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

This standard is issued under the fixed designation E 135; 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:*

E 180 Practice for Determining the Precision of ASTM Methods for Analysis and Testing of Industrial Chemicals[2]

E 876 Practice for Use of Statistics in the Evaluation of Spectrometric Data[3]

E 1914 Practice for Use of Terms Relating to the Development and Evaluation of Methods for Chemical Analysis[3]

2.2 *ISO Standard:*

ISO Guide 30—Terms and Definitions Used in Connection with Reference Materials[4]

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

absorbance, *n—in spectrometry,* the logarithm to the base 10 of the reciprocal of the transmittance, *T*.

$$A = \log_{10}(1/T) = -\log_{10} T \quad (1)$$

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.

absorption spectrometry, *n*—the branch of spectroscopy pertaining to the absorption of electromagnetic radiation by atoms, ions, radicals, and molecules.

analytical curve—see **calibration curve.**

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

analytical gap, *n—in optical 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.

anneal, *vt—in fire assay*, to heat and then gradually cool a metal to remove internal stresses and make the material less brittle.

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

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

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

arc, noncapacitive ac, *n—in optical 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, noncondensed, intermittent dc—see **arc, noncapacitive, intermittent dc.**

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

atomic absorption spectrometry, *n*—the branch of spectroscopy pertaining to the absorption of electromagnetic radiation by free atoms.

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

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[1] This terminology is under the jurisdiction of ASTM Committee E-1 on Analytical Chemistry for Metals, Ores, and Related Materials and is the direct responsibility of Subcommittee E01.23 on Terminology.

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[2] *Annual Book of ASTM Standards*, Vol 15.05.

[3] *Annual Book of ASTM Standards*, Vol 03.06.

[4] Available from American Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

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, etc.

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, etc.

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, the composition or properties of which are certified by a recognized standardizing agency or group.

DISCUSSION—A standard reference material, SRM, is a certified reference material issued by the National Institute of Standards and Technology.

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

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

combine, *v—in sampling*, to join together two or more increments without prior division or comminution.

comminution, *n—in sample preparation*, processes which improve the microscale homogeneity of a sample by reducing the particle size.

concentration, (*c***),** *n*—the quantity of a substance contained in a unit quantity of sample.

concentration index, *n*—the concentration of an element at which the intensities of the analytical and internal standard lines are equal.

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

confidence interval, *n*—the range of values that may be expected to encompass the true value, generally stated at some probability, the confidence level.

confidence level, *n*—the probability that the true value lies within a stated range (the confidence interval).

counter electrode, *n—in optical 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.

cupel, *n*—a small, shallow, porous cup, used in assaying to separate precious metals from lead and other base metals.

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).

division, *n—in sample preparation*, processes which divide a sample into two or more subsamples of equal mass and 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.**

emission spectrometry, *n*—the branch of spectroscopy pertaining to the emission of electromagnetic radiation by atoms, ions, radicals, and molecules.

emulsion calibration curve, *n—in photographic optical 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.

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

exposure, *n*—the irradiance of a receiver integrated over the exposure time.

exposure time, *n*—the time during which a receiver is irradiated.

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

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

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

filter, 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.

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

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

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

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

homologous lines, *n—in optical 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.

intensity ratio (relative intensity ratio), *n*—the ratio of two (relative) intensities.

intermittency effect, *n*—*in optical 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.

irradiance, *H*, (**of a receiver**), *n*—the radiant power per unit area incident on a receiver. See **exposure.**

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 making up 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 making up L radiation.

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

line pair, *n*—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.

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.

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, and fluorescence analysis. This may be combined with a burner to form a nebulizer burner.

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

noncapacitive, intermittent dc arc, *n*—a series of electrical discharges in which dc pulses are initiated by separate means, either mechanically or electrically.

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.

optical emission spectroscopy, *n*—pertaining to emission spectrometry in the ultraviolet, visible, or infrared wavelength regions of the electromagnetic spectrum.

parting, *vt*—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**

preform, *adj*—a descriptive word applied to a commercially produced spectroscopic electrode which is purified after cutting or machining.

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.

qualitative analysis, *n*—the identification of some or all of the constituents of a sample.

radiant energy, *n*—energy transmitted as electromagnetic radiation.

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.

reading, *n*—a numerical value obtained from a digital display or indicated on a scale or dial of an apparatus or instrument.

reciprocal linear dispersion, *n*—the derivative $d\lambda/dx$ where λ 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**

relative standard deviation, RSD—the standard deviation expressed as a percentage of the mean value.

$$RSD = (100/\bar{X})\sqrt{\Sigma d^2/(n-1)} \quad (2)$$

where:

d = difference between individual results and the average,

n = number of individual results, and

$\bar{X}$ = average of the individual results.

repeatability, *n*—the precision of a method expressed as the agreement attainable between independent determinations performed by a single analyst using the same apparatus and techniques.

DISCUSSION—This is the same definition as that of Practice E 180.

reproducibility, *n*—the precision of a method expressed as the agreement attainable between determinations performed in different laboratories.

DISCUSSION—This is the same definition as that of Practice E 180.

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

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**

sample, gross, *n*—a single large sample obtained by placing in a single container two or more increments taken from a lot.

sample, laboratory, *n*—a subsample selected from the properly prepared gross sample of a lot for submission to one or more laboratories for chemical analysis. See **select**.

sample, prepared, *n*—a sample on which comminution, division, blending, or other procedures have been performed to make the sample ready for analysis.

sample, 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.

sample, 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 optical 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.

select, *v—in sample preparation*, to mix and divide a sample (with or without comminution) to ensure that subsamples equally represent the original lot.

self-absorption, *n—in optical 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-electrodes, *n—in optical emission spectrometry*, a pair of electrodes composed of the material being analyzed.

self-reversal, *n—in optical 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.

soller slit—a slit containing a set of thin, closely placed parallel metal plates (or tubes) used for the purpose of largely eliminating convergent and divergent rays.

spark, *n—in optical 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 comparator, *n*—an instrument for the inspection and wavelength measurement of spectrograms.

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.

spectral line, *n—in optical emission spectrometry*, an image of an entrance slit formed at the focal plane of a spectrograph or spectrometer by the passage of a discrete wavelength of radiant energy.

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

target, *n*—that part of an X-ray tube which the electrons strike and from which X rays are emitted.

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.

triggered capacitor discharge—a series of electrical discharges from capacitors, the energy of which is obtained from either an ac or dc electrical supply.

DISCUSSION—Each discharge may have either an oscillatory, critically damped, or overdamped character. It is initiated by separate means and is extinguished when the voltage across the analytical gap falls to a value that no longer is sufficient to maintain it.

validation, *n*—proof, with reference materials or materials traceable to them, that a method is acceptable for all elements in its scope.

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.

X-ray emission spectrometry, *n*—pertaining to emission spectrometry in the X-ray wavelength region of the electromagnetic spectrum.

5. Acronyms

AES—atomic emission spectroscopy.

DCP—direct current plasma.

ICP—inductively coupled plasma.