

**Training Guidelines for the Fire Debris Analyst  
Lesson Plan (Module) 7**

**Date:** November 2006

**Instructor:** Qualified Instructor

**Subject:** Incendiary Devices

**Total Time:** 8 hours

---

**Learning Objectives**

- Knowledge of different types of incendiary devices.
  - Recognition of components making each device.
  - Understanding function of each component.
  - Understanding how pyrophoric or highly reactive elements like white phosphorus or potassium and sodium metals can be used in improvised incendiary devices.
  - Knowledge of spontaneous combustion and its use in incendiary devices.
  - Understanding how remote or delayed ignition sources work.
  - Knowledge of incendiary solid mixtures like thermite and black powder.
  - Comprehending the value of trace evidence, fingerprints, flammable or combustible liquids, and physical matching of materials.
  - Skills to prioritize testing and avoiding destruction of potential evidence.
  - Ability to identify residues for proper analysis.
- 

**Suggested Reading**

1. Fire Protection Handbook, NFPA, Quincy (MA): National Fire Protection Association, 2003
2. National Fire Protection Association. NFPA 921: Guide for Fire and Explosion Investigations, 2004 Edition. Quincy (MA): National Fire Protection Association, 2004
3. Dean WL (1984) Examination of Fire Debris for Flare (Fusee) Residues by Energy Dispersive X-Ray Spectrometry
4. DeHaan, JD, Kirk's Fire Investigation, Ed., 5<sup>th</sup> ed., Brady/Prentice-Hall, Inc. 2002
5. Shelef R et al. (1996) Development of Latent Fingerprints from Incendiary Bottles, Journal of Forensic Identification, 46(5), pp 556-69
6. "Setting Fires With Electrical Timers: An Earth Liberation Front Guide", Fireant Collective, May 2001
7. Saferstein, R, *Criminalistics: An Introduction to Forensic Science*. Pearson Prentice Hall 2003
8. Fire Findings (1995) Fusees get extremely hot, leave telltale signs of their presence, Fire Findings, 3(2), pp 5.
9. The Poor Man's James Bond, Vol. 1, Kurt Saxon, Delta press
10. Bertsch, W, Holtzer, G, Sellers, C, Chemical Analysis for the Arson Investigator and Attorney. Hüthig Verlag GmbH, Heidelberg 1993

## **Introduction**

Incendiary devices are often used to start malicious fires, both alone and in conjunction with ignitable liquids. Devices can be used to achieve remote ignition or delayed ignition or to assure ignition of fuel loads. The analyst must understand how such devices function and what residues are left that can aid in the identification of the contents, concealment and connections of such devices. This module teaches essential knowledge of various types of incendiary devices, including a simple Molotov cocktail bottle, a complicated improvised thermite bomb or destructive napalm, and metal-based incendiaries.

## **Outline**

1. Types of Incendiary Devices
  - a. Molotov cocktail
  - b. Incendiary capsule
  - c. Thermite
  - d. Spontaneous combustion
  - e. Phosphorus delay
  - f. Swimming pool chlorine and brake fluid
  - g. Timed gas explosion
  - h. Napalm
  - i. Safety flares or fusees
2. Components of Incendiary Devices
  - a. Container: bottle, capsule, pipe
  - b. Wicks (cloth rag) and other distributing media
  - c. Bung (rubber, glass, or plastic) to tightly close bottle, or glue to seal pipe bombs
  - d. Fuel: flammable/combustible liquids, metals, powders, or other elements
  - e. Mechanical, electromechanical, digital, biological or chemical timers
  - f. Igniter: matches, chemical reaction, electric spark or focused sun ray
3. Function of Components
  - a. Breakable glass bottles, resistant to fuel but breakable upon impact and wick or cloth rag soaked in flammable liquid to ignite spilled fuels of the shattered bottle
  - b. Other devices such as timed gas explosions use butane lighter refill (made of aluminum cylinders), sodium hydroxide and a candle. NaOH dissolves cylinder, butane is released and ignited by candle.
4. Evidence Recognition and Testing
  - a. View evidence and plan all tests to be conducted.

- b. Physical and nondestructive tests performed first to preserve evidence
  - c. Fingerprints from glass or other containers
  - d. ID switches, integrated circuits, or other electrical components used as timing device
  - e. Fiber identification of wick or fabric and possible matching with suspect's cloth. DNA clothing articles
  - f. Identification of fuels, metals, nonmetals, salts or other chemicals using proper analytical procedures
- 

### Teaching Aids

- Handouts
  - Video on safety handling of incendiary devices
  - PowerPoint presentation
  - Construction of incendiary device with simulated components
- 

### Summary

Educating laboratory analysts about the wealth of information obtained from examining undestroyed, partially destroyed, and post explosion incendiary devices is emphasized. A complete and successful examination can lead to proving the use of an incendiary device and to connecting a suspect to the incident (by recovering fingerprints for example). Knowledge of incendiary devices, their composition and how they function, will help new analysts plan and perform the proper examinations.

---

### Test Questions

1. Napalm is a mixture of:
  - a. Alcohol and potassium permanganate
  - b. Hydrochloric acid and aluminum foil
  - c. **Gasoline and melted paraffin wax or other thickener**
  - d. Smokeless powder and zinc powder
  
2. Reporting the possible presence of thermite requires, at least, the presence of:
  - a. Magnesium and Wood chips
  - b. Manganese and Ethylene chloride
  - c. Charcoal and sulfur
  - d. Aluminum and Titanium
  - e. **Aluminum and Iron**
  
3. Spontaneous combustion occurs when concentrated sodium chloride solution is added to phosphoric acid. True or **False**

4. White phosphorus is most soluble in:
  - a. Water
  - b. Ammonium hydroxide
  - c. **Carbon disulfide**
  - d. Cyclohexane
  - e. Vegetable oils
  
5. What happens when swimming pool chlorine (calcium hypochlorite) is mixed together with brake fluid (polyethylene glycol type)?
  - a. Nothing
  - b. **Mixture appears dormant for between 5 and 30 seconds, then it erupts in flame**
  - c. Increases the life of brake fluid
  - d. An endothermic reaction takes place and the mixture temperature is decreased
  - e. Instant eruption of fireball
  
6. A mixture that self ignites upon contact of its components is called:
  - a. pyrophoric
  - b. spontaneous
  - c. **hypergolic**
  - d. hygroscopic
  
7. The combination of fuel and oxidizer that is known to be unstable with long storage in pyrotechnics is:
  - a. aluminum and potassium perchlorate
  - b. aluminum and ammonium perchlorate
  - c. sulfur and ammonium perchlorate
  - d. **sulfur and potassium chlorate**
  
8. The pyrotechnic material in most modern firecrackers that causes the loud report is:
  - a. black powder
  - b. **flash powder**
  - c. lead picrate
  - d. mercury fulminate