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FORMULAS & CONVERSIONS

$$KW = \frac{BHP \ x\ 0.746}{Motor\ Eff.}$$

$$BTUH_{(Latent)} = 4700\ x\ CFM\ \ x\ \ \Delta W_{\ (\Delta\ humidity\ ratio)}$$

$$Mixed\ Air\ Temp = \frac{(OAT)(outside\ air\ CFM) + (RAT)(return\ air\ CFM)}{(outside\ air\ CFM) + (return\ air\ CFM)}$$

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

$$Sensible\ Heat, BTU/HR = CFM\ x\ 1.08\ x\ \Delta T\ (D.B.°F)$$

$$Latent\ Heat, BTU/HR = CFM\ x\ 0.68\ x\ \Delta g\ (grains)$$

$$Total\ Heat, BTU/HR = CFM\ x\ 4.5\ x\ \Delta h\ (enthalpy)$$

$$GPM = \frac{BTU/hr}{500\ x\ \Delta T\ (°F)}$$

$$Cooling\ Tower\ GPM\ (compression) = \frac{Tons\ x\ 30}{\Delta T\ (°F)}$$

$$Chiller\ GPM = \frac{Tons\ x\ 24}{\Delta T\ (°F)}$$

Lbs. Per Hour of Cooling:

$$Coil\ Condensate = \frac{4.5\ x\ CFM\ x\ \Delta W_{(\Delta\ humidity\ ratio)}}{7000}$$

For Pumps:

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

For Fans and Blowers:

$$HP = \frac{CFM\ x\ Pressure\ (in\ H_2O)}{6350\ x\ Efficiency}$$

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

Electrical Formulas

To Find	Single Phase	Two Phase-Four Wire	Three Phase
Amps when "HP" is known	$\frac{HP \times 746}{V \times \%EFF \times PF}$	$\frac{HP \times 746}{V \times \%EFF \times PF \times 2}$	$\frac{HP \times 746}{V \times \%EFF \times PF \times 1.73}$
Amps when "KW"is known	$\frac{KW \times 1000}{V \times PF}$	$\frac{KW \times 1000}{V \times PF \times 2}$	$\frac{KW \times 1000}{V \times PF \times 1.73}$
Amps when "kVA"is known	$\frac{kVA \times 1000}{V}$	$\frac{kVA \times 1000}{V \times 2}$	$\frac{kVA \times 1000}{V \times 1.73}$
Kilowatts	$\frac{V \times A \times PF}{1000}$	$\frac{V \times A \times PF \times 2}{1000}$	$\frac{V \times A \times PF \times 1.73}{1000}$
Kilovolt-Amps "kVA"	$\frac{V \times A}{1000}$	$\frac{V \times A \times 2}{1000}$	$\frac{V \times A \times 1.73}{1000}$
HP	$\frac{V \times A \times \%EFF \times PF}{746}$	$\frac{V \times A \times \%EFF \times PF \times 2}{746}$	$\frac{V \times A \times \%EFF \times PF \times 1.73}{746}$

V=VOLTS A=AMPS EFF=EFFICIENCY PF=POWER FACTOR

MOTOR FULL-LOAD AMPERES

Horse-power	Three-Phase AC Squirrel-Cage & Wound-Rotor			Single Phase AC		
	208 V	230 V	460 V	115 V	200 V	230 V
1/6				4.4	2.5	2.2
1/4				5.8	3.3	2.9
1/2	2.3	2	1	9.8	5.6	4.9
3/4	3.2	2.8	1.4	13.8	7.9	6.9
1	4.1	3.6	1.8	16	9.2	8
1.5	5.7	5.2	2.6	20	11.5	10
2	7.5	6.8	3.4	24	13.8	12
3	11	9.6	4.8	34	19.6	17
5	16.7	15.2	7.6	56	32.2	28
7.5	24	22	11	80	46	40
10	31	28	14	100	57.5	50
15	46	42	21			
20	59	54	27			
25	75	68	34			
30	88	80	40			
40	114	104	52			
50	143	130	65			
60	170	154	77			
75	211	192	96			
100	273	248	124			
125	342	312	156			
150	396	360	180			
200	528	480	240			

Basic Fan Laws

Variation	Fan Speed Change	Density Change
Volume	Varies Directly with Speed Ratio $CFM_2 = CFM_1 \left(\frac{RPM_2}{RPM_1}\right)$	No Change
Pressure	Varies with SQUARE of Speed Ratio $P_2 = P_1 \left(\frac{RPM_2}{RPM_1}\right)^2$	Varies DIRECTLY with Density Ratio $P_2 = P_1 \left(\frac{D_2}{D_1}\right)$
Horse Power	Varies with CUBE of Speed Ratio $HP_2 = HP_1 \left(\frac{RPM_2}{RPM_1}\right)^3$	Varies DIRECTLY with Density Ratio $HP_2 = HP_1 \left(\frac{D_2}{D_1}\right)$

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PSYCHROMETRIC CHART