

Basic Fan Laws

Variation	Fan Speed Change (RPM)
Volume (CFM)	Varies Directly with Speed Ratio $CFM_2 = \frac{RPM_2}{RPM_1} (CFM_1)$
Static Pressure (P)	Varies with SQUARE of Speed Ratio $P_2 = P_1 \left(\frac{RPM_2}{RPM_1} \right)^2$
Horse Power (HP)	Varies with CUBE of Speed Ratio $HP_2 = HP_1 \left(\frac{RPM_2}{RPM_1} \right)^3$

Electrical Formulas for Calculating Amperes, Horsepower, Kilowatts and kVA

To Find	Single Phase	Three Phase
Amps when "HP" is known	$\frac{HP \times 746}{V \times \%EFF \times PF}$	$\frac{HP \times 746}{V \times \%EFF \times PF \times 1.73}$
Amps when "KW" is known	$\frac{KW \times 1000}{V \times PF}$	$\frac{KW \times 1000}{V \times PF \times 1.73}$
Amps when "kVA" is known	$\frac{kVA \times 1000}{V}$	$\frac{kVA \times 1000}{V \times 1.73}$
Kilowatts (KW)	$\frac{V \times A \times PF}{1000}$	$\frac{V \times A \times PF \times 1.73}{1000}$
Kilovolt-Amps (kVA)	$\frac{V \times A}{1000}$	$\frac{V \times A \times 1.73}{1000}$
Horse Power (HP)	$\frac{V \times A \times \%EFF \times PF}{746}$	$\frac{V \times A \times \%EFF \times PF \times 1.73}{746}$

V= Volts A= Amps EFF = Efficiency PF= Power Factor

Conversion Factors

To Convert	To	Multiply By
Feet of Water	Inches of Mercury	0.8826
Feet of Water	Pounds/ Sq. Inch	0.4335
Gallons of Water	Pounds of Water	8.3452
Gallons of # 2 Oil	BTU's	140,000
Horsepower	Kilowatts	0.7457
Horsepower	BTU / Hr.	2545
Horsepower (boiler)	BTU / Hr.	33479
Horsepower (boiler)	Kilowatts	9.803
Inches of Mercury	Feet of Water	1.133
Inches of Mercury	Pounds/ Sq. Inch	0.4912
Kilowatts	BTU/ Hr.	3413
Kilowatts	Watts	1000
Pounds of Water	Cubic Feet	0.01602
Pounds of Water	Gallons	0.1198
Pounds/ Sq. Inch	Feet of Water	2.307
Therms of Gas	BTU's	100,000
Tons (refrigeration)	BTU/ Hr.	12,000
Watts	BTU/ Hr.	3.413

$$KW = \frac{BHP \times .746}{\text{Motor Eff.}}$$

$$\text{Mixed Air Temp} = \frac{(OAT) \times (OA \text{ CFM}) + (RAT) \times (RA \text{ CFM})}{(OA \text{ CFM}) + (RA \text{ CFM})}$$

$$\text{Boiler HP} = 33,475 \text{ BTU/HR}$$

$$\text{Sensible Heat, BTU/HR} = \text{CFM} \times 1.08 \times \Delta T \text{ (Dry Bulb } ^\circ\text{F)}$$

$$\text{Sensible Heat, kW} = \frac{\text{CFM} \times 1.08 \times \Delta T \text{ (Dry Bulb } ^\circ\text{F})}{3413}$$

$$\text{Latent Heat, BTU/HR} = \text{CFM} \times 0.68 \times \Delta g \text{ (grains/pound of dry air)}$$

$$\text{Total Heat, BTU/HR} = \text{CFM} \times 4.5 \times \Delta h \text{ (enthalpy)}$$

$$\text{BTU/HR} = 500 \times \text{GPM} \times \Delta T \text{ (} ^\circ\text{F)}$$

$$\text{Cooling Tower GPM (compression)} = \frac{\text{Tons} \times 30}{\Delta T \text{ (} ^\circ\text{F)}}$$

$$\text{Chiller GPM} = \frac{\text{Tons} \times 24}{\Delta T \text{ (} ^\circ\text{F)}}$$

Lbs. Per Hour of

$$\text{Cooling Condensate} = \frac{4.5 \times \text{CFM} \times \Delta g \text{ (grains/pound of dry air)}}{7000}$$

FOR FANS AND BLOWERS:

$$HP = \frac{\text{CFM} \times \text{Pressure (in H}_2\text{O)}}{6350 \times \text{Efficiency}}$$

FOR PUMPS:

$$HP = \frac{\text{GPM} \times \text{Head in Feet} \times \text{Specific Gravity}}{3960 \times \text{Efficiency of pump}}$$

PULLEY SPEEDS:

$$Sf = \frac{Dm \times Sm}{Df}$$

Where:

Sf = Fan Speed
 Sm = Motor Speed
 Df = Fan Pulley Diameter
 Dm = Motor Pulley Diameter