



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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

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 is intended for use by competent forensic science practitioners with the requisite formal education, discipline-specific training (see Practice [E2917](#)), 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, 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](#)

[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](#)
[E3245 Guide for Systematic Approach to the Extraction, Analysis, and Classification of Ignitable Liquids and Ignitable Liquid Residues in Fire Debris Samples](#)

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

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](#)).

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 March 1, 2024. Published March 2024. Originally approved in 1990. Last previous edition approved in 2017 as E1388 – 17. DOI: 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.

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, such as those described in Practices **E1386**, **E1412**, **E1413**, and **E2154**, and **E3189**.

4.4.1 This practice is less capable of recovering limited quantities of ignitable liquids than Practices **E1386**, **E1412**, **E1413**, **E2154**, and **E3189**, particularly for heavy range compounds.

4.5 This practice only removes a small aliquot of the headspace vapor from a closed container; therefore, the fire debris sample remains in approximately the same condition in which it was 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.

5. Apparatus

5.1 *Heating System*—An oven capable of reproducible temperature operation in the range of 50 °C to 100 °C.

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

5.3 *Sampling Syringe*—A disposable or reusable syringe capable of reproducibly sampling vapor volumes in the range of 0.1 mL to 2.0 mL.

5.4 *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, 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.

6.2.1 A system blank for static headspace sampling consists of an empty, clean, dry evidence container and the syringe that will be used for sampling.

6.2.2 If analysis of the system blank indicates contamination, review the results from all relevant questioned samples to determine if and how the questioned sample results were affected.

6.2.3 Maintain data from system blanks as a portion of the casework documentation.

6.3 Prepare at least one positive control each day that questioned samples are prepared, using the same conditions that will be used for the questioned samples. Analyze the positive control prior to analyzing questioned samples to demonstrate proper performance of the static headspace sampling technique.

6.3.1 A positive control for static headspace sampling consists of a known volume of reference ignitable liquid applied to a laboratory tissue placed into an otherwise empty, clean, dry evidence container.

6.3.2 If analysis of the positive control indicates a failure in the performance of the static headspace sampling technique, do not analyze questioned samples until the cause of the failure is identified, corrected, and fully resolved.

6.3.3 Maintain data from positive controls as a portion of the casework documentation.

7. Preparation for Sampling

7.1 Follow the applicable procedures for handling and documentation of all submitted samples as described in Guide **E1459** and Practice **E1492**.

7.1.1 Open and examine the fire debris sample to determine that it is consistent with its description.

7.1.2 Resolve any discrepancies between the submitting agency's description of the evidence and the analyst's observation prior to the completion of the report.

7.2 Prepare the evidence container or submitted sample for static headspace sampling.

7.2.1 Use the puncturing device to create a hole in the container lid such that a sampling syringe needle can be introduced. Seal the hole with tape, a rubber sleeve stopper, or equivalent. Alternatively, crack the container lid to allow a sampling syringe needle to be introduced, then close the lid immediately following sampling.

³ Ettling, B. V., and Adams, M. F., "The 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.