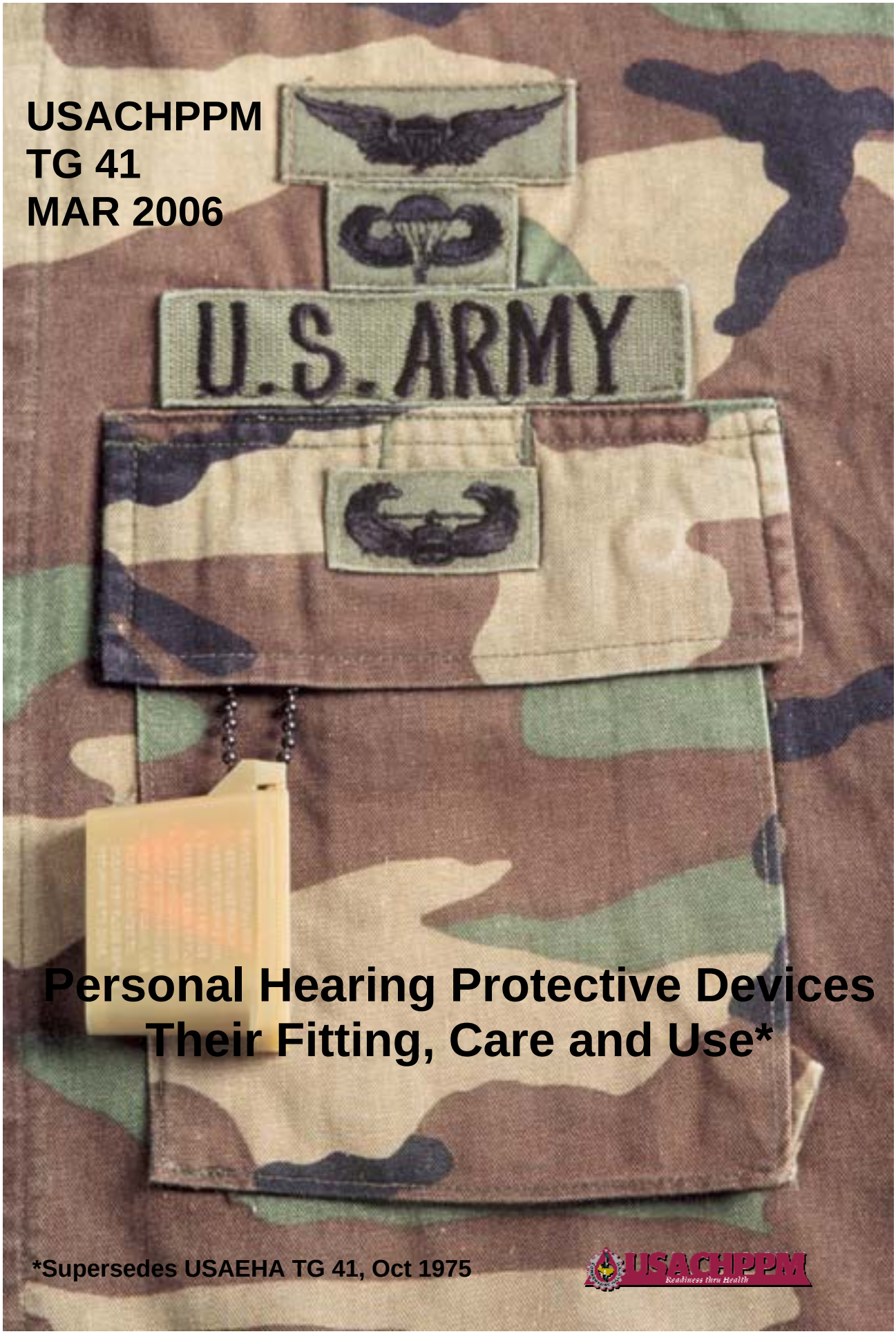


USACHPPM
TG 41
MAR 2006

Personal Hearing Protective Devices Their Fitting, Care and Use*

***Supersedes USAEHA TG 41, Oct 1975**

USACHPPM
Readiness thru Health

TABLE OF CONTENTS

APPENDICES

CHAPTER 1

INTRODUCTION

Regulatory Requirement for a Hearing Conservation Program

Guidance for establishing and conducting an effective hearing conservation program (HCP) is summarized in Department of Army (DA) Pamphlet (PAM) 40-501, as well as in applicable portions of Army Regulation 40-5 [Preventive Medicine (PM)] and DA PAM 40-11 (PM). Information on hearing protective devices (HPD), including the need and requirement for noise-exposed military and civilian personnel to wear them, their fitting, maintenance, issue, use and ordering is presented in this technical guide (TG).

Why a Hearing Conservation Program is Necessary

Preserving the ability to hear low intensity (i.e., soft) sounds or speech is critical to the readiness and safety of soldiers in both offensive and defensive operations. This is particularly crucial when vision may be limited (e.g., in situations such as sentry duty or reconnaissance in urban terrain). The need for hearing conservation is also important for personnel who must rely on their hearing to detect enemy movement and to communicate, irrespective of the mission (i.e., training or combat operations). In addition, our civilian employees who work in industrial operations must also be protected when exposed to hazardous noise.

When Hearing Protective Devices are Needed

Personal protective measures are necessary against both steady-state and impulse noise. Simply stated, steady-state (sometimes called continuous) noise is sound that varies little over time. Examples include generators, armored vehicles and rotary aircraft. Impulse (sometimes called impact) noise is sound of a short duration, but high amplitude transients. Examples include fire from pistols, rifles, machine guns, mortars and howitzers. HPD must be worn when steady-state noise measured by a sound level meter (SLM) on the A scale is 85 decibels (dBA) and higher, regardless of duration, and when impulse noise exceeds 140 dB peak (P) sound pressure level (SPL). In the latter case, all Army weapons produce impulse noise above this level. Therefore, hearing protection must be worn on firing ranges, during field firing exercises and other forms of weapons training or evaluation.

Wearing hearing protection is encouraged and advantageous in combat, but not mandatory, except where weapons are fired from positions out of the immediate zone of fighting. The hearing loss caused by noise to an unprotected ear may require many hours, sometimes days, before threshold sensitivity recovers (i.e., a temporary threshold shift), if at all. There is the inevitable consequence that hearing loss will be permanent, if exposure continues without adequate protection. **Some weapons are so loud that just one shot can cause immediate and total loss of hearing**. This is known as an acoustic trauma.

Soldiers, for whatever reason, may resist using HPD during live fire training exercises as well as during combat. Unfortunately, impulse noise hazards abound with all mounted and dismounted

weapon systems. It is well documented that impulse noise can cause permanent hearing damage. Soldiers will develop noise-induced hearing loss if no protector is worn or when their hearing protectors are fitted poorly, used inconsistently or improperly, or provide inadequate noise reduction.[1]

All personnel working in, or visiting, a noise-hazardous area (NHA) must have hearing protection with them and use it appropriately. Hearing protectors include earplugs, noise muffs, ear canal caps (with some restrictions), noise-attenuating helmets or a combination of these. Personnel may select the type of protector they desire, unless their selection is medically contraindicated or inappropriate for a particular noise-hazardous environment.

Hearing protectors are issued at no charge to all military and civilian personnel working in noise-hazardous operations or areas. An earplug carrying case is also provided at no charge with each set of preformed earplugs. This case can also be used for other than preformed earplugs to include the combat arms, pod foam and handformed varieties. Once issued, earplugs and carrying cases are not to be collected for recycling or re-issue.

[1]Vause, N. and LaRue, A. Creating our own Casualties: Auditory Effects of Anti-Tank Weapon Fire without Hearing Protection – A Clinical Case Study. Undated Paper Presentation.

CHAPTER 2

THE IMPORTANCE OF PROPERLY WORN HEARING PROTECTORS

The Basic Principles of Sound Transmission

In order to instruct others how to properly fit and use earplugs and noise muffs, one must understand the basic principles of sound transmission to the inner ear, as well as the various subjective impressions that users may have while wearing HPD. Below is an anatomical diagram depicting the outer and middle ear structure which serves as the pathway for air-conducted sound (Figure 1).

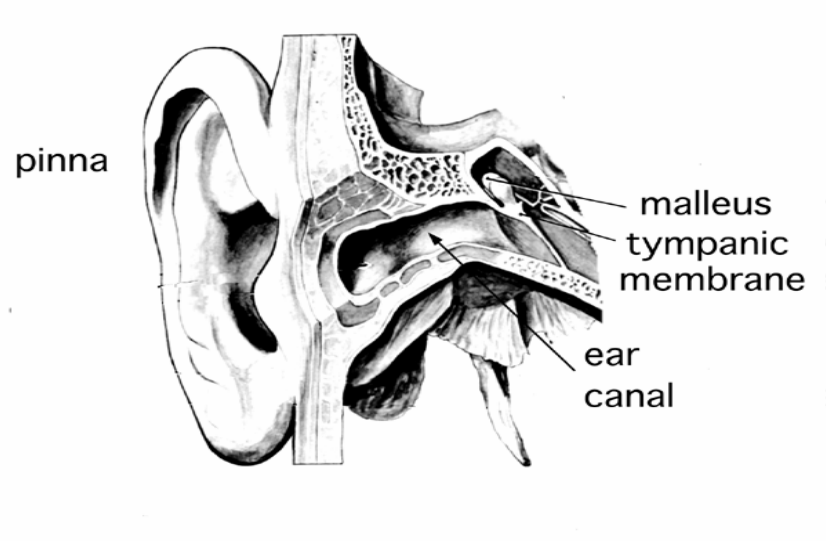


Figure 1

Outer and Middle Ear Air Conduction Pathway

Objective Measures

We hear our own voice via the air conduction and bone conduction pathways (Figure 2). When both ear canals are unoccluded (i.e., open and unblocked), the sound energy of our voice reaches the inner ear through the bones and tissues of the scull (the bone conduction pathway), as well as by the air conduction pathway (i.e., down the outer ear canal to the eardrum, across the middle ear space and into the inner ear). The sound of our own voice conducted through the bones and tissues of the head has a low frequency emphasis. You can confirm this by plugging one or both ear canals with a finger or an earplug and begin to talk. Since we hear our own voice about as loud by air conduction as by bone conduction, it will sound lower in pitch to us than it does to anyone else.

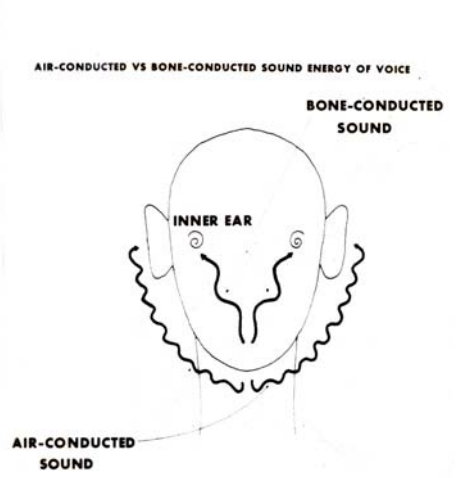


Figure 2

Air-Conducted and Bone-Conducted Vocal Sound Energy Pathways

When one or both ear canals are completely blocked (e.g., from impacted wax or an earplug), the bone-conducted sound energy of our voice will seem louder and sound slightly muffled. When earplugs are properly sized and seated, the user should experience a similar effect (i.e., their own voice will sound as if talking inside a barrel).

Other sounds inside the head will be similarly amplified. These include tinnitus which is a head noise of varying type and quality that is sometimes symptomatic of a noise-induced hearing loss. When it is present, the individual wearing hearing protection may note that sound seems louder in their ears. Although there is no guarantee that tinnitus will ever stop, hearing protectors are that properly and consistently worn should help to reduce the risk of further aggravation of the tinnitus condition.

Subjective Measures

Experiencing such sensory phenomena (e.g., lower voice quality) can be significant and demonstrate that some noise reduction was achieved. However, these are unreliable sources for estimating the optimum attenuation (i.e., sound reduction) of HPD. Individual, subjective impressions usually provide the best index of performance. For this reason, earplugs of other sizes and types should be tried, at least initially, so that comparisons can be made.

Maximum Attenuation from Hearing Protective Devices

To achieve maximum protection from an HPD, acoustic leaks need to be controlled. Figures 3 and 4 illustrate the four potential pathways by which sound reaches an occluded ear.[2]

[2] Berger, E. Hearing Protector Performance: How They Work – and What Goes Wrong in the Real World. E·A·RLog®$_{5,}$ 1980.

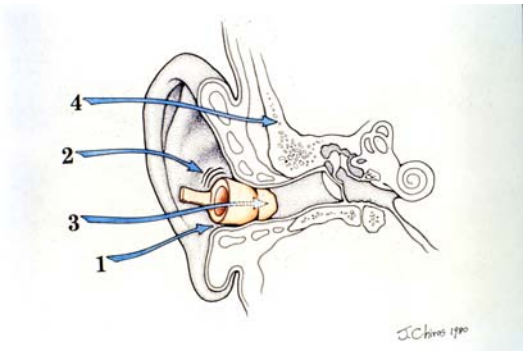


Figure 3 (Earplug)

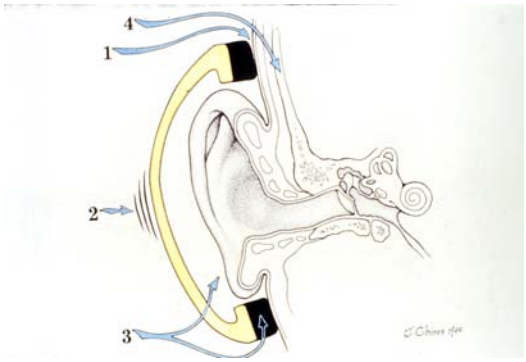


Figure 4 (Noise Muff)

Pathways by which Sound Reaches an Occluded Ear

Pathway 1 impacts air leaks that result from a poorly fitted earplug or noise muff where an air tight seal is not achieved either in the ear canal or against the side of the head.

Pathway 2 accounts for the vibration of the HPD. Earplugs can vibrate in a piston-like fashion within the canal and this limits attenuation of low frequency sounds. For noise muffs, when the cup vibrates against the head it can impact attenuation at the low frequencies as well.

Pathway 3 influences the transmission of sound through the material of the HPD. For most protectors, the impact is negligible except for noise muffs whose large surface area of each cup can reduce the amount of attenuation at select frequencies.

Pathway 4 involves the bone conduction transmission process and could be a major factor for the protected ear. When an HPD is worn, the bone conduction pathway is enhanced, especially for frequencies below 2000 Hertz (Hz) (the occlusion effect).

Pathway 1 is the only one that the wearer has any control over in order to prevent or lessen hearing loss. As the opening or pathway becomes larger, attenuation loss increases and can affect multiple frequencies depending upon the physical dimensions of the leak.

When using earplugs, effective hearing protection depends upon a good seal between the surface of the skin of the outer ear canal and the ear protector. Any air leak, no matter how small, can limit the effectiveness of the protection.

Figure 5 (below) highlights the real-ear attenuation obtained with well-fitted hearing protection. Earplugs and noise muffs, when worn in combination, usually provide an additional 5-10 decibels (dB) attenuation of the surrounding noise than either one worn separately. Their combined use is required when steady-state noise levels exceed 103 dBA for 8 hours time-weighted average (TWA).

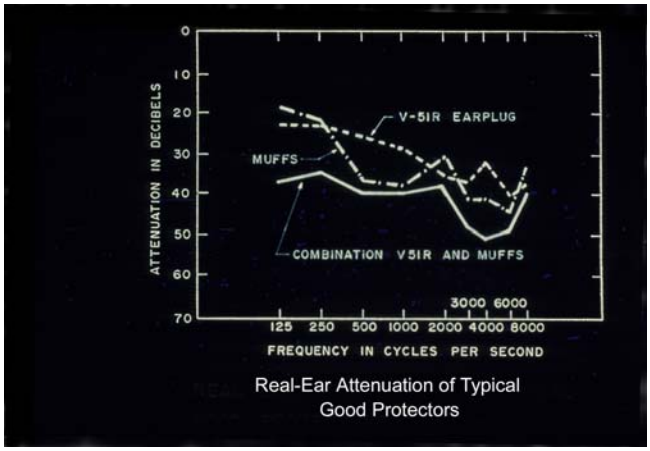


Figure 5

Attenuation Obtained from a Typical Noise Muff and Single-Flange Earplug (V-51R) Used Individually and in Combination

Protection afforded by a specific HPD for an individual on a given occasion may vary considerably from the general average, as well as from the individual's own average regardless of the evaluation method used (see below). Because of this variance, the exact attenuation afforded an individual at any one time cannot be known.

How to Measure the Attenuation of Hearing Protective Devices

The potential level of attenuation of an HPD can be obtained in the laboratory where a listener's hearing thresholds are measured in a sound-field with their HPD fitted and with their ears unoccluded. The difference between the threshold levels under these two sound-field conditions (the protectors-fitted and ears-open) is called the real-ear attenuation at threshold (REAT). According to Berger, "Selection and specification of HPD, especially for very high noise level environments such as found in the military, often requires a reliable estimate of the noise attenuation that the HPD provides, as well as a means for computing the effective exposure, based upon the presumed attenuation values for either individuals or groups of individuals."[3] Such attenuation was formerly measured in a laboratory using the American National Standards Institute (ANSI) standard (S), section 3.19-1974, which described the REAT procedure known as Method A. However, a more recent REAT standard, ANSI, S12.6-1997, was adopted. It also includes an alternate procedure, Method B, which was meant to provide a more representative estimate of actual field performance.[4]

[3] Berger, E. Some Thoughts on Testing and Rating Hearing Protectors. International Military Noise Conference. Baltimore, MD. April 2001.
Berger, E. A New ANSI Standard for Measuring Hearing Protection. CAOHC Update, Volume 9, Issue 4, Winter, 1998.

Method A. Adopted by ANSI as S12.6-1984, Method A evaluates the attenuation capability of HPD using trained and experienced test subjects. The experimenter is permitted to assist or facilitate the test subject in the fitting process. The subsequent data are considered best case.

Method B. **Adopted by ANSI as S12.6-1997, Method B tests the protective value of HPD of naive subjects. No assistance from the experimenter is permitted. The only information available to each participant is the manufacturer's written instructions on the packaging. This procedure is intended to provide a more realistic estimate of how well HPD are fitted in the field.**

There is debate about how well Method B suits Department of Defense (DoD) service members and noise-exposed civilian employees in a HCP who are supposed to receive annual instruction on how and when to use their hearing protection.

Method B values are often significantly less than Method A values for earplug attenuation. In addition, Method B underestimates the amount of protection offered by the various HPD. One outlier, a poor performing test subject, can significantly degrade Method B attenuation values. There appears to be relatively little difference between methods for noise muffs and communication headsets.[5]

Ideally, attenuation predictions should be based on informed user fit data, i.e., the best achievable attenuation data possible in a well-executed HCP. Method B, naive fit, was chosen over informed user fit because of better inter-laboratory agreement. Method B, however, encourages and institutionalizes the erroneous notion that earplugs can be handed out without formal instructions. The military services may have to develop their own informed user fit data to ensure realistic hearing protection predictions for our noisy weapons systems.[6]

DoD Tri-Service Hearing Conservation Working Group (HCWG)

The DoD Tri-Service HCWG, composed of functional experts (primarily audiologists) from the Army, Air Force and Navy, has been tasked to determine how attenuation testing is to be conducted (e.g., which standard and method). The manufacturers of hearing protection use older versions of the ANSI S.12 standard mandated by the Environmental Protection Agency (EPA). However, updated versions have not been required because that policy office within the EPA has not been funded.

[5] Air Force Research Laboratory, Human Effectiveness Directorate, Crew System Interface Division, Wright Patterson Air Force Base, OH. USAF Approved Hearing Protection Devices. August 2000.
[6] Ohlin, D. Email communication to ANSI S12.6, Part II, Working Group. July 21, 2003.

Explanation of the Noise Reduction Rating (NRR)

The NRR is an attempt to describe hearing protection via a single number descriptor. This was proposed to simplify complex attenuation data for the general public and was made a legal requirement by the EPA for manufacturers of hearing protection. The NRR has been widely criticized by the scientific community as being an oversimplification and a compromise. Applying complete octave band data provides more accuracy. Furthermore, the NRR was intended to be subtracted from C-weighted noise data. However, Occupational Safety and Health Administration (OSHA) inspection teams found that the NRR was often used in conjunction with A-weighted noise data in private industry. OSHA mandated a seven (7) dB correction factor to account for the difference in low-frequency weighting between A and C filters on sound measurement equipment when the NRR is subtracted from A-levels. The bottom line: You do not need to subtract an additional 7 dB from the NRR if your sound levels are obtained in C-weighted SPL.

The literature indicates that the average attenuation provided by HPD in the field is often only a fraction of the labeled NRR. To compensate, OSHA directives have suggested de-ratings, including the " 'NRR-7' divided by 2" scheme included in the OSHA inspector's technical manual (TM). These de-ratings provide motivation for the manufacturers of HPD to market devices with ultra-high NRR, without consideration for comfort, communication, and consistent performance.

Additional insight is provided by Berger on the topic of the protective value of earplugs in the laboratory versus the workplace. "No less that 22 studies conducted in 7 countries in over 90 industries with over 2,900 subjects have found a significant disparity between the amount of protection afforded between laboratory results and those achieved in the workplace. For example, in the workplace, earplugs achieved approximately 25 percent of the laboratory attenuation levels with a range of 5 to 52 percent. Noise muffs fared better in the workplace achieving 60 percent with a range of 47 to 76 percent."[7]

[7] Berger, E.H., Franks, J.R. and Lindgren F. Attenuation of Hearing Protectors – An International Comparison with Update on the Noise Reduction Rating (NRR). American Industrial Hygiene Conference, Anaheim, CA. Paper 70, 1996.

CHAPTER 3

COMMUNICATING WHILE USING HEARING PROTECTORS

Improved Communication When in Noise

People, whose hearing is within normal limits and who regularly wear personal protective equipment (PPE), can usually hear speech as well as other sounds even in a noisy environment. The explanation is that hearing protection lessens both the speech and the noise signal to a level where the ear can handle each one more efficiently, especially under conditions of acoustic overload. In other words, reducing the overall noise level using hearing protection decreases distortion, so that both speech and warning signals can be heard more clearly. This is similar to wearing sunglasses that cut excess glare, thereby improving one's vision. With this said, it is very possible to overprotect the ear (e.g., using double protection when a single protector will suffice) and thus create potential communication problems.

Hearing in the Presence of Background Noise

Since the "sound signature" of a machine can be a guide to its efficient operation, can the operator determine if it is running properly while wearing hearing protection? The answer is yes! Experience has shown that one becomes accustomed to the change of a familiar sound, even when using hearing protectors. Therefore, the machine operator can be guided by a change in sound or different characteristic of that sound.

Individuals with severe hearing loss, however, may find it difficult to understand speech, hear warning signals or machines running while using their PPE (Figures 6 and 7). In such cases, preventing additional hearing loss must take priority over one's ability to understand speech or hear machinery in high noise environments. On occasion, it may be necessary to install a warning device, such as a flashing light, for individuals whose hearing is sharply degraded or to reassign such personnel to non-noise hazardous duties.

Figure 6

Figure 7

Wearing Hearing Protection in Noise is Important Even When You Having Hearing Loss

Examples of a mild, moderate and severe hearing loss are illustrated in Figure 8 below. Understanding speech is not always helped by wearing hearing protectors when hearing loss is marked.

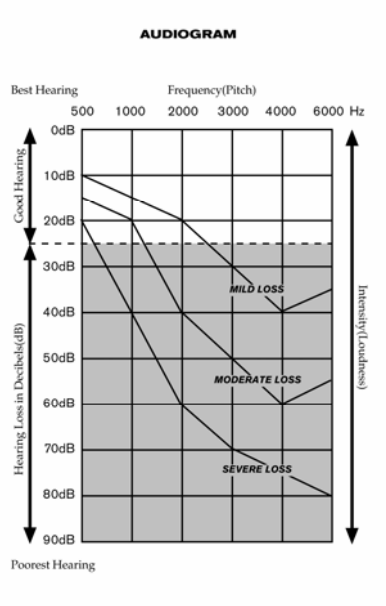


Figure 8

An Audiogram Depicting Various Degrees of Hearing Loss

An example would be a high steady-state noise environment of 130 dBA or more. Although military personnel are not normally exposed to levels this high, additional precautions are necessary. These include wearing earplugs in combination with a noise muff or helmet and/or limiting the duration of exposure. When noise levels are high, communication should be made via electronic headsets [see Chapter 13 – The Combat Vehicle Crewman (CVC) Helmet and Chapter 14 – Vehicular Intercommunication System (VIS)].

Vause, et.al, write that "communication in a background of noise is difficult and has long been a problem in a military operational environment. For example, artillery crew environments are relatively quiet and then suddenly become extremely noise hazardous with impulse noise levels often exceeding 180 dBP. Crewmen are reluctant to continuously wear HPDs before firing since they must quickly hear and understand brief voice transmissions (grid coordinates, deflection, elevation, fuse, projectile, number and type of rounds, etc.). Accurate communication of these elements is critical for mission success and safety. Unfortunately, soldiers cannot remove their helmets at the firing point; therefore, proper insertion of HPDs is impossible without delaying the fire mission. Some artillery charges exceed noise levels for single protection and may require double hearing protection…Results from this study indicate that communication is possible while wearing HPDs, but significant effort in human factors system design is required for user acceptability."[8]

[8]Vause, N., Froman, F., Breitenbach, F., Zubal, O., Todd, R. and Dooley, M. Emerging Communication Technologies and Double Hearing Protection. Undated Paper Presentation.

CHAPTER 4

APPROVED EARPLUGS AND CARRYING CASE

Earplugs – General

The eight types of earplugs pictured below (Figure 9) represent those currently approved by The Surgeon General (TSG) for use by DA personnel. They have been tested for attenuation characteristics in accordance with (IAW) the ANSI, S12.6-1997, as well as for durability and toxic effects. However, not all earplugs assigned a National Stock Number (NSN), listed in the Army Master Data File and obtainable through the Federal Supply Channel (FSC) are approved for use within DA. In addition, the use of commercially available earplugs is not recommended, since they may not provide adequate attenuation or be free from toxic effects. In some cases, Army-approved hearing protection may be more expensive when purchased through the FSC due to a surcharge added by the Defense Supply Center – Philadelphia (DSCP).

Figure 9

Sample Types of Approved Army Earplugs

Triple-Flange Earplug

General. The triple-flange earplug (Figure 10) is made of a soft, resilient material that is premolded. It is usually the first type of earplug that medically trained personnel fit.

Figure 10

Triple-Flange Earplug

Size/Color/Distribution. Its three sizes, their color code and typical size distribution (for ordering purposes) among users are listed below:

Size & Color	Size Distribution
Small (green)	5 percent
Regular (orange)	75 percent
Large (blue)	20 percent

In a population that includes a high proportion of women, young men and/or African-American men, some shift toward the smaller sizes may occur. An advantage of this plug is that it requires less time to fit than some of the other insert earplugs.

Quad-Flange Earplug

General. The quad-flange earplug is made from an ultra-soft polymer that is easy to insert and comfortable to wear. The Elvex® Quattro™ (Figure 11) is available only in one size (one-size-fits-many) in the color blue. These earplugs were approved by TSG as replacement alternatives for the single-flange earplug (see below) that is not currently being manufactured.

Figure 11

Elvex® Quattro™
Quad-Flange Earplug

Single-Flange Earplug

General. The single-flange earplug (Figure 12) was developed during World War II and has been a particularly effective earplug for ear canals that are curved. Although it is still approved for use, there is no current manufacturer producing it. However, some installations may still have limited quantities on hand. Continue to fit and issue this earplug as long as local supplies last.

Figure 12

Single-Flange Earplug

Size/Color/Distribution. Single-flange earplug sizes, color codes and typical size distribution* among users are as follows:

Size & Color	Size Distribution
Extra-small (white)	5 percent
Small (green)	15 percent
Medium (orange)	30 percent
Large (blue)	30 percent
Extra-large (red)	15 percent

*About five percent of ears will be too large for the extra-large size and approximately 20 percent of those fitted will require a different size plug for each ear. Due to its shorter tab, the single-flange earplug can be more effective than the triple-flange earplug when worn under some communication headsets.

Combat Arms Earplug (Double-Ended)

General. The double-ended combat arms earplug (Figure 13), approved by the TSG in 1999, is a device that is really two earplugs connected together. One (yellow end) aids speech communication in the presence of impulse noise (e.g., gunfire), while the other (olive drab end) serves as a conventional earplug in the presence of steady-state noise (e.g., tank).

Figure 13

Double-Ended Combat Arms Earplug

Non-Level-Dependent Mode (Olive drab end in ear canal). One end of the doubletree design is a solid-tipped earplug, olive drab color and designed for wearing under steady-state noise conditions (e.g., around generators, riding in helicopters or armored personnel carriers). The visibility of the light-colored end of the earplug in steady-state noise environments can assist in the enforcement and monitoring of the correct use of this device (Figure 14).

Figure 14

Double-Ended Combat Arms Earplug
Worn in Steady-State Noise (Non-Level-Dependent Mode/Olive Drab End Inserted)

Level-Dependent Mode (Yellow end in ear canal). For the dismounted soldier, however, a conventional (i.e., non-level-dependent) earplug can interfere with mission communication requirements, just when hearing protection is needed most (e.g., discharging weapons away from fixed firing points). Under relatively quiet conditions, conventional earplugs interfere with speech communication and the detection of low level environmental or combat sounds.[9]

The solution for the dismounted soldier is a level-dependent hearing protector (Figure 15) that lessens the hazard from weapons fire (impulse noise) over a desired range of intensity, yet does not interfere with required communication or with the detection of key combat sounds (e.g., vehicle noise, closing of a rifle bolt, stepping on dry leaves).

Figure 15

Double-Ended Combat Arms Earplugs
Worn in Impulse Noise (Level-Dependent Mode/Yellow End Inserted)

[9]Ohlin, D. Justification for a Non-Linear Earplug (Combat Arms Earplug). Letter to Joint Readiness Clinical Advisory Board. September 1997.

Scientists at the French-German Institute in Saint Louis, France, in collaboration with their American colleagues at the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM), Aberdeen Proving Ground (APG), MD, improved upon the initial design of a non-level-dependent plug by inserting a small "filter" into the center (stem) of an E·A·R UltraFit earplug. The filter is a cylindrical device with a hole of a very precise diameter at each end. When worn as a passive, level-dependent hearing protector, the combat arms earplug provides increased attenuation as the level of noise increases. This device, in effect, lets in weak sounds at full strength, while reducing intense sounds. The USACHPPM recommended the color coding scheme of this protector and funded the testing process at White Sands Missile Range, NM.

At the opposite end of the doubletree design, the yellow tipped earplug (level-dependent design) has a small opening (Figure 16) that must be kept clean and free of earwax. It is one of two calibrated holes at each end of the filter that is located within the center stem of the earplug. A view of the center calibrated hole is seen in Figure 17.

Figure 16

End View of Calibrated Hole (Double-Ended Combat Arms Earplug)

Figure 17

Center View of Calibrated Hole (Double-Ended Combat Arms Earplug)

These calibrated holes (set apart from each other in the cylinder) significantly dampen the more hazardous high level component of an impulse noise signature, thus protecting against impulse noise (weapons). Consequently, at low levels there is little or no sound reduction and speech can be heard without shouting. When noise increases to the level of weapons fire, the noise reduction does also.

Non-linearity begins at about 110 dBP and increases to an overall attenuation level of 25 dB achieved at 190 dBP, the level to which an American military test facility found this earplug protective.[10] While high frequency impulse noise is significantly reduced, most speech energy is passed. The combat earplug promotes realism in training because weapons fire sounds louder than with conventional hearing protection, but still protects soldier hearing.[11]

[10] Johnson, D. Non-linear Earplug Study. Research Project Conducted by EG&G Management Systems, Inc., under Contract DAMD-17-93-C-3101 to the U.S. Army Medical Research and Materiel Command. June 1995.
[11]Vause, N. and Ohlin, D. The Combat Arms Earplug. Undated ARL Information Paper.

Size/Color. It is a one-size-fits-many device with a doubletree design for use as both a level-dependent and non-level-dependent earplug. As noted above, it is olive drab and yellow in color.

Other Information. A detection model developed at the Army Research Laboratory (ARL) at APG, MD, predicts that the normal-hearing soldier (i.e., one with an H-1 physical profile) can detect a truck at the same distance (800 meters) with or without the level-dependent plug. The detection capability is cut in half (400 meters) when using conventional foam (handformed) earplugs (Figure 18).

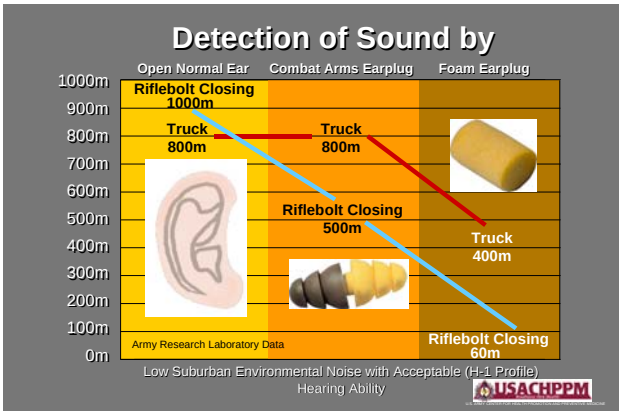


Figure 18

Sound Detection Capability (Combat Arms vs. Foam Earplugs)

Combat Arms Earplug (Single-Ended)

General. In 2004, a single-ended, level-dependent version of the combat arms earplug became available (Figure 19). It functions in the same way as that of its double-ended counterpart (level-dependent version only). However, users must understand that this plug provides no protection in steady-state noise!

Figure 19

Single-Ended Combat Arms Earplug
Worn in Impulse Noise
(Level-Dependent Mode)

Size/Color. It is also a one-size-fits-many device that is yellow in color.

Foam (Handformed) Earplug

General. Only one basic type of disposable (handformed) earplug is currently approved for use (Figure 20). It is made of polyvinyl chloride (PVC) foam and is useful for occasional, short-term exposures. It is handy for visitors to noise-hazardous areas who arrive without hearing protection or employees who have forgotten or temporarily misplaced their earplugs.

Figure 20

New Dynamics® Sound-Guard™ Two-Color Foam Earplug

Size/Color. Unlike fitted earplugs, handformed earplugs do not require fitting by medically-trained personnel. They are available in three different sizes (small, medium and large). The medium size, marketed as Sound-Guard™, is manufactured by New Dynamics® and was initially available in only a light green color. The mandatory use of this particular product is covered by the Javits-Wagner-O'Day Act (JWOD) (see below). In 2004, a two-color foam version (orange and light green) was made to promote a better fit and enhance compliance. The two other sizes (small and large) of foam, handformed, earplugs are available from the Aearo™ Company.

Size & Color	Availability
Small (yellow & orange)	Non-JWOD Source
Medium (green & orange)	FSC Only
Large (yellow & orange)	Non-JWOD Source

JWOD Act. ***The medium size of the handformed earplug must be purchased through the FSC. It is an item covered by the JWOD Act, in which each military service and all DoD agencies must procure such products only from an approved source (e.g., DSCP or a JWOD agency).***

This act was implemented under the Federal Acquisition Regulation (FAR). The Committee for Purchase from People Who Are Blind or Severely Disabled maintains a list of supplies/services that must be purchased from JWOD nonprofit sources. All government agencies must buy these listed items from such sources unless the appropriate JWOD agency specifically authorizes an exception IAW the FAR.[12]

[12]Lee, D. Application of Javits-Wagner-O'Day Act. Memorandum, Office of the Under Secretary of Defense. June 7, 2001.

When this TG was published, installations were authorized to purchase the Aearo™ E·A·R® foam earplug designed for small canals (Classic SuperFit 30™) as well as the E·A·R® foam earplug for large canals (Classic SuperFit 33™) until such time that federal law mandates a JWOD vendor purchase (Figures 21 and 22).

Figure 21

Aearo™ Classic SuperFit 30™

Figure 22

Aearo™ Classic SuperFit 33™

The SuperFit 33™ is longer than the Classic E·A·R® foam earplug (no longer available for purchase under federal law). Both sizes of the small and large E·A·R® products are sold in packages of 10 boxes (2000 pairs) per case under a General Services Administration (GSA) contract. The middle third of these plugs is fluorescent orange in color and permits an observer to determine if the earplug is inserted correctly by the user. The instructions on the package state: "For best fit, no orange should be showing in ear canal after insertion."

DO NOT use these plugs in situations where hazardous materials, such as solvents or grease, can be transferred from the hands to the ear via the earplug. In addition, DO NOT alter this earplug (e.g., cutting it in half) as the noise reduction benefit to the wearer will be degraded.

Pod Foam Earplug

General. The pod foam earplug (Figures 23 and 24) has a flexible stem grip attached to a yellow foam cushion pod.

Figure 23

Uncorded Pod Foam Earplug

Figure 24

Fitted Pod Foam Earplug

Size/Color. One-size-fits-many. Although the pod's foam is yellow, the flexible stem grips are available in five different colors (blue, green, purple, red & yellow). It is available with and

without an attached breakaway cord (a safety feature). The corded style is slightly more expensive than the uncorded version. The product is reusable, but also disposable. Like the traditional foam plug, it is strongly recommended that the foam cushion be rolled down before insertion. These plugs should be effective under 95 dBA exposure levels and for small arms fire.

Musician and Custom Earplugs

General. Employees may use custom earplugs only when they cannot be properly fitted with an approved hearing protector or when a custom device is required. One common example for a custom mold is the musicians' earplug for Army band members (Figure 25).

Audiologists, ear-nose-throat specialists or Army Medical Department (AMEDD)-credentialed personnel may take impressions of ear canals for fitting custom-molded plugs. Such plugs, especially deep-insert types, are expensive, can be uncomfortable and are a potential health or safety risk to the user at the time the plug impression is made, unless performed by a qualified and experienced individual.[13]

In addition, medically trained personnel must examine the fit and condition of all musician and custom earplugs at least annually. Funding for musician earplugs is a unit responsibility.

According to Gischia and Hartmann, this earplug is targeted for use by personnel exposed to sound levels between 90-120 dB and who need to hear accurately, with the primary focus being on musicians, dentists and aviators. Manufacturers generally offer custom earplugs with either a 15 dB filter for exposures less than 105 dBA or a 25 dB filter for exposures above 105 dBA. Both types are made with a relatively flat frequency response curve that preserves the natural frequency response of the ear. For each order, deep impressions are recommended.[14] Preformed musician's earplugs are also available.

Figure 25

Musician's Earplug

[13] Personal correspondence from Ahroon, W. (USAARL) to Ohlin, D. (USACHPPM). Undated.
[14] Gischia, C. and Hartmann, K. ER-15 Musicians Earplugs in the Armed Forces: Customer Satisfaction/Fitting Practices. Spectrum, 15 (Supplement 1), p. 25, 1998.
Another caveat concerning deep insertion earplugs comes from Ohlin. "It has yet to be established that service personnel will tolerate deep insertion earplugs for the duration of their workplace noise exposures. Unless something is done to desensitize the inner two thirds of the ear canal, our experience indicates that they will not tolerate it."[15]

Earplug Carrying Case

General. An earplug carrying case with seating device (Figure 26) must be given to everyone fitted with earplugs. It protects plugs by keeping them dry and, when worn on a uniform, readily available for use. The case, with its chain, can also be attached to a belt loop on the new Army combat uniform (ACU) or to load bearing equipment (LBE). It was initially designed to serve as a seating device for both triple- and single-flange earplugs (Figure 27). In 2006, a larger earplug case (with a wider base and insertion area for the earplug stem) was introduced. Fitting instructions and general information remain inscribed on the green, translucent case. Refer to Chapter 7 for additional information.

Figure 26

Triple-Flange/Single-Ended Combat Arms Insertion Device

Figure 27

Single-Flange Insertion Device with Tip

AR 670-1 (paragraph 1-18), Wear and Appearance of Army Uniform and Insignia, authorizes the wearing of the earplug carrying case on a uniform (Figure 28) or attached to a belt loop, when the safety or health of the individual soldier is a factor.

Figure 28

Earplug Carrying Case Worn on the BDU

[15] Email communication from Ohlin, D. to Ciliax, D. (USACHPPM). Undated.

CHAPTER 5

CONSIDERATIONS WHEN FITTING HEARING PROTECTIVE DEVICES

General

Before beginning the actual process of fitting hearing protection, consider your objective [i.e., will the HPD protect the noise-exposed employee at an accepted safe level around 75 to 80 dB, TWA]. For example, those with workplace noise exposures of less than 95 dBA TWA, 15–20 dB of protection is all that is required. Generally, there is a tendency to overprotect the worker. However, an overprotected worker is more likely to remove their HPD in order to communicate or to listen for critical sound cues from their equipment.

Who is Qualified to Fit Earplugs?

The initial sizing and fitting of HPDs (i.e., preformed, reusable earplugs) requires a medically trained fitter who has received one or more hours of lecture and practicum experience. The fitter must be knowledgeable in all aspects of the fitting process (including the anatomy and physiology of the ear) and judged competent to correctly fit various HPD.[16]

Audiologists, physicians and other AMEDD personnel, such as occupational health nurses and senior Non-Commissioned Officers (91B or 91W) can perform this training. Personnel who have been certified by the Council for Accreditation in Occupational Hearing Conservation (CAOHC), or its military equivalent, also are qualified and have the knowledge and expertise to fit hearing protection.

Items Needed in the Fitting Process

Prior to fitting earplugs, you will need the following items: an otoscope with a variety of specula sizes in adequate quantities (Figure 29); extra batteries (Figure 30); alcohol wipes (Figure 31); a variety of preformed earplugs in all sizes; and a work-space suitable for conducting the fitting process.

Figure 29

Otoscope

Figure 30

Batteries

Figure 31

Alcohol Wipes

[16]Hager, L. Hearing Conservation – Encouraging Compliance. Advance for Audiologists. November/December 2003, pp. 32 and 34.

Otoscope. **It is important that the otoscope provide a bright light (Figure 32) in order to see the ear canal and tympanic membrane. Not all commercial models are alike. Although wall-mounted units generally provide the best light source, this type of device may be unavailable or impractical to use. For hand-held otoscopes, have fresh batteries on hand and replace as needed. Remove them after finishing the fitting task to ensure the longevity of both otoscope and batteries. When fitting large groups, use disposable specula.**

Figure 32

Otoscope with a Bright Light for Observation

Hearing Protective Devices. **Medical units must stock preformed earplugs in all sizes (e.g., triple-flange/Figure 33). Plugs used in the fitting process, but not dispensed, can be returned to stock. However, they must be thoroughly cleaned, using a mild soap and warm water, rinsed and air-dried. Alcohol wipes can be used to clean trial earplugs dispensed on the spot.**

Figure 33

Triple-Flange Earplug

The Fitting Environment (Clinic versus Worksite)

A favorite site for fitting earplugs is a clinic facility where most medically trained personnel work and have the necessary tools readily available to complete this task. Typically, a clinic offers a quiet environment where conditions are optimal for giving personnel guidance about noise-induced hearing loss and instructions in the proper fit and wear of PPE.

Fitting earplugs in quiet surroundings, however, is not necessarily advantageous for demonstrating their effectiveness and protective value in noise. Consequently, the user

may not be fitted with the type of earplug that affords the maximum protection, in that, hearing protection fitted in quiet only makes for a quieter situation. Low noise levels are seldom disturbing and the employee receives no added relief. If anything, the individual will be more conscious of any slightly disagreeable or uncomfortable feature of the protector, rather than the noise reduction it affords. One possible solution for overcoming the disadvantage of a quiet clinic is to use an earplug fitting pack similar to the one featured below (Figure 34). It is equipped with its own noise-generating capability for fitting HPDs in quiet environments.

Figure 34

Earplug Fitting Pack

When hearing protectors are fitted at the work site, the reduction in noise achieved by the HPD can be dramatic. Any discomfort is, at least for the moment, outweighed by the obvious benefits. In addition, co-workers are likely to notice an employee's initial enthusiasm with a successful fit. A tool or fishing tackle box is also useful for carrying various types and sizes of earplugs. Its small compartments can hold several dozen plugs.

If hearing protectors are fitted in the clinic, the individual's use of such protection should be checked at their job site shortly thereafter. At that time, faulty practices can be corrected and, if necessary, another type of protector tried. A quick follow-up visit will minimize the formation of bad habits and promote general acceptance and appreciation of hearing protectors.

The fitting process is best handled one-on-one or in small groups (six or less). The goal is to educate individuals as to why hearing protection is important and to enable them, as wearers, to correctly fit and maintain their own PPE to preserve their hearing. In situations involving large groups, less personal interaction may result, but the goals of education and fitting remain the same.

CHAPTER 6

THE EARPLUG FITTING PROCESS

The Well-Lighted Visual Inspection

All fitting of reusable earplugs must be performed under medical supervision. Before any protective device is placed into an ear, a well-lighted visual inspection is necessary to determine whether any condition makes insertion inadvisable (e.g., a draining ear, occlusion due to impacted earwax). Below is a diagram of the ear (Figure 35).

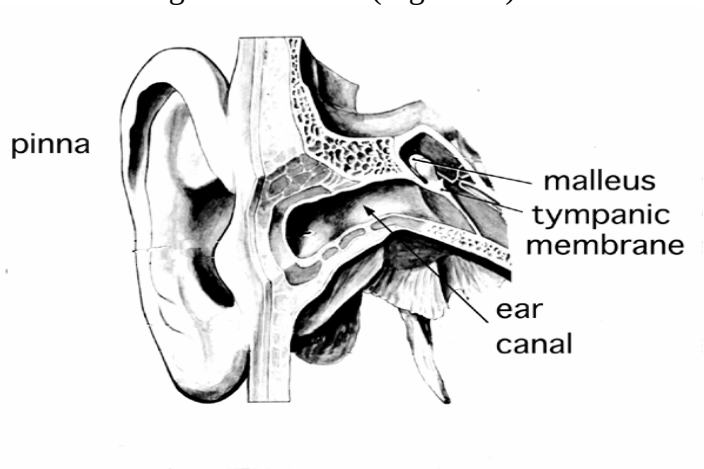


Figure 35

Schematic Drawing of the External and Middle Ear

To reveal the canal opening and to estimate an individual's earplug size requirements, grasp the pinna (Figure 36) and pull gently, but firmly in a direction away from the head. Pulling the ear up and back rarely gives the best view of the canal entrance and trajectory. The structural topography of the outer ear varies by individual.

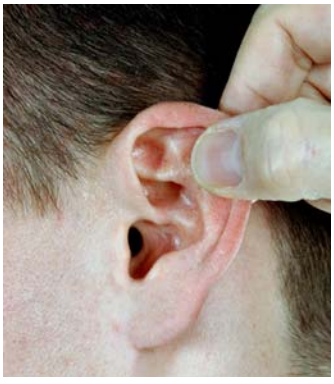


Figure 36

Visual Inspection of the Ear Canal for Initial Estimation of Earplug Size

Figure 37

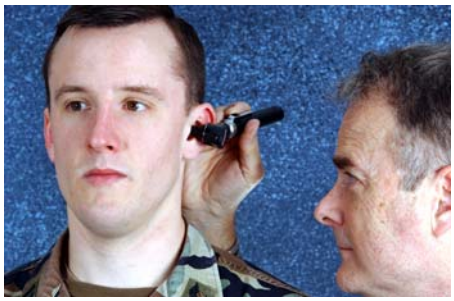


Figure 38

Correct (left) and Incorrect (right) Otoscopic Method of Viewing the External Ear Canal

The visual inspection of the ear canals will determine the appropriateness of proceeding with the fitting of hearing protection. The fitter must ensure that the visualization of the external canal is performed safely (Figure 37), protecting against any sudden movements that may cause injury to the employee from an inappropriately positioned otoscope (Figure 38).

Figure 39

Normal Tympanic Membrane

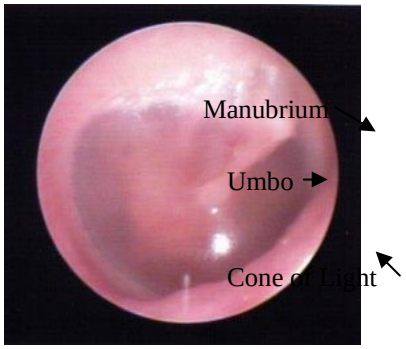


Figure 40

Landmarks of the Tympanic Membrane

A normal tympanic membrane (TM) should be completely intact and appear pearly gray in color (Figure 39). The TM's usual identifying landmarks include the manubrium, umbo and cone of light (Figure 40).

The Trial Plug

Begin with the triple-flange earplug. Before inserting the first trial plug, eyeball the approximate size of the canal opening. Most fitters can detect any gross error in plug size immediately. If too large, the plug will not penetrate far enough to allow contact of its outermost flange (Figure 41) at the canal opening. When stretching the canal opening, the plug may cause discomfort. If too small, the plug will fall into the canal and its depth of insertion will be limited by the size of the earplug-seating device or the fitter's fingers, not the flange(s) of the plug (Figure 42). A plug that makes contact with the interior wall of the canal, without appreciably stretching the tissues, is probably the right size (Figure 43).

Figure 41

Figure 42

Figure 43

Triple-Flange Earplug That Is Too Large (Left), Too Small (Center), Just Right (Right)

Although an inexperienced fitter initially tends to select plugs that are too small, more experienced personnel may be too concerned with the attenuation characteristics of the earplug, rather than its comfort and acceptability to the wearer. In that instance, there is a tendency to fill the ear canal too tightly, which invites rejection. The ultimate test of a good fit is the insertion and seating of the plug. The experienced fitter usually needs only a quick visual inspection and a trial plug to achieve the proper fit.

Some individuals may be embarrassed if cerumen (earwax) sticks to the plug. Put them at ease by reassuring them that plugs occupy space in the canal beyond the area that can be washed (Figure 44). Furthermore, explain that wax is useful in trapping foreign particles, repelling insects and preventing infection.

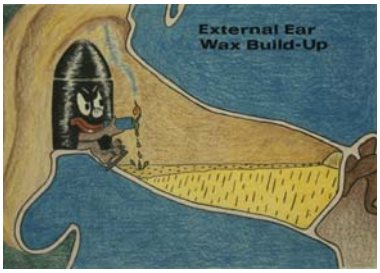


Figure 44

Cerumen in the Outer Ear Canal

Field Tests to Check Proper Fitting

After a plug is fitted, ask the individual to count loudly from one to five and report in which ear their voice sounds loudest, more resonant or low-toned. When an earplug is properly seated, these sensations should lateralize (i.e., be heard or felt more strongly) to the ear with the plug. If this is not the case, try a different size or type of earplug. Note that not everyone is able to hear or sense the lateralization of these phenomena. Most people, however, will be able to notice a change in the sound of their voice when both ear canals are properly sealed by correctly sized earplugs.

Personnel fitted with protective devices may report a vacuum sensation or backpressure in their canals. Frequently during plug insertion, air trapped in the canal is compressed. The fitter may observe the individual swallowing, moving their jaw or attempting to alleviate this uncomfortable feeling. The fitter can quickly fix this condition by breaking the seal, either by twisting the plug sideways (thereby stretching the canal), or by moving the plug outward very slightly before reseating it. Compression is less likely to occur when the plug is inserted with a slight twisting motion, or when the canal is straightened as the plug is inserted.

Gently pull the tab or stem of the trial plug. If the plug can be removed with little or no resistance, it is the wrong size or has not been inserted adequately into the canal. With a correct fit, the individual should experience a sensation of gentle suction on the eardrum.
In a noisy environment, the perceived sound levels should increase markedly when the user breaks the seal of each earplug or removes their noise muffs.

Fit the other ear in a similar manner. **It is possible that a different size earplug will be required for each ear**. If a correct fit is not possible with the triple-flange earplug, try another type of approved earplug (e.g., quad-flange).

The Cough Reflex

Occasionally, a person will cough as a plug is inserted. In some cases, this reaction stops as soon as the plug is seated; in others, it continues until the plug is removed. This is usually an involuntary response, not to be confused with the exaggerated wincing or grimacing sometimes displayed by someone who does not "believe in" earplugs, or who feigns pain to avoid using them. This involuntary response may be attributable to an irritation of the nerve pathway to the pharyngeal (throat) area that passes near the surface of the ear canal. Those who experience a cough reflex when seating plugs can usually learn to insert them without triggering this response. Those who cannot eliminate this behavior must wear noise muffs. Although an individual may feign severe discomfort in order to avoid using earplugs, all complaints of persistent pain must be referred to a physician.

Removing Earplugs

When a plug is abruptly yanked out, there can be an unpleasant or slightly painful suction exerted on the eardrum. Therefore, when removing a plug, it is advisable to break the seal by gently twisting the plug or by straightening the canal.

Comfort Issues

A common employee complaint is that earplugs hurt or are uncomfortable. This, in part, is due to filling the outer ear canal too tightly. In fact, most people can wear earplugs or noise muffs in a high-level noise environment for hours without difficulty. When intense noise causes greater annoyance or discomfort than does the protector, the protection is tolerable and welcome. Others find that both earplugs and noise muffs sometimes cause irritation and, occasionally, acute pain after long periods of wear. This is primarily attributable to poor blood circulation next to the skin surface caused by the continuous pressure of the protector.

Excessive friction between the ear canal and the earplug may also cause discomfort, if the canal lining lacks adequate cerumen. Using a small amount of petroleum jelly can alleviate this infrequent and unusual situation. However, consult a physician first.

Most individuals who initially experience discomfort become accustomed to their protectors and wear them for longer and longer periods. This tolerance is a result of a toughening of the skin along the ear canal wall, as well as a growing appreciation of the quieter environment and the protection afforded by the earplug.

When protection is worn faithfully, temporary hearing loss, fatigue and annoyance disappear. Also, non-attenuated noise levels are perceived as being unpleasant.

Quality Assurance Concerns

Although there are definite specifications for the materiel that comprise earplugs and other PPE, the manufacturing process can produce defective products. Such flaws may include missing flanges or stems, jagged edges on flanges, sizing issues, etc. If you receive a batch of hearing protectors that contains defective items, contact DSCP for guidance. You may be asked to fill out and forward online (https://dmmonline.dscp.dla.mil/forms/sf380.asp) an SF380 Form (Reporting & Processing Medical Materiel Complaints Quality Improvement Report) along with the product.

Triple-Flange and Quad-Flange Earplugs

Insertion Technique. Ear canals vary widely in size and shape; therefore, have all sizes of each plug available for fitting and issue. This product can be inserted by positioning one arm behind the head and pulling the ear gently, but firmly up and away from the head, using the free hand to fit the plug (Figure 45).

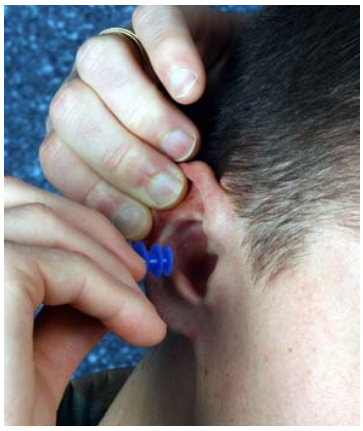


Figure 45

Fitting the Triple-Flange or Quad-Flange Earplug Using Both Hands

Proper and Improper Fit of a Quad-Flange Earplug.

Figure 46

Best Fit

Figure 47

Poor Fit?

The triple-flange earplug provides a proper fit and the best attenuation (protection) when the first two flanges have contact with all sides of the ear canal while the last flange completely blocks the canal opening. The quad-flange earplug provides the best fit and the most attenuation when the first three flanges have contact with all sides of the ear canal, while the last flange completely blocks the canal opening (Figure 46). However, those with smaller ear canals can still benefit with fewer flanges inserted in the canal provided that a good seal is achieved (Figure 47).

Maintenance. Wash after each use with mild soap, rinse and dry thoroughly before returning the earplugs to their carrying case.

Single-Flange Earplug

Insertion Technique. Insert this plug by positioning one arm behind the head and pulling the ear gently up and away from the head, using the free hand to fit the earplug (Figure 48).

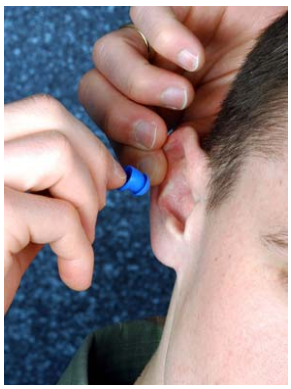


Figure 48

Correct Method to Insert, Twist (90) and Position a Single-Flange Earplug

Proper and Improper Fit of the Single-Flange Earplug (Figures 49 and 50, respectively).

Figure 49

Figure 50

Correct (left) and Incorrect (right) Insertion Placement of the Single-Flange Earplug

Maintenance. Wash after each use with mild soap, rinse and dry thoroughly before returning the earplugs to their carrying case.

Combat Arms Earplugs

Double-Ended Combat Arms Earplug Insertion Technique. The double-ended combat arms earplug is properly fitted and provides the best attenuation when all three flanges (olive drab or yellow) snugly contact all sides of the ear canal. Insert this item by positioning one arm behind the head and pulling the ear gently up and away from the head, using the free hand to fit the earplug (Figures 51 and 52, respectively).

Figure 51

Figure 52

Yellow (Steady-State Noise Conditions) and Olive Drab (Impulse Noise Conditions) Double-Ended Combat Arms Earplug Fitting Technique

Proper and Improper Fit of the Double-Ended Combat Arms Earplug (Figures 53 and 54, respectively)**.**

Figure 53

Figure 54

Proper (left) and Improper (right) Insertion of the Double-Ended Combat Arms Earplug

Single-Ended Combat Arms Earplug Insertion Technique. The single-ended combat arms earplug is best fitted and provides the most attenuation when all three flanges snugly contact all sides of the ear canal. However, those with smaller ear canals can still benefit with fewer flanges inserted in the canal provided that a good seal is achieved. Insert this item by positioning one arm behind the head and pulling the ear gently up and away from the head, using the free hand to fit the earplug, similar to the way a triple-flange earplug is fitted.

Proper and Improper Fit of the Single-Ended Combat Arms Earplug (Figures 55 and 56, respectively)**.**

Figure 55

Figure 56

Proper (left) and Improper? (right) Insertion of the Single-Ended Combat Arms Earplug

Maintenance. Wash carefully after each use with mild soap, rinse and thoroughly dry before returning these earplugs (double- and single-ended types) to their earplug carrying case.

Foam (Handformed) Earplug

Insertion Technique. Before inserting, roll the foam plug between the thumb and forefinger to form a thin, tapered cylinder (Figures 57 – 59). Insert the tapered end into the ear canal and gently hold in position for thirty seconds. This time is necessary to permit the earplug to expand in order to form an effective acoustical seal.

Figure 57 *Figure 58* *Figure 59*

Insertion Technique for the Foam (Handformed) Earplug (Roll, Insert, Hold)

Proper and Improper Fit of the Foam (Handformed) Earplug (Figures 60 and 61, respectively).

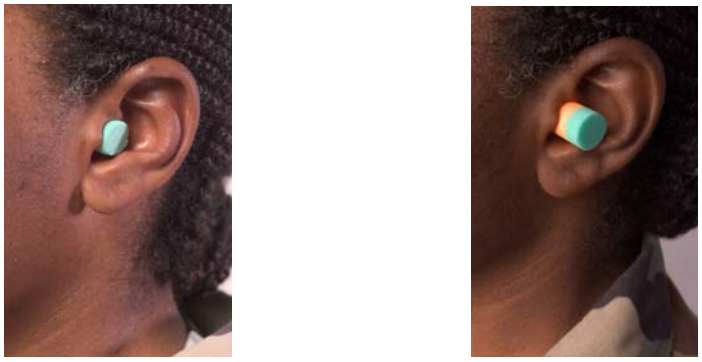


Figure 60 *Figure 61*

Proper (left) and Improper (Right) Fit of the Foam (Handformed) Earplug

The newest generation of foam earplugs incorporates a two-color design or a fitting ring feature that visually indicates when a proper insertion depth has been achieved. For these types of foam earplugs, no orange fitting ring or second color should be visible, indicating that the necessary two-thirds insertion depth has been obtained.

The foam earplugs come in three sizes (small, medium and large). Although the medium size is sometimes referred to as the universal fit, it is unsuitable for those individuals with very small or large canals. In those situations, such individuals will benefit from the appropriate size foam earplug.

DO NOT wear these plugs in situations where hazardous materials, such as solvents or grease, can be transferred from your hand to the ear via the earplug. In addition, **DO NOT** alter this earplug (e.g., cutting it in half) because the noise reduction benefit will be degraded.

Maintenance. Wash in warm water with a mild liquid detergent, rinse in clear water and thoroughly dry. Remove excess moisture from the foam to expedite the drying cycle. If kept clean, foam earplugs can be reused until they become discolored or disfigured. For hygienic reasons, wash your hands with soap and water before inserting into the ear canal. Quality PVC foam can be washed several times before its attenuation capability diminishes. However, when any foam product fails to return to its original shape or does not expand adequately, discard and get a new pair.

Other Information. Do not confuse PVC foam with polyurethane foam that is unauthorized for Army use because of its poor "memory" in humid environments. It cannot be rolled down sufficiently to allow for proper insertion. In addition, polyurethane foam has not been cleared through toxicology testing protocols.[17]

Pod Foam Earplug

Insertion Technique. For a good fit, insure that the rear edge of the foam tip is well inside the canal entrance (Figures 62 & 63). Insertion is easy, and the foam tip seats well and stays in place. "If inserted properly, these plugs should be effective under 95 dBA and for small arms fire. We don't agree with the manufacturer's instructions that do not include a requirement to roll the foam down before insertion. Instruct users to roll the foam down before insertion."[18]

Figure 62

Figure 63

Properly Inserted Pod Foam Earplugs (Uncorded and Corded Versions)

Maintenance. Wash in warm water with a mild liquid detergent, rinse in clear water and thoroughly dry. Remove excess moisture from the foam to expedite the drying cycle.

[17] Ohlin, D. Email communication to Stevens, M. (Fort Stewart). September 16, 2002.
[18] Ibid.

Musician and Custom Earplugs

General. Employees may use custom earplugs **only** if they cannot be properly fitted with approved hearing protectors or if a custom device is required for special circumstances. The Army provides either preformed or custom-molded musicians' earplugs for its band members (Figure 64). Funding for musician earplugs, however, is a unit (not AMEDD) responsibility.

Figure 64

Musician Earplug

Where indicated, only audiologists, ear-nose-throat specialists or AMEDD-credentialed personnel may take impressions of ear canals for fitting custom-molded plugs. In addition, medically trained personnel must examine the fit and condition of all musician and custom earplugs at least annually.

Maintenance. Wash in warm water with a mild liquid detergent, rinse in clear water and thoroughly dry.

CHAPTER 7

EARPLUG SEATING DEVICE

Earplug Carrying Case with Seating Device

The new, wider-based earplug carrying case with its larger seating device assists the insertion and proper seating of the triple-, single-, and quad-flange earplugs, as well as the single-ended combat arms earplug. The lid of the carrying case serves as the earplug seater for all these types of earplugs (Figures 65 and 66). It was designed so that neither the device nor the earplug can be inserted too far into the ear canal.

Figure 65

Figure 66

Seating Device for the Triple- and Quad-Flange and Single-Ended Combat Arms Earplug (left) and the Single-Flange Earplug (right)

Triple- and Quad-Flange/Single-Ended Combat Arms Earplug Seating Device. For example, place the stem of the triple-flange (Figure 67) or the single-ended combat arms (Figure 68) earplug into the open cylinder of the seating device.

Figure 67

Figure 68

The Seating Device using the Triple-Flange and Single-Ended Combat Arms Earplugs

Step 1. Insert the earplug of choice (e.g., triple-flange) into the ear canal (Figure 69).

Step 2. Wiggle the earplug toward the center of the head until a proper seal is achieved (Figure 70).

Step 3. Remove the seating device (Figure 71).

Figure 69

Figure 70

Figure 71

Steps for Obtaining a Proper Seal of the Canal Entrance with a Triple-Flange Earplug

Single-Flange Earplug Seating Device. After inserting the separate plastic tip into the open cylinder (see Figure 66), place the body of the single-flange earplug over it (Figure 72).

Figure 72

The Seating Device for the Single-Flange Earplug

Step 1. Insert the earplug with its tab down at the six o'clock position into the ear canal (Figure 73).

Step 2. Firmly twist the earplug 90 degrees (one quarter turn) so that the tab rests at the rear of the ear at the nine o'clock position (Figure 74).

Step 3. Gently remove the seating device. A well-fitted single-flange earplug seals the entrance to the canal with the tab correctly positioned to the rear of the head (Figure 75).

Figure 73

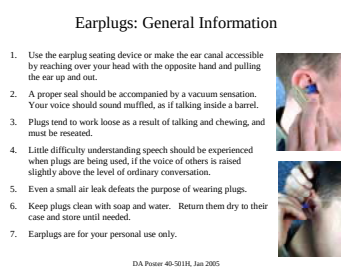
Figure 74

Figure 75

Steps for Correctly Inserting, Twisting and Positioning the Single-Flange Earplug

Training Insertion and Seating Techniques

As a fitter, initially demonstrate how the earplug is properly inserted and then have each person practice the process on themselves. The important points summarized in the posters below (Figures 76 – 78) should be reinforced. Fitting information for each type of hearing protector (and others) is located in Appendix A.



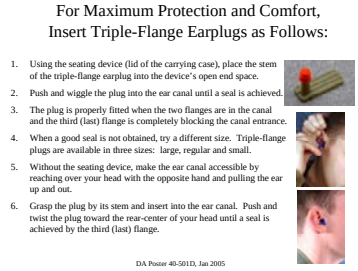


Figure 76 *Figure 77* *Figure 78*

Information on Triple- and Single-Flange Earplugs and their Proper Insertion

Fitters must be knowledgeable as to which earplug will likely offer the most protection to each individual. The best fit can often be accomplished using the earplug seating device for both triple- and single-flange earplugs, as well as the single-ended combat arms earplug.

General Fitting Information

Insert plugs properly into the ear canal. There may be a reluctance to do this initially because most people have been taught since childhood not to "put anything in their ear smaller than their elbow." However, partial insertions result in poor attenuation, retention and discomfort, because loosely fitted plugs break contact with the canal wall during jaw movement and swallowing. Physical and mental irritation can also result, at which point the plug may be removed.

After one or two trials, most individuals will understand how to insert and remove plugs correctly. For those who require additional assistance, the fitter can explain the difficulty and suggest corrective action.

If an individual requires a different size (or type) earplug for each ear, it is important to state which size earplug is appropriate for each ear.

Another task of the fitter is to teach supervisory personnel to recognize the appearance of a properly seated earplug. Supervisors must be taught to recognize when protective devices are being used incorrectly and to offer on-the-spot assistance for proper reseating. If they think that an individual is inadequately protected, they must refer them for refitting or re-instruction.

In view of the smallness of some earplugs, variations in an individual's finger size and shape also assume importance. Slim, nimble fingers handle earplugs more easily. Individuals with wide, blunt fingers and short nails or those with missing digits may experience greater difficulty.

Hand size, rather than the ear's configuration, may sometimes determine the choice of hearing protection selected in order to achieve the best fit.

Recent Changes to the Earplug Carrying Case and Seating Device

Due, in part, to the addition of other approved earplug products, the design and size of the earplug carrying case was modified in 2006. Several changes were made. The case's original matte finish replaced the shiny coat. The insertion tube's diameter (Figure 79) was increased to accommodate different earplug stem sizes. In addition, the base of the case was widened, expanding the interior dimensions in order to house two pair of most earplug types and to facilitate their quick removal.

Figure 79

Insertion Tube of the Earplug Seating Device

CHAPTER 8

THE FOLLOW-UP

Earplug Refitting

Enforcing the mandatory use of HPD is a command and supervisory responsibility. However, medical personnel can resolve most problems with wearing hearing protectors (e.g., poor fit, maintenance issues).

Encourage users to return to their local health clinic or battalion aid station for refitting, when necessary. Beware, that despite careful instruction in the initial fitting process, there will be those who have difficulty learning the proper technique of earplug insertion.

Medical personnel should make periodic (e.g., quarterly) visits to each NHA in order to observe when and how hearing protectors are used. In addition, solicit input from supervisory personnel who, through their own observations, can refer employees needing additional assistance.

Hearing Protection Must Be Checked Annually

An ideal time to confirm the appropriateness of hearing protection is in conjunction with the annual Defense Occupational and Environmental Health Readiness System – Hearing Conservation (DOEHRS-HC) periodic hearing check. Earplugs can lose their effectiveness by shrinking or swelling. In addition, ear canals get larger from regular earplug use, as well as from an individual's natural aging process.

Other opportunities to check, issue or refit hearing protection occur during Soldier Readiness Processing for deploying personnel or for employees, both military and civilian, who are in-processing at a new duty station.

Take the time, where indicated, to issue or reissue a new pair of earplugs to noise-exposed personnel, to include a thorough explanation as to how earplugs are to be fitted, used and maintained.

CHAPTER 9

THE ADVANTAGES AND DISADVANTAGES OF WEARING EARPLUGS

Monitoring Earplug Use

From a distance, supervisory personnel may have difficulty confirming employee compliance. Even at close range, long hair or other items can interfere with visual monitoring. Only users can actually know if their plugs are properly fitted. Military and civilian supervisors, nonetheless, need to be trained to recognize the appearance of properly and improperly fitted earplugs (or other types of protectors) and to check compliance regularly (Figures 80 – 82).

Figure 80

Single-Flange

Figure 81

Foam (Handformed)

Figure 82

Triple-Flange

Examples of Improperly Fitted Hearing Protective Devices

Advantages of Wearing Earplugs

Earplugs, when properly fitted and consistently worn, prevent hearing loss!

Earplug use is compatible with glasses, earrings, hairstyles and different types of headgear.

Earplugs are not usually affected by external temperature or environment.

Earplugs represent the most economical form of hearing protection. The cost for a pair of preformed earplugs (e.g., triple-flange) and carrying case can be less than a dollar ($1.00)! This is a bargain, considering the alternative (permanent hearing loss).

Earplugs do not usually interfere with work operations. There may be times, however, when "corded" hearing protection is preferable, especially if losing a single earplug could cause problems in the work environment.

They are easily carried or stored on the person for ready availability. Corded earplugs are not generally recommended for military personnel.

The Disadvantages of Wearing Earplugs

They can be lost or misplaced.

They work loose when the wearer talks, and must be reseated periodically.

Slightly more time is required to fit earplugs than for some other types of HPDs (e.g., noise muffs).

Insertion of earplugs may contribute to a problem of impacted wax in the ear canal.

They cannot be worn safely in an unhealthy ear; infection may result from failure to keep earplugs clean.

Gloves or helmets, when worn, need to be taken off before inserting or removing earplugs.

Greater variance in attenuation (protective value) is noted with earplugs when compared to noise muffs.

CHAPTER 10

NOISE MUFFS

Circumaural Noise Muff (External Type)

The circumaural protector is the only approved type of noise muff in the Army inventory (Figure 83). It has been thoroughly tested for attenuation characteristics and durability.

Figure 83

Type II Noise Muff

Noise Muff Effectiveness. In general, two factors determine noise muff effectiveness: headband tension and fit. When headband tension decreases, through normal wear or periodic user adjustment, attenuation decreases. When muffs are ill fitting, their effectiveness is compromised.

How to Wear Noise Muffs. Initially, estimate the requirement for adjusting the headband to ensure a correct fit (Figure 84).

Figure 84

Noise Muff with an Adjustable Headband

In some models, the headband can be worn in several positions, including the back of the head, under the chin or over the top of the head (Figures 85 – 87).

Figure 85

Figure 86

Figure 87

Possible Headband Positions When Wearing the Type II Noise Muff

Potential Problems Using Noise Muffs. Eyeglasses with wide temples may prevent a good acoustical seal and be uncomfortable when worn in combination with noise muffs (Figure 88). Even small air leaks permit sound to enter the ear canal and reduce attenuation capability. Therefore, thin or narrow temples are usually preferable (Figure 89).

Figure 88

Possible air leak with wide eyeglass temples

Figure 89

Air leaks less likely with narrow temple frame

A product known as an eyeglass temple adaptor is commercially available (Figure 90). It slides over the temple (Figure 91) and provides a snug fit between the earcup seal of the noise muff and the side of the wearer's head. With or without these adaptors, earcup seals must fit snugly around the eyeglass temples. The best fit is more likely using soft, compliant earcup seals.

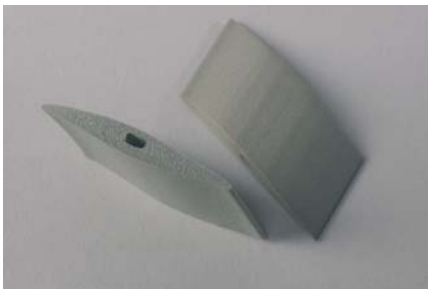


Figure 90

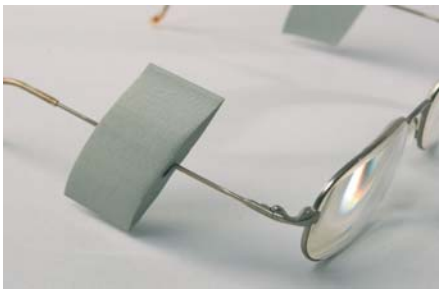


Figure 91

Eyeglass Temple Adaptors

As muffs are put on, glasses can shift and require readjustment, especially for those who use bifocal or trifocal lens. In other cases, glasses may shift slightly as the head moves.

In harsh climates, noise muff seals with liquid-filled cushions can be unbearably cold when first placed over the ears. This is true when the need for protectors is intermittent.

When otocups are too small or the headband too short because of an individual's head size (Figure 92), a different noise muff type must be fitted. On the other hand, earcups that are too large or a headband too long will also compromise an adequate fit (Figure 93). In both cases, comfort and protection are potentially sacrificed.

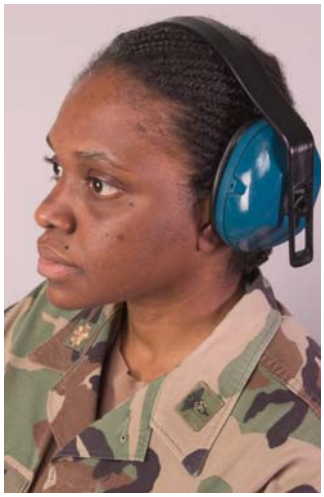


Figure 92

Figure 93

Poor fitting noise muffs due to improper headband length or sizing

Maintenance. After continuous use, soft and compliant earcup seals tend to harden due to the adverse effects of skin oil and perspiration (Figure 94). Seals can shrink and cause discomfort or leakage. Liquid-filled seals offer additional problems. The material used to contain the fluid must be thin and compliant, yet tough enough to resist tearing or piercing.

Figure 94

Hardened Noise Muff Seal

Noise muffs stocked in the Federal supply system come with an additional set of earcup seals. Replace them when they are torn, punctured, or hardened in order to maintain a comfortable fit and adequate noise attenuation.

Replace the acoustic filler once it starts to degrade (e.g., crumbles). If not maintained, serious deterioration may result, reducing the effectiveness of the noise muff (Figure 95). Never remove the lining of a noise muff unless a new replacement liner is added (Figure 96). Otherwise, this will markedly change the attenuation characteristics of the muff. When filler cannot be replaced, purchase new noise muffs. See Appendix C for replacement information.

It is important to store noise muffs in a clean, dry place away from ozone sources, that can deteriorate foam linings, and away from open, outdoor sites that can attract insects.

Figure 95

Degraded Acoustic Filler

Figure 96

Good Acoustic Liner

Earcup seals cannot be washed as conveniently as plugs. As a result, they are rarely cleaned or properly maintained, as recommended by the manufacturer. Warm, soapy water and a soft brush are necessary to remove the skin oil and dirt that harden a seal and impair its ability to fit adequately. When cleaned, ensure that the contents inside the cup do not get wet. Allow muffs to air-dry thoroughly so that remaining moisture evaporates. Noise muff headbands generally provide sufficient pressure to obtain good seals without wearer discomfort. However, they may require periodic adjustment or replacement.

Advantages of Noise Muffs

Noise muffs are convenient and practical for intermittent exposures. They can be easily put on or removed, even when wearing bulky gloves.

Most individuals receive some degree of noise reduction with them, irrespective of any prior instruction regarding their use.

Compared to earplugs, they provide less variance in attenuation (protective) levels.

Less time and expertise are required in the fitting process and one type of noise muff fits most adult heads.

Monitoring for compliance and proper use is easier for supervisors.

When worn in cold weather, their construction and fit can keep ears relatively warm.

They can be worn in the presence of minor ear infections.

Problems of impacted earwax and stimulation of the cough reflex are avoided.

Unlike earplugs, noise muffs are not as easily lost or misplaced.

Disadvantages of Noise Muffs

Noise muffs are bulky and difficult to carry around when not used.

They can interfere with work operations in close quarters.

They are incompatible with certain types of other required headgear.

They are unsatisfactory in hot, humid environments.

Noise muffs are more difficult to maintain and clean than earplugs.

Special muffs are required when worn with the Personnel Armor System for Ground Troops (PASGT) ballistic helmet (see Chapter 14).

Noise muffs are more expensive than earplugs, but no reason not to buy them. The purchase of noise muffs is a unit responsibility, whereas the AMEDD supplies preformed, reusable earplugs at no cost to the individual or their unit.

Inspection Requirements

The unit Hearing Conservation Officer (HCO), the Hearing Conservation Program Manager (HCPM), or an industrial hygienist, by regulation (DA PAM 40-501), must inspect the condition of all noise muffs, including earcup seals and foam lining, at least twice a year.

CHAPTER 11

EAR CANAL CAPS

Ear Canal Caps

General. This is one example of a currently approved type of ear canal cap (Figure 97).

Figure 97

Ear Canal Cap

Ear Canal Cap Effectiveness. Ear canal caps are recommended only for very short-term or intermittent exposures. Although not known for comfort, they can provide adequate hearing protection when hazardous noise levels are 95 dBA or less. In general, they are less effective in attenuating noise than most earplugs and noise muffs.

How to Wear Ear Canal Caps. This type of ear canal cap can be worn under the chin, behind the neck or over the head (Figures 98 – 100). Position the headband for a snug, comfortable fit with each single-flange cap completely blocking the ear canal opening.

Figure 98

Figure 99

Figure 100

Proper and Improper Fit of an Ear Canal Cap

In all cases, the tips or end caps should be placed at the opening of ear canal and pushed into the canal until a snug seal is obtained. A slight suction, especially when the caps are removed, indicates a proper fit (Figure 101). When the tips or end caps are not inserted parallel to the ear canal, an improper fit may occur (Figure 102).

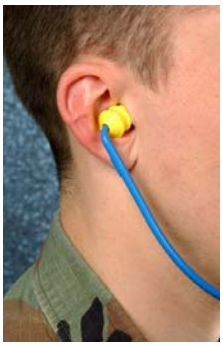


Figure 101

Figure 102

Proper Fit (Figure 101) vs. Improper Fit (Figure 102)

Maintenance. Never bend the headband, since the manufacturer presets the tension. Wash with hand-soap or a mild detergent. In models with an adjustable headband, lubricate the headband after cleaning with a few drops of mineral oil to ensure an easier fit.

CHAPTER 12

AVIATOR HELMETS

General

Aviator helmets protect the wearer against the impact of a crash, serious eye injuries and hearing loss, as well as provide radio communication capability. These helmets protect against high noise exposures by providing significant sound reduction. To achieve maximum ambient noise attenuation, the helmet's correct size, fit, and ongoing maintenance are critical.

In-flight noise in military aircraft is significant in both rotary (helicopters) and fixed wing (jets). This noise exposure may result in hearing loss or in other problems such as poor intercom intelligibility. The noise pattern varies with flight conditions and is predominantly low frequency in nature. Cockpit noise levels in military aircraft, particularly jets, are steadily increasing. Consequently, these higher noise levels require greater and more ingenious methods of noise reduction, if hearing damage risk is to be contained and speech and non-speech signal communications are to remain intelligible during front line operations.

Aviator Helmet Types

The HGU-56/P Aircrew Integrated Helmet System (AIHS). It is now the standard Army flight helmet (Figure 103) having replaced the SPH–4 & 4B Flyers Helmets (see below).

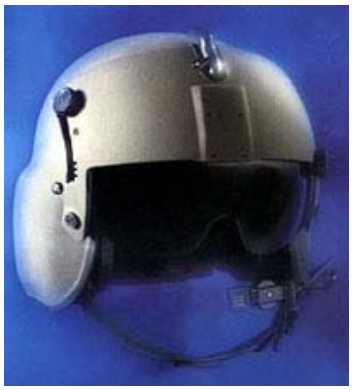


Figure 103

HGU-56/P AIHS

Components. The HGU-56/P components consist of: the basic helmet; liner; earcups; visors; chin and nape straps; boom microphone; and speakers. It comes in six head size configurations from extra, extra-small (XX-small) to extra large (X-large). Care must be exercised to ensure that proper head measurements are taken, due to the unique sizing requirements of this helmet.

The size "small" helmet shell can incorporate various liners to accommodate the three smallest head sizes. One possible add-on is the blast shield that helps to protect against muzzle blast when the aircraft's .50-caliber machine gun is fired (Figure 104).

Figure 104

HGU-56/P Helmet with Blast Shield and Night Vision Goggles

The helmet's chinstrap assembly consists of two earcup retaining pads, a chinstrap and a nape strap pad. Each earcup is attached to a retaining pad. Spacer pads can be installed behind each retaining pad to improve earcup fit.

Earseals provide both comfort and sound attenuation. The construction of the nape strap allows its pad and the earcups to be adjusted at the same time.

Advantages. The HGU-56/P provides improved protection over the SPH–4 and weighs much less. A new earcup design of an injected molded material provides greater energy absorption to protect against a lateral impact. The earcup offers improved sound attenuation to protect against hearing loss and to improve speech intelligibility by reducing ambient aircraft noise. The helmet shell is made from an advanced graphite composite for improved weight, tear and impact characteristics.[19]

How to Fit. A proper fit of the HGU 56/P ensures that the helmet is correctly adjusted for crash worthiness, hearing protection and comfort. The steps and techniques for properly fitting the HGU 56/P are specified in TM 1-8415-216-12P, "Operator's and Organizational Maintenance Manual**,** Including Repair Parts and Special Tool List, Helmet System, Aircrew Integrated," dated 13 Dec 96. The four primary subject areas covered include: helmet sizing, helmet fitting, earcup placement and earcup fit.

Adjust the crown straps to position the earcups. If necessary, adjust the cross-web straps to vary the earcup compression for maximum attenuation, retention and comfort. When cross-web straps are loose, hearing protection can be compromised. If a good acoustical seal cannot be obtained, use the earcup spacer pads to achieve greater pressure. Ensure that the cups comfortably enclose both ears, as proper earcup compression is important.

[19] Gentex® Corporation Information Pamphlet (2000). HGU-56/P AIHS.

Adjust the headband suspension to fit head size. If necessary, adjust the nape strap for ease of donning. Adjust the chinstrap. For best fit, protection, comfort and sound attenuation, ensure that the helmet fits snugly at the cheeks, forehead and nape of the neck.

Maintenance. Keep the helmet dry and clean. When parts are worn, frayed, separated or deteriorated, replace them. Inspect the earcups for cracks, breaks, damaged or loose fasteners, and any defective wiring harness. Appendix D lists earcup seal replacement data. Required checks include removing dirt and perspiration from the earcups by wiping them with a damp cloth. Ensure that excess moisture does not enter into the earcup space. For earseals, inspect for cuts, tears, and split seams. Check for earphone malfunction using the test set intercommunications unit.

Inspection Requirements. By regulation (DA PAM 40-501), all aviation helmets must be checked every six months by the unit HCO for serviceability of the earcup seals, chin straps, etc. The flight surgeon is responsible for monitoring helmet fit and use.

Precautions When Wearing the HGU 56/P. Hearing protection may be compromised by certain ancillary objects that are used in conjunction with the HGU-56/P helmet. Potential problems include the objects that can break the seal between the head and the circumaural hearing protection, thus reducing effective noise attenuation. Sources of this attenuation include: non-aviator eyeglass spectacles; the chemical-biological mask; hair length or style that can create a leakage path between the ear seal and the head; and the cold weather balaclava when worn over the head. In most of these situations, double hearing protection may be the solution.[20]

(2) **The SPH–4 Flyer Helmet.**

Components. Models SPH–4A (Figure 105) and –4B (Figure 106) consist of similar components found in the HGU-56/P. Each model comes in two sizes (regular and extra-large). Care must be taken to ensure that the proper size is worn.

How to Fit (see general information above).

Maintenance (see general information above).

Inspection Requirements (see general information above).

[20] Ostler, D., Ahroon, W. and Robinette, M. Effects of Ancillary Devices on Hearing Protection Provided by the HGU-56/P AIHS. Undated paper presentation.

Figure 105

Figure 106

The SPH–4 Series (4–A and 4–B) Flyers Helmets

How to Overcome Ambient Noise in the Cockpit.

Ambient aircraft noise poses problems for the rotary wing crew. The problems include: degradation of speech intelligibility, permanent hearing loss, and physical fatigue from extended exposure. Two methods of attenuating aircrew noise exposure include passive noise reduction (PNR) and active noise reduction (ANR). They differ in the kind and amount of noise they can reduce.

PNR

PNR provides a physical barrier around the ear to block out harmful background noise. This approach is most effective when noise is predominantly high frequency and is blocked by using large earcups filled with sound-absorbing material. The passive attenuation of an earcup is largely determined by the tightness of the seal against the head, the mass of the earcup and the volume of air inside it. Unfortunately, no matter how snug the seal or how substantial the barrier, low frequency noise will still find its way in.

ANR

ANR technology, on the other hand, does not rely on physical barriers to keep noise out. It provides noise reduction at low frequencies inside the headphone using an out-of-phase sound from the headphone's speaker that cancels much of the unwanted noise at the ear.

Helmets and headsets that have active noise reducing technology have a speaker inside each earcup, along with a tiny microphone and other electronic circuitry. The microphone detects what the user is hearing (i.e., low-frequency noise). This is compared to the signal the wearer wants to hear (e.g., speech over the intercom). The difference is the undesired noise to be cancelled. The electronic circuitry processes the signal to create an equal and opposite signal. The speaker then converts this signal to sound. Because the sound is exactly 180 degrees "out of phase," it cancels the noise. The process goes on continuously and rapidly, with the system reacting to whatever noise that gets into the earcup. The result is noise reduction at frequencies in an approximate range from 32 Hz to 500 Hertz.

Acoustical constraints make it difficult to achieve ANR at higher frequencies.[21] Because ANR is most effective in canceling low frequencies, the amount of noise cancellation is dependent upon the frequencies that comprise the noise.

The extent of noise cancellation also depends on the design of the user's acoustic cavity, the placement of the microphone within the earcup and the desired gain levels that the ANR technology can support. What is desired is the highest cancellation of noise at the ear, not at the microphone. Another variable is the power source that must be provided externally from either a battery pack or from within the aircraft or tank.

ANR is most helpful for aviators and the crew of armored vehicles. A key benefit of ANR is that be used to design devices that are more comfortable to wear because they don't just rely on a tight seal and weight to block noise. ANR can be a valuable tool in occupational hearing conservation, in part, because of new solutions to the comfort/attenuation tradeoff.

Advantages of ANR over PNR include: increased hearing protection and improved speech intelligibility.

Disadvantages of ANR include: added helmet weight, power required for operation, source of electromagnetic interference and higher cost.[22] ANR technology has not advanced to the point where impulse noise can be cancelled. Only PNR can protect from weapons fire.

Communications Earplug (CEP)

The CEP represents newer technology that provides increased hearing protection and a high quality speech signal for improved speech intelligibility to the aviator and other crew members (Figures 107 and 108). It is an alternate solution to the shortcomings of the ANR approach. The CEP was developed by the US Army Aeromedical Research Laboratory (USAARL) at Fort Rucker, AL to meet the significant noise threat of Army helicopters and greatly improve voice intelligibility.[23] The Army contracted with Gentex Corporation to integrate the CEP into the HGU-56/P helmet.

Components. It consists of two, lightweight elements: a miniature transducer with a threaded adapter encased in a hollow, plastic tube and a replaceable foam earplug that attaches to it. These elements provide a passive noise attenuating barrier between the user's ear and the noise source, as well as provide voice communications signals to each ear. The transducer connects directly into the communications system though a small, highly flexible coaxial wire. The foam earplug, when properly inserted into the ear canal, provides sound attenuation for the user. The speech signal from by the transducer is directly coupled into the occluded portion of the ear canal channel in the threaded adapter and foam earplug tip. The CEP unit is linked to the communications circuit of the helmet through a special connector.[24]

[21] Gauger, Dan. Should You Consider ANR for Hearing Protection? CAOHC Update, Volume 15, Issue 3, Fall 2003.
[22] Cep-usa Website. Undated.
[23, 24] Ibid.

Figure 107

Figure 108

The CEP Components: Detached and Attached to Aviator's Helmet

How to Fit. For best results with the CEP, the user needs to: "Screw the appropriate sized canal tip (standard, slim or short) onto the CEP transducer prior to inserting the tip into the ear canal (Figure 109). Then fit the right CEP into the right ear canal by slowly rolling the foam tip between the thumb and first two fingers of the right hand. Increase the pressure on the foam while continuing to roll the ear tip into a smaller cylinder. Do not squeeze the foam tip flat or compress it in a way to form a crease before inserting into the ear canal."[25] It is comfortable to wear for several hours and increases sound attenuation of the helmet.

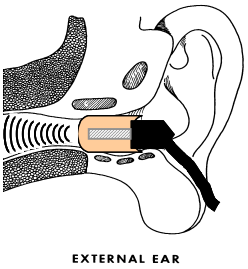


Figure 109

Proper Fit of the CEP in the Ear Canal

When ANR and CEP are compared, the latter has: a lower cost; less added weight; no aircraft modification costs; better compatibility. The CEP is an inexpensive device that can enhance air and ground crewmember voice communications in the operational environment.[26]

[25] Ahroon, W. and Ostler, D. Noise Attenuation of Candidate Hearing Protection Devices for the USMC Advanced Amphibious Assault Vehicle. USAARL Report No. 2002-xx, April 2002.
[26] Mozo, B. and Ribera J. The Communication Earplug: A logical choice for voice communications in aircraft. USAARL Report No. 98-09, January 1998.

CHAPTER 13

THE COMBAT VEHICLE CREWMAN (CVC) PROTECTIVE HELMET [MODEL DH-133A]

General

The Combat Vehicle Crewman (CVC) protective helmet, model DH-133A (Figure 110), is used in armored vehicles. It represents an upgrade to the DH-132 (Figure 111) and was designed to provide the wearer, when properly fitted, with a level of single hearing protection, a communications capability for crewmembers, as well as ballistic protection against head injury when riding in wheel and tract vehicles.

Figure 110 *Figure 111*

The Combat Vehicle Crewman (DH-133A and DH-132) Helmets

Major Components

The DH-133A CVC helmet consists of five major component parts: (1) a ballistics outer helmet shell; (2) an energy absorbing inner liner; (3) a thermoplastic liner (TPL); (4) a retention assembly (outer earcups); and (5) a microphone (communications) assembly.

(1) The rigid protective outer shell is partially made of a Kevlar ballistic protective fabric and comes in two sizes: medium and large (Figure 112).

(2) A separate, energy absorbing inner liner comes in three sizes: small, regular and large (Figure 113). Both the small and regular size inner liners can be used with the medium-sized outer shell. It consists of a three piece energy absorbing material that is bonded to the inside of the helmet shell with removable tabs placed over the retention assembly attachment points to allow retention adjustment without liner removal.

Figure 112

Kevlar Outer Shell (Interior View)

Figure 113

Mesh Liner System

(3) The TPL represents molded plastic layers and a cloth cover. The cover incorporates ventilated fabric for wear next to the head and sides make of pile fastener for attachment to hook fastener tabs on the energy absorbing liner.

(4) The retention assembly consists of a sewn, cotton/nylon fabric. It attaches to the helmet at four locations, with three holes at the end of each adjustment strap to allow individual adjustment. Adjustments provide for the raising/lowering and forward and aft positioning of the earcups.

(5) The communications assembly consists of a Headset-Microphone with a dynamic microphone with a frequency response of 300-3500 Hz.

Fitting the CVC Helmet

The fitting steps are outlined below. After the inner liner and the outer shell are combined:

(1) Select the proper size for the individual's use

(2) Adjust the crown straps to position the earcups.

(3) Adjust the nape strap to fit the head properly. If necessary, insure that the suspension is angled to accommodate goggles, gas mask, etc.

(4) Adjust the chinstrap securely. In order to obtain maximum sound attenuation (i.e., the best protection), the chinstrap must be fastened and properly tensioned.

Maintenance

For best performance, the helmet must fit properly (as above) and be reasonably maintained (e.g., kept dry and clean at all times; inspected frequently). Replace worn or frayed parts. This is especially critical for earcup seals that leak, become broken, deformed or otherwise damaged.

Inspection Requirements

All CVC helmets, by regulation (DA PAM 40-501), must be checked every six months to ensure appropriate maintenance and serviceability by the unit HCO.

Communication Enhancement and Protective System (CEPS)

Military personnel lack situational awareness when in the dismounted mode. When noise levels from riding in combat vehicles or weapons fire exceed the damage risk criteria, temporary (and even permanent) hearing loss can occur and compromise operational performance. Under these circumstances, soldiers are unable to localize various sounds, identify specific sound sources and face-to-face communications are compromised.

The CEPS was designed to systematically limit the level of sound received at the hearer's ear. Sound picked up by a microphone is processed through electronic circuitry and fed to the ear through a miniature earphone attached to a foam earplug. Signal volume is controlled by contact switches.[27] The CEPS has a triple purpose: it enhances communication for the dismounted infantry; enables localization of battle sounds; and protects the soldier's hearing from hazardous noise, whether steady-state or impulse. A soldier can hold a conversation and hear surrounding sounds while firing his weapon or communicating over the radio in noise.

Communication Using ANR and CEPS

ANR. The CVC helmet has an excellent ANR headset. The ANR circuitry modifies the sound field by canceling, through electro-acoustical means, background vehicle and weapon noise and allows "speaker recognizable" voice quality over the intercom.

CEPS. The configuration of the CEPS is shown below. The system includes a housing (Figure 114) containing a rocker type power on-off switch and an adjustable volume control (gain switches) powered by an AAA battery. The housing also has a connector for radio use. In addition, there is a hearing enhancement module. It contains the microphone and earphone that provide sound to one ear.

[27] Communication Enhancement and Protective System (CEPS) Brochure. Undated.

Figure 114

Figure 115

Communication Enhancement and Protective System (CEPS)

Both ear canal entrances are occluded by expanding foam ear tips that block substantial ambient sound from entering (Figure 115). All sound picked up by the microphone is processed through electronic circuitry. The noise reduction offered by the CEPS is equivalent to the protection afforded by other, properly fitted, foam earplugs. The amount of noise reduction will depend on how well the user inserts the Comply™ foam ear tips that come in three different sizes. The use of the shortest ear tip is discouraged because of the lower performance and less retention ability in the ear canal.

It is compatible with existing equipment and can be worn in three configurations: headband (Figure 116), recon (watch) (Figure 117) or helmet (Figure 118).

Figure 116
Headband Mode

Figure 117
Recon (Watch) Mode

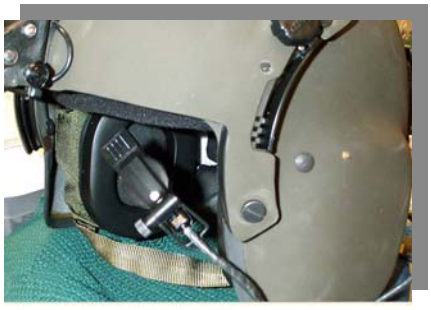


Figure 118
Helmet Mode

The user controls the input signal with the volume control. The gain setting is variable (from 0 to 35 dB). The maximum gain level is useful for detecting surrounding ambient activity. The mid-gain setting is appropriate for face-to-face communication. At high steady-state noise exposure levels, the lowest gain setting is appropriate with the output level safe for 95 dBA input. The impulse noise through-put limit is 128 dBP.

CHAPTER 14

The VEHICULAR INTERCOMMUNICATION SYSTEM (VIS)

General

The Vehicular Intercommunication System (VIS), also known as AN/VIC-3 (V), provides the commander and crewmembers of Army combat and combat service support vehicles with a clear and reliable digital intercom and radio access communication system, especially when ANR headsets are used. The VIS is deployed in a variety of vehicles (e.g., M109, M110, Self Propelled Artillery M113, Armored Personnel Carriers, M60, and M1A Tanks).

The ARL has been conducting research on ANR technology to improve communications in battlefield vehicles. As part of the VIS, ANR improves hearing protection and provides greater speech intelligibility in combat vehicles. VIS studies have shown that the overall noise reduction, using ANR, to be 30 decibels compared to 15 decibels for conventional passive helmets. This improvement increases the allowable exposure time in the Bradley Fighting Vehicle (BFV) from only 20 minutes per day to 13 hours per day. In addition, speech intelligibility scores of 89 percent are possible in the 115 dB BFV noise environment compared to 68 percent using conventional helmets. ANR also reduces voice levels at the ear to help prevent auditory damage.[28]

Major Component Headsets

The VIS works with various headsets, each of which provides a hands-off, two-way communications ability for the crewmember, plus hearing protection at high noise levels.

(1) CVC Helmet – Uses ANR
(2) Communication Aural Protective System (CAPS) Headsets
(3) Artillery Communication/Aural Protective System (ACAPS) Headsets

The CAPS and ACAPS headsets provide hearing protection from ambient noise. All six headset configurations fit under the PASGT ballistic helmet. All provide PNR (i.e., traditional noise protection), while three of the six also provide ANR (i.e., noise cancellation technology) and/or talk-through circuitry (TTC).

Component Parts of the CAPS/ACAPS Headsets

(a) Two circumaural earcups are attached to an adjustable band worn behind the neck.

(b) Each of the three ANR modules and their earphones are mounted in earcups and covered by replaceable foam dampers and damper covers that are retained by replaceable earcup seals. The neckband spring provides the pressure needed to maintain a seal between the headset and the head around the ear. It is cushioned by a soft neckband cover and adjusts to provide equal front and rear compression of the earcup seal, as well as a comfortable fit.

[28] Soldier's Magazine. VIS Helmet Reduces Noise. August 1998, p. 13.

(c) Two overhead straps with hook and pile connectors that loop over the PASGT helmet and hold the headset in place.

(d) Three of the six headset combinations have a switch attached to the right earcup seal (ANR/TTC, ANR only, or TTC only) that can activate either of the ANR modules or the TTC. The ANR and TTC features can be activated or deactivated by rotating the control switch back and forth from its center (or off) position.

Figure 119

RA108 Slimgard™ Headset

Figure 120

COM-TAC II Tactical Headset

The RA108 Slimgard™ headset (Figure 119) is compatible with the PASGT infantry helmet, and can incorporate optional electronic enhancements including ANR and a talk-through circuit.

Another example is the COM-TAC II headset (Figure 120) that is compatible with both the PASGT and the Modular Integrated Communications Helmets. It provides for continuous communication of two-way radios and the microphone provides a talk-thru listening capability, while suppressing harmful impact noises.

(e) A noise-canceling M-162 electret microphone is attached to a standard wire boom arm assembly on two of the PNR/ANR models. Two PNR headset models are equipped with an M-138 noise-canceling microphone mounted to the wire boom arm assembly. The other two models do not come with a microphone assembly.

(f) All three ACAPS headsets contain TTC. When activated, TTC allows the user to conduct normal conversations with others. It is battery powered and mounted on the neckband spring. One can transmit over both the radio and the intercom, as well as listen via both mediums.

Fitting the CAPS/ACAPS Headset with the PASGT Helmet

For optimum noise reduction, each headset must fit the head snugly around the ears to form a tight seal. In addition, the PASGT helmet must also be properly sized. Its five sizes range from extra-small through extra-large.

(a) Adjust the helmet's internal headband to fit snugly without causing discomfort.

(b) Allow sufficient room between the top of the ears and the headband for either a CAPS or ACAPS headset.

(c) When the helmet is adjusted too low on the head, the earcup seals will not align properly against the ears. A 1/2-inch clearance between the top of the head and the inside of the PASGT helmet is recommended.

(d) Adjust the chinstrap, if necessary, to allow the CAPS/ACAPS headset to sit evenly spaced around the ears.

(e) Although the PASGT helmet may initially appear to be correctly sized, variations in head shapes may require the next larger size when the CAPS/ACAPS headset is attached.

(f) The CAPS/ACAPS headsets can be put on/taken off without removing the helmet. The rear-mounted neckband is adjustable and provides the pressure to help keep the earcups snug.

(g) The spring neckband controls headset performance. Therefore, it is very important to adjust the neckband correctly.

(h) Put the headset on and adjust the neckband spring before donning the helmet. The head-set should be comfortable and parallel with the shoulders. The earcup seals should apply uniform pressure against the ears.

(i) With the helmet on, ensure sufficient clearance between the earcups and the inside of its shell. Check also for sufficient chinstrap length. Fasten the overhead straps and make adjustments as necessary.

Maintenance

Regularly inspect the headset and clean it with a damp cloth. Give special attention to the earcup seals, neckband cover, and neckband spring battery in the ACAPS. Keep moisture away from the earcups.

(4) CAC (Command and Control) Headset

The CAC headset provides communication in a command post environment. The headset consists of a single earcup attached to an adjustable overhead band. The overhead band provides a vertical adjustment for a secure fit and is covered by a soft headband cover. The earcup contains an earphone and a replaceable earcup seal. An M-138 noise-canceling microphone is attached to a standard wire boom arm assembly. The earcup can be worn on either side. In noise-hazardous situations, the uncovered ear requires its own hearing protection.

CHAPTER 15

TECHNIQUES FOR PROMOTING THE USE OF HEARING PROTECTIVE DEVICES

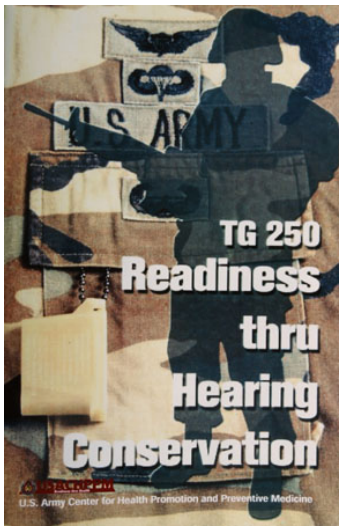
Inform Command and Supervisory Personnel

Educate command and supervisory personnel of the need to wear their personal hearing protective devices. When the leadership uses hearing protection, it raises interest and participation by subordinate personnel.

Provide Annual Health Education Programs

Maintain an ongoing, effective health education program. It is an annual requirement and the best way to change unhealthy behavior patterns! Promoting the use of protective equipment requires a long-term educational emphasis in order to be successful.

Use USACHPPM pamphlets [TG 250 – Readiness thru Hearing Conservation (Figure 121) and TG 175 – A Guide for Unit Commanders and Supervisors (Figure 122)] to help noise-exposed personnel and their superiors understand the need for wearing hearing protection.



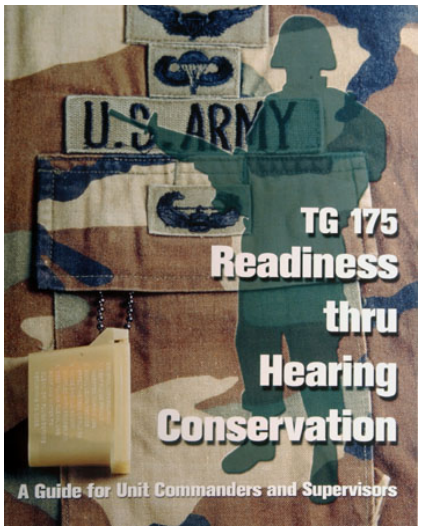


Figure 121 *Figure 122*

For Military & Civilian Personnel *For Unit Commanders & Supervisors*

Speak to groups of employees about the local HCP and encourage them to share their personal testimonials about the need to use HPDs. Many will be impressed with the need to wear hearing protection when peers relate their own experiences with hearing loss from noise. Some may report that, after using hearing protection, the ringing (tinnitus) in their ears has disappeared and/or they have less fatigue at the end of the workday.

Use media, such as The Hearing Video, to reinforce preventive medicine (PM) messages. Use the information that is readily available in the public sector or create your own materials that effectively address local issues.

Provide a Choice of Hearing Protective Devices to Fit and Issue

Offer a variety of insert-type, reusable hearing protective devices (e.g., triple- and quad-flange) and maintain an inventory of all available sizes. Avoid dictating the kind of earplug everyone must wear, unless you want unfavorable reactions.

Provide a trial period for the hearing protection fitted. Encourage your personnel to provide feedback to the installation HCPM or to their unit HCO, commander or supervisor regarding their experiences (both favorable and unfavorable) with hearing protection.

Educate Noise-Exposed Employees about Their Hearing Ability

The individual's own audiogram can be a convincing document that underscores the need for preserving residual hearing and for wearing properly fitting protective equipment faithfully when noise-exposed. Detecting a significant shift in hearing ability at several frequencies can be very informative and convicting, when reference (baseline) and periodic (e.g., annual) audiogram data are compared (Figure 123).

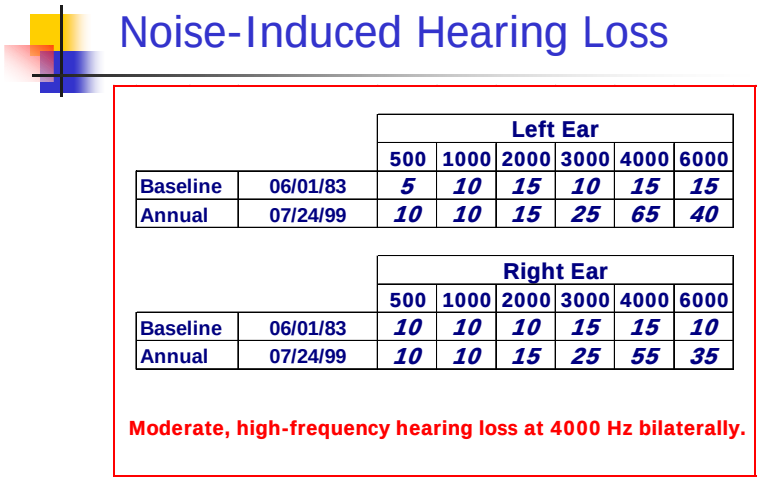


Figure 123

Sample Serial Audiograms for Comparative Purposes

In addition, military personnel must understand the critical, adverse impact of high frequency hearing loss on job-related tasks, like enemy detection (Figure 124).

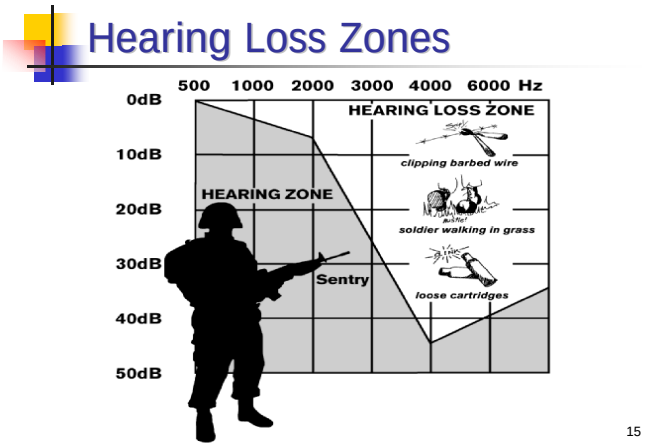


Figure 124

Hearing Loss and its Adverse Impact on the Job

Because hearing loss is not always evident to others or even readily detectable at first to those who have been noise-exposed from steady-state or impulse stimuli, the message that hearing loss can be the silent injury needs to be told, perhaps through posters (Figure 125).

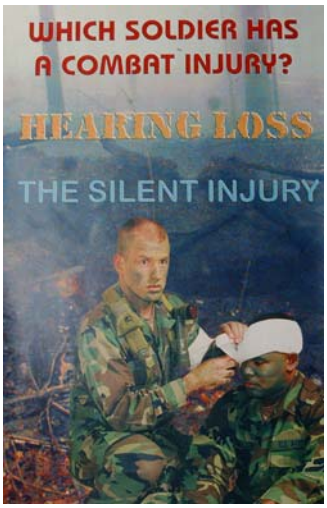


Figure 125

Hearing Loss can be a Combat Injury!

Other Options

Provide personal demonstrations of hearing protection effectiveness. Options include:

* Place someone in front of a steady-state noise source and suddenly remove his or her hearing protection, briefly.

* Demonstrate that successful communication in hazardous noise is not only possible, but actually enhanced, when wearing hearing protection.

* Use a hand-held clicker (impulse type noise source) to demonstrate the ability to detect sound with hearing protection in place and the added comfort of the attenuated noise. This is particularly effective when using combat arms earplugs.

Require that everyone in a NHA use hearing protection, to include supervisory personnel! As a last resort, refer habitual offenders for disciplinary action. For civilian offenders, refer to AR 690-700: Personnel Relations and Services (General), Change 5, Chapter 751, Discipline, Table 1-1, Offense 14b.

You can download the posters in this TG (Appendix A) from the USACHPPM HCP web page (http://chppm-www.apgea.army.mil/dcpm/hcp/hcp.htm) that review the fitting, care and use of various hearing protectors. You can also access this entire TG from the USACHPPM web site (http://chppm-www.apgea.army.mil/documents/TG/TECHGUID/TG041.pdf).

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TERMINOLOGY

Acronym	Title
A	Scale on Sound Level Meter
ACAPS	Artillery Communications/Aural Protective System
AIHS	Aircrew Integrated Helmet System
AMEDD	Army Medical Department
ANR	Active Noise Reduction
ANSI	American National Standards Institute
APG	Aberdeen Proving Ground
ARL	Army Research Laboratory
BDU	Battle Dress Uniform
BFV	Bradley Fighting Vehicle
C	Scale on Sound Level Meter
CAC	Command and Control (Headset)
CAOHC	Council for Accreditation in Occupational Hearing Conservation
CAPS	Communication Aural Protective System
CEP	Communications Earplug
CEPS	Communication Enhancement and Protective System
CVC	Combat Vehicle Crewman (Helmet)
DA	Department of Army
DA PAM	Department of Army Pamphlet
dB	Decibel
dBA	Decibel Level Using the A Scale
dBP	Decibel Level at Peak Pressure
DoD	Department of Defense
DSCP	Defense Supply Center – Philadelphia
EPA	Environmental Protection Agency
FAR	Federal Acquisition Regulation
FSC	Federal Supply Channel
GSA	General Services Administration
HCO	Hearing Conservation Officer
HCP	Hearing Conservation Program
HCPM	Hearing Conservation Program Manager
HCWG	Hearing Conservation Working Group
HPD	Hearing Protective Device(s)
Hz	Hertz
IAW	In Accordance With
JWOD	Javitz-Wagner-O'Day Act
LBE	Load Bearing Equipment
NHA	Noise-Hazardous Area(s)
NRR	Noise Reduction Rating
NSN	National Stock Number
OSHA	Occupational Safety and Health Administration
P	Peak Pressure on Sound Level Meter

PAGST	Personnel Armor System for Ground Troops
PAM	Pamphlet
PM	Preventive Medicine
PNR	Passive Noise Reduction
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
REAT	Real-ear Attenuation at Threshold
S	Standard
SLM	Sound Level Meter
SPL	Sound Pressure Level
TG	Technical Guide
TM	Technical Manual; also Tympanic Membrane
TPL	Thermoplastic Liner
TSG	The Surgeon General
TTC	Talk-Through Circuitry
TWA	Time-Weighted Average
USAARL	United States Army Aviation Research Laboratory
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
VIS	Vehicular Intercommunication System

Appendix A

Hearing Protective Devices Posters

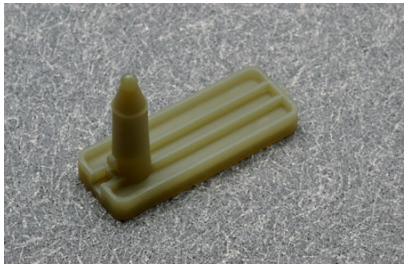
For Maximum Protection and Comfort, Insert Foam (Handformed) Earplugs as Follows:

1. Insure that hands and plugs are clean before using.
2. Roll, rather than squeeze, each plug into as small a cylinder or golf tee shape as possible (see diagram).
3. Insert quickly into the ear canal.
4. Hold gently in place with your fingertip for one minute until expansion is complete.
5. Keep plugs clean by washing in mild soap and rinsing thoroughly in water. Discard if discoloration or disfiguration occurs after cleaning.
6. Do not use where hazardous chemical vapors could be absorbed into the plug.
7. Do not cut these plugs in half, because there will be insufficient foam mass for effective noise reduction.

DA Poster 40-501B, Mar 2006

For Maximum Protection and Comfort, Insert Single-Flange Earplugs as Follows:

1. Use the seating device (top part of carrying case) and insert the pointed, plastic tip into the device's open-ended stem.
2. Place the single-flange plug over the tip and insert into the ear canal, with the tab down.
3. Twist the plug 90 degrees toward the back of the ear until a good seal is achieved.
4. When a good seal is not obtained, try a different size. Single-flange plugs come in five sizes, but are currently not being manufactured.
5. Without the seating device, make the ear canal accessible by reaching over the head with the opposite hand and pulling the ear up and out.
6. Grasp the plug by its tab and insert into the ear canal with the tab down. Twist the plug 90 degrees to the rear of the head until a seal is achieved by the flange.



DA Poster 40-501C, Mar 2006

For Maximum Protection and Comfort, Insert Triple-Flange Earplugs as Follows:

1. Using the seating device (lid of the carrying case), place the stem of the triple-flange earplug into the device's open end space.

2. Push and wiggle the plug into the ear canal until a seal is achieved.
3. The plug is properly fitted when the two flanges are in the canal and the third (last) flange is completely blocking the canal entrance.

4. When a good seal is not obtained, try a different size. Triple-flange plugs are available in three sizes: large, regular and small.
5. Without the seating device, make the ear canal accessible by reaching over your head with the opposite hand and pulling the ear up and out.
6. Grasp the plug by its stem and insert into the ear canal. Push and twist the plug toward the rear-center of your head until a seal is achieved by the third (last) flange.

DA Poster 40-501D, Mar 2006

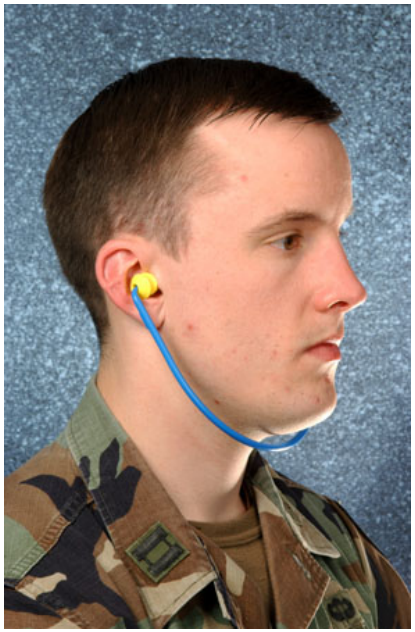
Noise Muffs: General Information

1. Adjust the headband and strap to insure earcup seals are in complete contact with the head.
2. Earcup seals must fit well around the temples of eyeglasses, when worn.
3. The type II noise muff can be worn over the head, behind the head or under the chin.
4. When noise muffs are properly worn, your own voice should sound muffled to you, as if talking inside a barrel.
5. Do not bend, alter or modify any part of the headband, otocups (including the lining and the seal).
6. Replace earcup seals that become hardened, damaged or otherwise unserviceable.
7. Even a small air leak eliminates the protection provided by noise muffs.

DA Poster 40-501F, Mar 2006

Ear Canal Caps: General Information

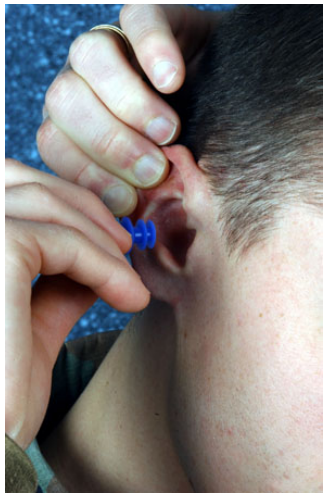
1. Ear canal caps can be worn over the head, behind the head or under the chin.
2. Adjust the headband, where possible, to your approximate head size.
3. Place the headband in the desired position and readjust it, if necessary, for a snug comfortable fit. Each cap must block the ear canal opening completely.
4. Push the canal caps against the canal opening until sealed. A slight suction, when caps are removed, indicates a proper fit.
5. Do not bend the headband, since the tension is preset by the manufacturer. Wash with hand soap or a mild detergent.
6. **Suitable for wear only in steady-state noise levels below 95 dBA.**



DA Poster 40-501G, Mar 2006

Earplugs: General Information

1. Use the earplug seating device or make the ear canal accessible by reaching over your head with the opposite hand and pulling the ear up and out.
2. A proper seal should be accompanied by a vacuum sensation. Your voice should sound muffled, as if talking inside a barrel.
3. Plugs tend to work loose as a result of talking and chewing, and must be reseated.
4. Little difficulty understanding speech should be experienced when plugs are being used, if the voice of others is raised slightly above the level of ordinary conversation.
5. Even a small air leak defeats the purpose of wearing plugs.
6. Keep plugs clean with soap and water. Return them dry to their case and store until needed.
7. Earplugs are for your personal use only.



DA Poster 40-501H, Mar 2006

For Maximum Protection and Comfort, Insert Quad-Flange Earplugs as Follows:

1. Grasp the plug by its stem and insert into the ear canal. Push and twist the plug toward the rear-center of your head until a seal is achieved.
2. The plug is best fitted when the three flanges are well inside the canal and the fourth flange (last) is blocking the canal entrance. However, smaller canals can still benefit with less flanges inserted in the canal when there is a good seal.
3. When a good seal is not obtained, try a different size or type of earplug. Quad-flange earplugs vary by manufacturer as to size availability.

DA Poster 40-501N, Mar 2006

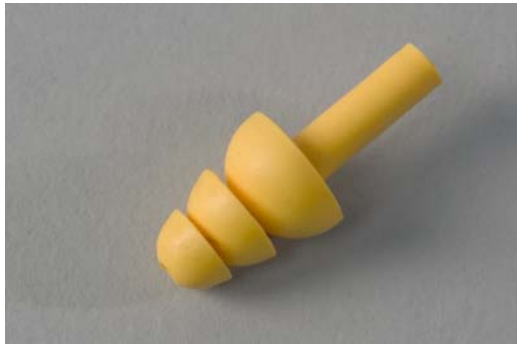
For Maximum Protection and Comfort, Insert the Combat Arms Earplug (Double-Ended) as Follows:

1. A one-size-only earplug with a doubletree design.
2. When the solid (olive-colored) tip of the plug is properly inserted into the ear canal, it protects against steady-state noise (e.g., helicopters or armored personnel carriers).
3. When the open (yellow-colored) tip of the plug is properly inserted into the ear canal, it protects against impulse noise (e.g., weapons fire).
4. In this latter configuration, the hearing protector allows speech communication and detection, as well as localization of acoustic sources.

DA Poster 40-501O, Mar 2006

For Maximum Protection and Comfort, Insert the Combat Arms Earplug (Single-Ended) as Follows:

1. A one-size-only earplug with a triple-flange design. The plug is best fitted when the first two flanges are in the canal and the third flange (last) is completely blocking the canal entrance. However, those with smaller ear canals can still benefit with less flanges inserted in the canal when a good seal is achieved.



2. When the open (yellow-colored) tip of the plug is properly inserted into the ear canal, it protects against impulse noise (e.g., weapons fire).

3. In this configuration, the hearing protector allows speech communication and detection, as well as localization of acoustic sources.

4. **This earplug provides inadequate protection for most steady-state noise conditions!**

DA Poster 40-501P, Mar 2006

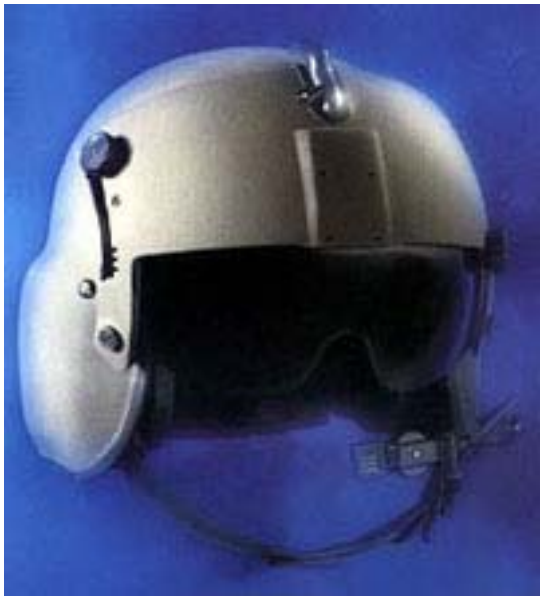
For Maximum Protection and Comfort, Insert Pod Foam Earplugs as Follows:

1. Insure that hands are clean before using.
2. Roll the foam tip down before insertion.
3. Insert quickly into the ear canal.
4. Insure that the rear edge of the foam tip is well inside the canal entrance.
5. **This plug is effective in steady-state noise under 95 dBA and for small arms fire only.**
6. Available in both corded and uncorded versions.

DA Poster 40-501Q, Mar 2006

Aviator Helmet: General Information

1. Aviator helmets include the HGU 56/P (below), SPH-4 and SPH-4B.
2. Adjust the crown straps to position the earcups. If necessary, adjust the cross-web straps to vary earcup compression for maximum attenuation, retention and comfort.
3. Adjust the headband suspension to fit head size.
4. If necessary, adjust the nape strap for ease of donning.
5. Adjust the chinstrap.
6. Keep the helmet dry and clean. Inspect frequently and, when parts are worn or frayed, replace them immediately.



CVC Tanker Helmet: General Information

1. The combat vehicle crewman (CVC), model DH-133A or DH-132, tanker helmet comes in three sizes: small, regular and large.
2. Adjust the crown straps to position the earcups.
3. Adjust the nape strap to fit head size. If necessary, insure that the suspension is angled to accommodate goggles, gas mask, etc.
4. Adjust the chinstrap securely.
5. Always keep the helmet shell and liner dry and clean. Inspect frequently and replace worn or frayed parts immediately.

Appendix B

Ordering Earplugs

APPENDIX B
Ordering Earplugs/Earplug Carrying Case

Type	Size/Color	NSN/Other	Price	Quantity	Possible Source	Price	Possible Source
(1) **Preformed Earplugs (Reusable)**		**Current as of 2/01/06**					
Triple-Flange	Small/Green	6515-00-442-4821	$3.88	24 Pkg	Defense Logistics Agency	Online	North Safety Products
	Regular/Orange	6515-00-442-4818	$3.88	24 Pkg	Directorate of Medical Materiel		www.northsafety.com
	Large/Blue	6515-00-467-0092	$3.94	24 Pkg	700 Robbins Avenue		(All purchases through state
					Philadelphia, PA 19111		or local distributors only - call)
						Call	Bacou-Dalloz Safety
							7828 Waterville Road
							San Diego, CA 92154
							(610) 371-4511
Quad-Flange	Uncorded/Blue	6515-01-492-0443	$51.00*	100 Box	Elvex Corporation	Call	Defense Logistics Agency
(One Size Only)		Elvex EP-401			PO Box 850		Directorate of Medical Materiel
	*$35.70/box when ordering 20 boxes or more				Bethel, CT 06801-2858		700 Robbins Avenue
	Corded/Blue	6515-01-492-0458	$73.00*	100 Box	(800) 888-6582	Call	Philadelphia, PA 19111
		Elvex EP-411					
	*$51.10/box when ordering 20 boxes or more						
Combat Arms	Double-Ended/Olive&Yellow	6515-01-466-2710	$7.00	Per Pair	Brock Sales Company	Call**	Defense Logistics Agency
		Aearo # 370-1000	(Pack of 50 Pair)		1155 Providence Road, Ste C		Directorate of Medical Materiel
					Brandon, FL 33511		700 Robbins Avenue
					(813) 662-2251		Philadelphia, PA 19111
					(866-604-7233/Toll Free)		
Combat Arms	Single-Ended/Yellow	6515-01-512-6072	$4.10	Per Pair	Brock Sales Company	Call**	Defense Logistics Agency
		Aearo # 370-1010	(Pack of 100 Pair)		(see address above)		(see address above)
							**Direct vendor items; price is
							subject to market demand.
(2) **Earplug Carrying Case**							
Carrying Case	Olive Drab, Translucent	6515-01-100-1674	$6.83	20 Pkg	Defense Logistics Agency		
					Directorate of Medical Materiel		
					700 Robbins Avenue		
					Philadelphia, PA 19111		

APPENDIX B
Ordering Earplugs/Earplug Carrying Case

Type	Size/Color	NSN/Other	Price	Quantity	Possible Source	Price	Possible Source
(3) **Handformed (Disposable)**							
Foam	Medium (Green&Orange)	6515-00-137-6345	$22.43	200 Pair	Defense Logistics Agency	$25.28	New Dynamics Corporation
(Sound Guard)	(two color)			(per/box)	Directorate of Medical Materiel		15 Fini Drive
					700 Robbins Avenue		Middletown, NY 10941
					Philadelphia, PA 19111		(845) 692-0022, ext 304
Procurement of Medium Size Foam Earplugs from DLA or New Dynamics Corp Only (Javits, Wagner, O'Day Act)!							
Foam	Small (Yellow/Orange Ring)		$22.40	200 Pair	Brock Sales Company	Online	GSA Contract #GS-07F-9123D
(E-A-R)	Classic SuperFit 30	Aearo # 310-1009			1155 Providence Road, Ste C		www.GSAAdvantage.gov
					Brandon, FL 33511		
					(813) 662-2251		
Foam	Large (Yellow/Orange Ring)		$24.00	200 Pair	Brock Sales Company	Online	GSA Contract #GS-07F-9123D
(E-A-R)	Classic SuperFit 33	Aearo # 310-1008			1155 Providence Road, Ste C		www.GSAAdvantage.gov
					Brandon, FL 33511		
					(813) 662-2251		
Pod Foam	Uncorded (5 Color Stems)	6515-01-430-6980	$40.00	100 Pair	Brock Sales Company	Online	GSA
(E-A-R)		Aearo # 321-2100			1155 Providence Road, Ste C		www.GSAAdvantage.gov
					Brandon, FL 33511		Defense Logistics Agency
					(813) 662-2251		(see address above)
Pod Foam	Corded (5 Color Stems)	6515-01-430-6975	$89.00	100 Pair	Brock Sales Company	Online	GSA
(E-A-R)		Aearo # 311-1127			1155 Providence Road, Ste C		www.GSAAdvantage.gov
					Brandon, FL 33511		
					(813) 662-2251		

APPENDIX B
Ordering Earplugs/Earplug Carrying Case

Type	Size/Color	NSN/Other	Price	Quantity	Possible Source	Price	Possible Source
(4) **Musician's Earplugs (Custom-molded)**							
Earmold impressions must be made by an audiologist or experienced ear-noise-throat technician.							
Order from a commercial vendor and always request a government-discounted price.							
Hi-Fi Earplugs	One Size Fits Most	6515-01-149-4133	Call	10 Box	Aearo Company	$87.96	Defense Logistics Agency
					E-A-R Auditory Systems		(see address above)
					5457 West 79th Street		
					Indianapolis, IN 46268		
					(800) 678-4163 (ext 1-42944)		
					(800) 225-9038		
Musician	Custom-molded	N/A	Call	Per Pair	Westone Laboratories, Inc.	Call	Precision Earmold Labs
					2235 Executive Circle		830 Sunshine Lane
					Colorado Springs, CO 80906		Altamonte Springs, FL 32714
					(800) 525-5071		(800) 327-4792
Musician	Custom-molded	N/A	Call	Per Pair	Earmold Design, Inc.	Call	Emtech Laboratories, Inc.
					3424 East Lake Street		PO Box 12900
					Minneapolis, MN 55406		Roanoke, VA 24022-2900
					(800)334-6466		(800) 336-5719
Musician	Custom-molded	N/A	Call	Per Pair	All-American Mold Lab, Inc.	Call	Starkey Labs, Inc.
					226 SW 6th Street		(800) 328-8602
					Oklahoma City, OK 73109		
					(405) 232-8144		
(5) **Ear Canal Caps**							
Ear Canal Cap	Universal Size, Type II	6515-00-392-0726	$7.81	Per Unit	Defense Logistics Agency	Call	Bacou-Dalloz Safety
	Adjustable Metal Headband	Willson Sound Ban			(see address above)		7828 Waterville Road
	with Insulation						San Diego, CA 92154
							(610) 371-4511
Ear Canal Cap	Universal Size	6515-01-149-4133	$4.97	Per Unit	Brock Sales Company		
	Caboflex® 600	Aearo #320-2001	$49.70	10/Box	1155 Providence Road, Ste C		
					Brandon, FL 33511		
					(813) 662-2251		

Appendix C

Ordering Noise Muffs

APPENDIX C
Ordering Noise Muffs

Type	Size/Color	NSN/Other	Price	Quantity	Possible Source
(1) **Noise Muffs**		**Current as of 2/01/06**			
Noise Muff	Aural Protector (Type II)	4240-00-022-2946	$5.36	Per Unit	Defense Logistics Agency
					Directorate of Medical Materiel
					700 Robbins Avenue
					Philadelphia, PA 19111
	Aural Protector (Type II)	Model H6A/V	$7.43	Per Unit	Brock Sales Company
					1155 Providence Road, Suite C
					Brandon, FL 33511
					(813) 662-2251
	Aural Protector (Type II)	Model H7A	$13.50	Per Unit	Brock Sales Company
	Aural Protector (Type II)	Model H10A	$16.35	Per Unit	Brock Sales Company
	Aural Protector (Type II)	Model 1000	$9.57	Per Unit	Brock Sales Company
		Aearo #330-3001			
Noise Muff	Aural Protector (Type I)	5965-00-168-9624	$123.58	Per Unit	Astrocom Electronics, Inc.
	Full Cushion Intercom Headset				115 D.K. Lifgren Drive/PO Box 370
					Oneonta, NY 13820
					(607) 432-1930
Noise Muff	Aural Protector (Type I)	5965-00-226-7870	$112.85	Per Unit	David Clark Company, Inc.
	Full Cushion Intercom Headset				360 Franklin Street, Box 15054
					Worchester, MA 01604--0054
					(800) 900-3434
(2) **Earcup Seals**					
Earcup Seals	Hygiene Kit for Model H6A/V	HY6/V	$6.57	Per Unit	Brock Sales Company
Earcup Seals	Hygiene Kit for Model H7A	HY7	$6.57	Per Unit	Brock Sales Company
Earcup Seals	Hygiene Kit for Model H10A	HY10	$6.85	Per Unit	Brock Sales Company
Noise Muff Cushions	Ear Cushions for Model 1000	Aearo #331-3010	$20.88	6 / Pkg	Brock Sales Company

APPENDIX C
Ordering Noise Muffs

Type	Size/Color	NSN/Other	Price	Quantity	Possible Source
(3) **Eyeglass Temple Adapters**					
Temple Adapter	Stop Gap Eyeglass Temple	Part 12500G-02	$5.00	Pair	David Clark Company, Inc.
	Cushions				360 Franklin Street, Box 15054
					Worchester, MA 01615-0054
					(800) 900-3434

Appendix D

Ordering Helmets/Headsets

APPENDIX D

Helmets/Headsets

Type	Size/Color	NSN/Other	Price	Quantity	Possible Source	Possible Source
(1) **Aviator Helmets**		**Current as of 2/01/06**				
HGU-56/P	Helmet Flyers, Crash Type					
	Extra, Extra-Small	8415-01-394-8032	$863.05	Per Unit	Defense Logistics Agency	
	Extra, Small	8415-01-394-8033	$863.05	Per Unit	700 Robbins Avenue	
	Small	8415-01-394-8036	$863.05	Per Unit	Philadelphia, PA 19111-5092	
	Medium	8415-01-394-8034	$863.05	Per Unit		
	Large	8415-01-394-8035	$863.05	Per Unit		
	Extra-Large	8415-01-394-6474	$863.05	Per Unit		
SPH-4B	Helmet Flyers, Crash Type					
	Regular	8415-01-308-5359	$582.05	Per Unit	Defense Logistics Agency	Gentex Corporation
	Extra-Large	8415-01-308-5360	$582.05	Per Unit		Eighth Avenue (PO Box 315
						Carbondale, PA 18407
						(717) 282-8504
(2) **Combat Vehicle Crewman's (CVC) Helmet**						
DH-132	Medium/Small Liner	8415-00-094-2679	$352.80	Per Unit	Defense Logistics Agency	USA Natick Research Center
	Medium/Medium Liner	8415-00-094-2691	$352.80	Per Unit		Attn: STRNC EMSS
	Large/Large Liner	8415-00-094-2684	$352.80	Per Unit		15 Kansas Street
						Natick, MA 01760
						(508) 233-4001
(3) **CVC Headsets**						
Helmet Liners for the Vehicular Intercommunication System (VIS) with Active Noise Reduction (ANR)						
Headset	Small/Medium	5965-01-453-2687	$1,208.00	Per Unit	Defense Logistics Agency	
	Large	5965-01-453-2684	$1,286.00	Per Unit		
(4) **Communications Earplug (CEP)**						
CEP Kit	CEP, Helmet Interface, Eartips	5965-01-474-5654	$109.01	Per Unit	Communications & Ear Protection	
					PO Box 311174	
					3700 Salem Road	
					Enterprise, AL 36331-1174	
					(877) 393-2377 or www.cep-usa.com	

APPENDIX D
Helmets/Headsets

Type	Size/Color	NSN/Other	Price	Quantity	Possible Source	Possible Source
(5) **Earcup Seals and Cushions**						
Ear Pad Seal	HGU-56/P Aviator Helmet	8415-01-074-1622	$5.25	Per Unit	Defense Logistics Agency	Gentex Corporation
						11525 6th Street
						Rancho Cucamonga, CA 91730
						(909) 481-7667
Ear Pad Kit	SPH-4B Aviator Helmet	8415-00-143-8577	Unknown	Per Unit	Defense Logistics Agency	
Ear Cushion	DS-132 CVC Helmet	5965-00-135-0505	$0.84	Per Unit	Defense Logistics Agency	HS Associates Corporation
	DS-132 CVC Helmet	5965-01-418-5535	$39.31	Per Unit		378 Fairhaven Road
	(AN/VIC-3 Intercom System)					Woodbury, NY 11797-1628
						(516) 496-2940
(6) **Headsets**						
Headset Mic	Noise Attenuating	5965-00-168-9624	$123.58	Per Unit	Defense Logistics Agency	Astrocom Electronics, Inc.
	Full Cushion Intercom Headset					115 D.K. Lifgren Drive
						PO Box 370
						Oneonta, NY 13820
						(607) 432-1930
Headset Mic	Noise Attenuating	5965-00-226-7870	$112.85	Per Unit	Defense Logistics Agency	David Clark Company, Inc.
	Full Cushion Intercom Headset					360 Franklin Street,
						PO Box 15054
						Worchester, MA 01640-0054
						(800) 900-3434
CAPS	Passive Noise Reduction	5965-01-388-4139	$683.00	Per Unit	Defense Logistics Agency	Northrop Grumman Corp.
CAPS w/o Mic	Active Noise Reduction	5965-01-385-7811	$1,925.00	Per Unit		South Oyster Bay Road
CAPS w/ Mic	Passive Noise Reduction	5965-01-388-4155	$971.00	Per Unit		Bethpage, NY 11714-3582
ACAPS, Type A	Passive Noise Reduction	5965-01-388-4136	$611.00	Per Unit		(516) 346-7086
ACAPS, Type B	Passive Noise Reduction	5965-01-388-4181	$674.00	Per Unit		
Headset	Commercial Grade	5965-01-387-1950	$685.00	Per Unit		

APPENDIX D
Helmets/Headsets

Type	Size/Color	NSN/Other	Price	Quantity	Possible Source	Possible Source
(7) **Eyeglass Temple Adapters**						
Temple Adapter	Stop Gap Eyeglass Temple	Part 12500G-02	$5.00	Pair	David Clark Company, Inc.	
	Cushions				360 Franklin Street, Box 15054	
					Worchester, MA 01615-0054	
					(800) 900-3434	