



# Standard Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials<sup>1</sup>

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<sup>e1</sup> NOTE—Definitions were added and withdrawn in February 2004

## 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:<sup>2</sup>

E 180 Practice for Determining the Precision of ASTM Methods for Analysis and Testing of Industrial and Specialty Chemicals

E 876 Practice for Use of Statistics in the Evaluation of Spectrometric Data

E 1914 Practice for Use of Terms Relating to the Development and Evaluation of Methods for Chemical Analysis

### 2.2 ISO Standard:

ISO Guide 30—Terms and Definitions Used in Connection with Reference Materials<sup>3</sup>

<sup>1</sup> This terminology is under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores, and Related Materials and is the direct responsibility of Subcommittee E01.23 on Terminology.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from American Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

## 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

**absorption (of electromagnetic radiation)**, *n*—a decrease in radiant energy when passing through matter, resulting in a corresponding increase in the energy of the absorbing system.

**accuracy**, *n*—of methods of chemical analysis, a characteristic manifested by agreement. **E 1914–98**

*analytical curve*—see **calibration curve**.

**analyte**, *n*—in methods of chemical analysis, the component determined by a method. **E 1914–98**

**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*—the particular wavelength of an element used in determining the presence or concentration of that element.

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

*continuous dc*, *n*—a self-maintaining dc discharge.

*noncapacitive ac*, *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.

*noncondensed, intermittent dc*—see **arc, noncapacitive, intermittent dc**.

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

**atom line**, *n*—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.

**b-value**, *n*—*in statistics*, the difference between the mean of a set of results on a material and its accepted reference value. (Compare **error**.) **E 1914–98**

**between-laboratory standard deviation**, *s<sub>R</sub>*, *n*—the standard deviation of results obtained on the same material in different laboratories (synonym: **reproducibility**). **E 1914–98**

**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 emission spectrometry*, (1) that portion of a solid specimen from which atoms were volatilized; (2) the act of burning.

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

**calibrant**, *n*—a reference material used for a calibration.

**calibrate**, *vt*—(1) to establish the relationship between the response of an instrument and the concentration or mass of the 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 concentration or mass of the substance determined; (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.

**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—See also **SRM**.

*characteristic emulsion curve*—see **emulsion calibration curve**.

**characteristic radiation**, *n*—*of X rays*, a unique set of X rays emitted by an element.

**comminution**, *n*—*in sample preparation*, a process that reduces the particle size of a sample.

**concentration range**, *n*—*in an analytical method*, the concentrations within which a method has been tested and found suitable for use.

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

**cupel**, *vt*—to refine precious metals in a cupel by exposure to high temperature in an oxidizing atmosphere.

*densitometer*—not recommended, see **microphotometer**.

**detection limit**—a stated limiting value that designates the lowest concentration or mass that can be estimated or determined with confidence and that is specific to the analytical procedure used (see Practice E 876).

**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 alloy bead which results from cupellation.

**drift**, *n*—*in instrumental methods of quantitative analysis*, a gradual change in instrument response from start to completion of a set of determinations.

**electrode**, *n*—*in emission spectrometry*, either of two terminals between which an electrical discharge occurs.

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

**emulsion calibration curve**, *n*—*in photographic atomic emission spectrometry*, the plot of the degree of blackening of the developed photographic emulsion as a function of the intensity of the spectral line to which it has been exposed.

**error**, *n*—*of a result*, the difference between a result obtained on a material and its accepted reference value. (compare *b-value*.) **E 1914–98**

**excitation potential (X-ray)**, *n*—the potential required to produce characteristic radiation from an element.

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

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

*neutral*, *n*—a filter that attenuates the radiant power reaching the detector by the same factor at all wavelengths within a prescribed wavelength region.

*nonselective*—not recommended, see **filter, neutral**.

**goniometer**, *n*—*in X-ray spectrometry*, a device used to adjust the angular relationships among a sample, crystal, and detector in an X-ray spectrometer.

**grating, concave**, *n*—a diffraction grating on a concave mirror surface.

*diffraction*, *n*—a series of a large number of narrow, close, equally spaced, diffracting slits or grooves capable of dispersing light into its spectrum.

*plane*, *n*—a transmission or reflecting diffraction grating whose surface is flat.

*reflection*, *n*—a diffraction grating from which the incident light is reflected to form a spectrum.

*transmission*, *n*—a transparent diffraction grating through which light is transmitted.

**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.

**inquartation**, *vt*—the addition of silver to an assay sample to facilitate parting.

**interlaboratory study**, ILS, *n*—a study undertaken to demonstrate the precision and accuracy of a test method.

**E 1914–98**

**intermittency effect**, *n*—*in atomic emission spectrometry*, the departure from the reciprocity law that may occur when the exposure of a photographic emulsion is made in a series of discrete increments, rather than in a continuous exposure of the same total energy.

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

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

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

**K radiation**, *n*—characteristic X rays produced by an atom or ion when a vacancy in the K shell is filled by one of the outer electrons.

**K-series**, *n*—the set of X-ray wavelengths composed of K radiation.

**L radiation**, *n*—characteristic X rays produced by an atom or ion when a vacancy in the L shell is filled by one of the outer electrons.

**L-series**, *n*—the set of X-ray wavelengths composed of L radiation.

**linear dispersion**, *n*—the derivative  $dx/d\lambda$  where  $x$  is the distance along the spectrum and  $\lambda$  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.

**E 1914–98**

**method**, *n*—instructions used to produce a numerical result, which are detailed in a document referred to as “the method.”

**E 1914–98**

**microphotometer**, *n*—an instrument for measuring the relative transmittance of small areas on a photographic emulsion such as spectral lines and X-ray diffraction patterns.

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

**E 1914–98**

**monochromator**, *n*—a device for isolating monochromatic radiation from a beam of polychromatic radiation.

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

*neutral filter*—see **filter, neutral**.

**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.

**optical axis**, *n*—an imaginary line joining the centers of curvature of the surfaces of lenses or mirrors in an optical system.

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

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

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

**precision**—*of methods of chemical analysis*, a characteristic manifested by agreement among individual results at a given analyte content.

**E 1914–98**

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

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

**profile**, *vt*—*in optical 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 intensity**,  $J$ , *n*—the radiant power emitted per unit solid angle in a specified direction.

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

**reciprocal linear dispersion**, *n*—the derivative  $d\lambda/dx$  where  $\lambda$  is the wavelength and  $x$  is the distance along the spectrum.

**reciprocity law**, *n*—the statement that in a photochemical reaction a constant effect is produced if the product of time and radiant power is a constant.

**reference material (RM)**, *n*—material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

**ISO Guide 30-1992**

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

**E 1914–98**

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

**E 1914–98**

**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).

**E 1914–98**

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

**E 1914–98**

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

**E 1914–98**

**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). **E 1914–98**

**resolution**, *n*—*in atomic spectrometry*, the minimum distance by which two spectral lines must be separated before they can be distinguished as being separate.

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

**E 1914–98**

**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**).

**E 1914–98**

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

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

*test*, *n*—a subsample selected from the properly prepared laboratory sample which has a suitable sample weight or volume for one or more determinations by chemical analysis.

*umpire*, *n*—a laboratory sample submitted 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 spectral lines 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.

**set**, *n*—*of results*, a group of results collected under specified conditions for statistical analysis. **E 1914–98**

**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 piece of material selected to be typical of the whole under the assumption that the whole is composed of pieces of similar composition. (Contrast **sample**). **E 1914–98**

**spectral background**, *n*—non-specific radiation within the spectrum that is not directly related to the observed line or overlapping lines.

**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.

**standardant**, *n*—a material used for standardization.

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

**standard deviation, between-laboratory**, *n*—see **between-laboratory standard deviation**. **E 1914–98**

**standard deviation, minimum**, *n*—see **minimum standard deviation**. **E 1914–98**

**standard deviation, within-laboratory**, *n*—see **within-laboratory standard deviation**. **E 1914–98**

**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.

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

**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*—*in emission spectrometry*, a material used to determine whether standardization is required.

**within-laboratory standard deviation**, *s<sub>w</sub>*, *n*—the standard deviation of results collected on the same material in the same laboratory on different days (synonym: **repeatability**).

**E 1914–98**

## 5. Acronyms

**AES**—atomic emission spectroscopy.

**DCP**—direct current plasma.

**ICP**—inductively coupled plasma.

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