

Page 1

[Influence of Crew Sizes and Arrival Times on Firefighting](#)

[Next Generation SCBA](#)

Page 2

[Cancer Risks for Female Firefighters](#)

Page 3

[Saving Lives in Dormitory Fires: Sprinklers, Alarms, and Closed Doors](#)

Page 4

[Coffee Break Training](#)

Influence of Crew Sizes and Arrival Times on Firefighting

A recent study issued by the National Institute of Standards and Technology (NIST) shows that the size of firefighting crews has a substantial effect on the fire service's ability to protect lives and property in residential fires. The report is the first to quantify the effects of crew sizes and arrival times on the fire service's lifesaving and firefighting operations for residential fires. Until now, little scientific data have been available.

Performed by a broad coalition in the scientific, firefighting and public-safety communities, the study found that four-person firefighting crews were able to complete 22 essential firefighting and rescue tasks in a typical residential structure 30 percent faster than two-person crews and 25 percent faster than three-person crews. The four-person crews were able to deliver water to a similar-sized fire 15 percent faster than the two-person crews and 6 percent faster than three-

person crews, steps that help to reduce property damage and lower danger to the firefighters. This study explored fires in a residential structure, where the vast majority of fatal fires occur. The two-story, 2000-square-foot test facility was constructed at the Montgomery County Public Safety Training Academy in Rockville, Md. Fire crews from Montgomery County, Md., and Fairfax County, Va., responded to live fires within this facility.



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Twenty-two fireground tasks were completed in each experiment. Meticulous procedures gathered data to measure key areas of focus, such as individual task start times, task completion times, and overall scenario performance times. Photo credit: NIST.

Next Generation SCBA

Recently, the Department of Homeland Security awarded the International Association of Fire Fighters (IAFF) a \$2 million contract to develop a new pressure vessel that will make the self-contained breathing apparatus (SCBA) worn by first responders substantially thinner and lighter. The global safety equipment manufacturer, MSA,

will develop the prototype SCBA and it is expected to demonstrate the superiority of new pressure-vessel technology that would replace the single air cylinder design of conventional fire fighting breathing apparatus.

The prototype design that is currently being tested and refined consists of a series of air

cylinders attached by flexible connectors between the bottles that allow for the pack to bend and conform with the firefighter's back and movements. The new-style SCBA will use a special high-temperature lining, consisting of Kevlar, and are wound with carbon fiber, instead of the conventional aluminum liners used in current technology.

Cont. on page 3.

<http://www.fire.gov/>

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Influence of Crew Sizes and Arrival Times on Firefighting, cont.

NIST researchers and their collaborators conducted more than 60 controlled fire experiments to determine the relative effects of crew size, the arrival time of the first fire crews, and the "stagger," or spacing, between the arrivals of successive waves of fire-fighting apparatus (vehicles and equipment). The stagger time simulates the typically later arrival of crews from more distant stations as compared to crews from more nearby stations.

Crews of two, three, four and five firefighters were timed as they performed 22 standard firefighting and rescue tasks to extinguish a live fire in the test facility. Those standard tasks included occupant search and rescue, time to put water on

fire, and laddering and ventilation. Apparatus arrival time, the stagger between apparatus, and crew sizes were varied.

Researchers also performed simulations using NIST's Fire Dynamic Simulator to examine how the interior conditions change for trapped occupants and the firefighters if the fire develops more slowly or more rapidly than observed in the actual experiments. The fire modeling simulations demonstrated that two-person, late-arriving crews can face a fire that is twice the intensity of the fire faced by five-person, early arriving crews. Additionally, the modeling demonstrated that trapped occupants receive less exposure to toxic combustion products—

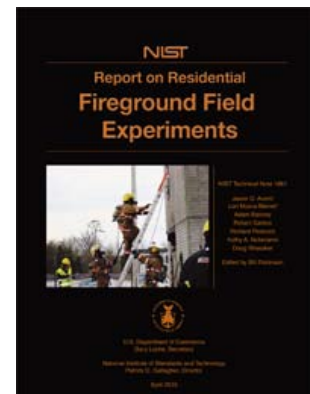
such as carbon monoxide and carbon dioxide—if the firefighters arrive earlier and involve three or more persons per crew.

The next step for this research team is to develop a training package for firefighters and public officials that would enable them to have both quantitative and qualitative understanding of the research, a project also funded by FEMA's Assistance to Firefighters Grant Program.

The report was funded by the U.S. Department of Homeland Security, Federal Emergency Management Agency's (FEMA) Assistance to Firefighters Grant Program and released today in Washington, D.C., before the start of the annual

Congressional Fire Services Institute meeting that draws top fire safety officials from across the nation.

The *Report on Residential Fireground Field Experiments*, (NIST Technical Note 1661), can be downloaded here: http://www.nist.gov/cgi-bin/get_pdf.cgi?pub_id=904607



Cancer Risks for Female Firefighters

Exposure to chemicals that may increase the risk of breast cancer can be encountered in all types of firefighting. There are very few studies on women firefighters and the risk of female cancers, including breast cancer; however, other studies of workplace exposures to certain chemicals have shown some evidence of a higher risk of breast cancer, and some of these chemicals are also encountered in firefighting (i.e., Formaldehyde and Benzene.) Hence, it is prudent to take precautions against exposures to these chemicals.

Occupational Studies in Women -- Formaldehyde – In women exposed to formaldehyde, two studies have shown a higher risk of developing breast cancer (Cantor et al., 1995; Coyle et al., 2005). Because of overall

evidence of increased risk of several types of cancer, and potential exposure in fire scenarios (IARC, 2006), it is important to take protective action to minimize exposure to this chemical. **Benzene** – Breast cancer risk was higher in several large-scale studies of women working in jobs exposed to high levels of benzene (as an organic solvent) (Hansen, 1999; Petralia et al., 1998). More studies are needed on whether benzene inhalation in other professions affects the risk of breast cancer.

Some Examples of Chemical Risks to Firefighters -- **Smoldering Combustion** – Benzene: generated from epoxy resins and the decomposition of polyester foam and fiberfill found in bedding and upholstery. Generated from polyvinyl chloride (PVC) used

as coating in wire and cables, in electrical equipment, and in window treatments (blinds and drapes) and wall coverings. **Formaldehyde**: released from permanent press finishes on fabric treated with melamine-formaldehyde resins and from simple acrylics found in paints and bed clothing and epoxy coatings. **Overhaul, Salvage, and Fire Investigation Activities** -- Benzene and formaldehyde: released during salvage tasks performed during and after a fire. They are released during such overhaul tasks as pulling apart walls, ceilings, and removing furniture to locate and extinguish hidden fires. The gases also are released during delayed off-gassing after chemicals adsorbed onto masonry and concrete.

Full details are available on a website created by Cornell

University's School of Industrial and Labor Relations (<http://www.ilr.cornell.edu/healthsafety/research/cancer/Fire08.html>) including a brochure, "BCERF Alert for Women Firefighters: Chemical Exposures in Your Workplace and Breast Cancer Risk."



Next Generation SCBA, cont.

They can handle operating pressures up to 4,500 psi the new vessels won't fragment if they're ruptured. A punctured vessel would simply vent contained air.

The weight has been pared from 30 pounds to 8 pounds, its profile is only 1.75 inches thick, it's rechargeable, and it's compatible with existing air supply hoses. Another advantage from using the smaller containers is that they don't heat up while filling, thus removing the need to "top off" the tanks after they cool down. The air packs, when emptied, are exchanged just like the cylinders are now. You simply unhook your regulator and mask and connect a filled pack.

Since they are thinner and flat, they can be stacked efficiently without the need for bottle racks, thereby permitting three times the number of air packs to be stored in a truck compartment.



Check out a short video on [FireEngineering.com](http://community.fireengineering.com/profiles/blog/show?id=1219672%3ABlogPost%3A172273): <http://community.fireengineering.com/profiles/blog/show?id=1219672%3ABlogPost%3A172273>. Photo Credit: FireEngineering.com

The IAFF expects the first prototype to be built by MSA by Sept. 30, 2010, and then field testing will follow. The unit will be tested by a team of evaluators that includes 12 firefighters and two law enforcement officers.



Photo Credit: IAFF

Saving Lives in Dormitory Fires: Sprinklers, Alarms, and Closed Doors

Recently, the National Institute of Standards and Technology (NIST) fire researchers had the opportunity to conduct experiments in a university dormitory that was going to be torn down. As part of a U.S. Fire Administration (USFA) initiative to improve fire safety in college housing, NIST conducted two series of full-scale fire experiments in abandoned dormitory buildings. The objective of the study was to compare the levels of hazard created by room fires in a dormitory building with and without automatic fire sprinklers in the room of fire origin.

Five experiments were conducted which included variables such as an open/closed door between the room of origin and the corridor, and with/without sprinklers in the room of origin. The rooms

used in the experiments were furnished as typical dorms, including clothing, books, and furniture. In two of the experiments, the door between the dorm room (room of fire origin) and the corridor was closed. In the other three experiments, the door from the

dorm room (room of fire origin) remained open to the corridor. In each case, door closed or door open, one of the experiments included an operating automatic fire sprinkler. The results from the experiments comparing the sprinklered and non-sprinklered

dorm rooms were presented, as well as a comparison of the results from the open and closed corridor door experiments. Rooms for experiments 2 and 3 had automatic sprinklers installed.

Cont. on page 4.



Post fire photographs of the dorm room for Experiment 1 (door closed) on the left and Experiment 5 (door open) on the right. Three of the five Experiments, 1, 4 and 5, were conducted without sprinklers. The first experiment had the dorm room door to the corridor closed, while the door was open in the latter two experiments (4 and 5). The photos and data show the impact that a closed door can have on the room of origin. Photo Credit: NIST.

Saving Lives in Dormitory Fires: Sprinklers, Alarms, and Closed Doors, cont.

The automatic fire sprinklers activated within two minutes after ignition in both experiments. In the sprinklered experiments tenability was maintained in the dormitory room and corridor. Experiments 4 and 5 were conducted with the dormitory room door open and no active sprinkler. In both experiments the tenability limits were exceeded in the dormitory room and corridor.

The experiments demonstrated the value of a closed door between the fire room and corridor in limiting the spread of smoke and gasses to other areas of the building. The potential life safety benefits of smoke alarms, compartmentation and automatic fire sprinkler systems in college dormitories and similar occupancies were demonstrated. To learn more about these experiments, see the

report “*Impact of Sprinklers on the Fire Hazard in Dormitories: Sleeping Room Fire Experiments*” (NISTTN 1658.) It is available at http://www.nist.gov/cgi-bin/get_pdf.cgi?pub_id=904640. Another report in the series, “*Impact of Sprinklers on the Fire Hazard in Dormitories: Day Room Fire Experiments*” (NISTIR 7120) also may be of interest. It is located at http://www.nist.gov/cgi-bin/get_pdf.cgi?pub_id=101409.

The study was performed as part of the U. S. Fire Administration’s initiative to improve fire safety in college housing and in cooperation with the University of Arkansas and the Fayetteville Fire Department.

For more information on the U. S. Fire Administration’s College Campus Fire Safety Program, go to their site: www.usfa.dhs.gov/citizens/college/.

Coffee Break Training

Fire and emergency medical services personnel with busy daily schedules often don’t have time to attend valuable skill-enhancing training sessions, so the United States Fire Administration (USFA) is providing “Coffee Break Training” bulletins for you to read and enjoy during your daily break. They consist of one-page training notices and a new one is posted every week. These notices contain administrative tips as well as training. In addition, each notice includes a photograph or drawing illustrating the point of the training session.

The series includes: Fire Protection, Fire Investigation,

The series includes: Fire Protection, Fire Investigation, and InfoSearch and Web 2.0. There also may be a Special Feature. On March 31, 2010, the Special Feature was: *Building Construction: U.S. Consumer Product Safety Commission Alert to Fire Safety Professionals*. There are also Coffee Break Videos to illustrate new techniques.

It is possible to do a Self Evaluation on a quarterly basis to see how well you have done in your studies. If you can’t find the answers to some of the questions, reference numbers are provided after the question to assist you in finding the answer.

Next time you have a few minutes, go to <http://www.usfa.dhs.gov/nfa/coffee-break/> and watch a video or go to one of the training

series to find some interesting information. One word of caution: Please don’t spill your coffee on the keyboard!

Coffee Break Videos



 [Fire Sprinkler Inspectors Test](#) (4:15)

Courtesy of USFA.

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