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AEROMEDICAL REVIEWS

CENTRAL REPOSITORY FOR HEARING CONSERVATION DATA

An Examination of the First Year's Reporting

Review 3-59

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RANDOLPH AFB, TEXAS

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CENTRAL REPOSITORY FOR HEARING CONSERVATION DATA

An Examination of the First Year's Reporting

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REVIEW 3-59

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October 1958

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INTRODUCTION

Air Force Regulation 160-3, "Hazardous Noise Exposure," has as its purpose the establishment of a program to minimize the undesirable effects of noise on Air Force personnel. Specifically, the regulatory sections of AFR 160-3 require that the Medical Service:

1. Identify, designate, and monitor areas where personnel are likely to be exposed to hazardous noise levels.
2. Identify those who are routinely assigned tasks in these areas.
3. Establish a baseline or reference audiogram for each of these individuals.
4. Fit, issue, and supervise the use of protective equipment.
5. Set up and carry out an audiometric monitoring program as a means of detecting threshold shifts in the hearing of those who have a reference audiogram.
6. Set up and maintain an education program which supports the over-all hearing conservation goal.
7. Accomplish Forms 1490 ("Hearing Conservation Data"), one copy of which is to be sent to the Central Repository, School of Aviation Medicine, USAF, Randolph Air Force Base, Tex

The Department of ENT of the School of Aviation Medicine, USAF, is responsible for the Central Repository for Hearing Conservation Data. This central repository has been receiving Forms 1490 for approximately one year. As these forms are received, the staff checks them for completeness and consistency; errors arising from misinterpretation or omission are noted and recorded. The forms are then filed by hearing classification, within each AFSC, for each air base; in addition, this information is entered in a summary log. Such a system allows identification of any installation whose audiograms reveal atypical hearing classification distributions: either as a product of some "real" noise hazard, or of poor audiometry. "Hazardous" career fields can be identified in the same fashion.

As of this date, 45,889 Forms 1490 have been reported by 89 bases. Table I shows the distribution of the reporting in terms of Air Force Specialty Codes. As would be expected, most of the AFSC's represented in number are those that have to do with aircraft maintenance. One exception, the Air Police, gained a great deal of its representation by virtue of SAC reporting, where many of the Air Police are stationed in aircraft parking and run-up areas. The very large civilian population is the result of several large AMC bases getting an early start in reporting on their large test-cell and engine run-up populations. It is interesting to note the relatively large officer population, the majority being rated flying personnel. Measurements made to date would seem to indicate that the sound levels being experienced in flight by most personnel are *not* hazardous. Probably the inclusion of a great many of these individuals in the noise hazard program is based upon the faulty assumption that they are exposed to noise levels equivalent to those experienced by the maintenance crews working on the aircraft they fly.

In reference to the problem of whom to include in the Hazardous Noise Exposure Program, attention should be given to paragraph 4c of AFR 160-3. Measurement and identification activities should be coordinated with other base facilities and activities; the Industrial Hygiene Engineer, the Base Engineer, the Safety Engineer, the Maintenance Engineer, Ground Safety, Installations – any or all of these facilities may offer engineering assistance in identifying the potentially noise hazardous areas. Such assistance would be in keeping with their missions, too. The utilization of such local assistance, together with the consultation services offered by Air Materiel, Air Research and Development, and Air University Commands (see par. 6, AFR 160-3) would allow the physician more time to spend on the medical and preventative aspects of the conservation program. It would also offer greater insurance that those in need of monitoring would be identified and that those not in need would not be claiming valuable time and effort.

PURPOSE OF REPORT

The value of any summary or analytic handling of the data being filed with the central repository is, of course, directly related to the accuracy of the reporting. It was anticipated that

there would be a period of "adjustment," during which misinterpretations, omissions, errors, etc., would be quite common. During the past year, efforts to speed up the transition from such a period to a time when the reported data could be used for meaningful analyses have taken several forms: trips into the field for a sharing of information by those gathering and reporting and those summarizing and analyzing; written correspondence with the reporting bases, calling attention to discrepancies and receiving information about test facilities and equipment; teaching contacts with the classes in Aviation Medicine; and through the consultation reports which are sent to those referring patients to the Diagnostic Hearing Center at the School of Aviation Medicine, USAF.

This report is an attempt to summarize and share some of the information gained from the first year's experience in handling and examining the Forms 1490, and in communicating with those persons responsible for their completion. It is hoped that such information will assist in improving the validity and reliability of the reporting being done. Accuracy in the reporting on those items listed on the AF Forms 1490 is not just of academic interest or importance. Valid data will not only allow verification and discovery on an Air Force-wide basis, it will allow *local* identification and verification of existing hazards, and it will allow an evaluation of the local hearing conservation program. Certainly it is of importance to the Air Force in general that these data be gathered and reported carefully and accurately.

AIR FORCE FORM 1490

As a means of organizing the following discussion, the subtitles for those sections of the Form 1490 with which we are concerned will be used as paragraph headings. For reference purposes, the AF Form 1490 is reproduced in figure 1.

Reference Audiogram

AFR 160-3 requires that a reference audiogram be made for all persons to be assigned to duty or training involving exposure to hazardous noise. It is this audiogram which is to be used as a baseline for computing an individual's threshold shift, should it occur. Any 1490 which contains an audiogram that is to be used as the reference should be identified by the word "yes" in the *Reference Audiogram* box.

TABLE I

Reporting distribution by Air Force Specialty Codes

Code		Class A N	Class A Percent	Class B N	Class B Percent	Class C N	Class C Percent	Total N	Percent of total
Intelligence	20	72	67	32	30	3	3	107	0.2
Photomapping	22	60	78	16	21	1	1	77	0.2
Photographic	23	81	63	44	34	3	2	128	0.3
Weather	25	55	60	36	39	1	1	92	0.2
Air Traffic Control	27	139	68	61	30	3	1	203	0.4
Communications	29	310	70	125	28	8	2	443	1.0
Radio-Radar	30	961	63	532	35	30	2	1,523	3.0
Guided Missile	31	26	79	7	21	0	0	33	0.1
Armament	32	849	64	447	34	31	2	1,327	3.0
Atomic Weapons	33	58	75	17	22	2	3	77	0.2
Training Devices	34	57	66	30	34	0	0	87	0.2
Wire Maintenance	36	75	66	34	30	4	4	113	0.2
Intricate Equipment Maintenance	40	151	61	88	36	7	3	246	0.5
Aircraft Accessories	42	1,576	61	929	36	82	3	2,537	6.0
Aircraft and Engine	43	7,808	57	5,524	40	428	3	13,760	30.0
Production Control	45	46	38	72	60	2	2	120	0.3
Munitions and Weapons	46	538	54	410	41	45	4	993	2.0
Equipment Maintenance	47	290	53	231	42	25	4	546	1.0
Metal Working	53	286	51	253	45	27	5	566	1.0
Construction	55	119	60	75	38	5	2	199	0.4

TABLE I (Contd.)

Code		Class A N	Class A Percent	Class B N	Class B Percent	Class C N	Class C Percent	Total N	Percent of total
Utilities	56	92	63	48	33	6	4	146	0.3
Fire Fighter	57	196	72	70	26	7	2	273	0.6
Fabrics, Leather, and Rubber	58	105	56	71	38	11	6	187	0.4
Marine	50	2	—	0	—	0	—	2	0.0
Transportation	60	178	53	150	44	10	3	338	0.7
Food Service	62	47	39	67	56	5	4	119	0.3
Supply	64	597	54	483	43	35	3	1,115	2.0
Procurement	65	3	—	6	—	0	—	9	0.01
Finance	67	8	—	6	—	0	—	14	0.03
Statistical Analysis	68	26	51	24	47	1	2	51	0.1
Administrative	70	320	64	165	33	13	3	498	1.0
Printing	71	16	59	9	33	2	7	27	0.05
Information	72	11	—	2	—	0	—	13	0.02
Personnel	73	86	48	91	51	3	2	180	0.4
Special Services	74	15	—	9	—	0	—	24	0.05
Education	75	15	44	19	56	0	—	34	0.07
Band	76	1	—	1	—	2	—	4	0.0
Air Police	77	871	59	530	36	64	4	1,465	3.0
Special Investigations	82	2	—	0	—	0	—	2	0.0
Medical	90	92	61	55	36	5	3	152	0.03
Air Crew Protection	92	44	54	35	43	2	2	81	0.02
Dental	98	6	—	6	—	0	—	12	0.0
Officer		1,633	56	1,205	42	61	2	2,899	6.0
Civilian		4,434	35	6,862	54	1,368	11	12,664	28.0
Miscellaneous		1,396	59	833	35	124	5	2,353	5.0
Totals		23,753	52	19,710	43	2,426	5	45,889	

HEARING CONSERVATION DATA

REFERENCE AUDIOGRAM	CLASS OF HEARING	CARD NO.	DATE

I. IDENTIFICATION

LAST NAME - FIRST NAME - MIDDLE NAME	COMPLETE NAME OF ORGANIZATION TO WHICH INDIVIDUAL IS ASSIGNED
COMPLETE ADDRESS OF THIS ORGANIZATION	TELEPHONE WHERE THE INDIVIDUAL MAY BE REACHED

(2)° STATUS				(2-10)° SOCIAL SECURITY NO.	SERVICE NUMBER	(10)° SEX			
	X MILITARY		Y CIVILIAN				Y MALE		X FEMALE

II. CURRENT NOISE EXPOSURE

(11-13) DEPARTMENT OR LOCATION	(14-18) JOB OR NOISE CODE (AFSC;MOS)	(19) TIME IN JOB										(20) EXPOSURE TIME
		MONTHS			YEARS							
		0-2	3-5	6-11	1	2	3	4	5-9	10-14	15-19	20+
		0	X	Y	1	2	3	4	5	6	7	8

(21)° WEARS EAR PROTECTION OTHER THAN DRY COTTON DURING EXPOSURE TO LOUD NOISE			
	1 ALWAYS OR FREQUENTLY		2 SELDOM OR NEVER

(21)° MOST FREQUENTLY USED EAR PROTECTION

TYPE			
CLASS: INSERT X		COVERS Y	
ELASTIC 3		MUFFS 6	
NON-ELASTIC (Waxy) 4		HELMET 7	
RIGID (Fitted) 5		OTHER 8	

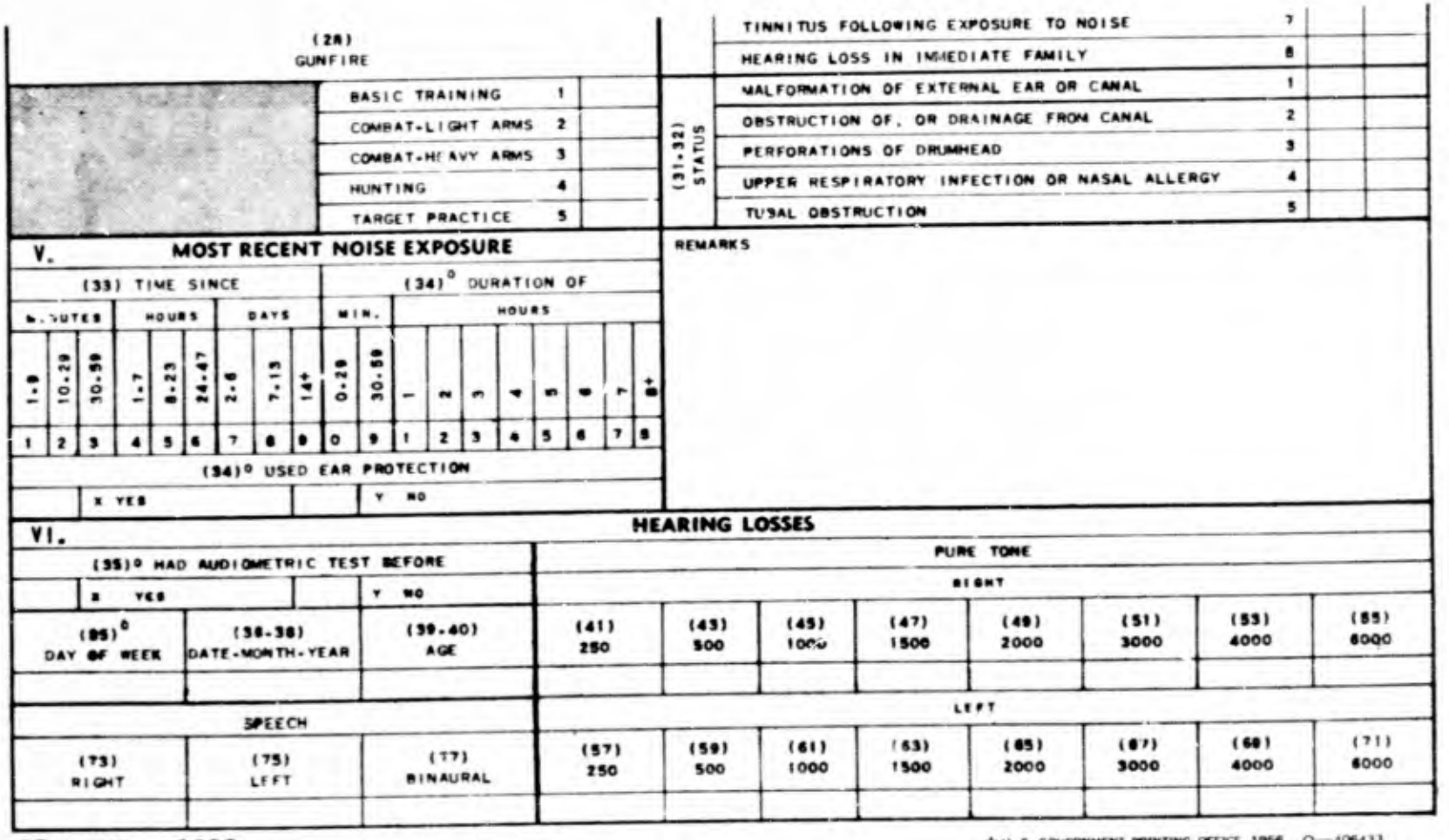
III. PREVIOUS NOISE EXPOSURE

	TIME IN EACH CATEGORY					
	(22) A	(23) B	(24) C	(25) D	(26) E	(27) F
PREVIOUS JOB						
JOB BEFORE THAT						
ALL PRIOR JOBS						
EAR PROTECTION	X Y	X Y	X Y	X Y	X Y	X Y

IV. MEDICAL HISTORY AND STATUS

(29-30) HISTORY

		R	L
AURAL PAIN	1		
DRAINAGE	2		
EAR INJURY (Mechanical)	3		
SURGERY (Ear or mastoid)	4		
HEAD INJURY, WITH UNCONSCIOUSNESS	5		
TINNITUS PRIOR TO FIRST NOISE EXPOSURE	6		



(28) GUNFIRE

BASIC TRAINING	1	
COMBAT-LIGHT ARMS	2	
COMBAT-HEAVY ARMS	3	
HUNTING	4	
TARGET PRACTICE	5	

(31-32) STATUS

TINNITUS FOLLOWING EXPOSURE TO NOISE	7		
HEARING LOSS IN IMMEDIATE FAMILY	8		
MALFORMATION OF EXTERNAL EAR OR CANAL	1		
OBSTRUCTION OF, OR DRAINAGE FROM CANAL	2		
PERFORATIONS OF DRUMHEAD	3		
UPPER RESPIRATORY INFECTION OR NASAL ALLERGY	4		
TUBAL OBSTRUCTION	5		

V. MOST RECENT NOISE EXPOSURE

(33) TIME SINCE

MINUTES			HOURS			DAYS		
1-9	10-29	30-59	1-7	8-23	24-47	2-6	7-13	14+
1	2	3	4	5	6	7	8	9

(34) DURATION OF

MIN.		HOURS						
0-29	30-59	1	2	3	4	5	6	7	8+
0	9	1	2	3	4	5	6	7	8

(34) USED EAR PROTECTION

	X YES		Y NO

REMARKS

VI. HEARING LOSSES

(35) HAD AUDIOMETRIC TEST BEFORE

	X YES		Y NO

(36) DAY OF WEEK	(37-38) DATE-MONTH-YEAR	(39-40) AGE

SPEECH

(73) RIGHT	(75) LEFT	(77) BINAURAL

PURE TONE

RIGHT

(41) 250	(43) 500	(45) 1000	(47) 1500	(49) 2000	(51) 3000	(53) 4000	(55) 6000

LEFT

(57) 250	(59) 500	(61) 1000	(63) 1500	(65) 2000	(67) 3000	(69) 4000	(71) 6000

AF FORM 15 OCT 56 1490

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FIGURE 1

There are several general problems associated with the filling-out of this part of the form. The first is simply one of omission: rather than write "yes" or "no" in the space provided, it is left blank. The problem then confronting the staff is to determine whether this is a monitoring report, or really an unmarked "reference" form. Usually it is the latter case. One of the explanations given by those in the field for not marking the audiogram as a reference has to do with the requirement that the examination for the reference audiogram not take place until at least 40 hours after the last exposure to hazardous noise. Trying to test everyone involved in the program on a Monday is an impossible task; trying to relieve individuals from duty for 40 hours during the week would interfere with the mission of the installation. A growing number of bases have compromised on this point by reading on to paragraph 13b(3) of AFR 160-3. Here it says that an audiogram can be classified as a reference audiogram if: (1) it is less than a year old; (2) it was obtained in a satisfactory test environment; and (3) it meets the requirement for Class A hearing. Many of the bases are scheduling testing daily; those who record a Class A audiogram are identified as having a reference audiogram. Those who have Class B or Class C hearing on this first test are then scheduled for a Monday test. Since summary data reveal that well over 50 percent of the noise-exposed individuals in the Air Force have Class A hearing, regardless of the day of their test, such a procedure cuts the Monday traffic to a manageable number.

From the point of view of those doing the tabulations and analyses of the 1490's, it would be of great value to have omission or "no" responses to this section of the form explained in the *Remarks* section. Actually, every 1490 sent to the Central Repository should have been accomplished for one of the following purposes: (a) to establish a *reference* form, (b) to report a 90-day follow-up, or (c) to report an annual check. The 15-hour and 40 hour audiograms are local procedures aimed at minimizing the roll of temporary threshold shift in this reporting.

A few comments might be made about the other type of audiogram required by the regulation: The *monitoring audiogram.* According to AFR 160-3 persons assigned to duty or training involving exposure to hazardous noise will be given a follow-up audiogram three months after they enter on such duty, and once

a year thereafter. It is felt that two factors associated with this phase of the conservation program need emphasis.

First, such a program of retesting demands that plans be made for calling these people in at the end of the designated time period. Unless such planning is done early in the program, the work load associated with identifying the personnel will be greatly magnified; yet, only one of the installations known to the staff of the repository has made an effort to set up a systematic means of handling the retesting! This particular installation had set up a "tickler" file for those who work in the noise hazard areas. This file was a part of the general "health hazard" file; in other words, the people who were subjected to noise hazards were called in on a yearly basis by the same system that called in those who might be exposed to the dangers of silicosis, toxic agents, etc. That copy of the 1490 which is retained in the office responsible for the audiometric examinations (see par. 7b, AFR 160-3) is the most logical object for such organization.

The second factor has to do with the *importance* of the monitoring program. It is only through comparing retest data with the baseline that those who might be suffering from the noise of their work environment can be identified with certainty. It should be realized that the noise risk criteria set down in AFR 160-3 are tentative; they are a product of the best information available at the time of writing. The validation of these criteria, and/or the discovery of any correction factors, will depend upon just such information as can be gathered from accurate monitoring audiometry.

Class of Hearing

Each of the *reference* audiograms reported on the Form 1490 should be classified as being either Class A, Class B, or Class C. An individual's assignment to a particular hearing class will be based on the following definitions:

Class A: For persons having an audiogram showing not more than 15 db hearing loss at any test frequency.

Class B: For persons whose audiogram shows a hearing loss of 20 db or more at one or more test frequencies in either ear, bu. who do not qualify for Class C.

Class C: For persons having an audiogram which shows an average hearing level, in either ear, of 20 db or more for the frequencies 500, 1000, and 2000 cps.

A large percentage of the audiograms examined at the repository are misclassified. The main reason for this misclassification seems to be that while there is a space for the 250 cps hearing level in the audiogram blocks, the regulation calls for testing only 500, 1000, 2000, 3000, 4000, and 6000 cps. The 250-cps hearing level should *not* be considered in determining the hearing classification.

When the hearing classifications are checked for accuracy, corrected where necessary, and tabulated, the percentage breakdown remains remarkably consistent from month to month. Table II shows the numbers and percentages resulting from the latest summary.

Department or Location

According to section B of attachment 4 to AFR 160-3 ("Codes for Air Force Work Areas") this section of the form will be filled in with a code consisting of two numerals and a letter. The first numeral will identify the general or basic work areas; the second will define smaller, more specific areas or work stations inside the basic area. The letter element (a, b, etc.) of the coding specifies the over-all noise level in the work location.

The only specific interpretive problem that has arisen in regard to this section of the 1490's has to do with the substitution of such write-in information as "jet-engine mechanic" or "tug

TABLE II

Distribution of hearing classifications

Class	Military		Civilian		Miscellaneous*		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
A	17,923	58	4,434	35	1,396	59	23,753	52
B	12,015	39	6,862	54	833	35	19,710	43
C	934	3	1,368	11	124	5	2,426	5
Total	30,872		12,664		2,353		45,889	
Percent of total reporting		67		28		5		

*Those forms so incomplete that categorization is difficult.

operator" – information that is given by the AFSC recorded in the adjacent box. The numerals of the *location* section should be easily determined in the interview. If the important noise level letter code is unknown, the most important write-in information would be that of identifying the noise source (i.e., "B-52," etc.).

One other trend is suspected to have crept into some of the reporting for this section: that of assigning the same environmental noise level to all of those members of the same career field. In most cases, the over-all noise level will vary with differences in the work area coding; aircraft jet-engine mechanics who work on the same aircraft in different environments are subjected to different noise levels. Those who work on different types of aircraft are usually subjected to different noise levels.

Job or Noise Code

In general, it is with the civilian employees that difficulties have arisen in the filling out of this section. A large number of the forms are sent to the repository with no information at all about the person's type of work. The regulation asks that either the industrial code for the job, if one has been assigned (see section C of attachment 4, AFR 160-3), or the comparable military AFSC be used for this description.

Several problems of compliance and interpretation have been reported for this section of the 1490. First of all, there are a few civilian job categories which do not fit into either the industrial coding or the military AFSC structure. With these cases, rather than leave the section blank, it is suggested that a brief job title or description be entered; if any elaboration is needed, the *Remarks* section should be used.

The use of the industrial noise and job codes of section C, attachment 4 of 160-3 will require judgment based on a knowledge of what information is desired from both the *Department or Location* and the *Job or Noise Code* sections. These two sections together provide a description of: (1) the person's physical location in terms of distance from the noise source, and whether he is inside a building or outside; (2) the source of the noise; (3) the over-all noise level in this work environment. The use of the letter codes for noise levels at a machine operator's position (par. 2, sec. C, AFR 160-3), together with proper location coding,

would offer no information about the source or type of noise. In order to fulfill the information requirements listed above, this description would have to be written in; this could be done under *Remarks*, or in the space just below the code box.

Time in Job

Recently a group of 15 airmen was flown into the Diagnostic Hearing Center at Randolph Air Force Base. As a gross means of estimating the validity of the various items on the AF Forms 1490 which accompanied their medical records, new 1490's were filled out in interview by a member of the staff of the repository. This was done without any knowledge of the information previously reported. When the original and this new form were compared for each airman, several rather large disagreements were found in the *Time in Job* section. An examination of the work histories of these airmen indicated that in some instances the time that the individual had spent in the Air Force was the figure coded on his reference form. In other cases it was the length of time the person had served in his present career field. What is required is the length of time the individual has been working in the *job just coded* (*both* location and AFSC). The *Previous Noise Exposure* section should be used for recording other noise exposures of varying intensity levels.

Exposure Time

The figure recorded in this section of the form should be the number of hours the individual is actually exposed to the *coded* noise during each work day. Cursory questioning will usually result in the reporting of eight-hour exposures; persistence and careful questioning result in reports of shorter time periods. If the exposures are too complicated or too irregular, the regulation states that an "X" may be placed in this box. The *Remarks* section might be utilized for any explanatory remarks.

Previous Noise Exposure

More often than not, the forms received by the repository do not have information recorded in this area. Whether this omission is a result of the person not having worked in noise previously, or the product of incomplete questioning, is not known by the person examining the form at a later date. Some installations have written the word "none" in this space when the interview has revealed that the individual has not worked in high level

noise before. Such information is of help to those who are charged with analysis of the forms.

Some of this absence of data is probably due to the fact that the interviewer did not ask for the information, or did not pursue the questioning to its logical conclusion. What such omission amounts to is the ignoring of what *might* have been contributory exposure in cases suspected of having a noise-induced hearing loss. Detailed case histories obtained at the Randolph Air Force Base Diagnostic Hearing Center often reveal such omissions:

> *Case A.* A master sergeant in the military police; 10 to 14 years service; Class C hearing. On the AF Form 1490 which had been completed at his air base, items 22 to 27 under *Previous Noise Exposure* were blank. Under *Gunfire* (item 28) there was a check mark after *Basic Training, Hunting,* and *Target Practice.* There were no comments in the *Remarks* section. In the interview accomplished at the Diagnostic Hearing Center it was found that this sergeant had been in combat as an infantry man in World War II; later he had served as an instructor on a firing range for one year. In this job he had been exposed, daily, to the noises associated with the firing of 30- to 50-caliber machine guns, bazookas, and the discharging of hand grenades!
>
> *Case B.* A master sergeant in production control work. His previous experience with other types of aircraft *had* been noted properly in the column titled *Previous Job.* Under *Remarks* it was noted that he had been unconscious for eight days as a result of an aircraft accident. The interviewer at the Diagnostic Center discovered that this man had also served in the Coast Artillery for over two years. In this capacity he participated in weekly firings of 155-mm. guns and 12-inch mortars!

In neither case was there conclusive evidence that the gunfire exposure had contributed to the hearing impairments; however, gaps such as these in a person's noise exposure case history lend confusion to the already complex problem of determining the etiology of perceptive hearing impairments.

Remarks

This section of the Form 1490 is provided for the medical examiner to enter any remarks he may have about the individual's medical or personal history, elaboration, explanation, reservations

concerning any of the data reported, and any other explanatory and/or supportive material that would be of value to the reader who was not familiar with the procedures of that particular air base. For example, acknowledging the use of automatic audiometers would be of value to those analyzing the audiograms. In general, it is felt that this particular section is not being used as much as it might be. Local symbols and methods often result in reporting that is not consistent with the regulation; without explanation, the data is worthless to those who are engaged in summary analysis. (See *Hearing Loss* section below.) Then too, in the interest of continuity in the preventive medicine program at the base itself, such explanations are necessary.

Age

Large sample hearing surveys have demonstrated conclusively that hearing acuity decreases as age increases. This inverse relationship is shown graphically in figure 2 (from Glorig et al., page 28, *1954 Wisconsin State Fair Hearing Survey*, American Academy of Ophthalmology and Otolaryngology, 1957). What this means, of course, is that any attempts to analyze the effects of environment or job assignment on hearing levels must consider and control this age variable. Otherwise, there would be no way of separating the influence of the normal aging process from the influence of some other contributory factor. The usual manner of controlling the age factor is to handle the data by age groups.

When AF Forms 1490 are sent to the repository [illegible] the ages reported, as is frequently the case, much [illegible] formation is wasted. The forms can be used [illegible] summary compilations.

Hearing Loss

AFR 160-3 requires that the examinee's hea[illegible] 500, 1000, 2000, 3000, 4000, and 6000 cps be rec[illegible] the spaces provided at the bottom of the Forms 1490. The whole concept of establishing a baseline audiogram, followed by use of any threshold shift found in monitoring audiometry as an indicant of hazard, demands *accurate* establishment of hearing levels. Also, any attempts to correlate such variables as *AFSC*, *Time on the Job*, *Noise Code*, etc., with hearing levels, will be meaningful only insofar as the audiograms are valid.

There appear to be two major factors affecting the accuracy of the audiometry being con[illegible] in connection with the Air Force's

hearing conservation program: (1) environmental noise, and (2) audiometric technics. Although AFR 160-125 ("Audiometer Booths for Medical Facilities") sets down the principles for installing testing booths and lists the necessary specifications (see table III), the fact remains that many of the air bases are accomplishing their audiometry in makeshift test rooms. Usually

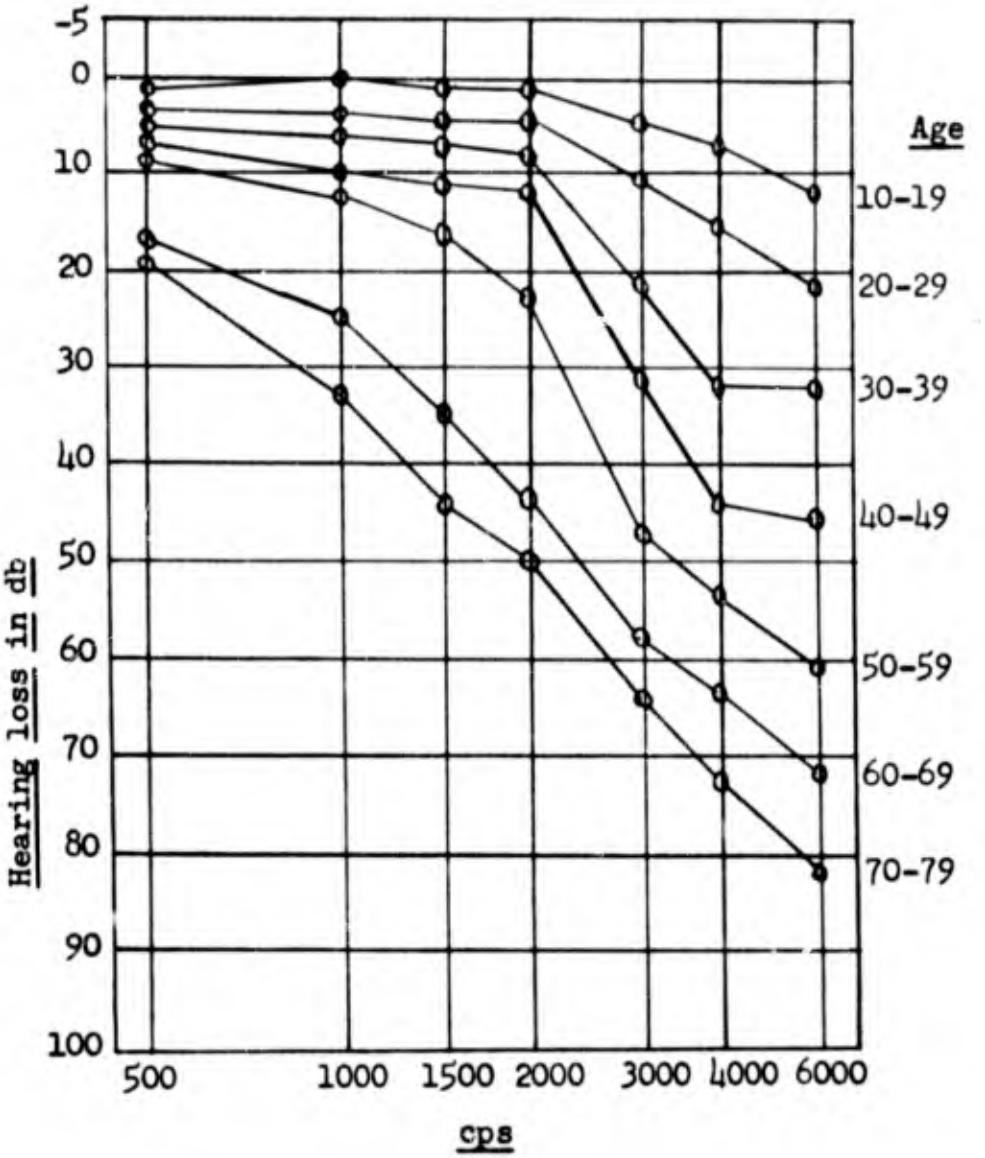

FIGURE 2

Median hearing losses of men in the total sample; left ear only (from Glorig et al., 1957).

TABLE III

Maximum allowable noise level inside booth

	Octave band (cps)					
	150-300	300-600	600-1200	1200-2400	2400-4800	4800-9600
Band sound pressure level (db)	40	38	40	48	57	67

in such testing areas the ambient noise levels are high enough to mask out some of the pure tones being introduced into the ear of the person being tested. As a result, spuriously high thresholds are established. In general, the spectra of the ambient noise in most rooms, and the attenuation characteristics of headsets, are such that the low frequencies on the audiogram are affected more than the high frequencies. As an illustration of this selective masking, figure 3 shows the difference between the threshold levels obtained on a subject in an audiometric testing booth and those obtained in one of the ENT clinical examination rooms (no sound treatment) at the School of Aviation Medicine.

Some air bases, while awaiting funds necessary for the purchase of demountable audiometric test booths that will meet the specifications of AFR 160-125, have lowered the noise levels inside their present booths by:

1. Covering any of the openings into the room with material which offers stiffness and mass: heavy plywood, etc.
2. Cutting down on the "shuffle" noise by carpeting the floor of the booth.
3. Making a better seal around the door (usually the weakest link) by applying weather stripping; some have nailed surgical tubing around the door jam and to the bottom of the door.
4. Cutting down on the noise outside of the booth by placing signs in the hallway ("Quiet, Testing in Progress"), by redirecting foot traffic in the area, and/or by carpeting the adjacent hallways.

Whatever the attempts made to combat the noise problem, it is important to remember that the sound level within the testing room is the product of two things: (1) the noise levels around

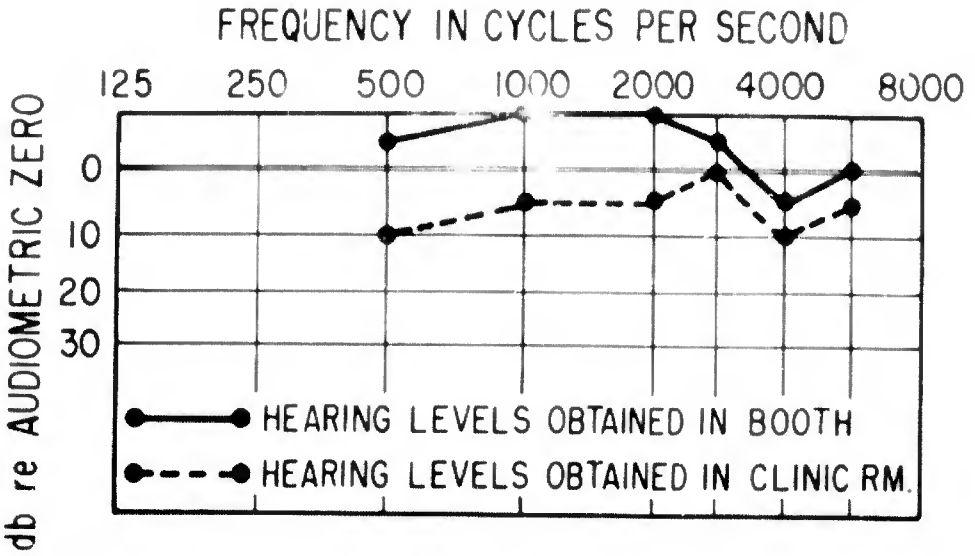

FIGURE 3

Influence of room noise on hearing levels.

the room, and (2) the attenuation factor of the room itself. In other words, the selection of the room *and* its location should both be considered; both isolation and insulation offer a buffer against noise. In addition, it should be noted that although absorptive lining material on the walls and ceiling will reduce reverberation in the room, it will *not* offer adequate insulation against outside noises.

The second major problem as to accuracy in audiometry relates to the technic and skill of the audiometrist giving the test. There is nothing magical about an audiometer; if it is handled in a clumsy or careless fashion, the resulting data will reflect it.

The Apprentice Aeromedical Specialist who attends the 90130 school at Gunter Air Force Base receives a total of seven hours of instruction in the ENT specialty; two hours of this are devoted to demonstration and practice in the use of the audiometer. Those who then attend the 90170 course at Gunter receive a total of six hours of instruction in the testing of hearing. Three hours are devoted to audiometry, function of the audiometer, and gross interpretation of the audiogram; three hours are given to hearing tests: whispered voice, tuning fork, and audiometric testing. Assuming that all individuals at the 90170 level have attended both of the above-named courses, a total of only eight hours of

lecture and practice in audiometry would constitute their training for accomplishing audiograms for the Medical Service.[1] In practice, many of the technicians have had little or no formal training in audiometry. In the interest of audiometric accuracy, the technicians testing the hearing of personnel in the field should, therefore, be "checked out" by someone with a knowledge of the basic principles of audiometry. Experience alone is not a good teacher; it may just make poor technic habitual. Field observations and a running analysis of the differences between the audiograms that accompany Diagnostic Hearing Center patients and those obtained here at the School of Aviation Medicine, USAF, suggest that the most common errors in audiometric technic are as follows:

1. The thresholds are not crossed often enough to be accurately identified. Thresholds, defined as that point where the subject responds 50 percent of the time, should be crossed at least three times; the threshold area should be explored in 5-db steps.

2. The interrupter switch on the audiometer is being ignored—the tone being on the entire time as the operator sweeps up and down with the intensity dial. The presentation of tone should be interrupted any time the frequency or intensity is changed. In addition, the tone at each frequency and at each intensity should be interrupted several times, and the listener's responses correlated with the presentation periods.

3. Often the person being tested is allowed to observe the audiometrist in action; in other words, he can see when the tone is presented and when it is interrupted. Such visual aid could allow the establishment of "normal" thresholds by a person with a hearing impairment. The subject should be seated in such a way as to prevent his watching the hands of the operator.

4. Sometimes the technician giving the test falls into a presentation pattern; the subject can get into "rhythm" with the tone presentations and follow them to a point far below his actual threshold. Both the silence and tone intervals should be varied in a random fashion.

5. The greatest disparity between field audiograms and those done by the audiologists at the School of Aviation Medicine occurs in cases with primarily a monaural hearing loss. The reason: the technician in the field did not use masking to prevent the

[1]Memorandum for the Surgeon General, USAF, 14 June 1957: "Report of the Sixth Meeting of the Surgeon General's Ad Hoc Committee on Audiology and Progress Report on the Conservation of Hearing Program to 1 June 1957."

recording of a "shadow curve." Whenever there is as much as 40-db difference between monaural thresholds, the poorer ear should be rechecked while masking is used in the good ear. Otherwise, there is the possibility that the intense tone being presented to the poorer ear will actually be heard in the good ear.

It is not within the scope of this report to teach audiometry; rather, the above comments are made to call attention to some of the problem areas observed in the field or identified as a result of the analyses being done at the School of Aviation Medicine. In the interest of accurate reporting such error areas should be discussed and clarified by those Medical Service personnel accomplishing the audiometry at each base.

Ideally, audiometers being used quite regularly should be sent in for factory calibration once a year; in practice, this is usually not possible. Regardless of the opportunity for an annual factory calibration, a daily "field calibration" should be accomplished at the beginning of each test day. The technician responsible for the testing should run a daily check on his own hearing and the hearing of someone else in the office whose threshold hearing levels are known by the tester. Such a check will allow the detection of any gross shift in calibration, and will prevent the recording of many audiograms that would be greatly in error. If such shifts in calibration are found, they should be verified by checking several others whose audiograms are known. If the error appears to be a constant one, and factory repair is not possible at the moment, correction figures should be applied to those read from the hearing loss dial. Such corrections should be considered only as a temporary measure; factory calibration should be obtained as soon as possible.

In addition to the specific comments noted above, several general problems associated with the completion of the AF Forms 1490 have been identified. One of the most common of these problems is that of "unexplained individualism." The individuals filling out the forms at the various air bases often use symbols and signs of their own devising. Such symbolism is probably of value to them but unless these markings are explained or defined, their value stops at the local level. In fact at a later date, with personnel changes, they may become meaningless to their own office! Recently the repository received 131 AF Forms 1490 from one of the reporting installations. The forms were filled out completely, with the exception of the audiogram section. Ninety-four of the forms had the figure 20 written

in the 4000 cps box, for both ears; nothing else appeared on the audiograms. Twenty-two of the forms had the figure *15* at 4000 cps for both ears; nothing else. Fourteen of them were completely blank in the *hearing loss* section. One other had a *20* for the right ear, and nothing for the left ear. To complete the picture of confusion, they were all identified as not being reference audiograms, but a check of the previous forms from this base (all with complete audiograms) showed that these were the only reports sent in for these particular men. How are these forms to be interpreted? Does the figure *20* mean that this is the threshold level? Not likely. Is it a screening level – an intensity arbitrarily selected as the "passing" point? If so, why do 17 percent of the forms have the figure *15* on them? What about the 11 percent that have no numbers at all? The answers to these questions will have to await an exchange of letters. If marks of local origin are to be used on the 1490's they should be explained in the *Remarks* section of the form. Then they become meaningful to others who seek information from them.

Finally, the problem of legibility is quite common. The pages slip out of alignment and the second or third page of the forms has the audiometric figures disappear over the margin of the page. Either this, or not enough pressure is applied when the form is filled out, and the carbon copies fade into illegible scratches. Either problem results in the time and effort of reporting the copy to the repository being wasted.

CONCLUSION

The preceding discussion of the problem areas associated with the gathering and reporting of hearing conservation data is reported with the hope that it will offer information of value to those complying with the Air Force Regulation 160-3. It is realized by those responsible for the Hearing Conservation Program that there are some problems associated with it as it now stands; revisions of the regulation and of the AF Form 1490 are being considered. Whatever the date or form of any revision, it should be realized that the regulation on "Hazardous Noise Exposure" (AFR 160-3) is an outgrowth of a great deal of careful research and study. Careful compliance with its requirements will not only pay dividends in dollars and in man-hours and save needless referrals to Diagnostic Hearing Centers, but will also offer valid information upon which to base considerations for future revisions.