



Useful Formulas

200.E.03

<p>WATER HORSEPOWER:</p> $= \frac{\text{GPM} \times 8.33 \times \text{Head}}{33000} = \frac{\text{GPM} \times \text{Head}}{3960}$	<p>WHERE:</p> <p>GPM = Gallons per Minute 8.33 = Pounds of water per gallon 33000 = Ft. Lbs. per minute in one horsepower Head = Difference in energy head in feet (field head).</p>
<p>LABORATORY BHP = $\frac{\text{Head} \times \text{GPM} \times \text{Sp. Gr.}}{3960 \times \text{Eff.}}$</p> <p>FIELD BHP = Laboratory BHP + Shaft Loss</p> <p>TOTAL BHP = Field BHP + Thrust Bearing Loss</p>	<p>WHERE:</p> <p>GPM = Gallons per Minute Head = Lab. Head (including column loss) Efficiency = Lab. Eff. of Pump Bowls (from price book curves) Shaft Loss = HP loss due to mechanical friction of lineshaft bearings Thrust = HP Loss in driver thrust bearings Bearing Loss (See (1) below under Misc.)</p>
<p>INPUT HORSEPOWER = $\frac{\text{Total BHP}}{\text{Motor Eff.}}$</p>	<p>Motor Eff. from Motor mfg. (as a decimal)</p>
<p>FIELD EFFICIENCY = $\frac{\text{Water Horsepower}}{\text{Total BHP}}$</p>	<p>Water HP as determined above Total BHP as determined above</p>
<p>OVERALL PLANT EFFICIENCY = $\frac{\text{Water Horsepower}}{\text{Input Horsepower}}$</p>	<p>Water HP as determined above Input HP as determined above</p>

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ELECTRICAL	$\text{INPUT HORSEPOWER} = \frac{\text{BHP}}{\text{Mot. Eff.}} = \frac{4.826 \times K \times M \times R}{T} = \frac{1.732 \times E \times I \times \text{PF}}{746}$	
	<p> BHP = Brake Horsepower as determined above Mot. Eff. = Rated Motor Efficiency K = Power Company Meter Constant M = Power Company Meter Multiplier, or Ratio of Current and Potential Transformers connected with meter R = Revolutions of meter disk T = Time in Sec. for R E = Voltage per Leg applied to motor I = Amperes per Leg applied to motor PF = Power factor of motor 1.732 = Factor for 3-phase motors. This reduces to 1 for single phase motors </p>	
	$\text{Kilowatt input to Motor} = .746 \times 1 \text{ HP} = \frac{1.732 \times E \times I \times \text{PF}}{1000}$	$\text{KW-Hrs. Per 1000 Gallons of Cold Water Pumped Per Hour} = \frac{\text{HD in ft.} \times 0.00315}{\text{Pump Eff.} \times \text{Mot. Eff.}}$
MISC.	<p>(1) Thrust Bearing Loss = .0075 HP per 100 RPM per 1000 lbs. thrust.* (2) Overall Plant Efficiency sometimes referred to as "Wire to Water" Efficiency *Thrust (in lbs.) = (thrust constant (k) laboratory head) + (setting in feet x shaft wt. per ft.) Note: Obtain thrust constant from curve sheets</p>	
	$\text{Discharge Head (in feet of fluid pumped)} = \frac{\text{Discharge Pressure (psi)} \times 2.31}{\text{Sp. Gr. of Fluid Pumped}}$	
	$\text{Velocity Head} = \frac{V^2}{2G}$ <p>V = Velocity of Water G = Acceleration Due to Gravity 32.2 ft./sec²</p>	

