# THE CHEAT SHEET II ™

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$$\frac{RPM_2}{RPM_1}=\frac{CFM_2}{CFM_1} \qquad RPM_2=RPM_1\times\frac{CFM_2}{CFM_1} \qquad CFM_2=CFM_1\times\frac{RPM_2}{RPM_1}$$

$$\frac{SP_2}{SP_1}=\left(\frac{CFM_2}{CFM_1}\right)^2 \qquad SP_2=SP_1\times\left(\frac{CFM_2}{CFM_1}\right)^2 \qquad CFM_2=CFM_1\times\sqrt{\frac{SP_2}{SP_1}}$$

$$\frac{BHP_2}{BHP_1}=\left(\frac{CFM_2}{CFM_1}\right)^3 \qquad BHP_2=BHP_1\times\left(\frac{CFM_2}{CFM_1}\right)^3 \qquad CFM_2=CFM_1\times\sqrt[3]{\frac{BHP_2}{BHP_1}}$$

$$FanBHP=\frac{CFM\times SP}{6356\times SE} \qquad FanSE=\frac{CFM\times SP}{6356\times BHP} \qquad PumpBHP=\frac{GPM\times TDH}{3960\times Eff} \qquad PumpEff=\frac{GPM\times TDH}{3960\times BHP}$$

For Standard Air (70F @ 29.92"):

$$V=4005\times\sqrt{VP} \qquad VP=\left(\frac{V}{4005}\right)^2$$

For Other Than Standard Air:

$$V=1096.7\times\sqrt{\frac{VP}{Den}} \qquad Den=0.075\times\frac{530}{460+T}\times\frac{BAR}{29.92}$$

$$BTUH=M\times sp.ht.\times\Delta T$$

M=Mass Flow Rate in Lbs. per Hour. sp.ht .= Specific Heat in BTU/Lb. per Degree F.

Water: sp.ht.=1.0 8.34 lbs.=1 gal. 8.34 lbs. x 60 min. = 500 lbs per hour x 1.0 sp.ht. = 500 BTUH / GPM

Air: sp.ht=0.24 0.075 lbs.=1 cu.ft. .075 lbs. x 60 min. = 4.5 lbs per hour x 0.24 sp.ht. = 1.08 BTUH / CFM

$$BTUH(Sensible)=CFM\times1.08\times\Delta T(DB)\times\frac{Den}{0.075} \qquad CFM=\frac{BTUH(Sensible)}{1.08\times\Delta T(DryBulb)} \qquad \Delta T=\frac{BTUH}{1.08\times CFM}$$

$$BTUH(Total)=CFM\times\Delta h\times4.5\times\frac{Den}{0.075}$$

h = Enthalpy in BTU per Lb.

$$MBH=\frac{BTUH}{1000}$$

$$BTUH=GPM\times500\times\Delta T \qquad GPM=\frac{BTUH}{500\times\Delta T(Water)} \qquad \Delta T=\frac{BTUH}{500\times GPM}$$

$$AirChanges/Hr.=\frac{CFM\times60}{RoomVolume} \qquad CFM=RoomVolume\times\frac{AirChanges/Hr}{60}$$

$$\%OA = \frac{(RAT - MAT)}{(RAT - OAT)} \times 100$$

$$MAT = \frac{(\%OA \times OAT) + (\%RA \times RAT)}{100}$$

$$OAT = \frac{(MAT \times 100) - (\%RA \times RAT)}{\%OA}$$

$$RAT = \frac{(MAT \times 100) - (\%OA \times OAT)}{\%RA}$$

$$FanTipSpeedFPM = RPM \times \frac{Circ.(in.)}{12} \qquad Circ.(in.) = \frac{Ts(FPM) \times 12}{RPM} \qquad RPM = \frac{Ts(FPM) \times 12}{Circ.(in.)}$$

BL=Belt Length (in.) C=Distance between shaft centers (in.) D= Fan sheave dia. (in.) d=Motor Sheave dia. (in.)

$$BL = 2C + (1.57 \times (D + d)) + \frac{(D - d)^2}{4C} \qquad FanRPM = MotorRPM \times \frac{d}{D} \qquad MotorRPM = FanRPM \times \frac{D}{d}$$

V=Volts A=Amperes R=Ohms P=Watts PF=Power Factor (Motor) Eff=Efficiency (Motor) HP=Horsepower
BHP=Brake Horsepower (Motor) r=running np=nameplate SF= Service Factor (SF x npHP @ Continuous Duty)

Ohm's Law: $V = A \times R \qquad R = \frac{V}{A} \qquad A = \frac{V}{R}$

$$\%Load = \frac{(rA - 0.5npA) \times rV}{0.5npA \times npV}$$

Single Phase: $P = V \times A \times PF \qquad BHP = \frac{V \times A \times Eff \times PF}{746}$

3 Phase: $P = V \times A \times PF \times 1.73 \qquad BHP = \frac{V \times A \times Eff \times PF \times 1.73}{746}$

$$Estimated\ BHP = npHP \times \frac{rV \times rA \times LF(FromTable)}{npV \times npA}$$

| | LF (Load Factor) | | |
|---|---|---|---|
| Motor HP | Load 50% | Load 75% | Load 100% |
| 1 | 0.710 | 0.885 | 1.0 |
| 1.5 | 0.715 | 0.890 | 1.0 |
| 2 | 0.780 | 0.935 | 1.0 |
| 3 | 0.795 | 0.940 | 1.0 |
| 5 | 0.835 | 0.950 | 1.0 |
| 7.5 | 0.875 | 0.970 | 1.0 |
| 10 | 0.890 | 0.975 | 1.0 |
| 15 - 30 | 0.910 | 0.980 | 1.0 |
| 40 - 125 | 0.940 | 0.990 | 1.0 |

$$GPM = C_V \times \sqrt{\Delta P(psi)} \qquad Cv = \frac{GPM}{\sqrt{\Delta P(psi)}} \qquad GPM = C_V \times \sqrt{\frac{\Delta P(feet)}{2.31}} \qquad \Delta P = \left(\frac{GPM}{C_V}\right)^2$$

NPSHA = Net Positive Suction Head Available = Inlet psig + Inlet Vp (psi) + 14.7 psi – Vapor Pressure (psi)

$$Coefficient\ Of\ Performance = \frac{BTUH}{Watts \times 3.41}$$

Cooling Tower Approach = $LWT - EAT_{WB}$
Cooling Tower Range = $EWT - LWT$

Equivalents:
1 psi = 2.31ft. $H_2O$ = 27.72 in. $H_2O$ = 2.04 in. Hg
1 in. Hg = 0.491 psi = 1.13 ft. $H_2O$ = 13.6 in. $H_2O$
0 psig at sea level = 14.7 psia = 29.92 in. Hg = 33.9 ft. $H_2O$ = 407 in. $H_2O$
1 gal $H_2O$ = 8.34 lbs. 1 lb. $H_2O$ = 0.12 Gal. 1 cu.ft. $H_2O$ = 7.48 gal. = 62.428 lbs.
1 Watt = 3.41 BTUH 1 HP = 746 Watts = 2546 BTUH
1 Ton Refrigeration = 12,000 BTUH 1 Ton Cooling Tower = 15,000 BTUH
1 gal Heating Oil = 140,000 BTU (Typ.) 1 cu.Ft. Natural Gas = 1000 BTU (Typ.)