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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 111. MC-1A MO--ETC(U)
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AMRL-TR-75-50-VOL-111

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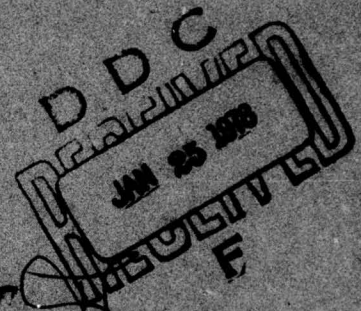


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**USAF BIOENVIRONMENTAL NOISE DATA
HANDBOOK**

Volume 111.

MC-1A Motor-Generator, Mobile



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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FOR THE COMMANDER


HENNING E. VON GIERKE
Director
Biodynamics and Bionics Division
Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The MC-1A Motor-Generator is an electric motor-driven unit designed to furnish AC and DC electrical power for use in aircraft hangers. 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		

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noise level, 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.

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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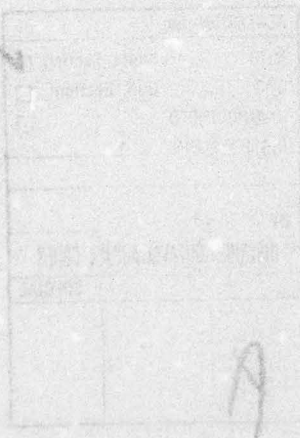
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INTRODUCTION

The MC-1A Motor-Generator is an electric motor-driven unit designed to furnish AC and DC electrical power for use in aircraft hangers.

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 MC-1A generator.

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, 70% 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.

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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.

2. 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 MC-1A Motor-Generator was operated inside, and approximately in the center of a large aircraft hanger (190.5 m long $\times$ 95.1 m wide $\times$ 18.3 m high) on a concrete floor at normal rated/loaded conditions. 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. The load bank was physically located so as to not interfere with the MC-1A noise field.

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 MC-1A 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

MC-1A Motor-Generator, Edwards AFB, 22 Sep 1972

Measurement Location

1

Operator Control Panel

Operation

A

Loaded

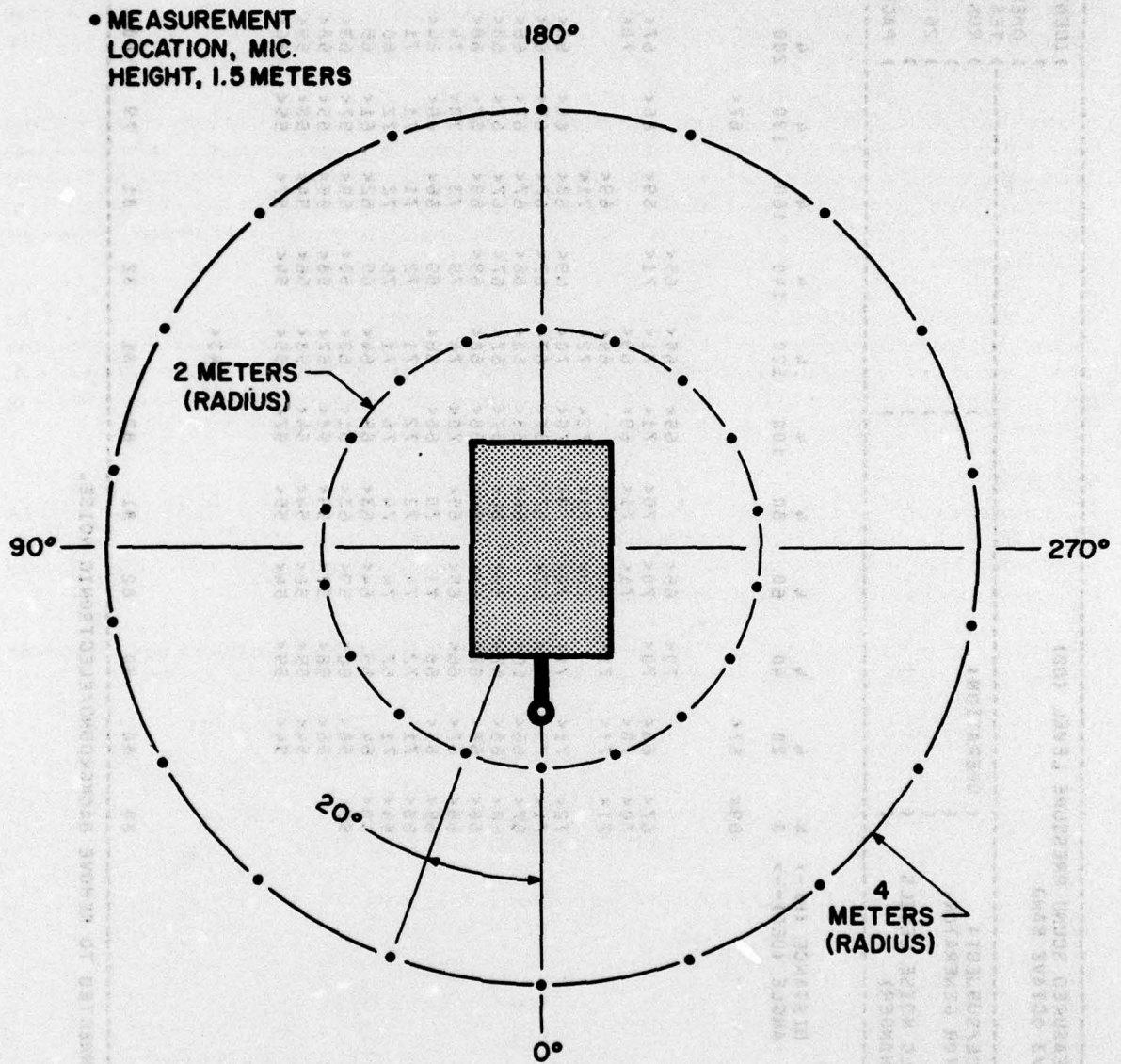


Figure 1. Measurement Locations

TABLE: MEASURED SOUND PRESSURE LEVEL (DB) 1/3 OCTAVE BAND																IDENTIFICATIONS:	
2																OMEGA 3.2	
NOISE SOURCE/SUBJECT: (OPERATION:)																TEST 71-020-360	
MC-1A MOTOR GENERATOR, ()																RUN 01	
MOBILE ()																26 AUG 74	
NEAR FIELD NOISE LEVELS ()																PAGE F1	
(INSIDE HANGER) ()																	
FREQ (HZ)	DISTANCE (M)--> ANGLE (DEG)-->	4	20	40	60	80	100	120	140	160	180	200	220	240			
25		69<	67<														
31.5																	
40																	
50																	
63		67<	66<	70<	70<	70<	65<	71<	71<	69<	66<	67<	71<	70<	78<		
80		71<	71<	71<	69<	70<	69<	69<	69<	69<	69<	69<	71<	71<	69<		
100																	
125		72<	71<	71<	70<	70<	72<	72<	69<	68<	68<	68<	68<	68<	72<		
160		71<	70<	69<	67<	67<	67<	67<	69<	67<	67<	67<	68<	67<	69<		
200		67<	66<	66<	66<	66<	66<	68<	66<	67<	67<	66<	66<	66<	69<		
250		68<	68<	67<	68<	68<	67<	67<	67<	67<	67<	68<	67<	68<	69<		
315		66<	66<	67<	68<	68<	68<	68<	69<	69<	67<	68<	68<	68<	69<		
400		66<	67<	66<	65<	65<	70<	74	75	73	70<	74	69<	77<	69<		
500		65<	65<	68	71	72	66<	66<	69	66<	66<	64<	65<	64<	64<		
630		68<	68<	71	72	72	72	71	72	71	71	71	71	73	73		
800		64<	64<	67	74	74	76	71	76	72	72	68	72	78	78		
1000		60<	64	65	64<	63<	65	64<	65	62<	61<	65	66	68	68		
1250		55<	58<	60<	59<	63<	61<	62<	60<	57<	57<	63<	62<	67	67		
1600			56<	56<	57<	59<	58<	57<	58	55<	55<	58<	61<	61<	61<		
2000			54<	55<	56<	54<	54<	58<	56<	54<	53<	59<	59<	60<	60<		
2500			54<	55<	56<	55<	57<	55<	54<	57<	55<	56<	55<	59<	59<		
3150																	
4000																	
5000																	
6300																	
8000																	
10000																	
OVERALL		60	60	60	62	61	62	61	62	61	79	80	80	82	82		
< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.																	

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)														IDENTIFICATION:	
2														OMEGA 3.2	
NOISE SOURCE/SUBJECT: (OPERATION:														TEST 71-020-360	
HC-1A MOTOR GENERATOR, (														RUN 02	
MOBILE (														26 AUG 74	
NEAR FIELD NOISE LEVELS (														PAGE F2	
(INSIDE HANGER) (															
FREQ (HZ)	DISTANCE (M) -->	4	4	4	4	4	4	4	4	4	4	4	4	2	2
ANGLE (DEG) -->	260	260	280	300	320	340	0	20	40	60	80	100	120	140	160
25	68<	67<					66<								
31.5															
40															
50															
63	72<	74<	72<	71<	70<	67<	73<	73<	75<	74<	67<	69<	69<	67<	67<
80	71<	71<	71<	70<	70<	70<	73<	73<	72<	73<	73<	72<	72<	77<	76<
100	70<	70<	71<	71<	71<	70<	74<	74<	74<	74<	71<	71<	71<	73<	71<
125							71<	71<							
160	70<	70<	69<	69<	71<	70<	72<	72<	72<	72<	71<	71<	71<	72<	72<
200	69<	68<	68<	68<	69<	71<	70<	71<	71<	71<	67<	66<	67<	67<	67<
250	70<	70<	70<	70<	70<	69<	68<	68<	67<	67<	70<	69<	69<	69<	67<
315	67<	68<	69<	69<	68<	68<	72<	71<	70<	71<	73<	73<	74<	74<	71<
400	68<	67<	68<	68<	67<	66<	74<	72<	73<	74<	73<	75<	76<	76<	74<
500	73<	68<	72<	69<	66<	64<	72<	69<	70<	73<	67<	75<	76<	75<	75<
630	66<	66<	66<	66<	66<	64<	63<	65<	66<	68<	68<	68<	68<	70<	70<
800	74<	73<	73<	75<	72<	72<	67<	69<	72<	75<	74<	73<	74<	73<	73<
1000	74<	72<	74<	74<	78<	74<	70<	71<	81<	79<	79<	77<	76<	75<	75<
1250	67<	68<	67<	64<	64<	60<	63<	69<	71<	73<	69<	69<	70<	71<	71<
1600	64<	65<	63<	61<	61<	59<	62<	66<	63<	63<	63<	68<	65<	66<	66<
2000	62<	61<	59<	58<	58<	56<	55<	57<	61<	62<	60<	61<	61<	63<	63<
2500	58<	58<	58<	58<	58<	55<	56<	57<	61<	59<	60<	61<	62<	60<	60<
3150	58<	58<	58<	58<	59<	56<	56<	57<	57<	61<	59<	59<	60<	61<	61<
4000	56<	57<	55<	55<	55<	56<	56<	57<	53<	55<	53<	55<	54<	55<	55<
5000	50<	50<	50<	50<	43<			44<	45<	50<	50<	50<	50<	50<	45<
6300	45<	46<	45<							46<	46<	46<	46<	46<	45<
8000															
10000															
OVERALL	82	81	82	83	83	81	83	83	85	85	85	85	85	85	84

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB) 1/3 OCTAVE BAND														IDENTIFICATION:	
2														OMEGA 3.2 TEST 71-020-360	
NOISE SOURCE/SUBJECT: (OPERATION:)														RUN 03	
MC-1A MOTOR GENERATOR, ()														26 AUG 74	
MOBILE ()														PAGE F3	
NEAR FIELD NOISE LEVELS ()															
(INSIDE HANGER) ()															
DISTANCE (M) --> 2 2 2 2 2 2 2 2 2 2 2 2 2 2														OPERATOR LOCATION	
ANGLE (DEG) --> 160 180 200 220 240 260 280 300 320 340														TEST CONDITION	
FREQ (HZ)														1/A	
25														67<	
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)													
OCTAVE BAND													
2													
NOISE SOURCE/SUBJECT: (OPERATION:)													
MC-1A MOTOR GENERATOR, ()													
MOBILE ()													
NEAR FIELD NOISE LEVELS ()													
(INSIDE HANGER) ()													
IDENTIFICATION:)													
OMEGA 3.2													
TEST 71-020-360													
RUN 01													
26 AUG 74													
PAGE J1													
FREQ (HZ)	DISTANCE (M)-->	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	71	72	73	74	73	74	74	72	74	72	74	74	74
63	75	74	74	75	75	74	75	72	74	72	74	75	75
125	74	73	72	70	71	72	72	71	72	72	71	72	72
250	71	72	72	73	72	73	75	77	75	73	75	72	78
500	70	74	73	77	76	77	74	78	75	74	73	76	76
1000	61	61	62	62	65	63	64	63	62	60	65	65	69
2000												61	62
4000													
8000													
OVERALL	80	80	80	82	81	82	81	81	80	78	79	80	82

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)															IDENTIFICATIONS	
2 OCTAVE BAND																
NOISE SOURCE/SUBJECT:																
MC-1A MOTOR GENERATOR,																
MOBILE																
NEAR FIELD NOISE LEVELS																
(INSIDE HANGER)																
OPERATION:																
TEST 71-020-360																
RUN 02																
26 AUG 74																
PAGE J2																

STUDY ON EFFECTS OF SUBSONIC WINDS ON AERODYNAMIC NOISE

1. PURPOSE
2. SCOPE
3. BACKGROUND
4. SUMMARY
5. CONCLUSIONS
6. REFERENCES
7. APPENDICES
8. GLOSSARY
9. INDEX

1. PURPOSE
2. SCOPE
3. BACKGROUND
4. SUMMARY
5. CONCLUSIONS
6. REFERENCES
7. APPENDICES
8. GLOSSARY
9. INDEX

TABLE 1. MEASURED SOUND PRESSURE LEVEL (DB)										IDENTIFICATION	
2											
NOISE SOURCE/SUBJECT											
MC-1A MOTOR GENERATOR, MOBILE											
NEAR FIELD NOISE LEVELS (INSIDE HANGER)											
OPERATIONS											
TEST 71-028-360											
RUN 03											
26 AUG 74											
PAGE J3											
DISTANCE (M) --> 2											
ANGLE (DEG) --> 160											
FREQ (HZ)	2	2	2	2	2	2	2	2	2	2	2
31.5	76	76	78	78	78	78	78	78	78	76	81
63	76	75	76	76	76	76	76	76	76	76	76
125	74	75	74	74	76	76	76	75	75	75	76
250	79	79	80	82	82	81	77	78	77	76	83
500	76	75	78	78	78	80	79	81	81	74	80
1000	65	66	67	70	72	72	72	70	67	65	74
2000	59	58	58	62	66	65	64	63	64	59	67
4000				53	53	52	52	51	51		58
8000											
OVERALL	84	84	85	86	86	85	85	85	85	83	87

TABLE: MEASURES OF HUMAN NOISE EXPOSURE														IDENTIFICATION:	
3														OMEGA 3.2	
NOISE SOURCE/SUBJECT:														TEST 71-020-360	
MC-1A MOTOR GENERATOR,														RUN 01	
MOBILE														26 AUG 74	
NEAR FIELD NOISE LEVELS														PAGE 41	
(INSIDE HANGER)															
DISTANCE (M)-->															
ANGLE (DEG)-->															
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 (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															
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:
NOISE SOURCE/SUBJECT: (OPERATION:)										OMEGA 3.2
MC-1A MOTOR GENERATOR, ()										TEST 71-020-360
MOBILE ()										RUN 03
NEAR FIELD NOISE LEVELS ()										26 AUG 74
(INSIDE HANGER) ()										PAGE M3
DISTANCE (M)-->	2	2	2	2	2	2	2	2	2	OPERATOR LOCATION
ANGLE (DEG)-->	160	180	200	220	240	260	280	300	320	340 TEST CONDITION 1/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 (AFR 161-35, JULY 73)										
NO PROTECTION										
OASLC	83	83	84	85	86	85	85	85	85	83
OASLA	79	79	80	82	82	82	81	82	82	77
T	960	960	960	679	679	679	807	679	679	960
MINIMUM QPL EAR MUFFS										
OASLA*	60	60	61	62	62	61	60	61	60	59
T	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS										
OASLA*	55	55	56	57	57	56	56	56	56	55
T	960	960	960	960	960	960	960	960	960	960
V-51R EAR PLUGS										
OASLA*	57	57	58	59	59	59	58	59	59	55
T	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS										
OASLA*	42	42	43	44	44	45	44	45	46	40
T	960	960	960	960	960	960	960	960	960	960
H-133 GROUND COMMUNICATION UNIT										
OASLA*	51	51	53	53	54	55	54	56	56	50
T	960	960	960	960	960	960	960	960	960	960
COMMUNICATION										
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)										
PSIL	73	73	75	77	77	77	76	76	75	72
ANNOYANCE										
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PHNDB)										
TONE CORRECTION (C IN DB)										
PNLT	92	92	92	95	96	94	92	95	95	91
C	2	3	2	3	2	2	0	2	3	2

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.