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Humidity at a Glance

Most Relevant Equations with Sample Code

This summary provides on overview on the most-used humidity-related formulas. The sample code is optimized for microprocessors (e.g. the common logarithm “log10” is used rather than the natural logarithm “ln”). For an in-depth study of the equations please refer to our complimentary paper “Introduction to Humidity” available on www.sensirion.com/humidity.

1 Relative humidity

Condition: Constant absolute humidity (e.g. closed systems).

$$RH_2 = RH_1 \exp\left[m \cdot T_n \frac{t_1 - t_2}{(T_n + t_1)(T_n + t_2)} \right]$$

RH_1	relative humidity at position 1
RH_2	relative humidity at position 2
t_1	temperature in °C at position 1
t_2	temperature in °C at position 2
m	17.62
T_n	243.12 °C

Sample code:

```
RH2 = RH1*exp(4283.78*(t1-t2)/(243.12+t1)/(243.12+t2));
```

2 Dew point

Definition: The dew point is the temperature to which a given parcel of air must be cooled, at constant barometric pressure, for water vapor to condense into water.

$$t_d(t, RH) = T_n \cdot \frac{\ln\left(\frac{RH}{100\%}\right) + \frac{m \cdot t}{T_n + t}}{m - \left[\ln\left(\frac{RH}{100\%}\right) + \frac{m \cdot t}{T_n + t}\right]}$$

t_d	dew point temperature in °C
t	actual temperature in °C
RH	actual relative humidity in %
m	17.62
T_n	243.12 °C

Sample code:

```
H  = (log10(RH)-2.0)/0.4343+(17.62*t)/(243.12+t);
td = 243.12*H/(17.62-H);
```

3 Absolute humidity

Definition: The absolute humidity is the mass of water vapor in a particular volume of dry air. The unit is g/m^3.

$$d_v(t, RH) = 216.7 \cdot \left[\frac{\frac{RH}{100\%} \cdot A \cdot \exp\left(\frac{m \cdot t}{T_n + t}\right)}{273.15 + t} \right]$$

d_v	absolute humidity in g/m^3
t	actual temperature in °C
RH	actual relative humidity in %
m	17.62
T_n	243.12 °C
A	6.112 hPa

Sample code:

```
dv = 216.7*(RH/100.0*6.112*exp(17.62*t/(243.12+t))/(273.15+t));
```

4 Mixing ratio

Definition: The mixing ratio is the mass of water vapor in a particular mass of dry air. The unit is g/kg.

$$r(t,RH) = \frac{622 \cdot \frac{RH}{100\%} \cdot A \cdot \exp\left(\frac{m \cdot t}{T_n + t}\right)}{p - \frac{RH}{100\%} \cdot A \cdot \exp\left(\frac{m \cdot t}{T_n + t}\right)}$$

r	mixing ratio in g/kg
t	actual temperature in °C
RH	actual relative humidity in %
p	barometric air pressure in hPa
m	17.62
T_n	243.12 °C
A	6.112 hPa

Sample code:

```
e = RH/100.0*6.112*exp(17.62*t/(243.12+t));
r = 622.0*e/(p-e);
```

5 Heat index

Definition: The heat index is determined according to the National Weather Service and Weather Forecast Office of the National Oceanic and Atmospheric Administration (NOAA).

$$HI_{Celsius}(t,RH) = t + \frac{5}{9} \cdot \left[\frac{RH}{100\%} \cdot \exp\left(\frac{m \cdot t}{T_n + t}\right) - 10\right]$$

$$HI_{Fahrenheit}(t,RH) = \frac{9}{5} \cdot HI_{Celsius} + 32$$

$HI_{Celsius}$	Heat index in °C
$HI_{Fahrenheit}$	Heat index in °F
t	actual temperature in °C
RH	actual relative humidity in %
m	17.62
T_n	243.12 °C

Sample code:

```
p   = RH/100.0*exp(17.62*t/(243.12+t));
HIC = t+5.0/9.0*(p-10.0); // this is the heat index in Celsius
HIF = 9.0/5.0*HIC+32.0; // this is the heat index in Fahrenheit
```

Revision History

Date	Revision	Changes
Aug. 20, 2008	1.0	Initial version

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