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CALCULATION OF RELATIVE HUMIDITY

Relative Humidity is by definition the percentage ratio of **Vapour Pressure** to **Saturation Vapour Pressure** and is a commonly used indicator of the amount of moisture in the air. Although there are instruments that can directly measure relative humidity, **Wet Bulb Temperature** is commonly measured to enable the calculation of vapour pressure and thus relative humidity. Its measurement involves a mercury thermometer with the bulb covered by the end of a muslin wick and the other end of the wick immersed in water. Evaporation of water from the muslin cools the thermometer below the air temperature, or dry bulb temperature, to a temperature determined by the evaporation rate, which in turn is related to the moisture content of the air. Another common moisture parameter is **Dew Point Temperature**, which is calculated from wet and dry bulb temperature or from relative humidity and dry bulb temperature. The dew point temperature is a direct measure of the atmospheric moisture content and physically corresponds with the temperature to which the air must be reduced for moisture in the air to condense and thus form dew.

The equations below are applicable only when the **air temperature is greater than or equal to 0.0ºC**. For temperatures below 0.0ºC, the constants in the equations must be adjusted to reflect possible phase changes.

The following equations allow Relative Humidity to be calculated given the known parameters:

Wet Bulb Temperature, Dry Bulb Temperature, and Station Level Pressure

$$U = \frac{100\left[\exp\left[1.8096+\left(\frac{17.2694T_w}{237.3+T_w}\right)\right]-7.866\times10^{-4}P(T-T_w)\left(1+\frac{T_w}{610}\right)\right]}{\exp\left[1.8096+\left(\frac{17.2694T}{237.3+T}\right)\right]}$$

where U = Relative Humidity (%), T = Dry Bulb Temperature (°C), T_w = Wet Bulb Temperature (°C),
P = Station Level Pressure (hPa)

If pressure is not known, the following table of standard pressures can be used as a first guess.

Station Altitude (m)	0 - 250	251 - 500	501 - 750	1001 - 1250	1251 - 1500
Pressure (hPa)	998.3	969.0	940.4	912.5	885.2

The calculated relative humidity given an accurately measured station level pressure is expected to vary by 2-3% from the value calculated using a pressure from the above table.

Dry Bulb Temperature and Dew Point Temperature

$$U = \frac{100\exp\left[1.8096+\left(\frac{17.2694T_d}{237.3+T_d}\right)\right]}{\exp\left[1.8096+\left(\frac{17.2694T}{237.3+T}\right)\right]}$$

where U = Relative Humidity (%),
T = Dry Bulb Temperature (°C),
T_d = Dew Point Temperature (°C)

References:

Abbott, P.F., and Tabony, R.C. 1985. The estimation of humidity parameters. *Met. Mag.*, 114, 49-56.
Bureau of Meteorology. 2003. *Equipment Specification A2669.* 215pp.