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JUL 79 H K HILLE
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The F-106A is a USAF all-weather fighter. This report provides measured data defining the bioacoustic environments at the pilot's location inside this aircraft for 19 flight conditions. 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 →

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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, Volume 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 723108, Crew Safety In Operational Noise Environments. The author acknowledges the efforts of Mr. John N. 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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INTRODUCTION

The F-106A is a USAF all-weather fighter manufactured by the Convair Division of General Dynamics. This aircraft is powered by one J75-P-17 turbojet engine rated at 24,500 lbs. maximum take-off thrust with afterburner. The engine is manufactured by the United Aircraft Corporation, Pratt & Whitney Aircraft 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 F-106A 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, nearfield ground crew noise, farfield 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) 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 F-106A aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard F-106A 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. 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, etc.

The microphone was attached to the pilot's helmet by means of a lightweight boom. This arrangement enabled adjustment of the microphone close to the ear level at a distance of 0.1 meter with its diaphragm parallel and facing away from the helmet's surface. 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 second integration time to obtain a power-averaged level which effectively smooths 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 F-106A aircraft at the specified location. This table includes the overall, ⅓ 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
F-106A, TYNDALL AFB, FL – 8 JUNE 1978

Location	*Position*	*Height above deck*
1	Pilot	Seated Head Level

Condition	*Description*
A	Ground Runup – Engine Idle – Canopy Closed × EC System Off
B	Ground Runup – Engine Idle – Canopy Closed – EC System On
C	Ground Runup – Engine Idle – Canopy Open
D	Ground Runup – Engine 80% – Canopy Closed – EC System Off
E	Ground Runup – Engine 80% – Canopy Closed – EC System On
F	Takeoff, Roll – Engine A/B
G	Takeoff – Gear Down
H	Takeoff – Gear Up
I	Climb To 16000′ PA – Military Power
J	Cruise – 25000′ PA .9M, EC System Off
K	Cruise – 25000′ PA .9M, EC System On
L	Cruise – 25000′ PA, .9M – IR Seeker Head-Up
M	Cruise – 25000′ PA, .95M – EC System Off
N	Cruise – 25000′ PA, .95M – EC System On
O	Cruise – 25000′ PA, .95M – IR Seeker Head-Up
P	Descent From 20000′ PA to 5000′ PA – Engine 85% RPM
Q	Approach – 180 KIAS
R	Landing
S	Roll Out

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

IDENTIFICATION:
OMEGA 3.2
TEST AD-079-801
RUN 01
23 JUL 79
PAGE F1

NOISE SOURCE/SUBJECT:
F-106A AIRCRAFT
IN-FLIGHT CREW NOISE

OPERATION:

FREQ (HZ)	LOCATION/CONDITION 1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I
25	77	88	83	76	87	96	90	86	87
31.5	67	82	85	70	86	88	90	82	80
40	68	82	91	72	87	90	91	83	81
50	69	83	84	79	89	90	96	85	85
63	71	84	89	91	86	92	100	84	82
80	89	97	97	90	87	103	105	95	92
100	83	93	96	93	88	104	110	105	102
125	74	85	90	97	88	97	100	95	89
160	68	84	88	85	83	89	93	89	86
200	71	87	88	88	87	94	95	97	89
250	70	91	90	93	91	96	96	101	90
315	72	95	99	93	96	98	99	102	94
400	70	89	102	87	91	93	94	99	91
500	69	90	99	87	94	94	95	96	92
630	64	86	96	83	90	93	98	94	91
800	69	87	102	86	91	88	87	93	92
1000	70	90	104	82	93	92	88	93	93
1250	72	90	108	83	91	93	89	91	93
1600	70	89	101	87	92	87	85	89	93
2000	70	91	98	89	94	89	88	90	94
2500	64	93	98	85	94	87	87	88	93
3150	69	92	102	91	95	89	89	89	93
4000	64	93	101	89	97	89	90	89	93
5000	57	89	97	78	96	88	88	88	91
6300	62	93	101	78	100	91	91	93	95
8000	64	92	96	76	100	89	89	89	92
10000	59	93	96	76	99	87	88	88	91
12500	62	86	92	74	97	84	84	84	87
OVERALL	90	105	114	103	108	109	113	110	107

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

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

IDENTIFICATION:
OMEGA 3.2
TEST AD-079-001
RUN 02
23 JUL 79
PAGE F2

NOISE SOURCE/SUBJECT:
F-106A AIRCRAFT
IN-FLIGHT CREW NOISE

OPERATION:

FREQ (HZ)	LOCATION/CONDITION 1/J	1/K	1/L	1/M	1/N	1/O	1/P	1/Q	1/R	1/S
25	83	85	90	84	85	85	81	85	80	84
31.5	79	80	86	81	82	82	77	80	80	79
40	78	83	87	80	83	82	77	80	80	81
50	81	83	86	83	86	85	78	89	85	82
63	80	84	91	83	84	92	89	98	102	88
80	98	96	101	93	96	104	89	102	97	100
100	104	97	104	110	98	108	91	98	101	97
125	91	91	101	94	91	100	92	96	99	88
160	90	90	101	96	90	102	78	86	89	80
200	93	95	109	94	95	112	86	86	94	86
250	100	102	115	102	101	116	87	89	88	86
315	96	101	108	97	102	110	86	88	88	84
400	96	99	107	97	99	109	87	84	86	81
500	99	102	110	100	102	108	87	83	84	80
630	96	101	107	97	100	105	86	81	81	76
800	97	103	106	98	103	106	86	80	81	77
1000	99	103	106	100	103	106	85	78	81	76
1250	99	103	106	100	103	102	85	78	78	79
1600	100	103	105	101	103	101	85	79	79	78
2000	105	104	107	106	104	105	87	82	82	79
2500	98	101	101	99	101	100	86	81	81	77
3150	96	102	100	97	101	99	85	81	82	76
4000	95	104	98	96	104	98	86	83	83	77
5000	90	102	93	92	102	93	84	81	81	73
6300	89	106	94	93	106	95	87	84	84	77
8000	85	105	91	89	105	91	84	81	81	76
10000	84	106	91	88	105	91	83	79	79	71
12500	81	102	89	85	101	89	79	74	74	71
OVERALL	111	116	120	114	115	120	100	106	107	103

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: 3 MEASURED SOUND PRESSURE LEVEL (DB) OCTAVE BAND			IDENTIFICATION:
NOISE SOURCE/SUBJECT: F-106A AIRCRAFT IN-FLIGHT CREW NOISE	OPERATION:		OMEGA 3.2 TEST AD-079-001 RUN 01 23 JUL 79 PAGE J1

	LOCATION/CONDITION								
FREQ (HZ)	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I
31.5	77	90	92	78	92	98	95	89	88
63	89	97	98	93	92	103	107	96	93
125	83	94	97	99	91	105	110	105	102
250	76	97	100	96	97	101	102	105	96
500	73	94	104	91	96	98	101	102	96
1000	75	94	110	88	96	96	93	97	97
2000	73	96	104	92	98	92	92	94	98
4000	70	96	105	93	101	93	93	94	97
8000	67	98	103	81	104	94	94	95	97
OVERALL	90	105	114	103	108	109	113	110	107

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

IDENTIFICATION:
OMEGA 3.2
TEST AD-079-001
RUN 02

23 JUL 79

PAGE J2

NOISE SOURCE/SUBJECT:
F-106A AIRCRAFT
IN-FLIGHT CREW NOISE

OPERATION:

FREQ (HZ)	LOCATION/CONDITION 1/J	1/K	1/L	1/M	1/N	1/O	1/P	1/Q	1/R	1/S
31.5	85	88	92	86	88	88	84	87	85	87
63	98	97	102	94	97	105	92	103	103	100
125	104	98	107	110	99	109	94	100	103	97
250	102	105	117	103	105	118	91	92	96	90
500	102	105	113	103	105	112	91	88	89	84
1000	103	107	111	104	107	109	90	83	85	82
2000	107	107	109	108	107	107	91	85	85	83
4000	99	108	103	100	107	102	90	86	87	80
8000	91	110	97	95	110	97	90	87	87	80
OVERALL	111	115	120	114	115	120	100	106	107	103

TABLE: 4 MEASURES OF HUMAN NOISE EXPOSURE

IDENTIFICATION:
OMEGA 3.2
TEST AD-079-001
RUN 01
23 JUL 79
PAGE H1

NOISE SOURCE/SUBJECT: F-106A AIRCRAFT IN-FLIGHT CREW NOISE

OPERATION:

	LOCATION/CONDITION 1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/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	90	104	113	103	107	109	112	110	107
OASLA	80	103	113	98	107	102	103	104	104
T	960	18	3.2	42	9	21	18	15	15
HGU-2A/P HELMET WITH H-154									
OASLA*	71	91	97	89	96	94	96	97	91
T	960	143	50	202	60	85	60	50	143
HGU-2A/P HELMET WITH H-154(A)									
OASLA*	69	89	93	85	86	90	93	93	86
T	960	404	101	404	339	170	101	101	339
HGU-2A/P HELMET WITH CUSTOM LINER									
OASLA*	75	94	107	92	96	98	99	100	96
T	960	85	9	120	60	42	36	30	60
COMMUNICATION									
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)									
PSIL	74	94	106	90	97	96	95	97	97
ANNOYANCE									
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)									
TONE CORRECTION (C IN DB)									
PNLT	96	118	128	115	123	118	121	119	120
C	2	1	2	2	1	1	2	2	2

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: 4 MEASURES OF HUMAN NOISE EXPOSURE

IDENTIFICATION: OMEGA 3.2 TEST AD-079-001 RUN 02 23 JUL 79 PAGE H2

NOISE SOURCE/SUBJECT: F-106A AIRCRAFT IN-FLIGHT CREW NOISE

OPERATION:

	LOCATION/CONDITION									
	1/J	1/K	1/L	1/M	1/N	1/O	1/P	1/Q	1/R	1/S
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	111	115	120	114	114	120	100	105	106	102
OASLA	110	115	116	111	115	115	97	94	95	90
T	5	2.2	P	4.5	2.2	2.2	50	85	71	170
HGU-2A/P HELMET WITH H-154										
OASLA*	95	102	108	98	102	110	85	87	89	84
T	71	21	8	42	21	5	404	285	202	480
HGU-2A/P HELMET WITH H-154(A)										
OASLA*	92	94	104	94	94	106	80	84	86	82
T	120	85	15	85	85	11	960	480	339	679
HGU-2A/P HELMET WITH CUSTOM LINER										
OASLA*	102	106	112	104	106	112	90	89	91	86
T	21	11	3.8	15	11	3.8	170	202	143	339
COMMUNICATION										
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)										
PSIL	104	107	111	105	107	110	91	85	86	83
ANNOYANCE										
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)										
TONE CORRECTION (C IN DB)										
PNLT	126	129	130	128	129	130	113	110	112	106
C	2	1	1	3	1	2	1	1	1	0

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

P ADDITIONAL EAR PROTECTION REQUIRED.