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# USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

## Volume 33 C-131B IN-FLIGHT CREW NOISE

MARCH 1977

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FOR THE COMMANDER



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Director  
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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br>The C-131B is a USAF transport/passenger aircraft which can be used as a flying laboratory. This report provides measured data defining the bioacoustic environments at flight crew/passenger locations inside this aircraft during normal flight operations. Data are reported for 9 locations 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 |                       |   |

A 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.

### 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 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 C-131B is a USAF transport/passenger aircraft which can be used as a flying laboratory. This aircraft, which is manufactured by the General Dynamics Corporation, Convair Division, is powered by two R-2800-103W reciprocating engines rated at 2,500 hp (wet) at 2,800 rpm maximum take-off power. Each engine drives a Hamilton Standard Hydromatic (or Curtiss Electric) four-blade constant-speed, 4 m diameter propeller through a 0.45 gear reduction. The engines are manufactured by the Aircraft Corporation, Pratt & Whitney Aircraft Division.

This volume provides measured data defining the bioacoustic environments produced inside this 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 C-131B 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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## IN-FLIGHT NOISE

### MEASUREMENTS

All noise measurements were made on-board a standard-configured C-131B aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard C-131B 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 various flight crew and passenger locations. Table 1 lists the measurement locations 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 position was at ear level external to headgear in a region 0.2—0.3 meter from the head when an individual was present. At unoccupied locations, measurements were made at ear level throughout a volume where the head would normally be located. In both cases, the microphone was randomly moved throughout a spherical volume approximately 0.3 meter in diameter 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.

Although the presence of a crew member or passenger at a measurement location affects the resultant sound field, the magnitude of such effects is generally small and not significant in determining exposure limits or voice communication capabilities. Consequently, no distinction is made in this report between occupied and unoccupied measurement locations.

### RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the C-131B aircraft at the 9 specified locations. 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 variety of measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1  
MEASUREMENT LOCATIONS AND TEST CONDITIONS

C-131B, Wright-Patterson AFB, 18 Jun 1975  
Serial # 53-7821

| <i>LOCATION</i> | <i>POSITION</i>                                   | <i>HEIGHT ABOVE DECK</i> |
|-----------------|---|--------------------------|
| 1               | Between Pilot and Copilot                         | Seated Head Level        |
| 2               | Galley (Aisle Seat, Propeller Plane)              | Seated Head Level        |
| 3               | Front of Passenger Cabin — Left Side Window Seat  | Seated Head Level        |
| 4               | Front of Passenger Cabin — Left Side Aisle Seat   | Seated Head Level        |
| 5               | Middle of Passenger Cabin — Left Side Window Seat | Seated Head Level        |
| 6               | Middle of passenger Cabin — Left Side Aisle Seat  | Seated Head Level        |
| 7               | Rear of Passenger Cabin — Left Side Window Seat   | Seated Head Level        |
| 8               | Rear of Passenger Cabin — Left Side Aisle Seat    | Seated Head Level        |
| 9               | Latrine — Right Side                              | Seated Head Level        |

  

| <i>CONDITION</i> | <i>DESCRIPTION</i>  |
|------------------|---|
| A                | Two Engines — Taxi Power. 1000 RPM, 19" Manifold Pressure.      |
| B                | Takeoff — Wet, 2800 RPM, 62" Manifold Pressure, 104 KIAS.       |
| C                | Climb — 2600 → 2400 RPM, 51" → 40" Manifold Pressure, 150 KIAS. |
| D                | Cruise — 2000 RPM, 30" Manifold Pressure, 160 KIAS, 4000 PA.    |
| E                | Approach — 2400 RPM, 26" Manifold Pressure, 150 → 120 KIAS.     |

| TABLE 1 MEASURED SOUND PRESSURE LEVEL (DB) |     |     |     |     |     |     |     |     |     |     | IDENTIFICATION 1 |     |     |     |     |
|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------------------|-----|-----|-----|-----|
| 1/3 OCTAVE BAND                            |     |     |     |     |     |     |     |     |     |     |                  |     |     |     |     |
| NOISE SOURCE/SUBJECT:                      |     |     |     |     |     |     |     |     |     |     |                  |     |     |     |     |
| ( OPERATION:                               |     |     |     |     |     |     |     |     |     |     |                  |     |     |     |     |
| C-131B AIRCRAFT                            |     |     |     |     |     |     |     |     |     |     | OMEGA 3.2        |     |     |     |     |
| INFLIGHT NOISE LEVELS                      |     |     |     |     |     |     |     |     |     |     | TEST 74-009-001  |     |     |     |     |
|  |     |     |     |     |     |     |     |     |     |     | RUN 01           |     |     |     |     |
|  |     |     |     |     |     |     |     |     |     |     | 04 MAR 77        |     |     |     |     |
|  |     |     |     |     |     |     |     |     |     |     | PAGE F1          |     |     |     |     |
| LOCATION/CONDITION                         |     |     |     |     |     |     |     |     |     |     |                  |     |     |     |     |
| FREQ (HZ)                                  | 1/A | 2/A | 1/B | 1/C | 2/C | 1/D | 2/D | 3/D | 4/D | 5/D | 6/D              | 7/D | 8/D | 9/D | 1/E |
| 25   | 84  | 84  | 88  | 79  | 82  | 80  | 81  | 82  | 81  | 80  | 80               | 80  | 79  | 82  | 78  |
| 31.5                                       | 77  | 80  | 88  | 78  | 82  | 84  | 89  | 89  | 85  | 87  | 85               | 89  | 88  | 87  | 77  |
| 40   | 75  | 79  | 91  | 88  | 92  | 93  | 95  | 97  | 92  | 91  | 90               | 89  | 86  | 98  | 86  |
| 50   | 77  | 82  | 90  | 106 | 105 | 91  | 96  | 98  | 93  | 90  | 89               | 91  | 88  | 97  | 99  |
| 63   | 83  | 86  | 99  | 98  | 97  | 86  | 90  | 98  | 93  | 96  | 91               | 94  | 89  | 89  | 91  |
| 80   | 85  | 87  | 90  | 90  | 88  | 90  | 93  | 97  | 95  | 90  | 89               | 90  | 85  | 86  | 90  |
| 100  | 84  | 85  | 95  | 98  | 104 | 90  | 96  | 100 | 99  | 93  | 92               | 91  | 89  | 89  | 98  |
| 125  | 82  | 80  | 110 | 97  | 101 | 90  | 97  | 101 | 100 | 97  | 92               | 95  | 90  | 94  | 93  |
| 160  | 79  | 74  | 107 | 99  | 101 | 86  | 91  | 94  | 95  | 97  | 92               | 93  | 89  | 94  | 94  |
| 200  | 77  | 73  | 102 | 91  | 95  | 90  | 91  | 94  | 92  | 98  | 97               | 93  | 89  | 95  | 89  |
| 250  | 74  | 73  | 97  | 88  | 94  | 79  | 87  | 88  | 90  | 90  | 96               | 89  | 91  | 88  | 84  |
| 315  | 71  | 73  | 95  | 85  | 89  | 79  | 85  | 87  | 85  | 92  | 94               | 94  | 93  | 88  | 82  |
| 400  | 71  | 70  | 90  | 82  | 86  | 79  | 81  | 85  | 83  | 92  | 90               | 92  | 91  | 89  | 78  |
| 500  | 67  | 63  | 87  | 80  | 81  | 78  | 78  | 80  | 80  | 85  | 85               | 89  | 89  | 91  | 78  |
| 630  | 66  | 64  | 85  | 77  | 79  | 77  | 74  | 77  | 75  | 84  | 93               | 88  | 86  | 88  | 74  |
| 800  | 68  | 68  | 79  | 74  | 73  | 75  | 71  | 74  | 73  | 80  | 79               | 82  | 82  | 83  | 72  |
| 1000                                       | 67  | 61  | 78  | 72  | 69  | 77  | 67  | 70  | 69  | 77  | 75               | 77  | 76  | 75  | 72  |
| 1250                                       | 68  | 63  | 76  | 74  | 69  | 77  | 68  | 69  | 68  | 74  | 73               | 74  | 74  | 59  | 72  |
| 1600                                       | 65  | 63  | 74  | 73  | 69  | 74  | 68  | 68  | 68  | 72  | 71               | 71  | 71  | 66  | 72  |
| 2000                                       | 65  | 59  | 72  | 71  | 6+  | 71  | 62  | 65  | 64  | 69  | 68               | 68  | 69  | 63  | 69  |
| 2500                                       | 63  | 58  | 72  | 68  | 64  | 70  | 66  | 65  | 65  | 66  | 65               | 65  | 66  | 61  | 59  |
| 3150                                       | 60  | 57  | 71  | 67  | 63  | 70  | 65  | 64  | 64  | 62  | 62               | 62  | 61  | 58  | 67  |
| 4000                                       | 60  | 57  | 72  | 66  | 63  | 69  | 65  | 66  | 64  | 61  | 61               | 50  | 59  | 57  | 57  |
| 5000                                       | 60  | 58  | 71  | 64  | 62  | 68  | 64  | 65  | 63  | 58  | 57               | 56  | 56  | 54  | 66  |
| 6300                                       | 60  | 54  | 69  | 63  | 60  | 68  | 62  | 62  | 60  | 58  | 58               | 55  | 55  | 52  | 65  |
| 8000                                       | 60  | 55  | 69  | 54  | 61  | 69  | 62  | 63  | 60  | 58  | 58               | 56  | 56  | 54  | 68  |
| 10000                                      | 58  | 54  | 67  | 62  | 59  | 67  | 60  | 61  | 59  | 56  | 59               | 54  | 54  | 53  | 66  |
| OVERALL                                    | 92  | 93  | 112 | 108 | 110 | 99  | 104 | 107 | 105 | 105 | 103              | 103 | 101 | 104 | 104 |

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

| TABLE: MEASURED SOUND PRESSURE LEVEL (D3)<br>OCTAVE BAND |    | IDENTIFICATION:                        |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|--|----|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|  |    | OMEGA 3.2<br>TEST 74-009-J01<br>RUN 01 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| NOISE SOURCE/SUBJECT:                                    |    | OPERATION:                             |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| C-131B AIRCRAFT  |    |  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| INFLIGHT NOISE LEVELS                                    |    | 04 MAR 77                              |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|  |    | PAGE J1                                |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|  |    | LOCATION/CONDITION                     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|  |    | 1/A                                    | 2/A | 1/B | 1/C | 2/C | 1/D | 2/D | 3/D | 4/D | 5/D | 6/D | 7/D | 8/D | 9/D | 1/E |
| FREQ<br>(HZ)   |    |  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 31.5   | 85 | 86                                     | 94  | 89  | 93  | 93  | 93  | 97  | 98  | 93  | 93  | 91  | 92  | 90  | 99  | 87  |
| 63   | 87 | 90                                     | 100 | 105 | 105 | 105 | 94  | 98  | 102 | 99  | 98  | 94  | 97  | 93  | 98  | 100 |
| 125  | 87 | 86                                     | 111 | 102 | 107 | 95  | 104 | 103 | 104 | 103 | 101 | 97  | 93  | 94  | 98  | 100 |
| 250  | 79 | 76                                     | 104 | 93  | 98  | 90  | 93  | 95  | 95  | 99  | 99  | 101 | 97  | 96  | 97  | 91  |
| 500  | 73 | 72                                     | 92  | 85  | 87  | 82  | 83  | 83  | 87  | 85  | 93  | 92  | 95  | 94  | 94  | 82  |
| 1000   | 72 | 69                                     | 82  | 73  | 75  | 80  | 73  | 71  | 76  | 75  | 82  | 81  | 83  | 84  | 83  | 77  |
| 2000   | 69 | 65                                     | 77  | 76  | 71  | 77  | 71  | 71  | 71  | 70  | 74  | 73  | 73  | 74  | 69  | 75  |
| 4000   | 65 | 62                                     | 76  | 71  | 67  | 74  | 69  | 69  | 70  | 68  | 85  | 85  | 65  | 64  | 61  | 72  |
| 8000   | 64 | 59                                     | 73  | 68  | 65  | 72  | 66  | 66  | 67  | 65  | 62  | 63  | 60  | 60  | 58  | 71  |
| OVERALL  | 92 | 93                                     | 112 | 103 | 110 | 99  | 104 | 104 | 107 | 105 | 135 | 103 | 103 | 101 | 104 | 104 |



## REFERENCES

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.