

# **Protect your hearing so you can enjoy the sounds you love.**

Detection, Protection and Validation, each is critical to solving the hearing conservation challenges unique to your work site, ensure you and your workers are not exposed to potential hearing hazards.

# Introduction

Do you know what level of protection your employees are receiving from their hearing protectors? Now you can with a field attenuation estimation system (FAES). FAES is a quantitative method for individual fit-testing hearing protection devices (HPDs). This white paper describes the 3M™ E-A-Rfit™ Dual-Ear Validation System and the value it can provide for your hearing loss hearing conservation program (HCP).

## The Technology

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. Specially designed, dual element microphones make it possible to measure the sound level at 2 different locations and for both ears simultaneously. The external microphones measure the level of the test signal outside the ear. The internal microphones are connected to one of the specially modified 3M™ probed hearing protectors to allow measurement of the sound level inside the wearer's ear canal while the hearing protector is worn. The 3M™ E-A-Rfit™ Dual Ear Validation System also has earmuff testing capabilities. Both ears are accurately measured simultaneously, and in less than 5 seconds, a personal attenuation rating (PAR) is displayed.



## It starts with Personal Attenuation Rating (PAR)

The measurement of attenuation for a fit-tested hearing protector is displayed as a PAR. To be sure that your employees are getting the protection they need, you should to know the PAR of every employee. Hearing protector ratings such as the noise reduction rating (NRR), the single number rating (SNR) and the sound level conversion (SLC<sub>80</sub>) are derived from measurements gathered in a carefully controlled laboratory environment. Although the ratings are an accurate measurement of the capabilities of a particular hearing protector under the specific test conditions, they may not represent what an individual worker will achieve when the device is worn. Most employees receive adequate protection, while some may not if they are not using the hearing protector correctly or have not chosen the correct size or style (Figure 1). Note the wide range of PAR values tested on four (4) earplugs considered high attenuating according to their labeled values.

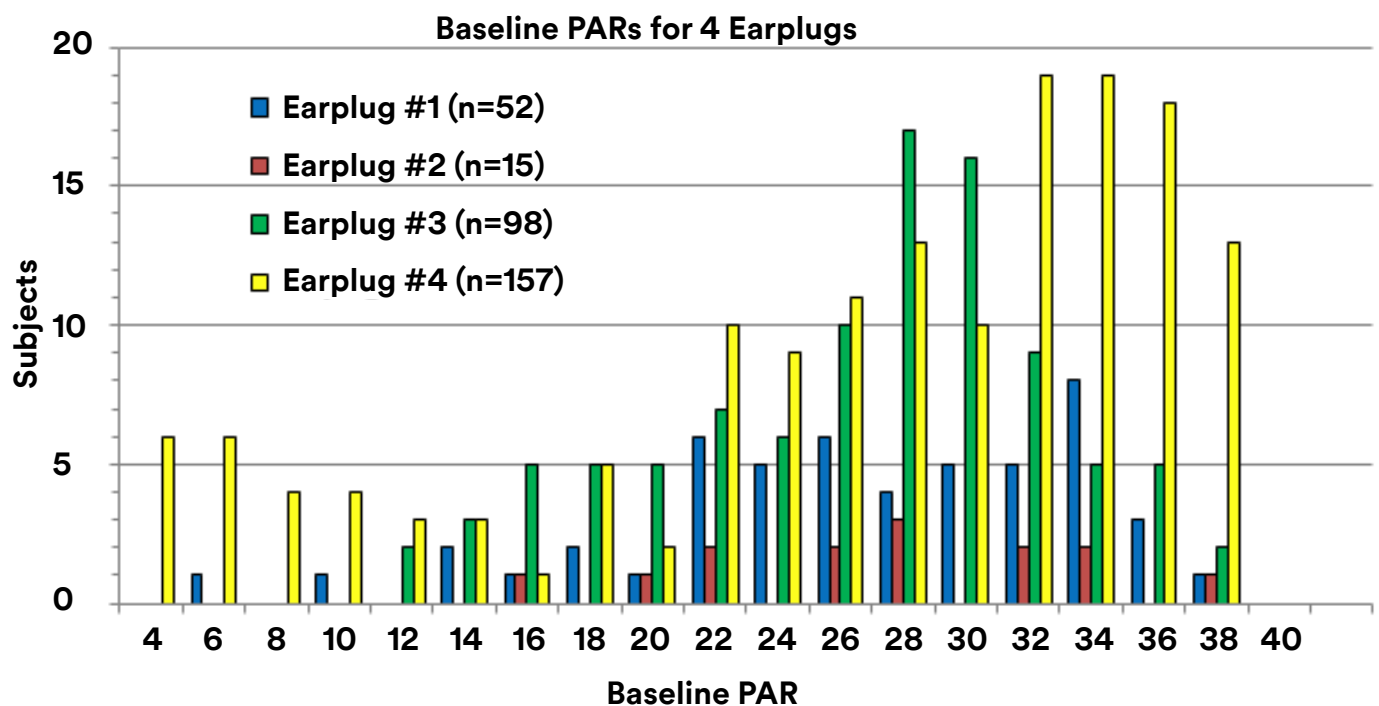


Figure 1 – Initial baseline PAR measurements of 4 earplugs for a group of manufacturing workers (n=322).

Why use PAR vs. the labeled value? Figure 2 displays PAR values for earplug #4, measured on 157 employees. The green represents the workers with PAR values (minus their uncertainties), who achieved at least the  $SLC_{80}$  value or more. But the PAR values in red indicate the workers would have not met the  $SLC_{80}$  value. This highlights the importance of using individual worker attenuation data rather than labeled values, to predict user protection.

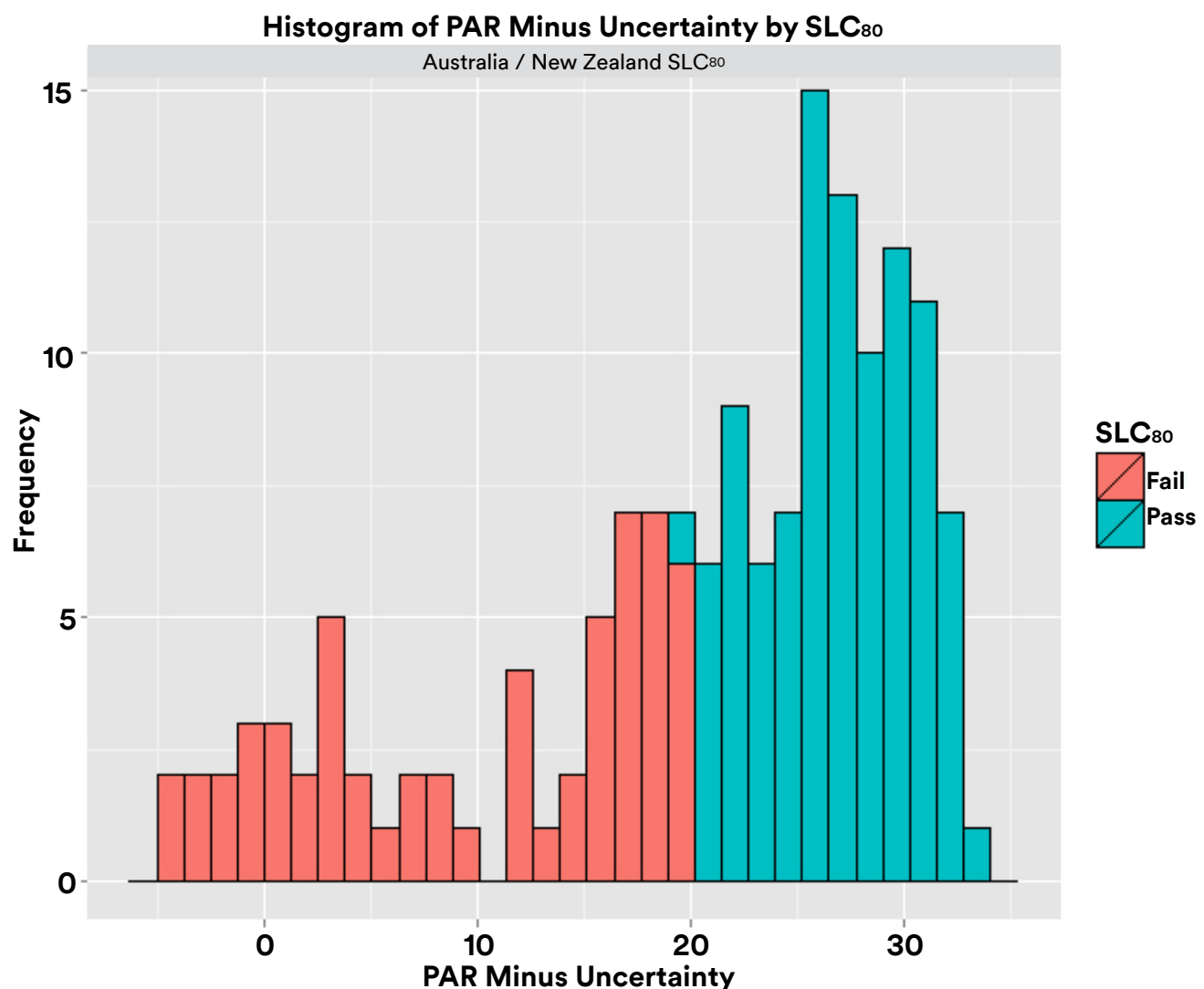


Figure 2 – PAR values minus uncertainties who would have passed/failed using the  $SLC_{80}$  value



# WHO do you test and who conducts the testing?

## *Who Should Be Tested?*

The target population is presumably the group of employees expected to be at risk for noise-induced hearing loss (NIHL) and may either be limited or broadly defined.

Examples of target populations include:

- All employees regardless of noise exposure at work
- Newly hired employees
- Particular focus applied to employees ;
  - with a measured temporary threshold shift (TTS) or standard threshold shift (STS)
  - who work in the highest noise areas or are required to wear dual hearing protection
  - who are at the margins of inclusion for mandatory hearing protection
  - exposed to ototoxic chemicals as well as to noise



## *Who Conducts the Fit-Tests and/or Manages the Fit-Test Program?*

In general, those responsible for the HCP will manage the fit-test program.

Examples of personnel typically responsible, previously referred to as operators, for conducting fit-tests include:

- Occupational Hygienists
- Site Safety Officer
- Occupational health nurses
- Personnel trained by 3M to use and operate the 3M™ EARfit™ Dual Ear Validation system
- Authorised service providers



# HOW do you use the 3M™ E-A-Rfit™ Dual-Ear Validation System?

Newly hired employees unfamiliar with hearing protector use will require careful training along with fit-testing to ensure they are adequately protected against the hazardous noise. All other workers could follow the decision tree below (Fig 3) when conducting fit-tests for the first time. Baseline measurements capture how employees “normally” wears their hearing protectors and serve as a benchmark for all future measurements. Caution: HPD fit-testing should not be performed on employees experiencing ear pain on the day of testing.

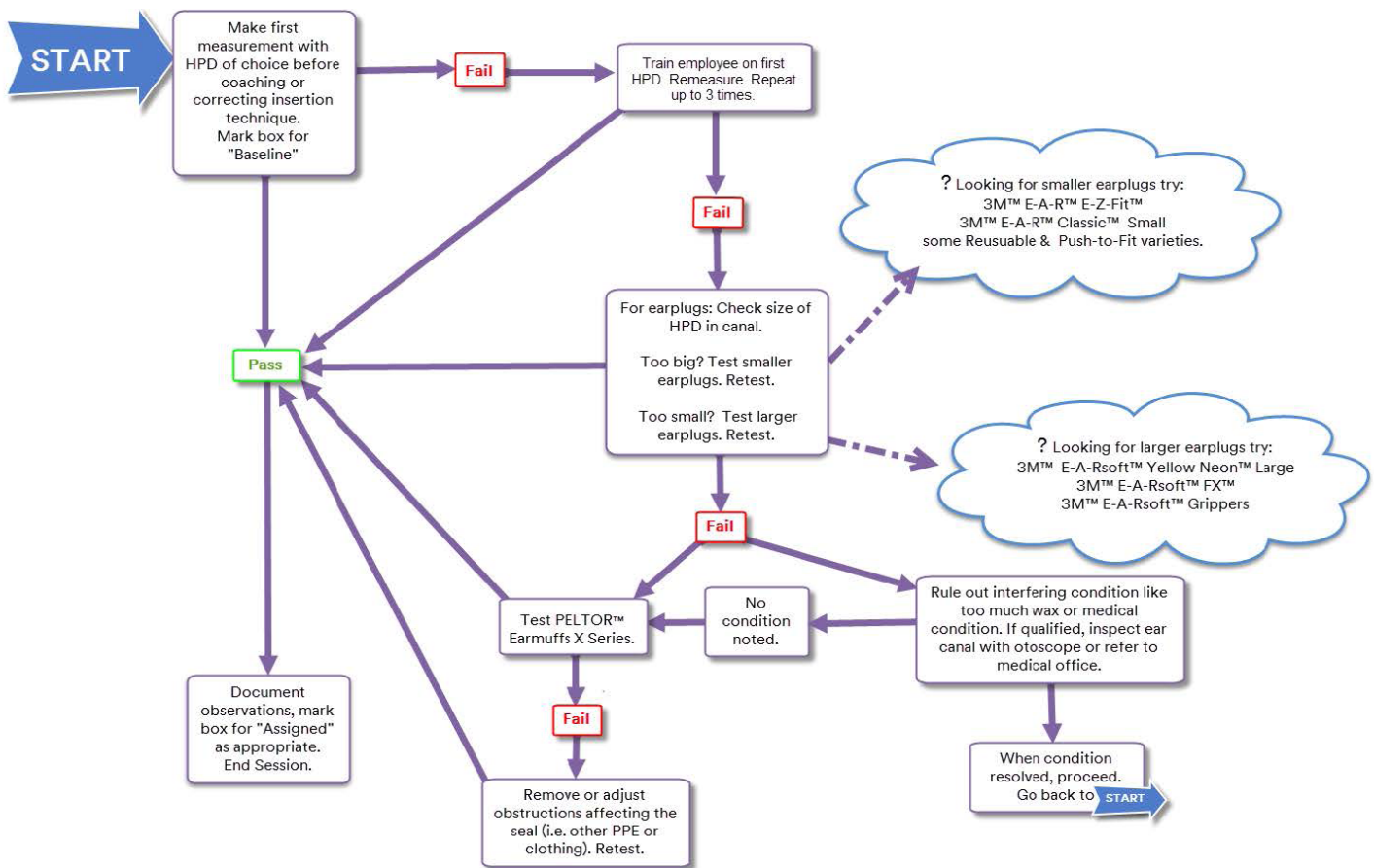


Figure 3 – Best practice fit-testing decision tree

## How Much Protection Do Employees Need?

Each employee's target PAR is based on the company exposure limit and the employee's exposure. For example, if Employee A has a time-weighted average (TWA) of 95 dBA and the company exposure limit is 80 dB, then the employee must receive a PAR of at least 15 or above in order to ✓ "Pass". If the employee achieved 10-dB PAR, then the measurement will display ✗ "Fail".

Example:

95 dBA	TWA
-80 dBA	Company Exposure Limit
15 dBA	Target Minimum PAR

### ***How Often Should You Fit-Test?***

Much like audiometric testing, hearing protector fit-testing is not a one-time event. Ideally, all employees in your hearing conservation program should be initially fit-tested. For those who required extra training and/or a new size or style hearing protection, early follow-up is recommended to be sure the employee has access to the newly assigned hearing protectors, is wearing the usual or newly assigned hearing protectors, and the HPD is continuing to provide adequate protection. Annual HPD fit-testing can provide assurance the hearing protectors are being worn correctly and give additional opportunity for further hearing conservation training.

### ***How is fit-testing conducted and where?***

The physical location for testing may vary depending on your company but implementing fit-testing is more efficient and effective if:

- The fit-test location is centrally located and easily accessible to the workers.
- Managers and supervisors are engaged in the process and can assist in assuring the workers can leave their workstations to be fit-tested quickly and on a timely basis.
- A flexible schedule with individual time slots is employed.
- A Fit-Test Support person is designated who can assist and ensure the efficient flow of workers to be tested.
- Educational materials and tools such as Fit Posters are available if additional training is required.
- A complete selection of hearing protector samples of all types that are used at the plant is available to give to workers, especially for cases in which they have been “reassigned” a different size or style based on fit-test results.





# WHY use the 3M™ E-A-Rfit™ Dual-Ear Validation System?

Incorporating fit-testing within a HCP results in a number incremental benefits. The list below highlights the most compelling reasons why you should use the 3M E-A-Rfit Dual-Ear Validation System.

1. Identify workers with low PARs who are consequently at risk for developing NIHL.
2. Verify the performance of HPDs without relying on laboratory derived labels (SLC<sub>80</sub> rating) that are intended for groups of employees and not individual workers.
3. Train and motivate employees on the proper use and fit of HPDs.
4. Select and assign HPDs based on noise exposures, expected protection levels and the anatomy of the worker's ear canal.
5. Baseline system for training personnel responsible for teaching employees the proper use and fit of HPDs.
6. Provide a useful temporary threshold shift (TTS) follow-up procedure that can be used to determine whether the problem may be related to either the fit or the attenuation capabilities of the HPD.
7. Provide data that may be accepted by regulatory agencies as a better alternative to using labeled attenuation values and derated to assess HPD adequacy.
8. Audit departments to evaluate overall HPD effectiveness and suitability.
9. Provide potentially useful documentation to demonstrate hearing loss prevention efforts conducted by a company that go beyond regulatory requirements.

## 3M Hearing Protection



Detection Solutions



Hearing Protection



Protective  
Communications



E-A-Rfit™ Dual-Ear  
Validation System

We don't just sell hearing protection. We're dedicated to the success of your entire hearing conservation program. 3M™ E-A-R™ and PELTOR™ Hearing Protection Products are some of the most recognised on the market and are designed to provide protection, comfort and ease of use. With a broad range of solutions available we have your hearing conservation needs covered. Contact your 3M Personal Safety Specialist to find out more about our 3M™ E-A-Rfit™ Dual-Ear Validation System or for assistance in solving your complex or day to day hearing conservation challenges.



Luciana Macedo is the Occupational Hygienist for 3M's Personal Safety Division. Luciana works closely with OHS professionals providing training and guidance on different aspects of Occupational Hygiene including respiratory protection, body protection, air monitoring, noise surveys and hearing conservation programs management. She is actively involved with Standards Australia as a member of the Protective Clothing committee (SF-004) as well as the Acoustics Human Effects committee (AV-003), a member of the Australian Institute of Occupational Hygiene (AIOH), Safety Institute of Australia (SIA) and National Hearing Conservation Association (NHCA).



## References

1. Third-Party Validation Studies:  
Trompette, N. & Kusy, A. (2013)  
Voix, J., Pienkowski, J., & Delnavaz, A. (2014))  
Dyrba, P., Dantscher, S., Augustin, S., Fritsch, T., Sikert, P. (2014)
2. Published Field Research: Smith, P., Monaco, B., & Lusk, S.L. (2014)



### Personal Safety Division

**3M Australia Pty Ltd**  
Bldg A, 1 Rivett Road,  
North Ryde, NSW 2113  
TechAssist Helpline: 1800 024 464  
Customer Services: 1300 363 565  
Email: [techassist@mmm.com](mailto:techassist@mmm.com)  
[3M.com/au/ppesafety](http://3M.com/au/ppesafety)

**3M New Zealand Limited**  
94 Apollo Drive, Rosedale,  
Auckland 0632  
TechAssist Helpline: 0800 364 357  
Customer Services: 0800 252 627  
[www.3M.com/nz/ppesafety](http://www.3M.com/nz/ppesafety)