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Standard Terminology Relating to Nuclear Materials¹

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1. Scope

1.1 This terminology standard contains terms, definitions, descriptions of terms, nomenclature, and explanations of acronyms and symbols specifically associated with standards under the jurisdiction of Committee C26 on Nuclear Fuel Cycle. This terminology may also be applicable to documents not under the jurisdiction of Committee C26, in which case this terminology may be referenced in those documents.

2. Terminology

absorbance, A —*in spectrochemical analysis*, the logarithm to the base 10 of the reciprocal of the transmittance. **abundance sensitivity**, n —*in methods of chemical analysis*, the ratio of the ion beam intensity of the major isotope, M , to the background current at the adjacent mass positions.

$$A = \log(1/T) \quad (1)$$

Abundance sensitivity = ion current at mass M / ion current at $M \pm 1$

absorptivity, a —*in spectrochemical analysis*, the absorbance (A) divided by the product of the cell path length (b) and the concentration (c):

$$a = A/bc \quad (2)$$

analyte, n —*in method of chemical analysis*, a sample component whose presence and concentration is of interest.

abundance sensitivity (isotopic measurement)—the ratio of the ion beam intensity of the major isotope, M , to the background current at the adjacent mass positions.

$$\text{Abundance sensitivity} = \frac{\text{ion current at mass } M}{\text{ion current at } M \pm 1} \quad (3)$$

continuing calibration blank check solution (CCB)—*in methods of chemical analysis*, a standard solution that has no analyte and is used to verify blank response and freedom from carryover.

accelerator—*as used in a furnace*, a material used to promote the rapid and complete reaction of a sample. **continuing calibration verification check solution (CCV)**—*in methods of chemical analysis*, a standard solution (or set of solutions) used to verify freedom from excessive instrument drift; the concentration is to be near the midrange of a linear curve.

accelerator (for pyrohydrolysis)—a substance that speeds a reaction, in this case, a pyrohydrolysis. **determination**, n —the process of carrying out a series of operations specified in the test method whereby a single value is obtained.

acceptance test—a test, or series of tests, conducted by the procuring agency, or an agent thereof, to determine whether an individual lot of materials conforms to the purchase order or contract or to determine the degree of uniformity of the material supplied by the vendor, or both.

Discussion—Specifications usually state sampling technique, test procedures, and minimum requirements for acceptance. **initial calibration verification check solution (ICV)**—*in methods of chemical analysis*, a standard solution (or a set of standard solutions) used to verify calibration standard levels; the concentration of analyte is to be near mid-range of the linear curve that is made from a stock solution having a different manufacturer or manufacturer lot identification than the calibration standards.

accountability—a term used to designate the internal control system used for nuclear materials, but does not include physical protection. **linear range check solution (LRS)**—*in methods of chemical analysis*, a solution containing known concentrations of the analytes that is used to determine the upper limit of the linear range.

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actinide series—the series of elements beginning with actinium, Element No. 89, and continuing through lawrencium, Element No. 103. **mass bias or fractionation, n** —in methods of chemical analysis, the deviation of the observed or measured isotope ratio from the true ratio as a function of the difference in mass between the two isotopes.

aliquant—a representative portion of a whole that divides the whole leaving a remainder. **on-peak spectral interference correction, n** —adjustments made in observed net intensity of peak interest to compensate for error introduced by spectral interferences.

aliquant (solution)—a measured quantity of a homogeneous, liquid mixture that, when taken by either weight or volume, is not an evenly divisible portion of the total mixture. **quench standard curve, n** —in methods of radiochemical analysis, a relationship between sample quench and detection efficiency. A quench curve for an isotope in a given cocktail and vial combination is developed by counting a series of standards containing the same activity of that isotope, but each with different quench. Sample quench is typically quantified by variety of parameters.

aliquot—a representative portion of a whole that divides the whole exactly without leaving a remainder. **sequential flow injection, n** —in methods of chemical analysis, an automated non-chromatographic flow analysis technique for concentrating the analytes and separating them from sample components by reproducibly and sequentially manipulating flow of sample and reagents through a column of sorbent material.

alpha activity—the spontaneous emission of doubly charged helium ions from the nucleus.

analysis (physical or chemical)—the determination of physical or chemical properties or composition of a material.

analytical reagent grade—reagents of high purity that meet ACS specifications, as published by the American Chemical Society.

apparent density—the mass of a material divided by its apparent volume including closed pores.

archive sample—any sample retained for record or for future use.

atomic absorption spectrometry—the measurement of the light absorbed at the wavelength of resonance lines by the unexcited atoms of an element.

atomic weight—the mean weight of the atom of an element in relation to $^{12}\text{C}=12.000$.

background intensity—in spectrochemical analyses, the optical density or darkening of the photographic plate or film near the spectrographic line being measured, or the intensity of light measured with a phototube near the spectrographic line being measured.

bagout port—*in the nuclear industry*, an opening in a glovebox to which a bag is attached and in which material and equipment can be encased, then removed without possible contamination of the surrounding environment.

barn—a unit of area equal to 10^{-24} cm², used to express the probability of the occurrence of a specific nuclear interaction.

batch—a quantity of material made in a production sequence that is expected to be uniform in isotopic, physical, and chemical characteristics.

beta activity—the spontaneous emission of electrons from a nucleus.

bias—a persistent positive or negative deviation of the method average from the correct value or accepted reference value. (Also referred to as “constant” or “systematic error.”)

binder—a cementing medium; either a material added to the powder to increase the green strength of the compact, and that is expelled during sintering; or a material (usually of relatively low melting point) added to a powder mixture for the specific purpose of cementing together powder particles that alone would not sinter into a strong body.

boron equivalent—*in the nuclear industry*, the absorptive capacity for thermal neutrons of weights of various elements expressed in terms of the weight of natural boron.

branching—*in the nuclear industry*, the existence of two or more modes by which a radionuclide can undergo radioactive decay.

bulk density—the mass of a material divided by its exterior volume.

burnable neutron absorber—a neutron absorber, such as boron, purposely included in a reactor to help control long-term reactivity changes by its progressive burnup. (Also referred to as burnable poison.)

burnable poison—See **burnable neutron absorber**.

calibration—the determination of the values of the significant parameters by comparison with values indicated by a reference instrument or by a set of reference standards.

calibration curve—the graphical or mathematical representation of a relationship between the assigned (known) values of standards and the measured responses from the measurement system.

calibration standard—a standard having an accepted value (reference value) for use in calibrating a measurement instrument or system.

carrier gas—a gas that is inert in the analysis that is used to sweep gaseous products through the analysis system.

certificate of test—a written, printed, or signed document attesting to the validity of the test performed.

certified reference material—a reference material with one or more property values that are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation that is issued by a certifying body. A certifying body is a technically competent body (organization or firm, public or private) that issues a reference material certificate. A reference material certificate is a document certifying one or more property values for a certified reference material, stating that the necessary procedures have been carried out to establish their validity. (ISO definition: ISO Guide 30, *Terms and Definitions Used in Connection with Reference Materials*.)

chemical assay—a chemical measurement of the quantity of one or more components of a material.

chemical separation—the removal, isolation, or separation of the desired substance from the remainder of the sample by methods that involve difference(s) in the chemical properties of the substances involved.

clean room—an area in which the temperature, humidity, and airborne contamination particulate are controlled as required.

colorimetric—See the preferred term, **spectrophotometry**.

colorimetry—See the preferred term, **spectrophotometry**.

compaction—in ceramics or powder metallurgy, the preparation of a compact or object produced by the compression of a powder, generally while confined in a die, with or without the inclusion of lubricants, binders, etc., and with or without the concurrent applications of heat.

comparator, spectral—an instrument for the inspection and wavelength measurement of spectrograms. (E135, E-2)

composite lot sample—a single sample prepared by combining samples from several containers in the same ratio as the quantities in the containers sampled.

concurrent analysis—an analysis performed at the same or nearly the same time, or in immediate sequence, often in relationship or association to another analysis. In analytical chemistry, a term used to describe a series of measurements in which reference material samples are analyzed in tandem with samples whose chemical composition or particular chemical property(ies) are being determined.

“cone and quartering” method—a form of sampling in which a powder is piled into a conical heap, spread into a circular cake, and divided into quarters, of which a diagonally opposite pair are taken as samples.

Discussion—The procedure can be repeated until powder samples of the desired size are obtained.

controlled fission—*in the nuclear industry*, fission under conditions of continuous adjustment of control rods and of other control mechanisms in a reactor that compensates for the changes in reactivity.

controlled potential coulometry—the measurement of the number of coulombs required for an electrochemical reaction occurring under conditions where the working electrode potential is precisely controlled.

control rod—*in the nuclear industry*, a device used to control chain reactions, usually a neutron-absorbing material.

copper spark method—*in emission spectroscopy*, a method using high voltage spark excitation for the determination of elemental constituents of material deposited, usually by evaporation, on a pair of copper electrodes.

coulometer—an electrolytic cell or electronic device arranged to measure the quantity of electricity by the chemical action produced in accordance with Faraday’s law.

counter electrode (electrochemical)—an electrode in an electrochemical cell that is used to transfer current to or from a working or a reference electrode, or both.

criticality—*in the nuclear industry*, the condition wherein a system or medium is capable of sustaining a nuclear chain reaction.

criticality controls—those mechanisms which provide a high level of assurance that the probability of occurrence of a critical excursion is acceptably low.

critical mass—*in the nuclear industry*, the minimum mass of fissile material that can be made critical with a specified geometrical arrangement and material composition.

current efficiency—the proportion, usually expressed as a percentage, of the current that is effective in carrying out a specific process in accordance with Faraday’s law.

daughter—a nuclide, stable or radioactive, formed by radioactive decay. A synonym for decay product.

dead time correction—an adjustment to the elapsed counting time of a detector system to compensate for the time the system is processing signals and cannot accept new signals.

density—the mass of a unit volume of the material at any given temperature. The unit of mass is expressed in grams, the unit of volume in cubic centimetres (unless otherwise specified), and the temperature scale in degrees Celsius. The SI unit of density is kilogram per cubic metre.

density (film or line)—the quantitative measure of film blackening.

$$D = \log I_0 / I \quad (4)$$

where:

D = density,

I_0 = light intensity incident on the film, and

I = light intensity transmitted.

depleted uranium—less than the accepted value of the weight percent of the isotope ^{235}U in natural uranium.

detection limit—a stated limiting value which designates the lowest concentration or mass that can be estimated or determined with confidence and which is specific to the analytical procedure used.

detector efficiency—in the measurement of radioactivity, the fraction of particles or photons striking the detector that gives rise to a detected response. (In many cases, it is defined to mean relative efficiency, the product of detector efficiency and detector geometry.)

detector geometry—in the measurement of radioactivity, the fraction of emissions from the source (particles or photons) that impinge on the detector. Also called solid angle.

dilution factor—for a specified constituent, the ratio of the quantity of a diluted material to the quantity of the undiluted material.

electrical calibration—the calibration of an instrument by use of known quantities of electrical energy.

electrolytic cell—a unit apparatus in which electrochemical reactions are produced by applying electrical energy, or that supplies electrical energy as a result of chemical reactions and that includes two or more electrodes and one or more electrolytes contained in a suitable vessel.

emulsion calibration curve—the plot of a function of the relative transmittance of the emulsion versus a function of the exposure.

end point—in chemical analysis, that stage during a titration at which a marked change is observed. This could be a change in indicator color, potential, or some other indicating parameter.

end point inflection—the largest change in observed property per unit quantity of titrant. This is indicative of the end point.

enriched uranium—greater than the accepted value of the weight percent of the isotope ^{235}U in natural uranium.

equivalent boron content (EBC)—*in the nuclear industry*, the concentration of natural boron that would provide a thermal neutron absorption cross section equivalent to the concentration of a specific impurity element.

equivalent boron content (EBC) factor—the ratio of the product of the atomic weight of boron and a specified impurity thermal neutron absorption cross section to the product of the boron thermal neutron absorption cross section and the atomic weight of a specified impurity element.

$$\frac{(\text{at. wt. of boron})(\sigma \text{ of impurity})}{(\sigma \text{ of boron})(\text{at. wt. of impurity})} \quad (5)$$

This factor is used to convert an impurity element concentration to a neutron absorption equivalent to natural boron.

equivalent uranium content (EUC)—a concentration of ^{238}U that would provide a fast neutron absorption cross section equivalent to the concentration of a specific impurity element.

equivalent weight—the weight of an element that will combine with, react with, or replace one atomic weight of hydrogen or one half atomic weight of oxygen.

filler—a general term for a material that is inert under the conditions of use and serves to occupy space and may improve physical properties.

fissure—a surface irregularity in the form of a narrow opening or crack.

fluorination—the process of chemically reacting a material with fluorine or a fluorine-containing compound to produce a desired product, for example, the reaction of UO_3 with fluorine to produce UF_6 .

fuel assembly—*in the nuclear industry*, a grouping of fuel elements that is not taken apart during the charging and discharging of a reactor core.

fuel element—*in the nuclear industry*, the smallest structurally discrete part of a reactor that has fuel as its principal constituent.

gamma activity—the spontaneous emission from the nucleus of high energy, short wavelength, electromagnetic radiation.

germanium detector, lithium drifted—a semi-conductor detector that can be used for high-resolution gamma-ray spectrometry.

historical sample—See preferred term, **archive sample**.

integrator (count rate)—a device for obtaining the time integral of the counts as from a radioactive material.

intensity—ideally, the radiant power per unit area. In spectrochemical analysis, the radiant power as measured by a photographic or photoelectric receiver, or as estimated visually.

intensity (line)—the light intensity of an image of a slit formed in the focal plane of a spectrograph or spectrometer and having a width approximately equal to that formed by monochromatic radiation. Also see **spectral line**.

internal standard—a material present in or added to samples that serves as an intensity reference for spectral measurements.

internal standard line—a spectral line of an internal standard, with which the radiant energy of an analytical line is compared.

iodometry—an application of iodine chemistry to oxidation-reduction titrations for the quantitative analysis of chemical compounds.

isotope—nuclides having the same atomic number but different mass numbers.

isotopic assay—the determination of the percentage (by weight or by atoms) of isotopic constituents of an element.

isotopic composition—the relative amounts, expressed in atom or weight fraction of the various isotopes of an element in a sample or material.

isotope ratios—the relative amounts of two isotopes of an element, expressed as a ratio, in a sample or material.

linear dispersion—*in spectrochemical analysis*, the derivative $dx/d\lambda$ where x is the distance along the spectrum and λ is the wavelength. Linear dispersion is usually expressed as millimetres per angstrom.

lot—a quantity of material that is thought to be uniform in one or more stated properties such as isotopic, chemical, or physical characteristics.

matrix material (preparation of reference materials)—the principal materials in which one or more constituents may be dispersed.

measurement control standard—a material or item used for monitoring the performance of a measurement system.

mechanical properties—those properties of a material which are associated with elastic and inelastic reaction when force is applied, or which involve the relationship between stress and strain.

Discussion—These properties have often been referred to as “physical properties,” but the term “mechanical properties” is preferred.

moderator—a material used to reduce neutron energy by scattering without appreciable capture.