FIRE ENGINEERING

QUANTIFYING THE EFFECTS OF CLASS A FOAM IN STRUCTURE FIREFIGHTING:

THE SALEM TESTS

BY DOMINIC J. COLLETTI

Class A foam methodology is easily understood after a close examination of the dynamics at work (see "Class A Foam for Structure Firefighting," *Fire Engineering*, July 1992). However, the claim that Class A foam increases the effectiveness of water for fire suppression remains controversial. Anecdotal/empirical evidence and limited comparative testing have yielded a "three to five times more effective than plain water" guideline, but quantitative evidence is necessary.

Last year, members of the fire service and private industry took a preliminary step toward quantifying the effects of Class A foam for structure fire suppression. A series of controlled room-and-contents fires were performed at Wallops Island, Virginia, and Salem, Connecticut, by Ansul Fire Protection, the Atlantic (VA) Fire Department, Elkhart Brass Manufacturing Company Inc., the Fairfax County (VA) Fire Department, FIERO (the Fire Industry Equipment Research Organization), Hale Fire Pump Company, the International Society of Fire Service Instructors, the National Aeronautic and Space Administration-Goddard Flight Department, and the Salem (CT) Fire Department. The tests provide insight into the effects of Class A foam in municipal fire operations.

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THE SALEM TESTS

The test objective was to measure time/temperature-reduction relationships with the application of water, Class A foam solution, and Class A foam aspirated through a compressed-air foam system (CAFS). Using a thermocouple-strip chart recorder, identical rooms in acquired structures were instrumented. The goal in using acquired structures was to perform testing in a manner that was as "real world" as possible, giving the utmost attention to such variables as fuel loading, fuel placement, agent application, and room ventilation.

The same nozzleman was used on each interior attack to duplicate agent application. In each case, the stream was applied after flashover had occurred. After indirect attack (ceiling) application for 60 seconds, direct application was made to room contents for an additional 60 seconds. Identical gpm and total water flow rates were established through the use of sensitive flow-measuring equipment.

In the Connecticut burns, room sizes were 11- by 10- by eight-feet-high, with moderate fuel loading. Ignition fuel was straw and pallets, providing a duplicable scenario with similar

Reprinted from the February 1993 edition of **FIRE ENGINEERING**

fuel combustion characteristics.

A 20-gpm flow of plain water in burn #1 provided a flow slightly above the mean critical application rate. Any additional improvement in fire suppression capability would be identified in the time/temperature chart during burn #2, Class A foam solution at 20 gpm, and burn #3, compressed-air foam at 20 gpm. (Note: These evolutions were not NFPA 1403 training burns but rather data-collecting fires performed by veteran firefighters and industry professionals.)

TEST RESULTS

The ceiling thermocouple time/temperature difference recorded on all three burns was negligible. This was not surprising, because agent application was made directly to the ceiling (with some direct thermocouple impingement) for the first 60 seconds.

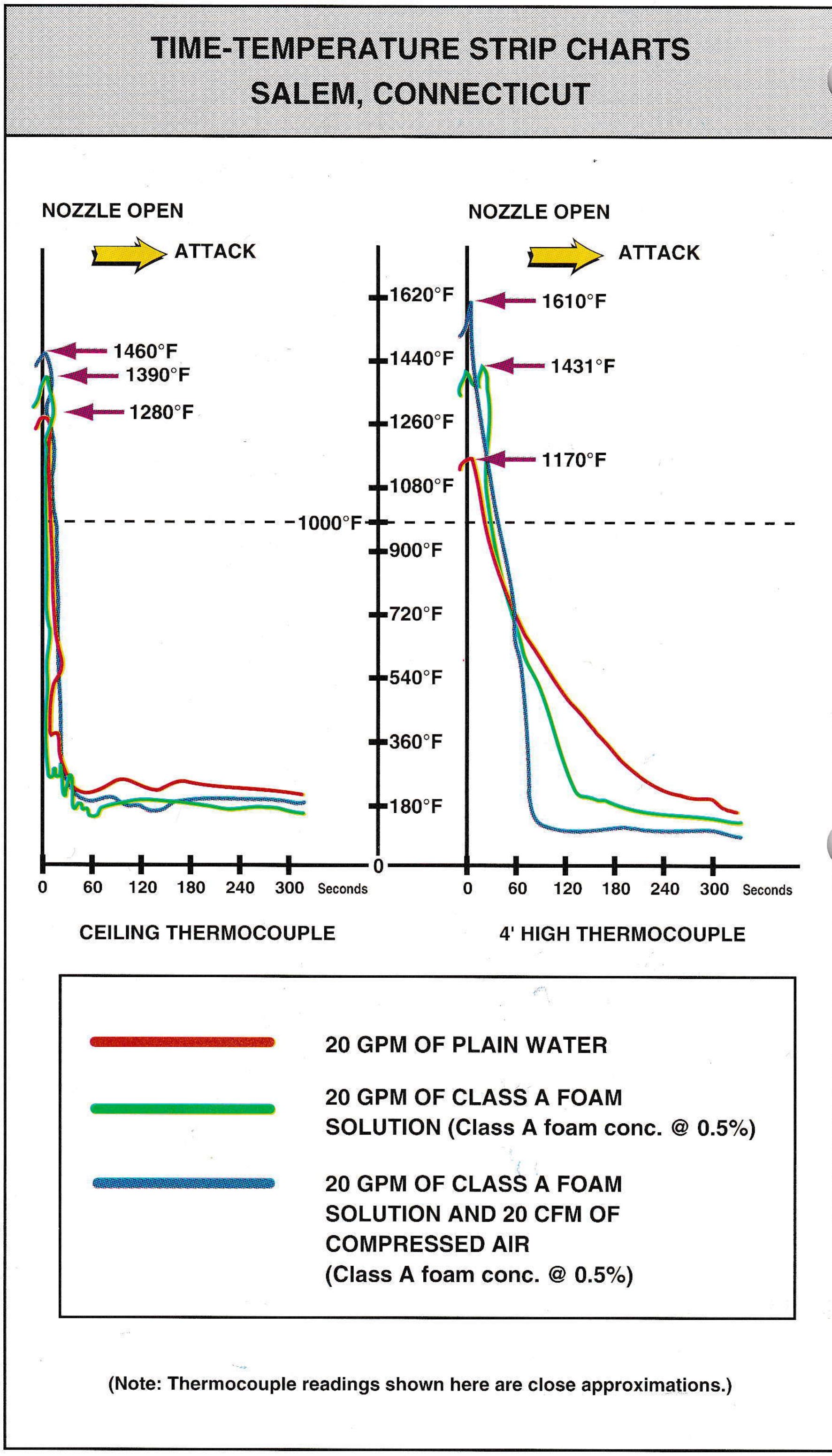
The four-foot thermocouple, however, yielded graphic results:

Temperature Drop
Four-Foot Level
1,000°F to 212°F

	Time (sec.)	Drop Rate (deg./sec.)
Water	222.9	3.5
Foam solution	102.9	7.6
Compressed-air foam	38.5	20.5

Heat at the four-foot level would directly affect the stress/survivability of trapped occupants in close proximity to the room of involvement and also that of firefighting personnel involved in rescue/suppression operations. The tests revealed an increased heat-absorbing ability of foam solution and compressed-air foam, using the same amount of water—thus reducing stress and increasing tenability for occupants and personnel. In this test, water as CAFS discharge (remember, Class A foam does not *replace* water, it *enhances* it; water is still doing the work) was 480 percent more effective than plain water, and water as foam solution was 110 percent more effective than plain water in working to lower room temperature.

The total water supply needed to lower the temperature as indicated was 13 gallons using compressed-air foam, 34 gallons using foam solution, and 74 gallons using plain water, had the nozzle been closed at the 212°F point. Practical experience with Class A foam and common sense dictate that water damage and smoke/fire



damage would be reduced (though these tests were not set up to yield data to prove this).

In all tests, one specific point commented on by the attack crew time and again was the outstanding visibility with little smoke and steam from the application of compressed-air foam. The vapor-sealing/penetrating ability of CAFS discharge produces only small amounts of steam. This maintains a stable thermal balance, providing superior ventilation for removal of combustion products, thus increasing visibility. (These tests did not include fire gas analysis; therefore, no fire gas toxicity data were collected, and no fire gas vs. agent comparison was possible.)

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 aspiration device employed. Note that in the plain water and foam solution applications, an adjustable fog nozzle set on straight stream was used. Experience shows that an air-aspirating nozzle, had it been used to apply the foam solution, would have increased the efficiency of foam solution application. The goal in these tests was to duplicate agent application using the same straight fire stream. Compressed-air foam was applied with a ball shut-off valve only, providing a straight stream.

PRACTICAL RAMIFICATIONS

The introduction of rapidly burning synthetic furnishings over the past three decades has reduced the ability of handline water flows to suppress interior fires. Modern interior attacks using water flows higher than 90 gpm with 1¾-inch hoseline and automatic nozzle have increased application rates from years past. However, factors such as limited personnel resources, nozzle reaction force, and immobility of larger-diameter hoseline dictate that there are practical limits to introducing higher gpm application rates to reduce flame knockdown times and increase firefighter safety.

Adding Class A concentrate through a proportioning system on structural pumpers can be one way to increase the fire-killing ability of water flows, as scientific and anecdotal evidence indicates. A possible 100-percent increase could give 120 gpm of foam solution flow the suppression ability of up to 240 gpm of plain water, if applied correctly. The suppression effectiveness of booster tank water can be enhanced by CAFS, if applied correctly, by 300 to 500 percent. As such, its effect on increased firefighter safety, improved operational efficiency, and reduced property damage during manual structure fire operations should be seriously considered. Data such as that compiled in the Salem and Wallops Island tests, as well as anecdotal field success, confirm the need for full-scale, controlled laboratory comparative testing by third-party agencies. ■