

## CHAPTER 6

### HUMIDITY

6.1 **GENERAL.** Humidity is a measure of the water vapour content of the air. It is calculated with respect to water, both at temperatures above and below freezing. Humidity is commonly expressed in terms of dew-point temperature and relative humidity.

6.2 **DEWPOINT – Definition.** The dewpoint is the temperature at which the air would become saturated (with respect to water) if cooled at constant pressure and without the addition or removal of water vapour. The dewpoint is expressed in degrees Celsius.

6.3 **RELATIVE HUMIDITY – Definition.** Relative Humidity is the ratio, expressed as a percentage, of the amount of water vapour actually present in the air to the amount of water vapour which would be present if the air were saturated with respect to water at the same temperature and pressure.

6.4 **DETERMINATION OF RELATIVE HUMIDITY.** The wet and dry bulb psychrometer is the standard equipment used to determine relative humidity. The computation of the dew-point temperature and relative humidity shall be carried out using the approved psychrometric tables. Each observing station is provided with the appropriate books of psychrometric tables for both ventilated and non-ventilated psychrometers. The various psychrometric tables with form numbers are listed below:

#### Ventilated Psychrometer

Book 1 Form 63-2201 Station elevation less than 305 m (1000 ft.)

Book 2 Form 63-2202 Station elevation 305 m to 760 m (1000 to 2500 ft.)

Book 3 Form 63-2203 Station elevation more than 760 m (2500 ft.)

#### Non-ventilated Psychrometer

Book 4 Form 63-2204 Station elevation less than 305 m (1000 ft.)

Book 5 Form 63-2205 Station elevation 305 m to 760 m (1000 to 2500 ft.)

Book 6 Form 63-2206 Station elevation more than 760 m (2500 ft.)

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Notes: (1) For detailed instructions with examples on the calculation of dewpoint and relative humidity, refer to Psychrometric Tables, page vi, para.3.

(2) The discontinuity in relative humidity and dew-point values, which appears in the psychrometric tables along a diagonal line through points corresponding to the change in the wet bulb temperature from 0°C to less than 0°C, is NOT an error in the tables. Refer Psychrometric Tables, page vii, paragraph 3.2.2.

6.4.1 Humidity at Low Temperature. Great care shall be taken to ensure proper functioning of the wet bulb (para. 5.4) particularly at low temperatures when the difference between the wet and dry bulb temperatures is small, as errors in reading, correcting and maintaining the thermometer result in large humidity errors.

6.5 DEWCEL. The dewcel is an instrument used to determine the dewpoint. It consists of a temperature sensor covered with wicking soaked in a solution of lithium chloride, and over which is wound a pair of bare gold wires, which do not touch each other. An electrical potential applied to the wires causes a flow of current through the lithium chloride solution and raises the temperature of the solution until its vapour pressure is in equilibrium with that of the ambient air.

6.5.1 At certain designated stations the AES Dewcel, in conjunction with a Dry Bulb Thermistor and Remote Temperature Indicator, is used as operational equipment for the purpose of determining air temperature, dewpoint and relative humidity. Detailed instructions regarding the operation, maintenance and limitations of this equipment are given in Instrument Manual 32 – Remote Temperature and Dew-point Measuring System Type 2. From the readings of the Remote Temperature Indicator, the temperature and dewpoint may be determined for instrument exposures up to 300 m distant. The wet bulb temperature and the relative humidity cannot be obtained directly from this equipment; they can, however, be determined by referring the derived dry bulb and dew-point temperatures to the appropriate Book of Psychrometric Tables.

6.5.2 Low Temperature Limit. The AES Dewcel will not operate below ambient temperatures of -45 C. It will not be damaged however, by exposure to temperatures below its effective limit. The associated Dry Bulb Thermistor may be used throughout the entire range of ambient air temperature.

6.5.3 Dew-point temperatures may be read and recorded directly from the right display of the AES Remote Temperature and Dewpoint (1987) System (RTD-87), at stations so equipped. Operating instructions are found in Section 4 of the Technical Manual TM 02-04-01.

## 6.6 DEWCEL/PSYCHROMETRIC COMPARISONS

6.6.1 Purpose: Dewpoint-Dewcel comparisons are required to confirm the accuracy of the dewcel system, help to establish the washing frequency and to ensure that a servicable psychrometer is available in the event that the dewcel becomes inoperative. All comparisons shall be made with a ventilated psychrometer, motor or sling.

### 6.6.2 Frequency of Comparisons

- a) During the Initial Installation, Inspector on site: To the extent possible, comparisons should be made hourly for the first 24 h of operation. Comparisons should be made at least during daylight hours.
- b) After Acceptance: During the first four months following acceptance, dewcel-psychrometric comparisons shall be made 4 times daily, at the "synoptic hours. This comparison is to help establish the cleaning frequency.

6.6.2.1 Comparisons After Cleaning: After the installation of a cleaned and activated dewcel, verify its operation by making 4 comparisons at consecutive hourly observing times. When the dewcel operation is verified, make comparisons once a week. The time of the day and the day of the week for

the comparison is left to the discretion of the station manager.

6.6.3 Recording of Comparisons: Except for the comparisons made during the initial installation, all comparisons are to be recorded.

6.6.3.1 On form 63-2325: Record the time, UTC, of the comparison reading and the values observed.

6.6.3.2 On form 63-2322: In column 1, record only the time, UTC, of the comparison.

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6.6.3.3 The above schedule of comparison readings is essential.

6.6.4 Dewcel Unserviceable. When the dewcel is unserviceable for any reason, other than low temperature limit, the psychrometric data shall be calculated from dry and wet bulb readings obtained from one of the following; motor ventilated psychrometer, sling psychrometer, simple psychrometer.

6.7 HYGROGRAPH. Some stations are equipped with a hygrograph, which consists of humidity-sensitive elements (strands of hair) whose movements are communicated by suitable linkage to a pen, marking a chart mounted on a clockwork-driven drum. This instrument is calibrated to provide a continuous record of relative humidity. Even at temperatures below freezing, the hair continue to indicate humidity with respect to water and are, therefore, quite suitable for meteorological purposes. However, at low temperatures, other effects result in lack of correct response. The hygrograph is not regarded as a primary standard for measuring humidity, but if it is maintained in good condition and check readings indicate that it is reasonably close to values of humidity determined from the wet and dry bulb psychrometer, it may be used when the regular wet bulb psychrometer is out of service. When the relative humidity and dry bulb temperature are known it is possible to work back through the tables to determine the dew-point. In all cases when the relative humidity and dew-point are determined by use of the hygrograph, rather than the wet and dry bulb psychrometer, an identifying mark (\*) shall be made over the recorded entries and a note made on the page to indicate that the values entered were determined from the hygrograph.