

Department of Forensic Science

TRACE EVIDENCE PROCEDURES MANUAL

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4 **FIRE DEBRIS****4.1 Analytical Approach**

- 4.1.1 Generate one or more Fire Debris Worksheets.
- 4.1.2 Briefly open each container, make a gross visual inspection and record a description of the contents. Do not intentionally smell the contents of the container while observing the contents but do make a notation of any unavoidable odor from the contents.
- 4.1.3 If a nonaqueous liquid is present, test to confirm its nonaqueous nature. A nonaqueous liquid will be immiscible with water and will be noted on the worksheet. A nonaqueous liquid or appropriate water miscible liquid (e.g., alcohols) may be injected directly into the gas chromatograph – mass spectrometer (GC-MS). See Direct Injection procedure, ¶ 4.2. The term “aqueous” applies to those liquids that are miscible with water and will be noted on the worksheet. If not appropriate for direct injection, an aqueous liquid will either be analyzed by the Passive Adsorption-Elution procedure (¶ 4.5) or extracted first by Ambient Headspace analysis (¶ 4.3) followed by the Solvent Extraction procedure (¶ 4.4).
- 4.1.4 It may be necessary to determine if an unknown liquid sustains a flame. This determination would only be necessary when a non-routine or otherwise unusual liquid is encountered. Attempt to ignite a small amount of the liquid on a watch glass in a hood and record the results on the Fire Debris Worksheet.
- 4.1.5 If the sample contains enough ignitable liquid to give an unavoidable strong odor, resists heating (e.g., insulation), or when a distinction is needed between Kerosene and Diesel Fuel, then solvent extraction should be employed. Unless the sample contains enough ignitable liquid to give an unavoidable strong odor or is not packaged in an airtight container, a headspace extraction should be performed before the solvent extraction.
- 4.1.6 If a latent prints examination is requested on a bottle or other container and no nonaqueous liquid is present, a solvent extraction of the interior may be performed using caution while wearing gloves or holding the item with tongs or forceps.
- 4.1.7 Any sample extract vials generated during analysis are returned in the can, or other container, corresponding to their particular item. Any deviation is noted on the Fire Debris Worksheet to include in which container vials that contain combined extracts are being returned.
- 4.1.8 The GC-MS Total Ion Chromatogram (TIC) for case samples is compared to the GC-MS TIC for known reference samples according to retention times and overall patterns. When extracted ion chromatography (EIC), also known as mass spectral ion profiling (MSIP), is applied to case samples and to known reference samples, the patterns that are generated are compared.
- 4.1.9 If data generated from a Passive Adsorption-Elution extraction contains peaks/pattern that may be consistent with a heavy petroleum distillate, then a follow-up Solvent Extraction may be performed.
- 4.1.10 For the analysis of vegetable oil based products, see section 6.11.
- 4.1.11 Safety Considerations
- Intentional inhalation of the odor of the contents of items for fire debris analysis is prohibited due to the potential health concerns related to this activity.
- 4.1.12 Minimum Standards and Controls
- 4.1.12.1 The processing of questioned and known evidence (or samples suspected to contain large amounts of ignitable liquids) must be separated in time and/or space to prevent incidental contamination.

- 4.1.12.2 Carbon disulfide (CS₂) - Each new bottle or lot of carbon disulfide must be tested prior to its use in casework. Approximately 5 ml of the new solvent is evaporated to a few drops. 2 µl of this evaporated solvent is injected into the GC-MS. If the resulting data has no significant peaks which interfere with the analysis, then the solvent is available for use in casework. The data labeling shall include, at a minimum, the manufacturer, lot number, start volume, end volume, the suitability results, the evaluator's initials, and the date of evaluation.
- 4.1.12.3 Pentane (C₅) - Each new bottle or lot of pentane must be tested prior to its use in casework. Approximately 500 ml of the new solvent is evaporated to a few drops. 1-2 µl of this evaporated solvent is injected into the GC-MS. If the resulting data has no significant peaks which interfere with the analysis, then the solvent is available for use in casework. The data labeling shall include, at a minimum, the manufacturer, lot number, start volume, end volume, the suitability results, the evaluator's initials, and the date of evaluation.
- 4.1.12.4 Charcoal strips – Each new lot of charcoal strips must be tested with a positive and negative control prior to their use in casework. The negative control will be eluted as received or halved prior to elution. The positive control will consist of a charcoal strip half suspended in a can spiked with a 1:1 gasoline/kerosene mixture, to reflect a broad range. The negative and positive controls will be extracted and analyzed by the method used in casework. The strips are deemed suitable for casework when the negative control's resulting data indicates no ignitable liquids and the positive control's resulting data shows the presence of a mixture of gasoline and kerosene. The data labeling shall include, at a minimum, the name of control, charcoal strip lot number being tested, positive control reagent lot number (when applicable), the suitability results, the evaluator's initials, and the date of evaluation.
- 4.1.12.5 Paint cans – Paint cans are used by the section for a variety of purposes, such as for analysis of controls, blanks, and for evidence packaging. Each new lot/batch of paint cans must be tested prior to their use in casework. One can from each lot/batch will be tested using the method used in casework. The lot/batch is deemed suitable for casework when the resulting data indicates no ignitable liquids or other interfering patterns are present. The data labeling shall include, at a minimum, the can distributor/vendor, can size and lot or batch number being tested, the suitability results, the evaluator's initials, and the date of evaluation.
- 4.1.12.6 Extract Vials – Each new lot of vials used for fire debris extraction (to include passive adsorption elution and solvent extraction techniques) and whole liquids must be tested prior to their use in casework. Approximately 250 µl of CS₂ will be added to one capped vial and left at room temperature for at least 16 hours. Following injection of the CS₂ into the GC-MS, the data shall be evaluated for suitability. The lot is deemed suitable for casework when the resulting data indicates no ignitable liquids or other interfering patterns are present. The data labeling shall include, at a minimum, the vial manufacturer and lot number being tested, the suitability results, the evaluator's initials, and the date of evaluation.
- 4.1.12.7 Data from carbon disulfide, pentane, charcoal strip, paint can, and vial checks shall be printed and retained pursuant to the Library of Virginia Specific Schedule Number 778-001 (Quality Assurance: Equipment, Standards, and Instruments 200540 series).
- 4.1.12.8 There must be at least one blank between each case sample injected. If the autosampler sequence runs longer than the work day or overnight, the Resolution Test Mixture (RTM) shall be included at the end of the sequence.
- 4.1.12.9 Evidence submitted for fire debris analysis shall be stored in a manner to avoid contamination and minimize degradation.
- 4.1.12.9.1 To minimize degradation, the majority of fire debris evidence will be stored in a flammable-materials refrigerator in their respective sealed metal cans until such

time as they are able to be analyzed. Whole liquids do not need to be refrigerated.

- 4.1.12.9.2 To avoid contamination, large containers (e.g., gasoline containers) or items with a strong petroleum product odor shall be stored in a hood or away from other fire debris evidence.
- 4.1.12.10 Most fire debris evidence packaged in a paint can requires the agency submission of an empty, unused paint can of corresponding size from the same lot/batch to serve as a control.
 - 4.1.12.10.1 The control can will be tested for ignitable liquids as a case Item, and the results will be reported on the Certificate of Analysis. If ignitable liquids are present in the control can(s), any similar product present in any samples would be clearly reported and qualified.
 - 4.1.12.10.1.1 If the control can data exhibits similarities to data from a corresponding sample that requires concentration, then the control can shall also be concentrated.
 - 4.1.12.10.2 Control cans are not required for whole, non-aqueous liquids as the liquid is sampled and analyzed directly from the container. If submitted, a control can corresponding to a can containing whole, non-aqueous liquid should be appropriately addressed on the report (e.g., not analyzed). If no control can was submitted for a whole, non-aqueous liquid, the appropriate disclaimer should be added to the report.
 - 4.1.12.10.3 For fire debris evidence submitted in a non-air-tight container (e.g., clothing in a paper or plastic bag) that is transferred to a DFS provided can for passive adsorption-elution analysis, a control can shall be addressed on the report.
 - 4.1.12.10.4 Occasionally, the submission of a control can is prevented due to insufficient inventory from the same lot/batch. In such instances, the lack of control can shall be addressed on the report.

4.2 Direct Injections

4.2.1 Purpose

When a whole liquid is obtained, a direct injection may be performed. The purpose of a direct injection is to introduce a whole liquid into the GC-MS.

4.2.2 Minimum Standards and Controls

- 4.2.2.1 A small amount, determined by the examiner, should be injected to ensure that the GC-MS is not overloaded.
- 4.2.2.2 If a solvent is used to dilute the sample, then a solvent blank must be included in the case file.
- 4.2.2.3 Precautions should be taken to preserve a portion of untested liquid, which will be returned with the evidence. Given the volatility and sample amount, preservation may require adsorption onto a charcoal strip.

4.2.3 Analytical Procedures

- 4.2.3.1 Whole liquid samples can be injected directly into the gas chromatograph-mass spectrometer (GC-MS).

4.2.3.2 Alternatively, whole nonaqueous liquid samples may be diluted with either pentane or carbon disulfide and injected directly into the GC-MS.

4.2.4 References

4.2.4.1 Midkiff, Charles R. "Arson and Explosive Investigation," Forensic Science Handbook, Volume 1, 2nd Edition, Pearson Education, Inc., 2002, pages 479-524.

4.2.4.2 Stauffer, E., Dolan, J., and Newman, R., Fire Debris Analysis, Burlington, MA, Elsevier, Inc., 2008, pp. 296-354.

4.3 Ambient Headspace

4.3.1 Purpose

If a sample contains highly volatile components, these components will be in the vapor state at room temperature. The purpose of an ambient headspace extraction is to sample volatile components present in the air space above the debris. A portion of this vapor sample is injected directly into the gas chromatograph-mass spectrometer (GC-MS).

Special considerations that should be noted with this extraction technique:

4.3.1.1 May be affected by the presence of water in the sample, particularly if the compound of interest is miscible with water.

4.3.1.2 Produces a disproportionate representation of low boilers (highly volatile) in the headspace i.e., swamping of headspace with more volatile components producing an incomplete pattern OR ignitable liquid mixtures may be masked by the presence of only the most volatile components.

4.3.1.3 Must follow-up with a more comprehensive recovery method such as solvent extraction or adsorption-elution if more complex hydrocarbon mixtures are to be identified.

4.3.2 Minimum Standards and Controls

4.3.2.1 Use a new disposable syringe for each sample and standard injected.

4.3.2.2 A syringe/room air blank must be run prior to each sample. These blank runs must be satisfactory, having no significant peaks in the region of interest, before injecting case samples.

4.3.3 Analytical Procedures

4.3.3.1 Using a disposable syringe that has been flushed with room air, draw off about 1 ml of vapor from the interior of the container.

4.3.3.2 Inject the vapor sample directly into the GC-MS. Generally, the headspace method is used.

4.3.3.2.1 If no significant or identifiable peaks of interest are present continue with another recovery method. Peaks that are considered significant should be pursued, however, if they are not pursued, an explanation shall be recorded in the case notes.

4.3.3.2.1.1 The presence of an oxygenated solvent would be considered significant if it is present at an abundance of at least one order of magnitude above the overall matrix peaks in the chromatograph. If there are no matrix peaks in the chromatograph, the

oxygenated solvent would be significant if it were present at an abundance of at least one order of magnitude above the background.

4.3.3.2.1.2 The examiner may pursue an oxygenated solvent for identification should he/she feel that the presence of the solvent at low levels would be significant to the case. (i.e., Isopropanol is observed at low levels in a case where the investigator states that rubbing alcohol is suspected to have been used as an ignitable liquid.)

4.3.3.2.2 If a peak(s) of interest is present, run a standard(s) using the library search as a guideline.

4.3.3.2.2.1 Inject the vapor sample directly into the polar column GC. A semi-polar column may be used, if necessary.

4.3.3.2.2.2 Inject the appropriate standard(s).

4.3.3.2.2.3 Continue with another recovery method.

4.3.4 References

- 4.3.4.1 ASTM E 1388-17, Standard Practice for Sampling of Headspace Vapors from Fire Debris Samples.
- 4.3.4.2 Caddy B., Smith F. P., Macy J.: Methods of Fire Debris Preparation for Detection of Accelerants: *Forensic Science Review* 3: 57; 1991.
- 4.3.4.3 Midkiff, Charles R. "Arson and Explosive Investigation," *Forensic Science Handbook*, Volume 1, 2nd Edition, Pearson Education, Inc., 2002, pages 479-524.
- 4.3.4.4 Stauffer, E., Dolan, J., and Newman, R., *Fire Debris Analysis*, Burlington, MA, Elsevier, Inc., 2008, pp. 395-399.
- 4.3.4.5 ASTM E 1618-19, Standard Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry.
- 4.3.4.6 Phelps, J. L., Chasteen, C. E., Render, M. M., "Extraction and Analysis of Low Molecular Weight Alcohols and Acetone From Fire Debris Using Passive Headspace Concentration," *Journal of Forensic Sciences*, Vol. 39, No. 1, Jan. 1994, pp. 194-205.

4.4 Solvent Extraction

4.4.1 Purpose

The purpose of a solvent extraction is to remove petroleum products which may be present in the debris. This extract may be concentrated by evaporation, if needed, and a portion injected into the gas chromatograph-mass spectrometer (GC-MS).

Special considerations that should be noted with this extraction technique:

- 4.4.1.1 Many components from the debris are also soluble in pentane and these may interfere with chromatogram interpretation. Generally, solvent extraction is not preferred for the extraction of clothing, leather goods and melted plastics due to these interferences.

4.4.2 Safety Considerations

- 4.4.2.1 Pentane (C₅) should be kept from heat, heat sources and sources of ignition.
- 4.4.2.2 Perform extractions in a fume hood.
- 4.4.3 Minimum Standards and Controls
 - 4.4.3.1 Previously cleaned glassware is rinsed with pentane prior to use.
 - 4.4.3.2 With this procedure, an extraction blank must be obtained at the same time as the debris extraction. Approximately the same volume of pentane decanted off for the extraction should be used for the extraction blank and this extraction blank should be reduced to at least the same approximate volume as the most reduced sample. For example, if 80 ml of pentane is used to extract the debris and only approximately 50 ml is decanted off and the extract is evaporated to 2 ml, then use approximately 50 ml of pentane and evaporate to 2 ml for the extraction blank. Compare the extraction blank to the debris extract(s).
 - 4.4.3.3 If the sample extract is to be concentrated by evaporation, the extraction blank will be evaporated a similar amount. A copy of the extraction blank will be placed in each case file extracted at that time.
- 4.4.4 Analytical Procedures
 - 4.4.4.1 Add pentane to the selected debris. The amount of pentane needed will vary with the amount and kind of debris. Use enough solvent to permit thorough “wetting” of the debris.
 - 4.4.4.2 The debris may be transferred to a beaker, evaporating dish or other suitable container or may be wetted with pentane while inside the original paint can container.
 - 4.4.4.3 As appropriate, the entire sample or a representative portion may be selected for extraction. If only a portion is extracted, a description of the portion selected is recorded in the case notes.
 - 4.4.4.4 If the extraction is performed in a beaker and the debris is flexible/absorbent, a smaller beaker may be used as a plunger to promote removal of the pentane from the debris.
 - 4.4.4.5 If the debris is nonporous, the extraction may be performed by rinsing the surfaces.
 - 4.4.4.6 Decant the pentane, filter and concentrate, as necessary.
 - 4.4.4.6.1 Decant the pentane into an evaporating dish, beaker or other suitable container.
 - 4.4.4.6.1.1 If only pentane is present, Whatman #1 or #1PS filter paper or a Pasteur pipette with a small plug of glass wool may be used.
 - 4.4.4.6.1.2 If two phases are present (i.e., pentane and water), the water may be removed by using Whatman #1PS filter paper or a separatory funnel.
 - 4.4.4.6.1.3 Alternatively, either the solvent layer or the water layer may be removed with a Pasteur pipette.
 - 4.4.4.6.1.4 If filter paper or glass wool is used, filter the extraction blank as well.
 - 4.4.4.6.2 Alternatively, decant the pentane into an Erlenmeyer flask. Place the flask in a dish of warm water or an ultrasonic cleaner and apply a vacuum to a disposable pipette inserted into a rubber stopper in the neck of the flask.

- 4.4.4.6.3 The pentane may be concentrated using a disposable pipette attached to a vacuum line to pull off the vapors above the extract, by using house air with, or without, a microevaporator, or by allowing the uncapped vials to sit in the hood.
- 4.4.4.7 The amount of concentrating (evaporating) will be based on the sample. A strong sample (one which possesses an unavoidable strong petroleum odor) may need little to no evaporation. A sample that is weak (one which does not possess an unavoidable petroleum odor) should be evaporated down to about 1.0 – 0.5 ml.
- 4.4.4.8 Transfer extract to a labeled vial.
- 4.4.4.9 Record in the notes the approximate volume of pentane “in”, the approximate volume of pentane “out” and the approximate volume to which the pentane is reduced for both the case sample(s) and the extraction blank, as appropriate.
- 4.4.4.10 Inject an appropriate volume of pentane into the GC-MS.
- 4.4.4.11 For preservation purposes, adsorb at least a portion of the analyzed extract on a charcoal strip, package appropriately, and return with the evidence.
- 4.4.5 References
- 4.4.5.1 ASTM E 1386-15, Standard Practice for Separation and Concentration of Flammable or Combustible Liquid Residues from Fire Debris Samples by Solvent Extraction.
- 4.4.5.2 Caddy B., Smith F. P., Macy J.: “Methods of Fire Debris Preparation for Detection of Accelerants”: Forensic Science Review 3: 57; 1991.
- 4.4.5.3 Midkiff, Charles R. "Arson and Explosive Investigation," Forensic Science Handbook, Volume 1, 2nd Edition, Pearson Education, Inc., 2002, pages 479-524.
- 4.4.5.4 Stafford, David T. "Fire Investigation. Part II: Laboratory Investigation", Crime Laboratory Digest Vol. 14, No. 1 January 1987.
- 4.4.5.5 Stauffer, E., Dolan, J., and Newman, R., Fire Debris Analysis, Burlington, MA, Elsevier, Inc., 2008, pp. 395-399.

4.5 Passive Adsorption-Elution

4.5.1 Purpose

The purpose of the passive adsorption-elution extraction is to remove volatile compounds, petroleum products and other ignitable liquids which may be present in the debris and put them into a liquid which can be analyzed via gas chromatography-mass spectrometry (GC-MS). Passive adsorption-elution is a headspace concentration method, also referred to as the **charcoal strip method**, which relies on the volatility of ignitable liquids. Volatilized ignitable liquids are removed by heat without a vacuum and are trapped on a charcoal strip. Ignitable liquids are eluted from the charcoal with a solvent (carbon disulfide) and analyzed.

Special considerations that should be noted with this extraction technique:

- 4.5.1.1 Samples containing a large amount of petroleum products can exhibit selective adsorption of the components.
- 4.5.1.2 If a sample resists heating, such as insulation, this extraction method is not preferred.

4.5.1.3 This extraction method may not fully recover petroleum products of low volatility. (i.e., Kerosene and Diesel Fuel cannot be distinguished by this method.) If a heavy petroleum distillate is indicated by the data, a follow-up pentane extraction may be conducted.

4.5.2 Safety Considerations

4.5.2.1 Carbon disulfide (CS₂) is a hazardous chemical with respect to both health and safety and must be handled with extreme care. Avoid physical contact with CS₂. Avoid inhalation of CS₂.

4.5.2.2 CS₂ should be kept from heat, heat sources and sources of ignition.

4.5.2.3 Perform elutions in a fume hood.

4.5.2.4 Care should be exercised when removing cans from ovens. Cans must be allowed to cool to approximately room temperature prior to opening for removal of the charcoal strip.

4.5.3 Minimum Standards and Controls

4.5.3.1 For each day that samples are prepared using this method, an extraction blank will be prepared and extracted in each oven used. To prepare an extraction blank, one pre-cut charcoal strip will be extracted using the same procedure as for the evidentiary samples. A copy of the extraction blank will be placed in each case file extracted that day.

4.5.3.2 If the sample extract is to be concentrated by evaporation, the extraction blank will be evaporated a like amount.

4.5.3.3 Two pre-cut halves of a new charcoal strip are used for every case item: one half for examination purposes, the other for preservation purposes. Strips will be cut using a clean scalpel.

4.5.3.4 Ovens will be regularly checked to ensure they are functioning properly.

4.5.4 Analytical Procedures

4.5.4.1 The sample must be in a metal can or polyethylene terephthalate (PET) can.

4.5.4.2 Suspend two halves of a pre-cut charcoal strip inside the evidence container via a paper clip. Close the container.

4.5.4.3 Lids should be taped down during extraction.

4.5.4.3.1 If a lid does pop up or off, document this in the case file notes and determine if the extraction blank has been affected by this event.

4.5.4.4 Place the can in an oven set at 65 °C for approximately 16 hours.

4.5.4.4.1 Record the oven used for each case sample on the Fire Debris Worksheet.

4.5.4.5 Remove the cans from the oven and allow them to cool, if necessary.

4.5.4.6 Open the lid and remove the suspended strips. Place the strips into separate labeled vials.

4.5.4.7 The vial containing the strip half chosen for preservation will be properly packaged for return with the evidence.

4.5.4.8 To the vial containing the strip half chosen for elution, add CS₂ (generally 250uL or less).

- 4.5.4.9 Inject a portion of the CS₂ extract into the GC-MS.
- 4.5.4.10 If the autosampler is to be used, agitate the vial, and transfer the extraction solution to a labeled autosampler vial fitted with an insert via disposable pipette.
 - 4.5.4.10.1 Autosampler vials should be recapped if further analysis is necessary.

4.5.5 References

- 4.5.5.1 ASTM E 1412-19, Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris by Passive Headspace Concentration with Activated Charcoal.
- 4.5.5.2 Dietz, W.R., "Improved Charcoal Packaging for Accelerant Recovery by Passive Diffusion," *Journal of Forensic Sciences*, Vol. 36, No. 1, Jan. 1991, Pp 111-121.
- 4.5.5.3 Material Safety Data Sheet for Carbon Disulfide.
- 4.5.5.4 Newman, R.T., Lothridge, K. And Dietz, W., "The Use of Activated Charcoal Strips for Fire Debris Extractions by Passive Diffusion Part 1: The Effects of Time, Temperature, Strip Size, and Sample Concentration," *Journal of Forensic Sciences*, Vol. 41, No. 3, May 1996, Pp. 167-176.
- 4.5.5.5 Stauffer, E., Dolan, J., and Newman, R., *Fire Debris Analysis*, Burlington, MA, Elsevier, Inc., 2008, pp. 399-415.

4.6 Gas Chromatography-Mass Spectrometry (GC-MS)

4.6.1 Purpose

Gas Chromatography-Mass Spectrometry (GC-MS) provides a Total Ion Chromatogram (TIC) pattern for the sample as well as the ability to extract patterns for groups of specific ions. Extracted ion chromatography (EIC), or mass spectral ion profiling (MSIP), is especially useful when samples show a high degree of debris interference.

4.6.2 Analytical Procedures

- 4.6.2.1 Each day that the GC-MS is used for case samples, the Resolution Test Mixture (RTM) and the Oxygenate Check Sample (OCS) (1:2:1 acetone, ethanol and methylethylketone in CS₂) must be injected prior to case samples. This will serve as a check of the resolution and proper functioning of the instrument.

- 4.6.2.1.1 See ¶ 14.3.1.3 and ¶ 14.3.1.4 for acceptance criteria.

- 4.6.2.2 Mass Spectral Quality Control

- 4.6.2.2.1 Full scan mass spectral classification of an ignitable liquid: No rigid TIC or Ion Profile match criteria are defined to classify a product. Flexibility is given to the experienced interpreter because rigid criteria can lead to misidentification as well as under-identification. Classification will be based on a number of factors, such as, relative retention times, compounds present, patterns present in the TIC as well as the patterns and relative profile abundances present in the Ion Profiles, contribution from the matrix and literature references.

- 4.6.2.2.2 Whenever possible, the classification of an ignitable liquid product should be based on a comparison of TIC and Ion Profile patterns from the sample and from

an actual reference material. If a reference material is not available, literature references or internal historical data may be used.

- 4.6.2.2.3 The data files for the reference materials used for direct comparison to the samples should be collected within approximately two months of the sample data files. These data files may only be used if no instrument maintenance affecting the RTM acceptance criteria retention times was completed within the approximate two month time period.
- 4.6.2.3 Systematic naming shall be used for standard fire debris methods with the autosampler: AUTF + injection volume + split. Systematic naming shall be used for standard fire debris methods using manual injection: MANF + split.
- 4.6.2.4 The injection volume and split ratio will vary for the AUTF and MANF methods, but the temperature and mass spec acquisition parameters will be the same.
- 4.6.2.4.1 These methods cannot be changed without prior approval of the Chemistry Program Manager.
- 4.6.2.5 Systematic naming and content shall be used for standard fire debris macros.
- 4.6.2.5.1 These macros cannot be changed without prior approval of the Chemistry Program Manager.
- 4.6.2.6 A portion of the extract or whole liquid is injected into the GC-MS.
- 4.6.2.7 A Library Summary Report may be generated to give an indication of the types or classes of compounds present when many peaks are present in the TIC.
- 4.6.2.8 The data handling system is used to extract selected ion chromatograms for each compound type. Two or more characteristic ions are summed to enhance signal-to-noise and decrease interference by extraneous compounds that contain only one of the ions. The following ions are used for the individual classes of hydrocarbons:
- Alkanes: Ions 57, 71, 85, and 99
 Aromatics: Ions 91, 105, 119, 134
 Indanes: 117, 131
 Olefins/Cycloparaffins: 55, 69, 83
 Polynuclear aromatics (PNAs): 128, 142, 156
- 4.6.2.9 Total ion chromatograms and extracted ion chromatograms of the unknown sample are visually compared against the corresponding extracted ion chromatograms from reference samples.
- 4.6.3 References
- 4.6.3.1 ASTM E 1618-19, Standard Guide for Identification of Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry.
- 4.6.3.2 Christy, B., Winters, K., Rossheim, A., Newman, R., Tang, L., "A foundational study of fire debris using quantitative measures of chromatographic features in gasoline and the use of graphical display to demonstrate data sufficiency", *Forensic Chemistry*, 24, 2021.
- 4.6.3.3 Newman, R., Gilbert, M., Lothridge, K. "GC-MS Guide to Ignitable Liquids," CRC Press, 1998, pages 1-5.

- 4.6.3.4 Stauffer, E., Dolan, J., Newman, R. "Fire Debris Analysis," Elsevier, Inc., 2008, pages 235-293.

4.7 Identification Criteria

- 4.7.1 Possible reported results include: No Identification or Identification.
- 4.7.1.1 Used less frequently, but still appropriate in some circumstances, would include: Consistent.
- 4.7.2 No Identification - The sample does not contain sufficient peaks/pattern that correlate to reference patterns on file. The report would generally read: No ignitable liquids were identified in the Item __ extract.
- 4.7.2.1 If the sample contains some peaks/patterns (as indications) of a reference pattern on file, but due to being weak, having interferences, or other factors, no identification is made, a descriptive sentence may be added to the report. This would generally read: However, the data contains some peaks/patterns of a ___ reference sample but, due to being weak, having interferences or other factors, an identification could not be made.
- 4.7.2.1.1 At least one "reason" must be listed in the descriptive sentence.
- 4.7.3 Identification - The sample contains sufficient peaks/pattern correlating to a reference pattern on file. There is no set number assigned to the number of peaks that must correlate. It is the overall patterns that are compared to the reference patterns. The report would generally read: The Item __ extract contained a _____.
- 4.7.4 Consistent – The sample contains peaks/patterns that correspond well to portions of a reference pattern or a combination of reference patterns on file but there is no one reference pattern that correlates in its entirety with the data. The report would generally read: The Item __ extract was consistent with containing a _____.

4.8 Documentation

- 4.8.1 As a minimum, each case file will include:
- A Fire Debris Worksheet(s),
 - One or more full page, landscape format, integrated TIC's covering the entire sample run time for each Item of evidence analyzed,
 - One or more full page, landscape format, integrated TIC's covering the region of interest for each Item of evidence analyzed with pattern at least 75% on scale,
 - Blanks before each Item of evidence analyzed. Either full page, landscape format covering the region of interest at a minimal abundance or, if identifying individual peaks, extracted ions for the individual compounds over the region of interest,
 - One or more sets of EIC's for each Item of evidence analyzed, as appropriate,
 - Data for each reference necessary to support the conclusions,
 - An extraction blank and, as appropriate, a concentrated extraction blank,
 - At least one copy of the daily Resolution Test Mixture and Oxygenate Check Sample integrated TICs,
 - At least one copy of the Polar Check Sample integrated chromatogram or TIC, if a polar column was used, and
 - A Library Search Report for all samples being reported as negative, as appropriate. For example, it would not be necessary to include a Library Search Report for a sample showing no peaks.
- 4.8.2 Each case sample shall be checked at the lowest abundance setting as practicable to ensure that no other patterns are present that should be addressed.

- 4.8.3 The minimum requirements for labeling data are as follows:
- Case Number
 - Item Number
 - Handwritten Examiner's Initials
 - Injection volume (except Auto method)
 - Injection solvent
 - Note if the original sample has been concentrated
 - If the reference has been diluted, note solvent used
- 4.8.4 Blanks shall be printed at the same abundance value as or less than the case sample chromatograms.
- 4.8.5 When identifying single components such as alcohol, acetone, pinene, etc., retention time data for samples and standards are needed from at least the semi-polar or polar GC (or GC-MS) column along with retention time and spectral data from the nonpolar GC-MS column.
- 4.8.6 When identifying normal alkanes or light aromatic products, retention times and mass spectra for the major peaks are necessary.
- 4.8.6.1 At a minimum, retention times and mass spectra should be compared to primary standards. In addition, a minimum of one (1) product from the reference collection should be included as an example of a commercially available normal alkanes or light aromatic product.
- 4.8.6.1.1 If an appropriate commercially available normal alkanes or light aromatic product is available and examined for inclusion in the case file for pattern comparison, only the nonpolar GC-MS retention time data and mass spectra are necessary.
- 4.8.6.1.2 If no appropriate commercially available normal alkanes or light aromatic product is available or if only one or two normal alkanes are present for identification (no pattern exists), retention time data from a second GC system is necessary.
- 4.8.7 For EIC: at a minimum, include the following:
- A single-page, portrait format, printout of a series of five summed extracted ion profiles (EIPs) covering the entire sample/standard run time, including
 - Alkanes (57 + 71 + 85 + 99)
 - Aromatics (91 + 105 + 119 + 134)
 - Indanes (117 + 131)
 - Olefins/Cycloparaffins (55 + 69 + 83)
 - Polynuclear aromatics (PNAs) (128 + 142 + 156)
 - A single page portrait format printout of the series of five summed extracted ion profiles covering the sample/standard run time of interest.
- 4.8.8 When there are indications that gasoline may be present in the data, the Excel Sufficiency Workbook shall be used. The retention time and the background subtracted abundance of the peaks of interest shall be recorded in the appropriate locations of the Sufficiency Workbook. The Retention Time Worksheet and the Sufficiency Graph with the plotted data point will be included in the case file. The generated Sufficiency Workbook shall be saved to the object repository. This workflow is not necessary when there is minimal matrix contribution to the data.
- 4.8.8.1 An identification is made when the data point is plotted in the green section of the Sufficiency Graph and no identification is made when the data point is plotted in the red section of the Sufficiency Graph.

- 4.8.8.2 When the data point is plotted in the yellow section of the Sufficiency Graph, additional documentation justifying the drawn conclusion shall be included in the case file.
- 4.8.9 If GC-FID chromatograms have also been generated, include: one or more chromatograms for each Item of evidence analyzed and each reference necessary to support the conclusions, blanks before each Item of evidence analyzed, and a check sample. Label chromatograms as per ¶ 4.8.3.
- 4.8.9.1 To the maximum extent possible, case samples and references need to be at least 75% on scale or greater in the printed chromatogram.
- 4.8.9.2 Blanks shall be printed at the same mV value or less than the case sample chromatograms

4.9 Report Wording

- 4.9.1 Methods: Techniques utilized in the analysis shall be listed on the report.
- 4.9.1.1 Item _____ was extracted using a passive adsorption-elution technique. The Item _____ extract was examined using Gas Chromatography-Mass Spectrometry (GC-MS).
- 4.9.1.2 Items _____ and _____ were extracted using a passive adsorption-elution technique. The Item _____ and _____ extracts were examined using Gas Chromatography-Mass Spectrometry (GC-MS).
- 4.9.1.3 Item _____ was extracted using ambient headspace and solvent techniques. The Item _____ extracts were examined using Gas Chromatography (GC) and Gas Chromatography-Mass Spectrometry (GC-MS).
- 4.9.2 If a container is submitted and not described with any detail in the item description, then provide this information in the Results.
- 4.9.2.1 For example: Item 1 White plastic bottle. RESULTS AND INTERPRETATIONS: Item 1 was commercially labeled, “Safeway Charcoal Lighter...32 FL OZ”.
- 4.9.2.2 In some instances it may be more appropriate to report that Item 1 was commercially labeled in part... or that the Item 1 bottle was melted and charred and the only legible labeling read...
- 4.9.2.3 When the liquid from the container or the extract of the container is determined to be consistent with what would be its expected use: ...consistent with the Item _____ product as labeled; consistent with the contents label on Item _____; consistent with the labeling on the Item _____ container.
- For example: Item 1 White plastic bottle RESULTS AND INTERPRETATIONS: Item 1 was commercially labeled, “Safeway Charcoal Lighter...32 FL OZ”. The Item 1 liquid was identified as a medium petroleum distillate which is consistent with the labeling on the Item 1 container.
- Or: Item 5 Bottle of Lamplight Farms Cherry Lamp Oil RESULTS AND INTERPRETATIONS: The Item 5 extract contained a medium naphthenic-paraffinic product consistent with the product as labeled.
- 4.9.3 Results and Interpretations:

- 4.9.3.1 For no identification (ID):

4.9.3.1.1 No ignitable liquids were identified in the Item _____ extract.

4.9.3.1.2 No ignitable liquids were identified in the Item _____ or _____ extracts.

- 4.9.3.1.3 No ignitable liquids were identified in the extract of the Item _____ aqueous liquid.
- 4.9.3.1.4 No ignitable liquids were identified in the Item ___ extract. However, the data contained some peaks/patterns of a _____ reference sample but, due to being weak, having interferences, or other factors, an identification could not be made.
- 4.9.3.2 For No Conclusion Reached:
- 4.9.3.2.1 In some circumstances, a definitive conclusion cannot be reached as to the absence or presence of an ignitable liquid. A report wording example:
- Items 1 and 2 were extracted using a passive adsorption-elution technique. During this extraction, the metal cans containing each item opened; therefore, no conclusion could be reached as to the results of these extracts.
 - The Item C container did not remain airtight during the passive adsorption-elution extraction. Therefore, no conclusion could be reached on the passive adsorption-elution extraction data.
- 4.9.3.3 For IDs:
- 4.9.3.3.1 Generally speaking, the ignitable liquid classification categories reported are based on ASTM E1618. With the exception of gasoline, these classes are further classified as light, medium or heavy based on n-alkane (boiling) range. A light product is generally n-C4-n-C9, a medium product is generally n-C8-n-C13, and a heavy product is generally n-C9-n-C20+. A product may also be classified as “light to medium” or “medium to heavy” as appropriate. The ignitable liquid classification categories are as follows:
- Gasoline,
 - Petroleum Distillates (Light, Medium or Heavy),
 - Isoparaffinic Products (Light, Medium or Heavy),
 - Aromatic Products (Light, Medium or Heavy),
 - Naphthenic-Paraffinic Products (Light, Medium or Heavy),
 - Normal-Alkanes products (Light, Medium or Heavy),
 - Oxygenated Solvents, and
 - Miscellaneous products (Light, Medium or Heavy).
- Heavy Oil/Lubricant petroleum products may also be reported. This classification is generally not considered ignitable and is not covered under ASTM 1618.
- 4.9.3.3.1.1 A minimum of two (if possible) and maximum of three (if necessary) examples of commercial products would typically be listed for most of the above ignitable liquid classifications. The examples used most routinely for medium petroleum distillates are some mineral spirits, paint thinners and charcoal starter fluids. The commercial products used as examples for Heavy Petroleum Distillates include Kerosene and/or Diesel Fuel as appropriate.
- 4.9.3.3.2 The Item _____ extract contained _____.

- 4.9.3.3.3 The Item _____ extract contained _____ which can be found in, but is not limited to, some _____ (give examples of general product types).
- 4.9.3.3.4 The Item _____ and _____ extracts each contained _____.
- 4.9.3.3.5 The Item _____ extract contained a mixture of _____ and _____.
- 4.9.3.3.6 The Item _____ and _____ extracts each contained a mixture of _____ and _____.
- 4.9.3.3.7 The combined Item _____ and _____ extracts contained a mixture of _____ and _____.
- 4.9.3.3.8 The combined Item _____ and _____ extracts contained a mixture of _____ and _____. The _____ can be found in, but is not limited to, some _____ (give examples of general product types).
- 4.9.3.3.9 Certain types of debris (such as leather, newsprint, and carbonless copy paper) are known to give petroleum product patterns on GC-MS. When this type of debris is analyzed and a petroleum product is identified, the following statement should be used:

It should be noted that some _____ (e.g., leather goods) may contain _____ (e.g., heavy petroleum distillates).

4.9.3.4 For liquids:

- 4.9.3.4.1 The Item _____ liquid was identified as _____.
- 4.9.3.4.2 The Item _____ and _____ liquids were each identified as _____.
- 4.9.3.4.3 If an aqueous liquid is encountered:
The extract of the Item _____ aqueous liquid contained _____.
- 4.9.3.4.4 If applicable, an aqueous and a nonaqueous liquid may be described as “immiscible”.

Item # Two immiscible liquids

RESULTS AND INTERPRETATIONS:

The Item _____ nonaqueous liquid was identified as _____.

The Item _____ aqueous liquid consisted essentially of _____. or,
The extract of the Item _____ aqueous liquid contained _____.

4.9.3.5 For heavy oil/lubricant petroleum products:

- 4.9.3.5.1 Due to the nature of heavy oil/lubricant petroleum products, there is some flexibility in how they may be reported.

The Item _____ extract was consistent with containing a heavy oil/lubricant petroleum product. Consistent with means that the data contained peaks/patterns that corresponded well to portions of a reference pattern or a combination of

reference patterns on file but there was no one reference pattern that correlated in its entirety with the data.

- 4.9.3.5.2 If physical properties of a heavy oil/lubricant petroleum product are also present:

The Item _____ extract contained a heavy oil/lubricant petroleum product.

The Item _____ extract contained gasoline and was physically and chemically consistent with containing a heavy oil/lubricant petroleum product. Chemically consistent with means that the data contained peaks/patterns that corresponded well to portions of a reference pattern or a combination of reference patterns on file but there was no one reference pattern that correlated in its entirety with the data.

- 4.9.3.6 For wood and/or turpentine:

- 4.9.3.6.1 When data suggests compounds present in both wood and turpentine and wood is present or may be present in an item, the examiner may identify the α -pinene and report as follows:

The Item _____ extract contained α -pinene. It should be noted that α -pinene occurs naturally in some woods and is also found in turpentine and some cleaning products.

- 4.9.3.6.1.1 If more than one terpene is identified, either list the individual compounds identified or use the word terpenes [e.g., The Item _____ extract contained terpenes. It should be noted that terpenes (or list the individual compounds) occur naturally in some woods and are also found in turpentine and some cleaning products.]

- 4.9.3.6.2 When data suggests compounds present in turpentine and the item is a whole liquid, then report as follows:

The Item _____ liquid was physically and chemically consistent with turpentine (a medium miscellaneous product).

- 4.9.3.6.3 When data suggests compounds present in turpentine and no wood is present and the item is an extract, then report as follows:

The Item _____ extract contained _____ (terpenes or list individual compounds). It should be noted that terpenes (or list the individual compounds) occur naturally in some woods and are also found in turpentine and some cleaning products.

- 4.9.3.7 For normal alkanes:

- 4.9.3.7.1 When reporting normal-alkanes products when a commercially available product is available:

The Item _____ extract contained a (light, medium or heavy) normal-alkanes product which can be found in, but is not limited to, some lamp oils.

- If physical properties of wax are also present:

Item _____ contained a paraffin wax.

4.9.3.7.2 When reporting normal alkanes when no commercially available product is available or if only one or two normal alkanes are identified, the individual alkanes should be listed on the report.

The Item _____ extract contained a mixture of undecane and dodecane (normal alkanes).

4.9.3.8 For volatiles analysis (e.g., ethanol, acetone, toluene):

4.9.3.8.1 The Item _____ liquid/extract contained _____ (e.g., methanol, ethanol, isopropanol, acetone) (an oxygenated solvent).

4.9.3.8.2 The Item _____ liquid consisted essentially of _____ (e.g., methanol, ethanol, isopropanol, acetone) (an oxygenated solvent).

4.9.3.8.3 No oxygenated solvents or other ignitable liquids were identified in the Item _____ extract.

4.9.3.8.4 No alcohols or other ignitable liquids were identified in the Item _____ extract.

4.9.3.8.5 No ethanol was identified in the Item _____ extract.

4.9.3.8.6 No ethanol or other ignitable liquids were identified in the Item _____ extract.

4.9.3.8.7 No ignitable liquids were identified in the Item _____ extract.

4.9.3.8.8 If appropriate, common sources of the compound may be included:

Item 1 consisted essentially of isopropanol (an oxygenated solvent), commonly referred to as rubbing alcohol.

4.9.3.9 For comparisons:

4.9.3.9.1 Generally speaking, when a comparison between items has been requested and the result is implied, then no specific mention of the comparison is made in the CoA.

4.9.3.9.1.1 The results for both items are the same classification, e.g., Items 1 and 2 contain gasoline; therefore, it is implied that they could have had a common origin.

4.9.3.9.1.2 The results for both items are a different classification, e.g., Item 1 contains gasoline and Item 2 contains a medium isoparaffinic product; therefore, it is implied that they could not have had a common origin.

4.9.3.9.2 Upon occasion it may be necessary to include a statement regarding the comparison of samples. The results of the comparison, an appropriate conclusion statement, and level of association shall be reported with a "Terminology Key for Comparative Examinations" on the Certificate of Analysis. For example:

4.9.3.9.2.1 The Item _____ liquid was identified as acetone (an oxygenated solvent) and is consistent with the labeling on the can. Therefore, Item _____ was eliminated as a possible source of the Item _____ light petroleum distillate due to differences in chemical composition (**Exclusion/Elimination**).

4.9.3.9.2.2 The Item ____ liquid was identified as _____ (results). Item _____ could not be associated with the Item ____ extract due to differences in chemical composition (**Exclusion/Elimination**).

4.9.3.10 For napalm:

4.9.3.10.1 When a homemade napalm material is received, in addition to the petroleum product, the identity of the added material should be pursued.

4.9.3.10.2 The Item _____ extract contained gasoline. Additionally, Item _____ was physically and chemically consistent with containing _____. (e.g., polystyrene, soap)

4.9.3.10.3 The following statement may also be added: It should be noted that some mixtures of gasoline and _____ (e.g., polystyrene, soap) may be referred to as “napalm”.

4.9.3.11 For reporting controls:

4.9.3.11.1 When the control pattern is seen in case samples (product examples are optional under this scenario):

4.9.3.11.1.1 The Item 1 and 2 (control can) extracts each contained a light aromatic product. Therefore, the packaging cannot be excluded as the source of the light aromatic product.

4.9.3.11.1.2 The Item 1 and 2 (control can) extracts each contained a light aromatic product, which can be found in, but is not limited to, the cans used as containers and adhesive removers.

4.9.3.11.1.3 Optionally, when the concentration of the ignitable liquid pattern in the Item is much higher than the concentration present in the control can:

Based on the relative concentration, the packaging, as represented by Item 3, was excluded as the source of the gasoline identified in Items 1 and 2.

4.9.3.11.2 When different Ignitable Liquids are identified in the control and case samples:

The Item 1 extract contained gasoline.

The Item 2 (control can) extract contained a light aromatic product. The packaging, as represented by Item 2, was excluded as the source of the gasoline identified in Item 1.

4.9.3.11.3 When control sample shows an Ignitable Liquid that is not seen in the case samples (No ID):

No ignitable liquids were identified in the Item 1 or 2 extracts.

The Item 3 (control can) extract contained a light aromatic product.

4.9.3.11.4 When the controls are negative and an Ignitable Liquid is identified in the case sample:

- The Item 1 extract contained gasoline.

No ignitable liquids were identified in the Item 2 (control can) extract. The packaging, as represented by Item 2, was excluded as the source of the gasoline identified in Item 1.

- The Item 1 extract contained a medium petroleum distillate which can be found in, but is not limited to, some mineral spirits, paint thinners, and charcoal starter fluids.

No ignitable liquids were identified in the Item 2 or 3 (control) extracts. The gauze, as represented by Item 2, and the packaging, as represented by Item 3, were excluded as the source of the medium petroleum distillate identified in Item 1.

4.9.3.11.5 Same Ignitable Liquid in control and sample, plus another Ignitable Liquid in the sample:

The Item 1 extract contained a medium petroleum distillate which can be found in, but is not limited to, some charcoal starter fluids and paint thinners.

The Item 1 and 2 (control can) extracts each contained a light aromatic product.

The packaging, as represented by Item 2, was excluded as the source of the medium petroleum distillate identified in Item 1, but cannot be excluded as the source of the light aromatic product.

4.9.3.11.6 Control(s) and Items are negative:

No ignitable liquids were identified in the Item 1, 2, or 3 extracts.

4.9.3.11.7 When there is no control can submitted:

- It should be noted that no control can was submitted for analysis.
- It should be noted that no control can was submitted for Items 1, 2, and 3.
- For whole, non-aqueous liquids: While no control can was submitted for Item 1, it should be noted that no control can was needed or necessary for analysis.
- For items submitted in non-air-tight containers and later transferred into a DFS can for analysis: The packaging containing Item 1 was not airtight. It should be noted that ignitable liquids are volatile and airtight packaging is required to prevent loss. Item 1 was transferred to a laboratory provided airtight can for analysis. One can from the same lot/batch of laboratory provided cans was previously analyzed, served as a control can, and was found to contain no ignitable liquids. Therefore, the re-packaging of Item 1 was excluded as the source of the (ignitable liquid class) identified in Item 1.

4.9.3.11.8 Control can is physically different from the evidence cans:

Item 2 (control can) could be distinguished from the can containing Item 1 based on manufacturing characteristics; therefore, Item 2 could not serve as the control can for Item 1. Item 2 was not further examined.

4.9.4 Full Report Wording Examples – Fire Debris

4.9.4.1 Example 1

Item 1	Fire debris from couch
Item 2	Fire debris from living room floor
Item 3	Control can

METHODS:

Items 1, 2, and 3 were extracted using a passive adsorption-elution technique. The Item 1, 2, and 3 extracts were examined using Gas Chromatography-Mass Spectrometry (GC-MS).

RESULTS AND INTERPRETATIONS:

The Item 1 extract contained gasoline.

No ignitable liquids were identified in the Item 2 or 3 extracts. The packaging, as represented by Item 3, was excluded as the source of the gasoline identified in Item 1.

The evidence is being retained for personal pickup.

4.9.4.2 Example 2

Item 12	Carpet and padding from living room
Item 13	Carpet and padding from dining room
Item 14	Carpet and padding from bedroom
Item 15	Liquid from red plastic container on porch
Item 16	Control can

METHODS:

Items 12 through 14 and Item 16 were extracted using a passive adsorption-elution technique. Item 15, the Item 16 extract, and the Item 12 through 14 extracts were examined using Gas Chromatography-Mass Spectrometry (GC-MS).

RESULTS AND INTERPRETATIONS:

The Item 15 liquid was identified as gasoline.

No ignitable liquids were identified in the Item 12 or 13 extracts. However, the Item 12 and 13 data contained some peaks/patterns of a gasoline reference sample but, due to being weak, having interferences, or other factors, an identification could not be made.

The Item 14 extract was consistent with containing a heavy oil/lubricant product. Consistent with means that the data contained peaks/patterns that corresponded well to portions of a reference pattern or a combination of reference patterns on file but there was no one reference pattern that correlated in its entirety with the data.

No ignitable liquids were identified in the Item 16 extract. The packaging, as represented by Item 16, was excluded as the source of the gasoline identified in Item 15, the peaks/pattern seen in the Item 12 and 13 data, and the heavy oil/lubricant product identified in Item 14.

The evidence is being retained for personal pickup.

4.9.4.3 Example 3

Item 6	Liquid from plastic bottle
Item 7	Shirt from victim
Item 8	Control can

METHODS:

Item 6 was examined using a miscibility test and Gas Chromatography-Mass Spectrometry (GC-MS). Items 7 and 8 were extracted using a passive adsorption-elution technique. The Item 7 and 8 extracts were examined using Gas Chromatography (GC) and GC-MS.

RESULTS AND INTERPRETATIONS:

The Item 6 liquid was identified as a medium petroleum distillate which can be found in, but is not limited to, some mineral spirits, paint thinners, and charcoal starter fluids.

The Item 7 extract contained isopropanol (an oxygenated solvent), commonly referred to as rubbing alcohol.

The Item 8 extract contained a light aromatic product. The packaging, as represented by Item 8, was excluded as the source of the isopropanol identified in Item 7.