INDIANAPOLIS-MARION COUNTY FORENSIC SERVICES AGENCY

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EVIDENCE SUBMISSION GUIDELINE #4

FORENSIC ANALYSIS OF FIRE DEBRIS RESIDUES

INTRODUCTION

A fire investigation is an unenviable task. The devastation, charred debris, collapsed structures, water soaked ashes, together with the smoke and stench, makes the task uninviting and seemingly impossible. The basic role of an investigator at a fire scene is twofold: firstly to determine the origin of the fire (the site where the fire began), and secondly to examine closely the site of origin to try and determine what it was that caused a fire to start at or around that location. An examination would typically begin by trying to gain an overall impression of the site and the fire damage; this could be done at ground level or from an elevated position. From this, one might proceed to an examination of the materials present, the fuel load, and the state of the debris at various places.

Fire debris is a general term used to define the materials collected from a fire scene for laboratory examination. When a fire investigator suspects that a fire might have been deliberately set using accelerants such as ignitable liquids, it is possible to collect and analyze fire debris to see if such products are present. Combustion requires three elements — heat, oxygen, and fuel. Fire will be extinguished when any one of these three elements is absent. Fire does not burn solids or liquids (in general), but rather the gases formed above them. Heat acts to vaporize the liquid or solid, converting it to a gas which then combines with oxygen to “burn” above the liquid pool. Thus, when flammable liquids soak into material or run into “cracks” there will be insufficient oxygen to support combustion. In these cases residue of ignitable liquids can be collected.

A. THE SCENE

1. Often the ignitable liquids are poured in more than one place to be certain that “everything will go.” Multiple points of origin are typical.
2. An arsonist on occasion will use more than enough liquid accelerant to be sure he has plenty. This means that some can remain for the careful investigator.

B. LOCATING THE EVIDENCE

The search for the fire's origin should be based on elementary rules such as:·

- Fire tends to burn upwards and outwards (look for V-patterns along walls).
- The presence of combustible materials will increase the intensity and extent of the fire; the fire will rise faster as it gets hotter (look for different temperature conditions).
- The fire needs fuel and oxygen to continue.

A fire's spread will be influenced by factors such as air currents, walls and stairways. Falling burning debris and the effect of fire-fighters will also have an influence.

1. Points of origin of a fire should be located by an experienced arson investigator. Specialized experience and training are invaluable in determining a correct cause. For example: arsonists have been known to pour a volatile liquid around each electric outlet to make the fire appear as though it was of electrical origin.

2. Newspapers, furniture, carpet, and padding, or piled trash may serve to protect an accelerant liquid from heat that would otherwise have vaporized and burned away.

3. Remember that if a liquid is poured on a dry surface it will act like water in the sense that it will wet, run, spill, leak, drip, pool, or spread. To some extent it will be absorbed by porous materials.

4. It will flow downward into and along cracks and through holes. It may then be protected by cracks and seams of the flooring, the soil, or whatever surface there is below the floor.

5. A liquid will protect the surface carrying it until the liquid is vaporized away, causing charring. The unburned areas around and beneath the char may very well still contain the suspected liquid which can often be verified by analysis.

C. COLLECTING THE EVIDENCE

Make sure all tools used are clean before use, a good grease cutting detergent will do the job.

1. After a suspected area is discovered, first document it with proper photographs, sketches, and notes.

2. Within reason, collect as much of the suspected material as possible, and place in a sealed air-tight container. A clean, non-oiled one-gallon or quart wide-mouthed paint can is usually sufficient. Do not use a container which has been used previously to hold any volatile flammable, solvent or oil. Do not use plastic bottles or bags; they are porous to volatile flammables.

3. Liquid samples, thought to be accelerants, should be brought to the lab in clear glass bottles or jars. Only a small amount is needed (1 ounce).

4. Collect in different areas from each set, placing each sample in a separate labeled container. Equipment and tools should be cleaned between the collection of each item.

Containers for the collection and storage of fire debris samples should be durable, inert, impermeable to volatile materials, and devoid of any residues that may interfere with test results. Unused unlined paint cans, glass jars, and special-purpose polymer bags have traditionally been used for this purpose. In the experience of this laboratory unlined metal cans have been found to be the best containers.

DO NOT OVERLOOK OTHER TYPES OF PHYSICAL EVIDENCE MATERIAL TO THE CASE; e.g. BROKEN GLASS, TOOLMARKS, ETC.

D. COMPARISON STANDARDS

1. Always attempt to obtain samples (comparison standards) of any liquids that could possibly have been used as the volatile flammable accelerant. Also obtain comparison standards (controls) of other unburned “fuels” such as carpets, drapes, upholstery, etc., as they may contribute to the residues detected.

2. Place each comparison standard in a separate sealed air-tight metal container. Always label each comparison standard as carefully and completely as any other evidence material (see above).

3. Always transport in such a way that there can be no question regarding the possible accidental contamination of any of the questioned sample above. A narrative report describing the fire scene, its suppression and follow-up investigation should be included when available.

E. RESULTS

Once the analysis is done, it is important to interpret the results carefully. Modern furniture and clothing are composed of polymers that are based from petroleum products, the same petroleum products that are used to manufacture most of the flammable and combustible liquids such as gasoline, diesel fuel, charcoal starter fluid, and paint thinner. Thus, it is very important for the forensic scientist to be able to distinguish the presence of ignitable liquid from the chemicals that are produced by modern substrates. Only the proper collection, examination, analysis, and interpretation of the fire debris sample allow the forensic scientist to reach the proper conclusion. Mass spectroscopic ion profiling is being adapted by many forensic laboratories as the preferred method for interpreting GC/MS data from fire debris samples. GC/MS analysis along with the use of extracted ion profiling can be a useful tool for the fire debris analyst, particularly in distinguishing an ignitable liquid from interference due to pyrolysis products or other contaminants. The following results may be reported:

1. The laboratory identified ignitable liquids as present. This identification may not be specific and only point to a class on ignitable liquids, due to changes undergone by the liquid during or after the fire. In cases of unusual or extensively burned accelerants, the lack of a comparison standard can make identification difficult.

2. The flammable accelerant or lab standard can be identified as consistent in origin with a submitted control.

3 The laboratory did not detect ignitable liquids as being present in the fire debris.

Local agencies may wish to consult with the Indiana State Fire Marshal for assistance.
For further information you may wish to consult with the I-MCFSA Laboratory in Indianapolis. The laboratory number is: 317-327-3670.

Evidence Submission Guideline #4 adapted from the Indiana State Police Laboratory Physical Evidence Bulletins.