NFPA 921 – 2017 Edition

NSW AFI

IAAI Chapter 47

NSW Association of Fire Investigators

Contents

Randy Watson

Randy Watson

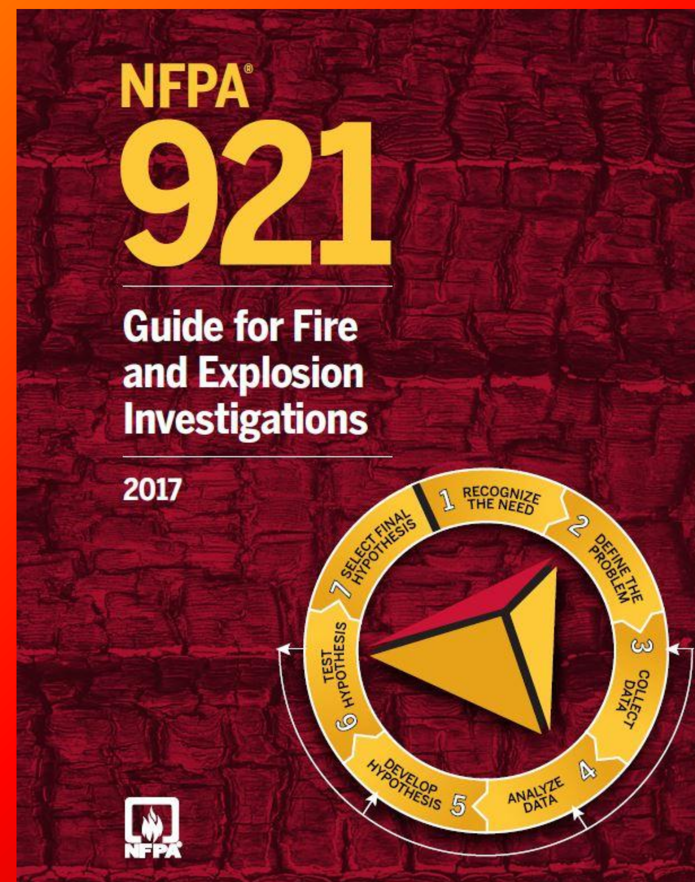
- Been on the NFPA 921 Technical Committee since 1991.
- Chairman of that committee since 2008.
- On the Technical Committee for NFPA 1033.
- IAAI Board of Directors
- IAAI-CFI, IAAI-CI, CFEI, CVFI, CFII,

F-IAFI

QUALIFICATIONS

VS

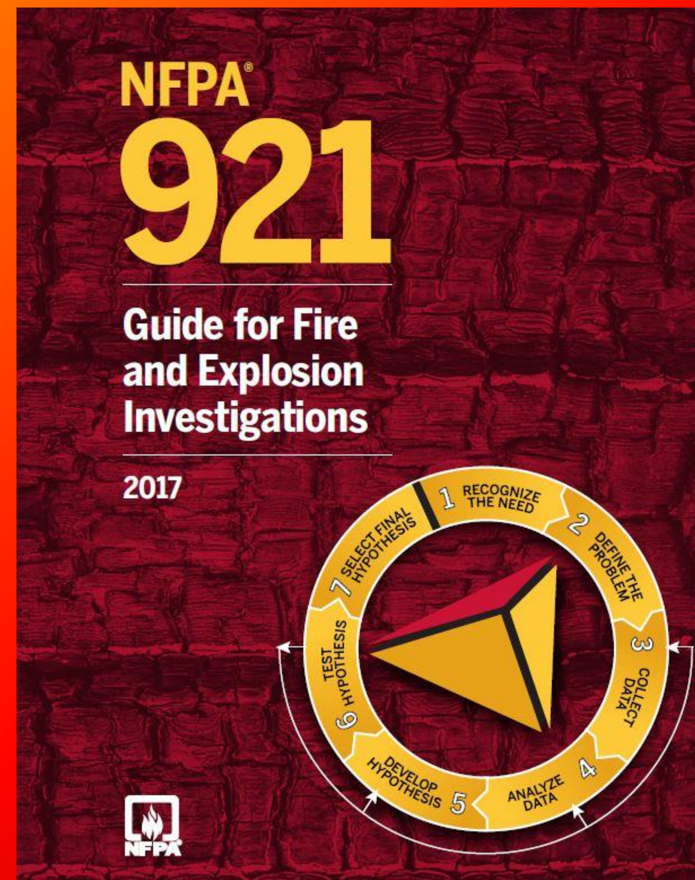
METHODOLOGY



REQUIREMENTS TO BE!

WHAT ACTIVITY TO DO!

VS



HOW

(APPLICATION)

Certifications depend on 921 and 1033

The application of NFPA 921

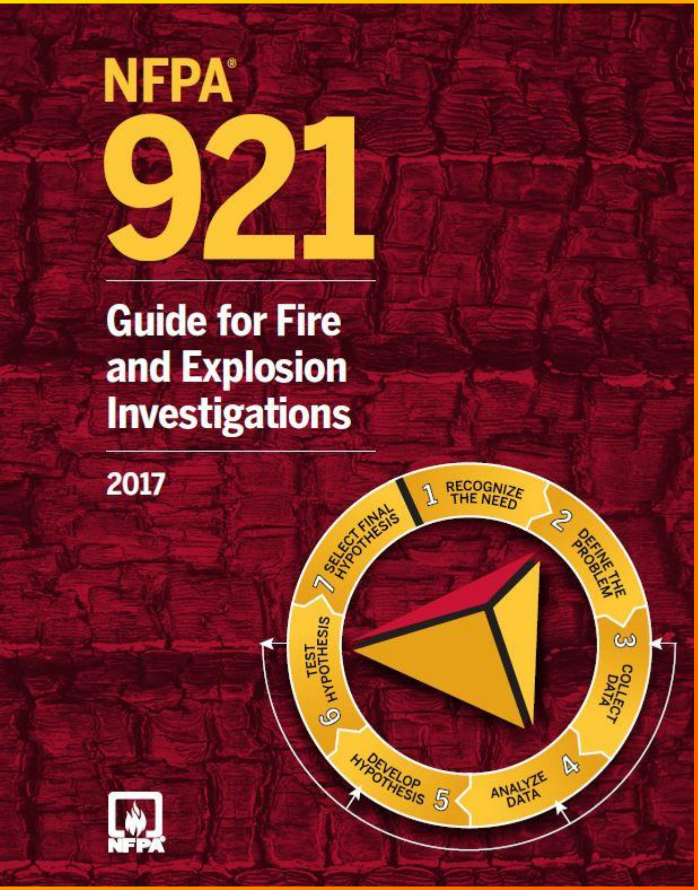
1.3.5 This document is not intended as a comprehensive scientific or engineering text. Although many scientific and engineering concepts are presented within the text, the user is cautioned that these concepts are presented at an elementary level and additional technical resources, training, and education may often need to be utilized in an investigation.

Code of Ethics

As fire, arson, and explosion investigators, we shall:

- Regard ourselves as members of a vital and ethical profession;
- Conduct both our personal and official lives so as to inspire the confidence of the public;
- **Regard it as our duty to avail ourselves of every opportunity to learn more about our profession;**
- Encourage and support professional standards for fire, arson, and explosion investigators;
- Avoid alliances with those whose practices are inconsistent with an honest and unbiased investigation; and
- Bear in mind that we are first and foremost truth-seekers, not case makers; it is our duty to protect the innocent and hold accountable those responsible for loss by fire or explosion.

2017 EDITION



- More colour images throughout
- Chapter 1 – NFIRS (US only)
- Definitions – 12 new and 5 revised
- Chapter 5 – Fire Science
- Chapter 8 – Fire protection systems
- Chapter 9 – Electrical
- Chapter 16 – Documentation
- Chapter 18 – Origin
- Chapter 19 – Cause
- Chapter 20 – Explosions (dust)
- Chapter 27 – Vehicles
- 426 pages – 30 chapters
- 204 definitions

2017 EDITION

This edition includes the following usability features as aids to the user. Technical changes are indicated by gray shading of the sections. An entire figure caption or table title with gray shading indicates a change to an existing figure or table. New sections, figures, and tables are indicated by a bold, italic ***N*** in a gray box to the left of the new material. Where one or more sections have been deleted, the deletion is indicated by a bullet (•) between the sections that remain.

2017 EDITION

3.3.101* Heat. A form of energy characterized by vibration of molecules and capable of initiating and supporting chemical changes and changes of state.

3.3.102 Heat and Flame Vector. An arrow used in a fire scene drawing to show the direction of heat, smoke, or flame flow.

3.3.103 Heat Flux. The measure of the rate of heat transfer to a surface or an area, typically expressed in kW/m^2, or W/cm^2.

3.3.104* Heat of Ignition. The heat energy that brings about ignition.

3.3.105* Heat Release Rate (HRR). The rate at which heat energy is generated by burning.

N **3.3.106 Heat Transfer.** The exchange of thermal energy between materials through conduction, convection, and/or radiation.

30 Chapters

1 Administration
2 References
3 Definitions
4 Methodology
5 Fire Science
6 Patterns
7 Building Systems
8 Fire Protection
9 Electricity
10 Fuel Gas Systems
11 Human Behaviour
12 Legal
13 Safety
14 Sources of Info
15 Planning
16 Documentation
17 Evidence
18 Origin
19 Cause
20 Classification of cause

30 Chapters

21 Responsibility
22 Failure Analysis
23 Explosions
24 Incendiary
25 Deaths and Injuries
26 Appliances
27 Vehicles
28 Wildfire
29 Complex
30 Marine

Annexes
A Explanatory
B Bibliography
C Information
D Photo Credits

2017 EDITION

Definitions: New

- Fire Area: The boundary of fire effects within a scene in which the area of origin will be located. The fire area is characterized by identifying the border between damaged and undamaged areas characterized by fire effects and patterns created by flame, heat and smoke.

- Thermodynamics: The branch of physics that deals with the relationship
between heat and other forms of energy.

- Heat Transfer: The exchange of thermal energy between material through conduction, convection and /or radiation.

2017 EDITION

Definitions: New

- Active Fire Protection System: A system that uses moving mechanical or electrical parts to achieve a fire protection goal.

- Energy: Energy is a property of matter that is manifest as an ability to perform work, either by moving an object against force or by transferring heat.

2017 EDITION

Definitions: New

- Explosible: A material with a pressure ratio (maximum pressure/pressure at ignition, in absolute units) equal to or greater than 2.0 in any test when tested using the explosibility or go/no-go screening test described in Section 13 of ASTM E1226, Standard Test Method for Explosibility of dust Clouds.

- Explosion Dynamics: The detailed study of how chemistry, physics, fire science, the engineering disciplines of fluid and solid mechanics, and heat transfer interact to influence explosion behavior.

2017 EDITION

Definitions: New

- Fire Effects: The observable or measurable changes in or on a material as a result of a fire.

- *Hybrid Mixture: An explosible heterogeneous mixture, comprising gas with suspended solid or liquid particulates, in which the total flammable gas concentration is > 10 percent of the lower flammable limit (LFL) and the total suspended particulate concentration is > 10 percent of the minimum explosible concentration MEC).

2017 EDITION

Definitions: New

- Minimum Explosible Concentration (MEC): The minimum concentration of a combustible dust cloud that is capable of propagating a deflagration through a uniform mixture of the dust and air under the specific conditions of test.

- Passive Fire Protection System: Any portion of a building or structure that provides protection from fire or smoke without any type of system activation or movement

- Power: Power is a property of a process such as fire that describes the amount of energy that is emitted, transferred, or received per unit time. Power is measured in joules per second (J/s) or watts (W)

2017 EDITION

Definitions: Revised

- Heat Flux: The measure of the rate of heat transfer to a surface or an area, typically expressed in kW/m2, W/cm2

- Incendiary Fire: A fire that is intentionally ignited in an area or under circumstances where and when there should not be a fire.

2017 EDITION

Definitions: Revised

• Overload: Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

2017 EDITION

Definitions: Revised

- Point of Origin: The exact physical location within the are of origin where a heat source and a fuel first interact, resulting in a fire or explosion.

- Radiant Heat: Heat energy carried by electromagnetic waves that are longer than visible light wave and shorter than radio waves; radiant heat (electromagnetic radiation) increases the sensible temperature of any substance capable of absorbing the radiation, especially solid and opaque objects.

2017 EDITION

Definitions: Revised

- Scientific Method: The systematic pursuit of knowledge involving the recognition and definition of a problem; the collection of data through observation and experimentation; analysis of the data; the formulation, evaluation and testing of ~~a hypothesis~~ hypotheses; and when possible, the selection of a final hypothesis.

2017 EDITION

4.3.6 Testing the Hypothesis (deductive reasoning)

The investigator does not have a valid or reliable conclusion unless the hypothesis can stand the test of careful and serious challenge. Testing of the hypothesis is done by the principle of deductive reasoning, in which the investigator compares the hypothesis to all known facts as well as the body of scientific knowledge associated with the phenomena relevant to the specific incident. <u>Testing of hypothesis should be designed to disprove, or refute, the hypothesis. This may also be referred to as falsification of the hypothesis. Working to disprove a hypothesis occurs when an attempt is made to find all the data, or reasons, why the hypothesis is not supported, or not true, rather than simply finding and relying on data that supports the hypothesis , or why the hypothesis is true. This method of testing the hypothesis can prevent "confirmation bias," which can occur when the hypothesis or conclusion relies only on supporting data (see Section on Confirmation Bias). .....</u>

2017 EDITION

4.3.9* Confirmation Bias

Different hypotheses may be compatible with the same data. When using the scientific method, testing of hypotheses should be designed to disprove the hypothesis (falsification of the hypothesis), rather than relying only on confirming data that support the hypotheses.. Confirmation bias occurs when the investigator relies exclusively on data that supports the hypothesis and fails to look for, ignores, or dismisses contradictory, or non-supporting data. The same data may support alternate or even opposing hypotheses. The failure to consider alternate or opposing hypotheses, or prematurely discounting seemingly contradictory data without analysis and testing can result in incorrect conclusions. A hypothesis can be said to be valid only when rigorous testing has failed to disprove the hypothesis. Disproving the hypothesis is a process in which all the evidence is compared against the proffered hypothesis in an effort to find why the hypothesis is not true.

2017 EDITION

4.3.6.1

Any hypothesis that is incapable of being tested either physically or analytically, is an invalid hypothesis. A hypothesis developed based on the absence of data is an example of a hypothesis that is incapable of being tested. The inability to refute a hypothesis does not mean that the hypothesis is true.

2017 EDITION

4.3.7 Select Final Hypothesis

The final step in applying the Scientific Method is to Select the final hypothesis. Once the hypothesis has been tested, the investigator should review the entire process, to ensure that all credible data are accounted for and all feasible alternate hypotheses have been considered and eliminated. When using the Scientific Method, the failure to consider alternate hypotheses is a serious error. A critical question to be answered is, "Are there any other hypotheses that are consistent with the data?" The investigator should document the facts that support the final hypotheses to the exclusion of all other reasonable hypotheses.

2017 EDITION

Chapter 5 Basic Fire Science

5.1.1 Fire and Energy. Fire is a rapid oxidation process, which is an exothermic chemical reaction, resulting in the release of heat and light energy in varying intensities. It is therefore important that the fire investigator understands the basic concepts of energy, power, and radiant heat flux, and how the units of measurement of these properties are used to describe the behavior of fire.

2017 EDITION

Chapter 5 Basic Fire Science

5.1.2 Energy. Energy is a property of matter that is manifest as an ability to perform work, either by moving over a distance or by transferring heat. Energy can be changed in form (e.g., from chemical to mechanical energy), or transferred to other matter, but it can neither be created nor destroyed. Energy is measured in joules (J) or calories (cal) or British Thermal Units (Btu). A joule is the heat produced when one ampere is passed through a resistance of one ohm for one second, or it is the work required to move over a distance of one meter against a force of one newton. A calorie is the amount of energy required to raise the temperature of 1 g of water by 1 °C (from 14 to 15 °C); a calorie is equal to 4.184 J. A Btu is the quantity of heat required to raise the temperature of one pound of water 1 °F at the pressure of 1 atmosphere and temperature of 60 °F; a British thermal unit is equal to 1055 joules, and 252.15 calories

2017 EDITION

Chapter 5 Basic Fire Science

5.1.3 Power. Power is a property that describes energy released *per unit time. The same amount of energy is* required to carry a load up a flight of stairs whether the person carrying it walks or runs, but more power is needed for running because the work is done in a shorter amount of time. Raising the temperature of a volume of water requires the same amount of energy whether the temperature increase takes place in 10 seconds or in 10 minutes. Raising the temperature more quickly requires that the energy be transferred more quickly. Power is measured in joules per second (J/s) or watts (W).

2017 EDITION

Chapter 5 Basic Fire Science

5.1.4 Heat flux. Heat flux is a property that describes the amount of power *per unit area. A kilowatt spread over one* square meter is approximately equal to the radiant heat flux outdoors on a sunny day. If that same kilowatt is concentrated using a magnifying glass and only spread over .05 m2 (500 cm2), there may be sufficient energy transferred to that area to cause ignition of combustibles. Heat flux is measured in kW/m2 or W/cm2.

2017 EDITION

Chapter 5 Basic Fire Science

5.2.3.4* Diffusion flames can only occur for certain concentrations of the mixture components. The lowest oxygen concentration in nitrogen is termed the limiting oxygen index (LOI). For most fuel vapors, the LOI is in the range of 10 percent to 14 percent by volume at ordinary temperatures (Beyler 2002). Similarly, the fuel gas stream can be diluted with nitrogen or other inert gas to the extent where burning is no longer possible. For example, methane diluted with nitrogen to below 14 percent methane will not burn with air at normal temperatures. An under-ventilated compartment fire may behave like a large diffusion flame. In a ventilation-controlled compartment fire, oxygen concentrations can drop to near zero at locations away from sources of ventilation. This will limit flaming combustion within the compartment.

2017 EDITION

Chapter 5 Basic Fire Science

5.3.9 Smoke production rates are generally less in the early phase of a fire but increase greatly shortly before and with the onset of flashover, if flashover occurs. At the beginning of a fire, there is an abundance of oxygen, but after flashover, the fire usually becomes significantly under-ventilated. This can be demonstrated by putting a glass over a candle and observing increased smoke production due to reducing oxygen in the volume surrounding the flame.

2017 EDITION

Chapter 5 Basic Fire Science

5.5.5.3.4* Most fire science calculations involving temperature require that specific units of temperature be used (typically Kelvins or degrees Celsius). It is important to understand the particular equation and know what units are required to ensure accurate results.

2017 EDITION

Chapter 5 Basic Fire Science

5.10.2.7. If the air flow into the compartment is not sufficient to burn all of the combustibles being pyrolyzed by the fire, the fire will shift from fuel controlled (i.e., where the heat release rate of the fire depends on the amount of fuel involved) to ventilation controlled (i.e., where ~~all~~ the ~~fuel is on fire, and the~~ heat release rate is controlled by the amount of oxygen available). In a ventilation controlled fire, the hot gas layer will contain reduced oxygen levels. Fires that reach full room involvement can produce high levels of unburned pyrolysis products and carbon monoxide, and low levels of oxygen (e.g., 0–5 percent). *(See Figure 5.10.2.7 for an example of a ventilation-controlled fire.)*

2017 EDITION

Chapter 5 Basic Fire Science

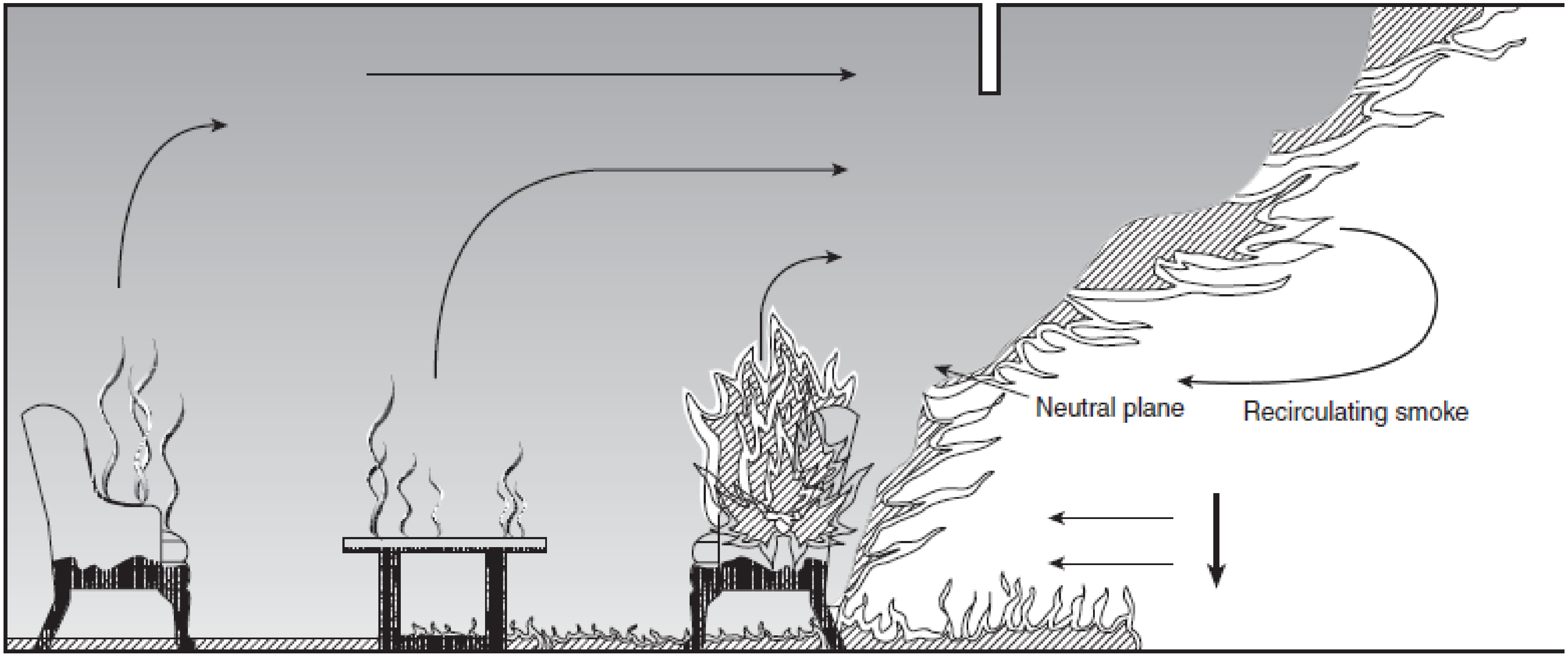


FIGURE 5.10.2.7 Postflashover or Full Room Involvement in a Typical Compartment Fire. Although pyrolysis can continue throughout the compartment, flaming combustion will only occur where there is sufficient oxygen present. Depending on the momentum of the entraining air, flaming combustion may occur within the ventilation stream at various depths into the compartment.

2017 EDITION

Chapter 6 Fire Patterns

6.2.11 Clean Burn. A clean burn is a distinct and visible fire effect generally apparent on non-combustible surfaces after combustible layer(s) (such as soot, paint, and paper) have been burned away. ~~A~~ The effect may also appear where soot has failed to deposit because of high surface temperatures. A fire exposure to the surface can produce a clean area adjacent to areas darkened by products of combustion, as shown in Figure 6.2.11(a) and Figure 6.2.11(b) . Clean burn patterns produced by burning away of soot can be produced by direct flame contact or intense radiated heat. Smoke deposits on surfaces are subject to oxidation. The dark char of the paper surface of gypsum wallboard, soot deposits, and paint can be oxidized by continued flame exposure. The carbon will be oxidized to gases and disappear from the surface. *[See Figure 6.2.11(c) .]*

2017 EDITION

Chapter 6 Fire Patterns

NSW Association of Fire Investigators

2017 EDITION

Chapter 6 Fire Patterns

6.2.11.1 Although they can be indicative of intense heating in an area, clean burn areas by themselves do not necessarily indicate areas of origin, though such patterns should be carefully examined. Clean burning that results from ventilation will usually occur after the fire has become ventilation-controlled. Such late-developing patterns may be misleading in origin determination, see Figure 6.2.11.1(A) and (B). The lines of demarcation between the clean burned and darkened areas may be used by the investigator to determine direction of fire spread or differences in intensity or time of burning. Determinations as to the direction of fire spread based on such patterns should be accompanied by a determination as to the likely mode of the pattern generation.

2017 EDITION

Chapter 6 Fire Patterns

6.3.3.2.5

Holes in floors may be caused by glowing combustion, radiation, or an ignitible liquid, <u>or ventilation/air entrainment as a result of gaps or penetrations .</u> The surface below a liquid remains cool (or at least below the boiling point of the liquid) until the liquid is consumed. Holes in the floor from burning ignitible liquids may result when the ignitible liquid has soaked into the floor or accumulated below the floor level. Evidence other than the hole or its shape is necessary to confirm the cause of a given pattern.

2017 EDITION

Chapter 6 Fire Patterns

IGNITABLE LIQUIDS

6.3.5.2* Research has shown that ignitable liquids generally burn off in less than 90 seconds on smooth surfaces, and less than 5 minutes on carpeted surfaces. Consequently, it is usually not possible for ignitable liquids to cause penetrations in horizontal surfaces.

A.6.3.5.2 For more information see Mealy, Benfer and Gottuk, *Fire Dynamics and Forensic Analysis of Liquid Fuel Fires , NCJ 238704, 2011, available at NCJRS.gov*

2017 EDITION

Chapter 6 Fire Patterns

6.4.1.2.1

Every fire pattern in a fully involved compartment should be analyzed to determine whether it could have resulted from ventilation. Patterns that can be accounted for in terms of ventilation may provide little insight into the behavior of the fire in its early stages.

2017 EDITION

Chapter 8 Fire Protection Systems

- 8.1 - Introduction
- 8.2 - Documentation of Fire Protection Systems
- 8.3 - Fire Alarm Systems
- 8.4 - Water-Based Fire Suppressions Systems
- 8.5 - Non-Water-Based Fire Suppressions Systems
- 8.6 - Spoliation Issues

This chapter was completely reorganized with a significant number of colour images added.

2017 EDITION

Chapter 8 Fire Protection Systems

This chapter provides a basic understanding of active fire protection systems, which includes general information, key components, operational and installation parameters, data gathering, and analysis. Passive fire protection systems are addressed in chapter 7. It is important to have a basic knowledge of fire protection systems and their performance during an incident, in order to understand the role of the system and potential impact on the fire.

2017 EDITION

Chapter 8 Fire Protection Systems

8.1.4 The documentation and analysis of active fire protection systems often needs the technical assistance of engineers or technical specialist. The movement, manipulation, energizing, and de-engerizing of system components may result in the destruction of critical data. The loss of this data may hinder the analysis and formulation of origin and cause hypotheses and might be considered spoliation of evidence. Even if the scope of an investigator's assignment does not include the analysis of the fire protection systems, the documentation and analysis of those systems may be important to other interested parties, so the preservation of those systems is critical.

2017 EDITION

Chapter 9 Electricity

9.6.3.4 Ground Fault Circuit Interrupter (GFCI).

In newer installations, a GFCI is required for specific circuits, such as those serving bathrooms, kitchens, and outside receptacles. All GFCIs are required to have a built-in test function for periodic testing. GFCIs are required to trip when an imbalance of 4–6 ma is detected. This level of current is deemed appropriate to avoid the inability to "let-go" of a live circuit. The GFCI is intended for bathrooms, patios, kitchens, or other locations where a person might be electrically grounded while near or using electrical appliances.

9.6.3.4.1 Ground Fault Circuit Interrupter (GFCI). GFCIs can be found in the following configurations:

(1) ***Portable GFCI.*** GFCI not connected to the buildings electrical distribution panel and intended to provide GFCI protection — ground fault only, not overcurrent — for those instances where a GFCI is required but not provided within a building.

(2) ***Receptacle type.*** Electrical current is supplied by an electrical distribution panel to the GFCI. The GFCI provides ground fault protection – not overcurrent protection — at that location and all duplex outlets located downstream of the GFCI receptacle.

(3) ***Circuit breaker–type GFCIs located within the distribution panel.*** This type of GFCI provides ground fault and overcurrent protection to devices downstream from the panel.

2017 EDITION

Chapter 9 Electricity

9.6.3.5 Arc Fault Circuit Interrupter (AFCI). AFCIs are designed to mitigate fires caused by arcing faults in home electrical wiring. The AFCI circuitry continuously monitors current flow. AFCIs use special circuitry to discriminate between normal and unwanted arcing conditions. Once an unwanted arcing condition is detected, the control circuitry in the AFCI opens the internal contacts, thus de-energizing the circuit and reducing the potential for a fire to occur. An AFCI should not trip during normal arcing conditions, which can occur when a switch is opened or a plug is pulled from a receptacle. Depending upon when the device was installed, *NFPA 70 may have* required that a branch circuit supplying outlets or devices in kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sunrooms, recreation rooms, closets, hallways, laundry areas, or similar rooms or areas be protected by an AFCI.

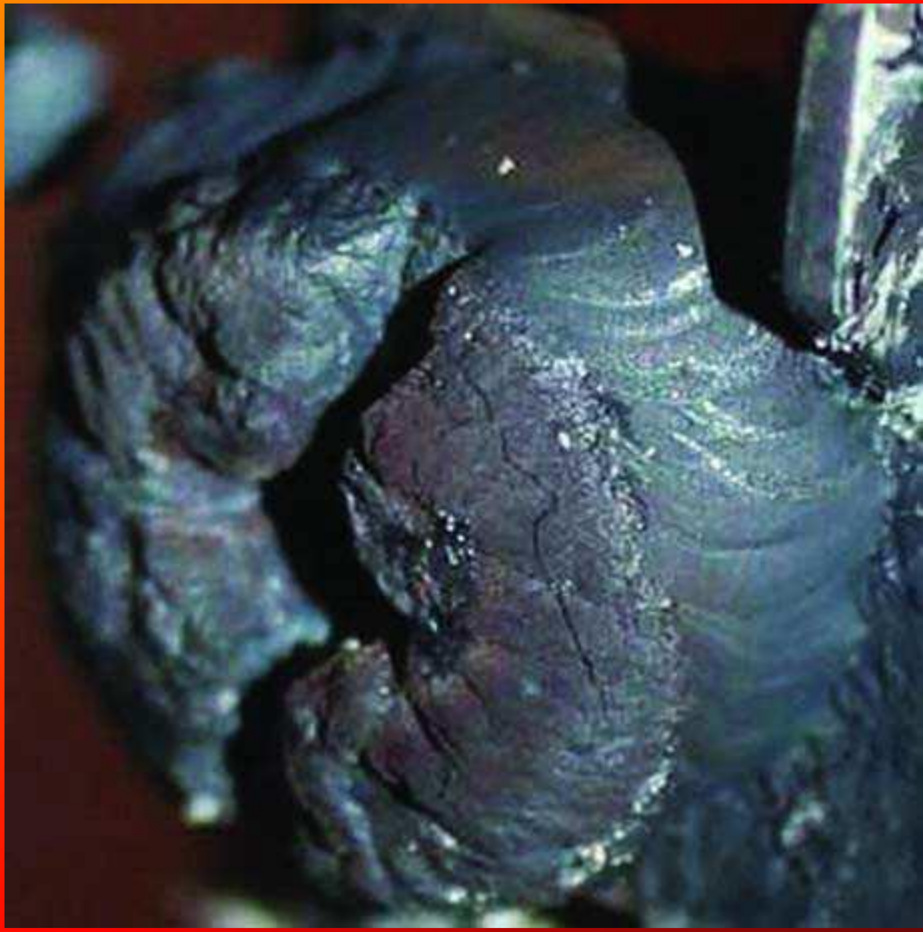
2017 EDITION

Chapter 9 Electricity

9.10.4.1: Overheating in Duplex Receptacles

Overheating of poor electrical connections in duplex receptacles can lead to glowing connections [see Figure 9.10.4(d)]. Persistence of glowing connections can produce distinct evidence including melted copper conductors around steel screw terminals [see Figure 9.10.4.1(a)], severed copper conductors at or near the screw head [see Figure 9.10.4.1(b)], and enlarged screw heads due to severe corrosion [see Figure 9.10.4.1(c)] . These types of evidence are unique in appearance compared to melting and arcing events from external fire exposure. Poor connections may also exist at the point where the male plug blade contacts the internal receiver, or bus, of the duplex receptacle. The investigator should also find evidence of a loose or poor electrical connection.

2017 EDITION



NSW Association of Fire Investigators

2017 EDITION

Chapter 9 Electricity

9.10.7 * Insulation Damage.

Electrical insulation is rated to withstand a certain maximum operating voltage. If this voltage is exceeded, the insulation may break down (i.e., an electric discharge could pass through the solid material, permanently damaging it and causing a temporary fault path during the event). Insulation materials are normally specified to resist voltages above the intended operating voltage, including a safety margin. However, mechanical damage to the insulation is likely to reduce the dielectric breakdown strength. If the reduction is so large that the breakdown strength falls below the operating voltage, then a dielectric breakdown can be expected. Damaged insulation may have a breakdown strength above the normal operating voltage, yet below the voltage of some surges that might occur. In such cases, breakdown will occur only when a surge of sufficient magnitude is experienced.

2017 EDITION
Chapter 9 Electricity

9.10.7.1 * Hammer Mis-Hits.

If a hammer is used to install electric cables, a mis-hit may occur whereby the installer strikes the cable instead of the staple with the hammer. This can result in difficult-to-see damage to the wire insulation. For some mis-hits, the dielectric strength of the damaged cable can become lower than expected surge voltages. This can create arcs and a potential fire when a high-voltage surge occurs, which could happen long after the original installation.

9.12.8.2 Lightning Bolt Characteristics.

Typical lightning channels have a core of energy plasma 12.7 mm to 19 mm (½ in. to ¾ in.) in diameter, surrounded by a 102 mm (4 in.) thick channel of superheated ionized air. Lightning return stroke currents average between 30,000 A and 45,000 A depending upon location, but can exceed 200,000 A. Potentials can range up to 15,000,000 V.

2017 EDITION

Chapter 9 Electricity

9.12.8.3.1

Lightning tends to strike the tallest object on the ground in the path of its discharge. Lightning enters structures in four ways may strike any object that generates a successful upward-going streamer connecting with the dart leader generated from the cloud. This may be the tallest object but could also be the perimeter of a roof that is not the tallest item on the structure. Lightning threats to a structure consist of the following :

(1) By striking a metallic object like a TV antenna, a cupola, or an air-conditioning unit extending up and out from the building roof A direct strike to the structure or an item attached to the structure, such as a TV antenna, air-conditioning unit, and so forth, extending up and out from the building roof.

(2) By directly striking the structure A strike near a structure that couples energy onto internal conductors

(3) By hitting a nearby tree or other tall structure and moving horizontally to the building A direct strike to incoming conductors connected to the structure

(4) By striking nearby overhead conductors and by being conducted into buildings along the normal power lines A strike near overhead conductors that can couple lightning currents onto conductors connected to the structure

2017 EDITION

Chapter 9 Electricity

9.12.8.4 Lightning Damage.

Damage by lightning is caused by two characteristic properties: first, the extremely high currents and energy in a lightning strike; and second, the extremely high heat energy and temperatures generated in the channel by the electrical discharge. (A) through (D) are examples of these effects.

(A) Occasionally a tree may be shattered by the explosive action of the lightning stroke striking the tree and the heat immediately lightning current being conducted deeper into the tree's heartwood with the heat vaporizing the moisture in the tree into steam, causing explosive effects.

(B) Copper conductors not designed to carry the thousands of amperes of a lightning strike may be melted, severed, or completely vaporized by the overcurrent effect of a lightning discharge. Lightning currents may also generate overvoltages that trigger power system overcurrents sufficient to sever conductors in one or numerous locations. Properly sized and routed copper and aluminium conductors (in accordance with NFPA 780) will not be damaged by up to a 200,000 A lightning impulse current.

2017 EDITION

Chapter 9 Electricity

9.12.8.4 Lightning Damage (cont)

(C) When lightning strikes a steel-reinforced concrete building, the current may follow the steel reinforcing rods as the least resistive path . The high energy may destroy the surrounding concrete with explosive forces to get to the reinforcing steel.

(D) Lightning can also cause fires by damaging fuel gas systems. Fuel gas appliance connectors have been known to have their flared ends damaged by electrical currents induced by lightning and other forms of electrical discharge. When gas lines are damaged, fuel gas can leak, and the same arcing that caused the gas line to fail may also cause ignition of the fuel gas.

2017 EDITION

FIGURE 9.10.4(b) Overheated Connections on Two-Pole Circuit Breakers.

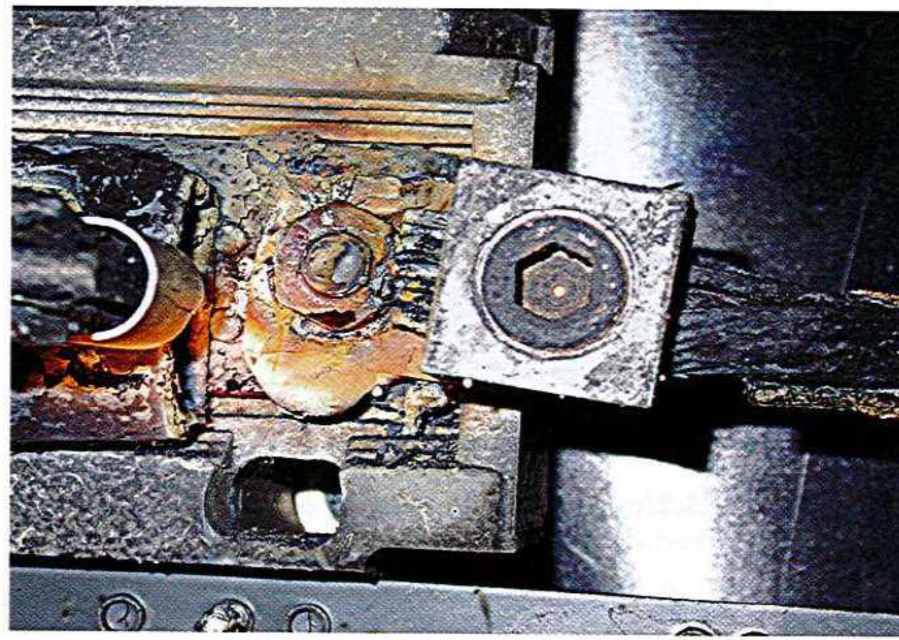


FIGURE 9.10.4(a) Overheated Connection on 208 V 3-Phase Fuse Terminal.

2017 EDITION

Chapter 11 Human Behavior

11.3.1.2 Cognitive Comprehension Limitations.

Cognitive comprehension limitations, which may affect an individual's ability to recognize and react appropriately to the hazards presented by a fire or an explosion incident, include age (as it relates to and mental comprehension) level , level of rest, alcohol use, drug use (legal or illegal) drug use, developmental disabilities, mental illness, and inhalation of smoke and toxic gases. These cognitive limitations are more likely to affect an individual's ability to accurately assess the hazards presented by a fire or explosion. Often, such limitations account for delayed or inappropriate responses to such hazards. Children may fail to recognize the a hazard and choose an inappropriate response, such as hiding or seeking a parent. Many times a victim may be affected by multiple agents (e.g., alcohol ingested in a pre-ignition period and carbon monoxide in a post-ignition period). Investigators should carefully assess all possibilities before making assumptions. Behavior that is often determined to be inappropriate may be due to confusion caused by toxic gases.

2017 EDITION

Chapter 13 Safety

Change:

From

- MSDS (Material Safety Data Sheets)

to

- SDS (Safety Data sheets)

2017 EDITION

Chapter 15 Planning

15.2.8.2

The investigator, the private-sector investigator in particular, should recommend to the client that they need to notify all identifiable interested parties who may have a legal interest in the investigation of the inspection and give them the opportunity to participate or witness and record such activities. (See Section 12.3 and ASTM E-860, Standard Practice for Examining and Preparing Items that Are or May Become Involved in Criminal or Civil Litigation .)

2017 EDITION

Chapter 16 Documentation

16.1 Introduction

16.1.1: The goal in documenting any fire or explosion investigation is to make an accurate recording of the investigation using media that will allow investigators to recall and communicate their observations at a later date. Common methods of accomplishing this goal include the use of photographs, video , diagrams, maps, overlays, audio recordings, laser surveys, digital and handwritten, notes, sketches, and reports.

16.1.2: Thorough and accurate documentation of the investigation is critical, because compilation of factual data is necessary to support and verify investigative opinions and conclusions. There are a number of resources to assist the investigator in documenting the investigation.

2017 EDITION

Chapter 16 Documentation

16.2 Photography

- 16.2.1 General
- 16.2.2 Timing
- 16.2.3 Basics
- 16.2.4 Understanding the Parts of a Camera
- 16.2.5 Lighting
- 16.2.6 Special Types of Photography
- 16.2.7 Video
- 16.2.8 Suggested Activities to Be Documented
- 16.2.9 Photograph Tips
- 16.2.10 Presentation of Photograph

2017 EDITION

Chapter 16 Documentation

16.3 Note Taking (Note taking is a method of documentation in addition to drawings and photographs.)

16.3.1 Forms of Incident Field Notes

16.3.2 Forms for Collecting Data

16.3.3 Dictation of Field Notes

16.4 Diagrams and Drawings

16.4.1 Types of Drawings

16.4.2 Selection of Drawings

16.4.3 Drawing Tools and Equipment

16.4.4 Diagram Elements

16.4.5 Drawings

16.4.6 Prepared Design and Construction Drawings

2017 EDITION

Chapter 16 Documentation

16.3.2 Forms for Collecting Data

Table 16.3.2 Field Notes and Forms

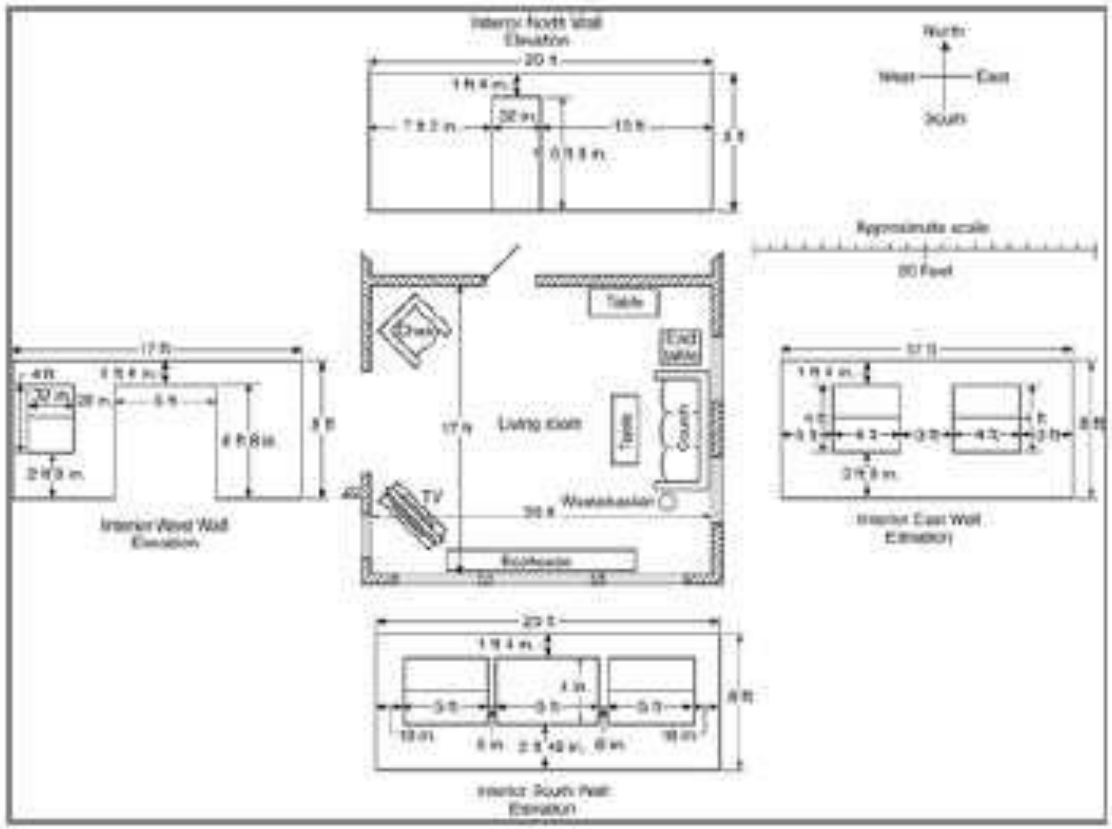
Form	Purpose
Fire incident field notes	Any fire investigation to collect general incident data
Casualty field notes	Collection of general data on any victim killed or injured
Wildfire field notes	Data collection specifically for wildfire
Evidence form	Documentation of evidence collection and chain of custody
Vehicle inspection form	Data collection of incidents specifically involving motor vehicles
Photograph log	Documentation of photographs taken during the investigation
Electrical panel documentation	Collection of data specifically relating to electrical panels
Structure fire notes	Collection of data concerning structure fires
Insurance information	Documentation of insurance coverage for fire loss
Records/documents	Documentary records considered in the investigation
Compartment fire modeling	Collection of data necessary for compartment fire modeling

2017 EDITION

Chapter 16 Documentation

16.4 Diagrams and Drawings

Figure 16.4.2(c) Diagram of Room and Contents Showing Dimensions.

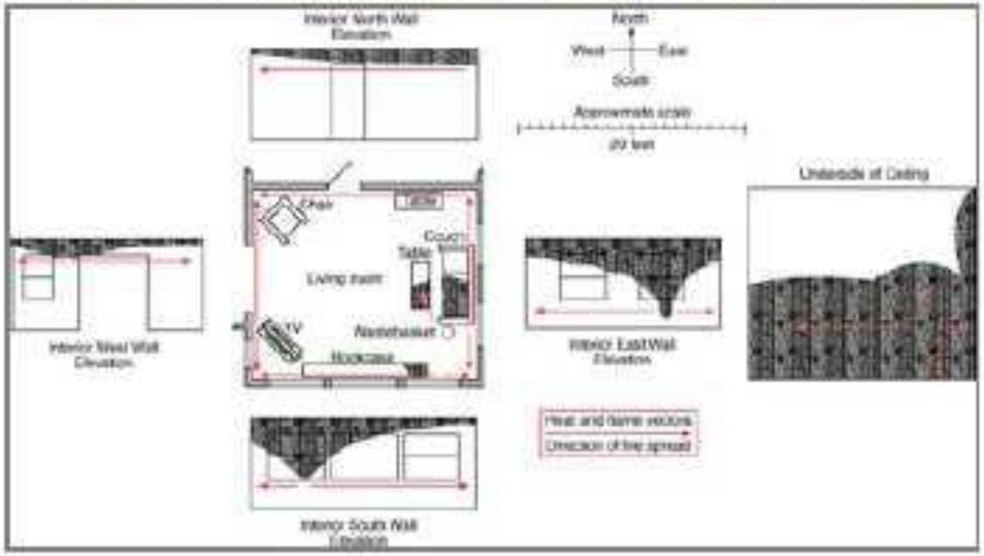


2017 EDITION

Chapter 16 Documentation

16.4 Diagrams and Drawings

Figure 16.4.2(d) Exploded Room Diagram Showing Damage Patterns, Sample Locations, and Photo Locations.



2017 EDITION

Chapter 16 Documentation

16.5 Reports

The final step in the documentation of the investigation may be the preparation and submittal of a report. The format and content of the report will depend on the needs of the organization or client on whose behalf the investigation was performed. Therefore, no report format is prescribed here. However, for guidance on court- mandated reports, see Chapter 12.

2017 EDITION

Chapter 16 Documentation

16.5 Reports

16.5.1 Purpose

The purpose of a written report is to document an accurate and concise reflection of the investigator's findings. The report should contain facts and data that the investigator can rely on to render any opinions and should contain the investigator's reasoning of how each opinion was reached. The report should meet the needs or requirements of the intended audience(s). Reports may be used for: improvement of public safety, prevention of similar future incidents, the basis for criminal or civil litigation, the basis for insurance claims, or simply documentation of the facts for the record. *(See A.4.3.6 of NFPA 1033 .)*

2017 EDITION

Chapter 16 Documentation

16.5 Reports

16.5.2 Report Organization

16.5.3 Descriptive Information

16.5.4 Opinions and Conclusions

16.5.5 Pertinent Facts

16.5.6 Reference to Methodology

<u>When the investigator states that the scientific method was used (see Section 4.3) to determine origin and cause, the report should give sufficient detail to show that the methodology was indeed used and not just cited.</u>

2017 EDITION

Chapter 18 Origin Determination

This chapter recommends a methodology to follow in determining the origin of a fire. The area of origin is defined as a structure, part of a structure, or general geographic location within a fire scene, in which the "point of origin" of a fire or explosion is reasonably believed to be located. The point of origin is defined as the exact physical location within the area of origin where a heat source and the fuel interact, resulting in a fire or explosion. The origin of a fire is one of the most important hypotheses that an investigator develops and tests during the investigation. Generally, if the origin cannot be determined, the cause cannot be determined, and generally, if the correct origin is not identified, the subsequent cause determination will also be incorrect. The purpose of determining the origin of the fire is to identify in three dimensions the locations at which the fire began.

Example of Applying the Scientific Method to Origin Determination

Recognize the Need
- A fire has occurred
- The origin is unknown

Define the Problem
- Determine the origin

Collect Data
- Basic site data
- Determine pre-fire conditions
- Documentation of post-fire conditions
- Excavation, examination, and reconstruction of the scene
- Witness statements and observations
- Fire department information
- Alarm, detector, and security data

Analyze the Data
- Pattern analysis
- Identify ventilation-generated patterns
- Heat and flame vector analysis
- Origin matrix analysis
- Depth of char and calcination surveys
- Arc mapping
- Event sequencing
- Fire dynamics consideration
- Building construction and occupancy considerations

Develop a Hypotheses
- Initial origin hypotheses
- Working origin hypotheses
- Alternate hypotheses

Test the Hypotheses
- Is there a competent ignition source at the origin?
- Does the origin explain the data?
- Are contradictions resolved?
- Does an alternate origin explain the data equally well?

Select Final Hypothesis
- Area of origin
- Point of origin
- Origin insufficient to determine cause

2017 EDITION

Information Sources for Origin Determination

18.1.2 Determination of the origin of the fire involves the coordination of information derived from one or more of the following:

(1) Witness Information. and/or Electronic Data. The analysis of observations reported by persons who witnessed the fire or were aware of conditions present at the time of the fire as well as the analysis of electronic data such as security camera footage, alarm system activation, or other such data recorded in and around the time of the fire event

(2) Fire Patterns. The analysis of effects and patterns left by the fire (see Chapter 6 .)

(3) Arc Mapping. The analysis of the locations where electrical arcing has caused damage and the documentation of the involved electrical circuits (see Section 9.10 .)

(4) Fire Dynamics. The analysis of the fire dynamics[i.e. , the physics and chemistry of fire initiation and growth (see Chapter 5), and the interaction between the fire and the building's systems (see Chapter 7 .)]

2017 EDITION

Chapter 18 Origin Determination

- **18.2.3 Sequential Pattern Analysis.** The area of origin may be determined by examining the fire effects and fire patterns. The surfaces of the fire scene record all of the fire patterns generated during the lifetime of the event, from ignition through suppression, although these patterns may be altered, overwritten, or obliterated after they are produced. The key to determining the origin of a fire is to determine the sequence in which these patterns were produced. Investigators should strive to identify and collect sequential data and, once collected, organize the information into a sequential format. Sequential data not only indicate what happened, but the order in which it happened. <u>One of the most important factors in determining the sequence of pattern production is considering whether the pattern can be accounted for in terms of ventilation. A large area of clean burning located next to, or directly across the room from an opening probably was created after full room involvement was achieved. As such, this pattern will offer little insight into the area of origin.</u>

2017 EDITION

Chapter 18 Origin Determination

18.3.1.6 Structure Interior. On the initial assessment, investigators should examine all rooms and other areas that may be relevant to the investigation, including those areas that are fire damaged or adjacent to the fire and smoke damaged areas. The primary purpose of this assessment is to identify the areas that need more detailed examination. The investigator should be observant of conditions of occupancy, including methods of storage, nature of contents, housekeeping, and maintenance. The type of construction, interior finish(es), and furnishings should be noted. Areas of damage, and extent of damage in each area (severe, minor, or none) should be noted. At this point, the investigator should attempt to identify which compartments became fully involved (ventilation-controlled), and which did not. This damage should be compared with the damage seen on the exterior. During this examination, the investigator should reassess the soundness of the structure.

2017 EDITION

Chapter 18 Origin Determination

18.4 Analyze The Data

18.4.1.6* Every pattern should be evaluated to determine whether it can be accounted for in terms of ventilation. Ventilation-generated patterns may not be produced early in the fire. Patterns that cannot be accounted for in terms of ventilation are the patterns that require careful examination.

A.18.4.1.6 For further information, see Cox, A., Origin Matrix Analysis: A Systematic Methodology for the Assessment and Interpretation of Compartment Fire Damage. Fire and Arson Investigator, July 2013.

2017 EDITION

Chapter 18 Origin Determination

18.4.4.2 * Measuring Depth of Calcination.

The technique for measuring and analyzing depth of calcination should be performed using a probe survey. The probe method requires that a survey of the depth of calcination be undertaken by inserting a probe device, such as illustrated in Figure 18.4.4.2(a) and Figure 18.4.4.2(b) , into the gypsum wallboard within the room of interest. Based on experimental data, it is recommended that the probe have a blunt tip with no tapering shoulders. The cross-sectional surface area of the probe used should be relatively small. Cross-sectional areas used in experimental work have ranged in size from 1.9 to 3.1 mm 2 (0.003 to 0.005 in.2). The probe can be 2 attached to a force gauge to ensure uniform pressure is applied at the probe tip during each measurement. The pressure required to reach the line of demarcation where calcined and virgin gypsum meet has been studied and values are generally consistent ranging from 800 to 900 g/m 2 (1120 to 1270 psi). Care should be taken to use approximately the same insertion pressure for each measurement. Currently available data suggests that probe pressures in this range are appropriate for both regular 12.7 mm (0.5 in.) and fire-rated 15.875 mm (0.625 in.) gypsum wallboard.

2017 EDITION

Chapter 18 Origin Determination

18.4.4.2 * Measuring Depth of Calcination.

For lightweight gypsum wallboard, which is becoming increasingly prevalent, less pressure should be used. When using this method the investigator should conduct the survey at regular lateral and vertical grid intervals along the surface of the involved wallboard, usually in increments of 0.3 m (1 ft) or less. Such surveys can be made on either wall or ceiling installations of wallboard. Some limited correlations between depth of calcination and total heat exposure have been developed that can be used to enhance the information obtained from a calcination depth survey.

2017 EDITION

NSW Association of Fire Investigators

2017 EDITION

Chapter 18 Origin Determination

18.4.7 Fire Dynamics

18.4.7.1* One of the most important fire dynamics considerations is the availability of oxygen. If the area of origin becomes oxygen deprived as a result of full room involvement, there may actually be less damage around the origin than elsewhere. The most severely damaged areas may have been damaged solely as a result of increased ventilation that occurred late in the fire. Basing an origin determination solely on the degree of damage has led to erroneous origin determinations in test fires.

A.18.4.7.1 For additional information see Carman, S.W., "Improving the Understanding of Post-flashover Fire Behavior."

2017 EDITION

Chapter 18 Origin Determination

18.4.7.2* One tool a fire investigator may consider to account for the history of the various fire patterns observed is to divide each compartment into volumes, and then consider the extent of the damage expected before and at flashover, a short time after flashover, and a long time after flashover, given an origin in each of the volumes. This analysis has been called Origin Matrix Analysis.

A.18.4.7.2 For further information, see Cox, A., Origin Matrix Analysis: A Systematic Methodology for the Assessment and Interpretation of Compartment Fire Damage. Fire and Arson Investigator, July 2013.

2017 EDITION

Chapter 18 Origin Determination

2017 EDITION

18.6.1.3 Means of Hypothesis Testing

Ultimately, the investigator should be able to explain how the growth and development of a fire, starting at the hypothesized origin, is consistent with the data.

2017 EDITION

CHAPTER 19: CAUSE

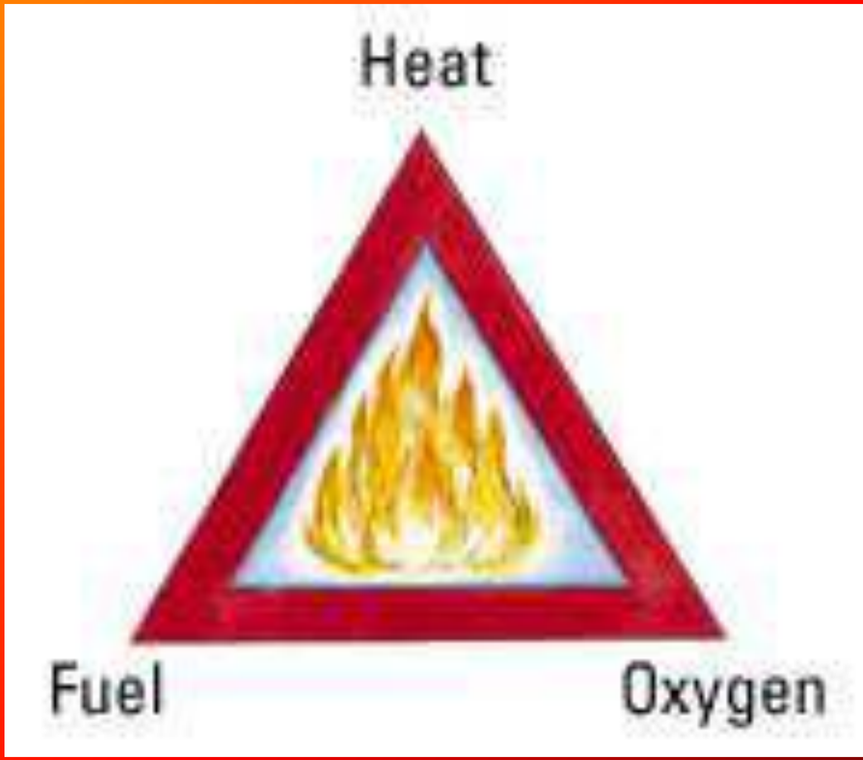
19.1 Introduction. This chapter recommends a methodology to follow in determining the cause of a fire. Fire cause determination is the process of identifying the first fuel ignited, the ignition source, the oxidizing agent, and the circumstances that resulted in the fire. Fire cause determination generally follows origin determination (see Origin Determination Chapter). Generally a fire cause determination can be considered reliable only if the origin has been correctly determined.

2017 EDITION

CHAPTER 19: CAUSE

19.1.1 FIRE CAUSE FACTORS

- First fuel ignited
- Ignition source
- Oxidant
- Ignition sequence



Example of Applying the Scientific Method to Cause Determination

Recognize the Need
A fire has occurred
The cause is unknown

↓

Define the Problem
The origin has been determined
Determine the cause

↓

Collect Data
Identify fuels in area of origin
Identify potential ignition sources
Identify oxidizing agent
Identify circumstances

↓

Analyze Data
Analyze fuel (ignition temperature, quantity)
Analyze ignition source (temperature, energy, time)
Analyze oxidizer, especially if other than air
Analyze potential ignition sequences

↓

Develop Cause Hypotheses
Separate hypothesis for each potential ignition source
Consider absent ignition sources
Propose a first fuel for each ignition source
Consider alternate hypotheses

↓

Test the Hypotheses
Is (or was) the hypothesized ignition source located at the origin?
Can the hypothesized ignition source ignite the first fuel?
Did the hypothesized ignition source have sufficient time?
Is the hypothesized cause consistent with all known facts?
Are contradictions resolved?
Does another cause hypothesis explain the data equally well?

↓

Select Final Hypothesis
Cause of the fire
List of potential causes
Insufficient information to determine the cause

NSW Ass

2017 EDITION

CHAPTER 19: CAUSE

19.1 Introduction. This chapter recommends a methodology to follow in determining the cause of a fire. Fire cause determination is the process of identifying the first fuel ignited, the ignition source, the oxidizing agent, and the circumstances that resulted in the fire. Fire cause determination generally follows origin determination (see Origin Determination Chapter). Generally a fire cause determination can be considered reliable only if the origin has been correctly determined.

2017 EDITION

CHAPTER 19: CAUSE

19.4.4.2.1 (Ignition Sequence)

In each fire investigation, the various contributing factors to ignition should be investigated and included in the ultimate explanation of the ignition sequence. These factors should include the following :

(1) How and sequentially when the first fuel ignited came to be present in the appropriate shape, phase, configuration, and condition to be capable of being ignited ~~(a competent fuel)~~;

(2) How and sequentially when the oxidant came to be present in the right form and quantity to interact with the first fuel ignited and ignition source and allow the combustion reaction;

(3) How and sequentially when the competent ignition source came to be present and interact with the fuel;

(4) How and sequentially when the competent ignition source transferred its heat energy to the fuel, causing ignition;

2017 EDITION

CHAPTER 19: CAUSE

19.4.4.2.1 (Ignition Sequence)

(5) How safety devices and features designed to prevent fire from occurring operated or failed to operate. (see Chapter 26)

(6) How and sequentially when any acts, omissions, outside agencies, or conditions brought the fuel, oxidant, and competent ignition source together at the time and place for ignition to occur;

(7) How the first fuel subsequently ignited any secondary, tertiary, and successive fuels that resulted in any fire spread. <u>If the hypothesized ignition location is not within the main area of fire destruction, then, for the hypothesis to be valid, the investigator should be able to demonstrate that there was a viable fire spread mechanism that facilitated a path of fire propagation along which fire would have been able to propagate.</u>

2017 EDITION

CHAPTER 19: CAUSE

19.4.4.3

Any determination of fire cause should be based on evidence rather than on the absence of evidence; however, there are limited circumstances when the ignition source cannot be identified, but the ignition sequence can be logically inferred.

2017 EDITION

CHAPTER 19: CAUSE

19.4.4.3

This inference may be arrived at through the testing of alternate hypotheses involving potential ignition sequences, provided that the conclusion regarding the remaining ignition sequence is consistent with all known facts.

2017 EDITION

CHAPTER 19: CAUSE

19.4.4.3 EXAMPLES

- Diffuse fuel explosions and flash fires.
- When ignitable liquid residue is found with no innocent explanation.
- Multiple fires (origins)
- Trailers

2017 EDITION

CHAPTER 19: CAUSE

19.5.1

Devices present at the origin which are either heat-producing or are capable of heat production when they sustain a fault or failure should always be placed on the list of hypotheses, even if, for some reason, they are easy to eliminate.

2017 EDITION

CHAPTER 19: CAUSE

19.5.2

The investigator should carefully consider potential ignition sources which do not correspond to a physical device that can be recovered.

Given the lack of a physical device, other evidence is needed to establish the presence or absence of an ignition source.

2017 EDITION

CHAPTER 19: CAUSE

19.5.3

For each potential ignition source in the area of origin, it must be established that there existed a fuel or fuels, in the appropriate form and configuration, for which the potential ignition source could be considered a competent ignition source.

A cause hypothesis can be developed even in the absence of being able to state specifically which of these fuels was first ignited.

2017 EDITION

CHAPTER 19: CAUSE

19.5.4

There may be multiple competent ignition sources in the area of origin with a known first fuel.

A cause hypothesis can be developed in the absence of being able to state specifically which of these competent ignition sources ignited the known first fuel.

2017 EDITION

CHAPTER 19: CAUSE

19.6 TESTING THE CAUSE HYPOTHESIS

Each of the alternate hypotheses that were developed must be tested using the scientific method. If one remaining hypothesis is tested using the "scientific method" and is determined to be probable, then the probable cause of the fire is identified.

2017 EDITION

CHAPTER 19: CAUSE

19.6.4 Means of Hypotheses Testing

•Scientific literature

•Fundamental principles of science

•Physical experiments or testing

•Cognitive experiments (Analytically applying the principles of science)

•Time lines

•Fault trees

•Failure Analysis & Analytical Tools

2017 EDITION

19.6.5 Appropriate Use of the Process of Elimination:
The process of elimination is an integral part of the scientific method. All potential ignition sources present, or believed to be present in the area of origin should be identified and alternative hypotheses should be considered and challenged against the facts. Elimination of a testable hypothesis by disproving the hypothesis with reliable evidence is a fundamental part of the scientific method. However, the process of elimination can be used inappropriately. Identifying the ignition source by believing to have eliminated all ignition sources found, known, or suspected to have been present in the area of origin, and for which no supporting evidence exists, is referred to by some investigators as negative corpus. Determination of the ignition source must be based on data or logical inferences drawn from that data. Negative corpus has typically been used in classifying fires as incendiary, although the process has also been used to characterize fires classified as accidental. The negative corpus process is not consistent with the scientific method, is inappropriate, and should not be used because it generates untestable hypotheses, and may result in incorrect determinations of the ignition source and first fuel ignited. Any hypotheses formulated for the causal factors (e.g., first fuel, ignition source, and ignition sequence), must be based on the analysis of facts and logical inferences that flow from those facts . Those facts and logical inferences are derived from evidence, observations, calculations, experiments, and the laws of science. Speculative information cannot be included in the analysis.

2017 EDITION

WHAT DOES THIS PARAGRAPH REALLY SAY?

WHERES THE PROOF?

2017 EDITION

St. of Wisconsin v. Joseph Awe

Circuit Court, Marquette County

In 2007, the defendant was convicted of arson with intent to defraud in a September 2006 fire that destroyed a Wisconsin bar he owned. The defendant had served nearly all of his sentence before his conviction was vacated and a new trial granted in 2013.

A county circuit judge granted the new trial because the public investigator in the case had used “negative corpus” to conclude that the fire must have been incendiary because he could find no accidental cause. In the interim between the defendant’s conviction and his successful appeal, NFPA 921 was revised to say that negative corpus should never be used to reach a conclusion.

2017 EDITION

St. of Wisconsin v. Joseph Awe

Circuit Court, Marquette County

The defendant's motion for a new trial included the grounds that there was "newly discovered evidence which to a reasonable probability would have caused a jury to have a reasonable doubt as to his guilt." The judge's order specifically cited "a maturing development in the arson field [that] would bury the 'negative corpus' approach" from NFPA 921 (2011 Edition) section 18.6.5 as the new evidence upon which the new trial was ordered. Prior to 2011, the scientific objections to the use of negative corpus were not as strongly stated.

The 2011 Edition of 921 changed that, and thus this new standard, if it had existed at the time of the original trial, would have been used to impeach the State's expert witness who used a now unapproved method to reach his conclusion of incendiary fire.

2017 EDITION

St. of Wisconsin v. Joseph Awe

Circuit Court, Marquette County

Because the case was “utterly dependent” on the expert’s opinion that it was a “set fire” due to the absence of physical evidence of incendiary fire, circumstantial evidence of motive, and arguable “removal of keepsakes (just as likely consumed by the fire)”, this new evidence of unapproved method created a reasonable probability that the jury would have had reasonable doubt as to the defendant’s guilt if that evidence had been available at the original trial. Therefore, the defendant was released and a new trial ordered.

2017 EDITION

19.6.5.1 CAUSE UNDETERMINED

In the circumstance where all hypothesized fire causes have been eliminated and the investigator is left with no hypothesis that is evidenced by the facts of the investigation, the only choice for the investigator is to conclude that the fire cause, or specific causal factors, remains undetermined.

That is, it is improper to opine a specific ignition source that has no evidence to support it even though all other hypothesized sources were eliminated.

2017 EDITION

19.6.5.1 CAUSE UNDETERMINED

The final opinion is only as good as the quality of the data used in reaching that opinion.

If the level of certainty of the opinion is only “possible” or “suspected,” the fire cause is unresolved and should be classified as “undetermined.”

The decision as to the level of certainty – rests with the investigator.

2017 EDITION

Chapter 20 Classification of Fire Cause

- Classification of fire cause and responsibility were combined into one chapter in previous editions. The combination of the two had lead to confusion about fire cause vs. classification of fire cause. The committee made the decision to split the chapter in an attempt to eliminate the confusion

- The four classifications remained the same.

2017 EDITION

Chapter 20 Classification of Fire Cause

Four Classifications of Fire Cause

- Accidental Fire Cause Classification
- Natural Fire Cause Classification
- Incendiary Fire Cause Classification
- Undetermined Fire Cause Classification

2017 EDITION

UNDETERMINED

20.1.4(B)

In the instance in which the investigator fails to identify the ignition source, the fire need not always be classified as undetermined. If the evidence established one factor, such as the use of an accelerant, the evidence may be sufficient to establish an incendiary fire cause classification even where other factors such as ignition source cannot be identified.

2017 EDITION

Chapter 23 Explosions

23.9 Dust Explosions

2017 EDITION

Chapter 24 Incendiary

24.3.2 Forced Entry.

Evidence of forced entry may be discovered by the investigator. Broken door locks, windows, and other points of entry should be documented and examined for potential physical evidence. The investigator is cautioned that first responders and suppression personnel may force entry as part of their response to the fire. Forced entry may be evidence of burglary. It may also be staged by the owner or occupant in an attempt to mislead investigators.

2017 EDITION

Chapter 25 Death and Injuries

25.10.3 Pre-Fire Victim Impairment.

2017 EDITION

Chapter 26 Appliances

26.5.2.3 Batteries.

Batteries are used for a wide variety of applications, including stationary and portable appliances. There are two types of batteries —primary and secondary. Primary batteries are discharged once and reach end of life, whereas secondary batteries can be discharged and recharged repeatedly. Batteries are produced in a variety of chemistries, each with their advantages and disadvantages. Some battery chemistries are better suited for certain applications than others. Batteries are produced in a wide variety of designs and form factors, for example, battery cells can be interconnected in series or parallel combinations to create a battery pack, which is housed in an enclosure that acts as a single unit. Depending on the chemistry and the materials used in the battery, remains of batteries that were present in an appliance may be found after a fire. They may be too damaged to indicate whether they provided power for ignition. However, what they were connected to could be important. A battery can provide enough power to ignite some materials under certain conditions. However, in most battery-powered devices circuitry and/or safety mechanisms should prevent the energy of the battery from being concentrated enough at one spot at one time to achieve ignition.

2017 EDITION

Chapter 27 Vehicles

27.3.1.1 * Hot Surface Ignition.
27.4.1 Open Flames.
27.4.2.6 * Lamp Bulbs and Filaments.
27.4.2.6.1
27.5.3.3.4 * Arc Mapping
27.5.3.6 Engine Control Modules (ECMs).
27.5.4.4 Electric Motors.
27.8.1 General.
27.8.1.1

NFPA 921

It is not enough to just do a good investigation!

You MUST be able to ARTICULATE that good investigation!

NFPA 921

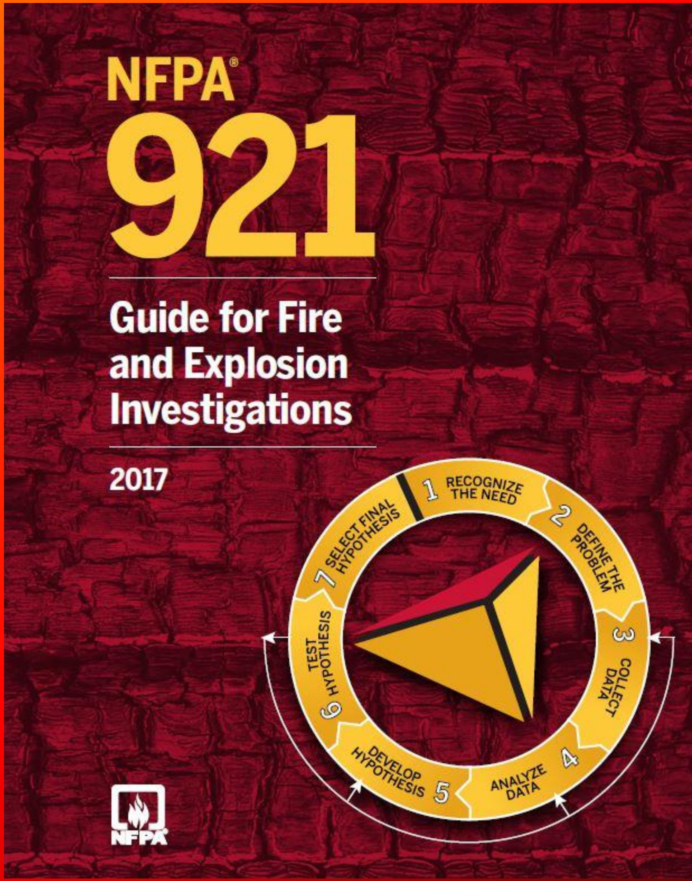
How Lawyers Build the Case for Your Exclusion

– Expert not ***qualified to give the specific*** opinions to which the investigator intends to testify
– The opinions are not the product of a ***reliable methodology***

NFPA 921

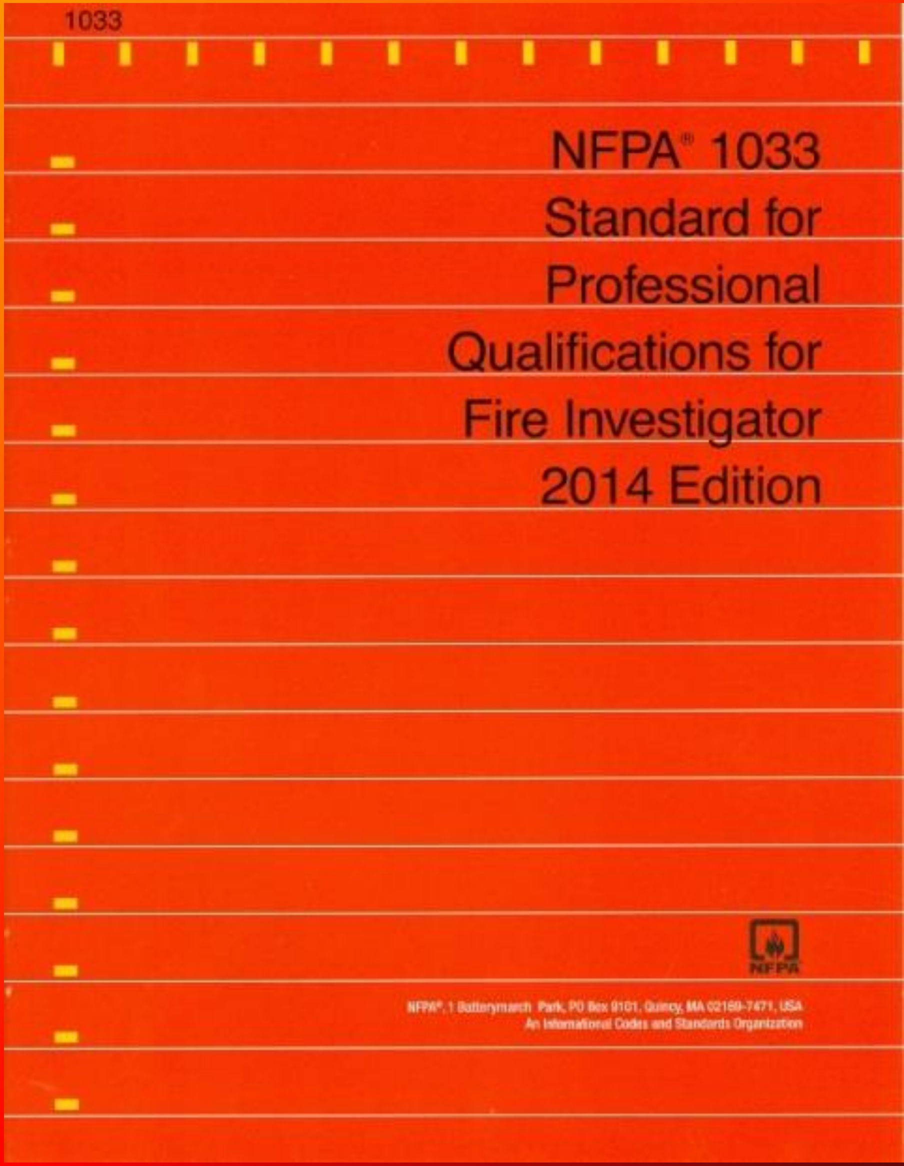
Task Groups for 2020 Edition:

Marine Chapter
Sources of Information Chapter
Fire Patterns Chapter
Wildfire Chapter
Heating Systems
Canines



NFPA 1033

2021 Edition
Currently Open for
Public Input



NFPA 921-Where to buy?

NFPA 921

KEEP ON LEARNING

BECAUSE

YOU WILL NEVER BE MORE AS AN INVESTIGATOR THAN YOU PUT INTO YOUR TRAINING!