Telephone: 1-251-653-6888
Toll Free: 1-800-329-6888

Fluid Power Transmission Conversion Factors

Length	
Inches to Millimeters	x 25.4
Millimeters to Inches	x 0.03937
Torque	
Foot-pounds to Newton-Meters	x 1.3558
Newton-Meters to Foot-pounds	x 0.73756
Foot-pounds to deca-Newton-Meters	x 0.13558
deca-Newton-Meters to Foot-pounds	x 7.3756
Foot-pounds to Kilogram-Meters	x 0.13828
Kilogram-Meters to Foot-pounds	x 7.233
Pressure	
PSI to BAR	x 0.06895
BAR to PSI	x 14.5038
PSI to Kg/cm2	x 0.07032
Kg/cm2 to PSI	x 14.216
BAR to daN/cm2	x 1.00
daN/cm2 to BAR	x 1.00
Weight	
Pounds to Kilograms	x 0.4536
Kilograms to Pounds	x 2.2046
Pounds to deca Newtons	x 0.4448
deca Newtons to Pounds	x 2.248
Pounds to Newtons	x 4.4482
Newtons to Pounds	x 0.2248
Displacement	
Cubic Inches to Cubic Centimeters	x 16.387
Cubic Centimeters to Cubic Inches	x 0.06102
Power	
Horsepower to Kilowatts	x 0.74571
Kilowatts to Horsepower	x 1.341
Flow	
GPM to liters/min	x 3.7848
Liters/min to GPM	x 0.2642
GPM to cm3/min	x 3784.8
cm3/min to GPM	x 0.00026
Liters to Gallons	x 0.2642

Fluid Power Formulas

Fluid Power Formulas

Torque and horsepower Relations:
$T = HP \times 5252 \div RPM$
$HP = T \times RPM \div 5252$
$RPM = HP \times 5252 \div T$
Torque values are in foot pounds.

Hydraulic (fluid power) horsepower:
$HP = PSI \times GPM \div 1714$
PSI is gauge pressure in pounds per square inch; GPM is oil flow in gallons per minute.

Velocity of oil flow in pipe:
$V = GPM \times 0.3208 \div A$
V is oil velocity in feet per second; GPM is flow in gallons per minute; A is inside area of pipe in square inches.

Charles' Law for behavior of gases:
$T_1V_2 = T_2V_1$, or $T_1P_2 = T_2P_1$
T_1, P_1, and V_1 are initial temperature, pressure, and volume, and T_2, P_2, and V_2 are final conditions.

Boyle's Law for behavior of gases:
$P_1V_1 = P_2V_2$
P_1 and V_1 are initial pressure and volume; P_2 and V_2 are final conditions.

Circle formulas:
Area $= \pi r^2$, or $\pi D^2 \div 4$
Circumference $= 2\pi r$, or πD
r is radius; D is diameter, inches.

Heat equivalent of fluid power:
BTU per hour = PSI × GPM × 1½

Hydraulic cyl. piston travel speed:
$S = CIM \div A$
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.

Force or thrust of any cylinder:
$F = A \times PSI$
F is force or thrust, in pounds; A is piston net area in square inches; PSI is gauge pressure.

Force for piercing or shearing sheet metal:
$F = P \times T \times PSI$
F is force required, in pounds; P is 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.

Side load on pump or motor shaft:
$F = (HP \times 63024) \div (RPM \times R)$
F is the side load, in pounds, against shaft; R is the pitch radius, in inches, of sheave on pump shaft; HP is driving power applied to shaft.

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 degrees F between oil and surrounding air.

Burst pressure of pipe or tubing:
$P = 2t \times S \div O$
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.

Relationship between displacement and torque of a hydraulic motor:
$T = D \times PSI \div 24\pi$
T is torque in foot-lbs.; D is displacement in cubic inches per revolution; PSI is pressure difference across motor; $\pi = 3.14$.

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 is 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.

Compressibility of water:
Volume reduction is about 1/3% for every 1000 PSI 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 PSI, 10 to 15 feet per sec; pressure lines 500 to 3000 PSI, 15 to 20 feet per sec.; pressure lines over 3000 PSI, 25 feet per sec.; all oil lines in air-over-oil system, 4 feet per sec.

Fluid Power Formulas
in SI Metric Units

Fluid power formulas in English units are shown in the left column. SI (International) unit equivalents of these formulas are shown in the right column.

English Units	*Metric (SI) Units*
Torque, HP, Speed Relations in Hydraulic Pumps & Motors	
$T = HP \times 5252 \div RPM$ $HP = T \times RPM \div 5252$ $RPM = HP \times 5252 \div T$	$T = Kw \times 9543 \div RPM$ $Kw = T \times RPM \div 9543$ $RPM = Kw \times 9543 \div T$
T = Torque, foot-lbs. RPM = Speed, revs/minute HP = Horsepower	T = Torque, Nm (Newton-meters) RPM = Speed, revs/minute Kw = Power in kilowatts
Hydraulic Power Flowing through the Pipes	
$HP = PSI \times GPM \div 1714$	$Kw = Bar \times dm^3/min \div 600$
HP = Horsepower PSI = Gauge pressure, lbs/sq. inch GPM = Flow, gallons per minute	Kw = Power in kilowatts Bar = System pressure dm^3/min = Flow, cu. dm/minute
Force Developed by an Air or Hydraulic Cylinder	
$F = A \times PSI$	$N = A \times Bar \times 10$
F = Force or thrust, lbs. A = Piston area, square inches PSI = Gauge pressure, lbs/sq. inch	N = Cylinder force in Newtons A = Piston area, sq. centimeters Bar = Gauge pressure
Travel Speed of a Hydraulic Cylinder Piston	
$S = V \div A$	$S = V \div A$
S = Travel Speed, inches/minute V = Volume of oil to cyl., cu. in/min. A = Piston area, square inches	S = Travel Speed, meters/sec. V = Oil flow, dm^3/minute A = Piston area, square centimeters
Barlow's Formula — Burst Pressure of Pipe & Tubing	
$P = 2t \times S \div O$	$P = 2t \times S \div O$
P = Burst pressure, PSI t = Pipe wall thickness, inches S = Tensile strength, pipe mat'l, PSI O = Outside diameter of pipe, inches	P = Burst pressure, Bar t = Pipe wall thickness, mm S = Tensile strength, pipe mat'l, Bar O = Outside diameter of pipe, mm
Velocity of Oil Flow in Hydraulic Lines	
$V = GPM \times 0.3208 \div A$	$V = dm^3/min \div 6A$
V = Velocity, feet per second GPM = Oil flow, gallons/minute A = Inside area of pipe, sq. inches	V = Oil velocity, meters/second dm^3/min = Oil flow, cu. dm/minute A = Inside area of pipe, sq. cm
Recommended Maximum Oil Velocity in Hydraulic Lines	
fps = feet per second	mps = Meters per second
Pump suction lines – 2 to 4 fps Pres. lines to 500 PSI – 10 to 15 fps Pres. lines to 3000 PSI – 15 to 20 fps Pres. lines over 3000 PSI – 25 fps Oil lines in air/oil system – 4 fps	Pump suction lines – 0.6 to 1.2 mps Pres. lines to 35 bar– 3 to 4½ mps Pres. lines to 200 bar– 4½ to 6 mps Pres. lines over 200 bar– 7½ mps Oil lines in air/oil system – 1¼ mps

Table of Equivalents

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. **Example:** To convert 7 gallons into cubic inches multiply 7 × 231 = 1617.

To convert units appearing in Column 2 (center) into equivalent values of units in Column 1 (left), divide by factor in Column 3. **Example:** To convert 25 horsepower into BTU per minute, divide 25 by 0.02356 = 1061.

To Convert... →	Into... →	Multiply By...
← Into...	← To Convert...	← Divide By...
Atmospheres	Feet of Water	33.9
Atmospheres	Inches of Mercury (Hg)	29.92
Atmospheres	PSI (Pounds per Sq. Inch)	14.7
BTU	Foot Pounds	778.3
BTU per Hour	Watts	0.2931
BTU per Minute	Horsepower	0.02356
Celsius (Centigrade)	Fahrenheit	°C × 1.8 + 32
Centimeters	Inches	0.3937
Cubic Centimeters	Gallons (U.S. Liquid)	0.0002642
Cubic Centimeters	Liters	0.001
Cubic Feet	Cubic Inches	1728
Cubic Feet	Gallons (U.S. Liquid)	7.48052
Cubic Inches	Cubic Feet	0.0005787
Cubic Inches	Gallons (U.S. Liquid)	0.004329
Days	Seconds	86,400
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 (Pounds per Sq. Inch)	0.4335
Feet per Minute	Miles per Hour	0.01136
Feet per Second	Miles per Hour	0.6818
Foot-Pounds	BTU	0.001286
Foot-Pounds per Minute	Horsepower	0.0000303
Foot-Pounds per Second	Horsepower	0.001818
Gallons (U.S. Liquid)	Cubic Feet	0.1337
Gallons (U.S. Liquid)	Cubic Inches	231
Gallons of Water	Pounds of Water	8.3453
Horsepower	BTU per Minute	42.44
Horsepower	Foot-Pounds per Minute	33,000
Horsepower	Foot-Pounds per Second	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 (Pounds per Sq. Inch)	0.4912
Inches of Water	PSI (Pounds per Sq. Inch)	0.03613
Liters	Cubic Centimeters	1000
Liters	Gallons (U.S. Liquid)	0.2642
Micron	Inches	0.00004
Miles (Statute)	Feet	5280
Miles per Hour (M.P.H.)	Feet per Minute	88
Miles per Hour	Feet per Second	1.467
Ounces (Weight)	Pounds	0.0625
Ounces (Liquid)	Cubic Inches	1.805
Pints (Liquid)	Quarts (Liquid)	0.5
Pounds	Grains	7000
Pounds	Grams	453.59
Pounds	Ounces	16
PSI (Pounds per Sq. Inch)	Atmospheres	0.06804
PSI (Pounds per Sq. Inch)	Feet of Water	2.307
PSI (Lbs per Square Inch)	Inches of Mercury (Hg)	2.036
Quarts	Gallons	0.25
Square Feet	Square Inches	144
Temperature (°F - 32)	Temperature (°C)	0.5555
Tons (U.S.)	Pounds	2000
Watts	Horsepower	0.001341

Pneumatic Cylinder Force

Pneumatic Cylinder Force

Extension and Retraction – 60 to 130 PSI Pressure Range

Cylinder forces are shown in pounds for both extension and retraction. Lines in **bold type** show extension forces, using the full piston area. Lines in ***italic type*** show retraction forces with various size piston rods. Remember that force values are *theoretical*, derived by calculation.

Pressures along the top of the chart do not represent air supply pressure; they are differential pressures across the two cylinder ports. In practice, the air supply line must supply another 5% of pressure to make up for cylinder loss, and must supply an estimated 25 to 50% additional pressure to make up for flow losses in lines and valving so the cylinder will have sufficient travel speed.

For good design and highest circuit efficiency, open the cylinder speed control valves as wide as practical and reduce the pressure regulator setting to as low a pressure as will give satisfactory cylinder force and speed.

For pressures not shown, use the effective areas in the third column as power factors. Multiply effective area times differential pressure to obtain theoretical cylinder force.

Piston Dia., In.	Rod Dia., In.	Effec. Area, Sq. In.	60 PSI	70 PSI	80 PSI	90 PSI	100 PSI	110 PSI	120 PSI	130 PSI
1½	None	1.77	106	124	142	159	177	195	212	230
	5/8	*1.46*	*88*	*102*	*117*	*132*	*146*	*161*	*176*	*190*
	1	*.985*	*59*	*69*	*79*	*89*	*98*	*108*	*118*	*128*
1¾	None	2.41	144	168	192	216	241	265	289	313
	5/8	*2.10*	*126*	*147*	*168*	*189*	*210*	*231*	*252*	*273*
	1¼	*1.18*	*71*	*83*	*95*	*106*	*118*	*130*	*142*	*154*
2	None	3.14	188	220	251	283	314	345	377	408
	5/8	*2.83*	*170*	*198*	*227*	*255*	*283*	*312*	*340*	*368*
	1	*2.35*	*141*	*165*	*188*	*212*	*235*	*259*	*283*	*306*
2½	None	4.91	295	344	393	442	491	540	589	638
	5/8	*4.60*	*276*	*322*	*368*	*414*	*460*	*506*	*552*	*598*
	1	*4.12*	*247*	*289*	*330*	*371*	*412*	*454*	*495*	*536*
	1⅜	*3.43*	*206*	*240*	*274*	*308*	*343*	*377*	*411*	*445*
3	None	7.07	424	495	565	636	707	778	848	919
	1	*6.28*	*377*	*440*	*503*	*565*	*628*	*691*	*754*	*817*
	1¾	*4.66*	*280*	*326*	*373*	*420*	*466*	*513*	*560*	*606*
3¼	None	8.30	498	581	664	747	830	913	996	1079
	1	*7.51*	*451*	*526*	*601*	*676*	*751*	*827*	*902*	*977*
	1⅜	*6.82*	*409*	*477*	*545*	*613*	*681*	*750*	*818*	*886*
	1¾	*5.89*	*354*	*413*	*472*	*531*	*589*	*648*	*707*	*766*
3½	None	9.62	577	674	770	866	962	1058	1155	1251
	1	*8.84*	*530*	*618*	*707*	*795*	*884*	*972*	*1060*	*1149*
4	None	12.57	754	880	1006	1131	1257	1382	1508	1634
	1	*11.78*	*707*	*825*	*943*	*1061*	*1178*	*1296*	*1415*	*1532*
	1⅜	*11.09*	*665*	*776*	*887*	*998*	*1109*	*1219*	*1330*	*1441*
	1½	*10.16*	*610*	*712*	*813*	*915*	*1016*	*1118*	*1220*	*1321*
5	None	19.64	1178	1375	1571	1768	1964	2160	2357	2553
	1	*18.85*	*1131*	*1320*	*1508*	*1697*	*1885*	*2074*	*2263*	*2451*
	1⅜	*18.16*	*1089*	*1271*	*1452*	*1634*	*1816*	*1997*	*2179*	*2360*
6	None	28.27	1696	1979	2262	2544	2827	3110	3392	3675
	1⅜	*26.79*	*1607*	*1875*	*2143*	*2411*	*2679*	*2946*	*3214*	*3482*
	1¾	*25.90*	*1552*	*1811*	*2069*	*2328*	*2586*	*2845*	*3104*	*3362*
7	None	38.49	2309	2694	3079	3464	3849	4234	4619	5004
	1⅜	*37.01*	*2220*	*2590*	*2960*	*3331*	*3701*	*4071*	*4441*	*4811*
8	None	50.27	3016	3519	4022	4524	5027	5530	6032	6535
	1⅜	*48.79*	*2927*	*3415*	*3903*	*4391*	*4879*	*5366*	*5854*	*6342*
	1¾	*47.90*	*2872*	*3351*	*3829*	*4308*	*4786*	*5265*	*5744*	*6222*
10	None	78.54	4712	5498	6283	7069	7854	8639	9425	10210
	1¾	*76.14*	*4568*	*5329*	*6091*	*6852*	*7614*	*8375*	*9136*	*9898*
	2	*75.40*	*4524*	*5278*	*6032*	*6786*	*7540*	*8294*	*9048*	*9802*
12	None	113.1	6786	7917	9048	10179	11310	12441	13572	14703
	2	*110.0*	*6598*	*7697*	*8797*	*9896*	*10996*	*12095*	*13195*	*14295*
	2½	*108.2*	*6491*	*7573*	*8655*	*9737*	*10819*	*11901*	*12983*	*14075*
14	None	153.9	9234	10773	12312	13851	15390	16929	18468	20007
	2½	*149.0*	*8939*	*10429*	*11919*	*13409*	*14899*	*16389*	*17879*	*19369*
	3	*146.8*	*8810*	*10278*	*11747*	*13215*	*14683*	*16151*	*17620*	*19088*

Hydraulic Cylinder Force

Hydraulic Cylinder Force

Low Pressure Range – 500 to 1500 PSI – 1½" to 14" Bores

Cylinder forces, both extension and retraction, are shown in pounds. The chart on this page covers cylinder operation in the pressure range of 500 to 1500 PSI, and the chart on the next page covers the 2000 to 5000 PSI range. Lines in **bold type** show extension force, using the full piston area. Lines in *italic type* show retraction force with various size piston rods.

Remember that force values are theoretical, derived by calculation. Experience has shown that probably 5%, but certainly no more than 10% additional pressure will be required to make up cylinder losses.

For pressures not shown, the effective piston areas in the third column can be used as power factors. Multiply effective area times (continued on page 16)

Bore Dia., In.	Rod Dia., In.	Effec. Area, Sq. In.	Pressure Differential Across Cylinder Ports 500 PSI	750 PSI	1000 PSI	1250 PSI	1500 PSI
1½	None*	1.7672	884	1325	1767	2209	2651
	⅝	*1.4604*	*730*	*1095*	*1460*	*1826*	*2191*
	1	*0.9818*	*491*	*736*	*982*	*1227*	*1473*
2	None*	3.1416	1571	2356	3142	3927	4712
	1	*2.3562*	*1178*	*1767*	*2356*	*2945*	*3534*
	1⅜	*1.6567*	*828*	*1243*	*1657*	*2071*	*2485*
2½	None*	4.9087	2454	3682	4909	6136	7363
	1	*4.1233*	*2062*	*3092*	*4123*	*5154*	*6185*
	1⅜	*3.4238*	*1712*	*2568*	*3424*	*4280*	*5136*
	1¾	*2.5034*	*1252*	*1878*	*2503*	*3129*	*3755*
3	None*	7.0686	3534	5301	7069	8836	10,603
	1	*6.2832*	*3142*	*4712*	*6283*	*7854*	*9425*
	1⅜	*5.5837*	*2792*	*4188*	*5584*	*6980*	*8376*
	1¾	*4.6633*	*2332*	*3498*	*4664*	*5830*	*6996*
3¼	None*	8.2958	4148	6222	8296	10,370	12,444
	1⅜	*6.8109*	*3405*	*5108*	*6811*	*8514*	*10,216*
	1¾	*5.8905*	*2945*	*4418*	*5891*	*7363*	*8836*
	2	*5.1542*	*2577*	*3866*	*5154*	*6443*	*7731*
4	None*	12.567	6284	9425	12,567	15,709	18,851
	1¾	*10.162*	*5081*	*7622*	*10,162*	*12,703*	*15,243*
	2	*9.4254*	*4713*	*7069*	*9425*	*11,782*	*14,138*
	2½	*7.6583*	*3829*	*5744*	*7658*	*9573*	*11,487*
5	None*	19.635	9818	14,726	19,635	24,544	29,453
	2	*16.493*	*8247*	*12,370*	*16,493*	*20,616*	*24,740*
	2½	*14.726*	*7363*	*11,045*	*14,726*	*18,408*	*22,089*
	3	*12.566*	*6283*	*9425*	*12,566*	*15,708*	*18,849*
	3½	*10.014*	*5007*	*7511*	*10,014*	*12,518*	*15,021*
6	None*	28.274	14,137	21,206	28,274	35,343	42,411
	2½	*23.365*	*11,683*	*17,524*	*23,365*	*29,206*	*35,048*
	3	*21.205*	*10,603*	*15,904*	*21,205*	*26,506*	*31,808*
	3½	*18.653*	*9327*	*13,990*	*18,653*	*23,316*	*27,980*
	4	*15.707*	*7854*	*11,780*	*15,707*	*19,634*	*23,561*
7	None*	38.485	19,243	28,864	38,485	48,106	57,728
	3	*31.416*	*15,708*	*23,562*	*31,416*	*39,270*	*47,124*
	3½	*28.864*	*14,432*	*21,648*	*28,864*	*36,080*	*43,296*
	4	*25.918*	*12,959*	*19,439*	*25,918*	*32,398*	*38,877*
	4½	*22.581*	*11,291*	*16,936*	*22,581*	*28,226*	*33,872*
	5	*18.850*	*9425*	*14,138*	*18,850*	*23,563*	*28,275*
8	None*	50.266	25,133	37,700	50,266	62,833	75,399
	3½	*40.645*	*20,323*	*30,484*	*40,645*	*50,806*	*60,968*
	4	*37.699*	*18,850*	*28,274*	*37,699*	*47,124*	*56,549*
	4½	*34.362*	*17,181*	*25,772*	*34,362*	*42,953*	*51,543*
	5	*30.631*	*15,316*	*22,973*	*30,631*	*38,289*	*45,947*
	5½	*26.508*	*13,254*	*19,881*	*26,508*	*33,135*	*39,762*
10	None*	78.540	39,270	58,905	78,540	98,175	117,810
	4½	*62.636*	*31,318*	*46,977*	*62,636*	*78,295*	*93,954*
	5	*58.905*	*29,453*	*44,179*	*58,905*	*73,631*	*88,358*
	5½	*54.782*	*27,391*	*41,087*	*54,782*	*68,478*	*82,173*
	7	*40.055*	*20,028*	*30,041*	*40,055*	*50,069*	*60,082*
12	None*	113.10	56,550	84,825	113,100	141,375	169,650
	5½	*89.339*	*44,670*	*67,004*	*89,339*	*111,673*	*134,009*
14	None*	153.94	76,970	115,455	153,940	192,425	230,910
	7	*115.46*	*57,730*	*86,595*	*115,460*	*144,325*	*173,190*

*These figures are for extension force. No piston rod diameter is involved.

Hydraulic Cylinder Force

High Pressure Range – 2000 to 5000 PSI – 1½" to 14" Bores

(continued from page 15) pressure to obtain cylinder force produced. Values in two or more columns can be added for a pressure not listed, or, force values can be obtained by interpolating between the next higher and the next lower pressure columns.

Pressure values along the top, of each chart are differential pressures across the two cylinder ports. This is the pressure to just balance the load, and not the pressure which must be produced by the system pump. There will be circuit flow losses in pressure and return lines due to oil flow, and these will require extra pressure. When designing a system, be sure to allow sufficient pump pressure, probably an extra 25% to 30% on the average, to supply both the cylinder and to satisfy system flow losses.

Bore Dia., In.	Rod Dia., In.	Effec. Area, Sq. In.	Pressure Differential Across Cylinder Ports 2000 PSI	2500 PSI	3000 PSI	4000 PSI	5000 PSI
1½	None*	1.7672	3534	4418	5302	7069	8836
	⅝	*1.4604*	*2921*	*3651*	*4381*	*5842*	*7302*
	1	*0.9818*	*1964*	*2455*	*2945*	*3927*	*4909*
2	None*	3.1416	6283	7854	9425	12,566	15,708
	1	*2.366*	*4712*	*5891*	*7069*	*9425*	*11,781*
	1⅜	*1.6567*	*3313*	*4142*	*4970*	*6627*	*8284*
2½	None*	4.9087	9817	12,272	14,726	19,635	24,544
	1	*4.1233*	*8247*	*10,308*	*12,370*	*16,493*	*20,617*
	1⅜	*3.4238*	*6848*	*8560*	*10,271*	*13,695*	*17,119*
	1¾	*2.5034*	*5007*	*6259*	*7510*	*10,014*	*12,517*
3	None*	7.0686	14,137	17,672	21,206	28,274	35,343
	1	*6.2832*	*12,566*	*15,708*	*18,850*	*25,133*	*31,416*
	1⅜	*5.5837*	*11,167*	*13,959*	*16,751*	*22,335*	*27,919*
	1¾	*4.6643*	*9329*	*11,661*	*13,992*	*18,657*	*23,322*
3¼	None	8.2958	16,592	20,740	24,887	33,183	41,479
	1⅜	*6.8109*	*13,622*	*17,027*	*20,433*	*27,244*	*34,055*
	1¾	*5.8905*	*11,781*	*14,726*	*17,672*	*23,562*	*29,453*
	2	*5.1542*	*10,308*	*12,886*	*15,463*	*20,617*	*25,771*
4	None*	12.567	25,134	31,418	37,701	50,268	62,835
	1¾	*10.162*	*20,324*	*25,405*	*30,486*	*40,648*	*50,810*
	2	*9.4254*	*18,851*	*23,564*	*28,266*	*37,702*	*47,127*
	2½	*7.6583*	*15,317*	*19,146*	*22,975*	*30,633*	*38,292*
5	None*	19.635	39,270	49,088	58,905	78,540	98,175
	2	*16.493*	*32,986*	*41,233*	*49,479*	*65,972*	*82,465*
	2½	*14.726*	*29,450*	*36,815*	*44,178*	*58,904*	*73,630*
	3	*12.566*	*25,132*	*31,415*	*37,698*	*50,264*	*62,830*
	3½	*10.014*	*20,028*	*25,035*	*30,042*	*40,056*	*50,070*
6	None*	28.274	56,548	70,685	84,822	113,096	141,370
	2½	*23.365*	*46,730*	*58,413*	*70,095*	*93,460*	*116,825*
	3	*21.205*	*42,410*	*53,013*	*63,615*	*84,820*	*106,025*
	3½	*18.653*	*37,306*	*46,633*	*55,959*	*74,612*	*93,265*
	4	*15.707*	*31,414*	*39,268*	*47,121*	*62,828*	*78,535*
7	None*	38.485	76,970	96,213	115,455	153,940	192,425
	3	*31.416*	*62,832*	*78,540*	*94,248*	*125,664*	*157,080*
	3½	*28.864*	*57,728*	*72,160*	*86,592*	*115,456*	*144,320*
	4	*25.918*	*51,836*	*64,795*	*77,754*	*103,672*	*129,590*
	4½	*22.581*	*45,162*	*56,453*	*67,743*	*90,324*	*112,905*
	5	*18.850*	*37,700*	*47,125*	*56,550*	*75,400*	*94,260*
8	None*	50.266	100,532	125,665	150,798	201,064	251,330
	3½	*40.645*	*81,290*	*101,613*	*121,935*	*162,580*	*203,225*
	4	*37.699*	*75,398*	*94,248*	*113,097*	*150,796*	*188,495*
	4½	*34.362*	*68,724*	*85,905*	*103,086*	*137,448*	*171,810*
	5	*30.631*	*61,262*	*76,578*	*91,893*	*122,524*	*153,155*
	5½	*26.508*	*53,016*	*66,270*	*79,524*	*106,032*	*132,540*
10	None*	78.540	157,080	196,350	235,620	314,160	392,700
	4½	*62.636*	*125,272*	*156,590*	*187,908*	*250,544*	*313,180*
	5	*58.905*	*117,810*	*147,263*	*176,715*	*235,620*	*294,525*
	5½	*54.782*	*109,564*	*136,955*	*164,346*	*219,128*	*273,910*
	7	*40.055*	*80,110*	*100,138*	*120,165*	*160,220*	*200,275*
12	None*	113.10	226,200	282,750	339,300	452,400	565,500
	5½	*89.339*	*178,678*	*223,348*	*268,017*	*357,356*	*446,695*
14	None*	153.94	307,880	384,850	461,820	615,760	769,700
	7	*115.46*	*230,920*	*288,650*	*346,380*	*461,840*	*577,300*

*These figures are for extension force. No piston rod diameter is involved.

Horsepower to Drive a Pump

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 80% 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 × GPM ÷ (1714 × 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 77 GPM, power will be the sum of the figures shown in the 75 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 this rule-of-thumb:

1 HP is required for each 1 GPM @ 1500 PSI

For example, a 5 GPM pump operating at 1500 PSI would need 5 HP, or at 3000 would need 10 HP. A 10 GPM pump at 1000 PSI would need 6⅔ HP, or the same pump operating at 1500 PSI would need 10 HP, etc.

Another rule-of-thumb states that about 5% of the pump maximum rated horsepower is required to idle 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	5000 PSI
1/2	.172	.257	.343	.429	.515	.600	.686	.858	1.03	1.72
1	.343	.515	.686	.858	1.03	1.20	1.37	1.72	2.06	3.43
1½	.515	.772	1.03	1.29	1.54	1.80	2.06	2.57	3.09	5.15
2	.686	1.03	1.37	1.72	2.06	2.40	2.75	3.43	4.12	6.86
2½	.858	1.29	1.72	2.14	2.57	3.00	3.43	4.29	5.15	8.58
3	1.03	1.54	2.06	2.57	3.09	3.60	4.12	5.15	6.18	10.3
3½	1.20	1.80	2.40	3.00	3.60	4.20	4.80	6.00	7.21	12.0
4	1.37	2.06	2.75	3.43	4.12	4.80	5.49	6.86	8.24	13.7
5	1.72	2.57	3.43	4.29	5.15	6.00	6.86	8.58	10.3	17.2
6	2.06	3.09	4.12	5.15	6.18	7.21	8.24	10.3	12.4	20.6
7	2.40	3.60	4.80	6.00	7.21	8.41	9.61	12.0	14.4	24.0
8	2.75	4.12	5.49	6.86	8.24	9.61	11.0	13.7	16.5	27.5
9	3.09	4.63	6.18	7.72	9.27	10.8	12.4	15.4	18.5	30.9
10	3.43	5.15	6.86	8.58	10.3	12.0	13.7	17.2	20.6	34.3
12	4.12	6.18	8.24	10.3	12.4	14.4	16.5	20.6	24.7	41.2
15	5.15	7.72	10.3	12.9	15.4	18.0	20.6	25.7	30.9	51.5
20	6.86	10.3	13.7	17.2	20.6	24.0	27.5	34.3	41.2	68.6
25	8.58	12.9	17.2	21.4	25.7	30.0	34.3	42.9	51.5	85.8
30	10.3	15.4	20.6	25.7	30.9	36.0	41.2	51.5	61.8	103
35	12.0	18.0	24.0	30.0	36.0	42.0	48.0	60.0	72.1	120
40	13.7	20.6	27.5	34.3	41.2	48.0	54.9	68.6	82.4	137
45	15.4	23.2	30.9	38.6	46.3	54.1	61.8	77.2	92.7	154
50	17.2	25.7	34.3	42.9	51.5	60.0	68.6	85.8	103	172
55	18.9	28.3	37.8	47.2	56.6	66.1	75.5	94.4	113	189
60	20.6	30.9	41.2	51.5	61.8	72.1	82.4	103	124	206
65	22.3	33.5	44.6	55.8	66.9	78.1	89.2	112	134	223
70	24.0	36.0	48.0	60.0	72.1	84.1	96.1	120	144	240
75	25.7	38.6	51.5	64.3	77.2	90.1	103	129	154	257
80	27.5	41.2	54.9	68.6	82.4	96.1	110	137	165	275
85	29.2	43.8	58.3	72.9	87.5	102	117	146	175	292
90	30.9	46.3	61.8	77.2	92.7	108	124	154	185	309
95	32.6	48.9	65.2	81.5	97.8	114	130	163	196	326
100	34.3	51.5	68.6	85.8	103	120	137	172	206	343