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Standard Terminology
Relating to Thermophysical Properties[1]

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1. Scope

1.1 This is a compilation of terms and corresponding definitions commonly used in the study of thermophysical properties. Terms that are generally understood or defined adequately in other readily available sources are either not included or their sources identified.

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.

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

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:

$$k = Ae^{-E/RT} \tag{1}$$

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.

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. **D4092**

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.

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[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.

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: $T_c = T - 273.16$ 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 ($A \cdot \mathrm{cm}^{-2}$) through a specimen to the potential gradient (V/cm) in the same direction as the current.

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

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.

critical point, *n*—in a binary phase diagram, that specific value of composition, temperature, pressure, or combinations thereof at which the phases of a heterogeneous equilibrium become identical.

critical pressure, *n*—that pressure at the critical point.

critical surface, *n*—in a ternary or higher order phase diagram, the area upon which the phases in equilibrium become identical. **E7**

critical temperature, *n*—that temperature at the critical point.

crystal, *n*—solid composed of atoms, ions, or molecules, arranged in a pattern which is periodic in three dimensions. **E7**

crystallinity, *n*—regular arrangement of the atoms of a solid in space.

Discussion—In most materials, this state is usually imperfectly achieved. The crystalline regions (ordered regions) are submicroscopic volumes in which there is more or less regularity of arrangement of the component molecules.

crystallite, *n*—crystalline grain not bounded by habit planes. **E7**

crystallization, *n*—arrangement of previously disordered material segments of repeating patterns into geometric symmetry.

crystallization temperature, *n*—that temperature at which a specimen undergoes crystallization upon cooling.

Curie point, *n*—see **Curie temperature**.

Curie temperature, *n*—temperature above which a ferromagnetic or ferroelectric material becomes paramagnetic, or paraelectric, respectively.

Discussion—There may be more than one if there are multiple materials.

damping, *n*—loss in energy, dissipated as heat, that results when a material or material system is subjected to an oscillatory load or displacement. **D4092**

devitrification, *n*—crystallization of an amorphous substance. **E7**

dielectric constant, *n*—see **permittivity, relative**.

dielectric dissipation factor, *D*, *n*—the ratio of the loss factor, ε'', to the absolute permittivity, ε', or:

$$D = \varepsilon''/\varepsilon' \qquad (2)$$

Discussion—The dielectric dissipation factor is numerically equal to the tangent of the dielectric loss angle and may be referred to as the loss tangent, $\tan \delta$, or the cotangent of the phase angle, θ.

dielectric loss angle, *n*—the angle whose tangent is the dissipation factor or arctan $\varepsilon''/\varepsilon'$.

Discussion—It is also the difference between 90 degrees and the phase angle.

differential thermocouple, *n*—see **differential thermopile**.

differential thermopile, *n*—a number of temperature sensors connected in series-opposing and arranged so that there is an increase in output signal for a given temperature difference between alternate junctions maintained at a reference temperature and the measured temperature.

dilatancy, *n*—the increase in volume caused by shear.

dipole relaxation time, γ, *n*—the exponential decay time required for the electric polarization of any point of a suitably charged dielectric to fall from its original value to 1/e of that value, due to the loss of dipole orientation.

Discussion—Under conditions of an alternating applied field and in systems with a single dipole relaxation time, it is equal to $1/\omega$ at the loss factor peak in cases where the peak is caused by a dipole mechanism.

dissipation factor, *n*—see **tangent delta**.

dissociation, *n*—as applied to heterogeneous equilibria, the transformation of one phase into two or more new phases, all of different composition. **E7**

dynamic modulus, *n*—see **complex modulus**.

elasticity, *n*—that property of materials that causes them to return to their original form or condition after the applied force is removed. **D4092**

elastic limit, *n*—the greatest stress that can be applied to a material without permanent deformation.

elastic modulus, *n*—the ratio of stress to corresponding strain within the elastic limit of the stress-strain curve.

Discussion—The elastic modulus may also be measured in tension (E'), compression (K'), flexure (E'), or shear (G'). (See also **complex modulus**.)

enthalpy, *n*—a thermodynamic *function* defined by the equation $H = U + PV$ where H is the enthalpy, *U* is the *internal* energy, P is the pressure, and V the volume of the system.

Discussion—At constant pressure the change in enthalpy measures the quantity of heat exchanged by the system and its surrounding.

equilibrium diagram, *n*—see **constitutional diagram**.

eutectic point, *n*—see **eutectic**.

eutectic, *adj*—mixture of two or more substances which solidifies as a whole when cooled from the liquid state, without change in composition.

Discussion—The temperature at which the eutectic mixture solidifies is called the eutectic point. This temperature is constant for a given composition, and represents the lowest melting point of the system.

expansivity, *n*—the change in dimension resulting from an infinitesimal change in an independent variable (such as temperature or humidity).

failure, *n*—the point beyond which a material ceases to be functionally capable of its intended use.

failure criterion, *n*—specification of the chemical, physical, mechanical, electrical, or other condition under which a material ceases to be functionally capable of its intended use.

failure temperature (T_f), *n*—the temperature at which a material fails.

Fahrenheit, *n*—designation of a degree on the Fahrenheit temperature scale that is related to the International Practical Temperature Scale by means of the equation:

$$T_F = 1.8\ T_C + 32 \qquad (3)$$

where:

T_F = the temperature in degree Fahrenheit, and
T_C = the temperature in degrees Celsius.

freezing temperature, *n*—see **crystallization temperature**.

frequency, f, *n*—the number of cycles per unit time of periodic process.

Discussion—The unit is Hertz (Hz) which is equal to 1 cycle per/s.

frequency profile, *n—in dynamic mechanical measurement*, plot of the dynamic properties of a material, at a constant temperature, as a function of test frequency. **D4092**

gage pressure, *n*—pressure measured relative to atmospheric pressure.

Discussion—Gage pressure is the difference between absolute pressure and atmospheric pressure.

gamma (γ) loss peak, *n—in dynamic mechanical measurement*, third peak in the damping curve below the melt, in the order of decreasing temperature or increasing frequency. **D4092**

Gibbs Phase Rule, *n*—maximum number of phases (P) that may coexist at equilibrium is equal to two, plus the number of components (C) in the mixture, minus the number of degrees of freedom (F): $P + F = C + 2$. **E7**

glass transition, *n*—reversible change in an amorphous material or in amorphous regions of a partially crystalline material, from (or to) a viscous or rubbery condition to (or from) a hard and relatively brittle one.

Discussion—The glass transition generally occurs over a relatively narrow temperature region and is similar to the solidification of a liquid to a glassy state. Not only do hardness and brittleness undergo rapid changes in this temperature region, but other properties, such as coefficient of thermal expansion and specific heat capacity, also change rapidly. This phenomenon sometimes is referred to as a second order transition, rubber transition, or rubbery transition. When more than one amorphous transition occurs in a material, the one associated with segmental motions of the backbone molecular chain, or accompanied by the largest change in properties is usually considered to be the glass transition.

glass transition temperature, *n*—a temperature chosen to represent the temperature range over which the glass transition takes place.

Discussion—The glass transition temperature can be determined readily by observing the temperature region at which a significant change takes place in some specific electrical, mechanical, thermal, or other physical property. Moreover, the observed temperature can vary significantly depending on the property chosen for observation and on details of the experimental technique (for example, heating rate, frequency of test). Therefore, the observed Tg should be considered valid only for that particular technique and set of test conditions.

heat capacity, *n*—quantity of heat necessary to change the temperature of an entity, substance or system by one Kelvin of temperature.

Discussion—The SI units of measurement are *J/K*.

impedance, Z, *n*—the ratio of the time dependent voltage, $v(t)$, across a circuit, a circuit element, or material to the time dependent current, $i(t)$, through it; that is:

$$Z = v(t)/i(t) \tag{4}$$

Discussion—The impedance of a circuit, circuit element, or material is a measure of its ability to oppose the transmission of an alternating current. It is expressed in ohms. Its value depends on the angular frequency, ω, of the measurement.

invariant equilibrium, *n*—stable state among a number of phases exceeding by two the number of components in the system and in which more of the external variables (pressure, temperatures, or concentrations) may be varied without causing a decrease in the number of phases present. **E7**

invariant point, *n*—point defined by the unique values of temperature, pressure, and concentrations in a system with the maximum number of phases that can coexist in equilibrium. **E7**

isohume, *n*—constant relative humidity.

isotropic, *adj*—having the same magnitude of a property in all directions.

Kelvin, *n*—designation of the thermodynamic temperature scale and the degree on this scale. **E344**

Discussion—This Kelvin scale was defined by the 10th General Conference on Weights and Measure in 1954 by assigning the temperature of 273.16 K to the triple point of water. Also, the degree on the International Practical Kelvin Temperature Scale.

kinetics (chemical), *n*—the study of rates of chemical reactions.

lifetime, *n*—the period of time during which an object, performance property, or process exists and functions in accordance with stated requirements.

liquidus, *n*—locus of points in a phase diagram, representing the temperature, under equilibrium conditions, at which each composition in the system begins to freeze during cooling, or completes melting during heating. **E7**

loss angle, δ**,** *n*—see **phase angle**.

*loss factor***,** *n*—see **tangent delta**.

loss factor, ε", *n*—the magnitude of the imaginary part of the complex permittivity. (See **permittivity, complex**.)

Discussion—The loss factor is the product of the absolute permittivity and the dissipation factor.

loss modulus, *n*—quantitative measure of energy dissipation, defined as the ratio of stress 90° out of phase with oscillating strain to the magnitude of strain. **D4092**

Discussion—The loss modulus may be measured in tension (E"), compression (K"), flexure (E"), or shear (G"). See also **complex modulus**.

*loss tangent***,** *n—in dielectric measurements*, see **tangent delta**.

magnetic transformation, *n*—intensive property change from a ferromagnetic to a paramagnetic state, or the reverse, which occurs in certain solid materials under applied pressure and temperature, or both. (See also **Curie temperature**). **E7**

*mechanical loss factor***,** *n*—see **tangent delta**.

melting, *n*—thermal process by which a material changes from a crystalline to a liquid form.

Discussion—See **glass transition** for amorphous solids.

melting point, *n*—in a phase diagram, the temperature at which the liquidus and solidus coincide at an invariant point. **E7**

melting temperature, *n*—at a given pressure, the temperature at which a crystalline solid undergoes a phase transition to the isotopic state when heat is added.

modulus, complex, *n*—see **complex modulus**.

modulus, elastic, *n*—see **complex modulus** and **storage modulus**.

modulus, loss, *n*—see **complex modulus** and **loss modulus**.

modulus, storage, *n*—see **complex modulus** and **storage modulus**.

modulus of elasticity, *n*—see **complex modulus** and **storage modulus**.

Neel temperature, *n*—the temperature above which an antiferromagnetic material becomes paramagnetic.

negative thixotropy, *n*—synonym of **anti-thixotropy**.

Newtonian viscosity, *n*—see **viscosity, Newtonian**.

non-Newtonian viscosity, *n*—see **viscosity, non-Newtonian**.

oxidative induction time, OIT, *n*—an accelerated aging index for relative resistance to oxidative decomposition.

Discussion—OIT is usually recorded as the elapsed time from first exposure to an oxidizing gas to the onset of oxidation of a material at elevated pressure and/or temperature.

permittivity, absolute, ε', *n*—the magnitude of the real part of the complex permittivity expressed in F/m.

permittivity, complex, ε*, *n*—a material property deduced from the ratio of the admittance, Y_p, of a given electrode configuration separated by that material, to the admittance of the identical electrode configuration separated by a vacuum (or air for most practical purposes), Y_v:

$$\varepsilon^* = Y_p/Y_v = Y_p/iWC_v = \varepsilon' - i\varepsilon'' \tag{5}$$

where:

ε' = absolute permittivity,
ε'' = loss factor,
C_v = capacitance with vacuum separating the electrodes, and
i = $\sqrt{-1}$.

permittivity, high frequency, ε∞', *n*—the permittivity of a material that is approached asymptotically as the applied frequency is increased to the point at which dipoles can no longer reorient.

Discussion—The high frequency permittivity may be referred to as the unrelaxed permittivity.

permittivity, low frequency, ε∞', *n*— the permittivity of a material that is approached asymptotically as the applied frequency is decreased to the point at which all dipoles can reorient.

Discussion—The low frequency permittivity may be referred to as the relaxed permittivity.

permittivity, relative, κ', *n*—a material property deduced from the ratio of capacitance of a given configuration of electrodes separated by the material, C_p, to the capacitance of the same electrode configuration separated by a vacuum (or air for most practical purposes), C_v:

$$\kappa' = C_p/C_v = \varepsilon'/\varepsilon_o \tag{6}$$

$$\kappa'_{vac} = 1 \tag{7}$$

Experimentally, the material separating the electrodes must replace the vacuum (or air) at all points where it makes a significant change in capacitance. Relative permittivity is commonly referred to as the dielectric constant. The use of κ' (kappa prime) for *relative* permittivity, and ε' (epsilon prime) for *absolute* permittivity is recommended and is consistent with the strict definition of terms; however, the scientific literature is not consistent.

permittivity of free space (vacuum), ε_o, *n*—is defined by the following equation derived from wave theory:

$$\varepsilon_o = 1/\mu_o \cdot c^2 = 8.854 \times 10^{-12}\ \text{F/m} \tag{8}$$

where the magnetic permeability of free space, μ_o is:

$$\mu_o = 4\pi \times 10^{-7}\ \text{H/m} \tag{9}$$

and the speed of electromagnetic waves in free space, c, is given by:

$$c = 2.998 \times 10^{8}\ \text{m/s} \tag{10}$$

phase, *n*—homogeneous, distinguishable portion of a material system.

phase angle, δ, *n*—angle between a sinusoidally applied strain and the resultant sinusoidal stress. **D4092**

phase angle, Θ, *n*—the angular difference in phase between the sinusoidal alternating voltage applied to a dielectric and the component of the resulting current (to ground) having the same frequency as the voltage.

Discussion—It is also the angle whose cotangent is the dissipation factor.

phase diagram, *n*—see **constitutional diagram**.

phase rule, *n*—see **Gibbs Phase Rule**.

pre-exponential factor (A), *n*—in chemical kinetics, the rate constant at infinite temperature.

Discussion—The term frequency factor has been used as a synonym for *pre-exponential factor*; this use is discouraged.

pressure, *n*—the force exerted to a surface per unit area.

proportional limit, *n*—the greatest stress that a material sustains without any deviation from proportionality of stress to strain.

polymorphic substance, *n*—element, or compound, capable of stable existence in different temperature and pressure ranges in two, or more, different crystalline forms.

reaction, *n*—any change in chemical composition accompanied by a change of enthalpy.

reaction isotherm, *n*—a temperature-concentration phase diagram, a tie-element at constant temperature representing univariant equilibrium among three or more phases. **E7**

reaction order (n, m, p), *n*—in chemical kinetics, the power to which a concentration term in the rate equation is raised.

reference junction, *n*—that junction of a thermocouple which is maintained at a known temperature.

reference junction correction, *n*—correction in the terms of electromotive force to be applied to the electromotive force generated by a thermocouple to compensate for the difference between the actual temperature of the reference junction and that used as the basic reference junction temperature in the standard conversion tables. **E7**

relative humidity, RH, *n*—the ratio of actual water vapor pressure to the saturated water vapor pressure at the same temperature, expressed as a percent.

relative rigidity, *n—in dynamic mechanical measurement*, ratio of modulus at any temperature, frequency, or time to the modulus at a reference temperature, frequency, or time.

Discussion—As commonly used, the term relative rigidity compares the stiffness or storage modulus of materials usually at the same temperature and frequency. For example, a high relative rigidity means a high storage modulus and a hard, rigid material.

relative thermal index, RTI, *n*—the maximum temperature at which a critical property of a material will conform to stated performance and time relative to that of a reference material of acceptable performance.

resistivity, ρ, *n*—the reciprocal of conductivity.

rupture, *n*—the sudden breaking or tearing apart of a material.

shear, *n*—parallel to (or tangent to) the area considered. For example, shear rate.

solidus, *n*—locus of points in a phase diagram representing the temperature, under equilibrium conditions, at which each composition in a system begins to melt during heating or completes freezing during cooling. **E7**

solvus, *n*—locus of points in a phase diagram representing the temperature under equilibrium conditions at which each composition of a solid phase becomes capable of coexistence with another solid phase, that is, a solid-solubility limit usually applied to the terminal solid solution. **E7**

specific heat, *n*—the ratio of the specific heat capacity of a material to the specific heat capacity of a reference material at the same temperature.

Discussion—Specific heat is a dimensionless quantity. The most commonly used reference material is water.

specific heat capacity, c, *n*—quantity of heat required to provide a unit temperature change to a unit mass of material.

Discussion—The SI units of measurement are *J/(g K)*. The subscript *p*, or *v*, is used to denote the specific heat capacity determined at constant pressure volume, such as, c_p or c_v.

stiffness, *n*—resistance of a solid to an elastic deformation caused by a given increase of a force.

storage modulus, *n*—quantitative measure of elastic properties defined as the ratio of the stress, in-phase with strain, to the magnitude of the strain. **D4092**

Discussion—The storage modulus may be measured in tension (E'), compression (K'), flexure (E'), or in shear (G'), see also **complex modulus**.

strain, *r*, *n*—the change in length, due to an applied force, per unit length of a specimen.

Discussion—Strain is a dimensionless quantity that may be conveniently expressed in mm/m.

stress, *s*, *n*—force per unit area.

Discussion—The SI units of measurement are N/m^2.

sublimation pressure, *n*—in a binary system, at a stated temperature, that pressure at which congruent equilibrium between a solid substance and its vapor occurs.

Discussion—See also **vapor pressure**. The sublimation pressure is often referred to as the vapor pressure.

sublimation temperature, *n*—in a binary system, at a stated pressure, that temperature at which congruent equilibrium between a solid substance and its vapor occurs.

supercooling, *v*—to cool a substance below a transition temperature without the transition occurring, especially to cool below the freezing point without solidification.

tangent delta, tan δ, *n—in dielectric measurements*, the ratio of the loss factor, ε'', to the absolute permittivity, ε'; that is:

$$\tan \delta = \varepsilon''/\varepsilon' \qquad (11)$$

Discussion—The angle delta, δ, is known as the loss angle, and tangent delta is sometimes referred to as the dielectric dissipation factor (*D*), the loss tangent, or the cotangent of the phase angle, θ.

temperature (T), *n*—a physical property of matter that quantitatively expresses its kinetic energy.

temperature index, *n*—a numerical value corresponding to the thermal life of a material or system at a specified temperature.

Discussion—Temperature index is usually expressed in °C at a thermal life. Common thermal life values for which temperature indexes are reported include 20 000, 40 000, and 100 000 h. For example: Temperature Index (20 000 h) = 160°C.

thermal conductance, Γ, *n*—time rate of heat flow through a unit area of a body induced by a unit temperature difference between the body surfaces.

Discussion—The thermal conductance is the reciprocal of the thermal resistance.

thermal conductivity, λ, *n*—time rate of heat flow, under steady conditions, through unit area, per unit temperature gradient in the direction perpendicular to the area.

thermal curve—*in thermal analysis*, plot of a dependent variable (such as, heat flow or weight loss) against an independent variable, time or temperature, under defined time-temperature conditions.

Discussion—The term thermogram is often used incorrectly in thermophysical property measurements instead of thermal curve.

thermal diffusivity, *n*—ratio of thermal conductivity of a substance to the product of its density and specific heat capacity.

thermal effusivity, e, *n*—a measure of a material's ability to exchange thermal energy with its surroundings.

$$e = (\lambda\ \rho\ c_p)^{1/2} \qquad (12)$$

where:

λ = the thermal conductivity,
ρ = the density, and
c_p = the specific heat capacity.

thermal electromotive force, *n*—voltage generated when one junction of two dissimilar electrical conductors is at a different temperature than the other junction.

thermal endurance, *n*—property of a material to resist changes in chemical, physical, mechanical, or electrical properties upon exposure to temperatures for extended periods of time.

Discussion—Thermal endurance may be presented graphically by an Arrhenius plot with logarithm of time-to-failure as ordinate and corresponding abscissae being the reciprocals of the absolute temperature of exposure. The least squares fit to these points is known as the Arrhenius plot and most completely describes the thermal endurance of a material at a specific condition of test.

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

thermal index, TI, *n*—the maximum temperature at which a critical performance property of a material will acceptably function for a stated time.

thermal life, *n*—the time necessary for a property of a material or system to degrade to a defined end-point at a specified temperature.

thermal resistance, R, *n*—under steady-state conditions, the temperature difference required to produce a unit of heat flux through a specimen.

Discussion—Thermal resistance is the reciprocal of thermal conductance.

thermal resistivity, r, *n*—under steady-state conditions, the temperature gradient, in the direction perpendicular to the isothermal surface, per unit heat flux.

Discussion—Thermal resistivity is the reciprocal of thermal conductivity.

thermal stability, *n*—resistance to permanent changes in property caused solely by heat.

thermal transmittance, *n*—time rate of unidirectional heat transfer per unit area in the steady state, between parallel planes, per unit difference of temperature of the planes.

thermocouple, *n*—two dissimilar electrical conductors joined as to produce a thermal electromotive force.

thermogram, *n*—see **thermal curve**.

thermopile, *n*—a number of temperature sensors connected in series and arranged such that there is an increase in output signal for a given temperature difference between alternate junctions maintained at a reference temperature and the measured temperature.

thixotropy, *n*—a decrease 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.

thixotropy, negative, *n*—synonym of **anti-thixotropy**.

tie line, *n*—in a binary or higher order phase diagram, an isothermal, isobaric straight line connecting the compositions of a pair of conjugate phases. **E7**

time-temperature curve, *n*—in thermal analysis, a curve produced by plotting time against the temperature. **E7**

transformation temperature, *n*—temperature at which a change in phase occurs. **E7**

under cooling, *v*—see **supercooling**.

vacuum, *n*—pressure less than atmospheric pressure.

vaporization point, *n*—at a given pressure, the temperature at which the vapor pressure of the liquid is equal to the external pressure or at a stated temperature the external pressure on the liquid that is equal to its vapor pressure.

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

vapor pressure, *n*—in a binary system, that pressure at which a liquid and its vapor are in equilibrium at a definite temperature and total pressure.

Discussion—See also **sublimation pressure.**

viscoelasticity, *n*—the property exhibited by a material which possesses both elastic and viscous properties that vary with strain, strain rate and frequency.

viscosity, η, *n*—the flow resistance characteristic of a material that is quantitatively defined as the quotient of the shear stress divided by the shear rate.

viscosity, Newtonian, *n*—the property exhibited by a material in which the coefficient of viscosity is independent of strain rate and time (at a given temperature and density).

viscosity, non-Newtonian, *n*—the property exhibited by a material in which the coefficient of viscosity is dependent on strain rate or time, or both (at a given temperature and density).

volatility, *n*—the tendency of a solid or liquid material to pass into the vapor state at ordinary temperature.

yield point, *n*—the point on the stress/strain or stress/rate of strain curve corresponding to the transition from elastic to plastic deformation.

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