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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK, VOLUME 102, A-10A IN--ETC(U)

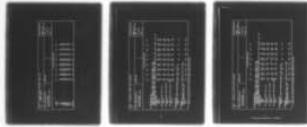
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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK.

Volume 102.

A-10A In-Flight Crew Noise

9 Technical rept.,

10 Harold K. Hille

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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

H. E. von Gierke
HENNING E. VON GIERKE
Director
Biodynamics and Biotics Division
Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The A-10A is a USAF single-seat close support aircraft. 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		

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Air Force ear protectors. Refer to Volume 1 of this handbook, USAF Bio-environmental 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, 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.

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INTRODUCTION

The A-10A is a single seat close support aircraft manufactured by the Fairchild Republic Company. Power is provided by two GE TF34-GE-100 turbofan engines each rated at 9065 lb maximum takeoff thrust. The engines are manufactured by the General Electric Company, Aircraft Engine Group, Military Engine Division.

This volume provides measured 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 A-10A 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, 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 are 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.

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.

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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 an A-10A aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard A-10A environments but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Measurements were made inside the cockpit at the pilot's location with MICROPAK, which is 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 diaphragm parallel to the surface pointing away from the helmet.

In the analysis, microphone corrections for random incidence were applied to the overall system's response. The recorded samples were analyzed using a 4- or 8-second integration time to obtain power-averaged levels that effectively smooth out short duration fluctuations and best describes the exposure.

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.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the A-10A 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 LOCATION AND TEST CONDITIONS

A-10A, EDWARDS AFB, 14 APRIL 1976

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Cockpit	Seated Head Level
CONDITION	DESCRIPTION	
A	Engine Start — Canopy Open	
B	Runup — Max. Power	
C	Takeoff — Max Power	
D	Climb — 2500' \nearrow 5000' MSL — Intermediate Power 190 KIAS	
E	Climb — 5000' \nearrow 7000' MSL — Intermediate Power 200 KIAS — ECS System On, Flow At Minimum	
F	Climb — 7000' \nearrow 10000' MSL — Intermediate Power 200 KIAS — ECS System On, Flow At Medium	
G	Climb — 10000' \nearrow 15000' MSL — Intermediate Power — ECS System On, Flow At Medium	
H	Cruise — 15000' MSL — Intermediate Power — ECS System On, Flow At Minimum	
I	Cruise — 15000' MSL, 255 KIAS	
J	Descent — 15000' 5000' MSL	
K	Range Sweep — 5000' MSL, 255 KIAS	
L	1st Gun Firing — GAU-8/A	
M	2nd Gun Firing — GAU-8/A	
N	3rd Gun Firing — GAU-8/A	
P	Cruise — 11000' MSL, 80% RPM — Speed Brakes Extended	
S	Traffic Pattern — 160 KIAS	

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

NOISE SOURCE/SUBJECT: OPERATION:

A-10A AIRCRAFT
INFLIGHT NOISE LEVELS

IDENTIFICATION:

OMEGA 3.2
TEST 75-049-001
RUN 01

08 SEP 76

PAGE F1

LOCATION/CONDITION

FREQ (HZ)	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I
50	76	87	76	77	76	87	76	81	75
63	77	90	85	84	83	87	87	82	81
80	82	83	81	79	79	80	82	74	75
100	87	86	86	86	85	87	87	87	90
125	88	90	86	84	84	87	86	85	87
160	83	93	92	90	88	90	90	88	90
200	86	87	96	89	88	91	90	87	89
250	82	88	91	90	90	91	91	91	92
315	92	89	92	90	94	93	91	93	93
400	90	87	86	88	87	90	89	90	93
500	82	83	88	89	88	90	90	89	92
630	84	81	86	86	85	90	89	86	91
800	87	83	87	87	86	92	91	86	89
1000	87	86	85	86	85	92	91	85	86
1250	86	84	84	84	83	91	90	83	84
1600	86	83	83	84	84	92	90	83	85
2000	88	83	82	83	82	91	90	81	84
2500	88	82	82	83	83	92	92	82	82
3150	88	82	81	82	82	93	92	82	80
4000	87	81	80	81	81	94	93	82	82
5000	86	78	80	80	80	91	90	81	82
6300	88	79	84	83	83	92	92	83	85
8000	86	80	80	80	80	93	92	82	83
10000	83	77	77	78	78	92	91	82	82
OVERALL	100	100	101	100	99	105	104	99	102

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

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

NOISE SOURCE/SUBJECT	OPERATION	LOCATION/CONDITION						1/S
		1/J	1/K	1/L	1/M	1/N	1/P	
A-10A AIRCRAFT INFLIGHT NOISE LEVELS								
50	77	84	98	95	96	70	67	74
63	86	91	105	104	105	81	75	79
80	82	82	102	97	102	75	80	83
100	90	95	106	99	102	81	77	81
125	87	94	107	99	104	82	83	86
160	93	95	111	103	106	89	82	87
200	93	95	110	110	114	87	90	91
250	95	100	110	105	110	87	87	92
315	95	101	109	105	110	89	89	87
400	91	97	104	104	103	85	86	89
500	92	98	104	104	104	85	83	89
630	90	97	103	103	105	82	83	81
800	90	96	106	105	109	82	81	78
1000	88	96	104	102	107	81	80	76
1250	86	97	100	98	100	81	81	79
1600	86	96	98	96	97	80	80	79
2000	85	93	96	96	96	77	79	79
2500	83	90	95	93	95	76	76	77
3150	81	88	94	94	96	76	76	76
4000	82	89	95	97	98	75	76	76
5000	83	89	94	96	97	76	73	71
6300	86	90	95	98	101	77	75	70
8000	83	90	96	97	100	74	73	70
10000	80	91	96	91	94	71	69	68
OVERALL	103	109	119	116	119	97	96	96

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE I MEASURED SOUND PRESSURE LEVEL (DB) OCTAVE BAND

TABLE 1 MEASURED SOUND PRESSURE LEVEL (dB) 2 OCTAVE BAND		IDENTIFICATION					
NOISE SOURCE/SUBJECT	OPERATION	TEST 75-049-001		TEST 75-049-001		TEST 75-049-001	
A-10A AIRCRAFT INFLIGHT NOISE LEVELS	(RUN 01		OMEGA 3.2		PAGE J1	
FREQ (HZ)		LOCATION/CONDITION					
		1/A	1/B	1/C	1/D	1/E	1/F
63	84	92	87	85	85	86	83
125	91	95	94	92	91	93	91
250	93	93	96	95	94	97	96
500	91	89	92	92	92	95	94
1000	92	89	90	90	89	96	90
2000	92	88	87	88	86	97	87
4000	92	85	85	86	86	97	86
8000	91	84	86	86	86	97	87
OVERALL	100	100	101	100	99	105	102

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

NOISE SOURCE/SUBJECT:	OPERATIONS:						LOCATION/CONDITION		
	1/J	1/K	1/L	1/M	1/N	1/P	1/R	1/S	
A-10A AIRCRAFT INFLIGHT NOISE LEVELS									
63	88	92	107	105	107	82	81	85	
125	95	99	114	106	110	90	86	90	
250	99	104	114	112	116	93	93	95	
500	96	102	106	108	111	89	90	92	
1000	93	101	108	107	111	86	85	83	
2000	90	98	101	99	101	83	83	83	
4000	87	94	95	100	102	80	80	79	
8000	66	95	100	101	104	79	77	74	
OVERALL	103	109	119	116	119	97	96	98	

TABLE I MEASURES OF HUMAN NOISE EXPOSURE
3

		IDENTIFICATION	
		OPERATION:	
NOISE SOURCE/SUBJECT:		A-10A AIRCRAFT INFLIGHT NOISE LEVELS	
		TEST 75-049-001 RUN 01 08 SEP 76 PAGE H1	
		LOCATION/CONDITION	
		1/A	1/B
		1/C	1/D
		1/E	1/F
		1/G	1/H
		1/I	1/J
HAZARD/PROTECTION		C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR	
C-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) 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)		MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)	
NO PROTECTION			
OASLC		100	100
OASLA		99	95
T		36	71
HGU-2A/P HELMET WITH H-154			
OASLC*		86	86
T		339	339
HGU-2A/P HELMET WITH H-154(A)			
OASLC*		62	62
T		679	679
HGU-2A/P HELMET WITH CUSTOM LINER			
OASLC*		91	90
T		143	170
COMMUNICATION			
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)		92	89
PSIL		90	90
ANNOYANCE			
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)			
TONE CORRECTION (C IN DB)		114	110
PNLT		1	1
C			

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE 1 MEASURES OF HUMAN NOISE EXPOSURE
3

NOISE SOURCE/SUBJECT		OPERATION		LOCATION/CONDITION		IDENTIFICATION			
A-10A AIRCRAFT INFLIGHT NOISE LEVELS									
				1/J	1/K	1/L	1/M	1/N	1/P
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	103	106	119	116	119	97	96	98	
OASLA	99	106	112	111	114	92	92	92	
T	36	11	3.6	4.5	2.7	120	120	120	
MGU-2A/P HELMET WITH H-154									
OASLC*	91	96	106	103	107	85	85	87	
T	143	60	11	16	9	404	404	265	
MGU-2A/P HELMET WITH H-154 (A)									
OASLC*	87	92	102	99	103	81	81	83	
T	285	120	21	36	16	807	807	571	
MGU-2A/P HELMET WITH CUSTOM LINER									
OASLC*	95	101	109	107	111	88	88	90	
T	71	25	6	9	4.5	240	240	170	
COMMUNICATION	PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)								
PSIL	93	100	106	105	108	86	86	86	
ANNOYANCE	PERCEIVED NOISE LEVEL, TONE CORRECTED (PMLT IN PHOB)								
TONE CORRECTION (C IN DB)									
PMLT	113	120	126	125	128	106	106	106	
C	1	1	1	1	1	1	1	1	

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.