

FIRE INVESTIGATION PROTOCOLS



INTRODUCTION

- One of the important aspects of the complexities involved in the investigations is that of fire.
- It is a rapid persistent chemical change that releases heat and light and is predominantly accompanied by flame.
- There is an exothermic oxidation of combustible substances .

OBJECTIVES

- Major objectives of fire investigation are
- Cause of fire
- Origin of fire
- Whether any criminal activity is involved
- Evidences for further analysis

BASIC METHODS

- Fire dynamics-physics and chemistry of fire
- Chemistry of combustion
- Heat transfer
- Fuel
- Ignition
- Fire development
- Products of development

FIRE CRITERIA

- In order for a fire to occur, three conditions must be met. Fire triangle FOXHET
- There must be a combustible (fuel)
- An oxidizer (oxygen)
- A sufficient heat energy source (source of ignition).

CLASSIFICATION OF CAUSES OF FIRE

- Cause of the fire should be based on the presence rather than the absence of evidence.
- The cause of a fire is generally classified as accidental, natural, incendiary, or undetermined.
- In some cases the cause is undetermined for many reasons and may be due to the degree of damage to the structure, lack of witness information, or other physical evidence.

Accidental

- This classification encompasses situations that generally do not involve direct human involvement, such as fires caused by appliance failure, electrical wiring, or other nonhuman causes.
- However, an accidental classification can be used in instances that encompass noncriminal human involvement.

Natural

- This classification encompasses fires that are typically identified as acts of God, such as fires related to lightning strikes, earthquakes, etc. No human involvement is linked to the natural fire classification.

VARIOUS RESOURCES

- Heat energy can be produced by mechanical, electrical, chemical, or radioactive means. The role of fire investigation is to identify the event that brought together the combustible, the oxidizer, and the source of ignition that started the fire.

CAUSES OF FIRE

- Causes of fire can be natural, accidental, deliberate, or undetermined.
- Natural causes of fire include all the actions of nature that can cause a fire, such as lightning from the sky or lava from a volcano.
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- Accidental fires include both fires that are caused by a negligent human intervention or by accidental occurrence without the presence of a human being .
- Deliberate fires are caused by the intentional intervention of a human being. However, not all deliberate fires are arsons. For example, if one sets fire to backyard debris, it is deliberate but may not constitute **arson**.

ARSON

- The term “arson” is used to describe a crime that involves the intentional burning of property.
- Malicious burning of property

ORIGIN OF FIRE

- The determination of the origin of a fire is made based on observations of smoke, heat, and burn patterns at the fire scene.
- Fire evolves following the laws of physics and chemistry.

- While combustion is a complicated phenomenon that can be random in some instances, it is most often possible to determine the direction of fires.
- By tracing the direction backward, it is possible to find the origin of the fire. Once the origin of a fire is found, it is necessary to determine its cause.

- One of the most important objectives in fire investigation is determining if a crime occurred in connection with the fire.
- If the fire is due to arson, it is extremely important to quickly determine that a crime occurred and gather **evidence**.
- If an accidental or natural fire occurred, it is important to determine how it started, so that the proper measures can be taken to prevent similar fires and to protect lives and property from future damage.

- In addition, in the case of accidental fire, it is important to determine the exact cause of the fire, because people or companies might bear a responsibility in the loss. The responsibility might be civil or criminal and carry an important financial burden.
- There are certain cases where in owner of a property deliberately set it fire for claims such as insurance claims,(a faulty evidentiary clues of the non expensive substances set on fire)

- Fire debris have to be collected in order to find out the causes of fire.
- A failure in the circuit or apparatus may also be revealed on systematic examination .
- If the failure of a shaft in a factory is suspected to have created the blaze by overheating, it may be determined about the exact cause of the failure of the shaft.
- Fire investigation is a harsh job, as it consists of working in dangerous conditions around burned structures or vehicles and in atmospheres containing many contaminants that are detrimental to the lungs and health.

Collection and Preservation of Evidence

- Evidence can be anything that furnishes proof and assists in supporting a theory. In the case of a fire scene investigation, evidence is typically used to support the cause of the fire or other issues related to the fire scene. Fire investigators should attempt to protect and preserve the fire scene and its contents as much as possible in an effort to properly identify the prefire conditions. This is why the establishment of a controlled-access perimeter around the scene is important.

Scene management

- First responders (ability to observe and record)
- Observation of the fire scene conditions
- Self safety and Public safety issues (very vulnerable when it involves the chemicals or petroleum products or uncontrolled fire) on inspection
- Special materials (clothing needed)

- Shifting of the victims for first aid / sending them to hospitals for clinical care
- Valuable clues available from the patients and the victims
- Instruction of the nursing and medical care unit to take care of the evidences

- Barricade the scene with securing and no one is allowed to enter that area
- No vehicle or individuals allowed to leave
- Evaluations of the severity
- The structure is inspected for occupancy
- Locked from in or out
- Presence of the goods and burnt materials

- Weather (wind direction and condition)
- Lights turned on or off
- Other electrical installations Odors or smells ventilation
- Clues of the weapons or tools
- Trace evidences hair, fibre, fingerprints, blood

- Documenting the scene is at most important
- Not to leave any material un recorded.
- Processing the evidences is at most important
- The recording of the entire scene of fire may be mandatory.

- Examples of other items which might be collected or documented at the fire scene include portions of a door and lock that indicate forced entry, containers of suspected ignitable liquids, tire or foot impressions, tools, documents, and blood.
- Each fire scene is unique. So the responsibility of the trained fire investigator to determine what constitutes evidence, and then make the proper arrangements for the collection and preservation of these items.

- The evidence most frequently collected from the scene of a suspected incendiary fire is debris and other materials such as flooring, carpet, and pieces of furnishings. These items are collected for later examination for the presence of an ignitable liquid
- Usually the porous materials have the retention of the fuels

- arsonists often utilize available materials such as paper, cardboard, and other lightweight items to initiate and accelerate the spread of the fire.
- Thus, the use of an ignitable liquid may not occur in all incendiary fires.

- Some of these signs could include abnormal fire spread, intense localized fire damage, the presence of flammable liquid containers, the odor of petroleum products, a visible sheen on the surface of pooled water and burn patterns consistent with the use of an ignitable liquid.

Sample collection

- Samples of fire debris or the material suspected of containing ignitable liquid residue are generally placed in clean, unused metal cans with a friction-fit lid .The tight lid containers made up of glass is also of much use. The metal containers are also used for these purposes.
- They provide a secure and convenient way to collect and preserve fire scene evidence that may possibly contain volatile residues.
- Because by nature fire debris tends to be wet, the use of Teflon TM-lined cans is recommended over unlined cans for the collection of fire debris at fire scene. The lined cans will limit the potential for rust, keeping the sample intact. A lined paint can will limit the degradation of the container.
- All samples collected from the scene should be properly documented.

- Wear new, clean and unused disposable gloves during the collection of each piece of evidence.
- If possible, only one person should handle and package the evidence to eliminate potential chain of custody issues.
- Use a clean (decontaminated), unused tool in the collection of evidence or utilize the can lid to assist in the recovery process.
- Use an evidence marker to identify each item of evidence collected; photograph the evidence collection area with and without the evidence marker in place.
- Photograph each step of the collection process. Make sure to include one photograph that shows the relative location of the sample collected within the structure.

- Making sure that no debris rests in the groove of the can. Use a rubber to seal the can. The use of a hammer is not recommended, as it can damage the can and disrupt the seal.
- Write the date, time, location, item number, description, and collector's name on the metal can using a permanent marker; additional information can also be added as appropriate.
- After the evidence container is sealed, new disposable gloves should be worn by the person collecting the next item of evidence should don new disposable gloves.

Analytical techniques

- In general the volatile substances are examined by the gas chromatography techniques
- The presence of these substances may be determined with much precision.
- Ignitable liquid residue analysis
- FT-IR best tech

- Electrochemical sensors are based on the reaction between a target gas molecule and an applied reagent to produce an electrical current that is measured by an instrument. Catalytic bead sensors use a combustion chamber to burn combustible gases on the surface of a catalyst bead.
- The resultant increase in resistance is then converted into concentration by the instrument
- computer.

- Electrochemical systems are inexpensive, quick to respond, and
- contain no moving parts, making them popular as portable devices. The
- sensors are sensitive but lacking in selectivity, such that false positives may
- be readily observed.

- The catalytic sensor requires recalibration after 3 months, and the typical lifetime of such an electrochemical sensor is only 2 years.
- Solid-state detectors employ a metal oxide transistor that changes resistance when the vapor molecule interacts with the transistor surface.
- This form of detector is inexpensive and boasts a considerably longer lifetime than paper tape or electrochemical sensing, but it is less selective and so gives rise to higher occurrences of false positives and erroneous alerts

Exclusive findings

- Vast potential is available with the victims belongings in the form of gas liquid adsorption
- These can be made out with smell Adjoining and affected tissues
- The smoke colour gives a valuable information about the type of the substance

Vehicular fire



Photo by Greg Jolly www.firenews.org

Thatched structure on fire



Destruction due to fire on building



CLASSICAL STRUCTURAL FIRE (accidental)



Fire involving the oil refinery



- The nature of fire is of different kinds
- The fuel sources may be of petroleum products
- The source may be the edible oils
- The fire due to chemicals
- Fire due to friction or machinery failures

Establishing Identity of the victim and accused

- In all probability the flash over the roll over would have an effect on these
- The documents and the electronic evidences carry good clues about the criminal act if at all.
- These are all tamper proof and give the break through in these cases.