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MIL–STD–2077B (NAVY)
22 APRIL 1991

SUPERSEDING
MIL–STD–2077A (NAVY)
5 FEBRUARY 1987

MILITARY STANDARD

GENERAL REQUIREMENTS
TEST PROGRAM SETS

AMSC–N5094

AREA ATTS

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DEPARTMENT OF DEFENSE
WASHINGTON, DC 20301

General Requirements Test Program Sets

MIL-STD-2077B(NAVY)

1. This military standard is approved for use by the Department of the Navy, and is available 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 standard should be addressed to: Commanding Officer, Naval Air Engineering Center, Systems Engineering and Standardization Department (Code 5313), Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this standard or by letter.

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FOREWORD

The Naval Air Systems Command, the Space and Naval Warfare Systems Command and the Naval Sea Systems Command have revised MIL-STD-2077A(NAVY). Clearly not all of the requirements for Test Program Sets (TPSs) are identical for each Systems Command. Careful attention to tailoring the requirements of this standard is required to avoid duplication of data and ensure that TPSs provide useful information to serve their intended function.

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1. SCOPE

1.1 General. This standard contains the requirements to achieve cost-effective acquisition and life cycle maintenance of Operational Test Program Sets/Test Program Sets (OTPS/TPSs).

1.2 Purpose. This document establishes a standard for design, development, documentation, configuration management, validation, verification, quality assurance and preparation for delivery of OTPS/TPSs. A TPS is composed of a Test Program (TP), Interface Device (ID), and Test Program Instruction (TPI). The OTPS shall be the result of merging one or more TPSs into a group which share a single ID. This document is specifically limited to OTPS/TPS developments for Automatic Test Equipment (ATE) systems.

1.3 Applicability. This document provides guidance and direction to Engineers, Analysts and Program Managers in the design and development process of TPSs. The methodology and requirements articulated within this document represent a preferred approach approved by the issuing activity. Any test program development project undertaken must conform to these requirements unless expressly directed otherwise by the cognizant Navy activity.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards and handbooks. Unless otherwise specified, the following specifications, 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 standard to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-E-17555	Electronic and Electrical Equipment, Accessories, and Provisioned Items (Repair Parts); Packaging of
MIL-N-18307	Nomenclature and Identification for Aeronautical Systems Including Joint Electronics Type Designated Systems and Associated Support Systems
MIL-T-28800	Test Equipment for Use With Electrical and Electronic Equipment, General Specification for
MIL-B-81705	Barrier Materials, Flexible, Electrostatic-Free Heat Sealable

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STANDARDS

MILITARY

MIL-STD-12	Abbreviations for Use on Drawings, and in Specifications, Standards, and Technical Documents
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-480	Configuration Control - Engineering Changes, Deviations and Waivers
MIL-STD-482	Configuration Status Accounting Data Elements and Related Features
MIL-STD-1456	Contractor Configuration Management Plans
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-2165	Testability Program for Electronic Systems and Equipments

HANDBOOKS

MILITARY

MIL-HDBK-217	Reliability Prediction of Electronic Equipment
DOD-HDBK-263	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

(Copies of specifications, standards, handbooks, drawings 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.)

2.2 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard takes precedence. Nothing in this standard, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. DEFINITIONS

3.1 Operational Test Program Set (OTPS). The OTPS shall be a single TPS or a group of TPSs consisting of those items of hardware, software and documentation which enable the Unit Under Test (UUT) to be connected to, test, fault detect and fault isolate to a failed SRA and/or component and verify repairs utilizing an ATE system. The OTPS shall be the result of merging one

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or more TPSs into a group which share a single ID for testing a selected grouping of Weapon Replaceable Assemblies (WRAs) or Shop Replaceable Assemblies (SRAs) on an ATE system. The Interface Device (ID) TPS is part of the OTPS. The OTPS shall consist of an Operational Test Program Medium (OTPM), an Operational Test Program Instruction (OTPI), Operational Test Program Hardware (OTPH), and the Master Test Program Set Index (MTPSI) deck.

3.1.1 Operational Test Program Medium (OTPM). The OTPM shall be the OTPS element that contains a merged group of all test programs of the OTPS including the ID self test program.

3.1.2 Operational Test Program Instruction (OTPI). The OTPI shall be the OTPS element that contains information needed to test a single or a group of UUTs. The OTPI shall consist of a single TPI or a group of TPIs supporting the OTPS. Each TPI consists of test set-up diagrams, program start procedures, probe point locations, illustrations, tables, test diagrams, and any other special instructions needed to test the UUT.

3.1.3 Operational Test Program Hardware (OTPH). The OTPH shall consist of a panel ID or a combination of a panel ID, test fixture(s), cable set(s), and any other ID-related hardware elements required by the OTPS.

3.1.4 Master Test Program Set Index (MTPSI) Deck. The MTPSI deck shall be the OTPS element that consists of all individual MTPSI cards required for the UUTs supported by the OTPS. The MTPSI provides the operator/technician with a list of all items required to test/fault isolate a UUT on the ATE.

3.1.5 Test Program Set (TPS). A TPS shall consist of those items necessary to test a UUT on an ATE. The individual elements of the TPS shall be the Test Program (TP), Interface Device (ID), Test Program Instruction (TPI) and MTPSI card.

3.1.6 Test Program. The TP is the individual code of instructions residing on the OTPM that controls the simulation of the functional environment with application of appropriate stimuli and response evaluations for testing and fault isolation of a UUT. The objective of the TP shall be to automatically ascertain the functional readiness condition of the UUT, detect the presence of faults in the UUT, and isolate to the required level and ambiguity group as specified by the requiring activity.

3.1.7 Panel ID. The panel ID shall contain the necessary wiring and circuitry to interface the UUT to the ATE and to resolve any incompatibilities which exist between the ATE and the UUT in order to implement the operational simulation and test requirements. The panel ID shall provide electrical interface connectors to electrically interface the UUT operational connector(s) and test connector(s) directly or via an external cable assembly. In cases where the UUT is mounted directly to the panel ID, the UUT shall be supported and restrained to prevent damage to the UUT/ID/ATE during testing.

3.1.8 Interface Device (ID). The ID shall provide the necessary electrical, mechanical, hydraulic, pneumatic, radiated and optical interfaces between the ATE and the UUT. An ID may only consist of a simple panel ID

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which mates directly to the ATE interface, or a panel ID, cable set and test fixture(s), as required by the individual TPS.

3.1.9 Cable set. The cable set, when required, shall provide the means to route power, stimulus, response, measurement and test point signals between the UUT/ID/ATE during testing of the UUT and self-test of the panel ID.

3.1.10 Text fixture. When required by a particular UUT, a test fixture shall be provided in addition to the panel ID as part of the TPS to provide support and additional interface with the UUT. Circuitry to resolve incompatibilities between the UUT and ATE which is not appropriate for inclusion in the panel ID because of size, weight, or heat limitations may, upon approval by the acquisition activity, be contained in the test fixture.

3.1.11 Test Program Instruction (TPI). The TPI shall provide TPS related information needed for testing and information necessary to analyze the TPS. The TPI shall consist of test set-up diagrams, program start procedures, probe point locations, illustrations, tables, test diagrams, and any other supplementary testing data needed to test the UUT.

3.1.11.1 Test Program Set Document. The TPSD consists of the OTPI and MTPSI. The data supports the operation of the TPS and is used in conjunction with ATE.

3.1.12 End-to-end run time. The end-to-end run time is the time required for a TP to determine that the UUT is capable of performing its designed functions when inserted into its next higher assembly.

3.1.12.1 Performance tests (PT). The PT shall verify that the UUT will perform all its designed functions when inserted into its next higher assembly and meet any other functional, safety, and operational requirements as stated in the applicable source documentation. Satisfactory completion of the PT establishes the UUT as Ready for Issue (RFI).

3.1.13 Test Accuracy Ratio (TAR). TAR is defined as the ratio of the stimulus/measurement accuracy required to test the UUT to the accuracy of the stimulus/measurement introduced by the uncertainty of the ATE. For example, if it is required that a UUT output be accurate to 5% and the ATE/TPS accuracy in measuring the parameter is .010%, the TAR is 500.

3.2 Engineering Support Data (ESD). Engineering Support Data consists of OTPS documentation essential to meet the objectives of autonomous organic maintenance support. The ESD provides a full comprehension of the intent, design, structure and interrelationship of all OTPS elements to enable the Cognizant Field Activities (CFA) to maintain or recreate the test program.

3.3 Fault. A fault is a degradation outside of normal performance limits in UUT operation due to detuning, maladjustment, misalignment, failure of parts and so forth. See Table I for devices and examples of possible faults.

3.3.1 Fault detection. Fault detection involves one or more tests performed to determine if any faults are present in the UUT.

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TABLE I. Examples of possible faults.

Device	Possible Faults
Capacitors	Opens and shorts (see Note 2).
Resistors	Opens (see Notes 2 and 3).
Transformers	Opens and shorts (see Notes 1 and 2).
Inductors	Opens and shorts (see Notes 1 and 2).
Diodes	Opens and shorts (see Note 2).
Transistors	Opens and shorts.
Relays	Open contacts, stuck contacts. Coil open and short (see Note 1).
Circuit Breakers	Stuck shut. Stuck open.
Rotary Switches	Open wipers and high resistance contacts.
Level or Pushbutton Switches	Open normally-closed contacts. Stuck contacts.
Delay Lines	Opens and shorts.
Microcircuit, Linear, SSI, MSI, LSI	The possible faults shall include only the pins external to the microcircuit with the following failure mode indication(s): 1. Hardover Positive (latched/saturated at or near maximum positive supply voltage). 2. Hardover Negative (latched/saturated at or near the maximum negative supply voltage). 3. Excessive DC Offset from a reference voltage. 4. Output clipped. 5. Latched/saturated at a maximum extreme of a device output. 6. No Output Signal (refers only to cases where the failure mode cannot be classified in any of the above categories and there is no response to an input signal. 7. Parameter out of tolerance (only when the UUT circuit design allows measurement to the parameter).

NOTE 1. The effect of short(s) must make a device parameter that is measurable as installed in the circuit fall outside acceptable limits.

NOTE 2. UUT will be evaluated to determine if drift of precision components should be considered as a fault.

NOTE 3. Extremely remote failure modes shall not be considered (e.g., resistors shorting).

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TABLE I. Examples of possible faults (Continued).

Device	Possible Faults
Microcircuit Digital, SSI, MSI, LSI	For microcircuits which are modeled according to a NAND equivalent modeling scheme and whose operability is to be graded relative to the operation of an associated NAND equivalent circuit, the fault set will consist of gate-level faults associated with the NAND equivalent model of the particular microcircuit, specifically: NAND gate outputs stuck at zero and NAND gate input junctions stuck at one, NAND gate outputs stuck at one and NAND gate input junctions stuck at zero. Faults associated with NANDs added to the model solely to enhance the operation of Automatic Test Generation (ATG) will be excluded. For microcircuits other than memory devices (RAMs, ROMs and PROMs), which are not modeled according to a NAND equivalent modeling scheme, the fault set will consist of continuous conditions observable at the terminations to the microcircuit, specifically: stuck at one, and stuck at zero. For RAMs which are not modeled according to a NAND equivalent modeling scheme, the fault set will be limited to the following: 1. External pins stuck at one or stuck at zero. 2. Memory cells stuck at one or stuck at zero. 3. Perturbation of unaddressed cells during a write operation. 4. Failure to access all memory cells. 5. Slow access time. 6. Failure to retain data between refresh operations (dynamic RAMs). For ROMS and PROMs which are not modeled according to a NAND equivalent modeling scheme, the fault set will be limited to external terminations stuck at one or stuck at zero and memory cells stuck at the complement of the correct value.

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3.3.2 Fault isolation. Fault isolation involves tests performed to isolate detected faults within the UUT.

3.4 Unit Under Test (UUT). A UUT is any system, set, subsystem, assembly or subassembly undergoing testing.

3.5 Test Program Set integration. TPS integration is that phase in the development of a TPS by which the developer interfaces the TPS elements with the UUT and ATE for the purpose of debugging the TPS. This integration is accomplished prior to TPS validation.

3.6 Test Program Set validation and verification. TPS validation is that process in the development of a TPS by which the correctness of the program is evaluated by running it on the ATE together with the UUT and its appropriate ID. The process includes the identification of run-time errors, procedure errors and other errors, or omissions inhibiting test performance.

3.7 Production acceptance test. Production acceptance testing is test, inspection and quality assurance process used to ascertain that the contents of a production TPS are in conformance with the contents of a first article verified TPS.

3.8 Automatic Test Program Generator (ATPG). An ATPG is a generic computer program which automatically generates the test patterns and responses from UUT circuit equivalent inputs.

4. GENERAL REQUIREMENTS FOR TPS

4.1 Test Program Set. A TPS shall be prepared for each UUT. A TPS is composed of one TP, one or more IDs and one TPSD. An ID may be shared by multiple UUTs. The TP and TPSD shall be unique to a UUT.

4.2 Accuracy requirements.

4.2.1 Test Accuracy Ratio (TAR) requirement. In order to assure sufficient TP accuracy with respect to UUT tolerances, as well as reliability and repeatability of test results, TPs are required to be designed to meet, as a design goal, a TAR of 10:1. The minimum acceptable TAR to be incorporated into a TP is 3:1. When analysis indicates a TAR equal to or greater than 3:1 cannot be achieved, a Test Accuracy Ratio Analysis shall be provided to the cognizant Navy activity describing the nature of the problem and proposed solution to the problem and/or trade-offs to be considered.

4.2.2 Accuracy augmentation. When specified TARs cannot be met, consideration will be given to the use of auxiliary test equipment which is generally more accurate than the ATEs complement. Specific permission for each accuracy augmentation will be considered after review of the subject "Test Accuracy Ratio Analysis" report for the subject UUT.

4.3 Safety. TPSs shall be so designed that hazard to users is minimized. The requirement for safety is paramount. Safety consideration shall, as a minimum, be implemented in accordance with MIL-T-28800 as defined for Type III Class 4 equipment.

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4.3.1 Test Program. The TP shall warn operators of hazards via the ATE system display or printout. A warning message shall precede application of power to the UUT and individual messages shall precede all test processes where an increased hazard is presented. Further, the TP shall minimize operator contact with dangerous UUTs. In particular, high voltage probing should be effected by affixing clip probes to the UUT, after removing power, and then restoring power and continuing test when the operator is clear.

4.3.2 Interface Devices. IDs shall be constructed to present minimal hazards in themselves and protect users from UUT hazards. Where appropriate, the ID shall have warning legends and shall enclose or shield hazardous UUTs.

4.3.3 Test Program Instruction. The TPI section of the TPSD shall provide detailed instructions of how to safely perform hazardous tests.

4.4 First article acceptance.

4.4.1 Test program set verification. TPS verification shall consist of a first article acceptance of all elements of an OTPS. The acceptance test procedures and reports for verification shall be as indicated in this standard and the work authorization document (see 6.1). The TPS shall be demonstrated on two UUTs, selected at random from inventory by the cognizant Navy activity. Each TP shall be verified by insertion of faults in the UUT to demonstrate the ability to successfully perform the level of fault detection/isolation on the UUT for which the TP was written, thereby demonstrating the integration of the TPS to the ATE and the UUT. The developer shall maintain a TPS integration log book (see 6.1).

4.4.1.1 Test Program. The TP shall be capable of detecting faults as specified in 5.1.7.9. Those faults determined by the cognizant Navy activity to be "non-detectable" shall be specifically waived. The TP shall be capable of isolating all detectable faults. Any fault which could result in catastrophic failure of the UUT or ATE shall not be inserted.

4.4.1.2 Interface Devices (ID). The IDs used for verification shall be inspected:

a. To insure that sound engineering practices have been incorporated in the design.

b. To verify that the design has been reviewed for elimination of duplication.

c. To insure that the ID is identified electrically in accordance with this standard and that all elements of the ID are identified in accordance with the requirements of MIL-N-18307.

4.4.1.3 Test Program Instruction (TPI). The TPI shall be inspected to insure that the proper numbering sequence has been used and that the document is complete, accurate and legible and has the proper format. The TPI shall be inspected for print quality and size of margins for reproducibility considerations and shall be demonstrated during TPI verification.

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4.4.1.4 Engineering Support Data. In addition to the TPS, the ESD shall be available for review during verification.

4.4.2 Production acceptance testing. Production acceptance testing shall consist of the production inspection of a TPS for conformance to the verified first article TPS (see 6.1). Each set of TPSs delivered shall also be inspected to insure integrity of performance and acceptability for final release. Testing of all TPS elements will be performed by the cognizant Navy activity prior to release.

4.4.2.1 Interface Devices. IDs shall be inspected for conformance with the approved Acceptance Test Procedure (ATP).

4.4.2.2 Test Program media. All TPs shall be inspected to verify conformance to the verified first article TPS.

4.4.2.3 Test Program Instruction. The TPI shall be inspected to verify conformance to the approved ATP.

4.5 Configuration Management.

4.5.1 Test Program Set numbering. A single cognizant Navy activity shall assign a part number to each element of the TPS. These part numbers will be assigned within the cognizant Navy activity's part numbering system and shall be consistent for all TPSs developed.

4.5.2 Configuration management procedures. Configuration management for the identification, control, updating and status accounting of developed TPSs shall be documented in accordance with MIL-STD-1456 (see 6.1). Specific requirements for a configuration management system are as follows:

4.5.2.1 Control and updating. All elements of validated TPSs shall be subject to formal engineering change control in accordance with MIL-STD-480 (see 6.1). All modifications to TPSs shall meet the requirements of quality assurance provisions of this standard. It is the developer's responsibility to maintain an internal configuration management program during the TPS development period.

4.5.2.2 Status accounting. Configuration status accounting information necessary to effectively manage the TPS configuration shall be recorded and reported in accordance with MIL-STD-482 (see 6.1).

5. DETAIL REQUIREMENTS

5.1 Detail requirements for TP. The TP shall provide the coded sequence which, when executed by the ATE, will provide the ATE a set of instructions sufficient to automatically ascertain the operational condition and perform fault isolation of a UUT. Each UUT for which a TPS is to be prepared shall have a unique TP. The specific elements of the TP shall be designed to perform the functions as defined in this standard and cited in the work authorization document.

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5.1.1 Automatic Test Generation (ATG). An approved ATG shall be used to generate all digital TPs developed under this standard.

5.1.2 Message display. All directions for operator actions required during the running of the TP shall be displayed on the ATE display or printing device. Appendix A shall be used as a guide for displaying messages. When it is impractical to display the message on the ATE display or printing device, the operator will be referred to the Test Program Instruction (TPI) for illustrations or special procedures required as an integral part of the testing or diagnostic procedure.

5.1.3 Removal of UUT power and stimuli. Once testing has been completed, either through fault identification or successful completion of the program, all power, stimuli and measurement device connections shall be removed, under program control, from the UUT and ATE interface.

5.1.4 Merging. When TPs are related, merging onto a single physical unit (i.e., program medium) may be required.

5.1.5 Utilization of BIT/BITE. UUTs that include Built-In Test and/or Built-In Test Equipment (BIT/BITE) circuitry shall be tested in a manner that efficiently utilizes these testing aids. This requirement does not preclude the need for fully testing the BIT/BITE circuitry to ensure that it is functional.

5.1.6 Test language. All test programs developed under this standard shall be as specified by the acquisition activity.

5.1.7 Test Program content.

5.1.7.1 Elements. The TP shall consist of the following elements, as optionally required depending on the test requirements for the UUT, the capability of the ATE and the requirements of the work authorization document. The organization of the elements shall be designed to provide the functions defined in the following paragraphs:

a. Program Heading and Identification

b. Identity Checks for UUTs and Interface Devices (IDs)

c. Self-Test Survey

d. Safe-To-Turn-On Tests

e. Power Application

f. Cautions and Warnings

g. BIT/BITE

h. Performance Routines (End-To-End Test)

i. Diagnostic Fault Isolation Routine (including active IDs)

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j. Adjustment/Alignment Routines (including active IDs)

k. Program Entry Points

l. Test Program Comments

5.1.7.2 Program heading and identification. Program heading and identification data shall contain information concerning the pertinent configuration identifiers associated with the TP. This shall include the TP name, identification number and revision level; the ID identification and revision level; the UUT name, identification (P/N and NSN) and revision level; and such additional information as may be necessary to allow the operator to verify that the elements required for testing have been assembled.

5.1.7.3 Identity checks. The identity checks or handshakes shall verify that the ID, when feasible, the UUT and the interconnections are correct. The checks are intended to preclude equipment damage and shall be performed prior to turning on power. Low power, low voltage tests such as resistance, capacitance or logic levels shall be used. If UUT identity cannot be ascertained electrically with high confidence, the operator shall be so informed and instructed to check the identity visually.

5.1.7.4 Self-test survey. The self-test survey routines are designed to test these resources (ATE and ID) that will be required by the TP. It is normally included as a set of optional tests that may be performed based on the ATE operator's discretion.

5.1.7.5 Safe-to-turn-on test. Safe-to-turn-on test shall be provided if there is a possibility of ID and/or UUT conditions that could damage the UUT, ID or ATE. The test shall not be restricted to power lines; signal lines must also be considered within the limits of ATE capability and UUT design.

5.1.7.6 Power application. Power shall be applied to the UUT in accordance with the UUT test requirements. When necessary, the TP shall incorporate time delays to make suitable provision for UUT warm-up.

5.1.7.7 Cautions and warnings. When voltages or currents exceeding critical levels specified in MIL-STD-454, Requirement 1, are applied to the UUT or ID, the TP shall display a message which warns the operator of the hazard. The message shall be displayed prior to connection of the voltage or current. A message shall also be displayed after the hazard is removed from the UUT or ID.

5.1.7.8 BIT/BITE. BIT/BITE shall be run on those UUTs that contain BIT/BITE, and utilized to the greatest extent possible for fault detection and isolation. Where practical, UUT BIT shall be used early in the performance tests to aid in reducing program run times. Testing over and above BIT to verify the UUT as RFI and for fault isolation of BIT failures.

5.1.7.9 Performance routines. The performance routines shall consist of discrete tests designed to automatically detect and annunciate the presence of any fault within the UUT commensurate with the design requirements. ATPG or simulator developed programs shall be designed to provide maximum percent

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fault detection consistent with reasonable cost targets; minimum fault detection shall be 95%. A fault not detectable at the UUT input/output connector shall be considered a "no-contest" fault (non-detectable). The test shall contain the discrete steps to set up the ATE/UUT interface, apply all necessary power and stimuli, and to verify individual UUT parameters based on measured, stored or calculated data. Performance routines shall be designed to minimize program end-to-end run time.

5.1.7.9.1 Pass criteria. Satisfactory completion of the performance routine shall assure that the UUT will perform its designed function when installed in its next higher assembly.

5.1.7.9.2 Fail criteria. Unsatisfactory completion of any test or step of the performance routine shall invoke a diagnostic fault isolation routine or adjustment/alignment routine or exit to repair action message.

5.1.7.10 Diagnostic Fault Isolation (DFI) routine. The DFI routine shall isolate and identify the fault(s) detected by the performance routine(s) to the next lower assembly or component(s). The DFI routine shall consist of fault isolation routines designed to minimize the run time and operator intervention required for isolation.

5.1.7.11 Adjustment/alignment routine. When a test in the performance routine fails and that failure is possibly attributable to improper setting of an adjustment device in the UUT or the ID, the performance routine shall invoke an alignment/adjustment routine to provide for correction of the possible improper setting of the UUT or the ID.

5.1.7.12 Program entry point. This is an independent entry point which begins execution of the TP at a point other than its beginning. Program entry points should be placed at the beginning of long test sequences, at the beginning of the test of a module or group of modules, and at the beginning of tests for critical parameters. This will facilitate access to various parts of the program for incorporating design changes, during TPS maintenance, and for the purpose of easing debugging. All program entry points are to be followed by a repeat of the initialization sequence or sequences.

5.1.7.12.1 Performance entry point. A performance entry point shall consist of an entry point flag, protection tests (signature and safe-to-turn-on tests), and standard UUT test setups including power-up as needed. A performance entry point shall be used to begin every performance test group. During normal execution of the test program, i.e., from the initial entry point, performance entry point protection tests and test setups already in effect shall be bypassed. When a program is started at a performance entry point, program flow after completion of the protection tests and test setups shall be the same as for normal execution.

5.1.7.12.2 Test execution integrity check. A test execution integrity check shall be implemented in the test program to prevent the classification of a UUT as RFI if all performance test groups have not been executed.

5.1.7.13 Test Program comments. Each test group and each test within the group shall be preceded by comments briefly and concisely describing its

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purpose and any special conditions. The annotation of ATG programs shall apply only to the non-ATG sections. Comments within a test shall be avoided unless the information cannot be described at the test level.

5.2 Detail requirements for ID. The ID shall provide mechanical and electrical connections and signal conditioning, if required, between the ATE and the UUT. Requirements for the design, testability, maintainability and documentation are specified in the following paragraphs.

5.2.1 General design. All IDs shall be designed in conformance with the requirements of MIL-STD-454 and MIL-STD-1472. In addition, it is a requirement that ID design minimize the complexity of the ID and the need for adjustment or alignment.

5.2.2 ID optimization. IDs shall be optimized so that as many UUTs as is cost effective can be tested by the same basic ID assembly, with the objective of reducing ID storage requirements.

5.2.3 ID cables. ID cables shall be designed to be completely repairable using standard tools, or special tools provided with the ID set.

5.2.3.1 ID expansion capabilities. The IDs shall be designed with a 10% expansion capability. That is, provisions shall be made in the design of the ID to accommodate unanticipated ID requirements including number of wires, added functions and/or subassemblies 10% greater than the defined requirements.

5.2.4 Mean Time Between Failure (MTBF). Each ID shall be designed to have minimum MTFB of 1000 hours calculated in accordance with MIL-HDBK-217.

5.2.5 Testability. IDs shall be designed in conformance with the requirements of MIL-STD-2165 to maximize design for testability to accommodate automatic fault detection and piece part isolation. In addition, IDs shall be designed to be tested on the ATE in the same manner as a typical UUT except that no additional ID shall be required. In this context shorting plugs and test cables are not considered IDs.

5.2.6 Identification. All elements of the ID shall be identified in accordance with the requirements of MIL-N-18307.

5.2.7 Identity checks. The ID must contain circuitry permitting its identification by the program (TP). If ID identity cannot be ascertained electrically with high confidence, the operator shall be so informed and instructed to check identity visually.

5.2.8 Safe-to-turn-on test. IDs shall be designed to accommodate safe-to-turn-on testing if there is a possibility of ID conditions that could damage the UUT, ID or ATE. The test shall not be restricted to power lines; signal lines must also be considered within the limits of the ATE capability.

5.2.9 ID self-test. IDs shall be designed to accommodate self-testing by the test program for the UUT, with the UUT connected if possible. If the complexity of the ID is such that evaluation of the performance of the ID requires the use of shorting plugs and/or test cables, the ID shall be treated

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as a typical UUT; performance and diagnostic tests are to be performed as required and a separate TP and TPI shall be provided and applicable sections of this standard shall apply. When a failure is detected in the overall performance of the ID, the ATE display/printout shall indicate the maintenance action or the running of a DFI routine.

5.2.10 Test points. IDs shall be designed to provide access for repair and troubleshooting. The test points shall be provided, when appropriate, to ensure ID maintainability and/or performance of any of the testability requirements. Also, IDs shall be provided with test points to enable measurement of necessary input/output and circuit parameters for alignment of the ID, introduction of any necessary functional inputs and/or dummy loads necessary to conduct a test, or to monitor ID test signals undistorted by the ATE.

5.2.11 BIT/BITE. BIT/BITE shall be an integral part of ID design when BIT/BITE is the most appropriate means of ensuring the testability and maintainability of the ID.

5.2.12 Mechanical considerations.

5.2.12.1 Size and weight. Each ID shall be small enough to permit both the ID and the UUT to be physically supported by the ATE. The weight of that portion of the ID including cables that must be fastened to the ATE shall not exceed 40 pounds. The total weight of an ID shall not exceed the requirements of MIL-STD-1472. Modifications of this requirement may be authorized consistent with the ATE constraints.

5.2.12.2 Holding fixture. When required by a particular UUT, and in addition to the ID, a holding fixture shall be provided as part of the TPS.

5.3 Detailed requirements for TPSD. The TPSD is the Data Item Description (DID) which establishes the style, format, structure and content preparation instructions for the data generated to support the TP (see 6.1). The data consists of the OTPI and MTPSI. The data supports the delivery of the OTPS and is used in conjunction with an ATE system. The OTPI and MTPSI data are required at the Intermediate and Depot levels of maintenance.

5.4 Detailed requirements for Engineering Support Data (ESD). The ESD shall be prepared to describe all OTPS documentation essential to meet the objective of autonomous organic maintenance support. The ESD shall provide a full comprehension of the intent, design, structure and interrelationship of all OTPS elements to enable Cognizant Field Activities (CFA) to maintain or recreate the test program. ESD shall consist of the following elements depending on the test requirements for the UUT, the capability of the ATE, and the requirements of the work authorization document (see 6.1).

a. Test Strategy Report (TSR).

b. ATPG Support Data.

c. TPS Source Data/Computer Program Aids.

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5.5 Computer program aids. All software associated computer program aids, and methodology documentation required to develop and maintain the TPS or used by the contractor which are not commercially available to the Government, shall be provided. The aids developed by the contractor shall be provided on the same media used by the contractor, as well as hard copy of the source code.

5.6 Preparation for delivery.

5.6.1 Preparation of magnetic media. Magnetic tapes, discs and other program media shall be packaged in barrier material in accordance with MIL-B-81705 and DOD-HDBK-263, Class 2, requirements.

5.6.2 Marking of shipping containers. All deliverable items shall be marked in accordance with MIL-STD-129.

5.6.3 Physical protection. The requirements of MIL-E-17555 shall be met, unless otherwise specified.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Data requirements. The following Data Item Descriptions (DIDs) must be listed, as applicable, on the Contract Data Requirements List (DD Form 1423) when this standard is applied on a contract, in order to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.4.1, 4.4.2	DI-ATTS-80281	Test Program Set Integration Log Book	
4.4.1, 4.4.2	DI-ATTS-80282A	Test Program Set (TPS) and Operational Test Program Set (OTPS) Acceptance Test Procedures (ATPs)	
4.4.1, 4.4.2	DI-ATTS-80283A	Test Program Set (TPS) and Operational Test Program Set (OTPS) Acceptance Test Report (ATR)	
4.5.2	CI-CMAN-80858	Configuration Management Plan	
4.5.2.1	DI-CMAN-80639 DI-CMAN-80640 DI-CMAN-80641	Engineering Change Proposal Request for Deviation Request for Waiver	

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Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.5.2.2	DI-E-2039	Configuration Status Accounting Reports	
5.3	DI-ATTS-80284A	Test Program Set Document	
5.4	DI-ATTS-80285A	Engineering Support Data	

The above DIDs 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 DIDs are cited on the DD Form 1423.

(Data item descriptions related to this standard and identified in Section 6 will be approved and listed as such in DoD 5010.12-L, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2 Subject term (key word) listing.

Automatic test equipment
Automatic test generation
Configuration management
Data requirements
Digital test program comprehension
Engineering support data
First article acceptance
Interface device
Operational test program set
Production acceptance test
Supplementary data
Test accuracy ratio
Test program
Test program instruction
Test program set
Test program set document
Test program set integration
Unit under test
Validation
Verification

6.3 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.

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Custodians:
Navy - AS

Review Activities:
Navy - EC, SH

Preparing Activity
Navy - AS
(Project No. ATTS - NP03)

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APPENDIX A

STANDARDIZATION OF MESSAGES FOR AUTOMATIC TEST EQUIPMENT (ATE)

10. SCOPE

10.1 General. This Appendix contains the requirements for standardizing the format of operator instructions and messages specified by the test engineer for display on the Cathode Ray Tube (CRT), printer or other ATE I/O media. The Test Program Instruction (TPI) section of the Test Program Set Document (TPSD) shall contain those messages which are not capable of being readily supplied on the ATE communication media. This Appendix is a mandatory part of this standard. The information contained herein is intended for compliance.

10.2 Purpose. This Appendix establishes standardized display format statements developed to deal with most situations encountered by the operator in the functioning of an ATE station. The I/O device shall display those messages necessary for the execution of the program.

20. REFERENCED DOCUMENTS

20.1 Government documents. The following documents of the issue listed in the Department of Defense Index of Specifications and Standards (DODISS) and its supplements, form a part of this appendix to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-12	Abbreviations for Use on Drawings, Specifications and in Technical Documents

30. GENERAL REQUIREMENTS

30.1 Message format. Messages shall be designed in a manner consistent with the capabilities of the ATE I/O media and in a format which facilitates ease in reading. Messages shall be separated into single steps or instructions which require a response prior to the next instruction being supplied. Detailed requirements and specific examples of standardized messages and formats are provided in Section 40. Formats shall be arranged to avoid the splitting of words or symbols between lines.

30.2 Abbreviations. All message statements must be concise and unambiguous. Clarity is of prime consideration in using any abbreviation. If the items to be abbreviated appear on the approved list (see Table B-1), only the approved abbreviation is to be used.

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TABLE A-I
STANDARD LIST OF ABBREVIATIONS

WORD OR WORD COMBINATIONS	ABBREVIATION
ADJUSTMENT/ADJUST	ADJ
ALTERNATING CURRENT	AC
ALTERNATE	ALTN
AMPERES	A
APPROXIMATELY/APPROXIMATE	APROX
ASSEMBLY	ASSY
AUXILIARY	AUX
AVAILABLE	AVAIL
BUILDING BLOCK	BB
BUILT IN TEST	BIT
BUILT IN TEST EQUIPMENT	BITE
CALIBRATE	CAL
CATHODE RAY TUBE	CRT
CHANNEL	CHAN
CHECK	CHK
CIRCUIT	CKT
CONFIGURATION	CONFIG
CONTINUE	CONT
CURRENT	CUR
DATA TRANSFER UNIT	DTU
DECIBLES	DB
DEGREES	DEG
DIAGNOSTIC	DIAG
DIGITAL SUBSYSTEM	DSS
DIRECT CURRENT	DC
DISCONNECT	DISC
DISPLAY	DISPL, DSP
ELECTRONIC MODULE	EM
EQUAL TO	EQ
EXTERNAL	EXT
FAILURE	FLR
FARADS	F
FEET	FT
FILTER	FL
FREQUENCY	FREQ
GIGA	G
GREATER THAN	GT
GROUND	GND
HERTZ	HZ
HENRIES	H
HORIZONTAL	HORIZ
IDENTIFY/IDENTIFICATION	IDENT
INDICATOR	IND
INITIAL/INITIALIZE/INITIATE	INIT
INSTRUCTION	INST
INTERFACE DEVICE	ID

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TABLE A-I (Continued)
STANDARD LIST OF ABBREVIATIONS

WORD OR WORD COMBINATIONS	ABBREVIATION
INTERFACE	INTFC
INTERMEDIATE FREQUENCY	IF
INTEGRATED CIRCUIT	IC
KILO (PREFIX)	K
LESS THAN	LT
LIMIT	LIM
LOWER LIMIT	LL
MAINTENANCE INSTRUCTION MANUAL	MIN
MANUAL	MNL
MAXIMIZE/MAXIMUM	MAX
MEGA (PREFIX)	M
MICRO (PREFIX)	U
MILLI (PREFIX)	MILLI
MINIMIZE/MINIMUM	MIN
MISSION	MSN
MONITOR	MON
NANO (PREFIX)	N
NOT EQUAL TO	NE
NO-GO HI	NH
NOMINAL	NOM
NUMBER	NO.
OHM	OHM
OPERATE/OPERATOR	OPR
OSCILLOSCOPE	SCOPE
OVERFLOW	OVFL
PARAMETER	PRMTR
PERCENT	PCT
PICO (PREFIX)	P
POSITION	POSN
POSITIVE	POS
POTENTIOMETER	POT
POWER	PWR
PRINTED CIRCUIT BOARD	PCB
PROBABLE CAUSE OF FAILURE	PCOF
PROCEDURE	PROC
RADIO FREQUENCY	RRF
READY-FOR-ISSUE	RFI
REFERENCE	REF
REMOVE	REM
REMOVE AND REPLACE	R/R
REPEAT	RPT
REQUIRED	REQD
RESISTORS/RESISTANCE	RES
SECOND (TIME)	SEC
SENSITIVE	SENS
SIGNAL	SIG

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TABLE A-I (Continued)
STANDARD LIST OF ABBREVIATIONS

WORD OR WORD COMBINATIONS	ABBREVIATION
SIGNATURE	SIGNTR
STATION	STA
STATUS	STAT
SWITCH (NOUN)	SW
SYSTEM	SYS
TEMPERATURE	TEMP
TEST PROGRAM INSTRUCTION	TPI
TEST POINT	TP
TESTING DATA TABLE	TDT
TOLERANCE	TOL
TRANSFORMER	XFMR
TRIGGER	TRIG
UNIT-UNDER-TEST	UUT
UNKNOWN	UNK
UPPER LIMIT	UL
VERTICAL	VERT
VOLTMETER	VM
VOLTS: VOLTAGE	V
WEAPONS REPLACEABLE ASSEMBLY	WRA

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30.2.1 Individual words. Individual words and word combinations can only be abbreviated when their meaning is unquestionably clear. When in doubt, the word(s) must be spelled out.

30.2.2 Five letter words. In general, words having five (5) letters or less are not abbreviated, except those established by long-standing practice, e.g., the letter V is used to abbreviate "Volts."

30.2.3 Word combinations. Word combinations in general are not abbreviated; there are, however, some exceptions. Approved abbreviations for word combinations are listed in Table B-I.

30.2.4 Abbreviations in Table B-I. Only the abbreviations identified in Table B-I are to be displayed. This table will be updated to include new abbreviations, as deemed necessary.

30.2.5 MIL-STD-12. The abbreviations listed in Table B-I reflect the requirements of MIL-STD-12.

30.3 Instructions. Keep the display message simple. Instructions should be easily remembered and executed.

30.4 Operator intervention. There shall be an "-OPR ACTION-" statement when operator intervention is required.

30.5 Readability. An effort should be made to increase readability whenever possible. As an additional aid to readability, vertical and horizontal centering of the message should be used.

30.6 Failure message. "Failure" messages must indicate the "failed" test.

30.7 Printed displays. All displays containing information necessary for the documentation of the test in process should be printed out on a teletypewriter or line printer.

30.8 Operator message. When the required operator action is described in the TPI section of the TPSD, the following message, properly centered, should be displayed:

SEE TPSD TABLE 1-1 TXXX FOR INST

40. STANDARDIZED MESSAGES

40.1 General. Standardized display messages have been developed for most common situations faced by the programmer. When a special message is necessary, standardized messages should be used as guidelines for preparing the special message. The use of a standardized message, where applicable, is mandatory.

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40.2 Identity checks. The identity checks verify that the proper UUT/ID(s) is (are) connected to the ATE for the selected test program. When the identity check results in a NOGO condition, the program shall display a message and execute an instruction to halt the test program. Then the operator is informed of the improper ID or UUT signature on the CRT display.

40.3 Operator intervention. The operator action statement requires operator intervention during test program execution and will generally fall into one of the following categories: UUT adjustment, UUT response monitoring or end of program. Standard message formats for each of these categories described in the subsequent paragraphs.

40.3.1 UUT adjustment. If the UUT and/or ID contains switches, calibration controls and/or other adjustment features, display statements will generally have to be composed to manually change their position during the execution of a test program. Unless otherwise indicated, it is assumed that all controls and switches to be repositioned/adjusted are located on the UUT. If they are elsewhere, their location must be identified on the displayed instructions. If more than one switch or control must be repositioned, the required settings shall be described in the TPI section of the TPSD or displayed. The operator display shall provide the direction for repositioning settings one switch or control at a time with an operator action required to resume program execution after each section. The designations shown in these messages should be the marking engraved on the UUT (or the ID) and shall be highlighted by asterisks.

EXAMPLE 1

```
-OPERATOR ACTION-
CHANGE SWITCH A1 POSITION TO ON
FOR GAIN TEST
SEE TPI TABLE 1-2 TXXX FOR INST
```

EXAMPLE 2

```
-OPERATOR ACTION-
ADJUST "GAIN" POT FOR
1.9v to 2.1v OUTPUT
CONTINUE
DEPRESS YES
ADJUSTMENT IS NOT POSSIBLE
DEPRESS NO
```

Note: It is preferable to provide the actual voltage between which an adjustment can be made, than to indicate a nominal voltage and tolerance.

EXAMPLE 3

```
-OPERATOR ACTION-
PRESS AND HOLD "LAMP TEST" SWITCH
CHECK IF ALL LAMPS ARE LIT AND
REPLACE ALL LAMPS NOT LIT
DEPRESS YES TO CONTINUE
```

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40.3.2 UUT response monitoring. When the UUT contains indicator lights and/or meters, statements will likely have to be generated for visual response monitoring.

EXAMPLE

```
-OPERATOR ACTION-
CHECK "BIT FAIL" LIGHT
IF OFF, DEPRESS YES
IF ON, DEPRESS NO
SEE TPI TABLE 1-1 TXXX FOR INST
```

40.3.3 "End of Program" messages. In the "end of program" message it is understood that the required repairs will be accomplished off-line. The following examples of "end of program" messages are for TPs without fault isolation.

EXAMPLE 1

```
END OF PROGRAM
UUT FAULTY
TEST XXX FAILED
```

EXAMPLE 2

```
END OF PROGRAM
UUT GOOD
```

40.4 Fault isolation. "End of program" messages when fault isolation is provided are described in the following paragraphs. In both examples shown, any other component which could be the source of the problem will be listed in the TPI section of the TPSD or the display in order of lowest MTBF (Highest Failure Rate) to highest MTBF (Lowest Failure Rate).

40.4.1 Isolation to one component. In cases where fault isolation is provided and isolates to one component, the "end of program" message is:

EXAMPLE

```
END OF PROGRAM
UUT FAULTY
TEST XXX FAILED
(PERFORMANCE ROUTINE TEST NUMBER)
R/R Z1
```

40.4.2 Isolation to two or more components. In cases where fault isolation is provided and isolates to a group of two or more components, the "end of program" message is:

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EXAMPLE

END OF PROGRAM
UUT FAULTY
TEST XXX FAILED
(PERFORMANCE ROUTINE TEST NUMBER)
PROBABLE ORDER OF FAILURE-
R/R Z1, Z3, Z9

40.5 Probe message. A probe message shall contain, as a minimum, the component name and pin number to be probed. A period is to be used to separate the component reference designator from the pin number. For example, a message would read as follows:

PROBE U1.2

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of 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.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-STD-2077B (NAVY)	91/04/22

3. DOCUMENT TITLE
TEST PROGRAM SETS, GENERAL REQUIREMENTS

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code)	
COMMANDING OFFICER NAVAL AIR ENGINEERING CENTER SYSTEMS ENGINEERING AND STANDARDIZATION DEPT	(1) Commercial (908)323-2326	(2) AUTOVON 624-2326
ADDRESS (Include Zip Code) CODE 53 LAKEHURST, NJ 08733-5100	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703)756-2340 AUTOVON 289-2340	

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