Hearing Conservation Program – Quick Tips

Occupational hearing loss is the most significant health hazard in today's workplace. The Centers for Disease Control and Prevention (CDC) and the National Institute for Occupational Safety and Health (NIOSH) estimate that 22 million U.S. workers are subjected to potentially damaging occupational noise each year. In 1983 the Occupational Safety and Health Administration (OSHA) incorporated the Hearing Conservation Amendment (HCA) into its existing Occupational Noise Exposure Standard in Title 29 Code of Federal Regulations (CFR) Part 1910.95.

A hearing conservation program is designed to protect workers with significant occupational noise exposures (85 decibels (dB) or above) from hearing impairment over their entire working lifetimes. For information on the elements of an effective hearing conservation program please review QuickTip #260.

Having a working knowledge of OSHA's hearing conservation program, definitions and screening tools is important to better understand the requirements of OSHA's noise standard.

Definitions

Action level – 85 dB measured as an eight-hour time-weighted average (TWA). When exposures are equal to or exceed the action level, a hearing conservation program is required.

Annual check – The calibration of audiometers must be checked at least annually to ensure they are within prescribed acoustic tolerance limits for sound pressure output and linearity. Deviations beyond acceptable limits indicate the need for an exhaustive calibration.

Attenuation – Reduction of noise level.

Audio dosimeter – Audio dosimeters are integrating sound-level meters that measure the sound level and exposure length. The dosimeter processes this information and calculates an exposure dose. If an employee's noise dose exceeds 100 percent, an over-exposure exists. To be acceptable for use under the standard, a dosimeter must integrate all continuous, intermittent and impulsive sound levels from 80 dB and higher into the noise exposure measurement.

Audiogram – A chart, graph or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

Audiologist – A professional specializing in the study and rehabilitation of hearing and who is certified by the American Speech-Language-Hearing Association or licensed by a state board of examiners.

Baseline audiogram – The audiogram against which future audiograms are compared.

Council for Accreditation in Occupational Hearing Conservation (CAOHC) – A professional organization dedicated to providing consumer safety and protection by offering credentialing to those working to prevent noise-induced hearing loss.

Criterion sound level – The constant sound level in dB that, if applied for eight hours, would accumulate a dose of 100 percent.

Decibel – (dB) Unit of measure for sound levels, based on a logarithmic scale.

Dose – A percentage of the maximum allowable noise that a worker can be exposed to per day. This is a computation that is based on the following variables: criterion sound level, lower threshold and exchange rate. Dose is expressed as a percentage.

Dosimeter – An instrument worn or used by an individual to measure the accumulation of their noise exposure over a work period. Dosimeters monitor all noise sources and are used when time and mobility are issues. Dosimeters generally sample 16 times per second.

Exceedance level – Exceedance levels represent the percent of the run time that was spent at or above the corresponding dB level and are typically expressed with percentages (L%). For example, an L40 equal to 73 dB would mean that for 40 percent of the run time, the decibel level was equal to or higher than 73 dB.

Exchange rate – The rate at which your dose doubles. Using a decibel scale, every time the sound energy doubles, the measured level increases by three dB. This is the three dB exchange rate that most of the world uses. For every increase of three dB in the time-weighted average, the measured does would double. OSHA uses a five dB exchange rate. The exchange rate affects the integrated readings Lavg, dose and TWA, but does not affect the instantaneous sound level.

Exhaustive calibration – An exhaustive calibration must be performed at least every two years, or when-ever the annual check indicates the audiometer is out of limits. The calibration process checks the audiometers output waveform for linearity, frequency, amplitude and distortion.

Frequency – Pitch or the number of cycles that a sound wave completes per second. Measured in Hertz or cycles per second (CPS).

Hertz – Unit of measurement of frequency, numerically equal to cycles per second.

Level average (Lavg) – The average sound level, in dB, for the measurement period based on either a four, five or six dB exchange rate. If the exchange rate is three dB, then Lavg becomes Level Equivalent (LEQ).

Level day/night (LDN)) – A 24-hour average sound level where 10 dB is added to all of the ratings that occur between 10 p.m. and 7 a.m. This is primarily used in community noise regulations where there is a 10 dB penalty for nighttime noise. Typically LDNs are measured using A weighting, a 3 dB exchange rate and no threshold.

Level equivalent (LEQ)) – The average sound level for the measurement period based on a 3 dB exchange rate. If the exchange rate is 4, 5 or 6 dB, then Level Equivalent (LEQ) becomes Level Average (Lavg).

Max level – The highest sound pressure level, in decibels, that occurs during a given time period using either slow or fast response rate and A or C frequency weighting.

Noise cancellation – Noise cancellation equipment uses a microphone to pick up sound waves from a noise source. The microphones output is fed to a computerized signal processor, which generates a waveform identical to the original but 180 degrees out-of-phase. This out-of-phase signal is amplified and directed back toward the noise

source via a speaker system. When the two sound waves combine, they cancel each other out, reducing the noise.

Noise reduction rating (NRR) – Measure of the estimated attenuation capacity of a hearing protector.

Octave band analyzers – Measures the sound energy in each octave band for purposes of assessing background levels in audiometer rooms or to identify the noisiest frequencies emitted by a particular machine.

Otolaryngologist – A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

Peak level – The absolute highest measurement taken.

Permissible exposure limit (PEL) – An eight-hour time-weighted average of 90 dBA.

Response rate (fast, slow) – Determines how quickly the instrument responds to fluctuating noise. Fast response has a time constant of 125 milliseconds. Slow response has a time constant of one second. OSHA regulations require the use of slow response.

Representative exposure– Measurements of an employee's noise dose or eight-hour TWA sound level that the employers deem to be representative of the exposures of other employees in the workplace.

Sound exposure level (SEL) – The constant sound level in dBs which, if lasting for one second, would deliver the same amount of acoustical energy as that delivered over the entire measurement period. SEL is usually measured with a three dB exchange rate. However, the dosimeter will also allow SEL to be measured with four, five or six dB exchange rates. (SEL is not used by OSHA)

Sound level meter – A sound-level meter is a handheld, direct-reading instrument with a microphone, an electronic-filter network and a visual display such as a meter or digital readout. Because sound-level meters provide a real-time indication of noise loudness, they are typically used to initial survey an area. Once high-noise areas are identified, more exhaustive monitoring can be done with an audio dosimeter.

Sound level meters are good for the following:

1. Measuring a given point in time
2. Measuring continuous sound sources
3. Spot checking
4. Taking surveys

Threshold (cut off) – Sound levels below this point are excluded from all averaging. Threshold is used for averaging and integrating functions affecting Lavg, TWA and dose measurements. Threshold does not affect measurements in the sound level mode. The OSHA Hearing Conservation Amendment (1983) uses an 80 dB threshold and calls for a hearing conservation program to be put in place if the eight-hour TWA exceeds 85 dB (50 percent dose). This amendment is what most U.S. industrial operations comply with.

Time-weighted average (TWA) – The average of the sampled sound generally over an eight-hour period. If the time period is more than eight hours, the time-weighted average will always be less than the average sound level (Lavg). If the time period is less than eight hours, the time-weighted average will always be more than the average sound level (Lavg). At eight hours TWA and Lavg are exactly equal.

Weighting – Response networks, which cover the frequency, range of human hearing (10 Hz to 20 kiloHz). A, C and Linear are the common weighting networks available.

A weighting is typically used in both industrial and community noise applications. A-weighted measurements are often reported as dBA. The A-weighted filter responds close to the way the human ear hears at conversational levels. It attenuates the frequencies below several hundred Hz, as well as the high frequencies above 6,000 Hz.

C-weighting provides a flat frequency response with only slight attenuation of the very high and very low frequencies. C-weighting is intended to represent how the ear perceives sound at high dB levels and is often used as a flat response when Linear is not available. C-weighted measurements are often reported as dBC.

Linear weighting is a flat frequency response over the entire measurement frequency range. Linear is most commonly found on upper model sound level meters and is typically used when performing octave band filter analysis.

Related Articles

Quick Tips #260: Effective Hearing Conservation Program Elements.

Sources

29 CFR 1910.95, Occupation Noise Exposure.

Hearing Conservation, OSHA Document 3074, 2002