Designation: ~~E3197 – 20~~ E3197 – 23

An American National Standard

Standard Terminology Relating to Examination of Fire Debris[1]

This standard is issued under the fixed designation E3197; 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 is a compilation of terms and corresponding definitions that are used in fire debris analysis. Some legal or scientific terms that are generally understood or defined adequately in other readily available sources are included.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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]

D56 Test Method for Flash Point by Tag Closed Cup Tester
E1388 Practice for Static Headspace Sampling of Vapors from Fire Debris Samples
E1412 Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration with Activated Charcoal
E1413 Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Dynamic Headspace Concentration onto an Adsorbent Tube
E1618 Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry
E1732 Terminology Relating to Forensic Science
E2154 Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration with Solid Phase Microextraction (SPME)
E3189 Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Static Headspace Concentration onto an Adsorbent Tube

2.2 *Other Standards:*

NFPA 921 Guide for Fire and Explosion Investigations, ~~2017~~2021 Edition[3]

3. Significance and Use

3.1 These terms have particular application to fire debris analysis. In addition, several sources of definitions were used in the

[1] This terminology is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.01 on Criminalistics.
Current edition approved ~~July 15, 2020~~June 1, 2023. Published ~~July 2020~~June 2023. Originally approved in 2020. Last previous edition approved in 2020 as E3197 – 20.
DOI: ~~10.1520/E3197-20.~~10.1520/E3197-23.

[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.

[3] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

development of this terminology: *Hawley's Condensed Chemical Dictionary*, Fifteenth Edition (**1**);[4] *Kirk's Fire Investigation*, Fifth Edition (**2**); *The Chemistry and Technology of Petroleum*, Third Edition (**3**); *Merriam-Webster's Collegiate Dictionary*, Tenth Edition (**4**); and *Fire Debris Analysis* (**5**). A suitable definition was developed after all of the sources were found wanting.

4. Terminology

4.1 *Definitions:*

absorption, *n*—the penetration of one substance into the inner structure of another, as distinguished from adsorption, in which one substance is attracted to and held on the surface of another. **Hawley's**[5]

absorbent, n—any substance exhibiting the property of absorption. **Hawley's**[6]

accelerant, *n*—a fuel or oxidizer, often an ignitable liquid, intentionally used to initiate a fire or increase the rate of growth or spread of fire. **NFPA 921, 3.3.2**

DISCUSSION—
(*1*) Whether a substance is an accelerant depends not on its chemical structure but on its use. (*2*) This term is not used in fire debris analysis but is included in this standard for historical purposes and for clarity of meaning when used by stakeholders.

activated carbon, *n*—a form of carbon characterized by high adsorptivity for many gases, vapors, and colloidal solids that is typically activated by heating to 800–900°C with steam or carbon dioxide, which results in a porous internal structure; also known as activated charcoal.

activated carbon strip, ACS, n—a homogenous mixture of activated charcoal and an inert polymer formed into a strip; a convenient adsorption medium for fire debris analysis.

adsorption, *n*—adherence of atoms, ions, or molecules of a gas or liquid to the surface of another substance. **Hawley's**[7]

adsorbent, n—a substance that has the ability to condense or hold molecules of other substances on its surface. **Hawley's**[8]

DISCUSSION—
Activated carbon, activated alumina, silica gels, Tenax,[9] and some stationary phase-coated SPME fibers are examples of adsorbents or adsorbent devices.

aliphatic, *adj*—descriptive of one of the major groups of organic compounds, characterized by normal, branched-, or cyclic chain arrangement of the constituent carbon atoms, but does not include aromatic compounds.

branched alkane, n—a subclass of aliphatic hydrocarbons with the general formula C_nH_{2n+2}, with subordinate chains branching off of the main chain; also known as isoparaffin and isoalkane.

cycloalkane, n—a subclass of aliphatic hydrocarbons with the general formula C_nH_{2n}, where the chain of constituent carbon atoms connects to produce a ring structure (with or without side chains) containing only single bonds; also known as cycloparaffin or, historically, naphthene.

DISCUSSION—
Naphthenes should not be confused with the term 'naphthalenes,' which can be used to refer to a subclass of polyaromatic hydrocarbons which is based on naphthalene.

normal alkane, n—a subclass of aliphatic hydrocarbons with the general formula C_nH_{2n+2}, with a single unbranched chain of carbon atoms; also known as n-alkane.

alkane, *n*—a class of aliphatic hydrocarbons characterized by a straight or branched carbon chain; generic formula C_nH_{2n+2}; also known as paraffin. **Hawley's**[10]

DISCUSSION—
In the plural form, also sometimes used to refer to the general class of aliphatic compounds that includes branched, normal, and cycloalkanes.

[4] The boldface numbers in parentheses refer to a list of references at the end of this standard.
[5] *Hawley's Condensed Chemical Dictionary* (**1**), 2007, s.v. "absorption."
[6] *Hawley's Condensed Chemical Dictionary* (**1**), 2007, s.v. "absorbent."
[7] *Hawley's Condensed Chemical Dictionary* (**1**), 2007, s.v. "adsorption."
[8] *Hawley's Condensed Chemical Dictionary* (**1**), 2007, s.v. "adsorbent."
[9] Tenax is a trademark of Buchem B.V. in Apeldoorn, Netherlands.
[10] *Hawley's Condensed Chemical Dictionary* (**1**), 2007, s.v. "paraffin."

alkene, *n*—a class of unsaturated aliphatic hydrocarbons having one or more double bond(s); also known as olefin.

DISCUSSION—
In the plural form, also sometimes used in fire debris analysis to refer to the general class of aliphatic compounds with one or more double bonds.

alkadiene, n—a class of unsaturated aliphatic hydrocarbons having two double bonds; also known as diene.

aromatic, *n*—a major group of unsaturated cyclic hydrocarbons containing one or more rings, typified by benzene, which has a 6-carbon ring containing nominally three double bonds.

DISCUSSION—
In fire debris, this term is typically used to refer to alkylbenzenes, which are benzene rings with aliphatic substitutions.

combustible, *n*—any substance that will burn, regardless of its autoignition temperature, or whether it is a solid, liquid or gas. **Hawley's[11]**

combustible, *adj*—capable of undergoing combustion.

NFPA 921, 3.3.32

combustible liquid, *n*—see **ignitable liquid**.

combustion, *n*—a usually rapid chemical process (as oxidation) that produces heat and usually light. **Webster's[12]**

combustion product, *n*—the heat, gases, volatilized liquids and solids, particulate matter, and ash generated by combustion. **NFPA 921, 3.3.36**

DISCUSSION—
Combustion products are the result of complete or incomplete combustion, but not thermal decomposition (see **pyrolysis**).

comparison sample, *n—fire debris*, (*1*) a sample of material collected from a fire scene which is, to the best of the collector's knowledge, similar with respect to relevant characteristics to a sample suspected of containing ignitable substance, but which is not expected to contain an ignitable substance; (*2*) a sample of suspected ignitable substance submitted for the purpose of comparing with any ignitable substance separated from a debris sample.

DISCUSSION—
A comparison sample should not be confused with a control sample. For example, a comparison sample might include unburned carpet or flooring that meets the requirements in (*1*). **E1732**

DISCUSSION—
Although, in theory, the use of comparison samples can help clarify the presence of a suspected inherent ignitable liquid, the presence of an ignitable liquid in a comparison sample does not necessarily mean it is inherent to the material.

control sample, *n*—material of established origin that is used to evaluate the performance of a test or comparison. **E1732**

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

crude oil, *n*—a naturally occurring mixture of gaseous, liquid, and solid hydrocarbon compounds usually found trapped deep underground beneath impermeable cap rock and above a lower dome of sedimentary rock such as shale.
Chemistry and Technology of Petroleum (3), p. 901

debris, *n*—the ruins or rubble which results from the burning of materials. (See also **fire debris**.)

[11] *Hawley's Condensed Chemical Dictionary* (**1**), 2007, s.v. "combustible material."
[12] *Merriam-Webster's Collegiate Dictionary* (**4**), 1993, s.v. "combustion."

desorption, *n*—the process of removing an adsorbed material from the solid (adsorbent) on which it is adsorbed. (See also **elution**.)

DISCUSSION—
Desorption may be accomplished by heating, by reduction of pressure, by the presence of another more strongly adsorbed substance, or by a combination of these means. **Hawley's[13]**

distillation, *n*—a physical separation based on the vaporization of the different components of the mixture to be separated. **Fire Debris Analysis (5), p. 379**

drying oil, *n*—an organic liquid that, when applied as a thin film, readily absorbs oxygen from the air and polymerizes to form a tough, elastic film. **Hawley's[14]**

DISCUSSION—
Some examples of drying oils include linseed, tung, and soybean oils. Drying oils are prone to spontaneous heating when exposed to air.

dynamic headspace concentration, *n*—an extraction technique in which a portion of the headspace vapors is exchanged from the sample container and concentrated onto an adsorbent medium through applied positive or negative pressure.

elution, *n*—the process of removing an adsorbed substance from an adsorbent by a solvent.

DISCUSSION—
This term can also refer to the process of a sample passing through a chromatographic stationary phase under the influence of a mobile phase.

evaporation, *n*—the change of a substance from the liquid phase to the gaseous or vapor phase, which can occur at or below the normal boiling point of the liquid.

extracted ion profile, EIP, *n*—any plot of signal intensity observed at a chosen *m/z* value or set of values in a series of mass spectra recorded as a function of time. **Definitions of Terms Relating to Mass Spectrometry (6)**

fatty acid, *n*—a long chain alkyl group characterized by a terminal carboxyl group –COOH.

DISCUSSION—
Fatty acids are derivatized for analytical or commercial purposes, such as in an automotive fuel. A common derivatization replaces the terminal –COOH with $–CO(OCH_3)$, converting the fatty acid into a fatty acid methyl ester (FAME).

fire, *n*—a rapid oxidation process, which is a chemical reaction resulting in the evolution of light and heat in varying intensities (see **combustion**). **NFPA 921, ~~3.3.66~~3.3.68**

fire debris, *n*—material of interest at a fire scene that can be collected by an investigator as evidence to analyze.

fire debris analysis, *n*—the science related to the examination of fire debris samples performed to potentially detect and identify ignitable liquid residues (ILR).

fire suppression, *n*—see **suppression**.

fire tetrahedron, *n*—a symbol to describe the necessary requirements for fire to occur: fuel, heat, oxidizer, and an uninhibited chemical reaction.

[13] *Hawley's Condensed Chemical Dictionary* (1), 2007, s.v. "desorption."
[14] *Hawley's Condensed Chemical Dictionary* (1), 2007, s.v. "drying oil."

flammable, *adj*—capable of burning with a flame. **NFPA 921, ~~3.3.83~~3.3.87**

flammable liquid, *n*—see **ignitable liquid**.

flash point, *n*—the lowest temperature corrected to a pressure of 101.3 kPa (760 mm Hg) at which application of an ignition source causes the vapors of a specimen of the sample to ignite under specified conditions of the test. **D56**

DISCUSSION—
There are several methods for determining the flash point. The preferred method used by authorities in delineating between flammable and combustible liquids is a closed-cup flash point test.

fuel, *n*—a material that will maintain combustion under specified environmental conditions. **NFPA 921, ~~3.3.91~~3.3.95**

fuel additive, *n*—chemical compound or mixture of compounds added to a fuel for various purposes.

headspace, *n*—the space above a material that includes the vapors produced by the liquid or solid material.

headspace analysis, *n*—practice for sampling and analyzing the headspace in a closed container.

DISCUSSION—
In fire debris analysis, there are several types of headspace sampling techniques, which are listed below. The applicable ASTM Standard Practice number for each technique is indicated in parentheses.

static—see **static headspace sampling** (E1388), and **static headspace concentration** (E3189).

passive (E1412 and E2154)—see **passive headspace concentration**.

dynamic (E1413)—see **dynamic headspace concentration**.

homologous series, *n*—a series of organic compounds in which each successive member has one more repeating unit (for example, methylene group, $–CH_2–$) in its molecule than the nearest preceding member.

DISCUSSION—
For example, methanol, ethanol, propanol, etc., form a homologous series as do nonane, decane and undecane, etc.

hypergolic, *adj*—igniting upon contact of components without external aid (as a spark). **Webster's[15]**

ignitable liquid, *n*—any liquid that is capable of fueling a fire.

DISCUSSION—
(*1*) The liquids historically referred to as 'flammable liquid' and 'combustible liquid' are all considered ignitable liquids.

(*2*) Examples of classes of ignitable liquids include aromatic products, gasoline, isoparaffinic products, naphthenic-paraffinic products, normal alkane products, oxygenated products, and petroleum distillates. Refer to Test Method E1618 for further information about these classes.

ignitable liquid residue(s), ILR, *n*—relatively small amount of ignitable liquid retained in or on a substrate.

immiscible, *adj*—descriptive of substances of the same phase or state of matter that cannot be uniformly mixed or blended. **Hawley's[16]**

incendiary, *n*—chemical compound, metal, or mixture capable of producing intense heat.

[15] *Merriam-Webster's Collegiate Dictionary* (**4**), 1993, s.v. "hypergolic."
[16] *Hawley's Condensed Chemical Dictionary* (**1**), 2007, s.v. "immiscible."