

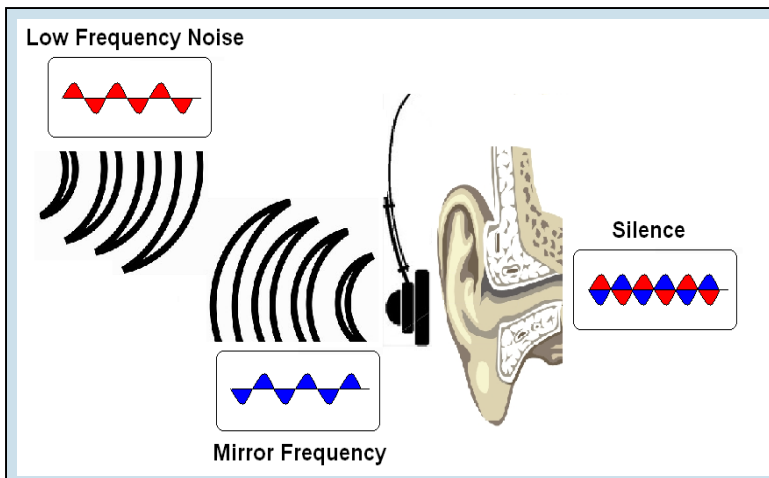
Research Request:

Active Noise Reduction Headsets

Research Response:

Introduction

On the flight deck ambient sounds can disrupt communication, fatigue pilots, and damage long-term hearing capacity. The benefits of erasing unwanted sounds has long been recognized by a majority of the aviation community. Eliminating distracting ambient sound can be accomplished with noise-canceling circuitry in a headset, referred to as active noise reduction (ANR).



A new initiative in hearing attenuation, active noise reduction is essentially the act of erasing sound. ANR headsets use a microphone inside the ear piece to record ambient noise and simultaneously produce a mirror image sound wave. The sound wave is produced at a frequency 180 degrees out of sync with the unwanted noise; the two cancel each other out and the result is silence. All of this is done in real time without any required user action. Previous headsets possessed only passive noise reduction properties, using physical materials such as foam and plastic as a sound barrier. Passive noise reduction serves to muffle ambient noise, but with a tradeoff in added weight and discomfort. ANR headsets use a combination of both passive and active noise reduction methods, achieving optimum comfort and clarity. There are, however, safety advantages and disadvantages to using ANR headsets. A discussion of these issues follows.



Advantages

Speech Intelligibility

The most immediate benefit of using an ANR headset is the clarity of ATC communication. Misunderstood ATC instructions due to interference noise are an ongoing concern for every flight crew. The potential distraction is frustrating, and interrupts concentration on the tasks at hand. The ability to hear communications clearly increases situational awareness and eliminates uncertainty. In the following ASRS report, filed in June of 2008, a pilot describes his concern about the poor quality of company supplied headsets and their negative effectives on the safety of flight.

NARRITVE:

After using an aftermarket ANR headset the past couple of yrs and now having to revert back to 1970's technology, the difference is astounding. Safety has definitely taken a back seat. The number of missed calls, the 'what did he say' happens far too frequently with the company supplied Plantronics headset. This is a very inferior product which in no way enhances safety. The ear spike continually falls from your ear and the volume needed to understand ATC must be turned up way too high to be considered safe for one's hearing. The recirculation fan has to be turned off, otherwise you cannot understand ATC whatsoever. I came to realize that while using this headset you are more worried about trying to understand what is being said, rather than concentrating on the task at hand. The stress and fatigue factor at the end of the day using the Plantronics with ear spike has been greatly increased. In closing, with today's technology this headset should not even be considered, let alone recommended, for use in company acft. The company should provide a quality headset for the plts to use. Their choice of headsets leaves a lot to be desired. Using an ear mold is not an option. Contrary to the rbf the addition of an ear mold, is an alteration to the tso of the headset. This is in accordance with the regulations as written. This is not only a safety issue but also a health issue for the pilot's hearing. ANR headset with hot mike can only enhance the safe op of company aircraft.

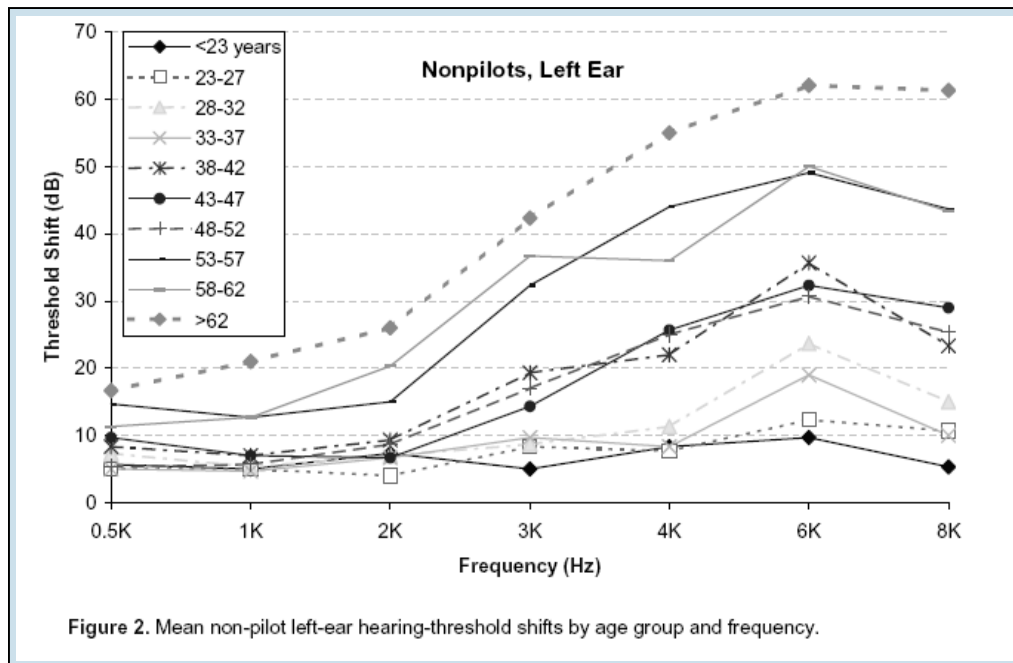


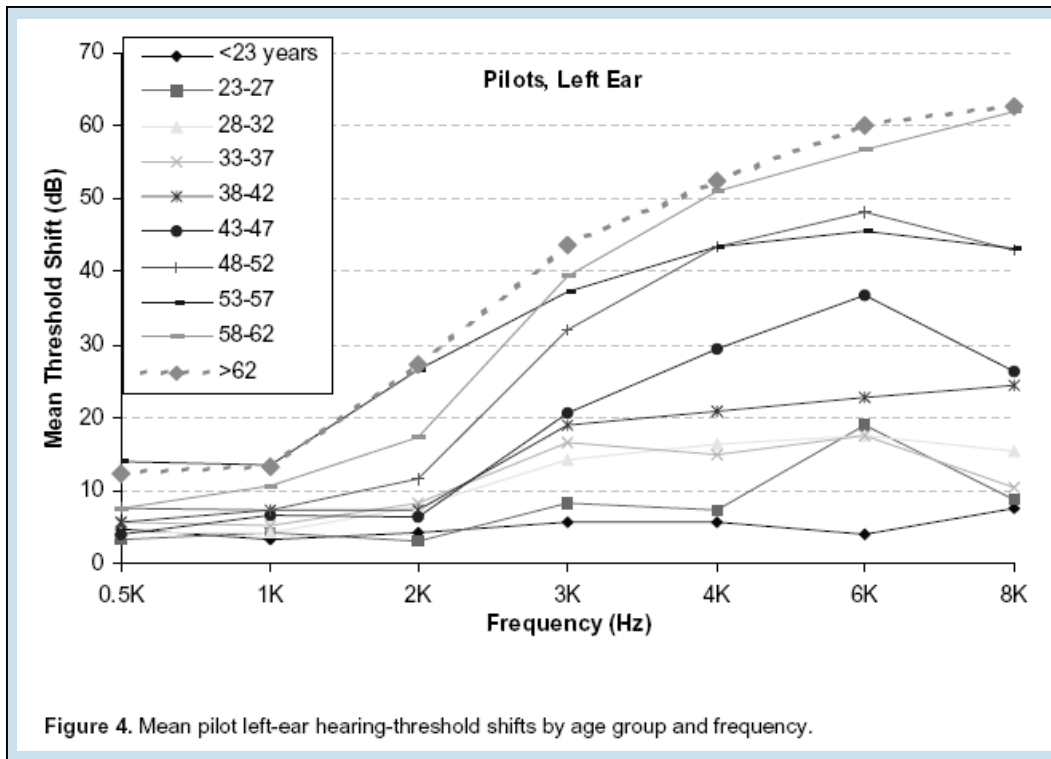
Hearing Protection

Hearing loss is the long term physiological effect of working without adequate hearing protection around aircraft powerplants, pressurization systems, and communication equipment. The Occupational Safety and Health Administration (OSHA) defines the maximum level of noise an employee may be exposed to in an 8 hour workday as 90 dB. Any contact with noise above 90 dB requires hearing protection. Examining the chart on the right clearly indicates that the inside of a jet cabin can border on this limit. Exposure to noise in excess of 130dB can cause ear pain or eardrum rupture.

SOURCES	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 (Cabin)	60-88
Small Single Plane (Cockpit)	70-90
Public Address (PA) Systems	90-100
Busy City Street	80-100
Single Rotor Helicopter (Cockpit)	80-102
Power Lawn Mower, Chain Saw	100-110
Snowmobile, Thunder	110-120
Rock Concert	115-120
Jet Engine (Proximity)	130-160

A study conducted by D. Beringer and H. Harris of the Civil Aerospace Medical Institute in 2005 tested the hearing of 150 pilots and 150 non-pilots. The study finding produced the most significant results when pilots between the ages of 48 and 57 were tested at frequencies of 2,000 Hz and 3,000Hz. Pilots in this age bracket (48-57) showed hearing levels similar to non-pilots 5 years older than them. This is significant because normal conversation takes place between 1,000Hz and 3,000Hz. The summary of the report recommended promoting the use of active noise protection devices.





Fatigue Reduction

Along with reducing the negative long-term effects of noise, ANR technology also reduces fatigue and its negative psychological effects. The American Speech-Language-Hearing Association describes noise or unwanted sound as a performance detractor that will increase fatigue, and cause irritability. According to the ASLHA:

“Noise can reduce efficiency in performing daily tasks by reducing attention to tasks. This is a concern of employers when it comes to assuring workers' safety. Because of noise, we often find ourselves fatigued and irritable. We don't even realize the effect until the noisy hubbub stops and we feel relief.

From another perspective, your own inability to hear and understand others clearly can cause you to feel angry and frustrated. Instead of accepting the problem is yours, you misdirect your feelings to others and blow up at them.

Noise also makes speech communication harder. More concentration and energy is needed not only to listen and hear over the noise but also to speak louder above the noise. As a result, voices can be strained and vocal cord abuses, such as laryngitis, develop. It is a physical strain to carry on even an enjoyable conversation in the presence of noise.”

Disadvantages

Cancellation of Alerts

In June of 2007 the FAA published an InFO (Information for Operators) report concerning the noise attenuation properties of noise-canceling headsets. The report addresses fears that ANR headsets could possibly block out audible alarms, abnormal mechanical noises, and irregular vibrations or wind noises.

There have been at least 15 reported incidents where piston engine pilots have claimed that gear and stall warning horns were not audible due to the use of ANR headsets. There is dispute as to the validity of some of these claims. In this gear up landing report the pilot maintains his ANR headset blocked out the gear warning horn.

NARRATIVE:

After flying for over 5 hrs and very tired I was approaching Williamsburg, Youngstown airport in Virginia. I had slowed down the airplane to flap speed and did my 'gump' but decided because I was already slowed down that I would put the gear down when I reached base leg, then pushed the mixture full rich and prop full rpm. As I was turning base a flock of birds came around and I managed to avoid them. I then proceeded to final and forgot to put the gear down. By the time I noticed that the gear was up. It was too late, the prop hit the runway then the belly scrap and stop. I was wearing a 'pilot' 9001 noise canceling headset and did not hear the warning horn, which was blaring when I took the headset off. Warning horn should be piped into noise canceling headsets



In another instance a Cirrus SR22 stalled and inadvertently entered a spin. The pilot deployed the aircraft parachute system and the plane subsequently crashed in a retention pond. When interviewed after the accident, passengers could not recall hearing the stall warning horn. They were using BOSE active noise reduction headsets. The NTSB investigation reported:



“Demonstration flights were flown with NTSB investigators in a SR22 using the same type of BOSE headsets used in the accident airplane. During stall maneuvers, the stall warning horn sounded and could be heard while using the headsets. On January 9, 2007, a FAA avionics inspector and a representative of Cirrus Design tested the stall horn and the stall horn pressure switch on the airplane. The stall warning horn tested at 97dbm and an exemplar horn tested at 94dbm. During the examination of the pressure switch, electrical continuity was confirmed and the switch functioned when tested.”

The frequency and decibel level of sound that an ANR headset cancels out is predetermined by the manufacturer. This preset can also vary with the model of headset. The FAA recommends sampling available make and models and evaluating their attenuation properties during normal flight operations in order to ascertain if any alarms or environmental noises are inaudible.

Abnormal noises in an aircraft can be a pilot's first indication that something is amiss. Bumps, bangs, clunks, and thuds give added insight into mechanical problems. Usually, noises associated with mechanical mishaps are louder than the preset decibel level that an ANR headset blocks out. However, this scenario is arguable.

Power Supply

Another disadvantage of ANR headsets is that they require a power source to operate. This is usually in the form of rechargeable batteries. In one incident, contrary to the others previously mentioned, a pilot claims a causal factor to his gear up landing was the fact that he wasn't using his noise cancelling headset due to dead batteries.

NARRATIVE:

Pilot stated he hadn't flown in a month and had a limited time to fly. After doing some maneuvers to get back into flying, he decided to practice some touch and go's. There was a crosswind of approximately 15 knots (the pilot's personal maximum) and he was concentrating on the crosswind correction and forgot to put the gear down. Contributing factor could be the fact the pilot's normal noise cancelling headset had dead batteries, so he used a set from the back of his aircraft. He stated there was a lot of static, which was distracting.



Synopses

Pilot feedback concerning the use of ANR headsets has been exceptionally positive. Their use undisputedly reduces fatigue, which in turn allows crews to concentrate on what is important, flying the aircraft. The elimination of static and white noise over the radio clarifies ATC instruction, eliminates guessing games and frequent requests to "say again". Noise levels on the flight deck of the average airliner have been measured between 74 and 79 db, the long-term use of ANR headsets will ultimately protect pilot hearing capability.

The hazards associated with ANR technology are outlined in InFO 07001. As stated in the InFO, noise cancelling properties of a headset are proprietary to the manufacturer. For this reason it is difficult to assess exactly what ambient noise will be cancelled out. Operators are encouraged to make their own evaluation of active noise reduction headsets to determine their benefits and/or potential risk.