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An Evaluation of 42 Accelerant Detection Canine Teams

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ABSTRACT: It is estimated that over 200 accelerant detection canines (ADCs) are currently assisting in fire investigations throughout the United States. On many occasions, their ability and reliability have been called into question. The Pinellas County Forensic Laboratory evaluated 42 accelerant detection canine teams in their ability to discriminate between common accelerants and pyrolysis products, to detect common accelerants at low concentrations, to precisely locate accelerants and, to detect different classes of accelerants. Ultimately, the accuracy, dependability and overall effectiveness varied from canine to canine and handler to handler and appeared to be somewhat limited by the canine's training, handling and maintenance. While most of the canine teams performed extremely well and could be an asset to fire investigation, some proved to be unreliable. A universal endorsement or condemnation of all accelerant detection canines could not be made; however, endorsements of specific canine teams and trainers were possible. Every working canine team should be evaluated independently. Routine testing is imperative to establish the canine abilities and limitations.

KEYWORDS: criminalistics, canines, fire investigation, accelerant detection, arson

Forensic laboratories are limited in the detection and identification of accelerants in fire debris by the contents of the samples submitted from the field. Investigators are limited in sample collection by the nature of the fire and destruction level of the scene. It can be difficult to locate areas where flammable or combustible liquids have survived the heat and suppression associated with an accelerated fire. While taking numerous samples would increase the odds of receiving positive laboratory results in the event of an accelerated fire, it also greatly increases the time and cost of analysis. Electronic "sniffers" were devised to assist the investigator in locating residual accelerants; however, these devices often cannot discriminate accelerants from common pyrolysis products.

Canines have the ability to detect and discriminate scents at low levels. This is evident by the popularity and effectiveness of drug, explosives and tracking canines. Accelerant detection canines were introduced to locate residual accelerants with more accuracy, precision and sensitivity than the electronic detectors.

Accelerant detection canines (ADCs) are becoming commonplace in fire investigations. Their popularity has led to criticism and debate regarding their use, accuracy and reliability. This study was devised to evaluate as many ADC teams as possible. The subjects tested represented 39 canines, 39 handlers, and 10 trainers from across the United States.

Each test served to evaluate a different aspect of accelerant detection: scent discrimination, accelerant location, detection of various types of accelerants, and detection limits. The Scent Discrimination Tests (Test 1 and Test 2) were devised to determine the canine's ability to discriminate between accelerants and common pyrolysis products. The Accelerant Location Test (Test 3) was designed to demonstrate the canine's ability to indicate the precise location of the accelerant. The Classes of Accelerants Test (Test 4) determined the canine's ability to detect various classes of accelerants (i.e., light petroleum products, medium petroleum products, heavy petroleum products, isopars and gasoline). The final test, The Detection Limits Test (Test 5), was created to determine if the lowest identification limits of the laboratory for a common accelerant (gasoline) was within the detection range of the canine.

The tests were performed in conjunction with various national and local canine association meetings. Participation in the testing was voluntary. Although some of the trainers present utilized the testing for recertification of their canines, it was the intent of this study to simply gather data, not determine what constituted pass or fail.

The role of a canine in fire investigation is to locate residual accelerants. The search techniques are defined by the canine's training and behavior. Canines indicate the presence and location of accelerants by sitting, pointing, digging and/or chewing. Some are quite aggressive in their response, others are very subtle. Some of the canines are rewarded for finding an accelerant with food, others with play. Because the canines behavior varied, the handlers were instructed to locate the accelerants in the various tests by whatever search and reward techniques they commonly used. As a result, accelerant location was determined by the handler, based on their interpretation of the canines behavior. The analysts were instructed to prepare the samples and record the handlers response.

Canine and handlers were evaluated as teams. Some canines had more than one handler and some handlers had more than one canine. As a result, of the 39 canines and 39 handlers, 42 teams were assessed. Time constraints and conference scheduling did not allow for all the teams to perform all the tests. Canine teams in attendance at more than one meeting were tested at each and their results combined.

Procedure

Test 1—Basic Scent Discrimination

Individual samples consisting of five quart cans were prepared for each canine team. Can 1 contained a 2″ × 2″ piece of yellow pine which was ignited with a propane torch and allowed to free burn for 2–3 minutes before extinguishment by smothering. Can 2 contained a 2″ × 2″ piece of high density polyethylene (HDPE),

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ignited with a propane torch and allowed to free burn for approximately 15–30 seconds. Can 3 contained approximately 10 styrofoam peanuts which were heated until it had diminished to roughly half the original amount. Can 4 contained 2″ × 2″ pieces of carpet (50% nylon:50% polyester) and chipped foam carpet pad which were ignited with a propane torch and allowed to free burn for 2–3 minutes before extinguishment by smothering. Can 5 contained a Kimwipe tissue with 3 μL of 50% gasoline (evaporated by volume) added with a 10 μL syringe.

The cans were placed in a line approximately 10″ apart. The handlers were instructed to use their canine to determine which sample contained an accelerant. Since the training and behavior of each canine team is unique, the search techniques varied and were defined by the individual handlers.

Test 2—Mixed Matrix-Scent Discrimination

A mixed matrix of burned pine, plastic (high density polyethylene), carpet (50% nylon:50% polyester), chipped foam carpet pad, and styrofoam were prepared by placing 100 2″ × 2″ pieces of each item into a clean unused 50 gallon steel drum. The mixture was ignited with propane torches and allowed to free burn for approximately 10 minutes before extinguishment by smothering. The mixture was aggressively stirred both during and after the heating process. The burned debris was randomly divided into quart paint cans.

Five cans were prepared for each team. Two microliters of 50% evaporated gasoline were added to 1–3 of the samples using a 10 μL syringe. The cans were placed in a line approximately 10″ apart. The handlers were unaware of the number or location of the spiked samples. They were instructed to locate any accelerants as in Test 1.

Test 3—Location Accuracy

A piece of 1″ × 4″ × 24″ board was marked into 6 numbered 4″ × 4″ sections with a graphite pencil. Three microliters (3 μL) of 50% evaporated gasoline were placed in the center of one square with a 10 μL syringe. The spot was allowed to dry sufficiently so there was no visible evidence of an accelerant. The ADC team was instructed to determine which square contained the accelerant.

Test 4—Classes of Accelerants

Ten quart cans were prepared for each canine team. Each can contained a clean cotton ball. Immediately preceding the test four of the cans were spiked with 5 μL of various accelerants: Ronsonol Lighter Fluid (light petroleum product), Royal Oak Charcoal Lighter (medium petroleum product), diesel fuel (heavy petroleum product) and Gulf Lite Charcoal Starter (isoparriffinic mixture). The six remaining cans were used as controls. The cans were randomly placed in two lines of five cans each. The handlers were unaware of the number and location of the accelerant-laced samples.

Test 5—Detectability Limits

Cotton balls were placed in 5 quart paint cans. One can was spiked with 0.05 μL of 50% evaporated gasoline utilizing a 0.5 μL positive displacement syringe (Scientific Glass Engineering). The cans were placed in a line approximately 10″ apart in random order. The handlers were unaware of the number and location of spiked samples. The procedure was repeated with 0.01 μL and 0.005 μL of 50% evaporated gasoline.

Results and Conclusion

The majority of the canine teams (60%) performed the scent discrimination tests without error (Table 1 and 2). Missed accelerants accounted for the most errors (28 of 40), representing 16 of the 39 canines tested. Several of the "misses" could be attributed to handler error. In several instances, canines indicated on positive samples and were ignored or removed by their handlers. This appeared to be a problem with the handler's training and confidence rather than a reflection of the canine's ability.

False positives were of the largest concern, but were not common, 20% of all canines tested had false indications, of these the frequency of false positives ranged from 5% to 25%. Handlers were encouraged to consult with trainers to evaluate and correct problems. As opposed to a proficient canine, one which routinely indicates on common pyrolysis products would minimize the likelihood of postive laboratory results.

The value of the accelerant detection canine to the fire investigator lies strictly in sample collection. Under normal circumstances,

TABLE 1—*Test 1: basic scent discrimination.*

Canine Team	Wood	Plastic	Styro-foam	Carpet/ Pad	Gasoline	% Accuracy
1	–	–	–	–	+	100.0
2	–	–	–	–	+	100.0
3	+	–	–	–	+	80.0
4	–	–	–	–	–	80.0
5	–	–	–	–	+	100.0
6	–	–	–	–	+	100.0
7	–	–	–	–	+	100.0
8	–	–	–	–	+	100.0
9	–	–	–	+	+	80.0
10	–	–	–	–	+	100.0
11	–	–	–	–	+	100.0
12	–	–	–	–	+	100.0
13	–	–	–	–	+	100.0
14	–	–	+	–	+	80.0
15	–	–	–	–	+	100.0
16	–	–	–	–	+	100.0
17	–	–	–	–	+	100.0
18	+	–	–	–	–	60.0
19	–	–	–	–	+	100.0
20	–	–	–	–	+	100.0
21	–	–	–	–	+	100.0
22	–	–	–	–	+	100.0
23	–	–	–	–	+	100.0
24	–	–	–	–	+	100.0
25	–	–	–	–	+	100.0
26	–	–	–	–	+	100.0
27	–	–	–	+	+	80.0
28	–	–	–	–	+	100.0
29	–	–	–	–	+	100.0
30	–	–	–	–	+	100.0
31	–	–	–	–	+	100.0
32	–	–	–	–	+	100.0
33	–	–	–	–	+	100.0
34	–	–	–	–	+	100.0
35	–	–	–	–	+	100.0
36	–	–	–	–	+	100.0
37	–	–	–	–	+	100.0
38	–	–	–	–	+	100.0
39	–	–	–	–	+	100.0
40	–	–	–	–	+	100.0
41	–	–	–	–	+	100.0
42	–	–	–	–	+	100.0
Totals	2	0	1	2	40	
Percent	4.8	0.0	2.4	4.8	95.2	96.7

TABLE 2—*Test 2: mixed matrix—scent discrimination.*

Canine Team	Total Cans	Positive Samples	Indications	False Positives	Misses	% Accuracy
1	15	6	6	0	0	100.0
2	5	1	1	0	0	100.0
3	5	1	2	1	0	80.0
4	5	1	2	1	0	80.0
5	15	7	5	0	2	86.7
6	15	6	5	0	1	93.3
7	5	2	2	0	0	100.0
8	5	2	1	0	1	80.0
9	5	1	1	0	0	100.0
10	10	4	2	1	2	70.0
11	10	4	1	1	3	60.0
12	10	4	2	0	2	80.0
13	10	4	2	0	2	80.0
14	10	4	2	0	2	80.0
15	10	4	0	2	4	40.0
16	15	6	6	0	0	100.0
17	5	1	1	0	0	100.0
18	5	1	0	2	1	40.0
19	5	1	1	0	0	100.0
20	5	3	2	0	1	80.0
21	5	2	2	0	0	100.0
22	10	4	4	0	0	100.0
23	5	2	2	0	0	100.0
24	15	6	6	0	0	100.0
25	15	5	4	0	1	93.3
26	15	5	5	0	0	100.0
27	15	5	4	0	1	93.3
28	5	2	2	0	0	100.0
29	10	4	2	0	2	80.0
30	5	2	2	0	0	100.0
31	5	2	2	0	0	100.0
32	5	2	2	0	0	100.0
33	5	1	1	0	0	100.0
34	5	1	1	1	0	80.0
35	15	6	6	0	0	100.0
36	5	3	3	0	0	100.0
37	15	6	6	0	0	100.0
38	15	5	5	0	0	100.0
39	5	4	1	0	3	40.0
40	—	—	—	—	—	
41	—	—	—	—	—	
42	—	—	—	—	—	
Totals	345	130	104	9	28	89.3

TABLE 3—*Test 3: location accuracy.*

Canine Team	Correct	Off one square	Off two squares	>Two squares
1	X			
2	X			
3	X			
4				X
5		X		
6	X			
7	X			
8	X			
9	X			
10	X			
11	X			
12				X
13	X			
14	X			
15				X
16	X			
17		X		
18		X		
19		X		
20	X			
21		X		
22	X			
23	X			
24	X			
25		X		
26		X		
27	X			
28	X			
29			X	
30	X			
31	X			
32				X
33	X			
34	X			
35		X		
36	X			
37		X		
38	X			
39		X		
40	—	—		—
41	—	—		—
42	—	—		—
Totals	24	10	1	4
Percent	61.5	25.6	2.6	10.3

an investigator can determine if and where an accelerant was used in a fire. It is much more difficult to determine where residual accelerant has survived a fire. Most of the canine teams (60%) were able to indicate precisely the location of a 3 μL drop of gasoline (Table 3), which demonstrated the need for the handler/investigator to take precise samples. Samples taken 3″ from a canine's indication may not contain residual accelerants, thus the laboratory findings may not reveal flammable or combustible liquids which would corroborate the canine's findings. This test also stresses the importance of the canine team re-checking samples after they have been collected (in sample containers) to determine if the collected sample does, in fact, contain the residual accelerant.

Fourteen of the seventeen canines which participated in Test 4 (Classes of Accelerants) were trained primarily on 50% evaporated gasoline. The other three were trained on a variety of common accelerants (Table 4). Seventy six percent (76%) accurately indicated on the light petroleum product (Ronsonol lighter fluid). This represented 11 of the 14 trained on gasoline and 2 of the 3 trained on various accelerants. Eighty eight percent (88%) correctly indicated on the medium petroleum product (Royal Oak charcoal lighter fluid). The two teams which failed to indicate were trained on 50% evaporated gasoline. Ninety four percent (94%) indicated on the heavy petroleum product (diesel fuel). The team that did not was trained on 50% evaporated gasoline. Eighty eight percent (88%) of the canines indicated on a flammable isopariffinc mixture (Gulf-Lite charcoal lighter fluid). The two misses represented canines trained on 50% evaporated gasoline. Overall, the misses represented five of the seventeen canines. The majority of the canines trained on 50% evaporated gasoline (10 of 14 or 71%) could locate accelerants from all the classes. Two of the three (66%) canines trained on a variety of accelerants could locate all the accelerants; however, since this group was poorly represented, these figures could not be used to determine which training technique is more effective.

The analysis techniques utilized by this laboratory have a lower threshold identification limit of 0.1 microliter of gasoline in a quart paint can. Of the five canines involved in the detection limits test, all five could locate gasoline at that level (Table 5). Four of

TABLE 4—*Test 4: classes of accelerants.*

Team No.	Trained On	Light	Medium	Heavy	Isopar	Gasoline
1	Gasoline	X	X	X	X	X
6	Gasoline	X	X	X	X	X
7	Gasoline		X		X	X
11	Various Accelerants	X	X	X	X	X
12	Various Accelerants		X	X		X
13	Gasoline			X	X	X
14	Gasoline	X	X	X	X	X
15	Gasoline	X	X	X	X	X
16	Gasoline	X	X	X	X	X
17	Gasoline	X	X	X	X	X
23	Gasoline	X	X	X		X
24	Gasoline	X	X	X	X	X
28	Gasoline	X	X	X	X	X
30	Gasoline			X	X	X
35	Gasoline	X	X	X	X	X
38	Gasoline	X	X	X	X	X
39	Various Accelerants	X	X	X	X	X
Totals:	17 teams	13	15	16	15	17
Percent:		76.5	88.2	94.1	88.2	100.0

TABLE 5—*Test 5: detectability limits.*

Canine Team	Lowest Detected
1	0.005
16	0.005
25	0.005
26	0.01
38	0.005

the five could detect the gasoline at a level 0.005 microliters (the minimum volume limit of the dispensing syringe).

The canine and the laboratory are tools of the investigator to aid in locating and identifying flammable or combustible liquids in a suspicious fire. The determination of the cause of a fire is the role of the investigator and is based primarily on the visual evidence left by the fire. The identification of an accelerant is secondary to the scene investigation and does not, in itself, determine "arson." Arson does not require flammable or combustible liquids; common combustibles are often used to start or accelerate fires. The presence of flammable or combustible liquids does not, in itself, preclude arson, as there are numerous flammable and combustible liquids incidental to most aspects of life. The roles of the investigators, laboratory, and canines should be understood and well defined. Misuse of the canines to determine "arson" is not uncommon and should be discouraged.

The canine can, and should, be a valuable tool for the investigator in locating residual accelerants. A properly trained and maintained canine would be more sensitive and accurate than electronic devices currently used for the same purpose. By taking specific samples, the investigator can submit fewer samples for laboratory analysis thus reducing the time and cost of analysis. Special care should be given to continual evaluation and testing of the canines to ascertain that their level of competence is maintained.

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