



ATF-LS-FD4 Passive Charcoal Adsorption	Published Online: March 2018
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I.Scope:

This policy and procedure guideline establishes a standard system for extracting fire debris evidence by the passive headspace concentration method (activated charcoal strip).

This method, under certain instrumental (gas chromatograph-mass spectrometer) parameters, may be used to recover both light oxygenated products and hydrocarbon products. Therefore, this technique may be used to identify light oxygenated products without the use of Simple Headspace (ATF Fire Debris protocol). It should be noted, this method may not be efficient for the extraction of methanol. If instrumental conditions are not adjusted to recover light oxygenated products, Simple Headspace must be used to identify a light oxygenated product.

This method may not recover hydrocarbons with a boiling point above heptadecane (C₁₇) and therefore may not be able to fully recover some heavy petroleum distillates. If appropriate, Solvent Extraction (ATF Fire Debris protocol) may also be used for the separation and concentration of ignitable liquid residues from fire debris samples.

II.References:

ASTM E1412, Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris by Passive Headspace Concentration

ASTM E1618, Guide for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry

ASTM E752, Standard Practice for Safety & Health Requirement relating to Occupational Exposure to Carbon Disulfide

Occupational Health Guidelines for Carbon Disulfide, U.S. Department of Labor and Department of Health, September 1978.

Material Safety Data Sheet for Carbon Disulfide

Newman, R.T., Lothridge, Kevin 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

Dietz, W. R. Improved Charcoal Packaging for Accelerant Recovery by Passive Diffusion, Journal of Forensic Sciences 36(1):111-121.

III.Apparatus/Reagents:

- Activated charcoal strips
- Carbon disulfide with automatic volume pipetter
- New, unused paperclips, safety pins, fishing line or similar device

- Magnets
- Vials, autosampler vials, autosampler vial inserts
- Analytical oven

IV. Safety Precautions:

Personal protective equipment including but not limited to safety glasses, gloves, and lab coat will be worn.

Carbon disulfide is a hazardous chemical with respect to both health and fire safety, and should be handled with extreme care. Use of carbon disulfide should be confined to a properly operating ventilation hood. Avoid physical contact with carbon disulfide. Carbon disulfide should be kept from heat, heat sources and sources of ignition.

Care should be exercised when removing cans from ovens. All cans should be allowed to cool to approximately room temperature prior to removing charcoal strips.

V. Procedures:

Open and examine the fire debris sample in order to determine its contents. Suspend pre-cut activated charcoal strips inside the evidence container using a paperclip, fishing line or similar device. Close the container.

Based on examiner discretion or any discernible odor, one of the following suggested sets of extraction conditions may be employed. Other conditions may be used at the examiner's discretion.

- Allow the evidence container to sit at 60 - 70°C for approximately 16 hours.
- Allow the evidence container to sit at 60 - 70°C for 2 to 4 hours.
- Allow the evidence container to sit at room temperature for a minimum of 16 hours.

The oven's temperature shall be monitored during extractions in order to ensure consistent temperatures. If the monitoring process indicates a significant deviation from the set temperature, it shall be documented in the case notes. Based on the circumstances of the case and the degree of temperature deviation, the examiner will determine if an additional extraction is necessary. The temperature monitoring chart shall be retained in a file near the oven.

Once cans have cooled, remove the pre-cut activated charcoal strips. One of the strips will be placed in a vial labeled with case and exhibit numbers and returned to submitter with the evidence. The other strip will be extracted and analyzed. To extract the strip for analysis, add, at a minimum, enough carbon disulfide to the vial to wet the strip. The actual volume used is sample dependent and is at the discretion of the analyst. Further dilution may be necessary due to the concentration of the sample. Agitate the vial, and transfer the carbon disulfide solution using a clean disposable pipette to an autosampler vial fitted with an insert.

VI. Quality Control:

Prior to a new batch/lot number of charcoal strips being implemented for casework it will be tested to determine that it is free of contaminants and that it qualitatively performs as expected for passive headspace analyses. A charcoal strip or portion thereof will be placed in two separate metal cans. One can will contain 5 – 10 mL of a 50:50 gasoline:diesel mixture on a Kimwipe (or

equivalent). The other can will contain a Kimwipe (or equivalent). Each can shall then be extracted using the first set of conditions listed above. Both gasoline and the heavy petroleum distillate shall be identifiable as per the Ignitable Liquid Classification System (ATF Fire Debris protocol) in the positive (spiked) can. The results of these tests will be noted in a log and the data will be maintained with the log.

For each day that samples are prepared using this method, a system blank will be prepared and extracted. To create a system blank, a charcoal strip or portion thereof will be extracted using the same procedure as the sample. If a sample extract is diluted, filtered or concentrated, the system blank shall be treated the same way. A copy of the system blank will be maintained in the appropriate case record.

Extract Storage - The duplicate charcoal strip will be placed in a vial labeled with case and exhibit numbers and returned to submitter with the evidence.

Oven Performance Check - The oven temperature reading and the temperature monitoring device shall be checked on an annual basis using a NIST traceable thermometer. This thermometer will be placed in the oven at 65°C for a minimum of two hours. The temperature of the thermometer, the oven and the monitoring device will be recorded. The tolerance will be $\pm 15^{\circ}\text{C}$.