Noise Control in Industry:

A Basic Guide

CCOHS

Prepared by the Canadian Centre for Occupational Health and Safety

Target Audience

This guide is for workers, supervisors, health and safety committee members, health and safety representatives, industrial hygienists, occupational health and safety nurses and others with an interest in hearing conservation. The technical level of this guide meets the needs of the target audience.

Summary

Noise is a major occupational hazard. Short term effects of noise exposure include temporary hearing loss, stress, annoyance, difficulty in verbal communication, and safety hazards. The primary long-term health effect of noise exposure is permanent hearing loss. Both short-term and long-term effects can be prevented by timely recognition, evaluation and control of noise exposure.

This guide provides an overview of the methods of recognition, evaluation and control of workplace noise exposure. Topics covered include: a review of the units and measures of noise; methods of measuring noise level and noise exposure; instruments used to measure noise; the relationship between noise exposure and risk of hearing loss; noise exposure limits; engineering methods of noise control; and the effectiveness of hearing protectors. Basic components of a hearing conservation program are outlined.

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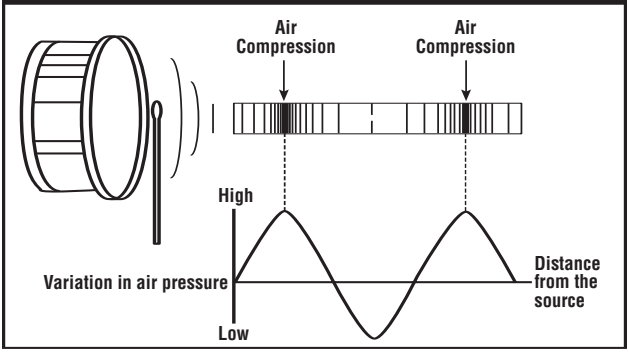
3. Production and Transmission of Noise

Noise (or sound) comes from vibrating objects. Vibration can result from air flow, high speed rotating machines, friction or mechanical impacts involved in machine operation. From the source, noise spreads out as a series of air pressure fluctuations known as sound waves. The spread of sound waves from the source to other locations occurs via the surrounding air or other media such as water and solids. This process of sound transmission or propagation is similar to the spread of ripples on the surface of a lake when a rock is dropped into in the water.

The following example illustrates the production and transmission of sound waves. Imagine striking a drum surface with a stick. As a result of the impact, the drum surface vibrates back and forth. As it moves forward, it pushes the air in contact with the surface and produces a dense (high pressure) region in contact with the drum. When the surface moves in the opposite direction, it creates a rarified (low-pressure) region by decompressing the air in contact with the drum. As the drum surface vibrates, it creates alternating regions of high and low pressure.

PRODUCTION AND TRANSMISSION OF SOUND WAVES



Typical A-Weighted Sound Levels	
NOISE SOURCE	**dB(A)**
pneumatic chipper at 1 metre	115
hand-held circular saw at 1 metre	115
textile room	103
newspaper press	95
power lawn mower at 1 metre	92
diesel truck (50 km per hour at 20 metres)	85
passenger car (60 km per hour at 20 metres)	65
conversation at 1 metre	60
quiet room	40

Sound Pressure Level and Sound Energy

The sound pressure level is related to the sound energy entering the ears of exposed persons. The following table gives some useful relationships between changes in decibel level and corresponding changes in the sound energy.

Sound Pressure Level and Sound Energy: Basic Rules	
CHANGE IN dB	**CHANGE IN SOUND ENERGY**
3 dB increase	Sound energy doubled
3 dB decrease	Sound energy halved
10 dB increase	Sound energy increased by factor of 10
10 dB decrease	Sound energy decreased by factor of 10
20 dB increase	Sound energy increased by factor of 100
20 dB decrease	Sound energy decreased by factor of 100

- As a person ages, hearing may worsen because "age-related hearing loss" adds to the existing noise induced hearing loss.
- Both ears are equally affected except in cases when one ear is exposed to a higher noise level than the other.
- Hearing loss is a cumulative process; both level of noise and exposure time are important factors.

Hearing Loss Due to Aging

Hearing sensitivity naturally declines as people become older. Like noise-induced hearing loss, everyone is not affected equally. Age-related hearing loss adds to noise-induced hearing loss and therefore hearing ability may continue to worsen even after a person stops working in a noisy environment.

Other Causes of Hearing Loss

Exposure to ototoxic chemicals (eg. toluene, lead, manganese), certain medications and diseases may also cause hearing loss. Generally, it is not possible to distinguish hearing loss due to noise from hearing loss due to other causes. Judgement in such cases is based on the noise exposure history.

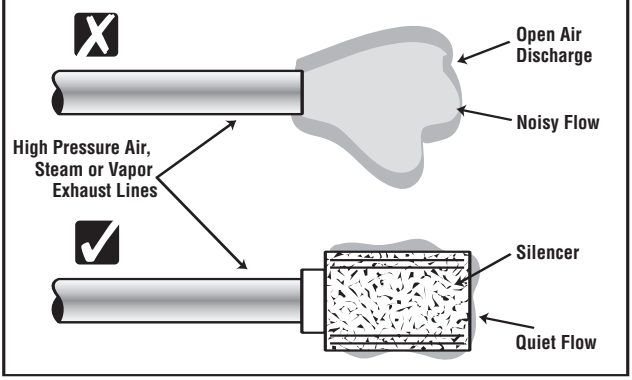
2. Measures of Hearing Loss

Hearing loss is measured as threshold shift in dB units using an audiometer. The 0 dB threshold shift-reading of the audiometer represents the average hearing threshold level of a young adult with disease-free ears. The threshold shift as measured by audiometry is the dB level of sounds of different frequencies barely audible to that individual. A positive threshold shift represents hearing loss, and a negative threshold shift means better than average hearing.

Mufflers

A muffler is an acoustic filter. Its performance varies with the sound frequency. A muffler reduces the transmission of sound and allows the free flow of gas. Mufflers are installed to reduce noise where large quantities of high pressure gas, liquid, steam or air are discharged into the open air.

Reducing air exhaust noise by installing muffler.



Selection Criteria for Mufflers

Acoustical Criterion: Noise reduction capability measured as insertion loss.

Insertion Loss (dB) =
SPL before muffler – SPL after muffler

Aerodynamic Criterion: Maximum acceptable pressure drop through the muffler.

Geometrical Criterion: Maximum allowable volume and restrictions on the shape.

Mechanical Criterion: Durability, maintenance, and environmental conditions.