The Science of HPD Fit Testing: 3M™ E-A-Rfit™ Dual-Ear Validation System

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Today’s Presenter

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Opening Points

This presentation is based on selected current national requirements. Other country or local requirements may be different. Always consult User Instructions and follow local laws and regulations.

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ASSE Delmarva Chapter Technical Discussion Agenda

- Why Fit Test Hearing Protectors?
- How Fit Testing is Changing the Practice of Hearing Conservation
- 3M E-A-Rfit Dual-Ear Validation System Technology Overview
- Fit Testing Research
- Benefits of Fit Testing
- Resources
REAT: Real Ear Attenuation at Threshold

REAW: Real Ears At WORK
Real Ear Attenuation at Threshold (REAT)

Human subject test in laboratory
Measure hearing thresholds
• 10 Subjects / 3 Repeats
• Careful HPD fitting by experimenter
• Motionless subject
Sounds presented using loudspeakers
• 1/3-Octave Noise
• Random Incidence
• Reverberant room

EPA 40 CFR 211 states that the NRR be measured and calculated according to ANSI S3.19-1974 (R1979)
History of the Noise Reduction Rating

NRR describes “Best Fit” of hearing protector when worn in laboratory

However, sometimes...

There is a race for the highest NRR
Employers have established HPD policies based on minimum allowable NRR
Purchasing decisions are made based on NRR alone
Labeled vs. Field Performance of HPDs

- Labeled NRR
- RW NRR$_{84}$
- ± 1 SD

Bar chart showing the comparison of labeled NRR and field performance for different types of hearing protection devices (HPDs): Roll-Down Foam, Premolded, Custom, Semi-Insert, and Earmuff.
### Selected HPD ratings and derating schemes

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Rating</th>
<th>Earplugs</th>
<th>Muffs</th>
<th>Dual HPD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Formable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS / NZ</td>
<td>SLC$_{80}$</td>
<td>No derating needed (rating based on naïve subject method)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>NRR$_{sf}$</td>
<td>No derating needed (rating based on naïve subject method)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>NRR</td>
<td>50%</td>
<td>30%</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>SNR(SF$_{84}$)</td>
<td>No derating needed (rating based on naïve subject method)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class</td>
<td>Derating built-in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>SNR</td>
<td>Requires SNR of 17-34 for $L_{ex} &lt; 95$, SNR &gt; 34 for $L_{ex} &gt; 95$ dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>England</td>
<td>SNR</td>
<td>4 dB (absolute derating)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finland/Spain</td>
<td>SNR</td>
<td>No derating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>SNR</td>
<td>10 dB</td>
<td>5 dB</td>
<td>5 dB</td>
</tr>
<tr>
<td>Germany</td>
<td>SNR</td>
<td>9 dB</td>
<td>5 dB</td>
<td>5 dB</td>
</tr>
<tr>
<td>Italy</td>
<td>SNR</td>
<td>50%</td>
<td>70%</td>
<td>25%</td>
</tr>
<tr>
<td>US OSHA</td>
<td>NRR</td>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US NIOSH</td>
<td>NRR</td>
<td>50%</td>
<td>70%</td>
<td>25%</td>
</tr>
</tbody>
</table>
The search for measuring attenuation for individual workers begins
FAES (Field Attenuation Estimation System) then...

Early NIOSH Field Fit-Test Device
*Circa 1976*
FAES now...

- There are several commercially available systems,
- Recognized as a best practice,
- Included in standards and textbooks,
- Growing body of scientific literature,
- Embraced by employers and employees.
Hearing protector fit testing is changing the practice of hearing conservation
Regulatory Update on Fit-testing
OSHA Letter of Interpretation issued 10/2017

Personal Attenuation Rating (PAR) is not a replacement for Noise Reduction Rating (NRR)
OSHA states: personal fit testing may be used toward satisfying the following requirements:
1910.95(i)(5) The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

Personal fit testing may be included toward satisfying training requirements 1910.95(i)(4) and 1910.95(k)(3)(ii)

For more info: http://go.3M.com/HPFTUpdate

Question 3: Can employers use a personal fit-testing system to provide training to employees in the use and care of hearing protector devices?

Reply: Yes. OSHA’s Noise Standard requires employers to provide training in the use and care...
FAES is included in text books

2011: Hearing Conservation in Occupational, Recreational, Educational, and Home Settings
  Vishaka Rawool, Thieme


http://www.caohc.org
3M E-A-Rfit Dual-Ear Validation System Technology Overview
The 3M™ E-A-Rfit™ Dual-Ear Validation System uses F-MIRE technology to determine individual hearing protection levels

The 3M™ E-A-Rfit™ Dual-Ear Validation System measures the effectiveness of the earplug from inside an employee’s ear, providing accurate, quantitative results. And because test administrators can simultaneously check both ears, you will help them have more time to educate employees on the importance of fit and compliance.

**Features**

- Dual-ear testing in less than 5 seconds
- Fast, clear accurate results
- Earplug, earmuff, and banded HPD testing capability
- Tests 7 frequencies - 125Hz to 8000Hz
- Seamless software integration
- Science-based, quantitative testing
- Compact design
- Know if you are getting the protection you need
Key Components

External Microphone

Internal Microphone

Probed earplugs
The Set Up
It starts with a Personal Attenuation Rating (PAR)

Fit testing is not a one-time event

PAR Considerations

- Can be subtracted directly from an A-weighted noise exposure
- Represents a moment in time
- Noise levels determine how much protection needed
The 3M™ E-A-Rfit™ Dual-Ear Validation System is a critical piece within the overall 3M Hearing Conservation Program.
Growing body of scientific literature quantifying the value of HPD fit testing

Disclaimer: Only select conclusions presented as interpreted by the presenter. Studies include additional information not presented. Read original studies before making any conclusions.
Third-Party Validated Studies


Comparison of different measurement systems for the assessment of the individual noise attenuation of earplugs. Dyrba, et. al (2014).

Real-World Variability for Two Earplugs

Quantifying the Effects of Intervention During Fit Testing

- Large US metal can and lid company in 4 plants
- 327 subjects; 85% male, > 50% with 10+ years’ experience, 70% of total workforce is 40 or older years of age
- Workers never experienced hearing protector fit testing
- Protected exposure goal = 85 dB or below.

Summary of Study Results

- Average PAR values for the **intervention** group (n=91) increased significantly from baseline after training or alternative earplug selection.
- 6 months later, average PAR values for the intervention group (n=70) remained significantly higher than baseline.
- However, average PAR values dropped slightly from post-intervention to follow-up.
  - Comfort
  - Access
  - Reluctance to Change

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Real-World Variability for 4 Earplugs

OSHA Derating – Is it Protective Enough?

Histogram of PAR Minus Uncertainty by USA OSHA Derating

![Histogram](image.png)

Top Benefits of Fit Testing

1. Identify At-Risk Population
2. Train & Motivate
3. Selection Tool
4. Verify Performance
5. Train-the-Trainer
6. Provides Documentation
Resources & References

- User Support Website – [http://earfit.3M.com](http://earfit.3M.com)
- 3M E-A-Rfit Dual-Ear Validation Training, click [here](http://earfit.3M.com)
- Third-Party Validation Studies
  - Trompette, N. & Kusy, A. (2013)
  - Voix, J., Pienkowski, J., & Delnavaz, A. (2014)
  - Dyrba, Dantscher, Augustin, Fritsch, & Sickert (2014)
- Published Field Research
  - Smith, P., Monaco, B., & Lusk, S.L. (2014)
- Fit Testing Applied Research Study Summary - Technical Data Bulletin #236
- 3M™ E-A-Rfit™ Dual-Ear Validation System Summary - Technical Data Bulletin #237
Thank you
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QUESTIONS?