

CHAPTER 6 **Tables, Formulas, and Planning Support**

In this chapter, the most useful tables and formulas have been provided for your reference. Because many calculations today are made with the use of a handheld calculator or laptop computer, tabulations of basic data in this guide have been limited to those most frequently performed in the field.

This chapter will cover:

1. Units of Measurement
2. Common Minerals and Metals
3. Useful Conversion Factors
4. Useful Formulas
5. Capacity Tables
6. Annular Velocity
7. Single Salt Fluid Composition and Blending Tables

Units of Measurement

TABLE 13. Units of Measurement—Symbols and Abbreviations

Standard Oilfield Measurements and Abbreviations Used in this Guide			
Measurement	Symbol	Solutions Guide	Other
Capacity (hole, casing, pipe, annulus)	C	bbl/ft	
Density, (SI) kilograms per cubic meter	d	kg/m ³	
Density, pounds per gallon	d	lb/gal	ppg
Diameter, inside	ID	in	
Diameter, outside	OD	in	
Fluid displacement (hole, casing, pipe, annulus)	Dis	ft/bbl	
Force, pounds	f	lb	lbf
Length, feet	h	ft	
Pi (π), unitless		3.1416	

TABLE 13. Units of Measurement — Symbols and Abbreviations

Standard Oilfield Measurements and Abbreviations Used in this Guide			
Measurement	Symbol	Solutions Guide	Other
Pressure, pounds per square inch	P	lb/in ² , psi	
Specific Gravity, unitless	SG	SG	sg, Sp Gr
Velocity, feet per minute	Vel	ft/min	
Volume, barrels	v	bbl	
Volume, cubic feet	v	ft ³	cu. ft.
Volume, cubic inches	v	in ³	cu. in.
Volume, U.S. gallons	v	gal	

Common Minerals and Metals

TABLE 14. Common Minerals and Metals

Common Minerals and Metals			
Name	Formula	Specific Gravity	lb/gal
Aluminum	Al	2.70	22.5
Barite	BaSO ₄	4.2	35.0
Brass (red)		8.75	72.9
Calcite	CaCO ₃	2.72	22.7
Steel, Stainless		8.02	66.8
Steel (13 Cr)		7.75	64.6
Steel, Carbon		7.8	65
Chromium	Cr	7.19	59.9
Copper	Cu	8.96	74.6
Diatomaceous Earth		0.4 - 0.6	3.3 - 5.0
Dolomite	CaMg(CO ₃) ₂	2.85	23.7
Feldspar		2.57 - 2.76	21.4 - 23.0
Galena	PbS	7.5	62.5
Gypsum	CaSO ₄ +2H ₂ O	2.32	19.2
Halite (salt)	NaCl	2.16	18.0
Hematite	Fe ₂ O ₃	4.9 - 5.3	40.8 - 44.1
Iron	Fe	7.86	65.5
Montmorillonite (bentonite)		2.5	20.8
Quartz	SiO ₂	2.65	22.1
Sepiolite (clay)		2	16.7
Siderite	FeCO ₃	3.9	32.5
Zinc	Zn	7.14	59.5

Useful Conversion Factors

TABLE 15. Useful Conversion Factors

Conversion Factors		
Multiply	by	to Get
acres, ac	0.4047	hectares, ha
acres, ac	43,560	square feet, ft ²
acres, ac	4047	square meters, m ²
acre-feet	43560	cubic feet, ft ³
atmospheres, atm	14.70	pounds per square inch, lb/in ²
bars	0.9869	atmospheres, atm
bars	14.5	pounds per square inch, lb/in ²
barrels, bbl	5.614	cubic feet, ft ³
barrels, bbl	0.159	cubic meters, m ³
barrels, bbl	42	gallons, gal
British thermal units, Btu	252	calories (gram), g-cal
British thermal units, Btu	777.65	foot pounds, ft-lb
Btu/hr	0.29287	watts, W
calories (gram), g-cal	0.003969	British thermal units, Btu
calories (gram), g-cal	4.183	joules, j
Celsius, (degrees)	$(C \times \frac{9}{5}) + 32$	Fahrenheit (degrees)
centipoise, cp	0.001	newton-sec per sq meter, N-sec/m ²
centipoise, cp	0.002089	pound-sec per sq foot, lb-sec/ft ²
cubic feet, ft ³	0.0370	cubic yards, yd ³
cubic feet, ft ³	0.0283	cubic meters, m ³
cubic feet, ft ³	7.4805	gallons, gal
cubic feet, ft ³	28.32	liters, l
cubic feet per minute, ft ³ /min	0.4719	liters per second, l/sec
Fahrenheit (degrees)	$(F-32) \times \frac{5}{9}$	Celsius (degrees)
feet, ft	12	inches, in
feet, ft	0.3048	meters, m
feet, ft	30.48	centimeters, cm
feet of water, (head)	0.0295	atmospheres, atm
feet per minute, ft/min	0.5080	centimeters per second, cm/sec
feet per minute, ft/min	0.0183	kilometers per hour, km/hr
feet per minute, ft/min	0.0114	miles per hour, mi/hr
feet per second, ft/sec	0.6818	miles per hour, mi/hr
feet per minute, ft/min	0.3048	meters per minute, m/min
foot pounds, ft-lb	0.001286	British thermal units, Btu
foot pounds, ft-lb	0.3236	calories (gram), g-cal
foot pounds, ft-lb	1.356	newton meters, Nm
gallons, gal (U.S.)	3785	cubic centimeters, cm ³
gallons, gal (U.S.)	0.1337	cubic feet, ft ³
gallons, gal (U.S.)	231	cubic inches, in ³
gallons, gal (U.S.)	0.003785	cubic meters, m ³
gallons, gal (U.S.)	3.7854	liters, l

TABLE 15. Useful Conversion Factors

Conversion Factors		
Multiply	by	to Get
gallons per minute, gal/min (gpm)	0.0238	barrels per minute, bbl/min
gallons per minute, gal/min (gpm)	0.00223	cubic feet per second, ft ³ /sec
gallons per minute, gal/min (gpm)	0.003785	cubic meters per minute, m ³ /min
gallons per minute, gal/min (gpm)	0.0631	liters per second, l/sec
grams per cubic centimeter, g/cm ³	62.43	pounds per cubic foot, lb/ft ³
grams per cubic centimeter, g/cm ³	0.03613	pounds per cubic inch, lb/in ³
grams per liter, g/l	0.00834	pounds per gallon, lb/gal
hogsheads (U.S.)	8.422	cubic feet, ft ³
horsepower, hp	42.44	Btu per minute, Btu/min
horsepower, hp	746	joules per second, j/sec
horsepower, hp	746	watts, W
inches, in	2.54	centimeters, cm
inches, in	0.0833	feet, ft
inches, in	0.0254	meters, m
inches of mercury, in	0.0333	atmospheres, atm
inches of mercury, in	1.133	feet of water (head)
inches of mercury, in	0.03453	kilograms per sq centimeter, kg/cm ²
inches of mercury, in	0.4911	pounds per square inch, lb/in ²
inches of water, (4°C)	0.002455	atmospheres, atm
inches of water, (4°C)	0.0361	pounds per square inch, lb/in ²
joules, j	0.2391	calories (gram), g-cal
kilograms, kg	2.205	pounds, lb
kilograms, kg	0.001102	tons (short)
kilograms per cubic meter, kg/m ³	0.001	grams per cubic centimeter, g/cm ³
kilograms per cubic meter, kg/m ³	0.06243	pounds per cubic foot, lb/ft ³
kilograms per square centimeter, kg/cm ²	28.96	inches of mercury, in Hg
kilograms per square centimeter, kg/cm ²	32.81	feet of water, ft (head)
kilograms per square centimeter, kg/cm ²	14.22	pounds per square inch, lb/in ²
kilometers, km	0.6214	miles, mi (statute)
kilometers, km	0.5396	miles, NM (nautical)
kilometers per hour	27.78	centimeters per second, cm/sec
kilometers per hour	54.68	feet per minute, ft/min
kilometers per hour	0.6214	miles per hour, mi/hr
kilopascals, kPa	0.145	pounds per square inch, lb/in ²
kilowatts, kW	56.92	Btu per minute, Btu/min
kilowatts, kW	1.341	horsepower, hp
kilowatt-hours, kWh	860.5	kilogram-calories, kg-cal
liters, l	0.2642	gallons, gal
liters, l	0.00629	barrels (oilfield), bbl
liters, l	0.0353	cubic feet, ft ³
liters, l	0.001	cubic meters, m ³
liters, l	1.057	quarts (U.S.), qt
liters per minute, l/min	0.2642	gallons per minute, gal/min
liters per minute, l/min	0.00629	barrels per minute, bbl/min
meters, m	100	centimeters, cm

TABLE 15. Useful Conversion Factors

Conversion Factors		
Multiply	by	to Get
meters, m	3.281	feet, ft
meters, m	0.9144	yards, yd
meters per min, m/min	3.281	feet per minute, ft/min
meters per min, m/min	0.060	kilometers per hour, km/hr
meters per min, m/min	0.03728	miles per hour, mi/hr
miles (statute), mi	5280	feet, ft
miles (statute), mi	1609	meters, m
miles (statute), mi	1.609	kilometers, km
miles (statute), mi	0.8690	nautical miles, NM
miles per hour, mi/hr	1.466	feet per second, ft/sec
miles per hour, mi/hr	0.6214	kilometers per hour, km/hr
miles per hour, mi/hr	0.8690	knots, kn
miles per hour, mi/hr	26.82	meters per minute
nautical miles, NM	6076	feet, ft
nautical miles, NM	1852	meters, m
nautical miles, NM	1.151	statute miles, mi
newtons per square meter, N/m ²	1	pascals, Pa
ounces, oz	28.35	grams, g
ounces, oz	0.0625	pounds, lb
ounces, oz	0.9115	ounces (troy)
parts per million, ppm	0.0584	grains per gal (U.S.), grain/gal
parts per million, ppm	0.0001	weight percent, wt%
pounds, lb	453.6	grams, g
pounds, lb	0.4356	kilograms, kg
pounds, lb	16	ounces, oz
pounds per gallon, lb/gal	119.8	kilograms per cubic meter, kg/m ³
pounds per gallon, lb/gal	7.48	pounds per cubic foot, lb/ft ³
pounds per square inch, lb/in ²	2.307	feet of water (head)
pounds per square inch, lb/in ²	703.1	kilograms per square meter, kg/m ²
pounds per square inch, lb/in ²	6.897	kilopascals, kPa
pounds per square inch, lb/in ²	144	pounds per square foot, lb/ft ²
quarts (U.S.), qt	946.3	cubic centimeters, cm ³
quarts (U.S.), qt	0.9463	liters, l
quarts (U.S.), qt	0.0334	cubic feet, ft ³
quarts (U.S.), qt	57.75	cubic inches, in ³
radians	57.30	degrees
square centimeters, cm ²	0.001076	square feet, ft ²
square centimeters, cm ²	0.1550	square inches, in ²
square centimeters, cm ²	0.0001	square meters, m ²
square feet, ft ²	929	square centimeters, cm ²
square feet, ft ²	144	square inches, in ²
square feet, ft ²	0.0929	square meters, m ²
square inches, in ²	6.45	square centimeters, cm ²
square inches, in ²	0.00694	square feet, ft ²
square inches, in ²	0.000645	square meters, m ²

TABLE 15. Useful Conversion Factors

Conversion Factors		
Multiply	by	to Get
square kilometers, km ²	247.1	acres, ac
square kilometers, km ²	0.3861	square miles, mi ²
square meters, m ²	0.000247	acres, ac
square meters, m ²	10.76	square feet, ft ²
square meters, m ²	1.196	square yards, yd ²
square yards, yd ²	9	square feet, ft ²
square yards, yd ²	1296	square inches, in ²
square yards, yd ²	0.8361	square meters, m ²
tons (long)	1016	kilograms, kg
tons (long)	2240	pounds, lb
tons (long)	1.016	tons (metric)
tons (long)	1.120	tons (short)
tons (metric)	1000	kilograms, kg
tons (metric)	2204.6	pounds, lb
tons (metric)	0.9841	tons (long)
tons (metric)	1.1023	tons (short)
tons (short)	907.2	kilograms, kg
tons (short)	2000	pounds, lb
tons (short)	0.8929	tons (long)
tons (short)	0.907	tons (metric)
watts, W	3.415	Btu per hour, Btu/hr
watts, W	44.25	foot pounds per minute, ft-lb/min
watts, W	1	joules per second, j/sec
yards, yd	91.44	centimeters, cm
yards, yd	3	feet, ft
yards, yd	36	inches, in
yards, yd	0.000914	kilometers, km
yards, yd	0.9144	meters, m
yards, yd	0.000568	miles, mi

Useful Formulas

Converting Milligrams per Liter to Parts per Million to Weight Percent

The conversions between milligrams per liter (mg/l), parts per million (ppm), and weight percent (wt%) can be confusing because the definitions are not always clearly spelled out.

Units of milligrams per liter (mg/l) are often used to report concentrations of dissolved constituents. Milligrams per liter is a ratio of mass or weight per volume. Parts per million (ppm), on the other hand, represents a ratio of weight per weight such as grams per million grams or

pounds per million pounds. When the base fluid is fresh water, the value in ppm is numerically equal to the value reported in mg/l. The previous statement is true only because the specific gravity of the base fluid, water, is very close to 1.0. As long as the amount of dissolved solids is less than 1% or so, a liter of water weighs approximately 1,000 grams, which is equal to 1,000,000 milligrams.

Confusion can arise when the base fluid has a specific gravity substantially different than 1.0, as is the case for virtually all CBFs. In these cases, the conversion from mg/l to ppm must take into account the specific gravity of the base fluid.

To make the conversion, divide the value reported in mg/l by the specific gravity of the base fluid to convert to ppm.

EQUATION 22.

$$\frac{\left(\frac{\text{mg}}{\text{l}}\right)}{\text{SG}} = \text{ppm}$$

or going the other way,

EQUATION 23.

$$\text{ppm} * \text{SG} = \frac{\text{mg}}{\text{l}}$$

A third common unit of concentration is weight percent (wt%). Another way to think about weight percent is parts per hundred. By its definition, weight percent is a ratio of pounds of a substance per hundred pounds of total weight. It is a ratio of weight per weight and, as such, is similar to ppm. The easiest way to remember the conversion from weight percent to parts per million is that one tenth of a percent (0.1%) by weight is equal to 1,000 parts per million.

EQUATION 24.

$$0.1 \text{ wt}\% = 1000 \text{ ppm}$$

A quick conversion between the three different units of concentration can be made as long as the specific gravity is known.

Hole (Pipe, Tubing) Capacity

(in barrels per one linear foot, bbl/ft)

The first three equations are applicable to calculating internal volume and displacement for hole, pipe, or tubing using the inside diameter in inches.

EQUATION 25.

$$C = \frac{ID^2}{1029.4}$$

C = capacity, bbl/ft

ID = inside diameter of hole, pipe, tubing, in

1029.4 = units conversion factor, in² -ft/bbl

To determine the total volume of a hole, pipe, or tubing, multiply the value from Equation 25 by the length of the hole or pipe in feet.

EQUATION 26.

$$v_{\text{tot}} = C * h$$

v_{tot} = total volume of hole or pipe, bbl

C = capacity of hole or pipe, bbl/ft

h = length of hole or pipe, ft

Annular Capacity

(in barrels per linear foot, bbl/ft)

The values derived using Equation 27 and Equation 28 are applicable to any combination of hole, casing, or liner on the outside and tubing or drill pipe on the inside.

EQUATION 27.

$$C_{\text{an}} = \frac{(ID^2 - OD^2)}{1029.4}$$

C_{an} = capacity of annular space per linear foot, bbl/ft

ID = inside (casing, liner) diameter, in

OD = outside (work string, tubing) diameter, in

1029.4 = units conversion factor, in² -ft/bbl

The capacity calculated using Equation 27 is the space for each foot of depth between casing and tubing or open hole and drill pipe.

Annular Volume

(volume between casing and tubing, bbl)

EQUATION 28.

$$v_{an} = C_{an} * h$$

v_{an} = total volume of annulus with pipe/tubing in well, bbl

C_{an} = capacity of annulus, bbl/ft

h = length of annulus, ft

Velocity

(fluid flow rate, ft/min)

You use the same formula to determine velocity whether it is in a hole, pipe, or annulus. The input values are (1) the capacity in bbl/ft, gal/ft, or ft³/ft and (2) the pumping rate in bbl/min, gal/min, or ft³/min. Barrels, gallons, and cubic feet can be used as long as both terms (1) and (2) use the same unit of measurement.

EQUATION 29.

$$Vel = \frac{Q}{C}$$

Vel = velocity, ft/min

Q = flow rate, bbl/min

C = capacity of hole, pipe, annulus, bbl/ft

Pressure Differentials

Two columns of fluid exist, one in the annulus and one inside the tubing. They are in hydraulic connection, but substantial pressure differentials may exist between the two columns, especially when fluids are being changed or displaced from the hole.

Each length of annulus or tubing containing fluid with a different density is calculated separately. For example, if the annulus has three fluids with densities of d_1 , d_2 , and d_3 , respectively, and the true vertical lengths of coverage for each fluid are h_1 , h_2 , and h_3 , respectively, then the bottom-hole pressure in the annulus (P_{an}) is:

EQUATION 30.

$$P_{an} = [(d_1 * h_1) + (d_2 * h_2) + (d_3 * h_3)] * 0.052$$

P_{an} = hydrostatic pressure, psi

d_n = density of fluid n in annulus, lb/gal

h_n = true vertical length of coverage of fluid n in annulus, ft

If the tubing of length (h_t) is filled with a single fluid of density (d_4) then Equation 30 simplifies to:

$$P_t = d_4 * h_t * 0.052$$

In this case, the pressure differential (P_{dif}) between the annulus and tubing (P_t) is the difference between the pressure exerted by the two columns of fluid:

$$P_{dif} = P_t - P_{an}$$

It is worth mentioning that the lengths of the two columns of fluid are normally equal:

$$h_t = h_1 + h_2 + h_3$$

The preceding formulas will correctly calculate the volumes, quantities, and values they are designed to calculate. However, they are based on a perfect world. In the field, a 10.0 lb/gal fluid rarely, if ever, weighs exactly 10.0 lb/gal and fresh water rarely, if ever, weighs 8.34 lb/gal. Using the formulas to determine the volumes of various fluids or the quantity dry salt to use for a specific purpose is of great value. However, when applying this data to the actual exercise of adjusting fluid densities, approach the end point of this activity with caution. In other words, never add all of the required spike, dilution fluid, or dry salt without closely monitoring the progress of the fluid adjustment, especially as you near your end point. Adopting this approach will allow you to complete the adjustment with much greater accuracy.

Capacity Tables

For speed and convenience, the following standard tables have been included. Using the formulas given in the previous section, the values provided in the tables can all be calculated.

Open Hole Capacity (Volume)

TABLE 16. Hole Capacity
(in barrels per foot and feet per barrel)

Hole Capacity		
Hole Diameter	Capacity	Capacity
in	bbl/ft	ft/bbl
3	0.0087	114.387
3-1/8	0.0095	105.419
3-1/4	0.0103	97.466
3-3/8	0.0111	90.380
3-1/2	0.0119	84.040
3-5/8	0.0128	78.344
3-3/4	0.0137	73.208
3-7/8	0.0146	68.561
4	0.0155	64.343
4-1/8	0.0165	60.502
4-1/4	0.0175	56.996
4-3/8	0.0186	53.785
4-1/2	0.0197	50.839
4-5/8	0.0208	48.128
4-3/4	0.0219	45.628
4-7/8	0.0231	43.318
5	0.0243	41.179
5-1/8	0.0255	39.195
5-1/4	0.0268	37.351
5-3/8	0.0281	35.634
5-1/2	0.0294	34.033
5-5/8	0.0307	32.537
5-3/4	0.0321	31.138
5-7/8	0.0335	29.827
6	0.0350	28.597
6-1/8	0.0364	27.442
6-1/4	0.0379	26.355
6-3/8	0.0395	25.331
6-1/2	0.0410	24.367
6-5/8	0.0426	23.456
6-3/4	0.0443	22.595
6-7/8	0.0459	21.781
7	0.0476	21.010
7-1/8	0.0493	20.279
7-1/4	0.0511	19.586
7-3/8	0.0528	18.928
7-1/2	0.0546	18.302
7-5/8	0.0565	17.707
7-3/4	0.0583	17.140
7-7/8	0.0602	16.600

TABLE 16. Hole Capacity
(in barrels per foot and feet per barrel)

Hole Capacity		
Hole Diameter	Capacity	Capacity
in	bbl/ft	ft/bbl
8	0.0622	16.086
8-1/8	0.0641	15.595
8-1/4	0.0661	15.126
8-3/8	0.0681	14.677
8-1/2	0.0702	14.249
8-5/8	0.0723	13.839
8-3/4	0.0744	13.446
8-7/8	0.0765	13.070
9	0.0787	12.710
9-1/8	0.0809	12.364
9-1/4	0.0831	12.032
9-3/8	0.0854	11.713
9-1/2	0.0877	11.407
9-5/8	0.0900	11.113
9-3/4	0.0923	10.830
9-7/8	0.0947	10.557
10	0.0971	10.295
10-1/8	0.0996	10.042
10-1/4	0.1021	9.799
10-3/8	0.1046	9.564
10-1/2	0.1071	9.338
10-5/8	0.1097	9.119
10-3/4	0.1123	8.908
10-7/8	0.1149	8.705
11	0.1175	8.508
11-1/8	0.1202	8.318
11-1/4	0.1229	8.134
11-3/8	0.1257	7.956
11-1/2	0.1285	7.784
11-5/8	0.1313	7.618
11-3/4	0.1341	7.457
11-7/8	0.1370	7.301
12	0.1399	7.149
12-1/8	0.1428	7.003
12-1/4	0.1458	6.860
12-3/8	0.1488	6.722
12-1/2	0.1518	6.589
12-5/8	0.1548	6.459
12-3/4	0.1579	6.333
12-7/8	0.1610	6.210

TABLE 16. Hole Capacity
(in barrels per foot and feet per barrel)

Hole Capacity		
Hole Diameter	Capacity	Capacity
in	bbl/ft	ft/bbl
13	0.1642	6.092
13-1/8	0.1673	5.976
13-1/4	0.1705	5.864
13-3/8	0.1738	5.755
13-1/2	0.1770	5.649
13-5/8	0.1803	5.546
13-3/4	0.1836	5.445
13-7/8	0.1870	5.348
14	0.1904	5.252
14-1/8	0.1938	5.160
14-1/4	0.1972	5.070
14-3/8	0.2007	4.982
14-1/2	0.2042	4.896
14-5/8	0.2078	4.813
14-3/4	0.2113	4.732
14-7/8	0.2149	4.653
15	0.2186	4.575
15-1/8	0.2222	4.500
15-1/4	0.2259	4.427
15-3/8	0.2296	4.355
15-1/2	0.2334	4.285
15-5/8	0.2371	4.217
15-3/4	0.2410	4.150
15-7/8	0.2448	4.085
16	0.2487	4.021
16-1/8	0.2526	3.959
16-1/4	0.2565	3.899
16-3/8	0.2605	3.839
16-1/2	0.2645	3.781
16-5/8	0.2685	3.725
16-3/4	0.2725	3.669
16-7/8	0.2766	3.615
17	0.2807	3.562
17-1/4	0.2890	3.460
17-1/2	0.2975	3.362
17-3/4	0.3060	3.268

TABLE 16. Hole Capacity
(in barrels per foot and feet per barrel)

Hole Capacity		
Hole Diameter	Capacity	Capacity
in	bbl/ft	ft/bbl
18	0.3147	3.177
18-1/4	0.3235	3.091
18-1/2	0.3324	3.008
18-3/4	0.3415	2.928
19	0.3507	2.852
19-1/4	0.3599	2.778
19-1/2	0.3694	2.707
19-3/4	0.3789	2.639
20	0.3885	2.574
20-1/4	0.3983	2.511
20-1/2	0.4082	2.450
20-3/4	0.4182	2.391
21	0.4284	2.334
21-1/4	0.4386	2.280
21-1/2	0.4490	2.227
21-3/4	0.4595	2.176
22	0.4701	2.127
22-1/4	0.4809	2.080
22-1/2	0.4918	2.034
22-3/4	0.5027	1.989
23	0.5138	1.946
23-1/4	0.5251	1.904
23-1/2	0.5364	1.864
23-3/4	0.5479	1.825
24	0.5595	1.787
24-1/4	0.5712	1.751
24-1/2	0.5831	1.715
24-3/4	0.5950	1.681
25	0.6071	1.647
26	0.6566	1.523
27	0.7081	1.412
28	0.7615	1.313
29	0.8169	1.224
30	0.8742	1.144
31	0.9335	1.071
32	0.9947	1.005

Drill Pipe Capacity and Displacement

TABLE 17. API Drill Pipe Capacity and Displacement

API Drill Pipe Capacity and Displacement						
Nominal Size	Weight	OD	ID	Capacity	Capacity	Pipe Displacement
in	lb/ft	in	in	bbl/ft	ft/bbl	bbl/100 ft
2-3/8	6.65	2.375	1.815	0.0032	311.43	0.228
2-7/8	10.40	2.875	2.151	0.0045	221.73	0.353
3-1/2	9.50	3.500	2.992	0.0087	114.60	0.320
3-1/2	13.30	3.500	2.764	0.0074	134.29	0.448
3-1/2	15.50	3.500	2.602	0.0066	151.53	0.532
4	11.85	4.000	3.476	0.0118	84.91	0.381
4	14.00	4.000	3.340	0.0109	91.96	0.471
4-1/2	13.75	4.500	3.958	0.0153	65.49	0.445
4-1/2	16.60	4.500	3.826	0.0143	70.08	0.545
4-1/2	20.00	4.500	3.640	0.0129	77.43	0.680
5	16.25	5.000	4.408	0.0189	52.80	0.541
5	19.50	5.000	4.276	0.0178	56.11	0.652
5	25.60	5.000	4.000	0.0156	64.12	0.874
5-1/2	21.90	5.500	4.778	0.0223	44.94	0.721
5-1/2	24.70	5.500	4.670	0.0213	47.04	0.820

API Casing and Liner Capacity and Displacement

TABLE 18. Casing and Liners — Weight, Dimensions, and Capacities

Casing and Liner Capacity and Displacement						
Nominal Size	Weight w/ Coupling	OD	ID	Capacity	Capacity	Pipe Displacement
in	lb/ft	in	in	bbl/ft	ft/bbl	bbl/100 ft
4-1/2	9.50	4.500	4.090	0.0162	61.54	0.342
4-1/2	10.50	4.500	4.052	0.0159	62.70	0.372
4-1/2	11.60	4.500	4.000	0.0155	64.34	0.413
4-1/2	13.50	4.500	3.920	0.0149	67.00	0.474
4-1/2	15.10	4.500	3.826	0.0142	70.33	0.545
5	11.50	5.000	4.560	0.0202	49.51	0.409
5	13.00	5.000	4.494	0.0196	50.97	0.467
5	15.00	5.000	4.408	0.0189	52.98	0.541
5	18.00	5.000	4.276	0.0178	56.30	0.652
5	21.40	5.000	4.126	0.0165	60.47	0.775
5	23.20	5.000	4.044	0.0159	62.95	0.840
5	24.10	5.000	4.000	0.0155	64.34	0.874
5-1/2	14.00	5.500	5.012	0.0244	40.98	0.498
5-1/2	15.50	5.500	4.950	0.0238	42.02	0.558
5-1/2	17.00	5.500	4.892	0.0232	43.02	0.614

TABLE 18. Casing and Liners — Weight, Dimensions, and Capacities

Casing and Liner Capacity and Displacement						
Nominal Size	Weight w/ Coupling	OD	ID	Capacity	Capacity	Pipe Displacement
in	lb/ft	in	in	bbl/ft	ft/bbl	bbl/100 ft
5-1/2	20.00	5.500	4.778	0.0222	45.09	0.721
5-1/2	23.00	5.500	4.670	0.0212	47.20	0.820
5-1/2	26.80	5.500	4.500	0.0197	50.84	0.971
5-1/2	29.70	5.500	4.376	0.0186	53.76	1.078
5-1/2	32.60	5.500	4.250	0.0175	57.00	1.184
5-1/2	35.30	5.500	4.126	0.0165	60.47	1.285
5-1/2	38.00	5.500	4.000	0.0155	64.34	1.384
5-1/2	40.50	5.500	3.876	0.0146	68.53	1.479
5-1/2	43.10	5.500	3.750	0.0137	73.21	1.572
6-5/8	20.00	6.625	6.049	0.0355	28.14	0.550
6-5/8	24.00	6.625	5.921	0.0341	29.37	0.699
6-5/8	28.00	6.625	5.791	0.0326	30.70	0.846
6-5/8	32.00	6.625	5.675	0.0313	31.97	0.976
7	17.00	7.000	6.538	0.0415	24.08	0.608
7	20.00	7.000	6.456	0.0405	24.70	0.711
7	23.00	7.000	6.366	0.0394	25.40	0.823
7	26.00	7.000	6.276	0.0383	26.14	0.934
7	29.00	7.000	6.184	0.0371	26.92	1.045
7	32.00	7.000	6.094	0.0361	27.72	1.152
7	35.00	7.000	6.004	0.0350	28.56	1.258
7	38.00	7.000	5.920	0.0340	29.37	1.355
7	42.70	7.000	5.750	0.0321	31.14	1.548
7	46.40	7.000	5.625	0.0307	32.54	1.686
7	50.10	7.000	5.500	0.0294	34.03	1.821
7	53.60	7.000	5.376	0.0281	35.62	1.952
7	57.10	7.000	5.250	0.0268	37.35	2.082
7-5/8	24.00	7.625	7.025	0.0479	20.86	0.854
7-5/8	26.40	7.625	6.969	0.0472	21.20	0.930
7-5/8	29.70	7.625	6.875	0.0459	21.78	1.056
7-5/8	33.70	7.625	6.765	0.0445	22.49	1.202
7-5/8	39.00	7.625	6.625	0.0426	23.46	1.384
7-5/8	42.80	7.625	6.501	0.0411	24.36	1.542
7-5/8	45.30	7.625	6.435	0.0402	24.86	1.625
7-5/8	47.10	7.625	6.375	0.0395	25.33	1.700
7-5/8	51.20	7.625	6.251	0.0380	26.35	1.852
7-5/8	55.30	7.625	6.125	0.0364	27.44	2.003
7-3/4	46.10	7.750	6.560	0.0418	23.92	1.467
8-5/8	24.00	8.625	8.097	0.0637	15.70	0.858
8-5/8	28.00	8.625	8.017	0.0624	16.02	0.983
8-5/8	32.00	8.625	7.921	0.0609	16.41	1.131
8-5/8	36.00	8.625	7.825	0.0595	16.81	1.278
8-5/8	40.00	8.625	7.725	0.0580	17.25	1.429

TABLE 18. Casing and Liners — Weight, Dimensions, and Capacities

Casing and Liner Capacity and Displacement						
Nominal Size	Weight w/ Coupling	OD	ID	Capacity	Capacity	Pipe Displacement
in	lb/ft	in	in	bbl/ft	ft/bbl	bbl/100 ft
8-5/8	44.00	8.625	7.625	0.0565	17.71	1.578
8-5/8	49.00	8.625	7.511	0.0548	18.25	1.746
9-5/8	32.30	9.625	9.001	0.0787	12.71	1.129
9-5/8	36.00	9.625	8.921	0.0773	12.94	1.268
9-5/8	40.00	9.625	8.835	0.0758	13.19	1.417
9-5/8	43.50	9.625	8.755	0.0745	13.43	1.553
9-5/8	47.00	9.625	8.681	0.0732	13.66	1.679
9-5/8	53.50	9.625	8.535	0.0708	14.13	1.923
9-5/8	58.40	9.625	8.435	0.0691	14.47	2.088
9-5/8	59.40	9.625	8.407	0.0687	14.57	2.133
9-5/8	64.90	9.625	8.281	0.0666	15.01	2.338
9-5/8	70.30	9.625	8.157	0.0646	15.47	2.536
9-5/8	75.60	9.625	8.031	0.0626	15.96	2.734
10-3/4	32.75	10.750	10.192	0.1009	9.91	1.135
10-3/4	40.50	10.750	10.050	0.0981	10.19	1.414
10-3/4	45.50	10.750	9.950	0.0962	10.40	1.609
10-3/4	51.00	10.750	9.850	0.0942	10.61	1.801
10-3/4	55.50	10.750	9.760	0.0925	10.81	1.972
10-3/4	60.70	10.750	9.660	0.0906	11.03	2.161
10-3/4	65.70	10.750	9.560	0.0888	11.26	2.348
10-3/4	73.20	10.750	9.406	0.0859	11.64	2.631
10-3/4	79.20	10.750	9.282	0.0837	11.95	2.856
10-3/4	85.30	10.750	9.156	0.0814	12.28	3.082
11-3/4	42.00	11.750	11.084	0.1193	8.38	1.477
11-3/4	47.00	11.750	11.000	0.1175	8.51	1.657
11-3/4	54.00	11.750	10.880	0.1150	8.70	1.912
11-3/4	60.00	11.750	10.772	0.1127	8.87	2.140
11-3/4	65.00	11.750	10.682	0.1108	9.02	2.327
11-3/4	71.00	11.750	10.586	0.1089	9.19	2.525
13-3/8	48.00	13.375	12.715	0.1570	6.37	1.673
13-3/8	54.50	13.375	12.615	0.1546	6.47	1.919
13-3/8	61.00	13.375	12.515	0.1521	6.57	2.163
13-3/8	68.00	13.375	12.415	0.1497	6.68	2.405
13-3/8	72.00	13.375	12.347	0.1481	6.75	2.568
16	65.00	16.000	15.250	0.2259	4.43	2.277
16	75.00	16.000	15.124	0.2222	4.50	2.648
16	84.00	16.000	15.010	0.2188	4.57	2.982
16	109.00	16.000	14.688	0.2096	4.77	3.911
18-5/8	87.50	18.625	17.755	0.3062	3.27	3.074
20	94.00	20.000	19.124	0.3553	2.81	3.329

TABLE 18. Casing and Liners — Weight, Dimensions, and Capacities

Casing and Liner Capacity and Displacement						
Nominal Size	Weight w/ Coupling	OD	ID	Capacity	Capacity	Pipe Displacement
in	lb/ft	in	in	bbl/ft	ft/bbl	bbl/100 ft
20	106.50	20.000	19.000	0.3507	2.85	3.788
20	133.00	20.000	18.730	0.3408	2.93	4.778

Tubing Capacity and Displacement

TABLE 19. API Tubing — Weight, Dimensions, and Capacities

API Tubing Capacity and Displacement							
Nominal Size	End Fin ¹	Weight	OD	ID	Capacity	Capacity	Pipe Displacement
in		lb/ft	in	in	bbl/ft	ft/bbl	bbl/100 ft
1	N	1.14	1.050	0.824	0.0007	1516.23	0.041
1	E	1.20	1.050	0.824	0.0007	1516.23	0.041
1	N	1.48	1.050	0.742	0.0005	1869.87	0.054
1	E	1.54	1.050	0.742	0.0005	1869.87	0.054
1.5/16	N	1.70	1.315	1.049	0.0011	935.56	0.061
1.5/16	U	1.80	1.315	1.049	0.0011	935.56	0.061
1.5/16	E	1.72	1.315	1.049	0.0011	935.56	0.061
1.5/16	N	2.19	1.315	0.957	0.0009	1124.08	0.079
1.5/16	U	2.24	1.315	0.957	0.0009	1124.08	0.079
1.11/16	E	2.10	1.660	1.410	0.0019	517.82	0.075
1.11/16	N	2.30	1.660	1.380	0.0018	540.58	0.083
1.11/16	U	2.40	1.660	1.380	0.0018	540.58	0.083
1.11/16	E	2.33	1.660	1.380	0.0018	540.58	0.083
1.11/16	N	3.03	1.660	1.278	0.0016	630.32	0.109
1.11/16	U	3.07	1.660	1.278	0.0016	630.32	0.109
1-7/8	E	2.40	1.900	1.650	0.0026	378.14	0.086
1-7/8	N	2.75	1.900	1.610	0.0025	397.16	0.099
1-7/8	U	2.90	1.900	1.610	0.0025	397.16	0.099
1-7/8	E	2.76	1.900	1.610	0.0025	397.16	0.099
1-7/8	N	3.65	1.900	1.500	0.0022	457.55	0.132
1-7/8	U	3.73	1.900	1.500	0.0022	457.55	0.132
1-7/8	N	4.42	1.900	1.400	0.0019	525.25	0.160
1-7/8	N	5.15	1.900	1.300	0.0016	609.16	0.187
2-1/16	E	3.25	2.063	1.751	0.0030	335.77	0.116
2-3/8	N	4.00	2.375	2.041	0.0040	247.14	0.143
2-3/8	N	4.60	2.375	1.995	0.0039	258.66	0.161
2-3/8	U	4.70	2.375	1.995	0.0039	258.66	0.161

¹N = Non-Upset, E = External Upset, U = Integral Joint

TABLE 19. API Tubing — Weight, Dimensions, and Capacities

API Tubing Capacity and Displacement							
Nominal Size	End Fin ¹	Weight	OD	ID	Capacity	Capacity	Pipe Displacement
in		lb/ft	in	in	bbl/ft	ft/bbl	bbl/100 ft
2-3/8	N	5.80	2.375	1.867	0.0034	295.35	0.209
2-3/8	U	5.95	2.375	1.867	0.0034	295.35	0.209
2-3/8	N	6.60	2.375	1.785	0.0031	323.11	0.238
2-3/8	N	7.35	2.375	1.703	0.0028	354.97	0.266
2-3/8	U	7.45	2.375	1.703	0.0028	354.97	0.266
2-7/8	N	6.40	2.875	2.441	0.0058	172.78	0.224
2-7/8	U	6.50	2.875	2.441	0.0058	172.78	0.224
2-7/8	N	7.80	2.875	2.323	0.0052	190.78	0.279
2-7/8	U	7.90	2.875	2.323	0.0052	190.78	0.279
2-7/8	N	8.60	2.875	2.259	0.0050	201.74	0.307
2-7/8	U	8.70	2.875	2.259	0.0050	201.74	0.307
2-7/8	N	9.35	2.875	2.195	0.0047	213.67	0.335
2-7/8	U	9.45	2.875	2.195	0.0047	213.67	0.335
2-7/8	N	10.50	2.875	2.091	0.0042	235.46	0.378
2-7/8	N	11.50	2.875	1.995	0.0039	258.66	0.416
3-1/2	N	7.70	3.500	3.068	0.0091	109.37	0.276
3-1/2	N	9.20	3.500	2.992	0.0087	115.00	0.320
3-1/2	U	9.30	3.500	2.992	0.0087	115.00	0.320
3-1/2	N	10.20	3.500	2.922	0.0083	120.58	0.361
3-1/2	N	12.70	3.500	2.750	0.0073	136.13	0.455
3-1/2	U	12.95	3.500	2.750	0.0073	136.13	0.455
3-1/2	N	14.30	3.500	2.640	0.0068	147.71	0.513
3-1/2	N	15.50	3.500	2.548	0.0063	158.57	0.559
3-1/2	N	17.00	3.500	2.440	0.0058	172.92	0.612
4	N	9.50	4.000	3.548	0.0122	81.78	0.331
4	U	11.00	4.000	3.476	0.0117	85.20	0.381
4	N	13.20	4.000	3.340	0.0108	92.28	0.471
4	N	16.10	4.000	3.170	0.0098	102.45	0.578
4	N	18.90	4.000	3.000	0.0087	114.39	0.680
4	N	22.20	4.000	2.780	0.0075	133.21	0.803
4-1/2	N	12.60	4.500	3.958	0.0152	65.72	0.445
4-1/2	U	12.75	4.500	3.958	0.0152	65.72	0.445
4-1/2	N	15.20	4.500	3.826	0.0142	70.33	0.545
4-1/2	N	17.00	4.500	3.740	0.0136	73.60	0.608
4-1/2	N	18.90	4.500	3.640	0.0129	77.70	0.680
4-1/2	N	21.50	4.500	3.500	0.0119	84.04	0.777
4-1/2	N	23.70	4.500	3.380	0.0111	90.11	0.857
4-1/2	N	26.10	4.500	3.240	0.0102	98.07	0.947

¹N = Non-Upset, E = External Upset, U = Integral Joint

Annular Capacity (Volume)

The values in Table 20 on the following pages are given as annular capacity in barrels per linear foot (bbl/ft). API tubing sizes are given along the top of the table, and casing and plain end liner dimensions are the values in the first three columns on the left. The capacity is given in the cell that represents the intersection of the tubing column and the casing row.

TABLE 20. Annular Capacity
(in bbl/ft between API casing and API tubing)

API Casing & Liners			API Tubing Nominal Sizes and OD (in)									
Nominal Size	Weight	ID	1"	1-5/16"	1-11/16"	1-7/8"	2-1/16"	2-3/8"	2-7/8"	3-1/2"	4"	4-1/2"
in	lb/ft	in	1.050 OD	1.315 OD	1.660 OD	1.900 OD	2.063 OD	2.375 OD	2.875 OD	3.500 OD	4.000 OD	4.500 OD
4-1/2	9.50	4.090	0.0152	0.0146	0.0136	0.0127	0.0121	0.0108	0.0082	0.0043	0.0007	N/A
4-1/2	10.50	4.052	0.0149	0.0143	0.0133	0.0124	0.0118	0.0105	0.0079	0.0040	0.0004	N/A
4-1/2	11.60	4.000	0.0145	0.0139	0.0129	0.0120	0.0114	0.0101	0.0075	0.0036	0.0000	N/A
4-1/2	13.50	3.920	0.0139	0.0132	0.0122	0.0114	0.0108	0.0094	0.0069	0.0030	N/A	N/A
4-1/2	15.10	3.826	0.0131	0.0125	0.0115	0.0107	0.0101	0.0087	0.0062	0.0023	N/A	N/A
5	11.50	4.560	0.0191	0.0185	0.0175	0.0167	0.0161	0.0147	0.0122	0.0083	0.0047	0.0005
5	13.00	4.494	0.0185	0.0179	0.0169	0.0161	0.0155	0.0141	0.0116	0.0077	0.0041	N/A
5	15.00	4.408	0.0178	0.0172	0.0162	0.0154	0.0147	0.0134	0.0108	0.0070	0.0033	N/A
5	18.00	4.276	0.0167	0.0161	0.0151	0.0143	0.0136	0.0123	0.0097	0.0059	0.0022	N/A
5	21.40	4.126	0.0155	0.0149	0.0139	0.0130	0.0124	0.0111	0.0085	0.0046	0.0010	N/A
5	23.20	4.044	0.0148	0.0142	0.0132	0.0124	0.0118	0.0104	0.0079	0.0040	0.0003	N/A
5	24.10	4.000	0.0145	0.0139	0.0129	0.0120	0.0114	0.0101	0.0075	0.0036	0.0000	N/A
5-1/2	14.00	5.012	0.0233	0.0227	0.0217	0.0209	0.0203	0.0189	0.0164	0.0125	0.0089	0.0047
5-1/2	15.50	4.950	0.0227	0.0221	0.0211	0.0203	0.0197	0.0183	0.0158	0.0119	0.0083	0.0041
5-1/2	17.00	4.892	0.0222	0.0216	0.0206	0.0197	0.0191	0.0178	0.0152	0.0113	0.0077	0.0036
5-1/2	20.00	4.778	0.0211	0.0205	0.0195	0.0187	0.0180	0.0167	0.0141	0.0103	0.0066	0.0025
5-1/2	23.00	4.670	0.0201	0.0195	0.0185	0.0177	0.0171	0.0157	0.0132	0.0093	0.0056	0.0015

TABLE 20. Annular Capacity

(in bbl/ft between API casing and API tubing)

API Casing & Liners			API Tubing Nominal Sizes and OD (in)									
Nominal Size	Weight	ID	1"	1-5/16"	1-11/16"	1-7/8"	2-1/16"	2-3/8"	2-7/8"	3-1/2"	4"	4-1/2"
in	lb/ft	in	1.050 OD	1.315 OD	1.660 OD	1.900 OD	2.063 OD	2.375 OD	2.875 OD	3.500 OD	4.000 OD	4.500 OD
5-1/2	26.80	4.500	0.0186	0.0180	0.0170	0.0162	0.0155	0.0142	0.0116	0.0078	0.0041	0.0000
5-1/2	29.70	4.376	0.0175	0.0169	0.0159	0.0151	0.0145	0.0131	0.0106	0.0067	0.0031	N/A
5-1/2	32.60	4.250	0.0165	0.0159	0.0149	0.0140	0.0134	0.0121	0.0095	0.0056	0.0020	N/A
5-1/2	35.30	4.126	0.0155	0.0149	0.0139	0.0130	0.0124	0.0111	0.0085	0.0046	0.0010	N/A
5-1/2	38.00	4.000	0.0145	0.0139	0.0129	0.0120	0.0114	0.0101	0.0075	0.0036	0.0000	N/A
5-1/2	40.50	3.876	0.0135	0.0129	0.0119	0.0111	0.0105	0.0091	0.0066	0.0027	N/A	N/A
5-1/2	43.10	3.750	0.0126	0.0120	0.0110	0.0102	0.0095	0.0082	0.0056	0.0018	N/A	N/A
6-5/8	20.00	6.049	0.0345	0.0339	0.0329	0.0320	0.0314	0.0301	0.0275	0.0236	0.0200	0.0159
6-5/8	24.00	5.921	0.0330	0.0324	0.0314	0.0305	0.0299	0.0286	0.0260	0.0222	0.0185	0.0144
6-5/8	28.00	5.791	0.0315	0.0309	0.0299	0.0291	0.0284	0.0271	0.0245	0.0207	0.0170	0.0129
6-5/8	32.00	5.675	0.0302	0.0296	0.0286	0.0278	0.0271	0.0258	0.0233	0.0194	0.0157	0.0116
7	17.00	6.538	0.0405	0.0398	0.0388	0.0380	0.0374	0.0360	0.0335	0.0296	0.0260	0.0219
7	20.00	6.456	0.0394	0.0388	0.0378	0.0370	0.0364	0.0350	0.0325	0.0286	0.0249	0.0208
7	23.00	6.366	0.0383	0.0377	0.0367	0.0359	0.0352	0.0339	0.0313	0.0275	0.0238	0.0197
7	26.00	6.276	0.0372	0.0366	0.0356	0.0348	0.0341	0.0328	0.0302	0.0264	0.0227	0.0186
7	29.00	6.184	0.0361	0.0355	0.0345	0.0336	0.0330	0.0317	0.0291	0.0252	0.0216	0.0175
7	32.00	6.094	0.0350	0.0344	0.0334	0.0326	0.0319	0.0306	0.0280	0.0242	0.0205	0.0164

TABLE 20. Annular Capacity

(in bbl/ft between API casing and API tubing)

API Casing & Liners			API Tubing Nominal Sizes and OD (in)									
Nominal Size	Weight	ID	1"	1-5/16"	1-11/16"	1-7/8"	2-1/16"	2-3/8"	2-7/8"	3-1/2"	4"	4-1/2"
in	lb/ft	in	1.050 OD	1.315 OD	1.660 OD	1.900 OD	2.063 OD	2.375 OD	2.875 OD	3.500 OD	4.000 OD	4.500 OD
7	35.00	6.004	0.0339	0.0333	0.0323	0.0315	0.0309	0.0295	0.0270	0.0231	0.0195	0.0153
7	38.00	5.920	0.0330	0.0324	0.0314	0.0305	0.0299	0.0286	0.0260	0.0221	0.0185	0.0144
7	42.70	5.750	0.0310	0.0304	0.0294	0.0286	0.0280	0.0266	0.0241	0.0202	0.0166	0.0124
7	46.40	5.625	0.0297	0.0291	0.0281	0.0272	0.0266	0.0253	0.0227	0.0188	0.0152	0.0111
7	50.10	5.500	0.0283	0.0277	0.0267	0.0259	0.0252	0.0239	0.0214	0.0175	0.0138	0.0097
7	53.60	5.376	0.0270	0.0264	0.0254	0.0246	0.0239	0.0226	0.0200	0.0162	0.0125	0.0084
7	57.10	5.250	0.0257	0.0251	0.0241	0.0233	0.0226	0.0213	0.0187	0.0149	0.0112	0.0071
7-5/8	24.00	7.025	0.0469	0.0463	0.0453	0.0444	0.0438	0.0425	0.0399	0.0360	0.0324	0.0283
7-5/8	26.40	6.969	0.0461	0.0455	0.0445	0.0437	0.0430	0.0417	0.0391	0.0353	0.0316	0.0275
7-5/8	29.70	6.875	0.0448	0.0442	0.0432	0.0424	0.0418	0.0404	0.0379	0.0340	0.0304	0.0262
7-5/8	33.70	6.765	0.0434	0.0428	0.0418	0.0409	0.0403	0.0390	0.0364	0.0326	0.0289	0.0248
7-5/8	39.00	6.625	0.0416	0.0410	0.0400	0.0391	0.0385	0.0372	0.0346	0.0307	0.0271	0.0230
7-5/8	42.80	6.501	0.0400	0.0394	0.0384	0.0375	0.0369	0.0356	0.0330	0.0292	0.0255	0.0214
7-5/8	45.30	6.435	0.0392	0.0385	0.0375	0.0367	0.0361	0.0347	0.0322	0.0283	0.0247	0.0206
7-5/8	47.10	6.375	0.0384	0.0378	0.0368	0.0360	0.0353	0.0340	0.0314	0.0276	0.0239	0.0198
7-5/8	51.20	6.251	0.0369	0.0363	0.0353	0.0344	0.0338	0.0325	0.0299	0.0261	0.0224	0.0183
7-5/8	55.30	6.125	0.0354	0.0348	0.0338	0.0329	0.0323	0.0310	0.0284	0.0245	0.0209	0.0168

TABLE 20. Annular Capacity
(in bbl/ft between API casing and API tubing)

API Casing & Liners			API Tubing Nominal Sizes and OD (in)									
Nominal Size	Weight	ID	1"	1-5/16"	1-11/16"	1-7/8"	2-1/16"	2-3/8"	2-7/8"	3-1/2"	4"	4-1/2"
in	lb/ft	in	1.050 OD	1.315 OD	1.660 OD	1.900 OD	2.063 OD	2.375 OD	2.875 OD	3.500 OD	4.000 OD	4.500 OD
7-5/8	46.10	6.560	0.0407	0.0401	0.0391	0.0383	0.0377	0.0363	0.0338	0.0299	0.0263	0.0221
8-5/8	24.00	8.097	0.0626	0.0620	0.0610	0.0602	0.0595	0.0582	0.0557	0.0518	0.0481	0.0440
8-5/8	28.00	8.017	0.0614	0.0608	0.0598	0.0589	0.0583	0.0570	0.0544	0.0505	0.0469	0.0428
8-5/8	32.00	7.921	0.0599	0.0593	0.0583	0.0574	0.0568	0.0555	0.0529	0.0490	0.0454	0.0413
8-5/8	36.00	7.825	0.0584	0.0578	0.0568	0.0560	0.0553	0.0540	0.0514	0.0476	0.0439	0.0398
8-5/8	40.00	7.725	0.0569	0.0563	0.0553	0.0545	0.0538	0.0525	0.0499	0.0461	0.0424	0.0383
8-5/8	44.00	7.625	0.0554	0.0548	0.0538	0.0530	0.0523	0.0510	0.0484	0.0446	0.0409	0.0368
8-5/8	49.00	7.511	0.0537	0.0531	0.0521	0.0513	0.0507	0.0493	0.0468	0.0429	0.0393	0.0351
9-5/8	32.30	9.001	0.0776	0.0770	0.0760	0.0752	0.0746	0.0732	0.0707	0.0668	0.0632	0.0590
9-5/8	36.00	8.921	0.0762	0.0756	0.0746	0.0738	0.0732	0.0718	0.0693	0.0654	0.0618	0.0576
9-5/8	40.00	8.835	0.0748	0.0741	0.0731	0.0723	0.0717	0.0703	0.0678	0.0639	0.0603	0.0562
9-5/8	43.50	8.755	0.0734	0.0728	0.0718	0.0709	0.0703	0.0690	0.0664	0.0626	0.0589	0.0548
9-5/8	47.00	8.681	0.0721	0.0715	0.0705	0.0697	0.0691	0.0677	0.0652	0.0613	0.0577	0.0535
9-5/8	53.50	8.535	0.0697	0.0691	0.0681	0.0673	0.0666	0.0653	0.0627	0.0589	0.0552	0.0511
9-5/8	58.40	8.435	0.0680	0.0674	0.0664	0.0656	0.0650	0.0636	0.0611	0.0572	0.0536	0.0494
9-5/8	59.40	8.407	0.0676	0.0670	0.0660	0.0651	0.0645	0.0632	0.0606	0.0568	0.0531	0.0490

TABLE 20. Annular Capacity

(in bbl/ft between API casing and API tubing)

API Casing & Liners			API Tubing Nominal Sizes and OD (in)									
Nominal Size	Weight	ID	1"	1-5/16"	1-11/16"	1-7/8"	2-1/16"	2-3/8"	2-7/8"	3-1/2"	4"	4-1/2"
in	lb/ft	in	1.050 OD	1.315 OD	1.660 OD	1.900 OD	2.063 OD	2.375 OD	2.875 OD	3.500 OD	4.000 OD	4.500 OD
9-5/8	64.90	8.281	0.0655	0.0649	0.0639	0.0631	0.0625	0.0611	0.0586	0.0547	0.0511	0.0469
9-5/8	70.30	8.157	0.0636	0.0630	0.0620	0.0611	0.0605	0.0592	0.0566	0.0527	0.0491	0.0450
9-5/8	75.60	8.031	0.0616	0.0610	0.0600	0.0591	0.0585	0.0572	0.0546	0.0508	0.0471	0.0430
10-3/4	32.75	10.192	0.0998	0.0992	0.0982	0.0974	0.0968	0.0954	0.0929	0.0890	0.0854	0.0812
10-3/4	40.50	10.050	0.0970	0.0964	0.0954	0.0946	0.0940	0.0926	0.0901	0.0862	0.0826	0.0784
10-3/4	45.50	9.950	0.0951	0.0945	0.0935	0.0927	0.0920	0.0907	0.0881	0.0843	0.0806	0.0765
10-3/4	51.00	9.850	0.0932	0.0926	0.0916	0.0907	0.0901	0.0888	0.0862	0.0823	0.0787	0.0746
10-3/4	55.50	9.760	0.0915	0.0908	0.0899	0.0890	0.0884	0.0871	0.0845	0.0806	0.0770	0.0729
10-3/4	60.70	9.660	0.0896	0.0890	0.0880	0.0871	0.0865	0.0852	0.0826	0.0787	0.0751	0.0710
10-3/4	65.70	9.560	0.0877	0.0871	0.0861	0.0853	0.0846	0.0833	0.0807	0.0769	0.0732	0.0691
10-3/4	73.20	9.406	0.0849	0.0843	0.0833	0.0824	0.0818	0.0805	0.0779	0.0740	0.0704	0.0663
10-3/4	79.20	9.282	0.0826	0.0820	0.0810	0.0802	0.0796	0.0782	0.0757	0.0718	0.0681	0.0640
10-3/4	85.30	9.156	0.0804	0.0798	0.0788	0.0779	0.0773	0.0760	0.0734	0.0695	0.0659	0.0618
11-3/4	42.00	11.084	0.1183	0.1177	0.1167	0.1158	0.1152	0.1139	0.1113	0.1074	0.1038	0.0997
11-3/4	47.00	11.000	0.1165	0.1159	0.1149	0.1140	0.1134	0.1121	0.1095	0.1056	0.1020	0.0979
11-3/4	54.00	10.880	0.1139	0.1133	0.1123	0.1115	0.1108	0.1095	0.1070	0.1031	0.0994	0.0953

TABLE 20. Annular Capacity

(in bbl/ft between API casing and API tubing)

API Casing & Liners			API Tubing Nominal Sizes and OD (in)									
Nominal Size	Weight	ID	1"	1-5/16"	1-11/16"	1-7/8"	2-1/16"	2-3/8"	2-7/8"	3-1/2"	4"	4-1/2"
in	lb/ft	in	1.050 OD	1.315 OD	1.660 OD	1.900 OD	2.063 OD	2.375 OD	2.875 OD	3.500 OD	4.000 OD	4.500 OD
11-3/4	60.00	10.772	0.1116	0.1110	0.1100	0.1092	0.1086	0.1072	0.1047	0.1008	0.0972	0.0930
11-3/4	65.00	10.682	0.1098	0.1092	0.1082	0.1073	0.1067	0.1054	0.1028	0.0989	0.0953	0.0912
11-3/4	71.00	10.586	0.1078	0.1072	0.1062	0.1053	0.1047	0.1034	0.1008	0.0970	0.0933	0.0892
13-3/8	48.00	12.715	0.1560	0.1554	0.1544	0.1535	0.1529	0.1516	0.1490	0.1451	0.1415	0.1374
13-3/8	54.50	12.615	0.1535	0.1529	0.1519	0.1511	0.1504	0.1491	0.1466	0.1427	0.1390	0.1349
13-3/8	61.00	12.515	0.1511	0.1505	0.1495	0.1486	0.1480	0.1467	0.1441	0.1402	0.1366	0.1325
13-3/8	68.00	12.415	0.1486	0.1480	0.1470	0.1462	0.1456	0.1442	0.1417	0.1378	0.1342	0.1300
13-3/8	72.00	12.347	0.1470	0.1464	0.1454	0.1446	0.1439	0.1426	0.1401	0.1362	0.1325	0.1284
16	65.00	15.250	0.2248	0.2242	0.2232	0.2224	0.2218	0.2204	0.2179	0.2140	0.2104	0.2062
16	75.00	15.124	0.2211	0.2205	0.2195	0.2187	0.2181	0.2167	0.2142	0.2103	0.2066	0.2025
16	84.00	15.010	0.2178	0.2172	0.2162	0.2153	0.2147	0.2134	0.2108	0.2069	0.2033	0.1992
16	109.00	14.688	0.2085	0.2079	0.2069	0.2061	0.2054	0.2041	0.2015	0.1977	0.1940	0.1899
18-5/8	87.50	17.755	0.3051	0.3045	0.3035	0.3027	0.3021	0.3007	0.2982	0.2943	0.2907	0.2865
20	94.00	19.124	0.3542	0.3536	0.3526	0.3517	0.3511	0.3498	0.3472	0.3434	0.3397	0.3356
20	106.50	19.000	0.3496	0.3490	0.3480	0.3472	0.3465	0.3452	0.3426	0.3388	0.3351	0.3310
20	133.00	18.730	0.3397	0.3391	0.3381	0.3373	0.3366	0.3353	0.3327	0.3289	0.3252	0.3211

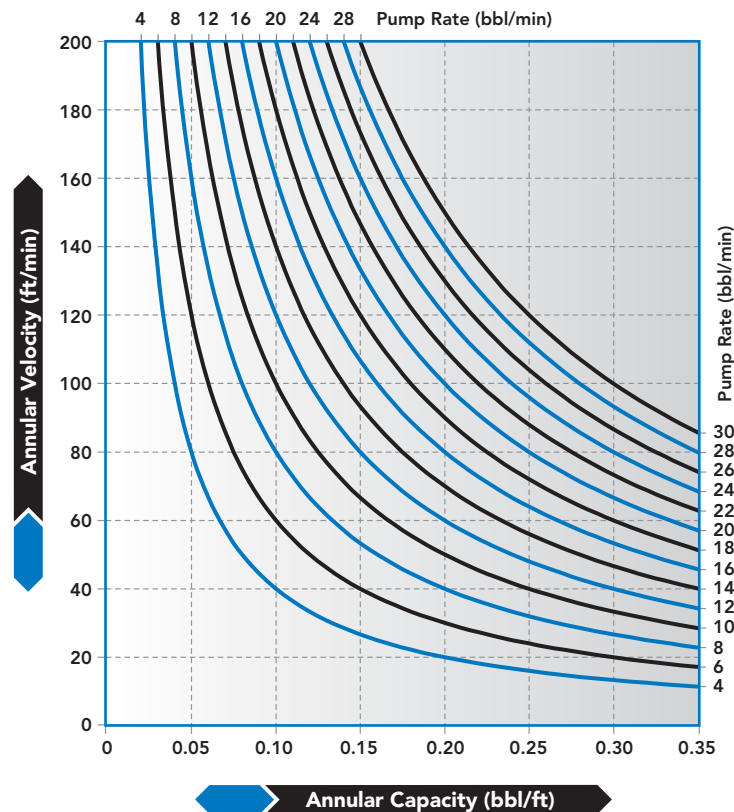
Annular Velocity

The values in Table 20 can be used to get a quick estimate of fluid velocity using Figure 16. The values along the bottom of the figure are annular capacity in barrels per foot (bbl/ft). The values along the vertical axis are annular velocity in feet per minute (ft/min). The curves that run from upper left to lower right are pump rates in barrels per minute (bbl/min).

Move up along the annular capacity line until you find the annular velocity you want and read the pump rate in bbl/min from the curve that is closest to the velocity you are hoping to achieve.

As an alternative, follow the annular capacity line up until you hit the pump rate curve and read the annular velocity given on the left axis.

FIGURE 16. Annular Velocity



Single Salt Fluid Composition and Blending Tables

The following single salt fluid tables are organized according to the CBF density. Each single salt fluid shown has three tables: (1) density and composition information, (2) cutback information, and (3) weight up information. The information in the following tables is intended as a guide. The values are representative of TETRA's clear brine fluids; however, there can be slight variations in the values provided in the tables versus those measured in actual fluids. These variations are due to slight compositional differences inherent in the manufacturing processes.

To see the equations necessary for conversions between milligrams per liter (mg/l), parts per million (ppm), and weight percent (wt%), see Equation 22 through Equation 24 beginning on page 125.

Using the Density and Composition Tables

The density and composition tables provided here are based on dissolving commonly available commercial grade salts in fresh water. Densities in pounds per gallon (lb/gal) shown in column one are measured at 60°F. Column three shows the volume of water in barrels that, when mixed with the weight in pounds of commercial purity dry salt shown in column four, will yield one barrel at the density shown in column one. The average purity of the dry salt is given in parentheses at the top of column four. Column five is the concentration of salt on a 100% basis.

Using the Single Salt Cutback Tables

The cutback tables for single salt fluids provided here are based on weight percentages of salt in the starting fluid and the target fluid, as shown in Equation 15 on page 72.

Values along the top of each cutback table show starting density, and values in column one show target density. Values in the table are fractions of a barrel of starting fluid required to make a single barrel of target fluid. For example, it takes 0.623 bbl of 9.4 lb/gal KCl to make one barrel of 9.0 lb/gal KCl when it is brought up to one barrel with fresh water. In short, first add the CBF and then bring it up to the target volume with fresh water.

Using the Single Salt Weight Up Tables

The single salt weight up tables provided here give pounds of dry chemical that can be added to one barrel of brine (with the starting density shown in column one) to achieve a density increase that ranges from 0.1 lb/gal to 0.6 lb/gal. A volume increase will be experienced and you will

be able to estimate it using Equation 14 on page 71. The purity of the dry chemical is provided in the title of each table.

Ammonium Chloride

TABLE 21. Ammonium Chloride (NH₄Cl) Density and Composition Table

Ammonium Chloride Density and Composition Information						
Density	Spec Grav	Water	NH ₄ Cl	NH ₄ Cl	Cl ⁻	TCT
lb/gal	SG	bbl	lb 99%	wt%	wt%	°F
8.4	1.008	0.979	10.7	3.0	2.0	29
8.5	1.020	0.958	23.1	6.4	4.2	24
8.6	1.031	0.919	38.0	10.9	7.2	18
8.7	1.044	0.889	55.0	14.8	9.8	12
8.8	1.055	0.859	69.7	18.9	12.5	8
8.9	1.068	0.812	90.7	24.1	16.0	45

TABLE 22. Ammonium Chloride (NH₄Cl) Cutback Table (bbl/bbl)

Ammonium Chloride Cutback Information					
Target Density	Starting Density				
lb/gal	8.5	8.6	8.7	8.8	8.9
8.4	0.463	0.269	0.196	0.152	0.117
8.5	1.000	0.580	0.422	0.327	0.254
8.6		1.000	0.728	0.564	0.437
8.7			1.000	0.774	0.600
8.8				1.000	0.775
8.9					1.000

TABLE 23. Ammonium Chloride (100% NH₄Cl) Weight Up Table (lb/bbl)

Ammonium Chloride Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
8.4	12.64	25.28	38.83	52.41	67.50	83.74
8.5	12.35	25.59	38.86	53.59	69.47	84.25
8.6	12.94	25.92	40.33	55.86	70.31	87.05
8.7	12.68	26.75	41.91	56.03	72.37	
8.8	13.76	28.58	42.38	58.36		
8.9	14.45	27.91	43.49			
9.0	13.10	28.27				
9.1	14.82					

Potassium Chloride

TABLE 24. Potassium Chloride (KCl) Density and Composition Table

Potassium Chloride Density and Composition Information						
Density	Spec Grav	Water	KCl	KCl	Cl ⁻	TCT
lb/gal	SG	bbf	lb 99%	wt%	wt%	°F
8.4	1.008	0.995	4.0	1.1	0.5	31
8.5	1.020	0.986	11.6	3.2	1.5	29
8.6	1.032	0.976	18.9	5.2	2.5	28
8.7	1.044	0.969	26.1	7.1	3.4	26
8.8	1.056	0.960	33.4	9.0	4.3	25
8.9	1.068	0.950	40.7	10.9	5.2	23
9.0	1.080	0.943	47.9	12.7	6.0	22
9.1	1.092	0.933	55.2	14.4	6.8	20
9.2	1.104	0.924	62.4	16.1	7.7	18
9.3	1.116	0.917	69.7	17.8	8.5	16
9.4	1.128	0.907	76.9	19.5	9.3	14
9.5	1.140	0.898	84.2	21.1	10.0	18
9.6	1.152	0.890	91.5	22.7	10.8	40
9.7	1.164	0.881	98.7	24.2	11.5	60

TABLE 25. Potassium Chloride (KCl) Cutback Table (bbf/bbf)

Potassium Chloride Cutback Information								
Target Density	Starting Density							
	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7
lb/gal								
8.4	0.084	0.072	0.064	0.057	0.052	0.048	0.044	0.041
8.5	0.242	0.210	0.186	0.166	0.151	0.138	0.127	0.118
8.6	0.395	0.342	0.303	0.271	0.246	0.224	0.207	0.191
8.7	0.545	0.473	0.418	0.374	0.339	0.310	0.285	0.264
8.8	0.697	0.605	0.535	0.479	0.434	0.397	0.365	0.338
8.9	0.850	0.737	0.652	0.584	0.529	0.483	0.445	0.412
9.0	1.000	0.868	0.768	0.687	0.623	0.569	0.523	0.485
9.1		1.000	0.885	0.792	0.718	0.656	0.603	0.559
9.2			1.000	0.895	0.811	0.741	0.682	0.632
9.3				1.000	0.906	0.828	0.762	0.706
9.4					1.000	0.913	0.840	0.779
9.5						1.000	0.920	0.853
9.6							1.000	0.927
9.7								1.000

TABLE 26. Potassium Chloride (99% KCl) Weight Up Table (lb/bbl)

Potassium Chloride Weight Up Information						
Starting Density lb/gal	Weight Up Increments					
	0.1	0.2	0.3	0.4	0.5	0.6
8.4	7.71	15.26	22.83	30.65	38.62	46.61
8.5	7.47	14.97	22.71	30.60	38.52	46.71
8.6	7.43	15.11	22.92	30.77	38.88	47.02
8.7	7.61	15.36	23.13	31.18	39.25	47.60
8.8	7.68	15.39	23.35	31.35	39.62	47.93
8.9	7.64	15.53	23.45	31.65	39.88	48.39
9.0	7.82	15.67	23.80	31.95	40.39	49.00
9.1	7.78	15.82	23.90	32.26	40.79	49.35
9.2	7.97	15.98	24.26	32.71	41.19	
9.3	7.93	16.13	24.50	32.90		
9.4	8.13	16.42	24.74			
9.5	8.21	16.45				
9.6	8.16					

Sodium Chloride

TABLE 27. Sodium Chloride (NaCl) Density and Composition Table

Sodium Chloride Density and Composition Information						
Density	Spec Grav	Water	NaCl	NaCl	Cl ⁻	TCT
lb/gal	SG	bbl	lb 99%	wt%	wt%	°F
8.4	1.008	0.998	4	1.1	0.7	31
8.5	1.020	0.993	9	2.5	1.5	29
8.6	1.032	0.986	16	4.4	2.7	27
8.7	1.044	0.981	22	6.0	3.6	26
8.8	1.056	0.976	28	7.6	4.6	24
8.9	1.068	0.969	35	9.4	5.7	22
9.0	1.080	0.962	41	10.8	6.6	19
9.1	1.092	0.955	47	12.3	7.5	17
9.2	1.104	0.948	54	14.0	8.5	14
9.3	1.116	0.940	61	15.6	9.5	11
9.4	1.128	0.933	68	17.2	10.4	9
9.5	1.140	0.926	74	18.5	11.2	6
9.6	1.152	0.919	81	20.1	12.2	3
9.7	1.164	0.910	88	21.6	13.1	-1
9.8	1.176	0.902	95	23.1	14.0	-5
9.9	1.188	0.895	102	24.5	14.9	5
10.0	1.200	0.888	109	26.0	15.8	25

TABLE 28. Sodium Chloride (NaCl) Cutback Table (bbl/bbl)

Sodium Chloride Cutback Information								
Target Density lb/gal	Starting Density							
	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0
8.4	0.066	0.059	0.054	0.049	0.045	0.042	0.039	0.037
8.5	0.148	0.132	0.122	0.111	0.102	0.095	0.088	0.083
8.6	0.262	0.235	0.216	0.198	0.182	0.168	0.157	0.147
8.7	0.361	0.324	0.297	0.272	0.250	0.232	0.216	0.202
8.8	0.459	0.412	0.378	0.346	0.318	0.295	0.275	0.257
8.9	0.574	0.515	0.473	0.432	0.398	0.368	0.343	0.321
9.0	0.672	0.603	0.554	0.506	0.466	0.432	0.402	0.376
9.1	0.770	0.691	0.635	0.580	0.534	0.495	0.461	0.431
9.2	0.885	0.794	0.730	0.667	0.614	0.568	0.529	0.495
9.3	1.000	0.897	0.824	0.753	0.693	0.642	0.598	0.560
9.4		1.000	0.919	0.840	0.773	0.716	0.667	0.624
9.5			1.000	0.914	0.841	0.779	0.725	0.679
9.6				1.000	0.920	0.853	0.794	0.743
9.7					1.000	0.926	0.863	0.807
9.8						1.000	0.931	0.872
9.9							1.000	0.936
10.0								1.000

TABLE 29. Sodium Chloride (99% NaCl) Weight Up Table (lb/bbl)

Sodium Chloride Weight Up Information						
Starting Density lb/gal	Weight Up Increments					
	0.1	0.2	0.3	0.4	0.5	0.6
8.4	4.92	11.91	17.96	24.06	31.33	37.58
8.5	6.98	13.01	19.10	26.36	32.59	38.89
8.6	5.99	12.03	19.23	25.42	31.67	39.15
8.7	6.01	13.18	19.34	25.56	33.00	40.57
8.8	7.13	13.26	19.44	26.86	34.39	42.04
8.9	6.08	12.22	19.58	27.05	34.64	41.11
9.0	6.11	13.43	20.86	28.42	34.86	42.63
9.1	7.28	14.68	22.20	28.61	36.34	44.20
9.2	7.34	14.80	21.15	28.83	36.63	44.56
9.3	7.40	13.70	21.32	29.05	36.92	44.92
9.4	6.25	13.80	21.48	29.28	37.22	45.29
9.5	7.51	15.15	22.91	30.81	38.84	
9.6	7.57	15.28	23.11	31.07		
9.7	7.64	15.40	23.30			
9.8	7.70	15.53				
9.9	7.77					

Sodium Formate

TABLE 30. Sodium Formate (NaO₂CH) Density and Composition Table

Sodium Formate Density and Composition Information					
Density	Spec Grav	Water	NaO ₂ CH	NaO ₂ CH	TCT
lb/gal	SG	bbbl	lb 100%	wt%	°F
9.0	1.08	0.943	48	12.7	16
9.1	1.09	0.932	56	14.7	6
9.2	1.10	0.921	64	16.6	1
9.3	1.12	0.910	72	18.5	-0.6
9.4	1.13	0.898	81	20.4	1
9.5	1.14	0.887	89	22.2	3
9.6	1.15	0.876	97	24.0	6
9.7	1.16	0.864	105	25.8	10
9.8	1.18	0.853	113	27.5	13
9.9	1.19	0.841	122	29.2	15
10.0	1.20	0.829	130	30.9	17
10.1	1.21	0.818	138	32.6	18
10.2	1.22	0.806	146	34.2	19
10.3	1.24	0.795	155	35.7	20
10.4	1.25	0.783	163	37.3	21
10.5	1.26	0.771	171	38.8	23
10.6	1.27	0.760	179	40.3	26
10.7	1.28	0.749	188	41.7	30
10.8	1.30	0.737	196	43.1	39
10.9	1.31	0.726	204	44.5	44
11.0	1.32	0.715	212	45.9	57
11.1	1.33	0.704	220	47.2	73

TABLE 31. Sodium Formate (NaO₂CH) Cutback Table (bbl/bbl)

Sodium Formate Cutback Information								
Target Density	Starting Density							
lb/gal	10.4	10.5	10.6	10.7	10.8	10.9	11.0	11.1
9.0	0.296	0.281	0.269	0.257	0.246	0.236	0.227	0.219
9.1	0.345	0.328	0.313	0.300	0.287	0.276	0.265	0.255
9.2	0.395	0.376	0.358	0.343	0.328	0.315	0.303	0.292
9.3	0.444	0.423	0.404	0.386	0.370	0.355	0.341	0.329
9.4	0.494	0.471	0.449	0.429	0.411	0.395	0.380	0.366
9.5	0.545	0.518	0.495	0.473	0.453	0.435	0.418	0.403
9.6	0.595	0.566	0.540	0.517	0.495	0.475	0.457	0.440
9.7	0.645	0.614	0.586	0.560	0.537	0.516	0.496	0.478
9.8	0.696	0.662	0.632	0.604	0.579	0.556	0.535	0.515
9.9	0.747	0.711	0.678	0.648	0.621	0.596	0.574	0.553
10.0	0.797	0.759	0.724	0.692	0.663	0.637	0.613	0.590
10.1	0.848	0.807	0.770	0.736	0.706	0.677	0.652	0.628
10.2	0.899	0.855	0.816	0.780	0.748	0.718	0.690	0.665
10.3	0.949	0.904	0.862	0.825	0.790	0.758	0.729	0.703

TABLE 31. Sodium Formate (NaO₂CH) Cutback Table (bbl/bbl)

Sodium Formate Cutback Information								
Target Density	Starting Density							
lb/gal	10.4	10.5	10.6	10.7	10.8	10.9	11.0	11.1
10.4	1.000	0.952	0.908	0.869	0.832	0.799	0.768	0.740
10.5		1.000	0.954	0.912	0.874	0.839	0.807	0.778
10.6			1.000	0.956	0.916	0.880	0.846	0.815
10.7				1.000	0.958	0.920	0.885	0.852
10.8					1.000	0.960	0.923	0.889
10.9						1.000	0.962	0.926
11.0							1.000	0.963
11.1								1.000

TABLE 32. Sodium Formate (99% NaO₂CH) Weight Up Table (lb/bbl)

Sodium Formate Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
9.0	8.69	17.64	26.86	36.35	46.12	56.17
9.1	8.85	17.96	27.33	36.99	46.93	57.16
9.2	9.00	18.27	27.81	37.63	47.74	58.15
9.3	9.15	18.58	28.28	38.27	48.55	59.13
9.4	9.31	18.89	28.75	38.91	49.36	60.11
9.5	9.46	19.20	29.23	39.54	50.16	61.09
9.6	9.61	19.51	29.70	40.18	50.97	62.06
9.7	9.77	19.82	30.16	40.81	51.76	63.03
9.8	9.92	20.13	30.63	41.43	52.55	63.98
9.9	10.07	20.43	31.09	42.05	53.33	64.92
10.0	10.22	20.73	31.54	42.66	54.10	65.85
10.1	10.37	21.03	31.99	43.27	54.85	66.76
10.2	10.51	21.32	32.43	43.86	55.59	67.65
10.3	10.65	21.61	32.87	44.43	56.32	68.51
10.4	10.79	21.89	33.29	45.00	57.02	69.35
10.5	10.93	22.16	33.70	45.54	57.70	70.16
10.6	11.06	22.43	34.10	46.07	58.35	
10.7	11.19	22.68	34.48	46.57		
10.8	11.32	22.93	34.84			
10.9	11.44	23.16				
11.0	11.55					

Potassium Formate

TABLE 33. Potassium Formate (KO₂CH) Density and Composition Table

Potassium Formate Density and Composition Information					
Density	Spec Grav	Water	KO ₂ CH	KO ₂ CH	TCT
lb/gal	SG	bbbl	lb 98%	wt%	°F
8.4	1.008	0.980	10	2.7	29
8.5	1.020	0.972	17	4.7	28
8.6	1.032	0.963	24	6.6	27
8.7	1.044	0.953	32	8.5	25
8.8	1.056	0.944	39	10.4	24
8.9	1.068	0.934	47	12.3	22
9.0	1.080	0.924	55	14.2	20
9.1	1.092	0.914	63	16.0	17
9.2	1.104	0.903	70	17.9	15
9.3	1.116	0.892	78	19.7	12
9.4	1.128	0.881	86	21.5	9
9.5	1.140	0.870	95	23.2	6
9.6	1.152	0.859	103	25.0	3
9.7	1.164	0.847	111	26.7	-1
9.8	1.176	0.835	119	28.4	-4
9.9	1.188	0.823	128	30.1	-8
10.0	1.200	0.811	136	31.8	-12
10.1	1.212	0.798	145	33.5	-16
10.2	1.224	0.786	153	35.1	-20
10.3	1.236	0.773	162	36.7	-25
10.4	1.248	0.760	171	38.3	-29
10.5	1.261	0.747	180	39.9	-34
10.6	1.273	0.734	189	41.5	-38
10.7	1.285	0.720	197	43.0	-43
10.8	1.297	0.707	206	44.6	-48
10.9	1.309	0.693	215	46.1	-53
11.0	1.321	0.679	224	47.6	-58
11.1	1.333	0.665	233	49.1	-63
11.2	1.345	0.651	243	50.5	-68
11.3	1.357	0.637	252	52.0	-74
11.4	1.369	0.623	261	53.4	-78
11.5	1.381	0.609	270	54.8	-72
11.6	1.393	0.594	279	56.2	-66
11.7	1.405	0.580	289	57.5	-60
11.8	1.417	0.565	298	58.9	-54
11.9	1.429	0.551	307	60.2	-48
12.0	1.441	0.536	316	61.5	-42
12.1	1.453	0.521	326	62.8	-36
12.2	1.465	0.507	335	64.1	-30
12.3	1.477	0.492	345	65.4	-24
12.4	1.489	0.477	354	66.6	-18
12.5	1.501	0.462	363	67.8	-12
12.6	1.513	0.447	373	69.0	-6

TABLE 33. Potassium Formate (KO₂CH) Density and Composition Table

Potassium Formate Density and Composition Information					
Density	Spec Grav	Water	KO ₂ CH	KO ₂ CH	TCT
lb/gal	SG	bbl	lb 98%	wt%	°F
12.7	1.525	0.432	382	70.2	0
12.8	1.537	0.417	392	71.4	6
12.9	1.549	0.403	401	72.5	12
13.0	1.561	0.388	410	73.6	17
13.1	1.573	0.373	420	74.8	23

TABLE 34. Potassium Formate (KO₂CH) Cutback Table (bbl/bbl)

Potassium Formate Cutback Information								
Target Density	Starting Density							
	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.1
9.0	0.155	0.151	0.147	0.143	0.140	0.136	0.133	0.130
9.1	0.177	0.172	0.168	0.164	0.160	0.156	0.152	0.149
9.2	0.199	0.194	0.189	0.184	0.180	0.176	0.172	0.168
9.3	0.221	0.216	0.210	0.205	0.200	0.196	0.191	0.187
9.4	0.244	0.238	0.232	0.226	0.221	0.216	0.211	0.206
9.5	0.267	0.260	0.254	0.247	0.241	0.236	0.230	0.225
9.6	0.290	0.283	0.276	0.269	0.262	0.256	0.250	0.245
9.7	0.314	0.306	0.298	0.291	0.283	0.277	0.271	0.265
9.8	0.337	0.329	0.320	0.312	0.305	0.298	0.291	0.284
9.9	0.361	0.352	0.343	0.334	0.326	0.319	0.311	0.305
10.0	0.385	0.375	0.366	0.357	0.348	0.340	0.332	0.325
10.1	0.409	0.399	0.389	0.379	0.370	0.361	0.353	0.345
10.2	0.434	0.423	0.412	0.402	0.392	0.383	0.374	0.366
10.3	0.458	0.446	0.435	0.424	0.414	0.405	0.395	0.386
10.4	0.483	0.470	0.459	0.447	0.436	0.426	0.416	0.407
10.5	0.508	0.495	0.482	0.470	0.459	0.448	0.438	0.428
10.6	0.533	0.519	0.506	0.493	0.481	0.470	0.459	0.449
10.7	0.558	0.543	0.530	0.517	0.504	0.492	0.481	0.470
10.8	0.583	0.568	0.554	0.540	0.527	0.515	0.503	0.492
10.9	0.608	0.593	0.578	0.564	0.550	0.537	0.525	0.513
11.0	0.634	0.618	0.602	0.587	0.573	0.560	0.547	0.534
11.1	0.659	0.643	0.626	0.611	0.596	0.582	0.569	0.556
11.2	0.685	0.668	0.651	0.635	0.619	0.605	0.591	0.578
11.3	0.711	0.693	0.675	0.659	0.643	0.628	0.613	0.600
11.4	0.737	0.718	0.700	0.683	0.666	0.651	0.636	0.621
11.5	0.763	0.743	0.725	0.707	0.689	0.674	0.658	0.643
11.6	0.789	0.769	0.750	0.731	0.713	0.697	0.681	0.665
11.7	0.815	0.794	0.774	0.755	0.737	0.720	0.703	0.687
11.8	0.841	0.820	0.799	0.779	0.760	0.743	0.726	0.710
11.9	0.868	0.846	0.824	0.804	0.784	0.766	0.749	0.732
12.0	0.894	0.871	0.849	0.828	0.808	0.790	0.771	0.754
12.1	0.921	0.897	0.874	0.853	0.832	0.813	0.794	0.776
12.2	0.947	0.923	0.900	0.877	0.856	0.836	0.817	0.799

TABLE 34. Potassium Formate (KO₂CH) Cutback Table (bbl/bbl)

Potassium Formate Cutback Information								
Target Density	Starting Density							
lb/gal	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.1
12.3	0.974	0.949	0.925	0.902	0.880	0.860	0.840	0.821
12.4	1.000	0.974	0.950	0.926	0.904	0.883	0.863	0.843
12.5		1.000	0.975	0.951	0.928	0.906	0.885	0.866
12.6			1.000	0.976	0.952	0.930	0.908	0.888
12.7				1.000	0.976	0.953	0.931	0.910
12.8					1.000	0.977	0.954	0.933
12.9						1.000	0.977	0.955
13.0							1.000	0.978
13.1								1.000

TABLE 35. Potassium Formate (98% KO₂CH) Weight Up Table (lb/bbl)

Potassium Formate Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
8.4	7.39	15.02	22.91	31.06	39.49	48.21
8.5	7.57	15.38	23.46	31.82	40.46	49.40
8.6	7.74	15.75	24.03	32.59	41.45	50.63
8.7	7.93	16.13	24.61	33.38	42.47	51.88
8.8	8.12	16.51	25.20	34.20	43.52	53.17
8.9	8.31	16.91	25.81	35.03	44.59	54.50
9.0	8.51	17.31	26.44	35.89	45.70	55.87
9.1	8.71	17.73	27.08	36.78	46.83	57.27
9.2	8.92	18.16	27.74	37.68	48.00	58.72
9.3	9.13	18.60	28.42	38.62	49.21	60.21
9.4	9.35	19.05	29.12	39.58	50.44	61.74
9.5	9.58	19.52	29.84	40.57	51.72	63.32
9.6	9.81	20.00	30.58	41.59	53.04	64.95
9.7	10.05	20.49	31.35	42.64	54.40	66.64
9.8	10.30	21.00	32.13	43.72	55.80	68.38
9.9	10.55	21.52	32.95	44.84	57.24	70.18
10.0	10.81	22.06	33.78	46.00	58.74	72.03
10.1	11.08	22.62	34.65	47.19	60.28	73.96
10.2	11.36	23.20	35.54	48.43	61.88	75.95
10.3	11.64	23.79	36.46	49.70	63.54	78.01
10.4	11.94	24.40	37.42	51.02	65.26	80.15
10.5	12.25	25.04	38.41	52.39	67.03	82.37
10.6	12.56	25.70	39.43	53.81	68.88	84.68
10.7	12.89	26.38	40.50	55.29	70.80	87.08
10.8	13.23	27.08	41.60	56.82	72.79	89.58
10.9	13.58	27.82	42.74	58.41	74.87	92.18
11.0	13.95	28.58	43.93	60.06	77.03	94.89
11.1	14.33	29.37	45.17	61.79	79.28	97.72

TABLE 35. Potassium Formate (98% KO₂CH) Weight Up Table (lb/bbl)

Potassium Formate Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
11.2	14.72	30.19	46.46	63.58	81.63	100.67
11.3	15.13	31.05	47.80	65.46	84.09	103.77
11.4	15.56	31.94	49.20	67.41	86.65	107.00
11.5	16.00	32.87	50.66	69.46	89.34	110.40
11.6	16.47	33.84	52.19	71.61	92.17	113.97
11.7	16.95	34.86	53.80	73.85	95.13	117.72
11.8	17.46	35.92	55.48	76.22	98.24	121.67
11.9	17.99	37.04	57.24	78.70	101.52	125.84
12.0	18.54	38.21	59.09	81.31	104.98	130.25
12.1	19.13	39.44	61.05	84.07	108.64	134.91
12.2	19.74	40.73	63.10	86.98	112.51	139.86
12.3	20.38	42.10	65.28	90.06	116.62	145.12
12.4	21.06	43.54	67.58	93.33	120.98	150.73
12.5	21.78	45.07	70.02	96.81	125.63	156.71
12.6	22.54	46.69	72.61	100.51	130.59	
12.7	23.35	48.41	75.38	104.46		
12.8	24.20	50.24	78.33			
12.9	25.11	52.20				
13.0	26.09					

Sodium Bromide

TABLE 36. Sodium Bromide (NaBr) Density and Composition Table

Sodium Bromide Density and Composition Information						
Density	Spec Grav	Water	NaBr	NaBr	Br	TCT
lb/gal	SG	bbl	lb 98%	wt%	wt%	°F
8.4	1.008	0.999	3	0.9	0.7	30
8.5	1.020	0.998	8	2.2	1.7	30
8.6	1.032	0.993	14	3.8	2.9	29
8.7	1.044	0.989	19	5.2	4.0	29
8.8	1.056	0.984	25	6.7	5.2	29
8.9	1.068	0.979	31	8.2	6.4	28
9.0	1.080	0.974	37	9.7	7.5	28
9.1	1.092	0.970	43	11.0	8.5	27
9.2	1.104	0.965	49	12.4	9.6	26
9.3	1.116	0.960	55	13.8	10.7	25
9.4	1.128	0.955	61	15.1	11.7	24
9.5	1.140	0.949	67	16.5	12.8	23
9.6	1.152	0.945	73	17.7	13.7	19
9.7	1.164	0.940	79	18.9	14.7	18
9.8	1.176	0.923	89	21.1	16.4	17
9.9	1.188	0.931	90	21.3	16.5	16

TABLE 36. Sodium Bromide (NaBr) Density and Composition Table

Sodium Bromide Density and Composition Information						
Density	Spec Grav	Water	NaBr	NaBr	Br	TCT
lb/gal	SG	bbbl	lb 98%	wt%	wt%	°F
10.0	1.200	0.925	96	22.5	17.5	15
10.1	1.212	0.920	102	23.6	18.3	13
10.2	1.224	0.915	108	24.8	19.2	12
10.3	1.236	0.912	114	25.8	20.0	11
10.4	1.248	0.907	119	26.8	20.8	10
10.5	1.261	0.902	125	27.9	21.6	9
10.6	1.273	0.897	132	29.0	22.5	6
10.7	1.285	0.892	137	30.0	23.3	3
10.8	1.297	0.887	143	31.0	24.0	1
10.9	1.309	0.883	149	31.9	24.8	-2
11.0	1.321	0.878	155	32.9	25.5	-5
11.1	1.333	0.873	161	33.8	26.2	-6
11.2	1.345	0.868	167	34.8	27.0	-8
11.3	1.357	0.862	173	35.7	27.7	-10
11.4	1.369	0.857	179	36.6	28.4	-12
11.5	1.381	0.852	185	37.6	29.2	-14
11.6	1.393	0.848	191	38.4	29.8	-16
11.7	1.405	0.842	197	39.3	30.5	-19
11.8	1.417	0.838	202	40.0	31.1	-21
11.9	1.429	0.834	208	40.8	31.7	-13
12.0	1.441	0.828	214	41.7	32.3	-6
12.1	1.453	0.825	220	42.4	32.9	5
12.2	1.465	0.819	226	43.2	33.5	10
12.3	1.477	0.817	231	43.8	34.0	27
12.4	1.489	0.810	238	44.7	34.7	33
12.5	1.501	0.805	243	45.4	35.3	38
12.6	1.513	0.800	249	46.2	35.8	50
12.7	1.525	0.797	255	46.8	36.3	65

TABLE 37. Sodium Bromide (NaBr) Cutback Table (bbl/bbl)

Sodium Bromide Cutback Information											
Target Density	Starting Density										
	11.5	11.6	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	
10.0	0.521	0.506	0.490	0.477	0.463	0.450	0.439	0.427	0.418	0.406	
10.1	0.552	0.536	0.519	0.505	0.491	0.477	0.465	0.452	0.442	0.430	
10.2	0.585	0.568	0.550	0.535	0.520	0.506	0.493	0.479	0.469	0.456	
10.3	0.615	0.597	0.578	0.562	0.547	0.532	0.518	0.504	0.493	0.479	
10.4	0.646	0.627	0.607	0.590	0.574	0.558	0.544	0.529	0.517	0.503	
10.5	0.678	0.658	0.637	0.620	0.602	0.586	0.571	0.555	0.543	0.528	
10.6	0.711	0.690	0.668	0.650	0.632	0.615	0.599	0.582	0.570	0.554	
10.7	0.743	0.721	0.698	0.679	0.660	0.642	0.626	0.608	0.595	0.578	
10.8	0.774	0.751	0.727	0.708	0.688	0.669	0.652	0.634	0.620	0.603	
10.9	0.807	0.783	0.758	0.737	0.717	0.697	0.679	0.660	0.646	0.628	

TABLE 37. Sodium Bromide (NaBr) Cutback Table (bbl/bbl)

Sodium Bromide Cutback Information											
Target Density	Starting Density										
lb/gal	11.5	11.6	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	
11.0	0.838	0.813	0.787	0.766	0.744	0.724	0.705	0.686	0.671	0.652	
11.1	0.870	0.844	0.817	0.795	0.773	0.752	0.733	0.712	0.697	0.677	
11.2	0.902	0.875	0.848	0.825	0.801	0.780	0.760	0.738	0.723	0.702	
11.3	0.935	0.907	0.878	0.855	0.831	0.808	0.787	0.765	0.749	0.728	
11.4	0.967	0.938	0.909	0.884	0.859	0.836	0.815	0.792	0.775	0.753	
11.5	1.000	0.970	0.939	0.914	0.888	0.864	0.842	0.818	0.801	0.778	
11.6		1.000	0.968	0.942	0.916	0.890	0.868	0.843	0.825	0.802	
11.7			1.000	0.973	0.946	0.920	0.896	0.871	0.853	0.829	
11.8				1.000	0.972	0.945	0.921	0.895	0.876	0.852	
11.9					1.000	0.973	0.948	0.921	0.902	0.876	
12.0						1.000	0.975	0.947	0.927	0.901	
12.1							1.000	0.972	0.951	0.924	
12.2								1.000	0.979	0.951	
12.3									1.000	0.972	
12.4										1.000	

TABLE 38. Sodium Bromide (98% NaBr) Weight Up Table (lb/bbl)

Sodium Bromide Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
8.4	5.53	11.73	17.35	23.34	29.61	35.61
8.5	6.17	11.78	17.75	24.00	29.97	36.23
8.6	5.57	11.51	17.73	23.67	29.89	35.94
8.7	5.92	12.11	18.03	24.23	30.26	36.58
8.8	6.16	12.05	18.23	24.23	30.52	37.00
8.9	5.86	12.00	17.97	24.23	30.68	37.44
9.0	6.11	12.06	18.29	24.71	31.44	37.50
9.1	5.91	12.12	18.50	25.20	31.23	37.69
9.2	6.17	12.53	19.20	25.20	31.63	37.87
9.3	6.32	12.96	18.93	25.33	31.54	37.68
9.4	6.60	12.54	18.91	25.08	31.18	38.14
9.5	5.90	12.23	18.37	24.44	31.35	37.67
9.6	6.30	12.42	18.46	25.34	31.63	38.40
9.7	6.08	12.09	18.94	25.20	31.93	38.04
9.8	5.98	12.80	19.03	25.73	31.82	38.09
9.9	6.79	13.00	19.67	25.72	31.97	38.70
10.0	6.17	12.80	18.82	25.03	31.72	38.77
10.1	6.60	12.59	18.77	25.43	32.45	39.11
10.2	5.96	12.10	18.72	25.70	32.33	38.87
10.3	6.12	12.71	19.67	26.26	32.78	39.66
10.4	6.57	13.49	20.06	26.54	33.40	40.02
10.5	6.89	13.42	19.87	26.69	33.27	40.23

TABLE 38. Sodium Bromide (98% NaBr) Weight Up Table (lb/bbl)

Sodium Bromide Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
10.6	6.49	12.91	19.68	26.23	33.15	40.15
10.7	6.38	13.12	19.63	26.52	33.48	40.68
10.8	6.71	13.19	20.04	26.97	34.14	41.22
10.9	6.44	13.26	20.15	27.28	34.33	41.62
11.0	6.78	13.64	20.73	27.75	35.01	41.68
11.1	6.82	13.87	20.85	28.07	34.71	42.43
11.2	7.01	13.95	21.13	27.73	35.41	41.81
11.3	6.90	14.04	20.59	28.23	34.59	41.70
11.4	7.10	13.62	21.22	27.54	34.61	41.76
11.5	6.48	14.03	20.32	27.35	34.45	41.10
11.6	7.51	13.77	20.77	27.84	34.45	42.59
11.7	6.21	13.16	20.19	26.76	34.84	40.44
11.8	6.92	13.92	20.46	28.51	34.09	42.88
11.9	6.96	13.47	21.47	27.02	35.77	42.74
12.0	6.47	14.43	19.95	28.65	35.59	43.37
12.1	7.93	13.42	22.08	28.99	36.74	43.21
12.2	5.46	14.05	20.91	28.60	35.03	
12.3	8.57	15.42	23.09	29.50		
12.4	6.79	14.39	20.75			
12.5	7.57	13.90				
12.6	6.29					

Calcium Chloride

TABLE 39. Calcium Chloride (CaCl₂) Density and Composition Table

Calcium Chloride Density and Composition Information						
Density	Spec Grav	Water	CaCl ₂	CaCl ₂	Cl ⁻	TCT
lb/gal	SG	bbl	lb 95%	wt%	wt%	°F
9.0	1.080	0.970	39	9.7	6.2	21
9.1	1.092	0.965	45	11.1	7.1	19
9.2	1.104	0.960	50	12.4	7.9	17
9.3	1.116	0.955	56	13.7	8.8	15
9.4	1.128	0.950	62	15.0	9.6	12
9.5	1.140	0.946	68	16.2	10.3	9
9.6	1.152	0.940	74	17.5	11.2	6
9.7	1.164	0.935	80	18.7	11.9	3
9.8	1.176	0.930	86	19.9	12.7	0
9.9	1.188	0.925	92	21.1	13.5	-4
10.0	1.200	0.919	99	22.3	14.2	-8
10.1	1.212	0.913	105	23.5	15.0	-13
10.2	1.224	0.907	111	24.6	15.7	-18

TABLE 39. Calcium Chloride (CaCl₂) Density and Composition Table

Calcium Chloride Density and Composition Information						
Density	Spec Grav	Water	CaCl ₂	CaCl ₂	Cl ⁻	TCT
lb/gal	SG	bbf	lb 95%	wt%	wt%	°F
10.3	1.236	0.901	117	25.8	16.5	-23
10.4	1.248	0.895	124	26.9	17.2	-29
10.5	1.261	0.889	130	28.0	17.9	-36
10.6	1.273	0.883	136	29.1	18.6	-43
10.7	1.285	0.876	143	30.2	19.3	-51
10.8	1.297	0.869	149	31.3	20.0	-59
10.9	1.309	0.862	156	32.4	20.7	-40
11.0	1.321	0.855	163	33.5	21.4	-22
11.1	1.333	0.847	170	34.6	22.1	-11
11.2	1.345	0.841	176	35.6	22.7	0
11.3	1.357	0.832	183	36.7	23.4	13
11.4	1.369	0.825	190	37.7	24.1	27
11.5	1.381	0.817	197	38.8	24.8	35
11.6	1.393	0.809	204	39.8	25.4	44

TABLE 40. Calcium Chloride (CaCl₂) Cutback Table (bbf/bbl)

Calcium Chloride Cutback Information											
Target Density	Starting Density										
	lb/gal	10.7	10.8	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6
8.4	0.026	0.025	0.024	0.023	0.022	0.021	0.020	0.020	0.019	0.018	
8.5	0.052	0.050	0.048	0.046	0.044	0.043	0.041	0.040	0.038	0.037	
8.6	0.090	0.086	0.083	0.079	0.076	0.074	0.071	0.068	0.066	0.064	
8.7	0.136	0.130	0.125	0.120	0.116	0.112	0.107	0.104	0.100	0.097	
8.8	0.162	0.155	0.149	0.143	0.138	0.133	0.127	0.123	0.119	0.115	
8.9	0.207	0.199	0.191	0.184	0.177	0.170	0.163	0.158	0.153	0.147	
9.0	0.256	0.246	0.236	0.227	0.219	0.211	0.202	0.195	0.189	0.182	
9.1	0.301	0.289	0.277	0.267	0.257	0.247	0.237	0.229	0.222	0.214	
9.2	0.344	0.330	0.317	0.305	0.293	0.282	0.271	0.262	0.254	0.244	
9.3	0.388	0.372	0.357	0.343	0.330	0.318	0.305	0.295	0.286	0.275	
9.4	0.432	0.414	0.398	0.383	0.368	0.355	0.340	0.329	0.318	0.307	
9.5	0.474	0.455	0.437	0.420	0.404	0.389	0.373	0.361	0.350	0.337	
9.6	0.518	0.497	0.477	0.459	0.441	0.425	0.407	0.394	0.382	0.368	
9.7	0.562	0.539	0.518	0.498	0.479	0.461	0.442	0.428	0.414	0.399	
9.8	0.607	0.582	0.559	0.537	0.517	0.498	0.477	0.462	0.447	0.431	
9.9	0.649	0.623	0.598	0.575	0.553	0.533	0.511	0.494	0.479	0.461	
10.0	0.693	0.664	0.638	0.613	0.590	0.568	0.545	0.527	0.510	0.492	
10.1	0.737	0.707	0.679	0.652	0.628	0.605	0.580	0.561	0.543	0.523	
10.2	0.781	0.750	0.720	0.692	0.666	0.641	0.615	0.595	0.576	0.555	
10.3	0.824	0.790	0.759	0.730	0.702	0.676	0.648	0.627	0.607	0.585	
10.4	0.867	0.832	0.799	0.768	0.739	0.711	0.682	0.660	0.639	0.616	
10.5	0.911	0.873	0.839	0.806	0.776	0.747	0.717	0.693	0.671	0.647	
10.6	0.955	0.916	0.880	0.846	0.814	0.784	0.751	0.727	0.704	0.678	
10.7	1.000	0.959	0.921	0.886	0.852	0.821	0.787	0.761	0.737	0.710	

TABLE 40. Calcium Chloride (CaCl₂) Cutback Table (bbl/bbl)

Calcium Chloride Cutback Information										
Target Density	Starting Density									
lb/gal	10.7	10.8	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6
10.8		1.000	0.960	0.923	0.888	0.856	0.820	0.794	0.768	0.741
10.9			1.000	0.961	0.925	0.891	0.854	0.826	0.800	0.771
11.0				1.000	0.962	0.927	0.889	0.860	0.832	0.802
11.1					1.000	0.963	0.923	0.893	0.865	0.834
11.2						1.000	0.959	0.928	0.898	0.866
11.3							1.000	0.968	0.937	0.903
11.4								1.000	0.968	0.933
11.5									1.000	0.964
11.6										1.000

TABLE 41. Calcium Chloride (95% CaCl₂) Weight Up Table (lb/bbl)

Calcium Chloride Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
9.0	5.85	11.88	18.11	24.54	31.18	37.51
9.1	6.01	12.21	18.61	25.22	31.52	38.57
9.2	6.17	12.54	19.12	25.39	32.41	39.10
9.3	6.34	12.89	19.13	26.11	32.77	39.64
9.4	6.43	12.72	19.66	26.28	33.12	40.19
9.5	6.51	13.07	19.66	26.46	33.48	40.74
9.6	6.60	13.42	20.19	27.18	34.40	41.24
9.7	6.69	13.23	20.17	27.35	34.14	41.80
9.8	6.77	13.59	20.72	27.48	35.09	42.31
9.9	6.86	13.96	20.67	28.24	35.41	42.82
10.0	6.96	13.72	21.24	28.37	35.73	44.04
10.1	7.06	14.10	21.18	28.49	36.75	44.58
10.2	7.16	14.47	21.74	29.95	37.74	45.80
10.3	7.27	14.20	22.35	30.09	38.09	45.61
10.4	7.37	15.27	22.95	30.91	38.38	46.88
10.5	7.47	15.68	23.58	31.00	39.44	48.19
10.6	7.57	15.40	22.76	31.13	39.80	47.97
10.7	7.77	15.08	23.38	31.99	40.10	49.33
10.8	7.25	15.49	24.03	32.07	41.24	49.87
10.9	8.19	16.67	24.66	33.77	42.34	51.23
11.0	8.41	16.33	25.36	33.86	42.67	51.80
11.1	7.85	16.79	25.22	33.95	42.99	
11.2	8.07	17.24	25.90	34.88		
11.3	8.28	16.86	25.75			
11.4	8.50	17.32				
11.5	8.73					

Calcium Bromide

TABLE 42. Calcium Bromide (CaBr₂) Density and Composition Table

Calcium Bromide Density and Composition Information						
Density	Spec Grav	Water	CaBr ₂	CaBr ₂	Br	TCT ¹
lb/gal	SG	bbbl	lb 95%	wt%	wt%	°F
11.6	1.393	0.860	186	36.3	29.0	-32
11.7	1.405	0.856	192	37.1	29.7	-36
11.8	1.417	0.852	198	37.9	30.3	-40
11.9	1.429	0.848	203	38.6	30.9	-45
12.0	1.441	0.844	209	39.3	31.4	-50
12.1	1.453	0.840	214	40.1	32.1	-55
12.2	1.465	0.836	220	40.8	32.6	-61
12.3	1.477	0.832	226	41.5	33.2	-67
12.4	1.489	0.828	231	42.2	33.7	-73
12.5	1.501	0.824	237	42.8	34.2	-80
12.6	1.513	0.820	242	43.5	34.8	-88
12.7	1.525	0.816	248	44.2	35.3	-92
12.8	1.537	0.811	254	44.8	35.8	-96
12.9	1.549	0.807	259	45.5	36.4	-87
13.0	1.561	0.803	265	46.1	36.9	-78
13.1	1.573	0.799	271	46.8	37.4	-70
13.2	1.585	0.794	277	47.4	37.9	-63
13.3	1.597	0.790	282	48.0	38.4	-53
13.4	1.609	0.786	288	48.6	38.9	-43
13.5	1.621	0.781	294	49.2	39.3	-39
13.6	1.633	0.777	299	49.8	39.8	-34
13.7	1.645	0.772	305	50.4	40.3	-27
13.8	1.657	0.768	311	51.0	40.8	-20
13.9	1.669	0.763	317	51.6	41.3	-13
14.0	1.681	0.758	323	52.1	41.7	-7
14.1	1.693	0.754	328	52.7	42.1	1
14.2	1.705	0.751	333	53.1	42.5	10
14.3	1.717	0.744	340	53.8	43.0	17
14.4	1.729	0.739	346	54.3	43.4	23
14.5	1.741	0.734	352	54.9	43.9	30
14.6	1.753	0.730	358	55.4	44.3	36
14.7	1.765	0.724	364	56.0	44.8	43
14.8	1.777	0.719	370	56.5	45.2	50
14.9	1.789	0.714	376	57.0	45.6	56
15.0	1.801	0.709	382	57.6	46.1	61
15.1	1.813	0.704	388	58.1	46.5	66

¹TCT values from Bridges 2000.

TABLE 43. Calcium Bromide (CaBr₂) Cutback Table (bbl/bbl)

Calcium Bromide Cutback Information										
Target Density	Starting Density									
lb/gal	13.3	13.4	13.5	13.6	13.7	13.8	13.9	14.0	14.1	14.2
11.6	0.660	0.647	0.635	0.622	0.610	0.599	0.588	0.577	0.567	0.559
11.7	0.680	0.667	0.654	0.641	0.629	0.617	0.606	0.595	0.584	0.576
11.8	0.700	0.686	0.673	0.660	0.647	0.635	0.623	0.612	0.601	0.592
11.9	0.720	0.705	0.692	0.678	0.665	0.653	0.641	0.630	0.618	0.609
12.0	0.740	0.725	0.711	0.697	0.684	0.671	0.659	0.647	0.636	0.626
12.1	0.759	0.744	0.730	0.716	0.702	0.689	0.676	0.664	0.653	0.643
12.2	0.779	0.764	0.749	0.734	0.721	0.707	0.694	0.682	0.670	0.660
12.3	0.799	0.783	0.768	0.753	0.739	0.725	0.712	0.699	0.687	0.676
12.4	0.819	0.803	0.787	0.772	0.757	0.743	0.729	0.716	0.704	0.693
12.5	0.839	0.822	0.806	0.791	0.776	0.761	0.747	0.734	0.721	0.710
12.6	0.859	0.842	0.825	0.809	0.794	0.779	0.765	0.751	0.738	0.727
12.7	0.879	0.861	0.845	0.828	0.813	0.797	0.783	0.769	0.755	0.744
12.8	0.899	0.881	0.864	0.847	0.831	0.816	0.801	0.786	0.773	0.761
12.9	0.919	0.901	0.884	0.866	0.850	0.834	0.819	0.804	0.790	0.778
13.0	0.939	0.921	0.903	0.885	0.869	0.852	0.837	0.822	0.807	0.795
13.1	0.960	0.941	0.922	0.904	0.887	0.871	0.855	0.839	0.825	0.812
13.2	0.980	0.960	0.942	0.924	0.906	0.889	0.873	0.857	0.842	0.829
13.3	1.000	0.980	0.961	0.943	0.925	0.907	0.891	0.875	0.859	0.846
13.4		1.000	0.981	0.962	0.943	0.926	0.909	0.892	0.877	0.864
13.5			1.000	0.981	0.962	0.944	0.927	0.910	0.894	0.881
13.6				1.000	0.981	0.963	0.945	0.928	0.912	0.898
13.7					1.000	0.981	0.963	0.946	0.929	0.915
13.8						1.000	0.982	0.964	0.947	0.933
13.9							1.000	0.982	0.965	0.950
14.0								1.000	0.982	0.968
14.1									1.000	0.985
14.2										1.000

TABLE 44. Calcium Bromide (95% CaBr₂) Weight Up Table (lb/bbl)

Calcium Bromide Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
11.6	6.50	13.06	19.68	26.36	33.10	39.92
11.7	6.53	13.12	19.77	26.48	33.26	40.11
11.8	6.56	13.18	19.86	26.61	33.42	40.30
11.9	6.59	13.24	19.96	26.74	33.58	40.50
12.0	6.62	13.31	20.05	26.87	33.75	40.69
12.1	6.65	13.37	20.15	27.00	33.91	41.09
12.2	6.68	13.43	20.25	27.13	34.27	41.49
12.3	6.72	13.50	20.35	27.45	34.63	41.89
12.4	6.75	13.56	20.64	27.78	35.01	42.31

TABLE 44. Calcium Bromide (95% CaBr₂) Weight Up Table (lb/bbl)

Calcium Bromide Weight Up Information						
Starting Density	Weight Up Increments					
lb/gal	0.1	0.2	0.3	0.4	0.5	0.6
12.5	6.78	13.82	20.93	28.12	35.38	42.73
12.6	7.00	14.08	21.23	28.46	35.77	43.15
12.7	7.04	14.16	21.35	28.62	35.96	43.39
12.8	7.08	14.23	21.46	28.77	36.16	43.63
12.9	7.12	14.31	21.58	28.93	36.35	43.86
13.0	7.15	14.38	21.69	29.08	36.55	44.32
13.1	7.19	14.46	21.81	29.24	36.97	44.79
13.2	7.23	14.54	21.93	29.62	37.40	45.27
13.3	7.27	14.62	22.27	30.00	37.83	45.75
13.4	7.31	14.91	22.61	30.39	38.27	46.25
13.5	7.56	15.21	22.96	30.79	38.72	46.75
13.6	7.61	15.31	23.10	30.98	38.96	45.16
13.7	7.65	15.40	23.23	31.17	37.33	47.56
13.8	7.70	15.49	23.38	29.50	39.68	48.10
13.9	7.74	15.58	21.67	31.79	40.16	48.65
14.0	7.79	13.84	23.90	32.22	40.66	49.21
14.1	6.01	16.01	24.28	32.67	41.17	50.03
14.2	9.96	18.22	26.58	35.05	43.88	52.85
14.3	8.17	16.45	24.84	33.60	42.48	51.48
14.4	8.23	16.56	25.26	34.08	43.03	52.11
14.5	8.28	16.92	25.68	34.57	43.59	52.74
14.6	8.58	17.29	26.12	35.08	44.16	
14.7	8.64	17.41	26.31	35.33		
14.8	8.71	17.54	26.50			
14.9	8.77	17.67				
15.0	8.83					

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