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## DETECTION OF TRACES OF COMBUSTIBLE FLUIDS IN ARSON CASES

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One of the common methods employed to start or increase the size of incendiary fires is the use of flammable liquids of various types. When either large amounts of such fluids are applied or the fire is rapidly detected and extinguished, their use can often be readily detected by investigators. Indications of the presence of such substances being explosions; rapid spread of fire which is not explainable by structural, weather, or other conditions; odors at the fire scene; stains on the floor or at unusual locations at the fire scene and others.

While fire investigators can frequently detect that flammable fluids were used or could have been used at a fire scene, they frequently encounter difficulty in recovering suitable samples of debris from which the laboratory can separate identifiable amounts of the fluid employed. This difficulty in collecting satisfactory specimens for laboratory analysis is particularly troublesome when the fire was intense and the structural damage extensive. Any samples from which the laboratory can separate flammable fluids must, of course, originate from an area contacted by the fluid and at least some of the less volatile fractions of this fluid must still remain in the material collected. Even when a strong odor of gasoline or kerosene is apparent, it may be difficult to locate the principal source of the odor. In addition, many flammable fluid odors are masked by strong smells produced by combustion of materials normally present in the fire scene area. Difficulty in obtaining adequate samples for laboratory analysis has recently become even more serious because of the more frequent use of fluids which have little or no odor. When such substances as alcohols, odorless paint thinners, and barbecue charcoal lighters are employed in incendiary fire cases, the presence of traces of such fluids may not be detected in many instances.

In the past, some fire investigators have attempted to detect or locate traces of flammable

fluids through the use of combustible vapor detectors of various types. Most of these instruments, however, have had such low sensitivity that they were of little aid under normal conditions when mere traces of combustible vapors were present. Recently a new and improved instrument came to the attention of the author's laboratory which has proven to be of valuable assistance to the arson investigator. This device is the J-W Aromatic Hydrocarbon Indicator, Model SS.<sup>1</sup> Possibly other comparable instruments, made by other manufacturers, may also now be available. This apparatus is a dual-range combustible gas indicator designed to indicate vapors of aromatic hydrocarbons in the flammable and toxic ranges. The instrument meter is graduated in two ranges which may be selected at the option of the user. The first of these ranges is the same as that of many standard combustible gas indicators (0 to 1.0 of the lower explosive range). The second range, which is of primary interest to the fire investigator, is graduated from 0 to 1000 ppm of aromatic hydrocarbons. While this device was designed primarily for testing vapors of specific substances such as benzene, and reads directly on these vapors in terms of either explosibility or parts per million, it can also be used to detect and even measure the concentration of most other combustible vapors. The only flammable fluid frequently encountered in arson cases for which this device is not always suitable is leaded gasoline, but even when such gasolines are suspected, this meter can be used if care is taken to prevent damage to the filament in the detector cell.

The operating principal of the J-W Aromatic Hydrocarbon Indicator is relatively simple and like many other combustible gas indicators except that it has a far more sensitive meter. Vapor is drawn through a probe and sampling hose under suction produced by a rubber aspirator bulb. The sample passes across a platinum wire filament coil

<sup>1</sup> Manufactured by Johnson-Williams, Ltd., Palo Alto, California

which is connected as one arm of a balanced Wheatstone Bridge and operated at controlled temperature. Any combustible gas present burns and raises the coil temperature—hence its electrical resistance—and unbalances the Bridge. The meter shows the degree of unbalance which is proportional to the concentration of the combustible gas. Another identical platinum coil, sealed away from the vapor, serves as an adjacent leg of the Bridge and compensates for variations in ambient temperature, voltage, and resistance. Flashback arrestors are also included.

In fire investigations the measurement of the exact amount of combustible vapor present is usually of no primary importance. What is desired is a device for determining whether or not there are odorless vapors or traces of other flammable fluids or vapors present in the burned building, the smell of which may be masked by other substances. A device is also needed for locating areas at the fire where the largest amount of fluid and vapors are concentrated so that the most suitable specimens of charred wood, fabric, or other material can be secured for laboratory analysis. An instrument of the type mentioned can have considerable value for both of these purposes.

The use of a suitable combustible gas indicator at a fire scene is relatively simple, but to be most effective, should only be done by an experienced fire investigator. Before tests are made the fire must be extinguished and the building permitted to cool so that the excessive amounts of steam and vapors from the combustion of the building can dissipate. Care must also be taken to avoid being misled by readings obtained from areas where flammable liquids are normally expected, such as gasoline or solvents in garages or shops. Carbon dioxide, in excessive amounts, will give negative readings or reduce readings obtained from traces of combustible gases. Interpretations must therefore be made with care in areas where CO<sub>2</sub> from fire extinguishers is present or some other circumstance has produced an abnormally high carbon dioxide level in the air. If these precautions are taken and the operating instructions of the manufacturer are followed, the instrument can furnish considerable assistance to the fire investigator by aiding him in determining that combustible vapors are present and to assist in the selection of areas from which suitable specimens for laboratory study can be secured.

Equal to its value at the fire scene is the assistance that the combustible gas indicator can render

to the criminalist or other laboratory specialist concerned with the separation and identification of flammable fluids recovered in arson cases. Prior to the development of this sensitive instrument, the chemist had to either depend on odor to determine which samples were suitable for conducting distillation or other extraction processes, or else lengthy procedures had to be used on most specimens submitted for examination. With such a sensitive instrument available, it is possible in each case to rapidly select the best specimens for complete analysis. Containers holding samples of debris can be opened, any odors present detected by smell, and then tests made for combustible vapor by inserting the probe of the meter directly into the container. Where there is no odor present and no readings are obtained on the meter, the absence of combustible fluids can be rapidly and conclusively established. Thus, considerable time is saved by eliminating the need for carrying out extraction procedures or other tests which would be of no value. Odor cannot be disregarded in such preliminary laboratory tests since, in instances where heavy fuel oils have been subjected to heat and fire, there may be no detectable amounts of combustible vapors present. The odor of these heavier fractions usually does remain, however, and the traces of oil present may later be identified by the application of appropriate procedures. By means of such rapid and simple tests, it is now possible in most cases for the laboratory to almost immediately inform the investigator submitting samples for study that traces or larger amounts of flammable fluids are or are not present. The officer, therefore, need not wait until complete and often lengthy laboratory testing is completed before he can secure preliminary information.

No instrument or device can take the place of a thorough investigation made by a trained and experienced fire investigator in a suspected arson case. A suitable combustible gas indicator can, however, be of great aid both at the fire scene and in the laboratory when used by trained personnel. The instrument mentioned in this article has been employed at a number of fire scenes and on numerous occasions in the author's laboratory and in all of these cases it has amply demonstrated its value to both the fire investigator and the laboratory worker. Consideration should therefore be given to the use of such instruments by all laboratories and arson details which regularly encounter cases where flammable fluids have been employed.