Test and Evaluation Report of the IVAC® Vital Check Monitor Model 4000AEE

By

James E. Bruckart (Project Officer)
Joseph R. Licina (Project Officer)
Bill Olding (UES, Inc.)
Martin Quattlebaum (UES, Inc.)

Biodynamics Research Division

February 1992

Approved for public release; distribution unlimited.

United States Army Aeromedical Research Laboratory
Fort Rucker, Alabama 36362-5292
Notice

Qualified requesters

Qualified requesters may obtain copies from the Defense Technical Information Center (DTIC), Cameron Station, Alexandria, Virginia 22314. Orders will be expedited if placed through the librarian or other person designated to request documents from DTIC.

Change of address

Organizations receiving reports from the U.S. Army Aeromedical Research Laboratory on automatic mailing lists should confirm correct address when corresponding about laboratory reports.

Disposition

Destroy this document when it is no longer needed. Do not return it to the originator.

Disclaimer

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation. Citation of trade names in this report does not constitute an official Department of the Army endorsement or approval of the use of such commercial items.

Reviewed:

DENNIS F. SHANAHAN
LTC, MC, MFS
Director, Biodynamics
Research Division

Released for publication:

ROGER W. WILLEY, O.D., Ph.D.
Chairman, Scientific Review Committee

DAVID H. KARNEY
Colonel, MC, SFS
Commanding
Test and Evaluation Report of the IVAC® Vital Check Monitor Model 4000AEF

The IVAC® Vital Check Monitor Model 4000AEF was tested for electromagnetic interference/compatibility in the UH-60A helicopter under the U.S. Army Program for Testing and Evaluation of Equipment for Aeromedical Operations. The tests were conducted using current military and industrial standards and procedures for electromagnetic interference/compatibility and human factors. The IVAC® Vital Check Monitor Model 4000AEF was found to be compatible with U.S. Army medical evacuation UH-60A Blackhawk. However, ambient noise levels in the helicopter prevented proper operation of the microphone in the blood pressure cuff which resulted in measurement errors.


Table of contents

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. EXECUTIVE DIGEST</td>
<td></td>
</tr>
<tr>
<td>1.1 Test objectives</td>
<td>1-1</td>
</tr>
<tr>
<td>1.2 Testing authority</td>
<td>1-2</td>
</tr>
<tr>
<td>1.3 Scope</td>
<td>1-2</td>
</tr>
<tr>
<td>1.4 Material description</td>
<td>1-3</td>
</tr>
<tr>
<td>1.5 Summary</td>
<td>1-3</td>
</tr>
<tr>
<td>1.6 Conclusion</td>
<td>1-4</td>
</tr>
<tr>
<td>2. SUBTESTS</td>
<td></td>
</tr>
<tr>
<td>2.1 Initial inspection</td>
<td>2-1</td>
</tr>
<tr>
<td>2.2 Battery life evaluation</td>
<td>2-1</td>
</tr>
<tr>
<td>2.3 Electrical safety evaluation</td>
<td>2-2</td>
</tr>
<tr>
<td>2.4 Human factors evaluation (laboratory)</td>
<td>2-3</td>
</tr>
<tr>
<td>2.5 Altitude (low pressure) test</td>
<td>2-3</td>
</tr>
<tr>
<td>2.6 Vibration test</td>
<td>2-4</td>
</tr>
<tr>
<td>2.7 High temperature test</td>
<td>2-6</td>
</tr>
<tr>
<td>2.8 Low temperature test</td>
<td>2-7</td>
</tr>
<tr>
<td>2.9 Humidity test</td>
<td>2-8</td>
</tr>
<tr>
<td>2.10 Electromagnetic characteristics test</td>
<td>2-9</td>
</tr>
<tr>
<td>2.11 In-flight human factors evaluation</td>
<td>2-12</td>
</tr>
<tr>
<td>2.12 In-flight EMI/EMC characteristics test</td>
<td>2-13</td>
</tr>
</tbody>
</table>
### 3. SUPPORTING DOCUMENTATION

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Detailed test information</td>
<td>3-1</td>
</tr>
<tr>
<td>3.2</td>
<td>Test data</td>
<td>3-3</td>
</tr>
<tr>
<td>3.3</td>
<td>Criteria, significant problems, and suggested improvements</td>
<td>3-37</td>
</tr>
<tr>
<td>3.4</td>
<td>References</td>
<td>3-40</td>
</tr>
<tr>
<td>3.5</td>
<td>Abbreviations</td>
<td>3-42</td>
</tr>
<tr>
<td>3.6</td>
<td>List of manufacturers</td>
<td>3-44</td>
</tr>
<tr>
<td>3.7</td>
<td>Distribution list</td>
<td>3-45</td>
</tr>
</tbody>
</table>
Section 1. Executive digest

The Army program for Test and Evaluation of Aeromedical Equipment uses existing military standards (MIL-STD) and collective professional expertise to test and evaluate selected medical equipment proposed for use aboard Army aircraft. Equipment meeting these standards ensures the safety of the crew, patients, and aircraft by eliminating risks due to: (1) Interference by the medical equipment with aircraft systems/subsystems operation, (2) the aircraft system’s interference with the operation of the medical equipment, (3) the medical equipment’s susceptibility to environmental exposure, or (4) physical and/or functional incompatibility while in use on board selected rotary-wing aircraft. This program tests both developmental and nondevelopmental (off the shelf) medical equipment destined for use aboard Army medical evacuation aircraft.

1.1 TEST OBJECTIVES

1.1.1 To determine if the medical equipment is complete and operational per the manufacturer’s operating instructions.

1.1.2 To ensure the electrical safety of the medical equipment.

1.1.3 To ensure the equipment will function as designed throughout the rated battery operation time.

1.1.4 To ensure the safety of the operator, the patient, and the aircrew.

1.1.5 To assess design considerations which potentially could contribute to an operator error.

1.1.6 To determine if the medical equipment can function as designed in a low pressure environment.

1.1.7 To determine the ability of the medical equipment to withstand the vibrational stresses expected in a rotary-wing flight environment without degradation or malfunction.

1.1.8 To determine the ability of the medical equipment to be stored and operated in a high-temperature environment.

1.1.9 To determine the ability of the medical equipment to be stored and operated in a low-temperature environment.

1.1.10 To determine the ability of the medical equipment to operate satisfactorily for short periods during exposure to high humidity conditions.
1.1.11 To assess the levels of electromagnetic emissions produced by the medical equipment within selected frequency ranges.

1.1.12 To assess the minimum electromagnetic susceptibility levels of the medical equipment within selected frequency ranges.

1.1.13 To assess the physical and/or functional compatibility of the medical equipment while in use on board the aircraft.

1.1.14 To assess the electromagnetic interference (EMI) and electromagnetic compatibility (EMC) characteristics of the medical equipment with the host aircraft and its installed systems.

1.2 TESTING AUTHORITY


1.3 SCOPE

1.3.1 This test was conducted at the United States Army Aeromedical Research Laboratory (USAARL), Cairns Army Airfield (CAAF), and designated test flight areas in and around Fort Rucker, Alabama.

1.3.2 The USAARL UH-60A aircraft, serial number 88-26069, with subsystems delineated in paragraph 3.2.2, was configured with the IVAC® Vital Check monitor*, model 4000AEE and used as the test aircraft for the in-flight evaluation. The in-flight evaluation required 2.1 flight hours.

1.3.3 Laboratory testing was accomplished at USAARL using government furnished equipment (GFE) by Universal Energy Systems, Inc. (UES), under contract No. DAMD 17-86-C-6215.

1.3.4 Prior to flight testing, the following tests were accomplished: Acceptance inspection, equipment training, electromagnetic compatibility, human factors and safety, environmental compatibility, and in-flight compatibility.

1.3.5 An airworthiness release (AWR) dated 12 Jul 1990 was received from the U.S. Army Aviation Systems Command (AVSCOM) prior to the in-flight testing of the IVAC® Model 4000AEE.

* See list of manufacturers
1.4 MATERIAL DESCRIPTION

The IVAC® Model 4000AEE Vital Check monitor is a portable device designed to measure a patient's blood pressure (BP) and temperature. The front panel contains light emitting diodes (LED) displays that show the patient's systolic pressure, diastolic pressure, mean arterial pressure (MAP), pulse and temperature. The BP measurements may be initiated manually or automatically at timed intervals. A control knob on the front panel allows the user to select cuff pressures of 100, 125, 150, or 200 mmHg. A second control knob allows the user to select automatic BP measurements at 1-, 2.5-, 5-, 15-, or 30- minute intervals. The unit can recall up to 20 BP readings. The monitor will reinflate the cuff when it detects artifact, low signal intensity, or an unusually high BP reading. The unit provides a visual display of the Korotkoff sounds and is equipped with a stethoscope attachment to monitor the sounds. The visual display of the Korotkoff sounds is presented on the front panel under the pulse reading. The on/off and start/reset buttons are located under the control knobs on the front panel. A control switch on the rear panel selects whether temperature readings are displayed in Fahrenheit or Celsius. Audible beeps indicate when a new BP or predictive temperature has been reached.

1.5 SUMMARY

1.5.1 Laboratory testing

1.5.1.1 Battery life evaluation: The IVAC® Model 4000AEE was operated on a fully-charged battery with 2.5 minute measurement interval mode until a low battery indication light was noted and an audio alarm sounded. The fully-charged IVAC® Model 4000AEE averaged 7 hours and 13 minutes of operation (174 measurements). The monitor battery is rated for 2.5 hours of operation or 150 BP measurements. This exceeds the manufacturer's specification.

1.5.1.2 Electrical safety evaluation: All measurements were within acceptable limits. No unsafe qualities were found in the IVAC® Model 4000AEE. The limits for currents and resistances were in accordance with (IAW) the National Association of Fire Prevention (NAFP) standards.

1.5.1.3 Human factors evaluation: The IVAC® Model 4000AEE was found to be satisfactory in all major categories of the evaluation criteria with one exception. The red light emitting diode displays do not have an intensity control.

1.5.1.4 Environmental tests: The IVAC® Model 4000AEE can be expected to perform in a variety of environmental conditions. Its performance was found to be satisfactory in all stages of the environmental testing. The requirements for environmental tests
are established in MIL-STD-810D, methods 500.2 (altitude), 514.3 (vibration), 501.2 (high temperature), 502.2 (low temperature), and 507.2 (humidity).

1.5.1.5 Radiated emissions tests (RE02): The IVAC® Model 4000AEE may be unsatisfactory for use in certain EMI sensitive environments. Narrowband (NB) and broadband (BB) radiated emissions were detected in the test frequency ranges. Some narrowband and broadband emissions exceeded the test limits. Emission limits are set forth in MIL-STD-461A, Notice 4.

1.5.1.6 Radiated susceptibility test (RS03): The IVAC® Model 4000AEE was found to be susceptible to radio frequency interference in the testing range and magnitude.

1.5.1.7 Conducted emissions test (CE01, CE02, and CE04): Conducted emissions were measured in the frequency range 19.033 to 41.898 MHz at levels 0.7 to 7.5 dB over specification limits.

1.5.1.8 Conducted susceptibility test (CS02 and CS06): No susceptibility to the test power line spikes was noted in the IVAC® Model 4000AEE.

1.5.2 In-flight testing

1.5.2.1 During the in-flight human factors evaluation, the IVAC® Model 4000AEE was found to be satisfactory in all categories of the evaluation criteria with two exceptions. The audible beeps could not be heard and there is no provision to vary the intensity of the LED display.

1.5.2.2 The aircraft and its subsystems were not adversely affected by the operation of the IVAC® Model 4000AEE in any of the prescribed flight test modes.

1.5.2.3 The ambient noise levels during ground operation and cruise flight prevented the cuff microphone from receiving valid Korotkoff sounds. This resulted in inaccurate BP and heart rate readings for 70 percent of the machine cycles during these phases of flight.

1.6 CONCLUSIONS

Based on the results of laboratory and in-flight testing, the IVAC® Model 4000AEE was found to be compatible with U.S. Army medical evacuation UH-60A Blackhawk with the subsystems listed in paragraph 3.2.2. Ambient noise levels in the helicopter prevented proper operation of the microphone in the BP cuff which resulted in measurement errors.
Section 2. Subtests

2.1 INITIAL INSPECTION

2.1.1 Objective

To determine if the IVAC® Model 4000AEE is complete and operational for testing per the manufacturer's operating instructions.

2.1.2 Criteria

2.1.2.1 The physical inventory is conducted solely for investigation and documentation.

2.1.2.2 The IVAC® Model 4000AEE will display consistent and accurate measurements as an acceptable performance test.

2.1.3 Test procedure

2.1.3.1 A complete physical inventory of the IVAC® Model 4000AEE was completed per the manufacturer's equipment list.

2.1.3.2 An operational validation test of the IVAC® Model 4000AEE was conducted per the manufacturer's operating instructions by USAARL's medical maintenance personnel.

2.1.4 Test findings

2.1.4.1 The IVAC® Model 4000AEE was inventoried and found to be complete.

2.1.4.2 The IVAC® Model 4000AEE operated as prescribed in the manufacturer's operating manual P/N 120713 NC. Criteria met.

2.2 BATTERY LIFE EVALUATION (Laboratory)

2.2.1 Objective

To ensure the equipment will function as designed throughout the rated battery operation time.

2.2.2 Criterion

Verify manufacturer's specified full power internal battery life expectancy of 2.5 hours monitor operation or 150 BP measurements.
2.2.3 Test procedure

2.2.3.1 Charging and operation cycles were conducted in ambient room conditions.

2.2.3.2 The IVAC® Model 4000AEE was operated continuously using its fully-charged internal battery in the 2.5-minute cycle mode until a low battery indication occurred. The depletion time was noted and the battery was recharged. This procedure was repeated three times.

2.2.4 Test findings

The test was conducted using the fully-charged internal battery. The average operating time in testing was 7 hours and 31 minutes at room temperature. During this period, 174 BP measurements were completed. This exceeds manufacturer's specification of 30 minutes. Criterion met.

2.3 ELECTRICAL SAFETY EVALUATION

2.3.1 Objective

To ensure the electrical safety of the IVAC® Model 4000AEE by evaluation of case-to-ground resistance and case-to-ground current leakage.

2.3.2 Criterion

The IVAC® Model 4000AEE shall meet the standards established in NAFP 99 for electrical safety of medical equipment.

2.3.3 Test procedure

Measurements in the electrical safety evaluation were made with a Neurodyne-Dempsey model 431F electrical safety analyzer*, IAW the procedures described in Technical Bulletin (TB) Number 38-750-2. Case-to-ground resistance and various case-to-ground leakage currents were measured. Leakage currents were measured using a 10 by 20 centimeter aluminum foil sheet taped flush to the equipment case. Checks were made for safety concerns such as case integrity, breaks in power cord insulation, and connectors.

2.3.4 Test findings

Grounding conductor resistance was 69.3 milliohms and maximum case leakage current was 11.5 microamperes. These measurements are below the limits specified in NAFP 99. Criterion met.
2.4 HUMAN FACTORS EVALUATION (Laboratory)

2.4.1 Objectives

2.4.1.1 To assure the safety of the operator, the potential patient, and the aircrew.

2.4.1.2 To assess the design considerations which could potentially contribute to an operator error.

2.4.2 Criterion

The IVAC\textsuperscript{1} Model 4000AEE must be rated satisfactory in all major categories of the evaluation. These include visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.4.3 Test procedure

2.4.3.1 The evaluation was conducted in a laboratory under fluorescent lighting and ambient room conditions.

2.4.3.2 The IVAC\textsuperscript{1} Model 4000AEE was operated according to prescribed instructions through its full range of functions.

2.4.4 Test finding

The IVAC\textsuperscript{1} Model 4000AEE was found to be satisfactory in all of the evaluation criteria with one exception. The red LED displays do not have an intensity control. Criterion partially met.

2.5 ALTITUDE (LOW PRESSURE) TEST [IAW MIL-STD-810D, METHOD 500.2]

2.5.1 Objective

To determine if the IVAC\textsuperscript{1} Model 4000AEE can function as designed in a low-pressure environment.

2.5.2 Criterion

The IVAC\textsuperscript{1} Model 4000AEE will display consistent and accurate measurements while exposed to an altitude equivalency of 15,000 feet above sea level.

2.5.3 Test procedure

2.5.3.1 A pretest performance check was conducted to ensure proper operation of the IVAC\textsuperscript{1} Model 4000AEE.
2.5.3.2 The altitude test was performed in a Tenney Engineering model 64S altitude chamber*. This test is based on MIL-STD-810D, Method 500.2. The IVAC® Model 4000AEE was turned on in the standby mode and placed on the floor of the chamber. Chamber pressure was decreased to 420 mmHg (15,000 ft equivalent altitude) over a 15-minute period, held constant for 60 minutes, then raised, at 1500 fpm, to ambient conditions (760 mmHg) over a 10-minute period. There were no provisions for the control of temperature or humidity inside this chamber.

2.5.3.3 A posttest performance check was conducted to ensure proper operation of the IVAC® Model 4000AEE after the exposure to low pressure.

2.5.4 Test findings

2.5.4.1 The pretest performance check met criterion 2.1.2.2.

2.5.4.2 No failures in the performance of the IVAC® Model 4000AEE were noted before, during, or after the altitude test. Criterion met.

2.5.4.3 The posttest performance check met criterion 2.1.2.2.

2.6 VIBRATION TEST [IAW MIL-STD-810D, METHOD 514.3]

2.6.1 Objective

To determine the ability of the IVAC® Model 4000AEE to withstand the vibrational stresses expected in a rotary-wing environment without degradation or malfunction.

2.6.2 Criterion

The IVAC® Model 4000AEE will remain operational and be able to display consistent and accurate measurements while exposed to vibrational stresses.

2.6.3 Test procedure

2.6.3.1 A pretest performance check was conducted to ensure proper operation of the IVAC® Model 4000AEE.

2.6.3.2 The vibration test was performed using an Unholtz-Dickey model TA115-40/CSTA vibration test system*. It is a single-axis system with an electromagnetic driver unit. The test consisted of sinusoidal vibrations superimposed on random vibrations over a frequency range of 500 Hz, as shown below. These vibrations are derived from measurements taken on the floor under the copilot's seat in a UH-1 helicopter traveling at 120 knots. The reference spectrum breakpoints are from MIL-STD-810D, Method 514.3;
reference spectrum levels are based on field measurements with a conservatism factor of 1.5. Independent tests were conducted in the X, Y, and Z axes.

Z-axis

duration: 60 minutes
broadband intensity: 0.4506 G<sub>rms</sub>
random vibration: initial slope : 99.00 dB/Hz
   5 Hz level: 0.00006210 G<sub>sqr/Hz</sub>
   100 Hz level: 0.0006210 G<sub>sqr/Hz</sub>
   300 Hz level: 0.0006210 G<sub>sqr/Hz</sub>
   500 Hz level: 0.00006210 G<sub>sqr/Hz</sub>
final slope: -99.00 dB/oct

sinusoidal vibration: .5450 G<sub>pk</sub> at 11.25 Hz
   .1690 G<sub>pk</sub> at 22.50 Hz
   .1200 G<sub>pk</sub> at 33.75 Hz
   .0310 G<sub>pk</sub> at 45.00 Hz
   .0530 G<sub>pk</sub> at 56.25 Hz

X and Y axes

duration: 60 minutes each
broadband intensity: 0.3099 G<sub>rms</sub>
random vibration: initial slope: 99.00 dB/oct
   5 Hz level: 0.00002920 G<sub>sqr/Hz</sub>
   100 Hz level: 0.0002920 G<sub>sqr/Hz</sub>
   300 Hz level: 0.0002920 G<sub>sqr/Hz</sub>
   500 Hz level: 0.00002920 G<sub>sqr/Hz</sub>
final slope: -99.00 dB/oct

sinusoidal vibration: .3200 G<sub>pk</sub> at 11.25 Hz
   .0670 G<sub>pk</sub> at 22.50 Hz
   .0950 G<sub>pk</sub> at 33.75 Hz
   .0350 G<sub>pk</sub> at 45.00 Hz
   .0770 G<sub>pk</sub> at 56.25 Hz

The IVAC® Model 4000AEE was strapped to the vibration table fixture, and its performance was evaluated before, during, and after exposure to vibration.

2.6.3.3 A posttest performance check was conducted to ensure proper operation of the IVAC® Model 4000AEE.

2.6.4 Test findings

2.6.4.1 The pretest performance check met criterion 2.1.2.2.

2.6.4.2 No failures in the performance of the IVAC® Model 4000AEE occurred before, during, or after exposure to vibration. Criterion met.

2.6.4.3 The posttest performance check met criterion 2.1.2.2.
2.7 HIGH TEMPERATURE TEST [IAW MIL-STD-810D, METHOD 501.2]

2.7.1 Objective

To determine the ability of the IVAC® Model 4000AEE to be stored and operated in a high-temperature environment.

2.7.2 Criteria

2.7.2.1 The IVAC® Model 4000AEE will display consistent and accurate measurements during the high-temperature operation check.

2.7.2.2 The IVAC® Model 4000AEE will display consistent and accurate measurements after the high-temperature storage cycle.

2.7.3 Test procedure

2.7.3.1 A pretest performance check was conducted to ensure proper operation of the IVAC® Model 4000AEE.

2.7.3.2 The high-temperature test was conducted in a Tenney Engineering model ZWUL-10107D walk-in controlled environment chamber*. This test is based on MIL-STD-810D, Method 501.2. For the high-temperature operation test, the IVAC® Model 4000AEE was turned on in the standby mode and placed on the floor of the environmental chamber. The chamber temperature was raised to 49°C and the humidity was stabilized at a maximum of 20 percent RH within 15 minutes. The environmental control system is capable of regulating temperature within ±2°C and humidity within ±5 percent RH. Temperature and humidity were held constant for 2 hours. At 30-minute intervals, the chamber door was opened briefly to minimize the change in chamber conditions during performance checks. After the operational test, the IVAC® Model 4000AEE was allowed to return to ambient conditions over a 30-minute period.

2.7.3.3 A posttest performance check was conducted to ensure proper operation of the IVAC® Model 4000AEE.

2.7.3.4 The IVAC® Model 4000AEE was stored (not operated) at temperatures of 63°C for 1 hour, 71°C for 4 hours, then again at 63°C for 1 hour. The chamber and IVAC® Model 4000AEE then were returned to ambient conditions over a 30-minute period.

2.7.3.5 A poststorage performance check was conducted to ensure proper performance of the IVAC® Model 4000AEE.

2.7.4 Test findings

2.7.4.1 The pretest performance check met criterion 2.1.2.2.
2.7.4.2 No operational failures occurred during the high-temperature test. Criterion met.

2.7.4.3 The posttest performance check met criterion 2.1.2.2.

2.7.4.4 The IVAC® Model 4000AEE functioned properly after the high-temperature storage test. Criterion met.

2.8 LOW TEMPERATURE TEST [IAW MIL-STD-810D, METHOD 502.2]

2.8.1 Objective

To determine the ability of the IVAC® Model 4000AEE to be stored and operated in a low-temperature environment.

2.8.2 Criteria

2.8.2.1 The IVAC® Model 4000AEE will display consistent and accurate measurements during the low-temperature operation check.

2.8.2.2 The IVAC® Model 4000AEE will display consistent and accurate measurements after the low-temperature storage cycle.

2.8.3 Test procedure

2.8.3.1 A pretest performance check was conducted to ensure proper operation of the IVAC® Model 4000AEE.

2.8.3.2 The IVAC® Model 4000AEE was placed on the floor of the environmental chamber and the temperature was lowered to 0°C within 25 minutes. The environmental control system is capable of regulating temperature within 2°C. Humidity cannot be controlled in the chamber at freezing temperatures. The temperature was held constant for 2 hours. Every 30 minutes, the chamber door was opened briefly to minimize the change in chamber conditions and a performance check was conducted. The chamber temperature then was raised to ambient temperature within a 30-minute period.

2.8.3.3 A posttest performance check was conducted to ensure proper operation of the IVAC® Model 4000AEE.

2.8.3.4 The IVAC® Model 4000AEE was "stored" in a nonoperational mode. The IVAC® Model 4000AEE was placed on the floor of the environmental test chamber and the temperature was lowered to -46°C for 6 hours. The chamber then was raised to ambient temperature over a 30-minute period.

2.8.3.5 A poststorage performance check was conducted to ensure proper operation of the IVAC® Model 4000AEE.
2.8.4 **Test findings**

2.8.4.1 The pretest performance check met criterion 2.1.2.2.

2.8.4.2 No operational failures occurred during the low-temperature test. Criterion met.

2.8.4.3 The posttest performance check met criterion 2.1.2.2.

2.8.4.4 The IVAC® Model 4000AEE functioned properly after the low-temperature storage test. Criterion met.

2.9 **HUMIDITY TEST [IAW MIL-STD-810D, METHOD 507.2]**

2.9.1 **Objective**
To determine the ability of the IVAC® Model 4000AEE to operate satisfactorily for short periods of time during exposure to highly humid conditions.

2.9.2 **Criterion**
The IVAC® Model 4000AEE will display consistent and accurate measurements while exposed to a high humidity environment.

2.9.3 **Test procedure**

2.9.3.1 A pretest performance check was conducted to ensure the proper operation of the IVAC® Model 4000AEE.

2.9.3.2 The humidity test was conducted in a Tenney Engineering model ZWUL-10107D walk-in controlled environment chamber*. This test is based on MIL-STD-810D, Method 507.2. For the humidity test, the IVAC® Model 4000AEE was placed ready for operation on the floor of the environmental chamber. The chamber temperature was raised to a temperature of 30°C and a relative humidity of 95 percent within 25 minutes. Temperature and relative humidity were maintained for 4 hours. The environmental control system is capable of regulating temperature within ± 2°C and humidity within ± 5 percent RH. At 45-minute intervals the performance of the BP monitor was checked. The chamber door was opened briefly to minimize the change in chamber conditions. The chamber and the IVAC® Model 4000AEE were returned to ambient conditions before the posttest performance validation check was conducted.

2.9.3.3 A posttest performance check was conducted to ensure the proper operation of the IVAC® Model 4000AEE.
2.9.4 Test findings

2.9.4.1 The pretest performance check met criterion 2.1.2.2.

2.9.4.2 No failures were noted in the IVAC® Model 4000AEE performance checks conducted during the exposure to the high humidity environment. Criterion met.

2.9.4.3 The posttest performance check met criterion 2.1.2.2.

2.10 ELECTROMAGNETIC CHARACTERISTICS TEST [IAW MIL-STD-461A, Notice 4, and MIL-STD-462, Notice 3]

2.10.1 Objectives

2.10.1.1 To assess the maximum levels of radiated electromagnetic emissions produced by the IVAC® Model 4000AEE in the 14 kHz to 12.4 GHz frequency range.

2.10.1.2 To assess the tolerances of radiated electromagnetic susceptibility of the IVAC® Model 4000AEE within the 10 kHz to 10 GHz electric field.

2.10.1.3 To assess the maximum levels of conducted electromagnetic emissions produced by the IVAC® Model 4000AEE in the 10 kHz to 50 MHz frequency ranges.

2.10.1.4 To assess the tolerances of conducted electromagnetic susceptibility of the IVAC® Model 4000AEE within the range of 50 kHz to 400 MHz and power spikes.

2.10.2 Criteria

2.10.2.1 The IVAC® Model 4000AEE will not produce emissions in excess of the limits set forth in MIL-STD-461A, Notice 4, paragraph 6.13.

2.10.2.2 The IVAC® Model 4000AEE will not malfunction when it is subjected to radiated emissions as specified in MIL-STD-461A, Notice 4, paragraph 6.20.

2.10.2.3 The IVAC® Model 4000AEE shall not conduct emissions in excess of the limits set forth in MIL-STD-461A, Notice 4, paragraphs 6.1 and 6.2.

2.10.2.4 The IVAC® Model 4000AEE shall not malfunction when it is subjected to conducted emissions as specified in MIL-STD-461A, Notice 4, paragraphs 6.7 and 6.10.

2.10.3 Test procedure
2.10.3.1 The radiated emissions test was performed according to MIL-STD-462, Notice 3, Method RE02. The IVAC® Model 4000AEE was positioned on a wooden test stand inside the EMI chamber, 1 meter away from the receiving antennas. The antennas were mounted for both vertical and horizontal polarities and connected to EMI receivers. The IVAC® Model 4000AEE was connected through an extended tube to a cuff outside the chamber. The cuff was placed around a test engineer’s arm while the IVAC® Model 4000AEE took BP measurements at 2.5-minute intervals. While the IVAC® Model 4000AEE was operating, the frequency spectrum (14 kHz to 12.4 GHz) was scanned for emissions. The IVAC® Model 4000AEE was operated with both ac and battery power.

2.10.3.2 The radiated susceptibility test was performed according to MIL-STD-462, Notice 3, Method RS03. The IVAC® Model 4000AEE was positioned on a wooden test stand inside the EMI chamber 1 meter away from the transmitting antennas. The antennas were mounted for both vertical and horizontal polarities and connected to radio frequency (RF) transmitters. The IVAC® Model 4000AEE was operating in the monitor temperature mode. The BP portion of the unit was in standby mode. While the IVAC® Model 4000AEE was operating, it was monitored for faulty operation during exposures to fields of 1 V/m from 10 kHz to 2 MHz, and 5 V/m from 2 to 30 MHz, 10 V/m from 30 MHz to 2 GHz, and 5V/m from 2 to 10 GHz. The IVAC® Model 4000AEE was operated with ac power only.

2.10.3.3 The conducted emissions tests were performed according to MIL-STD-462, Notice 3, Methods CE02 and CE04. The IVAC® Model 4000AEEE was placed on a grounded, copper covered workbench. The top of the workbench was 1 meter from floor level, 1.37 meters long and 0.81 meters wide. Power was supplied via a pair of line impedance stabilization networks (LISN) and a test jig. The test jig is a wooden tray with two power receptacles and two slots to hold current probes in place around power supply conductors. While the IMED 927 was operating, the frequency range (10 kHz to 50 MHz) was scanned for emissions conducted in the power cable from the IVAC® Model 4000AEE.

2.10.3.4 The conducted susceptibility spike test was performed according to MIL-STD-462, Notice 3, Method CS06, on a chemical resistant counter top. Power was supplied via a customized metal connection box. The connection box has two power receptacles and four banana jacks on its front panel. Connections to the individual power lines are made in series through the banana jacks. Transient spikes of 100 volts, 10 microseconds were generated with a Solar Electronics model 8282-1 transient pulse generator* and induced onto the power leads at the connection box banana jacks. The spikes were monitored with a Tektronix 2235 oscilloscope* connected to a power receptacle on the connection box. The IVAC® Model 4000AEE was plugged into the other receptacle on
the connection box and placed in operation. It was observed for correct operation and visual displays while it was subjected to the power line spikes.

2.10.3.5 The conducted susceptibility test was performed according to MIL-STD-462, Notice 3, Method CS02. The IVAC® Model 4000AEE was placed on a grounded, copper covered workbench. Radio frequency interference was induced on the power leads and measured at the IMED 927 power cable. The frequency of the interference was incremented over the 50 kHz to 400 MHz range while the IVAC® Model 4000AEE was operated. It was observed for correct operation and visual displays while it was subjected to the radio interference on the power leads. Each frequency was held for 15 seconds.

2.10.4 Test findings

2.10.4.1 During the radiated emissions test, emissions which exceeded specification limits of MIL-STD-461A, Notice 4, were detected. These included:

<table>
<thead>
<tr>
<th>Power</th>
<th>Frequency range</th>
<th>Emission exceeding standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>ac:</td>
<td>0.024 - 242 MHz</td>
<td>0.2 - 46.8 dB (NB)</td>
</tr>
<tr>
<td></td>
<td>5.500 - 30 MHz</td>
<td>0.8 - 12.3 dB (BB)</td>
</tr>
<tr>
<td>ac:</td>
<td>0.557 - 229.125 MHz</td>
<td>0.1 - 45.8 dB (NB)</td>
</tr>
<tr>
<td></td>
<td>20.538 - 45 MHz</td>
<td>0.8 - 20.3 dB (BB)</td>
</tr>
</tbody>
</table>

Criterion partially met.

2.10.4.2 The IVAC® Model 4000AEE was found to be susceptible to radio frequency interference in the testing range and magnitude.

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Maximum field strength without susceptibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.4 - 200 MHz</td>
<td>0.89 - 6.68 V/m</td>
</tr>
<tr>
<td>200.0 - 332 MHz</td>
<td>0.79 - 5.31 V/m</td>
</tr>
<tr>
<td>556.0 - 592 MHz</td>
<td>5.01 - 7.50 V/m</td>
</tr>
</tbody>
</table>

Criterion partially met.

2.10.4.3 Narrowband emissions of 0.7 to 7.5 dB over specification were detected from 19.03 to 41.898 MHz. Criterion partially met.

2.10.4.4 The test signals were not detectable on the power lines due to conducted emissions from the IVAC® Model 4000AEE. The IVAC® Model 4000AEE was not susceptible to test spikes during the conducted susceptibility tests. Criterion partially met.
2.11 IN-FLIGHT HUMAN FACTORS EVALUATION

2.11.1 Objective

To assess the physical and/or functional compatibility of the IVAC® Model 4000AEE while in use on board the aircraft.

2.11.2 Criterion

The flight surgeon will be able to operate the IVAC® Model 4000AEE without physical or functional restrictions aboard the aircraft. Major areas of concern include: Proper operation, visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.11.3 Test procedure

2.11.3.1 A human factors evaluation was performed IAW MIL-STD-1472D, AAMI human factors engineering guidelines, and UL-544 to ensure the compatibility of the IVAC® Model 4000AEE and the in-flight environment. The flight surgeon conducted the test wearing a flight suit, flight gloves, and an SPH-4 flight helmet. An evaluation of the compatibility with the nuclear, biological, and chemical (NBC) protective equipment was not conducted. Due to restrictions of the AWR, testing was conducted during daylight hours only.

2.11.3.2 The IVAC® Model 4000AEE was placed on the floor of the aircraft next to the bottom pan of the litter carousel which was configured for four patients. The litter carousel was flown in the "load" position (perpendicular to the long axis of the helicopter). The IVAC® Model 4000AEE was tested with the cuff placed on the right arm of a simulated patient lying in the bottom pan of the litter carousel. The IVAC® Model 4000AEE was tested using both ac and battery power in all flight scenarios required by the In-Flight Test Operations Procedures (ITOP) (refer to section 3.2).

2.11.4 Test findings

During the in-flight human factors evaluation, the IVAC® Model 4000AEE was found to be satisfactory in all but two of the categories of the evaluation criteria. The first deficiency was the lack of brightness control on the LED display noted in the laboratory evaluation (paragraph 1.5.1.3). In addition, audio alarms were not audible above the ambient noise in the aircraft. Ambient noise levels prevented reception and interpretation of Korotkoff sounds by the IVAC® Model 4000AEE. Background noise was frequently interpreted as a Korotkoff sound and cuff pressures increased to their maximum (>250 mmHg). This resulted in
high cuff pressures, delays in the machine cycle, and erroneous heart rate and BP measurements. Errors were noted in 50 percent of the machine cycles during ground operation, 30 percent during hover, and 90 percent during cruise flight. These errors could not be prevented by moving the cuff to the other arm, muffling the microphone, or changing patient position. The temperature probe worked properly in all phases of flight.

Criterion partially met.

2.12 IN-FLIGHT EMI/EMC CHARACTERISTICS

2.12.1 Objective

To assess the EMI/EMC characteristics of the IVAC® Model 4000AEE with the host aircraft and its installed systems.

2.12.2 Criteria

2.12.2.1 The IVAC® Model 4000AEE will not radiate EMI to disrupt or interfere with other equipment or systems aboard the aircraft.

2.12.2.2 The aircraft will not radiate EMI to disrupt or interfere with the IVAC® Model 4000AEE's operation.

2.12.3 Test procedure

A qualitative EMI/EMC assessment was performed with both the IVAC® Model 4000AEE and the aircraft operating as source and victim. The IVAC® Model 4000AEE and applicable aircraft instruments and systems were monitored for unusual operation, readings, surges, or power anomalies for each checklist item (see pages 3-5 through 3-8).

2.12.4 Test findings

2.12.4.1 There were no adverse instances of EMI/EMC noted with the IVAC® Model 4000AEE acting as either the source or victim. Criterion met.

2.12.4.2 There were no adverse instances of EMI/EMC noted with the aircraft acting as either the source or victim. Criterion met.
Section 3. Supporting documentation

3.1 DETAILED TEST INFORMATION

3.1.1 General information

3.1.1.1 IVAC® Model 4000AEE testing is not considered a major action significantly affecting the quality of the human environment and, therefore, qualifies for categorical exclusion A-28, appendix A, AR 200-1.

3.1.1.2 A safety pilot will be designated for each flight. Flight operations will be conducted IAW the aircraft operator's manual, appropriate aircrew training manuals, and test item technical data.

3.1.2 Material description

3.1.2.1 The IVAC® Model 4000AEE Vital Check Monitor is a portable device designed to measure a patient's BP and temperature. The front panel contains LED displays that show the patient's systolic pressure, diastolic pressure, MAP, pulse and temperature. The BP measurements may be initiated manually or automatically at timed intervals. A control knob on the front panel allows the user to select cuff pressures of 100, 125, 150, or 200 mmHg. A second control knob allows the user to select automatic BP measurements at 1-, 2.5-, 5-, 15-, or 30-minute intervals. The unit can recall up to 20 BP readings. The monitor will reinflate the cuff when it detects artifact, low signal intensity, or an unusually high BP reading. The unit provides a visual display of the Korotkoff sounds and is equipped with a stethoscope attachment to monitor the sounds. The visual display of the Korotkoff sounds is presented on the front panel under the pulse reading. The on/off and start/reset buttons are located under the control knobs on the front panel. A control switch on the rear panel selects whether temperature readings are displayed in Fahrenheit or Celsius. Audible beeps indicate when a new BP or predictive temperature has been reached.

3.1.2.2 Method of operation: The IVAC® Model 4000AEE Vital Check Monitor is a microprocessor based unit which displays systolic pressure, diastolic pressure, MAP, pulse, and temperature. The BP is found using two methods: An auscultation method, and an oscillometry method. The unit can read BP up to 275 mmHg systolic pressure and down to 20 mmHg diastolic pressure. An erratic pulse is represented by flashing decimal points under the reading. There are two modes of measuring temperature, predictive and monitor. The predictive mode ranges from 32.2°C to 42.1°C (90.0°F to 107.9°F) and the monitor mode ranges form 31.1°C to 42.1°C (88.0°F to 107.9°F). Error messages are
displayed on the front panel and, in the event of an internal malfunction, the unit will display "FIX ME" followed by a character to identify the malfunction.

3.1.2.3 Dimensions:  8.83 x 5.63 x 11.63 in. (21.27 x 14.29 x 29.53 cm).

3.1.2.4 Weight: 15.8 lb (7.2 kg).

3.1.2.5 Standard accessories: Stethoscope with luer connector, IVAC® standard probes and disposable probes, pediatric cuff, adult cuff, and operating instructions.

3.1.2.6 Power requirements:  95 to 135 Vac, 50 or 60 Hz, 0.7 amp, 3-wire grounded system. Internal battery is a rechargeable lead-acid type which provides 2.5 hours of rated operation or approximately 150 BP measurements. Charge time for a completely discharged battery to full charge is 12 to 16 hours. Power cord is PECO, 18-3, type SJT, PE CO, of approximately 116 inches in length.

3.1.2.7 Environmental considerations: Atmospheric pressure, less than 11,000 feet; operating temperature, 5 to 45 degrees C; storage temperature, -30 to 65 degrees C; relative humidity, 0 to 95 percent.
3.2 TEST DATA

3.2.1 Photographic description
### Aircraft Equipment List

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Nomenclature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Receiver radio -- R-1496A/ARN-89 (automatic direction finder)</td>
</tr>
<tr>
<td>2</td>
<td>Displacement gyro -- CN-1314/A</td>
</tr>
<tr>
<td>3</td>
<td>Gyro directional -- CN-998/ASN-43</td>
</tr>
<tr>
<td>4</td>
<td>Signal data converter -- CV-3338/ASN-128</td>
</tr>
<tr>
<td>5</td>
<td>Receiver -- R-2139/ARN-123 (VOR/LOC/MB/GS)</td>
</tr>
<tr>
<td>6</td>
<td>Command instrument system processor -- 70600-01038-101</td>
</tr>
<tr>
<td>7</td>
<td>SAS amplifier -- 70901-02908-104 (flight control stability augmentation system)</td>
</tr>
<tr>
<td>8</td>
<td>Rate gyro -- TRU-2A/A</td>
</tr>
<tr>
<td>9</td>
<td>Amplifier, impedance -- AM-4859A/ARN-89</td>
</tr>
<tr>
<td>10</td>
<td>Cargo hook -- FE-7590-145</td>
</tr>
<tr>
<td>11</td>
<td>Receiver, radar -- RT-1193/ASN-128 (doppler navigation receiver)</td>
</tr>
<tr>
<td>12</td>
<td>Barometric altimeter -- AAU-31/A-1</td>
</tr>
<tr>
<td>13</td>
<td>Barometric altimeter -- AAU-32A</td>
</tr>
<tr>
<td>14</td>
<td>Receiver/transmitter -- RT-1300/ARC-186 (VHF-AM and/or FM radio)</td>
</tr>
<tr>
<td>15</td>
<td>UHF-AM radio set -- RT-1518/ARC-164</td>
</tr>
<tr>
<td>16</td>
<td>Interphone control -- C6533/ARC (aircraft intercom control)</td>
</tr>
<tr>
<td>17</td>
<td>Receiver/transmitter -- RT-1115D/APN-209 (radar altimeter)</td>
</tr>
<tr>
<td>18</td>
<td>Indicator altimeter -- ID-1917C/APN-209 (radar altimeter)</td>
</tr>
<tr>
<td>19</td>
<td>Control radio set -- C-7392A/ARN-89 (automatic direction finder)</td>
</tr>
<tr>
<td>20</td>
<td>Comparator signal data -- CM-482/ARC-186 (comparator for ARC-186)</td>
</tr>
<tr>
<td>21</td>
<td>Receiver/transmitter -- RT-1296A/APX-100 (transponder with IFF)</td>
</tr>
<tr>
<td>22</td>
<td>Computer display unit -- CP-1252/ASN-128 (doppler navigation system)</td>
</tr>
<tr>
<td>23</td>
<td>Compass set controller -- C-8021E/ASN75</td>
</tr>
<tr>
<td>24</td>
<td>Magnetic compass - standby -- MS-17983-4</td>
</tr>
</tbody>
</table>
3.2.3 **In-flight test data card**

DATA CARD FORMAT

GUIDELINE FOR DATA COLLECTION

IN-FLIGHT SUITABILITY TEST OF MEDICAL ITEMS

1. Installation/removal. Suitable Comments

   | a. Weight and balance | Yes | No |
   | (DD Form 365-4, Clearance Form F) | X |

   | b. Space/area allocation. |
   | (1) Operational requirements. | X |
   | (2) Storage requirements. | X |

   | c. Interface connections (safe, positive, secure). | X |

   | d. Installation/removal (expedient/easily achieved). | X |

   | e. Mounting/final configuration (functional/stable). | X |

2. Operations and performance. Suitable Comments

   | a. Manufacturer's operating instruction. | X |

   | b. Medical item operation before aircraft run-up. | X |

   | c. System interface during aircraft engine run-up and medical item operation (EMI switchology checklist). |
   | (1) Aircraft voltage output. | X |

3-5
(2) Flight control function (UH-60).

(3) Stabilator function (UH-60).

(4) Radio communication vs medical item operation.
   (a) FM  X
   (b) UHF  X
   (c) VHF  X

(5) Navigation equipment vs medical item operation.
   (a) Transponder  X
   (b) ADF  X
   (c) VOR  X
   (d) Doppler  X

(6) Radar altimeter operation vs medical item operation.

   d. System interface during aircraft hover and medical item operation (EMI switchology check-list).

   (1) Voltage output.  n/a

   (2) Radio communication vs medical item operation.
      (a) FM  X
      (b) UHF  X
      (c) VHF  X
<table>
<thead>
<tr>
<th>(3) Navigation equipment operation vs medical item operation.</th>
<th>Suitable</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Transponder</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(b) ADF</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(c) VOR</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(d) Doppler</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**e. Flight mission profile vs medical item operation (EMI switchology checklist).**

(1) Straight and level (1000 ft MSL for 20 minutes).

(a) Compatibility of flight mode and medical item operation. X

(b) Radio communication vs medical item operation.

a. FM X

b. UHF X

c. VHF X

(2) NOE (20 minutes). X
compatibility of flight mode and medical item operation.

(3) FM homing (10 minutes). X

(4) Doppler navigation vs medical item operation.

(a) Initialize function. X

(b) Fix function. X

(c) Update function. X

3-7
(5) VOR navigation
7000 ft MSL for 20
minutes) vs medical
item operation.

(6) ILS approach vs
medical item operation.

f. Medical item operation
after engine shutdown
(external power source).

g. Restrictions to the
medical item’s use (i.e.,
electrical connectors).

h. Deviations from the laboratory test results.

(1) Electrical/
electronic. None

(2) Mechanical
environment. See comment 3b.

(3) Human factors
(user interface, controls,
markings, lighting, egress). None

(4) Safety. None

3. Deviations from the in-flight test protocol.

a. The VOR navigation portion of the in-flight test conducted at 2000 feet MSL due to air traffic control clearance.

b. Ambient noise levels in all phases of flight prevented proper reception and interpretation of Korotkoff sounds. Countermeasures included changing the cuff to the other arm, changing arm position, and muffling the microphone area. These countermeasures did not improve reception of these sounds in operational testing.
## 3.2.4 EMI Switchology Checklist

EMI SWITCHOLOGY CHECKLIST UH-60 AIRCRAFT

IN-FLIGHT SUITABILITY OF MEDICAL ITEMS

<table>
<thead>
<tr>
<th>ENG INSTRUMENTS/CDU</th>
<th>No EMI Affect</th>
<th>EMI Affected</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel quantity</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel indicator test</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XMSN oil temperature</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XMSN oil pressure</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 engine oil temperature</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 engine oil temperature</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 engine oil pressure</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 engine oil pressure</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 TGT</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 TGT</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 Ng speed</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 Ng speed</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDU digits on/off</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDU instruments dim</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENG INSTRUMENTS/PLT PDU</th>
<th>No EMI Affect</th>
<th>EMI Affected</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 engine RPM</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 engine RPM</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor RPM</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 torque</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 torque</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENG INSTRUMENTS/COPLT PDU</th>
<th>No EMI Affect</th>
<th>EMI Affected</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 engine RPM</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 engine RPM</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotor RPM</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 torque</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 torque</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ENG CONTROLS

<table>
<thead>
<tr>
<th>Description</th>
<th>No EMI</th>
<th>EMI Affected</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 overspeed</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>#2 overspeed</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>RPM switch</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>#1 engine anti-ice</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>#2 engine anti-ice</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>#1 inlet anti-ice</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>#2 inlet anti-ice</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

### RADIO EQUIPMENT

<table>
<thead>
<tr>
<th>Description</th>
<th>No EMI</th>
<th>EMI Affected</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICS, C-6533 ARC</td>
<td></td>
<td>X</td>
<td>Not installed</td>
</tr>
<tr>
<td>VHF-FM, ARC-186/115</td>
<td></td>
<td>X</td>
<td>Not installed</td>
</tr>
<tr>
<td>VHF-AM, ARC-186/115</td>
<td></td>
<td>X</td>
<td>Not installed</td>
</tr>
<tr>
<td>UHF-AM, ARC-164(V)</td>
<td></td>
<td>X</td>
<td>Not installed</td>
</tr>
<tr>
<td>Crypto, KY-28</td>
<td></td>
<td>X</td>
<td>Not keyed with code</td>
</tr>
<tr>
<td>Radio retransmissions PLN</td>
<td></td>
<td>X</td>
<td>Not installed</td>
</tr>
<tr>
<td>Transponder, APX-100(V)</td>
<td></td>
<td>X</td>
<td>Not installed</td>
</tr>
<tr>
<td>KIT-1A/TSEC IFF computer</td>
<td></td>
<td>X</td>
<td>Not installed</td>
</tr>
</tbody>
</table>

### MISSION EQUIPMENT

<table>
<thead>
<tr>
<th>Description</th>
<th>No EMI</th>
<th>EMI Affected</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RWR, APR-39(V)</td>
<td></td>
<td>Not installed</td>
<td></td>
</tr>
<tr>
<td>IR CM, ALQ-144</td>
<td></td>
<td>Not installed</td>
<td></td>
</tr>
<tr>
<td>Chaff dispenser, M-130</td>
<td></td>
<td>Not installed</td>
<td></td>
</tr>
<tr>
<td>Cargo hook system</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

### HYDRAULIC CONTROL SYSTEM

<table>
<thead>
<tr>
<th>Description</th>
<th>No EMI</th>
<th>EMI Affected</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup hydraulic pump</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Servo off 1st stage/PLT</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Servo off 2nd stage/PLT</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Servo off 1st stage/COPLT</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Servo off 2nd stage/COPLT</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hydraulic leak test</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tail servo</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Boost servos</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>FUEL SYSTEM</strong></td>
<td>No EMI</td>
<td>EMI AFFECTED</td>
<td>Explanation</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>--------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Fuel pump switch</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel boost pump #1</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel boost pump #2</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel cont panel ESSS</td>
<td>Not installed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WARNING SYSTEM</strong></th>
<th>No EMI</th>
<th>EMI AFFECTED</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low rotor RPM</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master caution</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caution advisory</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire warning</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AFCS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stabilator</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 engine out</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 engine out</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>NAVIGATION INSTRUMENTS</strong></th>
<th>No EMI</th>
<th>EMI AFFECTED</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnetic compass</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONUS NAV, ARN-123</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doppler, ASN-128</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gyro mag compass (PLT)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gyro mag compass (COPLT)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compass cont panel, ASN-75</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSI</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>FLIGHT INSTRUMENTS</strong></th>
<th>No EMI</th>
<th>EMI AFFECTED</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radar altimeter</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stabilator pos indicator</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSI</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIS mode select</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAS 1</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAS 2</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trim</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go-around enable</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclic trim release</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclic stick trim</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALR encoder</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3-11
<table>
<thead>
<tr>
<th>FLIGHT INSTRUMENTS (CONT)</th>
<th>No EMI Affected</th>
<th>EMI Affected</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSI/VSI mode select (PLT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPLR</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOR/ILS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BACK CRS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM HOME</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TURN RATE</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRS HDG</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VERT GYRO</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRG 2</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSI/VSI Mode Select (COPLT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DPLR</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOR/ILS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BACK CRS</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM HOME</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TURN RATE</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRS HDG</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VERT GYRO</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRG 2</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MISCELLANEOUS EQUIPMENT</td>
<td>No EMI Affected</td>
<td>EMI Affected</td>
<td>Explanation</td>
</tr>
<tr>
<td>Blade deice</td>
<td>Not tested</td>
<td></td>
<td>Ambient temperature was out of test limits.</td>
</tr>
<tr>
<td>Windshield anti-ice</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pitot heat</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vent blower</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windshield wiper</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heater</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APU</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generator #1</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generator #2</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generator APU</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air source heat start</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tail wheel lock</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gyro erect</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIGHTING</td>
<td>No EMI Affect</td>
<td>EMI Affected Gnd</td>
<td>EMI Affected Flt</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Cockpit utility</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cockpit flood</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabin dome</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search light</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Search light control</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landing light</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flt instr lights (PLT)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flt instr lights (COPLT)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonflight instr lights</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Console lights, upper</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Console lights, lower</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position lights</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formation lights</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticollision lights</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVG lighting</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3-13
3.2.5 Battery life evaluation

Battery Life Evaluation Report Form

Nomenclature: Vital check monitor
Manufacturer: IVAC® Inc.
Model number: IVAC® Model 4000AEE
Serial number: 010013
Military item number: None

Options installed: None

Manufacturer battery life specification: 2.5 hours or 150 BP measurements.

Specified battery recharge time: 12 to 16 hours.

Specified mode of operation under battery power: 2.5 minute cycle mode, in which automatic BP measurements are taken at 2.5 minute intervals.

Overall performance: Pass

Measurements: The unit averaged 7 hours and 13 minutes of operation in the 2.5 minute mode.

Comments: None
3.2.6 Electrical safety test

Electrical Safety Test
Report Form

Nomenclature: Vital check monitor
Manufacturer: IVAC® Inc.
Model number: IVAC® Model 4000AEE
Serial number: 010013
Military item number: None

Options installed: None

Date of test: 5 Apr 89

Measurements:

Grounding conductor resistance (milliohms): 69.3

Leakage current - Case to ground (microamperes):

unit off, grounded, normal polarity 1.5
unit off, ungrounded, normal polarity 11.3
unit off, ungrounded, reverse polarity 11.5
unit on, grounded, normal polarity 11.5
unit on, ungrounded, normal polarity 11.3
unit on, ungrounded, reverse polarity 11.5

MAXIMUM LIMITS:

ground resistance (milliohms): 150

current (microamperes)
current (grounded, type A unit): 10
current (ungrounded, type A unit): 100
current (grounded, type B unit): 50
current (ungrounded, type B unit): 500

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None
3.2.7 Human factors evaluation

Human Factors Evaluation
Report Form

Nomenclature: Vital check monitor
Manufacturer: IVAC® Inc.
Model number: IVAC® Model 4000AEE
Serial number: 010013
Military item number: None

Options installed: None

Date of test: 5 Apr 89

Item configuration during test: Item prepared for operation, sitting on a counter top.

Checklist for HFE

RESULTS

VISUAL DISPLAYS: Unsatisfactory

display type, format, content
location of displays
indicator lights
scalar displays
color coding
legends and labels
cathode ray tubes
counters
flags, go-no-go, center-null indicators

Comments: Scalar displays, color coding, counters, and cathode ray tubes (CRT) are not applicable. The LED's are red in color and have no brightness controls. Controls are not illuminated for low light conditions.

CONTROLS: Satisfactory

location
characteristics of controls
labeling
control - display relationships

Comments:

3-16
TIME REQUIRED TO PREPARE FOR OPERATION (list in comment)

Comments: 2 minutes required to prepare for operation.

MAINTAINABILITY: Satisfactory

component location
component characteristics
rests and stands
covers, cases, access doors
handles
lubrication
component mounting
cord storage provisions
external accessibility
internal accessibility
list special tools required
list realistic inspection requirements
list realistic inspection intervals

Comments: A standard cross-point screwdriver is needed to access the battery and computer interface module. A self-test is initiated at each power-on. A 6-month interval for operational, electrical, damage and wear inspections and calibration are listed in the operator's manual.

CONDUCTORS: Satisfactory

binding and securing
length
protection
routing
conductor coding
fabrication
connectors

Comments: None

FASTENERS: Satisfactory

access through inspection panel covers
enclosure fasteners
device mounting bolts and fasteners

Comments: The enclosure is held in place with cross-point screws.
TEST POINTS: Satisfactory

general
location and mounting
test point labeling and coding

Comments: A display test pushbutton is mounted on the rear panel.

TEST EQUIPMENT: Satisfactory

general
equipment self-test
indicators (list in comments)
controls
positive indication of proper operation

Comments: An internal self-test outputs codes for normal status and for failures. A connector for external pressure calibration is located on the rear panel.

FUSES AND CIRCUIT BREAKERS: Satisfactory

external accessibility
easy replacement or reset by operator

Comments: A pushbutton reset circuit breaker is located on the rear panel.

LABELS and CODING: Satisfactory

placed above controls and displays
near or on the items they identify
not obscured by other equipment components
describe the function of the items they identify
readable from normal operating distance
conspicuous placards adjacent to hazardous items

Comments: None
SAFETY: Satisfactory

manual
materials
fire and explosive protection
operator protection from mechanical hazards
patient protection from mechanical hazards
electrical safety (operator and patient)

Comments: A placard warns against operation in the presence of flammable anesthetics. The pump shuts down and releases cuff pressure when an overpressure state occurs.
3.2.8 Altitude test

Altitude Test Report Form

Nomenclature: Vital check monitor
Manufacturer: IVAC® Inc.
Model number: IVAC® Model 4000AEE
Serial number: 010013
Military item number: None

Options installed: None

Date of test: 10 Apr 89

Item configuration during test: Item turned on in the standby mode, operating on dc (battery) power, sitting on chamber floor.

Performance test criteria: Consistent and accurate displays and measurements

Ambient conditions outside chamber:

- Temperature: 59°F
- Humidity: 62% RH
- Barometric pressure: 1 atm

PRETEST DATA

Pretest performance check:

- Item functional (based on performance test criteria): Yes

Installation of item in test facility:

- list connections to power: None (battery)
- list connections to simulators: None
- list connections to dummy loads: None
- list unconnected terminals: ac

IN-TEST DATA

Time of test start: 0905
POSTTEST DATA

Posttest performance check (complete check of item and accessories):

Time of test end: 1035

Item functional (based on performance test criteria): Yes

Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None
3.2.9 Vibratıon test

Vibration Test Report Form

Nomenclature: Vital check monitor
Manufacturer: IVAC® Inc.
Model number: IVAC® Model 4000AEE
Serial number: 010013
Military item number: None

Options installed: None

Date of test: 10 Apr 89

Item configuration during test: Item strapped down on vibration table fixture; ac and dc operation.

Performance test criteria: Consistent and accurate measurements and displays.

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criteria): Yes

Installation of item in test facility:
list connections to power 120 Vac
list connections to simulators None
list connections to dummy loads None
list unconnected terminals None

Ambient conditions
Temperature 68°F
Humidity 59% RH
Barometric pressure 1 atm

IN-TEST DATA

Data and performance checks during test:

Time at first check:
X: 1430 (4-10-89) Y: 1535 (4-10-89) Z: 0755 (4-11-89)
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Time at second check:
X: 1525 Y: 1630 Z: 0850

3-22
Item functional (based on performance test criteria): Yes

Deviation from pretest: None

POSTTEST DATA

Time at test end:

Posttest performance check (complete check of item and accessories):

  Item functional (based on performance test criteria): Yes
  Item intact: Yes
  Deviation from pretest: None

Comments on item setup or checks:
  The test engineer's arm was used to check the accuracy of the unit and an Extech thermometer was used to check the accuracy of the temperature probe. Times are on different days.

Comments on test run (including interruptions): None

Comments on other data: None
3.2.10 **High temperature test**

**High Temperature Test**  
*(Equipment Operating)*  
**Report Form**

**Nomenclature:** Vital check monitor  
**Manufacturer:** IVAC® Inc.  
**Model number:** IVAC® Model 4000AEE  
**Serial number:** 010013  
**Military item number:** None

**Options installed:** None

**Date of test:** 10 May 89

**Item configuration during test:** Unit was sitting on chamber floor, ready for operation.

**Performance test criteria:** Consistent and accurate displays and measurements.

**Ambient conditions outside chamber:**
- **Temperature:** 24°C  
- **Humidity:** 61% RH  
- **Barometric pressure:** 1 atm

**PRETEST DATA**

**Pretest performance check:**
- **Item functional (based on performance test criteria):** Yes

**Installation of item in test facility:**
- list connections to power: 120 Vac  
- list connections to simulators: None  
- list connections to dummy loads: None  
- list unconnected terminals: None  
- distance from north wall (meters): 0.6223  
- distance from south wall (meters): 0.5334  
- distance from east wall (meters): 1.4986  
- distance from west wall (meters): 1.2446  
- distance from ceiling (meters): 1.3208  
- distance from floor (meters): 0.4826

**IN-TEST DATA**

**Time of test start:** 0815
Performance checks during test:

First check:

<table>
<thead>
<tr>
<th>Time:</th>
<th>0845</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>49°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>15% RH</td>
</tr>
<tr>
<td>Barometric pressure:</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

Item functional (based on performance test criteria): Yes, all ok

Deviation from pretest: None

Second check:

<table>
<thead>
<tr>
<th>Time:</th>
<th>0915</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>49°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>15% RH</td>
</tr>
<tr>
<td>Barometric pressure:</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

Item functional (based on performance test criteria): Yes, all ok

Deviation from pretest: None

Third check:

<table>
<thead>
<tr>
<th>Time:</th>
<th>0945</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>49°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>15% RH</td>
</tr>
<tr>
<td>Barometric pressure:</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

Item functional (based on performance test criteria): Yes, all ok

Deviation from pretest: None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

<table>
<thead>
<tr>
<th>Time of test end:</th>
<th>1040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item functional (based on performance test criteria):</td>
<td>Yes, all ok</td>
</tr>
</tbody>
</table>

Deviation from pretest: None

Comments on item setup or checks:
The test engineer's arm was used to test the unit's accuracy during performance checks.

Comments on test run (including interruptions): None

Comments on other data: None

3-25
3.2.11 High temperature storage test

High Temperature Test
(Equipment in Storage)
Report Form

Nomenclature: Vital check monitor
Manufacturer: IVAC® Inc.
Model number: IVAC® Model 4000AEE
Serial number: 010013
Military item number: None

Options installed: None

Date of test: 11 May 89

Item configuration during test: Sitting on chamber floor, in storage, not operating.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>23°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>50% RH</td>
</tr>
<tr>
<td>Barometric pressure</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criteria): Yes

Installation of item in test facility:

list connections to power: None
list connections to simulators: None
list connections to dummy loads: None
list unconnected terminals: all

distance from north wall (meters): 0.6223
distance from south wall (meters): 0.5334
distance from east wall (meters): 1.4986
distance from west wall (meters): 1.2446
distance from ceiling (meters): 1.3208
distance from floor (meters): 0.4826

Time of test start: 1115
POSTTEST DATA

Posttest performance check:
   (complete check of item and accessories)

   Time of test end: 1445
   Item functional (based on performance test criteria): Yes
   Deviation from pretest: None

Comments on item setup or checks:
The unit was allowed to cool overnight, before the posttest
performance check was completed.

Comments on test run (including interruptions): None

Comments on other data: None
3.2.12 **Low temperature test**

Low Temperature Test  
(Equipment Operating)  
Report Form

Nomenclature: Vital check monitor  
Manufacturer: IVAC® Inc.  
Model number: IVAC® Model 4000AEE  
Serial number: 010013  
Military item number: None

Options installed: None

Date of test: 10 May 89

Item configuration during test: Sitting on chamber floor, ready for operation.

Performance test criteria: Consistent and accurate displays and measurements.

Ambient conditions outside chamber:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>23°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>not available</td>
</tr>
<tr>
<td>Barometric pressure</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

**PRETEST DATA**

Pretest performance check:  
Item functional (based on performance test criteria): Pass

Installation of item in test facility:

- list connections to power: 120 Vac
- list connections to simulators: None
- list connections to dummy loads: None
- list unconnected terminals: None
- distance from north wall (meters): 0.6223
- distance from south wall (meters): 0.5334
- distance from east wall (meters): 1.4986
- distance from west wall (meters): 1.2446
- distance from ceiling (meters): 1.3208
- distance from floor (meters): 0.4826

Time of test start: 1100
Performance checks during test:

First check:

Time: 1130
Temperature: 0°C
Humidity: n/a
Barometric pressure: 1 atm
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Second check:

Time: 1200
Temperature: 0°C
Humidity: n/a
Barometric pressure: 1 atm
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Third check:

Time: 1230
Temperature: 0°C
Humidity: n/a
Barometric pressure: 1 atm
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1315
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks:
The test engineer’s arm was used to test the accuracy of the unit.

Comments on test run (including interruptions): None

Comments on other data: None
3.2.13 **Low temperature storage test**

Low Temperature Test  
(Equipment in Storage)  
Report Form

Nomenclature: Vital check monitor  
Manufacturer: IVAC® Inc.  
Model number: IVAC® Model 4000AEE  
Serial number: 010013  
Military item number: None

Options installed: None

Date of test: 12 May 89

Item configuration during test: ac power cord and cuff tube coiled and laying on top of the unit. The unit is in storage, not operating.

Performance test criteria: Consistent and accurate displays and measurements

Ambient conditions outside chamber:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>23°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>50% RH</td>
</tr>
<tr>
<td>Barometric pressure</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

**PRETEST DATA**

Pretest performance check:

* Item functional (based on performance test criteria): Yes

Installation of item in test facility:

<table>
<thead>
<tr>
<th>Connection Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>list connections to power</td>
<td>None</td>
</tr>
<tr>
<td>list connections to simulators</td>
<td>None</td>
</tr>
<tr>
<td>list connections to dummy loads</td>
<td>None</td>
</tr>
<tr>
<td>list unconnected terminals</td>
<td>All</td>
</tr>
<tr>
<td>distance from north wall (meters)</td>
<td>0.6223</td>
</tr>
<tr>
<td>distance from south wall (meters)</td>
<td>0.5334</td>
</tr>
<tr>
<td>distance from east wall (meters)</td>
<td>1.4986</td>
</tr>
<tr>
<td>distance from west wall (meters)</td>
<td>1.2446</td>
</tr>
<tr>
<td>distance from ceiling (meters)</td>
<td>1.3208</td>
</tr>
<tr>
<td>distance from floor (meters)</td>
<td>0.4826</td>
</tr>
</tbody>
</table>

Time of test start: 0800  
Midtest time: 1130  
Midtest temperature: -46°C
POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end: 1500
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: The unit was allowed to return to ambient conditions overnight before final performance check.
3.2.14 **Humidity test**

**Humidity Test Report Form**

Nomenclature: Vital check monitor  
Manufacturer: IVAC® Inc.  
Model number: IVAC® Model 4000AEE  
Serial number: 010013  
Military item number: None

Options installed: None

**Date of test:** 15 May 89

**Item configuration during test:** The unit was sitting on the chamber floor, ready for operation.

**Performance test criteria:** Consistent and accurate displays and measurements.

**Ambient conditions outside chamber:**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>24°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>62% RH</td>
</tr>
<tr>
<td>Barometric pressure</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

**PRETEST DATA**

**Pretest performance check:**

*Item functional (based on performance test criteria): Yes*

**Installation of item in test facility:**

<table>
<thead>
<tr>
<th>Connection</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>list connections to power</td>
<td>120 Vac</td>
<td></td>
</tr>
<tr>
<td>list connections to simulators</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>list connections to dummy loads</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>list unconnected terminals</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>distance from north wall (meters)</td>
<td>0.6223</td>
<td></td>
</tr>
<tr>
<td>distance from south wall (meters)</td>
<td>0.5334</td>
<td></td>
</tr>
<tr>
<td>distance from east wall (meters)</td>
<td>1.4986</td>
<td></td>
</tr>
<tr>
<td>distance from west wall (meters)</td>
<td>1.2446</td>
<td></td>
</tr>
<tr>
<td>distance from ceiling (meters)</td>
<td>1.3208</td>
<td></td>
</tr>
<tr>
<td>distance from floor (meters)</td>
<td>0.4826</td>
<td></td>
</tr>
</tbody>
</table>

**IN-TEST DATA**

**Time of test start:** 0845
Performance checks during test:

First check:

<table>
<thead>
<tr>
<th>Time:</th>
<th>0930</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>29.5°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>95% RH</td>
</tr>
<tr>
<td>Barometric pressure:</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Second check:

<table>
<thead>
<tr>
<th>Time:</th>
<th>1015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>29.5°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>95% RH</td>
</tr>
<tr>
<td>Barometric pressure:</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Third check:

<table>
<thead>
<tr>
<th>Time:</th>
<th>1100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>29.5°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>95% RH</td>
</tr>
<tr>
<td>Barometric pressure:</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Fourth check:

<table>
<thead>
<tr>
<th>Time:</th>
<th>1145</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>29.5°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>95% RH</td>
</tr>
<tr>
<td>Barometric pressure:</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Fifth check:

<table>
<thead>
<tr>
<th>Time:</th>
<th>1230</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td>29.5°C</td>
</tr>
<tr>
<td>Humidity:</td>
<td>95% RH</td>
</tr>
<tr>
<td>Barometric pressure:</td>
<td>1 atm</td>
</tr>
</tbody>
</table>

Item functional (based on performance test criteria): Yes
Deviation from pretest: None

3-33
POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 1400
Item functional (based on performance test criteria): Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None
3.2.15 **Electromagnetic characteristics test**

******************************************************************************

Electromagnetic Characteristics Testing
Evaluation of Performance
******************************************************************************

**T & E Item Number:** 14 **Date:** 12 Apr 89

**Nomenclature:** Vital check monitor
**Manufacturer:** IVAC® Inc.
**Model number:** IVAC® Model 4000AEE
**Serial number:** 010013
**Military item number:** n/a

******************************************************************************

**Conducted Emissions Tests**

**CE01**

Testing configuration(s): n/a
Performance (pass/fail): n/a

Comments: n/a

**CE02**

Testing configuration(s): Operating on copper work bench in 2.5-minute cycle mode.
Performance (pass/fail): Pass

Comments: No signal failures.

**CE04**

Testing configuration(s): Operating on copper work bench.
Performance (pass/fail): Fail

Comments: NB failure 0.7 to 7.5 dB over specifications in range 19.033 - 41.898 MHz.

**Conducted Susceptibility Tests**

**CS02**

Testing configuration(s): Operating on test bench, connected to test jig.
Performance (pass/fail): n/a

Comments: Unable to test because noise generated by the unit is greater than the test signal (unable to measure test signal).
CS06  Testing configuration(s): Operating on counter top.
Performance (pass/fail): Pass
Comments: Not susceptible to test spikes

Radiated Emissions Tests

RE02  Testing configuration(s): Operating on wooden test stand in the EMC chamber, ac and battery power.
Performance (pass/fail): Fail
Comments: ac operating failure data:
NB failures 0.2 to 46.8 dB over specifications in range 0.024 to 242 MHz; BB failures of 0.8 to 12.3 dB over specification in range 5.5 to 30 MHz.

Battery operating failure data:
NB failures 0.1 to 45.8 dB over specifications from 0.557 to 229.125 MHz; BB failures of 0.8 to 20.3 dB over specification in range 20.538 to 45.0 MHz.

Radiated Susceptibility Tests

RS03  Testing configuration(s): Operating on the wooden test stand in the EMC chamber, ac power only.
Performance (pass/fail): Fail
Comments: Susceptibility data:
0.89 - 6.68 V/m from 33.4 - 200 MHz
0.79 - 5.31 V/m from 200 - 332 MHz
5.01 - 7.50 V/m from 556 - 592 MHz

The temperature probe was placed in a cup of warm water with the mean temperature maintained from 89 to 106 degrees Fahrenheit.
3.3 CRITERIA, SIGNIFICANT PROBLEMS, AND SUGGESTED IMPROVEMENTS

3.3.1 Criteria

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Criteria (source)</th>
<th>Remarks</th>
<th>Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The physical inventory is conducted solely for investigation and documentation.</td>
<td>n/a</td>
<td>2.1.2.1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>The IVAC® Model 4000AEE will display consistent and accurate measurements.</td>
<td>met</td>
<td>2.1.2.2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Verify manufacturer's specified full power internal battery life expectancy of 2.5 hours or 150 blood pressure measurements.</td>
<td>met</td>
<td>2.2.2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>The IVAC® Model 4000AEE will meet the limits established in NAFP 99 for electrical safety of medical equipment.</td>
<td>met</td>
<td>2.3.2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>The IVAC® Model 4000AEE will be rated satisfactory in all major categories of the evaluation. These include: Visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.</td>
<td>partially met</td>
<td>2.4.2</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>The IVAC® Model 4000AEE will display consistent and accurate measurements while exposed to an altitude equivalency of 15,000 feet above sea level.</td>
<td>met</td>
<td>2.5.2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>The IVAC® Model 4000AEE will remain operational and display consistent and accurate measurements while exposed to vibrational stresses.</td>
<td>met</td>
<td>2.6.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>met</td>
<td>2.7.2.1</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------</td>
<td>-----</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>display consistent and accurate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>measurements during the high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>temperature operation check.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>met</td>
<td>2.7.2.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>display consistent and accurate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>measurements after the high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>temperature storage.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>met</td>
<td>2.8.2.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>display consistent and accurate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>measurements during the low</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>temperature operation check.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>met</td>
<td>2.8.2.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>display consistent and accurate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>measurements after the low</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>temperature storage.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>met</td>
<td>2.9.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>display consistent and accurate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>measurements while exposed to a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>high humidity.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>par-</td>
<td>2.10.2.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>not produce emissions in excess of</td>
<td>tially</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the limits set forth in MIL-STD-</td>
<td>met</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>par-</td>
<td>2.10.2.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>not malfunction when it is subjected</td>
<td>tially</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>to radiated fields as specified</td>
<td>met</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>in MIL-STD-461A, Notice 4, para-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>graph 6.20.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>par-</td>
<td>2.10.2.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>not conduct emissions in excess of</td>
<td>tially</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the limits set forth in MIL-STD-</td>
<td>met</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>461A, Notice 4, paragraphs 6.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and 6.2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The IVAC® Model 4000AEE will</td>
<td>par-</td>
<td>2.10.2.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>not malfunction when it is subjected</td>
<td>tially</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>to conducted emissions as spec-</td>
<td>met</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ified in MIL-STD-461A, Notice 4,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>paragraphs 6.7 and 6.10.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3-38
The flight surgeon will be able partially to operate the IVAC® Model 4000-AEE without physical or functional restrictions aboard the aircraft.

The IVAC® Model 4000AEE will not meet radiate EMI to disrupt or interfere with the other equipment or systems aboard the aircraft.

The aircraft will not radiate EMI to disrupt or interfere with the IVAC® Model 4000AEE.

3.3.2 Significant problems which require corrective action

Ambient noise levels during in-flight testing prevented proper reception and interpretation of Korotkoff sounds resulting in excess cuff pressures and errors in BP and heart rate measurements.

3.3.3 Suggested improvements

Microphone system in the BP cuff should be redesigned to improve operation in the aircraft noise environment.
3.4 REFERENCES


3.4.12 IVAC® Inc. *Directions for use, vital check vital signs measurement system 4000 Series.* San Diego, California. P/N 120713 NC.

3.5 ABBREVIATIONS

ac alternating current
AEST aeromedical equipment suitability test
AVSCOM U.S. Army Aviation Systems Command
AWR airworthiness release

BB broadband
BP blood pressure
BPM beats per minute

CAAF Cairns Army Airfield
CRT cathode ray tube
dB decibel
dc direct current

ECG electrocardiograph
EMC electromagnetic compatibility
EMI electromagnetic interference
fpm feet per minute

GFE government furnished equipment
Gpk gravity, peak
G(rms) gravity (root mean square)
Hz hertz

IAW in accordance with
ITOP in-flight test operating procedure
IGE in-ground effect

IVAC® Model 4000AEE IVAC® Inc. vital check monitor

kg kilogram
kHz kilohertz
KIAS knots indicated airspeed

lb pound
LCD liquid crystal display
LED light emitting diode
LISN line impedance stabilization network

MAP mean arterial pressure
MEDEVAC medical evacuation
MHZ megahertz
MIL-STD military standard
mL milliliter
mm millimeter
mmHg millimeters of mercury
MSL mean sea level
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAFP</td>
<td>National Association of Fire Prevention</td>
</tr>
<tr>
<td>NB</td>
<td>narrowband</td>
</tr>
<tr>
<td>NBC</td>
<td>nuclear, biological, and chemical</td>
</tr>
<tr>
<td>NiCad</td>
<td>nickel cadmium</td>
</tr>
<tr>
<td>NOE</td>
<td>nap-of-the-earth</td>
</tr>
<tr>
<td>NVG</td>
<td>night vision goggle</td>
</tr>
<tr>
<td>RAM</td>
<td>random access memory</td>
</tr>
<tr>
<td>RF</td>
<td>radio frequency</td>
</tr>
<tr>
<td>RH</td>
<td>relative humidity</td>
</tr>
<tr>
<td>ROM</td>
<td>read only memory</td>
</tr>
<tr>
<td>TB</td>
<td>technical bulletin</td>
</tr>
<tr>
<td>TFT</td>
<td>technical feasibility testing</td>
</tr>
<tr>
<td>T &amp; E</td>
<td>test and evaluation</td>
</tr>
<tr>
<td>UES</td>
<td>Universal Energy Systems, Inc.</td>
</tr>
<tr>
<td>USAARL</td>
<td>U.S. Army Aeromedical Research Laboratory</td>
</tr>
<tr>
<td>V/m</td>
<td>volts per meter</td>
</tr>
</tbody>
</table>
3.6 MANUFACTURERS' LIST

3.6.1 IVAC Corporation
10300 Campus Point Drive
San Diego, CA 92121-1579

3.6.2 Sikorsky Aircraft
6900 Main Street
Stratford, CT 06601

3.6.3 Neurodyne-Dempsey, Inc.
200 Arrowhead Drive
Carson City, NV 89701

3.6.4 Tenney Engineering, Inc.
1090 Springfield Road
P.O. box 3142
Union, NJ 07083

3.6.5 Unholtz-Dickey Corporation
6 Brookside Drive
Wallingford, CT 06492

3.6.6 Solar Electronics Company
901 North Highland Avenue
Hollywood, CA 90038

3.6.7 Tektronix, Inc.
P.O. Box 500
Beaverton, OR 97077
3.7 DISTRIBUTION LIST

Commander, U.S. Army Natick Research, Development and Evaluation Center
ATTN: STRNC-MIL (Documents Librarian)
Natick, MA 01760-5040

Commander
U.S. Army Aviation Systems Command
ATTN: AMSAV-ECU
4300 Goodfellow Bouuvelard
St. Louis, MO 63120-1790

Commander/Director
U.S. Army Combat Surveillance and Target Acquisition Lab
ATTN: DELCS-D
Fort Monmouth, NJ 07703-5304

Commander
10th Medical Laboratory
ATTN: Audiologist
APO New York 09180

Naval Air Development Center
Technical Information Division
Technical Support Detachment
Warminster, PA 18974

Commanding Officer, Naval Medical Research and Development Command
National Naval Medical Center
Bethesda, MD 20814-5044

Deputy Director, Defense Research and Engineering
ATTN: Military Assistant for Medical and Life Sciences
Washington, DC 20301-3080

Commander, U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760

U.S. Army Avionics Research and Development Activity
ATTN: SAVAA-P-TP
Fort Monmouth, NJ 07703-5401

U.S. Army Communications-Electronics Command
ATTN: AMSEL-RD-ESA-D
Fort Monmouth, NJ 07703

Library
Naval Submarine Medical Research Lab
Box 900, Naval Sub Base
Groton, CT 06349-5900

Commander
Man-Machine Integration System
Code 602
Naval Air Development Center
Warminster, PA 18974

Commander
Naval Air Development Center
ATTN: Code 602-B (Mr. Brindle)
Warminster, PA 18974

Commanding Officer
Harry G. Armstrong Aerospace Medical Research Laboratory
Wright-Patterson
Air Force Base, OH 45433

Director
Army Audiology and Speech Center
Walter Reed Army Medical Center
Washington, DC 20307-5001

Commander, U.S. Army Institute of Dental Research
ATTN: Jean A. Setterstrom, Ph. D.
Walter Reed Army Medical Center
Washington, DC 20307-5300
Commandant
U.S. Army Aviation
Logistics School
ATTN: ATSQ-TDN
Fort Eustis, VA 23604

Headquarters (ATMD)
U.S. Army Training
and Doctrine Command
Fort Monroe, VA 23651

Structures Laboratory Library
USARTL-AVSCOM
NASA Langley Research Center
Mail Stop 266
Hampton, VA 23665

Naval Aerospace Medical
Institute Library
Building 1953, Code 03L
Pensacola, FL 32508-5600

Command Surgeon
HQ USCENTCOM (CCSG)
U.S. Central Command
MacDill Air Force Base FL 33608

Air University Library
(AUL/LSE)
Maxwell Air Force Base, AL 36112

U.S. Air Force Institute
of Technology (AFIT/LDEE)
Building 640, Area B
Wright-Patterson
Air Force Base, OH 45433

Henry L. Taylor
Director, Institute of Aviation
University of Illinois-Willard Airport
Savoy, IL 61874

COL Craig L. Urbauer, Chief
Office of Army Surgeon General
National Guard Bureau
Washington, DC 50310-2500

Commander
U.S. Army Aviation Systems Command
ATTN: SGRD-UAX-AL (MAJ Gillette)
4300 Goodfellow Blvd., Building 105
St. Louis, MO 63120

U.S. Army Aviation Systems Command
Library and Information Center Branch
ATTN: AMSAV-DIL
4300 Goodfellow Boulevard
St. Louis, MO 63120

Federal Aviation Administration
Civil Aeromedical Institute
Library AAM-400A
P.O. Box 25082
Oklahoma City, OK 73125

Commander
U.S. Army Academy
of Health Sciences
ATTN: Library
Fort Sam Houston, TX 78234

Commander
U.S. Army Institute of Surgical Research
ATTN: SGRD-USM (Jan Duke)
Fort Sam Houston, TX 78234-6200

AAMRL/HEX
Wright-Patterson
Air Force Base, OH 45433

John A. Dellinger,
Southwest Research Institute
P. 0. Box 28510
San Antonio, TX 78284

Product Manager
Aviation Life Support Equipment
ATTN: AMCPM-ALSE
4300 Goodfellow Boulevard
St. Louis, MO 63120-1798
Commander
U.S. Army Aviation
   Systems Command
ATTN: AMSAV-ED
4300 Goodfellow Boulevard
St. Louis, MO  63120

Commanding Officer
Naval Biodynamics Laboratory
P.O. Box 24907
New Orleans, LA  70189-0407

Assistant Commandant
U.S. Army Field Artillery School
ATTN: Morris Swott Technical Library
Fort Sill, OK 73503-0312

Commander
U.S. Army Health Services Command
ATTN: HSOP-SO
Fort Sam Houston, TX 78234-6000

Director of Professional Services
HQ USAF/SGDT
Bolling Air Force Base, DC  20332-6188

U.S. Army Dugway Proving Ground
Technical Library, Building 5330
Dugway, UT  84022

U.S. Army Yuma Proving Ground
Technical Library
Yuma, AZ  85364

AFFTC Technical Library
6510 TW/TSTL
Edwards Air Force Base, CA  93523-5000

Commander
Code 3431
Naval Weapons Center
China Lake, CA  93555

Aeromechanics Laboratory
U.S. Army Research and Technical Labs
Ames Research Center, M/S 215-1
Moffett Field, CA 94035

Sixth U.S. Army
ATTN: SMA
Presidio of San Francisco, CA  94129

Commander
U.S. Army Aeromedical Center
Fort Rucker, AL  36362

U.S. Air Force School
   of Aerospace Medicine
Strughold Aeromedical Library Technical
Reports Section (TSKD)
Brooks Air Force Base, TX 78235-5301

Dr. Diane Damos
Department of Human Factors
ISSM, USC
Los Angeles, CA  90089-0021

U.S. Army White Sands
   Missile Range
ATTN: STEWS-IM-ST
White Sands Missile Range, NM  88002

U.S. Army Aviation Engineering
   Flight Activity
ATTN: SAVTE-M (Tech Lib) Stop 217
Edwards Air Force Base, CA  93523-5000

Ms. Sandra G. Hart
Ames Research Center
MS 262-3
Moffett Field, CA 94035

Commander, Letterman Army Institute
   of Research
ATTN: Medical Research Library
Presidio of San Francisco, CA 94129
COL Eugene S. Channing, O.D.  
Brooke Army Medical Center  
ATTN: HSHE-EAH-O  
Fort Sam Houston, TX 78234-6200

Commander  
U.S. Army Medical Materiel  
Development Activity  
Fort Detrick, Frederick, MD 21702-5009

Commander  
U.S. Army Aviation Center  
Directorate of Combat Developments  
Building 507  
Fort Rucker, AL 36362

U. S. Army Research Institute  
Aviation R&D Activity  
ATTN: PERI-IR  
Fort Rucker, AL 36362

Commander  
U.S. Army Safety Center  
Fort Rucker, AL 36362

U.S. Army Aircraft Development  
Test Activity  
ATTN: STEBG-MP-P  
Cairns Army Air Field  
Fort Rucker, AL 36362

Commander U.S. Army Medical Research  
and Development Command  
ATTN: SGRD-PLC (COL Sedge)  
Fort Detrick, Frederick, MD 21702

MAJ John Wilson  
TRADOC Aviation LO  
Embassy of the United States  
APO New York 09777

Netherlands Army Liaison Office  
Building 602  
Fort Rucker, AL 36362

British Army Liaison Office  
Building 602  
Fort Rucker, AL 36362

Italian Army Liaison Office  
Building 602  
Fort Rucker, AL 36362

Directorate of Training Development  
Building 502  
Fort Rucker, AL 36362

MAJ Terry Newman  
Canadian Army Liaison Office  
Building 602  
Fort Rucker, AL 36362

German Army Liaison Office  
Building 602  
Fort Rucker, AL 36362

LTC Patrice Cottebrune  
French Army Liaison Office  
USAAVNC (Building 602)  
Fort Rucker, AL 36362-5021

Brazilian Army Liaison Office  
Building 602  
Fort Rucker, AL 36362
Australian Army Liaison Office
Building 602
Fort Rucker, AL 36362

Dr. Garrison Rapmund
6 Burning Tree Court
Bethesda, MD 20817

Commandant Royal Air Force
Institute of Aviation Medicine
Farnborough Hants UK GU14 6SZ
Dr. A. Kornfield, President
Biosearch Company
3016 Revere Road
Drexel Hill, PA 29026

Commander
U.S. Army Biomedical Research
and Development Laboratory
ATTN: SGRD-UBZ-I
Fort Detrick, Frederick, MD 21702

Defense Technical Information Center
Cameron Station
Alexandria, VA 22313

Commander, U.S. Army Foreign Science
and Technology Center
AIFRTA (Davis)
220 7th Street, NE
Charlottesville, VA 22901-5396

Director,
Applied Technology Laboratory
USARTL-AVSCOM
ATTN: Library, Building 401
Fort Eustis, VA 23604

U.S. Army Training
and Doctrine Command
ATTN: Surgeon
Fort Monroe, VA 23651-5000

Aviation Medicine Clinic
TMC #22, SAAF
Fort Bragg, NC 28305

U.S. Air Force Armament
Development and Test Center
Eglin Air Force Base, FL 32542

Commander, U.S. Army Missile
Command
Redstone Scientific Information Center
ATTN: AMSMI-RD-CS-R/ILL
Documents Redstone Arsenal, AL 35898

U.S. Army Research and Technology
Laboratories (AVSCOM)
Propulsion Laboratory MS 302-2
NASA Lewis Research Center
Cleveland, OH 44135

Dr. H. Dix Christensen
Bio-Medical Science Building, Room 753
Post Office Box 26901
Oklahoma City, OK 73190

Dr. Christine Schlichting,
Behavioral Sciences Department
Box 900, NAVUBASE NLON
Groton, CT 06349-5900

Commandant
Academy of Health Sciences
ATTN: HSHA-COM (LTC Huether)
Fort Sam Houston, TX 78234

U.S. Air Force Armament
Development and Test Center
Eglin Air Force Base, FL 32542

COL Eugene S. Channing, O.D.
Brooke Army Medical Center
ATTN: HSHE-EAH-O
Fort Sam Houston, TX 78234-6200