



# **TOOL BOX TALKS: HEARING CONSERVATION IN THE SHIPBUILDING INDUSTRY**



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# **TOOL BOX TALKS: HEARING CONSERVATION IN THE SHIPBUILDING INDUSTRY**

## **TOPICS COVERED:**

- Anatomy Of The Hearing System
- Characteristics Of Noise Induced Hearing Loss
- Degrees Of Hearing Loss And Its Impact On Speech
- What Does Noise-Induced Hearing Loss Look Like?
- How Do I Know If I Have A Hearing Loss?
- Shipbuilding Noise Levels
- When Is Hearing Protection Required?
- Selecting Hearing Protection
- Hearing Protection Factors
- Hearing Protection Fit
- Hearing Protection Fit – Flange Type Earplug
- Insertion Of Foam Earplugs
- How To Tell If Hearing Protection Is Working
- Hearing Protection Myths
- Hearing Protection Check List

## **REFERENCES/RESOURCES:**

- OSHA Noise and Hearing Conservation eTool: <http://www.osha.gov/dts/osta/otm/noise/index.html>
- OSHA Noise and Hearing Conservation Safety and Health Topics Page: <http://www.osha.gov/SLTC/noisehearingconservation/index.html>
- Hearing Conservation (OSHA 3074) - <http://www.osha.gov/Publications/OSHA3074/osha3074.html>
- NIOSH Safety and Health Topic: Noise and Hearing Loss Prevention: <http://www.cdc.gov/niosh/topics/noise/pubs/presentations.html>
- American Academy of Audiology: <http://www.audiology.org/Pages/default.aspx>
- American Academy of Otolaryngology: <http://www.entnet.org/healthinformation/ears.cfm>
- American Speech Language Hearing Association: <http://www.asha.org/public/hearing/disorders/>
- American Tinnitus Association: <http://www.ata.org/>
- Department of Army - Personal Hearing Protective Devices Their Fitting Care and Use: <http://chppm-www.apgea.army.mil/documents/TG/TECHGUID/TG41FinalFeb06.pdf>
- House Ear Institute: <http://www.hei.org>
- National Institute on Deafness and Other Communicative Disorders: <http://www.nidcd.nih.gov>
- “Bad Assumptions About Hearing Protection” - *Occupational Health and Safety*, September 1, 2008: <http://ohsonline.com/articles/2008/09/bad-assumptions-about-hearing-protection.aspx>
- U.S. Navy - Hearing Conservation Toolbox - [http://www-nehc.med.navy.mil/occupational\\_health/audiology/hearingconservation\\_toolbox.aspx](http://www-nehc.med.navy.mil/occupational_health/audiology/hearingconservation_toolbox.aspx)
- Workers’ Compensation Board of British Columbia – Hearing Loss Prevention: [http://www.worksafebc.com/publications/health\\_and\\_safety/by\\_topic/hearing\\_conservation/default.asp](http://www.worksafebc.com/publications/health_and_safety/by_topic/hearing_conservation/default.asp)

Through the OSHA and National Institute for Occupational Safety and Health and National Hearing Conservation Association Alliance, the OSHA and the American Shipbuilding Association Alliance, the OSHA and the National Shipbuilding Research Program Alliance, and the OSHA and the Shipbuilders Council of America Alliance, the participants developed this series of Tool Box Talks for informational purposes only. They do not necessarily reflect the official views of OSHA or the U.S. Department of Labor. (04/09)



# TOOL BOX TALKS

**SERIES: HEARING PROTECTION**

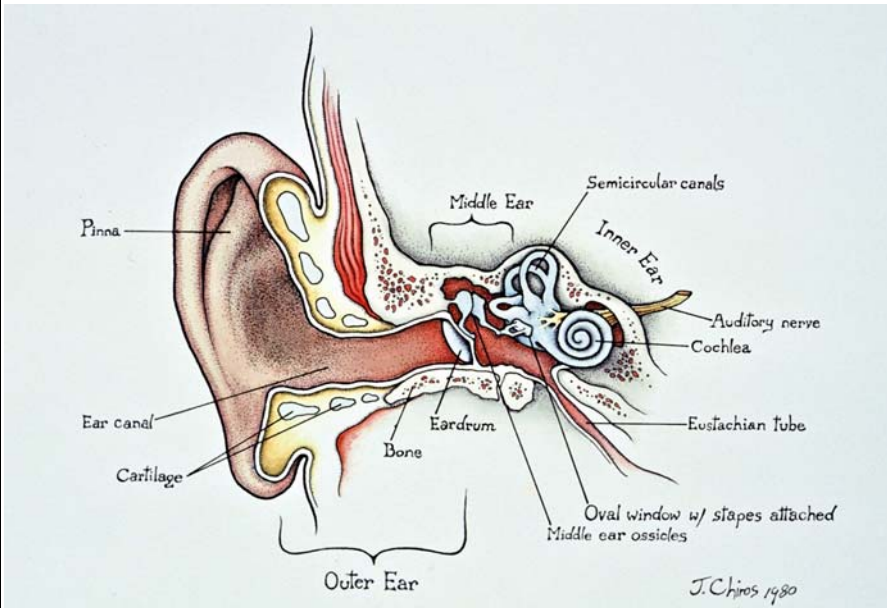
## **ANATOMY OF THE HEARING SYSTEM**

### **MEETING GOALS**

At the end of this meeting, employees will understand the anatomy of the hearing system.

### **LESSON CONTENT**

How we hear: The outer ear acts like a satellite dish that collects sound. Sound enters the ear through the pinna. Sound travels through the ear canal in the form of sound waves (vibrations). Sound waves strike the eardrum in the middle ear causing it to vibrate. The three small bones in the middle ear vibrate and send the vibrations to the inner ear. The vibrations are relayed to a snail shaped cochlea inside the inner ear. Inside the cochlea, the vibration is changed into an electrical signal. The signal is carried to the brain and interpreted as sound. The brain distinguishes vowels from consonants in the particular way the sound wave moves the hair cells in the cochlea.



- Outer ear collects the sound and channels it through the canal
- Sound waves strike the eardrum, which transmits vibration through the three small bones in the middle ear
- Vibrations travel to the cochlea in the inner ear
- Signal is carried to the brain and interpreted as sound

*Credit: Elliott Berger, Aearo Technologies a 3M Company; illustration by J. Chiros.*

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# TOOL BOX TALKS

**SERIES: NOISE EXPOSURE DAMAGE**

## CHARACTERISTICS OF NOISE INDUCED HEARING LOSS

### MEETING GOALS

At the end of this session, employees will understand the basic characteristics of hearing loss due to noise exposure.

### LESSON CONTENT

What you need to know about noise induced hearing loss:

- ⊙ It Is Painless!
  - *Loud noise over time kills the hair cells in the inner ear.*
- ⊙ It Is Progressive!
  - *The longer the ear is exposed, the more cells are destroyed.*
- ⊙ It Is Permanent!
  - *Dead hair cells cannot be repaired.*
- ⊙ It Is Totally Preventable!

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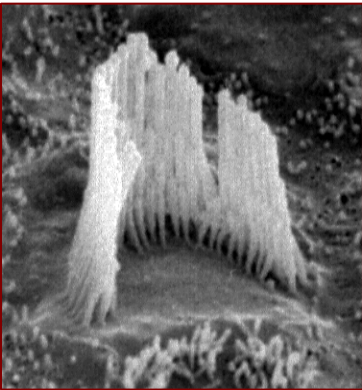
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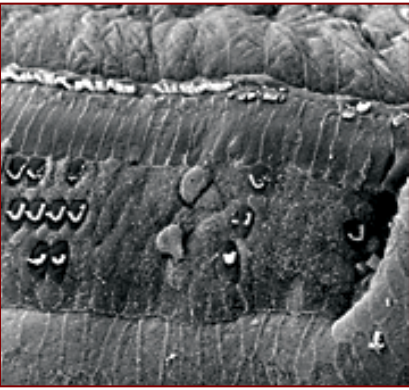
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**Normal Hair Cells**



**Damaged Hair Cells**



*Credit: House Ear Institute*



# TOOL BOX TALKS

## SERIES: HEARING PROTECTION

### DEGREES OF HEARING LOSS AND ITS IMPACT ON SPEECH

#### MEETING GOALS

At the end of this meeting, employees will know why it is difficult to understand speech and will know the different degrees of hearing loss.

#### LESSON CONTENT

Why can I hear but have trouble understanding speech?

The consonant sounds that give meaning to words are in the high frequencies (itches). People who have a noise-induced hearing loss have a loss in the high frequencies where the primary consonant sounds are. The speech cues are in the higher frequencies. Consonant sounds that are in the high frequencies, such as *p*, *t*, *f*, *th*, *sh*, *k*, and *s*, are difficult to distinguish. You may confuse words that start or end with these sounds, such as “*sin*” and “*fin*.” Most likely you are still able to understand the words from the context of the conversation.

#### Why is it difficult to Understand Speech?

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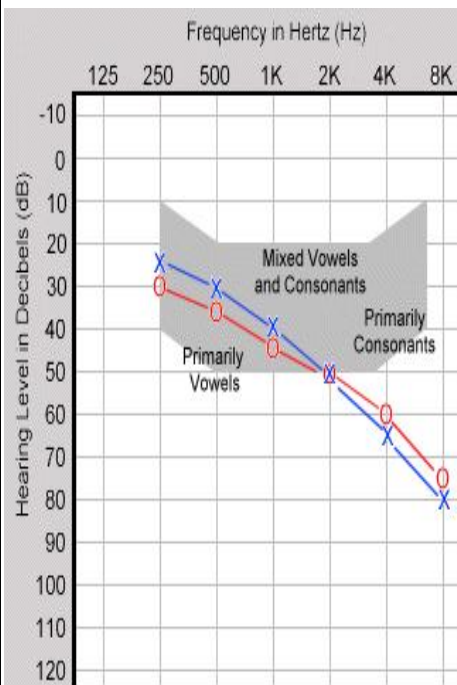


Figure One Audiogram  
The "Speech Banana"

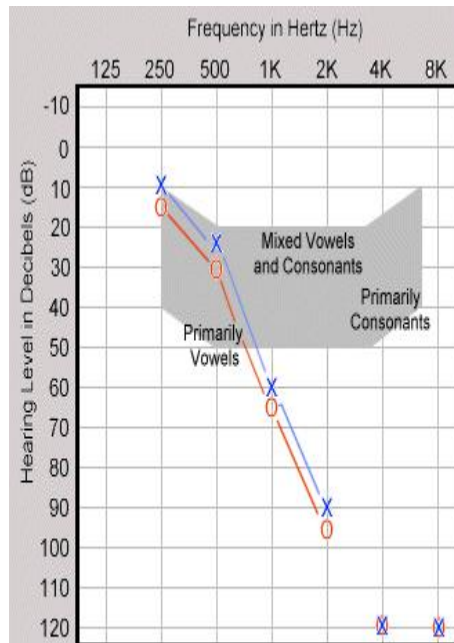


Figure 2 Audiogram - The "Ski Slope"  
A severe-to-profound high frequency hearing loss  
("ski slope" curve)

#### Degrees of Hearing Loss (HL)

**Normal Hearing** 0-25 dB

**Mild HL** 26 -40 dB

**Moderate HL** 41-70 dB

**Severe HL** 71-90 dB

**Profound HL** >91 dB

Credit: *The Audiogram: Explanation and Significance*. *Hearing Loss*, 25 (3), 29-33 Ross, M. (2004).



# TOOL BOX TALKS

SERIES: HEARING PROTECTION

## WHAT DOES NOISE-INDUCED HEARING LOSS LOOK LIKE?

### MEETING GOALS

At the end of this meeting, employees will know about types of hearing loss, what a hearing loss looks like on an audiogram, and its effect on understanding speech.

### LESSON CONTENT

What does a noise-induced hearing loss (NIHL) look like?? There are different types of hearing loss. The type that is always associated with noise exposure is a sensorineural or high frequency hearing loss. There is damage to the hair cells in the cochlea in the inner ear. A sensorineural loss not only makes sounds seem much softer, it also affects the ability to understand speech. Another type of hearing loss is a conductive hearing loss which typically involves only the low frequencies and is often due to a cold or infection in the outer or middle ear. It is not associated with noise exposure. But, you can have both at the same time.

### How to read an audiogram:

The graphs below are audiograms that plot the degree of hearing loss. Frequencies (pitch) are across the top. Frequency is measured in Hertz (Hz). Low pitch sounds (such as vowels) are towards the left of the audiogram and high pitch sounds (such as consonants) are towards the right of the audiogram. Hearing threshold levels are on the left side. Soft sounds are towards the top and loud sounds are towards the bottom of the audiogram. Loudness of sound is measured in decibels (dB). The greater the amount of sound needed to hear a test tone that is presented during audiometric testing, the greater the hearing loss.

The shape of the loss on the left audiogram shows early stages of a noise-induced hearing loss. The loss in both ears is the same and follows a similar pattern. It has a notch in the high frequencies most affected by noise early on. Most workers do not realize they have a hearing loss at this stage. The right audiogram shows what happens after repeated exposure. The hearing loss will progress to the middle frequencies which now involve the speech frequencies making it more difficult to understand speech.

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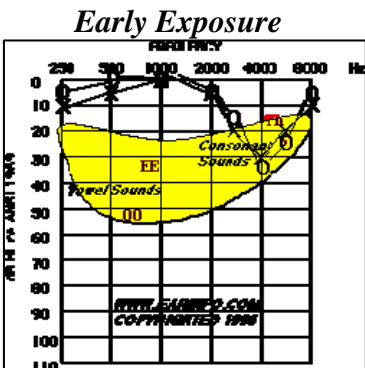
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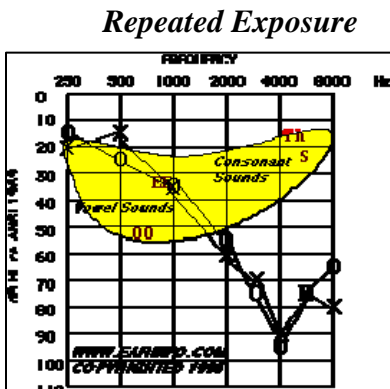
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### Audiogram

### Audiogram



**Early Exposure**  
Hearing loss shows up as a notch in the high pitches. It affects both ears. You may not yet notice you have a loss.



**With Repeated Exposure**  
Hearing loss spreads to middle and then lower pitches. Hearing becomes progressively worse. Speech may be difficult to understand.



# TOOL BOX TALKS

**SERIES: HEARING PROTECTION**

## HOW DO I KNOW IF I HAVE A HEARING LOSS?

### MEETING GOALS

At the end of this meeting, employees will know the typical symptoms of hearing loss and if any apply to them.

### LESSON CONTENT

1. Think others are mumbling?
2. Confuse similar sounding words and mistake the message?
3. Hard to follow verbal instructions when focused on job task?
4. Ask others to speak up or repeat themselves?
5. Hard to hear with background noise?
6. Hard to follow discussions in training sessions or meetings?
7. Easier to follow what is being said if you can see speakers face?
8. Trouble understanding on the telephone?
9. Can't hear back-up and other alarms in the shipyard?
10. Can't hear wrist watch/cell phone alarm or cell/telephone ringing if it is not next to you?
11. Sometimes hear ringing or noises in your ear?
12. Raise the volume of your radio, CD or MP3 player at the end of the workday?

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*If some or all of these apply to you, you may have a hearing loss.*

*Credist: American Academy of Audiology and National Institute on Deafness and Other Communicative Disorders*



# TOOL BOX TALKS

**SERIES: HEARING PROTECTION**

## SHIPBUILDING NOISE LEVELS

### MEETING GOALS

At the end of this session, employees will know about typical noise levels present in shipbuilding.

### LESSON CONTENT

Examples of noise levels based on an 8 hour exposure

Burner .....	85-91	dB
Crane operator.....	88-97	dB
Electrician.....	86-89	dB
Fitter.....	92-102	dB
Laborer.....	95-97	dB
Machinist.....	82-89	dB
Sandblaster.....	97-105	dB
Welder.....	91-100	dB

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\* **dB**A Sound is measured with a dosimeter or SLM using the dB A scale that most closely replicates how the ear responds to sound.



*Credit: WorkSafe BC-Workers' Compensation Board of British Columbia*





# TOOL BOX TALKS

**SERIES: HEARING PROTECTION**

## WHEN IS HEARING PROTECTION REQUIRED?

### MEETING GOALS

At the end of this meeting, employees will know when hearing protection is required to be worn, and when it will be made available.

### LESSON CONTENT

Required Hearing Protection Usage

#### *When is it required?*

- Noise exposure is 90 dBA and above.
- Noise exposure is 85 dBA
- And
- employee incurred a standard threshold shift (STS)
  
- Prior to baseline/retest audiogram.
- Noise exposure at 105 dBA requires dual hearing protection.
  - Dual = muff and earplug.

*Reference: 29 CFR 1910.95*

Choose to wear hearing protection at 85 dBA.

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# TOOL BOX TALKS

## SERIES: HEARING PROTECTION

### SELECTING HEARING PROTECTION

#### MEETING GOALS

At the end of this meeting, employees will know about the different types of hearing protection and their features. There is one just right for you.

#### LESSON CONTENT

Type	Features	Concerns
<b>Roll down foam</b> 	Fits many different ear canals.  Provides good protection for most noise situations.  Convenient.  Maintenance free; can throw away.	Takes practice to insert.  Must be inserted properly to get the highest possible protection.
<b>Reuseable earplugs</b> 	Many have flanges and handles.  Come in different sizes.  Come with cords, convenient to carry.  Re-useable. Washable.  In dusty environment, don't need to roll them.	Pre-formed so may not fit as wide a variety of ear canals as foam plugs.  May need a different size for each ear.  Must keep them clean.  If quickly removed, it can inflame the ear canal.
<b>Custom molded</b> 	Molded to user's ear.  Always comfortable.  Long-term wear.  Best for difficult to fit.	Must be made by a licensed hearing protection provider.
<b>Canal caps</b> 	On a band, can be worn under chin, over head or behind neck.  Ideal for in and out of noise.  Can be put on and taken off quickly.	Not as comfortable.  Not as much protection as others.
<b>Earmuffs</b> 	Easy to use and wear. Fit most people. Easy to keep clean. May be preferable in certain environments.  Can benefit workers with hearing loss or who have special communication needs.  Some are specially designed with electronic components that help users communicate or block impulsive noises.	Can be hot and heavy.  May be more difficult to get a good fit with glasses, or sideburns, or may interfere with other protective gear.

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Credits: NIOS; Howard Leigh; Aearo Technologies, a 3M Company; Bilsom; WorkSafe BC; Northern Safety and Industrial



# TOOL BOX TALKS

## SERIES: HEARING PROTECTION

### HEARING PROTECTION FACTORS

#### MEETING GOALS

At the end of this session, employees will understand what factors best hearing protector for them.

#### LESSON CONTENT

Many types of hearing protectors are available. Several factors best hearing protector for an individual employee:

### COMFORT!! COMFORT!! COMFORT!!

Employee and the fitter should work together to select hearing is comfortable and convenient so that it will be worn consistently.

Some considerations include; ease of putting on and off; with other safety gear such as masks, hard hats, respirators; job task such as crawling into a confined or tight spaces, strenuous activity; practicality of environment such as working in the heat, the dirty environment or around chemicals.

Each ear should be fitted separately, because your ear canals may be one another in size and shape.

#### Important factors to consider are:

- Noise levels exposed to
- Communication needs
- Hearing ability
- Physical requirements of job (climbing, bending, lying down)
- Temperature in the workplace
- Use of other PPE
- Physical characteristics of employee (size of ear canals)
- Comfort

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# TOOL BOX TALKS

**SERIES: HEARING PROTECTION**

## HEARING PROTECTION FIT

### MEETING GOALS

At the end of the meeting, employees will be able to tell if their hearing protection is a good fit.

### LESSON CONTENT

A well fit plug or muff provides protection against hazardous noise. Regardless of type, the take away here is make sure it fits properly for you. Do not choose what your buddy is using.

**\*Use whichever one is best for you\***

- The important issue is a good fit with no leaks
- Earplugs must fit snugly in the canal
- Earmuffs must fit snugly against the head

### GOOD FIT IS IMPORTANT

*Sound is like water, and it will slip in through the cracks*

*-- Dr. Lynn Cook*

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# TOOL BOX TALKS

## SERIES: HEARING PROTECTION

### HEARING PROTECTION FIT - FLANGE TYPE EARPLUG

#### MEETING GOALS

At the end of this meeting, employees will be able to determine if they put the flange type earplug in correctly.

#### LESSON CONTENT

Flange type plug

- Handle may be visible from the front.
- Flange should not be sticking out.

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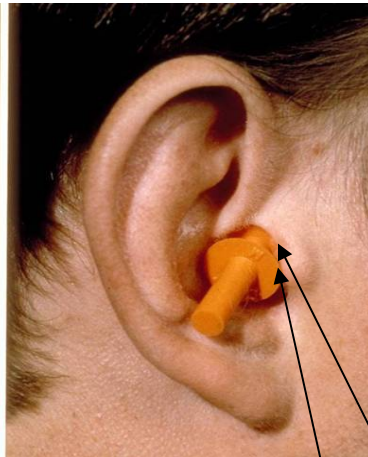
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**CORRECT**



**INCORRECT**



Flange sticking out here.

*Credit: Aearo Technologies, a 3M Company*



# TOOL BOX TALKS

## SERIES: HEARING PROTECTION

### INSERTION OF FOAM EARPLUGS

#### MEETING GOALS

At the end of this meeting, employees will know how to properly insert soft foam earplugs.

#### LESSON CONTENT

##### How to Insert Soft Foam Earplugs

*Use clean hands to keep from getting dirt and germs into your ears!*

**Roll** the earplug up into a small, thin "snake" with your fingers. You can use one or both hands.

**Pull** the top of your ear up and back with your opposite hand to straighten out your ear canal. The rolled up earplug should slide right in.

**Check the fit** when you're all done. If the plug is sticking out of your ear, then it is not fitting properly. Take the earplug out and try again.

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Credit: NIOSH



# TOOL BOX TALKS

**SERIES: HEARING PROTECTION**

## HOW TO TELL IF HEARING PROTECTION IS WORKING

### MEETING GOALS

At the end of this meeting you will be able to check your hearing protection (HP) to tell if it is a good fit.

### LESSON CONTENT

The following are 2 types of tests you can do yourself to check that your HP is fitting properly.

#### Loudness Test

- Insert plug in both ears, cup hands over them and release.
- The earplugs should be blocking enough noise so that covering the ears with your hands results in no significant change in noise level.

### Loudness Check



#### Tug Test (Flange type)

- Tug gently in and out on handle of plug.
- Wearer should feel resistance or suction.

*Credit: Howard Leight by Sperian*

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# TOOL BOX TALKS

**SERIES: HEARING PROTECTION**

## HEARING PROTECTION MYTHS

### MEETING GOALS

At the end of this meeting, employees will know the common myths associated with hearing protection and the truths about them.

### LESSON CONTENT

This graphic can be used to address common worker complaints about hearing protectors, with the following responses:

- Even if you have lost some hearing, it is critical to prevent further hearing loss by wearing hearing protection (HP).
- The ear cannot “get accustomed to noise.” Instead, this may be a sign of a mild hearing loss developing.
- If uncomfortable, find an HP style that is more comfortable for extended wear. A properly-fit HP should feel comfortable for all-day use.
- Earplugs are designed to insert at a safe distance from the eardrum. You will not damage the eardrum by using HP.
- If you suffer from a current ear infection, switch temporarily to an earmuff until the infection heals.
- Users of HP will hear sounds differently (co-workers’ voices, machinery, etc.). But HP reduces the background noise level as well as the signals you want to hear. It may require some adjustment period, but most users find they can still hear the signals they want to hear, even while wearing HP.
- Hearing aids are not a substitute for normal hearing and can not be worn instead of HP. Only HP can prevent hearing loss from noise.

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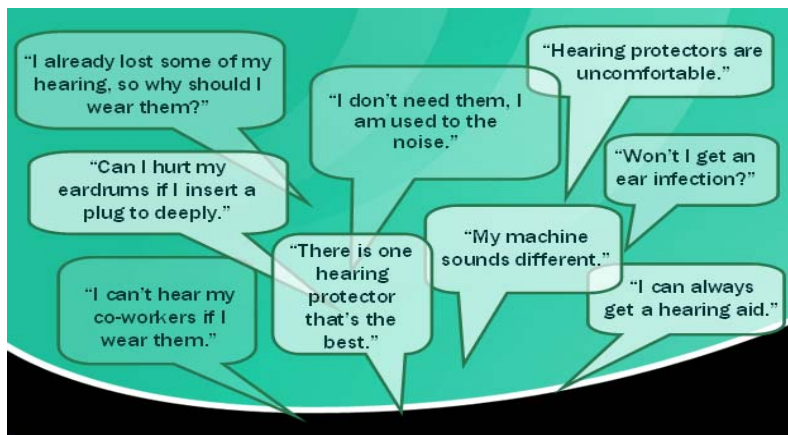
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*Credit: Howard Leight, Hearing Conservation, Bacou-Dalloz Hearing Safety Group; Aearo Technologies, a 3 M Company*





## **SERIES: HEARING PROTECTION**

### **HEARING PROTECTION MYTHS - CONTINUED**

#### *Answers to hearing protection myths*

- ⊙ **Earplugs are too difficult to insert**
  - With practice it becomes easy.
  - The important thing is:
    - You should choose the most comfortable style that YOU WILL WEAR as long as you are exposed to loud noise.
  
- ⊙ **You can poke out your eardrum when inserting the earplug.**
  - Not possible. You do the math:
    - Your ear canal is 1 1/4 inches long.
    - An earplug is about 1/2 to 3/4 inches long.
    - Your ear canal is not straight – makes it hard to get near your eardrum
  - **Don't poke any other object in your ear.**
  
- ⊙ **If earplugs get dirty, my ears can get infected.**
  - Earplugs will not cause an infection, but you should still keep them clean.
  - Clean your hands before inserting earplugs or use plugs with stems that let you insert them without having to touch the part that goes into the ear canal.
    - You may temporarily switch to an earmuff if that style is more comfortable if you have an existing ear infection.
  
- ⊙ **I can't hear warning sounds if I am wearing hearing protectors.**
  - Hearing protectors decrease the noise often making it easier to hear warning sounds.
    - If this is not the case for you, switch to another HP style that will make warning sounds easier to hear.
  
- ⊙ **Hearing protectors will keep me from hearing important machinery and equipment sounds.**
  - If you have normal hearing, you should be able to hear machinery sounds. BUT,
  - HPs may make the sound seem different.
    - If you can't hear your machinery, switch to another HP style that will enable you to hear machine sounds better.
  
- ⊙ **I won't be able to hear others talk when wearing hearing protectors.**
  - Most people wearing HP hear/understand speech just fine. Some don't.
  - If you can't, another HP style will work for you.
    - *You and your co-workers should try talking more loudly and slowly when communicating in noise.*
  
- ⊙ **It takes long time to get used to hearing protectors.**
  - Some people adjust more quickly than others.
  - It is almost like adjusting to a new pair of shoes, or bifocals.

- If HPs are the wrong size or are worn out, they will not be comfortable.
  - Find one that is **comfortable** and works best for you.



## **SERIES: HEARING PROTECTION**

### **HEARING PROTECTION MYTHS - CONTINUED**

#### **⊙ You have to be in noise a long time before it's hazardous.**

- Hearing loss from noise is related to both the loudness of the noise and the length of time you are exposed to the noise.
  - Be sure that you always protect your ears by wearing HP anytime you are around loud noise.

#### **⊙ I can't tell if a noise situation is too loud.**

- If you have to raise your voice to talk to someone who is an arm's length away, *then the noise is too loud.*
- If after leaving a noisy place, your ears are ringing or sounds seem dull or flat, *then the noise is too loud.*
- If after leaving a noisy place, you raise the volume of your radio or CD player when you get back to your car, *then the noise is too loud.*

#### **⊙ Hearing protection won't help me. I already have a hearing loss.**

- HP protects the hearing that you have left.
- Loud noises can continue to damage your hearing making it even more difficult to communicate at work and with your family and friends.

#### **⊙ There is one hearing protector that is the best.**

- The "*best*" hearing protector is the one that **fits well**, is **comfortable**, and **YOU will wear.**



# TOOL BOX TALKS

**SERIES: HEARING PROTECTION**

## HEARING PROTECTION CHECK LIST

### MEETING GOALS

At the end of this meeting, employees will know the key components of hearing protection and will be able to check off each box so that they are confident the program is working for them.

### LESSON CONTENT

#### Hearing Protection (HP) Checklist

- HP used at 90 dB.
- HP used at 85 dB **and** you have a significant threshold shift in hearing.
- Dual HP (muff and ear plug) used above 105 dB.
- HP worn 100% of time in loud noise.
- You are fitted individually for the most appropriate HP for you.
- Your HP is the most **comfortable** for you to wear.
- Your HP selection is based on comfort, convenience, job tasks, communication, noise levels and compatibility with other safety equipment
- You are shown how to use and care for your HP.

\_\_\_\_\_  
Session Date

\_\_\_\_\_  
Supervisor/Instructor

Attendee List:

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