

Basic Fluid Power Formulas / Hydraulics / Pneumatics

Variable	Word Formula w/ Units	Simplified Formula
Fluid Pressure - P	(PSI) = Force (Pounds) / Area (Sq. In.)	$P = F / A$
Fluid Flow Rate - Q	GPM= Flow (Gallons) / Unit Time (Minutes)	$Q = V / T$
Fluid Power in Horsepower - HP	Horsepower = Pressure (PSIG) × Flow (GPM)/ 1714	$HP = PQ / 1714$

Actuator Formulas

Variable	Word Formula w/ Units	Simplified Formula
Cylinder Area - A	(Sq. In.) = $\pi \times \text{Radius (inch)}^2$	$A = \pi \times R^2$
	(Sq. In.) = $\pi \times \text{Diameter (inch)}^2 / 4$	$A = \pi \times D^2 / 4$
Cylinder Force - F	(Pounds) = Pressure (psi) × Area (sq. in.)	$F = P \times A$
Cylinder Speed - v	(Feet / sec.) = $(231 \times \text{Flow Rate (gpm)}) / (12 \times 60 \times \text{Area})$	$v = (0.3208 \times \text{gpm}) / A$
Cylinder Volume Capacity - V	Volume = $\pi \times \text{Radius}^2 \times \text{Stroke (In.)} / 231$	$V = \pi \times R^2 \times L / 231$
		(L = length of stroke)
Cylinder Flow Rate - Q	Volume = $12 \times 60 \times \text{Velocity (Ft./Sec.)} \times \text{Net Area(In.)}^2 / 231$	$Q = 3.11688 \times v \times A$
Fluid Motor Torque - T	Torque (in. lbs.) = Pressure (psi) × disp. (in. ³ / rev.) / 6.2822	$T = P \times d / 6.2822$
	Torque = HP × 63025 / RPM	$T = HP \times 63025 / n$
	Torque = Flow Rate (GPM) × Pressure × 36.77 / RPM	$T = 36.77 \times Q \times P / n$
Fluid Motor Speed - n	Speed (RPM) = $(231 \times \text{GPM}) / \text{Disp. (in.)}^3$	$n = (231 \times \text{GPM}) / d$
Fluid Motor Horsepower - HP	HP = Torque (in. lbs.) × rpm / 63025	$HP = T \times n / 63025$

Pump Formulas

Variable	Word Formula w/ Units	Simplified Formula
Pump Output Flow - GPM	GPM = (Speed (rpm) × disp. (cu. in.)) / 231	$GPM = (n \times d) / 231$
Pump Input Horsepower - HP	HP = GPM × Pressure (psi) / 1714 × Efficiency	$HP = (Q \times P) / 1714 \times E$
Pump Efficiency - E	Overall Efficiency = Output HP / Input HP	$E_{\text{Overall}} = \text{HP}_{\text{Out}} / \text{HP}_{\text{In}} \times 100$
	Overall Efficiency = Volumetric Eff. × Mechanical Eff.	$E_{\text{Overall}} = \text{Eff}_{\text{Vol.}} \times \text{Eff}_{\text{Mech.}}$
Pump Volumetric Efficiency - E	Volumetric Efficiency = Actual Flow Rate Output (GPM) / Theoretical Flow Rate Output (GPM) × 100	$\text{Eff}_{\text{Vol.}} = Q_{\text{Act.}} / Q_{\text{Theo.}} \times 100$
Pump Mechanical Efficiency - E	Mechanical Efficiency = Theoretical Torque to Drive / Actual Torque to Drive × 100	$\text{Eff}_{\text{Mech.}} = T_{\text{Theo.}} / T_{\text{Act.}} \times 100$
Pump Displacement - CIPR	Displacement (In. ₃ / rev.) = Flow Rate (GPM) × 231 / Pump RPM	$\text{CIPR} = GPM \times 231 / \text{RPM}$
Pump Torque - T	Torque = Horsepower × 63025 / RPM	$T = 63025 \times \text{HP} / \text{RPM}$
	Torque = Pressure (PSIG) × Pump Displacement (CIPR) / 2π	$T = P \times \text{CIPR} / 6.28$