallon} = \frac{24.51}{D^2}$$

D = Diameter in inches

EQUATIONS FOR VOLUME AND HEIGHT
BETWEEN MULTIPLE TUBING STRINGS
AND HOLE (OR CASING)

$$\text{Barrels per lineal foot} = (D^2 - nd^2) 0.0009714$$

$$\text{Lineal feet per barrel} = \frac{1029.4}{D^2 - nd^2}$$

$$\text{Cubic feet per lineal foot} = (D^2 - nd^2) 0.005454$$

$$\text{Lineal feet per cubic foot} = \frac{183.35}{D^2 - nd^2}$$

$$\text{Gallons per lineal foot} = (D^2 - nd^2) 0.0408$$

$$\text{Lineal feet per gallon} = \frac{24.51}{D^2 - nd^2}$$

WHERE:

D = Diameter of hole, inches (or ID of casing)

d = Outside diameter of tubing, inches

n = Number of tubing strings

METRIC UNITS EQUATIONS FOR CALCULATING CAPACITY OF PIPE

$$\text{Cubic meters per lineal meter} = \frac{D^2}{1,273,000}$$

$$\text{Lineal meters per cubic meter} = \frac{1,273,000}{D^2}$$

$$\text{Hectoliter per lineal meter} = \frac{D^2}{127,300}$$

$$\text{Lineal meter per hectoliter} = \frac{127,300}{D^2}$$

$$\text{Liter per Lineal meter} = \frac{D^2}{1273}$$

$$\text{Lineal meter per liter} = \frac{1273}{D^2}$$

D = Diameter in mm

EQUATIONS FOR VOLUME AND HEIGHT BETWEEN MULTIPLE TUBING STRINGS AND HOLE (OR CASING)

$$\text{Cubic meter per meter} = \frac{(D^2 - nd^2)}{1,273,000}$$

$$\text{Meter per cubic meter} = \frac{1,273,000}{(D^2 - nd^2)}$$

$$\text{Hectoliter per meter} = \frac{(D^2 - nd^2)}{127,300}$$

$$\text{Meter per hectoliter} = \frac{127,300}{(D^2 - nd^2)}$$

$$\text{Liter per meter} = \frac{(D^2 - nd^2)}{1273}$$

$$\text{Meter per liter} = \frac{1273}{(D^2 - nd^2)}$$

WHERE:

D = Diameter of hole or ID of casing, mm

d = Outside diameter of tubing, mm

n = Number of tubing strings

ENGLISH UNITS

BALANCE CEMENT PLUG JOB

It is desired to place a 110 Cu. Ft. cement plug in the bottom of 8,000' of 7", 26# casing, using 2.875" tubing. The operator wants the cement column equalized. He also wants a balanced column of water (the same height of water in the space between the tubing and casing as exists within the tubing).

EQUALIZATION POINT FORMULA

$$h = \frac{N}{C + T} \quad \text{- where}$$

N = Cu. Ft. of Cement slurry used.

h = height of balanced cement column.

C = Cu. Ft. per linear foot of space between tubing (or drill pipe), and casing (or hole). C may be found in Volume and Height Tables, Section 221 and/or Section 122.

T = Cu. Ft. per linear foot inside tubing (or drill pipe, or casing). T may be found in Capacity Tables, Section 210.

N = 110 Cu. Ft. Cem. slurry: C = .1697 Cu. Ft./Ft.

T = .0325 Cu. Ft./Ft.

$$h = \frac{110}{.1697 + .0325} = \frac{110}{.2022} = 544'$$

8000' - 544' = 7456' x .00579 Bbls./Ft. (Capacity Tables) = 43.17 Bbls. displacement required to equalize the cement column.

To balance the water that is to be placed ahead of the cement with the water that is to follow the cement, one must obtain (from the Handbook) the height that one Bbl. of water will fill in the space between the casing and the tubing, and the height that one Bbl. of water will fill inside the tubing.

Height between tubing and casing = 33.11'/Bbl. (Handbook).

Height inside tubing = 172.7'/Bbl. (Handbook).

A ratio of 5.22 Bbl. $\frac{(172.6')}{33.11}$ of water ahead of the cement to one

bbl. of water behind will give a balanced column of 172.7' of water. This ratio may be used to balance any desired amount of water the operator wants to use. 2 Bbls. of water behind the cement - 2 x 5.22 = 10.44 Bbls. of water ahead of the cement. This gives a balanced water column of 345.4'.

ENGLISH UNITS DISPLACEMENT

BUOYANCY FACTORS FOR STEEL PIPE IN VARIOUS WEIGHT FLUIDS (Fluid Density — lb./gal.)

Lb./Gal.	Buoyancy Factor	Lb./Gal.	Buoyancy Factor	Lb./Gal.	Buoyancy Factor
6.0	.9083	11.0	.8319	16.0	.7555
6.1	.9068	11.1	.8304	16.1	.7540
6.2	.9053	11.2	.8289	16.2	.7524
6.3	.9037	11.3	.8273	16.3	.7509
6.4	.9022	11.4	.8258	16.4	.7494
6.5	.9007	11.5	.8243	16.5	.7479
6.6	.8991	11.6	.8227	16.6	.7463
6.7	.8976	11.7	.8212	16.7	.7448
6.8	.8961	11.8	.8197	16.8	.7433
6.9	.8946	11.9	.8182	16.9	.7417
7.0	.8930	12.0	.8166	17.0	.7402
7.1	.8915	12.1	.8151	17.1	.7387
7.2	.8900	12.2	.8136	17.2	.7372
7.3	.8884	12.3	.8120	17.3	.7356
7.4	.8869	12.4	.8105	17.4	.7341
7.5	.8854	12.5	.8090	17.5	.7326
7.6	.8839	12.6	.8075	17.6	.7311
7.7	.8823	12.7	.8059	17.7	.7295
7.8	.8808	12.8	.8044	17.8	.7280
7.9	.8793	12.9	.8029	17.9	.7265
8.0	.8778	13.0	.8013	18.0	.7249
8.1	.8762	13.1	.7998	18.1	.7234
8.2	.8747	13.2	.7983	18.2	.7219
8.3	.8732	13.3	.7968	18.3	.7204
8.33*	.8727	13.4	.7952	18.4	.7188
8.4	.8716	13.5	.7937	18.5	.7173
8.5	.8701	13.6	.7922	18.6	.7158
8.6	.8686	13.7	.7906	18.7	.7142
8.7	.8671	13.8	.7891	18.8	.7127
8.8	.8655	13.9	.7876	18.9	.7112
8.9	.8640	14	.7861	19	.7097
9.0	.8625	14.1	.7845	19.1	.7081
9.1	.8609	14.2	.783	19.2	.7066
9.2	.8594	14.3	.7815	19.3	.7051
9.3	.8579	14.4	.7800	19.4	.7035
9.4	.8564	14.5	.7784	19.5	.7020
9.5	.8548	14.6	.7769	19.6	.7005
9.6	.8533	14.7	.7754	19.7	.6990
9.7	.8518	14.8	.7738	19.8	.6974
9.8	.8502	14.9	.7723	19.9	.6960
9.9	.8487	15.0	.7708	20.0	.6944
10.0	.8472	15.1	.7693		
10.1	.8457	15.2	.7677		
10.2	.8441	15.3	.7662		
10.3	.8426	15.4	.7647		
10.4	.8411	15.5	.7631		
10.5	.8395	15.6	.7616		
10.6	.8380	15.7	.7601		
10.7	.8365	15.8	.7586		
10.8	.8350	15.9	.7570		
10.9	.8334				

FOR OPEN ENDED PIPE

Pipe Wt. (in Fluid) = Pipe Wt. (In Air) x Buoyancy Factor

*Weight of Water at 68°F (20°C)

TABLE 204

STRETCH DATA FOR DRILL PIPE, TUBING AND CASING

Size of Tubing, D.P. or Casing	Stretch Per Length of Pipe Suspended in Well, Feet	Pull Above 1000 Lb. Pull Above Wt. of Pipe, Inches Factor C	Stretch Weight of Pipe Per In. Stretch of Pipe Pounds	Due To Own Weight Suspended in Water, Inches
2.375" Upset Tubing 4.70 #/Ft.	500	.115	6,450	.14
	1,000	.310	3,225	.56
	2,000	.620	1,612	2.22
	3,000	.930	1,075	5.00
	4,000	1.240	806	8.88
	5,000	1.550	644	13.88
	10,000	3.100	322	55.51
2.875" Upset Tubing 6.50 #/Ft.	500	.110	9,080	.14
	1,000	.220	4,540	.56
	2,000	.440	2,270	2.22
	3,000	.660	1,513	5.00
	4,000	.880	1,135	8.88
	5,000	1.100	908	13.88
	10,000	2.200	454	55.51
3.500" Upset Tubing 9.30 #/Ft.	500	.0772	12,960	.14
	1,000	.1544	6,480	.56
	2,000	.3088	3,240	2.22
	3,000	.4632	2,160	5.00
	4,000	.6176	1,620	8.88
	5,000	.7720	1,296	13.88
	10,000	1.544	648	55.51
2.875" Drill Pipe 10.40 #/Ft.	500	.070	14,300	.14
	1,000	.140	7,150	.56
	2,000	.280	3,575	2.22
	3,000	.420	2,383	5.00
	4,000	.560	1,787	8.88
	5,000	.700	1,430	13.88
	10,000	1.40	715	55.51

FORMULA FOR DETERMINING STRETCH IN PIPE

$$S = \frac{L \times P \times C}{1000 \times 1000}$$

(use to set tension packer with no weight indication)

FORMULA FOR DETERMINING PULL OF PIPE

$$P = \frac{1000 \times 1000 \times S}{C \times L}$$

FORMULA FOR FREE PIPE DEPTH

$$L = \frac{S \times 1000 \times 1000}{P \times C}$$

- Where:
- L = Length of free pipe in feet.
 - S = Stretch pulled in pipe, in inches.
 - P = Pull on pipe to get the stretch "S" in pounds
 - C = Constant for given pipe size and weight being stretched.
(For this equation use C factor at pipe length of 1000 ft.)

TABLE 204

STRETCH DATA FOR DRILL PIPE, TUBING AND CASING

Size of Tubing, D.P. or Casing	Stretch Per Length of Pipe Suspended in Well, Feet	Pull Above 1000 Lb. Pull Above Wt. of Pipe, Inches Factor C	Stretch Weight of Pipe Per In. Stretch of Pipe Pounds	Due To Own Weight Suspended in Water, Inches
3.500" Drill Pipe 13.30 #/Ft.	500	.055	18,200	.14
	1,000	.110	9,100	.56
	2,000	.220	4,550	2.22
	3,000	.330	3,033	5.00
	4,000	.440	2,275	8.88
	5,000	.550	1,820	13.88
	10,000	1.10	910	55.51
4.500" Drill Pipe 16.60 #/Ft.	500	.0450	22,200	.14
	1,000	.0900	11,100	.56
	2,000	.180	5,550	2.22
	3,000	.270	3,700	5.00
	4,000	.360	2,775	8.88
	5,000	.450	2,220	13.88
	10,000	.900	1,110	55.51
5.500" Casing 17 #/Ft.	500	.0402	24,800	.14
	1,000	.0804	12,400	.56
	2,000	.160	6,230	2.22
	3,000	.240	4,133	5.00
	4,000	.320	3,100	8.88
	5,000	.402	2,480	13.88
	10,000	.804	1,240	55.51
7.000" Casing 23 #/Ft.	500	.0301	33,220	.14
	1,000	.0602	16,610	.56
	2,000	.120	8,305	2.22
	3,000	.181	5,537	5.00
	4,000	.241	4,152	8.88
	5,000	.301	3,322	13.88
	10,000	.602	1,661	55.51

NOTE: The above figures apply only to steel pipe that has not been stretched or is not being stretched beyond its elastic limit.

Example:

A 7" RTTS is set at 15,000 feet on 2 3/8: 4.7 #/ft. EUE tubing. There are indications that the casing has collapsed above the tool. Pick up pipe weight, mark pipe and pull 20,000 pounds above pipe weight. This 20,000 pounds stretches pipe 25 inches. Where is the casing collapsed?

S = 25 inches

P = 20,000 pounds

C = .31 (C factor from table at 1000 ft.)

$$L = \frac{25 \times 1000 \times 1000}{20,000 \times .31}$$

L = 4032 feet

TABLE 205

SLACK-OFF DATA FOR TUBING AND DRILL PIPE

Size of Tubing or Drill Pipe	Slack-Off Factor*
1.900 O.D. EUE Tubing	0.68
2.375 O.D. EUE Tubing	0.39
2.875 O.D. EUE Tubing	0.26
3.500 O.D. EUE Tubing	0.17
2.875 O.D. 10.40 lb/ft DP	0.16
3.500 O.D. 13.30 lb/ft DP	0.12
4.500 O.D. 16.60 lb/ft DP	0.10

* Inches to slack-off to obtain 1000 lbs. weight on packer for each 1000 ft. of depth. An allowance is included for coiling and friction.

$$\text{Required slack (inc.)} = \frac{\text{Desired Weight}}{1000} \times \frac{\text{Packer Depth}}{1000} \times \text{Factor}$$

Example:

Weight desired on packer 15,000 lbs.
 Depth packer set 5,000"
 Size of Tubing 2.375" EUE
 Slack-off factor for 2.375" EUE from table = 0.39

$$\frac{15,000}{1000} \times \frac{5,000}{1000} \times 0.39 = 29.25 \text{ (use 29 inches)}$$

The setting stroke required to set any particular tool is not included in these figures and will have to be added.

NOTE: The above figures apply only to pipe that has not been stretched, or is not being stretched beyond its elastic limit.

ENGLISH UNITS**EFFECT OF TEMPERATURE ON STEEL**

Steel expands or contracts .0000828" per foot per degree (F) of temperature change.

Therefore:

$$\epsilon T = \text{depth} \times .0000828 \times \Delta T \text{ (F}^\circ\text{)}$$

when:

$$\epsilon T = \text{change in length in inches}$$

$$\text{depth} = \text{feet}$$

$$\Delta T = \text{average temperature change}$$

ENGLISH/METRIC UNITS

HYDROSTATIC PRESSURE AND FLUID WEIGHT CONVERSION TABLES

To find the Hydrostatic pressure of a column of fluid, multiply the appropriate value in Lbs./Sq. in. per foot of depth times the depth in feet.

Example: find the Hydrostatic Pressure at a depth of 13,760 feet (4 194m) in a hole filled with mud weighing 12.3 Lbs./Gal. (92.01 Lbs./Cu. Ft.) (1.474 kg/L) The value 0.6390 is found opposite 12.3 Lbs./Gal. in the table. Then $0.6390 \times 13760 = 8793$ Lbs. per Sq. In. (or $14.455 \text{ kPa/m} \times 4 194\text{m} = 60 624 \text{ kPa}$) hydrostatic pressure.

HYDROSTATIC PRESSURE AND FLUID WEIGHT

Lbs./Gal.	Lbs./Cu. Ft.	Sp. Gr.	Lbs./Sq. In.		
			Per Ft. of Depth	kg/L	kPa/m
7.0	52.36	0.84	0.3636	0.839	8.225
7.1	53.11	0.85	0.3688	0.851	8.342
7.2	53.86	0.86	0.3740	0.863	8.460
7.3	54.61	0.87	0.3792	0.875	8.578
7.4	55.36	0.89	0.3844	0.887	8.695
7.5	56.10	0.90	0.3896	0.899	8.813
7.6	56.85	0.91	0.3948	0.911	8.931
7.7	57.60	0.92	0.4000	0.923	9.048
7.8	58.35	0.93	0.4052	0.935	9.166
7.9	59.10	0.95	0.4104	0.947	9.283
8.0	59.84	0.96	0.4156	0.959	9.401
8.1	60.59	0.97	0.4208	0.971	9.519
8.2	61.34	0.98	0.4260	0.983	9.636
8.3	62.09	0.99	0.4312	0.995	9.754
8.33*	62.31	1.00	0.4330	1.000	9.807
8.4	62.84	1.01	0.4364	1.007	9.872
8.5	63.58	1.02	0.4416	1.019	9.989
8.6	64.33	1.03	0.4468	1.031	10.107
8.7	65.08	1.04	0.4519	1.043	10.222
8.8	65.83	1.05	0.4571	1.054	10.340
8.9	66.58	1.07	0.4623	1.066	10.457
9.0	67.32	1.08	0.4675	1.078	10.575
9.1	68.07	1.09	0.4727	1.090	10.693
9.2	68.82	1.10	0.4779	1.102	10.810
9.3	69.57	1.11	0.4831	1.114	10.928
9.4	70.32	1.13	0.4883	1.126	11.046
9.5	71.06	1.14	0.4935	1.138	11.163
9.6	71.81	1.15	0.4987	1.150	11.281
9.7	72.56	1.16	0.5039	1.162	11.399
9.8	73.31	1.17	0.5091	1.174	11.516
9.9	74.06	1.19	0.5143	1.186	11.634
10.0	74.80	1.20	0.5195	1.198	11.751
10.1	75.55	1.21	0.5247	1.210	11.869
10.2	76.30	1.22	0.5299	1.222	11.987
10.3	77.05	1.23	0.5351	1.234	12.104
10.4	77.80	1.25	0.5403	1.246	12.222

* Density of water at 20°C. or 68°F.

ENGLISH/METRIC UNITS

**HYDROSTATIC PRESSURE
AND FLUID WEIGHT**

Lbs./Gal.	Lbs./Cu. Ft.	Sp. Gr.	Lbs./Sq. In. Per Ft. of Depth	kg/L	kPa/m
10.5	78.55	1.26	0.5455	1.258	12.340
10.6	79.29	1.27	0.5506	1.270	12.455
10.7	80.04	1.28	0.5558	1.282	12.573
10.8	80.79	1.29	0.5610	1.294	12.690
10.9	81.54	1.31	0.5662	1.306	12.808
11.0	82.29	1.32	0.5714	1.318	12.925
11.1	83.03	1.33	0.5766	1.330	13.043
11.2	83.78	1.34	0.5818	1.342	13.161
11.3	84.53	1.35	0.5870	1.354	13.278
11.4	85.28	1.37	0.5922	1.366	13.396
11.5	86.03	1.38	0.5974	1.378	13.514
11.6	86.77	1.39	0.6026	1.390	13.631
11.7	87.52	1.40	0.6078	1.402	13.749
11.8	88.27	1.412	0.6130	1.414	13.866
11.9	89.02	1.43	0.6182	1.426	13.984
12.0	89.77	1.44	0.6234	1.438	14.102
12.1	90.51	1.45	0.6286	1.450	14.219
12.2	91.26	1.46	0.6338	1.462	14.337
12.3	92.01	1.47	0.6390	1.474	14.455
12.4	92.76	1.49	0.6442	1.486	14.572
12.5	93.51	1.50	0.6493	1.498	14.688
12.6	94.25	1.51	0.6545	1.510	14.805
12.7	95.00	1.52	0.6597	1.522	14.923
12.8	95.75	1.53	0.6649	1.534	15.040
12.9	96.50	1.55	0.6701	1.546	15.158
13.0	97.25	1.56	0.6753	1.558	15.276
13.1	97.99	1.57	0.6805	1.570	15.393
13.2	98.74	1.58	0.6857	1.582	15.511
13.3	99.49	1.59	0.6909	1.594	15.629
13.4	100.24	1.61	0.6961	1.606	15.746
13.5	100.99	1.62	0.7013	1.618	15.864
13.6	101.73	1.63	0.7065	1.630	15.981
13.7	102.48	1.64	0.7117	1.624	16.099
13.8	103.23	1.65	0.7169	1.654	16.217
13.9	103.98	1.67	0.7221	1.666	16.334
14.0	104.73	1.68	0.7273	1.678	16.452
14.1	105.48	1.69	0.7325	1.690	16.570
14.2	106.22	1.70	0.7377	1.702	16.687
14.3	106.97	1.71	0.7429	1.714	16.805
14.4	107.72	1.73	0.7480	1.726	16.920
14.5	108.47	1.74	0.7532	1.738	17.038
14.6	109.22	1.75	0.7584	1.750	17.155
14.7	109.96	1.76	0.7636	1.761	17.273
14.8	110.71	1.77	0.7688	1.773	17.391
14.9	111.46	1.79	0.7740	1.785	17.508

ENGLISH/METRIC UNITS

**HYDROSTATIC PRESSURE
AND FLUID WEIGHT**

Lbs./Gal.	Lbs./Cu. Ft.	Sp. Gr.	Lbs./Sq. In.		kPa/m
			Per Ft.	of Depth	
15.0	112.21	1.80	0.7792	1.797	17.626
15.1	112.96	1.81	0.7844	1.809	17.744
15.2	113.70	1.82	0.7896	1.821	17.861
15.3	114.45	1.83	0.7948	1.833	17.979
15.4	115.20	1.85	0.8000	1.845	18.096
15.5	115.95	1.86	0.8052	1.857	18.214
15.6	116.70	1.87	0.8104	1.869	18.332
15.7	117.44	1.88	0.8156	1.881	18.449
15.8	118.19	1.89	0.8208	1.893	18.567
15.9	118.94	1.91	0.8260	1.905	18.685
16.0	119.69	1.92	0.8312	1.917	18.802
16.1	120.44	1.93	0.8364	1.929	18.920
16.2	121.18	1.94	0.8416	1.941	19.037
16.3	121.93	1.95	0.8468	1.953	19.155
16.4	122.68	1.97	0.8519	1.965	19.270
16.5	123.43	1.98	0.8571	1.977	19.388
16.6	124.18	1.99	0.8623	1.989	19.506
16.7	124.92	2.00	0.8675	2.001	19.623
16.8	125.67	2.01	0.8727	2.013	19.741
16.9	126.42	2.03	0.8779	2.025	19.859
17.0	127.17	2.04	0.8831	2.037	19.976
17.1	127.92	2.05	0.8883	2.049	20.094
17.2	128.66	2.06	0.8935	2.061	20.211
17.3	129.41	2.07	0.8987	2.073	20.329
17.4	130.16	2.09	0.9039	2.085	20.447
17.5	130.91	2.10	0.9091	2.097	20.564
17.6	131.66	2.11	0.9143	2.109	20.682
17.7	132.40	2.12	0.9195	2.121	20.800
17.8	133.15	2.13	0.9247	2.133	20.917
17.9	133.90	2.14	0.9299	2.145	21.035
18.0	134.65	2.16	0.9351	2.157	21.153
18.1	135.40	2.17	0.9403	2.169	21.270
18.2	136.15	2.18	0.9455	2.181	21.388
18.3	136.89	2.19	0.9506	2.193	21.503
18.4	137.64	2.20	0.9558	2.205	21.621
18.5	138.39	2.22	0.9610	2.217	21.738
18.6	139.14	2.23	0.9662	2.229	21.856
18.7	139.89	2.24	0.9714	2.241	21.974
18.8	140.63	2.25	0.9766	2.253	22.091
18.9	141.38	2.26	0.9818	2.265	22.209
19.0	142.13	2.28	0.9870	2.277	22.327
19.1	142.88	2.29	0.9922	2.289	22.444
19.2	143.63	2.30	0.9974	2.301	22.562
19.3	144.37	2.31	1.0026	2.313	22.679
19.4	145.12	2.32	1.0078	2.325	22.797

ENGLISH/METRIC UNITS

**HYDROSTATIC PRESSURE
AND FLUID WEIGHT**

Lbs./Gal.	Lbs./Cu. Ft.	Sp. Gr.	Lbs./Sq. In.		kg/L	kPa/m
			Per	Ft. of Depth		
19.5	145.87	2.34		1.0130	2.337	22.915
19.6	146.62	2.35		1.0182	2.349	23.032
19.7	147.37	2.36		1.0234	2.361	23.150
19.8	148.11	2.37		1.0286	2.373	23.268
19.9	148.86	2.38		1.0338	2.385	23.385
20.0	149.61	2.40		1.0390	2.397	23.503
20.1	150.36	2.41		1.0442	2.409	23.620
20.2	151.11	2.42		1.0493	2.421	23.736
20.3	151.85	2.43		1.0545	2.433	23.853
20.4	152.60	2.44		1.0597	2.445	23.971
20.5	153.35	2.46		1.0649	2.456	24.089
20.6	154.10	2.47		1.0701	2.468	24.206
20.7	154.85	2.48		1.0753	2.480	24.324
20.8	155.59	2.49		1.0805	2.492	24.442
20.9	156.34	2.50		1.0857	2.504	24.559
21.0	157.09	2.52		1.0909	2.516	24.677
21.1	157.84	2.53		1.0961	2.528	24.794
21.2	158.59	2.54		1.1013	2.540	24.912
21.3	159.33	2.55		1.1065	2.552	25.030
21.4	160.08	2.56		1.1117	2.564	25.147
21.5	160.83	2.58		1.1169	2.576	25.265
21.6	161.58	2.59		1.1221	2.588	25.383
21.7	162.33	2.60		1.1273	2.600	25.500
21.8	163.07	2.61		1.1325	2.612	25.618
21.9	163.82	2.62		1.1377	2.624	25.735
22.0	164.57	2.64		1.1429	2.636	25.853
22.1	165.32	2.65		1.1480	2.648	25.968
22.2	166.07	2.66		1.1532	2.660	26.086
22.3	166.82	2.67		1.1584	2.672	26.204
22.4	167.56	2.68		1.1636	2.684	26.321
22.5	168.31	2.70		1.1688	2.696	26.439
22.6	169.06	2.71		1.1740	2.708	26.557
22.7	169.81	2.72		1.1792	2.720	26.674
22.8	170.56	2.73		1.1844	2.732	26.792
22.9	171.30	2.74		1.1896	2.744	26.909
23.0	172.05	2.76		1.1948	2.756	27.027

EFFECT OF WATER ON MUD WEIGHT

Water Added Bbl./100 bbl. Mud	Weight of Resulting Mud Lb./Gal.								
0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0
5	9.9	10.9	11.8	12.8	13.7	14.7	15.6	16.6	17.5
10	9.8	10.8	11.7	12.6	13.5	14.4	15.3	16.2	17.1
15	9.8	10.6	11.5	12.4	13.3	14.1	15.0	15.9	16.8
20	9.7	10.6	11.4	12.2	13.1	13.7	14.7	15.6	16.5
25	9.7	10.5	11.3	12.1	12.9	13.7	14.5	15.3	16.1
30	9.6	10.4	11.1	11.9	12.7	13.5	14.2	15.0	15.8
35	9.6	10.3	11.0	11.8	12.5	13.3	14.0	14.7	15.5
40	9.5	10.2	10.9	11.7	12.4	13.1	13.8	14.5	15.2
45	9.5	10.2	10.9	11.6	12.2	12.9	13.6	14.3	15.0
50	9.4	10.1	10.8	11.4	12.1	12.8	13.4	14.1	14.8
60	9.4	10.0	10.6	11.2	11.9	12.5	13.1	13.7	14.4
70	9.3	9.9	10.5	11.1	11.7	12.2	12.8	13.4	14.0
80	9.3	9.8	10.4	10.9	11.5	12.0	12.6	13.1	13.7
90	9.2	9.7	10.3	10.8	11.3	11.8	12.4	12.9	13.5
100	9.2	9.2	10.2	10.7	11.2	11.7	12.2	12.7	13.2

ENGLISH UNITS

(From "Principles of Drilling Mud Control" Eleventh Edition)

MUD WEIGHT ADJUSTMENT WITH BARITE OR WATER

Initial Mud Weight, lb/gal	Desired Mud Weight, lb/gal																	
	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0
9	29	59	90	123	156	192	229	268	308	350	395	442	490	542	596	653	714	778
9.5		29	60	92	125	160	196	234	273	315	359	405	452	503	557	612	672	735
10	43		30	61	93	128	164	201	239	280	323	368	414	464	516	571	630	691
10.5	85	30		31	62	96	131	167	205	245	287	331	376	426	479	531	588	648
11	128	60	23		31	64	98	134	171	210	251	294	339	387	437	490	546	605
11.5	171	90	46	19		32	66	101	137	175	215	258	301	348	397	449	504	562
12	214	120	69	37	16		33	67	103	140	179	221	263	310	357	408	462	518
12.5	256	150	92	56	32	14		34	68	105	144	184	226	271	318	367	420	475
13	299	180	115	75	48	27	12		34	70	108	147	188	232	278	327	378	432
13.5	342	210	138	94	63	41	24	11		35	72	111	150	194	238	286	336	389
14	385	240	161	112	76	54	36	21	10		36	74	113	155	199	245	294	345
14.5	427	270	185	131	95	68	48	32	19	9		37	75	116	159	204	252	302
15	470	300	208	150	110	82	60	43	29	18	8		37	77	119	163	210	259
15.5	513	330	231	169	126	95	72	54	39	26	16	8		39	79	122	168	216
16	556	360	254	187	142	109	84	64	48	35	24	15	7		40	81	126	172
16.5	598	390	277	206	158	123	96	75	58	44	32	23	14	7		41	84	129
17	641	420	300	225	174	136	108	86	68	53	40	30	21	13	6		42	86
17.5	684	450	323	244	189	150	120	96	77	62	49	38	28	20	12	6		43
18	726	480	346	262	205	163	132	107	87	71	57	45	35	26	18	12	5	

ENGLISH UNITS

The lower left half of this table shows the number of barrels of water which must be added to 100 bbl. of mud to produce desired weight reductions. To use this portion of the table, locate the initial mud weight in the vertical column at the left, then locate the desired mud weight in the upper horizontal row. The number of barrels of water to be added per 100 bbl. of mud is read directly across from the initial weight and directly below the desired mud weight. For example to reduce an 11 lb./gal. mud to a 9.5 lb./gal. mud, 128 bbl. of water must be added for every 100 bbl. of mud in the system.

The upper right half of this table shows the number of sacks of barite which must be added to 100 bbl. of mud to produce desired weight increases. To use this portion of the table, locate the initial mud weight in the vertical column to the left, then locate the desired mud weight in the upper horizontal row. The number of sacks of barite to be added per 100 bbl. of mud is read directly across from the initial weight and directly below the desired mud weight. For example, to raise an 11 lb./gal. mud to 14.5 lb./gal., 251 sacks of barite must be added per 100 bbl. of mud in the system.

ENGLISH UNITS

EQUATIONS FOR CALCULATING
VELOCITY AND HORSEPOWER

$$\text{Feet per second} = \frac{\text{B.P.H.} \times .2859}{(\text{Diameter in inches})^2}$$

$$\text{Feet per second} = \frac{\text{B.P.D.} \times .0119}{(\text{Diameter in inches})^2}$$

$$\text{Feet per second} = \frac{\text{G.P.M.} \times .4085}{(\text{Diameter in inches})^2}$$

$$\text{Hydraulic Horsepower} = \frac{\text{B.P.H.} \times \text{Pressure (psi)}}{2447}$$

$$\text{Hydraulic Horsepower} = \text{B.P.H.} \times \text{Pressure (psi)} \times .000408$$

$$\text{Hydraulic Horsepower} = \text{B.P.D.} \times \text{Pressure (psi)} \times .000017$$

$$\text{Hydraulic Horsepower} = \text{B.P.M.} \times \text{Pressure (psi)} \times .0245$$

$$\text{Hydraulic Horsepower} = \text{G.P.M.} \times \text{Pressure (psi)} \times .000583$$

$$\text{Brake Horsepower} = \frac{\text{B.P.H.} \times \text{Pressure (psi)} \times .000408}{\text{Efficiency}}$$

$$\text{Brake Horsepower} = \frac{\text{B.P.D.} \times \text{Pressure (psi)} \times .000017}{\text{Efficiency}}$$

$$\text{Brake Horsepower} = \frac{\text{G.P.M.} \times \text{Pressure (psi)} \times .000583}{\text{Efficiency}}$$

NOTE:

B.P.M. = Barrels per minute

B.P.H. = Barrels per hour

B.P.D. = Barrels per day

psi = Pounds per square inch

METRIC UNITS

EQUATIONS FOR CALCULATING VELOCITY AND POWER

$$\text{Meters per second} = \frac{\text{m}^3/\text{hr} \times 353.68}{D^2}$$

$$\text{Meters per second} = \frac{\text{m}^3/\text{day} \times 14.737}{D^2}$$

$$\text{Meters per second} = \frac{\text{L}/\text{min} \times 21.221}{D^2}$$

$$\text{Kilowatt} = \text{L}/\text{min} \times \text{MPa} \times .0167$$

$$\text{Kilowatt} = \text{m}^3/\text{min} \times \text{MPa} \times 16.7$$

$$\text{Kilowatt} = \text{m}^3/\text{hr} \times \text{MPa} \times 1000$$

$$\text{Kilowatt} = \text{m}^3/\text{day} \times \text{MPa} \times 24000$$

ABSOLUTE VOLUME FACTORS FOR MATERIALS IN SOLUTION AT 20°C (68°F)

NaCl Percent by weight of water	NaCl Absolute Volume gal./lb.	KCl Percent by weight of water	KCl Absolute Volume gal./lb.	CaCl ₂ Percent by weight of water	CaCl ₂ Absolute Volume gal./lb.
5.00	.0368	1.00	.0436	2.00	.0220
6.00	.0372	2.00	.0440	4.00	.0229
10.00	.0385	3.00	.0444	5.00	.0234
12.00	.0391	5.00	.0450	10.00	.0252
15.00	.0398	10.00	.0463	15.00	.0266
18.00	.0405	15.00	.0475	20.00	.0278
20.00	.0409	20.00	.0481	30.00	.0296
24.00	.0417	25.00	.0488	40.00	.0311
25.00	.0418	30.00	.0493	50.00	.0325
30.00	.0426	31.58	.0495	60.00	.0339
35.14	.0433	—	—	66.67	.0346
37.07*	.0458*	—	—	—	—

*Solution at 60°C (140°F)

Slurry Density, Water Requirements, and Yield Calculations

Weight of Materials in one sack of the following cement slurry:

Premium Cement + 35% SSA-1 + 0.5% GasStop + 0.3% CFR-3 + 0.2% HR-5
Mix Slurry at 16.0 lb/gal Density; Find Yield and Water Requirements

Cement	94 lbs
SSA-1	$(94 \text{ lbs} \times 35/100) = 32.9 \text{ lbs}$
GasStop	$(94 \text{ lbs} \times 0.5/100) = 0.47 \text{ lbs}$
CFR-3	$(94 \text{ lbs} \times 0.3/100) = 0.282 \text{ lbs}$
HR-5	$(94 \text{ lbs} \times 0.2/100) = 0.188 \text{ lbs}$
Water	$(8.33 \text{ lbs/gal} \times A \text{ gals}) = 8.33A \text{ lbs}$

Total Weight of Slurry = 127.84 lbs + 8.33A lbs

Volume of Materials in one sack of the cement slurry:

	Weight lbs		Absolute Vol. Factor gals/lb		Volume gals
Cement	94 lbs	X	0.0382	=	3.5908 gals
SSA-1	32.9 lbs	X	0.0456	=	1.5002 gals
GasStop	0.47 lbs	X	0.1009	=	0.0474 gals
CFR-3	0.282 lbs	X	0.0938	=	0.0265 gals
HR-5	0.188 lbs	X	0.0750	=	0.0141 gals
Water	8.33A	X	0.1200	=	A gals

Total Volume of Slurry = 5.1790 gals + A gals

Slurry Density, Water Requirements, and Yield Calculations

Density of the cement slurry:

$$\text{Slurry Density} = \frac{\text{Slurry Weight}}{\text{Slurry Volume}} = \frac{127.84 \text{ lbs} + 8.33A \text{ lbs}}{5.1790 \text{ gals} + A \text{ gals}}$$

$$16.0 \text{ lb/gal} = \frac{127.84 \text{ lbs} + 8.33A \text{ lbs}}{5.1790 \text{ gals} + A \text{ gals}}$$

$$16.0 (5.1790 + A) = 127.84 + 8.33A$$

$$16.0 A - 8.33A = 127.84 - 82.864$$

$$A = 44.976 / 7.67 = 5.86 \text{ gals water per sack}$$

Slurry Yield:

$$\text{Slurry Volume (gals)} \times 0.1337 \text{ cuft/gal} = (5.1790 + 5.86) \times 0.1337 \text{ cuft} = 1.48 \text{ cuft/sk}$$

SLURRY TABLES**Neat Cement****Class A, C, G, or H Cements****Mixed With Fresh Water****Commonly Applied Slurry Properties**

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
14.00	1.51	7.71
14.10	1.48	7.52
14.20	1.46	7.33
14.30	1.44	7.14
14.40	1.41	6.97
14.50	1.39	6.80
14.60	1.37	6.63
14.70	1.34	6.47
14.80	1.32	6.31
14.90	1.30	6.16
15.00	1.28	6.02
15.10	1.27	5.88
15.20	1.25	5.74
15.30	1.23	5.60
15.40	1.21	5.47
15.50	1.19	5.35
15.60	1.18	5.22
15.70	1.16	5.11
15.80	1.15	4.99
15.90	1.13	4.88
16.00	1.12	4.76
16.10	1.10	4.66
16.20	1.09	4.55
16.30	1.07	4.45
16.40	1.06	4.35
16.50	1.05	4.25
16.60	1.04	4.16
16.70	1.02	4.07
16.80	1.01	3.98
16.90	1.00	3.89
17.00	0.99	3.80
17.10	0.98	3.72
17.20	0.97	3.63
17.30	0.96	3.55
17.40	0.94	3.48
17.50	0.93	3.40

**35% SSA-1 (BWOC) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
15.00	1.69	7.58
15.10	1.67	7.39
15.20	1.64	7.21
15.30	1.62	7.03
15.40	1.60	6.86
15.50	1.58	6.69
15.60	1.55	6.53
15.70	1.53	6.37
15.80	1.51	6.22
15.90	1.49	6.07
16.00	1.47	5.92
16.10	1.45	5.78
16.20	1.44	5.64
16.30	1.42	5.51
16.40	1.40	5.38
16.50	1.38	5.25

**35% SSA-2 (BWOC) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
16.00	1.47	5.92
16.10	1.45	5.78
16.20	1.44	5.64
16.30	1.42	5.51
16.40	1.40	5.38
16.50	1.38	5.25
16.60	1.37	5.13
16.70	1.35	5.00
16.80	1.33	4.88
16.90	1.32	4.77
17.00	1.30	4.65
17.10	1.29	4.54
17.20	1.27	4.43
17.30	1.26	4.33
17.40	1.25	4.22
17.50	1.23	4.12
17.60	1.22	4.02
17.70	1.21	3.93
17.80	1.19	3.83
17.90	1.18	3.74

**Hi-Dense #4 (10 lbs/sk) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Hi-Dense Conc. Lbs/sk
16.50	1.19	5.01	10.00
16.60	1.18	4.90	10.00
16.70	1.16	4.80	10.00
16.80	1.15	4.70	10.00
16.90	1.14	4.60	10.00
17.00	1.12	4.50	10.00
17.10	1.11	4.41	10.00
17.20	1.10	4.31	10.00
17.30	1.08	4.22	10.00
17.40	1.07	4.13	10.00
17.50	1.06	4.05	10.00
17.60	1.05	3.96	10.00
17.70	1.04	3.88	10.00

**Hi-Dense #4 (15 lbs/sk) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Hi-Dense Conc. Lbs/sk
16.50	1.25	5.39	15.00
16.60	1.23	5.28	15.00
16.70	1.22	5.17	15.00
16.80	1.20	5.06	15.00
16.90	1.19	4.95	15.00
17.00	1.18	4.85	15.00
17.10	1.16	4.75	15.00
17.20	1.15	4.65	15.00
17.30	1.14	4.56	15.00
17.40	1.12	4.46	15.00
17.50	1.11	4.37	15.00
17.60	1.10	4.28	15.00
17.70	1.09	4.20	15.00
17.80	1.08	4.11	15.00
17.90	1.07	4.03	15.00
18.00	1.06	3.94	15.00

**Hi-Dense #4 (20 lbs/sk) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Hi-Dense Conc. Lbs/sk
16.50	1.32	5.77	20.00
16.60	1.30	5.65	20.00
16.70	1.28	5.53	20.00
16.80	1.27	5.42	20.00
16.90	1.25	5.31	20.00
17.00	1.24	5.20	20.00
17.10	1.23	5.10	20.00
17.20	1.21	4.99	20.00
17.30	1.20	4.89	20.00
17.40	1.18	4.79	20.00
17.50	1.17	4.70	20.00
17.60	1.16	4.60	20.00
17.70	1.15	4.51	20.00
17.80	1.13	4.42	20.00
17.90	1.12	4.33	20.00
18.00	1.11	4.25	20.00
18.10	1.10	4.16	20.00
18.20	1.09	4.08	20.00

**Hi-Dense #4 (25 lbs/sk) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Hi-Dense Conc. Lbs/sk
17.00	1.30	5.55	25.00
17.10	1.29	5.44	25.00
17.20	1.27	5.33	25.00
17.30	1.26	5.23	25.00
17.40	1.24	5.12	25.00
17.50	1.23	5.02	25.00
17.60	1.22	4.92	25.00
17.70	1.21	4.83	25.00
17.80	1.19	4.73	25.00
17.90	1.18	4.64	25.00
18.00	1.17	4.55	25.00
18.10	1.16	4.46	25.00
18.20	1.14	4.37	25.00
18.30	1.13	4.28	25.00
18.40	1.12	4.20	25.00
18.50	1.11	4.12	25.00
18.60	1.10	4.04	25.00

**35% SSA-2 (BWOC) + 10 lbs/sk Hi-Dense
Added to Class G or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Hi-Dense Conc. Lbs/sk
16.50	1.52	6.03	10.00
16.60	1.50	5.89	10.00
16.70	1.48	5.76	10.00
16.80	1.46	5.63	10.00
16.90	1.45	5.50	10.00
17.00	1.43	5.37	10.00
17.10	1.41	5.25	10.00
17.20	1.40	5.13	10.00
17.30	1.38	5.02	10.00
17.40	1.37	4.90	10.00
17.50	1.35	4.79	10.00
17.60	1.34	4.68	10.00
17.70	1.32	4.58	10.00
17.80	1.31	4.47	10.00
17.90	1.30	4.37	10.00
18.00	1.28	4.27	10.00
18.10	1.27	4.17	10.00
18.20	1.26	4.07	10.00
18.30	1.24	3.98	10.00
18.40	1.23	3.89	10.00

**35% SSA-2 (BWOC) + 15 lbs/sk Hi-Dense
Added to Class G or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Hi-Dense Conc. Lbs/sk
17.00	1.49	5.72	15.00
17.10	1.48	5.60	15.00
17.20	1.46	5.47	15.00
17.30	1.44	5.35	15.00
17.40	1.43	5.23	15.00
17.50	1.41	5.12	15.00
17.60	1.40	5.00	15.00
17.70	1.38	4.89	15.00
17.80	1.37	4.78	15.00
17.90	1.35	4.68	15.00
18.00	1.34	4.57	15.00
18.10	1.33	4.47	15.00
18.20	1.31	4.37	15.00
18.30	1.30	4.27	15.00
18.40	1.29	4.17	15.00
18.50	1.27	4.08	15.00

**35% SSA-2 (BWOC) + 20 lbs/sk Hi-Dense
Added to Class G or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Hi-Dense Conc. Lbs/sk
17.00	1.55	6.05	20.00
17.10	1.54	5.92	20.00
17.20	1.52	5.79	20.00
17.30	1.50	5.67	20.00
17.40	1.49	5.54	20.00
17.50	1.47	5.42	20.00
17.60	1.45	5.30	20.00
17.70	1.44	5.19	20.00
17.80	1.42	5.07	20.00
17.90	1.41	4.96	20.00
18.00	1.39	4.85	20.00
18.10	1.38	4.75	20.00
18.20	1.37	4.64	20.00
18.30	1.35	4.54	20.00
18.40	1.34	4.44	20.00
18.50	1.33	4.34	20.00
18.60	1.31	4.25	20.00
18.70	1.30	4.15	20.00
18.80	1.29	4.06	20.00
18.90	1.27	3.97	20.00

**35% SSA-2 (BWOC) + 25 lbs/sk Hi-Dense
Added to Class G or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Hi-Dense Conc. Lbs/sk
17.50	1.53	5.77	25.00
17.60	1.51	5.64	25.00
17.70	1.50	5.52	25.00
17.80	1.48	5.40	25.00
17.90	1.47	5.29	25.00
18.00	1.45	5.18	25.00
18.10	1.44	5.06	25.00
18.20	1.42	4.96	25.00
18.30	1.41	4.85	25.00
18.40	1.39	4.74	25.00
18.50	1.38	4.64	25.00
18.60	1.37	4.54	25.00
18.70	1.35	4.44	25.00
18.80	1.34	4.35	25.00
18.90	1.33	4.25	25.00
19.00	1.32	4.16	25.00

**Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
14.00	1.51	7.71
14.10	1.48	7.52
14.20	1.46	7.33
14.30	1.44	7.14
14.40	1.41	6.97
14.50	1.39	6.80
14.60	1.37	6.63
14.70	1.34	6.47
14.80	1.32	6.31
14.90	1.30	6.16
15.00	1.28	6.02
15.10	1.27	5.88
15.20	1.25	5.74
15.30	1.23	5.60
15.40	1.21	5.47
15.50	1.19	5.35
15.60	1.18	5.22
15.70	1.16	5.11
15.80	1.15	4.99
15.90	1.13	4.88
16.00	1.12	4.76
16.10	1.10	4.66
16.20	1.09	4.55
16.30	1.07	4.45
16.40	1.06	4.35
16.50	1.05	4.25
16.60	1.04	4.16
16.70	1.02	4.07
16.80	1.01	3.98
16.90	1.00	3.89
17.00	0.99	3.80
17.10	0.98	3.72
17.20	0.97	3.63
17.30	0.96	3.55
17.40	0.94	3.48
17.50	0.93	3.40

**3% Salt (BWOW) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Salt Conc. Lbs/sk
14.00	1.54	7.88	1.97
14.10	1.52	7.68	1.92
14.20	1.49	7.48	1.87
14.30	1.46	7.29	1.82
14.40	1.44	7.10	1.78
14.50	1.41	6.93	1.73
14.60	1.39	6.75	1.69
14.70	1.37	6.59	1.65
14.80	1.35	6.43	1.61
14.90	1.33	6.27	1.57
15.00	1.31	6.12	1.53
15.10	1.29	5.97	1.49
15.20	1.27	5.83	1.46
15.30	1.25	5.69	1.42
15.40	1.23	5.56	1.39
15.50	1.21	5.43	1.36
15.60	1.20	5.30	1.32
15.70	1.18	5.18	1.29
15.80	1.16	5.06	1.26
15.90	1.15	4.94	1.24
16.00	1.13	4.83	1.21
16.10	1.12	4.72	1.18
16.20	1.10	4.61	1.15
16.30	1.09	4.51	1.13
16.40	1.07	4.40	1.10
16.50	1.06	4.31	1.08
16.60	1.05	4.21	1.05
16.70	1.03	4.11	1.03
16.80	1.02	4.02	1.00
16.90	1.01	3.93	0.98
17.00	1.00	3.84	0.96
17.10	0.99	3.76	0.94
17.20	0.98	3.67	0.92
17.30	0.96	3.59	0.90
17.40	0.95	3.51	0.88
17.50	0.94	3.43	0.86
17.60	0.93	3.35	0.84
17.70	0.92	3.28	0.82
17.80	0.91	3.21	0.80
17.90	0.90	3.13	0.78

**5% Salt (BWOW) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Salt Conc. Lbs/sk
14.00	1.57	8.01	3.34
14.10	1.54	7.80	3.25
14.20	1.51	7.59	3.16
14.30	1.48	7.40	3.08
14.40	1.46	7.21	3.00
14.50	1.43	7.03	2.93
14.60	1.41	6.85	2.85
14.70	1.39	6.68	2.78
14.80	1.36	6.51	2.71
14.90	1.34	6.35	2.65
15.00	1.32	6.20	2.58
15.10	1.30	6.05	2.52
15.20	1.28	5.90	2.46
15.30	1.26	5.76	2.40
15.40	1.24	5.62	2.34
15.50	1.23	5.49	2.29
15.60	1.21	5.36	2.23
15.70	1.19	5.24	2.18
15.80	1.17	5.11	2.13
15.90	1.16	4.99	2.08
16.00	1.14	4.88	2.03
16.10	1.13	4.77	1.99
16.20	1.11	4.66	1.94
16.30	1.10	4.55	1.90
16.40	1.08	4.45	1.85
16.50	1.07	4.34	1.81
16.60	1.06	4.25	1.77
16.70	1.04	4.15	1.73
16.80	1.03	4.06	1.69
16.90	1.02	3.96	1.65
17.00	1.01	3.87	1.61
17.10	0.99	3.79	1.58
17.20	0.98	3.70	1.54
17.30	0.97	3.62	1.51
17.40	0.96	3.54	1.47
17.50	0.95	3.46	1.44
17.60	0.94	3.38	1.41
17.70	0.93	3.30	1.38
17.80	0.92	3.23	1.34
17.90	0.91	3.16	1.31

**10% Salt (BWOW) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Salt Conc. Lbs/sk
14.00	1.62	8.28	6.89
14.10	1.59	8.05	6.71
14.20	1.56	7.83	6.53
14.30	1.53	7.63	6.35
14.40	1.50	7.42	6.18
14.50	1.48	7.23	6.02
14.60	1.45	7.04	5.87
14.70	1.43	6.86	5.72
14.80	1.40	6.69	5.57
14.90	1.38	6.52	5.43
15.00	1.36	6.36	5.29
15.10	1.33	6.20	5.16
15.20	1.31	6.04	5.03
15.30	1.29	5.90	4.91
15.40	1.27	5.75	4.79
15.50	1.25	5.61	4.68
15.60	1.24	5.48	4.56
15.70	1.22	5.35	4.45
15.80	1.20	5.22	4.35
15.90	1.18	5.09	4.24
16.00	1.17	4.97	4.14
16.10	1.15	4.86	4.05
16.20	1.13	4.74	3.95
16.30	1.12	4.63	3.86
16.40	1.10	4.52	3.77
16.50	1.09	4.42	3.68
16.60	1.08	4.32	3.60
16.70	1.06	4.22	3.51
16.80	1.05	4.12	3.43
16.90	1.04	4.03	3.35
17.00	1.02	3.93	3.28
17.10	1.01	3.84	3.20
17.20	1.00	3.75	3.13
17.30	0.99	3.67	3.06
17.40	0.97	3.58	2.99
17.50	0.96	3.50	2.92
17.60	0.95	3.42	2.85
17.70	0.94	3.34	2.79
17.80	0.93	3.27	2.72
17.90	0.92	3.19	2.66

**18% Salt (BWOW) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Salt Conc. Lbs/sk
14.00	1.71	8.70	13.04
14.10	1.68	8.45	12.66
14.20	1.64	8.21	12.30
14.30	1.61	7.98	11.96
14.40	1.58	7.76	11.63
14.50	1.55	7.54	11.31
14.60	1.52	7.34	11.00
14.70	1.49	7.14	10.71
14.80	1.47	6.95	10.42
14.90	1.44	6.77	10.15
15.00	1.41	6.59	9.88
15.10	1.39	6.42	9.63
15.20	1.37	6.25	9.38
15.30	1.34	6.10	9.14
15.40	1.32	5.94	8.91
15.50	1.30	5.79	8.68
15.60	1.28	5.65	8.47
15.70	1.26	5.51	8.26
15.80	1.24	5.37	8.05
15.90	1.22	5.24	7.85
16.00	1.20	5.11	7.66
16.10	1.19	4.99	7.48
16.20	1.17	4.87	7.30
16.30	1.15	4.75	7.12
16.40	1.14	4.63	6.95
16.50	1.12	4.52	6.78
16.60	1.11	4.42	6.62
16.70	1.09	4.31	6.46
16.80	1.08	4.21	6.31
16.90	1.06	4.11	6.16
17.00	1.05	4.01	6.02
17.10	1.04	3.92	5.88
17.20	1.02	3.83	5.74
17.30	1.01	3.74	5.60
17.40	1.00	3.65	5.47
17.50	0.99	3.56	5.34
17.60	0.97	3.48	5.22
17.70	0.96	3.40	5.10
17.80	0.95	3.32	4.98
17.90	0.94	3.24	4.86

**36% Salt (BWOW) Added to
Class A, C, G, or H Cements
Mixed With Fresh Water**

Commonly Applied Slurry Properties

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Salt Conc. Lbs/sk
14.00	1.94	9.64	28.91
14.10	1.89	9.33	27.97
14.20	1.85	9.03	27.08
14.30	1.81	8.75	26.23
14.40	1.76	8.48	25.42
14.50	1.73	8.22	24.64
14.60	1.69	7.97	23.90
14.70	1.65	7.73	23.19
14.80	1.62	7.51	22.51
14.90	1.58	7.29	21.86
15.00	1.55	7.08	21.23
15.10	1.52	6.88	20.63
15.20	1.49	6.68	20.05
15.30	1.47	6.50	19.49
15.40	1.44	6.32	18.95
15.50	1.41	6.15	18.44
15.60	1.39	5.98	17.94
15.70	1.36	5.82	17.46
15.80	1.34	5.67	16.99
15.90	1.32	5.52	16.54
16.00	1.29	5.37	16.11
16.10	1.27	5.23	15.69
16.20	1.25	5.10	15.28
16.30	1.23	4.96	14.89
16.40	1.21	4.84	14.51
16.50	1.19	4.71	14.14
16.60	1.18	4.60	13.78
16.70	1.16	4.48	13.43
16.80	1.14	4.37	13.10
16.90	1.13	4.26	12.77
17.00	1.11	4.15	12.45
17.10	1.09	4.05	12.14
17.20	1.08	3.95	11.84
17.30	1.06	3.85	11.55
17.40	1.05	3.76	11.26
17.50	1.04	3.66	10.99
17.60	1.02	3.57	10.72
17.70	1.01	3.49	10.46
17.80	1.00	3.40	10.20
17.90	0.98	3.32	9.95

Class A, C, G, or H Cements**74 lb/sk Pozmix****Mixed With Fresh Water****Commonly Applied Slurry Properties****50/50 Poz Cement with No Bentonite**

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
14.00	1.27	5.93
14.10	1.25	5.77
14.20	1.23	5.61
14.30	1.21	5.45
14.40	1.19	5.30
14.50	1.17	5.16
14.60	1.15	5.02
14.70	1.13	4.89
14.80	1.12	4.75
14.90	1.10	4.63
15.00	1.08	4.50
15.10	1.07	4.38
15.20	1.05	4.27
15.30	1.04	4.16
15.40	1.02	4.05
15.50	1.01	3.94
15.60	0.99	3.84
15.70	0.98	3.73
15.80	0.97	3.64
15.90	0.95	3.54
16.00	0.94	3.45
16.10	0.93	3.36
16.20	0.92	3.27
16.30	0.91	3.18
16.40	0.90	3.10

**Class A, C, G, or H Cements
74 lb/sk Pozmix
Mixed With Fresh Water**

Commonly Applied Slurry Properties

50/50 Poz Cement with 2% Bentonite

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
13.00	1.58	8.12
13.10	1.54	7.87
13.20	1.51	7.64
13.30	1.48	7.41
13.40	1.45	7.19
13.50	1.42	6.98
13.60	1.40	6.78
13.70	1.37	6.58
13.80	1.35	6.40
13.90	1.32	6.22
14.00	1.30	6.04
14.10	1.28	5.87
14.20	1.25	5.71
14.30	1.23	5.55
14.40	1.21	5.40
14.50	1.19	5.25
14.60	1.17	5.11
14.70	1.16	4.97
14.80	1.14	4.84
14.90	1.12	4.71
15.00	1.10	4.58
15.10	1.09	4.46
15.20	1.07	4.34
15.30	1.06	4.23
15.40	1.04	4.12

Class A, C, G, or H Cements**74 lb/sk Pozmix****Mixed With Fresh Water****Commonly Applied Slurry Properties****50/50 Poz Cement with 4% Bentonite**

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
12.50	1.80	9.71
12.60	1.76	9.39
12.70	1.72	9.09
12.80	1.68	8.81
12.90	1.64	8.53
13.00	1.61	8.27
13.10	1.57	8.02
13.20	1.54	7.78
13.30	1.51	7.54
13.40	1.48	7.32
13.50	1.45	7.11
13.60	1.42	6.90
13.70	1.40	6.70
13.80	1.37	6.51
13.90	1.35	6.33
14.00	1.32	6.15
14.10	1.30	5.98
14.20	1.28	5.81
14.30	1.26	5.65
14.40	1.24	5.50
14.50	1.22	5.35
14.60	1.20	5.20
14.70	1.18	5.06
14.80	1.16	4.93
14.90	1.14	4.79

**Class A, C, G, or H Cements
74 lb/sk Pozmix
Mixed With Fresh Water**

Commonly Applied Slurry Properties

50/50 Poz Cement with 6% Bentonite

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
12.50	1.83	9.88
12.60	1.79	9.56
12.70	1.75	9.26
12.80	1.71	8.96
12.90	1.67	8.68
13.00	1.64	8.42
13.10	1.60	8.16
13.20	1.57	7.91
13.30	1.54	7.68
13.40	1.51	7.45
13.50	1.48	7.23
13.60	1.45	7.02
13.70	1.42	6.82
13.80	1.40	6.63
13.90	1.37	6.44
14.00	1.35	6.26
14.10	1.32	6.08
14.20	1.30	5.91
14.30	1.28	5.75
14.40	1.26	5.59
14.50	1.24	5.44
14.60	1.22	5.29
14.70	1.20	5.15
14.80	1.18	5.01
14.90	1.16	4.88

Class A, C, G, or H Cements**74 lb/sk Pozmix****Mixed With Fresh Water****Commonly Applied Slurry Properties****50/50 Poz Cement with 8% Bentonite**

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
12.00	2.12	11.96
12.10	2.06	11.54
12.20	2.01	11.14
12.30	1.96	10.76
12.40	1.91	10.40
12.50	1.87	10.06
12.60	1.82	9.73
12.70	1.78	9.42
12.80	1.74	9.12
12.90	1.70	8.84
13.00	1.67	8.56
13.10	1.63	8.30
13.20	1.60	8.05
13.30	1.57	7.81
13.40	1.54	7.58
13.50	1.51	7.36
13.60	1.48	7.15
13.70	1.45	6.94
13.80	1.42	6.74
13.90	1.40	6.55
14.00	1.37	6.37
14.10	1.35	6.19
14.20	1.33	6.02
14.30	1.30	5.85
14.40	1.28	5.69

**Class A, C, G, or H Cements
74 lb/sk Pozmix
Mixed With Fresh Water**

Commonly Applied Slurry Properties

65% Cement / 35% Poz with 6% Bentonite

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
11.50	2.54	15.19
11.60	2.47	14.61
11.70	2.39	14.06
11.80	2.32	13.55
11.90	2.26	13.06
12.00	2.20	12.60
12.10	2.14	12.16
12.20	2.08	11.75
12.30	2.03	11.36
12.40	1.98	10.98
12.50	1.93	10.63
12.60	1.89	10.29
12.70	1.84	9.97
12.80	1.80	9.66
12.90	1.76	9.36
13.00	1.73	9.08
13.10	1.69	8.81
13.20	1.66	8.55
13.30	1.62	8.30
13.40	1.59	8.06
13.50	1.56	7.83
13.60	1.53	7.61
13.70	1.50	7.40
13.80	1.47	7.19
13.90	1.45	6.99
14.00	1.42	6.80
14.10	1.40	6.62
14.20	1.37	6.44
14.30	1.35	6.27
14.40	1.33	6.10
14.50	1.31	5.94
14.60	1.29	5.79

Class A, C, G, or H Cements**74 lb/sk Pozmix****Mixed With Fresh Water****Commonly Applied Slurry Properties**

65% Cement / 35% Poz with 6% Bentonite and 3% Salt

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Salt Conc. lbs/sk
11.50	2.60	15.45	3.86
11.60	2.52	14.85	3.71
11.70	2.44	14.28	3.57
11.80	2.37	13.74	3.43
11.90	2.30	13.24	3.31
12.00	2.24	12.77	3.19
12.10	2.18	12.32	3.08
12.20	2.12	11.89	2.97
12.30	2.06	11.49	2.87
12.40	2.01	11.10	2.77
12.50	1.96	10.74	2.68
12.60	1.92	10.39	2.60
12.70	1.87	10.06	2.51
12.80	1.83	9.74	2.43
12.90	1.79	9.44	2.36
13.00	1.75	9.15	2.29
13.10	1.71	8.88	2.22
13.20	1.68	8.61	2.15
13.30	1.64	8.36	2.09
13.40	1.61	8.11	2.03
13.50	1.58	7.88	1.97
13.60	1.55	7.65	1.91
13.70	1.52	7.44	1.86
13.80	1.49	7.23	1.81
13.90	1.46	7.03	1.76
14.00	1.44	6.83	1.71
14.10	1.41	6.65	1.66
14.20	1.39	6.47	1.62
14.30	1.36	6.29	1.57
14.40	1.34	6.12	1.53
14.50	1.32	5.96	1.49
14.60	1.30	5.80	1.45

**Class A, C, G, or H Cements
74 lb/sk Pozmix
Mixed With Fresh Water**

Commonly Applied Slurry Properties

65% Cement / 35% Poz + 6% Bentonite + 10 lb/sk Gilsonite

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
11.50	2.57	14.27
11.60	2.49	13.69
11.70	2.42	13.13
11.80	2.35	12.61
11.90	2.28	12.12
12.00	2.22	11.66
12.10	2.16	11.21
12.20	2.11	10.80
12.30	2.05	10.40
12.40	2.00	10.02
12.50	1.95	9.66
12.60	1.91	9.32
12.70	1.86	8.99
12.80	1.82	8.68
12.90	1.78	8.38
13.00	1.74	8.10
13.10	1.71	7.82
13.20	1.67	7.56
13.30	1.64	7.31
13.40	1.61	7.07
13.50	1.58	6.84
13.60	1.55	6.61
13.70	1.52	6.40
13.80	1.49	6.19
13.90	1.46	5.99
14.00	1.44	5.80
14.10	1.41	5.61
14.20	1.39	5.43
14.30	1.36	5.26
14.40	1.34	5.09
14.50	1.32	4.93
14.60	1.30	4.77

**Class A, C, G, or H Cements
74 lb/sk Pozmix
Mixed With Fresh Water**

Commonly Applied Slurry Properties

85% Cement / 15% Poz with 8% Bentonite

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
11.00	3.28	20.65
11.10	3.17	19.76
11.20	3.06	18.94
11.30	2.95	18.17
11.40	2.86	17.45
11.50	2.77	16.77
11.60	2.68	16.14
11.70	2.60	15.54
11.80	2.53	14.98
11.90	2.46	14.45
12.00	2.39	13.95
12.10	2.33	13.48
12.20	2.27	13.03
12.30	2.21	12.60
12.40	2.15	12.20
12.50	2.10	11.81
12.60	2.05	11.44
12.70	2.01	11.09
12.80	1.96	10.75
12.90	1.92	10.43
13.00	1.88	10.13
13.10	1.84	9.83
13.20	1.80	9.55
13.30	1.76	9.28
13.40	1.73	9.02
13.50	1.70	8.77
13.60	1.66	8.53
13.70	1.63	8.29
13.80	1.60	8.07
13.90	1.57	7.86
14.00	1.55	7.65
14.10	1.52	7.45

Class A, C, G, or H Cements

74 lb/sk Pozmix

Mixed With Fresh Water

Commonly Applied Slurry Properties

85% Cement / 15% Poz with 8% Bentonite and 3% Salt

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk	Salt Conc. lbs/sk
11.00	3.38	21.12	5.28
11.10	3.25	20.18	5.04
11.20	3.14	19.32	4.83
11.30	3.03	18.51	4.63
11.40	2.93	17.76	4.44
11.50	2.83	17.06	4.26
11.60	2.74	16.40	4.10
11.70	2.66	15.78	3.94
11.80	2.58	15.20	3.80
11.90	2.51	14.66	3.66
12.00	2.44	14.14	3.53
12.10	2.37	13.65	3.41
12.20	2.31	13.19	3.30
12.30	2.25	12.75	3.19
12.40	2.19	12.33	3.08
12.50	2.14	11.93	2.98
12.60	2.09	11.55	2.89
12.70	2.04	11.19	2.80
12.80	1.99	10.85	2.71
12.90	1.95	10.52	2.63
13.00	1.90	10.21	2.55
13.10	1.86	9.91	2.48
13.20	1.82	9.62	2.40
13.30	1.79	9.34	2.33
13.40	1.75	9.08	2.27
13.50	1.72	8.82	2.20
13.60	1.68	8.58	2.14
13.70	1.65	8.34	2.08
13.80	1.62	8.11	2.03
13.90	1.59	7.89	1.97
14.00	1.56	7.68	1.92
14.10	1.54	7.48	1.87

**Class A, C, G, or H Cements
74 lb/sk Pozmix
Mixed With Fresh Water**

Commonly Applied Slurry Properties

85% Cement / 15% Poz + 8% Bentonite + 10 lb/sk Gilsonite

Slurry Density Lbs/Gallon	Slurry Yield cuft/sk	Water Ratio gals/sk
11.00	3.32	19.77
11.10	3.20	18.88
11.20	3.09	18.04
11.30	2.98	17.26
11.40	2.89	16.54
11.50	2.79	15.86
11.60	2.71	15.22
11.70	2.63	14.62
11.80	2.55	14.05
11.90	2.48	13.52
12.00	2.41	13.01
12.10	2.35	12.53
12.20	2.29	12.08
12.30	2.23	11.65
12.40	2.18	11.24
12.50	2.12	10.84
12.60	2.07	10.47
12.70	2.03	10.12
12.80	1.98	9.78
12.90	1.94	9.45
13.00	1.90	9.14
13.10	1.86	8.85
13.20	1.82	8.56
13.30	1.78	8.29
13.40	1.75	8.02
13.50	1.71	7.77
13.60	1.68	7.53
13.70	1.65	7.29
13.80	1.62	7.07
13.90	1.59	6.85
14.00	1.56	6.64
14.10	1.54	6.44

ENGLISH UNITS

EQUATIONS FOR MAKING FLOW CALCULATIONS

1. DISPLACEMENT VELOCITY

$$V = \frac{17.157 Q_b}{D^2} = \frac{3.056 Q_{cf}}{D^2}$$

where,	V	=	velocity, ft. per sec.
	Q _b	=	pumping rate, bbls, per min.
	Q _{cf}	=	pumping rate, cu. ft. per min.
	D	=	inside dia. of pipe, inches.
For annulus	D ²	=	D _O ² - D _I ²
where,	D _O	=	outer pipe inside dia. or hole size, in.
	D _I	=	inner pipe outside dia., in.

2. REYNOLDS NUMBER

$$N_{Re} = \frac{1.86 V^{(2-n')} \rho}{K' (96/D)^{n'}}$$

where,	N _{Re}	=	Reynolds Number, dimensionless.
	V	=	velocity, ft. per sec.
	ρ	=	slurry density, lbs. per gal.
	n'	=	flow behaviour index, dimensionless.
	K'	=	consistency index, lbs.-sec. ^{n'} per sq. ft.
	D	=	inside dia. of pipe, in.
For annulus	D	=	D _O - D _I

3. FRICTIONAL PRESSURE DROP

$$\Delta P_f = \frac{0.039 L \rho V^2 f}{D}$$

where,	ΔP _f	=	friction pressure drop, psi.
	L	=	length of pipe, ft.
	ρ	=	slurry density, lbs. per gal.
	V	=	velocity, ft. per sec.
	f	=	friction factor, dimensionless.
	D	=	inside dia. of pipe, in.
For annulus,	D	=	D _O - D _I

3a. **Turbulent Friction Factor** for slurries containing no bentonite.

$$f = 0.0303/N_{Re}^{0.1612}$$

3b. **Turbulent Friction Factor** for slurries containing bentonite.

$$f = 0.00454 + 0.645/N_{Re}^{0.7}$$

3c. **Plug and Laminar Friction Factor** $f = 16/N_{Re}$

4. VELOCITY AT SOME SPECIFIC REYNOLDS NUMBER

For generalized calculations:

N_{Re} for Plug Flow = 100 (maximum)

N_{Re} for for Turbulence = 3000

$$V = \left(\frac{N_{Re} K' (96/D)^{n'}}{1.86 \rho} \right)^{\frac{1}{2-n'}}$$

where,	V	=	velocity, ft. per sec.
	K'	=	consistency index, lb.-sec. ^{n'} per sq. ft.
	n'	=	flow behaviour index, dimensionless.
	ρ	=	slurry density, lbs. per gal.
	D	=	inside diameter of pipe, in.
	N _{Re}	=	specified Reynolds No., dimensionless.
For annulus	D	=	D _O - D _I
where,	D _O	=	outer pipe inside dia. or hole size, in.
	D _I	=	inner pipe outside dia., in.

5. HYDROSTATIC PRESSURE

$$P_h = .05195 \rho H$$

where,	P _h	=	hydrostatic pressure, psi.
	ρ	=	fluid density, lbs. per gal.
	H	=	height of column, ft.

METRIC UNITS

EQUATIONS FOR MAKING FLOW CALCULATIONS

1. DISPLACEMENT VELOCITY

$$V = \frac{21221 Q}{D}$$

- where, V = velocity, m per s.
 Q = pumping rate, m³ per min.
 D = inside diameter of pipe, mm.
- For annulus, $D^2 = D_o^2 - D_i^2$
 where, D_o = outer pipe inside diameter or hole size, mm.
 D_i = inner pipe outside diameter, mm.

2. REYNOLDS NUMBER

$$N_{Re} = \frac{8 V^{(2-n')} \rho}{K' \left(\frac{8000}{D} \right)^{n'}}$$

- where, N_{Re} = Reynolds Number, dimensionless.
 V = velocity, m. per sec.
 ρ = slurry density, kg. per m³.
 n' = flow behaviour index, dimensionless.
 K' = consistency index, Pa-s ^{n'} .
 D = inside diameter of pipe, mm.
- For annulus $D = D_o - D_i$

3. FRICTIONAL PRESSURE DROP

$$\Delta P_f = \frac{2 L \rho V^2 f}{D}$$

- where, P_f = friction pressure drop, kPa.
 L = length of pipe, m.
 ρ = density of slurry, kg/m³.
 V = velocity, m/s.
 f = friction factor, dimensionless.
 D = inside diameter of pipe, mm.
- For annulus, $D = D_o - D_i$

3a. **Turbulent Friction Factor** for slurries containing no bentonite.

$$f = 0.0303/N_{Re}^{0.1612}$$

3b. **Turbulent Friction Factor** for slurries containing bentonite.

$$f = 0.00454 + 0.645/N_{Re}^{0.7}$$

3c. **Plug and Laminar Friction Factor** $f = 16/N_{Re}^{0.7}$

4. VELOCITY AT SOME SPECIFIC REYNOLDS NUMBER

For generalized calculations:

N_{Re} for Plug Flow = 100 (maximum)

N_{Re} for Turbulence = 3000

$$V = \left(\frac{N_{Re} K' (8000/D)^{n'}}{8 \rho} \right)^{\frac{1}{2-n'}}$$

- where, V = velocity, ft. per sec.
 K' = consistency index Pa-s ^{n'} .
 n' = flow behaviour index, dimensionless.
 ρ = slurry density, kg per m³.
 D = inside diameter of pipe, mm.
 N_{Re} = specified Reynolds No., dimensionless.
- For annulus $D = D_o - D_i$
 D_o = outer pipe inside diameter or hole size, mm.
 D_i = inner pipe outside diameter, mm.

5. HYDROSTATIC PRESSURE

$$P_h = .00981 \rho H$$

- where, P_h = hydrostatic pressure, kPa.
 ρ = fluid density, kg/m³.
 H = height of column, m.

ENGLISH UNITS

SAND (20-40 MESH) FILL-UP IN CASING

Size in.	Weight lb/ft	ID in.	Capacity ft ³ /ft	Capacity ft/ft ³	Pounds Sand per Linear Foot	Linear Feet per Per Pound of Sand
4½	9.50	4.090	0.0912	10.9604	9.7259	0.1028
	10.50	4.052	0.0896	11.1669	9.5460	0.1048
	11.60	4.000	0.0873	11.4592	9.3026	0.1075
	13.50	3.920	0.0838	11.9316	8.9342	0.1119
5	11.50	4.560	0.1134	8.8174	12.0897	0.0827
	13.00	4.494	0.1102	9.0783	11.7422	0.0852
	15.00	4.408	0.1060	9.4360	11.2971	0.0885
	18.00	4.276	0.0997	10.0276	10.6307	0.0941
	21.00	4.154	0.0941	10.6253	10.0327	0.0997
5½	13.00	5.044	0.1388	7.2065	14.7923	0.0676
	14.00	5.012	0.1370	7.2988	14.6052	0.0685
	15.00	4.974	0.1349	7.4107	14.3845	0.0695
	15.50	4.950	0.1336	7.4828	14.2461	0.0702
	17.00	4.892	0.1305	7.6613	13.9142	0.0719
	20.00	4.778	0.1245	8.0312	13.2732	0.0753
	23.00	4.670	0.1189	8.4070	12.6800	0.0789
7	17.00	6.538	0.2331	4.2893	24.8527	0.0402
	20.00	6.456	0.2273	4.3989	24.2332	0.0413
	22.00	6.398	0.2233	4.4790	23.7998	0.0420
	23.00	6.366	0.2210	4.5242	23.5623	0.0424
	24.00	6.336	0.2190	4.5671	23.3408	0.0428
	26.00	6.276	0.2148	4.6549	22.9008	0.0437
	28.00	6.214	0.2106	4.7482	22.4506	0.0445
	29.00	6.184	0.2086	4.7944	22.2343	0.0450
	30.00	6.154	0.2066	4.8413	22.0191	0.0454
	32.00	6.094	0.2026	4.9371	21.5918	0.0463
	34.00	6.040	0.1990	5.0257	21.2109	0.0471
	35.00	6.004	0.1966	5.0862	20.9588	0.0477
	38.00	5.920	0.1911	5.2315	20.3764	0.0491
40.00	5.836	0.1858	5.3832	19.8023	0.0505	
7-5/8	20.00	7.125	0.2769	3.6116	29.5158	0.0339
	24.00	7.025	0.2692	3.7152	28.6931	0.0349
	26.40	6.969	0.2649	3.7751	28.2375	0.0354
	29.70	6.875	0.2578	3.8791	27.4808	0.0364
	33.70	6.765	0.2496	4.0062	26.6085	0.0376
	39.00	6.625	0.2394	4.1773	25.5186	0.0392
	43.50	6.435	0.2259	4.4277	24.0759	0.0415
8-5/8	24.00	8.097	0.3576	2.7966	38.1182	0.0262
	28.00	8.017	0.3506	2.8527	37.3687	0.0268
	32.00	7.921	0.3422	2.9222	36.4791	0.0274
	36.00	7.825	0.3340	2.9944	35.6003	0.0281
	38.00	7.775	0.3297	3.0330	35.1468	0.0285
	40.00	7.725	0.3255	3.0724	34.6962	0.0288
	43.00	7.651	0.3193	3.1321	34.0346	0.0294
	44.00	7.625	0.3171	3.1535	33.8037	0.0296
	49.00	7.511	0.3077	3.2500	32.8005	0.0305
9-5/8	29.30	9.063	0.4480	2.2322	47.7561	0.0209
	32.30	9.001	0.4419	2.2630	47.1049	0.0212
	36.00	8.921	0.4341	2.3038	46.2713	0.0216
	38.00	8.885	0.4306	2.3225	45.8986	0.0218
	40.00	8.835	0.4257	2.3489	45.3835	0.0220
	43.50	8.755	0.4181	2.3920	44.5653	0.0224
	47.00	8.681	0.4110	2.4329	43.8151	0.0228
	53.50	8.535	0.3973	2.5169	42.3537	0.0236
	58.40	8.435	0.3881	2.5769	41.3671	0.0242
	61.10	8.375	0.3826	2.6140	40.7807	0.0245
	71.80	8.125	0.3601	2.7773	38.3823	0.0261

METRIC UNITS

SAND (20-40 MESH) FILL-UP IN CASING

Size mm	Weight kg/m	ID mm	Capacity m ³ /m	Capacity m/m ³	Kilograms Sand per Meter	Meters per Per Kilogram of Sand
114.30	14.14	103.89	0.0085	117.98	14.47	0.0691
	15.63	102.92	0.0083	120.20	14.21	0.0704
	17.26	101.60	0.0081	123.35	13.84	0.0723
	20.09	99.57	0.0078	128.43	13.30	0.0752
127.00	17.11	115.82	0.0105	94.91	17.99	0.0556
	19.35	114.15	0.0102	97.72	17.47	0.0572
	22.32	111.96	0.0098	101.57	16.81	0.0595
	26.79	108.61	0.0093	107.94	15.82	0.0632
	31.25	105.51	0.0087	114.37	14.93	0.0670
139.70	19.35	128.12	0.0129	77.57	22.01	0.0454
	20.83	127.31	0.0127	78.56	21.73	0.0460
	22.32	126.34	0.0125	79.77	21.41	0.0467
	23.07	125.73	0.0124	80.54	21.20	0.0471
	25.30	124.26	0.0121	82.47	20.71	0.0483
	29.76	121.36	0.0116	86.45	19.75	0.0506
	34.23	118.62	0.0110	90.49	18.87	0.0530
177.80	25.30	166.07	0.0217	46.17	36.98	0.0270
	29.76	163.98	0.0211	47.35	36.06	0.0277
	32.74	162.51	0.0207	48.21	35.42	0.0282
	34.23	161.70	0.0205	48.70	35.06	0.0285
	35.72	160.93	0.0203	49.16	34.73	0.0288
	38.69	159.41	0.0200	50.10	34.08	0.0293
	41.67	157.84	0.0196	51.11	33.41	0.0299
	43.16	157.07	0.0194	51.61	33.09	0.0302
	44.64	156.31	0.0192	52.11	32.77	0.0305
	47.62	154.79	0.0188	53.14	32.13	0.0311
	50.60	153.42	0.0185	54.10	31.57	0.0317
	52.09	152.50	0.0183	54.75	31.19	0.0320
	56.55	150.37	0.0178	56.31	30.32	0.0330
59.53	148.23	0.0173	57.94	29.47	0.0340	
193.68	29.76	180.98	0.0257	38.87	43.92	0.0228
	35.72	178.44	0.0250	39.99	42.70	0.0234
	39.29	177.01	0.0246	40.63	42.02	0.0237
	44.20	174.63	0.0240	41.75	40.90	0.0244
	50.15	171.83	0.0232	43.12	39.60	0.0253
	58.04	168.28	0.0222	44.96	37.98	0.0263
	64.74	163.45	0.0210	47.66	35.83	0.0280
219.08	35.72	205.66	0.0332	30.10	56.73	0.0176
	41.57	203.63	0.0326	30.71	55.61	0.0180
	47.62	201.19	0.0318	31.45	54.29	0.0184
	53.57	198.76	0.0310	32.23	52.98	0.0189
	56.65	197.49	0.0306	32.65	52.30	0.0191
	59.53	196.22	0.0302	33.07	51.63	0.0194
	63.99	194.34	0.0297	33.70	50.65	0.0197
	65.48	193.68	0.0295	33.94	50.31	0.0199
	72.92	190.78	0.0286	34.98	48.81	0.0204
244.48	43.60	230.20	0.0416	24.03	71.07	0.0140
	48.07	228.63	0.0411	24.36	70.10	0.0143
	53.57	226.59	0.0403	24.80	68.86	0.0145
	56.55	225.68	0.0400	25.00	68.30	0.0146
	59.53	224.41	0.0395	25.28	67.54	0.0148
	64.74	222.38	0.0388	25.75	66.32	0.0150
	69.94	220.50	0.0382	26.19	65.20	0.0153
	79.62	216.79	0.0369	27.09	63.03	0.0159
	86.91	214.25	0.0361	27.74	61.56	0.0162
	90.93	212.73	0.0355	28.14	60.69	0.0165
	106.85	206.38	0.0335	29.89	57.12	0.0175

ENGLISH/METRIC UNITS

DEPTH CONVERSION TABLE

FEET	FEET OR METERS TO BE CONVERTED	METERS
3.28083	1	0.3048
6.56	2	0.61
9.84	3	0.91
13.12	4	1.22
16.40	5	1.52
19.68	6	1.83
22.97	7	2.13
26.25	8	2.44
29.53	9	2.74
32.81	10	3.05
65.62	20	6.10
98.42	30	9.14
131.23	40	12.19
164.04	50	15.24
196.85	60	18.29
229.66	70	21.34
262.47	80	24.38
295.27	90	27.43
328.08	100	30.48
656.17	200	60.96
984.25	300	91.44
1,312.33	400	121.92
1,640.42	500	152.40
1,968.50	600	182.88
2,296.58	700	213.36
2,624.66	800	243.84
2,952.75	900	274.32
3,280.83	1,000	304.80
6,561.66	2,000	609.60
9,842.49	3,000	914.40
13,123.32	4,000	1,219.20
16,404.15	5,000	1,524.00
19,684.98	6,000	1,828.80
22,965.81	7,000	2,133.60
26,246.64	8,000	2,438.40
29,527.47	9,000	2,743.20
32,808.30	10,000	3,048.00
49,212.45	15,000	4,572.00
65,616.60	20,000	6,096.00
82,020.75	25,000	7,620.00

ENGLISH/METRIC UNITS

VOLUME CONVERSION TABLE

Gals. Converted to Cu. Ft	Litres	Gals. or Cu. Ft to be converted	Cu. Ft. Converted to Gals.	Cu. Meters
0.13368	3.78533	1	7.48052	0.028317
0.27	7.57	2	14.96	0.0566
0.40	11.36	3	22.44	0.0850
0.53	15.14	4	29.92	0.113
0.67	18.93	5	37.40	0.142
0.80	22.71	6	44.88	0.170
0.94	26.50	7	52.36	0.198
1.07	30.28	8	59.84	0.227
1.20	34.07	9	67.32	0.255
1.34	37.85	10	74.81	0.283
2.67	75.71	20	149.61	0.57
4.01	113.56	30	224.42	0.85
5.35	151.41	40	299.22	1.13
6.68	189.27	50	374.03	1.42
8.02	227.12	60	448.83	1.70
9.36	264.97	70	523.64	1.98
10.69	302.83	80	598.44	2.27
12.03	340.68	90	673.25	2.55
13.37	378.53	100	748.05	2.83
26.74	757.07	200	1,496.10	5.66
40.1	1,135.6	300	2,244.2	8.5
53.5	1,514.1	400	2,992.2	11.3
66.8	1,892.7	500	3,740.3	14.2
80.2	2,271.2	600	4,488.3	17.0
93.6	2,649.7	700	5,236.4	19.8
106.9	3,028.3	800	5,984.4	22.7
120.3	3,406.8	900	6,732.5	25.5
133.7	3,785.3	1,000	7,480.5	28.3
267.4	7,570.7	2,000	14,961.0	56.6
401.0	11,356.0	3,000	22,441.6	85.0
534.7	15,141.3	4,000	29,922.1	113.3
668.4	18,926.7	5,000	37,402.6	141.6
802.1	22,712.0	6,000	44,883.1	169.9
935.8	26,497.3	7,000	52,363.6	198.2
1,069.4	30,282.6	8,000	59,844.2	226.5
1,203.1	34,068.0	9,000	67,324.7	254.9
1,336.8	37,853.3	10,000	74,805.2	283.2
2,005.2	56,780.0	15,000	112,207.8	424.8
2,673.6	75,706.6	20,000	149,610.4	566.3
3,342.0	94,633.3	25,000	187,013.0	707.9

ENGLISH/METRIC UNITS

COMPRESSIVE STRENGTH CONVERSION TABLE

PSI	kPa	N/cm ² or PSI		kPa
		to be converted	N/cm ²	
7.25	50	5	3.45	34.5
14.5	100	10	6.89	68.9
29.0	200	20	13.8	138
43.5	300	30	20.7	207
58.0	400	40	27.6	276
72.5	500	50	34.5	345
87.0	600	60	41.4	414
102	700	70	48.3	483
116	800	80	55.2	552
131	900	90	62.1	621
145	1 000	100	68.9	689
290	2 000	200	138	1 380
435	3 000	300	207	2 070
580	4 000	400	276	2 760
725	5 000	500	345	3 450
870	6 000	600	414	4 140
1,020	7 000	700	483	4 830
1,160	8 000	800	552	5 520
1,310	9 000	900	621	6 210
1,450	10 000	1000	689	6 890
1,600	11 000	1,100	758	7 580
1,740	12 000	1200	827	8 270
1,890	13 000	1,300	896	8 960
2,030	14 000	1,400	965	9 650
2,180	15 000	1,500	1 030	10 300
2,320	16 000	1,600	1 100	11 000
2,470	17 000	1,700	1 170	11 700
2,610	18 000	1,800	1 240	12 400
2,760	19 000	1,900	1 310	13 100
2,900	20 000	2,000	1 380	13 800
4,350	30 000	3,000	2 070	20 700
5,800	40 000	4,000	2 760	27 600
7,250	50 000	5,000	3 450	34 500
8,700	60 000	6,000	4 140	41 400
10,200	70 000	7,000	4 830	48 300
11,600	80 000	8,000	5 520	55 200
13,100	90 000	9,000	6 210	62 100
14,500	100 000	10,000	6 890	68 900
21,800	150 000	15,000	10 300	103 000
29,000	200 000	20,000	13 800	138 000

1 N/cm² = 10 kPa1 N/cm² = 1.450377 PSI1 PSI = .6894757 N/cm²

1 PSI = 6.894757 kPa

ENGLISH/METRIC UNITS

TEMPERATURE CONVERSION TABLES

Reading in °F or °C			Reading in °F or °C		
°F	to be converted	°C	°F	to be converted	°C
-0.4	-18	-27.78	+116.6	+47	+8.33
+3.2	-16	-26.67	+118.4	+48	+8.89
+6.8	-14	-25.56	+120.2	+49	+9.44
+10.4	-12	-24.44	+122.0	+50	+10.00
+14.0	-10	-23.33	+123.8	+51	+10.56
+17.6	-8	-22.22	+123.8	+52	+11.11
+19.4	-7	-21.67	+127.4	+53	+11.67
+21.2	-6	-21.11	+129.2	+54	+12.22
+23.0	-5	-20.56	+131.0	+55	+12.78
+24.8	-4	-20.00	+132.8	+56	+13.33
+26.6	-3	-19.44	+134.6	+57	+13.89
+28.4	-2	-18.99	+136.4	+58	+14.44
+30.2	-1	-18.33	+138.2	+59	+15.00
+32.0	±0	-17.78	+140.0	+60	+15.56
+33.8	+1	-17.22	+141.8	+61	+16.11
+35.6	+2	-16.67	+143.6	+62	+16.67
+37.4	+3	-16.11	+145.4	+63	+17.22
+39.2	+4	-15.56	+147.2	+64	+17.78
+41.0	+5	-15.00	+149.0	+65	+18.33
+42.8	+6	-14.44	+150.8	+66	+18.89
+44.6	+7	-13.89	+152.6	+67	+19.44
+46.4	+8	-13.33	+154.4	+68	+20.00
+48.2	+9	-12.78	+156.2	+69	+20.56
+50.0	+10	-12.22	+158.0	+70	+21.11
+51.8	+11	-11.67	+159.8	+71	+21.67
+53.6	+12	-11.11	+161.6	+72	+22.22
+55.4	+13	-10.56	+163.4	+73	+22.78
+57.2	+14	-10.00	+165.2	+74	+23.33
+59.0	+15	-9.44	+167.0	+75	+23.89
+60.8	+16	-8.89	+168.8	+76	+24.44
+62.6	+17	-8.33	+170.6	+77	+25.00
+64.4	+18	-7.78	+172.4	+78	+25.56
+66.2	+19	-7.22	+174.2	+79	+26.11
+68.0	+20	-6.67	+176.0	+80	+26.67
+69.8	+21	-6.11	+177.8	+81	+27.22
+71.6	+22	-5.56	+179.6	+82	+27.78
+73.4	+23	-5.00	+181.4	+83	+28.33
+75.2	+24	-4.44	+183.2	+84	+28.89
+77.0	+25	-3.89	+185.0	+85	+29.44
+78.8	+26	-3.33	+186.8	+86	+30.00
+80.6	+27	-2.78	+188.6	+87	+30.56
+82.4	+28	-2.22	+190.4	+88	+31.11
+84.2	+29	-1.67	+192.2	+89	+31.67
+86.0	+30	-1.11	+194.0	+90	+32.22
+87.8	+31	-0.56	+195.8	+91	+32.78
+89.6	+32	±0.00	+197.6	+92	+33.33
+91.4	+33	+0.56	+199.4	+93	+33.89
+93.2	+34	+1.11	+201.2	+94	+34.44
+95.0	+35	+1.67	+203.0	+95	+35.00
+96.8	+36	+2.22	+204.8	+96	+35.56
+98.6	+37	+2.78	+206.6	+97	+36.11
+100.4	+38	+3.33	+208.4	+98	+36.67
+102.2	+39	+3.89	+210.2	+99	+37.22
+104.0	+40	+4.44	+212.0	+100	+37.78
+105.8	+41	+5.00	+213.8	+101	+38.33
+107.6	+42	+5.56	+215.6	+102	+38.89
+109.4	+43	+6.11	+217.4	+103	+39.44
+111.2	+44	+6.67	+219.2	+104	+40.00
+113.0	+45	+7.22	+221.0	+105	+40.56
+114.8	+46	+7.78	+222.8	+106	+41.11

ENGLISH/METRIC UNITS

TEMPERATURE CONVERSION TABLES

°F	Reading in °F or °C to be converted	°C	°F	Reading in °F or °C to be converted	°C
+224.6	+107	+41.67	+332.6	+167	+75.00
+226.4	+108	+42.22	+334.4	+168	+75.56
+228.2	+109	+42.78	+336.2	+169	+76.11
+230.0	+110	+43.33	+338.0	+170	+76.67
+231.8	+111	+43.89	+339.8	+171	+77.22
+233.6	+112	+44.44	+341.6	+172	+77.78
+235.4	+113	+45.00	+343.4	+173	+78.33
+237.2	+114	+45.56	+345.2	+174	+78.89
+239.0	+115	+46.11	+347.0	+175	+79.44
+240.8	+116	+46.67	+348.8	+176	+80.00
+242.6	+117	+47.22	+350.6	+177	+80.56
+244.4	+118	+47.78	+352.4	+178	+81.11
+246.2	+119	+48.33	+354.2	+179	+81.67
+248.0	+120	+48.89	+356.0	+180	+82.22
+249.8	+121	+49.44	+357.8	+181	+82.78
+251.6	+122	+50.00	+359.6	+182	+83.33
+253.4	+123	+50.56	+361.4	+183	+83.89
+255.2	+124	+51.11	+363.2	+184	+84.44
+257.0	+125	+51.67	+365.0	+185	+85.00
+258.8	+126	+52.22	+366.8	+186	+85.56
+260.6	+127	+52.78	+368.6	+187	+86.11
+262.4	+128	+53.33	+370.4	+188	+86.67
+264.2	+129	+53.89	+372.2	+189	+87.22
+266.0	+130	+54.44	+374.0	+190	+87.78
+267.8	+131	+55.00	+375.8	+191	+88.33
+269.6	+132	+55.56	+377.6	+192	+88.89
+271.4	+133	+56.11	+379.4	+193	+89.44
+273.2	+134	+56.67	+381.2	+194	+90.00
+275.0	+135	+57.22	+383.0	+195	+90.56
+276.8	+136	+57.78	+384.8	+196	+91.11
+278.6	+137	+58.33	+386.6	+197	+91.67
+280.4	+138	+58.89	+388.4	+198	+92.22
+282.2	+139	+59.44	+390.2	+199	+92.78
+284.0	+140	+60.00	+392.0	+200	+93.33
+285.8	+141	+60.56	+393.8	+201	+93.89
+287.6	+142	+61.11	+395.6	+202	+94.44
+289.4	+143	+61.67	+397.4	+203	+95.00
+291.2	+144	+62.22	+399.2	+204	+95.56
+293.0	+145	+62.78	+401.0	+205	+96.11
+294.8	+146	+63.33	+402.8	+206	+96.67
+296.6	+147	+63.89	+404.6	+207	+97.22
+298.4	+148	+64.44	+406.4	+208	+97.78
+300.2	+149	+65.00	+408.2	+209	+98.33
+302.0	+150	+65.56	+410.0	+210	+98.89
+303.8	+151	+66.11	+411.8	+211	+99.44
+305.6	+152	+66.67	+413.6	+212	+100.00
+307.4	+153	+67.22	+415.4	+213	+100.56
+309.2	+154	+67.78	+417.2	+214	+101.11
+311.0	+155	+68.33	+419.0	+215	+101.67
+312.8	+156	+68.89	+420.8	+216	+102.22
+314.6	+157	+69.44	+422.6	+217	+102.78
+316.4	+158	+70.00	+424.4	+218	+103.33
+318.2	+159	+70.56	+426.2	+219	+103.89
+320.0	+160	+71.11	+428.0	+220	+104.44
+321.8	+161	+71.67	+431.6	+222	+105.56
+323.6	+162	+72.22	+435.2	+224	+106.67
+325.4	+163	+72.78	+438.8	+226	+107.78
+327.2	+164	+73.33	+442.4	+228	+108.89
+329.0	+165	+73.89	+446.0	+230	+110.00
+330.8	+166	+74.44	+449.6	+232	+111.11

ENGLISH/METRIC UNITS

TEMPERATURE CONVERSION TABLES

°F	Reading in °F or °C to be converted	°C	°F	Reading in °F or °C to be converted	°C
+453.2	+234	+112.22	+669.2	+354	+178.89
+456.8	+236	+113.33	+672.8	+356	+180.00
+460.4	+238	+114.44	+676.4	+358	+181.11
+464.0	+240	+115.56	+680.0	+360	+182.22
+467.6	+242	+116.67	+683.6	+362	+183.33
+471.2	+244	+117.78	+687.2	+364	+184.44
+474.8	+246	+118.89	+690.8	+366	+185.56
+478.4	+248	+120.00	+694.4	+368	+186.67
+482.0	+250	+121.11	+698.0	+370	+187.78
+485.6	+252	+122.22	+701.6	+372	+188.89
+489.2	+254	+123.33	+705.2	+374	+190.00
+492.8	+256	+124.44	+708.8	+376	+191.11
+496.4	+258	+125.56	+712.4	+378	+192.22
+500.0	+260	+126.67	+716.0	+380	+193.33
+503.6	+262	+127.78	+719.6	+382	+194.44
+507.2	+264	+128.89	+723.2	+384	+195.56
+510.8	+266	+130.00	+726.8	+386	+196.67
+514.4	+268	+131.11	+730.4	+388	+197.78
+518.0	+270	+132.22	+734.0	+390	+198.89
+521.6	+272	+133.33	+737.6	+392	+200.00
+525.2	+274	+134.44	+741.2	+394	+201.11
+528.8	+276	+135.56	+744.8	+396	+202.22
+532.4	+278	+136.67	+748.4	+398	+203.33
+536.0	+280	+137.78	+752.0	+400	+204.44
+539.6	+282	+138.89	+755.6	+402	+205.56
+543.2	+284	+140.00	+759.2	+404	+206.67
+546.8	+286	+141.11	+762.8	+406	+207.78
+550.4	+288	+142.22	+766.4	+408	+208.89
+554.0	+290	+143.33	+770.0	+410	+210.00
+557.6	+292	+144.44	+773.6	+412	+211.11
+561.2	+294	+145.56	+777.2	+414	+212.22
+564.8	+296	+146.67	+780.8	+416	+213.33
+568.4	+298	+147.78	+784.4	+418	+214.44
+572.0	+300	+148.89	+788.0	+420	+215.56
+575.6	+302	+150.00	+791.6	+422	+216.67
+579.2	+304	+151.11	+795.2	+424	+217.78
+582.8	+306	+152.22	+798.8	+426	+218.89
+586.4	+308	+153.33	+802.4	+428	+220.00
+590.0	+310	+154.44	+806.0	+430	+221.11
+593.6	+312	+155.56	+809.6	+432	+222.22
+597.2	+314	+156.67	+813.2	+434	+223.33
+600.8	+316	+157.78	+816.8	+436	+224.44
+604.4	+318	+158.89	+820.4	+438	+225.56
+608.0	+320	+160.00	+824.0	+440	+226.67
+611.6	+322	+161.11	+827.6	+442	+227.78

$$^{\circ}\text{F} = 9/5 \times ^{\circ}\text{C} + 32^{\circ}$$

$$^{\circ}\text{C} = 5/9 (^{\circ}\text{F} - 32^{\circ})$$

ENGLISH/METRIC UNITS

CONVERSION OF PERCENT SALT IN SALT WATER TO PARTS PER MILLION

Per Cent Salt	Parts per Million	Milligrams per Liter
½	5,000	5,020
1	10,000	10,050
2	20,000	20,250
3	30,000	30,700
4	40,000	41,100
5	50,000	52,000
6	60,000	62,500
7	70,000	73,000
8	80,000	84,500
9	90,000	95,000
10	100,000	107,100
11	110,000	118,500
12	120,000	130,300
13	130,000	142,000
14	140,000	154,100
15	150,000	166,500
16	160,000	178,600
17	170,000	191,000
18	180,000	203,700
19	190,000	216,500
20	200,000	229,600
21	210,000	243,000
22	220,000	256,100
23	230,000	270,000
24	240,000	279,500
25	250,000	283,300
26	260,000	311,300

The parts per million column is true parts per million by weight of the salt solution.

It is quite common for many laboratories, analyzing water samples, to report milligrams of salt per liter as parts per million. If it is known that an analysis is reported in this way, the milligram per liter column should be used in converting to percent salt rather than the parts per million column. At low concentrations the error of using the incorrect column is very small. At high concentrations the error is appreciable unless the correct column is used.

PHYSICAL PROPERTIES OF SODIUM CHLORIDE SOLUTIONS

Percent Sodium Chloride by Weight		Density of Solution†		Specific Gravity @ 20° C	Weight of Salt			Yield of Solution	Freeze Point	
of Solution	of Water	Lbs./Gal.	kg/m3		Lbs./Gal. of Water	Lbs./Bbl. of Water	kg/m3 of Water		°F	°C
0		8.34	998	0.998				1.000		
1	1.01	8.38	1005	1.005	0.08	3.54	10.08	1.005	30.9	- 0.6
2	2.04	8.45	1013	1.013	0.17	7.15	20.36	1.008	29.9	- 1.2
3	3.09	8.51	1020	1.020	0.26	10.82	30.85	1.011	28.8	- 1.8
4	4.17	8.57	1027	1.027	0.35	14.61	41.63	1.015	27.7	- 2.4
5	5.26	8.62	1034	1.034	0.44	18.42	52.51	1.018	26.2	- 3.0
6	6.38	8.68	1041	1.041	0.53	22.35	63.69	1.022	25.3	- 3.7
8	8.70	8.81	1056	1.056	0.73	30.47	86.85	1.029	22.9	- 5.1
10	11.11	8.93	1071	1.071	0.93	38.92	110.90	1.038	20.2	- 6.6
12	13.64	9.06	1086	1.086	1.14	47.78	136.16	1.047	17.3	- 8.2
14	16.28	9.18	1101	1.101	1.36	57.03	162.51	1.056	14.1	- 9.9
16	19.05	9.31	1116	1.116	1.59	66.73	190.16	1.067	10.6	-11.9
18	21.95	9.44	1132	1.132	1.83	76.89	219.11	1.077	6.7	-14.0
20	25.00	9.57	1148	1.148	2.09	87.57	249.56	1.089	2.4	-16.5
22	28.21	9.71	1164	1.164	2.35	98.81	281.60	1.101	-2.5	-19.2
24	31.58	9.84	1180	1.180	2.63	110.62	315.24	1.115	+ 1.4*	-17.0*
26	35.14	9.98	1197	1.197	2.93	123.09	350.78	1.129	+27.9*	- 2.3*

* Precipitation @ -17°C, 1.4°F **Precipitation @ -2.3°C, 27.9°F

† Density in kg/L and kg/dm3 is equal in numerical value to specific gravity.

PHYSICAL PROPERTIES OF CALCIUM CHLORIDE SOLUTIONS

Percent Calcium Chloride		Density of Solution*		Specific* Gravity @ 20° C	Weight of Anhydrous Calcium Chloride			Yield of Solution	Freeze Point	
by Wt. of Solution	by Wt. of Water	Lbs./Gal.	kg/m3		Lbs./Gal. of Water	Lbs./Bbl. of Water	Kg/m3 of Water		°F	°C
0.0	—	8.34	998	0.998	—	—	—	1.000	32	0.0
1.0	1.01	8.41	1008	1.008	0.08	3.54	10.08	1.002	31.1	-10.5
2.0	2.04	8.47	1015	1.015	0.17	7.15	20.36	1.004	30.2	-11.0
3.0	3.09	8.54	1024	1.024	0.26	10.82	30.85	1.006	29.7	-11.3
4.0	4.17	8.61	1032	1.032	0.35	14.61	41.63	1.008	28.4	-12.0
5.0	5.26	8.69	1042	1.042	0.44	18.42	52.51	1.012	27.7	-12.4
10.0	11.11	9.04	1084	1.084	0.93	38.92	110.90	1.024	22.3	-15.4
15.0	17.65	9.44	1132	1.132	1.47	61.74	176.19	1.040	13.5	-10.3
20.2	25.00	9.82	1178	1.178	2.09	87.57	249.56	1.060	-10.4	-18.0
25.0	33.33	10.24	1228	1.228	2.78	116.76	332.71	1.090	-20.6	-29.2
30.0	42.86	10.69	1282	1.282	3.57	149.94	427.84	1.114	-49.0	-45.0
35.0	53.85	11.15	1337	1.337	4.49	188.58	537.55	1.151	—	—
40.0	66.67	11.72	1405	1.405	5.56	233.52	665.52	1.186	—	—

* Density in kg/L and kg/dm³ is equal in numerical value to specific gravity.

ENGLISH/METRIC UNITS

PHYSICAL PROPERTIES OF POTASSIUM CHLORIDE SOLUTIONS

Percent Potassium Chloride by Weight of Solution of Water		Density of Solution† Lbs./Gal. kg/m3		Sp. Gr. † @ 20° C	Weight of Potassium Chloride			kg of Pottassium per m3 of Water	kg of Chloride per m3 of Water	Freeze Point	
					Lbs./Gal. of Water	Lbs./Bbl. of Water	kg/m3 of Water			°F	°C
0		8.34	998	0.998	—	—	—	—	—	—	—
1	1.01	8.38	1005	1.005	0.08	3.54	10.08	5.27	4.78	31.2	- 0.44
2	2.04	8.43	1011	1.011	0.17	7.15	20.36	10.6	9.6	30.3	- 0.94
3	3.09	8.48	1017	1.017	0.26	10.82	30.85	16.0	14.5	29.5	- 1.39
4	4.17	8.54	1024	1.024	0.35	14.61	41.63	21.5	19.5	28.7	- 1.83
6	6.38	8.65	1037	1.037	0.53	22.35	63.69	32.6	29.6	27.0	- 2.78
8	8.70	8.75	1050	1.050	0.73	30.47	86.85	44.0	39.8	25.2	- 3.78
10	11.11	8.87	1063	1.063	0.93	38.92	110.90	55.8	50.5	23.3	- 4.83
12	13.64	8.98	1077	1.077	1.14	47.78	136.16	67.8	61.4	21.4	- 5.89
14	16.28	9.10	1091	1.091	1.36	57.03	162.51	80.0	72.5	19.3	- 7.06
16	19.05	9.21	1104	1.104	1.59	66.73	190.16	92.6	84.0	17.4	- 8.11
18	21.95	9.33	1119	1.119	1.83	76.89	219.11	105.4	95.5	14.9	- 9.50
20	25.00	9.45	1133	1.113	2.09	87.57	249.56	118.8	107.8	15.0	- 9.44
22	28.21	9.57	1147	1.147	2.35	98.81	281.60	132.1	119.8	32.6	10.33
24	31.58	9.69	1162	1.162	2.63	110.62	315.24	146.3	132.6	52.0*	11.11*
26.5	36.05	9.82	1178	1.178	3.01	126.28	359.86	163.7	148.5	78.3*	25.72*

* Precipitates

† Density in kg/L and kg/dm3 is equal in numerical value to specific gravity.

ENGLISH/METRIC UNITS

ENGLISH/METRIC UNITS

API GRAVITY CONVERSION TABLE

API Gravity	Specific* Gravity	Density* Lbs./Gal.	Density* Kg/m3	Pressure Gradient PSI/Ft.	Pressure Gradient kPa/m
15% HCL	1.0750	8.962	1075.0	.4654	10.547
10 (Water)	1.0000	8.337	1000.0	.4330	9.807
12	.9861	8.221	986.1	.4270	9.670
15	.9659	8.053	965.9	.4182	9.472
18	.9465	7.891	946.5	.4098	9.282
20	.9340	7.787	934.0	.4044	9.159
22	.9218	7.685	921.8	.3991	9.044
24	.9100	7.587	910.0	.3940	8.924
26	.8984	7.490	898.4	.3890	8.810
28	.8871	7.396	887.1	.3841	8.700
30	.8762	7.305	876.2	.3794	8.592
31	.8708	7.260	870.8	.3771	8.539
32	.8654	7.215	865.4	.3747	8.487
33	.8602	7.171	860.2	.3725	8.436
34	.8550	7.128	855.0	.3702	8.385
35	.8498	7.085	849.8	.3680	8.334
36	.8448	7.043	844.8	.3658	8.284
37	.8398	7.001	839.8	.3638	8.235
38	.8348	6.960	834.8	.3615	8.187
39	.8299	6.919	829.9	.3593	8.139
40	.8251	6.879	825.1	.3573	8.091
41	.8203	6.839	820.3	.3552	8.044
42 (Diesel)	.8156	6.800	815.6	.3532	7.998
43	.8109	6.760	810.9	.3511	7.952
44	.8063	6.722	806.3	.3491	7.907
46	.7972	6.646	797.2	.3452	7.818
48	.7883	6.572	788.3	.3413	7.731
50	.7796	6.500	779.6	.3376	7.645
55	.7587	6.325	758.7	.3285	7.440
60	.7389	6.160	738.9	.3200	7.246

*Density in kg/L and kg/dm³ are equal in value to specific gravity.

$$\text{Sp gr @ } 60^{\circ}\text{F} = \frac{141.5}{131.5 + \text{API Gravity}}$$

$$\text{API Gravity} = \frac{141.5}{\text{Sp gr @ } 60^{\circ}\text{F}} - 131.5$$

ENGLISH/METRIC UNITS

DETERMINE THE API GRAVITY OF AN OIL

Use the API Hydrometer and obtain the gravity of the oil. At the same time obtain the temperature of the oil. The gravity should be reported in API* at 60°F. If the temperature of the oil is not 60°F., a correction must be made. If the oil is above 60°F., the correction is (-) minus. If the oil is below 60°F., the correction is (+) plus.

The correction is 1° API for every 10°F. over or under 60°F. (15.56°C.)*

Example:

Temperature above 60°F.

Observed API Gravity	=	35.2° API
Observed Temperature	=	77°F.
Correction is (-) minus		77-60
temperature is above 60°F.	=	$\frac{\quad}{10}$ = 1.7
Correction		10

The API Gravity corrected to 60°F., is:

$$35.2 - 1.7 = 33.5^\circ \text{ API @ } 60^\circ \text{F.}$$

Temperature below 60°F.

Observed API Gravity	=	38.3° API
Observed Temperature	=	51.0°F.
Correction is (+) plus as		60-51
temperature is below 60°F.,	=	$\frac{\quad}{10}$ = 0.9
Correction		10

The API Gravity corrected to 60°F., is:

$$38.3 + 0.9 = 39.2^\circ \text{ API @ } 60^\circ \text{F.}$$

* Must convert Celsius (°C) to Fahrenheit (F°) for this correction. See Section 240, pages 9, 10 and 11 for temperature conversions.

ENGLISH/METRIC UNITS

STANDARDS FOR METRIC CONVERSION FACTORS

The following conversion factors are those published by the American Society for Testing and Materials (ASTM) in E380-76. These same units may be found in literature published by all U.S. Technical Societies, i.e., API Bulletin 2563, American National Standards Institute ANSIZ 210.1, Society of Petroleum Engineers, The Canadian Petroleum Association (CPA) and others.

The metric units and conversion factors adopted by the ASTM are based on the "International System of Units" (designated SI for Systeme International d'Unites), fixed by the International Committee for Weights and Measures. This system has been adopted by the International Organization for Standardization in ISO Recommendation R-31.

Conversion factors herein are written as a number equal to or greater than one and less than ten with six or less decimal places. This number is followed by the letter E (for exponent), a plus or minus symbol, and two digits which indicate the power of 10 by which the number must be multiplied to obtain the correct value. For example:

(1) $3.523\ 907\ E-02$ is $3.523\ 907 \times 10^{-2}$

or
 $0.035\ 239\ 07$

(2) $3.386\ 389\ E+03$ is $3.386\ 389 \times 10^3$

or
 $3\ 387.389$

(3) Further examples of conversion are:

To convert from:	To	multiply by:
pound-force per square foot	Pa	$4.788\ 026\ E+01$
inch	m	$2.540\ 000\ E-0$

$$1\ \text{lbf/ft}^2 = 47.880\ 26\ \text{Pa}$$

$$1\ \text{inch} = 0.0254\ \text{m (exactly)}$$

ENGLISH/METRIC UNITS

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
ACCELERATION		
ft/s ²	meter per second ² (m/s ²)	3.048 000 *E-01
free fall, standard (g)	meter per second ² (m/s ²)	9.806 650 *E+00
gal	meter per second ² (m/s ²)	1.000 000 *E-02
in/s ²	meter per second ² (m/s ²)	2.540 000 *E-02
ANGLE		
degree (angle)	radian (rad)	1.745 329 E-02
minute (angle)	radian (rad)	2.908 882 E-04
second (angle)	radian (rad)	4.848 137 E=06
AREA		
acre (U.S. survey) ¹	meter ² (m ²)	4.046 873 E+03
are	meter ² (m ²)	1.000 000 *E+02
barn	meter ² (m ²)	1.000 000 *E-28
circular mil	meter ² (m ²)	5.067 075 E-10
ft ²	meter ² (m ²)	9.290 304 *E-02
hectar	meter ² (m ²)	1.000 000 *E+04
in ²	meter ² (m ²)	6.451 600 *E-04
mi ² (international)	meter ² (m ²)	2.589 988 E+06
mi ² (U.S. survey) ¹	meter ² (m ²)	2.589 988 E+06
section	meter ² (m ²)	(see footnote 1)
township	meter ² (m ²)	(see footnote 1)
yd ²	meter ² (m ²)	8.361 274 E-01

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
BENDING MOMENT OR TORQUE		
dyne • cm	newton meter (N•m)	1.000 000 *E-07
kgf • m	newton meter (N•m)	9.806 650 *E+00
ozf • in	newton meter (N•m)	7.061 552 E-03
lbf • in	newton meter (N•m)	1.129 848 E-01
lbf • in	newton meter (N•m)	1.355 818 E+00
BENDING MOMENT OR TORQUE PER UNIT LENGTH		
lbf • ft/in	newton meter per meter (N•m/m)	5.337 866 E+01
lbf • ft/in	newton meter per meter (N•m/m)	4.448 222 E+00
CAPACITY (See Volume)		
DENSITY (See Mass Per Unit Volume)		
ELECTRICITY AND MAGNETISM⁸		
abampere	ampere (A)	1.000 000 *E+01
abcoulomb	coulomb (C)	1.000 000 *E+01
abfarad	farad (F)	1.000 000 *E+09
abhenry	henry (H)	1.000 000 *E-09
abmho	siemens (S)	1.000 000 *E-09
abohm	ohm (Ω)	1.000 000 *E-09
abvolt	volt (V)	1.000 000 *E-08
ampere hour	coulomb (C)	3.600 000 *E+03
EMU of capacitance	farad (F)	1.000 000 *E+09
EMU of current	ampere (A)	1.000 000 *E+01
EMU of electric potential	volt (V)	1.000 000 *E-08

⁸ESU means electrostatic cgs unit. EMU means electromagnetic cgs unit.

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
ELECTRICITY AND MAGNETISM⁸ (Cont'd)		
EMU of inductance	henry (H)	1.000 000 *E-09
EMU of resistance	ohm (Ω)	1.000 000 *E-09
ESU of capacitance	farad (F)	1.112 650 E-12
ESU of current	ampere (A)	3.335 6 E-10
ESU of electric potential	volt (V)	2.997 9 E+12
ESU of inductance	henry (H)	8.987 554 E+11
ESU of resistance	ohm (Ω)	8.987 554 E+11
faraday (based on carbon-12)	coulomb (C)	9.648 70 E+04
faraday (chemical)	coulomb (C)	9.649 57 E+04
faraday (physical)	coulomb (C)	9.652 19 E+04
gamma	tesla (T)	1.000 000 *E-09
gauss	tesla (T)	1.000 000 *E-04
gilbert	ampere (A)	7.957 747 *E-01
maxwell	weber (Wb)	1.000 000 *E-08
mho	siemens (S)	1.000 000 *E+00
oersted	ampere per meter (A/m)	7.957 747 E+01
ohm centimeter	ohm meter (Ω m)	1.000 000 *E-02
ohm circular-mil per foot	ohm millimeter ² per meter (Ω mm ² /m)	1.662 426 E-03
statampere	ampere (A)	3.335 640 E-10
statcoulomb	coulomb (C)	3.335 640 E-10
statfarad	farad (F)	1.112 650 E-12
stathenry	henry (H)	8.987 554 E+11
statmho	siemens (S)	1.112 650 E-12
statohm	ohm (Ω)	8.987 554 E+11
statvolt	volt (V)	2.997 925 E+02
unit pole	weber (Wb)	1.256 637 E-07

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
ENERGY		
(Includes Work)		
British thermal unit (International Table) ³	joule (J)	1.055 056 E+03
British thermal unit (mean)	joule (J)	1.055 87 E+03
British thermal unit (thermochemical)	joule (J)	1.054 350 E+03
British thermal unit (39°F)	joule (J)	1.059 67 E+03
British thermal unit (59°F)	joule (J)	1.054 80 E+03
British thermal unit (60°F)	joule (J)	1.054 68 E+03
calorie (International Table)	joule (J)	4.186 800 *E+00
calorie (mean)	joule (J)	4.190 02 E+00
calorie (thermochemical)	joule (J)	4.184 000 *E+00
calorie (15°C)	joule (J)	4.185 80 E+00
calorie (20°C)	joule (J)	4.181 90 E+00
calorie (kilogram, International Table)	joule (J)	4.186 800 *E+03
calorie (kilogram, mean)	joule (J)	4.190 02 E+03
calorie (kilogram, thermochemical)	joule (J)	4.184 000 *E+03
electrovolt	joule (J)	1.602 19 E-19
erg	joule (J)	1.000 000 *E-07
ft • lbf	joule (J)	1.355 818 E+00
ft • poundal	joule (J)	4.214 011 E-02
kilocalorie (International Table)	joule (J)	4.186 800 *E+03
kilocalorie (mean)	joule (J)	4.190 02 E+03
kilocalorie (thermochemical)	joule (J)	4.184 000 *E+03
kW • h	joule (J)	3.600 000 *E+06
therm	joule (J)	1.055 056 E+08
ton (nuclear equivalent of TNT)	joule (J)	4.184 E+0920
W • h	joule (J)	3.600 000 *E+03
W • s	joule (J)	1.000 000 *E+00

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
ENERGY PER UNIT AREA TIME		
Btu (thermochemical)/ft ² •s	watt per meter ² (W/m ²)	1.134 893 E+04
Btu (thermochemical)/ft ² •min	watt per meter ² (W/m ²)	1.891 489 E+02
Btu (thermochemical)/ft ² •h	watt per meter ² (W/m ²)	3.152 481 E+00
Btu (thermochemical)/in ² •s	watt per meter ² (W/m ²)	1.634 246 E+06
cal (thermochemical)/cm ² •min	watt per meter ² (W/m ²)	6.973 333 E+02
erg/(cm ² •s)	watt per meter ² (W/m ²)	1.000 000 *E+03
W/cm ²	watt per meter ² (W/m ²)	1.000 000 *E+03
W/in ²	watt per meter ² (W/m ²)	1.550 003 E+03
FLOW		
(See Mass Per Unit Time or Volume Per Unit Time)		
FORCE		
dyne	newton (N)	1.000 000 *E-05
kilogram-force	newton (N)	9.806 650 *E+00
kilopond	newton (N)	9.806 650 *E+00
kip (1000lbf)	newton (N)	4.448 222 E+03
ounce-force	newton (N)	2.780 139 E-01
pound-force (lbf) ⁷	newton (N)	4.448 222 E+00
lbf/lb (thrust/weight (mass) ratio)	newton per kilogram (N/kg)	9.806 650 E+00
poundal	newton (N)	1.382 550 E-01
ton-force (2000 lbf)	newton (N)	8.896 444 E+03
FORCE PER UNIT AREA		
(See Pressure)		
FORCE PER UNIT LENGTH		
lbf/ft	newton per meter (N/m)	1.459 390 E+01
lbf/in	newton per meter (N/m)	1.751 268 E+02

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
HEAT		
Btu (International Table) •ft/h • ft ² • °F (k, thermal conductivity)	watt per meter kelvin (W/m • K)	1.730 735 E+00
Btu (thermochemical) •ft/h • ft ² • °F (k, thermal conductivity)	watt per meter kelvin (W/m • K)	1.729 577 E+00
Btu (International Table) •in/h • ft ² • °F (k, thermal conductivity)	watt per meter kelvin (W/m • K)	1.442 279 E-01
Btu (thermochemical) •in/h • ft ² • °F (k, thermal conductivity)	watt per meter kelvin (W/m • K)	1.441 314 E-01
Btu (International Table) •in/s • ft ² • °F (k, thermal conductivity)	watt per meter kelvin (W/m • K)	5.192 204 E+02
Btu (thermochemical) •in/s • ft ² • °F (k, thermal conductivity)	watt per meter kelvin (W/m • K)	5.188 732 E+02
Btu (International Table) ft ²	joule per meter ² (J/m ²)	1.135 653 E+04
Btu (thermochemical)/ft ²	joule per meter ² (J/m ²)	1.134 893 E+04
Btu (International Table) •h • ft ² • °F (C, thermal conductance)	watt per meter ² kelvin (W/m ² • K)	5.678 263 E+00
Btu (thermochemical)/h • ft ² • °F (C, thermal conductance)	watt per meter ² kelvin (W/m ² • K)	5.674 466 E+00
Btu (International Table)/s • ft ² • °F	watt per meter ² kelvin (W/m ² • K)	2.044 175 E+04
Btu (thermochemical)/s • ft ² • °F	watt per meter ² kelvin (W/m ² • K)	2.042 808 E+04
Btu (International Table)/lb	joule per kilogram (J/kg)	2.326 000 *E+03
Btu (thermochemical)/lb	watt per kilogram (J/kg)	2.324 444 E+03
Btu (International Table)/lb • °F (c, heat capacity)	joule per kilogram kelvin (J/kg • K)	4.186 800 *E+03
Btu (thermochemical)/lb • °F (c, heat capacity)	joule per kilogram kelvin (J/kg • K)	4.184 000 E+03
cal (thermochemical)/cm • s • °C	watt per meter kelvin (W/m • K)	4.184 000 *E+02
cal (thermochemical)/cm ²	joule per meter ² (J/m ²)	4.184 000 *E+04
cal (thermochemical)/cm ² • min	watt per meter ² (W/m ²)	6.973 333 E+02
cal (thermochemical)/cm ² • s	watt per meter ² (W/m ²)	4.184 000 *E+04
cal (International Table)/g	joule per kilogram (J/kg)	4.186 800 *E+03
cal (thermochemical)/g	joule per kilogram (J/kg)	4.186 000 *E+03

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
HEAT (Cont'd)		
cal (International Table)/g • °C	joule per kilogram kelvin (J/kg • K)	4.186 800 *E+03
cal (thermochemical)/g • °C	joule per kilogram kelvin (J/kg • K)	4.184 000 *E+03
cal (thermochemical)/min	watt (W)	6.973 333 E-02
cal (thermochemical)/s	watt (W)	4.184 000 *E+00
clo	kelvin meter ² per watt (K • m ² /W)	2.003 712 E-01
°F • h • ft ² /Btu (International Table) (R, thermal resistance)	kelvin meter ² per watt (K • m ² /W)	1.761 102 E-01
°F • h • ft ² /Btu (thermochemical) (R, thermal resistance)	kelvin meter ² per watt (K • m ² /W)	1.762 280 E-01
ft ² /hl (thermal diffusivity)	meter ² per second (m ² /s)	2.580 640 *E-05
LENGTH		
angstrom	meter (m)	1.000 000 *E-10
astronomical unit ²	meter (m)	1.495 979 E+10
caliber (inch)	meter (m)	2.540 000 *E-02
fathom	meter (m)	1.828 8 E+00
fermi (femtometer)	meter (m)	1.000 000 *E-15
foot	meter (m)	3.048 000 *E-01
foot (U.S. survey) ²	meter (m)	3.048 006 E-01
inch	meter (m)	2.540 000 *E-02
league	meter (m)	(see footnote 1)
light year	meter (m)	9.460 55 E+15
microinch	meter (m)	2.540 000 *E-08
micron	meter (m)	1.000 000 *E-06
mil	meter (m)	2.540 000 *E-05
mile (international nautical)	meter (m)	1.852 000 *E+03
mile (U.K. nautical)	meter (m)	1.853 184 *E+03
mile (U.S. nautical)	meter (m)	1.852 000 *E+03
mile (international)	meter (m)	1.609 344 *E+03
mile (statute)	meter (m)	1.609 3 E+03

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
LENGTH (Cont'd)		
mile (U.S. survey) ¹	meter (m)	1.609 347 E+03
parsec ¹³	meter (m)	3.085 678 E+16
pica (printer's)	meter (m)	4.217 518 E-03
point (printer's)	meter (m)	3.514 598 *E-04
rod	meter (m)	(see footnote 1)
yard	meter (m)	9.144 000 *E-01
LIGHT		
footcandle	lux (lx)	1.076 391 E+01
footlambert	candela per meter ² (cd/m ²)	3.426 259 E+00
lambert	candela per meter ² (cd/m ²)	3.183 099 E+03
MASS		
carat (metric)	kilogram (kg)	2.000 000 *E-04
grain	kilogram (kg)	6.479 891 *E-05
gram	kilogram (kg)	1.000 000 *E-03
hundredweight (long)	kilogram (kg)	5.080 235 E+01
hundredweight (short)	kilogram (kg)	4.535 924 E+01
kgf • s ² /m (mass)	kilogram (kg)	9.806 659 *E+00
ounce (avoirdupois)	kilogram (kg)	2.834 952 E-02
ounce (troy or apothecary)	kilogram (kg)	3.110 348 E-02
pennyweight	kilogram (kg)	1.555 174 E-03
pound (lb avoirdupois) ⁸	kilogram (kg)	4.535 924 E-01
pound (troy or apothecary)	kilogram (kg)	3.732 417 E-01
slug	kilogram (kg)	1.459 390 E+01
ton (assay)	kilogram (kg)	2.916 667 E-02
ton (long, 2240 lb)	kilogram (kg)	1.016 047 E+03
ton (metric)	kilogram (kg)	1.000 000 *E+03
ton (short, 2000 lb)	kilogram (kg)	9.071 847 E+02
tonne	kilogram (kg)	1.000 000 *E+03

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
MASS PER UNIT AREA		
oz/ft ²	kilogram per meter ² (kg/m ²)	3.051 517 E-01
oz/yd ²	kilogram per meter ² (kg/m ²)	3.390 575 E-02
lb/ft ²	kilogram per meter ² (kg/m ²)	4.882 428 E+00
MASS PER UNIT CAPACITY (See Mass Per Unit Volume)		
MASS PER UNIT LENGTH		
denier	kilogram per meter (kg/m)	1.111 111 E-07
lb/ft	kilogram per meter (kg/m)	1.488 164 E+00
lb/in	kilogram per meter (kg/m)	1.785 797 E+01
tex	kilogram per meter (kg/m)	1.000 000 *E-06
MASS PER UNIT TIME (Includes Flow)		
perm (0° C)	kilogram per pascal second meter ² (kg/Pa • s • m ²)	5.721 35 E-07
perm (23° C)	kilogram per pascal second meter ² (kg/ Pa • s • m ²)	5.745 25 E-11
perm • in (0° C)	kilogram per pascal second meter (kg/ Pa • s • m)	1.453 22 E-12
perm • (23° C)	kilogram per pascal second meter (kg/ Pa • s • m)	1.459 29 E-12
lb/h	kilogram per second (kg/s)	1.259 29 E-12
lb/min	kilogram per second (kg/s)	7.559 873 E-03
lb/s	kilogram per second (kg/s)	4.535 924 E-01
lb/hp • h (SFC, specific fuel consumption)	kilogram per joule (kg/J)	1.689 659 E-07
ton (short)/h	kilogram per second (kg/s)	2.519 958 E-01

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
MASS PER UNIT VOLUME		
(Includes Density and Mass Capacity)		
grain (lb avoirdupois/7000)/gal (U.S. liquid)	kilogram per meter ³ (kg/m ³)	1.711 806 E-02
g/cm ³	kilogram per meter ³ (kg/m ³)	1.000 000 *E+03
oz (avoirdupois)/gal (U.K. liquid)	kilogram per meter ³ (kg/m ³)	6.236 021 E+00
oz (avoirdupois)/gal (U.S. liquid)	kilogram per meter ³ (kg/m ³)	7.489 152 E+00
oz (avoirdupois)/in ³	kilogram per meter ³ (kg/m ³)	1.729 994 E+03
lb/ft ³	kilogram per meter ³ (kg/m ³)	1.601 846 E+01
lb/in ³	kilogram per meter ³ (kg/m ³)	2.767 990 E+04
lb/gal (U.K. liquid)	kilogram per meter ³ (kg/m ³)	9.977 633 E+01
lb/gal (U.S. liquid)	kilogram per meter ³ (kg/m ³)	1.198 264 E+02
lb/yd ³	kilogram per meter ³ (kg/m ³)	5.932 764 E-01
slug/ft ³	kilogram per meter ³ (kg/m ³)	5.153 788 E+02
ton (long)/yd ³	kilogram per meter ³ (kg/m ³)	1.328 939 E+03
ton (short)/yd ³	kilogram per meter ³ (kg/m ³)	1.186 553 E+03
POWER		
Btu (International Table)/h	watt (W)	2.930 711 E-01
Btu (International Table)/s	watt (W)	1.055 056 E+03
Btu (thermochemical)/h	watt (W)	2.928 751 E-01
Btu (thermochemical)/min	watt (W)	1.757 250 E+01
Btu (thermochemical)/s	watt (W)	1.054 350 E+03
cal (thermochemical)/min	watt (W)	6.973 333 E-02
cal (thermochemical)/s	watt (W)	4.184 000 *E+00
erg/s	watt (W)	1.000 000 E-07
ft • lbf/h	watt (W)	3.766 161 E-04
ft • lbf/min	watt (W)	2.259 697 E-02
ft • lbf/s	watt (W)	1.355 818 E+00
horsepower (550 ft • lbf/s)	watt (W)	7.456 999 E+02
horsepower (boiler)	watt (W)	9.809 50 E+03
horsepower (electric)	watt (W)	7.460 000 *E+02

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
POWER (Cont'd)		
horsepower (metric)	watt (W)	7.354 99 E+02
horsepower (water)	watt (W)	7.460 43 E+02
horsepower (U.K.)	watt (W)	7.457 0 E+02
kilocalorie (thermochemical)/min	watt (W)	6.973 333 E+01
kilocalorie (thermochemical)/s	watt (W)	4.184 000 *E+03
ton (refrigeration)	watt (W)	3.516 800 E+03
PRESSURE OR STRESS (Force Per Unit Area)		
atmosphere (standard)	pascal (Pa)	1.013 250 *E+05
atmosphere (technical = 1 kgf/cm ²)	pascal (Pa)	9.806 650 *E+04
bar	pascal (Pa)	1.000 000 *E+05
centimeter of mercury (° C)	pascal (Pa)	1.333 22 E+03
centimeter of water (4° C)	pascal (Pa)	9.806 38 E+01
dyne/cm ²	pascal (Pa)	1.000 000 *E-01
foot of water (39.2° F)	pascal (Pa)	2.988 98 E+03
gram-force/cm ²	pascal (Pa)	9.806 650 E+01
inch of mercury (32° F)	pascal (Pa)	3.386 38 E+03
inch of mercury (60° F)	pascal (Pa)	3.376 85 E+03
inch of water (39.2° F)	pascal (Pa)	2.490 82 E+02
inch of water (60° F)	pascal (Pa)	2.488 4 E+02
kgf/cm ²	pascal (Pa)	9.806 650 *E+04
kgf/m ²	pascal (Pa)	9.806 650 *E+00
kgf/mm ²	pascal (Pa)	9.806 650 *E+06
kip/in ² (ksi)	pascal (Pa)	6.894 757 E+06
millibar	pascal (Pa)	1.000 000 *E+02
millimeter of mercury (0° C)	pascal (Pa)	1.333 22 E+02
poundal/ft ²	pascal (Pa)	1.488 164 E+00
lbf/ft ²	pascal (Pa)	4.788 026 E+01

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
PRESSURE OR STRESS (Cont'd)		
lbf/in ² (psi)	pascal (Pa)	6.894 757 E+03
psi	pascal (Pa)	6.894 757 E+03
torr (mm Hg, 0° C)	pascal (Pa)	1.333 22 E+02
SPEED		
(See Velocity)		
STRESS		
(See Pressure)		
TEMPERATURE		
degree Celsius	kelvin (K)	tK = toC + 273.15
degree Fahrenheit	degree Celsius	toC = (toF - 32)/1.8
degree Fahrenheit	kelvin (K)	tK = (toF - 459.67)/1.8
degree Rankine	kelvin (K)	tK = toR/1.8
kelvin	degree Celsius	toC = tK - 273.15
TIME		
day (mean solar)	second (s)	8.640 000 E+04
day (sidereal)	second (s)	8.616 409 E+04
hour (mean solar)	second (s)	3.600 000 E+03
day (sidereal)	second (s)	3.590 170 E+03
minute (mean solar)	second (s)	6.000 000 E+01
minute (sidereal)	second (s)	5.983 617 E+01
month (mean calendar)	second (s)	2.628 000 E+06
second (sidereal)	second (s)	9.972 696 E-01
year (365 days)	second (s)	3.153 600 E+07
year (sidereal)	second (s)	3.155 815 E+07
year (tropical)	second (s)	3.155 693 E+07

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
TORQUE		
(See Bending Moment)		
VELOCITY		
(Includes Speed)		
ft/h	meter per second (m/s)	8.466 667 E-05
ft/min	meter per second (m/s)	5.080 000 *E-03
ft/s	meter per second (m/s)	3.048 000 *E-01
in/s	meter per second (m/s)	2.540 000 *E-02
km/h	meter per second (m/s)	2.777 778 E-01
knot (international)	meter per second (m/s)	5.144 444 E-01
mi/h (international)	meter per second (m/s)	4.470 400 *E-01
mi/min (international)	meter per second (m/s)	2.682 240 *E+01
mi/s (international)	meter per second (m/s)	1.609 344 *E+03
mi/h (international)	kilometer per hour (km/h)*	1.609 344 *E+00
VISCOSITY		
centipoise	pascal second (Pa • s)	1.000 000 *E-03
centistokes	meter ² per second (m ² /s)	1.000 000 *E-06
ft ² /s	meter ² per second (m ² /s)	9.290 304 *E-02
poise	pascal second (Pa • s)	1.000 000 *E-01
poundal • s/ft ²	pascal second (Pa • s)	1.488 164 E+00
lb/ft • h	pascal second (Pa • s)	4.133 789 E-04
lb/ft • s	pascal second (Pa • s)	1.488 164 E+00
lb/ft • h ²	pascal second (Pa • s)	4.788 026 E-01
lbf • in ²	pascal second (Pa • s)	6.894 757 E+03
rhe	1 per pascal second (1/Pa • s)	1.000 000 *E+01
slug/ft • s	pascal second (Pa • s)	4.788 026 E+01
stokes	meter ² per second (m ² /s)	1.000 000 *E-04

* Although speedometers may read km/h, the correct SI unit is m/s.

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
VOLUME		
(Includes Capacity)		
acre-foot (U.S. survey) ¹	meter ³ (m ³)	1.233 489 E+03
barrel (oil, 42 gal)	meter ³ (m ³)	1.589 873 E-01
board foot	meter ³ (m ³)	2.359 737 E-03
bushel (U.S.)	meter ³ (m ³)	3.523 907 E-02
cup	meter ³ (m ³)	2.365 882 E-04
fluid ounce (U.S.)	meter ³ (m ³)	2.957 353 E-05
ft ³	meter ³ (m ³)	2.831 685 E-02
gallon (Canadian liquid)	meter ³ (m ³)	4.546 090 E-03
gallon (U.K. liquid)	meter ³ (m ³)	4.546 092 E-03
gallon (U.S. dry)	meter ³ (m ³)	4.404 884 E-03
gallon (U.S. liquid)	meter ³ (m ³)	3.785 412 E-03
gill (U.K.)	meter ³ (m ³)	1.420 654 E-04
gill (U.S.)	meter ³ (m ³)	1.182 941 E-04
in ³ (U.K.)	meter ³ (m ³)	1.638 706 E-05
litre (see footnote 5)	meter ³ (m ³)	1.000 000 *E-03
ounce (U.K. fluid)	meter ³ (m ³)	2.841 307 E-05
ounce (U.S. fluid)	meter ³ (m ³)	2.957 353 E-05
peck (U.S.)	meter ³ (m ³)	8.809 768 E-03
pint (U.S. dry)	meter ³ (m ³)	5.506 105 E-04
pint (U.S. liquid)	meter ³ (m ³)	4.731 765 E-04
quart (U.S. dry)	meter ³ (m ³)	1.101 221 E-03
quart (U.S. liquid)	meter ³ (m ³)	9.463 529 E-04
stere	meter ³ (m ³)	1.000 000 E+00
tablespoon	meter ³ (m ³)	1.478 676 E-05
teaspoon	meter ³ (m ³)	4.928 922 E-06
ton (register)	meter ³ (m ³)	2.831 685 E+00
yd ³	meter ³ (m ³)	7.645 549 E-01

CLASSIFIED LIST OF UNITS

To convert from	To	Multiply by
VOLUME PER UNIT TIME		
(Includes Flow)		
ft ³ /min	meter ³ per second (m ³ /s)	4.719 474 E-04
ft ³ /s	meter ³ per second (m ³ /s)	2.831 685 E-02
gallon (U.S. liquid)/hp • h (SFC, specific fuel consumption)	meter ³ per joule (m ³ /J)	1.410 089 E-09
in ³ /min	meter ³ per second (m ³ /s)	2.731 177 E-07
yd ³ /min	meter ³ per second (m ³ /s)	1.274 258 E-02
gallon (U.S. liquid) per day	meter ³ per second (m ³ /s)	4.381 264 E-08
gallon (U.S. liquid) per minute	meter ³ per second (m ³ /s)	6.309 020 E-05
WORK		
(See Energy)		

- | | |
|--|--|
| <p>(1) "Units and Systems of Weights and Measures. Their Origin, Development, and Present Status," NBS Letter Circ, LC 1035, January 1960, amended January 1976.</p> <p>(2) "NBS Guidelines for Use of the Metric System," NBS LC 1056, August 1975.</p> <p>(3) Chart—"The Modernized Metric System" NBS Spec. Publ. 304, 1972.</p> <p>(4) Mechtly, E A, "The International System of Units—Physical Constants and Conversion Factors," National Aeronautics and Space Administration, Publication SP-7012. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.</p> | <p>(5) McNish, A G, "The International System of Units," Materials Research and Standards, Am, Soc, Testing Mats., Vol. 5, No. 10, October 1965.</p> <p>(6) "Changing to the Metric System, Conversion Factors, Symbols, Definitions," Nat. Physical Lab., Her Majesty's Stationery Office, London, England, 1965.</p> <p>(7) Metric Standards for Engineering, British Standard Handbook No. 18 (1972).</p> <p>(8) Hvistendahl, H S, Engineering Units and Physical Quantities, Macmillan and Co. Ltd., London, 1964.</p> |
|--|--|

ENGLISH/METRIC UNITS

CONVERSION CONSTANTS

MULTIPLY		BY		AND OBTAIN
Barrels	x	5.6146	=	Cu. Ft.
Barrels	x	9702	=	Cu. In.
Barrels	x	42.0	=	Gal.
Cu. Ft.	x	1728	=	Cu. In.
Cu. Ft.	x	0.037037	=	Cu. Yd.
Cu. Ft.	x	7.4805	=	Gal.
Cu. Ft.	x	0.1781	=	Bbls. (42 Gal.)
Cu. Ft./Min.	x	0.1781	=	Bbls./Min.
Cu. Ft./Min.	x	10.686	=	Bbls./Hr.
Cu. Ft.—Water	x	62.31*	=	Pounds
Cu. In.	x	0.0005787	=	Cu. Ft.
Cu. In.	x	0.004329	=	Gal.
Cu. In.	x	0.0001031	=	Bbls.
Cu. Yd.	x	27.0	=	Cu. Ft.
Cu. Yd.	x	201.977	=	Gal.
Gal.—Water	x	8.33*	=	Pounds
Gal.	x	0.13368	=	Cu. Ft.
Gals./Lb.	x	8.345	=	Litres/Kg.
Lbs./Gal.	x	0.119839	=	Kg./Litres
Specific Gravity	x	62.42	=	Lbs./Cu. Ft.
Specific Gravity	x	8.345	=	Lbs./Gal.
Feet	x	0.3048	=	Metres
Feet	x	3.048	=	Decimeters
Feet	x	30.48	=	Centimeters
Inch	x	2.54	=	Centimeters
Inch	x	25.4	=	Millimeters
Miles	x	5280	=	Feet
Miles/Hr.	x	1.4666	=	Ft./Sec.
Sq. In.	x	0.006944	=	Sq. Ft.
Sq. Ft.	x	144	=	Sq. In.
Pounds—Water	x	0.12005*	=	Gal.—Water
Pounds—Water	x	0.016048*	=	Cu. Ft. Water
Horsepower	x	33000	=	Ft. Lbs./Min.
Horsepower	x	550	=	Ft. Lbs./Sec.
Square of Dia.	x	0.7854	=	Area of Circle

*Water at 20°C, (68°F.)

**Water at 4°C. (39.2°F.)

ENGLISH/METRIC UNITS

FRACTIONAL INCHES TO: DECIMAL INCHES/MILLIMETERS

Fractional Inches	Decimal Inches	Millimeters	Fractional Inches	Decimal Inches	Millimeters
			17/32	.531250	13.49375
1/1000	.001000	0.02540	35/64	.546875	13.89063
2/1000	.002000	0.05080	9/16	.562500	14.28750
3/1000	.003000	0.07620	37/64	.578125	14.68437
4/1000	.004000	0.10160	19/32	.593750	15.08125
5/1000	.005000	0.12700	39/64	.609375	15.47813
6/1000	.006000	0.15240	5/8	.625000	15.87500
7/1000	.007000	0.17780	41/64	.640625	16.27187
8/1000	.008000	0.20320	21/32	.656250	16.66875
9/1000	.009000	0.22860	43/64	.671875	17.06563
10/1000	.010000	0.25400	11/16	.687500	17.46250
15/1000	.015000	0.38100	45/64	.703125	17.85937
1/64	.015625	0.39687	23/32	.718750	18.25625
1/32	.031250	0.79375	47/64	.734375	18.65313
3/64	.046875	1.19061	3/4	.750000	19.05000
1/16	.062500	1.58750	49/64	.765625	19.44687
5/64	.078125	1.98437	25/32	.781250	19.84375
3/32	.093750	2.38125	51/64	.796875	20.24063
7/64	.109375	2.77813	13/16	.812500	20.63750
1/8	.125000	3.17500	53/64	.828125	21.03437
9/64	.140625	3.57187	27/32	.843750	21.43125
5/32	.156250	3.96875	55/64	.859375	21.82813
11/64	.171875	4.36563	7/8	.875000	22.22500
3/16	.187500	4.76250	57/64	.890625	22.62187
13/64	.203125	5.15937	29/32	.906250	23.01875
7/32	.218750	5.55625	59/64	.921875	23.41563
15/64	.234375	5.95313	15/16	.937500	23.81250
1/4	.250000	6.35000	61/64	.953125	24.20937
17/64	.265625	6.74687	31/32	.968750	24.60625
9/32	.281250	7.14375	63/64	.984375	25.00313
19/64	.296875	7.54063	1 in.	1.0 in.	25.40000
5/16	.312500	7.93750	2 in.	2.0 in.	50.80000
21/64	.328125	8.33437	3 in.	3.0 in.	76.20000
11/32	.343750	8.73125	4 in.	4.0 in.	101.60000
23/64	.359375	9.12813	5 in.	5.0 in.	127.00000
3/8	.375000	9.52500	6 in.	6.0 in.	152.40000
25/64	.390625	9.92187	7 in.	7.0 in.	177.80000
13/32	.406250	10.31875	8 in.	8.0 in.	203.20000
27/64	.421875	10.71563	9 in.	9.0 in.	228.60000
7/16	.437500	11.11250	10 in.	10.0 in.	254.00000
29/64	.453125	11.50938	11 in.	11.0 in.	279.40000
15/32	.468750	11.90625	12 in.	12.0 in.	304.80000
31/64	.484375	12.30313	13 in.	13.0 in.	330.20000
1/2	.500000	12.70000	14 in.	14.0 in.	355.60000
33/64	.515625	13.09687	15 in.	15.0 in.	381.00000

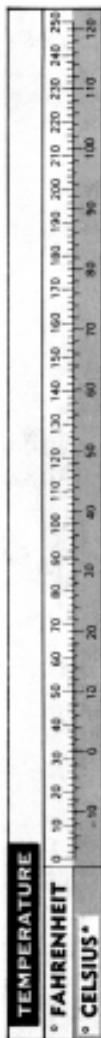
ENGLISH/METRIC UNITS



ENGLISH/METRIC UNITS



ENGLISH/METRIC UNITS



*Formerly known as Centigrade

ENGLISH/METRIC UNITS



(1 Bar equals 100 Kilopascals.)

