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Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)[1]

This standard is issued under the fixed designation E337; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 *General:*

1.1.1 This test method covers the determination of the humidity of atmospheric air by means of wet- and dry-bulb temperature readings.

1.1.2 This test method is applicable for meteorological measurements at the earth's surface, for the purpose of the testing of materials, and for the determination of the relative humidity of most standard atmospheres and test atmospheres.

1.1.3 This test method is also applicable when the temperature of the wet bulb only is required. In this case, the instrument comprises a wet-bulb thermometer only.

1.1.4 Relative humidity (RH) does not denote a unit. Uncertainties in the relative humidity are expressed in the form $RH \pm rh$ %, which means that the relative humidity is expected to lie in the range ($RH - rh$) % to ($RH + rh$) %, where RH is the observed relative humidity. All uncertainties are at the 95 % confidence level.

1.2 *Method A—Psychrometer Ventilated by Aspiration:*

1.2.1 This method incorporates the psychrometer ventilated by aspiration. The aspirated psychrometer is more accurate than the sling (whirling) psychrometer (see Method B), and it offers advantages in regard to the space which it requires, the possibility of using alternative types of thermometers (for example, electrical), easier shielding of thermometer bulbs from extraneous radiation, accidental breakage, and convenience.

1.2.2 This method is applicable within the ambient temperature range 5 °C to 80 °C, wet-bulb temperatures not lower than 1 °C, and restricted to ambient pressures not differing from standard atmospheric pressure by more than 30 %.

1.3 *Method B—Psychrometer Ventilated by Whirling (Sling Psychrometer):*

1.3.1 This method incorporates the psychrometer ventilated by whirling (sling psychrometer).

1.3.2 This method is applicable within the ambient temperature range 5 °C to 50 °C, wet-bulb temperatures not lower than 1 °C and restricted to ambient pressures not differing from standard atmospheric pressure by more than 30 %.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 **Warning—***Mercury has been designated by many regulatory agencies as a hazardous material that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Safety Data Sheet (SDS) for additional information. Users should be aware that selling mercury and/or mercury containing products into your state or country may be prohibited by law.*

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* (For more specific safety precautionary statements, see 8.1 and 15.1.)

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D861 Practice for Use of the Tex System to Designate Linear Density of Fibers, Yarn Intermediates, and Yarns

D1193 Specification for Reagent Water

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

[1] This test method is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.11 on Meteorology.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

D1357 Practice for Planning the Sampling of the Ambient Atmosphere
D3631 Test Methods for Measuring Surface Atmospheric Pressure
D4023 Terminology Relating to Humidity Measurements (Withdrawn 2002)[3]
D4230 Test Method for Measuring Humidity with Cooled-Surface Condensation (Dew-Point) Hygrometer
E1 Specification for ASTM Liquid-in-Glass Thermometers
E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids
IEEE/ASTM SI-10 Practice for Use of the International System of Units (SI) (the Modernized Metric System)

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of humidity terms used in this test method, refer to Terminology D4023.

3.1.2 For definitions of other terms in this test method, refer to Terminology D1356.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Method A—Aspirated Psychrometer:*

3.2.1.1 *aspiration*—the wet and dry bulbs (and the psychrometer) are described as aspirated because there is provision for the forced ventilation by drawing air over the bulbs by suction. The flow may be either transverse or parallel to the axes of the bulbs.

3.2.1.2 *thermometer*—for purposes of this standard, and except where a specific type is indicated, the term thermometer means any temperature-measuring device.

3.2.1.3 *wet-bulb covering and wick*—the wet bulb is provided with a water-retaining covering of a woven-cotton material. A cotton wick which connects the covering to a water reservoir may be provided so that water is fed to the covering continuously by capillarity.

3.2.2 *Method B—Sling Psychrometer:*

3.2.2.1 *ventilation*—the wet and dry bulbs (and the psychrometer) are described as ventilated because there is provision for a flow of the air over the bulbs. The flow is transverse to the axes of the bulbs.

3.2.2.2 *wet-bulb covering*—the wet bulb is provided with a water-retaining covering of a woven-cotton material.

4. Summary of Methods

4.1 *General:*

4.1.1 The wet-bulb temperature depression, the dry-bulb temperature, and the ambient pressure provide the basis for deriving the relative humidity.

4.2 *Method A—Aspirated Psychrometer:*

4.2.1 Establish the airflow (see 7.4) and maintain it until a minimum wet-bulb temperature is attained. (With mercury-in-glass thermometers, about 2-min ventilation time is usually necessary.)

4.2.2 Read the thermometers with the necessary precision, obtaining the dry-bulb temperature with an overall uncertainty of ±0.2 °C or better, and the temperature depression with an overall uncertainty of ±0.2 °C or better for an uncertainty in the relative humidity of ±3 % RH. For an uncertainty in the relative humidity of ±2 % RH, obtain the dry-bulb temperature with an overall uncertainty of ±0.2 °C or better and the temperature depression with an overall uncertainty of ±0.1 °C or better. (Also see Section 12.)

4.3 *Method B—Sling Psychrometer:*

4.3.1 Holding the instrument well away from the body, and for outdoor measurements to windward and in the shade, whirl it at such a rate as to achieve the specified airspeed at the wet and dry bulbs, see 14.4.

4.3.2 Read the thermometers with the necessary precision, obtaining the dry-bulb temperature with an overall uncertainty of ±0.6 °C or better, and the temperature depression with an overall uncertainty of ±0.3 °C or better for an uncertainty in the relative humidity of ±5 % RH, also see Section 19.

5. Significance and Use

5.1 The object of this test method is to provide guidelines for the construction of a psychrometer and the techniques required for accurately measuring the humidity in the atmosphere. Only the essential features of the psychrometer are specified.

METHOD A—PSYCHROMETER VENTILATED BY ASPIRATION

6. Interferences

6.1 When an aspirated psychrometer is used for measurements in a small enclosed space and steadily rising wet- and dry-bulb temperatures are observed, consider whether heat and moisture liberated by the instrument itself are affecting the conditions.

6.2 While the thermometers are being read, keep all surfaces that are at temperatures other than the environment (such as the hands, face, and other warmer or colder objects) as far as possible from the thermometer bulbs.

6.3 This method should not be used where there is heavy contamination of the air with gases, vapors, or dust.

7. Apparatus

7.1 *Thermometers for an Aspirated Psychrometer:*

7.1.1 The range of the thermometers shall not exceed the range 0 °C to 80 °C. This range may be achieved by providing more than a single pair of matched thermometers. When the uncertainty in the derived relative humidity is required to be not more than ±3 % RH, the thermometers shall be such that their readings give the temperature depression with an uncertainty of not more than ±0.2 °C. When the uncertainty in the relative humidity is required to be not more than ±2 % RH, they shall be such that their readings give the temperature depression with an uncertainty of not more than ±0.1 °C. The uncertainty in the reading of the dry-bulb temperature shall be not more than ±0.2 °C.

7.1.2 Electrical thermometers may be so connected that the readings give the temperature depression and the dry-bulb temperature directly.

[3] The last approved version of this historical standard is referenced on www.astm.org.