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NOISE EXPOSURE STUDY OF REESE AFB PERSONNEL WORKING ON THE FLIGHTLINE AND IN SELECTED ADJACENT SHOPS

AUGUST 1983

USAF Occupational and Environmental Health Laboratory
Aerospace Medical Division (AFSC)
Brooks Air Force Base, Texas 78235

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A survey of noise in and around flightline shops at Reese AFB was accomplished to determine the extent and location of hazardous noise as defined in AFR 161-35, "Hazardous Noise Exposure," 9 Apr 1982. The survey included personal dosimetry and an analysis of flightline generated noise during the multiple shifts common to maintenance activities. Survey results support the conclusion that assignment to a flightline shop, per se, does not constitute assignment to a hazardous noise area. Exposures received by personnel assigned to the Egress and Fuel Systems shops are not considered to pose a high risk of

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noise exposure from either in-shop or flightline noise. Dosimetry results from persons assigned to the following areas support their inclusion in the Hearing Conservation Program: Repair and Reclamation, Pneudraulics, Flightline Support Services, Fuel Management, Structural Repair and Welding. The decision to recommend inclusion of those shops in the program is documented in the report as being based on both in-shop or adjacent noise source exposure and the employees' duties.

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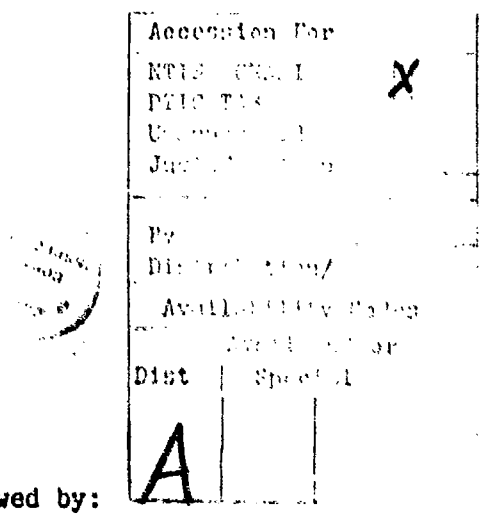
HEALTH LABORATORY

Brooks AFB, Texas 78235

Noise Exposure Study of Reese AFB Personnel Working on the Flightline and in Selected Adjacent Shops

August 1983



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I. INTRODUCTION

Since 1979 there has been an increase in hearing loss claims from Reese AFB personnel. Key base personnel were becoming increasingly involved. In response to this concern, Capt Gene Killan, Reese AFB Bioenvironmental Engineer, contacted the USAF OEHL for: (1) assistance in determining exposure levels for several specific jobs on or near the flight line, (2) assistance in recommending hearing conservation program actions, and (3) suggested future sampling.

In support of this request for assistance, Maj Dick Jordan and Lt Carolyn Jones made a one day presurvey visit on 30 Sep 82 to determine the scope of the project, visit affected maintenance organizations, and to determine equipment requirements. Past survey data from the shops were reviewed but found to be inconclusive. The base data were a mixture of A-weighted sound levels, and average equivalent levels from noise dosimeters used less than six hours per sample. The data indicated the possibility of individual workers exceeding the daily allowable limit on a regular basis. On 18 Oct 82 a USAF OEHL team returned to Reese AFB to conduct the survey.

II. BACKGROUND

Hazardous noise on aircraft flightlines and in the surrounding areas is not a new problem. The Air Force has shown its concern for the individual worker by first issuing AFR 160-3, Precautionary Measures Against Noise Hazards, on 21 Oct 48. It has been subsequently revised and changed many times with the latest revision, AFR 161-35, Hazardous Noise Exposure, dated 9 Apr 82. This regulation, from its inception, was designed to document noise levels and protect the individual worker from hearing loss through the USAF Hearing Conservation Program.

The Air Force has recently made some changes to strengthen their Hearing Conservation Program. The USAF Hearing Conservation Data Registry was transferred 1 Jul 82 to the USAF Occupational and Environmental Health Laboratory, Consultant Services Division (USAF OEHL/EC) from the USAF School of Aerospace Medicine (USAFSAM/NGEA). It contains approximately 1.7 million hearing test results on over 500,000 individuals, and is headed by a board certified audiologist. The USAF OEHL is engaged in an effort to orient the Registry's data base to meet the operational needs of the USAF.

III. PROCEDURES

For five consecutive days, a noise dosimetry survey was conducted for three shifts (days, swings, and mids) in eight different shops located in close proximity to the Reese AFB flightline. These shops are identified in Appendix 2. Each was selected from a larger list by mutual agreement between the base BEE and the USAF OEHL survey team to insure the survey included shops where high noise exposure was believed to exist. Each selected shop represented an area where the BEE had a specific need for additional documentation.

The survey consisted of monitoring shop personnel for each working shift during a 24-hour period for five consecutive days. Dosimeters were rotated among shop personnel to gain maximum job exposure for each day and for each shift. Personnel were monitored using GenRad Model 1954 and Metrosonic Model 301 personnel dosimeters. Each dosimeter was calibrated before and after each surveyed shift. Each person monitored was asked to identify where the majority of his work was performed so the noise dosimetry data could be categorized by work center.

In addition to using dosimeters, a sound level meter was used in selected work areas and community noise analyzers were used on the fringe of the flightline. Sound levels were taken with a GenRad Sound Level Meter, Model 1982, USAF OEHL #01266, in Bldgs 59 and 82. Noise measurements were made to determine the effects of flightline aircraft operations, and noise within the buildings, on shop personnel. Two GenRad 1945 Community Noise Analyzers, USAF OEHL #00105 and #00107, were repositioned daily at new locations along the entire length of the industrial complex side of the flightline/aircraft parking area. Eight-hour equivalent continuous sound levels (Leqs) were recorded with the community noise analyzers each day and used both as an indication of exposure to individuals working just off the flightline, and to help define the hazardous noise boundary from flightline operations. Both the sound level meter and community noise analyzers were calibrated before and after each day's use. GenRad 1945 Community Analyzers are not designed to measure hazardous noise. However, it was felt they added meaningful data by supplementing the noise dosimeters.

IV. DISCUSSION/RESULTS

Noise dosimeters provide continuous exposure data without requiring the BEE or his staff to follow the worker with a sound level meter positioned near the ear. Dosimeters permit more monitoring with minimal supervision, but the surveyor must have knowledge of the events that occurred during the monitoring period. The nearly continuous nature of dosimetry data requires cautious interpretation. It must be coupled to an understanding of the environment in which it was collected, for example, impulse noise versus a continuous noise source, to determine the degree of risk for hearing loss. Noise levels do not appear to conform to any single statistical distribution. In the case of motor vehicle traffic, those locations free of "strong sources" but exposed to moderate or high traffic volume, the distribution of A-weighted sound levels are approximately Gaussian. However, when there are "strong sources" for short periods of time, the data will show a large departure from a Gaussian distribution.[1] In this survey, there were "strong sources," i.e., riveting, grinding and aircraft engine run-ups, both within the shops and on the flightline which would tend to affect the distribution of data within a day. Likewise, work requirements for a specific job varied considerably from one day to another. In interpreting the survey data, we have examined both the energy average from a reasonable sample size and the spread of the data, and compared that information to independent knowledge of the sources of exposure.

Dosimetry data in this survey ranged from approximately 6 1/2 hours to 8 hours depending on the time required to change out and read each unit. To

allow all data within a shop to be compared, regardless of the sampling time, each dosimeter's equivalent continuous sound level (ECL) reading was normalized relative to the allowable exposure period for the actual exposure time as defined in AFR 161-35, Table 5. This normalization resulted in a 1.0 being assigned to an exposure that exactly met the criteria described in AFR 161-35, Table 5, and with <1 and >1 values assigned to exposures less than and greater than the standard respectively (Ref Appendix 3). In other words, a person exposed to 88 dBA for 8 hours would have a normalized exposure of 1.05. A normalized exposure greater than one indicates the individual was overexposed per AFR 161-35, Table 5.

Of the work centers identified in Appendix 3, six work centers had at least one shift with the average normalized ECL less than 1.0. However, when all shifts are considered, the normalized ECLs for only two of these six work centers, Bldg 82 for Egress and Bldg 80 for Fuel Systems, were less than 1.0. Egress and Fuel Systems were also the only shops where the normalized ECLs were below 1.0 for all the individuals monitored (reference Appendix 4).

The community noise analyzers were used since they could be operated for 24 continuous hours and be programmed to collect data for three distinct consecutive eight hour periods. By carefully selecting the start time, these eight hour periods approximated the three different work shifts. By moving the two analyzers daily to a new position on the fringe of the flightline, the overall expected environmental exposure could be determined. The instruments were used to collect Leq for this survey.

Like the ECL computed by a dosimeter, the Leq represents the equivalent A-weighted sound level over a specific time period. Both represent similar measurements, i.e., a steady state noise level equivalent to the actual variable level over the same duration. In the case of the ECL, the USAF uses a 4 dB exchange rate for its calculation. The Leq, on the other hand, is based on a 3 dB exchange rate.[3] For the same noise source, the Leq will be higher than the ECL.[3] Of the 24 measured Leqs, only two were greater than 84 dBA, (reference Appendix 5). This indicates that the perimeter of the flightline/aircraft parking area toward the shops was not a hazardous noise area at the time of the survey. If an individual occupied only this area then he would not exceed the standard as described in AFR 161-35, Table 5.

The A-weighted sound levels measured inside Bldgs 59 and 82 were as expected. An 82 dBA was the highest sound level found inside Bldg 59 from activities in an adjoining shop inside this same building. The 82 dBA was measured in the Welding shop when they were having a break and personnel in the Structural Repair shop were riveting. In this same area, an A-weighted sound level of 75 dBA was measured during an aircraft flyover. The background sound level inside Bldg 82 without equipment operating was 62 dBA. With a MK-6, External Hydraulic Power Unit, operating in about the middle of the hangar, the A-weighted sound level did not drop below 75 dBA anywhere inside the open bay. The sound level remained constant beyond 30 feet from the MK-6. As a point of reference, the A-weighted sound level was 88 dBA, 15 feet from the MK-6.

V. CONCLUSIONS

Personnel assigned to the Egress and Fuel Systems shops are not expected to routinely exceed the hazardous noise standards found in AFR 161-35, Table 5 on the basis of survey measurements and a description of their normal daily responsibilities.

At the time of the survey, overexposure to personnel while in their shops or hangars was due to tools and equipment within their immediate area and not aircraft on the flightline.

Hazardous noise areas caused by aircraft and associated AGE equipment ends at some point on the concrete apron of the flightline/aircraft parking area.

In Bldg 59 there are several hazardous noise shops. At the time of the survey, individuals exceeded the allowable limits because of the noise sources within that shop and not the adjacent shops.

VI. RECOMMENDATIONS

A. Personnel who spend the majority of their daily time working in the work centers below should be placed on the Hearing Conservation Program:

1. Repair and Reclamation - flightline, hangar
2. Pneudraulics - flightline
3. Flightline Support Services - flightline, sound suppressor, flightline truck
4. Fuel Management - fuel truck
5. Structural Repair - shop, hangar, flightline
6. Welding - shop

B. The base BEE should expand on this survey to include other base shops. Sampling should be for a minimum of one week. The sampling protocol is important to insure adequate coverage. Random sampling should continue throughout the year beyond the basic survey, including those shops in this report. The data should be compared and combined, if possible, with the previous results for a larger sample size. Previous medical and engineering recommendations should be reevaluated at least annually.

Appendix 1

Appendix 1

1. Harris, Cyril M., Handbook of Noise Control, 2nd Ed., McGraw-Hill Book Store, 1979.

2. Technical Review, B&K Instruments, Inc., No. 4, 1974.

Appendix 2

Appendix 2

Noise Dosimetry Sampling Schedule

Organization/Shop	Days Monitored	Shifts Monitored	Primary Location of Duties (Work Centers)
Repair & Reclamation	18 Oct	swing	flightline
	20 Oct	mid, day, swing	hangar, office
	21 Oct	day	hangar
	22 Oct	mid	hangar
Fuel Systems	18 Oct	swing	shop
	20 Oct	day, swing	shop
Pneudraulics	19 Oct	day, swing	shop, flightline, office
Flightline Support Services	18 Oct	swing	flightline truck, sound suppressor, hangar, flightline
	19 Oct	mid, day, swing	flightline truck, sound suppressor, flightline
	20 Oct	mid, day, swing	flightline truck, sound suppressor, hangar, flightline
	21 Oct	mid, day, swing	flightline truck, hangar, flightline
	22 Oct	mid	hangar
Egress	19 Oct	mid, day, swing	flightline, shop, hangar
	21 Oct	mid, day, swing	hangar
Fuel Management	19 Oct	mid, day, swing	fuel truck, lounge
Structural Repair	18 Oct	swing	hangar, shop
	19 Oct	day, swing	shop
	20 Oct	mid, day, swing	shop, flightline, hangar
	21 Oct	mid, day, swing	shop, flightline, hangar
	22 Oct	mid	shop

Appendix 2 (continued)

Noise Dosimetry Sampling Schedule

Organization/Shop	Days Monitored	Shifts Monitored	Primary Location of Duties (Work Centers)
Welding	18 Oct	swing	shop
	19 Oct	day, swing	shop
	20 Oct	day	shop
	21 Oct	day	shop
Machine	20 Oct	day	shop
	21 Oct	day	shop

Appendix 3

Appendix 3

Noise Sampling Summary

Organization/Work Center/Shift		Sample Size	Normalized Sample Mean
Repair & Reclamation Shop			
Hangar	-Mids	6	1.02
	-Days	5	1.01
	-Swings	3	.98
	-All Shifts	14	1.01
All Locations	-Mids	6	1.02
	-Days	5	1.01
	-Swings	5	.98
Total All Repair & Reclamation Samples		16	1.00
Fuel Systems Shop			
	-Swings	3	.89
	-All Shifts	4	.90
Pneudraulics Shop			
Total All Pneudraulics Samples		4	.97
Flightline Support Shop (FLSS)			
Flightline	-Mids	6	.97
	-Swings	3	1.01
	-All Shifts	10	.99
Hangar	-Mids	3	1.03
	-Days	4	.99
	-Swings	3	.97
	-All Shifts	10	1.00
Flightline Truck	-Days	4	1.11
	-Swings	6	1.10
	-All Shifts	12	1.08
Sound Suppressor	-All Shifts	4	1.26
All Locations	-Mids	13	1.02
	-Days	10	1.07
	-Swings	13	1.06
Total All FLSS Samples		36	1.05
Egress Shop			
Hangar	-All Shifts	5	.94
Total All Egress Samples		7	.95

Appendix 3 (continued)

Noise Sampling Summary

Organization/Work Center/Shift		Sample Size	Normalized Sample Mean
Fuel Management Shop			
Fuel Truck	-All Shifts	4	1.01
Total All Fuel Management Samples		5	1.00
Fabrication			
Structural Repair Shop			
Hangar	-Swings	3	1.07
	-All Shifts	4	1.04
Shops	-Mids	4	1.03
	-Days	5	1.02
	-Swings	7	1.10
	-All Shifts	16	1.06
Flightline	-Swings	3	1.05
	-All Shifts	6	1.00
All Locations	-Mids	6	.99
	-Days	7	1.02
	-Swings	13	1.08
Total All Structural Repair Samples		26	1.05
Welding Shop	-Days	3	1.06
	-Swings	3	1.09
Total All Welding Shop Samples		6	1.08

Appendix 4

Appendix 4

Distribution of Normalized Noise Data

Organization/Location/Shift	Sample Size (N)	≤.90	.90-.95	.96-1.00	≥1.00
Repair & Reclamation					
Hangar	14		2	9	3
Other	2		1		1
Mids	6		1	4	1
Days	5			4	1
Swings	5		2	1	2
Fuel Systems					
Shop	4	2	1	1	
Days	1		1		
Swings	3	2		1	
Pneudraulics					
All Locations	4	1		1	2
Days	2				2
Swings	2	1		1	
Flightline Support Shop					
Flightline	10		2	5	3
Hangar	10		6	1	3
Flightline Truck	12		1		11
Sound Suppressor	4				4
Mids	12		4	5	3
Days	14		2	1	11
Swings	10		3		7
Egress					
Hangar	5		5		
Other	2			2	
Mids	2		1	1	
Days	2		2		
Swings	3		2	1	

Appendix 4

Distribution of Normalized Noise Data

Organization/Location/Shift	Sample Size (N)	≤.90	.90-.95	.96-1.00	≥1.00
Fuel Management					
Fuel Truck	4		2		2
Other	1		1		
Mids	2		2		
Days	2		1		1
Swings	1				1
Fabrication					
Structural Repair					
Hangar	4			1	3
Shop	16	1	2	1	12
Flightline	6	1	1	1	3
Welding	6		1		5
Machine	2		2		
Mids	4	1	2		1
Days	12	1	3	2	6
Swings	18		1	1	16

Appendix 5

Appendix 5

8-Hour Equivalent Sound Levels (Leqs)

Locations

Date/ 8-Hour Shift	Outside Bldg 98	Inside Bldg 92	Outside Bldg 98	Outside Bldg 70	Pol Tank Farm	Inside Bldg 52	Outside Bldg 78	Outside Bldg 78
18/19 Oct								
1st shift	78				75			
2nd shift	68				76			
3rd shift	84				78			
19/20 Oct								
1st shift		74				70		
2nd shift		77				75		
3rd shift		74				75		
20/21 Oct								
1st shift			73				67	
2nd shift			80				75	
3rd shift			74				76	
21/22 Oct								
1st shift				86				85
2nd shift				81				81
3rd shift				73				76