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An American National Standard

Standard Terminology Relating to Solar Energy Conversion[1]

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absorber—that part of a solar collector whose primary function is to absorb radiant energy and transform it into another form of energy.

NOTE 1—A thermal absorber usually possesses a solid surface through which energy is transmitted by thermal conduction to the transfer fluid; however, the transfer fluid itself can be the absorber in the case of an optically transparent container and a "black liquid". A photovoltaic absorber converts part of the incident solar flux into electrical energy, and part to thermal energy.

absorptance, α— the ratio of the absorbed radiant or luminous flux to the incident flux. (Practice E 491, for Solar Simulation for Thermal Balance Testing of Spacecraft[2]). See **radiometric properties and quantities**.

absorption—the process by which incident radiant energy is transformed into another form of energy by interaction with matter.

air handling unit—a device used for distributing conditioned air supply to a room, space, or area.

air mass, AM—the ratio of the mass of atmosphere in the actual observer-sun path to the mass that would exist if the observer was at sea level, at standard barometric pressure, and the sun was directly overhead.

NOTE 2—(Sometimes called air mass ratio.) Air mass varies with the zenith angle of the sun and the local barometric pressure, which changes with altitude. For sun zenith angle, *Z*, of 62° or less and local atmospheric pressure, *P*, where P_o is standard atmospheric pressure, AM ≃ sec Z (P/P_o).

albedo—the use of the term *albedo* is discouraged in favor of the preferred term, **reflectance**.

altazimuthal mount—a supporting device that facilitates tracking of the sun and allows rotation about horizontal and vertical axes. It can be used to aim equipment such as heliostats, concentrating collectors, exposure specimens, or radiometers.

angle of incidence—the angle between a ray and the normal to the plane on which it is incident. (The plane of incidence may be the aperture plane, the collector, or any other plane of interest.)

angle of reflection—the angle between the direction of propagation of a reflected ray and the normal to the surface at the point of reflection.

angle of refraction—the angle between the direction of propagation of a refracted ray and the normal to the interface at the point of refraction.

aperture area—see **area, aperture**.

apparent solar time, apt—the hours of the day as computed from the position of the sun using the equation of time. (See ASHRAE *Handbook of Applications,* 1982, Chapter 57.)

area, absorber—the total uninsulated heat transfer surface area of the absorber, including unirradiated as well as irradiated portions.

area, aperture— of a flat plate collector, (*1*) the maximum projected area of a solar collector through which the unconcentrated solar radiant energy may be admitted to the absorber. (*2*) *effective aperture area*—the area as defined above projected normal to the sun's rays and corrected for any shading. Units: square metres (m^2) [square feet (ft^2)].

area, collector panel—the total area of the panel assembly (with its containing box, if present), projected on the aperture plane.

area, gross aperture— *of a concentrating collector*, the maximum projected area through which the unconcentrated solar radiant energy is admitted, including any area of the reflector or refractor shaded by the receiver and its supports, and including gaps between reflector segments within a collector module.

area, gross collector—the maximum area of the complete collector module, including integral mounting means, projected on the aperture plane.

area, net aperture—*of a concentrating collector,* the maximum projected area through which the unconcentrated solar radiant energy is admitted, excluding any area of the reflector or refractor shaded by the receiver and its supports, and excluding gaps between reflector segments within a collector module.

auxiliary energy subsystem—in solar energy applications, equipment using nonsolar energy sources to supplement or backup the output provided by a solar energy system.

beam, radiant energy—a collection of rays confined to a specific path.

blackbody—a hypothetical "body" that completely absorbs all incident radiant energy, independent of wavelength and direction; that is, one which neither reflects nor transmits any

[1] These definitions are under the jurisdiction of ASTM Committee E44 on Solar, Geothermal, and Other Alternative Energy Sources and are the direct responsibility of Subcommittee E44.09 on Photovoltaic Electric Power Conversion.

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[2] *Annual Book of ASTM Standards*, Vol 15.03.

of the incident radiant energy. It is the emitter of electromagnetic radiant energy which, at a given temperature, presents the maximum spectral density of radiant exitance or radiance at all wavelengths.

NOTE 3—No real material is a blackbody. A completely enclosed cavity with opaque walls at a uniform temperature contains blackbody radiation. A blackbody radiator can be approximated in the laboratory to any desired degree of approximation by a furnace containing a cavity with opaque walls at a uniform temperature, that contains an aperture through which the blackbody radiation is observed. The degree of approximation to a true blackbody radiator is inversely related to the ratio of the area of the aperture to the area of the interior wall of the cavity.

blackbody radiant energy— see **radiant energy, blackbody**.

building heat loss factor—a measure of the heat loss rate of a building expressed in joules per degree day (or Btu per degree day). This factor is multiplied by the number of degree days in a given period to estimate the energy required to heat the building during that period.

charge capacity—see **thermal capacity**.

cloud cover—that portion of the sky which is covered by clouds, usually expressed in tenths of sky covered.

collector, concentrating—a solar collector that uses reflectors, lenses, or other optical elements to redirect and concentrate the solar irradiance on the collector aperture onto an absorber of which the surface area is smaller than the collector aperture area.

collector efficiency— see **efficiency, collector**.

collector, evacuated tube—a solar collector made from transparent tubing (usually glass) with an evacuated space between the tube and the absorber. The absorber may consist of an inner tube or another shape, with means for removal of thermal energy and may be specially coated.

collector, flat plate—a nonconcentrating solar collector in which the absorbing surface is essentially planar.

collector, line-focus—a concentrating solar collector that concentrates the solar flux in one dimension only.

collector, point focus—a concentrating collector that focuses the solar flux to a point.

collector, solar thermal—a device designed to absorb solar irradiance and to transfer the thermal energy to a fluid passing through it.

collector subsystem—that portion of the solar system which includes the solar collectors and related piping or ducts.

collector, tracking—a solar collector that moves so as to follow the apparent motion of the sun during the day, rotating about one axis or two orthogonal axes.

collector, trickle—a flat plate solar collector in which unpressurized liquid flows or "trickles" over the absorber.

collector cover (glazings)— see **cover plate, collector.**

combustible liquid—a liquid having a flash point at or above 37.8°C (100°F). The flash point of a liquid having a viscosity less than 45 SUS at 37.8°C (100°F) and a flash point below 93.4°C (200°F) shall be determined in accordance with the Test Methods D 93, for Flash Point by the Pensky-Martens Closed Tester.[3]

concentrating collector— see **collector, concentrating.**

concentration ratio, geometric—the ratio of the collector aperture area to the absorber area.

concentrator—an optical device (lenses or mirrors) that, as part of a solar collector, receives the unconcentrated solar irradiance and redirects (concentrates) it to a smaller area (the receiver).

conical, ω— over a solid angle larger than an infinitesimal element of solid angle and less than a hemisphere. The geometry of the solid angle must be described in the text. For incident beams it is assumed that the radiance is constant over the entire solid angle. (See **Radiometric properties and quantities)**

containment material—in a solar energy system, a material that encloses the heat-transfer fluid or is in contact with the heat transfer or heat storage material, or both.

convection—the transport of heat by fluid flow.

convection, forced—convection caused by mechanical forces such as fans and injectors.

convection, natural—convection within a fluid, due to density differences caused by temperature differences.

cover plate, collector—a sheet of transparent (or translucent) glazing placed above the absorber in a solar collector, to provide thermal and environmental protection.

degree day—see **degree day, heating** and **degree day, cooling.**

degree-day, cooling, (DDC or DDF, Celsius or Fahrenheit respectively)—one cooling degree-day is counted for each degree that the daily mean temperature is higher than a base temperature; used to estimate energy requirements for air conditioning or refrigeration.

degree-day, heating, (DDC or DDF, Celsius or Fahrenheit respectively)—one heating degree-day is counted for each degree that the daily mean temperature is lower than a base temperature; used to estimate energy requirements for heating.

design life—the period of time during which a system or component is expected to perform its intended function, without significant degradation of performance and without requiring major maintenance or replacement.

diffuse, *adj*—referring to radiometric quantities, indicates that the flux propagates in many directions, as opposed to direct beam which refers to collimated flux. When referring to solar irradiance, it is the global irradiance less the direct beam irradiance. When referring to reflectance, it is the directional hemispherical reflectance less the specular reflectance.

NOTE 4—Diffuse has been used in the past to refer to hemispherical collection (including the specular component) or irradiation, with equal radiance for all directions over a hemisphere. This use is deprecated in favor of the more precise term hemispherical.

directional—over an infinitesimal element of solid angle in a given direction. For properties, a solid angle small enough that the property does not vary within the solid angle may be considered an element of solid angle. Indicated by the symbols θ, Φ, where θ is the angle between the given direction and the normal to the sample surface, and;uf is the azimuth angle of the direction measured counter-clockwise from a reference mark on the sample. See **radiometric**

[3] *Annual Book of ASTM Standards,* Vol 05.01.

properties and **quantities.**

discharge capacity, thermal—the amount of heat that can be removed from a storage device during a period of time and for a specific set of values for the initial and final temperatures of the storage device, the temperature of the entering fluid, and the mass flow rate of fluid through the storage system.

discharge test time—the duration of a single transient test in which energy is removed from the storage device.

distribution subsystem—that portion of the solar system from the storage device to the point of ultimate use.

drainback solar energy system—see **solar energy system, drainback.**

draindown solar energy system—see **solar energy system, draindown.**

efficiency, collector—*of a solar thermal collector*, the ratio of the amount of energy removed by the heat transfer fluid to the solar energy incident on the collector.

NOTE 5—For flat-plate collectors, the value of the incident solar energy used is usually based on gross collector area; for concentrating collectors the value is usually based on the aperture area.

efficiency, instantaneous collector—ratio of the amount of energy removed by the heat transfer fluid of a solar collector over a specified time period (usually 5 or 15 min) to the solar energy incident on the collector area in the same period, under steady-state or quasi-steady state.

NOTE 6—For flat plate collectors, the area used is usually the gross collector area; for concentrating collectors the area used is usually the gross aperture area.

efficiency, period system—ratio of the useful energy supplied by the solar energy system over a period of time to the solar energy incident on the collector area of the system in the same period.

NOTE 7—The period considered has to be of a suitable length for the type of system. For example, it would not be useful to define the efficiency of a solar space heating system over a month in the summer.

NOTE 8—For flat-plate collector systems, the value of incident solar energy used is usually based on the gross collector area; for concentrating collector systems, the value is usually based on the aperture area.

emissive power—the use of the term emissive power is discouraged in favor of the preferred term **radiant exitance**.

emittance, ϵ— for a sample at a given temperature, ratio of the radiant flux emitted by a sample to that emitted by a blackbody radiator at the same temperature, under the same spectral and geometric conditions of measurement. See **radiometric properties and quantities**.

equatorial mount—a sun-tracking mount, usually clock-driven, whose axis of rotation is parallel to that of the earth.

evacuated tube collector— see **collector, evacuated tube.**

exitance, radiant— see **radiant exitance.**

exposure racks, at-latitude—in solar energy applications, racks that hold specimens at an inclination angle equal to the latitude of the rack location, facing south.

flammable liquid—a liquid having a flash point below 37.8°C (100°F) and having a vapor pressure not exceeding 40 psi (absolute) at 37.8°C and shall be known as a Class I liquid.

flash point—of a liquid, the minimum temperature at which it gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid within the vessel as specified by appropriate test procedure and apparatus.

flux, radiant—see **radiant flux**.

forced convection— see **convection, forced.**

free convection—see **convection, natural.**

Fresnel lens, circular—a sheet of transparent material into which concentric grooves have been formed in such a pattern that light will be focused as with a lens. (Focusing mirrors of similar design are also available.)

Fresnel lens, linear—a sheet of transparent material into which parallel grooves have been formed in such a pattern that light will be focused as by a cylindrical lens. (Focusing mirrors of similar design are also available.)

Fresnel-reflector system—flat mirrors arranged in an array such that they reflect onto a target, the illuminated area of which simulates the shape and size of the flat mirror. (Such an array simulates the ray-tracing of a parabolic trough of the same aperture angle.)

full radiator—see **blackbody.**

gross collector area— see **area, gross collector.**

heat-actuated cooling—the use of thermal energy to initiate a thermodynamic cycle which results in a local decrease in temperature.

heat capacity—see **thermal capacity.**

heat loss rate—the rate at which heat is lost from a system or component of a system, per degree temperature difference between its average temperature and the average ambient air temperature.

heat transfer fluid—(*1*) *in solar energy systems*, a liquid or gas that passes through the solar collector and carries the absorbed thermal energy away from the collector. (*2*) any fluid that is used to transfer thermal energy between subsystems in solar energy systems.

heliostat—a reflector that is mechanically moved so that solar flux is reflected in a constant direction to a stationary receiver or target.

hemispherical, 2π—over an entire hemisphere. It is assumed that the incident radiance is uniform in density over the hemisphere.

illuminance—luminous irradiance.

incident angle—see **angle of incidence.**

in-service conditions—the normal conditions to which a system and its components will be exposed during their operational lifetimes. This does not include stagnation conditions; see **stagnation conditions.**

insolation—the use of the term *insolation* is discouraged in favor of the preferred term, **solar irradiance.**

instantaneous collector efficiency—see **efficiency, instantaneous collector.**

international phyrheliometric scale—pyrheliometric scale decreed as being in operation from July 1, 1957, in order to meet an urgent need for a single international scale.

irradiation—(*1*) process of exposing a surface or material to radiant flux; (*2*) at a point on surface, see **radiant exposure.**

isohel—curve on a map showing areas of equal sunshine duration during a given interval of time, normally a year.

isopleth—a line on a chart or graph connecting points having

a specified constant value of a single variable as a function of two other specified variables.

isotropic radiant energy— see **radiant energy, isotropic**.

line-focus collection— see **collector, line-focus.**

luminous (photometric)—referring to a radiometric quantity, indicates the weighted average of the spectral radiometric quantity, with the photopic spectral luminous efficiency function given in Annex A1 of Practice E 971, for Calculation of Photometric Transmittance and Reflectance of Materials to Solar Radiation,[4] being the weighting function.

natural convection— see **convection, natural.**

natural-type environment—in solar energy applications, the natural aspects of the outdoor exposure environment elements (or simulation), including changes with time, that may affect the thermal performance of a collector through degradation of collector materials or physical damage to the collector configuration. (Typical aspects include radiant exposure, ambient temperature, and rain impingement.)

natural weathering—long-term exposure of materials to unconcentrated sunlight on fixed-angle (or seasonally adjusted) racks, the purpose of which is to assess the effects of environmental factors in various functional and decorative parameters of interest.

nonoperational mode—the condition that exists when a solar collector has been filled, purged of heat transfer fluid (if a liquid), and capped (but not sealed) to prevent contamination by foreign substances prior to exposure.

nonselective surface—a surface for which the spectral optical properties reflectance, absorptance, transmittance, and emittance are essentially independent of wavelength over a particular wavelength range.

NOTE 9—For solar absorbers, the absorption of solar energy is largely confined to the wavelength range from 0.3 to 3.0 μm, but there is significant flux emitted at wavelengths out to about 30 μm.

normal, ⊥—directional in a direction normal (perpendicular) to a surface.

operating conditions, extreme—unusual physical conditions to which a component or system may be exposed and for which it is not designed or intended to withstand, nor is it required to withstand by a local regulatory agency.

operating conditions, normal—the usual range of physical conditions (for example, temperature, pressure, wear and tear, weather) for which the component or system was designed.

outgassing—the process by which materials expel gases.

period system efficiency— see **efficiency, period system.**

point focus collector— see **collector, point focus**.

polarization—for plane polarized beams the plane of polarization is taken as the electric vector. For elliptically or partially polarized beams, polarization must be handled by use of the Stokes parameters, which is rather complex and must be handled in the text. The direction of polarization of a plane polarized beam is taken as the angle between the plane of polarization and the plane of incidence or of reflection or transmission. For other than parallel or perpendicular polarization, the subject is most easily handled in the text.

polarization, parallel, ||—with the plane of polarization parallel to the plane of incidence, reflectance, or transmittance.

polarization, perpendicular, ⊥— with the plane of polarization perpendicular to the plane of incidence, reflectance, or transmittance.

potable water—water that is satisfactory for drinking and culinary purposes, meeting the requirements of the health department having jurisdiction.

preheating, solar—the use of solar energy to partially heat a substance, such as domestic potable water, prior to heating it to a higher desired temperature with auxiliary fuel.

pressure relief device—a pressure-activated valve designed to automatically relieve excessive pressure.

pulsed simulator—simulator whose irradiance output at the test plane area is in a single short duration pulse of 100 ms or less.

quasi-steady state—state of the solar collector test when the flow rate and temperature of the fluid entering the collector are constant. The exit fluid temperature changes are small and due only to the normal change in irradiance that occurs with time for clear sky conditions.

radiant emissive power— see **radiant exitance, emitted.**

radiant energy—energy in the form of photons or electromagnetic waves.

radiant energy, atmospheric—the part of terrestrial radiation that is emitted by the atmosphere.

radiant energy, blackbody—radiant energy emitted by a (laboratory) blackbody, or radiant energy having that spectral distribution. (Refer to Planck's law as defined in standard tests).

radiant energy, circumsolar—radiation scattered by the atmosphere so that it appears to originate from an area of the sky immediately adjacent to the sun. It causes the solar aureole, and its angular extent is directly related to the atmospheric turbidity, being greater with higher turbidity.

radiant energy, effective nocturnal—energy transfer required to maintain a horizontal upward-facing blackbody surface at the ambient air temperature, in the absence of solar irradiance.

radiant energy, infrared—radiant energy with wavelengths longer than 770 nm and less than 1 mm (approximately).

radiant energy, isotropic—diffuse radiant energy that has the same radiance in all directions. See **radiometric properties and quantities**.

radiant energy, terrestrial—radiant energy emitted by the earth, including its atmosphere.

radiant exitance at a point on a surface, $M = \mathbf{d}\Phi_e/\mathbf{d}A$— the quotient of the radiant flux leaving an element of the surface containing the point, by the area of that element. The exitance may be emitted, transmitted and/or reflected flux, and is measured in watts per square metre ($W \cdot m\Sigma^{-2}$).

radiant exitance, emitted—radiant flux emitted per unit surface area.

radiant exposure, H—time integral of irradiance, measured in joules per square metre.

[4] *Annual Book of ASTM Standards*, Vol 12.02.

radiant flux, $\Phi = dQ/dt$ **[Watt (W)]**—power emitted, transferred, or received in the form of electromagnetic waves or photons. See **radiometric properties and quantities.**

radiant flux, net—difference between downward and upward (total solar and terrestrial) radiant flux; net flux of all radiant energy across an imaginary horizontal surface.

radiant flux, net terrestrial—difference between downward and upward terrestrial radiant fluxes; net flux of terrestrial radiant energy.

radiant intensity of a point source in a given direction, $I = d\Phi/d\Omega$— quotient of the radiant flux emitted by a source, or by an element of source, in an infinitesimal cone containing the given direction, by the solid angle of the cone, measured in watts per steradian. (Refer to the inverse square law.)

radiant power—see **radiant flux.**

radiation—the process by which energy is emitted or transferred in the form of photons or electromagnetic waves. (See also **radiant energy**.)

radiation coefficient—the quotient of the net radiant exitance of a blackbody (full radiator), by the temperature difference between the blackbody and the surroundings with which it is exchanging radiation.

radiometric properties and quantities modifiers—modifiers that can be used to indicate the geometric, spectral, and polarization conditions under which radiometric properties and quantities are evaluated. Radiometric properties and quantities vary with the direction and geometric extent (solid angle) over which the incident or exitant flux, or both, is evaluated, and with the relative spectral distribution of the incident flux and the spectral response of the detector for exitant flux. For reflectance and transmittance, the direction and geometric extent of both the incident beam and exitant beam must be specified. For emittance, only the exitant beam need be specified, and for absorptance, only the incident beam need be specified. The properties also vary with the polarization of the incident flux and the sensitivity to polarization of the collector-detector system for flux incident or exitant at angles greater than about 15° from normal. See the following modifiers: **conical; directional; hemispherical; normal;** and **spectral.**

receiver—in solar energy systems, that part of the solar collector to which the solar irradiance is finally directed or redirected, and includes the absorber and any associated glazings through which the redirected energy must pass.

reflectance, p— the ratio of the reflected flux to the incident flux. See **radiometric properties and quantities.**

reflection—the process by which incident flux is returned from the surface of incidence of a stationary sample, without change in frequency.

reflection angle—**angle of reflection.**

reflectivity, R_∞—the reflectance of a microscopically homogeneous sample with a clean optically smooth surface and of thickness sufficient to be a completely opaque.

NOTE 10—Reflectivity is a property of a material and reflectance is a property of a sample of the material, with no restriction on thickness or surface topography.

refraction angle—see **angle of refraction.**

reradiation—loss of energy by radiation from a surface previously heated by absorption.

selective surface—a surface for which the spectral optical properties reflectance, absorptance, emittance, or transmittance vary significantly with wavelength, which enhances the collection (or rejection) of radiant energy in a restricted portion of the spectrum.

NOTE 11—An example of a selective surface would be a collector cover glazing that has a high transmittance over the solar spectrum (300 to 2500 nm) and high reflectance over the spectral region of principal thermal infrared emission from the absorber.

shading or shadowing—the act of casting a shadow across any surface.

solar, *adj*—(*1*) *referring to radiometric quantities*, indicates that the radiant flux involved has the sun as its source, or has the relative spectral distribution of solar flux. (*2*) *referring to an optical property*, indicates a weighted average of the spectral property, with a standard solar spectral irradiance distribution as the weighting function.

solar constant—the total solar irradiance at normal incidence on a surface in free space at the earth's mean distance from the sun (1 AU = 1.496×10^{11} m).

NOTE 12—The current accepted value of the solar constant at 1 AU is 1353 ± 21 W·m^{-2} and is subject to change. See Definitions E 491.[2]

solar cooling systems—the complete assembly of subsystems and components necessary to convert solar energy into other forms of energy for space cooling purposes.

solar degradation—(*1*) the process by which exposure to solar energy deteriorates the properties of materials and components; (*2*) The deterioration produced by exposure to solar energy.

solar energy—the radiant energy originating from the sun. Approximately 99 % of solar energy lies between the wavelengths of 300 to 3500 nm.

solar energy system, active—a solar energy system that uses mechanical equipment (pumps, fans) that is not an integral part of a structure to collect and transfer thermal energy, either to the point of use or to be stored for later use.

solar energy system, drainback—a solar energy system in which the heat transfer fluid is drained out of the collector and exposed piping, and into a storage tank, a holding tank, or expansion tank in order to protect the collector and piping from damage due to freezing.

solar energy system, draindown—a solar energy system in which the heat transfer fluid is drained out of the collector and exposed piping to an external drain in order to protect the collector and piping from damage due to freezing.

solar energy system, hybrid—any solar energy system that combines the characteristics of two separate systems. Particularly, a solar energy system supplemented by a conventional energy system may be termed a hybrid system.

solar energy system, open—a solar energy system that has its storage tank exposed (open) to atmospheric pressure.

solar energy system, passive—a solar energy system that uses natural convection, conduction, or radiation to distribute thermal energy through a structure, or a portion of that structure within the limits of the indoor design temperature conditions. It can include movable components such as

dampers, insulation, or blinds, which may be moved periodically either manually or automatically.

solar energy system, thermosiphon—a solar energy system in which the heat transfer fluid circulates by convection as the less dense, warm fluid rises and is displaced by the denser, cooler fluid.

solar fraction—ratio of the amount of input energy contributed by the solar energy system to the total input energy required for the application.

solar heating and cooling systems—the complete assembly of subsystems and components necessary to convert solar energy into thermal energy and use this energy in combination with auxiliary energy, where required, for combined heating and cooling purposes.

solar heating system—the complete assembly of subsystems and components necessary to convert solar energy into thermal energy and use this energy in combination with auxiliary energy, where required, for heating purposes.

solar irradiance at a point of a surface, $E_s = d\Phi_s/dA$—the quotient of the solar flux incident on an element of a surface containing the point, by the area of that element, measured in watts per square metre.

solar irradiance, average, E_s—the time integral of solar irradiance over a specified time period divided by the duration of that time period.

solar irradiance, diffuse, E_s**(d)**—the downward scattered solar flux as received on a horizontal surface from a solid angle of 2π steradian (hemisphere) with the exception of a conical solid angle with a 100 milliradions (approximately 6°) included plane angle centered upon the sun's disk, measured in watts per square metre.

solar irradiance, direct, E_s—solar flux coming from the solid angle of the sun's disk incident on a surface perpendicular to the axis of that solid angle. In conventional instruments the acceptance cone includes a plane angle of about 6°.

solar irradiance duration—(*1*) a bright sunshine duration: time interval during which direct solar energy casts distinct shadows; (*2*) Geographically or topographically possible sunshine duration: maximum interval during which solar energy can reach a given surface.

solar irradiance, global, $E_s(2\pi)$—solar irradiance received on an upward-facing horizontal surface directly from the solid angle of the sun's disk and scattered or diffusely reflected in traversing the atmosphere, measured in watts per square metre.

solar irradiance, instantaneous—solar irradiance at a point in time measured in watts per square metre.

solar irradiation— see **radiant exposure,** the preferred term.

solar noon—that instant of any day at which the sun reaches its zenith, or crosses the meridian.

solar radiation—see **solar energy.**

solar rights—the legal right of a person who uses a solar energy device not to have his or her sunlight blocked by another person's new structure or foliage.

solar spectrum—spectral distribution of typical terrestrial sunlight at air mass 1.5 as defined in Standard E 891, for Terrestrial Direct Normal Solar Spectral Irradiance Tables for Air Mass 1.5.[4]

solar thermal collector— see **collector, solar thermal.**

solar water heating system—the complete assembly of subsystems and components necessary to convert energy into thermal energy and use this energy in combination with auxiliary energy, where required, to provide hot water.

solar water heating system, direct—a solar water heating system in which the potable water passes directly from the water supply, through the collectors and storage, to the residential hot water supply.

solar water heating system, indirect—a solar water heating system in which a closed circulation loop isolates one fluid from contact with others in the system. This closed loop may contain a nonpotable fluid.

spectral—(*1*) for a radiometric quantity, concentration per unit wavelength (or frequency), indicated by the subscript λ following the symbol for the quantity, as $L\lambda = dL/d\lambda$; at a specific wavelength, indicated by the subscript λ with the wavelength in parentheses, as $L\lambda$ (500 nm). (*2*) For a radiometric property, at a specific wavelength (or frequency), indicated by the wavelength in parentheses, as ρ (750 nm), or as a function of wavelength, indicated by the symbol (λ) following the symbol for the property, as $\epsilon(\lambda)$. See **radiometric properties** and **quantities.**

stagnation conditions—in solar energy systems, the conditions (that is, temperature and pressure) existing when energy system has attained a quasi-steady state after the flow of heat-transfer fluid has stopped, but the absorber continues to receive significant solar irradiance.

steady state simulator—simulator whose irradiance output at the test plane area is continuous for periods of a second or greater.

storage component, thermal—a component of a building used for storing thermal energy. Includes all identifiable elements that serve an architectural as well as thermal function.

storage device, thermal—the container(s) plus all contents of the container(s) used for storing thermal energy. The transfer fluid and accessories such as heat exchangers, flow switching devices, valves, and baffles which are integral with the thermal storage container(s) are considered a part of the storage device.

storage medium, thermal—the material in the storage device, independent of the containing structure, in which the major portion of the thermal energy is stored.

thermal capacity—the amount of thermal energy that can be stored in a storage device during a period of time and for a specific set of values (that is, initial temperature of the storage device, the temperature of the entering fluid, and the mass flow rate of fluid through the storage system).

thermal capacity, theoretical—the amount of energy that can be stored in the storage device if all its components undergo an increase in temperature from the original value to a final value.

thermal storage medium— see **storage medium, thermal.**

thermosiphon solar energy system— see **solar energy system, thermosiphon.**

tilt angle—*in solar energy applications,* the angle between the

horizontal and the plane of the detector (collector, photovoltaic array, instrument) surface.

time constant—of a solar collector, the time required for the fluid leaving a solar collector to attain 63.2 % of the resulting change in equilibrium outlet temperature following a step change in solar irradiance or inlet fluid temperature.

NOTE 13—The step change involved should be spelled out in the procedure.

total—see **radiometric properties and quantities.**

tracking collector— see **collector, tracking.**

tracking error—(*1*) for a two-axis tracking collector, the angular deviation between the collector-sun line and a line that is normal to the aperture plane. (*2*) for a single-axis tracking collector, the angular deviation between two planes that intersect along the axis of rotation. One plane contains the optical axis of the collector and the other contains the center of the sun.

trickle collector— see **collector, trickle.**

transmission—passage of radiant energy through a material so that it emerges from a surface other than the surface of incidence, without change in frequency.

transmission coefficient—fraction of monochromatic flux internally transmitted by unit path length of a medium. One minus the absorption coefficient.

NOTE 14—The transmission coefficient changes with wavelength.

transmittance, τ—the ratio of the transmitted radiant flux to the incident flux (Practice E 491[2]). See **radiometric properties and quantities.**

weather conditions, normal—the (actual or anticipated) range of environmental conditions (rain, snow, hail, wind, temperature, pollution) that will typically occur in a local climatic region over several years.

INSTRUMENTS

bolometer—instrument for measuring irradiance. Its principle is based on the variation of electrical resistance, with the incoming radiation, as a result of temperature change, of one or both of the resistance elements which comprise the instrument.

net pyrgeometer—see **pyranometer, net.**

net pyrradiometer— see **pyranometer, net.**

photometer—an instrument for measuring photometric quantitities, such as luminous intensity or luminous flux. See Terminology C 859, Relating to Nuclear Materials.[5]

pyranometer—(*1*) a radiometer to measure the global solar irradiance in the plane of its aperture; (*2*) A radiometer used to measure the total solar radiant energy incident upon a surface per unit time per unit area. This energy includes the direct radiant energy, diffuse radiant energy, and reflected radiant energy from the background.

pyranometer, field—a pyranometer essentially meeting the World Meteorological Organization Class II specifications, appropriate to field use and typically exposed continuously.

pyranometer, net—an instrument for measuring the difference between the irradiance falling on the top and bottom of a horizontal surface.

pyranometer, reference—a pyranometer essentially meeting the World Meteorological Organization Class I specifications and used principally to calibrate other instruments.

pyranometer, spherical—instrument for measuring the solar flux falling from a solid angle 4π on a spherical surface.

pyrgeometer—an instrument for measuring net atmospheric irradiance on a horizontal upward facing black surface at the ambient air temperature.

pyrheliometer—a radiometer used to measure the direct or beam solar irradiance incident on a surface normal to the sun's rays.

pyrheliometer, compensated—pyrheliometer based on the comparison of the heating of two identical metal strips, one exposed to a solar radiant energy, the other to a joule effect.

pyrheliometer, secondary reference—a pyrheliometer essentially meeting the World Meteorological Organization Class I specifications but not having self-calibrating capability.

pyrradiometer, spherical—instrument for measuring total flux falling from a solid angle 4π on a spherical surface.

radiometer—instrument for measuring irradiance in energy or power units.

reflectometer—an instrument for measuring reflectance.

BIOMASS FUELS

biomass—any material, excluding fossil fuels, which is or was a living organism that can be used as a fuel peanut hulls, agricultural waste, corn and other grains, sugar, and bagasse are all examples of biomass.

biomass fuel—fuel derived from biomass.

denatured fuel ethanol—fuel ethanol to which chemicals (denaturants) have been added to make the ethanol unfit for human consumption in accordance with regulations of the Bureau of Alcohol, Tobacco, and Firearms of the U. S. Treasury Department.

fermentation fuel—a fuel produced by fermentation of biomass.

NOTE 15—Ethyl alcohol is the most common form of fermentation fuel.

fuel alcohol—ethyl, methyl, or higher alcohols with impurities (including water but excluding denaturants) produced for use as a fuel alone or as an addition to other fuels, such as gasoline.

hogged fuel—ground wood fuel that is usually a by-product of a wood products manufacturing process.

wood fuel—fuel derived from biomass composed of woody trees or shrubs.

[5] *Annual Book of ASTM Standards,* Vol 12.01.