

Hearing protection

The human hearing apparatus consists of three parts with differing functions. Firstly, the outer ear that you can see acts to direct sound into the ear canal and onto the eardrum causing vibration. The next part is the middle ear where the vibrations of the eardrum cause 3 tiny structures, the auditory ossicles, to move and transmit these vibrations via a mechanical linkage system to the inner ear. The inner ear itself is a spiral organ containing the sensory organs for hearing and balance. The vibrations from the middle ear are transmitted to this inner ear causing hair cells to move relative to the surrounding boundaries of the inner ear resulting in nerve stimulation which the brain interprets as sound.

There are two main ways that hearing loss can occur. The sound wave transmission can be interrupted on the way to the inner ear, for example by a burst eardrum or as you age by the movements of the middle ear ossicles decreasing. Damage to the ear drum can occur by foreign objects, pressure or infection. This will result in the loss of ear drum vibration that sets in motion all the subsequent vibrations deeper into the ear.

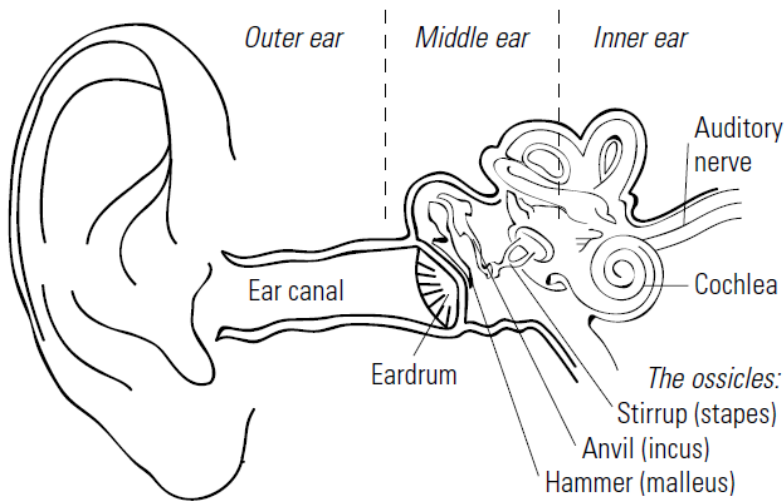
The second main way that hearing loss can occur is within the spiral organ of the inner ear where damage can occur to minute structures including the hair cells. Exposure to excessive levels of noise permanently damages the hair cells that transmit vibration into nerve impulses. This is more commonly known as industrial or noise related deafness

Noise related damage is a result of both decibel level and the amount of time that a person is exposed to a sound. Risks for hearing loss can vary from prolonged exposure to high levels of noise to shorter term excessively loud noises such as at a rock concert or impulse noises experienced in activities such as rifle shooting. A common example of prolonged exposure to increased noise that can be damaging is listening to an ipod or MP3 players with inner ear speakers so close to the eardrum and the volume too high. It is suggested that you should have the volume of the headphones of an ipod/MP3 low enough that you can still carry on a conversation. Noise-cancelling headphones are a better alternative to listening to uninterrupted music as the volume does not need to be as high and the speakers are further way from the eardrum.

There are many websites that list safe noise levels and ways to prevent hearing loss. The list below is just one example of the types of noises and exposures that are considered "safe". In the workplace under OHS law, noise levels above 85 decibels are considered unsafe and hearing protection strategies must be taken. These include using earplugs, reducing exposure to the noise, and rest periods away from noise.

There are many types of earplugs available. One affordable protection method thought to not detrimentally impact as much on the quality of the sound is the Etymotic ER-20 earplugs. These cost around \$35 a pair, are reusable, and are designed to reduce sound levels evenly providing about 15-20 decibels of attenuation.





Maximum exposure times for different sound pressure levels

Sound level (dBA)	Maximum Exposure	Time
82		16 hours
85		8 hours
88		4 hours
91		2 hours
94		1 hour
97		30 minutes
100		15 minutes
103		7.5 minutes

Approximate sound level (decibels)

- 45-55
- 60-70
- 75-85
- 80
- 90
- 92-95
- 94
- 95
- 105-120
- 120-137
- 140
- 150

Sound source

- Normal conversation at arm's length
- Piano played at moderate levels
- Chamber music in a small auditorium
- Telephone dial tone
- Train whistle at 150 metres away
- Piano played loudly
- ipod/MP3 at half volume (5/10)
- Subway train at 60 metres away
- Amplified rock music at 1-2 metres away
- Symphonic music peak
- Jet engine at 30 metres away
- Rock music peak

Reference for tables and picture on page 2:

Safety and Health in Arts Production and Entertainment (SHAPE) Listen While You Work. Hearing Conservation for the Arts (2001) <http://www.shape.bc.ca/resources/pdf/listen.pdf>