
Physical Evidence Bulletin

FIRE DEBRIS and IGNITABLE LIQUID EVIDENCE

Introduction

Evidence submitted for ignitable liquid analysis is examined specifically for the presence or absence of ignitable liquids. An ignitable liquid is a liquid or liquid phase of any material that is capable of fueling a fire. This includes a flammable liquid, combustible liquid, or any material that can be liquified and burned. Ignitable liquids can include single compounds, mixtures, petroleum-based products and non-petroleum-based products. If an ignitable liquid is detected, the report will usually provide the type of ignitable liquid and examples of products that may contain that type of ignitable liquid. This list should not be considered all-inclusive.

The term accelerant is not synonymous with ignitable liquid. An accelerant is any material used to initiate or promote the spread of a fire. An ignitable liquid may be an accelerant, but this depends on its intended use. The identification of an ignitable liquid does not necessarily lead to the conclusion that the liquid was used as an accelerant. There may be a legitimate reason for the presence of the ignitable liquid, or it may be inherent to the substrate material.

The absence of a detectable quantity of an ignitable liquid does not preclude the possibility that an ignitable liquid was present at the scene and consumed in the fire, environmentally altered, or otherwise indistinguishable from the substrate. In addition, the volatility of ignitable liquids, the solubility of some types of liquid in water, and various sampling techniques may cause an ignitable liquid not to be captured.

This analysis is limited to the presence or absence of an ignitable liquid. It does not identify what an unknown substance is.

Ignitable liquids are volatile and easily lost through evaporation. The evidence samples should be collected, stored, and transported in such a way to prevent loss and contamination. Samples should be collected as soon after the incident as possible in air-tight containers and must not be dried prior to packaging. Evidence items that are handled or packaged improperly may not be examined.

The Physical Evidence Bulletin (PEB) is a guideline intended as a resource for law enforcement agencies and fire departments for the collection and submission of evidence to BFS Laboratories. Physical Evidence Bulletins are not intended to be used in lieu of training in the collection of evidence.

Contact a BFS laboratory for specific case questions or additional information.

Scope of Testing

Refer to the current *Certificate of Accreditation* issued to BFS by the ANSI National Accreditation Board (ANAB), to obtain a list of BFS laboratories that are accredited to conduct various testing types (Certificate # FT-0334).
<https://search.anab.org/>

Based upon the BFS Scope of Accreditation, BFS offers the following types of accredited examination types for the Fire Debris discipline:

- **Qualitative Determination (Fire Debris)** – The identification of ignitable liquids from fire debris or other samples.

BFS does **NOT** perform the following examination types:

- Explosives

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Safety

Scenes and evidence can be the source of various hazards, including biological, chemical, physical, and environmental hazards. Appropriate safety precautions and personal protective equipment (PPE) are recommended to be utilized for both the wearer's safety and to protect the integrity of the evidence. PPE may consist of but is not limited to, gloves, protective clothing, masks, eye protection, and respiratory equipment.

Preliminary Considerations

- In addition to ignitable liquid examination, evidence in a fire investigation may be suitable for other types of analysis. Common evidence to consider are explosives, latent prints, toolmarks, broken glass, shoe/tire prints, bloodstains, saliva, DNA, and trace evidence. Different types of evidence may require different conditions for handling, preservation, and packaging. One type of packaging may be detrimental to another type of evidence. Refer to the Physical Evidence Bulletins for collection and preservation of other types of physical evidence. Consult your regional laboratory for any case-specific recommendations. **Note: DNA or other analyses are performed on a case-by-case basis and may not be performed in all circumstances.**
- Sample selection: Location and properties of a material should be considered when collecting samples. Some examples of areas to consider:
 - Volatile liquids may burn off from the center of highly burned areas, so edges of these areas may have more of the liquid remaining.
 - Liquids naturally flow by gravity and path of least resistance, so lower areas or areas where liquids can pool may retain more of the ignitable liquid.
 - Absorbent materials, such as carpet padding or upholstery padding, may soak up and retain more of the ignitable liquid.
 - Liquids may be found in protected areas such as under furniture, under flooring, or soaked into lower layers
- Evidence collected for ignitable liquid analysis may be in liquid form or residue on solid items.
- Comparison samples, which are unused collection tools (ex: gauze), packaging (ex: a new lot of metal cans or a heat-sealable bag), or solid substrates (ex: carpet) believed to be free of ignitable liquids may also be recommended. See specific sections below for more information.
- Contamination Prevention:
 - Use clean disposable gloves for collecting items. Change gloves between collection of unrelated items of evidence or more frequently when they become soiled.
 - Use clean disposable tools for collecting items. Alternatively, multiple-use tools may be used if they are thoroughly cleaned between samples. Avoid using a cleaning solvent/solution that may contain a product that is an ignitable liquid or could have a contaminant that interferes with ignitable liquid analysis. If you are unsure about your cleaning solution or process, consult your regional laboratory.
 - Collection gloves, evidence markers, disposable tools, etc. should not be put in any container that contains a sample to be analyzed. These items could interfere with the analysis and interpretation of the results.
 - DNA evidence has specific precautions for contamination prevention. Refer to PEB 4 Biological Materials for DNA Analysis

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Evidence Collection and Packaging

Evidence must be appropriately identified and packaged in clean, unused, air-tight containers impermeable to ignitable liquid solvents. Packaging containers should be free from residual liquids or oils from the manufacturing process that would interfere with ignitable liquid analysis. Containers should be of sufficient size to loosely hold the contents without a very large amount of unused space, while also not filling the container more than two-thirds full. Lids must fit properly and be securely affixed. Heat-seals need to be complete with no gaps or holes in the seal. It is recommended to keep a variety of containers in several sizes on hand.

Solids (examples: debris, wood, plastic, carpet, soil, other material):

- Collect evidence in clean unused airtight containers such as metal cans, glass jars, or heat-sealed bags recommended for fire debris (e.g. nylon or heat-sealable polyester bags that are designed for fire debris) and securely seal.
- Contact a BFS laboratory for questions regarding the use of heat-sealable bags. Heat-sealable bags can be checked in advance for the presence of any interfering components by the laboratory. Alternatively, submit an empty heat-sealable bag as a comparison sample (“control”).
- Avoid using plastic containers, plastic bags, paper bags, or other non-airtight packaging; they are porous to ignitable liquids and could cause ignitable liquid to be lost.
- Use an appropriately sized container for the amount of evidence material. Fill container to maximum of two-thirds full. Do not fill to the top and do not pack down the contents.
- **CAUTION - SOIL SAMPLES:** Soil samples may contain microbes that degrade ignitable liquids. These samples need to be stored frozen or transported to the laboratory as soon as possible
- **Collect comparison substrate samples** that have similar materials as the questioned samples (such as carpets, drapes, upholstery, soil, wood, etc.) and are not suspected of containing an ignitable liquid as they may aid in providing information to the laboratory analyst regarding what is normally present in a specific substrate material.
 - A comparison sample may be collected from an area adjacent to the area where the evidence is collected (Examples: From a protected area in the same room as the fire origin; from the room next to the fire origin; or from outside of a clearly defined pour pattern) and should be uncontaminated by the suspected flammable liquid.
 - If available, burned comparison substrate samples collected away from the ignition source are preferred.
 - Place each comparison sample in a separate airtight container (recommended for fire debris). If possible, use the same type of container that the questioned sample was collected in (see above).
 - The outer packaging should be clearly marked as a comparison sample.

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Liquids (examples: containers of liquid, standing pools of liquid, or other liquid source):

- Liquid samples can be collected with clean, unused syringes, eye droppers, pipettes or similar device. Liquid samples should be packaged in clean unused airtight glass jars (e.g. Qorpak® bottles), in small metal cans, or the original container (if small amount). Glass vials/jars are preferred, and Teflon lined lids are recommended. A secondary outer container, such as a heat-sealed bag, is recommended to help contain liquid in the event of leakage.
- BFS laboratories will not accept large quantities of liquid. For large quantities, a maximum of one ounce sample should be taken and submitted.
- Avoid freezing liquids in glass containers. Some liquids are aqueous and freezing may result in expansion of the sample and cause the glass container to break.
- Containers present at the fire scene could have water present from fire suppression or other causes. Water and ignitable liquid frequently do not mix and may result in a two-layered liquid. (Similar to an oil-and-vinegar-based salad dressing.) Make sure to collect a representative sample of both layers if present.
- If liquid is present that cannot be sampled into a container, the liquid can be soaked up onto an absorbent material, like a gauze pad or cotton ball. Submit a comparison sample of unused absorbent material in a separate container.

Clothing items:

- Clothing items should be collected as soon as possible after the incident and not dried. The items should be packaged in clean unused airtight containers such as metal cans, glass jars, or heat-sealed bags recommended for fire debris (e.g. nylon or heat-sealable polyester bags that are designed for fire debris) and securely sealed.
- Package individual clothing items into separate containers (i.e. pants, shirt, shoes, jacket, etc.).
- Each item should be loosely placed in the container and not tightly rolled or folded. Containers should be no more than two-thirds full.
- Generally, only outer layers of clothing should be submitted (i.e. not underwear) unless case circumstances demonstrate a potential for ignitable liquids to be on these layers.

Molotov cocktails:

- Package flammable liquid and wick separately from the bottle, jar, or glass fragments. If there is no visible liquid, the wick remains are more likely to contain residue than the glass. Liquid should be packaged like the liquids described above and the wick should be packaged like the solid samples described above.
- If fingerprint examination is desired, the glass should be stored so it can dry out rapidly. Fingerprints are dissolved by flammable liquids.
- If there is insufficient liquid, seal the glass in an airtight container as described in the solids section above. Separate the larger pieces, which are most likely to contain latent prints for drying and fingerprint processing. If there is not enough glass to process for both prints and for liquid analysis, a decision must be made as to which of the processes to sacrifice.
- Dry portions of the wick can be preserved for DNA analysis or Trace Evidence analysis; this would be analyzed at the discretion of the laboratory.

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Evidence Storage

- If possible, store evidence items in a refrigerator or freezer. Avoid storing this evidence in a warm environment.
- Submit evidence to the laboratory as soon as possible. Metal cans that contain debris with water present can rust through which can cause ignitable liquids to be lost.
- If latent print analysis is required in addition to an examination for ignitable liquids, the item of evidence should be kept at room temperature. Avoid refrigeration or freezing.
- Freeze soil samples as soon as possible to prevent microbial degradation or transport items containing soil to the laboratory as soon as possible. Freezing of the sample is preferred to preserve the integrity of the evidence.
- CAUTION: If DNA analysis is requested, in addition to ignitable liquids examination, DNA samples should be preserved as soon as possible and stored in non-airtight packaging appropriate for DNA. Note if the entire sample is stored in non-airtight packaging, ignitable liquids will evaporate and be lost. Such storage will most likely preclude ignitable liquid analysis. It may or may not be possible to perform both types of examination on the same evidence. Consult with your regional BFS laboratory if needed.

Evidence Submittal

- Label the container with the agency case number, item number, and brief description as appropriate. Tape seal or heat seal the container; date and initial the seal. Submit evidence to the laboratory along with a completed *Physical Evidence Submission Form (BFS-1)* and a case report or case summary.
- Evidence submission to the laboratory in-person is recommended; however, if evidence must be shipped to the laboratory, be aware of commercial courier shipping restrictions.
- Some types of cases may require pre-approval to submit evidence. Contact your regional BFS laboratory for more information.

Contact Information

Please contact your regional BFS laboratory with any further questions that you may have.

- **For a list of regional laboratories please go to:**
<https://oag.ca.gov/bfs/services>
- **To locate the most current Physical Evidence Bulletins please go to:**
<https://oag.ca.gov/bfs/peb>

References

Additional resources to consider:

- National Fire Protection Association (NFPA) 921 Guide for Fire and Explosion Investigations.
- Almirall, J. R., & Furton, K. G. (Eds.). (2004). *Analysis and Interpretation of Fire Scene Evidence*. CRC Press.
- Icove, David J. and Haynes, Gerald A. (Eds) (2017). *Kirk's Fire investigation*. Pearson Education, Inc.
- Stauffer, E., Dolan, J. A., Newman, R., (2008). *Fire Debris Analysis*. Academic Press.
- "Strengthening Fire and Explosion Investigation in the United States: A Strategic Vision for Moving Forward"; NIST Organization of Scientific Area Committees (OSAC) Fire & Explosion Investigation Subcommittee.
<https://www.nist.gov/adlp/spo/organization-scientific-area-committees-forensic-science/osacs-fire-explosion-investigation>
- ASTM International Standard: E1188 Standard Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator.
- ASTM International Standard: E1459 Standard Practice for Physical Evidence Labeling and Related Documentation