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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 113. MK-1 TES--ETC(U)
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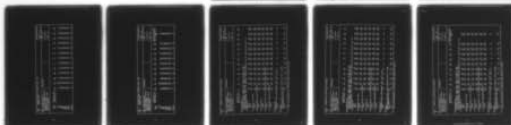
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**USAF BIOENVIRONMENTAL NOISE DATA
HANDBOOK**
Volume 113
MK-1 Test Stand, Aircraft Hydraulic System

9 *Technical rept.*

10 *Nick A. Farinacci*

11 DEC 1976

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AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The MK-1 Hydraulic Test Stand is an electric motor-driven unit designed to test aircraft hydraulic systems. This report provides measured data defining the bioacoustic environments produced by this unit operating inside a large aircraft hangar at normal rated/loaded conditions. Near-field data are reported for 37 locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and			

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→ limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, ^{USAF} Bioenvironmental Noise Data Handbook, Vol. 1: Organization, Content and Application, AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. ↗

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 723104, Measurement and Prediction of Noise Environments of Air Force Operations.

The author acknowledges the efforts of Mr. Robert T. England and Mr. Robert G. Powell who conducted the field measurements, and Mr. John N. Cole who established the data analysis requirements and assisted in the preparation of this report. Mr. Henry Mohlman and Mr. David Eilerman of the University of Dayton assisted in the mechanics of data processing, and Mrs. Norma Peachey typed and prepared the graphics.


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NEAR-FIELD NOISE

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INTRODUCTION

MK-1 Hydraulic Test Stand is an electric motor-driven unit designed to test aircraft hydraulic systems.

This volume provides measured data defining the bioacoustic environments produced by this unit. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the MK-1 test stand.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of B-1 Force aircraft and ground support equipment. The far-field, community-type, noise data in this handbook describe the noise produced during *ground operations* of aircraft, ground support equipment, other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Volume 2 provides a method and data for adjusting the handbook's far-field noise data, which are for standard meteorological conditions (15C temperature, 65% relative humidity, 0.760 meters Hg barometric pressure) to derive comparable data for other meteorological conditions. Refer to *Volumes 1 and 2* (references 1 and 2) for such information because it is not stated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BBE, Wright-Patterson AFB, 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Contact any questions concerning the technical data in this report and other handbook volumes to: AMRL/BBE, Wright-Patterson AFB, OH 45433; Autovon 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 2: Procedure to Evaluate Effects of Non-standard Meteorological Conditions on Far-Field Noise*, AMRL-TR-75-50 (2), AMRL, Wright-Patterson AFB, OH, 1975.

NEAR-FIELD NOISE

MEASUREMENTS

A standard MK-1 Test Stand was operated inside, and approximately in the center of a large aircraft hanger (167.6 m long × 36.6 m wide × 18.3 m high) on a concrete floor at a normal rated/loaded condition. The hanger walls and ceiling were not acoustically treated. No aircraft were in the vicinity of the unit while being measured. No far-field acoustic data were acquired because of the relatively close proximity of the hanger walls.

Figure 1 identifies 36 noise measurement locations at a height of 1.5 meters above the concrete apron (nominal ear level of ground crew). The 0 degree reference direction passes through the tow bar. These locations are in the acoustic near-field of the source where the sound wave fronts generally do not spherically diverge and the source appears to be spatially distributed (i.e., not a point source). Consequently, these near-field data cannot be extrapolated to longer distances but do properly define the levels at locations close to the unit.

Near-field measurements were also made at ear level at the operator control panel. Table 1 lists the numeric/alphabetic designators used on the data pages in this report to identify the operator measurement location and test conditions. The designator 1/A means operator location 1 and test condition A. Such a descriptor is essential in many handbook volumes that involve multiple combinations of locations/conditions. It is used in this report to maintain format consistency.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced by the MK-1 unit at the 37 specified, near-field locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data one can calculate the variety of measures in Table 3 which are widely used to assess the effects of noise on personnel and their performance.

For data at other intermediate near-field locations (i.e., for radial distances less than 4 meters) you can interpolate between the 36 measured data points.

TABLE 1

MEASUREMENT LOCATION AND TEST CONDITION FOR OPERATOR NOISE MEASUREMENTS

MK-1 Test Stand, Aircraft Hydraulic System
Wright Patterson AFB, 8 Nov 1972

Measurement Location

1 Operator Control Panel

Operation

A System Pressurized

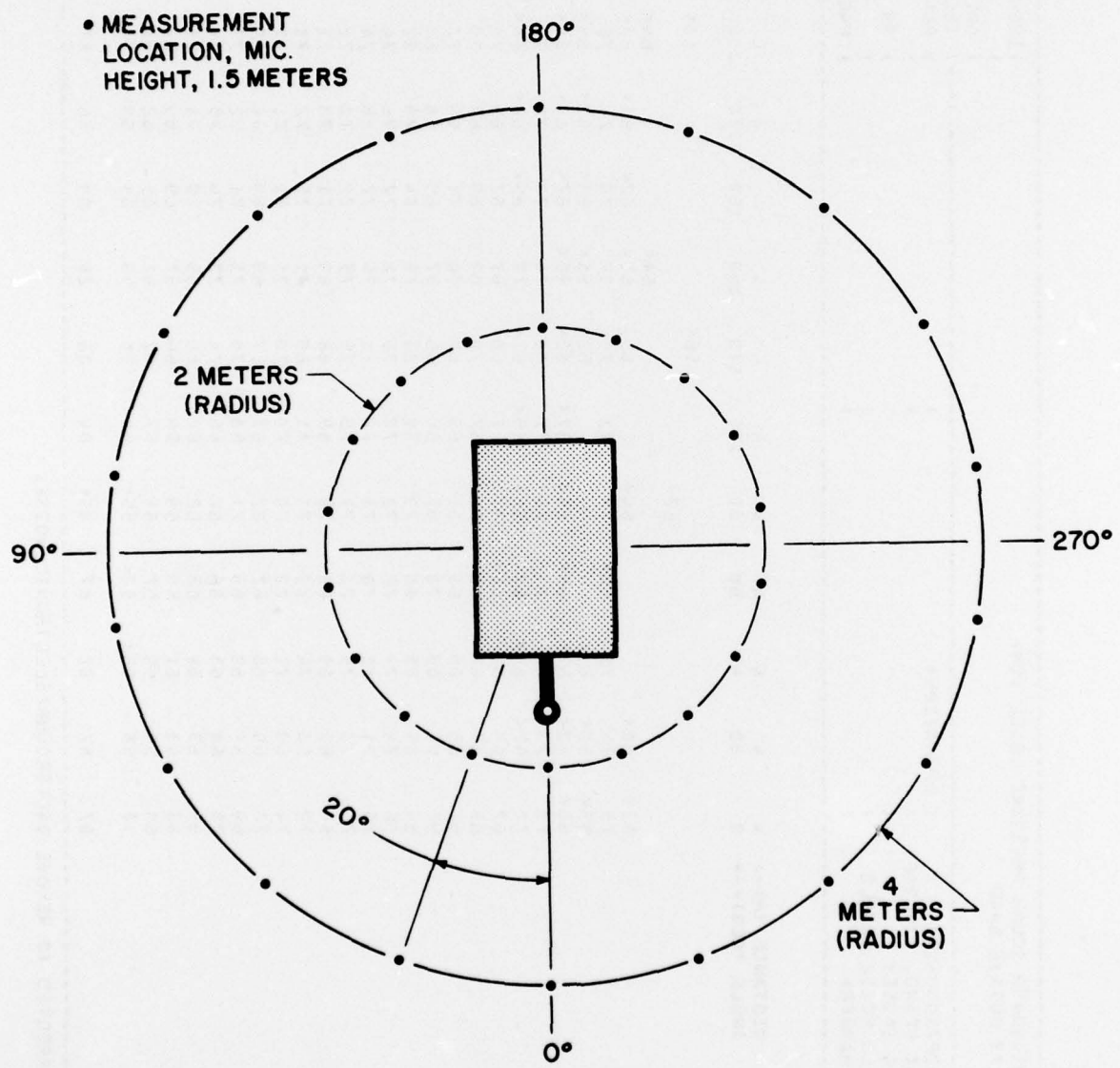


Figure 1. Measurement Locations

TABLE: MEASURED SOUND PRESSURE LEVEL (DB) 1/3 OCTAVE BAND			IDENTIFICATION:																			
2			OMEGA 3.2 TEST 71-020-380																			
NOISE SOURCE/SUBJECT (OPERATION)			RUN 01																			
MK-1 TEST STAND, AIRCRAFT			20 AUG 74																			
HYDRAULIC SYSTEM			PAGE F1																			
NEAR FIELD NOISE LEVELS (INSIDE HANGER)																						
FREQ (HZ)	DISTANCE (M)-->	ANGLE (DEG)-->	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
25																						
31.5																						
40																						
50																						
63																						
80																						
100																						
125																						
160																						
200																						
250																						
315																						
400																						
500																						
630																						
800																						
1000																						
1250																						
1600																						
2000																						
2500																						
3150																						
4000																						
5000																						
6300																						
8000																						
10000																						
OVERALL																						

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB) 1/3 OCTAVE BAND											IDENTIFICATION:												
2											OMEGA 3.2												
											TEST 71-020-380												
											RUN 02												
											20 AUG 74												
											PAGE F2												
NOISE SOURCE/SUBJECT: (OPERATION:)																							
MK-1 TEST STAND, AIRCRAFT ()																							
HYDRAULIC SYSTEM ()																							
NEAR FIELD NOISE LEVELS ()																							
(INSIDE HANGER)																							
FREQ (HZ)	DISTANCE (M)-->	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2	2	
()	ANGLE (DEG)-->	260	300	320	340	0	20	40	60	80	100	120	140	()	()	()	()	()	()	()	()	()	()
25			61<																				
31.5																							
40			59<																				
50		64<	65<	71	61<		69	60<	63<	66<	66<	66<	67<	67<	67<	67<	67<	67<	67<	67<	67<	67<	67<
63		77	79	75	74	61<	69	71	76	78	78	78	78	78	78	78	78	78	78	78	78	78	78
80		63<	63<	62<	61<	62<	64<	64<	60<	60<	60<	60<	60<	60<	60<	60<	60<	60<	60<	60<	60<	60<	60<
100		64<	65<	63<	64<	65<	67<	66<	68<	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<
125		73	71	70<	71	70<	70<	70<	76	75	75	75	75	75	75	75	75	75	75	75	75	75	75
160		65<	66<	64<	65<	64<	73	72	69	70	71	71	71	71	71	71	71	71	71	71	71	71	71
200		65<	65<	64<	65<	64<	74	73	71	68	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<	66<
250		64<	64<	64<	64<	64<	74	73	68	66	68	68	68	68	68	68	68	68	68	68	68	68	68
315		64	66	66	67	67	72	69	68	68	68	68	68	68	68	68	68	68	68	68	68	68	68
400		79	74	76	78	87	88	88	82	79	79	79	79	79	79	79	79	79	79	79	79	79	79
500		72	69	69	72	79	80	80	74	73	73	73	73	73	73	73	73	73	73	73	73	73	73
630		72	74	67	70	70	77	74	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
800		72	74	67	70	70	77	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
1000		68	74	67	77	74	81	79	78	78	78	78	78	78	78	78	78	78	78	78	78	78	78
1250		65	67	65	70	68	74	73	69	72	69	72	72	72	72	72	72	72	72	72	72	72	72
1600		68	65	71	72	75	77	75	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
2000		71	64	69	72	67	76	70	72	70	69	72	72	72	72	72	72	72	72	72	72	72	72
2500		65	63	65	68	66	72	71	71	71	67	68	68	68	68	68	68	68	68	68	68	68	68
3150		63	65	68	67	68	73	75	73	74	74	74	74	74	74	74	74	74	74	74	74	74	74
4000		66	67	69	69	69	76	75	73	71	70	69	69	69	69	69	69	69	69	69	69	69	69
5000		63	63	65	66	67	72	71	68	67	66	66	66	66	66	66	66	66	66	66	66	66	66
6300		62	61	63	63	64	69	68	67	65	64	64	64	64	64	64	64	64	64	64	64	64	64
8000		59	59	59	61	60	65	65	64	63	62	63	63	63	63	63	63	63	63	63	63	63	63
10000		55<	55<	56<	59	58	62	65	63	61	60	59	60	60	60	60	60	60	60	60	60	60	60
OVERALL		84	83	82	84	89	91	86	86	87	86	87	88	88	88	88	88	88	88	88	88	88	88

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)
1/3 OCTAVE BAND

IDENTIFICATION:

OMEGA 3.2
TEST 71-020-380
RUN 03
20 AUG 74
PAGE F3

NOISE SOURCE/SUBJECT: (OPERATION:
MK-1 TEST STAND, AIRCRAFT ()
HYDRAULIC SYSTEM ()
NEAR FIELD NOISE LEVELS ()
(INSIDE HANGER) ()

FREQ (HZ)	DISTANCE (M) →										OPERATOR LOCATION	
	160	180	200	220	240	260	280	300	320	340	TEST	CONDITION
25			57<								56<	56<
31.5	64<	65<	63<	64<								
40					69<							
50		62<	62<	65<	69<			68<	64<	60<	62<	62<
63	63<	75	74	78	82	83	82	81	78	73	70	70
80	65<	67<	65<	64<	65<	65<	65<	65<	64<	65<	64<	64<
100	71<	73	70<	65<	65<	68<	68<	68<	68<	68<	66<	66<
125	81	84	82	75	72	72	72	76	77	74	71	71
160	72	73	72	69	67<	66<	68<	67<	70	71	72	72
200	75	76	76	76	71	69	67	68	73	73	69	69
250	75	76	75	72	70	68	68	66	70	73	70	70
315	74	77	74	72	70	67	67	67	68	72	71	71
400	72	74	72	72	72	71	71	72	71	72	76	76
500	85	87	84	72	74	81	72	81	82	86	81	81
630	81	83	81	72	70	74	70	74	75	78	75	75
800	81	81	79	75	75	73	73	73	73	73	74	74
1000	83	81	81	76	73	72	72	71	75	75	81	81
1250	78	77	76	73	69	67	67	67	70	73	74	74
1600	78	79	77	72	71	66	68	70	77	79	79	79
2000	76	76	76	74	70	68	67	70	71	75	76	76
2500	74	74	74	71	67	65	64	68	71	72	74	74
3150	79	79	76	72	69	72	71	70	72	77	78	78
4000	79	81	78	74	70	69	70	71	74	75	75	75
5000	75	77	75	71	67	67	67	67	70	71	70	70
6300	72	74	72	69	65	66	65	66	68	68	67	67
8000	67	68	66	64	62	63	62	63	64	65	66	66
10000	63	65	62	61	60	60	60	60	62	64	63	63
OVERALL	91	93	91	86	86	87	85	87	88	89	88	88

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											IDENTIFICATION:										
OCTAVE BAND																					
2											OMEGA 3.2										
											TEST 71-020-380										
											RUN 01										
											20 AUG 74										
											PAGE J1										

NOISE SOURCE/SUBJECT: (OPERATION:																					
MK-1 TEST STAND, AIRCRAFT (
HYDRAULIC SYSTEM (
NEAR FIELD NOISE LEVELS (
(INSIDE HANGER) (

FREQ (HZ)	DISTANCE (M)-->	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
	ANGLE (DEG)-->	0	20	40	60	80	100	120	140	160	180	200	220	240							
31.5		76	74	71											65						
63		75	74	77											75						
125		72	72	72	72	76	78	79	80	75	74	75	77	75	75	77					
250		84	86	86	86	81	81	83	83	83	83	83	83	84	82						
500		78	76	77	75	79	77	77	78	79	80	77	77	80	73						
1000		77	73	77	75	74	74	73	75	77	75	75	75	75	72						
2000		73	71	72	71	72	71	74	76	77	77	77	77	74	71						
4000		66	65	63	62	62	62	66	69	70	70	68	66	65							
8000																					
OVERALL		87	87	87	87	85	84	86	86	88	86	87	87	85	87	87	87	87	87	87	85

	MEASURED SOUND PRESSURE LEVEL (DB)														IDENTIFICATION																										
	OCTAVE BAND														OMEGA	TEST 71-020-380																									
2																RUN 02																									
	NOISE SOURCE/SUBJECT:		(OPERATION:																																						
	MK-1 TEST STAND, AIRCRAFT		(
	HYDRAULIC SYSTEM		(
	NEAR FIELD NOISE LEVELS		(20 AUG 74																									
	(INSIDE HANGER)		(PAGE J2																									
	FREQ (HZ)		DISTANCE (M)	260	280	300	320	340		0	2	20	40	60	80	100	120	140																							
			ANGLE (DEG)	-->																																					
	31.5																																								
	63		77	79	75	71	73	74	74	70	70	72	76	78	80	81	81	81	77																						
	125		74	73	71	69	71	71	71	75	78	76	77	77	77	77	77	77	80																						
	250		69	70	69	77	79	87	87	89	89	88	81	83	80	77	73	75																							
	500		80	76	77	77	79	87	87	89	89	88	81	83	80	77	73	75																							
	1000		74	77	71	71	78	76	76	83	83	81	80	74	81	77	77	75																							
	2000		73	69	73	73	76	76	76	80	80	77	77	76	75	75	75	78																							
	4000		69	70	72	72	72	73	73	79	79	79	78	76	76	76	75	78																							
	8000		64	64	65	65	66	66	66	71	71	71	69	68	67	67	68	71																							
	OVERALL		84	83	82	82	84	89	89	91	86	86	86	86	87	86	87	88																							

MEASURES OF HUMAN NOISE EXPOSURE													IDENTIFICATION:			
3																
NOISE SOURCE/SUBJECT: (OPERATION:)													OMEGA 3.2			
MK-1 TEST STAND, AIRCRAFT ()													TEST 71-020-300			
HYDRAULIC SYSTEM ()													RUN 01			
NEAR FIELD NOISE LEVELS ()													20 AUG 74			
(INSIDE HANGER) ()													PAGE H1			
DISTANCE (M)--> 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4													4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4			
ANGLE (DEG)--> 0 20 40 60 80 100 120 140 160 180 200 220 240													200 220 240			
HAZARD/PROTECTION																
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR																
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR																
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)																
NO PROTECTION																
OASLC																
OASLA																
MINIMUM QPL EAR MUFFS																
OASLA*																
T																
AMERICAN OPTICAL 1700 EAR MUFFS																
OASLA*																
T																
V-51R EAR PLUGS																
OASLA*																
T																
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS																
OASLA*																
T																
H-133 GROUND COMMUNICATION UNIT																
OASLA*																
T																
COMMUNICATION																
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)																
PSIL																
ANNoyANCE																
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)																
TONE CORRECTION (C IN DB)																
PNLT																
C																

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE											IDENTIFICATION:		
3											OMEGA 3.2		
NOISE SOURCE/SUBJECT: (OPERATION:)											TEST 71-020-380		
MK-1 TEST STAND, AIRCRAFT ()											RUN 02		
HYDRAULIC SYSTEM ()											20 AUG 74		
NEAR FIELD NOISE LEVELS ()											PAGE H2		
(INSIDE HANGER)													
DISTANCE (M)--> 4 4 4 4 4 4 4 4 4 4 4											2 2 2 2 2 2 2 2 2 2 2		
ANGLE (DEG)--> 260 280 280 300 320 340 0 0 0 0 0											20 40 60 80 100 120 140		
HAZARD/PROTECTION													
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR													
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR													
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)													
NO PROTECTION													
OASLC													
OASLA													
T													
MINIMUM OPL EAR MUFFS													
OASLA*													
T													
AMERICAN OPTICAL 1700 EAR MUFFS													
OASLA*													
T													
V-51R EAR PLUGS													
OASLA*													
T													
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS													
OASLA*													
T													
H-133 GROUND COMMUNICATION UNIT													
OASLA*													
T													
COMMUNICATION													
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)													
PSIL													
ANNNOYANCE													
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)													
TONE CORRECTION (C IN DB)													
PNLT													
C													

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE													IDENTIFICATION:
3													OMEGA 3.2
NOISE SOURCE/SUBJECT: (OPERATION:)													TEST 71-020-360
MK-1 TEST STAND, AIRCRAFT ()													RUN 03
HYDRAULIC SYSTEM ()													20 AUG 74
NEAR FIELD NOISE LEVELS ()													PAGE H3
(INSIDE HANGER) ()													
DISTANCE (M)--> 2 2 2 2 2 2 2 2 2 2 2 2 2													2 2 2 2 2 2 2 2 2 2 2 2 2
ANGLE (DEG)--> 160 180 200 220 240 260 280 300 320 340													340
													OPERATOR LOCATION
													1/A
HAZARD/PROTECTION													
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN OBC) AT EAR													
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR													
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)													
NO PROTECTION													
OASLC	91	93	90	86	85	87	85	86	87	89	88	88	
OASLA	90	91	89	84	82	83	81	83	85	88	88		
T	170	143	202	480	679	571	807	571	404	240	240		
MINIMUM QPL EAR MUFFS													
OASLA*	67	69	66	61	60	62	60	62	63	65	63		
T	960	960	960	960	960	960	960	960	960	960	960		
AMERICAN OPTICAL 1700 EAR MUFFS													
OASLA*	61	63	61	57	57	58	57	58	58	59	57		
T	960	960	960	960	960	960	960	960	960	960	960		
V-51R EAR PLUGS													
OASLA*	65	66	64	58	57	59	56	59	60	63	62		
T	960	960	960	960	960	960	960	960	960	960	960		
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS													
OASLA*	51	51	50	45	43	45	43	44	46	47	48		
T	960	960	960	960	960	960	960	960	960	960	960		
H-133 GROUND COMMUNICATION UNIT													
OASLA*	62	62	61	57	55	55	54	55	57	59	60		
T	960	960	960	960	960	960	960	960	960	960	960		
COMMUNICATION													
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)													
PSIL	84	85	83	78	76	77	74	77	80	82	82		
ANNOYANCE													
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)													
TONE CORRECTION (C IN DB)													
PNLT	105	107	104	99	96	99	96	98	101	104	103		
C	3	3	2	1	1	3	1	3	3	4	2		

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.