

# 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.

### Action level (AL)

A regulatory term used to indicate when an employer must act to prevent an occupational illness or injury. In the US, the action level for noise is 85 dBA Time Weighted Average (TWA), which is the same as 50% of the allowable daily dose of noise exposure.

### 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. Each year the annual audiogram is compared to the baseline audiogram 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.cdc.gov/niosh/topics/buyquiet/default.html>

#### 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.

#### Criterion level

The maximum allowable daily exposure to accumulated noise in decibels (dB). This is set by regulatory bodies, and sets the conditions that result in 100% dose.

#### 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 (dBA). 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 Rating (NRR) 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. Noise reduction obtained under workplace conditions is often less than what is obtained in the laboratory where the NRR is measured. U.S. OSHA policy is to apply 50% derating to the NRR for enforcement purposes when hearing protectors are used as a substitute for noise controls.

### 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. 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.

### Exchange rate

The change in sound level that results in a doubling of daily noise dose. Most US federal agencies use a 5 dB exchange rate. 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 is typically used in determining workers' compensation, which is defined by each state in the U.S.

### 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. 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 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.

### Maximum Permissible Ambient Noise Levels

The highest noise level in decibels (dB SPL) at each frequency band allowed by U.S. OSHA in the room where hearing testing is performed for audiometric monitoring as part of a hearing conservation program.

### 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. In the US, a 100% dose is equal to the PEL, or 90 dBA TWA. A 50% dose is equal to the action level, or 85 dBA TWA.

### 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).



#### Noise Reduction Rating (NRR)

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. U.S. Environmental Protection Agency (EPA) regulation 40 CFR 211 specifies how HPD manufacturers must determine the NRR and how it appears on HPD packages.

The Single Number Rating (SNR), used in Europe and a variety of other regions, is similar to the NRR but is measured using a slightly different test method and computation. For more information on differences between the NRR and SNR, visit NIOSH

<https://www.cdc.gov/niosh/topics/noise/hpdcomp/>

#### Occupational Hearing Conservationist (OHC)

A person specially trained to perform audiometric testing and other tasks involved with Occupational Hearing Conservation. A Certified OHC (COHC) is a person who has been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC).

#### Octave band analysis

A method of measuring the sound pressure level of a specific group of frequencies by filtering the sound spectrum into a smaller segments or bands. This type of analysis is used by engineers to isolate noise sources in the workplace and design noise controls. When sound frequency is doubled, the interval is described as one octave. For example, 2000 Hz is one octave higher than 1000 Hz. A 1-octave band analysis splits the sound that is measured into 11 frequency bands. A 1/3-octave band analysis filters the sound sample into 33 segments for a finer frequency resolution.

#### OSHA 300 Log

A form that employers in the U.S. are required to use to report incidents of occupational illness and injury, including hearing loss, to OSHA on an annual basis.

#### Permanent threshold shift

A change in hearing sensitivity that persists over time.

#### Permissible exposure limit (PEL)

The maximum daily employee exposure allowed by U.S. OSHA. For noise exposure, the 8-hour PEL is 90 dBA TWA.

#### 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.



### Professional Supervisor (PS)

OSHA requires that an audiologist, otolaryngologist or other physician provide professional oversight to the audiometric component of a hearing conservation program. The PS may establish policies, supervise the activities conducted by the OHC, review problem audiograms, determine the work-relatedness of cases of employee hearing loss, recommend follow-up actions and manage the audiometric database for an employer.

### 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 (dBA).

### Recordable STS

A change in a worker's hearing level (dB HL) in either ear is considered recordable if it is work-related and it meets BOTH of these criteria:

- The employee has experienced an OSHA Standard Threshold Shift (STS) in one or both ears, and
- The employee's total hearing level is 25 decibels (dB HL) or more above audiometric zero (averaged at 2000, 3000, and 4000 Hz) in the same ear(s) as the STS.

OSHA requires employers to enter recordable STS cases on the OSHA 300 Log.

### 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. U.S. OSHA allows employers to conduct an audiometric retest within 30 days after an annual audiogram as part of an occupational hearing conservation program. Retesting is most often done when the annual audiogram indicates a possible Standard Threshold Shift (STS).

### 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.

### Sound (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).

### Standard Threshold Shift (STS)

The U.S. OSHA definition of the amount of hearing change that triggers employer intervention: an average shift in hearing of 10 dB or more in the frequencies 2000, 3000, and 4000 Hz in either ear compared to the worker's baseline hearing test. When an STS occurs, the employer must follow-up with the employee to help prevent further changes in hearing.

### Temporary threshold shift

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

### Threshold level for noise measurement

The level below which all measured values are assigned a value of zero energy or contribution to dose. US federal regulations use 80 dBA. Sounds in the workplace below this level are not added into total sound level measured during the sample period.

### Time-weighted average (TWA)

The measured noise exposure in decibels (dBA) of a worker when continuous, intermittent, and impulsive noise levels are averaged over an 8-hour work shift using a 5-dB exchange rate.

### Wear time

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

### 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 filter setting used to measure sound in the frequency range where human ears are most sensitive; roughly 250 to 8000 Hz. 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**

The filter setting used to measure a wider range of sound frequencies than A-weighting; roughly 63-8000 Hz. This is often used for measuring peak sound pressure levels, when evaluating hearing protection options, or when there is a substantial low frequency component to the workplace noise. Sound levels are labeled as dBC.

**Z-weighting**

The term used to indicate that sound measurements were made with no filtering. All sounds present in the frequency range between 10 Hz and 20,000 Hz are included in the sound level measured. Sound levels are labeled dBZ. These measurements may also be described as 'unweighted' or 'linear'.

