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.) = $\pi \times$ Radius (inch)^2	$A = \pi \times R^2$
	(Sq. In.) = $\pi \times$ 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 × Flow Rate (gpm)) / (12 × 60 × Area)	$v = (0.3208 \times gpm) / A$
Cylinder Volume Capacity - V	Volume = $\pi \times$ Radius$^2 \times$ Stroke (In.) / 231	$V = \pi \times R^2 \times L / 231$ (L = length of stroke)
Cylinder Flow Rate - Q	Volume = 12 × 60 × Velocity (Ft./Sec.) × 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 × GPM) / Disp. (in.)^3	$n = (231 \times GPM) / d$
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	$E_{Overall} = HP_{Out} / HP_{In} \times 100$
	Overall Efficiency = Volumetric Eff. × Mechanical Eff.	$E_{Overall} = Eff_{Vol.} \times Eff_{Mech.}$
Pump Volumetric Efficiency - E	Volumetric Efficiency = Actual Flow Rate Output (GPM) / Theoretical Flow Rate Output (GPM) × 100	$Eff_{Vol.} = Q_{Act.} / Q_{Theo.} \times 100$
Pump Mechanical Efficiency - E	Mechanical Efficiency = Theoretical Torque to Drive / Actual Torque to Drive × 100	$Eff_{Mech} = T_{Theo.} / T_{Act.} \times 100$
Pump Displacement - CIPR	Displacement (In.$_3$ / rev.) = Flow Rate (GPM) × 231 / Pump RPM	$CIPR = GPM \times 231 / RPM$
Pump Torque - T	Torque = Horsepower × 63025 / RPM	$T = 63025 \times HP / RPM$
	Torque = Pressure (PSIG) × Pump Displacement (CIPR) / 2π	$T = P \times CIPR / 6.28$