

# **SECTION 4 - FIRE INVESTIGATION & ARSON**

## **UNIT 1 - FIRE INVESTIGATION & FIRE LOSS**

### **UNIT GOAL**

To introduce the student to basic concepts of how a fire is investigated and how that information is used for analysis of fire problems in a given area.

### **UNIT OBJECTIVES**

The Student by the End of the Semester Shall:

- List Three [3] Areas Covered under the Scope of an Investigation
- Describe the Three [3] Factors Involved in the Ignition Sequence
- Define the Following Terms
  - Area of Origin
  - Point of Origin
  - Fire Cause
- List at Least Three [3] Organizations That Investigate Large Loss Fires
- List Three [3] Common Causes of Accidental Fires
- List the Three [3] Major Areas of a Fire Reporting System

### **KEY TERMS**

Area of Origin

Fire Spread

Char

Heat of Ignition

Fire Analysis

Fire

Fire Cause

Point of Origin

Fire Investigation

Pyrolysis

### **INTRODUCTION**

In order to better fight fires and to prevent fires it is important to know what causes fires. Fire investigation allows us to determine what caused the fire, what materials or equipment were involved, what allowed the fire to spread and if there were any causalities.

These investigations give us data that allows us to see what the fire problem is on a local, state, and national level. With this data we can better determine what are our problem areas are and how to deal with them. This data helps us to effectively allocate the money in our budgets for education, prevention and suppression measures.

In this session we will look at what is involved in doing a fire investigation, who is responsible, and certain legal issues pertaining to fire investigation. We will also discuss how the information from the investigation is gathered into data and used to analyze fire problems on a local, state and national level.

## FIRE INVESTIGATION

Throughout history a major concern of society has been preventing fires. When they do start it was important to determine why they started so we could prevent it from happening again. Some of the early reasons for fires, especially in urban areas, were wood construction, combustible roofing materials, crowded building conditions. Over the years the investigation techniques have improved so we may more easily determine the causes. Fire investigation has also helped in the improvement of medical research in regards to deaths from burns and toxic gases.

### Purpose of Fire Investigations

The primary purpose of a fire investigation is to determine the location and cause of the fire. From this we can tell if it was accidental or a result of a criminal activity. We can also develop preventative measures to prevent it from occurring again.

### Scope of Investigation

The scope of the investigation covers three major areas

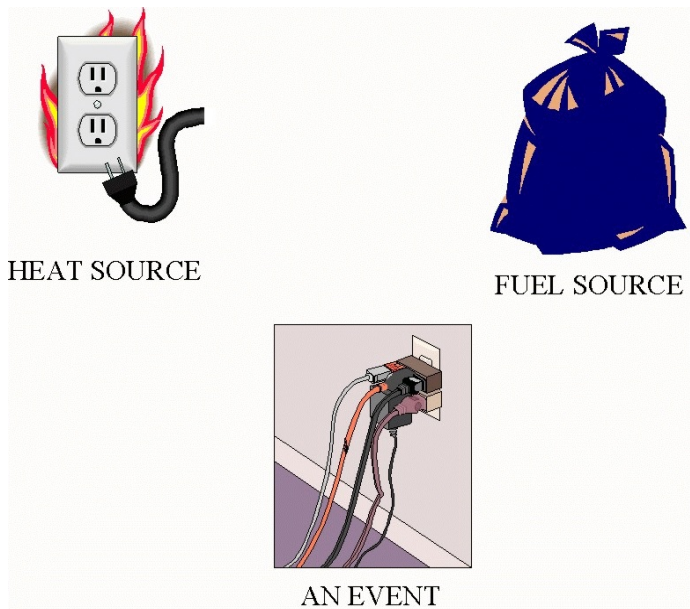
- Ignition of Fire
- Development of Fire
- Casualties (Dead/injured)

### Ignition

In order to determine the cause we must first determine where the ignition of the fire began. To understand this we must determine the sequence of events that occurred to allow the fire to begin..

There are three factors to this sequence

- Heat Source
  - Electrical
  - Smoking Material
- Combustible Material
  - Combustible Solid
  - Flammable Liquid
- An Event
  - Human Action
  - Natural Action



### Example of Three Factors

Each factor must be identified separately. There must be a logical reason for this to occur. The heat source must be capable of igniting the fuel in the form it was in and the event that brought the fuel and heat source together must make sense. When this has been determined we now have our point of origin. In many cases the cause of the fire can be determined by an eyewitness, if there is none then we must determine the point of origin. In order to determine this we work from the large picture to the specific area. By looking at the overall area we can determine the Area of Fire Origin. Once these two are determined we can determine, in most cases, the Fire Cause

*Area of Fire Origin* - The room or area where the fire began.

*Point of Origin* - The exact physical location where a heat source and a fuel come in contact with each other and a fire begins.

*Fire Cause* - The circumstances, conditions, or agencies that bring together a fuel, ignition source, and oxidizer (such as air or oxygen) resulting in a fire or a combustion explosion

***An example would be a fire in the kitchen [ Area of Origin ], with the overloading of an electrical outlet [ Point of Origin ], caused damage to the toaster and nearby paper products. Cause was overloading the electrical outlet by owner***

An area of origin investigation can determine the following:

- the Level of Fire Origin
- Direction of the Burn
- 

There are times where these may not always be that obvious. Each heat source needs to be determined to determined the following:

- Provide enough heat to ignite material that burned
- If there was a proper relationship with the fuel to ignite it
- If it was equipment, was it operating/on to provide heat

### **Development**

Fire growth is based on a number of factors

- Materials that burned should be identified and evaluated to the overall fire development
- Compartmentation of structure
- Firewalls, fire doors or other fire limiting devices
- Any conditions that would allow for unusual fire spread
- Time fire spread prior to detection and time from detection to transmitting of alarm
- Effects of suppression devices (sprinklers, extinguishing systems) on spread of fire
- If a delay occurred, why
  - fault of detection equipment
  - failure of automatic suppression equipment
- Fire department operations
  - adequate/inadequate resources
  - proper/improper tactics

### **Casualties**

- Investigation into each injury and fatality must be investigated
- Can lead to prevention of future incidents

## **CONDUCTING INVESTIGATIONS**

When conducting fire investigations the following are helpful guidelines:

- Interview witnesses and firefighters, find the discoverer of the fire, try to determine from them what was the location of the fire and its size, and also the color of the smoke and flame, from this you can develop a history of growth of the fire. It also aids in determining the accuracy of each witness. Try to discover if there were any unusual circumstances regarding the fire.

Unusual circumstances can be:

- strangers in area
- strange sounds
- no electricity
- building closed up during the summer
- building opened during winter
- minimal contents
- Examine the structures exterior, start investigation on the outside and work inward
- Examine the structures interior. Most damaged area will probably be area of fire origin. Look for pointers:
  - Charring under furniture
  - Melted light bulbs
  - Depth of char
  - Damage to ceiling and roof beams and joists (charring will be greatest over the point of origin)
  - Look for “V” shaped pattern. This characteristic cone-shaped pattern left on a vertical surface at or near a fire’s point of origin. Fire patterns are useful in arson investigation or fire recreations.

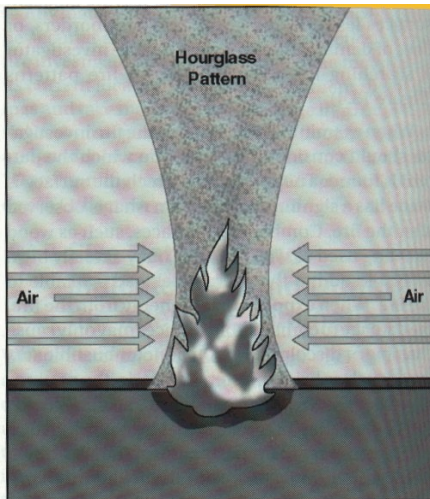


Figure 19.8 Illustration of how the hourglass pattern is formed.



Figure 2- Example of a “V” Pattern

### Determining Cause

Once you have gathered all the information it is time to determine the cause. Cause can be broken

down in to the following categories. Based on the category the direction of the investigation will be determined.

- Accidental fire cause
  - Accidental fires involve all those where the proven cause does not involve a deliberate human act to ignite or spread fire into an area where the fire should not be. In most cases this classification will be clear, but some deliberately set fires can still be accidental. For example, a trash fire in a legal setting might be spread by a sudden gust of wind. The spread of fire was accidental even though the initial fire was deliberate.
- Natural fire cause
  - Natural fire causes involve fires caused without direct human intervention, such as lightning, earthquake, wind, and the like.
- Incendiary fire cause
  - The incendiary fire is one deliberately set under circumstances in which the person knows that the fire should not be set.
- Undetermined fire cause
  - Whenever the cause cannot be proven, the proper classification is undetermined. The fire might still be under investigation, and the cause may be determined later. In the instance in which the investigator fails to identify all of the components of the cause of the fire, it need not always be classified as undetermined. If the physical evidence establishes one factor, such as the presence of an accelerant, that may be sufficient to establish the cause even where other factors such as ignition source cannot be determined. Those situations are also encountered to a lesser degree in accidentally caused fires. Determinations under such situations are more subjective, therefore, investigators should strive to keep an open unbiased thought process during an investigation.

### **Common Causes of Accidental Fire**

- Smoking
- Heating Equipment
- Cooking
- Electrical Equipment
- Low Temperature Ignition (Pyrolysis)
- Spontaneous Heating

If no logical reason for a fire to occur can be found (heat source and material coming together - toaster igniting curtains) then begin to consider the possibility of an intentionally set fire.

Any investigation must be supported by credible evidence. It is critical that an investigator take accurate notes and provide for a chain of custody of all evidence. Typical evidence can be photographs, videos; lab samples sent to laboratory facilities (forensic science);. It is also important to get experts to review material. Preserving evidence is critical. As mentioned before chain of custody of evidence is critical. Just as important is the securing of fire scene. There are times where the investigator is not on the scene the same time that the fire department. It is essential that a chain of custody of the fire scene. If not a warrant must be obtained to reenter the fire scene to investigate. If this is not done the courts most likely will throw out any evidence gathered. Most of the is based on the following legal decision.

#### *Michigan V. Tyler Legal Decision*

- Fire in Store

- Fire Department Arrived and Extinguished Fire
- Left the Premises Unsecured
- Investigator Went Back next Day and Found Additional Evidence
- Owner Brought to Trial and Convicted
- Appealed - Defendants Fourth Amendment Rights Were Violated
- Fire Chief and Investigator Failed to Secure a Warrant to Reenter the Property, Therefore the Evidence Was Not Retrieved Legally

## **RESPONSIBILITY FOR INVESTIGATIONS**

Who is responsible for the investigation of a fire. It will vary with each district or state. In most state the primary responsibility is that of the state fire marshal or equivalent. On a local level the responsibility can be the fire chief or the head fire prevention official. Depending on the investigation local enforcement personal may aid in the investigation.

Preliminary investigation done by one of the following agencies

- Local Fire Department
- Can Be Fire Prevention Bureau
- Fire Investigation Team (City Fire Marshals)
- Can Be Fire Department Officers

In most states the ultimate responsibility falls under the fire chief. Fire that cause a large loss of life of monetary loss can also be investigate by the following agencies or individuals

- Insurance Companies
- Insurance Bureaus (For Special Type Fires)
- Manufacturer of Product
- Experts for Lawyers in Cases Where Litigation May Occur
- National Fire Protection Association
- United States Fire Administration

## **RECORDING THE FIRE PROBLEM**

Once the fire cause has been determined all information must be compiled into a report. Some reports are brief, some are very extensive

### **Purpose of Report**

Any fire report is a legal record of the fire. It provides fire department management with information on what is happening in their response area. It tracks trends in fires and the effectiveness of fire prevention programs, code enforcement and what changes need to be made in them.

It is critical for accurate data that there be uniformity in reporting procedures.. The NFPA has developed NFPA Standard 901 & 902, Uniform Coding for Fire Protection

### **Fire Reporting Systems**

Fire reporting systems Consists of three major areas.

- Fact Finding - is used for input into system
  - common terminology and definitions
  - procedures for forwarding to central area
- Fact Processing - legal, statistical, planning and management purposes
  - must be accurate and complete

- combine information on incident from several reports into a composite record
- create a fact file of all records of reported incidents
- Fact Use
  - has many uses
    - legal document
    - statistical data
    - spot possible trends
    - look at potential problems on a local, regional, state or national level

**Benefits of the System**

- Describes Community Fire Problems
- Supports Budget Requests
- Supports Code Refinements
- Evaluate Code Enforcement Programs
- Evaluate Public Fire Safety Education Programs
- Future Fire Protection Planning
- Improving Allocation of Resources
- Scheduling Non-emergency Activities
- Regulating Product Safety
- Support Major Fire Engineering Analysis

**EXAMPLES OF COMPILED FIRE DATA AS A RESULT OF FIRE INVESTIGATIONS**

**NEW JERSEY 1994 DATA**

	<b>All Fires</b>	<b>Civilian Fires Deaths</b>	<b>Civilian Injuries</b>	<b>Dollar Loss</b>	<b>Total Fires</b>	<b>Percent of Deaths Per 1,000</b>
<b>Overall</b>	27,097	44	616	\$57,700,374.00	100.00%	1.58
<b>Structure</b>	9,127	31	511	\$38,449,650.00	32.71%	3.40
<b>Residential</b>	6,928	31	418	\$26,606,762.00	24.83%	4.47
<b>Vehicle</b>	7,005	9	36	\$18,070,931.00	25.10%	1.28
<b>Outside</b>	11,306	2	35	\$618,355.00	40.51%	.18
<b>Other</b>	469	2	44	\$561,438.00	1.68%	4.26