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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK VOLUME 152

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C-12A IN-FLIGHT CREW NOISE(U) AIR FORCE AEROSPACE

MEDICAL RESEARCH LAB WRIGHT-PATTERSON AFB. H K HILLE

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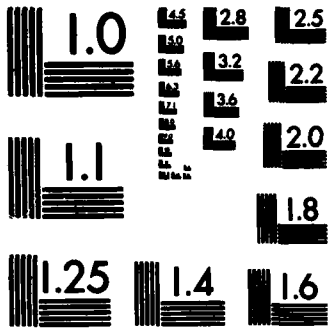
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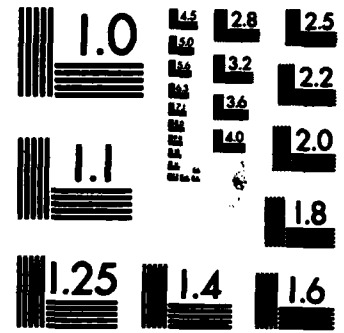
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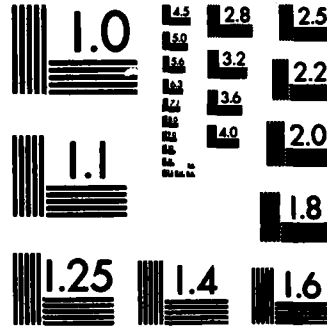
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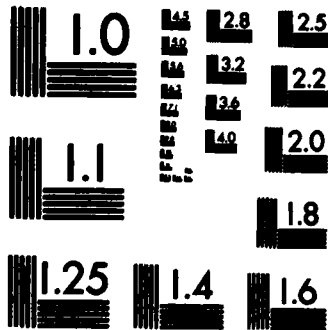
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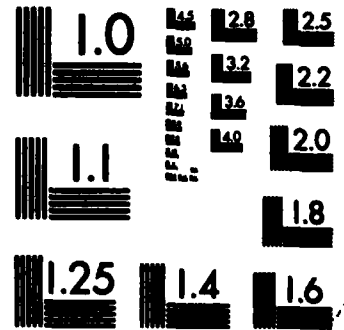
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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Volume 152

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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 152

C-12A IN-FLIGHT CREW NOISE

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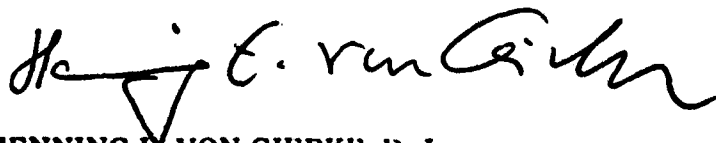
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AMRL-TR-75-50, Vol. 152

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



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Director
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The C-12A is a military version of the Beechcraft Super King Air 200. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this aircraft during normal flight operations. Data are reported for five 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 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, Air Force Aerospace Medical Research Laboratory, under Project/Task 723109, Communication and Performance Capability and Operational Noises. The author acknowledges the efforts of Mr. John Cole who established the data analysis requirements, Mr. Henry Mohlman, and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Norma Peachey who typed this report and prepared it for publication.

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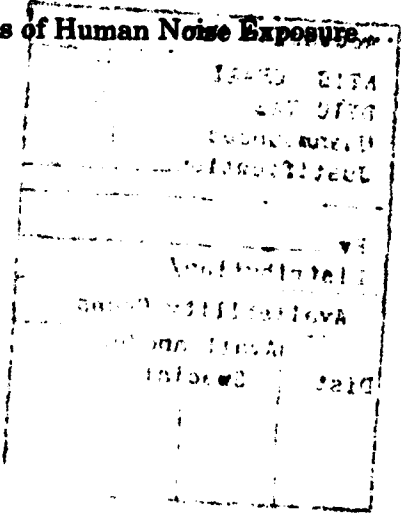


TABLE OF CONTENTS

INTRODUCTION	Page 3
IN-FLIGHT NOISE	4

LIST OF TABLES

1. Measurement Location and Test Conditions for Noise Measurements	5
2. Measured Sound Pressure Level 1/3 Octave Band	6-8
Octave Band	9-11
3. Measures of Human Noise Exposure	12-14



INTRODUCTION

The C-12A is a military version of the Beechcraft Super King Air 200 and is used for operational support airlift. This aircraft is manufactured by the Beech Aircraft Corporation and is powered by two PT6A-38 turboprop engines each rated at 750 shp. The engines are manufactured by the Pratt & Whitney Aircraft Division of Canada.

This volume provides measured and extrapolated data defining bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the C-12A aircraft.

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 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, definition 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.

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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.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a standard-configured C-12A aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard C-12A environments, but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made at various flight crew and passenger locations. Table 1 lists the measurement locations and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

The microphone position was at ear level external to headgear in a region 0.2-0.3 meter from the head when an individual was present. At unoccupied locations, measurements were made at ear level throughout a volume where the head would normally be located. In both cases, the microphone was randomly moved throughout a spherical volume approximately 0.3 meter in diameter and the resultant samples analyzed using a 4- or 8- second integration time to obtain a power-averaged level, which effectively smooths out short-duration fluctuations and best describes the exposure.

Although the presence of a crew member or passenger at a measurement location affects the resultant sound field, the magnitude of such effects is generally small and not significant in determining exposure limits or voice communication capabilities. Consequently, no distinction is made in this report between occupied and unoccupied measurement locations.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the C-12A aircraft at the five specific locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35 with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1
MEASUREMENT LOCATIONS AND TEST CONDITIONS

C-12A, Andrews AFB, 8 June 1982

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Pilot/Copilot	Seated Head Level
2	First Row Seats, Centerline	Seated Head Level
3	Second Row Seats, Centerline	Seated Head Level
4	Third Row Seats, Centerline	Seated Head Level
5	Aft Aircraft Storage Area	Seated Head Level

CONDITION	DESCRIPTION
A	Engine Start, Both Engines Idle, Taxi
B	High Speed, Ground, Idle 900 RPM
C	Military Ground Runup 1800 RPM
D	Takeoff/Roll
E	Liftoff, Gear Up, Climb to 5000 ft., 2000 RPM
F	Climb thru 5000 ft., 1900 RPM
G	Climb thru 10000 ft.
H	Cruise 24000 ft. - 1900 RPM, 170 KIAS
I	Cruise 24000 ft. - 2000 RPM (High Speed)
J	Cruise 24000 ft. - 1900 RPM
K	Cruise 24000 ft. - 1800 RPM
L	Cruise 24000 ft. - 1700 RPM
M	Descending to 1500 ft. - 1900 RPM
N	Cruise 15000 ft. - 2000 RPM
O	Cruise 15000 ft. - 1900 RPM
P	Cruise 15000 ft. - 1800 RPM
Q	Cruise 15000 ft. - 1700 RPM
R	Cruise 8000 ft. - 2000 RPM
S	Cruise 8000 ft. - 1900 RPM
T	Cruise 8000 ft. - 1800 RPM
U	Cruise 8000 ft. - 1700 RPM
V	Approach 1500 ft. - 1700 RPM
W	Simulated Missed Approach
X	Approach 1500 ft. - 2000 RPM, Gear Down
Y	Landing Roll

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													
1/3 OCTAVE BAND													
IDENTIFICATION:													
2													
OMEGA 3.2													
TEST BZ-082-001													
RUN 01													
C-13A													
IN-FLIGHT CREW NOISE													
15 JUL 62													
PAGE F1													
NOISE SOURCE/SUBJECT: (OPERATION:)													
C-13A ()													
IN-FLIGHT CREW NOISE ()													
()													
()													
()													
()													
LOCATION/CONDITION													
FREQ (HZ)	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	2/I	3/I	4/I	5/I
25	97	99	98	90	84	82	76	79	80	77	70	71	79
31.5	77	85	86	87	83	83	85	82	80	81	87	85	82
40	72	80	79	85	83	82	82	82	83	81	88	84	83
50	75	81	81	83	87	84	78	84	84	79	86	85	78
63	82	86	85	85	90	85	85	82	82	85	81	84	81
80	70	81	95	85	89	90	85	81	81	77	81	77	78
100	69	77	103	102	107	105	100	96	94	94	95	91	96
125	75	81	84	86	91	85	81	82	82	82	80	80	82
160	82	87	89	83	88	85	83	81	82	81	80	79	79
200	78	83	90	95	101	93	90	90	97	96	92	87	84
250	73	84	90	85	88	90	85	84	84	83	80	77	77
315	67	82	88	95	97	96	88	91	90	89	83	79	78
400	65	81	91	89	89	89	85	91	92	86	81	77	77
500	67	74	85	83	85	87	82	86	87	83	82	78	78
630	67	72	84	77	81	83	78	86	86	82	81	79	77
800	72	68	81	75	81	81	76	83	82	79	78	77	74
1000	65	67	83	72	81	85	75	75	78	82	79	78	74
1250	61	64	79	70	80	89	75	75	75	80	76	75	71
1600	63	61	73	70	78	84	68	69	70	79	71	67	66
2000	65	59	69	66	78	81	63	67	68	72	68	63	63
2500	65	57	65	63	70	79	60	63	63	68	66	62	61
3150	58	56	61	59	65	69	58	60	61	60	60	59	58
4000	57	56	60	58	64	63	58	60	60	58	57	57	58
5000	55	53	59	57	63	61	62	58	59	56	57	56	57
6300	54	54	59	56	61	59	55	57	58	54	55	56	57
8000	54	54	59	56	61	58	55	59	58	54	54	55	56
10000	54	53	60	56	59	57	55	56	56	53	53	56	57
OVERALL	97	100	105	104	109	106	101	101	101	100	99	95	98

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

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

IDENTIFICATION:
 OMEGA 3.2
 TEST 82-082-001
 RUN 02
 15 JUL 82
 PAGE F2

NOISE SOURCE/SUBJECT: OPERATION:
 C-12A
 IN-FLIGHT CREW NOISE

LOCATION/CONDITION

FREQ (HZ)	1/J	1/K	1/L	1/M	1/N	2/N	3/N	4/N	5/N	1/O	1/P	3/P	1/Q
25	81	80	82	80	83	77	72	73	82	81	81	82	75
31.5	78	76	80	77	80	83	85	84	82	82	78	79	80
40	83	82	82	82	83	83	87	86	83	84	85	85	87
50	85	84	84	85	88	83	84	88	79	88	88	88	85
63	84	83	82	83	87	86	84	86	83	87	87	86	85
80	83	86	93	82	84	79	81	80	79	85	92	102	96
100	95	89	86	93	97	94	94	96	94	96	96	95	88
125	81	80	81	81	85	82	82	83	83	83	84	84	80
160	83	85	89	84	84	82	81	82	82	87	89	90	87
200	95	88	82	96	99	96	91	86	89	99	91	84	81
250	83	89	89	84	86	84	79	79	79	88	92	91	81
315	86	85	83	89	92	89	83	82	81	92	87	86	80
400	86	82	81	88	90	85	82	80	78	89	86	85	79
500	87	82	79	86	88	85	86	81	80	87	84	83	82
630	83	79	78	82	86	85	85	80	78	83	81	81	83
800	78	76	74	78	82	82	82	78	76	84	79	78	81
1000	77	76	75	79	81	83	83	82	77	85	77	77	82
1250	73	72	72	74	84	84	81	77	73	86	76	75	82
1600	69	68	68	71	86	84	71	68	67	85	71	71	73
2000	67	66	65	67	84	74	67	64	63	77	69	67	67
2500	63	62	62	63	78	70	63	62	61	71	65	65	63
3150	60	59	59	61	65	62	61	59	59	63	62	62	61
4000	60	59	59	61	64	61	59	57	58	62	61	61	59
5000	58	58	57	59	63	60	59	56	57	61	60	60	58
6300	56	55	54	57	61	58	57	56	58	57	57	57	57
8000	56	53	53	57	61	57	57	57	58	57	56	56	56
10000	54	53	52	55	59	56	56	57	59	57	56	55	56
OVERALL	100	97	97	100	103	100	98	99	97	103	101	104	99

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		IDENTIFICATION:										
2		OMEGA 3.2										
C-12A		TEST BZ-082-001										
IN-FLIGHT CREW NOISE		RUN 03										
		15 JUL 62										
		PAGE J3										
FREQ (HZ)	LOCATION/CONDITION											
	1/R	2/R	3/R	4/R	5/R	1/S	1/T	1/U	1/U	1/H	1/X	1/Y
31.5	88	88	91	88	87	88	86	86	81	85	87	101
63	92	89	89	91	87	92	99	99	88	89	91	97
125	98	98	98	101	100	99	102	93	83	100	94	94
250	100	95	95	91	93	100	95	90	83	94	94	91
500	95	89	87	86	86	93	91	88	79	85	88	89
1000	88	84	87	83	83	85	83	83	74	78	81	87
2000	86	75	73	70	74	75	74	73	65	72	71	82
4000	70	63	65	64	67	66	65	64	57	64	64	69
8000	64	59	61	62	67	63	62	61	55	59	61	67
OVERALL	103	101	101	102	101	103	104	101	91	101	99	103

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MEASURES OF HUMAN NOISE EXPOSURE												
IDENTIFICATION:												
3												
OMEGA 3.2												
TEST BZ-082-001												
RUN 01												
15 JUL 82												
PAGE H1												
LOCATION/CONDITION												
1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	2/I	3/I	4/I	5/I
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	94	97	105	104	109	106	101	101	100	98	95	97
OASLA	78	83	93	92	96	96	88	93	91	88	85	84
T	960	571	101	120	60	60	240	101	143	240	404	480
H-157 IN-FLIGHT COMMUNICATION UNIT												
OASLA*	66	72	83	83	88	84	79	81	80	77	73	75
T	960	960	571	571	240	480	960	807	960	960	960	960
U-31R EAR PLUGS												
OASLA*	56	63	71	72	75	74	68	71	69	66	63	63
T	960	960	960	960	960	960	960	960	960	960	960	960
MINIMUM GPL EAR MUFFS												
OASLA*	64	70	83	82	87	84	79	79	77	76	72	76
T	960	960	571	679	285	480	960	960	960	960	960	960
COMMUNICATION												
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)												
PSIL	71	72	84	80	85	89	79	83	83	85	81	76
ANNOYANCE												
PERCEIVED NOISE LEVEL, TONE CORRECTED (PMLT IN PHNB)												
TONE CORRECTION (C IN DB)												
PMLT	93	97	109	108	113	112	106	108	107	104	100	102
C	2	1	2	3	3	3	3	3	2	2	2	3

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

MEASURES OF HUMAN NOISE EXPOSURE												
IDENTIFICATION:												
NOISE SOURCE/SUBJECT: (OPERATION:)												
IN-FLIGHT CREW NOISE ()												
C-12A ()												
OMEGA 3.2												
TEST BZ-082-001												
RUN 03												
15 JUL 62												
PAGE H3												
LOCATION/CONDITION												
1/R	2/R	3/R	4/R	5/R	1/S	1/T	1/U	1/U	1/X	1/Y		
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 151-35, JULY 73)												
NO PROTECTION												
OASLC	103	100	101	102	101	103	104	101	90	101	98	102
OASLA	95	90	91	89	89	94	91	89	80	89	89	91
T	71	170	143	202	202	85	143	202	960	202	202	143
H-157 IN-FLIGHT COMMUNICATION UNIT												
OASLC	83	79	79	80	80	82	82	79	68	80	77	78
T	571	960	960	960	960	679	679	960	960	960	960	960
U-51R EAR PLUGS												
OASLC	73	69	69	67	67	73	70	68	59	68	68	69
T	960	960	960	960	960	960	960	960	960	960	960	960
MINIMUM SPL EAR MUFFS												
OASLC	81	78	79	80	79	81	82	78	67	80	76	77
T	907	960	960	960	960	907	679	960	960	960	960	960
COMMUNICATION												
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)												
PSIL	90	83	83	80	81	84	83	81	73	79	80	86
ANNNOYANCE												
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)												
TONE CORRECTION (C IN DB)												
PNLT	111	106	106	107	106	109	108	104	94	106	103	105
C	2	2	2	3	3	2	2	1	1	3	2	1

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.