FAN LAWS – Changing Fan RPM on a Given Fan System

$$\mathbf{CFM_2} = CFM_1 \times (RPM_2 \div RPM_1)$$
$$\mathbf{SP_2} = SP_1 \times (RPM_2 \div RPM_1)^2$$
$$\mathbf{HP_2} = HP_1 \times (RPM_2 \div RPM_1)^3$$

1 = Initial; 2 = Desired

MOTOR HEAT

BTUH = BHP x 2547 ÷ Efficiency

FAN HORSEPOWER

$$\mathbf{BHP} = \frac{\text{CFM x Static Pressure (Inches)}}{\text{6356 x Static Efficiency}}$$

MOTOR ELECTRICAL CALCULATIONS

ALL MOTORS

$$\text{KW Input} = \frac{\text{BHP x .746}}{\text{Efficiency}}$$

SINGLE PHASE MOTORS

$$\text{KW} = \frac{\text{AMPs x Volts x Power Factor}}{1000}$$

$$\text{AMPS} = \frac{\text{746 x BHP}}{\text{Efficiency x Volts x Power Factor}}$$

THREE PHASE MOTORS

$$\text{KW} = \frac{\text{AMPs x Volts x 1.732 x P.F.}}{1000}$$

$$\text{AMPS} = \frac{\text{746 x BHP}}{\text{Efficiency x Volts x P.F. x 1.732}}$$

ELECTRIC HEAT CALCULATIONS

1 kW = 3,413 BTUH / kW = 3.413 MBH

$$\text{LAT} = \frac{\text{Heater kW x 3,413 BTUH / kW}}{\text{1.08* x SCFM}} + \text{EAT}$$

** Air density at sea level. Reduce by 0.036 for each 1000 feet of altitude above sea level.*

LAT = Leaving Air Temperature
EAT = Entering Air Temperature
Heaters > 48 AMPs are subdivided and fused

HEATER AMP CALCULATION

VOLTAGE	AMPs per kW
115/1	8.70
120/1	8.33
208/1	4.81
230/1	4.35
240/1	4.17
277/1	3.61
208/3	2.78
230/3	2.51
240/3	2.41
460/3	1.26
480/3	1.20
575/3	1.00
600/3	.962

PRESSURE DROP FOR VALVE PACKAGE COMPONENTS

$(GPM \div C_V \text{ Ball Valve})^2 \times (\text{Qty. of Ball Valves}) + (GPM \div C_V \text{ Strainer})^2 + (GPM \div C_V \text{ Flow Control})^2 + (GPM \div C_V \text{ Control Valve})^2$
= Pressure Drop (PSI)

CHANGING WATER FLOW IN A GIVEN CLOSED PIPING SYSTEM

$$PD_2 = PD_1 (GPM_2 \div GPM_1)^2$$

1 = Initial; 2 = Desired

CAPACITY CALCULATIONS

1 Ton = 12,000 BTUH

For Glycol: 20% use 475, 30% use 464, 40% use 449, 50% use 433

Water Side (no glycol) BTUH = 500 x GPM x ΔT
Sensible Heat BTUH = 1.08 x CFM x ΔT x ADR*
Latent Heat BTUH = 0.68 x CFM x Grain Difference x ADR*
Total Heat BTUH = 4.5 x CFM x Enthalpy Difference x ADR*
Pressure of Water in Feet = 2.31 x PSI

$$\text{Pump Horsepower BHP} = \frac{\text{GPM x Head in Feet}}{\text{3960 x Pump Efficiency}}$$

$$\Delta PSIG = (GPM \div C_V)^2$$

** ADR = Air Density Ratio*

Altitude	Air Density Ratio at 70°F Air Temp.
2000	.930
4000	.864
6000	.801
8000	.743

AIR BALANCING

$\mathbf{V}$ = CFM ÷ Area $\mathbf{P_V} = (V \div 4005)^2$

$\mathbf{P_S} = P_T - P_V$ (inches of water column)

V = Velocity (fpm). P_V = Velocity Pressure. P_S = Static Pressure. P_T = Total Pressure.