

CHAPTER 13 DETERMINING THE ORIGIN

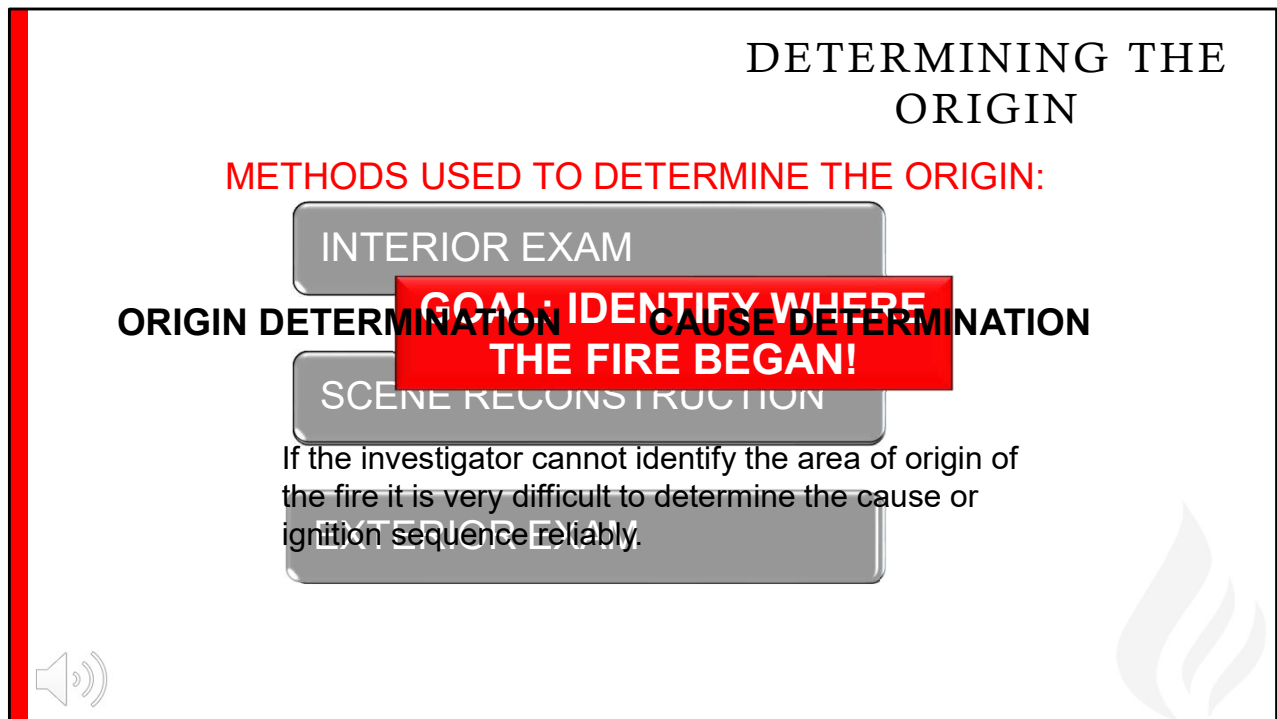


CH. 18



Welcome to Chapter 13 – Determining the Origin.

If you're following this program in NFPA 921 (2021) we will be covering Chapter 18 Origin Determination.



The goal in determining the origin of the fire is to identify the location where the fire began. In this chapter we will discuss the methods used to determine the origin of the fire and describe various investigative steps including initial scene assessment, a safety assessment, the exterior examination, the interior examination, fire scene reconstruction, and fire spread as they relate to the origin determination in structure fires.

Although they are treated as two separate topics, origin determination and cause determination are closely related. If the investigator cannot identify the area of origin of the fire it is very difficult to determine the cause or ignition sequence reliably. Fire cause determination, which will be discussed in Chapter **14**, is the process of identifying the first fuel ignited, the ignition source, and the oxidizing agent, as well as the sequence of events that brought these components together that ultimately resulted in the fire.

AREA & POINT OF ORIGIN

AREA OF ORIGIN OF ORIGIN CAUSE WILL BE VERY DIFFICULT
TO DETERMINE

POINT OF ORIGIN:
EXACT LOCATION



Determining the origin of the fire involves identifying the area where the fire started and then identifying the point where the fire started. These are referred to as the Area of Origin and Point of Origin.

The area of origin refers to the room, building, or general area where the point of origin is located. The point of origin is the exact location where the oxygen, heat source and the fuel came into contact with each other under the right circumstances resulting in ignition of the fire.

The area of origin can be vague or specifically defined. For example, in this garage fire the area of origin was not specifically known so the investigator identified the Area of Origin as the garage.

In this example the area of origin was the South West corner of the living room. The point of origin is where the fuel, heat and oxygen came together under the right circumstances to sustain combustion. In this case, the Point of Origin was on the sofa seat cushion near the right hand end of the sofa.

If the investigator can not determine the area of origin and point of origin it is very

difficult to determine the cause of the fire.

DETERMINING THE ORIGIN

DEPTH OF CHA

ELECTRONIC FA

FIRE PATTERNS

FIRE SPREAD ANALYSIS



Determining the origin of the fire relies on a number of factors that may include witness information, electronic data, fire patterns, fire spread analysis, depth of char, electrical faults, and fire dynamics.

Witness information may be valuable if they saw the fire start but can not always be relied upon. An example of that is a fire in a multi-storey factory where the first arriving fire and police personnel reported seeing the fire on the ground floor of the building. They were adamant that was where the fire started. Their information did not support the findings of the fire investigation team which determined the fire started in the basement of the structure. The first arriving units only had a view of two sides of the structure but, had they been able to see the other sides, they would have realized the fire started in the basement and travelled to the main and upper floors.

FIRE SPREAD ANALYSIS★

~~FIRE SPREAD ANALYSIS~~
FIRE DYNAMICS MUST ALSO BE CONSIDERED

IS THE DAMAGE & DATA CONSISTENT WITH THE
ORIGIN OF THE FIRE?



The purpose of fire spread analysis is to determine whether the resulting physical damage and available data are consistent with the origin of the fire. If damaged electrical components or circuits are found these could be indicators of the origin of the fire. A technical expert may be required to analyse this potential origin.

Depth of char can be used as an indicator of the direction of fire travel but not the length of burn time. Depth of char may indicate the location of fire origin and it may also indicate an area where the fire burned longer so deeper char depth is not conclusive proof of the area of fire origin.

Fire dynamics which includes the physics and chemistry of fire ignition and growth and the interaction between the fire and building systems must also be considered.

DETERMINING THE ORIGIN

Updated slide by changing title, no update to narration required

~~CONTACT THE FIRE ALARM~~
COMPANY

MAY INDICATE THE ORIGIN
OF THE FIRE



Electronic information may also be valuable. Modern fire alarm systems for example, may indicate the sequence that initiating devices responded to the fire. Initiating devices that respond first, may indicate the area origin of the fire. The investigator may need to contact the fire alarm company to determine if this information is available and to collect the information.

DETERMINING THE ORIGIN



In this case, the fire occurred in a three-storey apartment building in suite 204. The sole occupant of the suite said he heard the fire alarm and jumped out the bedroom window. He said that the door to suite 204 was not used to exit the suite but investigators did not believe him for several reasons, including the fact that there were no footprints in the snow where he would have landed if he jumped from the bedroom window.

The investigators contacted the fire alarm company and were able to determine the sequence of activation of the fire alarm system. The first initiating device to activate was the smoke detector in the hallway outside the suite. The second device to activate was the heat detector inside the suite. The door to the suite was tight fitting and provided heat and smoke separation from the hallway. For the smoke detector in the hallway to activate prior to the heat detector in the suite the door would have had to be opened to allow the passage of smoke.

This was not conclusive proof as to the cause of the fire but just one piece of the puzzle.

DETERMINING THE ORIGIN

SECURITY SYSTEMS

CLOSED CIRCUIT CAMERAS

BUILDING OR NEIGHBORHOOD

TIME SENSITIVE



Security systems can also be a reliable source of information as can closed circuit surveillance cameras. These systems may have captured events leading up to the fire or the actual ignition and development of the fire. This photo captured on a security camera shows a person spreading a liquid accelerant that resulted in a total loss house fire. Often security cameras produce low quality pictures but enough to determine that the fire was deliberately set. They may be systems associated with the building or neighborhood., but in many cases they are time sensitive as they may be recorded over regularly.

DETERMINING THE ORIGIN

BURN PATTERN ANALYSIS

DETERMINE IF DAMAGE/DATA ARE CONSISTENT
WITH THE ORIGIN OF THE FIRE

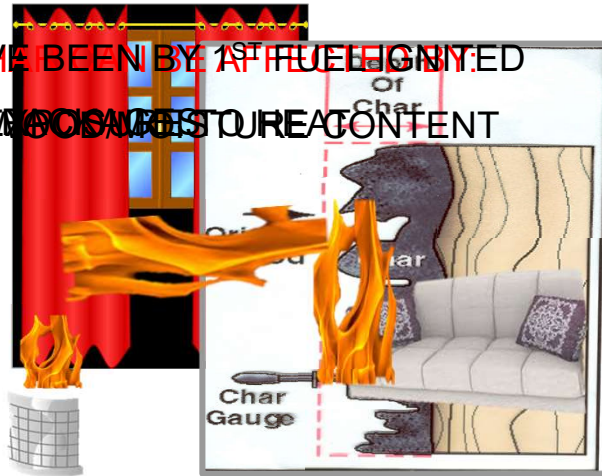


The analysis of the visual effects and burn patterns left by the fire may also lead the investigator to the origin of the fire especially if the fire does not reach the fully developed stage.

The purpose of fires spread analysis is to determine whether the resulting physical damage and available data are consistent with the origin of the fire. For example, if damaged electrical components or circuits are found these could be indicators of the origin of the fire. A technical expert may be required to analyse this potential origin.

DEPTH OF CHAR ★

~~MAY NOT HAVE BEEN BY 1ST FUEL IGNITED~~
~~ORIGIN OF FIRE MAY BE IN A DIFFERENT LOCATION~~



Depth of char in wood can be used as an indication of the direction of fire travel that could point towards the location of fire origin. In many cases, the depth of char is deeper near the origin of the fire but this can be effected by many factors including:

- The species of the wood and moisture content
- The length of exposure to the heat source
- Ventilation openings
- And
- Placement of other fuel packages.

Fire investigators must be aware however, that the fire patterns and depth of char may not have been created by the first fuel ignited. For example, a fire may have started in ordinary combustibles like a garbage can on one side of the room which ignited drapes over a window. The fire on the drapes spread across the room to a foam chesterfield. The chesterfield, having a much higher heat release rate, burned much more aggressively creating much deeper char patterns in an area well away from the origin of the fire.

Fire dynamics which includes the physics and chemistry of fire ignition and growth and the interaction between the fire and building systems must also be considered.

SYSTEMATIC APPROACH:

HIGHEST POINT LOWEST POINT



11

DETERMINING THE ORIGIN



A good example of missing evidence is in the case where an investigator was asked to attend the scene of a gas station/convenience store fire to assist the local fire inspector. The investigator was assigned to two fires that day so he stopped by the convenience store and met with the local fire inspector who said the store owner told him it was an electrical fire that started in the electrical room. They went into the electrical room and both agreed the fire originated under or at the electrical panel. The investigator recommended that the electrical inspector be called and then left the scene. Several days later the investigator received a call from the insurance adjuster assigned to the store. The adjuster asked the fire investigator if he had seen all the fire sets on the shelves throughout the store portion of the building. The fire investigator was embarrassed to admit that in his haste to move on to the second fire he did not work from the area of least damage to the area of most damage and missed a number of deliberately set fires.

ORIGIN DETERMINATION

SAFETY ASSESSMENT WILL BE REQUIRED?
RECOMMENDED METHOD OF EXAMINATION

- INITIAL SCENE ASSESSMENT
- 360 DEGREE ASSESSMENT OF EXTERIOR ORIGIN
- RECONSTRUCTION OF THE SCENE
- INTERNAL EXAMINATION



It is important for the fire investigator to develop a consistent approach to each type of fire they will be investigating. Checklists can assist in making sure nothing is overlooked, but they are not foolproof.

The recommended method of fire scene examination includes an initial scene assessment, a 360 degree assessment of the exterior, developing a preliminary hypothesis about fire spread, an internal scene examination, locating the origin of the fire, detailed examination of the origin of the fire, reconstruction of the scene and the development of a final hypothesis.

The initial scene assessment includes determining what resources will be required. Is it a multi-storey building or a garage fire? The manpower and equipment needs will probably be dramatically different. Initial assessment should also include a safety assessment to determine if the scene is safe to enter and what personal protective equipment will be required.

ORIGIN DETERMINATION

BUILDING OPENINGS PATTERNS

USE:
NOTES
PHOTOGRAPHS
SKETCHES



The fire investigator should do a 360 degree examination of the exterior of the structure and document it with notes, photographs and sketches. The exterior examination may identify what should and should not be at the scene. For example, the owner is a car buff and his 49 Ford which is always parked in the carport was move to another location the day prior to the fire. There may be a valid reason for this and the investigator will want to interview the owner to find out why it was moved.

Look for fire and ventilation patterns on the exterior of the buildings so these can be evaluated when doing the interior exam. The investigator will want to compare ventilation openings and patterns on the outside of the building with burn patterns on the interior. Do the patterns support the investigator's fire development hypotheses?

Look at building openings such as doors and windows to see what role they may have played in the fire. Were these doors in the open or closed position during the fire? (Tim please leave a pause).



One of the ways to tell the position of the doors during a fire is to examine the door frame, jam and door stop. In this case the door frame and door stop are clean and unburned so they were in the closed position during the fire which protected them from heat and direct flame contact.. (JULIE RED ARROW)

Where was the fire? (Tim please leave pause). The fire originated inside the building which was determined by the fire patterns on the inside of the doors.

Where inside the building did the fire start, on the right hand side or on the left hand side? (Tim please pause) The fire started on the right hand side because the line of demarcation from heat is lower on the right hand side than on the left. (JULIE YELLOW ARROWS)

The smoke and soot staining above the door occurred from the pressure built up inside the building and escaping at the top of the door during the fire.(JULIE RED CURVED LINE)



What about this door? Was it open or closed during the fire? (Tim please leave pause)

Which way did the door swing? (Tim please leave a pause)

The door swung outwards as can be determined by the hinges. (JULIE WHITE ARROW)

The door jam and door stop was protected during the fire (JULIE RED ARROW). This became a critical piece of information in the investigation. It was originally thought that this door had been in the open position which provided access to the building. The fire investigator was able to prove the door was closed during the fire.

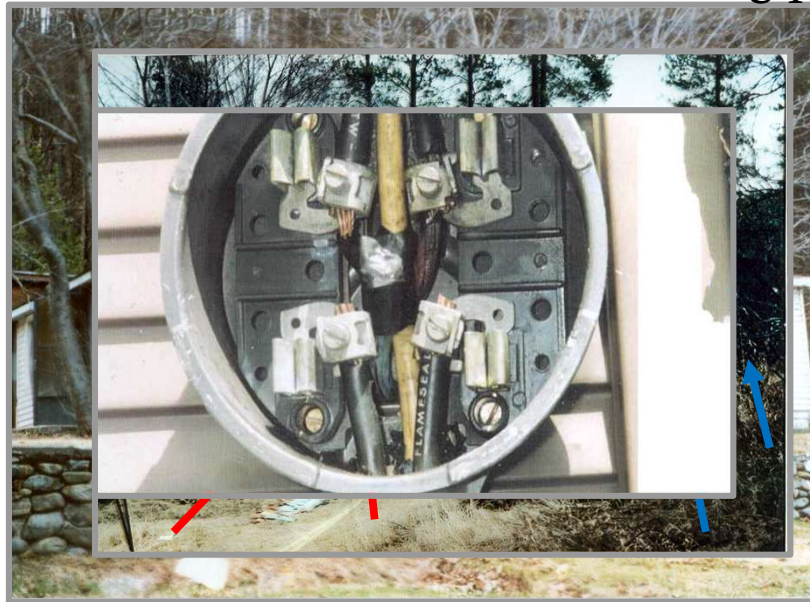


Was this door locked or unlocked? Tim please leave pause.

It was locked as can be seen in this photo. The clean area around the lock determined that the door was locked. (JULIE RED ARROW)

Investigators should also look for signs of forced entry and then determine through interviews if this was done by firefighters or someone else.

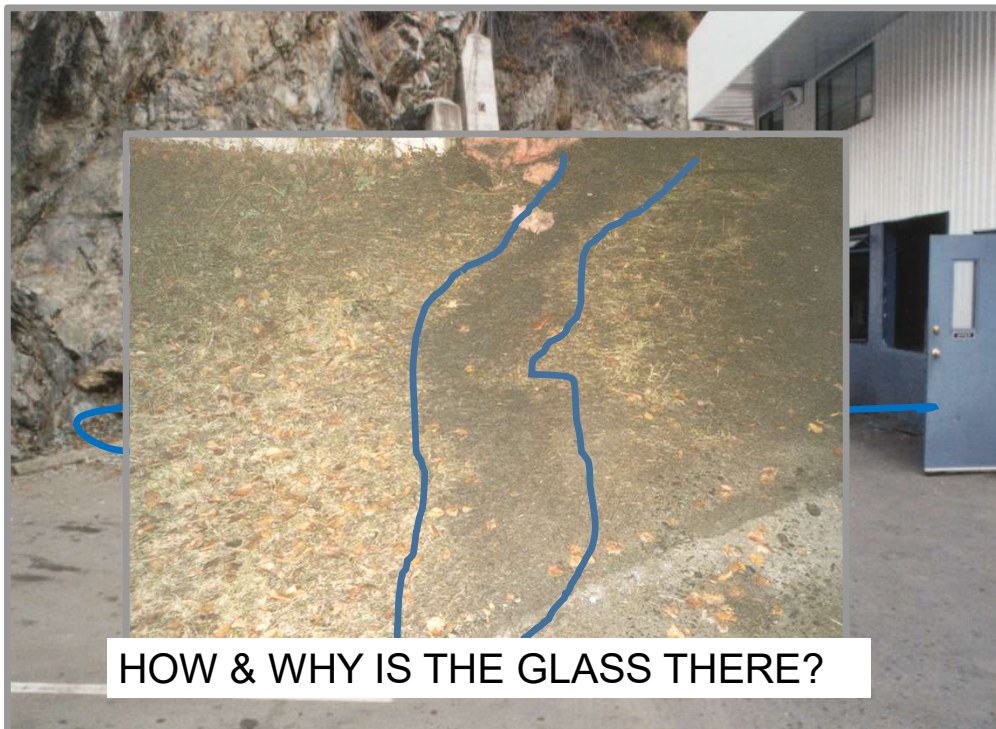
UTILITIES



Fire investigators look at and document the building utilities and other features during the exterior 360. In this case it is an older home and the utilities were disconnected at the time of the fire. JULIE RED ARROWS Investigators also noted that several windows were broken. JULIE BLUE ARROWS The investigator must determine the significance of these as part of the investigation. Most of the external fire damage was located on the Delta side of the building as shown in this photograph.

In this case, the electrical meter was bypassed, indicating criminal activity which would trigger police involvement in the investigation. The theft of electrical power could be the extent of the criminal activity but in this case and most cases it is an indication of an illegal marijuana grow operation. Identifying this raises concerns for the safety of the firefighters but also the fire investigators.

GLASS - DEFLAGRATION



Also, look for glass on the outside of the structure which may indicate the origin of the fire. It is normal to find broken glass at a structure fire but if the glass is more than a few feet from the building footprint, the investigator will have to determine how and why it is there. In this case, a natural gas vapor explosion occurred causing a deflagration which blew the windows out of the building. Explosions will be covered in detail later in this course.

Investigators should also look for unusual patterns outside the building. What would cause a pattern like this? (Tim please pause)

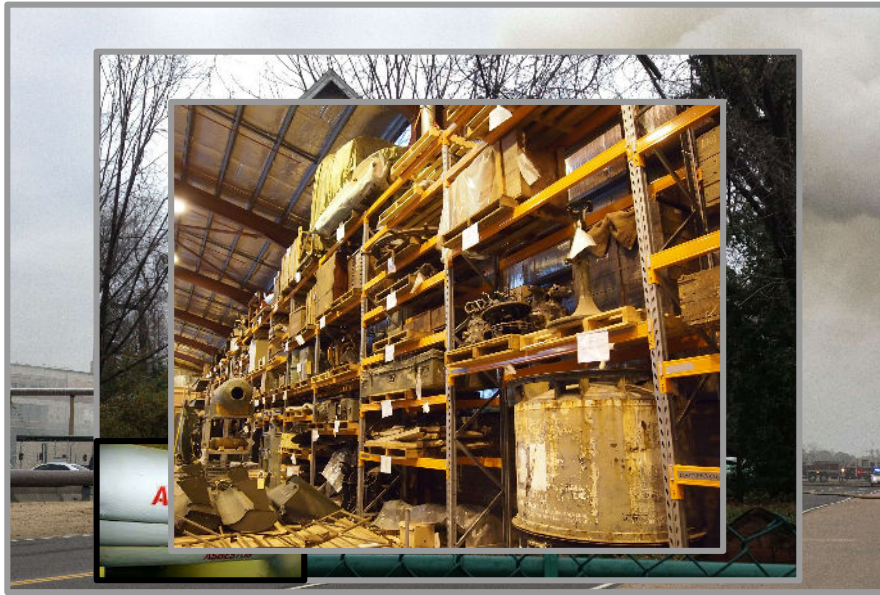
It is a pour pattern from an ignitable liquid that was used as a trailer to spread the fire from outside to inside the building. Fire investigators should quickly capture a sample of the earth for laboratory analysis.

WITNESS VIEW POINTS



Investigators also look for potential witness vantage points from which the fire or explosion may have been observed. In this case, the neighbors in the house in this photograph were interviewed and they heard and felt the explosion but they did not see anything. However, the neighbor in this house, which is located across the valley, witnessed the house explosion as he was standing on his deck and described what he said was a tremendous boom and the house just disappeared. Two people were killed in the explosion.

USE & OCCUPANCY



Determine the use and occupancy classification of the structure prior to the fire, as the use of the building may provide information about safety concerns that may be present. In this case, the building was a military warehouse. Fire investigators would need to know what was stored in the building. This information may provide the investigators with clues about the potential hazards they may encounter when performing the internal survey.

Fire investigators will try to determine the age of the building as part of in the initial scene assessment. Older buildings are more likely to have specific hazards such as asbestos wrapped pipe, or floor coverings made from asbestos, which can delay or even prevent the investigation from moving forward.

Often old buildings can be designated as heritage sites which would limit the property owners ability to replace or renovate the structure. In some cases, the property value would increase dramatically if the building was not there. Imagine how the property value could change if this heritage building was replaced with a high-rise or multi-family complex.

INTERNAL SURVEY

COMPARE OTHER THINGS TO CONSIDER:

- PRE-EXISTING BUILDING PROTECTION/ALARMS
- BUILDING MAINTENANCE
- EXPLOSION DAMAGE



The next step in identifying the origin of the fire is the internal examination or survey. The internal survey works from the area of least damage to the area of most damage. The investigator should check all rooms and areas inside the building.

The damage on the interior should be compared with the exterior damage to establish the fire growth hypotheses.

Other things to consider while performing the interior survey include:

- the pre-fire conditions of the building
- the contents of the structure
- storage
- housekeeping
- building maintenance
- areas of fire or explosion damage
- HVAC, electrical, fire protection and alarms
- wall and floor patterns
- position of doors and windows and other ventilation openings
- fire travel indicators including heat, smoke, and burn patterns

And

- the extent of fire damage in each area.

INTERNAL SURVEY

PRE-FIRE CONDITIONS

DAMAGED FIRE
SEPARATION DOORS



Fire investigators try to identify the pre-fire conditions of the building including construction details and/or defects such as holes in walls and floors that may allow the fire to enter concealed spaces. They also check for damaged fire separations or doors that are removed or propped open during the fire which could lead to fire spread and development away from the origin of the fire.

In this case, the fire started on the ground floor at the rear of the building and travelled upwards to the top floor because the fire separation doors in the rear stair tower were propped open with elephants feet. Had the fire separation doors been working as designed, the fire would have been contained and loss of life would be unlikely.

INTERNAL SURVEY

BUILDING CONTENTS

WHAT YOU WOULD EXPECT? NOT EXPECT?



During the internal survey the building contents should be identified. Are the contents that you would expect to find in this occupancy there? If not, the investigator will want to interview the owner or occupants about the content. Are there things one would not expect to find? Again, interviewing the occupants may explain this.

This is a restaurant fire that occurred after the restaurant closed for the day. One of the kitchen staff carried some food down to a cooler in the basement storage area just before closing and locking the building. After extinguishment the fire investigator questioned the kitchen staff about the number of cardboard boxes in the basement. The staff member said that the boxes were not there when she placed the food in the cooler the previous night. The fire in this area was extinguished when a soldered joint in a copper water line running along the ceiling melted and the water escaped and acted as a sprinkler system. The cardboard was added as additional fuel load which did not ignite.

INTERNAL SURVEY

~~MAINTENANCE~~
~~HOUSEKEEPING~~

BUILDING MAINTAINED?



Identify the level of housekeeping in the structure. Poor housekeeping can contribute to the cause and spread of the fire. Combustible materials can spread the fire from one area to another and act as ladder fuels so the flame plume reaches the ceiling faster.

Building maintenance should also be observed and documented. If the building is well maintained it will inhibit the spread of fire but if things are left in a state of disrepair or clutter fire spread may go unchecked.

Doors that do not close and latch properly or are not tight fitting can allow the fire, smoke and hot gasses to spread from one compartment to another. Holes in fire separations can result in fire travelling into concealed spaces making fire suppression difficult and the extent of damage more severe.

Look for evidence of explosion damage. This could include obvious damage, but also, subtle damage like the bulging of a wall.

INTERNAL SURVEY

FIRE PROTECTION SYSTEMS

OTHER PROTECTION SYSTEMS MAINTAINED AS WELL

MAINTAINED AS REQUIRED?

DEFICIENCIES NOTED?



HVAC systems can assist in controlling the spread of fire or they can enhance the development and spread of fire. Some HVAC duct systems are equipped with fire detectors and fire dampers to prevent the spread of fire. The condition and location of these devices should be documented and if it's a monitored system, records should be reviewed. One way to determine if HVAC systems were operating at the time of the fire is to inspect the filters for accumulation of soot or heat damage.

Careful examination of building fire protection systems should be performed. If the building is equipped with a sprinkler system it should be connected to the fire alarm system and monitored. The sequence of activation of sprinkler heads may be recorded by the fire alarm control panel which may support the hypothesis of fire development and spread. Each individual sprinkler head should be examined to determine if the fusible link melted allowing for the release of water from the system.

Other fire protection systems maintenance documents should be checked as well. Are they maintained as required, or are there deficiencies noted? In this case, the inspection tag on the standpipe and hose system indicates that additional work was required. Did this have any effect on the growth of the fire?

INTERNAL SURVEY

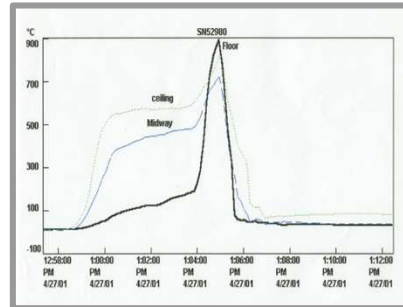
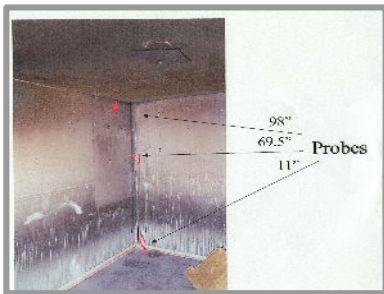
WALL COVERINGS



Fire investigators must consider how, or if, wall coverings contributed to the development and spread of the fire. In this case, the home was owned and maintained by the company and provided to the employee as part of the compensation package. The home was painted regularly by the company and over time paint built up on the walls and cabinets, as can be seen in this photo. When heated, the paint would blister and flake off the walls and become burning sheets in the air. In one test, a 10' X 10' room was set on fire using a 2 cubic foot cardboard carton as the only fuel package in the room with no other furnishings. The paint blistered and came off the walls and full room involvement was achieved in less than a minute and a half.

INTERNAL SURVEY

FLOOR COVERINGS



Fire investigators sometimes fail to consider floor coverings as part of the fuel package. This is another test fire to determine the hottest point in the room. Thermocouples were placed at 98" , 69.5" and 11" above the floor and the synthetic carpet in the room was ignited. To the surprise of the investigators, the hottest point in the room was 11" above the floor as can be seen in this graph. Most firefighters are taught that the hottest point in the room is at ceiling level but that was not true in this fire.

It is important to identify the type and make of the carpet, if possible, so that exemplars can be used in testing the hypothesis.

INTERNAL SURVEY ★

DIRECT INDICATORS: FIRE DAMAGE
HEAT, SMOKE, BURN PATTERNS
REACHED FULLY DEVELOPED STAGED?



Room Dimensions		Floor Plan	
Width	Length	Room #	Area
_____	_____	_____	_____

Walls: Structural/material	Thickness	Covering	Sample? Y/N
Structural/material	Thickness	Covering	Sample? Y/N
Ceiling: Structural/material	Thickness	Covering	Sample? Y/N
Floor: Structural/material	Thickness	Covering	Sample? Y/N

Openings (door, window, other vents) into room (number on plan above):				
Height (bottom to top of opening)	Sill Height	Soffit Depth (above opening)	Width	Open or Closed? (Change During Fire?)
1	_____	_____	_____	_____
2	_____	_____	_____	_____
3	_____	_____	_____	_____
4	_____	_____	_____	_____
5	_____	_____	_____	_____
6	_____	_____	_____	_____
7	_____	_____	_____	_____

HVAC System:
 Description: _____
 Operated prior to/ during fire? _____

Furniture (descriptions of major fuel items, including floor and wall coverings, draperies):

Time Line: Alarm time _____ PD arr. time _____ Control time _____
 Detection _____
 Pre-Fire Events: _____



The investigator should determine the severity of fire damage and which rooms reached the fully developed stage and how ventilation affected fire development. Fire travel indicators including heat, smoke, and burn patterns can be used to help determine the origin of the fire.

The position and condition of doors, windows and other potential ventilation openings like skylights can also play a major role in determining the origin of the fire and should be accurately documented. Room dimensions are the most frequently overlooked element of scene documentation. It is vital for reconstruction to have reasonably accurate dimensions of walls, floors, ceiling heights, window and door openings with sill and soffit heights. Dimensions are essential for any fire engineering study which will be done manually or computer-based.

DEBRIS REMOVAL & SCENE RECONSTRUCTION



As part of the overhaul process, fire suppression personnel are often required to move furnishings and other articles in the area of origin of the fire. In most cases, the items that were moved must be put back in place to analyze fire patterns accurately. Most firefighters are trained to remove debris carefully so they should be interviewed to find out if they know the original location of the articles, why they moved them, and if they documented the scene prior to overhaul.

In this case, the firefighters did an excellent job. They removed the debris from the scene but protected it with tarps and placed all items together. When investigators arrived the scene looked like this, minus the yellow picture identifiers. There were very distinct heat shadows on the walls and an irregular pattern on the floor. The heat shadows helped the investigator return the furnishings to their pre-fire positions accurately.

DEBRIS REMOVAL & SCENE RECONSTRUCTION ★



When the scene was reconstructed there were very distinct burn patterns visible on the floor and furnishings. Because the room did not reach flashover, interpretation of the burn patterns was straight forward. The irregular burn pattern on the floor in front of the chest of drawers is consistent with an ignitable liquid. The burn pattern extended under the chest of drawers which is also an indication that an ignitable liquid was present. If it was not an ignitable liquid, how would the burn pattern be present under the chest of drawers? The laboratory confirmed an ignitable liquid was present in the location of the fire origin. The final determination was that this was an incendiary fire set by a juvenile fire setter.

The firefighters did not need to remove all the furnishings due to the limited fire damage in the room of origin, but they did so very carefully which allowed for the scene to be accurately reconstructed.

Of note all the drawers in the dresser were the same size so great care was needed to make sure they went back in, in the right order. The mother of the juvenile was able to confirm the location of the drawers.



Here is another example of the value of fire scene reconstruction. Investigators determined the cause of this fire was accidental resulting from inadequate clearance from combustibles. The single walled smoke pipe used to vent this solid fuel appliance, a wood stove, was too close to other combustible materials resulting in the fire. When the area was reconstructed there was only 2" clearance from the wall. As they say, a picture is worth a thousand words.

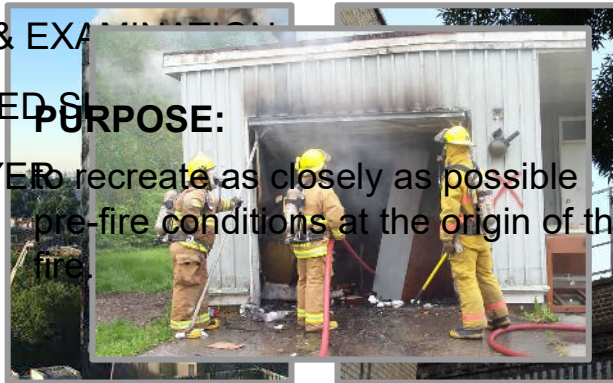
Fire investigators must take care, however, to ensure accurate scene reconstruction so that false data is not included in their analysis.

DEBRIS REMOVAL & SCENE RECONSTRUCTION

EXCAVATION & EXAMINATION

MUST PROCEED SLOWLY

LAYER BY LAYER
PURPOSE:
To recreate as closely as possible pre-fire conditions at the origin of the fire.



Fire scene excavation and examination is like an archeological dig. The investigator must proceed slowly and remove the debris layer by layer so that nothing is missed and so burn patterns can be exposed. Depending on the extent of damage, the excavation can be fairly simple or it may be very complex requiring a lot of manpower. For example, the Grenfell fire in London England in 2017, that claimed 71 lives, took months for investigation teams to search the entire building for human remains.

In the case of this garage fire, the area was limited so the excavation was simple and done by hand.

The purpose of fire scene reconstruction is to recreate as closely as possible pre-fire conditions at the origin of the fire.

DEBRIS REMOVAL & SCENE RECONSTRUCTION

DOCUMENTATION BEFORE & AT KEY INTERVALS

SAFETY 1ST



Heavy equipment will sometimes be required to assist with the scene excavation especially when there is the potential for building collapse or other safety issues. In the case of this old hotel, a strong gust of wind would likely cause the walls to fall. This fire was suspected to have been deliberately set so an accelerant detection dog searched the scene prior to using heavy equipment which could contaminate the scene. Once the dog completed it's work, the excavator was used to lay the walls down flat.

The type of construction may also necessitate the use of shoring and blocking before investigators can enter the scene. This is tilt up construction and investigators are wise to remember it tilts down much quicker than it tilts up.

The scene should be thoroughly documented before and at key intervals during the excavation.

Fire investigators must make sure the scene is safe for themselves and anyone else that may enter the area.

DEBRIS REMOVAL & SCENE RECONSTRUCTION

ANALYSIS OF SCENE AS TO SAFETY
FIREFIGHTERS & OCCUPANTS

PHOTOS & BUILDING PLANS
CAN BE USEFUL



The purpose of fire scene excavation and reconstruction is to recreate as closely as possible pre-fire conditions in the area of origin of the fire. Interviews with firefighters and occupants, photos and building plans can be helpful in determining pre-fire conditions.

In this case, the pre-fire photo was provided by the building owner. As can be seen, it was an older three storey hotel prior to the fire, but post fire the top two storeys were either consumed or collapsed onto the ground floor. Again, an excavator was used to carefully remove the debris.

A briefing session should be held with the equipment operator outlining the method and speed of the excavation. The fire scene excavation will probably be much slower than the machine operator is used to. Understanding hand signals used to communicate with the operator will greatly increase the safety and efficiency of the **excavation**.

If performing body recovery as part of the excavation be sure that the machine operator is aware and prepared.

DEBRIS REMOVAL★

HANDS-ON APPROACH IS THE MOST EFFECTIVE WAY

TOGETHER WITH SCIENTIFIC METHOD

WILL LEAD TO THE ORIGIN & CAUSE



DEBRIS MAY NEED TO BE TRANSPORTED



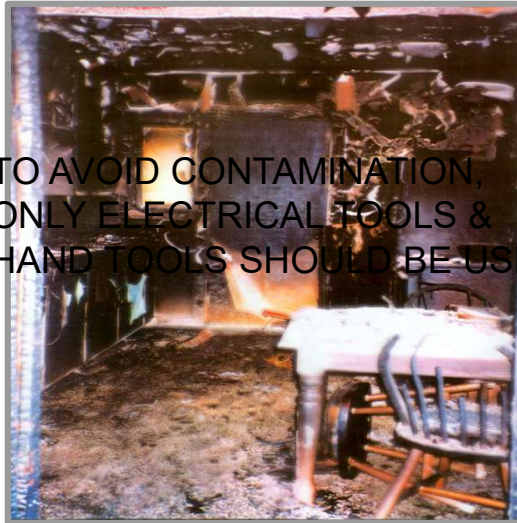
The removal of fire debris is a critical step in discovering evidence of the fire origin and to interpret burn patterns. While heavy equipment can assist in the debris removal process, especially with objects that are too heavy for the fire investigator to lift, a simple hands-on approach to excavating the origin of the fire is the most effective way to process the scene. This hands-on approach together with the scientific method, will lead fire investigators to the origin and cause.

The fire investigator must plan for the removal of fire debris. Depending on the location of the fire, and the surrounding area, debris may have to be transported away from the scene. Debris should be moved to an area that is not involved in the fire or an area that has already been examined.

Debris removal can be an expensive process so the investigator should know in advance who is going to pay for the removal and disposal of the debris. It is a good idea to put this in writing.

DEBRIS REMOVAL

TO AVOID CONTAMINATION,
ONLY ELECTRICAL TOOLS &
HAND TOOLS SHOULD BE USED



In structure fires, burn patterns are normally located on the floor, along baseboards, walls, ceilings, and on the furnishings in the room. Depending on the stage of fire development, these areas are often covered by fire debris which must be removed to uncover evidence and accurately analyze fire patterns. To do this effectively, a systematic and detailed process must be performed to remove the debris using hand tools like shovels, rakes and brooms. Once the larger debris is removed by hand and shovel, a broom can be used to clean up the charred areas. Using a broom for the final clearing of debris can avoid damage caused by shovels.

To avoid contamination of the scene, only electric powered tools and manual hand tools should be used.

FLOOR PATTERNS

**WASHING MAY REVEAL
BURN PATTERNS
RAINBOW PATTERN
LAB SAMPLES
INDICATIVE OF
HYDROCARBON FUEL
AFTER
DOCUMENTATION**



Washing the floor after all the debris removal has taken place may reveal burn patterns. This should only be done after the floor has been properly documented and samples have been taken. Char patterns, or alligatoring, on wood floors were once considered to indicate the use of an ignitable liquid. Today, this type of pattern can easily be created by radiant heat. Washing the floor may reveal a rainbow colored pattern indicative of a hydrocarbon fuel. The hydrocarbon fuel, being lighter than water, will float to the surface. When this occurs additional samples for lab analysis should be taken.

Do you think this burn pattern was caused by radiant heat or an ignitable liquid on the floor? (Tim please leave a pause)

Have a look at the video of this fire.



Tim: I would like to take out the swear word if possible but we can leave the rest.

Julie, the video with the swearing removed is pasted in this slide and just needs formatting – unless we want to embed it from YouTube., Tim



It is unlikely that the chair would still be in this position after suppression activities but if it was, or the scene was reconstructed accurately, it is easy to tell at a glance that this was radiant heat. The seat of the chair is burned but the floor underneath the chair is a protected area. The damage to the floor was caused by radiant heat.

DEBRIS REMOVAL

SMALL PIECES OF
EVIDENCE:

PROPER DEBRIS REMOVAL
Fire investigation without proper debris removal and scene reconstruction leaves room for errors and assumptions as to the fire origin.



Photo courtesy of Monty McGill

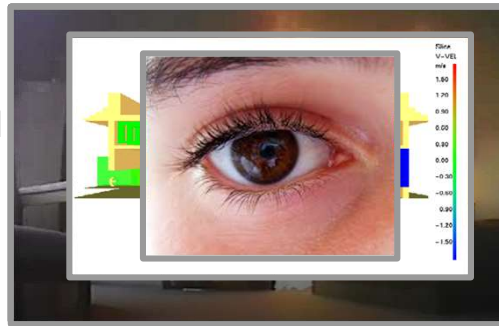


In some fire investigations it may become important to look for very small pieces of evidence in the debris. This could include, but is not limited to, personal effects that were supposed to be in the fire, parts of an explosive device, a timing delay device or small pieces of human remains. When searching in this detail, useful tools include sifting screens such as the one in this photo which was provided courtesy of Monty McGill. These screens are easy to build on-site and the mesh size can differ depending on the needs of the fire investigator.

Fire investigation without proper debris removal and scene reconstruction leaves room for errors and assumptions as to the fire origin. Merely kicking around debris and assuming the origin of the fire based on the heaviest or deepest charring without debris removal and contents reconstruction is a dangerous practice.

OTHER CONSIDERATIONS

OTHER
CONSIDERATIONS



Obviously, there are many other considerations when fire investigators are determining the origin of the fire.

It is important to identify the pre-fire conditions of the room and contents. Detailed documentation of the contents or the remains of the contents should be done. Owners or occupants of the building may be able to provide pictures or sketches of the pre-fire location of items of interest.

Computer models are sometimes used to simulate the growth and spread of the fire. The accuracy of these models depends to a large degree on the accuracy of the information being entered into the program.

Eye witnesses may also be a good source of information about the origin of the fire. It is important to remember however that witnesses may be unreliable. In all the wrongful convictions that have been overturned in US courts by DNA evidence, over seventy percent of the original convictions were based on eye witness testimony.

HYPOTHESIS

HYPOTHESES ARE FORMED BY:

DO NOT JUST TRY TO PROVE THE INITIAL HYPOTHESIS!

A valid origin determination is one that is based on deductive reasoning.

- INTERVIEWING WITNESSES
- INITIAL SCENE ASSESSMENT
- INTERPRETING FIRE PATTERNS

INITIAL HYPOTHESIS MAY CHANGE



Fire investigators may form several hypotheses about the origin of the fire. These hypotheses are formed by interviewing witnesses, conducting the initial scene assessment, and by interpreting the movement and intensity patterns of the fire. The investigation should be conducted so that it does not focus on trying to prove the initial hypothesis but is open to all other possibilities. The investigator may change the initial hypothesis many times as the investigation proceeds, so they must keep an open mind.

In order to confirm the hypothesis in line with the scientific method, the investigator must test it using deductive reasoning. For example, in this fire the owner was adamant that the louvered closet doors were closed when she left the residence. Burn patterns tell otherwise. If a witness said that a door was in the closed position during the fire, this could be confirmed by examining the door jam and the area under the door leaf for protected areas.

A valid origin determination is one that is uniquely consistent with the available data.

Julie we need to highlight the shadow where the bifold doors protected the floor showing that they were in the open position.

HYPOTHESIS

WHEN EVALUATING THE HYPOTHESIS, QUESTION:
REVIEW INVESTIGATION PROCESS

CONSIDER ALTERNATIVE ORIGIN?
CONSISTENT WITH DATA?



POSSIBLY,
ADDITIONAL INVESTIGATION



The investigator should ask the following questions when evaluating the hypothesis:

- Is there a competent ignition source at the point of origin of the fire?
- Would a fire starting at this point, result in the observed damage?
- Is the fire growth and development consistent with the available data?
- Are the time lines consistent with the growth of the fire?

Once the final hypothesis has been identified and tested, the investigator should review the entire investigation process to ensure all data is accounted for. When using the scientific method, failing to consider alternative hypotheses is a serious error. Investigators should ask themselves “Are there any other origin hypotheses that are consistent with the data?” If so, additional investigation is required, or the origin of the fire is undetermined.

END OF CHAPTER 13



That's the end of **Chapter 13**.

Please Move on to Part **1** of **Chapter 14** which deals with **Cause Determination** but **please do the quiz for this chapter first**.