Can You Hear Me Now?

Preventing Noise Induced Hearing Loss (NIHL)

Ron Nunley CIH, CSP
ASSE Bakersfield Chapter

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Can You Hear Me NOW!!
The problem isn’t going away…

• Most common work related illness (US)
• 22M exposed to hazardous noise
• Progressive & painless
• **World Health Organization** 1.1 billion people are at risk of hearing loss due to recreational noise (iPods, Smart Phones, concerts, sporting events, etc.).
• **NIOSH:** 22% aged 12-19 suffer moderate levels of hearing loss
• Completely preventable
Anatomy and Physiology of Hearing

The pinna directs sound waves into the ear.

The oval window and the round window separate the fluid-filled inner ear from the air-filled middle ear.
Anatomy and Physiology of Hearing

- Noise induced hearing loss occurs in the inner ear with the hair cells (in the organ of Corti within the Cochlea).
- Cells at the base of the Cochlea are most sensitive to high Hz.
- Cells at the apex of the Cochlea are most sensitive to low Hz.
- Breakage of the hairs results in loss of hearing.

Temporary threshold shift
Permanent threshold shift
Tinnitus
Types of hearing loss.

- **Conductive:**
  - Losses tend to be uniform across frequencies
  - Outer and/or middle ear

- **Sensory neural**
  - Losses increase with frequency
  - Inner ear.
  - Usually permanent.

- **Presbycusis**
  - Age related hearing loss.

- **Chemical induced:**
  - Ototoxins – Carbon disulfide, carbon monoxide, lead, manganese, styrene, toluene, ethyl benzene, xylene, aspirin.
Physics of Sound

- Sound travels as a wave
  - SI unit: Pascal (N/m²)
  - Threshold of normal hearing
  - Threshold of pain
  - SPL: Logarithmic quantity
  - Decibel

<table>
<thead>
<tr>
<th>Sound Pressure, Pa</th>
<th>Sound Pressure Level, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00001</td>
<td>0</td>
</tr>
<tr>
<td>0.00002</td>
<td>10</td>
</tr>
<tr>
<td>0.00005</td>
<td>20</td>
</tr>
<tr>
<td>0.0001</td>
<td>30</td>
</tr>
<tr>
<td>0.0005</td>
<td>40</td>
</tr>
<tr>
<td>0.001</td>
<td>50</td>
</tr>
<tr>
<td>0.01</td>
<td>60</td>
</tr>
<tr>
<td>0.2</td>
<td>70</td>
</tr>
<tr>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>50</td>
<td>110</td>
</tr>
<tr>
<td>100</td>
<td>120</td>
</tr>
</tbody>
</table>

Examples:
- Pneumatic Chipper (at 5 ft.)
- Textile Loom
- Newspaper Press
- Diesel Truck 40 mph (at 50 ft.)
- Passenger Car 50 mph (at 50 ft.)
- Conversation (at 3 ft.)
- Quiet Room
Exposure Limits:

• Hearing Conservation Program
  – Daily Dose: 85 dBA for 8 hrs
  – Requires monitoring
  – Baseline and annual audiometric testing
  – Provide hearing protectors
  – Evaluate hearing protection attenuation
  – Annual Training

• PEL: 90 dBA for 8 hr
  – Administrative controls
  – Engineering controls
  – Require hearing protectors

• 5 dBA Exchange Rate

Table N-1 Permissible Noise Exposure

<table>
<thead>
<tr>
<th>Sound Level (dBA)</th>
<th>Permitted Duration (hours/minutes)</th>
<th>Permitted Duration (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>8-0</td>
<td>8.00</td>
</tr>
<tr>
<td>91</td>
<td>6-50</td>
<td>6.96</td>
</tr>
<tr>
<td>92</td>
<td>6-4</td>
<td>6.06</td>
</tr>
<tr>
<td>93</td>
<td>5-17</td>
<td>5.28</td>
</tr>
<tr>
<td>94</td>
<td>4-36</td>
<td>4.60</td>
</tr>
<tr>
<td>95</td>
<td>4-0</td>
<td>4.00</td>
</tr>
<tr>
<td>96</td>
<td>3-29</td>
<td>3.48</td>
</tr>
<tr>
<td>97</td>
<td>3-2</td>
<td>3.03</td>
</tr>
<tr>
<td>98</td>
<td>2-38</td>
<td>2.63</td>
</tr>
<tr>
<td>99</td>
<td>2-18</td>
<td>2.30</td>
</tr>
<tr>
<td>100</td>
<td>2-0</td>
<td>2.00</td>
</tr>
<tr>
<td>101</td>
<td>1-44</td>
<td>1.73</td>
</tr>
<tr>
<td>102</td>
<td>1-31</td>
<td>1.52</td>
</tr>
<tr>
<td>103</td>
<td>1-19</td>
<td>1.32</td>
</tr>
</tbody>
</table>
Hazard Recognition

- Qualitative Estimate of 85 dBA
  Raise your voice within 3 feet
Measure Noise Exposure (Uncertainty is the enemy)

- Quantitative Assessment
  - Noise Calibrator
  - Sound Level Meter
  - Noise Dosimeter
  - Octave Band Analyzer

Need Type 1 or Type 2 for IH monitoring
The noise survey....

- Basic Survey (Eliminates areas that do not have high noise areas)
  - List of areas with noise sources of concern
- Detailed Noise Survey
  - Map
  - List of tasks
  - Task durations documented
  - Task frequency
  - Sampling plan
  - Dosimetry results
- Engineering Control Survey
  - Octave Band Analysis
### Noise Evaluation

- Noise dosimeter settings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>OSHA HC Parameters</th>
<th>OSHA PEL Parameters</th>
<th>ACGIH TLV Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold Level</td>
<td>80 dB</td>
<td>90 dB</td>
<td>80 dB</td>
</tr>
<tr>
<td>Criterion Level</td>
<td>90 dB</td>
<td>90 dB</td>
<td>85 dB</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>5 dB</td>
<td>5 dB</td>
<td>3 dB</td>
</tr>
<tr>
<td>Frequency Weighting</td>
<td>A</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Response</td>
<td>Slow</td>
<td>Slow</td>
<td>Slow</td>
</tr>
</tbody>
</table>
Effectively educate

- Communicate results of the noise surveys/audiograms
- Simple
- Short
- Meaningful
- Consider fit testing to obtain Personal Attenuation Rating (PAR)
- Include supervision
- Minimize the effect on production
Provide hearing protection devices that will be used

• Provide a variety of HPD’s
  – One size may not fit all
  – Plugs and Muffs
  – But not too many
• Provide fitting instructions
• Require a NRR of 25
• Require double hearing protection for noise sources greater than 105 dBA
Proper fit is key to HPD effectiveness

<table>
<thead>
<tr>
<th>Single-Use</th>
<th>Single-Use</th>
<th>Multiple-Use</th>
<th>Banded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No-Roll foam</strong></td>
<td><strong>Roll-Down foam</strong></td>
<td><strong>SmartFit®</strong></td>
<td><strong>Earplug</strong></td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>1</strong> Reach over your head with a free hand, pull your ear up and back, and insert the earplug well inside your ear canal.</td>
<td><strong>1</strong> With clean hands, roll the entire earplug into narrowest possible crease-free cylinder.</td>
<td><strong>1</strong> While holding the stem, reach a hand over your head and gently pull top of your ear up and back.</td>
<td><strong>1</strong> Position band under your chin as shown above. Use your hands to press the ear plugs well into the ear canal using an inward motion.</td>
</tr>
</tbody>
</table>
| **2** Earplugs should be inserted as shown in the drawing. Stop pushing earplug when your finger touches your ear. | **2** Reach over your head with a free hand, pull your ear up and back, and insert the earplug well inside your ear canal. | **2** Insert the earplug so all flanges are well inside your ear canal. | **2** Proper Fit
If either or both earplugs do not seem to be fitted properly, remove the earplug and restart. |
| **3** If properly fitted, the end of the earplugs should not be visible to someone looking at you from the front. | **3** Hold for 30 - 40 seconds, until the earplug fully expands in your ear canal. If properly fitted, the end of the earplugs should not be visible to someone looking at you from the front. | **3** If properly fitted, the tip of the earplug stem may be visible to someone looking at you from the front. | **3** Protection levels are improved by pulling your ear up and back when fitting as shown. |
| **4** Acoustical Check
In a noise environment, lightly press the band inward with your fingertips as shown. You should not notice a significant difference in noise level. | **4** Removal
Gently twist earplug while slowly pulling in an outward motion for removal. | **4** | **4** Earplugs should block enough noise so that covering your ears with your hands should not result in a significant noise difference. |
Methods to estimate HPD adequacy

OSHA Methods:

**Dosimeter:**
1. C-weighted TWA – NRR = A-weighted attenuated TWA under HPD

**Sound Level Meter:**
1. C-weighted Sound Pressure Level – NRR = A-weighted attenuated TWA under HPD
2. A-weighted Sound Presser Level – (NRR-7) = A-weighted attenuated TWA under HPD

**NIOSH Method:**
A-weighted TWA-[(NRR-7)/2]=A-weighted attenuated TWA under HPD

**Duel Hearing Protection:**
A-weighted TWA-[[((NRR-7)/2)+5]=A-weighted attenuated TWA under HPD
Hearing protection must be worn to be effective

- HPD not worn for 30 min
  - Reduces NRR > 1/2
Properly fitted hearing protective devices have limits

1. Air leaks
2. Hearing protector vibration
3. Structural transmission
4. Bone and Tissue Conduction
Noise Control

Hierarchy of Controls

- **Elimination**: Physically remove the hazard
- **Substitution**: Replace the hazard
- **Engineering Controls**: Isolate people from the hazard
- **Administrative Controls**: Change the way people work
- **PPE**: Protect the worker with Personal Protective Equipment

Most effective to least effective.
Noise Control

- Substitution

Helical gears are quieter than spur gears because their teeth engage a little at a time.

Spur Gear  Helical Gear
Practical Engineering Controls:

- Eliminate sources (-3 dBA)
- Double the distance (-6 dBA)
- Reduce fan speed (-2-15 dBA)
- Avoid bends w/in 2-3 duct diameters of fan intake
- Regulate compressed air and pneumatic devices to reduce air velocities
- Alignment/greasing oiling preventative maintenance of pumps
- Enclosure the noise source
- Replace pneumatic nozzles for high efficiency units
- Vibration isolation pad machine feet, pumps
- Minimize gaps in machine guards (-3-10 dBA)
- Replace noisy chain drives with timing belts
- Replace existing electric motors with quieter models
Audiometric testing programs are valuable

- Baseline audiograms
- Annual audiograms
- Workers should be encouraged to avoid non occupational noises (14 hours)
- Hearing conservation personnel react to hearing threshold shifts
- Correct for age (age 60)
- Results can be used to provide employee feedback to encourage worker responsibility for preserving their hearing
- Assess of overall program effectiveness

**OSHA Recordable.** If an employee's hearing test (audiogram) reveals that the employee has experienced a work-related Standard Threshold Shift (STS) in hearing in one or both ears, and the employee's total hearing level is 25 decibels (dB) or more above audiometric zero (averaged at 2000, 3000, and 4000 Hz) in the same ear(s) as the STS, you must record the case on the OSHA 300 Log.

*Retest: must be completed within 30 days.*
Simple ways to promote hearing conservation

Sound Limiting Headphones
Volume < 85 dBA

- Phone apps are proving useful
Develop an effective hearing conservation program

- Education/Training
- Noise Surveys
- Noise Controls
- Hearing Protective Devices
- Audiometric Monitoring
  - Baseline Audiograms
  - Annual Audiograms
  - ID near recordable
What does hearing loss sound like?