AERONAUTICAL DESIGN STANDARD

STANDARD PRACTICE

ENVIRONMENTAL AIRWORTHINESS AND QUALIFICATION REQUIREMENTS FOR ELECTRONICS, AVIONICS, AND MISSION EQUIPMENT INSTALLED ON ARMY AIRCRAFT

AMSC N/A

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ENVIRONMENTAL AIRWORTHINESS AND QUALIFICATION REQUIREMENTS FOR ELECTRONICS, AVIONICS, AND MISSION EQUIPMENT INSTALLED ON ARMY AIRCRAFT

FUNCTIONAL DIVISION

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ADS-71-SP, STANDARD PRACTICE FOR ENVIRONMENTAL AIRWORTHINESS AND QUALIFICATION REQUIREMENTS FOR ELECTRONICS, AVIONICS, AND MISSION EQUIPMENT INSTALLED ON ARMY AIRCRAFT

Rationale for Certification:

Decision:

General Type	Decision (√)	Certification
Specification		Performance
		Detail
Standard		Interface Standard
	√	Standard Practice
		Design Standard
		Test Method Standard
		Process Standard
Handbook		Handbook (non-mandatory use)
Alternative Action		

	Concur	Non-concur	Date
Division Chief, Mission Equipment Division Frederick Reed	✓		7/24/09
AMCOM Standardization Branch Chief William J. Smith	✓		9/29/09
Director, Aviation Engineering Dr. William Lewis	✓		9/11/09

FOREWORD

1. This standard is approved for use by all Departments and Agencies of the Department of Defense (DoD).

2. This Aeronautical Design Standard (ADS) establishes the requirements and verification processes through which airworthiness and environmental qualification of avionics, electronics, or other related mission equipment is accomplished.

3. Comments, suggestions, or questions on this should be addressed to the Aviation Engineering Directorate (AED), Mission Equipment Division (MED), Electronics Branch, Environmental Team, Bldg. 4488, Redstone Arsenal, Huntsville, AL. 35898-5000

Table of Contents

1 **SCOPE.** This Aeronautical Design Standard (ADS) applies to all new and/or modified avionics, electronics, and mission equipment installed or affiliated with Army aircraft and contains the environmental test requirements for satisfying the various phases of airworthiness from Safety of Flight (SOF) through full qualification.

1.1 **General.** The operational requirements for Army aircraft components ultimately originate from the User who specifies the performance criteria. Frequently included in these performance criteria is the ability of the component to operate within its design specifications under specific induced and natural environments. For optimum results, a Life Cycle Environmental Profile (LCEP) should be generated by the combat/materiel developer to define the most extreme environmental stressors or combination of environmental stressors that a component will be exposed to during its service life. The LCEP supports the User specified performance criteria thereby influencing the design and test phases of the component developmental process. MIL-STD-810, Task 402 (Life Cycle Environmental Profile (LCEP)) explains this process in detail. After the engineering design phase of the component LCEP has been completed, the component is subjected to specific environmental testing to verify the design satisfies the intended performance and airworthiness/qualification requirements as defined in AR-70-62. The primary goal of this ADS is the definition of environmental requirements. Among qualification methodologies, the preferred is testing, but other methods such as similarity or analysis are also accepted.

1.2 **Purpose.** This ADS establishes the requirements and verification processes through which airworthiness and environmental qualification of avionics, electronics, or other related mission equipment is accomplished.

2 APPLICABLE DOCUMENTS

2.1 **General.** The documents listed in this section are specified in sections 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this standard.

2.2 Government Documents

2.2.1 **Specifications, Standards and Handbooks.** The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

MIL-STD-810	Test Method Standard, Environmental Engineering Considerations and Laboratory Tests
MIL-PRF-28800	General Specification for Test Equipment for Use with Electrical and Electronic Equipment

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/.)

2.2.2 Other Government Documents, Drawings, and Publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AR70-62	Airworthiness Qualification of U.S. Army Aircraft Systems.
ADS-27-SP	Aeronautical Design Standard, Requirements for Rotorcraft Vibration Specifications, Modeling and Testing

(Copies of these documents are available online at http://www.redstone.army.mil/amrdec/sepd/tdmd/StandardAero.htm or http://www.apd.army.mil/USAPA_PUB_pubrange_P.asp

2.3 Non-Government Publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

RTCA/DO-160	Environmental Conditions and Test Procedures for Airborne Equipment

(Copies of this document are available online at: http://www.rtca.org.)

2.4 Order of Precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3 DEFINITIONS

3.1 Equipment Classifications.

3.1.1 Flight Critical Equipment. Generated anomalies involving this equipment would cause immediate or almost immediate loss of aircraft control or unsafe situations with loss of life a likely occurrence.

3.1.2 Flight Essential Equipment. Generated anomalies involving this equipment could cause an emergency landing with possible damage to the aircraft, or would cause the pilot to take other emergency action. Injury or loss of life is possible.

3.1.3 Safety Critical Equipment. Generated anomalies involving this equipment would cause a safety hazard to personnel or to the aircraft.

3.2 General.

3.2.1 Full Qualification. Full Qualification is defined as formal compliance with this ADS and other technical specifications cited in the contract. Equipment will be considered fully qualified when it has successfully demonstrated compliance to all formal qualification test requirements. Refer to Section 5.3 for Full Qualification Test Requirements.

3.2.2 Fielding. In this ADS, Fielding is defined as a number of aircraft fielded for a period of time designated to fulfill a specific mission in the field. A fielding Airworthiness Release (AWR) is valid for the mission duration and is terminated upon transfer of the designated aircraft, changes in equipment configuration, or upon issuance of a later AWR, whichever occurs first. Refer to Section 5.2 for Fielding Test Requirements.

3.2.3 Multi-Platform. Multi-platform is defined as equipment that is planned or has the potential for use on more than one specific type/model U.S. Army aircraft.

3.2.4 Platform Specific. Platform specific is defined as equipment planned for use on one (1) specific type/model U.S. Army aircraft platform.

3.2.5 Safety of Flight (SOF). In this ADS, Safety of Flight is defined as the first flight, limited experimental test flights, User evaluations, or ferrying flights for the purpose of gathering system data, verifying system operation of newly designed or modified equipment, or moving an aircraft from one location to another. A SOF AWR is valid until the date identified on the specific AWR and is terminated upon transfer of the subject helicopters, changes in equipment configuration, or upon issuance of a later AWR, whichever occurs first. Refer to Section 5.1 for SOF Test Requirements.

3.3 Acronyms/Abbreviations

°C	Degrees Celsius
°F	Degrees Fahrenheit
ADS	Aeronautical Design Standard
AED	Aviation Engineering Directorate
AWR	Airworthiness Release
EEMP	Environmental Engineering Management Plan
FAA	Federal Aviation Administration
FCP	Functional Check Procedure
g	Acceleration due to gravity
Hz	Unit of frequency
IAW	In Accordance With
In Hg	Inches of Mercury

kPa	Kilopascal
LCEP	Life Cycle Environmental Profile
LRU	Line Replaceable Unit
MED	Mission Equipment Division
OED	Operational Environment Documentation
RH	Relative Humidity
RTCA	Radio Technical Commission for Aeronautics
SOF	Safety of Flight
SRS	Shock Response Spectrum
UAS	Unmanned Aircraft System
UUT	Unit Under Test

4 GENERAL REQUIREMENTS. Environmental testing shall be in accordance with the test methodologies, procedures, and requirements as set forth in MIL-STD-810. Equipment which has had previous test approvals in meeting commercial or other airworthiness qualification programs may be accepted for Army approval to the extent that their individual test requirements and methods satisfies the environmental technical requirements as set forth in this ADS. For general laboratory test method guidelines, see Appendix A.

4.1 Selection of Tests. Normally, specific and comprehensive environmental requirements should be identified by the User community (combat/materiel developer) at the beginning of the acquisition process from which LCEP(s), Environmental Engineering Management Plans (EEMP(s), Operational Environmental Documents (OED(s), approved Aircraft Specifications, etc., are generated. However, if environmental requirements are not clearly specified from these sources, the basic test requirements as contained in this ADS shall apply. Test requirements shall be tailored depending on specific mission requirements.

4.2 Sequence of Tests. If a specific test sequence has not been specifically identified by the procuring office or agency, the test order as identified in MIL-STD-810 shall be applied. It is highly recommended that for conducting the explosive atmosphere test, vibration, shock, and temperature tests be conducted on the same unit prior to the Explosive Atmosphere test.

4.3 Temperature/Altitude Test Requirements

4.3.1 Platform Specific Requirements. Unless platform specific environmental test requirements have been specified in a government approved requirements document for US Army aircraft, the temperature/altitude requirements in **TABLE I** shall apply.

4.3.2 Multi-Platform Requirements. The temperature/altitude requirements in **TABLE I** shall apply to multi-platform components and represent the most extreme environmental conditions cited in aircraft specifications across platforms.

TABLE I.
Temperature/Altitude Test Parameters

Low Temperature – Storage (Non-Operational)	-62°C (-80°F)
Low Temperature Operational	-54°C (-65°F)
High Temperature Operational	+71°C (+160°F)
High Temperature – Storage (Non-Operational)	+85°C (+185°F)
Low Pressure (Altitude) – Storage/ Air Transport	15,240m (50,000 ft)
Altitude Operational	6,096m (20,000 ft)

4.4 Equipment Verification Criteria. Aircraft equipment may satisfy environmental requirements by one or a combination of any of the following verification methods:

4.4.1 Test. Verification by test is the standard and most accurate method of verification. Testing often proves to be the quickest and least expensive of the verification methods.

4.4.2 Analysis. Verification by analysis will be accepted whenever perceived to be feasible by the procuring agency.

4.4.3 Similarity. Verification by similarity shall include the appropriate data on the verified component to which similarity is being claimed. The similarity argument shall detail the similarity rationale based on the data described below. The minimum data requirements and rules for similarity are as follows:

a. The two components being compared to each other shall be operated in similar environments with similar performance and duty cycle requirements. Significant differences in operating environments shall be discussed and rationale for similarity provided.

b. Test results shall verify that the component to which similarity is being claimed shall have passed tests that are the same or more stringent than the test requirements being substantiated. Differences in test environment, criteria, or method shall be clearly delineated. If test failures occurred during verification, such shall be properly documented, including corrective action and successful retest.

c. The component to be verified shall be similar to the previously verified component. Similarity statements shall provide a detailed accounting of all differences between the two components. Detailed substantiating data shall also be required to be provided in the form of similarity arguments, similarity rationale, detailed comparative diagrams (photos, sketches), etc., that clearly depict every aspect (on a part-to-part basis) of the equipment to be verified and compares the same with the existing verified component. Any aspect of the two components that is not identical (regardless of perceived insignificance) shall be disclosed with accompanying rationale provided to show how each non-identical aspect affects qualification. Differences in manufacturing processes, cleaning methods, protective coating methods, materials, etc., shall also be identified as non-identical aspects.

5 DETAILED REQUIREMENTS

5.1 Environmental Test Requirements for a SOF Airworthiness Release (AWR). TABLE II, in conjunction with the detailed test requirements herein, provides the standard testing that shall be conducted prior to obtaining a SOF AWR.

TABLE II.
Environmental Test Requirements for a SOF AWR

Test Requirement	MIL-STD-810	Remarks
Low Pressure – Altitude	Test Method 520.3, Procedure III	Note 1, 2

Test Requirement	MIL-STD-810	Remarks
(Operational)		
High Temperature (Operational)	Test Method 520.3, Procedure III	Note 1, 2
Low Temperature (Operational)	Test Method 520.3, Procedure III	Note 1, 2
Explosive Atmosphere	Test Method 511.5, Procedure I	
Vibration	Test Method 514.6	Note 3
Shock - Crash Hazard	Test Method 516.6, Procedure V	Note 2, 4
Gunfire Shock	Restricted	See detailed requirements

Note 1: This requirement may also be satisfied by conducting Procedure II of the individual MIL-STD-810 Test Methods 500.5, 501.5 or 502.5 for altitude, high, low temperatures respectively. The combined test may be tailored to a Temperature/Altitude/Humidity or a Temperature/Altitude test (Temp/Alt - for SOF purposes only). A minimum of three (3) cycles shall be conducted.

Note 2: Federal Aviation Administration (FAA) Radio Technical Commission for Aeronautics (RTCA), DO-160 test data may be used to satisfy this requirement to the extent that it meets the requirements of MIL-STD-810.

Note 3: Vibration requirements may also be satisfied by methods described in ADS-27-SP. Vibration testing may be tailored or omitted depending on the flight safety implications of the particular installation or modification.

Note 4: This test is not applicable to materiel worn or attached to the crew.

5.1.1 SOF - Detailed Test Requirements

5.1.1.1 SOF - Low Pressure (Altitude) – Operational. A low pressure (altitude) operational test should be conducted In Accordance With (IAW) MIL-STD-810, Test Method 520.3, Procedure III. The combined Temperature/Humidity/Vibration/Altitude test is the recommended method to meet the SOF AWR Altitude requirements although tailoring is permissible. This test should be conducted to satisfy the aircraft Altitude requirement.

5.1.1.2 SOF - Low Temperature – Operational. A low temperature operational test should be conducted IAW MIL-STD-810, Test Method 520.3, Procedure III. The combined Temperature/Humidity/Vibration/Altitude test is the recommended method to meet the SOF AWR low temperature requirements and tailoring of the combined test is permitted per the guidance of this ADS.

5.1.1.3 SOF - High Temperature – Operational. A high temperature operational test should be conducted IAW MIL-STD-810, Test Method 520.3, Procedure III. The combined Temperature/Humidity/Vibration/Altitude test is the recommended method to meet the SOF

AWR high temperature requirements and tailoring of the combined test is permitted per the guidance of this ADS.

5.1.1.4 SOF - Explosive Atmosphere. An explosive atmosphere test shall be conducted IAW MIL-STD-810, Test Method 511.5, Procedure I to determine the ability of equipment to either operate in fuel-air explosive atmospheres without causing ignition and/or Procedure II for verifying containment of an explosive or burning reaction of encased equipment (e.g., batteries, etc.). It is recommended that vibration and temperature testing be conducted prior to the test and on the same unit. Components shall function at their maximum input voltage and operated at their maximum loads. Each functional mode shall be tested at each test altitude. All contacts, (especially power), shall be exercised as frequently as practical during the test.

5.1.1.5 SOF - Vibration. A Vibration test shall be conducted IAW either MIL-STD-810, Test Method 514.6 or ADS-27-SP. Depending on the safety implications of potential equipment failure due to vibration, this test may be tailored, omitted, or the equipment restricted from use.

5.1.1.6 SOF - Shock – Crash Hazard. A crash hazard test shall be conducted IAW MIL-STD-810, Test Method 516.6, Procedure V, to reveal mounting and structural weaknesses of equipment which can cause ejection of components (or their sub-elements) presenting a hazard to personnel (or other equipment impacting aircraft crashworthiness) during or after a crash sequence. In general, this test shall be applicable to all aircraft components installed in the following locations and/or meeting the criteria below:

- Equipment located in cockpit and cabin areas (which may become a hazard to personnel)
- Equipment containing displays or LED(s) which may break into fragments
- Equipment located in the aircraft where components (or their sub-elements) could become projectiles and enter an engine or fuel tank (reducing the crashworthiness of the aircraft)
- Equipment located in the aircraft where components (or their sub-elements) could become projectiles and possibly block aircrew/passenger egress or rescue personnel ingress

Whenever this test also evaluates the possibility of ejected sub-elements of a component, the use of a mock up or dummy shall be prohibited; however, the use of an equivalent component is acceptable.

If measured data is not available the test should utilize the waveform based on the SRS. If shock response spectrum analysis capabilities are not available, the classical terminal peak sawtooth pulse may be substituted. If testing has already been conducted, any of the classical waveforms will be accepted.

5.1.1.7 SOF - Gunfire Shock. In general, gunfire shall be restricted for a SOF release. In the event gunfire is needed in a test, the requirement for component testing will be evaluated on a case-by-case basis.

5.2 Environmental Test Requirements for a Fielding AWR. TABLE III, in conjunction with the detailed test requirements contained herein, provides the standard environmental test requirements that shall be conducted prior to obtaining a Fielding AWR.

Note: Flight Critical, Flight Essential, or Safety Critical equipment shall be fully qualified.

TABLE III.
Environmental Test Requirements for a Fielding AWR

Test Requirement	MIL-STD-810	Remarks
Low Pressure (Altitude) – Storage/ Air Transport	Test Method 500.5, Procedure I	Note 1
High Temperature – Storage (Non-Operational)	Test Method 501.5, Procedure I	
Low Temperature – Storage (Non-Operational)	Test Method 502.5, Procedure I	Note 1
Rain	Test Method 506.5, Procedure I or III	
Blowing Sand and Dust	Test Method 510.5, Procedure I and II	
Explosive Atmosphere	Test Method 511.5, Procedure I	
Vibration	Test Method 514.6	Note 2
Shock – Functional	Test Method 516.6, Procedure I	
Shock – Crash Hazard	Test Method 516.6, Procedure V	Note 3
Gunfire Shock	Test Method 519.6	
Temperature/Humidity/Vibration/Altitude	Test Method 520.3, Procedure III	Note 4

Note 1: This test may be tailored into the combined environments test provided the full test ranges and requirements of the individual test are incorporated. If tailored into the combined test, it shall be incorporated at the beginning of the first cycle only, prior to the operational low temperature soak.

Note 2: Vibration requirements may also be satisfied by methods described in ADS-27-SP. Vibration testing may be tailored or omitted depending on the flight safety implications of the particular installation or modification.

Note 3: This test is not applicable for materiel attached to or worn by the crew.

Note 4: Provided a separate Vibration test is conducted, the test may be tailored to a Temperature/Altitude/Humidity test which will be the maximum tailoring allowed.

5.2.1 Fielding - Detailed Test Requirements.

5.2.1.1 Fielding - Low Pressure (Altitude) – Storage/ Air Transport. A low pressure (altitude) non-operational test shall be conducted IAW MIL-STD-810, Test Method 500.5, Procedure I. This test may be tailored into Test Method 520.3, Procedure III.

5.2.1.2 Fielding - High Temperature – Storage (Non-Operational). A high temperature non-operational/storage test shall be conducted IAW MIL-STD-810, individual Test Method 501.5, Procedure I. The diurnal cycle, per Table 501.5-III of MIL-STD-810, shall apply for aircraft with non-operational temperature requirements of +71°C per aircraft specification. If the maximum non-operational temperature requirement for a component has not been specified by a government approved requirements document for US Army aircraft, the diurnal cycle as depicted in TABLE IV shall apply. A minimum of 7 cycles shall be conducted.

TABLE IV.
High Temperature – Storage (Non-Operational) (+85°C) Diurnal Cycle

Time of Day	Temperature °C	Temperature °F	Time of Day	Temperature °C	Temperature °F	Time of Day	Temperature °C	Temperature °F
0100	36	96	0900	48	118	1700	80	175
0200	34	94	1000	58	136	1800	74	165
0300	34	94	1100	64	148	1900	63	146
0400	33	91	1200	74	165	2000	54	128
0500	33	91	1300	82	180	2100	44	111
0600	33	91	1400	84	183	2200	41	106
0700	37	99	1500	85	185	2300	38	101
0800	43	109	1600	84	183	2400	36	96

5.2.1.3 Fielding - Low Temperature – Storage (Non-Operational). A low temperature non-operational test shall be conducted IAW MIL-STD-810, Test Method 502.5, Procedure I. This test may be tailored into Test Method 520.3, Procedure III. Test durations for various component materials shall be IAW the criteria specified in MIL-STD 810.

5.2.1.4 Fielding - Rain. Rain testing shall be conducted IAW the requirements of MIL-STD-810 for aircraft equipment which may be exposed to rain, water spray or dripping water.

5.2.1.4.1 Fielding - Blowing Rain. A blowing rain test shall be conducted IAW MIL-STD-810, Test Method 506.5, Procedure I, for all equipment designed to be located external to the

aircraft (including partially or intermittently exposed internal components) and which will be unprotected from rain or blowing rain.

5.2.1.4.2 Fielding - Dripping Rain. A dripping rain test shall be conducted IAW MIL-STD-810, Test Method 506.5, Procedure III for all internal aircraft equipment normally protected from blowing rain but which may be exposed to falling water from condensation or leakage from upper surfaces.

5.2.1.5 Fielding - Sand and Dust. A sand and dust test shall be conducted IAW MIL-STD-810, Test Method 510.5, (Procedures II and I respectively) to verify the ability of equipment to be able to be stored and operated under blowing sand conditions and to withstand the effects of dust that may obstruct openings, penetrate into cracks, crevices, bearings and joints.

5.2.1.6 Fielding - Explosive Atmosphere. An explosive atmosphere test shall be conducted IAW MIL-STD-810, Test Method 511.5, Procedure I to determine the ability of equipment to either operate in fuel-air explosive atmospheres without causing ignition and/or Procedure II to verify containment of an explosive or burning reaction of encased equipment. It is recommended that vibration, shock, and temperature testing be conducted prior to this test and on the same unit. Components shall function at their maximum input voltage, operated at their maximum loads, and each functional mode shall be tested at each test altitude. All contacts, especially power, shall be exercised as frequently as practical during the test.

5.2.1.7 Fielding - Vibration. A Vibration test shall be conducted IAW either MIL-STD-810, Test Method 514.6 or ADS-27-SP. These methods allow for tailoring to account for specific service life duration. In the event tailoring is desired, a specific service life must be indentified for a Fielding AWR.

5.2.1.8 Fielding - Shock – Functional. A functional shock test shall be conducted IAW MIL-STD-810, Test Method 516.6, Procedure I to verify that equipment shall meet all of its performance requirements during and after exposure to aircraft operational shocks. If measured data is not available, the test shall utilize the waveform based on the SRS. If shock spectrum analysis capabilities are not available, the classical terminal peak sawtooth pulse may be used as a substitute. The equipment shall be operational before, during, and after the test.

5.2.1.9 Fielding - Shock – Crash Hazard. A crash hazard test shall be conducted IAW MIL-STD-810, Test Method 516.6, Procedure V, to reveal mounting and structural weaknesses of equipment which may cause ejection of components (or their associated sub-elements) and can present a hazard to personnel or other equipment impacting crashworthiness during or after a crash sequence. In general, this test shall be applicable to all aircraft components installed in the following locations and/or meeting the criteria below:

- Equipment located in cockpit and cabin areas (which may be a hazard to personnel)
- Equipment containing displays or LED(s) which may break into fragments
- Equipment located in the aircraft where components or parts thereof could become projectiles and enter an engine or fuel tank (reducing the crashworthiness of the aircraft)

- Equipment located in the aircraft where components or their sub-elements could become projectiles and possibly block aircrew/passenger egress or rescue personnel ingress

Whenever this test also evaluates the possibility of ejected sub-elements of a component, the use of a mock-up or dummy shall be prohibited, however the use of an equivalent component is acceptable.

If measured data is not available, the test shall utilize the waveform based on the SRS. If shock spectrum analysis capabilities are not available, the classical terminal peak sawtooth pulse may be used as a substitute.

5.2.1.10 Fielding - Gunfire Shock. A gunfire test shall be conducted IAW MIL-STD-810, Test Method 519.6. This test may be omitted if gunfire is restricted or not applicable.

5.2.1.11 Fielding - Combined Temperature, Humidity, Vibration, and Altitude. A temperature, humidity, vibration, and altitude test shall be conducted IAW of MIL-STD-810, Test Method 520.3, Procedure III. This test shall be used to primarily satisfy the operational requirements for temperature and altitude. A minimum of 10 cycles shall be conducted.

5.3 Environmental Test Requirements for Full Qualification. TABLE V, in conjunction with the detailed test requirements contained herein shall provide the standard full qualification test requirements. Externally mounted antenna test requirements shall be as cited in Appendix B. Test equipment environmental requirements shall be as cited in Appendix C.

TABLE V.
Environmental Test Requirements for Full Qualification

Test Requirement	MIL-STD-810	Remarks
Low Pressure (Altitude) – Storage/ Air Transport	Test Method 500.5, Procedure I	Note 1
Low Pressure (Altitude) – Rapid Decompression	Test Method 500.5, Procedure III	Aircraft with pressurized cabins
High Temperature – Storage (Non-Operational)	Test Method 501.5, Procedure I	
Low Temperature – Storage (Non-Operational)	Test Method 502.5, Procedure I	Note 1
Temperature Shock	Test Method 503.5, Procedure I-C	High/Low Non-Operating temperatures (3 cycles minimum)
Contamination by Fluids	Test Method 504.1	
Solar Radiation (Sunshine)	Test Method 505.5, Procedure I or II	External or internal solar sensitive components.
Rain	Test Method 506.5, Procedure I or III	
Humidity	Test Method 507.5, Procedure II	Note 2

Test Requirement	MIL-STD-810	Remarks
Fungus	Test Method 508.6	84 day exposure (Minimum – 28 days).
Salt Fog	Test Method 509.5	Minimum of four 24 hr alternating wet/dry cycles.
Sand & Dust	Test Method 510.5, Procedure I and II	Procedure II – Minimum velocity for internal equipment
Explosive Atmosphere	Test Method 511.5, Procedure I and/or II	Procedure II (Containment)
Immersion	Test Method 512.5, Procedure I and/or II	
Acceleration	Test Method 513.6, Procedure I and/or II	
Vibration	Test Method 514.6 or IAW ADS-27-SP	
Shock	Test Method 516.6, Procedure I, IV, V, VI	Note 3
Gunfire Shock	Test Method 519.6	
Temperature/Altitude/Humidity/ Vibration	Test Method 520.3, Procedure III	Note 4
Icing/Freezing Rain	Test Method 521.3	

Note 1: This test may be tailored into Test Method 520.3 provided all requirements and the full test ranges of the individual test are incorporated. If tailored into the combined test, it shall be incorporated at the beginning of the first cycle only, prior to the operational low temperature soak.

Note 2: The Humidity component of the combined Test Method 520.3 (Temperature, Altitude, Humidity, Vibration) is only one component of a synergistic test specifically designed to simulate airborne operational environments, therefore the test was not designed to substitute for individual Test Method 507.5 which is primarily designed to test materiel deployed in warm, humid ground/storage conditions.

Note 3: Procedure I (Functional Shock) and Procedure V (Crash Hazard) are not generally applicable to materiel worn or attached to the crew. In addition, for both Procedures, unless measured data is available, the SRS spectrum should be utilized. However, if shock spectrum analysis capabilities are not available, the classical terminal peak sawtooth pulse may be used as an alternative.

Note 4: Provided a separate Vibration test is conducted, the test may be tailored to a Temperature/Altitude/Humidity test which will be the maximum tailoring allowed.

5.3.1 Full Qualification Detailed Test Requirements

5.3.1.1 Low Pressure (Altitude). Low pressure (altitude) testing shall be conducted IAW the requirements of MIL-STD-810 to determine if aircraft equipment during operation and storage can withstand and/or operate in a low pressure environment and/or withstand rapid pressure changes without affecting equipment safety, integrity, or performance.

5.3.1.1.1 Low Pressure (Altitude) Operational. The low pressure (altitude) operational requirement shall be met by conducting the combined Temperature, Humidity, Vibration, and Altitude test IAW MIL-STD-810, Test Method 520.3, Procedure III.

5.3.1.1.2 Low Pressure (Altitude) – Storage/ Air Transport. The low pressure (altitude) non-operational test shall be conducted IAW MIL-STD-810, Test Method 500.5, Procedure I (also see Note 1). The minimum exposure shall be 1 hour.

5.3.1.1.3 Low Pressure (Altitude) – Rapid Decompression. For pressurized aircraft, a low pressure (altitude) – rapid decompression test shall be conducted IAW MIL-STD-810, Test Method 500.5, Procedure III to verify that rapid pressure changes on equipment components shall not affect equipment safety, integrity, or performance.

5.3.1.2 High Temperature. High temperature testing shall be conducted IAW the requirements of MIL-STD-810 to determine if aircraft equipment during operation and storage can withstand and/or operate in a high temperature environment without affecting equipment safety, integrity or performance.

5.3.1.2.1 High Temperature Operational. The high temperature operational requirements shall be met by conducting the combined Temperature, Humidity, Vibration, and Altitude test IAW MIL-STD-810, Test Method 520.3, Procedure III.

5.3.1.2.2 High Temperature – Storage (Non-Operational). A high temperature storage test shall be conducted IAW MIL-STD-810, Test Method 501.5, Procedure I, to verify that high temperature non-operational/storage conditions shall not affect equipment safety, integrity, or performance. The diurnal cycle, per Table 501.5-III of MIL-STD-810, shall apply for aircraft non-operational temperature requirements of +71°C per aircraft specification. If the maximum non-operational temperature requirement for a component has not been specified by a government approved requirements document for US Army aircraft, the diurnal cycle as depicted in

TABLE VI shall apply. A minimum of 7 cycles shall be conducted.

TABLE VI.
High Temperature – Storage (Non-Operational) (+85°C) Diurnal Cycle

Time of Day	Temperature °C	Temperature °F	Time of Day	Temperature °C	Temperature °F	Time of Day	Temperature °C	Temperature °F
0100	36	96	0900	48	118	1700	80	175
0200	34	94	1000	58	136	1800	74	165

Time of Day	Temperature °C	°F	Time of Day	Temperature °C	°F	Time of Day	Temperature °C	°F
0300	34	94	1100	64	148	1900	63	146
0400	33	91	1200	74	165	2000	54	128
0500	33	91	1300	82	180	2100	44	111
0600	33	91	1400	84	183	2200	41	106
0700	37	99	1500	85	185	2300	38	101
0800	43	109	1600	84	183	2400	36	96

5.3.1.3 Low Temperature. Low Temperature testing shall be conducted IAW the requirements of MIL-STD-810 to determine if aircraft equipment during operation and storage can withstand and/or operate in a low temperature environment without affecting equipment safety, integrity or performance.

5.3.1.3.1 Low Temperature Operational. The low temperature operational requirements shall be met by conducting the combined Temperature, Humidity, Vibration, and Altitude test IAW MIL-STD-810, Test Method 520.3, Procedure III.

5.3.1.3.2 Low Temperature – Storage (Non-Operational). A low temperature non-operational test shall be conducted IAW MIL-STD-810, Test Method 502.5, Procedure I (also see Note 1). The test shall be conducted with the unit under test configured in its worst-case non-operational configuration. Test durations for various component materials shall be IAW the criteria specified in the Test Method.

5.3.1.4 Temperature Shock. A temperature shock test shall be conducted IAW MIL-STD-810, Test Method 503.5, Procedure I-C to determine if aircraft equipment can withstand sudden changes in temperature (greater than 10°C per minute) without experiencing physical damage or deterioration in performance. Testing shall consist of using the full non-operational temperature range and shall consist of a minimum of three (3) cycles.

5.3.1.5 Contamination by Fluids. A contamination by fluids test (if applicable) shall be conducted IAW MIL-STD-810, Test Method 504.1, to determine if aircraft equipment can be affected by temporary exposure to contaminating fluids (liquids) that may be encountered during its life cycle. In general this test shall apply to equipment with new materials and/or coatings that have not been previously in service on U.S Army aircraft. Testing shall include the appropriate fluid groups and test fluids selected from MIL-STD-810, Test Method 504.1.

5.3.1.6 Solar Radiation (Sunshine). A solar radiation test shall be conducted IAW MIL-STD-810, Test Method 505.5, Procedure I or Procedure II to verify that equipment directly exposed in the open to solar radiation shall not experience physical damage or degradations in performance. Procedure I (Cycling (thermal effects)) shall apply for evaluating the effects on components of thermal loading via continuous diurnal cycles. A minimum of three (3) diurnal cycles shall be

conducted. Procedure II (Steady State) shall apply for investigating possible actinic effects (photo-degradation) due to components having extended periods of sunlight exposure.

For Procedure I, the A1 (worldwide deployment) high temperature diurnal cycle category shall be selected. Equipment expected to operate while exposed to direct sunlight shall be operated during the test. After the test, the performance characteristics of the equipment shall not be altered to the extent that the equipment does not meet its functional requirements. If procedure II is selected, any actinic effects shall not affect component performance, usage, durability, or required characteristics.

5.3.1.7 Rain. Rain testing shall be conducted IAW the requirements of MIL-STD-810 for aircraft equipment which may be exposed to rain, water spray or dripping water.

5.3.1.7.1 Blowing Rain. A blowing rain test shall be conducted IAW MIL-STD-810, Test Method 506.5, Procedure I, for all equipment designed to be located external to the aircraft (including partially or intermittently exposed internal components) and which will be unprotected from blowing rain.

5.3.1.7.2 Dripping Rain. A dripping rain test shall be conducted IAW MIL-STD-810, Test Method 506.5, Procedure III, for all internal aircraft equipment normally protected from blowing rain but may be exposed to falling water from condensation or leakage from upper surfaces.

5.3.1.8 Humidity. A humidity test shall be conducted IAW the requirements of MIL-STD-810, Test Method 507.5, Procedure II to determine the effects of a warm, moist environment on aircraft equipment stored and/or exposed to hot, highly humid deployment conditions (also see Note 2). A minimum of 10 cycles (240 hr total exposure) shall be conducted.

5.3.1.9 Fungus. A fungus test shall be conducted IAW MIL-STD-810, Test Method 508.6 to verify the extent aircraft equipment will support fungal growth and how any growths may affect performance or materiel usage. Twenty eight (28) days shall be the minimum test period. For components under maximum risk environments for fungal growth, the recommended eighty four (84) days shall be required.

5.3.1.10 Salt Fog. A salt fog test shall be conducted IAW MIL-STD-810, Test Method 509.5 to verify that salt deposits shall not generate electrical/mechanical equipment malfunctions or present immediate or potential long term corrosive effects which may affect either performance or the structural integrity of equipment.

5.3.1.11 Sand and Dust. A sand and dust test shall be conducted IAW MIL-STD-810, Test Method 510.5, (Procedures II and Procedure I respectively), to verify the ability of equipment to be able to be stored and operated when subjected to blowing sand and dust that may obstruct openings, penetrate into cracks, crevices, bearings and joints.

5.3.1.12 Explosive Atmosphere. An explosive atmosphere test shall be conducted IAW MIL-STD-810, Test Method 511.5, Procedure I to determine the ability of equipment to either operate in fuel-air explosive atmospheres without causing ignition and/or Procedure II to verify containment of an explosive or burning reaction of encased equipment (such as batteries, etc.). It is recommended that vibration, shock, and temperature testing be conducted prior to this test and

on the same unit. Components shall function at their maximum input voltage, operated at their maximum loads, and each functional mode shall be tested at each test altitude. All contacts, especially power, shall be exercised as frequently as practical during the test.

5.3.1.13 Immersion. An immersion test shall be conducted IAW the requirements of MIL-STD-810, Test Method 512.5, Procedure I (or Procedure II as applicable) for equipment that may be partially or completely submerged in water.

5.3.1.14 Acceleration. An acceleration test shall be conducted IAW MIL-STD-810, Test Method 513.6, Procedure I (Structural) and/or Procedure II (Operational) to verify that equipment exposed to steady state inertial loads shall not affect equipment structural integrity or functionality. If acceleration test levels for a component are not specified in a government approved requirements document for US Army aircraft, the test levels of MIL-STD-810 shall apply.

5.3.1.15 Vibration. A vibration test shall be conducted IAW either MIL-STD-810, Test Method 514.6 or ADS-27-SP.

5.3.1.16 Shock. Shock testing shall be conducted IAW MIL-STD-810 to verify equipment exposed to mechanically induced shocks during the life cycle shall not affect the structural integrity or functional performance of the equipment.

5.3.1.16.1 Functional Shock. A functional shock test shall be conducted IAW MIL-STD-810, Test Method 516.6, Procedure I to verify that equipment shall meet all of its performance requirements during and after exposure to aircraft operational shocks. If measured data is not available, the test shall utilize the waveform based on the SRS. The equipment shall be operational before, during, and after the test (also see Note 4).

5.3.1.16.2 Transit Drop Shock. A transit drop test shall be conducted IAW MIL-STD-810, Test Method 516.6, Procedure IV, to verify the structural and functional integrity of the equipment. The test shall be conducted for temporary installations, carry-on(s), B-Kits, etc., which will be exposed to transit drops during its lifecycle.

5.3.1.16.3 Crash Hazard Shock. A crash hazard test shall be conducted IAW MIL-STD-810, Test Method 516.6, Procedure V, to reveal mounting and structural weaknesses of equipment causing ejection of components or any sub-elements which can present a hazard to personnel (or other critical equipment impacting crashworthiness) during or after a crash sequence. In general, this test shall be applicable to all aircraft components installed in the following locations and/or meeting the criteria below:

- Equipment located in cockpit and cabin areas (which may be a hazard to personnel)
- Equipment containing displays or LED(s) which may break into fragments
- Equipment located in the aircraft where components or parts thereof could become projectiles and enter an engine or fuel tank (reducing the crashworthiness of the aircraft)
- Equipment located in the aircraft where components or parts thereof could become projectiles and possibly block aircrew/passenger egress or rescue personnel ingress

Whenever this test also evaluates the possibility of ejected sub-elements of a component, the use of a mock-up is prohibited; however, the use of an equivalent component is acceptable.

5.3.1.16.4 Bench Handling Shock. A bench handling test shall be conducted IAW MIL-STD-810, Test Method 516.6, Procedure VI, to verify the ability of equipment to withstand typical levels of shock associated with bench handling (maintenance and repair), or packaging. This test shall apply to medium-to-large equipment out of its transit or combination case that has a maximum dimension greater than approximately 23 cm (9 inches). Small materiel systems, in general, will be tested to higher levels during Procedure IV, Transit Drop.

5.3.1.17 Gunfire Shock. A gunfire shock test shall be conducted IAW MIL-STD-810, Test Method 519.6.

5.3.1.18 Combined Temperature, Humidity, Vibration, and Altitude. A temperature, humidity, vibration, and altitude test shall be conducted IAW of MIL-STD-810, Test Method 520.3, Procedure III (Also see Note 4). A minimum of 10 cycles shall be conducted.

5.3.1.19 Icing/Freezing Rain. An icing/freezing rain test shall be conducted IAW MIL-STD-810, Test Method 521.3 to verify equipment shall satisfy its performance requirements during and after partial or direct exposures to icing as produced by freezing rain or freezing drizzle. This test shall be conducted for all equipment exposed to icing conditions on the aircraft (including partially or intermittently exposed internal components).

5.4 Unmanned Aircraft System (UAS)

5.4.1 UAS Level I Airworthiness Full Qualification Environmental Test Requirements. The following environmental test requirements, as outlined in **TABLE VII**, in conjunction with the full qualification detailed test requirements of paragraph 5.3.1 contained herein, shall be conducted for Level I airworthiness full qualification which qualifies Unmanned Aircraft Systems to standards equivalent to manned systems.

TABLE VII.
UAS Level I Airworthiness Full Qualification Environmental Test Requirements

Test Requirement	MIL-STD-810	Remarks
Low Pressure (Altitude) – Operational	Test Method 520.3, Procedure III or Test Method 500.5, Procedure II	Note 1
Low Pressure (Altitude) – Storage/ Air Transport	Test Method 500.5, Procedure I	Note 2
High Temperature – Operational	Test Method 520.3, Procedure III or Test Method 501.5, Procedure II	Note 1
High Temperature – Storage (Non-Operational)	Test Method 501.5, Procedure I	Note 3
Low Temperature – Operational	Test Method 520.3, Procedure III or Test Method 502.5, Procedure II	Note 1
Low Temperature –	Test Method 502.5, Procedure I	Note 2

Test Requirement	MIL-STD-810	Remarks
Storage (Non-Operational)		
Temperature Shock	Test Method 503.5, Procedure I	
Solar Radiation	Test Method 505.5, Procedure I and/or II	
Rain	Test Method 506.5, Procedure I or III	
Humidity	Test Method 507.5, Procedure II	
Fungus	Test Method 508.6	
Salt Fog	Test Method 509.5	
Sand and Dust	Test Method 510.5, Procedure I and II	
Explosive Atmosphere	Test Method 511.5, Procedure I	
Acceleration	Test Method 513.6, Procedure I and/or II	
Vibration	Test Method 514.6	
Functional Shock	Test Method 516.6, Procedure I	
Bench Handling Shock	Test Method 516.6, Procedure VI	
Icing/Freezing Rain	Test Method 521.3	
Rail Impact	Test Method 526	

Note 1: For airborne equipment, Test Method 520.3, Procedure III, shall be conducted. For ground equipment, Procedure II of the individual Test Methods 500.5 (Altitude), 501.5 (High Temperature), and 502.5 (Low Temperature) shall be conducted.

Note 2: This test may be tailored into Test Method 520.3. If tailored into the combined test, it shall be incorporated at the beginning of the first cycle, prior to the operational low temperature soak.

Note 3: Seven Diurnal (24 hour) temperature cycles shall be conducted per paragraph 5.3.1.2.2 herein.

5.4.1.1 UAS Level I Airworthiness Full Qualification Detailed Environmental Test Requirements. UAS Level I Airworthiness Full Qualification Detailed Environmental Test Requirements are identified in paragraph 5.3.1 with the addition of the following detailed requirement.

5.4.1.1.1 Rail Impact. A rail impact test shall be conducted IAW MIL-STD-810, Test Method 526 to determine the effect of railroad car impacts that may occur during rail shipment, to verify the structural integrity of the equipment, and to evaluate the adequacy of the tiedown system and the tiedown procedures, and to assess transportability. All items are to be tested at their maximum gross weight (fully loaded) rating.

5.4.2 UAS Level II Airworthiness Fielding Environmental Test Requirements. The following environmental test requirements as outlined in **TABLE VIII**, in conjunction with the fielding detailed test requirements of paragraph 5.2.1 contained herein, shall be conducted for

Level II airworthiness ensuring the ability of the system to be safely operated in the intended environment.

TABLE VIII.
UAS Level II Airworthiness Fielding Environmental Test Requirements

Test Requirement	MIL-STD-810	Remarks
Low Pressure (Altitude) – Operational	Test Method 520.3, Procedure III or Test Method 500.5, Procedure II	Note 1
Low Pressure (Altitude) – Storage/ Air Transport	Test Method 500.5, Procedure I	Note 2
High Temperature – Operational	Test Method 520.3, Procedure III or Test Method 501.5, Procedure II	Note 1
High Temperature – Storage (Non-Operational)	Test Method 501.5, Procedure I	Note 3
Low Temperature – Operational	Test Method 520.3, Procedure III or Test Method 502.5, Procedure II	Note 1
Low Temperature – Storage (Non-Operational)	Test Method 502.5, Procedure I	Note 2
Rain	Test Method 506.5, Procedure I or III	
Blowing Sand and Dust	Test Method 510.5, Procedure I and II	
Explosive Atmosphere	Test Method 511.5, Procedure I	
Vibration	Test Method 514.6	
Shock – Functional	Test Method 516.6, Procedure I	

Note 1: For airborne equipment, Test Method 520.3, Procedure III, shall be conducted. For ground equipment, Procedure II of the individual Test Methods 500.5 (Altitude), 501.5 (High Temperature), and 502.5 (Low Temperature) shall be conducted.

Note 2: This test may be tailored into Test Method 520.3. If tailored into the combined test, it shall be incorporated at the beginning of the first cycle, prior to the operational low temperature soak.

Note 3: Seven Diurnal (24 hour) temperature cycles are required per paragraph 5.2.1.2 herein.

5.4.3 UAS Level III Airworthiness Safety of Flight Environmental Test Requirements.
The following environmental test requirements, as outlined in **TABLE IX**, in conjunction with the Safety of Flight detailed test requirements of paragraph 5.1.1 contained herein, shall be conducted for Level III airworthiness ensuring the minimal acceptable level of safety.

TABLE IX.
UAS Level III Airworthiness Safety of Flight Environmental Test Requirements

Test Requirement	MIL-STD-810	Remarks
Low Pressure (Altitude) –	Test Method 520.3, Procedure III or	Note 1

Test Requirement	MIL-STD-810	Remarks
Operational	Test Method 500.5, Procedure II	
High Temperature – Operational	Test Method 520.3, Procedure III or Test Method 501.5, Procedure II	Note 1
Low Temperature – Operational	Test Method 520.3, Procedure III or Test Method 502.5, Procedure II	Note 1
Explosive Atmosphere	Test Method 511.5, Procedure I	
Vibration	Test Method 514.6	

Note 1: For airborne equipment, Test Method 520.3, Procedure III, shall be conducted. For ground equipment, Procedure II of the individual Test Methods 500.5 (Altitude), 501.5 (High Temperature), and 502.5 (Low Temperature) shall be conducted.

5.4.4 Airborne versus Ground Equipment. Temperature and Altitude test requirements for UAS Airborne versus Ground Support Equipment shall be as listed in **TABLE X**.

TABLE X.
Temperature/Altitude test requirements for Airborne versus Ground Equipment

Test Requirement	Airborne Equipment	Ground Equipment
Low Pressure (Altitude) – Operational	Test Method 520.3, Procedure III	Test Method 500.5, Procedure II
High Temperature – Operational	Test Method 520.3, Procedure III	Test Method 501.5, Procedure II (cyclic)
Low Temperature – Operational	Test Method 520.3, Procedure III	Test Method 502.5, Procedure II
Low Pressure (Altitude) – Storage/ Air Transport	Test Method 500.5, Procedure I	Test Method 500.5, Procedure I
High Temperature – Storage (Non-Operational)	Test Method 501.5, Procedure I	Test Method 501.5, Procedure I
Low Temperature – Storage (Non-Operational)	Test Method 502.5, Procedure I	Test Method 502.5, Procedure I

6 NOTES.

6.1 Acquisition requirements. Acquisition documents should specify the following:

Title, number and date of this standard, and

The applicable phase of airworthiness, i.e., SOF, Fielding, or Full Qualification

6.2 Test Plans/Procedures. Test Plans should be prepared in accordance with MIL-STD-810, Task 405 (Detailed Environmental Test Plans). The test plan should include all of the specific data required from each of the individual test methods (usually identified per paragraph 3 - INFORMATION REQUIRED of MIL-STD-810). If detailed test procedures are not submitted under separate cover, the detailed test procedures should be included in the test plan. For

operational tests which require functional checks during the environmental exposure, the test plan should also include the functional check procedures. Refer to Appendix D for more information on functional performance checks.

6.3 Test Reports. Detailed test reports should be prepared in accordance with MIL-STD-810, Part One, Task 406 (Environmental Test Report). The report should include all of the required data IAW Task 406 in conjunction with any specific data requirements referenced in paragraph 3.0 of a given Test Method. All test result data as required in paragraph 5.0 (Analysis of Results) of a given Test Method should be included in the report. Any test deviations (along with accompanying rationale) from prior approved test procedures should be clearly addressed in the report.

6.4 System-Level Qualification versus Component Qualification. The use of a system-level test in lieu of box-level (component) testing is considered to be highly problematic. Although the use of a system-level test in lieu of box-level qualification may be possible; the increased test complexities, troubleshooting difficulties, data acquisition, functional/operational requirements, and environmental control issues will ultimately make a successful test program more costly and may result in ambiguous and controversial test results.

Testing methodology is based on an iterative process starting at the subcomponent level and proceeding through each level of development until the full system is assembled and tested. Each level of testing provides unique data and contributes to the successful development and operation of the final system. Elimination of any level of testing significantly increases the risk of system failure and will increase the life cycle cost of the system.

Elimination of box-level testing increases the risk of box-level failures during system testing. In addition, at the system-level these failures may be difficult to isolate and may require extended periods of troubleshooting. Corrective actions at the system-level are more expensive and result in greater program delays.

Component obsolescence at the Line Replaceable Unit (LRU) level may require system re-qualification as opposed to box-level re-qualification if the individual boxes are qualified.

Qualification at the system level may result in the individual LRU's not being qualified. The LRU's could not be incorporated into other systems without additional qualification testing, thus increasing U.S. Army costs.

System-level qualification testing introduces many difficulties/issues into the test program. The development of detailed system-level environmental test procedures IAW MIL-STD-810 to produce, monitor, and maintain the test environment across the full system is much more complex and increases costs. The development of system-level functional test procedures to fully test and monitor functionality of each LRU and the means to exercise the system also adds more risk and complexity. The overall system-level test setup with all LRU's and the test instrumentation needed to measure inputs and outputs of each LRU; voltage levels, power input/output, waveforms (analog / digital), etc., definitely add risk and complexity to the test setup. This may require the use of multiple breakout boxes. (Note: extensive instrumentation may corrupt the signals/data being sampled.)

Troubleshooting methodology and techniques to isolate problems to a specific LRU or interconnect level will take more time. Test interruption guidelines for continuing the test following LRU failures, loss of environmental conditions (overtest/undertest), etc., may require that the test be rerun adding greatly increased risk at the system level than at the LRU level.

Life cycle re-qualification at the system level following LRU replacement/modification adds significant risk, complexity, cost, and schedule impacts. When qualified only at the system level; the redesign, modification, or replacement of an LRU may require complete re-qualification of the system instead of just the one LRU.

6.5 Combined Environments Test Method 520.3 versus Individual Test Methods. Method 520.3 is specifically designed to address operational qualification of air vehicle components by replicating the synergistic effects of combined environmental stressors on air vehicle components. Under operational conditions, various environmental conditions (Temperature, Altitude, Humidity, and Vibration) are rapidly changing, are interrelated, and the combined effects may be magnified producing synergistic effects. The combined test is designed to vary the test parameters concurrently in order to obtain the desired replication of the environment and its associated effect on components as experienced in field settings. For maximum test accuracy relating to real world conditions, Test Method 520.3 should be conducted as designed using all required environmental forcing functions as specified in MIL-STD-810 (Temperature, Altitude, Humidity, and Vibration). However, provided a separate vibration test will be conducted, this Test Method may be tailored to a Temperature/Altitude/Humidity test as indicated in MIL-STD-810 but is the maximum tailoring permitted to maintain the intent and integrity of the test.

In general, Test Method 520.3 test is not designed to address non-operational/storage conditions although cold temperature storage is recommended to be tailored into the test for unpressurized aircraft due to test design limitations of the individual Test Method. In addition, Test Method 520.3 was not designed to satisfy and should not be substituted to satisfy Humidity requirements (per Test Method 507.5) which relates to ground/storage conditions in warm, humid climates.

For ground based equipment, the individual operational Temperature and Altitude test methods are typically appropriate. During operation of ground equipment the altitude (pressure) is nearly constant and the temperature variation tracks the ambient diurnal cycle, with the potential addition of solar loading. In addition, the relative humidity will also track the ambient diurnal cycle. Although coupling of the various environmental factors will continue to occur, the synergistic effects will be significantly less than for airborne equipment. The individual operational test methods (Test Methods 500.5, 501.5, and 502.5; Procedure II) are deemed sufficient and appropriate for most ground based support equipment.

APPENDIX A: GENERAL LABORATORY TEST METHOD GUIDELINES

See MIL-STD-810, Part I, Section 5 for complete information.

A.1 STANDARD AMBIENT TEST CONDITIONS

When the term "standard ambient" is specified, use the values shown below. If the term is not used and no specific values are called for in the test method or the materiel specification, conduct the item tests (e.g.; pre-test, during test, and post-test) at standard ambient conditions.

Temperature	25°C ±10°C (77°F±18°F)
Relative Humidity	20 to 80%
Atmospheric Pressure	Site Pressure

A.2 CONTROLLED AMBIENT TEST CONDITIONS

Temperature	23°C ±2°C (73°F±3.6°F)
Relative Humidity	50 ±2%
Atmospheric Pressure	96.45 +6.6 / -10.0 kPa 28.5 +2.0 / -3.0 in Hg

A.3 TOLERANCES

A.3.1 Temperature Tolerance

The temperature should be maintained within ±2°C (3.6°F) of the required test temperature. Wider temperature tolerances are acceptable in situations such as:

a. For large items with a volume greater than $5m^3$, the temperature tolerance can be ±3°C. When a wider tolerance is required, approval should be obtained prior to testing.

b. For test temperatures greater than 100°C, the temperature tolerance can be ±5°C.

A.3.2 Operating Temperature Stabilization

Test Item Operating: Operating temperature stabilization is attained when the temperature of the functioning part(s) of the test item considered to have the longest thermal lag is changing at a rate of no more than 2°C (3.6°F) per hour.

A.3.3 Non-Operating Temperature Stabilization

Test Item Non-operating: Non-Operating temperature stabilization is attained when the temperature of the functioning part(s) of the test item considered to have the longest thermal lag reaches a temperature that is within the temperature tolerance of the air surrounding the test item.

A.3.4 Pressure

±5 percent of the value or ±200 Pa, whichever is greater

A.3.5 Humidity

Keep relative humidity at the chamber control sensor to ±5 percent RH of the specified value.

A.3.6 Vibration Amplitude

Sinusoidal	±10 percent
Random	See method 514.6

A.3.7 Vibration Frequency

Measure vibration frequency of 25 Hz and above to an accuracy of ±2 percent. Below 25 Hz, use ±½ Hz.

A.3.8 Acceleration

Measure acceleration (g's) within 10 percent of the specified value.

A.3.9 Time

Control time (e.g., test durations and data gathering intervals) within 5 minutes for total test durations greater than 8 hours, and within 1 percent of the specified value for durations or intervals of 8 hours or less, unless the nature of the test requires greater accuracy.

A.3.10 Air Velocity

Maintain within 10 percent of specified value.

APPENDIX B: EXTERNALLY MOUNTED ANTENNA

TABLE B-I, in conjunction with the full qualification detailed test requirements contained herein, shall be used for the environmental qualification testing requirements for externally mounted antenna. Additional tests may be required or specific tests waivers granted if indicated by the equipment environmental life cycle or design. For the purposes of this document, Active Antennae are antennae that contain powered circuitry.

TABLE B-I.
Antenna Environmental Test Requirements for Full Qualification

Test	MIL-STD-810 Test Method	Active	Non-Active
Low Pressure (Altitude) Storage/ Air Transport	Test Method 500.5, Procedure I	X	X
High Temperature – Storage (Non-Operational)	Test Method 501.5, Procedure I	X	X
Low Temperature – Storage (Non-Operational)	Test Method 502.5, Procedure I	X	X
Temperature Shock	Test Method 503.5, Procedure I	X	X
Contamination by Fluids	Test Method 504.1	X	X
Solar Radiation (Sunshine)	Test Method 505.5, Procedure I	X	X
Rain - Blowing	Test Method 506.5, Procedure I	X	X
Humidity	Test Method 507.5, Procedure II	X	X
Fungus	Test Method 508.6	X	X
Salt Fog	Test Method 509.5	X	X
Sand & Dust - Blowing Dust	Test Method 510.5, Procedure I	X	X
Sand & Dust - Blowing Sand	Test Method 510.5, Procedure II	X	X
Explosive Atmosphere	Test Method 511.5, Procedure I	X	
Immersion	Test Method 512.5, Procedure I	X	X
Vibration	Test Method 514.6	X	X
Shock - Functional	Test Method 516.6, Procedure I	X	X
Shock - Bench Handling	Test Method 516.6, Procedure VI	X	X
Gunfire Shock	Test Method 519.6	X	Platform Dependant
Temperature/Altitude/Humidity/ Vibration	Test Method 520.3, Procedure III	X	
Icing/Freezing Rain	Test Method 521.3	X	X

APPENDIX D: FUNCTIONAL CHECK PROCEDURE (FCP)

D.1 FUNCTIONAL CHECK PROCEDURE (FCP)

In accordance with the requirements of MIL-STD-810, Functional Check Procedures (FCP) should be performed to verify that the Unit Under Test (UUT) is functional within specified parameters. All environmental tests require Pre-Test and Post-Test FCPs. Operational tests also require 'During-Test' FCPs. The FCP should include a description of the test set-up required to perform the FCP, along with step by step procedural instructions.

Note: When environmental testing is performed sequentially on the same test item (with no component modifications or test failures, at the same test facility, and within a reasonable time span) the Post-Test FCP for one test may be utilized as the Pre-Test FCP for the following test.

D.1.1 PRE-TEST FCP

A Pre-Test FCP is performed immediately prior to the environmental exposure. The test item should be operated at standard ambient conditions to ensure that the test item is operating properly and to obtain baseline data. The Pre-Test FCP should verify critical functional parameters and operational limits specified in the performance specification or requirements document. The critical test parameters should be clearly defined in the test procedure. The data should be recorded for comparison with the 'During' and Post FCP data. The FCP data should be included in the test report.

D.1.2 DURING TEST FCP

During Test FCPs should be performed during operational tests as directed by the environmental test procedure and required by MIL-STD-810. The 'During' Test FCP should verify the same operational parameters as the Pre-Test FCP, within the monitoring/access capabilities of the test chamber. Failure of the UUT to meet the FCP requirements during the environmental exposure should constitute a test failure.

D.1.3 POST-TEST FCP

A Post-Test FCP is performed after environmental exposure in accordance with MIL-STD-810. The test item should be operated at standard ambient conditions. The post-test data should be compared to the Pre-Test FCP data, and 'During' Test FCP data when applicable, to determine whether the test item successfully passed the environmental test.

APPENDIX C: TEST EQUIPMENT

Test Equipment shall be tested in accordance with MIL-STD-810 requirements. The individual operational temperature and altitude (if applicable) Test Methods shall be used unless the combined environments Test Method 520.3 has been tailored for ground support equipment.

Note: The combined environments Test Method 520.3 was not designed as a ground test.

As an option, testing may also be performed per MIL-PRF-28800, Class 1 Equipment. If MIL-PRF-28800 is used, TABLE C-I shall serve as recommended test requirements but is subject to tailoring depending on the application.

TABLE C-I.
Test Equipment Environmental Tests Requirements for Full Qualification

MIL-PRF-28800 Environmental Conditions	MIL-PRF-28800 Class 1 Equipment Requirements
Temperature, Not Operating	-51°C to +71°C
Temperature, Operating	-40°C to +55°C Continuous with +71°C for 20 minutes
Relative Humidity	5 to 95 ±5 percent (10°C to 30°C) 5 to 85 ±5 percent (30°C to 40°C) 5 to 60 ±5 percent (above 40°C)
Altitude, Not Operating	15,000 ft.
Altitude, Operating	15,000 ft
Vibration Limits	Random 10 – 2000 Hz
Bounce, Loose Cargo	Yes
Shock, Functional	Use MIL-STD-810, Test Method 516.6, Procedure I
Transit Drop	Yes
Bench Handling	Yes
Shock, High Impact	Platform dependent
Watertight, 0.9m	Yes
Splash Proof	Yes
Drip Proof	Yes
Fungus Resistance	Yes
Salt Exposure, Enclosure	48 hours
Salt Exposure, Structural Parts	48 hours
Explosive Atmosphere	Yes
Dust Resistance	Yes
Solar Radiation	Yes