THE OFFICIAL MAGAZINE OF **FIRE-RESCUE INTERNATIONAL**

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JULY 2004

FULL-ON FOAM

Fast knockdowns, quick thermal-gas cooling impress departments in Ohio and England.

[TECHNICAL RESCUE] [DIVER TRAINING]

A PRIMEDIA Publication

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A view inside "the can" at the Staffordshire, U.K., training center shows fire development just prior to the overhead rollover of flaming combustion gases. Compressed-air foam application effectively knocked down flaming fire gases and cooled thermal layers overhead.

MASSIVE ATTACK

Still on the fence in the CAFS debate? An Ohio department put a system through rigorous testing to help its decision along.

By Dominic Colletti

Compressed-air foam, a tool that evolved out of the wildland fire sector, is being adopted by municipal fire departments faster than ever before. The strategy is simple: Use foam technology to unleash massive and overwhelming force during initial attack. The result is abrupt fire stops in dwellings and large commercial-occupancy structures. So why are more fire officers turning to CAFS now?

First, according to the NFPA, the structure fire problem causes the highest-dollar fire loss for many communities. They also are where the majority of fireground injuries and deaths to fire personnel occur. Fire suppression improvements can reduce property loss and increase firefighter safety.

Second, progressive departments keep their equipment and tactics up-to-date by using high-volume fire pumps, large-diameter supply and attack hose, and more efficient portable monitors. These widely available, incremental innovations improve fire suppression capability but exhaust quickly. The next step in the evolution of equipment and tactics is implementing discontinuous innovations such as CAFS.

How CAFS work

A full-size engine with a high-volume caf system contains three integrated pump systems. Typically, these three systems are a 1,250- to 2,000gpm single-stage water pump, a 5gpm foam concentrate pump, and a 200cfm rotary air compressor. The foam pump injects small amounts of Class A concentrate into a water stream to create foam solution. (Normally the concentrate is proportioned at between a 0.3% and 0.5% ratio.) The air compressor then adds air to the foam solution. Foam bubbles are created in the apparatus and then transported through standard fire hose. Foam is applied from handlines and/or fixed and portable monitors.

CAF systems can produce a wide range of foam consistencies, ranging from wet melted ice cream to dry shaving cream. Each consistency suits specific suppression application needs. Wet foam is the best choice for initial attack, while fluid and dry consistencies are used for exposure protection and fire control in the wildland-urban interface. The primary difference among the three foam types is the amount of moisture contained within the foam blankets and their drain time, or the relative "strength" of the foam blanket. For example, dry foam has a low moisture content, is stiff and has a longer drain time compared to wet foam, whereas wet foam contains a lot of moisture and drains rapidly.

The key to trouncing a structure fire with CAFS is to use wet foam in bursts of high intensity. The foam clings well to fuel surfaces and absorbs heat rapidly. Because the majority of a wet-finished foam blanket is water (99.5% if a Class A foam concentrate proportioning ratio of 0.5% is used), ordinary combustibles cool rapidly. This retards and eventually eliminates pyrolysis, the solid fuel–to-vapor conversion process. With rapid fuel cooling, flames lose the vapor needed to support combustion.

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Put to good use

Chief Charles Wiltrout of the Butler Township (Ohio) Fire Department had long considered installing compressed-air foam capability on a full-size engine, but he had a healthy level of skepticism about its effectiveness. He invited several fire apparatus vendors to demonstrate CAFS equipment at his station and requested product performance information.

Afterward, Wiltrout requested a "Winning Strategies for the Successful Use of CAFS" seminar for his combination department's 11 full-time and 45 part time paid/on-call members. After the seminar, crews witnessed two specific foam application tactics during a live-fire training exercise in an acquired structure. Although the single-story dwelling was in excellent shape, it needed to be razed for a highway improvement project.

Many departments around the country face the same problem as Butler Township: sometimes assembling too-few initial personnel at working fires to safely mount an aggressive interior attack. This also inhibits meeting the two-in/two-out guideline. The training scenario was set up to show how CAFS could improve the actions of initial responders working under these conditions.

Flashover was allowed to develop during a kitchen fire scenario. A two-person attack team directed a CAFS stream through a removed window at the kitchen ceiling to simulate an exterior attack and test the foam's ability to hold the fire until additional personnel arrived. After four seconds, the fire darkened and the line was shut down. The quick foam application from the exterior kept the fire from spreading into other parts of the structure. Five minutes later, crews made entry and mopped up the remaining fire.

Over the course of the day, three interior foam applications were conducted on well-involved room-and-contents fires. Afterward, students commented that knockdowns were quick and hoselines were light and easy to maneuver. The latter is due to the fact that the hose is filled with around one-third air, by volume. Interior visibility was excellent due to the absence of the moisture cloud typically associated with a water-only attack.

The day's final evolution, an aggressive attack on a fully involved dwelling, was intense. Clips (at left) were captured from amateur video shot during the burn. Note the elapsed time on the video clips. Only seven seconds elapsed between the nozzleman opening up and blackout inside the structure.

After this burn, students said they were extremely surprised and impressed by the knockdown power of CAFS. Prior to an aggressive entry through the front door, crews extinguished about 80% of the fire throughout the entire structure. Upon entry, only four spot fires needed to be extinguished and overhauled.

The attack hoseline was a 1¾-inch hose with a nozzle that consisted of a ¼-turn ball valve with 1⅜-inch open butt. The CAFS pump pressure was set to deliver 120gpm of Class A foam solution and 60cfm of compressed air for fire attack. Therefore, during the last evolution, only 14 total gallons of

These photos were taken during the last fire evolution of live-fire training exercise in Butler Township, Ohio. Photo A shows a view of fire development at the front porch five minutes after ignition. Photo B shows the attack team taking position for aggressive foam application. The nozzleman has just been ordered to open up in Photo C. The time between photos C and F spans seven seconds, when 14 gallons of compressed-air foam solution application trounced this fire.

This Staffordshire, U.K., compressed-air foam engine features a rear-mount multi-stage fire pump with an integrated 50cfm air compressor and foam proportioner that generates compressed-air foam.

water achieved flame knockdown throughout the structure.

Across the pond

In February, at the request of the Staffordshire Fire Brigade Training Center in the United Kingdom, I provided a one-day CAFS seminar. The brigade has several CAFS units used for automobile and lorry blazes, as well as for other outdoor fires.

The reason for my visit was to assist a team of instructors at Staffordshire tasked with bringing the technology into service for structure firefighting. They hesitated to use CAFS for interior firefighting, hypothesizing that compressed-air foam solid fire streams wouldn't be efficient enough to absorb heat from fire gases in a room's atmosphere to prevent or discontinue a flashover.

The current standard tactic for interior fire attack in the United Kingdom is a low-volume, high-pressure water fog application. High-pressure fog streams efficiently cool fire gases while turning to steam. Quick cooling of thermal layers in the fire atmosphere is key to protecting firefighters caught in rapidly deteriorating interior conditions.

During the visit, one set of fire evolutions occurred in a flashover simulator at their training field. A series of fires conducted inside "the can" qualitatively assessed the ability of compressed-air foam to cool fire gases. With ignited fire gases moving off a particleboard fuel load rolling overhead, I opened up a CAFS hoseline and pointed the stream overhead in front of us. A two-second burst of foam onto the steel ceiling flame achieved knockdown. Blackout not only occurred directly overhead, but it also occurred as far away as 20 feet into the room where the fuel load was burning.

The Staffordshire instructors were very impressed. This visually confirmed that CAFS hose streams effectively cool burning gases in the thermal layer to the degree that blackout occurs.

This dynamic has been witnessed time and again during foam application in response to real-world fires. This is important to firefighter safety in a scenario where an attack team advances a hoseline down a long hallway, battling flames overhead that are fed by a fire originating in a well-involved room with an open door at the end of the hall.

The caution zone

Department officers seeking to adopt CAFS technology into their operations need a well–thought out integration plan. The integration plan needs to address issues in the "caution zone." As with any new firefighting technology, there always exists a caution zone.

Waiting in the first circle are such problems as overcoming outdated tradition and firefighter skepticism. Deeper in the caution zone lurk half-truths about technology that obscure facts and data, leading to flawed decisions; it is also where hype and misinformation railroad common sense. There are cold, warm and hot areas of the caution zone associated with compressed-air foam.

While there are many important issues found in the caution zone, one that is central to firefighter safety is compressed-air foam delivery rate for structure fire attack. Some departments substantially reduce their liquid delivery rates when using compressed-air foam. This is neither a good nor a recommended practice.

I occasionally receive phone calls and e-mails from fire officers and firefighters concerned over lack of expected results from CAFS. One chief contacted me and stated he had problems with high interior heat levels and minor firefighter thermal injury during live-fire training using compressed-air foam.

Prior to adopting CAFS, this department's SOP was to use 1¾-inch preconnects delivering 125gpm of water for interior fire attack. They ordered and took delivery of a new full-size engine with a high-volume CAFS. After pump operation training provided by the manufacturer, the department used their unit in a highly controlled NFPA 1403–compliant live-fire training session.

Problems occurred during the training session. The root cause of high heat and thermal insult to one firefighter was traced back to the flow rate from their 1¾-inch attack hoselines. The CAFS apparatus was set up for a delivery rate only of 50gpm of Class A foam solution (liquid) and 50cfm of compressed air.

I couldn't help but ask the chief why he had reduced the delivery rate from their original robust 125gpm of water to an inadequate 50gpm of Class A foam solution (liquid). He said, "The salesman who delivered the fire truck told us to use that flow rate, since that is how CAFS work — less flow rate is needed."

Reducing delivery rates when using CAFS for the interior structure fire attack is categorically and unequivocally wrong. This unfortunate department was a victim of the hype

Right: The foam application device on this $1^3/_4$-inch CAFS attack hose is a quarter-turn ball valve with $1^3/_8$-inch open butt. This hose flows 120gpm of Class A foam solution and 60cfm of compressed air to generate wet-finished foam.

Below: A $2^1/_2$-inch line connected to portable monitor flows compressed-air foam at a live-fire training session. This foam stream, when aggressively applied during initial attack on a fully involved dwelling, has high fire-stopping power.

associated with the increases in the fire-stopping power of water, when applied as compressed-air foam. Don't allow this type of sales hype to overrun and hijack common sense.

While it is true that compressed-air foam absorbs heat faster than water, there have been no quantitative tests showing how much flow rates can be reduced. The best practice is to turn adequate water delivery rates into compressed-air foam streams. After our discussions, the aforementioned fire department reverted to using the same liquid flow rate they had used with plain water — a 125gpm foam solution delivery rate, with 60cfm of air, from 1¾-inch hoselines. This flow rate was adequate for firefighter protection with plain water and subsequently with CAFS.

When using compressed-air foam for structure fire attack, a high-volume, short-duration attack works best. Don't use a low-volume long-duration attack — it will severely punish your firefighters and you will lose the building.

Implementing a CAFS program is an excellent way to provide increased leverage to trounce structure fire, as many departments around the United Sates have found. When formulating a CAFS integration plan for your department, be sure to address the issues in the caution zone. The benefits of a well-executed plan are well worth it — reduced property damage and increased levels of firefighter safety. [FC]

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FIRE-28-RB

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