FIRE CHIEF

EVERY DEPARTMENT, EVERY LEADER

BUBBLES beat water

The members of the Los Angeles County Fire Department knew they had a firefighting winner in compressed-air foam, but they had only a string of anecdotes to prove it. In a quest for hard numbers, the LACFD conducted a series of tests and released the results to FIRE CHIEF.

By Chris Cavette, Senior Editor

The Los Angeles County Fire Department has been a leader in implementing Class A foam as a firefighting agent. As one of the first major departments to equip all of their new engines and quints with foam proportioners, it regularly uses Class A foam for direct attack, exposure protection, overhaul and vegetation pretreatment.

Although the department had considerable experience using both naturally aspirated foam and compressed-air foam for exterior structural attacks, its members had less experience in using

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Six lessons learned

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

1) **Interior CAF attacks should be made at the flow rate required for the structure.** CAF saves water by knocking down the fire faster, not by knocking down the fire with a lower flow rate.
2) **A fully charged CAF line has a very strong nozzle reaction.** Pistol-grips or other auxiliary support devices are recommended, because the high-energy 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 and reduces exposure for firefighters. Firefighters should aim at the ceiling level for the best results.
4) **When CAF hits a fire, it generates a large volume of steam.** Because this 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, the upper portions of rooms will still be quite hot.** Once inside, the attack team should stay low and not stand up too quickly after knockdown.
6) **Always overhaul.** Firefighters should use low foam concentrations to produce a wet CAF, as high foam concentrations produce a dry foam that doesn't penetrate as well.

foam for interior structural attack.

To quantify the effectiveness of Class A foam for interior attack, Chief Engineer P. 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 results of these tests present one of the first side-by-side comparisons of the relative effectiveness of these three extinguishing agents for interior attack.

Test conditions

The LACFD began using a Class A foam/water solution on wildland fires in 1988. At that time, the premixed foam was dropped on the fire from specially designed tanks fitted to the department's helicopter fleet.

In 1990, the department began an intensive evaluation of Class A foam proportioners on engine companies. 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, the 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.

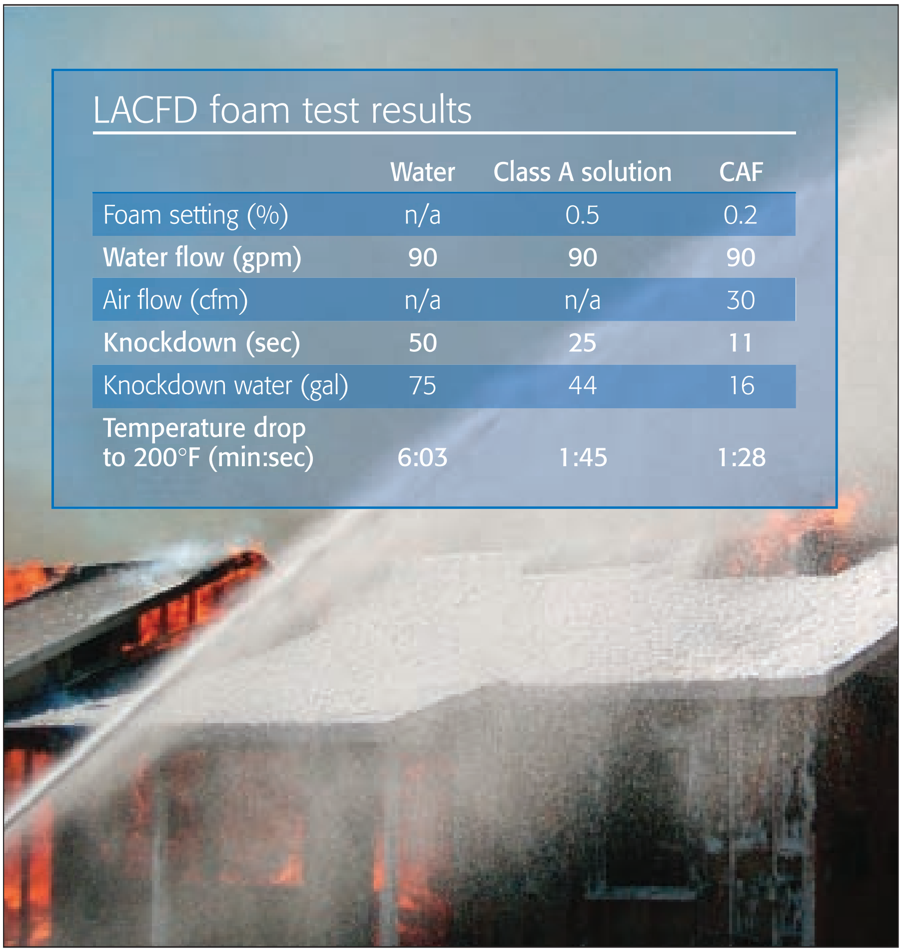
Structures. The burn tests were conducted in Palmdale, Calif., which is in the high desert region of northern Los Angeles County. The test structures consisted of three one-story, wood-framed single-family dwellings that were part of a large housing development built in the 1940's to house workers at a nearby airbase. In recent years, many of the buildings had been left vacant and were condemned, including the three used in these tests.

Each of the test structures had an identical 1,105-square-foot floor plan consisting of six rooms. Interior walls were lath-and-plaster construction, but the exterior stucco walls had been removed prior to the tests because of asbestos contamination. The composition shingle roofing was left in place. All window glass had been removed and replaced with plywood.

Each structure was furnished with identical new furniture to simulate a typical small-residence fire load. Items included beds and bedding, dressers, wood dining room tables and chairs, bookcases, chairs, upholstered couches, coffee tables, various plastic items, magazines, and wall hangings. All carpets were removed. The interior of each structure was rigged with thermocouples to detect temperatures at various locations.

Weather. All tests were conducted in the afternoon within two days of each other in February. Outside air temperatures were in the low- to mid-60s, with partly cloudy or overcast skies at the time of the tests. Winds were light and judged not to be a factor.

Equipment. All attacks were conducted using the same LACFD structure



LACFD foam test results

	Water	Class A solution	CAF
Foam setting (%)	n/a	0.5	0.2
Water flow (gpm)	90	90	90
Air flow (cfm)	n/a	n/a	30
Knockdown (sec)	50	25	11
Knockdown water (gal)	75	44	16
Temperature drop to 200°F (min:sec)	6:03	1:45	1:28

In the Class A foam/water solution test, LACFD personnel used only 31 fluid ounces of concentrate to knock down and overhaul the fire in four rooms. At an average of $13 per gallon, that comes to $3.10 worth of concentrate. The CAF test used even less – only six fluid ounces of concentrate, about 60 cents.

pumper equipped with a 1,500 gpm single-stage centrifugal pump, Waterous/Pneumax 100 cfm CAFS, FoamPro 2001 foam proportioning system, and Phos-Chek WD881 Class A foam concentrate by Astaris. The attack line was 200 feet of $1\frac{3}{4}$-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.

Data acquisition was performed by ThermaDAQ, using an Omega OM-272 charting data logger connected to a computer running DasyLab Data Acquisition System Laboratory 5.62 software.

Attack method

All attacks were conducted by fire suppression personnel trained in the use of foam for interior attacks. The same attack team was used in each test. Capt. Darryl Dutton, who has been instrumental in the development of Class A foam use within the department, supervised the attacks.

Fires were started by igniting furnishings with a propane torch at several locations within each of the four main rooms. Accelerants or added fuels weren't used, and the bathroom in the center rear of the house, laundry room and attached garage weren't involved in the tests. When the average interior room temperature reached between 550° and 850°F, firefighters outside the building started pulling the plywood panels away from the windows with trash hooks to simulate heat failure of the glass.

After the interior was exposed to outside air and 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 across the front of the structure or around to one side to direct a stream through another opening. The CAF attack was started from a position at the curb, approximately 35 feet from the front of the dwelling, because of the tremendous carry of the caf stream.

All flowrates were based on the Iowa formula. The flowrates for the water and the Class A foam/water solution attacks were 90 gpm; the flowrate for the CAF attack was 90 gpm with 30 cfm air. Foam concentrations were set at 0.5 % for the Class A foam/water solution test and 0.2 % for the CAF test.

All attacks were halted when the fire was knocked down, but data recording continued through overhaul. In the case of the water attack, firefighters eventually had to enter the dwelling and switch to a Class A foam/water stream to stop the fire, which had extended into the attic. This was the only test where firefighters had to enter the structure to attack the fire.

The results

The test results seemed to confirm many things that were generally known about foam, but had not been rigorously documented. Most importantly, the tests clearly showed where CAF is superior to either water or Class A foam/water solution for interior attacks.

First of all, it took only 25 seconds to knock down the fire with the Class A foam/water solution, compared to the 50 seconds it took with water. (See table at left.) Using CAF cut that figure by more than half to 11 seconds, making CAF roughly four times more effective than water in terms of knockdown time.

Along with faster knockdown, foam also outscored water in terms of gallons used. The attack team used 44 gallons of Class A foam/water solution to knock down the fire, versus 75 gallons of plain water. The CAF test produced even more dramatic results. It took only 16 gallons of CAF to knock down the fire in all four rooms, which is impressive considering that they started the attack from 35 feet away at the curb. Again, this figure shows CAF to be roughly four times more effective than water in terms of the gallonage required for knockdown.

As an added benefit, the heat-absorbing properties of foam reduced the average interior temperatures significantly faster than water. With Class A foam/water solution, it took 1:45 minutes for the average interior temperature to drop from 600°F to 200°F, compared to 6:03 minutes with water. CAF produced slightly better results with a time of 1:28 minutes.

A plot of interior temperatures versus

time reveals that not only did the foam cool the interior in less time, it started to work more quickly. This was especially true for CAF, which produced an almost immediate reduction of temperatures. By contrast, there was an extended period of high temperature before the cooling effect kicked in when using water. In fact, CAF cooled the interior from 600°F to 200°F about four times faster and with a significantly larger initial temperature drop.

The test team noted several other benefits of foam, but those factors weren't measured in the test.

Less water damage to a building and its contents, as well as less contaminated water runoff.

Faster knockdown means fewer products of combustion in the building and eventually outside in the air.

Increased firefighter standoff distance as a result of CAF's throw being 33% greater than either Class A foam/water solution or water.

After reviewing the results of these tests, Chief Deputy Larry Miller said, "The Los Angeles County Fire Department has made a large investment in developing and utilizing Class A foam and compressed air foam.

"We are very pleased with the outcome of these tests and will continue to develop foam techniques and tactics," continued Miller. "We currently purchase all engines and quints with Class A foam and we intend to purchase more engines with compressed-air foam systems in the near future." FC

CAF success stories

These tests weren't the first time the Los Angeles County Fire Department had seen the benefits of compressed-air foam. Engine companies assigned to CAFS-equipped pumpers had numerous other success stories to tell.

Fire in a two-story single-family dwelling. Upon entry, fire was visible at the top of the second-story stairs. Knockdown was achieved from outside the front door using a CAF stream containing 10 gallons of water. Thermal balance inside the structure was maintained, enabling the firefighters who entered the building to detect and avoid a large hole burned through the staircase landing, thus avoiding possible injury.

Fire in a five-acre pile of shredded tires. Smoke and flames were visible 40 miles away at night. The initial attack with master streams of water was unsuccessful. Three CAFS-equipped engines were dispatched and had the fire knocked down in less than six hours using handlines. Local air and water quality agencies were pleased with the quick extinguishment and minimal environmental impact.

Wildland-urban interface fire structure protection. With a wind-driven wildland fire rapidly advancing toward them, an engine company pretreated a wood-sided house with a blanket of % CAF before evacuating. Two hours later a helicopter pilot, mistaking the white foam for wood ash, reported the structure had been lost. Unwilling to believe the report, the engine company drove back to the house and found it fully intact, even though the fire had burned everything else in the area.

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