



Designation: ~~E1388~~–17 E1388 – 24

An American National Standard

Standard Practice for Static Headspace Sampling of Vapors from Fire Debris Samples¹

This standard is issued under the fixed designation E1388; 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 practice describes the procedure for removing a vapor sample from the headspace of a fire debris container for the purpose of detecting or identifying ignitable liquid residues.

1.2 Separation and concentration procedures are listed in the referenced documents. (See Practices [E1386](#), [E1412](#), [E1413](#), [E2154](#) and [E3189](#).)

1.3 This practice offers a set of instructions for performing one or more specific operations. ~~This standard cannot replace knowledge, skill, or ability acquired through appropriate education, training, and experience is intended for use by competent forensic science practitioners with the requisite formal education, discipline-specific training (see Practice [E2917](#) and should be used in conjunction with sound professional judgment.), and demonstrated proficiency to perform forensic casework.~~

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

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health, safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *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

- [E1386 Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction](#)
- [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](#)
- [E1459 Guide for Physical Evidence Labeling and Related Documentation](#)
- [E1492 Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Science Laboratory](#)

¹ This practice 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, 2017; March 1, 2024. Published July 2017; March 2024. Originally approved in 1990. Last previous edition approved in 2012 as [E1388 – 12](#); [E1388 – 17](#). DOI: [10.1520/E1388-17](#); [10.1520/E1388-24](#).

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.

[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 \(SPME\)](#)

[E2917 Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs](#)

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

[E3197 Terminology Relating to Examination of Fire Debris](#)

~~[E2454](#)~~[E3245 Practice for Preserving Guide for Systematic Approach to the Extraction, Analysis, and Classification of Ignitable Liquids and Ignitable Liquid Residue Extracts from Residues in Fire Debris Samples](#)

[E3255 Practice for Quality Assurance of Forensic Science Service Providers Performing Forensic Chemical Analysis](#)

3. Summary of Practice

3.1 The headspace of an item is sampled, preferably in its original container, for analysis by an appropriate technique (for example, gas chromatography-mass spectrometry). The container may be heated prior to sampling to increase the volatility of any ignitable liquid residues.

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology [E1732](#) and Terminology [E3197](#).

4. Significance and Use

4.1 This practice is intended for use as a sampling technique within a general scheme for the analysis of ignitable liquids and ignitable liquid residues from fire debris samples in accordance with Guide [E3245](#).

4.2 Headspace samples obtained using this practice are screened using a gas chromatograph with a flame ionization detector (GC-FID) or analyzed using a gas chromatograph with a mass spectrometer (GC-MS, refer to Test Method [E1618](#)).

4.3 This practice is most applicable for sampling light to medium range ignitable liquids.^{3, 4, 5, 6} It is not capable of sufficient recovery of heavy range ignitable liquids to support accurate analysis using Test Method [E1618](#).

NOTE 1—When present in high concentrations, highly volatile compounds can saturate the headspace, inhibiting the recovery of less volatile compounds by this practice. This skewed recovery can lead to the detection or identification of only the more volatile compounds in the sample.

4.4 This practice is useful for sampling fire debris to screen for the presence of ignitable liquid residues prior to extraction with other techniques. It is most appropriate for sampling light to medium range ignitable liquids (such as light oxygenates, lacquer thinners, and other similar volatile compounds or products), and less appropriate for sampling ignitable liquids that have compounds in the techniques, such as those described in Practices [E1386](#) heavy, [E1412](#) range-, [E1413](#)-, and [E2154](#)-, and [E3189](#).

4.4.1 When sampled for screening purposes, the instrumentation typically utilized is a gas chromatograph with either a mass spectrometer (GC-MS, refer to ~~This practice is less capable of recovering limited quantities of ignitable liquids than Practices [E1386](#) Test, [E1412](#) Method, ~~[E1618](#)~~[E1413](#)), [E2154](#) or flame, and [E3189](#) ionization detector (GC-FID)-, particularly for heavy range compounds.~~

4.2 This practice is generally less efficient at recovering limited quantities of ignitable liquids than Practices [E1386](#), [E1412](#), [E1413](#), and [E2154](#), particularly for higher boiling compounds.

4.5 The separation takes place in a closed container and the ~~This practice only removes a small aliquot of the headspace vapor~~

³ Ettling, B. V., and Adams, M. F., “The Study of Accelerant Residues in Fire Remains—Study of Accelerant Residues in Fire Remains,” *Journal of Forensic Sciences*, Vol 13, No. 1, 1968, pp. 76–89.

⁴ Stauffer, E., Dolan, J. A., and Newman, R., *Fire Debris Analysis*, Boston, MA: Academic Press, 2008.

⁵ Hinshaw, J. V., “Headspace Sampling,” *LCGC Europe*, Vol 24, No. 10, 2011.

⁶ Evans-Nguyen, K., and Hutches, K. (Eds.), *Forensic Analysis of Fire Debris and Explosives*, Springer Nature Switzerland AG: Cham, Switzerland, 2019.

from a closed container; therefore, the fire debris sample remains in approximately the same condition in which it was submitted. Since only a small aliquot of the sample headspace is removed for analysis, sample reanalysis may be possible. Submitted, and reanalysis using a new headspace sample, or a different sampling technique, is possible. However, removing multiple headspace samples continually reduces the concentration of ignitable liquid vapors, if originally present, and can eventually result in non-recovery by static headspace sampling.

NOTE 2—The headspace sample collected using this practice is consumed in the subsequent screening by GC-FID or analysis by GC-MS.

~~4.4 High concentrations of highly volatile compounds can saturate the headspace, inhibiting the recovery of less volatile components and leading to the detection or identification of only the more volatile compounds in the sample.~~

~~4.5 This practice is intended for use in conjunction with other extraction techniques, such as those described in Practices E1386, E1412, E1413, and E2154, when analysis of a sample for all classes of ignitable liquids is required or desired.~~

NOTE 1—The headspace specimen (the portion in the syringe) is consumed in the analysis. Preserve an extract for potential reanalysis (see Practice E2451) using an alternative separation and concentration practice, such as those described in Practices E1386, E1412, and E1413, if preservation is required per laboratory policies.

5. Apparatus

~~5.1 Heating System—An oven or equivalent, capable of reproducible temperature operation for in the desired range that can accommodate the evidence container. range of 50 °C to 100 °C.~~

~~5.1.1 An oven is recommended to achieve a constant temperature throughout the system.~~

~~5.2 Temperature Measuring Device—A thermometer or thermocouple capable of measuring temperatures in the required range of operation. 50 °C to 100 °C.~~

~~5.3 Disposable or reusable gas-tight syringes, Sampling Syringe—A disposable or reusable syringe capable of reproducibly sampling vapor volumes in the range from 0.5 to 2.0 mL. of 0.1 mL to 2.0 mL.~~

~~5.4 Disposable or reusable syringe needles.~~

~~5.4 Gas-tight vials and caps. Headspace Vials—Gas-tight vials and caps.~~

~~5.5 Puncturing Device—A tool or device capable of creating holes in evidence containers (for example, drill, hole punch, hammer and nail).~~

~~5.6 Tape, rubber sleeve stoppers, or equivalent, capable of sealing holes in evidence containers.~~

6. Quality Assurance and Quality Control

6.1 Verify the practice of static headspace sampling of vapors prior to use on questioned samples utilizing Test Method E1618.

6.1.1 Use a selection of ignitable liquids that together cover the entire range of compounds to be sampled with this practice, a range of concentrations of those ignitable liquids, and ignitable liquids on matrices such as wood and carpet created to simulate common questioned samples.

6.1.2 Maintain records of the verification in accordance with Practice E3255.

6.2 Prepare at least one system blank each day that questioned samples are prepared, using the same conditions that will be used for the questioned samples. Analyze the system blank prior to analyzing questioned samples to demonstrate that the materials and apparatus used are free from contaminants that could interfere with the subsequent analysis and ability to identify ignitable liquids in questioned samples.