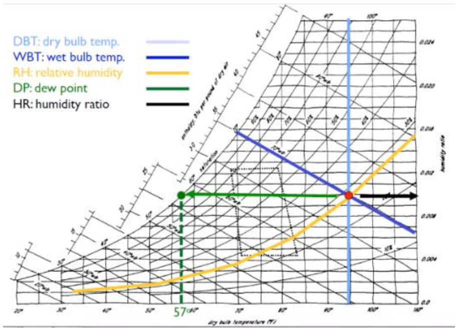
Dew point temperature: Temperature and pressure effect

Dew point? Gibbs free energy change ΔG between moisture in air and water is zero. No mass transfer between air and water at dew point.

The water-vapour content of the atmosphere varies from place to place and from time to time because the humidity capacity of air is determined by temperature. For example, at 20 degc , a cubic meter of air can hold a maximum of 18 grams of water. At 25 degc it can hold 22 grams of water. Dew points indicate the amount of moisture in the air. The higher the dew points, the higher the moisture content of the air at a given temperature. The dew point is the temperature at which air is saturated with water vapor, which is the gaseous state of water. When the air has reached the dew-point temperature at a particular pressure, the water vapor in the air is in dynamic equilibrium with liquid water, meaning water vapor is condensing at the same rate at which liquid water is evaporating, Water < = > vapor in the air]. At every temperature, the air has a certain capacity to absorb water. As temperature increases and air expands, the air has more space to absorb water, RH increases. Therefore, the dew point increases with an increase in air temperature and vice-versa. When the dew point temperature and air temperature are equal, the air is said to be saturated. Dew point temperature is never greater than the air temperature. RH can be inferred from dew point values. When air temperature and dew point temperatures are very close, the air has a high RH. The opposite is true when there is a large difference between air and dew point temperatures, which indicates air with lower RH.



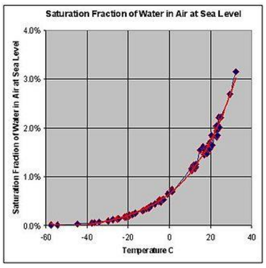


Image: Google LHS Psychrometric chart RHS saturated moisture in air

Reading dew point from the psychrometric chart: You can read the dew-point temperature directly from a psychrometric chart. Draw a horizontal line [green line] from the red point where DBT and RH intersect until you hit the 100% relative humidity line on the extreme left curve, and then read the temperature on the DBT X-axis. The chart is showing 57 deg F dew point. As explained above, as temperature increases at the same RH dew point increases because with a rise in temperature the expanded air has more capacity to hold water. This can be seen in the psychrometric chart.

At equilibrium, Water < = > Water vapor in air

At dew point temperature, at a given pressure water vapor in the air is in equilibrium with the water

Increase air temperature

Increase air temperature, which gives air capacity to hold more moisture. Air can take more water. Dew point temperature of air increases.

Decrease air temperature: Reduced temperature reduces air's moisture absorption capacity Dew point temperature of air reduces.

Effect of pressure:

The pressure of air at a temperature = [Partial pressure of O2 + Partial pressure of N2 + Partial pressure of water vapor].

At air-water equilibrium Water < = > Moisture in air

Increasing pressure increases the partial pressure of water vapor.

RH of air = [Partial pressure of moisture]/ [Equilibrium Vapor pressure of water at that temperature]

RH of water goes-up, air can take more moisture. Dew point temperature of air increases with increases in pressure and vice - versa.

Gibbs free energy: If the liquid and vapor are pure, in that they consist of only one molecular component and no impurities, then the equilibrium state between the two phases is described by the following equations

P^ [liq] = P^ [vap]

T^ [liq]=T^ [vap] and

G^ [liq]= G^ [vap]

where P^[liq] and P^[vap] are the pressures within the liquid and vapor, T^[liq] and T^[vap] are the temperatures within the liquid and vapor, and G}}^[liq] and G ^[vap]are the molar Gibbs free energies (units of energy per amount of substance) within the liquid and vapor, respectively. In other words, the temperature, pressure, and molar Gibbs free energy are the same between the two phases when they are at equilibrium.