Occupational Noise & Hearing Loss

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Can You Imagine?

Not being able to
- Hear what the other person is saying?
- Listen to the sound of music?
- Listen to the sound of nature?

Being afflicted with
- Uncomfortable ringing in your ears?
- Abnormal sounds that interfere with your sleep
Did You Know?

- About 30 million workers are exposed to hazardous noise on the job. One in 4 of these workers (or 7.5 million Americans) will develop permanent hearing loss.

- Noise-induced hearing loss is the most common occupational hazard for American workers.

- Rates of noise-induced hearing loss continue to rise with a 26% increase among 45 to 64 year olds.
Anatomy and Physiology

Ear Canal
Stapes
Semicircular Canals
Cochlea
Ossicles
Ear Drum
Eustachian Tube

Occupational Noise
How We Hear Sounds

- Sound waves enter the ear canal striking the eardrum
- When eardrum vibrates, ossicles conducts vibrations to the cochlea
- Tiny hairlike cells in cochlea respond to vibrations by generating nerve impulses
- Brain interprets nerve impulses as sound
- Note: Healthy hair cells are the key to good hearing. Although, some die off naturally as you age, many more are killed early, from unprotected exposure to hazardous noise
How is Noise Measured?

- Noise levels are measured in decibels (dB)
- Decibels are not linear measurements
- The difference in energy between 100 decibels and 110 is not 10% - it actually is 100 times the sound level pressure
## Common Noise Exposures

<table>
<thead>
<tr>
<th>Source</th>
<th>dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whisper</td>
<td>20</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>40</td>
</tr>
<tr>
<td>Conversation</td>
<td>60</td>
</tr>
<tr>
<td>Average TV</td>
<td>74</td>
</tr>
<tr>
<td>Blender</td>
<td>80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>i-pod</td>
<td>90</td>
</tr>
<tr>
<td>Woodworking</td>
<td>93-120</td>
</tr>
<tr>
<td>Gun Shot</td>
<td>130-140</td>
</tr>
<tr>
<td>Riding Motorcycle</td>
<td>90</td>
</tr>
<tr>
<td>Snow Mobile</td>
<td>120</td>
</tr>
<tr>
<td>Rock Concert</td>
<td>140</td>
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</table>
Hearing Conservation Standard

- Also referred to as Noise Conservation or Noise Standard
- Occupational Safety and Health Administration (OSHA) Regulation
  - General Industry: 29 CFR 1910.95
  - Construction: 29 CFR 1926.52
  - Establishes a Permissible Exposure Limit (PEL) and an Action Limit (AL)
- Goal is to prevent hearing loss associated with high noise levels in the work environment
## Allowable Exposure Times

How long can a person be exposed to noise without hearing protection based on the OSHA Standard.

<table>
<thead>
<tr>
<th>Noise Level</th>
<th>Allowable Exposure Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 decibels</td>
<td>16 hours</td>
</tr>
<tr>
<td>90 decibels</td>
<td>8 hours</td>
</tr>
<tr>
<td>100 decibels</td>
<td>2 hour</td>
</tr>
<tr>
<td>105 decibels</td>
<td>1 hour</td>
</tr>
<tr>
<td>110 decibels</td>
<td>30 minutes</td>
</tr>
<tr>
<td>115 decibels</td>
<td>15 minutes</td>
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</tbody>
</table>
Exposure limits in noise exposure are a trade-off between sound level (decibels) and duration of exposure (time).
OSHA HCP Standard

- If 8-hour average exceeds 85 dBA then the employer must:
  - Monitor (measure) exposure and notify employee of the results
  - Provide audiometric testing
  - Provide hearing protection
  - Provide training
  - Keep records of monitoring and audiometric testing

- If 8-hour average exceeds 90 dBA, then:
  - Above items plus
  - Hearing protection use is mandatory
Elements of a HCP

- Noise Monitoring
- Hearing Protectors
- Audiometric Testing
- Evaluation of Audiogram
- Audiometric Test Requirements
- Audiometer Calibration
- Training
- Record Keeping
Noise Monitoring Program

Why does noise need to be measured or monitored:

• Required by OSHA regulations
• Factors that may suggest need for monitoring include employee complaints, indications that employees are losing their hearing, STS, or noisy conditions that make normal conversation difficult
• Results will indicate whether or not a Hearing Conservation Program needs to be implemented
• Results may be used to determine appropriate control measures including use of hearing protection
• Monitoring should be repeated whenever changes are made to production, equipment or processes
Noise Monitoring Surveys

- All noise levels from 80 to 130 decibels should be included in monitoring.
- An initial noise mapping or walkthrough survey is useful as a screening tool to identify potential high noise areas or activities.
- Survey should include a representative number of employees working in areas of interest or completing tasks of interest.
- Noise mapping is helpful to identify low noise exposure areas so that dosimetry is not necessary.
Sound measurements are collected using A-scale to replicate the response of the human ear.
Noise Dosimetry Monitoring

- Dosimetry measures personal exposures
- Measures sound levels only, not actual sounds or words
- Produces a time-weighted average for 8-hour exposure (or longer)
- Measures exposure over a normal work day including job rotation, breaks, etc.
Sound Level Meter Survey

- May also be referred to as Noise Mapping Survey
- Measures sound levels at a given point in time in an identified area
- Useful for determining noise exposure due to specific equipment, vehicles or processes
- Can be used for octave band/frequency analysis
Employee Involvement in Surveys

- Employees involved in the survey should be given the following information:
  - Purpose of survey and how it will affect them
  - They should conduct their normal work routine
  - Sound levels are recorded, not actual words (not a speech recording device)
  - Not to cover the microphone
When is Noise Too Loud?

- If two people 3 feet apart must shout to be heard, the background noise is too loud (above 85 decibels)

- Noise above 140 decibels causes pain and immediate hearing loss
What is Too Much?

- Damage from noise exposure depends on the loudness and length of exposure.
- Scientific studies have shown that hearing loss can occur when 8-hour average noise exposure exceeds 85 decibels.
- The risk of hearing loss increases dramatically as noise levels increase.
- Exposure to noise levels above 115 decibels for even five minutes is very risky.
Long Term Exposure to Noise

- Our ears can recover from short exposure to loud noise, but over time nerve damage will occur.
- The longer and louder the noise, the greater chance permanent damage will occur.
- There is no such thing as “tough ears” or “getting used to it.”
Effects of Noise

Hair cells in inner ear transmit noise signals to the brain

Normal Hair Cells  Noise-damaged Hair Cells
Effects of Exposure to Loud Noise

- Exposure to loud noise will inevitably cause hearing loss over time.
- Once the nerves of the inner ear are destroyed or damaged from exposure to excessive noise, the damage is permanent.
- Loud noise damages or destroys the nerves in the inner ear.
- Another effect can be “tinnitus” or permanent ringing in the ear.
Symptoms of Overexposure

- **Temporary Threshold Shift**
  - muffled sound after noise exposure
  - if continued overexposure, shift can worsen and become permanent
  - resulting in untreatable damage to hearing

- **Tinnitus**
  - ringing in the head when trying to sleep at night
  - if continued overexposure, ringing can become permanent, constant annoyance
Tinnitus from Noise Exposure

- Exposure to high noise levels can also cause permanent ringing in the ear or “tinnitus”

- Tinnitus sufferers usually complain of constant whistling, squealing, roaring or buzzing in one or both ears

- Severe tinnitus may disrupt sleep, reduce concentration and cause irritability and depression
Noise Exposure Effects

➢ Excessive noise may have other effects on employees:
  • Interferes with speech understanding and conversations
  • Interferes with sleep
  • Lowers morale
  • Increases annoyance
  • Reduces efficiency
  • Interferes with concentration
  • Causes fatigue
Noise-Induced Hearing Loss

- Causes no pain
- Causes no visible trauma
- Leaves no visible scars
- Is unnoticeable in its earliest stages
- Accumulates with each overexposure
- Takes years to notice a change

IS Permanent + 100% Preventable
Signs of Hearing Loss

- Difficulty hearing people speak
- Inability to hear certain high-pitched or soft sounds
- Noise or ringing in ears.
- Getting complaints that the radio or TV is too loud
Noise Induced Hearing Loss

- Noise induced hearing loss stems from exposure to loud noises.
  - Constant exposure over a period of time
  - Exposed to sound level over 140 dBA
  - Tinnitus

- Age Induced Hearing loss
  - Exposure to high sound levels
  - Hereditary
  - Nerve damage
  - Reduced neuronal response
Factors Affecting Hearing Loss

The following factors can affect hearing loss:

• Noise Intensity or Sound Pressure
• Frequency or Pitch of sound
• Length of Daily Exposure
• Duration of Exposure in Years
• Individual Susceptibility
• Other Factors (disease, genetics, lifestyle, age, etc.)
Occupational vs. Non-Occupational

- **Occupational Hearing Loss**
  - Results from constant exposure to sound levels above 85 dBA TWA
  - Damage to hair cells in cochlea

- **Non-Occupational Hearing Loss**
  - Results from constant exposure to sound levels above 85 dBA TWA
  - Results from damage to outer, middle, or inner ear and may be hereditary, ototoxic drugs, noise
  - Damage to hair cells in cochlea, damage to nerve cells relaying sound message to brain, damage to structure of ear
Audiometric Testing

- Audiometric Testing is required by OSHA for all employees exposed to greater than 85 dBA over 8-hours.
- The purpose of Audiometric Testing is to:
  - Measure hearing by sending tones to each ear through headphones.
  - Show how one’s hearing compares to normal hearing based on age.
  - Determine whether hearing is being conserved.
  - Alert employee and employer for noise, age or medical related hearing loss.
What is an Audiogram?

An audiogram is a printed chart of the results of the hearing test similar to those shown below:

- **Normal Hearing**
- **Severe Hearing Loss**
Audiometric Testing

- Baseline test conducted on first hire or before assignment
- Testing repeated every year and compared to baseline
- Testing produces audiograms which show hearing ability at several pitches or frequencies, including those of the human voice
- If there is a hearing loss of 10 decibels or more in the human voice frequencies, refer to an audiologist
Standard Threshold Shift

- STS is defined as “a change in hearing threshold of 10 dB or more at 2000, 3000, and 4000 Hz in either ear”
- If a comparison of the annual audiogram to the initial audiogram and previous audiograms indicate that the employee has experienced a STS, retest within 30 days
- If retest still indicates STS, refer employee to audiologist or physician for further evaluation
Standard Threshold Shift

➢ Other requirements if a STS is shown to have occurred:
  • Inform the employee within 21 days
  • Fit employee with hearing protectors and train in their use.
  • If already using hearing protection, refit and retrain.
Revised Baseline Audiogram

- Annual audiogram may be substituted for original baseline test if:
  - STS is deemed to be persistent
  - Hearing threshold indicates significant improvement
Noise Control Measures

The employer must take some steps to control noise exposure in the workplace, such as:

- Identifying noise hazardous equipment
- Using Engineering, Administrative and Hearing Protection to minimize or eliminate noise exposure
- Modifying the source of the noise so it is quieter, using engineering controls
- Increasing distance between the employee and the noise hazard
- Limiting worker exposure time
- Requiring the use of hearing protection devices when the above measures are not feasible and/or do not decrease noise levels below a TWA-8 of 90 dBA
Hierarchy of Controls

ENGINEERING CONTROLS
- Buy Quiet
- Vibration Pads
- Enclosures
- Barriers
- Isolation

ADMINISTRATIVE CONTROLS
- Rotate Workers
- Extended Breaks
- 2nd/3rd Shift

PERSONAL PROTECTIVE EQUIPMENT

Occupational Noise
Engineering Controls

Engineering controls are the most preferred option in reducing or eliminating the noise hazard by:

- Reducing or eliminating noise at the source
- Interrupting the noise path
- Reducing reverberation and structural vibration
Administrative Controls

If engineering controls do not work to eliminate the noise hazard, then administrative controls should be considered, including:

- Operate noisy equipment on second or third shifts when there are less employees in the area
- Rotate employees through high-noise areas
- Modify existing machinery
- Place noise limit specifications on new equipment
- Maintain equipment in good condition
- Use noise control when installed
- Reporting noisy equipment to supervisor for repair
Personal Protective Equipment

- If engineering or administrative controls do not work to eliminate the noise hazard, then personal protective equipment should be considered as a last resort.

- This includes using hearing protection, such as ear plugs or ear muffs.
Types of Hearing Protection

There are three types of hearing protection – ear muffs, earplugs and ear caps

Ear muffs and earplugs provide about equal protection, ear caps somewhat less
Types of Hearing Protectors

- All hearing protectors are designed to reduce the intensity (loudness) of noise to the inner ear.
- They work much better than wads of cotton or bits of cloth stuffed in the ear.
- All three types have advantages and disadvantages and people vary on which they prefer to use.
Hearing Protection – Ear Plugs

- Earplugs are made of foam, rubber or plastic and are either one-size-fits-all or in sizes small, medium and large.
- Some are disposable, some are reusable.
- They are lightweight, and require no maintenance.
- They are inserted into the ear canal.
Ear Plug Comfort

- Some people may find ear plugs uncomfortable to wear for long periods at first
- Ear plugs rarely cause infection or prolonged irritation of the ear canal
- Most people can find a comfortable fit by trying several different sizes, types or brands
- Custom-molded earplugs can be obtained for maximum comfort
Inserting Foam Earplugs

Foam type earplugs are one-size-fits-all and must be inserted properly into the ear.

Earplug incorrectly inserted

Earplug correctly inserted
Inserting Foam Earplugs

1. **Roll** entire earplug into a crease-free cylinder

2. **Pull Back** upper edge of ear by reaching over head with free hand, gently pull up and back

3. **Insert** earplug well into ear canal and hold until it fully expands
Inserting Multiple-Use Earplugs

1. Reach
While holding the stem, reach hand overhead and gently pull top of ear up and back.

2. Insert
Insert earplug so all flanges are well inside the ear canal.

3. Fit
If properly fitted, only the stem of the earplugs should be visible to someone looking at you from the front.
Is the Earplug in Far Enough?

1. Visual Check
   The earplug should sit well inside the ear canal and not stick out.

2. Acoustical Check
   Cup hands over ears and release. Earplugs should block enough noise so that covering your ears with hands should not result in a significant noise difference.
Ear Muffs

- Ear muffs cover the whole ear and are preferred by some people
- They have replaceable pads and some high-tech styles filter out specific noise pitches
- They last longer than most plugs
Attached Earmuffs

- Some muffs are attached to hard hats or goggles
- Some high-tech muffs can filter out certain frequencies or have radios inside for communication in high noise areas
Earmuff Comfort and Glasses

- Muffs can be uncomfortable in hot weather

- Muffs don’t seal well for someone with glasses or heavy sideburns
Ear Caps

- Ear caps are like earplugs, except they do not go into the ear canal, they only block it.
- They are good for occasional use or for people who find earplugs uncomfortable.
- They are not as protective as earplugs or muffs.
Noise Reduction Ratings

- The “noise reduction rating” or “NRR” of hearing protection is measured in decibels.
- The NRR is found on the earmuff or earplug package.
- The higher the number, the greater the protection, theoretically.
- Must subtract 7 dB for actual reduction in use.
Proper Use of Hearing Protection

- It takes just a few minutes of unprotected exposure at noise above 115 decibels to risk hearing damage.

- Earplugs not well inserted into the ear canal will not provide complete protection.

- Likewise, earmuffs not snug against the head will “leak” noise into the ear.
Hearing Aids

- Hearing aids do not block out enough sound for most workplace noise
- Some hearing aids can actually increase the noise level at the ear
- Just turning off the hearing aids will not prevent further hearing loss from noise exposure
Portable Radios/iPods/Etc

- These devices do not provide protection from noise.
- The earphones are not earmuffs and the music only adds to background other noise.
- The music level in the earphones themselves can exceed 85 decibels and cause hearing loss.
Selection, Fitting, Use and Care of Hearing Protection

- **Ear plugs**
  - Keep clean and free of materials
  - Wash in mild liquid detergent and warm water
  - Squeeze excess water and air dry
  - Discard plugs when hardened or do not re-expand

- **Ear Caps**
  - Clean like normal ear plugs
  - Do not tamper with the headband and the acoustic seal
Selection, Fitting, Use and Care of Hearing Protection

- **Ear Muffs**
  - Keep clean and free of debris
  - Clean cushions with warm soapy water
  - Do not tamper with the acoustic seal between the cushions and the headband
  - Do not modify the ear muffs in any way
  - Do not stretch or abuse the headband
Recordkeeping

- Exposure measurements (noise survey results): Maintained by employer for at least two years
- Audiometric Tests: Employer should retain for the duration of the employee’s employment plus five years
Training

➢ Training is required for employees who are exposed to noise at or above 8 hr TWA of 85 dB

➢ Topics must include:
  • Effects of Noise on Hearing
  • Purpose of Hearing Protectors
  • Advantages and Disadvantages of Different Types of Hearing Protectors
  • Attenuation of Different Types of Hearing Protectors
  • Instructions on Selection, Fitting, Use, and Care of Hearing Protectors
  • Purpose of Audiometric Testing
Employer Responsibility

Employers are responsible for the following:

• Provide occupational noise training
• Provide hearing protection devices
• Demonstrate commitment – wear hearing protection devices, or PPE, when required
• Enforce the use of PPE
• Keep up to date with PPE selection and use
• Encourage questions and resolve problems
Employee Responsibility

- Employees are responsible to:
  - Understand the need for personal protective equipment and audiometric testing
  - Wear PPE and seek replacements when needed
  - Encourage co-workers to wear PPE
  - Communicate problems to supervisors
  - Communicate concerns regarding noise exposure to supervisors/management
  - Properly maintain equipment
Noise exposures occur

On the Job

Off the Job

Protecting hearing means taking precautions around hazardous noise both on- and off-the-job.

We live in a NOISY world!
Communicate a Clear Message

Hearing Conservation is part of everyday life

- Include recreational hearing conservation in annual training
- Provide extra HPDs for home use
- Promote hearing conservation at company/family events
Thank you!
- The Members of the ATC Team