



Designation: E1732 – 22

Standard Terminology Relating to Forensic Science¹

This standard is issued under the fixed designation E1732; 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 terminology standard includes definitions of terms used in the forensic sciences.

1.2 Legal and scientific terms in common use that are generally understood or defined adequately in other readily available sources may not be included, except when dictionaries show multiple definitions and it seems desirable to indicate the definitions recommended for forensic science use.

1.3 Section A defines terms that are common to multiple areas of forensic science, whereas, the subsequent sections define terms pertaining to specific forensic science areas, as follows:

Section A: General (Common) Forensic Science Terms

The terms defined in Section A are the direct responsibility of Subcommittee E30.92, Terminology.

Section B: Criminalistics

The terms defined in Section B are the direct responsibility of Subcommittee E30.01, Criminalistics.

Section B1: Terms for Seized Drug Analysis

Section B2: Terms for Gunshot Residue (GSR) Analysis and Smokeless Powder Analysis

Section B3: Terms for Paint Analysis

Section B4: Terms for Textile, Fiber, Cord, and Tape Examination

Section B5: Terms for Glass Examination

Section B6: Terms for Fire Debris

Section C: Digital and Multimedia Evidence

The terms defined in Section C are the direct responsibility of Subcommittee E30.12, Digital and Multimedia Evidence.

Section C1: Terms for Computer Forensics

Section C2: Terms for Digital Image Processing and Multimedia Evidence Examination

Section C3: Terms for Magnetic Card Reader Examination

Section C4: Terms for Facial Image Examination

Section D: Interdisciplinary

The terms defined in Section D are the direct responsibility of Subcommittee E30.11, Interdisciplinary Forensic Science Standards.

Section E: Questioned Documents

The terms defined in Section E were formerly the direct responsibility of Subcommittee E30.02, Questioned Documents, and are currently the direct responsibility of Subcommittee E30.90, Executive Committee.

1.4 Entries listed in Sections B–E reflect only those existing in Committee E30 standards current with the date of a once yearly review of Committee E30 standards. Changes to standards or entries following this date will appear in Sections B–E after the following year’s review date.

1.5 An alphabetical list of the terms defined in this standard is given in **Appendix X1**, which also identifies the section(s) in which each term is defined.

1.6 Definitions identical to those published by another standards-developing organization or ASTM committee are identified with the abbreviation of the name of the organization or the identifying document and ASTM committee; for example, ASME is the American Society of Mechanical Engineers.

1.7 In some cases different usage of a term in different fields has been noted.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

C162 Terminology of Glass and Glass Products

D123 Terminology Relating to Textiles

D6161 Terminology Used for Microfiltration, Ultrafiltration, Nanofiltration, and Reverse Osmosis Membrane Processes

E131 Terminology Relating to Molecular Spectroscopy

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E456 Terminology Relating to Quality and Statistics

E860 Practice for Examining And Preparing Items That Are

¹ This terminology is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.92 on Terminology.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

Or May Become Involved In Criminal or Civil Litigation

E1187 Terminology Relating to Conformity Assessment (Withdrawn 2006)³

E1301 Guide for Proficiency Testing by Interlaboratory Comparisons (Withdrawn 2012)³

E1402 Guide for Sampling Design

E1413 Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Dynamic Headspace Concentration onto an Adsorbent Tube

E1588 Practice for Gunshot Residue Analysis by Scanning Electron Microscopy/Energy Dispersive X-Ray Spectrometry

E1605 Terminology Relating to Lead in Buildings

E1610 Guide for Forensic Paint Analysis and Comparison

E1968 Practice for Microcrystal Testing in Forensic Analysis for Cocaine

E1969 Practice for Microcrystal Testing in Forensic Analysis for Methamphetamine and Amphetamine

E2125 Practice for Microcrystal Testing in Forensic Analysis for Phencyclidine and Its Analogues

E2161 Terminology Relating to Performance Validation in Thermal Analysis and Rheology

E2224 Guide for Forensic Analysis of Fibers by Infrared Spectroscopy

E2225 Guide for Forensic Examination of Fabrics and Cordage

E2227 Guide for Forensic Examination of Non-Reactive Dyes in Textile Fibers by Thin-Layer Chromatography (Withdrawn 2022)³

E2228 Guide for Microscopical Examination of Textile Fibers

E2363 Terminology Relating to Process Analytical Technology in the Pharmaceutical Industry

E2388 Guide for Minimum Training Requirements for Forensic Document Examiners (Withdrawn 2020)³

E2678 Guide for Education and Training in Computer Forensics

E2808 Guide for Microspectrophotometry in Forensic Paint Analysis

E2809 Guide for Using Scanning Electron Microscopy/X-Ray Spectrometry in Forensic Paint Examinations

E2882 Guide for Analysis of Clandestine Drug Laboratory Evidence

E2916 Terminology for Digital and Multimedia Evidence Examination

E2917 Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs

E2927 Test Method for Determination of Trace Elements in Soda-Lime Glass Samples Using Laser Ablation Inductively Coupled Plasma Mass Spectrometry for Forensic Comparisons

E2937 Guide for Using Infrared Spectroscopy in Forensic Paint Examinations

E2998 Practice for Characterization and Classification of Smokeless Powder

E2999 Test Method for Analysis of Organic Compounds in Smokeless Powder by Gas Chromatography-Mass Spectrometry and Fourier Transform Infrared Spectroscopy

E3017 Practice for Examining Magnetic Card Readers

E3085 Guide for Fourier Transform Infrared Spectroscopy in Forensic Tape Examinations

E3115 Guide for Capturing Facial Images for Use with Facial Recognition Systems

E3148 Guide for Postmortem Facial Image Capture

E3149 Guide for Facial Image Comparison Feature List for Morphological Analysis

E3189 Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Static Headspace Concentration onto an Adsorbent Tube

F2725 Guide for European Union's Registration, Evaluation, and Authorization of Chemicals (REACH) Supply Chain Information Exchange

2.2 ISO Standards:⁴

ISO 3534:1993 (E/F) Statistics—Vocabulary and Symbols
Part 1: Probability and General Statistical Terms
Part 2: Statistical Quality Control

ISO 3534–1:2006 Statistics—Vocabulary and Symbols—
Part 1: General Statistical Terms and Terms Used in
Probability

ISO 3534–2:2006 Statistics—Vocabulary and Symbols—
Part 2: Applied Statistics

ISO 9000:2005 (E) Standard Quality Management
Systems—Fundamentals and Vocabulary

ISO Guide 2 General Terms and Their Definitions Relating
to Standardizing Activities

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

ISO Guide 35 Reference Materials—General and Statistical
Principles for Certification

ISO GUM Guide to the Expression of Uncertainty in Mea-
surement (GUM)

ISO/IEC 7813:2006 Information Technology—
Identification Cards—Financial Transaction Cards

ISO/IEC 10918-1:1994 Information Technology — Digital
Compression and Coding of Continuous-Tone Still Im-
ages: Requirements and Guidelines

ISO 18158:2016 Workplace air — Terminology

ISO 21043-1:2018 Forensic sciences — Part 1: Terms and
definitions

2.3 Other Sources:

ANSI/NIST-ITL 1-2011 Data Format for the Interchange of
Fingerprint, Facial, and Other Biometric Information⁵

EURACHEM *The Fitness for Purpose of Analytical
Methods*, EURACHEM Working Group, English Edition

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

⁵ Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, <http://www.nist.gov>.

IAAI Glossary *Glossary of Terms Related to Chemical and Instrumental Analysis of Fire Debris*, IAAI Forensic Science Committee⁶

IEEE 100-2000 *The Authoritative Dictionary of IEEE Standards Terms*, 7th Edition⁷

IUPAC Terminology *IUPAC Compendium of Chemical Terminology*, Second Edition, 1997

JCGM 200:2012 *The International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (2.26 [3.9] VIM)*⁸

NIST SP 800-86 *Guide to Integrating Forensic Techniques into Incident Response*⁵

NIST SP 800-88 *Guidelines for Media Sanitization*⁵
SWGDRUG⁹

3. Significance and Use

3.1 These terms have particular application to forensic practice. Entries for Section A of E1732 are chosen variously from Webster’s Online Dictionary, international standards, textbooks, and the Compilation of ASTM Standard Definitions. The subcommittee develops definitions when conventional sources fail to yield suitable candidates. Reference citations include:

3.1.1 For ASTM standards, the standard designation is followed by a dash and a two-digit year designation, e.g., E2161-19. The year citation references the year of publication of the standard from which the entry is taken, not necessarily the current year of publication of the standard.

⁶ Available from the International Association of Arson Investigators, Inc. (IAAI), 2111 Baldwin Avenue, Suite 203, Crofton, MD 21114, <https://www.firearson.com>.

⁷ Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., Piscataway, NJ 08854, <http://www.ieee.org>.

⁸ Available from Joint Committee for Guides in Metrology (JCGM), <https://www.bipm.org/en/committees/jc/jcgm>.

⁹ Available from the Scientific Working Group for the Analysis of Seized Drugs, <http://www.swgdrug.org>.

3.1.2 Citations from other than ASTM standards may include an abbreviation and the standard number followed by a four-digit year designation, e.g., ISO 9000:2015. The year citation references the year of publication of the standard from which the entry is taken. Such standards may also be referenced by a name followed by a year designation, e.g., IUPAC Gold Book 2020. Abbreviations are explicated under “2. Referenced Documents.”

3.1.3 For entries created by members of E30, a brief statement to that effect and a year designation follows the entry, e.g., Created by E30 in 2021.

3.1.4 For entries followed simply by a reference, e.g., ISO 9000:2015 or E456-17, the reader can assume that the entry is accurately copied from the reference with no modifications except for ASTM format conventions. For entries that are slightly modified versions of something from a known source, reference citations read, “Based upon definition by...” Following the “by” is the source name and year that the entry was taken, or modified, for inclusion in Section A.

3.1.5 For entries from textbooks a reference following the entry will have the name or title of the text, author(s), edition (if applicable) and the year of publication or copyright.

3.1.6 For entries of unknown origin currently in E1732 Section A, a statement declaring that a review of these entries by E30 occurred in a particular year follows the entry e.g., Reviewed by E30 in 2021.

3.1.7 An entry may be such that the definition of a term has one reference and the DISCUSSION, following the definition, has a different reference.

3.1.8 Citations from Merriam-Webster’s Online Dictionary include the date retrieved from the online dictionary and the URL of the cited term and definition.

4. Terminology

SECTION A: GENERAL (COMMON) FORENSIC SCIENCE TERMS

The terms defined in Section A are the direct responsibility of Subcommittee E30.92, Terminology.

accuracy, *n*—the closeness of agreement between a test result and the accepted reference value. **E177 – 19**

DISCUSSION—(1) In practice, the accepted reference value is substituted for the true value.

(2) The term “accuracy,” when applied to a set of test or measurement results, involves a combination of random components and a common systematic error or bias component.

(3) Accuracy refers to a combination of trueness and precision.

ISO 3534-2:2006

associative evidence, *n*—item(s) that could link a person, place, or thing with another person, place, or thing.

Created by E30 in 2021

calibration, *n*—the set of operations that establishes, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system or values represented by a material, and the corresponding known values of measurement.

DISCUSSION—This definition was originally defined in Terminology E1187, a standard discontinued by ASTM.

chain of custody, *n*—procedures and documents that account for the possession of a sample by tracking its handling and storage from its point of collection to its final disposition.

class, *n*—a group, set, or kind sharing common attributes. (Examples provided in reference.) **Merriam-Webster (1)¹⁰**

class characteristic(s), *n*—the attribute(s) that establish membership in a class.

classification, *n*—the systematic arrangement of persons or objects into categories (groups or classes) based on shared traits or characteristics.

Osterburg and Ward (2), p. 835

¹⁰ The boldface numbers in parentheses refer to a list of references at the end of this standard.

control sample, *n*—material of established origin that is used to evaluate the performance of a test or comparison.

DISCUSSION—A control sample should not be confused with a comparison sample. For example, in fire debris, a control sample might include an empty can from the same lot as that used to collect samples.

criminalistics, *n*—a branch of forensic science concerned with the examination and interpretation of physical evidence, for the purpose of aiding forensic investigation.

exemplar, *n*—a specimen of physical evidence of known origin.

Osterburg and Ward (2), p. 837

expanded uncertainty (U), *n*—quantity defining an interval about a result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand.

DISCUSSION—(1) The fraction may be regarded as the coverage probability or level of confidence of the interval.

(2) To associate a specific level of confidence with the interval defined by the expanded uncertainty requires explicit or implicit assumptions regarding the probability distribution characterized by the measurement result and its combined standard uncertainty. The level of confidence that may be attributed to this interval can be known only to the extent to which such assumptions can be justified.

(3) An expanded uncertainty *U* is calculated from a combined standard uncertainty *u_c* and coverage factor *k* using:

$$U = k \times u_c$$

EURACHEM-12

false positive, *n*—a result that shows something is present when it really is not.

Merriam-Webster (3)

known, *adj* or *n*—of established origin or identity associated with a matter of interest.

Created by E30 in 2021

limit of detection, detection limit, LOD, *n*—lowest amount of an analyte that is detectable with a given confidence level

ISO 18158:2016

measurement uncertainty, *n*—non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used. (Also *uncertainty of measurement, uncertainty*.)

DISCUSSION—(1) Measurement uncertainty includes components arising from systematic effects, such as components associated with corrections and the assigned quantity values of measurement standards, as well as the definitional uncertainty. Sometimes estimated systematic effects are not corrected for but, instead, associated measurement uncertainty components are incorporated.

(2) The parameter may be, for example, a standard deviation called standard measurement uncertainty (or a specified multiple of it), or the half-width of an interval, having a stated coverage probability.

(3) Measurement uncertainty comprises, in general, many components. Some of these may be evaluated by Type A evaluation of measurement uncertainty from the statistical distribution of the quantity values from series of measurements and can be characterized by standard deviations. The other components, which may be evaluated by Type B evaluation of measurement uncertainty, can also be characterized by standard deviations, evaluated from probability density functions based on experience or other information.

(4) In general, for a given set of information, it is understood that the measurement uncertainty is associated with a stated quantity value

attributed to the measurand. A modification of this value results in a modification of the associated uncertainty. **JCGM 200:2012**

population, *n*—the totality of items or units of material under consideration.

DISCUSSION—The word “items” may be interpreted in the sense of measurements, or possible measurements, of a single characteristic, or occasionally for multiple characteristics, on all items or units of material being considered. The word “totality” may refer to items not available for inclusion in samples as well as those which are available.

E456

procedure, *n*—specified way to carry out an activity or a process.

DISCUSSION—(1) Procedures can be documented or not.

(2) When a procedure is documented, the term “written procedure” or “documented procedure” is frequently used. The document that contains a procedure can be called a “procedure document.”

ISO 9000:2005(E)

proficiency testing, *n*—*laboratory*, determination of laboratory testing performance by means of interlaboratory test comparisons.

E1301

qualitative analysis, *n*—*chemical*, analysis in which substances are identified or classified on the basis of their chemical or physical properties, such as chemical reactivity, solubility, molecular weight, melting point, radiative properties (emission, absorption), mass spectra, nuclear half-life, etc. (See also **quantitative analysis**.) **IUPAC Terminology**

quality assurance, *n*—all the planned and systematic activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfill requirements for quality.

ISO Guide 2

quantitation limit, *n*—the minimum amount that can be quantitated with acceptable accuracy and precision. **E2161**

quantitative analysis, *n*—*chemical*, analyses in which the amount or concentration of an analyte may be determined (estimated) and expressed as a numerical value in appropriate units. Qualitative analysis may take place without quantitative analysis, but quantitative analysis requires the identification (qualification) of the analytes for which numerical estimates are given. **IUPAC Terminology**

questioned, *n*—associated with the matter under investigation about which there is some question, including, but not limited to, whether the questioned and known items have a common origin.

recovery, *n*—*chemical*, term used in analytical and preparative chemistry to denote the fraction of the total quantity of a substance recoverable following a chemical procedure.

IUPAC Terminology

reference material, *n*—a material or substance, one or more of whose property values are sufficiently homogenous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. **E1301**

reference sample, *n*—material from a known source used for comparison purposes in a forensic process (3.15).

DISCUSSION—(1) This includes biological material taken from a person (e.g. hair, blood, saliva), and non-biological material (e.g. carpet, paint, fabric).

(2) A reference sample can be taken from an item (3.19) in order to ensure the substrate (3.31) has no adverse effect on the performance of the test.

(3) A reference sample can be used to address the question of the source of an unknown sample (3.28), one would compare the unknown sample (3.28) with a reference sample. (Numbers within parentheses were added editorially to designate other definitions within the ISO standard).

ISO 21043-1:2018

repeatability, *n*—precision under repeatability conditions.

E177, E456

repeatability conditions, *n*—conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time.

E177, E456

reproducibility, *n*—precision under reproducibility conditions.

E177, E456

reproducibility conditions, *n*—conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment.

E177, E456

sample—subset of a population made up of one or more sampling units.

ISO 3534-1:2006

population—totality of items under consideration.

ISO 3534-1:2006

DISCUSSION—Note that a population may be real and finite, real and infinite, or completely hypothetical.

sampling unit—one of the individual parts into which a population is divided.

ISO 3534-1:2006

sampling, *n*—(the) process of drawing or constituting a sample.

E1402, ISO 3534:1993

selectivity, *n*—(1) (*qualitative*): the extent to which other substances interfere with the determination of a substance according to a given procedure; (2) (*quantitative*): a term used in conjunction with another substantive (for example, constant, coefficient, index, factor, number) for the quanti-

tative characterization of interferences.

EURACHEM, IUPAC Terminology

standard, *n*—material of established origin with certified properties.

test, *n*—determination of one or more characteristics according to a procedure.

ISO 9000:2005(E)

test method, *n*—a definitive procedure that produces a test result.

E456

traceability—property of a result of a measurement or value of a standard whereby it can be related with a stated uncertainty, to stated references, usually national or international standards through an unbroken chain of comparisons.

ISO Guide 30:1992(E/F)

DISCUSSION—(1) The concept is often expressed by the adjective traceable.

(2) The unbroken chain of comparisons is called a traceability chain.

(3) (Applicable only to the French text.)

(4) Traceability of values in the certification of reference materials for chemical composition is discussed in ISO Guide 35:1989 (subclause 9.3.1) where attention is drawn to the special problems associated with chemical analysis. Traceability of the chemical species is frequently of equal or greater importance than the traceability of the calibration of the instruments used in the analysis.

validation, *n*—confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled.

DISCUSSION—(1) The term “validated” is used to designate the corresponding status.

(2) The use conditions for validation can be real or simulated.

ISO 9000:2005(E)

verification, *n*—confirmation, through the provision of objective evidence, that specified requirements have been fulfilled.

DISCUSSION—(1) The term “verified” is used to designate the corresponding status.

(2) Confirmation can comprise activities such as: performing alternative calculations; comparing a new design specification with a similar proven design specification; and undertaking tests and demonstrations, and reviewing documents prior to issue.

ISO 9000:2005(E)

SECTION B: CRIMINALISTICS

The terms defined in Section B are the direct responsibility of Subcommittee E30.01, Criminalistics.

Section B1: Terms for Seized Drug Analysis

aggregation, *n*—the collecting of units or parts into a mass or whole.

E1968, E1969, E2125

birefringence, *n*—property of some crystals, those having more than one refractive index; this will result in interference colors which are viewed through a polarized light microscope.

E2125

birefringence, *n*—property of some crystals, those having more than one refraction index; this property will result in interference colors, which are viewed through a polarized light microscope.

E1968, E1969

birefringent, *adj*—material exhibiting birefringence.

E1968, E1969, E2125

- blades**, *n*—broad, flat, elongated crystals. **E1969**
- capacity**, *n*—the amount of finished product that could be produced, either in one batch or over a defined period of time, and given a set list of variables. **E2882, SWGDRUG**
- catalyst**, *n*—a substance whose presence initiates or changes the rate of a chemical reaction, but does not itself enter into the reaction. **D6161, E2882**
- cocaine**, *n*—either *d*- or *l*- cocaine; it should be noted that *l*-cocaine is the naturally occurring isomer found in the coca plant. **E1968**
- finished product**, *n*—a manufactured product ready for use. **E2882, SWGDRUG**
- grains**, *n*—thick tablets having nearly equal width, breadth and thickness. **E1969, E2125**
- habit**, *n*—the external morphology of the crystal. **E1968, E1969, E2125**
- intermediate**, *n*—substance that is manufactured for and consumed in or used for chemical processing to be transformed into another substance. **F2725, E2882**
- microdrop**, *n*—a small drop of liquid that would fit on the end of a standard size, flattened toothpick; the approximate volume of this drop would be 10 to 25 μL . **E1968, E1969, E2125**
- nails**—a skeleton of some kinds of triangles, elongated, usually pointed with a short head usually thicker or broader. **E2125**
- needles (acicular)**, *n*—long, thin crystals with pointed ends. **E1968, E1969, E2125**
- nuggets**, *n*—irregularly formed grains without sharp faces or edges. **E2125**
- plates**, *n*—blades with nearly equal length and breadth and of a thickness substantially less than the width. **E1969**
- pliers**, *n*—crystals resembling pliers, generally X-shaped. **E2125**
- razor blades**, *n*—thin oblong crystals with length about twice the width, resembling a safety razor blade. **E2125**
- reagent**, *n*—a chemical used to react with another chemical, often to confirm or deny the presence of the second chemical. **E1605, E2882**
- rods**, *n*—long, thin crystals with squared off ends. **E1969**
- sheaves**, *n*—elongated crystals form two opposite fans from the same joining point. **E2125**
- skeletal crystal**, *n*—a crystal in which all of the spaces in the crystal lattice are not occupied. **E2125**
- spindles**, *n*—shorter than course needles, but more substantial cross-section. **E2125**
- tablets**, *n*—plates with appreciable thickness but less than the length or breadth. **E1969**
- yield, expected**, *n*—the quantity of material or the percentage of theoretical yield anticipated at any appropriate phase of production based on previous laboratory, pilot scale, or manufacturing data. **E2363, E2882**
- yield, theoretical**, *n*—the quantity that would be produced at any appropriate phase of production based upon the quantity of material to be used, in the absence of any loss or error in actual production. **E2363, E2882**

Section B2: Terms for Gunshot Residue (GSR) Analysis and Smokeless Powder Analysis

- ball powders**, *n*—a class of smokeless powders produced by a process where the final grain morphologies are spherical, flattened-ball, or flake. **E2998**
- characteristic particles**, *n*—particles that have compositions rarely found in particles from any other source. **E1588**
- commonly associated particles**, *n*—particles have compositions that are also commonly found in environmental particles from numerous sources. However, when present, in addition to particles that are characteristic of, and/or consistent with GSR, these particles can be of significance in the interpretation of a population of particles and, consequently, the likelihood that that population is GSR. In isolation, however, such particles have little significance in examinations for GSR. **E1588**
- consistent particles**, *n*—particles that have compositions that are also found in particles from a number of relatively common, non-firearm sources. Particles within this group are produced through the operation of a variety of processes, equipment, or devices and can be found in the environment with varying levels of frequency. **E1588**
- deterrent**, *n*—a compound to slow the burning rate of a powder. **E2998**
- double-base**, *n*—propellant containing nitrocellulose and nitroglycerin. **E2998, E2999**
- energetic**, *n*—an explosive compound used to enhance the burning rate of a powder. **E2998**
- extruded powders**, *n*—a class of smokeless powders produced by an extrusion process where the final grain morphologies are disc or cylinder. **E2998**
- grain**, *n*—an individual particle of smokeless powder. **E2998, E2999**
- marker**, *n*—a colored grain of smokeless powder to assist in the visual identification of a bulk reloading smokeless powder. **E2998**
- morphology, n; morphological, adj**—referring to size, shape, structure, and texture. **E1588**
- perforation**, *n*—a hole in a disc powder or one or more holes running through the length of a cylinder powder created

during the manufacturing process in extruded powders.
E2998

single-base, *n*—propellant containing nitrocellulose as the major energetic material.
E2998, E2999

smokeless powder, *n*—a propellant and low explosive composed of nitrocellulose and other organic and inorganic compounds.
E2998, E2999

stabilizer, *n*—a compound to prevent or slow down self-decomposition.
E2998

stub, *n*—sample device with an adhesive surface used to collect materials for SEM/EDS analysis.
E1588

triple-base, *n*—propellant containing nitrocellulose, nitroglycerin, and nitroguanidine.
E2998, E2999

Section B3: Terms for Paint Analysis

additive (modifier)—any substance added in a small quantity to improve properties. Additives can include substances such as driers, corrosion inhibitors, catalysts, ultraviolet absorbers, plasticizers, etc.
E1610

additive (modifier), *n*—any substance added in a small quantity to improve properties; additives include substances such as driers, corrosion inhibitors, catalysts, ultraviolet absorbers, and plasticizers.
E2937

background, *n*—the signal produced by the entire analytical system apart from the material of interest.
E2937

background X-rays (Bremsstrahlung, braking radiation, continuous spectrum), *n*—nonspecific X-ray radiation with a continuous energy range from zero up to the beam voltage in which background radiation results from the deceleration of beam electrons in the atomic Coulombic field.
E2809

DISCUSSION—A typical X-ray spectrum consists of both a continuous background and peaks from characteristic X-rays.

backscattered electrons, *n*—primary beam electrons that are scattered from the sample after undergoing few inelastic interactions.
E2809

DISCUSSION—The probability of backscattering is proportional to the atomic number.

binder—a non-volatile portion of a paint which serves to bind or cement the pigment particles together.
E1610

binder, *n*—a nonvolatile portion of the liquid vehicle of a coating, which serves to bond or cement the pigment particles together.
E2937

bulk analysis, *n*—type of scanning electron microscopy (SEM) analysis that determines the average elemental composition of a material in which the area of analysis is as large as possible and may be achieved by a single large area raster or the summed results from multiple smaller area rasters.
E2809

cathodoluminescence, *n*—emission of photons in the ultraviolet (UV), visible (Vis), and infrared (IR) regions of the electromagnetic spectrum as a result of electron beam interaction with certain materials.
E2809

characteristic X-rays, *n*—X-ray emission resulting from de-excitation of an atom following inner shell ionization in which the energy of the X-rays is related to the atomic

number of the atom, providing the basis for energy dispersive X-ray spectrometry (EDS).
E2809

DISCUSSION—A typical X-ray spectrum consists of both a continuous background and peaks from characteristic X-rays.

charge-coupled device (CCD), *n*—a silicon-based semiconductor chip consisting of a linear or two-dimensional array of photo sensors or pixels that transfers an electrical charge and converts it into a digital value.
E2808

charging, *n*—negative charge accumulation on either a non-conductive sample or a sample that is not properly grounded.
E2809

DISCUSSION—This effect may interfere with image formation and X-ray analysis because of beam deflection. It can usually be eliminated by the application of a conductive coating.

coating—a generic term for paint, lacquer, enamel, or other liquid or liquifiable material which is converted to a solid, protective, decorative, or combination thereof, film after application.
E1610

coating, *n*—a generic term for paint, lacquer, enamel, or other liquid or liquefiable material that is converted to a solid, protective, or decorative film or a combination of these types of films after application.
E2937

colorimetry, *n*—conversion of instrumental light measurements into psychophysical descriptions or numerical notations that can be correlated with visual evaluations of color and color differences.
E2808

concentration, *n*—for the purpose of this guide, the following ranges shall apply: major: greater than 10 %; minor: 1 to 10 %; and trace: less than 1 %.
E2809

dead time, *n*—time during which the EDS is not able to process X-rays.
E2809

DISCUSSION—Dead time is typically expressed as a percentage of real time during which the detector is not collecting X-ray data.

detector fluorescence peak (dead-layer peak, silicon internal fluorescence peak), *n*—peak resulting from the emission of characteristic X-rays in a thin layer of inactive crystal area in the front of an EDS detector.
E2809

DISCUSSION—The peak is characteristic of the type of detector, such as silicon for a lithium-drifted silicon detector. In a silicon detector, this peak may appear at 0.2 % apparent concentration.

discriminate—to distinguish between two samples based on meaningful differences; to differentiate.
E1610

discriminating power—the ability of an analytical procedure to distinguish between two items of different origin. **E1610**

effect pigment, *n*—any paint pigment that is designed to produce a significant change in color attribute(s) in a paint film when the film is viewed or illuminated from varied angles. **E2808**

electron probe microanalyzer (EPA, EPMA, EMMA), *n*—electron beam instrument designed for quantitative X-ray analysis (electron probe microanalysis). **E2809**

DISCUSSION—It is related to SEM but with multiple wavelength spectrometers and is designed to work at reproducible and stable beam currents and specimen-beam-X-ray detector geometries. Electron probe microanalysis is the determination of elemental concentration by X-ray emission from the microvolume of material in which a static electron beam interacts.

embedding, *n*—procedure for casting a sample in a block of material that polymerizes, or otherwise hardens, to permit handling during further preparation. **E2809**

energy dispersive X-ray spectrometry (EDS, EDXA, EDX), *n*—EDX spectrometry is complementary to wavelength dispersive spectrometry (WDS). **E2809**

escape peak, *n*—peak resulting from incomplete deposition of the energy of an X-ray entering the EDS detector. **E2809**

DISCUSSION—This peak is produced when an incoming X-ray excites a silicon atom within the detector crystal and the resulting silicon (Si) K-alpha fluorescence X-ray exits the detector crystal. It occurs at the principal peak energy minus the energy of the Si K-alpha fluorescence X-ray (1.74 KeV). The escape peak intensity is about 1 to 2 % of the parent peak.

extraneous material, *n*—material originating from a source other than the specimen (synonyms: contaminant and foreign material). **E2809**

extraneous material (contaminant, foreign material), *n*—material originating from a source other than the specimen. **E2937**

final aperture, *n*—last beam-restricting orifice in an electron optical column. **E2809**

DISCUSSION—The orifice diameter influences the beam current and depth of focus.

grating, *n*—parallel set of linear, regularly repeating grooves that, when illuminated, produces dispersion of light into its requisite wavelengths with maxima and minima of light intensity as a consequence of interference. **E2808**

DISCUSSION—These maxima and minima vary in position with wavelength. This allows radiation of any given wavelength to be isolated from a mixture of wavelengths (for example, white light) and allows the grating to be used as part of a monochromator. The dispersion or ability to resolve separate wavelengths is expressed as the number of lines (or steps) in the grating per millimetre.

interaction volume, *n*—sample volume in which the electron beam loses most of its energy. **E2809**

DISCUSSION—It is generally thought of as the volume in which detectable X-rays are produced. The actual volume varies depending upon beam voltage, average atomic number, and density of the sample.

known sample—a coating sample of established origin. **E1610**

live time, *n*—time in which the EDS electronics are available to accept and process incoming X-rays. **E2809**

DISCUSSION—Live time is often expressed as a percentage of real time.

meaningful difference—a feature or property of a sample that does not fall within the variation exhibited by the comparison sample, considering the limitations of the sample or technique, and therefore indicates the two samples do not share a common origin. The use of this term does not imply the formal application of statistics. **E2808, E1610**

meaningful difference(s), *n*—a feature or property of a sample that does not fall within the variation exhibited by the comparison sample, considering the limitations of the sample or technique, and therefore indicates the two samples do not share a common origin. The use of this term does not imply the formal application of statistics. **E2937**

measuring aperture, *n*—element in the optical path of a MSP system that limits the area of illumination reaching the detector focal plane. **E2808**

metameric samples, *n*—two or more samples that appear to have the same color under one type of illumination but can appear dissimilar under different lighting conditions, or two or more samples that appear to be the same color under all lighting conditions, yet their reflectance/transmittance spectral curves are different. **E2808**

microspectrophotometer (MSP), *n*—a specialized spectrophotometer designed to measure the absorbance, reflectance and emission spectra of microscopic areas on samples. **E2808**

microtomy, *n*—sample preparation method that sequentially passes a blade at a shallow depth through a sample resulting in sections of selected thickness as well as a flat block. **E2809**

DISCUSSION—Each may be used for the determination of sample characteristics.

microtomy, *n*—a sample preparation method that sequentially passes a blade at a shallow depth through a specimen, resulting in sections of selected thickness. **E2937**

monochromator, *n*—device designed to isolate narrow wavelength ranges of light from complex, broad-spectrum radiation. **E2808**

paint, *n*—a pigmented coating. **E2937**

paint—commonly known as a pigmented coating (see coating). **E1610**

particle analysis, *n*—analytical method intended to determine the elemental composition of a single particle such as a pigment particle in a paint layer. **E2809**

DISCUSSION—Usually performed with a static (nonscanning) electron beam.

photomultiplier tube (PMT), *n*—photosensitive vacuum tube device that quantitatively converts photons of light into electrical energy. **E2808**

pigment, *n*—a finely ground, organic or inorganic, insoluble, and dispersed particle. Besides color, a pigment can provide many of the essential properties of paint, such as opacity, hardness, durability, and corrosion resistance (see also *effect pigment*). **E2808**

pigment, *n*—a finely ground, inorganic or organic, insoluble, and dispersed particle; besides color, pigments provide many of the essential properties of paint such as opacity, hardness, durability, and corrosion resistance; the term pigment includes extenders. **E2937**

pigment—a finely ground, inorganic or organic, insoluble, dispersed particle. Besides color, a pigment can provide many of the essential properties of paint, such as opacity, hardness, durability, and corrosion resistance. The term pigment includes extenders. **E1610**

pixel binning, *v*—the process of combining counts from adjacent pixels in a CCD detector during readout. **E2808**

pulse processor time constant, *n*—operator-selected value for pulse-processing time in which a higher value (longer time) results in a more accurate determination of the detector amplifier pulse height (better spectral resolution) and a lower value results in a higher count rate but with reduced spectral resolution. **E2809**

questioned sample—a coating sample whose original source is unknown. **E1610**

raster, *n*—rectangular pattern scanned by the electron beam on a sample. **E2809**

DISCUSSION—The raster dimensions change inversely with magnification.

representative sample, *n*—representative portion of the specimen selected and prepared for analysis that is believed to exhibit all of the elemental characteristics of the parent specimen. **E2809**

sample polishing, *n*—sample preparation method using progressively finer abrasives to achieve a flat, smooth sample surface. **E2809**

DISCUSSION—Generally, this is required for quantitative analysis.

sample size, *n*—for the purposes of this guide, the following terms are used to describe sample size with the actual size demarcation between each being somewhat arbitrary. **E2809**

fragment, *n*—*only within this guide*, sample or specimen smaller than approximately 0.2 mm. **E2809**

DISCUSSION—If the material from which the fragment originated was layered, then the fragment may also show a layered structure with light microscopy inspection and SEM analysis. A fragment is frequently not of sufficient size to permit multiple tests.

particle, *n*—*only within this guide*, sample or specimen whose greatest dimension is less than approximately 50 μm . **E2809**

DISCUSSION—Material of this size generally has none of the overall structural characteristics that can be associated with the material from which the particle originated. A particle is generally not of sufficient size to permit multiple tests.

piece, *n*—sample or specimen larger than approximately 0.2 mm. **E2809**

DISCUSSION—If the material from which the piece originated was layered, then the piece may show a layered structure. A sample of this size is sufficient to perform all of the suggested cross-sectional preparation and analytical methods.

scanning electron microscopy (SEM), *n*—type of electron microscope in which a focused electron beam is scanned in a raster on a solid sample surface. **E2809**

DISCUSSION—The strength of resulting emissions of signals varies according to sample characteristics such as composition or topography. As the electron beam of the SEM scans the surface of a sample, a signal is continuously registered by the imaging system which produces a two-dimensional image of the sample on the display monitor. By popular usage, the term SEM may also include the analytical techniques EDS and WDS.

secondary electrons (SE), *n*—low-energy electrons produced from the interaction of beam electrons and conduction band electrons of atoms within the interaction volume that are produced throughout the interaction volume, but only those near the surface have enough energy to escape. **E2809**

DISCUSSION—The secondary electron signal is typically used to form topographic images.

smear, *n*—transfer of paint resulting from contact between two objects and consisting of comingled particles, fragments, and possible pieces of one or both surfaces. **E2809**

smear, *n*—a transfer of paint resulting from contact between two objects; these transfers can consist of co-mingled particles from two or more sources, fragments, or contributions from a single source. **E2937**

specimen, *n*—material submitted for examination. **E2809**

DISCUSSION—Samples are removed from a specimen for analysis.

spectral artifacts, *n*—spectral peaks other than characteristic peaks produced during the EDS detection process. **E2809**

DISCUSSION—Examples are escape peaks and sum peaks.

spectral resolution, *n*—measure of the ability to distinguish between adjacent peaks in a spectrum; it is usually determined by measuring peak width at half the maximum value of the peak height or full-width half-maximum (FWHM). **E2808**

DISCUSSION—Spectral resolution is not to be confused with spatial resolution (the smallest features that can be resolved in the field of view of the MSP camera or eyepieces or can be used to refer to the smallest spectral sampling area of the MSP).

spectral resolution, *n*—measure of the ability to distinguish between adjacent peaks in an X-ray spectrum and it is usually determined by measuring peak width at half the maximum value of the peak height or full-width half-maximum. **E2809**

sum peak, *n*—peak occurring at the sum of the energy of two individual peaks. **E2809**

system peaks (stray radiation), *n*—peaks that may occur in the X-ray spectrum resulting from interaction of the electron beam or fluorescent radiation with components of the SEM itself. **E2809**

- takeoff angle**, *n*—angle between the specimen surface and the detector axis. **E2809**
- thick section**, *n*—for the purpose of this guide, a sample that is 2 μm or thicker. **E2809**
- thin section**, *n*—for the purpose of this guide, a sample with a thickness of less than 2 μm. **E2809**
- transmission electron microscopy (TEM)**, *n*—type of electron microscopy in which an image of a sample prepared as a thin section is formed by the interaction of the beam passing through the sample. **E2809**
- variable pressure scanning electron microscopy (LV, CP, VP, ESEM)**, *n*—type of SEM that is designed to operate at

higher chamber pressure than the conventional in which the need for application of a conductive coating is minimized when using a variable pressure SEM; however, EDS may be complicated because of the electron beam spread experienced at higher operating pressures. **E2809**

wavelength dispersive spectroscopy (WDS, WDXA), *n*—X-ray spectroscopy that separates and identifies X-rays based on their differences in wavelength. **E2809**

DISCUSSION—WDS is a complementary spectroscopy to EDS.

Section B4: Terms for Textile, Fiber, Cord, and Tape Examination

- activation**—the heating of the adsorbent layer on a plate to dry out the moisture and maximize its adsorptive power. **E2227**
- adsorbent**—the stationary phase for adsorption TLC. **E2227**
- adsorption**—the attraction between the surface atoms of a solid and an external molecule by intermolecular forces. **E2227**
- anisotropic**, *adj*—a characteristic of an object in which the refractive index differs depending on the direction of propagation or vibration of light through the object. **E2228, McCrone (4)**
- aperture**, *n*—an opening in an optical system that controls the amount of light passing through a system. **E2224**
- attenuated total reflection (ATR)**, *n*—a method of spectrophotometric analysis based on the reflection of energy at the interface of two media which have different refractive indices and are in intimate contact with each other. **E2224**
- background**, *n*—apparent absorption caused by anything other than the substance for which the analysis is being made. **E2224, E131**
- background**, *n*—the signal produced by the entire analytical system apart from the material of interest. **E3085**
- barrier filter**, *n*—a filter used in fluorescence microscopy that suppresses unnecessary excitation energy that has not been absorbed by the fiber and selectively transmits only energy of greater wavelengths than the cut-off wavelength or within a specific wavelength range. **E2228**
- Becke line**, *n*—the bright halo near the boundary of a fiber that moves with respect to that boundary as the microscope is focused through best focus when the fiber is mounted in a medium that differs from its refractive index. **E2228, McCrone (4)**
- Becke line method**, *n*—a method for determining the refractive index of a fiber relative to its mountant by noting the direction in which the Becke line moves when the focus is changed. **E2228, McCrone (4)**

DISCUSSION—The Becke line always moves toward the higher refractive index medium (fiber or mountant) when focus is raised (stage is lowered) and towards the lower refractive index medium when focus is lowered (stage is raised). At the point where the index of the fiber matches the index of the mounting medium, the Becke line is no longer visible. The Becke line is generally viewed at a wavelength of 589 nm (the D line of Sodium [n_D]).

birefringence, *n*—the numerical difference in refractive indices (*n*) for a fiber, given by the equation:

$$|n_{\parallel} - n_{\perp}|$$

Birefringence (B) can be calculated by determining the retardation (*r*) and thickness (*T*) at a particular point in a fiber and by using the equation:

$$B = r \text{ (nm)} / 1000T \text{ (}\mu\text{m)}$$

E2228, McCrone (4)

braid, *n*—the intertwining of strands in a braiding process to produce a rope structure. **E2225, The Cordage Institute (5)**

cellulosic fiber, *n*—fiber composed of polymers formed from glucose subunits (for example, vegetable, rayon/Lyocell). **E2224**

chamber—a glass chamber in which TLC development is carried out. **E2227**

chromatography—a method of analysis in which substances are separated by their differential migration in a mobile phase flowing through or past a stationary phase. **E2227**

comparison microscope, *n*—a system of two microscopes positioned side-by-side and connected via an optical bridge so that two specimens are examined simultaneously in either transmitted or reflected light. **E2228**

compensator, *n*—any variety of optical devices that can be placed in the light path of a polarized light microscope to introduce known, fixed or variable retardation in a specific vibration direction; the retardation and sign of elongation of the fiber can then be determined. **E2228, Delly (6)**

DISCUSSION—Compensators often contain a fixed mineral plate of constant or varying thickness or a mineral plate that is rotated, or have

its thickness varied by tilting, to alter the thickness presented to the optical path (and retardation introduced) by a set amount.

compensator, full-wave (or red plate), *n*—a compensator (usually a plate of gypsum, selenite or quartz) that introduces a fixed retardation between 530 to 550 nm (approximately the retardation of the first order red color on the Michel-Lévy chart).

E2228, McCrone (4), Delly (6)

compensator, quarter-wave, *n*—a compensator (usually a mica plate) that introduces a fixed retardation between ~137–147 nm (approximately the retardation of first-order gray on the Michel-Lévy chart).

E2228, McCrone (4), Delly (6)

compensator, quartz wedge, *n*—a wedge, usually cut from quartz, having continuously variable retardation extending over several orders (usually 3 to 7) of interference colors.

E2228, McCrone (4)

compensator, Sénarmont, *n*—a quarter-wave plate inserted above the specimen in the parallel “0” position with a calibrated rotating analyzer; measures low retardation and requires the use of monochromatic light.

E2228

compensator, tilting (Berek), *n*—a compensator typically containing a plate of calcite or quartz, which can be tilted by means of a calibrated drum to introduce variable retardation.

E2228

cord, *n*—a twisted or formed structure composed of one or more single or plied filaments, strands, or yarns of organic polymer or inorganic materials.

E2225, D123

DISCUSSION—Generally, cords have a diameter less than $\frac{3}{16}$ in.

cordage, *n*—a collective term for twines, cords and ropes made from textile fibers and yarns.

E2225, The Cordage Institute (5)

core, *n*—a textile product (yarn, strand, small diameter rope, etc.) placed in the center of a rope and serving as a support for the strands around it.

E2225, The Cordage Institute (5)

DISCUSSION—Core can be of any continuous construction including parallel strands, twisted strands or braided strands.

cortex, *n*—the main structural component of hair consisting of elongated and fusiform (spindle-shaped) cells; the cortex can contain pigment grains, air spaces called cortical fusi, and structures called ovoid bodies.

E2228

course, *n*—in knitted fabrics, a row of successive loops in the width direction of the fabric.

E2225, D123

crimp, *n*—the curl, wave, or compression that is naturally occurring or otherwise imparted to a fiber.

E2228

crown, *n*—the raised portion of a strand in twisted cordage.

E2225

cuticle, *n*—in mammalian hair fibers, the layers of flattened cells enclosing the cortex, which form an envelope of overlapping scales surrounding the fiber.

E2228

delustrant, *n*—a pigment, usually titanium dioxide, used to dull the luster of a manufactured fiber.

E2224, E2228, KoSa (7)

development—the movement of the mobile phase through the adsorbent layer to form a chromatogram.

E2227

dichroism, *n*—the property of exhibiting different colors, especially two different colors, when viewed along different axes by plane polarized light.

E2228

dislocations, *n*—distinct features that occur in natural fibers (for example, flax, ramie, jute, hemp) in the shape of X’s, I’s, and V’s that are present along the fiber cell wall; these features are often useful for identification.

E2228

dispersion of birefringence, *n*—the variation of birefringence with wavelength of light.

E2228

DISCUSSION—When dispersion of birefringence is significant in a particular fiber, anomalous interference colors not appearing in the regular color sequence of the Michel-Lévy chart can result. Strong dispersion of birefringence can also interfere with the accurate determination of retardation in highly birefringent fibers.

dispersion staining, *n*—an optical staining technique in which colors are produced by the differential refraction of different wavelengths of light due to mounting the sample in a liquid having a different dispersion of refractive index.

E2228, McCrone (4)

DISCUSSION—The procedure employs central or annular stops placed in the objective back focal plane of a microscope. Using an annular stop with the substage iris closed, a fiber mounted in a high dispersion medium shows a colored boundary of a wavelength where the fiber and the medium match in refractive index. Using a central stop, the fiber shows colors complementary to those seen with an annular stop.

dye, *n*—soluble substances that add color to textiles.

E2228, KoSa (7)

DISCUSSION—Dyes are classified into groups that have similar chemical characteristics (for example, aniline, acid, and azo). They are incorporated into the fiber by chemical reaction, absorption, or dispersion.

dye extraction—the removal of the dye from a fiber by incubating it in an appropriate solvent.

E2227

elastomer, *n*—the polymeric backbone of a pressure sensitive adhesive imparting elastic properties, for example, rubber.

E3085

eluent—the solvent mixture that acts as the mobile phase in TLC.

E2227

excitation filter, *n*—a filter used in fluorescence microscopy that transmits specific bands or wavelengths of energy capable of inducing visible fluorescence in various substrates.

E2228

extinction, *n*—the condition in which a birefringent particle appears dark when viewed between crossed polarizers.

E2228, Delly (6)

DISCUSSION—Most fibers exhibit extinction when their long axis is oriented parallel to the privileged direction of one of the polarizing filters.