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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK: D-4 TEST STAND, AIRC--ETC(U)  
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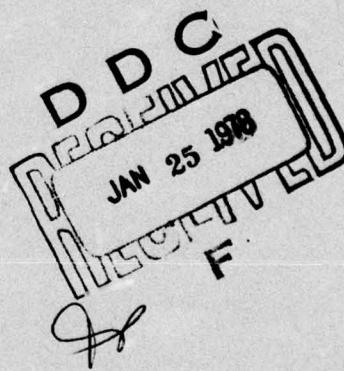


## USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 115

D-4 Test Stand, Aircraft Hydraulic System

DECEMBER 1976



Approved for public release; distribution unlimited.

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) <b>The D-4 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 hanger 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 limiting times</b>			

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→ 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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## INTRODUCTION

The D-4 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 D-4 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 Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, ground support equipment, and 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, 0% rel 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 repeated 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, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

Direct 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) 55-3675 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, WPAFB, OH, 1975.

## **NEAR-FIELD NOISE**

## **MEASUREMENTS**

A standard D-4 Test Stand was operated inside, and approximately in the center of a large aircraft hanger (167.6 m long  $\times$  36.6 m wide  $\times$  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 D-4 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 I

## **MEASUREMENT LOCATION AND TEST CONDITIONS- FOR OPERATOR NOISE MEASUREMENTS**

**D-4 Test Stand, Aircraft Hydraulic System  
Wright Patterson AFB, 2 Nov 1972  
FSN 4520-817-1793**

### ***Measurement Location***

## **1 Operator Control Panel**

### *Operation*

**A System Pressurized**

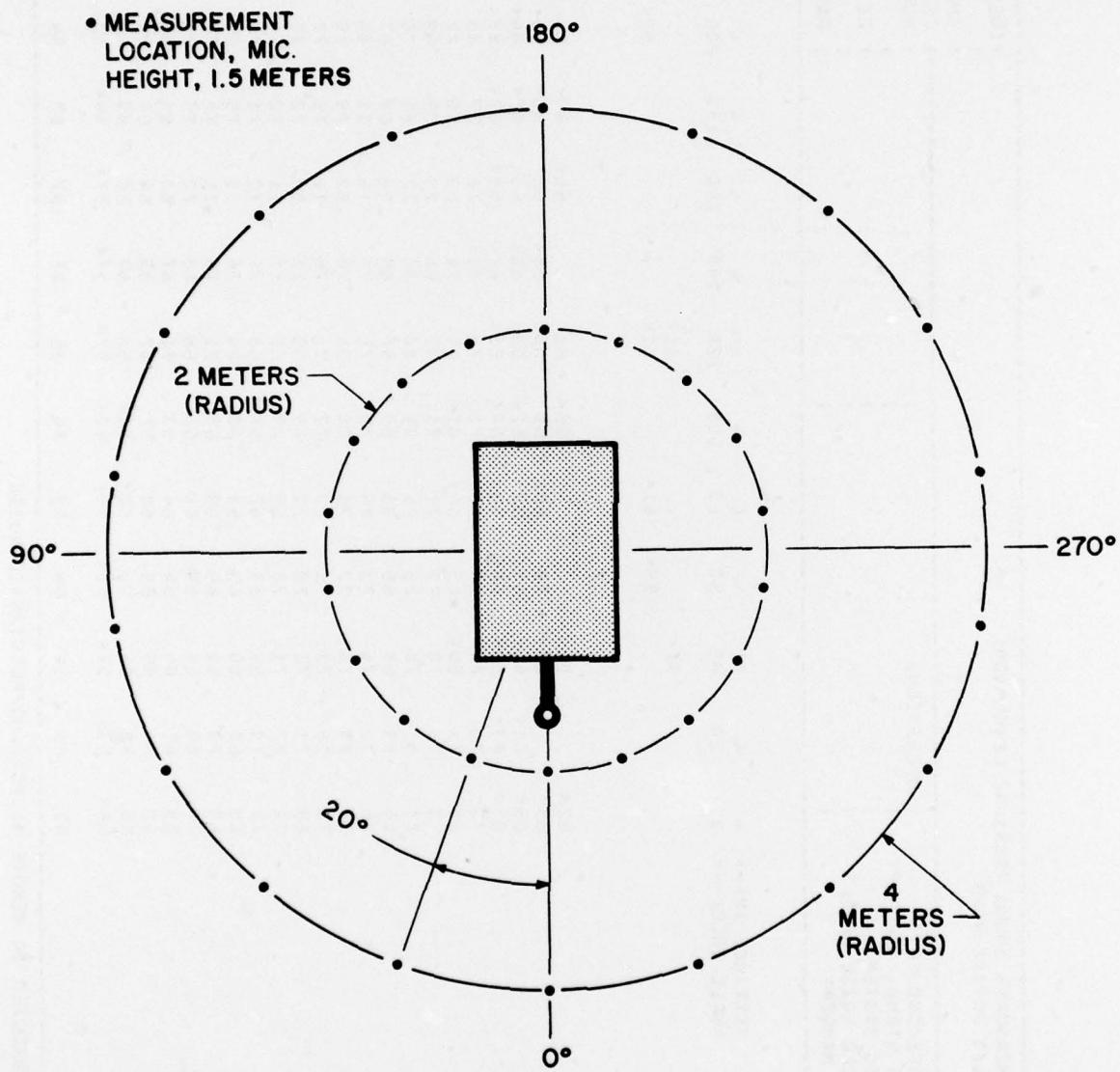


Figure 1. Measurement Locations

TABLE 2  
MEASURED SOUND PRESSURE LEVEL (DB)  
1/3 OCTAVE BAND

NOISE SOURCE/SUBJECT:		OPERATION:		IDENTIFICATION:	
D-4 TEST STAND, AIRCRAFT		TEST 71-020-400		OMEGA 3.2	
HYDRAULIC SYSTEM		RUN 01		TEST 71-020-400	
NEAR FIELD NOISE LEVELS		20 AUG 74		20 AUG 74	
(INSIDE HANGER)		PAGE F1		PAGE F1	
FREQ (HZ)	ANGLE (DEG)-->	DISTANCE (M)-->	4	4	4
25	31.5	0	20	40	60
			57<	59<	61<
					61<
					62<
40	60	62<	65<	66<	68<
50	61<	67<	70	66<	69
63	63<	61<	62<	63<	64<
80	63<	61<	63<	60<	62<
100	63<	59<	60<	61<	63<
125	73	74	76	71	79
160	74	75	77	79	83
200	75	76	79	71	79
250	68	71	66<	65<	65<
315	73	70	72	71	72
400	77	81	75	81	80
500	64	69	66	69	66
630	76	72	75	75	74
800	75	73	75	72	71
1000	78	76	73	72	71
1250	69	71	73	70	69
1600	70	72	71	70	69
2000	70	70	69	67	67
2500	69	68	69	68	68
3150	69	70	69	69	68
4000	70	69	69	69	68
5000	68	65	64	64	63
6300	62	61	59	58	57
8000	56	56	55	54	52<
10000	54<	53<	52<	50<	49<
OVERALL		85	85	84	84
			83	84	85
			87	87	87
			87	89	89
			88	88	88

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)  
2 1/3 OCTAVE BAND

NOISE SOURCE/SUBJECT		OPERATIONS				IDENTIFICATION			
D-4 TEST STAND, AIRCRAFT HYDRAULIC SYSTEM	NEAR FIELD NOISE LEVELS (INSIDE HANGER)	TEST 71-020-400	RUN 02	20 AUG 74	PAGE F2	OMEGA 3.2	TEST 71-020-400	RUN 02	20 AUG 74
FREQ (HZ)	DISTANCE (M) ->	4	4	4	4	2	2	2	2
ANGLE (DEG) -->	260	280	300	320	340	0	20	40	60
25						60<			
31.5									
40									
50									
63									
80	60<	59<	59<	61<	58<	57<	58<	58<	58<
100	60<	59<	66<	68<	73	74	70	68<	70
125	61<	59<	60<	61<	64<	63<	61<	61<	62<
160	61<	59<	61<	62<	69	68	64<	62<	60<
200	78	72	77	68	81	87	83	83	63<
250	70	68	69	64<	71	76	73	71	70
315	78	73	74	73	71	78	74	71	70
400	81	77	76	80	75	82	76	72	76
500	65	67	65	69	64	70	68	71	64
630	74	74	78	70	72	78	76	71	74
800	75	83	77	78	79	78	77	80	74
1000	78	77	78	81	76	78	74	72	75
1250	73	74	72	73	72	75	74	72	73
1600	71	76	73	70	69	74	75	70	71
2000	71	72	71	72	72	75	76	73	74
2500	73	72	75	74	71	73	74	71	70
3150	75	71	75	74	73	72	76	70	68
4000	72	72	71	73	72	72	72	71	69
5000	68	69	68	68	68	68	69	65	65
6300	64	64	63	64	63	64	65	63	61
8000	61	62	61	60	58<	57<	59	57	57
10000	59	59	59	58<	58<	58<	56<	54<	53<
OVERALL	87	87	86	87	86	90	88	86	86

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE I MEASURED SOUND PRESSURE LEVEL (DB)  
2 1/3 OCTAVE BAND

NOISE SOURCE/SUBJECT:		OPERATION:		TEST CONDITION:		LOCATION:		IDENTIFICATION:	
D-4 TEST STAND, AIRCRAFT HYDRAULIC SYSTEM		NEAR FIELD NOISE LEVELS (INSIDE HANGER)		TEST 71-020-400 RUN 03 20 AUG 74		OMEGA 3.2		TEST 71-020-400 RUN 03 20 AUG 74	
FREQ (HZ)		DISTANCE (M) ->		2 1/3 OCTAVE BAND		2 1/3 OCTAVE BAND		2 1/3 OCTAVE BAND	
25	31.5	59<	62<	2 180	200	220	240	260	280
50	40	60<	62<	2 62<	64<	64<	64<	64<	64<
63	50	61<	64<	2 64<	65<	65<	65<	65<	65<
80	63	62<	67<	2 66<	67<	67<	67<	67<	66<
100	72	63<	69<	2 69<	67	67	67	67	64<
125	67	65<	70	2 71	69	69	69	69	64<
160	81	71	81	2 84	86	89	89	89	72
200	71	74	74	2 76	78	79	79	79	91
250	74	76	77	2 73	74	75	76	76	80
315	76	74	77	2 74	75	76	76	75	80
400	84	81	90	2 89	81	87	84	85	85
500	73	72	78	2 77	72	76	73	72	76
630	78	81	82	2 76	86	86	82	81	84
800	77	79	85	2 83	84	83	77	84	80
1000	79	87	83	2 86	83	83	85	81	85
1250	79	82	76	2 79	77	77	79	77	81
1600	81	75	76	2 76	77	78	79	74	81
2000	78	76	75	2 77	76	77	76	77	79
2500	77	74	79	2 78	79	79	75	75	79
3150	79	77	77	2 80	80	81	79	77	81
4000	77	78	81	2 81	81	81	79	76	79
5000	73	72	76	2 74	74	73	73	72	74
6300	68	66	68	2 70	70	70	68	68	70
8000	63	64	65	2 66	66	65	65	64	67
10000	61	61	63	2 64	63	63	63	62	63
OVERALL	90	91	94	2 93	94	93	93	90	95

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE 2		MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION:			
		NOISE SOURCE/SUBJECT: D-4 TEST STAND, AIRCRAFT HYDRAULIC SYSTEM NEAR FIELD NOISE LEVELS (INSIDE HANGER)										OPERATION: TEST 71-020-400 RUN 01 20 AUG 74 PAGE J1			
FREQ (HZ)	DISTANCE (M) -->	4	4	4	4	4	4	4	4	4	4	4	4	4	4
63	69	65	69	71	68	70	67	70	68	68	70	69	69	69	69
125	76	77	80	76	75	80	83	78	80	80	85	80	82	80	82
250	79	82	80	78	82	82	82	81	81	83	81	84	84	84	84
500	80	79	78	76	75	74	80	83	78	82	83	82	83	82	82
1000	74	75	74	73	73	72	77	77	76	78	77	79	77	77	77
2000	74	73	73	73	72	74	73	75	76	75	75	78	78	78	78
4000	64	63	61	60	59	59	64	66	66	67	66	67	68	68	68
8000															
OVERALL	85	85	84	84	83	84	85	87	87	87	89	89	88	88	88

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)  
2 OCTAVE BAND

NOISE SOURCE/SUBJECT		OPERATION		IDENTIFICATION	
D-4 TEST STAND, AIRCRAFT	HYDRAULIC SYSTEM	NEAR FIELD NOISE LEVELS	(INSIDE HANGER)	TEST 71-020-400	OMEGA 3.2
63	69	65	62	68	68
125	81	76	79	82	84
250	82	79	80	81	83
500	80	84	81	83	83
1000	81	83	81	82	81
2000	76	78	77	75	79
4000	77	75	77	76	78
8000	67	67	66	65	66
OVERALL	87	87	86	87	86
				20 AUG 74	
				PAGE J2	
FREQ (HZ)	DISTANCE (M) ->	4	4	4	2
	ANGLE (DEG) -->	260	280	300	320
		340	340	0	20
				40	60
				75	75
				71	71
				70	70
				74	74
				82	82
				79	79
				86	85
				78	79
				75	74
				74	79
				72	76
				63	64
				63	69
				64	
				87	88

TABLE 6 MEASURED SOUND PRESSURE LEVEL (dB)  
OCTAVE BAND

TABLE I MEASURED SOUND PRESSURE LEVEL (DB)												
2 OCTAVE BAND												
NOISE SOURCE/SUBJECT! OPERATIONS												
0-4 TEST STAND, AIRCRAFT												
HYDRAULIC SYSTEM												
NEAR FIELD NOISE LEVELS												
(INSIDE HANGER)												
FREQ (HZ)	DISTANCE (IN) --> ANGLE (DEG) -->	2 160	2 180	2 200	2 220	2 240	2 260	2 280	2 300	2 320	2 340	OPERATOR LOCATION TEST CONDITION 1/A
31.5												
63	70	74	74	72	71	71	70	71	73	73	66	
125	63	77	83	84	87	90	90	89	90	86	73	
250	85	84	91	89	87	86	86	87	86	86	91	
500	63	69	67	68	67	66	66	66	66	66	86	
1000	84	80	82	82	82	82	82	82	82	82	87	
2000	81	81	83	84	83	83	82	82	80	80	85	
4000	70	69	70	72	72	71	70	70	70	70	83	
8000											72	
OVERALL		90	91	94	93	94	93	93	93	90	95	

TABLE 3 MEASURES OF HUMAN NOISE EXPOSURE

		HAZARD/PROTECTION						COMMUNICATION						ANNOYANCE	
		C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR						PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)						PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)	
		A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR						PNLT IN PSIL						TONE CORRECTION (C IN DB)	
		MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)						PNLT						C	
		NO PROTECTION						PSIL						T	
NOISE SOURCE/SUBJECT:	OPERATION:	O-4 TEST STAND, AIRCRAFT	0	20	40	60	80	100	120	140	160	180	200	4	4
D-4 HYDRAULIC SYSTEM		NEAR FIELD NOISE LEVELS												220	240
Near Field Noise Levels (Inside Hanger)															
DISTANCE (M) -->	ANGLE (DEG) -->	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		0	20	40	60	80	100	120	140	160	180	200	220	240	
OASLC	QPL	84	85	84	84	83	84	85	87	86	86	89	88	88	88
OASLA*	EAR MUFFS	83	83	82	81	81	82	82	84	85	85	86	87	86	86
T		571	571	679	807	807	679	679	480	404	404	339	285	339	339
AMERICAN OPTICAL 1700 EAR MUFFS		59	61	60	60	58	60	61	63	61	62	64	63	63	63
OASLA*		960	960	960	960	960	960	960	960	960	960	960	960	960	960
T		54	55	54	55	52	55	56	58	55	57	60	58	58	58
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS		960	960	960	960	960	960	960	960	960	960	960	960	960	960
OASLA*		45	44	43	42	42	43	42	45	47	45	47	48	48	48
T		960	960	960	960	960	960	960	960	960	960	960	960	960	960
H-133 GROUND COMMUNICATION UNIT		55	55	55	54	53	53	54	57	57	57	58	60	58	58
OASLA*		960	960	960	960	960	960	960	960	960	960	960	960	960	960
T		78	78	76	76	77	76	77	80	79	80	82	81		

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE I MEASURES OF HUMAN NOISE EXPOSURE  
3

NOISE SOURCE/SUBJECT:		OPERATION		IDENTIFICATION*	
D-4 TEST STAND, AIRCRAFT				OMEGA 3.2	
HYDRAULIC SYSTEM				TEST 71-020-400	
NEAR FIELD NOISE LEVELS				RUN 02	
(INSIDE HANGER)				20 AUG 74	
				PAGE H2	
DISTANCE (M) -->	ANGLE (DEG) -->	4	4	4	2
260	260	300	320	340	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	87	87	86	86	86
OASLA	85	86	85	84	87
T	404	339	404	339	404
MINIMUM QPL EAR MUFFS					
OASLA*	62	60	61	61	67
T	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS	57	54	55	56	62
OASLA*	T	960	960	960	960
V-51R EAR PLUGS					
OASLA*	60	62	60	61	59
T	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS	46	48	46	47	48
OASLA*	T	960	960	960	960
H-133 GROUND COMMUNICATION UNIT	56	58	58	57	59
OASLA*	T	960	960	960	960
COMMUNICATION PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)					
PSIL	79	81	80	78	81
ANNOYANCE PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)					
TONE CORRECTION (C IN DB)					
PNLT	100	99	100	99	101
C	2	2	3	2	2
					3
					2
					2
					3

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE I MEASURES OF HUMAN NOISE EXPOSURE

2

• BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.