



Standard Terminology Relating to Humidity Measurements¹

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absolute humidity, vapor concentration, vapor density, d_v —the ratio of the mass of water vapor m_v to the total volume of the moist air v :

$$d_v = \frac{m_v}{v} \quad (1)$$

dew cell, dew probe—an instrument that measures the temperature at which a saturated salt solution (usually of lithium chloride) is in equilibrium with the water vapor in moist air.

dew-/frost-point hygrometer—an instrument that measures the surface temperature at which ambient water vapor condenses.

dry-bulb temperature, t —the temperature of the ambient air, for example, the temperature that is measured by the drybulb thermometer of a psychrometer.

electric hygrometer—an instrument that determines the water vapor content of an atmosphere by measuring the change in resistance or capacitance of hygroscopic material.

enhancement factor—the correction for the departure of the mixture of air and water vapor from ideal gas laws.

ice-bulb temperature, t_i —the temperature that a thermometer indicates when its bulb is surrounded by a thin film of ice (or a frozen moistened covering), and allowed to cool by sublimation of the ice into the surrounding air.

mechanical hygrometer—an instrument for determining the water vapor content of an atmosphere by measuring the dimensional change produced in an hygroscopic material.

mixing ratio, r —the ratio of the mass of water vapor m_v to the mass of dry air m_a present in the moist air;

$$r = \frac{m_v}{m_a} \quad (2)$$

mole fraction of water vapor, x_v —the ratio of the number of moles of water vapor n_v to the total number of moles of water and dry air;

$$x_v = \frac{n_v}{n_v + n_a} \quad (3)$$

where:

$$n_v = \frac{m_v}{M_v} \quad (4)$$

$$n_a = \frac{m_a}{M_a} \quad (5)$$

and where M_v and M_a are the molecular weights of watervapor and air, respectively.

psychrometer, aspirated—an hygrometer comprising wet- and dry-bulb thermometers that are mounted in a housing to which is attached a motordriven fan or blower that draws air over the thermometer bulbs at a rate which produces the minimum wet-bulb reading.

psychrometer, sling (whirling)—an hygrometer comprising wet- and dry-bulb thermometers that are mounted on a frame that can be rotated or whirled.

relative humidity with respect to ice, U_i —the ratio in percent of the mole fraction of water vapor x_v in moist air to the mole fraction of water vapor x_{vi} that moist air would have if it were saturated with respect to ice at the same pressure p and temperature t ;

$$U_i = \frac{x_v}{x_{vi}} \times 100 \quad (6)$$

If the water vapor and air assumed to behave as ideal gases, then

$$U_i = \frac{e}{e_i} \times 100 \quad (7)$$

where e is the partial pressure of the water vapor in the moist air and e_i is the saturation vapor pressure with respect to ice at the same temperature t .

relative humidity with respect to water, U_w —the ratio in percent of mole fraction of water vapor x_v in moist air to the mole fraction of water vapor x_{vw} that the moist air would have if it were saturated with respect to water at the same pressure p and temperature t :

$$U_w = \frac{x_v}{x_{vw}} \times 100 \quad (8)$$

If water vapor and air are assumed to behave as ideal gases, then

$$U_w = \frac{e}{e_w} \times 100 \quad (9)$$

where e is the partial pressure of the water vapor in the moist air and e_w is the saturation vapor pressure with respect to water at the same temperature t .

saturation—the condition existing when a vapor is in equilibrium with the plane surface of a condensed phase of the same

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substance (liquid or solid).

saturation mixing ratio—the ratio of the mass of water vapor m_v to the mass of dry air m_a present in saturated air. The saturation mixing ratio is designated by r_w when saturation is with respect to the plane surface of liquid water, and by r_i when saturation is with respect to the plane surface of ice.

saturation vapor pressure of water—the pressure of water vapor in equilibrium with plane surface of a condensed phase. When the condensed phase is liquid, the saturation vapor pressure is designated by e_w , and when the condensed phase is solid, the saturation vapor pressure is designated by e_i . The saturation vapor pressure is a function of temperature.

specific humidity, q —the ratio of the mass of water vapor m_v to the total mass $m_v + m_a$ of the moist air:

$$q = \frac{m_v}{m_v + m_a} \quad (10)$$

thermodynamic dew-point temperature, T_d —the temperature at which moist air with mixing ratio r and total pressure p , when saturated with respect to water at the same pressure p , will have a saturation mixing ratio r_w equal to the given mixing ratio r .

thermodynamic frost-point temperature, T_f —the temperature at which moist air with mixing ratio r and total pressure p , when saturated with respect to ice at the same pressure p , will have a saturation mixing ratio r_i equal to the given mixing ratio r .

thermodynamic ice-bulb temperature, T_i —the temperature that moist air at pressure p , temperature t , and mixing ratio r will attain when brought adiabatically to saturation at pressure p by sublimation of pure ice into the moist air. The ice-bulb temperature t_i is approximately, but *not* identically, equal to the thermodynamic ice-bulb temperature T_i .

thermodynamic wet-bulb temperature, T_w —the temperature that moist air at pressure p , temperature t , and mixing ratio r will attain when brought adiabatically to saturation at pressure p by the evaporation of pure liquid water into the moist air. The wet-bulb temperature t_w is approximately, but *not* identically, equal to the thermodynamic wet-bulb temperature T_w .

vapor pressure of moist air, e —the product of the mole fraction of water vapor x_v and the total pressure p at temperature t :

$$e = px_v \quad (11)$$

If the moist air is assumed to behave in accordance with the ideal gas laws, then the vapor pressure e is identically equal to the partial pressure of the water vapor in the moist air.

wet-bulb depression, $t - t_w$ —the difference between the dry-bulb temperature and the wet-bulb temperature.

wet-bulb temperature, t_w —the temperature indicated by the wet-bulb thermometer of a psychrometer.

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