SECTION I — USEFUL INFORMATION

MAXIMUM TOTAL HEAD is the maximum pressure that can be developed by the pump. This is always given in feet of head rather than in pounds. The pump selected must have a maximum total head greater than the sum of the PUMPING LEVEL and the TOTAL DISCHARGE HEAD. (Shown in illustration as Total Head.)

When figuring PUMPING LEVEL the following conditions must be considered:

STANDING WATER LEVEL is the distance from the top of the well to the top of the water when the pump is not operating.

DRAWDOWN is the distance the water level drops below the standing water level while pump is operating.

ELEVATION is the distance between the ground level at the pump and the ground level at the top of the well. There is no elevation when the pump is installed right at the well.

SUBMERGENCE is the distance the injector, submersible pump, or foot valve is installed below the pumping level.

HORIZONTAL PIPE RUN is the distance the jet or piston pump is installed away from well. (See Friction Loss.)

When figuring TOTAL DISCHARGE HEAD the following conditions must be considered —

SERVICE PRESSURE is the pressure in pounds at the point of use. (Service pressure can be converted to feet by multiplying by 2.31.)

FRICTION LOSS is the loss of pressure due to friction of water flowing through pipe and fittings. If pump is installed some distance from the well this friction loss can be overcome by increasing the pipe size. (See page 5.)

When properly selected each pump or water system will give years of dependable satisfactory service. Never underestimate the requirements of the job. A pump a little too large will always do the job properly. A pump a little too small will either have to be replaced or will prove unsatisfactory to the owner.

PRACTICAL SUCTION LIFTS AT VARIOUS ELEVATIONS

ELEVATION	Barometer Reading Lbs. Per Sq. In.	Theoretical Suction Lift Feet	Practical Suction Lift Feet	Vacuum Gauge* Inches
At Sea Level	14.7	34.0	22	19.5
¼ mile — 1,320 feet — above sea level	14.0	32.4	21	18.6
½ mile — 2,640 feet — above sea level	13.3	30.8	20	17.7
¾ mile — 3,960 feet — above sea level	12.7	29.2	18	15.9
1 mile — 5,280 feet — above sea level	12.0	27.8	17	15.0
1¼ mile — 6,600 feet — above sea level	11.4	26.4	16	14.2
1½ mile — 7,920 feet — above sea level	10.9	25.1	15	13.3
2 miles — 10,560 feet — above sea level	9.9	22.8	14	12.4

NOTE: Multiply barometer in inches by .491 to obtan lbs. per sq. in.
*Vacuum gauge readings in inches correspond to practical suction lift in feet only when pump is stopped. Pipe friction increases vacuum gauge readings when pump is running. For quiet operation, vacuum gauge should never register more than 20 inches when pump is running. Based on a water temperature of 65°F. (18.33°C)

PRACTICAL SUCTION LIFTS AT VARIOUS WATER TEMPERATURES AND ELEVATIONS IN DEGREES FAHRENHEIT

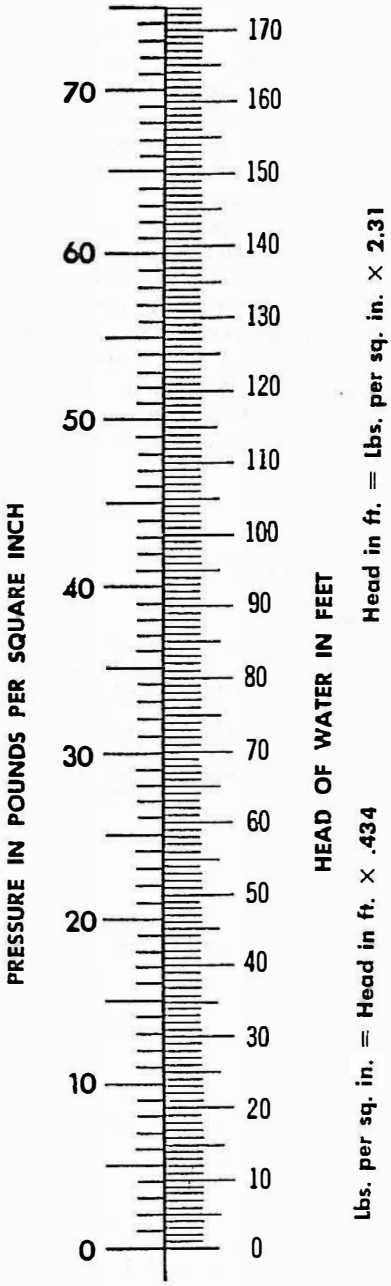
Altitude	120	130	140	150	160	170	180	190	200	210
Sea Level	—10	—7	—5	—2	0	+ 3	+ 5	+ 7	+10	+12
2,000	— 7	—5	—2	+1	+ 3	+ 5	+ 7	+10	+12	+15
4,000	— 5	—2	+1	+3	+ 5	+ 7	+10	+12	+14	
6,000	0	+1	+3	+5	+ 7	+10	+12	+14	+16	
8,000	0	+3	+5	+7	+ 9	+12	+14	+16		
10,000	+ 2	+4	+7	+9	+11	+14	+16	+18		

This table gives the maximum permissible lift or the minimum head permitted on the suction side of a pump at various altitudes and liquid temperatures. A minus sign before a number indicates suction lift. A plus sign before a number indicates minimum head. These figures are to be used as a guide and are not guaranteed.

When pumping volatile liquids such as gasoline and naptha, special consideration must be given to the amount of suction lift and the size of the suction pipe used. On such liquids the suction lift, whether it is actual vertical lift or is caused by pipe line friction, must be kept as low as possible, and should never exceed 12 feet.

For liquids such as lube oil, molasses, etc., a suction lift up to 24 feet, at sea level, is usually satisfactory.

SECTION I — USEFUL INFORMATION



VOLUME

1 U.S. gallon = 231 cu. in.

1 U.S. gallon = 3.785 liters

1 Imperial gallon = 1.2 U.S. gallons

1 barrel (oil) = 42 U.S. gallons

1 cubic foot = 7.48 U.S. gallons

1 acre foot = 325,850 U.S. gallons

1 cubic meter = 264.2 U.S. gallons

CAPACITY

1 Cubic Foot Per Second ... 449 g.p.m.

1 Acre Foot Per Day ..... 227 g.p.m.

1 Acre Inch Per Hour ..... 454 g.p.m.

1 Cubic Meter Per Minute .. 264.2 g.p.m.

1,000,000 gal. per day ..... 595 g.p.m.

WEIGHT

1 U.S. gallon water weighs 8.35 lbs.

1 cubic foot water weighs 62.4 lbs.

LENGTH

1 Inch ..... 2.54 centimeters

1 Meter ..... 39.37 inches

1 Rod ..... 16.5 feet

1 Mile ..... 5280 ft. (1.61 kilometers)

HEAD

1 lb. per sq. in. = 2.31 ft. of water

1 foot of water = 0.433 lbs. per sq. in.

1 inch of mercury = 1.133 ft. of water

1 atmosphere (sea level)
= 14.7 lbs. per sq. in.

1 kilopascal (KPa) = .145 lbs. per sq. in.

1 PSI = 6.895 KPa

TO FIND CAPACITY OF A TANK OR A CISTERN:

Diameter of Tank in Feet Squared X .7854 X Height of Tank in Feet X 7.48 = Capacity in U.S. Gallons

HORSEPOWER

1 H.P. Equals . . .
.746 kilowatts or 746 watts
33,000 ft. lbs. per minute
550 ft. lbs. per second

WATER HORSEPOWER

$$= \frac{\text{GPM X 8.33 X Head}}{33{,}000} = \frac{\text{GPM X Head}}{3960}$$

GPM = Gallon per Minute
8.33 = Pounds of Water per Gallon
33,000 = Ft.-lb. per Minute in one HP

LABORATORY BHP

$$= \frac{\text{Head X GPM X Sp. Gr.}}{3960 \text{ X Eff.}}$$

GPM = Gallon per Minute
Head = Laboratory Head
(inc. column loss)
Eff. = Pump Only Efficiency

MOTOR INPUT HP

$$= \frac{\text{Laboratory BHP}}{\text{Motor Eff.}}$$

Total BHP from above
Motor Eff. from Manufacturer

UNIT EFFICIENCY

$$= \frac{\text{Water Horsepower}}{\text{Motor Input Horsepower}}$$

Water Horsepower from above
Input Horsepower from above

ELECTRIC POWER

AC = Alternating current power

DC = Direct current

E = Volts = Electrical pressure
(similar to head)

I = Amperes = Electrical current
(similar to rate of flow)

W = Watts = Electrical power
(similar to head capacity)

KW = Kilowatts = 1000 watts

Apparent Power = Volts X amperes
= Voltamperes

Apparent Power = EI

Useful Power W = EI X P.F.

Power factor = ratio of useful power to apparent power

Power factor = PF = $\frac{W}{EI}$

KW Hr. = Kilowatt hour

Single phoase power W = E X I X PF

3 Phase Power W = 1.73 X 1 X PF

Where
E = Average voltage between phases
I = Average current in each phase

100 boiler H.P. requires 7 G.P.M. feed water approximately.

SECTION I — USEFUL INFORMATION

METRIC SYSTEM
SI UNIT PREFIXES

AMOUNT	MULTIPLES AND SUBMULTIPLES	PREFIXES	SYMOLS	MEANS
1 000 000 000 000	10^{12}	tera	T	One trillion times
1 000 000 000	10^{9}	giga	G	One billion times
1 000 000	10^{6}	mega	M*	One million times
1 000	10^{3}	kilo	k*	One thousand times
100	10^{2}	hecto	h	One hundred times
10	10	deka (deca)	da	Ten times
Base Unit 1	10^{0}			
0.1	10^{-1}	deci	d	One tenth of
0.01	10^{-2}	centi	c*	One hundredth of
0.001	10^{-3}	milli	m*	One thousandth of
0.000 001	10^{-6}	micro	u*	One millionth of
0.000 000 001	10^{-9}	nano	n	One billionth of
0.000 000 000 001	10^{-12}	pico	p	One trillionth of
0.000 000 000 000 001	10^{-15}	femto	f	One quadrillionth of
0.000 000 000 000 000 001	10^{-18}	atto	a	One quintillionth of

*Most commonly used

WHEN YOU KNOW		YOU CAN FIND		IF YOU MULTIPLY BY
Length				
Inches	(in)	Millimeters	(mm)	25.4
Inches	(in)	Centimeters	(cm)	2.539 3
Feet	(ft)	Meters	(m)	0.304 8
Yards	(yd)	Meters	(m)	0.914 4
Miles (statute)	(mi)	Kilometers	(km)	1.609 344
Millimeters	(mm)	Inches	(in)	0.039 370 1
Meters	(m)	Feet	(ft)	3.280 840
Centimeters	(cm)	Inches	(in)	0.393 7
Meters	(m)	Yards	(yd)	1.093 61
Kilometers	(km)	Miles (statute)	(mi)	0.621 371 2
Area				
Square Inches	(in^2)	Square Centimeters	(cm^2)	6.451 6
Square Feet	(ft^2)	Square Meters	(m^2)	0.092 903 04
Square Yards	(yd^2)	Square Meters	(m^2)	0.836 127
Square Miles	(mi^2)	Square Kilometers	(km^2)	2.589 9
Acres		Hectares	(ha)	0.404 685 6
Square Centimeters	(cm^2)	Square Inches	(in^2)	0.155 000 3
Square Meters	(m^2)	Square Feet	(ft^2)	10.763 91
Square Meters	(m^2)	Square Yards	(yd^2)	1.195 99
Square Kilometers	(km^2)	Square Miles	(mi^2)	0.386 1
Hecares	(ha)	Acres		2.471 054
Liquid Volume				
Ounces	(oz)	Milliliters	(ml)	29.574
Pints	(pt)	Liters	(l)	0.473 2
quarts	(qt)	Liters	(l)	0.946 3
Gallons	(gal)	Liters	(l)	3.785 412
Lb/$Foot^3$	(lb/ft^3)	Kilogram/$Meter^3$	(kg/m^3)	16.018 46
Lb/Gal	(lb/gal)	Kilogram/$Meter^3$	(kg/m^3)	119.826 4
Milliliters	(ml)	Ounces	(oz)	0.033 818
Liters	(l)	Pints	(pt)	2.113 271 3
Liters	(l)	Quarts	(qt)	1.056 747 3
Liters	(l)	Gallons	(gal)	0.264 172 0
Kilogram/$Meter^3$	(kg/m^3)	Lb/$Foot^3$	(lb/ft^3)	0.062 427 97
Kilogram/$Meter^3$	(kg/m^3)	Lb/Gal	(lb/gal)	0.008 345 4
Mass				
Ounces	(oz)	Grams	(g)	28.349 52
Pounds	(lb)	Kilograms	(kg)	0.453 592 4
Grams	(g)	Ounces	(oz)	0.035 275 97
Kilograms	(kg)	Pounds	(lb)	2.204 622

SECTION I — USEFUL INFORMATION

WHEN YOU KNOW		YOU CAN FIND		IF YOU MULTIPLY BY
Force				
Foot Pound Force	(ft-lbf)	Joule	(J)	1.355 818
Newtons	(N)	Kilogram Force	(kgf)	0.101 971 6
Joule	(J)	Foot Pound Force	(ft-lbf)	0.737 562 1
Kilogram Force	(kgf)	Newtons	(N)	9.806 650
Power				
Horsepower	(hp)	Kilowatt	(kW)	0.745 699 9
Horsepower	(hp)	Watt	(W)	745.699 99
Kilowatt	(kW)	Horsepower	(hp)	1.341 022
Watt	(W)	Horsepower	(hp)	0.001 341 022
Pressure				
Lb/Inch²	(lb/in²)	Kilograms/meter²	(kg/m²)	703.069 7
Lb/Inch²	(lb/in²)	Kilopascal	(kPa)	6.894 7
Lb/Inch²	(lb/in²)	Meters of Water	(m)	0.704 089
Inches of Mercury	(inHg)	Kilograms/meter	(kg/m²)	345.3
Kilograms/meter²	(kg/m²)	Lb/inch²	(lb/in²)	0.001 422 3
Kilopascal	(kPa)	Lb/inch²	(lb/in)	0.145 038 9
Meters of Water	(m)	Lb/inch²	(lb/in²)	1.420 274
Kilograms/meter²	(kg/m²)	Inches of Mercury	(inHg)	0.002 896
1 Atmosphere	14.7 lb/in²	Kilograms/Centimeter²	(kg/cm²)	1.033
1 Atmosphere	14.7 lb/in²	Kilograms/Meter²	(kg/m²)	10 335.0
1 Atmosphere	14.7 lb/in²	Kilopascal	(kPa)	101.35
1 Atmosphere	14.7 lb/in²	76.0 Centimeters Mercury	(cmHg)	5.17
1 Atmosphere	29.92 inHg	76.0 Centimeters Mercury	(cmHg)	2.54
Pascal	(Pa)	Newton/meter²	(N/m²)	1.0
Pascal	(Pa)	Kilogram Per Meter²	(kg/m²)	0.101 971 6
Temperature				
Degrees Fahrenheit	(°F)	Degrees Celsius	(°C)	(°F-32) 0.555 555
Degrees Celsius	(°C)	Degrees Fahrenheit	(°F)	(1.8 x °C) + 32
Velocity & Flow				
Feet Per Second	(fps)	Meter Per Second	(m/s)	0.304 8
Mile Per Hour	(mph)	Kilometer Per Hour	(km/h)	1.609 344
Gallons Per Minute	(gpm)	Liter Per Minute	(l/min)	3.785 412
Gallons Per Minute	(gpm)	Cubic Meter Per Minute	(m³/min)	0.003 785 412
Meter Per Second	(m/s)	Feet Per Second	(fps)	3.280 840
Kilometer Per Hour	(km/h)	Mile Per Hour	(mph)	0.621 371 2
Liter Per Minute	(l/m)	Gallons Per Minute	(gpm)	0.264 172
Cubic Meter Per Minute	(m³/min)	Gallons Per Minute	(gpm)	264.172 0

Electrical terms: Amperes, Watts, Kilowatts, Volts and Ohms are the same in Metric.

SECTION I — USEFUL INFORMATION

FRICTION LOSSES IN PLASTIC PIPE; C = 140

TABLE 1
1 Inch

1.049" inside dia.

FLOW U.S. gal. per min.	Velocity ft. per sec.	Velocity head ft.	Head loss ft. per 100 ft.
2	.74	.01	.31
3	1.11	.02	.67
4	1.49	.03	1.16
5	1.86	.05	1.74
6	2.23	.08	2.43
8	2.97	.14	4.15
10	3.71	.21	6.3
12	4.46	.31	8.8
14	5.20	.42	11.7
16	5.94	.55	15.0
18	6.68	.68	18.6
20	7.43	.86	22.5
22	8.17	1.04	27.0
24	8.91	1.23	31.5
26	9.66	1.45	36.5
28	10.4	1.7	42
30	11.1	1.9	48
35	13.0	2.6	64
40	14.9	3.5	81
45	16.7	4.3	101

TABLE 2
1¼ Inch

1.380" inside dia.

FLOW U.S. gal. per min.	Velocity ft. per sec.	Velocity head ft.	Head loss ft. per 100 ft.
4	.86	.01	.30
5	1.07	.02	.46
6	1.29	.03	.64
7	1.50	.04	.86
8	1.72	.05	1.10
10	2.15	.07	1.65
12	2.57	.10	2.31
14	3.00	.14	3.06
16	3.43	.18	3.95
18	3.86	.23	4.90
20	4.29	.29	5.9
25	5.36	.45	9.1
30	6.43	.64	12.6
35	7.51	.88	16.4
40	8.58	1.14	21.4
50	1.07	1.8	32.3
60	12.9	2.6	45.1
70	15.0	3.5	61
80	17.2	4.6	77
90	19.3	5.8	96

TABLE 3
1½ Inch

1.610" inside dia.

FLOW U.S. gal. per min.	Velocity ft. per sec.	Velocity head ft.	Head loss ft. per 100 ft.
4	.63	.01	.14
5	.79	.01	.21
6	.95	.01	.31
7	1.10	.02	.41
8	1.26	.02	.51
9	1.42	.03	.64
10	1.58	.04	.78
12	1.89	.06	1.11
14	2.21	.08	1.45
16	2.52	.10	1.86
18	2.84	.13	2.31
20	3.15	.15	2.81
22	3.47	.19	3.35
24	3.78	.22	3.94
26	4.10	.26	4.50
28	4.41	.30	5.18
30	4.73	.35	5.95
32	5.04	.39	6.70
34	5.36	.45	7.5
36	5.67	.50	8.3
38	5.99	.56	9.2
40	6.30	.62	10.1
42	6.62	.68	11.2
44	6.93	.75	12.1
46	7.25	.82	13.2
48	7.57	.89	14.6
50	7.88	.97	15.3
55	8.67	1.17	18.3
60	9.46	1.39	21.5
65	10.2	1.60	25.0

TABLE 4
2 Inch

2.067" inside dia.

FLOW U.S. gal. per min.	Velocity ft. per sec.	Velocity head ft.	Head loss ft. per 100 ft.
5	.48	.00	.064
6	.57	.01	.091
7	.67	.01	.119
8	.77	.01	.152
9	.86	.01	.190
10	.96	.01	.231
12	1.15	.02	.322
14	1.34	.03	.430
16	1.53	.04	.55
18	1.72	.05	.69
20	1.91	.06	.83
22	2.10	.07	1.00
24	2.29	.08	1.17
26	2.49	.10	1.34
28	2.68	.11	1.55
30	2.87	.13	1.76
35	3.35	.17	2.35
40	3.82	.23	3.00
45	4.30	.29	3.75
50	4.78	.36	4.55
55	5.26	.43	5.50
60	5.74	.51	6.40
65	6.21	.60	7.35
70	6.69	.70	8.50
75	7.17	.80	9.10
80	7.65	.91	10.8
85	8.13	1.03	12.1
90	8.61	1.15	13.4
95	9.06	1.28	14.8
100	9.56	1.42	16.3

SECTION I — USEFUL INFORMATION

FRICTION LOSSES IN PLASTIC PIPE; C = 140

TABLE 5
3 Inch

3.068" inside dia.

FLOW U.S. gal. per min.	Velocity ft. per sec.	Velocity head ft.	Head loss ft. per 100 ft.
10	.43	.00	.034
15	.65	.01	.072
20	.87	.01	.122
25	1.09	.02	.186
30	1.30	.03	.257
35	1.52	.04	.342
40	1.74	.05	.440
45	1.95	.06	.550
50	2.17	.07	.665
55	2.39	.09	.790
60	2.60	.11	.940
65	2.82	.12	1.08
70	3.04	.14	1.24
75	3.25	.16	1.41
80	3.47	.19	1.58
85	3.69	.21	1.78
90	3.91	.24	1.96
95	4.12	.26	2.18
100	4.34	.29	2.40
110	4.77	.35	2.86
120	5.21	.42	3.36
130	5.64	.49	3.91
140	6.08	.57	4.56
150	6.51	.66	5.10
160	6.94	.75	5.76
180	7.81	.95	7.10
200	8.68	1.17	8.60
220	9.55	1.42	10.1
240	10.4	1.7	12.1
260	11.3	2.0	14.4
280	12.2	2.3	16.1
300	13.0	2.6	18.2
320	13.9	3.0	20.7
340	14.8	3.4	24.0
360	15.6	3.8	25.6
380	16.5	4.2	28.4
400	17.4	4.7	31.1
420	18.2	5.1	34.0
440	19.1	5.7	37.1
460	20.0	6.2	40.5
480	20.8	6.7	43.7
500	21.7	7.3	47.0
550	23.9	8.9	56.1
600	26.0	10.5	66.2
650	28.2	12.4	76.7

TABLE 6
4 Inch

4.026" inside dia.

FLOW U.S. gal. per min.	Velocity ft. per sec.	Velocity head ft.	Head loss ft. per 100 ft.
20	.50	.00	.033
30	.76	.01	.068
40	1.01	.02	.116
50	1.26	.03	.177
60	1.51	.04	.245
70	1.76	.05	.33
80	2.02	.06	.42
90	2.27	.08	.53
100	2.52	.10	.64
110	2.77	.12	.76
120	3.02	.14	.90
130	3.28	.17	1.02
140	3.53	.19	1.19
150	3.78	.22	1.34
160	4.03	.25	1.52
170	4.29	.29	1.71
180	4.54	.32	1.90
190	4.79	.36	2.09
200	5.05	.40	2.30
220	5.55	.48	2.75
240	6.05	.57	3.25
260	6.55	.67	3.72
280	7.06	.77	4.30
300	7.57	.89	4.85
320	8.07	1.01	5.50
340	8.50	1.14	6.20
360	9.08	1.28	6.80
380	9.59	1.43	7.60
400	10.1	1.6	8.30
420	10.6	1.7	9.10
440	11.1	1.9	9.4
460	11.6	2.1	10.8
480	12.1	2.3	11.7
500	12.6	2.5	12.4
550	13.9	3.0	15.0
600	15.1	3.5	17.6
650	16.4	4.2	20.4
700	17.6	4.8	23.5
750	18.9	5.6	26.6
800	20.2	6.3	30.0
850	21.4	7.1	33.5
900	22.7	8.0	37.2
950	24.0	9.0	41.2
1000	25.2	9.9	45.5
1100	27.7	11.9	55.0

SECTION I — USEFUL INFORMATION

FRICTION LOSS PER 100 FEET OF 17 YEAR OLD STEEL PIPE; C = 100

TABLE 7

FOR NEW PIPE MULTIPLY READINGS BY 0.6
FOR 25 YEAR OLD PIPE MULTIPLY READINGS BY 1.2

	1" Pipe Area = .8643			1¼" Pipe Area = 1.4957			1½" Pipe Area = 2.0358			2" Pipe Area = 3.3556			2½" Pipe Area = 4.7878			3" Pipe Area = 7.3927			4" Pipe Area = 12.7303			5" Pipe Area = 20.0059			6" Pipe Area = 28.8903		
U.S. GPM	Vel. Ft./ Sec.	Vel. Hd. Ft.	Head Loss Ft./ 100'	Vel. Ft./ Sec.	Vel. Hd. Ft.	Head Loss FL/ 100'	Vel. Ft./ Sec.	Vel. Hd. Ft.	Head Loss Ft./ 100'	Vel. Ft./ Sec.	Vel. Hd. Ft.	Head Loss Ft./ 100'	Vel. Ft./ Sec.	Vel. Hd. Fl.	Head Loss Ft./ 100'	Vel. Ft./ Sec.	Vel. Hd. Fl.	Head Loss Ft./ 100'	Vel. Ft./ Sec.	Vel. Hd. Ft.	Head Loss FL/ 100'	Vel. Ft./ Sec.	Vel. Hd. Ft.	Head Loss Ft./ 100'	Vel. Ft./ Sec.	Vel. Hd. Ft.	Head Loss Ft./ 100'
10	3.71	.21	11.7	2.15	.07	3.08	1.58	.04	1.45																		
15	5.57	.48	25.8	3.22	.16	6.6	2.37	.09	3.20																		
20	7.43	.86	42.1	4.29	.29	11.1	3.15	.15	5.24	1.91	.06	1.55															
25	9.28	1.3	65.0	5.36	.45	16.8	3.94	.24	7.88	2.39	.09	2.7															
30	11.1	1.9	89.2	6.43	.64	23.5	4.73	.35	11.1	2.87	.13	3.29	2.01	.06	1.39												
35	13.0	2.6	119	7.51	.88	31.2	5.52	.47	14.5	3.35	.17	4.37	2.35	.09	1.84												
40	14.9	3.5	152	8.58	1.14	40.0	6.30	.62	18.9	3.82	.23	5.60	2.68	.11	2.36												
45				9.66	1.45	49.5	7.10	.78	23.4	4.30	.29	6.96	3.02	.14	2.93												
50				10.7	1.8	60.4	7.88	.97	28.5	4.78	.36	8.46	3.35	.17	3.56	2.17	.07	1.24									
60				12.9	2.6	84.7	9.46	1.39	40.0	5.74	.51	11.9	4.02	.25	4.99	2.60	.11	1.74									
70				15.0	3.5	114	11.0	1.9	53.2	6.69	.70	15.8	4.69	.34	6.64	3.04	.14	2.31									
80				17.2	4.6	144	12.6	2.5	68.1	7.65	.91	20.2	5.36	.45	8.50	3.47	.19	2.96									
90							14.2	3.1	84.7	8.61	1.15	25.1	6.03	.57	10.6	3.91	.24	3.67	2.27	.08	.980						
100							15.8	3.9	103	9.56	1.42	30.5	6.70	.70	12.8	4.34	.29	4.47	2.52	.10	1.19						
110										10.5	1.7	36.4	7.37	.84	15	4.77	.35	5.33	2.77	.12	1.14						
120										11.5	2.1	42.7	8.04	1.00	18.0	5.21	.42	6.26	3.02	.14	1.67						
130										12.4	2.4	49.6	8.71	1.18	20.9	5.64	.49	7.26	3.28	.17	1.93						
140										13.4	2.8	56.9	9.38	1.37	23.9	6.08	.57	8.32	3.53	.19	2.22						
150										14.3	3.2	64.7	10.0	1.6	27.3	6.51	.66	9.48	3.78	.22	2.53						
160										15.3	3.6	72.8	10.7	1.8	30.7	6.94	.75	10.7	4.03	.25	2.84						
170										16.3	4.1	61.4	11.4	2.0	34.3	7.38	.85	11.9	4.29	.29	3.18						
180													12.1	2.3	38.1	7.81	.95	13.2	4.54	.32	3.53	2.88	.13	1.18			
190													12.7	2.5	42.1	8.25	1.06	14.6	4.79	.36	3.90	3.05	.14	1.30			
200													13.4	2.8	46.3	8.68	1.17	16.1	5.05	.40	4.29	3.20	.16	1.43			
220													14.7	3.4	55.3	9.55	1.42	19.2	5.55	.48	5.12	3.52	.20	1.70			
240													16.1	4.0	66.4	10.4	1.7	22.6	6.05	.57	6.01	3.85	.23	200			
260																11.3	2.0	26.2	6.55	.67	6.97	4.17	.27	2.32			
280																12.3	2.3	30.0	7.06	.77	8.00	4.49	.31	2.66	3.11	.15	1.09
300																13.0	2.6	34.1	7.57	.89	9.09	4.81	.36	3.03	3.33	.17	1.24
320																13.9	3.0	38.4	8.07	1.01	10.2	5.13	.41	3.41	3.56	.20	1.39
340																14.8	3.4	43.0	8.58	1.14	11.5	5.45	.46	3.81	3.78	.22	1.56
360																15.6	3.8	47.8	9.08	1.28	12.7	5.77	.52	4.24	4.00	.25	1.73
380																			9.59	1.43	14.1	6.09	.58	4.88	4.22	.28	1.92
400																			10.1	1.6	15.5	6.41	.64	5.15	4.44	.31	2.11
420																			10.6	1.7	16.9	6.73	.70	5.64	4.67	.34	2.31
440																			11.1	1.9	18.5	7.05	.77	6.14	4.69	.37	2.52
460																			11.6	2.1	20.0	7.38	.85	6.67	5.11	.41	2.74
480																			12.1	2.3	21.7	7.70	.92	7.22	5.33	.44	2.98
500																			12.6	2.5	23.4	8.02	1.00	7.79	5.56	.48	3.19
550																			13.9	3.0	27.9	8.82	1.21	9.28	6.11	.58	3.80
600																			15.1	3.5	32.8	9.62	1.49	10.9	6.66	.69	4.46
650																			16.4	4.2	38.0	10.4	1.7	12.6	7.22	.81	5.17
700																						11.2	1.9	14.5	7.78	.94	5.93
750																						12.0	2.2	16.5	8.34	1.08	6.74
800																						12.8	2.5	18.8	8.90	1.23	7.60
850																						13.6	2.9	20.8	9.45	1.39	8.50
900																						14.4	3.2	23.1	10.0	1.6	9.44
950																						15.2	3.6	25.5	10.5	1.7	10.2
1000																						16.0	4.0	28.1	11.1	1.9	11.5
1100																									12.2	2.3	13.7
1200																									13.3	2.7	16.1
1300																									14.4	3.2	18.6
1400																									15.6	3.8	21.4
1500																									16.7	4.3	24.3

BASED ON WILLIAMS & HAZEN FORMULA WITH CONSTANT C = 100

When Velocity Head Reading opposite Centrifugal Pump capacity and under Pipe Size of discharge piping on pump is 3 feet or more, increase discharge piping to next larger size.

SECTION I — USEFUL INFORMATION

TABLE 8

FRICTION LOSS CHART FOR OFF-SET PIPING TWIN LINES EJECTO PUMPS

EJECTO HP	Pipe sizes for Off-Set Lines in Inches (mm)						
	1-1¼ (25-32)	1¼-1¼ (32-32)	1¼-1½ (32-38)	1½-1½ (38-38)	1½-2 (38-51)	2-2 (51-51)	2½-3 (64-76)
	Friction Loss in Feet (m) per 100 Feet (30m) Off-Set						
⅓	12 (3.7)	8 (2.4)	6 (1.8)	4 (1.2)			
½	18 (5.5)	12 (3.7)	8 (2.4)	6 (1.8)	3 (.91)	2 (.60)	
¾	25 (7.6)	22 (6.7)	16 (4.9)	11 (3.4)	6 (1.8)	4 (1.2)	
1		30 (9.1)	25 (7.6)	16 (4.9)	9 (2.7)	6 (1.8)	
1½					13 (3.9)	8 (2.4)	
2					20 (6.1)	13 (3.9)	7 (2.1)

Consult Factory if Off-Set Lines Exceed 300 feet (91m)

TABLE 9

EQUIVALENT LENGTH IN FEET OF NEW STRAIGHT PIPE FOR VALVES AND FITTINGS FOR TURBULENT FLOW ONLY

FITTINGS			PIPE SIZE													
			¼	⅜	½	¾	1	1¼	1½	2	2½	3	4	5	6	7
REGULAR 90° ELL.	SCREWED	STEEL	2.3	3.1	3.6	4.4	5.2	6.6	7.4	8.5	9.3	11	13			
		C.I.										9.0	11			
	FLANGED	STEEL			.92	1.2	1.6	2.1	2.4	3.1	3.6	4.4	5.9	7.3	8.9	12
		C.I.										3.6	4.8		7.2	9.8
LONG RADIUS 90° ELL.	SCREWED	STEEL	1.5	2.0	2.2	2.3	2.7	3.2	3.4	3.6	3.6	4.0	4.6			
		C.I.										3.3	3.7			
	FLANGED	STEEL			1.1	1.3	1.6	2.0	2.3	2.7	2.9	3.4	4.2	5.0	5.7	7.0
		C.I.										2.8	3.4		4.7	5.7
REGULAR 45° ELL.	SCREWED	STEEL	.34	.52	.71	.92	1.3	1.7	2.1	2.7	3.2	4.0	5.5			
		C.I.										3.3	4.5			
	FLANGED	STEEL			.45	.59	.81	1.1	1.3	1.7	2.0	2.6	3.5	4.5	5.6	7.7
		C.I.										2.1	2.9		4.5	6.3
TEE-LINE FLOW	SCREWED	STEEL	.79	1.2	1.7	2.4	3.2	4.6	5.6	7.7	9.3	12	17			
		C.I.										9.9	14			
	FLANGED	STEEL			.69	.82	1.0	1.3	1.5	1.8	1.9	2.2	2.8	3.3	3.8	4.7
		C.I.										1.9	2.2		3.1	3.9
TEE-BRANCH FLOW	SCREWED	STEEL	2.4	3.5	4.2	5.3	6.6	8.7	9.9	12	13	17	21			
		C.I.										14	17			
	FLANGED	STEEL			2.0	2.6	3.3	4.4	5.2	6.6	7.5	9.4	12	15	18	24
		C.I.										7.7	10		15	20
180° RETURN BEND	SCREWED	STEEL	2.3	3.1	3.6	4.4	5.2	6.6	7.4	8.5	9.3	11	13			
		C.I.										9.0	11			
	REG. FLANGED	STEEL			.92	1.2	1.6	2.1	2.4	3.1	3.6	4.4	5.9	7.3	8.9	12
		C.I.										3.6	4.8		7.2	9.8
	LONG ROD FLANGED	STEEL			1.1	1.3	1.6	2.0	2.3	2.7	2.9	3.4	4.2	5.0	5.7	7.0
		C.I.										2.8	3.4		4.7	5.7
GLOBE VALVE	SCREWED	STEEL	21	22	22	24	29	37	42	54	62	79	110			
		C.I.										65	86			
	FLANGED	STEEL			38	40	45	54	59	70	77	94	120	150	190	260
		C.I.										77	99		150	210
GATE VALVE	SCREWED	STEEL	.32	.45	.56	.67	.84	1.1	1.2	1.5	1.7	1.9	2.5			
		C.I.										1.6	2.0			
	FLANGED	STEEL								2.6	2.7	2.8	2.9	3.1	3.2	3.2
		C.I.										2.3	2.4		2.6	2.7
ANGLE VALVE	SCREWED	STEEL	12.8	15	15	15	17	18	18	18	18	18	18			
		C.I.										15	15			
	FLANGED	STEEL			15	15	17	18	18	21	22	28	38	50	63	90
		C.I.										23	31		52	74
SWING CHECK VALVE	SCREWED	STEEL	7.2	7.3	8.0	8.8	11	13	15	19	22	27	38			
		C.I.										22	31			
	FLANGED	STEEL			3.8	5.3	7.2	10	12	17	21	27	38	50	63	90
		C.I.										22	31		52	74
FOOT VALVE	SCREWED	C.I.	7.2	7.3	8.0	8.8	11	13	15	19	22	27	38	50	63	90

Pipe Sizing Chart - Volume

Pipe Size (Diameter in inches)	Gallons per 100 ft (flooded)
½"	1.6
¾"	2.8
1"	4.5
1 ¼"	7.8
1 ½"	10.5
2"	17
3"	38
4"	66
8"	260
10"	410
12"	588
14"	716
16"	950
18"	1200
20"	1500
24"	2350
26"	2760