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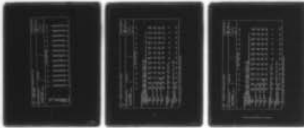
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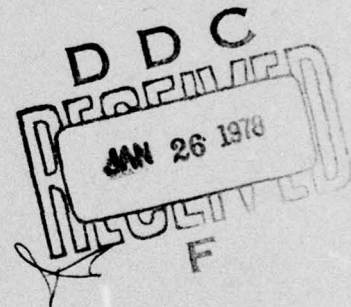


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# USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 36

T-38A In-Flight Crew Noise



SEPTEMBER 1975

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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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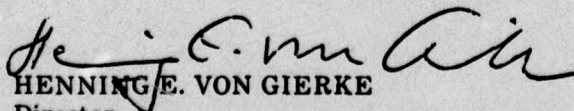
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**FOR THE COMMANDER**

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



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The T-38A is a USAF supersonic aircraft providing flight instruction in all phases of basic pilot training. This report provides measured data defining the bioacoustic environments at flight crew locations inside this aircraft during normal flight operations. Data are reported for 1 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		

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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. ↑

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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. Col Justus F. Rose, Jr., conducted the field measurements and performed the data analysis; Capt Nick Farinacci prepared this report.

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

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## INTRODUCTION

The T-38A is a USAF supersonic aircraft providing supervised flight instruction in all phases of basic pilot training. This aircraft, which is manufactured by the Northrop Corporation, NORAIR Division, is powered by two J85-GE-5 turbojet engines rated at 3,850 lb maximum take-off thrust with afterburner. The engines are manufactured by the General Electric Company, Aircraft Engine Group, Military Engine 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 T-38A 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 aerospace ground equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, aerospace ground 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., in-flight/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 the updated index as it is generated.

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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 T-38A aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard T-38A 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 one flight crew 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.

The microphone was randomly moved external to the headgear in a region 0.2-0.3 meter from the head 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.

### RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the T-38A 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

T-38A, Eglin AFB, 21 Jul 1971  
Serial # 70-1558

LOCATION	POSITION	HEIGHT ABOVE DECK
1	Rear Seat	Seated Head Level
CONDITION	DESCRIPTION	
A	Ground power unit operating, canopies open.	
B	#1 engine start, ground power unit operating, canopies open.	
C	#2 engine start, #1 engine idle (44% RPM), ground power unit operating, canopies open.	
D	Taxiing, canopies open (46-75% RPM).	
E	Takeoff — afterburner.	
F	Initial acceleration to 300 KIAS, gear and flaps up, afterburner.	
G	Climb — 350 KIAS, 100% RPM, 10.0M PA ↗	
H	Cruise — 500 KIAS, .9M, Military power — 100% RPM, 10.0M PA.	
I	Afterburner climb 3.0M to 10.0M PA, .89M.	
J	Afterburner climb 10.0M to 20.0M PA, .89M.	
K	Cruise — 260 KIAS, .9M, 93% RPM, 41.0M PA.	
L	Supersonic — 320 KIAS, 1.1M, afterburner, 38.0M PA.	
M	Instrument penetration — 300 KIAS, 85% RPM, 33.0M PA ↘ speed brakes.	
N	Typical holding pattern airspeed — 250 KIAS, .56M, 91% RPM, 20.0M PA.	
P	Descent — 280 KIAS, 85% RPM, 16.0M PA ↘ speed brakes.	
Q	Cruise — 290 KIAS, 89% RPM, 4.0M PA.	
R	GCA traffic pattern — 1500', 88% RPM, gear and flaps down.	
S	Final approach — 160 KIAS, 94% RPM, gear and flaps down.	
T	Missed approach — gear and flaps up.	
U	Cruise — 320 KIAS, Left engine — 54%, right engine — 100%, 3.0M PA.	
V	Cruise — 375 KIAS, .6M, Left engine — 94%, right engine — 90% RPM, 3.0M PA.	
W	VFR overhead traffic pattern — initial (1500'), 230 KIAS, 85% RPM.	
X	VFR overhead traffic pattern — pitchout.	
Y	VFR overhead traffic pattern — base leg, gear and flaps down.	
Z	VFR overhead traffic pattern — final approach, 160 KIAS, gear and flaps down.	
AA	Landing roll.	

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)  
 1/3 OCTAVE BAND  
 2  
 NOISE SOURCE/SUBJECT: ( OPERATION:  
 T-38A AIRCRAFT ( )  
 INFLIGHT NOISE LEVELS ( )  
 IDENTIFICATION:  
 OMEGA 3.2  
 TEST 71-014-052  
 RUN 01  
 10 JAN 75  
 PAGE F1

FREQ (HZ)	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	1/M			
25	67	77	79	88	85	80	80	81	78	82	72	73	73			
31.5	81	83	84	91	89	85	84	85	84	86	76	78	79			
40	92	93	94	89	93	89	88	88	88	89	82	82	83			
50	82	88	90	89	89	82	82	81	81	82	75	76	79			
63	93	92	93	97	81	79	80	80	78	79	73	74	75			
80	96	95	96	91	86	82	79	79	79	79	72	73	74			
100	87	87	86	85	94	87	87	87	87	88	81	82	83			
125	90	90	89	86	96	95	95	95	95	97	90	91	93			
160	88	88	89	87	88	91	92	91	93	94	86	83	85			
200	87	88	90	90	92	93	94	94	94	92	84	83	85			
250	87	87	90	89	90	91	91	89	85	85	79	84	79			
315	87	86	86	87	89	90	89	90	92	89	79	84	84			
400	82	85	86	82	85	86	90	93	93	93	79	85	86			
500	76	79	80	82	86	88	93	94	96	96	82	86	87			
630	79	84	85	85	90	92	99	101	101	100	88	93	91			
800	80	82	83	83	90	93	96	97	98	97	84	87	87			
1000	83	83	83	81	90	95	95	97	99	99	85	89	88			
1250	77	80	83	83	87	89	94	96	98	96	83	87	86			
1600	80	86	88	85	86	88	95	96	97	98	81	87	84			
2000	82	87	88	90	86	91	98	98	99	101	84	89	86			
2500	86	86	88	89	84	89	96	96	96	98	81	85	83			
3150	88	90	90	88	81	86	92	94	95	96	78	84	80			
4000	88	95	96	97	81	88	93	94	96	97	78	84	79			
5000	88	89	90	100	82	86	92	92	92	95	80	76	76			
6300	29	95	93	98	81	85	92	89	89	93	75	78	76			
8000	94	96	96	94	77	82	89	86	87	91	71	75	74			
10000	96	89	89	93	75	82	88	84	84	90	70	73	71			
12500	90	87	88	91	74	82	88	83	83	89	70	73	71			
16000	97	88	89	90	73	79	88	81	81	87	69	72	70			
OVERALL	104	104	105	106	103	103	107	108	109	109	96	100	99			

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.



TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													IDENTIFICATION:			
1/3 OCTAVE BAND													OMEGA 3.2			
NOISE SOURCE/SUBJECT: ( OPERATION: )													TEST 71-014-052			
T-38A AIRCRAFT ( )													RUN 02			
INFLIGHT NOISE LEVELS ( )													10 JAN 75			
( )													PAGE F2			
LOCATION/CONDITION																
FREQ (HZ)	1/N	1/P	1/Q	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y	1/Z	1/AA			
25	79	76	76	87	88	79	81	80	76	77	89	92	90			
31.5	83	82	82	89	89	84	86	83	81	82	90	93	93			
40	87	86	86	92	91	88	90	88	87	87	95	97	97			
50	79	80	79	85	86	81	82	81	80	81	91	91	86			
63	76	77	77	81	82	80	81	79	78	79	81	80	82			
80	77	78	78	82	83	79	82	80	78	79	84	85	88			
100	85	87	87	91	91	88	89	88	87	89	93	94	95			
125	94	96	95	97	99	96	99	98	97	96	99	99	96			
160	93	91	93	90	92	90	93	90	89	88	91	91	88			
200	88	91	93	94	94	92	96	93	89	89	94	93	87			
250	83	88	89	91	93	91	94	87	86	88	90	90	83			
315	86	86	88	91	93	90	93	87	86	87	89	89	84			
400	87	85	85	85	86	84	89	88	85	84	86	84	80			
500	89	88	88	84	86	86	91	91	87	88	87	85	74			
630	94	93	91	86	90	91	96	97	90	89	88	85	75			
800	90	91	91	83	90	90	97	93	89	88	86	83	75			
1000	91	90	89	81	91	90	97	93	88	86	84	80	73			
1250	91	88	87	78	86	87	93	92	86	85	81	78	72			
1600	89	87	85	76	85	85	93	91	84	84	80	76	74			
2000	94	91	89	78	89	89	98	94	87	86	84	79	75			
2500	88	88	85	76	86	87	94	91	83	83	80	76	72			
3150	85	84	82	75	84	84	90	88	81	81	79	75	72			
4000	87	85	83	76	85	86	93	88	81	81	79	76	84			
5000	85	82	81	74	84	83	92	86	79	79	78	75	77			
6300	85	83	80	81	82	83	90	85	80	81	81	81	77			
8000	81	80	80	83	81	80	88	83	80	80	83	83	89			
10000	78	78	76	69	78	79	87	80	74	73	73	70	75			
12500	79	79	75	65	77	79	86	79	73	72	72	67	71			
16000	78	78	74	64	75	76	84	78	70	70	70	65	65			
OVERALL	103	102	102	102	104	102	107	105	101	101	104	104	103			

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		IDENTIFICATION:												
OCTAVE BAND														
2		OMEGA 3.2												
		TEST 71-014-052												
NOISE SOURCE/SUBJECT:		RUN 01												
( OPERATION:														
(														
( T-38A AIRCRAFT		10 JAN 75												
( INFLIGHT NOISE LEVELS														
(		PAGE J1												
(														
		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	1/M
FREQ														
(HZ)														
31.5		92	94	94	94	95	91	90	90	90	91	83	84	84
63		98	97	99	99	91	86	85	85	84	85	78	79	81
125		93	93	91	91	98	97	97	97	97	99	92	92	94
250		91	92	93	93	95	96	96	96	96	94	86	88	88
500		84	88	89	88	92	94	100	102	103	102	89	94	93
1000		86	86	88	87	94	95	99	101	103	102	89	93	91
2000		88	91	93	93	90	94	101	101	102	104	87	92	89
4000		92	97	97	102	86	91	97	98	99	101	82	87	83
8000		99	99	98	100	83	88	94	92	92	96	77	81	78
16000		98	91	91	93	76	84	91	85	85	91	72	75	73
OVERALL		104	104	105	106	103	103	107	108	109	109	96	100	99

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		IDENTIFICATION:											
2		OMEGA 3.2											
NOISE SOURCE/SUBJECT:		TEST 71-014-052											
T-38A AIRCRAFT		RUN 02											
INFLIGHT NOISE LEVELS		10 JAN 75											
		PAGE J2											
		LOCATION/CONDITION											
FREQ (HZ)	1/N	1/P	1/Q	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y	1/Z	1/AA
31.5	89	88	88	95	94	90	92	90	88	89	97	99	99
63	82	83	83	88	89	85	86	85	83	84	92	92	91
125	96	97	97	99	100	97	100	99	98	97	100	100	99
250	91	94	95	97	98	95	99	94	92	93	96	95	89
500	95	95	93	90	93	93	98	98	93	92	92	90	82
1000	95	95	94	86	94	94	100	97	92	91	89	86	78
2000	96	94	92	82	92	92	100	97	90	89	86	82	79
4000	90	88	87	80	89	89	96	92	85	85	83	80	85
8000	87	86	84	85	85	85	93	87	83	84	85	85	90
16000	81	82	77	67	79	81	88	82	75	74	74	69	72
OVERALL	103	102	102	102	104	102	107	105	101	101	104	104	103



MEASURES OF HUMAN NOISE EXPOSURE													IDENTIFICATION:		
3													OMEGA 3.2		
NOISE SOURCE/SUBJECT: ( OPERATION: )													TEST 71-014-052		
I-38A AIRCRAFT ( )													RUN 01		
INFLIGHT NOISE LEVELS ( )													28 APR 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	1/K	1/L	1/M			
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															
	102	103	104	105	103	107	108	108	109	96	99	99			
	OASLC														
	100	102	102	105	98	100	106	107	108	93	98	96			
	OASLA														
	30	21	21	13	42	30	11	9	8	6	101	42			
	T														
	HGU-2A/P HELMET WITH H-154														
	93	90	90	92	88	69	92	92	92	93	81	84			
	OASLA*														
	101	170	17J	120	240	202	120	120	120	101	807	480			
	T														
	HGU-2A/P HELMET WITH H-154(A)														
	81	81	82	84	85	86	87	88	87	76	80	79			
	OASLA*														
	807	607	67S	679	404	339	285	240	285	960	960	960			
	T														
	HGU-2A/P HELMET WITH CUSTOM LINER														
	87	88	90	89	93	94	99	101	101	88	92	91			
	OASLA*														
	285	240	170	202	101	85	36	25	25	240	120	143			
	T														
COMMUNICATION															
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)															
	86	89	90	89	92	95	100	102	102	88	93	91			
	PSIL														
ANNOYANCE															
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)															
TONE CORRECTION (C IN DB)															
	115	119	119	121	112	115	121	121	122	123	108	112			
	PNLT														
	2	2	2	1	1	1	1	2	1	1	2	1			
	C														

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

MEASURES OF HUMAN NOISE EXPOSURE											IDENTIFICATION:												
NOISE SOURCE/SUBJECT:	(	OPERATION:	(																				
1/N	1/P	1/Q	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y	1/Z	1/AA											
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	102	102	102	104	102	107	105	101	101	103	103	102											
OASLA	101	130	98	99	99	106	103	97	96	95	93	92											
T	25	30	42	101	36	11	18	50	60	71	101	120											
HGU-2A/P HELMET WITH H-154																							
OASLA*	87	87	88	89	90	88	93	86	86	89	88	85											
T	285	285	240	202	170	240	101	202	339	202	240	404											
HGU-2A/P HELMET WITH H-154(A)																							
OASLA*	82	83	84	84	86	84	88	85	82	84	84	80											
T	679	571	480	480	339	480	240	404	679	480	480	960											
HGU-2A/P HELMET WITH CUSTOM LINER																							
OASLA*	94	94	93	91	94	93	99	97	92	91	92	85											
T	85	85	101	143	85	101	36	50	120	143	120	404											
COMMUNICATION																							
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)																							
PSIL	95	94	93	86	93	93	100	97	92	91	89	86											
ANNoyANCE																							
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)																							
TONE CORRECTION (C IN DB)																							
PNLT	116	114	113	109	114	113	121	117	112	111	111	110											
C	2	1	1	1	1	1	2	2	1	1	1	1											

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.