

3M Center for Hearing Conservation

Key Terms in Occupational Hearing Conservation

Absorption

A noise control method featuring sound-absorbing materials that are placed in an area to reduce the reflection and buildup of sound.

Active Learning

Educational methods designed to engage people who are learning in activities, such as reading, writing, discussion, or problem solving that promote understanding of ideas, development of skills or changing attitudes.

Exposure Action level (AL)

A regulatory term used to indicate when an employer must act to prevent an occupational illness or injury. In Europe there are two distinctive terms applied in respect of the daily noise exposure levels and peak sound pressure levels. The two terms are Exposure Action Value and Exposure Limit Value.

Lower Exposure Action Value (LEAV): $L_{EX,8h} = 80$ dB(A) and Peak pressure $P_{peak} = 135$ dB(C)

Upper Exposure Action Value (UEAV): $L_{EX,8h} = 85$ dB(A) and Peak pressure $P_{peak} = 137$ dB(C)

Exposure Limit Value (ELV): $L_{EX,8h} = 87$ dB(A) and Peak pressure $P_{peak} = 140$ dB(C)

On reaching the LEAV, the employer is required to make provision for suitable hearing protectors on request.

At UEAV, use of suitable hearing protectors must be strictly enforced and a hearing conservation programme initiated.

The ELV must not be exceeded under any circumstances and can be achieved by using hearing protectors.

Annual audiogram

The results of a yearly hearing test displayed on a graph. In a hearing conservation program, the annual audiogram is compared with the baseline audiogram each year to identify changes in a worker's hearing level over time.

Audiogram

A graph displaying the hearing threshold level in decibels (dB HL) of an individual at specific sound frequencies (Hz) as measured with an audiometer. Both right and left ears are displayed.

Audiologist

A health care professional who specializes in prevention, assessment, diagnosis of hearing and balance disorders and provides rehabilitation services for people with hearing loss and related conditions.

Audiometer

A calibrated instrument used to measure hearing threshold levels in decibels (dB HL) across a range of sound frequencies (Hz).



Audiometric database analysis

A standardized process used to review historical hearing test results to detect high variability in the data. Advocates of this type of analysis suggest that high variability in audiometric data is an indication of a poorly managed or ineffective Hearing Conservation Program.

Attenuation

The decrease in sound level (dB) in the wearer's ears when a hearing protection device (HPD) is worn. May also be referred to as noise reduction.

A-weighting

See weighting

Banded Protector

A hearing protector featuring soft foam or elastic ear tips held in place by a flexible band that is worn under the wearer's chin, over the head or behind the neck. Ear tips may simply cap the opening of the ear or may be inserted into the ear canal.

Baseline audiogram

The results of a hearing test that is used as the reference to track changes in a person's hearing over time. In a hearing conservation program, the baseline test is conducted prior to exposure to hazardous workplace noise or as soon as possible afterward. The annual audiogram is compared to the baseline audiogram at a suitable time interval (typically every year) to identify any possible change in hearing.

Baseline revision

Establishing a new reference audiogram for an individual after there has been a persistent change in hearing. The decision to revise the baseline is made by the Professional Supervisor; an audiologist or physician who reviews audiograms for an employer.

Bio-acoustic simulator

A device used to verify that an audiometer is functioning normally each day that hearing tests are conducted.

Buy Quiet

An approach to eliminating or minimizing sources of noise during the design phase of an industrial process. Buy Quiet is a type of Prevention Through Design strategy focused specifically on occupational noise exposure.

To learn more visit NIOSH <https://www.hse.gov.uk/Noise/buy-quiet/>

Calibration

A process to verify the proper function of an audiometer and re-adjust any functions that fall outside the specifications established by the manufacturer and technical standards for audiometers.

Decibel (dB)

The unit used to describe the intensity of one sound compared to a reference. When sound levels are described in decibels, a reference must be indicated. Noise measurements are typically reported in decibels Sound Pressure Level (dB SPL) or A-weighted Sound Level dB(A). Hearing levels are reported in decibels Hearing Level (dB HL) or Hearing Threshold Level (dB HTL). Since dB values are calculated using a logarithmic formula, they cannot be added together using a simple mathematical method.

Damping

A noise control method in which material such as foam, resin or tape is placed on a noise source so that it vibrates less, creating less noise.



Derating

The practice of decreasing the noise reduction of a hearing protector by a certain percentage or number of decibels to estimate the average noise reduction obtained by a group of people who wear hearing protection in the workplace. Attenuation achieved under workplace conditions is often less than what is obtained in the laboratory. In Europe, the exact amount of derating depends on applicable national laws and the type of hearing protector. The derating figure can range from 3dB to 10dB. Typically, earplugs have the highest amount of derating compared with earmuffs.

Dosimeter

An electronic sound measurement device that is like a sound level meter with an internal clock, calculator, and memory to store measured and calculated data. The dosimeter is worn by a worker to continuously measure the sound level during the sampling period and calculate a Time Weighted Average, noise dose, and other data.

Dual Protection

Earmuffs worn in combination with earplugs.

Earmuff

Plastic cups cover the ears to help block out hazardous sound. Cups are held in place with an adjustable headband or attached directly to the side of safety helmets or rigid head tops. Soft, cushions seal against the side of the wearer's head.

Earplug

Soft foam or elastic plugs worn inside the ear canal to help block out hazardous sounds. Earplugs are either inserted deep into the ear canal or seated at the entrance part of the ear canal.

Exchange rate

The change in sound level that results in a doubling of daily noise dose. In Europe a 3dB exchange rate is applied. This can also be called a dose doubling or trade rate.

Field Attenuation Estimation System (FAES)

Equipment used to measure the hearing protector noise reduction (attenuation) obtained by individuals in the workplace and to calculate the Personal Attenuation Rating in dB for each worker. Also known as a fit test system.

Hearing Level

The sound level scale on an audiogram expressed in decibels (dB HL). May also be expressed as Hearing Threshold Level (dB HTL).

Hearing loss impairment formula

A mathematical method for calculating the percentage of hearing loss using pure-tone threshold values from a hearing test. An impairment formula may be applied in determining workers' compensation for occupational hearing loss.

Hearing Threshold

The lowest sound level in decibels (dB HL) to which a person responds at least 50% of the time that it was presented at a specific frequency during an audiometric test.

Hertz

The measurement unit for sound frequency. It is a description of the number of cycles per second (CPS) produced by a sound source. Abbreviated Hz. The abbreviation kHz is used when frequency is expressed in the units of kiloHertz. For example, 1000 Hz is the same as 1 kHz.



Impulse noise

Sounds with short duration (less than 1 second) such as gunfire, explosions or the “pop” of a pneumatic nail gun, fireworks or an explosion. These sounds typically have extremely fast onset and often reach very high sound pressure levels (SPL).

Isolation

A noise control method in which springs, foam or other damping materials are used to reduce the transmission of sound from noise sources to floors, walls or connected equipment.

Key Performance Indicator

A quantifiable measure used to evaluate the success of an occupational hearing conservation program (HCP) in meeting objectives such as: 1) preventing occupational hearing loss, 2) reducing the number of OSHA recordable hearing loss incidents or 3) increasing worker compliance with hearing conservation policies or procedures.

Level-dependent hearing protectors

Hearing protectors that provide more noise reduction (attenuation) for high level sounds than for low level sounds. Passive types use non-electronic acoustic filters which allow low level sounds to pass through while attenuating high level sounds. Active types use environmental microphones and electronics to pick up and amplify low level sounds. When high level sounds occur, the electronic signal is instantly reduced while the hearing protector helps block out hazardous sounds.

Noise Control Survey

An extensive sound survey of noise sources in the workplace and the sound pathways between noise sources and noise-exposed workers. Used by engineers and occupational health and safety team members to develop and implement methods to control noise, through engineering or administrative approaches.

Noise dose

A regulatory limit, based on the criterion level. 100% dose is the maximum allowable daily exposure to accumulated noise when measured according to the regulatory specifications. See definition of Action Values. 100% Dose may vary according to national regulation.

Noise-induced hearing loss (NIHL)

A decrease in hearing sensitivity measured in decibels (dB HL) caused by exposure to noise and other loud sounds. NIHL typically appears first in the frequency range between 3000 and 6000 Hertz (Hz).

Single Noise Reduction (SNR)

A single-number description of the noise reduction capability in decibels (dB) of a hearing protector when tested under standardized laboratory conditions. Based on measurements of the average (mean) attenuation obtained by experienced hearing protector users over a wide range of sound frequencies. European legislation define how hearing protection manufacturers determine SNR as well as HML (High, Medium and Low) and Octave Band attenuation is determined and reported on packaging.

The Single Number Rating (SNR), used in Europe and a variety of other regions, is similar to the NRR used in the US, but is measured using a slightly different test method and computation.

Octave band

Sounds audible to the human ear have a frequency component in the range of 20 Hz to 20 kHz. For convenience, the sound frequency is split into sections or bands as follows:



31.5 Hz
63 Hz
125 Hz
250 Hz
500 Hz
1000 Hz
2000 Hz
4000 Hz
8000 Hz
16000 Hz

Each band has a band width of either one octave or one-third octave.

One octave band is described as a frequency band where the highest frequency is twice the lowest frequency. To illustrate this point, let's consider the reference frequency of 1000 Hz (centre point).

The lowest frequency of this octave band is 707 Hz and upper frequency is 1414 Hz.

By contrast one-third octave has a band width that is a third of that of an octave band and hence contains greater amount of information on the frequency content.

Permanent threshold shift

A change in hearing sensitivity that persists over time.

Personal Attenuation Rating (PAR)

An estimate of the noise reduction in decibels (dB) obtained in one or both ears of an individual worker during a hearing protector fit test. Measured using a Field Attenuation Estimation System (FAES).

Problem audiogram

An audiogram that exhibits certain characteristics which indicate the need for review and potential follow-up as part of an occupational hearing conservation program.

Protected Exposure

The time-weighted average (TWA) noise exposure of a worker after the protection provided by the HPD is taken into account. Usually described as an A-weighted sound level in decibels dB(A).

Reflection

A noise control method in which barriers or partitions are placed in the sound path to deflect sound away from employees. For example, enclosures may be used to block the sound path around employees or a sound source.

Retest audiogram

The results of a hearing test performed to confirm the results of a previous test. Retesting is most often done when the annual audiogram indicates a shift from the baseline.

Situational awareness

When this term is used in hearing conservation, it refers to the perception of the environment around the worker and relates to the worker's ability to detect, identify, and locate important sounds in the workplace.

Slow response

A setting on sound measurement instruments specified by most regulations when noise surveys are performed as part of a hearing conservation program. The sound level in decibels (dB) displayed on the device is based on the 1-second average sound level measured.



Sound level meter (SLM)

An electronic device that measures sound pressure and displays measured sound pressure level in decibels (dB). It typically has a microphone, amplifier, range controls, and various filters. Type 2 (Class 2) instruments are 'general purpose' meters and are most often used to measure noise in occupational hearing conservation. Type 1 (Class 1) 'precision grade' instruments can also be used for hearing conservation but are not required. A Type 1 SLM may have an added feature of filtering by octave band analysis.

Noise surveys

A systematic approach to measuring the noise in a workplace. Types range from simple walk-through or screening surveys to identify if hazardous noise is present to more detailed noise surveys to quantify the average worker noise exposure over a specified time or the workers noise dose. More extensive surveys may be necessary to develop and implement methods to control noise, through engineering or administrative approaches. Various noise measurement equipment can be used to measure sound pressure levels in decibels (dB).

Temporary threshold shift

A short-term change in hearing sensitivity that goes away after a period of lower noise exposure.

Daily noise exposure level $L_{EX,8h}$ dB(A)

The daily noise exposure level is weighted average of the exposure level and duration over an eight hour working day. There are three distinctive levels; Lower Exposure Action Value (LEAV) $L_{EX,8h} = 80$ dB(A), Upper Exposure Action Value (UEAV) $L_{EX,8h} = 85$ dB(A) and Limit Value (LV) $L_{EX,8h} = 87$ dB(A) which trigger an appropriate action point. There are corresponding Peak sound pressure values of 112 Pa (LEAV), 140 Pa (UEAV) and 200 Pa (LV) which equate to 135 dB(C), 137 dB(C) and 140 dB(C) respectively.

Wear time

The percentage of time hearing protection is worn during a workplace noise exposure.

Frequency Weighting

An electronic filter on sound measurement instruments to specify the relative contribution of each sound frequency to the sound levels that are measured. Different weighting filters are labeled A, C, and Z.

A-weighting

The A-Weighted filter is used for adjusting sound measurement to best correspond the way in which human ear corresponds to different sound frequencies.

An A-Weighted sound pressure level corresponds best to the subjective reception of sounds at low sound pressure levels. Nearly all occupational hearing conservation regulations specify that the A-weighting filter be used for measuring worker noise exposure. Sound levels are labeled as dBA.

C-weighting

Commonly referred to as dB(C), the C-weighted filter corresponds best to the subjective reception of sounds of audible frequencies at high sound pressure levels. It is normally used for measurement of sounds dominated by low frequencies. This filter is also used for measuring peak sound pressure level when set on fast response.

Z-weighting

This filter is not used in the EU (European Union).

The EU standards cover frequencies in the range of 125 Hz to 8000 Hz.