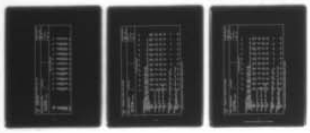
AD-A048 831 AEROSPACE MEDICAL RESEARCH LAB WRIGHT-PATTERSON AFB OHIO F/G 20/1
USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK. VOLUME 41. A-7D IN-F--ETC(U)
OCT 76 H K HILLE

UNCLASSIFIED AMRL-TR-75-50-VOL-41 NL

1 OF 1
ADA048831



END
DATE FILMED
2-78
DDC

AMRL-TR-75-50
Volume 41

(2 NW)

USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 41

A-7D In-Flight Crew Noise

OCTOBER 1976

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

NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Please do not request copies of this report from Aerospace Medical Research Laboratory. Additional copies may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with Defense Documentation Center should direct requests for copies of this report to:

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314

TECHNICAL REVIEW AND APPROVAL

This report has been reviewed by the Information Office (OI) 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

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

AIR FORCE/56780/19 December 1977 — 300

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AMRL-TR-75-50 Vol 41	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER: Technical rept.	
4. TITLE (and Subtitle): USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK, A-7D In-flight Crew Noises	5. TYPE OF REPORT & PERIOD COVERED: Volume 41 of a series
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Harald K. Hille	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Aerospace Medical Research Laboratory, Aerospace Medical Division, Air Force Systems Command, Wright-Patterson AFB, OH 45433	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 62202F 7231-04-18
11. CONTROLLING OFFICE NAME AND ADDRESS: Same as above	12. REPORT DATE: Oct 1976
	13. NUMBER OF PAGES: 15
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*: 15p.	15. SECURITY CLASS. *(of this report)*: Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Noise
Noise Environments
Bioenvironmental Noise
In-flight Crew Noise
A-7D Aircraft

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The A-7D is a USAF tactical fighter. This report provides measured data defining the bioacoustic environments at the pilot's location inside this aircraft during normal flight operations. Data are reported for one location 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

→ over

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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 72310418, Measurement of Noise and Vibration Environments of Air Force Operations.

The author acknowledges the efforts of John N. Cole who established the data analysis requirements and assisted in the preparation of this report, and Henry Mohlman and David Eilerman of the University of Dayton who assisted in the mechanics of data processing.

Table of Contents

List of Tables

INTRODUCTION

The A-7D is a single-seat tactical fighter manufactured by the LTV Aerospace Corporation. Power is provided by one TF41-A-1 turbofan engine rated at 14,250 lb maximum takeoff thrust. The engines are manufactured by the Detroit Diesel Allison Division, General Motors Division.

This volume provides measured data defining the 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 A-7D aircraft.

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. *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 AMRL/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: AMRL/BBE, Wright-Patterson AFB, OH 45433; AUTOVON 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

---

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 an A-7D aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard A-7D 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 inside the cockpit at the pilot's location with MICROPAK, a small in-flight recording system worn by the pilot. The miniature electret condenser microphone was attached to the pilot's helmet on a light-weight boom and positioned at ear level 0.1 meter from the helmet's surface with its diaphram parallel to the surface pointing away from the helmet. Table 1 lists the measurement location 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.

In the analysis, microphone corrections for random incidence were applied to the overall systems response. The recorded samples were analyzed using a four or eight sec integration time to obtain power-averaged levels that effectively smooth out short-duration fluctuations and best describes the exposure.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the A-7D aircraft at the specified location. 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

A-7, EDWARDS AFB, CA — 17 APRIL 1976

LOCATION	*POSITION*	*HEIGHT ABOVE DECK*
1	Cockpit	Seated Head Level

CONDITION	*DESCRIPTION*
A	Idle — 53% RPM, Canopy Open
B	Taxi — Canopy Open
C	Takeoff — Full Military Power
D	Climb to 5000′ MSL — Military Power
E	Climb to 15000′ MSL — Military Power
F	Climb to 20000′ MSL — Military Power
G	Climb to 23000′ MSL — Military Power
H	Climb to 25000′ MSL — Military Power
I	Climb to 30000′ MSL — Military Power
J	Cruise — .76M, 88% RPM, 30000′ MSL
K	Cruise — .76M, 88% RPM, 30000′ MSL — DEFOG ON
L	Cruise — .76M, 88% RPM, 30000′ MSL — DEFOG OFF
M	Simulated Weapon Delivery — 500 KIAS
N	Pull Up — Full Mil Power
P	Weapon Delivery — 45° Dive Angle
R	Weapon Release — 480 KIAS
S	Simulated Traffic Pattern — 13000′ MSL
T	Turn to Simulated Base — Gears and Flaps Down
U	High Speed Run — 1000′ AGL, 540 KIAS
V	High Speed Run — 3000′ AGL, 540 KIAS
W	High Speed Run — 50′ AGL, 540 KIAS
X	Normal Traffic Pattern — Gear and Flaps Down
Y	Touchdown and Roll

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

IDENTIFICATION:
OMEGA 3.2
TEST 76-407-001
RUN 01

13 SEP 76

PAGE F1

NOISE SOURCE/SUBJECT:
A-7D AIRCRAFT
INFLIGHT NOISE LEVELS

OPERATION:

LOCATION/CONDITION

FREQ (HZ)	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J	1/K	1/L
50	89	93	91	84	79	75	73	73	72	72	74	72
63	83	90	93	85	81	82	77	77	77	76	78	78
80	88	89	95	86	82	83	78	80	79	80	80	81
100	88	89	96	84	86	86	81	81	80	82	85	83
125	80	87	91	85	87	86	82	81	80	82	85	81
160	83	84	95	87	91	91	88	87	87	87	91	88
200	84	82	96	90	90	91	88	88	88	88	88	89
250	86	80	95	92	91	91	88	88	88	88	87	89
315	77	78	97	91	93	93	91	91	90	90	91	91
400	80	76	98	94	94	94	94	94	92	92	93	93
500	84	77	96	93	93	93	92	91	90	89	90	92
630	83	74	97	92	94	94	93	91	91	90	92	92
800	82	76	99	96	96	95	93	93	93	93	94	94
1000	85	86	99	96	97	96	93	92	93	93	94	94
1250	91	92	98	96	97	95	91	91	89	90	93	93
1600	80	76	96	93	94	92	88	88	87	88	90	90
2000	81	74	96	93	95	93	89	88	87	88	90	89
2500	83	78	97	95	95	100	95	93	91	91	94	94
3150	81	77	99	95	95	98	90	91	92	91	98	90
4000	84	79	106	109	104	98	86	86	89	94	97	94
5000	83	80	100	101	100	91	83	83	85	86	94	89
6300	82	80	102	100	99	94	83	84	87	88	95	89
8000	82	75	103	98	100	93	82	82	85	87	94	89
10000	86	73	101	98	98	92	83	83	85	86	92	88
OVERALL	99	99	113	111	110	107	103	103	102	103	106	104

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

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

IDENTIFICATION:
OMEGA 3.2
TEST 76-407-001
RUN 02
13 SEP 76
PAGE F2

NOISE SOURCE/SUBJECT:
A-7D AIRCRAFT
INFLIGHT NOISE LEVELS

OPERATION:

LOCATION/CONDITION

FREQ (HZ)	1/M	1/N	1/P	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y
50	81	81	83	80	85	80	80	80	82	83	85
63	84	84	86	82	87	85	84	83	86	85	91
80	91	86	91	85	89	88	85	84	88	86	96
100	91	88	95	92	92	84	87	89	91	91	88
125	87	87	91	89	89	82	88	89	90	90	84
160	92	91	96	95	95	87	93	94	96	95	87
200	97	98	101	94	94	91	94	92	96	99	87
250	100	98	100	96	95	90	94	94	97	99	85
315	105	99	101	99	100	92	98	97	100	100	86
400	102	104	104	99	99	91	100	99	102	101	85
500	104	101	105	99	99	90	99	100	104	103	84
630	102	99	102	98	99	90	100	100	105	100	79
800	102	101	104	102	101	90	103	104	108	100	78
1000	102	100	103	102	102	90	101	102	105	100	81
1250	101	100	101	100	100	88	99	99	103	98	94
1600	99	97	97	97	98	87	98	98	102	95	83
2000	95	94	95	95	95	87	96	97	100	94	82
2500	93	91	95	94	95	83	97	98	99	96	81
3150	91	90	93	92	93	85	98	98	100	94	79
4000	93	91	92	95	96	83	104	102	105	102	80
5000	90	90	91	92	95	80	98	98	101	96	78
6300	91	90	91	92	97	80	98	99	103	97	80
8000	90	90	90	91	92	77	101	101	103	98	78
10000	89	89	90	89	90	76	96	97	100	94	73
OVERALL	112	111	113	110	110	101	112	112	115	111	101

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

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

IDENTIFICATION:
OMEGA 3.2
TEST 76-407-001
RUN 01
13 SEP 76
PAGE J1

NOISE SOURCE/SUBJECT:
A-7D AIRCRAFT
INFLIGHT NOISE LEVELS

OPERATION:

LOCATION/CONDITION

FREQ (HZ)	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J	1/K	1/L
63	92	96	98	89	86	86	81	82	82	82	83	83
125	89	92	99	90	93	93	90	89	88	89	92	90
250	88	85	100	96	96	97	94	94	93	93	93	94
500	87	80	101	98	98	99	97	97	96	95	97	97
1000	92	93	103	101	101	100	97	97	97	97	98	98
2000	86	81	101	99	99	101	97	95	93	94	96	96
4000	87	83	108	110	106	101	92	93	94	96	101	96
8000	88	82	107	103	104	98	87	88	90	91	98	94
OVERALL	99	99	113	111	110	107	103	103	102	103	106	104

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

IDENTIFICATION:
OMEGA 3.2
TEST 76-407-001
RUN 02

13 SEP 76

PAGE J2

NOISE SOURCE/SUBJECT:
A-7D AIRCRAFT
INFLIGHT NOISE LEVELS

OPERATION:

LOCATION/CONDITION

FREQ (HZ)	1/M	1/N	1/P	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y
63	92	89	93	88	92	90	88	87	91	90	97
125	95	94	99	97	97	90	95	96	98	97	91
250	106	103	105	102	102	96	100	100	103	104	91
500	107	106	109	104	104	95	104	104	108	106	88
1000	106	105	107	106	105	94	106	107	111	104	94
2000	101	99	101	100	101	91	102	102	105	100	87
4000	96	95	97	98	99	88	106	104	107	103	84
8000	95	94	95	95	98	83	103	104	107	101	83
OVERALL	112	111	113	110	110	101	112	112	115	111	101

TABLE: 3 MEASURES OF HUMAN NOISE EXPOSURE

IDENTIFICATION:
OMEGA 3.2
TEST 76-407-001
RUN 01
13 SEP 76
PAGE H1

NOISE SOURCE/SUBJECT:
A-7D AIRCRAFT
INFLIGHT NOISE LEVELS

OPERATION:

LOCATION/CONDITION

	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J	1/K	1/L
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	98	99	112	111	109	107	103	103	102	102	105	104
OASLA	96	95	112	112	110	107	102	102	101	102	106	103
T	60	71	3.8	3.8	5	9	21	21	25	21	11	18
HGU-2A/P HELMET WITH H-154												
OASLA*	83	80	98	95	95	92	88	88	88	88	91	89
T	571	960	42	71	71	120	240	240	240	240	143	202
HGU-2A/P HELMET WITH H-154(A)												
OASLA*	78	77	90	86	87	86	84	84	83	83	84	84
T	960	960	170	339	285	339	480	480	571	571	480	480
HGU-2A/P HELMET WITH CUSTOM LINER												
OASLA*	90	89	102	98	99	98	96	95	95	95	96	96
T	170	202	21	42	36	42	60	71	71	71	60	60
COMMUNICATION												
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)												
PSIL	89	85	102	99	100	100	97	96	95	95	97	97
ANNOYANCE												
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)												
TONE CORRECTION (C IN DB)												
PNLT	112	111	130	131	127	123	118	116	115	118	121	119
C	3	4	2	4	2	1	2	1	0	2	1	2

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE 3 MEASURES OF HUMAN NOISE EXPOSURE

IDENTIFICATION: OMEGA 3.2 / TEST 76-407-001 / RUN 02 / 13 SEP 76 / PAGE H2

NOISE SOURCE/SUBJECT: A-7D AIRCRAFT INFLIGHT NOISE LEVELS

OPERATION:

	LOCATION/CONDITION										
	1/M	1/N	1/P	1/R	1/S	1/T	1/U	1/V	1/W	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 161-35, JULY 73)											
NO PROTECTION											
OASLC	112	110	113	110	110	101	111	111	115	111	101
OASLA	110	108	111	109	109	98	111	111	115	110	97
T	5	8	4.5	6	6	42	4.5	4.5	2.2	5	50
HGU-2A/P HELMET WITH H-154											
OASLA*	99	97	99	95	96	88	97	97	100	98	84
T	36	50	36	71	60	240	50	50	30	42	480
HGU-2A/P HELMET WITH H-154(A)											
OASLA*	95	93	95	92	92	84	91	91	95	93	81
T	71	101	71	120	120	480	143	143	71	101	807
HGU-2A/P HELMET WITH CUSTOM LINER											
OASLA*	106	104	106	104	104	94	104	104	108	104	91
T	11	15	11	15	15	85	15	15	8	15	143
COMMUNICATION											
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)											
PSIL	105	104	105	103	103	93	104	104	108	103	90
ANNOYANCE											
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)											
TONE CORRECTION (C IN DB)											
PNLT	122	120	122	122	122	111	128	126	130	127	114
C	1	1	1	1	1	0	2	1	1	2	4

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.