IMSA Journal
November/December 1999

Intelligent Intelligibility

by Dean K. Wilson, P.E.

Question: I've heard that the new *National Fire Alarm Code,* NFPA 72-1999, now includes information regarding the intelligibility of voice alarm systems. If this is so, how will it impact jobs I will start shortly?

Answer: Imagine that. The 1999 edition of the *National Fire Alarm Code* finally offers some guidance on the intelligibility of voice fire alarm notification. Well, actually, that's not really fair. NFPA 72-1996, Section 6-3.2.2, and its related Appendix Section A-6-3.2.2 stated:

> 6-3.2.2* To ensure that audible public mode signals are clearly heard, they shall have a sound level at least 15 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 ft (1.5 m) above the floor in the occupiable area.
>
> A-6-3.2.2 The constantly changing nature of pressure waves, which are detected by ear can be measured by electronic sound meters, and the resulting electronic waveforms can be processed and presented in a number of meaningful ways. Most simple sound level meters quickly average a sound signal and present a root mean square (RMS) level to the meter movement or display. However, this quick average of impressed sound results in fast movements of the meter's output that are best sent when talking into the microphone; the meter quickly rises and falls with speech. However, when surveying the ambient sound levels to establish the increased level at which a notification appliance will properly function, the sound source needs to be averaged over a longer period of time. Moderately priced sound level meters have such a function, usually called L_{eq} or "equivalent sound level." For example, an L_{eq} of speech in a quiet room would cause the meter movement to rise gradually to a peak reading and slowly fall well after the speech is over. L_{eq} readings can be misapplied in situations where the background ambient noises vary greatly during a 24-hour period. L_{eq} measurements should be taken over the period of occupancy.

Interesting information, to be sure, but the only portion of the previous text that actually deals with the ability to understand a voice message is the phrase, "To ensure that audible public mode signals are clearly heard…"

In contrast, the new edition of the *National Fire Alarm Code*, NFPA 72-1999, Section 4-3.1.5 and its related Appendix Section A-4-3.1.5 states:

> 4-3.1.5* Emergency voice/alarm communications systems shall be capable of the reproduction of prerecorded, synthesized, or live (for example, microphone, telephone handset, and radio) messages with voice intelligibility.
>
> A-4-3.1.5 Voice intelligibility should be measured in accordance with the guidelines in Annex A of IEC 60849, Second Edition: 1998, *Sound Systems for Emergency Purposes.* When tested in accordance with Annex B, Clause B1, of IEC 60849, the system should exceed the equivalent of a common intelligibility scale (CIS) score of 0.70. Intelligibility is achieved when the quantity $I_{av\text{-}s}$, as specified in B3 of IEC 60849, exceeds this value. I_s is the arithmetical average of the measured intelligibility values on the CIS and σ (sigma) is the standard deviation of the results.
>
> Objective means of determining intelligibility are found in IEC 60268, Part 16, Second Edition: 1998, *The Objective Rating of Speech Intelligibility by Speech Transmission Index.* Subject-based techniques for measuring intelligibility are defined by ANSI S3.2-1989, *Method for Measuring the Intelligibility of Speech Over communications Systems.* ANSI S3.2-1989 should be considered an acceptable alternative to ISO TR 4870, where referenced in IEC 60268, Part 16, Second Edition: 1998, *The Objective Rating of Speech Intelligibility by Speech Transmission Index.*

WOW! Sounds complicated, and sounds expensive. Well, I'm told that the instrument that measures intelligibility on the common intelligibility scale does cost a significant amount of money. And, the technician who operates this equipment and takes the measurements must have a significant amount of training. However, when life safety at a particular occupancy depends on the ability of the occupants to hear, understand, and execute the instructions they receive from the emergency voice/alarm communications system, this would obviously justify the added cost.

The very fact that technicians can actually measure intelligibility comes as startling news to most fire alarm system designers, installers, and authorities having jurisdiction. For the end user of

a system, the benefit becomes obvious. No longer in large open venues will occupants have to strain to understand the garbled message from the emergency voice/alarm communication system.

What impact will this have on fire alarm jobs you may be designing, installing, or, as an authority having jurisdiction, reviewing? To start with, please note that no one expects that a technician will need to measure intelligibility for all locations where a building owner has chosen to install an emergency voice/alarm communications system. For the vast majority of ordinary occupancies, well-placed audible notification appliances providing an adequate sound pressure level in conformance with the requirements of NFPA 72-1999, Section 4-3.2.2.

In typical venues such as office buildings, mercantile establishments, school buildings, hotel sleeping room floors, hospital patient areas, and so forth, designers, installers, and authorities having jurisdiction will most likely continue to rely on their ears to determine if a system can produce intelligible notification. But, for special large venues, such as the atrium/lobby area of a large hotel, or a sports arena, field house, stadium, or concert hall, increasingly technicians will actually measure the intelligibility of emergency voice/alarm communications systems.

Recently, an acquaintance of mine attended a sporting event along with nearly 45,000 other fans. Two-thirds of the way through the event, a fire broke out in the kitchen area of one of the food vendor’s kiosks. While occupants could clearly hear all of the public address system announcements relating to the game in progress, the notification of the fire, though quite loud, could not be readily understood. The emergency voice/alarm communications system had provided an adequate sound pressure level. But, in reality, the system had a very low level of intelligibility.

Wise fire alarm designers, installers, and authorities having jurisdiction who must review the adequacy of fire alarm systems, must all keep this in mind: loud enough is not necessarily good

enough. If a person can't understand what the emergency voice/alarm communications system tells him or her to do, how can that person possibly do it?

IMSA member Dean K. Wilson, a licensed professional fire protection engineer with an office in Windsor, CT, serves as a Senior Engineer with the fire protection engineering and code consulting firm, Hughes Associates, Inc. (www.haifire.com). The opinions expressed in this article are strictly his own. You can reach him by phone at (860) 687-1009; by FAX at (860) 687-1308; or by e-mail at dwilson@haifire.com.