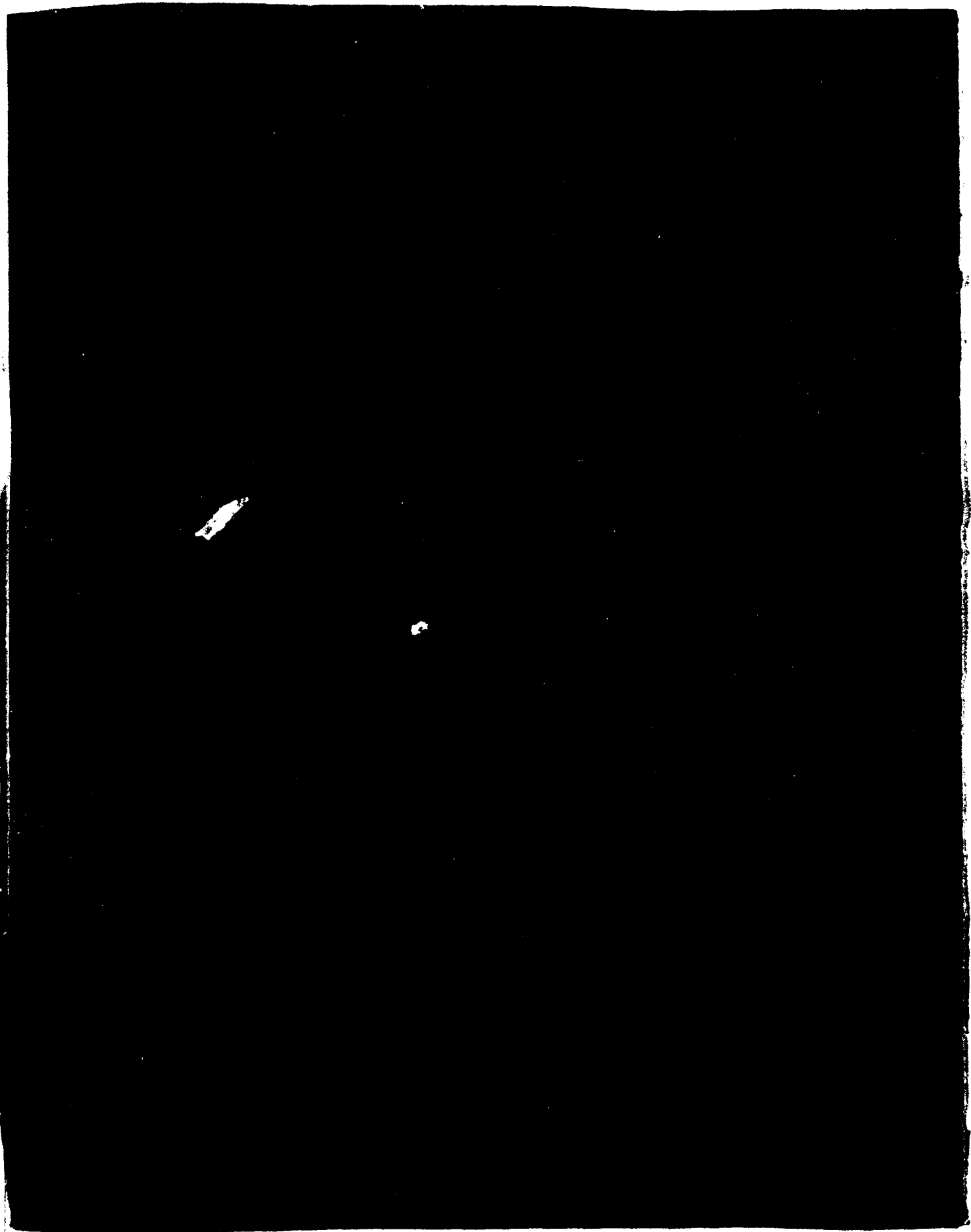


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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The MD-4MO generator set is an electric motor-driven source of electrical power used primarily for the starting of aircraft, and for ground maintenance. This report provides measured and extrapolated data defining the bioacoustic environments produced by this unit operating outdoors on a concrete apron at a normal rated condition. 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			

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interference levels, perceived noise levels, and 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, Air Force Aerospace Medical Research Laboratory, under Project/Task 723107, Measurement and Prediction of Noise Environments of Air Force Operations.

The author gratefully acknowledges Mr. John N. Cole for his assistance in preparing this report, Mr. Robert G. Powell for his assistance in acquiring the raw data, Mr. Henry T. Mohlman and Mr. Fred D. Lampley of the University of Dayton for their assistance in the mechanics of data processing, and Mrs. Norma J. Peachey who typed and prepared the graphics.

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Location for this work is in the unpublished literature
Author Title Date

INTRODUCTION

The MD-4MO generator set is an electric motor-driven source of electric power used for the starting of aircraft, and for ground maintenance. This unit is manufactured by Teledyne Sprague Engineering.

This volume provides measured and extrapolated data defining 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 MD-4MO generator set.

This volume is one of a series published by the Air Force Aerospace Medical Research Laboratory (AFAMRL) 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. Refer to Volume 1 (reference 1) 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 AFAMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of each updated index as it is generated.

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

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1. 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.*

NEAR-FIELD NOISE

MEASUREMENTS

A standard MD-4MO generator was operated outside in front of radar docks used for aircraft maintenance, on a concrete slab, at a normal rated condition. Due to the proximity of the radar docks, no far-field data were acquired.

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 location/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 MD-4MO unit at 37 the 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 LOCATIONS AND TEST CONDITIONS
FOR OPERATOR NOISE MEASUREMENTS

MD-4MO Generator
Tyndall AFB, 19 June 1980
FBN 0125-100-0079, Field #A101

Measurement Location	
1	Operator Control Panel
Operation	
A	Unloaded

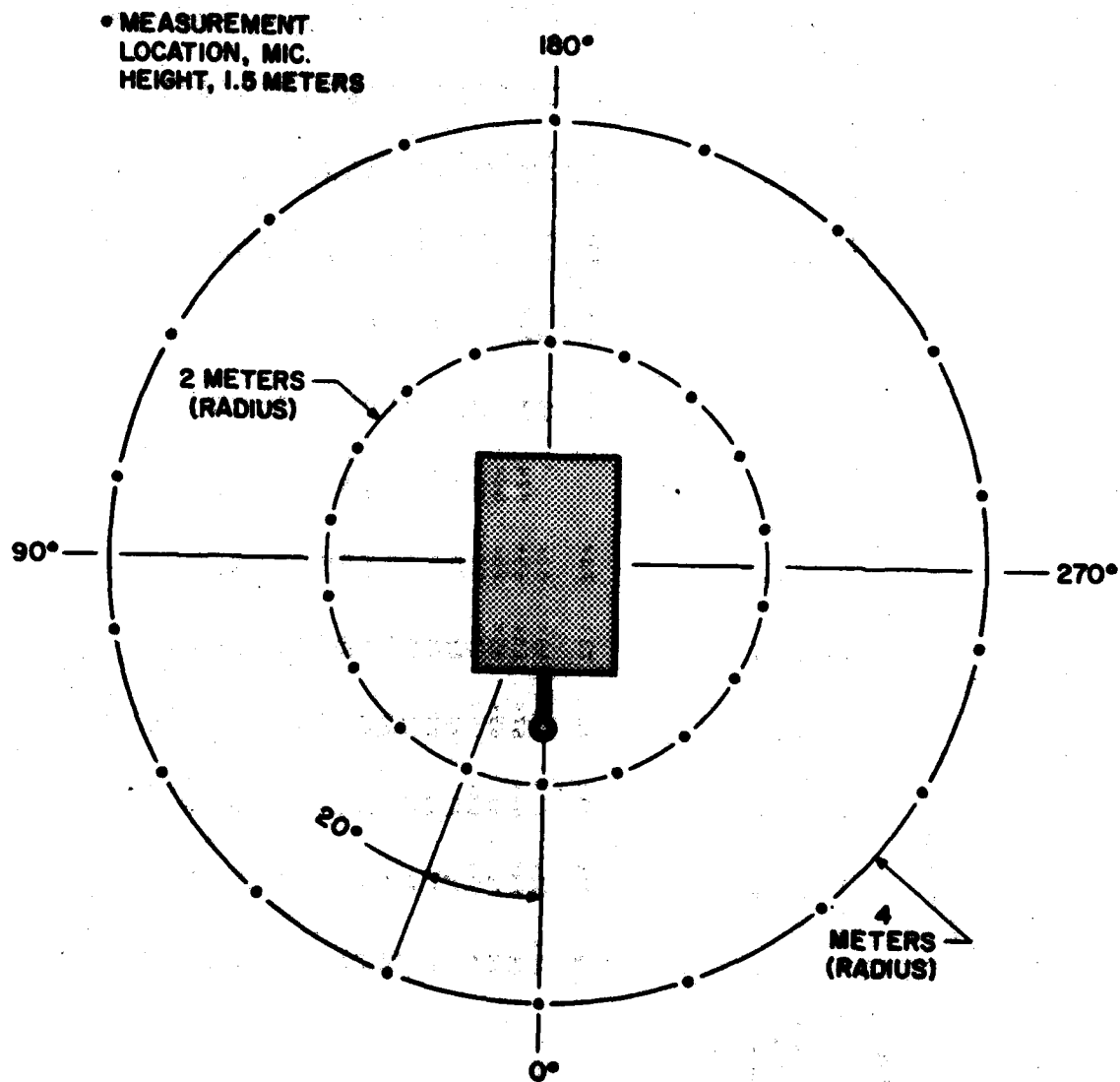


Figure 1. Measurement Locations

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		IDENTIFICATION											
2 1/3 OCTAVE BAND		OMEGA 3.2											
NOISE SOURCE/SUBJECT:		OPERATIONS:										TEST BA-888-887	
MO-4ND GENERATOR		UNLOADED										RUN 81	
GROUND CREW												06 APR 62	
NEAR FIELD NOISE LEVELS												PAGE F1	
FREQ (HZ)	DISTANCE (M)-->	LOCATION/CONDITION											
	ANGLE (DEG)-->	0	20	40	60	80	100	120	140	160	180	200	220
	CONDITION-->	A	A	A	A	A	A	A	A	A	A	A	A
25													
31.5													
40													
50													
63													
80													
100		72											
125		70	71	73	73	73	73	71	73	74	71	72	73
160													
200		69	69	70	69	69	69	69	69	69	69	69	69
250		68	68	69	67	68	68	67	68	72	70	68	68
315		70	71	67	68	68	68	67	71	71	72	70	73
400		68	68	68	67	68	68	67	71	67	68	67	69
500		72	71	71	71	71	71	71	71	69	67	67	69
630		70	71	70	71	70	70	70	69	67	67	67	70
800		70	69	70	70	69	69	69	68	67	66	67	70
1000		69	69	70	70	69	69	69	68	68	68	67	70
1250		70	69	69	71	70	69	69	67	64	64	65	69
1600		68	64	65	65	65	65	64	62	60	60	60	65
2000		66	60	61	60	61	61	60	59	58	57	57	61
2500		59	59	61	61	60	60	59	59	57	56	56	60
3150		59	59	60	60	60	60	60	59	58	57	59	60
4000		59	59	59	57	56	56	56	55	53	53	54	58
5000		54	54	54	53	52	52	52	51	50	50	51	55
6300		52	52	52	51	50	50	50	49	48	48	51	54
8000		51	51	51	50	49	49	49	48	47	47	51	54
10000		49	49	49	48	47	47	47	46	45	45	47	50
OVERALL		63	61	62	61	60	60	59	58	58	57	58	62

* LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB) 1/3 OCTAVE BAND													IDENTIFICATION	
2													OMEGA 3.2	
NOISE SOURCE/SUBJECT: (NO-4NO GENERATOR)													TEST DA-888-887	
(OPERATIONS: UNLOADED)													RUN 82	
GROUND CREW													06 APR 82	
NEAR FIELD NOISE LEVELS													PAGE F2	
FREQ (HZ)	DISTANCE (M)-->	LOCATION/CONDITION												
		4	4	4	4	4	2	2	2	2	2	2	2	
	ANGLE (DEG)-->	260	280	300	320	340	0	20	40	60	80	100	120	140
	CONDITION-->	A	A	A	A	A	A	A	A	A	A	A	A	A
25														
31.5														
40														
50														
63														
80														
100		75<	73<	75<	75<	73<	74<	74<	73<	74<	74<	74<	72<	
125														
160		69<	71<	71<	69<	68<	75<	75<	74<	73<	72<	70<	69<	69<
200		68<	68<	68<	69<	68<	77	77	75<	73<	72<	69<	72<	71<
250		69<	72<	70<	65<	69<	78	77	76	74	75	77	76	75
315		68<	68<	69<	70<	69<	75	75	76	70	76	76	77	75
400		78	69	78	73	73	73	74	76	73	73	73	71	71
500		70	70	74	75	75	76	77	78	77	76	74	75	74
630		70	70	73	73	70	78	77	76	76	76	75	74	76
800		69	70	71	72	72	75	76	78	73	73	73	73	72
1000		72	71	69	72	71	74	74	75	74	75	75	73	72
1250		70	70	71	69	72	75	76	75	74	74	73	72	70
1600		67	66	67	64	64	70	69	70	70	70	70	68	66
2000		63	62	63	61	60	65	65	66	66	64	63	64	62
2500		62	61	62	61	61	64	64	65	65	64	64	64	63
3150		61	61	62	61	61	64	63	65	66	65	65	65	63
4000		58	58	59	58	57	61	61	62	62	61	61	60	60
5000		57	56	57	56	56	57	59	60	58	59	59	58	57
6300		56	56	57	55	55	55	57	60	58	57	58	57	57
8000		55	55	56	55	54	56	59	62	58	57	59	58	58
10000		52	51	52	52	52	53	54	55	56	53	55	54	53
OVERALL		61	61	63	63	62	66	66	66	66	65	65	64	63

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											IDENTIFICATION:	
2	1/3 OCTAVE BAND										OMEGA 3.2	
NOISE SOURCE/SUBJECT:	OPERATION:										TEST BA-888-887	
HD-4MO GENERATOR	UNLOADED										RUN 83	
GROUND CREW											86 APR 82	
NEAR FIELD NOISE LEVELS											PAGE F3	
	LOCATION/CONDITION										OPERATOR LOCATION	
FREQ (Hz)	DISTANCE (M)-->	2	2	2	2	2	2	2	2	2	2	TEST CONDITION
	ANGLE (DEG)-->	160	180	200	220	240	260	280	300	320	340	1/A
	CONDITION-->	A	A	A	A	A	A	A	A	A	A	
25												
31.5												
40												
50												
63												
80							73<		74<			75<
100		72<	73<	74<	73<	74<	75<	75<	76<	74<	75<	79<
125			72<	71<	71<	71<	72<	71<	71<		71<	81<
160		69<	74<	72<	70<	70<	70<	72<	73<	74<	75<	80<
200		71<	73<	73<	69<	72<	69<	71<	73<	74<	76	79
250		73<	75	74<	75	75	77	75	77	77	78	79
315		73	72<	73	76	77	76	76	77	77	76	79
400		71	70	71	71	71	74	73	74	73	75	77
500		72	69	72	74	77	76	76	77	77	77	76
630		72	68	72	74	77	75	76	77	77	76	75
800		69	68	70	74	74	76	75	76	76	77	74
1000		70	67	71	74	75	75	75	75	76	76	73
1250		60	66	60	73	75	76	76	74	73	76	72
1600		62	62	62	60	69	70	71	71	70	70	67
2000		60	50<	59	64	67	67	67	67	66	65	63
2500		59	50	59	64	67	66	67	67	67	65	62
3150		60	50	59	64	67	66	66	67	67	65	61
4000		56	55	55	61	63	62	62	64	63	62	59
5000		54	54	54	60	61	60	60	60	60	59	56
6300		51	51<	51	57	60	50	59	59	59	59	56
8000		51	52	50<	58	61	57	60	60	59	59	57
10000		40<	47<	40<	55	56	55	55	56	56	55	52
OVERALL		82	82	83	84	86	86	86	87	86	87	89

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB) 2 OCTAVE BAND		IDENTIFICATION:												
NOISE SOURCE/SUBJECT:		OPERATIONS:										OMEGA 3.2		
MO-4MO GENERATOR		UNLOADED										TEST BA-888-887		
GROUND CREW												RUN 81		
NEAR FIELD NOISE LEVELS												86 APR 82		
												PAGE J1		
FREQ (HZ)	DISTANCE (M)-->	LOCATION/CONDITION												
	ANGLE (DEG)-->	0	20	40	60	80	100	120	140	160	180	200	220	240
	CONDITION-->	A	A	A	A	A	A	A	A	A	A	A	A	A
31.5														
63														
125		78	73	76	74	74	75		73	76	77	76	73	76
250		74	74	73	72	72	73	73	74	75	75	74	74	76
500		77	76	78	76	74	75	76	74	73	73	72	75	77
1000		74	74	75	75	74	74	72	73	78	78	71	74	75
2000		67	66	67	67	67	67	66	65	63	63	63	67	69
4000		61	62	62	63	62	63	62	61	60	59	61	62	66
8000		56	57	57	58	57	57	60	59	53	53	55	56	60
OVERALL		68	61	62	61	60	60	79	68	68	61	68	68	62

TABLE: MEASURED SOUND PRESSURE LEVEL (DB) OCTAVE BAND		IDENTIFICATION:												
2		OMEGA 3.2												
NOISE SOURCE/SUBJECT:		OPERATIONS:										TEST BA-888-887		
MD-4MO GENERATOR		UNLOADED										RUN 82		
GROUND CREW												06 APR 82		
NEAR FIELD NOISE LEVELS												PAGE J2		
		LOCATION/CONDITION												
FREQ (HZ)	DISTANCE (M)-->	4	4	4	4	4	2	2	2	2	2	2	2	2
	ANGLE (DEG)-->	200	200	300	320	340	0	20	40	60	80	100	120	140
	CONDITION-->	A	A	A	A	A	A	A	A	A	A	A	A	A
31.5														
63														
125		75	76	78	76	74	78	78	77	77	76	77	74	
250		73	74	74	73	73	81	81	81	80	79	80	80	79
500		75	74	77	78	78	81	81	81	81	80	79	78	79
1000		75	75	75	76	76	79	80	81	81	78	78	78	78
2000		69	68	69	67	67	72	71	72	72	71	71	70	69
4000		64	63	65	63	63	66	66	66	66	67	67	67	65
8000		59	59	61	59	58	59	62	64	62	61	62	61	61
OVERALL		81	81	83	82	82	86	86	86	86	85	85	84	83

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											IDENTIFICATIONS	
2											OCTAVE BAND	OMEGA 3.2
NOISE SOURCE/SUBJECTS											TEST BA-000-007	
MD-4MD GENERATOR											RUN 03	
GROUND CREW											06 APR 82	
NEAR FIELD NOISE LEVELS											PAGE 33	
											OPERATOR LOCATION	
FREQ (HZ)	DISTANCE (M)-->	ANGLE (DEG)-->	LOCATION/CONDITION								TEST CONDITION	L/A
	2	160	2	2	2	2	2	2	2	2	2	
	2	180	2	2	2	2	2	2	2	2	2	
	2	200	2	2	2	2	2	2	2	2	2	
	2	220	2	2	2	2	2	2	2	2	2	
	2	240	2	2	2	2	2	2	2	2	2	
	2	260	2	2	2	2	2	2	2	2	2	
	2	280	2	2	2	2	2	2	2	2	2	
	2	300	2	2	2	2	2	2	2	2	2	
	2	320	2	2	2	2	2	2	2	2	2	
	2	340	2	2	2	2	2	2	2	2	2	
	2	360	2	2	2	2	2	2	2	2	2	
31.5												80
63												85
125	74	78	78	76	77	77	78	78	77	79		85
250	77	78	78	79	80	80	79	80	81	81		84
500	76	74	76	78	80	80	80	81	81	81		81
1000	74	72	74	78	79	80	80	79	80	81		78
2000	65	64	65	71	72	72	74	74	73	72		69
4000	62	61	61	67	69	69	69	69	69	67		64
8000	59	59	59	61	64	62	63	63	63	63		60
OVERALL	82	82	83	84	86	86	86	86	86	87		89

TABLE: MEASURES OF HUMAN NOISE EXPOSURE													IDENTIFICATION:		
3													OMEGA 3.2		
NOISE SOURCE/SUBJECT: (NO-440 GENERATOR)													TEST SA-000-007		
(OPERATION: UNLOADED)													RUN 01		
GROUND CREW													06 APR 02		
NEAR FIELD NOISE LEVELS													PAGE 01		
													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	83	81	82	81	80	80	79	80	80	81	80	80	82		
OASLA	78	77	79	78	77	77	77	76	74	75	75	77	79		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
MINIMUM OPL EAR MUFFS															
OASLA*	60	57	58	57	56	57	55	56	57	56	57	56	59		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
AMERICAN OPTICAL 1700 EAR MUFFS															
OASLA*	55	52	53	52	51	52	49	51	52	53	52	51	53		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
V-51R EAR PLUGS															
OASLA*	55	54	55	54	53	53	53	53	52	52	52	54	56		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS															
OASLA*	41	40	41	40	39	39	39	38	37	38	38	40	41		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
M-133 GROUND COMMUNICATION UNIT															
OASLA*	51	49	50	50	49	49	48	48	48	48	48	50	52		
T	960	960	960	960	960	960	960	960	960	960	960	960	960		
COMMUNICATION															
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)															
PSIL	73	72	73	73	72	72	72	71	69	69	69	72	74		
ANNOYANCE															
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PHN0)															
TONE CORRECTION (C IN DB)															
PNLT	90	88	89	88	89	88	90	87	86	87	87	88	91		
C	1	0	0	0	1	0	3	0	0	1	1	0	1		

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE											IDENTIFICATION	
3											OMEGA 3.2	
NOISE SOURCE/SUBJECT: (OPERATION:)											TEST 9A-886-887	
MO-4MO GENERATOR (UNLOADED)											RUN 82	
GROUND CREW ()											06 APR 82	
NEAR FIELD NOISE LEVELS ()											PAGE 02	
LOCATION/CONDITION												
DISTANCE (M-->	4	4	4	4	4	2	2	2	2	2	2	2
ANGLE (DEG)-->	260	280	300	320	340	0	20	40	60	80	100	120
CONDITION----	A	A	A	A	A	A	A	A	A	A	A	A
HAZARD/PROTECTION												
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR												
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR												
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (APR 161-35, JULY 73)												
NO PROTECTION												
OASLC	81	81	83	83	82	86	86	88	88	85	85	84
OASLA	79	78	79	79	79	83	83	84	82	82	82	81
T	960	960	960	960	960	571	571	480	679	679	679	607
MINIMUM QPL EAR MUFFS												
OASLA*	58	58	59	60	58	62	63	62	62	61	61	60
T	960	960	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS												
OASLA*	52	52	54	55	53	57	57	57	57	56	56	54
T	960	960	960	960	960	960	960	960	960	960	960	960
V-51R EAR PLUGS												
OASLA*	54	54	55	56	56	59	60	60	59	59	58	57
T	960	960	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS												
OASLA*	48	48	41	42	41	45	46	46	44	44	44	43
T	960	960	960	960	960	960	960	960	960	960	960	960
M-133 GROUND COMMUNICATION UNIT												
OASLA*	51	51	51	51	51	55	55	56	54	54	54	53
T	960	960	960	960	960	960	960	960	960	960	960	960
COMMUNICATION												
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)												
PSIL	73	72	74	74	74	77	77	78	77	77	76	74
ANNoyANCE												
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PHDB)												
TONE CORRECTION (C IN DB)												
PNLT	89	89	91	90	91	94	95	95	94	93	93	94
C	0	1	1	0	1	1	2	1	1	0	1	0

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

END

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