HVAC Formulae

AirSide

Q_{Total}=CFM x (h_i-h_f) x 4.5 Btuh

$Q_{Sensible}$=CFM x (t_i-t_f) x 1.085 Btuh

Q_{Latent}=CFM x (Gr_i-Gr_f) x 0.068 Btuh

Humidification = CFM x (Gr_f-Gr_i) /1,555lbs /hr

CFM = l/s x 2.12

Air Pressure Drop (in.WG) = Pa/249

WaterSide

Q = USGPM x (t_i-t_f) x 500 Btuh

Q = USGPM x (t_i-t_f) x 450 Btuh (50% E.G.)

Q = USGPM x (t_i-t_f) /24Tons

USGPM = l/s x 15.85

Water Pressure Drop (ft.wg) = kPa x 0.335

1.0 PSI = 2.31 wg

7,000 Grains = 1.0 lb

The Affinity Laws (Fan/Pump Laws)

rpm2/ rpm 1 = flow 2/ flow 1

$\Delta P_2 / \Delta P_1 = (Flow_2 / Flow_1)^2$

$mhp_2 / mhp_1 = (Flow_2 / Flow_1)^3$

Pump BHP = USGPM x Head (ft. wg)/ 3960 x Pump Efficiency

FanBHP=CFM x S.P. (inchesWG)/ 6356 x Static Efficiency

Air-Conditioning Basics

1 Ton of refrigeration=12,000 Btu/h = 200Btu/min

1 Therm =100,000 Btuh =100 MBH

COP = 3.516/(kw/Ton)

EER =Tons x 12/(TotalkWinput)

Btuh = Watt x 3.412

HP = kW x 1.3405

1 Boiler HP = 33.48 MBH

1 USGallon = 8.33lbs

1watt=3.412Btu/h

1horsepower=2545Btu/h

1lb=7000 grains

1ft(head)=0.433 psi

1 sq ft EDR(equivalent direct radiation) = 240 Btu

1 boiler horse power = 33,479 Btu/h

No. of air changes(N) = 60 cfm/ft^3

Chiller capacity (tons)= gpm (chilledwater) x Δt x (water)/24

ForAir:

1 lb/h = 4.5 Q
1 ton = $Q\,h/2670$

For Water:

1 lb/h=500gpm
1 ton = (gpm)$\Delta t/24$

$$\text{Pump HP} = \frac{\text{gpm x ft head x Sp Gravity}}{\text{3960 x Efficiency}}$$

Small pumps 0.40–0.60 efficiency
Large pumps 0.70–0.85 efficiency