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CAFS - COMPRESSED AIR FOAM SYSTEMS IN STRUCTURAL FIREFIGHTING

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Page last updated on 21 May 2004

[CAFS - CEMAC DUTCH VERSION](#)



The use of CAFS for interior structural fire attack proposes a complete turn-around of the current approach to compartmental or interior structural firefighting for firefighters in Europe and several parts of the world. Are we truly ready to turn our backs on the lessons learned following the loss of firefighters lives? These tragedies prompted us to direct more attention and encourage awareness of fire gases form, transport and occasionally ignite inside fire involved structures. When used from an interior attack position is CAFS able to deal with the hazards of fire gases forming in the overhead approach route or in compartments adjacent to the fire? Is CAFS just 21st century hype or does the strategy offer us the latest approach to interior firefighting tactics?

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The use of Compressed Air Foam Systems (CAFS) in the rural setting undoubtedly offer great benefits, as do regular Class 'A' foams, for their penetrating and protective qualities. However, the inevitable hype and marketing associated with such effective and innovative tools have exploited the urban arena and we are finding ourselves facing an in-depth strategic review concerning our approach to structural firefighting.

In general, a large majority of fire departments have developed (outside the US) a systematic approach based upon high pressure water delivery (HPD) systems. A small percent of our structural firefighting, utilizing finely divided water droplet foams and inert the gases in the overhead before reverting to straight stream attack for complete extinguishment. The Swedish influence during the 1980s advanced our knowledge further still as we were directed to pay closer attention to the overhead gas layers that formed, transported and often ignited to kill or injure firefighters advancing their attack. The introduction of *fire behavior training* and *3D fire fog applications* provided the firefighter with the knowledge and the confidence to work at close quarters with the fire whilst encouraging a greater element of assessment, control and safety. It was the transport of gases in the overhead that we had overlooked for so long that had created a hazardous environment that we appeared to have little control.

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The transition to CAFS for interior firefighting applications has its appeal - we can work at long range, for the reach of a CAFS firefighting stream is similar to that of a fog pattern. There are even false assumptions that CAFS attacks can replace the need for Positive Pressure Ventilation (PPV) as initial attack method applied from the exterior. CAFS decreases the surface tension of water to cooling, however although it has been stated that CAFS offers twice the cooling of plain water - CAFS DOES NOT increase water's ability to absorb heat. CAFS and penetrates surfaces far more effectively than water but when applied at long range CAFS does **not** deal with the gases in the overhead! Any total transition to CAFS for compartmental or interior firefighting demands we re-assess our tactics and neglect those gases that have caused so many firefighter deaths over the years.

CAFS streams are (most effectively) applied through dedicated smooth-bore nozzles. When combination fog nozzles are utilised the effect appears to 'strip' much of the air from the bubble structure and produce something more similar to a regular 'A' foam stream. Such a stream, applied in a fog pattern, will produce smaller droplets as the surface tension is reduced. These smaller droplets will have good effects in the gases but may evaporate closer to the nozzle operator. It is understood that such a stream is only slightly more effective, if at all, than plain water at cooling and *inerting* gas layers.

Research has demonstrated that the benefits and advantages associated with CAFS in *un-shielded* post-flashover fires involving open-plan areas are countered by the fire in a *pre-flashover* involving a 'shielded' area that is perhaps partitioned or sectioned throughout. What if the fire is in a room at the end of a long hallway, with heavy amounts of gases, smoke and heat filling the hall; or perhaps there is a reservoir banking down at the top of a stairway, filling the overhead with fire and smoke. How can a CAFS stream in smooth-bore form take control of such a fire that isn't yet on fire? You cannot 'coat' the gases with foam from a straight stream. CAFS is undoubtedly effective on the **post-flashover un-shielded fire** and knockdown effects have been frequently demonstrated.

The University of Canterbury in New Zealand have evaluated CAFS on both *un-shielded* and *shielded* fires. This research does not consider operational issues such as the ease of use, cost effectiveness and effects of differing suppression equipment settings, size of delivery hose, class A agents, or methods of application. These studies are centered directly on comparing the effectiveness of three firefighting methods based on New Zealand fire service current operating procedures, and is not intended to assess the optimum method of application. There is no comparison, for example, of CAFS versus water streams in jet (straight stream) mode.

The New Zealand research (to date) evaluates the suppressive effectiveness of high pressure water-fog (HPD), Class A foam (fog) and CAFS (smooth-bore) on a **flashover** fire in a 2.4m x 2.4m x 3.6m compartment. This enables a comparison of the knockdown effectiveness of each method to be assessed relative to each other and the times required for the compartment to reach tenable conditions.

It is useful at this stage to qualitatively discuss the mechanisms of extinguishment which contribute to the effectiveness of HPD. Friedman has studied the mechanisms of fire suppression, and the associated mechanisms that are involved. Fire can be supported if the following four mechanisms are present (ie the four sides of a tetrahedron), presence of oxidiser, presence of fuel, uninhibited chemical reaction and temperature. The mechanisms present that are thought to disrupt the tetrahedron, are discussed below:

- * The vaporisation of fine droplets of water into steam. As the fog is conveyed, steam energy is absorbed, and the fire temperature decreases, reducing the rate of combustion. Because water droplets have a large surface area compared to a direct water stream, this mechanism is far more efficient for a fog than a direct stream.
- * As the water mist expands to steam (steam is 1700 times the volume of water), the volume of air around the fire reduces, resulting in reduced oxygen concentration.
- * The presence of water fog reduces the flame temperature, thus less radiative energy is available to pyrolyse the fuel.
- * The presence of steam blocks the radiative transfer between the flame and the pyrolysing fuel. Thus less energy is available for the fuel to pyrolyse.
- * The impingement of steam and water droplets onto the fuel load effectively reduces the fuel load and reduces the pyrolysis rate.

Some of the above mechanisms are similar to those of the CAFS and Solution suppression methods being examined in this project.

It is considered that the provision of CAFS through low-pressure hose-lines (45mm) for dealing with *post-flashover fires* in *un-shielded* structural compartments will optimize the potential of such agents, achieving extremely rapid knockdown when compared with water and increasing the capability of the amount of foam carried onboard first arriving fire engines. It should be accepted that the increased use of Class 'A' foams and CAFS have raised concerns over environmental and personal safety issues. These include eye and skin irritation; respiratory problems and diarrhoea if ingested. It is also well established that the desired effect of increasing water surface tension has inadvertently resulted in large amounts of fish and birds drowning in rivers and lakes following agent run-off.

It is also worth noting that standard commercial fire hose carried on apparatus is not designed to transport air and may react violently under such use conditions.

FEMA has urged the NFPA Technical Committee on Fire Department Apparatus to provide guidance on the use of hose that is suitable and safe for use on a CAFS system. At a minimum, the standard should state that: No hose shall be used for a CAFS system unless such use is recommended by the manufacturer of the solution and the hose manufacturer and the hose is so marked for such use in a conspicuous manner. In the interim, FEMA has issued a technical bulletin to alert interested persons of this situation.

It is interesting that NIST in USA have recently completed research that suggests water additives, when used through high-pressure delivery systems, may not be as effective as plain water! [LINK TO RESEARCH HERE](#)

Un-Shielded Fires

[Michael Dunn - University of Canterbury - Christchurch, New Zealand \(Report 1998/2\)](#)

A comparison is made between CAFS (compressed air Foam), HPD (High Pressure Discharge) and HPD with Class A Solution on unshielded post flashover compartment fires. Extinguishment was carried out by trained fire fighters using hand held

whilst the method of attack was carried out following New Zealand Fire Service operating procedures. The effectiveness of each method was determined, recording the heat release rate using the method of Oxygen Calorimetry. Knockdown effectiveness was also evaluated by recording internal compartment temperatures with the use of thermocouples. In addition comments from firefighters have been recorded and video footage reviewed so that a qualitative assessment could also be made. It was found that CAFS performed more effectively than HPD or Class A solution, in that less water was needed to obtain a similar knockdown performance. No noticeable benefit was obtained when Class A was added to the unmodified HPD line. The biggest advantage of CAFS over other methods was the ability in being able to attack the compartment indirectly from a distance, which has additional benefits with respect to firefighter safety.

For these three firefighting methods agent was applied at a constant rate of 12 litres per minute to a post flashover, wood crib fire in a standard 2.4m x 2.3 x 3.6m unshielded enclosure. A mix of 0.3% foam solution was used for the Class C runs which provided an average expansion ratio of 5.0 for the CAFS runs and 2.3 for the Class A runs. In all 10 experimental runs were carried out, which provided a minimum of three runs for each method. All experiments had identical fuel loads with the measured peak Heat release rate varying between 3 and 10 MW.

It was found that in order to achieve total suppression CAFS required on average 12 litres of agent whilst HPD and Class A required 19 and 21 litres respectively. In terms of the time taken for the compartment to reach tenable conditions and the heat release rate to be knocked down to 30%, 20%, and 10% of its initial value a clear difference was found between either three of the methods. When the application for the latter two methods was reduced to 12 litres for one set of runs it was found that compartment conditions at termination of suppression were tenable for the CAFS run, and re-ignition of the cribs was less likely using CAFS. The use of plain water in fog form (HPD) was found to cool temperatures in the overhead more effectively than with CAFS. The main advantage of CAFS over HPD and Class 'A' Solution found during these tests is the benefit it has regarding its ability to *indirectly* attack the compartment fire from a distance.

Shielded (by Partition) Fires

[Neil Gravestock - University of Canterbury - Christchurch, New Zealand. \(Report 1998/3\)](#)

A research project by Gravestock looks at the effect of the three firefighting methods discussed above when held in comparison for extinguishing a shielded post-flashover fire. A partition prevented any direct impingement on the fire which was located towards the rear of the test-rig. The indirect applications of 170 litres of agent over 120 seconds achieved compartmental temperature reductions from 820 deg C to 200 deg C within 80 seconds. However, the report stated that cooling rates were similar for all three methods although plain water was again seen to be the most effective of the three agents. It was noted that the CAFS stream passed through the flames and only had any real cooling effect when it came into contact with superheated surfaces towards the rear of the test-rig. This caused an amount of steam to be blown out of the test-rig doorway to a distance of 2-3 metres on initial applications.

The conclusion of the Gravestock research was similar to that of Dunn in that a little difference was found in the suppressive effectiveness of the three firefighting methods although it was suggested that additional research using these agents

larger compartment fires may prove worthwhile.

USA Experience of CAFS

In a range of field trials the operational capabilities of fire-fighting stream been compared for structural firefighting effectiveness. In most cases the comparisons were made in straight-stream or smooth-bore form only. The effectiveness of water-fog applications were rarely evaluated.

[A series of controlled room and contents fires](#) were performed at Wallops Island Virginia and Salem, Connecticut by Hale Fire Pump, the Atlantic Virginia Fire Department, Ansul Fire Protection, the International Society of Fire Service Instructors, Elkhart Brass, the National Aeronautic and Space Administration Goddard Flight Center Fire Department, the Charlotte North Carolina Fire Department, the Fairfax County Virginia Fire Department and F.I.E.R.O. (Fire Industry Equipment Research Organization) and the Salem Connecticut Fire Department.

Using a thermocouple-strip chart recorder, identical rooms in acquired structures were instrumented, the objective to measure time/temperature reduction relationships with the application of water, class A foam solution, and Compressed Air Foam System (CAFS) aspirated class A foam solution, applied in straight form. The goal in using acquired structures was to perform testing in a more real world as possible, while still giving the utmost attention to variables such as fuel loading, fuel placement, agent application, and room ventilation. The nozzle-man was used on each interior attack, duplicating agent application streams being applied after flash over occurred. After indirect (ceiling) application for 60 seconds (straight-stream), direct application was made to room contents an additional 60 seconds. Identical gallon per minute and total water flow were established through the use of sensitive flow measuring equipment. In the Connecticut burn series shown in the chart below, room sizes were 11' x 10' with moderate fuel loading. The fuel was straw and pallets providing a duplicate scenario with similar fuel combustion characteristics.

A 20 Gpm flow of plain water in burn number one provided a flow slightly above mean critical application rate. Any additional improvement in fire suppression capability would be identified in the time/temperature chart during burns three with the application of class A foam solution, and class 'A' foam solution Compressed Air Foam delivered at the same application rates. (*Note: The evolution tests were not NFPA 1403 training burns, but data collecting fires performed by veteran professionals).

Test Results

The ceiling thermocouple time/temperature difference recorded on all three was negligible. This was not surprising because agent application was made to the ceiling for the first 60 seconds.

The four-foot level thermocouple however, yielded graphic results.

Temperature Drops™ High Level -1000 DEG. F. Down To 212 Deg. F.

	Time (Sec.)	Drop Rate (Deg.F Per Sec.)
Water	222.9	3.5
Foam Solution	102.9	7.6
Compressed Air Foam	38.5	20.5

Firefighter/Victim Stress

These four-foot level thermal readings would directly affect stress/survival of trapped occupants in close proximity to the room of involvement, and also firefighting personnel involved in rescue/suppression operations in an actual fire.

In all tests, a total of nine rooms were instrumented, with agent applied in the same fashion. Results of the Salem tests were typical of all tests. An important factor in the effect of class 'A' foam solution application is the type of application device employed. Note that in the plain water and foam solution applications, an adjustable fog nozzle set on straight stream was the application device. Experiments show that had an air-aspirating nozzle been used, higher efficiency would have been gained from the application of the foam solution. The goal in these tests was to duplicate agent application **using the same straight fire stream**. CAFS application used a ball shut off valve only, providing a straight stream.

In 1990, the [LA County Fire Department](#) began an intensive evaluation of foam. That led to the specification of direct-injection, multiple-outlet foam proportioners on all new engines starting in 1992. In 1995, the department purchased three engines equipped with compressed-air foam systems. Today, LACFD has 224 front-line engines, 10 reserve engines and 15 front-line quints equipped with Class A foam proportioners. An additional 19 front-line engines are equipped with CAFS.

To quantify the effectiveness of Class A foam for interior attack, Chief Engineer Michael Freeman and Chief Deputy Larry C. Miller recently directed department members to conduct a series of controlled burn tests in three identical residential structures using water, a Class A foam/water solution and CAF. Each structure was instrumented with temperature sensors, and the entire process was videotaped. The attacks were conducted using the same LACFD structure pumper equipped with a 1,500gpm single-stage centrifugal pump, Waterous/Pneumax 100cfm CAFS, 2001 foam proportioning system, and Phos-Chek WD881 Class A foam concentrate. The attack line was 200 feet of 1 1/2 inch hose. A combination nozzle was used in the water and Class A foam/water solution tests, and a 1-inch smooth bore nozzle was used in the CAF test. After the interior was exposed to outside conditions, allowed to burn freely for a short time, the attack began and data recording started. The attack team started from a position in front of the structure and directed a stream through an open window or door. The team then moved to the front of the structure or around to one side to direct a stream through an opening. The CAF attack was started from a position at the curb, approximately 10 feet from the front of the dwelling, because of the tremendous carry of the stream.

Six lessons learned

Using compressed-air foam for an interior attack requires training. Here are lessons the Los Angeles County Fire Department personnel learned:

1. **Interior CAF attacks should be made at the flow rate required for structure.** CAF saves water by knocking down the fire faster, not by down the fire with a lower flow rate.
2. **A fully charged CAF line has a very strong nozzle reaction.** Pistol other auxiliary support devices are recommended, because the high stream can kick up loose objects. Eye protection should be used when working up close.
3. **An interior CAF attack often can be made by directing the stream through a door or window.** This allows a greater standoff distance, reduces exposure for firefighters. Firefighters should aim at the ceiling for the best results.
4. **When CAF hits a fire, it generates a large volume of steam.** Because steam will fill the structure and vent strongly through any exterior openings, other personnel working in the vicinity should take adequate precautions.
5. **Even though CAF reduces interior temperatures faster than water (not fog), the upper portions of rooms will still be quite hot.** Once the attack team should stay low and not stand up too quickly after knockdown.
6. **Always overhaul.** Firefighters should use low foam concentrations to wet CAF, as high foam concentrations produce a dry foam that does not penetrate as well.

A known property of resistance to re-ignition also makes possible an extinguishing technique known as 'panel-soaking', here described by Fornell (1991): The firefighter tackle one panel at a time....The ceiling should be taken care of first....One panel at a time can then be soaked...reducing not only the fuel load but also the radiation ability. A panel penetrated by Class-A agent radiates almost no heat and can no longer contribute to the total heat load, helping reduce the chance of flashover....Removing the fire's fuel by panel soaking does have a cumulative reducing effect. By eliminating heat and fuel piece by piece, large fires can sometimes be successfully extinguished piece by piece. (p. 324,325).

A research project by Robert G. Taylor Morristown Fire Bureau, New Jersey explored the feasibility of enhancing firefighting crews consisting of limited manpower by equipping them with Class-A foam and Compressed Air Foam (CAFS) technology and training. The problem that was addressed was that, especially in the early stages of fire suppression operations, there were frequently insufficient personnel to employ traditional extinguishment methods safely and efficiently. The purpose of this research project was to determine if CAFS technology and procedures could be used to increase effectiveness, efficiency and safety under limited personnel resource conditions.

During most of 1992 and the early part of 1993, the [Boston Fire Department](#) participated in a field test of a compressed air foam system (CAFS). The test evaluation project involved Engine Company 37, Boston's busiest fire company which serves a densely populated and highly diversified district west of the downtown area.

The overall objective of the test program was to evaluate the effectiveness

suitability of CAFS as a fire fighting agent in an urban environment. The study intended to weigh the costs and benefits of installing CAFS on urban apparatus, the relative effectiveness of CAFS versus water for interior and urban fire suppression, and the positive and negative operational characteristics of CAFS that would influence a decision on whether or not to install CAFS on new vehicles.

An important consideration of the study was to identify any critical deficiencies or potential hazards that would cause CAFS to be considered unsuitable for use or that would require special precautions. The primary attack capability that was used for the structure fires during CAFS evaluation was the 400 foot 1-3/4 inch attack line with 1-1/8 inch straight bore tip. This did not preclude the use of 1-1/2 inch hose where conditions warranted, such as well involved structures, large warehouse type occupancies, or commercial occupancies which have greater loads than residential structures. The 1-3/4 inch hose is quicker to stretch, lighter in weight, and flows approximately 150 gpm when proper pump pressures are supplied. The effectiveness of this attack line was compared to a regular 2 inch hoseline flowing plain water.

Two firefighters could easily handle and advance a fully charged CAFS line. The flow through the hoseline is a mixture of foam solution and compressed air. The entrained air reduces the density of the flowing stream, which allows the line to be more flexible, as well as lighter in weight, so firefighters can advance and handle the charged line more easily. A 1-3/4 inch hose filled with water weighs approximately one pound per foot, while the same hose filled with CAFS weighs about half as much.

- Crews felt CAFS was equal to or superior to plain water, with all other conditions the same. The crews felt that in almost every case the fire suppression effectiveness of the CAFS line was at least equal or equivalent to the water that they would have used in the same situation. (Their normal interior attack is a 1-3/4 inch hose with a 150 gpm combination nozzle.) They felt that the CAFS line was clearly superior in terms of weight and maneuverability. It was much less fatiguing to advance, operate, and extend than a water stream, particularly when going up or down stairs.

- The ability to attack with tank water meant that they did not have to stop to lay supply lines or pick up wet supply hose. This gave them a time advantage attacking the fire. Also, one of the benefits from the air compression was the ability to blow all liquid from the hose before repacking it back on board.

- They did not notice an appreciable difference in knockdown capability for structure fires. (Note, however, that the knockdown was achieved with about half the rate of a conventional water stream.)

- The CAFS application greatly reduced the need to overhaul contents of a structure with an interior fire. It soaked into and through materials to fully extinguish all fire much more effectively than water.

- The foam stream did not have the "punch" of a water stream, so a different tactical approach was needed when fighting interior fires. This was not reported to be a problem in any of the fires.

- Where fire was burning in a concealed space, such as a wall cavity or ceiling, it was necessary to have someone open a hole to apply the stream. However, when the CAFS stream was applied through the hole it was much more effective than water at reaching and extinguishing pockets of fire. When applied into a cockloft, it soaked into all of the insulation and extinguished the fire.

- The firefighters did not feel an appreciable difference in heat absorbed by the CAFS line and they did not have a problem on the few occasions that the CAFS compressor quit working during the attack. The built-in fail safe of the CAFS compressor all else failed, plain water could be pumped through the line already stretched back out to a safe refuge and regrouping, another attack on the fire was possible.

- Kinking of the hose was not a problem, as long as they paid attention to where they were going. It was a benefit when they wanted to extend the line because they could completely stop the flow to add hose by manually kinking the line.

- The most obvious advantages of CAFS were seen with vehicle and dumpster fires, where the CAFS virtually eliminated the need for overhaul. A brief application of CAFS completely controlled and extinguished the fires. There was no need for lengthy overhaul. Large dumpsters, which normally require extensive overhaul and a supply line from a hydrant were extinguished with less than 200 gallons of foam solution.

- There are several hospitals in Engine 37's area that use large containers for contaminated waste and sharps. Fires in these containers were handled without having to climb in or dump the contents for overhaul. This was considered a major advance.

- Footing on a fire ground is never completely without obstacles, whether it be several inches of water or piles of lathes, plaster or other fire debris. The conditions caused by the foam were not a problem to the crews that were working with it. To other members it was something strange and foreign.

A few other observations were made by other companies and officers.

These were:

- The foam obscures the floor, hiding hazards that firefighters could slip or trip over. It also makes the footing slippery.

- Although members' face-pieces, at times, would be covered by foam, it was understood, a simple wipe with a gloved hand removed it. A side benefit was the cleaning effect from the detergent base of the foam solution.

- A fire investigator complained that the foam covered up the fire area, making it impossible to find a point of origin. The investigator did not have time to

the foam blanket to break down to proceed with the investigation. The other is that foam aids investigation. It doesn't dislodge and disorder room contents, fixtures, etc. the way hose streams do. It doesn't wash away paper trailers and in fact safeguards some physical evidence.

■ The Boston Fire Department Chemist noted that the foam residue could or complicate the detection of hydrocarbon accelerants in the rubble of a fire. A more sophisticated analysis would be needed to isolate the foam from any of accelerants taken from the scene of a fire.

■ Some of the District Chiefs, particularly in surrounding areas, were convinced when Engine 37 came in to their fires with the 1-3/4 inch line as a back-up tank water instead of a supply line from a hydrant. They were not convinced the CAFS was an equivalent to a 2-1/2 inch back-up line supplied from a hydrant.

Controlled Fire Experiments

In addition to the field test of CAFS by Engine 37, a series of controlled fires were conducted at the Massachusetts State Fire Academy. The experiment was designed to conduct a more objective comparison of the effectiveness of a CAFS with a conventional fire stream in interior structural fire fighting by using the same load and fuel load configuration in each fire. The tests measured the number of gallons of agent (CAFS or water) used and the time required to extinguish the fire. The tests were not intended to be rigorous, rather they were meant to provide an objective, measurable comparison of the effectiveness of CAFS in interior fire fighting and to validate the field experience.

RESEARCH PROJECT - MONTGOMERY COUNTY, MARYLAND - 2002

[Report by District Chief Steve Lohr available here](#)

The problem in Montgomery County, MD is the fire rescue service are unable to deliver a stated fire flow goal equivalent to 500 gallons per minute (gpm) for 10 minutes (min) in many areas of the county. The purpose of this applied research project was to explore the possibility of using compressed air foam system (CAFS) as a method to deliver an equivalent fire fighting capability to the 500 gpm fire flow expectation with less water. Historical research, including the literature review, was used to identify and summarize known information on CAFS. The review included experiences gained by others who have tested, used, or evaluated CAFS. Evaluative research was used to conduct a series of live test burns in a high-rise building to verify the effectiveness of CAFS when pumped through a standpipe riser, while measuring agent usage, temperature drop rates, and extinguishment parameters. The procedure started with a literature review to provide a current analysis of CAFS usage by identifying the advantages, disadvantages, limitations and past experiences using the technology. Live testing was initiated in a high rise building to validate the work of others and to provide new research regarding CAFS when pumped through a standpipe riser. Test data was evaluated carefully to classify water and foam use characteristics and to monitor the impact on fire fighting crews. CAFS was found to extinguish fires in one-third the time, while using less than one-third the amount of water. The quality of finished foam was not degraded after pumping through the various pipe diameters. Separation of air and water components did not occur.

in extinguishing parameters that were consistent with previous testing. Further recommendations were developed to pilot test a CAFS equipped pumper in Montgomery County, and to develop a research partnership with third party facilities in or near Montgomery County to validate the role of CAFS for interior firefighting.

RESEARCH BY THE UNIVERSITY OF WUPPERTAL, GERMANY 1997-99



Holger de Vries City of Hamburg Fire Department

Extensive research by a City of Hamburg Fire officer in Germany between 1997 and 1999 on the use of CAFS and CLASS A FOAMS in comparison to WATER on post-flashover fires is reported by Dr.-Ing. Holger de Vries, HBM - Platoon Commander Hamburg Fire & Rescue Services Station F1931 - Hamburg/Germany.

CRIB FIRES REPORT 1997

[CAFS REPORT 1998](#)

[CLASS A FOAM REPORT 1999](#)

CONCLUSIONS

The use of CAFS applied in pulsing fog patterns has not yet been compared to pulsing water-fog in the research to date. It is apparent that CAFS offers rapid knockdown when applied in straight stream form and enables the fire attack to be mounted from a safer distance and sometimes from an exterior position. The use of CAFS on post-flashover unshielded fires has undoubtedly been proven more effective than a direct attack from a plain water stream and ensures the minimal amount of water carried on first-arriving fire engines is used to much greater effect. CAFS may be most useful to firefighters when using water direct from tank supplies or when connecting to a hydrant system or open water supply.

The use of CAFS from an interior position has yet to be proven more effective than pulsing water-fog patterns in gas cooling applications. Therefore any reversal of the *direct fire attack streams* on an interior approach route that, in turn, results in neglect of the forming fire gas layers that have been responsible for the loss of many firefighters lives may be a mistake. It is considered that a pulsing fog pattern from a simple class 'A' line may offer greater potential than that of a CAFS equivalent when hose-lines are advanced inside fire-involved structures, especially where the fire remains in a ventilation controlled and shielded state.

Firetactics.com March 2002