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HEARING PROTECTION OF EARMUFFS WORN OVER EYEGLASSES

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The hearing protection ordinarily provided by earmuffs is reduced when worn by persons who also wear eyeglasses because sound enters the device throught air leaks around the eyeglass temple - earmuff cushion interface. This study examined the acoustic fit of different earmuff protectors and various types of eyeglass frames found in a population, measured the loss of attenuation due to programmed air leaks and measured differences in earmuff protection for subjec subjects while wearing and not wearing eyeglasses. Results demonstrated that

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) earmuffs worn over eyeglasses lose from 1 dB to 10 dB of attenuation at individual frequencies. The amount of loss is related to type of earmuff, type of eyeglasses as well as frequency of the sound. Two remedial approaches were identified as (1) authorizing for use by eyeglass wearers only earmuffs that demonstrate by test satisfactory sound protection with eyeglasses and (2) the use of an insert or pad at the eyeglass temple - earmuff cushion interface to minimize and eliminate the acoustic leak.

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FOR THE COMMANDER

HENNING E. VON GIERKE
Director
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SUMMARY

Laboratory evidence, both of a physical and psychophysical nature, substantiates informal subjective reports from operational situations that attenuation of earmuffs is reduced when worn over eyeglasses. This reduction ranges from about 1 dB to 10 dB at individual frequencies and is shown to be associated with air leaks created when the eyeglass frame keeps the earcup seal away from the side of the head. The amount and the patterns of the losses vary from earmuff to earmuff and with type of eyeglass temple. The greater the distance of the earcups away from the head, the greater is the air leak and subsequent attenuation loss. Within limits, the size of the air leak corresponds to the amount of attenuation loss with larger leaks showing larger losses. Attenuation losses were greater at the low and high frequencies than at the middle frequencies.

Well-trained subjects demonstrated via psychophysical methods that the standard AF issue zylonite eyeglass frame does contribute to losses of attenuation when worn with standard AF circumaural ear protectors. The amount of the loss varies with the particular earmuff worn and to some extent with the type of eyeglass bow, as well as with variations in the configuration of the wearer's head. In addition, the nominal amount of loss for an earmuff-eyeglass combination at each of the individual test frequencies can be specified, on the average. The incidence of eyeglass users in the population is relatively high and of sufficient proportion that the loss of sound attenuation is considered an operational problem. The critical issue is whether eyeglass wearers experience more noise induced hearing loss (with earmuffs) than non-wearers as a result of the reduced protection. An investigation of hearing levels of AF

personnel who wear the earmuff-eyeglass combination vs those who do not wear eyeglasses but work in the same noise environs should be conducted. AF Forms 1490, Hearing Conservation Data and 1491, Reference Audiogram already contain information regarding the use of earmuffs as well as eyeglasses (including safety glasses). Therefore, these data should be available for investigation from the USAF Hearing Conservation Data Registry, Brooks AFB, Texas.

In view of the eyeglasses-earmuff hearing protection problem discussed herein, some remedial action seems desirable. Of the various alternatives dicussed, two appear to be most workable: (1) evaluation of earmuff performance with eyeglasses would be routinely accomplished when earmuffs are initially evaluated for potential AF use. Those items showing little attenuation loss with eyeglasses would be identified for use by eyeglass wearers while those showing significant loss would not be approved for eyeglass wearers. (2) Another approach would be to provide removable inserts or pads to be used at the temples of all earmuff-eyeglass wearers to effectively minimize or eliminate the leakage-protection problem. A short-term applied research effort could identify suitable materials and configurations, their relative efficiency in terms of increased protection and provide guidance for implementation by earmuff-eyeglass wearers.

PREFACE

This study was accomplished by the Bioacoustics Branch, Biodynamics and Bionics Division of the Aerospace Medical Research Laboratory, Wright Patterson Air Force Base, Ohio. The research was conducted by Charles W. Nixon, Ph.D. and SSgt William C. Knoblach under Project 7231, "Biomechanics of Aerospace Operations," Task 723103, "Biological Acoustics in Aerospace Environments," and Work Unit 16 , "Auditory Responses to Acoustic Energy Experienced in Air Force Activities." Acknowledgement is made to Mr. Jack Kelly, formerly of the University of Dayton Research Institute, and Capt David Krantz of the Bioacoustics Branch for their support.

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INTRODUCTION

United States Air Force noise sources comprise some of the most intense acoustic environments in existence. These environs require major ongoing programs of noise control and hearing conservation to insure that Air Force personnel are not unnecessarily exposed to noise levels exceeding the limits specified in Air Force Regulation 161-35, Hazardous Noise Exposure, 27 July 1973 (7). When noise control measures for maintaining exposures to within limiting values are not feasible, personal hearing protective devices are required. A variety of earmuff type and insert earplug type protectors are provided to individuals routinely exposed to intense noise. Currently, AF standard earmuffs are distributed in the field as personal equipment items and AF standard earplugs are dispensed as medical service items. Both types of sound protectors are in widespread use throughout the world.

Observations over the years and informal subjective reports from personnel working in noise environments have indicated that some of the types of earmuffs in use do not appear to provide adequate sound protection for persons wearing eyeglasses. Presumably air leaks occur at the points where the earmuffs fit over the eyeglass temples* and these leaks result in reduced sound protection.

A number of different earmuff protectors are found in the USAF inventory (5). Earmuff protectors are procured by the AF in large quantities through a central purchasing procedure. Procurement is accomplished on a competitive basis which involves the selection of one specific device for purchase from a group of items which are qualified as technically acceptable by test (6) and are included on a Qualified Products List (QPL). Each

*The terms eyeglass "temple" and eyeglass "bow" are used interchangeably.

central procurement selects one earmuff from the QPL for acquisition and placement in the world-wide inventory. Subsequent procurements may and do select different items from the same list. As a consequence of this method, which employs a list of qualified products, several different earmuffs are now in use in AF operational situations. The evaluation of earmuffs for consideration of their inclusion on the QPL and possible use by the AF does not include tests of their effectiveness when worn over eyeglasses.

PURPOSE

The purpose of this investigation was to evaluate the hearing protection performance of earmuff protectors, some of which are presently on the AF Qualified Products List, when they are worn by persons who also wear eyeglasses. This effort considered if problems existed, the nature of the problems and recommendations for remedial action where appropriate.

APPROACH

Decrements in the amount of protection provided by earmuffs when they are worn over eyeglasses may be a function of the inability of the earcup cushion to fit closely around the eyeglass frame and form a good acoustic seal against the head. The degree to which this acoustic seal is or is not accomplished and the extent of the resulting air leak determines the reduction in protection from that obtained when eyeglasses are not worn. Since earmuffs differ in shape, size, material flexibility, and the like, from manufacturer to manufacturer, some may be better than others when worn over eyeglasses. This effort was carried out in three phases, each of which was directly concerned with determining the compatibility of earmuffs with the use of eyeglasses, and it attempted to quantify the amount of difference between attenuation of earmuffs when worn with and without eyeglasses.

The first phase of the study considered the relationship of a muff-type protector to the various types of eyeglass frames found in a typical population, primarily the fit or seal of the muffs to the head. The second portion was concerned with physical measures of loss of attenuation for earmuffs due to programmed leaks created by using various sizes of hollow tubing inserted under the earcup cushion. The third phase involved measurements of the actual differences in attenuation provided with the QPL earmuffs for the same subjects while wearing and not wearing eyeglasses.

EYEGLASS-EARMUFF INTERACTION

Typically an earmuff protector in use encircles the pinna and the earcup cushion rests against that area of the head immediately surrounding the ear to provide an acoustic seal against the outside noise. Maximum sound protection demands that a good acoustic seal be accomplished and maintained. Ideally, an earmuff cushion should fit equally the individual who wears eyeglasses as well as it does those who do not wear them. However, observation and experience suggest that eyeglasses do interfere with the proper fit and seal of the earmuff cushion.

Eyeglass Temple Displacement of Earmuff

Earmuffs rest against the bows of the user's eyeglasses just in front of the pinna. Some types of bows appear to "bend" inward under the weight or tension of the muffs and to rest against the sides of the head, while others hold the earmuff seal away from the head creating an obvious air leak that is visible to an observer. The actual displacement or distance of the eyeglass bows from the head of each subject was measured with various earmuffs in place on the head and compared to the same measurements when no earmuff was worn.

All subjects who participated in the measurement survey normally wore eyeglasses and measurements were taken with their own personal eyeglasses which had been professionally fitted to them by their own physicians. Consequently, the data are representative of the types of frames and the kinds of fits that might be expected in typical populations. All measurements were taken by an individual with training and experience in the fitting of eyeglasses.

The eyeglass temple displacement with and without earmuffs was measured on more than 100 volunteers, both left and right ears, and the various types of eyeglass bows observed were tabulated. Approximately 80% of the bows were of various sizes and thicknesses of plastic, about 10% were metal and about 10% of thin wire. The mean displacement values measured on these individuals are shown in table 1.

It was assumed, prior to initiation of the measurement survey, that placement of the earmuff over the eyeglass temples would reduce the distance of the bows from the sides of the head. Contrary to this assumption, it was observed that three of the four earmuffs measured with eyeglasses showed bow displacements from the side of the head that were greater with the earmuff than when no earmuff was worn (table 1). It appeared, on inspection, that the muff may have exerted pressure on that portion of the eyeglass bow behind the pinna in such a way that the

TABLE I

MEAN DISTANCE OF EYEGLASS TEMPLES FROM SIDE OF HEAD WHEN WORN WITH FOUR DIFFERENT EARMUFF PROTECTORS

	EYEGLASSES WITHOUT EARMUFF	EYEGLASSES WITHOUT EARMUFF A	EYEGLASSES WITHOUT EARMUFF B	EYEGLASSES WITHOUT EARMUFF D	EYEGLASSES WITHOUT EARMUFF E
RIGHT SIDE	6.33*	6.11	6.61	6.49	6.78
LEFT SIDE	6.30	5.67	6.75	6.50	6.88

*DISTANCE IN MILLIMETERS

forward part of the bow "bulged out" at the temporal area of the head and the effectiveness of the seal around the bow in front of the pinna was reduced.

The exception to this finding was demonstrated by Earmuff A, which was the only device for which the measured displacement of the eyeglass bows was less with than without the earmuff. The earcup opening for this unit is quite large and the cushion is relatively narrow. This configuration appeared to allow the cushion to seal against the head behind that portion of the bow which extends behind the ear of the subject instead of resting against the end of the frame. The other earmuffs examined have smaller openings and wider cushions which press against the end of the frame. On this basis, device A would be expected to show the least amount of attenuation decrement of the muffs examined when worn with eyeglasses.

Earcup Cushion Material

Perhaps the most common, and possibly most important source of air leak when earmuffs are worn with eyeglasses, is the degree to which the material of the earcup cushion fails to conform to or around the eyeglass bow. The more compressible and flexible materials are better able to mold or form themselves around the temples providing a more effective seal than with the less conforming cushions. This characteristic and its relationship to attenuation loss is clearly demonstrated in a report by Webster and Rubin (4) which examined earmuff protection for individuals wearing eyeglasses as a function of three types of cushion material on the earmuffs.

Size of Eyeglass Temple

Another factor which contributes to loss of attenuation due to air leaks, which is not independent of cushion material, is the physical thickness or size of the eyeglass bow. Generally, the greater the thickness of the bow, the greater is the possibility of loss of attenuation due to air leaks. Effects of military issue type frames are reflected in the psychoacoustic measurements which appear later. The effects of thin wire bows would ordinarily be expected to be negligible in front of the pinna, all other variables excluded.

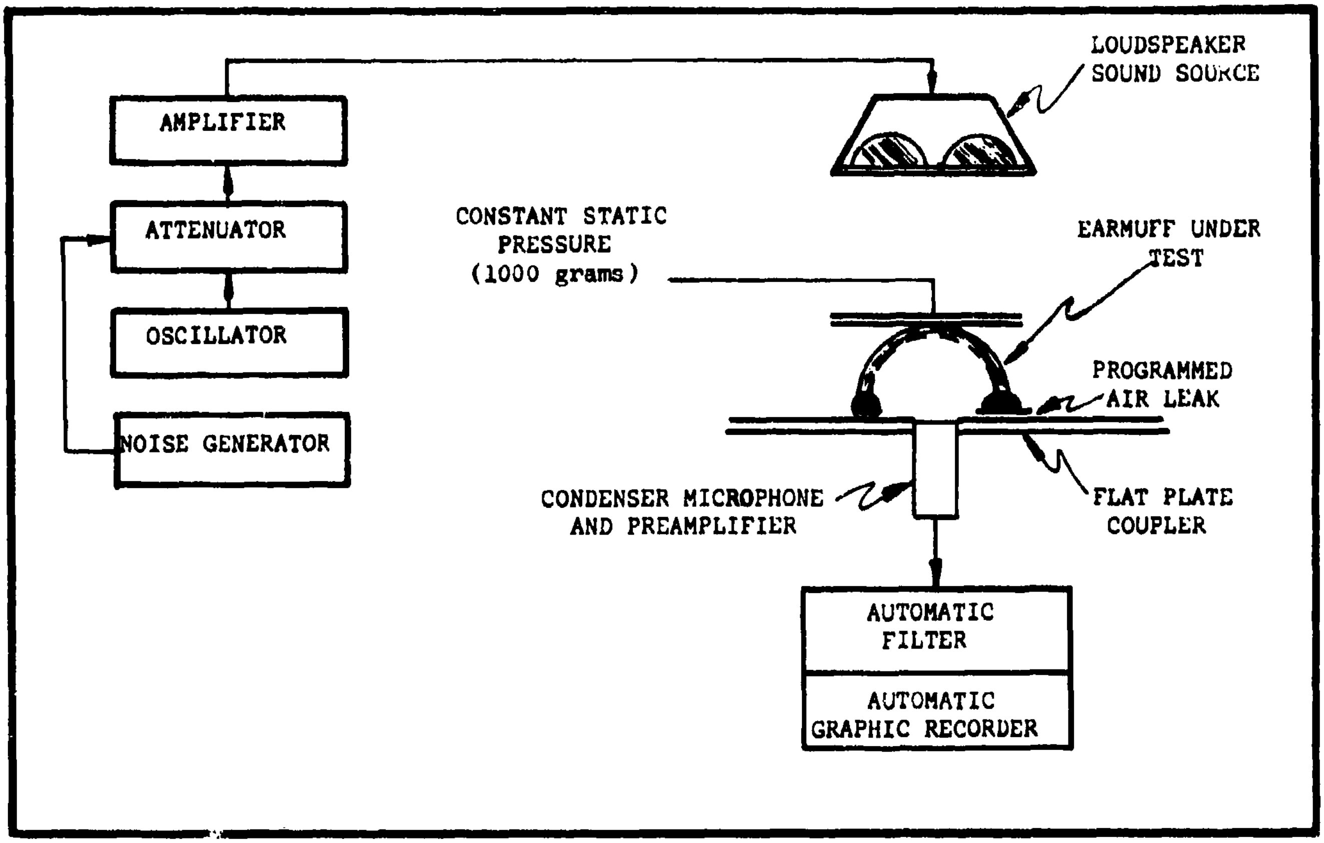
The amount of air leak and attenuation loss appears to be a function of various combinations of at least the three factors mentioned above, the displacement of the temples from the sides of the head, the ability of the earcup cushion material to conform around the temples, and the thickness of the temples or bows. In addition, the shape of the head of the wearer, the amount of headband tension, the degrees of freedom of the headband suspension, and the like, may all contribute singly or in combination to a reduction in acoustic seal and attenuation of an earmuff worn over eyeglasses. The earmuff itself would appear to be the most controllable factor of those identified.

PROGRAMMED AIR LEAKS

The necessity of obtaining a good acoustic seal with circumaural devices to insure maximum hearing protection is demonstrated by a series of physical measures of attenuation of earmuffs for which simulated air leaks were created. A flat plate system for measuring sound pressure levels inside an earcup was assembled and calibrated in accordance with figure 1. The condenser microphone in the flat plate system recorded the amount of sound pressure present inside the test earcups. Attenuation of four different test earcups was measured first without an air leak and then again with simulated air leaks. The sizes of the air leaks were determined by selecting plastic tubing with inside diameters ranging from 0.046 mm to 0.233 mm. The plastic tubing (3/4" lengths) was positioned between the flat plate and the earcup cushion for the measurements. Soft. clay was used to seal around the plastic tubes and assure that the only air leak was through and not around the tube. Care was taken to assure that the tube was not collapsed by the weight of the earcup or by the clay used for sealing around the tubes. A constant static pressure of 1000 grams was applied to each earcup during the measurements.

Earcup performance with and without the four simulated air leaks was measured for various test frequencies at four different intensity levels of broad band noise exposure: 70 dB, 80 dB, 90 dB, and 100 dB SPL. Observation of the data reveals that the amount of attenuation loss due to air leaks is reasonably constant with ambient level for the range of measurements recorded and that the attenuation is generally the same at 100 dB as it is at 70 dB, particularly at the frequencies most affected by leaks. This "constancy" characteristic permits us to discuss loss due to air leaks in terms of amount of loss, test frequency, and particular earmuff involved, without specifying the various intensity levels (within the range investigated).

Attenuation losses due to programmed air leaks were examined for tubing with inner diameters covering a wide range of sizes, however,

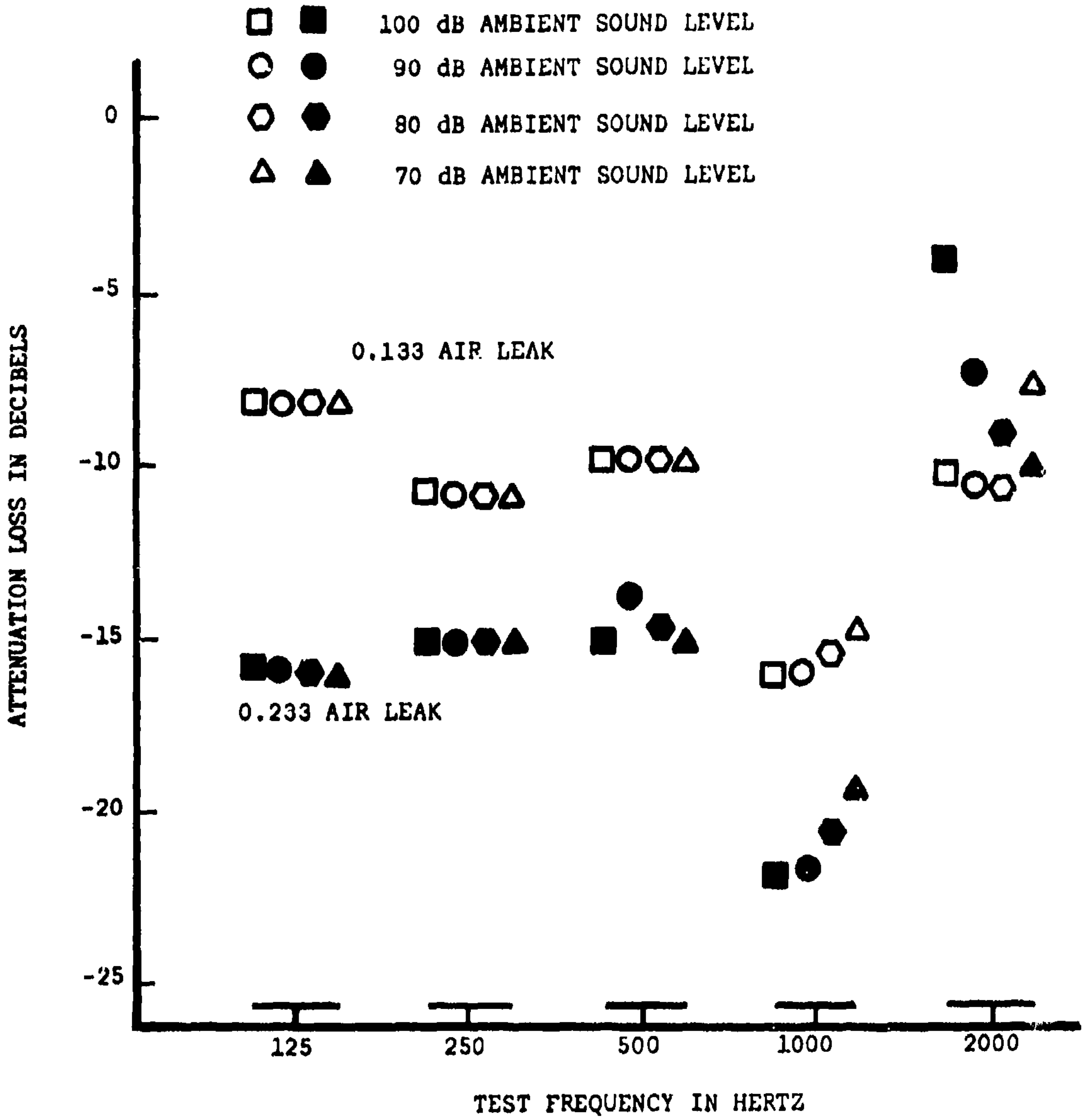


PHYSICAL SYSTEM USED TO MEASURE EFFECT OF VARIOUS PROGRAMMED AIR LEAKS ON EARCUP ATTENUATION

FIGURE 1

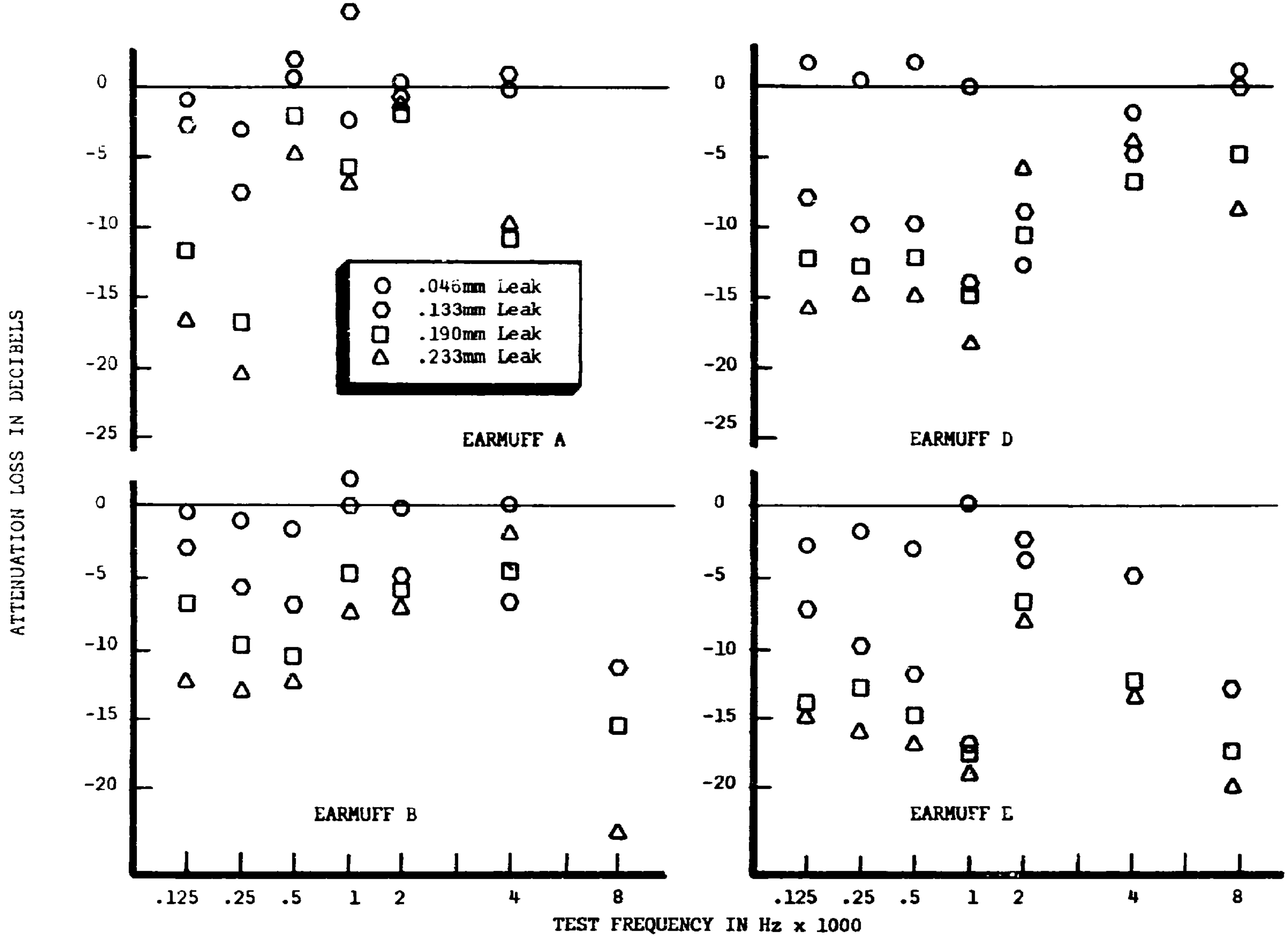
major effects were observed primarily in the range between the 0.046 mm and 0.233 mm openings. Attenuation was not significantly affected by leaks smaller than 0.046 mm, and it changed little for those leaks greater than 0.233 which were examined. Consequently, all subsequent measurements were taken with four sizes of air leaks within the 0.046 to 0.233 mm range.

Loss of attenuation due to two of the simulated air leaks for an earmuff in various levels of noise is summarized in figure 2. These data clearly demonstrate that the amount of loss is about the same in the range of ambient levels from 70 dB to 100 dB. It is also observed that as the size of the air leak is increased from 0.133 to 0.233 the amount of attenuation loss also increases, as expected. The amount of attenuation loss is frequency dependent with the greatest losses occurring at the low frequency end of the scale (125 Hz and 250 Hz). The frequency dependency is also directly related to the individual earmuffs, as shown in figure 3. It can be seen that a specific air leak caused different losses at the various frequencies as well as different losses among the various earmuffs. The extent of this variability is such that general trends or rules of thumb describing amounts of loss as a function of air leak sizes are not readily formulated. The exception to this statement is that very small air leaks do, in fact, cause substantial losses in the low frequency attenuation performance of earmuff devices. Further, that different muffs show differing amounts of attenuation loss for the same air leak. Therefore, air leaks introduced when earmuffs are worn with eyeglasses would be expected to have different effects on the attenuation depending upon which earmuff is worn.



LOSS OF EARCUP ATTENUATION DUE TO PROGRAMMED
AIR LEAKS IN FOUR DIFFERENT LEVELS OF AMBIENT NOISE

FIGURE 2



VARIATION IN AMOUNT OF ATTENUATION LOSS DUE TO DIFFERENT SIZES OF AIR LEAKS AS A FUNCTION OF EARCUP AND TEST FREQUENCY

FIGURE 3

An earmuff-eyeglasses combination with a small air leak could act as a helmholtz resonator at particular test frequencies, producing a sound pressure level under the earcup that is higher than the level outside the earmuff. The "earcup-hollow tube" arrangement used in the programmed air leak measurements constitutes such a resonator. The resonance effects could not be seen in these data because measurement were taken only at specific test frequencies. A continuously changing or sweeping test signal moving across the frequency range of interest could have identified the resonant peaks. Although this study did not consider resonance effects of earmuff-eyeglass combinations, it is pointed out that these effects are encountered in use and generally reduce the effectiveness of the protector under those conditions.

Physical data from the air leak measurements are not sufficient and variability is too great to permit formulation of a simple scheme for predicting these effects. Consequently, measurements of the actual attenuation provided by earmuffs worn by persons with and without eyeglasses was the next logical consideration of this study.

PSYCHOACOUSTIC TESTS

Five circumaural earmuff protectors, some of which appear on the Air Force QPL and are known to be in use in the operational situation, were evaluated when worn with eyeglasses. The method of measuring attenuation closely followed the American National Standards Institute (ANSI) Method for the measurements of Real Ear Attenuation of Ear Protectors at Threshold (1) which is described in detail in an earlier report (5).

With this method subjects actually wearing the sound protectors determine the amount of protection provided in a specified sound field. This is, in effect, a real life test even though it is conducted in the laboratory at very low sound pressure levels.

Since the primary purpose of this investigation was to evaluate a potential AF problem, all subjects were personally fitted with standard AF issue eyeglasses with standard zylonite frames but with no lenses. A medical technician with training and experience in this special medical area individually fit each subject with the appropriate size frames using a "spectacle-fitting kit" which provides a basic selection of sizes. The technique, method and purpose of this exercise were coordinated with an ophthalmologist. All subjects were judged to be provided proper frames for their head shape and configuration. It is understood by the investigators that the fitting of eyeglasses is somewhat influenced by the individual lenses required; however, for the purposes of this evaluation the procedure employed was considered appropriate and correct. Standard AF frames were used in the evaluation in order that findings might be related to the actual operational situation.

Subjects who participated in this phase of the study were male university students with normal hearing at the audiometric test frequencies of from 125 Hz to 8000 Hz. Each subject participated in all tests, that is, he wore the same eyeglass frames with each of the five earmuffs investigated. Subjects, using the psychophysical method of adjustment (3), determined their thresholds of hearing under three separate conditions, (1) open-ear (eyeglass frames with no muff), (2) wearing an earmuff (no eyeglass frames), and (3) wearing eyeglass frames and an earmuff.

Differences in the threshold of hearing between the open ear condition and the two earmuff conditions are described as the attenuation attributed to the muff or to the muff and eyeglasses combination worn in that condition. The differences in attenuation between the earmuff and the earmuff-plus-eyeglass condition is described as the attenuation loss due to eyeglasses.

Differences in the attenuation of the selected earmuffs worn with and without eyeglass frames are summarized in figure 4. The amount of area between the curves and the zero lines represents the average amount of attenuation loss or reduction experienced by that particular muff when it was worn over AF eyeglass frames. Several observations may be made from these data.

First, the attenuation reduction is frequency selective. All devices reveal greater losses of attenuation at the low and high frequency regions of the spectrum than at the mid-frequency range. Also, minimum and maximum reduction values occur at different test frequencies for each of the different devices tested. Clearly, both attenuation and loss of attenuation due to air leak are directly related to the frequency of the test signal.

Second, all earmuffs show losses in attenuation at all frequencies when eyeglass frames are worn. Further, the amount of loss varies significantly from earmuff to earmuff, confirming that reduction in attenuation is a function of the individual earmuff. None of the items showed improved protection with eyeglasses at any test frequency.

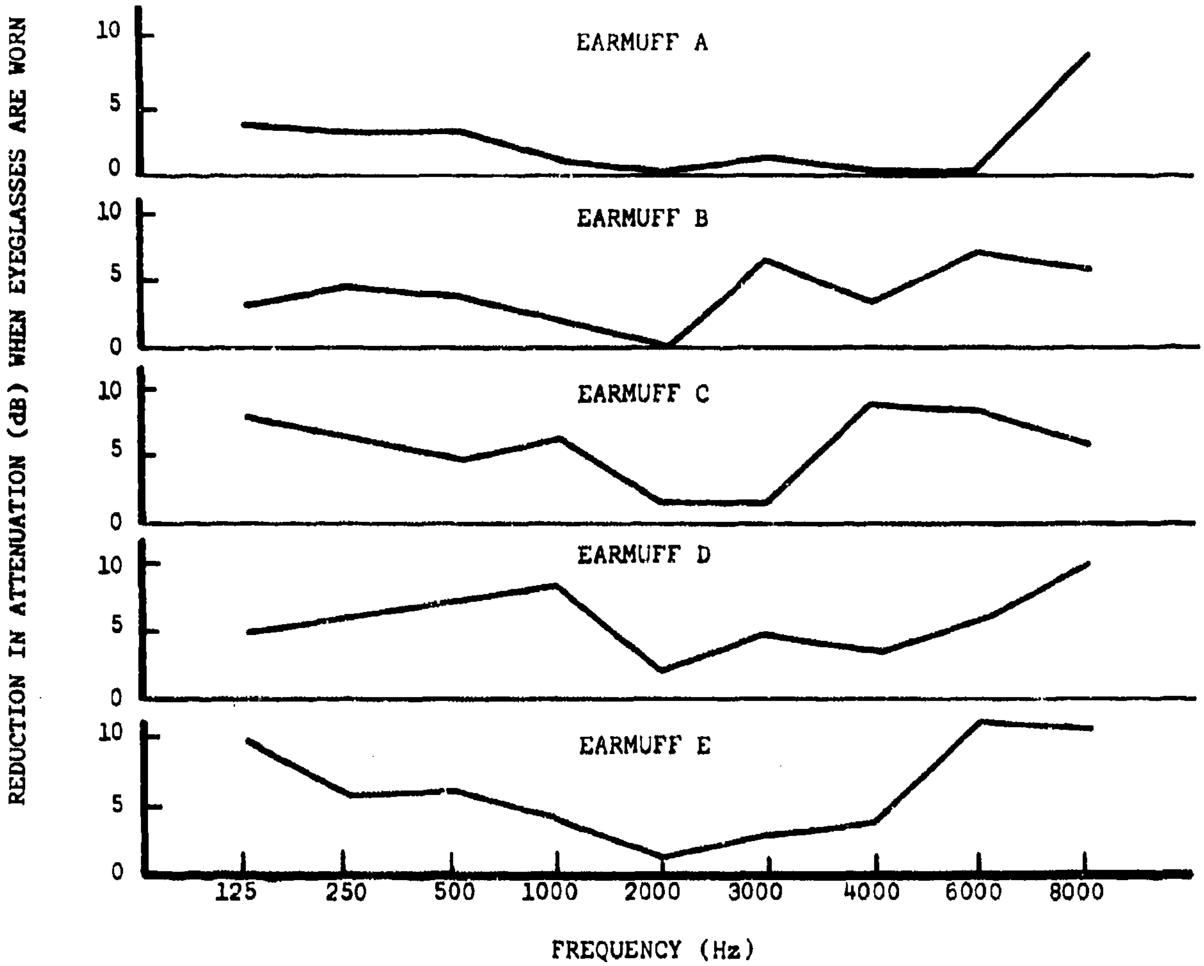


FIGURE 4

DIFFERENCES IN ATTENUATION

Third, the earmuffs can be categorized or ranked in terms of their susceptibility to loss of attenuation when worn with eyeglasses, or conversely stated, in terms of their efficiency when used with eyeglasses. Figure 4 ranks the muffs by inspection from the best at the top to the poorest item at the bottom. When the difference values are actually ranked and summed, the order of the numerical values for the last two items are reversed with the item E showing the greatest loss of attenuation. In terms of percentage change in reduction of attenuation, earmuff A shows 8.3% loss, earmuff B 16.2%, earmuff C 21.1%, earmuff D 19.9%, and earmuff E 21.6%. Clearly, item A is best re percentage change when worn with eyeglasses; i.e., it shows the least attenuation loss, and item E is the worst, although items C and D are very close to item E.

Forty-five t-tests, on 30 measures each of the differences between attenuation of earmuffs worn with and without eyeglasses, are summarized in table 2. Differences which were not statistically significant are underlined and indicate that essentially the same attenuation is provided with the eyeglasses as without them. This statistically significant difference amounted to about 2.5 dB. It is clear that earmuff A is least affected by eyeglasses and that earmuff E is most affected. At the test frequency of 2000 Hz, no significant differences between attenuation were found for any of the devices.

Data on differences in earmuff attenuation with and without eyeglasses as reported by Webster and Rubin (4) and by Fletcher and Loeb (2) are summarized in table 3. Items V, W, and X show rather large differences. Item Z is the earmuff with foam-latex cushions which was essentially unaffected by the eyeglasses.

TABLE 2

MEAN DIFFERENCE SCORES BETWEEN EARMUFF ATTENUATION WHEN WORN WITH vs WITHOUT EYEGLASSES

TEST FREQUENCY	EARMUFF A	EARMUFF B	EARMUFF C	EARMUFF D	EARMUFF E
125	3.35*	2.71	5.26	7.05	4.48
250	3.23	4.63	5.36	4.88	4.56
500	3.17	3.12	5.19	4.76	5.34
1000	1.13	1.37	3.97	3.56	5.33
2000	0.17	0.02	0.99	0.45	1.72
3000	1.25	4.08	1.08	1.89	3.38
4000	0.15	1.79	6.49	3.09	2.74
6000	0.30	3.57	4.32	8.71	3.32
8000	4.97	2.71	2.45	6.78	5.44

*Entries are t-test s ores. Mean differences in excess of 2.46 are statistically significant, underlined scores indicate that essentially the same attenuation was provided with the eyeglasses as without them.

TABLE 3

DIFFERENCES IN ATTENUATION OF EARMUFFS WORN WITH AND WITHOUT EYEGLASSES (IN DECIBELS)

TEST FREQUENCY	EARMUFF				
	V*	W*	X**	Y**	Z**
125	6.1***	3.1	9	6	0
250	7.0	7.5	9	7	0
500	6.1	6.7	5	4	-1
1000	0.9	4.6	5	2	0
2000	8.7	5.1	0	0	-1
3000	7.2	-1.0	-	-	-
4000	11.8	7.0	5	5	0
6000	8.2	11.4	12	5	0
8000	4.7	9.3	-	-	-

*FLETCHER AND LOEB
**WEBSTER AND RUBIN
***POSITIVE ENTRIES INDICATE AMOUNT OF ATTENUATION LOSS DUE TO THE EYEGLASSES

DISCUSSION

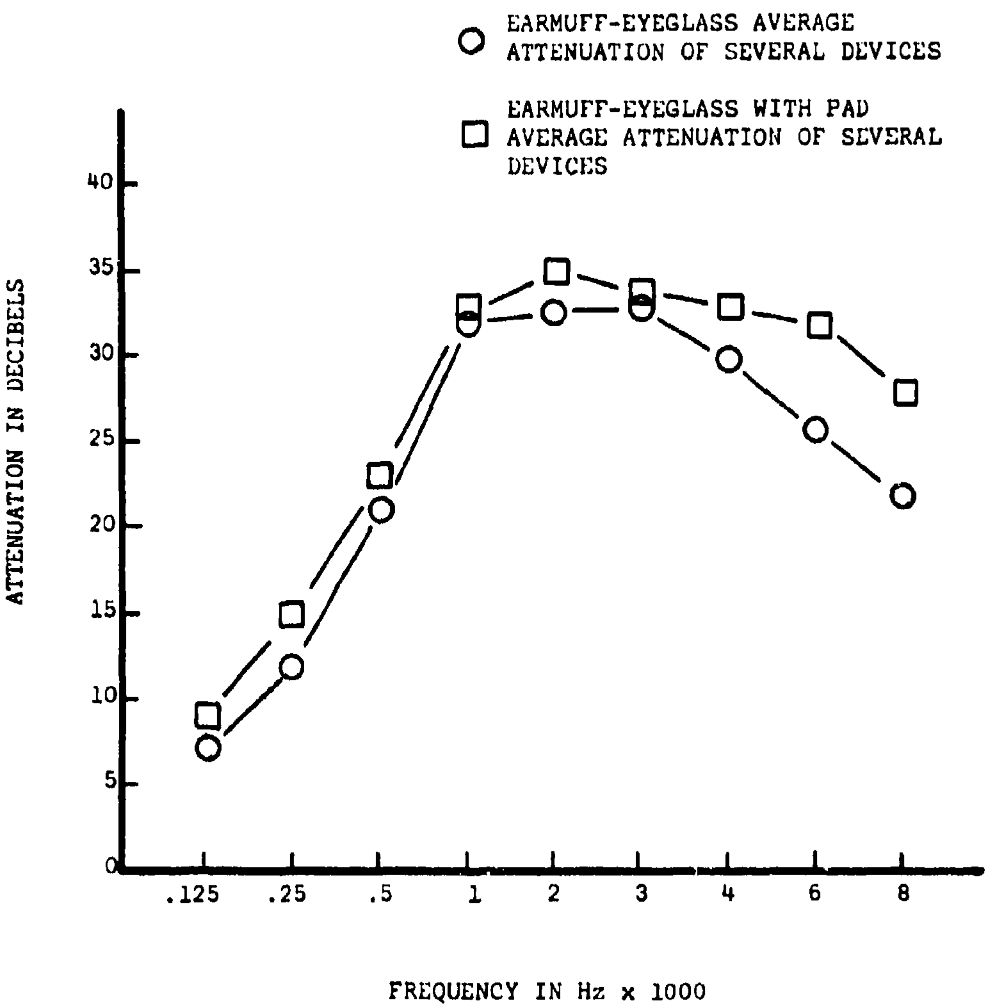
It is the opinion of the investigators that the state-of-the-art of earmuff design is sufficiently advanced that the loss of earmuff attenuation when worn over eyeglasses is a technically solvable problem. The performance of earmuff A over that of earmuff E demonstrates that better compatability is already achievable. Webster (4) found that an earmuff with foam-laxtex cushions had little effect on attenuation while vinyl covered cushions resulted in the usual noticeable low-frequency loss when eyeglasses are worn. He suggested that a piece of foam-latex or similar material be placed under/over the eyeglass temples to form a more effective seal than would be obtained otherwise.

The problem of earmuff-eyeglass compatability may be approached in a number of different ways. One alternative is to provide special earmuffs (clearly marked on the units) for persons who work in noise and who also wear eyeglasses. This would require a separate performance specification and evaluation for these earmuffs. Another alternative is to apply a correction factor to current earmuff performance specifications to account for the attenuation losses due to air leaks. Unlike the first approach, this correction factor(s) would be determined for each earmuff at the time of its evaluation for potential AF use and would be reflected in the performance data. No personnel, other than the evaluators, would be directly involved. This method would adequately protect the eyeglass wearer and would overprotect the non-wearer of eyeglasses.

Eyeglass wearers could be provided with foam-latex (or similar material with configuration to be determined) inserts or applicators to be used at the eyeglass temples to improve the acoustic seal with all earmuffs. A commercially available pad designed for this purpose was evaluated recently in our laboratory. Its effectiveness in minimizing the attenuation loss is seen as increased average protection at all test frequencies in figure 5. The use of some material at the temple may well be the most practical approach since it would be applicable to all items already in use operationally, to those in the inventory and to those procured in the future. The relative cost would be expected to be small. An investigation into types of materials and of appropriate configurations would precede final selection.

Thin wire eyeglass temples which rest close to the head have essentially no effect on the attenuation of earmuffs worn over them. Some personnel in the field have removed or stripped the plastic off the temples of AF standard eyeglass frames leaving only the thin metal strip to minimize and eliminate air leaks. A brief examination of this approach in our laboratory confirmed that temple-stripping does improve attenuation. Earmuffs which seal poorly over unstripped temples show the greatest improvement and as might be expected, earmuffs which initially seal well show little improvement when worn over stripped temples.

Finally, the current procedure for the selection of earmuffs for use by AF personnel in noise does not contain provisions for eyeglass wearers who usually receive less protection than is indicated. In general, if the attenuation values of earmuffs already on the QPL were corrected (reduced) for protection lost due to air leaks around eyeglass bows, the resulting values would not be expected to satisfy the performance requirements in the earmuff specification, MIL-P-38268B. The implication for eyeglass-earmuff wearers in noise is clear.



AVERAGE ATTENUATION OF SEVERAL EARMUFF-EYEGLASS COMBINATIONS WITH AND WITHOUT A FOAM INSERT (PAD) AT THE TEMPLE

FIGURE 5

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