An important measure of a fire department’s fire suppression capability is the gpm applied per firefighter via effective hose streams. During the last 30 years, numerous innovations have made it possible to increase water-delivery rates from hose streams. However, one of the most important firefighting technology improvements does not follow this same path. It does not act to increase water-delivery rates at all. What it does do, however, is make water delivery rates more effective at suppressing fire. This firefighting technology improvement is compressed air foam systems (CAFS).

In simple terms, CAFS take water delivery rates and create finished-foam streams. We apply these finished-foam streams onto fire hazards by using standard-diameter attack hose and fixed or portable monitors. The concept is to apply high-quality CAFS-generated foam blankets. Doing this allows fire departments to increase the fire-stopping power of available fireground water supplies while increasing firefighter safety and reducing property damage.
Firefighters from Kimberton Fire Company in Chester County, Pa., gain first-hand, live-fire application experience prior to the purchase of their first apparatus equipped with CAFS technology. An attack team initiates an aggressive interior fire attack using CAFS during a training session in an acquired structure.
CAFS ADVANTAGES

As an end-user of CAFS for nearly two decades, I’ve come to expect quick knockdowns and reduced total water supply need, sometimes by as much as two-thirds, as compared to using water alone. Time after time, fire after fire, CAFS show significant advantages over straight water. These advantages include:

- Fire extinguished in less time;
- Fire extinguished with less total water supply;
- Reduced personnel stress from advancing lightweight compressed air foam-filled hoselines;
- Reduced personnel stress due to quick extinguishment;
- Reduced personnel exposure to heat and the toxic products of combustion;
- Greater fire volume extinguishment from the initial exterior foam application point (when conducting an offensive attack on a fully involved dwelling) prior to the crew making aggressive entry;
- Reduced fire and water damage to structures; and
- More effective exposure protection applications.

Using CAFS, we can handle a much greater volume of fire...
CAFS, early incoming resources, personnel, equipment and water supply have superior fire-stopping power. This is a key benefit during the critical property-saving window of opportunity. That window opens immediately following fire scene arrival, when property is most likely still standing and can be saved. CAFS aid rural fire departments by multiplying the fire-fighting force’s effectiveness.

**CAFS IN THE STICKS**

Rural fire departments should research what it takes to effectively implement CAFS. It can help take the edge off the rural fire response problems, such as limited initial water supply and excessive travel time to fire scenes. These factors can combine to create exceptional firefighting challenges.

If you are a rural fire department officer, consider the fact that fire attack is an all-or-nothing game. There are no silver medals in fire combat; second place pays zero. When challenged by a well-involved structure, initial attack resources are either adequate, or they are not and the building is lost. When using CAFS, early incoming resources, personnel, equipment and water supply have superior fire-stopping power. This is a key benefit during the critical property-saving window of opportunity. That window opens immediately following fire scene arrival, when property is most likely still standing and can be saved. CAFS aid rural fire departments by multiplying the firefighting force’s effectiveness. The following is an example of real-life rural CAFS application:

The Humane Fire Company (HFC), located in Royersford, Montgomery County, Pa., is one of many rural departments around the country with real-world CAFS application experience. The HFC (Montgomery County Station 84) took delivery of a new CAFS equipped engine in 2002 (for details, see “Humane’s CAFS Equipped Engine,” p. 72–73).

My department’s fire district can be classified as a mix of...
Pottstown Chief Richard Lengel ordered Engine 84 to arrive on scene through an alley on Side C of the fire building after connecting to a hydrant and laying-in with 500’ of 5” supply hose. Chief 84, John Major, gave orders to advance 150’ of pre-connected 3” attack hose from Engine 84’s right-rear CAFS capable discharge. The line was advanced to the building and a gated wye installed. Dual 150’ lengths of 1 3⁄4” attack line were coupled to the gated wye outlets. The first attack line was advanced up a rear fire escape and into the third floor interior. It went into service knocking down fire in the attic space on Side B. All told, we not only put the two 1 3⁄4” CAFS attack lines to good use, but we positioned a Blitzfire portable monitor flowing compressed air foam for a blitz attack to knock down heavy fire. The highlight of CAFS use at this response involved heavy fire in the attic space. After laddering the building and standing on a rear second-story flat roof, Royersford Borough Chief Gary Wezel and I were able to open the gable side of the attic space at the C and D corners with pike poles. This allowed a fireball to vent and provided an access hole to apply compressed air foam. At this time, a Blitzfire portable monitor with a 2” smoothbore tip connected to the 3” CAFS attack hose was set up on the ground in the backyard. After we stepped down from the roof, Chief Major opened the monitor, and then closed it after only 30 seconds. Compressed air foam application provided more than just quick, short-term flame darkening; it achieved 98 percent fire extinguishment in the attic space during the short time it was applied. Continuing, we entered the third floor, mopped-up fire there using 1 3⁄4” CAFS hoselines, pulled ceilings and overhauled the attic, which did not require a lot of work. From beginning to end, to put a stop on this fire, Engine 84 discharged 2,556 gallons of water and 10.6 gallons of Class A foam concentrate (as compressed air foam).

CAFS IN THE CITY
CAFS’ benefits are not specific to rural fire departments. Firefighters in suburban and urban locations can benefit as well. On March 29, 2002, in Silver Spring, Md., the Montgomery County Fire and Rescue Service performed

Without CAFS, in some severe fire cases, we would ordinarily choose a defensive water application strategy—stand back, let the main body of fire burn & protect exposures.
several live-fire tests with CAFS. The tests were unique because compressed air foam was pumped into a dry stand-pipe riser up to the fifth floor of a downtown high-rise office building during a NFPA 1403-compliant live-fire training burn (see Figure 2).

Using a CAFS engine supplied by Conshohocken Fire Company No. 2, Station 35, several fire companies from southeast Pennsylvania participated with Maryland firefighters and received real-world experience in combating ventilation-limited fires in a high-rise setting using compressed air foam.

There are advantages to using CAFS to deliver firefighting agents to high elevations, such as in high-rise building stand-pipes. Since finished-foam is less dense than water, compressed air foam can be pumped to a higher elevation than water at a given pump pressure.

CAFS TRAINING & MECHANICS

For rural departments integrating CAFS into their fire-suppression strategy, training and education is paramount. CAFS’ benefits are directly proportionate to an understanding of what it is, how it works and how to use it.

Let’s briefly review how CAFS hardware works to produce finished foam. There are many types of CAFS hardware available today. Most can dispense the two widely used types of foam agents—Class A and B foams. Our discussion here is limited to Class A foam.

In simple terms, a full-size engine with CAFS hardware works by first mixing Class A foam concentrate with water to create foam solution. The foam concentrate-proportioning ratio typically used is from 0.3 to 0.5 percent. Compressed air, usually supplied by a rotary air compressor, is then added to foam solution delivery. Both the foam solution and compressed air are subsequently agitated in a mixing chamber (a baffled tube) to create finished-foam bubbles. A homogenized mixture of foam bubbles is then transported under pressure through apparatus piping and fed into pre-piped master stream devices and standard-diameter attack hoses. Firefighters subsequently discharge the finished-foam product out of handheld nozzles.

Using CAFS, we can handle a much greater volume of fire than ever before. This know-how has redefined our perceptions of what we can do with initial arriving resources.
Humane’s CAFS Equipped Engine

Humane’s engine, manufactured by Kovatch Mobile Equipment, is designed for dual-purpose firefighting duty—either as a fire attack or water supply workhorse.

The truck committee, as a first order of business in the specification process, developed the following mission statement:

“The mission of the apparatus committee is to specify an apparatus that provides outstanding value—a high level of fire protection for the community and high levels of safety for company members. The committee defines the word “value” as those features that give the fire company a competitive advantage in extinguishing fire quickly, making the apparatus functional and user friendly, providing for easy and minimal maintenance, and extending the apparatus life cycle.”

The unit was outfitted with the following fire suppression features:

• 2000-gpm Hale Qmax single-stage fire pump;
• 200-scfm Hale CAFSPro compressed air foam system;
• 750-gallon booster tank;
• Hale AutoFill automatic booster tank electric fill valve;
• 50-gallon Class A foam tank;
• (2) 1¾-inch x 200-feet crosslays, CAFS;
• (1) 1½-inch x 250-feet crosslay, foam solution;
• (1) 3-inch x 150-feet right-rear preconnect, CAFS;
• (1) 2½-inch crosslay, water;
• (2) 4-inch LDH discharges, officer side pump panel, water;
• (3) Hale Electric Master Intake Valves (MIV);

Discharge valves – all Hale Torrent stainless steel;
(5) 6-inch x 13-feet lightweight Kochek hard sleeve suction hose;
(4) Hale Oil-less primer pre-prime valves;
(1) LDH rear inlet;
2,500-feet x 5-inch supply hose; and
750-feet x 3-inch attack hose.

As you can see in the photos, the engine is also equipped with a compliment of assorted hand and power tools and ground ladders.

When a pump operator places this unit from “road into pump,” the CAFSPro system automatically engages. The 4-inch tank-to-pump valve opens automatically. There are no extra pump operation steps required to discharge compressed air foam. The Humane SOP is to use CAFS at every fire. The advantage is that personnel become accustomed to effectively using CAFS application. Smaller fires become unscheduled CAFS training sessions, making firefighters more effective and confident at large fire incidents using CAFS.
When involved in fire attack, the single most important component of any compressed air foam stream is the liquid content.

and/or monitors for application onto a fire.

To effectively use CAFS, fire officers and engineers must understand the important subtleties of compressed air foam delivery. The first item to note involves hoseline finished-foam delivery: Always remember that the liquid content (the Class A foam solution) in the finished-foam stream is what performs the fire-extinguishing work. The compressed air content alone will not extinguish any fire. In CAFS, all the compressed air does is create finished foam bubbles and add horsepower to propel the foam stream.

Therefore, when involved in fire attack, the single most important component of any compressed air foam stream is the liquid content. For fire extinguishment to occur, foam solution delivery rate (gpm) must be at a threshold where it absorbs heat faster than the rate at which heat is being generated by the burning fuel load.

Fire pump operators, when delivering only water, are primarily concerned with producing adequate gpm flow rate (volume) through a given diameter/length hoseline. When pumping a CAFS apparatus, he or she needs to remain concerned with developing adequate flow rate. The flow rate value, however, is expressed in compressed air scfm (standard cubic feet per minute) and foam solution gpm (gallons per minute).

For fire attack service, CAFS pump settings are typically adjusted to discharge a ½–1 ratio of air to foam solution into hoses and monitors. A ½–1 ratio refers to half a standard cubic-feet-per-minute of compressed air to one gallon-per-minute of Class A foam solution.

To deploy 1½” diameter handlines for fire attack, for example, the Humane Fire Company’s Engine 84 SOP is to use a delivery rate of 60 scfm and 120 gpm per hoseline. This is a ½–1 ratio of air to foam solution.

The photo in Figure 3 shows a firefighter with 150 feet of 1½” hose connected to a CAFS engine. With the CAFS pump pressure at 110-psi, this hose/nozzle configuration flows 73-scfm of air and 145-gpm of Class A foam solution.

Fire departments around the country that actively use CAFS employ various nozzle strategies. Some use smoothbore, automatic or variable-gallon nozzles as foam discharge devices. After taking delivery of CAFS, the decision on which specific type of nozzle used by each is generally tied to prior training on fireground tactics more than anything else.

For an example of a smoothbore application, take notice of the firefighter in Figure 4. He has removed the stacked tips from the ¼-turn pistol grip ball shutoff valve. All that is used is the open butt of the ball valve for a foam application device. In reality, there is a smoothbore tip; we’re just not able to see it. The smoothbore tip is the 1½” inside diameter opening of the ¼-turn ball valve.

No nozzle is required is because finished foam is produced. There is no need to “shape” or “enhance” the CAFS finished-foam stream as it exits the last section of hose by using a nozzle pattern. It is highly effective and doesn’t require any additional finishing.

THE 2½” CAFS LINE

Figure 6 shows a firefighter advancing a 2½” fully charged CAFS hoseline with a portable monitor. Flow rate from this monitor with a 2” smoothbore tip is approximately 125-scfm of compressed air and 250-gpm of foam solution.

Since the 2½” hoseline is partially filled with air, this hose feels, handles and advances more like a 1½” line filled with water. Ease of repositioning makes the 2½” attack line a highly valuable fire-suppression tool—a key benefit during initial aggressive fire attack when personnel are limited. A minimal crew of one or two firefighters can deploy the monitor, apply foam, shut down and easily reposition the charged hose to another location to best hit the fire.

The 2½” hoseline and portable monitor’s ability to move high-compressed air foam delivery rates, be easily maneuvered, provide excellent stream reach and bring a large fire to an abrupt end is most impressive.

In summary, CAFS technology has arrived, shows significant advantages and is here to stay. While CAFS are not a panacea, they substantially improve a fire department’s capability to control and suppress fire. The technology deserves serious review and should be an item on every truck committee’s new apparatus equipment list.

Dominic Colletti is assistant chief of the Humane Fire Company in Royersford, Pa. Colletti is the author of Class A Foam—Best Practice For Structure Firefighters and co-author of Foam Firefighting Operations 1 and The Rural Firefighting Handbook with Larry Davis. He also offers a Winning Strategies for the Successful Implementation of Compressed Air Foam Systems seminar. E-mail Colletti at dcolletti@idexcorp.com.