CALCULATE WHETHER THERE IS A RISK OF CONDENSATION ON THE MIRROR!!

Each material has its own radiation cooling property (which is not easy to calculate by the way). Just know that if there is no wind, the radiation cooling is low and surfaces will not equilibrate thermally with the ambient temperature very quick. Also, a surface, even with moderate ability to radiate, looking into a "cold" sky can cool down several degrees below ambient temperature. Fortunately, a mirror radiates very little. Nevertheless, when cooling the mirror during the day, the mirror temperature is usually several degrees below ambient temperature and there are risk of condensation. The control loop will turn off the cooling when the difference between the mirror temperature and the dew point shrinks to only 2 degrees.

Knowing the Relative Humidity (RH in %) and the ambient temperature (Ta) of the air, one can calculate the dew point temperature (Td) and determine whether a surface at temperature Ts can become wet or not :

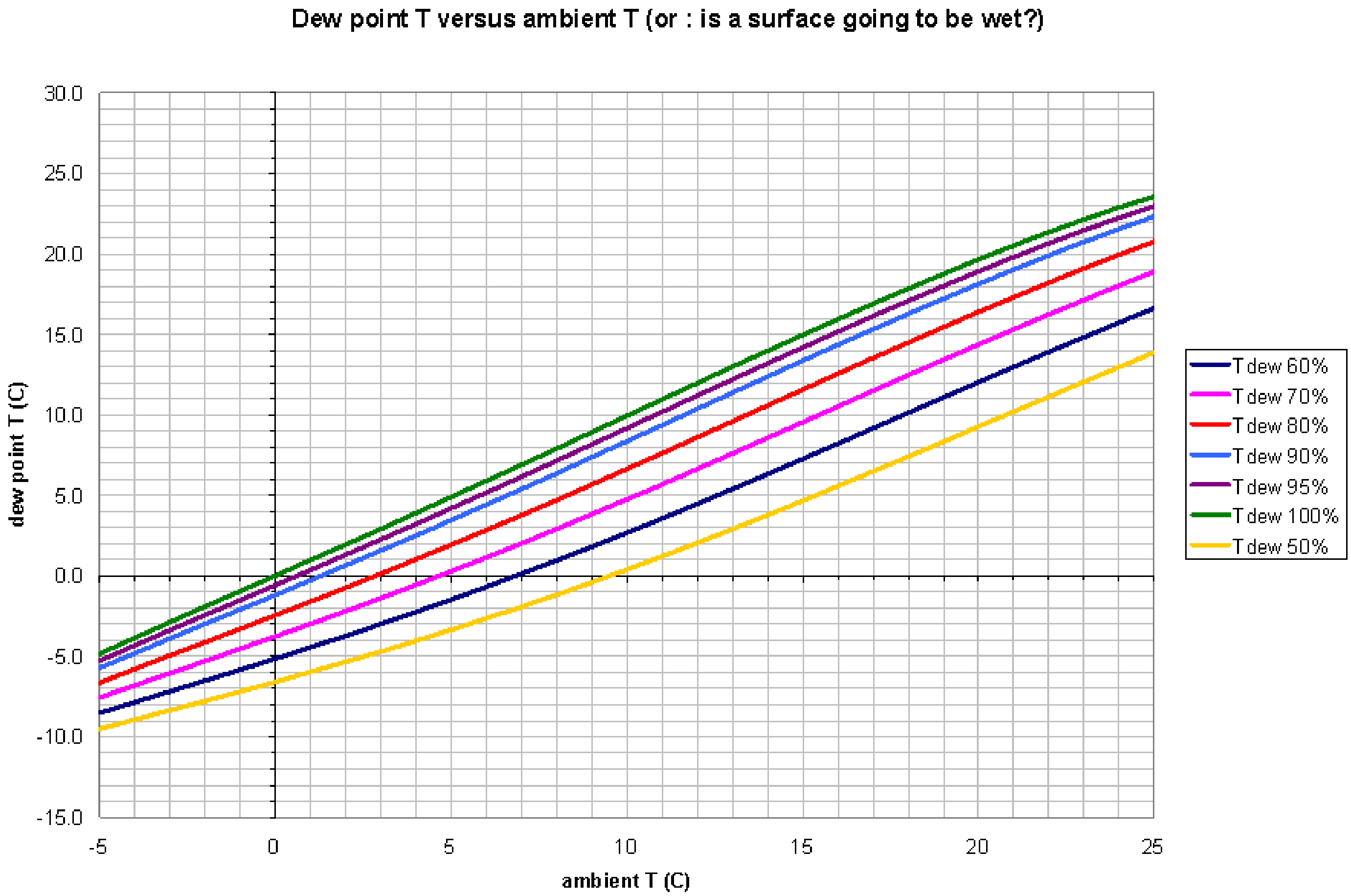
- if Ts<Td: surface becomes wet
- if Ts>Td: surface keeps dry

I think "dew point" refers only to the case where RH=100%; when RH<100% we might have to talk about condensation point. We won't do that distinction anymore in the text.

How to use the table?

From your ambient temperature on the X-axis, go up to intersect the curve corresponding to the RH, then move horizontally onto the left to read the dew point on the Y-axis. You can then check if your surface is hotter or colder than this dew point value.

Example: Ta is 10°C, RH is 80%, Td is 6.5°C. So a 5°C mirror would be wet!



Calculation of dew point:

- The dew point is the temperature at which the partial pressure of ambient air (PA) is equal to the partial pressure of saturated water vapour (PS).

- The pressure of saturated water vapour is tabulated versus temperature at sea level in thermodynamic books. Numbers from -10 to +35degC are used to determine empirically the relation PS = f(T) and adjust it for Tololo's elevation.

  PS = (5.10^-7.T^3 + 10^-5.T^2 + 5.10^-4.T + 0.0061) / 1.294

- PV = RH * PS where RH is between 0 and 1

- We can then empirically determine Td = g(PV) for different values of RH with the following equation:

  Td = 6.10^8.PV^5 - 10^8.PV^4 + 6.10^6.PV^3 - 193789.PV^2 + 3957.9.PV -14.911

- The fit is quite good, yielding accuracy for Td of less then 0.3deg between 0 and 20deg C.