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Noise: Health Effects and Controls

Outline

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5. Monitoring Noise Levels
6. Controlling Noise Levels
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Objectives

Participants will be able to:

1. Recognize the health effects of being exposed to high levels of noise.
2. Describe how a sound level meter works.
3. Discuss the basic Cal/OSHA limits for noise.
4. Describe basic components of a hearing conservation program.

Noise Health Effects and Controls

What is Noise? Is conversation with friends and family noise? Is music noise? Is a factory machine running at high-speed noise?

The only difference between music and factory sounds is whether the sound is desired. In most cases the music is wanted sound and the factory noise is unwanted sound. Noise is defined as "unwanted sound."

There are many sources of noise in the workplace. These include machinery which has moving parts and metal-on-metal contacts; vehicles; pumps and compressors; air hoses; and many others.

However, even the most desired music can be just as damaging to the human ear as the worst factory noise. The health effects depend on the loudness of the sound, not whether the sound is wanted or not.

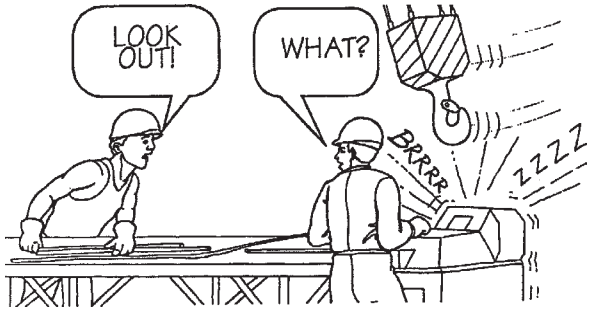
How Much is "Too Much" Noise?

Simple ways of determining if noise levels at work are too high include:

- if you have to yell or speak loudly to be understood at an arm's length away from someone else
- if your ears are ringing when you leave the area
- if you have difficulty hearing a normal conversation after work
- if you get headaches or feel dizzy from the noise
- if any of your co-workers also have these problems or have been diagnosed by a doctor with hearing problems

Health Effects of Noise

High levels of noise can have both immediate and long-term effects on hearing. High noise levels can cause:



- hearing loss, both temporary and permanent
- headaches
- dizziness
- high blood pressure
- nervousness and stress leading to stomach ulcers, sleeping problems, heart disease
- loss of concentration
- accidents if warning alarms or shouts are not heard.

The level of damage to the ear can be determined by hearing tests called "audiograms." Loss of hearing in the range of sound where human speech occurs (between 2,000 and 4,000 Hertz) has temporary and permanent effects.

Some Other Hazards of Noise

A Noisy Work Environment Contributes to Accidents

Cal/OSHA Noise Standard is set to protect workers from permanent hearing loss. However, noise levels below OSHA permissible limits can impact people's ability to carry out an assigned task, by causing anxiety or fatigue.

Noise can increase human error, contributing to accidents by:

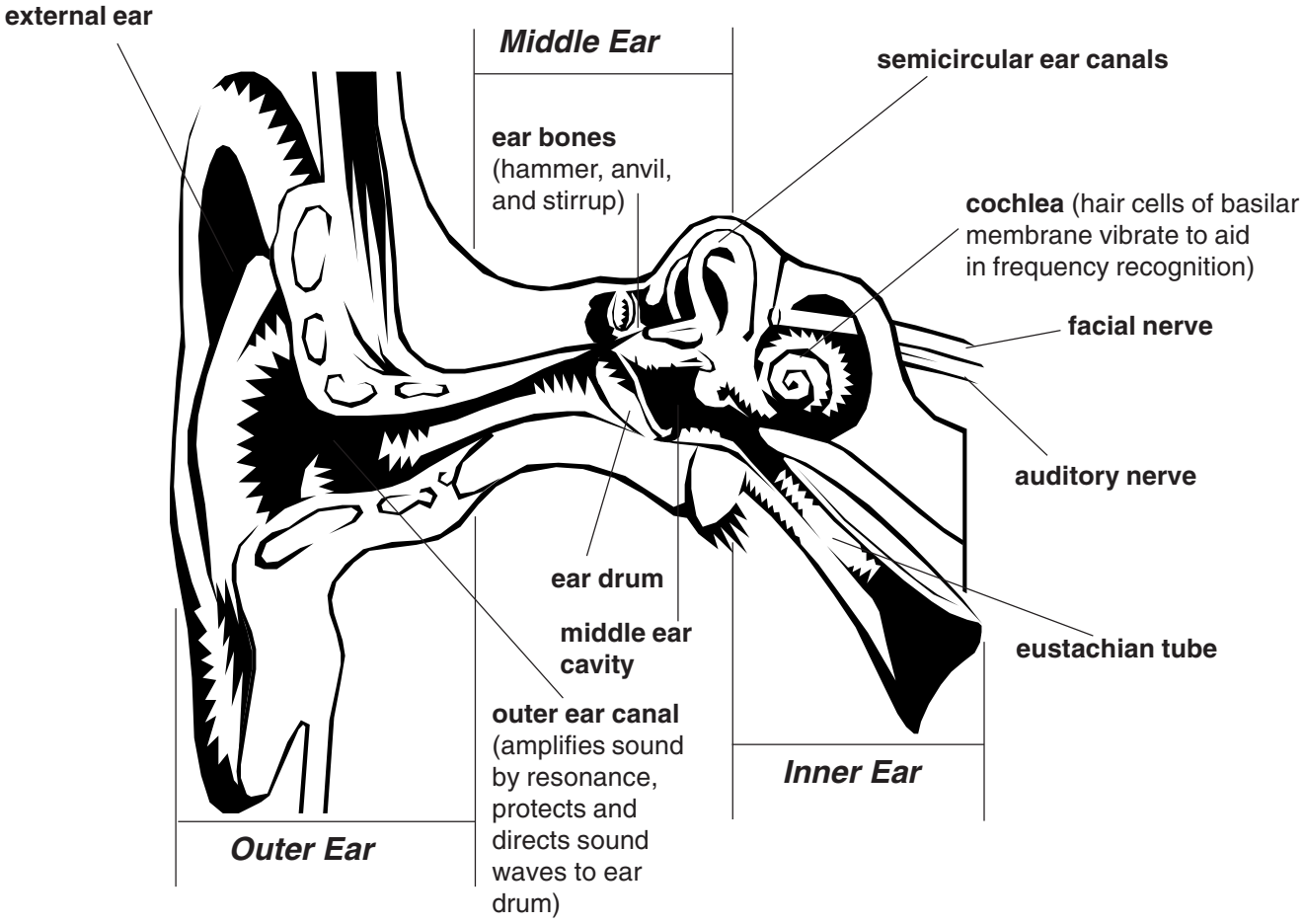
- "masking" audible alarms, verbal messages, etc.
- increasing worker fatigue and anxiety
- harder to process complex info for difficult tasks
- harder to monitor and interpret unusual events, by narrowing the span of attention.

Noise May Contribute to Heart Disease

Exposure to loud noise can cause the blood vessel to constrict. This makes the heart work harder to pump the same amount of blood around. Through the years, this may contribute to heart disease.

Anatomy of the Ear

The anatomy of the ear consists of the outer ear, the middle ear and the inner ear.



Ear Canal Cross Section

There is a spiral-shaped bone in the inner ear called the cochlea, which is lined with tiny hair cells. Sound waves are transmitted via the outer ear, through the middle ear, to the inner ear. In the inner ear, the sound wave pressure moves the hair cells, which then send messages to the brain, via the nervous system, about the sounds heard by the ear.

High noise levels will damage the hair cells in the inner ear and reduce the ability of the ear to "hear" sounds and transmit the information to the brain. Once the hair cells in the inner ear have been damaged, there is no way to repair the damage.

HEARING LOSS IS PERMANENT!

Measuring Noise Levels: What Are Decibels?

Decibels

Noise is measured in units called "decibels" which is a measure of how much pressure is created by the sound wave producing the sound. The range of decibels is from 0 to about 140, or from the smallest sound human ears can hear to the sound level that will do immediate and permanent damage to the ear. The word "decibels" is abbreviated as "dB" and there are three scales – A, B and C – but the scale closest to human hearing is the A scale or "dBA."

0 dB —— Minimum level needed to hear a sound

10 dB——A whisper; leaves blowing in the wind

40 dB——A quiet office

70 dB——A traffic jam

90 dB——Heavy machinery

130 dB——A jet engine at 10 meters

Monitoring Workplace Noise Levels

Two kinds of measurements can be taken to determine noise levels in the workplace.

Direct Reading Instruments

A "direct-reading" instrument called a "sound level meter" is used to measure sound at one particular moment. Usually sound level meter readings are taken to identify areas where noise levels appear to be higher than the occupational exposure limit, 85 dBA.

Personal Dosimeter

A "personal dosimeter" is used to determine the amount of sound the worker hears over the entire work shift. This should cover the entire work shift—8, 10 or 12 hours, or however long the shift is. The dosimeter is placed on the worker's belt and a small

microphone is located near the worker's ear. The dosimeter measures the amount of sound the worker hears over the entire work shift.

Both sound level meters and personal dosimeters give a numerical result that can be compared to the occupational exposure limit of 85 dBA for an 8-hour shift, 40-hour work week (lower for longer shifts).

Decibels are measured on a special scale—a logarithmic scale where every increase in 3 decibels actually doubles the intensity of the sound. That means that an increase from 90 decibels to 93 decibels means the sound is twice as loud. An increase from 90 dBA to 96 dBA would mean the sound level is four times as loud.

90 dB——Heavy machinery

93 dB——Twice as loud

96 dB——4 times as loud

99 dB——8 times as loud

The important thing to remember is that a small increase in decibels means a large increase in the sound level and the damage it can do to the ear.

Controlling Noise Levels

If noise levels are found to be above 85 dBA for an 8-hour shift, 40-hour work week, the employer is required by law to reduce the noise levels.

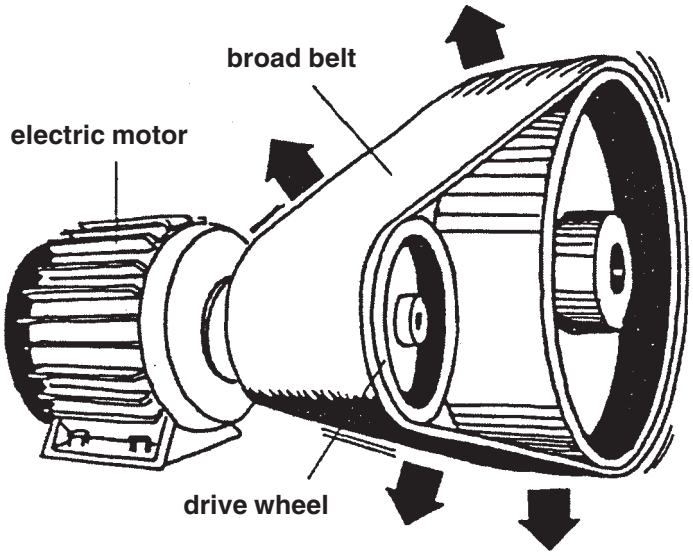
Engineering controls at the source of the noise are the most effective means of reducing noise levels. The controls should always reduce the loudest source of the noise first. Engineering controls include:

- redesigning equipment to reduce the speed or impact of moving parts; to install mufflers on intakes and exhausts; to replace old equipment with newer, better designed equipment;

- servicing and maintaining equipment to replace worn parts and to lubricate all moving parts;

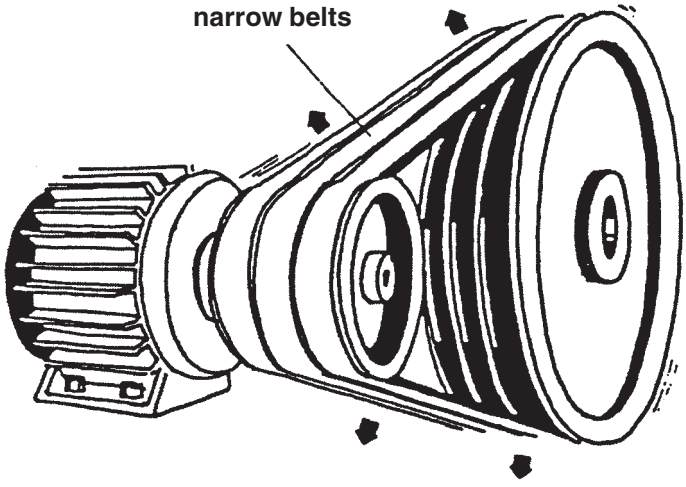
- isolating equipment either by distance, by enclosures or by barriers;
- damping and cushioning noise sources by using rubber pads to reduce vibration and noise coming from metal parts; reducing the drop height of objects falling into bins or onto belts;
- installing absorptive baffles in work areas to absorb sounds generated there.

Examples of Engineering Controls



Problem

A belt drive provides a large amount of low frequency noise because of the vibration of the broad belt.

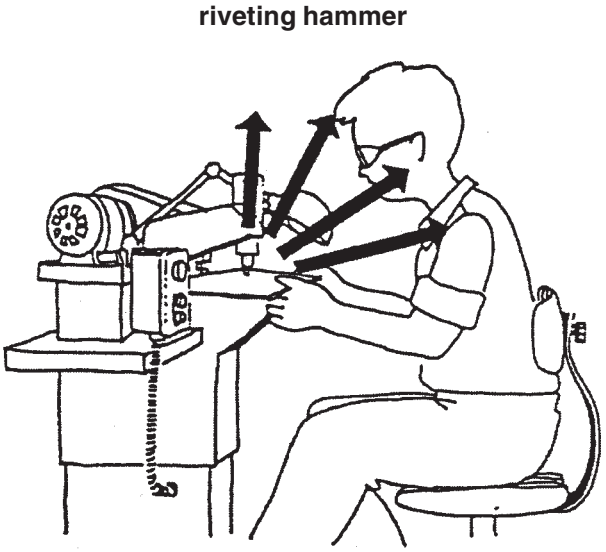


Control measure

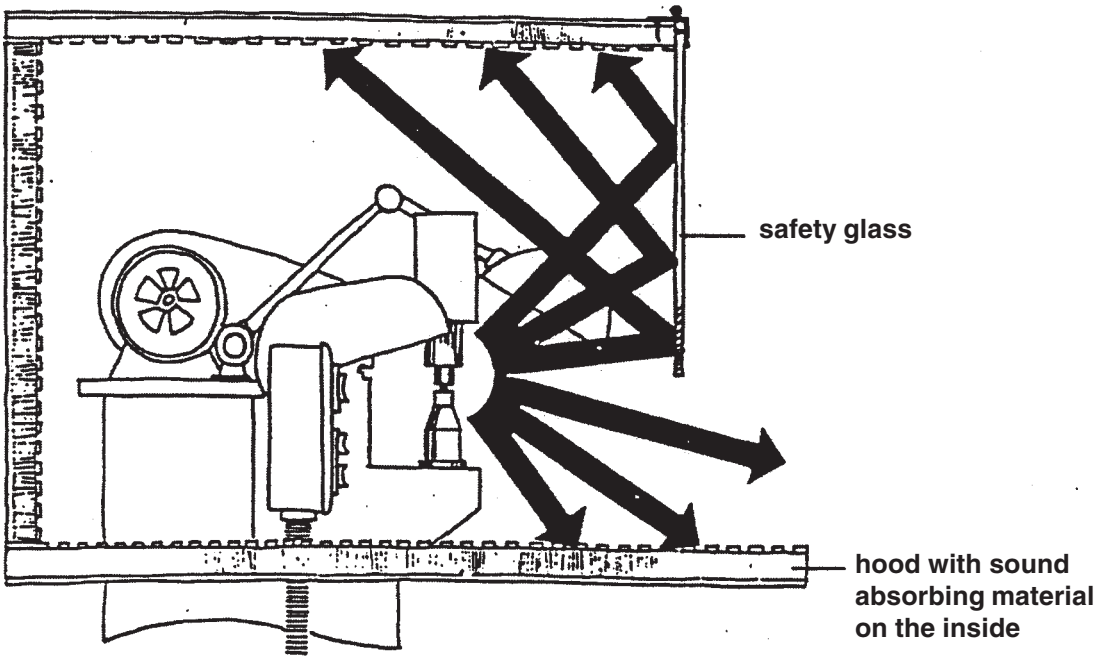
The broad drive belt is replaced by narrower belts, separated by spacers. This reduces the noise problem.

Examples of Engineering Controls

Problem

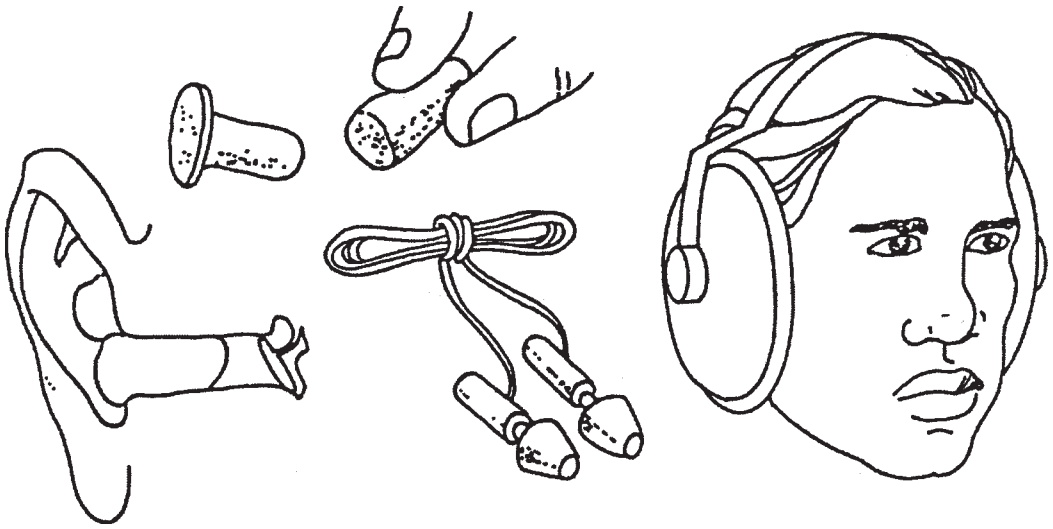


Control measure



Administrative controls for noise reduction include rotating workers in and out of areas with high noise levels, and providing training to workers about noise hazards and ways to reduce noise exposures and protect hearing.

Personal protective equipment (PPE) for noise reduction includes ear plugs and ear muffs. Like all PPE, this control depends on selecting the correct equipment for the specific noise levels, and proper use and care of the equipment. It is important to recognize that the noise is still present, and that the PPE (if used correctly) simply reduces the amount of noise reaching the inner ear.



Some users of hearing protection equipment have developed serious ear infections that have damaged their hearing, so workers should be sure to report any health problems resulting from the use of PPE.

Control of Noise Exposure

Title 8, Calif. Code of Regs., Sections 5095 – 5100 (Cal/OSHA Standard)

Administrative or Engineering Controls: When employees are subjected to sound levels exceeding the sound levels in the table below, feasible administrative or engineering controls shall be utilized:

90 dBA…	8 hours per workday
95 dBA…	4 hours per workday
100 dBA…	2 hours per workday

105 dBA…	1 hour per workday
110 dBA…	30 minutes per workday
115 dBA	15 minutes per workday

Personal Protective Equipment: If feasible administrative or engineering controls fail to reduce sound levels within the levels from the above table, personal protective equipment shall be provided and used to reduce sound levels to within the levels of the table.

Impulsive or Impact Noise: Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

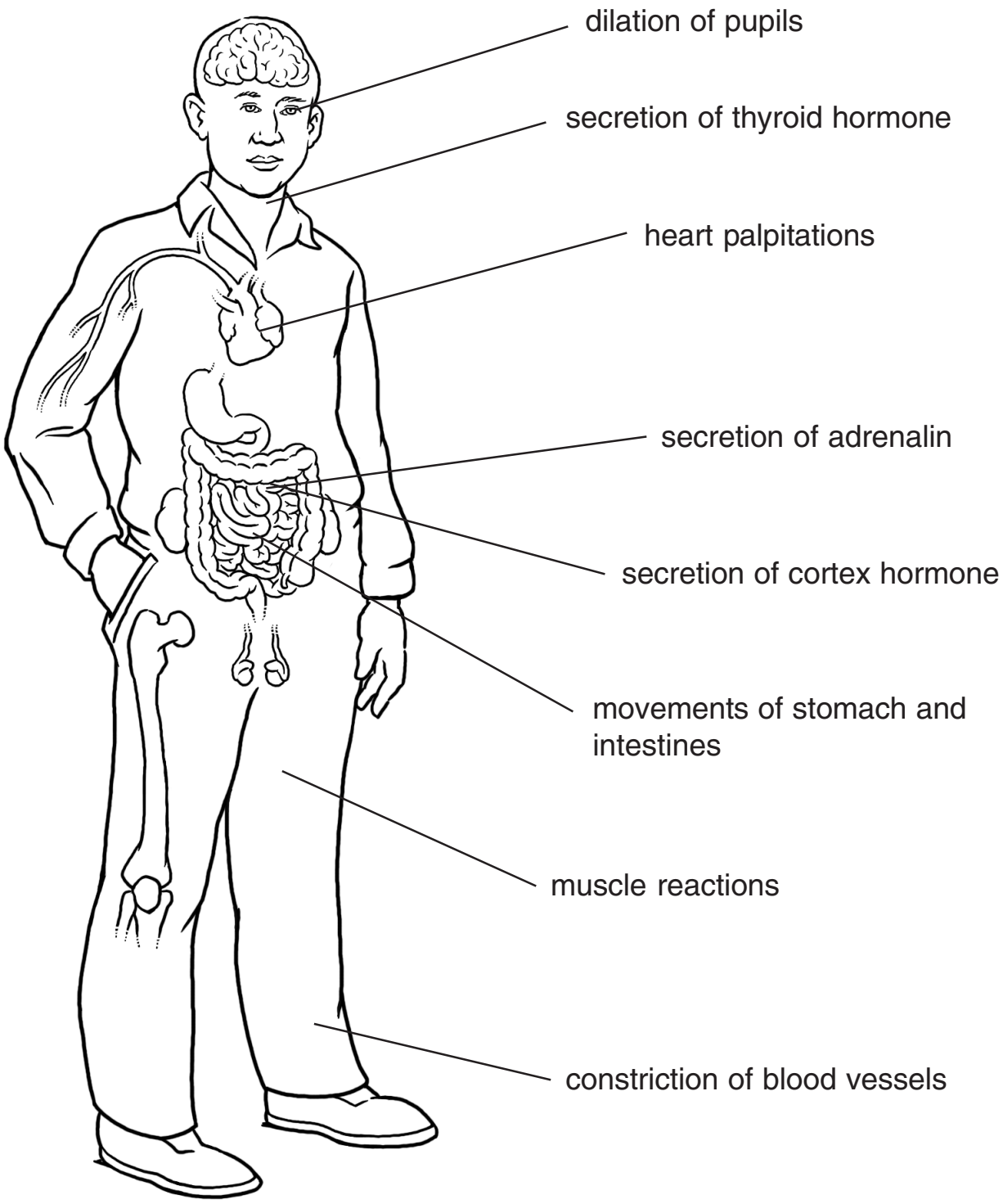
Hearing Conservation Program: The employer shall administer a continuing, effective conservation program whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 dBA (slow response), or equivalently, a dose of 50 percent. An effective hearing conservation program includes:

- Monitoring: initial monitoring and repeated monitoring whenever a change in production, process, equipment or controls increases noise exposures, as specified in the Cal/OSHA standard.

- Audiometric Testing Program, as specified in the Cal/OSHA standard.

Appendix A

Effects of Excessive Noise



Appendix B

Noise Monitoring with Sound Level Meter

Demonstration Checklist

1. Turn on the sound level meter. Make sure the batteries are sufficiently charged (absence of "LOBAT" indicator in the window).

2. Place the wind screen on the sound level meter.

3. Set the weighting switch to "A" (reflecting the frequency response of the human ear).

4. Set the decibel range to 30 – 100 dB.

5. Set the response switch to FAST (to measure short duration noises) or SLOW (to measure noise in most situations).

6. Set the mode switch to RUN (continuously displays the current sound level).

7. Turn on the calibrator. Make sure the battery is sufficiently charged ("LOBAT" indicator not lit).

8. Place the calibrator on the sound level meter. Make sure the meter reads at 114 dB.

9. Turn off the calibrator.

10. Turn on the radio.

11. Read the sound levels. Increase the decibel range of the meter if the overload indicator (red triangle) lights up. Decrease the decibel range if the underrange indicator (yellow triangle) lights up.

12. Turn off the sound level meter.

Appendix C
Ear Plugs Don't Work

NIOSH Criteria Document Proves the Need for Engineering Controls for Noise

Years ago, the battle for OSHA enforcement of the Noise Standard was lost in the Occupational Safety and Health Review Commission. The OSHR ruled that an employer could balance the cost of hearing conservation (earplugs and audiograms) against the cost of engineering controls of noise exposure. The rationale was that earplugs would protect, and any loss of hearing was the worker's own fault for not wearing them. NIOSH has shown that that isn't true.

The new NIOSH criteria document on noise compiles the scientific evidence which proves the need for engineering control of noise, and the ineffectiveness of Hearing Protection Devices. For years, so-called "hearing conservation" programs have provided workers with earplugs, and then measured how fast they were going deaf. We now know why these have failed. In addition, we now have new information confirming concerns that noise damages general health as wel as hearing.

The key points documented by NIOSH are:

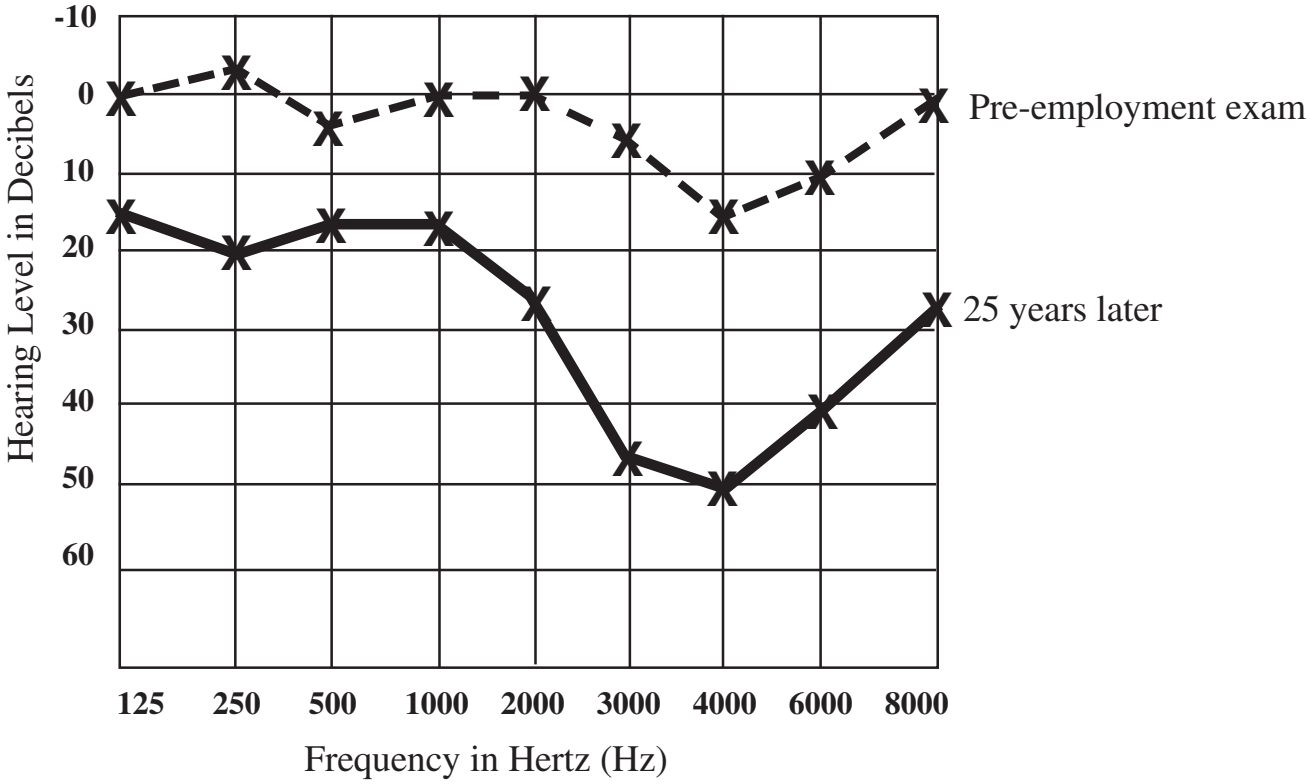
- Hearing loss begins at 80 dBA, not 85 or 90. Compiled studies show that 3% of employees exposed to 80 dBA average over a working lifetime will suffer moderate to severe hearing loss.

- Hearing protection devices provide only 10-15 dBA noise reduction. Manufacturers of HPDs advertise NRRs of 30 dBA or more based on laboratory tests, but field tests show much less protection. Earmuffs are better than soft plugs which are better than hard plugs, but all of them fail and leave workers at risk. An NRR of 10-15 dBA is the best you can expect.

- The worker's noise exposure inside the ear protector is equal to measured exposure with the NRR of hearing protection device subtracted. Any exposure over 95, and perhaps over 90, will result in moderate to severe hearing loss if it is permitted to continue.

In summary, workers who go deaf at work have been blamed for their own infirmity because they could have worn hearing protection devices. Of course, if you are exposed to noise above 80 dBA you should ask for and wear hearing protectors—you have to protect yourself. However, the hearing protectors won't be fully protective. So you also have to fight for engineering controls.

Appendix D
How To Understand Your Audiogram



An Audiogram Showing Hearing Loss

This audiogram is typical of someone whose hearing was damaged by noise. It is difficult without a work history to determine what sort of noise caused the loss, but the pattern shown in the graph is typical of that caused by noise. The numbers under the graph represent the various frequencies of sound heard during the hearing test. The numbers to the left indicate how many decibels loud the sound is in the ear when it is first perceived by the person taking the test. The dotted line on the upper part of the graph is taken from the pre-employment audiogram. The lower solid line is the results taken after 25 years exposure to a noisy machine. In this type of audiogram, the lower the line, the worse the hearing. Note that the hearing is worse and is lost first in the higher frequencies, especially at the 4000 Hz level. Different type graphs can be produced by different sorts of audiometers, but most usually look something like the one above. Each worker should always ask for a copy of the audiogram and a medical opinion (written if possible) on the results.

Evaluating the Exposure—The normal limits of hearing are about 10-15 decibels across the whole range of frequencies. Many people with good hearing actually have

audiogram results at zero and in the minus range. Any change at the 2000 Hz frequency is worrisome since this frequency is in the middle of the speech frequencies. Similarly any results worse than 20 decibels at 3000 and 4000 Hz is cause for concern. A person with an audiogram like the one above most likely has trouble hearing people speak clearly.

Compensation Schemes Most Workers' Compensation schemes take hearing loss at 500, 1000, and 2000 Hz and average them. Any result above 27 is compensable. In this case the hearing losses respectively are 15, 15, and 25, which average out to about 18 decibels loss. This is not enough to qualify for compensation, even though the worker is hard of hearing. The U.S. Department of Labor uses a slightly different formula for federal employees. The hearing losses are averaged instead at 1000, 2000, and 3000 Hertz. Thus, in this case, the losses are 15, 25, and 45 respectively, which averages out to 28 and might qualify for a small amount of compensation. Many reputable scientists believe that the loss at 4000 Hz should also be included in evaluations for compensation, but this usually is not done. The whole issue of compensation for hearing loss is actually more complicated than indicated here and is in need of considerable reform. Most states do not provide for any workers' compensation benefits for long term noise-induced hearing loss.