Performance of Personal Alert Safety Systems in Laboratory and Full-Scale Experiments

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In 1998, over 500 firefighters in the United States were trapped in structure fires that resulted in injury or death of firefighters. Firefighters can be quickly overcome by the heat or smoke of a fire and may be unable to alert other fire ground personnel to their need for assistance. Personal Alert Safety System (PASS) devices are designed to signal for aid via an audible alarm. Typically, PASS devices sense movement or lack of movement and activate a 95-decibel alarm signal if the lack of motion exceeds a specific time period. The loud alarm signal alerts other personnel that a firefighter has become incapacitated and it helps to guide rescue personnel to the location of the incapacitated firefighter. While the current NFPA Standard for PASS devices(1982) requires only a motion detector, some manufacturers are beginning to incorporate thermal exposure sensors into each PASS device. Some PASS devices are also being integrated into fire ground personnel accountability systems. This research will assess the current state-of-the-art in PASS technology and will examine specific enhancements, which may include elimination of false alarms, improve accuracy, linking to Global Positioning Systems (GPS) and/or personnel tracking systems, and incorporating additional sensors, such as thermal sensors or toxic gas analyzers.

This project assessed current PASS device technology by purchasing PASS devices from four different vendors and evaluating devices both in the laboratory as well as in full-scale burns. Laboratory evaluations include controlled exposure/response in ovens and plunge test apparatus. Instrumented mannequins were inserted into furnished rooms which were subsequently burned in full-scale tests. Mannequins were instrumented front and rear with three PASS devices during a series of townhouse/apartment burns in Pinal County, Arizona. PASS devices are also being exposed to different temperature ranges in non-flow or static oven tests and in flowing or moving air plunge apparatus experiments.

The field and laboratory evaluations demonstrated that 1) thermal exposure type PASS devices did alarm after exposure to full-scale fires and lab-scale oven tests, 2) radiation can accelerate the response of PASS devices, and while thermal exposure type PASS devices can warn fire fighters of harmful exposure to thermal energy, performance test/protocols must include both thermal radiation and heat conduction in order to fully characterize thermal performance of PASS devices.