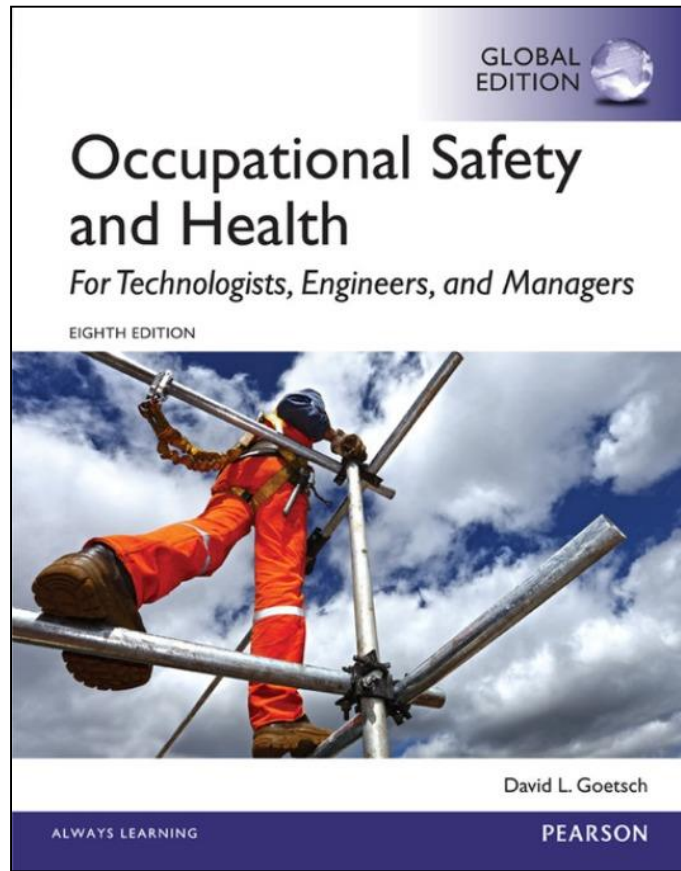


Occupational Safety and Health

for Technologists, Engineers, and Managers

EIGHTH EDITION



CHAPTER 22

Noise and Vibration Hazards

Noise and Vibration

- Noise in the modern workplace poses two safety- and health-related problems.
 - Noise can distract workers and disrupt concentration, which can lead to accidents.
 - Exposure to noise that exceeds prescribed levels can result in permanent hearing loss.

Terms

- **Sound** is any pressure change that can be detected by the ear.
- **Noise** - any unwanted sound.
- **Noise dose** - the noise exposure expressed as a percentage of the allowable daily exposure.
 - OSHA considers a 100% dose equals an eight-hour exposure to a continuous 90-dBA noise.

Hearing Loss Prevention Terms

- Terms common to hearing loss prevention:
 - **Hazardous Noise** - any sound for which any combination of frequency, intensity, or duration is capable of causing permanent hearing loss in a specified population

Hearing Loss Prevention Terms

- Terms common to hearing loss prevention:
 - **Dosimeter** - the instrument that measures sound levels over a specified interval, stores the measures, and calculates the sound as a function of sound level and sound duration.

Characteristics of Sound

- What we think of as sound, the eardrum senses as fluctuations in atmospheric pressure.
 - The eardrum responds to these fluctuations by vibrating.
 - The vibrations are carried to the brain in the form of neural sensations and interpreted as sound.

Characteristics of Sound

- One decibel represents the smallest difference in the level of sound that can be perceived by the human ear.
- The weakest sound that can be heard by a healthy human ear in a quiet setting is known as the threshold of hearing (1 dBA).

FIGURE 22–2 Selected sound levels.

| Source | Decibels (dBA) |
|-----------------------|----------------|
| Whisper | 20 |
| Quiet library | 30 |
| Quiet office | 50 |
| Normal conversation | 60 |
| Vacuum cleaner | 70 |
| Noisy office | 80 |
| Power saw, lawn mower | 90 |
| Chain saw | 90 |
| Grinding operations | 100 |
| Passing truck | 100 |
| Gunshot blast | 140 |
| Jet aircraft | 150 |
| Rocket launching | 180 |

- The threshold of discomfort is between 85 and 95 dB.
- The threshold of pain is between 120 and 140 dB.

Characteristics of Sound

- The three broad types of industrial noise are described as follows:
 - **Wide band noise** - noise that is distributed over a wide range of frequencies.
 - Most noise from manufacturing machines is wide band noise.
 - **Narrow band noise** - is confined to a narrow range of frequencies, such as that produced by power tools.

Characteristics of Sound

- The three broad types of industrial noise are described as follows:
 - **Impulse noise** - transient pulses that can occur repetitively or nonrepetitively, such as noise produced by a jackhammer.

Hazard Levels and Risks

- Exposure to excessive noise levels for an extended period can damage the inner ear.
 - Ability to hear high-frequency sound is diminished or lost.
 - Additional exposure can increase damage until even lower frequency sounds cannot be heard.

Hazard Levels and Risks

- Factors hearing loss associated with exposure to excessive noise:
 - Intensity of the noise (sound pressure level).
 - Type of noise (wide band, narrow band, or impulse).
 - Duration of daily exposure.
 - Total duration of exposure (number of years).

Hazard Levels and Risks

- Factors hearing loss associated with exposure to excessive noise:
 - Age of the individual.
 - Coexisting hearing disease.
 - Nature of environment in which exposure occurs.

Hazard Levels and Risks

- Factors hearing loss associated with exposure to excessive noise:
 - Distance of the individual from the source of the noise.
 - Position of the ears relative to the sound waves.

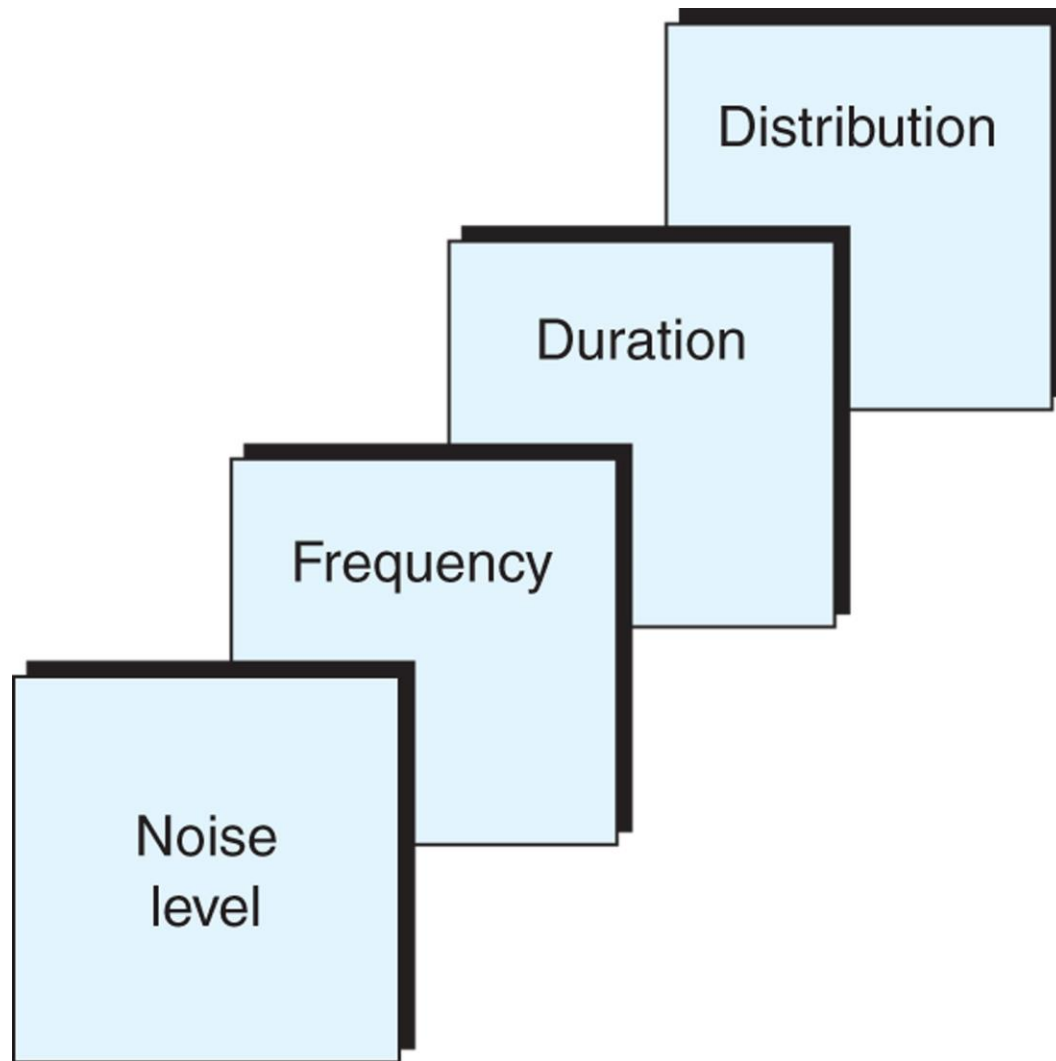
Hazard Levels and Risks

- The most critical factors are sound level, frequency, duration, and distribution
- Exposures of less than 80 dBA may be considered safe for the purpose of risk assessment.

Hazard Levels and Risks

- A TWA (threshold) of 85 dBA should be the maximum limit of continuous exposure over eight-hour days without protection.

FIGURE 22–3 Critical noise risk factors.



Standards and Regulations

- OSHA regulations require implementation of hearing conservation programs under certain conditions.
 - OSHA regulations should be considered minimum standards.

OSHA Regulations

- OSHA 29 CFR 1910.95 requirements for hearing conservation programs are as follows:
 - Hearing hazards monitoring.
 - Engineering and administrative controls.
 - Audiometric evaluation.
 - Personal hearing-protection devices.
 - Education and motivation.
 - Record keeping Program evaluation.

Hazards Monitoring

- The most common measurements are area surveys, dosimetry, and engineering surveys.
 - Area survey results are often plotted in the form of a “noise map,” showing noise level measurements for the different areas of the workplace.
 - Dosimetry involves the use of body-worn instruments (dosimeters) to monitor exposure over the work shift.

Hazards Monitoring

- The most common measurements are area surveys, dosimetry, and engineering surveys.
 - Engineering surveys typically employ more sophisticated acoustical equipment in addition to sound-level meters.

Engineering and Administrative Controls

- Engineering and administrative controls represent the first two echelons in the hierarchy of controls:
 - Remove the hazard and remove the worker.
- These controls should reduce hazardous exposure to the point where the risk to hearing is eliminated, or at least more manageable.

Engineering and Administrative Controls

- Administrative controls are changes in the work schedules or operations that reduce noise exposure.
 - The practice of rotating employees between quiet and noisy jobs may reduce the risk of substantial hearing loss in a few workers, but actually *increase* the risk of small hearing losses in many workers.

Engineering and Administrative Controls

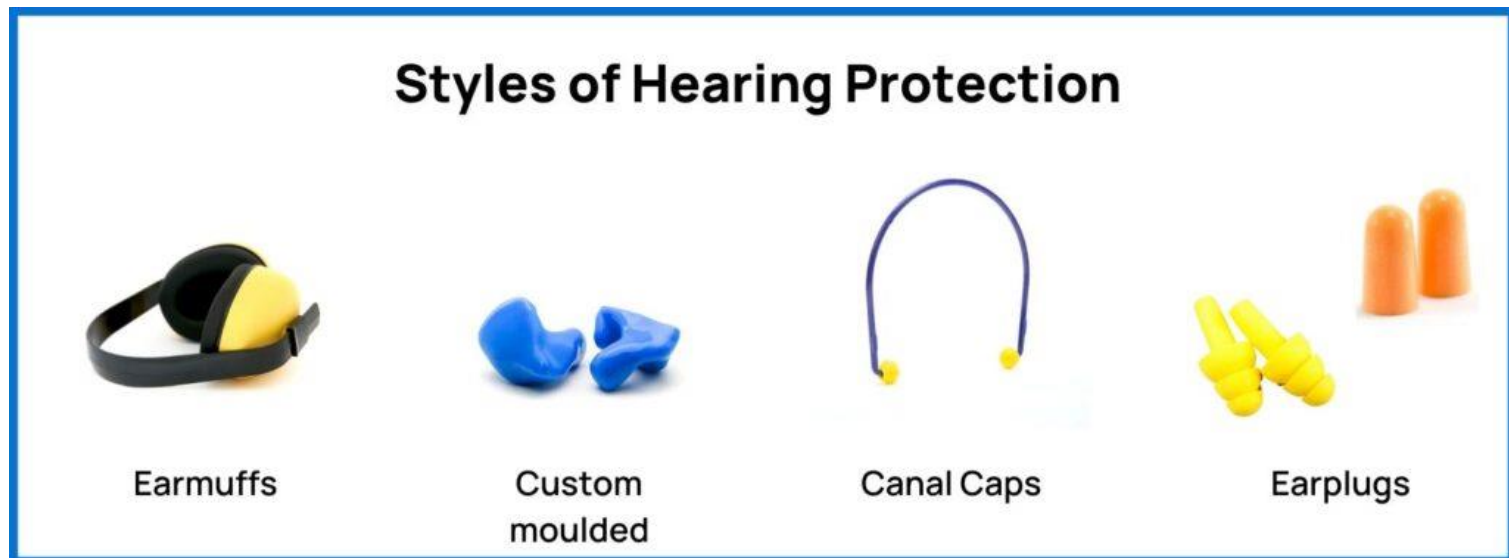
- A more practical administrative control is to provide for quiet areas where employees can gain relief from workplace noise.

Audiometric Evaluation

- Audiometric evaluation is the only way to determine whether hearing loss is being prevented.
 - Occupational hearing loss occurs gradually & is not accompanied by pain, so an affected employee may not notice the change until a large threshold shift accumulates.

Personal Hearing Protection Devices

- A personal hearing protection device (or “hearing protector”) is anything that can be worn to reduce the level of sound entering the ear.
- Earmuffs, ear canal caps & earplugs are the 3 main types.



Personal Hearing Protection Devices

- Regardless of the kind of ear protection device used, it is important to remember the four Cs:
 - Comfort, convenience.
 - Communication (the device should not interfere with the worker's ability to communicate).
 - Caring (workers must care enough about protecting their hearing to wear the devices).

Fit Testing

- With all PPE fit is an important consideration. A poor fit can undermine the effectiveness of any kind of PPE including hearing protection devices (HPDs). Fit testing is a process for ensuring the best possible fit of HPDs. The goal is to ensure that the HPD fits the individual properly as well as the situation.

Education and Motivation

- To obtain sincere, energetic management support and active employee participation, it is necessary to educate and motivate both groups.

Education and Motivation

- Employees & managers who appreciate the sense of hearing and understand the reasons for, and the mechanics of, the hearing loss prevention program will be more likely to participate.
 - Rather than viewing the program as an imposition.

Record Keeping

- Audiometric comparisons, reports of hearing protector use, and analysis of hazardous exposure measurements all involve the keeping of records.
 - Records are often kept poorly because there is no organized system, and those responsible for maintaining the records do not understand their value.

Workers' Compensation & Noise Hazards

- Some states have written hearing loss into their workers' compensation law, and others cover claims whether hearing loss is in the law or not.
- Medical professionals have established a procedure for determining if there is a causal relationship between workplace noise and hearing loss.

Workers' Compensation & Noise Hazards

- Because about 15% of all working people are exposed to noise levels exceeding 90 dBA, hearing loss may be as significant in workers' compensation costs in the future as back injuries, carpal tunnel syndrome, and stress are now significant.

Identifying/Assessing Hazardous Noise

- Identifying and assessing hazardous noise conditions in the workplace involve.
 - Conducting periodic noise surveys.
 - Conducting periodic audiometric tests.
 - Record keeping.
 - Follow-up action.

Noise Control Strategies

- Noise can be reduced by engineering and administrative controls applied to one or more of these components.

Noise Control Strategies

- The most desirable noise controls are those that reduce noise at the source.
- The second priority is to reduce noise along its path.

Noise Control Strategies

- The last resort is noise reduction at the receiver using personal protective devices.
 - The latter approach should never be substituted for the two former approaches.

Vibration Hazards

- Vibration hazards are closely associated with noise hazards because tools that produce vibration typically also produce excessive levels of noise.

Vibration Hazards

- Vibration-related problems are serious & widespread.
 - Up to 8 million workers are exposed to some type of vibration hazard, and of these, it is estimated that more than half will show some signs of injury.
 - Types of injuries associated with vibration depend on its source.

Vibration Hazards

- The most common vibration-related problem is known as hand-arm vibration syndrome(HAV).
 - HAV is a form of Reynaud's Syndrome, striking workers who use vibrating power tools daily as part of their jobs.

Vibration Hazards

- Environmental conditions and worker habits can exacerbate the problems associated with vibration.
 - Working with vibrating tools in a cold environment is more dangerous than the same work in a warm environment.
 - Gripping a vibrating tool tightly will lead to problems sooner than using a loose grip.

Vibration Hazards

- Environmental conditions and worker habits can exacerbate the problems associated with vibration.
 - Smoking and excessive noise also increase potential for HAV and other vibration-related injuries.

Vibration Hazards

- Prevention is especially important with HAV because the disease is thought to be irreversible.
 - Treatments developed to date only reduce the symptoms.

Vibration Hazards

- Prevention strategies that can be used in any company regardless of its size:
 - Purchase low-vibration tools.
 - Limit employee exposure.
 - Change employee work habits.