Running Head : Trust Your Dog

Trust Your Dog, a Study of theEfficacy of Accelerant Detection Canines

William A.Hogsten

Charlottesville Fire Department, Charlottesville VA.

CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and the appropriate credit is given where I have used the language, ideas, expressions, or writing of another.

Signed: ____________________________

Abstract

ADC (Accelerant Detection Canines) are used to assist fire investigators in locating the areas that have accelerants, which help start the fire and accentuate its flame spread. These canine teams have proven to be the most efficient tool that fire investigators can use to locate accelerants. Once the area containing accelerants is located, fire debris samples are taken from the area that canine alerts and sent to the laboratory for testing. It is highly preferable that the fire debris evidence be confirmed by the laboratory for it to be entered into evidence in the arson case. These canine teams have come under a great deal of scrutiny since they were first introduced in 1984. The problem was that fire debris identified as containing ignitable liquids by certified ADC is not being confirmed by the laboratory as having ignitable liquids. The purpose of this research was to identify the variables that would assist the accelerant detection canine team in a higher rate of ignitable liquid confirmations from the lab. The confirmed laboratory reports would be more acceptable to the courts as scientifically based evidence. A descriptive research method was utilized to answer the following research questions: (a)What is a certified ADC? (b) Can ADCs detect levels of accelerants that the laboratory cannot confirm? (c) Does the method of collection fire debris evidence that is thought to contain accelerants lead to negative laboratory confirmations? (d) Can fire debris evidence unconfirmed by the laboratory of having accelerants, be utilized as evidence in a court of law? The recommendations based on the results could assist in a higher number of laboratory confirmations by the ADC handler maintaining impeccable records, assist in collecting evidence, delivering evidence to the laboratory without delay, and keep all tools, including the canine clean to minimize cross-contamination.

Table of Contents

Introduction

ADCs (Accelerant Detection Canine) are used to assist fire investigators in locating the areas that have accelerants, which help start the fire and accentuate its flame spread. These canine teams have proven to be the most efficient tool that fire investigators can use to locate accelerants("Accelerant Detection Canine Team," 2010). Once the area containing accelerants is located, fire debris samples are taken from the area that canine alerts and sent to the laboratory for testing. It is highly preferable that the fire debris evidence be confirmed by the laboratory for it to be entered into evidence in the arson case.

These canine teams have come under a great deal of scrutiny since they were first introduced in 1984. The problem was that fire debris identified as containing ignitable liquids by certified ADC is not being confirmed by the laboratory as having ignitable liquids(NFPA 921, 2011, Figure 3.3.98).

The purpose of this research was to identify the variables that will assist the accelerant detection canine team in a higher rate of ignitable liquid confirmations from the lab. A descriptive research methodology was utilized to answer the following questions: (a) What is a certified ADC? (b) Can ADCs detect levels of ignitable liquids that the laboratory cannot confirm? (c) Does the method of collection fire debris evidence that is thought to contain accelerants lead to negative laboratory confirmations? (d) Can fire debris evidence unconfirmed by the laboratory of having accelerants, be utilized as evidence in a court of law?

Background and Significance

The purpose of fire investigations was to determine the origin, cause, and the development of the fire. This process requires the fire investigator to analyze the totality of the circumstances of the fire to make these determinations (National Fire Protection Association921, 2011). There are four classifications of cause for a fire: accidental, natural, incendiary, and undetermined. The undetermined classification means that one of the other three causes cannot be proven to an acceptable level of certainty (NFPA 921, 2011).

Natural fires are those that start without human intervention, such as lightening, earthquakes, and wind. Fires that involve human intervention that are not shown to have an intentional motive are classified as accidental(Virginia Department of Fire Programs [VDFP], 2009). Incendiary fires (arson) are those fires that are intentionally set by those that understand that the fire should not have been ignited. However, if the motive of what was believed to be incendiary cannot be determined, then the fire is classified as undetermined (NFPA 921, 2011). Thus, showing the intent is a key component in proving the crime of arson.

The use of accelerants in a fire shows that there was intent to start the fire, and /or accentuate the growth and spread of the fire. Ignitable liquids are the most common accelerant used by arsonist(Bombard et al., 2001). They are liquids that are capable of fueling a fire such as flammable or combustible liquids. For the purposes of this research accelerants and ignitable liquids can be used interchangeably. Common products classified as ignitable liquids include but are not limited to: gasoline, diesel fuel, fuel oils, acetone, lacquer, paint thinner, turpentine, and toluene(*Alcohol Tobacco Firearms 89,* 2010, p. 2).

Fire scenes present a unique problem to investigators as the original scene before the fire is typically vastly different after the fire and fire suppression operations are complete. This complex endeavor requires a systematic approach to determine the origin and cause of the fire. The scientific method is the recommended approach to fire investigations which has definitive steps that include: recognizing the need, defining the problem, collecting data, analyzing the data, developing a hypothesis, testing that hypothesis, and selecting the final hypothesis(NFPA

921, 2011, figure 3.3.144). By following this method it should help alleviate bias, uncover all factual data, eventually lead to a prosecution in incendiary fires.

Fire investigators have had to spend countless hours sifting through fire debris, uncovering layers of rubble that has fallen on top of the other as the fire progressed and compromised the structural integrity of the structure (Bombard et al., 2001). Needless to say that finding the area that the fire started is an arduous task. Furthermore, identifying the area to take evidence for the potential of accelerants is accentuated. Multiple samples from multiple locations in the fire scene were taken from any area that was believed to have the potential of having ignitable liquids(Accelerant Detection Canine Team, 2010). This is a time consuming and labor intensive task(Ensminger, 2011 b). It also slows the process for obtaining laboratory analysis as they have a large number of samples of fire debris to analyze.

The best and most efficient tool for assisting fire investigators in identifying fire debris evidence that has accelerants is by far the ADC(Gialamas, 1995). Sometimes the expectation of these canines is beyond the scope of their ability. Fire investigators must realize that the ADC is a tool and not infallible(Lentini, 2012a). An alert by an ADC to areas identified as containing accelerants is not the magic bullet to show intent. The fire debris from that alert should be collected and sent for analysis to an accredited laboratory for confirmation. Investigators and prosecutors that use the alert of the ADC without confirmation from a laboratory as expert testimony, do so at the risk of compromising the entire case.

There are a number of landmark cases that set what was thought to be a precedence on the topic of using unconfirmed ADC alerts as evidence in court. NFPA 921 (2011) states that unconfirmed laboratory canine alerts should not be considered validated (p.150). However, there are still trial judges that allow the unconfirmed alerts in as evidence(Lentini, 2012b). As the courts continue to battle this aspect of the utilization of ADC alerts as evidence, there are recommendations that the ADC teams can do to establish their effectiveness and credibility in courtroom testimony. "It should also be the ethical responsibility of prosecuting attorney's not to abuse the role of the accelerant detection canine in a fire/arson investigation" (Jonas & Bueker, 1999, p. 4).

This research was conducted to identify the variables that will assist in the ADC team in achieving a higher rate of laboratory confirmations of evidence alerted to as containing ignitable liquids. The higher rate will lead to a higher rate of convictions of arson, removing those arsonist from the general public. Reducing the number of arsonists reduces the level of risk to the community through mitigation (United States Fire Administration, 2011). By identifying the areas in which ADC teams can increase the number of convictions through recognizing and improving the investigative techniques, it accentuates the professional status of those teams (United States Fire Administration, 2011).

Literature Review

Dogs have been man's best friend for over 20,000 years. In the late 1900 century, Ghen Belgium was the first jurisdiction to formalize a program for training police canines. The "Ghent" program was hugely successful and attracted wide attention and prompted other European cities to use canines in law enforcement(Ensminger, 2011a). Eight years after the Ghent experiment, The New York City Police Department was the first law enforcement agency in the United States to use canines in police work on a normal basis. The role of canines in law enforcement since the Ghent experiment has grown exponentially(Ensminger, 2011a). Canines are currently used as guard dogs, attack dogs, detection dogs, seeing-eye dogs, autism dogs, cancer dogs, epilepsy dogs, diabetes dogs and most recently detecting bed bugs. "It is widely accepted that well trained dogs are the most portable and versatile tools in use today for odor detection" (Latimer, 2010, p. 5).

Canines in the fire service dates back to the eighteen century when horses pulled the fire apparatus. The ancient breed called Dalmatia (known commonly now as Dalmatians), were used to calm the horses at fire scenes(Jonas & Bueker, 1999). The Dalmatians also ran beside the horses responding to the fires to keep people from running into the street and to keep the horses moving forward("History of the Dalmation," n.d.).

The inspiration that a canine could be utilized to assist in arson investigation came from a conversation between Robert Noll and Joe Toscano during training at Federal Law Enforcement Training Center (FLETC). Noll was a member the New York City Bomb Squad and worked at that time as a trainer of explosive canines. He later came to work with the ATF Explosive Technology Office. Toscano was an inspector for the Connecticut State's Attorney Office. After returning home from FLETC, Noll began working with the family pet "Nellie" on accelerant detection(Gialamas, 1995). This endeavor intrigued ATF forensic chemist Richard Stroebel. Together, Noll and Stroebel join forces in developing a program to imprint and train Nellie.

As a feasibility study, ATF trained the first accelerant detection canine (ADC) "Nellie" in 1984 to assist in locating evidence in arson scenes. After the results were studied by the American Academy of Forensic Sciences, Connecticut State Police trained "Mattie", the first operational "arson dog"(ATF Accelerant Detection Canine Program, n.d.). Mattie was trained for 38 days on flammable liquids. As the training progressed, the amounts of the liquids were decreased to a point where they were less than one drop, with no change in her ability to recognize the odor(Gialamas, 1995).

Nellie and Mattie were trained to detect accelerants in fire scenes. Accelerants are used by arsonist to accentuate the ability to ignite the fire and increase the spread and growth of fire. Through the combined efforts of ATF, Connecticut State Police, and New Haven State's Attorney's Office, the experiment with the two arson dogs far exceeded expectations(Bureau of Alcohol, Tobacco, Firearms, and Explosives [BATFE], n.d.). From the results, came inquiries from across the United States and Canada.

Public and private agencies began inquiring about the canines commonly known as "arson dogs". Local, state and federal agencies wanted these new tools as did insurance companies, private investigators, and laboratories in the private sector(Davis, 2006). ATF continued the development of the ADC program in Front Royal VA, at the canine training facility(BATFE, n.d.). ATF partnered with local and state law enforcement agencies to strategically place ADCs across the United States. Each of these teams holds a federal certification and is part of the National Response Team (NRT). NRTs are charged with meeting the challenges of arson and explosive incidents by partnering with local, state, and federal agencies. These teams help to identify the origin of the fire, determine the cause, gather evidence, and support criminal prosecutions. Each NRT call for arson is supported by one of the 50 ATF trained and certified ADCs(Bureau of Alcohol, Tobacco, Firearms, and Explosives [BATFE], n.d.).

With this demand, other organizations saw the need and started to train ADC's. State Farm Insurance partnered with law enforcement to help fight the crime of arson through the sponsorship of ADC's(Gialamas, 1995). State Farm Insurance partnered with the Maine State Police to sponsor and train ADC's after a State Farm Insured property was burned by an arsonist in South Carolina("Accelerant Detection Canine Team," 2010). During the course of the investigation an ADC was used to identify the location of the accelerants used to start the fire, which help lead to an arrest and conviction. The trainer of this specific canine was from the Maine State Police. An agreement was made between the Maine State Police and State Farm Insurance to sponsor ten canines a year over the course of three years for local and state fire department fire investigators("Accelerant Detection Canine Team," 2010). The first canines from this program became operational in 1993. The three year program is still operational today. State Farm's slogan is now, "a man's best friend is an arsonist worst nightmare"(Davis, 2006. p. 18).

Canine Accelerant Detection Association (CADA) is the oldest national organization dedicated completely to the use of ADC. Founded in 1991, canine teams belonging to CADA are made up of fire departments, police departments and some private sector agencies. The canines are rewarded by food, treat or play. CADA takes the position that ADC's are valuable tools in a fire investigation that help locate the trace evidence of ignitable liquids("CADA," 2012). With the canines being a tool in the total scheme of the investigation, the term "arson dog" is not recommended as the canine does not determine arson(CADA Arson Dog, n.d., p. 1).

Fire K9.org is a non-profit corporation founded in 2009, to support independent ADC teams on an international level. These teams are used to assist fire department investigators, law enforcement and arson tasks forces in fire investigations. Fire K9.org hosts training programs for members to help achieve greater proficiency through networking, updates on technical and scientific information(www.firek9.org). The teams of Fire K9.org are certified annually by independent forensic labs through double blind testing.

Scientific Working Group on Dog and Orthogonal Detector Guidelines (SWGDOG)mission is to enhance the performance of detector teams. SWGDOG was founded in 1989 with the mission of improving local state, federal and international law enforcement agencies by improving the overall reliability of detector dogs. By establishing best practices for canine teams, it improves the performance and consistency, which increases the reliability in court through peer review. In part, SWGDOG was founded to establish the reliability of detector dogs that was constantly under attack. SWGDOG uses consensus based best practices to ensure quality assurance and control(Scientific working group on dog and orthoganal detector guidelines [Scientific Working Group on Dog and Orthoganal Detector Guidelines], 2010).

Training is not a one-time endeavor that the canine passes the certification tests that are initially required(Latimer, 2010). These dogs must be trained daily with a variety of ignitable liquids and a variety of distracters, at a variety of venues(*ATF 89*, 2010). The vast majority of ADCs are food reward canines. Studies have shown that canines really don't want to please their master, but rather they want to know what is in it for them(Frawley, n.d.). Behaviors that are rewarded are statistically more likely to be repeated. The key to the repeated behavior is that the trainer and eventually the handler must understand the right behavior for the reward(Frawley, n.d.). The fact is that some methods will work for some dogs and others will not ("Toy v. Food," 2011). With the variety of ignitable liquids, and number of distracters and the variety of environments that the canine is exposed to, the food reward method has proven to be the most effective(BATFE, n.d.).

Some skeptics claim that the food reward method may lead to false positive alerts. The fact of the matter is that properly trained canine and a prudent handler is as reliable as a toy reward canine team, maybe more(Frawley, n.d.). A canine with an excellent food drive can work all day after being fed because they still want to work more for the love of food. Therefore it is advised that the handler of food reward canines spread out the daily allotment of food, and not have just one training session where all the food is consumed(Frawley, n.d.). There is a reason that ATF, Customs and USDA almost exclusively use food reward canines, reliability ("Toy v. Food," 2011).

The use of canines in detecting accelerants is based on two theories; Locard's Exchange Principle, and Pavlov's Classic Conditioning. Locard stated that when there is contact with two items occurs; there will always be an exchange of particles(Virginia Department of Fire Programs [VDFP], 2009, p. 1). Whereas these particles might not be visible to the human eye, they do exist. Sometimes those particles are in the minutest form, but they are measurable amounts. This is the case when accelerants are poured to help start a fire. Ignitable liquids come in contact with the item that is being burned and a residue is left even after the fire(Virginia Department of Forensic Science, 2010). Pavlov's Classic Conditioning is an automatic type of learning is which a stimulus evokes a response that was originally evoked by another stimulus(McCloud, 2007). In the case of imprinting and training ADC's, the food reward system is used. The canine searches and finds an ignitable liquid, for which they are trained to "alert" (sit) in order to get food (Wagner, 1997).

The food reward system is preferable due to three distinct advantages: the speed of training, stronger stimulus, and multiple handlers. The food reward system subjects the canine to multiple repetitions daily. The typical training day would expose the canine to 125 repetitions a day by feeding a minute portion of the daily allowance of food each repetition. That would be an annual total of 45,465 repetitions(Accelerant Detection Canine Course #89, 2010). The canines are never fed without exposure to an ignitable liquid. With food being the reward, the canines can work longer and in tougher environments ("Toy vs. Food," 2011). Food reward allows for multiple handlers, provided that the handler is properly trained(BATFE, n.d.).

The intense motivation of the canine by the food reward system also helps in discrimination training. ADC's are trained to discriminate between pyrolysis odors and accelerant odors(Wagner, 1997). This is important in the investigation of a fire scene as pyrolysis is part of the rapid oxidation process commonly known as fire (NFPA 921, 2011, p. 16). Various matrixes are formed that have burned materials that are typically known to have pyrolysis along with burned materials that have been spiked with accelerants(Wagner, 1997). The canines must discriminate between the burned materials with accelerants and those without accelerants with pyrolyzed material being a constant in all(BATFE, n.d.).

Training of the ADC team is a two phase processes, imprint the canine and training the handler(Accelerant Detection Canine Course #89, 2010). Canines are imprinted to ignitable liquids through the food reward system (note that the term is reward and not bribe)(Frawley, n.d.). Once the canineis imprinted, distractors are introduced to simulate the different scents that they could encounter while searching a fire scene. When this training is complete, the handlers are trained and introduced to the canine(BATFE, n.d.).

The imprinting process starts off simple with the canine being exposed to a minute amount of ignitable liquid in the form of a sniffer tin or on a cotton ball. As soon as the scent is smelled by the canine, they are immediately given a small portion of food(Frawley, n.d.). The process is repeated until the daily allotment of food is consumed. The next step is to have the canine sit (or alert) after locating the scent, then immediately feed them. Once the trainer and canine are proficient with that exercise of alerting to the proper scent, distractors are introduced(Scientific Working Group on Dog and Orthoganal Detector Guidelines, 2010). The distractors are items that would typically found in a fire scene: sheet rock, lumber, shingles, carpet, padding, parts of furniture… The process of discriminating between burned products of the fire scene and ignitable liquids is what sets the canine apart from the fire investigator(Gialamas, 1995). After this skill is mastered with the first imprinted ignitable liquid, the next ignitable liquid is introduced. The whole process is repeated until all the ignitable liquids have been imprinted in the canine, and discernment is mastered. It is at this point that the handler is introduced into the training process of the team.

The assumption is that the handler is a novice with a fire investigative background and in most case with law enforcement authority. Thus, the training is from ground up similar to that of the canine partner that the handler will eventually be working with. The training will include but not limited to safety, records, canine first aid, basic handling skills, behavior modification, commands, grooming, training programs, training aids, ignitable liquids, evidence collection, testifying, and last but not least searching fire scenes(Accelerant Detection Canine Course #89, 2010).

Some of the other motivations for canine training include toy play reward, praise reward and force corrections. Toy play reward is utilized for canines that have prey drive which means that they are motivated to chase a ball, rabbit or a stick. Prey drive is an inherited characteristic, not learned(Frawley, n.d.). Whereas praise is a critical component in canine training, it has only been proven effective in 1% of working canines. Praise reward also requires for there to a solid relationship between the handler and the canine. With that said, it would be hard to have a trainer, and then transfer that canine to a handler as the relationship as the only form of motivation would have to be reestablished(Duno, 2009). Force correction training (or escape training as it sometimes referred to) is left for those canines that are not motivated by food, prey or praise. Very few if any canines are lacking of a food, prey or praise drive, therefore the "yank and crank" (Frawley, n.d., p. 12)method of training is not desirable for ADCs. That is not to say that corrective actions do not need to be taken. Corrective actions are a significant part of any training program, but the correction needs to change the undesired behavior followed by a reward for the corrected action(Duno, 2009).

ADCs are exposed to some the most diverse environments of any working canine. The variety of contents within a structure is unlimited, as well as the components that are used to build the structure(BATFE, n.d.). Not only do ADCs perform searches in structures but in a number of other venues including: vehicles and equipment, open air, people and crowd searches. Vehicles are also subject to arson and the assistance of ADCs can be invaluable in locating the accelerants(Cal Fire, 2002). Open air searches are conducted for brush and forest fires to locate accelerants that may have been used to start the fire(California Department of Forestry & Fire Protection, Office of the State Fire Marshal [California Department of Forestry & Fire Protection, Office of the State Fire Marshal], 2009). People and crowd searches are conducted in the same format as the infamous line-up(Scientific working group on dog and orthoganal detector guidelines(Scientific Working Group on Dog and Orthoganal Detector Guidelines, 2010). There are times when residue from the accelerant is left on the hands, shoes or clothing of the arsonist. From the people search, a clothing search is also an important function(United

States Police Canine Association, Inc, 2009). Someone taken into custody may have residue on the clothing, thus a clothing search is appropriate.

As the use and demand of the ADCs increased, so did the number of trainers, handlers and entities providing the canines and certifying them. The certification standards and methods were not uniform across the United States, England and Australia(Wagner, 1997). This dilemma brought scrutiny from defense attorneys that caused prudent trainers and certifying agencies to standardize the testing procedures(Katz & Midkiff, 1998). ATF, State Farm, CADA, SWGDOG and Fire K-9 all have standards that in essence have commonality in the testing and methodology.

There are two basic tests thateach of the fiveaccelerant detection organizations may have. Each has a slight variation, but have the same basic components. Test one is an odor recognition test and test two is a practical application test(Wagner, 1997). The purpose of the odor recognition test is for the canine to demonstrate the ability to recognize accelerant odors and the handler's ability to interpret the canines change in behavior(California Department of Forestry & Fire Protection, Office of the State Fire Marshal, 2009). The purpose of test two is for the canine team to demonstrate proficiency in an operational environment(United States Police Canine Association, Inc, 2009). Typically, these certification procedures are double blind tests. "One reason for using double blind testing is the acceptance by animal behavior experts and veterinary scientists as a valid method to test the reliability of a canine team as a valid scientific instrument" (Latimer, 2010, p. 5).

An odor recognition test is conducted in an extremely controlled environment. One method of testing is to utilize clean evidence cans with perforated lids to place items in for the canines to examine(California Department of Forestry & Fire Protection, Office of the State Fire Marshal, 2009). The contents in these can be anything that might be found in a fire scene as well as food products. Some of the contents are burned to replicate what the team may find in real fire scenes(Scientific Working Group on Dog and Orthoganal Detector Guidelines, 2010). Typical items include but are not limited to: shingles, roof felt paper, plywood, lumber, sheetrock, foam rubber, vinyl siding, particle board, paper products, carpet, and carpet underlayment(Tindall & Lothridge, 1995). Some of these “distracters” form partial pyrolysis when burned, and it is reported in a number of studies that ADCs will alert to these(Jonas & Bueker, 1999). Thus, it is advantageous to not only train on these products but to also test on them(Latimer, 2010).

The cans have the distracters placed in them and are placed in a discrimination line or in some cases a circle. The total number of cans can be determined; some tests have as many as forty(California Department of Forestry & Fire Protection, Office of the State Fire Marshal, 2009). With the perforated lids still not placed upon the cans, ignitable liquids are added. The handlers are not told how many cans are “hot” (spiked with an ignitable liquid) if any. The recommended parameters of ignitable liquid per hot can is between 10-20 µl (microliters). It is also recommended that at least one accelerant from each of the classifications be represented in the testing: light petroleum distillates, medium petroleum distillates, heavy petroleum distillates, naphthenic/paraffinic, medium isoparaffinic, and gasoline(BATFE, n.d.). Great care must be taken to not contaminate the “clean” (those cans without ignitable liquids) with any residue of accelerants.

The practical exercise is the second test which is a search exercise. The team can be required to search any of the following; indoor – interior rooms, vehicles or equipment, open areas, crowds, people or clothing(United States Police Canine Association, Inc, 2009). Another drill that is typically administered is a pinpoint drill which requires the canine to exact the location of the alert. The value of this drill is to make sure that location the evidence is taken is the area that the accelerant is located. With the minute amounts that the canines are imprinted to detect, it is important to be exact in collecting the evidence(www.firek9.org). The variations of this test are endless as the number of distracter, number of accelerants and number of venues combined yield a plethora of combinations just as the real operational environment presents the same potential(Latimer, 2010).

The search exercises (phase two) have six different potential component; the test must utilize any four of the six. A minimum of one odor per test must be used(Cal Fire, 2002). If the ADC team misses one or more of the accelerants placed in the area of the search, or has a false indication, the evaluator will determine the reason for the error and determine if it is the canine, handler or both at fault(Scientific Working Group on Dog and Orthoganal Detector Guidelines, 2010). Misses are those areas with accelerants that the team did not locate. False indicators are alerts that have no accelerants present.

There are three general goals in the second phase of the testing: ensure that the canine can detect the odors to which they were imprinted, ensure that the ADC team can search and clear an area in a systematic fashion that exposes the canine to all areas, ensure that the handler can accurately interpret the canines change in behavior upon the final response(Bureau of Alcohol, Tobacco, Firearms, and Explosives [BATFE], 2010). It is crucial that the ADC team can distinguish accelerants in the operational environment. Teams must have a 100% test score for both phases in order to pass.

There is a slight deviation in the required scores for certification of the canine teams. ATF requires a 100% score for the initial certification and annual recertification. This is not to say that the canine teams are perfect, but rather in the event of an error such as a miss or false positive, they are given one chance to correct the error. SWGDOG (Scientific Working Group on Dog and Orthoganal Detector Guidelines, 2010)requires a 90% accuracy rate on confirmations and no more than a 10% rate of false positives. CADA requires 100% accuracy in all tests: scent discrimination, mixed matrix, pinpointing, and practical search exercises.

USPCA (United States Police Canine Association, Inc, 2009)has outlined standards for certification of ADCs. The accelerants used for testing are from the three major groups: LPD (Light Petroleum Distillates), MPD, (Medium Petroleum Distillates), and HPD (Heavy Petroleum Distillates) (Appendix B). There are four search tests that are administered: indoor, vehicle, perimeter, and crowds. The tests that utilize burned materials (indoor and vehicle) are raw oak that has six ounces of approved ignitable liquids pour over them, ignited and allowed to burn unrestricted until out. The perimeter search utilizes a one gallon container that will have four ounces of an ignitable liquid placed in it and then poured out. The residue left in the can will be the target of the test. The crowd search will utilize clothing that is contaminated with two ounces of acetone and allowed to air dry. A passing score is 140 points of 200 possible, with each of the four tests worth 50 points each(United States Police Canine Association, Inc, 2009).

With the number of certifying entities, some states are mandating their own criteria for not only certification standards, but also canine selection, handler selection, training, maintenance, criteria for viable fire scene searches, and record keeping. California is one of those states. In 2009 The Office of the Fire Marshal of California published theAccelerant Detection Canine Team Standards (CaADCTS) which was the first State adopted standard of its type for the State of California(Cal Fire, 2002). The two main objectives were to provide guidance to agencies that want to establish and ADC Team, and to establish standards that ensure a high degree of credibility. Standards were compiled from ATF, SWGDOG, CADA and California Freighters Association – Canine Committee. The goals of this document are to: define ADC Team, provide guidelines for starting an ADC program, provide training guidelines, and to establish standardized certification tests(California Department of Forestry & Fire Protection, Office of the State Fire Marshal, 2009).

The CaADCTS defines ADC as a canine that is trained to detect ignitable liquids as defined by American Standards and Testing Materials (ASTM). This document goes further to outline the selection criteria for the canine and the handler. The handler must also be well versed in the criteria for fire searches and the legal right to search the scene. The handler must also be a California certified fire investigator with a minimum of three years' experience. This goes to help establish the credibility of the handler as not only someone who can work the canine, but has a solid background in fire investigations. In knowing burn patterns and the effects of fire on various scenes, it will assist in performing search patterns in search of accelerants(California Department of Forestry & Fire Protection, Office of the State Fire Marshal, 2009).

A number of articles came out as the canines notoriety grew. Whistine (1992) writes in an article titled "Four Legs, a Tail and a Badge… Canines in the Fire service, it is clear that properly trained ADCs could be as valuable to the fire service as canines trained to sniff out drugs are to the police agencies" (p. 44). If the training is sacrificed in any way, it will have the potential of being a detriment to all ADCs. The article "Barney: The Arson-Sniffing Dog" says that ADCs are the most innovative idea in assisting the fire investigator in some 25-30 years, but the training must be correct(Spicer & Thomas, 1988).

With the notoriety also comes scrutiny. The ADCs were assisting in fire investigations and were getting convictions on arsonist. Thus, defense attorneys began to dig deeper into what these new arson dogs are. Thus, the discussion about the training, certification and the accuracy of the alerts (especially those not confirmed by an accredited laboratory) became a point of contention(Katz & Midkiff, 1998).

As a result of the scrutiny a number of studies have been conducted by various agencies. Most of the early publications of the studies were in forensic journals, justice magazines, and published animal science studies. For the most part these articles and publications are studying the perceived deficiencies in the ability of the ADCs to be a reliable litmus test for accelerants on fire scenes.

One constant contention is the canine's ability to distinguish between accelerants and products of pyrolysis. "Dogs used as detectors for accelerants in controlled tests and actual fire scenes sometimes respond positively to burnt carpet and rubber underlayment on which no ignitable liquid has been placed"(Tranthim-Fryer and DeHaan, 1997, p. 40). The study that followed that introductory quote was conducted in California from 1992-1994. The study showed a canine accuracy level of greater than 80% in identifying accelerants. Four of the seven canines used in the testing were found to alert to pyrolysis materials at a rate of 26% (nine of the 35 tests presented). The samples that they alerted to were five samples of burnt carpet, two samples of burnt plastic, one sample of burnt foam rubber, and one sample of plywood(Tranthim-Fryer & DeHaan, 1997).

The testing of the distracters used in this experiment was all tested to find the chemical composition when heat that mirrored that of a fire was applied. The carpet and backing samples were heated to 770°C, which yielded pyrolysis products. The results were found to be "complex, unusual, and not indicative of styrene-butadiene adhesives" (Tranthim-Fryer & DeHaan, 1997, p. 44). These results were not indicative of the typical results of similar materials. "Without further investigation, the chromatogram may be misinterpreted as volatiles from a flammable or combustible liquid,"(Tranthim-Fryer & DeHaan, 1997, p. 44). Thus it was concluded that the complex nature of the carpets, backings, and the adhesives make it difficult for analyst to interpret. "Dogs cannot discriminate between gasoline used as an accelerant and volatile traces of carpet adhesives"(Tranthim-Fryer &DeHaan, 1997, p. 45).

The accuracy of the canines has also been called into question. Satisfactory testing criterion is different for different certifying agencies ranging from 100-50% accuracy. Multiple tests are constantly run in the daily training and the certification and recertification process. In a test of 34 CADA ADCs found that canines are remarkably accurate in detecting 50% evaporated gasoline at a level of 5µl and above(Kurz et al., 1996). The rate of success in the same 34 canines dropped significantly in 50% evaporated gasoline in quantities lower than 2µl. This may be attributed to some of the canines being trained at quantities of 30µl or greater(Kurz et al., 1996). The same canines in this test were also less successful in detecting other ignitable liquids due to not being imprinted specifically on those products.

In 1994 the International Association of Arson Investigators (IAAI) Committee of Forensic Science wrote a position paper that addressed the ADCs. In that paper it advised an alert by an ADC is probable cause for further investigation, but was not admissible in court without laboratory confirmation. The National Fire Protection Association(NFPA) ratified the position of the IAAI and wrote an emergency amendment to NFPA 921, that unconfirmed ADC alerts did not constitute science(Lentini, 2012b). The NFPA Fire Investigations Technical committee on Fire investigations went further to state,

> The committee, as specially trained members of the scientific, engineering and fire investigative community, know that evidence and testimony relied upon by our nation's courts have been empirically proven to be false. In essence a fraud is being perpetuated in the judicial system.(Lentini, 2012b p3).

The NFPA is an international nonprofit organization dedicated to minimizing the possibility and effects of fire and other risks through the implementation of consensus codes and standards(National Fire Protection Association website, n.d.). NFPA 1033 (2011) is the standard for professional qualifications for fire investigators that is intended to develop clear and concise job performance requirements that can be used to determine that a person, when compared to the standard, has the skills and knowledge to perform as a competent fire investigator NFPA 1033 (2011). NPFA 921 (2011)is the guide for fire and explosion investigation that is intended to assist in improving fire investigation processes, and the quality of information from fire investigations. Whereas the NFPA publishes over 300 codes and standards, it is worth noting the subtle differences in the title of the two NFPA publications that relate to fire investigations and ADC's. NFPA 1033 (2011) is a standard and NFPA 921 (2011) is a guide.

NFPA publishes four types of consensus documents: codes, standards, guides and recommended practices. There is a subtle but significant difference in each of the four types of publications that impact the application of that publication in the professional community(National Fire Protection Association website, n.d.). A code is an extensive compilation of provisions concerning broad subject matter or that is suitable for adoption into law independent of other codes. Codes are also adopted into law by the authority having jurisdiction and failure to comply with the codes have penalties that range from monetary fines to prison time(National Fire Protection Association website, n.d.). A standard is a document that the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and is in a form suitable for adoption into law(National Fire Protection Association website, n.d.). Standards have a definitive focus, but typically require only limited interpretation. A guide is a document that is advisory or informative in nature and contains only nonmandatory provisions, of which is not suitable to be adopted into law(National Fire Protection Association website, n.d.). Recommended practices are the infancy of codes and standards that utilize the word “should” rather than “shall”. Since they can be generalized, far more interpretation is required prior to application.

The administration section (Chapter 1) of NFPA 921 outlines the scope, purpose and application of the document. The scope is to assist those investigating and analyzing fire and explosion incidents. The purpose is to establish guidelines and recommendations for the safe and systematic analysis of fire investigations (NFPA 921, 2011, Chapter 1). The application provides a basic framework by which effective investigations can be accomplished. The framework is representative of the judgments of the NFPA consensus process. Words such as assist, guide, recommend, and basic included in chapter 1 establish the criteria for interpretation not only by the investigator, but the attorneys (both prosecution and defense), juries and judges (NFPA 921, 2011, Chapter 1).

The latest version of NFPA 921 is the 2011 edition. It goes into great detail in addressing the use of ADC teams with the following guidelines. Properly trained and validated ADC teams have proven to be an asset in fire investigation by helping to locate ignitable liquids. For the evidence found by the ADC team to be validated, it must be analyzed by a laboratory. The use of an ADC team produces a higher probability of producing laboratory reports of confirmed ignitable liquids than without the use of the ADC team. The ADC team should be used in conjunction with other fire investigative methods (NFPA 921, 2011).

NFPA 921 goes further to address the perceived limitations of the ADC. Unlike drug or explosive canines, ADC is subject to items common to everyday living. As a result of these everyday items, the probability is that items typically known to produce pyrolysis when heated will be present in the fire scenes. The research has shown that ADC have alerted to products of pyrolysis that are not produced by ignitable liquids. The discriminatory ability of ADC to discriminate between products of pyrolysis and ignitable liquids is impressive but not perfect (NFPA 921, 2011).

Once and ADC alerts to what is believed to be an ignitable liquid on the fire scene, it is imperative that the fire investigator and/or evidence technician collect, package, label, and preserve that evidence. American Society for Testing and Materials (ASTM) E2451 is the “Standard Practice for Preserving Ignitable Liquids and Ignitable Liquid Residue from Fire Debris Samples”("ASTM E2451-08," 2011, p. 2). This practice describes the processes for preserving ignitable liquids extracted from fire debris. It is important to preserve the substance for laboratory analysis, as the laboratory confirmation with what is recommended by NFPA 921 for the alert to be admitted into evidence (NFPA 921, 2011). This practice does not address the various issues associated with long-term of said debris.

Fire debris presents the investigator with a number of challenges in the identification, collection and preservation. There are three general questions that the fire investigator should ask when collecting debris that has been identified as evidence (and in this case as it pertains solely to collecting ignitable liquids)(Virginia Department of Forensic Science, 2010). What am I trying to preserve? How can I prevent its loss or damage? How can I prevent it from being contaminated to insure its integrity?

Fire debris that that is identified by an ADC is typically found in three forms: mixed with other liquids such as water from extinguishing by fire suppression efforts, in porous materials such as wood, upholstery, carpet and ashes, a residue on nonporous surfaces such as glass or metal(Kurz et al., 1996). Each presents its own nuances. Liquid residues can be absorbed by using sterile gauze pads and placing the soaked pad in either clean lined metal evidence can or a clean unused glass jar with a cap lining that is inert(Stauffer & Lentini, 2002). Glass or metal debris that is identified to have a residue on it can be placed in a clean lined metal can. If that same container has liquid in it, the liquid must be removed and placed in another packaging as listed above for liquid samples. The separation of the liquid from the container is due to the solid surfaces have the potential of latent prints; some efforts should be made to preserve them intact(Virginia Department of Forensic Science, 2010).

Fire debris itself is typically collected in a clean lined metal can, leaving one third of the top empty as headspace. This provides the best opportunity for effective extraction from the laboratory. NFPA 921-16.6.2.1 states, “The recommended container for the collection of liquid and solid accelerant evidence is an unused clean metal can” (p. 152). There is a debate from various labs as to the preference of lined verses unlined cans for the preservation of accelerant evidence. Some labs even request that tape be used to seal the edges where the lid and can is in contact to help seal the can even tighter(Virginia Department of Forensic Science, 2010). Light petroleum distillates have been found to evaporate through sealed metal cans.

The ultimate goal of fire investigators is to determine the origin and cause of the fire. There are four classifications of fire cause are: accidental, natural, undetermined and incendiary (or arson as it is commonly known) (NFPA 921, 2011). Accidental fires are those that do not include an intentional human element. Natural fires are those that result from natural events such as lightning, earthquakes, and wind. Incendiary are fires that are intentionally ignited under circumstances in which the person knew that a fire should not be set. Whenever a cause cannot be determined, it is to be classified as undetermined (p. 12). The ultimate goal of arson fires is to arrest and prosecute the arsonist. Thus, the courts have the final say as to the admissibility of evidence collected on the fire scene(Virginia Department of Forensic Science, 2010).

David Reisch appealed his conviction of arson in the second degree. In Reisch v. State of Delaware (1993), the appeal is based on the contention that the courts abused its discretion in allowing the evidence identified by an ADC. No laboratory tests were performed on the areas identified by the ADC as having accelerants(*Reisch v. Delaware*, 1993). The investigators had also ruled out any form or accidental or natural cause for the fire. Using negative corpus, they classified the fire as incendiary. On appeal, Reisch contended that the canine that was used to locate what was believed to be accelerants had only been verified by laboratory analysis 17 of 80 times. Furthermore the handler acknowledged that the canine was only slightly better than average(Reisch v. Delaware, 1993).

The court ruled that the conviction in the Reisch case was affirmed based on a previous case (Cook v. State of Delaware) of a tracking canine. In the Cook case the court permitted evidence if there was proof of: the handlers and canines' qualifications, the teams' experience, training, reputation, and the circumstances critical to the case itself. In the Reisch case the court also said that whereas the ADC had only been confirmed 17 of 80 times, there was no evidence that the ADC was ever incorrect(Reisch v. Delaware, 1993).

One of the most celebrated arson cases was that of Weldon Wayne Carr. Carr was convicted of arson and murder for a fire that broke out in his home on April 7, 1993. In that fire his wife died of smoke inhalation. The fire investigators testified that they identified a pour pattern in the area of the kitchen. The ADC that assisted the fire investigators alerted to 12 locations in the course of the search("Weldon Wayne Carr," 2005). All the samples submitted to the laboratory were negative.

On appeal, Carr contended that the court erred in allowing the evidence of a dog alerting to the possible presence of an accelerant as substantive. The fire fighters also testified to the fact that the burn patterns were consistent with those that have an accelerant. The court ruled that the canine alerts are conceptual and indistinguishable; therefore the ADC should meet the requirements of scientific verifiability("Weldon Wayne Carr," 2005). The foundation of the evidence admitted was based on the handler's testimony, training, certification, and anecdotal evidence of the canines' success in tests. What was not presented was "verifiable certainty that those tests are an accurate and reliable means of ascertaining whether an accelerant is actually present" ("Weldon Wayne Carr," 2005, p. 3). The conviction was reversed in 2004 after Carr had spent ten years incarcerated.

The Iowa Supreme Court was the first ruling on the admissibility of evidence identified by an ADC in Iowa. In State v. Buller, Buller was arrested for setting a fire in an apartment. An ADC was used to search the fire scene and located an area on a mattress that was the area that fire investigators determined the fire started. However, there were no accelerants detected from the evidence submitted to the laboratory(Stittleburg, 1995). The plaintiff appealed the admissibility of the canine's testimony of accelerants present without laboratory confirmation.

The State of Iowa Rule 702 states:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to determine the evidence or to determine the fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education may testify thereto in the form of an opinion or otherwise.(Stittleburg, 1995, p. 19).

The court determined that Hiles, the canine handler, could testify to the reactions of his canine in the fire scene. This is based on the documented reliability of the ADC teams training, certification, record keeping and track record. This ADC team had a distinguished record of accuracy that was confirmed by laboratories. This became the litmus test in Iowa, and at the time (1995) could have been used in other states as precedent(Stittleburg, 1995).

Unites States v. Marji (1998)allowed the evidence alerted to by an ADC team as an accelerant (Fleck, 2005). The plaintiff contended that the proposed amendment to NFPA 921 stated that the ADC was not always reliable. The court ruled, "All that these sources suggest is that special weight not be assigned to the dog sniff evidence in the absence of any corroborating evidence"(Fleck, 2005, p. 9).

The Second Circuit affirmed the ruling of the lower court in United States v. Paccione (2000), that the they did not see any error in the admissibility of the ADC alerted several times to detect accelerants used to set the fire. "Moreover, the danger of unfair prejudice was not great here, since there is no reason to think the jury found the dog's actions more convincing than the corroborative laboratory results"(Fleck, 2005, p. 10). Thus the evidence identified as accelerants by the ADC was sufficiently reliable to be admitted in the arson prosecution.

The case of State of New Jersey v. Sharp (2006) presented a pretrial motion to preclude the ADC handler from testifying as an expert witness to his canine alerting in certain locations as proof of the presence of an accelerant. The laboratory reports came back negative. The basis for the pretrial motion was that, "the opinion would be based on a novel scientific theory that a canine's sense of smell is more accurate than laboratory instruments" (State of New Jersey v. Sharp, 2006, p. 1). The court ruled that in the absence of laboratory confirmation of accelerants identified by the ADC team is inadmissible. The judicial states that, "the courts may exclude relevant evidence if its probative value is substantially outweighed by the risk of undue prejudice, confusion of the issues, or misleading the jury" (State of New Jersey v. Sharp, 2006, p. 7). The risk of admitting the testimony of the ADC handler as to the accuracy of the canine was not allowed.

Robert Yell appealed his first degree arson conviction with the Commonwealth of Kentucky in 2007. The appeal was based on the ascertain that there was no legal authority for allowing the ADC pursuant to Daubert, because the six alerts were not confirmed by the laboratory(Yell v. Commonwealth of Kentucky, 2006). The ADC handler testifies that in two previous cases that the lab results were unconfirmed, the defense admitted to the arson and to using accelerants in the location that the ADC alerted. Furthermore the laboratory forensic technician testified that just because they could not detect accelerants at the lab does not mean they do not exist.

Kentucky argues that the canine does not fall under the Daubert challenge as the canine's sense of smell is not dependent on scientific explanation (Daubert, n.d.). A comparison of tracking dogs that were not held to the Daubert challenge standards was presented. While tracking dogs' reliability has been generally accepted in courts, the courts are much less likely to blindly accept ADCs alerts in court. Part of the rationale is based on the theory that the ADC program was built on laboratory analysis in the training and certification; "he who uses a dog as an expert without lab confirmation is a fool"(Yell v. Commonwealth of Kentucky, 2006 p7).

The United States District Court in West Virginia attempted to enter into evidence positive canine alerts taken from clothing that did not have confirmed laboratory analysis. In United States v. Meyers, the ADC alerted to the defendants shoes, pants leg, jacket sleeve and the right front of the inside of the defendants car. This search was conducted in March of 2009, with evidence taken at that time. The laboratory testing did not take place until June 2010, fourteen months later(Fleck, 2011). The laboratory results were negative of accelerants. The handler testified in the case as to the behavior of the canine while searching the fire scene, affirming that the ADC alerted to the items taken into evidence. The handler also agreed with the defense that NFPA 921 served as a standard for ADCs in conducting fire investigations. The court concluded, "The use of expert testimony beyond its proper application and scope is neither relevant nor helpful in the trier of facts. The court must exercise its gatekeeper function by concluding that the evidence does not meet the Daubert standards"(Fleck, 2011, p. 71).

In 2006 James Hebshie was convicted of arson of a commercial structure in Tauton, Massachusetts based largely on the testimony of an ADC handler. In the course of the testimony, the handler gave a lengthy oration as to his ADCs mystical powers. The handler went further to describe his emotional attachment to the ADC and his lone ability to read the ADC reactions(US v. Hebshie, 2010). The ADC was taken in the area of the structure to search and alerted at the area thought to be the point of origin. That was the only sample taken and ended the search (Fleck, 2011).

The defendant in this case chose to defer from the court appointed attorneys and hire his own council. During the course of the trial the hired attorney failed to request a Daubert challenge as the canines' alerts in court without laboratory confirmation. The judge stated, "Given everything that Spinales (attorney) knew about the canine alert in this case, it was a constitutional error for them not to ask for a Daubert hearing"(Fleck, 2011, p. 72).

Another point of contention was brought into the courts in William Halliday v. State of Alaska, (William Halliday v. State of Alaska, 2011). Halliday was convicted of first degree arson for burning his house. He appealed his conviction contending that the jury was prejudiced when the ADC was allowed to perform a demonstration in court. During the course of the trial The ADC handler was qualified as an expert witness without objection. The defense argued that the demonstration that the ADC handler performed with her canine did not represent that of a real fire scene. It should be noted that three of the seven samples taken from the fire scene were confirmed by the laboratory to be positive for ignitable liquids. The appeal was denied, "Ultimately, it was the laboratory testing that determined the prescience of accelerants.

Accordingly, the testimony and the demonstration with Jodi (ADC) were not prejudicial."(William Halliday v. State of Alaska, 2011)

The evidence collected by investigators on the fire scene is sometimes identified by ADCs as to having accelerants. The canines are trained to pin point the area in which they detect the odor of that accelerant. Once the evidence is collected and secured, it is sent to a laboratory for testing(Accelerant Detection Canine Course #89, 2010). This testing is done by a Gas Chromatograph – Mass Spectrometer (GC-MS).

The GC-MS is a method of testing that actually combines the features of the gas chromatography and mass spectrometry into what is called the gold standard for identifying fire debris. The GC is used to separate mixtures into individual components. Once separated, the individual components can be evaluated. The MS takes the individual components and bombards them with electrons that break them down further (ASTM E1618-11, 2011). From the breaking down of the components, the MZ (mass to charge ratio) can be determined. The computer graphs these finding on a mass spectrum. The x-axis represents the MZ ratios and the y axis represents the abundance of the fragments during the scan. When the GC is combined with the MS a laboratory can not only identify the individual components of each sample but can determine the quantity(Stauffer & Lentini, 2002).

Evidence that is sent to the laboratory for analysis that is tested for accelerants with a GC-MS will produce one of three results: positive for ignitable liquids, negative for ignitable liquids, or inconclusive(Virginia Department of Forensic Science, 2010). If the sample comes back positive, the classification of the product will typically be identified. Those results that are returned as inconclusive have the potential to be problematic for the investigator and moreover the prosecutor that attempts to utilize the canine alert as evidence of the presence of an accelerant.

In a test that was intended to test the accuracy of the canines, the GC-MS results from the samples utilized in the study were equally revealing. There have been arguments that the canines can sense levels of accelerants that the laboratory cannot(Tindall & Lothridge, 1995). In this test the canines were exposed to accelerants from the six typical classifications at various levels, from 0.5-0.1µl(Kurz et al., 1996). These products were also placed on a number of substrates including those that are known to produce pyrolysis. The GC-MS was 100% accurate with all classifications on various substrates at 0.5µl. However, at levels of 0.2µl or below, the GC-MS was accurate only 60% of the time. It was also determined that accelerants placed on pyrolyzed materials could not be confirmed in quantities below 1.0µl due to the interference from the pyrolyzed materials(Tindall & Lothridge, 1995).

ASTM E1618-11 is the standard test method for ignitable liquid residues in extracts from fire debris by GC-MS. ASTM E1618-11 states, "Because of the volatility of ignitable liquids and various sampling techniques, the absence of detectable quantities of ignitable liquids does not necessarily lead to the conclusion that ignitable liquids were not present at the fire scene" (ASTM E1618-11, 2011, p. 2). Thus, there is the possibility that accelerants do exist that cannot be confirmed. ASTM has revised the classification system to include more categories and provides more precise descriptions of ignitable liquid residues.

The contamination of the evidence can be problematic when investigating the fire scene. The contamination process starts when the fire starts, as the rapid oxidation process changes the composition of the objects burning, moves the debris around as the structural components shift and/or fail. In addition, fire suppression crews enter the structure with boots and gear that could have residues from other fire scenes (NFPA 921, 2011). As the fire suppression crews flow sometimes thousands of gallons of water with up to 100 psi (pounds per square inch), fire debris gets shifted and diluted. Salvage on overhaul operations require the suppression crews to search for hidden fire to confirm that the fire is out (NFPA 921, 2011). In doing so they remove items, shift items and are continually walking through the potential “crime scene.”

When investigators arrive on scene to conduct the origin and cause investigation, they too can add to the potential for contamination if they are not careful. Boots, gear and tools from previous fire scenes that have not been properly cleaned can have traces of the products of those scenes on them (NFPA 1033, 2011). Enter the ADC that can pick up residue from previous fire scenes in their fur and on their feet. The fear is that materials from other areas of the scene (or other scenes) can transfer which may lead to false positive results. Contamination destroys the evidentiary value of samples collected(Virginia Department of Fire Programs, 2009).

The cans that are used for collecting evidence must be sealed and clean. In a recent experiment studying the potential for contamination of fire debris evidence containers, it was determined that lids placed on metal evidence cans with palm of the hand pressure can reasonably be expected not to acquire contamination(Koussiafes, 2012). It goes further to suggest that lids secured with only palm pressure can become dislodged when heat is applied. Cans containing fire debris evidence should has the lid tightened with a rubber mallet and then sealed with evidence tape. This helps to secure the lid from inadvertently opening due to heat or kinetic energy, but ensures the chain of command has not been broken(Virginia Department of Forensic Science, 2010).

Modern firefighting tools have also created a concern for fire investigators and ADC teams. The introduction of F-500, an additive that is marketed as a microcell encapsulator of ignitable liquid vapors, has investigators concerned(Shadic, Ryan, & Bachner, 2009). The product is effective in extinguishing the fire. The investigative issue arises when the ignitable liquid vapors are encapsulated; this has alleviated or altered the fire debris samples so that there is no accelerant detected by the ADCs in the laboratory analysis.

The opinions of the authors of the various magazines gave no consensus as to the effectiveness and the reliability of the ADCs. The search turned to the standards and guides as a point of reference to assist in answering the questions stated in the introduction of this paper. NFPA 921, Guide for Fire & Explosion Investigations was researched for information on ADCs. The 2011 edition is the latest and most applicable version to date. However, it is worth noting that the first NFPA position taken on the ADCs was in the form of an emergency amendment to the 1996 edition stating that the courts are advised that unconfirmed canine alerts did not constitute valid science(Lentini, 2012b).

Procedures

The content of the survey was based on the findings from the literature review.A survey (Appendix C) was sent to the ADC organizations that were found to be involved in training, certification and setting standards for ADCs. These organizations were: ATF, State Farm (Maine State Police), CADA, Fire K9.org, and SWGDOG. The questions from the survey were derived from the variety of standards that canines were trained and certified by the various agencies.The survey was sent to the main contact email address of each organization with a request to distribute to the pertinent members of their organizations. The survey itself was an attachment sent with the email (Appendix C). The survey asked for basic information in regards to training, certification, reward system, ignitable liquids imprinted on, number of positive alerts and those that are confirmed by an accredited laboratory (Appendix C).

The components of the experiments were based on the common components found in each of the ADC agencies testing processes. An experiment (Appendixes D and E) was conducted to test the ability of the ADCs to detect various ignitable liquids from each of the six basic groups: LPD, MPD, HPD, napthenic / paraffinic products, medium isoparffinic products, and 50% evaporated gasoline. The second experiment (Appendixes G and H) was to determine the ability of the ADCs to discriminate between products of pyrolysis and accelerants. The third experiment was a practical application test that tested the ADCs ability to find accelerants in areas that would be potential fire scenes. The pin-point drill was used to show how close to the actual accelerant the ADCs are able to determine the location of minute amounts of ignitable liquids.

A request (Appendix C) was sent to eleven ADC Teams across the Mid-Atlantic States to participate in the experiment. The offer was made to perform the experiments in areas that would minimize the travel for those interested in participating. The invitations were submitted to public and private sector ADCs. All of the ADC teams in the Mid-Atlantic States are public sector and sponsored by either State Farm Insurance or ATF.

For the purposes of the experiments new clean unlined quart and gallon cans were used. A Hamilton model 80400 syringe was used for the purpose of measuring accelerants added to the various locations or cans. This syringe is calibrated from 1-25μl. six syringes used for each of the six classifications of ignitable liquid. There wasonly one product from each of the six classifications represented in any of the tests. They was as follows:

1. LPD, *Ronsonol Lighter Fluid*
2. MPD, *E-Z Paint Thinner*
3. HPD, *Off Road Diesel Fuel*
4. Naphthenic / Paraffinic Product, *Citronella Torch Fuel*
5. Medium Isoparaffinic Product, *Wizard Charcoal Lighter Fluid*
6. 50% Evaporated Gasoline, *89 Octane Exxon*.

The first test was the odor recognition test (Appendixes D and E), which tests the canine's ability to recognize the ignitable liquids listed in appendixes A and B. For this test a single blind method was utilized as the person conducting the test will need to know the "hot" cans. The test guidelines were as follows:

- The test consisted of 24 cans (2 circles of 12).
- The can were quart cans with perforated lids inside a gallon can with no lid.
- Substrates were burned and unburned. Note that the materials used in this test were not those common known to produce products of pyrolysis. No food distracters were used in this test.
- At least one product from each of the six classifications was used in the test, no more than one of each. The quantities ranged from 5µl to 10µl.
- The bottom of the hot cans had a small round red stick on the bottom of the quart cans; the remaining cans had a green sticker. There was a hand written number on the red sticker of the hot cans which references what the specific product is.
- There is no pass or fail criteria, and the results were given in confidence if so requested, and was not be observed by other ADC teams.

The second test was a discrimination test with the focus being on distracters that are known to produce pyrolysis products when burned (Appendix G & H). These include: carpet, foam rubber, parquet flooring, foam peanut packing and carpet backing. Other products used in the discrimination tests were: wood products (from 2X4 spruce pine), OSB particle board, sheetrock, shingles, felt paper, cardboard, paper, and #15 felt.

The test consisted of 24 cans (2 lines of 12 each can spaced 4 feet apart).

- The can were quart cans with perforated lids inside a gallon can with no lid.
- All distracters were burned by propane torch for 20 seconds. No food distracters will be used in this test.
- At least one product from four classifications (50% gasoline, HDP, MDP, and LDP) was used in the test, no more than one of each. The quantities will range from 5µl to 10µl.
- The bottom of the hot cans had a small round red stick on the bottom of the quart cans; the remaining cans will have a green sticker. There was a hand written number on the red sticker of the hot cans which references what the specific product is.
- There is no pass or fail criteria, and the results were given in confidence if so requested, and was not be observed by other ADC teams.

The third test utilized the props and facilities that are available at the test site, such as a structure that is intact (meaning four walls and a roof to facilitate an indoor search), open air, crowd, and a vehicle search). With this test being dynamic as a result of what facilities the test site had to offer, it was recommended that at a minimum of an open air and vehicle search be conducted.

The fourth test was a pinpoint test to determine the ADC ability to specifically locate the area that an accelerant is located. This test consisted of:

- One piece of clean carpet minimum of 12’ wide and ten feet long. A propane torch was used to burn a continuous line the length of the carpet that at a minimum melts the carpet fibers.
- The carpet was divided into 10” segments with a marker, which was numbered 1-12. One (5µl LPD) was placed in the center of one of the segments.
- The ADC team searched the whole carpet and identified which square the canine alerts to. The ADC handler was not told the number of hot squares prior to the test.

The hot cans used in test one and test two were submitted to a private laboratory for GC-MS analysis of the contents. Two of the cans that contained carpet and carpet backing that were not hot were also submitted to the laboratory for analysis. The perforated lids were replaced with solid lids and evidence tape was placed around the edges sealing the connection of the lid and the can. The sealed quart containers were delivered to the laboratory within 48 hours of completing the tests. There was an expectation that the laboratory will have completed the GC-MS analysis within 2 weeks. A total of twelve quart containers were analyzed. Test one submitted six cans, test two submitted four cans, and there were two cans from test two that are negative with one containing burned carpet and the second containing burned carpet backing.

There were eight additional cans submitted to the laboratory to test two things; first, the lowest amount of ignitable liquid that can be detected and second, the amount of time that it takes for ignitable liquids to evaporate from evidence cans to the point that the laboratory cannot make a definitive analysis. All eight one gallon cans were the same composition and quantity of fire debris in each (filled to ¾ full). This debris was spruce lumber, #15 felt, and sheetrock; all of which was exposed to a propane torch for 30 seconds each and extinguished with a mist of water from a spray bottle and allowed to air dry.

Four of the cans were used for the first test and the remaining for cans for the second test. The first four cans were spiked with 50% evaporated gasoline in the following quantities: can #1 - 1µl, can #3 – 0.5µl, can #5 - 2µl, and can #7 – 0.5µl. These cans were sealed with metal lids (note that evidence tape wasnot utilized to seal the lid/can connection to maintain continuity of the cans being tested). They were submitted to the lab within 24 hours, with the expectation that the laboratory would conduct the testing within 48 hours from receipt.

The second set of four cans was staggered in the testing to simulate a time delay of cans waiting to be submitted and/or tested. These four cans were the same type, quantity and batch of fire debris as cans 1, 3, 5, and 7. Can #8 had 1µlRonsonol Lighter Fluid(LPD) added 3 weeks prior to the date of submittal to the laboratory; sealed and stored in a secure evidence cabinet with evidence tape across the top to ensure the chain of evidence. Can #6 had 1µl Ronsonol Lighter Fluid (LPD) added 2 weeks prior to the date of submittal to the laboratory; sealed and stored in a secure evidence cabinet with evidence tape across the top to ensure the chain of evidence. Can #4 had 1µlRonsonol Lighter Fluid (LPD) added 1 week prior to the date of submittal to the laboratory; sealed and stored in a secure evidence cabinet with evidence tape across the top to ensure the chain of evidence. Can #2 had 1µlRonsonol Lighter Fluid (LPD) 24 hours prior to the date of submittal to the laboratory; sealed and stored in a secure evidence cabinet with evidence tape across the top to ensure the chain of evidence.

All eight cans were submitted at the same time and all eight cans presented the exact same exterior appearance with the exception of the numbering. The expectation was that the testing wouldbe performed within 48 hours. Any deviation in the 48 time constraint that was not met by the laboratory was noted and taken into consideration in the results.

There are several limitations noted in the research and writing of this research paper. Apprehension played a large role in the reluctance of ADC organizations and handlers to complete the surveys. Demographics played a major part in the ability to facilitate true experiments with all vested interests having the opportunity to participate. Funding for this research could also attribute to some of the limitations of the experiments.

The unwillingness of ADC organizations and the handlers to participate in the surveys was unforeseen. It was an assumption that handlers would want to share what their canine has done and what they can do. However, only eleven of the estimated 200 ADC teams across the United States participate was disappointing. That 6% participation group only did so under the assurance ofconfidentiality. With the ADC teams from all the ADC organizations spread across the United States, it was understood that only a small sample of experiments would be able to be facilitated by the one person team. Having only three participants was disappointing, but does have value. It would have been ideal to at least have 50% of all the ADC organizations invited to participate in the experiments.As budgets for all organizations tightened every year, it is recognized that funding for in depth analysis was a key limiting factor.

A total of three ADC teams participated in the experiment. The low participation rate is due to the logistics of travel and reluctance discussed earlier. It is worth noting that all three of the ADC teams participating in the experiment also completed the survey. Of the three teams that participated, two were 100% accurate with the odor recognition test and the third team was 95% accurate (not accurately alerting on can #20 that contained 5µl of Ronsonol Lighter Fluid). Note that there were no false positive alerts in the odor recognition test.

The scent discrimination test yield 100% accuracy in all three teams in identifying the five ignitable liquids that were presented. However, one team did have a false positive alert on burned carpet backing. The three ADC teams clearly identified the square that was spiked with 5µl LPD (Ronsonol Lighter Fluid) in the pin point accuracy test. One ADC team alerted to the square next to the spiked square, which was ten inches away from the spiked square.

To perform the practical test, the burn structure was utilized. This is a concrete structure that is built so that fire fighters can have live fire training. Three pieces of upholstered furniture were used in this phase of testing, noting that all three are identical in make, age, and came from the same atmosphere. One of the three pieces of furniture was spiked with 20µl of 50% evaporated gasoline (this was on the top level of the structure). Each was placed on a different level of the burn structure and ignited with a road flare and allowed to burn out without any suppression efforts from fire department personnel.

All three of the furniture fires were ignited the evening before the testing the next morning to allow the atmosphere to cool down and to simulate a typical scenario of an ADC team responding to a call. Each canine was calibrated outside the structure using 5µl of 50% evaporated gasoline at a point far enough away from the burn building as not to interfere with the ADC performance.

There were a total thirteen quart cans and eight one gallon cans were submitted to the laboratory for MS-GC analysis. The laboratory results for the thirteen cans represented the quart cans used in tests one and two confirmed the correct cans for ignitable liquids. There were two quart cans that came back negative for ignitable liquids, numbers six and seven. Can number six was burned pile carpeting and number seven was burned carpet padding. Neither had any ignitable liquids added.

The eight one gallon cans submitted to the laboratory were all examined in within the time constraints that were set forth in the procedures. Cans numbered one, three, five and seven all came back positive for ignitable liquids which ranged from 2µl 50% evaporated gasoline down to 0.5µl 50% evaporated gasoline. This time constraint is imperative in trying to maintain the continuity of the time delays for the testing of cans numbered two, four six and eight, each of which was spiked with 1µl Rosonal Lighter Fluid (LPD). The difference is that can eight was set to the lab within 48 hours of being spiked, but can four was spiked one week before being submitted to the laboratory, can six delayed two weeks before being submitted to the laboratory, and can two was delayed three weeks before being submitted to the laboratory.

Results

The surveys that were sent to the five ADC certification groups initially yielded no results. A follow-up email and phone call was made to each of the organizations. It was a consensus from the phone conversations that each organization was reluctant to answer the questions posed. It was determined that the underlying issue for the reluctance was the fear that the organizations and the canines were being compared to each other. This goes back to the tests that were earlier done and published in the forensic trade magazines which drew a great deal of scrutiny. The end result from the survey is that those individual teams that did respond did so under the assurance of anonymity. There were four research questions used to guide this study. The first question asked:What is a certified accelerant detection canine?

With the number of “certifying” agencies and the various criteria set forth by each, the term certified ADC is ambiguous. Each certifying group listed in the related literature has a slightly different certifying nuance. One commonality that the vast majority of ADC certifying agencies was, referencing the standards and training of ATFE(BATFE, 2010) and Maine State Police. The certification standards varied from 100% accuracy on all testing to 50%. The amount of time utilized to imprint the canines on the selected ignitable liquids varied from two weeks to six weeks, which typically paralleled with the number and classes of ignitable liquids that the canine was trained to recognize. The vast majority of the ADC teams used the food reward method of motivation for the canines. There were a few ADC teams that use a combination of food reward and play reward motivation.

A total of eleven teams responded to the survey in the form of email. The groups from which they are trained and certified are not disclosed. The results can be viewed in appendixes G and I. The majority of the ADC teams were trained for six weeks. 91% utilize the food reward method of training. One team used a combination of food reward and play motivation. 91% of the ADC teams recertify annually with 9% recertifying every two years. 91% of the ADC teams are imprinted on all six of the classes of ignitable liquids (50% evaporated gasoline, Medium Isopaffinic Products, Naphathenic / Paraffinic Products, HPD, MPD, LPD), with 9% imprinted of four classes of ignitable liquids (50% evaporated gasoline, HPD, MPD, LPD). The average rate of confirmation is 79.8% with the highest rate being 91% and the lowest rate being 72%.

The results of the practical experiment that was conducted confirmed that the three canines passed the tests that would have certified them in a certification test based solely on the criteria that each of the certifying agencies set forth for their canine. However, with one canine having a 95% accuracy rate, the whole sample group of canines would not have passed the highest standards of certification from other agencies. This reinforces that there is not a consensus definition of certified ADC. The second research question was: Can accelerant detection canines detect levels of accelerants that the laboratory cannot confirm?

Lentini (2012) states in a recent article stated, “Laboratories today are capable of detecting 0.1 µl (1/500 of a drop) of ignitable liquid in a gallon of fire debris without breaking a sweat" (p. 3). There have been a number of opinions rendered in regards to which is more sensitive to detecting ignitable liquids the laboratory or the dog. Double blind tests conducted in the late 1990's that were intended to test the lower limits of the canines ability to detect ignitable liquids found that in a number of the tests administered, the canines could detect lower levels than the GC(Katz & Midkiff, 1998).

In an experiment over a sixteen month period a variety of concentrations of 50% evaporated gasoline were used testing the ADCs. The positive alerts were taken to the laboratory for confirmation. It was found that some canines could detect levels as low as 0.01 µl of 50% evaporated gasoline(Kurz et al., 1996). The CG could only detect petroleum products 0.25µl and above. The same test was replicated using kerosene and the canines could accurately detect kerosene as low as .01µl while the CG could only detect levels at a minimum of 0.5 µl(Kurz et al., 1996).

In the experiments facilitated for this research paper, the ability of the canines to detect limits of ignitable liquids lower than the laboratory can verify is not verifiable. The two positive alerts by the canine that were known to have ignitable liquids were intentionally delayed from going to the laboratory with the sole intention of determining if LPD could evaporate from sealed metal evidence cans. The report for cans number eight and six were positive for ignitable liquids. The report for can number four were inconclusive for ignitable liquids. The report for can number two were negative for ignitable liquids. One can that was a positive alert was found to be negative by the laboratory, but it was delayed for three weeks. The other can in question was a positive alert by the canine but was inconclusive by the laboratory, and this one also was delayed, but only two weeks. The question remains, "Who knows best, the laboratory or the Labrador?"(Katz & Midkiff, 1998, p. 329).

The third research question asked: Does the method of collecting fire debris evidence that is thought to contain accelerants have the potential to lead to negative laboratory confirmations?The collection ofphysical fire debris evidence is addressed in Chapter 16 of NFPA 921. The distortion of the evidence begins with the fire itself, continues with the suppression, overhaul, and salvage phases. The fire itself changes the composition of the items that are burned, and produces products that can mirror accelerants in the form of pyrolysis. Suppression crews enter the structure to extinguish the flames using large amounts of water at over 100 psi (pounds per square inch). The volume of water and the pressure can move debris to the point that accelerants that may have been used to start the fire may end up in an area that is not close to the location that the burn patterns indicate where it started.

Suppression crews then have the arduous task of looking for hidden fires to ensure that the fire has been completely extinguished. The overhaul process entails opening up all areas that might have hidden fire. It also requires that smoldering fire debris be removed. This is again problematic in that evidence of accelerants can be displaced or removed as well as the ability to analyze the fire patterns. Salvage operations involves removing items that are still of value to an area that is safe from further damage. This operation can also move potential accelerant evidence.

All personnel that enter the structure (or crime scene) have the potential of contaminating the evidence. Suppression personnel, investigators as well as the canine are included in the group of contaminating the scene. The issue of cross-contamination (in this case of ADCs looking for ignitable liquids) is inadvertently carrying accelerants from another source into the crime scene, thus contaminating it. Suppression personnel may have had the same boots on fighting the fire as they did earlier in the day fueling up the ladder truck. Investigators may not have completely washed the tools from the last fire scene that had accelerants. The canine may have walked through the parking lot where a diesel engine leaked, and carried that residue on his feet to the fire scene(Lynch & Sawyer, 2001). These situations sound minute, but the ADC and laboratory are able to detect amounts as small as 1µl of 50% evaporated gasoline (1/10 of a drop).

The collection of the evidence itself has the most potential of contamination. Investigators digging through fire debris protect their hands with gloves. The leather fire gloves are porous and readily absorb liquids, including ignitable liquids. Investigators also use rubber gloves to protect their hands from liquids. Therefore, it is probable that in the process of sorting through debris, that these rubber gloves can also become contaminated. Utensils used to scoop fire debris to place into evidence cans may have been used on previous scenes and have residue of accelerants on them. The power tools used to cut lumber, metal and sheetrock can easily become contaminated and it extremely difficult to completely "sterilize." Some investigators have combated this by using the lid of the evidence can as a scoop (NFPA 921, 2011). That is an acceptable practice as long as the lid is clean.

The evidence cans that the fire debris is collected must not become contaminated. These new evidence cans may sit for weeks and even months in the back of an SUV or the trunk of a car with the lid placed on tight(Williams & Sigman, 2007). The evidence containing ignitable liquids from the previous scenes may be transported to the laboratory in that same space. It would be plausible to think that if evidence cans have been proven to have accelerants evaporate, that the clean cans in that same space in a close proximity might become contaminated. The defense is only looking for reasonable doubt to exclude the evidence.

During the course of the experiments (Appendix E) (Appendix I), a subject came up that sparked a great deal of debate and potential for evidence submitted to the laboratory not to be positive (even if there was ignitable liquids used in setting the fire). Once an area it alerted by the ADC, how is that spot identified and moreover, who collects the evidence? The majority of the time, the canine handler of the ADC is not the lead investigator and may be assisting another jurisdiction as the ADC team only, not as the lead investigator. Therefore, it was distinctly possible that ADC handler was identifying the locations that the ADC alerts and someone else was marking it and also collecting the evidence.

Investigators must understand the manner in which the ADC works. They are alerting to the area that has been followed back to the strongest scent. That scent might be different than the exact location of the accelerant used due to a number of factors. The scene that the ADC is working may be open to the air and therefore subject to the wind. The ability of a slight draft to move the minuscule products of a LPD or 50% evaporated gasoline is significant(ASTM E2451-08, 2011).Also the ignitable liquid can be covered by layers of fire debris, and the site that was alerted to be the strongest odor that the canine can physically get to but is only the vapors from the liquid buried deep in the pile.

The fourth research questions asked: Can fire debris evidence unconfirmed by the laboratory of having accelerants, be utilized as evidence in a court of law?

NFPA 921 (2011 16.5.4.7) states,

> In order for the presence or absence of an ignitable liquid to be scientifically confirmed in a sample, that sample should be analyzed by a laboratory in accordance with 16.5.3. Any canine alert not confirmed by laboratory analysis should not be considered validated.

There is no mention that fire debris that was alerted to by ADC that was not confirmed by laboratory analysis cannot be used as evidence in a court of law. This debate has been ongoing since the inception of ADCs. There are two items that stand out in this debate drawn from NFPA 921. First NFPA 921 is a guide, not a standard, not a code, and not a law. Secondly, with NFPA 921 being a consensus guide, there must not be a consensus when the terminology from 16.5.4.7 state that the evidence (should not be considered validated).

With NFPA 921 being a guide and using words like should, it does not give the definitive parameters that one would need to be compelled not to attempt to place unconfirmed fire debris evidence into court. The litmus test for the admissibility and the credibility of any evidence is the courts. The cases reviewed in the literature reviewalso do not give definitive guidelines("Legal Update NFPA 921 - 2011 Changes," 2011). However, the trend has been that the most recent cases that were appealed that the fire debris alerted to by ADCs was not confirmed by a laboratory were excluded as evidence on appeal. The fact that the issue of the admissibility of unverified ADC alerts has to be appealed to be excluded reinforces the ambiguity that the courts have in regards to ADCs.

In 2000, NFPA 921 became "generally accepted by the relevant scientific community" ("Legal Update NFPA 921 - 2011 Changes," 2011, p. 6)primarily based on the report from the United States Department of Justice (DOJ). The report "Fire and Arson Scene Evidence" established NFPA 921 as the "benchmark for the training and expertise of everyone who purports to be an expert in the origin and cause determination of fires"(Lentini, 2012b, p. 3). Soon after that report was released, the IAAI endorsed NFPA 921. Still some overzealous prosecutors pursue admitting unconfirmed ADC alerts into court, and some trial courts allow it.

This practice "has the potential for setting up a gross miscarriage of justice. And the judge should not allow such witchcraft to be presented to the jury"(Lentini, 2012b, p. 3).

Discussion

ADC teams are the best known tool for locating accelerants in fire scenes. One of the problems is that is that some lab reports are returning negative for ignitable liquids from debris that has been identified on fire scenes by certified accelerant detection canines. The term certified ADC does not mean a great deal to most of the stakeholders in a fire investigation. It is assumed that certified means that team has formally and successfully met a set of standards. In a generic sense, that assumption is true. However, as was found in the literature review(BATFE, 2010), there is a wide variation in the certification standards from the accuracy rate of testing, to the frequency of testing, to the practical application tests(United States Police Canine Association, Inc., 2009). There is some commonality for all the processes, but the credibility of the certification itself, has the significant potential of being scrutinized.

The debate continues as to who is more accurate the laboratory or Labrador. There are a number of variables that may influence this debate that outside that of extensive controlled experiments no definitive conclusion can be drawn. These variables include but are not limited to: the type of testing that is performed the quality of the testing, and the parameters in which the laboratory technician can classify a product as positive for accelerants. These issues may sound minute, but the quantities that both "labs" (laboratories and Labradors) are dealing with are as low as .05 µl and in some cases less.

Collecting fire debris evidence can determine the outcome of the test for accelerants. First and foremost, the person marking the location of the ADC alert must be sure that the area they are marking is actually the correct location. Once the location(s) of the ADC alerts are marked, the fire debris evidence must be collected. Who collects that evidence can dictate if the results are confirmed or disaffirmed. Thus, it must be someone who is not only well versed in fire debris evidence collection, but also understands the nuances of the ADCs. The method of collection may come under scrutiny if prudent collection techniques are not used to avoid cross contamination.

There are those that not only feel that “not only should dogs be retired from accelerant detection, but the handlers and those advocating and association with the use of arson dogs should receive additional training regarding objectivity” (Roberts & Roberts, 2001, p. 6). Roberts goes further to question the visual cues that handlers give canines. This theory is discussed by a number of trainers (Lit, Schweitzer, & Oberbauer, 2011). This thought again leaves the use of ADC open to scrutiny by the courts (Papet & Ensminger, 2011). “Until the time comes when a better, more efficient way of locating and detecting ignitable liquid evidence is developed the ADC is here to stay” (Bombard et al., 2001, p. 11).

In essence, it all boils down to the ability to utilize the evidence thought to contain accelerants in court to assist with the prosecution of the crime of arson. Fire debris evidence that is not confirmed by a laboratory to contain ignitable liquids has been utilized in courts despite NFPA 921 stating, “Any canine alert not confirmed by laboratory analysis should not be considered validated(NFPA 921, 2011, p. 150). However, aggressive prosecutors have utilized unconfirmed ADC alerts in court and the trial judges have allowed it.

It seems that all the factors and variables are against the use of ADCs in fire investigation. There is no established consensus criterion for the certification process of the ADC teams which leads to scrutiny. The fire scene has been compromised for evidential integrity from: the time the fire starts, to the extinguishment, to salvage and overhaul, to investigation, and through evidence collection. The evidence also comes into question as to the potential for cross contamination. All these hurdles to show that .05µl of an ignitable liquid exist. That makes it seem like the process is doomed from the onset.

Then one must factor in the legal aspects of that .05µl of an ignitable liquid that the fire investigators have so diligently preserved. The resource that investigators, forensic technicians, attorneys and judges typically refer to is NFPA 921. This guide has also been left to interpretation and subject to examination. The title of NFPA 921 sets the tone as it is not a standard, code or law, but just a guide for fire investigations. The courts themselves send mixed signals as to what constitutes admissible evidence of ignitable liquids that are identified solely by the ADC alert(Katz & Midkiff, 1998).

Fire investigators that call for the assistance of ADCs, sometimes have expectations that exceed the limitations of the ADC teams. The ADC alert to an area of fire debris is not the litmus test for arson. The fire investigative community must understand that the ADC teams (regardless of where they were trained, how they were certified, and what ADC organization they originated) are merely a tool(Neitch, 2012). ADCs are only one part of the totality of the circumstances surrounding the fire investigation. However, if the investigator has right of entry, secures a criminal search warrant, avoids cross contamination, does not have a scene that is compromised by suppression salvage overhaul operations, has an ADC alert on that .05µl of an ignitable liquid, and that minute amount is confirmed by an accredited laboratory, that might be the part that leads to a trial, conviction and withstands the challenges from appeals that protects society from that arsonist setting another fire. Therefore, NFPA 921(2011) is correct in its guidance of the use of only validated ADC alerts.

Recommendations

It is recommended that investigators and ADC Teams utilize clean protective gear, tools, and evidence collection containers when entering the fire scene. Furthermore, those tools that were used in one area to dig and collect evidence must be cleaned before digging the next area even though it is the same scene. That means that there is no possibility of contaminants from other areas of the scene on the tools, gear or shoes. The cans that are used to collect the evidence must be clean unused cans that are secured in a place where remnants from other evidence cannot contaminate them. The same due diligence must be applied with the cans containing evidence, secure and away from the potential of contaminants.

It is recommended that the ADC handler at minimum assist in the collection of evidence of that the ADC alerts as well as the control samples. The best practice would be for the ADC handler to collect the debris that was identified by the ADC alerts themselves. That would help to assure that the area of the alert was exactly where the handler identified as to the alert. Once the evidence is collected, it is recommended that the ADC Team work the cans to confirm or disaffirm that the ADC alerts to the cans that were taken in the areas of the alerts.

It is recommended that the evidence be delivered to the laboratory without delay. The preferred delivery method is to be hand delivered within 24 hours of collecting the evidence. It is further recommended that the ADC handler meet with the laboratory technicians at the laboratory that they will primarily be using before the first item of evidence is submitted. This will give the handler the opportunity for the laboratory personnel to meet the ADC as well as to articulate the nuances of ignitable liquids in fire debris. By taking the time to explain the importance, the handler not only establishes his or her credibility, but it helps to build a working relationship with the technicians. Through this collaborative effort, there will be an established point of contact should either party have a question while in the field collecting evidence or from the laboratory testing the evidence.

It is recommended that the handler keep impeccable records of everything that the ADC team does including but not limited to health care maintenance, grooming, daily training (Appendixes K and L), recertification, scenes worked (positive and negative), laboratory results (positive and negative), and the health care and grooming records which show that the canine is cleaned after scenes so as not to cross contaminate other scenes and evidence.

Each of the recommendations presented is done so due to the vague nature in which each issue has been utilized. The ADC handler then must go above and beyond the typical due diligence of a typical canine handler for the courts to accept the findings and survive the appeals. The Daubert challenge is a hearing conducted before the judge where the validity and admissibility of expert testimony is challenged by opposing counsel. The expert is required to demonstrate that his/her methodology and reasoning are scientifically valid and can be applied to the facts of the case (Daubert, n.d.). The key aspects of this are the validity of expert testimony, the ability to demonstrate that the methodology is scientifically based, and these facts are applicable to the case. Thus, if the ADC team can show that the training, certification, recertification, fire scenes, and laboratory analysis records are up to date and accurate and the laboratory confirms the presence of accelerants in the ADC alerts, then it would be difficult if not impossible to refute those findings. You can “Trust Your Dog” ("State v. Sharp," 2006, p. 4), but you need to validate with the lab, and you will prevail in the courts.

References

ASTM E1616-11, Test methods for ignitable liquid residues in extracts from fir debris samples by gas chromatography - mass spectrometry. (2011). Retrieved from http://www.astm.org/Standards/E1618.html

ASTM E2451 - 08 Standard practice for preserving ignitable liquids and ignitable liquid residue from fire debris samples. (2011). Retrieved from http://www.astm.org/Standards/E2451.html

ATF accelerant detection canine program [Fact sheet]. (n.d.). Retrieved from Interfire: http://www.interfire.org/res_file/canine.asp

Accelerant detection canine course #89 [Power point slides]. (2010).: Office of training and professional development (BATFE).

Accelerant detection canine team. (2010). Retrieved July, 16, 2012, from http://www.chulavistaca.gov/city_services/public_safety/fire_department/about_cvfd/prevention/adk9team.asp

Accelerant detection canine team standards. (2009). In Accelerant detection canine team standards. Retrieved from http://osfm.fire.ca.gov/strucfireengineer/pdf/fireworks/Accelerant%20Detection%20Canine%20Team%20Standards%2006-09%20_K9_.pdf

Bombard, T. P., Coletta, G. A., Drugan, J. E., Horgan, P. A., Lynch, D. W., & Mazza, M. S. (2001, October). Accelerant detection canines: the other side of the coin [Magazine]. *Fire and Arson Investigator*, *52*(1), 10-11.

Bureau of Alcohol, Tobacco, Firearms, and Explosives. (2010). *Accelerant detection canine certification* (SOP 25). Front Royal, VA: BATFE.

Bureau of Alcohol, Tobacco, Firearms, and Explosives. (n.d.). *ATF national response team*. Retrieved from http://www.atf.gov: http://www.atf.gov/publications/factsheets/factshett-national-response-team.html

Bureau of Alcohol, Tobacco. Firearms and Explosives. (n.d.). *Accelerant detection canine program*. Retrieved from ATF: http://www.atf.gov

CADA's position on testifying to negative samples. (2012). Retrieved Nov. 11, 2012, from http://cadafiredogs.com/wp-content/uploads/2012/01/CADAS-Position-on-Testifying-to-Negative-Samples.pdf

CADA's position on the term "arson dog". (n.d.). Retrieved July 30, 2012, from http://cadafiredogs.com/wp-content/uploads/2012/07/CADAs-position-on-Arson-Dog.pdf

Cal Fire. (2002, February). *Canine team recertification* [Policy brief Cal Fire 9445]. Retrieved from Cal Fire: http://webmain02.fire.ca.gov/pubs/issuance/9400/9445.pdf

California department of forestry & fire protection, office of the state fire marshal. (2009). *Accelerant detection canine team standards* [Standards]. Retrieved from http://osfm.fire.ca.gov/strucfireengineer/pdf/fireworks/Accelerant%20Detection%20Canine%20Team%20Standards%2006-09%20_K9_.pdf: http://osfm.fire.ca.gov

Carr, Weldon Wayne . (2005). Retrieved from http://www.law.umich.edu/special/exoneration/Pages/casedetail.aspx?caseid=3936

Daubert. (n.d.). Retrieved June 13, 2012, from http://definitions.uslegal.com/d/daubert-challenge/

Davis, K. D. (2006). Arson Dogs. Retrieved Aug.12, 2012, from http://www.veterinarypartner.cpm/Content.plx?P=Print&A=2220

Duno, S. (2009). Are you making these 10 training mistakes? Retrieved July 12, 2012, from http://www.moderndogmagazine.com/articles/are-you-making-these-10-training-mistakes/29092

Ensminger, J. (2011a). Early police dogs in Belgium and New York. Retrieved from http://dogreporte.blogspot.com/2010/10/early-police--dogs-in-belgium-and new.html

Ensminger, J. (2011b). Accelerant detection dogs. In *Police and military dogs* (pp. 235-236). doi:10.1201/b11265-22

Fleck, T. (2005, September). *Accelerant canine legal update and opinions* [White paper]. Retrieved from K9fleck: http://www.k9fleck.org

Fleck, T. (2011, November / December). K-9 accelerant / arson cases [Magazine]. *Police K-9 Magazine*, 70-73.

Frawley, E. (n.d.). The theory of motivation in dog training. Retrieved July 18, 2012, from http://leerburg.com/pdf/theoryofmotivation.pdf

Gialamas, D. M. (1995, July 10). Enhancement of fire scene investigations using accelerant detection canines. *Science & Justice*, *36*(1), 51-54.

History of the dalmation. (n.d.). Retrieved July 30, 2012, from http://fbfire.org/site/index.php?option=com_content&view=article&id=30&Itemid=31

Jonas, T. R., & Bueker, E. M. (1999). *Accelerant detection canines: Uses and misuses* [White paper]. Retrieved from Land of Pure Gold: http://landofpuregold.com/the-pdfs/use-misuse.pdf

Katz, S. R., & Midkiff, C. R. (1998, March). Unconfirmed canine accelerant detection: a reliability issue in court. *Journal of Forensic Science*, *43*(2), 329-333.

Koussiafes, P. M. (2012, October). Potential for Contamination of Fire Debris Evidence Containers [Magazine]. *Fire & Arson Investigator*, *63*(2), 26-31.

Kurz, M. E., Schultz, S., Griffin, J., Broadas, K., Sparks, J., Dabdoub, G., & Brock, J. (1996, September). Effect of background interference on accelerant detection by canines [Magazine]. *Journal of Forensic Science, 41*(5), 868-873. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8789850

Latimer, D. (2010). The importance of canine certification testing [Magazine]. *World Detector Dog Organization*, 5-8. Retrieved from http://wddo.org/News/NBBA_atricle.pdf

Legal update NFPA 921 - 2011 changes. (2011). *Fire K9.org Quarterly Newsletter*, 6. Retrieved from www.firek9.org

Lentini, J. (2012 a, Fall). Re: CADA recertification [Online forum comment]. Retrieved from http://www.linkedin.com/groups/Canine-Accelerant-Detection-Association-CADA-4141036

Lentini, J. (2012 b, November 1). The Evolution of Fire Investigation and Its Impact on Arson Cases. *Criminal Justice*, *27*. Retrieved from http://www.americanbar.org/content/dam/aba/publications/criminal_justice_magazine/sp12_fire_investigation.authcheckdam.pdf

Lit, L., Schweitzer, J. B., & Oberbauer, A. M. (2011, Jan. 12). *Handler beliefs affect scent detection dog outcomes* [White paper]. Retrieved from National Center for Biotechnology Information: http://www.ncbi.nlm.nih.gov/pubmed/21225441

Lynch, P. A., & Sawyer, S. B. (2001, April). Cross contamination and accelerant detection canines - A cause for concern? Or junk science? *Fire and Arson Investigator*, *51*(3), 23-25.

McCloud, S. (2007). Pavlov's dogs. Retrieved Aug. 12, 2012, from http://www.simplypsychology.org/pavlov.html

NFPA 1033, standard for professional qualifications for fire investigators. (2011). In *NFPA 1033, standard for professional qualifications for fire investigators* (2011,). Quincy MA: National Fire Protection Association.

NFPA 921 guide for fire & explosion investigations. (2011). In NFPA 921 guide for fire & explosion investigations. Quincy MA: National Fire Protection Association.

National Fire Protection Association website. (n.d.). www.nfpa.org

Neitch, D. (2012, October). Tools of the trade [Magazine]. *Fire & Arson Investigator*, *63*(2), 40-42.

Papet, L. E., & Ensminger, J. L. (2011). Cueing and probable cause: research may increase defense attacks on and judicial skepticism of detection dog evidence. Retrieved Oct. 3, 2012, from http://www.animallaw.info/articles/art_details/print.html

Reisch v. Delaware, 92-01-214 1 (C.A. 1993).

Roberts, C. D., & Roberts, E. G. (2001,). April [Magazine]. *Fire and Arson Investigator*, *51*(3), 6-8.

STATE of New Jersey, plaintiff v. Bryan SHARP, defendant. (2006). Retrieved Oct. 3, 2012, from http://caselaw.findlaw.com/nj-superior-court/1290006.html

Scientific working group on dog and orthoganal detector guidelines. (2010). *SWGDOG SC8 - substance detector dogs - Accelerant detection* [Policy brief]. Retrieved from http://swgdog.fiu.edu/approved-guidelines/sc8_accelerants.pdf: http://swgdog.fiu.edu

Shadic, R., Ryan, J., & Bachner, F. (2009, September 14). *F-500 Project* [Fact Sheet]. Montour Falls, NY: Office of Fire Prevention.

Spicer, R., & Thomas, R. B. (1988, August). Barney: The arson-sniffing dog [Magazine]. *Firehouse*, 18-19.

Stauffer, E., & Lentini, J. L. (2002, September). ASTM standards for fire debris analysis: A review. *Forensic Science International*, *132*, 63-67. doi:10.1016/S0379-0738(02)00459-0

Stittleburg, P. P. (1995, February). Court makes it official: dog's nose knows [Magazine]. *Fire Chief*, 18-19.

Tindall, R., & Lothridge, K. (1995, July). An evaluation of 42 accelerant detection canine teams [Magazine]. *Journal of Forensic Science*, *40*(4), 561-564.

Toy reward verse food reward. (2011). Retrieved Aug. 12, 2012, from http://www.ironheartdogs.com/blog/?p=24

Tranthim-Fryer, D., & DeHaan, J. (1997, December 12). Canine accelerant detectors and problems with carpet pyrolysis products [Magazine]. *Science & Justice*, *37*(1), 39-46.

US v. Hebshie, 02cr10185-NG D.C. MA 1 (D. MA. 2010).

United States Fire Administration. (2011). *Strategic plan, fiscal years 2010-2014*. Retrieved from United States Fire Administration: http://www.usfa.fema.gov/about/strategic/

United States Police Canine Association, Inc. (2009). *Governing rules and regulations for certification accelerant detection* [Policy brief]. Retrieved from http://www.uspcak9.com/certification/USPCARulebook2012.pdf: http://www.uspcak9.com

Virginia Department of Fire Programs. (2009). *CFFI module 2, crime scene*. Richmond VA: Virginia Department of Fire Programs.

Virginia Department of Forensic Science. (2010). *Evidence handling & laboratory capabilities guidebook*. Richmond, VA: Author.

Wagner, E. (1997, April). *The use of canines in accelerant detection* [White paper Fire Investigation 65758]. Retrieved from TC Forensic: http://www.tcforensic.com.au/docs/uts/essay2.pdf

What is an arson dog. (n.d.). Retrieved July 18, 2012, from http://arsondog.org/about/what-is-an-arson-dog/

Whistine, L. (1992, August). Four legs, a tail, and a badge... Canines in the fire service! *Firehouse*, 44-45.

Why do trainers use food when training? (n.d.). Retrieved August 12, 2012, from http://www.apdt.com/petowners/choose/usingfood.aspx

William Halliday v. State of Alaska, Court of Appeals No. A-10704 Court of Appeals of Alaska (AK 2011).

Williams, M. R., & Sigman, M. (2007, May). Performance testing of commercial containers for collection and storage of fire debris evidence [Magazine]. *Journal of Forensic Science, 52*(3), 579-585. doi:10.111/j.1556-4029.2007.00435.x

Yell v. Commonwealth of Kentucky, Supreme Court of Kentucky No. 2006-SC-000327-MR (Ky 2006).

Appendix A

Twenty Common Ignitable Liquids Used as Fire Accelerants

1. Acetone - (dimethyl ketone, 2-propanone), (C_3H_6O), flash point -4 degrees F (-20 degrees C); ignition temperature 869 degrees F (465.4 degrees C); explosive limits 2.6%-13.0%; vapor density 2.0; specific gravity 0.792; toxicity (3). A volatile, flammable, colorless, liquid ketone having a fragrant odor and miscible with water, alcohol, and most oils. Principal uses are as a solvent in lacquers, varnishes, cosmetics, nail polish remover, and in the mixture of other solvents.

2. Carbon Disulfide - (carbon disulfide), (CS_2) flash point -22 degrees F (-30 degrees C); ignition temperature 212 degrees F (100 degrees C); explosive limits 1.3% to 50%; vapor density 2.6; specific gravity 1.26; toxicity (2). A volatile, flammable, colorless to yellow liquid with a rotten egg odor. Carbon Disulfide, unlike most of the other common ignitable liquids, is heavier than water and will sink.

3. Coleman Fuel - (Coleman fuel C-2538, white gasoline, camping stove fuel, camping lantern fuel); (chemical formula - Coleman fuel is a mixture of hydrocarbons & doesn't have a single formula); flash point -27 degrees F (-33 degrees C); ignition temperature - not reported; explosive limit LEL is 0.7% - UEL not reported; vapor density 3.7; specific gravity .744; toxicity (3). A straight run, unrefined, petroleum distillate used in camping stoves and lanterns. Camp stove fuels in general have a carbon range of C_5 - C_{11}.

4. Ethyl Alcohol - (ethanol, grain alcohol), (C_2H_5OH), flash point 55 degrees F (13 degrees C); ignition temp. 689 degrees F (365 degrees C); explosive limits 3.5%-19.0%; vapor density 1.6; specific gravity 0.8; toxicity (0). A volatile, flammable, colorless liquid having a pleasant odor

and miscible in water and many organic liquids. Principal uses are in alcoholic beverages, as a solvent in pharmaceuticals, cleaning preparations, and some antifreezes.

5. Ethyl Ether - (ether, diethyl ether), $(C_2H_5)_2O$, flash point -49 degrees F (-45 degrees C); ignition temperature 356 degrees F (180 degrees C); explosive limits 1.9% - 36%; vapor density 2.6; specific gravity 0.7; toxicity (2). A volatile, highly flammable, colorless liquid which forms explosive peroxides under the influence of air and light and has a sweetish odor and is slightly miscible in water, methanol, and oils. Principle uses as a solvent in organic synthesis, smokeless powder and industrial solvents.

6. Fuel oil no. 1- (kerosene, range oil, coal oil, Jet - A (aviation) fuel); Chemical formula is a carbon range of C_9 - C_{17}; flash point 110 degrees F - 162 degrees F (42 degrees C - 72 degrees C); ignition temp. 410 degrees F (210 degrees C); explosive limits 0.7% - 5%; vapor density .7 - 5; specific gravity 0.81; Toxicity (3). A colorless, combustible, straight run petroleum distillate liquid having a characteristic odor miscible in petroleum solvents and immiscible in water. Principal uses as an ingredient in lamp oils, charcoal starter fluids, jet engine fuels and insecticides. K-1 kerosene has a low sulfur content and is used in portable space heaters.

7. Fuel oil no. 2 (home heating fuel, diesel fuel), Chemical formula is a carbon range of C_9 - C_{23}, flash point 126 degrees F-204 degrees F (52 degrees C- 96 degrees C); ignition temperature 494F (257C); explosive limits - not reported; vapor density greater than 1; specific gravity less than 1; toxicity (3). A light brown, combustible, straight run or cracked petroleum distillate consisting mostly of C_9 - C_{23} range hydrocarbons. Principal uses include heating fuel in domestic or commercial atomizing type burners and as a fuel in diesel engines.

8. Gasoline - (gas, motor fuel) Chemical formula - gasoline is a blended mixture of aromatic and aliphatic hydrocarbons; flash point -45 degrees F (-43 degrees C); ignition temp. 536 degrees F (280 degrees C) for 56 - 60 octane grade; explosive limits 1.4%-7.6%; vapor density 3.0 - 4.0; specific gravity 0.8; Toxicity (3). A highly flammable, blended liquid composed of more than 300 volatile hydrocarbon compounds manufactured from the fractionation or distillation of petroleum. Gasoline is the most commonly identified ignitable liquid accelerant reported by American forensic laboratories. Its principal use is as a fuel in spark ignited, internal combustion engines.

9. Isopropyl alcohol- (IPA, isopropanol, 2-propanol), (CH_3 $CHOHCH_3$), flash point 54 degrees F (12 degrees C); ignition temp. 750 degrees F (399 degrees C); explosive limits 2.5%-12.0%; vapor density 2.1; and specific gravity 0.79; Toxicity (3). A colorless, flammable liquid which is miscible in water, ether, and alcohol and having a pleasant odor. Principal uses as an ingredient in lacquers, rubbing alcohol, denaturant and lotions.

10. Kerosene - Refer to Fuel Oil #1. Kerosene is identical to Fuel Oil #1 from an investigator's standpoint.

11. Lacquer - Composition and properties of this category of product vary by manufacturer. A spirit varnish such as shellac; any of clear or colored synthetic organic coatings that typically dry to form a film by evaporation of the solvent.

12. Lacquer Thinner - A mixture of highly volatile solvents, miscible in water, of varying composition and properties depending on the manufacturer.

13. Methyl alcohol (methanol, wood alcohol) (CH_3OH); flash point 54 degrees F (12 degrees C); ignition temp. 867 degrees F (484 degrees C); explosive limits 6.7% - 36%; vapor density 1.1; specific gravity 0.79; toxicity (4). A colorless, flammable, poisonous liquid having a slight alcohol odor when pure, miscible in water, ethanol, ketones and most other organic solvents. Principal uses as an ingredient in antifreeze, dry gas, windshield washer fluids and as a denaturant in ethanol.

14. Methyl ethyl ketone (MEK,2-butanone) ($CH_3COCH_2CH_3$); flash point 16 degrees F (-9 degrees C); ignition temp. 759 degrees F (404 degrees C); explosive limits 1.9%-10.0%; vapor density 2.5; specific gravity O.8; and toxicity (3). A colorless, flammable liquid having an acetone-like odor miscible in alcohol, ether, and slightly soluble in water. Principal use as a solvent in nitrocellulose coatings and lacquers, paint removers, cements and adhesives and in the manufacture of printed circuit boards.

15. Mineral Spirits (see paint thinner)

16. Naphtha (V M & P) A general term which may describe combustible products such as mineral spirits or flammable products such as petroleum ether. The IAAI Forensic Science Committee recommends that the term be avoided. Principle uses of products in this class include thinner in paints and varnishes and as a fuel for pocket lighters. Flash point, explosive limits and other properties vary by manufacturer.

17. Paint Thinner (mineral spirits), Paint thinner or mineral spirits is a complex petroleum distillate; flash point range is listed as 104 degrees F (40 degrees C) - 110 degrees F (43 degrees C); ignition temperature 473 degrees F (245 degrees C); explosive limits 0.8% @ 212 degrees F

(100 degrees C); vapor density 3.9; specific gravity 0.8; toxicity (3). A category of clear, combustible liquid having petroleum type odor. Mineral spirits are midrange petroleum distillates ranging from C8 to C12 which is present in many paint thinners, oil base stains, dry cleaning solvents, and some brands of charcoal starter fluids. There may be slight variations in the chemical information provided for different manufacturers.

18. Toluene (methylbenzene, phenylmethane) ($C_6H_5CH_3$); flash point 40 degrees F (4 degrees C); ignition temp. 896 F (480 degrees C); explosive limits 1.3% -7.0%; vapor density 3.1; specific gravity 0.8; toxicity (2). A colorless, flammable liquid with a benzene-like odor, miscible in alcohol, ether, acetone and very slightly soluble in water. Principal use as a solvent in paints and coatings, paint removers, explosives (TNT), adhesive solvent for model airplanes, and as a base for polyurethane resins.

19. Turpentine (oil of turpentine) ($C_{10}H_{16}$) - The chemical formula varies with the manufacturer; flash point 90 degrees F-115 degrees F (32 degrees C - 46 degrees C); ignition temp. 488 degrees F (253 degrees C); explosive limit (LEL) .8% - (UEL) not reported ; vapor density less than 1; specific gravity 0.8; toxicity (4). A colorless, combustible liquid derived from steam distillation of wood from pine (conifer) trees. Turpentine is miscible in oils, ether, and chloroform. Principal uses are as a drying agent or as a solvent for thinners of paints, lacquers, varnishes and used in wax-based polishes and liniments. It is also used to manufacture certain linoleums, soap, ink, artificial campour and rubber.

20. Xylenes - (dimethylbenzene) C_6H_4 $(CH_3)_2$; flash point 29 degrees F (- 2 degrees C) ; ignition temperature 867 degrees F (464 degrees C); explosive limits - not reported (moderate fire risk) ; vapor density > 1; specific gravity 0.86; toxicity (4). A colorless, flammable liquid miscible in

alcohol and ether, insoluble in water. Xylene is isolated from crude wood distillate or obtained from fractional distillation of petroleum or coal tar. Commercial xylene is a mixture of three isomers, o-, m-, and p-xylene, the m-isomer predominates. Xylenes, a common chemical, are used for conversion to polyester fibers and plasticizers in the plastic industry, in aviation gasoline, rubber cements, automotive enamels, paints and lacquers, and a variety of other commercial applications.

Appendix B

Common Ignitable Liquids

(LPD) Light Petroleum Distillates
Ronsonol Lighter Fluid
VM&P Naphtha
Un-Do Adhesive Remover
Camplite Camp Fuel

(MPD) Medium Petroleum Distillates
Klean-Strip Paint Thinner
Klean-Strip Paint Clean-Up
Mineral Spirits
E-Z Painter Thinner
Gum Out Xtra Fuel Injector Cleaner
Publix Charcoal Starter
Stoddard Solvent

(HPD) Heavy Petroleum Distillates
Kerosene
JP-4 (Jet Fuel
Twi-Light Lamp Oil
Sunnyside Kerosene
Tiki Torch Fuel
Classic Glo-Light Torch Fuel
Boron Gardens Torches Lamp Oil
Diesel Fuel

Naphathenic / Paraffinic Products
Beachcomber CitronellaTorch Fuel
Mr. Solvent
Lamplight Farms Lamp Oil

Medium Isopaffinic Products
Sunnyside Paint Thinner
A&P Charcoal Lighter Fluid
Exxon Mobil ISOPAR G
Exxon Mobil ISOPAR H
Whitaker Odorless Mineral Spirits
Wizard Charcoal Lighter
Liquidex Permitine Turpentine

50% Evaporated Gasoline
All brands and grades of automotive gasoline

Appendix C

Survey Request

W. A. Hogsten
203 Ridge St.
Charlottesville VA. 22902
May 1, 2013

Dear [**Recipient Name**]:

I am currently writing a research paper for the National Fire Academy's EFOP (Executive Fire Officer Program) about ADC (Accelerant Detection Canines). The purpose of this paper is to determine the factors that would potentially lead to more confirmed alerts by the laboratory and thus leading to more credible evidence in court. This would lead to more arson convictions.

You have my assurance that this information will be kept confidential in the sense that there will be no specific reference as to where the data originated. However, the generic information that is posted online such as training and certification will be cited in the paper. I ask that you distribute the short questionnaire below to you general membership along with this cover letter. The responses can be sent back as an attachment to my email address hogsten@charlottesville.org. Thank you for your time and help with this project.

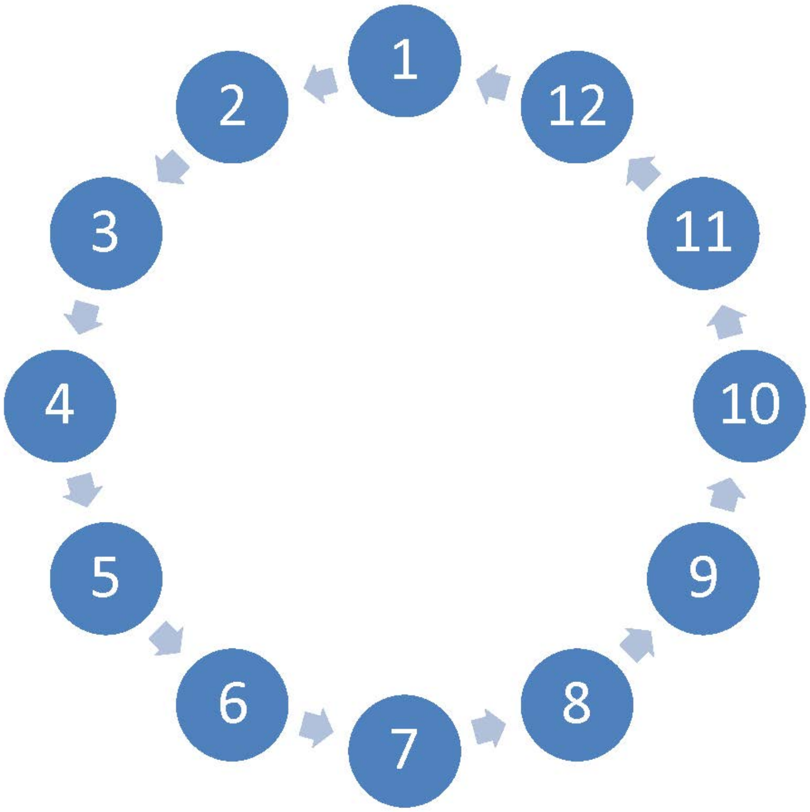
Sincerely,

W. A. Hogsten
ADC Handler of "Quaker"

1. How many weeks is your canine imprinted?
2. How many weeks are you (the handler) trained?
3. How often are you required to recertify?
4. What type of reward system do you use as motivation for your canine?
5. What percentage of evidence submitted to a certified laboratory is confirmed as being positive for accelerants?

Appendix D

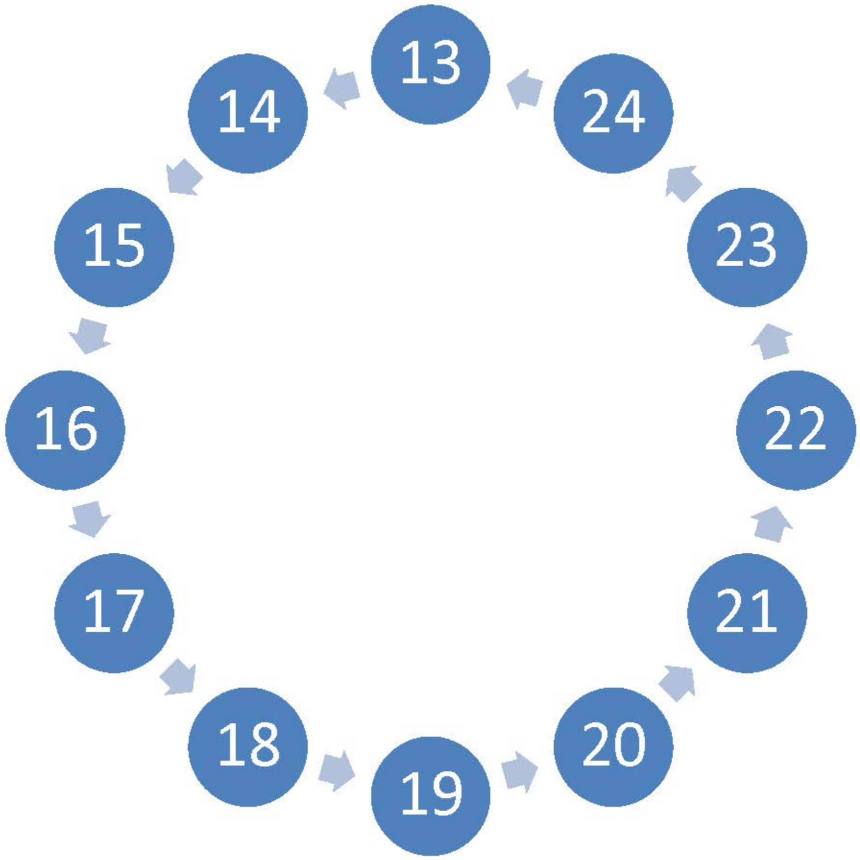
Test #1, Circle #1



1. Sheetrock (burned)
2. Cardboard (burned)
3. Shingles
4. Spruce lumber
5. Vinyl Siding (burned) **<u>HOT</u>** (5µl Citronella Torch Fuel)
6. Paper
7. OSB (burned)
8. Sheetrock (burned)
9. Cardboard
10. Spruce lumber (burned)
11. Spruce lumber (burned) **<u>HOT</u>**, (5µl evaporated gasoline)
12. OSB

Appendix E

Test #1 (Circle 2)



7. Paper (burned)
8. OSB (burned)
9. Vinyl Siding
10. Paper (burned) **HOT**, (5µl Wizard Charcoal Lighter Fluid)
11. Sheetrock (burned)
12. Cardboard
13. Spruce lumber
14. Shingles (burned) **HOT**, (5µl Ronsonol Lighter Fluid)
15. Spruce lumber (burned) **HOT**, (10µl off road diesel fuel)
16. Cardboard
17. Vinyl Siding
18. Sheetrock (burned) **HOT**, (5µl E-Z Paint Thinner)

Appendix F

Test #1 Results

Test #1 Odor Recognition Results					
			ADC Team		
Can #	**Distractor**	**Ignitable Liquid**	**#1**	**#2**	**#3**
1	Sheetrock (burned)				
2	Cardboard (burned)				
3	Shingles				
4	Spruce lumber				
5	Vinyl siding (burned)	(5µl Citronella Torch Fuel)	X	X	X
6	Paper				
7	OSB (burned)				
8	Sheetrock (burned)				
9	Cardboard				
10	Spruce lumber (burned)				
11	Spruce lumber (burned)	(5µl evaporated gasoline)	X	X	X
12	OSB				
13	Paper (burned)				
14	OSB (burned)				
15	Vinyl siding				
16	Paper (burned)	(5µl Charcoal Lighter Fluid)	X	X	X
17	Sheetrock (burned)				
18	Cardboard				
19	Spruce lumber				
20	Shingles (burned)	(5µl Ronsonol Lighter Fluid)	X	X	
21	Spruce lumber (burned)	(10µl off road diesel fuel)	X	X	X
22	Cardboard				
23	Vinyl siding				
24	Sheetrock (burned)	(5µl E-Z Paint Thinner)	X	X	X

"X" denotes an alert by the testing canine

Appendix G

Test #2 (Can Line 1)

CAN #	DISTRACTOR
1.	1. Peanut Foam
2.	2. Foam Rubber (5µl LPD)
3.	3. Cardboard
4.	4. Spruce
5.	5. OSB (5µl HPD)
6.	6. Carpet
7.	7. Carpet Backing
8.	8. Parquet Flooring
9.	9. Shingles
10.	10. #15 Felt
11.	11. Clothing (5µl LPD)
12.	12. Foam Rubber

Appendix H

Test #2 (Can Line 2)

CAN #DISTRACTOR

CAN #		DISTRACTOR
13.	○	13. Foam Rubber
14.	○	14. Cardboard
15.	○	15. OSB
16.	○	16. Carpet
17.	○	17. Clothing (5µl LPD)
18.	○	18. Foam Rubber
19.	○	19. #15 Felt
20.	○	20. Spruce (5µl 50% gasoline)
21.	○	21. Peanut Foam
22.	○	22. Carpet Backing
23.	○	23. Shingles
24.	○	24. Parquet Flooring

Appendix I

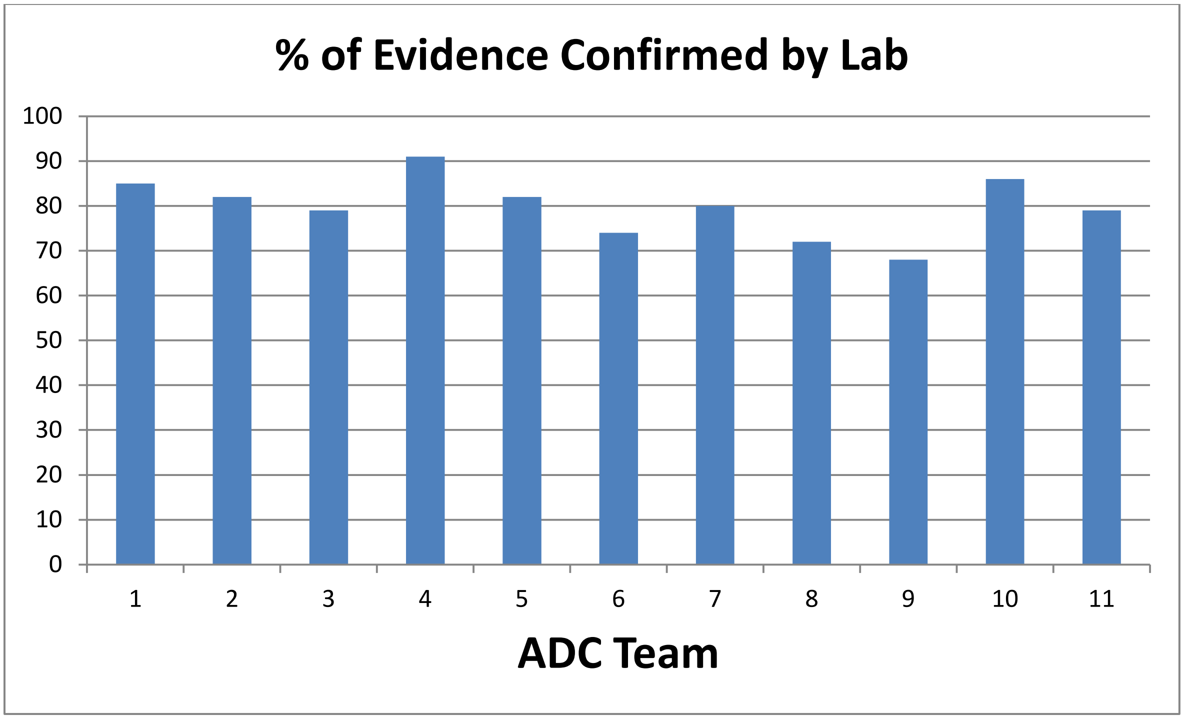
Test #2 Results

Test #2 Scent Discrimination Results					
			ADC Team		
Can #	**Distractor**	**Ignitable Liquid**	**Canine #1**	**Canine #2**	**Canine #3**
1	Peanut foam				
2	Foam rubber	(5µl LPD)	X	X	X
3	Cardboard				
4	Spruce lumber				
5	OSB	(5µl HPD)	X	X	X
6	Carpet				
7	Carpet padding				X
8	Parquet flooring				
9	Shingles				
10	# 15 felt				
11	Clothing	(5µl LPD)	X	X	X
12	Foam rubber				
13	Foam rubber				
14	Cardboard				
15	OSB				
16	Carpet				
17	Clothing	(5µl LPD)	X	X	X
18	Foam rubber				
19	# 15 felt				
20	Spruce lumber	(5µl 50% gasoline)	X	X	X
21	Peanut foam				
22	Carpet padding				X
23	Shingles				
24	Parquet flooring				

"X" denotes an alert by the testing canine

Appendix J

Survey Results



ADC Team	Train	Reward	Recert	Imprint
1	6 wks	Food	1	6 wks
2	6 wks	Food	1	6 wks
3	6 wks	Food	1	6 wks
4	4 wks	Food	1	6 wks
5	3 wks	Combo	2	4 wks
6	4 wks	Food	1	6 wks
7	6 wks	Food	1	6 wks
8	6 wks	Food	1	6 wks
9	6 wks	Food	1	6 wks
10	4 wks	Food	1	6 wks
11	4 wks	Food	1	6 wks

Appendix K

Sample Suggested Training Records 1

ATF

Accelerant Detection Canine Training Record

Month February 2011

Handler | Canine | Canine DOB

Type of Training	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Month Total REPS
Bricks																																0
Calibration																																0
Cans																																0
Carpet																																0
Clothing																																0
Cracks-Floor																																0
Fire Scene																																0
Neg. Search																																0
Open Areas																																0
People																																0
Pin Point																																0
Stairs																																0
Vehicle																																0
Wall																																0
Wheel																																0
																																0
																																0
DAY Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food Amount Record																																
Cups Fed																																0.00

Canine Weight Record

Range		Week # 1		Week # 2		Week # 3		Week # 4		Week # 5	
Range	63. to 65. lbs.	Week # 1	lbs.	Week # 2	lbs.	Week # 3	lbs.	Week # 4	lbs.	Week # 5	lbs.

ATF Accelerant Record Blank.doc

ATF Accelerant Detection Canine - Monthly Training Record
Revised - Dec 2005

Page 1 of 2

Appendix L

Sample Suggested Training Records 2

Training Aids and Distractors Used Record					
Handler			Canine		Month February 2011
Day	Training Aids Used		Distractors Used During Month		Comments / Remarks
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					

ATF Accelerant Record Blank.doc

ATF Accelerant Detection Canine - Monthly Training Record
Revised - Dec 2005

Page 2 of 2