The California
Fire-Arson Investigator

California Conference of Arson Investigators

November 2001

Testing the Fire Cause Hypothesis

Over the years we have all heard the disclaimers regarding NFPA 921. Many recommend not taking it too seriously because it's only a guide, believing that we can't be held accountable for the information within. However, it doesn't matter that it's "only a guide." If this stand is taken as a defense for not adhering to the recommendations of this "guide," be prepared to stand alone. This is the recognized text for investigative procedures. That is not the same as being the best publication we have available. Many of us have our favorites. Instead, it is the most widely accepted document from a diverse committee of industry experts.

The significance of the consensus committee approach is that it reduces the possibility of an individual agenda or opinion, which is possible in a text authored by one person. Also, NFPA is well respected as an organization advocating scientifically-based consensus codes and standards. All of these aspects more or less qualify NFPA 921 as a standard in the legal community. The legal community doesn't care about the wording on the front cover, but whether the industry experts recognize it as a valid document. A look at the technical committee will show that this document has some industry horsepower behind it.

However, it's perfectly acceptable not to adhere to all of the recommendations in NFPA 921 as long as there is a reasonable basis for the decision to deviate. One example is the use of lined evidence cans instead of the recommended unlined cans, because the lab that you use wants only lined cans submitted. There are many other possible scenarios throughout the text that may not be adhered to for various reasons.

That said, this article will examine one link of the Scientific Method described in NFPA 921; Test the Hypothesis (Deductive Reasoning).

NFPA 921 has recommended the Systematic Approach, specifically the Scientific Method, for the fire scene examination. An examination of 2.3.6 Test the Hypothesis (Deductive Reasoning) reveals changes between the 1998 and 2001 editions. Probably the most significant change is the clarification that the deductive reasoning can be cognitive or experimental. An experimental examination of a hypothesis is something that we should strive to do whenever possible. No matter how many years of fire investigation or fire suppression experience we have accumulated, it is still a given that virtually all of that is post-fire, or at least, post-origin, experience. Any first-hand knowledge regarding the origin of fires and the ensuing fire behavior is gained by training classes or personal experimentation. The value of starting your own fire is that there is no question of where and how the fire started and what fuel packages were present and in what configurations.

The following fires are examples where experimentation was of value toward making determinations regarding the cause.

Scientific Method

Recognize the need
(Identify the problem)
↓
Define the problem
↓
Collect data
↓
Analyze the data
(Inductive reasoning)
↓
Develop a hypothesis
↓
Test the hypothesis
(Deductive reasoning)
↓
Select final hypothesis
(Determine cause)

Case one:

A marine fiberglasser was working on the lazaret of a dry docked boat in a boatyard. The boat was not connected to shore power but there were extension cords on board to energize the work tools. Reportedly, the work performed that day was on a workbench behind the boat. The fiberglasser cleaned the area and stored the containers of resin, acetone, catalyst and putty on the portside lazaret of the boat. About one hour after leaving the scene, a fire occurred in the boat. The area of origin was clearly around the containers left by the fiberglasser.

Yard workers stated that the fiberglasser had a reputation for rushing the work

by over-catalyzing the resin and had caused a trashcan fire in the same manner with resin and rags. It sounded reasonable, but the fiberglasser insisted that there was no resin-catalyst mixture in any of the buckets and that even if he did over catalyze a mixture, it would only be from the standard two percent catalyst to maybe three or four percent. Otherwise, the resin would crack and the job would be ruined.

Employees of numerous surf and marine shops contacted believed that if too much catalyst were used in the resin there would be a fire; some believed they had experienced it. I decided to find out how much it took to make the fire occur. Using the same resin and catalyst involved in the loss, mixtures were set up, in the sun, at approximately the same time of day, at approximately the same ambient temperature. The mixture started out at two percent catalyst-to-resin, which made a nice chunk of light green cured resin and proceeded to a fifty percent mixture. The fifty percent mixture made a roiling mass of light brown foam-like material that didn't resemble cured resin at all, but still no fire.
More tests were conducted with toothpicks and twisted paper towels, halfway immersed, but still no fire. The peak temperature of the fifty percent mixture was 660° F, which occurred about thirty minutes into the test as the resin furiously reacted, then dropped in temperature significantly. Of course, this is an unrealistic percentage that would not be used by the fiberglasser. In fact, at five percent catalyst-to-resin, only three percent over the standard amount, the normally light green resin turned brown and had large cracks throughout.

A torch was used on the outside of a pan of resin without catalyst, causing the resin to boil vigorously, with no autoignition occurring. However, when the open flame was raised high enough to reach the vapors, there was immediate ignition, with or without preheating.

This experimentation caused the determination that over-catalyzed resin was not the cause of the fire. Other possible causes were ignition of the ignitable vapors, (notably acetone or resin), by an unknown ignition source, or the fire was incendiary.

It turns out that Firefindings conducted similar tests and came up with the same results in 1997, (see Volume 5, Number 1, page 6). It's always nice to have independent confirmation of an opinion. It is noted, though, that the exclusion of over-catalyzed resin is not a unanimous opinion among the investigators involved.

Case two:

A painter placed a 500-watt portable halogen worklight in front of the newly painted door of a bedroom under renovation and left for the day. The light was in place to speed drying time. The wind swung the door, which knocked the halogen light facedown. The halogen light lay on the plastic tarp that covered the bare plywood flooring and eventually caused ignition. The painter stated that there was a safety grill with the light when it was purchased but he hadn't installed it. A question was posed as to whether the safety grill would have prevented the fire.

Exemplar plywood, tarps and halogen lights were obtained and set up in the configuration found at the scene. It was discovered that with the safety grill in place and the light facedown, the temperature never attained over 360° F and the plywood did not char. However, without the safety grill a fire occurred, not on the tarp, but on the plywood, in fourteen minutes with a temperature of 1120° F. The peak temperature was 1144° F at eleven minutes. Also, the exemplar halogen light revealed that there were instructions on the light lens regarding the high temperatures involved. There was also a leaflet in the box regarding the safety grill, which stated that the light should not be operated without the safety grill installed.

These two cases were a learning experience and lent credibility to the determination of cause. In both cases, experimentation yielded much more information than deductive or cognitive reasoning alone. In the name of scientific research, try to think of past cases that left unanswered questions on your mind. I have one from years ago: The man is ironing a bed sheet in the living room; the lady is in the shower, reportedly not feeling well. The man goes to check on the lady's welfare and comes back a couple minutes later to find the iron on the floor and the sheet on fire. The man grabs the sheet and drags it to the patio, igniting the living room along the way.

At the time of the investigation, the sheet is found on the patio, the ironing board and iron are found in the living room and the distraught man and lady are outside (the man thinks his dog may have toppled the iron by running over the cord). "Iron igniting combustibles" goes in the report, but later a Firefindings article was published that put the scenario into question. Was the call correct? Or was it a failure at the plug, iron controls or elsewhere in the iron? Or was it insurance fraud? I still wonder; which keeps me from thinking I know too much.

Physically test your hypothesis whenever possible. Reconstruct and ignite. If anyone is bothered by the smell, tell them NFPA 921 made you do it!

Article and Opinions by:
Fred Herrera, CFI

About the author: Fred Herrera is a fire investigator with San Diego's Metro Arson Strike Team (MAST) and Engineering & Fire Investigations (EFI). He is also a CCAI Board member and the San Diego Roundtable Coordinator (RT12).