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MIL–STD–810E
NOTICE 3
31 JULY 1995

DEPARTMENT OF DEFENSE

ENVIRONMENTAL TEST METHODS AND ENGINEERING GUIDELINES

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1. THE FOLLOWING PAGES OF MIL–STD–810E HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
i	31 JULY 1995	i	14 JULY 1989
ii	31 JULY 1995	ii	1 SEPTEMBER 1993
iii	31 JULY 1995	iii	1 SEPTEMBER 1993
iv	31 JULY 1989	iv	14 JULY 1989
v	31 JULY 1989	v	14 JULY 1989
vi	1 SEPTEMBER 1993	vi	REPRINTED WITHOUT CHANGE
1	31 JULY 1995	1	14 JULY 1989
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19	31 JULY 1995	19	14 JULY 1989
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2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

AMSC F4766 AREA ENVR

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MIL–STD–810E
14 JULY 1989
SUPERSEDING
MIL–STD–810D
19 JULY 1983

DEPARTMENT OF DEFENSE

TEST METHOD STANDARD

FOR

ENVIRONMENTAL ENGINEERING CONSIDERATIONS

AND LABORATORY TESTS



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FOREWORD

This test method standard is approved for use by all Departments and Agencies of the Department of Defense. Although prepared specifically for DoD applications, this standard may be tailored for commercial applications as well.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASC/ENSI, Bldg 125, 2335 Seventh St Ste 6, Wright–Patterson AFB OH 45433–7809 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL–STD–810E has been revised to require careful attention to environments throughout the development process. A course of action for determining and assessing the environments to which an item will be exposed during its service life has been added to section 4, General Requirements. The additional General Requirements aid in preparation for design and preparation for test. Documentation requirements for the design and testing process have also been added to section 4.

The bulk of the standard remains devoted to test methods. Individual methods have been revised to encourage accurate determination of the environmental stresses that an equipment will encounter during its service life. Guidance for accelerated or aggravated testing during the design process is included in some cases. Each test method has been divided into two sections: Section I provides guidance for choosing and tailoring a particular test procedure, Section II includes step–by–step test procedures. In some methods, not only the test values, but also the sequence of steps is tailorable.

The result of this revision will be that this standard cannot be called out or applied as a fixed, relatively simple routine. Instead, an environmental engineering specialist will have to choose and alter the test procedures to suit a particular combination or sequence of environmental conditions for a specific equipment application.

The methods of this standard are not intended to satisfy all safety compliance testing requirements.

Technical questions may be addressed to the following offices:

Aeronautical Systems Center
ATTN: ASC/ENFS
2335 Seventh Street, Suite 6
Wright–Patterson AFB, OH 45433–7809
Telephone: Commercial (513) 255–3330, ext 4142
DSN 785–3330, ext 4142
FAX (513) 476–4546

Supersedes page ii of MIL–STD–810E, Notice 2.

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U.S. Army Test and Evaluation Command
ATTN: AMSTE–CT–T
Aberdeen Proving Ground MD 21005–5055
Telephone: Commercial (410) 278–1476
DSN 298–1476
FAX (410) 278–4989

Naval Air Warfare Center
Weapons Division
ATTN: Code 473140D
China Lake, CA 93555–6001
Telephone: Commercial (619) 939–4667
DSN 437–4667
FAX (619) 939–1065

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Check the source to verify that this is the current version before use.

CONTENTS

PARAGRAPH		PAGE
1.	**SCOPE**	**1**
1.1	Purpose	1
1.2	Application	1
1.3	Limitations	1
2.	**APPLICABLE DOCUMENTS**	**1**
2.1	General	1
2.2	Government documents	1
2.2.1	Specifications, standards, and handbooks	1
2.2.2	Other Government documents, drawings, and publications	2
2.3	Non–government documents	2
2.4	Order of precedence	2
3.	**DEFINITIONS**	**2**
4.	**GENERAL REQUIREMENTS**	**4**
4.1	General	4
4.2	Tailoring	4
4.2.1	Objective of tailoring	4
4.2.2	Tailoring tasks	4
4.2.2.1	Environmental management plan	8
4.2.2.2	Life cycle environmental profile	8
4.2.2.3	Environmental design test plan	9
4.2.2.4	Operational environmental verification plan	9
4.3	Use of field/fleet data	9
5.	**TEST METHODS**	**10**
5.1	Test conditions	10
5.1.1	Tolerances for test conditions	11
5.1.2	Accuracy of test instrumentation calibration	11
5.1.3	Stabilization of test temperature	11
5.1.3.1	Test item operating	11
5.1.3.2	Test item nonoperating	12
5.1.4	Test sequence	12
5.1.5	Test procedures	12
5.1.6	Test conditions	12
5.2	General test performance guidance	12
5.2.1	Pretest performance record	12
5.2.2	Installation of test item in test facility	12
5.2.3	Performance check during test	13
5.2.4	Interrupted tests	13
5.2.4.1	In–tolerance interruptions	13
5.2.4.2	Methods 503.3, 506.3, 510.3, 511.3, 514.4, 516.4, and 519.4	13
5.2.4.3	Methods 500.3, 501.3, 502.3, 505.3, 508.4, 509.3, 512.3, 513.4, 520.1, and 521.1	15
5.2.5	Combined tests	15
5.2.6	Post–test data1	5
5.2.7	Failure criteria	15

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Check the source to verify that this is the current version before use.

PARAGRAPH **PAGE**

5.2.8 Additional or different failure criteria 16
5.2.9 Environmental test report 16
5.3 Climatic regions 16
5.3.1 Map of climatic regions 16
5.3.2 Delimitation of climatic design types 16
5.4 Individual test methods 19

6. NOTES 19

6.1 Intended use 19
6.2 Subject term (key word) listing 19
6.3 Data requirements 19
6.4 International standardization agreement 20
6.5 Changes from previous issue 20

METHOD NO.

500.3 Low Pressure (Altitude) . . . . . 500.3–1 – 500.3–10
501.3 High Temperature . . . . . 501.3–1 – 501.3–18
502.3 Low Temperature . . . . . 502.3–1 – 502.3–14
503.3 Temperature Shock . . . . . 503.3–1 – 503.3–14
505.3 Solar Radiation (Sunshine) . . . . . 505.3–1 – 505.3–18
506.3 Rain . . . . . 506.3–1 – 506.3–14
507.3 Humidity . . . . . 507.3–1 – 507.3–16
508.4 Fungus . . . . . 508.4–1 – 508.4–16
509.3 Salt Fog . . . . . 509.3–1 – 509.3–12
510.3 Sand and Dust . . . . . 510.3–1 – 510.3–16
511.3 Explosive Atmosphere . . . . . 511.3–1 – 511.3–20
512.3 Leakage (Immersion) . . . . . 512.3–1 – 512.3–8
513.4 Acceleration . . . . . 513.4–1 – 513.4–14
514.4 Vibration . . . . . 514.4–1 – 514.4–A88
515.4 Acoustic Noise . . . . . 515.4–1 – 515.4–18
516.4 Shock . . . . . 516.4–1 – 516.4–30
519.4 Gunfire . . . . . 519.4–1 – 519.4–18
520.1 Temperature, Humidity, Vibration, Altitude . . . . . 520.1–1 – 520.1–28
521.1 Icing/Freezing Rain . . . . . 521.1–1 – 521.1–10
523.1 Vibro–Acoustic, Temperature . . . . . 523.1–1 – 523.1–20

TABLES

TABLE **PAGE**

500.3–I Minimum cargo compartment pressures 500.3–4
501.3–I High temperature cycles, climatic category – hot 501.3–7
501.3–II High temperature cycles, climatic category – basic hot 501.3–8

Source: https://assist.dla.mil -- Downloaded: 2026-11-08T00:57Z
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Custodian:
Army – TE
Navy – AS
Air Force – 11

Review activities:
Army – MI, ME, AV, GL, MT, AT, CE, AR, SM
Navy – SH, OS, YD, EC
Air Force – 10, 18, 19, 69

International interest:
See 6.3

Preparing Activity:
Air Force – 11

(Project ENVR–0042)

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TABLE **PAGE**

501.3–III Summary of high temperature diumal cycle ranges 501.3–9
502.3–I Summary of low temperature diumal cycle ranges 502.3–5
503.3–I Diumal cycle of temperature for high–temperature climatic categories 503.3–5
503.3–II High–temperature geographical climatic categories 503.3–6
503.3–III Low–temperature geographical climatic categories 503.3–7
505.3–I Temperature/solar radiation diumal cycles 505.3–5
505.3–II Spectral energy distribution and permitted tolerances 505.3–11
507.3–I High humidity diumal categories 507.3–4
507.3–II Test cycles (days) 507.3–9
508.4–I Evaluation scheme for visible effects 508.4–5
508.4–II Test fungi 508.4–11
509.3–I Temperature and pressure requirements for operation at 35°C 509.3–6
512.3–I Water pressures at various depths 512.3–4
513.4–I Suggested G levels for Procedure I – Structural test 513.4–3
513.4–II Suggested G levels for Procedure II Operational test 513.4–4
514.4–I Vibration environment categories 514.4–3
514.4–II Suggested functional test conditions for propeller aircraft equipment 514.4–16
514.4–III Broadband vibration test values for jet aircraft equipment . . . . . 514.4–19 – 514.4–20
514.4–IV Default test peak amplitudes for equipment on helicopters 514.4–25
514.4–V Fundamental source frequencies 514.4–26
514.4–VI Vibration criteria for external stores carried on airplanes . . . . . 514.4–31 – 514.4–33
514.4–VII Suggested minimum integrity test durations for equipment installed in aircraft 514.4–39
514.4–AI Random vibration program data for secured cargo transportation, composite two–wheeled trailer 514.4–A66
514.4–AII Random vibration program data for secured cargo transportation, composite wheeled vehicle 514.4–A67
514.4–AIII Narrowband random–on–random vibration program data for secured cargo transportation tracked vehicle 514.4–A68

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1. SCOPE

1.1 Purpose. This standard provides:

a. Guidelines for conducting environmental engineering tasks to tailor environmental tests to end–item equipment applications.

b. Test methods for determining the effects of natural and induced environments on equipment used in military or commercial applications.

1.2 Application. This standard shall not be invoked on a blanket basis, but each requirement will be assessed in terms of the need. Application of this standard early in the development phase of the acquisition process is encouraged. Selected application at other points in the acquisition process may be appropriate. The methods of this standard are not all–inclusive. Additional environments or combinations of environments should be included in the environmental test specification when appropriate. The test methods of this standard are intended to be applied in support of the following objectives:

a. To disclose deficiencies and defects and verify corrective actions.

b. To assess equipment suitability for the environmental conditions anticipated throughout its life cycle.

c. To verify contractual compliance.

1.3 Limitations. This standard purposely does not address the following:

a. Electromagnetic interference (EMI).

b. Lightning and magnetic effects.

c. Nuclear weapons and nuclear weapons' effects.

d. Piece parts, such as bolts, wires, transistors, and integrated circuits.

e. Tests of basic materials.

f. Certain aspects of the safety testing of munitions.

g. Test criteria utilized for determining packaging performance or design.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, and 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 documents cited in sections 3, 4, and 5 of this standard, whether or not they are listed.

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 listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

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SPECIFICATIONS

STANDARDS

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Ave, Building 4D, Philadelphia PA 19111–5094.)

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 are those cited in the solicitation.

(Copies of specifications, standards and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.3 Non–government documents. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitaiton. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI NCSL Z540–1	General Requirements for Calibration Laboratories and Measuring and Test Equipment

(Application for copies should be addressed to the American National Standards Institute (ANSI), 11 West 42nd Street, New York NY 10036.)

2.4 Order of precedence. 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 The following definitions shall apply:

a. Accelerated test. A test designed to shorten the test time by increasing the frequency or duration of environmental stresses that would be expected to occur during field use.

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b. Aggravated test. A test in which one or more conditions are set at a more stressful level than the test item will encounter in the field in order to reduce test time or assure a margin of safety.

c. Ambient environment. The conditions (e. g., temperature and humidity) characterizing the air or other medium that surrounds materiel.

d. Environmental conditions. (See Forcing function.)

e. Environmental engineering specialist. One whose principal work assignment lies in the technical area of natural and induced environments and their relation to equipment. A person who has expertise in measuring and analyzing field environmental conditions, formulating environmental test criteria, specifying laboratory simulation of environments, and evaluating the effects of environments on equipment.

f. Forcing function. A climatic or mechanical environmental input to an item of equipment that affects its design, service life, or ability to function. (Also referred to as an environmental condition or an environmental stress.)

g. Hermetic seal. A permanent air–tight seal.

h. Induced environment. A local environmental condition that is predominantly man–made or equipment–generated. Also refers to any internal condition that results from the combination of natural forcing functions and the physical/chemical characteristics of the equipment.

i. Life cycle history. A time history of events and conditions associated with an item of equipment from its release from manufacturing to its removal from service. The life cycle should include the various phases that an item will encounter in its life, such as: handling, shipping, and storage prior to use; mission profiles while in use; phases between missions, such as stand–by or storage, transfer to and from repair sites, and alternate locations; and geographical locations of expected deployment.

j. Mission profile. That portion of the life cycle associated with a specific operational mission.

k. Platform. Any vehicle, surface, or medium that carries the equipment. For example, an aircraft is the carrying platform for internally installed avionics equipment and externally mounted stores. The land is the platform for a ground radar set and a man for a hand–carried radio.

l. Platform environment. The environmental conditions an equipment experiences as a result of being attached to or loaded onto a platform. The platform environment is a result of forcing functions induced or modified by the platform and any on–board environmental control systems.

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m. Tailoring. The process of choosing or altering test procedures, conditions, values, tolerances, measures of failure, etc., to simulate or exaggerate the effects of one or more forcing functions to which an item will be subjected during its life cycle. The tailoring process, broadly speaking, also includes the engineering tasks and preparation of planning documents to assure proper consideration of environments throughout the life cycle.

n. Test level. The value at which a test condition is set.

o. Test method. The criteria and procedures used to formulate an environmental test. Test methods are identified by environment (or combinations of environments) in section 5 of this document.

p. Test procedure. A sequence of actions, the correct performance of which will result in a valid test of an item's response to a particular forcing function or combination of functions. Within each test method there are one or more test procedures.

4. GENERAL REQUIREMENTS

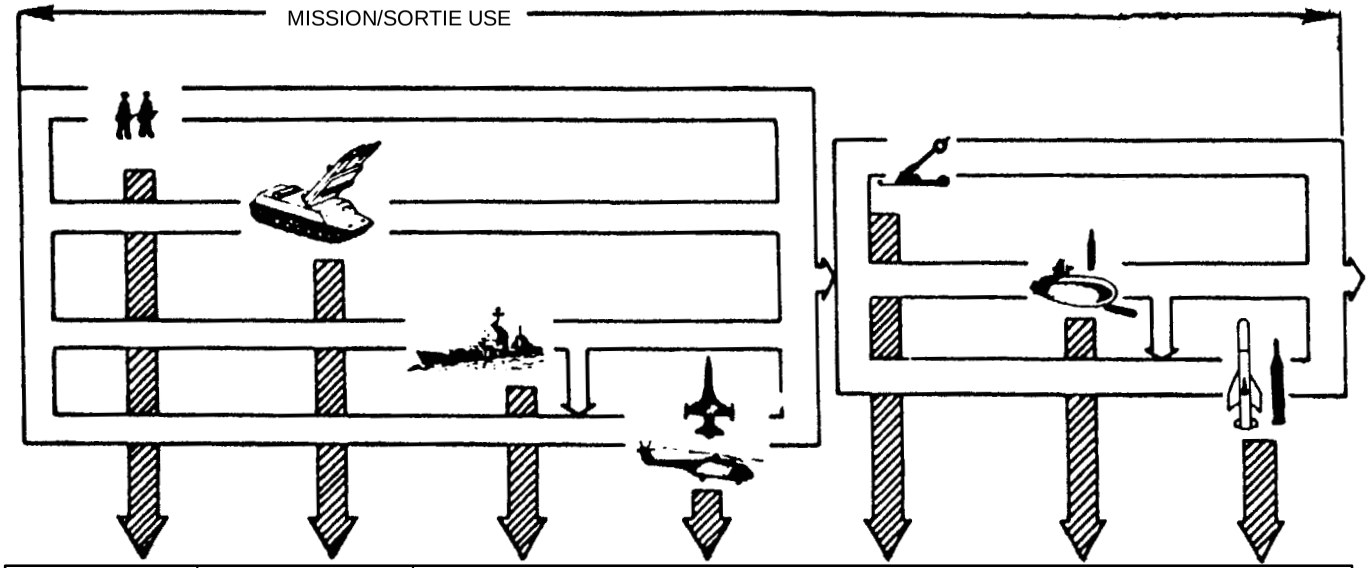
4.1 General. This standard describes a series of engineering tasks and supporting documentation to assure the tailoring of environmental test conditions to individual equipment applications. An environmental engineering specialist should be utilized to effectively apply this standard.

4.2 Tailoring

4.2.1 Objective of tailoring. The objective of tailoring, as applied in this standard, is to assure that equipment is designed and tested for resistance to the environmental stresses it will encounter during its life cycle. Figure 2 illustrates the environmental tailoring process. Figure 3 shows generalized environmental life cycle histories that may be used in developing a life cycle profile.

4.2.2 Tailoring tasks. It is necessary to give proper consideration to environments throughout the development process in order to obtain a quality product. To assure such consideration, environmental management plans shall be formulated that require the following engineering tasks: determination of life cycle environmental conditions; establishment of environmental design and test requirements, including a test plan; and collection and analysis of field data for verification of environmental design and test criteria. Proper attention to each of these tasks insures that the correct environments are identified for tests, that engineering development as well as qualification tests are phased properly into the item's acquisition program, that environmental test conditions are traceable to life cycle conditions realistically encountered, and that testing is appropriate for the test item application. The following plans, tasks, and documentation are established to facilitate the tailoring process.

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Deployment & Use by Foot Soldiers/Ground Personnel	Deployment & Use on Landing Vehicles (Wheeled & Tracked)	Deployment& Use Aboard Ships	Deployment & Use on Aircraft Including Captive Stores (Fixed/Rotary Wing)	Delivery to Target Projectile	Delivery to Target Torpedo/Underwater Launched Missile	Delivery to Target Missile/Rocket
Handling Shock (Dropping/ Slamming/ Overturning) Firing/Blast Shock Acoustic Noise Explosive Atmosphere Electromagnetic Interference	Road/Off Road Vibration (Surface Irregularities/ Tread Laying) Engine Induced Vibration Acoustic Nosie Handling Shock (Including Bench) Road/Off Road Shock (Large Bumps/Holes) Land Mines/Blast Shock Weapon Firing Shock/ Vibration Explosive Atmosphere Electromagnetic Interference	Wave Induced Vibration (Sinusoidal) Engine–Induced Vibration Acoustic Noise Wave–Slam Shock Mine/Blast Shock Weapon Firing Shock Explosive Atmosphere Electromagnetic Interference Increased Pressure (Submarine)	Rotary Induced Vibration Aerodynamic Turbulence (Random Vibration) Maneuver Buffet (Vibration) Gunfire Vibration Engine Induced Vibration Acoustic Noise Take–Off/Landing/ Maneuver Acceleration Air Blast Shock Catapult Launch/Arrested Landing Shock Handling Shock (Including Bench) Aerodynamic Heating Explosive Atmosphere Electromagnetic Interference	Firing Shock Firing Acceleration Handling/Landing Shock Acoustic Nosie Aerodynamic Heating Explosive Atmosphere Electromagnetic Interference	Launch Acceleration Handling/Launch Shock Engine Induced Vibration Acoustic Noise Pyrotechnic Shock (Booster Separation) Explosive Atmosphere Electromagnetic Interference	Launch/Maneuver Attack Handling/Launch Shock Engine Induced Vibration Aerodynamic Turbulence (Random Vibration) Acoustic Noise Aerodynamic Heating Explosive Atmosphere Electromagnetic Interference
High Temperature (Dry/Humid) Low Temperature/ Freezing Thermal Shock (Storage to Use) Rain/Hail Sand/Dust/Mud Salt Fog Solar Radiation Fungus Growth Chemical Attack	High Temperature (Dry/Humid) Low Temperature/ Freezing Thermal Shock (Storage to Use) Rain/Hail Sand/Dust/Mud Salt Fog Solar Radiation Fungus Growth Chemical Attack	High Temperature (Dry/Humid) Low Temperature (Freezing) Thermal Shock (Storage to Use) Rain Salt Fog Solar Radiation Fungus Growth Chemical Attack	High Temperature (Dry/Humid) Low Temperature/ Freezing Thermal Shock (Storage to Use) Rain Salt Fog Solar Radiation Rain Impingement Sand/Dust Impingement Fungus Growth Chemical Attack	Thermal Shock (Storage to Use) Rain Impingement Sand/Dust Impingement	Immersion Thermal Shock	Rain Impingement Sand/Dust Impingement

Fig 3. Generalized life cycle histories for military hardware.

(SEE NOTE 4)

Note 1
The environmental stress events experienced by actual hardware may not always occur in the sequence shown in this profile. The generalized profile is intended to be used as a starting point for a tailored life cycle stress analysis and to provide confidence that all potentially significant environmental conditions have been considered

Note 2
The generalized profile provides only representative decision making information. It does not impose or imply a specific test order although it can and is suggesting potentially useful environmental test stress combinations or sequencies.

Note 3
Hardware may be subjected to any or all of the shipping/ transportation modes shown. Therefore, in any life cycle stress analyses, the anticipated stresses experienced by the hardware on each mode should be evaluated and the most significant of these incorporated in the test program.

Note 4
The generalized profile shows only areas of environmental concern and does not attempt to show operational use patterns. The relative frequency and duration of storage, shipping, and mission events must be considered in determining the cycle environmental test parameters. It should also be remembered that even one shot devices (rockets, shells, etc) must endure combinations and repetitions of all these events before they are ultimately fired.

Note 5
In the interest of completeness some environmental stress generating mechanisms have been included for which corresponding tests are not included in this document. Their absence from this document does not imply a lack of importance; they should be given equal consideration in the life cycle stress analysis.

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4.2.2.1 Environmental management plan. The overall purpose of this plan is to develop a viable and cost effective program to assure that equipment will be designed and tested for all pertinent environmental conditions to which it will be subjected during its life cycle. The overall management of the environmental program shall include consideration of manpower requirements, scheduling, life–cycle environmental conditions, test tailoring, test performance, analysis of results, corrective actions, and collection of data about, and analysis of, actual field environments. Plans for monitoring, assessing, reporting and implementing the entire environmental program shall be addressed. The environmental management plan shall be documented according to DID DI–ENVR–80859.

4.2.2.2 Life cycle environment profile. A life cycle history of events and associated environmental conditions for an item from its release from manufacturing to its retirement from use shall be determined. The life cycle shall include the various phases an item will encounter in its life, such as: handling, shipping or storage prior to use; phases between missions, such as stand–by or storage or transfer to and from repair sites; geographical locations of expected deployment; and platform environments. The environment and combination of environments the equipment will encounter at each phase shall be determined. All potential deployment scenarios should be described as a baseline to identify the environments most likely to be associated with each life cycle phase. The information presented in the figure does not necessarily include all environments or combinations of environments to which materiel will be exposed. The following factors should also be taken into account:

a. Configuration of the hardware.

b. Environment that is encountered.

c. Platform with which the hardware interfaces.

d. Interfaces with other equipment.

e. Absolute and relative duration of exposure phase.

f. Number of times phase will occur; intermittency of phase.

g. Probability of occurrence of environmental conditions.

h. Geographical locations.

i. Any other information which will help identify any environmental conditions which may act upon the item.

The life cycle environment profile shall be documented according to DID DI–ENVR–80860.

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5.1.1 Tolerances for test conditions. Unless otherwise specified, tolerances for test conditions shall be as follows:

a. Temperature. The test item shall be totally surrounded by an envelope of air (except at necessary support points). The temperature of the test section measurement system and the temperature gradient throughout this envelope, which is measured close to the test item, shall be within ±2°C (±3.6°F) of the test temperature and shall not exceed 1°C per meter or a maximum of 2.2°C total (equipment nonoperating).

b. Pressure. ±5% (±200 Pa).

c. Humidity. Relative humidity at the chamber control sensor shall be ±5 percent RH of the measured value.

d. Vibration amplitude

Sinusoidal: ±10 percent

Random: See method 514.4

e. Vibration frequency. Vibration frequency shall be measured with an accuracy of ±2 percent, or ±1/2 Hz below 25 Hz.

f. Acceleration.. Acceleration (g's) shall be measured to within ±10%.

g. Time. Elapsed time shall be measured with an accuracy of ±1%.

h. Air velocity. Air velocity shall be within 10% of specified value.

5.1.2 Accuracy of test instrumentation calibration. The accuracy of instruments and test equipment used to control or monitor the test parameters shall be verified prior to and following each test and then calibrated in predetermined intervals and shall meet the requirements of ANSI NCSL Z540–1 to the satisfaction of the procuring activity. All instruments and test equipment used in conducting the tests specified herein shall:

a. Be calibrated to laboratory standards whose calibration is traceable to the National Standards via primary standards.

b. Have an accuracy of at least one–third the tolerance for the variable to be measured. In the event of conflict between this accuracy and a requirement for accuracy in any one of the test methods of this standard, the latter shall govern.

5.1.3 Stabilization of test temperature

5.1.3.1 Test item operating. Unless otherwise specified, temperature stabilization is attained when the temperature of the operating part of the test item considered to have the longest thermal lag is changing no more than 2.0°C (3.6°F) per hour.

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5.1.3.2 Test item nonoperating. Unless otherwise specified, temperature stabilization is attained when the temperature of the operating part of the test item considered to have the longest thermal lag reaches a temperature within test tolerances of the nominal test temperature, except that any critical component (e.g., battery electrolyte for engine starting test) will be within 1°C (1.8°F). Structural or passive members are not normally considered for stabilization purposes. When changing temperatures, for many test items, the temperature of the chamber air may be adjusted beyond the test condition limits to reduce stabilization time, provided the extended temperature does not induce response temperature in a critical component or area of the test item beyond the test temperature limits for the test item.

5.1.4 Test sequence.. Experience has shown definite advantages to performing certain tests immediately before, in combination with, or immediately following other tests. Where these advantages have been identified, guidance has been put in I–3c of the test methods and shall be followed. Other sequences and combination consistent with 1.2 and 4.2.1 of General Requirements may be used with the permission of the acquisition agency.

5.1.5 Test procedures. Guidance for choosing among the procedures of a method is found in section I of each method.

5.1.6 Test conditions. Whenever practical, specific test levels, ranges, rates, and durations shall be derived from measurements made on actual or appropriately similar equipment (see 4.3). When specific measured data are not available, the test characteristics shall be tailored using the guidance found in section 5.

5.2 General test performance guidance.

5.2.1 Pretest performance record. Before testing, the test item should be operated at standard ambient conditions (see 4.4) to obtain and record data determining compliance with the requirements document(s) and for comparison with data obtained before, during, and after the environmental test(s). The identification and environmental test history of the specific test item(s) should be documented for failure analysis purposes. The pre–test record shall include (as applicable):

a. The functional parameters to be monitored during and after the test if not specified in the equipment specification or requirements document. This shall include acceptable functional limited (with permissible degradation) when operation of the test item is required.

b. Additional evaluation criteria (in addition to 5.2.7).

5.2.2 Installation of test item in test facility. Unless otherwise specified, the test item shall be installed in the test facility in a manner that will simulate service usage, with connections made and instrumentation attached as necessary.

a. Plugs, covers, and inspection plates not used in operation, but used in servicing, shall remain in place.

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c. Cold and severe–cold climatic regions. These areas include northern North America, Greenland, northern Asia, and Tibet. In the cold area, temperature during the coldest month in a normal year may be colder than the basic cold extreme of –32°C (–25°F). In the severe–cold areas, temperature during the coldest month in a normal year may be colder than the cold extreme of –46°C (–50°F), but colder than –51°C (– 60°F) no more than 20 percent of the hours in the coldest month of the coldest part of the area (northern Siberia) where absolute minimum temperatures as low as –68°C (– 90°F) have been recorded). Because the extreme low temperatures are not controlled by a daily solar cycle, they persist for a long enough period of time for materiel to reach equilibrium at a temperature near the minimum.

5.4 Individual test methods. Individual methods for environmental testing follow Appendix A.

6. NOTES

6.1 Intended use. The purpose of this standard is to standardize the design and conduct of tests for assessing the ability of equipment to withstand environmental stresses it will encounter during its life cycle, and to insure that plans and test results are adequately documented.

6.2 Subject term (key word) listing

Acceleration
Acoustic Noise
Climatic Environment
Dust
Environmental Engineering Specialist
Environmental Life Cycle
Environmental Test Procedures
Environmental Test Report
Explosive Atmosphere
Fungus
Gunfire Vibration
Humidity
Induced Environment
Low Pressure (altitude)
Natural Environment
Rain
Salt Fog
Sand
Shock, Mechanical
Solar Radiation
Temperature
Temperature Shock
Vibration

6.3 Data requirements. Unless the DOD FAR supplement 27.475.1 exempts the requirements for a DD Form 1423 (Contract Data Requirements List), the following Data Item Descriptions (DIDs) must be listed, as applicable, on the contract.

Reference Paragraph	DID Number	DID Title
4.2.2.1	DI–ENVR–80859	Environmental Management Plan
4.2.2.2	DI–ENVR–80860	Life Cycle Environment Profile
4.2.2.3	DI–ENVR–80861	Environmental Design Test Plan
4.2.2.4	DI–ENVR–80862	Operational Environment Verification Plan
5.2.9	DI–ENVR–80863	Environmental Test Report

The above DID's were those cleared as of the date of this standard. The current issue of DOD 5010.12–L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

The DIDs are in Appendix A.

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6.4 International standardization agreement. Certain provisions of this standard are the subject of international standardization agreement STANAG 2895, “Extreme Climatic Conditions and Derived Conditions for Use in Defining Design/Test Criteria for NATO Forces Materiel,” STANAG 3518 AE, “Environmental Test Methods for Aircraft Equipment and Associated Ground Equipment,” and STANAG 4370, “Environmental Testing.” When amendment, revision, or cancellation of this standard is proposed that will affect or violate the international agreements concerned, the preparing activity will take appropriate reconciliation action through international standardization channels including departmental standardization offices, if required.

6.5 Changes from previous issue. Asterisks or vertical lines are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes. Vertical lines, however, are used to identify changes to MIL–STD–810E (14 July 1989) included in Notice 3 (Proposed).

Custodian:
Army – TE
Navy – AS
Air Force – 11

Review activities:
Army – MI, ME, AV, GL, MT, AT, CE, AR, SM
Navy – SH, OS, YD, EC
Air Force – 10, 18, 19, 69

International interest: See 6.4

Preparing Activity:
Air Force – 11

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