# Joint Enroute Care Equipment Test Standard

# (JECETS)

Developed by:

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Fort Rucker, Alabama

and

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# 1. INTRODUCTION

## 1.1 Scope

This document describes the test procedures for medical equipment that will be used onboard U.S. military transport vehicles during enroute patient care. This document defines the test methods required for airworthiness certification by the Department of Defense (DoD) joint services. Hereafter, this document will be referred to as the Joint Enroute Care Equipment Test Standard (JECETS). Test methods found in this document can be tailored based on the type of test article and its performance specifications. Other considerations for tailoring test methods may include, but are not limited to, "single-use" items and medical consumables. In this document, aeromedical equipment is referred to as certified carry-on medical equipment used aboard military aircraft. Carry-on medical equipment is defined as portable medical equipment used by health care providers during the treatment of ill or injured patients onboard U.S. military dedicated or opportune vehicles whether it is by air, land, or sea.

Aeromedical equipment will have a service specific certification authorizing onboard use for each respective vehicle platform. For the U.S. Army, certification consists of a fleet Airworthiness Release (AWR) and an Aeromedical Certification Memorandum (ACM). For the U.S. Air Force (USAF), certification consists of concurrence to a Safe-to-Fly (STF) recommendation. Certification for the U.S. Navy consists of Navy Flight Clearance through Class Desks Managers at Naval Air Systems Command (NAVAIR). In accordance with Army Regulation 40-61 and Air Force Instruction (AFI) 11-202, the U.S. Army Aeromedical Research Laboratory (USAARL) and USAF Aeromedical Branch (ASC/WNUP) Aeromedical Test Laboratory (ATL) are the primary organizations for performing airworthiness and STF certification testing.

The test methods described in this document apply to aeromedical equipment to be used aboard opportune or dedicated aircraft, as follows:

Fixed-wing: C-17, C-130 E/H, C-130J, KC-10, KC-135, C-21, C-5, and C-27J

Rotary-wing: UH-1, H-60 Series Helicopters (UH-60 and HH-60), and CH-47

## 1.2 Background

In general, medical devices are designed to function in environmentally controlled locations, such as stationary hospitals, and not in the harsh, dynamic aircraft environment. Yet, the same medical devices used to care for patients in a hospital environment are often the most capable devices for patient care during transport from one location to another. These types of transport missions are commonly referred to as medical evacuation (MEDEVAC) and aeromedical evacuation (AE) missions. These missions provide life-sustaining care for a vast array of patients. However, because medical carry-on items are typically designed for use in a controlled environment, there are concerns that they may adversely affect the operation of aircraft systems. Further, the aircraft may adversely affect the proper operation and efficacy of the aeromedical equipment. Failure of medical devices during in-flight medical care may result in exposing patients and aircrew to hazardous situations. Military and civilian standards, regulations, and specifications, as well as professional experience and expertise, are all part of the AWR and STF evaluation process.

## 1.3 Document Overview

This document contains the requirements needing to be met for aeromedical equipment to obtain airworthiness certification (AWC) from the USAARL and STF certification from the USAF ATL. In general, MIL-HDBK-516 establishes the airworthiness certification criteria to be used as guidance for defining certification requirements. All components, including aeromedical equipment, either individually or as part of a subsystem, must be verified to pass all safety-related qualification tests. The test methodologies, located in Section 2, used to assess aeromedical equipment, are derived from military standards, such as MIL-STD-810.

The method and procedure numbers referenced in Section 2 may change when there is an update available for a standard. In those circumstances, equivalent test methods and procedures will be used from the latest revision of the referenced standard. The latest revisions of military standards and handbooks can be retrieved online at http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

Aeromedical equipment is not permanently installed inside the aircraft; therefore, these standards must be tailored from the original guidelines. Tailoring may be required because of the physical and functional variations between aeromedical equipment needed in MEDEVAC and AE missions. The requirements herein apply to all joint platforms; however, if an AWC or STF is requested for a test article onboard a specific platform, the test requirements may be further tailored accordingly.

Appendix A provides an overall summary of the test methods and standards used for guidance.

## 1.4 Points of Contact

For questions, comments, or change requests, contact the following personnel:

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# 2. JOINT ENROUTE CARE EQUIPMENT TEST STANDARD

The JECETS utilizes a three phase test and evaluation approach to test aeromedical equipment. The three phases include a baseline performance assessment, laboratory tests, and an in-flight assessment (IFA).

## 2.1 Test Plan

Test personnel will develop a test plan which will generally include the following information:

- An introduction providing scope and background
- A description of the test article, its components, and how it operates
- A description of test requirements, including information for any deviation from this document due to the applicability of the requirements
- Test setup, functional performance procedures, support equipment and facilities to be used
- Specific safety concerns that the test article may pose during the tests along with risk mitigation plans in accordance with (IAW) organizational safety policies and procedures.
- Any planned on-ground or in-flight form, fit, and function checks
- Performance or physical susceptibility criteria
- List of reports to be generated
- A test schedule
- Referenced documents

If the manufacturer of a test article has not yet received Food and Drug Administration (FDA) clearance through a 510(k) submission at the time of testing, testing may commence; however, neither an AWR nor an STF recommendation letter will be sought until the manufacturer shows evidence of FDA clearance. Medical equipment that is under testing and evaluation are expected to have an identification marking, preferably using MIL-STD-130 as guidance.

## 2.2 Phase I: Baseline Performance Assessment

The purpose of this assessment is to verify that the test article operates IAW the manufacturer's specifications and the operator's manual. This assessment includes the evaluation of the test article for human factors, basic electrical safety checks, securing procedures, and possible damage incurred during shipment. The assessment also familiarizes test personnel with the operation and characteristics of the device.

### *2.2.1 Human Factors Assessment*

The test article will be evaluated for adherence to optimum human factors referenced in MIL-STD-1472. The assessment will include a visual inspection for quality of workmanship.

### *2.2.2 Securing Procedures*

The baseline performance assessment will also include the evaluation of the test article for vehicle interface and identification of securing procedures prior to laboratory tests. Acceleration and tie-down considerations should be addressed in this phase for test articles weighing greater than 5 pounds, large or bulky articles, articles with any hazardous material related factors, or any test

articles with special considerations. A technical data package including drawings, bill of material/part numbers and specifications may be required. The test article will also be assessed for the operational configuration of the item per AFI 10-2909 for use onboard USAF fixed-wing aircraft.

### *2.2.3 Battery Tests (Discharge and Recharge)*

The battery tests will be performed three (3) times at ambient room temperature to obtain a mean value. Refer to Section 2.3.3.4 for battery testing at extreme temperatures. Rotary-wing mission times rely on battery power and normally do not exceed 4 to 5 hours. With an additional 2 hours to act as a safety margin, the battery tests will not be required for items that operate more than 7 hours on battery power.

### *2.2.4 Electrical Safety*

Electrical safety tests will be performed for leakage current, ground resistance, and other safety concerns. The test personnel will use ANSI/AAMI ES60601-1:2005 – Medical electrical equipment, Part 1: *General requirements for basic safety and essential performance* or National Fire Protection Association (NFPA) 99, as guidance for electrical safety tests. For electric generator or converter equipment such as frequency converters, that will be used for powering aeromedical medical equipment in the USAF aircraft, the equipment's electrical generating characteristics will be evaluated for the aircraft's electrical power interface, using MIL-STD-704 and MIL-HDBK-704 as guidance.

To ensure the integrity of the test article is not compromised during testing, chassis leakage and safety checks will occur before testing. If required, the electrical safety test will be repeated following completion of all laboratory testing.

### *2.2.5 Applicable Standards and Specifications*

The test personnel will indentify additional standards and specifications applicable for testing based on the equipment's specific characteristics.

## 2.3 Phase II: Laboratory Tests

The two overall goals for all laboratory tests are as follows:

- Identify the potential safety concerns that the article may pose for the aircraft, patient, and aircrew, and
- Identify the physical or functional degradation that the test article may experience within the enroute care environment.

Laboratory test results will be assessed by USAARL and ATL subject matter experts (SME) and any anomalies will be evaluated using the risk assessment methodology as described in Section 2.5 with respect to aircraft, aircrew and patient safety. Fail-safe results are those failures that are assessed by a panel of SME and found to be tolerable with respect to patient safety and approved by the procuring agency.

### *2.3.1 Vibration*

Vibration testing is critical in determining the operational and physical integrity of the equipment when it is exposed to vibratory stresses encountered in the enroute care environment. The test article will typically be secured to a litter or stretcher. Any deviations in securing will be noted in the test plan. In general, the structural integrity, including any securing hardware, should not be compromised. Aeromedical equipment must perform to its expected functionality during exposure to vibration. This test will be performed using MIL-STD-810G, Method 514.6, as guidance. The test article will be subjected to rotary-wing, jet, turbo-prop, and wheeled vehicle vibration profiles on three axes, X, Y, and Z, using the breakpoints shown in the following paragraphs:

#### *2.3.1.1 Rotary-wing (Combined)*

The test parameters for this test are:

Test Type: Sine on Random

Axes: X, Y, Z (three independent tests in horizontal, longitudinal, and vertical directions, respectively)

Test Duration: 60 minutes (per axis)

Frequency Range: 10 to 500 Hz

Total Intensity: 2.56 $G_{rms}$

Applicable Aircraft: UH-1, H-60 Series Helicopters (UH-60 and HH-60), and CH-47

The test breakpoints for this test are shown in Table 1.

**Table 1 – Breakpoints for the Combined Rotary-wing Vibration Tests**

| Random Vibration | | Sinusoidal Vibration |
|---|---|---|
| Initial Slope: | 99.00 dB/oct | 0.08 $G_{pk}$ at 4.48 Hz |
| 10 Hz level: | 0.0007 $g^2$/Hz | 0.77 $G_{pk}$ at 11.03 Hz |
| 100 Hz level: | 0.007 $g^2$/Hz | 1.20 $G_{pk}$ at 17.20 Hz |
| 300 Hz level: | 0.007 $g^2$/Hz | 1.54 $G_{pk}$ at 22.05 Hz |
| 500 Hz level: | 0.0007 $g^2$/Hz | 1.75 $G_{pk}$ at 33.53 Hz |
| Final Slope: | -99.00 dB/oct | 1.05 $G_{pk}$ at 51.60 Hz |

#### *2.3.1.2 Fixed-wing (Jet Aircraft)*

The test parameters for this test are:

Test Type: Random (Jet Aircraft Profile, General Exposure)

Axes: X, Y, Z (three independent tests in horizontal, longitudinal, and vertical directions, respectively)

Frequency Range: 15 to 2000 Hz

Test Duration: 30 minutes (per axis)

Total Intensity: 4.02 $G_{rms}$

Applicable Aircraft: C-17, KC-10, KC-135, C-21, and C-5

The test breakpoints for this test are shown in Table 2.

**Table 2 – Breakpoints for the Jet Aircraft (General Exposure)**

| Hz | $g^2$/Hz | dB/Oct |
|---|---|---|
| 15 | 0.01 | |
| 105.94 | 0.01 | |
| | | 6 |
| 150 | 0.02 | |
| 500 | 0.02 | |
| | | -6 |
| 2000 | 1.3E-3 | |

*2.3.1.3 Fixed-wing (Turbo-Propeller Aircraft)*

This test will be performed using the combined profile for C-130 E/H and C-130J incorporating the four and six propeller calculations referenced in MIL-STD-810G, Table 514.6C-IX, Category 8. Table 3 does not include the frequency breakpoints for the three-blade propeller (C-130A).

The test parameters for this test are:

Test Type: Random Vibration

Axes: X, Y, Z (three independent tests in horizontal, longitudinal, and vertical directions, respectively)

Frequency Range: 15 to 2000 Hz

Test Duration: 60 minutes (per axis)

Total Intensity: 5.29 $G_{rms}$

Applicable Aircraft: C-130 E/H/J

The test breakpoints for this test are shown in Table 3.

**Table 3 – Combined C-130E/H and C-130J Break Points**

| Hz | $g^2$/Hz | Hz | $g^2$/Hz |
|---|---|---|---|
| 15 | 0.01 | 193.80 | 0.075 |
| 63.35 | 0.01 | 212.95 | 0.075 |
| 64.36 | 0.3 | 214.20 | 0.01 |
| 70.14 | 0.3 | 257.15 | 0.01 |
| 71.40 | 0.01 | 258.45 | 0.0189 |
| 95.69 | 0.01 | 289.45 | 0.0189 |
| 96.90 | 0.3 | 290.70 | 0.034 |
| 105.85 | 0.3 | 320.05 | 0.034 |
| 107.10 | 0.01 | 321.30 | 0.01 |
| 127.95 | 0.01 | 386.35 | 0.01 |
| 129.20 | 0.0754 | 387.60 | 0.019 |
| 141.55 | 0.0754 | 427.15 | 0.019 |
| 142.80 | 0.01 | 428.40 | 0.010 |
| 192.55 | 0.01 | 2000 | 0.01 |

*2.3.1.4 Composite Wheeled Vehicle*

MIL-STD-810G Method 514.6, Annex C will be used as guidance during the composite wheeled vibration exposure tests. This vibration profile is intended to simulate 800 kilometers of transport from a port staging area to a forward supply point using various trucks and/or semi-trailers.

The test parameters for this test are:

Test Type: Random Vibration

Axes: X, Y, Z (three independent tests in horizontal, longitudinal, and vertical directions, respectively)

Frequency Range: 5 to 500 Hz

Test Duration: 60 minutes (per axis)

Total Intensity: ($G_{rms}$): 2.24 (Vertical), 1.48 (Transverse), and 1.90 (Longitudinal)

The test breakpoints for this test are shown in Table 4 (MIL-STD-810G, Table 514.6C-IV).

## Table 4 – Composite Wheeled Vehicle Break Points

| Vertical | | Transverse | | Longitudinal | |
|---|---|---|---|---|---|
| Frequency (Hz) | PSD ($g^2$/Hz) | Frequency (Hz) | PSD ($g^2$/Hz) | Frequency (Hz) | PSD ($g^2$/Hz) |
| 5 | 0.1759 | 5 | 0.0998 | 5 | 0.0441 |
| 8 | 0.512 | 7 | 0.0799 | 7 | 0.039 |
| 11 | 0.066 | 9 | 0.1115 | 8 | 0.0576 |
| 12 | 0.0585 | 10 | 0.0577 | 9 | 0.043 |
| 13 | 0.0348 | 14 | 0.0294 | 10 | 0.0293 |
| 15 | 0.1441 | 15 | 0.0651 | 13 | 0.0221 |
| 16 | 0.1237 | 16 | 0.0646 | 15 | 0.0558 |
| 20 | 0.0241 | 17 | 0.0436 | 16 | 0.0585 |
| 23 | 0.0536 | 18 | 0.0393 | 18 | 0.016 |
| 26 | 0.0124 | 19 | 0.0622 | 20 | 0.0099 |
| 27 | 0.0118 | 24 | 0.01 | 23 | 0.0452 |
| 30 | 0.0331 | 37 | 0.0045 | 25 | 0.011 |
| 34 | 0.0086 | 38 | 0.0065 | 35 | 0.0036 |
| 39 | 0.0347 | 44 | 0.0033 | 37 | 0.0098 |
| 43 | 0.0073 | 55 | 0.0024 | 40 | 0.004 |
| 45 | 0.0141 | 57 | 0.0042 | 41 | 0.0044 |
| 49 | 0.0084 | 59 | 0.0019 | 45 | 0.0023 |
| 52 | 0.0089 | 76 | 0.0012 | 47 | 0.0047 |
| 57 | 0.0045 | 79 | 0.0021 | 50 | 0.0016 |
| 67 | 0.016 | 83 | 0.001 | 54 | 0.0017 |
| 80 | 0.0037 | 114 | 0.0006 | 64 | 0.001 |
| 90 | 0.0077 | 135 | 0.0017 | 69 | 0.003 |
| 93 | 0.0053 | 142 | 0.001 | 77 | 0.0007 |
| 98 | 0.0065 | 158 | 0.0018 | 85 | 0.0015 |
| 99 | 0.0063 | 185 | 0.001 | 90 | 0.0012 |
| 111 | 0.0046 | 191 | 0.0007 | 97 | 0.0015 |
| 123 | 0.0069 | 206 | 0.0008 | 104 | 0.0036 |
| 128 | 0.0055 | 273 | 0.0035 | 114 | 0.004 |
| 164 | 0.0031 | 300 | 0.0016 | 122 | 0.0015 |
| 172 | 0.0035 | 364 | 0.0074 | 132 | 0.0013 |
| 215 | 0.0133 | 374 | 0.0022 | 206 | 0.0033 |
| 264 | 0.0056 | 395 | 0.0051 | 247 | 0.0226 |
| 276 | 0.0096 | 500 | 0.0012 | 257 | 0.0041 |
| 292 | 0.0032 | Total Intensity: 1.48 Grms | | 264 | 0.0054 |
| 348 | 0.0044 | | | 276 | 0.004 |
| 417 | 0.0031 | | | 303 | 0.0073 |
| 500 | 0.0008 | | | 332 | 0.0092 |
| Total Intensity: 2.24 Grms | | | | 353 | 0.0172 |
| | | | | 382 | 0.0071 |
| | | | | 428 | 0.0157 |
| | | | | 500 | 0.0016 |
| | | | | Total Intensity: 1.90 Grms | |

**Note:** The expected displacement during the vertical axis is 2.19 inches. Many existing electrodynamic shakers in use today have a maximum of 2 inches of displacement. Minor adjustments may be made to the signal amplitude at low frequency to accommodate for the shaker

limitation. If adjustments are required, the actual amplitudes will be documented. No adjustments are expected for the transverse and longitudinal axes.

### *2.3.2 Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC)*

Electromagnetic interference testing is conducted to determine if aircraft navigation and communication equipment is susceptible to electromagnetic emissions produced by the aeromedical equipment. Additionally, this testing determines if aeromedical devices are susceptible to the fields generated by the aircraft equipment. The EMI; conducted emissions (CE), conducted susceptibility (CS), radiated emissions (RE), and radiated susceptibility (RS) tests will be performed per MIL-STD-461F, using the test methods shown in Table 5. For more information and guidance on EMI testing of carry-on medical equipment, refer to MIL-STD-461F, Appendix A, Section A.4.2.4 (4.2.4) Non-Developmental Items. Items not meeting criteria may receive acceptance based on the risk assessment covered in Section 2.5 of this document.

**Table 5 – EMI Tests**

| Test Methods | MIL-STD 461F Limits |
|---|---|
| CE101 | Figure CE101-4 (Army Aircraft) |
| CE102 | Figure CE102-1 (All Applications) |
| CS101 | Figure CS101-1 (All Applications) |
| CS114 (Aircraft External) | Figure CS114-1 (All Applications, Curves 3 and 5) |
| CS115 | Figure CS115-1 (All Applications) |
| CS116 | Figure CS116-2 (All Applications) |
| RE102 | Figure RE102-3 (Helicopter and Fixed-Wing Limits) |
| RS103 | 2 MHz-18 GHz, 20, 60 and 200 V/m |

#### *2.3.2.1 U.S. Army EMI/EMC Evaluation*

For U.S. Army Airworthiness, the Aviation Engineering Directorate (AED) under the U.S. Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC) and USAARL will review and concur with EMI test results per Army Regulation (AR) 70-62 and AR 40-61.

If the test article does not pass the radiated and conducted emissions during the laboratory tests, the USAARL personnel will investigate the EMI issues further in an aircraft chamber facility where spectrum analyzer testing will be performed. The EMI/EMC characteristics of the test article with the test aircraft and its installed systems will be assessed. Items not meeting the emissions criteria may receive acceptance based on the results of the risk assessment by aircraft program managers. Anomalies noted during the susceptibility tests will be evaluated for potential risks by the USAARL test personnel. In general, aeromedical equipment on items must pass RS103 at 20 and 60 V/m. If a test article does not pass at 200 V/m, a failure without safety risks is expected.

#### *2.3.2.2 U.S. Air Force EMI/EMC Evaluation*

For USAF STF approval, the Aeronautical Systems Center, Engineering Directorate, Communication and Networks Branch (ASC/ENAC), will review and concur with the test procedures and test results.

Additionally, ASC/ENAC will issue a memorandum indicating the aeromedical equipment is flight worthy and can be flown without degrading aircraft avionics performance and minimal risk of causing any interference to aircraft, antennas, or radio frequency receivers. If there are anomalies observed during the EMI laboratory tests, EMC ground checks will be performed as required per MIL-STD-464C.

### *2.3.3 Climatic Tests*

Climatic testing will be performed using MIL-STD-810 as guidance. Additionally, guidance from the Army Chair was used to develop these test procedures. Any anomalies observed during these tests will be addressed during the risk assessment (see Section 2.5).

#### *2.3.3.1 High Temperature (Tactical-Standby to Operation)*

This test is tailored from MIL-STD-810G, Method 501.5, Procedure III. The procedure considers the high temperature extremes, simulating the mission environment during the full spectrum of enroute care.

Three high temperature tests will be performed at 49±2°C, 54.4±2°C, and 60±2°C. The 54.4°C and 60°C tests are performed to characterize equipment performance and identify equipment limitations. Humidity will be kept at 20% or less. The test article pre-test performance check will be conducted under ambient room temperature, which will be recorded before the test. Once the climatic chamber temperature has stabilized at set temperature, the test article (while on) will be placed inside the chamber and remain in operational mode for 2 hours (operational phase). Performance checks will be conducted every 30 minutes. When 2 hours have elapsed, the test article will be turned off for 3 hours (mission-ready storage phase). Subsequently, the test article will be turned on for the last remaining hour. With the test article still on, it will be removed from the chamber and a performance test will be immediately conducted outside of the chamber under ambient conditions. After 30 minutes, a post-test will be conducted. If anomalies occur, the test will be reaccomplished for repeatability at the highest set temperature where the test article did not meet the susceptibility criteria listed in the test plan. In general, medical carry-on items are expected to pass at 49°C. Figure 1 illustrates the high temperature profile.

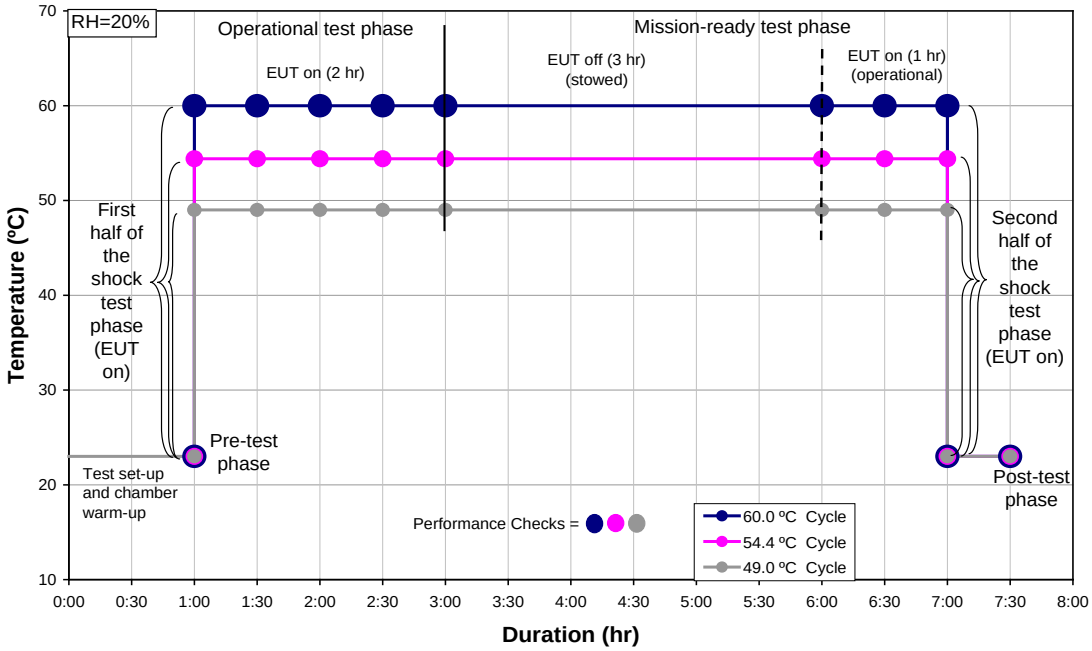


**Figure 1 – High Temperature Testing**

*2.3.3.2 High Humidity and High Temperature*

This test is tailored from MIL-STD-810G, Method 507.5. The procedure considers the potential synergistic effects of hot temperature and high humidity. The condensation is maximized by changing conditions and the equipment's operational status. MIL-HDBK-310 was used to determine the 95% relative humidity (RH) and 29.5°C temperature conditions. The 41°C level was selected to expose the unit to high temperature and high humidity conditions.

Testing will be performed at set temperatures of 29.5±2°C and later at 41±2°C. Humidity shall be kept at 95%±2 and later at 88%±2. The test article pre-test performance check will be conducted under ambient temperature which will be recorded before the test. Once the climatic chamber temperature has stabilized at 29.5±2ºC and 95% RH, the test article (while on) will be placed inside the chamber and remain in operational mode for 2 hours (operational phase). Performance checks will be conducted every 30 minutes. When 2 hours have elapsed, the test article will be turned off for 2 hours (to simulate operational-ready storage). After the 2 hour stowage, the chamber temperature will be increased to 41±2°C and the RH will be decreased to 88%±2 for the remainder of testing. A performance check will be conducted when the test article is powered on and will be repeated every 30 minutes for the remainder of this test (see Table 6). With the test article still on, it will be removed from the chamber and a performance check will be immediately conducted outside of the chamber under ambient conditions. After 30 minutes, a post-test will be conducted. In general, medical carry-on items are expected to pass with no permanent failures. Table 6 illustrates the high temperature and high humidity profile.

**Table 6 – Humidity Cycle Testing (Duration: 7 hrs).**

| Step | Duration (hr) | Humidity (%RH) | Temperature (°C) | Test Article |
|---|---|---|---|---|
| 1 | 2 | 95±2 | 29.5±2 | ON |
| 2 | 2 | 95±2 | 29.5±2 | OFF |
| 3 | 2 | 88±2 | 41.0±2 | OFF |
| 4 | 1 | 88±2 | 41.0±2 | ON |
| NOTE 1 – The temperature settling time between steps 2 and 3 is expected to be less than 20 minutes.<br>NOTE 2 – Performance checks will be conducted every 30 minutes. | | | | |

*2.3.3.3 Low Temperature*

This test is tailored from MIL-STD-810G, Method 502.5, Procedure II – Operation. The procedure considers the low temperature extremes, simulating the mission environment during the full spectrum of enroute care.

Three low temperature tests will be performed at 0°C, -13±2°C, and -26±2°C. The test article pre-test performance check will be conducted under ambient temperature which will be recorded before the tests. Once the climatic chamber temperature has stabilized at set temperature, the test article (while on) will be placed inside the chamber and remain in operational mode for 2 hours (operational phase). Performance checks will be conducted every 30 minutes. When 2 hours have elapsed, the test article will be turned off for 3 hours (mission-ready storage phase). Subsequently, the test article will be turned on for the last remaining hour. With the test article still on, it will be removed from the chamber and a performance test will be immediately conducted outside of the chamber under ambient conditions. After 30 minutes, a post-test will be conducted. If anomalies occur, the test will be reaccomplished for repeatability at the lowest set temperature where the test article did not meet the susceptibility criteria listed in the test plan. In general, medical carry-on items are expected to pass at 0°C. Figure 2 illustrates the low temperature profile.

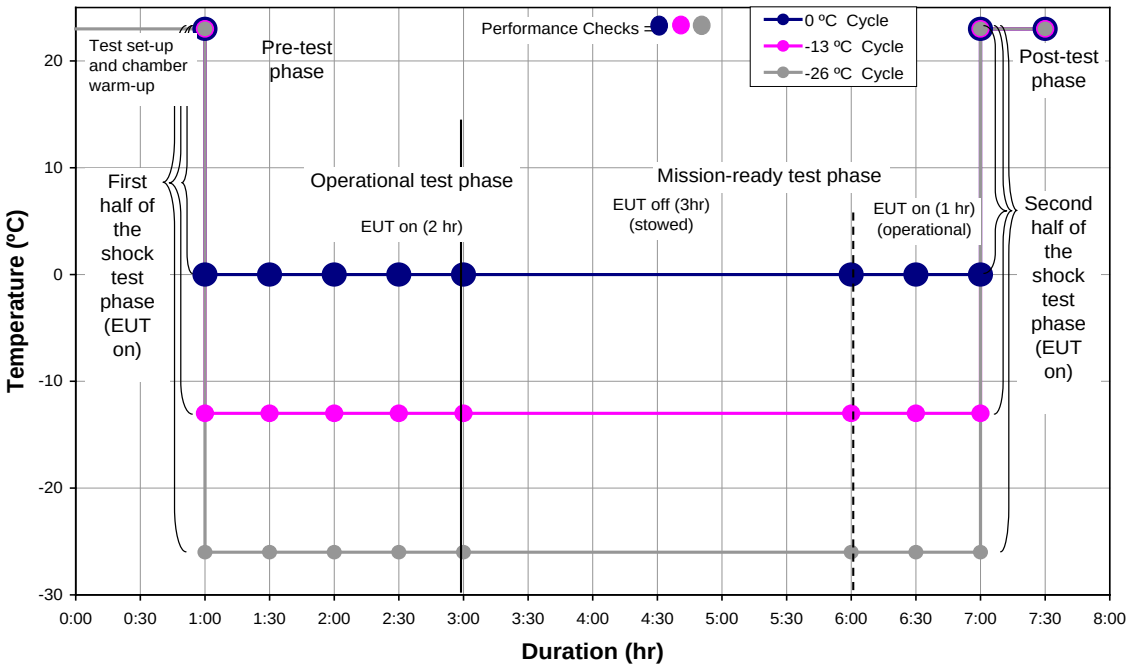


**Figure 2 – Low Temperature Testing**

*2.3.3.4 Battery Life Extreme Temperature*

To ascertain how environmental temperature extremes affect the performance (duration of operation) of test article batteries, an operational test for battery duration and battery recharging will be performed once at the most extreme temperatures where the test article passed (both hot and cold).

### *2.3.4 Low Pressure (Altitude)*

This test will be performed to assess equipment performance at various altitudes, using MIL-STD-810G, Method 500.5, Procedure II, as guidance. Functional checks will be performed at the following altitudes during ascent: 2,000; 4,000; 6,000; 8,000; 10,000; 12,500; 15,000; and 18,000 feet (ft). The ascent and descent rates will not exceed 5,000 feet per minute (fpm). The dwell time will be 5 minutes at each level; however, dwell time may be tailored, if necessary. In general, medical carry-on items must pass at all altitudes up to 10,000 ft. Ground level elevation at the test facility will be documented at the time of testing.

### *2.3.5 Rapid Decompression*

This test will be performed using MIL-STD-810G, Method 500.5, Procedure III, as guidance. This test will verify that the equipment will not:

- Experience any susceptibilities, per the test plan, following a rapid decompression event, or
- Pose a risk to the aircraft, aircrew members, or the patient during or following a rapid decompression event.

This procedure involves a pre-test during which a physical inspection and functional check of the test article will be accomplished at ground level. The test event involves a chamber simulating the ascension to 8,000 ft at a rate not to exceed 5,000 fpm followed by a decompression to 45,000 ft in 60 seconds while observing device performance and potential safety hazards. The altitudes will be maintained for 2 to 5 minutes and then returned to 8,000 ft at a rate not to exceed 5,000 fpm. Once stabilized, the sequence will be repeated for a 7 second and a 1 second rapid decompression. The test article will then be returned to ground level and a physical inspection and functional check of the device will be performed.

### *2.3.6 Explosive Atmosphere*

This test will be performed to validate equipment will operate safely in a fuel-air explosive atmosphere without causing ignition, using MIL-STD-810G, Method 511.5, Procedure I, as guidance.

The test article will be placed in a chamber and exposed to an environment containing 3.8% volumetric fuel vapor, 8.33 air/vapor ratio (AVR) by weight, at 49±2°C (minimum required operational temperature for medical carry-on devices). The test article shall be turned on and off as many times as the test interval will allow. Test articles that take a long time to turn on or off shall be operated a minimum of three times by slowing the altitude decent rate to a suitable test interval or by repeating the test until three operating cycles have been completed.

The test will be conducted in an atmosphere equivalent to 10,000 ft and at ground level. No ignition must occur during this test.

### *2.3.7 Night Vision Devices*

Per memorandum for record, Supplemental Cockpit Lighting Check dated 25 January 2011, issued by the U.S. Army Night Vision Devices Branch, the operator is responsible to ensure that the light source does not interfere with the ability to see outside the aircraft. Cockpit lighting can interfere with the proper operation of Night Vision Devices (NVD) in several specific ways. If the reflection, glare, or stray light interferes with the NVD aided vision of any crewmember the light source is unacceptable. MIL-STD-3009 establishes requirements for the emission characteristics of aircraft lighting and display equipment that is intended for use with NVDs. The requirements in MIL-STD-3009 are applicable to all systems, subsystems, component equipment, and hardware that provide the lighting environment on aircraft where NVDs are employed.

Aeromedical equipment is not directly used in the cockpit. However, the crew compartment is in close proximity to the flight compartment on smaller air vehicles such as rotary-wing aircraft. Therefore, aeromedical equipment with displays; especially items that might potentially be used in tactical environments, will be tested to identify any interference characteristics with the NVDs. The test will provide a general assessment of the test article's potential signature with various NVDs. The procedure included in the following paragraph is the current implementation at the USAARL for basic characterization of the medical device for NVD compatibility. This test method is provided herein as an example and may be modified based on specific platform and service requirements.

The test article is placed in a darkened chamber and estimated simulated star light illumination is added with a small incandescent light source where the illumination is adjusted with a variable

aperture without changing the color temperature (night sky). An NVD with known image intensifier tube performance is used. The NVD is optically coupled to a miniature digital camcorder with an adaptor. Video or still images of the test article are taken with and without the image intensifier using a Class A minus blue filter over the objective lens of the intensifier system. The addition of the minus blue filter simulates the Aviator's Night Vision Imaging System (ANVIS) used by U.S. Army aircrew members.

### *2.3.8 Acceleration/Crash*

In general, aeromedical equipment with high mass, for example items which weigh more than 5 pounds, that may cause injury to personnel during emergency landings, ditching, and crash loads must be restrained to meet acceleration/crash criteria as listed in Table 7. The tests will verify whether test articles maintain their spatial position relative to the vehicle occupants under acceleration/crash loads. The methods utilized in the acceleration/crash test and evolutions are detailed in the paper titled "A New Process for the Acceleration Test and Evaluation of Aeromedical Equipment for US Air Force Safe-to-Fly-Certification" (Cicek, I. and Beisner, G.; 2010). The following paragraphs summarize the acceleration test process from this referenced publication.

MIL-STD-810, MIL-STD-209, and MIL-STD-1366 will be used for identifying test methods and procedures for acceleration/crash testing. MIL-STD-810G provides a description of acceleration testing in Method 513.6. MIL-STD-209 establishes interface standards for design and testing of lifting, tie-down, and cargo tie-down provisions.

Additional guidance from MIL-HDBK-1791 will be used. This guidance covers general design and performance requirements of military equipment for internal air transport in military prime mission cargo aircraft and the long range international segment of the Civil Reserve Air Fleet (CRAF). There will be a transportability analysis for the test articles that have structural interface with the aircraft. This analysis will ensure that the test article meets the dimensional, weight, floor loading and unloading limits of each transport aircraft. MIL-HDBK-1791 and cargo loading and unloading technical manuals for fixed-wing; MIL-STD-1366 for rotary-wing aircraft will be used as guidance for this analysis.

The acceleration test loads are identified for the joint platforms as shown in Table 7. The fixed-wing aircraft include the C-17, KC-10, KC-135, C-130E/H, C-130J, C-21 and C-27J. The rotary-wing aircraft includes H-60 and H-47. The tilt-rotor aircraft includes CV-22.

**Table 7 – Acceleration/Crash Load Restraint Criteria**

| Aircraft Type | Acceleration Levels | | | | |
|---|---|---|---|---|---|
| | **Forward (*g*)** | **Aft (*g*)** | **Up (*g*)** | **Down (*g*)** | **Lateral (*g*)** |
| **Fixed-wing** | 9 | 1.5 | 4 | 8 | 4 |
| **Rotary-wing** | 12 | 3 | 3 | 4 | 8 |
| **Tilt-rotor** | 9 | 3 | 3 | 6 | 3 |

For USAF aircraft, the acceleration test and evaluation process will also include the assessment of the tie-down method and procedures applied on the aircraft floor through the interfacing components IAW the aircraft's allowable limits, as applicable. Acceleration testing will be performed IAW airframe requirements if greater than the acceleration test loads in Table 7.

### *2.3.9 Blowing Sand*

This test will be performed using MIL-STD-810G, Method 510.5, Procedure II, as guidance. Prior to testing, a functional performance test will be conducted on the test article IAW the manufacturer's manual. The test article will be placed inside the chamber in its operational mode, powered by alternating current (AC) or battery. The EUT will be unprotected. The test article must not occupy more than 30 percent of the volume of the test chamber. Orientation will include the three most vulnerable sides of the test article, beginning with the side that includes the test article screen, display/control knobs, etc. Testing will be cycled by exposing the test article to three, 10-minute periods. Following each 10-minute exposure, the test article will be removed from the chamber, brushed off, functionally checked, returned to the chamber, and reoriented. Upon completion of the test, the test article will be removed from the test chamber and visually inspected. Abrasion, clogging effects, and any evidence of sand penetration will be noted. An operational performance check will then be conducted.

Sand should not penetrate in a quantity to interfere with the expected operation of the apparatus or to impair safety. In general, medical carry-on items are expected to function normally during and after this test. Any anomalies will be evaluated by SME who will compare the test results to expected functionality.

### *2.3.10 Blowing Dust*

This test will be performed using MIL-STD-810G Method 510.5, Procedure I, as guidance. Prior to testing, a functional performance test will be performed on the test article IAW the manufacturer's manual. The test article will be placed inside the chamber in its operational mode (powered by battery only). The EUT will be unprotected. The test article must not occupy more than 30 percent of the volume of the test chamber. Orientation will include the two most vulnerable sides of the test article beginning with the side that includes the test article screen display/control knobs, etc. The test article will be exposed for one, 10-minute period and one,

20-minute period. Following the 10-minute exposure, the test article will be removed from the chamber, brushed off, functionally checked, returned to the chamber, and reoriented for the

remaining 20 minutes of exposure. Upon completion of the test, the test article will be removed from the test chamber and inspected for dust penetration followed by an operational performance check.

Dust should not penetrate in a quantity to interfere with the expected operation of the apparatus or to impair safety. In general, medical carry-on items are expected to function normally during and after this test. Any anomalies will be evaluated by SME who will compare the test results to expected functionality.

### *2.3.11 Blowing Rain*

This test will be performed using MIL-STD-810G Method 506.5, Procedure I (Rain and Blowing Rain) as guidance. If available, a fresh test article which has not been exposed to blowing sand and blowing dust should be used. Prior to testing, a functional performance test will be conducted on the test article IAW the manufacturer's manual. The test article will be secured inside the chamber (or outdoor test fixture) in its operational mode (powered by battery only) while it is unprotected. Orientation will include the three most vulnerable sides of the test article beginning with the side which includes the test article screen display/control knobs, etc. The test article will be subjected to a rainfall rate of 2 inches of water per hour with a 40 mph wind velocity. Testing will be cycled by exposing the test article to three, 10-minute periods. Following each 10-minute exposure, the test article will be removed from the chamber, dried off, functionally checked, returned to the chamber, and reoriented. Upon completion of the test, the test article will be removed from the test chamber and inspected for water penetration followed by an operational performance check.

Rain should not penetrate in a quantity to interfere with the expected operation of the apparatus or to impair safety. In general, medical carry-on items are expected to function normally during and after this test. Any anomalies will be evaluated by SMEs who will compare the test results to expected functionality.

## 2.4 Phase III: In-Flight Assessment (IFA) (USAF) / Flight Testing (U.S. Army)

### *2.4.1 Fixed-wing (IFA)*

The test article will be evaluated during USAF evacuation training missions by aeromedical evacuation crewmembers to validate laboratory findings and assess human factors (human factors assessment additionally guided by MIL-STD-1472) during in-flight operation. Proper clinical function, placement, and aircraft interface (i.e., oxygen, electrical, and litter support systems) will be evaluated during the airborne assessment using AFI 10-2909 Aeromedical Evacuation Equipment Standards, AFI 11-2AE, Volume 3, AE Operations Procedures, and AFI 11-2AE, Volume 3, Addenda-A Aeromedical Evacuation Operations Configuration/Mission Planning.

Crewmember feedback will be solicited to address issues regarding equipment fit, form, function, as well as ensuring safe and effective clinical operation of equipment in the actual airborne environment. The IFA also includes checks to determine if the test article causes restrictions during patient loading and unloading, securing of aeromedical equipment, and an egress assessment.

Prior to the IFA, when applicable, the device must pass EMI, rapid decompression, acceleration, and explosive atmosphere tests. A memorandum from ASC/ENAC, indicating the test article can be flown without jeopardizing flight safety from EMI must be obtained. In addition, a memorandum from the Engineering Test and Prototype Lab at Warner-Robins ALC, GA, stating the test article will not cause combustion in a fuel-rich environment is required. Finally, an Interim STF Waiver must be obtained from the aircraft Systems Program Office (SPO) representing the aircraft that will host the IFA. A copy for each test article will be presented to the Medical Crew Director (MCD) during the mission crew brief. An additional copy of the Interim STF Waiver for each test article must be hand carried by the AE SME while conducting the IFA.

The details of the IFA, such as the date, location, and aircraft used, will be documented along with the IFA checklist and feedback captured from the AE crewmembers.

### *2.4.2 Rotary-wing (Flight Testing)*

The test article will be evaluated for fit, form, and function during actual aircraft flights by test personnel, medical personnel, and/or a qualified medical flight crew to validate laboratory findings and assess human factors associated with the test article using MIL-STD-1472 as guidance during in-flight operation as well as ensuring safe and effective clinical operation of equipment in the actual airborne environment. Prior to flight testing, the test article must receive a “test AWR” issued by AED, Redstone Arsenal, AL. Flight testing aboard a rotary-wing aircraft consists of two elements:

(a) Aircraft EMC:

- Qualitative EMC Checklist with the aircraft as the victim

(b) Performance and Susceptibility Assessments:

- Electromagnetic Susceptibility Assessment with the test article as the victim
- Ground Human Factors Assessment
    - Restrictions due to medical carry-on items during patient loading/unloading

- Securing of the test article
- Egress interference assessment

- Flight Human Factors Assessment
  - Assess the ability to recognize different audible and visual alarms.
  - Assess the operation of various control buttons
  - Ensuring adequate performance and sufficient patient intervention and quality of patient care in the rotary-wing environment
  - Evaluate the proper usage of nomex, cold weather, and chemical resistant butyl gloves
  - Evaluate the operation and screen legibility with normal and night vision cabin lights during night hours while aircraft is on the ground

## 2.5 Medical Risk Assessment

The objective of this assessment is to identify the safety concerns noted during laboratory tests using Army Field Manual (FM) 5-19, Composite Risk Management and MIL-STD-882D as guidance.

Safety concerns identified during laboratory tests will be evaluated by SME, laboratory test engineers, and clinicians, for potential risks to the patient, crew, or aircraft prior to requesting a fleet-wide AWR (U.S. Army) and STF approval letter (USAF). The risk assessment will categorize each safety concern and provide a suggested corrective action or risk mitigation. This risk assessment process is summarized in the following paragraphs:

### *2.5.1 Risk Severity*

Risk severity categories are defined to provide a qualitative measure of the worst credible event resulting from personnel error, environmental conditions, design inadequacies, procedural deficiencies, system or subsystem component failure, or malfunction as shown in Table 8.

**Table 8 – Risk Severity Categories**

| Description | Category | Definition |
|---|---|---|
| CATASTROPHIC | I | Death, system loss, or severe environmental damage |
| CRITICAL | II | Severe injury, severe occupational illness, major system or environmental damage |
| MARGINAL | III | Minor injury, minor occupational illness, or minor system or environmental damage |
| NEGLIGIBLE | IV | Less than minor injury, occupational illness, or less than minor system or environmental damage |

### *2.5.2 Risk Probability*

The probability that a risk will be created during the planned life expectancy of the system can be described in terms of potential occurrences per unit of time, events, population, items, or activity. The qualitative probability ranking is shown in Table 9.

**Table 9 – Risk Probability Levels**

| Description* | Level | Specific Individual Item | Fleet or Inventory** |
|---|---|---|---|
| FREQUENT | A | Occurs very often in service life | Occurs continuously |
| PROBABLE | B | Occurs several times in the life of item | Occurs frequently |
| OCCASIONAL | C | Occurs some time in service life of item | Occurs several times |
| REMOTE | D | Occurs in service life of the item, but only remotely possible | Occur as isolated incidents |
| IMPROBABLE | E | Occurrence not impossible, but not probable | Occurs vary rarely |

*Definitions of descriptive words may have to be modified based on quantity involved.
**The size of the fleet or inventory should be defined.

### *2.5.3 Risk Assessment*

Risk classification by severity and probability will be performed by using a mishap risk assessment matrix. This assessment allows SME to assign a risk assessment value for a potential risk based on estimated severity and its probability. A risk assessment value will be identified as in Table 10.

**Table 10 – Risk Assessment Values**

| Probability Levels | Severity Category | | | |
|---|---|---|---|---|
| | I Catastrophic | II Critical | III Marginal | IV Negligible |
| A Frequent | 1 | 3 | 7 | 13 |
| B Probable | 2 | 5 | 9 | 16 |
| C Occasional | 4 | 6 | 11 | 18 |
| D Remote | 8 | 10 | 14 | 19 |
| E Improbable | 12 | 15 | 17 | 20 |

The risk assessment values will be categorized as high, medium, or low risks as shown in Table 11. Army FM 5-19, Composite Risk Management, was used for categorization the risk assessment values.

**Table 11 – Risk Assessment Categories**

| Risk Assessment Value | Risk Category |
|---|---|
| **1 – 8** | **High*** |
| **9 – 13** | **Medium** |
| **14 – 20** | **Low** |
| *NOTE: "High" risk category includes "Serious" or "Extremely High" risks in this example. | |

The identified risks will be evaluated and identified as "warning," "caution," or "note," as described in MIL-STD-38784 and AFI 11-2AE, Volume 3, as follows:

"**Warning**" indicates operating procedures, techniques, etc., which could result in personal injury or loss of life if not carefully followed.

"**Caution**" indicates operating procedures, techniques, etc., which could result in damage to equipment if not carefully followed.

"**Note**" indicates operating procedures, techniques, etc., that are considered essential to emphasize.

### *2.5.4 Risk Mitigation*

The SME, when possible, will identify and recommend procedures or methods for controlling, reducing, or eliminating the risks. Residual risk is the potential risk remaining after the control measures have been implemented. Any high residual risk may require a test article modification or limitations listed in the AWR or recommendation letters submitted for approval. However, the SME may reject the test article for airworthiness or STF recommendation if the risk cannot be mitigated.

## 3. RECERTIFICATION

For aeromedical equipment having upgrades or modifications, the test article will be evaluated under configuration management and the testing agencies will determine the additional required tests.

## 4. DOCUMENT UPDATES

The JECETS document is intended to be a "living document" to be updated as new concepts, technologies, and methodologies evolve. Any approved changes will be formally implemented in the form of a "Change Notice" and will be reflected in the Document Change Log listed on page 2 of this document.

## 5. REFERENCED DOCUMENTS


1. AFI 10-2909, 19 May 2008, Operations, Aeromedical Evacuation Equipment Standards.
2. AFI 11-2AE, Volume 3, 18 May 2010, Aeromedical Evacuation (AE) Operations Procedures.
3. AFI 11-202, Volume 3, 22 October 2010, Flying Operations General Flight Rules.
4. ANSI/AAMI ES60601-1:2005 – Medical Electrical Equipment, Part 1: General Requirements for Basic Safety and Essential Performance.
5. Army Field Manual 5-19, Composite Risk Management, Department of the Army, July 2006.
6. Army Regulation 40-61, 28 January 2005, Medical Logistics Policies and Procedures.
7. Cicek, I. and Beisner, G.S. "A New Process for the Acceleration Test and Evaluation of Aeromedical Equipment for US Air Force Safe-to-Fly- Certification", Defense Acquisition Review Journal (ARJ), October 2010.
8. Memorandum for Record, U.S. Army Night Vision Devices Branch, Supplemental Cockpit Lighting Check, 25 January 2011, Fort Rucker, AL.
9. MIL-HDBK-310, 23 June 1997, Global Climatic Data for Developing Military Products.
10. MIL-HDBK-516B, 29 February 2008, Department of Defense Handbook, Airworthiness Certification Criteria.
11. MIL-HDBK-704, 9 April 2004, Department of Defense Handbook, Guidance for Test Procedures for Demonstration of Utilization Equipment Compliance to Aircraft Electrical Power Characteristics.
12. MIL-HDBK-1791(2), 14 February 1997, Department of Defense Handbook, Designing for Internal Aerial Delivery in Fixed-Wing Aircraft.
13. MIL-STD-130N, 17 December 2007, Identification Marking of U.S. Military Property.
14. MIL-STD-209K, 22 February 2005, Department of Defense Interface Standard for Lifting and Tie-down Provisions.
15. MIL-STD-461F, 10 December 2007, Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment, Department of Defense, Washington, D.C.
16. MIL-STD-464C, 1 December 2010, Electromagnetic Environmental Effects, Requirements for Systems, Department of Defense Interface Standard, MIL-STD-704F, Department of Defense Interface Standard, Aircraft Electric Power Characteristics.
17. MIL-STD-704F, 12 March 2004, Department of Defense Interface Standard, Aircraft Electric Power Characteristics.
18. MIL-STD-810G, 31 October 2008, Environmental Engineering Considerations and Laboratory Tests.
19. MIL-STD-882D, 10 February 2000, Standard Practice for System Safety, Department of Defense, Washington, D.C.
20. MIL-STD-1366E, 31 October 2006, Department of Defense Interface Standard for Transportability Criteria.

21. MIL-STD-1472F, 23 August 1999, Design Criteria Standard, Department of Defense, Washington, D.C.

22. MIL-STD-3009, 2 February 2001, Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatibility.

23. MIL-STD-38784, 2 July 1995, Standard Practice for Manuals, Technical: General Style and Format Requirements.

24. NFPA 99: Health Care Facilities Code, 2012 Edition.

## 6. SYMBOLS AND ACRONYMS

| | |
|---|---|
| AAMI | Association for the Advancement of Medical Instrumentation |
| AC | Alternating Current |
| ACM | Aeromedical Certification Memorandum |
| AE | Aeromedical Evacuation |
| AED | Aviation Engineering Directorate |
| AFB | Air Force Base |
| AFI | Air Force Instruction |
| AMRDEC | Aviation and Missile Research, Development, and Engineering Center |
| ANSI | American National Standards Institute |
| ANVIS | Aviator's Night Vision Imaging System |
| AR | Army Regulation |
| ASC | Aeronautical Systems Center |
| ATL | Aeromedical Test Laboratory |
| AVR | Air/Vapor Ratio |
| AWC | Airworthiness Certification |
| AWR | Airworthiness Release |
| °C | Degrees Celsius |
| CE | Conducted Emissions |
| CRAF | Civil Reserve Air Fleet |
| CS | Conducted Susceptibility |
| dB | Decibel |
| DoD | Department of Defense |
| EMC | Electromagnetic Compatibility |
| EMI | Electromagnetic Interference |
| FDA | Food and Drug Administration |
| FM | Field Manual |
| fpm | Feet Per Minute |
| ft | Feet |
| *g* | Gravity |
| GHz | Gigahertz |
| $G_{pk}$ | Gravity, Peak |

| | |
|---|---|
| $G_{rms}$ | Gravity, Root-Mean-Square Acceleration |
| $g^2/Hz$ | Gravity Squared per Hertz |
| hr | hour |
| Hz | Hertz |
| IAW | In Accordance With |
| IFA | In-Flight Assessment |
| JECETS | Join Enroute Care Equipment Test Standard |
| kHz | Kilohertz |
| MCD | Medical Crew Director |
| MEDEVAC | Medical Evacuation |
| MIL-HDBK | Military Handbook |
| MIL-STD | Military Standard |
| mph | miles per hour |
| NAVAIR | Naval Air Systems Command |
| NFPA | National Fire Protection Association |
| NVD | Night Vision Devices |
| Oct | Octave |
| PSD | Power Spectral Density |
| RAC | Risk Assessment Code |
| RE | Radiated Emissions |
| RH | Relative Humidity |
| RMS | Root Mean Square |
| RS | Radiated Susceptibility |
| RTTC | Redstone Technical Test Center |
| SME | Subject Matter Expert |
| SPO | Systems Program Office |
| STF | Safe-to-Fly |
| USAARL | United States Army Aeromedical Research Laboratory |
| USAF | United States Air Force |
| V/m | Volts per meter |
| WPAFB | Wright-Patterson Air Force Base |

# APPENDIX A, JECETS SUMMARY

| JECETS Summary and Traceability | | |
|---|---|---|
| **Test/Assessment Item** | **Guidance** | **JECETS Section** |
| Baseline Performance | Human Factors Assessment, MIL-STD-1472<br>Aircraft Interface Checks, Securing Procedures, Technical Data Package<br>Electrical Safety (ANSI/AAMI ES60601-1:2005)<br>Aircraft Electrical Interface: MIL-STD-704F<br>Battery Tests: 7 hours normal operation | 2.2 |
| Vibration | X, Y, and Z axis (three independent tests)<br>Rotary-wing (UH-1, H-60 and CH-47): 10 – 500 Hz, 2.56 $G_{rms,}$ 60 minutes<br>Jet (C-17, KC-10, KC-135, C-21, C-5): 15 – 2000 Hz, 4.02$G_{rms}$, 30 minutes<br>Turboprop (C-130E/H, C-130J): 15 – 2000 Hz, 5.29 $G_{rms}$, 60 minutes<br>Composite Wheeled Vehicle: 5 – 500 Hz, $G_{rms}$: 2.24 (Vertical), 1.48 (Transverse), and 1.90 (Longitudinal), 60 minutes | 2.3.1 |
| EMI (Emissions) | MIL-STD-461F, CE101 (Army Aircraft): Figure CE101-4<br>MIL-STD-461F, CE102 (All Applications): Figure CE102-1<br>MIL-STD-461F, RE102 (Helicopter and Fixed-Wing Limits): Figure RE102-3<br>Aircraft Chamber Testing (U.S. Army) | 2.3.2 |
| EMI (Susceptibility) | MIL-STD-461F, CS101 (All Applications): Figure CS101-1<br>MIL-STD-461F, CS114 (Aircraft External, All Applications), Figure CS114-1 (Curves 3 thresholding; Curve 5 no thresholding)<br>MIL-STD-461F, CS115 (All Applications): Figure CS115-1<br>MIL-STD-461F, CS116 (All Applications): Figure CS116-2<br>MIL-STD-461F, RS103: 2 MHz – 18 GHz, 20 and 60 V/m (thresholding); 200 V/m (no thresholding) | 2.3.2 |
| Climatic Tests | High Temp, Tactical-Standby to Operation: MIL-STD-810G, Method 501.5, three consecutive tests at 49 ± 2°C; 54.4 and 60°C, <20% RH 6 hours<br>Humidity: MIL-STD-810G, Method 507.5, 95 ± 2% RH and 29.5°C. After stowage, ramp chamber to 88% and 41°C. Total duration = 7 hours<br>Low Temp, Operational and Mission-Ready Storage: MIL-STD-810G, Method 502.5, three consecutive tests at 0°C, -13°C ± 2°C, and -26°C ± 2°C<br>Battery Life Extreme Temp: Repeat tests with battery operation at the most extreme temperatures where the test article passed (both hot/cold) | 2.3.3 |
| Low Pressure (Altitude) | MIL-STD-810G, Method 500.5, Procedure II<br>Ascend to 2,000, 4,000, 6,000 8,000, 10,000 12,500, 15,000, and 18,000 ft.<br>Dwell time: Minimum of 5 minutes at each level<br>Ascend/descend rate: not to exceed 5,000 fpm | 2.3.4 |
| Rapid Decompression (RD) | MIL-STD-810G, Method 500.5, Procedure III<br>Ascend to 8,000 ft, then decompress to 45,000 ft in 60, 7, and 1 seconds | 2.3.5 |
| Explosive Atmosphere | MIL-STD-810G, Method 511.5. Exposure to 3.8% volumetric fuel vapor (8.33 AVR by weight) at 49°C. Conducted in an atmosphere equivalent to 10,000 ft and at ground level. | 2.3.6 |
| Night Vision Devices | Perform compatibility and safety assessment | 2.3.7 |
| Acceleration/Crash | MIL-STD-1366E, MIL-STD-810G, Method 513.6, and applicable portions of MIL-STD-209K and MIL-HDBK-1791<br>Fixed-Wing: Fwd: 9g, Aft: 1.5g, Lateral: 4g, Down: 8g, Up: 4g<br>Rotary-Wing: Fwd: 12g; Aft: 3g; Up: 3g; Down: 4g; Lateral: 8g<br>Tilt-Rotor: Fwd: 9g; Aft: 3g; Up: 3g; Down: 6g; Lateral: 3g | 2.3.8 |
| Blowing Sand | MIL-STD-810G, Method 510.5, Procedure II, Duration: 30 minutes | 2.3.9 |
| Blowing Dust | MIL-STD-810G, Method 510.5, Procedure I, Duration: 30 minutes | 2.3.10 |
| Rain and Blowing Rain | MIL-STD-810G, Method 506.5, Procedure I, Rainfall rate: 2 inches of water per hour with a 40 mph wind velocity. Duration: 30 minutes | 2.3.11 |
| USAF In-Flight Assessment | Form, fit, and function checks (fixed-wing)<br>Device must pass EMI, RD, acceleration, and explosive atmosphere tests prior to the IFA.<br>Aeromedical evacuation mission (AFI 10-2909)<br>Human factors assessment additionally guided by MIL-STD-1472 | 2.4.1 |
| U.S. Army Flight Tests | EMC checklist<br>Form, fit, and function checks (rotary-wing)<br>Human factors assessment additionally guided by MIL-STD-1472 | 2.4.2 |
| Medical Risk Assessment | MIL-STD-882D and Army FM 5-19 will be used as guidance | 2.5 |