OSHAcademy™
Occupational Safety & Health Training

# Hearing Conservation Program Management

OSHA's hearing conservation program is designed to protect workers with significant occupational noise exposures from hearing impairment even if they are subject to such noise exposures over their entire working lifetimes. This course summarizes the required components of OSHA's hearing conservation program for general industry. It covers monitoring, audiometric testing, hearing protectors, training, and recordkeeping requirements.

This page intentionally blank

# OSHAcademy Course 751 Study Guide

## Hearing Conservation Program Management



This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 751.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

OSHAcademy

15220 NW Greenbrier Parkway, Suite 230
Beaverton, Oregon 97006
www.oshatrain.org
instructor@oshatrain.org
+1 (888) 668-9079



Revised: May 14, 2018

This page intentionally blank

# Contents

# Course Introduction

## Millions Are Exposed to Hazardous Levels of Noise Each Day

In the United States, four million workers go to work each day in damaging noise. Ten million people have a noise-related hearing loss. Occupational hearing loss is the most common work-related illness in the United States. Approximately 22 million U.S. workers are exposed to hazardous noise levels at work, and an estimated $242 million is spent annually on worker's compensation for hearing loss disability.

Over 23,000 cases of occupational hearing loss that was great enough to cause hearing impairment are reported every year. Reported cases of hearing loss accounted for 14% of occupational illness and 82% of the cases involving occupational hearing loss in the manufacturing sector. Noise-related hearing loss has been listed as one of the most prevalent occupational health concerns in the United States for more than 25 years. Thousands of workers every year suffer from preventable hearing loss due to high workplace noise levels.

## High-Risk Industries

While any worker can be at risk for noise-induced hearing loss in the workplace, workers in many industries have higher exposures to dangerous levels of noise. Industries with high numbers of exposed workers include: agriculture; mining; construction; manufacturing and utilities; transportation; and military.

Noise-induced hearing loss is one of the most common occupational disease and the second most self-reported occupational illness or injury. Industry specific studies reveal:

- 44% of carpenters and 48% of plumbers reported that they had a perceived hearing loss.
- 49% of male, metal/nonmetal miners, will have a hearing impairment by age 50 (vs. 9%
- of the general population) rising to 70% by age 60.

While any worker can be at risk for noise- induced hearing loss in the workplace, workers in many industries have higher exposures to dangerous levels of noise. Industries with high numbers of exposed workers include: agriculture; mining; construction; manufacturing and utilities; transportation; and military.

## What's the Standard?

OSHA sets legal limits, in decibels, on noise exposure in the workplace. A decibel is the unit used to measure the intensity of a sound and we'll talk more about this later in the course. These limits are based on the average amount of time a worker is exposed to noise over an 8-hour day (called a time-weighted average). It's important that you're familiar with two important noise level limits in the workplace:

1. OSHA's permissible exposure limit (PEL) is **90 dBA for all workers for an 8 hour day**.

2. OSHA requires employers to implement a Hearing Conservation Program where **workers are exposed to a time-weighted average noise level of 85 dBA** or higher over an 8-hour work shift.

## Hearing Conservation Program

OSHA's hearing conservation program is designed to protect workers with significant occupational noise exposures from hearing impairment even if they are subject to such noise exposures over their entire working lifetimes.

Hearing Conservation Programs require employers to:

- measure noise levels,
- provide free annual hearing exams and free hearing protection,
- provide training, and
- conduct evaluations of the adequacy of the hearing protectors in use unless changes to tools, equipment and schedules are made so that they are less noisy, and worker exposure to noise is less than the time-weighted average of 85 dBA over an 8-hour work shift.

This course summarizes the required component of OSHA's hearing conservation program for general industry. It covers monitoring, audiometric testing, hearing protectors, training, and recordkeeping requirements.

# Module 1: The Basics

## Sound and Noise – What's the difference?

**Sound** - consists of pressure changes in a medium (usually air), caused by vibration or turbulence. These pressure changes produce waves emanating away from the turbulent or vibrating source.

**Noise** - is nothing more than **unwanted sound**. Noise is one of the most widespread occupational health problems. It is a by-product of many industrial processes.

## How is sound measured?

Sound is measured in two ways: decibels and frequency.

Decibels measure the pressure of sound. Frequency is related to a sound's pitch and is measured in units called hertz (Hz), or cycles per second. The pitch of a sound — how high or low it seems — is how you perceive its frequency; the higher the pitch, the higher the frequency. High-frequency sounds are generally more annoying than low-frequency sounds and can be more harmful to hearing.

Human hearing is most sensitive to frequencies between 3,000 and 4,000 Hz. That's why people with damaged hearing have difficulty understanding higher-pitched voices and other sounds in the 3,000 to 4,000 Hz range.

Check out the CDC Noise Meter page to get a better idea how "loud" is loud.

## How does the ear work?

When sound waves enter the outer ear, the vibrations impact the ear drum and are transmitted to the middle and inner ear.

In the middle ear three small bones called the malleus (or hammer), the incus (or anvil), and the stapes (or stirrup) amplify and transmit the vibrations generated by the sound to the inner ear.

The inner ear contains a snail-like structure called the cochlea which is filled with fluid and lined with cells with very fine hairs. These microscopic hairs move with the vibrations and convert

the sound waves into nerve impulses–the result is the sound we hear. Exposure to loud noise can destroy these hair cells and cause hearing loss!

## The Perils of Exposure

Exposure to noise is measured in units of sound pressure levels called decibels, named after Alexander Graham Bell, using A-weighted sound levels (dBA). The A-weighted sound levels closely match the perception of loudness by the human ear.

Exposure to high levels of noise causes hearing loss and may cause other harmful health effects as well. The extent of damage mostly depends on the **intensity** of the noise and the **duration** of the exposure. Hearing loss caused by noise can be temporary or permanent.

- Temporary hearing loss results from short-term exposures to noise, with normal hearing returning after a period of rest.
- Prolonged exposure to high noise levels over a period of time gradually causes permanent damage.

Loud noise can also create physical and psychological stress, reduce productivity, interfere with communication and concentration, and contribute to workplace accidents and injuries by making it difficult to hear warning signals.

Noise-induced hearing loss limits your ability to hear high frequency sounds, understand speech, and seriously impairs your ability to communicate. The effects of hearing loss can be profound as hearing loss can interfere with your ability to enjoy socializing with friends, playing with your children or grandchildren, or participating in other social activities you enjoy, and can lead to psychological and social isolation.

## Exposure to chemicals

No longer is noise considered to be the only source of hearing loss associated with work. Exposure to chemicals, such as aromatic solvents and metals such as lead, arsenic, and mercury can result in hearing loss.

Combined exposures to noise and chemicals can cause more hearing loss than exposure to either agent alone. Vibration and extreme heat are also potentially harmful to hearing when combined with noise.

## How does sound damage hearing?

Very loud sounds can damage the sensitive hair cells in your inner ear. Hair cells are the foot soldiers for your hearing. As the number of damaged hair cells increases, your brain receives fewer impulses to interpret as sound. When you damage hair cells, you damage hearing.

While a single exposure to loud noise can damage your hair cells, it probably won't destroy them. You may experience ringing in your ears and some sounds may be muffled, but your hair cells will recover and so will your hearing. This is called a temporary threshold shift. But repeated exposures to loud noise can damage hair cells to the point that they won't recover. Because the damage is permanent, the result is called a permanent threshold shift. No treatment will restore it. When you destroy hair cells, you destroy hearing.

### How to know if your hearing is damaged

Hearing loss is painless and gradual. It usually develops over several years — you might not even notice the loss during those years.

Sometimes, overexposure to loud noise can trigger ringing or other sounds in your ears, called Tinnitus. While tinnitus may be a symptom of damaged hearing, it can also be caused by infections, medications, and earwax.

The only way to know for sure if noise has damaged your hearing is to have a hearing examination by a certified audiometric technician, audiologist, otolaryngologist, or physician.

If you answer "yes" to any of the following questions, your hearing may be at risk:

- Do you frequently ask people to repeat sentences?
- Do you feel your hearing is not as good as it was 10 years ago?
- Have family members noticed a problem with your hearing?
- Are you exposed to loud noise without hearing protection where you work?
- Do you have to shout to a co-worker because of the noise around you?
- Are you exposed to noise from firearms, motorcycles, snowmobiles, power tools, or loud music without hearing protection?

## Module 1 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Sound - consists of pressure changes in a medium (usually air), caused by _____ or _____.**

    a. vibration, turbulence
    b. turbulence, noise
    c. vibration, noise
    d. both A and B

2. **What is noise?**

    a. Pressure changes
    b. Unwanted sound
    c. Decibels
    d. Varying frequencies

3. **Between which frequencies is human hearing most sensitive to?**

    a. 1,000 to 5,000 Hz
    b. 3,000 to 8,000 Hz
    c. 1,000 to 2,000 Hz
    d. 3,000 to 4,000 Hz

4. **What are the two factors that determine the amount of hearing loss a person experiences when exposed to loud noises?**

    a. Decibels and frequency
    b. dBA and A-weighted sound levels
    c. Intensity and duration
    d. Sound and noise

5. **Sometimes, overexposure to loud noise can trigger ringing or other sounds in your ears, called _____.**

   a. audiotis
   b. ringitis
   c. frunitis
   d. tinnitus

# Module 2: Evaluating Exposures

## Warning Signs of Hazardous Workplace Noise

Noise may be a problem in your workplace if:

- You hear ringing or humming in your ears when you leave work.
- You have to shout to be heard by a co-worker an arm's length away.
- You experience temporary hearing loss when leaving work.

Noise-induced hearing loss can develop rapidly in workers exposed to relatively high noise levels on a daily basis.

## How to Evaluate Noise Exposure

The first step toward solving any noise problem is to define it. To understand what requirements must be implemented according to OSHA's noise standard, it is necessary to determine exposure levels. The following sections provide information about evaluating noise exposure levels:

- Indications of a Problem
- Walk-around Survey
- Work-shift Sampling
- Instruments Used to Conduct a Noise Survey

## Indications of a Problem

There are various factors that may indicate noise is a problem in the workplace. While people react differently to noise, subjective responses should not be ignored because they may provide warnings that noise may be at unacceptable levels.

Noisy conditions can make normal conversation difficult.

- When noise levels are above 80 decibels (dB), people have to speak very loudly.
- When noise levels are between 85 and 90 dB, people have to shout.

- When noise levels are greater than 95 dB, people must move close together to hear each other at all.

Do you work in a noisy environment? If so, you may be experiencing some hearing loss without even realizing it. A new study from the Harvard Medical Center shows neural damage can continue for months after exposure to noise has ended, resulting in worsening tinnitus and difficulty interpreting speech.

### Walk-Around Survey

A walk around survey should be performed to screen for noise exposures and to determine if additional monitoring is necessary. When screening for noise exposures, sound level meter measurements and estimates of the duration of exposure are sufficient. The resulting spot readings can be used to determine the need for a more thorough evaluation. The following general approach may be followed:

- Tour the facility and develop a detailed understanding of facility operations and potential noise sources. Make notes on a diagram of the floor plan if possible. Look for indications that noise may be a problem.

- Use a sound level meter to take spot readings of operations that are in question. It may be useful to mark the sound levels on a diagram of the floor plan. Make notes regarding what equipment is on or off.

- Estimate exposures by identifying workers and their locations, and estimate the length of time they spend in different areas or how long they operate particular equipment or tools.

If the results of the walk around survey indicate time-weighted average (TWA) exposures of 80 dBA or more, then additional noise monitoring should be performed.

### Work-Shift Sampling

When the results of the walk around survey indicate that the noise levels may exceed those outlined in OSHA's noise standard, additional monitoring is necessary. Establish a sampling protocol for your workplace. A general protocol is provided as an example. Follow this sampling protocol:

1. Inform the employee being monitored that the dosimeter (noise sampling equipment) should not interfere with his/her normal duties, and emphasize that the employee should continue to work as usual.

2. Explain the purpose of the dosimeter to each employee being sampled and emphasize that the dosimeter is not a speech recording device.

3. Instruct the employee being sampled not to remove the dosimeter unless absolutely necessary and not to cover the microphone with a coat or outer garment or move it from its installed position. Inform the employee when and where the dosimeter will be removed.

4. The microphone should be located in the employee's hearing zone. OSHA defines the hearing zone as a sphere with a two-foot diameter surrounding the head. Clip the microphone to the employee's clothing according to the manufacturer's instructions. Most manufacturers recommend that the microphone be placed on the shoulder area midway between the head and the point of the shoulder. Practicality and safety will dictate the actual microphone placement at each survey location.

5. Use the microphone windscreen to protect the microphone when the wearer is outdoors or in dusty or dirty areas (the windscreen will not protect the microphone from rain or extreme humidity).

6. When noise levels are different at each of the employee’s ears, the higher level must be sampled.

7. Position and secure any excess microphone cable to avoid snagging or inconvenience to the employee. If practical, the cord should be run under the employee's shirt or coat.

8. Check the dosimeter periodically to ensure the microphone is properly oriented.

9. Obtain and note sound level meter readings during different phases of work the employee performs during the shift. There is no minimum regarding the number of readings to obtain, but it is important to take enough readings to identify work cycles. For statistical reasons, more readings should be taken when noise levels fluctuate widely.

10. Record the information required on the OSHA-92 Noise Survey Report.

## Noise Survey Instruments

### Sound Level Meter

There are various factors that may indicate noise is a problem in the workplace. While people react differently to noise, subjective responses should not be ignored because they may provide warnings that noise may be at unacceptable levels. A sound level meter (SLM) is the basic instrument for investigating noise levels.

For compliance purposes, readings with an ANSI Type 2 sound level meter and dosimeter are considered to have an accuracy of ±2 dBA while a Type 1 instrument has an accuracy of ±1 dBA.

Sound level meters can be used to:

- Spot-check noise dosimeter performance.
- Determine the employee's noise dose whenever use of a noise dosimeter is unavailable or inappropriate.
- Identify and evaluate individual noise sources for abatement purposes.
- Aid in determining the feasibility of engineering controls for individual noise sources.
- Evaluate hearing protectors.

Please click here to learn more about the considerations of use for sound level meters.

### Dosimeter

Like a sound level meter, a noise dosimeter can also measure sound levels. However, the dosimeter is actually worn by the employee in order to determine the personal noise dose during the work shift or sampling period. According to OSHA's noise standard, the noise dosimeter is the primary instrument for making compliance measurements.

Dosimeters can be used to:

- Make compliance measurements according to OSHA's noise standard.
- Measure the employee's exposure to noise and automatically compute the necessary noise dose calculations.

Please click here to learn more about the considerations of use for dosimeters.

## Employees Wearing Headsets are at Risk

Noise overexposure in the workplace can occur where employees wear a communications headset as part of their employment. Clerical personnel, aircraft pilots and other cockpit personnel, air traffic controllers, emergency personnel, reservation clerks, receptionists, and telephone operators are just a few examples of the more than three million workers who can be exposed to high noise levels via communication's headsets.

## Module 2 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **The first step towards solving any nose problem is to _____ it.**

    a. Decline
    b. neglect
    c. ignore
    d. avoid

2. **ANSI Type 2 meters have an accuracy of _____.**

    a. +/- 1 DBa
    b. +/- 2 DBa
    c. +/- 3 DBa
    d. +/- 4 DBa

3. **According to OSHA's noise standard 29 CFR 1910.95, the _____ is the primary instrument for making compliance measurements?**

    a. noise dosimeter
    b. acoustic limited devices
    c. octave band analyzers
    d. audio equalizer

4. **Can overexposure to noise in the workplace occur where employees wear a communications headset?**

    a. Yes
    b. No

**5. When may noise be a problem in your workplace?**

a. You hear ringing or humming in your ears when you leave work
b. You have to shout to be heard by a co-worker an arm's length away
c. You experience temporary hearing loss when leaving work
d. All of the above

# Module 3: Reducing Noise Related Hazards

## Introduction

Noise control strategies are the first line of defense against excessive noise exposure. The use of these controls should aim to reduce the hazardous exposure to the point where the risk to hearing is eliminated or minimized.

With the reduction of even a few decibels, the hazard to hearing is reduced, communication is improved, and noise-related annoyance is reduced. There are several ways to control and reduce worker exposure to noise in the workplace.

## The Hierarchy of Control Strategies

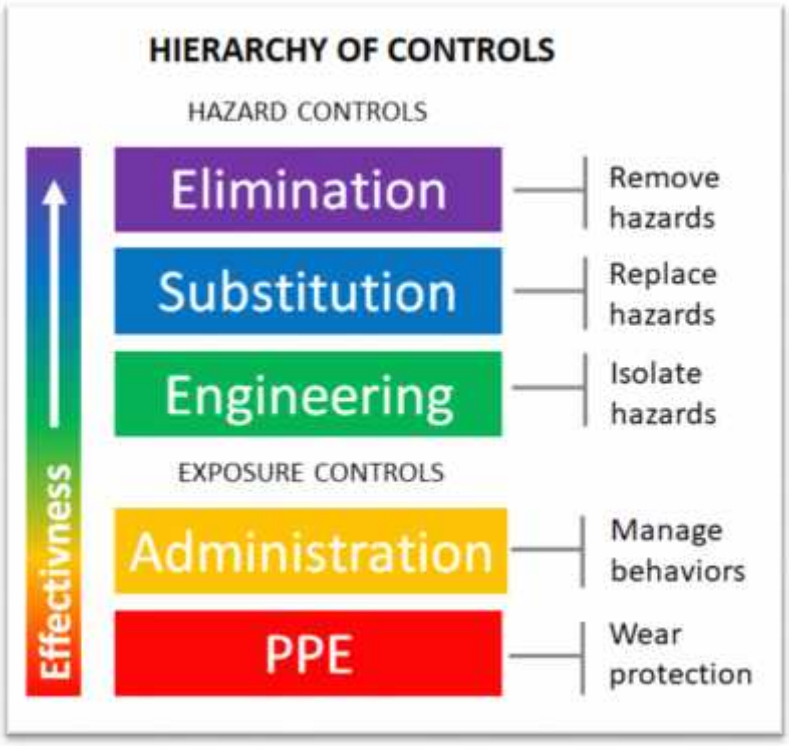
Occupational safety and health professionals use the "Hierarchy of Controls" to determine how to implement feasible and effective controls. This approach groups actions by their likely effectiveness in reducing or removing the noise hazard. The first three control strategies attempt to change the source of the hazard to reduce noise levels. The last two strategies attempt do not change the source of the noise, but rather, they try to reduce employee exposure to the noise.

**Hazard Controls** - These controls change the source of the noise hazard:

1. **Elimination** - remove the source of the hazard.
2. **Substitution** - replace the source of the hazard with a quieter source.
3. **Engineering** - design/redesign equipment to isolate the source of the noise.

**Exposure Controls** - These controls manage employee exposure to the source of the noise hazard:

4. **Administration** - information and training, scheduling, work practices, rules, etc.
5. **Personal protective equipment (PPE)** - ear plugs and muffs, etc.




The use of these controls should reduce exposure to the point where the risk to hearing is eliminated or at least more manageable. Administrative and PPE are less reliable because they only work when employees use or otherwise comply with the strategies.

### Elimination and Substitution

In most cases, the preferred approach is to eliminate the source of hazardous noise. When elimination is not possible, substitution of the loud equipment for quieter equipment may be the next best alternative to protect workers from hazardous noise.

### Engineering Controls

Engineering controls that reduce sound exposure levels are available and technologically feasible for most noise sources. Engineering controls involve modifying or replacing equipment, or making related physical changes at the noise source or along the transmission path to reduce the noise level at the worker's ear.

Simple engineering noise control solutions can reduce the noise hazard to the extent that audiometric testing, a hearing conservation program, and the use of hearing protectors, are not necessary. Examples of inexpensive, effective engineering controls that can be applied include:

- Choosing low-noise tools and machinery (e.g., compressors, grinders, etc.).

- Maintaining and lubricating machinery and equipment (e.g., oil bearings).
- Placing a barrier between the noise source and employee (e.g., sound walls or curtains).
- Enclosing or isolating the noise source.

### Examples of Engineering Controls

For hearing loss prevention purposes, engineering controls are defined as any modification or replacement of equipment, or related physical change at the noise source or along the transmission path (with the exception of hearing protectors) that reduces the noise level at the employee's ear.

Typical engineering controls involve:

1. reducing noise at the source
2. interrupting the noise path
3. reducing reverberation
4. reducing structure-borne vibration

Common examples of the implementation of such controls are:

1. installing a muffler
2. erecting acoustical enclosures and barriers
3. installing sound absorbing material
4. installing vibration mounts and providing proper lubrication

### Selecting Engineering Controls

Assessing the applicability of engineering controls is a sophisticated process.

- First, the noise problem must be thoroughly defined. This necessitates measuring the noise levels and developing complete information on employee noise exposure and the need for noise reduction.

- Next, an approach to engineering control must be developed, requiring the identification of individual noise sources and assessment of their contributions to the overall noise levels.

When choosing the most applicable engineering controls, you will need to consider the cost of purchasing, operating, servicing, and maintaining the control. For this reason, engineering, safety, and industrial hygiene personnel, as well as employees who operate, service, and maintain equipment, must be involved in the noise-control plan.

Employees who work with the equipment on a daily basis will be able to provide valuable guidance on such important matters as the positioning of monitoring indicators and panels, lubrication and servicing points, control switches, and the proper location of access doors for operation and maintenance.

In situations where employees will be working on or around equipment fitted with engineering controls, it is important to explain to everyone involved why the controls should not be modified, removed, or otherwise defeated.

### Administrative Controls

Administrative controls are changes in the workplace that reduce or eliminate the worker exposure to noise, examples include:

- Operating noisy machines during shifts when fewer people are exposed.
- Limiting the amount of time, a person spends at a noise source.
- Providing quiet areas where workers can gain relief from hazardous noise sources (e.g., construct a soundproof room where workers' hearing can recover – depending upon their individual noise level and duration of exposure, and time spent in the quiet area).
- Restricting worker presence to a suitable distance away from noisy equipment. Controlling noise exposure through distance is often an effective, yet simple and inexpensive administrative control. This control may be applicable when workers are present but are not actually working with a noise source or equipment. Increasing the distance between the noise source and the worker, reduces their exposure. In open space, for every doubling of the distance between the source of noise and the worker, the sound level of the noise is decreased by 6.02 dB. No matter what the scale of measurement, you will get a 6.02 dB sound level drop for every doubling of distance.

## Personal Protective Equipment

If other hazard and exposure control strategies to reduce noise levels can't be used or fail to reduce noise levels below OSHA's permissible exposure limits (PELs), the employer should make sure all exposed employees wear hearing protective devices There are many different types of hearing protection.

Each type is designed for certain noise conditions. But remember - unless employees wear hearing protection properly and wear them all the time in high noise areas, the devices will not be effective. Proper use of hearing protection is one of the major challenges inherent in this exposure control strategy.

Convenience and comfort are important for frequent use of hearing protective devices. Earmuffs and foam earplugs in most cases offer the most noise reduction. However, preformed plugs or canal caps may be more convenient where construction work generates moderate daily average noise levels. There is no one device that is the best type for all situations. You can see the various types by enlarging the image below.

### Hearing Protective Devices

| Type | Features | Concerns |
|---|---|---|
| **Roll down foam**  | Fits many differently shaped ear canals.<br>Provides good protection for most noisy environments.<br>Convenient, disposable. | Must be inserted properly to get the highest possible protection.<br>If the plug doesn't make a good seal, it won't protect your hearing. |
| **Reusable earplugs**  | Many have flanges and handles. Come in different sizes.<br>Come with cords, convenient to carry.<br>Reusable.<br>Washable. | Preformed so may not fit as wide a variety of ear canals as foam plugs.<br>May require a different size for each ear.<br>Must keep them clean. |
| **Custom molded**  | Molded to user's ear.<br>Always comfortable.<br>Long term wear.<br>Best for difficult-to-fit ears. | Must be made by a licensed hearing protection provider. |

| | | |
|---|---|---|
| **Canal caps**  | On a band, can be worn under chin, over head, or behind neck.<br>Can be put on and taken off quickly. | Not as comfortable as other devices.<br>Not as much protection as other devices. |
| **Earmuffs**  | Easy to use and wear. Fit most people.<br>Easy to keep clean. | Can be hot and heavy.<br>May be more difficult to get a good fit with glasses and/or may interfere with other protective gear. |
| **New Types**<br>**Flat**<br>**Attenuated**<br>**Communication** | Flat reduction of noise over all frequencies.<br>Have a baffle to reduce impact noise.<br>Radio Communication while still reducing noise. | Can be expensive.<br>Must be custom fitted. |

We'll discuss the OSHA requirements for hearing protective devices as part of the employer's Hearing Conservation Program (HCP) later in the course.

## Management Responsibilities

Management's primary responsibilities are to make sure that potentially controllable noise sources are identified, and that priorities for controls are set and accomplished. It is also management's responsibility to see that any changes of equipment or process are done only after evaluation of their impact on employee noise exposure.

Purchasing more quiet equipment can be very helpful, but sometimes the company must be willing to pay more for quieter equipment, but these investments should be cost-effective in the long run.

Implementing a buy quiet program can significantly reduce the amount of time it takes for workplace noise to no longer be hazardous.

Often a noise-control effort may seem to be overwhelming. As a result, the company may decide that noise control is not feasible and instead rely on hearing loss prevention measures to prevent hearing loss. However, if noise sources are taken on one at a time, dealing with the noisiest or easiest to quiet sources first, the problem can become manageable over time so that hearing loss prevention measures will be needed only until the noise is reduced to a safe level. Many times two hazards can be reduced or eliminated at once such as in the case of enclosing a noisy machine that generates high heat levels as well. The enclosure can trap the noise and the heat can be vented off to the outside.

Managers may need to commit resources for in-house development of technology to control exposure problems specific to their companies and processes. In some cases, they may need to budget for maintenance of exposure control devices to prevent their deterioration over time. Finally, they should make sure that lunch and break areas are as free from noise hazards as reasonably possible, and that other avenues of administrative controls have been explored.

## Employee Responsibilities

Employees who operate or maintain and repair the equipment are often the ones who know most about the processes involved, they need to express their concerns and ideas to management, the program implementer, or the noise-control engineer so that the noise-control devices will be as practical and effective as possible. Employee assistance is especially critical to the success of engineering noise surveys where sound sources within a work process or a piece of equipment need to be evaluated, and only the employee knows the proper operation of the equipment. Employees also need to cooperate by maintaining their normal work routine when asked to wear dosimeters, so that the results will be representative of their actual exposures.

Sound levels often increase when equipment begins to wear or fails to receive appropriate maintenance. Also, changes in equipment placement may cause unintended effects on sound

levels. When employees notice such changes, they need to inform the supervisory personnel or the program implementer that a change has occurred. A re-survey will be needed to evaluate the new sound levels and employee exposures whenever equipment or production changes occur.

Employees also have the responsibility of learning to operate their machines with the noise controls in place, of maintaining the controls properly, and of notifying the appropriate personnel when additional maintenance is needed.

## Module 3 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Typical engineering controls involve all of the following except _____.**

    a. reducing noise at the source
    b. interrupting the noise path
    c. reducing verberation
    d. redesign of the equipment

2. **In situations where employees will be working on or around equipment fitted with engineering controls, it is important to explain to everyone involved why the controls should not be modified, removed, or otherwise defeated?**

    a. True
    b. False

3. **What are administrative controls?**

    a. Changes in the workplace the replaces equipment
    b. Changes in the workplace that increase the worker exposure to noise
    c. Changes in the workplace that reduce or eliminate the worker exposure to noise
    d. Changes in the workplace that modify equipment

4. **Which of the choices below are examples of administrative controls?**

    a. Provide quiet areas for workers
    b. Restrict workers to a suitable distance away from noise
    c. Interrupting the noise path
    d. Putting a noisy machine in an enclosed space

**5. _____ and _____ controls represent the first two primary strategies in the Hierarchy of Controls.**

a. Engineering and management
b. Elimination and substitution
c. Administrative and management
d. Management and employee

# Module 4: Hearing Conservation Program

## Introduction

Hearing conservation programs strive to prevent initial occupational hearing loss, preserve and protect remaining hearing, and equip workers with the knowledge and hearing protection devices necessary to safeguard themselves. Employers are required to measure noise levels; provide free annual hearing exams, hearing protection, and training; and conduct evaluations of the adequacy of the hearing protectors in use (unless changes made to tools, equipment, and schedules result in worker noise exposure levels that are less than the 85 dBA). Research indicates that workplaces with appropriate and effective hearing conservation programs have higher levels of worker productivity and a lower incidence of absenteeism.

## What Constitutes an Effective Hearing Conservation Program?

An effective hearing conservation program can prevent hearing loss, improve employee morale and a general feeling of well-being, increase quality of production, and reduce the incidence of stress-related disease.

The employer should administer a continuing, effective hearing conservation program whenever employee noise exposures are at or above an eight-hour time-weighted average (TWA) of 85 dBA or, equivalently, a dose of 50 percent.

## Program Elements

As detailed in OSHA's 1910.95 rule, the elements of an effective hearing conservation program are:

- monitoring program
- audiometric testing program
- hearing protection devices (HPDs)
- employee training and education
- recordkeeping

There are also specific hearing conservation program requirements for agricultural, maritime, and construction worksites.

### Monitoring Program

The employer must develop and implement a monitoring program whenever information indicates that any employee's exposure may equal or exceed the action level.

- The sampling strategy must be designed to identify all employees for inclusion in the hearing conservation program, and enable the proper selection of hearing protectors.
- The monitoring requirement is performance-based, as it allows employers to choose a monitoring method that best suits each individual work situation. Either personal or area monitoring may be used.

If there are circumstances that may make area monitoring generally inappropriate, such as high worker mobility, significant variations in sound level or a significant component of impulse noise, then the employer must use representative personal sampling unless it can be shown that area sampling produces equivalent results.

- **Measurement of Noise:** Noise measurements must integrate all continuous, intermittent, and impulsive noise levels from 80 to 130 dBA.
- **Repeated Monitoring**: Monitoring must be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that additional employees may be exposed at or above the action level or the attenuation provided by hearing protectors used by employees may be rendered inadequate to meet the requirements described in Hearing Protection Devices (HPDs).
- **Employee Notification**: The employer must notify each employee who is exposed at or above the action level of the results of the monitoring.
- **Observation of Monitoring**: The employer must provide affected employees or their representatives with an opportunity to observe noise monitoring procedures.

## Providing Hearing Protection Devices (HPD's)
## Management Responsibilities

Management has two primary responsibilities in ensuring that hearing protection devices protect hearing effectively: facilitation and enforcement.

## Facilitation

Management facilitation involves ensuring that program implementers obtain the types of devices they need. Management can do this by making sure the procurement department does not override the implementer's selections. Employee participation in the selection of hearing protectors should be encouraged.

Management should extend its commitment to hearing protectors by requiring all personnel, including managers and visitors, to wear protectors in designated areas, and by encouraging employees to take hearing protectors home to use whenever engaging in noisy activities.

Management should give program implementer's the opportunity to pilot-test hearing protectors on a few employees. This will greatly facilitate decisions relating to the selection and ultimate effectiveness of these devices.

Program implementers should also be given resources and facilities to train employees in the use and care of hearing protectors.

## Enforcement

**Enforcing** is the use of hearing protectors is management's second vital responsibility.

Use of personal safety equipment, such as hearing protectors, must be clearly stated as a condition of employment, and management should be prepared to deal accordingly with those who violate the policy. Those who have decided not to wear hearing protection in noisy areas also have decided not to work for the company.

### Hearing Protection Devices - Basic Requirements

Hearing protection devices (HPDs), which are a form of personal protection equipment (PPE), are considered the **last** option to control exposures to noise. HPDs are generally used during the necessary time it takes to implement engineering or administrative controls, or when such controls are not feasible.

- Employers must make HPDs available to all employees exposed at or above the action level. These must be provided at no cost to employees and must be replaced as necessary.
- Employers must ensure that HPDs are worn by employees: where feasible administrative and engineering controls fail to reduce sound levels within those listed in Table G-16 of 29 CFR 1910.95 or who are exposed at or above the action level and who:
    - have not yet had a baseline audiogram established or

- have experienced a standard threshold shift (STS).

## HPD Selection and Use

It is essential to the success of the program to have someone responsible for the selection of hearing protection devices and the supervision of their use. They must be able to evaluate and select appropriate devices for each employee, based on proper fit, the employee's noise exposure, hearing ability, communication needs, personal preferences and other constraints imposed by job tasks or work environment.

Not every person can wear every hearing protector. Some people may be unable to wear certain types of earplugs because of the shape or size of their ear canals. Because of individual differences in the shapes and sizes of heads, some people will be unable to wear some earmuffs. Individual assessment of comfort and ability to tolerate prolonged use of a given device cannot be predicted and will vary widely between individuals. Also, some protectors may be incompatible with differing safety and protective devices.

Therefore, program implementer's must make a **variety of devices available**. Preferably, program implementers should make available a set of devices that have been pilot-tested for effectiveness and employee acceptance.

## Fitting HPD's

When fitting hearing protectors, attention needs to be given to each ear. It is not uncommon for a person to have right and left ear canals that are different sizes and must, therefore, be fitted with earplugs that are separately sized for each ear. Ear canals should be inspected to assure that no physical problems, such as infections or excessive ear wax, will compromise or complicate the use of hearing protectors.

Employees must be given the opportunity to select their HPDs from a suitable variety. Generally, this should include a minimum of two devices, representative of at least two different types.

The employer must provide training in the use and care of all HPDs provided to employees.

The employer must ensure proper initial fitting of HPDs and supervise their correct use.

Program implementers should be alert for common pitfalls associated with use and care of hearing protectors. For example, motorcycle helmets, personal stereo headsets, swimmer's earplugs, and hearing aids cannot be substituted for hearing protectors. Program implementers should be proactive in working with employees to avoid such pitfalls.

## HPD Attenuation

Attenuation refers to the damping or decrease of noise levels as a result of wearing HPDs.

- The employer must evaluate HPD attenuation for the specific noise environments in which the HPD will be used.
- HPDs must attenuate employee exposure to at least an eight-hour time-weighted average of 90 dBA. [29 CFR 1910.95(j)(2)]
- For employees who have experienced a standard threshold shift (STS), HPDs must attenuate exposure at or below the action level of 85 dBA-TWA (time-weighted average).
- The adequacy of the HPDs must be re-evaluated whenever employee noise exposures increase to the extent that they may no longer provide adequate attenuation. The employer must provide more effective hearing protectors as necessary.
- Employer needs to know and understand the methods for estimating HPD attenuation.

### Employee Training and Education

The employer must institute a training program for all employees with noise exposures at or above the action level and ensure employee participation.

- Training must be repeated **annually** for each employee in the hearing conservation program.
- Information must be updated to be consistent with changes in protective equipment and work processes.

An employee's failure to correctly insert an earplug or adjust an earmuff are arguably the chief culprits responsible for diminished real-world hearing protection. Thus, even if an employee has been issued a correctly-sized hearing protector and has been trained in its use and care, it is quite possible that he or she could receive little or no effective hearing protection because of a faulty fit. Employees must resolve to wear their hearing protection correctly, or they will greatly reduce its ability to prevent harmful noise from damaging their hearing.

Willful failure to wear hearing protection should be taken seriously. Employees should consider that management is responsible for ensuring compliance with health and safety requirements. Should employees fail to wear their hearing protection, management can be held accountable and may be cited and penalized for noncompliance with health and safety regulations.

**Employees need to cultivate a vigilant attitude about hearing protection.** Employees should expect their hearing protectors to slip or work lose over a period of time. Throughout their work shift, employees must periodically check to see if they need to readjust or refit their protector in order to maintain a reliable fit.

**Hearing protectors break and become worn.** Employees also need to check their protector regularly and to seek repair or replacement whenever necessary. Lastly, they can help each other by encouraging their co-workers to use hearing protectors and to seek help when they have problems.

**Employees must guard against acquiring a false sense of safety.** As the discussion and figures in this section have illustrated, it is easy to misuse hearing protectors and greatly reduce their effectiveness. Employees CAN prevail over most hearing health hazards if they:

- properly wear their hearing protectors,
- exercise a commitment to wear their hearing protectors consistently, and
- maintain their hearing protectors by repairing or replacing them when necessary.

### Access to Information and Training Materials

The employer must ensure that each employee is informed of the following:

- The effects of noise on hearing.
- The purpose of hearing protectors; advantages, disadvantages and attenuation of various types; and instructions on selection, fitting, use and care.
- The purpose of audiometric testing and an explanation of test procedures.

The employer must:

- Make copies of the noise standard available to affected employees or their representatives and post a copy in the workplace.
- Provide affected employees with any informational materials pertaining to the standard that are supplied to the employer by OSHA.
- Provide, upon request, all material relating to the employer's training and education program to OSHA.

## Module 4 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **What is considered the last option to control exposures to noise?**

    a. Hearing protective devices (HPDs)
    b. Engineering controls
    c. New equipment with sound absorbing enhancements
    d. Both B and C

2. **Employers must make HPDs available to all employees exposed at or above the action level. These must be provided _____.**

    a. at no cost to employees
    b. must be replaced as necessary
    c. on an annual basis
    d. both A and B
    e. all of the above

3. **What is the "action level" at which the employer must institute a training program for all employees with noise exposures and ensure their participation?**

    a. 80 dBa
    b. 85 dBa
    c. 90 dBa
    d. 100 dBa

4. **How often must training be completed for each employee in the hearing conservation program?**

    a. Annually
    b. Bi-annually
    c. Monthly
    d. Every 2 years

5. **The employer must provide training in the _____ and _____ of all HPDs provided to employees.**

    a. care, limitations
    b. use, care
    c. use, limitations
    d. benefits, limitations

# Module 5: Hearing Conservation Program Benefits

## Introduction

When a company has an effective hearing conservation program, everyone wins–the employers, the employees, and the safety and health professionals who implement the program. This course is not about minimal criteria that meet only the letter of the law. It is concerned with programs that are effective as well as efficient: those optimizing program elements that succeed in preventing hearing loss in a practical and cost-effective manner.

## The Costs

In Washington State, workers' compensation disability settlements for hearing-related conditions cost $4.8 million in 1991 (not including medical costs). When applied to the national workforce, occupational hearing loss costs an estimated $242.4 million per year in disability alone.

This figure does not include medical costs or personal costs which can include approximately $1500 for a hearing aid and around $300 per year for batteries. Moreover, workers' compensation data is an underestimate of the true frequency of occupational illness, representing only the tip of the iceberg.

In British Columbia, in a five-year period from 1994 to 1998, the workers' compensation board paid $18 million in permanent disability awards to 3,207 workers suffering hearing loss. An additional $36 million was paid out for hearing aids.

Through their hearing conservation program, the U.S. Army **saved** $504.3 million by reducing hearing loss among combat arms personnel between 1974 and 1994. The Department of Veterans Affairs **saved** $220.8 million and the Army an additional $149 million by reducing civilian hearing loss between 1987 and 1997.

## Employer Benefits

A good hearing conservation program is good business. It promotes good labor relations because employees know that management is concerned, and this type of concern may translate to improved productivity and product quality. Indeed, noise itself can have an adverse effect on productivity. For complex jobs and those requiring concentration, studies show that greater efficiency is linked to lower noise levels. Also, the ease and accuracy of communication is improved as noise levels are lowered. These benefits should prove to be cost-effective for management. Additionally, the prevention of hearing loss leads to the preservation of valuable employee resources.

*Studies of noisy companies that have implemented hearing loss prevention programs show reductions in accident rates, illnesses, and lost time.*

Versatility, adaptability, and promotability of employees are likely to be maintained when employees retain good hearing. Morale may also benefit, which should lead to greater employee satisfaction and retention. Of course, employers who take the appropriate preventive action now will greatly reduce the risk of future claims. As with other effective health and safety measures, hearing conservation programs should also extend beyond the workplace.

*The company that encourages employees to take their earplugs home to wear during woodworking, target practice, or other noisy off-duty activities is reducing the possibility of illegitimate work-related claims, as well as educating the employees to the need for hearing loss prevention in recreational settings.*

Finally, the company that places a high value on safety and health maintenance should evaluate the performance of managers responsible for hearing conservation programs and reward those whose programs succeed in preventing hearing loss. An effective hearing conservation program costs money to implement, but the necessary investment will produce a beneficial return.

### Employee Benefits

The hearing conservation program's most obvious benefit to employees is that it saves their hearing and ability to communicate. Because occupational hearing loss creeps up slowly, many individuals are unaware of their impairment until it is too late. Moreover, occupational hearing loss represents permanent damage, i.e., it cannot be restored through medical/surgical treatment. A good hearing conservation program, however, can identify minor changes in hearing, and prevent deterioration to the point where it is permanent. Employees who have labored for 35 or 40 years should be able to enjoy their retirement; they should be able to socialize with family and friends, and listen to music and the sounds of nature.

*Hearing loss due to noise appears during the first five to ten years of exposure, so young workers are at most risk of noise-induced hearing loss.*

Preventing hearing loss benefits employees all through life, not just in retirement, since the ability to communicate is critical in all of our interpersonal relationships. When good hearing is a prerequisite for a job, an effective hearing conservation program will enable employees to sustain their hearing ability and thus continue to qualify for jobs (perhaps higher level) that have such requirements.

Another benefit reported by employees in companies with effective hearing conservation programs is that they generally feel better; less tired and irritable. They sometimes report that

they sleep better at night, and they are no longer bothered by temporary reductions in hearing ability at the end of the day, or by the tinnitus (ringing in the ears) that often accompanies the development of noise-induced hearing loss.

There is also evidence that long-term noise exposure may contribute to stress-related disease, especially cardiovascular disease. By reducing noise, the chances of other health impairments are consequently controlled and reduced. Noise reduction and maintenance of hearing sensitivity can benefit safety because employees are better able to communicate, and to hear alarms and warning shouts. Good hearing is essential for more subtle warning signals, such as a malfunctioning machine or the sounds of "roof-talk" in underground mines.

In summary, a good hearing conservation program is consistent with good health and good business. At a minimum, employees benefit with good hearing. Reductions in noise exposure may also result in less fatigue and irritation, and possibly fewer stress-related health complaints. The company benefits from reduced worker compensation payments and medical expenses, and a reduced likelihood of an OSHA citation for hearing conservation violations. Reduced noise exposures also can be associated with improved employee morale, and, in some cases, higher production efficiency.

## Module 5 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **For complex jobs and those requiring concentration, studies show that greater efficiency is linked to _____.**

    a. not using hearing protection
    b. higher noise levels
    c. lower noise levels
    d. both A and B

2. **Who is more at risk of developing hearing loss?**

    a. A worker exposed to noise for 10-12 years
    b. A worker exposed to noise the first 5-10 years
    c. A worker exposed to noise for 10-15 years
    d. None of the above

3. **Studies of noisy companies that have implemented hearing conservation programs show reductions in _____.**

    a. accident rates
    b. illness
    c. lost time
    d. all of the above

4. **Many individuals are unaware of their hearing impairment until it is too late.**

    a. True
    b. False

5. **How can noise reduction and the maintenance of hearing sensitivity benefit the safety of employees?**

    a. Employees can feel slippery surfaces
    b. Employees are able to hear alarms
    c. Employees are able to smell dangerous odors
    d. All of the above

# Module 6: Hearing Conservation: Required Monitoring

## Introduction

The hearing conservation program requires employers to monitor noise exposure levels in a way that accurately identifies employees exposed to noise at or above 85 decibels (dB) averaged over 8 working hours, or an 8-hour time-weighted average (TWA).

Employers must monitor all employees whose noise exposure is equivalent to or greater than a noise exposure received in 8 hours where the noise level is constantly 85 dB.

The exposure measurement must include all continuous, intermittent, and impulsive noise within an 80 dB to 130 dB range and must be taken during a typical work situation.

This requirement is performance-oriented because it allows employers to choose the monitoring method that best suits each individual situation.

## When Must the Employer Repeat Monitoring?

Employers must repeat monitoring whenever changes in production, process, or controls increase noise exposure. These changes may mean that more employees need to be included in the program or that their hearing protectors may no longer provide adequate protection.

## What is Audiometric Testing?

Audiometric testing monitors an employee's hearing over time. It also provides an opportunity for employers to educate employees about their hearing and the need to protect it. The employer must establish and maintain an audiometric testing program.

The important elements of the program include:

- baseline audiograms
- annual audiograms
- training
- follow-up procedures

Employers must make audiometric testing available at no cost to all employees who are exposed to an action level of 85 dB or above, measured as an 8-hour TWA. The audiometric testing program follow up should indicate whether the employer's hearing conservation program is preventing hearing loss.

A licensed or certified audiologist, otolaryngologist, or another physician must be responsible for the program. Both professionals and trained technicians may conduct audiometric testing. The professional in charge of the program does not have to be present when a qualified technician conducts tests. The professional's responsibilities include:

- Overseeing the program and the work of the technicians
- reviewing problem audiograms, and
- determining whether referral is necessary.

The employee needs a referral for further testing when test results are questionable or when related medical problems are suspected. If additional testing is necessary or if the employer suspects a medical pathology of the ear that is caused or aggravated by wearing hearing protectors, the employer must refer the employee for a clinical audiological evaluation. There are two types of audiograms required in the hearing conservation program: baseline and annual audiograms.

### What is a Baseline Audiogram?

The baseline audiogram is the reference audiogram against which future audiograms are compared. Employers must provide baseline audiograms within 6 months of an employee's first exposure at or above an 8-hour TWA of 85 dB. An exception is allowed when the employer uses a mobile test van for audiograms. In these instances, baseline audiograms must be completed within 1 year after an employee's first exposure to workplace noise at or above a TWA of 85 dB. Employees, however, must be fitted with, issued, and required to wear hearing protectors whenever they are exposed to noise levels above a TWA of 85 dB for any period exceeding 6 months after their first exposure until the baseline audiogram is conducted. Employees should not be exposed to workplace noise for 14 hours before the baseline test or wear hearing protectors during this time period.

### What are Annual Audiograms?

Employers must provide annual audiograms within 1 year of the baseline. It is important to test workers' hearing annually to identify deterioration in their hearing ability as early as possible. This enables employers to initiate protective follow-up measures before hearing loss progresses.

Employers must compare annual audiograms to baseline audiograms to determine whether the audiogram is valid and whether the employee has lost hearing ability or experienced a standard threshold shift (STS). An STS is an average shift in either ear of 10 dB or more at 2,000, 3,000, and 4,000 hertz.

## What is an Employer Required to Do Following an Audiogram Evaluation?

The employer must fit or refit any employee showing an STS with adequate hearing protectors, show the employee how to use them, and require the employee to wear them. Employers must notify employees within 21 days after the determination that their audiometric test results show an STS.

Some employees with an STS may need further testing if the professional determines that their test results are questionable or if they have an ear problem thought to be caused or aggravated by wearing hearing protectors. If the suspected medical problem is not thought to be related to wearing hearing protection, the employer must advise the employee to see a physician.

If subsequent audiometric tests show that the STS identified on a previous audiogram is not persistent, employees whose exposure to noise is less than a TWA of 90 dB may stop wearing hearing protectors.

The employer may substitute an annual audiogram for the original baseline audiogram if the professional supervising the audiometric program determines that the employee's STS is persistent. The employer must retain the original baseline audiogram, however, for the length of the employee's employment. This substitution will ensure that the same shift is not repeatedly identified. The professional also may decide to revise the baseline audiogram if the employee's hearing improves. This will ensure that the baseline reflects actual hearing thresholds to the extent possible.

## When Should an Employer Perform an Audiogram?

For **maximum protection of the employees** (and for that matter, the company), audiograms should be performed:

- During pre-employment;
- prior to initial assignment in a hearing hazardous work area;
- annually as long as the employee is assigned to a noisy job;
- at the time of reassignment out of a hearing hazardous job; and
- at the termination of employment.

In addition, it is suggested that employees who are not exposed be given periodic audiograms as part of the company's health care program. The audiograms of these employees can be compared to those of the exposed employees whenever the overall effectiveness of the hearing

conservation program is evaluated. In an optimally effective program, the two employee groups will show essentially the same amount of audiometric change.

### When are Employees Required to Wear Hearing Protectors?

Employees must wear hearing protectors:

- for any period exceeding 6 months from the time they are first exposed to 8-hour TWA noise levels of 85 dB or above, until they receive their baseline audiograms if these tests are delayed due to mobile test van scheduling;
- if they have incurred standard threshold shifts that demonstrate they are susceptible to noise; and
- if they are exposed to noise over the permissible exposure limit of 90 dB over an 8-hour TWA.

Employers should provide employees with a selection of at least one variety of hearing plug and one variety of hearing muffs.

### Noise Reduction Ratings (NRR)

Hearing protectors must adequately reduce the noise level for each employee's work environment. Most employers use the Noise Reduction Rating (NRR) that represents the protector's ability to reduce noise under ideal laboratory conditions. The employer then adjusts the NRR to reflect noise reduction in the actual working environment.

### Standard Threshold Shift (STS)

OSHA's definition of a standard threshold shift is a change, relative to baseline, of 10 dB or more in the average hearing level at 2000, 3000, and 4000 Hz in either ear.

NIOSH's definition of significant threshold shift is a 15 dB change at any of the frequencies 500, 1000, 2000, 3000, 4000, or 6000 Hz, demonstrated on a repeat audiogram for the same ear and same frequency, with the retest being administered immediately after the audiogram that showed the shift as compared to the baseline audiogram.

### What Training is Required?

Employee training is very important. Workers who understand the reasons for the hearing conservation programs and the need to protect their hearing will be more motivated to wear their protectors and take audiometric tests.

Employers must train employees exposed to TWAs of 85 dB and above at least annually in:

- the effects of noise;
- the purpose, advantages, and disadvantages of various types of hearing protectors;
- the selection, fit, and care of protectors; and
- the purpose and procedures of audiometric testing.

The training program may be structured in any format, with different portions conducted by different individuals and at different times, as long as the required topics are covered.

### What Exposure and Testing Records Must Employers Keep?

Employers must keep noise exposure measurement records for 2 years and maintain records of audiometric test results for the duration of the affected employee's employment. Audiometric test records must include the employee's name and job classification, date, examiner's name, date of the last acoustic or exhaustive calibration, measurements of the background sound pressure levels in audiometric test rooms, and the employee's most recent noise exposure measurement.

Employers are required to record work-related hearing loss cases when an employee's hearing test shows a marked decrease in overall hearing. Employers will be able to make adjustments for hearing loss caused by aging, seek the advice of a physician or licensed health-care professional to determine if the loss is work-related, and perform additional hearing tests to verify the persistence of the hearing loss.

### Management Responsibilities

Managers should support the audiometric evaluation phase by allocating sufficient resources. Management must ensure all employees (even mobile/itinerant workers) are included in the audiometric phase.

Management may opt to contract for audiometric services with an external source such as a mobile testing contractor or a local hearing clinic. Alternatively, management may choose to purchase audiometric equipment and train a company employee to perform audiometric testing on-site under the supervision of an audiologist or a qualified physician. The third option is to combine internal and external resources. The choice depends upon economic considerations as well as the size, policies, and geographical location of the company. If contract services are used, it is critically important that management still assign responsibility for overseeing the hearing conservation program to a key on-site individual.

All employees, not just those with threshold shifts, should receive prompt written summaries of their current hearing status from the professional reviewer. Employees also should receive summaries of their hearing trends over time, along with recommendations for further evaluation or any extra precautions needed, such as more careful use of hearing protectors.

## Module 6 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. **Employers must monitor all employees whose noise exposure is equivalent to or greater than a noise exposure received in 8 hours where the noise level is constantly _____ dB.**

    a. 80
    b. 85
    c. 88
    d. 90

2. **Employers must provide _____ audiograms within 6 months of an employee's first exposure at or above an 8-hour TWA of 85 dB.**

    a. annual
    b. baseline
    c. monthly
    d. yearly

3. **Employers must provide annual audiograms within _____ year of the baseline.**

    a. 2
    b. 1
    c. 3
    d. 4

4. **For maximum protection of the employees (and for that matter, the company), audiograms should be performed on the following occasions.**

    a. Pre-employment. Prior to initial assignment to hearing hazardous work area
    b. Annually, as long as the employee is assigned to a noisy job (a time weighted average)
    c. At the time of reassignment out of a hearing hazardous work area and at the termination of employment
    d. All of the above

5. **NIOSH's definition of significant threshold shift is a _____ dB change at any of the frequencies 500, 1000, 2000, 3000, 4000, or 6000 Hz, demonstrated on a repeat audiogram for the same ear and same frequency, with the retest being administered immediately after the audiogram that showed the shift as compared to the baseline audiogram.**

   a. 10
   b. 5
   c. 15
   d. 3

# Module 7: Hearing Conservation Program Audit (Optional)

## Introduction

Preventing occupational hearing loss is a complex matter, but it is often entered into without first assessing the assets available, the assets required, and the expected outcome of the program. Before any program to prevent hearing loss is put into place, or before any changes in an existing program are made, an audit should be performed on the system as it exists. Many companies decline to perform an audit because they either can't conceive of a need for it or don't recognize its value as the foundation of a successful program. A hearing conservation program audit should be considered as important to the outcome of the program as is a business plan to the success of the company.

## Program Evaluation Checklist, Can Serve Well

It is best to perform the audit from the top down, with administrative issues addressed first. In the United States, occupational safety and health programs historically have been driven by regulations. Thus, it is important to assure that the regulations for hearing conservation programs are being addressed by the program. At the same time, there needs to be a corporate recognition that addressing only regulatory issues will not create an effective program. Good safety and health practices need to be followed. The company policy must be developed and all who administer or participate in the program must be aware of the policies.

Decisions need to be made as to who is responsible for providing facilities and materials for the hearing conservation program. Decisions also need to be made about whom the program implementer or key person will be and guidelines for evaluating the effectiveness of that person need to be established. The role of supervisors in the program should be established. If front-line supervisors have a role, the role must be defined and procedures to notify supervisors and train them in their role should be established.

Hazard assessments should be addressed during the audit. The audit should determine if appropriate measurements have been taken. Methods should be developed to evaluate the results of hazard measurement. Who will notify employees and how they will be notified of the results of hazard measurement should be determined. It is important to identify the critical measurements that need to be taken and how often they should be repeated. A system should be developed to ensure that the results of hazard assessment are included in the affected employees' health records and into shop folders. The program implementer should also be aware of the assessment results.

Since the most effective means of preventing occupational hearing loss is to remove or control the hearing hazards, engineering and administrative controls should be evaluated heavily during

the audit. Hazard control priorities should be established. In the long run, addressing hazards in order from greatest to least will, over time, remove the hazards from the workplace. The cost-effectiveness of engineering and administrative controls must be considered in the audit. While it may not be feasible to control all of the hazards at once, it may be reasonable to resolve one or two situations per year until all have been addressed. Most companies will not have hazard control expertise in house and will have to rely upon outside consultants and contractors.

Provisions for the use of outside experts must be included in the audit.

Monitoring audiometry and related record keeping are critical parts of the hearing conservation program. Often, many companies assume that this is the simplest part of the program, and they are wrong. The training and experience of the supervisor of the audiometric testing program (this should be an audiologist or a physician) are important. It may be more efficient to contract out for the testing and record keeping services, but it will be necessary for the company's program implementer to be well versed in this aspect of the hearing conservation program regardless of who conducts the testing.

Among matters to be considered for an internally or externally managed company are quality of the audiograms, access to prior audiograms by persons performing hearing testing, training and certification of audiometric technicians, adequacy of the testing environment, methods for determining changes in hearing status, communication of test results to employees, and follow-up procedures for those employees showing shifts in hearing.

Regular testing of employees' hearing is the most effective means of ascertaining that hearing loss is being prevented. But, there will be employees whose hearing does change for the worse. It may become necessary to refer these employees for further testing and evaluation. The audit should address no less than the following: clear referral policies; agreement between the company and consulting audiologists or physicians as to the expectations from a referral; establishment of mechanisms to ensure that employees needing evaluation or treatment actually receive the service; timely and accurate transmission of records between the company and the consulting audiologist or physician; and guidelines for providing evaluation and treatment for hearing loss or ear disease determined to be not related to hazard exposure at work.

Those employees exposed to hazardous noise will need to use hearing protectors. While seemingly simple, this can become a complicated aspect of the hearing conservation program. The audit should address the criteria for determining whether or not the use of hearing protectors is required. Types of hearing protection and sources should be addressed and if not implemented in a policy, the person(s) responsible for making the decisions should be identified.

Hearing protectors need maintenance and replacement and how that is to be achieved should be a topic of the audit. The audit should also consider what to do about the employee who continues

to show increasing hearing loss even though using hearing protection. Lastly, the audit should address the employee who refuses to use hearing protection when it is required or who wishes to use self-provided protection.

An effective hearing conservation program ensures that employees and management receive training and educational experiences. The audit should address the frequency of the training, how the training is provided, and what the training emphasis will be. For example, training may be spaced over the year with some of it given by an instructor, some by reading materials, some by video tape or interactive computer program, and some by the audiometric technician at the time of the hearing test.

The audit will help the company determine the resources needed for training, identifying those easily accessible and those that must be acquired. Plans should be made in advance to evaluate the effectiveness of the hearing conservation program. Many companies find that after a couple of years of operating a program they have no idea if their efforts are having any effect. The audit should define what metrics will be used to determine if the program is successful or not. Once the metrics have been selected, the program implementer must make sure that all data collected support the evaluation strategy selected.

The hearing conservation program audit should be reviewed annually by the program implementer and appropriate managerial personnel. As the program grows and evolves, the audit will provide a mechanism to force into review all aspect of the program. By using the audit, it will be unlikely that any portion of the program will run ineffectively or incorrectly, since problems should be identified so that they may be remediated immediately.

## How Does Safety and Health Management System Assistance Help Employers and Employees?

Working in a safe and healthful environment can stimulate innovation and creativity and result in increased performance and higher productivity. The key to a safe and healthful work environment is a comprehensive safety and health management system. OSHA has electronic compliance assistance tools, or eTools, on its website that “walk” users through the steps required to develop a comprehensive safety and health program. The eTools are posted at **www.osha.gov**, and are based on guidelines that identify four general elements critical to a successful safety and health management system:

- management leadership and employee involvement;
- worksite analysis;
- hazard prevention and control; and

- safety and health training.

### Hearing Conservation Program Evaluation Checklist

## Training and Education

Failures or deficiencies in hearing conservation programs (hearing conservation programs) can often be traced to inadequacies in the training and education of noise-exposed employees and those who conduct elements of the program.

1. Has training been conducted at least once a year?
2. Was the training provided by a qualified instructor?
3. Was the success of each training program evaluated?
4. Is the content revised periodically?
5. Are managers and supervisors directly involved?
6. Are posters, regulations, handouts, and employee newsletters used as supplements?
7. Are personal counseling sessions conducted for employees having problems with hearing protection devices or showing hearing threshold shifts?

## Supervisor Involvement

Data indicates that employees who refuse to wear hearing protectors or who fail to show up for hearing tests frequently work for supervisors who are not totally committed to the hearing conservation programs.

1. Have supervisors been provided with the knowledge required to supervise the use and care of hearing protectors by subordinates?
2. Do supervisors wear hearing protectors in appropriate areas?
3. Have supervisors been counseled when employees resist wearing protectors or fail to show up for hearing tests?
4. Are disciplinary actions enforced when employees repeatedly refuse to wear hearing protectors?

## Noise Measurement

For noise measurements to be useful, they need to be related to noise exposure risks or the prioritization of noise control efforts, rather than merely filed away. In addition, the results need to be communicated to the appropriate personnel, especially when follow-up actions are required.

1. Were the essential/critical noise studies performed?
2. Was the purpose of each noise study clearly stated? Have noise-exposed employees been notified of their exposures and apprised of auditory risks?
3. Are the results routinely transmitted to supervisors and other key individuals?
4. Are results entered into health/medical records of noise exposed employees?
5. Are results entered into shop folders?
6. If noise maps exist, are they used by the proper staff?
7. Are noise measurement results considered when contemplating procurement of new equipment? Modifying the facility? Relocating employees?
8. Have there been changes in areas, equipment, or processes that have altered noise exposure? Have follow-up noise measurements been conducted?
9. Are appropriate steps taken to include (or exclude) employees in the hearing conservation programs whose exposures have changed significantly?

### Engineering and Administrative Controls

Controlling noise by engineering and administrative methods is often the most effective means of reducing or eliminating the hazard. In some cases engineering controls will remove requirements for other components of the program, such as audiometric testing and the use of hearing protectors.

1. Have noise control needs been prioritized?
2. Has the cost-effectiveness of various options been addressed?
3. Are employees and supervisors apprised of plans for noise control measures? Are they consulted on various approaches?

4. Will in-house resources or outside consultants perform the work?

5. Have employees and supervisors been counseled on the operation and maintenance of noise control devices?

6. Are noise control projects monitored to ensure timely completion?

7. Has the full potential for administrative controls been evaluated? Are noisy processes conducted during shifts with fewer employees? Do employees have sound-treated lunch or break areas?

### Monitoring Audiometry and Record Keeping

The skills of audiometric technicians, the status of the audiometer, and the quality of audiometric test records are crucial to hearing conservation program success. Useful information may be gathered from the audiometric records as well as from those who actually administer the tests.

1. Has the audiometric technician been adequately trained, certified, and recertified as necessary?

2. Do on-the-job observations of the technicians indicate that they perform a thorough and valid audiometric test, instruct and consult the employee effectively, and keep appropriate records?

3. Are records complete?

4. Are follow-up actions documented?

5. Are hearing threshold levels reasonably consistent from test to test? If not, are the reasons for inconsistencies investigated promptly?

6. Are the annual test results compared to baseline to identify the presence of an OSHA standard threshold shift?

7. Is the annual incidence of standard threshold shift greater than a few percent? If so, are problem areas pinpointed and remedial steps taken?

8. Are audiometric trends (deteriorations) being identified, both in individuals and in groups of employees? (NIOSH recommends no more than 5% of workers showing 15 dB Significant Threshold Shift, same ear, and the same frequency.)

9. Do records show that appropriate audiometer calibration procedures have been followed?

10. Is there documentation showing that the background sound levels in the audiometer room were low enough to permit valid testing?

11. Are the results of audiometric tests being communicated to supervisors and managers as well as to employees?

12. Has corrective action been taken if the rate of no-shows for audiometric test appointments is more than about 5%?

13. Are employees incurring STS notified in writing within 21 days? (NIOSH recommends immediate notification if retest shows 15 dB Significant Threshold Shift, same ear, and the same frequency.)

### Referrals

Referrals to outside sources for consultation or treatment are sometimes in order, but they can be an expensive element of the hearing conservation program, and should not be undertaken unnecessarily.

1. Are referral procedures clearly specified?

2. Have letters of agreement between the company and consulting physicians or audiologists been executed?

3. Have mechanisms been established to ensure employees needing evaluation or treatment actually receive the service (i.e., transportation, scheduling, and reminders)?

4. Are records properly transmitted to the physician or audiologist, and back to the company?

5. If medical treatment is recommended, does the employee understand the condition requiring treatment, the recommendation, and methods for obtaining such treatment?

6. Are employees being referred unnecessarily?

### Hearing Protection Devices

When noise control measures are not feasible, or until such time as they are installed, hearing protection devices are the only way to prevent hazardous levels of noise from damaging the inner

ear. Making sure that these devices are worn effectively requires continuous attention on the part of supervisors and program implementers as well as noise-exposed employees.

1. Are hearing protectors made available to all employees whose daily average noise exposures are 85 dBA or above? (NIOSH recommends requiring HPD use if noises equal or exceed 85 dBA regardless of exposure time.)

2. Are employees given the opportunity to select from a variety of appropriate protectors?

3. Are employees fitted carefully with special attention to comfort?

4. Are employees thoroughly trained, not only initially but at least once a year?

5. Are the protectors checked regularly for wear or defects, and replaced immediately if necessary?

6. If employees use disposable hearing protectors, are replacements readily available?

7. Do employees understand the appropriate hygiene requirements?

8. Have any employees developed ear infections or irritations associated with the use of hearing protectors? Are there any employees who are unable to wear these devices because of medical conditions? Have these conditions been treated promptly and successfully?

9. Have alternative types of hearing protectors been considered when problems with current devices are experienced?

10. Do employees who incur noise-induced hearing loss receive intensive counseling?

11. Are those who fit and supervise the wearing of hearing protectors competent to deal with the many problems that can occur?

12. Do workers complain that protectors interfere with their ability to do their jobs? Do they interfere with spoken instructions or warning signals? Are these complaints followed promptly with counseling, noise control, or other measures?

13. Are employees encouraged to take their hearing protectors home if they engage in noisy non-occupational activities?

14. Are new types of or potentially more effective protectors considered as they become available?

15. Is the effectiveness of the hearing protector program evaluated regularly?

16. Have at-the-ear protection levels been evaluated to ensure that either over or under protection has been adequately balanced according to the anticipated ambient noise levels?

17. Is each hearing protector user required to demonstrate that he or she understands how to use and care for the protector? The results documented?

### Administrative

Remaining organized and current on administrative matters will help the program run smoothly.

1. Have there been any changes in federal or state regulations? Have the hearing conservation program's policies been modified to reflect these changes?

2. Are copies of company policies and guidelines regarding the hearing conservation program available in the offices that support the various program elements? Are those who implement the program elements aware of these policies? Do they comply?

3. Are necessary materials and supplies being ordered with a minimum of delay?

4. Are procurement officers overriding the hearing conservation program implementer's requests for specific hearing protectors or other hearing loss prevention equipment? If so, have corrective steps been taken?

5. Is the performance of key personnel evaluated periodically? If such performance is found to be less than acceptable, are steps taken to correct the situation?

6. Safety: Has the failure to hear warning shouts or alarms been tied to any accidents or injuries? If so, have remedial steps been taken?

# Module 8: Policy Needs (Optional)

## Policies Management Must Address

1. Corporate environment should promote a safety culture where the employees are empowered to protect their own health and to facilitate the protection of the health of fellow workers.

2. Program policies should be based on effective practices rather than on minimum compliance with government regulations.

3. The hearing conservation program must be a functional part of the overall company safety and health program. It should not be a stand-alone, separately-budgeted operation.

4. A key individual (referred to as the program implementer during this course) should have ultimate responsibility for the program. This person may not necessarily perform all of the functions of the hearing conservation program, but is in charge of the overall program. Experience with successful hearing conservation programs shows that a single individual often makes the crucial difference between success and failure. This person is often a nurse or an audiometric technician, but may be a safety and health officer, a supervisor, or a designated employee. This program implementer acts as the conscience and champion of the hearing conservation program. He or she focuses the attention of both management and employees on the hearing conservation program's policies and ensures that they take the necessary steps to implement them. The program implementer should also have stature in the hearing conservation program's organizational chart, with authority to make decisions, correct deficiencies, and enforce necessary actions.

5. The program implementer should work with management and employees to develop and implement hearing loss prevention plans and policies for an effective program. As a team leader, the program implementer should be given the authority to establish hearing loss prevention provisions that meet or exceed the letter and intent of OSHA’s noise control and hearing conservation regulations.

6. Employee and administrative compliance with the company's hearing conservation program policies and procedures should be a condition of employment.

7. Hearing conservation program policies should clearly describe standard operating procedures for each phase of the program. Specific policy statements should be developed for the important elements of the program. For example, it should be company policy to require the participation of all noise-exposed employees in the audiometric program and

to require the consistent and proper wearing of hearing protectors in posted areas, even if employees or supervisors are only passing through these areas. These requirements should be conditions of employment. Other important policy statements should be written to cover:

a. Adopting a prescribed schedule for monitoring of employee noise exposure levels and other risks, including ensuring that equipment and personnel training are appropriate to the task.

b. Counseling of employees immediately following each audiometric test, whether it is the initial, annual, retest, threshold-shift confirmation, or termination examination.

c. Determining the adequacy and correct use of hearing protection devices by on-site equipment checks.

d. Educating, training, and motivating employees to support the company's hearing conservation program provisions; assessing employee attitudes and assessing knowledge gained from periodic training.

e. Establishing a program of quality assurance for the performance of audiometry and management of audiometric records.

f. Reviewing audiometric data to verify the effectiveness of the hearing conservation program.

g. Encouraging employees to use company-provided hearing protectors for off-the-job exposure.

h. Purchasing hearing protectors, audiometers, noise measuring equipment, and quieter machinery. This policy should address the reasons why the program implementer responsible for the hearing conservation program, not the purchasing department, should have final decision about anticipated purchases.

8. Companies may have varying needs for services which they cannot undertake with in-house staff. These can include noise surveys, employee education, audiometric testing, medical counseling, or the fitting of hearing protection devices. Outside vendors or contractors should be selected carefully so their services complement the abilities of the company staff and functional conduct of the in-house program elements. Vendors must understand and agree to abide by the company's hearing conservation program policies and standards of operation. On-site personnel must supervise contractors to make sure

they carry out their obligations. Regardless of whether outside vendors or contractors are used, responsibility for the program stays with the program implementer.

Companies that issue clearly defined hearing loss prevention policies, and then adhere to these policies consistently, will have smoothly running hearing conservation programs. Employees will be fully informed, will comprehend their functional role, and will know what is expected of them. Equipment will be appropriate, hearing protection will be used by the right people in the right places, and the program elements will be implemented in a timely fashion.

### Setting Up Training Sessions

Management must emphasize the importance of the educational phase of the hearing conservation program by setting a high priority on and requiring attendance at regular hearing loss prevention training sessions. Training sessions should be mandatory not only for noise-exposed employees, but also for the supervisors and managers responsible for noisy production areas. A manager should participate in each employee training session to outline company policies and to explain and model the company's commitment to the hearing conservation program. The training program should consist of more than films and pamphlets. It must be tailored to the company's particular hearing loss prevention needs, and should include live presentations by articulate and knowledgeable speakers and hands-on practice sessions with hearing protectors.

Hearing loss prevention presentations should be updated and presented at least annually or more frequently if there is a significant turnover in employees. In addition to training sessions focused specifically on hearing loss prevention, management should also require the inclusion of hearing health topics in regularly-scheduled general safety meetings. These general meetings may be brief "reminder" meetings held weekly or monthly that also serve to inform workers about progress made toward meeting the goals of the company's various safety programs. In this way, hearing health will become an integrated part of the overall health and safety climate of the workplace.

Management should make sure that the hearing conservation program's staff (audiometric technicians, hearing-hazard assessors, noise control experts, those who fit and issue hearing protection devices, and supervisors) have received detailed instructions in hearing loss prevention so that they are qualified to lead employee training sessions and comfortable with answering employees' questions. Individuals who make the main presentations in the formal educational programs must be carefully selected to project genuine interest in the employees' welfare, and they must be speakers capable of gaining the employees' attention and respect. Peers can be particularly influential, and should be utilized whenever possible.

*For example, a senior worker who has sustained a hearing loss may be willing to share stories about his/her frustrations with communication difficulties in day-to-day activities.*

A powerful testimonial and behavioral modeling from a respected co-worker can be extremely effective in convincing other workers to improve their hearing loss prevention behaviors.

The periodic hearing loss prevention training sessions are best structured in small groups. Often groups will consist of a supervisor and the employees in that production unit. Because these individuals will have common noise exposures, they will fall under a common hearing protector policy, and they often feel comfortable enough with each other to ask questions freely and make constructive comments. Management must ensure that the questions and concerns raised during educational sessions receive thoughtful and prompt follow-up.

In some situations, it may be best to arrange separate educational sessions for employees and supervisors/managers of noisy departments. This will permit each group to discuss concerns relevant to their respective needs and responsibilities. However, at some point, representatives of both groups will need to work together to resolve concerns and implement the hearing conservation program. If necessary, a neutral facilitator can be chosen to assist in the process by attending both groups' meetings. This facilitator might be the company health and safety professional or an outside consultant hired by the company to assist with the training and motivation phase of the program.

### Program Implementer Responsibilities

Because the program implementer is usually responsible for planning the educational sessions, and in some instances, may be the appropriate person to conduct sessions, it is extremely important that the program implementer have training that is current and relevant to the hearing conservation program. The type of training that the program implementer will need is often available at state, regional, and national conferences sponsored by safety or hearing conservation associations.

The program implementer should plan sessions that are limited in content to short, simple presentations of the most relevant facts. When stressing health promoting behaviors (such as consistently wearing hearing protection while working in noise) research suggests that the focus should be on the real-life losses employees might expect if they don't act to protect their hearing. They might not be able to hear children's voices. They might not understand speech at a party, enjoy music and the sounds of nature, or perceive sounds that may convey other critical information—such as danger or equipment malfunctions.

Another useful approach might be to explain audiometric results so employees can see how their hearing threshold levels compare to those of non-noise exposed individuals with normal hearing in their own age group. Once employees agree upon why they need to conserve their hearing and how to monitor their audiogram results, the remainder of the program can focus on how to

protect their hearing on and off the job through the effective use of hearing protection devices and good maintenance of engineering noise controls.

The program implementer needs to ensure that presenters tailor education and motivation sessions to each particular group of employees and their supervisors. It is important to accurately describe the group's noise exposures, the group audiometric results, the options available to them with respect to hearing protection devices, and the engineering controls in place or planned for their department. Other topics may include progress reports on the status of specific elements of the hearing conservation program, comparisons of company-wide audiometric results, reports on the use of hearing protectors by department, and responses to questions or concerns expressed by employees. Materials should be updated every year. New multimedia materials such as interactive computer-based training may be considered for use.

Program implementers should ensure that films and pamphlets are used only as supplementary reinforcements for the live presentations, never as the whole program. Whenever possible, hands-on activities will facilitate learning. For example, workers can break into teams or small groups, and partners can help each other practice fitting various types of hearing protectors. Similarly, workers could initially break into small groups to brainstorm solutions to a particular noise problem in the plant, and then reconvene as a complete group to discuss the options and select a solution that is agreeable to the group. In this type of meeting, the program implementer would act as facilitator; guiding the workers through the various components of the meeting and coordinating the presentation of each group's suggestions.

Aside from formal educational presentations, program implementers should use every chance to remind employees and supervisors of the importance of the hearing conservation program and their active participation in it. One of the greatest opportunities to influence employee attitudes about hearing loss prevention occurs at the time of the annual audiometric test, when the program implementer or technician can compare the current thresholds to past results and check the fit and condition of hearing protection devices. Praise for employees with stable hearing and cautions for those with threshold shifts are effective if the comments come from a sincere and knowledgeable individual.

Contrary to the approach suggested above for promoting prevention behaviors, research has suggested that when faced with detecting a health problem that may have already occurred (i.e., discovering a hearing loss), workers may respond best at this time to health messages stressing what they have to gain by engaging in behaviors that will preserve their remaining good hearing. Program implementers in this situation should stress how employees can act to *maintain their ability to hear* music, voices, warning signals, etc.

In effective hearing conservation programs, the program implementers interact with employees more than just once a year. They ask questions and make comments about the hearing

conservation program whether meeting workers on the plant floor or in the halls and cafeteria - wherever contact is made. The goal is to make the hearing conservation program a visible and ongoing concern.

### Rewards and Punishments

In the past, it has been very popular to suggest that management should reward workers who wear their hearing protectors and punish those who do not. In reality, research has noted that managers are sometimes greatly disappointed with the results of this type of behavior modification approach. Sometimes reward and punishment systems can foster destructive competitiveness between workers in a group as well as bitter animosity between work groups and the managers who supervise them. Specific rewards can lose their appeal over time, sometimes requiring management to continually "sweeten the pot" to maintain the desired behaviors.

Additionally, management-designed reward systems can damage employee's self-esteem and intrinsic motivation for performing their work well. This can lead to lowered productivity, declining quality of work, and a lack of motivation to apply oneself in that work situation. Workers who minimally follow the rules and put in their time may have simply decided that they have little personal responsibility for their contribution on the job. This type of apathy leads to negative attitudes toward work and the health programs associated with work, including hearing loss prevention.

There is a great amount of literature discussing the importance of an individual's perceptions of personal control in a wide variety of situations. It suggests that one reason why rewards sometimes fail to maintain desired behaviors is that workers perceive that they have little real control over their work and that management's system of doling out rewards and punishments controls their behavior on the job in a manipulative manner.

Similarly, there are well documented negative side effects of relying on punishment to discipline workers for infraction of safety rules. While punishment may stop or discourage undesirable behavior when the behavior is closely monitored, it does not directly encourage desirable behaviors. Furthermore, in many settings, the punisher is also the person (usually a supervisor or the program implementer) who is responsible for administering rewards. This creates a difficult situation that might seriously diminish the effectiveness of rewards.

If an incentive system is in place or desired by management and the workers, a successful program can be developed with care. Both management and employees should agree on specific goals for the program. Both groups should work together to choose the rewards and sanctions that will apply to the program. As much as possible, the affected workers should set up the system and enforce it; otherwise management may damage the motivation and morale of the

workers with inappropriate and unnecessary controls. In this way, workers can be encouraged to assume as much responsibility as feasible for their health and their work environment. They will look out for and police each other. This "bottom-up" approach is more likely to build camaraderie and group commitment to safety than the traditional "top-down" management centered approaches of the past.

## Recordkeeping

Records quite often get the least attention of any of the hearing conservation program's components. But audiometric comparisons, reports of hearing protector use, and the analysis of hazardous exposure measurements all involve the keeping of records. Unfortunately, records are often kept poorly because there is no organized system in place, and in many cases, those responsible for maintaining the records do not understand their value. People tend to assume that if they merely place records in a file or enter them into a computer, adequate record keeping procedures are being followed.

Many companies have found that their record keeping system was inadequate at the moment accurate information was most needed. This has often occurred during the processing of compensation claims. Problems can be avoided by implementing an effective record keeping system, in which: 1) management encourages that the system be kept active and accessible, 2) hearing conservation program implementers make sure that all of the information entered is accurate and complete, and 3) employees validate the information.

Hearing conservation program records should include all items for each phase of the program: 1) hearing loss prevention audit, 2) monitoring hearing hazards, 3) engineering and administrative controls, 4) audiometric evaluation, 5) personal hearing protective devices, 6) education and motivation, and 7) program evaluation. Each phase generates its own form of records, and the information from the various records must be considered in order to evaluate the effectiveness of the hearing conservation program.

## Management Responsibilities

Management should make available the facilities to store records and should provide sufficient resources to process them quickly and accurately. The forms or computer format used to gather information is the foundation of a good record keeping system. These forms should be designed so that necessary actions are triggered and then documented. If a company does not have the available resources to design a hearing loss prevention record keeping system compatible with the general safety and health record system, the company should turn to consultants for assistance.

Because hearing conservation program records can be complex, management should see that program implementers are fully trained in the record keeping system and its function. There should be working copies of records as well as archived copies. If an outside contractor keeps the records, a method should be established to ensure that original records are accurate, and are returned and entered into the company's files in a timely fashion. Hearing loss prevention records are medical records and, as such, deserve the same level of integrity and confidentiality as other medical records. The company needs to make sure that these records are accessible only to program implementers, affected employees or their designated representatives, and government inspectors.

Increasingly, companies maintain all of their employee health and safety records in a computer system. The use of computers supports easy access and storage of data, provides for automatic triggering of actions based on the data contained in the records, and generates hard copies to be maintained as archives. Prudent managers will see that original copies of records pertaining to individual audiometry and hazard exposure monitoring are retained in personal medical or industrial hygiene folders. The records should be made available at the time of audiometric testing.

Having the audiogram available will allow an instantaneous check of the new audiogram with the others on record so that checks for threshold shift can be made and so that the reliability of the new audiogram can be assessed. Having information about hearing hazard exposure, hearing protector use, and related information available will allow the tester to make an accurate and timely report to the employee of the outcome of the evaluation as well as conduct the one-on-one training that is so important to hearing conservation program success.

While management may provide the record keeping system and the necessary resources, the program implementers must ensure that the system works. The most important attributes of an effective record keeping system are **standardization, maintenance, integration, and documentation**.

Standardization ensures commonality and consistency of data and format. Maintenance keeps records current and accurate. Integration of the recorded information allows the program implementer to assess the impact of the program on employees' hearing. Documentation of hearing conservation program elements permits analysis of long-range implications since cause-effect relationships associated with hazardous exposure levels only become evident over time.

Program implementers may wish to consider the following rule of thumb regarding how long records should be kept: Keep all records until you leave – then let the next person decide how long to keep the records. More practically, records should be kept for the length of employment

plus 30 years, just as is standard practice with medical records. Thus, it is important for the program implementer to have resources for adequate records storage facilities be they computer based or in hard copies.

In addition, a working group of the American National Standards Institute has drafted guidelines for analyzing audiometric data to evaluate hearing conservation program effectiveness–ANSI S12.13, Draft Standard for Evaluating the Effectiveness of Hearing Conservation Programs. The procedures of this standard are most useful in determining that the audiometric data are consistent and lack much variability; that the database has integrity. If year-to-year audiograms show changes that are due to poor audiometry and not to changes in hearing, it will be impossible to use the audiometric data to determine whether or not the hearing conservation program is successful.

The domain of hearing loss prevention embraces many technical disciplines: hearing science, audiology, industrial hygiene, occupational health, psychology, sociology, electroacoustics, and mechanical engineering, to name a few. Each of these is a dynamic specialty. Within any of these fields, what constituted "standard practice" only a few years ago is unlikely to be today's standard. It follows that today's standards will also evolve. Because hearing loss prevention represents the integration of many vibrant elements, it too, must change.

# Module 9: The Future of Hearing Loss Protection (Optional)

## Introduction

Present approaches for storing and retrieving hearing loss prevention records work well in some, but not all situations. Many workers (e.g., construction workers) routinely move from job to job. Other workers may do part time work, work that is migratory in nature, or be self-employed. Traditional record management techniques may be impractical for these workers.

Emerging information management hardware and software can provide solutions to the problems associated with managing the records of a mobile or migrant workforce. In particular, optical cards, or memory sticks may be useful in developing hearing conservation programs that serve these workers. Historically, such workers have, at best, had access to personal hearing protective devices. Perhaps a fortunate minority may have even received training in the use and care of their hearing protectors. They almost certainly would not have been served by an audiometric monitoring component of a hearing conservation program.

By its very nature, audiometric monitoring is a long-term process. Recall that current hearing conservation programs are site-based; all aspects of the program stay with the site. If a worker leaves, their audiometric and noise exposure records remain at the site. By contrast, an optical card or memory stick will be in the possession of the worker. When the worker changes jobs, the worker will carry their "records" to the next job. The continuity of care for a worker would be assured whether they received hearing health services from one or many occupational health care providers. Such continuity of care would make it reasonable to establish an audiometric baseline and monitor the hearing of a mobile or migrant worker. Finally, optical cards and memory sticks can enable the development of creative approaches in which either the worker or management or both adopt responsibility for procuring audiometric test services.

## Holistic Approach: Looking at Factors Other Than Noise

Occupational hearing loss prevention has focused almost entirely on the prevention of disorders due to noise exposure. Since noise has been one of the most widespread occupational hazards, this attention has been justifiable. However, other factors may affect hearing or interact with noise. Many environmental hazards are usually observed in work environments. Combined with other organizational and psychosocial stressors, they are potentially hazardous to health. It has been observed that a worker may be exposed to as many as nine concurrent hazards, and the average worker is exposed to 2 to 3 hazardous agents simultaneously. Even considering only chemicals, the number of agents used and possible combinations is substantial. It may be inappropriate to restrict the term occupational hearing loss to a synonym for noise induced hearing loss, even though the two terms previously have been used as such. Ototoxic (Damage to the ear (oto-), specifically the cochlea or auditory nerve and sometimes the vestibular system, by

a toxin.) properties have been identified among at least three classes of industrial chemicals: metals, solvents and asphyxiants. The indication that occupational chemicals could alter auditory function by either ototoxicity, neurotoxicity, or a combination of both processes, has serious implications.

It is plausible to expect that if these chemicals were present in the workplace in sufficiently high concentrations; these could affect hearing despite the lack of occupational exposure to noise. It is important that those involved in hearing loss prevention take into account exposure to chemicals during the various phases of the process (monitoring for hazards, assessing hearing, controlling exposures).

Currently, ototoxic properties of industrial chemicals and interactions between them and noise have only been investigated for a very small number of substances. This poses an obstacle for the appraisal of risk. When specific ototoxicity information is not available on the chemical in question, the program implementer should then gather information on the agent's general toxicity, neurotoxicity and complaints from exposed populations. As the ototoxic properties of chemicals are more thoroughly explored, it may be advisable to derive new hearing damage risk criteria that address the risk associated with exposure to noise and/or chemicals.

### Task-Based Exposure Assessment

For many workers, (e.g., those in the construction trades) an 8 hour time-weighted average (TWA) represents a complex mixture of events. While the TWA is an extremely useful metric, it may be of limited use in predicting the exposure of workers with frequently changing environments and/or who perform multiple tasks of variable duration. The Task-Based Exposure Assessment Model (T-BEAM) may prove useful in developing a rational approach for health and safety professionals who must deal with these types of noise exposures. The T-BEAM concept uses work tasks as the central organizing principle for collecting descriptive information on variables used to assess the hearing hazard for a worker. T-BEAM methods are also being developed not only to characterize hazardous noise, but also the hazards associated with occupational exposures to asbestos, lead, silica, and solvents.

To apply the T-BEAM process, the hazardous agent to be studied is first identified - in this case, noise. Next, "experts" (e.g., journeymen), who are familiar with the processes associated with a given occupation, developed a list of tasks associated with each process. This becomes the basis for a hazardous task inventory which may then be used in developing approaches for surveying the tasks. The results of the ensuing task surveys are then applied towards developing intervention strategies. As might be the case with traditional surveys, the results could be used to prioritize candidates for engineering controls as well as for assessing tasks where engineering controls have already been applied. Because a T-BEAM survey is focused on tasks instead of shifts

or areas, the survey results can be used to protect workers from hazards associated with specific tasks.

**Example:**
*Consider the case of a worker who frequently changes job sites and whose main noise exposure comes from the intermittent use of power tools or machinery. Assume the worker's equipment produces a 100-dB(A) noise level. Under present OSHA guidelines, a two-hour cumulative exposure would equate to a 100% dose. Continuing with this example, assume that some days the worker uses this equipment for two hours or more. A hazard survey conducted on such days would identify this worker for inclusion in a hearing loss prevention program. A hazard survey conducted on other days might not. In situations such as these, the task rather than the shift should be the focus of intervention strategies. This approach is conceptually similar to how other intermittent noise exposures are addressed.*

**Example:**
*A police officer may only be exposed to hazardous noise in the course of periodic weapons training. Nevertheless, during weapons training the officer is provided hearing protectors, instructed in their proper use and may well be enrolled in an audiometric monitoring program. Many manufacturing operations require persons walking through hazardous noise areas to wear hearing protectors. The point is, a singular focus on the time-weighted average should not be the sole basis for decisions regarding hearing loss prevention measures. Workers engaged in tasks in which they are routinely exposed to hazardous noise or ototoxic agents should be included in hearing loss prevention activities.*

The above examples point to the need for an alternate method for use in situations where current dosimetry or area monitoring may not identify workers exposed to hazardous noise. Current studies are assessing approaches for developing hazardous task inventories for individual occupations and crafts within the construction industry. To be effective, a hazardous task inventory must classify distinctive tasks, should quantify time-to-task parameters, and be able to account for the effects of adjacent noise. If research demonstrates T-BEAM methods are effective, hazardous task inventory's can be used to establish databases representing the occupational hazards associated with many trades. Such databases would enable one to characterize a worker's exposure profile without requiring an individual hazard assessment survey.

Although, at least for noise, the exposure profile may not be able to predict the specific exposure for an individual worker, it still may be possible to categorize a worker as having no risk, having some risk, or having substantial risk of hazardous noise exposure. Such categorization could be used to select an efficient intervention strategy based on and tailored to the degree of risk predicted for the worker.

## New Directions in Theories about Self-Protective Behavior

With a wealth of research and published information available to guide the development of effective hearing conservation programs, why do some workers in apparently quality programs simply fail to protect themselves? In the past, popular models of health behavior such as the Health Belief Model and the Theory of Reasoned Action have tried to explain this phenomenon by tending to emphasize characteristics and beliefs of the individual worker.

For example, a particular worker might hold attitudes or beliefs that conflict with the principles of the safety program, e.g., "I'm not susceptible to noise-induced hearing loss, so why bother with protectors" or "Protectors interfere with warning signals...better to be deaf than dead!" While still useful as integral parts of newer models, these person-centered models have not adequately addressed many other factors now known to contribute to safe work behavior.

Newer models of health behavior currently under development stress interdisciplinary viewpoints and may contain parameters that focus on the interaction of environmental, psychological, and social determinants of behavior. Social aspects such as shared values and beliefs, the social relationship in which a specific behavior occurs, and the physical context of the behavior have taken on new importance. In particular, the issue of "safety climate" in the workplace is receiving renewed interest. Safety climate can be broadly defined as the general level of safety awareness and commitment among management and workers in the organization. The safety climate guides relevant behavior in the workplace by serving as a central point of reference for decision-making by workers and management about safety concerns.

One recent report has attempted to incorporate safety climate into a model of employee adherence to safety precautions. In this model, organizational safety climate depends upon such factors as explicit company safety policies and organizational attitudes and responses toward safety concerns. Worker characteristics (such as knowledge about health risks), availability of personal protective equipment in the work area, provision of employee feedback with respect to adherence to the safety program, and the social and physical environment of the workplace also contribute to worker adherence to safety practices.

In a study of medical personnel and adherence to universal precautions (to protect against HIV transmission), it was noted that providing extensive knowledge-based training and adequate supplies of personal protective equipment was not enough to lead to greater adherence to universal precautions (DeJoy, et al., 1995). Maximal adherence depended upon establishing an organizational safety climate, embraced by the workers as well as management that supported and fostered strict adherence to safety precautions.

Such a climate develops when management and workers take ownership for their safety program, and thereby facilitate and reinforce its provisions. Many prior studies designed around the health belief/promotion models have noted that perceived barriers or job hindrances have a strong influence on worker adherence to safety rules. In this new model, it was reported that "Job hindrances was the strongest predictor of adherence to universal precautions, and safety climate was the best predictor of job hindrances."

Most hearing loss prevention professionals agree that passive protection of workers from hearing loss by applying engineering controls to diminish hazards in the workplace is a preferred approach. However, in many occupational settings, protecting the workforce from hearing loss and other occupational hazards ultimately depends upon personal protective equipment (e.g., personal hearing protectors) and the voluntary actions of the hazard-exposed workers.

Training programs for these workers will continue to be very important, but the expanding research findings suggest that such programs may need to include more than factual presentations about mechanisms involved in hearing loss and how to properly wear personal protective equipment. Training programs in the future may increasingly concentrate on 1) modifying the organizational climate, and 2) providing workers with the skills and strategies they need to take responsibility for managing their own health by collectively uncovering and reducing barriers to safe work behavior.

## Additional Resources

1. Glossary of Terms
2. Hearing Conservation - OSHA
3. Noise and Hearing Loss Prevention - NIOSH
4. Occupational Noise Exposure
5. OSHA Technical Manual - Noise, OSHA
6. Work Related Hearing Loss - NIOSH

# Endnotes


1. Occupational Safety and Health Administration. (2002). Hearing Conservation. Retrieved from: https://www.osha.gov/Publications/OSHA3074/osha3074.html

2. National Institute for Occupational Safety and Health. (8/2015). Noise and Hearing Loss Prevention. Retrieved from: http://www.cdc.gov/niosh/topics/noise/stats.html

3. Occupational Safety and Health Administration. (2014). Safety and Health Topics: Occupational Noise Exposure. Retrieved from: https://www.osha.gov/SLTC/noisehearingconservation/

4. Occupational Safety and Health Administration. (8/2013). OSHA Technical Manual (OTM): Appendix E-Noise Reduction Rating. Retrieved from: https://www.osha.gov/dts/osta/otm/new_noise/appendixe.pdf

5. Centers for Disease Control and Prevention. (2001). DHHS (NIOSH) Publication Number 2001-103: Work Related Hearing Loss. Retrieved from: http://www.cdc.gov/niosh/docs/2001-103/

6. CDC A-Z Index of Terms