Hearing Protection Device (HPD) Fit Testing

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Objectives

- Identify at least two types of hearing protector device fit test (HPDFT) systems
- Explain methods for incorporating HPDFT into an employer’s hearing conservation programs (HCP)
- Discuss how OSHA Letters of Interpretation regarding HPDFT and the Occupational Noise Exposure Standard (29 CFR 1910.95)
Disclaimer

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- I am presenting today as a private citizen, not as a representative of my employer. The views expressed in this presentation are my own and do not reflect the official policy or position of my employer. The presentation does not represent official interpretation of OSHA standards and does not add to or subtract from the regulatory requirements in The OSH Act of 1970.
- The information is derived from publicly available websites and from my personal experience working as a nurse practitioner in occupational health for the past ten years.
- Mention of commercial products or programs does not imply endorsement.
- This presentation should not be relied upon in isolation as content is often accompanied by additional and/or clarifying information or discussion. Information is current as of the time of this presentation.
- Stock images from MS Office 365 are used in this presentation unless otherwise noted.
- I have no financial interests to disclose.
Impact of Occupational Noise Induced Hearing Loss (NIHL)
Quality of Life
INJURY PREVENTION
Occupational Noise Induced Hearing Loss Prevention

Hierarchy of Controls

- **Elimination**: Physically remove the hazard
- **Substitution**: Replace the hazard
- **Engineering Controls**: Isolate people from the hazard
- **Administrative Controls**: Change the way people work
- **PPE**: Protect the worker with Personal Protective Equipment

Image by NIOSH
https://www.cdc.gov/niosh/topics/hierarchy/default.html
Noise Reduction Rating (NRR)

- Laboratory Derived from experienced users
- Experimenter fit HPD into user’s ear prior to measuring attenuation
- Wide variability between NRR and the actual attenuation achieved by workers in the field
Methods for Derating the NRR

One method:
• Subtract 50% from the labeled NRR

Another Option:
• Earmuff: Subtract 25% from NRR
• Moldable earplugs: Subtract 50% from NRR
• Pre-formed earplugs: Subtract 70% from NRR
Effective A-weighted noise level
ENL = exposure dBA – (derated NRR – 7)

Estimate Examples

NRR labeled as 22dB (formable)
ENL = 100dBA - (11 - 7)
ENL = 96 dBA

NRR labeled as 33dB (premolded)
ENL = 100 dBA - (10 - 7)
ENL = 97 dBA
How much noise is reaching the worker’s ears?

100 dBA; NRR 22 dB

Answer: We have no idea!
Hearing Protector Device
Fit Testing
**Personal Attenuation Rating (PAR)**

- Field test (may be at or near worksite)
- Individual measure of noise attenuation based on how an employee “usually” inserts HPDs
- Can test employees on a variety of earplugs available in workplace
- PAR has been validated as comparable to NRR in estimating actual attenuation of HPD - worker learns the “feel” of proper fit
**HPD Fit Test Process Map**

1. **Employer selects HPD with appropriate NRR**
2. **Worker fits HPD**
3. **Fit test to measure PAR**
4. **Compare to target**
5. **Retrain/refit as needed**

National Hearing Conservation Association (NHCA) Seminar, 2022
Which Type of Hearing Protector Fit Test System?

It Depends...
Types of HPDFT Systems – Response-based

Real Ear Attenuation at Threshold (REAT)
• Michael and Associates
• Benson Medical Instruments
• Workplace Integra
• Edare Incorporated
  
  FitCheck Solo™ and FitCheck Muffs™
  CCF-200 Fit-test™
  IntregraFit™
  WAHTS™ Wireless Audiometric Hearing Test Systems

Loudness Balance System
• Honeywell
  
  Veripro™
FitCheck Solo™
### FitCheck Solo™

**Features**

<table>
<thead>
<tr>
<th>Features</th>
<th>FitCheck Solo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test method</td>
<td>REAT Headphone, Method of Adjustment</td>
</tr>
<tr>
<td>System Cost</td>
<td>~$3200</td>
</tr>
<tr>
<td>Equipment</td>
<td>Isolating headphones, mouse</td>
</tr>
<tr>
<td>Applicability</td>
<td>Earplugs</td>
</tr>
<tr>
<td>Test Learning Time</td>
<td>~ 3-5 minutes</td>
</tr>
<tr>
<td>Testing time</td>
<td>~ 5-7 minutes</td>
</tr>
<tr>
<td>Fit-Test Output</td>
<td>A-weighted attenuation/PAR</td>
</tr>
<tr>
<td>Listener Requirements</td>
<td>Thresholds &lt; 45 dB HL</td>
</tr>
<tr>
<td>Tester Training Level</td>
<td>CAOHC certification recommended</td>
</tr>
<tr>
<td>Background noise</td>
<td>58 dBA</td>
</tr>
<tr>
<td>Binaural/monaural</td>
<td>Binaural (Monoaural possible)</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>3 to 5 dB</td>
</tr>
</tbody>
</table>

Courtesy of William J. Murphy, PhD; National Academies of Engineering Technology for a Quieter America Workshop October 2023
Benson Medical Instruments: CCF-200 Fit Test™

- REAT under Headphones
- Multiple languages for automatic voice instructions and error coaching
- Integrates with CCA-100mini or CCA-200mini. Can be used as stand-alone unit
- Optional Sound Level Meter capabilities to allow for quiet room testing
- Test any number of frequencies. Allowing a faster test or more comprehensive test. (default 500 & 1k)
- Match testing to sound survey to comply with OSHA and NIOSH PEL - permission to work
- Annual calibration and daily calibration check
- Works with a wide range of earplugs
Workplace Integra INTEGRAfit™

Testing Frequency

- 500 Hz is a conservative, efficient test
  - PAR @ 500 Hz takes ~3 mins
  - the test yields a PAR value of ~3 db less than a multiple frequency value
- 500 Hz has a low hearing loss rate
  - higher frequencies have high hearing loss rates which impacts tests results
- 500 Hz has superior air leak detection versus higher frequencies
  - air leaks allow noise to bypass the ear plug yielding poor noise reduction

Image credit: Workplace Integra, Inc.
Edare/WAHTS System Components

- Computer-based Real-Ear Attenuation at Threshold (REAT) under headphones
- ½ Octave noise band stimuli
- Monaural and binaural
- Sound isolation headphones: > 45 dB
- Capacity to integrate fit testing with monitoring audiometry
- Mobile app
- Export to electronic record systems possible
<table>
<thead>
<tr>
<th>Features</th>
<th>WAHTS Fit-test System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Method</td>
<td>REAT Headphone</td>
</tr>
<tr>
<td>System Cost</td>
<td>~$7350 (hearing testing and fit testing)</td>
</tr>
<tr>
<td>Equipment</td>
<td>WAHTS Headset, Tablet and Carrying Case</td>
</tr>
<tr>
<td>Applicability</td>
<td>In-ear hearing protectors, e.g. foam, flange, custom etc.</td>
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<tr>
<td>Test Learning Time</td>
<td>~30 sec</td>
</tr>
<tr>
<td>Testing Time</td>
<td>~3 min</td>
</tr>
<tr>
<td>Fit-Test Output</td>
<td>Personal Attenuation Rating (PAR)</td>
</tr>
<tr>
<td>Listener Requirements</td>
<td>Thresholds &lt; 55 dB HL</td>
</tr>
<tr>
<td>Tester Training Level</td>
<td>CAOHC Recommended</td>
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<tr>
<td>Background noise</td>
<td>Below 55 dB</td>
</tr>
<tr>
<td>Binaural/monaural</td>
<td>Binaural and Monaural</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>2-4 dB</td>
</tr>
</tbody>
</table>
Microphone in Real Ear (MIRE)

- Objective measurement
- No worker response required
- Earplug surrogate must be utilized
- Can test muffs or earplugs (specific brands)

3M Company
- 3M™ E-A-Rfit™ Dual-Ear Validation System
- 3M™ Peltor™ PIC-100 Integrated System
3M™ E-A-Rfit™ Dual-Ear Validation System
<table>
<thead>
<tr>
<th>Performance Requirements</th>
<th>3M™ E-A-Rfit™ Dual-Ear Validation System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Method</td>
<td>Field-Microphone in Real Ear (F-MIRE) using a surrogate hearing protector device</td>
</tr>
<tr>
<td>Duration of Test</td>
<td>3 seconds</td>
</tr>
<tr>
<td>Objective</td>
<td>No listener response is required</td>
</tr>
<tr>
<td>Listener Requirements</td>
<td>None</td>
</tr>
<tr>
<td>Hearing Protectors</td>
<td>Measures earplugs, earmuffs and electronic hearing protectors</td>
</tr>
<tr>
<td>Test site noise requirements</td>
<td>The maximum allowable ambient noise level limit is 85 dBA or 91 dBC</td>
</tr>
<tr>
<td>Reports PAR</td>
<td>Yes: L, R and Binaural measured simultaneously</td>
</tr>
<tr>
<td>Typical PAR Uncertainty</td>
<td>~ 5-7 dB. The combined variability of the attenuation estimate consists of three primary components: measurement, fit, and spectral.</td>
</tr>
</tbody>
</table>
3M™ E-A-Rfit™ Dual-Ear Validation System

• F-MIRE provides an objective measure of noise reduction
• F-MIRE measures the difference between the sound levels inside and outside the hearing protector at the same time.
• Personal Attenuation Rating (PAR) is calculated from attenuation measured at seven frequencies per ear simultaneously
• E-A-Rfit tests earplugs, earmuffs and electronic hearing protectors (both in-ear and over-the-ear)
• E-A-Rfit is compliant to ASA/ANSI S12.71-2018 (R2022)
3M™ PELTOR™ Professional In-Ear Communication Headset, PIC-100

Key Features

On-Demand Fit Test
helps assess proper fit in real time

Hearing Protection
with replaceable eartips in multiple types & sizes

Close-Connect Wireless Technology
enables group communication and allows for simultaneous speakers

Bluetooth® Technology
allows for connection to smart devices and/or two-way radios

Environmental Listening
helps promote auditory situational awareness

In-Ear Speech Microphone
enables clear communication in noise
**Take-Aways for HPD fit testing**

- NRR = *capability* of a given HPD to attenuate noise
- PAR is individualized measure of attenuation of a given earplug
- Feasible
- Efficient
- Quick (less than 10 minutes)
Implementation Considerations

• Effective training tool for workers
• Identify a champion for hearing protection who knows how to insert HPDs and troubleshoot
• Know the noise exposure level in the workplace
• Test using the HPDs available in the workplace
• Encourage workers to replicate the “feel” of properly inserted HPD
Standards and Guidance

Occupational Safety and Health Administration (OSHA)

Mining Safety and Health Administration (MSHA)

Federal Railroad Administration (FRA)

National Institute for Occupational Safety and Health (NIOSH)

Local State National International

ANSI/ASA S12.71-2018 Performance Criteria for HPD Fit Testing

https://www.osha.gov/noise/standards
OSHAP’s General Industry Occupational Noise Exposure Standard
29 CFR 1910.95

Employers shall:

• Train workers in the use and care of all HPs provided to employees 1910.95(i)(4)

• Ensure proper initial fitting and

• Supervise the correct use of all HPs 1910.95(i)(5)
OSHA’s General Industry Occupational Noise Exposure Standard
29 CFR 1910.95

- The employer shall evaluate HPD attenuation for the specific noise environments in which the HPD will be used.

- The employee shall use one of the evaluation methods described in Appendix B: *Methods for Estimating the Adequacy of Hearing Protection Attenuation* 1910.95(j)(1)
OSHA’s General Industry Occupational Noise Exposure Standard
29 CFR 1910.95

HPDs must attenuate employee exposure to at least an 8-hour time-weighted average (TWA) of 90 decibels (dB) 1910.95(j)(2) - EXCEPT

For employee with significant threshold shift, HPD must attenuate exposure to 8-hour TWA of 85 dB or below 1910.95(j)(3)
OSHA’s General Industry Occupational Noise Exposure Standard
29 CFR 1910.95

Employer shall train each employee who is exposed to noise at or above an 8-hour TWA of 85 dB in accordance with the standard.

Training will include:

• Purpose of HPDs
• Advantages, disadvantages and attenuation of various types of HPDs
• Instruction on selection, fitting, use and care
Employees with standard threshold shift (STS)
29 CFR 1910.95(g)(8)(ii)(A) and 1910.95(g)(8)(ii)(B)

- Mandatory fitting or refitting of HPDs
- Mandatory training or retraining on HPD use and care
NHCA-OSHA-NIOSH Alliance:


Valuable training tool:
Proper use of HPDs

Selection/fitting of HPDs
Train the trainer

STS follow-up: fit/refit/ and train/retrain worker to select/fit HPD with appropriate attenuation)

Provides documentation of HPD adequacy and training

http://www.hearingconservation.org/assets/docs/AllianceRecommendationsForFitTesting_Final.pdf

A tool to assess overall effectiveness of employer’s hearing conservation program

Enables matching employee’s HPD attenuation to their noise exposure level (especially critical for safety sensitive positions or those with hearing loss)

Aids in selecting the best HPD from available options

http://www.hearingconservation.org/assets/docs/AllianceRecommendationsForFitTesting_Final.pdf
**OSHA Letters of Interpretation**

"This letter constitutes OSHA’s interpretation of the requirements discussed."

OSHA’s requirements are set by statute, standards and regulations.

Letters of interpretation do not create new or additional requirements but rather explain these requirements and how they apply to particular circumstances.
Will OSHA accept a personal attenuation rating (PAR) instead of the NRR/NRR(SF) de-rating?

RESPONSE: THE OSHA NOISE STANDARD REQUIRES EMPLOYERS TO USE A NOISE REDUCTION RATING (NRR) METHOD DESCRIBED IN APPENDIX B. AN EMPLOYER WOULD BE IN VIOLATION OF PARAGRAPH 1910.95(J)(I) IF A METHOD CONSISTENT WITH APPENDIX B WAS NOT USED. SEE 2017 LETTER OF INTERPRETATION.

https://www.osha.gov/laws-regis/standardinterpretations/2021-12-16-0
Appendix B must be utilized to select options for HPDs; Employee chooses one from a variety of adequate options.

Paragraph 1910.95(i)(5) requires the employer to ensure proper initial fitting and correct use of all HPDs.

OSHA has always embraced newer technology that enhances workplace safety, but is prohibited from formally testing, evaluating, certifying, or approving of products, processes or programs.
Can employers use a personal fit-testing system to provide training to employees in the use and care of hearing protectors?

“Yes. OSHA’s Noise Standard requires employers to provide training in the use and care of all HPDs provided to employees, per paragraph 29 CFR 1910.95(i)(4).

Paragraph (k)(3)(ii) is the requirement to inform employees on the purpose of HPDs, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care…”

Can employers use a personal fit-testing system to provide training to employees in the use and care of hearing protectors?

“The means and methods that employers use to provide this training is a performance-based requirement, so Employers may use any means that are most suitable and effective, which may include the use of a personal fit-testing system.”

Example

01 Employer used Appendix B as mandated in the OSHA Noise Standard

02 Employee chooses one of the available protectors

03 Personal fit-testing indicates that a proper initial fit is not possible for an employee using the selected adequate HPD (i.e., has an adequate NRR)

04 The employer and employee should select another adequate HPD from the variety of options selected IAW the standard
HPDFT enables employers to determine how well individual HPDs protect workers.

Especially useful when workers have experienced an STS.

“HPD fit-testing could be utilized to determine the appropriate attenuation for a given environment, by identifying an HPD that would provide necessary attenuation to protect the hearing, but not so much that it would interfere with the ability to hear warning alarms.” (Section 4. Personal Protective Equipment)

https://www.osha.gov/otm/section-3-health-hazards/chapter-5
“HPD fit-testing cannot be substituted for the NRR when assessing the adequacy of a given protector to reduce noise exposure; however HPD fit-testing can be used in addition to NRR.

The OSHA/National Hearing Conservation Association (NHCA) Alliance has recommended HPD fit-testing as a best practice and valuable training tool that can help in training the worker to achieve an optimal fit.” (Section M. Training)
Summary

• HPD Fit Testing is recognized as a best practice by OSHA since 2008
• OSHA’s letters of interpretation support the use of HPDFT for training workers to effectively use HPDs
• While no US regulatory agencies currently require HPDFT, some other nations have incorporated it in their policies
HPD Fit Testing

Best Practice

Everyday Practice
References


Department of Defense instruction (DoDI) 6055.01. (2014, Oct 14), DoD safety and occupational health (SOH) Program.


