MIL-STD-781D
17 October 1986
SUPERSEDING
MIL-STD-781C
21 October 1977
MIL-STD-1635 (EC)
3 February 1978
MIL-STD-2068 (AS)
21 March 1977

MILITARY STANDARD

RELIABILITY TESTING
FOR
ENGINEERING DEVELOPMENT, QUALIFICATION, AND PRODUCTION

AMSC N3988

AREA RELI

DEPARTMENT OF DEFENSE
Washington, DC 20363-5100

RELIABILITY TESTING
FOR ENGINEERING DEVELOPMENT, QUALIFICATION, AND PRODUCTION

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Space and Naval Warfare Systems Command, ATTN: SPAWAR 003-121, Washington, DC 20363-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

1. MIL-STD-781D is a complete revision of MIL-STD-781C. This standard is organized on a tailorable task basis and is fully coordinated with MIL-STD-785.

2. The most significant change in MIL-STD-781 is the reorganization of this document into tailorable tasks which can be selected to suit the specific needs of each program. This standard is intentionally structured to discourage indiscriminate blanket applications. Tailoring will ensure that specific tasks will be selected and that the procuring activity will provide specified essential information. Four task areas are specified: (1) Test Planning and Control; (2) Development Testing; (3) Reliability Accounting Tests; (4) Environmental Stress Screening.

3. The statistical test plans and test environments have been transferred to MIL-HDBK-781, which will be issued simultaneously with the standard. The standard test plans which were in MIL-STD-781C are now included in MIL-HDBK-781 without change except that the suffix letter C at the end of each test plan number has been changed to D. (For example, Test Plan IVC in MIL-STD-781C is included in MIL-HDBK-781 as Test Plan IV-D.)

CONTENTS

CONTENTS - Continued

TASKS

CONTENTS - Continued

FIGURES

1. SCOPE

1.1 Purpose. This standard specifies the general requirements and specific tasks for reliability testing during the development, qualification, and production of systems and equipment.

1.2 Application. This standard establishes the tailorable requirements for reliability testing performed during integrated test programs specified in MIL-STD-785. Task descriptions for Reliability Development/Growth Testing (RD/GT), Reliability Qualification Testing (RQT), Production Reliability Acceptance Tests (PRAT), and Environmental Stress Screening (ESS) are defined. Tasks specified in this standard are to be selectively applied in DOD contracted procurements, requests for proposals, statements of work (SOWs), and Government in-house developments which require reliability testing of systems and equipment.

1.3 Equipment categories. This standard is applicable to six broad categories of equipment, distinguished according to their field service applications:

Category 1. Fixed ground equipment

Category 2. Mobile ground equipment

A. Wheeled vehicle
B. Tracked vehicle
C. Shelter configuration
D. Manpack

Category 3. Shipboard equipment

A. Naval surface craft
B. Naval submarine
C. Marine craft
D. Underwater vehicle

Category 4. Equipment for jet aircraft

A. Fixed wing
B. Vertical and short takeoff and landing (V/STOL)

Category 5. Turboprop aircraft and helicopter equipment

A. Turboprop
B. Helicopter

Category 6. Missiles and assembled external stores

A. Air-launched missiles
B. Assembled external stores
C. Ground-launched missiles

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Standards and handbooks. Unless otherwise specified, the following standards and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this document to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-280	Definitions Of Item Levels, Item Exchangeability, Models, And Related Terms
MIL-STD-721	Definitions Of Terms For Reliability And Maintainability
MIL-STD-785	Reliability Program For Systems And Equipment Development And Production
MIL-STD-810	Environmental Test Methods And Engineering Guidelines
MIL-STD-45662	Calibration System Requirements

HANDBOOKS

MILITARY

MIL-HDBK-189	Reliability Growth Management
MIL-HDBK-781	Reliability Test Methods, Plans, And Environments For Engineering *Development, Qualification, And Production*

(Copies of standards and handbooks required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. DEFINITIONS

3.1 Terms. Terms used herein are in accordance with the definitions in MIL-STD-280, MIL-STD-721, MIL-STD-785, MIL-STD-810, and MIL-HDBK-189, with the exception and addition of the terms specified in 3.1.1 through 3.1.9.

3.1.1 Contractor. Contractor includes Governmental or industrial activities developing or producing Military systems and equipment.

3.1.2 Corrective maintenance (repair). The actions performed, as a result of failure, to restore an item to a specified condition.

3.1.3 Decision risks. Decision risks shall be as specified in 3.1.3.1 through 3.1.3.3.

3.1.3.1 Consumer's risk (β). Consumer's risk (β) is the probability of accepting equipment with a true mean-time-between-failures (MTBF) equal to the lower test MTBF (θ_1). The probability of accepting equipment with a true MTBF less than the lower test MTBF (θ_1) will be less than (β).

3.1.3.2 Producer's risk (α). Producer's risk (α) is the probability of rejecting equipment with a true MTBF equal to the upper test MTBF (θ_0). The probability of rejecting equipment with a true MTBF greater than the upper test MTBF will be less than (α).

3.1.3.3 Discrimination ratio (d). The discrimination ratio (d) is one of the standard test plan parameters; it is the ratio of the upper test MTBF (θ_0) to the lower test MTBF (θ_1); that is, $d = \theta_0 / \theta_1$.

3.1.4 Failures. Failure types and classifications are specified in MIL-STD-721 with the exception of multiple, pattern, and chargeable failures which are specified in 3.1.4.1 through 3.1.4.3.

3.1.4.1 Multiple failures. The simultaneous occurrence of two or more independent failures. When two or more failed parts are found during troubleshooting and failures cannot be shown to be dependent, multiple failures are presumed to have occurred.

3.1.4.2 Pattern failures. The occurrence of two or more failures of the same part in identical or equivalent applications when the failures are caused by the same basic failure mechanism and the failures occur at a rate which is inconsistent with the parts predicted failure rate.

3.1.4.3 Chargeable failure. A relevant, independent failure of equipment under test and any dependent failures caused thereby which are classified as one failure and used to determine contractual compliance with acceptance and rejection criteria.

3.1.5 Failure categories. Failures shall be categorized as specified in 3.1.5.1 through 3.1.5.5.

3.1.5.1 Equipment design failure. Any failure which can be traced directly to the design of the equipment; that is, the design of the equipment caused the part in question to degrade or fail, resulting in an equipment failure.

3.1.5.2 Equipment manufacturing failure. A failure caused by poor workmanship or inadequate manufacturing process control during equipment construction, testing, or repair prior to the start of testing; for example, the failure of an assembly due to cold solder joints.

3.1.5.3 Part design failure. The failure of parts which can be traced directly to inadequate design.

3.1.5.4 Part manufacturing failure. Part manufacturing failures are the result of poor workmanship or inadequate manufacturing process control during part assembly, inadequate inspection, or improper testing.

3.1.5.5 Software error failure. A failure caused by an error in the computer program associated with the hardware.

3.1.6 Measures of reliability. *Reliability measurement shall be as specified in 3.1.6.1 through 3.1.6.9.*

3.1.6.1 Demonstrated MTBF interval (θ_d): Demonstrated MTBF interval (θ_d) is the probable range of true MTBF under test conditions; that is, an interval estimate of MTBF at a stated confidence level.

3.1.6.2 Observed MTBF ($\hat{\theta}$). Observed MTBF ($\hat{\theta}$) is equal to the total operating time of the equipment divided by the number of relevant failures.

3.1.6.3 Lower test MTBF (θ_1). Lower test MTBF (θ_1) is that value which is unacceptable. The standard test plans will reject, with high probability, equipment with a true MTBF that approaches (θ_1).

3.1.6.4 Upper test MTBF (θ_0). Upper test MTBF (θ_0) is an acceptable value of MTBF equal to the discrimination ratio times the lower test MTBF (θ_1). The standard test plans will accept, with high probability, equipment with a true MTBF that approaches (θ_0). This value (θ_0) shall be realistically attainable, based on experience and information.

3.1.6.5 Predicted MTBF (θ_p). Predicted MTBF (θ_p) is that value of MTBF determined by reliability prediction methods; it is a function of the equipment design and the use environment. (θ_p) should be equal to or greater than (θ_0) in value, to ensure with high probability, that the equipment will be accepted during the reliability qualification test.

3.1.6.6 Observed cumulative failure rate (P(t)). The observed cumulative failure rate (P(t)) at time t is equal to the number of relevant system failures N(t) accumulated by t, divided by t.

3.1.6.7 Intensity function ($\rho(t)$). The intensity function ($\rho(t)$) is the change per unit time of the expected value of N(t), the number of system failures by time t. This is written as:

$$\rho(t) = dE(N(t))/dt$$

where E represents the expected value

3.1.6.8 Instantaneous MTBF function (M(t)). The instantaneous MTBF function at t is equal to the reciprocal of the failure rate function.

3.1.6.9 Observed reliability (R(t)). A point estimate of reliability equal to the probability of survival for a specified operating time, t, given that the equipment was operational at the beginning of the period.

3.1.7 Mission profile. A generic definition is specified in MIL-STD-721. This amplification of that definition applies to reliability test programs: A thorough description of all of the major planned events and conditions associated with one specific mission. A mission profile is one segment of a life-cycle profile (for example, a missile captive-carry phase or a missile free-flight phase). The profile depicts the time span of the event, the expected environmental conditions, energized and nonenergized periods, and so forth.

3.1.8 Life-cycle profile. A thorough time-life description of the events and conditions associated with an item of equipment from the time of final factory acceptance until its ultimate disposition (for example,

factory-to-target sequence). Each significant life-cycle event, such as transportation, dormant storage, test and checkout, standby and ready modes, operational deployment, and mission profiles, are addressed, including alternate possibilities. The profile depicts the time span of each event, the environmental conditions, and the operating modes.

3.1.9 Procuring activity. As used in this standard, procuring activity refers to the Government agency or the prime contractor in transactions with their suppliers.

4. GENERAL REQUIREMENTS

4.1 Reliability test program. The reliability test program shall be integrated with other development and production tests in accordance with the general requirements of this standard and the task(s) specified by the procuring activity. The reliability tests shall be selected and tailored according to the type of item and for each appropriate acquisition phase.

4.2 Integrated reliability test planning. In order to avoid duplication of test effort and to ensure that deficiencies are not overlooked, the integrated reliability test plan document shall define procedures which ensure that reliability data is derived from all other tests required by contract. The integrated test plan shall contain a description of the test plans selected for use, the decision risks, and the environmental test conditions, and shall be keyed to the program life-cycle phases and the appropriate sections of this standard and MIL-HDBK-781.

4.3 Environmental test conditions. The environmental test conditions to be applied during the test specified in this standard and their variation with time shall be representative of the field service and mission environment of the equipment under test. This requirement does not apply to ESS.

4.3.1 Combined environmental test conditions. Unless otherwise specified by the procuring activity, the stress types defined in 4.3.1.1 through 4.3.1.5, shall be combined in the same chamber at levels and rates of change appropriate to the specified stress data. The combined environmental test conditions profile shall be developed in accordance with the guidance provided in MIL-HDBK-781, Section 5.

4.3.1.1 Electrical stress. Electrical stress shall include equipment ON-OFF cycling, operation in accordance with the specified operating modes and duty cycles, and input voltage variation above and below the nominal value specified in the contract.

4.3.1.2 Vibration stress. Vibration test levels and profiles shall be tailored to the specified intended application of the equipment and shall consider the mounting location and the classification category for field use. The minimum factors to be considered in the definition of realistic vibration stress shall be a) type of vibration (sine sweep, complex, or random); b) frequency range; c) amplitude; and d) manner and axis of application. The intent of this requirement is to produce in the equipment on test a vibration response with a character, magnitude, frequency range, and duration similar to that produced by the field service environment and mission profile. The mechanical impedance effects (the interaction of equipment, fixtures, attachment structures, and shakers which would influence the laboratory simulation of the effects of vibration environments) shall be accounted for in establishing vibration levels for all tests. As a minimum, the weight reduction criteria of MIL-STD-810, Test Method 514.3, shall be applied.

4.3.1.3 Thermal stress. The thermal stress profile shall be a realistic simulation of the actual thermal environment that the equipment experiences in the service application. The minimum factors to be considered in the definition of thermal stress shall be; a) starting temperature (heat soak, cold soak) and turn on (warmup) time; b) operating temperature (range, rate of change, and frequency of change; c) number of temperature cycles per mission profile; and d) cooling airflow (rate and fluctuation).

4.3.1.4 Moisture. Moisture levels during the temperature cycles shall be sufficient to produce visible condensation and frosting or freezing, when such conditions can be expected in field service. The humidity should be controlled during the test cycle and may be increased to produce the desired result by injecting water vapor at appropriate times in the test cycle.

4.3.1.5 Equipment cycling. Equipment cycling imposed during reliability tests shall be representative of field operation, see MIL-HDBK-781, Section 5.

4.4 Test instrumentation and facilities. Test instrumentation and facilities used in conducting the tests are described in MIL-HDBK-781, Section 6. These items shall be fully calibrated and tested in accordance with MIL-STD-45662.

4.4.1 Tolerance of test environments. Unless otherwise stated in the equipment specification, tolerance of test environments shall be as specified in a and b:

a. Temperature: ± 2°Celsius (C) (3.6°Fahrenheit (F)), after thermal stabilization.
b. Vibration amplitude: Sinusoidal, ± 10 percent. Random, as specified in MIL-STD-810 and MIL-HDBK-781, Section 5.

4.4.2 Calibration of test apparatus. The calibration of instruments, test equipment, and chambers used to control or monitor the test parameters shall be verified, periodically, in accordance with the requirements of MIL-STD-45662 and to the satisfaction of the procuring activity. All instruments and test equipment used in conducting the test shall be as specified in a through c:

a. Conform to laboratory standards whose calibration is traceable to the National Bureau of Standards of the U.S. Department of Commerce
b. Have a precision of at least one-third the tolerance for the variable to be measured
c. Be appropriate for measuring the conditions concerned

4.5 Performance baselines. Both performance and reliability shall be assessed in a test program of statistically valid length under combined, cyclic, and time-varying environmental conditions which simulate conditions expected in service use. This shall be accomplished by demonstrating an acceptable performance baseline, through detailed performance measurement, before the start of reliability testing. After completion of the detailed performance measurements, selected performance test criteria shall be used during the reliability test to ensure acceptable equipment performance. Unless otherwise specified by the procuring activity, all pretest and post-test measurements shall be performed at standard ambient conditions. Whenever standard ambient conditions must be controlled to obtain reproducible results, the measurements and tests shall be made using those tolerances required to obtain the desired precision of measurement. Actual test conditions shall be recorded during the test period, whether controlled or not.

4.5.1 Pretest performance. Prior to starting tests, the performance level of the test item relative to the specified requirements shall be established under standard ambient conditions. Performance data shall be recorded to determine compliance with performance requirements and to provide reference levels or criteria for checking designed performance of the item during and at the conclusion of the test. The pretest performance check shall be made after installation of the item in the test facility. The conditions during the pretest check will be standard ambient unless otherwise specified. This test shall also be used to establish anomalies in system performance caused by malfunctioning software. Identified and corrected software errors shall not be counted as hardware failures.

4.5.2 Performance during test. Performance data shall be recorded for the test item during each test cycle. These data shall be compared with pretest and during-test performance data. The conditions considered acceptable during the performance check shall be those specified in the equipment specifications and in the test procedure.

4.5.3 Post-test performance. Performance data shall be recorded for the test item at the conclusion of the test. These data shall be compared with pretest and during-test performance data and the specified requirements. The conditions during the post-test will be standard ambient, unless otherwise specified by the procuring activity.

4.6 Failure reporting, analysis, and corrective action system (FRACAS). A closed loop system shall be used to collect data on, analyze, and record timely corrective action for all failures that occur during reliability tests. The contractor's existing FRACAS shall be utilized with the minimum changes necessary to

conform to the requirements of MIL-STD-785 and this standard. The system shall cover all test items, interfaces between test items, test instrumentation, test facilities, test procedures, test personnel, and the handling and operating instructions.

4.6.1 Problem and failure action. At the occurrence of a problem or failure that affects satisfactory operation of the equipment, entries shall be made in the appropriate data logs and the failed equipment shall be removed from test with minimum interruption to the equipment continuing on test.

4.6.1.1 Problem and failure reporting. A failure report shall be initiated at the occurrence of each problem or failure of contractor hardware and software, and Government-furnished equipment (GFE) (see 6.3). The report shall contain the information required to permit determination of the origin and correction of failures. The existing failure report forms may be used with minimum changes necessary to conform to the requirements of this standard and shall include the information specified in a through c:

a. Descriptions of failure symptoms, conditions surrounding the failure, failed hardware identification, and operating time (or cycles) at time of failure.

b. Information on each independent and dependent failure and the extent of confirmation of the failure symptoms, the identification of failure modes, and a description of all repair action taken to return the item to operational readiness

c. Information describing the results of the investigation, the analysis of all part failures, an analysis of the item design, and the corrective action taken to prevent failure recurrence. If no corrective action is taken, the rationale for this decision shall be recorded.

4.6.1.2 Identification and control of failed items. A failure tag shall be affixed to the failed item immediately upon the detection of any failure or suspected failure. The failure tag shall provide space for the failure report serial number and for other pertinent entries from the item failure record. All failed parts shall be marked conspicuously or tagged and controlled to ensure disposal in accordance with contract requirements. Failed parts shall not be handled in any manner which may obliterate facts which might be pertinent to the analysis. Failed parts shall be stored pending disposition by the authorized approval agency of the failure analysis.

4.6.1.3 Problem and failure investigations. An investigation and analysis of each reported failure shall be performed. Investigation and analysis shall be conducted to the level of hardware or software necessary to identify causes, mechanisms, and potential effects of the failure. Any applicable method (that is, test, microscopic analysis, applications study, dissection, X-ray analysis, spectrographic analysis, and so forth) of investigation and analysis which may be needed to determine failure cause shall be used. When the removed item is not defective or the cause of failure is external to the item, the analysis shall be extended to include the circuit, higher hardware assembly, test procedures, and subsystem if necessary. Investigation and analysis of GFE failures shall be limited to verifying that the GFE failure was not the result of the contractor's hardware, software, or procedures. This determination shall be documented for notification of the procuring activity.

4.6.1.4 Failure verification. Reported failures shall be verified as actual failures or an acceptable explanation provided to the procuring activity for lack of failure verification. Failure verification is determined either by repeating the failure mode on the reported item or by physical or electrical evidence of failure (leakage residue, damaged hardware, and so forth). Lack of failure verification, by itself, is not sufficient rationale to conclude the absence of a failure.

4.6.1.5 Corrective action. When the cause of failure has been determined, a corrective action shall be developed to eliminate or reduce the recurrence of the failure. Repairs shall be made in accordance with normal field operating procedures and manuals. The procuring activity shall review the corrective actions at the scheduled status review prior to implementation. In all cases, the failure analysis and the resulting corrective actions shall be documented. The effectiveness of the corrective action should be demonstrated by restarting the test at the beginning of the test cycle in which the original failure occurred.

4.6.1.6 Problem and failure tracking and closeout. The closed loop failure reporting system shall include provisions for tracking problems, failures, analyses, and corrective actions. Status of corrective actions for all problems and failures shall be reviewed at scheduled test status reviews. Problem and failure closeout shall be reviewed to assure their adequacy.

4.7 Failure categories.. All failures occurring during reliability qualification and production reliability acceptance tests shall be classified as relevant or nonrelevant. Relevant failures shall be further classified as chargeable or nonchargeable. Rules for classification of failures shall be in agreement with the approved Failure Definition and Scoring Criteria. The procuring activity will make the final determination of failure classifications (see FIGURE 1).

4.7.1 Relevant failures. Relevant failures shall be as specified in a through d:

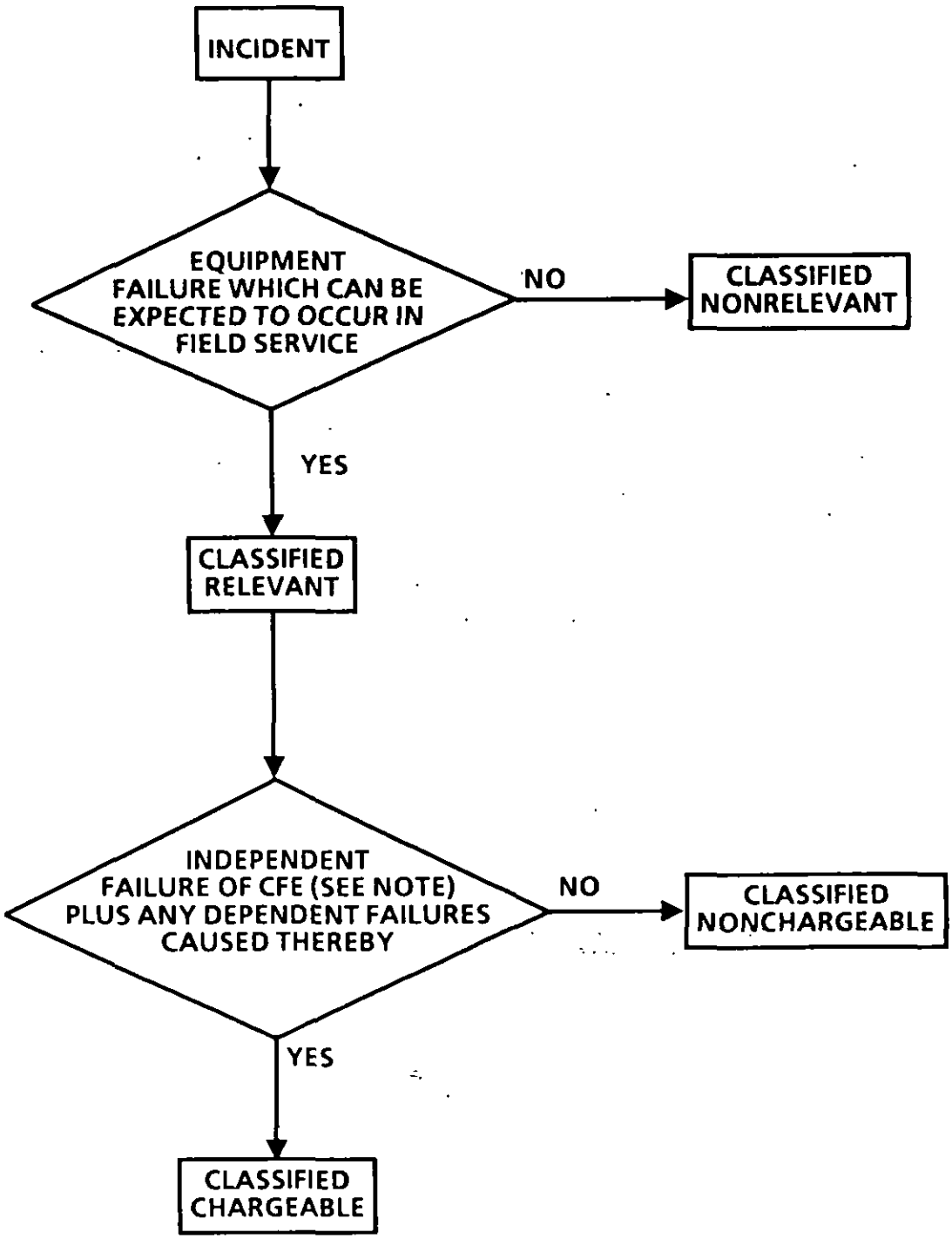
a. Intermittent failures
b. Unverified failures (failures which cannot be duplicated, which are still under investigation, or for which no cause could be determined)
c. Verified failures not otherwise excluded under 4.7
d. Pattern failures

4.7.2 Nonrelevant failures. Nonrelevant failures shall be as specified in a through g:

a. Installation damage
b. Accident or mishandling
c. Failures of the test facility or test-peculiar instrumentation
d. Equipment failures caused by an externally applied overstress condition, in excess of the approved test requirements
e. Normal operating adjustments (nonfailures) specified in the approved equipment operating instructions
f. Secondary failures within the equipment, which are directly caused by nonrelevant or relevant primary failures. The secondary failures must be proved to be dependent on the primary failure
g. Failures caused by human errors

4.7.3 Chargeable failures. Chargeable failures shall be as specified in a through d:

a. Intermittent failures
b. Unverified or verified failures
c. Independent failures
   1. Equipment design
   2. Equipment manufacturing
   3. Part design
   4. Part manufacturing
   5. Software errors identified, corrected, and verified during the pretest, the system verification, and the test, shall not be chargeable as equipment failures
   6. CFE (operating, maintenance, or repair procedures that cause equipment failures)
d. Relevant failures



NOTE:
Contractor-furnished equipment

FIGURE 1. Example of failure catagories.

4.7.4 Nonchargeable failures. Nonchargeable failures shall be as specified in a through c:

a. Nonrelevant failures
b. Failures induced by GFE operating, maintenance, or repair procedures
c. Failures of items having a specified life expectancy and operated beyond the specified replacement time of the item

4.7.5 Alternate failure categories. The alternate failure categories specified in a through c can be used to categorize both hardware and software failures for systems the operations of which are controlled by embedded software.

a. Critical failure is a failure which prevents the system from performing its mission
b. Major failures are as specified in 1 through 6:
1. Any failure which reduces performance of on-line hardware or software so that the system mission capability is degraded but not eliminated
2. Any failure which prevents built-in test equipment (BITE) from detecting major failures in on-line hardware or software
3. Any failure which causes BITE to continuously indicate a major failure in on-line hardware or software when such a failure does not exist
4. Any failure which prevents BITE from isolating and localizing on-line hardware or software major failures to the lowest group
5. Any failure which causes BITE to continuously isolate and localize a major failure in on-line hardware or software when such failure does not exist
6. Any failure which causes BITE false alarm rate to exceed the specified level
c. Minor failures are as specified in 1 and 2:
1. Any failure which impairs on-line hardware or software performance, but permits the system to fully perform mission
2. Any failure which impairs BITE performance (creates false alarms), but permits BITE, when recycled, to isolate and localize to the required level, except when false alarm rate exceeds specified level

4.8 GFE. Equipment, facilities, and material furnished by the Government will be specified in the contract. Reliability test data will be provided by the Government for any GFE included in the equipment to be tested.

5. DETAIL REQUIREMENTS

5.1 Task descriptions. Task descriptions are divided into four general tasks: Section 100, Test Planning and Control; Section 200, Development Testing; Section 300, Reliability Accounting Tests; and Section 400, Environmental Stress Screening.

6. NOTES

6.1 Tailoring of task descriptions. The task descriptions specified herein are intended to be tailored as required by governing regulations, and as appropriate, to the particular system or equipment, program type, magnitude, and funding.

6.1.1 Details to be specified. The Details to be specified by the procuring activity paragraph under each task description specifies the details, additions, modifications, deletions, or options to the requirements of the task that should be considered by the procuring activity when tailoring the task description to fit program needs. Details annotated by an asterisk (*) are essential and shall be provided to the contractor for proper implementation of the task.

6.2 Method of reference. When specifying the task descriptions of this standard as requirements, both the standard and the specific task description number(s) shall be cited. Applicable information required for the Details to be specified by the procuring activity paragraph of each task shall be included in the SOW.

6.3 Data Item Descriptions (DID). When this standard is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements specified for Task 101 through Task 401 shall be developed as specified by an approved DID (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DOD FARSUP 52.227-7031 are invoked and the DD Form 1423 is not used, the data specified for Task 101 through Task 401 and 4.6 shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are:

TASK	APPLICABLE DID	DATA REQUIREMENT
101	DI-RELI-80250	Reliability Test Plan
102	DI-RELI-80251	Reliability Test Procedures
103	DI-RELI-80250	Reliability Test Plan
106	DI-RELI-80252	Reliability Test Report
201	DI-RELI-80247	Thermal Survey Report
	DI-RELI-80248	Vibration Survey Report
202	DI-RELI-80250	Reliability Test Plan
	DI-RELI-80251	Reliability Test Procedures
	DI-RELI-80252	Reliability Test Report
	DI-RELI-80253	Failed Item Analysis Report
	DI-RELI-80254	Corrective Action Plan
	DI-RELI-80255	Failure Summary and Analysis Report
301	DI-RELI-80250	Reliability Test Plan
	DI-RELI-80251	Reliability Test Procedures
	DI-RELI-80252	Reliability Test Report
	DI-RELI-80253	Failed Item Analysis Report
	DI-RELI-80254	Corrective Action Plan
	DI-RELI-80255	Failure Summary and Analysis Report

302	DI-RELI-80250	Reliability Test Plan
	DI-RELI-80251	Reliability Test Procedures
	DI-RELI-80252	Reliability Test Report
	DI-RELI-80253	Failed Item Analysis Report
	DI-RELI-80254	Corrective Action Plan
	DI-RELI-80255	Failure Summary and Analysis Report
401	DI-RELI-80249	Environmental Stress Screening Report
	DI-RELI-80250	Reliability Test Plan
	DI-RELI-80251	Reliability Test Procedures
	DI-RELI-80253	Failed Item Analysis Report
	DI-RELI-80255	Failure Summary and Analysis Report
Paragraph		
4.6	DI-RELI-80253	Failed Item Analysis Report
	DI-RELI-80254	Corrective Action Plan

6.4 Subject term (key word) listing.

Built-in test (BIT)
Built-in test equipment (BITE)
Development Testing Tasks
Environmental Stress Screening (ESS) Tasks
Failure reporting, analysis, and corrective action (FRACAS)
Production Reliability Acceptance Tests (PRAT)
Reliability Accounting Tests Tasks
Reliability Development/Growth Testing (RD/GT)
Reliability Qualification Testing (RQT)
Test Planning and Control Tasks

Custodians:
Army - CR
Navy - EC
Air Force - 11

Preparing activity:
Navy - EC
(Project No. RELI-0025)

Review activities:
Army - CR, MI, AR, AV
Navy - AS, SH, OS
Air Force - 01, 10, 13, 16, 17, 18, 19

User activities:
Army - AR, ME

TASK SECTION 100

TEST PLANNING AND CONTROL

TASK 101

INTEGRATED RELIABILITY TEST PLAN DOCUMENT

101.1 Purpose. The purpose of TASK 101 is to develop an integrated reliability test plan document which identifies the reliability tests required by the contract and integrates them into a comprehensive reliability test program.

101.2 Task description. An integrated reliability test plan shall be prepared which identifies and integrates all tests that provide data for evaluating the reliability of systems and equipment (see 6.3).

101.3 Details to be specified by the procuring activity (see 6.1.1). The details to be specified in the SOW shall include the information specified in a through f, as applicable:

* a. Identification of the reliability test tasks
* b. Identification of the contractual status of the integrated reliability test plan document
* c. Identification of the life-cycle, mission, and environmental profiles which represent equipment usage in service
* d. Identification of MIL-STD-785 tasks for use in support of the reliability test program (that is, Reliability Predictions, Failure Mode Effects, and Criticality Analysis (FMECA), Failure Reporting, Analysis, and Corrective Action System (FRACAS), and so forth)
* e. Specification of alternate failure categories
f. DI-RELI-80250, Reliability Test Plan, applies to this task and shall be specified when required as a deliverable data item

*Essential

TASK 102

RELIABILITY TEST PROCEDURE

102.1 Purpose. The purpose of TASK 102 is to develop reliability test procedures for each test included in the integrated reliability test plan document after its approval by the procuring activity.

102.2 Task description. A separate reliability test procedure shall be prepared for each test in the integrated reliability test plan document (see 6.3).

102.3 Details to be specified by the procuring activity (see 6.1.1). The details to be specified in the SOW shall include the information specified in a through f, as applicable:

* a. Identification of contractual status of reliability test procedures
* b. Identification of equipment to be used for reliability qualification testing
c. Identification of equipment and quantity to be used for reliability development and growth testing
* d. Details of hardware configuration and system operation under test
* e. Performance parameters to be monitored during the test
f. DI-RELI-80251, Reliability Test Procedures, applies to this task and shall be specified when required as a deliverable data item

*Essential

TASK 103

RELIABILITY GROWTH PLANNING

103.1 Purpose. The purpose of TASK 103 is to develop a reliability growth planning curve which specifies the plan for achieving specified reliability values and which provides a means for tracking reliability growth and monitoring progress as the test proceeds.

103.2 Task description. A graphically portrayed reliability growth planning curve shall be prepared to indicate what the reliability value should be at various points in full-scale development if conformance to the reliability requirement is to be achieved.

103.2.1 Reliability growth planning curve development. The reliability growth planning curve development shall be based on data from previous development programs for items of the same type being developed. These data shall be analyzed to determine the length of the reliability growth test period and to provide project management with a means of monitoring progress during test (see 6.3). Detailed guidelines are provided in MIL-HDBK-189.

103.2.2 Reliability growth curve preparation. The reliability growth curves shall be prepared as point estimates of each reliability parameter specified (that is, system MTBF, mission MTBF, probability of success, and so forth) for the entire system and each major subsystem, as specified by the procuring activity. The vertical axis of the graph shall portray cumulative values of the reliability parameter of the system or major subsystem and the horizontal axis shall be in units of both calendar time and test time. Each test planned shall be clearly indicated. A growth curve is shown in FIGURE 103-1.

103.2.3 Reliability growth curve starting point. Planned growth curves shall depict planned levels of reliability achievement at specific points in calendar time and test time and shall be coordinated with the scheduled reliability program reviews. Values along the planned growth curve shall represent the planned reliability improvement as measured by a point estimate. The MTBF value indicated by the planned growth curve at the end of any test program (for example, RD/GT in FIGURE 103-1) should be achieved or exceeded at or before the end of that test program. The starting point for the planned growth curve shall be determined: 1) from information of previous programs on similar systems; 2) by specifying a minimum level of reliability which must be achieved to conform to the specified requirements; or 3) by conducting an engineering assessment of the design and any previous development test data. If historical data are unavailable, the starting point may be estimated by applying a constant factor (K) (that is, 10 percent, 15 percent, and so forth) to the reliability predicted for the mature system. Every effort should be made, however, to obtain information relevent to a realistic starting point prior to applying a K. A second curve, called the Adjusted Growth curve, which reflects the level at which the achieved reliability would be if the corrected failures were discounted, may also be provided.

103.2.4 Predicted reliability growth rate. Engineering rationale shall be provided for the reliability growth rate that is predicted between the scheduled review points. When the predicted growth curves have been derived from historical data from similar programs, these programs and the similarities and differences with the present program shall be specified.

103.3 Details to be specified by the procuring activity (see 6.1.1). The details to be specified in the contract shall include the information specified in a through e, as applicable:

* a. Identification of contractual status of the reliability growth planning curve
b. Identification of major subsystems which require reliability growth planning curves
* c. Imposition of TASK 101 with the requirement to incorporate the reliability growth planning curves

* d. Termination criteria for test

e. DI-RELI-80250, Reliability Test Plan, applies to this task and shall be specified when required as a deliverable data item

*Essential

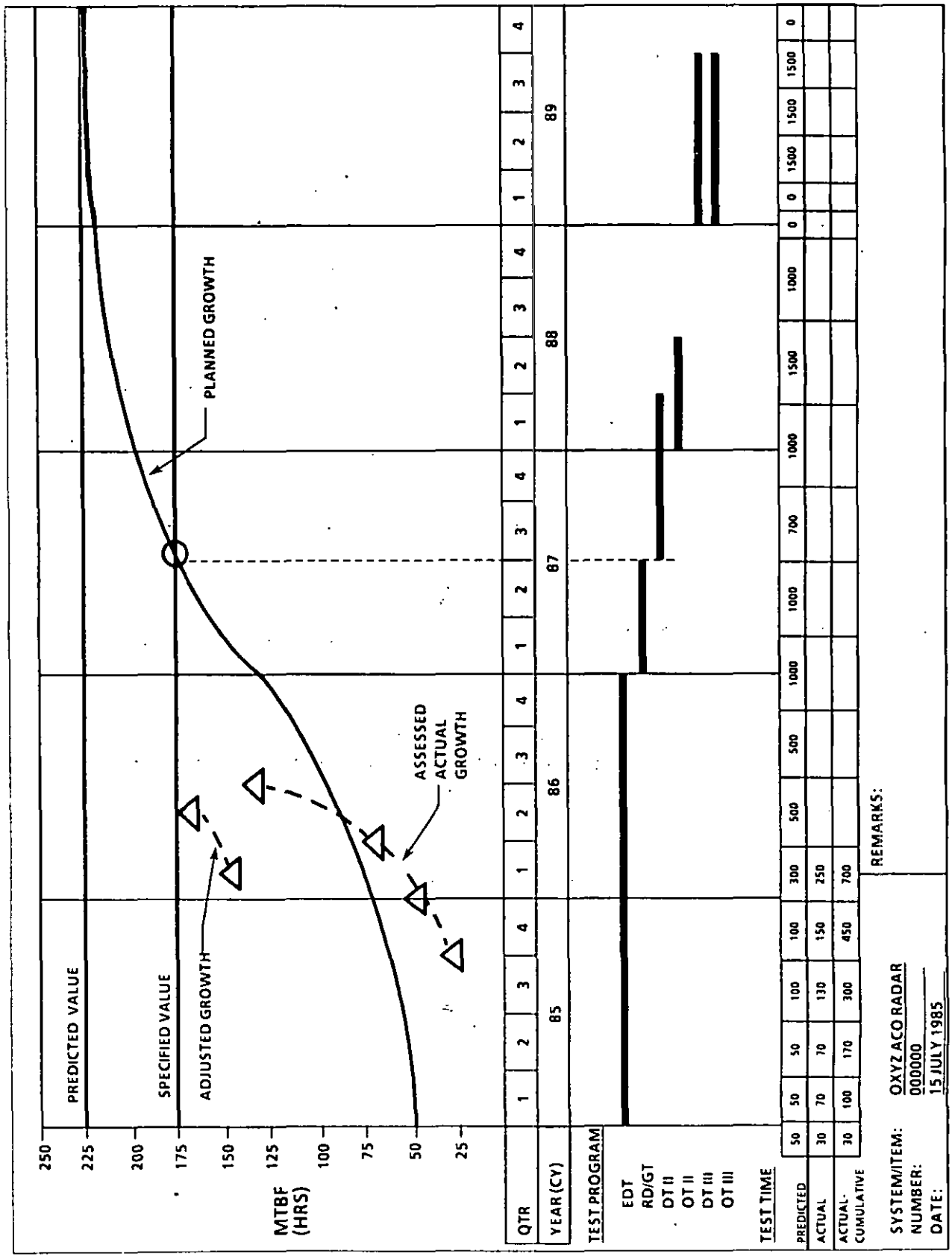


FIGURE 103-1. Reliablity growth profile (example)

TASK 104

TEST PROGRAM REVIEWS

104.1 Purpose. The purpose of TASK 104 is to establish a requirement to conduct test program reviews at specifed times to ensure that reliability tests are proceeding in accordance with contractual milestones.

104.2 Task description. The reliability test program shall be planned and scheduled to permit the review of test status. Formal review and assessment of contract test requirements shall be conducted at major program points as specified by the contract. Progress of individual tests shall be assessed by test status reviews. Test reviews shall be scheduled with subcontractors and vendors as appropriate. The procuring activity shall be informed in advance of each review.

104.2.1 Test readiness reviews. To assure that the test item and all supporting elements are ready at the start of the test, a test readiness review shall be planned and scheduled at least 7 days prior to the start of any test.

104.2.2 Pretest readiness review. (This review shall be conducted when specified for U.S. Army procurements). After the procuring activity approves the reliability test procedure and before start of the reliability test, a reliability test readiness review shall be convened at the contractor's test facility to review the test prerequisites and to ensure that all test requirements specified in the approved test plan and test procedures are compatible and understood by all parties. The contractor shall notify the procuring activity a minimum of 10 days before conduct of the review. The results of the pretest readiness review shall be documented by the contractor and made available to the procuring activity at least 2 days prior to the start of the test.

104.2.3 Status reviews. Formal reviews shall be scheduled as preplanned milestones during the reliability tests to permit the review of testing status and the results achieved to date. The status reviews shall be scheduled in accordance with the contract and shall consider, but not necessarily be limited to, the information specified in a through g:

a. Current reliability assessments and projections based on test results
b. Results of current problem and failure investigations and engineering analysis
c. Preventive and corrective action recommendations
d. Potential design problems based on the preventive and corrective action recommendations
e. Status of subcontractor and supplier, or both, reliability development tests
f. Status of previously assigned action items
g. Assignment of action items resulting from the review including scheduled completion dates

104.2.4 Test completion review. A test completion review shall be conducted at the completion of the test. This review shall be conducted to evaluate the results of the test and shall consider the information specified in a through f:

a. Current reliability growth assessments and achievements based on test results
b. Status of open problems and failures
c. Status of preventive and corrective actions
d. Status of previously assigned action items
e. Assignment of action items resulting from the review, including scheduled completion dates
f. Conclusions of the review

104.2.5 As specified by the procuring activity, the contractor shall document each review.

104.3 Details to be specified by the procuring activity (see 6.1.1). Details to be specified in the contract shall include the information specified in a through e, as applicable:

* a. A record of the results of each review
* b. The specific number of days advance notice for test readiness and pretest readiness reviews
c. Identification of advance notification for other scheduled reviews
d. Identification of procuring activity and contractor follow-up methods on review of open items
e. Delivery identification of any data item required

*Essential

TASK 105

JOINT TEST GROUP

105.1 Purpose. The purpose of TASK 105 is to require the establishment of a joint test group (JTG) to provide coordination throughout the reliability test program and to periodically review all test data.

105.2 Task description. The JTG shall periodically review test data including subcontractor reliability, qualification, and acceptance test data (see 6.3). The JTG also shall approve on the spot changes to previously approved preventive maintenance schedules and detailed test procedures.

105.2.1 JTG membership. The membership of the JTG shall be comprised of Government and contractor personnel and shall be chaired by a Government representative. Contractor JTG members shall include appropriate representatives from design, reliability, system safety, test, parts, and quality assurance activities. Additional contractor or Government personnel may be assigned as temporary members for special tasks, as required.

105.2.2 Specific JTG tasks. Specific tasks to be performed by the JTG shall include, but not be limited to, the tasks specified in a through e:

a. Conduct periodic review of all test data
b. Approve on the spot changes to all previously approved preventive maintenance schedules and detailed test procedures
c. Review and approve all corrective action recommendations generated as a result of malfunction reports
d. Approve recommended classifications of malfunctions and failures as relevant or nonrelevant during the reliability qualification or production reliability acceptance tests
e. Approve acceptance recommendations at the completion of the test and conduct an audit of all documentation at the end of the test to affirm compliance with contractual requirements

105.3 Details to be specified by the procuring activity (see 6.1.1). Details to be specified in the contract shall include the information specified in a through d, as applicable:

a. Identification of Government representatives
b. Identification of additional tasks
c. Recording of the results of the tasks
d. Delivery identification of any data items required

TASK 106

RELIABILITY TEST REPORTS

106.1 Purpose. The purpose of TASK 106 is to establish a requirement for the preparation of reliability test reports which summarize reliability test results obtained to date and other pertinent information.

106.2 Task description. Periodic summary and final test reports shall be prepared to summarize test results obtained. The test reports shall include summaries of failures, failure analyses, and recommended or implemented corrective actions.

106.2.1 *Final reliability test report*. The final reliability test report shall include a general analysis of equipment reliability. A summary of pertinent data and information shall be presented including applicable charts or graphs with test data plotted thereon, failures plotted against time, and observed MTBF plotted against test time.

106.3 Details to be specified by the procuring activity (see 6.1.1). Details to be specified in the contract shall include the information specified in a through c, as applicable:

* a. Identification of tests which require final test reports
b. Delivery schedule
c. DI-RELI-80252, Reliability Test Report, applies to this task and shall be specified when required as a deliverable data item

*Essential

TASK SECTION 200

DEVELOPMENT TESTING

TASK 201

SURVEY TESTING

201.1 Purpose. The purpose of TASK 201 is to establish and implement survey testing procedures so that thermal stabilization and resonant conditions of the equipment can be determined.

201.2 Task description. Thermal and vibration survey testing shall be conducted on a sample of the equipment to determine the level of equipment thermal stabilization and to search for resonant conditions and design weaknesses. Thermal and vibration surveys shall be performed prior to the start of reliability growth testing and, when specified, prior to reliability qualification testing and environmental stress screening (ESS). Equipment selected for reliability testing shall not be used for survey testing unless specifically authorized by the procuring activity.

201.2.1 Thermal survey. A thermal survey shall be performed on one sample of the equipment to be tested, under the temperature and duty cycle specified in the reliability test procedures. The thermal survey shall be used to identify hot spots and the component of greatest thermal inertia, and to establish the time-temperature relationship between the equipment and the chamber air. These relationships shall be used to determine the level of equipment thermal stabilization. The lower test level temperature stabilization occurs when the temperature of the point of the maximum thermal inertia is within 2°C of the lower test level temperature or the rate of change is less than 2°C per hour. Upper test level temperature stabilization occurs when the temperature of the maximum thermal inertia point is within 2°C of the upper temperature level or the rate of change is less than 2°C per hour. Temperatures of equipment cooling air and chamber air shall be recorded continuously during both the survey and the tests. Should the results of the thermal survey indicate local temperatures significantly higher than those predicted by the final thermal design analysis or greater than those used for derating in the reliability prediction, corrective action shall be accomplished, verified, and approved prior to the start of reliability testing.

201.2.2 Vibration survey. A vibration survey shall be performed on one sample of the equipment to be tested to search for resonant conditions and design weaknesses. Unless otherwise specified by the procuring activity, the vibration conditions shall be those specified in the reliability test procedures. Any failures which occur during vibration survey testing shall be reported, investigated, and analyzed for cause; and corrective action shall be accomplished, verified, and approved prior to the start of reliability testing. Equipment mounting for the vibration survey shall simulate mounting in actual use.

201.3 Details to be specified by the procuring activity (see 6.1.1). Details to be specified in the contract shall include the information specified in a and b, as applicable:

a. Identification of vibration and temperature conditions if other than specified in the reliability test procedures

b. DI-RELI-80247, Thermal Survey Report, and DI-RELI-80248, Vibration Survey Report, apply to this task and shall be specified when required as deliverable data items

TASK 202

RELIABILITY DEVELOPMENT/GROWTH TEST

202.1 Purpose. The purpose of TASK 202 is to conduct a reliability development/growth test (RD/GT), also known as test, analyze, and fix (TAAF), which provides a basis for resolving reliability problems and incorporating corrective actions into the design.

202.2 Task description. An RD/GT shall be conducted to enhance system reliability through the identification, analysis and correction of failures, and the verification of corrective action effectiveness. The RD/GT test will incorporate performance monitoring, failure detection, failure analysis, and the verification of design corrections which minimize the recurrence of failures (see MIL-HDBK-189).

202.2.1 Combined environmental test conditions. The combination of environmental test conditions (see 4.3) applied during RD/GT tests shall be as specified by the procuring activity.

202.2.1.1 Installation of test item in test facility. The equipment to be tested shall be installed in the test facility in a manner which is representative of a typical field installation, and the flow of external air around the equipment shall simulate corresponding anticipated operational conditions. All instrumentation required to monitor the test, including the operation of the test facility, shall be provided. Calibration and adjustment of the test items during the test shall be limited to that which is specified in the approved test procedure.

202.2.1.2 Testing sequence. The testing sequence shall be performed as specified in the test procedure and shall be repeated until a failure occurs. When a failure occurs, investigation and analysis shall be initiated to determine failure cause (see 4.6).

202.2.2 Reliability test records. Reliability test records shall be maintained continuously as specified in the approved test procedures and shall account for all calendar and operating time.

202.2.2.1 Performance parameter measurements. The equipment performance parameters to be measured and the frequency of measurement shall be as specified by the procuring activity. When the value of required performance parameters is not within specified limits, a failure shall be recorded. If the exact time of failure cannot be determined, the failure shall be presumed to have occurred at the time of the last recorded measurement of the same parameter. The results of all measurements shall be made and recorded during the test cycle. At least one set of measurements shall be made when the equipment is first energized after any specified equipment startup period.

202.2.2.2 Failure actions. When a failure is observed, entries shall be made on the data logs and the failed equipment shall be removed from test with minimum interruption to the equipment continuing on test. Failure actions shall be specified in the test procedure. The absence of one or more items of equipment from test shall not interfere with the continued entry of log data.

202.2.2.3 Replacement of failed items. Temporary replacement of plug-in items or replacement of failed parts may be authorized by the procuring activity to permit the test to continue while failures are being investigated. Modules and subassemblies shall not be permanently replaced unless previously designated as disposable-at-failure items. Failure of disposable-at-failure items shall be investigated to determine failure cause (see 4.6.1.3).

202.2.2.4 Failure recording, analysis, and corrective action. All failures occurring during RD/GT tests shall be recorded, investigated, and analyzed to determine the cause of failure. Corrective actions shall be developed to preclude recurrence of the failure (see 4.6.1). The effectiveness of each corrective action shall be demonstrated prior to incorporating it in the equipment design.

202.2.3 Reliability growth monitoring. Reliability growth shall be monitored during RD/GT tests by comparing test results to the reliability growth profile. The achieved reliability, expressed as a point estimate, shall be plotted on the same chart as the predicted growth curve (see FIGURE 103-1). Data from the RD/GT test and other applicable tests shall be used to plot this curve. The achieved reliability curve shall not be adjusted by excluding past failures after the design changes which purport to eliminate these failures have been implemented.

202.2.4 Reliability estimates and projections. Reliability parameter estimates and future projections shall be prepared for each specified system reliability parameter. Projections shall be made using the statistical methods and techniques in MIL-HDBK-189 and MIL-HDBK-781, Section 4.

202.3 Details to be specified by the procuring activity (see 6.1.1). Details to be included in the contract shall include the information specified in a through i, as applicable:

* a. Specification of the required value for each reliability parameter to be measured
b. Identification of equipment to be used
* c. Specification of the combination of environmental test conditions and levels
* d. Specification of performance parameters to be measured and frequency of measurement
* e. Imposition of TASK 102 as a prerequisite task
* f. Imposition of TASK 103 as a prerequisite task
* g. Imposition of MIL-STD-785, TASK 104, Failure Reporting, Analysis, and Corrective Action System (FRACAS), as a requisite task
h. Authorization of temporary use of plug-in modules to permit continued testing during failure investigation
i. The following data item descriptions (DIDs) apply to this task and shall be specified when required as deliverable data items:

DID	TITLE
DI-RELI-80250	Reliability Test Plan
DI-RELI-80251	Reliability Test Procedures
DI-RELI-80252	Reliability Test Report
DI-RELI-80253	Failed Item Analysis Report
DI-RELI-80254	Corrective Action Plan
DI-RELI-80255	Failure Summary and Analysis Report

*Essential

TASK SECTION 300

RELIABILITY ACCOUNTING TESTS

TASK SECTION 400

ENVIRONMENTAL STRESS SCREENING

* d. Specification of performance parameters to be measured during the test and the frequency of measurement

* e. Imposition of TASK 102 as a prerequisite task

* f. Imposition of MIL-STD-785, TASK 104, Failure Reporting, Analysis, and Corrective Action System (FRACAS), as a prerequisite task

g. Identification of refurbishment requirements

h. The following data item descriptions (DIDs) apply to this task and shall be specified when required as deliverable data items:

DID	TITLE
DI-RELI-80250	Reliability Test Plan
DI-RELI-80251	Reliability Test Procedures
DI-RELI-80252	Reliability Test Report
DI-RELI-80253	Failed Item Analysis Report
DI-RELI-80254	Corrective Action Plan
DI-RELI-80255	Failure Summary and Analysis Report

*Essential

TASK 302

PRODUCTION RELIABILITY ACCEPTANCE TEST

302.1 Purpose. The purpose of TASK 302 is to determine if the production equipment continues to conform to specified performance and reliability requirements under specified environmental conditions.

302.2 Task description. Production Reliability Acceptance Tests (PRAT) shall be conducted on selected equipments from each production lot as specified by the procuring activity. PRAT shall be as selected by the procuring activity from the sequential, fixed duration, or all-equipments production acceptance tests specified in MIL-HDBK-781, Section 4 and shall be executed under the same combined environmental test conditions used in the reliability qualification tests. For a sampling-type test, the equipments tested shall statistically represent the lot from which they are selected. Lot size shall be defined and the rules for sample selection shall be as specified by the procuring activity. All equipment selected for PRAT shall be subjected to acceptance preconditioning and shall pass the tests specified in the production test specification.

302.2.1 Combined environmental test conditions. The combined environmental test conditions (see 4.3) to be applied during reliability production acceptance tests shall be as specified or approved by the procuring activity.

302.2.1.1 Installation of test item in test facility. The equipment to be tested shall be installed in the test facility in a manner which is representative of a typical field installation, and the flow of external air around the equipment shall simulate corresponding anticipated operational conditions. All instrumentation required to monitor the test, including the operation of the test facility, shall be provided. Calibration and adjustment of the test items during the test shall be limited to that which is specified in the approved test procedure.

302.2.1.2 Testing sequence. The testing sequence shall be performed as specified in the test procedure. This sequence shall be repeated until an accept or reject decision is reached or the total test time is completed.

302.2.2 Reliability test records. Reliability test records shall be maintained as specified in the approved test procedure.

302.2.2.1 Performance parameter measurements. The equipment performance parameters to be measured and the frequency of measurement shall be as specified by the procuring activity. When the value of any required performance parameter is not within specified limits, a failure shall be recorded. If the exact time of failure cannot be determined, the failure shall be presumed to have occurred at the time of the last recorded observation or successful measurement of that parameter. Observations and measurements shall be periodically made and recorded during the test cycle. At least one set of measurements shall be recorded when the equipment is first energized after any specified equipment shutdown period.

302.2.2.2 Failure actions. At the time of failure, entries shall be made on the data logs and the failed equipment shall be removed from test and repaired with minimum interruption to the equipment continuing on test. Failure actions shall be as specified in the test procedure. All failed items shall be replaced. Any item which has deteriorated but does not exceed specified tolerance limits shall not be replaced unless that part is known to have been stressed beyond its rated capability due to the failure of another part. After a failed and repaired equipment has been returned to operable condition, and the effectiveness of the repair verified, the equipment shall be returned to test with minimum interruption to the other equipment on test. The absence of one or more items of equipment undergoing repair shall not interfere with the continued entry of log data. Unless determined to be nonrelevant, failures discovered in equipment or subelements during troubleshooting which are not dependent on the basic failure, shall be

categorized, recorded and considered as relevant multiple failures occurring at the same time as the basic failure. Failed modules and subassemblies shall not be permanently replaced unless previously designated as disposable-at-failure items or approved by the procuring activity. Temporary replacement of plug-in items may be authorized by the procuring activity during troubleshooting and repair periods, when necessary, to permit the test to continue. Piece parts removed during repair shall not be reinstalled when the reliability of the equipment could be impaired.

302.2.3 Failure classification. All failures shall be classified as relevant or nonrelevant. Relevant failures shall be further classified as chargeable or nonchargeable. Classification of failures shall be proposed by the contractor and forwarded to the procuring activity for approval. Failure categories are specified in 4.7.

302.2.4 Lot acceptance. If an accept decision is reached on a lot sampling basis by conforming to the requirements of the specified test plan and procedures, all equipment in that production lot shall be accepted. The reliability test units shall be resubmitted for the performance acceptance tests. When refurbishment of test units is required, see 302.2.10.

302.2.5 All-equipment test acceptance. During all-equipment production reliability acceptance testing, all equipment that complete the specified test satisfactorily shall be accepted until the reject line of the test is crossed.

302.2.6 Lot rejection. If a reject decision is reached on a lot sampling basis, all equipment in that lot are noncompliant, and further acceptance and shipment of units shall be discontinued. Corrective action shall be taken as specified (see 302.2.8).

302.2.7 All-equipment test rejection. If all-equipment production reliability acceptance testing results in a reject decision by crossing the reject line of the test plan, further acceptance shall be discontinued. Corrective action shall be taken as specified (see 302.2.8).

302.2.8 Corrective action. When a reject decision is reached or the occurrence of pattern failures is determined, the procuring activity shall be immediately notified and a corrective action plan developed. The corrective action plan shall specify the proposed corrective action and its impact on the program and the reliability of the equipment. Requirements for the disposition of all defective material and material rendered obsolete because of any redesign shall be included to ensure their exclusion from the production equipment. Prior to implementation, the corrective action plan shall be submitted to the procuring activity for its approval in accordance with contract requirements.

302.2.9 Preventive maintenance. Only preventive maintenance procedures specified for the equipment during service use and specified in the approved test procedures shall be performed during PRAT. No additional preventive maintenance is permitted during PRAT or during repair unless specifically authorized by the procuring activity.

302.2.10 Refurbishment. Unless otherwise specified by the procuring activity, the equipment shall be refurbished and returned to satisfactory operation at the completion of PRAT. Failed parts and parts which have deteriorated but have not exceeded specified tolerance limits shall be replaced, unless the procuring activity directs otherwise. All refurbished equipment shall successfully complete the acceptance test procedures prior to shipment.

302.3 Details to be specified by the procuring activity (see 6.1.1). Details to be specified in the contract shall include the information specified in a through h, as applicable:

* a. Specification of test plan to be used
* b. Specification of rules for sample selection and definition of a lot
* c. Specification of the combined environmental test conditions and levels

* a. Specification of test plan to be used
* b. Identification of equipment to be used
* c. Specification of the combined environmental test conditions and levels
* d. Specification of performance parameters to be measured during the test and the frequency of measurement
* e. Imposition of TASK 102 as a prerequisite task
* f. Imposition of MIL-STD-785, TASK 104, as a prerequisite task
g. Identification of refurbishment requirements after completion of test
h. The following data item descriptions (DIDs) apply to this task and shall be specified when required as deliverable data items:

DID	TITLE
DI-RELI-80250	Reliability Test Plan
DI-RELI-80251	Reliability Test Procedures
DI-RELI-80252	Reliability Test Report
DI-RELI-80253	Failed Item Analysis Report
DI-RELI-80254	Corrective Action Plan
DI-RELI-80255	Failure Summary and Analysis Report

*Essential

TASK 301

RELIABILITY QUALIFICATION TEST

301.1 Purpose. The purpose of TASK 301 is to demonstrate that the equipment design conforms to specified performance and reliability requirements under the specified combined environmental conditions.

301.2 Task description. Reliability qualification tests shall be conducted on equipments which are representative of the approved production configuration. Unless otherwise specified, two equipments shall be used for reliability qualification testing. Test plans utilized and the appropriate α, β, and d values shall be those from MIL-HDBK-781, Section 4, as specified or approved by the procuring activity.

301.2.1 Reliability qualification test requirements. Reliability qualification tests shall be conducted in accordance with reliability test procedures which have been approved by the procuring activity. Testing shall be continued until an accept or reject decision has been reached or the total required test time has been completed, unless otherwise directed by the procuring activity.

301.2.1.1 Combined environmental test conditions. The combined environmental test conditions (see 4.3) applied during reliability qualification tests shall be as specified or approved by the procuring activity.

301.2.1.2 Installation of test items in test facility. The equipment to be tested shall be installed in the test facility in a manner which is representative of a typical field installation, and the flow of external air around the equipment shall simulate corresponding anticipated operational conditions. All instrumentation required to monitor the test, including the operation of the test facility, shall be provided. Calibration and adjustment of the test items during the test shall be limited to that which is specified in the approved test procedure.

301.2.2 Reliability test records. Reliability test records shall be maintained as specified in the approved test procedure.

301.2.2.1 Performance parameter measurements. The equipment performance parameters to be measured and the frequency of measurement shall be as specified by the procuring activity. When the value of any required performance parameter is not within specified limits, a failure shall be recorded. If the exact time of failure cannot be determined, the failure shall be presumed to have occurred at the time of the last recorded observation or successful measurement of that same parameter. Observations and measurements shall be made at the specified interval and recorded during the test cycle. At least one set of measurements shall be recorded when the equipment is first energized after any specified equipment shutdown period.

301.2.2.2 Failure actions. At the time of failure, entries shall be made on the data logs and the failed equipment shall be removed from test and repaired with minimum interruption to the equipment continuing on test. Failure actions shall be as specified in the test procedure. All failed items shall be replaced. Any item which has deteriorated but does not exceed specified tolerance limits shall not be replaced unless that part is known to have been stressed beyond its rated capability due to the failure of another part. After a failed and repaired equipment has been returned to operable condition, and the effectiveness of the repair verified, the equipment shall be returned to test with minimum interruption to the other equipment on test. The absence of one or more items of equipment undergoing repair shall not interfere with the continued entry of log data. Unless determined to be nonrelevant, failures discovered in equipment or subelements during troubleshooting which are not dependent on the basic failure, shall be categorized, recorded, and considered as relevant multiple failures occurring at the same time as the basic failure. Failed modules and subassemblies shall not be permanently replaced unless previously designated as disposable-at-failure items or approved by the procuring activity. Temporary replacement of plug-in items may be authorized by the procuring activity during troubleshooting and repair periods, when necessary, to

permit the test to continue. Piece parts removed during repair shall not be reinstalled when the reliability of the equipment could be impaired.

301.2.3 Failure classification. All failures shall be classified as relevant or nonrelevant. Relevant failures shall be further classified as chargeable or nonchargeable. Classification of failures shall be proposed by the contractor and forwarded to the procuring activity for approval. Failure categories are specified in 4.7.

301.2.4 Reliability qualification compliance. Reliability qualification compliance shall be reviewed by the procuring activity after each equipment failure is categorized or at any other appropriate time. Compliance shall be based on the total accumulated test time and the total number of chargeable failures at the time of the review.

301.2.4.1 Compliance determination. Compliance shall be determined by comparing the test results with the accept or reject criteria of the specified test plan. The accumulated test time is the total equipment operating time or exposure time, whichever is appropriate, and shall be recorded as accumulated equipment test hours. Failures classified as chargeable shall not be reclassified as nonchargeable on the basis of a recommended corrective action.

301.2.4.2 Accept decision. The equipment design shall be qualified for production with respect to reliability when an accept decision is reached by conforming to the requirements of the specified test plan and the procedure of the reliability qualification test. An accept decision shall not be made at a point where any single equipment has accumulated less than one-half of the average creditable test time for all equipments on test.

301.2.4.3 Reject decision. If the reliability qualification test results in a reject decision, the equipment design has not been qualified for production with respect to reliability. In the event of a reject decision, a corrective action plan shall be developed in accordance with 301.2.5 which shall address all failures that have occurred during the test. After the corrective actions have been approved and incorporated in the equipment, a retest shall be conducted using the same or other sample size as approved by the procuring activity. Unless otherwise specified by the procuring activity, the thermal and vibration surveys shall be repeated if those aspects of the design are affected by the corrective action.

301.2.5 Corrective action. When a reject decision is reached or the occurrence of pattern failures is determined, the procuring activity shall be immediately notified and a corrective action plan developed. The corrective action plan shall specify the proposed corrective action and its impact on the program and the reliability of the equipment. Requirements for the disposition of all defective material and material rendered obsolete because of any redesign shall be included to ensure their exclusion from the production equipment. Prior to implementation, the corrective action plan shall be submitted to the procuring activity for its approval in accordance with contract requirements.

301.2.6 Preventive maintenance. Only the preventive maintenance procedures specified for the equipment during service use and listed in the approved test procedures shall be performed during the reliability qualification test. No additional preventive maintenance shall be permitted during the reliability qualification test or during repair unless specifically authorized by the procuring activity.

301.2.7 Refurbishment. Unless otherwise specified by the procuring activity, the equipment shall be refurbished and returned to satisfactory operation at the completion of the reliability qualification test. Failed items shall be replaced and items which have deteriorated but do not exceed specified tolerance limits shall be replaced, unless the procuring activity directs otherwise. All refurbished equipment shall successfully complete the acceptance test procedures prior to shipment.

301.3 Details to be specified by the procuring activity (see 6.1.1). Details to be included in the contract shall include the information specified in a through h, as applicable:

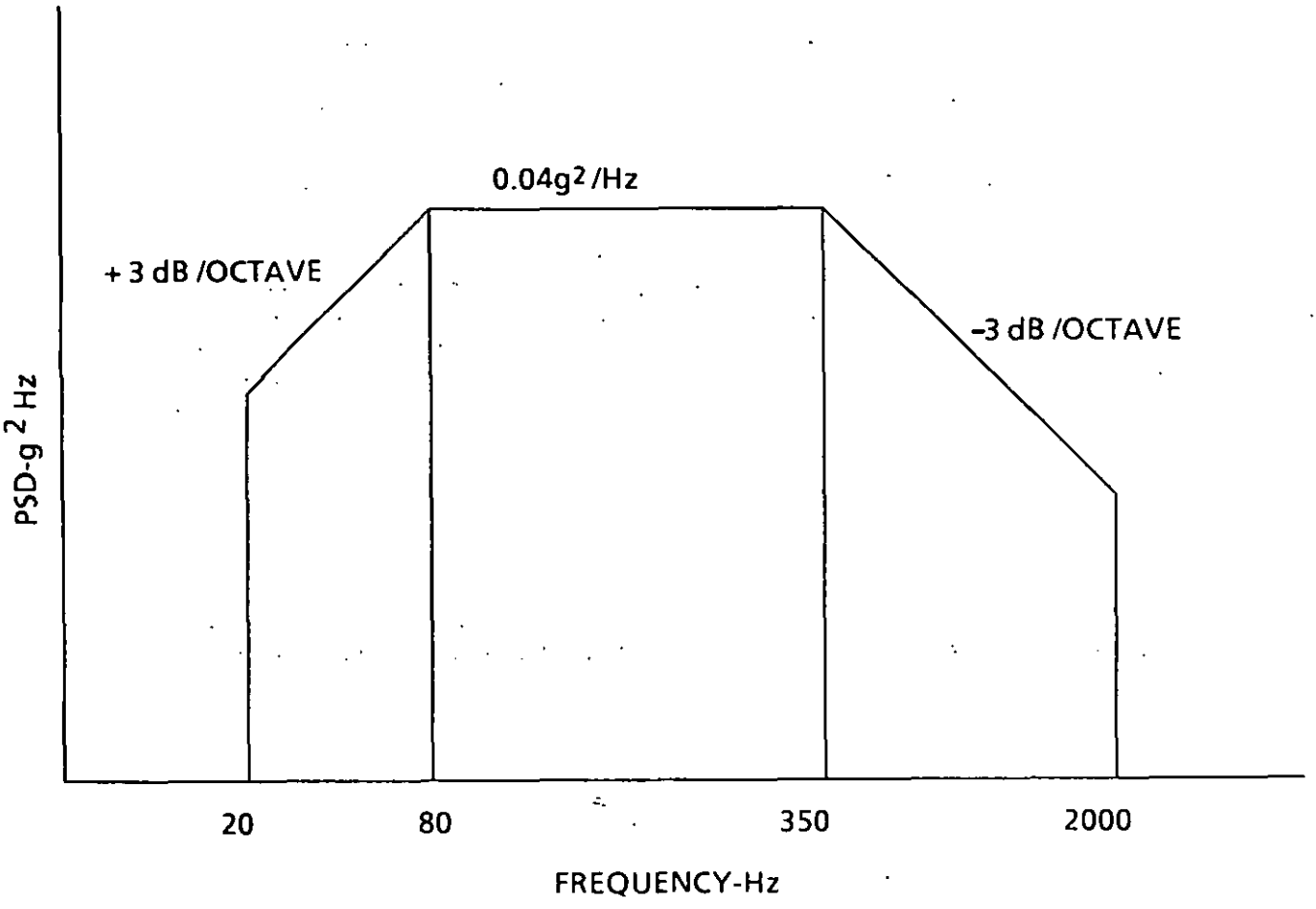


FIGURE 401-1. Random vibration spectrum.

TASK 401

ENVIRONMENTAL STRESS SCREENING

401.1 Purpose. The purpose of TASK 401 is to require the formulation and implementation of environmental stress screening (ESS) to detect and correct latent manufacturing defects (marginal and defective parts, workmanship defects, and other nonconforming anamolies) before the initiation of reliability accounting tests. (ESS also may be applied to each production item before acceptance by the procuring activity.)

401.2 Task description. ESS shall be conducted at selected levels of assembly. During full-scale development, ESS procedures shall be developed for the system and for all lower levels of equipment which may be procured separately as spare or repair parts. The application and implementation of these procedures during full-scale development and production shall be included in the overall reliability test planning.

401.2.1 ESS design. ESS shall be designed to stimulate failures due to latent manufacturing defects. The applied environmental stresses need not simulate the item's specified life-cycle, mission and environmental profile. During ESS, the item shall be cycled through operational modes while simultaneously being subjected to the required environmental stresses. A discussion of ESS techniques is specified in MIL-HDBK-781.

401.2.2 Environmental stresses. Unless otherwise specified by the procuring activity, the environmental stresses applied during ESS shall be random vibration and temperature cycling. The random vibration power spectral density curve and the thermal profile definition for temperature cycling shall be as specified by the procuring activity. These environmental stresses may be applied either in combination or in sequence. Unless otherwise specified by the procuring activity, the random vibration spectrum specified in FIGURE 401-1 shall be utilized.

401.2.2.1 Equipment installation. Unless otherwise specified or approved by the procuring activity, the equipment shall be hard-mounted on the vibration platform or fixture.

401.2.2.2 Random vibration. Random vibration shall be applied for a minimum of 10 minutes. The number of axes along which vibration shall be applied shall be based on the packaging design of the equipment. When vibration on more than one axis is required, the vibration shall be applied for a minimum of 5 minutes on each axis.

401.2.2.3 Temperature cycling. Temperature cycling shall be performed continuously in accordance with the specified thermal profile and for the specified number of cycles. Unless otherwise specified by the procuring activity, the rate of temperature change may be the maximum attainable by the chamber but in no case shall it cause the equipment to experience a rate of change less than 5°C per minute nor shall it cause the equipment to experience thermal shock. More detail is provided in MIL-HDBK-781.

401.2.2.4 ESS sequence. The ESS sequence shall be performed as specified in the ESS procedure. This sequence shall be continuously repeated until a failure occurs or the specified failure free time or number of failure free cycles is completed. When a failure occurs, the equipment shall be repaired and ESS resumed until the specified failure free time or cycles are completed.

401.2.3 ESS applicability. ESS shall be applied to all equipments submitted for reliability testing. Failures occurring during ESS are not chargeable for accept or reject decisions but shall be recorded and analyzed, and appropriate repair action shall be taken. Repair shall be limited to that which is necessary to restore the equipment to its prefailure condition, in accordance with contract requirements. Unless

otherwise specified in the ESS procedures, the last repair during the ESS shall be verified by a failure-free operating period of at least two consecutive temperature cycles.

401.3 Details to be specified by the procuring activity (see 6.1.1). Details to be specified in the contract include the information specified in a through k, as applicable:

a. Imposition of TASK 101, Integrated Reliability Test Plan Document, and TASK 102, Reliability Test Procedure
b. Environmental stress types
* c. Specification of random vibration power spectral density curve
* d. Specification of thermal profile for temperature cycling
* e. Specification of number of hours (cycles) for the ESS
f. Specification of number of consecutive failure-free operating hours (cycles)
g. Equipment mounting requirements for vibration
h. Vibration axes requirements and minimum vibration time per axis
i. Performance measurement requirements before, during, and after ESS
* j. Imposition of MIL-STD-785, TASK 104, Failure Reporting, Analysis, and Corrective Action System (FRACAS), as a prerequisite task
k. The following data item descriptions (DIDs) apply to this task and shall be specified when required as deliverable data items:

DID	TITLE
DI-RELI-80249	Environmental Stress Screening Report
DI-RELI-80250	Reliability Test Plan
DI-RELI-80251	Reliability Test Procedures
DI-RELI-80253	Failed Item Analysis Report
DI-RELI-80255	Failure Summary and Analysis Report

*Essential

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

(Fold along this line)

(Fold along this line)

DEFENSE LOGISTICS AGENCY

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 4966 WASHINGTON D. C.
POSTAGE WILL BE PAID BY THE DEFENSE LOGISTICS AGENCY

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-STD-781D	

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)