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MANAGEMENT OF ELECTRONIC  
TEST EQUIPMENT

VOLUME I: PROGRAM OF ACTION

July 1986

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Frans Nauta

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LOGISTICS MANAGEMENT INSTITUTE  
6400 Goldsboro Road  
Bethesda, Maryland 20817-5886

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PREFACE

The Department of Defense (DoD) has a long history of problems with the acquisition and support of test equipment. In a previous report, Test Equipment Management, January 1985, we summarized the nature and extent of the underlying problems and recommended that the Assistant Secretary of Defense (Manpower, Installations, and Logistics), ASD(MI&L), take the lead in effecting needed improvements. The ASD(MI&L) concurred with that recommendation and established a "DoD Test Equipment Management Improvement Program" under the overall guidance of the Maintenance Directorate. This report presents a set of actions for that program.

The report is published in four volumes. Volume I presents a program of action for improving test equipment management and support within the DoD. Volume II reviews previous studies and initiatives pertaining to test equipment management and support. Volume III describes how the Military Services are organized to carry out that management and support. Volume IV reviews and assesses the adequacy of related DoD policy.

Throughout the report, all references to military organizations apply to the situation in early 1985. Subsequent organizational changes, such as the Navy's disestablishment of the Naval Material Command and the reorganization of Naval Electronic Systems Command into Space and Naval Warfare Systems Command, are not reflected in the text. As a result, several old office symbols and references are used. Similarly, several recent events regarding test equipment management and support may not be included.



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## Executive Summary

### MANAGEMENT OF ELECTRONIC TEST EQUIPMENT

Since the early 1970's, the Office of the Secretary of Defense and the Military Services have sponsored numerous studies of test equipment—manual and automatic test equipment and test program sets. Those studies have repeatedly documented the problems and identified solutions. Some solutions implementable through the acquisition process are being pursued: greater emphasis is being placed on support during development; procurement of test equipment is being delayed until weapons system designs stabilize; and standardized automatic test equipment is being developed. However, those solutions that require changes in the management and support of test equipment after it enters the inventory are receiving less attention. Recognizing this shortcoming, the Department of Defense (DoD), in June 1985, established the DoD Test Equipment Management Improvement Program and prescribed 11 objectives. We now set forth a program of action to achieve those objectives.

To give the program the impetus and direction it needs at its outset, we recommend that the Assistant Secretary of Defense (Acquisition and Logistics) take four steps immediately

1. **Prepare and issue a DoD instruction on management and support of common test equipment.** The draft instruction we have developed contains the principal measures we think necessary: establishing a single manager for common test equipment within each Military Service, giving preference to procurement of commercial off-the-shelf test equipment rather than military specification equipment; employing a DoD-wide preferred items list for common test equipment, and using contractor maintenance and supply support when cost effective.
2. **Request the Defense Science Board to convene a task force to investigate the duplication between the test software required to support the manufacture of weapons systems and that required to maintain them.** We believe that the DoD can reduce substantially the acquisition costs for test program sets used in maintenance by making better use of those used in the manufacturing process. Additionally, we believe that such a task force would provide the best forum to develop recommendations on improving DoD policy regarding test program set acquisition, quality assurance, and

support. Our draft Defense Science Board Task Force Charter will aid in convening such a task force.

3. **Task the Defense Logistics Agency to make the Federal Catalog System a more effective instrument for standardization of, among other things, test equipment across the DoD.** Several shortcomings of the Federal Catalog System need to be corrected before standardization of test equipment can become a reality within the DoD. They include enforcing system discipline to ensure all items are cataloged, enhancing data screening procedures to eliminate duplicate stock numbers for the same item, and upgrading data base search capabilities to facilitate retrieval of needed data.
4. **Request the Joint Logistics Commanders to establish a metrology and calibration improvement program for development and execution by the Joint Technical Coordination Group for Metrology and Calibration (JTTCG-METCAL).** The JTTCG-METCAL, a Joint Service group responsible for coordinating the DoD METCAL Program, has given little attention to management improvements or correction of existing technical deficiencies. We believe a comprehensive METCAL improvement program is needed, one that encompasses, among other things, standardization of calibration procedures and equipment, modernization of calibration methodologies and equipment, development of calibration technology for automated test equipment, and development of plans for wartime calibration services.

Some actions pursuant to those steps plus other essential actions can be initiated by the Director, Maintenance Policy or the Military Services.

- Revise DoD instructions or directives to stress test equipment standardization in the acquisition process.
- Revise DoD policy on funding of software maintenance to eliminate the artificial distinction between funding of hardware and software changes.
- Obtain accurate and timely information on test equipment requirements and inventories.
- Designate a single manager for common electronic test equipment in each Military Service.
- Compile a DoD preferred items list for common electronic test equipment
- Consolidate DoD procurements of common test equipment.
- Develop automated management information systems for monitoring the performance of automatic test equipment and associated test software.
- Develop procedures to accommodate commercial off-the-shelf components in automatic test equipment.
- Correct shortcomings in training of personnel in the use, calibration, and repair of test equipment.

- Refocus test equipment research and development efforts to reduce duplication and meet urgent needs, such as software tools to verify and validate test requirement specifications.

The actions comprise a comprehensive agenda for the DoD Test Equipment Management Improvement Program. They enable the DoD to move forward with its program to bring under control the test equipment problems that have for so long plagued the Department.

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## 1. INTRODUCTION

### BACKGROUND

Since the early 1970's, the Office of the Secretary of Defense (OSD), the Military Services, and industry have sponsored numerous studies of test equipment, formed several joint panels to investigate selected technical issues, and initiated a variety of programs to correct identified problems. Despite such attention, the Department of Defense (DoD) still faces many significant problems with fielded test equipment.

In a previous report, Test Equipment Management, January 1985, we summarized the nature and extent of those problems and recommended that the Assistant Secretary of Defense (Manpower, Installations, and Logistics), ASD(MI&L), take the lead in effecting needed improvements in test equipment management and support. The ASD(MI&L) concurred with that recommendation and established, via an action memorandum for the Under Secretaries of the Military Departments, dated 26 June 1985, a "DoD Test Equipment Management Improvement Program" under the overall guidance of his Maintenance Directorate. In that memorandum, he specified the following program objectives:

- (1) Develop a DoD-wide preferred items list for electronic test equipment, as well as procedures to assure that program and item managers use the items on that list to satisfy electronic test equipment requirements.
- (2) Maximize standardization of manual and automatic test equipment to the extent feasible and practical.
- (3) Maximize use of commercial, off-the-shelf test equipment to the extent feasible and practical.
- (4) Increase consolidation of manual and automatic test equipment procurements, including both joint and multiyear procurements.
- (5) Improve logistics supportability of manual and automatic test equipment throughout the equipment life cycle.
- (6) Establish systematic replacement programs for general-purpose manual and automatic test equipment.

- (7) Reduce numeric shortfalls in manual and automatic test equipment to satisfy wartime requirements.
- (8) Improve availability, utilization, and performance of automatic test equipment, including test program sets, installed below depot level
- (9) Develop, promulgate, and implement DoD policy on the management and support of test equipment.
- (10) Institute reporting of automatic test equipment performance and availability.
- (11) Establish the collection of test program sets run times and performance.

Since the issuance of that action memorandum, the Maintenance Directorate has been coordinating DoD-wide efforts to implement the DoD Test Equipment Management Improvement Program. This report bolsters the Maintenance Directorate's initiative by first detailing a comprehensive program of action and then recommending several of those actions for immediate implementation by the Assistant Secretary of Defense (Acquisition and Logistics), ASD(A&L).

#### PROGRAM STRUCTURE

The proposed program includes both OSD and Military Service actions. The former are presented in Chapter 2. The latter, which are provided in Chapter 3, are divided into two categories: those pertaining to the management and support of manual electronic test equipment (ETE) and those pertaining to the management and support of automatic test equipment (ATE) and test program sets (TPSs). This division is necessary because the problems in managing and supporting ETE differ substantially from those in the ATE and TPS areas. Many of the Military Service actions need to be addressed and resolved in a common framework through joint regulations, procedures, and initiatives. Finally, in Chapter 4, we recommend several near-term actions for the ASD(A&L) that should serve as the cornerstone of an aggressive DoD Test Equipment Management Improvement Program.

#### RATIONALE AND REPORT ORGANIZATION

Test equipment management is a complex, multifaceted issue. It is also dynamic, as evidenced by the many previous and ongoing initiatives to identify and implement improvements, and by the

rapid technological advances that are occurring in the area of test equipment. As a consequence, much of the rationale for the proposed management actions is provided in Volumes II, III, and IV of this report. Volume II reviews previous studies and initiatives pertaining to test equipment management and support; Volume III describes how the Military Services are organized to carry out that management and support; and Volume IV reviews and assesses the adequacy of DoD policy. A careful reading of Volume II shows that only a few of the proposed actions are new; most were originally proposed in previous studies but were not acted upon either by OSD or the Military Services.

## 2. OSD ACTIONS

The actions proposed for OSD can be broken down into six categories: (1) strengthening DoD policy, (2) providing test equipment management information, (3) improving the Federal Catalog System, (4) overseeing the DoD Test Equipment Management Improvement Program, (5) reducing the acquisition cost of test software, and (6) improving metrology and calibration services.

### DoD POLICY

Four major issues need to be addressed in the area of policy. These issues are discussed below.

#### Test Equipment Management and Support

The DoD lacks clear explicit policy on test equipment management and support. Much of the current policy only indirectly applies to test equipment. Because the DoD's investment in test equipment is so large – over \$30 billion, and increasing rapidly – and problems with test equipment have been so persistent, this situation needs to be corrected.

Action #1. Develop and promulgate DoD policy on test equipment management and support.

#### Prime Equipment Acquisition

The principal policy guidance for acquisition program managers is provided by the 5000-series of directives and instructions. Those directives and instructions include references to standardization objectives, but they pertain mainly to prime equipment, parts, components, and subsystems, with little direct applicability to support and test equipment. They need to state that standardization of test equipment is a logistics objective in prime equipment acquisition.

Action #2. Revise DoD Instruction 5000.2, "Major System Acquisition Procedures," 8 March 1983, to require information on the extent to which common test equipment will be used and justification for any new peculiar test equipment. For example, in Enclosure 5 ("Format for Integrated Program Summary"), under Section 7 ("Readiness, R&M [Readiness and Maintainability], Support, and Personnel"), add a paragraph requiring identification of peculiar test equipment planned, commitment to using standardized common test equipment where possible, and justification for new peculiar test equipment.

Action #3. Revise DoD Directive 5000.39, "Acquisition and Management of Integrated Logistic Support for Systems and Equipment," 17 November 1983, to include commonality of test equipment as a logistics objective. For example, in Enclosure 3 ("Support Considerations in the Acquisition Process") emphasize standardization of support and test equipment; and in Enclosure 4 ("Program Manager ILS [Integrated Logistic Support] Responsibilities"), under paragraph 2.d, include the use of contractor incentives to reward prime equipment designs permitting maximum use of existing support and test equipment when cost effective.

#### Software Maintenance Funding

Current DoD policies require that maintenance of fielded test programs (as well as the software embedded in the weapon) be paid from Operations and Maintenance funds, except for software changes that result from hardware modifications. The latter are funded from Research and Development and/or procurement funds associated with the hardware modification. Because Operations and Maintenance appropriation requests are frequently subjected to across-the-board reductions and software support tends to lose its weapons system identity in the planning, programming, and budgeting system, TPS item managers frequently lack the resources to maintain their TPSs. One alternative for generating the needed resources would be to fund software maintenance from Research and Development or procurement funds, thus correcting an artificial distinction in the funding of hardware and software changes.

Action #4. Consider revision of DoD policy for the funding of software maintenance.

#### Standardization

Current policies pertaining to standardization and competition in acquisition are often perceived to be conflicting. This situation needs to be clarified.

Action #5. Revise DoD Directive 4120.3, "Defense Standardization and Specification Program," 10 February 1979, to include procedural guidance on the use, maintenance, and application of preferred items lists in controlling entry of new test equipment into the DoD inventory.

Action #6. Revise DoD Directive 4245.9, "Competitive Acquisitions," 17 August 1984, to include policy and procedural guidance on exceptions to competition requirements permitted under law, including standardized items under formal standardization programs as identified on preferred items lists.

## MANAGEMENT INFORMATION

The current planning, programming, and budgeting system process provides little information on test equipment requirements, including logistic support. Other reporting systems, such as the Joint Chiefs of Staff's Unit Status and Identity Report and DoD's mission-capable reporting system, similarly overlook test equipment. To exercise its oversight responsibility for test equipment, OSD requires more information than is currently available.

Action #7. Require the Military Services to provide backup data to their test equipment budget requests in the form of a support and test equipment master plan. That plan should include aggregate data on current test equipment inventory, obsolescence, planned modernization, and wartime contingency requirements.

Action #8. Consider revision of DoD Instruction 7730.25 "Materiel Condition Reporting for Mission-Essential Systems and Equipment," 22 May 1980, to include large-scale ATE used at field-level maintenance activities as mission-essential equipment.

Action #9. Require the Military Services to develop a methodology for including test equipment in their readiness reporting systems such that the impact of test equipment status and support on weapons system readiness can be monitored.

## FEDERAL CATALOG SYSTEM

One of the keys to increased standardization of test equipment in the DoD is the Federal Catalog System. That system currently has several shortcomings which need to be corrected before standardization of test equipment can occur. The Defense Logistics Agency is aware of those problems, but it needs support, as well as resources, to make the needed improvements such as the widespread installation of the DIDS (Defense Integrated Data System) Remote Terminal System for on-line access. This and other improvements to the Federal Catalog System will be an evolutionary, not a short-term, process.

Action #10. Task the Defense Logistics Agency to undertake a Federal Catalog System Improvement Program to alleviate deficiencies in the system.

## PROGRAM OVERSIGHT

The largest and most important part of the program consists of the actions to be taken by the Military Services to improve their management and support of test equipment. An outline of the actions we believe are necessary is provided in Chapter 3. As the office of primary responsibility for the DoD Test Equipment Management Improvement Program, the Maintenance Directorate needs to monitor the development and implementation of those actions.

## TEST SOFTWARE ACQUISITION

The acquisition of automatic testing software, which is the test program portion of the TPS, is singled out for separate investigation. Current acquisition policies and procedures invariably result in a strict dichotomy between test software developed by manufacturers for in-plant use—such as quality assurance and manufacturing process control—and test software developed either by the same prime contractor, an ATE contractor, or a third-party TPS development contractor for field-level maintenance support of the prime equipment. Considerable duplication exists between these two types of test software for functional testing of prime equipment modules (circuit cards and higher assembly levels), but they are normally developed independently. In many cases, the Government ends up paying twice for essentially the same software. We believe that the development cost of TPSs can be reduced substantially if the DoD exploits the duplication in functional testing requirements for TPSs. The best forum to explore this issue would be a Defense Science Board task force.

*Action #11.* Request the Defense Science Board to convene a task force to examine the extent of duplication between test software required for manufacturing process control and that for maintenance support at all maintenance levels; identify the changes required in current acquisition policies, procedures, and practices to exploit this duplication to reduce the acquisition cost of TPSs; and develop recommended policy and procedures for DoD-wide TPS acquisition, quality assurance, and support.

## METROLOGY AND CALIBRATION

In accordance with DoD Directive 4155.1, "Quality Program," 10 August 1978, the ASD(A&L) is responsible for assuring that effective metrology and calibration services are provided, and a Joint Service committee, the Joint Technical Coordinating Group for Metrology and Calibration

(JTCG-METCAL), is responsible for coordination of the DoD METCAL Program. The JTCG-METCAL has sponsored several regional consolidation studies that, in some cases, have resulted in reducing the number of calibration activities. In other areas, such as standardization of calibration procedures and equipment, development of calibration technology for ATE, and modernization of calibration methodologies and equipment, the JTCG-METCAL has been less active. One of the factors contributing to the latter situation is that the JTCG-METCAL lacks authority and clear direction. The Tri-Service Metrology Research, Development, and Engineering Plan, recently issued by the JTCG-METCAL, is responsive to projected metrology and calibration requirements for new, technically advanced weapons systems, but does not address needed management improvements. Furthermore, that plan is focused on future technology requirements, with existing technical deficiencies accorded little emphasis. This oversight needs to be corrected.

Action #12. Task the JTCG-METCAL to develop a comprehensive METCAL Improvement Program that considers, as a minimum, the following issues:

- (1) Standardization on three levels of calibration
- (2) Standard DoD calibration procedures, equipment, and documentation
- (3) Actions to ensure maximum reliance on autocalibration for new generations of programmable test equipment
- (4) Methods for monitoring the condition of calibration equipment and plans for systematic replacement of obsolete calibration equipment, including introduction of automated calibration equipment
- (5) Single DoD environmental standard for all calibration laboratories
- (6) Feasibility and cost effectiveness of remote calibration
- (7) Standard methodology for determining calibration intervals based on cost effectiveness, with differential reliability targets for each class of test equipment based on criticality and out-of-tolerance rate
- (8) Policies, plans, and procedures for calibration services in wartime
- (9) Certification program for all calibration activities supporting the DoD
- (10) Consolidation of test equipment calibration and repair activities

- (11) Standard methodology for calibrating ATE
- (12) Automation of administrative procedures through the use of memory chips in lieu of manual calibration labels.

Action #13. Following review of, and concurrence with, the METCAL Improvement Program, task the Military Services to implement the program and establish review procedures to assure that the program is successfully implemented.

Action #14. Provide direct funding to the National Bureau of Standards for a research and development program in ATE calibration to develop the hardware, software, and procedures suitable for the calibration of field- and depot-level ATE. The JTCG-METCAL would be an ideal monitor for such a program.

### 3. MILITARY SERVICE ACTIONS

This chapter identifies a number of Military Service actions that are key to the success of the DoD Test Equipment Management Improvement Program. The actions are divided into three categories: (1) those aimed at strengthening the management structure, (2) those directed toward improving ETE management tools and procedures, and (3) those directed toward improving ATE/TPS management. A fourth category, revising Military Service regulations in response to changes in DoD policy is not discussed, even though it is inherent in the program.

Some of the actions entail the development and installation of improved management tools that appear to qualify for support from DoD's "Productivity-Enhancing Capital Investment Fund." [That fund, which consists of approximately \$180 million (fiscal year 1986 budget request) along with \$50 million from each of the Military Departments, is to be used in promoting productivity-enhancing investments.] We believe that OSD should provide full or partial funding for those actions, both to ensure rapid installation of the needed management tools as well as to promote their use throughout the DoD. This support also will indicate to the Military Services the importance that OSD attaches to the DoD Test Equipment Management Improvement Program.

#### MANAGEMENT STRUCTURE

Effective and efficient management of common test equipment can only be accomplished through a centralized manager who has the requisite authority and resources to carry out assigned responsibilities.

#### Centralizing Test Equipment Management

Each of the Military Services has taken a different approach to centralizing management responsibility for common ETE. Only the Army has a single organization responsible for integrated management (funding, acquisition, and support) of all common ETE. The Air Force has dispersed management responsibilities among various organizations. Although the Naval Electronic Systems Command is the Navy's central manager of common ETE by policy, it has little influence

over the test equipment actions undertaken by the Naval Air Systems Command, for example. In both the Air Force and Navy, the test equipment manager does not have the authority to challenge the test equipment planned or selected for a new weapons system program. Without that authority, the test equipment manager cannot be effective.

Action #1. Each Military Service designate a single manager for common ETE. The single manager should be assigned responsibility for controlling the entry of new test equipment into the inventory, and authority to impose restrictions on early test equipment plans and subsequent selections for new weapons system programs, and act as final approval authority for new test equipment.

#### Providing the Management Resources

Many of the problems encountered by the Military Services in test equipment management are caused by shortages in experienced personnel. The development and execution of the DoD Test Equipment Management Improvement Program will increase the requirements for experienced personnel, although only for a temporary period. Once the resulting management tools and procedures have been developed and implemented, test equipment management should be improved substantially. In the meantime, however, additional personnel resources will be required to ensure the job is done right.

Action #2. Provide personnel resources as needed to review, develop, coordinate, and implement provisions of the DoD Test Equipment Management Improvement Program.

#### ETE MANAGEMENT IMPROVEMENTS

The actions proposed in this section are intended to correct shortfalls in ETE management and support by improving management information, establishing more effective controls on the entry of new ETE into the DoD inventory, consolidating procurements of ETE, basing logistic support planning on cost effectiveness, instituting procedures for inventory and support management, and correcting personnel training shortcomings.

#### Improving Management Information

Each of the Military Services is developing an automated data base for common ETE, with the Army and Navy going one step further by developing a management information system

Those efforts are essential for improved management. However, they need to be extended to include peculiar ETE, as well as data related to logistic support and inventory management, such as distribution, procurement history, reliability, spare parts information, and vendor support termination date. The need for information on peculiar ETE arises because much of that equipment eventually could become categorized as common ETE. Effective management therefore mandates that the single manager for common ETE have full visibility of the peculiar ETE in the inventory.

Action #3. Develop and implement automated management information systems for common and peculiar ETE, including all data elements needed for effective management and support. Ensure that all ETE is cataloged such that each line item is identified by a single national stock number and its main function identifiable by its name. For ETE that is modular or equipped with different accessories or plug-ins, develop and implement a DoD-wide standard methodology for identifying the basic item as well as the associated accessory items.

#### Establishing a DoD Preferred Items List

The principal management tool for controlling proliferation of ETE is a preferred items list (PIL), which contractors are to screen when they prepare their support equipment recommendation data (SERD) or logistic support analysis record (LSAR) for a new weapons system program. The Military Services use various PILs, and contractors are required to determine whether test/measurement requirements can be met by an item of test equipment that is already in the Government inventory, preferably an item on the PIL. Furthermore, the contractor's recommendations are normally subject to Government review. In spite of the logic of this approach, the process is largely ineffective in stemming the proliferation of ETE. Among the reasons are that the SERDs are prepared after the prime equipment design has been frozen, inhibiting design tradeoffs against test equipment commonality; PIL data are often incomplete, out of date, and difficult to access; inter-service commonality/standardization is not considered; and the Government review process is limited by time, available engineering skills and experience, and inadequate guidance. These shortcomings can be resolved by stressing support equipment commonality in acquisition policy, as discussed in the preceding chapter, and by automating, consolidating, and streamlining the PIL screening, SERD/LSAR preparation, and review processes.

Action #4. Develop and implement a standard methodology for identifying standard or preferred items on each Military Service's automated data base for common ETE, and for extracting the items from those data bases and linking them together to form a DoD-wide PIL.

Action #5. Develop and install a standard data base management system to maintain the PIL (adding, deleting, or replacing items) and to permit data retrieval using selected keys, such as national stock number, nomenclature, and measurement capabilities from remote terminals. (This action is a candidate for OSD funding of capital investment.)

Action #6. Develop a Joint Regulation on the operating procedures for the DoD-wide PIL, specifying responsibilities and procedures for keeping the PIL up-to-date. [This regulation should be incorporated into the Joint Regulation on the Standard Integrated Support Management System, 27 May 1977 (Change 4, 17 September 1982).]

Action #7. Develop a Joint Guide for contractors and Government activities using the DoD-wide PIL. For contractors, the guide should describe how data can be retrieved and should prescribe formats for certifying that the PIL has been screened in preparation of the SERD and for justifying any need for nonstandard ETE. For Government activities, the guide should list the specific responsibilities of the various reviewing organizations and the specific methodology for review, including validation of the prime equipment measurement requirements by metrology and calibration centers.

#### Consolidating DoD Procurements

For various reasons, military design specifications are frequently used when commercial test equipment is available; local procurements of commercial test equipment are not centrally managed; commercial warranties are not exploited; and similar test equipment is reprocured under separate contracts year after year, resulting in unnecessary proliferation of different makes and models.

Action #8. Modify implementing instructions for DoD Directive 5000 37, "Acquisition and Distribution of Commercial Products (ADCP)," 29 September 1978, to ensure that they direct use of commercial products and distribution channels whenever practical.

Action #9. Develop a Joint Regulation on procurement of common ETE that considers the following management aspects:

- (1) Each Military Service is assigned DoD-wide procurement responsibility for a specific family of common ETE. This will eliminate duplicate testing of bid samples and consolidate ETE purchases. The regulation should include the specific ETE assignments of each Military Service, those assignments should be incorporated in the next revision of DoD Instruction 4115 1, "DoD Coordinated Procurement Program - Purchase Assignments," 1 September 1972.

- (2) Commercial common ETE is procured unless the required measurement capabilities, as verified by the cognizant metrology and calibration center, are not available in the commercial marketplace.
- (3) Procurement of new common ETE is competed in a two-step procedure of (a) purchase description and standard bid sample testing, and (b) invitation for bid to those vendors passing the first step. The regulation should include a standard bid sample test procedure for use by the Military Services.
- (4) A procurement contract for new common ETE, following the above procedure, is awarded on the basis of lowest (estimated) life cycle cost. The regulation should include a standard life cycle cost model for ETE which identifies the parameters to be estimated in the bid sample test. The parameter values may differ among the Military Services as a result of different operating and support practices, but only one parametric model should be used. That model should be prescribed only when the ETE will be supported organically.
- (5) Common ETE is procured generally on multiyear contracts, not to exceed 5 program years, to the extent first-year funds are appropriated for advance procurement budget requests in accordance with DoD Directive 7200.4, "Full Funding of DoD Procurement Program," 6 September 1983.
- (6) Reprocurement of common ETE is limited to specific items on the PIL, with contracts awarded sole source at or below established catalog prices in accordance with the standardization exception clause in the Federal Acquisition Regulation.
- (7) Available commercial warranties on common ETE, offered at no cost, are exploited to the maximum extent, those offered at additional cost are evaluated on a life cycle cost basis and used if cost effective. The regulation should address this issue in some detail, pointing out the differences between dealer warranties and in-house service warranties where the manufacturer reimburses the military activity for repair work on items under warranty. Other types of warranties, such as extended life cycle warranties (i.e., contractor support agreements), also need to be addressed.

*Action #10* As part of the Joint Regulation, waive the requirement to use the Federal Supply Schedule for certain items of common ETE on the basis of the exception clause for "centralized items" in DoD Instruction 4140.14 "Local Purchase of Materiel from Federal Supply Schedules or the National Buying Program of the General Services Administration," 27 April 1962. Alternatively, develop a Memorandum of Understanding with the General Services Administration that limits the test equipment items on the Federal Supply Schedule to those on the DoD PIL.

### Issuing Logistic Support Policy

Since none of the Military Services has issued specific policy on maintenance of ETE, the same policies and procedures pertaining to prime equipment routinely apply to support equipment, even when the resulting maintenance concept for ETE is not cost effective. We believe that the maintenance concept for support equipment needs to place more emphasis on cost effectiveness. The DoD is a relatively small customer in the commercial ETE marketplace. That fact, coupled with rapid model changes in a competitive search for increasing market share, total configuration control by the manufacturer, and frequent proprietary limitations on technical data, justify the need for the DoD to develop a separate, well-defined maintenance policy for test equipment.

*Action #11. Each Military Service develops implementing guidance for maintenance of common ETE that considers the following characteristics:*

- (1) Ownership. Use life cycle cost analyses to determine criteria for lease-versus-buy decisions based upon the density of common ETE, with a lease decision normally including vendor support.
- (2) Repairable-Versus-Consumable. Establish dollar limits on the unit cost of common ETE below which items will be treated as consumables (several recent studies have found that repairing items costing less than \$200 may not be cost effective within the DoD)
- (3) Organic-Versus-Nonorganic Support. Base decisions regarding organic depot maintenance, interservice support, or contractor support for owned common ETE on cost effectiveness. The factors that should enter into this evaluation include maintenance intensity (density of ETE and its reliability), maintenance complexity (fault isolation resolution of the built-in test, feasibility of isolating failures to a single replaceable module based on accessibility, availability of schematics, and troubleshooting procedures); and logistics overhead costs associated with organic maintenance.
- (4) Forward Support. Tailor the maintenance plan for a new piece of commercial common ETE to the characteristics of the ETE, not those of prime equipment. Below depot support of common ETE is provided by a worldwide network of calibration and repair activities, including small detachments, mobile vans providing on-site calibration and simple repairs, and well-equipped shops. This support environment is substantially different than that for most prime equipment.
- (5) Uniform Repair Limits. Adopt a standard methodology for adjusting the maintenance expenditure limit for fielded test equipment such that the limit becomes zero at the end of the item's useful life.

- (6) Configuration Management. Institute configuration management procedures that permit substitution of interchangeable parts (i.e., same form, fit, and function) without untoward consequences in the use and organic support of the equipment. The adoption of commercial off-the-shelf test equipment means giving up configuration control to manufacturers who may substitute interchangeable parts as market conditions demand. In the case of commercial test instruments embedded in ATE, such procedures should include serial number tracking; for stand-alone common ETE, the procedures will be considerably simpler.
- (7) Calibration and Repair Procedures. Use the same activities to calibrate and repair common ETE. In contrast to the Army and Air Force, which consolidate these services, the Navy splits them among different activities, causing serious problems in the Fleet.
- (8) Availability. Include guidance on the computation of common ETE floats and revise current policies, as needed, to authorize floats for test equipment. The sole purpose of maintenance support for ETE is to ensure that the equipment is available in operating condition when and where it is needed. Consequently, any economic analysis of alternative support options should include the additional quantity of ETE ("float items") required to protect equipment availability when it is being repaired.
- (9) Overall Trend. As a result of the potential shortage in technical skills, stress nonorganic support of common ETE. Based on the characteristics of commercial ETE, the traditional approach of relying extensively on organic maintenance has lost much of its claim to cost savings. Recent studies have indicated that on a life cycle cost basis there is little difference between organic and vendor support of commercial test equipment.

#### Tightening Inventory Management

The Military Services need to improve long-range planning for ETE and to monitor more effectively the ownership and support costs of that equipment. The following actions are aimed primarily at strengthening these areas.

Action #12 Task the single managers for common test equipment to prepare annual support and test equipment master plans in support of budget submissions. The master plans should provide summary information on (1) test equipment inventory (quantities and costs) by standard work breakdown structure (common/peculiar), (2) percentage of test equipment that is obsolete, (3) funds required to replace obsolete items, (4) funds for spare parts provisioning for current test equipment inventory, (5) total wartime contingency requirements and the percentage covered by current and programmed test equipment, (6) similar information as in (1) through (5) for calibration equipment, and (7) extent of industrial preparedness and

contingency plans to meet inventory shortfalls in the event of mobilization per Defense Guidance.

Action #13. Include projected spares requirements in the same multiyear contract for the ETE itself. (The newly revised DoD Directive 7200.4, "Full Funding of DoD Procurement Programs," 6 September 1983, has eliminated the past prohibition on buying in anticipation of needs.)

Action #14. Institute a system for monitoring and resolving potential spare parts supply shortages for ETE that is organically maintained. This system may require entering in advance the manufacturer's support termination date in the PIL data base, estimating the remaining economic life of that item, and planning how that item should be supported. (Although primarily focused on prime equipment, DoD Directive 4005.16, "Diminishing Manufacturing Sources and Material Shortages Program," 16 May 1984, provides detailed guidance on this issue )

Action #15. In support of ETE replacement decisions, develop an economic assessment system that compares the support costs of fielded ETE with the amortized costs plus support costs of new ETE. A decision-tree approach may be the best format for addressing these types of recurring decisions.

Action #16. Develop and implement systematic replacement programs to avoid an inventory of obsolete ETE, either in technical or economic terms.

Action #17. Establish a Joint Service ETE Advisory Group to monitor ETE industry developments (technical trends, business policies, product line features, design standards for reliability and maintainability) as well as overall trends in prime equipment measurement requirements. It also should advise in PIL development and maintenance, review bid sample testing procedures and results, and advise on replacement programs.

#### Correcting Personnel Training Shortfalls

Even though training shortfalls have a considerable impact on test equipment management, test equipment managers are not responsible for the training of personnel that use, calibrate, or repair test equipment. Drawing upon the JTTCG-METCAL, which has a vote in the curriculum of the Joint Service calibration course at Lowry Air Force Base, Colorado, the test equipment community needs to influence the training of technicians that use and repair test equipment

Action #18. Require test equipment managers to review current training practices pertaining to test equipment use, calibration, and repair, to identify major shortfalls, and recommend improvements

#### ATE/TPS MANAGEMENT IMPROVEMENTS

The improvements outlined in this section are intended to correct shortfalls in management and support of ATE and TPSs by improving management information, instituting standard

management tools and procedures, tightening inventory management, supporting research and development efforts, and correcting personnel training shortcomings.

#### Improving Management Information

The Air Force recently installed an ATE management information system, separate from its standard maintenance data collection system, to monitor the utilization and readiness of field-level ATE. (The other Military Services use their standard data collection systems to provide information on ATE, but they do not provide all of the required information ) One disadvantage of the Air Force's approach, however, is that it places an additional reporting burden on ATE personnel in the field even though most of the needed information can be collected automatically by using the ATE computer.

Action #19. Develop a standard module for ATE executive software to accumulate a daily log of ATE usage, including identification of TPSs executed, their run time and results; and a log of ATE failures, downtime, and maintenance.

Action #20. Revise the executive software of existing ATE to incorporate the above module and add the appropriate output medium for storing the daily log.

Action #21. Develop a standard ATE management information system using the Air Force's system design as a point of departure but replacing the manually prepared inputs by the daily logs. Implement the standard system with procedures for transmitting the daily logs from all field-level ATE installations to a central dedicated computer system within each Military Service. (This action is a candidate for OSD funding of capital investment.)

#### Developing Improved TPS Management Procedures

The development, validation, and postfielding maintenance support and enhancement of TPSs is a complex process for which each of the Military Services has developed its own standards and procedures. Although past attempts to institute the same standards and procedures have not been successful, we believe that the Military Services need to strive toward adopting a single standard for the test requirements document (TRD), a single standard for TPS development and acquisition, and a common standard/guideline for TPS validation and verification. Furthermore, they should jointly develop a TPS improvement warranty concept for incorporation in TPS development contracts. Such

a concept could be used much like the reliability improvement warranties for hardware to motivate the contractor to improve the diagnostic performance and run time of TPSs. Other needed improvements in management procedures include the capability to conduct "should cost/performance" analyses for TPS development on the basis of documented test requirements (TRD). This capability is critical to budgeting for TPS development, evaluating TPS proposals, and assessing the cost effectiveness of various levels of diagnostic performances for TPSs. Finally, the Military Services need to strengthen their configuration management procedures for TPSs. The Navy has developed a powerful on-line, computer system, installed at the Fleet Analysis Center, Corona, California, to monitor the configuration and distribution of fielded TPSs. That system has broader application.

Action #22. Develop a single TRD standard, reconciling current differences among the Military Services, and issue the resulting standard as an update to Military Standard (MIL-STD) -1519 for use DoD-wide.

Action #23. Consolidate existing military standards and Military Service-peculiar specification documents for TPS development into a single standard for use DoD-wide. Promulgate Joint Service guides for TPS development and for TPS validation and verification.

Action #24. Develop a standard contracting clause to implement the TPS improvement warranty concept and provide guidelines for its application in the TPS development guide.

Action #25. Institute collection of TPS development cost, run time, and diagnostic performance data for purposes of building a TPS cost/performance analysis capability.

Action #26. Adopt the Navy's system for configuration and distribution management of fielded TPS for use throughout the DoD.

#### Developing Improved ATE Management Procedures

Design concepts for future ATE are based on standardizing architectures, interfaces, and languages; permitting substitution of various stimulus and measurement test instruments without the need for total redesign of the ATE software; and making extensive use of commercial test equipment. These concepts will introduce many new problems, particularly in the area of configuration management where the manufacturer will exercise control. The Military Services have not developed the procedures for resolving this problem. However, a partial solution may lie in the

institution of serial number tracking procedures for all commercial ETE embedded in ATE as tester-replaceable units.

Action #27. Develop and implement management procedures needed to accommodate commercial off-the-shelf test equipment in ATE.

#### Adopting Standard Support Tools

The private sector is a rich source of support tools for TPS development and maintenance. Unfortunately, the Military Services have been slow to adopt some of those tools, particularly the Automatic Test Program Generators (ATPGs) and engineering work stations. Among the dozens of available ATPGs – which consist of proprietary software designed to generate test programs for digital circuit cards with minimum user intervention, available today – the LASAR Version 6, marketed by Teradyne, Inc., is universally recognized as the most powerful and best-supported software package. It is installed at over 100 DoD contractor facilities and military activities in support of TPS development. Similarly, among the many engineering work stations for TPS support, the PAWS (Personalized ATLAS<sup>1</sup> Work Station), marketed by TYX Corporation, is the industry leader. The DoD needs to take maximum advantage of these and other tools that the private sector is developing. The alternative, Government-owned support tools, is not always the best option. We believe that the following action is a necessary first step.

Action #28. Develop generic specifications for needed test program support tools and procure the required quantities for installation at all activities responsible for TPS development and support. [This action is a candidate for OSD funding of capital investment.]

#### Supporting Research and Development Requirements

Each of the Military Services is sponsoring or conducting a variety of research and development projects in the area of automatic testing. Some of those projects duplicate what is being produced in private industry, others are duplicated among several research activities, some appear conceptually sound but have little practical utility, and a small number are designed to meet actual needs. It is clear that a thorough review of current research and development programs is required to

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<sup>1</sup>Abbreviated Test Language for All Systems

eliminate unneeded projects, to better coordinate the remaining projects, and to refocus research attention on those critical areas that are not receiving needed support. In the latter category are needed enhancements to ATLAS, software tools to verify and validate the TRD, and analog ATPGs.

Several research projects are designed to exploit artificial intelligence technology (expert systems or knowledge-based systems) to supplement the ATE/TPS diagnostic capability. They have some promise and should be continued, although with less duplication. Other than the Air Force, the Military Services are not pursuing straightforward data processing applications to supplement the ATE. The experience of the Military Airlift Command with its Automated Maintenance System at Dover Air Force Base, Delaware, has been most impressive and represents most, although certainly not all, of the gains that might be expected from much more sophisticated and expensive artificial intelligence approaches.

*Action #29.* Review current research and development programs in the automatic testing area to eliminate unneeded programs and improve DoD-wide coordination. Refocus efforts that are designed to meet urgent needs.

*Action #30.* Review Military Airlift Command's Automated Maintenance System and adopt a similar approach for the development of maintenance support tools supplementing ATE/TPS capabilities.

#### Correcting Personnel and Training Shortfalls

The problems with personnel and training for ATE operation and maintenance have been a recurring theme in most of the past studies of ATE. Although test equipment managers are not responsible for those aspects of ATE usage, personnel and training shortfalls have impacts that often are perceived as deficiencies in ATE itself.

*Action #31.* Drawing upon the findings and conclusions from previous studies regarding personnel and training requirements for ATE operation and maintenance, develop a joint specification of the needed skills and training, and correct current shortfalls.

#### 4. PROGRAM IMPLEMENTATION

One of the keys to a successful DoD Test Equipment Management Improvement Program is clear, strong direction from OSD, both in prescribing overall guidance and establishing priorities. Accordingly, we recommend that the ASD(A&L) issue a memorandum for the Under Secretaries of the Military Departments to (1) affirm his support for the DoD Test Equipment Management Improvement Program, (2) announce his near-term initiatives to bring that program to fruition, and (3) request their full cooperation in implementing the program.

We recommend that the ASD(A&L) include the following among his near-term initiatives.

First, prepare and issue a DoD instruction on the management and support of common ETE. The principal features of that instruction should include establishing a single manager for common ETE within each Military Service; emphasizing the procurement of commercial off-the-shelf ETE, rather than military specification equipment; and developing and employing a DoD-wide preferred items list for common ETE to minimize proliferation. A draft of the proposed instruction is provided as Appendix A.

Second, request the Defense Science Board to convene a task force to examine the duplication between test software required for manufacturing process control and that for maintenance support, and to identify ways to exploit that duplication to reduce the acquisition cost of TPSs. We believe that the DoD can reduce substantially the acquisition costs for test program sets used in maintenance by making better use of those prepared to support the manufacturing process. Additionally, the task force should be directed to recommend improvements in current policies and procedures regarding TPS acquisition, quality assurance, and support. To aid in convening such a task force, we provide a draft charter for the task force as Appendix B.

Third, task the Defense Logistics Agency to make the Federal Catalog System a more effective instrument for standardization of common test equipment across the DoD. Strengthening usage policies and enforcing system discipline are two improvements that are key to an effective Federal

Catalog System. Although this tasking goes well beyond the specific subject of test equipment, an improved Federal Catalog System is necessary to enable standardization of common ETE.

Fourth, task, through the Joint Logistics Commanders, the JTTCG-METCAL to develop a comprehensive METCAL Improvement Program. Such a program should focus on, but not be limited to, development of standard calibration procedures, equipment, and documentation; development of standard methodologies for determining calibration intervals based on cost effectiveness; automation of calibration as well as calibration management systems; consolidation of test equipment calibration and repair activities; improvements in ATE calibration; and plans and procedures for calibration services in wartime.

As opportunities develop, we recommend also that the ASD(A&L) propose modifications to DoD Instruction 5000.2 and DoD Directive 5000.39 to provide more explicit guidance on the use of common test equipment; and DoD Directives 4120.3 and 4245.9 to clarify procedures for acquiring preferred items of test equipment. These modifications are necessary to ensure consistency and clarity in DoD policies related to test equipment acquisition and support.

Although the problems associated with managing and supporting test equipment within the DoD have persisted for years, we believe that the actions recommended for the ASD(A&L) are feasible and would solve many of the problems.

APPENDIX A

DRAFT DoD INSTRUCTION ON MANAGEMENT AND SUPPORT  
OF TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE)

**Department of Defense**  
**INSTRUCTION**

NUMBER 4265 XX

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ASD(A&L)

**SUBJECT:** Management and Support of Test, Measurement, and Diagnostic Equipment (TMDE).

- References:**
- (a) DoD Directive 5000.39, "Acquisition and Management of Integrated Logistic Support for Systems and Equipment," 17 November 1983
  - (b) DoD Directive 4120.3, "Defense Standardization and Specification Program," 10 February 1979
  - (c) DoD Directive 5000.37, "Acquisition and Distribution of Commercial Products (ADCP)," 29 September 1978
  - (d) DoD Instruction 4115.1, "DoD Coordinated Procurement Program," 1 September 1972 (to be updated)
  - (e) through (u), see Enclosure 1

**A. PURPOSE**

This Instruction provides policy and procedures for acquiring, managing, and supporting test, measurement, and diagnostic equipment (TMDE), and assigns responsibility for the management of common TMDE within the Department of Defense (DoD)

**B. APPLICABILITY AND SCOPE**

1. The provisions of this Instruction apply to the Office of the Secretary of Defense (OSD), the Military Departments, the Organization of the Joint Chiefs of Staff, and the Defense Agencies (hereafter referred to collectively as "DoD Components") having responsibilities for the acquisition, inventory management, and support of TMDE, for the maintenance of defense systems and equipment, or for the readiness condition of mission-essential materiel

2. This Instruction pertains to all end items of TMDE developed, procured, or leased by DoD Components for which a DoD or contractor maintenance capability is anticipated.

C. DEFINITIONS

Terms used in this Instruction are defined in Enclosure 2

D. POLICY

1. General

a. The objective of life cycle management of TMDE is to assure, at minimum life cycle cost, the availability of operable TMDE when and where needed to meet supported weapons system readiness requirements in peacetime and sustainability requirements in wartime.

b. Management of common TMDE shall be coordinated through a DoD Common TMDE Program under the direction of the Assistant Secretary of Defense (Acquisition and Logistics), with the Maintenance Directorate being the office of prime responsibility for the DoD Common TMDE Program.

c. Each DoD Component shall designate a single manager to be responsible for its portion of the DoD Common TMDE Program and to control the entry of new items of common TMDE into its inventory

d. Each DoD Component single manager for common TMDE shall maintain full visibility of the Component's inventory of peculiar TMDE for the purpose of potential adoption of peculiar items as common items of TMDE.

2. Acquisition

a. Requirements for TMDE shall be established to meet prime equipment test and measurement requirements that have been verified by the materiel developer and validated by the DoD Component.

b. Prime equipment acquisition programs shall minimize, or eliminate where feasible and cost effective, requirements for peculiar TMDE and maximize the use of common TMDE in accordance with reference (a) to reduce the variety and numbers of TMDE items required by supporting maintenance units at all levels of maintenance

c. The entry of new TMDE into the DoD inventory in accordance with reference (b) shall be controlled by establishing and maintaining a DoD TMDE Standardization Program to minimize proliferation of different makes/models of common TMDE.

d. Procurement of common TMDE shall normally be limited to commercial off-the-shelf equipment in accordance with the policy of reference (c), but exceptions may be authorized where necessary or cost effective on a case-by-case basis under waiver procedures instituted by the DoD Components.

e. Each category of common TMDE shall be managed by a single assignee who is the primary inventory control agent with procurement responsibility for all DoD Components. Such assignments for TMDE shall be in accordance with the assignees for standardization under the Defense Standardization and Specification Program and conform to the purchase assignments provided in reference (d).

f. Candidate items of common TMDE shall be evaluated prior to procurement decisions in order to determine the most cost-effective item on a life cycle cost basis in accordance with the same management principles and objectives as established by reference (e) for major system acquisitions.

g. Cost analyses shall be conducted to determine the procurement approach most favorable to the Government, with lease of equipment and type of warranty accorded particular emphasis.

h. Common TMDE shall be procured to the maximum extent through multiyear contracts to meet planned DoD-wide requirements for each category of TMDE under the advance procurement authority for economic order quantity of reference (f)

i. Reprocurements of common TMDE, outside the original multiyear procurement contracts for those items, shall be permitted as an exception to meet unforeseen or unplanned TMDE requirements or attrition. Such reprocurements shall qualify for selected or sole-source contracting under the standardization exception clause of reference (g), as further amplified in reference (h), provided the items involved are included in the DoD TMDE Standardization Program in accordance with the provisions of reference (i).

j. All procurement contracts (both lease and buy) for common TMDE shall include the total range of needed logistic support items as determined by procurement approach and maintenance plan. Operator manuals, calibration procedures, and an operator training package (if necessary)

shall be included in all procurements. Repair manuals, spare parts, and a maintainer training package shall be included only to the extent that organic maintenance is planned.

k. Common TMDE shall be procured in sufficient quantities to support peacetime operating tempos as determined by unit authorizations and such maintenance floats as required to assure availability of TMDE in consonance with the readiness requirements of supported weapons systems established by DoD Components pursuant to reference (j).

### 3. Logistic Support

a. Maintenance plans for all TMDE shall be determined on the basis of cost and effectiveness over the projected life cycle. When the life cycle cannot be estimated, such as for most common TMDE, a standard life of 7 years should be assumed for the purpose of evaluating tradeoffs between alternative support options. When technical data are proprietary to the manufacturer, organic maintenance plans should be limited to one level of indenture above that involving proprietary data.

b. For commercial off-the-shelf TMDE, contractor maintenance and supply support shall be the preferred option (including adequate maintenance floats to protect TMDE availability during the turnaround time for contractor maintenance), unless it is estimated to cost more than 10 percent in excess of organic maintenance and supply support

c. If contractor support is the planned support concept for a new item of TMDE, that requirement shall be included in the original invitation for bid. If organic support is the planned support concept, the invitation for bid shall include all necessary logistic support elements, including provisioning of spare parts determined in accordance with reference (k)

d. Contractor support agreements shall include appropriate clauses for emergencies and wartime conditions.

e. Support concepts for common TMDE, procured in accordance with the DoD TMDE Standardization Program, shall be identical for all DoD Components and implemented through interservice support agreements, if organically supported, or through one or more contractor support agreements, if not organically supported.

f. Calibration and repair of organically supported TMDE shall be performed by the same organizations to the maximum extent possible. The maintenance level (field or depot) and

source (organic or contractor) for repairs of tester replaceable units shall be determined on the basis of wartime readiness, cost, and effectiveness

g. Uniform repair versus replacement criteria shall be used for organically supported TMDE in accordance with the principles set forth in reference (l).

h. Centralized data systems shall be installed for managing the recall of all items of TMDE that require calibration, and for monitoring equipment status as needed to adjust calibration intervals so as to meet predetermined reliability (within-tolerance rate) criteria in accordance with the provisions of reference (u). Reliability criteria should not be uniform for all TMDE, but should be established by type of TMDE as a function of criticality of measurement accuracy and equipment out-of-tolerance rate to enable the most cost effective utilization of available calibration resources

i. The numbers of separate field-level TMDE calibration and repair activities shall be minimized through consolidation and interservicing whenever practical and cost effective, subject to wartime contingency requirements.

#### 4 Inventory Management

a. The physical inventory of TMDE shall be monitored by each DoD Component, with annual summary reports for TMDE similar to the inventory control policy for principal and secondary materiel items established by references (m) and (n).

b. Future requirements for TMDE shall be identified by each DoD Component in a TMDE master plan, updated annually in support of Program Objectives Memorandum submissions. Such master plans shall discriminate between common and peculiar TMDE and outline the TMDE programmed/planned to reduce peacetime inventory deficits, to meet additional requirements caused by planned changes in force structure or the fielding of new weapons systems, and to replace obsolete TMDE.

c. Requirements for initial provisioning and replenishment spares for organically supported TMDE shall be included in the TMDE master plans. Systems shall be installed to monitor spares usage and to revise projected spares requirements as necessary.

d. Systematic TMDE modernization programs shall be instituted to provide for timely replacement of TMDE that is obsolete either because of unavailability of parts (support obsolescence), technological advances requiring higher performance (technical obsolescence), or escalation of support cost that makes purchase of new TMDE a cost-effective option (economic obsolescence).

e. Support obsolescence of TMDE shall be minimized by applying the management principles and procedures of reference (o). Technical obsolescence of common TMDE should be minimized by procuring the most advanced commercial equipment, even if its performance characteristics are beyond the measurement requirements at the time of purchase. Economic obsolescence should be monitored and measured by collecting TMDE support costs, establishing trends, and making economic assessments when those trends exceed predetermined limits.

#### 5. Contingency Planning

a. Contingency plans shall be prepared and updated as necessary to maintain management visibility of the additional TMDE resources needed in wartime and to satisfy those additional requirements if needed, including spare parts, calibration capacity (calibration standards and personnel), and repair capacity.

b. In balancing peacetime cost effectiveness and wartime preparedness, TMDE inventory and spare parts deficits shall be constrained to industry's capacity to meet those deficits within an acceptable period of mobilization surge, using the general guidelines of reference (p).

#### E. PROCEDURES

1. DoD Components shall develop, implement, and maintain automated management information systems and supporting data bases that include all data elements needed for effective management and support of both common and peculiar TMDE

2. DoD Components shall implement a standard methodology for identifying standard or preferred items of common TMDE and for linking their TMDE data bases to form a DoD-wide preferred items list (PIL) for common TMDE

3. DoD Components shall issue a Joint Regulation on the operation and maintenance of the DoD-wide PIL, supplementing the existing guidance of reference (q)

4. DoD Components shall jointly install a DoD-wide standard system for remote access to and retrieval from the DoD PIL for DoD contractors and Government activities responsible for generating or reviewing support equipment recommendation data.

5. DoD Components, working through existing Joint Service TMDE working groups, shall review all Federal Supply Classes that include or may include common TMDE, define homogeneous categories of common TMDE, assign a single primary inventory control agent for each category, with corresponding secondary inventory control agents in those DoD Components not assigned the

primary role; and prepare a memorandum of agreement, in the form of a Joint Regulation, that defines the responsibilities and procedures of the primary and secondary agents in implementing the centralized, consolidated, and standardized procurement policy for common TMDE prescribed by this Instruction.

6. DoD Components shall conduct decision-tree analyses in identifying the most economic procurement method and support concept for TMDE, based on such characteristics as type (commercial off-the-shelf, modified, or military design), unit procurement cost, density, calibration requirements, susceptibility to technological obsolescence, and other parameters.

7. DoD Components shall establish special procedures for procurement of common TMDE outside centralized procurement programs to meet emergency requirements. Such procedures shall authorize local purchase of common TMDE from the Federal Supply Schedule of the General Services Administration in accordance with reference (r), but only for those items that are included in the DoD PIL for common TMDE. Commercial off-the-shelf items with a unit cost below \$200, however, shall be exempted from this restriction on local purchase.

8. DoD Components shall institute long term planning procedures to manage the procurement and support of TMDE. Spare parts usage for organically maintained TMDE shall be monitored to revise, as needed, projected spare parts requirements on the basis of empirical data.

9. DoD Components shall collect TMDE support cost data and implement economic assessment procedures to determine TMDE replacement (modernization) requirements before inventory equipment becomes uneconomical to support.

10. DoD Components, working through the Joint Technical Coordination Group for Metrology and Calibration, shall adopt reliability targets tailored to the characteristics and performance requirements of the different makes and models of TMDE, revise and maintain calibration intervals accordingly to optimize utilization of available calibration resources; ensure that each make/model of TMDE has no more than one authorized calibration procedure, develop procedures for transitioning to wartime conditions; and identify calibration capability shortfalls in wartime as well as the resources required to overcome those shortfalls.

11. DoD Components, working through the Joint Technical Coordination Group for Metrology and Calibration, shall review past and ongoing calibration consolidation studies, reassess the reason for not implementing recommended consolidations, and continue implementing all consolidations that are cost effective in peacetime and consistent with wartime mission requirements.

12. DoD Components shall revise or supplement their existing regulations and instructions to implement the logistic support and inventory management policy for TMDE prescribed by this Instruction.

F. RESPONSIBILITIES

1. The Assistant Secretary of Defense (Acquisition and Logistics) shall ensure that the provisions of this Instruction are carried out, and shall conduct periodic reviews of the status and effectiveness of TMDE management and support in each DoD Component.

2. Heads of DoD Components shall carry out the provisions of this Instruction.

G. EFFECTIVE DATE AND IMPLEMENTATION

This Instruction is effective immediately. Forward two copies of implementing documents to the Assistant Secretary of Defense (Acquisition and Logistics) within 120 days

James P. Wade, Jr.  
Assistant Secretary of Defense  
(Acquisition and Logistics)

Enclosures – 2

- 1 References
- 2 Definitions

REFERENCES, continued

- (e) DoD Directive 5000.1, "Major System Acquisitions," 29 March 1982
- (f) DoD Directive 7200.4, "Full Funding of DoD Procurement Programs," 6 September 1983
- (g) Federal Acquisition Regulation, Part 6, "Competition Requirements"
- (h) DoD FAR Supplement, Defense Acquisition Circular 84-10, 10 January 1985
- (i) DoD Directive 4245.9, "Competitive Acquisitions," 17 August 1984 (to be revised)
- (j) DoD Instruction 7730.25, "Materiel Condition Reporting for Mission-Essential Systems and Equipment," 22 May 1980
- (k) DoD Directive 4140.40, "Provisioning of End Items of Materiel," 28 June 1983
- (l) DoD Instruction 7220.21, "Uniform Criteria for Repair Cost Estimates Used in Determination of Economical Repair," 1 May 1973
- (m) DoD Instruction 4140.35, "Physical Inventory Control for DoD Wholesale Supply System Materiel," 16 May 1984
- (n) DoD Instruction 4140.18, "Inventory Management Report of Materiel Assets," 9 November 1981
- (o) DoD Directive 4005.16, "Diminishing Manufacturing Sources and Material Shortages Program," 16 May 1984
- (p) DoD Instruction 4005.3, "Industrial Preparedness Planning," 18 April 1985
- (q) Joint Regulation AFLCR/AFSCR 800-24, DARCOM-R700-97, NAVMATINST 4000.38A, MCO P4110.1B, "Standard Integrated Support Management System," 27 May 1977 (Change 4, 17 September 1982)
- (r) DoD Instruction 4140.14, "Local Purchase of Materiel from Federal Supply Schedules or the National Buying Program of the General Services Administration," 27 April 1962
- (s) Military Specification, MIL-T-28800C, "Test Equipment for Use with Electrical and Electronic Equipment, General Specification for," 23 December 1981
- (t) Military Standard, MIL-STD-1309C, "Definitions of Terms for Test, Measurement, and Diagnostic Equipment," 18 November 1983
- (u) DoD Instruction 4140.59, "Serial Number Tracking of Selected Parts, Components, and End Items," 19 September 1985

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## DEFINITIONS

1. Test, Measurement, and Diagnostic Equipment (TMDE). Any equipment used to measure, calibrate, gauge, test, inspect, diagnose, or otherwise examine materiel, supplies, and equipment to: (a) determine compliance with established specifications, (b) evaluate operating condition, or (c) identify or isolate (or both) any actual or potential malfunction. TMDE includes both physical/mechanical and electric/electronic TMDE, either of which can be manual or automated. (For purposes of this Instruction, TMDE excludes "test program sets," which are executed on automatic test equipment and are addressed by separate policy. It also excludes "special test equipment," which is Government-funded equipment for in-plant quality assurance for prime equipment development and production.)

2. Common TMDE. TMDE which is applicable to two or more systems, subsystems, or prime equipment items of basically different design.

3. Peculiar TMDE. TMDE which is applicable to only one system, subsystem, or prime equipment item.

4. Type of TMDE. TMDE is classified in three types in accordance with the provisions of reference (s):

- Type I, "Military Specification": TMDE that is designed specifically for military use to meet specific requirements as invoked by a detailed military specification.
- Type II, "Modified Commercial Off-the-Shelf": TMDE that is in regular commercial production but modified to conform to one or more military requirements not available in Type III.
- Type III, "Commercial Off-the-Shelf": TMDE that is in regular production sold in substantial quantities to the general public and/or industry at established market or catalog prices and that meets military needs

5. Category of Common TMDE. Generic group of common TMDE which is similar based on the parameters measured. Items of common TMDE within the same category may differ from each other in performance (range and accuracy), design, and other characteristics defined in reference (s).

6. Other Terms. For further definitions related to TMDE and the different terms used by the Military Departments, see reference (t).

## APPENDIX B

### DRAFT CHARTER FOR DEFENSE SCIENCE BOARD TASK FORCE

- References:
- (a) DoD Directive 5105.18, "DoD Committee Management Program," 20 March 1984
  - (b) DoD Directive 5129.22, "Defense Science Board," 26 June 1978
  - (c) Assistant Secretary of Defense (MI&L) memorandum for Under Secretaries of the Military Departments, Subject: "DoD Test Equipment Management Improvement Program," 26 June 1985
  - (d) Assistant Secretary of Defense (A&L) memorandum for Under Secretaries of the Military Departments, Subject: "DoD Test Equipment Management Improvement Actions," (to be developed)

#### 1.0 GENERAL

The Test Program Acquisition Task Force is hereby established in accordance with the provisions of Department of Defense (DoD) Directive 5105.18 [reference (a)] and DoD Directive 5129.22 [reference (b)] in support of the DoD Test Equipment Management Improvement Program [reference (c)] as requested by the Assistant Secretary of Defense (Acquisition and Logistics) [reference (d)]. This charter defines the purpose, objective, membership, and operation of the Task Force.

#### 2.0 PURPOSE

The purpose of the Test Program Acquisition Task Force shall be to: (1) examine the duplication of automatic testing requirements between the manufacturing process (for quality assurance and process control) and field service support (for maintenance and repair) of defense systems and equipment, with the goal of achieving economy and performance benefits for the DoD in the acquisition of test program sets (TPSs); (2) recommend policies and procedures which will maximize these benefits; and (3) recommend changes in current policies and procedures to improve the TPS acquisition and support process.

#### 3.0 OBJECTIVE

The objectives of the Task Force are described as follows.

- 3.1 To examine the trend toward "functional testing" (as opposed to "in-circuit testing") as an automated tool for quality assurance/quality control in the assembly of modules and components of electronic equipment produced for the DoD.
- 3.2 To investigate the feasibility of adopting the test program software used for functional testing in the manufacturing plant for use in field- and depot-level maintenance support.

- 3.3 To analyze the economics of acquiring and using the same test program software for both in-plant and maintenance testing, even though the automatic test equipment (ATE) may differ between the two.
- 3.4 To identify impediments to the adoption of test program software that is common to manufacturing and maintenance, and to assess the significance of several factors responsible for impediments such as, but not limited to, the following:
- 3.4.1 Differences in fault profiles. In-plant and in-service fault profiles of electronic assemblies frequently are so different that a test program designed for in-plant use may not provide adequate fault coverage or diagnostic performance for classes of faults encountered only or primarily in the field environment. (This does not prohibit using the same process for generating the two types of test programs with a common core program.)
- 3.4.2 Lack of rehostability. Because of an absence of universal standards for automatic testing software and hardware, test programs generated by manufacturers for their own in-plant use may not be easily rehostable to ATE used by the Military Services. Since test languages are intimately tied to the hardware and software architectures they support, rehosting involves more than just translation. It also requires an engineering evaluation because a tester-independent test specification language does not presently exist. (This does not prevent using the manufacturer's test program software as a source for generating maintenance test programs.)
- 3.4.3 Organizational impediments. Different organizations are generally responsible for design engineering, production engineering, and maintenance (logistics) engineering. To the extent there are barriers between these functional organizations in the procuring Military Services, the idea of adopting production tools such as test program software for maintenance support may be impractical without better functional integration.
- 3.4.4 Procedural impediments. Acquisition policies, procedures, and practices may inadvertently pose impediments that should be corrected. Such impediments may include competition, proprietary data rights, standards, and incompatibilities between manufacturer's special test equipment and the Military Service's general-purpose ATE.
- 3.5 To develop solutions for reducing or eliminating the impediments to consolidation of manufacturing and maintenance test program software development.

3.6 To investigate current TPS acquisition policies, procedures, and practices of the Military Services which may need change, clarification, or improvement to capture the potential savings offered by adopting manufacturing test program software for maintenance test programs and to improve the quality (fault coverage, diagnostic performance, and run time) of operational TPSs fielded by the Military Services, such as, but not limited to, the following:

3.6.1 Test Requirements Documentation. Even under the contemplated change in TPS acquisition approach, detailed documentation of the test requirements for each unit-under-test will continue to be required to enable the procuring Military Service to perform software maintenance as well as to identify ATE and interface device requirements that may differ from those used by the manufacturer. The Military Services, however, use different military standards for, and put different emphasis on, the test requirements document (TRD). The Task Force should develop specific recommendations for a single, DoD-wide TRD standard, consolidating and tightening the multiple standards in current use.

3.6.2 Verification Tools. Inadequate TRDs are one of the causes of TPS development and performance problems. An automated tool to verify or assess the adequacy of TRDs is needed. The Task Force should survey the methodologies used in industry; ascertain the status and capabilities of recent DoD projects, such as those sponsored by the Rome Air Development Center; and determine specifications for a standard software package, for use by industry and Government, to assess TRD adequacy, given the requisite unit-under-test design information.

3.6.3 TPS Cost-Performance Analysis. Because the Military Services have not collected and analyzed TPS development cost and performance data in a systematic way, they lack the capability to perform "should-cost" analyses. Such a capability is needed not only for programming and budgeting purposes, but also for performing marginal analysis, i.e., relating improvements in fault coverage or fault resolution to additional development costs. The Task Force should examine the models used in industry and develop specifications for a standard methodology and TPS data base that would enable the Military Services to perform "should-cost" analysis.

3.6.4 Integration with Built-in Test. Development of built-in test diagnostic software and off-line TPSs have traditionally been separated from each other. Yet, there is a great deal of overlap between the two, especially at the line replaceable unit level. The Task Force should investigate the feasibility of integrated development of built-in-test diagnostic software and TPSs to reduce costs, improve vertical testability (consistency

of test results at different maintenance levels), and reduce TPS run time, and it should recommend the requisite procedures to achieve such integration.

- 3.6.5 TPS Support Tools. To take full advantage of developments by industry, the Task Force should survey the commercially available TPS support tools most needed by the Military Services, including engineering work stations; assess their costs and effectiveness; and identify and recommend a set of TPS development and support tools for implementation DoD-wide.
- 3.6.6 TPS Validation and Verification. The Task Force should investigate independent validation and verification procedures that emphasize the use of fault simulation models for assessing TPS fault coverage and fault resolution and the exploitation of operational experience in the field to improve TPS diagnostic performance and run time. Such operational experience may be captured by means of a closed-loop fault reporting, analysis, and correction data system that is managed by the contractor during the initial period under a TPS warranty concept. The Task Force should recommend a cost-effective TPS validation and verification process and steps to implement it.
- 3.6.7 Contracting. Contracts for development of TPSs have traditionally been awarded on a "cost-plus" basis, with some recent examples of firm fixed-price contracts. Those types of contracts, however, provide little incentive to the contractor to deliver high-quality TPSs. The Task Force should evaluate alternative contracting approaches that provide the necessary incentives with the concept of a TPS improvement warranty (similar to hardware reliability improvement warranties) accorded particular attention. The Task Force should recommend for implementation the most cost-effective method of contracting for TPS development.
- 3.6.8 Field Feedback. The Military Services have installed TPS data bases for managing the distribution and configuration management of TPSs, with one of the most advanced systems being the Navy's ATE/TPS Coordination Center at the Fleet Analysis Center, Corona, California. None of those data bases, however, includes data elements for the diagnostic performance and run time of fielded (operational) TPSs. Much of the latter data are included in the Military Services' standard maintenance data collection system, but those systems are not designed to provide the level of detail nor the responsiveness needed to monitor TPS performance. The Task Force should develop specifications for data collection systems, including the use of an automated daily log generated by the ATE computers, that will enable the Military Services to track the

operational performance (fault coverage, fault resolution, run time) of fielded TPSs and identify shortfalls as well as needed corrective actions.

- 3.7 To formulate and recommend improved DoD policies and procedures for the acquisition and support of TPSs. In pursuing this objective, the Task Force should consider the requirement of the weapons system acquisition process to compress the acquisition cycle and the resulting design instability at the time of initial production, including the relative costs and benefits of departures from current practices such as phased development and fielding of TPSs (i.e., TPSs initially limited to fault detection at Milestone 3, with the fault diagnostic portions fielded only after the period of design instability and associated engineering changes has passed)

#### 4.0 MEMBERSHIP

The Test Program Acquisition Task Force shall be composed of 16 members plus a chairman, selected as follows:

- 4.1 A Senior Executive Service representative from the Office of the Secretary of Defense (OSD), with the responsibility and authority to implement the recommendations of the Task Force, to serve as the Executive Secretary of the Task Force.
- 4.2 A flag-level representative from OSD with responsibility for, and an authority on, DoD procurement policies and procedures.
- 4.3 One flag-level representative from each of the Military Services responsible for, and an authority on, the Military Services' acquisition and support of TPSs and with the responsibility and authority to implement the Task Force's recommendations.
- 4.4 A single representative from each of not more than ten established commercial suppliers of defense hardware, ATE, and TPSs, with the requisite stature and authority in his or her respective organization and distinctly knowledgeable of the Military Services' TPS requirements. Qualified representatives shall be drawn from four (4) major defense prime contractors, three (3) suppliers of military ATE, and three (3) "third-party" independent TPS development contractors. representatives from prime contractors shall be selected to include both those contractors who customarily integrate the development of test programs for their own in-plant use and customer service support and those who have not done so.
- 4.5 A chairman selected by the OSD.
- 4.6 Invitations to membership shall be issued by the Defense Science Board.

## 5.0 OPERATION

The Task Force shall meet at frequent intervals with the view to pursuing the assigned tasks as expeditiously as possible. Meetings shall normally be open and conform to an agenda prepared at the conclusion of the previous meeting except the first meeting whose purpose shall be to decide on the specific initial efforts of the Task Force and the necessary information research efforts required. Meetings shall be publicly announced in accordance with existing policies [reference (a)]. Any member may invite to any meeting such other individuals as he or she may desire in a belief they will be useful in contributing to the work of the Task Force. Further, each member may use such other persons as required in pursuing the work of the Task Force. The Chairman and Executive Secretary jointly shall determine the extent of technical support services required for a successful performance of the assigned tasks; the method of support, contractor and/or consultants; and the selection of individual consultants and/or contractors; all within the guidelines established by the Defense Science Board and the available budget established by the Under Secretary of Defense for Research and Engineering.

## 6.0 RECOMMENDATIONS OF THE TASK FORCE

The recommendations of the Task Force shall be reported orally and in writing to the Deputy Secretary of Defense at a time and to the extent that he may direct.

## 7.0 TERMINATION

The Task Force shall terminate 1 year after the date of approval of this Charter, or sooner if its mission is completed, or unless prior approval for its continuation is obtained. Specifically, the Task Force should first focus on the feasibility and potential economics of consolidating test program development for in-plant and in-service use (objectives 3.1 through 3.3). Only if its findings are affirmative in this regard, should it continue with the tasks concerning implementation of such consolidation (objectives 3.4 and 3.5). Conversely, if either the feasibility or economic payoff (or both) are doubtful, it should terminate that part of its mission. In either case, the Task Force should continue with investigating the shortcomings of current TPS acquisition policies, procedures, and practices and with formulating recommended DoD policy and procedures (objectives 3.6 and 3.7).

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<p>Since the early 1970's, the Office of the Secretary of Defense, the Military Departments, and industry have sponsored numerous studies of test equipment, formed several joint panels to investigate selected technical issues, and initiated a variety of programs to correct identified problems. Despite such attention, the Department of Defense still faces many significant problems with fielded test equipment.</p> <p>In a previous report, <u>Test Equipment Management</u>, January 1985, we summarized the nature and extent of those problems and recommended the Assistant Secretary of Defense (Manpower Installations, and Logistics), ASD(MI&amp;L), take the lead in effecting needed improvements in test equipment management and support. The ASD(MI&amp;L) concurred with that recommendation and established, via an action memorandum for the Under Secretaries of the Military Departments, dated 26 June 1985, a "DoD Test Equipment Management Improvement Program" under the overall guidance of his Maintenance Directorate.</p> <p>Since the issuance of that action memorandum, the Maintenance Directorate has been coordinating DoD-wide efforts to implement the DoD Test Equipment Management Improvement Program. This report, which is published in four volumes, bolsters the Maintenance Directorate's initiative. Volume I lays out a specific program of action for the Assistant Secretary of Defense (Acquisition and Logistics) to serve as a cornerstone for the DoD Test Equipment Management Improvement Program; Volume II reviews previous studies and initiatives pertaining to test equipment management and support; Volume III describes how the Military Departments are organized to carry out that management and support; and Volume IV reviews and assesses the adequacy of DoD policy.</p>			
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