



Standard Test Method for Identification of Ignitable Liquids in Fire Debris Analysis by Gas Chromatography-Mass Spectrometry¹

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1. Scope

1.1 This test method covers the identification of ignitable liquids based on interpretation of gas chromatography-electron ionization mass spectrometry (GC-MS) data within the context of fire debris analysis.

1.2 This test method is suitable for data obtained from liquids and extracts recovered from fire debris samples, including those that contain high background levels of substrate materials, pyrolysis products, combustion products, or a combination of these materials.

1.3 This test method is also suitable for the identification of single compounds, simple mixtures, and non-petroleum based ignitable liquids.

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 test method is intended for use by competent forensic science practitioners with the requisite formal education, discipline-specific training (refer to Practice E2917) and demonstrated proficiency to perform forensic casework.*

1.6 *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.*

1.7 *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

- E620 Practice for Reporting Opinions of Scientific or Technical Experts
- E1386 Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction
- 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
- 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) (Withdrawn 2024)³
- E2451 Practice for Preserving Ignitable Liquids and Ignitable Liquid Residue Extracts from Fire Debris Samples
- E2549 Practice for Validation of Seized-Drug Analytical Methods (Withdrawn 2023)³
- E2881 Test Method for Extraction and Derivatization of Fatty Acid-Based Products from Fire Debris and Liquid Samples with Analysis by Gas Chromatography-Mass Spectrometry
- E2917 Practice for Forensic Science Practitioner Training, Continuing Education, and Professional Development Programs
- E2997 Test Method for Analysis of Biodiesel Products by Gas Chromatography-Mass Spectrometry
- 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

¹ This test method is under the jurisdiction of ASTM Committee E30 on Forensic Sciences and is the direct responsibility of Subcommittee E30.13 on Ignitable Liquids, Explosives, and Gunshot Residue (ILEGSR).

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

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

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

E3407 Classification for Ignitable Liquids Encountered in Fire Debris Analysis

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms that can assist in interpreting this test method, refer to Terminology **E1732**, Terminology **E3197**, and Practice **E3255**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *analytical batch, n*—a set of specimens that are analyzed together on the same instrument.

3.2.1.1 *Discussion*—An analytical batch is composed of multiple injections or sequences analyzed within a 24 h period.

3.2.2 *component, n*—a compound, or group of compounds, present in an ignitable liquid.

3.2.3 *diagnostic feature, n*—a component used in the identification of a class of ignitable liquid.

3.2.3.1 *Discussion*—In fire debris analysis, diagnostic features can refer to patterns of components, such as a bell-shaped distribution of peaks, patterns within a distinct carbon range, a homologous series of *n*-alkanes or other hydrocarbons, a series of diagnostic aromatic patterns, or isolated peaks.

3.2.4 *extracted ion chromatogram, n*—a chromatogram drawn from the total ion chromatogram (TIC) using a single *m/z* (mass-to-charge ratio) value.

3.2.5 *fatty acid-based products, n*—ignitable liquids composed of fatty acids refined from plant or animal sources.

3.2.5.1 *Discussion*—These products cover those composed of fatty acids, fatty acid methyl esters (FAMEs), or a combination thereof, and include pure oils that have the potential for self-heating, biofuels, and products made from transesterified fatty acids.

3.2.6 *GC-MS configuration, n*—the complete set of instrument parameters used in the analysis of a specimen including the apparatus settings and operational conditions.

3.2.7 *intergroup ratio, n*—the relative relationship or proportions among different diagnostic features or extracted ion profiles.

3.2.7.1 *Discussion*—Intergroup ratios are evaluated qualitatively based on visual assessment.

3.2.8 *intragroup ratio, n*—the relationship or relative proportions among different components within a diagnostic feature.

3.2.8.1 *Discussion*—Intragroup ratios are evaluated qualitatively based on visual assessment.

3.2.9 *major component, n*—component(s) present with a relative abundance of more than 75 % of the full-scale TIC.

3.3 Abbreviations of Terms Specific to This Standard:

3.3.1 *DF*—diagnostic feature

3.3.2 *EIC*—extracted ion chromatogram

3.3.3 *EIP*—extracted ion profile

3.3.4 *FAME*—fatty acid methyl ester

3.3.5 *GC-MS*—gas chromatography-electron ionization mass spectrometry

3.3.6 *HAP*—heavy aromatic product

3.3.7 *HPD*—heavy petroleum distillate

3.3.8 *LAP*—light aromatic product

3.3.9 *LPD*—light petroleum distillate

3.3.10 *MAP*—medium aromatic product

3.3.11 *MPD*—medium petroleum distillate

3.3.12 *MTBE*—2-methoxy-2-methylpropane (methyl tertiary-butyl ether)

3.3.13 *PNA*—polynuclear aromatic

3.3.14 *PTFE*—polytetrafluoroethylene

3.3.15 *TIC*—total ion chromatogram

3.3.16 *TMB*—trimethylbenzene

4. Summary of Test Method

4.1 The specimen is analyzed using a gas chromatograph (GC) that is interfaced to a mass spectrometer (MS) and a data station capable of storing, processing, and displaying chromatographic and mass spectral data.

4.2 The GC-MS data are evaluated against a set of acceptance criteria to establish their suitability for interpretation.

4.3 Interpretation is based on evaluation of TICs and EIPs characteristic of ignitable liquids as well as mass spectra for the identification of diagnostic features.

4.4 At a minimum, data interpretation for the identification of ignitable liquids requires that the TIC and five major EIPs associated with petroleum-based ignitable liquids (**11.3.3**) are evaluated for visual pattern agreement to a comparable ignitable liquid reference.

5. Significance and Use

5.1 This test method covers procedures for the generation, evaluation, and interpretation of GC-MS data for the identification of ignitable liquids.

5.1.1 This test method is intended for use in conjunction with Classification **E3407** and the quality assurance procedures covered in Practice **E3255**.

5.1.2 This test method uses GC-MS configurations that have been validated in accordance with Practice **E2549** and Practice **E3255**.

5.1.3 Refer to Guide **E3245** for perspective on the use of this test method within the framework of ignitable liquid analysis.

5.1.4 Refer to Practices **E1386**, **E1388**, **E1412**, **E1413**, **E2154**, and **E3189**, and Test Method **E2881** for fire debris sample preparation and extraction procedures.

5.1.5 Refer to Practice **E620** for requirements related to reporting of results.

5.2 The data processing, evaluation, and interpretation techniques described in this test method facilitate the identification