

# PRO AUDIO REVIEW

PAR FEATURE  
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## How Loud Is Too Loud? THE DANGER OF EXCESSIVE AUDIO LEVELS

"My left ear is there basically to balance my face because it doesn't work at all," says once headbangingly loud wild-man rocker Ted Nugent in the Hearing Education and Awareness for Rockers' "Can't Hear You Knocking" hearing loss education video. "Now I always wear an earplug in my right ear."

Like it or not, hearing is a contact activity. And like football and other contact sports, there are on-the-job injuries that can happen and, in some cases, ruin the career of sound professionals such as musicians and studio personnel.

Kathy Peck, executive director of H.E.A.R. (Hearing Education and Awareness for Rockers), a non-profit group attempting to educate musicians and sound professionals about threats to hearing, warns: "Just because your ears don't bleed doesn't mean you're not causing damage ... The damage that you receive when you're young won't be apparent until you're older ..." The bassist for the all-female punk band the Contractions should know. Back in the mid-'80s she discovered she was losing her hearing from loud club dates, especially noticeable after a gig at the Oakland Coliseum opening for then hot Duran Duran. Not long afterward, Peck ran into a friend, Dr. Flash Gordon, at a painfully loud club and they hatched an idea. From that

H.E.A.R. was started in 1988. She laments, "We see at the H.E.A.R. clinic young people in their 20s, 30s and 40s who have the audiograms of people in their 60s ... It's depressing to have to tell someone they have to get a hearing aid ... that's your livelihood that's being ruined."

Unfortunately, rock musicians, along with some producers and engineers, have a "Play it loud — the louder the better" approach to music. Pete Townshend and the late Keith Moon of The Who were the first really big stars to come out about hearing loss. Both were part of a band that made history for its loud concerts and they lived to regret it. Moon took to wearing airport ground crew earmuffs during concerts as he swatted his drums and fans near the stage commented on Townshend's earplugs. Some older acts such as Led Zeppelin and the Grateful Dead followed The Who's lead, but younger acts, especially heavy metal bands, still take it as a rite of passage, a demonstration of their bandhood so to say, to play louder than a 747.

### Ear assault force

Nancy Nadler of the Noise Center at the League for the Hard of Hearing describes the effect of loud, continuous noise, something audio professionals can find themselves subject to on the job noise as "a continuous assault on the inner ear." She explains: "What typically happens is that when the ears are exposed to high levels of noise they shift the range of hearing ... What is happening is that the hair cells that respond to those frequencies are dead ..." The effect is quite stealthy, "So musicians and engineers who are exposed to it tend to lose their hearing slowly ... and painlessly ..." And of course as their hearing seems to

fade they crank the sound higher, which increases the rate at which damage is done. The cycle builds logarithmically just as the dB scale does.

But it isn't only the loudness that is harmful. On-the-job hearing loss, that is loss which is not genetic or caused by a disease, is actually governed by two factors: loudness and time exposed. Lengthy exposure to only moderately "loud" sounds can do significant damage.

Then what is loud? The federal government's Occupational Safety and Health Administration (OSHA) has produced guidelines for unprotected exposure to on-the-job noise, which technically includes sound studios. According to OSHA, exposure for an eight-hour day should average no more than 90 dB, though 85 dB is preferred. If exposure is above that, say 95 dB, OSHA guidelines call for a drastic reduction in time exposed. For 95 dB the exposure time is four hours. One-hundred decibels cuts exposure time to two hours. OSHA guidelines prohibit unprotected exposure to anything over 115 dB, even for only a minute.

So how do you know when the noise is too loud? Shorthand calculations can do for those who don't carry around a sound level meter. Normal conversation tends to occupy the 60 dB–70 dB range. An easy-to-remember rule of thumb for telling when you should be conscious of the sound level in an area is if you have to shout to be heard at two to three feet distance — then it's probably too loud.

Interestingly, it's not only rockers who are at risk. Several audiologists have noted that classical musicians are often hard of hearing. The reason, as audio researcher Marshall Chasin of the Centre For Human Performance and Health has measured, a symphony at crescendo can easily top 120 dB and much of today's "sonic spectacular" programmatic favorites, dominated by blaring brass and thundering drums, involve numerous extended crescendos. These crescendos are comparatively louder than the average rock concert, which is loud all the way through. It doesn't help that classical

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musicians tend to be much older and already suffering from age-induced hearing loss.

And of course a sound engineer, no matter what music is being played, is at risk when the level edges over 90 dB for any length of time (95 dB of the mellowest Satie *Gymnopaedie* is just as dangerous as 95 dB of Metallica's screaming guitars).

### Bad impressions

A lot of sound professionals are under the impression they have "gotten used to" loud sound. That's a myth. Elliott Berger, former president of the National Hearing Conservation Association and a senior scientist for Aearo Company, a leading hearing protection device company, warns, "Repeated exposure to noise does not toughen the ears." Ears do not develop temporary calluses the way skin does. Nor does some hearing loss prevent further hearing loss. In fact, if you find yourself "getting used to" the loud noise, that's a bad sign. Get a hearing test.

As anyone who's fired a cap gun or attended a rock concert can tell you, some "hearing loss" is temporary. There might be a ringing in the ears but it will go away after a few hours, or in traumatic cases, days. But don't be fooled. Anything that causes even temporary hearing loss is destructive in the

your friends seem to be "mumbling" more than they used to while others are just as loud as they always were? Maybe a particular singer or instrument seems to be flatter than in the past? Does the keyboard need to be constantly retuned because its tones seem to be shifting all by themselves? This spotty hearing is called noise-induced hearing loss or sensorineural deafness and also known as nerve loss deafness.

Another problem, tinnitus, is probably the most common overall hearing affliction that can affect all ages. It is the "ringing" (or "whooshing") in the ears that people hear after a loud noise. It usually dissipates after a short period of time. However, many people, in more advanced cases, have that ringing in their ears for extended periods of time or permanently; and there are cases where people's lives have been ruined by chronic tinnitus. Exact causes are unclear and "cures" are uncertain. But some research at Britain's Royal National Institute for Deaf People has indicated that, at least sometimes, tinnitus may be more psychological than physiological and can be treated through medication or hypnosis. Still, at the minimum, tinnitus is annoying and whenever your ears ring after a loud sound they are telling you not to do that again.

Tinnitus is what musicians developing hearing problems first complain of. Townshend named tinnitus as one of the afflictions that has kept him off stage for many years. He also described symptoms of hyperacusis — a growing, often painful, sensitivity to certain sounds (or in extreme cases any loud sound).

There are debates on just how much "permanent" hearing loss is permanent. But most hearing professionals would agree — consider any loss permanent. Damage to and the death of the tiny hairs in the inner ear's cochlea are irreparable at this time. Like a balding man, those hairs do not grow back and there is no such thing as "inner ear Rogaine". There have been some medical experiments that have successfully regenerated such hairs in lab animals, but this is far from human use. And even in those cases it's unclear as to whether the new hairs perform properly (much of our hearing sense is not actually instinct but unconsciously learned during the first few months of life).

Other damage to the ear through aging or abuse is rarely reparable. In the wonderful

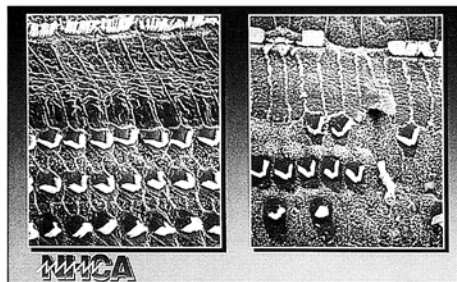
Star Trek future hearing damage will be curable through miracle medicine or implants/transplants but until then ... your hearing only goes around once.

### What to do?

Now, what to do to save those ears. The obvious solution would be to record at lower levels — those within sound (pardon the pun) guidelines — everyone's hearing would be protected from unnecessary damage. Yet despite a general increased awareness of hearing dangers, there are few studios with lowered level recording policies. Nor is there an industry-wide policy on hearing and recording levels.

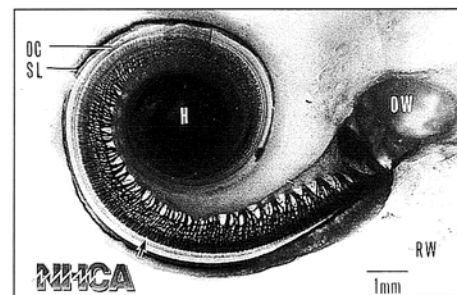
Frank Wells of Masterfonics in Nashville says, "To my knowledge there aren't any studios doing a great deal about this ... You don't stay in business long that way ..." "LOUDER=BETTER" still seems to be the rule.

But Bob Ludwig of Gateway Mastering in Portland, Maine is blazing a quieter trail. He says: "I know that certainly early on in their careers a lot of mix engineers listen at blazing hot levels to the point where one's ears ring ... I just noticed as the years went on more and more clients can't hear." Ludwig strictly adheres to OSHA guidelines for sessions at his operation. He says of the guidelines, "It's kind of a maximum value ... The one we pay the most attention to is



**An undamaged (left) and damaged chinchilla cochlea segment.**

long run — it may not be fully noticeable at that time. The first range of hearing to be lost is high-frequency reception. Due to the construction of the ear, the receptor hairs tuned to high frequencies and the aging process, high-frequency hearing is the first to show signs of wear and abuse. The tiny hairs die and they can't be replaced. Or, if your job involves sound, you might find that you can no longer hear certain mid-range sounds very well. Perhaps some of



**A healthy human cochlea.**

90 dB for 8 hours." He stresses, "We make it a point to listen at 85 dB." If for some reason a client wants it louder, and Ludwig knows the customer is always right, Ludwig will leave the room. He's found over the years that listening to loud sounds, +90 dB, even for a short time can be harmful. "If I do it even for a short time I find I lose my reference point ... then 85–90 dB sounds too quiet." Even outside the controlled confines of his studio, Ludwig is ever vigilant for

sound dangers: "If you want to be a mastering engineer there is no such thing as going to a concert without wearing ear plugs."

If things aren't so good at the studio level, Brian Keefe, a sound monitor engineer who's worked with Neil Young, Rush, Frankie Valli and now Queensryche, sees things a little differently on the live sound end. He describes the change in concern about hearing loss over the last decade:

"It's now a money business ... as the industry has matured and people can make a living at it, it's no longer a bunch of hippies smoking dope in a van ... Hearing protection has become mainstream ... More often than not you have people who wear (at least) ER-15s and ER-25s or foam plugs." He adds, "Ironically, it was brought about by engineers who made the musicians aware (of loud sound dangers)."

Keefe himself has experienced slight hearing loss and now uses in-ear monitors. He says, "It was a youthful thing ... working with bar bands ... during those days hearing protection wasn't an issue." But it was a band that wised him up about hearing protection, "They were really into it. I've always worn them since the information was available ..." Over the years though he's seen what hearing loss can do to live sound: "When musicians have hearing problems it makes mixing and monitoring very difficult ... They're missing something and you don't know what it is ... Communication is very difficult ... It's like a painter who's colorblind."

### Career choices

Nancy Nadler of the Noise Center points out the obvious but seemingly overlooked: "For people in this industry their hearing is so critical. If they lose their hearing they could lose their career." And if that's not enough consider that noise stress also has an impact on health. It can cause indigestion, high blood pressure, irritability, loss of sleep and increase fatigue. *The Voice* (now *Hearing Health* magazine) carried an article (July/August 1990) outlining even more frightening things that can happen to those ODing on sound including aggravated intestinal disorder



**EAR Classic foam earplugs from Aearo.**

(hilariously spoofed in the mock rockumentary *This Is Spinal Tap*) and loss of sexual potency in men. For head-banging expectant mommies, sound stress induced hormonal imbalances can harm the fetus.

So you're convinced — you need hearing protection but you think that hearing protection devices might be uncomfortable and they definitely cramp your carefully

crafted look. Elliott Berger points out, "Hearing protection devices may be uncomfortable, but hearing loss is permanent." He equates hearing protection devices with sunglasses on a bright day — they make it possible to focus on what is important.

Modern hearing protection devices (HPDs) come in a variety of styles and approaches, ranging from almost invisible customized earplugs and in-ear monitors to enormous earmuffs. The cheapest, quickest and handiest, yet still quite effective, are simple foam one-size-fits-all earplugs. Disposable (or sort-of reusable), they can be bought by the gross in pre-packaged pairs for handing out to employees at recording sessions or at concerts. The EAR Classic, from Aearo, with their snazzy bright yellow foam, are an extremely popular example but many companies make them. A couple of pair should be in every sound professional's desk, pocket or instrument case.

Straightforward foam plugs deaden high frequencies with a little more brio than the rest of the scale, great for industrial lathe operators but not so good for the sound professional. If you want equal, across the board attenuation look at the more upscale earplugs. There are many types of these specialized flat attenuation earplugs — simple premolded flexible plugs (e.g. Aearo's ER-20 *Hi-Fi ear plugs*), passive custom-molded plugs with noise attenuators (e.g. the ubiquitous ER-15 and ER-25) and premolded (e.g. Etymotic Research's ER-4 Insert Earphones) and custom-molded in-ear monitors (e.g. Sensaphonics' ProPhonic line, Garwood Communications' Micro Monitor, Westone's Ultimate Ears, Future Sonics Ear Monitors or Shure's Personal Stereo Monitors). With the exception of the premolded ER-4 and ER-20, both of which

look like a stupa on a toothpick, all of these require casts, poured by a qualified audiologist, to be made of the ear canal for customizing the plug to fit tightly into or "seal" the ear canal.

At the sledge-hammer end, many drummers now use earmuffs/headphones (the distinction is easily blurred). There are many types available ranging from simple noise-deadening cups on a band (boring yet effective) to elaborate designs, such as GK Music's DrumPhones, with built-in noise-canceling circuits and monitor feeds (similar to those used by pilots and airport ground employees).

But don't be fooled into thinking headphones are a panacea. Frank Wells warns that not all hearing loss results from ear-splitting monitors at loud recording sessions and concerts: "It's the proximity to the ears. It isn't always on stage and on the road ... We have studio musicians who never travel who have lost their hearing just from listening through headphones that were too loud." He has a story with which most sound professionals can associate (sympathize) with: "I've made the mistake of picking up someone else's headphones twice, not checking the level. I definitely won't make that mistake again."

While in-ear monitors technically are not hearing protection, many audio engineers praise them for their capacity to keep noise levels down and from affecting other people — everyone sets a level which they are comfortable with. Their ability to localize noise can alleviate things like "monitor competition" wherein stage monitors conflict with each other leading each artist to demand that their monitor be turned up louder as to be heard over the others. With an effective in-ear monitor system, standard monitors can be turned way down or removed from the stage or a studio.

Brian Keefe, monitor engineer for well-known loud bands such as Rush and Queensryche and a long-time user of in-ear monitors, has seen such behavior as monitor competition and highly recommends the use of in-ear monitors. He explains — "Wedge-type stage monitors and others ... by the time you compensate for feedback ... there's so little fidelity ... But in-ear monitors — some of them now ... they're so good. When you get good isolation (ear seal) from ambient noise, the fidelity is so good you can tell

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the differences between some preamps and mixing consoles. Suddenly the audio equipment becomes important."

Michael Santucci, president of Sensaphonics, has pushed in-ear monitoring to an art. His firm uses tiny microphones to measure in-ear noise levels at the ear drum to better customize the fit and performance of the in-ear monitors. Santucci says, "One of the things you want to do with in-ear monitors is to create a signal-to-noise that is optimum ... It has to have good isolation (of external noise)." If the in-ear monitor doesn't seal the ear from external noise, the user may increase the volume to drown out the noise. H.E.A.R.'s Kathy Peck has seen this abuse happen before, "In-ear monitors are good but they can be dangerous. It can be 105-110 dB right in the old ear canal." In the long run, there still is no substitute for turning the sound down.

### Have you heard?

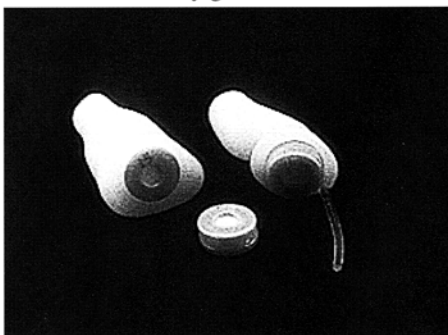
There are many organizations concerned about hearing protection and loss: the League for the Hard of Hearing ([www.lhh.org](http://www.lhh.org)), the National Hearing Conservation Association ([www.globaldialog.com/~nhca](http://www.globaldialog.com/~nhca)), the American Speech-Language-Hearing Association ([www.btg.com/asha](http://www.btg.com/asha)), the American Academy of Otolaryngology-Head and Neck Surgery ([www.entnet.org](http://www.entnet.org)), and the American Academy of Audiology. All freely provide important information and several have informative websites.

Unlike the organizations listed above, which are concerned about all hearing loss in all cases, Michael Santucci's Sensaphonics works exclusively in the music/recording industry. Santucci started the company in 1985 and describes the change in hearing loss awareness since then: "It is almost laughable ... Twelve years ago I would go to trade shows and literally be ridiculed for offering hearing protection." Now he can reel off a list of concerned musicians (and many clients) — "Geddy Lee (Rush) was very concerned ... Alex Lifeson (Rush) ... Queensryche ... Prince, David Bowie, Dave Matthews Band ... Pat Metheny Group ... Once you get a guy in a band saying, 'I won't work without these (hearing protection)' the rest of the band tends to follow along."

Yet all of these look mainline compared

to Kathy Peck's rock 'n rollin' Hearing Education and Awareness for Rockers (H.E.A.R.). According to Peck the main thrust of H.E.A.R.'s activity is "an outreach to the recording studios — trying to make it an important part of the musician's and engineer's life to get a hearing test every year." H.E.A.R. is wholly voluntary, calling on the efforts of musicians such as Pete Townshend, Ted Nugent, the Grateful Dead's Mickey Hart, Ray Charles (who knows a thing or two about sensory loss), Huey Lewis, and others.

Peck and her H.E.A.R. cofounder Dr. Flash Gordon are busy these days. They've been to the South by Southwest gathering in Austin, Texas and the North by Northwest gathering in Seattle, the recent NAMM show in Los Angeles and handed out 60-70,000 foam earplugs during the latest Lollapalooza tour. Dr. Gordon recently gave a talk at the Rock 'n



### Etymotic Research's ER-15/25 in-ear monitor

Roll Hall of Fame on hearing loss among sound professionals. At the same time Peck was at the annual convention of the American Academy of Audiology hosting a panel discussion on hearing loss in the music industry.

H.E.A.R. runs hearing clinics in the San Francisco Bay Area and occasionally schedules benefit concerts. One recent San Francisco event was a "Vibe-O-Thon" featuring lower than normal music levels that were reinforced with a Clark Synthesis Tactile Sound Transducer (an extra hefty subwoofer-like device which transduces sound into physical vibrations to be radiated by floors and surrounding furniture) to pound-out undamaging bass waves. These essentially "unheard" sounds (low-end energy) are designed to compensate for the lack of high-end noise. H.E.A.R. is also compil-

ing a benefit CD to raise funds. The CD, "Wear Your Damn Earplugs!," is highlighted by hearing loss PSAs and music from several rock stars.

As if that wasn't enough, H.E.A.R. has a 24-hour hearing crisis hotline (415-773-9590 and amazingly busy according to Peck) and has constructed a comprehensive website ([www.hearnet.com](http://www.hearnet.com)) filled with useful information on research into hearing loss and tinnitus, hearing protection products, a list of recommended audiologists (who can set you up with customized earplugs or in-ear monitors) and numerous links to related sites — "People can just go to the website and find someone or something they need," Peck says.

Despite a great deal of positive publicity with an MTV appearance, favorable national press, several pieces in music industry publications, a PSA campaign and the endorsements of numerous bonafide stars, Peck worries over lack of funding to keep the education effort going. She's especially bothered about a lack of concern (and funding!) from major studios and audio equipment companies, "You'd think they'd be more concerned. This affects them ... We're still looking for our corporate angels."

### Meanwhile, at the studio

Frank Wells tells a story about a well-known heavy metal band recently recording at Masterfonics in Nashville. The guitarists brought their amps into and played in the control room. Wells had to spend a couple of thousand dollars to replace blown monitors during and after the session. If speakers designed to handle hundreds of watts can be torn up, imagine what the sound is doing to your unprotected ears, he said.

While the studios blare on, Ludwig aside, Wells has noticed a change amongst studio personnel: "Among engineers and producers there is definitely more awareness than there was in the past ... They think about how long they have it cranked up ... and they take regular breaks." And the occasional small victory can be won. Wells says: "When we built the new tracking room ... it's so clean ... you don't realize how loud it is until you measure it ... On that basis we keep a Radio Shack sound level meter on the console and urge the engineers to keep it on."

*Brett Moss is staff writer for Pro Audio Review.*