Myths and Misconceptions about Hearing Protection

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Myths and Misconceptions about Hearing Protection

As someone who has kept up with the literature in the field of hearing conservation for over 30 years, I have had the opportunity to learn much, but also to observe common myths and misconceptions that cause confusion in the application of hearing protection devices (HPDs). This talk will address five common fallacies: 1) HPDs must be ANSI certified or otherwise approved (false in the U. S.); 2) The 7-dB correction used when applying the NRR is a “real-world” correction (false); 3) Earmuffs provide better protection than earplugs from sound that excites the bone-conduction pathways, and real-ear attenuation at thresholds tests cannot reveal these bone-conduction issues (mostly false); 4) For the best fit and protection, roll-down foam earplugs must be held in place during expansion in the ear canal (false); 5) Level-dependent HPDs are designed for impulse noise and therefore provide better protection from gun shots and blasts than conventional passive (non-electronic) HPDs (false). Explanations will be provided to unravel these statements and clarify the facts.

Learning Objectives:

1. Understand the reason for and application of the 7-dB correction for use with the NRR.
2. Be able to describe the relative effectiveness of earplugs vs. earmuffs in blocking bone-conducted sound transmission.
3. Understand the limitations of level-dependent HPDs and which type of HPD provides the most protection from blast noise.
Having worked in our field for many years, I have had the opportunity to read the literature, conduct my own research, collaborate with many bright people, and attend conferences such as this one. I have been able to sort the wheat from the chaff. My intent today is to share some of those learnings with respect to five common myths and misconceptions related to hearing protection.
Myths and Misconceptions

- HPDs must be ANSI certified or otherwise approved
- The OSHA 7-dB adjustment factor is a “real-world” correction
- Earmuffs block bone-conducted energy better than earplugs especially at high levels, and REAT cannot measure this effect
- Roll-down foam plugs must be held in place during expansion
- Level-dependent (“nonlinear”) HPDs provide more protection from impulse noise (gunshots) than do simple plugs or muffs

The five topics to be discussed are outlined on this first slide.
HPDs must be ANSI certified or otherwise approved

Relevant Standards Groups and Federal Agencies

- ANSI standards on *how to measure* attenuation
- EPA labeling regulation that requires attenuation be measured and reported
- OSHA specifies use of HPDs above Action Level, and defines how to determine HPD suitability
- MSHA specifies use of HPDs above Action Level
- NIOSH best practice guidance; no requirements or regulations
- NVLAP accredits laboratories, *not* their test results
- FDA HPDs are not considered to be medical devices
- CPSC no requirements with respect to HPD performance

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Another issue is that customers may ask for or “require” use of approved or certified devices.
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OSHA’s 7-dB adjustment is a real-world correction

Background information:
- The actual adjustment factor as well as the math underlying the NRR derives from NIOSH 76-120.
- The adjustment factor provides the best agreement, when used with dBA, between a NIOSH-style single-number rating and a long-method octave-band computation.
- The adjustment has nothing to do with real-world use/misuse of HPDs.

Patricia Kroes, Roy Fleming, and Barry Lempert

76-120 is the source document for the math underlying the NRR. The adjustment appears in the OSHA HCA Appendix B.
Using the NRR

\[ \text{dBC} - \text{NRR} = \text{dBA}´ \]

workplace noise  effective employee exposure
A better approach is fit testing.
Earmuffs block bone-conducted energy better than earplugs, and REAT cannot measure that effect

The facts are these:

- The small area of coverage of the skull by earmuff cushions does not substantially affect airborne excitation of those areas.
- REAT (real-ear attenuation at threshold) is the “gold standard” for measuring HPD attenuation.
- REAT is based on subjective thresholds, i.e., response of the cochlea; it accounts for all pathways including BC.
- REAT is valid up to the point at which conventional HPDs become level-dependent, about 160 – 170 dB SPL.
- The attenuation of an earmuff and earplug as measured by REAT is a valid indicator of their relative performance.

REAT is valid for the way in which the HPDs were fit for the testing that was conducted.
Used lead muff plus deep-insert plug to estimate BC limits
Roll-down foam plugs must be held during expansion

This idea originated in the early 1970s

Another potential reason for the misconception is illustrated in the next slide.
The Inadequate Roll Down
Key Experimental Details

- Laboratory testing according to ANSI S12.6-2008 in 3M’s E•A•RCAL facility
- Test conditions: Method A, w/pinna pull (trained fit, n = 16)
  Method B (inexperienced-subject fit, n = 15)
- In each test the same subjects did both the hold and the no-hold
- Presentation order was counter balanced
- Paired t-tests indicated no significant effect of holding at any frequency

Illustration of the Method-B Instructions

Only about ½ of Method-B subjects followed instructions
About ½ of Method-B subjects pulled pinna
More important is to teach correct tight, smooth, and crease-free roll downs and the correct pinna pull
Level-dependent HPDs provide better protection from impulse noise than simple earplugs or earmuffs.

Other common terms describing level dependency are, nonlinear, sound-transmission, and amplitude-sensitive.

Conventional HPDs – no electronics, no moving parts, simple sound barriers – provide level-independent attenuation up to about 160-170 dB peak SPL.
Passive
level-dependent earplugs

Active
level dependent earmuff

Combat Arms – 0.3-mm ID hole in a 0.1-mm thick plate
North – elastic element constricted between two metal plates
Level-dependent HPDs include a sound bypass to let sound in at lower levels.

This can be accomplished passively (by mechanical design) or actively (by electronics using a power source such as a battery).

Sound = movement of air molecules; orifice create turbulent air flow.

Key point – level dependency in passive HPDs does not begin until about 110 – 120 dB SPL.
**Impulse Hearing Protectors**

**Positive**
Provides better hearing when noise not present, and can sound more natural.

**Neutral or Possibly Negative**
Never more protective than, and possibly not as protective as, a conventional HPD
Summary Remarks

- In North America HPDs do not require certification
- OSHA’s 7-dB adjustment is not a correction for real-world performance, rather it is a function of using the NRR with dBA vs. dBC
- Muffs and plugs are about equal in blocking bone-conducted sound, and their relative performance can be properly measured via the standardized REAT procedure
- No evidence was found for the need to hold a roll-down earplug during expansion; key factors for fit are the roll down and the pinna pull
- Level-dependent HPDs do not provide more protection from impulses than conventional HPDs, rather they let you hear better between the impulses, that is, during the “quiet” times

Though certification is not required testing to ANSI S3.19-1974 and labeling ARE required.
References


Questions?