

AD-A053 850

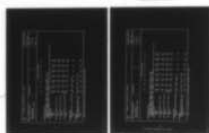
AEROSPACE MEDICAL RESEARCH LAB WRIGHT-PATTERSON AFB OHIO F/G 1/2  
USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK, VOLUME 103. F-5E IN---ETC(U)  
OCT 76 H K HILLE

UNCLASSIFIED

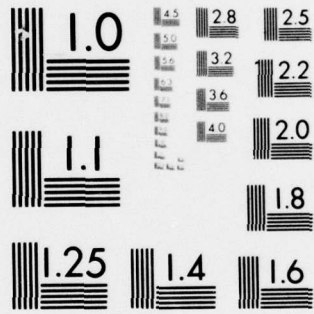
AMRL-TR-75-50-VOL-103

NL

|OF|  
AD  
A053850



END  
DATE  
FILMED  
6 -78  
DDC



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

AD A 053850

AMRL-TR-75-50  
Volume 103

*P  
NW*

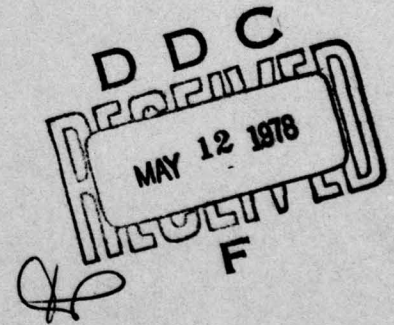


# USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 103

F-5E In-Flight Crew Noise

OCTOBER 1976



AD NO. \_\_\_\_\_  
DDC FILE COPY

Approved for public release; distribution unlimited.

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:

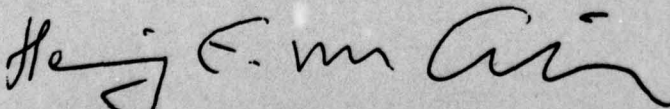
Defense Documentation Center  
Cameron Station  
Alexandria, Virginia 22314

## 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 Bioengineering Division  
Aerospace Medical Research Laboratory

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1. REPORT NUMBER AMRL-TR-75-50 - Vol - 103	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK, F-5E In-flight Crew Noise,	5. TYPE OF REPORT & PERIOD COVERED Volume 103 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 723104-18		
11. CONTROLLING OFFICE NAME AND ADDRESS Same as above	12. REPORT DATE October 1976		
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Technical rept.	13. NUMBER OF PAGES 14		
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited	15. SECURITY CLASS. (of this report) Unclassified		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE		
18. SUPPLEMENTARY NOTES	16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Noise Noise Environments Bioenvironmental Noise In-flight Crew Noise F-5E Aircraft	17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The F-5E is a USAF light 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	18. SUPPLEMENTARY NOTES		

DDC  
MAY 12 1978  
FBI

4331265  
4342702

009850

hc

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.



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

## 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.

ACCESSION for	
NTIS	White Section <input checked="" type="checkbox"/>
DDC	Buff Section <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
DISTRIBUTION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
DI	SPECIAL
A	

## Table of Contents

	<i>Page</i>
INTRODUCTION .....	3
IN-FLIGHT NOISE .....	4

### List of Tables

1. Measurement Location and Test Conditions for Noise Measurements .....	4
2. Measured Sound Pressure Level	
1/3 Octave Band .....	5—6
Octave Band .....	7—8
3. Measures of Human Noise Exposure .....	9—10



## INTRODUCTION

The F-5E is a single-seat light tactical fighter manufactured by the Northrop Corporation. Power is provided by two GE J85-GE-21 turbojet engines each rated at 5000 lb maximum takeoff thrust with afterburner. 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 F-5E 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 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-5E aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard F-5E 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 F-5E 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

F-5E, Edwards AFB, 16 April 76

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Cockpit	Seated Head Level
CONDITION	DESCRIPTION	
A	Left Engine Start — Canopy Open	
B	Idle — Both Engines — Canopy Closed	
C	Ground Runup — 80% RPM — Canopy Closed	
D	Takeoff — Max. Power	
E	Climb to 5000' MSL — Mil Power	
F	Climb to 10,000' MSL — Mil Power	
G	Climb to 15,000' MSL — Mil Power	
H	Firing Range Sweep — 15,000' MSL	
I	Climb to 20,000' MSL — Mil Power	
J	Cruise 375 KIAS — 20,000' MSL	
K	Cruise — 380 KIAS — 21,100' MSL	
L	Descent With Missile Firing	
M	Final Approach — Flaps Down	
N	Touch Down and Landing Roll	
P	Taxi	



TABLE: MEASURED SOUND PRESSURE LEVEL (DB) 1/3 OCTAVE BAND		IDENTIFICATION:									
2		OMEGA 3.2 TEST 76-406-001 RUN 02									
NOISE SOURCE/SUBJECT:		OPERATION:									
F-5E AIRCRAFT											
INFLIGHT NOISE LEVELS		13 SEP 76									
		PAGE F2									
		LOCATION/CONDITION									
FREQ (HZ)	1/I	1/J	1/K	1/L	1/M	1/N	1/P				
50	79	79	78	80	79	86	82				
63	80	78	80	81	80	84	84				
80	82	81	82	83	82	87	90				
100	95	94	94	95	95	92	91				
125	98	96	96	96	97	95	93				
160	94	90	91	92	93	88	86				
200	94	91	92	93	94	89	81				
250	93	90	92	95	93	92	82				
315	94	89	92	94	91	92	82				
400	94	90	92	95	93	88	86				
500	98	96	97	100	98	86	79				
630	93	92	94	96	93	80	72				
800	93	91	92	96	92	79	74				
1000	92	89	92	96	91	77	73				
1250	92	89	91	93	92	76	72				
1600	92	90	92	93	92	76	71				
2000	92	90	91	91	91	76	70				
2500	91	89	90	90	90	74	69				
3150	92	89	90	91	91	74	70				
4000	92	90	91	91	93	75	72				
5000	89	86	87	88	88	74	69				
6300	89	87	87	88	89	76	75				
8000	90	88	88	88	90	73	74				
10000	91	90	90	90	92	70	67				
OVERALL	107	104	105	107	106	101	98				

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.



TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		IDENTIFICATION:										
OCTAVE BAND		OMEGA 3.2										
		TEST 76-406-001										
		RUN 02										
		13 SEP 76										
		PAGE J2										
NOISE SOURCE/SUBJECT: ( OPERATION: )												
( )												
( )												
( )												
( )												
( )												
LOCATION/CONDITION												
FREQ (HZ)	1/I	1/J	1/K	1/L	1/M	1/N	1/P					
63	85	84	85	86	85	90	92					
125	101	98	99	99	100	97	95					
250	99	95	97	99	98	96	86					
500	100	98	99	102	100	90	87					
1000	97	94	96	99	96	82	78					
2000	96	94	96	96	96	80	75					
4000	96	94	94	95	96	79	75					
8000	95	93	93	93	95	78	78					
OVERALL	107	104	105	107	106	101	98					



MEASURES OF HUMAN NOISE EXPOSURE		IDENTIFICATION:									
NOISE SOURCE/SUBJECT:	OPERATION:	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J
3											
OMEGA 3.2											
TEST 76-406-001											
RUN 01											
13 SEP 76											
PAGE H1											
LOCATION/CONDITION											
HAZARD/PROTECTION											
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN OBC) 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		100	100	107	107	105	106	106	106	107	107
OASLA		98	99	104	102	101	103	103	103	104	104
T		42	36	15	21	25	18	18	18	15	15
HGU-2A/P HELMET WITH H-154		90	85	92	93	91	92	92	92	93	93
OASLA*		170	404	120	111	143	120	120	120	101	101
T											
HGU-2A/P HELMET WITH H-154(A)		78	79	88	88	87	87	87	87	88	88
OASLA*		960	960	240	240	285	285	285	285	240	240
T											
HGU-2A/P HELMET WITH CUSTOM LINER		86	89	99	97	96	97	97	97	98	98
OASLA*		339	202	36	50	60	50	50	50	42	42
T											
COMMUNICATION											
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)											
PSIL		86	90	98	95	96	97	97	97	98	98
ANNOYANCE											
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)											
TONE CORRECTION (C IN DB)											
PNLT		113	116	120	119	118	119	119	119	119	119
C		1	1	2	2	2	2	2	2	2	1

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.