

FIRE DEBRIS ANALYSIS TRAINING GUIDELINES

**CMPD-Crime Laboratory
Chemistry Section**

<u>History</u>	<u>Issue Date</u>	<u>Section(s) Revised</u>
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Approval

Director _____ Date:
Matthew C. Mathis

Issuance

Section Administrator _____ Date:
Lillian Ngong

Introduction:

The Fire Debris Analysis program is comprised of a series of training modules. Actual completion time will vary depending upon the prior experience of the trainee, and his/her rate of progress through the modules/stages. Progression from one stage/module to the next is by trainer's approval, and this progression is based upon satisfactory review of the trainee's work product, and/or by successful completion of a competency test. In addition to practical, hands-on exercises, specific required readings will be assigned, and together with seminar material, will form the basis of the written knowledge-based examinations.

Individuals previously qualified in Fire Debris Analysis in other laboratories may omit some modules/stages at the discretion of the trainer. However, all individuals, regardless of prior experience, must successfully complete all examinations (knowledge-based), practical skills, and proficiency tests. A record of progress through the training will be maintained in the form of a training checklist (Appendix 1) that will be completed by the trainer(s).

Upon successful completion of this training program, the trainee will be equipped with the knowledge, skills and abilities to perform Fire Debris analysis of potential ignitable liquids in the items recovered from a fire scene.

When an analyst has been absent from the Chemistry Laboratory for an extended period of time, refresher training is mandatory. The training format will be custom-designed based on several factors such as length of time missed, magnitude of change of standard operating procedures, and the analyst's abilities. Upon completion of the training and prior to commencing casework analysis, the analyst will demonstrate competency by successfully passing the relevant written and practical competency examinations.

Stage 1. Orientation and Standard Operating Procedures

Handling, Receipt, Custody and Security of Physical Evidence

The trainee should become thoroughly familiar with the General Laboratory Training Program – Quality, Policy and Operational Manuals.

Laboratory Safety

The trainee should be familiarized with General Laboratory Safety Procedures. They should be informed about the Laboratory Safety Manual, Chemical Hygiene Plan and the Procedure Manual of the Chemistry Section.

Stage 1. Orientation and Standard Operating Procedures

Module 1. Evidence handling

Training Goals: To provide a practical model for the laboratory procedures used in maintaining chain of custody, proper documentation of packaging, and general rules for the proper handling of evidence. **Learning and understanding how to use PLIMS.**

Training Objectives: Trainee will be covering: 1) PLIMS; 2) chain of custody; 3) evidence handling/packaging; 4) documentation of packaging. Trainee must observe an analyst perform these functions on a total of at least three occasions.

Assessment: Progress will be monitored by Trainer; trainee will complete written certification that the readings were completed. Practical demonstration using various types of containers, in a variety of situations.

Readings:

1. Evidence Integrity. Doyle, James E. ed. (1993). In *Physical Evidence Handbook*. Wisconsin Department of Justice. pp. 3-20 (also on the internet).
2. Kirk's Fire Investigation, chapter 14

Stage 1. Orientation and Standard Operating Procedures

Module 2. Documentation

Training Goals: To provide a practical model for the laboratory procedures used in the documentation of evidence.

Training Objectives: Trainee will cover: 1) documentation of exhibits; 2) assignment of identifiers; Trainee must observe an analyst perform these functions on a total of three cases (may be done concurrently with Module 1).

Assessment: Progress will be monitored by trainer; trainee will complete written certification that the readings were completed.

Readings:

1. Evidence Integrity. Doyle, James E. ed. (1993). In *Physical Evidence Handbook*. Wisconsin Department of Justice. pp. 3-20 (also on the internet).

Stage 2. Overview/ Background

Module 1. Chemistry and Physics of Fire

Training Goals: To provide basic understanding of fuels, combustion and pyrolysis.

Training Objectives: Trainee will cover the basis of fuels and combustion including: 1) flames; 2) smoldering; 3) combustion products; 4) heat release rates; 5) heat fluxes; 6) ignition temperatures; 7) flash points; 8) flammability ranges; 9) spontaneous combustion; 10) flashover, etc. Trainee must complete assigned readings before beginning module 2.

Readings:

1. Kirk's Fire Investigation, chapter 2-5
2. Scientific Protocols for Fire Investigation, John J. Lentini

Video example reference:

NFPA Countdown to Disaster.

Stage 2. Overview/ Background

Module 2. Chemical composition of petroleum products

Training Objectives: Trainee should have an understanding of 1) hydrocarbons; 2) historical review of petroleum products; 3) carbon numbers; 4) homologous series.

Readings:

1. Organic Chemistry, Morrison & Boyd (or other textbook)
Select readings, as recommended by trainer.
2. TWGFEX: Glossary of terms for fire investigators and fire debris analyst.
3. Fire Debris Analysis, Stauffer, Dolan, Newman Ch. 4

Stage 2. Overview/ Background

Module 3. Refinery process

Training Goals: To provide a basic familiarity with the refining process.

Training Objectives: The trainee must have an understanding of: 1) Distillation; 2) fractionation; 3) cracking; 4) alkylation; 5) reformation; 6) blending; 7) seasonal and regional variations; 8) marketing and distribution; 9) product trends (isopars, norpars, naphthenics, de-aromatized). .

Readings:

1. Fire Debris Analysis, Stauffer, Dolan, Newman Ch. 7
2. Scientific Protocols for Fire Investigation, John J. Lentini

Optional: (if possible)

Refinery Tour
Videos

Stage 2. Overview/ Background

Module 4. Classification scheme (ASTM)

Training Goals: To know and understand the current classification scheme as in ASTM 1387 and 1618.

Training Objectives: The trainee will classify knowns and unknowns according to the ASTM guidelines.

Readings:

1. GC-MS Guide to Ignitable Liquids; Reta Newman, et al.
2. NSFS Ignitable Liquid Reference library.
3. Fire Debris Analysis, Stauffer, Dolan, Newman Ch. 16
4. ASTM 1618-10

Stage 2. Overview/ Background

Module 5. Effects of Fire

Training Goals: To provide a basic familiarity with the effects of heat and fire on petroleum products and various substrates.

Training Objectives: The trainee will perform the following tasks: 1) burn and evaporate petroleum products with periodic analysis by GC-MS to observe changes over a range of fresh to depleted product; 2) burn various substrates and evaluate chromatograms. The trainee should be able to recognize petroleum products at various stages of weathering, evaporation, and combustion.

Readings:

John J. Lentini, Scientific Protocols for Fire Investigation

Stage 2. Overview/ Background

Module 6. Health and safety risks: Chemical, biological and physical.

Training Goals: To have the knowledge of blood borne pathogens, hazardous communications right to know, compressed gas cylinder safety, flammability of solvents, explosive hazards, fire extinguisher information, proper disposal (biohazard, toxic, flammables, explosives).

Training Objectives: The trainee will be able to properly label, store, and dispose of a chemical. Awareness, recognition, and appropriate response to hazards in the workplace.

Readings:

1. Criminalistics: An introduction to Forensic Science_ Richard Saferstein.
2. Fundamentals of Forensic Science, Max Houck & Jay Siegel

Stage 3. Scene Processing

Module 1. Incendiary Devices

Training Goals: To have an understanding of incendiary devices: 1) recognition of components; 2) residues and function of common improvised incendiary devices (fuels, firing train, residues, timing delays, candles, match books);

Readings:

1. Scientific Protocols for Fire Investigation, John J. Lentini
2. Kirk's Fire Investigation, John D. DeHaan

Practical: (if possible)

Accompany qualified fire investigators in field investigations.

Stage 4. Laboratory Examination

Module 1. Sample preparation/ Extraction techniques

Training Goals: To be familiar with all separation/ extraction techniques (solvent extraction, passive adsorption elution, heated headspace) and understand the advantages and limitations of each technique.

Training Objectives: The trainee will perform the extraction techniques commonly used in this laboratory. The trainee will use different extraction techniques on similar items to determine which techniques would be best procedure to use.

Readings:

1. Extraction and Sample Preparation Techniques
 - ASTM E1386, E1388, E1412, E1413, E2154
 - Control and comparison samples
 - Preserving Ignitable liquids and Ignitable Liquid Residue Extracts
 - ASTM E2451
2. Fire Debris Analysis, Stauffer, Dolan, Newman Ch. 5,6

Stage 4. Laboratory Examination

Module 2. Gas Chromatography/ Mass spectrometry

Training Goals: To be familiar with the theory, practice and maintenance of mass spectrometry and selected ion methods.

Training Objectives: The trainee will operate the mass spectrometer and use extracted ion profiling for fire debris samples.

The trainee must also be aware that in a very limited number of cases it may be necessary to further characterize suspect materials utilizing any or all of the spectroscopic and analytical methods offered by the Laboratory.

Assessment: Practical demonstration of skill by running 10 samples and obtaining meaningful data to the satisfaction of the trainer.

Readings:

1. Manufacturer's manuals (e.g. Agilent)
2. Fire Debris Analysis, Stauffer, Dolan, Newman Ch. 8
3. Criminalistics: An introduction to Forensic Science, Richard Saferstein.
4. Fundamentals of Forensic Science, Max Houck & Jay Siegel

Stage 5. Interpretation of Data

Module 1. Interpretation/ Identification

Training Goals: Classification of gas chromatographic and mass spectral data of ignitable liquids and pyrolysis products and other interfering matrices

Training Objectives: The trainee will interpret and identify ignitable liquids using peak pattern recognition and extracted ion techniques. Have the ability to recognize GC and GC-MS patterns of common pyrolysis products and other interfering matrices.

Assessment: The trainee will interpret data from at least 10 samples and identify ignitable liquid residues if present.

Readings:

1. Criminalistics: An introduction to Forensic Science, Richard Saferstein (section on arson).
2. Fire Debris Analysis, Stauffer, Dolan, Newman Ch. 12
3. "Microbial Degradation of Gasoline in Soil" Mann, D.C., and Gresham, W.R. *J. Forensic Sci.* (1990) 35(4) 913-923.
4. TWGFEX Report Wording Guidelines
5. Reference standards of CMPD Chemistry Lab library.

Stage 5. Interpretation of Data

Module 2. Report Writing

Training Goals: Basic writing skills adequate to accurately convey results of scientific data and opinions.

Training Objectives: The trainee will be given the results for a minimum of 5 previously worked cases. The trainee will interpret the data and generate a report.

Assessment: Reports will be reviewed with trainer. Each report produced will be compared with the actual case report and differences discussed.

Readings:

1. ASTM E-1618, E1387 (section on reports)
2. Criminalistics: An introduction to Forensic Science_ Richard Saferstein.
3. Fundamentals of Forensic Science, Max Houck & Jay Siegel

Stage 6. Final Qualification

Module 1. Written and Competency Test

Training Goals: To provide the opportunity to demonstrate proficiency in the techniques employed while evaluating/ analyzing a mock fire debris case.

Training Objectives: The trainee must successfully complete the analysis of at least two mock cases involving several types of evidence representative of true case material.

Assessment: Relevant case notes and analytical data will be reviewed by the trainer.

Written exams require 80% accuracy.

After review, completed written tests shall be placed in the analyst's training file. Tests and/or copies of test shall not be retained by the analyst.

Subjective answers may be challenged by the analyst. Ultimate resolution shall lie with the Laboratory Director.

Readings: N/A

Stage 6. Final Qualification

Module 2. Courtroom testimony

Training Goals: To assess the trainee's ability to effectively communicate in a mock trial situation. Familiarize the trainee with the Law, Legal issues, Challenges, and Decisions.

Training Objectives: The trainee will be able to communicate results and conclusions, in a simple manner understandable to a layperson. Maintain a professional demeanor and appearance. Unbiased presentation of scientific data.

Assessment: The performance of the trainee in the mock trial will be assessed by the trainer(s) and the Director of Laboratory (or designee). The performance will be graded, utilizing the courtroom testimony checklist, and scored as either satisfactory or unsatisfactory. The results will be discussed with the trainee. In the case of an unsatisfactory mock trial performance, the trainee will be provided the opportunity to satisfactorily complete a second mock trial.

Readings:

1. Criminalistics: An introduction to Forensic Science, Richard Saferstein.
2. Fundamentals of Forensic Science, Max Houck & Jay Siegel
3. Scientific Protocols for Fire Investigation, John J. Lentini.
4. CMPD Crime Lab SOP, Legal Training section of the General Lab training program.

Practical:

Attend courtroom during one whole trial and on several occasions with an experienced expert witness from the laboratory.

General:

ASTM standards for the analysis of fire debris.

- **E 1385** Practice for the Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Steam Distillation
- **E 1386** Practice for the Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Solvent Extraction
- **E 1387** Test Method for Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography
- **E 1388** Practice for Sampling of Headspace Vapors from Fire Debris Samples
- **E 1412** Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Passive Headspace Concentration
- **E 1413** Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Dynamic Headspace Concentration
- **E 1459** Guide for Physical Evidence Labeling and Related Documentation
- **E 1492** Standard Practice for Receiving, Documenting, Storing, and Retrieving Evidence in a Forensic Laboratory

- **E 1618** Guide for Identification of Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry
- **E 2154** Standard Practice for the Separation and Concentration of Ignitable Liquid Residues
- from Fire Debris Samples by Passive Headspace Concentration with Solid Phase Micro Extraction (SPME)

Required Legal Readings:

Giglio v. United States

Frye v. United States

Brady v. Maryland

Daubert v. Merrell Dow Pharmaceuticals

Melendez-Diaz v. Massachusetts

Rule 702

NC General Statute § 14-15 (Arson and other burnings)

The trainee should be made aware of:

- Southern Association of Forensic Scientists (*SAFS*)
- American Academy of Forensic Science (*AAFS*).
- American Board of Criminalistics (*ABC*) Certification.
- American Society of Crime Laboratory Directors (*ASCLD*)
- American Society of Crime Laboratory Directors, Laboratory Accreditation Board (*ASCLD/LAB*).

Appendix 1. Fire Debris Analysis Training Checklist

Trainee: _____

Training Program: Fire Debris Analysis Training Guidelines.

Activity	Trainee Approval		Trainer Approval	

Stage 1. Introduction

Training guidelines and agenda				
General Laboratory SOP (QM/PM/OM)				
Evidence Handling, Documentation and Safety Using PLIMS				

Stage 2. Overview/Background

Module 1. Chemistry and Physics of Fire				
Module 2. Chemical composition of petroleum products.				
Module 3. Refinery process				
Module 4. Classification scheme				
Module 5. Effects of Fire				
Module 6. Health and Safety Risks				

Stage 3. Scene Processing

Module 1. Investigative Process - collection, packaging, submission				
Module 2. Incendiary Devices				

Stage 4. Laboratory Examination

Module 1. Sample Prep/Extraction techniques Substrate and Matrix Effects				
Module 2. Gas Chromatography				
Module 3. GC/ Mass Spectrometry				

Stage 5. Interpretation of Data

Module 1. Interpretation/ Identification				
Module 2. Report Writing (using PLIMS)				

Stage 6. Legal Aspects

Chain of Custody				
Legal Issues (Criminal and Civil Law Procedures), Challenges and Decisions				

Stage 7. Final Qualification

Module 1. Competency Test Oral/written test				
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Approved to Perform Casework:

Trainer **Date**

Chemistry Section Supervisor **Date**

Director, Crime Laboratory Division **Date**