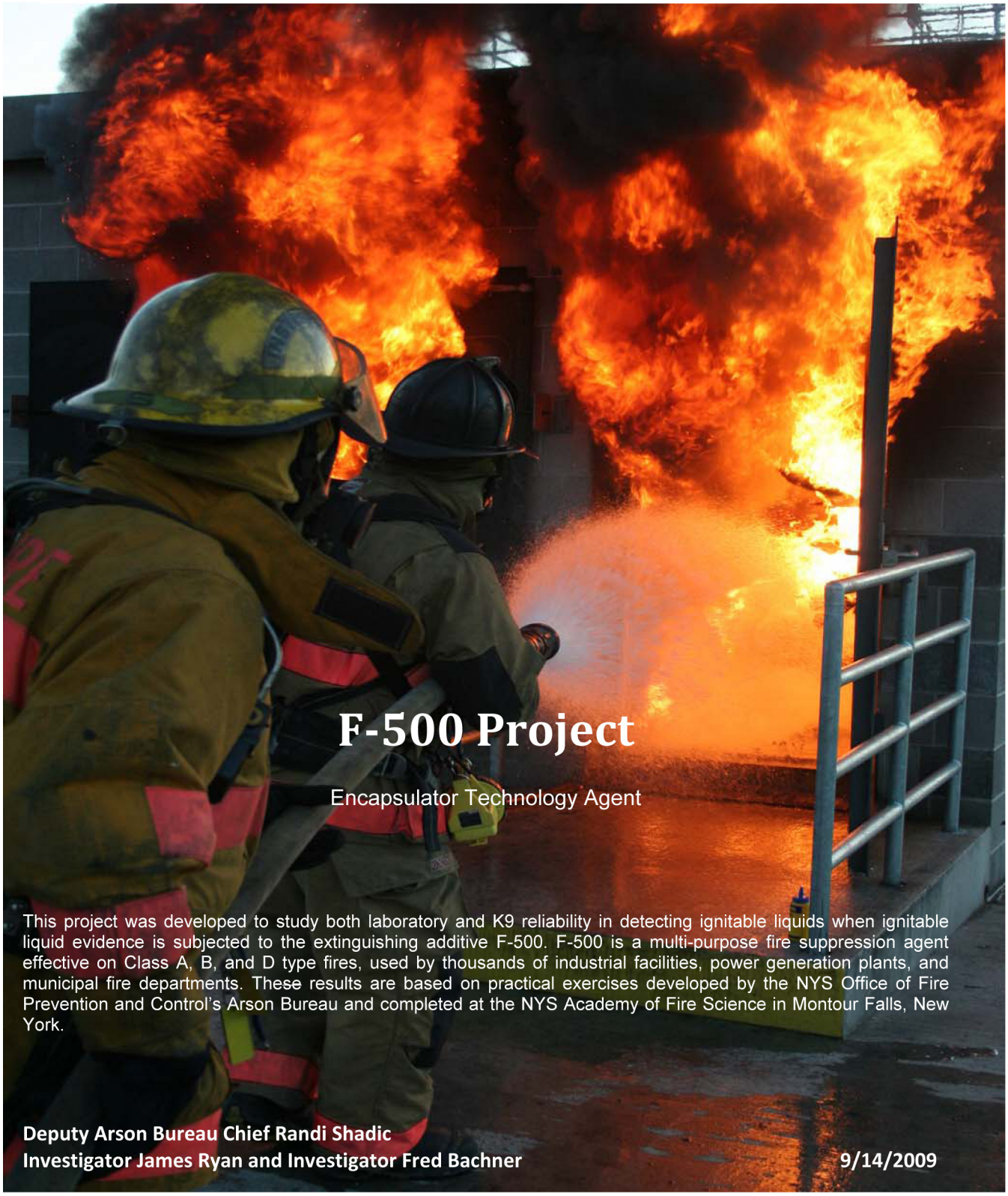
OFFICE OF
FIRE PREVENTION & CONTROL



F-500 Project

Encapsulator Technology Agent

This project was developed to study both laboratory and K9 reliability in detecting ignitable liquids when ignitable liquid evidence is subjected to the extinguishing additive F-500. F-500 is a multi-purpose fire suppression agent effective on Class A, B, and D type fires, used by thousands of industrial facilities, power generation plants, and municipal fire departments. These results are based on practical exercises developed by the NYS Office of Fire Prevention and Control's Arson Bureau and completed at the NYS Academy of Fire Science in Montour Falls, New York.

Deputy Arson Bureau Chief Randi Shadic
Investigator James Ryan and Investigator Fred Bachner

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Introduction

This project was undertaken to address concerns encountered in the field by fire investigators and Accelerant Detection Canine Teams in relation to the potential of ignitable liquid "masking" properties of certain fire suppression additives. As modern fire suppression tactics evolve, certain chemical additives are commonly being introduced into the extinguishment phase of fire department operations. The introduction of these chemical additives present a concern to the fire investigation community relative to their potential affect on the forensic investigation of a fires cause, where factors relative to the fires ignition and spread may rely on the identification or confirmation of ignitable liquid residues as often relied upon to identify the use of an accelerant in an intentionally set fire.

K9 Shadow making a positive indication for ignitable liquid in Arson Bureau test facility.

Today's fire and arson investigators have many resources available to them to better pinpoint the origin and cause of a fire. One of those resources includes the use of a certified accelerant detection K9 team. This team is a valuable tool in identifying the presence of ignitable liquids through the use of their keen olfactory senses. For detection to be possible the K9 Team, much like the forencic laboratory Analyst, rely on the presence of ignitable liquid vapor residue in or on substrate materials left after a fire occurs. The concern over the use of a suppression additive focuses on its potential to mask or chemically alter the ignitable liquid to a state which would inhibit the canine or crime laboratory from identifying the presence of the original ignitable liquid in the fire debris.

An example of such an additive is F-500. Hazard Control Technologies Incorporated is the developer and manufacture of F-500 which is currently marketed as a "microcell encapsulator of ignitable liquid vapors". This encapsulation is described to result in an alteration of the original ignitable liquid by capturing vapors preventing them from mixing with oxygen thus stopping the combustion process and in doing so encapsulates the original ignitable liquid, changing its ignitable properties. *1.*

As a means to explore the potential impact on the ability to identify ignitable liquids in fire debris where extinguishment utilized a chemical suppression additive such as F-500, a series of practical exercises were conducted at the New York State Academy of Fire Science in Montour Falls. In addition to the Office of Fire Prevention and Controls Arson Bureau, the NYS Crime Laboratory Arson Technical Work Group would participate in what would include analyzing a series of samples as well as take part in evidence collection of a mock burned fire scene.

Erie County Forensic Lab staff document evidence before collecting.

The objective of these exercises was to establish the ability of the Accelerant Detection Canine and Forensic Crime Laboratory in identifying ignitable liquid residue when the fire debris had been subjected to F-500 during the fires extinguishment phase. As a means to conduct the practical exercises, parameters were developed into three phases.

Phase I ~ General Ignitable Liquid Test

This phase of the practical exercise consisted of conducting two evolutions. Evolution A would provide a general screening of three common categories of ignitable liquids in relationship to their ability to be detected by the Forensic Crime Laboratory when sample evidence had been subjected to extinguishment with the F-500 product in varying concentrations. Evolution B would utilize the sample test samples as in Evolution A to examine the ability for detection by the Accelerant Detection Canine. To represent the light category, 10mL of Camp fuel was used, the medium category, 10mL of paint thinner and representing the heavy category, 10 mL of diesel fuel was utilized.

Evolution "A" consisted of twenty-six blocks of unsealed hardwood approximately 2.5" X 2.5" in size used as the substrate material onto which the ignitable liquid would be placed, ignited and then extinguished with a varied concentration of an F-500 in water solution. The 26 test blocks would then be divided into two identical groups of 13 test blocks for analysis by two different forensic crime laboratories.

The Agilent Technologies 6890N Network GC System is use by lab technicians to test samples from the study and provide the supporting data for this report.

The process involved ignitable liquid being applied independently to one test block at a time allowing the liquid to stand for 60 seconds prior to ignition with a propane torch and allowed to free burn for 30 seconds. Following the period of open flame combustion, the blocks were then extinguished with a .5%, 1%, and 3% solution of F-500 respectively as well as a set of blocks extinguished with plain water. Two blank blocks were additionally provided as a control and were burned with a propane torch until charred without the application of an ignitable liquid and were extinguished with plain water to complete the series of 26 blocks. Each laboratory in addition was provided one unburned wooden block as a representative blank.

Evolution A also included providing the laboratories with liquid samples of the F-500 product in varying concentrations with water to establish a base line of the F-500 product, at .5% in water, at 1% in water, at 3% in water and 100% concentration.

The Forensic Crime Laboratories participating in the Practical Exercise included the Erie County Crime Lab and the Monroe County Crime Lab. Each lab completed their sample analysis independently with the objective to test the ability of the laboratory and instrumentation to detect a light, medium and heavy petroleum distillate product when extinguished with .5%, 1% and 3% solution of F-500 as well as plain water. After the laboratories completed their analysis the samples were returned to the Arson Bureau at the State Fire Academy in Montour Falls, NY for the second Evolution "B" phase of the test.

Phase I / Evolution "A" Summary Chart: **General Ignitable Liquids**
Conducted: on 6/24/08 at NYSFA by Inv. Jim Ryan & Inv. Fred Bachner

Crime Lab Analysis – Erie County [13 samples]

% of F-500 in Water	Light	Medium	Heavy	Control Block
Water - 0%	+	+	+	-
.5%	+	+	+	
1%	* *N/A*	* *N/A*	* *N/A*	
3%	+	+	+	

+ Positive Finding for Ignitable Liquid
- Negative Finding for Ignitable liquid
* N/A test could not be completed due to lab instrument breakdown

Crime Lab Analysis – Monroe County [13 samples]

% of F-500 in Water	Light	Medium	Heavy	Control Block
Water – 0%	+	+	+	-
.5%	+	+	+	
1%	+	+	+	
3%	+	+	+	

+ Positive Finding for Ignitable Liquid
- Negative Finding for Ignitable liquid

Evolution "B" provided a sample group for further examination as part of an olfactory screening search by the certified Canine Accelerant Detection Team. New York State Office of Fire Prevention & Control Arson Bureau K9 Shadow would be utilized for the conduction of this screening, utilizing the 13 test blocks as analyzed by the Monroe County Crime Lab in Phase I, Evolution A.

The objective of Evolution B was to test the canine's ability to detect ignitable liquid residue on the test samples to provide comparative results of what had been confirmed as ignitable liquid through laboratory analysis. Each search was documented and charted for the purpose of the study as described in the following summary.

Phase I / Evolution B Summary Chart: **General Ignitable Liquids**
Conducted: 8/26/08 at NYSFA by Deputy Chief Randi Shadic, Inv. Jim Ryan, K9 Shadow and Inv. Dale Moone

Canine Accelerant Detection Olfactory Analysis
[Monroe County Laboratory Analysis Phase I Evolution A samples utilized]

% of F-500 in Water	*Light*	*Medium*	*Heavy*	*Blank*
Water - 0%	+	+	+	-
.5%	+	+	+	
1%	+	+	+	
3%	+	+	+	

+ Positive Finding for Ignitable Liquid Vapor Residue
- Negative Finding for Ignitable Liquid Vapor Residue

Phase II ~ Gasoline Test

This phase of the Practical Exercise involved specifically using gasoline as a representative common ignitable liquid often found at scenes of accelerated fires. The gasoline would be prepared by being placed on a hardwood substrate as well as a plain liquid sample, both sample testing schemes to be conducted in a burned and unburned state. The exercise would examine the laboratory's ability to identify the ignitable liquid as well as the canine's ability to alert on the ignitable liquid samples. The F-500 suppression additive would be applied in both ignited and un-ignited applications. Evolution A would include the liquid gasoline samples and Evolution B the use of gasoline on a hardwood substrate.

Evolution "A" consisted of 100 mL of gasoline being placed in two, one quart metal evidence cans. The ignitable liquid was ignited and allowed to burn to self sustaining combustion for a period of 30 seconds. The burning liquid vapors were then extinguished with a 1% and 3% mixture of F-500 in water respectively. After extinguishment was complete, a 5mL sample of the extinguished mixture was extracted from each can and sent for analysis by the two participating crime laboratories. Additionally, a 60 uL sample of the 1% and 3% extinguished liquid was extracted from the respective quart containers and placed in a line up article search for an olfactory search by K9 Shadow. A 100% F-500 sample was also included as a baseline/background sample for the conduction of an Accelerant Detection Canine olfactory search.

Phase II / Evolution A Summary Chart: **Liquid Gasoline**
Test conditions
Date Conducted: 8/19/08 Time Conducted: 11:30am
Accelerant detection canine evaluation conducted: 2:00pm
Amount of free burn before extinguishment: approx. 30 seconds
Amount of Liquid Gasoline used per sample burn: 100 uL
Ambient Conditions: Generally Overcast
Air temp: 65 F Wind direction: E/NE Velocity: 3-5mph RH: 69%

Extinguished with x % of F-500	**Erie Lab**	**Monroe Lab**	**K9 Shadow**	**Total Samples**
1% F-500	+	+	+	3
3% F-500	+	+	+	3
100% F-500 raw sample no fire			-**	1
Total Liquid Samples				7

**A raw 100% F-500 sample was also evaluated by the canine as a blank.
+ Positive Finding for Ignitable Liquid
- Negative Finding for Ignitable liquid

Evolution "B" consisted of 6 hardwood samples subjected to testing with gasoline and extinguished with an F-500 solution. The 6 test blocks would then be divided into two identical groups of 3 test blocks for analysis by two different forensic crime laboratories. The process would involve applying 5 mL of gasoline to the wooden blocks and allowing the liquid to stand for forty five seconds then ignited with a propane torch and allowed to free burn for thirty seconds prior to extinguishment. Two of the blocks were extinguished with a 1% solution of F-500, two extinguished with 3% solution of F-500, and the last two with plain water. The extinguished wooden block samples were then placed in individual one quart metal evidence cans for submission to the Erie County and Monroe County Crime Laboratories respectively. Prior to submission to the laboratory an accelerant detection canine search was conducted of the set of samples which would be sent to the Monroe County Lab.

Phase II / Evolution B Summary Chart: Gasoline/Wood

Date Conducted: 8/19/08 Time Conducted: 11:00am
Accelerant Detection Canine search conducted: 2:30pm
Amount of free burn before extinguishment: approx. 30 seconds
Amount of Liquid Gasoline used per sample burn: 5 mL
Ambient Conditions: Generally Overcast
Air temp: 65 F Wind direction: E/NE Velocity: 3-5mph RH: 69%

Extinguished with x % of F-500	Erie Lab	Monroe Lab *	K9 Shadow *
100 % water	+	+	+
1% F-500	+	+	+
3% F-500	+	+	+
Wood blank	*None submitted*	-	-

* Common samples used for Monroe County Laboratory Analysis and K9 Screening
\+ Positive Finding for Ignitable Liquid
\- Negative Finding for Ignitable liquid

Phase III ~ Room & Contents Burn Test [*as seen in cover photo*]

This phase of testing would utilize what would be anticipated to be a typical fire department application of F-500/water solution to suppress a fully involved room and contents fire. The fire would include the application of gasoline applied to room furnishings as an accelerant fuel to promote the spreading of the fire. The live fire evolution would utilize a room with approximate dimensions of 12' x 12' with walls and ceiling of painted sheetrock and furnished with typical contents of living room furniture to include a couch with cushions, chair, small desk and a carpet floor. The room would be ignited and allowed to free burn through flashover and include a period of post flashover burning prior to extinguishment with the F-500/water solution. Six Fire debris evidence samples would then be collected as part of a practical training exercise of the Arson Technical Working Group in a typical manner following accepted procedures for fire debris evidence collection. Two of the six samples would be collected as comparison samples as they would relate to typical room furnishing where a comparative sample of a non accelerated area would be anticipated. Prior to the application of the gasoline and the ignition of the room and contents fire, a certified accelerant detection canine team would conduct a search of the room to eliminate the probability of any trace residues of ignitable liquid. The K9 Team would also conduct an accelerant detection search following the extinguishment of the fire as a means to locate the best sites for evidence collection. Fire debris evidence samples would then be collected and sent to the Erie and Monroe County Labs for analysis.

Room & Contents Live Burn Practical Exercise

Date Conducted: October 9, 2008
Location Conducted: New York State Academy of Fire Science Arson Burn Building Room #2
Fire Extinguishment Method: By NYS OFPC Fire Protection Specialists utilizing typical fire apparatus to encompass a single 1/3/4" attack hose line flowing an inducted 1% solution of F-500
Burn Time: Ignition provided via an open flame propane torch directly to the gasoline allowing room to reach flashover followed by a period of 1 minute of post flashover burn prior to extinguishment.
Ignitable Liquid Utilized: 16 ounces of fresh gasoline
Fire Debris Evidence Sample Medium**:** would include carpeted areas, furniture, and gypsum wall board.
Fire Debris Evidence Collection: ATWG Practical Training Exercise Group #2
Accelerant Detection Canine Team: Canine Shadow & Handler/Investigator, James Ryan

ATWG Group 2 Room & Contents Burn F-500 Phase III Practical Exercise	K9 Findings for Ignitable Liquid Vapor Residue	Laboratory Findings for Gasoline		Forensic Laboratory
		Positive	Negative	
Sample 1	Positive	X		Monroe County
Sample 2 / Comparison of 1	Negative		X	Monroe County
Sample 3	Positive	X		Erie County
Sample 4 / Comparison of 3	Negative		X	Erie County
Sample 5	Positive	X		Erie County
Sample 6	Positive	X		Erie County
TOTAL Evidence Samples		**4**	**2**	

Project Summary & Conclusion

The conduction of this practical study was made possible through a joint effort between the New York State Office of Fire Prevention and Control's Arson Bureau and NYS Crime Laboratory Advisory Committee's Arson Technical Working Group. The project was conducted over a 10 month period and yielded results representative of the test objective identifying the laboratories and canines ability to detect ignitable liquids after being subjected to a fire extinguishing solution of F-500 product. The ATWG was instrumental in establishing the necessary testing parameters and providing technical laboratory support to the mission as conducted over the three Phases of this Practical Study.

The following serves to summarize conclusions as achieved through conducting this series of practical studies.

Phase I included conducting a study utilizing a representative liquid from three common ignitable liquid families being burned and extinguished with varying concentrations of the F-500 additive. All phases of testing resulted in positive findings for the subject trace ignitable liquid both by forensic crime laboratory analysis and certified Accelerant Detection Canine Team.

Phase II concentrated on the specific use of gasoline as representative of a common ignitable liquid used as an accelerant. This phase of testing included utilizing gasoline in a liquid and burned state extinguished with varying concentrations of the F-500 additive. All phases of testing resulted in positive findings for the subject trace ignitable liquid both by forensic crime laboratory analysis and certified Accelerant Detection Canine Team.

Phase III utilized gasoline being typically applied as an accelerant in a room and contents burn with the room encountering flashover and a one minute post flashover burn exposure. The room fire was then extinguished with a typical fire department application of a water F-500 solution followed by a certified Accelerant Detection Canine team conducting a search to identify sample sites for the collection of fire debris evidence. This testing concluded that under the typical conditions of a free burning room and contents fire, traces of gasoline remained detectable by the canine to allow for sample site selection with positive confirmation of gasoline from the analysis of these samples by the forensic crime laboratory.

In summary, each of the three phases of testing resulted in a conclusion that ignitable liquids could be detected with reasonable accuracy by both the forensic crime laboratory and the certified Accelerant Detection Canine after being subjected to extinguishment with an F-500 water solution.

1. *Hazard Control Technologies Inc, 150 Walter Way Fayetteville, GA 30214, USA*

A special thank you goes to the following that made this study possible:

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