

# FLUID POWER FORMULAS

ACTUATOR FORMULAS		
FORMULA FOR:	WORD FORMULA	LETTER FORMULA
CYLINDER AREA <i>In Square Inches</i>	AREA = $\pi \times \text{RADIUS}^2$ ( <i>Inches</i> )	A = $\pi r^2$
	= $\frac{\pi}{4} \times \text{DIAMETER}^2$ ( <i>Inches</i> )	A = $\frac{\pi D^2}{4}$ or A = $.785D^2$
CYLINDER FORCE <i>In Pounds, Push or Pull</i>	FORCE = PRESSURE (psi) X NET AREA (Square Inches)	F = psi X A or F = PA
CYLINDER VELOCITY or SPEED <i>In Feet/Second</i>	VELOCITY = $\frac{231 \times \text{FLOW RATE (GPM)}}{12 \times 60 \times \text{NET AREA (Square Inches)}}$	F = $\frac{231Q}{720A}$ or V = $\frac{.3208Q}{A}$
CYLINDER VOLUME CAPACITY <i>In Gallons of Fluid</i>	VELOCITY = $\frac{\pi \times \text{RADIUS}^2 \text{ (Inches)} \times \text{STROKE (Inches)}}{231}$	V = $\frac{\pi r^2 l}{231}$
	= $\frac{\text{NET AREA (Square Inches)} \times \text{STROKE (Inches)}}{231}$	V = $\frac{A l}{231}$ <i>l = Length of Stroke</i>
CYLINDER FLOW RATE <i>In Gallons Per Minute</i>	FLOW RATE = $\frac{12 \times 60 \times \text{VELOCITY (Feet/Sec)} \times \text{NET AREA (Square Inches)}}{231}$	Q = $\frac{720vA}{231}$ or Q = $3.117vA$
FLUID MOTOR TORQUE <i>In Inch Pounds</i>	TORQUE = $\frac{\text{PRESSURE (psi)} \times \text{F.M. DISPLACEMENT (Cu. In./Rev.)}}{2\pi}$	T = $\frac{\text{psi } d}{2\pi}$ or T = $\frac{Pd}{2\pi}$
	= $\frac{\text{HORSEPOWER} \times 63025}{\text{RPM}}$	T = $\frac{63025 \text{ HP}}{n}$
	= $\frac{\text{FLOW RATE (GPM)} \times \text{PRESSURE (psi)} \times 36.77}{\text{RPM}}$	T = $\frac{36.77QP}{n}$ or T = $\frac{36.77Q\text{psi}}{n}$
FLUID MOTOR TORQUE/100 psi <i>In Inch Pounds</i>	TORQUE/100 psi = $\frac{\text{F.M. DISPLACEMENT (Cu. Inches/Revolution)}}{.0628}$	T <sub>100psi</sub> = $\frac{d}{.0628}$
FLUID MOTOR SPEED <i>In Revolutions/Minute</i>	SPEED = $\frac{231 \times \text{FLOW RATE (GPM)}}{\text{F.M. DISPLACEMENT (Cu. Inches/Revolution)}}$	n = $\frac{231Q}{d}$
FLUID MOTOR POWER <i>In Horsepower Output</i>	HORSEPOWER = $\frac{\text{TORQUE OUTPUT (Inch Pounds)} \times \text{RPM}}{63025}$	HP = $\frac{Tn}{63025}$
THERMAL FORMULAS		
RESERVOIR COOLING CAPACITY <i>Based on Adequate Air Circulation</i>	HEAT (BTU/HR) = 2 X TEMPERATURE DIFFERENCE BETWEEN RESERVOIR WALLS AND AIR (°F) X AREA OF RESERVOIR (Sq. Ft.)	BTU/HR = 2.0 X ΔT X A
HEAT IN HYDRAULIC OIL (approx.) <i>Due to System Inefficiency (SG=.89-.92)</i>	HEAT (BTU/HR) = FLOW RATE (GPM) X 210 X TEMPERATURE DIFFERENCE (°F)	BTU/HR = Q X 210 X ΔT
HEAT IN FRESH WATER (approx.)	HEAT (BTU/HR) = FLOW RATE (GPM) X 500 X TEMPERATURE DIFFERENCE (°F)	BTU/HR = Q X 500 X ΔT
NOTE: One British Thermal Unit (BTU) is the amount of heat required to raise the temperature of one pound of water one degree. One Horsepower = 2545 BTU/HR.		

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## ACCUMULATOR FORMULAS

PRESSURE or VOLUME <i>w/ Constant "T" (Temperature)</i>	ORIGINAL PRESSURE X ORIGINAL VOLUME = FINAL PRESSURE X FINAL VOLUME	$P_1 V_1 = P_2 V_2$ Isothermic
PRESSURE or TEMPERATURE <i>w/ Constant "V" (Volume)</i>	ORIGINAL PRESSURE X FINAL TEMPERATURE = FINAL PRESSURE X ORIGINAL TEMPERATURE	$P_1 T_2 = P_2 T_1$ Isochoric
VOLUME or TEMPERATURE <i>w/ Constant "P" (Pressure)</i>	ORIGINAL VOLUME X FINAL TEMPERATURE = FINAL VOLUME X ORIGINAL TEMPERATURE	$V_1 T_2 = V_2 T_1$ Isobaric
PRESSURE or VOLUME <i>w/ Temperature Change Due to Heat of Compression</i>	ORIGINAL PRESSURE X ORIGINAL VOLUME <sup>n</sup> = FINAL PRESSURE X FINAL VOLUME <sup>n</sup>	$P_1 V_1^n = P_2 V_2^n$
	$\frac{\text{FINAL TEMP.}}{\text{ORIG. TEMP.}} = \left( \frac{\text{ORIG. VOLUME}}{\text{FINAL VOLUME}} \right)^{n-1} = \left( \frac{\text{FINAL PRESSURE}}{\text{ORIG. PRESSURE}} \right)^{n-1/n}$	$\frac{T_2}{T_1} = \left( \frac{V_1}{V_2} \right)^{n-1} = \left( \frac{P_2}{P_1} \right)^{n-1/n}$

NOTE: Where "P" = psia (ABSOLUTE) = psig (GAUGE PRESSURE) + 14.7 psi

## VOLUME & CAPACITY EQUIVALENTS

	Cubic Inches	Cubic Feet	Cubic Yards	Liters	U.S. Gallons	Imperial Gallons	Water at Max. Density 39.2°F 4°C	
							Pounds of Water	Kilograms of Water
Cu Inches	1	.0005787	.00002143	.016384	.004329	.0036065	.0361275	.0163872
Cu Feet	1728	1	.037037	28.317	7.48052	6.23210	62.4283	28.3170
Cu Yards	46,656	27	1	764.56	201.974	168.266	1685.56	764.559
Liters	61.0234	.0353145	.001308	1	.264170	.220083	2.20462	1
U.S. Gallons	231	.133681	.004951	3.78543	1	.833111	8.34545	3.78543
Imp. Gallons	277.274	.160459	.0059429	4.54374	1.20032	1	10.0172	4.54373
Lbs Water	27.6798	.0160184	.0005929	.453592	.119825	.0998281	1	.453593