

HUMIDITY LAB

How to determine Relative Humidity and Dew Point Temperatures

The formula for Relative Humidity is a very simple equation.

$$\text{RH \%} = \frac{\text{Actual H}_2\text{O (vapor)}}{\text{Capacity of Air}} \leftarrow \text{which is related to} \rightarrow \text{Air Temperature}$$

So you need to know the Air Temperature to find the Capacity (see chart below).

Thus if you know the amount of water vapor in the air (Actual H₂O) and the Capacity of the air, you simply perform a division problem to get your answer.

CAPACITY TABLE

Temperature		Capacity
°C	(°F)	(Sat. Mix. Ratio g/kg)
-40	-40	0.1
-30	-22	0.3
-20	-4	0.75
-10	14	2
0	32	3.5
5	41	5
10	50	7
15	59	10
20	68	14
25	77	20
30	86	26.5
35	95	35
40	104	47

For example:

An air mass has a temperature of 20° C and has 10 g/kg of water vapor

$$\text{RH\%} = \frac{\text{ACT H}_2\text{O}}{\text{CAP}} \leftarrow \rightarrow \text{TEMP}$$

The ACT is 10,
The TEMP is 20° ← But we need to use the table to determine the capacity...20° has a capacity of 14 g/kg

$$\text{RH\%} = \frac{10}{14} \leftarrow \rightarrow 20^\circ$$

$$\frac{10}{14} = 0.71428 \text{ (x 100)} = 71.4\% \text{ RH}$$

To determine DEW POINT TEMPERATURE, the formula and process is very similar.

The Dew Point Temperature is the temperature where the air reaches Saturation (or 100% RH)

Thus we can use the same basic formula, but change it so that we are not looking for the RH, but instead are looking for a new TEMP (which in this case will be the Dew Pt Temp.)

$$100\% \text{ RH} = \frac{\text{Actual H}_2\text{O (vapor)}}{\text{Capacity of DPT}} \leftarrow \text{which is related to} \rightarrow \text{Dew Point Temperature}$$

For example:

Determine the Dew Pt. Temp for the following:

An air mass has a temperature of 20° C and has 10 g/kg of water vapor

$$100\% \text{ RH} = \frac{\text{ACT H}_2\text{O}}{\text{CAP dpt}} \leftarrow \rightarrow \text{TEMP dpt}$$

The ACT is 10,
The TEMP is 20°, But we need to find the DEW PT TEMP!
All we know is the ACT!

$$100\% \text{ RH} = \frac{10}{X} \quad \text{Since 100\% is the same as 1, both the top (numerator) and bottom (denominator) must be the same!}$$

Thus the CAP (X above) is equal to the ACT H₂O in all cases with 100% RH

$$100\% \text{ RH} = \frac{10}{X} \quad 100\% = \frac{10}{10} \quad X = 10$$

The CAP of the Dew Pt Temp is 10.

Now using the capacity chart, look up a capacity of 10 g/kg and find the corresponding temperature is 15°

15° is the Dew Point Temperature of the air mass above.

6. If a parcel of air at 15°C contains 10 grams of water vapor, what is the relative humidity of the air?

7. What is the actual water vapor amount in 20°C air when relative humidity is 50%?

8. If a 25°C air mass is saturated, what is the actual water vapor amount?

9. What is the dew point of a 25°C parcel of air containing 14 grams of water vapor?

10. On a cold day in December the relative humidity measures 20% and on a hot day in August the relative humidity also measures 20%. Does this indicate the same water vapor presence on both days?

11. During the winter months, cold air is brought into homes and heated. Explain how this process changes the relative humidity in the house. In order to compensate for this phenomenon many homes utilize an appliance to keep their surroundings comfortable. What item might they use to fix this situation?