

Fluid Power Data Book

A collection of useful fluid power data, published in this condensed form for convenient reference. For expanded educational material on fluid power, see textbook listings on the last page of the booklet.



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Fluid Power Equivalents

Exact Equivalents

1 U.S. gallon:

- 231 cubic inches
- 4 quarts or 8 pints
- 128 ounces (Liquid)
- 133.37 ounces (weight)
- 8.3454 pounds
- 5.775 liters

1 Imperial gallon = 1.2 U.S. gallon

1 Liter = 0.2642 U.S. gallons

1 Cubic foot:

- 7.48 gallons
- 1728 cubic inches
- 62.4 pounds (water)

1 Cu. ft. water weighs 62.4 lbs.

1 Bar (average level):

- 14.504 PSI
- 0.98692 atmosphere
- 33.4 foot water column
- 41 feet oil column

Approx. 10 PSI decrease each 1000 feet of elevation.

1" Hg = 0.491 PSI

= 1.131 ft. water

1 Horsepower:

- 33,000 ft. lbs. per minute
- 550 ft. lbs. per second
- 42.4 BTU per minute
- 2545 BTU per hour
- 746 watts or 1.341 kw

1 PSI = 2.03307 Hg

= 27.71" water

= 0.0689 bar

1 Atmosphere:

- 1.013 bar
- 29.921" Hg
- 34.504 PSI
- 760 mm Hg

1 Foot water column = 0.433 PSI

1 Foot oil column = 0.344 PSI

1 Barrel oil = 42 gallons

1 Micro-meter (unit):

- 0.000001 meter (metric)
- 0.001 centimeter
- 0.00004 inch

20 Micron-meters = 0.001 inch

Approximate Equivalents

1 Foot = 2" approx. = 32 tablespoons =

60 teaspoons = 16 fl. oz. = 1 lb.

1 Quart = 4 cups = 2 pints =

32 fluid ounces = 2 pounds.

1 Gallon = 16 cups = 4 quarts = 8 pints =

128 fl. oz. = 271 cu. in.

1 Cup = 16 tablespoons = 48 tsp.

1 Tablespoon = 3 tsp. = 1/2 fluid oz.

1 Fluid oz. (volume) = 60 drops (std. oil).

1 Cubic inch = 250 drops (std.).

Fluid Power Abbreviations

abs	absolute (ps or psia)	rpm	revolutions per minute
AC	alternating current	rpm	revolutions per second
Alt	altitude (pressure number)	sq	square
Alt	altitude (thermal unit)	sq	maximum
C	degrees Centigrade (Celsius)	min	minimum
cc	cubic centimeter	mtl	mounted
cm	centimeter (distance)	nc	normally closed
cfm	cubic feet per minute	no	normally open
cfs	cubic feet per second	NPT	national pipe thread
cm	centimeter (distance)	NPTF	dryseal pipe threads
cm	centimeter (distance)	no	open center
cm	centimeter	or	orifice
cpm	cycles per minute	PCO	port opened
cpd	cycles per second	psa	pressure
cu. inch	cubic inches per revolution	PSI	pounds/square inch
cu.	cubic	psi	psi absolute
cy	cylinder	psi/g	psi/gauge
DC	direct current	psi	psi
dia	diameter	qt	quart
ext	external	r	radius
F	degrees Fahrenheit	r/s	rad (area) square
f	foot	rpm	revolutions per minute
fpm	feet per minute	rps	revolutions per second
ft	foot	scfm	standard cu. ft. per minute
ft-lb	foot pound	smf	smooth
gal	gallon	std	standard
gpm	gallons per minute	SSU	South universal universal
mg	milligram	SUS	South universal second
hp	horsepower	u	unions-unions or unions
hr	hour	T	torque
ID	inside diameter	vac	vacuum
in	inch	vis	viscosity index
in-lb	inch pound	visc	viscosity
int	internal		

Horsepower to Drive a Pump

Figures in the body of this table show the horsepower needed to drive a hydraulic pump having an efficiency of 85%. Most positive displacement pumps fall in the range of 85% to 90% efficiency, so this chart should be accurate to within 5% for nearly any pump. The table was calculated from the formula: $HP = (PSI \times GPM) \div (1714 \times 0.85)$. For pumps with other than 85% efficiency, this formula can be used, substituting actual efficiency in place of 0.85.

Using the Table ...

The range of 500 to 5000 PSI covers most hydraulic systems, but power requirements can be determined for conditions outside the table, or for intermediate values, by combining values in the table. For example, power at 4000 PSI will be exactly twice the figures shown for 2000 PSI. At 17 GPM, power will be the sum of the figures shown in the 7% and 2% GPM lines, etc.

For systems of less than 500 PSI, horsepower calculations tend to become inaccurate because mechanical friction losses reduce pump efficiency.

Rule-of-Thumb ...

Approximate power requirements can be figured with simple mental arithmetic, with the rule-of-thumb:

1 HP is required for each 1 GPM @ 1500 PSI

For example, a 1-GPM pump operating at 1500 PSI would need 1 HP, or at 3000 would need 2 HP. A 10-GPM pump at 1500 PSI would need 10 HP, or the same pump operating at 1000 PSI would need 10 HP, etc.

Another rule-of-thumb states that about 2% of the pump maximum rated horsepower is required to life that pump when it is "unloaded" and the oil is circulating at zero PSI. This amount of power is consumed in flow losses plus mechanical friction losses in bearings and pumping elements.

Figures in table are HP's required to drive a hydraulic pump

GPM	500 PSI	750 PSI	1000 PSI	1250 PSI	1500 PSI	1750 PSI	2000 PSI	2500 PSI	3000 PSI	3500 PSI	4000 PSI
10	0.113	0.217	0.320	0.423	0.526	0.630	0.800	1.068	1.336	1.604	1.872
1	0.240	0.315	0.390	0.465	0.540	0.615	0.820	1.073	1.326	1.579	1.832
1%	0.910	0.770	1.000	1.230	1.460	1.690	2.000	2.600	3.200	3.800	4.400
2	0.888	1.000	1.112	1.224	1.336	1.448	1.750	2.250	2.750	3.250	3.750
2%	0.888	1.29	1.72	2.14	2.57	3.00	3.43	4.29	5.15	6.01	6.88
3	1.00	1.34	1.69	2.03	2.37	2.71	3.05	4.12	5.19	6.26	7.33
3%	1.00	1.60	2.00	2.40	2.80	3.20	4.00	4.80	5.60	6.40	7.20
4	1.17	2.06	2.75	3.43	4.12	4.80	5.49	6.80	8.10	9.40	10.7
5	1.70	2.97	3.65	4.33	5.01	5.70	6.38	7.69	8.99	10.3	11.7
6	2.06	3.69	4.52	5.35	6.18	7.01	7.84	9.24	10.6	12.0	13.4
7	2.40	3.90	4.80	5.70	6.60	7.50	8.40	9.80	11.2	12.6	14.0
8	2.75	4.12	5.00	5.88	6.76	7.64	8.52	10.0	11.5	13.0	14.5
9	3.00	4.65	5.50	6.35	7.20	8.05	8.90	10.4	11.9	13.4	14.9
10	3.40	5.15	6.00	6.85	7.70	8.55	9.40	11.0	12.5	14.0	15.5
12	4.12	6.18	7.04	7.90	8.76	9.62	10.48	12.3	13.8	15.3	16.8
15	5.15	7.72	8.58	9.44	10.30	11.16	12.02	14.1	15.6	17.1	18.6
20	6.80	10.3	11.7	13.1	14.5	15.9	17.3	20.5	23.7	26.9	30.1
25	8.50	12.9	14.7	16.4	18.2	19.9	21.7	25.9	29.1	32.3	35.5
30	10.3	15.4	17.5	19.5	21.6	23.6	25.6	30.7	34.0	37.3	40.6
35	12.0	18.0	20.5	22.5	24.5	26.5	28.5	34.5	38.0	41.5	45.0
40	13.7	20.6	23.5	25.5	27.5	29.5	31.5	37.5	41.0	44.5	48.0
45	15.4	23.2	26.5	28.5	30.5	32.5	34.5	41.5	45.0	48.5	52.0
50	17.2	25.7	29.5	31.5	33.5	35.5	37.5	45.5	49.0	52.5	56.0
55	18.9	28.3	32.5	34.5	36.5	38.5	40.5	49.5	53.0	56.5	60.0
60	20.6	30.9	35.5	37.5	39.5	41.5	43.5	53.5	56.5	59.5	63.0
65	22.3	33.5	38.5	40.5	42.5	44.5	46.5	57.5	60.5	63.5	66.5
70	24.0	36.0	41.5	43.5	45.5	47.5	49.5	61.5	63.5	65.5	67.5
75	25.7	38.6	44.5	46.5	48.5	50.5	52.5	65.5	67.5	69.5	71.5
80	27.5	41.2	47.5	49.5	51.5	53.5	55.5	69.5	71.5	73.5	75.5
85	29.2	43.8	50.5	52.5	54.5	56.5	58.5	73.5	75.5	77.5	79.5
90	30.9	46.5	53.5	55.5	57.5	59.5	61.5	77.5	79.5	81.5	83.5
95	32.6	49.0	56.5	58.5	60.5	62.5	64.5	81.5	83.5	85.5	87.5
100	34.3	51.5	59.5	61.5	63.5	65.5	67.5	85.5	87.5	89.5	91.5