

## Session 3pNS

## Noise, ASA Committee on Standards, and Psychological and Physiological Acoustics: Passive and Active Noise Reduction in Hearing Protection

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Chair's Introduction—1:00

*Invited Papers*

1:05

**3pNS1. Development of an advanced hearing protection evaluation system.** Kevin Shank and Josiah Oliver (Adaptive Technologies Inc., 2020 Kraft Dr Ste 3040, Blacksburg, VA 24060, kevin@adaptivetechinc.com)

Acoustic Test Fixtures (ATFs) are practical and often necessary tools for testing Hearing Protection Devices (HPDs) especially with extremely loud impulsive and/or continuous noise, for which the use of live subjects might not be advisable. Although there have been various standardized and laboratory ATFs from past research, there still exists large uncertainty in the correlation between the attenuation results obtained from ATFs and those obtained from actual human subject tests, particularly for intraaural HPDs. It is suspected that one of the main factors contributing to the discrepancy may be insufficient fidelity in the circumaural/intraaural flesh and bone. Human subject testing was performed to obtain median parameters of ear canal geometry and eardrum reflectance, which are considered to be critical parameters for circumaural/intraaural HPD attenuation performance. This presentation discusses the research methodologies and design implementation of these important subsystems in this advanced Hearing Protection Evaluation System (HPES).

1:25

**3pNS2. Two case studies for fit testing hearing protector devices.** William J. Murphy, Christa L. Themann, Mark R. Stephenson, and David C. Byrne (Hearing Loss Prevention Team, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH 45226-1998, wjm4@cdc.gov)

Hearing protection devices (HPDs) are typically selected based upon the Noise Reduction Rating (NRR) and, until recently, were rarely tested for attenuation in real-world environments. The National Institute for Occupational Safety and Health has developed a fit-testing system (HPD Well-Fit™) that performs attenuation tests with a large circumaural earmuff, a portable computer and a computer mouse with a scroll wheel. HPD Well-Fit was used to estimate the attenuation of employees working in two different settings: inspectors for off-shore drilling rigs and sandblasters at a hydroelectric facility. The highest exposure levels for the inspectors and sandblasters were estimated to be 110 and 130 dBA, respectively. Fit testing and training were used to achieve a 25-dB Personal Attenuation Rating (PAR) for the inspectors. Fit testing before and after the sandblaster work shift demonstrated PARs of 30 to 42 dB using HPD Well-Fit. The average time to complete the fit tests was 10 minutes. If retraining was necessary, then an additional 3 to 6 minutes were required.

1:45

**3pNS3. Continuous and impulsive noise attenuation performance of passive level dependent earplugs.** Richard L. McKinley, Hilary L. Gallagher (Air Force Research Laboratory, 2610 Seventh Street, Wright Patterson AFB, OH 45433, richard.mckinley@wpafb.af.mil), Melissa Theis (Oak Ridge Institute for Science and Education, Dayton, Ohio), and William J. Murphy (National Institute for Occupational Safety and Health, Cincinnati, OH)

Level dependent hearing protectors, earplugs and earmuffs, have advanced in technology due to the needs of military personnel and others to reduce the risk of hearing damage from impulsive noise. These hearing protectors were developed to preserve ambient listening capabilities therefore improving situational awareness while reducing the risk of noise induced hearing loss by attenuating both continuous and impulsive noise. Four commercially available passive level dependent earplugs were assessed for both continuous noise attenuation and impulsive insertion loss performance. The continuous noise attenuation results were collected using American National Standard Institute (ANSI) S12.6-2008 Methods for Measuring the Real-Ear Attenuation of Hearing Protectors while the impulsive insertion loss results were collected using ANSI S12.42-2010 Methods for the Measurement of Insertion Loss of Hearing Protection Devices in Continuous or Impulsive Noise Using Microphone-in-Real-Ear (MIRE) or Acoustic Test Fixture Procedures. The presentation will include the passive noise attenuation performance of level dependent earplugs for both continuous and impulsive noise. The impulsive insertion loss results for these particular hearing protectors will be applied to impulsive noise damage risk criteria for an estimate of allowable impulsive noise exposure.