Evaluation of the Benson Medical Instruments Audiometer as a Hearing Protection Device Field Attenuation Estimation System

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HPD FAMS Prototype F-MIRE

- Hearing protector device (HPD) fit testing has been identified as a “best practice” for hearing conservation programs. HPD field-attenuation estimation systems (FAESs) are commercially available and used in the Army Hearing Program. The Benson Medical Instruments CCA200 and CCA200 mini computer-controlled audiometers are used in many DoD and industrial hearing conservation programs. This study’s purpose was to evaluate the Benson Medical CCA200 mini for use as an interim HPD FAES, augmenting the Operational Hearing Services mission of the Army Hearing Program. Three audiograms and one HPD FAES measurement were collected from 20 subjects who were accustomed to the Benson Audiometer hearing test. Occluded and unoccluded evaluations were collected using a large volume, circumaural headset. A preformed earplug was used for the occluded test. All testing was conducted at USAARL in 2014. The utility, efficiency, and cost of using the Benson Medical computer-controlled audiometer as a HPD FAES will be discussed.
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Hearing Protection Device
Field Attenuation Estimation Systems
No matter which test method is used, individual fit testing has the potential to serve several positive purposes in hearing conservation programs:

1. Can be a valuable training tool. OSHA’s Hearing Conservation standard requires employers to train employees in the use and care of hearing protectors (29 CFR 1910.95(i)(4)), and requires employers to ensure proper initial fitting and supervise the correct use (29 CFR 1910.95 (i)(5)).

2. Can be used as a train-the-trainer tool to teach others how to train employees.
NHCA/OSHA Alliance (2008)

3. Can assist with the OSHA required audiometric testing follow-up procedures.

   a. Audiometric test follow-up procedures require that when the evaluation of an audiogram indicates an STS, employees already wearing hearing protectors must be refitted and retrained in their use and provided with hearing protectors offering greater attenuation if necessary (29 CFR 1910.95 (g)(8)(ii)(B)), and

   b. Individual fit testing protocols will validate the amount of attenuation afforded by the individual user’s hearing protector and will enable the employer to better fulfill this requirement to provide a hearing protector with greater attenuation if necessary.
NHCA/OSHA Alliance (2008)

4. Can provide useful documentation regarding hearing protector adequacy and training. The software provides a written record of the attenuation achieved for the given hearing protector.

5. Can be used as a tool to assess the overall effectiveness of an employer’s hearing conservation program.

6. Can enable the hearing conservationist to match the employee’s hearing protector attenuation to his/her noise exposure level. This may be particularly useful in hearing-critical jobs or for those with hearing impairment.

7. Can aid in the selection of appropriate hearing protection for new hires. A variety of protectors can be tested, and the appropriate model can be selected for best protection.
Army Hearing Program

MISSION: The Army Hearing Program maximizes mission effectiveness through optimized hearing and communication by providing surveillance, oversight, education, and consultation to leaders, Soldiers and Civilians.

VISION: The leading resource for all Army Hearing Program stakeholders.

GOALS: To reduce the risk of acquired hearing loss through education, mitigation of noise hazards, and policy development.

COMPONENTS:
• Hearing Readiness
• Operation Hearing Services
• Clinical Hearing Services
• Hearing Conservation
Army Hearing Program – Hearing Readiness

- Hearing readiness (HR) is a process to ensure that Soldiers have the required hearing capability and personal protective equipment such as hearing protection, for readiness, deployment, lethality and survivability. The purpose of HR is to identify early changes in hearing, and to provide education, individual counseling, and refit hearing protection to prevent further damage to hearing.
Benson CCA-200 mini Computer-Controlled Audiometer

- The Benson Medical Instruments CCA-200 or CCA-200 mini is used in U.S. Army clinics and interfaced with the DOEHRSC-HC database as an important part of the Army Hearing Program.

- Can these be used to obtain a Soldier’s earplug’s Personal Attenuation Rating (PAR)?
Inclusion / Exclusion Criteria

• Inclusion criteria:
  – Uniformed personnel age 18 years or older
  – Civilian personnel age 19 years or older (AL age of majority)
  – Willingness to participate in the study which should be not more than two hours

• Exclusion criteria:
  – Features or physical disabilities that interfere with the proper fitting of a Howard-Leight AirSoft® preformed earplug including those that might arise from birth defects, ear surgery, or personal adornments
  – Ear canal size inappropriate for use with Howard-Leight AirSoft® earplugs
  – Excessive cerumen (ear wax), irritation, or infection (as determined by otoscopic examination)
Test Item

Howard-Leight AirSoft® Earplug
Headphones

Benson Medical CCA-200 mini headphones on a BAS-200slm Bioacoustic Simulator

Michael and Associates FitCheck™ headphones
## Experimental Design

\( n = 20 \)

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Measurement 1</th>
<th>Measurement 2</th>
<th>Measurement 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 5</td>
<td>Control Audiogram</td>
<td>FitCheck™ Unoccluded</td>
<td>Benson Occluded</td>
</tr>
<tr>
<td>6 - 10</td>
<td>Control Audiogram</td>
<td>Benson Unoccluded</td>
<td>Benson Occluded</td>
</tr>
<tr>
<td>11 - 15</td>
<td>FitCheck™ Unoccluded</td>
<td>FitCheck™ Occluded</td>
<td>Benson Unoccluded</td>
</tr>
<tr>
<td>16 - 20</td>
<td>Benson Unoccluded</td>
<td>Benson Occluded</td>
<td>Control Audiogram</td>
</tr>
</tbody>
</table>
Unoccluded Thresholds

![Graph showing unoccluded thresholds across different frequencies for Benson Left, Benson Right, Fitcheck Left, and Fitcheck Right.](image-url)
FitCheck Headphone Thresholds

![Graph showing FitCheck Headphone Thresholds](image-url)
Personal Attenuation Ratings

Legend

- FitCheck reported PAR
- FitCheck calculated PAR
- Benson PAR calculated with 7 frequencies
- Benson PAR calculated with 5 frequencies
- Benson earphones w/ offset calculated with 7 frequencies
Observations

- Benson Medical headphones should not be used for fit-testing purposes due to the close fit to the ear, possibly interfering with the earplug (thus warning the Soldier that an earplug is not inserted correctly).

- During annual audiograms, Soldiers can simply insert earplugs, change headphones, and perform a “second, occluded” audiogram.

- The data can be entered into a spreadsheet and PAR calculated automatically.
Protect the Warfighter