FORMULAS

FAN, PUMPS AND DRIVES

$\frac{BHP1}{BHP2} = \left(\frac{CFM1}{CFM2}\right)^2 = \left(\frac{RPM1}{RPM2}\right)^2 = \left(\frac{SP1}{SP2}\right)\frac{3}{2}$ Affinity Laws, Note: (CFM = GPM)

Synchronous Motor RPM = $\frac{Hertz \times 120}{Poles}$

Belt_Length = $2c + [1.57 \times (D+d)] + \frac{(D-d)^2}{4c}$

$\frac{RPM\ Motor}{RPM\ Fan} = \frac{DIA\ Fan_{Sheave}}{DAI\ Motor_{Sheaves}}$

$BHP_{Actual} = 1.73 \times Amps \times Volts \times \eta motor \times P.F.$

Rule of Thumb: $BHP_{Actual} = HP_{(name\_plate)} \times \frac{Amps\ Actual}{Amps\ Rated} \times \frac{Volts\ Actual}{Volts\ Rated}$

BHP = $\frac{GPM \times FTHD \times S.G.}{6{,}350 \times \eta pump}$ (For Pumps)

BHP = $\frac{CFM \times in.\ W.G.}{6{,}350 \times \eta fan}$ (For Fans)

ELECTRICAL EQUATIONS

KVA = $\frac{Amps \times Volts \times \sqrt{Ph}}{1{,}000}$

KW = KVA x P.F. = $\frac{P.F. \times Amps \times Volts \times \sqrt{Ph}}{1{,}000}$

KW motor input = $\frac{BHP \times 0.746}{\eta motor}$

V = IR

W = V x I = I^2 x R

$KW_{DC} = \frac{Amps \times Volts}{1{,}000}$

REFRIGERATION

KW / ton = 12 / EER

COP = EER / 3.412 = 12 / (KW / ton) / 3.412

Cond. Tons = $\frac{GPM \times \Delta T \times (1 + \frac{1}{COP})}{24}$

WATER SIDE HVAC FORMULAS

BTUH = GPM x 500 x T (water)

TONS = $\frac{GPM \times \Delta T}{24}$ (CH water) (CT Ton = 15,000 BTUH)

FTHD = $\frac{psi \times 2.31}{S.G.}$

$NPSH_A = h_a - h_{vpa} + h_{st} - h_{fs}$

h_a = Absolute Pressure in feet of liquid on surface supply level.

h_{vpa} = Head in feet corresponding to vapor pressure of liquid at the temperature being pumped.

h_{st} = Static height that the liquid level is above (+) or below (–) the pump centerline

h_{fs} = All suction line losses including the entrance loss and friction losses through pipe, valves and fittings.

AIR SIDE HVAC FORMULAS

$BTUH_{Total} = BTUH_{Sensible} + BTUH_{Latent}$

$BTUH_{Sensible} = (1.08) \times (CFM) \times \Delta T$

$BTUH_{Total} = (4.5) \times (CFM) \times \Delta H$

ACH = $\frac{60 \times CFM}{Floor\ Area \times Ceiling\ Height}$

$P_{velocity} = \left(\frac{V}{4{,}005}\right)^2 = \left(\frac{V}{C}\right)^2 \left(\frac{P}{2g}\right)$ C = 136.8, g = 32.2

$P_{Total} = P_{Velocity} + P_{Static}$