

# Researchers Recommend Safe Listening Levels for Apple iPod

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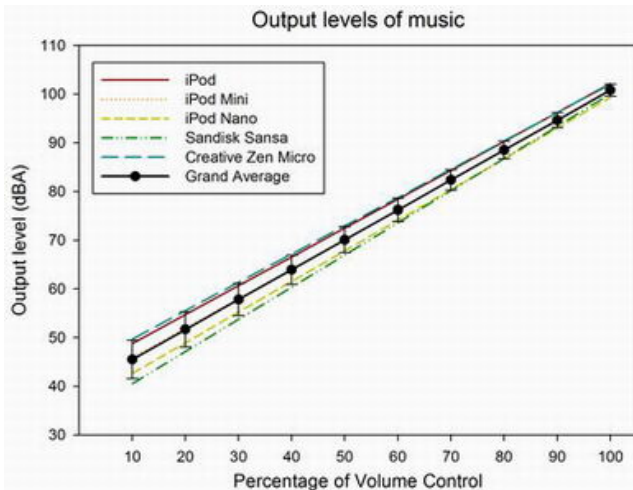


Figure 1. Free-field equivalent output levels of 5 MP3 players, using stock earphones, as a function of volume control settings. The Grand Average is the mean of all music genres across all players. Error bars represent 1 standard deviation around the Grand Average.

Sound levels of five popular portable music players.

Hearing researchers will present the first-ever detailed guidelines on safe volume levels for listening to the Apple iPod portable music player with earphones. In a second study, researchers found that in-ear earphones, which broadcast sound directly into the ears, are no more dangerous than headphones that are placed over the ears.

However, if individuals are listening to their music amidst noisy surroundings, they are much more likely to raise the volume to risky levels, the researchers found, suggesting that individuals should seek quieter listening areas when possible and use earphones that block out background noise.

Audiologists Brian Fligor (Children's Hospital/Harvard Medical School, Boston) and Terri Ives (PCO School of Audiology, Elkins Park, PA) and audiology doctoral candidate Cory

Portnuff (University of Colorado, Boulder) will present the studies later this week in the Cincinnati area at a national conference entitled "Noise-Induced Hearing Loss in Children at Work and Play," the first-ever national meeting devoted specifically to preventing and understanding noise-related hearing loss in the youngest age groups.

Portnuff and Fligor estimate that a typical person could safely listen to the iPod for 4.6 hours at 70 percent of full volume using the supplied earphones without greatly increasing the risk of hearing loss. However, listening to music at full volume through the iPod for more than 5 minutes per day through its stock earphones, they say, could increase the risk of hearing loss in a typical person. These guidelines apply in general to other music players, such as the Sandisk Sansa and the Creative Zen Micro, which they found to produce similar volume levels.

In a separate study to be presented at the conference, Fligor and Ives observed the listening habits of 100 doctoral students listening to iPods through earphones. When the students were in a quiet environment, they found that only 6 percent of them turned their players to risky sound levels. When in a noisy environment, a dramatically higher 80% of the students listened to the music at risky levels. When they used an "in-the-ear" earphone designed to block out background noise, only 20 percent exceeded sound levels considered to be risky. This suggests, Fligor says, that seeking out quiet environments and using "isolator" earphones designed to block out background noise help listeners avoid the tendency to play music at sound levels that can pose risks to their hearing.

% of Volume Control	Maximum listening time per day			
	Earbud	Isolator	Supra-Aural	iPod, stock earphones
10-50%	No limit	No limit	No limit	No limit
60%	No limit	14 hours	No limit	18 hours
70%	6 hours	3.4 hours	20 hours	4.6 hours
80%	1.5 hours	50 minutes	4.9 hours	1.2 hours
90%	22 minutes	12 minutes	1.2 hours	18 minutes
100%	5 minutes	3 minutes	18 minutes	5 minutes

**Table 1.** Maximum listening time per day using NIOSH damage-risk criteria. "Earbud" includes stock earphones and iPod In-ear earphones. "Isolator" includes Etymotic ER6i earphones and Shure E4c earphones. "Supra-Aural" includes Koss headphones that rest on top of the ear.

Recommended listening times for iPod depend on the type of earphones that are being used. Credit: Cory Portnuff/Dept. of Speech, Language and Hearing Science, University of Colorado; Brian Fligor/Children's Hospital Boston and Harvard Medical School

Conference organizers hope to raise awareness of these new findings as well as to other hearing hazards in children.

"Portable music players are not the only hearing hazard to which kids are exposed," says University of Northern Colorado audiologist Deanna Meinke, co-organizer of the conference, which takes place on October 19 and 20 at the Embassy Suites Hotel Cincinnati-Rivercenter in Covington, Kentucky. "Parents and teachers have to look across exposures for all noisy and loud activities."

Noise-induced hearing loss, she says, can be caused by two types of noise. Sudden bursts, such as firearms and fireworks, can immediately cause hearing loss in children, who are often reluctant to report such exposures to their parents. The other type is continuous exposure to loud noise, which can damage the ears over time. Sources of continuous noise, she says, including motorized recreational vehicles, loud sporting events, power tools, farming equipment, and amplified music.

For continuous noise exposure such as music, the "level and duration of exposure are important," she says. According to Meinke, "It takes repeated exposures over many years" to cause a gradual onset of noise-induced hearing loss in both children and adults. Since people have many possible encounters with loud sounds, she says, it's

important to use safe listening strategies when possible; move away from the noise, turn down the volume or wear properly fitting hearing protection.

Portable music players have sparked recent concern that they could contribute to such noise-induced hearing loss, since they are used frequently and with earphones that deliver the sound directly to the ear. As a result, they were investigated thoroughly by Portnuff, a graduate student at the University of Colorado, and Fligor, Director of Diagnostic Audiology at Children's Medical Hospital and Harvard Medical School in Boston.

Portnuff and Fligor measured specific sound levels that come out of five portable music players: the Apple iPod, the Apple iPod Nano, and the Apple iPod Mini; the Creative Zen Micro; and the SanDisk Sansa. For each player, they measured sound levels in music transmitted several different types of earphones, ranging from the "stock" earphones that come with the products to "isolator" earphones that block outside noise, to "supra-aural" earphones that fit over the ears.

Interestingly, they found that all five music players output very similar sound levels, especially at the highest volume levels. They also found no significant differences between sound levels in five different genres of popular music, especially when played the highest volume.

But those highest volumes, the researchers point out, can be dangerous—so dangerous that the researchers only recommend listening at those levels a few minutes a day, if at all.

"Damage to hearing occurs when a person is exposed to loud sounds over time," explains Portnuff, a Ph.D. candidate at the University of Colorado. "The risk of hearing loss increases as sound is played louder and louder for longer durations."

To come up with their recommended listening times, the researchers compared the players' volume levels to 85 dBA, the minimum sound level determined to pose the risk of hearing damage according to National Institute of Occupational

Safety and Health (NIOSH) guidelines. The unit "dBA" stands for "A-weighted" decibels, a scale that takes into account the fact that the human ear has different sensitivities to different frequency levels and reduces the weight for frequencies below 1,000 hertz and above 7,000 hertz, to which the ears are less sensitive.

The typical individual can tolerate about two hours of 91 dBA per day before risking hearing loss, Fligor says. Loud sounds stress and potentially damage the delicate hair cells in the inner ear which convert mechanical vibrations (sound) to electrical signal that the brain interprets as sound. Over time, the hair cells can become permanently damaged and no longer work, producing hearing loss.

With this in mind, Portnuff and Fligor say that typical individuals can listen to their iPods for a total of 1.2 hours a day with the supplied earphones if the volume is at 80 percent of maximum levels. Listening to iPods at full volume is not recommended for more than 5 minutes per day (if using the supplied earphones or other earbuds), 3 minutes per day (if using "isolator" earphones that block out background noise), or 18 minutes per day (if using "supra-aural" earphones that are placed over the ears rather than inside them). Summarized in table 1, these guidelines take into account, for example, that earbud-style earphones are inserted closer to the ear and they typically deliver sounds at levels 5.5 dBA higher than the supra-aural ones.

The maximum recommended listening times represent the amount of time that a "typical" person could listen to their portable music player every day without greatly increasing their risk of hearing loss.

"It is important to note, though, that not everyone shares the same risk of hearing loss," Portnuff explains.

For some people who have "tougher" ears, he says, the recommendations are overly cautious. For other people with more "tender" ears, these recommendations do not eliminate the risk of hearing loss.

"Today, however, we have no way of predicting

who has 'tough' ears and who has 'tender' ears. Hearing loss occurs slowly and is often not noticed until it is quite extensive, so early prevention is the key," Portnuff says.

Papers: "Output Levels of Portable Digital Music Players," Cory D. F. Portnuff and Brian J. Fligor, Sc.D., CCC-A , Thursday, October 19, 2006, 1:30 PM; laypaper at [www.hearingconservation.org/docs/essRoom/portnuff.htm](http://www.hearingconservation.org/docs/essRoom/portnuff.htm)

"Does earphone type affect risk for recreational noise-induced hearing loss?" Brian J. Fligor, Sc.D., CCC-A and Terri Ives, Sc.D, Thursday, October 19, 2006, 1:50 PM; laypaper at [www.hearingconservation.org/docs/essRoom/FligorIves.pdf](http://www.hearingconservation.org/docs/essRoom/FligorIves.pdf)

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