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Psychrometer Kit
#PSYCHRKT

Warning:

- **Not a toy; use only in a laboratory or educational setting.**
- **Contains latex.**
- **Contains small parts.**
- **Eye protection is recommended.**
- **California Proposition 65 Warning: This product can expose you to chemicals including nickel and lead, which are known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.**

Introduction

The purpose of a psychrometer is to measure the relative humidity in the air. The water vapor in the air will change based on the weather conditions in various regions of the world. For example, a rain forest, which has high humidity, will have a larger amount of water vapor content in the air compared to a desert with very low or no humidity.

Many substances are hygroscopic, meaning they attract water, usually in proportion to the relative humidity. Some of these substances are cotton, paper, wood products, sugar, chemicals and fertilizers. In many industries, it is important to reduce the amount of humidity to avoid condensation or corrosion which could ruin the product.

The psychrometer kit allows you to measure the amount of water vapor in the air relative to humidity and dew point.

Absolute Humidity is the total mass of water vapor present in a given volume of air. Absolute humidity can range from 0 to 30 grams per cubic meter when the air is saturated at 30° Celsius. Absolute Humidity is the mass of water vapor (mH_2O), divided by the volume of air and water vapor mixed (V_{net}). The absolute humidity will change as temperature or pressure changes. $AH = (mH_2O)/ V_{net}$.

Relative humidity is a percentage of how much moisture the air contains relative or compared to how much water the air could contain. Relative humidity is defined as the ratio of the partial pressure of water vapor in the air (PH_2O) relative to the equilibrium vapor pressure of water (P^*H_2O) at a given temperature. $RH = (PH_2O)/ (P^*H_2O)$.

At the point when the air contains the maximum capacity of water vapors it is **saturated**. The temperature at the point of saturation is called the **dew point**. As the temperature becomes lower it will eventually reach the point of saturation without a change in the water mass. The temperature has a significant effect on the amount of saturation; for example, a unit of water vapor may contain 28 grams of water per cubic meter of air at 30° Celsius, but only 8 grams of water at 8° Celsius.

Temperature is an important factor and is required to change water into water vapor which is known as **evaporation**. As water evaporates, it has a cooling effect on the air. Warm air holds more moisture then cool air. The more humidity there is in the air, the less evaporation or cooling can take place.

Materials Supplied:
- Dry-Bulb Thermometer
- Wet-Bulb Thermometer
- Sling Handle
- Cloth
- Rubber Bands

The Dry Bulb Thermometer is the temperature indicated on the thermometer exposed to the air.

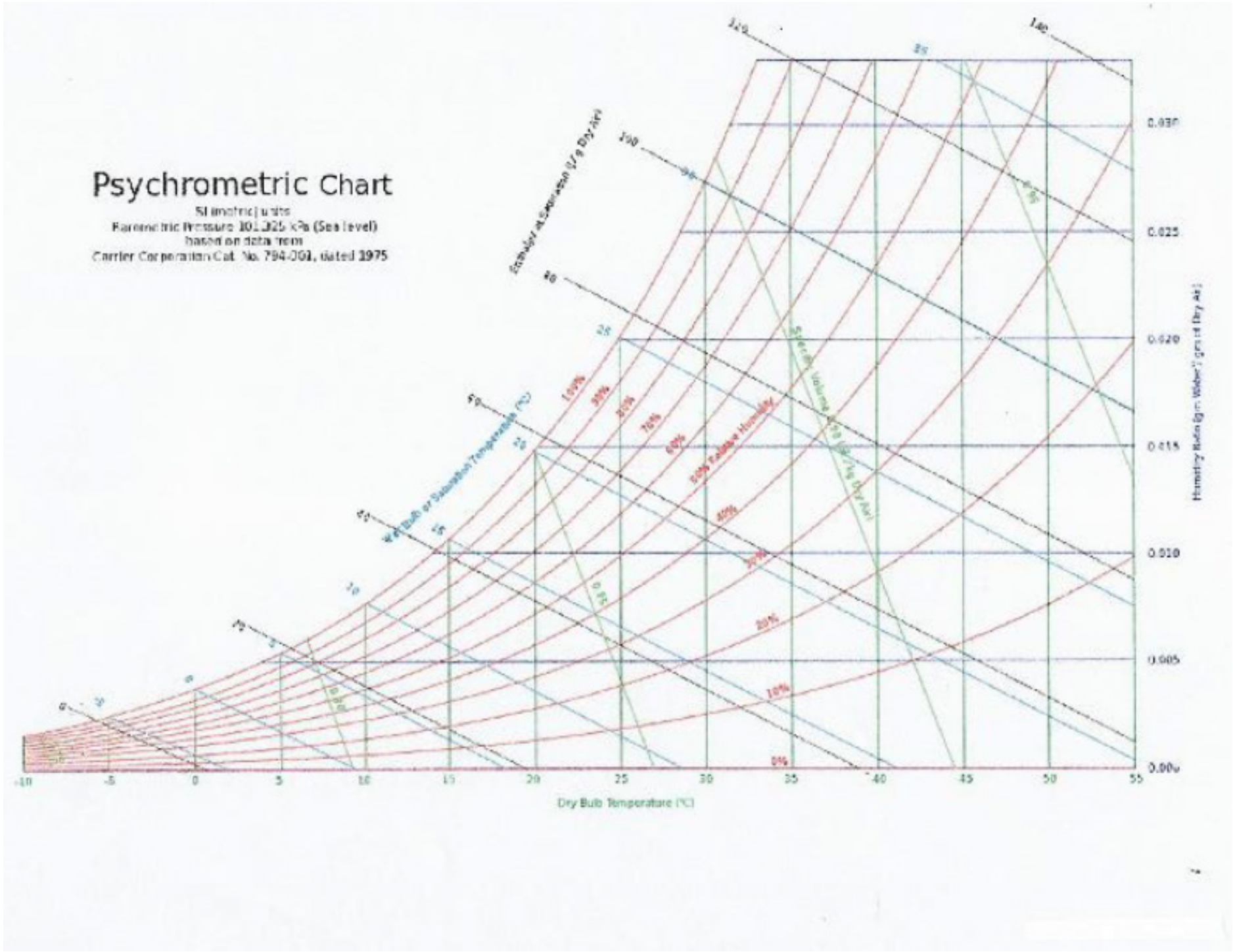
The Wet Bulb Thermometer provides a fairly accurate approximation of the thermodynamic wet-bulb temperature. The wet bulb thermometer is used to record how much evaporation takes place at the temperature of the air. If the air is dry, a greater amount of evaporation will take place as the air passes over the wet bulb thermometer, which will have a cooling effect. If the air is humid, less evaporation and cooling will take place and the temperature will register at a higher range. The accuracy of a wet bulb thermometer depends on how fast the air passes over the thermometer. The temperature taken with air moving at 2.5m/s or more is referred to as a sling temperature.

How to Use

1. Make sure your thermometers are securely fixed to the psychrometer.
2. Prepare your two thermometers. For the dry-bulb, do nothing. For the wet-bulb, soak the cotton cloth in distilled water just prior to slinging the psychrometer.
3. Sling your psychrometer by spinning the two thermometers around on their post for 30 seconds to a minute.
4. Compare your results to the chart on the following page.

    To determine the relative humidity, find the value of the dry bulb thermometer which represents the air temperature on the dew point chart. Find the temperature on the wet bulb thermometer on the diagonal axis on the left side of the chart. The point where the readings intersect on the chart is the relative humidity; the curved lines closest to the intersection of the two points.

    To determine the humidity ratio, start at the point where your two lines intersected and follow it to the right of the chart where the humidity ratio is listed horizontally.


Psychrometric Chart
SI metric units
Barometric Pressure 101.325 kPa (Sea level)
based on data from
Carrier Corporation Cat. No. 794-001, dated 1975
Dry Bulb Temperature (°C)
Wet Bulb or Saturation Temperature (°C)
Humidity Ratio (gm. Water / gm. of Dry Air)
Specific Volume m³/kg Dry Air
Enthalpy at Saturation kJ/kg Dry Air
100%
90%
80%
70%
60%
50% Relative Humidity
40%
30%
20%
10%
0%
-10
-5
0
5
10
15
20
25
30
35
40
45
50
55
0.030
0.025
0.020
0.015
0.010
0.005
0.000