



## Review of Audible Alarm Signal Waking Effectiveness

Smoke alarm and signaling systems are a proven strategy for reduction of fire fatalities in the general population, however many at-risk populations (e.g. elderly, children, alcohol impaired, and hard of hearing) do not fully benefit from conventional smoke alarm systems, particularly during sleeping hours. Research has been conducted to develop performance requirements to optimize the waking effectiveness for alarm and signaling systems to meet the needs of these at-risk groups. Past work has concluded that the 520 Hz low-frequency harmonic tone, three-pulse temporal pattern was the most effective signal to awaken hard of hearing participants, children and other at-risk groups. Performance requirements for a sound pressure level of 85-dBA at 10 feet from the device for single and multiple-station smoke alarms appear in multiple codes and standards, including UL 217, Standard for Smoke Alarms. The 85-dBA specification requires significantly more power, which makes the 520 Hz low-frequency harmonic tone signal a particular challenge for alarms operating on a battery/battery backup.

### **Project Goal & Approach**

The goal of this research project was to assess the data on the waking effectiveness of audible alarms to determine an acceptable reduction in the required sound pressure for sounders using a 520 Hz low-frequency harmonic tone signal that still provides superior waking effectiveness compared to high-frequency sounders.

### **Summary Observations**

The analysis conducted herein, among other research studies, have shown clear evidence that low frequency harmonic tones can provide equivalent or improved waking performance over traditional high frequency alarms for both normal and at-risk populations. A few highlighted findings include:

- A reduction in required sound pressure level could be justified to allow design of battery-operated low frequency smoke alarms.
- The primary research gap remaining, is the designation of the exact acceptable magnitude for reduction in sound pressure level (SPL).
- The initial recommendation for a reduction in SPL based on review of previous work, is as follows:
  - For high risk groups, a reduction of less than 20 dBA would likely provide improved performance over high frequency alarms
  - For normal population, a reduction of 4-6 dBA could possibly be justified.
- Next step is for stakeholders to review the data summarized and determine if and how much of a reduction could be justified.

For more information:

- Final report is available [here](#)
- Webinar recording is available [here](#)

### **Research by:**



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