

Basis Formulas

Formula For:	Word Formula:	Letter Formula:	
FLUID PRESSURE In Pounds/Square Inch	Pressure = Force (Pounds) Unit Area (Square Inches)	P = F/A or psi = F/A	
FLUID FLOW RATE In Gallons/Minute	Flow Rate = Volume (Gallons) Unit Time (Minute)	Q = V/T	
FLUID POWER In Horsepower	Horsepower = Pressure (psi) x Flow (GPM) 1714	hp = PQ/1714	

Fluid Formulas

Formula For:	Word Formula:	Letter Formula:		
VELOCITY THROUGH PIPING In Feet/Second Velocity	Velocity = .3208 x Flow Rate through I.D. (GPM) Internal Area (Square Inches)	V = .3208Q/A		
COMPRESSIBILITY OF OIL In Additional Required Oil to Reach Pressure	Additional Volume = $\frac{ ext{Pressure (psi) x Volume of Oil under Pressure}}{ ext{250,000 (approx.)}}$	V _A = PV/250,000 (approx.)		
COMPRESSIBILITY OF A FLUID	Compressibility = <u>1</u> Bulk Modulus of the Fluid	C(ß) = 1/BM		
SPECIFIC GRAVITY OF A FLUID	Specific Gravity = Weight of One Cubic Foot of Fluid Weight of One Cubic Foot of Water	SG = W/62.4283		
VALVE (Cv) FLOW FACTOR	Valve Factor = $\frac{\text{Flow Rate (GPM)}\sqrt{\text{Specific Gravity}}}{\sqrt{\text{Pressure Drop (psi)}}}$	$Cv = (Q\sqrt{SG})/(\sqrt{\Delta \rho})$		
	For Viscosities of 32 to 100 Saybolt Universal Seconds: Centistokes = .2253 x SUS - $\left(\frac{194.4}{SUS}\right)$	CS = .2253 SUS - (194.4/SUS)		
VISCOSITY IN CENTISTOKES	For Viscosities of 100 to 240 Saybolt Universal Seconds: Centistokes = .2193 x SUS - $\left(\frac{134.6}{SUS}\right)$	CS = .2193 SUS - (134.6/SUS)		
	For Viscosities greater than 240 Saybolt Universal Seconds: Centistokes = $\left(\frac{SUS}{4.635}\right)$	CS = SUS/4.635		

Note: Saybolt Universal Seconds can also be abbreviated as SSU.





Pump Formulas

Formula For:	Word Formula:	Letter Formula:			
PUMP OUTLET FLOW In Gallons/Minute	Flow = rpm x Pump Displacement (Cu. In./Ref.) 231	Q = nd/231			
PUMP INPUT POWER In Horsepower Required	Horsepower Input = Flow Rate Output (GPM) x Pressure (psi) 1714 Efficiency (Overall)	$Hp_{in} = QP/1714Eff. or$ (GPM x psi)/1714Eff.			
PUMP EFFICIENCY	Overall Efficiency = (Output Horsepower)x 100	Eff _{ov} = (HP /HP _{in}) x 100			
Overall in Percent	Overall Efficiency = Volumetric Eff. x Mechanical Eff.	Eff _{ov vol} x Eff _{mech}			
PUMP EFFICIENCY Volumetric in Percent	Volumetric Efficiency = Actual Flow Rate Output (GPM) Theoretical Flow Rate Output (GPM) × 100	$Eff_{vol} = (Q /Q_{theo}) \times 100$			
PUMP EFFICIENCY Mechanical in Percent	Mechanical Efficiency =	$Eff_{mech} = (T / T_{act}) \times 100$			
PUMP LIFE B ₁₀ Bearing Life	B ₁₀ Hrs. Bearing Life = Rated Life Hrs. x Rated Speed (rpm) x Rated Pressure (psi) New Speed (rpm) x New Pressure (psi)	B ₁₀ , /RPM _n) × (P ^r /P _n) ³			

Actuator Formulas

Formula For:	Word Formula:	Letter		
CYLINDER AREA In Square Inches	Area = ∏ x Radius ² (Inches)	A = ∏r²		
	Area = (P/4) x Diameter ² (Inches)	$A = (\prod D^2)/4 \text{ or } A = .785D^2$		
CYLINDER FORCE In Pounds, Push or Pull	Area = Pressure (psi) x Net Area (sq in.)	F = psi x A or F = PA		
CYLINDER VELOCITY or SPEED In Feet/Second	Velocity = 231 x Flow Rate (GPM) 12 x 60 x Net Area (sq in.)	v = 231Q/720A or v = .3208Q/A		
CYLINDER VOLUME CAPACITY	Volume = $\frac{\prod x \text{ Radius}^2 \text{ (in.) } x \text{ Stroke (in.)}}{231}$	V = (∏r²L)/231		
In Gallons of Fluid	Volume = <u>Net Area (sq. in.) × Stroke (in.)</u> 231	V= (A L)/231		
CYLINDER FLOW RATE In Gallons/Minute	Flow Rate = $\frac{12 \times 60 \times \text{Velocity (Ft/Sec)} \times \text{Net Area (sq. in.)}}{231}$	Q = (720vA)231 or Q = 3.117vA		
	Torque = Pressure (psi) x F.M. Displacement (Cu. In./Rev.) 2∏	T = psi d/2∏ or T = Pd/2∏		
FLUID MOTOR TORQUE In Inch Pounds	Torque = Horsepower x 63025 rpm	T = 63025 hp/n		
	Torque = Flow Rate (GPM) x Pressure (psi) x 36.77 rpm	T = 36.77QP/n or T = 36.77Qpsi/n		
FLUID MOTOR TORQUE/100 psi In Inch Pounds	TorqueF.M. Displacement (Cu. In./Rev.)100.0628	$T_{100psi} = d/.0628$		
FLUID MOTOR SPEED In Revolutions/Minute	Speed = 231 Flow Rate (GPM) F.M. Displacement (Cu. In./Rev.)	n = 231 Q/d		
FLUID MOTOR POWER In Horsepower Output	Horsepower = Torque Output (Inch Pounds) x rpm 63025	hp = Tn/63025		





Thermal Formulas

Formula For:	Word Formula:	Letter Formula:		
RESERVOIR COOLING CAPACITY Based on Adequate Air Circulation	Heat (BTU/Hr) = 2 x Temperature Difference Between Reservoir Walls and Air (F) x Area of Reservoir (Sq. Ft.)	BTU/Hr = 2.0 x DT x A		
HEAT IN HYDRAULIC OIL Due to System Inefficiency (SG=.8992)	Heat (BTU/Hr) = Flow Rate (GPM) x 210 x Temp. Difference (F)	BTU/Hr = Q x 210 x DT		
HEAT IN FRESH WATER	Heat (BTU/Hr) = Flow Rate (GPM) x 500 x Temp. Difference (F°)	BTU/Hr = Q x 500 x DT		

Note: One British Thermal Unit (BTU) is the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. One Horsepower = 2545 BTU/Hr.

Accumulator Formulas

Formula For:	Word Formula:	Letter Formula:	
PRESSURE OR VOLUME With Constant T (Temperature)	Original Pressure x Original Volume = Final Pressure x Final Volume	$P_1V_1 = P_2V_2$ Isothermic	
PRESSURE OR TEMPERATURE With Constant V (Volume)	Original Pressure x Final Temp. = Final Pressure x Original Temp.	$P_1T_2 = P_2T_1$ Isochoric	
VOLUME OR TEMPERATURE With Constant P (Pressure)	Original Volume x Final Temp. = Final Volume x Original Temp.	$V_1T_2 = V_2T_1$ Isobaric	
PRESSURE OR VOLUME	Original Press. x Original Volume ⁿ = Final Press. x Final Volume ⁿ	$P_1V_1^n = P_2V_2^n$	
With Temp. Change Due to Heat of Compression	Final Temp./Orig. Temp. = (Orig. Vol./Final Vol.) ^{$n-1$} = (Final Press./Orig. Press.) ^{$(n-1)/n$}	$T_2/T_1 = (V_1/V_2)^{n-1} = (P_2/P_1)^{(n-1)/n}$	

Volume and Capacity Equivalents

							Water at Max Density	
	Cubic Inches	Cubic Feet	Cubic Centimeters	Liters	U.S. Gallons	Imperial Gallons	Pounds of Water	Kilograms of Water
Cubic Inches	1	0.0005787	16.384	0.016384	0.004329	0.0036065	0.361275	0.0163872
Cubic Feet	1728	1	0.037037	28.317	7.48052	6.23210	62.4283	28.3170
Cubic Centimeters	0.0610	0.0000353	1	0.001	0.000264	0.000220	0.002205	0.0001
Liters	61.0234	0.0353145	0.001308	1	0.264170	0.220083	2.20462	1
U.S. Gallons	231	0.133681	0.004951	3.78543	1	0.833111	8.34545	3.78543
Imperial Gallons	277.274	0.160459	0.0059429	4.54374	1.20032	1	10.0172	4.54373
Pounds of Water	27.6798	0.0160184	0.0005929	0.453592	0.119825	0.0998281	1	0.453593

PRESSURE IS OUR BUSINESS