



MIOSHA Fact Sheet

General Industry Safety & Health Division

Noise & Hearing Conservation

What is noise?

Noise (unwanted sound) is caused by the vibration of an object, whether it is a guitar string, tool, or machine housing, which then causes the air around the object to vibrate. The sound wave then travels away from the source much like a wave that results when a pebble is tossed in a pond.

The two components of a sound wave are frequency and amplitude. Frequency, or pitch, is determined by how many cycles occur per second. Another name for cycles per second is hertz (Hz); therefore, 1,000 cycles per second equals 1,000 Hz. At best, humans hear sounds over a frequency range of about 20 Hz to 20,000 Hz. The amplitude of the sound wave causes air pressure fluctuations which are related to sound loudness.

What is a decibel?

Because the range of air pressure fluctuations that the ear can detect is so great, the decibel (dB) is used as a convenient way to measure sound levels. However, this unit often leads to much confusion because the decibel is non-dimensional and it represents a logarithmic ratio. Decibels on the A-scale (dBA) are used to determine employee exposure to noise. This is done to incorporate frequency considerations into the sound level measurement. An understanding of decibels and sound measurement are needed to properly interpret the results of noise exposure monitoring.

What are the harmful effects of excessive noise?

Sudden, very high noise levels can rupture the ear drum or dislodge the bones in the middle ear leading to an immediate loss of hearing. Fortunately, this acute trauma is very uncommon. The most common effect is chronic damage to the inner ear that results in a gradual hearing loss. The damage is permanent

and may not be noticed until the loss of hearing is severe. Although not as dramatic as acute trauma, this type of hearing loss can be more debilitating. The damage cannot be repaired.

Loss of hearing has implications regarding employment, social interactions, and family life. This includes misunderstanding communications, confusion during normal conversations, and not hearing an alarm or other warning signal. Other effects associated with noise include, tinnitus (hearing a ringing or buzzing noise when no noise is present), increased blood pressure, stress, nervousness, and fatigue.

When does noise become harmful?

The threshold of pain is in the range of 120 to 140 dB. However, most occupational exposures to noisy environments occur in the range of 80 to 100 dBA. Chronic exposure to noise, starting at about 80 dBA, is known to cause damage to the inner ear which can result in a loss of hearing. Increasing the noise level and exposure time will result in more risk of a hearing loss. Initially, a noise-induced hearing loss will first effect the ear's ability to hear sounds at about 4,000 Hz. As exposure continues, the loss of hearing at 4,000 Hz will increase and broaden to include lower (speech frequencies) and higher frequencies.

Due to the use of the dB, an increase in sound level from 80 to 83 dBA may not seem very large. However, it actually represents a doubling of the sound energy. This is true anytime there is a 3 dBA increase. Any increase of 20 dBA, such as 80 to 100 dBA, represents a hundred-time increase in the sound energy. This explains why a working life-time of exposure to noise at 80 dBA has a small risk of hearing loss; whereas, everyone will have significant hearing loss at 100 dBA.

When does Part 380 Occupational Noise Exposure standard apply?

Part 380 requires initial noise monitoring to determine if employee exposure to noise equals or exceeds the action level of 85 dBA or equivalently a noise dose of 50%. An average of 85 dBA for an 8-hour work period is equal to a noise dose of 50%. Monitoring must be done when information indicates that any employee's exposure equals or exceeds the action level. In addition, monitoring is done to determine if the permissible noise exposure limit of 90 dBA or equivalently a noise dose of 100% is exceeded. An average of 90 dBA over an 8-hour work period will result in a noise dose of 100%.

It is important to notice that as noise levels increase, the action level and permissible noise exposure limits will be exceeded in a shorter period of time. At an average noise level of 95 dBA, the action level will be exceeded after only 2-hours of exposure and the permissible noise exposure limit will be exceeded after 4-hours of exposure.

How is noise exposure determined?

Employee exposure is best determined using a noise dosimeter. The employee wears this device which has a microphone that is usually worn on the shoulder. The dosimeter records the data and computes the average noise exposure in dBA and the percent dose. Therefore, the results are representative of the employee's noise exposure.

How is employee hearing protected when the action level is met or exceeded?

Part 380 requires the implementation of a hearing conservation program when an employee's exposure meets or exceeds the action level. The main elements of this program are:

Noise monitoring (Rule 8) is usually not a one time occurrence. It is necessary to repeat monitoring when there are changes in machinery, processes, production levels, etc. This is done to determine if additional employees have exposure at or above the action level.

Audiometric testing (Rule 12) is required to determine the employee's threshold of hearing at six frequencies ranging from

500 to 6,000 Hz. Audiograms must be offered initially (baseline audiogram) and then annually. Each year, the annual audiogram is compared to the baseline. The main purpose of this testing is to recognize hearing problems and take action before the hearing loss becomes debilitating. The noise standard provides for the evaluation of an audiogram and defines a standard threshold shift (STS). A STS has occurred when the annual audiogram is compared to the baseline audiogram and an average difference of 10 dB or more is found at 2,000, 3,000 and 4,000 Hz, in either ear.

Hearing protectors (Rule 21 & Appendix A), as well as other requirements of the standard, must be provided without cost to the employees. A variety of hearing protectors must be provided. The wearing of hearing protectors is mandatory when:

- The permissible noise exposure level of 90 dBA for 8-hours or an equivalent dBA is exceeded.
- The employee has exposure to noise at or exceeding the action level and has not had a baseline audiogram.
- An employee had a standard threshold shift.

Employee training (Rules 21, 23 & 24) must include all of the following and be done annually:

- The effects of noise on hearing,
- Hearing protection: selection, fitting, use, care, advantages, disadvantages, and attenuation,
- Audiometric testing: purpose and procedure.

Recordkeeping (Rules 25 & 26) requirements include:

- All employee noise exposure measurements.
- Employee audiograms.
- Audiometer calibration and background sound levels in the booth or room used for audiometric testing.
- Record retention, provision, access and transfer.

Additional Information

Please visit the MIOSHA website at www.michigan.gov/mioshapublications where additional information may be available; or contact the Consultation, Education & Training Division at (517) 322-1809.

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