



Designation: E1142 – 23b

Standard Terminology Relating to Thermophysical Properties¹

This standard is issued under the fixed designation E1142; 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 (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This is a compilation of only those terms and corresponding definitions included in or being considered for inclusion in ASTM documents relating to thermophysical properties. It is not intended as an all-inclusive listing of thermophysical property terms. Terms that are generally understood or defined adequately in other readily available sources are not included.

1.2 A definition is a single sentence with additional information included in a *Discussion*.

1.3 Definitions of terms specific to a particular field (such as *dynamic mechanical measurements*) are identified with an italicized introductory phrase.

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

1.5 *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

D4092 Terminology for Plastics: Dynamic Mechanical Properties

E7 Terminology Relating to Metallography

E344 Terminology Relating to Thermometry and Hydrometry

E2744 Test Method for Pressure Calibration of Thermal Analyzers

¹ This terminology is under the jurisdiction of ASTM Committee E37 on Thermal Measurements and are the direct responsibility of Subcommittee E37.03 on Nomenclature and Definitions.

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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.

3. Terminology

3.1 Definitions:

absolute pressure, *n*—pressure measured relative to zero pressure corresponding to empty space.

DISCUSSION—Absolute pressure is atmospheric pressure plus gage pressure.

activation energy (E), *n*—in *chemical kinetics*, the energy that must be overcome in order for a chemical reaction to occur.

DISCUSSION—The term *activation energy* was introduced in 1889 by Svante Arrhenius as a mathematical term in the eponymous, empirical relationship between temperature and reaction rate constant.

admittance, *Y*, *n*—the reciprocal of impedance.

alpha (α) loss peak, *n*—in *dynamic mechanical measurement*, first peak in the damping curve below the melt, in order of decreasing temperature or increasing frequency. **E7**

amorphicity, *n*—a relative measure of amorphous material content, expressed as a percent of the total material content.

angular frequency, ω , *n*—the number of radians per second traversed by a rotating vector that represents any periodically varying quantity.

DISCUSSION—Angular frequency, ω , is equal to two π times the frequency, *f*.

anisotropic, *adj*—having different values for a property in different directions.

anti-thixotropy, *n*—an increase of the apparent viscosity under constant shear stress or shear rate followed by a gradual recovery when the stress or shear rate is reduced to zero.

Arrhenius equation, *n*—a mathematical relationship between the specific reaction rate constant and the temperature given as:

$$k = Ae^{-E/RT} \quad (1)$$

where:

k = the reaction rate constant,

A = the pre-exponential factor,

E = the energy of activation,

R = the gas constant, and

T = the absolute temperature.

atmospheric pressure, *n*—the pressure due to the weight of the atmosphere. **E2744**

DISCUSSION—Atmospheric pressure varies with elevation above sea level, acceleration due to gravity, and weather conditions.

autocatalytic reaction, *n*—a chemical reaction in which a product or reaction intermediate functions as a catalyst.

barometer, *n*—an instrument for measuring atmospheric pressure.

beta (β) loss peak, *n*—in *dynamic mechanical measurement*, second discrete peak in damping curve below the melt, in order of decreasing temperature or increasing frequency.

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boiling pressure, *n*—at a specific temperature, the value of the vapor pressure of the liquid at which it is equal to the external pressure.

boiling temperature, *n*—at a specific pressure, the temperature at which the vapor pressure of the liquid is equal to the external pressure.

capacitance, *n*—that property of a system of conductors and dielectrics that permits the storage of electrical charge when a potential difference exists between the conductors.

DISCUSSION—Capacitance is the ratio of a quantity of electric charge, Q , to a potential difference, V . A capacitance value is always positive. The unit of capacitance is the farad, F, which is equivalent to one coulomb per volt.

catalyst, *n*—a substance that increases the rate of a chemical reaction but is not consumed or changed by that reaction.

Celsius, *n*—designation of the degree on the International Practical Temperature Scale; also used for the name of the scale, as “Celsius Temperature Scale.” Formerly (prior to 1948) called “Centigrade.” The Celsius temperature scale is related to the International Kelvin Temperature Scale by the equation: $T_c = T - 273.16 \text{ K}$.

Centigrade, *n*—see **Celsius**.

coefficient of expansion, *n*—see **coefficient of linear thermal expansion**.

coefficient of linear thermal expansion, α_l , *n*—change in length, relative to the length of the specimen, accompanying a unit change of temperature, at a specified temperature.

coefficient of viscosity, *n*—the ratio between an infinitesimally small increase in stress and the corresponding increase in strain rate.

coefficient of volume thermal expansion α_v , *n*—for a solid or liquid, the change in volume, relative to the volume of the specimen, accompanying a change of temperature at a specified temperature.

color temperature, *n*—temperature in degrees Kelvin (K) at which a black body must be operated to give a color equal to that of the source in question.

complex modulus, E^* , G^* , or K^* , *n*—ratio of the stress to strain where each is a factor that may be represented by a complex number as follows: $E^* = E' + iE''$, $G^* = G' + iG''$, and $K^* = K' + iK''$.

where:

E^* = complex modulus, measured in tension or flexure,
 E' = storage modulus, measured in tension or flexure,
 E'' = loss modulus, measured in tension or flexure,

G^* = complex modulus, measured in shear,
 G' = storage modulus, measured in shear,
 G'' = loss modulus, measured in shear,

K^* = complex modulus, measured in compression,
 K' = storage modulus, measured in compression
 K'' = loss modulus, measured in compression, and
 $i = \sqrt{-1}$, measured in compression.

The complex modulus may be measured in tension or flexure, (E^*), compression, (K^*), or in shear, (G^*). **D4092**

complex shear compliance, J^* , *n*—reciprocal of complex shear modulus, where $J^* = 1/G^*$. **D4092**

complex tensile compliance, D^* , *n*—reciprocal of complex tensile modulus, where $D^* = 1/E^*$. **D4092**

complex viscosity, η^* , *n*—the complex modulus divided by the imposed frequency in rad/s.

compliance, J , *n*—the strain divided by the corresponding stress.

DISCUSSION—Compliance is the reciprocal of modulus.

composition, *n*—quantity of the components of a mixture; usually expressed in terms of the weight percentage, or the atomic percentage of each of the components in the mixture. **E7**

conductivity, electrical (volume), σ , *n*—the ratio of the current density ($A \cdot cm^{-2}$) through a specimen to the potential gradient (V/cm) in the same direction as the current.

DISCUSSION—Conductivity is normally expressed in units $(ohm \cdot cm)^{-1}$, but the correct SI units are Siemen.

congruent phases, *n*—those states of matter of unique composition that co-exist at equilibrium at a single point in temperature and pressure; for example, the two coexisting phases of a two-phase equilibrium. **E7**

congruent transformation, *n*—an isothermal, or isobaric, phase change in which both of the phases concerned have the same composition throughout the process; the order of a system becomes unary at a composition of congruency. **E7**

constitutional diagram, *n*—graphical representation of the compositions, temperatures, pressures, or combinations thereof at which the heterogeneous equilibria of a system occur.

cooling curve, *n*—graphical representation of specimen temperature or temperature change as a function of time or decreasing environment temperature.

cooling rate, *n*—average slope of the time-temperature curve taken over a specific time and temperature interval as the temperature is decreased.

critical curve, *n*—in a binary, or higher order, phase diagram, a locus of points along which two or more phases exist in stable thermodynamic equilibrium.