Hearing protector attenuation & noise exposure among metal manufacturing workers

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- The University of Washington School of Public Health
- The University of Michigan School of Public Health
Noise levels over time (OSHA IMIS)

Mean and Exceedance for AL and PEL Measurements by Year

Year of Publication

- Mean AL
- AL % Exceedance
- Mean PEL
- PEL % Exceedance
Noise levels over time (OSHA IMIS)

Mean and Exceedance for AL and PEL Measurements by Year

- Mean AL
- AL % Exceedance
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- PEL % Exceedance
Hearing loss trends in the US by industry

Prevalence of Hearing Loss by Time Period and Industry Sector, 1981 - 2010, for 1,816,812 Workers

Adapted from Figure 1, Masterson et al. 2015
Hearing protector fit may be an issue
Background

• Already had an on-going study
• >100 participants in NY and Indiana
• Primary and secondary metal manufacturing facilities
Methods

• Participants wore shoulder noise dosimeter
• Fit-testing performed during shift
• ~3 work shifts
• Attenuation subtracted from shoulder noise exposure to determine actual/effective exposure inside HPDs
Equipment
Equations: PAR

**PAR = Personal Attenuation Rating**

Decibels to hear with plugs – decibels to hear without plugs

### Most Recent Personal Attenuation Rating

<table>
<thead>
<tr>
<th>Protector</th>
<th>Custom Protect dB Blockers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Exposure</td>
<td>100.8</td>
</tr>
<tr>
<td>Test Result</td>
<td>PASS</td>
</tr>
</tbody>
</table>

### Most Recent REAT Test Results

<table>
<thead>
<tr>
<th>Trial</th>
<th>Occluded</th>
<th>Unoccluded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>250 Hz</td>
<td>500 Hz</td>
</tr>
<tr>
<td>1</td>
<td>67.0</td>
<td>30.8</td>
</tr>
</tbody>
</table>

### Test History

<table>
<thead>
<tr>
<th>Test Date</th>
<th>Protector</th>
<th>125 Hz</th>
<th>250 Hz</th>
<th>500 Hz</th>
<th>1000 Hz</th>
<th>2000 Hz</th>
<th>4000 Hz</th>
<th>8000 Hz</th>
<th>FitCheck Solo PAR</th>
<th>Maximum Exposure</th>
<th>Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Custom Protect dB Blockers</td>
<td>45.8</td>
<td>13.7</td>
<td>13.5</td>
<td>20.5</td>
<td></td>
<td></td>
<td></td>
<td>15.8</td>
<td>100.8</td>
<td>PASS</td>
</tr>
</tbody>
</table>
Equations: $P_{\text{EFF}}$

$P_{\text{EFF}} = \text{Effective Hearing Levels}$

Ambient noise levels – hearing protector attenuation (PAR)
Example: $P_{\text{EFF}}$

$P_{\text{EFF}} = \text{Effective Hearing Levels}$

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Ambient noise levels – hearing protector attenuation (PAR)
Example: $P_{\text{EFF}}$

15 dB PAR

90 dBA

75 dB $P_{\text{EFF}}$

$P_{\text{EFF}} = \text{Effective Hearing Levels}$

Ambient noise levels – hearing protector attenuation (PAR)
Results

- 91 workers monitored for 2.8 shifts
- Mean age ~50
- 40% female
- 77% white

- Noise Levels **Low**: 80 dBA (SD=7 dBA, n=255)
- PARs **High**: 20.1 dB (n=251)
Results

![Histogram showing the distribution of Peff (dB) with percentage values.]

- Overprotected region
- Underprotected region

- X-axis: Peff (dB)
- Y-axis: Percent (%)
Results

Ideal 70-80 dB $P_{\text{EFF}}$
Results

The results show a comparison of Average PAR (dB) between Custom and Non-Custom conditions across different fit-test numbers. The graph displays the average PAR values with error bars indicating the variability. The sample sizes (n) for each condition are provided for fit-test numbers 1, 2, and 3.
Results

Non-custom-molded earplugs

\[ p = 0.04 \]
Modeling PAR

• Significant effect of race on PAR when not accounting for HPD type
• Workers of color more likely to wear custom-molded plugs
  • Among custom-molded wearers, white workers had higher attenuation than workers of color
Conclusions

• Issues with safety because of over-protection?
• Custom- vs. non-custom issues
• Race as a factor in HPD use
• Necessity of fit-testing to ensure proper attenuation for workplace noise levels
Questions?

Thank you!