NEW SCIENCE
FIRE SAFETY
ARTICLE

INNOVATING FIRE ATTACK TACTICS

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NEW SCIENCE
FIRE SAFETY
OVERVIEW

UL's dedicated team of scientists, engineers and researchers is creating New Science in a variety of ways. From live experiments to computational modeling, statistical analysis to quantification of risk, we are constantly seeking to improve products, techniques, methodologies, processes and standards.

WHY INNOVATIVE FIRE ATTACK TACTICS MATTER

Firefighters are being challenged by different fireground hazards due to today's more open floor plans and the use of synthetic materials in furniture and building products.[1] These changes have made structure fires more deadly than ever before and call into question traditional firefighting tactics. Innovative fire attack tactics matter because, although they may go against traditional practices, they represent a more effective way to make the fireground safer for both building occupants and firefighters.

CONTEXT

The changes in modern building design and materials have altered the nature of structure fires, with modern homes able to reach flashover eight times faster than homes built 50 years ago.[2] This change is largely behind the 67% increase over the past 30 years in the rate of firefighter deaths due to traumatic injuries while operating inside structures.[3] And although the overall fire death rate in the U.S. has decreased by 64% during the same period,[4] it is clear that modern structure fires can be deadly to both firefighters and building occupants.

Many of the tactics employed by the American fire service have been developed based on personal experience — of individual firefighters and as passed down by their predecessors.[5] To the credit of many of these firefighters, their tactics have proven successful in controlling and mitigating the hazards of fire for more than 250 years.[6] However, the number of structure fires has decreased by 53% over the past 30 years,[7] which has had an unintended consequence of limiting the opportunities for firefighters and fire officers to gain the necessary experience to understand the increasingly complex fires they fight.[8]

One common practice was for firefighters to fight fires exclusively from inside a burning building during search and rescue efforts.[9] There was a widely held belief — supported by anecdotal evidence — that attacking a fire with water from outside the building would push the fire further into the structure, making conditions beyond the fire worse and potentially increasing the risk to firefighters and trapped victims.[10] Because of this, the firefighters who were first on the scene would typically pull a fire hose with them as they searched room-by-room for victims while the fire blazed and their colleagues watched outside and waited for them to emerge.[11]

Given these developments, UL saw a clear need for new insights about fire progression, fire behavior and what happens to the structural integrity of a building under fire conditions. UL also saw a need for improved firefighting tactics that would enable modern structure fires to be fought more effectively while improving firefighter safety and building occupant survivability.[12]

WHAT DID UL DO?

UL conducted two sets of full-scale, live-fire experiments to test a number of innovative fire attack tactics.

UL conducted two sets of full-scale, live-fire experiments to "demystify" the modern fireground — specifically, to better understand modern fire conditions and to evaluate the effectiveness of traditional and new firefighting tactics.[13] The first set of live-fire experiments were staged in two houses constructed in UL's large fire facility in Northbrook, IL.[14] These experiments were conducted under the United States Department of Homeland Security (DHS) Assistance to Firefighter Grant Program.[15] One of the houses had one story (1,200 ft^2, three bedrooms, one bathroom), with a total of eight rooms. The second house had two stories (3,200 ft^2, four bedrooms, two and a half bathrooms) and had a total of 12 rooms, a modern open floor plan, a two-story great room and an open foyer. A total of 17 full-scale residential structure fire experiments were conducted in the two houses to examine different ventilation scenarios and a variety of tactics, including controlling the front door, making different sized ventilation holes in the roof and using exterior hose streams.[16]

The second set of live-fire experiments were funded by the Fire Department of New York (FDNY) and carried out in partnership with the FDNY and the National Institute of Standards and Technology (NIST). The experiments[17] were conducted on a series of unoccupied homes on Governors Island. The structures were two-story townhouses with full basements, approximately 800 square feet per floor, concrete block walls, brick exterior, and wood-framed interior walls and flooring systems. The fuel load included real furniture of common construction — wood frame, polyurethane foam, polyester batting and fabric — to simulate current hazards. The furniture was consistent from home to home to enable comparison between experiments. All of the Governors Island experiments were also consistent with the previous room-and-contents fire experiments conducted by NIST and UL. These experiments resulted in ventilation-limited (fuel-rich) fires.

UL used these homes to test a variety of experimental scenarios, including a number of innovative exterior attack tactics. The exterior attack is an offensive approach — analogous to the military concept of "softening the target" — that requires an aggressive attack just prior to entry, search and tactical ventilation.[18] UL benchmarked the exterior attack against a traditional offensive attack that is initiated by deploying

hoselines inside the structure directly at the seat of the fire.[19] The UL experiments showed that the traditional approach is not always the best. Several experiments were conducted in homes with different fire conditions. In one example, in a two-story house, fire was showing from a second floor window:

> "Traditional tactics call for the hoseline to be charged in the front of the house prior to entry, but water is usually not flowed onto the fire prior to entry. Even if the interior path to the fire is known, flowing water directly onto the fire is faster from the outside than it is from the inside ... In this experiment, temperatures were measured in the hallway just outside the room and in the other bedrooms on the second floor. Twenty-five gallons of water directed off of the ceiling of the fire room from the exterior decreased fire room temperatures from 1,792 degrees F to 632 degrees F in 10 seconds; the hallway temperature decreased from 273 degrees F to 104 degrees F in 10 seconds."[20]

Applying water directly into the fire compartment as soon as possible results in the most effective means of suppressing the fire.[23]

The key findings of our experiments show that the common belief about exterior fire attack pushing the fire is unfounded and that innovative fire attack tactics can improve the safety and effectiveness of firefighting efforts:

Water applied via exterior attack does not push the fire.[21]

The anecdotal experience of firefighters can be explained by one of the following scenarios: 1) A flow path is changed with ventilation and not with water application. 2) A flow path is changed with water when the thermal layer is disrupted and steam moves ahead of the line, elevating the level of heat and creating the impression to those downstream that the fire is being pushed. 3) Turnout gear becomes saturated with energy, which begins to pass through to the firefighter. If this occurs in close proximity to when a hoseline is opened, it might appear that the hoseline caused the rapid buildup of heat. 4) One room is extinguished, allowing air to entrain into another room, which causes that room to ignite, burn more intensely or reach flashover.[22]

Rather than making conditions more hazardous, applying water directly into the fire compartment as soon as possible results in the most effective means of suppressing the fire.[23]

Specifically, our research showed that applying a hose stream through a window or door into a room involved in a fire significantly lowered room temperatures everywhere in the home. Even a small amount of water, applied as quickly as possible regardless of where it is from, improved conditions inside the burning home. And in cases where front and rear doors were open and windows had been vented, the application of water through one of the vents enhanced conditions throughout the structure.

Our experiments showed that exterior fire attack increases the potential survival time for building occupants and provides safer conditions for firefighters performing search and rescue. In fact, our experiments demonstrated that the traditional practice of increasing ventilation to a ventilation-limited structure fire by opening doors, clearing windows or cutting the roof increased fire hazards and the potential for a rapid transition to flashover.[24]

While the attack should be commenced from the exterior, to improve conditions for firefighters and building occupants, it must be finished inside.

Applying water to the fire as soon as possible from the outside softens the target and helps firefighters gain the upper hand, but the attack and size-up should be continued from inside the home. Once conditions inside the structure are made safer, continuing the attack from the inside increases the speed and effectiveness of fully extinguishing the fire.[25]

UL conducted full-scale, live-fire experiments to better understand modern fire conditions.

IMPACT

The UL research provided an enhanced understanding of fire behavior in structures and demonstrated the viability of innovative attack tactics. UL is now working to spread the word to transform the way firefighters think about and approach structure fires. UL is presenting the data from the experiments to the Fire Department Instructors Conference and Fire Rescue International. UL is also sharing the data with the International Society of Fire Service Instructors, the International Fire Service Training Association and the National Fire Protection Association.[26] In this way, the innovative tactics tested in UL's live-fire experiments will help ensure that firefighters around the world more safely and effectively fight modern structure fires.

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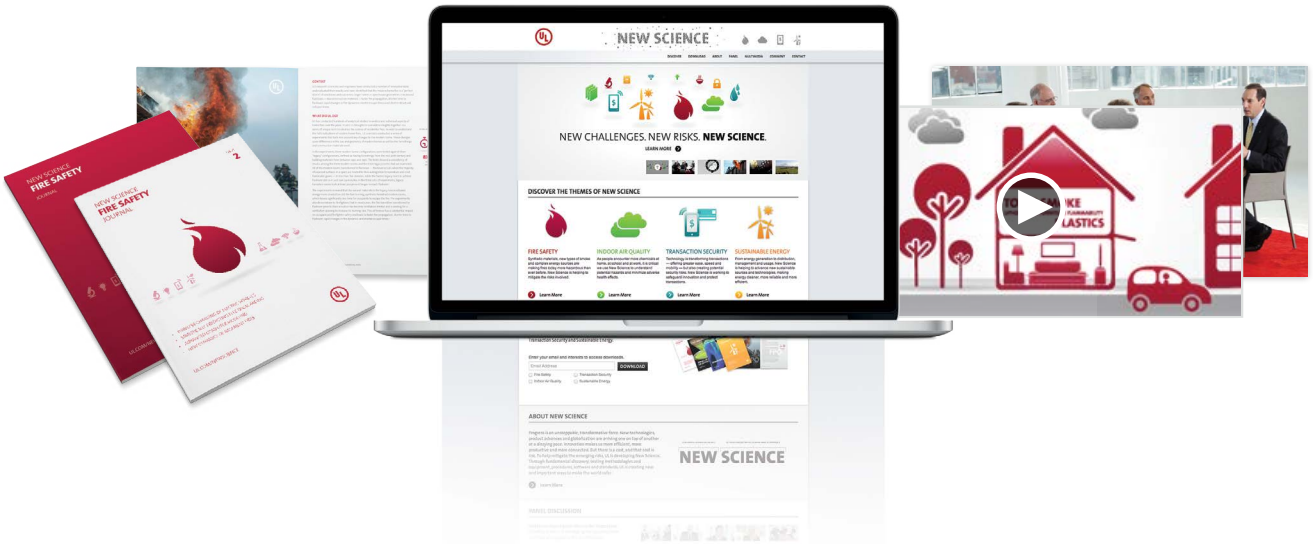

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