Standard Terminology Relating to
Analytical Chemistry for Metals, Ores, and Related Materials[1]

This standard is issued under the fixed designation E135; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This is a compilation of terms commonly used in analytical chemistry for metals, ores, and related materials. Terms that are generally understood or defined adequately in other readily available sources are either not included or their sources are identified.

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

1.3 Definitions identical to those published by another standards organization or ASTM committee are identified with the name of the organization or the identifying document and ASTM committee.

1.4 Definitions specific to a particular field (such as *emission spectrometry*) are identified with an italicized introductory phrase.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1914 Practice for Use of Terms Relating to the Development and Evaluation of Methods for Chemical Analysis (Withdrawn 2016)[3]

E2437 Practice for Designing and Validating Performance-Based Test Methods for the Analysis of Metals, Ores, and Related Materials (Withdrawn 2014)[3]

E2438 Practice for Implementing Standard Performance Based Test Methods for the Analysis of Metals, Ores, and Related Materials (Withdrawn 2014)[3]

2.2 *ISO Standard:*[4]

ISO Guide 30 Terms and Definitions Used in Connection with Reference Materials

3. Significance and Use

3.1 Definitions given in Section 4 are intended for use in all standards on analytical chemistry for metals, ores, and related materials. The definitions should be used uniformly and consistently. The purpose of this terminology is to promote clear understanding and interpretation of the standards in which definitions are used.

4. Terminology Definitions

aim interlaboratory uncertainty, *n*—the maximum deviation (95 % confidence) to be allowed in the design of the total interlaboratory uncertainty of a test method, beginning with the preparation of a homogeneous sample and ending with a final report value to the client.   **E2437**

aim total intralaboratory uncertainty, *n*—the maximum deviation (95 % confidence) to be allowed in the design of the total intralaboratory uncertainty of a test method, beginning with the preparation of a homogeneous sample and ending with a final report value to the client.

aim uncertainty budget, *n*—during the development of a standard performance-based test method, the target allocation of interlaboratory measurement uncertainty among specific components of a measurement process that contribute significantly to the overall deviation. The target allocation is made by the task group and serves as guidance for interlaboratory test participants during method testing.   **E2437**

analytical curve—see **calibration curve.**

analyte, *n*—*in methods of chemical analysis*, the constituent determined by a chemical measurement process.   **E1914**

analytical gap, *n—in atomic emission spectrometry*, the region between two electrodes in which the specimen is excited and from which radiant energy is used for analysis.

analytical line, *n—in atomic spectrometry,* the particular wavelength of electromagnetic radiation used in determining the presence or concentration of an element.

arc, condensed—see **discharge, triggered capacitor.**

noncapacitive ac arc, n—in atomic emission spectrometry, a series of separate electrical discharges, individually self-initiating or initiated separately by another means, in which each current pulse has a polarity that is reversed from the previous one.

arc line—not recommended, see **atom line.**

atom line, *n—in atomic emission spectrometry*, a spectral line resulting from radiation emitted during electron transition as an excited atom returns to a lower energy level.

atomic emission spectrometry (AES), *n*—pertaining to emission spectrometry in the ultraviolet, visible, or infrared wavelength regions of the electromagnetic spectrum.

bandpass filter—see under **filter.**

between-laboratory standard deviation, s_R, *n*—the standard deviation of results obtained on the same material using the same method in different laboratories.

buffer, *n—in spectrometric analysis*, a substance that tends to minimize the effects of one or more elements on the emission of other elements.

burn, *n—in atomic emission spectrometry*, that portion of a solid specimen from which atoms were volatilized or sputtered.

burn, *vt—in atomic emission spectrometry*, to vaporize, or sputter, and excite a specimen with sufficient energy to generate spectral radiation.

calibrate, *vt*——*(1)* to establish the relationship between the response of an instrument and the amount of analyte; *(2)* to establish a table of corrections to improve the accuracy of equipment used to measure physical properties such as mass, volume, temperature, and so forth.

calibration, *n*—the act, process, or result of establishing: *(1)* the relationship between the response of an instrument and the amount of analyte present; *(2)* a table of corrections to improve the accuracy of equipment used to measure physical properties such as mass, volume, temperature, and so forth.

calibration curve, *n*—the graphical or mathematical representation of the relationship between the response of an instrument and the concentration or mass of the analyte.

condensed arc—see under **discharge, triggered capacitor.**

certified reference material (CRM), *n*—a reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence.

DISCUSSION—Before the advent of the term certified reference material (CRM), the term standard reference material was used in many documents of ASTM International. This results from the use of the term Standard Reference Material (SRM) as the name for certified reference materials (CRM) issued by the National Institute of Standards and Technology (NIST), an agency of the United States government.

counter electrode, *n—in atomic emission spectrometry*, the electrode in an analytical pair that does not contain the specimen being analyzed.

detection limit, *n*—the smallest net signal (or the derived property value, constituent mass fraction, etc.) obtained by a given measurement procedure, that can be distinguished from the background signal at a specified confidence level.

E1914

DISCUSSION—The detection limit may be designated as L_D. An equivalent alternative term is Limit of Detection with an acronym of LOD.[5]

discharge, triggered capacitor, *n*—a series of electrical discharges from capacitors initiated by a separate means and extinguished when the voltage across the analytical gap falls to a value that no longer is sufficient to maintain it.

division, *n—in sample preparation,* a process which divides a sample into two or more subsamples without changing the composition.

doré bead, *n*—a gold and silver bead that results from cupellation and may contain platinum group metals.

drift correction, *n—in spectrometric analysis*, the process of adjusting for a translational shift or a rotational shift, or both, of an instrument calibration.

electrode gap—not recommended, see **analytical gap.**

error, *n—of a result,* the difference between a result obtained on a material and its accepted reference value.   **E1914**

fatigue, *n—in atomic emission spectrometry,* the decrease in response of a photoelectric radiant energy detector caused by the accumulated exposure of the detector to radiant energy.

filter, *n—in atomic spectrometry,* a substance that attenuates the radiant power in a definite manner with respect to spectral distribution.

bandpass filter—a filter that passes wavelengths (or frequencies) within a specified range and attenuates all wavelengths (or frequencies) outside that range.

gross sample—see under **sample.**

homologous lines, *n—in atomic emission spectrometry*, spectral lines that exhibit minimal change in their intensity ratios with variations in excitation conditions.

increment, *n—in sampling*, a portion of material removed from a lot by a single operation.

[5] For a complete discussion, refer to L. A. Currie (ed.), *Pure and Applied Chemistry*, Vol 67, No. 10, 1995, pp. 1699–1723.

inquartation, *n—in fire assay*, the addition of silver to facilitate parting.

interlaboratory study (ILS), *n*—a study undertaken to demonstrate the precision and bias of a test method. **E1914**

interlaboratory uncertainty, *n—in a performance based standard test method*, the precision of test results (95 % confidence) that participating laboratories achieved during an interlaboratory study, beginning with the preparation of a homogeneous sample and ending with a final report. **E2437**

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

internal standard line, *n—in atomic spectrometry*, a spectral line of an internal standard, to which the radiant energy of an analytical line is compared.

intralaboratory uncertainty, *n— in a performance based standard test method*, the precision (95 % confidence) that a laboratory achieves when the method is used by more than one operator. In test methods that establish maximum allowable intralaboratory uncertainties, users must be able to demonstrate compliance with those uncertainties in order to report that a given test result was produced using the named method. **E2437**

ion line, *n—in atomic emission spectrometry*, a spectral line resulting from radiation emitted during electron transition as an ionized atom decays to a lower, but still ionized, energy level; see **atom line.**

laboratory sample—see under **sample.**

linear dispersion, *n*—the derivative d*x*/dλ where *x* is the distance along the spectrum and λ is the wavelength.

line pair, *n—in atomic emission spectrometry,* an analytical line and the internal standard line with which it is compared.

lot, *n—in sampling*, a collection of material regarded as a unit.

matrix, *n—in methods of chemical analysis*, all components of a material except the analyte. **E1914**

method, *n—in chemical analysis,* instructions used to produce a numerical result, which are detailed in a document referred to as "the method." **E1914**

minimum standard deviation, s_M, *n*—the standard deviation of results on a test material obtained under conditions of minimum variability **E1914**

nebulizer, *n*—a device for converting a sample solution into a gas-liquid aerosol for atomic absorption, emission, fluorescence, or mass analysis.

noncapacitive ac arc—see under **arc.**

normalization, *n—in spectrometric analysis,* (1) the process of adjusting instrument output to conform to an established condition using one or more homogeneous specimens or reference materials; (2) the adjustment of the analysis total to 100 %, or some other total.

parting, *vt—in fire assay*, separating silver from gold by selectively dissolving the silver in acid.

performance based method, *n*—a test method that defines: *(1)* the general approaches for sampling, sample preparation, and making measurements on a specified type of material; and *(2)* defines maximum allowable uncertainties for each measured constituent over its validated concentration range.

polychromator, *n*—a device for simultaneously isolating several rays of monochromatic radiation from a beam of polychromatic radiation.

preburn period, *n—in atomic emission spectrometry*, the time interval after the initiation of a discharge during which the emitted radiation energy is not recorded for analytical purposes.

premix burner, *n—in flame atomic absorption and atomic emission spectrometry*, a burner in which the fuel gas is mixed with the oxidizing gas before reaching the combustion zone.

prepared sample—see under **sample.**

primary X-rays, *n—in spectrometry*, the emergent beam from the X-ray source.

profile, *vt—in atomic emission spectrometry*, to scan and set the deflection of the grating, or actual or apparent position of the entrance slit, or actual or apparent location of the exit slits, to produce optimum measurement of intensity.

proof, *n—in fire assay*, a synthetic verifier having a precious metal content similar to that expected in the test sample.

proof correction, *n—in fire assay*, the adjustment to the final assay obtained by analyzing the proof concurrently with the test sample.

radiant power, *P*, *n*—the rate at which energy is transported in a beam of radiant energy, preferably expressed in watts.

reciprocal linear dispersion, *n*—the derivative dλ/d*x* where λ is the wavelength and *x* is the distance along the spectrum.

reference material (RM), *n*—a material, sufficiently homogeneous and stable with respect to one or more specified properties, which has been established to be fit for its intended use in a measurement process. **ISO Guide 30**

repeatability, *n*—see **within-laboratory standard deviation.** **E1914**

repeatability index, r, *n*—an estimate of the maximum difference expected for results on the same test material on different days in the same laboratory, a difference not expected to be exceeded an average of more than once in 20 comparisons (95 % probability). **E1914**

repeatability standard deviation, *n*—see **within-laboratory standard deviation.** **E1914**

reproducibility, *n*—see **between-laboratory standard deviation.** **E1914**

reproducibility index, R, *n*—an estimate of the maximum difference expected for results on the same material in two laboratories, a difference not expected to be exceeded an average of more than once in 20 comparisons (95 % probability). **E1914**

reproducibility standard deviation, *n*—see **between-laboratory standard deviation.** **E1914**

result, *n*—value representing the quantity of analyte that is obtained by applying a method one time to a test material. **E1914**

sample, *n*—*in methods of chemical analysis*, a portion of a material selected and processed to render its composition representative of the composition of the whole. (Contrast **specimen**.) **E1914**

gross sample, n—a sample representing one lot of material and composed of a number of increments on which neither reduction nor division has been performed.

laboratory sample, n—a subsample, taken from the prepared sample of a lot, for submission to one or more laboratories for chemical analysis.

prepared sample, n—a subsample, taken from the gross sample, on which comminution, division, blending, or other procedures have been performed.

test sample, n—a quantity of material (selected from the properly prepared laboratory sample) that has a suitable mass or volume for one or more determinations by chemical analysis.

umpire sample, n—a laboratory sample retained for submission to a laboratory of recognized capability chosen to resolve a difference.

sample weight, *n*—the amount of test material determined by weighing with a balance.

scattering (of radiant energy), *n*—*in atomic emission spectrometry*, reflection of radiant energy in random directions by matter located between the source and the detector.

secondary X-rays, *n*—the X-rays emitted by a specimen irradiated by primary X-rays.

self-absorption, *n*—*in atomic emission spectrometry*, the reduction in relative intensity in the central portion of a spectral line resulting from selective absorption by the cooler outer vapor of the source envelope of radiation emitted by the hot central core.

self-reversal, *n*—*in atomic emission spectrometry*, the extreme case of self-absorption in which intensity decreases with increasing concentration.

sensitivity, *n*—the change of instrument response with change in analyte concentration.

spark, *n*—*in atomic emission spectrometry*, a high voltage capacitor discharge.

spark line—not recommended, see **ion line.**

specimen, *n*—*in methods of chemical analysis*, a portion of material selected to be typical of the whole under the assumption that the whole is composed of portions of similar composition. (Contrast **sample**.) **E1914**

spectral background, *n*—intensity that would be measured at the wavelength or energy of the analyte line if the analyte and overlapping lines were not present.

spectral distribution curve, *n*—the curve showing the absolute or relative radiant power emitted or absorbed by a substance as a function of wavelength, frequency, or any other directly related variable.

spectrochemical carrier, *n*—*in dc-arc spectrometry*, a material added to a specimen to facilitate selective vaporization of analytes into the analytical gap.

spectrophotometer, *n*—an instrument that provides the intensity ratio, or a function of the intensity ratio, of the radiant power of a beam as a function of spectral wavelength.

DISCUSSION—This term should be used only to describe instruments that obtain absorption measurements in the UV-Visible spectral region.

standardization, *n*—(*1*) the process of adjusting instrument output to a previously established calibration (that is, drift correction); (*2*) the experimental establishment of the concentration of a reagent solution.

standard deviation, between-laboratory, *n*—see **between-laboratory standard deviation.** **E1914**

standard deviation, minimum, *n*—see **minimum standard deviation.** **E1914**

standard deviation, within-laboratory, *n*—see **within-laboratory standard deviation.** **E1914**

standard reference material (SRM), *n*—see **certified reference material.**

test result, *n*—a value obtained by applying a method one time to a test material.

DISCUSSION—A test method may require replicate determinations to produce a test result.

test sample—see under **sample.**

transmittance, *n*—the ratio of the radiant power transmitted by a material to the radiant power incident upon it.

umpire sample—see under **sample.**

uncertainty budget, *n*—the allocation of intralaboratory measurement uncertainty among specific components of a measurement process that contribute significantly to the overall deviation.

validation, *n*—*of an analytical method,* the process by which a measurement method is shown to be useful for a specified purpose.

verification, *n*—confirmation that the calibration or standardization of an instrument is acceptable.

verifier, *n*—a material used to demonstrate whether the response of the measurement process has changed.

within-laboratory standard deviation, s_r**,** *n*—the standard deviation of results collected using the same method on the same material in the same laboratory on different days. **E1914**

5. Acronyms

AAS—atomic absorption spectrometry

AES—atomic emission spectrometry

CRM—certified reference material

DC Arc-AES—DC Arc atomic emission spectrometry

DCP—direct current plasma

DCP-AES—direct current plasma atomic emission spectrometry

FAAS—flame atomic absorption spectrometry

GD-AES—glow discharge atomic emission spectrometry

GD-MS —glow discharge mass spectrometry

GF-AAS—graphite furnace atomic absorption spectrometry

ICP—inductively coupled plasma

ICP-AES—inductively coupled plasma atomic emission spectrometry

ICP-MS—inductively coupled plasma mass spectrometry

ILS—interlaboratory study

RM—reference material

Spark-AES—spark atomic emission spectrometry

SRM—standard reference material

6. Keywords

6.1 accuracy; AES; analytical chemistry; arc; atomic emission spectrometry; bias; chemical analysis; DCP; definitions; ICP; mandatory; metals; ores; performance based methods; precision; spark; terminology; XRF