Conversion Table

Fluid Power Formulae

Torque and Horsepower Relations :

$T = HP \times 5252 / RPM$
$HP = T \times RPM / 552$
$RPM = HP \times 552 / T$
Torque values are in foot pounds

Hydraulic (fluid power) horsepower :

$HP = PSI \times GPM / 1714$
PSI is gauge pressure in pounds per square inch. GPM is oil flow in gallons per minute.

Charle's Law for behavior of gases :

$T_1 V_2 = T_2 V_1$ or $T_1 P_2 = T_2 P_1$

T_1, P_1 and V_1 initial temperature, pressure, and volume, and T_2, P_2 and V_2 are final conditions.

Boyle's law for behavior of gases :

$P_1 V_1 = P_2 V_2$

P_1 and V_1 are initial temperature, pressure, and volume, and, P_2 AND V_2 are final conditions.

Circle formulae

Area $= \pi r^2$, or $\pi D^2 / 4$

Circumference $= 2 \pi r$, or πD
r is radius, D is diameter, inches.

Heat equivalent of fluid power :

BTU per hour $= PSI \times GPM \times 1\text{-}1/2$

Hydraulic cyl.piston travel speed :

$S = CIM / A$
S is piston travel speed, inches per minute.
CIM is oil flow into cylinder, cubic inches per minute. A is piston area in square inches.

Thrust of force of any cylinder :

$T = A \times PSI$
T is thrust of force in pounds, A is piston net area in square inches. PSI is gauge pressure.

Force for piercing of shearing sheet metal :

$F = P \times T \times PSI$
F is the force required in pounds, P is the perimeter around area to be sheared, in inches. T is sheet thickness in inches. PSI is the shear strength rating of the material in pounds per square inch.

Pressure loss per foot of pipe

$$P = V \times Q / 18.300 D^4$$
P is pressure loss in PSI per foot of pipe length. V is SSU viscosity at operating temperature : Q is GPM flow, D is inside diameter of pipe, in inches.

Effective force of a cylinder working at an angle to direction of the load travel :

$F = T \times \sin A$
T is the total cylinder force. in pounds; F is the part of the force which is effective, in pounds; A is the least angle, in degrees, between cylinder axis and load direction.

Heat radiating capacity of a steel reservoir :

$HP = 0.001 \times A \times TD$
HP is the power radiating capacity expressed in horsepower; A is surface area, in square feet : TD is temperature difference in F between oil and surrounding.

Burst pressure of pipe or tubing :

$P = 2t \times S / O$
P is burst pressure in PSI , t is wall thickness in inches; S is tensile strength of material in PSI ; O is outside diameter, in inches.

Metric Prefixes and definitions :

Pico 10^{12}, nano 10^9, micro 10^6
mili 10^3, centil 10^2, kilo, mega 10^6, giga 10^9

Rules-of-Thumb

Horsepower for driving a pump :

For every 1 HP of drive, the equivalent of 1 GPM @ 1500 PSI can be produced.

Horsepower for idling a pump :

To idle a pump when it's unloaded will require about 5% of its full rated horsepower.

Compressibility of hydraulic oil :

Volume reduction is approximately 1/2% for every 1000 PSI of fluid pressure.

Wattage for heating hydraulic oil :

Each watt will raise the temperature of 1 gallon of oil by 1 F per hour.

Flow Velocity in hydraulic lines :

Pump suction lines 2 to 4 feet per second; pressure lines up to 500 to 3000 PSI, 15 to 20 ft/sec; pressure lines over 3000 PSI, 25ft/sec; all oil lines in air-over-oil system, 4ft/sec.

Vehicle speed :

Wheel RPM =

$$\frac{336.13 \times \text{miles per hour}}{\text{Wheel dia. (inches)}}$$

Hydraulic motor :

Torque (in lbs) =

$$\frac{\text{Displacement (CIPR)} \times \triangle P \text{ (PSI)}}{6.283}$$

Table of Equivalents

To convert units appearing in Column 1 (left column) into equivalent values in Column 2 (center column), multiply by factor in Column 3.

To convert units appearing in Column 2 (center column) into equivalent values of units in Column 1 (left column), divide by factor in Column 3.

Exemple : To convert 25 horsepower into BTU per minute, divide 25 by 0.02356 = 1061.

Column 1	Column 2	Column 3
Atmospheres	Feet of Water	33.9
Atmospheres	Inches of Mercury (Hg.)	29.92
Atmospheres	PSI (Lbs./Sq.In.)	14.7
BTU	Foot Lbs.	778.3
BTU/Hr.	Watts	0.2931
BTU/mIN.	Horsepower	0.02356
Celcius	Fahrenheit	C x 1.8 / 32
Centimeters	Inches	0.3937
Cubic Centimeters	Gallons (U.S. Liq)	0.0002642
Cubic Centimeters	Liters	0.001
Cubic Feet	Cubic Inches	1.728
Cubic Feet	Gallons (U.S. Liq)	7.48052
Cubic Inches	Cubic Feet	0.0005787
Cubic Inches	Gallons (U.S. Liq)	0.004329
Days	Seconds	86.4
Degrees (Angle)	Radians	0.01745
Feet	Meters	0.3048
Feet	Miles	0.0001894
Feet of Water	Atmospheres	0.0295
Feet of Water	Inches of Mercury (Hg.)	0.8826
Feet of Water	PSI (Lbs./Sq.In.)	0.4335
Feet/Min.	Miles/Hr.	0.01136
Feet/Sec.	Miles/Hr.	0.6818
Foot Lbs.	BTU	0.001286
Foot Lbs/Min.	Horsepower	0.0000303
Foot Lbs/Sec	Horsepower	0.001818
Gallons (U.S. Liq)	Cubis Feet	0.1337
Gallons (U.S. Liq)	Cubic Inches	231
Gallons of Water	Pounds of Water	8.3453
Horsepower	BTU/Min	42.44
Horsepower	Foot Lbs/Min.	33
Horsepower	Foot Lbs/Sec	550
Horsepower	Watts	745.7
Hours	Days	0.04167
Hours	Weeks	0.005952
Inches	Centimeters	2.54
Inches of Mercury (Hg.)	Atmospheres	0.03342
Inches of Mercury (Hg.)	Feet of Water	1.133
Inches of Mercury (Hg.)	PSI (Lbs./Sq.In.)	0.4912
Inches of Water	PSI (Lbs./Sq.In.)	0.03613
Liters	Cubic Centimeters	1
Liters	Gallons (U.S. Liq)	0.2642
Micron	Inches	0.00004
Miles (Statute)	Feet	5.28
Miles/Hr (MPH)	Feet/Min	88
Miles/Hr (MPH)	Feet/Sec.	1.467
Ounces (Weight)	Pounds	0.00625
Ounces (Fluid)	Cubic Inches	1.805
Pints (Fluid)	Quarts (Fluid)	0.5
Pounds	Grains	7
Pounds	Grams	453.5924
Pounds	Ounces	16
PSI (Lbs./Sq.In.)	Atmospheres	0.06804
PSI (Lbs./Sq.In.)	Feet of Water	2.307
PSI (Lbs./Sq.In.)	Inches of Mercury (Hg.)	2.036
PSI (Lbs./Sq.In.)	Kilopascals (kP)	6.894757
Quarts	Gallons	0.25
Square Feet	Square Inches	144
Temperature (F°) -32	Temperature (C°)	0.5555
Tons (Short)	Pounds	2
Watts	Horsepower	0.001341

Approximate equivalents

U.S 1 Pint = 2 cups = 32 tablespoons = 96 teaspoons = 16 fl. oz. = 1lb

U.S. 1 Quart = 4 cups = 2 pints = 32 fluid ounces = 2 pounds

U.S. 1 Gallon = 16 cups = 4 quarts = 8 pints = 128 fl. oz = 231 cu. ins.

1 cup = 16 tablespoons = 48 teaspoons

1 Tablespoon = 3 teaspoon = 1½2 fluid oz.

1 Fluid oz. (volume) = 600 drops hydraulic oil

1 Cubic inch = 330 drops (oil)

Fluid Power Equivalents

Exact equivalents

1 U.S. Gallon :
= 231 Cubic inches
= 4 Quarts of 8 pints
= 128 Ounces (liquid)
= 133.37 ounces (liquid)
= 8.3356 Pounds
3.785 Liters

1 Imperial gallon = 1.2 U.S gal.

1 Liter = 0.2642 U.S gallons

1 Cubic foot :
= 7.48 Gallons
= 1728 cubic inches
= 62.4 pounds (water)

1 Bar at sea level :
= 14.504 PSI
= 0.98692
= 33.6 foot water column
= 41 foot oil column

Approx. 1/2 PSI decrease each 1000 foot elevation.

1 hG = 0.490 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 of 0.746 kw

1 PSI = 2.0416 Hg
= 27.71 water
= 0.0689 bar

1 Atmosphere :
= 1.013 bars
= 29.921 Hg
= 14.696 PSI
= 760 mm Hg

1 foot water column = 0.433

1 Foot oil column = 0.377

1 Barrel oil = 42 gallons

Newton-metres to lb-ft
bar to psi
1 pm to gpm
kW to HP
mm to in.
Cubic centimeters to cubic inches
0.061

1 Micro-meter
= 1 millionth of a meter (micron)
= 0.000001 m
0.00004 inch

25 Micro-meters = 0.001 inch

Mult.
0.7353
14.5
0.2642
1.34
0.0394