

Noise Survey Discussion

Risk Control from Liberty Mutual Insurance



Highlights:

- Effects of Noise
- Recommended noise levels
- Calculating exposure estimates
- Noise control measures

Exposure to high noise levels for extended periods of time can cause hearing loss. It is typically first detected in exposed individuals by comparing periodic audiograms that show a reduced ability to hear tones in the 4,000 Hertz frequency range. This often happens before the individual realizes a hearing loss has occurred and before it becomes disabling.

With continued overexposure, the hearing loss can grow larger and spread to lower frequencies, including normal speech frequencies. When the hearing loss has impacted the speech frequencies, affected individuals lose the ability to hear vowels and consonant sounds, making conversation more difficult. Employees with hearing impairment may say, “I can hear you, but I cannot understand you.”

Compared to other occupational injuries, hearing loss is progressive, irreversible, and generally painless. Through proper use of hearing protection, noise reducing engineering controls, and employee education, noise induced hearing loss is 100 percent preventable in most industrial environments.

There are also non-auditory effects of noise exposures. Individuals who have lost hearing in the speech frequency range quite often feel isolated. They can suffer from tinnitus, which is a “ringing” in the ear. Those suffering from tinnitus have difficulty sleeping because the ringing keeps them awake at night. Other potential health effects from noise exposures include hypertension, nervousness, sleeplessness, and fatigue.

Recommended Levels

Recommended levels refer to sound pressure levels averaged over the workday. They represent conditions under which it is believed nearly all workers may be repeatedly exposed without adverse effects on their ability to hear and understand normal speech.

- The OSHA permissible exposure limit for noise is 90 decibels A-scale (dBA) measured as an 8-hour time-weighted average (TWA). A hearing conservation program is required when exposures equal or exceed 85 dBA as an 8-hour TWA. OSHA uses a 5 dB doubling rate (also referred to as an exchange rate or trading ratio) which is the permissible change in dBA with doubling or halving of the duration of exposure. Therefore, OSHA permits 8 hours of exposure at 90 dBA, 4 hours at 95 dBA, and 16 hours at 85 dBA, etc. In other words, for every 5 decibel increase or decrease, the allowable exposure time will double or be halved.
- The American Conference of Governmental Industrial Hygienists recommends 85 dBA as an 8-hour TWA as their TLV. The ACGIH uses a 3-dB doubling rate which allows 8 hours at 85 dBA, 4 hours at 88 dBA, and 16 hours at 82 dBA, etc. Essentially, a 3 decibel increase or decrease will double or halve the allowable exposure time. As one can see, a 3-dB exchange rate is more protective than OSHA's 5-dB exchange rate in their occupational noise standard.
- The National Institute for Occupational Safety and Health (NIOSH) has recommended that OSHA change their current exchange rate to 3 db, which is a more conservative and protective rate. However, OSHA has not yet adopted this NIOSH recommendation. Many industrialized nations have adopted the 3-dB exchange rate.

Both of these occupational exposure limit values have been established to protect the hearing of exposed workers, but due to individual susceptibility, they should not be regarded as fine lines between safe and dangerous levels.

When a Liberty Mutual Industrial Hygienist performs a noise survey, the measurement techniques include collection of noise dosimetry measurements and/or noise measurements with a sound level meter. The 8-hour TWA exposure estimates used in this report is based on either dosimetry readings or sound pressure level measurements, and exposure time estimates provided to us during the assessment for typical production situations. They can be compared to the recommended levels cited above but they are not intended, and were not collected in such a manner, to be used to document compliance or non-compliance with any federal or state occupational noise regulation. Rather, they are intended to be used as an estimate of the hazard to hearing loss for exposed workers and as a guide to where noise control efforts should be directed on a priority basis. Higher exposure estimates indicate a higher risk of hearing loss.

Calculating Exposure Estimates

When the work shift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by the following formula:

Dose = $100 (C_1/T_1 + C_2/T_2 + \dots + C_n/T_n)$, where C_n indicates the total time of exposure at a specific noise level and T_n indicates the allowable time at that level.

The worker's full day exposure must be added up to estimate the dose.

The equivalent 8-hour TWA in decibels may be calculated from the dose by the following formula:

$$TWA = 16.61 \text{ Log (Dose/100)} + 90$$

An example of conversions from dose to 8-hour TWA is as follows:

Dose (%)	Equivalent TWA (dBA)
25	80
50	85
100	90
200	95
400	100
800	105

Noise Control Measures

A complete hearing conservation program is indicated when exposures equal or exceed 85 dBA as an 8-hour TWA.

This program should include:

- Identifying exposed workers
- Identifying and reducing major noise sources most influencing worker exposure
- Use of adequate and properly fitted hearing protectors
- Audiometric testing
- Employee training on the effects of noise, use of hearing protectors, and the purpose of audiometric exams

The program should be continued until either engineering controls reduce the sound pressure level, or administrative controls are implemented that reduce employee exposure time and overall exposures drop below 85 dBA. Reducing the noise level at or near its source by engineering means is the most desirable approach to noise control because it can minimize or eliminate the problem, is less subject to circumvention, and can avoid administrative and record-keeping requirements associated with audiometric

testing and limiting exposure time. However, reducing noise to below the recommended levels is not always technically possible or practical, in which case a combination of engineering and administrative controls must be employed. Each control may only be a part of the solution eventually needed to reduce the risk of hearing loss in exposed workers.

Examples of the OSHA PEL Allowable Times (Reference Durations)

dBA Sound Level	Allowable Time, T _n
80	32 hours
85	16 hours
90	8 hours
95	4 hours
100	2 hours
105	1 hour
110	½ hour (30 minutes)
115	¼ hour (15 minutes)

References

AIHA Press. *The Noise Manual*, Revised 5th Edition. Edited by E.H. Berger, L.H. Royster, J.D. Royster, D.P. Driscoll, M. Layne, 2003.

U. S. Department of Labor, Occupational Safety and Health Administration. *Noise Control. A Guide for Workers and Employers*.

OSHA 29 CFR 1910.95, *Occupational Noise Exposure*.

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