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PERSPECTIVES

Fact or Fiction: Can You Trust Your Fire Investigator's Report?

Our perspectives feature the viewpoints of our subject matter experts on current topics and emerging trends.

INTRODUCTION

What separates a reliable fire cause determination from just another speculative opinion? An objective report rooted in scientific facts. In this report, we will examine key considerations that must be top of mind when developing or reviewing investigative reports following a fire.

NFPA 921 – THE FOUNDATION OF FIRE CAUSE DETERMINATIONS

The National Fire Protection Association's "NFPA 921 – Guide to Fire and Explosion Investigations" is acknowledged by the industry as a reliable, science-based guideline. First published in 1992, the NFPA 921 guideline established a methodology of fire investigation based on accepted scientific methods. Although it has undergone numerous iterations since then, the core message is the same: fire behavior, fire dynamics, and thermodynamics are sciences that define fire ignition, growth, and spread.

Here we will highlight many of the critical aspects of NFPA 921 and how and why they affect the eventual cause determination made by the investigator and their admissibility at trial.

The Scientific Method

The scientific method provides the building blocks for developing and proving a scientifically supported theory. Regarding fires, application of the scientific method requires a causation hypothesis to either be supported or disproved through actual data (e.g., fire patterns, witness statements, historical data, material properties, etc.). After available data is obtained, a theory as to the ignition and spread of the fire is developed. A defensible theory should include:

- A competent ignition source
- A first fuel ignited
- The events that brought them together
- The manner in which that fire spread

All theories must be tested in order to comply with the scientific method. There are different types of testing that can be conducted, including physical testing of similar conditions, analytical testing using accepted scientific principles, or by referring to research conducted by others (Reference 1). Failure to adequately test the theory is a leading cause of inadmissibility at trial.

When a theory is tested, and the hypothesis of the fire cause is found to match the available data, using accepted scientific principles, then it can be accepted and will be admissible as expert testimony. If the hypothesis does not match the available data, the theory should be discarded, and a new theory developed. This cycle continues until a scientifically supported cause is identified or the fire is classified as undetermined.

Objectivity

Data related to the cause of the fire must be obtained without prejudice or judgement. NFPA 921 identifies two forms of bias that can impact the conclusions and admissibility of a fire investigation – they are expectation bias and confirmation bias.

Expectation bias occurs when the investigator forms an opinion **prior** to gathering all available data. Expectation bias has been shown to impact the performance of the total investigation. Those operating under an expectation bias will often tailor the investigation to identify evidence that supports their pre-determined cause theory. Expectation bias is often fatal to the investigation as some data may not be able to be recovered later, either by the time of a lab exam or at trial. The missing data also prevents adequate testing of a hypothesis, which violates the investigation methods outlined in NFPA 921.

Confirmation bias occurs **during** the testing stage of the scientific method. This type of bias occurs when the investigator fails to use all available data and/or fails to test different theories. Some data may be compatible with different ignition scenarios, making the style of testing the ignition theory critical. NFPA 921 states that "testing of hypotheses should be designed to disprove a hypothesis" (Reference 2). By testing a hypothesis with the intent to disprove it, an investigator will need to look at all of the available data to compare it against the hypothesis.

Data Collection and Analysis

In order to properly test a proposed theory, all available data must be recovered, documented, and analyzed. Exclusion of data should only be considered if other data can conclusively prove its inaccuracy. Performing a thorough analysis of a site is paramount to a thorough and proper investigation.

Figure 1

Consider the following examples of initial cause determination theories, based on initial evidence:

- **Theory:** A laundry room fire that is determined to have been caused by ignition of lint in the dryer, due to reports that the dryer was in operation at the time of the event.
- **Theory:** A couch fire that is determined to have been caused by a cigarette due to reports that the occupants were smoking on the couch at the time of the event.
- **Theory:** A kitchen fire that is determined to have been caused by unattended cooking due to reports that the occupant was cooking prior to the fire and left oil on top of the stove.

All of these theories are plausible, however data collected at the scene may reveal a failed lithium ion battery in the laundry room, a failed power strip under the couch, or all four heating elements energized on the stove – following further data collection.

Each fire has a distinct set of facts, unique time frames, and different involved parties. A qualified investigator will perform a full and complete investigation regardless of the size of the fire scene and regardless of how familiar a fire scene first appears. In addition to fire patterns, arc mapping, and witness statements, investigators should also consider security cameras, newspaper articles, real estate data, building department records, and social media sites when collecting and analyzing data.

An entire report can be overturned due to one small missing detail. For instance, what happens when the alleged cooking fire on the electric range is countered with a statement from the utility company that they disconnected power to the home prior to the fire?

The Role of Witness Statements

Witness statements are crucial to any investigation. There is no better indicator of where a fire originated than an eyewitness statement from someone who saw it start or the emergency responders who can describe the fire in its incipient stage. Even statements from persons who did not witness the fire but who are familiar with what combustible materials were in the area prior to the fire can also be helpful to an investigation.

However, there are limits to the accuracy and reliability of witness statements. Most people are likely to be excited or emotional during a fire and, as such, may not recall events or facts accurately. For example, a witness may indicate that the entire room was engulfed in flames, while a second witness may indicate the fire was localized in the trash can. Not to mention that the third witness, who discarded his ashtray in the garbage can shortly before the fire, may lie, and indicate that the fire was actually on the counter next to the toaster.

When analyzing witness statements, it is important to always attempt to substantiate eyewitness accounts with physical evidence or corroboration throughout the data collection process. One thing to note here is that a statement which first appears contradictory to other evidence should not be immediately dismissed as inaccurate. There may be a scientific reason why the witness statement doesn't seem to match. It could indicate a secondary fuel load or a change in ventilation during the fire. This is where the full analysis of all available data and theory testing come together to form a scientifically supported determination.

Industry Advancements

The evolution of technology and advancements in fire science have occurred in conjunction with an increase in research and testing of materials, fire dynamics, and products. Fire science is changing not only as a result of the increased research but also as a result of changes with construction methods, building materials, furnishings, and home products. A qualified investigator will continue to seek out the most current science in pursuit of a scientifically supported ignition theory and fulfilling "NFPA 1033 – The Standard for Qualifications of a Fire Investigator" which requires post-secondary educational training on 16 separate topics related to fire and explosion investigations.

Figure 2

Report the Facts

It is what it is; a fire investigator's responsibility is to report the facts, or as we like to say at J.S. Held, "deliver the news".

The role of the fire investigator should always be to provide a professional, unbiased opinion as to the origin and cause of the fire. If the scientific method is applied properly, there should be no pre-conceived notions (expectation bias) and no personal stake in the determination of the cause of the fire. Fire investigators are tasked solely with identifying how and why the fire occurred. It is important to leave the ultimate outcome of those findings to the other parties involved.

Collaborate

Reaching out to other experts with specific-field knowledge, whether it be a forensic engineer, contractor, appliance technician, or utility lineman, will result in a more accurate determination. Working with others not only increases the amount and accuracy of data, but the collective knowledge can also assist with testing proposed theories, such as:

- The engineer may be able to exclude a heat source as being a potential and competent source of ignition because the thermodynamic analysis shows an inability to heat the first fuel to its ignition point.
- The manufacturer of a fireplace insert may be able to show that the exterior temperatures of a product are well below the ignition point of an identified first fuel.
- A public safety website might be able to point out a defect or recall in a product that supports a hypothesis.

The practice of having reports technically peer reviewed provides an additional layer of reinforcement in testing a proposed theory. In the scientific community, a theory is generally not accepted until published and reviewed by other scientists in the same field. The act of an independent technical peer review, even within an investigator's company, shows that someone else has reviewed the data, attempted to disprove the theory, and has also accepted the identified cause as valid and supported by the available data. It is imperative to understand an investigator's review process and if it meets the standards of a true technical review.

CONCLUSION

A scientifically supported fire cause determination requires both proper understanding and application of the scientific method, as well as an attention to detail and thoroughness required to obtain all available data with which to make and test a hypothesis. The legal requirements under Daubert (3) call for all testifying expert theories and opinions to be based on accepted scientific principles. This leads to the requirement to test the ignition theory either physically, analytically with available data, or through the research of others. Failing to apply the scientific method along with accepted scientific theory, can result in exclusion of testimony at trial.

Figure 3

So, how do you know when a report is rooted in science? Consider objectivity, thoroughness of data collection and how it was analyzed, what witnesses did and did not say, what we've learned from advancements in the industry, the presence of defensible facts, and if there were any other professionals called upon in the development and/or review of the report. If you're still unsure, have an outside subject matter expert test the proposed theory and see if they arrive at the same conclusion.

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MORE ABOUT J.S. HELD'S CONTRIBUTOR

Stuart Morrison is a Senior Engineer in J.S. Held's Equipment Consulting Practice. Stu has over 20 years of experience in fire investigation and the analysis of mechanical and electrical equipment related to the cause of fires. He also has nearly 25 years' experience as a volunteer firefighter. He was a fire investigator with Montgomery County and is a certified fire investigator with designations including IAAI-CFI and NAFI-CFEI. Prior to founding Morrison Engineering in 1996, Stu was the Technical Director in Failure Analysis at Encotech in Schenectady, NY. He is a licensed engineer in both New York and Vermont.

Stu can be reached at stu.morrison@jsheld.com or +1 518 504 6317.

REFERENCES

- NFPA 921 4.3.6 Test the Hypothesis (Deductive Reasoning)
- NFPA 921 4.3.10 Confirmation Bias
- *Daubert v. Merrell Dow Pharmaceuticals, 509 U.S. 579 (1993)*