

# How flames change the sound of a firefighters' personal safety alarm

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The PASS, short for "Personal Alert Safety System," has been used by firefighters for thirty years to help track members of their team who might be injured and need assistance to escape a fire. Though the alarm has saved many lives, there are cases in which the device is working correctly but is not heard or not recognized. In one recent incident report from 2010, firefighters inside a burning building either did not hear or heard and then stopped hearing an alarm that was easily audible from outside the building.

Working with the National Fire Protection Association (NFPA), a team of [mechanical engineers](#) from the University of Texas at Austin (UT Austin) has been assessing whether flames might be partially responsible for these occurrences. The researchers will present their findings on how flames affect the sound of the PASS alarm at the 21st [International Congress](#) on Acoustics (ICA 2013) in Montreal, to be held June 2-7, 2013.

"This study is the first time that the acoustics of the PASS device have been studied in this comprehensive a manner," says Mustafa Abbasi, a UT Austin graduate student who will present the team's work.

One aspect of the UT study involved making recordings of the PASS device in the presence of small, trash can-sized fires in a controlled laboratory setting. The team found that the development of the fire did indeed change the qualities of the alarm: just ten seconds after the fire was lit, the sound became muffled and quieter. And while the normal

call of the device sounded like two distinct whistles one after the other, the fiery environment seemed to merge those two sounds into one. "It did not change beyond recognition but it was an audible change," Abbasi says. "We believe the effect will be magnified by larger fires," he adds.

A potential reason for the merging of the calls is that flames can change the direction of a sound. Fire is a very strong scatterer: a noise can bounce off of [flames](#) similar to the way it might ricochet off a wall, making it difficult for [firefighters](#) to determine from where the noise originated. Fire also creates a temperature gradient in a room, with hotter air at the top and cooler air at the bottom. Since sound travels faster through hot air, the merged sound of the PASS [whistles](#) might come from this speed discrepancy – an overlap between two or more paths of sound.

Though it is too soon to make specific recommendations for changes to the device, the team believes that increasing the overall volume beyond its current setting of 95 decibels (dB) will be helpful. (95 dB is about as loud as a jack hammer from 50 feet away.) The UT Austin team also plans to test other types of signals that might be less difficult to distinguish in a noisy fire environment that includes the noise from fire alarms, generators, chainsaws, fans, fire hoses, the fire itself, radio chatter, and [fire](#) truck engines.

In addition to experimenting with the PASS device, the UT Austin researchers are examining the impact of protective gear (such as helmets) on a firefighter's ability to determine the source of sounds like a personal alarm or a rescue subject's calls for assistance. A second presentation on this subject will be made by UT Austin graduate student Joelle Suits.

**More information:** Presentation 4aEAb4, "Measuring the acoustic response of a compartment fire," is in the morning session on Thursday,

June 6. Abstract: [asa.aip.org/web2/asa/abstracts ...  
h.jun13/asa1074.html](https://asa.aip.org/web2/asa/abstracts...h.jun13/asa1074.html)

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