

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

Alton Burks & Kevin Michael

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 -

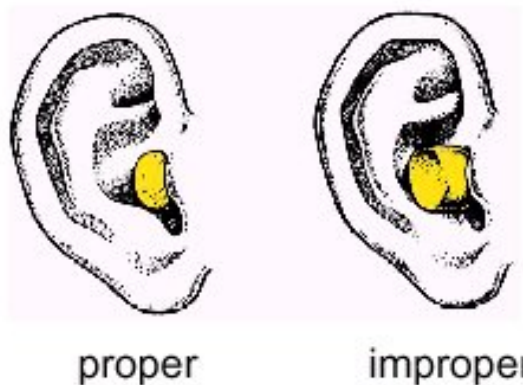
- Fit: “Fit tightly”
- Wearing time: “Wear all the time”

Training Counter-Productive?

- Discomfort increases with both fit and wearing time
- Safety/communications can be a problem when the ambient noise level is quiet

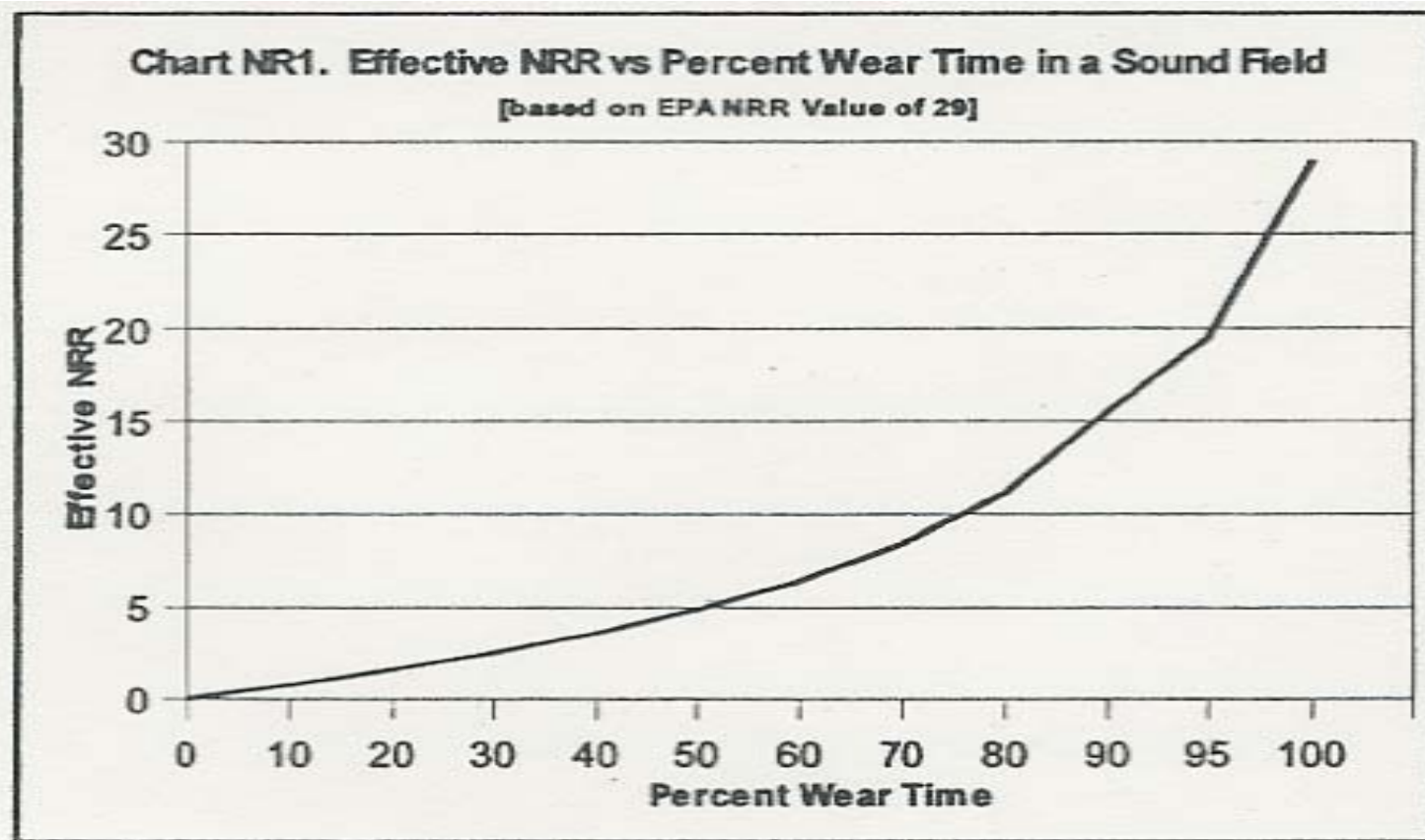
Training:Fit

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



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

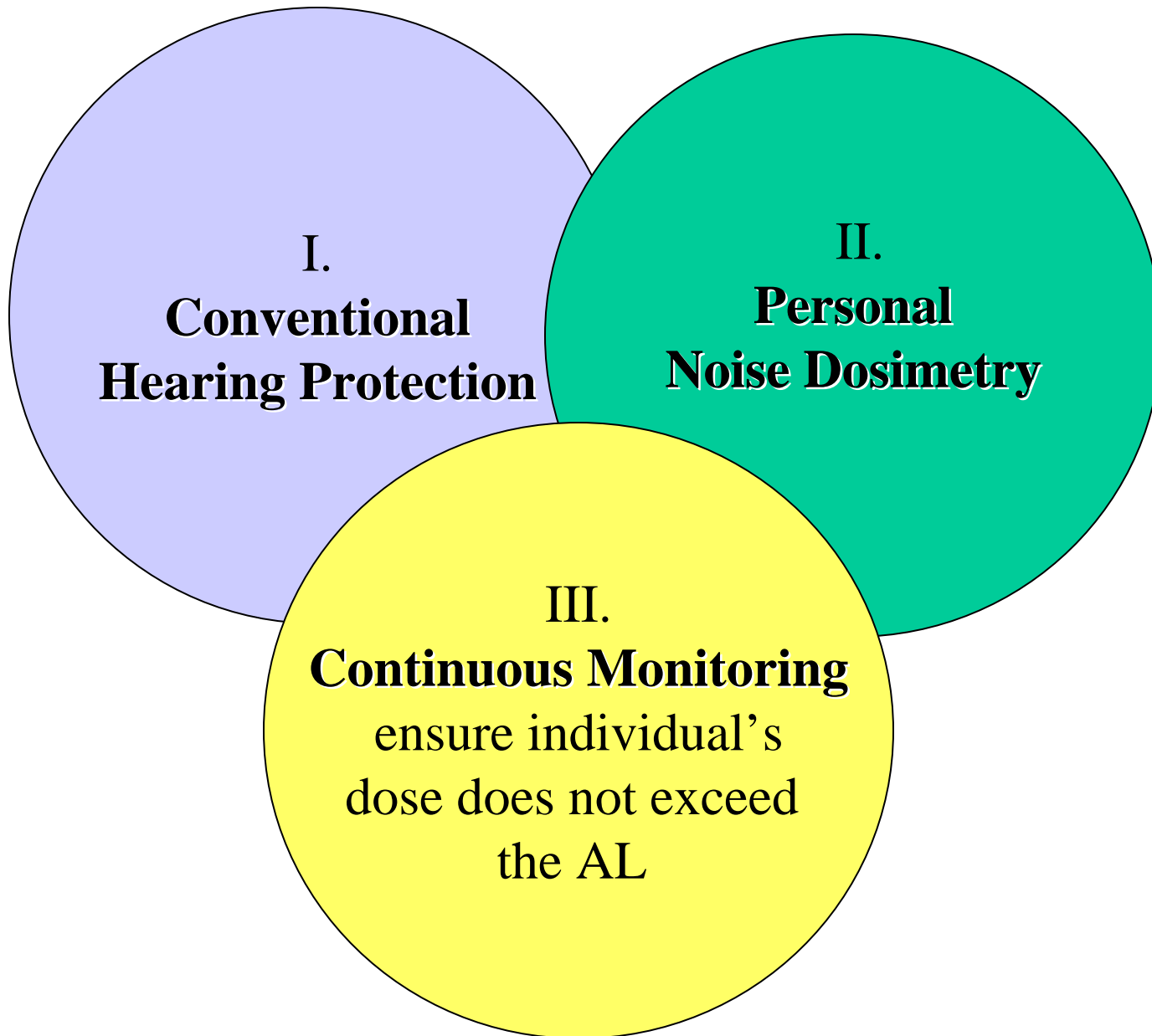
- Check-list approach
- Focus is on **COMPLIANCE**
- Can have an STS rate of 5 % and be in compliance

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?

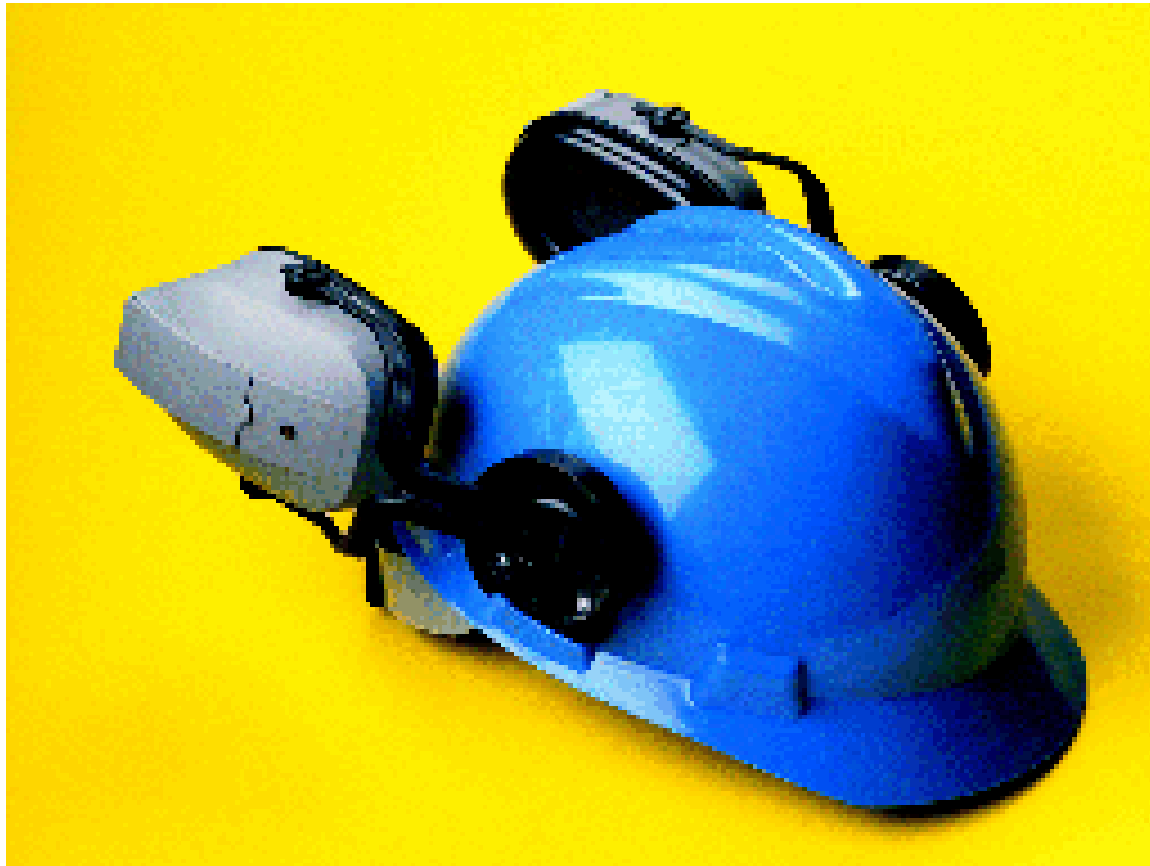
The Actual Noise Exposure

$$\text{Actual dose} = \Sigma \text{ unprotected dose}_i + \Sigma \text{ protected dose}_j$$

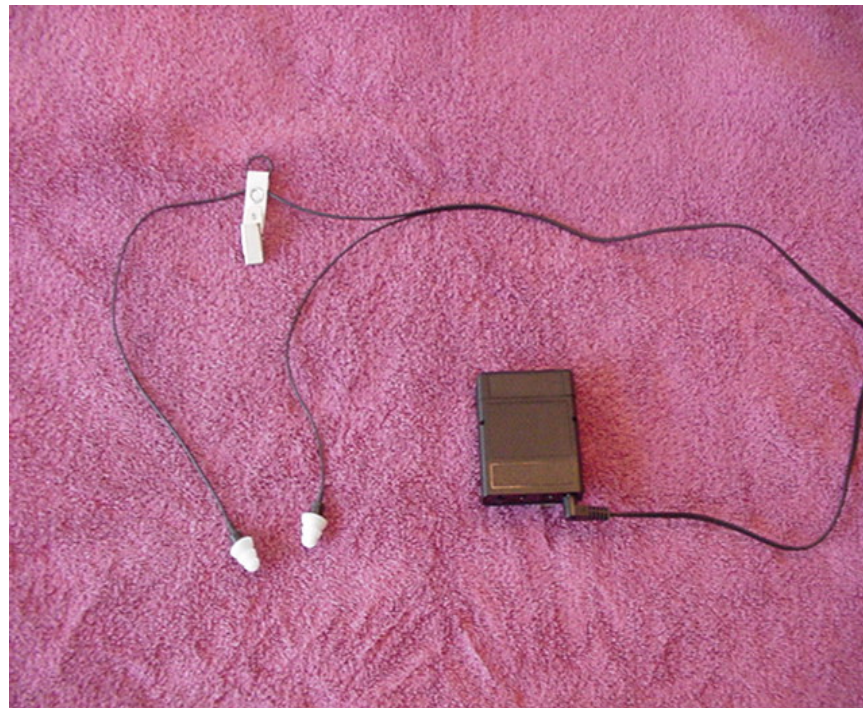
Exposure Smart Protector™ (ESP)

- **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



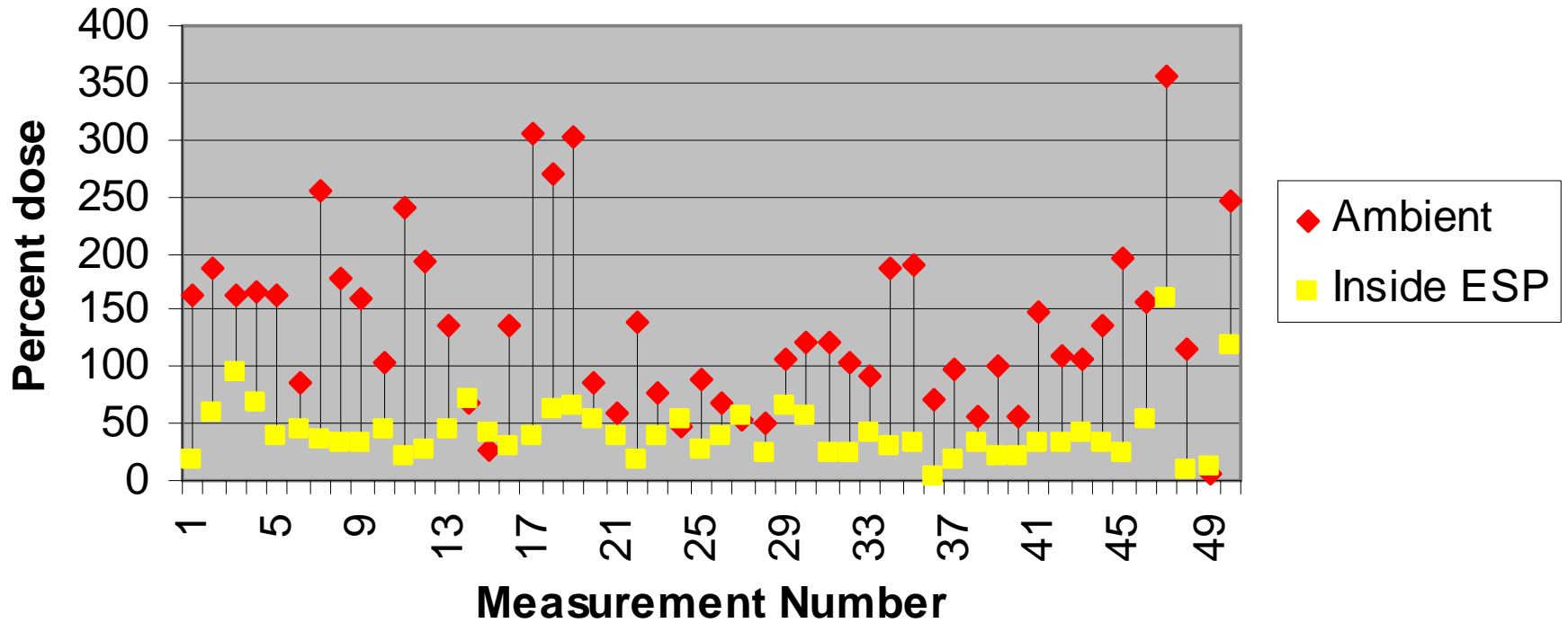
Field Studies

- Steel Mill
- Industrial Sand Mill
- Underground Coal Mines
- Surface Coal Mines

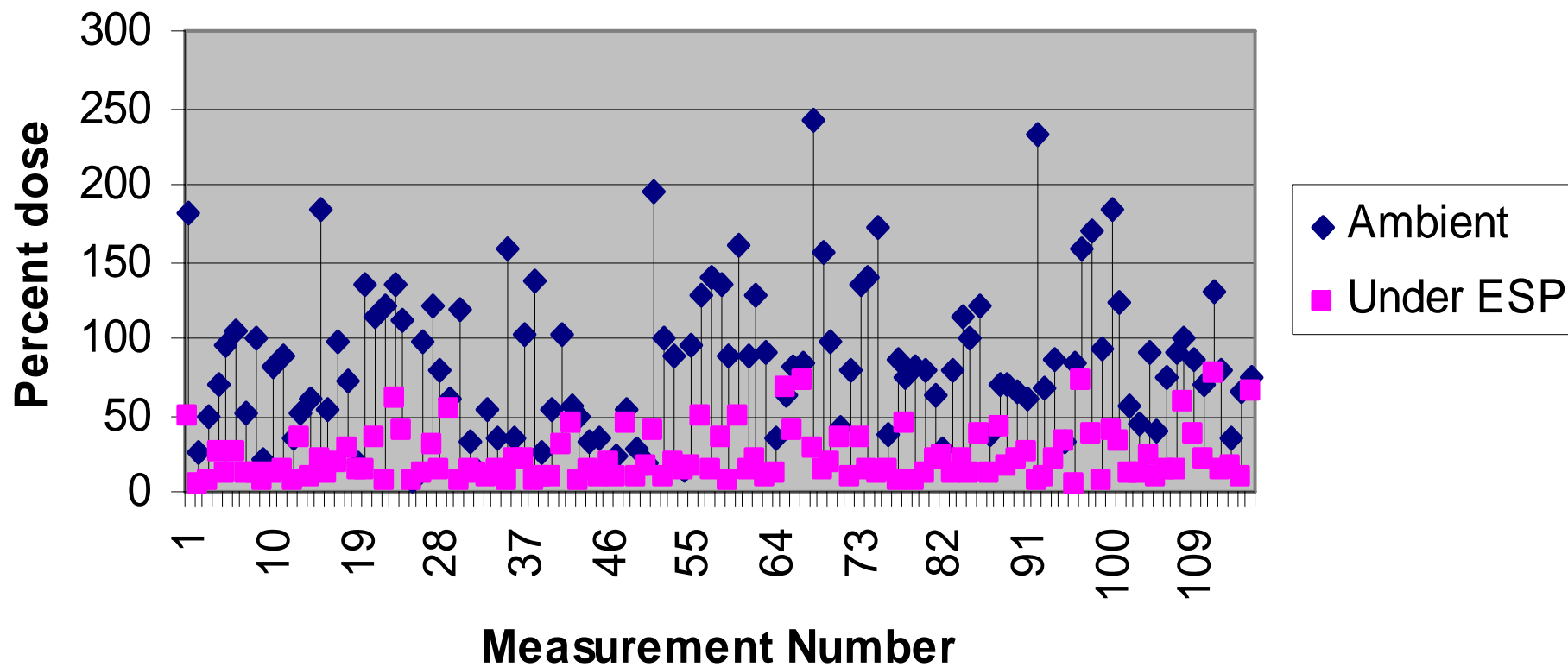
Underground Longwall Coal Miner



Noise dose: Ambient vs. Inside ESP Underground Coal



Noise dose: Ambient vs. Inside ESP Underground Coal Site 2



Extreme Exposure: Air-Arcing

Miner	Type of ESP Earplug	Actual Exposure Time (Minutes)	PEL Dose % - Actual		PEL Dose % - Projected (8 Hrs)		Permitted Exposure Time (Minutes)
			ESP	Top of Shoulder	ESP	Top of Shoulder	
Welder 1	reusable flanged silicone	25	4	119	77	2285	21
Welder 2	reusable flanged silicone	20	0	23	0	552	87
Welder 3	reusable flanged silicone	35	5	59	69	808	59
Welder 4	reusable flanged silicone	72.5	10	263	66	1741	28
Welder 4	reusable urethane foam	96	0	337	0	1685	28
Welder 5	reusable flanged silicone	111.5	13	240	56	1032	47
Welder 5	reusable urethane foam	51	0	110	0	1035	46
Welder 6	reusable flanged silicone	47	3	171	31	1746	28
Welder 6	disposable pvc foam	58	0	212	0	1754	27





Dose Readout/Display

doseBusters USA Data Management System

File Data

Station 1

John Doe

0%

Scan successful. Please turn off dosimeter.

ID Number	Last Name	First Name	Date	Dose (90)	Dose (80)	Duration	Time > 130 dBA	Time > 115 dBA	Dept. Name	Batte
15140			10-08-2002	4	4	.028	0	0		1.3
15140			10-08-2002	0	0	.281	0	0		1.2
15140			10-08-2002	0	0	.286	0	0		1.2
10438	Crumbaker	Charles	11-19-2001	0	0	.003	0	0		8.9
10451	Aulicino	John	11-19-2001	0	0	.028	0	0		9.2
10366	Sochor	Frank	11-19-2001	0	0	.003	0	0		9.1
10311	xx	xx	11-19-2001	0	0	.028	0	0		9.2
10438			11-19-2001	0	0	.081	0	0		9.0
10376	Jenkins	Ron	11-19-2001	0	0	.003	0	0		9.0
10498	Weaver	Mike	11-20-2001	0	0	.008	0	0		9.1
10323	Wells	Ernie	11-20-2001	0	0	.028	0	0		9.2
15140	Doe	John	10-09-2002	0	0	.026	0	0		1.3

Exposure Data are Archived

15179	2002-10-26	M.	Schautschick	13.1	16	21	0	0	1.4
15179	2002-10-27	M.	Schautschick	13.7	66	71	0	37	1.4
15179	2002-10-28	M.	Schautschick	12.2	4	10	0	0	1.3
15179	2002-10-29	M.	Schautschick	12.2	11	18	0	0	1.3
15179	2002-11-01	M.	Schautschick	12.1	5	11	0	2	1.3
15179	2002-11-02	M.	Schautschick	12.2	5	10	0	0	1.3
15179	2002-11-03	M.	Schautschick	12.5	9	13	0	0	1.2
15179	2002-11-06	M.	Schautschick	12.3	11	15	0	0	1.2
15179	2002-11-07	M.	Schautschick	12.6	1	4	0	0	1.2
15179	2002-11-08	M.	Schautschick	12.5	5	8	0	0	1.0
15179	2002-11-11	M.	Schautschick	12.2	15	20	0	0	0.7
15179	2002-11-13	M.	Schautschick	0.0	0	0	0	0	1.4
15179	2002-11-14	M.	Schautschick	12.6	12	19	0	0	1.4
15179	2002-11-16	M.	Schautschick	12.7	2	6	0	0	1.3
15179	2002-11-17	M.	Schautschick	11.9	7	8	0	0	1.3
15179	2002-11-18	M.	Schautschick	12.2	9	10	0	1	1.3

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.**

