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# TRACKING DOWN A KILLER

**Specially trained dogs are highly accurate but cannot report what they find.**

**PIDs are used to quantify the compound in question.**

*by Dave Kuiuwa*

**T**he firefighter's work of suppressing a blazing structure is the beginning of a string of activities that includes investigation of possible cause and potential criminal prosecution if arson is suspected. Once the flames are finally extinguished and the structure is secured, the work of determining the cause of a fire begins.

Fire investigators examine burn patterns and look for trace accelerants in an effort to determine whether the blaze was accidental or the work of an arsonist. Combing the soggy, burned-out building shell, the investigator searches for clues that will confirm the cause of the fire. Burn patterns that

emanate from electrical or combustion devices such as circuit panels and hot water heaters generally confirm an accident. But what if the fire was not an accident? How can this be confirmed?

One widely used technique is to look for trace accelerants during the overhaul process of a fire investigation. When an arsonist douses a stairwell with gasoline and lights a match, the fire spreads quickly and burns intensely. Sometimes the burn pattern alone is enough to confirm the event, but when it does not, the trace accelerants left behind indicate foul play.

If the building is destroyed and there are

no burn patterns to reference, the investigator must dig deeper to determine the cause. Pieces of the remains are cross-sectioned to get at planes that have been untouched by fire. These pieces are then labeled to document their location within the structure. Each piece must then be evaluated to determine whether trace accelerants are present.

There are several ways to "sniff" for accelerants. The most traditional is to use a specially trained dog. These animals have been conditioned to seek out and respond to minute levels of volatile organic compounds (VOCs) at the scene. Most "Flammable Liquid Detection K-9s" are cross-trained to

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detect several common accelerants in the light, medium, and heavy hydrocarbon categories. One breed most suited for this line of work is the Labrador retriever. Other breeds become aggressive when alerted to danger, but the Labrador keeps working to find the source of the accelerant.

Dogs can be either “aggressive alert canines” or “passive alert canines.” Aggressive alert canines alert their owner to the existence of accelerants via aggressive means. They become excited and usually bark and/or paw at the area, verifying the compound. This can cause problems because precious evidence can be disturbed. Passive alert canines, on the other hand, will sit down to alert the investigator that an accelerant may be present. In either case, the remains are then taken to a laboratory for analysis and confirmation.

These dogs are highly specialized, so they are very expensive and out of the reach of most fire department budgets. Furthermore, flammable liquid detection canines need to be recertified annually, usually with the U.S. Bureau of Alcohol, Tobacco, and Firearms. When utilized, the dogs are highly accurate and very reliable—but because they cannot report what they have found, quantifying the compound is impossible by this means alone. Supplemental electronic devices must be used.

### Using Photoionization Detectors

During the burn, most of the fuel is consumed. Investigators need to look for trace volatile organic compounds in parts per million (ppm) and sub-ppm concentrations. A Photoionization Detector (PID) is designed specifically for this task. Most PIDs use a detection method where a sample is drawn using a continuously operated, integral sampling pump. The sample then passes through an ionization chamber where it may or may not be ionized. The ionization is dependent on the ionization potential of the gas and the photon energy of the lamp used. Photon energy is measured in electron volts (eV); photon energy and ionization potential are directly related in determining the suitability of the detector for the job at hand.

Every VOC has an ionization potential. This is defined as the amount of energy required to take the gas from its current state and turn it into an ion. An ion is defined as a compound that has gained or lost electrons in its outer shell. PIDs use ultraviolet

light (UV) to ionize the compound. The photon energy of the UV lamp determines the range of VOCs the detector is capable of monitoring. The two most common UV lamps are 10.6 eV and 11.7 eV.

To this point we have covered a lot of technical terms, but one easy way of determining whether a compound will be detected is this: If the photon energy of the lamp is greater than the ionization potential of the compound, it will be detected by the device. For example, let's say we are using a PID with a 10.6 eV lamp and we want to determine whether someone used a can of xylene to start a fire. Xylene has an ionization potential of 8.6 eV. When compared to the 10.6 eV strength of the lamp we determine that it will be detected, if it is present.

Of the two lamps, one is more practical and one is more specialized. The 10.6 eV lamp is most common and will detect the majority of VOCs. The most noted advantages to the 10.6 eV lamp are its service life and replacement cost. Rated at 6,000 hours of service life, the 10.6 eV lamp is both durable and economical. On the other hand, the 11.7 eV lamp has a very short life and is extremely expensive to replace. Lifetime for this lamp is generally in the 40 to 80 hour range, and frequent calibration is necessary to keep the device accurate.

Once ionized, the compounds are then detected by the PID's electrodes, and the signal is sent to an amplifier for processing. That reading is then processed and a ppm or sub-ppm reading is sent to the unit's liquid crystal display. Ultimately, the investigator is provided with a ppm readout of sampled concentrations of VOCs.

The ideal PID has a monitoring range of 0.0 to 5000 ppm VOCs. Accuracy can be increased through the use of response factors. Because all PIDs respond with different signal strengths in the presence of varying compounds, the response factor allows the investigator to increase the accuracy of the device by selecting a specific compound, “tuning” the PID to a given compound. Response factors are built-in “electronic calculators” that are pre-programmed by the manufacturer. Response factors do the math for the user so he can focus on the investigation rather than calculating sampled readings.

### Consider Sampling Range, Datalogging

Sampling range and probe selection are also important. PIDs should have a sampling

range of 100 feet and utilize flexible and rigid probes, allowing the investigator to remain at a safe distance from weak structures. Battery selection also must be considered. Lithium-ion batteries provide maximum energy density (18 hours run time) and have excellent cold weather performance while providing “memory-free” operation. As an emergency backup, alkaline battery packs provide a readily available alternative to charging.

Other features to consider are datalogging and flexibility. Dataloggers give the investigator the ability to document the concentration of the volatile organic compounds and when/where the VOC reading was taken. Dataloggers can also be imprinted with user and site identification information, documenting who is using the instrument and where it is being used. This information can be downloaded to a personal computer and is invaluable in a court of law.

Finally, maintenance needs to be considered. With any electronic gas detector, the readings are only as accurate as the calibration performed prior to use. With most users, calibration is a process that can be lengthy and intimidating. Recently, individual instrument docking units have been introduced that automate the process and ensure accountability. These devices are connected to a personal computer or server system and are capable of automatically calibrating, bump testing, downloading, troubleshooting, and charging a PID. The PC or server continuously documents the transactions, tests, and results for recall at a later time. This documentation proves the PID has been properly maintained and is reading accurately, thus closing one more loophole.

In dealing with arsonists, we must be as ruthless and calculated as they are. The right tools, the proper measurement techniques, and complete documentation are the keys to ensuring these criminals do not go unpunished. ■

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