



Terminology Relating to Thermometry and Hydrometry¹

This standard is issued under the fixed designation E344; 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 This terminology is a compilation of definitions of terms used by ASTM Committee E20 on Temperature Measurement.

1.2 Terms with definitions generally applicable to the fields of thermometry and hydrometry are listed in 3.1.

1.3 Terms with definitions applicable only to the indicated standards in which they appear are listed in 3.2.

1.4 Information about the International Temperature Scale of 1990 is given in [Appendix X1](#).

2. Referenced Documents

2.1 *ASTM Standards*:²

- E1 Specification for ASTM Liquid-in-Glass Thermometers
- E77 Test Method for Inspection and Verification of Thermometers
- E100 Specification for ASTM Hydrometers
- E126 Test Method for Inspection, Calibration, and Verification of ASTM Hydrometers
- E207 Test Method for Thermal EMF Test of Single Thermoelement Materials by Comparison with a Reference Thermoelement of Similar EMF-Temperature Properties
- E220 Test Method for Calibration of Thermocouples By Comparison Techniques
- E230 Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples
- E452 Test Method for Calibration of Refractory Metal Thermocouples Using a Radiation Thermometer
- E574 Specification for Duplex, Base Metal Thermocouple Wire With Glass Fiber or Silica Fiber Insulation
- E585/E585M Specification for Compacted Mineral-Insulated, Metal-Sheathed, Base Metal Thermocouple Cable
- E601 Guide for Measuring Electromotive Force (emf) Sta-

- bility of Base-Metal Thermoelement Materials with Time in Air
- E608/E608M Specification for Mineral-Insulated, Metal-Sheathed Base Metal Thermocouples
- E644 Test Methods for Testing Industrial Resistance Thermometers
- E667 Specification for Mercury-in-Glass, Maximum Self-Registering Clinical Thermometers
- E696 Specification for Tungsten-Rhenium Alloy Thermocouple Wire
- E710 Test Method for Comparing EMF Stabilities of Base-Metal Thermoelements in Air Using Dual, Simultaneous, Thermal-EMF Indicators (Withdrawn 2006)³
- E780 Test Method for Measuring the Insulation Resistance of Mineral-Insulated, Metal-Sheathed Thermocouples and Thermocouple Cable at Room Temperature
- E825 Specification for Phase Change-Type Disposable Fever Thermometer for Intermittent Determination of Human Temperature
- E839 Test Methods for Sheathed Thermocouples and Sheathed Thermocouple Cable
- E879 Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
- E1061 Specification for Direct-Reading Liquid Crystal Forehead Thermometers
- E1104 Specification for Clinical Thermometer Probe Covers and Sheaths
- E1112 Specification for Electronic Thermometer for Intermittent Determination of Patient Temperature
- E1129/E1129M Specification for Thermocouple Connectors
- E1137/E1137M Specification for Industrial Platinum Resistance Thermometers
- E1159 Specification for Thermocouple Materials, Platinum-Rhodium Alloys, and Platinum
- E1256 Test Methods for Radiation Thermometers (Single Waveband Type)
- E1299 Specification for Reusable Phase-Change-Type Fever Thermometer for Intermittent Determination of Human Temperature
- E1350 Guide for Testing Sheathed Thermocouples, Thermocouples Assemblies, and Connecting Wires Prior to, and

¹ This terminology is under the jurisdiction of ASTM Committee E20 on Temperature Measurement and is the direct responsibility of Subcommittee E20.91 on Editorial and Terminology.

Current edition approved Nov. 1, 2016. Published December 2016. Originally approved in 1968. Last previous edition approved in 2013 as E344 – 13. DOI: 10.1520/E0344-16.

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.

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

After Installation or Service

E1502 Guide for Use of Fixed-Point Cells for Reference Temperatures

E1594 Guide for Expression of Temperature

E1684 Specification for Miniature Thermocouple Connectors

E1750 Guide for Use of Water Triple Point Cells

E1751 Guide for Temperature Electromotive Force (EMF) Tables for Non-Letter Designated Thermocouple Combinations (Withdrawn 2009)³

E1965 Specification for Infrared Thermometers for Intermittent Determination of Patient Temperature

E2181/E2181M Specification for Compacted Mineral-Insulated, Metal-Sheathed, Noble Metal Thermocouples and Thermocouple Cable

E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

E2593 Guide for Accuracy Verification of Industrial Platinum Resistance Thermometers

2.2 Other Standards, Supplementary Vocabularies, and Sources:⁴

International Vocabulary of Basic and General Terms in Metrology (VIM) 1993

Guide to the Expression of Uncertainty in Measurement (GUM) 1995

IEC 61298-1 Process Measurement and Control Devices General Methods and Procedures for Evaluating Performance- Part 1: General Considerations⁵

3. Terminology

3.1 Definitions:

accuracy, *n*—of a temperature measurement, closeness of agreement between the result of a temperature measurement and a true value of the temperature.

DISCUSSION—Accuracy is a qualitative concept.

base metal thermocouple, *n*—thermocouple whose thermoelements are composed primarily of base metals and their alloys. (See also **noble metal thermocouple**; **refractory metal thermocouple**.)

DISCUSSION—Base metals used in thermoelements include nickel, iron, chromium, copper, aluminum. Letter-designated types E, J, K, T, and N are considered base metal thermocouples.

bias, *n*—the scatter between the mean values of subsets of data, from each other or from the accepted value.

blackbody, *n*—the perfect or ideal source of thermal radiant power having a spectral distribution described by the Planck equation.

DISCUSSION—The term blackbody is often used to describe a furnace or other source of radiant power which approximates the ideal.

bulb, *n*—of a liquid-in-glass thermometer, reservoir for the thermometric liquid.

⁴ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

⁵ Available from International Electrotechnical Commission (IEC), 3 rue de Varembe, Case postale 131, CH-1211, Geneva 20, Switzerland, <http://www.iec.ch>.

calibration, *n*—of a thermometer or thermometric system, the set of operations that establish, under specified conditions, the relationship between the values of a thermometric quantity indicated by a thermometer or thermometric system and the corresponding values of temperature realized by standards.

DISCUSSION—(1) The result of a calibration permits either the assignment of values of temperature to indicated values of thermometric quantity or determination of corrections with respect to indications. (2) A calibration may also determine other metrological properties such as the effect of influence quantities. (3) The result of a calibration may be communicated in a document such as a calibration certificate or a calibration report. (4) The term *calibration* has also been used to refer to the result of the operations, to representations of the result, and to the actual relationship between values of the thermometric quantity and temperature.

calibration point, *n*—a specific value, established by a reference, at which the indication or output of a measuring device is determined.

Celsius, *adj*—pertaining to or denoting something related to the expression of temperature in degrees Celsius.

DISCUSSION—For example, “A Celsius thermometer has a scale marked in degrees Celsius.”

center wavelength, *n*—a wavelength, usually near the middle of the band of radiant power over which a radiation thermometer responds, that is used to characterize its performance.

DISCUSSION—The value of the center wavelength is usually specified by the manufacturer of the instrument.

clinical thermometer, *n*—thermometer of any type designed to measure human body temperature.

DISCUSSION—Some clinical thermometers may be designed to measure the body temperature of animals.

coaxial thermocouple—a thermocouple consisting of a thermoelement in wire form within a thermoelement in tube form with the wire being electrically insulated from the tube except at the measuring junction.

compensating extension wires, *n*—those extension wires fabricated from materials basically different in composition from the thermocouple.

DISCUSSION—They have similar thermoelectric properties and within a stated temperature range effectively transfer the reference junction to the other end of the wires.

complete immersion thermometer, *n*—a liquid-in-glass thermometer designed to indicate temperatures correctly when the entire thermometer is exposed to the temperature being measured. (Compare **total immersion thermometer** and **partial immersion thermometer**.)

connection head, *n*—a housing enclosing a terminal block for an electrical temperature-sensing device and usually provided with threaded openings for attachment to a protecting tube and for attachment of conduit.

defining fixed point, *n*—thermometric fixed point of an idealized system, to which a numerical value has been assigned, used in defining a temperature scale.

degree Celsius, °C, *n*—derived unit of temperature in the International System of Units (SI). (See **kelvin**.)

DISCUSSION—At any temperature, an interval of one degree Celsius is the same as an interval of one kelvin, by definition. For information about the relation between units and values of temperature expressed in different units, see Guide E1594.

degree centigrade, *n*—obsolete term. Use **degree Celsius**.

degree Fahrenheit, °F, *n*—non-SI unit of temperature commonly used in the United States of America.

DISCUSSION—At any temperature, an interval of one degree Fahrenheit is the same as an interval of 5/9 kelvin (or 5/9 degree Celsius). For information about the relation between units and values of temperature expressed in different units, see Guide E1594.

electromotive force (emf), *n*—the electrical potential difference which produces or tends to produce an electric current.

error, *n*—of a temperature measurement, result of a temperature measurement minus a true value of temperature.

extension wires, *n*—those having temperature-emf characteristics that when connected to a thermocouple effectively transfer the reference junction to the other end of the wires. (Compare **compensating wires**.)

Fahrenheit, *adj*—pertaining to or denoting something related to the expression of temperature in degrees Fahrenheit.

DISCUSSION—For example, “A **Fahrenheit** thermometer has a scale marked in degrees Fahrenheit.”

fixed point, *n*—in thermometry, reproducible temperature of equilibrium of a system of two or more phases under specified conditions.

freezing point, *n*—fixed point of a single component system in which liquid and solid phases are in equilibrium at a specified pressure, usually 101 325 Pa, and the system is losing heat slowly. (Compare **melting point**.)

grounded junction, *n*—A measuring junction of a thermocouple assembly that is electrically and physically connected to its sheath. Also see **Style G**.

DISCUSSION—The term “grounded” has been historically accepted in the field of thermometry to indicate the electrical connectivity of a thermocouple’s measuring junction to its sheath; the term does not indicate whether or not the measuring junction is electrically connected to earth or circuit ground.

hysteresis, *n*—The property of a device or instrument whereby it gives different output values in relation to its input values depending upon the directional sequence in which the input values have been applied. **IEC 61298-1**

ice point, *n*—thermometric fixed point of ice and water saturated with air at a pressure of 101 325 Pa.

industrial platinum resistance thermometer (IPRT), *n*—a rugged platinum resistance thermometer suitable for temperature measurements in harsh industrial environments over all or part of the temperature range -200 °C to 650 °C.

DISCUSSION—(1) The sensing element is made from platinum wire or film and packaged in a rugged housing to withstand harsh operating conditions. The sheath material is usually stainless steel or Inconel; however, other materials may be used for special applications. (2) The resistance-temperature relationship is usually defined by a specified

nominal equation and interchangeability tolerances over a specified temperature range. (3) IPRTs have ice-point resistance values of at least 100 ohms, and are available with two-wire, three-wire or four-wire terminations. (4) IPRTs are the most rugged and lowest cost platinum resistance thermometers.

International Practical Temperature Scale (IPTS-48), *n*—the temperature scale adopted by the 11th General Conference on Weights and Measures in 1960 and replaced in 1968 by the International Practical Temperature Scale of 1968.

International Practical Temperature Scale of 1968 (IPTS-68), *n*—the temperature scale adopted by the 13th General Conference on Weights and Measures in 1968.

DISCUSSION—The IPTS-68 was superseded in 1990 by the International Temperature Scale of 1990.

International Temperature Scale of 1990 (ITS-90), *n*—the temperature scale prepared in accordance with instructions of the 18th General Conference on Weights and Measures, and adopted on January 1, 1990.

kelvin, K, *n*—base unit of temperature in the International System of Units (SI).

liquid-in-glass thermometer, *n*—a temperature-measuring instrument whose indications are based on the temperature coefficient of expansion of a liquid relative to that of its containing glass bulb.

lower range value, *n*—the lowest quantity that an instrument is adjusted to measure.

maximum permissible errors, *n*—of a thermometer or thermometric system, extreme values permitted by regulation or specification of the difference between the indication of a thermometer or thermometric system and the true value of temperature.

DISCUSSION—The term *tolerance* is sometimes used in ASTM standards to represent this concept.

maximum self-registering clinical thermometer, *n*—clinical thermometer designed to retain the indication of its maximum measured temperature until reset.

measuring junction, *n*—that junction of a thermocouple which is subjected to the temperature to be measured.

melting point, *n*—fixed point of a single component system in which liquid and solid phases are in equilibrium at a specified pressure, usually 101 325 Pa, and the system is gaining heat slowly. (Compare **freezing point**.)

noble metal thermocouple, *n*—thermocouple whose thermoelements are composed primarily of noble metals and their alloys. (See also **base metal thermocouple**; **refractory metal thermocouple**.)

DISCUSSION—Noble metals used in thermoelements include platinum, rhodium, gold, palladium, iridium. Letter designated types B, R, and S are considered noble metal thermocouples.

partial immersion thermometer, *n*—a liquid-in-glass thermometer designed to indicate temperatures correctly when the bulb and a specified part of the stem are exposed to the