

HOW CREW SIZE AFFECTS LADDERING AND VENTILATION TIME FOR LOW HAZARD RESIDENTIAL STRUCTURE FIRE

Regardless of the size of a structure fire, firefighting crews identify four priorities: life safety of occupants and firefighters, confinement of the fire, property conservation, and reduction of adverse environmental impact. Interdependent and coordinated activities of all firefighting personnel are required to meet the priority objectives.

Two of the most influential tasks on these priorities are laddering and ventilation of the structure. Every firefighter knows the importance of properly raising ground ladders and executing ventilation in controlling a structure fire.

Firefighters on the scene are tasked with placing ground ladders to windows and the roof to provide a means of egress for occupants or firefighters themselves. Ventilation provides a more tenable atmosphere for occupants and firefighters and helps improve visibility in an otherwise “pitch black” environment. Ventilation must be coordinated with the advance of the attack line and water on fire to control the fire and not contribute to fire growth.

The following graphs shows the results for crew sizes of two, three, four, and five firefighters, documenting the start and end times for the tasks of laddering and ventilation and illustrate vividly the amount of time needed by various crew sizes.

The four- and five-person crews operating on a low-hazard structure fire completed laddering and ventilation (for firefighter safety and occupant rescue) 30% faster than the two-person crews and 25% faster than the three-person crews.

These data provide significant information for critical crew size decisions. The sooner important fire fighting tasks such as laddering and ventilation are completed, the lower the risk to firefighters and the greater the opportunity to rescue trapped occupants.

NIST Report on Residential Structure Fire

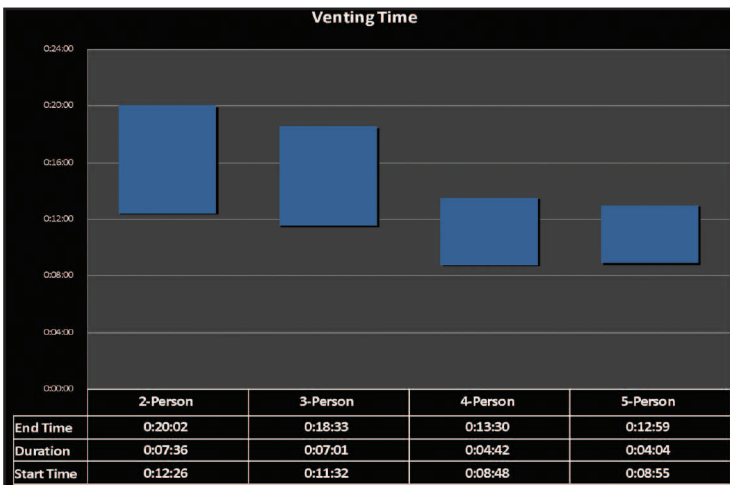
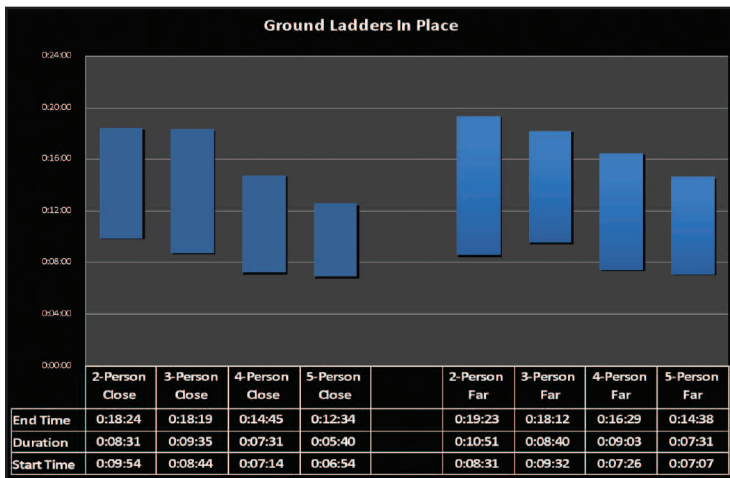
The study is the first to quantify fire service lifesaving and firefighting operations for a low-hazard residential structure including the effects of changes in crew size, arrival time, and stagger on rescue and suppression effectiveness.¹

The study included more than 60 controlled fire experiments, both in our large fire laboratory and at the custom low-hazard residential burn building constructed at the Montgomery County Training Academy.

Overall, the results of the study show that that the number of fire service crew members in each company responding to a fire in a 2,000 square-foot, two-story structure had a substantial effect on the crew’s ability to protect lives and property. The results also provide quantitative data to fire chiefs and public officials responsible for determining safe staffing levels, appropriate station locations, and necessary funding for community and firefighter safety.

Methods

A team of fire service experts designed a research methodology that led to over 60 experiments measuring time-to-task completion with crew sizes of two, three, four, and five firefighters, with different arrival times and different intervals between arrival of each apparatus. A burn building with sophisticated instrumentation was specially constructed for the project. Twenty-two key tasks were measured, beginning with the first engine stopped at the fire hydrant and ending with a fan operating at the front door for mechanical ventilation. Using firefighters acquainted with the tasks as timers and corroborating their data with video records, the researchers accurately timed each task as it was performed by the different crew sizes. Personnel from the Montgomery County (Maryland) and Fairfax County (Virginia) Fire and Rescue Departments performed the various tasks specified by the research methodology. The data from the time to task experiments were combined with results of fire modeling conducted at the National Institute of Standards and Technology to correlate task timing to fire growth rates.



¹ Funded by a grant from the Department of Homeland Security/Federal Emergency Management Agency Grant Program Directorate for Assistance to Firefighters Grant Program, the project was conducted by a research partnership of the Commission on Fire Accreditation International, the International Association of Fire Chiefs, the International Association of Firefighters, the National Institute of Standards of Technology, and Worcester Polytechnic Institute. The complete report is available for download at http://www.nist.gov/cgi-bin/view_pub.cgi?pub_id=904607&division=866