

Hearing Safety

This document is meant as a guide for users of the University of Michigan audio facilities. These facilities, and others are capable of extreme volume levels and personal injury can result from their misuse. This is meant to be a source of information for users who want to use this equipment responsibly.

It is a bit odd to consider that the people most vulnerable to occupational disability through hearing loss are also under the least regulation. Noise levels in factories and offices are carefully monitored and regulated by the Occupational Safety and Health Administration (OSHA), yet musicians and recording engineers routinely (and legally) expose themselves to sound levels that are well established as being able to cause permanent damage.

Amplified music is not alone in causing damage. Musicians seated in front of the brass section of an orchestra exhibit hearing damage as do jazz drummers who do not use any added amplification. Of course, once amplified, conditions can easily be made more serious.

It is not enough to consider the power of the amplifiers. The distance to the source, frequency distribution of the sound, and the length of exposure all factor in to the severity of the problem. For example, personal stereos such as the Walkman deliver only a fraction of a watt, but can be sources of very serious hearing damage.

Hearing fatigue is not a good indicator of whether damage has occurred. Fatigue is usually caused by excessive intermodulation distortion. While sometimes such distortion is caused by audio systems driven to extremes, it is not the only source. Damaging levels can be obtained by clean undistorted power, and it can be very painless.

Hearing loss can come from two different mechanisms. The first, acoustic trauma, is the result of a single event of extraordinary loudness. Noises such as explosions can attack all the components of the hearing system and have immediate effect.

The other mechanism is called noise induced hearing loss (NIHL) and can be much more insidious in its attack on the hearing system. Even short term exposures of moderate intensity sounds can cause temporary threshold shifts (TTS) that cause the listener to desire ever increasing volume levels in order to achieve the same apparent loudness. After leaving this environment, it is common for all the normal sensitivity to eventually return. It is possible to create permanent damage if the levels and durations are sufficient, and the TTS often encourages the listener to put himself in such a situation.

Hearing damage is irreparable, and therefore cumulative. It is ironic that, as a person's hearing is permanently damaged, the person requires louder volumes in order to perceive sounds. This means that the person will need to continue exposure to damaging sound levels.

Researchers still have much to learn about hearing loss and prevention. One argument states that all events of TTS cause at least some minor degree of NIHL, thus accounting for the general decline in hearing ability with age and a general lack of hearing sensitivity among the members of our modern communities which have a universally higher background sound level.

One undeniable sign of damage due to NIHL is a ringing in the ear that lasts from a few hours to a day or so after exposure to extremely loud sound. In that case, there is no question that permanent damage has occurred. Still, gradual deterioration can occur without any symptoms of physical discomfort.

The OSHA has given guidelines that are applied to just about every work environment except those where musicians work. There has been no study of how the spectral organization of the offending sound alters these guidelines. Also, these guidelines are geared towards disability, not subtle degradations of treble. For all these reasons, it is recommended that if you intend to use your hearing for critical listening, you should stay well within these limits.

Exposure during one day:

90 dBSPL	8 hours
92 dBSPL	6 hours
95 dBSPL	4 hours
97 dBSPL	3 hours
100 dBSPL	2 hours
102 dBSPL	1.5 hours
105 dBSPL	1 hour
110 dBSPL	30 minutes
115 dBSPL	15 minutes

To give an idea of what these levels represent:

30-40 dBSPL	ambient room noise / whisper
50-70 dBSPL	conversation
80-90 dBSPL	feature film in theater
90-110 dBSPL	bar with music and conversation
110-120 dBSPL	rock concert
130-140 dBSPL	painful sound

OSHA requirements state that if workers in a workplace are subjected to levels in excess of 90dB during an 8 hour shift, then engineering controls and mandatory hearing protection must be provided.

If you plan to use your hearing in your occupation, you should get your hearing checked regularly. Even healthy listeners have slightly different hearing and it is normal to have some loss over time, especially after age 50. What is also important is the rate of change of hearing ability. Keep records of your tests to see how your hearing changes over time.

Meanwhile, you can take control of your exposure to loud sounds. Take steps to decrease both the duration and intensity of your exposure. This is especially easy when it is your hand on the volume control.

- Turn up the volume only when it is necessary to hear an important detail and then return it to a normal setting as soon as possible.
- Remember that the apparent tonal balance of a sound is affected by its level. Try to mix at a level similar to what the listening audience will be using.
- Keep an eye on the monitor level control throughout the session and try to keep it from creeping upwards due to TTS.
- Take breaks throughout the session to give your ears a rest.
- Try to spend your pre and post session times in activities that do not involve exposure to loud sounds.

Remember that hearing loss due to noise exposure cannot be repaired by regeneration or by medical means. Many famous musicians, engineers, and producers have destroyed the very tool that brought them their success. It is not necessary to pay such a price for a successful career.

For more information on this topic, visit <http://www.hei.org/> or <http://www.osha.gov/>

This document, as well as many other helpful manuals are available as a download over the internet. They are found at <http://www.umm.umich.edu/audio>. The most up to date versions of all our documentation will be found here.

The Media Union

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