Chapter 5

COLLECTION AND PRESERVATION OF FIRE EVIDENCE

INTRODUCTION

The successful presentation of evidence from a fire scene is dependent upon the ability to properly identify such evidence at the scene. Evidence that is not collected, is collected or handled improperly, or is not properly documented will severely compromise any investigation.

Evidence collection and preservation is one of the most important tasks associated with fire investigation. Everything needed to confirm the origin, cause, or contributing factors associated with a particular fire must be collected and recorded.

Sketches are used in conjunction with photographs to present both selective and detailed illustration of the evidence. A photograph usually will show only a portion of the scene or evidence, but what is shown is depicted in great detail. A sketch depicting where evidence was collected will illustrate the entire area with distance and depth relationships to be selected. Presented together, sketches and photographs constitute thorough fire scene evidence reproduction.

EVIDENCE

Proper evidence collection and chain of custody are the responsibility of the scene investigator or a designated evidence technician who selects and assembles all evidence collection equipment and materials.

As evidence is identified, the investigator may work with a photographer and/or a schematic artist. The investigator is responsible for proper documentation of evidence prior to collection, maintaining an evidence log and numbering system, packaging and preserving all evidence collected, and maintaining custody at the fire scene and during transportation to a properly secure storage area. The investigator is also responsible for arranging for laboratory analysis requests and transmitting evidence to the laboratory.

Contamination of Evidence

Evidence can be contaminated even before it is discovered and collected, (either by fire personnel during extinguishment and overhaul or by returning occupants wanting to

view the damage and to salvage belonging. Crewmen who want to return to the fire scene to retrieve documents, medication, personal effects, etc. should be accompanied by investigative personnel.

Evidence also may be contaminated and/or lost by exposure to the atmosphere; thus, it must be sealed in an airtight container. It also may be contaminated by an improper evidence container. Flammable vapors may deteriorate portions of containers, at the seam of metal containers or the rubber seals of lids on glass containers.

Cross-Contamination

Cross-contamination is the transfer of liquid or solid accelerant residue from one fire scene or location to another evidence collection site.

There are four potential sources of cross-contamination at a fire scene: tools, turnout gear, evidence containers and portable generators or power tools. Fire investigators should carry out certain "housekeeping" procedures to preclude possible accelerant cross-contamination from previous fire scenes.

Tools

Each fire investigator should have a special tool kit to process fire scenes. These tools must never be coated with any rust preventive material. After a fire scene examination is completed, tools should be rinsed clean with a strong stream of flushing water. Before taking any excavation or cutting tools into a fire scene, it is a good practice to cleanse each tool with isopropyl alcohol and clean paper wipes or cloth, then flush with fresh water in the presence of a witness. Detergents such as dishwashing soaps are also effective in dissolving residues that remain on tools. Note that accelerant liquids derived from crude oil generally are not soluble in water alone. Check with the lab on recommended cleaning procedures.

Turnout Gear

It is important to clean boots prior to entering the area where samples are to be taken. Avoid walking through accelerants en route to the collection site. Do not handle accelerant samples with fire gloves on. Carry several pairs of latex gloves in your pocket or kit. Two latex "surgical type" gloves will conveniently fit into an empty *35mm* film container with a snap top. Wear latex gloves to handle potential residue evidence. Follow established procedures for glove retention/disposal.

Evidence Containers

Fire investigators should carry a supply of various evidence containers, including both one-quart and one-gallon clean, unused metal evidence cans, or the equivalent, in which to store residue samples. A good practice is to seal a one-quart evidence can and place it

inside a one-gallon evidence can. Then, seal the one-gallon can before placing the cans in your vehicle. This saves space and prevents contamination. Seal the can with only hand pressure to eliminate contamination from outside vapors. Open the cans just prior to physically collecting the samp5e at the collection site.

Portable Generators and Power Tools

Gasoline-powered equipment should be placed outside the scene in order to eliminate the possibility of vapor contamination. Investigators should work closely with firefighters to limit potential contamination when possible. Find out where such tools were used or fueled.

Chain of Custody

Chain of evidence problems are one of the prosecutor's greatest areas of concern in preparing and trying a criminal case. Any fire investigation must be approached and treated as a potential crime scene until it can be shown that the fire was accidental in nature.

Even though the prosecuting attorney usually is not involved in the investigative stages of the case, he will be very upset if the chain of custody of vital evidence has not been scrupulously maintained. There will be no chance to rehabilitate the integrity of the evidence once the chain of custody has been destroyed. Therefore, the fewer the people who have handled the evidence, the easier the proof of the chain of custody will be.

When evidence is expected to be subject to analysis, as in an arson investigation, it is necessary to be able to establish that the item seized is the same item that was analyzed. Consider the following advice from Melville, *Manual of Criminal Evidence,* Second Edition, Denver D.A. office:

"Whenever any piece of evidence must be passed from hand to hand to set up the chain of evidence in a case, it is essential that every person who has anything to do with the matter must be prepared to testify as to

1) when and how such piece of evidence came to him,
2) what he did with it while it was in his possession, and
3) when, why, how and to whom he delivered it."

Frequently important evidence is rejected because the prosecution is unable to prove continuity of possession from collection to being offered in evidence. An investigator always should take the precaution of initialing or otherwise physically marking every piece of physical evidence coming into his/her hands in the course of a criminal investigation so that he/she can give persuasive evidence of his/her one-time possession of the item by identifying his/her initials or other marks on it.

Types of Evidence

During the course of any fire scene investigation, the fire investigator is responsible for the proper collection of scene debris or evidence suspected to contain accelerant residue. When fire scene evidence is collected, the fire investigator should collect two evidence samples: primary evidence samples and comparison samples.

Primary Evidence

Primary evidence should be obtained in an area or areas suspected to have been exposed to some type of liquid accelerant and should be analyzed to identify the accelerant.

In cases where only a small quantity of accelerant is used, the investigator should search the area of origin for an unusual pattern of localized damage. Some reliable indicators would include an odor of accelerant; intermixed light, medium, and heavy horizontal burn patterns.

Common Sampling Errors

When collecting evidence to be analyzed, collecting insufficient samples (too small) is one of the common errors. Ineffective sample preservation techniques and obtaining no comparison sample are other errors. Sampling from the wrong area(s) or the wrong materials can result in a negative analysis.

Evidence Collection Areas

The key evidence collection skill is knowing what to collect and what not to collect. Accelerant liquids burn better than most surfaces they are poured onto. Expect to find better, stronger samples in protected areas and inside absorbent materials.

The most desirable areas for collecting include the lowest areas and insulated areas within a burn pattern. Porous plastic, synthetic fibers, cloth, paper, or cardboard in direct contact within the pattern will absorb any possible liquid which might have been used to expedite the fire.

Inside cracks, tears, seams, or deck drains are other good collection areas for residue, since liquids will collect or pool in these areas. Liquids also will collect around load-bearing support columns or along the base area of bulkheads.

Areas of deeply charred wood, gray ash areas, or edges of holes burnt through wooden decks are less desirable due to the complete burn of material. The center of any burn pattern is not a desirable area due to intense burn of fuel. In general, any area exposed to the greatest heat or hose streams is a less desirable collection area.

Comparison Samples

Comparison samples are materials or objects that are believed to be nearly identical to similar accelerant debris samples, with the exception that they are not believed to contain accelerant residues. The purpose of such samples is to identify and minimize or eliminate sources of interference in the analysis of such samples. Examples of comparison samples include the following:

- New, unused evidence containers. Most evidence containers yield no chromatographic interference. However, some types of containers, like certain types of plastic bags and specially coated containers, may give off background vapors which can obscure chromatographic analysis of evidence. New types of containers and new lots of certain container types, like plastic bags, should be submitted periodically to the laboratory for chromatographic analysis as comparison samples. Likewise, collection materials may sometimes present a source of interference. For example, some absorbent materials for controlling petroleum spills are unsuitable for evidence collection because they have been found to contain traces of contaminants.

- Comparable material samples. It is desirable to collect samples of materials that are identical to those found in the accelerant debris matrix except that they contain no accelerant. These materials, such as carpet or wood trim, often may give off pyrolysis products which partially obscure accelerant patterns during analysis. A comparison sample should be collected for every questioned fire debris sample. Absorbent materials for controlling petroleum spills are unsuitable for evidence collection because they have been found to contain traces of contaminants.

- Comparable accelerant samples. Often investigators need to identify similarities between samples of known flammable and combustible liquids collected at the scene, those found in containers or obtained from other sources near the fire scene, and flammable and combustible liquid residues found in fire debris. Flammable and combustible liquid residues in debris samples may come from sources inherent to the scene, or may be brought to the scene from another source. For example, insecticides often have a petroleum-based carrier. Comparing debris samples with samples of liquids from these sources and with comparison samples of materials similar to those present in the fire debris may be a valuable method of distinguishing between what was at the scene before the fire and what was brought to the scene to start or spread the fire.

Comparisons often are requested by fire investigators when statements, evidence, or circumstances indicate that an accelerant may have come from a specific source, like a suspect's automobile or a nearby gas station. Forensic science analysts can occasionally discriminate between samples of similar materials as having clearly different sources. However, if no differences are found, the strongest statement which can be made is that the samples may have had a common source. This is due largely to the marketing practices of the petroleum industry and the near impossibility of accounting for every possible source. Another possible conclusion is that the samples belong to the same or

different classes of petroleum products, identifiable using gas chromatographic pattern recognition. Liquid-to-liquid samples are the best for such comparisons. It is much more difficult to determine a common source using liquid samples and debris samples.

Comparison samples can be very important in making a positive identification of a material. When there is any doubt about whether a comparison sample is needed, one should be collected and submitted, or the laboratory should be contacted.

Trace Evidence

The characterization and comparison of trace evidence can provide compelling association of a suspect with an arson scene, or of one scene or device with another.

Glass fragments, torn matches, cigarette butts, cloth wicks, tape segments, or other device components may be associated with items in a suspect's possession through physical matching or torn or fractured edges, by analysis of the composition and construction of the materials present, or by comparison of incidental trace evidence such as hairs, fibers, or stains.

Toolmarks present on locks, doors, windows, valves, or sprinkler or alarm system components at an arson scene may be identified as having been produced by a specific tool recovered from a suspect.

Shoe impressions left at a fire scene may provide investigative leads regarding the number of individuals present or the type(s) of footwear represented, and may be compared with shoes recovered from a suspect.

Latent fingerprints also may survive on objects or surfaces at the scene.

Packaging Evidence

Evidence packaging is important for preserving and protecting evidence between the time it is collected and when it can be analyzed in the laboratory. In some cases, it may take several weeks to have evidence processed by a forensic science laboratory. Therefore, fire investigators should take particular care in packaging and preserving evidence to maintain the quality of the sample and prevent the release, deterioration, or contamination of such residue as flammable/ combustible liquids, insecticides, cleaning liquids, etc.

Metal Containers

The best containers for liquid accelerants and contaminated materials, according to laboratory personnel, are new, unused metal cans with tight-fitting lids. Laboratory personnel cite the advantages of the large openings in relation to overall container diameter, vapor-tightness, rigid form, lightness of weight, durability, lack of appreciable background interference during analysis, availability and range of available sizes. One-quart and one-gallon cans are recommended. The container should be loosely packed

and filled to no more than two-thirds of its volume, leaving the remaining one-third as airspace between the top of sample and lid.

Whenever the sample permits, e.g., carpet, linoleum, paper, cardboard, or cloth, it should be rolled prior to placing it in an evidence container. This is what is referred to as a "chimney roll."

Evidence must be documented with a photograph and a fixed line drawing.

After placing the sample in the container, seal the container by tapping the lid firmly into the container top. Do not place excessive pressure on the lid; you want to avoid distorting the seams on the sides of the container. A good basic rule is to always place the label on the side of the container and not on the lid. Lids may be removed during laboratory testing and may be misplaced or mixed up.

Special Evidence Bags

Many fire investigators have found Kapak bags to be a good substitute for metal containers. These self-sealing bags have an exterior layer of polyester and an interior layer of polyethylene. Despite their advantages these bags can tear if used for debris samples that contain sharp objects such as glass or nails. Consult your laboratory for its recommendation.

Glass Containers

For a small amount of a liquid residue or a liquid sample for comparison, glass containers may be used, e.g., glass jars, pharmacy bottles, etc.

Some fire investigators prefer Mason@ jars for collecting and preserving evidence. The primary advantages are the availability of these containers at hardware, variety, and farm stores, especially in remote or rural areas away from central cities. With proper protection and packaging these containers can be excellent for collecting and preserving accelerant residue samples. The screw-top, vapor-tight lids work well and the wide mouth makes it easy to insert and remove samples. Moreover, the sample remains visible, permitting inspection without opening the container.

The obvious major disadvantage of glass containers is the potential for breakage during transportation and/or storage. Also, some petroleum products and volatiles present in fire debris may degrade the jar's rubber lid seal, allowing vapors to escape. One proposed solution to this problem is to insert a layer of aluminum foil between the jar opening and the lid.

Other Common Containers

Other possible evidence containers include envelopes, paper bags, plastics bags, or containers designed for certain types of physical evidence. The selection of containers

depends on the size and shape of the type of physical evidence, laboratory policies and procedures and the type of exam or test being done.

Labeling Evidence

After the container has been sealed, it is important to label it and its contents**.** A variety of evidence labels which have an identifying information area are available. Attach these labels to the side of the container, not to the top or bottom of the container.

Record the exact description of the evidence, location where evidence was recovered with measurements, evidence number, who recovered the evidence, date, and time of recovery, and the investigator's name, rank, and agency. Other information to record includes the location of the fire scene, fire incident number and any witnesses present when evidence was recovered.

If the sample is for comparative purposes, that fact should be noted on the evidence label.

Storage of Evidence

Proper storage of evidence is important in the chain of custody. Keeping evidence with a law enforcement agency usually is the bes way to get "secured" storage, which is more readily acceptable to courts.

Store evidence in a fire investigator's office only as a last resort; it is often difficult to prove that the evidence was secure. At the very least storage should be in a locked cabinet and in a locked office area.

Follow local policy for storage of evidence.

With the delays in processing evidence becoming longer in many parts of the country, proper storage is increasingly important. Some agencies may find themselves responsible for evidence samples due to delays in shipment, laboratory backlogs, or samples returned from one laboratory awaiting shipment to another laboratory. Under such circumstances, fire investigators should be prepared to store, document, and preserve the evidence in the same manner as would occur while awaiting analysis at the laboratory. The American Society for Testing and Materials Standard ASTM E1492-92, *Standard Practice for Receiving, Documenting, Storing and Retrieving Evidence* in a *Forensic Science Laboratory,* details the specific practices recognized throughout the forensic science community for maintaining chain of custody and preserving evidence samples before and after forensic analysis.

Transportation of Evidence

The admissibility of evidence in a court of law depends entirely upon the fire investigator's efforts to maintain proper security, i.e., chain of custody from the time of discovery and collection, throughout storage, during shipping to laboratory, up to date of

court appearance. Whenever possible, evidence should be handled and control maintained by the original fire investigator (evidence technician).

Personal transportation of evidence to a laboratory for testing is the best method. If possible, the same person who recovers the evidence should seal, initial, and transport it to the laboratory. This eliminates the possibility of the chain of evidence being broken and also eliminates handling by other investigators or personnel. It may become necessary to ship (mail) evidence to a laboratory for examination or testing. When this becomes necessary, every precaution to preserve the chain of custody must be taken.

Select a durable shipping container (box) large enough to hold all of the evidence containers. Never ship evidence from more than one investigation in the same container.

All evidence containers should be properly sealed to prevent escape of vapors and properly identified and marked. Each evidence container should be properly protected from physical damage and packed securely in the shipping box. Seal the shipping box and mark "evidence" on it. Place a transmittal letter in an envelope and tape it on the box, and mark it "invoice." Wrap the sealed shipping box in outside wrapping paper and secure it with durable, resistant shipping tape.

Ship the sealed shipping box with any commercial courier company, (Federal Express, Airborne Express, United Parcel Service, etc.). If using the U.S. Postal Service, request registered mail with return receipts and signature.

EVIDENCE COLLECTION TECHNIQUES

Safety for the Fire Scene Investigator

Given the possible dangers at fire scenes under investigation, investigators need to keep in mind the potential for serious injury at any time and avoid taking unnecessary risks. A post-fire structure can be unstable; the investigator needs to be aware of the unknown when working in a fire scene.

When a threat to personal health and safety is present, special equipment may be required for scene investigation. Rubber gloves, self-contained breathing apparatus (SCBA), and specialized filter masks are examples of this type of equipment. Always wear protective gear, boots, gloves, and helmet when on the scene. If possible, never work alone.

Accelerant Detection Canine Teams

Accelerant detection canines are specially trained to detect-liquid accelerant residue at fire scenes. Canines are used when fire investigators cannot detect accelerant vapors but see indicators of possible accelerant use.

It is important that the evidence technician collect evidence from the exact location indicated by the canine. This is both the best location and best opportunity to obtain a positive sample. It's also important to tell the laboratory that you had canine assistance.

Liquid Accelerant Samples

The presence of accelerant residue, particularly where such evidence would not normally be expected, may be a good indication of incendiarism. However, many other cases involve the collection and analysis of such debris samples to rule out the presence of accelerants or to identify possible accelerant residue from sources other than accelerants.

Because of the volatile nature of liquid accelerants, the collection of debris samples should begin as soon as possible after fire suppression activities have been completed. Fire effects, evaporation, and dilution or dispersion by fire streams diminish the chances of collecting a positive sample where one should be present.

Clean, dry absorbent cotton, Sterile gauze bandages, sanitary napkins, or tampons make good absorbent materials for skimming and collecting liquid residue. Commercial absorbent pads, such as those made of polypropylene, are unsuitable because they often contain background contamination. These products are used in hazardous material spills and are designed specifically for that purpose, not for evidence collection.

If sanitary napkins are used, use non-deodorant, individually wrapped types. Paper towels can produce background contamination. A sample of any absorbent material should be submitted to the laboratory for comparison.

SAMPLING TECHNIQUES

The best place to collect samples when accelerants have been used is at the periphery of so-called pour patterns. These are identified by a distinct interface between the most heavily damaged area(s) and the less damaged areas.

Prior to collecting any samples, record this area by using sketches and photographs. This should be a standard practice for the collection of both the primary and comparison samples.

Photographing a suspected accelerant pattern after sampling damage has occurred may not represent a "fair and accurate representation of the evidence" and may not be admissible in a trial.

Carpet

Carpet readily absorbs accelerant and retains the residue for a longer period of time compared to other floor coverings.

Document the burn pattern with photographs prior to cutting the carpet. Cut the carpet in long strips along the edge of the stain or burn pattern.

A "chimney roll" is the best technique. Roll the carpet sample with the backing, nap, foam padding, or rubber to the inside to lessen the chance that it will stick to the inside of the container. The backing or padding contains background contamination.

Insert the rolled sample of carpet in the vertical position in the evidence container and photograph the container with evidence visible and in the cut area. Obtain a comparison sample outside the pattern area from the same type of carpet.

Floor Tiles

Floor tiles offer good residue collection because they have seams into which liquid accelerants can seep or be absorbed. Photograph all "ghost patterns." Additional background contamination is adhesives used to adhere tiles to flooring.

Photograph the area before you collect the sample. Cut strips along each side of seams and place the backing of one tile against the backing of another tile. This helps to eliminate the chances that the adhesive will stick to the side of the container. If the strips are too long to fit into the container, break in half and place both pieces in the container. Lay the container on its side while placing the sample tile vertically in the container. Photograph.

Linoleum

Linoleum is manufactured from products of wood, gum, burlap, cork, canvas, etc., for linoleum flooring and thermoplastic polymers of vinyl compounds for vinyl flooring, and coated with a nonabsorbent covering which repels or inhibits liquids on the surface of the product. When the product is installed, glue or epoxy is used to attach it to flooring.

A liquid accelerant on a surface such as linoleum will burn from the outer edges of the pooled liquid inward. The surface often will soften and begin to dissolve, and the edge of the pool will melt, burn, and/or char once ignited; this produces a burn pattern.

Identify the edge of the accelerant pool and document with photographs. Cut along the edge of the burn or stain area in long strips. Roll the sample with the backing to the inside to lessen the chances of the adhesive sticking to the side of the container. Insert the roll vertically into the container and photograph again. Always obtain comparison samples of both flooring and adhesive outside the burn area.

Wood/Wood Flooring

Liquid accelerants poured onto wood decks will seek joints or seams as collection areas. Liquids also will flow behind moldings, and under furniture, door frames, and threshold plates.

Wood sampling should be concentrated at seams and joints. Liquid accelerants seep between these seams and joints and may remain cool during a fire. Liquids are absorbed into the wood grain or fibers of the wood boards.

Collect splintered wood slivers from the edges of these seams, grooves, or joints and place them vertically in the evidence container. Lay container on its side and lay these splinters of wood in container. This helps to eliminate the chances of sharp edges puncturing the container. The container should not be filled to more than two-thirds of its volume. Always obtain a comparison sample of similar wood outside the burn area.

SUMMARY

For evidence to be accepted in court, it must be proved that it is relevant to the fire scene. It is the responsibility of the fire scene investigator to prove that the chain of custody has not been tainted from the time of recovery to the date it is presented in court.

Proper documentation through photographs, sketches, and proper evidence collection procedures are the fire investigator's responsibility. Failure to document a single step in this process usually results in the evidence being inadmissible in a court of law.

BIBLIOGRAPHY

Annual Book of ASTM Standards, Section 13, Medical Devices, 1992.

ATF Arson Investigative Guide. Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms.

Basic Tools and Resources for Fire Investigators: A Handbook. Federal Emergency Management Agency, United States Fire Administration, January 1993.

Dietz, W.E. "Physical Evidence of Arson: Its Recognition, Collection, and Packaging." *Fire and Arson Investigator,* Vol. 41, No. 4, p. 35, June 1991.

Guide to Fire and Explosion Investigations. Quincy, MA: National Fire Protection Association, 1992, NFPA 921.

Melville. *Manual of Criminal Evidence,* 2nd Ed. Denver, CO: District Attorney's Office.

Phillips, Calvin C. and David A. McFadden. "Investigating the Fireground. *Fire Engineering,* 1986.

Sanderson, J.L., C.A. Balliet, and M.A. Balliet. "Sampling Techniques for

Accelerant Residue Analysis," *Fire and Arson Investigator,* Vol. 40, No. 3, p. 36, March 1990.

Whistine, William H., Jr. *Sniffing the Ashes, K-9's in the Fire Service.* Ashland, MA: International Society of Fire Service Instructors, 1992.

ASTM STANDARDS

- *ASTME* 1385-90, Standard Practice for Separation and Concentration of Flammable and Combustible Liquid Residues from Fire Debris Samples by Steam Distillation.

- ASTME 1~86-90, Standard Practice for Separation and Concentration of Flammable and Combustible Liquid Residues from Fire Debris Samples by Solvent Extraction.

- ASTME 1387-90, Standard Test Method for Analysis of Flammable and Combustible Liquid Residues in Extracts from Samples *of* Fire Debris by Gas Chromatography.

- ASTME 1388-90, Standard Practice for Sampling of Headspace Vapors from Fire Debris Samples.

- ASTME 1412-91, Standard Practice for Separation and Concentration of Flammable and Combustible Liquid Residues from Fire Debris Samples by Dynamic Headspace Concentration.

- ASTME 1413-91, Standard Practice for Separation and Concentration of Flammable and Combustible Liquid Residues from Fire Debris Samples by Passive Headspace Concentration.