Exposure Smart Protector
A New Solution for the Prevention of Hearing Loss among Construction Workers

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doseBusters USA
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Prevention of Occupational NIHL
-The Fundamentals-

• Ensure individual worker’s actual noise exposure does not exceed a TWA of 85 dBA

• Ensure this level of protection is provided for a working lifetime: 30-40 yrs
Basic Elements of Current HCPs

- Monitoring
- Adequacy of Hearing Protection
- Training/Motivation
- Audiograms
Monitoring?

Top-of-shoulder dose monitoring

**Annual Survey**: Usually a single-shift sample; this is a valid predictor of hearing loss only if the worker wears no hearing protection, and all of the subsequent work conditions contributing to the exposure remain stable (rare in construction). D. J. Garvey, New Ideas in Construction Hearing Conservation, Professional Safety, February 2000, p 26-28
Noise Reduction Rating?

It has been repeatedly documented that the laboratory-derived NRR is absolutely unreliable in either predicting or estimating the actual efficacy of hearing protection for individuals in the workplace. Why? Because it fails to account for individual fit and wearing time. Yet, OSHA continues to give credit based on the NRR.
Training/Motivation?

- One size fits all approach -

• Fit: “Fit tightly”

• Wearing time: “Wear all the time”
Training Counter-Productive?

- Discomfort increases with both fit and wearing time

- Safety/communications can be a problem when the ambient noise level is quiet
Training: Fit

Everyone has seen the following:

What if the exposure is equal to the US average, i.e., about 92 dBA? Do you really want 30+ dB of attenuation in this situation???
Effect of wearing time on performance

Chart NR1. Effective NRR vs Percent Wear Time in a Sound Field
[based on EPA NRR Value of 29]
Audiograms?

The audiogram has become the central feature of HCPs, but as noted by Royster in the American Industrial Hygiene Association’s *The Noise Manual* (2000, p 457),

...audiograms are an expensive exercise in documenting hearing loss and reacting to it after the fact.

Simply stated, audiograms do not prevent hearing loss.
Current HCPs do not ensure Prevention of Occupational NIHL

- Check-list approach
- Focus is on **COMPLIANCE**
- Can have an STS rate of 5 % and be in compliance
Construction workers pose additional challenges...

• Most workers are employed by small companies.
• Most workers are seasonal employees.
• Most workers are mobile with limited tenure with a single employer.
• The day-to-day exposures of most workers are highly variable.
A Simpler Solution: What if...

• The efficacy of HP in protecting individual workers to a TWA of 85 dBA, or less, could be established on a daily basis, with absolutely no regard for the published NRR attenuation values?

• Plus, workers could tailor the fit and wearing time of their HPs to the job, and balance their individual needs for adequate protection and communication?
I. Conventional Hearing Protection

II. Personal Noise Dosimetry

III. Continuous Monitoring

ensure individual’s dose does not exceed the AL
Exposure Smart Protector
MIRE Monitoring

- Monitoring and protection: both ears
- Dual-microphone dosimeter
- IR readout
- Technology is now practical and affordable.
Exposure Smart Protector (ESP)

- **Primary wearing position**: HP occludes the ear; with the microphone in or near the ear, a worker’s *protected dose* is measured.
- **Secondary wearing position**: HP does not occlude the ear; with the microphone now exposed to ambient noise conditions, a worker’s *unprotected dose* is measured.
- **Effective dose**: the sum of all the partial *protected* and *unprotected doses*. 
What’s Important?
The Actual Noise Exposure

Actual dose = \( \sum \) unprotected dose\(_i\) + \( \sum \) protected dose\(_j\)
Exposure Smart Protector™ (ESP)

• Fit and wearing time: accounted for

• Actual exposure is measured over a full shift: worker sees dose daily

• Pre-Action Level warning light

• 85 dBA sound level warning light
ESP: Earmuffs
ESP: Earplugs
Microphone holder/earpiece
Field Studies

- Steel Mill
- Industrial Sand Mill
- Underground Coal Mines
- Surface Coal Mines
Underground Longwall Coal Miner
Noise dose: Ambient vs. Inside ESP
Underground Coal Site 2

Measurement Number

Percent dose

Ambient

Under ESP
## Extreme Exposure: Air-Arcing

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<th>Miner</th>
<th>Type of ESP Earplug</th>
<th>Actual Exposure Time (Minutes)</th>
<th>PEL Dose % - Actual</th>
<th>PEL Dose % - Projected (8 Hrs)</th>
<th>Permitted Exposure Time (Minutes)</th>
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Dose Readout/Display

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The ESP solves a 30-year old problem

What is the efficacy of personal hearing protection for individual users under real-world conditions?

For the first time a rational policy on the use of personal hearing protection can be established that is actually based on science, and not assumptions, guesses, and other equally bad prediction schemes.
Paradigm Shift in Hearing Conservation

• Current problems:
  – Unpredictable field performance of HPDs
  – Non-representative lab attenuation measurements (and arbitrary de-ratings)
  – Insufficient or inaccurate exposure measurements

• These problems disappear with the ESP.
Shift the Paradigm
Empower Workers with Information

• Provides daily, quantitative feedback on exposure
• Redundant information is available for decision-making: real-time, mid-shift, and end of shift
• Efficacy is under worker’s control: fit and wearing time can be tailored to achieve a balance between personal needs for protection and communication
• Accountability is established/reciprocal
ESP: Summary of Benefits

- Virtually eliminates the possibility of occupational NIHL through UPSTREAM PREVENTION, rather than downstream detection of hearing loss
- Eliminates the need for double protection
- Provides individual feedback to employees EVERY DAY on their daily noise exposures, allowing them to balance protection and communication, and effectively manage their own exposures
- Could be highly useful in helping to identify other causes of hearing loss resulting from chemicals, ototoxic drugs, and non-occupational noise exposures
Good Ears...
...Good Years

Workers...they deserve no less.