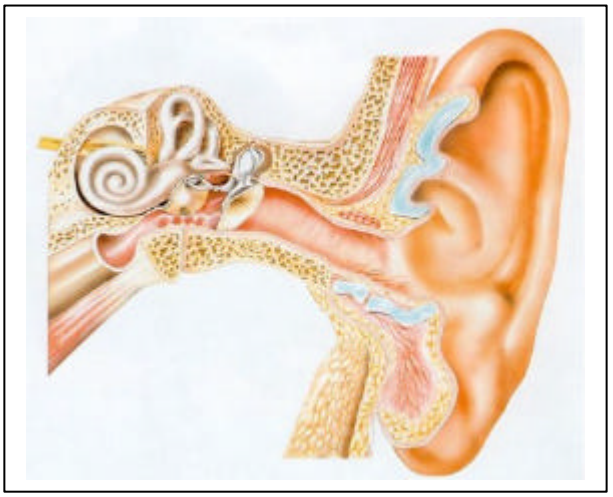
PROTECT YOUR HEARING

Original idea from David Carlisle

Aviation can be a noisy business that can assault tour ears and chip away at your ability to hear clearly. Prevention is your only effective defense.

On the ground or in the air aviation can be a noisy business that can 0 assault the delicate sensory apparatus of your ears and imperceptibly chip away at your ability to hear clearly.
Typically, hearing loss cannot be restored - at least not with current medical technology. Therefore, prevention is your only effective defense. Let's review how your ear transmits the sounds you hear and what you can do to reduce your chances of suffering premature hearing loss.

HOW YOU HEAR



Your ear is a complex, multipart organ. The external ear and the canals that enter your head gather sound, the middle ear amplifies sound vibration, and the inner ear translates sound vibration into nerve impulses that the brain interprets as sound.

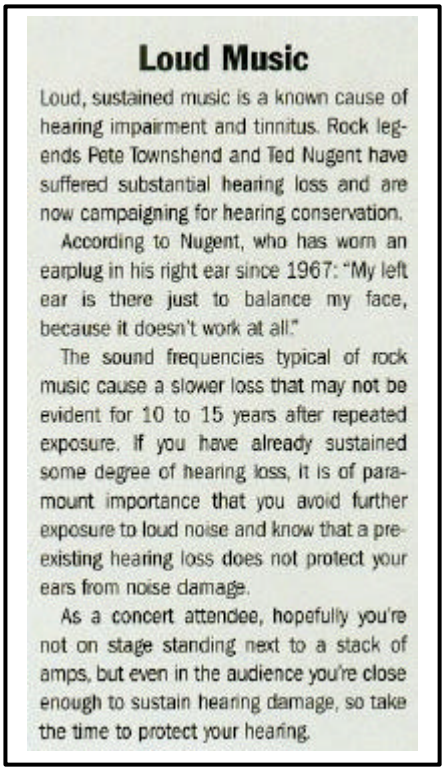
When sound waves - produced by the vibration of molecules - enter the middle ear they strike your eardrum, causing vibrations that are picked up and intensified by three ossicles, which are tiny bones attached to the eardrum. This amplified sound is then conducted to the inner ear.
The hearing portion of your inner ear, called the cochlea, is a hollow, bony canal filled with fluid and lined with specialized cells that have tiny hair-like tufts.Sound creates fluid waves in the hearing portion of your inner ear that stimulate these cells, triggering activity in nerve fibers; these fibers in turn transmit electrical impulses down the auditory, or hearing, nerve to your brain, which interprets them and allows you to perceive sound. Interruption of any step in this chain of events can impair or destroy your ability to hear.

TYPES OF HEARING LOSS

Varying degrees of hearing loss can occur and are attributed to an array of causes that can often overlap. Hearing loss is described as either conductive or sensorineural, depending on which part of the ear is damaged. The former is frequently reversible; the latter is not. Conductive loss occurs when the three tiny bones in your ear fail to conduct sound to the cochlea or when your eardrum fails to vibrate in response to sound because of some mechanical problem such as middle ear infections, blockage of your outer ear (by wax), damage to the eardrum, fluid in the ear(s) and other causes. Sensorineural refers to damage to the pathway for sound impulses from the hair cells of your inner ear to the auditory nerve and your brain. Common causes include acoustic trauma, viral infections, certain drugs, abnormal pressure in the inner ear and strokes.
However, the primary cause of sensorineural hearing loss is aging. As we get older, a certain degree of hearing loss, beginning with the high-pitched range, is nearly universal. It most likely results from a combination of genetic vulnerability, the effects of diseases such as high blood pressure, occupational noise exposure and a lifetime of exposure to the moderate noise levels found in most cities and towns. Age-related hearing loss represents the most common cause of deafness in the United States. The disorder occurs in about 25 percent of people age 65 to 75 and in 50 percent of those over age 75.

TRAUMATIC HEARING LOSS

After aging, noise trauma is the most common cause of hearing loss, accounting for nearly 20 percent of all cases of impaired hearing.
Any noise that exceeds 85 dB, especially with continuing exposure, can damage your hearing. Typical industrial noise is usually in the mid-90-dB range; rock concerts are even louder.
Day-to-day exposure to loud, intense noises on or off the job can cause sensorineural damage. The first loss occurs in the high-frequency register of high-pitched sounds. Continued exposure combined with a person's normal aging process will result in deterioration of lower register hearing as well.



Loud Music

Loud, sustained music is a known cause of hearing impairment and tinnitus. Rock legends Pete Townshend and Ted Nugent have suffered substantial hearing loss and are now campaigning for hearing conservation.

According to Nugent, who has worn an earplug in his right ear since 1967: "My left ear is there just to balance my face, because it doesn't work at all."

The sound frequencies typical of rock music cause a slower loss that may not be evident for 10 to 15 years after repeated exposure. If you have already sustained some degree of hearing loss, it is of paramount importance that you avoid further exposure to loud noise and know that a pre-existing hearing loss does not protect your ears from noise damage.

As a concert attendee, hopefully you're not on stage standing next to a stack of amps, but even in the audience you're close enough to sustain hearing damage, so take the time to protect your hearing.

At first, perception of conversational speech may only be a problem in settings in which there is a significant amount of background noise, but with continued exposure, the hearing loss will become apparent in everyday conversations.
Sudden, single, loud noises may cause a reversible hearing loss, termed temporary threshold shift, that will correct itself given time and protection from further noise trauma. Continued exposure to steady and intermittent noise will produce a permanent threshold shift.

People fear hazards to their eyes because the effects are often sudden and dramatic. They understand the need for eye protection. However, those same people often ignore hazards to their ears because the usual noise-induced hearing loss is of slow onset, permitting the gradual deterioration to go unnoticed until the process is far advanced.

Also, observes Jerry Tobias, Ph.D., *"Many people not recognizing that deafness is much more socially debilitating than blindness are terrified at the prospect of a loss of vision, but give little serious thought to the consequences of a loss of hearing."*
If you fly on a repeated basis, eventually you are going to experience some degree of barotrauma, which is sudden ear pain and a decreased hearing in one or both ears.

The proper function of your ear requires that the air pressure within your middle ear is equal to that of the surrounding atmosphere. Sudden changes in pressure can either put outward traction on your eardrum or cause it to collapse. In either event the result can be pain and diminished hearing. Any pressure change can damage your eardrum; most commonly it occurs during descents when flying or ascending when scuba diving.
That's why you should not fly or scuba dive when you have an infectious upper respiratory condition. Also, visit a doctor if you experience any sudden hearing loss or drainage of blood fi-om the ear associated with a change in pressure.

THE EARS ARE RINGING

Tinnitus refers to the perception of sound - a buzzing or ringing in the ears - in the absence of a source for the sound. Almost everyone has experienced a brief episode of ringing in the ears at one time or another, and these transient episodes are usually of no consequence.
However, if the problem is severe, the ringing can often be traced to one of a variety of specific problems related to the eardrum, the nerve of hearing, or the bones of the hearing portion of the inner ear.

This ringing does not indicate the onset of deafness, but often represents an early symptom of hearing impairment, thought to be caused by removal of the normal masking effect of low-level noise around us.
When the ear no longer perceives this low-level background noise from outside the body, the normally inaudible noise from inside the body created by the flow of blood, movement of muscles and vibrations of the eardrum may be heard as a buzz, ring or hum. Often this kind of ringing is ebbing and flowing with the rhythm of the body's blood flow.
Ringing in the ears can be frustrating for the sufferer because even when the cause is identified, there may be no treatment available to stop it.

Some people find that the sound of an FM radio helps them to sleep by creating competing noise. If you suffer from persistent ringing, see a doctor for evaluation and inquire about the resources available to help you cope.

MEDICINES AND HEARING LOSS

Several classes of medication are toxic to the auditory nerve and may produce a sensorineural hearing loss in both ears. Temporary hearing loss has been associated with use of aspirin and other anti-inflammatory drugs. Permanent loss sometimes occurs with certain antibiotics and some cancer drugs.

For most of these drugs, toxic damage to the hearing nerve is related to the amount of medication taken, with higher dosages causing more risk for hearing loss. However, even normal dosages of certain medications can cause problems.

If you are taking quinine, aspirin or some other medication and you develop ringing in the ears, or your perception of sound or your balance changes, notify your doctor immediately. Your prognosis is excellent in the case of aspirin or quinine toxicity and variable when other drugs are the cause. Your hearing loss may be permanent as there is no treatment to reverse toxic damage to hearing.

Sound and Noise

"The term 'sound' is used to describe the mechanical radiant energy that is transmitted by pressure waves in a medium [solid, liquid, or gas]. Sound waves are variations in air pressure above and below the ambient pressure, which describes the sensation perceived by the sense of hearing. All sounds have three distinctive variables: frequency, intensity [level], and duration," says Melchor J. Antuñano, M.D., director of the FAA Civil Aeromedical Institute.

Frequency is the physical property of sound that gives it a pitch. Since sound propagates in a waveform, it can be measured in terms of wave oscillations or wave cycles per second, known as hertz (Hz).

Intensity is the correlation between sound pressure level and loudness. The decibel (dB) is the unit used to measure sound pressure levels.

Long lasting, high level sounds are the most damaging to hearing and generally the most annoying. High-frequency sounds tend to be more hazardous to hearing than low-frequency sounds. The way sounds are distributed in time also is important, in that intermittent sounds appear to be somewhat less damaging to hearing than continuous sounds because of the ear's ability to regenerate during intervening quiet periods.

The definition of noise is highly subjective, but it's generally agreed that it refers to sound that is noticeably unpleasant, too loud, unwanted or annoying.

A general rule of thumb is that if you need to shout to be heard, the ambient sound is in the range that can damage your hearing.

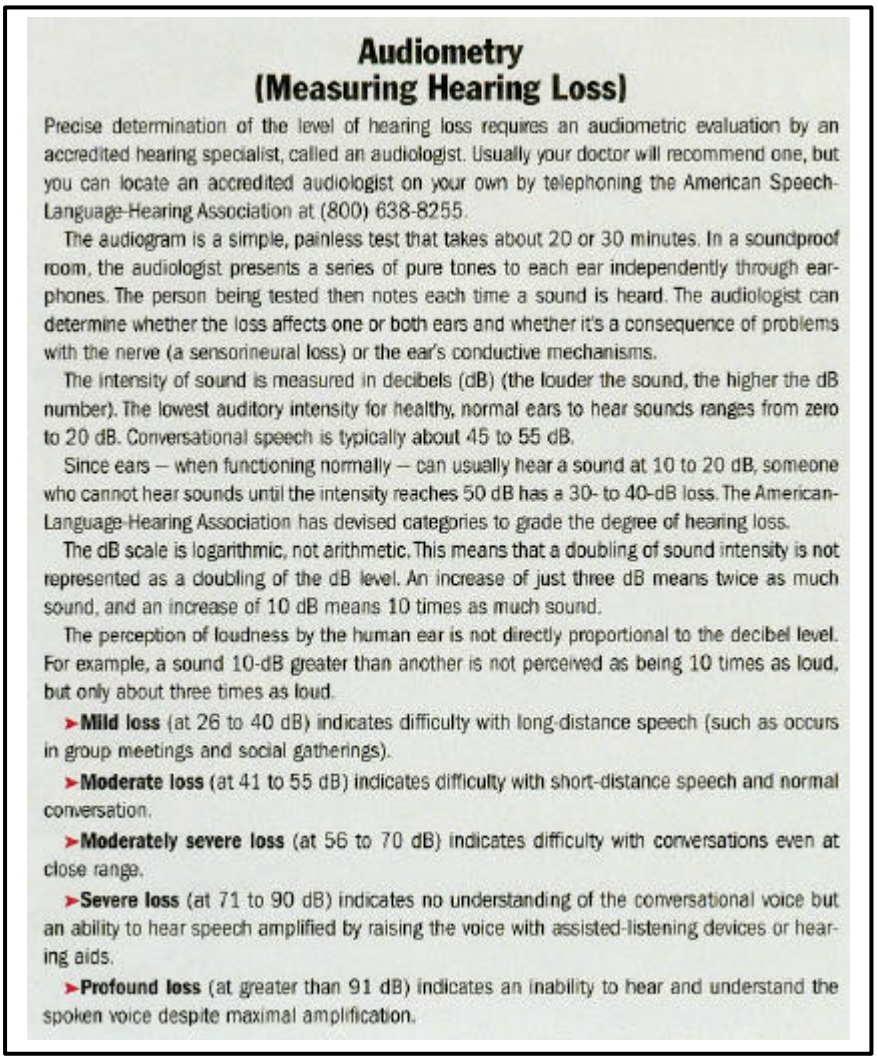
During flight, your aircraft's engines, propellers, pressurization and air conditioning systems, hydraulic and electrical actuators, communication equipment, and aerodynamic interaction between the relative wind and the aircraft can all cause high noise levels.

"While these auditory inputs allow you to assess and monitor your aircraft, you've probably experienced a cockpit that was so loud you had to shout to be heard. These sounds not only make the work environment stressful, but also over time can cause permanent hearing loss," says Dr. Antuñano.

PROTECT YOUR HEARING

Protecting your hearing - which is exceedingly important if you already suffer some degree of hearing loss - can be done by using simple earplugs, custom ear plugs or earmuffs. In a noisy environment, speech and emergency signals are more clearly heard when you are wearing earplugs or earmuffs.
Good earplugs can be found among all types; a good custom plug, a good wearer molded plug and a good pre-molded plug may be nearly indistinguishable in performance," says Tobias.The probability of getting a less than good plug is increased if selection is limited (no cigarette filters or Kleenex wads) or plugs are chosen that incorporate gimmicks such as perforated or lightweight construction.

Custom plugs can be a rational solution when a user's ear canal shape rules out over-the-counter-type plugs. Simple polyurethane plugs - tapered for easy insertion and removal - reduce noise by about 10 to 15 dB, which is often enough to take it below the critical damaging threshold of 85 dB. And when using plugs, periodically loosen them in flight to equalize the pressure differential in your external ear.



Audiometry (Measuring Hearing Loss)

Precise determination of the level of hearing loss requires an audiometric evaluation by an accredited hearing specialist, called an audiologist. Usually your doctor will recommend one, but you can locate an accredited audiologist on your own by telephoning the American Speech-Language-Hearing Association at (800) 638-8255.

The audiogram is a simple, painless test that takes about 20 or 30 minutes. In a soundproof room, the audiologist presents a series of pure tones to each ear independently through earphones. The person being tested then notes each time a sound is heard. The audiologist can determine whether the loss affects one or both ears and whether it's a consequence of problems with the nerve (a sensorineural loss) or the ear's conductive mechanisms.

The intensity of sound is measured in decibels (dB) (the louder the sound, the higher the dB number). The lowest auditory intensity for healthy, normal ears to hear sounds ranges from zero to 20 dB. Conversational speech is typically about 45 to 55 dB.

Since ears – when functioning normally – can usually hear a sound at 10 to 20 dB, someone who cannot hear sounds until the intensity reaches 50 dB has a 30- to 40-dB loss. The American-Language-Hearing Association has devised categories to grade the degree of hearing loss.

The dB scale is logarithmic, not arithmetic. This means that a doubling of sound intensity is not represented as a doubling of the dB level. An increase of just three dB means twice as much sound, and an increase of 10 dB means 10 times as much sound.

The perception of loudness by the human ear is not directly proportional to the decibel level. For example, a sound 10-dB greater than another is not perceived as being 10 times as loud, but only about three times as loud.

- **Mild loss** (at 26 to 40 dB) indicates difficulty with long-distance speech (such as occurs in group meetings and social gatherings).
- **Moderate loss** (at 41 to 55 dB) indicates difficulty with short-distance speech and normal conversation.
- **Moderately severe loss** (at 56 to 70 dB) indicates difficulty with conversations even at close range.
- **Severe loss** (at 71 to 90 dB) indicates no understanding of the conversational voice but an ability to hear speech amplified by raising the voice with assisted-listening devices or hearing aids.
- **Profound loss** (at greater than 91 dB) indicates an inability to hear and understand the spoken voice despite maximal amplification.

While the choice rests with the pilot, maintenance technician or ramp worker, Tobias suggests keeping several types available. "Having more than one kind on hand also decreases the number of cases in which a potential wearer cannot be successfully fitted." Properly insulated earmuff-style noise suppressors offer excellent damping sound on airport ramps, reducing levels by 15 to 25 dB. Usually fashioned from a solid cup filled with sound-absorbing material, they offer better protection but are less comfortable than plugs.

Tobias says that among pilots who fly the most, shifts in hearing thresholds are common. *"The use of hearing protection will help solve the problem for those with the greatest exposure to cockpit noises the flight crew. If your earmuffs stay in your aircraft or your plugs are always worn in your pocket, they won't conserve your hearing."*

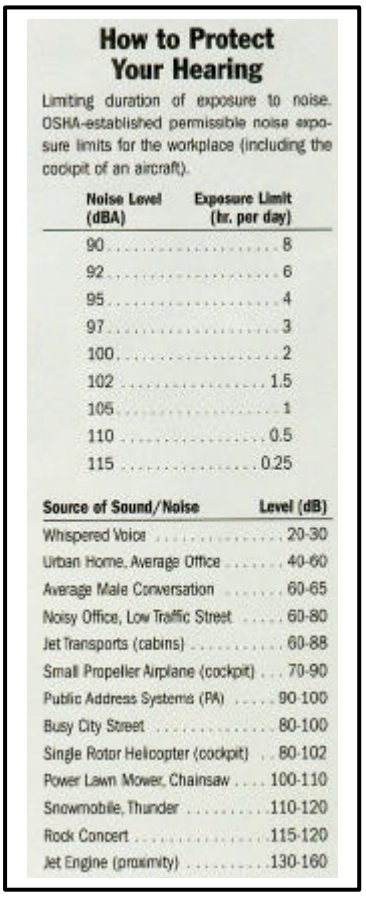
HEARING AND THE FAA

The FAA issues all classes of airmen medical certificates to hearing-impaired pilots. The medical flight test is authorized by the FAA and usually performed at your local FSDO. Upon satisfactory completion of the test, a waiver is issued with a statement that you must use *"hearing amplification"* during flight.

According to Stanley Mohler, M.D., vice-chairman and director of aerospace medicine at Wright State University School of Medicine in Dayton, Ohio, *"Pilots who lose hearing have few difficulties adjusting to flying, because they either develop their own strategies for coping with their reduced ability to hear or adjust to flight-deck use of hearing aids to compensate for hearing losses."*

No special considerations are involved in fitting pilots with hearing aids, Dr. Mohler says. Today most devices are fully digital or digitally programmed analog instruments that use digital signal processing to amplify sound, help the wearer hear better, and - in some instances - reduce background noise.

For questions about hearing problems, special issuances, or the status of your medical certificate, contact the FAA at (405) 954-4821.
Don't dismiss noise in your daily life as a price you pay for living in our modern world. Take the time to protect your hearing. If you know someone who is suffering from hearing loss, pass along this article and encourage him to see a doctor. It could be the best advice he'll ever hear.



How to Protect Your Hearing

Limiting duration of exposure to noise. OSHA-established permissible noise exposure limits for the workplace (including the cockpit of an aircraft).

Noise Level (dBA)	Exposure Limit (hr. per day)
90	8
92	6
95	4
97	3
100	2
102	1.5
105	1
110	0.5
115	0.25

Source of Sound/Noise	Level (dB)
Whispered Voice	20-30
Urban Home, Average Office	40-60
Average Male Conversation	60-65
Noisy Office, Low Traffic Street	60-80
Jet Transports (cabins)	60-88
Small Propeller Airplane (cockpit)	70-90
Public Address Systems (PA)	90-100
Busy City Street	80-100
Single Rotor Helicopter (cockpit)	80-102
Power Lawn Mower, Chainsaw	100-110
Snowmobile, Thunder	110-120
Rock Concert	115-120
Jet Engine (proximity)	130-160