NOISE HAZARDS AWARENESS CURRICULUM

Produced by the
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NOISE HAZARDS AWARENESS CURRICULUM

TABLE OF CONTENTS

Section:

- *Introduction*
- *Noise Reduction and Hearing Conservation Policies*
- *The Impact of Noise on Health*
- *Reducing Noise Hazards at the Worksite*
- *Selection and Use of Hearing Protection Devices*
- *The Role of Audiograms in Hearing Conservation*

Acknowledgments

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AWARENESS CURRICULUM INTRODUCTION

Overview of Curriculum

This curriculum is designed to provide basic awareness information on noise control and hearing conservation. It includes the following:

- Scripts covering five modules:

Topic	Time Allocation
Noise Reduction and Hearing Conservation Policies	5 minutes
Health Effects of Noise	10 minutes
Reducing Noise Hazards	15 minutes
Selection and Use of Hearing Protection	20 minutes
The Role of Audiograms in Hearing Conservation	10 minutes

- A description of the teaching objectives for each module and a description of what participants should be able to do following training;
- Notations in brackets where company or department-specific detail should be added;
- Suggestions for activities to help expand and reinforce the material and skills learned in each section.

Teaching Approach and Methods

The script is designed to guide training, not simply to be read aloud. You should adapt it to your workplace by adding in specific details and policies. Although the curriculum can be used in a basic lecture format if time is limited, a variety of participatory learning activities are included in the script and in the "Suggested Additional Activities" section of each module. In some cases, these activities will require more time than indicated in the list above, but if you can devote the time they will also encourage participation and develop important health and safety skills

The participatory activities include brainstorming, class discussion, and different types of small group exercises. The goal of all these activities is to get students to participate in the class and apply what they learn to their work. Participatory teaching methods are based on the basic principles of adult education theory:

- Adults expect to learn information that is relevant to them and has immediate application to their lives.
- Adults have enormous experience from work and their private lives that should be drawn into the classroom discussion.
- Learning is more interesting when concrete examples are drawn from the actual workplace.
- Adults learn well from each other. A good class set up keeps participants facing each other and working together.
- Adults learn best when they are actively engaged, when they learn by doing.
- Adults want to learn. If the conditions are right, training should be effective and enjoyable.

Class discussion

Class discussion is the most frequently used participatory method in this curriculum. The entire class participates by trying to answer a question. The instructor guides the discussion, exploring the issue with participants but normally not supplying the answer. The instructor also may add background information and further explanation after the question has been answered.

Here are some tips for leading a successful discussion:

- Don't read the answers from the script word-for-word.
- Make the discussion relevant by drawing on examples from students' experience.
- Include all the participants in the discussion. Address the question to the group as a whole first so everyone has a chance to think and respond. Then wait a short time for someone to answer (some educators recommend 4-5 seconds). If no one answers, you might want to call on someone in order to keep the discussion going.
- Feel free to use different (or extra) questions. The more relevant you can make the topic, the more your students will learn.
- Use the board often -- even when the curriculum doesn't specifically tell you to. Make lists. Draw pictures and diagrams.

Brainstorming

Brainstorming is another technique used in the modules. The class is asked to generate as many ideas as possible on a specific topic. With brainstorming, no idea is wrong or stupid; all ideas are encouraged. The instructor records all ideas on the board for everyone to see and discuss.

Small Group Activity

A third technique recommended for this noise hazards curriculum is the small group activity. To conduct any small group activity:

- Break the class into small groups.
- Distribute the handouts which relate to the activity.
- Explain the activity and tell people how long they will have to complete it.
- Ask each group to pick a recorder. Explain that the recorder will be responsible for taking notes and will report later to the whole class on the group's work.
- Have each group go to a separate room, or a separate part of the main classroom, to complete the exercise. After the scheduled time is up, bring the whole class back together.
- Ask the recorder chosen by each group to explain how that group did the activity and solved the problems or answered the questions. Then, ask the whole class to comment. Make sure that there is enough time to discuss why each group came up with its conclusions. Add any information that you think is relevant.

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Health and safety training does not have to be routine and by the book. It should be designed to answer real questions and help people solve problems as well as to achieve compliance. In particular, required annual training tends to be too familiar by the second or third go-around for anyone to take it very seriously. As you use this curriculum, try to adapt it to each group you train, and vary it somewhat year to year. Keep notes of what changes you have tried, and refer to them before you teach again. It is a good idea to have training participants evaluate the content and process of the workshop to help improve it. Keep a list of problems, questions, ideas and solutions that arise over the course of the year and use them to update your training. Take pictures of improvements to illustrate your workshops.

Above all, remember that if the trainer is bored, the trainees will be too. Keep the workshop content and activities interesting for you, and you are more likely to provide effective training.

NOISE REDUCTION AND HEARING CONSERVATION POLICIES

✏ **Teaching Objectives**

- to review company policies

✏ **Learning Objectives**

Participants will be able to:

- name the key person responsible for the hearing conservation program
- describe the role of management, individual workers [and those with specified responsibilities if appropriate] in running a successful hearing conservation program
- state three actions or behaviors he or she is responsible for

✓ **SAY**

The goal of this company's hearing conservation program is to protect all workers from hearing loss and to limit noise to safe levels. Management is committed to providing staff time, funding, and technical support to make this program a success. Employees from all areas are encouraged and expected to participate in this process. Participation means wearing hearing protection where recommended or required, pointing out new or unidentified sources of noise, providing suggestions for improvements, attending training and receiving audiograms as scheduled. Some people have additional responsibilities:

➢ **SHOW OVERHEAD -** ***List of phone numbers and work locations of people with hearing conservation program responsibilities***

✓ **SAY:**

- [Name and title] is responsible for coordinating all hearing conservation program activities.

- These are the names of who to contact with questions, complaints or suggestions about: noise identification and control; audiograms and hearing loss; hearing protection; and training. [If possible, provide names from each shift and department.]

➢ **SHOW OVERHEAD -** ***List of company policies***

✓ **SAY:**

In our facility, we have specific hearing conservation and noise reduction policies that cover the following areas:

- ***How we find out what areas are too noisy***: An initial noise survey, including sound level measurements, has been [will be] carried out throughout the facility. It will be repeated in noisy areas every [describe your schedule here], and wherever work conditions change or noise complaints occur.

- ***What we do to reduce noise exposures*:** Noise will be controlled at the source wherever possible by improving equipment selection and repair, by process improvements and eliminating or enclosing sources of noise.
  [Describe any specific policies not covered in other sections, for example, if you have a policy that sets noise specifications for new equipment purchases and new process development or a plan for replacing noisy equipment and improving noisy processes]

- ***What we do for workers in noisy areas:*** As you will hear later in the session, testing, training and hearing protection are provided and required when noise cannot be eliminated or reduced to a safe level.

- ***How workers' hearing will be tested***: Audiograms are provided to all workers exposed above 85 dBA. [State which other workers, if any, are offered testing.] This process will be described later.

- ***How hearing protection devices are selected, used, maintained and replaced:*** This will also be discussed during this training program. The most important policy item is that hearing protection is required to be worn by everyone exposed at or above 85 dBA and in all noise hazard areas. Hearing protection is available to other workers who request it for work [and home] noise exposures.

- ***What can be done for workers who have trouble hearing:*** Workers who experience hearing loss for any reason – whether or not they are exposed to noise at work – should contact [provide name and phone number here] with any problems or concerns. If needed, this person can help you, or refer you to someone who can help you, with:
  -- further hearing evaluation
  -- work accommodations
  -- temporary or permanent job reassignment
  -- workers' compensation information
  -- hearing protection device selection and use

✓ **SAY**

You can read the complete policy for our hearing conservation program that is in [state where written policy is found]. If you think anything is incorrect, missing or not being carried out as planned, please contact [name of appropriate person] with your ideas.

☞ **ADDITIONAL SUGGESTED ACTIVITIES**

- Ask if anyone has had problems or concerns about any of the areas described.
- If you are training a safety committee or any group likely to want to contribute to program development and implementation, consider breaking into smaller groups at this point to discuss what the policies in each area should cover, what problems they have encountered or expect to encounter, or ideas for implementing an effective program.

Company Policies

Our written policies cover:

- How we find out what areas are too noisy
- What we do to reduce noise exposures
- What we do for workers in noisy areas
- How workers' hearing will be tested
- How hearing protection devices are selected, used, maintained and replaced
- What can be done for workers who experience hearing loss

Contacts

Name

- Overall HCP ☛
- Noise identification and control ☛
- Audiograms and hearing loss ☛
- Hearing protection ☛
- Training ☛

THE IMPACT OF NOISE ON HEALTH

✏ **Teaching Objectives**

- To review how noise causes hearing loss
- To describe other effects of noise in the workplace

✏ **Learning Objectives**

Participants will be able to:

- explain how noise affects hearing
- state three ways noise affects workplace health and safety, other than hearing loss
- describe three other contributors to hearing loss (e.g. aging, specific diseases, off-the-job exposures)

? **ASK**

What is the problem with noise at work? What does it do that is so bad?

✍ **LIST** participants' answers (without criticism), then indicate which you will be covering in this section.

Expected answers:

- *makes people lose their hearing*
- *makes it hard to communicate*
- *is irritating*

✓ **SAY**

Noise is a problem at work mostly because it can cause hearing loss. Noise is the most common cause of hearing loss, and occupational noise is responsible for the majority of noise-induced hearing loss.

➢ **SHOW OVERHEAD - *Terms***

✓ **SAY**

Let's define a few terms before we get started. Technically, noise is a sound wave produced by vibration. Noise is described in terms of:

- amplitude -- the amount of sound, which the ear perceives as loudness. Loudness is measured in decibels. Decibels are calculated on a special scale called a log scale; loudness doubles every three decibels. So 93 decibels is actually twice as loud as 90 decibels.

- frequency and wavelength -- how high or low the sound is, also described as pitch.
- duration -- how long the sound lasts

➢ **SHOW OVERHEAD - *Noise chart***

- For reference, here is a diagram of the levels of noise experienced in various situations.
  - -- A quiet room normally has background noise around 40 dB.
  - -- Conversation or an air conditioner raises the level to 60 dB.
  - -- A car at a 50 feet is louder than conversation.
  - -- Notice that a diesel truck at the same distance is loud enough to cause damage if you're continually exposed. Trucks have been shown to cause hearing loss in drivers who leave the window open -- worse in the left ear than the right.
  - -- Machine exposures routinely produce unsafe levels that are not safe: Milling is 85dB, a newspaper press or a lawnmower is 95 dB, pneumatic equipment gets up to 115 dB.
  - -- Movies and music frequently generate 110 dB. Even a personal stereo headset set above 5 can reach this level, causing damage after regular use for less than fifteen minutes per day.

➢ **SHOW OVERHEAD - *Anatomy of the ear***

✓ **SAY**

- So how does noise lead to hearing loss? This is a picture of the ear. Sound waves travel through the ear canal -- vibrating the ear drum which passes the vibration through the middle ear along to the cochlea -- the snail-shaped part of the inner ear. The tiny hair cells lining the cochlea bend in response to vibration. This transmits a signal to the brain.

- Hearing loss is like taking a shortcut across a lawn. Your feet bend the grass down, and it takes a while for the blades to spring up after you pass. The more you walk, or the more heavily, the longer it takes for the grass to recover. And what happens if you walk over the same shortcut repeatedly, for days or weeks or years? The grass is worn away.

- Just like grass, it takes time for the hair cells to bend back and be able to respond to vibrations again after they have responded to noise. Loud noise forces the hair cells to bend so much they may require quite a lot of time to recover their upright position. The louder the noise or the longer the exposure, the longer the recovery time. The resulting short term hearing loss, called a temporary threshold shift, can last for hours.

- If exposure is severe enough, you may not recover completely before the next work shift begins. People differ in their ability to recover; it is affected by genetics, chemical exposures (including medications), age, and other noise exposures. Permanent hearing loss occurs when the hairs are so damaged they cannot recover, like the grass that has been trampled over too many times.

- Unfortunately, the sounds we rely upon for understanding speech occur in the frequency range most affected by noise. The ear is particularly sensitive to noise, and noise damage, around 4000Hz where consonants like T and S fall. When you cannot hear consonants, even if people "speak up" and increase their overall volume, you cannot understand parts of the words. This is why hearing loss is hard to correct with hearing aids.

? **ASK**

How much noise is too much?

✓ **SAY**

- OSHA restricts noise exposure to 90 dB(A), averaged over an eight hour workday. Other experts believe that 85 dB is loud enough to cause permanent damage after long-term exposure during an eight-hour work day. Some very sensitive people may lose hearing if regularly exposed to less than 85 dB(A).

- OSHA requires employers to cut the exposure time in half with every five decibels of increased noise. However, noise intensity actually doubles with every three decibels, so National Institute for Occupational Safety and Health recommends that exposure time be halved with every three decibels. Even one second of noise exposure around 140 dB can cause permanent damage.

? **ASK**

Some would argue that we'll all lose our hearing eventually, so why bother about noise?

✓ **SAY**

- While many people lose some hearing as they age, noise greatly increases the risk of hearing loss at all ages. Approximately one-third of the 20 million cases of hearing impairment in the American population are attributed to noise. And according to NIOSH, occupational noise exposure is the most common cause of noise-induced hearing loss.

- Of course, occupational noise is not the only cause of hearing loss.

? **ASK**

What off-the-job noise exposures also contribute to hearing loss?

Expected answers:

- *target shooting and sometimes hunting*
- *listening to loud music – concerts, stereos or through earphones*
- *using power tools*
- *using powered lawnmowers*
- *seeing movies in movie theaters*
- *frequent travel in airplanes*

✓ **SAY**

- If you spend a significant amount of time doing any of these noisy off-the-job activities, hearing protection should be used. Also, equipment maintenance and regular audiograms are recommended, just as for work exposures.

? **ASK**

What else can lead to hearing loss besides noise?

➢ **SHOW OVERHEAD - *Other causes of hearing loss***

✓ **SAY**

A few chemicals found in the industrial environment can damage hearing. Workers exposed to both chemicals and noise may be at higher risk. Some medicinal drugs can cause hearing loss. Infections and brain tumors can affect hearing by damaging the inner ear, the acoustic nerve, or the brain. Injuries to the head or ear may also cause hearing loss.

? **ASK**

Do you think noise affects your health in any other way?

➢ **SHOW OVERHEAD - *Other health effects***

✓ **SAY**

- Noise as low as 75 dB may also contribute to health problems.
  - -- The body can respond to excessive noise with increased muscle tension, breathing rates and heart beat, and constriction of the blood vessels. The response is similar to a startle or stress response.
  - -- Noise exposure may lead to longer-lasting changes in a worker's blood pressure, blood cholesterol, stomach lining or immune function.
  - -- The long-term effect of noise on health has not been completely determined.

- Finally, noise is also a problem because:
  - -- it can create serious safety hazards by masking alarms and other warning sounds;
  - -- it can discourage communication between workers because shouting is hard to do and hard to listen to; and
  - -- noise makes it harder for people with hearing loss to get information from the sounds frequencies that they can hear.

✓ SAY

- Many people do not take potential hearing loss seriously. It is true that hearing loss doesn't kill you but hearing loss can be very traumatic. It interferes with family life, social exchanges, the enjoyment of music and other important activities. It can contribute to depression and emotional conflicts.

- The bottom line is that repeated or prolonged exposure to noise can **permanently** damage hearing and cause other harmful effects. The best way to prevent all the hazards caused by noise is to reduce noise in the work environment. The best way to protect your hearing from any remaining noise is to wear well-fitted and well-maintained hearing protection that suits your exposure level and work activities. Noise reduction and hearing protection will be discussed in the next sections of this training.

☞ ADDITIONAL SUGGESTED ACTIVITIES

- Play a tape that simulates hearing loss.
- Invite a person with work-related hearing loss to speak to the group about how their hearing loss has affected their life at work and at home.

Noise terms

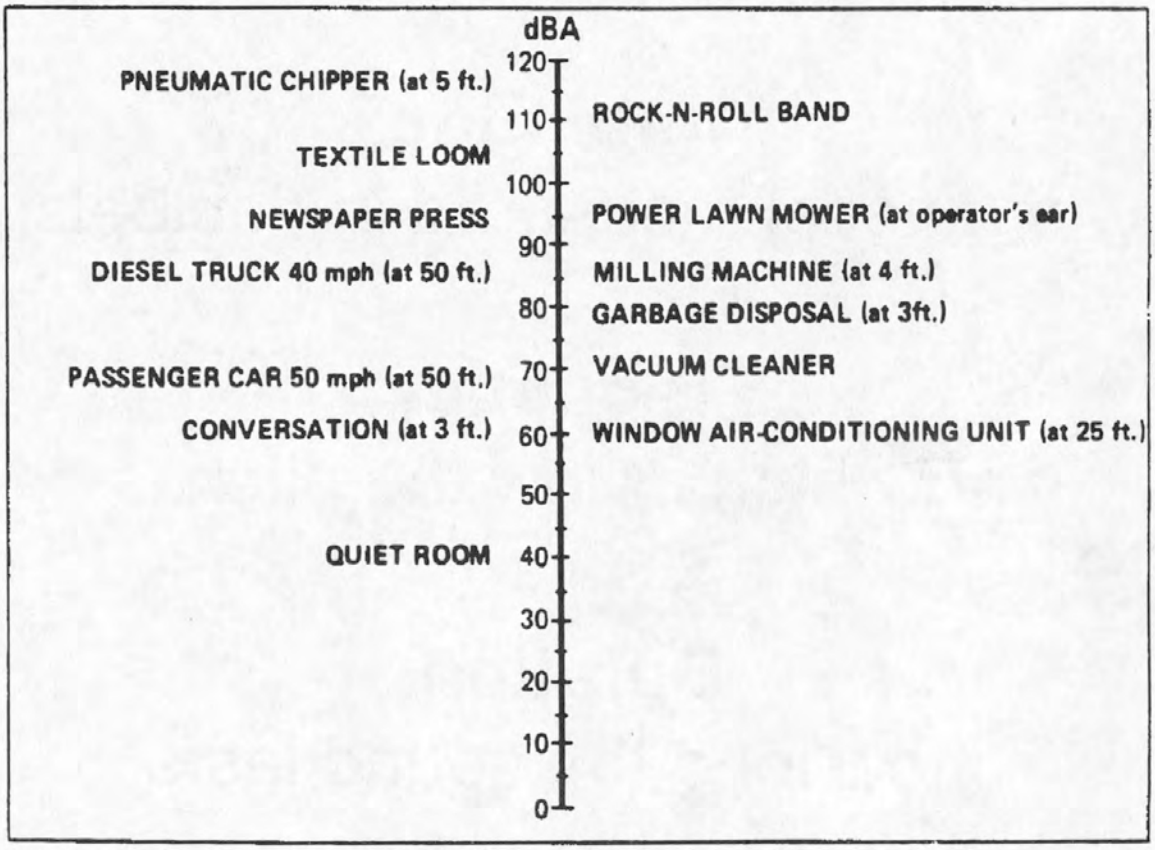
Amplitude:
loudness, measured in decibels

Frequency:
how high or low the pitch is

Duration:
how long the sound lasts

Sound intensities

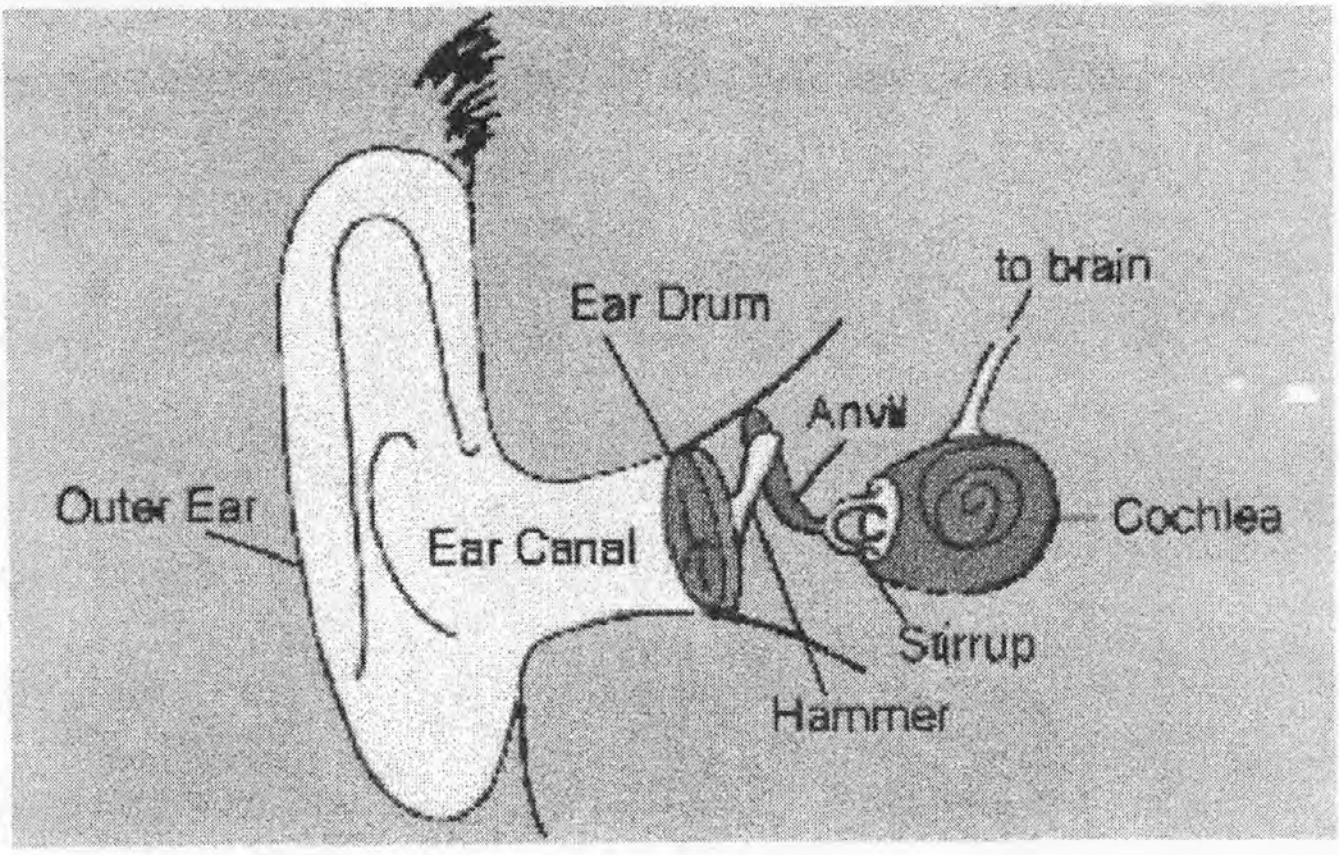
FIGURE 1. Typical A-weighted noise levels in decibels (dBA)*



*The decibel is a logarithmic measure of sound intensity; the "A-weighted scale" is used to weight the various frequency components of the noise to approximate the response of the human ear.

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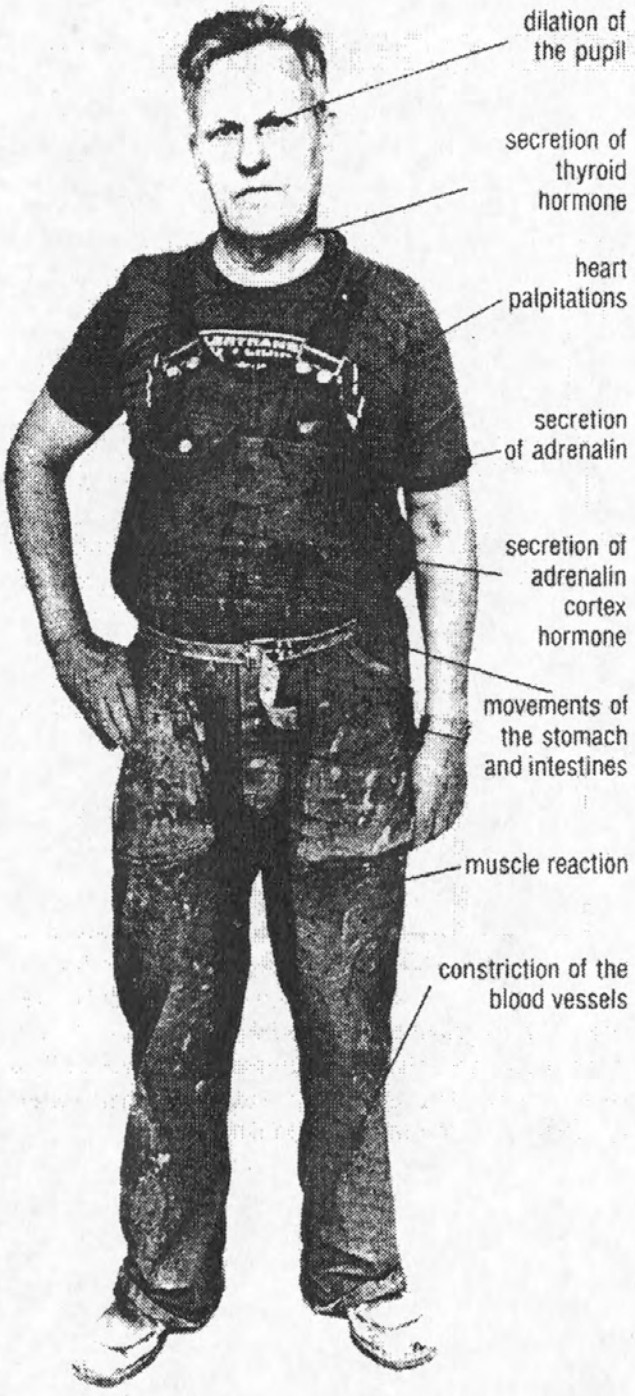
Ear


to brain
Ear Drum
Anvil
Outer Ear
Ear Canal
Cochlea
Stirrup
Hammer

Other causes of hearing loss

- Chemicals
- Diseases
- Injuries

Other effects



REDUCING NOISE HAZARDS AT THE WORKSITE

✏ **Teaching Objectives:**
- Review types of engineering and administrative controls

✏ **Learning Objectives**:
- describe at least one engineering control method to reduce noise at the source
- describe at least one engineering control method to reduce noise along the pathway
- describe at least one engineering control method to reduce noise at the receiver
- explain at least one administrative control to reduce noise
- state the company plans for reducing noise

? **ASK**

Do you think you're exposed to hazardous levels of noise here at work?

Expected answers:
- *It must be hazardous because I have to wear hearing protection*
- *It's probably over 85 dBA*
- *In some areas it's really loud*
- *Not at work, but at home*

✓ **SAY**
- We do have some areas in our facility where the noise levels are considered hazardous. You might have seen [name people involved in taking noise measurements] taking noise measurements. To make it easier for you to see where the problem areas are, we have used the information collected to develop a noise hazard map of the entire facility. [Review the noise hazard map.]

- Keep in mind, even if a workplace is not noisy enough to present a risk for hearing loss, there may be enough noise to cause safety or communication problems. We've also marked these areas on the map.

➢ **SHOW OVERHEAD** - ***Noise measurements for the group of participants***

✓ **SAY**
- As you can see, the level of noise in your [department or work area] is [state levels of noise measured, area and personal noise measurements].

- According to OSHA, when workers' daily noise exposures are at or above 90 dBA, employers have to take action to try to reduce noise levels by using engineering or administrative controls. But many experts, such as NIOSH, recommend controls be implemented when workers are exposed to levels at or above 85 dBA - which is significantly lower than OSHA's requirement. At our facility, we are following the NIOSH guidelines.

➢ **SHOW OVERHEAD - *Engineering and administrative noise control definitions***

? **ASK**
What are noise controls?

✓ **SAY**
NIOSH defines **engineering controls** as "any modification or replacement of equipment, or related physical change at the noise source or along the transmission path that reduces the noise level at the employee's ear." **Administrative controls** are defined as any change in work assignment, production schedules or policy decisions that reduce workers' noise exposures.

➢ **SHOW OVERHEAD - *Source/path/receiver***

✓ **SAY**
Simply put, we can reduce workers' noise exposures by making engineering or administrative changes at the noise source, along the pathway, or at the worker.

What we'll do now is discuss these approaches to noise control in more detail. Then we'll talk about the types of controls we are working on [or have already put into place] in our facility.

✓ **SAY**
The best method of controlling a noise problem is to minimize the noise at the source.

➢ **SHOW OVERHEAD - *List of noise controls at the source***

✓ **SAY**

- When attempting to control noise at the source, you can look at ways to replace or modify equipment, processes or materials and at ways to reduce vibration. You can also set up a maintenance program that regularly checks equipment. to repair or replace worn, loose or unbalanced parts of machine. Enforcing a "buy quiet" equipment purchase policy for any new equipment or when modifying existing equipment also helps reduce noise at the source.

- Let's go over some specific examples. A process can be made less noisy by replacing hydraulic presses for mechanical pressses.

➢ **SHOW OVERHEAD** - ***Example of quieter process (substituting pliers for hammer)*** [Ideally, use an example from your facility.]

✓ **SAY**

A simple example of a quieter process, shown in this overhead slide, is to use a pair of pliers to bend a strip of metal rather than using a hammer.

Replacing steel tires with rubber tires is an example of using a quieter material to reduce noise.

➢ **SHOW OVERHEAD** - ***Example of vibration isolation*** [Ideally, use an example from your facility.]

✓ **SAY**

Reducing vibration can also reduce excessive noise at the source. A vibration isolator is an elastic material which supports the vibrating machine and isolates it from the surrounding structure. This example shows how either the machine or the working area can be vibration isolated with the use of heavy springs.

➢ **SHOW OVERHEAD** - ***Vibration isolation materials*** [Ideally, use an example from your facility.]

✓ **SAY**

Vibration isolators are made of various materials and come in various shapes. Vibration isolation materials can be applied to the linings of tumbling barrels, chutes and hoppers.

? **ASK**

How do you think noise can be reduced along the pathway?

Expected answers:

- *don't let the sound get from the machine to the worker*
- *put up some partitions*

➢ **SHOW OVERHEAD** - ***List of control of noise along the pathway***

✓ **SAY**

There are several ways to reduce noise along the path. They include:

- Increasing the distance between the source and the receiver
- Enclosing the noise source
- Interrupting the path or reduce reverberation

➢ **SHOW OVERHEAD** - ***Example of enclosing the noise source*** *[or show your own]*

✓ **SAY**

An enclosure around a machine might look like this. The enclosure will reduce the amount of noise that can radiate from the source.

➢ **SHOW OVERHEAD** - ***Example of shields and absorbing baffles*** *[or show your own]*

✓ **SAY**

This overhead slide shows how a partial enclosure can be used to reduce noise. In this example, high frequency noise is traveling directly form the high-speed riveting machine to the worker's ears. The solution was to partially enclose the riveting machine. The hood is coated on the inside with sound-absorbing material. The upper portion of the opening is covered with safety glass. As sound starts towards the ears, the glass reflects it against the sound-absorbing walls, which reduces the sound level at the operator.

? **ASK**

Do you have any ideas how to reduce noise at the worker?

➢ **SHOW OVERHEAD** - ***List of noise controls at the worker***

✓ **SAY**

Controlling noise at the worker can be done by:

- enclosing the worker
- changing the work schedule or operations to reduce workers' noise exposure such as conducting a noisy operation over a period of a week, rather than one day
- transferring workers from noisy jobs to quieter jobs, but not at the expense of exposing more workers to hazardous noise levels
- providing quiet areas where workers can gain relief from workplace noise

➢ **SHOW OVERHEAD** - ***Example of enclosing the worker***

✓ **SAY**

You can reduce the workers' noise exposure by building an enclosure around the worker, such as a control booth. Although the noise levels from the machine have not changed, soundproof booths will prevent the noise from reaching the worker. All outlets must be sealed to prevent noise from entering the enclosure.

? **ASK**

What is the least effective way of reducing noise exposure?

✓ **SAY**

Hearing protection devices should be used only as a last resort. As you'll soon learn, proper selection, use and care of HPDs is not simple. It also takes a lot of work on your part to make sure you're wearing your HPDs properly and consistently. It's much easier if we make sure that there isn't a noise problem to begin with.

Keep in mind, our policy here is to first choose engineering and administrative controls that will reduce or eliminate noise -- such as buying quieter machines or changing processes -- rather than those that simply reduce the workers' time spent in noisy areas.

➢ **SHOW OVERHEAD -** ***Engineering and administrative controls implemented or planned***

✓ **SAY**

As you saw on the hazard map we showed you earlier, the level of noise you are exposed to in [describe the work area or department] is [state levels of noise measured, area and personal noise measurements].

That is why we have planned and implemented [or are in the process of planning and implementing] engineering and administrative controls in your area. Listed on the overhead are some of the engineering and administrative controls we have used [or plan to use].

✓ **ASK**

Now that we know a little more about engineering controls, does anyone have any suggestions for controlling noise in our facility?

✍ **LIST** (on a blank overhead slide or on a flipchart) what participants say.

✓ **SAY**

We will bring your ideas to the attention of [name of person in charge of this area] and will get back to you as soon as possible. [if possible, specify the state date].

☞ SUGGESTED ACTIVITIES

- Break participants into small groups and have them make a noise hazard map based on their own experience. The noise hazards could be related to potential for hearing loss, safety concerns, or stress. Participants then compare their noise map to the company noise map and discuss any discrepancies.
- Ask participants for suggestions on noisy areas to target and about ways to solve problems that still exist.
- Participants create hazard maps of their off-the-job exposures and discuss possible controls.
- Participants practice applying noise control methods and using sound level meters. Participants are given noise generating devices (alarm clocks, buzzers or bells) along with materials to control noise (boxes, foam, bubble wrap). Participants are asked to take noise measurements of the devices before and after implementing engineering controls.

Noise Survey Results

- [area #1 = xxx]
- [area #2 = xxx]
- [area #3 = xxx]

- TWA for [job classification A = xx]
- TWA for [job classification A = xx]
- TWA for [job classification A = xx]

Noise Controls

- **Engineering Controls** - any equipment modification, replacement or physical change at the noise source or along the path that reduces the noise level at the worker's ear

- **Administrative Controls** - any change in work assignment, production schedules or policy decisions that reduce noise exposure

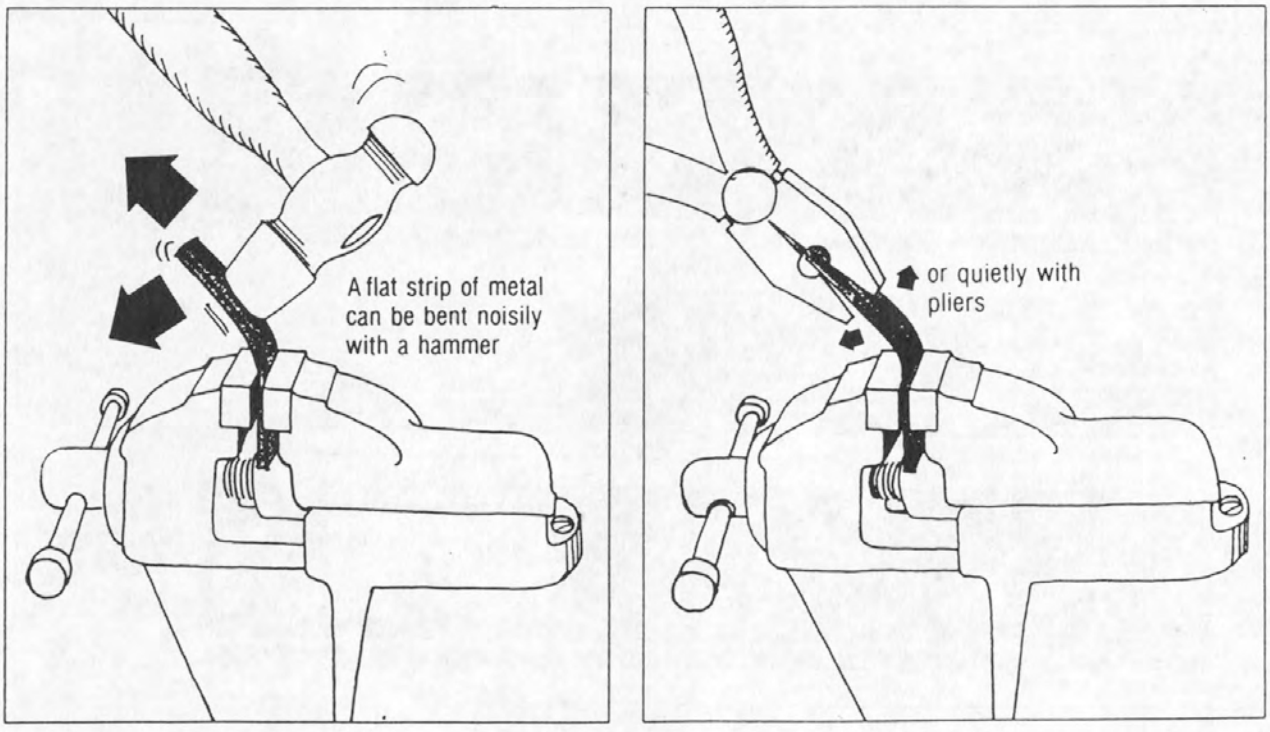
Controlling Noise

- Source
- Path
- Receiver

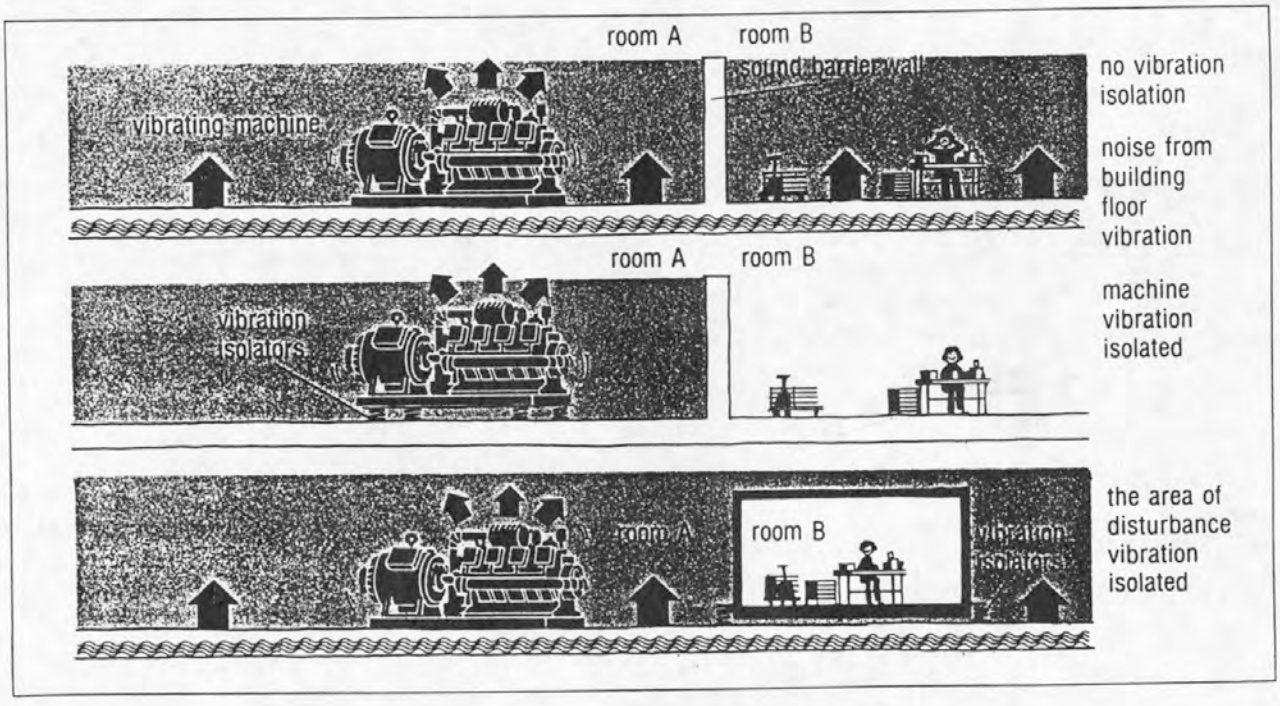
Noise Controls: Source

- Replace or modify
  - equipment
  - process
  - materials
- Reduce vibration
- Schedule regular maintenance and repair
- Establish "buy quiet" policy

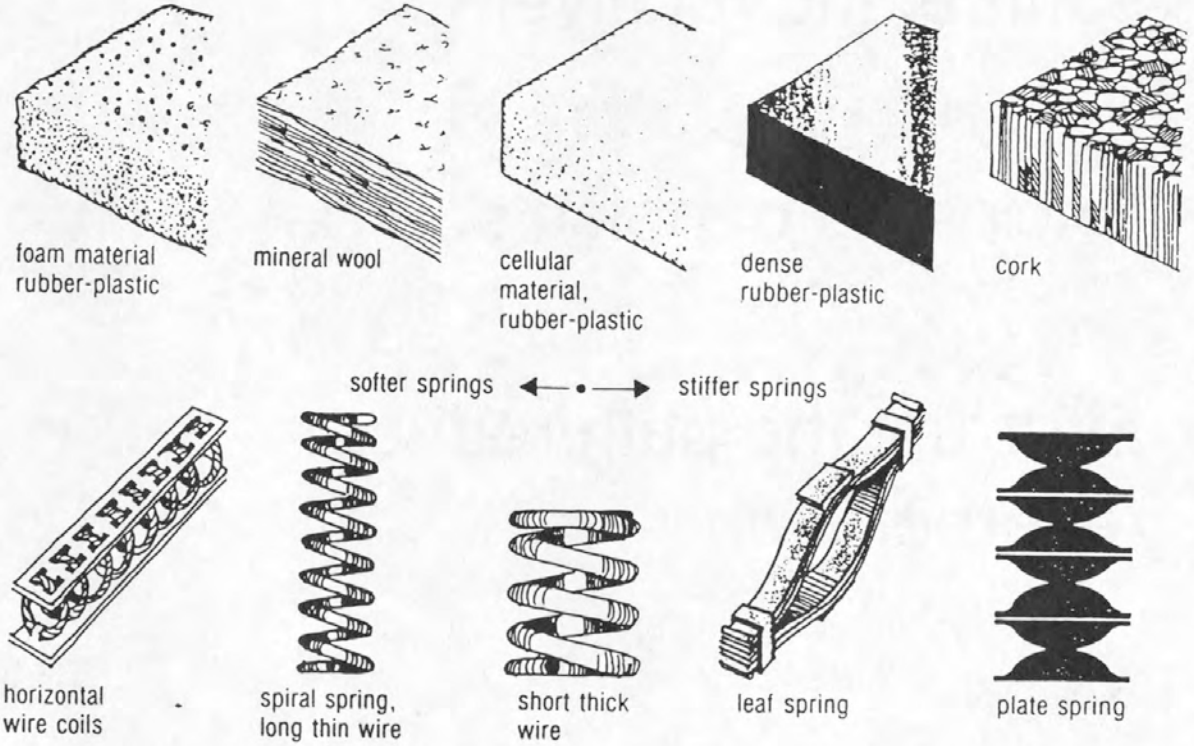
Noise Controls: Source



Noise Controls: Source



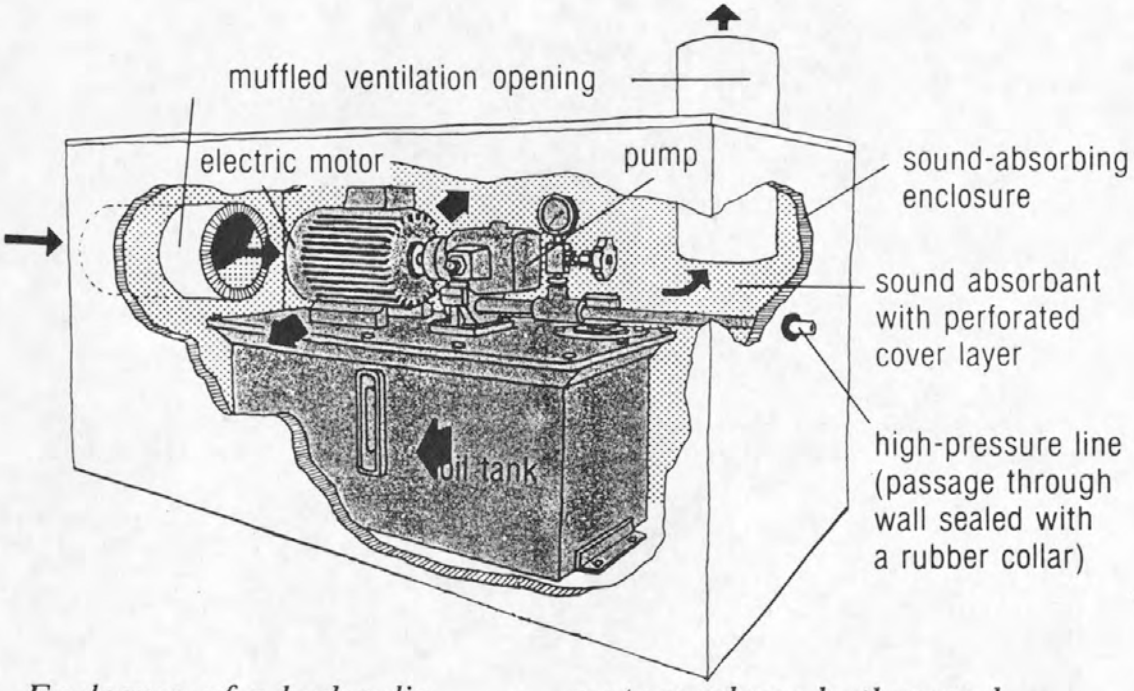
Noise Controls: Source



Noise Controls: Path

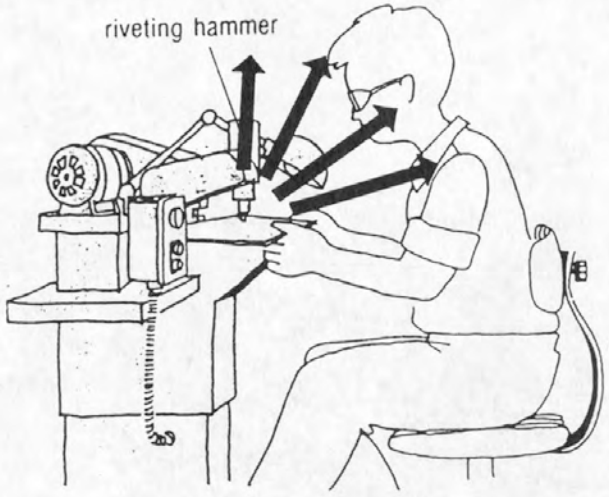
- Increase distance between source and receiver
- Enclosure of noise source
- Interrupt the path/reduce reverberation

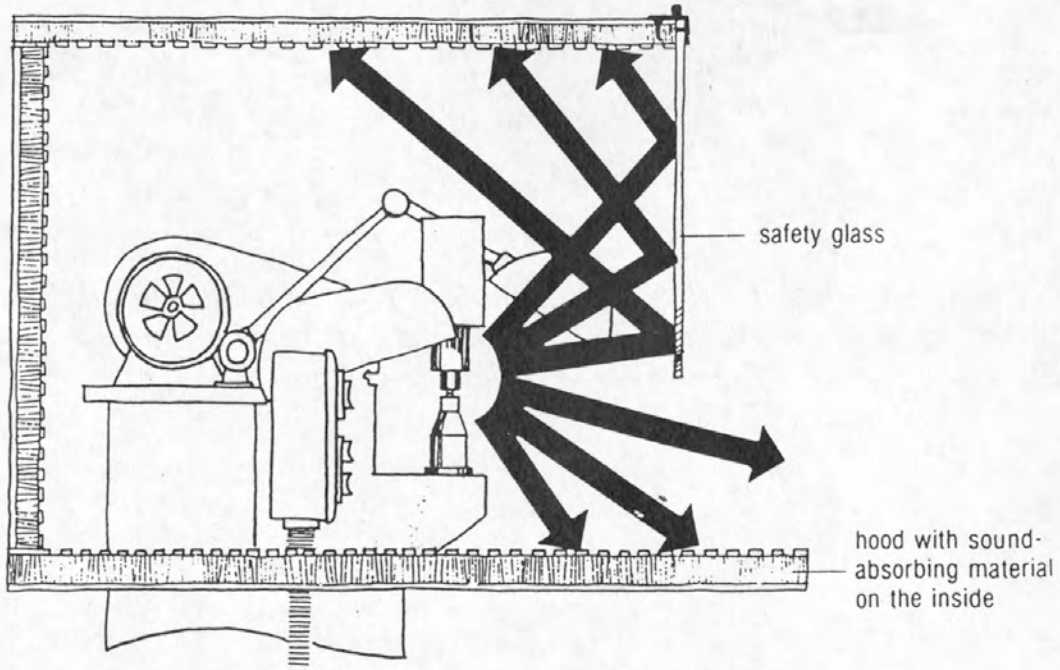
Noise Controls: Path



Enclosure of a hydraulic system requires muffled ventilation openings. Electric motors release both sound and heat, as do the pump and the oil tank.

Noise Controls: Path

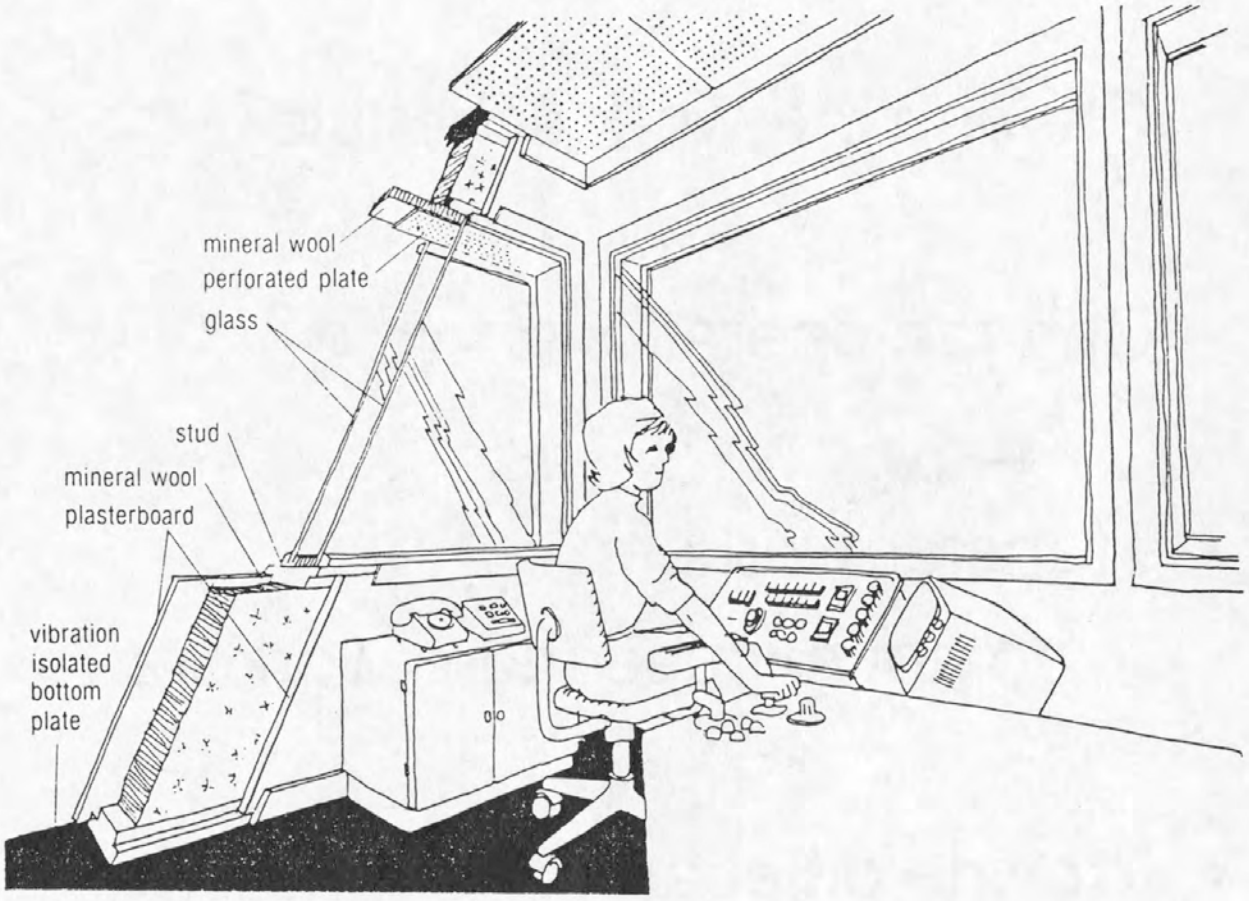




Noise Control: Worker

- Enclose worker
- Change the work schedule
- Change operations
- Transfer workers
  - do not expose more workers
- Provide quiet areas for breaks and meals

Noise Control: Worker



Our Plans for Reducing Noise

- What we have implemented
  - [xxxx]
  - [xxx]
  - [xxx]
  - [xxx]
- What we are planning
  - [xxx]
  - [xxx]
  - [xxx]
  - [xxx]

SELECTION AND USE OF HEARING PROTECTION DEVICES

✏ **Teaching Objectives**

- explain the benefit of wearing hearing protection devices
- review the company method for selecting hearing protection devices
- discuss the proper use and care of hearing protection devices and common problems associated with their use

✏ **Learning Objectives**

Participants will be able to:

- describe the purpose of hearing protectors
- list the choice of hearing protection devices (HPDs) available to them
- describe the advantages and disadvantages of each type of HPD
- explain the method used in selecting their department's choices of HPDs
- demonstrate the proper use and care of their hearing protectors

? **ASK:**

When do think you should wear hearing protection?

✍ **LIST** (on a blank overhead slide or on a flipchart) what participants say.

Expected answers:

- *when I run a noisy machine*
- *at work*
- *in certain areas of work where noise is a problem*

✓ **SAY**

- Any time noise levels are at or above 85 dBA, you are at risk for hearing loss. The more time you are exposed to high noise levels, the greater your chance of developing permanent hearing loss. Simply put, whenever you have to shout to be heard you are most likely being exposed to 85 dBA. Because the effects of noise accumulate, you need to reduce your exposure to high levels of noise both on and off the job.

- Ideally, the best way to keep you from being exposed to noise is through the use of engineering controls. For example, we've been able to reduce the noise [add where and which type of engineering control was used]. Because engineering and administrative controls have not reduced the levels below 85 dBA in your area, you need to wear hearing protection devices. Remember, to be adequately protected, you must wear your HPDs **properly** and **consistently**.

- Based on the noise levels we've measured throughout the facility, you'll need to wear hearing protection [state where or when hearing protection is required to be worn and if wearing HPDs is a condition of employment]. [name] is in charge of this part of the hearing protection component of our hearing conservation program.

? **ASK**
What do you think keeps people from wearing hearing protection devices?

✍ **LIST** (on a blank overhead slide or on a flipchart) what participants say, then add ideas that participants do not volunteer.

Expected answers:
- *you can't hear people speaking*
- *I can't hear my machine*
- *HPDs are really uncomfortable*
- *I'm used to the noise, I don't need to wear protection*
- *they're difficult to use*
- *it's too much of a hassle to go get them*

✓ **SAY**
As you can see, selecting, using and caring for hearing protectors is not so simple. In this training, we will tell you how our facility's hearing protection program has addressed the issues that you have just raised. Let's start by talking about hearing protection devices in more detail.

✓ **SAY**
- Hearing protectors come in a variety of styles and models. Let's go over the main types of hearing protectors that are available. [Demonstrate each type you talk about.]

- The three main types of hearing protectors you can choose from are:
  -- earplugs
  -- ear canal caps (semi-inserts)
  -- earmuffs

- [OPTIONAL: There are also more specialized HPDs available, such as custom molded ear plugs, electronic-based HPDs and noise cancellation HPDs. Electronic HPDs consist of earmuffs with electronics built in to take either outside sounds or radio communication and electronically limit the level on the inside of the muff cup to a safe value. Noise cancellation HPDs use sound sensors, amplifiers and speakers to generate "anti-noise" or cancellation wave patterns to reduce the noise inside the earcup.]

- All hearing protection devices reduce the amount of noise reaching the ear. For each type of device, there are a lot of options. HPDs differ in design, the size, shape and material used, and how much they can reduce noise. HPDs also vary in terms of how much they reduce noise at specific frequencies.

➢ **SHOW OVERHEAD** - ***Advantages and disadvantages of different types of HPDs***

✓ **SAY**

To review the general characteristics, advantages and disadvantage of the various HPDs available, let's review the next overhead slide.

Type of Earplug	Attenuation	Advantages	Disadvantages
Earplugs	• more protection at 125 Hz than muffs • varied NRRs	• inexpensive • readily available • come in a variety of styles • some can be cleaned and reused • can be custom molded (is more expensive) • linear attenuation models are available	• require clean fingers • proper insertion takes time and training
Semi-aural caps	• varied NRRs	• can be easy to insert • various styles • clean fingers are not required • many repeat usages • good for people going in and out of noisy areas	• not always properly inserted • additional cost • typically lower NRRs
Muffs	• more protection at 500 - 8000 Hz than earplugs • varied NRRs	• can be dedicated to work area • last much longer • easy to see on workers • can be fitted on hard hat • can be radio-equipped • linear attenuation models are available	• higher cost • cannot be used with glasses (breaks the seal) • not usually comfortable in hot, humid environments

✓ **SAY**

In general, earplugs reduce noise more than earmuffs at the lowest frequencies (125 hertz), whereas in the 500-8000 Hz range, ear muffs reduce noise more. HPDs that reduce noise equally in all the frequency bands are called "linear," "musician's earplugs," or "flat attenuation" devices. Earmuffs and earplugs models that provide linear reduction are available. Linear HPDs are useful for workers with preexisting hearing loss. Remember, workers with hearing loss have problems hearing the speech frequencies. Communication is more difficult when wearing non-linear HPDs, because these HPDs reduce sound levels in the speech frequencies to below what workers with hearing loss can hear.

➢ **SHOW OVERHEAD** - ***Noise survey results for group participants***

✓ **SAY**

- To determine what type of hearing protection device to use in the various areas of the facility, the noise survey results were reviewed.

NOTE TO TRAINER: If this section of the training is done immediately following the Reducing Noise Hazards section, do not repeat the review of the noise survey results. If this section of the training is done after significant time has elapsed since participants have been through the Reducing Noise Hazards section, say "The results of the noise survey for this [department, job classification] are [review results]."

- Based on this information, we made sure the initial choices of HPDs had Noise Reduction Ratings (NRR) protective enough for your work environment. The NRR is the amount of protection the manufacturer says their hearing protectors can provide.

➢ **SHOW OVERHEAD** - ***calculation using laboratory-based NRR vs. real-world NRR***

NOTE TO TRAINER: The following is an example of how to calculate the real-world NRR using an E-A-R ultrafit earplug.

✓ **SAY**

- For example, [the E-A-R ultrafit] has an NRR of 21 dB. This means that if you wear this type of HPD in a work area where the noise levels were measured at 98 dBA, your exposure would be reduced to 77 dBA. This sounds great, but this is the ideal situation. In the real world, HPD reduction (also called attenuation) is a lot less.

- To make sure that our HPD choices would really protect you enough, we used the OSHA method for estimating real world attenuation. In this method, 7 is subtracted from the NRR, the remainder is then divided by 2 to get the real-world attenuation. Using the example of the E-A-R ultrafit, the real-world attenuation would be 7dB (21 -7/ 2), not 21 dB. In other words, if you are exposed to 98 dBA and wear this hearing protector, your actual exposure will be 91 dBA not 77 dBA. Therefore, the actual exposure is above both the OSHA permissible exposure limit and the exposure limit recommended by NIOSH.

NOTE TO TRAINER: You may want to use the NIOSH recommended method for estimating real-world attenuation. This is summarized in Chapter 6 of the *NIOSH Criteria for a Recommended Standard: Occupational Noise Exposure*, 1998.

✓ **SAY**

- To narrow down the choices we:
  - -- reviewed the various areas in our facility to make sure problems would not come up with the use of any particular type of HPD (for example, communication, heat, humidity or dust in the environment]
  - -- based the final selection on comfort, convenience, ease of fit
    - --- we met with several co-workers and asked for their feedback on what HPDs they found were comfortable, easy to fit & convenient to use
- The specific types and models we offer are:
  - -- three earplugs [specify which]
  - -- two earmuffs [specify which]
  - -- one semi-aural [specify which]
- [state any department or job specific recommendations or restrictions]

➢ **SHOW OVERHEAD** - ***Fit, use and care of HPDs***

✓ **SAY**

- When it comes to the fit, use and care of HPDs
  - -- your initial HPD fitting and training will be done by [specify name of a trained person]
  - -- your HPD fit will be rechecked by the audiometric technician at the time of each annual audiogram
  - -- remember to fit and adjust your HPDs before and during the work shift.
  - -- review the manufacturer's instruction for use and care of your HPDs [specify]
  - -- for replacement HPDs you'll need to see [specify]

✓ **SAY**

- As we found out in the health effects section of this training, you need to wear hearing protection any time you are exposed to high levels of noise -- including exposures at home.

- If you need to use hearing protection off-the-job see [name person]. He/she will help you with the appropriate type of HPD.

? **ASK**

Are there any questions, comments or suggestions?

☞ **ADDITIONAL SUGGESTED ACTIVITIES**

- Break into teams of two. Have workers demonstrate to each other how to put on hearing protectors and check for fit.
- Break into small groups. Have each group discuss what keeps workers from wearing HPDs and identify solutions. Then have the small groups report their solutions to the entire group.

Types of HPDs

- Earplugs
- Semi-aural (Ear Canal Caps)
- Earmuffs

Earplugs

Attenuation	Advantages	Disadvantages
• more protection at 125 Hz than muffs • linear • varied NRRs	• inexpensive • readily available • come in a variety of styles • some can be cleaned and reused • can be custom molded (more expensive)	• require clean fingers • proper insertion takes time and training

Semi-aural Caps

Attenuation	Advantages	Disadvantages
• varied NRRs	• can be easy to insert • various styles • clean fingers are not required • many repeat usages • good for people going in and out of noisy areas	• not always properly inserted • additional cost • typically lower NRRs

Earmuffs

Attenuation	Advantages	Disadvantages
• more protection at 500 - 8000 Hz than earplugs • NRRs vary widely	• can be dedicate to area • last much longer • easy to see on workers • can be fitted on hard hat • can be radio-equipped	• higher cost • cannot be used with glasses (breaks the seal) • not usually comfortable in hot, humid environments

Noise Survey Results

- [area #1 = xxx]
- [area #2 = xxx]
- [area #3 = xxx]

- TWA for [job classification A = xx]
- TWA for [job classification A = xx]
- TWA for [job classification A = xx]

Laboratory vs. Real-World NRR

Laboratory NRR		Real-World NRR	
TWA measured using a dosimeter	98 dBA	TWA measured using a dosimeter	98 dBA
NRR of E-A-R Ultrafit	21 dB	NRR of E-A-R Ultrafit	21 dB
Formula = worker's TWA - NRR		Formula = worker's TWA - (NRR-7)/2	
Laboratory estimated worker's TWA wearing E-A-R Ultrafit	98 dBA - 21 **= 77 dBA**	Real-world estimated worker's TWA wearing E-A-R Ultrafit	98 dBA- (21-7/2) 98 dBA - (14/2) 98 dBA - 7 **= 91 dBA**

Fit, Use & Care Of HPDs

- Initial fitting & training is done by [name]
- Fit is rechecked at annual audiogram
- Fit & adjust your HPDs before & during work shift
- Review manufacturer's instructions
- See [name] for replacements & off-the-job needs

THE ROLE OF AUDIOGRAMS IN HEARING CONSERVATION

✏ **Teaching Objectives:**

- To explain the role of audiometric testing in preventing hearing loss
- To describe audiometric testing procedures
- To discuss the interpretation and implications of test results

✏ **Learning Objectives:**

Participants will be able to:

- state the purpose of hearing (audiometric) testing
- explain when audiograms will be give
- describe hearing test procedures
- describe what hearing loss looks like on an audiogram (normal, noise-induced, aging)
- describe follow up activities that should take place when hearing loss occurs

? **ASK**

Why do you think audiometric testing is important?

✍ **LIST** participants' answers (without criticism), then indicate which you will be covering in this section.

Expected answers:

- *so we'll know if we can hear okay*
- *checking our hearing every year can tell us if we're loosing our hearing*
- *OSHA says we have to get it*

✓ **SAY**

- Hearing tests are the only way to tell for sure that a hearing conservation program is working. Because occupational hearing loss occurs gradually, we often do not notice a change in hearing ability until a relatively large loss has occurred. Comparing annual hearing tests tells us early on if any workers are developing mild hearing losses. We can then do something to prevent further losses. For example, we can evaluate and improve engineering controls, refit hearing protectors, find out if off-the-job activities are the cause of the hearing loss, or retrain workers, so that no one suffers additional hearing loss.

? **ASK**

When are audiograms given?

➢ **SHOW OVERHEAD - *When audiometric testing is done***

✓ **SAY**

- All workers will be given baseline audiograms as part of their pre-employment medical examination. We give hearing tests to all employees for two reasons: One reason is that it is a good idea for everyone to monitor their hearing. The second reason is to compare the audiograms of the workers who work in noisy areas to those that work in quieter areas. If our hearing conservation program is effective, then the audiograms should be the same -- no hearing loss in either group.

- Annual audiograms will be given to workers who are exposed to 85 dBA or more for an 8-hour shift, for as long as they work in the noisy environment. This group of workers will be individually fitted with hearing protection devices by [name of person responsible for fitting HPDs]. If workers are assigned to areas where noise levels are less than 85 dBA, they will be given follow-up audiograms every 2-3 years.

- If an annual audiogram shows hearing loss compared to the baseline, a retest is done immediately. If the results are the same then the confirmation audiogram is scheduled within 30 days.

- Exit audiograms will be given to workers when they leave a noisy job or leave the company.

[OPTIONAL: Workers assigned to areas where the noise levels are 100 dBA or more will get their hearing tested twice a year just to make sure their hearing protection is adequate. Research has shown that the most susceptible 10% of a population exposed to daily average noise levels of 100 dBA with inadequate hearing protection could develop significant hearing loss well before the end of one year.]

? **ASK**

What is the actual hearing test procedure?

NOTE TO TRAINER: If participants have already had a baseline audiogram at the time of training, change the language of this section to the past tense. For example, say "As you remember, the audiometeric technician first took your noise exposure history, etc.]

✓ **SAY**

- The testing procedure is the same any time an audiogram is given. At the time of the testing, an audiometric technician will:
  - -- get your noise exposure history information
  - -- check your HPD for its fit and condition
  - -- instruct you on how to take the test
  - -- explain your results to you

- The technician will seat you in an audiometric test booth and fit you with a set of earphones. Your hearing is tested with an audiometer which sends audio signals in different frequencies through the earphones. Your hearing will be tested in seven different frequencies: 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hertz.

➢ **SHOW OVERHEAD - *Sample audiogram***

- You'll respond when you can first hear the sound generated by the audiometer. The softest sound you can hear at a specific frequency is called the hearing threshold for that frequency. The hearing threshold for each frequency that is tested is plotted on an audiogram that looks like this.

- The graph is similar to a piano keyboard with low to high frequencies (or pitches) going from left to right. The intensities (or loudness) of the sounds are arranged from the top of the graph (soft sounds) to the bottom (loud sounds). The intensities are expressed in terms of sound pressure levels, called decibels (dB) or decibels hearing threshold level (dB HL). Responses are recorded using a "O"s for the right ear and "X"s for the left ear.

- Before you're given the baseline audiogram, you should not be exposed to noise levels at or above 85 dBA for 12 hours. Wearing your hearing protectors does not substitute for the quiet period. The reason we want you to have 12 hours of quiet is to make sure you're being tested at your best. These conditions hold true for the confirmation and exit audiograms, but are different for the annual hearing test.

- The annual hearing test is given while you've already been at work because comparing results with your baseline audiogram will show any early signs of hearing loss due to excessive exposure. In the early stages of work-related hearing loss, noise exposures cause temporary shifts in hearing. These shifts can become permanent, if repeated on a regular basis. By testing toward the end of the workday, rather than before the work starts, these temporary shifts can be noted and we can take steps to prevent them from progressing any further.

➢ **SHOW OVERHEAD - *Normal audiogram***

? **ASK**

What does a normal audiogram look like?

✓ **SAY**

If you have normal hearing, your responses to the audiometer at the test frequencies will fall between 0 dB and 25 dB. [Use pointer to show where the line is falling between 0 and 25 db]

➢ **SHOW OVERHEAD - *Noise induced hearing loss audiogram***

✓ **SAY**

- If you have a hearing loss it might show up like this on the audiogram.

- This type of hearing loss is called noised-induced hearing loss. This type of impairment frequently shows a notch in the audiogram at 4,000 Hz with better hearing at 8,000 Hz as shown. As described earlier, dB on an audiogram refers to loudness levels. The more the volume on the audiometer has to be turned up for the worker to hear, the higher the decibel level reading on the audiogram. For the notch at 4000 Hz the volume has to be turned up to 40 dB for the worker to hear sounds at this frequency.

- When reading an audiogram, keep in mind that a value of zero dB is a reference level. Zero represents the softest sound that an average young adult (with good hearing) can hear at that test frequency. In fact some people with exceptionally good hearing will have audiograms showing responses below zero dB. In this audiogram, the worker has good hearing particularly in the test frequencies of 125, 250 and 2000 Hz.

➢ **SHOW OVERHEAD - *Age-related hearing loss audiogram***

✓ **SAY**

- The effects of aging can also be seen on an audiogram. Typically, losses are seen at the higher frequencies between 6000 and 8000 Hz.

? **ASK**

What happens if a hearing loss is seen on your audiogram?

✓ **SAY**

- The technician compares your annual audiogram to your baseline looking for a Significant Threshold Shift. A Significant Threshold Shift is a 15 dB change in any of the test frequencies (500 to 8,000 Hz) in either ear. If the technician sees the shift, a retest will be given. If the retest gives the same results, then you'll be scheduled for a confirmation audiogram to be taken within 30 days. Because the OSHA standard requires it, we will also test your hearing at 2000, 3000 and 4000 to see whether you have a standard threshold shift. This is defined by OSHA as an average of 10 dB increase in hearing threshold at these three frequencies, in either ear.

- The confirmation audiogram, like the baseline, should be conducted after a minimum of 12 hours of quiet, without the use of hearing protectors. If the confirmation audiogram indicates a persistent or permanent threshold shift, you'll be notified in writing and referred to [name person who will be the professional reviewer] for a review of your audiogram to find out the cause of your hearing loss. If the cause is not noise, then you'll be referred your own physician for evaluation and treatment.

? **ASK**

What do you think should be done if someone's audiogram shows hearing loss?

Expected answers:

- *give them better hearing protection*
- *train them better*
- *find out if they're doing something noisy off-the-job*

✓ **SAY**

These are all good ideas. Let's review what we will do at our facility if someone has hearing loss. We will:

-- check the fit of the hearing protection devices (HPD). It may be necessary to change the type of HPD for better protection.
-- find out if you're being exposed to noise off-the-job
-- give you more training so you can understand why and how to protect your hearing
-- check noise levels in your work area. Maybe it's noisier than the initial measurements indicated
-- move you to a less noisy job, if necessary

? **ASK**

- Does anyone have a question?
- Have you had any problems with any part of the hearing test process?
- Do you have any recommendations for improvements in this part of the hearing conservation program?

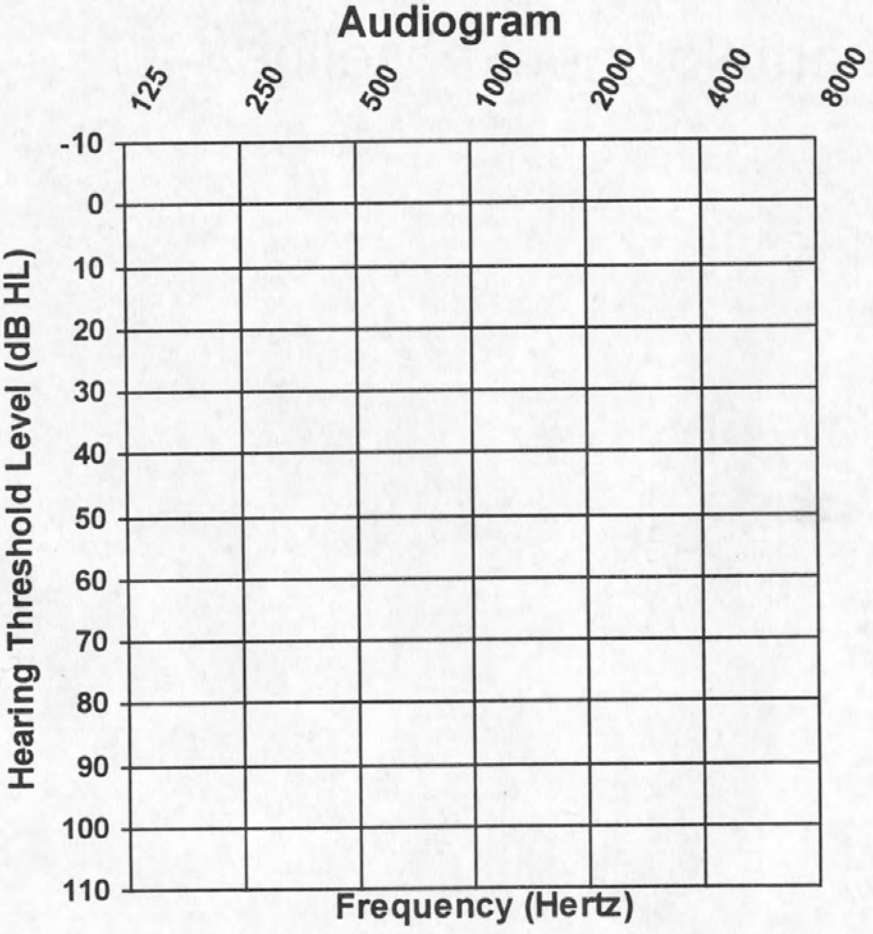
☞ **ADDITIONAL SUGGESTED ACTIVITIES**

- Audiogram game. Divide participants into 5 teams. Each team receives one of 5 different audiograms, each matched with one of two different baseline audiograms. The trainer draws a ticket with the name of a type of hearing loss. The team to identify that it has the audiogram that shows the selected type of hearing loss and why it is an example of the type wins. Then the next type ticket is drawn until all types have been reviewed. Everybody's a winner. (As prizes, you can give out miniature candy bars or safety-related trinkets.)
- Guest lecturer. Invite an audiometric technician or audiologist give a talk about case studies.
- Play a tape of hearing and show what the person's audiogram would look like.

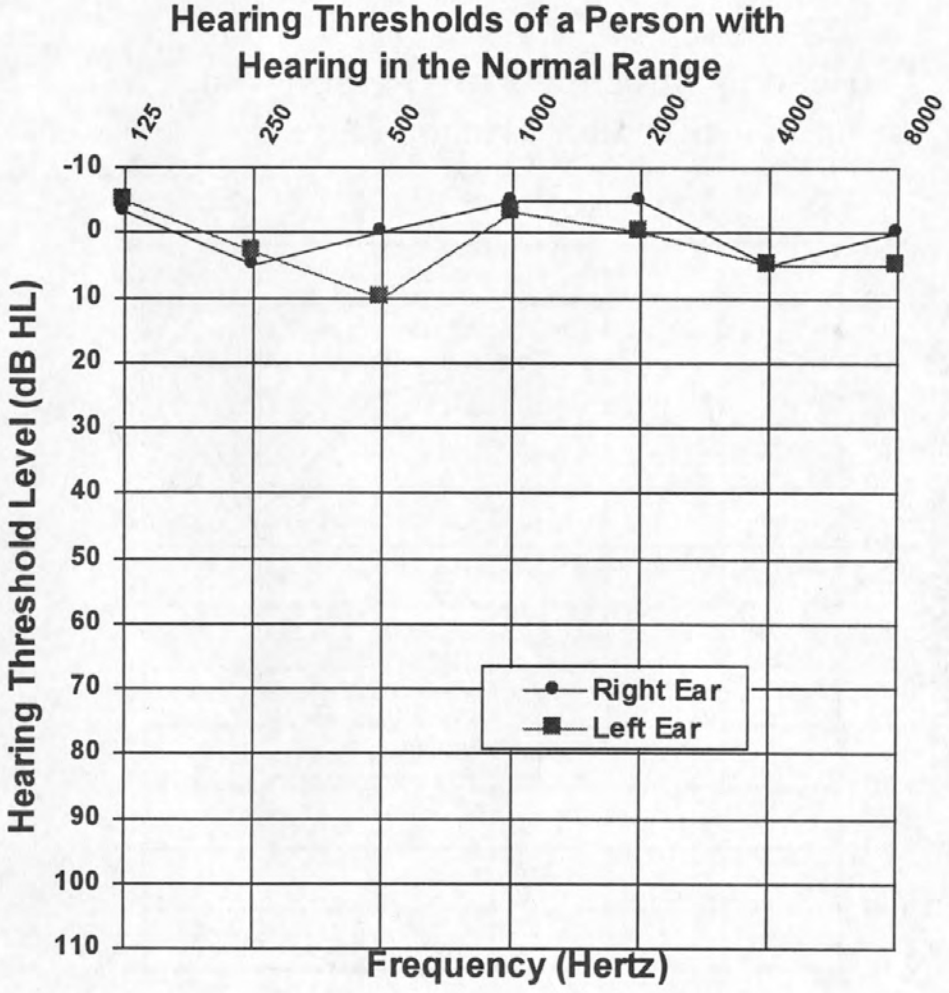
Audiometric Testing

- Pre-employment baseline
- Annual
- Follow-up
- Exit

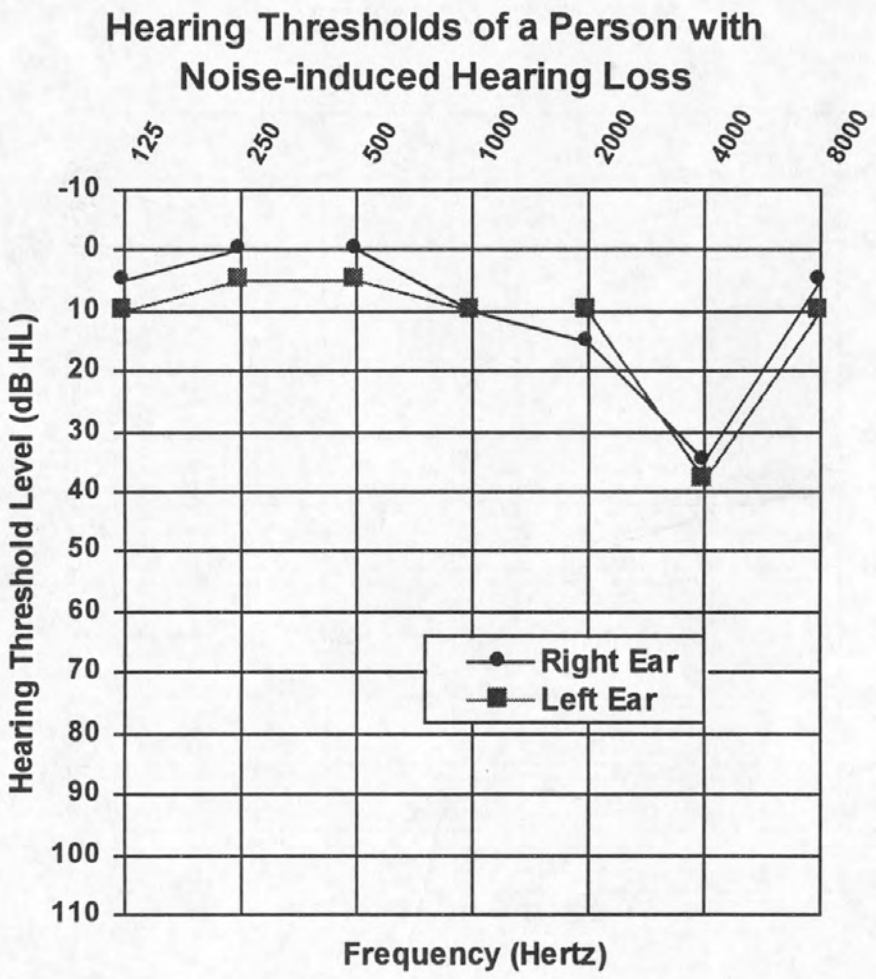
Audiogram


Audiogram
125
250
500
1000
2000
4000
8000
-10
0
10
20
30
40
50
60
70
80
90
100
110
Hearing Threshold Level (dB HL)
Frequency (Hertz)

Audiogram of Normal Hearing



Audiogram of Noise-Induced Hearing Loss



Audiogram of Age-Related Hearing Loss

