NIOSH Manual of Analytical Methods (NMAM), 5th Edition

Glossary of Abbreviations, Definitions and Symbols

Compiled by Kevin Ashley, Ph.D., NIOSH

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

Terms & Definitions

A

AAS - Atomic absorption spectrometry

Absorption Barrier - Any exposure surface that may retard the rate of penetration of an agent into a target. Examples of absorption barriers are the skin, respiratory tract lining, and gastrointestinal tract wall (cf. exposure surface). [Source: Zartarian V, Bahadori T, McKone T [2005]: Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol *15*:1–5.]

Acceptable Range (biological) - The range of values of a biological monitoring analyte that would be expected in workers with exposure to the chemical agent in the workplace at or below regulatory or recommended levels. These ranges are often method-specific. [Adapted from: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

Accuracy –

1. The degree of agreement between a measured value and the accepted reference value. In this manual, accuracy is calculated from the absolute mean bias of the method plus the overall precision, $\hat{S}_{rT}$ at the 95% confidence level. For an individual measurement, it includes the combination of precision and bias [Source: NIOSH [1977]: Documentation of the NIOSH Validation Tests. DHEW (NIOSH) Publication No. 77-185.]

2. Measure of confidence in a measurement. It is a qualitative term referring to whether there is agreement between a measurement made on an object and its true (target or reference) value. [Source: NIST/SEMATECH e-Handbook of Statistical Methods; Gaithersburg, MD: National Institute of Standards and Technology, http://www.itl.nist.gov/div898/handbook/]

3. The ability of a method to determine the "true" concentration of the environment sampled. Accuracy describes the closeness of a typical measurement to the quantity measured although it is defined and expressed in terms of the relative discrepancy of a typical measurement from the quantity measured. The special sense of accuracy for a method is embodied in the following definition and criterion: The accuracy of a method is the theoretical maximum error of measurement, expressed as the proportion or percentage of the amount being measured without regard for the direction of the error that is achieved with 0.9 probability by the method. [Source: NIOSH [1995]: Guidelines for air sampling and analytical method development and

evaluation. By Kennedy ER, Fischbach TJ, Song R, Eller PM, Shulman SA. DHHS (NIOSH) Publication No. 95-117, http://www.cdc.gov/niosh/docs/95-117/pdfs/95-117.pdf.]

4. The degree of conformity of a value generated by a specific procedure to the assumed or accepted true value. It includes both precision and bias. [Source: ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International]

ACGIH - American Conference of Governmental Industrial Hygienists

Acute Exposure - A contact between an agent and a target occurring over a short time, generally less than a day. Note: Other terms, such as "short-term exposure" and "single dose," are also used. [Source: Zartarian V, Bahadori T, McKone T [2005]: Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol *15*:1–5.]

Aerosol –

1. Airborne particles and the gas (and vapor) mixture in which they are suspended. Note: The airborne particles can be in or out of equilibrium with their own vapors. [Source: CEN [2011]. EN 1540, Workplace atmospheres – terminology. Brussels: European Standards Commission.]

2. Dispersion of solid or liquid particles in a gaseous medium. [Source: ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

Agent - A chemical, biological, or physical entity that contacts a target. [Source: Zartarian V, Bahadori T, McKone T [2005]: Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol *15*:1–5.]

Analyte –

1. Substance or chemical constituent that is determined in an analytical method [Source: CEN [2011]. EN 1540, Workplace atmospheres – terminology. Brussels: European Standards Commission.]

2. A specific chemical moiety being measured, which can be intact drug, biomolecule or its derivative, metabolite, and/or degradation product in a biologic matrix. [Source: FDA [2001]. Guidance for industry - bioanalytical method validation, http://www.fda.gov/downloads/Drugs/Guidances/ucm070107.pdf.]

Ashing - The decomposition, prior to analysis, of organic matrix constituents of the sample and sampler. The most common ashing techniques are solvent, acid, or alkali dissolution; alkaline fusion; and oxidation using either low-temperature oxygen plasma or muffle furnace. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

ASV - Anodic stripping voltammetry

Atmospheric Concentration - The quantity of a constituent substance per unit volume of air [Adapted from definition of 'concentration' in: ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

Atmospheric Deposition - The transfer of an atmospheric constituent to a surface due to gravity or another mechanism, or the material which is transferred [Adapted from definition of 'deposition' in: ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

Atmospheric Dispersion - The most general term for a system consisting of a constituent suspended in air [Adapted from definition of 'dispersion': ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

AW - Atomic weight

B

B - Media blank result for a single-section sampler (e.g., sorbent tube.)

B_b - Media blank result for back section of a sampler.

B_f - Media blank result for front section of a sampler.

Background Level - The amount of an agent in a medium (e.g., water, soil) that is not attributed to the source(s) under investigation in an exposure assessment. Background level(s) can be naturally occurring or the result of human activities. (Note: Natural background is the concentration of an agent in a medium that occurs naturally or is not the result of human activities.) [Source: Zartarian V, Bahadori T, McKone T [2005]: Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol *15*:1–5.]

Bias –

1. A systematic (nonrandom) deviation of the method average value or the measured value from an accepted value. [Source: ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

2. Difference between the average measured mass or concentration and reference mass or concentration expressed as a fraction of reference mass or concentration. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

3. An estimate of a systematic measurement error [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Bioaerosol - An aerosol consisting of (a) biological agent(s). Note: Airborne dusts of organic origin, for example, cotton dust, flour dust and wood dust, are not considered to be bioaerosols and are therefore not covered by this definition [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Bioavailability –

1. The rate and extent to which an agent can be absorbed by an organism and is available for metabolism or interaction with biologically significant receptors. Bioavailability involves both release from a medium (if present) and absorption by an organism. [Source: Zartarian V, Bahadori T, McKone T [2005]: Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol *15*:1–5.]

2. The extent to which a chemical substance to which the body is exposed (by ingestion, inhalation, injection, or skin contact) reaches the systemic circulation, and the rate at which this occurs. It is recognized that the bioavailability (for gastrointestinal absorption) of, for example, both essential and non-essential metals, depends on various factors including the composition of the diet and the type of the chemical compound and its state of dispersion. For instance, the absorption of lead and cadmium is increased if the food is deficient in calcium or iron [Source: ILO/IPCS. Glossary of terms on chemical safety (after WHO, 1979), http://www.ilo.org/legacy/english/protection/safework/cis/products/safetytm/glossary.htm]

Biological Agent - One of a number of agents such as bacteria, viruses, fungi and other micro-organisms or parts of them and their associated toxins, including those which have

been genetically modified, cell cultures or endoparasites which are potentially hazardous to human health. Note: Dusts of organic origin, for example, cotton dust, flour dust and wood dust, are not considered to be biological agents and are therefore not covered by this definition. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Biological Matrix - A discrete material of biological origin that can be sampled and processed in a reproducible manner. Examples are blood, serum, plasma, urine, feces, saliva, sputum, and various discrete tissues. [Source: FDA [2001]. Guidance for industry - bioanalytical method validation, http://www.fda.gov/downloads/Drugs/Guidances/ucm070107.pdf.]

Biological Monitoring –

1. The measurements of the absorption of an environmental chemical in the worker by analysis of a biological specimen for the chemical agent, its metabolites or some specific effect on the worker. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

2. The periodic examination of biological specimens (in accordance with the definition of monitoring). It is usually applied to exposure monitoring but can also apply to effect monitoring. [Source: ILO/IPCS. Glossary of terms on chemical safety (after WHO, 1979), http://www.ilo.org/legacy/english/protection/safework/cis/products/safetytm/glossary.htm]

Biomarker of Effect/Response - A measurable biochemical, physiologic, behavioral, or other alteration in an organism that, depending on the magnitude, can be recognized as associated with an established or possible health impairment or disease [Source: National Research Council of the National Academies (NRC) [2006]. Human Biomonitoring for Environmental Chemicals. Washington DC: The National Academies Press, http://www.nap.edu/catalog/11700/human-biomonitoring-for-environmental-chemicals.]

Biomarker of Exposure (e.g., Biological Indicator of Exposure) **-** A chemical, its metabolite, or product of an Interaction between a chemical or some target molecule or cell that is measured in and organism, such as humans [Source: National Research Council of the National Academies (NRC) [2006]. Human Biomonitoring for Environmental Chemicals. Washington DC: The National Academies Press, http://www.nap.edu/catalog/11700/human-biomonitoring-for-environmental-chemicals.]

Biomarker of Susceptibility - An indicator of an inherent or acquired ability of an organism to respond to exposure to a specific chemical substance. Such an indicator may be the result of

a genetic factor, nutritional status, lifestyle, or life stage that affect susceptibility to a chemical exposure. This kind of biomarker can be used to distinguish susceptible individuals or groups; for example, a cytochrome phenotype. [Source: U.S. Environmental Protection Agency (EPA) [2016]. Defining pesticide biomarkers, http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/defining-pesticide-biomarkers.]

Biomonitoring - A method used to assess human exposure to chemicals by measuring a chemical, its metabolite, or a reaction product in human tissues or specimens, such as blood and urine. [Source: National Research Council of the National Academies (NRC) [2006]. Human Biomonitoring for Environmental Chemicals. Washington DC: The National Academies Press, http://www.nap.edu/catalog/11700/human-biomonitoring-for-environmental-chemicals.]

Blank - See Field blank, Media blank, and Reagent blank.

Blank Sample - Unused collection substrate, taken from the same batch used for sampling, processed so as to measure artifacts in the measurement (sampling and analysis) process. [Source: CEN [2005]. EN 14902, Ambient air quality — Standard method for the measurement of Pb, Cd, As and Ni in the PM_{10} fraction of suspended particulate matter. Brussels: European Standards Commission.]

BP - Boiling point, °C.

Breakthrough Volume - Volume of air that can be passed through a sampler before the gas or vapor exceeds the capacity of the sampler. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Breathing Zone - The space around a worker's face from where he or she takes his or her breath. For technical purposes a more precise definition is as follows: A hemisphere of radius 0.3 m extending in front of the human face, centered on the midpoint of a line joining the ears; the base of the hemisphere is a plane through this line, the top of the head and the larynx. The definition is not applicable when respiratory protective equipment is used. [Source: CEN [2011]. EN 1540, Workplace atmospheres – terminology. Brussels: European Standards Commission.]

C

C –

1. Concentration of gaseous, liquid, or solid substance in air, mg/m^3;

2. Acceptable ceiling concentration (for a specified maximum time of exposure)

when applied to personal permissible exposure limits.

Calibration Graph - Plot of analytical response vs. known mass or concentration of analyte.

CAS # - Chemical Abstracts Service Registry Number.

CE - Collection efficiency, expressed as a decimal fraction.

Chemical Agent - Chemical element or compound on its own or admixed as it occurs in the natural state or as produced, used, or released, including release as waste, by any work activity, whether or not produced intentionally and whether or not placed on the market. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Chronic Exposure - A continuous or intermittent long-term contact between an agent and a target. (Other terms, such as "long-term exposure," are also used). [Source: Zartarian V, Bahadori T, McKone T [2005]. Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol. *15*:1-5.]

49 CFR 171-177 - Title 49 (Transportation), Code of Federal Regulations. U. S. regulations governing shipment of hazardous materials.

Conc. - Concentrated; concentration

Concentration –

1. A general term referring to the quantity of a material or substance contained in unit quantity of a given medium. [Source: ILO/IPCS. Glossary of terms on chemical safety (after WHO, 1979), http://www.ilo.org/legacy/english/protection/safework/cis/products/safetytm/glossary.htm]

2. The quantity of a substance contained in a total unit quantity of sample. [Source: ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

Control (biological) - A value or group of values of a biological monitoring parameter collected from workers with little or no occupational exposure to the specific chemical agent. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

C_v - Concentration of gaseous substance in air, parts per million (V/V). In this manual, C_v is referred to NTP such that $C_v = (C \times 24.46)/MW$.

Cumulative Exposure - The sum of exposures of an organism to a pollutant over a period of time. [Source: EPA [1997]: EPA Terms of Environment – Glossary of Exposure Assessment Related Terms: A Compilation. Prepared by the Exposure Terminology Subcommittee of the IPCS Exposure Assessment Planning Workgroup for the International Programme on Chemical Safety Harmonization of Approaches to the Assessment of Risk from Exposure to Chemicals, 2001.]

CV – See S_r : Estimate of the relative standard deviation, equal to S (sample standard deviation) divided by the mean of a series of measurements. A measure of precision; previously referred to as CV (coefficient of variation). [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

D

D - Density, g/cm^3

DE - Desorption efficiency; fraction of known quantity of analyte recovered from spiked solid sorbent media blank. DE may be a function of loading, and should be determined by the chemist for each lot of solid sorbent used for sampling, in the concentration range of interest. Plot (mass recovered minus average media blank)/ mass added vs. (mass recovered minus average media blank). [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

Detector - The part of the monitor that sees and/or measures and/or quantifies and/or ascertains the dimensions, quantity, or concentration of the gas or vapor of interest. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

D_s - Stokes diameter.

Detection Limit - See LOD; MDL. Lowest amount of an analyte that is detectable with a given confidence level. Note: The detection limit can be calculated as three times the standard deviation of blank measurements. This represents a probability of 50% that the analyte will not be detected when it is present at the concentration of the detection limit. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Diffusive Sampler –

1. Device which is capable of taking samples of gases or vapors from the atmosphere at a rate controlled by a physical process such as gaseous diffusion through a static air layer or permeation through a membrane, but which does not involve active movement of air through the sampler. [Source: ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

2. Passive sampler that collects gases or vapors at a rate governed by diffusion through a static air layer and/or permeation through a membrane. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Dose –

1. The amount of agent that enters a target after crossing an exposure surface. If the exposure surface is an absorption barrier, the dose is an absorbed dose/uptake dose (see uptake); otherwise it is an intake dose (see intake). [Source: Zartarian V, Bahadori T, McKone T [2005] Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol, *15*:1-5.]

2. The amount of a chemical administered to an organism. [Source: ILO/IPCS. Glossary of terms on chemical safety (after WHO, 1979), http://www.ilo.org/legacy/english/protection/safework/cis/products/safetytm/glossary.htm]

Dosimeter - An instrument to measure dosage; many so called dosimeters actually measure exposure rather than dosage. [Source: EPA [1997] EPA Terms of Environment – Glossary of Exposure Assessment Related Terms: A Compilation. Prepared by the Exposure Terminology Subcommittee of the IPCS Exposure Assessment Planning Workgroup for the International Programme on Chemical Safety Harmonization of Approaches to the Assessment of Risk from Exposure to Chemicals, 2001.]

Dosimetry - Process or technology of measuring and/or estimating dosage. [Source: EPA [1997] EPA Terms of Environment – Glossary of Exposure Assessment Related Terms: A Compilation. Prepared by the Exposure Terminology Subcommittee of the IPCS Exposure Assessment Planning Workgroup for the International Programme on Chemical Safety Harmonization of Approaches to the Assessment of Risk from Exposure to Chemicals, 2001.]

E

ECD - Electron capture detector

EPA - U.S. Environmental Protection Agency

Est - Estimated

Exposure -

1. Contact between an agent and a target. Contact takes place at an exposure surface over an exposure period. [Source: Zartarian V, Bahadori T, McKone T [2005]. Adoption of an official ISEA glossary. Jour Expo Anal & Environ Epidemiol, *15*:1–5.]

2. The amount of an environmental agent that has reached the individual (external dose) or has been absorbed into the individual (internal dose, absorbed dose). [Source: ILO/IPCS. Glossary of terms on chemical safety (after WHO, 1979), http://www.ilo.org/legacy/english/protection/safework/cis/products/safetytm/glossary.htm]

3. (By inhalation) Situation in which a chemical agent or biological agent is present in the air that is inhaled by a person. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Exposure Assessment -

1. The process of estimating or measuring the magnitude, frequency and duration of exposure to an agent, along with the number and characteristics of the population exposed. Ideally, it describes the sources, pathways, routes, and the uncertainties in the assessment. [Source: Zartarian V, Bahadori T, McKone T Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol, *15*:1–5.]

2. The quantification of the amount of exposure to a hazard for an individual or group [Source: ILO/IPCS. Glossary of terms on chemical safety (after WHO, 1979), http://www.ilo.org/legacy/english/protection/safework/cis/products/safetytm/glossary.htm]

Exposure Concentration - The exposure mass divided by the contact volume or the exposure mass divided by the mass of contact volume depending on the medium. [Source: Zartarian V, Bahadori T, McKone T [2005]: Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol, *15*:1–5.]

Exposure Route - The way an agent enters a target after contact (e.g., by ingestion, inhalation, or dermal absorption). [Source: Zartarian V, Bahadori T, McKone T [2005]: Adoption of an official ISEA glossary. J Expo Anal Environ Epidemiol, *15:*1–5.]

F

F - Fiber(s)

FID - (Hydrogen-air) flame ionization detector

Field Blank –

1. A sample (or sampler) handled exactly the same as the field samples, except no air is drawn through it. Used to estimate contamination in preparation for sampling, shipment and storage prior to measurement, but not actually subtracted from sample readings (see media blank). [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

2. Blank (sample) that is transported to the sampling site, but not used for sample collection. Discussion: A field blank is loaded in the sampler, where applicable, and returned to the laboratory in the same way as a sample. The results from the analysis of field blanks are used to identify contamination of the sample arising from handling in the field and during transport. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

FPD - Flame photometric detector

FTIR - Fourier transform infrared spectroscopy

G

GC - Gas chromatography

GFAAS - Graphite furnace atomic absorption spectrometry

GPO - U.S. Government Printing Office, Washington, DC 20402

H

Hemolysis - Rupture of red blood cells. [Adapted from Webster's English dictionary online, http://www.merriam-webster.com/]. Discussion: hemolysis may occur due to improper collection and handling of whole blood samples.

HGAAS - Hydride generation atomic absorption spectrometry

Hydrolysis - Chemical process of decomposition involving the splitting of a bond and the addition of the hydrogen cation and the hydroxide anion of water [Source: Webster's English dictionary online, http://www.merriam-webster.com/]

HPLC - High performance liquid chromatography

I

IC - Ion chromatography; ion-exchange chromatography

ICP-AES - Inductively coupled plasma - atomic emission spectrometry, also called ICP.

Internal Capsule - Air sampler insert consisting of a plastic housing (with an air inlet) attached to a membrane filter. Discussion: The internal capsule is fabricated so as to fit inside the body of the sampling device (e.g., closed-face cassette sampler), enabling capture of airborne particles within the housing / filter construct. [Adapted from: Harper M, Ashley K [2013]: Acid-soluble internal capsules for closed-face cassette elemental sampling and analysis of workplace air. J Occup Environ Hyg *10*:297-306.]

Interference Equivalent - Mass or concentration of interfering substance (interferant) which gives the same measurement reading as unit mass or concentration of substance being measured. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

Interferent - Constituent of the (air) sample or other aspect of the sampling or analytical procedure having an adverse effect on the accuracy of the measurement. Note: Interferents can include components of sampling or analysis equipment, reagents, etc. [Source: ISO

[2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

IR – Infrared

L

LAQL - Lowest analytically quantifiable level; see LOQ.

LC - Liquid chromatography

LOD –

1. Limit of detection (detection limit); smallest amount of analyte which can be distinguished from background. A good estimate for unbiased analyses, with media blanks not distinguishable from background, is three times the standard error of the calibration graph for low concentrations, divided by the slope (instrument reading per unit mass or per unit concentration of analyte). [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

2. The lowest concentration of an analyte that the bioanalytical procedure can reliably differentiate from background noise. [Source: FDA [2001]. Guidance for industry - bioanalytical method validation, http://www.fda.gov/downloads/Drugs/Guidances/ucm070107.pdf.]

3. The smallest amount, or lowest concentration, of a given substance that a given procedure will detect [Source: ILO/IPCS. Glossary of terms on chemical safety (after WHO, 1979), http://www.ilo.org/legacy/english/protection/safework/cis/products/safetytm/glossary.htm]

LOQ - Limit of quantitation; mass of analyte equal to 10 times the standard error of the calibration graph divided by the slope; approximately the mass of analyte for which relative standard deviation, S_r, equals 0.10. [Source: NIOSH [1995]: Guidelines for air sampling and analytical method development and evaluation. By Kennedy ER, Fischbach TJ, Song R, Eller PM, Shulman SA. DHHS (NIOSH) Publication No. 95-117, http://www.cdc.gov/niosh/docs/95-117/pdfs/95-117.pdf.]

Limit of Quantification - Synonymous with limit of quantitation, LOQ. Mass of analyte equal to 10 times the standard error of the calibration graph divided by the slope;

approximately the mass of analyte for which relative standard deviation, S_r, equals 0.10. [Source: NIOSH [1995]: Guidelines for air sampling and analytical method development and evaluation. By Kennedy ER, Fischbach TJ, Song R, Eller PM, Shulman SA. DHHS (NIOSH) Publication No. 95-117, http:/www.cdc.gov/niosh/docs/95-117/pdfs/95-117.pdf.]

LTA - Low temperature (oxygen plasma) ashing

M

MCE; MCEF - Mixed cellulose ester; Mixed cellulose ester membrane filter

MDL - Method detection limit; mass of analyte equal to 3 times the standard error of the calibration graph divided by the slope; approximately the mass of analyte for which standard deviation, S_r, equals 0.03. [Source: NIOSH [1995]: Guidelines for air sampling and analytical method development and evaluation. By Kennedy ER, Fischbach TJ, Song R, Eller PM, Shulman SA. DHHS (NIOSH) Publication No. 95-117, http://www.cdc.gov/niosh/docs/95-117/pdfs/95-117.pdf.]

Metabolite –

1. A substance produced directly by a biotransformation of a chemical. For example, phenol in urine is a metabolite of benzene and is representative of benzene absorption in the worker. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

2. A substance resulting from chemical transformation in an organism. [Source: ILO/IPCS. Glossary of terms on chemical safety (after WHO, 1979), http://www.ilo.org/legacy/english/protection/safework/cis/products/safetytm/glossary.htm]

Microbiome - The complete genetic content of all the microorganisms that typically inhabit a particular environment, especially a site on or in the body, such as the skin or the gastrointestinal tract. [Source: Medical Dictionary online, http://www.online-medical-dictionary.org/]

Measurement Range - Range of substance, in mass per sample, from the LOQ (or from 10 times the LOD, if LOQ is not known) to an upper limit characteristic of the analytical method, e.g., the limit of linearity or the mass at which precision of the method starts to become worse than S_r = 0.1. [Source: NIOSH [1995]: Guidelines for air sampling and analytical method development and evaluation. By Kennedy ER, Fischbach TJ, Song R, Eller PM, Shulman SA.

DHHS (NIOSH) Publication No. 95-117, http://www.cdc.gov/niosh/docs/95-117/pdfs/95-117.pdf.]

Media Blank - An unexposed sampler, not taken or shipped to the field, used for background correction of sample readings or for recovery studies. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

MP - Melting point, °C

MS - Mass spectrometry

MW - Molecular weight

N

Nanoparticle - Material with all three dimensions in the size range from approximately 1 nm to 100 nm [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

NIOSH - National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Public Health Service, U. S. Department of Health and Human Services.

Normal Range (biological) - The range of values for an analyte of interest in biological monitoring that would be expected in workers without exposure to the environmental chemical agent in the workplace. Note: Normal ranges are often method-specific. [Adapted from: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

NTIS - National Technical Information Service, Springfield, VA 22161.

NTP - Normal temperature and pressure, 25 °C (298 K) and 101.33 kPa (760 mm Hg), at which the molar volume of an ideal gas is 24.46 L.

O

OSHA - Occupational Safety and Health Administration, U. S. Department of Labor.

P

P –

1. Peak (maximum permissible instantaneous) concentration;

2. Pressure, in kPa, at which sampling pump is calibrated or when air sample was taken.

PAH - Polynuclear aromatic hydrocarbons; PNAH

PCM - Phase contrast microscopy

PEL - OSHA PEL; OSHA permissible exposure limit, expressed as ppm or mg/m^3 (of a substance in air).

Personal Exposure Monitor - Device used to measure an individual's personal exposure to environmental contaminants or other stressors. A device worn on or near the contact boundary that measures concentration [Source: Zartarian VG, Ott WR, Duan N [1997]. A quantitative definition of exposure and related concepts. J Exposure Anal Environ Epidemol *7*(4):411-437. and EPA [1997] EPA Terms of Environment – Glossary of Exposure Assessment Related Terms: A Compilation. Prepared by the Exposure Terminology Subcommittee of the IPCS Exposure Assessment Planning Workgroup for the International Programme on Chemical Safety Harmonization of Approaches to the Assessment of Risk from Exposure to Chemicals, 2001.]

Personal Sampler - Sampling device, attached to a person that collects gases, vapors, or airborne particles in the breathing zone for the purpose of measuring exposure to chemical agents and/or biological agents. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

PID - Photoionization detector

Plasma, blood - The clear supernatant from whole blood collected with anticoagulants. Discussion: Blood is collected, mixed with the anticoagulant and centrifuged to separate the plasma from red blood cells. [Adapted from Medical Dictionary online, http://www.online-medical-dictionary.org/.]

PLM - Polarized light microscopy

Pool (biological) - A combination of biological specimens (i.e., urine or serum) from many workers that is used to prepare small aliquots to be run with each batch of analyses. NOTE: The analyte must be stable in the biological matrix and under the storage conditions used. Discussion: Aliquots of these pools are analyzed with each batch of samples and the data are used to develop quality control charts. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

Precision –

1. The relative variability of measurements on replicate samples about the mean of the population of measurements. Discussion: Precision is expressed by the relative standard deviation of a series of measurements, and reflects the ability of a method to replicate measurement results. [Source: NIOSH [1995]: Guidelines for air sampling and analytical method development and evaluation. By Kennedy ER, Fischbach TJ, Song R, Eller PM, Shulman SA. DHHS (NIOSH) Publication No. 95-117, http://www.cdc.gov/niosh/docs/95-117/pdfs/95-117.pdf.]

2. The repeatability or reproducibility of individual measurements expressed as standard deviation, S, or relative standard deviation, S_r (q.v.). See Accuracy. [Source: NIOSH [2003]. Glossary of abbreviations, definitions, and symbols. In: NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113, http://www.cdc.gov/niosh/docs/2003-154/pdfs/glossary.pdf.]

3. The closeness of agreement (degree of scatter) between a series of measurements obtained from multiple sampling of the same homogenous sample under the prescribed conditions. [Source: FDA [2001]. Guidance for industry - bioanalytical method validation, http://www.fda.gov/downloads/Drugs/Guidances/ucm070107.pdf.]

Proficiency Testing - Any interlaboratory testing program where stable specimens are sent to participating laboratories for analysis. Discussion: Results from all participating laboratories are compared, pooled, and tabulated by the testing program operator with the purpose of improving laboratory performance. [Adapted from Medical Dictionary online, http://www.online-medical-dictionary.org/.]

PTFE - Polytetrafluoroethylene

PVC - Polyvinyl chloride

Q

Q - Sampling flow rate, L/min

Quantification Range - The range of concentrations, including upper and lower quantification limits (ULOQ and LLOQ, respectively), that can be reliably and reproducibly quantified with accuracy and precision through the use of a concentration-response relationship. [Source: FDA [2001]. Guidance for industry - bioanalytical method validation, http://www.fda.gov/downloads/Drugs/Guidances/ucm070107.pdf.]

R

Reagent Blank - All reagents used in sample preparation, in the same quantities used to prepare blank and sample solutions. Note: The reagent blank is used to assess contamination from the laboratory environment and to characterize background from the reagents used in sample preparation. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Recovery, R -

1. Fraction recovered (see DE); previously associated with Analytical Method Recovery (AMR), a term which is no longer preferred. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

2. The extraction efficiency of an analytical process, reported as a percentage of the known amount of an analyte carried through the sample extraction and processing steps of the method. [Source: FDA [2001]. Guidance for industry - bioanalytical method validation, http://www.fda.gov/downloads/Drugs/Guidances/ucm070107.pdf.]

Relative Standard Deviation (RSD) - Quotient of standard deviation over the mean; See S_r and Precision.

Repeatability - The variation in measurements taken under the same conditions. [Adapted from: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Reproducibility - A measure of the precision of a method under the same operating conditions on the same sample over short period of time. [Adapted from ASTM [2014].

D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

Respirable Dust - Dust deposited in the non-ciliated portions of the lungs. Discussion: Respirable dust is measured by using a respirable sampler when the respirable fraction of airborne dust is of interest. [Adapted from ISO [1995]. ISO 7708 Air quality — particle size fraction definitions for health-related sampling.' Geneva: International Organization for Standardization.]

R_f **-** In thin-layer chromatography, the ratio of distance travelled by the analyte from point of application to that of the solvent front.

RF - Radio frequency

Rotameter - A device, based on the principle of Stoke's Law, for measuring rate of fluid flow, consisting of a tapered vertical tube having a circular cross section, and containing a float that is free to move in a vertical path to a height dependent upon the rate of fluid flow upward through the tube. [Source: ASTM [2014] D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

RTECS - Registry of Toxic Effects of Chemical Substances (NIOSH)

Ruggedness Test - Partial or complete analysis of variance using experiments in which operational parameters of a sampling and measurement method are varied within a small range to determine their effect on overall variance [Source: Youden W, Steiner EH [1975]: Statistical manual of the AOAC, Arlington, VA: Association of Official Analytical Chemists.]

S

S **–**

1. Estimate of the standard deviation;

2. Specific mass, particles/mg.

S_b **-** Estimate of the standard deviation of media blank

S_r **-** Estimate of the relative standard deviation, equal to S divided by the mean of a series of measurements. A measure of precision. Equivalent to CV (coefficient of variation).

$\overline{S}_r$ - Pooled relative standard deviation

$\widehat{S}_{rT}$ - Estimate of overall precision including pump error

Sample Dissolution - The process of obtaining a solution containing the analyte(s) of interest from a sample. This may or may not involve complete dissolution of the sample. [Source: ASTM [2010]. D7035, Standard test method for determination of metals and metalloids in airborne particulate matter by inductively coupled plasma atomic emission spectrometry (ICP-AES). West Conshohocken, PA: ASTM International.]

Selectivity -

1. The ability of a bioanalytical method to measure and differentiate the analytes in the presence of interfering components that may be expected to be present. These could include metabolites, impurities, degradants, or matrix components. [Adapted from Medical Dictionary online, http://www.online-medical-dictionary.org/.]

2. Extent of independence of a measuring procedure from interferences. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Screening Test (biological) - An easily performed method, often relatively non-specific, to assess worker exposure to a class of compounds by use of biological monitoring. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

SEM - Scanning electron microscopy

Sensitivity –

1. The slope of the calibration curve. If the curve is in fact a 'curve', rather than a straight line, then of course sensitivity will be a function of analyte concentration or amount. If sensitivity is to be a unique performance characteristic, it must depend only on the chemical measurement process, not upon scale factors. [Source: Currie LA [1995] Nomenclature in evaluation of analytical methods including detection and quantification capabilities. Pure & Appl Chem *67*(10):1699-1723.]

2. The smallest change in the measured analyte concentration that will produce a reproducible change in a monitor's readout. [Source: NIOSH [2012]. NIOSH Technical report: Components for evaluation of direct-reading monitors for gases and vapors. DHHS (NIOSH) Publication No. 2012-162, http://www.cdc.gov/niosh/docs/2012-162/pdfs/2012-162.pdf.]

Serum - The clear supernatant from whole blood collected without anticoagulants, allowed to clot (30 minutes) and centrifuged to separate serum from the clotted blood. Serum does not contain clotting factors. [Adapted from Medical Dictionary online, http://www.online-medical-dictionary.org/.]

Sorbent Tube - Sorbent or a support impregnated with reagent, through which sampled air passes. Note: Some sorbent tubes are intended for use as active samplers and some as passive samplers. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Spike - A known mass of analyte added to a sampler for the purpose of determining recovery (analyst spikes), or for quality control (blind spikes). Also see DE. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

Sp. gr. - Specific gravity. Relative to water at the same temperature.

Spot Sample (urine) - Urine sample collected at a specified time. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

STEL - Short-Term (15-min) Exposure Limit.

T

T - Retention time, min

t –

1. Temperature, °C;

2. Time, min.

T_c **-** Temperature, degrees kelvin (K), at which sampling pump was calibrated

TEM - Transmission electron microscopy

TLC - Thin-layer chromatography

TLV - Threshold limit value, listed in TLVs® and BEIs®, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Indices (American Conference of Governmental Industrial Hygienists, Cincinnati, OH, 2015; updated annually).

T_s - Temperature, kelvins (K), at which air sample was taken

TWA - Time-weighted average; the concentration of a chemical or biological agent in the atmosphere, averaged over the reference period. [Adapted from: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

U

Ultrafine Particle - Particle with a nominal diameter (such as geometric, aerodynamic, mobility, projected-area or otherwise) of 100 nm or less, produced as a by-product of a process such as welding and combustion. [Source: ISO [2015]. ISO 18158 Workplace air – terminology. Geneva: International Organization for Standardization.]

Uncertainty - A limited knowledge of the agreement between data, information, or outcomes relative to an unknown truth. The uncertainty of a measurement is the parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand (the quantity being measured). [Source: Taylor BN, Kuyatt CE [1994]. NIST Technical note 1297, Guidelines for evaluating and expressing the uncertainty of NIST measurement results. Gaithersburg, MD, National Institute of Standards and Technology (NIST).]

User Check - An evaluation of a written procedure for clarity and accuracy in which an independent laboratory analyzes a small number of spiked samples following a draft sample preparation and analysis exactly as written and reviews the draft method for clarity. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

UV – Ultraviolet

V

V - Volume of air sample, in L, as taken at the sampling site, corrected if necessary for rotameter calibration at a different temperature and pressure:

$$V = (flow\ rate)(time)\left(\frac{P_c T_s}{P_s T_c}\right)^{0.5}$$

Validated Method - A Method which meets or exceeds certain sampling and measurement performance criteria; see for example, the criteria given in Chapter ME [Source: NIOSH [2016]. Development and evaluation of methods. In: NIOSH Manual of analytical methods, 5th ed. DHHS (NIOSH) Publication No. 2014-151, http://www.cdc.gov/niosh/nmam.]

Validation - Process of evaluating the performance of a measuring procedure and checking that the performance meets certain pre-set criteria. Discussion: Performance characteristics to be considered include confirmation of identity, selectivity/ specificity, limit of detection, limit of quantification, analytical recovery, working and linear dynamic ranges, accuracy, measurement repeatability, measurement reproducibility, ruggedness, and robustness. [Source: CEN [2011]. EN 1540, Workplace atmospheres – terminology. Brussels: European Standards Commission.]

Vapor –

1. The gaseous phase of matter that normally exists in a liquid or solid state [Source: ASTM [2014]. D1356, Standard terminology relating to sampling and analysis of atmospheres. West Conshohocken, PA: ASTM International.]

2. Gas phase of a substance in a state of equilibrium or disturbed equilibrium with the same substance in a liquid or solid state below its boiling or sublimation point [Source: CEN [2011]. EN 1540, Workplace atmospheres – terminology. Brussels: European Standards Commission.]

V_m - Volume of 1 mole of ideal gas at the specified temperature and pressure (e.g., 24.45 L at 25 °C and 1 atmosphere).

VOL-MAX - Maximum recommended air sample volume, L, based on sampler capacity or other limitation, at the OSHA PEL

VOL-MIN - Minimum recommended air sample volume, L, based on an atmosphere at the OSHA PEL concentration and collecting a mass of substance which is equal to the LOQ. See also Working range.

VP - Vapor pressure

W

W - Mass of analyte found on an exposed single-section sampler (e.g., membrane filter)

W_b - Mass of analyte found on the back section of an exposed sampler

W_f - Mass of analyte found on the front section of an exposed sampler

Working Range - Range of air concentrations, in ppm or mg/m^3, at specified air sample volume, extending from the LOQ to a maximum determined by sampler capacity or measurement considerations. [Source: NIOSH [1994]. NIOSH Manual of analytical methods (NMAM), 4th ed. DHHS (NIOSH) Publication No. 94-113.]

X

XRD - X-ray diffraction

XRF - X-ray fluorescence

Disclaimer

Mention of any company or product does not constitute endorsement by NIOSH. In addition, citations to websites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date.