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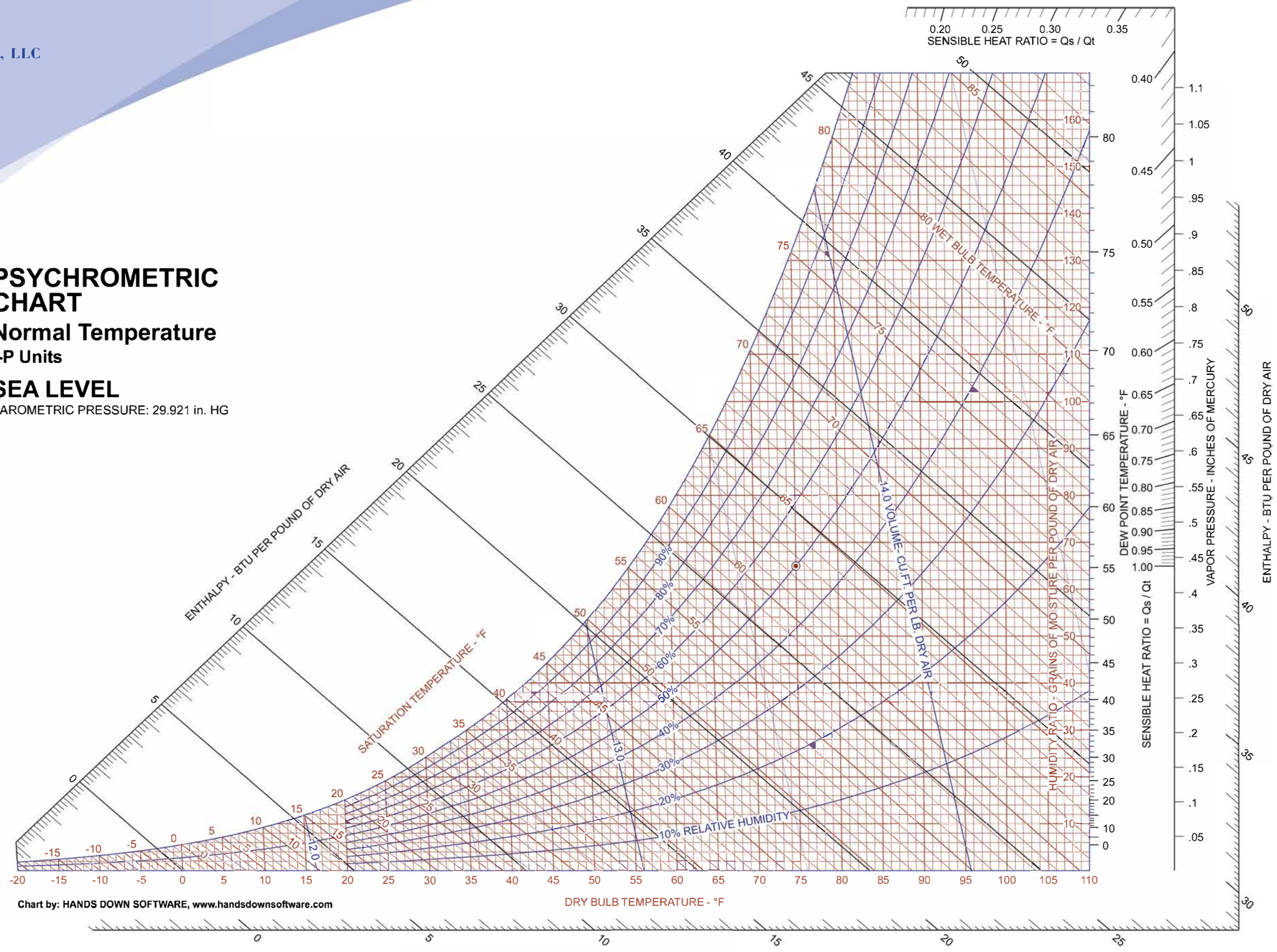
# PSYCHROMETRIC CHART

## Normal Temperature

**I-P Units**

## SEA LEVEL

BAROMETRIC PRESSURE: 29.921 in. HG



## PROPERTIES OF SATURATED STEAM

| PRESS. PSIG | TEMP. °F | SP. VOL. LIQUID | SP. VOL. VAPOR | ENTHALPY LIQUID | ENTHALPY EVAP. | ENTHALPY VAPOR |
|---|---|---|---|---|---|---|
| 0 | 212.0 | .0167 | 26.80 | 180.1 | 970.3 | 1150.4 |
| 5 | 228.0 | .0168 | 20.09 | 196.2 | 960.1 | 1156.3 |
| 10 | 240.1 | .0169 | 16.30 | 208.4 | 952.1 | 1160.6 |
| 15 | 250.3 | .0170 | 13.75 | 218.8 | 945.3 | 1164.1 |
| 20 | 259.3 | .0171 | 11.90 | 227.9 | 939.2 | 1167.1 |
| 25 | 267.2 | .0172 | 10.50 | 236.0 | 933.7 | 1169.7 |
| 30 | 274.4 | .0173 | 9.40 | 243.4 | 928.6 | 1172.0 |
| 40 | 287.1 | .0174 | 7.79 | 256.3 | 919.6 | 1175.9 |
| 50 | 298.0 | .0176 | 6.66 | 267.5 | 911.6 | 1179.1 |
| 75 | 320.3 | .0178 | 4.90 | 290.6 | 894.7 | 1185.3 |
| 100 | 338.1 | .0178 | 3.88 | 309.1 | 880.6 | 1189.7 |
| 125 | 353.0 | .0180 | 3.22 | 324.8 | 868.2 | 1193.0 |
| 150 | 365.5 | .0182 | 2.77 | 338.0 | 857.5 | 1195.5 |

## FAN LAWS

If fan speed is changed in a given system, with no other system modifications

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

$$TP_2 = TP_1 \times \left(\frac{RPM_2}{RPM_1}\right)^2$$

$$HP_2 = HP_1 \times \left(\frac{RPM_2}{RPM_1}\right)^3$$

To estimate fan horsepower:

$$HP = \frac{CFM \times TP}{6{,}356 \times EFF}$$

$$TR = \frac{HP \times 2{,}310}{CFM}$$

**CFM** = Airflow, Ft°/Min
**RPM** = Fan Speed, Revs/Min
**HP** = Power Input, Horsepower
**TP** = Air Total Pressure, Inches Water
**TR** = Air Temp. Rise, °F
**EFF** = Fan Efficiency

Typical fan efficiencies:
Forward Curved - .65 to .75
Backward Curved - .75 to .85
Axial Flow -.80 to .90

## PUMP LAWS

If pump speed is changed in a given system, with no other system modifications:

$$GPM_2 = GPM_1 \times \frac{RPM_2}{RPM_1}$$

$$H_2 = H_1 \times \left(\frac{RPM_2}{RPM_1}\right)^2$$

$$HP_2 = HP_1 \times \left(\frac{RPM_2}{RPM_1}\right)^3$$

To estimate pump horsepower:

$$HP = \frac{GPM \times H \times SG}{3{,}960 \times EFF}$$

**GMP** = Liquid Flow, Gais/Min
**RPM** = Pump Speed, Revs/Min
**HP** = Power Input, Horserpower
**H** = Total Head of Liquid, Feet
**SG** = Liquid Specific Gravity, Water = 1.0
**EFF** = Pump Efficiency

Typical pump efficiencies:
100 GPM - .55 to .65
200 GPM - .65 to .70
500 GPM - .70 to .75
1000 GPM - .75 to .80

## DEFINITIONS OF STANDARD AIR FLOW

**English Units**: Standard air is air that 70 °F, bone dry, and 29.92 in. Hg barometric pressure. Its density is 0.075 lbs/ft³

Airflow in Standard CFM (SCFM) = Airflow in actual CFM (ACFM) $\times \frac{13.34}{Sp.\ Vol.}$
(Airflow in SCFM) x 4.5 = (Airflow in lbs. dry air/hr)

**Metric Units:** Normal air is aire at 0 °C, bone dry, and 29.92 in. Hg barometric pressure. Its density is 1.293 Kg/m³.

Airflow in Normal M³/Min (nM³/Min) = Airflow in actual M³/Min $\times \frac{0.773}{Sp.\ Vol.}$
(Airflow in nM³/Min) x 77.58 = (Airflow in Kg. dry air/hr)

## FREQUENTLY USED CONVERSION FACTORS

### LENGTH
1 Meter = 3.28 Feet
1 Inch = 2.54 cm
1 Mile = 1.61 Km
1 Micron = 1 x $10^{-6}$ M

### AREA
1 $M^2$ = 10.67 $Ft.^2$
1 Acre = 43,560 $Ft.^2$

### VOLUME
1 $M^3$ = 35.31 $Ft^3$
1 $Ft.^3$ = 7.49 Gals
1 Gal = 231 $In^3$
1 Gal = 3.78 Liters

### LATENT HEAT
1 BTU/lb = 2326 J/Kg
1 Kg Cal/Kg = 1.8 BTU/lb

### SPECIFIC HEAT
1 BTU/lb - °F = Kg Cal/Kg – °K
1 BTU/lb - °F = 4,184 J/Kg– °K

### VOLUME FLOW
1CFM - 1.70 $M^3$/Hr
1 Liter/Sec = 15.9 GPM
1 $M^3$/Hr = 4.41 GPM

### ENERGY & WORK
1BTU = 1,055 Joules
1 Watt-Hr = 3.413 BTU
1 Kg Cal = 3.97 BTU
1 BTU = 778 Ft-lbs

### POWER
1 KW = 3,413 BTU/Hr
1 KW = 1.34 HP
1 HP = 2,545 BTU/Hr
1 Hp = 550 Ft-lb/Sec

### WEIGHT
1 Kg = 2,205 lbs
1 Metric Ton = 2,205 lbs
1 lb = 7,000 Grains
1 lb = 454 Grams

### Pressure
1 ATM = 14.696 PSI
1 ATM = 29.92 In Hg
1 Kg/$cm^2$ = 14.2 PSI
1 PSI = 6.895 KPa
1 PSI = 2.27 In W.C.

### ENERGY FLUX
1 BTU/Hr-$Ft^2$ = 3.15 W/$M^2$

### THERMAL CONDUCTIVITIY
1 W/M °K = 6.93 $\frac{BTU\text{-}In}{Hr\text{-}Ft^2 - °F}$

### THERMAL CONDUCTANCE
1 BTU/Hr-$Ft^2$ – °F = 5.68 w/$m^2$ – °K

## PSYCHROMETRIC CORRECTIONS FOR ALTITUDE

### BAROMETRIC PRESSURE

| Altitude Feet | Pressure In. Hg |
|---|---|
| -1000 | 31.02 |
| -500 | 30.47 |
| Sea Level | 29.92 |
| 500 | 29.38 |
| 1000 | 28.86 |
| 2000 | 27.82 |
| 3000 | 26.82 |
| 4000 | 25.84 |
| 5000 | 24.90 |
| 6000 | 23.98 |
| 7000 | 23.09 |
| 8000 | 22.22 |
| 9000 | 21.39 |
| 10000 | 20.58 |

**Dew Point Humidity for a Given Temperature:**
(Humidity @altitude) = (Humidity @ S.L.) x $\frac{29.92}{Baro.\ Press.}$

**Relative Humidity for a Given Humidity Ratio:**
(R.H. @ Altitude) = (R.H. @ S.L.) x $\frac{Baro.\ Press}{29.92}$

**Specific Volume for a Given Temperature & Humidity Ratio:**
(Sp. Vol @ Altitude) = (Sp. Vol @ S.L) x $\frac{29.92}{Baro.\ Press.}$

**Enthalpy for a Given Temperature & Humidity Ratio:**
(Enthalpy @ Altitude) = (Enthalpy @ S.L.)

## PSYCHROMETRIC CONVERSION FACTORS

### TEMPERATURE
°F = (1.8 X °C) + 32
°C = (°F – 32) / 1.8
°K = °C + 273
°R = °F + 460

### HUMIDITY RATIO
1 Gram/Kg = 7 Grains/lb
1 lb = 7000 Grains
1 Grain/Std. $Ft^3$ = 13.34 Grains/lb

### AIRFLOW
1 $M^3$/Min = 35.31 ACFM
1 $nM^3$/Min = 38.01 SCFM
1 $nM^3$/Hr = 0.633 SCFM

## GENERAL FORMULAS

**SENSIBLE HEAT LOAD**
CFM X 1.08 x ΔT

**LATENT HEAT LOAD**
CFM X .68 x ΔGr

**LOAD CALCULATION USING ENTHALPY**
CFM X 4.5 x ΔH

**MOISTURE ADDITION & REMOVAL**
CFM/1000 X .643 x ΔGr

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