



# Standard Guide for Expression of Temperature<sup>1</sup>

This standard is issued under the fixed designation E1594; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This guide covers uniform methods for expressing temperature, temperature values, and temperature differences.

1.2 This guide is intended as a supplement to [IEEE/ASTM SI-10](#).

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

[E344 Terminology Relating to Thermometry and Hydrometry](#)

[IEEE/ASTM SI-10 Standard for Use of the International System of Units \(SI\): The Modern Metric System](#)

## 3. Terminology

3.1 *General*—Standard terms used in this guide are defined in Terminology [E344](#) and in [IEEE/ASTM SI-10](#).

## 4. Basic Concepts

4.1 Temperature is a fundamental measurable quantity designated by the symbol  $T$  or the symbol  $t$  (see [5.1](#)).

4.2 A temperature value is expressed in terms of a temperature scale. The complete description consists of a numerical value designating the magnitude, a unit, and, where appropriate, a tolerance or uncertainty. Both the numerical value and the unit depend upon the scale.

4.3 A unit of temperature is understood to mean an interval on a temperature scale.

4.4 A temperature difference, interval, or increment is also described by a numerical value designating the magnitude, a unit, and, where appropriate, a tolerance or uncertainty.

## 5. Temperature Scales

### 5.1 *Thermodynamic Temperature Scales*:

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

5.1.1 By international agreement, the theoretical temperature scale to which all temperature values should be ultimately referable is the Kelvin Thermodynamic Temperature Scale (KTTS). A value of temperature expressed on the KTTS is known as a thermodynamic temperature, symbol  $T$ .

5.1.2 The unit of thermodynamic temperature is the kelvin, symbol K. The kelvin is a base unit in the International System of Units (SI). Note that the symbol for the kelvin is the capital letter K only; the degree sign ( $^{\circ}$ ) is not used.

5.1.3 The expression of a value of thermodynamic temperature is written:

$$T = n_k \text{ K} \quad (1)$$

where:

$n_k$  = a numerical value designating the magnitude,  
K = the symbol for the unit kelvin.

The magnitude may also be represented by the notation  $T/K$ .

5.1.4 A thermodynamic temperature may be expressed as a Celsius temperature. The symbol  $t$  is to be used to designate a Celsius temperature, but if this symbol leads to a conflict in notation in a given context, it is acceptable to use the symbol  $T$  instead to designate a Celsius temperature.

5.1.5 The unit of Celsius temperature is the degree Celsius, symbol  $^{\circ}\text{C}$ . The degree Celsius is a derived SI unit. Note that the symbol for the degree Celsius consists of the degree sign ( $^{\circ}$ ) followed by the capital letter C. Neither the degree sign nor the letter C alone represents the degree Celsius. The Unicode value for the degree sign is 176 (00B0 in hexadecimal). The symbol may be represented by the two separate Unicode characters, the degree sign ( $^{\circ}$ ) followed by the capital letter C. The Unicode character “ $^{\circ}\text{C}$ ” with the value 8451 (2103 in hexadecimal) may also be used as the degree Celsius symbol.

5.1.6 The expression of a value of Celsius temperature is written:

$$t = n_c \text{ }^{\circ}\text{C} \quad (2)$$

where:

$n_c$  = a numerical value designating the magnitude,  
 $^{\circ}\text{C}$  = the symbol for the unit degree Celsius.

The magnitude may also be represented by the notation  $t/^{\circ}\text{C}$ .

5.1.7 By definition, at any temperature, a temperature increment of one degree Celsius is equal to a temperature increment of one kelvin.