

Charlotte-Mecklenburg Police Department

Crime Lab - Chemistry Section:

Fire Debris Analysis Standard Operating Procedures

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1 General Evidence Procedures

1.1 Introduction

This section is intended to provide guidance when accepting, storing, and returning fire debris evidence.

1.2 Evidence Acceptance

- 1.2.1** A completed Lab Request must be received before analysis can proceed on a case.
- 1.2.2** All evidence submitted to the lab will follow QM 5.8.1. Additionally, basic forensic evidence handling expands these requirements to ensure the proper labeling of test items, prevention of contamination, and the securing of evidence and documentation (See 1.3).
- 1.2.3** Inappropriately packaged evidence which cannot be immediately corrected (and which does not impact the retention of possible ignitable liquids/residues/vapors) will be returned to Property Control (follow QM 5.8.3.1). The submitting investigator must be contacted by either the analyst or Property Control so that any issues can be corrected. Once the issue has been fixed the evidence can be re-requested by the analyst and work on the case can be resumed.
- 1.2.4** Submitted evidence that is not properly packaged with regards to the retention of possible ignitable liquids/residues/vapors (i.e. Packaged in paper or another non-vapor tight container/bag) may be initially accepted by the analyst in order to conduct a visual examination of the packaging and items within. If at that time the case is deemed not suitable for analysis by the fire debris section the analyst's observations of the packaging will be documented in their notes and the evidence will be returned to property control. The requesting party should be notified, when possible, of the rejection of the evidence. Exceptions may be made on a case by case basis and will be approved by the section administrator. (QM 5.8.3.1)

1.3 Evidence Handling

- 1.3.1** The chain of custody is recoded / maintained electronically in the PLIMS system by scanning the unique barcode label attached to the evidence. A copy of the chain of custody record will be kept as part of the case file.
- 1.3.2** The person receiving the evidence is responsible for ensuring that the Complaint number in PLIMS matches the evidence label affixed to the item and that the evidence is properly sealed and marked. (QM 5.8.1.3, QM 5.8.2)
- 1.3.3** The analyst will mark the evidence/package (at a minimum) to show receipt date, analyst initials, and laboratory number.

- 1.3.4** The evidence must be maintained in a secure location both before and after analysis.
- 1.3.5** Repackaged evidence will be marked using the analyst's initials and by placing a barcode evidence label on the exterior packaging. The original packaging will be included with the repackaged evidence. The case notes or in the case correspondence section in PLIMS will acknowledge how the evidence is repackaged. (QM 5.8.1.3)
- 1.3.6** When possible the outer packaging will be opened in a fashion that retains the integrity of previously attached seals. If this is not possible, the evidence should either be re-sealed in a way that shows the information from the original seals or be repackaged and the original package/seals should be included in the new package/container.
- 1.3.7** Outer packaging/containers will be closed and secured through the use of evidence tape and/or heat-sealed nylon plastic bags. The outer packaging seals will contain the initials and code number of the person sealing the package, along with the date the item was sealed.
- 1.3.8** Every effort must be made during sampling and analysis to conserve material for additional testing if necessary. For fire debris evidence this is done through the retaining of either the activated carbon strip or liquid samples. See 3.1 for more information.
- 1.3.9** All possible efforts will be made to prevent the cross-contamination of evidentiary material. Therefore, only one case will be opened at a time. In the event that the analysis of one case is not yet complete and the analyst needs to proceed with another case, all material from the incomplete case must be packaged and/or contained in such a manner that does not allow for the interchange of material. Work surfaces and tools will be cleaned/replaced as needed.
- 1.3.10** Discrepancies are considered any differences between how an item of evidence is listed/described and what is found in the evidence packaging. All discrepancies will be documented in the case notes and when possible verified by the Section Supervisor or another analyst. In the case of major discrepancies (significant differences in weight, count, or item description) the analyst may notify the submitting officer and if appropriate return the evidence to Property Control for correction.
- 1.3.11** Evidence that exhibits a strong solvent or other chemical odor should be stored and analyzed in a fume hood.
- 1.3.12** Evidence listed as containing soil should be stored in the refrigerator/freezer to minimize possible microbial degradation.

2 Analysis

2.1 Introduction

Identifications will be made using techniques accepted in the field of forensic science. The scope of the testing will be sufficient such that in the absence of the analyst, another competent analyst could evaluate what was done and interpret the data.

2.2 General Scheme of Analysis

- 2.2.1** Accept the evidence following procedures in Section 1.3.
- 2.2.2** Open the evidence, if unable to view through the packaging, and inventory contents. The evidence should be visually examined quickly to prevent possible loss of ignitable liquid residues.
- 2.2.3** Examine the evidence and take note of the presence of any materials/items that may be of potential use to the investigation, including but not limited to: sources of ignition, device components, and evidence amenable to latent print processing.
- 2.2.4** The analyst shall record a full description of evidence in the case notes.
- 2.2.5** Based on the nature/condition of the evidence choose an appropriate sample perpetration/analysis technique(s). The extraction/preparation procedures used by this laboratory for fire debris cases are: Solvent Extraction, Liquid Sample Preparation/Dilution, and Passive Headspace Concentration - ACS. See Section 3 for specific information on each technique. Note: The matrix of the debris and odor may be taken into consideration when determining which extraction procedure to use.
- 2.2.6** Analyze the prepared samples by instrumental analysis (GC/MS). Ensure all quality checks have been run prior to using the instrument. See section 7.7 Quality Assurance – GC/MS. Documentation of the complete extraction procedure used in a case shall be reflected in the chemist's notes.
- 2.2.7** Re-seal and/or re-package the evidence. Re-packaged evidence will be marked using the analyst's initials and by placing a new barcode evidence label on the exterior packaging. Place initials, code, and date on the seals. Child/sampled evidence (i.e. carbon strip archives) will be placed in an envelope or other appropriate container, properly sealed, and a new barcode evidence label will be affixed to the exterior.
- 2.2.8** Upon completion of all analyses, a report is issued and reviewed.
- 2.2.9** The evidence is returned to property control following procedures in Section 1.3.

3 Sample Preparation/Techniques of Analysis

3.1 Introduction

Fire debris samples shall be analyzed using approved and validated methods. Most fire debris evidence is extracted using passive headspace concentration. Exceptions to this are raw accelerants and non-aqueous liquid samples which are typically prepared using neat dilution. See Appendix C for references.

3.2 Sample Preparation

3.2.1 Passive Headspace Concentration – ACS

3.2.1.1 This procedure describes the process for removing small quantities of ignitable liquid residue from samples of fire debris using an adsorbent material to extract the residue from the static headspace above the sample, then eluting the adsorbent with a solvent.

3.2.1.2 Assemble the carbon strip apparatus (i.e. Suspend a paper clip from a piece of unwaxed dental floss/string and place an ACS strip on the paper clip).

3.2.1.3 Open the evidence container and insert the carbon strip apparatus such that it is not touching the debris or the sides, if possible. Close the container. If sufficient headspace is not present in the container the evidence can be re-packaged in a new container, be sure to document this in the case notes.

3.2.1.4 Based on the physical examination of the evidence, the chemist shall determine what temperature/ time conditions each sample requires for the initial passive headspace - ACS extraction. The routine screening parameters are 16-24 hours in a 60 degree Celsius oven. Samples may be re-extracted at the chemist's discretion.

3.2.1.4.1 Prepare positive and negative controls. See section 7.

3.2.1.5 Remove the container(s) from the oven and allow them to come to room temperature.

3.2.1.6 Remove the ACS from the sample container.

3.2.1.7 Cut or tear the carbon strip into two pieces.

3.2.1.8 Seal one half in an autosampler vial to act as a sample archive for potential future analysis.

3.2.1.9 Elute the second half of the strip with an appropriate amount of carbon disulfide (or other appropriate solvent). A glass insert may be used to minimize solvent volumes.

3.2.1.10 Prepare a blank using the same solvent that was used to extract the sample.

3.2.1.11 Transfer the autosampler vials to the GC tray and run the samples using the appropriate test methods. See Section 4.2 GC/MS.

3.2.1.12 Record procedures conducted in case notes.

3.2.2 Liquid Sampling

3.2.2.1 This procedure describes the process for the analysis of liquid case samples, liquid comparison samples, and reference liquids. Liquid samples submitted for identification or comparison purposes need to be prepared so that their chromatogram represents as close to possible the chromatogram obtained from extracts of fire debris.

3.2.2.2 Indicate color, clarity, and amount when such properties can be readily observed for samples. Be sure to note the presence of multiple layers (Note: it may be necessary to transfer the liquid to a new container to make observations/measurements).

3.2.2.3 Conduct a flammability test to determine if the liquid is ignitable (See section 4.3 for procedure) and document the results. If multiple layers are present and there is a sufficient quantity of sample, flammability tests should be conducted on each layer.

3.2.2.4 Conduct miscibility tests to determine if the liquid is miscible in water (See section 4.4 for procedure) and document the results. If multiple layers are present and there is a sufficient quantity of sample, miscibility tests should be conducted on each layer.

3.2.2.5 If the sample is not miscible in water dilute the liquid with an appropriate solvent (i.e. Carbon disulfide). Suggested dilution: Approximately 10 μ L of the sample to approximately 990 μ L of carbon disulfide (or other suitable solvent).

3.2.2.6 If the sample is miscible in water (or otherwise determined not be suitable for analysis by simple dilution) a sample of the liquid will be analyzed using the passive headspace concentration – ACS procedure. (Note: It may be necessary/desirable to transfer a sample of the liquid to a new container to perform the passive headspace concentration).

3.2.2.7 Prepare a blank using the same solvent that was used to dilute the sample.

3.2.2.8 Transfer the autosampler vials to the GC tray and run the samples using the appropriate test methods. See Section 4.2 GC/MS.

3.2.2.9 It may be necessary, for comparison purposes, to approximate a weathered state. This may be accomplished by evaporating the liquid, using low

heat only if necessary, to 95%, 75%, 50%, 25%, and 10% of its original volume and analyzing as documented above.

3.2.3 Solvent Extraction

3.2.3.1 This procedure describes the process for removing small quantities of ignitable liquid residues from fire debris samples using a solvent to extract the residue. This method is very sensitive, works best for non-porous surfaces, is relatively fast, and works well for heavy petroleum products. Some of the disadvantages are that light compounds tend to be lost, matrix effects are enhanced, handling/safety considerations, and the procedure is a destructive method.

3.2.3.2 The sample may be extracted in its original container, or placed in a disposable or new container for extraction.

3.2.3.3 Add sufficient solvent to thoroughly moisten the sample. Note: Simple rinsing of non-porous surfaces may result in adequate collection of residues.

3.2.3.4 A small beaker can be used as a plunger to promote extraction of flexible debris.

3.2.3.5 Mix the solvent and debris for approximately 1 minute.

3.2.3.6 Decant and filter the solvent, if necessary, using a funnel and filter paper.

3.2.3.7 Evaporate (concentrate) the solvent to approximately 500 μL . (Analyst may monitor by taking sample aliquots during the evaporation process. Evaporate at room temperature. Compressed dry nitrogen or filtered air can be used to accelerate the evaporation process. Use of heat for concentrating will cause the loss of the more volatile compounds present in the sample and is not recommended. Note: Sufficiently concentrated samples do not require evaporation.

3.2.3.8 Transfer the solvent to a vial that has been properly labeled.

3.2.3.9 Place an aliquot of the solvent extract in a labeled vial as a sample retain/archive.

3.2.3.10 Transfer approximately 0.5 ml of the extract to a properly labeled autosampler vial and cap.

3.2.3.11 Prepare a blank using the same solvent that was used to extract the sample.

3.2.3.11 Transfer the autosampler vials to the GC tray and run the samples using the appropriate test methods. See Section 4.2 GC/MS.

4 Techniques of Analysis

4.1 Introduction

This section documents the techniques most commonly used in the analysis of fire debris evidence.

4.2 GC/MS

4.2.1 This procedure describes the conditions and software steps necessary to perform GC/MS (Gas chromatography / Mass spectrometry) on extracts from fire debris samples and their reference samples. Volatile constituents in a sample are extracted by an appropriate extraction/ elution method. The sample will be injected into the GC/MS for analysis. Patterns characteristic of an ignitable liquid are identified through comparison of a series of ion profiles and/or target compound identification from the sample with those from a reference and/or library standard.

4.2.2 Prepare samples according to the appropriate preparation procedure, depending upon the type of sample and sensitivity required. See section 3.

4.2.3 Check and fill the solvent rinse bottles for the autosampler with an appropriate syringe rinse solvent.

4.2.4 Insure all the necessary quality assurance practices and procedures have been performed prior to using the instrument. See section 7.

4.2.5 Load samples and blanks (section 7.4) into the autosampler tray.

4.2.6 Analyze the samples using the appropriate acquisition and analysis method. Be sure to document the name of the method used in the case notes.

4.2.7 Upon completion of the analysis, review the chromatograms and samples to determine if any need to be re-analyzed, diluted or if additional samples need to be run. Proceed to Section 5: Data Interpretation and Classification of Ignitable Liquids to interpret and classify substances.

4.3 Flammability Determination

4.3.1 At times it may be necessary to determine the flammability of a liquid or substance. The flame test used in this laboratory is designed only to determine if the substance will ignite easily. The test does not determine the flash point, fire points, or auto ignition temperature of the substance.

4.3.2 To determine flammability two procedures can be used:

4.3.2.1 Technique 1: Place 1- 2 ml of substance in an evaporation dish in a hood and expose to a flaming wood splint. If the substance is flammable it will sustain burning when the flaming splint is removed.

4.3.2.2 Technique 2: The substance is placed/soaked onto a clean cotton swab or wooden splint. A flame is applied to the questioned substance and a non-soaked control. The analyst will note the ease of ignitability (amount of sustained flame needed before free burning occurs) of each swab and the ability to sustain the flame after the external flame is removed. If there is a sustained flame with reduced consumption of the substrate, then the substance is flammable.

4.3.3 The results of the flammability test(s) will be documented in the case notes and in the report.

4.4 Miscibility Test

4.4.1 Liquid samples encountered as evidence will be tested for miscibility in water and organic solvents.

4.4.2 Water Miscibility

4.4.2.1 Place a quantity of the liquid sample in a new test/culture tube and add water.

4.4.2.2 Cap and agitate the sample.

4.4.2.3 Wait for the liquid to settle and observe the presence or absence of any layers. A single layer indicates the sample is miscible in water, while multiple layers indicate the sample is water miscible.

4.4.2.4 Document observations/results in the case notes.

4.4.3 Organic solvent Miscibility

4.4.3.1 Place a quantity of the liquid sample in a new test/culture tube and add an appropriate organic solvent (ie. CS₂).

4.4.3.2 Cap and agitate the sample.

4.4.3.3 Wait for the liquid to settle and observe the presence or absence of any layers. A single layer indicates the sample is miscible in the organic solvent, while multiple layers indicate the sample is not miscible in the organic solvent.

4.4.3.4 Document observations/results in the case notes.

5 Data Interpretation and Classification of Ignitable Liquids

5.1 Introduction

The majority of ignitable liquids seen in fire debris analysis are derived from petroleum products, though it is possible to encounter other non-petroleum based materials (alcohols/oxygenated compounds and turpentine, for example). Data obtained from the GC/MS analysis of casework and reference samples will be examined, and will be compared through direct pattern matching with reference standard data and classified into one of 8 general categories using the ASTM E1618-19 (or newer edition) Ignitable Liquid Classification scheme as a guide. Extracted ion chromatograms, GC retention times, and MS data may aid in this identification, especially when interferences from sample matrixes are present.

5.2 Data Interpretation

- 5.2.1** Print a full scale Total Ion Chromatogram (TIC) for all samples and blanks. In the case of samples showing very low abundance or very few major peaks, zoomed in TIC's may be printed to assist in data interpretation.
- 5.2.2** Print Extracted Ion Chromatogram (EIC) data for each sample. See section 5.3.
- 5.2.3** Look for any clustering or grouping of peaks and any common diagnostic peak patterns. When possible be sure to also note the general hydrocarbon range the groupings fall under.
- 5.2.4** The sample matrix should be taken into account during data interpretation as some products that are present in ignitable liquids can also be found in other materials. (I.E. Terpenes and/or pinenes can be found in some types of wood, and petroleum distillates can be present in some wood stains or finishes.) Such situations are why obtaining comparison samples whenever possible is desirable.
- 5.2.5** If the presence of an ignitable liquid is indicated, the sample shall be directly compared to a suitable reference standard that was run on the same instrument under the same conditions. Identification or classification of ignitable liquids which consist of only a single peak (or that do not have a distinctive pattern) can be identified using mass spectral (MS) data and GC retention times (See section 7.7.9 for additional criteria).
- 5.2.6** Limitations of the sample preparation techniques should be taken into account during data interpretation.
- 5.2.7** Library searches should be performed to identify or classify compounds as needed or at the analyst's discretion.
- 5.2.8** All data used to perform a classification or identification will be included in the case file and/or recorded in the case notes.

5.3 Extracted Ion Chromatograms

5.3.1 Analyze the sample using GC/MS. See section 4.2

5.3.2 Using the instrument software (Chemstation/Masshunter) print the 4 page EIC report by using the pre-defined data macros. The four page report includes EIC data for: Alkanes, Cycloalkene/Alkenes, N- Alkylcyclohexane, Aromatics, Naphthalines, Indanes, Alkylanthracenes, Alkylbipheyl/Acenaphthenes, Alkylstyrenes, Monoterpenes, Alcohols, and Ketones.

5.3.3 Additional EIC's may be obtained manually using the instrument software for any other ions of interest. These EIC's may be used individually or may be summed to aid in data interpretation. At a minimum the 4 page EIC report will be generated for each sample or reference standard (excluding blanks and QC check mix) and that data will be included in the case file.

5.3.3.1 A table of common ions used in fire debris analysis can be found in ASTM E1618-19: Table 2, see appendix C.

5.3.3.2 Specific ions that are used during interpretation of fire debris evidence are listed below and can also be found in the 4 page fire debris macro report.

Compound Type	m/z
Alkane	43,57,71,85
Cycloalkane and Alkene	55,69
n-Alkylcyclohexanes	82,83
Aromatic-Alkylbenzenes	91,105,119,120,134
Indanes	117,118,131,132
Alkyl naphthalenes (Condensed ring aromatics)	128,142,156,170
Alkylstyrenes	104,117,118,132,146
Alkylanthracenes	178,192,206
Alkylbiphenyls/acenaphthenes	154,168,182,196
Monoterpenes	93,136
Ketones	43,58,72,86
Alcohols	31,45

Note: this listing is not all inclusive, other ions that are not listed may be used if necessary to aid in data interpretation. Any time extracted ions are used the specific ions will be documented in the case file.

5.3.4 If the presence of an ignitable liquid is indicated, the sample data shall be compared to similarly prepared reference standard data. If extracted ion data is used for the sample the reference standard data will be processed/treated in the same manner and included in the case file.

5.3.5 All EIC data used (including specific ions) to perform a classification or identification will be included in the case file and/or recorded in the case notes.

5.4 Classification of Ignitable Liquids

5.4.1 Ignitable liquids are classified primarily based on their composition and may be grouped into one of 8 classes as defined in the ASTM E1618-19 standards. It should be noted that no classification system can describe all possible ignitable liquids and that it is possible for manufactured/ blended products to fall under more than one of the classifications. In addition, samples that have undergone significant weathering or that show major interferences from the sample matrix may not be easily classified. Therefore, the classification system is best to be considered a guide.

5.4.2 Ignitable liquid classification scheme (taken from ASTM E1618-19):



TABLE 1 Ignitable Liquid Classification Scheme with Examples of Known Products for Each Class^{A, B, C}

Class	Light (C ₄ –C ₉)	Medium (C ₈ –C ₁₅)	Heavy (C ₁₀ –C ₂₀₊)
Gasoline — all brands, including gasohol and E85		Fresh gasoline is typically in the range C ₄ –C ₁₂	
Petroleum Distillates (including de-aromatized)	Petroleum Ether Cigarette Lighter Fluids Camping Fuels Naphtha	Charcoal Starters Paint Thinners Dry Cleaning Solvents Mineral Spirits Automotive Parts Cleaners Spray Lubricants Lamp Oils Deck Sealers Varnishes Kerosene Insecticides ^D	Kerosene Diesel Fuel Charcoal Starters Aviation Fuels Insecticides ^D Fuel Additives Lamp Oils Automotive Parts Cleaners
Isoparaffinic Products	Aviation Gasolines Lighter Fluids Charcoal Starters	Charcoal Starters Paint Thinners Copier Toners Mineral Spirits Solvent Cleaners Kerosene Lamp Oils Gun Oils	Spot Cleaners Penetrating Oils Insecticides ^D
Aromatic Products	Automotive Parts Cleaners Solvent Cleaners Xylenes Toluene-Based Products Lacquer Thinners	Automotive Parts Cleaners Specialty Cleaning Solvents Insecticides ^D Brush Cleaners	Insecticides ^D Adhesives
Naphthenic-Paraffinic Products	Cyclohexane-Based Solvents/Products	Charcoal Starters Insecticides ^D Lamp Oils Mineral Spirits Automotive Parts Cleaners	Insecticides ^D Lamp Oils
Normal Alkane Products		Candle Oils Copier Toners Lamp Oils Wax Cleaners	Candle Oils Lamp Oil Carbonless Forms Copier Toners
Oxygenated Solvents	Alcohols Ketones Lacquer Thinners Fuel Additives Surface Preparation Solvents Automotive Parts Cleaners Spray Adhesives Brush Cleaners	Metal Cleaners Gloss Removers Degreasers Furniture Strippers Cleaning Solvents Insecticides ^D	Biodiesels Fuel Additives Floor Finishes Insecticides ^D
Others-Miscellaneous	Single Component Products Enamel Reducers Lacquer Thinners Aviation Gasolines Racing Gasolines	Turpentine Products Mineral Spirits Fuel Additives Spray Lubricants Brush Cleaners Paint Thinners Citrus Cleaners Charcoal Starters	Lamp Oils Insecticides ^D Citrus Cleaners Automotive Parts Cleaners Kerosene Fuel Additives

6 Reporting and Documentation Procedures

6.1 Introduction

This procedure describes the reporting of the results of fire debris/ignitable liquid residue. Interpretations of the reported findings may also be presented in some instances. Examples given below are not all inclusive and other statements may be necessary as deemed appropriate by the analyst.

6.2 Case Files / Electronic Case Records

6.2.1 The case file or electronic case record will contain all documentation related to a request for analysis and all communication about that case, including but not limited to:

- Administrative documentation.
- Laboratory request forms (if available)
- Laboratory worksheet (if available)
- Case related conversations/correspondence (if any)
- The file in PLIMS shall contain, upon completion, a copy of the issued report, any addendum/supplemental reports, and corrected/amended reports.
- Each page within the case file should have at a minimum the Complaint and/or PLIMS Lab # for the case and the analyst's initials.
- The laboratory case files shall be maintained in secured areas of the Crime Laboratory.

6.3 Case Notes, Worksheets, & Photographs

6.3.1 The case file or electronic case record will contain all documentation related to a request for analysis and all communications about that case.

6.3.2 Worksheets will be used and all administrative data will be completed on the worksheet.

6.3.3 All notes will be neat, legible, clear, and concise.

6.3.4 Any drawings will representative of the object.

6.3.5 All handwritten records will be generated in ink.

6.3.6 Any photographs taken of evidence items that are printed out for inclusion in the case file shall have the lab number, the date, and the analyst's initials on them.

6.3.7 The "Date Started" field on the case notes is defined as the date the evidence was opened/examined for that specific case assignment.

6.4 Reports

6.4.1 The following are possible options for reporting results:

- Identity or class of ignitable liquid(s) found
- No ignitable liquids were detected
- Inconclusive (reason listed on worksheet and report)
- Not Analyzed
- Additional reporting options may be used with the approval of the Chemistry supervisor.

6.4.2 Testing used in the analysis shall be identified in the body of the report (i.e. Item(s) _____ was/were analyzed using Passive Headspace Concentration – ACS and by Gas Chromatograph – Mass Spectrometry (GC-MS)).

6.4.3 The date(s) of performance of laboratory activity will be present on the final laboratory report.

The start of laboratory activity date will be taken from the “Date Started” section of the case notes and will be displayed on the report in the comments section:

“Analysis of the above evidence was started on {Date} by {Analyst name}.”

The final report date will be used as the end of laboratory activity date.

6.4.4 Items received but not analyzed will be listed on the report.

6.4.5 The results shall contain a description of the item. If a container is submitted (i.e. “x brand” charcoal lighter container) a description of the container including the name will be reported.

6.4.6 The results of any flammability and/or miscibility test(s) that were conducted will be documented on the report.

6.4.7 Examples of general product types associated with the class of ignitable liquid reported will be listed.

6.4.8 Examples of common reported results:

a. An extraction using passive headspace concentration – ACS and analysis by Gas Chromatograph-Mass Spectroscopy of item _____ revealed the presence of _____.

The blank is usually filled in with one or more of the following:

Gasoline

Light, medium, or heavy range distillate

Light, medium, or heavy range isoparaffinic product.

Light, medium, or heavy range aromatic product.

Light, medium, or heavy range Naphthenic Paraffinic product.

Light, medium, or heavy range oxygenated product.

Light, medium, or heavy range petroleum product.
Miscellaneous product.

- b. Item _____ was extracted using passive headspace concentration – ACS and was analyzed by Gas Chromatograph-Mass Spectroscopy.
- c. Item _____ extract contained a _____.
- d. Item _____ extract contained _____ which can be found in, but not limited to, some _____ (examples).
- e. Item _____ extract failed to reveal the presence of an identifiable common ignitable liquid residue.
- f. No ignitable fluids were detected.
- g. No ignitable liquids were identified. (Used when an ignitable liquid may have been detected, but no references can be found that has the same characteristics or there was an indication of an ignitable liquid but not identifiable due to ambiguous test results or substrate interference. Case related communications and/or case notes would reflect conversations with investigators and in explaining results.)
- h. The submission of an appropriate control sample and/ or reference sample could assist in the determination of possible interfering compounds.
- i. Examples of _____ ignitable liquids consist of _____.
- j. Due to the volatility of ignitable liquids and to variations in sampling techniques, the absence of detectable quantities of ignitable liquid residues does not necessarily indicate that ignitable liquids were not present. It is notable that ignitable liquids are often consumed or evaporated during a fire.
- k. In many cases, the selection of an appropriate comparison sample can be difficult. Therefore it may sometimes occur that a selected comparison sample, such as _____, may test positive for an ignitable liquid residue.
- l. An additional passive adsorption extract was collected, preserved, and retained for return with the evidence to the submitting agency.
- m. The sample had an inadequate airtight seal, which may have allowed the escape of vapors.
- n. Inconclusive - Terpenes were detected. Terpenes are a natural component in some softwoods and are also found in turpentine solvents and pine-based cleaners. Therefore, a conclusion regarding the presence or absence of ignitable liquid residues cannot be made.
- o. Item _____ extract contained alpha-pinene. It should be noted that alpha pinene occurs naturally in some woods and is also found in turpentine and some cleaning products.
- p. Item _____ extract contained isopropanol (an oxygenated solvent), commonly referred to as rubbing alcohol.
- q. Inconclusive - Volatile compounds were detected. Although some of these volatile compounds are common to some ignitable liquids, they may also arise from the heating or burning of some materials or may be inherent constituents of the material. Therefore, a conclusion regarding the presence or absence of ignitable liquid residues cannot be made.

7 Quality Assurance

7.1 Introduction

This section will cover quality assurance practices for instruments/equipment, reagents, standards, blanks, color tests, gasses, the peer review process, and the validation of testing procedures.

7.2 Reagents

7.2.1 Reagents and solutions that affect the quality of work will be prepared utilizing materials of the highest practical purity.

7.2.2 When a reagent/solution is made, the lot numbers will be recorded on the Lab Solution Form and the reagent should be assigned a new lot number consisting of the date it was made and tested as well as the analyst's initials (example 062811AC). Preparer and supervisor or designee will initial and date the form.

7.2.3 Expiration of reagents/solutions may be one year from date of verification unless otherwise noted on the Lab Solution Form.

7.3 Standards

7.3.1 Ignitable reference liquid samples are used to aid the analyst in classifying any ignitable liquids that were found to be present during an analysis. Ignitable reference liquid samples can include (but are not limited to) commercially prepared products that are flammable or ignitable in nature, or those that are commonly encountered during the analysis of fire debris evidence (i.e. Charcoal lighter fluid, gasoline, kerosene, rubbing alcohol, paint thinners, cleaning products, etc.).

7.3.1.1 These samples typically do not have certificates of analysis and may be obtained from common sources (gas station, hardware store, or grocery store).

7.3.1.2 When a new ignitable liquid reference sample is obtained, a sample of it will be labeled using the manufacturers label or with a unique identification number of the formatting: "IRL#XX" where XX is the next available sample number (example for a purchased bottle of Kingsford Charcoal Lighter Fluid: IRL#02), the name of the product or information from the products label (if present), the date it was obtained, the laboratory number of the case it was obtained from (if appropriate), and the obtainer's initials.

7.3.1.3 Ignitable reference liquid samples will be analyzed using the same techniques as casework samples (GC/MS) and the resulting data saved for references purposes.

7.3.2 When a standard is used to verify results in a case, data for that standard should accompany sample data in the case file.

- 7.3.3** Standard Authentication packets will be kept in the laboratory for at least five years and archived as needed.
- 7.3.4** Standards will be stored in either the controlled refrigerator/freezer or in the flammable storage cabinet in the controlled supply room of the chemistry section.

7.4 Blanks

- 7.4.1** Blanks will be run in all analytical schemes to eliminate the possibility of carry over and the resulting data will be stored with the case file.
- 7.4.2** Running GC/MS Blanks
- 7.4.2.1** A blank consisting of the same solvent used to prepare the samples should be run before every case sample and standard.
- 7.4.2.2** The solvent blank must be run at the same or lower split ratio as the sample.
- 7.4.2.3** Any significant peaks in the blank chromatograms must be properly investigated and documented in the case file.
- 7.4.2.4** A blank should be re-run if a peak is observed in the blank within ± 0.05 minutes of a peak of interest in the sample/standard.

7.5 System positive/Negative controls

7.5.1 System positive control:

- 7.5.1.1** For cases using Passive Headspace Concentration – ACS:
- Place a new Kimwipe (or equivalent) in a new clean metal container or nylon bag.
 - Add ~10ul (or 1 drop) of the Standard Accelerant Mixture (SAM) test mixture.
 - Follow the procedure under section 3.2.1.2 for the preparation of the carbon strip apparatus and further processing.
- 7.5.1.2** For cases with only liquid samples:
- Add ~5ul of the SAM test mixture to ~1000ul of CS₂ (or other solvent), place in an autosampler vial, cap, and follow the rest of the procedure under section 3.2.2.

7.5.2 System negative control:

- 7.5.2.1** For cases using Passive Headspace Concentration – ACS:
- Place a new Kimwipe (or equivalent) in a new clean metal container or nylon bag.
 - Follow the procedure under section 3.2.1.2 for the preparation of the carbon strip apparatus and further processing.

7.5.2.2 For cases with liquid samples the sample blank will act as the negative control.

7.6 Validation of instruments, procedures, and methods

7.6.1 Prior to being incorporated into the Chemistry analytical procedures, laboratory developed and standard methods/procedures will be validated by the Chemistry section (see validation binder for method validation).

7.6.2 The validation process will ensure the expected results are obtained from the method/procedure and required instrumentation (QM 5.4.5).

7.6.3 Techniques used in validation may be one or a combination of the following:

- the use of reference standards/material
- comparison of results with those achieved using other methods (concordance studies)
- systematic assessment of the factors influencing the result
- assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience.

7.6.4 Instruments located within the Chemistry section will only be operated by authorized and trained personnel. A list of equipment and software used for fire debris analysis can be found in Appendix B.

7.6.4.1 Each instrument will have a QC notebook and maintenance log that is checked, initialed and dated monthly by the supervisor or designee.

7.6.4.2 Any instrument that fails the quality control checks or gives suspect results will be placed 'out of service' until the necessary repairs or maintenance are made to correct the problem.

7.6.4.3 Any repairs will be recorded in the instruments maintenance log.

7.6.4.4 After an instrument has been repaired or maintenance has been performed, the instrument must pass quality control checks before being placed back 'in service'.

7.6.4.5 Commercial software in general use within the Chemistry section will be considered to be sufficiently validated as long as it is used within the application it is designed for.

7.6.4.6 Commercial software that has been altered by the Chemistry section will be validated prior to use.

7.6.4.7 Test equipment/instrumentation with settings that can be adjusted will be safe guarded against unintentional changes following and during testing by only allowing authorized personnel to operate the instrument.

7.7 Gas Chromatograph/Mass Spectrometer (GC/MS)

7.7.1 Each GC/MS system will be identified from the other systems by use of a unique identifier.

7.7.2 A list of equipment, software and methods used for Fire Debris Analysis can be found in Appendix B. Any changes to the approved method must be documented in the fire debris case file and the resolution test mix must be run prior to use. Any changes to the approved method that may impact chromatographic performance (as based on the before and after data obtained from the resolution test mix) will be validated prior to use for casework.

7.7.3 New or significantly changed methods will be checked by running standard materials and case materials by both the old and new processes and comparing data. New methods must be verified by the chemistry supervisor.

7.7.4 Evaluating Chromatographic Performance

7.7.4.1 Chromatographic performance will be evaluated prior to any casework being performed. A GC/MS mix standard as the positive control and an appropriate solvent blank as the negative control using the ILRA1.M method or equivalent.

7.7.4.2 Chromatographic performance will also be evaluated after repairs to the instrument.

7.7.4.3 Chromatographic conditions must efficiently separate a test mixture consisting of C8-C20 even normal alkanes, toluene, m-ethyltoluene, o-ethyltoluene, 1,2,4-trimethylbenzene, p-xylenes. Other components may be included as deemed necessary by the analyst.

7.7.4.4 The resolution test mix shall be compared to the most recent standards to ascertain that no significant changes in abundance and retention times have occurred. Check that the baseline is relatively flat, that there are no gross retention time shifts, that there are nice sharp peaks, and you observe the expected sensitivity.

7.7.4.5 An acceptable positive and negative control will be stapled together, initialed by the analyst, and placed in the appropriate GC/MS notebook.

7.7.5 Tuning the Mass Spectrometer

7.7.5.1 The mass spectrometer will be tuned using 'instrument appropriate tune' before use and after repairs.

7.7.5.2 Acceptance criteria for the tune requires evaluation of several areas on the tune print out: see Tune acceptance criteria chart below.

Tune Acceptance Criteria (use Atune or Stune)

Tune Parameters	Specific Parameter	Stune	Atune
Ion Abundance/Ratios	69	= Base Peak	100%
Ion Abundance/Ratios	219	$\geq 40\%$ - $\leq 85\%$	$> 40\%$
Ion Abundance/Ratios	502	$\geq 1.0\%$ - $\leq 5.0\%$	≥ 2.4
Mass Assignments	69.00, 219.00, 502.00 amu	0.55 ± 0.10 amu	0.6 ± 0.10 amu
Isotope Ratios	Ratio of mass 70 to 69	≥ 0.5 - $\leq 1.6\%$	≥ 0.5 - $\leq 1.6\%$
Isotope Ratios	Ratio of mass 220 to 219	≥ 3.2 - $\leq 5.4\%$	≥ 3.2 - $\leq 5.4\%$
Isotope Ratios	Ratio of mass 503 to 502	≥ 7.9 - $\leq 12.3\%$	≥ 7.9 - $\leq 12.3\%$
Electron Multiplier		400 volts of previous setting & < 3000	400 volts of previous setting & < 3000
Air/Water Peak		$< 20\%$ abundance	$< 20\%$ abundance

References

Agilent website.

Instrument owner's manual/software.

7.7.5.3 An acceptable tune will be initiated by the analyst and placed in the appropriate GC/MS Tune notebook.

7.7.5.4 Additional analyses of controls may be analyzed at the discretion of the analyst.

7.7.5.6 If the instrument is not suitable for use, then maintenance and troubleshooting will be performed.

7.7.6 Additional controls may be analyzed at the discretion of the analyst.

7.7.7 Once the chromatographic performance evaluation and tuning of the MS has been accepted, the instrument will be considered acceptable for use.

7.7.8 If the instrument is not suitable for use, then maintenance and troubleshooting will be performed.

7.7.9 Acceptable results:

7.7.9.1 When identifying single compounds, the retention time of target analyte must be within ± 0.05 minutes of the reference standard.

7.7.9.2 Data from chemical reference standards, library matches, or published reference spectra used for comparison and to support positive conclusions will be included in the case file.

7.7.9.3 The spectra for the 5 most significant peaks in the TIC should be included in the case file, though more or less may be used depending on the data present and at the analyst's discretion.

7.7.9.4 The mass spectrum of a compound that does not meet the minimum requirements will be deemed inconclusive. Examples of this include spectra that are too weak, spectra of co-eluting compounds, or spectra that have no apparent matches.

7.8 Gasses

7.8.1 Gases used for instrumentation analysis shall be of the highest available quality. GC/MS instruments require ultra-pure Helium to be used as the carrier gas so as not to interfere in the analysis of items.

7.8.2 All gas cylinder pressures will be recorded on the Gas Cylinder and Pressure Log at least weekly.

7.8.3 Any gas cylinder pressure at or below 300 psi should be changed that day.

7.8.4 The Chemistry supervisor will be notified when gas cylinders need to be replaced/reordered.

7.9 Supplies

7.9.1 All supplies and materials used in the analysis of fire debris evidence should be checked prior to use to insure they do not adversely contribute to patterns obtained from case samples. The supplies/materials are acceptable if they are free from identifiable ignitable liquid residues. Low levels of some volatile organic compounds may be present in the atmosphere. The supplies/materials are acceptable for use in casework even if these compounds are present. The results of these tests will be placed in the Fire Debris-Quality Control Binder. When received, or put into use, fire debris supplies may be given an internal lot number (if needed) in order to distinguish between checked and unchecked supplies. I.E. Paper clips may be obtained, baked in the oven, and checked as per 7.9.2.1 and then given an internal lot number of PC(Date verified)Initials. [PC033012AO].

7.9.2 Activated Carbon Strips – Every new lot of activated carbon strips will be checked for both the capability of the lot of carbon strips to adsorb an ignitable liquid(s) as expected and that each jar of each lot is free of contamination. (Note: For additional jars/containers of the same lot only testing for contamination will be done.)

7.9.2.1 Capability to adsorb an ignitable liquid(s):

- a. Attach a paperclip to a piece of unwaxed dental floss.
- b. Attach a carbon strip from the new lot to the end of the paper clip.
- c. Suspend the carbon strip inside a nylon bag or metal can which contains a Kimwipe (or equivalent) that has been spiked with ~10ul of the SAM.

- d. Seal the container.
- e. Process in the oven and analyze as per 3.2.1

7.9.2.2 Contamination check:

- a. Place a carbon strip in a new autosampler vial and elute with approximately 600µl of CS₂.
- b. Prepare a blank using the same solvent that was used to elute the carbon strip.
- c. Run the blank and carbon strip vials on GC/MS.
- d. Analyze as per 3.2.1.11

7.9.3 Paperclips/Un-waxed dental floss/String

7.9.3.1 Paperclips that are to be used in the analysis of fire debris evidence should be baked in an approximately 60 degree oven for at least 16 hours, and then allowed to cool. A sample of the paper clips is then placed in a metal can or nylon bag and analyzed using the Passive Headspace Concentration – ACS method. If the resulting chromatogram shows excessive or unidentifiable peaks a new batch of paperclips must be obtained.

7.9.3.2 Un-waxed dental floss/string that is to be used in the analysis of fire debris evidence is checked by placing several feet into a metal can or nylon bag. The un-waxed dental floss/string is then analyzed using the Passive Headspace Concentration – ACS method. If the resulting chromatogram shows excessive or unidentifiable peaks a new batch of un-waxed dental floss/string must be obtained.

7.9.4 Metal cans/nylon bags – At least 1 specimen from each new box of bags or cans should be tested for contamination using the Passive Headspace Concentration – ACS method. In addition, any time a metal can or nylon bag from our laboratories inventory is used during casework, an empty comparison can or bag should be prepared and analyzed alongside the casework sample.

7.9.5 Casework Solvents – At least one bottle from each lot of solvent that is to be used for casework will be analyzed by GC/MS.

7.10 Peer Review

7.10.1 The final inspection of reports generated by the chemistry section consists of two stages, administrative and technical review. The administrative and technical reviews will be documented in the case file by the reviewer placing their initials and the date of the review in the assigned area of the worksheet or electronically using the case review functions of the PLIMS system.

7.10.2 Administrative review will be conducted on 100% of cases to ensure the completeness and correctness of the reports issued. An administrative review will be completed by someone other than the assigned analyst or technical reviewer. The administrative reviewer shall check for accuracy and clarity by reviewing:

- the report for typographical or grammatical errors, misspellings, incorrect dates, omissions, identifying case information errors, or data transfer errors.
- each page of the examination documentation has the unique case identifier(unless stapled together), initials of the analyst, and no improper corrections
- any supporting administrative documentation or case communication contains the unique case identifier (unless stapled together) and the initials of the analyst
- the case file contains the property report, examination documentation, and a report

7.10.3 Technical review will be conducted on a minimum of 10% of cases.

The technical reviewer shall check for accuracy and clarity by reviewing:

- the examination documentation to ensure the case notes, worksheets, photographs and other data support the conclusions
- the conclusions are reasonable and within the acceptable opinions of peers within the discipline
- manual calculations and data transfers are correct
- appropriate procedures and controls are performed and documented
- general initialing, dating, corrections, and unique case identifiers are correct and appropriate
- worksheets are properly utilized and filled out correctly
- all requested examinations have been performed and addressed on the report or documented by case communication

7.10.4 If a deficiency is detected during the review process, it shall be corrected and, if necessary, a new report generated.

Appendix A- Commonly Used Abbreviations

Refer to the Official Abbreviations for Chemistry Section document for a comprehensive list.

Appendix B – Instrument Methods

Equipment:

GC-MS A2: GC 7890B
MS 5977B
Autosampler 7693
Chemstation B.07.06.2704

GC-MS C: GC 7890
MS 5975C
Autosampler 7693
Chemstation E.02.02.1431

GC-MS Galileo: GC7890A
MS 5975C
Autosampler 7693
Chemstation E.02.02.1431

Chromatography Data System - Agilent Technologies GC ChemStation™ software (Optimized in accordance with vendor recommendation of revision changes).

Method:

ILRA1.M

Carrier Gas	Ultra pure Helium
Column	30m, 0.25 mm i.d., 0.25 µm film thickness (HP-1, HP-5MS or equivalent)
GC oven conditions	Initial 40°C, then 6°C/min to 80°C, then 15°C/min to 250°C for 8 minutes.
Split Ratio	5:1

Final times listed above are the minimum time requirements. Final times can be extended to include late eluting compounds as necessary. Also, the method may be edited to include alterations to the split ratio or the addition of a solvent delay if it is deemed necessary by the analyst to aid in data interoperation.

Any changes to the approved method MUST be documented in the fire debris case file and the resolution test mix must be run prior to use.

Any changes to the approved method that may impact chromatographic performance (as based on the before and after data obtained from the resolution test mix) will be validated prior to use for casework.

Appendix C – References

Section 1 –

CMPD Crime Lab Quality Program – Quality Manual
Section 2 –

CMPD Crime Lab Quality Program – Quality Manual

Section 3 –

ASTM E 1412-07 Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration with Activated Charcoal.

ASTM E 1386-10 Standard Practice for Separation of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction.

Newman, R.et.al. “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(3), 1996, pp. 361-370.

Section 4 –

ASTM E 1618-19 Standard Guide for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry.

Section 5 –

ASTM E 1618-19 Standard Guide for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry.

GC-MG Guide to Ignitable Liquids, Newman, Gilbert, Lothridge, CRC Press 1998

Section 6 –

Standard Guide for Fire Debris Report Writing -
http://ncfs.ucf.edu/twgfex/docs/Report_Writing_Guide_SWGFEX.pdf

Section 7 –
CMPD Crime Lab Quality Program - Quality Manual

ATF/ NFSTC Basic Fire Debris Analysis Course Student Manual.

Appendix D –

Fire Debris Macro Validation for CMPDFD1.MAC, CMPDFD2.MAC, and CMPDFD3.MAC

Fire Debris Macros:

Any changes or edits to the macros must be approved by the quality assurance committee and will be documented and updated in the SOP and the electronic copies on the computer.

CMPDFD1.MAC

!Macro Name: CMPDFD1

!Author: Andrew Oprysko

!Last Updated: 03-25-2014 - Changed SAMPLE to Sample Name so macro would work with
!LIMS.

!This macro is designed to print the currently loaded Total Ion Chromatogram
!

```
NAME GETTIC_INT
    FILE _DATAPATH$__DATAFILE$
    TIC, R4
    DRAW 3, R4
RETURN
```

```
NAME DO_FOOTER
    LOCAL page$, data$
    PAGESIZE PWIDTH, PHEIGHT
    !PAGENUM= 1
    data$ = _DATAPATH$__DATAFILE$
    IF (LEN (DATA$) >30)
        DATA$ = _DATAFILE$
    ENDIF
    STRPRINT _DATANAMES$,5,PHEIGHT-2
    !PAGE$="PAGE "+VAL$(PAGENUM)
    !STRPRINT"INITIALS_____", PWIDTH-32, PHEIGHT-2
    STRPRINT PAGE$,PWIDTH-16, PHEIGHT-2
    !PAGENUM= PAGENUM+1
    ENDPRINT
RETURN
```

```
NAME DO_HEADER
    VIAL$=VAL$(_ALSBOTTLE)
```

```
STARTPRINT
STRPRINT "CHARLOTTE MECKLENBURG POLICE DEPARTMENT",35,3
STRPRINT "CRIME LABORATORY- CHEMISTRY SECTION",37,4
STRPRINT "Total Ion Chromatogram", 44,5
STRPRINT "FILE NAME: "+_DATAPATH$+_DATAFILE$,3,9
STRPRINT "Sample Name: "+_DATANAME$,3,10
STRPRINT "MISC INFO: "+_MISCINFO$,3,11
STRPRINT "ACQUISITION METHOD: "+_ORGMETHFILE$,PWIDTH/2+14,10
STRPRINT "OPERATOR : "+_OPERATOR$,PWIDTH/2+14,12
STRPRINT "DATE OF ANALYSIS: "+_DATEACQUIRED$,PWIDTH/2+14,11
STRPRINT "INSTRUMENT: "+_instname$ + ": AGILENT 7890A GC - 5975C MS",3,12
! STRPRINT "INSTRUMENT: AGILENT 7890A GC - 5975C MS ON " + _instname$ + ",3,12
```

```
RETURN
```

```
NAME PRINT_TIC
    PAGESIZE PWIDTH, PHEIGHT
    WINPRINT 3,5,15,PWIDTH-10, PHEIGHT-20
RETURN
```

```
NAME CONTROL_TIC
! Outputs TICs to printer in landscape mode
ORIENTPR=2
PAGESIZE PWIDTH, PHEIGHT
GETTIC_INT
DO_HEADER
PRINT_TIC
DO_FOOTER
REMOVE GETTIC_INT, DO_HEADER, PRINT_TIC,DOFOOTER
RETURN
```

```
CMPDFD2.MAC
```

```
!Macro Name: CMPDFD2
!Author: Andrew Oprysko
!Last Updated: 03-25-2014 - Changed SAMPLE to Sample Name so macro would work with
LIMS.
!This macro is designed to produce summed extracted ion chromatograms
!for fire debris analysis (1-page report)
!
```

```
NAME DO_FOOTER2
    LOCAL page$, data$
    PAGESIZE PWIDTH, PHEIGHT
    !PAGENUM= 2
    data$ = _DATAPATH$+_DATAFILE$
    IF (LEN (DATA$) >30)
        DATA$ = _DATAFILE$
    ENDIF
    STRPRINT _DATANAME$,3,PHEIGHT-1
```

```
!PAGE$=" PAGE "+VAL$ (PAGENUM)
!STRPRINT"INITIALS____", PWIDTH-22, PHEIGHT-1
!STRPRINT PAGE$, PWIDTH-12, PHEIGHT-1
!PAGENUM= PAGENUM+1
RETURN

NAME DO_HEADER2
  PAGESIZE PWIDTH, PHEIGHT
  STRPRINT "CHARLOTTE MECKLENBURG POLICE DEPARTMENT", PWIDTH/2-18,2
  STRPRINT "CRIME LABORATORY- CHEMISTRY SECTION", PWIDTH/2-18,3
  STRPRINT "Summed Extracted Ion Profiles", PWIDTH/2-14,4
  STRPRINT "Sample Name:"+_DATANAME$,5,6   STRPRINT "MISC INFO:
"+_MISCINFO$,5,7
  STRPRINT "OPERATOR : "+_OPERATOR$,5,8
  STRPRINT "DATE OF ANALYSIS: "+_DATEACQUIRED$,5,9
  STRPRINT "DATA PATH : " + _datapath$ + _datafile$,5,10
RETURN

NAME DO_ALKANE
  !Extracts ion 43,57,71,85
  !Combine extracted ion spectra
  EIC ,43
  EIC ,57
  ADD X,Y
  EIC ,71
  ADD X,Y
  EIC ,85
  ADD X,Y
  DRAW 3,X
  STRPRINT "ALKANE PROFILE: Extracted ions 43 57 71 85", PWIDTH/2-21,11
  WINPRINT 3,5,12,PWIDTH-5, (PHEIGHT/7)
  REMOVE X
RETURN

NAME DO_AROMATIC
  !Extracts ion 91,105,119,133
  !Combine extracted ion spectra
  EIC ,91
  EIC ,105
  EIC ,119
  EIC ,133
  ADD X,Y
  ADD X,Y
  ADD X,Y
  DRAW 3,X
  STRPRINT "AROMATIC PROFILE: Extracted ions 91 105 119 133", PWIDTH/2-
21,PHEIGHT/7+14
  WINPRINT 3,5,PHEIGHT/7+15, PWIDTH-5, (PHEIGHT/7)
  REMOVE X
RETURN
```

```
NAME DO_CYCLOPARAFFIN
!Extracts ion 55,69,83
!Combine extracted ion spectra
EIC ,55
EIC ,69
EIC ,83
ADD X,Y
ADD X,Y
DRAW 3,X
STRPRINT "CYCLOPARAFFIN PROFILE: Extracted ions 55 69 83", PWIDTH/2-
21,(PHEIGHT/7)*2+17,
WINPRINT 3,5, (PHEIGHT/7)*2+18, PWIDTH-5, (PHEIGHT/7)
REMOVE X
RETURN
```

```
NAME DO_POLYNUCLEAR AROMATICS
!Extracts ion 128,142,156
!Combine extracted ion spectra
EIC ,128
EIC ,142
EIC ,156
ADD X,Y
ADD X,Y
DRAW 3,X
STRPRINT "POLYNUCLEAR AROMATICS PROFILE: Extracted ions 128 142
156",PWIDTH/2-21, (PHEIGHT/7)*3+20
WINPRINT 3,5, (PHEIGHT/7)*3+21, PWIDTH-5, (PHEIGHT/7)
REMOVE X
RETURN
```

```
NAME CONTROL_ARSON
!THIS IS AN EXTRACTED ION PROGRAM FOR ALKANES, AROMATICS,
CYCLOPARAFFINS
!AND POLYNUCLEAR AROMATICS
FILE _DATAPATH$__DATAFILE$
!MACRO "DRAWTIC2.MAC",GO
ORIENTPR=1
PAGESIZE PWIDTH, PHEIGHT
STARTPRINT
DO_HEADER2
DO_FOOTER2
DO_ALKANE
DO_AROMATIC
DO_CYCLOPARAFFIN
DO_POLYNUCLEAR AROMATIC
ENDPRINT
ORIENTPR=2
RETURN
```

CMPDFD3.MAC

!Macro Name: CMPDFD3

!Author: Andrew Oprysko

!Last Updated: 03-25-2014 - Changed SAMPLE to Sample Name so macro would work with LIMS.

!This macro is designed to produce summed extracted ion chromatograms

!for fire debris analysis (4-pages report)

!

NAME DO_HEADER

STARTPRINT

PAGESIZE PWID,PLEN

DO_HEADERA

RETURN

NAME DO_HEADERA

STARTPRINT

PAGESIZE PWID,PLEN

STRPRINT "INSTRUMENT: " + _instname\$ + " USING METHOD " + _ORGMETHFILE\$,5,2

STRPRINT "OPERATOR : " + _Operator\$,5,3

STRPRINT "Sample Name: " + _Dataname\$,5,4

STRPRINT "Acquired on: " + _DATEACQUIRED\$,5,5 STRPRINT "MISC INFO : " + _MISCINFO\$,5,6

STRPRINT "DATA PATH : " + _datapath\$ + _datafile\$,5,7

RETURN

NAME DO_FOOTER

LOCAL PAGE\$

!STRPRINT "Initials : _____",53,(PLEN-2)

!STRPRINT _Dataname\$ + " acquired on " + _DATEACQUIRED\$,5,(PLEN-1)

!PAGE\$="Page " + val\$(PAGENUM)

!STRPRINT PAGE\$,PWID-11,PLEN-1

!PAGENUM=PAGENUM+1

ENDPRINT

RETURN

NAME DO_ALKANE_SUMMED

! Extracts and sums ions 43 57 71 85

! Produces summed alkane profile

EIC ,43

EIC ,57

ADD X,Y

EIC ,71

ADD X,Y

EIC ,85

ADD X,Y

EXCHANGE R1,X

STRING1\$="Alkane profile: Extracted Ions 43 57 71 85"

STR\$="Summed Ion Profiles"

RETURN

NAME DO_CYCLOPARAFFINS_SUMMED

! Extracts and sums ions 55 69

! Produces summed cycloparaffin/alkene profile

EIC ,55

EIC ,69

ADD X,Y

EXCHANGE R2,X

STRING2\$="Cycloalkane/Alkene Profile: Extracted Ions 55 69"

RETURN

NAME DO_ALKYL CYCLOHEXANES_SUMMED

! Extracts and sums ions 82 83

! Produces summed n-alkylcyclohexane profile

EIC ,82

EIC ,83

ADD X,Y

EXCHANGE R3,X

STRING3\$="n-Alkylcyclohexane Profile: Extracted Ions 82 83"

RETURN

NAME DO_AROMATICS_SUMMED

! Extracts and sums ions 91 105 119 120 and 134

! Produces summed aromatic profiles

EIC ,91

EIC ,105

ADD X,Y

EIC ,119

ADD X,Y

EIC ,120

ADD X,Y

EIC ,134

ADD X,Y

EXCHANGE R1,X

STRING1\$="Aromatic Profile: Extracted Ions 91, 105, 119, 120, 134"

RETURN

NAME DO_NAPHTHALENES_SUMMED

! Extracts and sums ions 128 142 156 and 170

! Produces summed naphthalene profile

EIC ,128

EIC ,142

ADD X,Y

EIC ,156

ADD X,Y

EIC ,170

ADD X,Y

EXCHANGE R2,X

STRING2\$="Naphthalene Profile: Extracted Ions 128 142 156 170"

RETURN

NAME DO_INDANES_SUMMED

! Extracts and sums ions 117 118 131 and 132

! Produces summed indane profile

EIC ,117

EIC ,118

ADD X,Y

EIC ,131

ADD X,Y

EIC ,132

ADD X,Y

EXCHANGE R3,X

STRING3\$="Indane Profile: Extracted Ions 117 118 131 132"

RETURN

NAME DO_ALKYLANTHRACENES_SUMMED

! Extracts and sums ions 178 192 206

! Produces summed ALKYLANTHRACENES profile

EIC ,178

EIC ,192

ADD X,Y

EIC ,206

ADD X,Y

EXCHANGE R1,X

STRING1\$="Alkylanthracenes profile: Extracted Ions 178 192 206"

RETURN

NAME DO_ALKLYBIPHENYL_SUMMED

! Extracts and sums ions 154 168 182 and 196

! Produces summed ALKLYBIPHENYL profile

EIC ,154

EIC ,168

ADD X,Y

EIC ,182

ADD X,Y

EIC ,196

ADD X,Y

EXCHANGE R2,X

STRING2\$="Alkylbiphenyl/Acenaphthene Profile: Extracted Ions 154 168 182 196"

RETURN

NAME DO_ALKLYSTYRENES_SUMMED

! Extracts and sums ions 104 117 118 132 and 146

! Produces summed ALKLYSTYRENES profile

EIC ,104

EIC ,117

ADD X,Y

EIC ,118

ADD X,Y

```
EIC ,132
ADD X,Y
EIC ,146
ADD X,Y
EXCHANGE R3,X
STRING3$="Alkylstyrenes Profile: Extracted Ions 104 117 118 132 146"
RETURN
```

```
NAME DO_MONOTERPENES_SUMMED
! Extracts and sums ions 93 136
! Produces summed MONOTERPENES profile
EIC ,93
EIC ,136
ADD X,Y
EXCHANGE R1,X
STRING1$="Monoterpenes Profile: Extracted Ions 93 136"
RETURN
```

```
NAME DO_ALCOHOLS_SUMMED
! Extracts and sums ions 31 45
! Produces summed ALCOHOLS profile
EIC ,31
EIC ,45
ADD X,Y
EXCHANGE R2,X
STRING2$="Alcohols Profile: Extracted Ions 31 45"
RETURN
```

```
NAME DO_KETONES_SUMMED
! Extracts and sums ions 43 58 72 86
! Produces summed KETONES profile
EIC ,43
EIC ,58
ADD X,Y
EIC ,72
ADD X,Y
EIC ,86
ADD X,Y
EXCHANGE R3,X
STRING3$="Ketone Profile: Extracted Ions 43 58 72 86"
RETURN
```

```
NAME PRINT_SUMMED_PROFILES
! PRINTS SUMMED ION PROFILES ON ONE PAGE IN
! PORTRAIT CONFIGURATION
ORIENTPR=1
DO_HEADER
!STRPRINT "SUMMED ION PROFILES",(pWID-19)/2,6
DR 3,R1
STRPRINT STRING1$,4,9
```

```
WINPRINT 3,4,10,72,18
DR 3,R2
STRPRINT STRING2$,4,29
WINPRINT 3,4,30,72,18
DR 3,R3
STRPRINT STRING3$,4,49
WINPRINT 3,4,50,72,18
DO Footer
RETURN
```

```
NAME SUMMED_ION_CONTROL
! CONTROL PROGRAM FOR SUMMED ION SUBROUTINES
DO_ALKANE_SUMMED
DO_CYCLOPARAFFINS_SUMMED
DO_ALKYL CYCLOHEXANES_SUMMED
PRINT_SUMMED_PROFILES
DO_AROMATICS_SUMMED
DO_NAPHTHALENES_SUMMED
DO_INDANES_SUMMED
PRINT_SUMMED_PROFILES
DO_ALKYLANTHRACENES_SUMMED
DO_ALKLYBIPHENYL_SUMMED
DO_ALKLYSTYRENES_SUMMED
PRINT_SUMMED_PROFILES
DO_MONOTERPENES_SUMMED
DO_ALCOHOLS_SUMMED
DO_KETONES_SUMMED
PRINT_SUMMED_PROFILES
RETURN
```

```
NAME CONTROL
! CONTROL PROGRAM
SUMMED_ION_CONTROL
CLEAR 3
ORIENTPR=2
PRINT"MACRO COMPLETE"
REMOVE DO_HEADER,DO_FOOTER
REMOVE PAGENUM
RETURN
```