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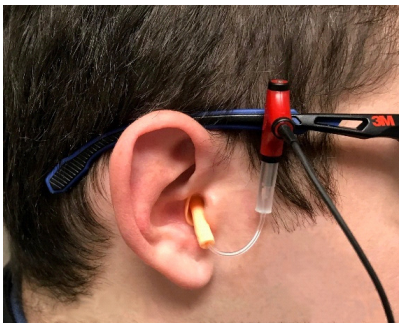
Technical Bulletin

August, 2018

Hearing Protection Fit Testing: What, Why and How

Introduction



Hearing protector fit testing is the measurement of the amount of noise reduction, or attenuation, a hearing protector provides while it is being worn by a specific individual. This real-world measurement is referred to as a "Personal Attenuation Rating" or PAR. The purpose of hearing protector fit testing is to verify that the attenuation is adequate for the individual and to help validate hearing protectors that can be used successfully in their work environments.

The adoption of individual hearing protector fit testing is steadily gaining traction in industry as a powerful tool for helping to improve occupational hearing conservation programs. The driving force behind this growing trend is the ability to accurately estimate the attenuation a given hearing protector provides for an individual, in contrast to the traditional approach of relying solely on single number ratings, such as the Noise Reduction Rating or Single Number Rating (NRR, SNR). The benefits of hearing protector fit testing are being realized by employers and employees alike, and fit testing has become a recommended best practice in hearing loss prevention. This bulletin describes the recent evolution of hearing protection fit testing, and the use of fit testing systems, or Field Attenuation Estimation Systems, (FAES) and their adoption by industry, regulators and health advocacy groups.

Why is Fit Testing Needed?

Until recently, the most practical way for employers to quantify the amount of noise reduction a hearing protector provided to an individual in the workplace, as required by OSHA's noise regulation, was to use a "single number rating" such as the noise reduction rating (NRR). Since the OSHA regulation was written, studies have shown that, although the NRR is a good indicator of the noise reduction capability of a hearing protector in ideal conditions, it is not necessarily a good predictor of the attenuation an individual receives when using the hearing protector in the workplace. Evidence shows that there can be a large range in attenuation achieved by individuals in the workplace for the same model of hearing protector. A 2008 study shows the wide distribution of Personal Attenuation Ratings (PARs) in a population of workers. Some workers receive more attenuation than the NRR would predict, while others received much less (see Figure 1).

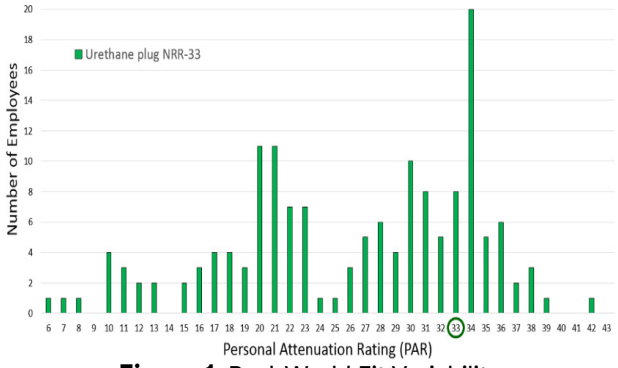


Figure 1. Real-World Fit Variability

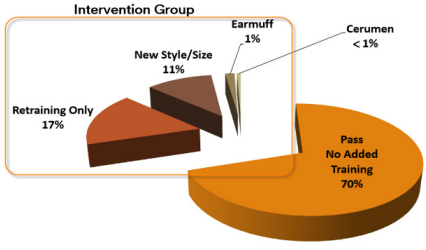


Figure 2. Initial Fit Test Results

A leading source of this variability is individual differences in training and proficiency at inserting hearing protectors properly. A 2013 study found that out of 327 experienced users tested, 17% had to be re-trained before achieving an adequate fit (see Figure 2). Another key source of fit variability is due to differences in individual ear canal size (too big or too small) or shape (sharp bends), requiring those workers to switch to a different model before achieving an adequate fit.

How Does Hearing Protector Fit Testing Work?

There are a variety of FAES technologies available on the market. The 3M™ E-A-Rfit™ Dual-Ear Validation System is based on field microphone-in-real ear (F-MIRE) technology. The system consists of a specially designed loudspeaker equipped with a digital signal processor that allows for a consistent presentation of the test signal and real-time communication between the microphones, speaker and software (see Figure 3). The dual-element microphone assembly attaches to specially probed hearing protectors to allow measurement of the sound level inside the test subject's ear canal while the hearing protector is worn. The "in-ear" sound level is simultaneously compared to the sound level just outside the hearing protector, as measured by the external microphone. The measured difference between the internal and external sound levels represents the noise attenuation in decibels.

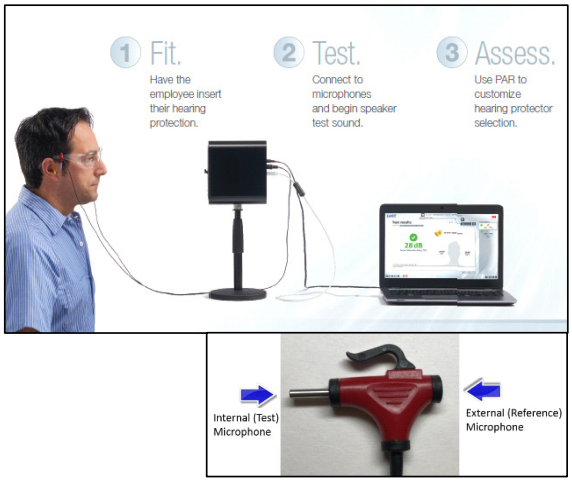


Figure 3. 3M™ E-A-Rfit™

The 3M™ E-A-Rfit™ Dual-Ear Validation System is an objective measurement system which means it does not depend on a response from the person being tested. This allows 3M™ E-A-Rfit™ Dual-Ear Validation System to test both ears across numerous frequencies simultaneously in less than 5 seconds. It also allows for normal background noise (up to 80 dB) to be present during the testing as compared to other subjective FAES systems, which require quieter test environments. The 3M™ E-A-Rfit™ Dual-Ear Validation System can also test 3M earmuffs and certain communications headsets.

What is a PAR?

The "Personal Attenuation Rating," or PAR, for a hearing protector is the noise attenuation achieved by the individual being tested. In simple terms, it is the difference in decibels between the sound levels on the inside of the hearing protector and just outside the hearing protector. As compared to the laboratory derived NRR rating, which is the average attenuation based on a panel of ten test subjects, PARs tell us how much attenuation a particular hearing protector model is providing when fitted in the actual user's ear, by the actual user.

Research Supports Hearing Protector Fit Testing

Recent research shows many advantages to hearing protector fit testing, including:

1. **Reduced likelihood of hearing loss**
   A study titled "A Mixed-Methods Assessment of Hearing Conservation Program Effectiveness" looked at a company's expenditures for different aspects of a company's Hearing Conservation Program at thirteen different facilities. They found that the four facilities which implemented hearing protector fit testing had significantly lower rates of age-corrected hearing loss (STS):

> *"Fit-testing – a best practice not required by any current HCP regulation – may be a high-impact expense, i.e., one that can result in an outsized reduction in NIHL. A variety of fit-testing technologies . . . appear to be becoming more integrated into hearing conservation programs that are based on best practices, rather than simple compliance with OSHA regulations."*
>
> Neitzel; Saylor et al, NHCA Spectrum · Vol. 34 (3) · December 2017

2. **Improved use of hearing protectors**
   A 2015 study of off-shore oil rig inspectors found that 40% of workers were not getting sufficient attenuation on the initial fit test. Without the PAR results, these workers would not have been identified as being at risk for developing noise-induced hearing loss (NIHL). The authors concluded that the labeled NRR has little predictive value in determining the level of noise reduction a worker receives.

> *"Forty percent or more of the workers were not getting sufficient attenuation from their hearing protectors. Through training and re-fitting, NIOSH was able to help 85% or more of the workers receive the appropriate amount of noise reduction."*
>
> *"Without fit-testing, nearly half of the oil rig inspectors would have been at risk for developing noise-induced hearing loss from their job exposures."*
>
> Murphy, Themann, Taichi, Murata, US Centers for Disease Control and Prevention, NIOSH. July 2015

3. **Ability to evaluate attenuation when combined with other Personal Protective Equipment (PPE)**
   When using earmuffs, any interference with the seal of the cushion to the head can reduce the attenuation. This can be caused by the temple bars of safety eyewear, hard hat headbands, respirator straps and other types of obstructions. Fit testing earmuffs can be done while wearing the usual combination of PPE to help identify causes of sound leakage and troubleshoot options to ensure the worker is adequately protected.

> *"Earmuffs are often selected as the preferred type of hearing protector due to ease-of-use and durability. On the other hand, earmuffs are more susceptible than earplugs to the interference and compatibility issues provided by other PPE when worn with earmuffs."*
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> Macedo, Gorman, Berger. Australian Institute of Occ. Hygienists, 34th Annual Conference & Expo, December 2016

Key Benefits of Fit Testing

Why use hearing protector fit test systems, such as the 3M™ E-A-Rfit™ Dual-Ear Validation System? Incorporating fit testing into a Hearing Conservation Program (HCP) can offer a multitude of benefits. For example, conducting hearing protector fit testing helps employers to:

1. Identify workers with poorly fitting hearing protectors BEFORE the worker develops hearing loss.
2. Create a unique training opportunity where employees can experience how correctly fitting hearing protectors impacts protection:
   - PAR results are seen immediately following test
   - One-on-one training targets the specific fitting issues observed
   - PAR improvements are seen immediately after re-training and re-inserting the earplug correctly
   - Workers can feel and hear the difference when their hearing protectors are properly inserted
3. Refine hearing protector selection based on individually validated protection levels.
4. Supplement hearing loss intervention strategies by helping to ensure employees with hearing shifts are properly trained and protected.
5. Implement pro-active, best practices approach to hearing loss prevention.

OSHA, NIOSH and NHCA Recommend Fit Testing as a Best Practice

The use of hearing protector fit testing is a recommended best practice by:

- US Occupational Safety & Health Administration (OSHA)
- National Institute of Occupational Safety & Health (NIOSH)
- National Hearing Conservation Association (NHCA)

"Research studies have suggested that when individuals are involved in the fitting process and receive positive feedback on the proper fit of their earplug, they will be more likely to have a positive attitude about protecting their hearing and will be more apt to use hearing protection correctly and consistently in the workplace. This positive outcome should result in reducing noise-induced hearing loss in the workplace."

Best Practice Bulletin: OSHA, NIOSH and NHCA Alliance

"Today, the issue of hearing protection attenuation is best addressed by testing the performance of hearing protection objectively. This fit testing technology is a huge advancement in efforts to save workers' hearing."

NIOSH Criteria for a Recommended Standard

Hearing Protection Fit Testing Helps with OSHA Compliance

A recent OSHA Letter of Interpretation states that fit testing can be used to meet the training requirements of section 1910.95 (i)(4) and the requirement to ensure proper initial fitting in section (i)(5):

OSHA 29 CFR 1910.95(i)(4): *The employer shall provide training in the use and care of all hearing protectors provided to employees.*

OSHA 29 CFR 1910.95(i)(5): *The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.*

Although OSHA does not require fit testing, this interpretation letter specifically recognizes fit testing as an acceptable way to fulfill the initial fitting requirement.

PAR vs NRR According to OSHA

To be sold in the US, a hearing protector must be tested, according to a standardized method, and labeled with the NRR. OSHA's noise standard 29 CFR 1910.95 requires employers to offer noise-exposed workers hearing protectors that can adequately reduce the hazardous noise exposure. The allowable methods for calculating the sufficiency of hearing protectors are included in Appendix B of the standard. Since the standard was written before the availability of FAES technology, there currently is no provision for using PAR values that exceed values calculated using Appendix B. If the noise exposure high enough that the noise reduction calculated using Appendix B is insufficient, then feasible noise controls and/or dual hearing protection should be used.

Fit Testing is HEAR to STAY

Fit testing hearing protection can make a difference. It can change how people use hearing protection, think about hearing protection, and are protected by hearing protection. When it comes to attenuation, why guess when you can know?

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