

Best Practices In Effective Hearing Conservation



Introduction

About Us

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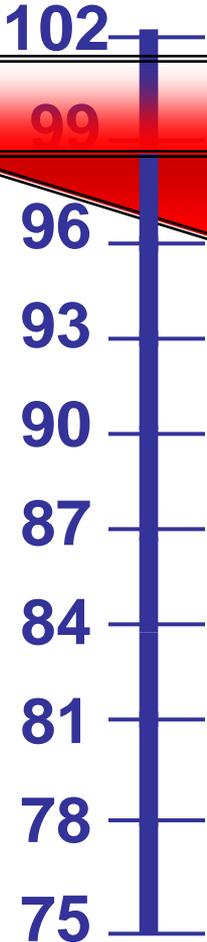
Hazardous noise exposures occur

On the Job



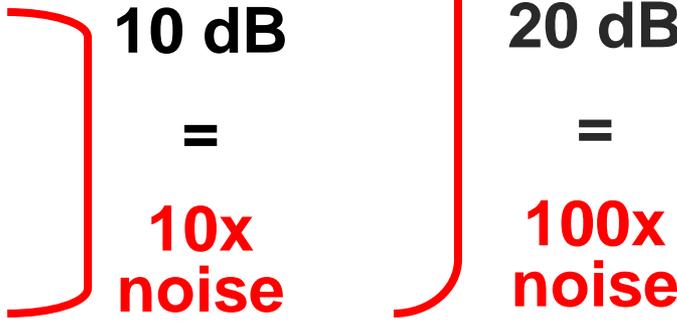
Off the Job

Sound energy and damage risk follow a **logarithmic scale**

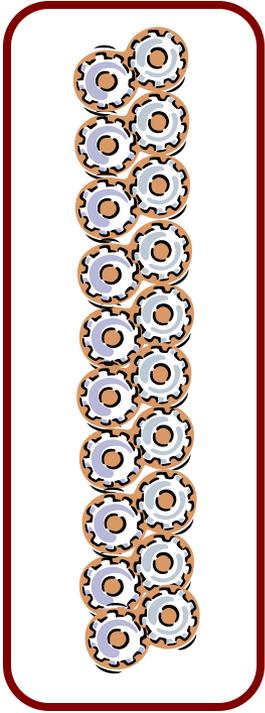


**Small increases
in dB level**

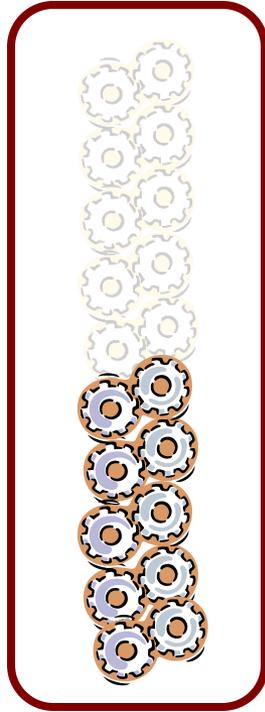
**represent enormous
increases in noise level**



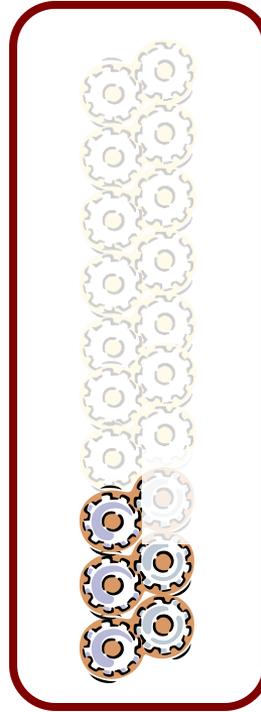
Noise + Acoustics



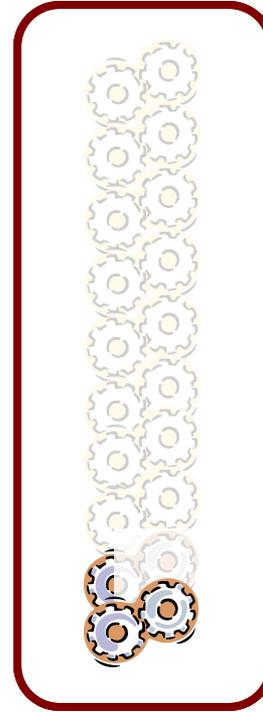
**95
dB**



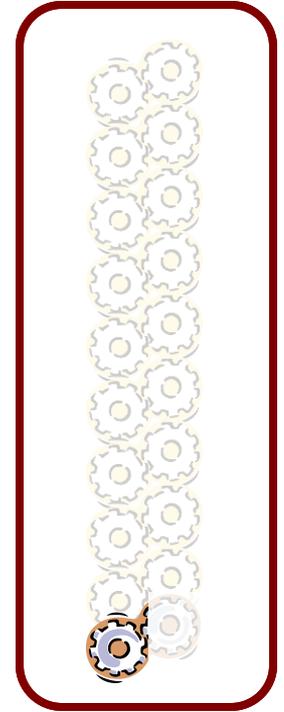
**92
dB**



**89
dB**

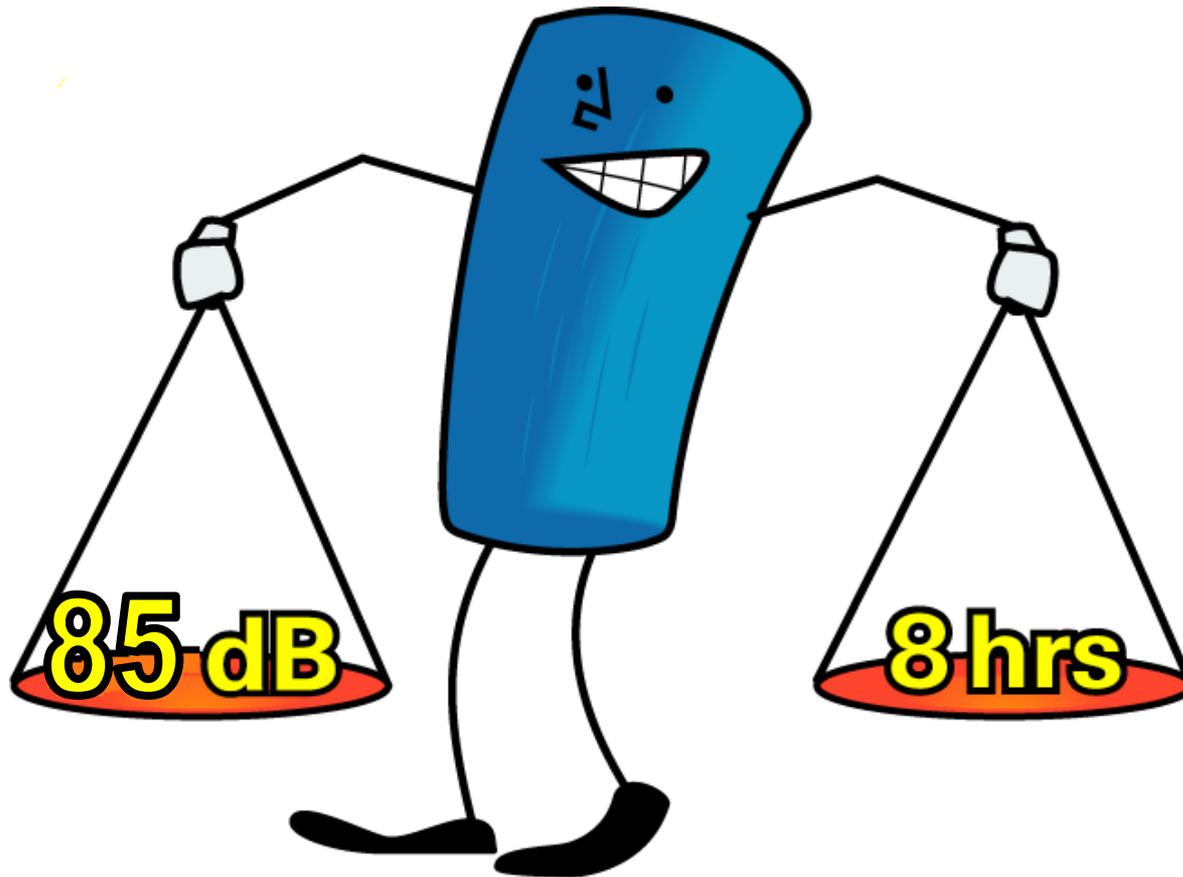


**86
dB**



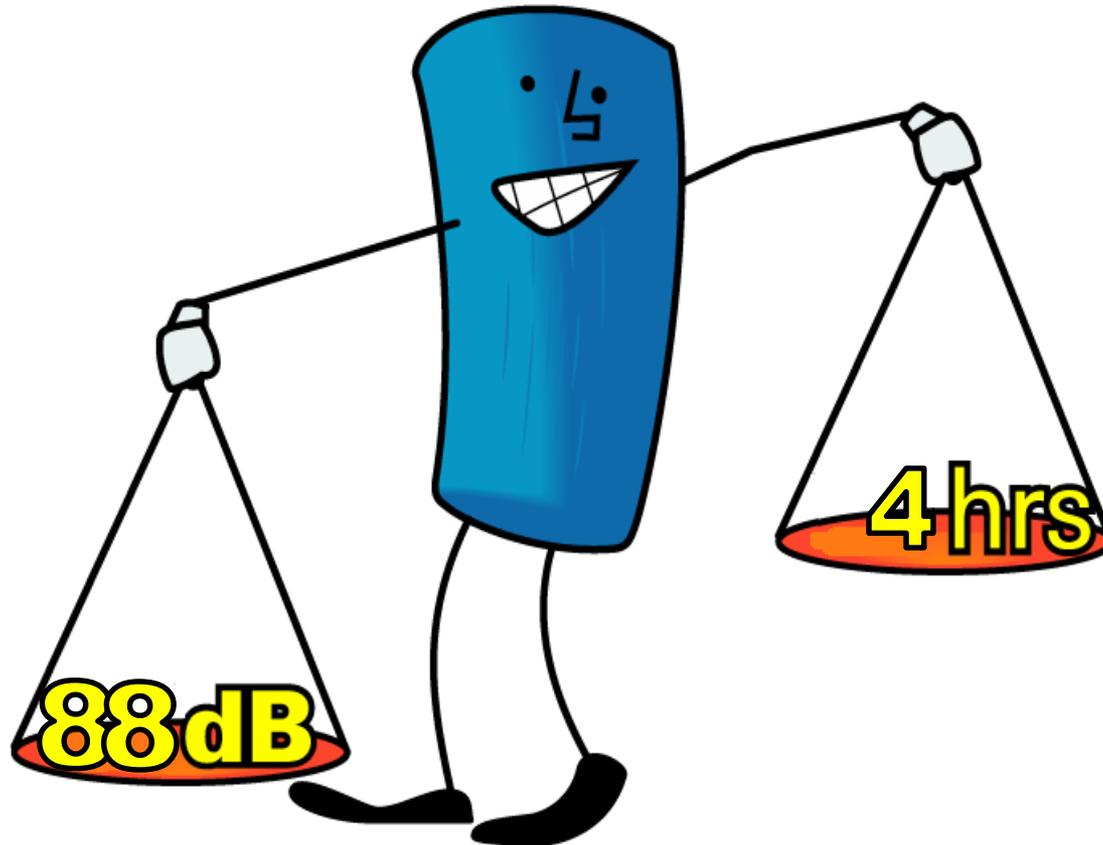
**83
dB**

L_{8h}



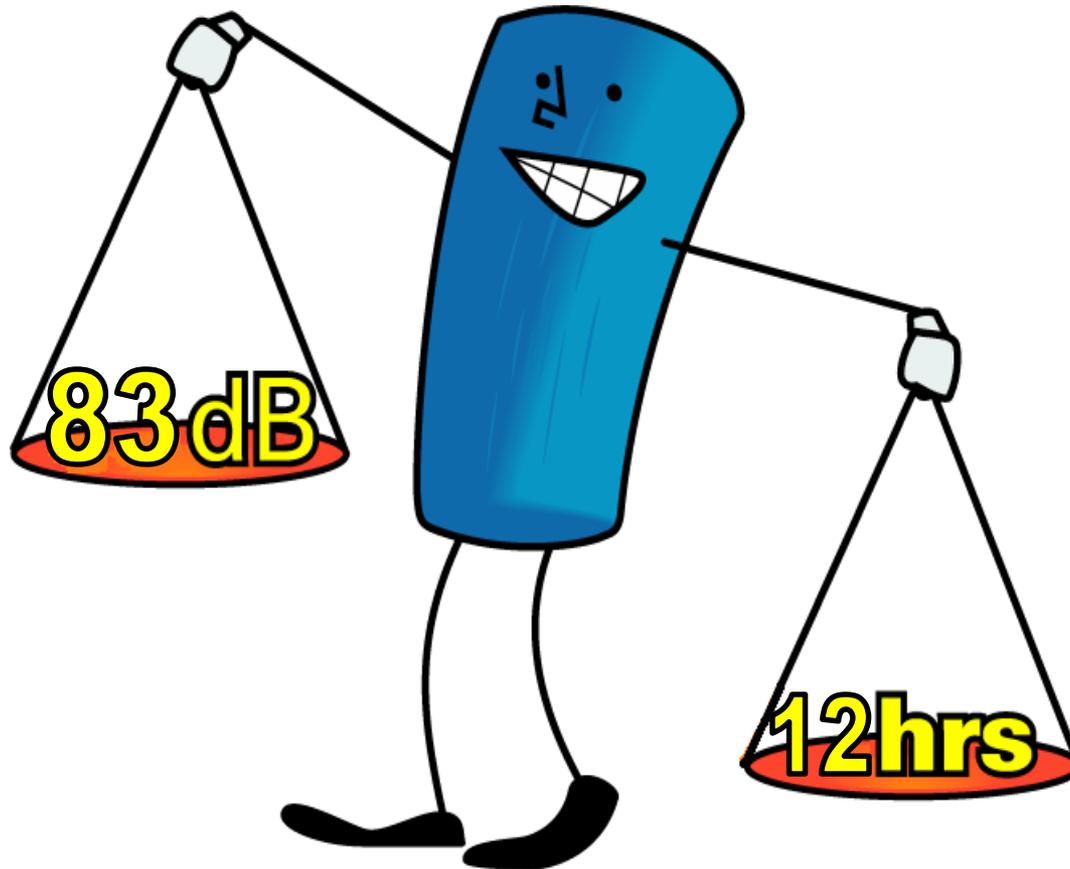
Upper Action Level

L_{8h}



Upper Action Level

L_{8h}



Upper Action Level

87 dB ~ Exposure Limit

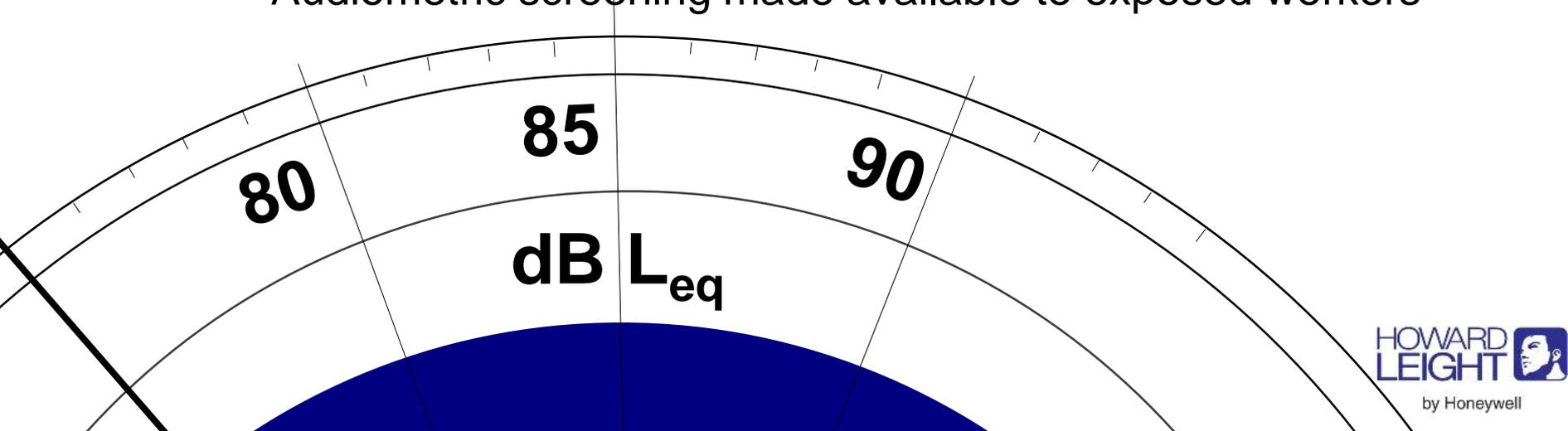
- Maximum allowable noise level in the ear with protectors

85 dB ~ Upper Action Level

- Hearing protectors required
- Audiometric evaluation made available to exposed workers
- Warning signs posted in noisy areas

80 dB ~ Lower Action Level

- Hearing protectors made available
- Training program for noise-exposed workers
- Audiometric screening made available to exposed workers



Factors in Achieving Protection

1. FIT

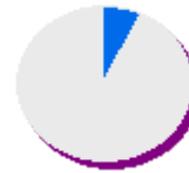
A worker who selects an HPD with an SNR of 30

but then removes that HPD for just ...

effectively reduced his 8-hour SNR to just ...

2. WEAR TIME

30 dB



5 min

19 dB



15 min

15 dB

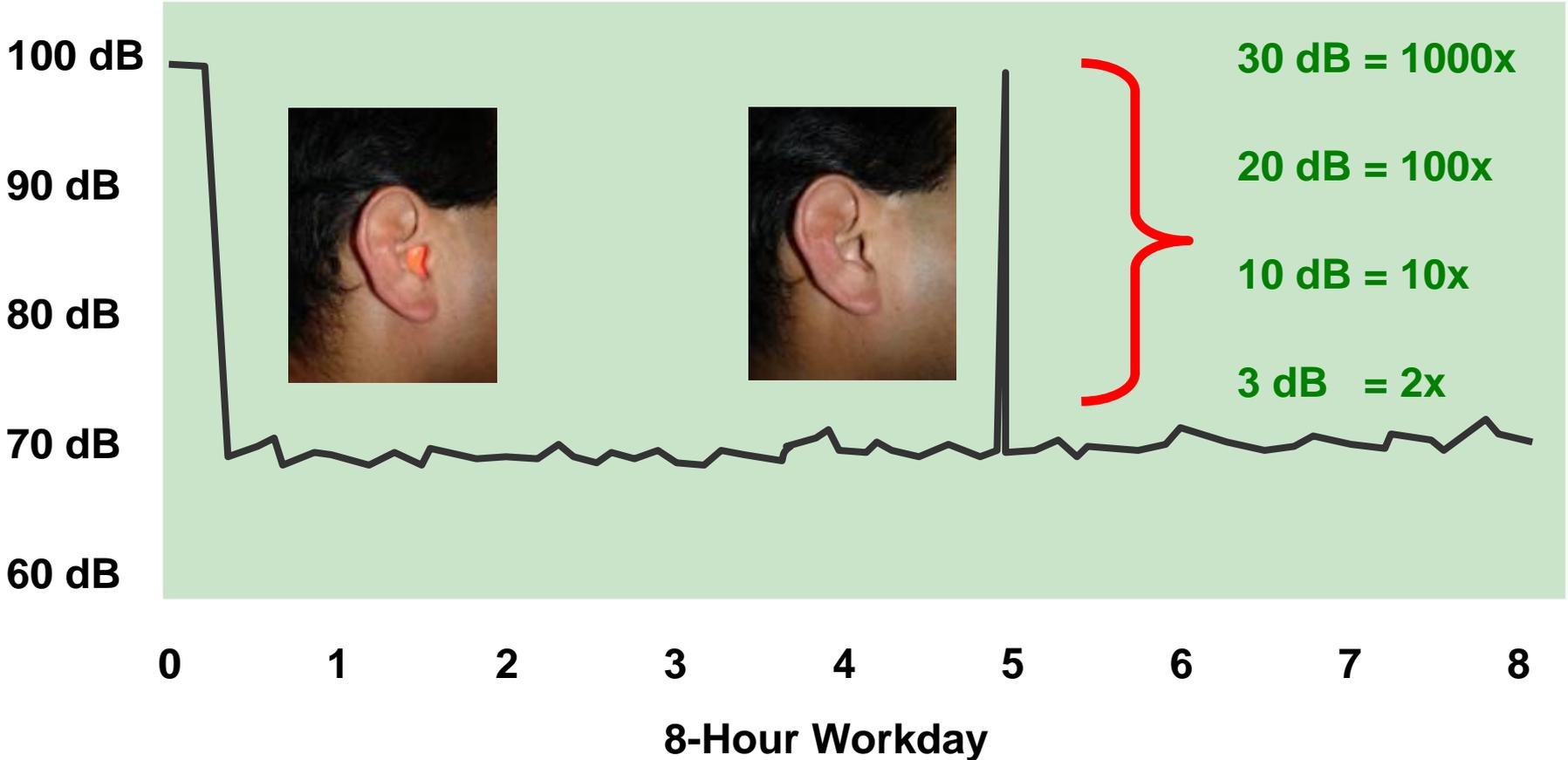


30 min

12 dB

In noise exposures, small intervals of no protection quickly void large intervals of adequate protection.

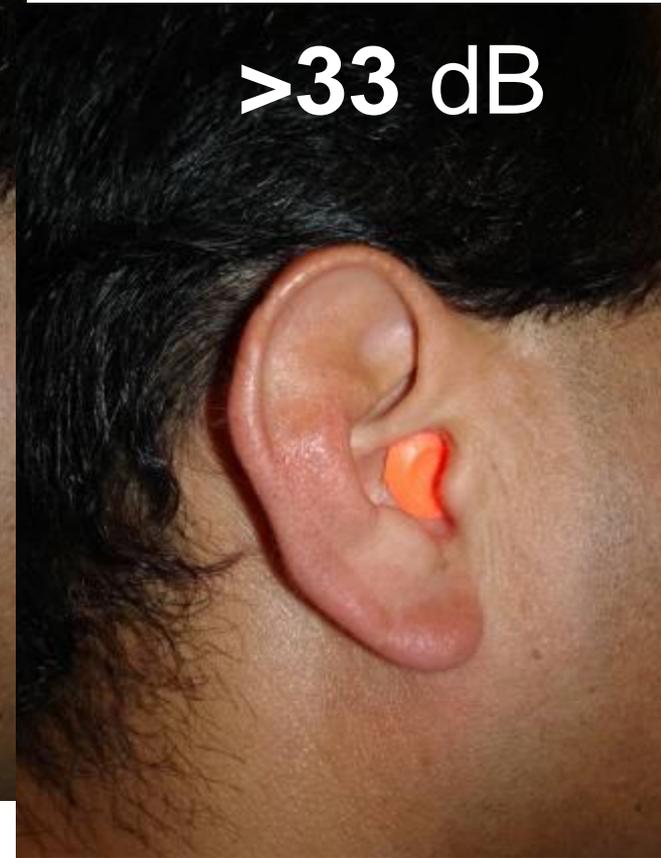
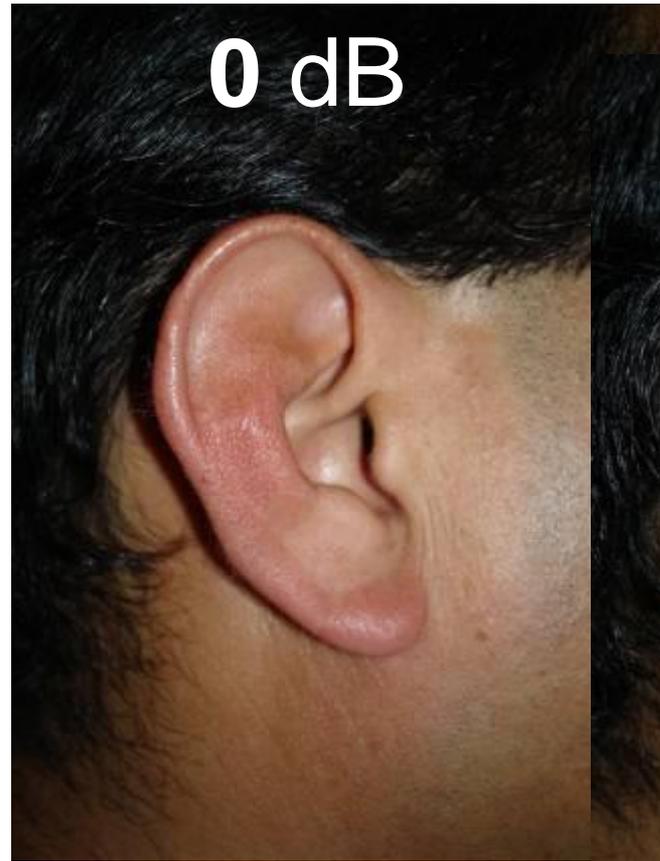
Evaluating Noise Reduction



Hearing Protector Fitting



Hearing Protector Fitting

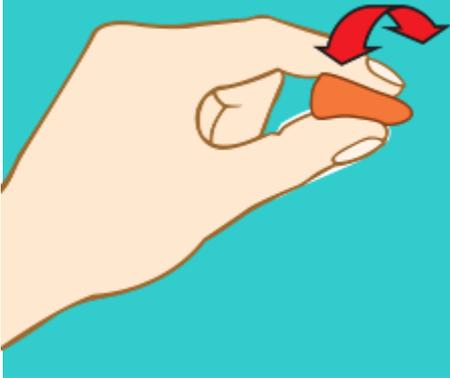


How much protection?

Roll-Down Foam Earplugs

1. Roll

entire earplug
into a crease-free
cylinder



2. Pull Back

pinna by reaching over head
with free hand, gently pull top
of ear up and out



3. Insert

earplug
well into
ear canal
and hold
until it fully
expands



Hearing Protector Fitting



Hearing Protector Fitting

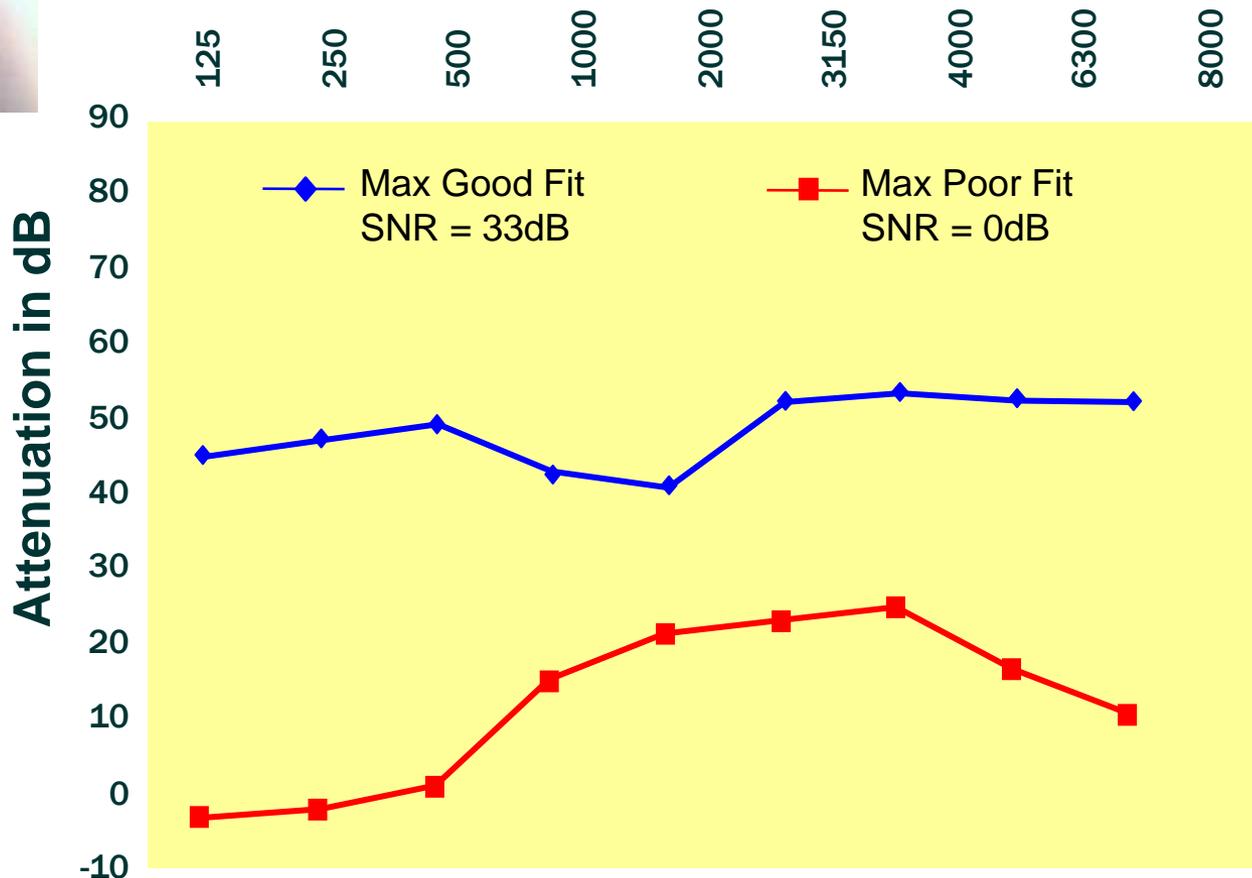


Hearing Protector Fitting



Good Fit vs Bad Fit

Frequency in Hz

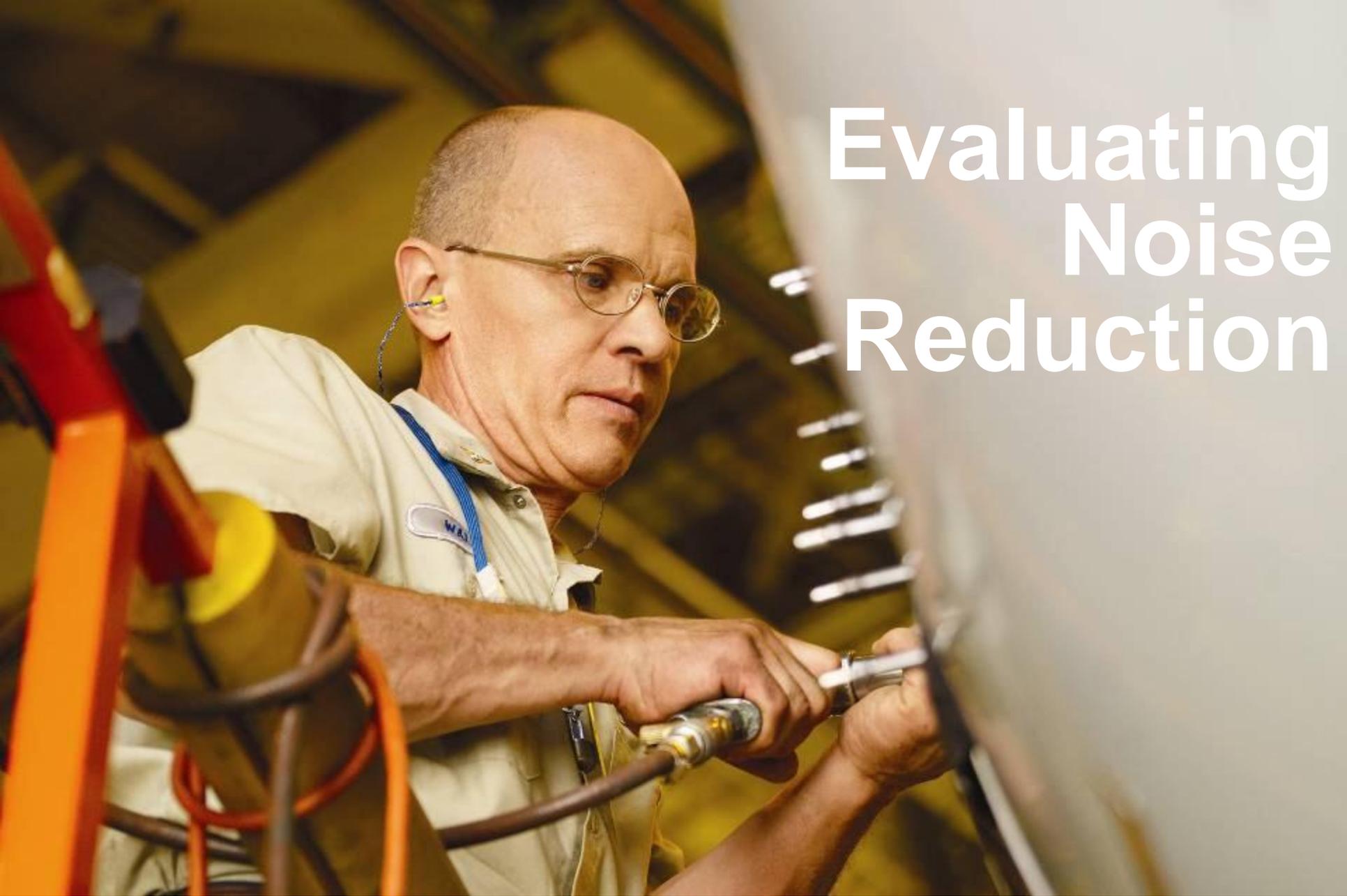


Exploding a Few Myths About ... Here are the facts!

- Bigger is **not** necessarily better
- There is **no such thing** as a one-size-fits-all earplug or earmuff
- It is **impossible** to predict individual protection from labeled ratings, even if de-rated
- An earplug inserted only half-way does **not** offer half the protection



Evaluating Noise Reduction



How much noise is reaching the ear of the worker ?

Noise Level 100 dBA

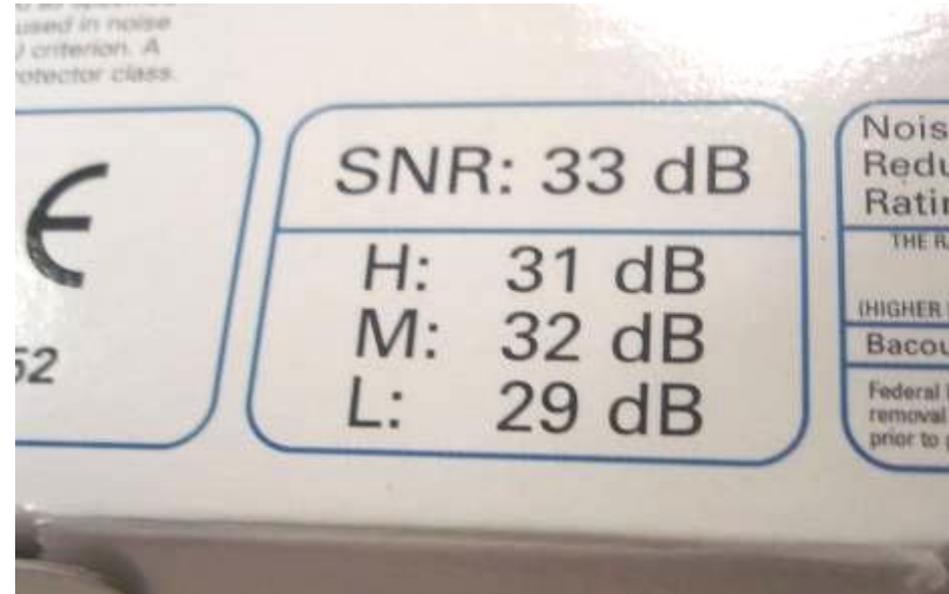
Package rating 25 dB

It's completely
UNKNOWN!



Single Number Rating (SNR)

- A laboratory estimate of the amount of attenuation achievable by most users **when properly fit**
- A population-based rating — some users will get more attenuation, some will get less



The SNR is only a population estimate, not a predictor of individual attenuation.

Determining the SNR

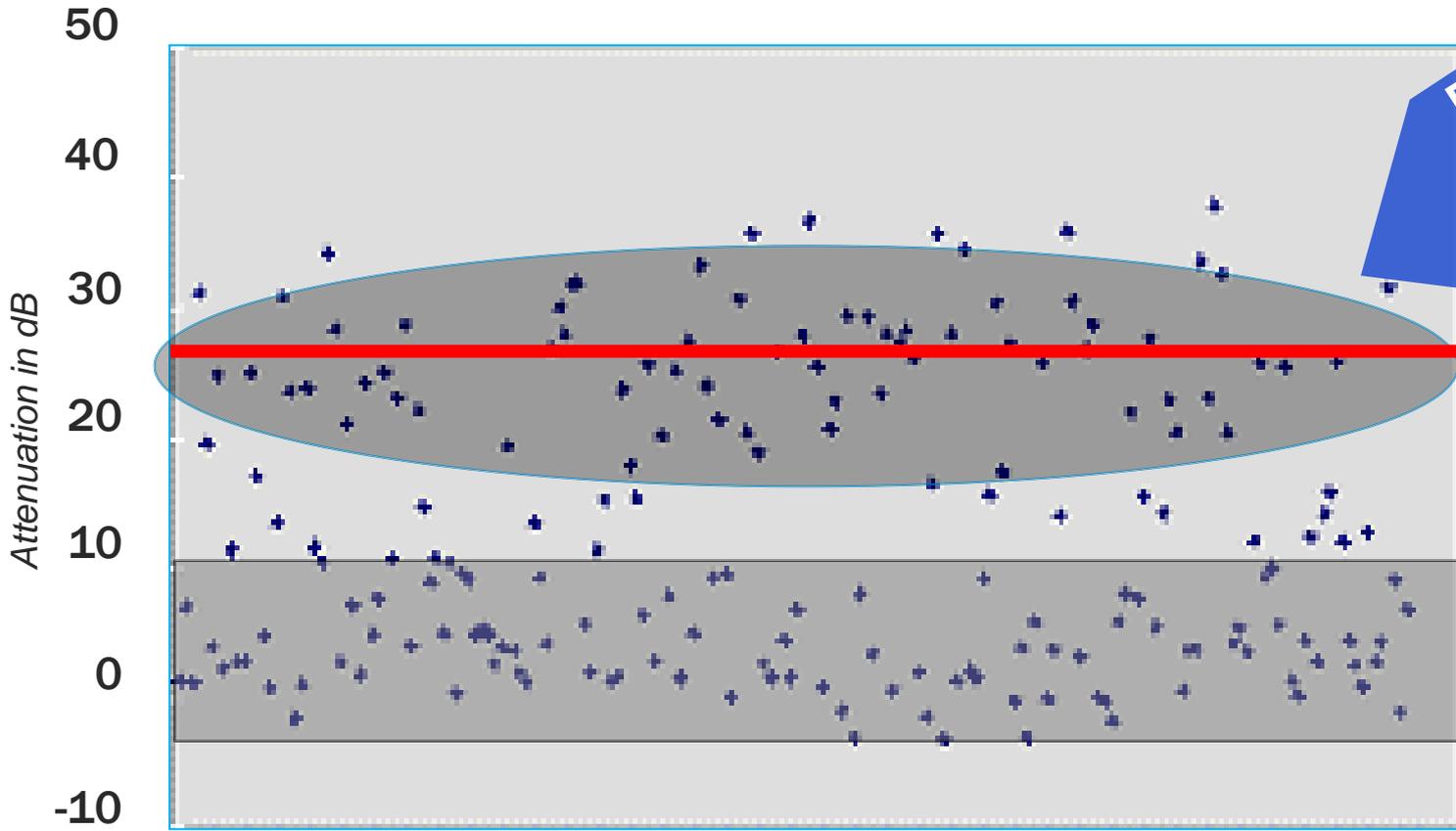
- 16 human subjects tested in a simulated industrial room
- Subjects fit their own protectors
- Tested with ears open / occluded at seven frequencies
- SNR calculated to be population average

A test subject in the Howard Leight Acoustical Lab, San Diego, CA, accredited by the National Voluntary Laboratory Accreditation Program (NVLAP)



Evaluating Noise Reduction

Real-World Attenuation \neq Rating



Real user
attenuation
<0 to 38 dB

Retraining
and refitting
resulted in
an average

14 dB
improvement
for this group

192 Users of a Flanged Multiple-Use Earplug (Rating 27)

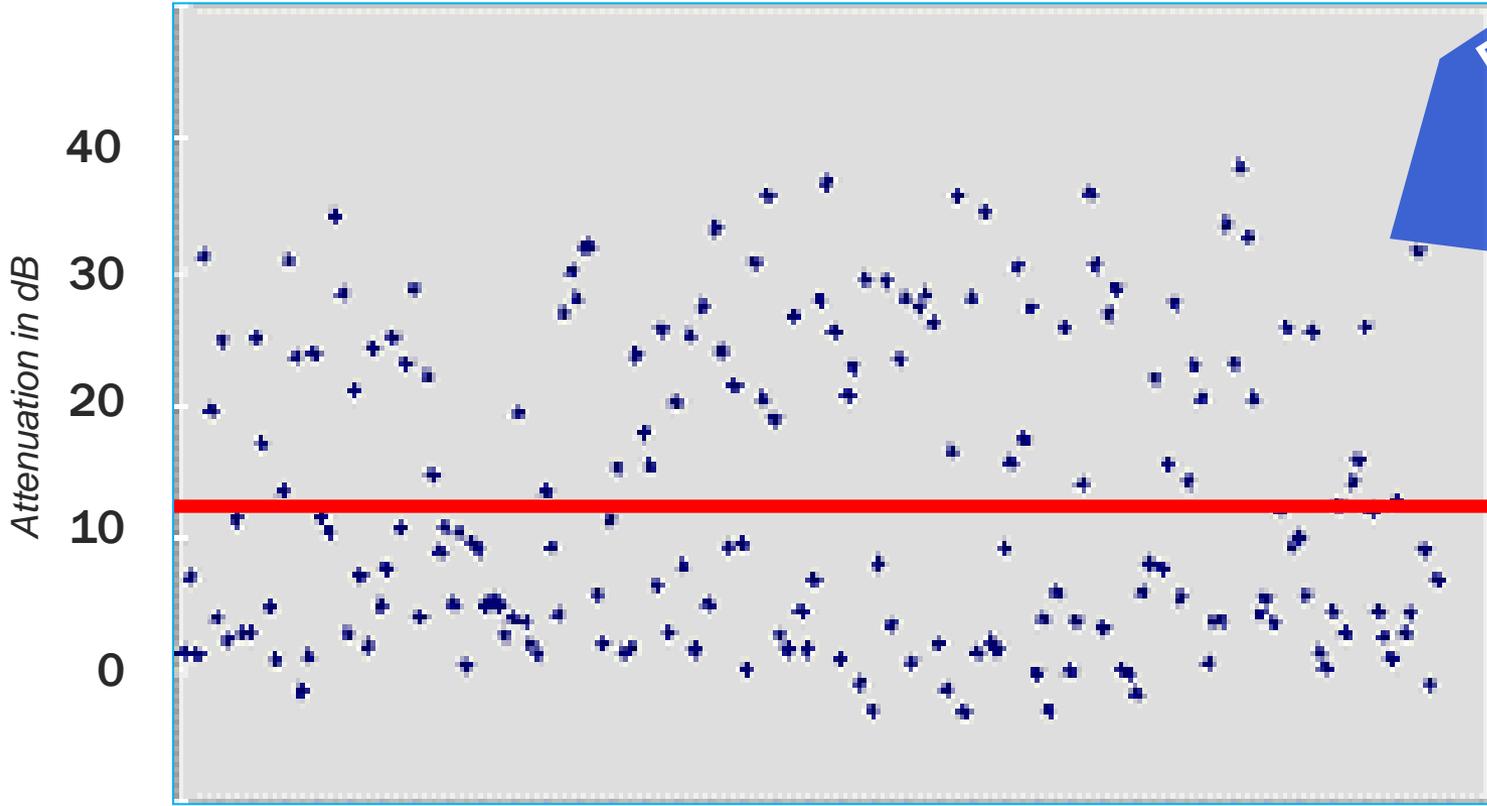


by Honeywell

From Kevin Michael, PhD and Cindy Bloyer "Hearing Protector Attenuation Measurement on the End-User"

Evaluating Noise Reduction

Effect of De-rating



Real user
attenuation
<0 to 38 dB

OLF credit
for all
earplugs

192 Users of a Flanged Multiple-Use Earplug (Rating 27)



by Honeywell

From Kevin Michael, PhD and Cindy Bloyer "Hearing Protector Attenuation Measurement on the End-User"

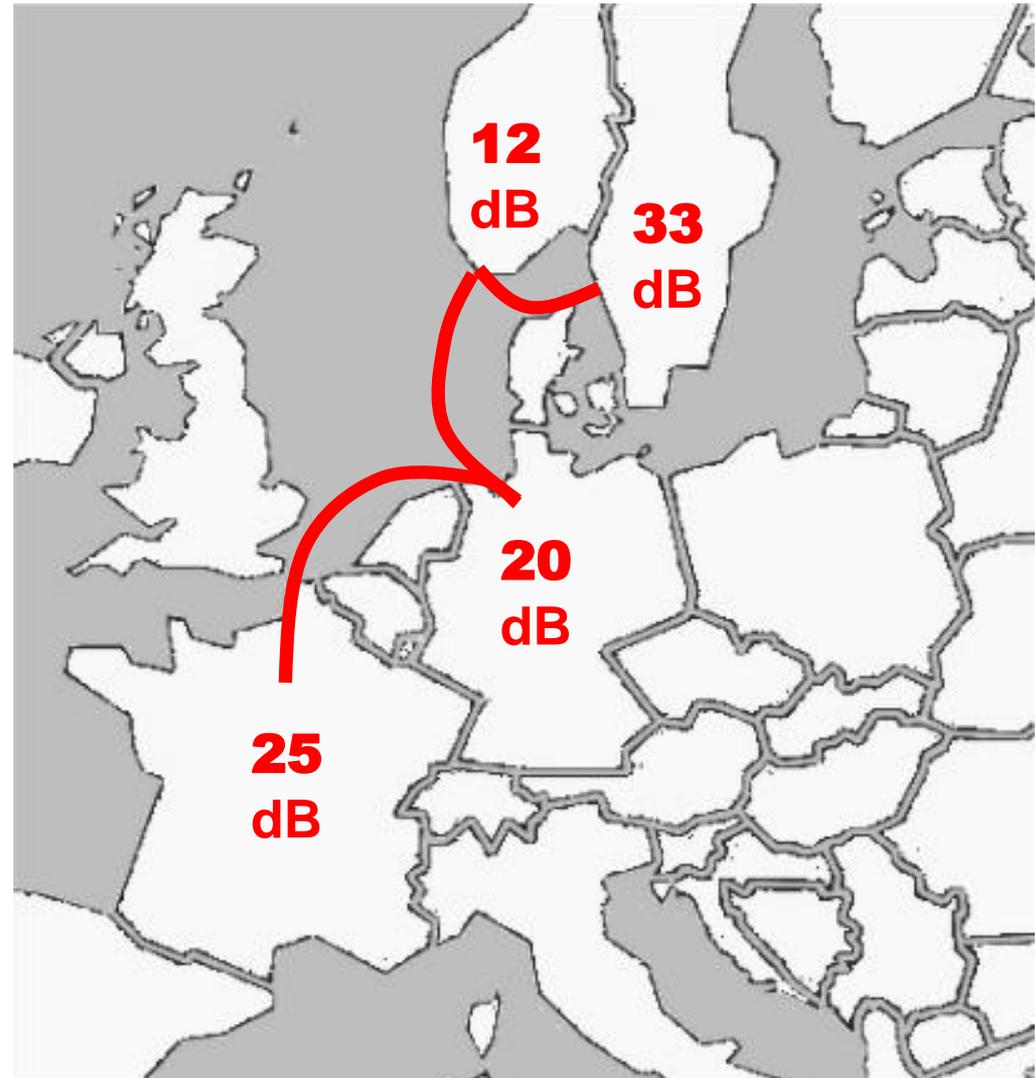
Evaluating Noise Reduction



RECOMMENDED DE-RATINGS

33 dB EARPLUG

France	- 8 dB
Germany	- 13 dB
Norway	- 21 dB
Sweden	- 0 dB



Using Leading Indicators



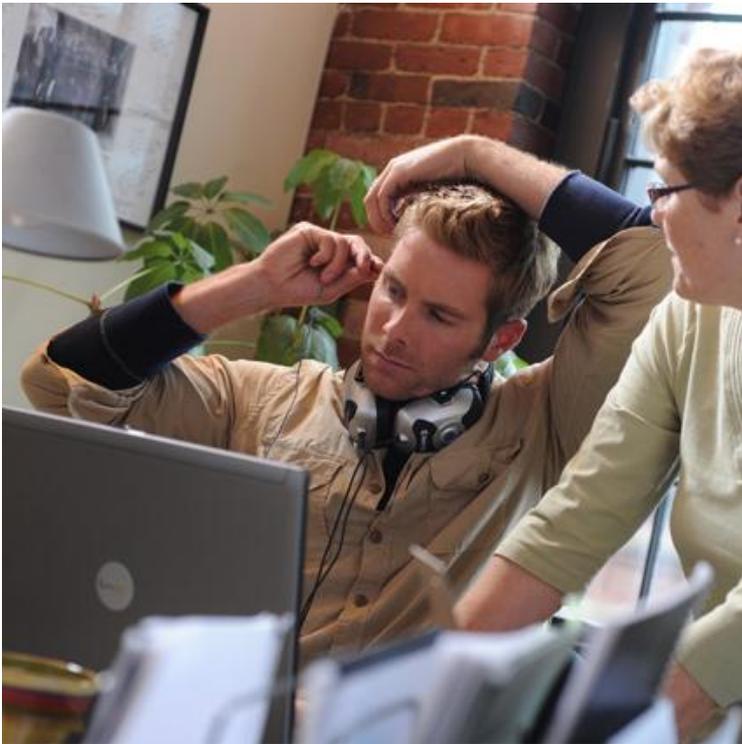
Using Leading Indicators



Lagging Indicators vs. Leading Indicators

New Measurement Technologies

Earplug Fit Testing

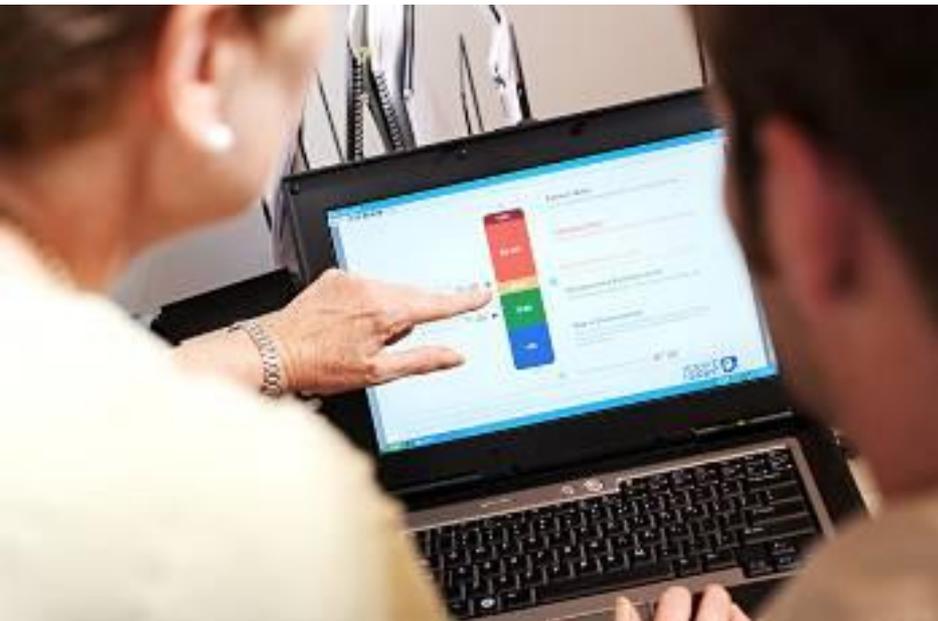


In-Ear Exposure Monitoring



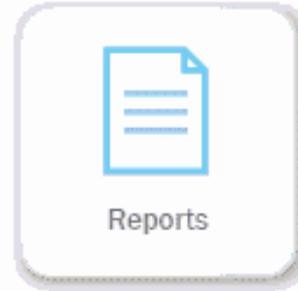
Earplug Fit Testing

Provides an *accurate, real-world* picture of your employees' hearing protector effectiveness.



- Selecting the right protector
- One-on-one training
- Makes published rating obsolete

Fit Testing



Complete Check

- 5 freqs in each ear
- Best for new users, reliability checks
- ↑ accuracy, ↑ test time

Quick Check

- 1 critical freq in each ear
- ↓ accuracy, ↓ test time
- Can use with severe hrg loss

Report Mode

- Individual
- Historical
- Results by freq

Fit Training

- Videos





User: Jim Smith

Set-Up

Part 1

Part 2

Part 3

Results

Earplug Selection

Please click the product buttons to select the earplug that you will use during the check.

Single-Use Earplugs



NEXT

Multiple-Use Earplugs



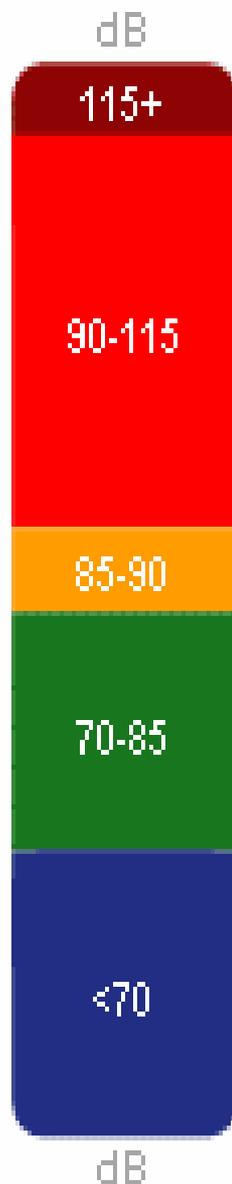
Detectable Earplugs



Other Earplugs

Other
Earplug

Your **safe** exposure level
with this **fit** of earplugs: **105 dB**



Extreme Noise

Short, unprotected exposures **cause** hearing damage.

Hazardous Noise

Frequent, unprotected exposures **can cause** hearing damage.

Required Protection Level

Hearing protection **recommended or required** in most areas.

Recommended Protection Level

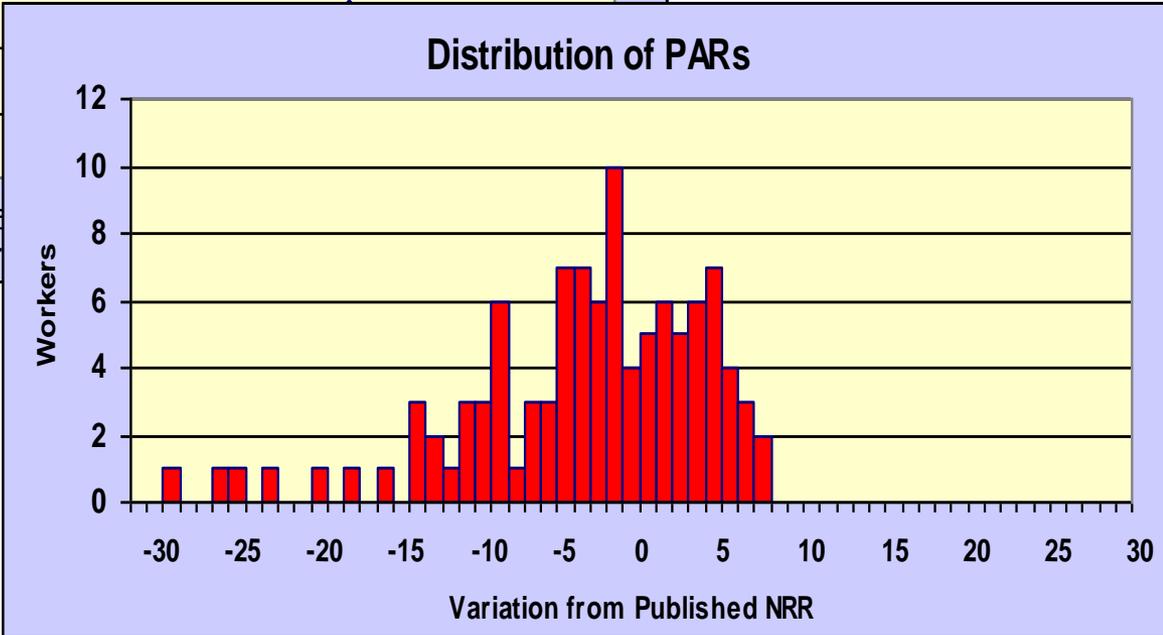
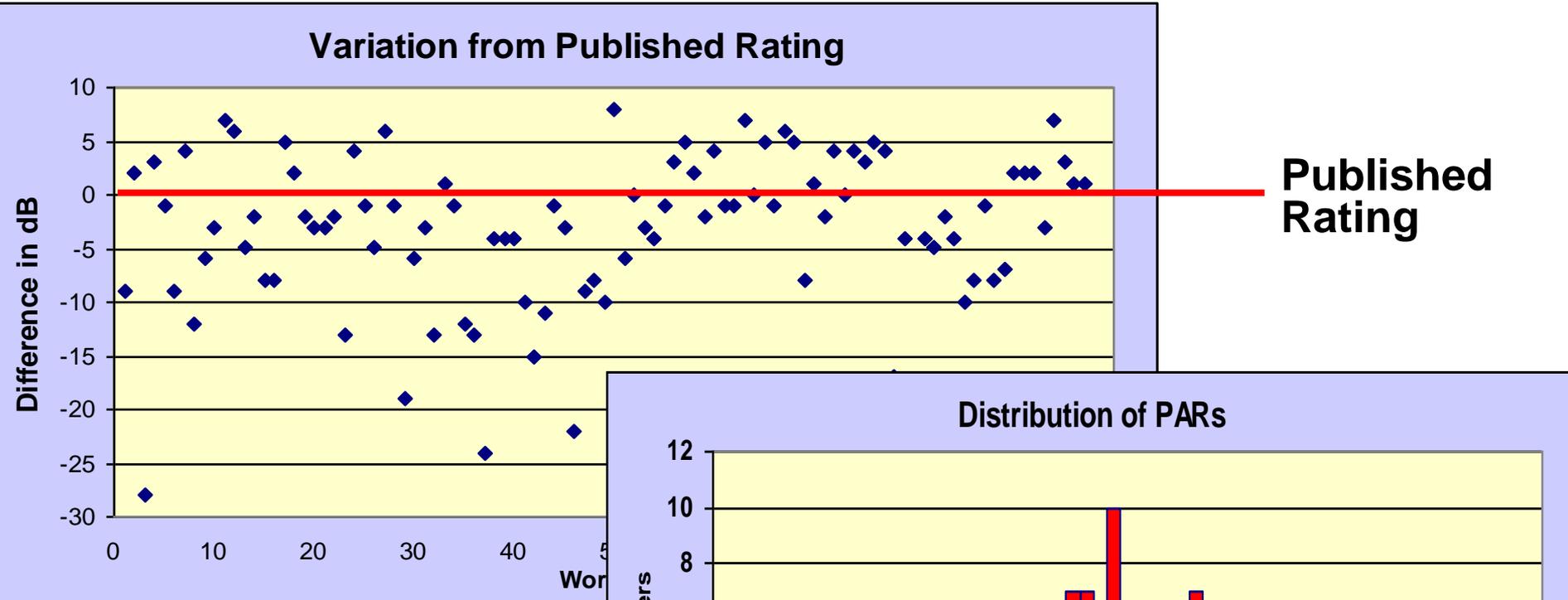
Protected noise exposures in this range are **generally safe**.

Risk of Overprotection

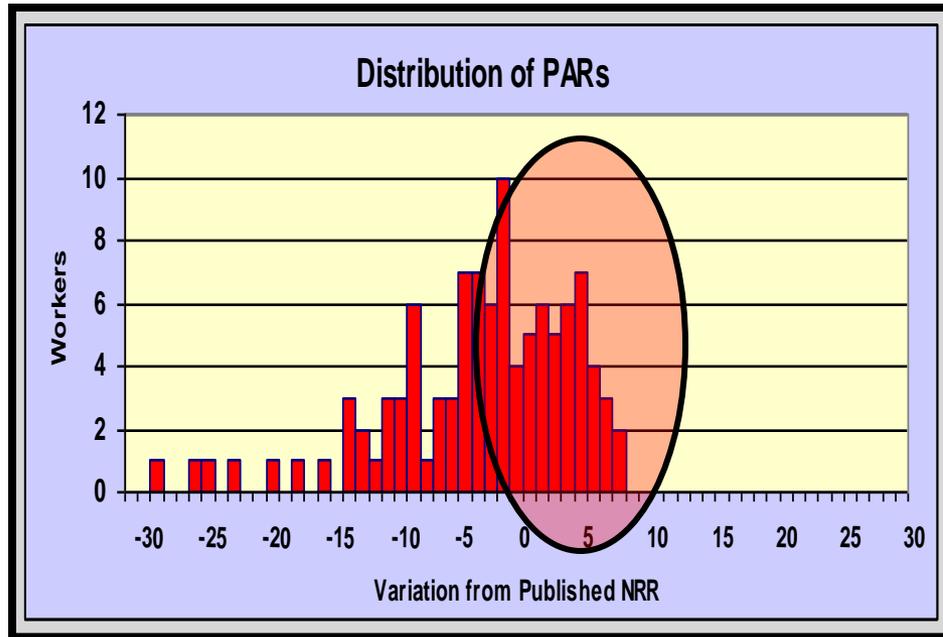
The earplugs you are using **maybe** too protective, blocking sounds you need to hear such as warning signals and co-workers' voices.

Your **protected** exposure level
with this **fit** of earplugs: **75 dB**

Using Leading Indicators



Using Leading Indicators



Personal Factors

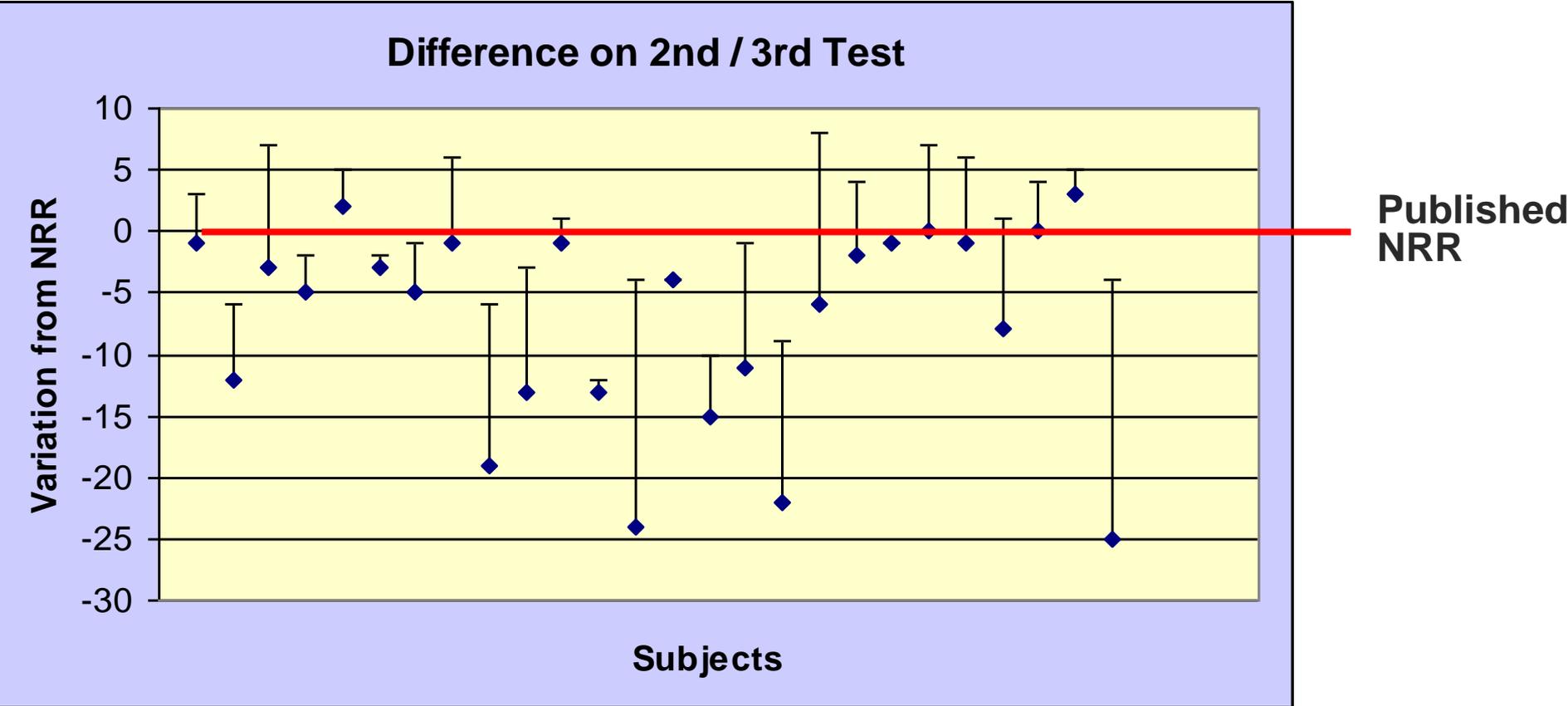
- ✘ Gender
- ✘ Age
- ✘ Years in Noise
- ✘ Ear Canal Size
- ✘ Familiarity
- ✘ Model of Earplug

Program Factors

- ✘ # Group Trainings
- ↑ # Personal Trainings

Result: One-on-one training was the only predictor of good protection

Using Leading Indicators



Result: Trying a second earplug often improves attenuation

PROs & CONs of Fit Testing

PRO

~~Estimate~~ / Measure
Ratings Obsolete
Regulatory Compliance
Eliminate De-Ratings
Medico-Legal Cases
Work-Relatedness
No Dual Protection
Employee Feedback

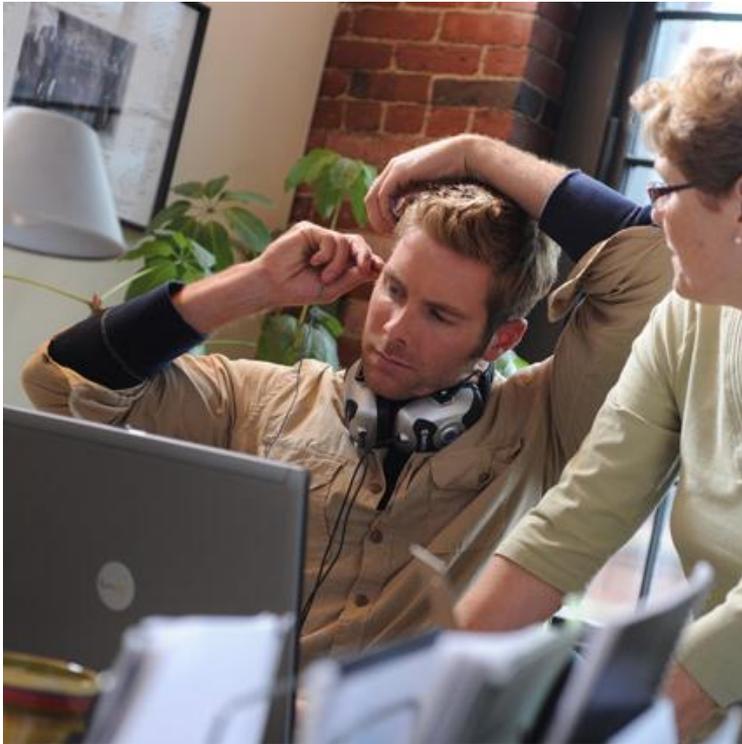
CON

Cost
Time Investment
Not Standardized

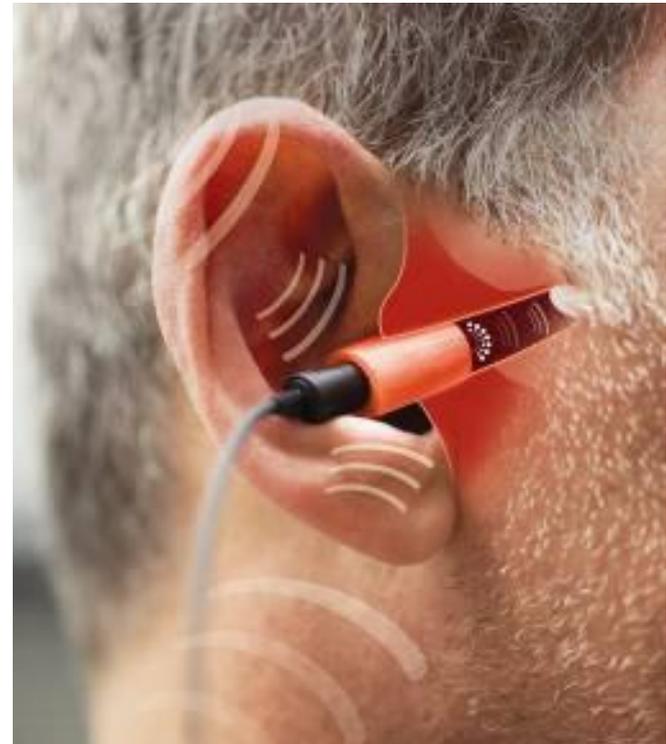


New Measurement Technologies

Earplug Fit Testing



In-Ear Exposure Monitoring



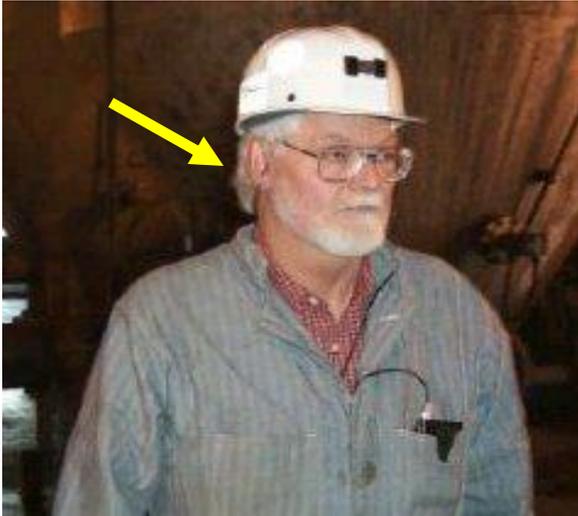
In-ear dosimetry measures/records worker's actual noise dose, with/ without protection

Provides real-time monitoring and alerts when worker approaches safe limits



Only leading indicator that directly prevents NIHL in real-time

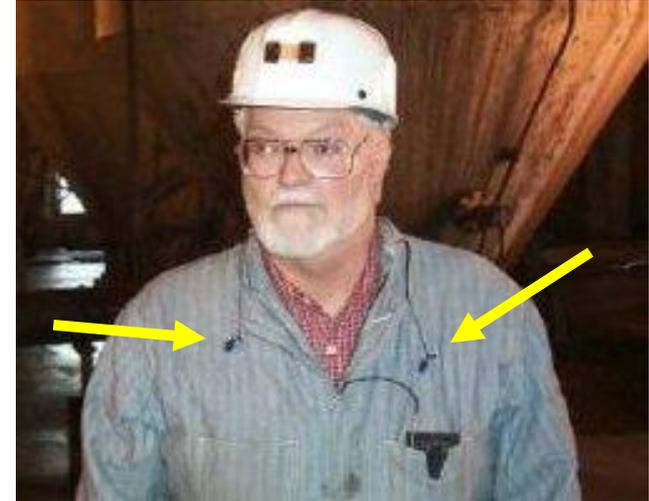
Using Leading Indicators



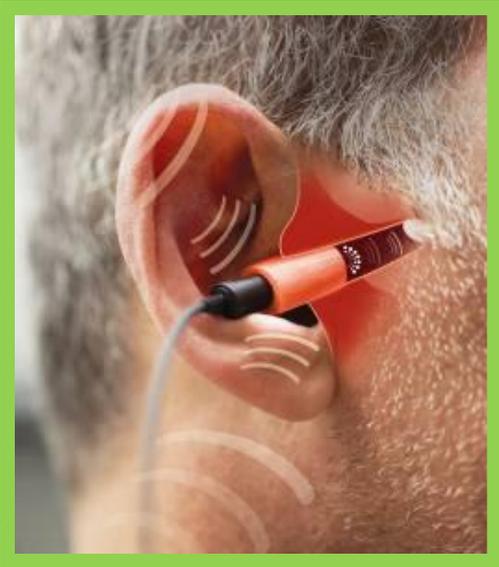
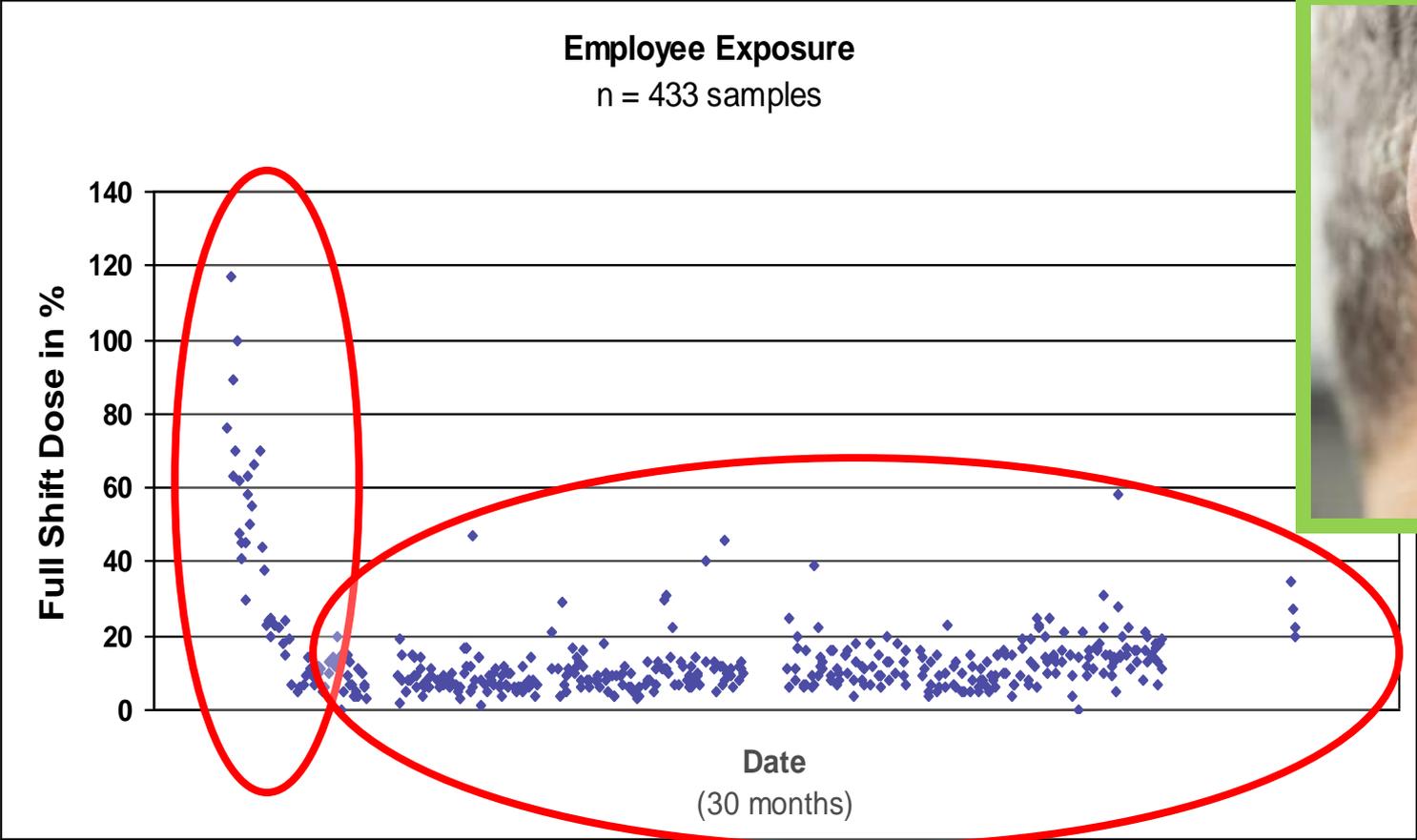
Dosimeter records ...

- Good fit
- Bad fit
- No fit

Immediate feedback if exposure >95% limit



Sample Personal Exposure



Preventive Action After NIHL

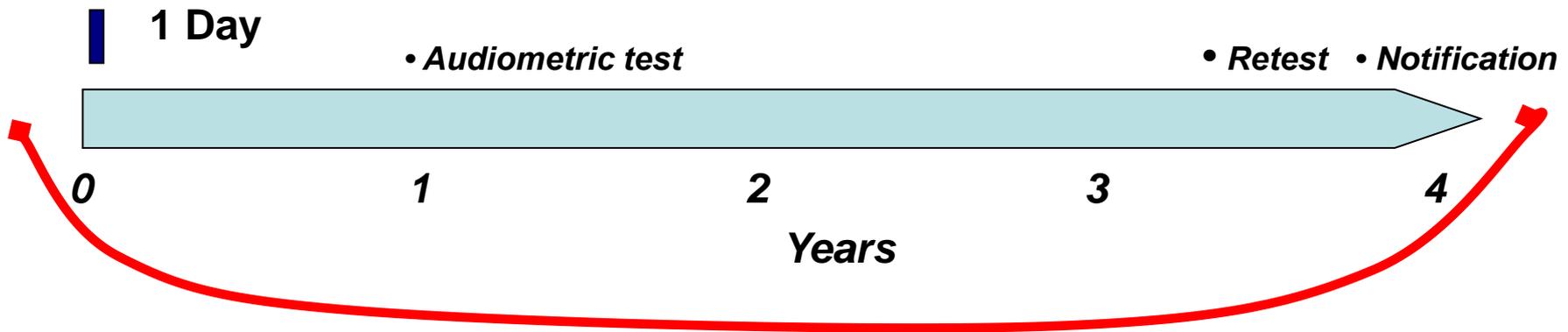
In practice, audiometric testing is not a preventive action

It is documentation of a hearing loss after the fact.

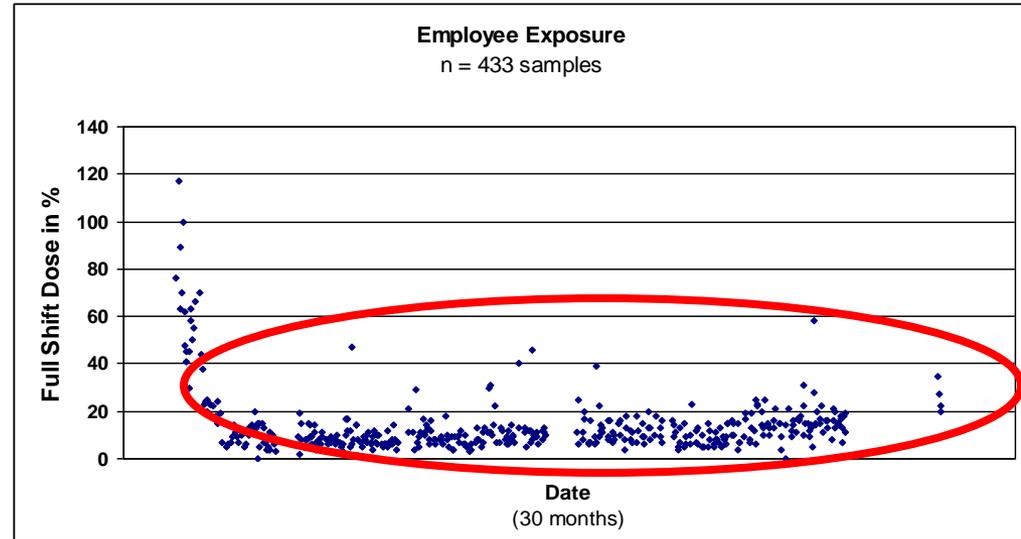
How soon will an employee suffering NIHL be re-fit / re-trained ?

“Best case scenario” per Hearing Conservation regulations ...

In-ear exposure monitor “worst case” scenario ...



Using Leading Indicators



Off-job + On-job = NIHL

Intelligent Hearing Protection

- Fit verification of earplug
- Active Noise Reduction
- Impulse Noise Protection
- Speech Enhancement
- ComRadio Connection
- Personal exposure monitoring



Introduction

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Bringing It Together



Case Study #1: Flooring Manufacturer



www.safeinsound.us

Noise Levels

- 105-112 dBA

HPD Requirements

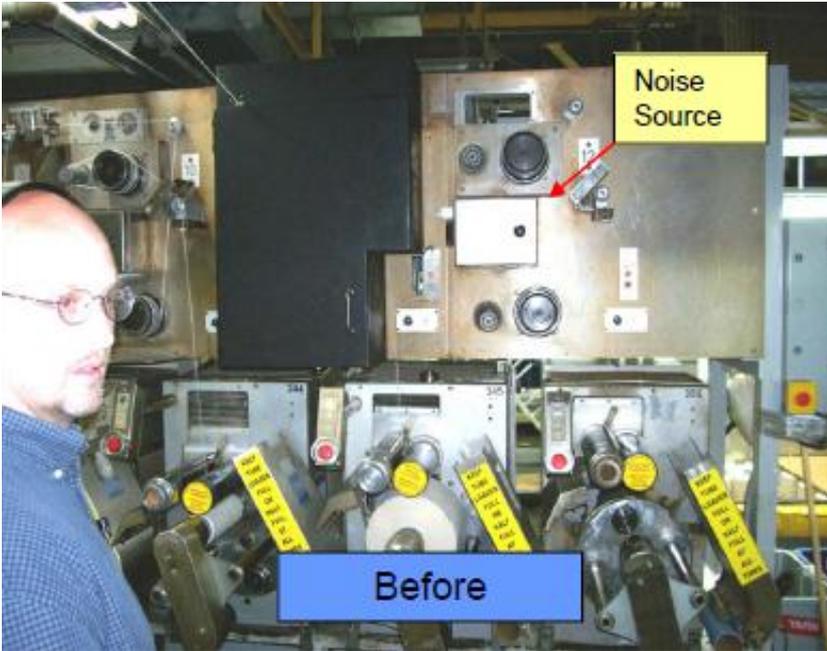
- 30+ dB protectors required!
- Dual Protection

Key Challenges

- Reduce noise levels through engineering controls
- Diverse workforce
- Ensure workers wear hearing protection properly, especially in extreme heat/humidity
- Validate amount of attenuation each worker achieves

Bringing It Together

Tactic #1: Engineering Controls



Location	Pre-Enclosure dBA	Post-Enclosure dBA	Hood Insulation dBA	Total Reduction dB
F/16 #2	111.4	104.9	103.9	7.5
F/16 #6	110.8	102.7	101.8	9.0
F/16 #11	107.3	100.2	99.7	7.6
Packout Table	106.4	98.6	96.8	9.6

Photos courtesy of Shaw Inc,

Bringing It Together

Tactic #2: Earplug Fit Testing

- All workers showing a shift in hearing receive a fit-test as part of “retraining”
- All new (or re-hire) employees receive a fit-test prior to beginning work:
 - Find the appropriate earplug
 - Ensure proper fit
- Existing workers are ‘certified’ to a particular earplug, can ‘graduate’ out of double protection

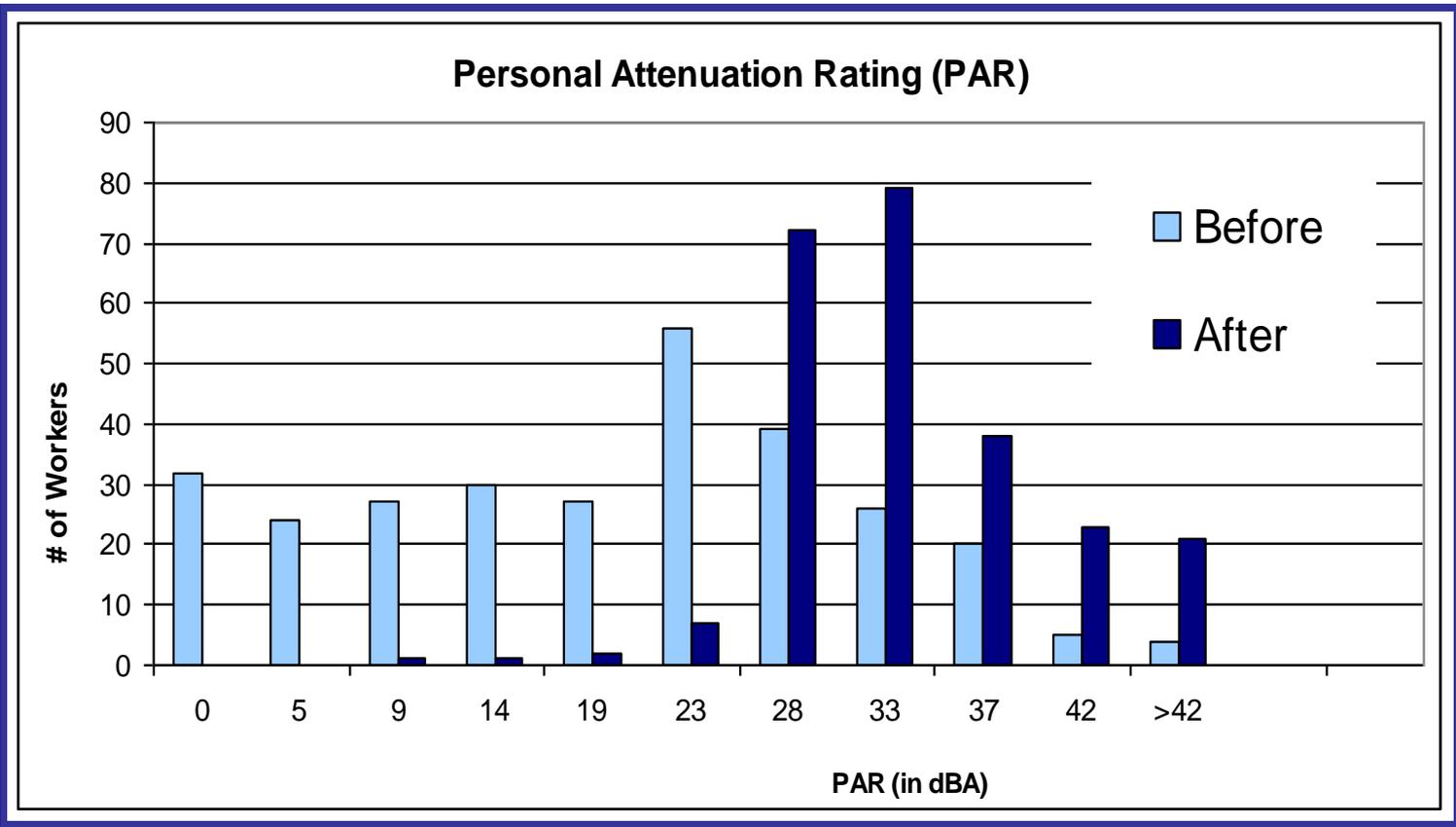
***“When an employee walks away,
he knows how a good fit***

feels and sounds.”



Photos courtesy of Shaw Inc,

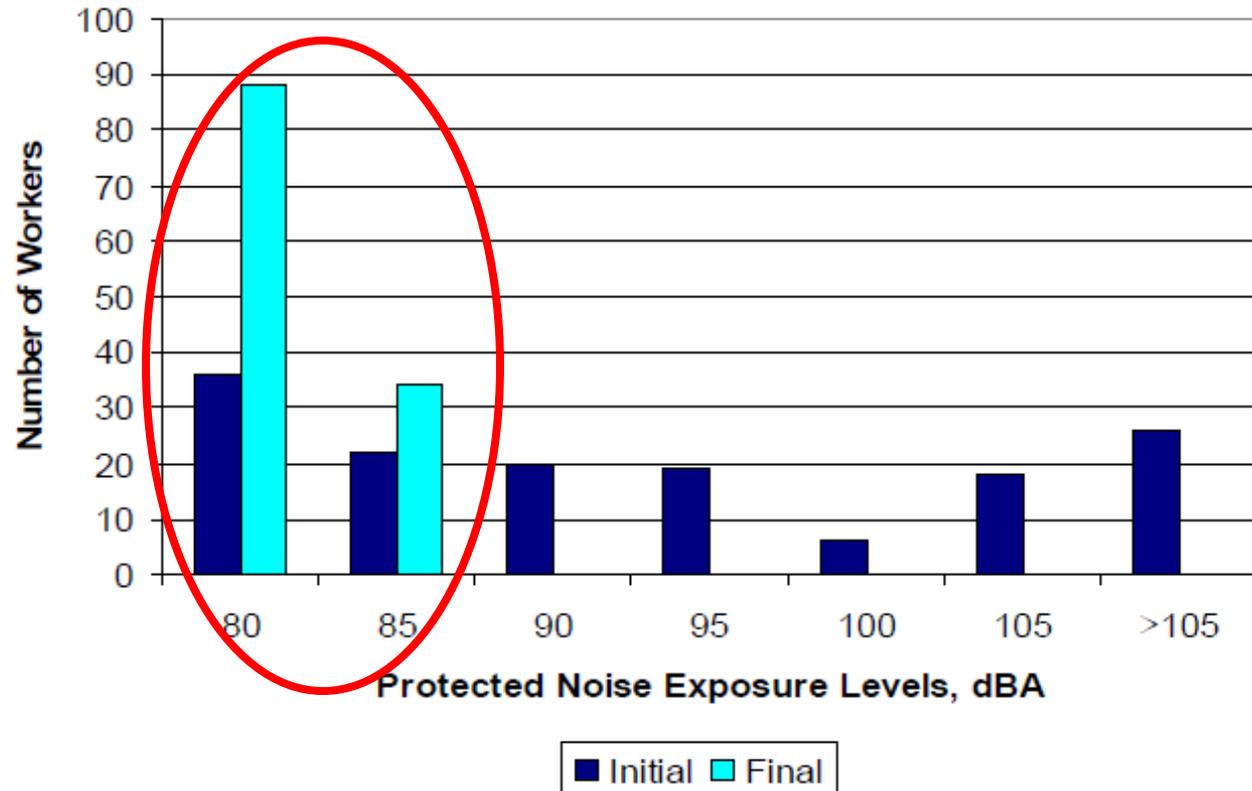
Result: Distribution of Protection Levels Shifted



Bringing It Together

Result: Protected Exposure Level Shifted

- **Before Training:**
17% achieve good fit
- **After Training:**
78% achieve good fit
(in-ear exposure 82 dB or below)
- **Two-thirds** of workers changed earplug model



Result: Reduction in Hearing Loss

Year	Confirmed Shift	Comment
2006	5	Prior to noise control
2007	0	
2008	0	
2009	1	Non-production associate
2010	0	

HC Program Improvements

- Expanded HPD offerings from 3 to 6 choices
- Employees happier with single protection
- Mandated job rotation in departments
- Emphasis on equipment maintenance

Case Study #2: Aerospace

Noise Levels

- 87-92 dBA TWA
- 102 dB peak common

HPD Requirements

- 100% wear time when on plant floor (even walking through)

Key Challenges

- High number of hearing shifts
- High intermittent noise exposures in enclosed spaces
- Moderately low TWA exposures
- Possible overprotection



Bringing It Together

Tactic #1: Fit-Testing

Test Worker with Usual Earplug
“Fit the way you normally wear it.”

Pass > 15 dB



Next

**Fit Training with
Same Earplug**



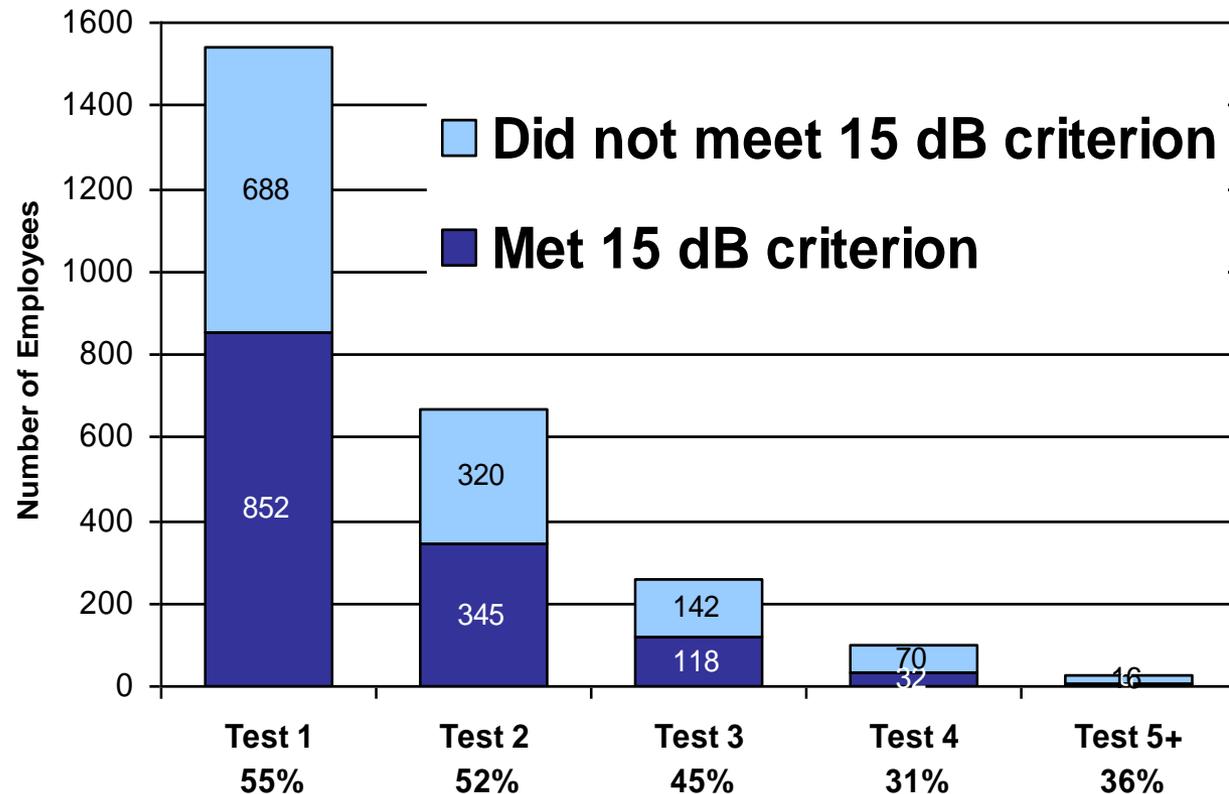
**Try a Different
Earplug**



Photo courtesy of Gulfstream Aerospace

Bringing It Together

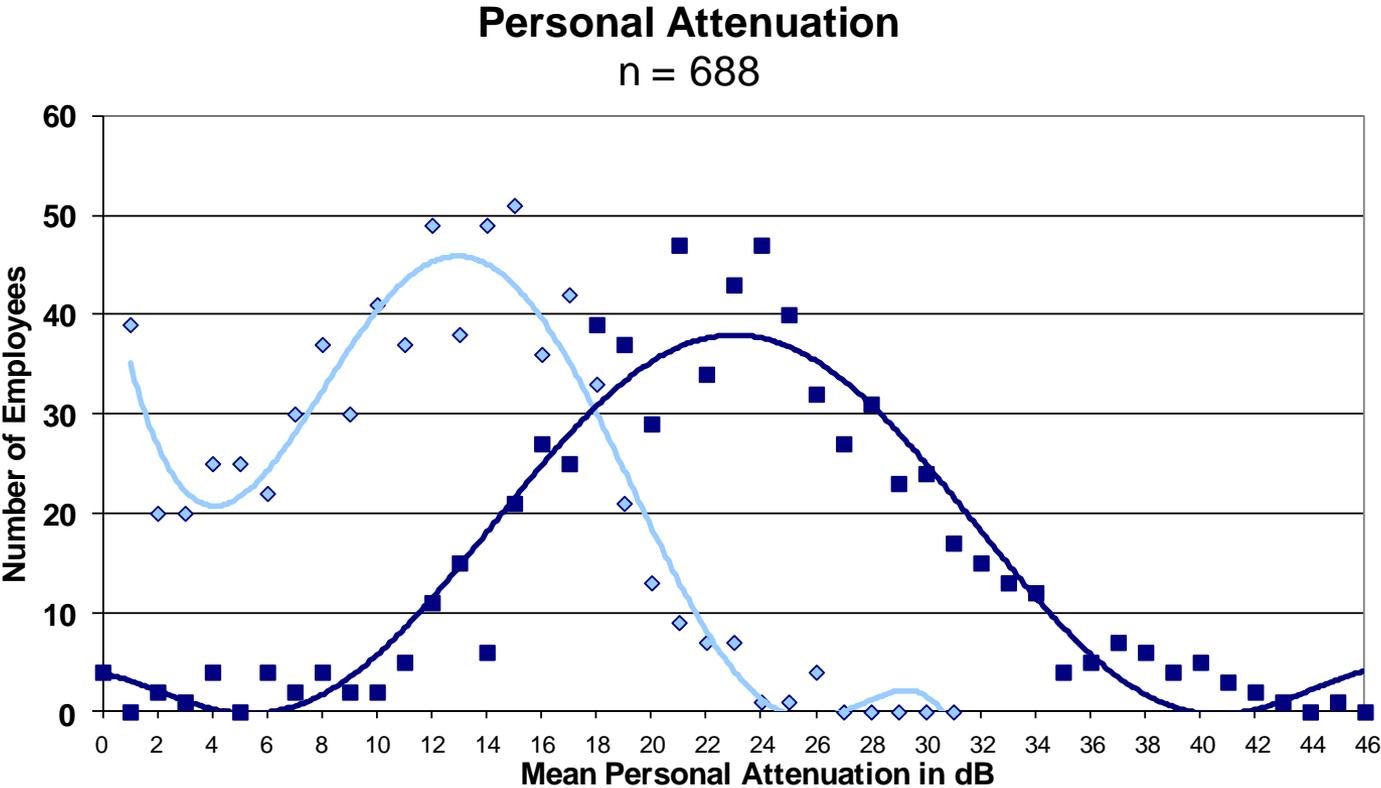
Result: Identifying workers with poor fit



One-on-one training until good fit is documented

Bringing It Together

Result: 120% improvement in protection levels

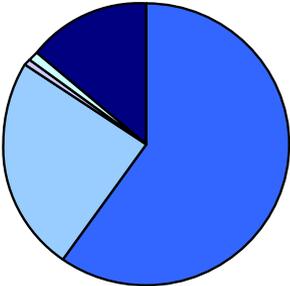


Goal of > 15 dB protection now achieved by nearly all workers

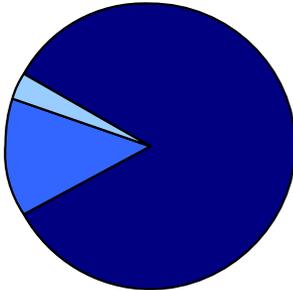
Bringing It Together

Result: Pre / Post Surveys

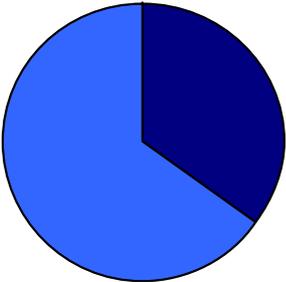
Pre-Test
How would you rate your ability to fit your earplugs?
73% - 'Expert or Good'



Post-Test
After this fit-test, are you better able to fit your earplugs?
84% - 'Yes'



Did you change your choice of earplugs as a result of the fit-test?
65% - 'No'



"I'll put a little more effort and get 'em deeper!"

"I learned I've been using my earplugs wrong my whole career."

"Amazed at difference with proper fit."

"Just learned how to effectively roll the plug before insert."

"Found the best ear protection to fit my ears I've ever had in 15 years in aviation."

Result: Significant decline in hearing shifts



HC Program Improvements

- Manager buy-in very successful
- Inventory of offered earplugs was decreased / adjusted to fill size gaps
- Continued earplug fit testing in other business units
- Possible development of fit-testing kiosks / workstations throughout facility
- Explore additional opportunities for engineering noise controls

Case Study #3: Offshore Platform

Noise Levels

- Frequent peak noise levels >110 dB
- Few engineering options

HPD Requirements

- High SNR protectors

Key Challenges

- Few noise control options
- 12-hour workshifts
- Situational awareness ('I'm safer without my earplugs')
- Hygiene / ease of insertion
- Compatibility with Com Radios
- Compatibility with other PPE



Tactic: Intelligent Protection

- Fit verification of earplug
- Active Noise Reduction
- Impulse Noise Protection
- Speech Enhancement
- ComRadio Connection



Results: Communication + Protection

Clear Two-Way Communication, Even in Extreme Noise

- Connected to two-way comm radios, in-ear microphones
- Users speak at normal level and can be heard *without picking up environmental noises or compromising speech intelligibility*
- Compatible with other PPE, including full-face respirators, helmets and other head protection



Hearing Loss Due to Noise Exposure Is...

- Painless
- Permanent
- Progressive

PREVENTABLE!