Compressed Air Foam in Limited Staffing Fire Attack

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September 4, 2008

CERTIFICATION STATEMENT

I hereby certify that the following statements are true:

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

2. I have affirmed the use of proper spelling and grammar in this document by using the spell and grammar check functions of a word processing software program and correcting the errors as suggested by the program.

Signed: _____

Printed Name: Timothy J. Paulus

ABSTRACT

The Palmyra and Edinburg Township Fire Departments are small combination departments with limited resources of both personnel and financial support. Using descriptive research methods, the author has researched many benefits of using Compressed Air Foam (CAF). The biggest negatives of CAF are cost and training, as the most prominent. The information provided will also address firefighter safety, injury prevention, fatigue and how a CAF will reduce all of these concerns. Benefits of Compressed Air Foam besides normal structural firefighting including faster extinguishment, reduced property loss and uses on different combustible materials are included.

Fifty fire departments in the State of Ohio were surveyed, forty-one departments responded. Only fire departments within Ohio were surveyed as the author wanted to see what the results would be from within the state. Knowing that foam has been in use in the forestry service for years, the author was only interested by the fire service with the use in Ohio.

The results of the survey are in agreement with the research conducted; that CAF can be, if used properly, a very important resource to firefighters. The author concludes that if you function with limited staffing, CAF will improve the fire suppression ability of these firefighters. While not advocating replacing firefighters with CAF, the author believes that by utilizing foam while staffing is limited, the result will be an improved customer service and safer outcome.

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INTRODUCTION

Statement of the Problem

During this time of budgetary reductions and limited staffing, can Compressed Air Foam Systems (CAFS) aid the firefighters of Palmyra and Edinburg Township Fire Departments during fire attack with fire extinguishment while still protecting both the public and themselves?

The fire service not only in the United States but worldwide is rich with tradition. Some true traditional fire departments have only one thought process: "put the wet stuff on the red stuff." While that is true in the most basic of thoughts, is there new technology that will make firefighters more effective? Tradition is a big part of the American fire service but we cannot let it impede progress. This author has examined many sources and studies to develop a conclusion as to whether a CAFS would really make a difference in extinguishing today's fires with limited staffing.

The research method chosen for this study was descriptive. Budgetary constraints have limited staffing at an absolute minimum, which greatly limits their fire suppression ability. The research that was completed determined if CAFS could increase the fire suppression abilities of limited staffed fire companies. In addition, the study addressed the effect CAFS has on injury prevention and reduction of firefighter fatigue.

Purpose of the Study

The purpose of this study is to identify need, cost benefit and firefighter benefit of Compressed Air Foam Systems (CAFS). When completed, the reader will have sufficient information needed to make an educated decision as to if a CAFS would be an affordable alternative to increased staffing. This report will also assist administrators in deciding if CAFS would be beneficial to either the Palmyra or Edinburg Township Fire Departments.

Research Questions

The author has answered the following research question using the descriptive research method:

1. How can a Compressed Air Foam System help prevent firefighter injury and fatigue?
2. What technical and strategic advantages does Compressed Air Foam Systems have in different fire suppression situations on different combustible materials?
3. How can Compressed Air Foam Systems speed extinguishment and lessen property loss?
4. How could a Compressed Air Foam System benefit the Palmyra and Edinburg Township Fire Departments with limited staffing?

BACKGROUND AND SIGNIFICANCE

Palmyra and Edinburg are neighboring townships located in northeast Ohio between Akron and Youngstown. This combined area has 5,158 residents, per 2005 census update figures. Of the two townships, 50 square miles are primarily rural landscape with about 1,600 residences and very little business or industrial manufacturing. Palmyra and Edinburg Townships are two separate townships located next to each other, even though they share the fire chief, EMS co-coordinator and four other personnel. The departments in 2006 answered a combined 583 alarms. Like many other fire departments nationwide, the departments have faced a serious drop in volunteers desiring to participate and become involved. Twenty years ago, both departments had waiting lists and limitations on how far a member could live away from the fire station; today both are gone. Five years ago the Trustees of both townships realized that a serious problem existed with the lack of persons available during the daytime hours and both began staffing their stations with daytime personnel. Due to the departments, limited resources of both available personnel and funding, Palmyra and Edinburg Townships began staffing weekdays 6 am – 6 pm.

Despite each stations staffing, the underlying problem still has not gone away. The personnel on duty may be the only two firefighters in the township during daytime hours. Though both departments have transitioned from total volunteer to combination departments, the communities do not have the alarm volume or tax base to justify additional personnel. The Departments have established an excellent Mutual Aid Box Alarm System (MABAS) that helps in getting additional resources on scene quicker; but the first arriving engine still only has two personnel. Of the two on the first engine, the passenger packs up en-route and stretches the hand

line once on scene. As the passenger deploys a hand line, the driver will set the pump, charge the line, pack up, and do a quick 360 around the structure. The two then meet to make entry. Our second truck due from the opposite township will be there within another minute. One of those firefighters takes over the pump panel and the other firefighter relieves the officer in charge on the hand line. This does not meet NFPA 1710 or 1720. The firefighters have to be very careful and provide the best service the departments can with the resources they have. The auto aid fire department should be on scene within three more minutes, but on occasion, the community gets lucky and firefighters are in the township and able to respond with additional resources. But not something that can be consistently relied upon.

Starting in 2004, both departments began looking into forming a joint fire district with our neighboring townships. Four townships dropped out for various reasons; the biggest being not wanting to lose their identity. Palmyra and Edinburg Townships continued to work towards a joint fire district. The department's goal was to improve staffing to a total of five personnel during weekdays and two personnel on weekends between the two departments. The townships placed the issue on the ballot in November of 2007, and failed. The feedback the townships received after the levy failure expressed only a couple of concerns. These were the loss of the identity of each local fire department, the name that the district board had chosen for the department and the average $ 20.00 a month increase in property taxes.

If additional firefighters were not feasible or justifiable, would a Compressed Air Foam System increase the effectiveness of the fire departments while improving safety with the resources that are currently in place?

LITERATURE REVIEW

Compressed Air Foam System, also known as CAFS, contains three basic parts. Water, foam concentrate and compressed air. Water has been extinguishing fires for many years, while foam appeared in 1877 as a new way to extinguish fire. NFPA 11 describes foam as:

> "A stable aggregation of small bubbles of lower density than oil or water that exhibits a tenacity to cover horizontal surfaces." It flows freely over burning liquid surfaces and forms a tough air-excluding, continuous blanket that seals volatile combustible vapors for access to air. (National Fire Protection Agency [NFPA], 2005)

Foam changes the chemical makeup of water, reducing its surface tension. Even though water is a versatile resource, and is the traditional method for extinguishing fires, even it has its limitations. For example, when extinguishing a campfire, water forms beads rolling away and may or may not extinguish the fire. Another problem now is the addition of smoke and hot steam from the water evaporating. With the addition of a foam solution to that water, the solution covers the fire rather than running off. Therefore, with the use of a foam solution the burning material extinguishes quicker. When firefighters add compressed air to this foam solution, depending on the firefighters mixing ratios anything from soapy water to stiff shaving cream will result (Brooks, 2007). The three essential elements of combustion are heat, fuel and oxygen. Compressed Air Foam (CAF) removes all three of these elements. It removes the heat by quickly cooling since the foam bubbles have more surface area than water droplets and does not run off because of the reduced surface tension. By separating the fuel from oxygen by the use of a foam blanket, the combustion process ceases. The author will not discuss specific equipment or the flow rates needed to operate a CAFS.

Brooks (2005) discusses that 65% of structural collapse firefighter deaths, occur during fire attack due to structural collapse. As administrators, is department policy allowing firefighters to enter that many unsafe buildings or are firefighters making the buildings unsafe? If a structure is on fire it has already begun to weaken; because of the fire. By the time the first engine arrives on scene, a structure has had several minutes to burn. The author estimates that a firefighter in complete structural firefighting gear including an SCBA, weighs 220 pounds. With the use of water for extinguishment, weight is added to a structure via a hand line, approximately 2, 000 pounds are added each minute (Brooks, 2007). There may be four firefighters in a structure, that is nearly a half ton of weight to an already weakened structure in the first minute by simply sending four firefighters into a structure with two hand lines flowing 125 GPM each.

The U.S. Fire Administration (USFA) conducted a series of studies and test fires and found that a CAF hose line are significantly lighter and easier to handle than a conventional water line (USFA, 1996) This is due to the foam in the hose is mostly air. The study discovered that the CAF line is about half the weight of the conventional water line of the same size. This reduces weight and increases maneuverability, directly reducing firefighter injury and fatigue. This study also found that CAF is much more effective at extinguishing a structure fire than just water (USFA, 1996). A 1990 study by the National Interagency Fire Center (NIFC) in Boise, Idaho showed that 90% of water used on their test fires made no difference to extinguishment because it did not penetrate the fire (Brooks, 2005). By adding foam to water, a solution with a reduced surface tension will result. This allows firefighters to penetrate fires with a foam blanket that inhibits the continuation of combustion while using less water. The less water used the less weight and runoff. In addition to inhibiting combustion by separating the fuel from oxygen, the foam blanket produces a cooling effect. This cooling effect is a direct result of the reduced

surface tension of water and the air trapped in the bubble. The USFA study also shows conservation of water supply (USFA, 1996). The report realized that CAF is five to fifteen times more effective than water for extinguishment. A Compressed Air Foam System equipped engine carrying 1,000 gallons of water could extinguish the same fire load as an engine carrying 5,000 to 15,000 gallons of water.

A study conducted in Salem, Connecticut in August of 1992, to test the theory that Compressed Air Foam cools faster than plan water (Colletti, 1998). The test measured the amount of time it took to lower the temperature from 1,000 degrees to 212 degrees four feet from the floor at an application rate of 20 GPM. Plain water took 222.9 seconds while Compressed Air Foam took only 38.5 seconds (Table 11 A). This test shows that Compressed Air Foam is 480 % faster at cooling than plain water when applied at the same rate. This faster cooling rate would also have a direct effect on the firefighters fatigue and stress levels.

Table 11-A

Cooling times water vs. CAFS

	Water	CAFS
Seconds to Extinguishment	229.9	38.5

**Amount of time to lower temperature from 1,000 to 212 degrees at 20 GPM, four feet from floor level*

USFA conducted another study (in conjunction with the Boston, Massachusetts Fire Department) concluded four lessons learned: extinguishing abilities, exposure protection, water usage and field installation (USFA, 1993). The field tests did have limitations. The Compressed Air Foam provided effective extinguishing capabilities with less manual effort than water extinguishment required. It did also reduce the labor required for overhaul particularly in vehicle and trash fires. Experiments were not conclusive; the evaluation was limited by the extent and

duration of the program and by the limited number of times that CAF was tested in challenging fire situations. The second lesson learned was exposure protection. The USFA study concluded that CAF was a very valuable asset in a few very critical situations, with the adhesion to vertical surfaces proving very effective for exposure protection. The third lesson learned was reduced water usage. The 750 gallons of water carried would support over 10 minutes of usage. While this was not a major concern for the Boston Fire Department, which has a fire hydrant on every corner, USFA noted that Compressed Air Foam would be very beneficial in a rural setting with a limited water supply. The last lesson learned was that field installation by city maintenance crews may not be the best as the installations did suffer some shortcomings. Also retrofitting apparatus may compromise some compartment space (USFA, 1993).

In 1990, the National Interagency Fire Center did a study and found in the state of Oregon, 75 percent of every dollar paid in fire claims was the result of water damage (Brooks, 2007). If 75 % of insurance claims are for water damage and 90 % of the water that we use is not effective, could Compressed Air Foam be the answer? By using, less water there is less of a chance of structural collapses due to additional weight of water. Quicker fire knockdown and quicker cooling would greatly increase firefighter safety and reduce fatigue.

Eddie Lucio in 1999 authored House Bill 1610 for the State of Texas. The house representative found through recognizing the importance of CAF, the Insurance Service Organization in the State of Texas was required to give 1.5 points for a CAFS equipped engine (Lucio, 1999). An amendment to the law in 2004 requires at least one CAFS to respond in the first alarm assignment. This amendment also set requirements for the CAFS as far as pump, compressor concentrate pump and foam tank minimum capacities.

Many sources cite advantages of CAF, but the author has taken great caution in citing references and researching possible alternative motives and employers. Does the manufacture-sponsored research use third parties to assist and confirm results or does their employer conduct the research? Brooks (2007) reports that while using Compressed Air Foam, insurance companies show water damage is 80-90 % less than of what is normally expected. Colletti (2006) discussed using Compressed Air Foam in firebreaks in wild land firefighting and as exposure protection for structural firefighting. Structures coated with a thick layer of Compressed Air Foam become isolated from radiant heat. The foam itself reflects heat and the water in the foam keeps the surface wet. Depending on the intensity of the heat, the foam blanket may need recoated several times, but this proactive blanket can last for hours. The USFA discovered that Compressed Air Foams are environmentally friendly, have little effect on soils, and plant life (USFA, 1996).

Daniel Madzykowski and David Stroup conducted a series of burn tests for the U.S. Department of Commerce and the Federal Emergency Management Agency. The studies purpose was to determine if there was a more effective way to extinguish tire fires. In the United States, more than 240 million scrap tires sent to landfills each year; these only add to the over 4 billion scrap tires in inventory. The difficulty in extinguishing tire fires has been a challenge for fire departments over the years. In 1999, an arson fire consumed seven of 21 million tires stored at the Kirby Recyclers in Sycamore Ohio (Wyandot County). The Ohio and U.S. EPA took control of this site and in one year treated over 5 million gallons of water, and recovered over 76,000 gallons of oil. This cost taxpayers over $ 22.8 million to clean up (Madzykowski & Stroup, 1998). Would the use of CAF have been a better option?

The study conducted another series of burn tests to determine if CAF would be a better alternative than water or an aspirated foam solution. Tires are unique in shape and shed water due to their material; synthetic rubber material that has a low auto ignition temperature of about 400 degrees Fahrenheit. When the fire heats the steel belt in a tire to the auto ignition temperature of the rubber, the rubber will continue to burn until the steel belt is cools below the auto ignition temperature. The cooling process is difficult because the rubber insulates the steel belt. The tests showed that CAF reduced extinguishment time by 50 % while preventing auto ignition during the half hour test window. Both water and nozzle aspirated foam extinguished the fire but took longer and used more water. The use of more water results in more contaminated runoff. Both water and nozzle aspirated foam had reignition within the half hour test. The study concluded that CAF was the best extinguishment choice on high carbon materials such as tires (Madzykowski & Stroup, 1998).

Compressed Air Foam is not only s being studied in the United States, a series of tests conducted in British Columbia in cooperation with the Justice Institute of British Columbia (JIBC). The first series of tests involved vehicle fires. With a fully involved vehicle fire, complete knock down of a fire in the passenger compartment took less than 20 seconds. The study also tested CAF with the use of a metal probe (basically a straight pipe extension) that could be inserted into the engine or trunk compartment and extinguish the fire in those compartments without having to open the compartment. This removed the firefighter from the specific hazards in those areas such as gas shock bumpers, shocks, struts and drive shafts. Another increase in safety was the foam blanket left on the ground preventing the ignition of fuel or flammable liquids that may leak from the vehicle. These tests discovered that fire reignition

did not occur with the application of Compressed Air Foam, and that there was minimal contaminated water runoff (Leigh, 1998).

The next test was interior structure fires. The researchers experienced rapid knock down and cooling without inverting the thermal layers. Since the handline of foam is so much lighter than a waterline, it was very easy to handle which reduced firefighter fatigue and without inversion of the thermal layering, the heat was tolerable. The probe pipe was also used to reach into deep-seated fires and extinguish them without tearing the pile apart. The final tests conducted involved a flammable liquid burn pit. The researchers tested the use of Class A and B foams in a CAFS and found both to be very effective, with Class A being biodegradable. The test also put Class B CAF against nozzle aspirated Class B foam the researchers discovered stream reach in CAF to be 70-80 feet, almost double that of nozzle aspirated foam. When the burn pit fire was extinguished with nozzle aspirated foam it took nearly twice the water and foam concentrate. The only disadvantage of the CAF was the velocity of the foam stream. The foam stream needs to deflect off something to reduce its velocity or splashing of the burning liquid will result. The JIBC concluded that the use of Compressed Air Foam would be very beneficial for limited staffing situations and departments with limited water resources (Leigh, 1998).

The Los Angeles County Fire Department began using Class A foam in 1988. Fire Chief Magazine reported about a series of test burns conducted using water, Class A foam and Compressed Air Foam. Using the same type house design, they set identical fires in four rooms; using an exterior fire attack from the front lawn and extinguished the fires (Table 16 A).

Table 16-A

Cooling effects of water vs. foam

	Water	Class A Foam	CAF
Gallons	75	44	16
Seconds to Extinguishment	50	25	11

**Identical Fires/Identical Attacks*

Water took the longest at 50 seconds and used 75 gallon of water. Class A foam was second with a knock down time of 25 seconds and used 44 gallons of water, while CAF was the most effective with knock down at 11 seconds using only 16 gallons of water (Cavett, 2001). That is very impressive in itself, but the interesting thing was that they were able to begin their fire attack from over 35 feet away due to the velocity of CAF. They also discovered less water damage with CAF because the reduction of water used. Faster knockdown means less pollution. With the Compressed Air Foam stream having a 33 % greater reach than water or Class A foam firefighter safety is greatly increased (Cavett, 2001).

PROCEDURES

Research material gathered from written sources such as; books, magazines, trade journals and online articles.

The author conducted a mail survey (APPENDIX 1) that was sent to 50 Ohio fire departments, this survey was being mailed with return postage paid envelops. Therefore, funding limited the size of the sample. They were chosen randomly; 10 from each quarter of the state, five from central Ohio and five were random choices The authors goal was to divide the state in to five sections. This division was the four corners and the central Ohio area. What the author desired to see was if economics and population may help make the decision for Compress Air Foam System purchase (APPENDIX 2).

Limitations of the Study

The cost of postage limited the size of the sample obtained the author provide return postage also. This study was purposely limited to the State of Ohio. The author wanted to research what similar departments, which function under similar laws and with similar resources, did in regards to Compressed Air Foam Systems (CAFS). The Ohio Fire Marshals fire department address link was the source of the mailing address. In counties that had volunteer departments, the survey was sent to a fifty percent mix of departments. Some counties did not have the 50% volunteer mix. The southeast section was mostly volunteer while the central section was primarily career. The biggest fault of the survey was that it was anonymous. The survey forms should have been marked so the department's location could be tracked.

RESULTS

Of the 41 surveys returned six departments have at least one Compressed Air Foam System (CAFS) equipped engine; equaling 15% of the respondents. Nine departments responded that they felt that there was a lack of research completed or that they did not know enough about it to justify the cost, of these two stated that they would be looking into a CAFS before they purchase their next engine. The twenty-six remaining departments stated that cost is the biggest reason for not purchasing (Table 19-A).

Table 19-A

Surveyed vs. responses

	Surveyed	Responded	CAFS Engines
Departments	50	41	6

** Responses from mail survey*

Four of the six departments that currently utilize Compressed Air Foam (CAF) stated that had an average of 26% - 35% reduction in water usage. Property loss reductions averaged 16% to 25% with one department reporting 36%. Only one of the six departments routinely responds with two firefighters the other five respond with four firefighters. All departments stated they did not have a reduction in the number of firefighters on the fire ground. All six departments responded that they would purchase a CAFS again and wished that the purchase had been made sooner. They also stated that improved firefighter safety and faster knockdown are benefits to both the department and the firefighters. The average added cost to add a CAFS was $ 25,000 - $ 35,000. It appears by the survey results that cost was the biggest reason not to have a

Compressed Air Foam System. Of the departments that currently do not use CAFS 66% stated that cost is the biggest reason they do not use CAF (Table 20A).

Table 20-A

Reasons for not owning CAFS

	Cost	To technical	Don't think it works
Departments	66%	6%	6%

* *Responses from mail survey*

Several of the returned surveys had notes written on them one that the author found very interesting and truly shows that training on the equipment is a very important part of owning a CAFS.

> "A department next to us has a CAFS and most times it is used, it turns into a Mr. Bubble Wonderland. I have seen front yards full of foam as well as it blowing 30 feet in the air out of the top of their fire trucks."
>
> Five surveys were returned with a note stating that they were "unsure of the technology".

DISCUSSION

The results of the survey agreed with the U.S. Fire Administration (1996) study about the reduction of water used for extinguishment. With both Palmyra and Edinburg Townships being rural communities, firefighting water supply is a large concern. There is a county water shuttle available if needed for large fires, but anything that can reduce the number of water tenders responding would increase safety and keep resources available. With water tenders being the most dangerous apparatus that fire departments have in their fleet due to the inherent danger of rollover, any precautions to ensure the safety of firefighters are very important.

The reduction in water that Brooks, (2007) reported seems to support the survey results with improved firefighter safety; by using less water there is less chance of collapse. The report by Cavett, C (2001) confirmed the survey results in that firefighter safety improved through speeding fire extinguishment. In reducing the time required for extinguishment, injuries that occur during this phase would reduce proportionately. Both Brooks and Cavett agree that 65% of firefighter deaths are due to collapse. By reducing the additional water added and the time in the building, the increase in safety would follow.

RECOMMENDATIONS

After completing research on Compressed Air Foam Systems (CAFS), the author believes that a CAFS could be a very valuable resource. The biggest drawback would be cost. The Palmyra Township Fire Department had Odin Foam Division quote a price (APPENDIX 3) to retro fit Palmyra's engine with a 200 CFM Compressed Air Foam System this price was $ 54,353.15. The cost greater than expected, this was not done in a competitive bid. This seems like a lot of money but it would cost me in excess of $ 132,000 to add just one person to my duty shift 24 hours a day 365 days a year. That would be the same coverage as this engine sitting in my apparatus bay.

Both the research and the survey support that a CAFS can help prevent firefighter injury and fatigue that the system would be beneficial to supplement our limited staffing and that CAF does indeed speed extinguishment and reduce property loss. I believe that CAF would benefit the Palmyra and Edinburg Township Fire Departments with our limited staffed fire attack. There are additional benefits including a reduction in water needed for extinguishment.

In using all the resources available to the author, applied to the FEMA/DHS Fire Act grant program to purchase CAFS for both Palmyra and Edinburg Township Fire Departments. If this grant were to be awarded, only five percent or approximately $ 2,718, would be required for the matching share. In case this grant is not successful, an equipment line item will be paced in the 2009 budget for half of the cost and again in 2010 so that the purchase may be made.

CAF was invented over 70 years ago for the United States Navy. With over 70 years of trial and error the product has improved tremendously. Things appear to be looked at differently by the fire service. The office computer was not around 70 years ago but today every office has

one. The laptop computer was never thought of 70 years ago but today almost every apparatus has one, they are there to make our jobs easier. The author finds it concerning that the fire service will accept a computer but not a CAFS that will reduce property damage or reduce injury and possibility prevent death. The author realizes that Ohio lacks a lot of history with the use of CAFS, but the departments using CAF are having great success with it. The author feels that this relates directly to a statement made at the beginning of this research project "the fire service not only in the United States but worldwide is rich in tradition". The author feels that though tradition is good there are new and improved technology that can make a difference by decreasing property loss costs, while protecting firefighters from injury and possible death.

While the author understands that cost of a CAFS is of major concern to department administrators. Do these administrators truly have the best interest of their residents and firefighters in mind? Are these administrators the same ones that approve spending funds on bright shinny sparkly things when purchasing a fire apparatus, when those nice looking and neat to have items make no different as the performance and functionality of the apparatus? After completing this research project the author is even a bigger believer in the importance of CAF and the roll it should play in providing top quality customer service.

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APPENDIX 1 – SURVEY

PALMYRA TOWNSHIP FIRE DEPARTMENT

Timothy J. Paulus, Fire Chief
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Phone 330-654-4098 Fax 330-654-4973
firechief@palmyratownship.com
www.palmyratownship.com

October 18, 2007

Chief xxxxx,
Fire Department address
City, Ohio Zip

Dear Chief,

My name is Tim Paulus; I currently serve as Fire Chief for Edinburg and Palmyra Township Fire Departments in Portage County. I am currently a student in the Ohio Fire Executive Program, Class 7. As part of the coursework for this class, I am required to complete an applied research project. I have chosen the topic of *Compressed Air Foam in limited Staffing Fire Attack.*

I ask that you take a few minutes, complete the attached survey, and return it in the envelope provided.

I thank you in advance for your cooperation.

Timothy J. Paulus
Fire Chief
OFE Class7

Ohio Fire Executive Applied Research Project

Compressed Air Foam in Limited Staffing Fire Attack

1. Does your Fire Department currently use COMPRESSED AIR FOAM SYSTEM on its primary fire attack engine?
   - ☐ Yes, please go to question number 4.
   - ☐ No, please answer 2 and 3 then stop.

2. If you do not have a COMPRESSED AIR FOAM SYSTEM have you ever considered purchasing a COMPRESSED AIR FOAM SYSTEM?
   - ☐ Yes
   - ☐ No

3. The biggest reason you did not make the purchase is?
   - ☐ Cost
   - ☐ Too much technology
   - ☐ Do not think it works
   - ☐ Not enough structure fires
   - ☐ Other _____

4. The biggest benefit my department has realized is (in your opinion)?
   - ☐ Improved firefighter safety
   - ☐ Reduced water usage
   - ☐ Faster fire knockdown
   - ☐ Reduced property loss/damage
   - ☐ Other _____

5. The biggest benefit my department has realized is (in the firefighters opinion)?
   - ☐ Improved firefighter safety
   - ☐ Reduced water usage
   - ☐ Faster fire knockdown
   - ☐ Reduced property loss/damage
   - ☐ Other _____

6. Water usage has been reduced by?
   - ☐ 0 – 15%
   - ☐ 16% - 25%
   - ☐ 26% - 35%
   - ☐ > 36%

7. Property loss has been reduced by?
   - □ No notable change
   - □ 1% -15%
   - □ 16% - 25%
   - □ 26% - 35%
   - □ > 36%

8. On a normal structure fire the COMPRESSED AIR FOAM SYSTEM engine responds with how many firefighters?
   - □ 2 firefighters
   - □ 3 firefighters
   - □ 4 firefighters
   - □ > 5 firefighters

9. The COMPRESSED AIR FOAM SYSTEM on your engine added how much to its cost?
   - □ < $ 15,000
   - □ $ 15,001 - $ 25,000
   - □ $ 25,001 - $ 35,000
   - □ $ 35,001 - $ 45,000
   - □ > $ 45,001

10. Having used a COMPRESSED AIR FOAM SYSTEM would you purchase one again?
   - □ No
   - □ Yes
   - □ Undecided

11. Your thoughts about COMPRESSED AIR FOAM SYSTEM?
   - □ Best thing since the invention of nomex
   - □ Nice to have but not used that often
   - □ Maintenance cost to expensive
   - □ Wish you would have purchased one sooner
   - □ Other _____

If you wish to receive an electronic copy of the results please provide your email address.

_____@_____

Please return in postage paid envelope.

Thank you for your assistance.

APPENDIX 2 – MAILING LIST

Chief Ron Pristera
Ashtabula Fire Department
4326 Main Ave.
Ashtubula Ohio 44004

Chief Walter G. Zilke
Madison Fire District
P O Box 338
Madison Ohio 44057-0338

Chief Christopher M. Flynn
Rocky River Fire Department
21012 Hillard Blvd
Rocky River Ohio 44116-3312

Chief John Sabo
Plain Twp Fire & Rescue
2600 Easton St NE
North Canton Ohio 44721

Chief Stanley G Deimling
Union Twp Fire Department
860 Clough Pike
Cincinnati Ohio 45245-1005

Chief John Johnson
Clinton-Highland Joint Fire District
P O Box 25
New Vienna Ohio 45159-0025

Chief Jack Royer
Eaton Fire Division
328 N Maple St
Eaton Ohio 45320-0027

Chief Marvin Wheeler
Wauseon Fire Department
230 Clinton St
Wauseon Ohio 43567-1198

Chief Richard C. Monto
Maumee Fire Division
2200 Illinois Ave
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Chief James M Steele
Van Wert Fire Department
515 E Main St
Van Wert Ohio 45891

Chief George D. Brown
Howland Twp. Fire Department
169 Niles Cortland Rd NE
Warren Ohio 44484

Chief Larry Gasper
Hardon Vol Fire Department
110 S Hambden St
Chardon Ohio 44024-1219

Chief C C Bittner
Lakemore Fire Department
P O Box 455
Lakemore Ohio 44250-0455

Chief Richard R. Brown
Blue Ash Fire Department
10647 Kenwood Rd
Blue Ash Ohio 45242-5699

Chief Doug J. Kramer
Kings Island Fire Department
P O Box 901
Kings Island Ohio 45034-0901

Chief Mike Swackhammer
Winchester Community Fire District
P O Box 355
Winchester Ohio 45697-0355

Chief Randy McNeil
Lynchburg Area Joint Fire & Ambulance
P O Box 355
Lynchburg Ohio 45142-0355

Chief Mark Marentette
Defiance Fire Department
702 W Third St
Defiance Ohio 43512

Chief Dexter Benecke
Ridgeville Twp Vol Fire Department
P O Box 244
Ridgeville Corners Ohio 43555-0244

Chief Ray Gerschutz
Miller City Vol Fire Department
P O Box 37
Miller City Ohio 45864-0037

Chief Andrew R. Frost
Austintown Fire Department
384 Niles Canfield Rd
Austintown Ohio 44515

Chief David W Barnes
Aurora Fire Department
65 W Pioneer Trail
Aurora Ohio 44202

Chief Mark Crumley
Medina Twp. Fire Department
3803 Huffman Rd
Medina Ohio 44256

Chief Corby Hansel
Milford Twp Fire Department
5107 Huston Rd
Collinsville Ohio 45004

Chief Lisa Reeves
Mount Orab Fire Department
P O Box 454
Mount Orab Ohio 45154-0454

Chief Chad E. Follick
Vandalia Fire Department
257 N Dixie Dr
Vandalia Ohio 45377

Chief Dennis Fackler
Pioneer Fire Department
205 S State St
Pioneer Ohio 43554

Chief Kenneth Thomas
Oakwood Vol Fire Department
201 N Sixth St
Oakwood Ohio 45873-0457

Chief Jeff klein
Perrysburg Fire Division
140 W Indiana Ave
Perrysburg Ohio 43551-1587

Chief Rober Hill
Washington Twp Fire Department
P O Box 256
Arcadia Ohio 44804-0256

APPENDIX 3 – COMPRESSED AIR FOAM SYSTEM QUOTE

Odin Foam Division
PO Box 310
10763 Yaquina Bay Road
Toledo, OR 97391
USA

PHONE: 541-336-5067
FAX: 541-336-2545

QUOTE #: 000888

PAGE NO. : 1
CHANGE ORDER : 0
DATE ORDERED : 03/17/2008
RELATED DOC # :
SALESMAN :
CUSTOMER PH # : 330-654-4098
CUSTOMER PO # :
FOB : ORIGIN

Palmyra Township Fire Department
Chief Timothy Paulus
3956 State Route 225
Diamond, OH 44412
USA

SHIP TO ADDR

Palmyra Township Fire Department
Chief Timothy Paulus
3956 State Route 225
Diamond, OH 44412
USA

SHIP VIA: Ground TERMS: NET 30 ACCT: PAL001

ITEM	PARTNO	DESCRIPT	DATE REQ	QTY	UNIT	PRICE	TOTAL PRICE
0001	PTO00036	PTO KIT - 200 CFM POWERTECH W/STND					
PTO00036			/ /	1	EA	13990.00	13990.00
0002	00006800	Hosing wiring and fittings					
Misc			/ /	1	EA	1350.00	1350.00
0003	00006800	Misc - Piping					
Misc			/ /	1	EA	675.00	675.00
Estimate includes the following:							
Combo Air Inject/ Drain/Line gauge 2.5"Cross							
Combo Air Inject/ Drain/Line gauge 1.5"Cross							
Solution Splitting Manifold to 4 discharges.							
0004	00004579	VALVE - 2.50 CHECK, MODIFIED					
5205101			/ /	2		601.40	1202.80
0005	00004520	Gasket - 2.75 ID x 4.88 OD					
3806307			/ /	2		2.44	4.88
0006	00000073	1.5" NPT SS CHK 300PSI HEAVY SPRING					
07-4-4SPX 1.5			/ /	2	EA	279.2475	558.50
0007	00007274	3" NPT SS CHK 300PSI HEAVY SPRING					
07-4-4SPX 3"			/ /	1	EA	537.81	537.81
0008	00007918	Flow Meter & "T" Assy 2.5"					
2660-0033			/ /	1	EA	818.00	818.00
0009	00005697	2001 Foam Pro W/Darley Logo*					
S105-2001-09			/ /	1	EA	7875.0356	7875.04
0010	00006398	Foam Cell-15 Gallon					
Foam Cell-Misc			/ /	1		765.00	765.00
0011	00007964	Water Disp - Vlv Cntrol: 50% & 85%*					
WLA200-A06			/ /	1	EA	533.9685	533.97
Price for estimate only.							
Match to MC that customer has.							
0012	OFG00070	GEN - DAV AIR VALVE MOUNT MANIFOLD					
OFG00070			/ /	1	EA	650.00	650.00

Odin Foam Division
PO Box 310
10763 Yaquina Bay Road
Toledo, OR 97391
USA

PHONE: 541-336-5067
FAX: 541-336-2545

QUOTE #: 000888

PAGE NO.	: 2
CHANGE ORDER	: 0
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SALESMAN	:
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Palmyra Township Fire Department
Chief Timothy Paulus
3956 State Route 225
Diamond, OH 44412
USA

SHIP TO ADDR

Palmyra Township Fire Department
Chief Timothy Paulus
3956 State Route 225
Diamond, OH 44412
USA

SHIP VIA: Ground TERMS: NET 30 ACCT: PAL001

ITEM	PARTNO	DESCRIPT	DATE REQ	QTY	UNIT	PRICE	TOTAL PRICE
0013	00001325	Switch - SPST Toggle On-Off					
5862-10			/ /	4	EA	14.0658	56.26
0014	00001468	Toggle Switch Safety Covers					
73209			/ /	4	EA	4.68	18.72
0015	00006731	PLACARD - "Compressor On-Off"					
SIG4-060707			/ /	4	EA	40.2865	161.15
0016	00007349	Air Valve & Actuator, ¼" SS*					
7349			/ /	2	EA	250.4658	500.93
0017	00007350	Air Valve & Actuator, ⅜" SS*					
7350			/ /	2	EA	310.4720	620.94
0018	00000509	Valve - 1/2" BSS 8003-51 Viton Chck					
0156345			/ /	2	EA	125.59	251.18
0019	00000509	Valve - 3/4" BSS 8004 DURABLA CHECK					
0156353			/ /	2	EA	138.9835	277.97
0020	00006800	PTO, shaft and Overspeed					
Misc			/ /	1	EA	3350.00	3350.00
Estimated for quote.							
OEM Supplied Muncie or Chelsea PTO and Shaft							
Muncie Overspeed Control							
0021	DAF00025	DAF - AUTOFILL, 2.5" STND*					
DAF00025			/ /	1	EA	1405.00	1405.00
OPTIONAL Direct Tank Auto Fill -							
Would need to be piped into tank							
0022	00000003	Odin Labor Hours					
Labor-Odin			/ /	250	HR	75.00	18750.00

Estimated Hours for Job: 200 to 250 hours.

NOTES:

SUBTOTAL:	54353.15
TAX:	0.00
TOTAL:	54353.15

TOTALS FOR SALES QUOTE : 000888