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Hearing protection for impulsive noise

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Objectives

Impulsive noise presents unique challenges for hearing conservation, with peak sound pressure levels that can reach 170 dB or higher. In addition to the very high peak levels, many impulsive noise exposures are interspersed with periods of relative quiet. During these quiet periods, situational awareness such as the ability to hear low-level environmental sounds or speech may be important. In such situations, the hearing conservationist is presented with the challenge of protecting hearing from the high-level impulsive sounds while retaining the ability to hear and communicate in quiet.

The term impulsive noise includes two categories: impulse noises (which are generated by explosions or the rapid expansion of gases) and impact noises (which are generated by the collision of two or more objects). Impulse noise sources include firearms, military weapons, and firecrackers. Impact noises may be produced by sources such as hammers, nail guns, forges, and stamping or punch presses.

Methods

Impulsive noises are often characterized by their peak sound pressure level and duration. Due to the very high peak sound pressure levels and short durations involved, specialized instrumentation is required to obtain accurate measurements of impulsive noises. Standard sound level meters and noise dosimeters are generally not suited to the task of impulsive noise measurements.

Hearing protection devices (HPDs) help to protect users by attenuating or reducing the level of sounds, including impulsive noises. They are available in various types, including earplugs, earmuffs, and communications headsets. The attenuation provided by HPDs is typically measured in a laboratory environment with the real-ear attenuation at threshold (REAT) procedure. REAT measurements use sounds at the threshold of human hearing and human listeners to determine HPD attenuation. The attenuation of impulsive noises may also be measured in a laboratory, using an impulsive noise source. An acoustical test fixture takes the place of human listeners, using ear simulators with microphones to record the reduction in impulsive sound levels when an HPD is placed onto the test fixture.

Results

HPDs may be passive devices, or they may include electronics that require batteries or another power source to operate. They may include features such as environmental microphones, level-dependent attenuation, or noise-cancelling speech microphones. Environmental microphones record ambient sounds around the person using hearing protection. Combined with level-dependent attenuation, this can enhance the user's ability to hear quiet sounds while providing attenuation of high-level impulsive sounds. Noise-cancelling speech microphones can facilitate speech communication in noisy environments.

Conclusions

This presentation will define impulsive noise and discuss challenges for measuring and characterizing impulsive noises. Hearing protection for impulsive noise and the measurement of impulsive noise attenuation will be explored. Finally, pros and cons of various types of hearing protection devices for impulsive noise will be discussed, including how some types may provide impulsive attenuation along with enhanced situational awareness.

Keywords

impulsive noise, hearing protection, impulse noise, impact noise, earplug, earmuff