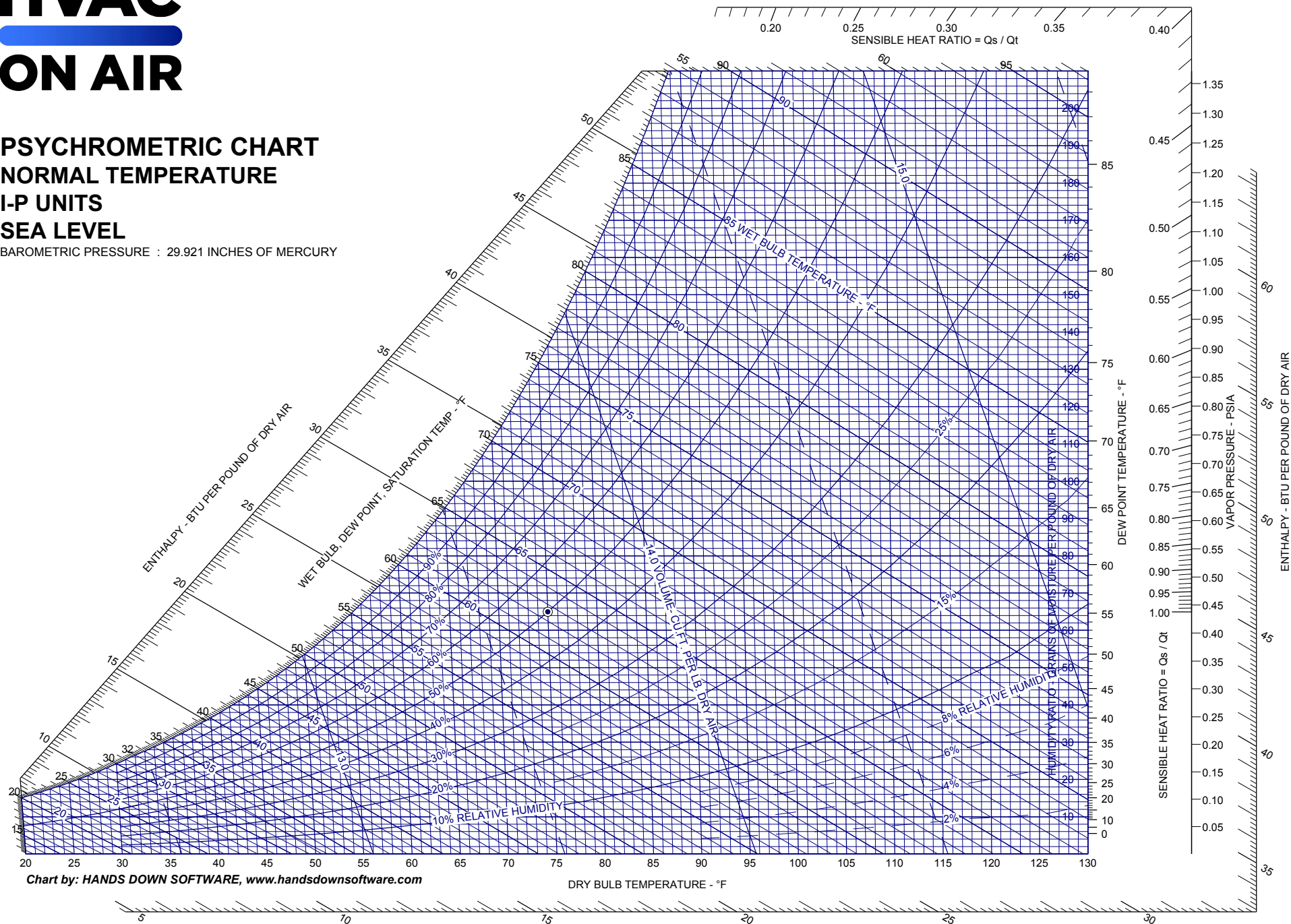


HVAC ON AIR

PSYCHROMETRIC CHART NORMAL TEMPERATURE I-P UNITS SEA LEVEL

BAROMETRIC PRESSURE : 29.921 INCHES OF MERCURY



ESSENTIAL HVAC EQUATIONS

Air-Side Heat Transfer

Sensible Heat (Air)

$$Q_s = 1.10 \cdot \text{CFM} \cdot \Delta T$$

Total Heat (Air)

$$Q_t = 4.5 \cdot \text{CFM} \cdot \Delta h$$

Sensible Heat Ratio (SHR)

$$\text{SHR} = Q_s / Q_t$$

Airflow, Velocity & Duct Relationships

Airflow, Velocity, and Area

$$\text{CFM} = A \cdot V$$

Velocity from Velocity Pressure

$$V = 4,005 \cdot \sqrt{\text{VP}}$$

Airflow from Velocity Pressure

$$\text{CFM} = A \cdot 4,005 \cdot \sqrt{\text{VP}}$$

Total Pressure Relationship

$$P_t = P_s + P_v$$

Air Changes Per Hour (ACH)

$$\text{ACH} = (\text{CFM} \cdot 60) / \text{Volume}$$

Hydronic Heat Transfer

Hydronic Heat Transfer (Water)

$$Q = 500 \cdot \text{GPM} \cdot \Delta T$$

Fan Laws

Fan – Flow

$$\text{CFM}_2 = \text{CFM}_1 \cdot (\text{RPM}_2 / \text{RPM}_1)$$

Fan – Pressure

$$P_{s2} = P_{s1} \cdot (\text{CFM}_2 / \text{CFM}_1)^2$$

Fan – Power

$$\text{HP}_2 = \text{HP}_1 \cdot (\text{CFM}_2 / \text{CFM}_1)^3$$

Pump Affinity Laws

Pump – Flow

$$\text{GPM}_2 = \text{GPM}_1 \cdot (\text{RPM}_2 / \text{RPM}_1)$$

Pump – Head

$$H_2 = H_1 \cdot (\text{RPM}_2 / \text{RPM}_1)^2$$

Pump – Power

$$\text{HP}_2 = \text{HP}_1 \cdot (\text{RPM}_2 / \text{RPM}_1)^3$$

Building Heat Transfer

Heat Transfer Through a Surface

$$Q = U \cdot A \cdot \Delta T$$

U-Value and R-Value Relationship

$$U = 1 / R$$

Electrical Power (HVAC Basics)

Electrical Power – Single-Phase

$$\text{kW} = (V \cdot I \cdot \text{PF}) / 1,000$$

Electrical Power – Three-Phase

$$\text{kW} = (\sqrt{3} \cdot V \cdot I \cdot \text{PF}) / 1,000$$

Horsepower to Electrical Power

$$\text{kW} \approx \text{HP} \cdot 0.746$$

Current from Power (Three-Phase)

$$I = (\text{kW} \cdot 1,000) / (\sqrt{3} \cdot V \cdot \text{PF})$$

HVAC

ON AIR

Common Engineering & HVAC Symbols

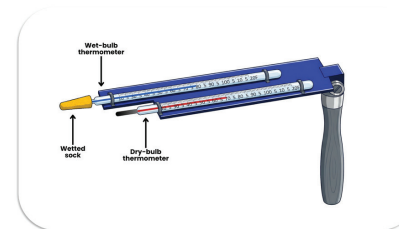
Symbol	Meaning	macOS	Windows
°	Degree	⌘ + ↑ + 8	Alt + 0176
Δ	Delta (change)	⌘ + J	Alt + 0394
✓	Square root	⌘ + V	221A → Alt + X
·	Multiplication (dot)	⌘ + ↑ + 9	Alt + 0183
×	Multiplication	↑ + 8	Alt + 0215
±	Plus / minus	⌘ + ↑ + =	Alt + 0177
≠	Not equal	⌘ + =	Alt + 8800
≤	Less than or equal	⌘ + ,	Alt + 8804
≥	Greater than or equal	⌘ + .	Alt + 8805

Properties of Air

Dry-bulb (DB)

Expressed in °F

Dry-bulb temperature is a sensible-only property and is independent of the moisture content of the air.



Wet-bulb (WB)

Expressed in °F

Wet-bulb temperature is the temperature indicated by a thermometer whose bulb is covered with a wetted wick and exposed to moving air

Humidity Ratio (w)

Expressed in grains/lb of dry air

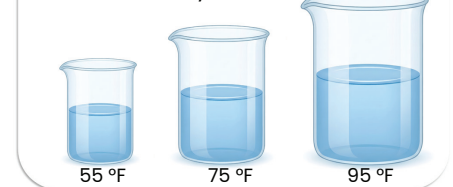
Humidity ratio is the actual amount of water vapor in the air, expressed as the mass of water vapor per mass of dry air.

Relative Humidity

Expressed in %

Relative humidity is the ratio of the actual amount of water vapor in the air to the maximum amount the air can hold at the same temperature.

Relative Humidity 50 %



Dew point (DP)

Expressed in °F

Dew point temperature is the temperature at which air becomes saturated and water vapor begins to condense when cooled at constant pressure.