



Application Note: Comfort indexes (Work In Progress)

This document is dedicated to comfort indexes, which are often related to humidity.

A comfort index is an attempt to evaluate the ability of a given set of environmental variables, such as temperature, humidity, wind, sunlight, to provide subjective comfort to human beings.

The main comfort indexes around the world include:

- Wet Bulb Globe Temperature (WBGT);
- Wind chill temperature;
- Heat Index;
- Humidex.

Various comfort indexes can be calculated based on data output from the RDL. In the current version of the RDL, only one index can be calculated within the device, the Wet Bulb Globe Temperature. Other comfort indexes can be calculated from the raw data as post-treatment by the user. The required equations are provided in the present document. A more advanced user could also add the equations into the source code.

- Wet Bulb Globe Temperature (WBGT)
 - The WBGT is commonly used as a measure of comfort. Devices like the QuesTEMP 32 are used to measure this index (Figure 1). The equation is:
 - $WBGT = (0.7 \times Tw) + (0.2 \times Tg) + (0.1 \times Ta)$
 - Tw = Natural wet bulb temperature, °C
 - Tg = Black globe temperature, °C
 - Ta = Ambient air temperature ('shade air temperature'), °C
 - In the absence of sunlight, such as in a room without windows, the equation is reduced to:
 - $WBGT = (0.7 \times Tw) + (0.3 \times Tg)$



Figure 1 QuesTEMP 32 device for WBGT measurements

- Wind chill temperature
 - Broadly speaking, the wind chill temperature (or wind chill index) is the apparent temperature perceived by the human face due to the increased heat loss caused by air velocity. The equation has evolved overtime and varies depending on regions, but the U.S. and Canada use a model accepted by the National Weather Service (see below). Wind chill is useful to evaluate thermal comfort and the risk of frostbites. The wind chill temperature is only defined for temperature at or below 10°C and wind speeds above 4.8 km/h.
 - The wind chill equation is ...
 - $R = 13.12 + 0.6215 T - 11.37 (V^{0.16}) + 0.3965 T (V^{0.16})$
 - where R is the wind chill index; T is the air temperature in degrees Celsius (°C); V is the wind speed at 10 meters (i.e., standard anemometer height), in kilometers per hour (km/h).
- Humidex
 - Humidex was invented by Canadians in 1965 to describe how hot, humid air feels on the human body. The equation is:
 - $H = T + (5 / 9)(P_v - 10)$
 - where H is humidex index, T is temperature in Celcius and P_v is the water vapor pressure in millibar (mbar)



Table 1 Degrees of comfort associated with humidex values

Range of humidex	Degree of comfort
Less than 29	No discomfort
30 to 39	Some discomfort
40 to 45	Great discomfort; avoid exertion
Above 45	Dangerous
Above 54	Heat stroke imminent

REFERENCES

Yunus A. Çengel. 2007. *Heat & Mass Transfer: A Practical Approach*. McGraw-Hill Education (India) Pvt Limited.

1. <https://www.weather-above.com/blackball%20sensor.html>