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INVESTMENT STRATEGY FOR DoD AUTOMATIC TEST SYSTEMS

Volume II: Supporting Data

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Herbert R. Brown

January 1994

Prepared for
Weapons Support Improvement Group
Office of the Assistant Secretary of Defense for Production and Logistics

IDA

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13. ABSTRACT (Maximum 200 words)

This paper reports the results of an investigation into optional investment strategies for DoD automatic test systems (ATS). The study was chartered by the Assistant Secretary of Defense for Production and Logistic, and was conducted by a DoD and IDA team under the guidance of an Office of Secretary of Defense/Joint Service Executive Steering Group. This paper documents the results, methodology, and conclusions of the detailed technical analyses conducted in conjunction with this effort. Fifteen weapon systems were selected as representative of Defense-wide programs for in-depth ATS data collection and analysis. Selected ATS were evaluated for technical capabilities and their ability to meet multiple weapon system applications. The resulting data provided a baseline for characterizing Defense ATS acquisition costs and investment focus. Future benefits of an improved ATS investment strategy were compared with present ATS acquisition approaches used by the Services. The study concluded that Defense-wide use of standard ATS families provides the best approach to meet automatic testing needs at the lowest possible cost. Volume I contains a summary and high-level analyses of the results; Volume II contains the supporting data.

14. SUBJECT TERMS
Automatic Test Systems (ATS), Automatic Test Equipment (ATE), Test Program Set (TPS), Weapon Systems, Acquisition.

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PREFACE

This paper was prepared by the Institute for Defense Analyses (IDA) under the Task Order, Integrated Diagnostics, and fulfills an objective of the task, to "provide analytic support for a DoD sponsored forum to develop an implementation approach for an investment strategy for DoD automatic test systems." The work was sponsored by the Director of the Weapon Support Improvement Group (WSIG), Office of the Assistant Secretary of Defense for Production and Logistics (ASD(P&L)).

This paper comprises two volumes: Volume I, Summary and Analyses, and Volume II, Supporting Data.

REPORT ORGANIZATION

This report is arranged as four major sections (Parts I, II, III, and IV) which have been divided into two volumes. The first three sections are in Volume I, and the last section, along with the references, bibliography and List of Acronyms are in Volume II.

Volume I: Summary and Analyses

a. Part I: *Introduction* provides a very brief introduction including purpose, report organization, glossary, and background.

b. Part II: *Conclusions* provides a short summary list of the primary conclusions and follows with a more detailed discussion of each.

c. Part III: *Analyses* provides summaries of data collected during the study and analyses that support the primary conclusions presented in Part II. Secondary findings and conclusions are also documented within sections that discuss the following:

- baseline data analysis,
- ATS investment strategy option case study analysis,
- DoD ATS investment analysis,
- analysis of DoD and Service ATS management policies and organizations,
- assessment of ATS requirements and applications, and
- assessment of ATS technology development and evolution.

Volume II: Supporting Data

d. Part IV includes weapon system profiles, ATS baseline data summaries, summaries of selected ATE comparisons, definitions of ATS investment strategy options, and lists of study participants.

VOLUME II
SUPPORTING DATA

(More detailed tables of contents are provided at the front of Appendices B, C, D and E.)

Appendix A. Data Request Formats and Details

At the onset of the study, the Executive Steering Group (ESG) asked the study team to use existing data and formats to the maximum extent practical. However, there was recognition that definitive DoD baselines of current automatic test systems (ATS) inventories, current and future equipment requirements, and future operational testing needs did not exist. The lack of definitive baselines was not viewed as prejudicial, but rather a factor of earlier acquisition and support environments and priorities. Therefore a set of view graphs were developed that summarized the type and range of data needed to evaluate potential DoD ATS investment strategies.

To help manage the study work load and scope, the ESG selected 15 weapon systems as representative of Defense-wide programs for ATS data collection and in-depth analysis. The study team was asked to focus new data collection around the 15 selected weapon systems shown in Figure A-1. The ESG identified systems within this group as most representative of current DoD ATS needs. These systems are marked with an asterisk, and the study team attempted to obtain in depth historical data as well as detailed projected ATS requirements for each.

• **Abrams ***	• **Avenger ***	• **F-16**
• **ACM**	• **AX (A-12) ***	• **F-18 ***
• **AMRAAM ***	• **Bradley ***	• **F-22 ***
• **AN/SQQ-89**	• **C-17 ***	• **MK-50**
• **Apache/Longbow ***	• **F-15 ***	• **MLRS**

*** In Depth History/Projection**

Figure A-1. Weapon System List for ATS Study

A series of technical interchange meetings (TIMs) were conducted to present the data requirements and to support the data collection. The Service representatives at these meetings were asked to coordinate the collection and delivery of detailed information on specific ATS types used or planned for each of the designated weapon systems. Figures A-2 through A-7 present copies of view graphs used to identify the baseline data requirements at the TIMs.

The purpose of these charts was to identify the type, range, and depth of information needed. Because of the desire to use existing information to the maximum extent practical, assembled data was not always in these specified formats. In other situations, the specific information either was not available or did not appropriately fall within the context of individual data sheets.

a. The Weapon System ATS Data Sheet (Figure A-2) was intended to identify needed ATS information for each of the 15 designated weapon systems.

b. The Data Sheet for Specific ATS (Figure A-3) was intended to identify additional needed information for the ATS by weapon system (and already identified by the Weapon System Data Sheets) which was used on other systems/applications.

c. The ATS History Data Sheets (Figure A-4) were intended to identify desired historical and background information on each of the ATS identified for the designated weapon systems.

d. The Service Development & Acquisition Organizational Data Sheets (Figure A-5) were intended to identify information needed to build ATS acquisition process charts for each of the Services.

e. The Weapon System Maintenance Concept Data Sheets (Figure A-6) were intended to identify the environment under which the Specific ATS were used.

f. The Factory and Depot ATS Data Sheets (Figure A-7) were intended to identify factory and depot ATS information for each of the designated weapon systems.

Summary ATS Application Data Sheets

Weapon System/Subsystem Name ____________

(Expect approximately 5 entries per weapon system)

ATS (Specific Station)		Application Location (i.e. Factory, O, I, D)		Number of Cards/Modules Tested				% Utilization	Size	Peculiar & Common Costs (with funding yr)			
										ATS		Annual Support	
						TPS Costs							
Name	Total #	Type	Av #	Types	TPS	Devel	Acq	Based on 24 Hr Clock	Wt/ Vol	R&D & Development	Production	HW	SW
(Name (and designation when applicable) of specific ATS used to manufacture, operate, or support components through subsystems on the specific weapon system)	(The total number of the specific ATS identified)	(The type of location(s) where the ATS are needed or used, potential categories include factory, O-, I-, D-level maintenance facilities, etc.)	(The average number of specific ATS units at each location type)	(The number of card (SRA/ SRU) or module (WRA/LRU/LRM) types tested at the different location types - Label the card types with a "C" and the module types with an "M")	(The number of different operational TPSs (may include several test programs if acquired as a package) needed at the different location types - If some TPSs are common across locations, indicate that numbers in parentheses & label with "C" or "M")	(The average cost (Non Recurring Eng.) to develop the card or module level TPSs - Label with a "C" or "M")	(The average cost (Recurring Eng.) to acquire the TPSs, including ITDs - Label with a "C" or "M")	(Summarize the percent utilization of each ATS unit at a typical shop location/ category, base the percentage on a potential of the full 24 hours - i.e., if used for 8 hours per day, this will by 33%)	(The size of the ATS and auxiliary equipment in terms of both weight and volume as deployed - provide assumptions)	(R&D and test system development costs for peculiar, common and augmentation ATS equipment to test components through subsystems on the specific weapon system)	(Production and acquisition costs for peculiar, common and augmentation ATS equipment, including hardware and operating software, to test components through subsystems on the specific weapon system)	(The annual ATS hardware and operating system software related support costs for peculiar, common, and augmenting hardware)	(The annual software related support costs for peculiar, common, and augmenting TPS software used on ATS)

Support Costs include any ATS related sustaining engineering, contractor support, training, technical manual, calibration, staffing, etc.
Application Categories include ATS used in the factory manufacturing or end-item inspection as well as the service repair levels (O, I, D).
R&D and Production Costs include all costs associated with the design and development of the specific ATS capability for the weapon system.
Production Costs include the production as well as acquisition of commercial off-the-shelf hardware/software for the weapon system ATS

Figure A-2. Weapon System ATS Data Sheet

ATS Data Summary Sheet

Name	Type Locations Used	Total Quantity Per Location	Total Number of TPSs Types Per Location	Costs			
				R&D / Development	Production	Operations & Support	Planned P^3I
(Name and nomenclature of specific designated ATS used to manufacture, operate, or support weapon system/components at any of the shop categories/location types)	(Identify the specific shop category/type locations where the designated ATS is used)	(Number of specific ATS types used at each location type)	(The number of different/unique TPSs used on each specific ATS for each specific location type)	(R&D and test system development costs, including both hardware and operating system software, for the designated ATS - If ATS capabilities are common to several weapon systems, show prorated share for each weapon system)	(Production and acquisition costs, including both hardware and operating system software, for the designated ATS - If ATS capabilities are common to several weapon systems, show prorated share for each weapon system)	(The annual hardware and software related operations and support costs for the designated ATS - If ATS capabilities are common to several weapon systems, show prorated share for each weapon system)	(The anticipated costs of any Pre-Planned Product Improvements for the designated ATS - If ATS capabilities will be common to several weapon systems, show prorated share for each weapon system)

Figure A-3. Data Sheet for Specific ATS

History of ATS Origin/Evolution

- **Description:**
- **Design Baseline**
  - **Summarize:**
  - **Design source/derivation (new, existing Govt/commercial)**
    - **If Derived from existing:% common elements ______**
    - **Where elements used:**
- **Any ATS (common or peculiar) derived from this system?**
    - **% common elements: __________**
    - **List known advantages/disadvantages:**
- **Other comments:**

Figure A-4. ATS History Data Sheets

Devel/Acq Organizational Responsibilities

IDA Action: (based on data deliverables)
Develop IDEF diagrams for the following:

- **Service wide ATS management - (macro view)**
- **Selected weapon system programs - (micro view)**
- **Service ATS standards development**
- **Service ATS development & acquisition**

Includes:
- **Funding/resources**
- **Organizations**
- **Products**
- **Controls/constraints**
- **Tools, etc.**

Figure A-5. Service ATS Development & Acquisition Organizational Data Sheets

Weapon System Maintenance Concept
(Current & Planned)

Weapon System: ___________

(Note if the concept applies to entire system or major sub-systems & describe)

Summary of Current Maintenance Concept

(BIT/BITE, LORA, basing concepts, etc.):

Describe the impact on ATS design and fielding concepts:

Summarize any planned changes to the maintenance concept, and describe potential impacts to the ATS:

Figure A-6. Weapon System Maintenance Concept Data Sheets

Factory & Depot ATS Investments

Factory Test Systems

- Rationale behind design/requirements
- Total cost estimate: ___________
  - % Program peculiar
  - % Commercial equipment
  - % GFE or ATE common to other DoD applications
- Applicability to other DoD requirements (low, med., high)

Depot Test Systems

- Rationale behind design/requirements
- Commonality with original factory ATS
- % commonality with I-Level
- % commonality with other depot/I-Level ATS
- Total cost estimate: ___________
  - % Program peculiar
  - % Commercial equipment
  - % GFE or ATE common to other DoD applications
- Applicability to other DoD requirements (low, med., high)

Figure A-7. Factory and Depot ATS Data Sheets

APPENDIX B. WEAPON SYSTEM PROFILES

Selected Army, Navy and Air Force weapon system profiles and general discussions of the automatic test systems used to support these systems are presented in this appendix. The profiles were prepared and submitted by Service representatives. The study team did not attempt to edit the Service submittals other than introducing minor format changes for consistency. This data is intended as background materiel and is provided for information purposes.

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NAVY PROFILES

B.1. CASS PROFILE

B.1.1 CASS System Background

B.1.1.1 Description

The Consolidated Automated Support System (CASS), together with its system software, will provide a comprehensive electronics test capability to support the operational requirements of Navy weapon systems. CASS is being developed for the Naval Air Systems Command (NAVAIR), the Naval Sea Systems Command (NAVSEA), and the Space and Naval Warfare Systems Command (SPAWAR) to meet electronic testing requirements.

The overall CASS objective is the development of an Automatic Test Equipment (ATE) system that will improve weapon system readiness at reduced life cycle cost. CASS goals are to:

- Provide an integrated system to support automatic testing of Navy electronics for the 1990 —2010 time frame with application not only at the intermediate level, but at the depot and factory (weapon system and electronic system production facilities) levels.
- Develop a workable architecture which will enable the Navy to develop configurations of CASS to maintain a broad spectrum of electronic technologies, while also providing for future growth.
- Establish a CASS support system that will be fully responsive to both the CASS mission requirements, yet be consistent with the overall concept.

The overall CASS project includes the tasks of developing, acquiring, managing and deploying a set of assets that can be configured to meet the performance and workload range required by prime weapon systems emerging in the 1990—2010 time frame. CASS hardware and software improvements will be capable of being easily incorporated within CASS without any major modifications or integration efforts. All CASS hardware and software assets will be fully supportable.

CASS will include management tools and procedures for selecting the proper CASS configuration needed at a particular site. Shop management procedures will be designed to enable the Intermediate Maintenance Activity (IMA) to operate in the most effective manner to maximize ATE throughput. The primary emphasis at the time of CASS initial deployment will be in support of avionics at the intermediate level. Additionally, CASS assets will meet the testing requirements of the Navy at depots and factories. (CASS Computer Resources Life Cycle Management Plan (CRLCMP))

B.1.1.2 Design Baseline

The CASS program is currently in the Engineering/Manufacturing Development (EMD) Phase. The first Low Rate Initial Production (LRIP) for 74 stations was awarded in FY90, with first delivery to commence in July 1992. The second LRIP for an additional 60 stations is currently being negotiated with contract award pending a successful Defense Acquisition Board (DAB) review. Baseline will be established following completion of the Physical Configuration Audit scheduled for the summer of fiscal year (FY) 1992.

CASS is a new development program with no predecessors upon which the design was based.

B.1.1.3 Justification

The CASS program was initiated due to Fleet and CINC concerns about increasing ATE deficiencies and the proliferation of unique test equipment. In 1976 an ASN (R&D) study addressing the state of ATE identified 20 major problem areas. NDCP W-0852-SL for this program was approved 27 August 1980. Between 1 January 1982 and 30 August 1983 a Phase I System Definition for the CASS was conducted. In March 1983, the scope of the CASS was expanded from test support for five selected avionics weapon systems to include all major TACAIR systems. In October 1983, ASN (RE&S) directed that the competition initiated in Phase I be continued into Full Scale Development (FSD) and production. By a March 1984 CNO letter, NAVAIR was directed to provide CASS as the support equipment for the A-6F, F-14D and the F/A-18 electro-optics with other weapons systems support to be transitioned to CASS as existing ATE is are phased out. In a March 1985 Program Decision Memorandum, the Secretary of the Navy directed the following: (1) expansion of CASS to provide support for all Navy electronics weapon systems and establishment of CASS as the standard Navy ATE, (2) upgrade of the program to ACAT II-S, and (3) continuation of industry competition in development and production. Source selection for a preliminary FSD phase was completed in August 1985, and competitive contracts were awarded to General Electric (GE) Company and Grumman Aerospace Corporation.

To avoid ATE acquisition and ownership costs, which are projected to increase significantly, and to correct existing ATE deficiencies, limitations and proliferation, major improvements in ATE capability are required. These improvements will provide technically capable and cost effective support for all current and future Department of the Navy (DON) weapon systems over the next 20 years. To improve fleet capability in sustaining high tempo operations, the following objectives should be met: (1) the throughput capability for Units Under Test (UUTs) should at least meet wartime surge capacity; (2) significantly improve ATE reliability and maintainability (R&M); (3) reduce Aircraft Carrier (CV) ATE space requirements; and (4) substantially decrease manpower, training and Life Cycle Costs (LCC). The users involved will be all aviation intermediate and depot level maintenance activities and those repair sites designated by NAVSEA and SPAWAR. (CASS NDCP)

B.1.2 CASS Acquisition and Management/P^{3}I Approach

B.1.2.1 Policies/Regulations

The introduction of CASS to the Navy is governed by two major policy statements;

a. NAVAIR Instruction 13630.2A, Introducing the Consolidated Automated Support System to Naval Aviation Maintenance, 22 March 1991.

b. SECNAV Instruction 3960.6, Department of the Navy Policy and Responsibility for Test, Measurement, Monitoring, Diagnostic Equipment and Systems, and Metrology and Calibration (METCAL), 12 October 1990.

In addition there are several supporting military standards;

c. MIL-STD-2076, Unit Under Test Compatibility with Automatic Test Equipment; General Requirements for

d. MIL-STD-2165, Testability Program for Electronic Systems and Equipment.

e. MIL-STD-2084, General Requirements for Maintainability of Avionic and Electronic Systems and Equipment.

NAVAIRINST 13630.2A defines policies, procedures and responsibilities for introducing CASS to Naval Aviation. This instruction defines the following policy:

(1) Electronic weapon systems/systems be designed for ease of testing and compatibility with CASS through the application of [MIL-STD's (3), (4) and (5)].

(2) CASS or CASS - compatible equipment be specified as the factory test equipment required at a development/manufacturing facility.

(3) CASS be the target system for all intermediate and depot level ATE requirements.

(4) Waiver approval be required if instances arise where CASS is determined not to be the optimum ATE support solution.

SECNAVINST 3960.6 applies to all components of the DON responsible for (1) design, acquisition, operation, and logistic support of weapons platforms, weapon systems, operational systems and associated support systems; and (2) design, acquisition, use and logistic support of test, measurement, calibration, monitoring, and diagnostic equipment and systems. The instruction states that it is DON policy to be responsible for the following:

> Ensure that diagnostic capabilities, including built-in-test (BIT), for each level of maintenance are consistent with the operational mission and intended use of the applicable systems. General purpose test equipment shall be used where possible. Commercially available test equipment and systems shall be used if they meet environmental requirements imposed by the operational mission and can be logistically supported. Automatic Test Equipment (ATE) should be standardized as much as possible. The Consolidated Automated Support System (CASS) is being developed as the Navy's standard ATE. Systems acquisition managers (program managers) will study and determine if and when it is economically practical to transition to CASS. Until then, they will continue to use their present test equipment. In the future, use of non-CASS ATE will require Assistant Secretary of the Navy for Research, Development, and Acquisition ASN (RD&A) approval. New ATE shall not be acquired if the requirements can be satisfied by CASS. Acquisition and life cycle costs must be considered during the design and acquisition process and in performing diagnostic capability tradeoffs. Test Program Set (TPS) development and distribution costs shall be included in the life cycle cost of ATE for acquisition planning.

B.1.2.2 Common ATS Management Organization

Within the Naval Air Systems Command, program management responsibilities reside with PMA-260. PMA-260 does not report to a Program Executive Office (PEO), but to the Deputy Commander for Acquisition and Operations, AIR-01. PMA-260 currently receives technical and logistic support from a matrix organization technical support from the Support Equipment Division (AIR-552), and logistics support from the Support Systems and Logistics Management Division (AIR-417). This relationship provides a control in the acquisition process to prevent the procurement of non-CASS ATS since AIR-552 provides a centralized acquisition function to all NAVAIR program offices. In addition to these acquisition responsibilities, AIR-552 is provides representation on each weapon system's Integrated Logistics Support Management Team and Systems Engineering Support Team. This centralized position provides visibility to all NAVAIR ATS requirements and facilitates the prevention of peculiar support solutions (see Figure B-1).

NAVAIR is currently in the process of decentralizing this function to field activities as part of its overall downsizing plan. In the future, field activity support will be directly funded by individual program offices to assess support equipment solutions and make procurements. A separate Support Equipment (SE) Program Management, Aircraft (PMA) will be responsible for oversight of the acquisition process. Since AIR-552 will no longer be allocated funding for peculiar support equipment, the control function will be provided through oversight of this process and communication between field activity personnel directly supporting weapon system program offices and the SE PMA (see Figure B-2). Further details of this reorganization and this process are currently unavailable.

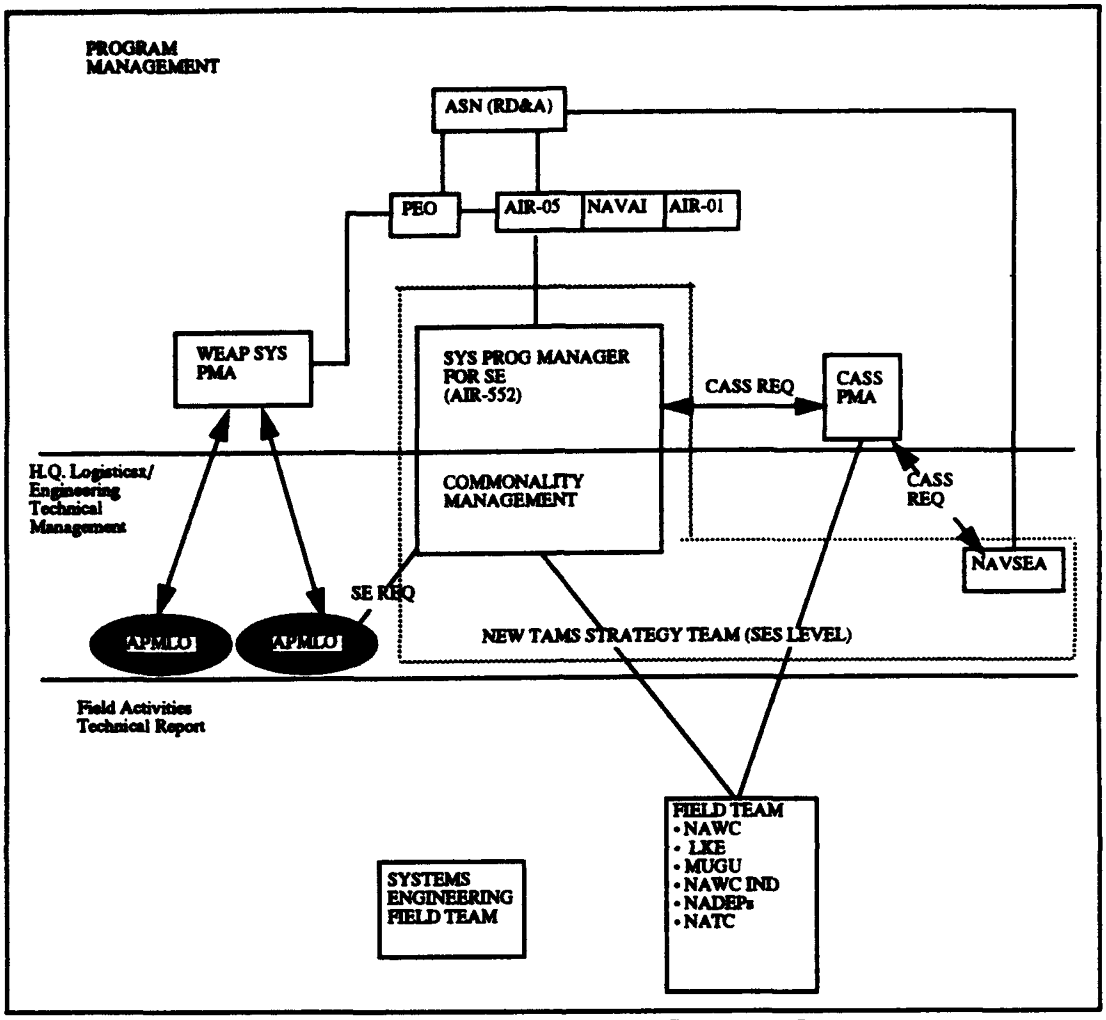

Figure B-1. Existing Checks and Balances Process

B.1.2.3 Relationship to Weapon System Management Organizations

For ATE procurement PMA-260 interfaces with AIR-01 for those weapon systems still managed within NAVAIR and the PEO organization for those programs outside NAVAIR. The TPS procurement function is being transferred to field activities who directly support the individual program offices.

B.1.2.4 Controls over Common ATS/Peculiar Weapon System Requirements

In addition to the waiver process defined by SECNAVINST 3960.6, PMA-260 has a mandatory review of all Acquisition Plans and Procurement Requests processed through NAVAIR. This review is used to ensure that the proper planning has been performed to ensure peculiar test equipment requirements are not generated

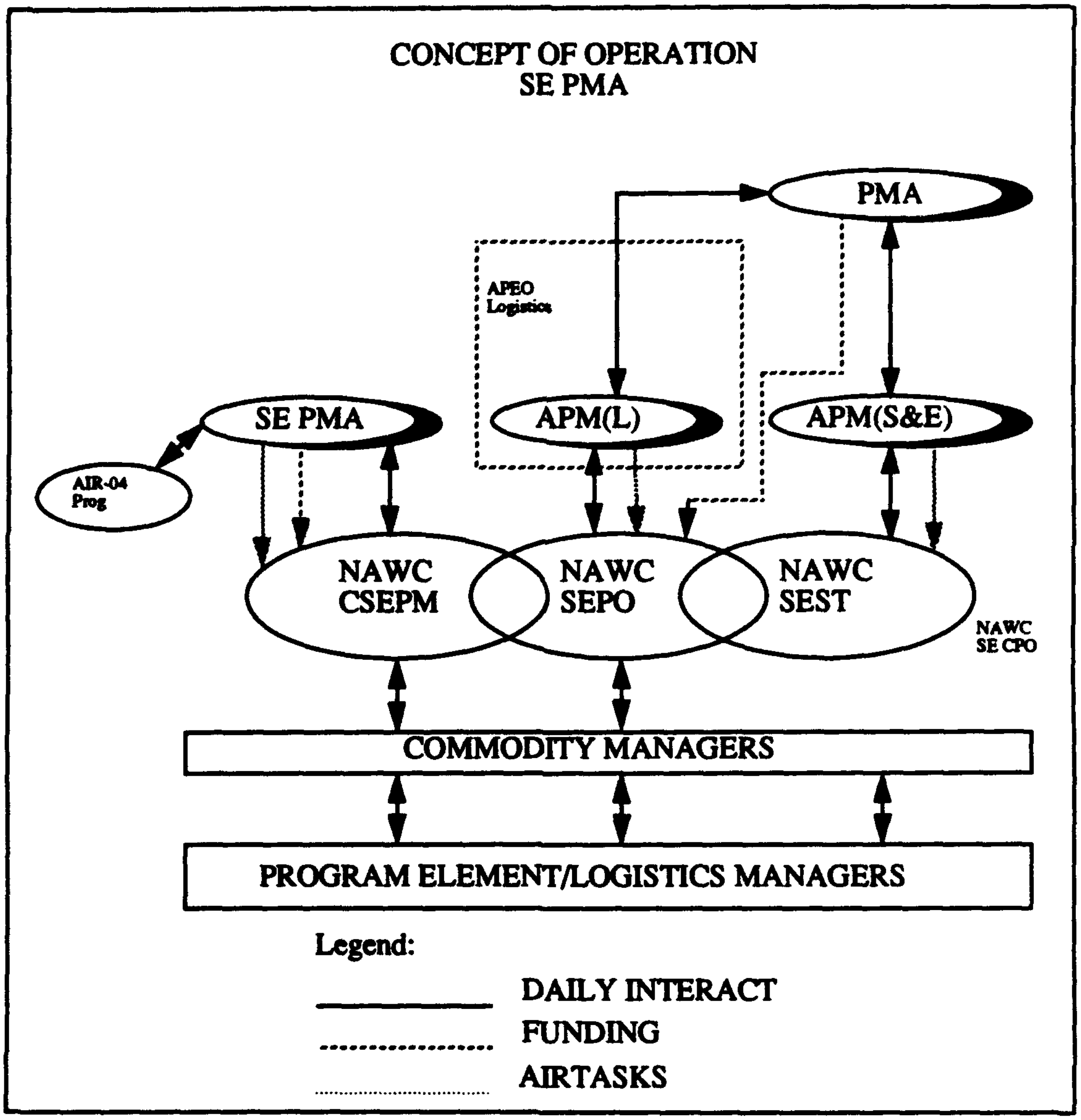

Figure B-2. SE PMA Concept of Operation

B.1.3 CASS Deployment Concepts

B.1.3.1 Navy Implementation

The Naval Air Systems Command (AIR-552) is responsible for consolidating the Naval Aviation community's requirements for CASS stations and allocating station deliveries to meet these requirements. AIR-552 documents this planning data in the CASS Introduction Plan (CIP). The latest revision to this plan is the 15 August 1991 version. The CIP provides an overview of each CASS TPS development program and CASS deliveries by program and site in detail for the present Future Year Defence Plan (FYDP) as well as projections for the subsequent FYDP. According to the latest planning data available from AIR-552, the following weapon systems are currently planning to be supported on or transitioned to CASS:

AIWS	F014D CFE WRA	AIS
AMRAAM	GPWS/HELO	F-14D CFE SRAs
AN/AAS-33A	GPWS/TRANSPORT	AAM-60 A-6
AN/ALE-47	HARM	AAM-60 S-3
AN/ALE-50	HARPOON/SLAM	ASM-614 EA-6B
AN/ALQ-126B RF SRAs	IRSTS	ASM-614 S-3
AN/ALQ-156	JTIDS	ASM-614 SH-60
AN/ALQ-165	MIDS	HATS S-3
AN/ALQ-165 SRAs	MINI-DAMA	TMV F-14B
AN/ALR-67 ASR	MMR/ARN-138	VAST F-14
AN/APG-73 (F/A-18)	PHOENIX	VAST S-3
AN/APN-217 (V) 5	SAHRS	USM-470(V) MINI VAST
AN//APS-137	SCS	USM-446 RSTS
AN/ARC-210 I/D	SH-60B BLOCK II	USM-392B
CAINS II	SH-60F/ALS	USM-458C NEWTS
EA-6B AIP	F/A-18E/F	USM-604 EETS
EA-6B AN/ALQ-149		USM-484 HTS (ARBS ONLY)
EA-6B RPG		

CASS mainframes are currently slated for deployment in aircraft carrier and Naval Air Station Aircraft Intermediate Maintenance Departments (AIMD), Mobile Maintenance Facilities (vans), Depots, Product Support Directorates (PSDs), WQECs & MAWMUs

(Missiles), Naval Maintenance Training Group Detachments (NAMTRAGRUDET) and eventually LHA/LHDs. CASS MTS are scheduled to go to WQECs, Depot's, Naval Weapon Stations, and MAWMU's. For detailed site activation data for the above weapon systems, please refer to the CIP. The average deployment quantities per site currently in the CIP are as follows:

Table B-1. CASS Site Activation Planning Numbers

SITE	CASS	MTS
CV/CVN	12	0
Shore-based AIMD	1—8	0
Depots/PSDs	1—0	17
NAMTRAGRUDET	6	1
Marine	1—7	0
WQEC	1—7	1– 5
NWS	0	14
MAWMU	0	6

B.1.3.2 Joint Operations

With the issuance and the effective implementation of SECNAVINST 3960 of 12 October 1990, which mandates CASS across Navy Systems Command and its, there will be an increasing number of weapon systems from NAVSEA and SPAWAR that will be supported on CASS as well as more joint- programs. As a result of this movement to a common, Navy-wide support solution, there will be benefits to the Battle Group Intermediate Maintenance Activity (BGIMA) concept. While there are several joint Service programs that are planning to use CASS, the Army is in the process of integrating the CASS EO Sub-System into its IFTE. All of these trends will increase operational effectiveness in the maintenance community during joint operations.

A list of joint Service/command weapon systems currently planning to use CASS is as follows:

JTIDS	MINI-DAMA	ALE-47
AMRAAM	AIWS	ATARS
MIDS		

B.1.3.3 ATS Workloading

CASS consists of a five-rack "hybrid" core and three specific configurations Radio Frequency (RF), Communications/ Navigation/ Identification (CNI), and Electro-Optics

(EO). CASS is constructed by attaching one additional rack to the core. The hybrid is common across each configuration. In addition, there are ancillary equipment for unique requirements such as pneumatics and inertial navigation. As a result, CASS affords the operator with a great deal of TPS transportability (any TPS built for a hybrid can run on any other CASS configuration). With this capability, the AIMD officer is given a great deal of flexibility in scheduling workload. A valuable tool that will augment this capability is the Operations Management System (OMS). The OMS is hosted on a stand-alone computer and is on-line with all CASS in the AIMD via ethernet. From this system, the work center manager is provided the capability to monitor the availability and usage status of each tester and therefore schedule workload effectively and efficiently.

B.1.3.4 CASS Support plans

B.1.3.4.1 CASS Maintenance Concept

CASS will utilize a two level maintenance concept as follows. At the intermediate level the Shop Replaceable Assemblies (SRA) will be fault isolated using the system's internal built-in-test, called background self-maintenance (SMAT), and calibration TPSs. The faulty SRA is removed and replaced. Off-line from the tester, all new development SRAs will be fault isolated to the failed component using support of support TPSs. Faulty components will be removed and replaced via microminiature repair. At the depot level select SRAs will be fault isolated using support of support TPSs and repaired via microminiature repair. Commercial Test Equipment will be supported by a combination of organic and vendor repair, based upon economic and technical feasibility which is yet to be determined.

B.1.3.4.2 Life Cycle

The annual operations and support (O&S) costs estimated for CASS by NAMO level off between FY 2005 and 2011 at the following ($M):

Table B-2. Estimates of Navy-wide CASS Arrival O&S Costs

APPROPRIATION	FUNDING ($M)
MILPERS	30.6
O&MN	63.0
Procurement	3.1
Total	96.7

These costs are in current (FY92) dollars and are based on the 556 CASS stations out of the total inventory objective of 720 that are planned to go to operational vice-contractor sites. With respect to the training aspect of the MILPERS cost, the Navy is currently planning to spend $8.523M to train Navy personnel in FY93 on the existing family of Navy testers. With CASS, the numerous NEC codes that account for this high training cost are reduced to merely two with a training cost of $1.764 million (Operator/Maintainer & Technician billets). The O&MN and procurement costs were consolidated into one number, $66.1 million. MILPERS were excluded from this comparison. (NAMO Life Cycle Cost Estimate of 1 October 1991)

Based upon the reductions in Table B-3, the projected savings associated with CASS in a Carrier environment are $8,000 million.

Table B-3. Projected CASS-Needed Savings

	EXISTING	CASS
Avionics Maint. Personnel	250	150
Training Courses	185	4
Test Equipment Types	93	6
Facilities (Square Feet)	15,000	10,000
Spares (Line Item)	30,000	3,800
Tech Pubs (Volumes)	634	4 (disks)

B.1.3.4.3 TPS Development Learning Curves

An additional benefit associated with the CASS system will manifest itself in several years as industry proceeds down the learning curve associated with the system itself and the standard TPS Red Team procurement package being used by the Navy for TPS development and acquisition. With increased industry acceptance of the CASS and its migration to the factory floor, the cost of TPSs should decrease while their quality and logistics supportability will increase.

B.1.4 CASS Inventory

The CASS inventory objective is 720 testers. The allocation of stations is documented in the CASS Introduction Plan of 15 August 1991. This document contains allocations in detail through FY 1996 with projections through FY 2002. For detailed information the CIP should be referenced.

B.1.5 Specific CASS Technical Capabilities

B.1.5.1 Mainframe CASS

B.1.5.1.1 Operating Software

CASS is based on top of Digital Equipment Corporation's VMS Version 5.2 Operating System. The CASS software system is composed of three main computer software configuration items (CSCI), which are the Station Control Software, the Support Software, and the Intermediate Maintenance Operations Management. The following is a list of the components contained in the CASS CSCIs:

Station Control Software:

- Test Executive
- Virtual Instrument Handlers
- Instrument Personality Interfaces
- Operator Interface
- Automated Technical Information
- Communication Handler
- Asset Allocation
- General Asset Monitor
- Kernal Asset Monitor
- Functional Extension Program
- IEEE 488 Translators
- Self Maintenance

Support Software:

- ATLAS Compiler

- IPTESTER
- Test Program Set Development Software
- Test Executive Simulator

Intermediate Maintenance Operations Management:

- BIT Test
- Data Processing
- Network
- Post Processing
- Pretest
- Station Management

B.1.5.1.2 TPS Development Environment

It is intended that CASS TPS development is done off-line on a VAX with a VMS operating system. The following products have been developed to facilitate this process.:

a. TE SIM (AGE product. It simulates all of CASS's functions, except for those of the Teradyne L200 Series DTU.)

b. DICONS (an optional, but extremely useful tool. It allows the operator to access and program CASS instruments directly.)

c. IEEE 716 ATLAS Compiler

d. L200 Series Compiler (Teradyne)

e. Fortran Compiler

This off-line TPS Development Process allows the implementation of another cost-saving measure, the use of Test Integration Facilities (TIF). The three Navy TIFs are located at Norfolk, VA; Jacksonville, FL; and San Diego, CA. After the TPS developer has completed his development and debugging (except for TPSs which utilize the L200, which can only be debugged at the CASS station), *he schedules time at the TIF for integration of his* TPS with CASS.

While the use of off-line development reduces the numbers of CASS required, there are some special cases of TPS development in which it is more cost effective to provide a CASS to the developer.

B.1.5.1.3 Ancillary Equipment

a. Pneumatics Function Generator

b. Inertial Navigation System Interface

- AR 57 Bus

c. Advanced Communication Bus Interface

- 2 Asset Controllers
- 1 RS-485 Bus (Manchester/Harpoon Bus)
- 1 FODB (Fiber Optic Data Bus)
- 1 HSDB (High Speed Data Bus) Bus Spec 86EZ00614

d. MS1397 Bus (MIL-STD-1397)

e. Video

f. Miscellaneous

- Support of Support-Operational TPSs
  - Holding Fixtures (UUTs)
  - Load Sets

B.1.5.1.4 Environmental Requirements and Tested Capabilities

The four CASS configurations (the Hybrid, RF, EO, and CNI) are all required by the CASS contract to be environmentally tested to modified limits of MIL-T-28800C and MIL-STD-167.

To date all configurations have passed environmental testing with the exception of some isolated assets in rack 5 and the SSMD 1 and 2 assets which will be tested in the future.

B.1.5.2 CASS Missile Test Station (MTS)

The MTS will be a new development effort that will be based upon the core CASS configuration. As a result, the specifics about its technical capabilities are yet to be defined.

B.1.5.2.1 Operating Software

This is yet to be determined. The additional equipment that will be used to augment the core CASS will dictate the specifics of the operating software.

B.1.5.2.2 Environmental Requirements and Tested Capabilities

As with the four existing CASS configurations, the MTS will be environmentally tested to modified limits of MIL-STD-28800C and MIL-STD-167. The MTS, however, will probably not have the same shock and vibration requirements since it will not be utilized in a carrier environment.

B.1.6 CASS Upgrade and/or Off-load Plans

B.1.6.1 CASS P^3I Program

The CASS program has budgeted $11.0 million per year beginning in FY95 for P^3I. Candidates for technology insertion are identified by the Navy using the System Synthesis Model (SSM). Part of the CASS Introduction program requires each candidate program provide SSM data sheets which document specific testing requirements. The SSM is an automated tool which compares these testing requirements to the capabilities of CASS. The technical deficiencies identified in CASS by this process, along with the planned inventory of the technology, are used by NAVAIR to set priorities on technology insertion candidates. Using this process to plan and program a structured Pre-Planned Product Improvement (P^3I) program will enable CASS to support emerging technology, and thereby minimize program risk and the potential for Peculiar Support Equipment (PSE) proliferation.

B.1.6.2 Existing ATE Off-load Plans

The Naval Air Systems Command (AIR-552) has implemented a structured ATE off-load program. Naval Aviation Depots Norfolk and Jacksonville provide technical and management support in this effort. The off-load process begins with a regular assessment of existing ATE capabilities, support costs, obsolescence issues, AIMD space requirements, and Fleet personnel concerns to identify a prioritized list of candidates. Once the candidates have been identified, a revised Level of Repair Analysis (LORA) is performed using actual failure data from the Navy's 3M system. The objective of this process is to only off-load to CASS those UUTs whose demonstrated reliability dictate intermediate-level maintenance. The potentially reduced UUT candidate list output from this effort is then used in a Cost/Benefit Analysis to identify projected quantitative and qualitative returns on investment to the Navy. This information is factored into an internal Support Equipment Decision (SED) process. Decision milestones, which require division director approval, include authority for program definition (SED I), development/pre-production (SED II), and production (SED III). The policy, procedures, and responsibilities of this SED program are documented in Support Equipment Program Instruction 3-90 of 23 February 1990. NAVAIR is in the process of executing the following programs that been granted authority to proceed into SED phase II:

AN/USM-247 VAST
AN/USM-470(V)2 Tailored MINI-VAST (F-14 only)
AN/AAM-60(V)4/6 EOSTS
AN/USM-403 HATS
AN/ASM-614B/C ESTS

This program encompasses 100 WRAs and 138 SRAs. In addition to these programs, NAVAIR 552 is in the process of assessing the following candidate testers for an SED I milestone brief:

AN/USM-446 RSTS
AN/USM-470(V)1 MINI-VAST
AN/USM-604 EETS
AN/USM-484 HTS (AV-8B only)
AN/USM-458C NEWTS
AN/USM-392B DMTS

B.1.7 Factory/Depot Use

SECNAVINST 3960.6 of 12 October 1990 defines the Navy policy that CASS shall be used in the factory during weapon system development programs to minimize Factory Test Equipment (FTE) costs and maximize the potential benefits of TPS vertical transportability. At the present time no programs have identified a requirement for CASS as FTE. Also, the Navy plans to maximize the use of CASS at both the intermediate and depot levels of maintenance, where practical.

B.2. F/A-18

B.2.1 F/A-18 Weapon System Background

B.2.1.1 Program Overview

The F/A-18 Hornet is a multi-mission capable, carrier-based aircraft flown by the U.S. Navy and U.S. Marine Corps. In its fighter role, it provides cover for tactical air projection and complements fleet air defense systems. In its attack role, it flies interdiction, close air support, defense suppression, and conventional/nuclear strike mission against land-and-sea based targets.

The F/A-18 is the Navy's lead platform for the incorporation of more than 20 weapons and avionics systems. The F/A-18 C/D Night Attack aircraft will reach its growth limit within the next five years. No further capability can be added without structural modifications to accommodate increased fuel volume and gross weights. The upgraded F/A-18 has been designed as the F/A-18 E/F. Various configurations of systems improvements were considered for this program.

The objective of the F/A-18 E/F program is to develop, test, produce, and deploy an upgraded F/A-18 with increased mission range, increased aircraft carrier recovery payload, additional growth, and enhanced survivability. The F/A-18 E/F program encompasses an airframe upgrade to the F/A-18 C/D Night Attack aircraft, limited avionics modifications to the C/D weapon system, and the development of an engine based on the F412 core in the 22,000 pound thrust class.

B.2.2 F/A-18 Program Execution Status

B.2.2.1 Current Program

In 1975, the Navy selected an aircraft capable variant of the Northrop YF-17 to satisfy its multi-mission strike fighter requirement. Full-Scale Development (FSD) contracts were awarded to McDonnell Douglass Aircraft (MCAIR) (with Northrop as principle subcontractor) for the airframe and General Electric (GE) for the engine. First Flight occurred in November 1978. The F/A-18 A/B entered Phase III, production, upon completion of development milestones listed in Table B-4. Specifically, the low-rate production go-ahead was based upon successful completion of DSARC IIIA in April 1980. Full rate production was approved in November 1980.

Table B-4. F/A-18 Development Milestones

MILESTONE	ACTUAL
Prototyped Aircraft Contract Award	04/72
Prototyped Engine	04/72
Prototyped Fire-Control Radar Contract Award	01/76
First Flight Prototype	06/74
Engine FSD Contract Award	11/75
DSARC II	12/75
System FSD Contract Award	12/75
Fire-Control Radar FSD Contract Award	08/76
Preliminary Design Review	10/76
Critical Design Review	04/77
Production Go-Ahead (Long-lead release)	12/77
Start Avionics Suite Bench Test	06/78
Engine Preliminary Flight Rating Test	06/78
First Flight/Development Test & Evaluation (DT&E) Start	04/79
Initial Operational Test and Evaluation (IOT&E) Start	04/79
First Flight/Avionics Suite Test Aircraft	06/79
Engine Model Qualifications Test	07/79
Production Readiness Review	02/80
DSARC IIIA (Low Rate Production)	04/80
Engine Accelerated Mission Test	08/80
Complete IOT&E	02/81
Physical Configuration Audit	06/81
DSARC IIIB (Full-Rate Production, Fighter)	06/81
Initial Operating Capability	03/82

Subsequent configuration changes have been accomplished by means of Engineering Change Proposals (ECPs) incorporated as part of the production program. Major aircraft changes were subject to Service-level and DoD-level review and approved by the acquisition regulations of the time. ECP 87-8 for the F/A-18 A/B models to C/D, beginning with the FY86 aircraft procurement.

The first major upgrade and versions of the F/A-18, the F/A-18C (single seat) and F/A-18D (dual seat) began delivery in October 1987. This aircraft contained provisions for the Airborne Self Protection Jammer (ASPJ), the Advanced Medium Range Air-to-Air Missile (AIM- 120 AMRAAM), and the infrared Imaging Maverick Air-to-Ground Missile

(AGM-65F). The F/A-18 C/D aircraft were delivered in October 1989 and subsequently were configured with an improved night attack capability featuring a Navigation Forward-Looking Infrared (NAVFLIR) pod, a raster head-up display, special cockpit lighting compatible with night vision devices, a digital color moving map and an independent multipurpose color display.

In July 1987, the Secretary of Defense issued a memorandum to the Secretaries of the Navy and the Air Force, directing them to begin studying advanced versions of the F/A-18 and F-16 aircraft. In response, the Assistant Chief of Naval Operations for Air Warfare initiated an upgrade study to evaluate various F/A-18 alternatives for the year 2000 and beyond. This study resulted in the F/A-18 aircraft concept from which the F/A-18 E/F is currently evolving.

The F/A-18 E/F program is scheduled for a Milestone IV/II Defense Acquisition [illegible] (DAB) review in second quarter FY92. A planning meeting was held on July 11, [illegible], with the OSD staff and U.S. Navy representatives to identify key macro issues that should be addressed during the DAB program review. The primary objective of the Milestone IV/II review will be determined if the major upgrade to the F/A-18 is warranted, and to establish an approved acquisition strategy and baseline.

B.2.2.2 F/A-18 E/F

The F/A-18 E/F will be the second major model upgrade since F/A-18 aircraft program inception. The F/A-18E (single seat) and the F/A-18 F (two seat) will be a high performance twin engine, mid-wing, multi-mission tactical aircraft designed primarily to meet current Navy and Marine Corps fighter escort and interdiction mission requirements, and to maintain additional F/A-18 fleet air defense and close-air support roles. Enhancements will include the increased range and improved carrier suitability required for the F/A-18 to continue its key strike fighter role against the advanced threat of the late 1990s and beyond. This Integrated Program Summary (IPS) covers the Engineering and Manufacturing Development (EMD) of the F/A-18 E/F aircraft and integration of the F414 engine. The Mission Element Need Statement of the F/A-18A/B is still applicable as the Mission Need Statement of the F/A-18E/F. The Operational Requirement (OR) for F/A 18E/F Upgrade is #281-05-92, approved 27 February 1991. The Document is currently in the approval cycle. (Acquisition Category ID, Program Element 0204136N, Project No. W1662)

The F/A-18 E/F program plans to award E&MD Sole Source Cost Plus Incentive Fee/Award (CPIF/AF) contracts to MCAIR and GE after the Milestone Decision Authority grants the authority to proceed in second quarter FY92, following a successful DAB review. Airframe and engine development will be contracted independently. Integration of the engine to the airframe will occur in FY95 following engine Preliminary Flight Qualification (PFQ). Successful completion of OPEVAL, in third quarter FY99, is required to proceed with the transition to program Phase III and Full-Rate Production. Prior to Milestone III (MS III) there will be three Low-Rate Initial Production (LRIP) lots of 12, 30, and 48 aircraft, under separate contracts authorized by individual Navy Program Decision Meeting (NPDMs). Full Rate Production (FRP) will start in second quarter FY00.

Airframe EMD will begin with a letter contract award in the second quarter of FY92 following acquisition MSIV approval. During E&MD, the contractor will develop an F/A-18 E/F production engineering change proposal and the proposed F/A-18 E/F production detail specification. The F/A-18 E/F detail specification will be developed through changes to the Lot XII F/A-18 C/D Night Attack specification (SD-565-2). During this stage, the contractor will design, develop, and build and test up to seven E&MD flight test F/A-18 E/F aircraft, and three ground test articles. The following events in Table B-5 are planned for airframe EMD.

Table B-5. F/A-18 E/F Planned Events

EVENT	DATE
Request for Proposal (RFP)	2nd Qtr. FY92
Proposal Received	2nd Qtr. FY92
Contract Award	2nd Qtr. FY92
Initial Design Review (PDR)	3rd Qtr. FY92
Contract Definitization	4th Qtr. FY92
Preliminary Flight Qualification	3rd Qtr. FY93
Critical Design Review (CDR) Production Readiness Review (PRR)	2nd Qtr. FY94 3rd Qtr. FY95

NPDMs will be conducted to ensure adequate progress is being made in EMD for the authorization of airframe and engine Advance Acquisition Contracts (AAC) and the definitization of those contracts for LRIP and FRP as depicted in Table B-6.

Table B-6. Projected F/A-18 E/F Program Decisions

EVENT	DATE	AUTHORIZATION	QUANTITY
NPDM I	1st Qtr FY96	AAC for LRIP I	Long Lead Only
NPDM II	1st Qtr FY97	LRIP I Start AAC for LRIP II	12 Aircraft Long Lead Only
NPDM III	1st Qtr FY98	LRIP II Start AAC for LRIP III	30 Aircraft Long Lead Only
NPDM IV	1st Qtr FY99	LRIP III Start AAC for FRP	48 Aircraft Long Lead Only
MS III	1st Qtr FY00	FRP Start	Full Production

B.2.2.3 Engine

Engine development and qualification will begin with a letter contract award in second quarter FY92 and continue through full production qualification in fourth quarter FY97/first quarter FY98. Major events leading to full production qualifications are depicted in Table B-7.

Table B-7. Projected Events Leading To Full Qualification Of F/A-18 E/F Engine

EVENT	DATE
Request for Proposal	2nd Qtr, FY92
Proposal Received	2nd Qtr, FY92
Contract Award	2nd Qtr, FY92
Contract Definitization	4th Qtr, FY92
First Engine to Test	2nd Qtr, FY93
Preliminary Flight Qualification	2nd Qtr, FY95
Limited Production Qualification	4th Qtr, FY96/1st Qtr, FY97
Full Production Qualification	4th Qtr, FY97/1st Qtr, FY98

Source : Inside the Navy, Vol 5, No.17, April 27, 1992)

B.2.3 F/A-18 ATS Acquisition and Management

B.2.3.1 Acquisition and Management Flow Charts and Text

Within the Naval Air Systems Command, Program Manager, Aircraft (PMA) 265, is the acquisition manager of the F/A-18 aircraft. PMA-265 receives engineering support from the Assistant Program Manager for Systems and Engineering (APMS&E) or "Class Desk" in AIR-511, and logistic support from the Assistant Program Manager for Logistics (APML) in AIR-04. The APML is responsible for ensuring all aspects of the aircraft are supported, including support equipment. The responsibility for this function is delegated to the support equipment division (AIR-552), within which a Support Equipment Project Officer (SEPO) is specifically assigned to the F/A-18. The SEPO plans, programs, budgets, and procures all support equipment required for a given weapon system including avionics, engines, airframe and weapons. .

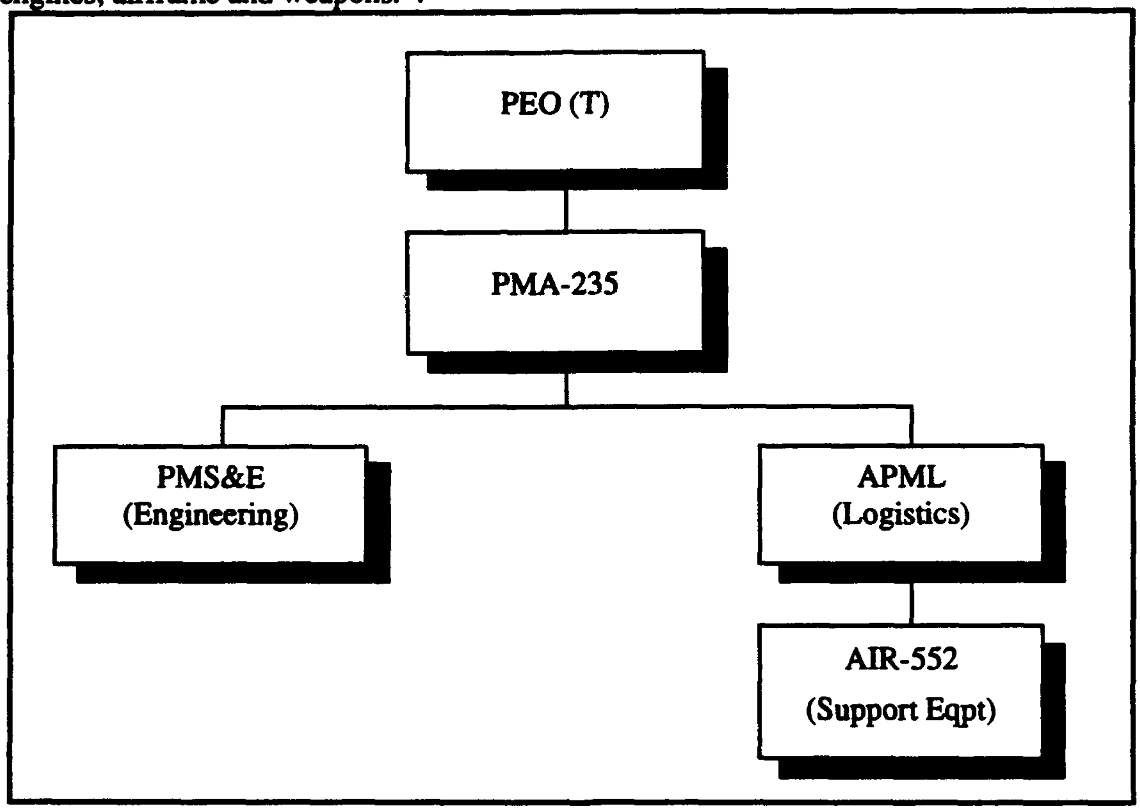

Figure B-3. F/A-18 Acquisition and Management Flow Chart

B.2.3.2 Special Policies or Regulations

The F/A-18, as all weapon systems within the Naval Air Systems Command, are subject to the following policies and regulations specifically established to minimize both the proliferation of peculiar support equipment and the life cycle cost of weapon systems:

a. NAVAIR Instruction 13630.2A, Introducing the Consolidated Automated Support System to Naval Aviation Maintenance, 22 March 1991.

b. SECNAV Instruction 3960.6, Department of the Navy Policy and Responsibility for Test, Measurement, Monitoring, Diagnostic Equipment and Systems, and Metrology and Calibration (METCAL), 12 October 1990.

c. MIL-STD-2076 (AS), Unit Under Test Compatibility with Automatic Test Equipment; General Requirements for,

d. MIL-STD-2165, Testability Program for Electronic Systems and Equipment,

e. MIL-STD-2084, General Requirements for Maintainability of Avionic and Electronic Systems and Equipment,

NAVAIRINST 13630.2A defines policies, procedures and responsibilities for introducing CASS to Naval Aviation while SECNAVINST 3960.6 performs the same function for the Department of the Navy (DON). The above Military Standards are supporting documents which ensure the development of maintainable systems compatible with CASS. For a further discussion of these documents please refer to the CASS Profile.

B.2.4 F/A-18 Weapon System Mainframe Concept

The baseline maintenance concept for the F/A-18E/F weapon system is to achieve full organic maintenance capability at the three levels of maintenance in accordance with OPNAVINST 4790.2. Initial planning is directed at achieving full organizational ("O") level and limited Intermediate ("I") level to the Weapon Replacement Assembly (WRA), organic maintenance capability by operational Evaluation (OPEVAL), full "I" level to the Shop Replacement Assembly (SRA) by IOC, and total organic maintenance capability by the scheduled Navy Support Date (NSD). However, an "O" to Depot ("D") level maintenance concept will be pursued for justification proven high reliability equipment/components. For example, repair of selected high reliability components would be performed at the "D" level, with an "I" level capability being pursued/established if analysis of fleet usage data indicates "I" level repair is necessary to meet and sustain operational/readiness requirements. Those systems/components demonstrating high reliability coupled with an effective Built-in-Test (BIT)/fault isolation capability, as applicable, and where sustained supportability/readiness requirement are achieved, will be retained at the "D" level. This approach/maintenance concept will be directed at minimizing support system cost (i.e., reduction of "I" level Automatic Test Equipment (ATE) requirement for land-based and shipboard sites) while sustaining operational/readiness objectives. Chapter 2 of the ILS-

DS-30A-252 details both the maintenance and support concepts for the F/A-18E/F weapon system. (Source: F/A-18E/F "DRAFT" ILSP)

B.2.5 F/A-18 Weapon System ATS Inventory

B.2.5.1 ATS Quantities, Types, Locations

B.2.5.1.1 AN/USM-470(V)1 Mini-VAST (MV)

The MV is an update and re-design of the AN/USM-247 Versatile Automated Shop Tester (VAST) that was undertaken because of the increase in testing requirements demanded by the F/A-18. The MV is used at I and D levels of maintenance. F/A-18 is the sole user of MV, with 27 TPS. The MV is a general purpose parametric tester.

The MV was developed by Harris Corporation in Syosset, NY, during FY79 and 80. Fifty-nine stations were built, as depicted in Table B-8.

Table B-8. Station Quantities

YEAR	STATION S/N
FY79-80	1-12
FY81	13-19
FY82	20-24
FY83	25-32
FY84	33-35
FY85	36-45
FY86	46-59

Stations 1-12 were constructed as ILASS stations, (ILASS being the interim acronym) and 2-12 were later re-built as MV stations. Serial number 1 was considered to be past its useful life and consequently not re-built.

There was Foreign Military Sales (FMS) participation in MV development. The Royal Australian Air Force and Royal Canadian Air Force both use MV stations for F/A-18 support. Typical deployment for MV stations depicted in Table B-9.

Table B-9. Typical MV Deployment Quantities

SITE	# STATIONS
CV/CVN	1
LAND SITE	1-3 (3 FOR LARGER SITES)
MARINE	2
TPS DEVELOPER	4
TRAINING	1-2
DEPOT	1

Marine Corps MV use consists of van-installed MV stations that can be deployed via air or sea transport to a forward area.

Off-load to CASS is currently scheduled. TPS development is to begin in FY94, with initial deployment scheduled for FY99. (NAEC Report MISC-52-0952)

B.2.5.1.2 AN/USM-446 Radar System Test Set (RSTS)

The Radar System Test Set (RSTS) was developed by Emerson Electric in St. Louis, MO, as a tester for the F/A-18 AN/APG-65 Radar System. It was developed because the advanced requirements of the APG-65 could not be supported on existing Navy test equipment. The RSTS is used at the I and D Levels of maintenance. The F/A-18 is the sole user of RSTS, with 27 TPS. The RSTS is a general purpose parametric tester.

The RSTS was developed in FY83. Fifty-five stations were built. Typical deployment for RSTS stations is depicted in Table B-10.

Table B-10. Typical RSTS Deployment Quantities

SITE	# STATIONS
CV/CVN	1
LAND SITE	1-3 (3 FOR LARGER SITES)
MARINE	2
TPS DEVELOPER	4
TRAINING	1-2
DEPOT	1

Marine Corps RSTS utilization consists of van-installed RSTS stations that can be deployed via air or sea transport to a forward area.

The APG-65 Radar system is in the process of being upgraded to the APG-73 configuration. This upgrade will replace three of the five existing WRAs while using the existing APG-65 antenna and transmitter. In lieu of a costly modification to the RSTS to test this new system, the APG-73 will be supported on CASS. As a result, the transition of the APG-65 antenna and transmitter to CASS has become a necessity to prevent the requirement for two testers to support the APG-73. In addition, the transition of the three non-upgraded APG-65 WRAs from RSTS to CASS is also planned to eliminate the requirement for two testers to support co-located squadrons of F/A-18s with each radar.

B.2.5.1.3 AN/ASM-686 Intermediate Automatic Test Set (IATS)

The Intermediate Automatic Test Set (IATS) was developed by MCAIR, and produced jointly by MCAIR and Harris Corp. The F/A-18 is the sole user of IATS, with 27 TPS. The IATS is a single purpose, functional tester.

Development of the IATS is somewhat peculiar. It was originally developed from the Intermediate Avionics Fault Tree Analyzer (IAFTA), which consisted of an "O"-level tester (the Avionics Fault Tree Analyzer (AFTA)) used to interrogate the F/A-18 fault-tree system, and an additional rack of equipment to mimic the airframe called the AIRSIM. The IAFTA was developed from F/A-18 factory test equipment, and provided an expansion of the original go/no go tester with fault isolation added. The IATS was developed as a permanent "I"-level tester from the IAFTA due to great fleet demand for a relatively simple tester for F/A-18 avionics to complement the AN/USM-470(v)1 MV.

The IATS was developed in FY86, and upgraded and retrofitted to test the F/A-18 Night Attack system during FY90 and 91. Thirty-one testers were built. Typical deployment for IATS stations is depicted in Table B-11.

Table B-11. Typical IATS Deployment Quantities

SITE	# STATIONS
CV/CVN	1
LAND SITE	1
MARINE	1
TPS DEVELOPER	1
TRAINING	1
DEPOT	1

Marine Corps IATS use consists of van-installed IATS stations that can be deployed via air or sea transport to a forward area. (NAEC Report MISC-52-0952)

Off-load to CASS is currently unscheduled.

B.2.5.1.4 AN/USM-629 Electro-Optical Test Set (EOTS)

The Electro-Optical Test Set (EOTS) was developed by MCAIR. to support the F/A-18 EO test requirements for AAS-38, AAR-50, and ASQ-173. The F/A-18 is the sole user of EOTS, with 11 TPS. The EOTS is a general purpose parametric tester.

EOTS was developed for F/A-18 C/D support in FY89 because insufficient EO test capability was available using existing Navy ATE, and CASS would not be available in time for AAS-38, AAR-50, and ASQ-173 deployment. Thirty-four EOTS stations were built. Typical deployment for EOTS stations is depicted in Table B-12.

Table B-12. Typical EOTS Deployment Quantities

SITE	# STATIONS
CV/CVN	1
LAND SITE	1
MARINE	1
TPS DEVELOPER	2
TRAINING	1
DEPOT	1

Marine Corps EOTS use consists of van-installed EOTS stations that can be deployed via air or sea transport to a forward area.

Off-load to CASS is currently unscheduled.

B.2.5.1.5 AN/ASM-608(v) Inertial Measuring Unit Test Set (IMUTS II)

The Inertial Measuring Unit Test Set (IMUTS II) was developed by Litton Guidance and Control Systems in Woodland Hills, CA, to test the CV-1263/ASN-92 Inertial Measuring Unit (IMU) and the AN/ASN-130A Inertial Navigation Unit (INU). The IMUTS II also supports F-14, E-2, S-3, F-4, A-6, EA-6, and AV-8 aircraft with 3 TPS. The IMUTS II is a purpose-built parametric tester. The F/A-18 represents approximately 50% of the IMUTS workload.

IMUTS was developed in FY75 and updated/upgraded to IMUTS II configuration in FY85. Ninety-eight IMUTS II stations were built. Typical deployment for IMUTS II stations is depicted in Table B-13.

Table B-13. Typical IMUTS II Deployment Quantities

SITE	# STATIONS
CV/CVN	1
LAND SITE	1-2
MARINE	1-4
TPS DEVELOPER	1-5
TRAINING	2
DEPOT	1-2

Marine Corps IMUTS II utilization consists of van-installed IMUTS II stations that can be deployed via air or sea transport to a forward area.

Off-load to CASS is currently unscheduled due to the Navy's plans to transition from the existing IMU and INU systems to the Carrier Aircraft Inertial Navigation System (CAINS II). CAINS II maintenance concept is "O"- to "D"-level, with no I-level supportable items, due to the high reliability associated with ring-laser gyro technology. As a result, the requirement for the IMUTS II will be eliminated before any transition to CASS can be fielded. CASS will be the "D"-level support for CAINS II.

B.2.5.1.6 AN/USM-484 Hybrid Test Set (HTS)

The Hybrid Test Set HTS was developed by Harris Corp. in Syosset, NY, to test analog and hybrid modules. The HTS also supports F-14, E-2, S-3, F-4, A-4, A-6, EA-6, SH-60, and AV-8 aircraft, as well as the AN/USM-470(v)1 MV and AN/USM-470(v)2 TMV via the Maintenance Test Equipment (MTE) Adapter. The MTE adapter is a roll-up cart containing related equipment and interfaces that allows the HTS to test components from other ATE. The F/A-18 is supported by 45 TPS and represents approximately 50% of the workload on HTS. The HTS is a general-purpose parametric tester.

HTS was developed in FY80. Approximately 20% of HTS is common with MV and TMV, although HTS was not developed as an outgrowth of either of these stations. Two hundred and twelve HTS stations were built as depicted in Table B-14.

Table B-14. HTS Station Quantities

YEAR	STATION S/N
FY80	1-34
FY83	35-48
FY84	49-75
FY85	76-119
FY86	120-153
FY87	154-201
FY88	202-212

Typical deployment for HTS stations id depicted in Table B-15.

Table B-15. Typical HTS Deployment Quantities

SITE	(F/A-18) # STATIONS	(TOTAL) # STATIONS
CV/CVN	2	4
LAND SITE	2-4	2-6
MARINE	1-4	1-6
TPS DEVELOPER	2-4	2-8
TRAINING	2	4
DEPOT	1-2	1-6

Marine Corps HTS use consists of van-installed HTS stations that can be deployed via air or sea transport to a forward area.

Off-load to CASS is not currently scheduled for F/A-18 peculiar systems; however, a program is being developed to transition AV-8B workload on the HTS to CASS.

B.2.5.1.7 AN/USM-458C New Electronic Warfare Test Set (NEWTS)

The New Electronic Warfare Test Set (NEWTS) was developed by Sanders Association in Nashua, NH, as an electronic warfare (EW) test station designed to test EW avionics common to the F/A-18, EA-6, F-14, A-7, and F-4 aircraft. The F/A-18 is supported by 7 TPS for the ALR-67 and ALQ-126B which represents approximately 60% of the NEWTS workload. NEWTS is a purpose-built parametric tester.

The AN/USM-458C Test Set is an upgrade of the AN/USM-458B Test Set. This upgrade was a result of Engineering Change Proposal (ECP) number Q003 of 7 July 1987. Approximately 70% of C is common with A and B. Forty-seven NEWTS stations were built. Typical deployment for NEWTS stations is depicted in Table B-16.

Table B-16. Typical NEWTS Deployment Quantities.

SITE	# STATIONS
CV/CVN	1
LAND SITE	1
MARINE	1
TPS DEVELOPER	2
TRAINING	2
DEPOT	1-2

Marine Corps NEWTS use consists of van-installed NEWTS stations that can be deployed via air or sea transport to a forward area.

With the support of new development EW systems on the CASS, such as the ALQ-165, ALQ-126B RF SRAs, ALE-47, ALE-50 and ALR-67 Advanced Special Receiver (ASR), it is operationally beneficial to transition existing EW systems currently on the USM-458C to CASS as well. Due to funding constraints, however, the transition of this tester to CASS is not currently scheduled. (Electronic Warfare Support Equipment, Reference Data Guide, Revision D, November 1991 & NAEC Report MISC-52-0952)

B.2.5.1.8 AN/USM-392B Digital Modular Test Set (DMTS)

The Digital Modular Test Set (DMTS) was developed as suitcase test system for ALQ-126B and ALR-67 pod systems. The F/A-18 is supported by 18 TPS which represents approximately 60% of the tester's workload. DMTS is a purpose-built tester. The DMTS performs functional testing, fault isolation, and repair verification to the component level of SRAs. The test set is portable, and requires either a three phase, 115V, 400Hz power source, or single phase, 115V, 60Hz power source.

DMTS was developed in FY83. Twenty-four DMTS's were built. Typical deployment for DMTS stations is depicted in Table B-17.

Table B-17. Typical DMTS Deployment Quantities

SITE	# STATIONS
CV/CVN	2
LAND SITE	2
MARINE	2
TPS DEVELOPER	2
TRAINING	2
DEPOT	1

As with the USM-458C, with all new development EW systems being supported on CASS, it becomes beneficial to transition the support of existing EW system SRAs to CASS. Funding constraints, however, have forced a delay in this offload. (Electronic Warfare Support Equipment, Reference Data Guide, Revision D, November 1991)

B.2.5.1.9 CASS

CASS supports the F/A-18 as a result of two program evolutions: the emergence of new development avionics and the off-load of existing, obsolete testers.

B.2.5.1.9.1 New Development Avionics/Weapon System Upgrades

As mandated by NAVAIR Instruction 13630.2A of 22 March 1991 and SECNAV Instruction 3960.6 of 12 October 1990, the following new development avionics (both peculiar and common to the F/A-18) are scheduled for support on CASS:

AN/ALQ-126B RF SRAs	AN/ALQ-165, ASPJ
AN/ALE-47	AN/ALR-67 ASR
AN/APG-73	AN/ARC-210 Depot
CAINS II Depot	SAHRS Depot

In addition to the above individual programs, any new systems in the avionics suite of the F/A-18 E/F will also be supported on CASS. (CASS Introduction Plan of 15 August 1991).

B.2.5.1.9.2.0 Existing ATS Off-loaded to CASS

Beyond targeting new weapon system developments for CASS implementation, NAVAIR (Code AIR-5522) has instituted a program to replace aging, obsolete test equipment with CASS. The objective of the off-load program is to both take advantage of the life cycle savings associated with a new tester while creating space within existing AIMD spaces by consolidating support on CASS. NAVAIR Code AIR-5522 is currently studying the testers depicted in Table B-18, which support the F/A-18 as candidates for the second phase of this program:

Table B-18. Programmed CASS Off-loads

TESTER	PROGRAM INITIATION
AN/USM-446 RSTS	FY93-94
AN/USM-470(V) 1 MV	FY95-96
AN/USM-458C NEWTS	FY9X
AN/USM-392B DMTS	FY9X

B.2.5.2 AN/USM-470(V)1 Mini-VAST (MV)

B.2.5.2.1 Test Instructions, Standard Procedures

Automatic testing is implemented through a Harris Corporation H-100 computer with a number of peripheral devices such as a terminal, keyboard, disk drive, thermal printer, and CRT. TPSs are written to minimize operator interaction during testing. Normally, test program instructions (TPI), a part of the TPS, inform the operator how to set up the hardware (UUT and TPS hardware) and how to start running the TPS program. The TPS program then instructs the operator what operator actions are required to perform proper testing. Operator actions include connecting/disconnecting cables to the UUT, toggling switches on the UUT, and verifying measurements displayed by MV assets or the UUT.

B.2.5.2.2 Sensor/Measurement Interfaces/Auxiliary

UUTs are connected to the MV station via the portion of a TPS known as the interface device (ID). ID's are attached to MV stations at the ID panel, which contains hundreds of pins that are used for stimulus and measurement signals. All MV TPSs, with the exception of several MV station self-test programs, require IDs.

Auxiliary equipment for the MV is limited to roll-up system calibration equipment. No known auxiliary equipment is required for TPS execution

B.2.5.2.3 Architecture

MV stations fit into the "rack and stack" category. These stations contain three types of stimulus and measurement assets (commercial off-the-shelf equipment; assets common with the VAST tester, and newly designed equipment), which are mounted in racks. The newly designed equipment was needed to meet the high speed, F/A-18 digital testing requirements that could not be met by the VAST station.

B.2.5.2.4 TPS Environment and Support

The underlying operating system software for the MV is VULCAN, a variation of a commercial operating system designed by Harris Corp.

The software program that both controls the operation of the MV assets and runs TPSs is called the Test Executive (TE). The TE provides a means for powering up and powering down station assets. In addition, the TE provides operators with a flexible and powerful, interactive environment for the execution of TPSs. For example, MV operators can repeat a test or a series of tests, pause testing, override the results of a test, and manually issue commands to certain station assets. The TE also provides a wide range of printing options to document testing results.

MV TPSs are developed and maintained using both the MV station and a Program Development Station (PDS). PDSs contain many of the same hardware components found on MVs. Some of the common hardware components are the 24-bit computer, the 20-

Mbyte disk drive (10-Mbytes fixed and 10-Mbytes removable), a "smart" terminal, and a thermal printer. To assist with TPS development, PDS's are also equipped with a larger mass storage device (a 300- Mbyte disk drive), a magnetic tape drive, additional terminals, and a high speed printer.

PDSs host many of the same software components as the MV. They both use the "VULCAN" operating system software, the same ATLAS compiler, and several software utilities and tools such as the Automatic Partition Collection and Ordering (APCO) program. In addition, the PDS hosts a number of software development tools, such as the Automatic Test Program Generator (ATPG) Pre-processor, a Fortran compiler, an assembler, and a test executive simulator.

The ATLAS compiler and a file editor are resident on the MV. These provide TPS development and maintenance personnel with the capability to make changes to a TPS on station rather than forcing them to use a software development station. This reduces the time required to maintain or develop TPSs.

B.2.5.3 AN/USM-446 Radar System Test Set (RSTS)

B.2.5.3.1 Test Instructions, Standard Procedures

Automatic testing is implemented through a computer and a number of its peripheral devices. TPSs are written to minimize operator interaction during testing. Normally, the TPI instructs the operator how to set up the UUT and TPS hardware, as well as how to start running the TPS program. The TPS program then informs the operator what operator actions are required to perform proper testing. Operator actions include connecting and disconnecting cables to the UUT, toggling switches on the UUT, or verifying measurements displayed by RSTS assets or the UUT. All RSTS TPSs are menu driven. Operators use the touch screen to input commands to the computer.

B.2.5.3.2 Sensor/Measurement Interfaces

UUTs are connected to the RSTS via IDs and electrical cables. IDs are attached to RSTS stations at the ID panel, which contains a large number of pins that can be used for stimulus and measurement signals.

B.2.5.3.3 Auxiliary equipment, power supplies

No known ancillary equipment is needed during RSTS TPS execution. However, some pieces of ancillary equipment, such as a HP8902 option E04 Attenuator/calibrator and a Fluke 5102B calibrator, are required during station calibration.

B.2.5.3.4 Architecture

RSTS stations fit into the "rack and stack" category. Approximately 70% of the stimulus and measurement equipment in the RSTS is commercial off-the-shelf. The remaining 30% is special purpose equipment built by Emerson Electric Company. All of this equipment is mounted in racks. The special purpose equipment was needed to meet RF requirements that could not be met by any other Navy tester. Several of these unique requirements are liquid cooling capability, RF load requirements, direct current (DC) load requirements, and the use of a vector voltmeter.

B.2.5.3.5 TPS environment and support

The RSTS uses RSX-11M-PLUS, a standard Digital Equipment Corporation (DEC) operating system. The RSTS operating system software environment, like the environments of the ATS(V)1, is flexible, powerful, and interactive with the station operator. For example, RSTS operators can repeat a test or a series of tests, pause testing, override the results of a test, and execute a TPS in single step mode. Although operators can also manually enter commands to certain station assets using the operating system software, the software that performs this function is not user friendly.

RSTS TPSs are developed and maintained using only the RSTS. No separate software development station is used.

The station uses a PDP-11/44 DEC modified computer with a Winchester disk drive, a cassette deck, additional serial ports for extra terminals, and a number of software packages. The RSX-11M-PLUS operating system hosts an editor and three compilers for TPS source code processing. The compilers are for Fortran 77, ATLAS, and Digit.

Since the compilers and a file editor are resident on the RSTS, station operators have the capability to make changes to a TPS when the TPS source code is available. This reduces TPS maintenance and development costs.

B.2.5.4 AN/ASM-686 Intermediate Automatic Test Set (IATS)

B.2.5.4.1 Test Instructions, standard procedures

Automatic testing is implemented through a computer and its peripheral devices. TPSs are written to minimize operator interaction during testing. The IATS Computer Operations Manual instructs the operator how to set up the UUT and the TPS hardware, as well as how to start running the TPS program. The TPS program then informs the operator what operator actions are required to perform proper testing. Operator actions include connecting cables to the UUT, toggling switches on the UUT, and verifying measurements displayed by station assets or the UUT.

B.2.5.4.2 Sensor/measurement interfaces

Unlike many other test stations, the IATS does not use "normal" interface devices. During testing, UUTs are attached to the stations using only cables, which may have one or more relatively passive boxes built into them. The cables are attached to the IATS at general purpose cable connector points.

B.2.5.4.3 Auxiliary Equipment, Power Supplies

A number of pieces of auxiliary equipment are used to execute IATS TPSs. Several examples are a photometer, a chrominance meter, a convergence meter, an oscilloscope, and the TTU-205 pressure generator.

B.2.5.4.4 Architecture

Most of the stimulus and measurement equipment in the IATS are special purpose equipment, such as digital and analog circuit boards, built by MCAIR. Few of the components are commercial off-the-shelf. All of the equipment is mounted in racks. The IATS was original built by MCAIR for temporary use as a factory tester. The AN/USM-470(V) (MV) was scheduled to be used, but the MV program was behind schedule and the tester was overworked. The IATS eventually became a permanent solution.

B.2.5.4.5 TPS environment and support

The computer within IATS uses the Versatile Real-Time operating system (VRTX) commercially produced by Ready Systems. TPSs are executed using an test written in Ada by Alsys Corporation. The IATS software is somewhat flexible. Operators can begin testing at various entry points in the test programs and can cycle tests. However, older IATS TPSs were written with few, if any, entry points. This severely limited operator options. Newer TPSs are more flexible with more entry points.

IATS TPSs are developed and maintained on International Business Machine (IBM) compatible personal computers (PC) with at least an Intel 80286 processor. Standard IBM PC compatible operating system software is used during TPS development and maintenance. In addition, compilers for an assembly language, the Fault Tree Interpreter (FTI) language, and PLM (a language similar to "C") are used to process TPS source code prior to loading the software onto an IATS. FTI is a "if-then-else" type language that was developed by MCAIR.

B.2.5.5 AN/USM-629 Electro-Optical Test Set (EOTS)

B.2.5.5.1 Test Instructions, Standard Procedures

Automatic testing is implemented through a PC with a number of peripheral devices, including a touch screen. TPSs are written to minimize operator interaction during testing. Normally, the TPI informs the operator which assets are required to use the TPS and how to start running the TPS program. The TPS program then instructs the operator what operator actions are required to perform proper testing. Operator actions include connecting cables to the UUT, toggling switches on the UUT, and verifying measurements displayed by EOTS assets or the UUT.

All EOTS TPS's are menu driven. Operators use the touch screen to input commands to the computer.

B.2.5.5.2 Sensor/Measurement Interfaces

In the case of UUTs that require optical testing, UUTs are connected to the EOTS via IDs and fixtures . IDs are attached to EOTS stations at the ID panel, which contains a large number of pins that can be used for stimulus and measurement signals.

B.2.5.5.3 Auxiliary Equipment, Power Supplies

There is no known auxiliary equipment for EOTS.

B.2.5.5.4 Architecture

The EOTS stations fit into the "rack and stack" category. Most of the stimulus and measurement equipment in the EOTS is commercial, off-the-shelf. The remaining equipment, which includes power distribution units and circuit card assemblies, is special purpose gear built by MCAIR. All of this equipment is mounted within the test bench. The special purpose equipment was needed to meet the EO testing requirements of the F/A-18 AAS-38, AAR-50, and ASQ-173 systems. EOTS was developed in FY89 because insufficient EO test capability was available in existing Navy ATE, and CASS would not be available in time for weapon system deployment.

B.2.5.5.5 TPS Environment and Support

The EOTS uses a version of the commercial VMS operating system to control the VAX computer within EOTS. TPS's are executed via a test executive written in Ada.

EOTS TPSs are developed and maintained on VAX computers using VMS operating systems, standard text editors, and a compiler for FTI language. All EOTS TPSs are written in FTI.

B.2.5.6 AN/ASM-608(V) Inertial Measuring Unit Test Set (IMUTS II)

B.2.5.6.1 Test Instructions, Standard Procedures

Automatic testing is implemented through a computer and its peripheral devices. TPSs are written to minimize operator interaction during testing. Normally, the TPI instructs the operator how to set up the TPS and UUT, as well as how to start running the TPS program. The TPS program then informs the operator what operator actions are required to perform proper testing. Operator actions include connecting cables to the UUT, toggling switches on the UUT, and verifying measurements displayed by HTS assets or the UUT.

B.2.5.6.2 Sensor/Measurement Interfaces

UUT's are connected to the IMUTS via ID's. IDs are attached to IMUTS stations at the ID panel, which contains approximately 1200 pins that can be used for stimulus and measurement signals.

B.2.5.6.3 Auxiliary Equipment, Power Supplies

The only ancillary equipment associated with the IMUTS is a pressure generator type unit that is used to pu.ge and fill UUTs with a gas during the testing and repair of the UUTs.

B.2.5.6.4 Architecture

The IMUTS fits into the "rack and stack" category. Some of the stimulus and measurement equipment in the IMUTS is commercial off-the-shelf. The remaining equipment, which includes gimbal calibration and repair-related equipment, is special purpose gear built by Litton Guidance and Control Systems. All of this equipment is mounted in the test bench. The special purpose equipment, which was needed to repair and calibrate inertial measuring units and inertial navigation units, was not available on existing Navy ATE.

B.2.5.6.5 TPS Environment and Support

The operating system software for the IMUTS is the Real Time Operating System (RTOS) version RTOS.E. It is the proprietary property of Litton Guidance and Control Systems. RTOS performs the test executive functions and a limited number of basic operating system software functions.

The station software provides operators with a some what flexible environment for executing TPSs. The software has the ability to run in "automatic" mode or "semi-automatic" mode, which permits sections of a TPS to be executed rather than the executing the program end-to-end. In addition, the operator can halt testing at any point in the program. can repeat tests, and can choose between print options.

IMUTS TPSs are developed and maintained using a DEC VAX computer system and a software development station.

The VAX computer uses the VAX/VMS operating system and hosts a number of software packages, such as test editor, a compiler for a subset of Fortran, and an ATLAS compiler.

The software development station is used to duplicate disks and load tapes. A special program called a "tape loader" is used to transfer software between tapes and disks.

B.2.6 AN/USM-484 Hybrid Test Set (HTS)

B.2.6.1 Test Instructions, Standard Procedures

Automatic testing is implemented through a Harris Corp. H-100 computer with a number of peripheral devices such as a terminal, keyboard, disk drive, thermal printer, and CRT. TPSs are written to minimize operator interaction during testing. Normally, the TPI informs the operator which assets are required to use the TPS and how to start running the TPS program. The TPS program then instructs the operator what operator actions are required to perform proper testing. Operator actions include connecting cables to the UUT, toggling switches on the UUT, and verifying measurements displayed on HTS assets or on the UUT.

B.2.6.2 Sensor/Measurement Interfaces

UUTs are connected to HTS stations via IDs. IDs are attached to HTS stations at the ID panel, which contains hundreds of pins that can be used for stimulus and measurement signals. All HTS TPSs, with the exception of several station self-test programs, require IDs.

B.2.6.3 Auxiliary Equipment, Power Supplies

Ancillary equipment for the HTS is used to calibrate the HTS and to execute certain TPSs. For example, roll-up equipment (containing a frequency synthesizer, a synchro/resolver angle indicator, a true RMS VAC meter, and a meter calibrator) is required to calibrate the HTS. Certain TPSs require the use of complex electronic equipmen and components, such as a high-resolution oscilloscope, in addition to the interface device.

B.2.6.4 Architecture

HTS stations fit into the "rack and stack" category. These stations contain both commercial off-the-shelf equipment and special purpose equipment, all of which is mounted in racks. The special purpose gear, which includes the digital word generator and the Manchester unit, was designed to allow the testing of the digital portions of hybrid circuit card assemblies.

B.2.6.5 TPS Environment and Support

The HTS operating software is almost identical to that of the MV. The differences between them are insignificant.

TPSs for the HTS are developed on a PDS using software similar or identical to the software used to develop MV TPSs.

B.2.7 AN/USM-458C New Electronic Warfare Test Set (NEWTS)

B.2.7.1 Test Instructions, Standard Procedures

Automatic testing is implemented through a computer and its peripheral devices, such as a terminal, keyboard, removable disk drive, and CRT. TPSs are written to minimize operator interaction during testing. Normally, the TPI informs the operator how to set up and start running the TPS program. The TPS program then instructs the operator what operator actions are required to perform proper testing. Operator actions include connecting and disconnecting cables to the UUT, toggling switches on the UUT, and verifying measurements displayed by NEWTS assets or the UUT.

B.2.7.2 Sensor/Measurement Interfaces

UUTs are connected to HTS stations via interconnecting boxes (IB). IBs are connected to NEWTS stations via cables that attach to non-military standard connectors. All NEWTS TPS's require the use of an IB.

B.2.7.3 Architecture

NEWTS stations fit into the "rack and stack" category. These stations contain approximately 70% COTS equipment and approximately 30% special purpose equipment, all of which is mounted in racks.

B.2.7.4 TPS Environment and Support

The underlying operating system software on the NEWTS is DOS 3.1. The software that runs TPSs is a group of software programs written in the "C" language. TPSs can be developed and maintained on station or on any IBM-compatible PC with DOS system software and any text editor. TPSs are written in "C", in assembly code, or in SCRIPT. SCRIPT is a language developed by Sanders Associates.

The station software provides operators with some degree of flexibility when running TPSs. For example, operators have the ability to re-run tests, override test results, pause testing, start testing at designated entry points, and print test results.Compilers for C and SCRIPT are used to process TPSs written in code other than assembly language. Assemblers for 8086, 8088, and 68020 are used to process TPSs written in assembly languages.

B.2.8 AN/USM-392B Digital Modular Test Set (DMTS)

B.2.8.1 Test Instructions, Standard Procedures

Automatic testing is implemented through a computer and its peripheral devices, such as a terminal, keyboard, and CRT. Execution of DMTS TPSs require relatively large numbers of operator interactions. Normally, test program instructions (TPI) inform the operator how to set up and start running the TPS program. The TPS program then instructs the operator what operator actions are required to perform proper testing. Operator actions include connecting and disconnecting cables to the UUT, toggling switches on the UUT, and using the probe.

B.2.8.2 Sensor/Measurement Interfaces

UUTs are connected to DMTS stations via IDs. IDs are attached to DMTS stations at the ID panel, which contains hundreds of pins that can be used for stimulus and measurement signals. All DMTS TPSs, with the exception several station self-test programs, require IDs.

B.2.8.3 Architecture

The DMTS contains no COTS equipment; all test equipment was special purpose.

B.2.8.4 TPS Environment and Support

The operating system for the DMTS is a software package developed to operate on 8086 processors. It was written in the English Language Programming (ELP) language. This operating system has relatively limited capabilities. Operators are limited to running DMTS TPSs either end-to-end with no pauses or by single step. No other options are available and test results cannot be printed out.

All DMTS TPSs are digital oriented and were developed with the use of Digital Automatic Test Program Generators (DATPG). The development work involving DATPGs was performed on commercial computers such as a DEC VAX. The remaining TPS development work was done on the DMTS station using compilers and an editor.

B.2.9 CASS

B.2.9.1 Mainframe CASS

B.2.9.1.1 Operating Software

The CASS system is based around DEC's VMS Version 5.2 operating system. The CASS software system is composed of three main CSCIs, which are the Station Control Software, Supoort Software, and Intermediate Maintenance Operations Management The following is a list of the components contained in the CASS CSCIs:

Station Control Software:

- Test Executive
- Virtual Instrument Handlers

- Instrument Personality Interfaces
- Operator Interface
- Automated Technical Information
- Communication Handler
- Asset Allocation
- General Asset Monitor
- Kernal Asset Monitor
- Functional Extension Program
- IEEE 488 Translators
- Self Maintenance

Support Software:

- ATLAS Compiler
- IPTESTER
- Test Program Set Development Software
- Test Executive Simulator

Intermediate Maintenance Operations Management:

- Buitl-In-Test
- Data Processing
- Network
- Post Processing
- Pretest
- Station Management

B.2.9.2 TPS Development Environment

CASS TPS development is done off-line on a VAX with a VMS operating system. Products have been developed to facilitate this process. The TPS development products are:

a. TESIM (A G.E. product. It simulates all of CASS's functions except for those of the Teradyne L200 Series DTU.)

b. DICONS It allows the operator to access and program CASS instruments directly.)

c. IEEE 716 ATLAS compiler

d. L200 Series compiler (Teradyne)

e. Fortran compiler

This off-line TPS Development Process allows the implementation of another cost saving measure, the use of Test Integration Facilities (TIF). The 3 three Navy TIFs are located at Norfolk, VA, Jacksonville, FL, and San Diego, CA. After the TPS developer has completed his development and debugging (except for TPSs which utilize the L200, which can only be debugged at the CASS station), he schedules time at the TIF for integration of his TPS with CASS.

While the use of off-line development reduces the numbers of CASS required, there are some special cases of TPS development in which it is more cost effective to provide a CASS to the developer.

B.2.9.3 Ancillary Equipment

a. Pneumatics Function Generator

b. Inertial Navigation System Interface
   - AR 57 Bus

c. Advanced Communication Bus Interface
   - 2 Asset Controllers
   - 1 RS-485 Bus (Manchester/Harpoon Bus)
   - 1 FODB (Fiber Optic Data Bus)
   - 1 HSDB (High Speed Data Bus) Bus Spec 86EZ00614

d. MS1397 Bus (MIL-STD-1397)

e. Video

f. Miscellaneous
   - SOS OTPS
     - Holding Fixtures (UUTs)
     - Load Sets

B.2.9.4 Environmental Requirements and Tested Capabilities

The four CASS configurations, Hybrid, RF, CNI, and EO are all required by the CASS contract to be environmentally tested to modified limits of MIL-T-28800C and MIL-STD-167.

To date all configurations have passed environmental testing with the exception of some isolated assets in rack 5 and the SSMD 1 and 2 assets which will be tested in the future.

B.2.10 F/A-18 ATS Upgrade and/or Off-load

There are no plans to upgrade any of the existing non-CASS ATS. Several testers are currently being assessed for their off-load to CASS, with the earliest potential start date being FY93 for the RSTS. The EOTS and the IATS are much earlier in their life cycle than those being considered for off-load and are currently expected to be utilized into the next century. The IMUTS II, on the other hand, will not be transitioned to CASS since the weapon systems it supports are being replaced by the CAINS II in a time frame that would not make such a program cost beneficial. The CAINS II has an "O"-to-"D" maintenance concept in which CASS is the depot ATS.

B.2.10.1 CASS P^3I Program

The CASS program has budgeted $11.0 million per year beginning in FY95 for P^3I. Candidates for technology insertion are identified by the Navy using the System Synthesis Model (SSM). Part of the CASS Introduction program includes the requirement for each candidate program to provided SSM data sheets which document specific testing requirements. The SSM is an automated tool which compares these testing requirements to the capabilities of CASS. The technical deficiencies identified in CASS by this process along with the planned inventory of the technology are used by NAVAIR to set priorities for technology insertion candidates. Use of this process to plan and program a structured P^3I program will enable CASS to support emerging technology and thereby minimize program risk and the potential for PSE proliferation.

B.2.11 Factory/Depot Use

The total cost of Factory Test Equipment (FTE), as well as the actual items bought, for the F/A-18 program could not be determined for this study. What was compiled were the FTE costs of a representative F/A-18 system, the AN/APG-73. From the Engineering Change Proposal (ECP) to upgrade the AN/APG-65 to the AN/APG-73, a total of $163 million (FY91) was paid for FTE. In addition, two hot bench test set C11M/Tester were bought for $22 million for interim support. Each hot bench included a radar system ($7 million) and a test stand ($4 million).

B.3. A-12

B.3.1 A-12 Weapon System Background

The Advanced Tactical Aircraft (ATA), designated the A-12, was designed by the team of General Dynamics and McDonnell Douglas as a replacement for the A-6 Intruder. The A-12 mission was a carrier-based, long-range, all-weather strike aircraft which incorporated major performance and survivability gains over the A-6. Its crew consisted of a pilot and a bombardier/navigator.

B.3.1.1 Program Objective

The intention of the program was to procure sufficient quantities of aircraft to provide the Navy with a fully capable carrier-based medium attack strike force. Since a replacement is under development, exact production figures will not be discussed.

B.3.1.2 Program Execution Status

The A-12 contract for the team General Dynamics-McDonnell Douglas was terminated in FY 1991 due to various programmatic difficulties. Milestones (projected and realized) as of the end of the program are presented in Table B-19. This data is provided to help illustrate the technical currency of CASS.

Table B-19. A-12 Aircraft Development Milestones

First Flight	First Quarter 1992
FSD	First Quarter 1992
Milestone IIIA (Low Rate Production)	Fourth Quarter 1993
Lot 1 Delivery	First Quarter 1994
TECHEVAL Start	Third Quarter 1994
PCA	Fourth Quarter 1994
Lot 2 Delivery	Fourth Quarter 1994
RFT	Second Quarter 1995
TECHEVAL End	Third Quarter 1995
OPEVAL Start	Third Quarter 1995
IOC	First Quarter 1996
Milestone IIIB (Full Rate Production)	Second Quarter 1996
Lot 4 Delivery	Fourth Quarter 1996
Lot 5 Delivery	Fourth Quarter 1997
Lot 6 Delivery	Fourth Quarter 1998

Avionics ATE-related milestones are depicted in Table B-20.

Table B-20. A-12 ATE Milestones

IATS Development Start	First Quarter 1989
CASS Development Start	Third Quarter 1990
CASS TPS Development "Full Go Ahead"	Second Quarter 1991
IATS and TPS Delivery	Second Quarter 1991
Production (IATS) Support	Second Quarter 1991
CASS and TPS Delivery	Second Quarter 1994
First Navy Site Stand-Up	Third Quarter 1994
First CASS Site Stand-Up	Fourth Quarter 1994
Production (CASS) Support	Third Quarter 1995

B.3.2 A-12 ATS Acquisition and Management

The acquisition manager of the A-12 aircraft was within the Naval Air Systems Command (NAVAIR), Program Manager, Aircraft (PMA) 235. PMA-235 receives engineering support from the Assistant Program Manager for Systems and Engineering (APMS&E) or "Class Desk" in AIR-511 and logistic support from the Assistant Program

Manager for Logistics (APML) in AIR-04. The APML is responsible for ensuring all aspects of the aircraft are supported, including support equipment. The responsibility for this function is delegated to the support equipment division (AIR-552), within which a Support Equipment Project Officer (SEPO) was specifically assigned to the A-12. The SEPO plans, programs, budgets, and procures all support equipment required for a given weapon system, including avionics, engines, airframe, and weapons. (See Figure B-4):

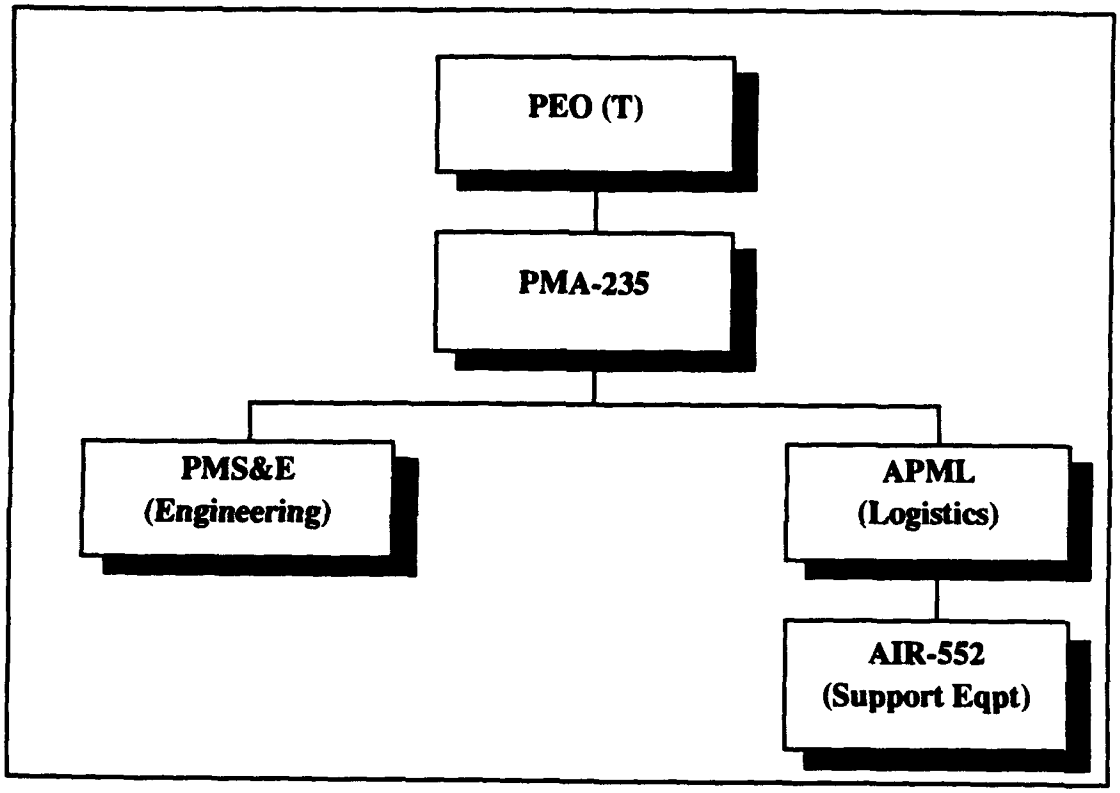

Figure B-4. A-12 Acquisition and Management Flow Chart

B.3.2.1 Special Policies or Regulations

The A-12, as all weapon systems within the NAVAIR is subject to the following policies and regulations specifically established to minimize both the proliferation of peculiar support equipment and the life cycle cost of weapon systems:

a. NAVAIR Instruction 13630.2A, Introducing the Consolidated Automated Support System to Naval Aviation Maintenance, 22 March 1991.

b. SECNAV Instruction 3960.6, Department of the Navy Policy and Responsibility for Test, Measurement, Monitoring, Diagnostic Equipment and Systems, and Metrology and Calibration (METCAL), 12 October 1990.

c. MIL-STD-2076 (AS), Unit Under Test Compatibility with Automatic Test Equipment; General Requirements for, DATE

d. MIL-STD-2165, Testability Program for Electronic Systems and Equipment, DATE.

e. MIL-STD-2084, General Requirements for Maintainability of Avionic and Electronic Systems and Equipment, DATE.

NAVAIRINST 13630.2A defines policies, procedures and responsibilities for introducing Consolidated Automated Support System (CASS) to Naval Aviation, while SECNAVINST 3960.6 performs the same function for the Department of the Navy (DON). These Military Standards are supporting documents which ensure the development of maintainable systems compatible with CASS.

NAVAIRINST 13630.2A defines the following policy:

a. Electronic weapon systems/systems are designed for ease of testing and compatibility with CASS through the application of MIL-STDs (3), (4) and (5);

b. CASS or CASS-compatible equipment is specified as the factory test equipment required at a development, manufacturing facility.

c. CASS is the target system for all intermediate and depot level ATE requirements.

d. Waiver approval is required if instances arise where CASS is determined not to be the optimum ATE support solution.

SECNAVINST 3960.6 applies to all components of the DON responsible for (a) design, acquisition, operation, and logistic support of weapons platforms, weapon systems, operational systems, and associated support systems; and (b) design, acquisition, use and logistic support of test, measurement, calibration, monitoring, diagnostic equipment and systems. The instruction states that it is DON policy to:

> Ensure that diagnostic capabilities, including built-in-test (BIT), for each level of maintenance are consistent with the operational mission and intended use of the applicable systems. General purpose test equipment shall be used where possible. Commercially available test equipment and systems shall be used if they meet environmental requirements imposed by the operational mission and can be logistically supported. Automatic Test Equip-

ment (ATE) should be standardized as much as possible. The Consolidated Automated Support System (CASS) is being developed as the Navy's standard ATE. Systems acquisition managers (program managers) will study and determine if and when it is economically practical to transition to CASS. Until then, they will continue to use their present test equipment. In the future, use of non-CASS ATE will require Assistant Secretary of the Navy for Research, Development, and Acquisition ASN (RD&A) approval. New ATE shall not be acquired if the requirements can be satisfied by CASS. Acquisition and life cycle costs must be considered during the design and acquisition process and in performing diagnostic capability tradeoffs. Test Program Set (TPS) development and distribution costs shall be included in the life cycle cost of ATE for acquisition planning.

B.3.3 A-12 Weapon System and ATS Deployment Concepts

B.3.3.1 Weapon System Maintenance Concept

The baseline maintenance concept for the A-12 weapon system is to achieve full organic maintenance capability at the three levels of maintenance in accordance with OPNAVINST 4790.2. Initial planning was directed at achieving the following:

- full organizational ("O") level and limited Intermediate ("I") level to the Weapon Replacement Assembly (WRA) organic maintenance capability by Operational Evaluation (OPEVAL),
- full "I" level to the Shop Replacement Assembly (SRA) by IOC, and total organic maintenance capability by the scheduled Navy Support Date (NSD).

However, an "O" to Depot ("D") level maintenance concept would be pursued for justified/proven high reliability equipment/components. For example, repair of selected high reliability components would be performed at the "D" level, with an "I" level capability being pursued/established if analysis of fleet usage data indicates "I" level repair is necessary to meet and sustain operational/readiness requirements. Those systems or components demonstrating high reliability coupled with an effective Built-In-Test (BIT)/ fault isolation capability, as applicable, and where sustained supportability/readiness requirement is achieved, will be retained at the "D" level. This approach/maintenance concept would be directed at minimizing support system cost (i.e., reduction of "I" level ATE requirement for land-based and shipboard sites) while sustaining operational/readiness objectives.

The maintenance concept envisioned for the A-12 was similar to other Navy aircraft. At the aircraft squadron organizational or "O" level, maintenance personnel remove and replace weapons replaceable assemblies, also known as WRAs or "black boxes." These defective units are then forwarded to the Intermediate or "I" level of maintenance, where the WRAs would be tested on ATE that indicate which Shop Replaceable Assembly (SRA) is defective. The SRA is replaced, then the WRA is re-tested to confirm proper function, and returned to the supply system. The ATE used initially would have been an AN/ASM-686 Intermediate Automatic Test Set (IATS) as interim support until the AN/USM-636V CASS was available (in FY 1995). As interim support, most A-12 avionics testing on IATS would have been at the "D" Level. The defective SRA (usually a circuit card) would be forwarded to the depot or "D" level for repair. Once CASS was available, most WRAs and many SRAs would be repaired at the "I" level.

WRAs and SRAs that cannot be repaired by the "I" level would be returned to the cognizant depot, or "D" level for repair or salvage. Planning for this aircraft included a fully capable organic "D" level support in FY 1996, timed to coincide with IOC. Initial support was to be via Navy and contractor using IATS. The A-12 was planned as the first aircraft to use CASS exclusively for primary avionics ATE support.

B.3.3.2 Plans to achieve concepts

The A-12 program developed two potential scenarios for avionics support. One was to use existing ATE as much as possible. This approach would use testers such as the AN/USM-467 (RADCOM) and the AN/ASM-686 (IATS) with modifications as well as "rack and stack" type equipment Hewlett Packard test equipment (to be developed) to provide support. The directives of SECNAVINST 3960.6,12 October 1990 and NAVAIRINST 3630.2A, 22 March 1991, eliminated this option.

The option selected for avionic support was to utilize the AN/ASM- 686 IATS for interim support until CASS was available. This option caused a slight increase in support costs because of some repeated TPS development efforts, but would provide operational savings through the life of the aircraft.

B.3.3.3 Supporting plans - personnel training, support for ATS.

A-12 avionics identified as requiring support are depicted in Table B-21

Table B-21. Listing of Identified Requirements for Operations TPSs by WRA

WRA NAME	OTPS	COMPLEXITY	ID REQD?
ACTIVE COUPLER *	1	SIMPLE	NO
AIRSPEED ALTITUDE INDICATOR	2	SIMPLE	NO
EXPENDABLES COUNTER	2	SIMPLE	NO
GPS	2	AVERAGE	NO
DIGITAL MEMORY UNIT	3	AVERAGE	YES
DIGITAL MAP COMPUTER	3	COMPLEX	NO
DISPLAY PROCESSOR	4	VERY COMPLEX	NO
DATA STORAGE UNIT **	5	SIMPLE	YES
ENGINE CONTROL UNIT	6	VERY COMPLEX	NO
FLIGHT CONTROL COMPUTER	7	VERY COMPLEX	NO
INTEG INERT SENSOR	7	COMPLEX	YES
SIGNAL DATA COMPUTER	8	COMPLEX	YES
FLIGHT DATA RECORDER	8	SIMPLE	NO
ALIGNMENT ACCEL MODULE *	9	SIMPLE	YES
HEAD UP DISPLAY	9	VERY COMPLEX	YES
STATION DECORDER UNIT*	10	AVERAGE	NO
WEAPON BAY DOOR CONTROL	10	AVERAGE	NO
INTEGRATED CONTROL PANEL *	10	AVERAGE	YES
INLET ICE DETECTOR *	11	SIMPLE	NO
MULTIFUNCTION DISPLAY	12	COMPLEX	YES
TACTICAL SITUATION DISPLAY	12	COMPLEX	YES
MISSION CONTROL COMPUTER	13	COMPLEX	YES
SATCOM XCVR	14	VERY COMPLEX	NO
SATCOM POWER AMPLIFIER	15	COMPLEX	NO
THROTTLE QUADRANT *	16	SIMPLE	YES
PRIMARY FLIGHT CONTROLLER *	16	SIMPLE	YES
LANDING GEAR CONTROL UNIT	17	SIMPLE	NO
BRAKE ANTI-SKID CONTROLLER *	17	AVERAGE	NO
REMOTE INTERTFACE UNIT	17	SIMPLE	NO
INTERIOR LIGHT CONTROLLER *	18	SIMPLE	NO
EXTERIOR LIGHT CONTROLLER *	18	SIMPLE	NO
FIRE DETECTOR CONTROLLER	1	SIMPLE	NO
UADC	1	AVERAGE	NO
USDC SENSOR	1	AVERAGE	NO
UHF DATA LINK RT/PR	2	AVERAGE	NO

Table B-21. Listing of Identified Requirements for Operations TPSs by WRA

UHF RADIO R/T	2	AVERAGE	YES
AIMS ANT SELECTOR	3	SIMPLE	YES
AIMS RESOURCE CONTROLLER	3	SIMPLE	YES
INTERCOM AMP *	26	SIMPLE	NO
IFF	4	AVERAGE	NO
TACAN R/T	4	SIMPLE	NO
LOWER ANTENNA ELEC UNIT	5	AVERAGE	YES
UPPER ANTENNA ELEC UNIT	5	AVERAGE	YES
GPS RCVR/PROC	6	AVERAGE	NO
RADAR ALT R/T *	7	AVERAGE	NO
NAVFLIR POWER SUPPLY	8	AVERAGE	NO
ESMS POWER SUPPLY	8	SIMPLE	YES
NAVFLIR SENSOR HEAD	9	VERY COMPLEX	YES
RADAR ANTENNA RECEIVER	24	COMPLEX	YES
RADAR BEAM STEER	25	COMPLEX	YES
RADAR TRANSMITTER	10	COMPLEX	YES
RADAR RCVR STALO	11	COMPLEX	YES
RADAR PSP	12	COMPLEX	YES
RADAR ANTENNA	13	COMPLEX	YES
APU CONTROLLER	14	AVERAGE	NO
ECS CONTROLLER	14	AVERAGE	NO
CFF SENSOR HEAD	15	VERY COMPLEX	YES
CFF HEAD CONTROLLER	16	VERY COMPLEX	NO
CFF PROCESSOR	17	COMPLEX	NO
CFF HEAD VIDEO PROCESSOR	18	VERY COMPLEX	NO
ESMS BAND 3 RCVR	19	COMPLEX	NO
ESMS WB CHANNELIZER	20	VERY COMPLEX	YES
ESMS IF PROCESSOR	21	VERY COMPLEX	YES
ESMS DIGITAL PROCESSOR	22	VERY COMPLEX	YES
MWS PROCESSOR	23	AVERAGE	NO
MWS SENSOR	23	COMPLEX	YES
WDL RF NETWORK	27	COMPLEX	NO

* Probable "D" Level Support Only

** I-Level Support already exists in the fleet

ATE TPS development "should cost" estimates were generated for the WRAs listed in this table and provided the funding projections used in this study.

B.3.4 A-12 Weapon System ATS Inventory

B.3.4.1 ATS Quantities, Types, and Locations

Avionics support equipment identified for the A-12 was the AN/ASM-686 Intermediate Automatic Test System (IATS).

The IATS was developed by McDonnell-Douglas Aircraft Corp. (MCAIR) , and produced jointly by McAir and Harris Corp. It was developed as peculiar support equipment for the F/A-18 aircraft; however, the IATS capabilities were sufficient for use as an interim tester for A-12 avionics until CASS was available. The IATS is a functional tester that performs functional analysis of digital, analog, and hybrid WRAs using aircraft avionics simulation equipment and computer control.

Development of the IATS is somewhat peculiar. It was originally developed from the IAFTA, which consisted of an F/A-18 O-level tester (the AFTA) used to interrogate the F/A-18 fault-tree system, and an additional rack of equipment of equipment to mimic the airframe called the AIRSIM. The IAFTA was developed from F/A-18 factory test equipment, and provided an expansion of the original go/no-go tester with fault isolation added. The IATS was developed as a permanent I-level tester from the IAFTA due to great fleet demand for a relatively simple tester for F/A-18. The A-12 program intended to procure additional IATS stations for interim production support during FY 91-96. CASS would start production support in FY 95.

The IATS was developed in FY 86, and upgraded and retrofitted to test the F/A-18 C/D Night Attack system during FY 90 and 91. Thirty-one testers were built, all for F/A-18 support.

B.3.4.1.1 CASS

CASS will be the avionics tester of the future (per SECNAVINST 3960.6, dated 12 October 1990, and NAVAIRINST 3630.2A, 22 March 1991.

CASS consists of a hybrid core, with add-on racks and equipment to test radio frequency (RF), electro-optical (EO), and communications and navigation (CNI) equipment. CASS tests digital, analog, and hybrid WRAs and SRAs.

The CASS inventory objective is 720 testers. The allocation of stations is documented in the CASS Introduction Plan (CIP) of 15 August 1991. This document contains allocations in detail through FY 1996, with projections through FY 2002. For detailed information the CIP should be referenced.

B.3.5 Specific A-12 ATS Technical Capabilities

B.3.5.1 AN/ASM-686 Intermediate Automatic Test Set (IATS)

Automatic testing is implemented through a computer and its peripheral devices. TPSs are written to minimize operator interaction during testing. The IATS Computer Operations Manual instructs the operator how to set up the UUT and the TPS hardware, as well as how to start running the TPS program. The TPS program then informs the operator what operator actions are required to perform proper testing. Operator actions include connecting cables to the UUT, toggling switches on the UUT, and verifying measurements displayed by station assets or the UUT.

B.3.5.1.1 Sensor/Measurement Interfaces

Unlike many other test stations, the IATS does not use "normal" interface devices. During testing, UUTs are attached to the stations using only cables, which may have one or more relatively passive boxes built into them. The cables are attached to the IATS at general purpose cable connector points.

B.3.5.1.2 Auxiliary Equipment, Power Supplies

A number of pieces of auxiliary equipment are used to execute IATS TPSs. Examples are a photometer, a chrominance meter, a convergence meter, an oscilloscope, and the TTU-205 pressure generator.

B.3.5.1.3 Architecture

Most of the stimulus and measurement equipment in the IATS are special purpose equipment, such as digital and analog circuit boards, built by McDonnell Aircraft Company. Few of the components are commercial off- the-shelff (COTS). All of the equipment is mounted in racks.

B.3.5.1.4 TPS Environment and Support

The computer within IATS uses the Versatile Real-Time operating system (VRTX) commercially produced by Ready Systems,. TPSs are executed using an executive written in Ada by Alsys Corporation. The IATS software is somewhat flexible. Operators can begin testing at various entry points in the test programs and can cycle tests. However, older IATS TPSs were written with few, if any, entry points. This severely limited operator options. Newer TPSs are more flexible with more entry points.

IATS TPSs are developed and maintained on International Business Machine (IBM)-compatible personal computers (PC) with at least an Intel 80286 processor. Standard IBM PC compatible operating system software is used during TPS development and maintenance. In addition, compilers for an assembly language, the Fault Tree Interpreter (FTI) language, and PLM (a language similar to C) are used to process TPS source code prior to loading the software onto an IATS. FTI is a "if-then-else" type of language that was developed by McDonnell Douglas Corporation.

B.3.5.2 CASS

B.3.5.2.1 Operating Software

The CASS system is based around Digital Equipment Corporation's VMS Version 5.2 operating system. The CASS software system is composed of three main computer software configuration items (CSCIs), which are the Station Control Software, the Support Software, and the Intermediate Maintenance Operations Management. The following is a list of the components contained in the CASS CSCIs:

Station Control Software:

- Test Executive
- Virtual Instrument Handlers
- Instrument Personality Interfaces
- Operator Interface
- Automated Technical Information
- Communication Handler
- Asset Allocation
- General Asset Monitor
- Kernal Asset Monitor
- Functional Extension Program
- IEEE 488 Translators
- Self Maintenance

Support Software:

- ATLAS Compiler
- IPTESTER
- Test Program Set Development Software
- Test Executive Simulator

Intermediate Maintenance Operations Management:

- Built-In-Test
- Data Processing
- Network
- Post Processing
- Pretest
- Station Management

B.3.5.2.2 TPS Development Environment

It is intended that CASS TPS development is done off-line on a VAX with a VMS operating system. Products have been developed to facilitate this process. The TPS development products are:

a. TE SIM (AGE product. It simulates all of CASSs functions except for those of the Teradyne L200 Series DTU.)

b. DICONS (n optional but extremely useful tool. It allows the operator to access and program CASS instruments directly.)

c. IEEE 716 ATLAS compiler

d. L200 Series compiler (Teradyne)

e. FORTRAN compiler

This off-line TPS Development Process allows the implementation of another cost saving measure, the use of Test Integration Facilities (TIF). The three Navy TIFs are located at Norfolk, VA; Jacksonville, FL; and San Diego, CA. After the TPS developer has completed his development and debugging (except for TPSs which utilize the L200, which can only be debugged at the CASS station), he schedules time at the TIF for integration of his TPS with CASS.

While the use of off-line development reduces the numbers of CASS required, there are some special cases of TPS development in which it is more cost effective to provide a CASS to the developer.

B.3.6 A-12 ATS Upgrade and/or Off-load

The A-12 was a newly-designed aircraft; with no upgrades in the planning stage before the program was terminated. Therefore, no ATS upgrades were driven by weapon system upgrades. For CASS to be capable of A-12 support, it needed an upgrade to its testing capability. This upgrade consisted of an additional asset to be built into CASS that would allow the station to address the fiber optic bus incorporated in the A-12. Since this bus is a new requirement for the Navy, it was considered for P^3I for CASS, to be funded by either the A-12 or CASS program. Research, development, and prototyping the required cards to accommodate this bus had been completed.

B.3.6.1 CASS P^3I Program

The CASS program has budgeted $11.0 million per year beginning in FY 1995 for P^3I. Candidates for technology insertion are identified by the Navy using the System Synthesis Model (SSM). Part of the CIP includes the requirement for each candidate program to provided SSM data sheets which document specific testing requirements. The SSM is an automated tool which compares these testing requirements to the capabilities of CASS. The technical deficiencies identified in CASS by this process along with the planned inventory of the technology are used by NAVAIR to set priorities for technology insertion candidates. Using this process to plan and program a structured P^3I program will enable CASS to support emerging technology, and thereby minimize program risk and the potential for PSE proliferation.

B.4. APACHE LONGBOW

B.4.1 Weapon System Background

B.4.1.1 Description

The Apache Helicopter is a single main rotor, twin engine, tandem seat attack helicopter armed with the Hellfire antitank missile, Hydra 70 (2.75-inch) rockets, and a 30mm chain gun. It is capable of defeating armor in day, night, and adverse weather. A target acquisition designation system (TADS) is housed in a turret on the nose of the helicopter and consists of a TV, forward-looking infrared radar (FLIR), direct view optics, laser designator/rangefinder, and spot tracker. The aircraft is equipped with a pilot night vision sensor (PNVS) which is a FLIR that allows map of the earth operations at night by the pilot independent of the co-pilot gunner's FLIR.

Longbow is a development and acquisition program for an air/ground targeting radar capable of being used day or night in adverse weather and with battlefield obscurants. The Longbow system is being developed for integration into the Apache attack helicopter and the Comanche armed reconnaissance helicopter. Longbow consists of a mast mounted millimeter-wave Fire Control Radar (FCR), a Radio Frequency Interferometer (RFI), and a radio frequency fire-and-forget Hellfire Missile. The FCR detects ground or air targets, and the RFI identifies active emitters. The central processor then classifies the target, establishes priority for engagement, and passes target information to the missile seeker. The pilot may then engage the targets with significantly reduced decision and exposure times. Longbow is being planned for integration into eleven pure Longbow Apache Battalions in Force Package 1, and into one third of the Comanche fleet.

The AH-64 Apache is the Army's primary attack helicopter. It is a quick-reacting, airborne antitank weapon system. Terrain limitations and the unknown placement of numerically superior enemy armor dictate the need for a system that can deploy quickly to the heaviest enemy penetration and destroy, disrupt, or delay the attack long enough for friendly ground maneuver units to reach the scene. The Apache is designed to fight and survive at day, night, and in adverse weather throughout the world. It is equipped with a

Target Acquisition Designation Sight and Pilot Night Vision Sensor (TADS/PNVS) which permit its two-man crew to navigate and attack in darkness and in adverse weather conditions. The Apache has a full range of aircraft survivability equipment and has the ability to withstand hits from rounds up to 23mm in critical areas. The processors for the radar are located in the aircraft's avionics bays. The Longbow Apache consists of the AH-64 aircraft modified with changes necessary to integrate the Longbow radar and missile. Changes are additional power, expanded avionics bays, additional cooling, upgraded processors, integrated avionics, and a MANPRINT crew station.

B.4.1.2 Performance and Effectiveness Indicators

A brief summary of performance and effectiveness indicators is provided below.

Mission Gross Weight:	14,770 lbs.
Cruise Speed:	145 knots
Crew:	2
Armament:	Hellfire Missiles, Hydra 70 rockets and 30mm M230 chain gun

B.4.1.3 Status of System and Performance

Apache production began in FY82 and the first unit was deployed in FY86. As of December 1991, 705 Apaches were delivered to the Army. The last Army Apache delivery is scheduled for February 1995. Twenty-five attack battalions are deployed and ready for combat. The Army is procuring a total of 811 Apaches to support a force structure of 40 battalions (26 Active, 2 Reserve; 12 National Guard). The Apache has been sold to Israel, Egypt, Saudi Arabia, the UAE, and Greece.

The Apache Longbow System entered Full-Scale Development in December 1990 following a successful Proof of Principle (POP) Phase. Technical success during POP culminated with the live firing of nine missiles against a wide variety of targets, moving and stationary, through smoke and obscurants. The current program objective calls for 227 Longbow Apache aircraft with first flight of the integrated radar commencing in 1993.

B.4.2 ATS Acquisition and Management

The Longbow system will require a significant number of TPSs at Depot level. There are 4 LRUs, 26 Shop Replacement Units (SRUs), and 45 LRMs for the FCR and 1 LRU and 34 SRUs for the RF Seeker. Acquisition and concept of the ATS is in accordance with the following.

B.4.2.1 Army Regulation 750-43

Army Regulation 750-43, Army Test, Measurement, and Diagnostic Equipment Program, 29 September 1989, establishes Army wide policy for ATE and TPS. The following criteria will be used for ATS selection:

a. Non-standard ATE will not be used in lieu of designed standard ATE without appropriate economic analysis.

b. System developers in coordination with Program Manager for Test, Measurement, and Diagnostic Equipment (PM TMDE), USATA, and TRADOC will determine their ATE requirements.

c. Once ATE requirements have been identified, system developer will perform the following:

- Determine if designed standard ATE will fulfill requirements and where they do not.
- Determine feasibility of expanding capabilities of standard ATE, and if neither of the above are feasible, then submit waiver request documenting the case for a nonstandard ATE

B.4.2.2 HQ, Material Command memorandum, AMC-M 750-1

HQ, Material Command memorandum, AMC-M 750-1, Automatic Test Equipment Policy, 6 August 1991, ensures that ATE development and fielding is according to Army Regulation 750-43. ACM-M 750-1 also designates the Integrated Family of Test Equipment (IFTE) to be the Army standard ATE that will be used for the following:

- All new systems as well as currently fielded systems undergoing P^3I.
- Systems requiring but currently lacking ATE.
- Systems to be in service after FY 94.

A waiver process requires that Army-wide cost and effectiveness considerations be made according to Army Regulation 750-43, and the PM TMDE is responsible for logistic support of ATE and embedded software. Major Subordinate Material Development Commands identify TPS requirements not later than Milestone II of prime system.

B.4.2.3 Army Pamphlet 750-43

Army Pamphlet 750-43, 28 February 1992, Army Test Program Set Procedures provides guidance for applying requirements, acquisition, development and life cycle management of TPS in support of Army Material Command systems.

B.4.3 Weapon System and ATS Deployment Concepts

B.4.3.1 Weapon System Fielding

TRADOC, FORSCOM, USAREUR, and NGB currently process the Apache. EUSA will receive the Apache in FY92. The USAR is scheduled for FY 93-95.

B.4.3.2 Maintenance Concept

The maintenance concept is given in AR 750-1, chapter 5, section V, except for printed circuit board (PCB) repair. Test facility electronic equipment, OQ290(2)/MSM, is located at non-divisional and divisional AVIM for line replaceable unit (LRU) repair. CONUS and selected OCONUS PCB repair is accomplished at depot. When economically and operationally feasible, the OQ290(2)/MSM will be replaced with IFTE.

The maintenance concept for the Longbow is two level maintenance (AVUM and Depot). The on-aircraft BIT is designed to detect at least 95% of all failures and 98% of mission-affecting failures. BIT is designed to isolate 95% of the detected failures to a single LRU or LRM with a Retest OK rate that will not exceed 9%. Use of the IFTE CEE is planned at depot level.

Apache is supported by ATS at AVIM (Aviation Intermediate Maintenance) and Depot/Factory.

- Level of Maintenance: AVUM TMDE (ATE): None.
- Level of Maintenance: OQ290(V)2/MSM, electronic equipment test facility.
- Level of Maintenance: Mainz Army Depot only TMDE (ATE): AN/USM 410(V)3 with Apache, augmentation electronic equipment test station.

Transitioning to IFTE will be influenced by cost and scheduling constraints.

B.4.3.2.1 Recurring Maintenance

AVUM is 2,184 hours and AVIM is 936 hours based on 20 flying hours per month. These hours are expected maximums based on specification maintenance man-hour per ground hour (MMH/GH) (100,000) hour maturity goal. Current maintenance man-hour per flying hour (MMH/FH) is 8/13.

B.4.3.2.2 Contract Maintenance

Contract maintenance below depot level is not applicable for support of Apache operational units. AVIM maintenance of all training base aircraft is accomplished by contract and budgeted by TRADOC. Transition to war status will require multi-shift operations for civilian performed maintenance.

B.4.3.2.3 Warranty/Special Support

The warranty for the Apache program covers the target acquisition designation system/pilot night vision sensor (TADS/PNVS) and Apache airframe.

B.4.3.3 Support for ATS

Maintenance support involves both calibration and repair. The U.S. Army Test, Measurement, and Diagnostic Equipment Support Group (USATSG), a subordinate element of the U.S. Army Test Measurement and Diagnostic Activity, is responsible for total TMDE support (i.e., calibration and repair) Army wide. Support is provided by way of mobile teams and fixed-station laboratories/repair facilities. Mobile teams provide DS level repair and transfer level calibration on site. Fixed facilities are strategically deployed primarily to support the mobile teams. Calibration is done on a cyclic basis in accordance with schedules and provisions of TB 43-180. Repairs are performed as required. The entire program is established and maintenance is performed according to directions contained in Chapter 6, AR 750-43.

The program was developed and implemented to ensure maximum availability of accurate, fully mission-capable TMDE for Army Weapon System diagnostic applications. This fundamental objective is applicable to TMDE in general and ATS in particular. It is managed, directed and controlled by the CG, AMC and implemented, both in the continental United States (CONUS) and outside CONUS (OCONUS), by the USATSG. The TMDE support normally will be based on the concept that repair should be performed by the element designation in TB 43-180 as being responsible for calibration support. Calibration and Rep for TMDE not listed in TB 43-180 will be provided by USATSG based on the specific support requirement as identified by the owner or user organization. TMDE support will be as follows:

a. All TMDE owners or users will perform organizational maintenance on organic TMDE.

b. TMDE support activities will provide calibration and Rep for all TMDE, General Purpose and TMDE, Special Purpose designated in TB 43-180 as being the support responsibility of the Area TMDE Support Center or Area TMDE Support Team (Mobile Team).

c. Normally, calibration of TMDE will be provided on a first-come, first-served basis unless extenuating circumstances dictate that support be provided according to the priorities established under paragraph 6.25 of the AR 750-43.

d. TMDE repair will be provide on a priority basis according to the maintenance priority designators outlined in AR 750-1.

e. DS/GS maintenance and AVIM units will provide support service for organic and supported units TMDE, Special Purpose designated in TB 43-180 as requiring DS/GS maintenance or AVIM unit calibration and/or repair.

f. Special Purpose TMDE may need calibration and repair to be performed by both a TMDE support activity and an DS/GS maintenance or AVIM unit on a coordinated basis. For example, a large TMDE, Special Purpose console may include some TMDE, General Purpose that normally would be serviced by a TMDE support activity. The remaining components of the console are TMDE, Special Purpose, and require a person with weapon system training to do the repair work. In these cases, the TMDE, General Purpose and DS/GS or AVIM unit personnel will work together to complete the required calibration and Rep. (This will be accomplished through a local agreement.)

B.4.4 Weapon System ATS Inventory

Table B-22 summarizes the Appache Longbow ATS requirements by location and quantity.

Table B-22. Appache Longbow ATS

ATS	QTY	LOCATION	# PER LOC
EETF	22	I, D	1
Digital Signal Processor	5	F	5
RF Test Set	5	F	5
Radar Systems Bench	5	F	5
Processing Test Set	5	F	5
Assembly Test Set	5	F	5
IFTE (CTS) - Outyear plans	-	-	-

B.4.5 Specific ATS Technical Capabilities

ATS resources include the Electronic Equipment Test Facility (EETF), four pre-production test sets, a system bench and the IFTE-based contact test set (CTS). The EETF is also referred to as the OQ290(V)2/MSM.

B.4.5.1 EETF

The EETF assembly consists of an expansible air-ride, 35-ft. semi-trailer van housing the ATE AN/USM-410(V)5, and a 35-ft. support van (modified XM991E1) housing the AVIM TPS for the AH-64A helicopter and other auxiliary items. The two semi-trailers capable of road, air, and sea transport and perform the test facility mission on the world wide military environment as specified in DRC-P-H501405B. The EETF is mobile and provides stimuli measurements and control functions to automatically test and fault isolate AVIM level LRUS and SRUS. The ATE operating in the expansible van consists of the core subsystem, AN/USM-410(V)4, (P/N B0421363); and the AH-64A peculiar subsystem (P/N 7-3651000001). The ATE core subsystem provides the capability to prepare, edit, compile, and execute test programs and test program instructions (TPI) in the equate atlas software language. The AH-64A peculiar subsystem and the E/O subsystem shall interface with and be controlled by the core subsystem.

B.4.5.2 Other ATE

Other ATE are the Digital Signal Processor (DSP) Test Set, Low Power Radio Frequency (LPRF) Test Set, Fire Control Radar (FCR) System Bench, Programmable Signal Processor (PSP) Test Set, and Mast Mounted Assembly (MMA) Test Set. All of these are being used for pre-production engineering test of developmental weapons subsystem. Longbow test equipment has been used since the Proof-of-Principles (POP) phase. Many of these items will be transferred to the FSD contract to avoid negative cost and schedule impacts. Furthermore, both contractors, Westinghouse Electric Corporation (WEC) and Martin Marietta Corporation (MMC), have significant quantities of existing software in their R&D facilities. A depot study is being accomplished during the FSD contract to look at the use of the IFTE. Outyear plans for using the IFTE Contact Test Set (CTS) currently are being considered.

B.5. Multiple Launch Rocket Systems (MLRS)

B.5.1 MLRS Weapon System Background

B.5.1.1 Description

The Multiple Launch Rocket System (MLRS) consists of a 12-round rocket launcher mounted on a highly mobile, tracked vehicle that is equipped with a man-rated cab and on-board computerized fire control system. The official nomenclature of the tracked vehicle is the Armored Vehicle Mounted Rocket Launcher, M270. Each MLRS battery employs nine M270s.

B.5.1.2 Mission

The primary missions of MLRS are counter fire and suppression of enemy air defenses, light material and personnel targets. The MLRS is a free-flight, area fire, artillery rocket system which supplements cannon artillery fires by delivering large volumes of firepower in a short time against critical, time-sensitive targets. The basic warhead carries improved conventual submunitions. A growth program is underway to add the Sense and Destroy Armor (SADARM) warhead to improve counter battery fires. The MLRS M270 launcher is being updated to accommodate launching a new MLRS family of munitions (MFOM), including the Army Tactical Missile System (ATACMS).

B.5.1.3 Characteristics

Length: 6.8	Cruising Range: 483 km	Rocket Range: 32 km
Width: 3 m	Average speed: 40 kph	Crew: 3
Weight: 24,756 kg	Maximum speed: 56 kph	

B.5.1.4 Status of System

The second multiyear procurement contract for FY89-93 was awarded in July 1989 for MLRS. The U.S. initial operational capability for MLRS was achieved in 1983. Starting in FY89, MLRS has been coproduced by the United States, United Kingdom, Germany, France, and Italy. As of 5 December 1991, a total of 406 units have been fielded. Potential improvements to the system include the improved fire control system (FCS). The IFCS will mitigate electronic obsolescence currently existing in the fire control system (FCS) and will accommodate the needs of the MFOM weapon systems under development and provide growth for future weapon systems.

MLRS performed extremely well in Operation Desert Storm (ODS). Significant numbers of MLRS launchers were deployed. The new upgrade MLRS (Deep Attack Launcher) also demonstrated its capability during the first operational firings of the longer range ATACMS.

B.5.2 MLRS ATS Acquisition and Management/ATS Upgrade Planning Approach

Army Regulation 750-43, 29 September 1989, Army Test, Measurement, and Diagnostic Equipment Program Establishes Army wide policy for ATE and TPS. The following criteria is used for ATS selection. Non-standard ATE will not be used in lieu of designed standard ATE without appropriate economic analysis

System developers in coordination with Program Manager for Test, Measurement, and Diagnostic Equipment (PM TMDE), USATA, and TRADOC will determine their ATE requirements. Once ATE requirements have been identified, system developer will:

- Determine if designed standard ATE will fulfill requirements and where they do not,
- Determine feasibility of expanding capabilities of standard ATE, and if neither of the above are feasible,
- Submit waiver request documenting the case for a non-standard ATE

HQ, Army Material Command memorandum, AMC-M 750-1, 6 August 1991, Automatic Test equipment Policy: Ensures that ATE development and fielding is per Army Regulation 750-43. AMC-M-750-1 also designates the Integrated Family of Test Equipment (IFTE) to be the Army standard ATE that will be used for:

- All new systems as well as currently fielded systems undergoing P^3I
- Systems requiring, but currently lacking ATE.
- Systems to be in service after FY 94.

A waiver process requires that Army wide cost and effectiveness considerations be made as per Army Regulation 750-43 and the PM TMDE responsible for logistic support of ATE and embedded software. Major Subordinate Material Development Commands identify TPS requirements not later than milestone II of prime system.

Army Pamphlet 75-43, 28 February 1992, Army Test Program Set Procedures: provide guidance for applying requirements, acquisition, development, and life cycle management of TPS in support of Army Material Command systems.

The MLRS is a fielded system undergoing a material change that will upgrade the system to the "Deep Attack" configuration. The MLRS Deep Attack will deploy several new munitions. MLRS is converting to the Integrated Family of Test Equipment (IFTE). Contracts have been awarded for the Test Program Sets (TPS). The TPSs are scheduled for fielding third quarter FY94. Thirty four TPSs are identified to support the MLRS including the Deep Attack version. There will be eight Line Replaceable Units (LRU) TPS, 22 Shop Replaceable Units (SRU) TPS, and four TPSs for the power supply. The built in test/built in test equipment (BIT/BITE) is falling short of the requirement. Plan is to redesign the fire control system and go to a data bus. The Contact Test Set will be used to read the data bus. The redesign is scheduled to begin in FY94.

B.5.3 MLRS Weapon System and ATS Deployment Concepts

B.5.3.1 *Fielding*

B.5.3.1.1 FORSCOM, TRADOC, USAREUR, and EUSA have achieved first unit equipped (FUE) status

406 tactical units fielded worldwide; 26 units are located at schools. There are no ATS at operator/organizational maintenance level. Common TMDE and BIT/BITE used at direct support. AN/USM-105(V)1 is used at general support. AN/USM-410 used at depot. MLRS will be transitioning to IFTE. Contracts have been awarded to develop TPS and are scheduled for fielding by third quarter FY94.

B.5.3.2 Maintenance Concept

Although future maintenance for MLRS will transition to the IFTE ATS the basic concept will encompass standard Army maintenance systems. The entire system is designated for ease of maintenance. Most on-site repair of electronic assemblies is done by replacement of line replaceable units (LRUs) (modules/components) by the MLRS organizational mechanics (MOS 13M10S8) or by the DS maintenance (MOS 27M) contact teams. The faulty component is isolated using BITE (built-in test equipment) and evacuated to the appropriate maintenance level for repair. GS repairs components by isolating and replacing printed circuit boards (PCB). Piece part repair of PCBs is done at depot. Standard test equipment-internal combustion engine (STE-ICE) is used to isolate faults in the engine and its major components.

B.5.3.3 Support for ATS

Maintenance support involves both calibration and repair. The U.S. Army test, Measurement, and Diagnostic Equipment Support Group USATSG a subordinate element of the U.S. Army Test Measurement and Diagnostic Activity, is responsible for total TMDE support (i.e., calibration and repair) Army-Wide. Support is provided by way of mobile teams and fixed-station laboratories/repair facilities. Mobile teams provide DS level repair and transfer level calibration on- site. Fixed facilities are strategically deployed primarily to support the mobile teams. Calibration is done on a cyclic basis in accordance with schedules and provisions of TB 43-180. Repairs are performed as required. The entire program is established and maintenance according to directions contained in Chapter 6, AR 750-43.

B.5.4 MLRS Weapons System ATS Inventory

The following table summarizes the quantity and type of ATS required to support the MLRS.

Table B-23. MLRS ATS

NAME	QTY	Factory O/I/D	# per loc	Tested Item	
				Qty.	Type (1)
MSM-105	1.65	I Level	1	12	LRU
AN/USM-410	0.15	D Level	1	25	LRU/SRU
BSTF	9.4	I Level	1	10	LRU/SRU
CEE	1	D, F Level	1	35	LRU/SRU
DIT-MCO	2	D Level	1	16	Cables
Cumulative	14.2			98	

B.5.5 Specific ATS Technical Capabilities

The following paragraphs summarize the capabilities of the following ATS: MSM-105, AN/USM-410, BSTF, CEE, and DIT-MCO.

B.5.5.1 MSM-105

The MSM-105 is an automatic test facility for performance, diagnostic, and fault isolation testing of various analog, digital, and hybrid electronic equipments. It contains the

AN/USM- 410(V)2 Test Station, AN/USM-465A Test Set, MK-2046/MSM Power Protect Kit, V-516(V) 1/MSM Van, and various items of manual TMDE. The system requires a controlled environment, which is provided in the field by an air conditioned, air suspension XM-995 Semi-trailer Van. The test facility is used with the AN/MJQ-12A Power Plant and the OA-8991/MSM Electronic Equipment Repair Facility (NSN: 6625-01-070-4404).

B.5.5.2 AN/USM-410(V)3

The AN/USM-410(V)3 is an automatic test station for performance, diagnostic, and fault isolation testing of various analog, digital, and hybrid electronic equipment. The system has an on-line compiler and automatic optical meter/dial reader; an automatic UUT control driver and the capability to generate all test signals (SINEWAVE, TRIANGLE, SERVO. SQUARE, PULSE TTY, and Digital) by synthesis. The testing is accomplished by an analog to digital converter, a digital voltmeter circuit and fairer analysis of the resultant voltage time relationship. The reverse is used to create any desired signal. The system has the capability for: (1) read only memory UUT program, (2) program preparation on-line, (3) actual value of UUT parameters plus a go/no-go indication, (4) central control and display, (5) automatic system selfcheck, (6) automatic antenna simulation, (7) dynamic digital testing, analog testing, and hybrid circuit testing. The 410 interface is programmable to the extend that it can accommodate differing analog/digital UUTs whose functional requirements are within the TMDE capabilities. The ATE is a third generation, individual rack system with a S/130 computer (32K bytes min to 256K bytes max), 8 to 76 input/output channels and a 0.2 USEC instruction cycle time. Type of readouts include: digital recorder, paper tape punch, magnetic tape, printer, and CRT. The Government has unlimited rights to technical data and computer software. The standard test program language is EQUATE-ATLAS. Software is available to government users that can make an HP-2100 compiler emulate a 410 for off-line TPS software development. The system requires a controlled environment and is designed for fixed facility installation.

The following table summarizes the AN/USM-410 test capabilities.

Table B-24. AN/USM-410 Measurement Capabilities

MEASUREMENT CAPABILITIES		
FUNCTION	**PARAMETER 1**	**PARAMETER 2**
DC - Voltage	0-200 VDC	N/A
Scaled AC	0-141 VRMS	01+50KHz
TRMS	0-141 VRMS	01KHz - 500 MHz
VP, VP-P	0-200 VP	01KHz - 500 MHz
Pulsed - DC VP, VP-P	0-200 VP	01KHz - 500 MHz
Resistance	0-10 M Ohms	1-10 Volts
Complex Impedance	0-100 M Phms	05KHz - 7KHz
Harmonic Distortion	10Hz - 100mHz	0-141 VRMS
Harmonic Analysis	2Hz - 100MHz	0-141 VRMS
DC Current	0-25 Amps	N/A
AC Current	0-10 Amps	.01KHz - 50KHz
AM Modulation	50KHz - 500KHz	0-30dBm
FM Modulation	10KHz Max	-10 to + 30dBm
Measure Sample	.1-141 VRMS	10KHz - 500MHz
Frequency	500MHz Max	.05-141 VRMS
Time Interval	10MHz Max	.05-141 VRMS
Phase	10MHz Max	.05-141 VRMS

B.5.5.3 CTS

Contact test set (CTS). The CTS is a two-box, man portable tester deployed at DS level for use by maintenance contact support teams. It augments system BIT/BITE and identifies failed LRUs in weapon systems. The CTS may be reconfigured to support specific systems using plug-in, pull-out modules. The CTS assembly case measures approximately 14.5 inches high, 10.8 inches wide, and 16.9 inches long. It weighs 35.6 pounds.

B.5.5.4 Base Shop Test Facility (IFTE) Characteristics

The BSTF is a tactical version of the CEE. The BSTF consists of the Base Shop Test Station (BSTF), in a 5-ton truck mounted S-280 Shelter, plus another 5-ton truck mounted S-280 shelter for Test Program Sets (TPS) storage powered by 60KW generator sets. The characteristics of the BSTF and CEE are listed in the following table.]

Table B-25. BSTF and CEE Measurement Capabilities

MEASUREMENT CHARACTERISTICS	
FUNCTION	**PARAMETERS**
RF MEASUREMENT	
* Power Meter (HP-438A)	Power Range 44 to -70dBM Frequency: 100KHz-26.5 GHz
* Spectrum Analyzer (HP 70000 Series)	Frequency: 50 KHz-22GHz Input Power Sensitivity to -132 dBM
ANALOG MEASUREMENT	
Digital Multimeter (HP-3457A)	DC Volts - 5uV-303 V AC Volts - 0-303 VRMS DC Current 0-1.5 A AC Current 0-1A Resistance 0-3.G ohm Reading Rate 1350/sec max
* Counter-Timer (RACAL-DANA 1995)	Frequency: DC-200 MHz Period 5 nsec to 10**7 sec Time Interval-2 nsec to 10**7 sec Rise/Fall nsec to 25 msec
Synchro/Resolver Indicator (DDC HSR 203)	Angle 0-359.99 degrees Frequency: 47 Hz to 1KHz Volts 6.8 to 90 V
VIDEO MEASUREMENT	Bandwidth Sampling:
Waveform Digitizer (HP 54201A)	Real-timec - 50 MHZ Repetitivedc - 300 MHz Range - 40mV to 16 V
HIGH POWER LOAD	
(Transistor Devices SPS3102-1)	8 Programmable Channels Power Dissipation Max 3000 Watts Single Channel 750 Watts

Table B-26. BSTF and CEE Digital Characteristics

DIGITAL CHARACTERISTICS	
FUNCTION	**PARAMETERS**
DIGITAL TESTING	
Dig Word Generator (Grumman peculiar)	I/O Pins - 192, increments of 16 Logic Levels: +30 to -30 V below 10 MHz +10 to -10 V above 10 MHz Frequency: Static to 50 Megabits/sec Resolution: 20 nsec Clock Period: 20 n to 20 msec

Table B-27. BSTF and CEE Stimuli Characteristics

STIMULI CHARACTERISTICS	
FUNCTION	**PARAMETERS**
ANALOG STIMULI	
* Function Generator (HP-3314A)	Waveforms - Sine, Square, Ramp, Triangle, Pulsed DC Frequency: .001 Hz-19.99 MHz Amplitude: 0 to 10 V p-p Resolution 3 1/2 digits
Synchro/Resolver Simulator (DDC SIM 31201)	Angle: 0-359.99 degrees Frequency: 47 Hz to 11 KHz

Table B-27. BSTF and CEE Stimuli Characteristics

RF STIMULI	
*RF Generator #1 (Gigatronics 900)	Frequency: 50 MHz to 26 GHz Resolution: 1 KHz Max Level Output + 5 dBm Pulse/Square Wave Modulation
RF Generator #2 (COMSTRON 7100D)	Frequency: 100 KHz to 1.3 GHz Resolution: 1 Hz Output Level +20 tp -140 dBm AM/FM/Phase Modulation
VIDEO STIMULI	
Video Generator (Grumman peculiar)	High Resolution Graphics Gen 4096 Data Points/Channel Full Range of Color/B+W
POWER STIMULI	
DC Power Supply (Superior 884-1, LAMBDA LGS5A10VR LAMBDA LRS-54-24, LAMBDA LGS6A280VR Superior 893-900)	8 Programmable Power Supplies 0-150 V (100W) each Fixed 28 V Supply Voltage: 0 -135 V 10A 0 - 270 V 5 A
AC Power Supply (Behlman KBT3-75D)	Frequency: 45-5000 Hz

B.5.5.5 DIT-MCO

The DIT-MCO 9500 Series has the capacity to test: aircraft cable and harness assembles, avionics racks and radio racks; cockpit wiring and interconnections, cable and wiring boards, 1553 bus systems and coax, triax and twisted pair conductors. It also has the ability to test circuits with active components - lights, relays, solenoids, motors. System consists of IBM PC/XT/AT or compatible computer, LPT-9 line printer, and DCS-III digital comparator system. Wiring Analyzer Graphics program displays tested circuit and shows the most probable location of the error. Graphics program permits automatic generation of schematics from wire lists and users symbol library.

B.5.6 ATS Upgrade and/or Off-load Plans

Army regulation 750-43 requires material developers/users to submit a waiver request and get the request approved prior to any P^3I related upgrades to existing ATE, unless the existing ATE happens to be a member of the IFTE family. IFTE is the Army Standard ATE. MLRS test requirements are to be transitioned to the IFTE family, beginning FY 94.

B.5.7 Factory/Depot Use

MLRS will be supported at Depot and Factory level by a commercialized version of the BSTF (CEE). The previously used ATS, AN/USM410, MSM-105 and the DIT-MCO will be replaced by IFTE. The BIT/BITE system now used at organizational level will be augmented or replaced by the CTS.

B.6. ABRAMS

B.6.1 Abrams Weapon System Background

B.6.1.1 Description

The M1 Abrams Tank is a full-tracked, armored vehicle capable of sustained offensive and defensive operations. It is designed to close with and destroy enemy forces using shock action, firepower, and mobility in coordination with supporting ground and air systems under all battlefield conditions and levels of combat.

B.6.1.2 Mission

The mission of the Abrams tank is to close with and destroy enemy forces on the integrated battlefield using mobility, firepower and shock effect. The 105mm main gun on the M1 and IPM1 and the 120mm main gun on the M1A1 combined with the powerful 1500 HP turbine engine and special armor make the Abrams particularly suitable for attacking or defending against large concentrations of heavy armor forces on a highly lethal battlefield. Additional features of the M1A1 are increased armor protection, suspension improvements and a Nuclear Biological and Chemical (NBC) protection system which provides additional survivability in a contaminated environment. The M1A2 development program builds on the M1A1 to provide an Abrams tank with the necessary improvements in lethality, survivability, and fightability required to defeat the threat of the mid nineties. Improvements being developed for the M1A2 include a Commanders Independent Thermal Viewer, and Independent Commanders Weapon Station, Position Navigation equipment, and a distribution data and power architecture.

B.6.1.3 Characteristics

Principal ones are noted in the following list:

- Combat weight loaded: 61.5 tons
- Length with gun forward: 384.5 inches
- Length with gun rearward: 353. 2 inches
- Reducible height: 96 + or -0.5 inches (top of turret)

- Reducible width: 144.125 inches
- Hull center ground clearance: 19 inches
- Ground pressure: 13.3 pounds per square inch
- Engine: 1,500-horsepower, air-cooled turbine
- Horsepower to ton ratio: 24.4 to 1
- Acceleration: 0 to 20 miles per hour in 7 seconds
- Maximum speed: 45 miles per hour (governed)
- Cross country speed: 30 miles per hour
- Speed on 10% slope: 20 miles per hour
- Speed on 60% slope: 4.5 miles per hour
- Main armament: M68E1, 105mm rifled cannon
- Coaxial weapon: M240, 7.62mm machine gun
- Loader's weapon: M240, 7.62mm machine gun
- Commander's weapon: M2, 50 caliber machine gun
- Sight stabilization: Elevation turret azimuth
- Night vision: Thermal imaging
- Computer: Digital solid state
- Range finder: Neodymium YAG laser
- Main gun basic load: 55 rounds
- Fuel: DF-2 (primary), DF-1, or DFA Capacity: 505 gallons
- Usable capacity: 498 gallons
- Refueling rate: 50 gallons per minute
- Cruising range: 310 miles at 29 miles per hour on level paved roads
- Operational range: 130 miles
- Crew: Four soldiers
- Obstacle crossing: Vertical, 49 inches and trench, 9 feet

B.6.1.4 Planned Systems Improvements

The Block II (M1A2) improvements over the M1A1 are to include a drivers integrated display, a navigational interface with the Global Positioning Systems (GPS) and a commander's independent thermal viewer. Testability improvements provide for the use of bus technology for diagnostics.

The Block III tank is a next-generation weapon system that is to include significant enhancements over the M1A2 with respect to lethality, rate-of-fire, survivability, mobility and shock effect.

B.6.2 Abrams ATS Acquisition and Management/ATS Upgrade Planning Approach

B.6.2.1 Flow charts and text

Army Policy (AR 750-43) requires that IFTE be considered for ATE support of any upgraded weapon system targeted for subsequent deployment. Outyear upgrade plans include the Abrams Block II and Block III programs. The process is sketched in the diagram below.

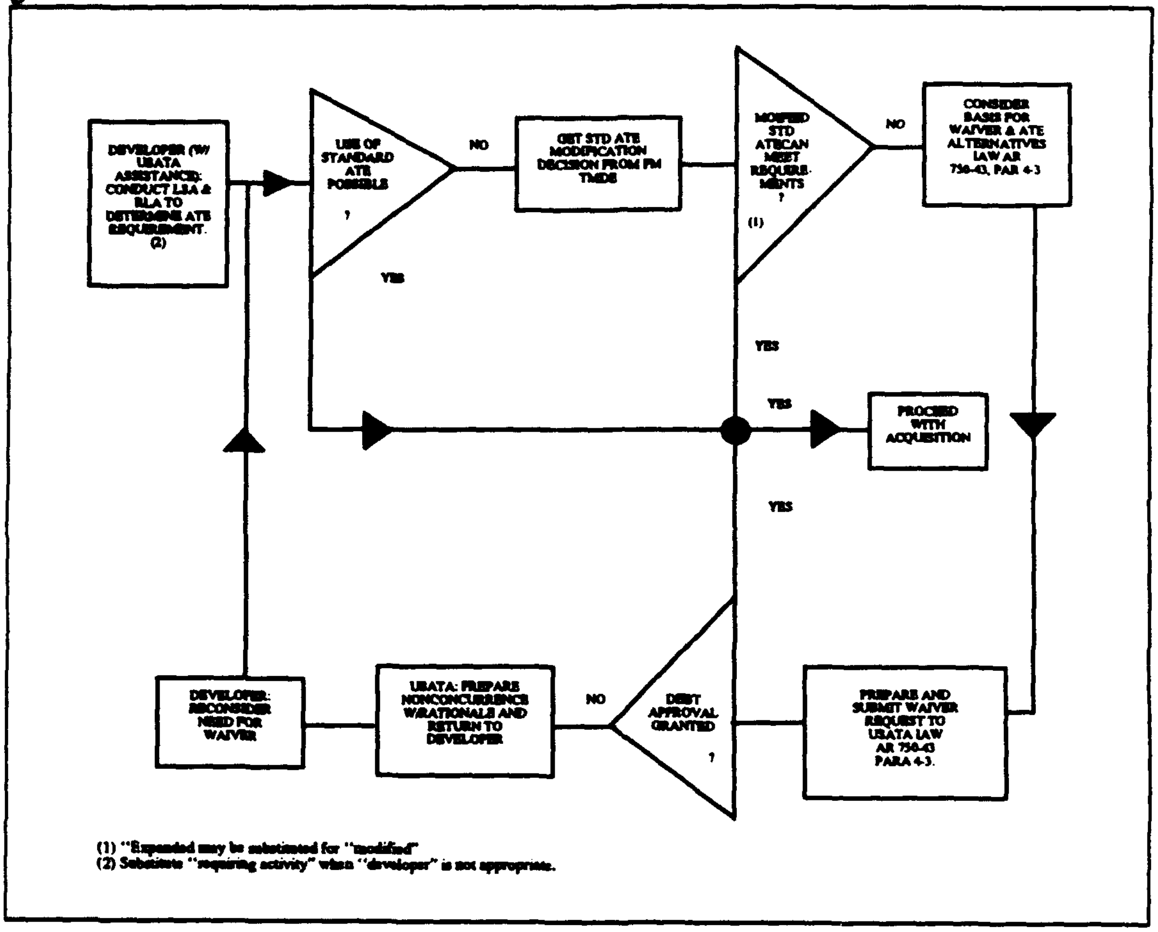

Figure B-5. ATE Waiver Processing Flowchart

B.6.2.2 Preliminary Plans

Preliminary plans call for the IFTE BSTF to be deployed in support of M1 systems beginning around outyear 2000. However, CTS support is expected to be initialized during FY94.

B.6.3 Special Policies and Regulations

Army Management guidance for ATE is contained in AR 750-43, DA PAM 750-43 and AMC-M 750-1. The basic regulation is AR 750-1. The DA Pamphlet addresses TPS requirements and AMC-M 750-1 deals primarily with requirements tester. Briefly, IFTE is required for any new or updated system which requires ATE support. The requirement must be recognized and complied with, unless a waiver is granted. Waiver processing procedures are explained in paragraph 4 of the AR. Documentation requirements are impacted by the waiver request classification. Either of four predefined classes may be considered: General, Technical, Cost, or Nonstandard Augmentation. The basis for the waiver must be explicitly identified and tailored to the class deemed most appropriate for the request being submitted.

a. General: Decisions must be based on HQDA or HQ AMC policy decisions or directives preclude use of the designated ATE standard. A copy of the decision document or directive precluding use of the designated ATE standard.

b. Technical: Decisions must be based on analysis that shows the use of the designated ATE standard to meet support weapon system ATE requirements is not technically feasible without obviously uneconomical major modifications or the use of the designated ATE standard would impose unrealistic program and/or technical obstacles. Documentation must include lists of the system test requirements in a side-by-side comparison with designated standard ATE capabilities and the proposed alternative and must demonstrate conclusively that the designated standard ATE fails to meet requirements. Examples of unmatched requirements to capabilities include engineering analysis estimates of modifications required to make the designated ATE standard compatibile. To qualify for technical exclusion, the comparison and analysis must unambiguously show that the standard ATE is not a viable alternative (otherwise an economic analysis is required).

c. Cost: Decisions must be based on analysis that shows the use of the designated standard is clearly not the most cost effective ATE alternative for the Army.

A copy of a cost/economic analysis reflecting use of the designated ATE standard versus use of the proposed ATE alternative is required. The analysis will be prepared according to AR 11-28 and DA Pams 11-2 through 5 and validated by the local comptroller. Critical cost differences will be highlighted and discussed in detail. The analysis must show that use of designated ATE standard is not cost effective for the Army. The analysis will be supported by the following:

(1) An assessment of the LSA (or a copy of the LSAR) that substantiates use of ATE in the material system maintenance concept. This assessment will address the trade-off among ATE, contractor support, and other test capability (including throwaway) with respect to the specific supported end item LRUs and printed circuit boards.

(2) An assessment of operational and readiness benefits to be derived if the proposed ATE alternative is approved. This assessment will also address whether the proposed ATE alternative can perform ATE workloads of other type end items in lieu of the designated ATE standard.

(3) Direct consideration of acquisition, operation, and support costs; TPS costs; deployment constraints; ATE workload requirements; and asset availability. When considering asset availability, the analysis will address the capability of existing and programmed designated ATE standard assets to accomplish the workload requirement through shared utilization as based on prorated costs.

d. *Nonstandard Augmentation: Decisions must* be based on analysis that shows the use of system peculiar ATE with the designated ATE standard is necessary to reduce the workload of the designated ATE standard. Documentation must include a copy of a cost/economic analysis reflecting use of existing, programmed, and additional designated ATE standard assets versus use of existing and programmed designated ATE standard assets with system peculiar

B.6.4 ATE Abrams Weapon System and ATS Deployment Concepts

B.6.4.1 Maintenance Concepts

To maximize combat effectiveness, the Abrams maintenance concept attempts to fix a problem as far forward as possible with repair on site preferred. During offense, disabled vehicles remain in place until contact teams moving with the maneuver elements repair or pass these to follow-on maintenance elements for repair/evacuation. During defense, the crew attempts repair. If unable to repair, the vehicle is evacuated, or destroyed if the position is in jeopardy; however, destruction should be the last resort. The Abrams fixed forward concept is supported by a four-level maintenance structure: organizational

(0), Direct Support (DS), General Support (GS) and depot. The fielding of supporting ATS resources is significantly influenced by requirements related to this structure.

B.6.4.2 Influence on Fielding

Abrams is supported by ATE at O, DS, GS and depot levels. Resources and maintenance echelons are identified in the following table.

Table B-28. Abrams ATE Resources by Maintenance Level

Maintenance Level					
	CTS[a]	STE-MI/ FVS[b]	DSESTS-M1/FVS[c]	ADADS[d]	EQUAT E
UL (0)	X	X			
DS	X	X	X		
GS		X	X		
Depot		X	X	X	X

a. Will repace STE-M1/FUS in early to mid 90s.
b. Primarily a unit level tester.
c. Primarily DS/GS ATE
d. Obsolete system. No longer supported.

B.6.4.3 Fielding

The Abrams tank is in its eleventh year of production. Over 7,000 tanks are in the field as of the beginning of 1992. By the end of FY92 all active component armor units will be equipped with the M1A1 or M1. Reserve Component Roundout units are also receiving the Abrams tank. The M1A2 has begun Technical and Operational testing and is expected to enter low rate production in 1992. Except for the IFTE CTS, supporting ATE has also been fielded. Fielding for the CTS is expected to commence in FY94.

B.6.4.4 Support for ATS

Maintenance support involves both calibration and repair. The U.S. Army Test, Measurement, and Diagnostic Equipment Support Group USATSG a subordinate element of the U.S. Army Test Measurement and Diagnostic Activity, is responsible for total TMDE support (i.e., calibration and repair) Army-Wide. Support is provided by way of mobile teams and fixed-station laboratories/repair facilities. Mobile teams provide DS level repair and transfer level calibration on- site. Fixed facilities are strategically deployed primarily to support the mobile teams. Calibration is done on a cyclic basis in accordance with schedules and provisions of TB 43-180. Repairs are performed as required. The entire program is established and maintenance according to directions contained in Chapter 6, AR 750-43.

The program was developed and implemented to ensure maximum availability of accurate, fully mission-capable TMDE for Army Weapon System diagnostic applications. This fundamental objective applicable to TMDE in general and ATS in particular. The program is managed, directed and controlled by the CG, AMC and implemented, both in the continental United States (CONUS) and outside CONUS (OCO-NUS), by the USATSG.

The TMDE support normally will be based on the concept that repair should be performed by the element designation in TB 43-180 as being responsible for calibration support. Calibration and Repair for TMDE not listed in TB 43-180 will be provided by USATSG based on the specific support requirement as identified by the owner or user organization. TMDE support will be as follows:

a. All TMDE owners or users will perform organizational maintenance on organic TMDE.

b. TMDE Support Activities will provide Calibration and Rep for all TMDE, General Purpose and TMDE, Special Purpose designated in TB 43-180 as being the support responsibility of the Area TMDE Support Center or Area TMDE Support Team (Mobile Team).

c. Normally, calibration of TMDE will be provided on a first-come- first-served basis unless extenuating circumstances dictate that support be provided according to the priorities established under paragraph 6.25 (AR 750-43).

d. TMDE repair will be provide on a priority basis according to the maintenance priority designators outlined in AR 750-1.

e. DS/GS maintenance and AVIM units will provide support service for organic and supported units TMDE, Special Purpose designated in TB 43-180 as requiring DS/GS maintenance or AVIM unit calibration and/or repair.

f. Certain TMDE, Special Purpose may require Calibration and Rep to be performed by both a TMDE Support Activity and an DS/GS maintenance or AVIM unit on a coordinated basis. For example: A large TMDE, Special Purpose console may include some TMDE, General Purpose that normally would be serviced by a TMDE Support Activity. The remaining components of the console are TMDE, Special Purpose and require a person with weapon system training to do the repair work. In these cases, the TMDE, General

Purpose and DS/GS or AVIM unit personnel will work together to complete the required Calibration and Rep. (This will be accomplished through a local agreement.)

B.6.5 Abrams Weapon System ATS Inventory

The Abrams M1 currently is supported by an array of ATS systems. The particular systems, along with some associated support specifics are identified in the following table:

Table B-29. Summary ATS Used with the ABRAMS.

			TPS	
System	**Quantity**	**Support Level**	**Type**	**Quantity**
USM-410	2	D	LRU/SRU	34
DSESTS	198	I,D	LRU/SRU	34
STE M1/FUS	737	O	LRU/SRU	1
DIT-MCO	1	D	Cables	92

Members of the IFTE family are designed to adequately satisfy Abrams test requirements now being supported by the above systems. Requirements off-load is scheduled to begin in FY94.

B.6.6 Abrams Specific ATS Technical Capabilities

The following ATS are discussed in this section: USM-410 DSESTS, STE M1/FUS and DIT-MCO.

B.6.6.1 AN/USM-410(V)

The AN/USM-410(V)3 is an automatic test station for performance, diagnostic, and fault isolation testing of various analog, digital, and hybrid electronic equipment. The system has an on-line compiler and automatic optical meter/dial reader; an automatic UUT control driver and possesses the capability to generate all test signals (SINEWAVE, TRIANGLE, SERVO, SQUARE, PULSE TTY, and Digital) by synthesis. Testing is accomplished by an analog to digital converter, a digital voltmeter circuit and fourier analysis of the resultant voltage time relationship. The reverse is used to create any desired signal. The system has the capability for: (1) read only memory UUT program, (2) program preparation on-line, (3) actual value of UUT parameters plus a go/no-go indication, (4) central control and display, (5) automatic system selfcheck, (6) automatic antenna simulation, (7) dynamic digital testing, analog testing, and hybrid circuit testing.

The 410 interface is programmable to the extend that it can accommodate differing analog/digital UUTs whose functional requirements are within the TMDE capabilities. The ATE is a third generation, individual rack system with a S/130 computer (32K bytes min to 256K bytes max), 8 to 76 *input/output channels* and a 0.2 USEC instruction cycle time. Type of readouts include: digital recorder, paper tape punch, magnetic tape, printer, and CRT.

The Government has unlimited rights to technical data and computer software. The standard test program language is EQUATE-ATLAS. Software is available to government users that can make an HP-2100 compiler emulate a 410 for offline TPS software development. The system requires a controlled environment and is designed for fixed fa installation.

Specifications for the AN/USM-410(v) are summarized in Table B-30 though B-34.

Table B-30. AN/USM-410 Measurement Capabilities

MEASUREMENT CAPABILITIES		
FUNCTION	**PARAMETER 1**	**PARAMETER 2**
DC - Voltage	0-200 VDC	N/A
Scaled AC	0-141 VRMS	01+50KHz
TRMS	0-141 VRMS	01KHz - 500MHz
VP, VP-P	0-200 VP	01KHz -500MHz
Pulsed-DC VP, VP-P	0-200 VP	01KHz-500MHz
Resistance	0-10 M Ohms	1-10 Volts
Complex Impedance	0-100 K Ohms	05KHz-7KHz
Harmonic Distortion	10Hz-100mHz	0-141 VRMS
Harmonic Analysis	2Hz-100MHz	0-141 VRMS
DC Current	0-25 Amps	N/A
AC Current	0-10 Amps	.01KHz-50KHz
AM Modulation	50KHz-500KHz	0-30dBm
FM Modulation	10KHz Max	-10 to +30dBm
Measure Sample	.1-141 VRMS	10KHz-500MHz
Frequency	500MHz Max	.05-141 VRMS
Time Interval	10MHz Max	.05-141 VRMS
Phase	10MHz Max	.05-141 VRMS

Table B-31. AN/USM-410 Stimulus Capabilities

STIMULUS CAPABILITIES		
FUNCTION	**FREQ/PERIOD**	**MAGNITUDE**
Sine Wave	0.015Hz-6.4MHz	0 to 20 Vpp
Square Wave	0.15Hz-3.2MHz	(1)
Triangle Wave	0.15Hz-3.2MHz	
Ramp Wave	0.15Hz-3.2MHz	
Complex Wave	0.15Hz-200KHz	
Main Pulse Delayed Pulse	100 ns to 1310. 72s	0 to +/-9.9vp
CW	60KHz-500MHz	-117dBm to 6dBm
AM	30Hz-100KHz	% Modulation 5%-90%
FM	100Hz-100KHz	(2)
PM	0.001Hz-10KHz	100%
(1) Programmable increments vary with the voltage range used. (2) 10% of carrier is maximum modulation for carrier frequencies <1MHz.		

Table B-32. AN/USM-410 Synchro Stimulus

SYNCHRO STIMULUS	
CHARACTERISTIC	**RANGE**
Synchro Angle	0.359.98 degrees
Synchro Output	11.8 VRMS Max
Reference Voltage	26 VRMS
Reference Frequency	400Hz

Table B-33. AN/USM-410 Digital Stimulus/Response

DIGITAL STIMULUS/RESPONSE	
DIGITAL CHARACTERISTICS	**PARAMETERS**
Date Type	Parallel or Serial
Data Format	RZ or NRZ
Digital Interface For Stim or Resp Additional for Resp Only	 1-128 Pins 1-128 Pins
Word Length	1-128 Bits
Message Length	1-32,767 words
Data Rate	0-2 M words/sec
Logic Levels Stimulus Response	 -20 to +20 V -200 to +200 V
Stimulus Output Current	 0-100 MA per pin
Stimulus Output Impedance	 6-875 ohms
Response Delay	0.2 use 6.5s

Table B-34. AN/USM-410 Power Stimulus Capabilities

POWER STIMULUS CAPABILITIES			
FUNCTION & QTY	**VOLTS**	**AMPS**	**REMARKS**
DC Power Supply (3)	0-36	25 Mar	2 supplies have a max of 9 amps.
DC Power Supply (2) DC Power Supply (1) DC Power Supply (1)	0-60 0-490 0-990	4 Max 0.4 Max 0.2 Max	2 A Max available at the program mobile interface unit (PIU)
Fixed DC Power Supply (1)	28	5 Max	
DC Standard	0-200	0-110 milli	
AC Standard	1 milli -120	50 MA Max	Frequency 10HZ-1MHZ

B.6.7 DSESTS

The Direct Support Electrical Systems Test Set (DSESTS) is a microprocessor-based automatic test system used to provide direct support test capability for the M1 Tank, M2 IFV, and M3 CFV systems. Two (2) memory modules with a capability of storing 512K bytes of data each are accommodated in the lid. The operator interface consists of a 60-character display and three (3) switches, YES/NO/STOP, for responding to instructions from DSESTS. Test cables are required for reach LRU. Additional or unusual stimulus and measurement requirements may be accommodated by external interfacing. Built-in-Test (BIT) verifies that the test sets computer and stimulus/measurement interface is fully operational with a confidence level of better than 98 percent. The system can be used in a fixed shop or mobile shop van.

The following list summarizes the DSETS Specifications.

B.6.7.1 Specifications

a. Voltage Measuring Capabilities

DC range - +/-40V, +/-10V, +/-4V, +/-0.4V

- Accuracy - 0.2% FS reading

DC impedance - Single ended - 250 Kohms +/-2%, 10pF

- Differential - 30 X 100 ohms, 30pF
- AC ranges - 400, 100, and 0.4V ranges
  - Accuracy 0.5% of FS reading
- AC impedance - Single ended - 250 kohms +/-2%, 10pF
- Differential - 30 X 100 ohms, 30 pF
- Filters available - DC to 8Hz, greater than 5Hz,
  - greater than 100Hz.

b. Frequency Measuring Capabilities:

- Analog channels - 0-17KHz, resolution - +/-1H
- Logic Input Channels - 0-900KHz, resolution - +/-1Hz

c. Stimulus Capabilities:

(1) Active Termination Function

Pull-up to 24Vdc through 3.30 Kohms Resistor

- Pull-up to 5Vdc through 100 ohms Resistor
- Pull-down to ground

(2) Digital Driver Functions

- 5V TTL logic output, 0/5Vdc, 30mA

(3) Linear Output Functions

- 10Vdc through +/-10Vdc, +1-12mA

(4) Frequency Output Functions

- Sinewave, 0.05 - 0000Hz, 0.2 - 20Vpp, 12mA
- Sawtooth, 0.05 - 000Hz, 0.2 - 20Vpp, 12mA
- Ramp, 0.05 - 0000Hz, 0.2 - 20Vpp, 12mA
- Squarewave, 2KHz - 512KHz, 0.2 - 20Vpp, 12mA

(5) Relay Driver Functions

- Relay Drive Up (RDU), Open/22Vdc, 1.
- Relay Drive Down (RDD), Open/2Vdc, 1.5A

(6) Logic Functions

- 64 bit serial TTL transmission capability
- Transmitting capability - 1MHz bit rate
- 16 bit/word
- input or output
- 32 bit parallel input

(7) Test Probe

DSESTS also has a hand-held test probe that the operator can use to measure DC voltage, AC voltage or frequency at points that are internal and not accessible at an LRU output connector. This feature is very useful in fault isolation of the defective LRU component.

(8) Signal Conditioning

Any special interface functions required by the LRU under test are resident on signal conditioning cards designed for that purpose. DSESTS has ten (10) card slots available for this application.

The General Purpose Interface Assembly (GPIA) is a modular assembly which is being added to the core DSESTS. It is a general purpose bus oriented system specifically designed to provide a testing capability for data bus communication system, electro-optical systems, and thermal imaging systems. It is planned that all DSESTS will be configured to include the GPIA. The GPIA does not have a stand alone test capability, requiring an additional controller (DSESTS & Operator Interface Unit (OIU). The DSETS & GPIA configuration enables testing of the M1 tank series and BFVS TIS components, and is planned to support BFCS digital LRU's and M1 Block Modernization programs. The core GPIA (without cabling or memory costs $44K). With cables and memory modules the GPIA cost is substantially more.

SPECIFICATIONS:

(1) Wideband Voltage Measurement

- Input ranges: ±0.4,±1,±4.0, volts, scale & expanded with
- Programmable +5 volt offset
- Accuracy: ±0.5% or range ±20mV
- Sample rate: 0-10 MHz asynchronous
- 0-20 MHz synchronous
- Input butter size: 4096 samples

(2) Frequency Measurement

- Frequency/event 0-30 MHz
- Period/A&B delay 2sec-1000sec
- Input levels:
- Digital: TTL, CMOS, ECI
- Analog
- Programmable threshold, ±10volts

(3) Digital Inputs

- Single-ended TTL, CMOS, ECU
- Differential TTL
- DC-20MHz
- Parallel trace capability
- 4096 word input butter
- 10 MHz data clock

(4) Stimulus Capabilities

- ANALOG OUTPUTS:
- Table driven waveform generator
- 12-bit resolution, 1MHz clock

- 8-bit resolution, 10MHz clock
- Available waveform
  -- Sine
  -- Square
  -- Triangle/ramp
  -- Pulse & 12n sec
  -- Complex (4096 segments per cycle)
- Digitally based static outputs
  -- +10 volts; 5mv resolution
  -- +2ma; 1.0 A resolution

(5) DIGITAL OUTPUTS

- Single-ended or differential TTL
- Synthesized 20 MHz clock, differential
- Table & driven pattern generator
  -- 4096-bit serial transmission
  -- 10 MHz transmission rate

B.6.7.2 STE-M1/FVS

The STE-M1-FVS was developed for use at the organization level of maintenance on the BFVS and M1 tank. It will perform on-vehicle troubleshooting, Line Replaceable Unit (LRU), fault isolation and system validation following repair. The STE-M1/FVS (sometimes called STE-T), consists of three unique TO&E line items and is configured to the unit mission by the MTO&E. The three segments of STE-M1/FVS are: (1) Common Core (4910-01-135-4389): 3 cases, consisting of the actual microprocessor driven test set and common cables/adapters/transducers: (2) M1 Peculiar Hardware (4910-01-142- 2640): 4 cases, consisting or adapter/simulators/transducers/cables which are used to test the M1 tank and, (3) FVS Peculiar Hardware (4910- 01-135-4379): 3 cases, consisting of adapters/ simulators/transducers/cables which are used to test the M2/M3 BFVs. (See Figure 1).

B.6.7.2.1 DIT-MCO

The DIT-MCO 9500 Series has the capacity to test: aircraft cable and harness assembles, avionics racks and radio racks; cockpit wiring and interconnections, cable and wiring boards, 1553 bus systems and coax, triax and twisted pair conductors. It also has the ability to test circuits with active components - lights, relays, solenoids, motors. The system consists of an IBM PC/XT/AT or compatible computer, LPT-9 line printer, and DCS-III digital comparator system. The Wiring Analyzer Graphics program displays tested circuits and shows the most probable location of the error. The graphics program permits automatic generation of schematics from wire lists and user symbol libraries.

The DIT-MCO system consists of commercial off-the-shelf equipment, and can satisfy test requirements across commodity lines. Table B-35 summarizes the DIT-MCO Specification and Characteristics.

B.6.8 ATS Upgrade and/or Off-load Plans

Army regulation 750-43 requires material developers/users to submit a waiver request and get the request approved prior to any P^3I related upgrades to existing ATE, unless the existing ATE happens to be a member of the IFTE family. IFTE is the Army Standard ATE. Abrams test requirements at the organizational maintenance level are to be off-loaded to the Contact Test Set (CTS), a member of the IFTE family, during FY 94, EO requirements include. The CTS EO capability exists in the CTS Elector-Optics Augmentation. About $24.5M has been programmed for IFTE P^3I through FY99.

B.6.9 Abrams Factory/Depot

Abrams is support at the factory by a commercialized version of DSESTS. The factory version is referred to as FACTS. FACTS uses repackaged hardware and some additional software (other that normally provided with the nonfactory version) for Quality Assurance (QA) type support. The QA software is used the check LRU before installation. Additional factory support is provided by the IFTE BSIF Commercial Equivalent Equipment (CEE). The CEE is being used to handle test requirements related to M1A2 development.

At the various Army depots, Abrams ATE requirement are satisfied with previously introduced DIT-MCO, AN/USM-410, DSESTS and semiautomatic testers for optics.

Table B-35. Summary of DIT-MCO Specifications & Capabilities

ITEM	SPECIFICATIONS/CHARACTERISTICS
(1) Computer	IBM PC/XT/AT or compatible
(2) Available Instrumentation	DCS-III Digital Comparator System System accuracy Continuity +/- 1% System accuracy Insulation +/- 3% Programmable continuity voltage and current DC Voltage measurement AC Voltage (RMS) measurement from 50Hz to 10KHz DC Dielectric current from 0.5 ma to 2.5 ma Simultaneous Insulation and high potential testing Remote diagnostic capability Completely floating design Auto-calibration
(3) DCS-III Options	Internal Calibration Standards
(4) CCS-1 Capacitance Comparator System Option	Accuracy: 100pf - 999.9 pf +/- 10% Inf - 9.9.nf +/- 5% .01uf - 0.999uf +/- 1% Self calibrating before each test sequence
(5) Other Options	AC Dielectric, Impedance comparator, dynamic and functional 1553 bus testing
(6) Bus Interface	IEEE STE 488 GPIB
(7) Environmental	Temperature Operating Range 60 to 90 degrees F
(8) Weight	Approximate weight: 1485 lbs (115 VAC) (1545 lbs other VAC)
(9) Recommended Operating Space	9 Ft. X 10.5 Ft.
(10) Power Requirements	115VAC/20A 1 phase, 3 wire (Model 9501) 60 Hz +/- 1% 208VAC/30A 3 phase, 5 wire (All others) 5o Hz +/- 1% (Transformer may be strapped for following input voltages: 100, 105, 110, 115, 120, 125, 200, 210, 230, 240, 250, VAC)

B.7. IFTE

B.7.1 IFTE System Background

B.7.1.1 Description

IFTE is a modular Test, Measurement and Diagnostic Equipment (TMDE) system which consists of four interrelated systems that provide generic Automatic Test Equipment (ATE) capability through all levels of the Army maintenance structure. Two tactical systems, the Contact Test Set (CTS) and the Base Shop Test Facility (BSTF), are capable of electronic ATE support. Electronic Technical Manuals (ETM), and Electro-Optical (EO) capability will be fielded in FY94. The CTS is man-portable ATE that augments supported systems BIT/BITE and isolates weapon systems failure to the appropriate LRU. The BSTF consists of the Base Shop Test Station (BSTS), in a truck-mounted S-280 shelter, plus another truck-mounted S-280 shelter for Test Program Sets (TPS) storage. The system is powered by 60KW generator sets and is to be positioned at DS/GS levels to fault diagnose evacuated LRUs to the Shop Replaceable Unit (SRU) level. The TPS includes the following: The software program, the Interface Connecting Device (ICD) that connects the UUT to the BSTS or Commercial Equivalent Equipment (CEE), and the documentation an operator uses to perform test operations. The non-tactical systems (the Army TPS Support Environment (ATSE) and the CEE) feature software that operates on Sun workstations and develops 65% of the software portion of the TPS. The CEE is a non-ruggedized equivalent of the BSTF and is used in special repair activities and depots to fault isolate and repair SRUs.

The Associated Support Items of Equipment (ASIOE) include: 50-60 Hz air conditioner, 400 Hz air conditioner, AN/ASM-147 electrical auxiliary shelter, PU 707 (HAWK) electrical power plant, AN/PSM-45 digital multimeter, AN/MJQ-10A electrical power plant, TA-312A/PT telephone set, M-923 cargo truck, M-927 or M-927A1 (HAWK) cargo truck, ES-19/9415/M-93 CME filter, and ES-19-9417 integrated external entrance. In addition, the BSTF is designed to operate within an NBC environment.

The BSTF and CTS are planned for field use. The CEE is planned for factory environment, test program set development, and potential use at Army depots.

B.7.1.2 Design Baseline

The IFTE program was officially initiated in February 1982 when the Department of the Army granted approval to enter into a two-phase system development program. Phase One was for concept definition and commenced with the award of five Advanced Development contracts in June 1983. Under this effort, contractors were required to develop system specifications, design plans, reliability data and other information which would form the basis of their second phase proposal. Although competition for the Phase Two Engineering Development contract was open to all five Phase One contractors, only Grumman and RCA submitted proposals in response to the Government RFP. Award of the firm fixed-price engineering development contract was eventually made to Grumman in September 1985.

The 32-month Engineering Development program concluded in May 1988. During this period, Grumman developed prototypes, in addition to completing documentation requirements necessary to allow for the transition to production.

The Integrated Family of Test Equipment (IFTE) was designed to meet the required operating capabilities for Automatic Test Equipment (ATE) at the Direct Support (DS) and Organizational maintenance level as stated in the IFTE Required Operational Capability (ROC) dated December 1983 and updated August 1989.

B.7.1.3 Justification

An urgent requirement exists for Automatic Test Equipment (ATE) at Intermediate Forward (IF), Aviation Intermediate Maintenance (AVIM) and operational units with IF missions to support highly complex communications, other electronics commodity equipment, missile, aircraft and combat vehicles, and replace the Land Combat Support System (LCSS) which is technologically obsolete and difficult to support. The IFTE will consist of three subsystems: Base Shop Test Facility (BSTF), Contact Test Set (CTS), and Electro-Optical Test Facility (EOTF).

State-of-the-art in weapon and support system electronic circuitry has rapidly out placed the capability of the Army's present inventory of Test Measurement and Diagnostic Equipment (TMDE), causing widespread proliferation of TMDE and ATE at the IF maintenance level, which adversely affects IF maintenance unit capabilities to support emerging weapon systems. To meet required operational readiness standards in sophisticated systems, a state-of-the-art, modular, reconfigurable ATE system tailorable to If commodity workloads has become an essential requirement with the intent to satisfy the largest possible number of test requirements across each commodity area.

B.7.2 IFTE Acquisition and Management/P^3I Approach

B.7.2.1 Policies/Regulations

Army Regulation 750-43, 29 September 1989, Army Test Measurement, and Diagnostic Equipment Program, established the Army-wide policy for ATE and TPSs. Non-standard ATE will not be used in lieu of designated standard ATE without appropriate economic analysis and waivers. System developers, in coordination with the Program Manager for Test, Measurement, and Diagnostic Equipment (PM TMDE), USATA, and TRADOC will determine ATE requirements. Once the ATE requirements have been identified, the system developer in coordination with the PM-TMDE will determine if the designated standard ATE will fulfill requirements and where it does not determine feasibility of expanding capabilities of standard ATE, and if neither is feasible, submit a waiver request documenting the case for a non-standard ATE. HQ, Army Material Command Memorandum, AMC-M 750-1, 6 August 1991, Automatic Test Equipment Policy, ensures that ATE development and fielding is per Army Regulation 750-43. Memorandum AMC-M 750-1 designates IFTE to be the Army standard ATE that will be used for all new systems as well as currently fielded systems undergoing Pre-Planned Product Improvement P^3I, system requiring, but currently lacking ATE, and systems to be in service after FY94. The waiver process requires that Army wide cost and effectiveness considerations be made as per Army Regulation 750-43.

B.7.2.2 Common ATS Management Organization

The PM TMDE is responsible for the development and acquisition of ATE and embedded software. Major subordinate Material Development Commands identify TPS requirements not later than milestone II of the prime systems. Army Pamphlet 750-43, 28 February 1992, Army Test Program Set Procedures, provides guidance for applying requirements, acquisition, development, and life cycle management of TPSs in support of Army Systems.

The weapon system management organizations are directed to use IFTE in lieu of system peculiar ATE as set forth in Army Regulation 750-43. Controls over common and peculiar weapon system requirements related to the ATS are set forth in Army Regulation 750-43. Proliferation of peculiar ATS is discouraged by Army Regulation 750-43, Army Pamphlet 750-43, and AMC-M 750-1.

B.7.3 Common ATS Deployment Concept

The BSTF will be used at AVIM and DS/GS maintenance units. (IFTE ROC, 375EE). The CTS will be used by AVIM/AVUM, DS/GS, and Unit level maintenance personnel (IFTE ROC, 375EE). The CEE will be used principally in depots and contractor facilities. It will be used for both TPS development and maintenance support (CEE Handbook).

The BSTF requirements were determined using the following methodology. Supported system failure data is provided by the CASCOM RAM Cell resident at OMMCS. The data at issue contain the number of electronic (EL), electro-optic (EO), and radio frequency (RF) Units Under Test (UUT) per system per day. Supported system density, fielding schedule, and Test Program Set (TPS) availability date from the AMC PM or the TPS Center is applied to the force structure and proponent school maintenance concept to provide the battlefield location and requirement year. Additional data elements, including EL, EO, and RF DS UUT runtime and IFTE available hours, are provided by the appropriate AMC PM. The system density, multiplied by the failure data, multiplied by the UUT runtime, results in the number of hours required to run the failed UUTs on the BSTF. Dividing this time by the BSTF availability in hours results in the number of BSTF's required for that system.

Overlaying these requirements on the projected force structure and TPS availability data results in the number of BSTFs required by year at all maintenance locations. This data is then compiled into POM year requirements and presented to the PM-TMDE as user BSTF requirements. The essence of the process is captured in the following relationship.

$$\text{BSTF Requirement} = \frac{\text{(\# UUTs/System/day) (\# of Systems)}}{\text{(Available BSTF Hrs)/(UUT Runtime Hrs)}}$$

CTS requirements are predicated on the maintenance concept and allocation rules provided by the proponent schools of the supported systems. Overlaying the proponent school CTS requirements, force structure and the TPS availability for each supported system results in POM year requirements which are presented to the PM-TMDE as user CTS requirements.

For the CTS, Interim Contractor Support (ICS) will be required for two years, starting with the first fielding. Total organic support will be established after the ICS period for all cost effective items. The maintenance strategy for CTS will be four levels of maintenance: Organizational, Direct Support, General Support and Depot. CTS will contain Built-in-test, which will be a GO-NO-GO check. At DS level, Diagnostic Tests will isolate to replaceable items such as display, PCBs, power supply, etc. Repair of the CTS is by replacement of defective parts. At GS levels, Diagnostics will include calibration of and isolation to replaceable items that are not accomplished at DS level and verification of replaceable items (such as processor failure, memory failure, etc.) prior to shipping the defective part.

The maintenance strategy for the BSTF will have four levels of maintenance: Organization, Direct Support, General Support and Depot. The BSTF operator has a DS Military Occupational Specialty (MOS) and serves as a DS level maintainer for his designated systems. The BSTF has a comprehensive self test that will fault isolate to an off the shelf Non-Developmental Item (NDI) resource, a virtual instrument card, or a removable module within the NDI resource. The system has been designed for maintainability of a "fix-forward" repair-by-replacement maintenance philosophy. The design objective is to unambiguously fault isolate to the failed item (SRU) using the self-test or simple manual troubleshooting procedures. Once a failed SRU has been removed, it will be sent through normal supply channels to either a DS or GS repair facility (e.g. TMDE Support Group) or a Depot Repair Activity, depending on support equipment and skill level requirements. A Direct Support Contact Team will provide an on-site repair capability for system failures beyond the operators ability. Repair and maintenance of the BSTS hardware and software will be performed through contractor support both on-site and in-house at the contractor's plant. Interim Contractor Support (ICS) will be used for the BSTS hardware for the first three years, then Depot support will take over at Tobyhanna Army Depot. The CECOM Center for Software Engineering will perform software maintenance for the life of the system. (Source: Army Acquisition Plans for IFTE and CTS.)

B.7.4 Cross Service Test Requirements Analysis

The Army provided Cross Service Test Requirements analysis on the F-18 Radar Set Receiver-Exciter and the Radar Target Data Processor to determine if they are testable on the IFTE BSTF or the CEE. Each Test Requirements Document (TRD) was analyzed to determine power, stimulus, and measurement requirements. The test envelope of both the Receiver-Exciter and the Radar Target Data Processor are within the capabilities of the

CEE and BSTF. The determination that these items are testable on the CEE or BSTF was based solely on the data available in the F-18 TRDs. (Source: Army Memo 6 April - Joseph M. Rivamonte).

B.7.5 Common ATS Upgrade

Plans include advanced electro-optic test capabilities, spread spectrum capability and further downsizing. Future plans for the CTS include an open architecture using industry standards (VXI), the Army Common Hardware System Laptop Computer and a flexible instrumentation set for application driven requirements. The software capability within the CTS includes a standard Army Presentation System for the presentation of Interactive Electronic Technical Manuals (IETM).

IFTE FUNDING PROFILE FY90-FY99 ($ in millions) (as of April 92)

Table B-36. IFTE Procurement

PROCUREMENT										
	90**	91**	92**	93	94	95	96	97	98	99	Total
BSTF	43.611	29.028	40.085	21.636	40.917	43.031	42.950	42.869	44.262	44.174	392.563
CTS	2.817	4.559	21.343	17.429	24.011	24.730	24.684	24.637	24.590	24.541	193.341
EOA	-	-	-	-	4.794	7.914	9.874	9.855	9.836	18.429	60.702
TOTAL	46.428	33.587	61.428*	39.065	69.722	75.675	77.508	77.361	78.688	87.144	646.606
INITIAL SPARES	-	-	-	1.566	12.509	14.838	14.810	14.782	9.836	9.816	78.157

Table B-37. IFTE R&D

RDTE											
	90**	91**	92**	93	94	95	96	97	98	99	Total
D537 (IFTE)	1.517	0.902	1.372	2.114	3.732	2.996	2.973	2.968	2.962	2.956	24.492
DL10 (ELECTRO-OPTICS)	1.665	2.974	5.882	2.664	7.513	6.000	2.922	1.978	1.975	1.971	35.544
DL59 (DIAG. EXP SYS DEV - TPS	4.119	2.616	10.674* **	3.863	3.873	3.949	3.916	2.473	2.468	2.463	40.234
TOTAL	7.301	6.492	17.928	8.461	15.118	12.945	9.811	7.419	7.405	7.390	100.270

* includes $14M plus-up taken from FY93

** FY90-FY92 are actuals. FY93-FY99 are taken from DR POM File as of 04/17/92

*** $6.851M Congressional plus-up for TPS development

B.8. BRADLEY FIGHTING VEHICLE SYSTEM (BFVS)

B.8.1 BFVS Weapon System Background

B.8.1.1 Description

The BFVS is a lightly armored, full-track fighting vehicle consisting of the Infantry Fighting Vehicle (IFV), M2/M2A1/M2A3, and the Cavalry Fighting Vehicle (CFV), M3/M3A1/M3A2.

Primary armament is the 25mm M242 automatic gun and mounts a two-tube TOW 2 missile system. The M23OC, 7.62mm, coax machine gun provides close-in suppressive fires. The 5.56mm M231 firing port weapons are installed on the IFV only. The IFV and CFV are the same vehicle with only minor internal modifications to optimize each vehicle for its primary mission. All A1 models will be upgraded to A2 models.

The BFVS Block I Improvement Program (M2/M3A1) changes the basic M2 with addition of TOW subsystem, 3-man gas particulate filter unit with ventilated facepiece, improved weapons interlock system, restowage and other minor improvements. M3A1 adds TOW2, 5 MANGAS particulate filter unit with ventilated facepiece, improved weapons interlock system, redesign rear cargo hatch to improve scouts visibility, restowage and other minor product improvements.

BFVS High Survivability Improvements (HS) Program (M2/M3A2) improvements are a modification to the M2A1/M3A1 BFVS and consist of additional passive armor; reactive armor; kevlar spall liner in the crew compartment; restowage of BII, ammo and TOE items; and vehicle changes to accommodate them. All M2A1/M3A1 vehicles will be modified, but there are no current plans to update the basic M2/M3 vehicles. A new 600 HP engine and transmission will be cut into production starting with May 89 deliveries.

B.8.1.2 Mission

The BFVS provides cross-country mobility, mounted firepower, and protection from artillery and small-arms fire to mounted infantry and cavalry combat operations and support to dismounted combat operations.

B.8.1.3 Characteristics

Table B-38. Summary of BFVS characteristics

Weight:	60,000 lbs (M2/M3A2 W/O Armor Tiles)	Crew:	3
Length:	21.5 ft.	Power Train:	600 Hp
Height:	9.75 ft.	Range:	300 Mi
Width:	10.5 ft	Road Speed:	38 Mph
Main Armament:	25mm Cannon	Swim Speed:	4.4 Mph
Secondary Armament:	TOW, 7.62 Coaxial MG		

B.8.1.4 Status of System

At the end of the latest contract with FMC in FY94, the Army will have produced a total of 6724 Bradleys, 4641 in the M2 or Infantry configuration and 2083 in the M3 or Cavalry configuration. Both the M2 and M3 were produced in three versions: the Army initially purchased 2300 basic or AO Bradleys; then 1371 vehicles in the A1 configuration which incorporates the TOW 2 Subsystem: and currently 3053 vehicles in the A2 High Survivability configuration. The Army is also in the process of converting all A1's to the A2 configuration at Mainz and Red River Army Depots. The BFVS exceeded expectations in lethality, mobility and operational readiness.

B.8.2 ATS Acquisition and Management/ATS Upgrade Planning Approach

B.8.2.1 Policy and Regulations

Army Regulation 750-43, 29 September 1989, Army Test, Measurement, and Diagnostic Equipment Program establishes Army wide policy for ATE and TPS. The following criteria will be utilized for ATS selection. Non-standard ATE will not be used in lieu of designed standard ATE without appropriate economic analysis. System developers in coordination with Program Manager for Test, Measurement, and Diagnostic Equipment (PM TMDE), USATA, and TRADOC will determine their ATE requirements. Once ATE requirements have been identified, system developer will:

- Determine if designed standard ATE will fulfill requirements and where they do not,
- Determine feasibility of expanding capabilities of standard ATE, and if neither of the above are feasible,

- Submit waiver request documenting the case for a nonstandard ATE

HQ, Army Material Command memorandum, AMC-M 750-1, 6 August 1991, Automatic Test equipment Policy: Ensures that ATE development and fielding is per Army Regulation 750-43. AMC-M 750-1 also designates the Integrated Family of Test Equipment (IFTE) to be the Army standard ATE that will be used for:

- All new systems as well as currently fielded systems undergoing P3I;
- Systems requiring, but currently lacking ATE.
- Systems to be in service after FY94.

A waiver process requires that Army wide cost and effectiveness considerations be made as per Army Regulation 750-43. The PM TMDE is responsible for logistic support of ATE and embedded software. Major Subordinate Material Development Commands identify TPS requirements not later than milestone II of prime system.

Army Pamphlet 750-43, 28 February 1992, outlines procedures and provides guidance for applying requirements, acquisition, development and life cycle management of TPS in support of Army Material Command systems.

B.8.2.2 Upgrade Planning

The field has low confidence in STE-M1/FVS ability to diagnose faults. Bulky and hard to handle equipment along with lengthy diagnostic procedures hinder field usability of the STE- M1/FVS. CTSIII is scheduled to replace the STE-M1/FVS. PM TMDE is evaluating the utilization of CTSIII to simplify tests routines on the M1/M1/M3.

B.8.3 BFVS Weapon System and ATS Deployment Concepts

B.8.3.1 Weapon System Fielding

a. FORSCOM first unit equipped March 1983, initial operating capability M2/M3, 15 January, 1984 (1-41 Infantry 2 AD) and M2/M3A1, 12 October 1987 (3-15 Infantry, 24 ID).

b. USAREUR, first unit equipped January 1988, initial operating capability M2/M3A2, 3rd Quarter FY89 (3AD).

c. NGB, first unit equipped February 1987, initial operating capability M2/M3A1, 30 July 1988 (1-121 Infantry, 48th Infantry Brigade).

B.8.3.2 Maintenance Concept

The BFVS conforms to the standard Army maintenance concept for tracked vehicles described in AR 750-1. The IFV/CFV is designed to make maximum use of repair by replacement of modules and quick disconnect techniques to facilitate emphasis on "repair forward."

The following table lists the ATS used to support the BFVS.

Table B-39. BFVS ATS Summary

Nomenclature/Type/Description	TPS Quantity	Level of Maintenance UL	DS/GS	Depot
STE/M1/FVS *		X	X	X
DSETS			X	X
EQUATE (AN/USM-410)	46			X
ADADS	2			X
TSS-SE		X		X

* STE/MI/FVS essentially is Unit Level (UL) ATE.

B.8.4 Support for ATS

Maintenance support involves both calibration and repair. The U. S. Army Test, Measurement, and Diagnostic Equipment Support Group (USATSG) a subordinate element of the U. S. Army Test Measurement and Diagnostic Activity, is responsible for total TMDE support (i.e., calibration and repair) Army-Wide. Support is provided by way of mobile teams and fixed- station laboratories/repair facilities. Mobile teams provide DS level repair and transfer level calibration on-site. Fixed facilities are strategically deployed primarily to support the mobile teams. Calibration is done on a cyclic basis in accordance with schedules and provisions of TB 43-180. Repairs are performed as required. The entire program is established and maintenance according to directions contained in Chapter 6, AR 750-43.

The program was developed and implemented to ensure maximum availability of accurate, fully mission-capable TMDE for Army Weapon System diagnostic application. This fundamental objective applicable to TMDE in general and ATS in particular.

The program is managed, directed and controlled by the CG, AMC and implemented, both in the continental United States (CONUS) and outside CONUS (OCO-NUS), by the USATSG.

The TMDE support normally will be based on the concept that repair should be performed by the element designation in TB 43-180 as being responsible for calibration support. Calibration and Rep for TMDE not listed in TB 43-180 will be provided by USATSG based on the specific support requirement as identified by the owner or user organization. TMDE support will be as follows:

a. All TMDE owners or users will perform organizational maintenance on organic TMDE.

b. Purpose and TMDE, Special Purpose designated in TB 43-180 as being the support responsibility of the Area TMDE Support Center or Area TMDE Support Team (Mobile Team)

c. Normally, calibration of TMDE will be provided on a first-come-first-served basis unless extenuation circumstances dictate that support be provided according to the priorities established under paragraph 6.25 (AR 750-43).

d. TMDE repair will be provided on a priority basis according to the maintenance priority designators outlined in AR 750-1.

e. DS/GS maintenance and AVIM units will provide support service for organic and supported units TMDE, Special Purpose designated in TB 43-180 as requiring DS/GS maintenance or AVIM unit calibration and/or repair.

f. Certain TMDE, Special Purpose may require Calibration and Rep to be performed by both a TMDE Support Activity and an DS/GS maintenance or AVIM unit on a coordinated basis. For example: A large TMDE, Special Purpose console may include some TMDE, General Purpose that normally would be serviced by a TMDE Support Activity. The remaining components of the console are TMDE, Special Purpose and require a person with weapon system training to do the repair work. In these cases, the TMDE, General Purpose and DS/GS or AVIM unit personnel will work together to complete the required Calibration and Rep. (This will be accomplished through a local agreement.)

B.8.5 Weapon System ATS Inventory

Summary of BFVS ATS advantages are provided in the following table.

Table B-40. BFVS ATS Inventory

ATS	QTY	Factory O/I/D	#per loc.	Tested Items	
				Qty.	Type
AN/USM-410	3	D, Level	1	46	LRU/SRU
DSETS	227	I, D Level	2	29	LRU/SRU
STE M1/FVS	842	O, Level		1	LRU
CTS	1390	O, I Level		1	LRU/SRU
Cumulative	2462			77	

B.8.6 Specific ATS Technical Capabilities

B.8.6.1 The AN/USM-410

The AN/USM-410 contains analog, digital, RF and synchro test capabilities with an on-line compiler and automatic optical meter/dial reader; an automatic UUT control driver and the capability to generate all test signals (SINEWAVE, TRIANGLE, SERVO, SQUARE, PULSE, TTY AND DIGITAL) by synthesis. The testing is accomplished by an analog to digital converter, a digital voltmeter circuit and fourier analysis of the resultant voltage time relationship. The reverse is used to create any desired signal. The system has the capability for: (1) read only memory UUT programs, (2) program preparation on-line, (3) actual value of UUT parameters plus a go/no-go indication, (4) central control and display, (5) automatic system self-check, (6) automatic antennae simulation, (7) dynamic digital testing, analog testing, and hybrid circuit testing.

The 410 interface is programmable to the extend that it can accommodate differing RF/analog/digital UUTs whose functional requirements are within the TMDE capabilities. The ATE is a third generation, individual rack system with a S/130 computer (32K bytes min to 256K bytes max), 0 to 76 input/output channels and a 0.2 USEC instruction cycle time. Type of readouts include: digital recorder, paper tape punch, magnetic tape, printer, and CRT.

The Government has unlimited rights to technical data and computer software. The standard test program language is EQUATE-ATLAS. There is available to government users software that can make an HP-2100 compiler emulate a 410 for off line TPS software development.

Table B-41. AN/USM-410 Measurement Capabilities

MEASUREMENT CAPABILITIES		
FUNCTION	**PARAMETER 1**	**PARAMETER 2**
DC - Voltage	0-200 VDC	N/A
Scaled AC	0-141 VRMS	01+50KHz
TRMS	0-141 VRMS	01KHz - 500MHz
VP, VP-P	0-200 VP	01KHz -500MHz
Pulsed-DC VP, VP-P	0-200 VP	01KHz-500MHz
Resistance	0-10 M Ohms	1-10 Volts
Complex Impedance	0-100 K Ohms	05KHz-7KHz
Harmonic Distortion	10Hz-100mHz	0-141 VRMS
Harmonic Analysis	2Hz-100MHz	0-141 VRMS
DC Current	0-25 Amps	N/A
AC Current	0-10 Amps	.01KHz-50KHz
AM Modulation	50KHz-500KHz	0-30dBm
FM Modulation	10KHz Max	-10 to +30dBm
Measure Sample	.1-141 VRMS	10KHz-500MHz
Frequency	500MHz Max	.05-141 VRMS
Time Interval	10MHz Max	.05-141 VRMS
Phase	10MHz Max	.05-141 VRMS

Table B-42. AN/USM-410 Stimulus Capabilities

STIMULUS CAPABILITIES		
FUNCTION	**FREQ/PERIOD**	**MAGNITUDE**
Sine Wave	0.015Hz-6.4MHz	0 to 20 Vpp
Square Wave	0.15Hz-3.2MHz	(1)
Triangle Wave	0.15Hz-3.2MHz	
Ramp Wave	0.15Hz-3.2MHz	
Complex Wave	0.15Hz-200KHz	
Main Pulse Delayed Pulse	100 ns to 1310. 72s	C to +/-9.9vp
CW	60KHz-500MHz	-117dBm to 6dBm
AM	30Hz-100KHz	% Modulation 5%-90%
FM	100Hz-100KHz	(2)
PM	0.001Hz-10KHz	100%
(1) Programmable increments vary with the voltage range used. (2) 10% of carrier is maximum modulation for carrier frequencies <1MHz.		

Table B-43. AN/USM-410 Synchro Stimulus

SYNCHRO STIMULUS	
CHARACTERISTIC	**RANGE**
Synchro Angle	0.359.98 degrees
Synchro Output	11.8 VRMS Max
Reference Voltage	26 VRMS
Reference Frequency	400Hz

Table B-44. AN/USM-410 Digitial Stimulus/Response

DIGITAL STIMULUS/RESPONSE	
DIGITAL CHARACTERISTICS	**PARAMETERS**
Date Type	Parallel or Serial
Data Format	RZ or NRZ
Digital Interface For Stim or Resp Additional for Resp Only	 1-128 Pins 1-128 Pins
Word Length	1-128 Bits
Message Length	1-32,767 words
Data Rate	0-2 M words/sec
Logic Levels Stimulus Response	 -20 to +20 V -200 to +200 V
Stimulus Output Current	 0-100 MA per pin
Stimulus Output Impedance	 6-875 ohms
Response Delay	0.2 use6.5s

Table B-45. AN/USM-410 Power Stimulus Capabilities

POWER STIMULUS CAPABILITIES			
FUNCTION & QTY	**VOLTS**	**AMPS**	**REMARKS**
DC Power Supply (3)	0-36	25 Max	2 supplies have a max of 9 amps.
DC Power Supply (2) DC Power Supply (1) DC Power Supply (1)	0-60 0-490 0-990	4 Max 0.4 Max 0.2 Max	2 A Max available at the programmable interface unit (PIU)
Fixed DC Power Supply (1)	28	5 Max	
DC Standard	0-200	0-110 milli	
AC Standard	1 milli -120	50 MA Max	Frequency 10HZ-1MHZ

Table B-46. AN/USM-410 RF Station Stimulus

FUNCTION	PARAMETER	REMARKS
CW	60KHZ-18GHZ	Two (2) Sources >500MHz
AM	30KH-100KHz	Max 20KHz for Carr >500MHz
PM PRF PM PW	10 K pps Max 1 us Min	
FM	10KHz-100KHz	Sinewave Modulation 10% of Carr Max Mod for Freq <1MHz
RF ATTEN	0-127dB	1 & 10dB increments

Table B-47. AN/USM-410 RF Station Measurement

FUNCTION	PARAMETER	REMARKS
RF/Microwave Counter	10KH - 1GHz	Max Resolution 1-1 KHz respectively Max Input Power 1 w

FUNCTION	CARRIER FREQ	MOD FREQ
AM	50KHz - 18GHz	50Hz - 25MHz
AM Spectrum Analysis	20MHz - 18GHz	10KHz - 25MHz
AM Distortion	500KHz - 18HHz	30Hz - 10KHz

FUNCTION	CARRIER FREQ	MOD FREQ	DEV RANGE
FM Deviation	10MHz - 18 GHz	30Hz - 49KHz	2KHz - 100KHz
FM Distortion	10MHz - 18 GHz	30Hz - 10KHz	5KHz - 100KHz
FM Spectrum Analysis	1MHz - 18 GHz	100KHz - 10MHz	

FUNCTION	CARRIER FREQ	PULSE REP RATE	PW	RISE/FALL
PM	1- 18 GHz	10,000 pps max	300ns min	30ns min
Peak Power (Input) - 15dBm to +30dBm				

FUNCTION	FREQ RANGE	LEVEL
Average Power	10Hz - 18GHz	-25dBm to +30dBm

TRANSMISSION	
FUNCTION	PARAMETER
Insertion Loss	0 to -50dB
Insertion Gain	0 to -50dB

TRANSMISSION		
FUNCTION	PARAMETER	REMARKS
Frequency	20MHz - 18GHz	
Bandwidth	10MHz	
Sensivity	-112 to -67 dBm	Inverse to carrier frequency and bandwidth

B.8.6.2 DSETS

The Direct Support Electrical Systems Test Set (DSESTS) is a microprocessor-based automatic test system used to provide direct support test capability for the M1 Tank, M2 IFV, and M3 CFV systems. Two (2) memory modules with a capability of storing 512K bytes of data each are accommodated in the lid. The operator interface consists of a 60-character display and three (3) switches, YES/NO/STOP, for responding to instructions from DSESTS. Test cables are required for reach LRU.

Additional or unusual stimulus and measurement requirements may be accommodated by external interfacing. Built-in-Test (BIT) verifies that the test sets computer and stimulus/measurement interface is fully operational with a confidence level of better than 98 percent. The system can be used in a fixed shop or mobile shop van.

DSESTS also has a hand-held test probe that the operator can use to measure DC voltage, AC voltage or frequency at points that are internal and not accessible at an LRU output connector. This feature is very useful in fault isolation of the defective LRU component.

Any special interface functions required by the LRU under test are resident on signal conditioning cards designed for that purpose. DSESTS has ten (10) card slots available for this application.

The following summarizes selected capabilities

a. Voltage Measuring Capabilities:
   - DC range - +/-40V, +/-10V, +/-4V, +/-0.4V
   - Accuracy - 0.2% FS reading
   - DC impedance - Single ended - 250 Kohms +/-2%, 10pF
     - Differential - 30 X 108 ohms, 30pF
   - AC ranges - 40V, 10V, and 0.4V ranges
     - Accuracy 0.5% of FS reading
   - AC impedance - Single ended - 250 kohms +/-2%, 10pF
     - Differential - 30 X 108 ohms, 30 pF
   - Filters available - DC to 8Hz, greater than 5Hz, greater than 100Hz.

b. Frequency Measuring Capabilities:
   - Analog channels - 0-17KHz, resolution - +/-1Hz
   - Logic Input Channels - 0-900KHz, resolution - +/-1Hz

c. Stimulus Capabilities

- Active Termination Functions
  - Pull-up to 24Vdc through 3.30 Kohms Resistor
  - Pull-up to 5Vdc through 100 ohms Resistor
  - Pull-down to ground
- Digital Driver Functions
  - 5V TTL logic output, 0/5Vdc, 30mA
- Linear Output Functions
  - 10Vdc through +/-10Vdc, +1-12mA

d. Frequency Output Functions

- Sinewave, 0.05 - 8000Hz, 0.2 - 20Vpp, 12mA
- Sawtooth, 0.05 - 800Hz, 0.2 - 20Vpp, 12mA
- Ramp, 0.05 - 8000Hz, 0.2 - 20Vpp, 12mA
- Squarewave, 2KHz - 512KHz, 0.2 - 20Vpp, 12mA

e. Relay Driver Functions

- Relay Drive Up (RDU), Open/22Vdc, 1.5A
- Relay Drive Down (RDD), Open/2Vdc, 1.5A

f. Logic Functions

- 64 bit serial TTL transmission capability
- Transmitting capability - 1MHz bit rate
- 16 bit/word
- Input or output
- 32 bit parallel input

B.8.6.2.1 GPIA

The GPIA is a modular assembly which is being added to the core DSESTS. It is a general purpose bus oriented system specifically designed to provide a testing capability for data bus communication systems, electro-optical systems, and thermal imaging systems. It is planned that all DSESTS will be configured to include the GPIA. The GPIA does not have a stand alone test capability, requiring an additional controller (DSESTS-Operator Interface Unit (OIU). The DSESTS-GPIA configuration enables testing of the M1 tank series and BFVS TIS components, and is planned to support BFVS digital LRU's and M1 Block Modernization programs. The core GPIA (without cabling or memory modules) costs $44K.

The following list summarizes the capacity introduced with the GPIA.

a. Wideband Voltage Measurement

- Input ranges: ±0.4,±1,0,±4.0, volts, scale & expanded with programmable

±5 volt offset

- Accuracy: ±0.5% or range ±20mV
- Sample rate: 0-10 MHz asynchronous
  - 0-20 MHz synchronous
- Input buffer size: 4096 samples

b. Frequency Measurement

- Frequency/event 0-30 MHz
- Period/A&B delay 2sec-1000sec
- Input levels:
  - Digital: TTL, CMOS, ECI
  - Analog: Programmable threshold, ±10volts

c. Digital Inputs

- Single-ended TTL, CMOS, ECU
  - Differential TTL
  - DC-20MHz
  - Parallel trace capability
  -- 4096 word input buffer
  -- 10 MHz data clock

d. Stimulus Capabilities

ANALOG OUTPUTS:

- Table driven waveform generator
  - 12-bit resolution, 1MHz clock
  - 8-bit resolution, 10MHz clock
  - Available waveforms
  -- Sine
  -- Square
  -- Triangle/ramp
  -- Pulse - 12nsec
  -- Complex (4096 segments per cycle)
  -- Video-system sweep signals
- Digitally based static outputs
  - +10 volts; 5mv resolution

- +2ma; 1.0 A resolution

e. DIGITAL OUTPUTS

- Single-ended or differential TTL
- Synthesized 20 MHz clock, differential
- Table & driven pattern generator
  - 4096-bit serial transmission
  - 10 MHz transmission rate

f. UUT POWER

- AC - 26/115 VAC, 400Hz, single phase
- DC:
  - 5 to 45 VDC
  - 18 to 30 VDC, 30 amps

g. SIGNAL CONDITIONING

- Hardware scaling and digitizing
- Software signal processing
  - RMS
  - Average
  - Peak-peak
  - Filtering
  - Video pattern analysis
- Synchronized analog/digital processing
  - Burst mode
  - Video frame

h. MISCELLANEOUS

- MIL-STD 28800 style C - portable
- 16-bit microprocessor controlled
- 1 megabyte internal memory capacity
- TPS stored externally or internally
- ATLAS/QUETOL/Assembly TPS development capability
- 1 MHz serial control interface
- Comprehensive BIT
- Self calibrating to internal voltage/frequency standard
- Sample rate to 100 MHz-future development
- Expandable 30-40%, card slots available

B.8.6.3 STE-M1/FVS

The STE-M1-FVS was developed for use at the organization level of maintenance on the BFVS and M1 tank. It will perform on-vehicle troubleshooting, Line Replaceable Unit (LRU), fault isolation and system validation following repair. The STE-M1/FVS (sometimes called STE-T), consists of three unique TO&E line items and is configured to the unit mission by the MTO&E. The three segments of STE-M1/FVS are: (1) Common Core (4910-01-135-4389): 3 cases, consisting of the actual microprocessor driven test set and common cables/adapters/transducers: (2) M1 Peculiar Hardware (4910-01-142-2640): 4 cases, consisting or adapter/simulators/transducers/cables which are used to test the M1 tank and, (3) FVS Peculiar Hardware (4910-01-135-4379): 3 cases, consisting of adapters/ simulators/transducers/cables which are used to test the M2/M3 BFVs.

B.9. AVENGER

B.9.1 Weapon System Background

B.9.1.1 Description

The Avenger is a light-weight, highly mobile and transportable, surface-to-air missile/.50 caliber machine gun system mounted on a HMMWV. It is operated by a two-man crew against low altitude helicopters and fixed-wing aircraft in all light and weather conditions. The fire unit has an operator's position with controls, displays, fire control electronics, and two standard vehicle mounted launchers (SVML) to support and to launch up to eight Stinger missiles.

B.9.1.2 Mission

To provide air defense support in all divisions, armored cavalry regiments, separate heavy brigades, and corps air defense brigades. Avenger is designed to counter hostile low-flying, high-speed, fixed-wing aircraft and helicopters attacking or transiting the division. Avenger fills the Line of Sight-Rear (LOS-R) portion of the Forward Area Air Defense System (FAADS).

B.9.1.3 Characteristics

This integrated system provides all the necessary functions to perform day/night and adverse weather target detection, acquisition, tracking, target ranging and friend or foe aircraft identification with either missile or machine gun. The Avenger's Standard Vehicle Mounted Launchers (SVMLs) interface and function with standard unmodified Basic Stinger, Stinger-POST and Stinger RMP missile rounds.

(1) Crew: 2

(2) Sensors: FLIR/Laser/Optical

(3) Fire Control: Digital Fire control

- computer/gyro-stabilized electronic turret

(4) Chassis: Modified HMMWV

(5) Physical

- Length: 195 inches
- Width: 87 inches
- Height: 104 inches
- Gross vehicle weight: 8,535 pounds
- Transportation weight: 7,880 pounds with missiles, ammunition, crew, TA-50, and identification friend or foe (IFF).
- Range of operation: 300 miles
- Speed: 60 miles per hour.
- Transportability

- Two systems with a C-130 aircraft.
- Six systems with a C-141 aircraft
- One system with a CH-47 helicopter.
- One demated fire unit with a UH-60 helicopter (one load required for the pedestal and for the HMMWV).
- Operational
  - -- Carries eight ready missiles and 200 rounds of .50 caliber ammunition.
  - -- Converts to man-portable (MANPAD) weapon operation.
  - -- Reload of missile pod in less than 4 minutes.
  - -- Traverses 360 degrees, elevates +60 degrees, and depresses - 10 degrees.
  - -- Automates critical tasks
  - -- Allows operation in mission-oriented protective posture (MOPP) IV gear.
  - -- Capable of 24-hour operation.

B.9.1.4 Status of System

The initial production contract for Avenger was awarded competitively to the Boeing Aerospace Company in August 1987. The Secretary of the Army approved the Avenger system for Type Classification - Standard in February 1990. The Avenger went into full-scale production in April 1990. In 1991, a five year multiyear procurement to buy units for the U.S. Army and the Marine Corps began.

Avenger was deployed during Operation Desert Shield/Storm and performed exceptionally.

B.9.2 ATS Acquisition and Management/ATS Upgrade Planning Approach

B.9.2.1 Policy and Regulations

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- Systems to be in service after FY 94.

A waiver process requires that Army wide cost and effectiveness considerations be made as per Army Regulation 750-43 and the PM TMDE responsible for logistic support of ATE and embedded software. Major Subordinate Material Development Commands identify TPS requirements not later than milestone II of prime system.

Army Pamphlet 750-43, 28 February 1992, Army Test Program Set Procedures outlines guidance for applying requirements, acquisition, development, and life cycle management of TPS in support of Army Material Command systems.

B.9.2.2 Upgrade Plans

The Avenger is to be supported by IFTE. The CEE will be used at Depot and Factory level. The BSTF, EOB (BSTF), CTS, EOA (CTS) will be used at intermediate level and the CTS and EOA (CTS) will be used at organizational level. Initial procurement of the CEE and BSTF is scheduled for FY92, the CTS for FY93 and the EOB(BSTF) and EOA (CTS) for FY94.

B.9.3 Weapon System and ATS Deployment Concepts

B.9.3.1 Weapon System Fielding

a. Weapon System Fielding:

b. FORSCOM, first unit equipped 3rd Qtr. FY89

c. TRADOC, first unit equipped 1st Qtr. FY90

d. USAREUR, first unit equipped FY92

e. EUSA, first unit equipped FY91

f. ARNG, first unit equipped FY94

g. ESTCOM, first unit equipped FY94

B.9.3.2 Maintenance Concept

The Avenger conforms to the standard Army maintenance concept for each of the component subsystems. Logistics support analysis (LSA) process reliability-centered maintenance concepts are used to identify maintenance tasks, skills, tools, TMDE, and support equipment required to sustain the Avenger weapon system at the required level of readiness. The MANPADS equipment that is used with the Avenger weapon system will be obtained from assets issued to MANPADS units and will be supported by the current Stinger maintenance concept. The captive flight trainer will be supported in a like manner. The HMMWV will be supported within the existing HMMWV maintenance structure using existing resources and facilities.

Unit maintenance will isolate to defective component using BIT/BIT. The Intermediate level maintenance is delayed until August 92 and the contractor will perform maintenance until organic support is available. The Avenger program is developing TPS for IFTE. Once developed Direct/general support will use IFTE-BSTF. Depot will use IFTE-CEE

The following table lists the ATS that will support the Avenger.

Table B-48. Avenger ATS

Nomenclature/type/ description	Level of Maintenance		
	UL	DS/GS	Depot/Factory
CTS	X	X	
EOA (CTS)	X	X	
BSTF		X	
EOB (BSTF)		X	
CEE			X

B.9.3.3 Support for ATS

Maintenance support involves both calibration and repair. The U.S. Army test, Measurement, and Diagnostic Equipment Support Group USATSG a subordinate element of the U.S. Army Test Measurement and Diagnostic Activity, is a responsible for total TMDE support (i.e., calibration and repair) Army-Wide. Support is provided by way of mobile teams and fixed—station laboratories/repair facilities. Mobile teams provide DS level repair and transfer level calibration on-site. Fixed facilities are strategically deployed primarily to support the mobile teams. Calibration is done on a cyclic basis in accordance with schedules and provisions of TB 43-180. Repairs are performed as required. The entire program is established and maintenance according to directions contained in Chapter 6, AR 750-43.

The program was developed and implemented to ensure maximum availability of accurate, fully mission-capable TMDE for Army Weapon System diagnostic applications. This fundamental objective applicable to TMDE in general and ATS in particular.

The program is managed, directed and controlled by the CG, AMC and implemented, both in the continental United States (CONUS) and outside CONUS (OCO-NUS), by the USATSG.

The TMDE support normally will be based on the concept that repair should be performed by the element designation in TB 43-180 as being responsible for calibration support. Calibration and Rep for TMDE not listed in TB 43-180 will be provided by USATSG based on the specific support requirement as identified by the owner or user organization. TMDE support will be as follows:

a. All TMDE owners or users will perform organizational maintenance on organic TMDE.

b. TMDE Support Activities will provide Calibration and Rep for all TMDE, General Purpose and TMDE, Special Purpose designated in TB 43-189 as being the support responsibility of the Area TMDE Support Center or Area TMDE Support Team (Mobile Team).

c. Normally, calibration of TMDE will be provided on a first-come-first-served basis unless extenuating circumstances dictate that support be provided according to the priorities established under paragraph 6.25 (AR 750-43).

d. TMDE repair will be provided on a priority basis according to the maintenance priority designators outlined in AR 750-1.

e. DS/GS maintenance and AVIM units will provide support service for organic and supported units TMDE, Special Purpose designated in TB 43-180 as requiring DS/GS maintenance or AVIM unit calibration and/or repair.

f. Certain TMDE, Special Purpose may require Calibration and Rep to be performed by both a TMDE Support Activity and an DS/GS maintenance or AVIM unit on a coordinated basis. For example: A large TMDE, Special Purpose console may include some TMDE, General Purpose that normally would be serviced by a TMDE Support Activity. The remaining components of the console are TMDE, Special Purpose and require a person with weapon system training to do the repair work. In these cases, the TMDE, General Purpose and DS/GS or AVIM unit personnel will work together to complete the required Calibration and Rep. (This will be accomplished through a local agreement.)

B.9.4 Weapons System ATS Inventory.

Summary of the Avenger ATS quantities are provided in the following table.

Table B-49. Avenger ATS Inventory

			Tested Items		
ATS	Qty.	Factory O/I/D	# Per Loc	Qty.	Type
CEE	2	D, F Level	1	29	LRU/SRU
BSTF	33	I	6	7	LRU/SRU
EOB (BSTF)	13.2	I	4	0	LRU/SRU
CTS	191	O, I Level		2	LRU/SRU
EOA (CTS)	191	O, I Level	0	2	LTU/SRU
Cumulative	430.2	O	0	0	0

B.9.5 Specific ATS Technical Capabilities

B.9.5.1 IFTE

IFTE is a modular Test, Measurement and Diagnostic Equipment (TMDE) system which consists of four interrelated systems that provide generic Automatic Test Equipment (ATE) capability through all levels of the Army maintenance structure. Two tactical systems: the Contact Test Set (CTS) and the Base Shop Test Facility (BSTF) are capable of electronic ATE support, Electronic Technical Manuals (ETM), and Electro-Optical (EO) capability will be fielded in FY94). The CTS is a man portable ATE system that augments supported systems DIT/BITE and isolates weapon systems failure to the appropriate LIUs. The BSTF consists of the Base Shop Test Station (BSTS), in a 5-ton truck mounted S-280 shelter, plus another 5-ton truck mounted S-280 shelter for Test Program Sets (TPS) storage powered by 60KW generator sets. It will be positioned at DS/GS levels to fault diagnose evacuated LRUs to the Shop Replaceable Line Unit (SRU) level. The TPS is the software program the Interface Connecting Device (ICD to connect the UUT to the BSTS or Commercial Equivalent Equipment (CEE), and the documentation an operator uses to perform test operations. The non-tactical systems: the Automatic Test Set Support Environment (ATSE) and the CEE texture the software system that operates on Sun workstations and develop 65% of the software portion of the TPS. The CEE is a non-ruggedized equivalent of the BSTE that is used in Special Repair Activity (SRA)/depots.

B.9.5.2 Characteristics

(1) Base shop test facility and station. The BSTF is an S-280 shelter that contains either a single-port or a dual-port base shop test station (BSTS). It is powered by a standard Army 50/60 cycle, 400 Hz generator and is deployed at the DS maintenance level. The BSTS is capable of digital, hybrid, and radio frequency stimulus and measurement. It is a modular system that supports repair of line replaceable units (LRU) either by shop replaceable units (SRU) and modules or by screening and evacuating these to higher levels of maintenance. Variants will be designed to support specific weapon systems or commodities such as the HAWK missile identified in table 103-2.

(2) Contact test set (CTS). The CTS is a two-box, man portable tester deployed at DS level for use by maintenance contact support teams. It augments system BIT/BITE and identifies failed LRUs in weapon systems. The CTS may be reconfigured to support specific systems using plug-in, pull-out modules. The CTS assembly case measures approximately 14.5 inches high, 10.8 inches wide, and 16.9 inches long. It weighs 35.6 pounds.

(3) Commercial equivalent equipment (CEE). CEE is used at echelons above corps (EAC) and depot to repair and maintain equipment for which test program sets (TPS) have been developed. A TPS consists of a software program, an interface connection device (ICD), and supporting paper and electronic documentation. CEE is configured to duplicate the functions of the BSTS and assists with TPS design, integration, and testing.

(4) Electro-optic test facility (EOTF). The EOTF is a standard S-280 shelter that contains a configured BSTS and an electro-optic bench (EOB) that together form an electro-optic test station (EOTS). The EOTF test thermal imaging devices, laser range finders/designators, television cameras/displays, image intensifier devices, trackers, and day optic devices. Electro-optic LRUs may be replaced or the SRU aligned and/or replaced using this equipment and system-unique TPS.

B.9.5.3 Commercial Equivalent Equipment (CEE) Characteristics

The CEE characteristics are summarized in tables B-50 through B-53.

Table B-50. CEE System Characteristics

SYSTEM CHARACTERISTICS	
FUNCTION	**PARAMETERS**
SYSTEMS CONTROL	
Computer	Originally targeted to the Motorola 68020 with 2 M Byte Memory. Other controllers can be substituted.
Disk Drive (AMCODYNE 7130S)	20 M Bytes Fixed 80 M Bytes Removable
Bubble Memory (Fujitsu #FBM-GRC-602)	2 Cassettes 1 M Bytes Each
OPERATOR INTERFACE	
Terminal (TEK 4208)	13 inch Color Monitor Full Graphics and Edit Standard Keyboard ATE Functions and Controls
Line Printer (HP 2225D)	80 columns 150 characters/sec

Table B-51. CEE Measurement Characteristics

MEASUREMENT CHARACTERTICS	
FUNCTION	**PARAMETERS**
RF MEASUREMENT	
* Power Meter (HP-438A)	Power Range: 44 to -70 dBm Frequency: 100 KHz-26.5 GHz
*Spectrum Analyzer (HP 70000 Series)	Frequency: 50 KHz-22GHz Input Power Sensitivity to - 132 dBm
ANALOG MEASUREMENT	
Digital Multimeter (HP-3457A)	DC Volts - 5 uV - 303 V AC Volts - 0-303 VRMS DC Current - 0-1.5A AC Current - 0-1A Resistance - 0-3.0 G ohm Reading Rate - 1350 / sec max
* Counter-Timer (RACAL-DANA 1995)	Frequency: DC-200 MHz Period - 5 nsec to 10**7 sec Time Interval - 2 nsec to 10**7 sec Rise/Fall - 5 nsec to 25 msec
Synchro/Resolver Indicator (DDC HSR 203)	Angle - 0-359.99 degrees Frequency: 47 Hz to 1 KHz Volts 6.8 to 90 V
VIDEO MEASUREMENT Waveform Digitizer (HP 54201 A)	Bandwidth Sampling: Real-time C - 50MHz Repetitive DC -300 MHz Range - 40mV to 16 V
HIGH POWER LOAD (Transistor Devices SPS3102-1)	8 Programmable Channels Power Dissipation Max 30000 Watts Single Channel 750 Watts

Table B-52. CEE Stimuli Characteristics

STIMULI CHARACTERISTICS	
FUNCTION	**PARAMETERS**
ANALOG STIMULI	
* Function Generator (HP-3314A)	Waveforms - Since, Square, Ramp, Triangle, Pulsed DC Freq. - .001 Hz-19.99 MHz Amplitude 0 to 10 V p-p Resolution 3 1/2 digits
Synchro/Resolver Simulator (DDC SIM 31201)	Angle 0-359.99 degrees Freq. - 47 Hz to 11 KHz
RF STIMULI	
* RF Generator #1 (Gigatronics 900)	Freq. - 50 MHz to 26 GHz Resolution - 1 KHz Max Leveled Output + 5 dBm Pulse/Square Wave Moldulation
RF Generator #2 (COMSTRON 7100D)	Freq. - 100 KHz to 1.3 GHz Resolution - 1 Hz Output Level +20 to -140 dBm AM/FM/Phase Modulation
VIDEO STIMULI	
Video Generator (Grumman peculiar)	High Resolution Graphics Gen 4096 Data Points/Chanel Full Range of Color/B+W
POWER STIMULI	
DC Power Supply (Superior 884-1, LAMBDA LGS5A150VR, LAMBDA LRS-54-24, LAMBDA LGS6A280VR, Superior 893-900)	8 Programmable Power Supplies 0-150 V (100 W) each Fixed 28 V supply
AC Power Supply (Behlman KBT3-75D)	Voltage - 0-135 V 10A 0-270 V 5A Freq. - 45-5000 Hz

Table B-53. CEE Digital Characteristics

FUNCTION	PARAMETERS
DIGITAL TESTING	
Dig Word Generator (Grumman peculiar)	I/O Pins-192, increments of 16 Logical Levels: +30 to -30 V below 10 MHz +10 to -10 V above 10 MHz Frequency: Static to 50 Megabits/sec Resolution - 20 nsec Clock Period: 20 n to 20 msec

B.9.5.4 Base Shop Test Facility (BSTF) Characteristics

The BSTF is a tactical version of the CEE. The BSTF consists of the Base Shop Test Station (BSTS), in a 5-ton truck mounted S-280 Shelter, plus another 5-ton truck mounted S-280 shelter for Test Program Sets (TPS) storage; powered by 60KW generator sets. The characteristics are those listed for the CEE.

AIR FORCE PROFILES

B.10. MATE PROFILE

B.10.1 Common ATS System Background

B.10.1.1 Description

Modular Automatic Test Equipment (MATE) is an evolutionary process for managing the acquisition, development, upgrade or replacement of automatic test systems (ATS). MATE provides four elements: 1) an acquisition management process, 2) a series of ATS architecture standards, 3) a set of software products, and 4) user support.

B.10.1.2 Design Baseline

The MATE system design baseline is depicted in Table B-54.

Table B-54. MATE System Baseline

Component	Previous (pre-Oct 91)	Current
Test Program	IEEE ATLAS 1985	IEEE ATLAS 1985
Control Computer	1750A Architecture	Program Choice
Operating System	MATE Operating System Version 5	Program Choice
TPS Compiler	MATE ATLAS Compiler Version 5	MATE ATLAS Compiler Version 6
Test Executive	MATE Test Executive Version 5	MATE Test Executive Version 6
Editor	MATE On-Line Editor	Program Choice
Computer/Test Instrument S/W Interface	MATE-STD-CIL	MATE-STD-CIL
Computer/Test Instrument H/W Interface	IEEE 488 Buss or VXI	IEEE 488 Buss or VXI

B.10.1.3 ATS Derivation

The original development was accomplished by Sperry Corporation/Unisys. Since the initial development, numerous ATS have been designed according to the MATE system architecture. The following table provides a summary of the ATS which have been developed using the MATE architecture and common instrument modules and the percentage of commonality within each system.

Table B-55. Percent Commonality of ATS with MATE System Baseline

ATS	% Commonality with MATE System Baseline
ADINTS	80
ALCC	80
AN/ALQ-122	
AN/ALQ-131	
ARTS	
ASE (AGM- 130)	70
ASE (GBU-15)	70
AWADS	
CAST	65
DATSA GPATS	80
DATSA B-1B	80
DECATS	65
DUST	80
GATS	70
GE-129 DRTS	50
IATS (A-10)	90
IATS (C-17)	
LANTIRN	80
MIDATS	80
MILSTAR (DL- 1)	75
MILSTAR (IL- 1)	75
OTH-B WCRS	80
SCADC	75
TISS	65
USM-607	50

NOTE: The percentage allocation for the ATS elements are as follows:

Control Computer Architecture --	20 percent
Control Software --	15 percent
Support Software ---	15 percent
Computer/Instrument S/W Interface --------------------------------------	5 percent
Computer/Instrument H/W Interface --------------------------------------	5 percent
Instruments --- (i.e. if all instruments communicate in CIIL, the ATE is given 35 points)	35 percent
Interface Connector Assembly --	5 percent

B.10.2 Justification

The MATE approach costs 28% less than non-MATE approach during an ATS development. This information is derived from MATE Effectiveness Evaluation Report, 30 November 1990, SofTech. The report was reviewed and analyzed for reasonableness, completeness, and accuracy by the USAF Cost Center.

Although in most cases life cycle cost savings will be realized by using the MATE standards, there are instances when this is not true. MATE allows alternate solutions for such instances using a waiver procedure outlined in AFSC/AFLC Regulation 800-23, Policy for Modular Automatic Test Equipment, 25 January 1984. Waivers can be granted for technical impracticalities, cost benefits, or schedule constraints.

B.10.3 Common ATS Acquisition and Management

B.10.3.1 Policies/Regulations

The MATE program was established by 24 May 1977 Program Management Directive (PMD) R-P7098 (1) 63247F: "to develop and demonstrate the use of a cost effective blend of state of the art technologies and management techniques to satisfy operational testing requirements." The goals and objectives of MATE are "to improve combat capability and reduce life cycle cost on weapon system support". AFSC/AFLCR 800-23 implemented the MATE program. AFSC/AFLCR 800-23 also defines the MATE process and all organizational responsibilities. In addition, an 18 February 1992 SAF/AQK Action Memorandum requires programs to use either MATE Control and Support Software (MCSS) version 6.0 or higher or Ada Based Environment for Test (ABET) as the software system for all future Air Force ATS acquisitions.

B.10.3.2 Common ATS Management Organization

There is no specific common ATS management function within the Air Force. The responsibility is separated into three distinct areas of responsibility. The MATE program office (ASD/SMGB) is responsible for the acquisition and development of the MATE product and standards. The MATE Operations Center (SA-ALC/LDAT) is responsible for the maintenance and support of the MCSS and supporting customers in their application of the MATE standards. The individual weapon system program offices are responsible for acquisition, development and support of the ATS for their program. Program offices are encouraged to communicate with both the MATE program office and the MATE Operations

Center and involve these agencies in resolving any concerns regarding the application of MATE to their systems.

B.10.3.3 Relationship to weapon system management organizations

The MATE program office and the MATE Operations Center work with weapon system program office through a memorandum of agreement (MOA). Generally, these MOAs detail the level of involvement the MATE program will perform in the development of the ATS. There are no regulatory requirements for MATE program office involvement, although it is encouraged.

B.10.3.4 Controls over common ATS/peculiar weapon system requirements

This does not apply to MATE in general because MATE is a system of standards, not a specific hardware system. MATE provides a common specification set as a section of the MATE Handbooks. These specifications provide control over specific interfaces. Weapon system program managers design and acquire ATS to meet weapon system requirements and use the MATE standards to develop standard interfaces for the ATS. Refer to specific weapon system programs for these requirements.

B.10.4 Common ATS Deployment Concepts

Unique common ATS fielding/laydown policies and plans, workload and utilization constraints or drivers. ATS support plans are developed in conjunction with the primary system. These separate categories do not apply to MATE in general because MATE is a system of standards, not a specific hardware system. Refer to specific weapon system programs for specific ATS requirements in each of these areas.

B.10.4.1 Summary of MATE ATS Inventories

Table B-56. ATS Derived from MATE Standards by Location

ATS	Location Used	Quantity	TPS Types
ADINTS	D	30	LRU
ALCC	I/D	5	LRU/SRU
AN/ALQ-122	D	3	SRU
AN/ALQ-131	I/D	6	LRU/SRU
ARTS	D	1	SRU
ASE (AGM- 130)	I	--	LRU
ASE (GBU-15)	I	30	LRU
AWADS	D	1	SRU
CAST	I/D	32	LRU/SRU
DATSA GPATS	D	13	LRU/SRU
DATSA B-1	D	30	LRU/SRU
DECATS	D	6	LRU/SRU
DUST	D	8	LRU/SRU
GATS	D	1	LRU/SRU
GE-129 DRTS	D	4	LRU/SRU
IATS (A-10)	I/D	27	LRU
IATS (C-17)	I	3	LRU
LANTIRN	I/D	28	LRU/SRU
MIDATS	I/D	25	LRU
MILSTAR (DL- 1)	D	1	SRU
MILSTAR (IL- 1)	I	6	LRU
OTH-B WCRS	D	2	LRU/SRU
SCADC	D	3	LRU/SRU
TISS	I/D	13	LRU
USM-607	I	13	LRU

B.10.5 Specific Common ATS Technical Capabilities

B.10.5.1 Operating Software

The MATE Control and Support Software (MCSS) is the operating system used with ATS developed using the MATE concepts. There are four components of the MCSS: the MATE Operating System, the MATE ATLAS Compiler, the MATE Test Executive, and the MATE On-Line Editor. These four elements are required when using an ISA-1750A architecture system. To date, an ISA-1750A system can use only MCSS 5 or lower.

The most recent release of the MCSS is version 6.1. This version eliminates the requirement for using an ISA-1750A computer and the MATE Operating System and

MATE On-Line Editor. There are three components of MCSS 6.1: the MATE ATLAS Compiler, the MATE Test Executive, and a small user-developed operating system interface shell. Using version 6.0, a developer chooses the CPU architecture which fits his requirements; he chooses the operating system which fits his requirements; and he chooses the system utilities (including a text editor) he needs to fit his requirements.

B.10.5.2 TPS Development environment

Programs have two choices when developing TPS under the MATE system: develop TPS on the ATS itself using the MCSS or develop TPS off-line using the MATE TPS High Volume Toolset. The MATE TPS High Volume Toolset consists for three elements: the MATE TPS Test Executive, the MATE TPS ATLAS Compiler, and the MATE TPS On-Line Editor. These product are virtual identical to the normal MCSS Products except they have been designed to operate on a VAX using the VMS operating system. This provides developers the opportunity to develop and debug all TPS on an off-line VAX and then port the TPS to the test station with no code changes required. It also provides developer the opportunity to design test stations with VAX computers as the central processor instead of ISA-1750A computers.

B.10.6 Common ATS Upgrade and/or Off-load Plans

This does not apply to MATE in general because MATE is a system of standards, not a specific hardware system. The individual weapon system program offices are responsible for planning and funding for any upgrades to the ATS for their program. Program offices are encouraged to communicate with both the MATE program office and the MATE Operations Center and involve these agencies in resolving any concerns during the upgrade process on their systems. Refer to specific weapon system programs for upgrade and off-load planning.

B.10.7 Factory/Depot Use

MATE has not been injected into the factory because the Air Force has no policy of placing requirements on contractors for their factory test equipment. Depot use of MATE is detailed in the following chart.

Table B-57. Depot Test Systems Derived from MATE Standards

ATS	Quantity
ADINTS	30
ALCC	5
AN/ALQ-122	3
AN/ALQ-131	6
ARTS	1
AWADS	1
CAST	32
DATSA GPATS	13
DATSA B-1	30
DECATS	6
DUST	8
GATS	1
GE-129 DRTS	4
IATS (A-10)	27
LANTIRN	28
MIDATS	25
MILSTAR (DL- 1)	1
OTH-B WCRS	2
SCADC	3
TISS	13

The MATE policy outlined in AFSC/AFLCR 800-23 does not differentiate among O, I, or D level testing and requires the policy to applied through all levels of Air Force test equipment.

B.10.8 Specific MATE Weapon System ATS

B.10.8.1 Advanced Deport Inertial Navigation Test System (ADINTS)

B.10.8.1.1 Description

ADINTS is a new ATS developed for the B-1B and Advanced Cruise Missile (ACM) Inertial Navigation System (INS) and also a replacement ATS for existing ATS in support of F-16, F-4, A-7 & Short Range Attack Missile (SRAM). Besides being generic to multiple weapon systems, the single configuration ADINTS tests four levels of INS (INV, Platform, Gyro & Accelerometer) which have always required different testers.

B.10.8.2 Design Baseline

ADINTS is MATE compliant depot level tester consisting of 80% commercial test replaceable units (TRU) and three non-developmental engineering (NDE) TRUs. The ADINTS uses MCSS version 5.0 tailored for ADINTS/Inertial Navigation System Testing application.

B.10.8.3 IATS

B.10.8.3.1 Description

The A-10 Intermediate Automatic Test Station (IATS) provides the capability to test and maintain A-10 LRUs. The IATS will be used to test & fault isolate defective LRUs. It will also be used to verify LRU operability after maintenance actions.

B.10.8.3.2 Design Baseline

The A-10 IATS is the first test system to use utilizing the MATE system. It employs the MATE Operating System, the MATE ATLAS compiler, the MATE Test Executive and the MATE On-Line Editor. All the other elements comply with MATE standards.

B.10.8.4 MIDATS

B.10.8.4.1 Description

The MATE Intermediate/Depot Automatic Test Systems (MIDATS) is a five bay test station, designed to support the B-52 digital and analog capability. It has been slightly modified for use on three additional programs: the Glide Bomb Unit-15 (GBU-15), Airborne Launch Control Center (ALCC) and the Over-the-Horizon Backscatter Radar (OTH-B).

B.10.8.4.2 Design Baseline

MIDATS is a MATE-compliant intermediate and depot level tester consisting of 80% commercial test replacement units (TRU). The MIDATS uses MCSS version 5.0 tailored for the MIDATS testing application.

B.10.8.5 SCADC

The SCADC test station is the standards D-level support equipment system for the Standard Control Air Data Computer (SCADC) being used on over 38 Air Force and Navy aircraft variants.

B.11. F-15

B.11.1 Weapon System Background

The F-15 was fielded in the early 1970s as an air superiority fighter. As of 19 May 1992, 710 of 874 A/B/C/D aircraft delivered remain in Air Force service; 68 have transferred to foreign military sales; 73 have attrited, and 23 have been retired. 156 of 209 F-15 E have been delivered. Numerous upgrades to the installed avionics and supporting automatic test equipment (ATE) have been accomplished to counter threat development and increase force effectiveness.

Automatic test systems (ATS) were procured to support a three level maintenance concept. Intermediate equipment is designed to be deployed within 30 days of the aircraft. The Air Force is currently reviewing the maintenance concept with a view toward minimizing I-level maintenance.

The Bendix Avionics Intermediate Shop (AIS), consisting of 3 automatic and 4 manual consoles, supports squadrons of 18 to 24 aircraft. This avionics equipment is complemented by one Tactical Electronic Warfare Systems (TEWS) Intermediate Support System (TISS). The TISS (a 1986 vintage station still in production) replaces the TEWS Intermediate Test Equipment (TITE) fielded with the aircraft in the early 70s. Full wings currently have an average of three of each of these test sets. Improvements to the test equipment have kept pace with avionics updates and technology advances in ATS systems to the maximum extent possible. The large mobility footprint, long test times for some of the more complex line replaceable units (LRU), and high maintenance costs are the primary drawbacks of the AIS.

San Antonio Air Logistics Center (SA-ALC) is pursuing the acquisition of a downsized tester (DST) to assure long term F-15 supportability and reduce airlift requirements during mobility. The increased emphasis on two-levels of maintenance will also minimize the number of test program sets (TPS) developed to support field maintenance.

The avionics depot uses primarily the Honeywell Avionics Depot Test System (ADTS) family consisting of three types of testers (digital, analog, RF/IF/video). Testing of newer systems (for example, the APG-70 Radar) is accomplished on the Teradyne L293 commercial digital test set or the specially developed Radar Module Test Station (for RF modules.) Sets of I-level equipment are maintained at the depot to repair LRUs returned by the field (approximately 15%) because they can't be repaired on site.

The TEWS depot uses the ALM-205 and ALM-206 for module repair. The TISS and TITE are used to repair returned LRUs and to test some of the more complex modules.

B.11.2 ATS Acquisition and Management

The requirement for changes and updates to the family of F-15 ATS falls into two general categories: mission-driven changes, and updates to preclude technological obsolescence. Historically, technological updates have been accomplished concurrently with mission-driven changes to lower the overall acquisition cost.

Mission-driven changes to ATS are identified either by the user, Air Combat Command (ACC), or through the systems engineering process in the program office itself. When a new capability is required by ACC, an Operational Requirements Document (ORD) is normally generated followed by formal direction in the Program Management Directive (PMD). Options for satisfying the requirement are generated and weighed, and an acquisition baseline is developed and jointly approved by the F-15 Integrated Weapon System Management Office (IWSMO) and ACC. Acquisition strategy is reviewed by the F-15 Business Management Board prior to any request for proposal release. Once an acquisition has begun, monthly reviews of baseline cost, schedule and performance parameters are conducted. Anticipated breaches and actual breaches of any critical parameter are reported directly to the F-15 program director.

The F-15 program office maintains a strong systems engineering approach both in-house and at the prime contractor facility. All additions and modifications to the avionics and weapons on the F-15 are closely scrutinized for impact to the ATS. Changes to the ATS, however minor, are never made without the coordination and approval of the user. HQ ACC representation is a constant on the F-15 Business Management Board and Configuration Control Board.

Whenever mission changes drive updates to the ATS, opportunities to reduce life cycle cost through technological upgrades are examined. As the existing stations become obsolete, the cost and availability of spare parts often threaten system supportability. Technology updates are accomplished concurrently with mission changes when the economic payback justifies the update.

B.11.3 Weapon System and ATS Deployment Concepts

B.11.3.1 Weapon system maintenance concepts

B.11.3.2 Mainttenance concepts

The F-15 aircraft is currently being supported by a three-level maintenance approach (organizational, intermediate, and depot). Pilot reported discrepancies (PRD) are fault isolated to the LRU using a combination of aircraft built-in-test and technical data/ troubleshooting procedures. Faulty LRUs are sent to the intermediate shop for fault isolation down to the defective shop replaceable unit (SRU). The SRUs are replaced and the LRU is returned immediately to service. Failed SRUs are sent to depot for repair and return to the supply system.

B.11.3.3 Impact on fielding

The F-15 has a rigorous mobility commitment, including bare-base taskings. The I-level ATS must be designed for transportability, ruggedness, and high reliability. As aircraft LRUs are upgraded to meet changing threats and improve performance, ATS improvements are accomplished to maintain compatibility and preclude technological obsolescence.

B.11.3.4 Plans to achieve concepts

Two major changes are worth noting. For the F-15 E, three large I-level testers, the Communications, Navigation, Identification (CNI), the Indicators/Controls (I&C), and the Computer Test Station (CTS) were replaced by a single small tester. The Mobile Electronic Test Set (METS) is light, highly reliable, and easily deployable. High failure rate A-D LRUs and new E model LRUs from all three testers were hosted on the METS. Those LRUs previously run on the CNI, I & C, or CTS that had high reliabilities were changed to a two-level maintenance concept.

Most recently, HQ ACC has proposed the elimination of the CNI, I & C, and CTS for the F-15 A-D fleet. This will create a substantial two-level depot maintenance requirement and reduce manning at the I-level by about 35 percent.

B.11.3.5 Supporting plans

Support for the F-15 suite of ATS is best described in two categories: repair support and technical (engineering) support. The ATS maintenance and repair strategy is contained in the F-15 Integrated Logistics Support Plan (ILSP). Engineering support for the ATS is outlined by the F-15 Post-Production Support (PPS) Management Plan.

The F-15 ILSP, Volume 4, establishes the Air Force plan for achieving organic repair capability at various depots for the airframe, avionics, and radar. The ILSP is managed and updated by the Depot Maintenance Activation Working Group (DMAWG). The DMAWG is a middle management-level group with representation from the F-15 Program Office and all Air Force Air Logistics Centers. For ATS, a similar group has been assembled — the Support Equipment Depot Activation Working Group (SEDAWG). Both groups formally meet each quarter to ensure progress towards organic repair capability is continuing on schedule. The DMAWG is the parent group managing depot activation, and provides oversight of SEDAWG activity. All activations are detailed in program baseline briefings, and are reviewed for approval by the F-15 Program Director. The size and scope of the SEDAWG effort is generating a separate volume, number 5, to the ILSP to ensure dedicated coverage and planning for ATS.

The F-15 Post-Production Support Plan outlines the requirement for ATS sustaining engineering and technical support. Management oversight is provided by the PPS Executive Steering Committee, with senior-level representation from the F-15 Program Office, each Air Logistics Center, and Air Combat Command. Sustaining engineering in past years has been reviewed, adjusted, and contracted for under the annual aircraft purchase contract. With anticipated F-15 production coming to a close, life cycle management of ATS technical support is being transferred to the Post-Production Support arena.

B.11.4 Weapon System ATS Inventory

The following tables provide summaries of F-15 ATS inventories.

Table B-58. F-15 Automatic Test Stations by Maintenance Levels

	A/B	C/D	E
Intermediate	141	110	49
Depot	21	31	31
Total	162	141	80

Note: There are a total of 41 depot testers for the F-15. The A/B, C/D and E models use the number of testers listed in Table B-58 out of this total.

Table B-59. F-15 A-B Intermediate Automatic Test Systems

Tester	Quantity	LRUs Tested	TPS
Antenna A&B	14	3	3
CNI	19	15	15
I&C	21	20	20
Computer	26	29	29
Display	25	14	14
Microwave	18	5	5
TISS	2	23	14
TITE	16	22	18
Totals	141	131	118

Table B-60. F-15 C-D Intermediate Automatic Test Systems

Tester	Quantity	LRUs Tested	TPS
Antenna A&B	12	3	3
Antenna A&B MSIP	1	3	3
CNI	13	15	15
I&C	13	23	23
Computer	15	29	29
Display	15	20	20
Microwave	15	7	7
MTS	1	9	9
TISS	14	23	14
TITE	11	22	18
Totals	110	154	141

Table B-61. F-15 E Intermediate Automatic Test Systems

Tester	Quantity	LRUs Tested	TPS
ARTS	6	3	3
METS	12	22	11
Display	12	14	14
Microwave	12	5	5
TISS	7	23	14
Totals	49	67	47

Table B-62. F-15 A/B Depot Automatic Systems

Tester	Quantity	SRUs Tested	TPS
TEWS			
ALM-205	3	39	39
ALM-206	2	21	21
ALM-205A	3	88	88
ALM-206A	2	49	49
Microwave ADTS	3	20	16
Digital ADTS	3	57	46
Analog ADTS	5	160	105
Totals	21	434	364

Table B-63. F-15 C/D Depot Automatic Test Systems

Tester	Quantity	SRUs Tested	TPS
TEWS			
ALM-205B	8	78	78
ALM-206B	1	13	13
Color Generating Display Test System-70 (CGDTS)	5	48	40
Microwave ADTS	3	20	16
Digital ADTS	3	57	46
Analog ADTS	5	330	105
Memory Module Test Station (MMTS)	3	26	21
Depot ARTS	3	21	8
Totals	31	593	327

Table B-64. Specifice ATS Technical Capabilities

Tester	Quantity	SRUs Tested	TPS
TEWS			
ALM-205B	8	92	92
ALM-206B	1	13	13
CGDTS-70	5	62	54
Microwave ADTS	3	20	16
Digital ADTS	3	57	46
Analog ADTS	5	398	166
MMTS	3	63	55
Depot ARTS	3	21	8
Totals	31	726	450

B.11.5 Specific ATS Technical Capabilities

B.11.5.1 F-15 AIS

The F-15 AIS contract was awarded in 1970. Although technological upgrades have been accomplished through the years to accommodate the F-15 C/D, Multi-stage Improvement Program (MSIP) and E model aircraft, most of the original AIS remains in service to this day. The F-15 AIS was designed to function in a classic three-level maintenance environment. In addition to performing the intermediate level function, the AIS ATS is also in place at the depot to fix LRUs not repairable at the base level. There are two basic configurations of F-15 AIS: the F-15 A/B/C/D and the F-15 E.

B.11.5.1.1 Design Baseline for F-15 A/B/C/D AIS

The original AIS suite consisted of seven testers, fielded in the early 1970s to test the full complement of F-15 avionics, radar, and electronic warfare systems. As system improvements and additions were made to the aircraft, additional TPS were developed to host the new LRUs on existing ATS. A mid-life update was accomplished in the early 1980s to replace some of the 1960s technology used in the ATS. The only major change to the original AIS was the addition of the TISS. The TISS replaced the aging TITE system that was no longer capable of testing the improved radar warning receiver (ALR-56C).

B.11.5.1.2 Design Baseline for F-15 E AIS

The major change to the F-15 AIS for the E fleet was the replacement of three large multi-bay testers with the smaller, man portable METS. The METS hosted the new LRUs brought on by the E model and also the high failure rate LRUs tested on the three older, replaced stations. The high reliability LRUs were not rehosted; the maintenance concept was changed to the two level (organizational and depot) approach. The METS was designed from an existing Navy tester, the Electronic Equipment Test Set (EETS). Commonality was approximately 80 percent with the EETS, and development costs were correspondingly reduced. A lesser change to the AIS was the development and production of the Aircraft Radar Test Station (ARTS). The ARTS was required to keep pace with the huge advance in radar technology from 1970 to 1990.

B.11.5.1.3 Known advantages/disadvantages

The advantages of maintaining maximum possible commonality through the years are reduced development cost and schedule risk for TPS additions, and stability in our operational fleet (logistics, deployment plans, training).

The disadvantages include technological obsolescence and mobility. The older stations are becoming increasingly hard to support because industry has moved onto newer technologies. The older systems are very large, heavy and relatively difficult to mobilize.

B.11.6 ATS Upgrade and/or Off-load Plans

SA-ALC is currently in a source selection for procuring an F-15 Downsized Tester. This acquisition is expected to procure 61 testers and 62 TPS for 97 LRUs. The current plan is a four phased acquisition, with only the first two phases currently funded. The following chart shows the proposed phases, the testers per phase, the LRUs and the TPS.

Table B-65. F-15 Downsized Tester and TPS Acquisition Planning

Phase	Testers Bought	LRUs Tested	TPS Bought	Comments
I	24	54	34	
II	31	11	6	
III	0	24	16	Not currently funded
IV	0	8	6	Not currently funded
Depot	6	0	0	Depot TPS included in Phases I-III
Totals	61	97	62	

B.11.7 Factory/Depot Use

B.11.7.1 Factory Use

McDonnell Aircraft (MCAIR) is the prime aircraft developer but manufactures none of the avionics. They use no avionics ATE on their production line, instead "hot mock-up" benches are used for acceptance testing and trouble shooting of subsystems. Numerous vendors (Hughes, Honeywell, Kaiser, etc.) manufacture avionics. Determining the extent of the subcontractor ATS resources and procedures would require an additional study, contracted through MCAIR. MCAIR would need approximately 60 days after contract award to address this issue. Taskings to MCAIR for new ATS and TPS requirements include instructions to utilize existing factory equipment if feasible.

When the avionics subsystems were selected in the early 70s there was no organized plan to minimize factory equipment types or assure its transportability to depot use. Several factory test set ups were examined to determine if they would be suitable for depot use. The APG-63 radar is the largest, most complex weapon system in the F-15 A-D. Hughes, the APG-63 manufacturer, proposed that the Air Force copy their factory equipment. This proposal was rejected because most of the equipment was manual and final test required installation in the next high assembly. Factory equipment for some less complex avionics, for example the Head-Up Display (HUD) and Horizontal Situation Indicator (HSI), was found to be adequate for depot support even though it was non-ATE technology. Copies of this equipment were procured for recurring cost only and are still in use at the depot.

In the early 70s when the F-15 avionics systems were being developed, most vendors used equipment from previous programs and ATE was not prevalent. Low production rates for the aircraft and the cost benefits of using on-hand equipment were deterrents to development of factory ATE. Today, most F-15 A-D avionics systems are out of production and the test equipment (which was mostly non-ATE) has been retired or disbursed. Applicability of any of this equipment to other programs at any level would be very low.

B.11.8 Depot Test Systems

The depot requirements are driven by the need to quickly and accurately primarily test SRUs in support of the three-level F-15 maintenance concept. Sets of I-level equipment are also necessary at depot to test the approximately 15 percent of LRUs the field is unable to repair on site. A wide spectrum of technologies (for example, microwave, digital, analog, high voltage/high power) require support.

The commonality with original factory ATS is less than 10%. Most factory equipment was non-ATS when the F-15 was developed, but the depot concept was geared toward ATS. The commonality with the I-level equipment is very low — less than 5 percent if the I-level equipment used at the depot to test LRUs returned by the field is discounted. This ratio will change considerably once two-level maintenance initiatives are implemented. Commonality with other depot/I-level ATS is also low; the F-16 adopted the analog ADTS for their depot but none of the TPS are common.

The applicability of the F-15 AIS to other DoD requirements is low for F-15 A-D ATS because of the age of the technology within the F-15.

B.12. F-16

B.12.1 Weapon System Background

The General Dynamics F-16 Fighting Falcon is the cornerstone of the USAF fighter aircraft force. Over 1700 are in use in the USAF today, and over 900 are in use by foreign countries. The two basic types of aircraft are the F-16A/B and the F-16C/D. The "B" and "D" designations indicate two seat versions (approximately 260 produced) that, in addition to performing all assigned combat missions, are used for pilot proficiency and checkout events. The difference in designation between F-16A/B and F-16C/D represents an "order of magnitude" improvement in weapons capabilities, reliability, and maintainability. The growth of the aircraft was not restricted to the change in series. The entire production of the aircraft was under the auspices of a multi-staged improvement program (MSIP); system capabilities were improved between production blocks and within the blocks themselves. The aircraft is capable of performing strategic aerospace defense, counter air, air interdiction and close air support missions. The aircraft would normally be deployed as squadrons (18-24 aircraft) with accompanying aviation packages ("organizational") accompanying the aircraft immediately. If the tasked squadron is designated "independent", follow-on support packages, including automatic test equipment, follow later. "Dependent" squadrons must collocate with intermediate support (from host or an independent deploying squadron).

B.12.2 ATS Acquisition and Management

Figure B-6 summarizes the flow for F-16 AIS planning process and beddown implementation.

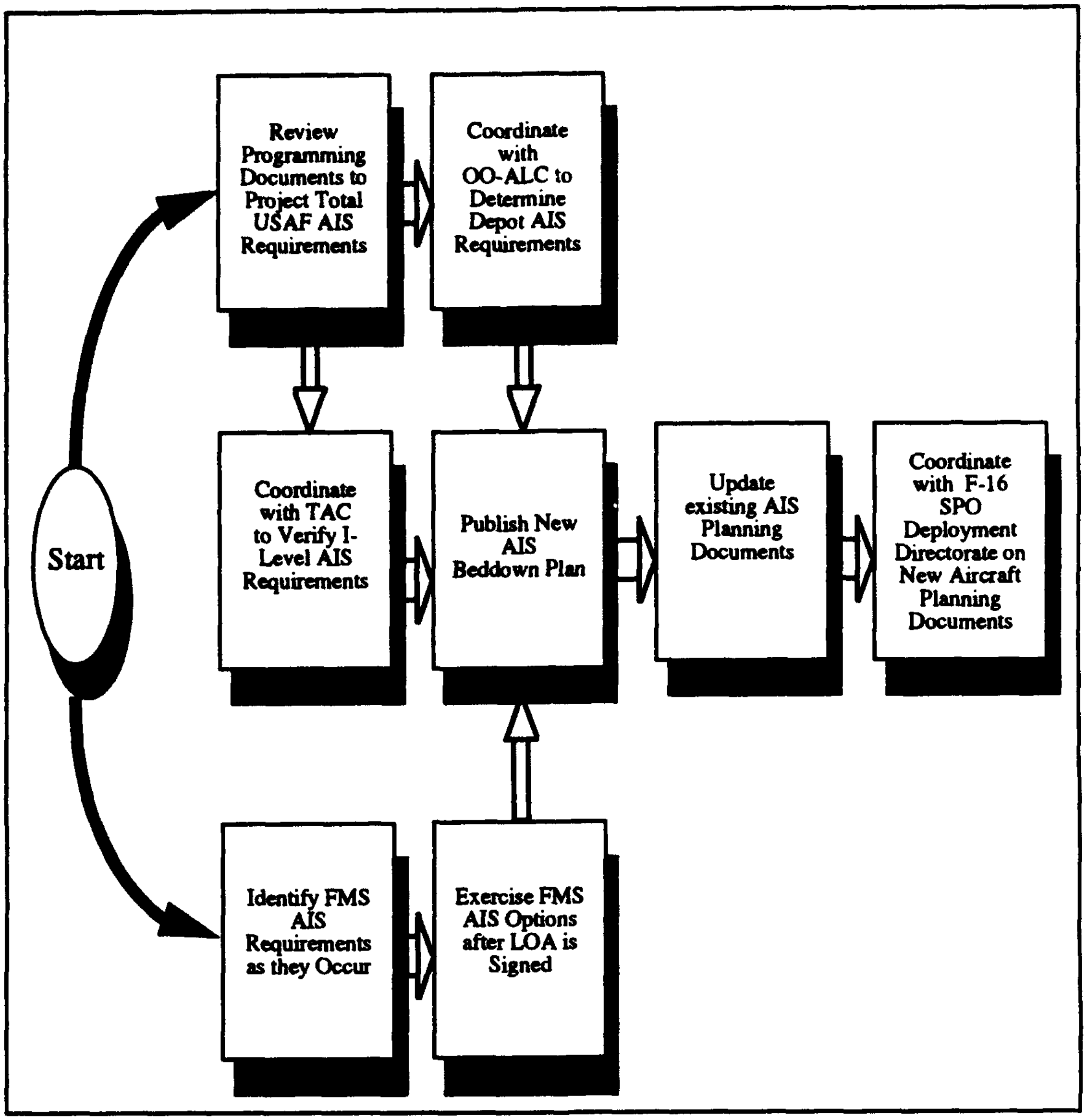

Figure B-6. Flow for F-16 AIS Planning and Beddown

B.12.3 Weapon System and ATS Deployment Concepts

B.12.3.1 Weapon system maintenance concepts

B.12.3.1.1 Maintenance concepts

F-16 avionics maintenance has traditionally been three-level. The F-16 Avionics Intermediate Shop (AIS) is used at the intermediate and depot levels. Suspected defective LRUs are removed from the aircraft, and returned to the I-level AIS shop. A performance test is then run on the LRU to determine if a fault exists. If the LRU passes performance testing, it is referred to as "bench-checked serviceable" and returned to base supply. LRUs that fail performance testing are then subjected to diagnostic testing to fault isolate to a single or group of suspected defective SRUs. Those SRUs are then removed and replaced, and the LRU undergoes performance testing again. If it passes performance testing, the LRU is returned to supply, and the defective components are returned to the depot for repair. In cases where the LRU repeatedly fails performance testing, or when an LRU retests okay (RTOKs) three times for the same on-aircraft failure, it is returned to the depot for repair. To ensure vertical testability, the depot uses the same AIS that field units have. The basis of issue for AIS allocation at the I-level has been 1 for 18-47 primary aircraft authorized (PAA), 2 for 48-95 PAA, and 3 for units with 96 or larger PAA. Although there is no difference in AIS assignment criteria for active, guard, and reserve units, guard and reserve units typically have 18-24 PAA, thus guard and reserve shops normally have 1 AIS, while active units have 2-3 AISs. The quantity of depot level shops is periodically adjusted based on projected LRU loading studies.

B.12.3.1.2 Impact on ATS design and fielding concepts

The AISs were designed to operate in a deployed environment as well as in a shop environment. For example, the AIS system specification required operations in ambient air from 50°F to 95°F, and 5 to 80% non-condensing relative humidity, at up to 6000 feet above sea level. The AIS was also designed with detachable front panels that serve as shipping containers for the test stations during transit. After early Harvest Bare tests using the AIS, a mobile shelter program was established. The shelter management office at ESD developed a mobile shelter that consisted of 12 8'x8'x20' isocontainers that held the AIS, ITAs, ESS, TOs, and support equipment. This set-up was fully deployable, however, it took three C-141B loads to transport it. This was one reason the F-16 SPO then developed the Improved AIS (IAIS). The IAIS was designed to be two-man portable, and fit completely on one 463L pallet. It currently is planned to host 22 of the highest usage LRUs, although other LRUs could be hosted if necessary.

B.12.3.1.3 Planned changes to the maintenance concept and potential impacts to the ATS

The most significant planned change to the maintenance concept is, of course, the move to two levels of maintenance. Because of the findings of the Coronet Deuce study, the Air Force is currently planning how to implement a two-level of maintenance structure for the F-16. Although no definitive plans have been established for avionics repair, it is envisioned that a number of the existing field AISs would be returned to Ogden ALC (OO-ALC) to support LRU repair. If the Air Force in fact decides to centralize F-16 LRU I-level repair at the depot, some quantity of AISs will probably become excess to Air Force requirements. The specific quantity depends on the degree to which the Air Force removes AISs from base-level shops. The full implementation of the two-level concept will also probably cause the IAIS to be used in an O-Level capacity as a go/no go tester. This could increase the total number of IAISs required. Another change envisioned is that the mobile shelter program will be phased down. If the full sized AISs are centralized at the depot, there will no longer be a mobility commitment that requires the use of mobile shelters. Instead, IAISs will assume the mobility commitment, and they require no special facilities.

B.12.3.2 Plans to achieve concepts

As illustrated in Section 2, the F-16 SPO determines AIS beddown requirements using an integrated planning approach. AIS planning is based on reviewing aircraft beddown plan support requirements with the various user functions (I-level, depot, training, etc.), and optimizing the allocation of available AIS assets among all those users.

The F-16 aircraft beddown plan is periodically updated at the Air Staff level based on the POM, BES, and President's Budget submissions. When these updated aircraft beddowns are provided to the SPO, the AIS program office analyzes them to project AIS requirements from present through the next five years. Available and projected AIS assets are then reallocated among all users based on need dates and unit priorities. The SPO then provides feedback on AIS supportability impacts of the aircraft beddown to the F-16 community in forums such as the F-16 Worldwide Beddown Conference and the F-16 AIS Supportability Reviews. The need to provide high level visibility into AIS supportability became apparent during the mid-1980s when the Air Force started to replace F-16A/B aircraft in TAC units with newer C/D models. Until that time, AIS requirements had been determined by the total projected TAC force, which was comprised primarily of 72 PAA operational wings. Based on AIS station loading models, each of these 72 PAA TAC sites required 2 AISs for support. However, as the A/B aircraft were reassigned from TAC to reserve and guard units, they were broken down into smaller packages of 18 PAA (for the guard) and 24 PAA (for the reserves). Since each of these smaller units required their own AIS, total F-16A/B avionics support requirements in essence doubled. This necessitated the acquisition of AISs to support the increasing number of 18-24 PAA units, in addition to the normal AIS buy that was needed to support the C/D program. By 1985 it became apparent that there were an insufficient number of A/B AISs within the USAF to support all the projected A/B sites. Several A/B sites would have to be supported by C/D version test stations. This was possible because the C/D AIS was developed to be fully backward compatible with the A/B aircraft. The Advanced Computer AIS is also fully backward compatible, however, A/B peculiar TPSs are no longer being procured, since adequate numbers were procured under the A/B and C/D AIS programs to support the entire A/B aircraft inventory.

In 1990, the F-16 SPO developed the Support Equipment Scheduling and Tracking System (SESATS) model, an automated AIS and support equipment beddown model. Through the use of a declassified version of the aircraft beddown plan, SESATS permits the SPO to optimize the allocation of existing and planned AIS and support equipment assets for all F-16 users. While the allocation algorithm is based on the same ground rules and priorities that were used to manually develop earlier AIS beddown plans, the time required to generate a new beddown is measured in hours instead of days. This model also calculates total support equipment requirements by part number, identifies existing equipment, and projects future buy requirements so the appropriate program manager can act lead-time away.

B.12.3.3 Supporting plans

The AIS program constituted the single largest cost element of the F-16 support equipment budget. It was also the most technically complex support equipment system procured. For these reasons, the SPO created a separate division within the logistics directorate for AIS acquisition management. During the earlier, AIS critical development years, ATS engineers were co-located with the logistics and acquisition program managers, in an arrangement suggestive of an integrated product development team. As the AIS procurement effort neared completion, the size of the AIS organization decreased appropriately. Today, the F-16 SPO AIS program is managed as a separate branch under the Support Equipment Division (ASD/YPLS).

Formal F-16 A/B and Advanced Computer AIS training programs for entry level technicians are conducted at Lowry Technical Training Center (LTTC). No C/D AIS training program exists because the C/D version AIS will be upgraded to the Advanced Computer configuration under ECP 1611 (See para 7.0). The AIS training development efforts were managed by HQ ATC/TTYR, however, the SPO provided the AISs and maintenance trainers that are used. In addition to having an A/B and Advanced Computer AIS, LTTC also has a complement of LT-2 and LT-12 AIS trainers that are used during classes.

B.12.4 Weapon System ATS Inventory

Table B-66. F-16 ATS Quantities by Location (Intermediate - Level AIS)

TYPE LOCATION	A/B	C/D[7]	Advanced Computer C/D[6]	IAIS[6]
Factory	6[1,3,4]			1
Depot	3		4	1
Intermediate	Active = 0 Reserve = 3 Guard = 15	Active = 0 Reserve = 4 Guard = 13	Active = 22 Reserve = 1 Guard = 11	Active = 14
Training	1		1	
FMS	15[2]	2	12	
Other			2[5]	
Total	43	19	53	16

Notes:

[1]Includes 3 pre-production version A/B shops.

[2]Includes 1 pre-production version A/B shop.

[3]Includes 1 shop set (set #22) which was upgraded to the C/D configuration.

[4]Includes 1 shop set (set #37) upgraded to the Advanced Computer configuration.

[5]One set is at the Air Force Flight Test Center at Edwards, the other is at the 3246 Test Wing at Eglin.

[6]Locations are based on F-16 AIS Beddown Plan 92-1. Twelve Advanced Computer and all 16 IAISs have not been delivered.

[7]CCP 1611 will upgrade all C/D version AISs to the Advanced Computer configuration. This upgrade will be completed by Apr 94.

Table B-67. AIS Test Program Sets by Location and Types

	A/B	C/D	Adv Comp	IAIS
Factory	52	70	75	22
Depot	52	70	75	22
Intermediate	40	58	46	22

Table B-68. Depot-Level ATE and Test Program Sets

	TI Digital	Analog	Microwave	Honeywell Digital	FACT II	DUST
Quantity at Depot	5	11	9	2	1	6
Quantity at Factory	1	2	2	3	---	---
Number of TPS per Station	224	216	42	107	116	46

B.12.5 General ATS Technical Capabilities

B.12.5.1 Intermediate-Level Test Equipment

The A/B, C/D, and Advanced Computer AISs all consist of four functionally separate stations: the Computer/Inertial (C/I), Display/Indicator (D/I), Processor/Pneumatic (P/P), and Radio Frequency (RF). These stations are comprised of programmable instrumentation which automatically provides required stimulus and measurement functions for checkout and fault isolation of assigned LRUs. Automatic testing is implemented through the computer and disk units using high level 416-ATLAS language test programs. Operator intervention is required only to change or verify set-up, observe specific measurement results, or close out testing. The control/display assembly provides operator interface to the station, furnishing mode indication and displaying all operator instructions during the course of testing. Required operator responses are made at either the keyboard or a remote control unit.

The IAIS is a down-sized version of the earlier AISs. It consists of 14 interconnected two-man portable modules that contain the operator console and display, instrumentation units, power supplies and controls, microwave measurement and stimulus units, frequency converter, and refrigeration and blower units. LRUs are tested by connecting them to inactive interface test adapters which mount on the IAIS via a pinless connector system. A majority of the LRU test software was transported directly from the AIS. Following is a general technical specification for each of the Advanced Computer AIS stations, as well as the IAIS.

B.12.5.1.1 C/I

The C/I test station primarily supports the flight control system, inertial guidance system, and the fire control system's computer. The following LRUs are supported by the C/I station:

Table B-69. C/I Station LRUs

Rate gyro assembly	Accelerometer Assembly
Inertial navigation unit	Fire control navigation panel
Fire control computer	Flight control computer (FLCC)
Flight control panel	Converter-multiplexer
HUD rate sensor	Rudder pedal assembly
Manual trim panel assembly	Flight control system data recorder
Pilot stick sensor assembly	Digital flight control computer (DFLCC)
Rate senor unit	Enhanced fire control computer (EFCC)
General avionics computer (GAC)	Data transfer unit (DTU)
Data transfer cartridge	Expanded data transfer cartridge (XDTC)
Electronic Cartridge assembly (ECA)	

B.12.5.1.2 D/I

The D/I test station tests the displays, indicators and optics. It includes a separate photometric bench. The following LRUs are supported by the D/I station.:

Table B-70. D/I Station LRUs

HUD electronic unit	HUD display unit
Indicator unit assembly	Radar electro/optical EU
ADI	HSI
Generator control unit	Instrument mode select coupler
Radar control panel	Radar EO
Multi-function display (MFD)	Programmable display generator (PDG)
WAC HUD DO	WAC HUD DU
Azimuth indicator	Generator control unit

B.12.5.1.3 P/P

The P/P station tests LRUs in the stores management, threat conditioning, air flow sensing, video synchronization, high voltage/current, digital signal processor graphics, video blanking, and high speed data bus systems. The following LRUs are supported by the P/P station:

Table B-71. P/P Station LRUs

Central air data computer	Pneumatic sensor assembly
Digital signal processor	Radar computer
Stores control panel	Programmable signal processor (PSP)
Central interface units (ACIU/ECIU)	Remote interface units
Signal processor transmission line coupler	
Interference blanker unit	

B.12.5.1.4 RF

The special purpose radio frequency test subsystems provide RF stimulus and measurement capability for testing specific RF type LRUs used for radar, communications, threat warning, and navigation systems. These RF requirements are beyond the capability of the general purpose core subsystems, and is not available on the other AIS stations. The special purpose subsystems consist of the RF stimulus, RF measurement, and pressure test systems. The LRUs tested on the RF station are as follows:

Table B-72. RF Station LRUs

Radar transmitter	Radar antenna
Low power RF (LPRF/MLPRF)	UHF receiver/transmitter
IFF receiver/transmitter (IFF/RT)	Amplitude detector
FSRS	Receiver controller
ILS receiver	Channel frequency indicator
Dual mode transmitter (DMT)	

B.12.5.1.5 IAIS

The IAIS was designed to operate in a field environment with no special facility or power requirements. It exceeded the requirements specified in the High Mobility Tester (HIMOT) SON for weight, power, cooling air, and facilities. In addition to the 14 interconnected modules, the IAIS also uses an optical test bench for display LRUs. Following is the list of high failure LRUs are currently being hosted on the IAISs. The group number refers to the order in which the TPSs are being developed. Group I TPSs are being developed first, followed by Group IIA and then Group IIB.

Table B-73. IAIS LRUs

Group I	Group IIA	Group IIB
ACIU/ECIU	DMT	IFF R/T
MLPRF	PDG	EFCC
PSP	DFLCC	WAC/DO DU
GAC	FLCC	WAC/DO EU
MFD	ECA	ALR-69 SP
DTU/XDTC		EXDEEU
Radar Antenna		

B.12.6 Depot-level Test Equipment

B.12.6.1 AISs

As shown in Table B-66, the depot has seven full sized AISs, and is scheduled to receive one IAIS. The AISs at the depot are the same configuration as those used at I-level locations. This was done to ensure vertical testability and minimize ATS development costs. Similarly, the IAIS, when delivered, will be same as those IAISs used in the field. The depot also uses the same TPSs the field does, however, on the full sized AISs there are 12 depot unique TPSs. There are no depot unique TPSs on the IAIS.

B.12.6.2 TI Digital Module Test Station

This is a Texas Instruments TI-960 tester that is used for testing digital type circuit card assemblies (CCAs) from A/B aircraft LRUs and the A/B AIS.

B.12.6.3 Analog Test Station

This Honeywell 2600 station (P/N UG2600MA01) tests analog type CCAs from A/B and C/D aircraft and the A/B, C/D, and Advanced Computer AISs.

B.12.6.4 Microwave Test Station

This a General Dynamics modified HP9231C tester (P/N 16U80800-3). It tests microwave type CCAs from the A/B and C/D aircraft and the A/B, C/D, and Advanced Computer AISs.

B.12.6.5 Honeywell Digital Module Test Station

This is a Honeywell 3500 station (P/N UG3500AY03) that is used only for testing digital type CCAs from the C/D aircraft, and the C/D and Advanced Computer AISs.

B.12.6.6 FACT II

This is a Hughes F-800-5 Flexible Automatic Circuit Tester. Its test capabilities include continuity, leakage, voltage, resistance, load, and phasing measurements; fault flag, elapsed time, and digital indicator operations; and circuit component integrity verification. The FACT II, which uses punched Mylar tape as test media, is becoming unsupportable. It is envisioned they will be replaced in the near future with FACT 4100 testers.

B.12.7 ATS Upgrade and/or Off-load Plans

B.12.7.1 C/D AIS

Although there are currently four configurations of F-16 AIS, the SPO is in the process of eliminating the C/D version AIS by upgrading it to the Advanced Computer configuration. The C/D version AIS was developed to support Block 25 and earlier aircraft by increasing the stimulus measurement and test instrument capability of the original A/B version AIS. However, by 1986 it became apparent that a number of the systems in the A/B and C/D AISs were increasingly difficult to support logistically. In particular, the HP1000 computer system, disk drive, terminal and display system had been out of production for several years, and there were a decreasing number of vendors willing to keep the existing systems going for an extended period. When the Advanced Computer AIS was developed, these systems were replaced; however, that did not resolve the C/D's impending support problems.

In 1987, the SPO had a cost-tradeoff study conducted to determine whether it would be more cost effective to upgrade the C/D AIS to the Advanced Computer configuration, or keep the current configuration. The analysis showed there would be a $40M (FY86$) cost avoidance by accomplishing the upgrade. Based on that finding, and user recommendations, the SPO elected to upgrade the C/D AISs. That upgrade is being accomplished under ECP 1611, and is scheduled to be completed by 1994.

B.12.7.2 IAIS

Several P^3I-type efforts are in work for the IAIS.

B.12.7.2.1 Advanced Bus Emulator

The IAIS was initially developed with an advanced bus emulator (ABE) capability to increase digital test capability. The ABE capability allows the IAIS to test a wide range of components by modifying test protocols with software. Although the F-16 SPO does not have a current requirement for it, GDE left the capability to add a fourth ABE card if future test technology would require it. Additionally, under an independent research and development (IRAD) effort, GDE is developing an advanced digital bus emulator that will allow digital simulation of both digital and analog test signals. It will be physically smaller and operate faster than the current ABE. This capability could be incorporated into the IAIS for future weapon system applications, since the F-16 SPO believes future technology will drive Scan Technology completely digital test systems.

B.12.7.2.2 Scan Technology

Although primarily designed as an I-level tester, in November 1991, the IAIS demonstrated the ability to successfully diagnose and fault isolate a defective SRU using scan technology. The test was done on a GAC CPU, one of the F-16GAC's circuit cards. GDE has another IRAD project to develop a LASAR post processor capability that could be incorporated in the IAIS. Similar in function to an automatic test program generator, this post processor, in conjunction with the existing scan capability on the IAIS, will provide future capability for combined I-level and D-level testing on a single system.

B.12.7.2.3 VXI

VXI technology was not mature when the IAIS was first developed, therefore, it was not designed into the IAIS. GDE is now, however, developing their own measurement system for VXI. When completed, this system could be added to the IAIS to allow flexibility to use other VXI instruments and make better utilization of COTS.

B.12.7.2.4 Ada/ABET

The IAIS, like all other F-16 AISs, uses an F-16 version of 416-ATLAS. As part of a capability demonstration, GDE developed an Ada version of an existing F-16 LRU test program and ran it on the IAIS. An optical disk was prepared that contained an ATLAS version performance test on one side, and an Ada version of the same performance test on the other. Both programs were able to successfully complete LRU performance testing. This showed the flexibility of the IAIS to use existing test languages, as well as future test software that may be developed under ABET.

B.12.8 Factory/Depot

Use F-16 factory use of production version ATS is limited. General Dynamics (GD) does use several modified pre-production version A/B AISs to support aircraft production. However, almost all of the LRUs that are used in the F-16 are provided by other vendors to General Dynamics/Fort Worth (GD/FW). If an LRU is found to be defective, GD returns it to the vendor for repair. The LRU vendors then use their own peculiar factory test equipment to repair the LRU.

The F-16 SPO and OO-ALC are on contract with GD/FW to provide sustaining engineering support for the A/B, C/D, and the Advanced Computer AIS. To provide this support, the SPO has provided GD/FW with one AIS of each configuration that remains in the Fort Worth facility. At the same time, the Air Force is attempting to become hardware and software organic on the F-16 AIS. To achieve that goal, one station of each configuration is located at OO-ALC in the Avionics Software Integration Facility (ASIF). Additionally, there are a number of AIS stations used in the depot maintenance facility for LRU support.

B.13. F- 22

B.13.1 Weapon System Background and Management

The F-22 is the Air Force's (USAF) air non-superiorty figther currently under development. The F-22 design characteristics are a blend of critical operational capabilities. The F-22 will incorporate very low observable design. The F-22 also is capable of cruising at supersonic speeds without using an afterburner. Coupled with increased maneuverability the F-22 will out-perform all current as well as projected threats. The F-22 accommodates a diverse complement of weapons, an internal load of AIM-120 Advanced Medium Range Air-to-Air Missiles (AMRAAM), AIM-9 Sidewinders, and an internal gun. The F-22 also incorporates a highly reliable integrated avionics suite, providing pilots with a complete picture of the surrounding air battle. Lastly, specificiations requirements for supportability of the F-22 exceed those of the F-15. Specific requirements include a 40% reduction in maintenance personnel, 53% reduction in C-141B airlift, and a 60% increase in sorties flown between major maintenance.

B.13.2 ATS Acquisition and Management

F-22 has developed a Common Automatic Test System (CATS) approach. CATS is based on current industry trend toward standard ATS architecture/interfaces and software. CATS includes a preferred commercial instrument list, common controller and station software, all developed and written in Ada. CATS leverages is intended to the large commercial ATS market to minimize F-22 research and development (R&D) investment and access widely available/current technology ATS components. CATS has been placed on contract with all F-22 Engineering and Manufacturing Development (EMD) subcontractors. The approach allows each subcontractor to tailor or configure ATS components to specific test requirements. Standardizing across the weapon system program is a new paradigm for ATS hardware and software development. The avionics and ATS design efforts are integrated and significant reuse of ATS hardware and software is expected at each program phase. The competitive commercial marketplace is driving instrument vendors to adopt industry standards and to provide maximum backward compatibility of new ATS products. This will allow F-22 to upgrade with minimum impact as the programs evolves from EMD to production and depot support. This evolutionary approach is intended to provide a mature support capability earlier with fewer vertical testability problems.

The F-22 program is employing a total weapon system, integrated product development approach. Integrated diagnostics and logistics support analysis (LSA) processes start early on to insure cost effective support and ATS selection. Emphasis on built-in-test (BIT), vertical testability and rapid deployment is driving ATS. The F-22 EMD program includes a pilot program for factory test equipment (FTE) for test software. The FTE is contractually controlled through the prime contractor to ensure the proper achievement of pilot program.

B.13.3 Weapon System and ATS Deployment Concepts

B.13.3.1 Weapon system maintenance concepts

B.13.3.1.1 Maintenance concepts

There are three distinct maintenance concepts being planned for the F-22. The first is a Main Operating Base (MOB) located in the continental United States. In this scenario, there is one wing with 72 aircraft, responsible for performing all O and I level maintenance. The second scenario is an operating base located in a NATO country or a third-world arena. In this instance, 24 aircraft would be deployed for 30 days. This location may not have F-22 peculiar automatic test equipment. Airlift would be required to support the 30 day operation. The last scenario is an unimproved location in a third world country. This would entail six dispersed aircraft with limited maintenance and deployed airlift capability for a six day operation.

B.13.3.1.2 Impact on fielding

The mobility requirements necessary to perform the F-22 missions are the principal impact on the ATS design. These mobility requirements preclude using a large Avionics Intermediate Shop (AIS), like the previous generation F-15 and F-16 aircraft. To date, no requirements have been identified for intermediate level ATS.

B.13.3.2 Plans to achieve concepts

The ATS pilot program is a total quality management (TQM) approach for integrated product development and concurrent engineering to determine affordable and timely support, mitigate risks and mature concepts and diagnostics. Recent advances in BIT effectiveness and avionics reliability will allow F-22 to be all or nearly all two-level maintenance. There is no O-level nor I-level ATS planned at this time. If intermediate is determined to be cost effective, regional maintenance approaches will be considered. One of the results of the EMD phase of acquisition is to document the most cost-effective ATS and then determine the proper selection/production of that ATS.

B.13.4 Weapon System ATS Inventory

None developed or procured at this time, although there are plans for factory test equipment (EMD and production). Table B-74 lists ATS that will be used across the many F-22 subcontractors during EMD.

Table B-74. F-22 Factory Test Systems

Function	Testers	TPS
Digital	50	75
Power Supply/Analog	9	75
RF/Digital	42	36
RF/Microwave	27	47
Electro-optics	20	14
System	2	6
Totals	150	253

B.13.5 Specific ATS Technical Capabilities

The F-22 program office is planning to support seven basic test functions at the factory: digital, RF, microwave, power supply, analog, electro-optic, and system level testing (flexibility of CATS interface standards and preferred instrument list will allow further tailoring to individual subcontractor requirements). The test strategy is to employ integrated avionics and exercise built-in test via a Joint Test Advisory Group (JTAG) interface.

B.13.6 Factory/Depot Use

B.13.6.1 Factory Use

CATS factory (EMD and production) test equipment is based upon commercial equipment and standards. Since the EMD program is a pilot program for production, significant reuse of the EMD ATS is likely.

B.13.6.2 Depot Test Systems

One of the key strategies of CATS is that factory test strategies and implementations will migrate to the depot. A high degree of equipment commonality with the factory and significant reuse of evolving test software is expected — minimizes cost and provides mature diagnostics capability earlier. A key task in the F-22 EMD program is to gain experience with CATS and use that information to define specific depot ATS requirements. Such requirements will determine commonality with factory ATS. Identification of depot test requirements is an LSA task in the EMD program.

Specific cost estimates for F-22 depot ATS do not exist. Only an overall peculiar support equipment cost was estimated (by a factored approach based on historical data) and, as such, there is no specific depot support equipment breakout.

B.14. C-17

B.14.1 Weapon System Background

The C-17 is a four-engine turbofan direct delivery aircraft capable of airlifting large payloads over intercontinental ranges without refueling. It has nearly the same wing span as the C-141 but can carry twice the payload. It can also transport the same outsized equipment as the C-5 to small austere airfields that were previously restricted to C-130s.

The C-17 mission is to provide worldwide airlift capability for U.S. combat forces, equipment and supplies. It will fly its cargo and troops for airland or airdrop delivery, aeromedical airlift and low altitude parachutes extraction system (LAPES). The C-17 has the capability to land on austere airfields as short as 3000 feet with payloads up to 172,200 lbs. allowing delivery of supplies and combat equipment directly to forward areas without intermediate transshipment.

The primary benefit of direct delivery is reduction in time required to deliver combat units to the battle zone. Direct delivery also eliminates the majority of the need for transshipment and thereby avoids the time, personnel and support equipment required for ground handling and transportation from off-load airfields to final destination. By eliminating the intermediate transshipment locations, aircraft and cargo vulnerability to attack as well as ground congestion is greatly reduced.

B.14.2 ATS Acquisition and Management

The C-17 uses the Support Equipment by Capability concept to acquire its automatic test systems (ATS). The support equipment by capability concept was conceived to incorporate systems supportability in the contractor's C-17 concepts. Each proposal included a costed support equipment package and was evaluated under competition. Funding for all support equipment and associated technical orders to support the C-17 aircraft was then negotiated up front and dispersed under a separate contract line item number. The contractor acquired total system support responsibility to identify and ultimately provide that contractor furnished equipment (CFE) which meets the system specification and the support equipment general specification. Support equipment that is ultimately necessary to support the C-17 aircraft is within the scope of the existing Engineering and Manufacturing Development (EMD) effort.

The contractor also identifies all organizational and intermediate level government furnished support equipment (GFE) in support of 16 aircraft at the initial base. Items and quantities of organizational and intermediate (O & I) level CFE and GFE support equipment shall be in accordance with all applicable Tables of Allowances mutually established by the government and the contractor based on the O & I Support Equipment Capability demonstration results. Following a successful systems evaluation of the support equipment and technical orders, the government will then establish a product baseline for the C-17 O & I support equipment.

B.14.3 Weapon System and ATS Deployment Concepts

B.14.3.1 Weapon system maintenance concepts

B.14.3.1.1 Maintenance concepts

The C-17 weapon system was originally conceived under a three-level maintenance concept requirement. This strategy has been tempered somewhat with the advent of regional maintenance centers (RMC) in lieu of a fully-configured, I-level shop at each main operating base (MOB). Each of the three RMCs will have two digital analog video (DAV) stations developed for the B-1B program and a photobench modified from the F-16 program. Additionally, three DAV stations and two photobenches will be provided to San Antonio Air Logistics Center (SA-ALC) and one DAV station to Warner-Robbins Air Logistics Center (WR-ALC) to support depot maintenance activities. Air Training Command (ATC) will also be provided a DAV station and photobench to support line replaceable unit (LRU) maintenance training operations.

The maintenance concept generally incorporates, to the maximum extent possible, two levels of maintenance (organizational and depot) to minimize the need for special test facilities, skills, tools or equipment at base level. Since the ATS is existing equipment that is currently fielded, the support structure is in place

The C-17 is currently in the EMD phase of acquisition and so the current maintenance concept is really the planned concept. The aircraft will be located at four MOBs, all in the continental United States (CONUS). The planned maintenance concept is a modified three-level approach using three regional maintenance centers. The Air Force plans to locate one regional center on the east coast, one on the west coast and the third in a central location. Avionics LRUs that exhibit in-flight or ground test failures at the MOBs will be fault isolated using a combination of built-in-test, portable testers and break-out boxes, and manual techniques. Once the faulty LRU is identified, it will be sent to the closest regional maintenance center. At the regional center, the LRU will be placed on a DAV ATS, originally designed for the B-1B with the appropriate test program set (TPS) and further tested to identify the defective shop replaceable unit (SRU). The SRU is then removed and sent to the depot. For LRUs with optical test requirements, a derivative of an F-16 Optical Bench will be used in conjunction with the DAV test station. The original F-16 bench design had to be augmented to add color capability.

The DAV ATS is scheduled for fielding at three main operating bases, one ATC location and at depot locations for LRU testing. The DAV stations were bought in 1989 to support a Military Airlift Command (MAC) requirement for regional maintenance centers, before the Air Force decided to explore the two-level maintenance concept.

B.14.3.1.2 Impact on fielding

The C-17 does not have a mobility requirement. The ATS will be permanently located in the regional centers. The C-17 fielding concepts had nothing to do with the initial ATS design since it was built for other weapon systems whose requirements, in general, equal or exceed those of the C-17.

B.14.3.2 Plans to achieve concepts

The maintenance concept generally incorporates, to the maximum extent possible, two levels of maintenance (organizational and depot) to minimize the need for special test facilities, skills, tools or equipment at base level. Since the ATS is existing equipment that is currently fielded, the support structure is in place. The item manager is in place, and additional spares are being identified to cover the new ATS procured for the C-17. In addition, other logistics elements are in place such as Technical Orders (T.O.s.). Any nonstandard facilities, tools and equipment or personnel must be justified by a separate life cycle cost analysis.

B.14.3.3 Supporting plans - personnel, training, support for ATS, etc.

The C-17 ATS training will be accomplished through the Field Training Detachment (FTD) concept. There will be two courses to train personnel in the maintenance and operation of the ATS. The C-17 ATE Operator and LRU Repair Course will use an ATE, additional support equipment and a representative number of TPS. The course will train and demonstrate the functions of the DAV station and the aspects of LRU repair on the ATS. The C-17 ATE Repair Course will use an ATS and a computer-aided visual simulator to train station repair, alignment and calibration procedures. The simulator will allow individual ATE troubleshooting training with self-paced instruction. Development of the FTD course is underway at Charleston AFB. Necessary equipment for the FTD has been procured and is being delivered with only minor schedule perturbations.

B.14.4 Weapon System ATS Inventory

Table B-75. C-17 ATS Quantities by Location

	Testers	Photobench	LRUs Tested	TPS
Depot	4	2	356	356
Intermediate	6	3	38	38
Training	1	1	38	38
Total	11	6		

B.14.5 Specific ATS Technical Capabilities

The DAV is the same as the B-1B DAV station. It consists of five equipment racks and one table which supports a graphic terminal and printer. Major components are the power and control module, video module, pneumatic module, sub-instrumental module (SIM), self-test adapter, I/O devices (keyboard, display, printer).

B.14.5.1 Design Baseline

The DAV station is a computer controlled unit consisting of rack mounted, tester replaceable units (TRUs), external peripheral equipment and accessories. When station is used in conjunction with station operating control software and TPS, it will test the C-17 LRUs.

B.14.5.2 Design source/derivation

The C-17 DAV was derived from the B-1B DAV ATS, itself a derivative of the F-16 Avionics Intermediate Shop (AIS). The hardware and software for the C-17 DAV are identical to the B-1B Intermediate Automatic Test Equipment (IATE) DAV station. Some additional self-test software was added to test the pneumatic function controller and the C-17 photobench. The photometric bench is a 60% modification to an F-16 AIS display/indicators (D/I) station adding a multi-color testing function to the photometry to accommodate the C-17 color multi-function displays (MFD) test capability. Some additional design to accommodate the C-17 head-up display (HUD) LRU was also accomplished.

B.14.5.3 Known advantages/disadvantages

Estimated $60 million savings to the government since very little nonrecurring development was incurred. Since depot support for the DAV is in place, there is an additional estimated $28 million savings in depot support.

B.14.5.4 Factory/Depot Use

No factory test systems identified yet for use in this program. There is no depot information available at this time because no decision has been made as of yet on which systems will be used for depot testing.

B.15. ADVANCED CRUISE MISSILE

B.15.1 Weapon System Background

B.15.1.1 Weapon system description

The Advanced Cruise Missile (ACM) system is designed to satisfy Strategic Air Command (SAC) requirements for a cruise missile having increased range, improved survivability and increased accuracy/flexibility. The ACM program is intended to enhance the capabilities of the air breathing leg of the strategic TRIAD. The Advanced Cruise Missile, AGM-129 is a turbofan powered missile which is designed to deliver a nuclear warhead in an air-to-ground mode to a preplanned target following deployment from a B-52H. Although there is no operational requirement to employ the ACM on the B-1B, the system will maintain, to the extent possible at no further cost, the level of partial integration previously demonstrated within the Strategic Arms Reduction Treaty constraints.

B.15.1.1.1 Acquisition Strategy

The Presidentially mandated Initial Operating Capability (IOC) required from the outset that ACM be a highly accelerated program. The compressed schedule and special security provisions required this program to receive intense high level management attention. To achieve ACM objectives, an acquisition strategy that balances technical risk with government fiscal commitment has been adopted.

B.15.1.1.2 Strategy for Engineering and Manufacturing Development (EMD)

A competitive contract was award to General Dynamics/Convair Division (GD/C) for development of the ACM. Sole source contracts were awarded for B-52 and B-1B integration and engines to the Boeing Military Airplane Company, Rockwell International and Williams International, respectively. All contracts are fixed price (firm and incentive). Contract features and provisions include economic price adjustment (EPA), award fee, missile incentive warranty, total system responsibility, associate contractor, not-to-exceed price production options and rapid change procedures.

B.15.1.1.3 Strategy for Production

The initial production contracts, Lots I - IV were fixed price incentive and included provisions for demonstration milestones, the statutory warranty, SECAF data rights clause, spare parts and support equipment pricing as required by current guidelines. Should Cost was accomplished on the Lot III buy. Separate annual buy contracts are planned for Lots V and VI with directed quantities to GD/C and McDonnell Douglas Missile System Company. A competitive source selection with a split buy in Lot VII was planned, followed by a down selection to one producer for Lots VIII - X. As a result of the 1992 President's State of the Union Address to Congress, the ACM program has been limited to a total purchase of 640 missiles. The Program Management Directive (PMD) truncated production at the end of the FY92 production buy.

B.15.2 Weapon System and ATS Deployment Concepts

Deployment to the first main operating base (MOB) at K.I. Sawyer AFB MI has commenced, with plans for deployment to the second MOB at Fairchild AFB WA in the near future. At each MOB there will be two levels of maintenance performed, organizational and intermediate. The weapon system can be deployed to dispersal base locations. Dispersed Emergency War Orders (EWO) sorties will be supported by MOB resources with dispersed base maintenance limited to organizational flight line tasks.

B.15.2.1 Weapon system maintenance concepts

The ACM weapon system will be supported by the three levels of maintenance (organization, intermediate, and depot). Organizational and intermediate level maintenance is the responsibility of the Munitions Maintenance Squadron. Depot level maintenance is organically provided in consonance with AF policy requiring such support of mission essential weapon systems. For all levels of maintenance, maximum use is made of existing and programmed organic resources.

B.15.2.1.1 Organizational maintenance

Organization maintenance will occur at both the flight line and the Weapon Storage Area (WSA), which includes the Intermediate Maintenance Facility (IMF). Organizational level missile maintenance will be performed at the IMF. Support and test equipment for organizational level repair was identified through the Logistics Support Analyses (LSA) processes during EMD.

B.15.2.1.2 Intermediate maintenance

Intermediate level maintenance will be performed at IMF and in the Maintenance and Inspection (M&I) Facility. Intermediate level maintenance will include repair of support equipment, component receipt and inspection, carrier aircraft equipment (CAE) and repair and replacement of warhead limited life components.

B.15.2.1.3 MOB maintenance requirements

Missiles will be uploaded on pylons and launchers in an all-up-round (AUR) configuration, including payload and will either be placed in storage igloos or loaded on aircraft for alert. The loaded pylons and launchers will tested annually to verify the operational readiness of the system. An empty launcher and pylon test will also be required every 20 months. The storage-to-alert-to-storage cycle with periodic testing will continue until either a malfunction is detected or limited-life components require replacement. The operations maintenance scenarios are nearly identical to the air-launched cruise missile (ALCM).

B.15.2.1.4 Ground operations/maintenance scenario

The ACM production vehicle will be fueled and certified to be mission- capable at the GD/C manufacturing facility, packaged in a reusable shipping container and transported to the appropriate SAC base. Upon arrival at the SAC MOB, the missile will be moved to the unarmed weapons storage facility, where it will be removed from the container and placed on a munitions handling trailer and transported to the IMF. As part of a receiving inspection, a Level I test will be performed using the Electronic System Test Set (ESTS). Any discrepancies found during the test will be corrected before weapon buildup.

B.15.2.1.5 Pylon building

The missile is built up to an EWO configuration by installing the warhead and mating the missile to the pylon. When the pylon or launcher is loaded with the prescribed number of missiles, a loaded launcher/pylon test is performed to validate the missile, launcher or pylon, attached avionics equipment and all interfaces among the assembled components.

B.15.2.1.6 Depot maintenance

Depot level maintenance will be performed at an Air Logistics Center or appropriate Technical Repair Center. Equipment designated for depot level repair was identified through Optimum Repair Level Analysis (ORLA) and maintenance requirements identified by the LSA process during EMD. Automatic test equipment (ATE) will be required at the depot for fault isolation of the more complex avionics components. With the exception of the engine recertification, there are no regularly scheduled depot maintenance requirements for the ACM.

B.15.2.2 Plans to achieve concepts (historical as appropriate)

The Advanced Cruise Missile program was directed by the PMD to use ALCM support equipment to the maximum extent possible. In the PMD, the program was specifically directed to use the ESTS for the intermediate level maintenance of the ACM. To determine the requirements for the depot level maintenance, the Director of Logistics performed an ORLA which showed certain line replaceable units (LRU) should be repaired at the depot. These LRUs are the Aft Avionics Unit (AAU), the Forward Avionics Unit (FAU), the Electro-Pneumatic Distribution Box (EPDB), the Laser Doppler Velocimeter (LDV) and the Navigation Control Assembly (NCA). In accordance with the Statement of Work and the Support Subsystem Specification, the contractor submitted Support Equipment Recommendation Data (SERDs) that recommended support equipment to test these LRUs at the depot. The Support Subsystem Specification required the contractor to consider existing equipment first, modified equipment second and new equipment last.As a result of this requirement, the recommended a piece of *special test equipment* (STE) that they were using in their factory to test the avionics boxes (the AAU, FAU, EPDB), a piece of STE that the LDV subcontractor was using in house to test the LDV and the Automatic Depot Inertial Navigation Test System (ADINTS) that San Antonio Air Logistics Center (SA-ALC) is developing to support the NAC.

SA-ALC determined that the piece of STE recommended to support the avionics boxes was not supportable. The ACM System Program Office (SPO) directed the contractor to update the STE into the AN/GSM-348 Guided Missile Test Set (GMTS) Configuration. At the same time, the SPO had the contractor request that the LDV subcontractor bid the cost of documenting the design of the System Acceptance Test Equipment (SATE), the Sensor Test software and the Transceiver Test Software. The effort was put on contract. The contractor will deliver the SATE station that was residual material from the LDV second source contract. The ACM SPO had SA-ALC modify the ADINTS contract to add two test stations, a test program set for the NCA and a test program set the Platform (a shop replaceable unit in the NCA) for the ACM. In its present form, the GMTS is also capable of testing the Circuit Card Assemblies of the avionics boxes. The SPO has a Memorandum of Agreement with Ogden Air Logistics Center (who will be supporting the avionics boxes) to develop test programs for the circuit cards using the GMTS.

B.16. AMRAAM

B.16.1 Weapon System Background

The Advanced Medium-Range Air-to-Air Missile (AMRAAM) is being jointly developed and acquired by the Air Force and Navy. It is intended as a replacement for the AIM-7 Sparrow Missile. It will provide all weather capability for the F-15, F-16, F-14, and F-18 aircraft.

The AMRAAM has an interial mid-course guidance and active radar terminal homing that provides launch and maneuver capacity.

B.16.2 ATS Acquisition and Management

B.16.2.1 Flow charts and text

The original automatic test system (ATS) strategy for AMRAAM included the Air Force Modular Automatic Test Equipment (MATE) concept. The maintenance interservice study subsequently resulted in the assignment of depot repair to the Navy at Alameda Naval Air Station. As a result of this assignment, the ATS strategy was changed to the Navy Consolidated Automated Support System (CASS). Finally, a later DDMC decision designated Letterkenny Army Depot as the technical repair center. This decision, however, did not change the ATS strategy of using the CASS.

B.16.2.2 Any special policies or regulations, etc.

The AMRAAM program, through a USAF/USN memorandum of agreement (MOA) dated December 1988, chose CASS as its depot ATS. Because of this, the AMRAAM program office is governed by two major policy statements in addition to several supporting military standards for the CASS:

a. NAVAIR Instruction 13630.2A, Introducing the Consolidated Automated Support System to Naval Aviation Maintenance, 22 March 1991

b. SECNAV Instruction 3960.6 Department of the Navy Policy and Responsibility for Test, Measurement, Monitoring, Diagnostic Equipment and Systems, and Metrology and Calibration (METCAL), 12 October 1990

c. MIL-STD-2076 (AS), Unit Under Test Compatibility with Automatic Test Equipment; General Requirements for

d. MIL-STD-2165, Testability Program for Electronic Systems and Equipment

e. MIL-STD-2084, General Requirements for Maintainability of Avionic and Electronic Systems and Equipment.

NAVAIRINST 13630.2A defines policies, procedures and responsibilities for introducing CASS to Naval aviation, while SECNAVINST 3960.6 defines similar guidance for the Navy as a whole. The three MIL-STDs listed above are intended for application to weapon system development contracts to ensure testable designs and CASS compatibility.

B.16.3 Weapon System and ATS Deployment Concepts

B.16.3.1 Weapon system maintenance concept

B.16.3.1.1 Maintenance concepts

B.16.3.1.1.1 Air Force

The basing requirements for the AMRAAM are consistent with present Air Force air-to-air missile systems. This includes Main Operating Base, Forward Operating Location, Collocated Operating Base, and Bare Base (remote sites). Field level facilities will vary from well-developed complexes at Main Operating Bases to little more than temporary shelters at remote sites. All associated logistics operations will occur over a wide spectrum of climatic extremes. Two levels of maintenance exist in the Air Force - Field and Depot. Field level consists of intermediate and organizational maintenance.

B.16.3.1.1.2 Organizational

The ATM-120A missile is delivered to and stored by the Air Force in a containerized, assembled AUR configuration. The wings, fins and buffer connectors are stowed separately within the container. The Air Force will use the CNU-431/E container which accommodates four missiles. Missiles are delivered to the flight line in the container or on MHU-141 trailers out of the container, for loading directly to the aircraft with no intermediate steps using the One Step Loading Adapter (OSLA). Operational system verification is accomplished using the BIT capability of the missile and the aircraft weapons control system. No missile tests are required prior to aircraft loading. Organizational maintenance consists of loading, unloading, BIT, and removal/replacement of wings, wing saddles, loose screws, fins and buffer connectors.

B.16.3.1.1.3 Intermediate

Missiles failing BIT are checked at the Intermediate level using the Guided Missile Circuitry Test Set (TS-4108/G), commonly known as the Missile BIT Test Set (MBTS), to verify the failure. Additional maintenance at the Intermediate level is limited to removal/replacement of selected components, cleaning, painting and corrosion control. Maintenance that does not involve assembly or disassembly and application of electrical power may be performed at any location, providing the missile is properly grounded. Assembly and disassembly of the AIM-120A at the Intermediate maintenance level involves the removal/replacement of the harness cover, boattail, suspension lug, launching shoe, fin actuator leaf spring retainer, fin actuator leaf springs, fin lock release lever, and wing quick release pin. Upon BIT failure verification using the MBTS, defective missiles will be shipped as AURS to the Joint Services Depot facility after organic capability is established.

The Load Training/Captive Carry Missile (LT/CCM) will be maintained at the field level. There are no explosive or electronic components associated with the LT/CCM and maintenance consist primarily of corrosion control, section removal/replacement, fin repair, and minor structural repair. Faulty sections are repaired or condemned within the field level maintenance activity.

Field level maintenance of the Air Force AUR Container consists of the removal/replacement of cushions, pressure value, latch assembly and desiccant. Container pressure testing, using common hardware, is also performed at this level. Major structural repair is accomplished at the JSD discussed in paragraph 2.3.1.

B.16.3.1.2 Navy

AMRAAM will be used in a manner consistent with existing Air-to-Air missiles. The maintenance plan allocates maintenance functions to the Fleet Organizational level (modified F-14 and F/A-18 squadrons), Fleet Intermediate level (Aircraft Carrier ships company), Naval Air Stations and Marine Corps Air Stations, (NAS/MCAS) and Depot level.

B.16.3.1.2.1 Fleet Level Maintenance

Fleet Organizational maintenance will be limited to aircraft loading/unloading, Built-in-Test and removal/replacement of wings, fins and buffer connector. The Navy at all activities and the Marine Corps aboard aircraft carriers will hand load missiles to the aircraft. The Marines will use mechanical loading equipment at the Marine Corps Air Stations. No missile tests will be required before loading on aircraft. Aircraft testing using the build-in test capability of the missile and the aircraft weapons control system will be used at the fleet organizational level to verify operability of the weapon system. No test equipment is authorized at the fleet level for failure verification. Failed missiles will be returned to the fleet intermediate level for shipment to the designated NAVWPNSTA/ NAWMU.

The AMRAAM will be delivered to and stored by Navy fleet activities in a containerized, assembled AUR configuration using the CNU-415/E container (4-pack). The missile wings, fins, and buffer connector are stowed separately within the container. The fleet intermediate level receives containerized AUR missiles from the NAVWPNSTA/NAWMU and provides handling and storage functions for deep stored and non-flight ready storage missiles. Visual inspections, minor corrosion control functions, and minor mechanical repair of wings and fins will be accomplished. The fleet intermediate level will containerize/decontainerize AURs and provide transportation to the flight line and flight ready storage areas. No assembly or disassembly of AURs is authorized at this maintenance level. Defective AURS will be returned to the NAVWPNSTA/NAWMU.

The LT/CCM will be fully maintained at the ashore fleet level (NAS/MCAS). There are no explosive or electronic components associated with the LT/CCM and maintenance will consist primarily of corrosion control, section removal/replacement and minor structural repair. The faulty section will be repaired or condemned within the NAS/MCAS fleet level maintenance activity.

Fleet level maintenance of the Navy AUR container consists of the removal/ replacement of accessible hardware, cleaning and corrosion control, and replacement of desiccant. Container pressure testing, using common hardware, is performed at this level. Major structural repair is accomplished at the NAVWPHSTA/NAWMU.

B.16.3.1.2.2 NAVWPNSTA/NAWMU Maintenance

The NAVWPNSTA/NAWMU will receive and inspect containerized new production Navy AUR missiles from the contractor and containerized AUR missiles returned from the fleet. These assets will be inspected and tested as necessary at the AUR level. The NAVWPNSTA/NAWMU will also provide fleet issue and long-term deep storage for stockpiled containerized Navy missiles.

The NAVWPPHSTA/NAWMU will perform functional testing and fault isolation of AUR missiles. Electro-mechanical testing of the AUR missile will include approximately 95 percent test thoroughness. AUR testing includes full power RF testing to verify operability of the active radar system and motion testing sufficient to verify operability of the electro-mechanical portions of the missile system. Fault diagnosis will be to the major section level. The NAVWPNSTA/NAWMU will have the capability to verify the integrity of: (1) the Guidance section battery squib circuits and pressure seal; (2) the Propulsion section Arm/Fire device (includes capability of arming the AFD); and (3) the Control section battery squib circuits.

Fleet returned missiles will be decontainerized, inspected, tested, and repaired by removal and replacement of defective sections or accessible AUR components. This includes the Filter/Rectifier, Rear Data Link, Wiring Harness Cover, Boattail, Suspension Lug, nutplates, and Armament Section Safety/Arming Device. Major corrosion control and painting will also be accomplished at this level. Wings and fins will be repaired at the NAVWPNSTA/NAWMU.

Missiles will be configured as training rounds (telemetry Equipped) or tactical rounds (warhead installed). The test equipment developed for the NAVWPNSTA/NAWMU test equipment will include the capability to test and verify operability of the telemetry configured missile to the same extent and depth as the tactical (warhead) configured missile.

Maintenance of the Navy AUR container at the NAVWPNSTA/NAWMU will consist of the same efforts as the fleet level plus the accomplishment of major structural repair. All maintenance of the reusable section containers is performed at this level. The containers are: (1) CNU-402/E, Control Section; (2) CNU-403/E, Warhead Section; CNU-463/E, Guidance Section; and (4) CNU-464/E, Propulsion Section. The CNU-452/E Wing/Fin Container and containers for the Arming, Firing Safety Device and Thermal Initiated Venting System may be added if required. Pressure testing will be performed at this level.

B.16.3.2 Joint Services depot

The basis for depot level maintenance is to accomplish those tasks which are beyond the capability of the field or fleet units. These tasks result from the need for personnel skills, support equipment, or facilities that are not available to the fleet or field units due to operational or economic considerations. Depot planning for AMRAAM must consider the unique requirements of the two services. The AMRAAM Joint Services Depot has been assigned to Letterkenny Army Depot by a Joint Depot Maintenance Activity Group (JDMAG) recommendation and a Memorandum of Agreement between the Air Force and the Navy.

To support the Air Force AUR depot level maintenance requirement, the Navy depot will use the AUR capabilities of the NAVWPNSTA's.

B.16.3.2.1 AUR Receipt/Handling

The NAVWFNSTA will perform functional testing and fault isolation of AUR missiles.

B.16.3.2.2 AUR Repair

Air Force and Navy returned missiles will be repaired by removal and replacement of defective sections or accessible AUR components at the NAVWPNSTA. Major corrosion control and painting at the section and AUR level will be accomplished. AUR repair may also involve removal/replacement of accessible AUR/section components such as the Filter/Rectifier Assembly, Rear Data Link, Wiring Harness, Wiring Harness Cover, Boattail, Suspension Lug, Nutplates, and Armament Section Safety/Arming Device.

B.16.3.3 Section/Component Maintenance

B.16.3.3.1 Designated Overhaul Points

The Navy is implementing the depot level repair capabilities at the appropriate Designated Overhaul Points (DOPs) within the Navy maintenance system. This approach takes full advantage of existing capabilities. The electrical/electronic repair of major sections and subassemblies has been assigned to the NAVAVNDEPOT, Alameda. The Naval Ordnance Station, Indian Head (NOSIH) will provide the necessary repair functions for the Propulsion and Armament sections. The NAVWPNSTA, Concord and Yorktown, are the DOPs for mechanical items such as the boattails, wiring harnesses, harness covers, wings fins, and containers.

B.16.3.3.2 Electrical/Electronic Components

NAVAVNDEPOT, Alameda will provide all fault isolation, repair and test of the guidance section, control section, filter rectifier assembly, rear data link and the components of these assemblies. The items will be received from the NAVWPNSTA and subjected to an incoming inspection and electrical test to verify failure and to fault-isolate to next lower assembly/component. Major assemblies will be repaired through replacement of faulty subassemblies/components, tested, and returned to the NAVWPNSTA to support AUR repair. The faculty subassemblies/components are also repaired, tested and returned to stock to support future repairs.

B.16.3.3.3 Explosive Components

The NOSIH has been designated as the depot repair facility for the Armament and Propulsion Sections. The predicted failure rates for both of these items are low and the failure modes are such that major repair is generally not required. At this time, no facilities for repair are planned for this activity. NOSTE is participating in the development of the depot planning. Planning for facilities/equipment to support major repair of explosives, such as removal/replacement of the Propulsion section Arm/Fire Device, regraining of the rocket motor, and replacing the explosive charge in the warhead will be instituted if future requirements warrant.

B.16.3.3.4 Mechanical Components

The NAVWPHNSTA perform major repair of the missile wings, fins, boattail, harness cover and containers. (Source: AMRAAM Navy/Joint Service ILSP).

B.16.4 Specific ATS Technical Capabilities

B.16.5 Mainframe CASS

B.16.5.1 Operating Software

The CASS system is based around Digital Equipment Corporations VMS Version 5.2 Operating system. The CASS software system is comprised of three main CSCIs, which are the Station Control Software. The following is a list of the components contained in the CASS CSCIs:

Table B-76. CASS System Software Modules

Station Control Software	Support Software	Intermediate Maintenance Operations Management
Test Executive Virtual Instrument Handlers Instrument Personality Interfaces Operator Interface Automated Technical Information Communication Handler Asset Allocation General Asset Monitor Kernal Asset Monitor Functional Extension Program IEEE 488 Translators Self Maintenance	ATLAS Compiler IPTESTER TPS Development Software Test Executive Simulator	BIT Test Data Processing Network Post Processing Pretest Station Management

B.16.5.2 TPS Development environment

The Navy intends to perform CASS TPS development off-line on a VAX with a VMS operating system. Products have been developed to facilitate this process. The TPS development products are:

a. TE SIM (AGE product. It simulates all of CASSs functions, except for those of the Teradyne L200 Series DTU.)

b. DICONS (An optical, but extremely useful tool. It allows the operator to access and program CASS instruments directly.)

c. IEEE 716 ATLAS Compiler

d. L200 Series Compiler (Teradyne)

e. FORTRAN Compiler

This off-line TPS Development Process allows the implementation of another cost saving measure, the use of Test Integration Facilities (TIF). The three Navy TIFs are located at Norfolk, VA, Jacksonville, FL, and San Diego, CA. After the TPS developer has completed his development and debugging (except for TPSs which utilize the L200, which can only be debugged at the CASS station), he schedules time at the TIF for integration of his TPS with CASS.

While the use of off-line development reduces the numbers of CASS required, there are some special cases of TPS development in which it is more cost effective to provide a CASS to the developer.

B.16.5.3 Ancillary equipment

a. Pneumatics Function Generator
b. Inertial Navigation System Interface
   - AR 57 Bus
c. Advanced Communication Bus Interface
   - 2 Asset Controllers
   - 1 RS-485 Bus (Manchester/Harpoon Bus)
   - 1 FODB (Fiber Optic Data Bus)
   - 1 HSDB (High Speed Data Bus) Bus Spec 86EZ00614
d. MS1397 Bus (MIL-STD-1397)
e. Video
f. Miscellaneous
   - SOS OTPS
   - Holding Fixtures (UUTs)
   - Load Sets

B.16.5.4 Environmental requirements and tested capabilities

The four CASS configurations, Hybrid, RF, CNI, and EO are all required by the CASS contract to be environmentally tested to modified limits of MIL-T-28800C and MIL-STD-167. To date all configurations have passed environmental testing with the exception of some isolated assets in rack 5 and the SSMD 1 and 2 assets which will be tested in the future.

B.16.6 CASS MTS

The MTS will be a new development effort that will be based upon the core CASS configuration. As a result, the specifics about its technical capabilities are yet to be defined.

B.16.6.1 Operating Software

This is yet to be determined. The additional equipment that will be used to augment the core CASS will dictate the specifics of the operating software.

B.16.6.2 Environmental requirements and tested capabilities

As with the four existing CASS configurations, the MTS will be environmentally tested to modified limits of MIL-STD-28800C and MIL-STD-167. The MTS, however, will probably not have the same shock and vibration requirements since it will not be utilized in a carrier environment.

B.16.7 Factory/Depot Use

In addition to the AMRAAM program's total FTE requirements, the Navy is in the process of procuring one guidance control test set at a cost of $6.5M (FY92) from the vendor for interim support at Letterkenny Army Depot. A combination of mainframe and MTS CASS is being used at the depot to support AUR, Sectional and lower level (WRA/SRA) testing requirements.

Appendix C. ATS Investment Strategy Options

Five ATS investment strategy options were defined and used for analyses. The following present the detailed definitions as they were used and discussed in this report.

Contents of Appendix C

C - 1. OPTION I: NO CHANGE TO CURRENT PRACTICES

C - 1.1 BASIC DEFINITION:

No unified or coordinated DOD policy, strategy, or investments. Some minimal coordination in ATE test language area.

Army, Navy, and Air Force continue current policies, programs, organizations, and funding lines.

> CASS and IFTE continue as planned, that is, current budgeted dollars, associated quantities, and funded fielding plans
>
> AF continues MATE process until the end of FY92. Current MATE system maintenance will be performed by SA-ALC.
>
> Factory, depot, and field ATS generally continue to be specified and acquired independently. In the Navy and Army there are current policy requirements to use CASS and IFTE respectively in the field and depot.
>
> No change to current waiver processes.

C - 1.2 P3I/TECHNOLOGY CURRENCY:

P3I will occur within CASS and IFTE programs in accordance with existing plans and currently budgeted levels.

AF R&D dollars for continued program technological currency unclear at this time. (Although the AF has no requirements process for new AF-wide technology test needs identification, there is current work underway to develop a process.)

C - 1.3 DoD COMMONALITY:

Commonality will be carried out at existing Service level and as dictated by Service unique instructions/directions. Joint depot inter-Servicing at the DoD level may also drive commonality at the depot level.

C - 2. OPTION II: ADOPT EXISTING COMMON ATS FAMILY(IES)

C - 2.1 BASIC DEFINITION:

A DoD wide policy, strategy, and related investments to apply common ATS families(y).

A common family of ATS addresses multiple weapon systems test needs. ATS family core capabilities are extended and/or new modules added when new capabilities are needed. Extensions tend to be applied across the board, but may be weapon unique for highly specialized instances. Families would have common core hardware and software and a range of additional modules to address a variety of test needs. DoD could have multiple families to address particular sets of similar test needs for different mission requirements. CASS and IFTE are examples of existing Service ATS common families.

Strategy adoption implies some revision to current policies, practices, organizations, investments, and waivers relating to the acquisition approach.

C - 2.2 P3I/TECHNOLOGY CURRENCY:

P3I/new technology R&D would be performed as purposeful, cross-Service coordinated investments to keep family(ies) capabilities current.

C - 2.3 DoD COMMONALITY:

Family implies a high% of in-family DoD internal hardware and/or software commonality to provide both cost and logistics support benefits. This common ATS family approach could be implemented immediately. However, because of current infrastructure, DoD adoption of such a strategy would entail a rate of increased commonality growth over time, rather than an abrupt goal.

C - 3. OPTION III: ADOPT A COMMON ATS SPECIFICATION SET

C - 3.1 BASIC DEFINITION:

A DOD wide policy, strategy, and related investments to apply a common ATS specification set. A common specification set is defined by selected hardware and software standards, some key software pieces, and possibly some hardware pieces. A common specification set would build upon existing DoD and commercial standards or pieces. A minimum set of standards and pieces would be selected as essential for DoD desired ATS cost and quality control; other elements might be provided as a library of preferred and proven pieces. MATE is an example of a common ATS specification set.

This option entails a lead-time before implementation could occur, that is, approximately one year would be required to define and select the correct DoD common specification set.

Strategy adoption implies some revision to current policies, practices, organizations, investments, and waivers relating to the ATS acquisition approach.

C - 3.2 P3I/ TECHNOLOGY CURRENCY:

P3I/new technology R&D would be performed as purposeful cross-Service coordinated investments. Since the emphasis in this approach is upon application of commercial standards and pieces, P3I would focus on moving with the commercial technology changes, while maintaining pieces of continued need to DoD.

C - 3.3 DoD COMMONALITY:

A common specification set implies DoD internal commonality or commonality of key DoD chosen elements or at key chosen interface points. This approach assumes that the elements chosen for specification are those deemed to be most useful to ensuring DoD cost control. Like Option II, this approach would increase certain aspects of DoD internal commonality over time, rather than with abrupt change; however this approach leaves the choice of commonality of unspecified hardware and software pieces to the developer.

C - 4. OPTION IV: DEVELOP A COMMON SOFTWARE ENVIRONMENT [Long Term Option]

C - 4.1 BASIC DEFINITION:

A DOD wide policy, strategy, and related investments to apply a common software environment. A common software environment here is a DoD defined ATS information and software reference architecture which fully elaborates all interfaces and other control points of interest to DoD in developing, implementing, and maintaining high quality, cost-controlled testing. This environment includes not only the architecture but a family of standards which are applied to carry out interfaces and to allow access and use of the full range of needed test software and information. The environment also includes libraries of reusable, proven practices and procedures. The environment would not impose or require a specific set of test hardware, but would allow reuse of software building blocks when hardware changes were needed.

Since this common software environment does not exist today, this is a long term strategy option. It must be considered in conjunction with one of the options earlier described.

C - 4.2 P3I/TECHNOLOGY CURRENCY:

This environment does not exist and would require significant R&D investment to develop. Once accomplished, the environment would incorporate a flexible architecture and set of updatable libraries to enhance movement with hardware technology over time.

R&D would be performed as purposeful continued investment to keep the environment current.

C - 4.3 DoD COMMONALITY:

DoD internal commonality in this approach is achieved through test software piece/library element reusability, standard interfaces, and standard architecture use. This allows maximum use of commercial test hardware capability. This approach assumes that test software and information costs are the largest portion and highest risk of the ATS cost elements today. This approach, would permit use of common hardware or commercial test hardware as desired.

C - 5. OPTION V: ADOPT A WEAPON SYSTEM, COMMERCIAL-BASED TEST APPROACH

C - 5.1 BASIC DEFINITION:

A DOD wide policy, strategy, and related investments for testability based on a weapon system engineering approach.

The ATS selection process will be structured to allow weapon system managers to select an optimum mix of new or current testers to meet system needs. Development of DOD peculiar ATS hardware and software will be pursued if acceptable commercial products or inventoried DOD testers are either not available or won't satisfy system requirements cost effectively. For austere environments, existing commercial hardware products will be repackaged for environmental protection, and peculiar designs will be developed only if repackaging is not advantageous.

C - 5.2 P3I/TECHNOLOGY CURRENCY:

Since this approach is based on use of commercial standards and products and since industry competition is fostering R&D and new technology faster than DoD, P3I/technology currency will be provided by advances in the marketplace. DoD will influence commercial advances by participating in key industry standardization efforts.

C - 5.3 DOD COMMONALITY:

No specific objective or central control to achieve DoD wide internal commonality is envisioned; commonality will be achieved by use of commercial industry products. Three levels of commonality are envisioned:

a. a family of commercial ATS to accommodate requirements common across multiple systems

b. compatibility of ATS software, hardware, and interfaces resulting from use of ATS commercial standards

c. use of common reuseable software components, commercial standard interfaces, and standard architecture (long term)

APPENDIX D. ATE COMPARISONS

This appendix includes four sets of Tables. Table D-1, D-2, and D-3 summarize and compare ATS specifications for the CASS and IFTE, CATS and METS, and the F-16 AIS and the IAIS. The structure of the tables are the same in each Therefore, due to specific ATS design differences some of the data fields may be blank. Since the row numbers correspond in each table, comparison between each of the testers is possible.

Table D-4 provides additional specification summaries for the F-16 Electro-Optics testing requirements as designed into the AIS and IAIS testers.

These ATE specifications were extracted from published documents for each system by Navy personnel at Naval Air Warfare Center, Lakehurst N.J. Subsequently, each manufacturer was asked to review the data and offer any corrections to the summaries needed to reflect current system specification baselines. GE ATE Department (recently acquired by Martin Marietta), Grumman, and GDE Systems (recently separated from GD) reviewed and corrected their respective specifications. Comments or revisions were not received from Lockheed Sanders for the CATS and from ESCO for the METS. The data reported herein reflects information received through March 19, 1993.

Contents of Appendix D

Table D-1. - Specification Summaries for CASS and IFTE

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
1	**STATION INFORMATION**			
2	Station Configurations:	Hybrid (Core) EO (Electro-Optical) CNI (Comm-Nav-Identif) RF (Radio Frequency) MTS (Missle Test System) (proposed) CPTS (portable) (proposed)	BSTF (Base Shop Test Facility)	Possible extensions based on current capability provided by Grumman
3	**SYSTEM CONTROL**			
4	OPERATING SYSTEM:			
5	operating environment	VAX/VMS	UNIX	UNIX
6	TPS software environment:			
7	ATLAS	Y	Y	Y
8	ADA	N	N	P^3I
9	**COMPUTER**			
10	Computer Type:	DEC uVAX-III - 3800/3900 Series	M68020 processor	SPARC 10
11	address/data bits	32	32	32
12	mips	4 to 5	2	86
13	clock speed (Mhz)	33	10	36
14	main memory - Mbytes	32	4	32
15	mass storage - Mbytes:			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
16	permanent	385 / 16 MBITS/sec	209	424
17	transfer rate	16 Mbits/sec		
18	removable	625 (optical disk)	600 (Optical disk)	600 (Optical disk)
19	transfer rate	2.25 Mbits/sec	>300K bytes/sec	> 2 Meg Bytes/sec
20	punched tape reader:	N	N	N
21	magnetic tape reader:	N	N	N
22	I/O ports:			
23	IEEE-802.3 Ethernet	Y (2)	Y (1)	Y (1)
24	RS-232	Y (4) (also RS-423 compatible)	Y (up to 5V levels)	Y (up to 5V levels)
25	IEEE-488	Y (2)	Y (4)	Y (4)
26	HP-IB (enhanced IEEE-488)	Y	Y (optional)	Y (optional)
27	SCSI	N	Y (1)	Y (1)
28	RS-422	Y		Y (optional)
29	RS-423	Y (see RS-232)	Y (4)	Y (4)
30	VME	N (Internal - no external conn)	Y (1)	Y (1)
31	VXI	N (installation in planning stages)	N	P^3I
32	Printer:	Y	Y	Y
33	characters/sec	240 char/sec - draft mode 80 char/sec - near letter quality 40 char/sec - letter quality	150 char/sec	150 char/sec

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
34	**OPERATOR INTERFACE**			
35	CRT:			
36	screen size	approx 14 inch diagonal	13 inch	14 inch
37	colors - number	monochrome	64	256
38	resolution	pixels 864 x 1024	pixels: 480 x 640	pixels 1152 x 900
39	type	electroluminescent		
40	Input Devices:			
41	keyboard	Y keys: 105	Y keys: 79	Y keys: 79
42	trackball	Y (RS-232-C port)	N	Y (optional)
43	mouse	N	N	Y (optional)
44	bar code reader	N	N	Y (optional)
45	touchscreen	N	Y	Y
46	hand-held terminal	N	N	N
47	**UUT/SYSTEM INTERFACE**			
48	I/O Pins:	Standard Patch Panel	Gold Dot	Gold Dot
49	quantity	1486 (total) (expandable)	3200	3200
50	volts/pin	up to 200 V (1500 V breakdown)	200 V	200 V
51	power paths	152	400	400
52	signal paths	1334	2800	2800
53	Feedthroughs:			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
54	low frequency:			
55	no. of pins	210		
56	max current	3 Amps		
57	frequency range	DC to 10 MHz		
58	power:			
59	no. of pins	76	68	68
60	max current	25 Amps	30A	30A
61	frequency range	DC to 1 kHz	DC - 5KHz	DC - 5KHz
62	Coax (RF):			
63	no. of pins	64		
64	max current	500 mA		
65	frequency range	DC to 2 GHz		
66	Digital Test Unit:			
67	no. of pins	448	224 (expandable to 480)	224 (expandable to 480)
68	no. of channels	336 (expandable to 432)	14	14
69	data rate	0 to 20 Mb/sec, 40 Mb/sec interleaved	50MBits/sec	50MBits/sec
70	logic levels	-5.0 to +15.0 V	Programmable; -30 to +30v	Programmable; -30 to +30v
71	compatibility:	TTL/CMOS/ECL/DCL/DTL/RTL/ HTL/MOS/CMS	TTL, CMOS, ECL, analog, etc.	TTL, CMOS, ECL, analog, etc.
72	Switching:			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
73	low frequency switch:			
74	no. of pins	420	130 univ., 144EP, 32 Form C = 306	130 univ., 144EP, 32 Form C = 306
75	max current	1 Amp	1A	1A
76	relay matrices:	42 1X4 and 70 1X2	Qty. 32, 1X2	Qty. 32, 1X2
77	frequency range	DC to 1 MHz	DC to 100 MHz	DC to 100 MHz
78	coax switch:			
79	no. of pins	192	13	13
80	relay matrices :	33 each 1X4 9 each 1X2	1 each 4X9	1 each 4X9
81	frequency range	DC to 1 GHz	DC to 22 GHz to 10 Watts	DC to 22 GHz to 10 Watts
82	power switch:			
83	no. of pins	76	36	36
84	relay matrices:	5 1X4 (high current @ 18.75 amps) 1 1x2 (high current - 18.75 amps) 2 1X2 (ganged high current - 18.75 amps) 6 1X2 (low current - 9 amps) DC to 1 kHz DC to 1kHz	Qty 12, 1x3	Qty 12, 1x3
85	Universal I/O:			
86	number of pins		130	130
87	number of instrument ports		48	48
88	maximum current		1 Amp (at 28VDC)	1 Amp (at 28VDC)

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
89	frequency range		DC to 40 MHz, +/- 3db	DC to 40 MHz, +/- 3db
90	Extended Performance I/O:			
91	number of pins		144	144
92	number of instrument ports		48	48
93	maximum current		1 Amp (at 28VDC)	1 Amp (at 28VDC)
94	frequency range		DC to 100 MHz, +/- 3db	DC to 100 MHz, +/- 3db
95	Digital/Analog Converters:			
96	quantity		8	8
97	voltage		-10V to +10V	-10V to +10V
98	max current		100 mA	100 mA
99	resolution		12 bits	12 bits
100	sampling rate			
101	synchro-resolver channel		1	1
102	**BUSSES**			
103	Number of Channels		2	2
104	Protocols Available:			
105	MIL-STD-1553 A/B	2 (expandable to 6)	Y	Y
106	MIL-STD-1773	2	N	Yes with transceiver
107	MIL-STD-1397A	2	N	*
108	EIA RS-232-C	2	Y	Y

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
109	EIA RS-422-A	2	N	Y
110	RS-485	Y	N	Y
111	AR-57A	Y	N	*
112	IEEE-488	Y	Y	Y
113	IEEE-802.3 (ethernet)	Y	Y	Y
114	Arinc-429	Y	N	*
115	H009	N	N	Y
116	F-16 AIS (Manchester)	Y	N	Y
117	PSP-RC	N	N	*
118	1750A processor bus	N	N	Y
119	8088 microprocessor bus	N	N	Y
120	80x86 microprocessor bus	N	N	Y
121	UART	N	N	Y
122	AIM-9 interface	N		*
123	HSDB (high speed data bus)	Y		Y
124	FODB (fiber optic data bus)	Y		N
125	RTDB	N		Y
126	MWG	N		*
127	EMC	N		
128	ASPJ jam bus	N		*

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
129	ASPJ status bus	N		*
130	MCAIR 3818A	2		
131	Frequency range:		DC to 70 MHz -10 to +10 volts p-p	DC to 1 MHz -10 to +10 volts p-p
132	**VIDEO**			
133	Video Signal Generation:			
134	horizontal timing		.01 to 1000 msec	.01 to 1000 msec
135	horizontal resolution		0.00005 msec	0.00005 msec
136	vertical timing		2 to 4096 horiz half-lines	2 to 4096 horiz half-lines
137	vertical timing resolution		1 half-line	1 half-line
138	synch format		All Video Formats, Comp, Separate, etc.	All Video Formats, Comp, Separate, etc.
139	video data			
140	video output modes:			
141	output 1		0 to 4 V (pp) with 20 MHz BW	0 to 4 V (pp) with 20 MHz
142	output 2		Y, 20 MHz	Y, 20 MHz
143	output 3		Y, 20 MHz	Y, 20 MHz
144	output 4		N	if needed
145	output 5		N	if needed
146	output 6		N	if needed

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
147	output 7			if needed
148			Display Analyzer	Display Analyzer
149	Display Measurement:		• Composite Image Acquisition	• Composite Image Acquisition
150	placement		- Full Frame Aquisition	- Full Frame Aquisition
151			- Pixel Resolution = 4 bits	- Pixel Resolution = 4 bits
152	resolution		- Max. Pixel/Line = 2048	- Max. Pixel/Line = 2048
153	intensity		- Max. Digitizing Rate = 40MHz	- Max. Digitizing Rate = 40MHz
154	intensity variation		- Digitizing Accuracy = +/- 1/4 LSB	- Digitizing Accuracy = +/- 1/4 LSB
155	Field Of View		- Auto Lock on Video Line Frequency Between 4.5KHz - 45KHz	- Auto Lock on Video Line Frequency Between 4.5KHz - 45KHz
156	modulation transfer function		- Software Target Image Display	- Software Target Image Display
157			• Raster/Stroke Image Acquisition - Captures Rectilinear Raster, Polar Raster and Stroke Video" - Normalized Image Written into X-Y-Z Array of 256 x 256 x 1 - Max. Digitizing Rate = 20 MHz - Digitizing Accuracy: +/- 1 LSB for X and Y +/- 1/8 LSB for	• Raster/Stroke Image Acquisition - Captures Rectilinear Raster, Polar Raster and Stroke Video" - Normalized Image Written into X-Y-Z Array of 256 x 256 x 16 - Max. Digitizing Rate = 20MHz - Digitizing Accuracy: +/- 1 LSB for X and Y +/- 1/8 LSB for
158	DIGITAL TESTING			
159	Pattern Rate - Patterns/Sec			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
160	test rates:	see digital test unit section		
161	minimum	see digital test unit section	static	static
162	maximum	see digital test unit section	50 million patterns/sec	50 million patterns/sec
163	I/O pins	see digital test unit section	192 (expandable to 480)	192 (expandable to 480)
164	memory depth / pin	16 kbits/pin	4 Kbits/pin (16 Kbits/pin @ 20-50MHz)	4 Kbits/pin (16 Kbits/pin @ 20-50MHz)
165	EEPROM programming pulse	N	Y	Y
166	Digital Test Unit:			
167	Bit Rate	0 to 20 MHz; to 40 MHz interleaved	0 to 50 MHz	0 to 50 MHz
168	pin interface	336 (168 in interleaved mode)	192 to 20MHz, 48 to 50MHZ	192 to 20MHz, 48 to 50MHZ
169	voltage ranges	-5 to +15 V	-10 to +10v (+/-30v @ 0-10MHz)	-10 to +10v (+/-30v @ 0-10MHz)
170	clock speed	16 kHz to 20 MHz	50 MHz	50 MHz
171	Diagnostic Probe: (digital)			
172	voltage range	-5 v to +15 v	-30 v to +30 v	-30 v to +30 v
173	input data rate (max)	20 MHz	50 MHz	50 MHz
174	resolution	10 mV	4.88 millivolts	4.88 millivolts
175	compatibility	TTL/CMOS/ECL/discrete	TTL, CMOS, ECL, Analog, etc.	TTL, CMOS, ECL, Analog, etc.
176	propagation delay	50 nsec maximum		
177	logic threshold	-4.00 V to +10.24 V	-30v to +30v	-30v to +30v
178	pulse detection	20 nsec	20 ns, min.	20 ns, min.

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
179	input impedance	500 kohms in parallel with 20 pF	10 M ohm	10 M ohm
180	output impedance		22 ohm	22 ohm
181	Timing Generation:			
182	frequency range	16 kHz to 20 MHz	11 MHz -220 MHz	11 MHz -220 MHz
183	pulse width range	25 nsec to 62.5 usec	2.27ns - 45.45ns	2.27ns - 45.45ns
184	Time Interval Measurement:	available using frequency/time interval counter or		
185	period	waveform digitizer	Y	Y
186	pulse characteristics		Y	Y
187	range		100ns to 10,000 sec.	100ns to 10,000 sec.
188	ANALOG SWITCHING			
189				
190	number signal paths	see switching section	30 Univ.,144 EP, 32 Form C = 306	130 Univ.,144 EP, 32 Form C = 306
191	bandwidth at voltage		100 MHz, +/- 3db	100 MHz, +/- 3db
192	LOADS			
193	Programmable Loads:	1 to 5000 ohms +/- 5%	8	8
194	max power dissipation	500 Watts	Max 3000w Total = 750w, 300w, 300w, 750w, 750w, 750w, 750w, 750w	Max 3000w Total = 750w, 300w, 300w, 750w, 750w, 750w, 750w, 750w
195	max voltage	500 Volts	50v, 50v, 50v, 50v, 130v, 130v, 130v, 250v	50v, 50v, 50v, 50v, 130v, 130v, 130v, 250v

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
196	max current	20 amps +/- 100mA	30, 15A, 15A, 30A, 15A, 15A, 15A, 5A	30, 15A, 15A, 30A, 15A, 15A, 15A, 5A
197	Programmable Precision Resistor:			
198	range			
199	accuracy	+/- 0.25 %		
200	Fixed Resistance:	see calibration signals section		
201	quantity		10	10
202	values		50 ohm (qty2), 75 ohm (qty2), 100 ohm (qty 2), 500 ohm (qty2),1000 ohm (qty 2)"	50 ohm (qty2), 75 ohm (qty2), 100 ohm (qty2), 500 ohm (qty2), 1000 ohm (qty2)"
203	ANALOG STIMULI			
204	Arb Funct/Wave Gen:			
205	channels	2	4	4
206	amplitude	-5 V to +5 V	50 mv to 10v p-p	50 mv to 10v p-p
207	amplitude resolution	0.5% (ch A); 0.03%(ch B)	0.50%	0.50%
208	sine waveform	Y	Y	Y
209	square waveform	Y	Y	Y
210	pulsed DC waveform	Y	Y	Y
211	ramp waveform	Y	Y	Y
212	arbitrary waveform	Y	Y	Y
213	DC level waveform	Y (using arbitrary waveform)	Y	Y

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
214	triangle waveform	Y	Y	Y
215	haversine	Y (using arbitrary waveform)		Y
216	random noise	Y (using arbitrary waveform)		Y
217	(sin x)/x	Y (using arbitrary waveform)		Y
218	frequency ranges:			
219	pulsed DC and square wave	0.01 Hz to 25 MHz	0.005Hz to 25 MHz	0.005Hz to 25 MHz
220	sine wave	0.01 Hz to 25 MHz	0.02Hz to 2 MHz	0.02Hz to 2 MHz
221	triangle and sawtooth wave	0.01 Hz to 25 MHz	0.2 MHz to 2 MHz	0.2 MHz to 2 MHz
222	arbitrary wave	48 Hz to 200 MHz clock rate	0.006 to 12.5 MHz	0.006 to 12.5 MHz
223	resolution:	10 mV to 80 mV	20 nsec	20 nsec
224	pulsed DC and square wave	0.1% of frequency	20 nsec	20 nsec
225	sine wave	0.008 Hz to 0.1 Hz	20 nsec	20 nsec
226	ramp wave	0.1% of frequency	20 nsec	20 nsec
227	arbitrary wave	0.1% of freq	20 nsec	20 nsec
228	point generation for arb wave	5 nsec maximum	20 nsec	20 nsec
229	max. point generation rate	200 Mpoints/sec	50 Million/sec.	50 Million/sec.
230	available modes of operation	TACAN, ILS, VOR	Continuous, burst, triggered(int/ext)	Continuous, burst, triggered(int/ext)
231	dual phase mode	Y	Y	Y
232	Discrete Generator:			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
233	Pulse Generator:			
234	quantity	2	4	4
235	period range	4 nsec to 99.9 msec	40 nsec to 20 sec	40 nsec to 20 sec
236	pulse width	2 nsec to 89.9 sec	20 nsec to 39.995 nsec	20 nsec to 39.995 nsec
237	accuracy	+/-5%	+/-(.001% of programmed value)	+/-(.001% of programmed value)
238	amplitude	-5V to +5V	50 mv to 10 v	50 mv to 10 v
239	delay	0 to 89.9 msec	10.0 nsec to 19.995 sec.	10.0 nsec to 19.995 sec.
240	double pulse	6 nsec to 89.9 msec		
241	pulse burst count	1 to 9999		
242	Counter/Timer Stimulus:	Available via Arbitrary Waveform Generator or RF Synthesizer or Synchro Generation		
243	voltage levels		50 mv to 100 v	50 mv to 100 v
244	frequency range		0.005 Hz to 100 MHz	0.005 Hz to 100 MHz
245	duty cycle		0.1% to 99.9%	0.1% to 99.9%
246	time delays		100 nsec to 10,000 sec.	100 nsec to 10,000 sec.
247	resolution of delay		10 nsec	10 nsec
248	accuracy of delay		.001%	.001%
249	pulse width		20 nsec to 39.995 sec.	20 nsec to 39.995 sec.
250	resolution of pulse width		20 nsec	20 nsec
251	accuracy of pulse width		+/-(0.001% of programmed value)	+/-(0.001% of programmed value)

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
252	digital to synchro generation			
253	voltage level		11.8/90 Vrms	11.8/90 Vrms
254	accuracy		0.12 degree no load/0.36 degrees full load 0.02 degree @ 60 Hz/0.01 degree @ 400-1KHz	0.12 degree no load/0.36 degrees full load 0.02 degree @ 60 Hz/0.01 degree @ 400-1KHz
255	power		1.5 VA	1.5 VA
256	Synchro Generation:			
257	quantity	3	1	1
258	angular range	0 to 360 degree	0 to 359.98 degrees	0 to 359.98 degrees
259	resolution	0.01 degree	0.02 degree @ 60 Hz/0.01 degree @ 400-1KHz	0.02 degree @ 60 Hz/0.01 degree @ 400-1KHz
260	angular rate	-100 to +100 deg/sec	140 degrees/Sec Max	140 degrees/Sec Max
261	index ref position		0 degrees	0 degrees
262	reference voltage	115 Vrms or 26 Vrms	26/115 Vrms	26/115 Vrms
263	voltage (synchro)	11.8 Vrms, 26 Vrms, or 90 Vrms	11.8/90 Vrms	11.8/90 Vrms
264	reference frequency	47 Hz to 1 kHz	60 Hz - 1 KHz	60 Hz - 1 KHz
265	frequency range	47 Hz to 1 kHz	60 Hz - 1 KHz	60 Hz - 1 KHz
266	Function Generator:	available via arbitrary waveform generator		
267	quantity		4	4
268	amplitude		50 mv to 10 Vp-p	50 mv to 10 Vp-p

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
269	slew rate		500,000 V/msec	500,000 V/msec
270	rise time		< 50 nsec or < 5.0 c (exp -11) ms	< 50 nsec or < 5.0 c (exp -11) ms
271	waveforms available:			
272	sine wave		Y	Y
273	square wave		Y	Y
274	ramp (sawtooth) wave		Y	Y
275	triangle		Y	Y
276	pulse		Y	Y
277	frequency range		0.02 Hz to 25 MHz	0.02 Hz to 25 MHz
278	arbitrary function		4096 points	4096 points
279	special capabilities		(Int, Burst Mode, Triggered (Int/ Ext), dual phase mode	(Int, Burst Mode, Triggered (Int/ Ext), dual phase mode
280	Square Wave Output:	available via arbitrary waveform generator or pulse generator		
281	frequency range		.005 Hz to 25 MHz	.005 Hz to 25 MHz
282	frequency accuracy		+/- 0.001% PV	+/- 0.001% PV
283	frequency resolution		.005 Hz	.005 Hz
284	phase shift range		+/- 180 degrees	+/- 180 degrees
285	duty cycle		0.1% to 99.9%	0.1% to 99.9%
286	amplitude		50 mv to 10 Vp-p	50 mv to 10 Vp-p
287	AC Line of Sight Seeker (Loss):			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
288	amplitude			
289	phase			
290	frequency			
291	**ANALOG MEASUREMENT**			
292	Digital Multi-Meter:			
293	DC range	0 to 1000 V (200 V direct, up to 1000 V w/ probe)	0.1V to 200V	0.1V to 200V
294	DC resolution	1 uV to 100 mV (range dependent)	1 uV to 10mV (range dependent)	1 uV to 10mV (range dependent)
295	AC range	0 to 700 Vrms (200 V direct, up to 700 V w/ probe)	0.1 V to 300V	0.1 V to 300V
296	AC resolution	1 uV to 100 mV (range dependent)	1 uV to 10mV (range dependent)	1 uV to 10mV (range dependent)
297	current range	0 to 2 A DC or AC		
298	current resolution	100 pA to 100 uA DC / 10nA to 100uA AC (range dependent)		
299	resistance range	0 to 30 Mohm	1 ohm to 10 Mohm	1 ohm to 10 Mohm
300	AC Voltage Ratio	calculated		
301	DC Voltage Ratio	calculated		
302	Frequency/Time Interval Counter:			
303	frequency range	0.001 Hz to 200 MHz	DC to 100MHz	DC to 100MHz
304	time interval range	4 nsec to 15000 sec	100nsec to 10E3 sec	100nsec to 10E3 sec

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
305	input voltage range	100 mVpp to 10 Vpp	100 mV to 200 V (1 Meg Ohm input impedance)	100 mV to 200 V (1 Meg Ohm input impedance)
306	count events	0 to 10E12-1	100 mV to 7 V (50 Ohm input impeddance)	100 mV to 7 V (50 Ohm input impeddance)
307	Microwave Counter:	Y		N
308	Frequency Response Analyzer	available via microwave transition analyzer or spectrum analyzer		Y
309	Vector Voltmeter:	available via microwave transition analyzer		Y (option)
310	Sampling Signal Analyzer:	available via microwave transition analyzer		
311	resolution			12 bits
312	rate			to 100MHz
313	resolution			10 nsec
314	Waveform Digitizer:			
315	channels	4	2	2
316	input voltage range	+/- 4 mV to +/- 200 V (1 Mohm/50 ohm) 450V with external probe	+/- 100mV to +/- 100V	+/- 100mV to +/- 100V
317	frequency response	DC to 500 MHz	DC to 50MHz	DC to 50MHz
318	amplitude resolution	8 bits (10 bits averaging) (+/- 0.1%)	12 bits up to 2MHz, 8 bits up to 100MHz	12 bits up to 2MHz, 8 bits up to 100MHz
319	sampling interval	25 usec to 50 sec (2 nsec interleaved resolution, real time 50 nsec)	10nsec to 42.9 sec (10 nsec inter-vals)	10nsec to 42.9 sec (10 nsec intervals)

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
320	storage depth	1024 points/channel	1001 samples (max)	4096 Samples, Max
321	sampling/conversion rate	30 Hz to 20 MHz	50MHz BW	50MHz BW
322	Synchro-Resolver:	3		
323	angular range	0 to 360 degrees	0 to 359.98 degrees	0 to 359.98 degrees
324	resolution	0.00035 degree (fine/36X)	0.02 degrees @ 60Hz/0.01 degrees @ 400-1KHz	0.02 degrees @ 60Hz/0.01 degrees @ 400-1KHz
325	angular rate (max)	720 deg/sec	140 degrees/sec 110 deg/sec @ 60 Hz	140 degrees/sec
326	reference voltage	10 to 130 Vrms	10 to 100 Vrms	10 to 100 Vrms
327	*voltage (synchro)*	11.8 Vrms, 26 Vrms or 90 Vrms		
328	reference frequency	47 Hz to 1 KHz	47 Hz to 1 KHz	47 Hz to 1 KHz
329	accuracy	+/- 0.005 deg	+/- 0.1 degrees	+/- 0.1 degrees
330	resolution		0.02 degrees @ 60Hz/0.01 degrees @ 400Hz-1KHz	0.02 degrees @ 60Hz/0.01 degrees @ 400Hz-1KHz
331	frequency range	47 Hz to 1 kHz	60Hz - 1KHz	60Hz - 1KHz
332	index reference position		0 degrees	0 degrees
333	Oscilloscope:	available via waveform digitizer		Option
334	traces			
335	bandwidth			
336	**DC POWER**			
337	PROGRAMMABLE:			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
338	Low Voltage:	0-32V(8);0-100V(1); 0-450V(2)	0-7V(2); 0-16V(2); 0-36V(1) **	0-7V(2); 0-16V(2); 0-36V(1) **
339	quantity	11 (expandable)	12	12
340	max. watts per supply	900 Watts	150	150
341	max. voltage	450 V	7V; 16V; 36V	7V; 16V; 36V
342	max. current	25 A 32 V @ 125 A when in parallel)	20.5A; 9.1A, 4.1A	20.5A; 9.1A, 4.1A
343	High Voltage:		0.55V(2); 0-100V(1); 0-200V(4) **	0.55V(2); 0-100V(1); 0-200V(4) **
344	quantity		0	0
345	voltage range		0-55V; 0-100V; 0-200V	0-55V; 0-100V; 0-200V
346	max. current		2.5A; 15A; 0.75A	2.5A; 15A; 0.75A
347	Current Source:	see calibration signals section		
348	unit 1: amplitude		0-20.5A(2); 0-9.1A(2); 0-4.1A(2)	0-20.5A(2); 0-9.1A(2); 0-4.1A(2)
349	resolution		10mA; 10mA; 10mA	10mA; 10mA; 10mA
350	unit 2-6: amplitude		0-2.5A(2); 0-1.5A(2); 0-0.75A(2)	0-2.5A(2); 0-1.5A(2); 0-0.75A(2)
351	resolution		10mA; 10mA; 10mA	10mA; 10mA; 10mA
352	FIXED:	0		
353	quantity		1	1
354	volts		28 VDC	28 VDC
355	amperes		22.5 A	22.5 A
356	watts		630 Watts	630 Watts

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
357	REFERENCE:	see calibration signals section		
358	quantity		8	8
359	voltage range		+10 V to -10 V	+10 V to -10 V
360	current		100 mA	100 mA
361	AC POWER			
362	PROGRAMMABLE:			
363	number of phases	1, 2 or 3	1, 2, and 3	1, 2, and 3
364	frequency	55 to 1200 Hz	45-5000 Hz	45-5000 Hz
365	voltage	1 to 135 Vrms	0 - 270 Vrms	0 - 270 Vrms
366	current	5 amps	10 A	10 A
367	power	675 Watts	2250VA cont, 4500VA Max	2250VA cont, 4500VA Max
368	FIXED:			
369	Facility Power Feed-Through:	115/200 V, 400 Hz, 3 ph (DOD-STD-1399B) 0 to 30 amps/phase	115V, 60Hz,1 phase	115V, 60Hz,1 phase
370	Pulsed Signal:			
371	Stimulus Power for UUTs:	available via facility power or from power supplies	Dc to 22GHz to 10 watts	Dc to 22GHz to 10 watts
372	RF STIMULI			
373	SYNTHESIZERS			
374	Synthesizer 1:		2 identical synths available	2 identical synths available

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
375	frequency range	10 MHz to 40 GHz	10 KHz to 1.3 GHz	10 KHz to 1.3 GHz
376	frequency resolution	0.4 Hz	1 Hz	1 Hz
377	power range:			
378	w/o amplifier	+10 dBm to -100 dBm if < 2.3GHZ, 0 dBm to -100 dBm if > 2.3GHZ	+17 dBm to -120 dBm	+17 dBm to -120 dBm
379	w/ amplifier		+38 dBm to -50 dBm	+38 dBm to -50 dBm
380	PM:			
381	on/off ratio	80 dB	>or = 55 dB	> or = to 55 dB
382	rise/fall time	50 nsec	<or = 400 nsec	< or = to 400 nsec
383	min. pulse width	1 usec	2 usec	2 usec
384	max. frequency	5 MHz	100 KHz	100 KHz
385	pulse on pulse modulation			
386	AM:			
387	frequency rate		DC-100KHz	DC-100KHz
388	modulation depth		0 to 99.9%	0 to 99.9%
389	FM:			
390	frequency rate	100 kHz to 10 MHz	20Hz-200KHz	20Hz-200KHz
391	Phase Modulation:			
392	frequency rate		20Hz - 15 KHz	20Hz - 15 KHz
393	deviation		0 to 300 deg	0 to 300 deg

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
394	IFF :			
395	frequency rate		100KHz Max	100KHz Max
396	CW:		Y	Y
397	Synthesizer 2:	High Power Synthesizer		
398	frequency range	3 MHz to 20 GHz	50 MHz to 22 GHz	50 MHz to 22 GHz
399	power range:			
400	w/o amplifier	+18 dBm to -100 dBm	-3 dBm to -100 dBm	-3 dBm to -100 dBm
401	w/ amplifier		+35 dBm to -50 dBm	+35 dBm to -50 dBm
402	PM:			
403	on/off ratio	80 dB	> or = 50dB	> or = 50dB
404	rise/fall time	50 nsec	<25 nsec	<25 nsec
405	min. pulse width	1 usec	100 Nsec	100 Nsec
406	max. frequency	5 MHz	50 KHz	50 KHz
407	AM:			
408	frequency rate	DC to 100 kHz	0-20Khz	0-20Khz
409	modulation depth	90% (20 dB) or 99.7% (50 dB) above 10 Hz	0 to 90 %	0 to 90 %
410	FM:			
411	max rate	100 kHz to 10 MHz		
412	Fast Switching Synthesizer:			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
413	frequency range	10 MHz to 18.4 GHz		1 - 2300MHz
414	power range	+9 dBm to -100 dBm		0 to -121 dBm
415	frequency switching time	1 usec		< 1 Msec
416	FM:			
417	rate	DC to 5 MHz		
418	deviation	1 MHz to 120 MHz (freq dependent)		
419	AM:			
420	rate			
421	depth			
422	Spread Spectrum Modulator/ Demodulator		Available via Virtual Microwave System (VMS) modification to IFTE	Available via Virtual Microwave System (VMS) modification to IFTE
423	Modulation Signals:			
424	high accuracy AM	Y		Y
425	(ILS and VOR)	Y		Y
426	TACAN	Y		Y
427	linear pulse	Y	Y	Y
428	FSK	Y	Y	Y
429	MSK	Y	Y	Y
430	BPSK	Y	Y	Y
431	QPSK	Y	Y	Y

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
432	OQPSK (GPS)	Y	Y	Y
433	Broadband Noise Source:			(Option)
434	frequency range	10 MHz to 26.5 GHz 12 to 17 dB (10 MHz to 12 GHz 14 to 17 dB (12 GHz to 26.5 G		10MHz - 26.5GHz
435	excess noise ratio			12 - 17dB
436	Phase Noise:			
437	pulsed		Y	Y
438	continuous wave (CW)		Y	Y
439	bandwidth		5 Hz to 18.1 Ghz	10MHz - 18GHz, 10Hz - 10MHz RF Freq Range Offset
440	Stabilized Local Oscillator:		10 MHz (+/- .02Hz)	10 MHz (+/- .02Hz)
441	**RF MEASUREMENT**			
442	Spectrum Analyzer 1:			
443	frequency range	100 Hz to 22 GHz	100Hz to 22GHz	100Hz to 22GHz
444	with ext. mixers	18 GHz to 220 GHz		22GHz to 100GHz
445	resolution bandwidth	10 Hz to 3 MHz	10Hz to 3MHz	10Hz to 3MHz
446	video bandwidth	3 Hz to 3 MHz	3Hz to 3MHz	3Hz to 3MHz
447	input amplitude:			
448	log	+30 dBm to -140 dBm	-100 to 40dBm	-100 to 40dBm
449	linear	7.07 V to 22 nV	0 to 22.4V	0 to 22.4V

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
450	Spectrum Analyzer 2:			(Option) FFT
451	frequency range			64MHz - 100KHz
452	with ext. mixers			
453	resolution bandwidth			25.6MHz - 12.5KHz
454	video bandwidth			25.6MHz - 12.5KHz
455	input amplitude:			
456	log			3.99mVp - 31.7Vp
457	linear			3.99mVp - 31.7p
458	Detection:			
459	Pulse	Y	Y	Y
460	AM	Y	Y	Y
461	FM	Y	Y	Y
462	Attenuation (dB)	Y	0 to 100dB in 10dB steps	0 to 100dB in 10dB steps
463	Millivolt Meter:			
464	voltage range	Y	200uV to 3Volts	200uV to 3Volts
465	bandwidth		Up to 1.2Ghz	Up to 1.2Ghz
466	Power bandwidth (MHZ)	Y	100Hz to 22GHz	100Hz to 22GHz
467	RF Power Meter:			
468	power range	-70 dBm to +44 dBm (sensor dependent)	-70 to +40dBm	-70 to +40dBm

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
469	frequency range	100 kHz to 50 GHz (sensor dependent)	8MHz - 22GHz	8MHz - 22GHz
470	CW Power Meter:			
471	power range	-70 dBm to +44 dBm (sensor dependent)	-70 to +40dBm	-70 to +40dBm
472	frequency range	100 kHz to 50 GHz (sensor dependent)	8MHz to 22GHz	8MHz to 22GHz
473	Noise Figure Meter:			(Option)
474	noise figure range			0 to 30dB
475	noise figure resolution			+/- 0.1dB
476	frequency range			10MHz to 22GHz
477	frequency resolution			1Hz
478	Carrier Noise Tester:			Option
479	frequency range			10MHz to 18GHz
480	amplitude			-15dBm to 20dBm
481	IF output bandwidth			5 to 1200MHz
482	IF output level			+7dBm
483	Sampling Signal Analyzer:	aka Microwave Transition Anlyzer		
484	SWR meas. range	10 MHz to 26.5 GHz ratio calculation		45MHz - 26GHz
485	vector voltmeter:			
486	frequency range	10 Hz to 1 GHz		45MHz - 26GHz

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
487	phase range	-180 deg to +180 deg		0 to 360 degrees
488	peak power meter:			
489	frequency range	30 kHz to 26.5 GHz		100Hz - 22GHz
490	power range	-60 dBm to 0 dBm		-100 to +40dBm
491	Vector Network Analyzer:			(Option)
492	Network Analysis:			
493	frequency range	10 MHz to 26.5 GHz	Y	Y
494	time	Y (pulse rise, fall, period, etc.)	Y	Y
495	bandwdith		45Mhz to 26.5 Ghz	45Mhz to 26.5 Ghz
496	max input	0 dBm		+14dBm
497	noise level	-44 dBm		-115dBm
498	(complex/fundamental signal measurement)			801, 4 S-parameters
499	IF bandwidth			20MHz
500	sweep time			100ns to 4000 sec
501	Frequency Counter/ Measurement:			
502	frequency counter:	see spectrum analyzer		
503	frequency range	and spread spectrum sections	100Hz to 22GHz	100Hz to 22GHz
504	accuracy		.00000025% (at 22GHz)	.00000025% (at 22GHz)
505	resolution		1Hz	1Hz

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
506	RF pulse width		100ns to CW	100ns to CW
507	RF power level		-100 to +40dBm	-100 to +40dBm
508	sensitivity		-100dBm	-100dBm
509	input power range		-100 to +40dBm	-100 to +40dBm
510	Modulation Evaluation:	see spectrum analyzer section		
511	Pulse Modulation:			
512	frequency range		100Hz - 22GHz	100Hz - 22GHz
513	pulse width		100ns to CW	100ns to CW
514	rise/fall time		10 nsec	10 nsec
515	dynamic range		100dB	100dB
516	sensitivity		-100dBm	-100dBm
517	PRF			
518	Amplitude Modulation:			
519	frequency range		100Hz - 22GHz	100Hz - 22GHz
520	modulation, frequency		0 - 20MHz	0 - 20MHz
521	sensitivity, valley		-100dBm	-100dBm
522	accuracy		+/- 0.5dB	+/- 0.5dB
523	Frequency Modulation			
524	frequency range		100Hz - 22GHz	100Hz - 22GHz
525	modulation frequency		0-20MHz	0-20MHz

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
526	distortion		100Hz - 22GHz	100Hz - 22GHz
527	spectrum		0 - 20MHz	0 - 20MHz
528	RF Input Characteristics:			
529	frequency range		100Hz - 22GHz	100Hz - 22GHz
530	input power		-100 to +40dBm	-100 to +40dBm
531	impedance		50 Ohm	50 Ohm
532	VSWR		1.3:1	1.3:1
533	**SPREAD SPECTRUM**	(CNI only)	Available via Virtual Microwave System (VMS) modification to IFTE	Available via Virtual Microwave System (VMS) modification to IFTE
534	Frequency range (Mhz)	10 MHz to 2 GHz	1 to 2300	1 to 2300
535	Hop rate (hops/sec)	100,000 hops/sec	0 to 100,000	0 to 100,000
536	Code rate (chips/sec)	10.23 MHz (GPS codes) 10.00 MHz (other codes)	DC to 20 Mega	DC to 20 Mega
537	Modulation / Demodulation:			
538	amplitude modulation (AM)	Y	Y	Y
539	precision AM	Y	Y	Y
540	pulse modulation (PM)	Y	Y	Y
541	pulse on pulse modulation		N	N
542	frequency modulation (FM)	Y	Y	Y
543	wideband FM	Y	Y	Y

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
544	narrowband FM	Y	Y	Y
545	frequency-shift keying (FSK)	Y	Y	Y
546	binary phase shift keying (BPSK)	Y (demodulator only)	Y	Y
547	continuous phase shift modulation (CPSM)		Y	Y
548	quadrature phase shift keying (QPSK)	N	Y	Y
549	offset quadrature phase shift keying (OQPSK)	N	Y	Y
550	Modulo-2	Y	Y	Y
551	JTIDS:	Y		
552	TACAN	Y	Y	Y
553	VOR	Y	Y	Y
554	ILS	Y	Y	Y
555	MSK	Y	Y	Y
556	GPS	Y	Y	Y
557	OPTICAL TESTING			
558	LASER			
559	Transmitter:			
560	aperture	0.5 to 5.0 inches		0.5 inch to 5.0 inch diameter

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
561	field of view	20 to 500 mrad in a 30 deg circular field		30 degrees Circular, Max
562	Pulse Repetition Frequency (PRF)	single shot, 8 to 20 Hz		8 - 20Hz
563	Divergence	200 to 820 uradians		200 to 820 Mrads
564	Range (kM)			250 to 12.5Km
565	resolution (meters)			50 Meters
566	energy input	30 to 300 mJoules		30 - 300 mjoules
567	power density (measurement)			40 m (exp w)/CM (exp 2)
568	power density (stimulus)	40 MW/cm2		0.5 x 10 (exp -10) to 0.5 x 10 (exp -6) w/cm
569	Wavelength	1.064 +/-0.01 um (0.53, 10.6, 1.54 growth)		1.064 micro meters (0.53, 10.6, 1.54 Growth)
570	Spectral Bandwidth			See wave length
571	Angle of regard	0 to 10 mradians (relative to TPS ref mirror)		1 - 10 mrad
572	Polarization	insensitive to polarization		Unpolarized to Linear Polarized, any angle
573	beam alignment range	0 to 10 mradians		1 - 10 mrad
574	Receiver:			
575	sensitivity ranges	5E-10 to 5E-6 W/cm2		0.5 x 10 (exp -10) to 5 x 10 (exp -6) w/cm (exp 2)

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
576	range gate	0.5 to 10 km		250 to 12.5KM
577	Field-Of-View (FOV):	20 to 500 mradians		20 to 500 mrads
578	apertures	0.5 to 5 inches in diameter		0.5 inch to 5.0 inch diameter
579	FOV coincidence	+/-10 mradians to +/-400 mradians		+/- 100 to +/- 400 mrad
580	coaxial	+/-100 uradians to +/- 10 mradians		+/- 100 to +/- 400 mrad
581	wavelength	1.064 um +/- 0.01 um		1.064 micro meters +/- 0.01 micro meters
582	acceptance PRF	single shot, 8 to 20 Hz		Single shot, 8Hz to 20Hz
583	fiber optic types			
584	separate aperture on coaxial	Y		
585	Tracker:			
586	sensitivity ranges	5E-10 to 5E-6 W/sqcm		5 x 10 (exp -10) to 5 x 10 (exp -6) w/cm (exp 2)
587	range gate	0.5 to 10 km		250 to 12.5Km
588	Field-Of-View (FOV):	30 deg circular maximum		30 degrees circular max
589	apertures	0.5 to 5 inches in diameter		0.5 inch to 5.0 inch diameter
590	coaxial			
591	wavelength	1.064 um +/- 0.01 um		1.064 micro meters +/- 0.01 micro meters (0.53, 10.6, 1.54 Growth)
592	acceptance PRF	single shot, 8 to 20 Hz		Single shot, 8Hz to 20Hz

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
593	**INFRARED**			
594	Number of targets	6		4 square, lcorner, 4 4-bar
595	Range (degrees C)	-10 to +40 deg C		-10 degrees to 40 degrees C
596	Resolution (degress C)			0.01
597	Aperture	10 in (max)		10 inch max
598	Field of View (max)	30 by 40 Degrees		30 degrees x 40 degrees max
599	Field of View (min)			0.5 degrees x 0.5 degrees max
600	Source Spacial Freq.	0.2 to 5.0 cycles/mradian		0.2 to 5.0 c/mrad
601	Spectral Bands	7 to 12 um		7 to 12 micro meters
602	Video Output	RS343, RS170, A6DRS, raw video		RS - 343, RS -170, A6DRS, Raw Video
603	Source temperature	280 to 340 deg K		280 to 340K
604	**VISUAL**			
605	Number of targets			4 square, 1 corner, 1 USAF Res.
606	Size	1 by 1 inch maximum		(apeture) 10 inch max
607	Spectral Band	0.6 to 1.1 um		0.6 to 1.1 micro meters
608	Video output	RS343,RS170, raw video		RS - 343, RS - 170
609	Effect. Source Lumin. @ TPS Entrance Aperture	320 to 32000 Candela/m2		3.2 x 10 (exp 2) to 3.2 x 10 (exp 4) cd/m (exp 2)
610	**INERTIAL TESTING**			Option
611	Stimulus:	capability available		

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
612	static load			100
613	rate			0 to 1000
614	acceleration			3000
615	torque			0.8 (at stall)
616	positional accuracy			10 Arc-Minutes Leveling
617	**AUDIO TESTING**			Option
618	Frequency Range	availble via other assets		DC-1MHz
619	Resolution			1Hz
620	Display Range			0dB - 72dB
621	Modes:			Freq, Volt, Pwr, Sinad, Sig/Noise, Audio Distortion
622	**PRESSURE/PNEUMATICS**			Option
623	Stimulus:			
624	Pressure:			
625	static	0.6 to 100 in Hg		0.3 - 36
626	total	0.6 to 100 in Hg		0.3 - 100
627	differential			0 to 100
628	rate	0 to 50,000 ft/min		120
629	**MAINTENANCE SOFTWARE**			
630	Built in test (BIT)	Y	Y	Y

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
631	Confidence test(s)	Y	Y	Y
632	Self-calibration	Y	Y	Y
633	OAFI			
634	**CALIBRATION SIGNALS**			
635	DC voltage source	0 to 200 V	90mV (+/- 6.84mV) .9V (+/- 68.4mV), 9.0V (+/- 68.4mV), 18.0VDC (+/-mV)	90mV (+/- 6.84mV), .9V (+/- 68.4mV), 9.0V (+/-68.4mV), 18.0VDC (+/- 1mV)
636	resolution	0.01 uV to 10 uV (range dependent)		
637	AC voltage source	0.022 Vrms to 220 Vrms	1.0V (+/- 600mV), 10.0V (+/- 6mV)	1.0V (+/- 600mV), 10.0V (+/- 6mV)
638	resolution	8 uV to 220 uV	freq: 10 Hz to 1 MHz	
639	DC current	0 to 2.2 A		
640	resolution	0.1 nA to 1.0 uA		
641	AC current:	0.9 to 2.2 A		
642	resolution	1.0 nA to 1.0 uA		
643	resistance	1 ohm to 190 kohms	100 Ohm (+/- .005), 1K Ohm (+/- .05), 10K Ohm (+/- .55), 100K Ohm (+/- 5.5), 1M Ohm (+/- 55)	100 Ohm (+/- .005), 1K Ohm (+/- .05), 10K Ohm (+/- .55), 100K Ohm (+/- 5.5), 1M Ohm (+/- 55)
644	resolution	0.06 % to 6.0 %		
645	current capacity	10 mA maximum		
646	**ATS CHARACTERISTICS**			
647	Special Design Equipment:			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
648	Transportibility:	Van Installation Available	Self-Contained $280 Shelter, 5 Ton Truck, Helicopter, Cargo Aircraft (C130), Rail, Ship, Dolly Mobilizer	Self-Contained $280 Shelter, 5 Ton Truck, Helicopter, Cargo Aircraft (C130), Rail, Ship, Dolly Mobilizer
649	Internal Cooling:			
650	Threat Simulators:			
651	type threats			Y
652	quantity			12
653	output:			
654	voltage			IF, RF: -100 to +38dBm/Video: +/- 10V
655	current			/Video: 200mA
656	bandwidth			10KHz to 22GHz
657	coded waveforms			Barker, PN
658	**DEPLOYMENT DATA**			
659	Size/Weight:	1		
660	number of 463L pallets (air transportable gear)	5 racks (Hybrid Core)	1 HCU-6/E pallet	1 HCU-6/E pallet
661	size/configuration (fixed gear)	4304 lbs (Hybrid Core)	2S-280 shelters, 1 generator	2S-280 shelters, 1 generator
662	weight (lbs)	128.09 x 63.88 inches (Hybrid Core)	35,000 lbs (IFTE + LRU spares + Generator)	35,000 lbs (IFTE + LRU spares + Generator)
663	footprint			

Table D-1. - Specification Summaries for CASS and IFTE (Continued)

ROW #	ATE SPECIFICATION ITEM	CASS	IFTE (BSTF)	IFTE (EXTENDED)
664	**ENVIROMENTAL DATA**			
665	Ambient Temp (for operation)	18 to 27 deg C		
666	Humidity	35 to 95 %		
667	external cooling source required	chilled air required for EO console UUT requires external A/C	not required	not required
668	heat generation	40,000 BTU (nominal)		
669	Internal Refrigeration Unit:			
670	use		station and UUT	station and UUT
671	air temperature			
672	shock tested	MIL-T-28800C	Meets MIL-M-8090 Class V	Meets MIL-M-8090 Class V
673	vibration tested	modified MIL-STD-167A		
674	water resistance tested	N (nominally drip-proof)		
675	Input Power Requirements:			
676	60 Hertz	multiple options (480, 440, 380, 115/ 200 Vrms, 3-ph)		
677	400 Hertz	115/200 Vrms up to 30 amps/phase (for UUT only)		
678	DC			
679	current load	13 kW (nominal)	15 KVA	15 KVA

* Capability can be provided with a software extension to the digital waveform generator.

** The power supplies can be put in parallel or services to obtain higher voltage, power, or current ranges.

Table D-2. - Specification Summaries for CATS and METS

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
1	**STATION INFORMATION**		
2	Station Configurations:	Utilizes VXI chassis built by Racal-Dana	METS (Mobile Electronic Test Set) RFMETS (Radio Frequency METS)
3	**SYSTEM CONTROL**		
4	OPERATING SYSTEM:		
5	Operating Environment	UNIX	derived RMX-86
6	TPS software environment:		
7	ATLAS	N	Y
8	ADA	Y	N
9	**COMPUTER**		
10	Computer Type:	Intel 80486 w/Natl Inst 776370-02 Bus Interface Kit	Intel 8086 based
11	address/data bits	32	16
12	mips		
13	clock speed (Mhz)	25 to 50 MHz	5
14	main memory - Mbytes		1
15	mass storage - Mbytes:		
16	permanent	TBD (various commercial types available)	1 (bubble memory)
17	transfer rate		
18	removable	TBD (various commercial types available)	5

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
19	transfer rate	TBD	
20	punched tape reader:	N	N
21	magnetic tape reader:	N	N
22	I/O ports:	via Talon BE-64 bus emulator	
23	IEEE-802.3 Ethernet	Y (via programmable bus)	N
24	RS-232	Y (via programmable bus)	Y
25	IEEE-488	Y (via programmable bus)	Y
26	HP-IB (enhanced IEEE-488)	Y (via programmable bus)	
27	SCSI	Y (via programmable bus)	
28	RS-422	Y (via programmable bus)	
29	RS-423	Y (via programmable bus)	
30	VME	Y (via programmable bus)	
31	VXI	Y (via programmable bus)	
32	Printer	TBD	Y
33	characters/sec	TBD	150 char/sec
34	**OPERATOR INTERFACE**		
35	CRT:		
36	screen size	15 or 21 inch diagonal	13 inch diagonal
37	colors - number	multiple	monochrome
38	resolution	pixels: 640 X 480 to 1024 X 768	pixels: 921H x 739V
39	type		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
40	Input Devices:		
41	keyboard	Y keys: 101	Y
42	trackball	Y	N
43	mouse	Y	N
44	bar code reader	Y	N
45	touchscreen	N	Y
46	hand-held terminal	N	N
47	UUT/SYSTEM INTERFACE		
48	I/O Pins:	UUT - System interface	
49	quantity	is not yet defined	
50	volts/pin		45
51	power paths		24
52	signal paths	MAC panel Hypertac	21
53	Feedthroughs:	TBD	
54	low frequency:		
55	no. of pins		
56	max current		
57	frequency range		
58	power:	TBD	
59	no. of pins		24
60	max current		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
61	frequency range		
62	Coax (RF):	TBD	
63	no. of pins		
64	max current		
65	frequency range		
66	Digital Test Unit:	TBD	
67	no. of pins		
68	no. of channels		
69	data rate		
70	logic levels		
71	compatibility:		
72	Switching:		
73	low frequency switch:	Racal-Dana 1277 series	
74	no. of pins	Undefined	
75	max current	2A	
76	relay matrices:	1 - 4	
77	frequency range	DC to 20 MHz	
78	coax switch:	TBD	
79	no. of pins		
80	relay matrices :		
81	frequency range		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
82	power switch:	Racal-Dana 1277 series	
83	no. of pins	Undefined	
84	relay matrices:	10 A	
85	Universal I/O:	MAC Panel series 75 interface	
86	number of pins		
87	number of instrument ports		
88	maximum current		
89	frequency range		
90	Extended Performance I/O:	Undefined	
91	number of pins		
92	number of instrument ports		
93	maximum current		
94	frequency range		
95	Digital/Analog Converters:	CDS 73A-256	
96	quantity	12 channels	2
97	voltage	+/- 16.4 V	+/- 0.3 V, +/- 3 V, +/- 10 V
98	max current	60 mA	
99	resolution	16 bits	10 bits
100	sampling rate	3000 conversions/sec	20 M (max)
101	synchro-resolver channel		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
102	BUSSES	Bus Emulator (Talon BE-64)	
103	Number of Channels	64	
104	Protocols Available:		
105	MIL-STD-1553 A/B	Y (via programmable bus)	Y
106	MIL-STD-1773	N	N
107	MIL-STD-1397A	Y (via programmable bus)	N
108	EIA RS-232-C	Y (via programmable bus)	N
109	EIA RS-422-A	Y (via programmable bus)	Y
110	RS-485	Y (via programmable bus)	N
111	AR-57A	Y (via programmable bus)	N
112	IEEE-488	Y (via programmable bus)	Y
113	IEEE-802.3 (ethernet)	Y (via programmable bus)	N
114	Arinc-429	Y (via programmable bus)	N
115	H009	Y (via programmable bus)	Y
116	F-16 AIS (Manchester)	Y (via programmable bus)	N
117	PSP-RC	Y (via programmable bus)	N
118	1750A processor bus	Y (via programmable bus)	N
119	8088 microprocessor bus	Y (via programmable bus)	N
120	80x86 microprocessor bus	Y (via programmable bus)	N
121	UART	Y (via programmable bus)	Y
122	AIM-9 interface	Y (via programmable bus)	

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
123	HSDB (high speed data bus)		
124	FODB (fiber optic data bus)		
125	RTDB		
126	MWG		
127	EMC		
128	ASPJ jam bus		
129	ASPJ status bus		
130	MCAIR 3818A		
131	Frequency range	to 50 MHz	
132	***VIDEO***		
133	Video Signal Generation:		
134	horizontal timing		
135	horizontal resolution		
136	vertical timing		
137	vertical timing resolution		
138	synch format		
139	video data		
140	video output modes:		
141	output 1		
142	output 2		
143	output 3		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
144	output 4		
145	output 5		
146	output 6		
147	output 7		
148			
149	display measurement:		
150	placement		
151			
152	resolution		
153	*intensity*		
154	intensity variation		
155	field of view		
156	modulation transfer function		
157			
158	DIGITAL TESTING		
159	Pattern Rate - Patterns/Sec	Undefined	
160	test rates:		
161	minimum		
162	maximum		
163	I/O pins	Undefined	
164	memory depth / pin		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
165	EEPROM programming pulse		
166	Digital Test Unit:	Undefined (under evaluation)	HP 70700A
167	Bit Rate		1 Hz to 10 MMHz
168	pin interface		
169	voltage ranges		-10 V to +10V
170	clock speed		
171	Diagnostic Probe: (digital)	UNK	
172	voltage range		
173	input data rate (max)		
174	resolution		
175	compatibility		
176	propagation delay		
177	logic threshold		
178	pulse detection		
179	input impedance		
180	output impedance		
181	Timing Generation:	UNK	
182	frequency range		
183	pulse width range		
184	Time Interval Measurement:	UNK	
185	period		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
186	pulse characteristics		
187	range		
188	**ANALOG SWITCHING**		
189		Racal-Dana 1277 series	
190	number signal paths	UNK	
191	bandwidth at voltage		
192	**LOADS**		
193	Programmable Loads:	Elgar (exact config TBD)	
194	max power dissipation		
195	max voltage		
196	max current		
197	Programmable Precision Resistor:		
198	range		
199	accuracy		
200	Fixed Resistance:		
201	quantity		
202	values		
203	**ANALOG STIMULI**		
204	Arb Funct/Wave Gen:	WAVETEK 1395	
205	channels	1	
206	amplitude	15 mV to +/- 30 V p-p	

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
207	amplitude resolution	+/- 1.0%	
208	sine waveform	Y	
209	square waveform	Y	
210	pulsed DC waveform	Y	
211	ramp waveform	Y	
212	arbitrary waveform	Y	
213	DC level waveform	Y	
214	triangle waveform	Y	
215	haversine	Y	
216	random noise	Y	
217	(sin x)/x	Y	
218	Frequency Ranges:		
219	pulsed DC and square wave	1 uHz to 25 MHz	
220	sine wave	1 uHz to 20 MHz	
221	triangle and sawtooth wave	1 uHz to 2 MHz	
222	arbitrary wave	0.1 Hz to 50 MHz	
223	Resolution:		
224	pulsed DC and square wave	8 digits (limited by 1 uHz)	
225	sine wave	8 digits (limited by 1 uHz)	
226	ramp wave	8 digits (limited by 1 uHz)	
227	arbitrary wave	5 digits (limited by 0.1 uHz)	

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
228	point generation for arb wave	32 Kpoints	
229	max. point generation rate	4096 points	
230	available modes of operation	multiple	
231	dual phase mode	N (external h/w required)	
232	Discrete Generator:	CDS 73A-411	
233	Pulse Generator:	CDS 73A-270 Pulse/Pattern Generator	
234	quantity	2 channel	
235	period range	100 nsec to 100 sec	
236	pulse width	100 nsec to 100 sec	
237	accuracy		
238	amplitude	+/-17.4 V	
239	delay	UNK	
240	double pulse	Y - programable	
241	pulse burst count		
242	Counter/Timer Stimulus:	Racal-Dana 2251 Opt 41	
243	voltage levels		TTL compatible
244	frequency range		0.01 Hz to 2.5 MHz
245	duty cycle		0 to 100%
246	time delays		800 nsec to 500 sec
247	resolution of delay		200 nsec
248	accuracy of delay		0.005 percent

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
249	pulse width		400 nsec to 500 sec
250	resolution of pulse width		200 nsec
251	accuracy of pulse width		0.01 percent
252	digital to synchro generation		
253	voltage level		
254	accuracy		
255	power		
256	Synchro Generation:		
257	quantity		(synchro stimulus)
258	angular range		0 to 359.95 degree
259	resolution		0.022 degree
260	angular rate		0 to 3600 deg/sec
261	index ref position		0 or 180 degree
262	reference voltage		26 Vrms
263	voltage (synchro)		11.8 Vrms
264	reference frequency		400 Hz (only)
265	frequency range		400 Hz (only)
266	Function Generator:	TEK VX4750	
267	quantity		
268	amplitude	up to 20 V p-p	
269	slew rate		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
270	rise time	<10 nsec	
271	Waveforms Available:		
272	sine wave	Y	
273	square wave	Y	
274	ramp (sawtooth) wave	Y	
275	triangle	Y	
276	pulse	Y	
277	frequency range	up to 25 MHz	
278	*arbitrary function*	up to 4096 points, 12 bits	
279	special capabilities	modulation *modes available*	
280	Square Wave Output:	via Function Generator	
281	frequency range		0 Hz to 20 MHz
282	frequency accuracy		0.01 percent
283	frequency resolution		0.00233 Hz
284	phase shift range		0 to 360 degrees
285	duty cycle		50 % with 100ns jitter at the logic level crossing pt
286	amplitude		TTL compatible into 50 ohms
287	AC Line of Sight Seeker (Loss):		
288	amplitude		
289	phase		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
290	frequency		
291	**ANALOG MEASUREMENT**		
292	Digital Multi-Meter:	HP E1410A (6 1/2 digit)	(not a DMM)
293	DC range		
294	DC resolution		
295	AC range		
296	AC resolution		
297	current range		
298	current resolution		
299	resistance range		0 to 100 Kohm
300	AC Voltage Ratio		
301	DC Voltage Ratio		
302	Frequency/Time Interval Counter:	Racal-Dana 2251 /opt41	
303	frequency range	DC to 1.3 GHz	
304	time interval range	2 nsec to 800,000 sec	
305	input voltage range		
306	count events		
307	Microwave Counter:	EIP 1231A	
308	Frequency Response Analyzer	Schlumberger 1270	
309	Vector Voltmeter:	HP 8508B	
310	Sampling Signal Analyzer:		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
311	resolution		
312	rate		
313	resolution		
314	Waveform Digitizer:	HP E1428A	
315	channels		
316	input voltage range		
317	frequency response		
318	amplitude resolution		
319	sampling interval		
320	storage depth		
321	sampling/conversion rate		
322	Synchro-Resolver:		(synchro measurement)
323	*angular range*		0 to 359.95 degrees
324	resolution		0.022 degree
325	angular rate (max)		3600 deg/sec
326	reference voltage		26. 0 Vrms
327	voltage (synchro)		11.8 Vrms L-L, 400Hz
328	reference frequency		400 Hz
329	accuracy		+/- 4 arc-minutes
330	resolution		0.022 degree
331	frequency range		400 Hz (only)

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
332	index reference position		0 or 180 degrees
333	Oscilloscope:		
334	traces		
335	bandwidth		
336	**DC POWER**		
337	PROGRAMMABLE:	Elgar VXP-1000 controller	
338	Low Voltage:	Elgar VXP-D7V0x	
339	quantity	6	
340	max. watts per supply	80 Watts	
341	max. voltage	50 VDC	
342	max. current	10 A	
343	High Voltage:	EMI 35030	
344	quantity	UNK	
345	voltage range		
346	max current		
347	Current Source:		
348	unit 1: amplitude		
349	resolution		
350	unit 2-6: amplitude		
351	resolution		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
352	FIXED:	undefined	
353	quantity		4
354	volts		5/-15/15/28
355	amperes		/unk/6.5/6.5/10-20
356	watts		200/200/200/100
357	REFERENCE:	HP-6621A and HP-6627A	
358	quantity	TBD	
359	voltage range	0 to 50 VDC	
360	current	50 Watts	
361	**AC POWER**		
362	PROGRAMMABLE:	Pulizzi Power Controller	
363	number of phases	1 to 3	
364	frequency	TBD	
365	voltage	TBD	
366	current	TBD	
367	power	TBD	
368	FIXED:	UNK	
369	Facility Power Feed-Through:		115/200 V, 400 Hz, 3 ph
370	Pulsed Signal:	UNK	
371	Stimulus Power for UUTs:	UNK	
372	**RF STIMULI**		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
373	SYNTHESIZERS		
374	Synthesizer 1:	HP 8662A	Wiltron 6747B-20
375	frequency range	10 KHz to 1.28 GHz	10 MHz to 20 GHz
376	frequency resolution	0.1 Hz	1 KHz
377	power range:		
378	w/o amplifier		+10 to -112 dBm
379	w/ amplifier		
380	PM:	N	
381	on/off ratio		80 dB
382	rise/fall time		10 nsec
383	min. pulse width		100 nsec
384	max. frequency		
385	pulse on pulse modulation		Y
386	AM:	Y	Y
387	frequency rate	400 Hz or 1 KHz	
388	modulation depth		
389	FM:	Y	Y
390	frequency rate	400 Hz or 1 KHz	
391	Phase Modulation:	N	N
392	frequency rate		
393	deviation		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
394	IFF :	N	
395	frequency rate		
396	CW:	N	Y
397	Synthesizer 2:	HP 83623A (w/8347 or 8349 amplifier)	
398	frequency range	10 MHz to 8.5 GHz	
399	power range:		
400	w/o amplifier		
401	w/ amplifier	+20 dBm	
402	PM:		
403	*on/off ratio*		
404	rise/fall time		
405	min. pulse width		
406	max. frequency		
407	AM:		
408	frequency rate		
409	modulation depth		
410	FM:		
411	max rate		
412	Fast Switching Synthesizer:		
413	frequency range		
414	power range		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
415	frequency switching time		
416	FM:		
417	rate		
418	deviation		
419	AM:		
420	rate		
421	depth		
422	Spread Spectrum Modulator/Demodulator	UNK	
423	Modulation Signals:		
424	high accuracy AM		
425	(ILS and VOR)		
426	TACAN		
427	linear pulse		
428	FSK		
429	MSK		
430	BPSK		
431	QPSK		
432	OQPSK (GPS)		
433	Broadband Noise Source:	UNK	
434	frequency range		
435	excess noise ratio		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
436	Phase Noise:	UNK	
437	pulsed		
438	continuous wave (CW)		
439	bandwidth		
440	Stabilized Local Oscillator:		
441	RF MEASUREMENT		
442	Spectrum Analyzer 1:	HP 8566B	HP 70790X A
443	frequency range	100 Hz to 22 GHz	50 KHz to 22 GHz
444	with ext. mixers	to 325 GHz	
445	resolution bandwidth	10 Hz to 3 MHz	
446	video bandwidth	1 Hz to 3 MHz	3 Hz to 300 KHz
447	input amplitude:		
448	log	+30 dBm to -134 dBm	-132 to +30 dBm
449	linear		
450	Spectrum Analyzer 2:	HP 3585B (RF Noise Analizer)	
451	frequency range	20 Hz to 40.1 MHz	
452	with ext. mixers		
453	resolution bandwidth	3 Hz to 30 KHz	
454	video bandwidth	1 Hz to 30 KHz	
455	input amplitude:		
456	log	+30 dBm to -137 dBm	

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
457	linear	7.08 Vrms to 31 mVrms	
458	Detection:		
459	Pulse	Y	
460	AM	Y	
461	FM	Y	
462	Attenuation (dB)	UNK	
463	Millivolt Meter:		
464	voltage range		
465	bandwidth		
466	Power bandwidth (MHZ)		
467	RF Power Meter:	WAVETEK 1342 and 80340	HP 70100A
468	power range	-70 dBm to +20 dBm	-70 to +20 dBm
469	frequency range	10 MHz too 40 GH	10 MHz to 18 GHz
470	CW Power Meter:	WAVETEK 1342 and 80300	
471	power range	10 MHz too 40 GH	
472	frequency range	-70 dBm to +20 dBm	
473	Noise Figure Meter:	HP 8970B w/HP 246C	
474	noise figure range	0 to 30 dB	
475	noise figure resolution	0.001 dB	
476	frequency range	10 MHz to 1.6 GHz	
477	frequency resolution	1 MHz	

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
478	Carrier Noise Tester:	HP 11729C	
479	frequency range	1.28 to 18 GHz	
480	amplitude	+7dBm to +18 dBm	
481	IF output bandwidth	5 to 1280 MHz	
482	IF output level	+7 dBm	
483	Sampling Signal Analyzer:	HP 3577A	
484	SWR meas. range		
485	vector voltmeter:	HP 8508A	
486	frequency range	100 KHz to 16 GHz	
487	phase range	*-180 deg to +180 deg*	
488	peak power meter:		
489	frequency range		
490	power range		
491	Vector Network Analyzer:	HP 8501B w/HP 8515	
492	Network Analysis:	HP 3577A/B	
493	frequency range	45 MHz to 50 GHz	
494	time		
495	bandwdith		
496	max input	+15 dBm	
497	noise level		
498	(complex/fundamental signal measurement)		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
499	IF bandwidth		
500	sweep time	100 msec to 6553 sec/scan	
501	Frequency Counter/Measurement:	Racal-Dana 2251 opt41	
502	frequency counter:		
503	frequency range	25 MHz to 20 GHz	
504	accuracy		
505	resolution	10 nsec	
506	RF pulse width	50 nsec	
507	RF power level	+7 dBm	
508	sensitivity	-15 dBm to -20 dBm	
509	input power range	-20 dBm to +7 dBm	
510	Modulation Evaluation:		
511	Pulse Modulation	Y	
512	frequency range		
513	pulse width		
514	rise/fall time		
515	dynamic range		
516	sensitivity		
517	PRF		
518	Amplitude Modulation	Y	
519	frequency range		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
520	modulation frequency		
521	sensitivity, valley		
522	accuracy		
523	Frequency Modulation		
524	frequency range		
525	modulation frequency		
526	distortion		
527	spectrum		
528	RF Input Characteristics:	Y	
529	frequency range		
530	input power		
531	impedance		
532	VSWR		
533	**SPREAD SPECTRUM**		
534	Frequency range (Mhz)	UNK	
535	Hop rate (hops/sec)	UNK	
536	Code rate (chips/sec)	UNK	
537	Modulation / Demodulation:	UNK	
538	amplitude modulation (AM)		
539	precision AM		
540	pulse modulation (PM)		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
541	pulse on pulse modulation		
542	frequency modulation (FM)		
543	wideband FM		
544	narrowband FM		
545	frequency-shift keying (FSK)		
546	binary phase shift keying (BPSK)		
547	continuous phase shift modulation (CPSM)		
548	quadrature phase shift keying (QPSK)		
549	offset quadrature phase shift keying (OQPSK)		
550	Modulo-2		
551	JTIDS:		
552	TACAN		
553	VOR		
554	ILS		
555	MSK		
556	GPS		
557	OPTICAL TESTING		
558	LASER		
559	Transmitter:	HP 81551mm and 81552sm (optical attenuator HP 8158B)	
560	aperture		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
561	field of view		
562	Pulse Repetition Frequency (PRF)		
563	Divergence		
564	Range (kM)		
565	resolution (meters)		
566	energy input		
567	power density (measurement)	> -2 dBm	
568	power density (stimulus)		
569	Wavelength	center freq 850 nm +/-10	
570	*Spectral Bandwidth*	< 1.5 nm	
571	Angle of regard		
572	Polarization		
573	beam alignment range		
574	Receiver:	Lightwave Multimeter, EIP 1231A Optical Power Meter HP-8153A with 81520A and 81521V optical head	
575	sensitivity ranges	+10 to -100 dBm	
576	range gate		
577	Field-Of-View (FOV):		
578	apertures		
579	FOV coincidence:		
580	coaxial		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
581	wavelength	450 nm to 1700 nm	
582	acceptance PRF		
583	fiber optic types	parallel beam, 9/125 to 100/140 um	
584	separate aperture on coaxial		
585	Tracker:	UNK	
586	sensitivity ranges		
587	range gate		
588	Field-Of-View (FOV):		
589	apertures		
590	*coaxial*		
591	wavelength		
592	acceptance PRF		
593	**INFRARED**		
594	Number of targets		
595	Range (degrees C)		
596	Resolution (degress C)		
597	Aperture		
598	Field of View (max)		
599	Field of View (min)		
600	Source Spacial Freq.		
601	Spectral Bands		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
602	Video Output		
603	Source temperature		
604	VISUAL		
605	Number of targets		
606	Size		
607	Spectral Band		
608	Video output		
609	Effect. Source Lumin. @ TPS Entrance Aperture		
610	INERTIAL TESTING		
611	Stimulus:		Genisco H342B
612	static load		
613	rate		0 to 2000 deg/sec
614	acceleration		
615	torque		
616	positional accuracy		+/- .1 deg
617	AUDIO TESTING	HP 8903B	
618	Frequency Range	20 Hz to 100 KHz	
619	Resolution	0.3 percent	
620	Display Range	0 to 99.99 dB	
621	Modes:	normal; sinad; distortion	

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
622	**PRESSURE/PNEUMATICS**		
623	Stimulus:		
624	Pressure:		
625	static		0.5 TO 32 in Hg
626	total		
627	differential		0 to 74 in Hg
628	rate		"0 to 90,000 ft/min
629	**MAINTENANCE SOFTWARE**		
630	Built in Test (BIT)	UNK	some
631	Confidence test(s)	UNK	
632	Self-calibration	UNK	
633	OAFI		
634	**CALIBRATION SIGNALS**	UNK	
635	DC voltage source:		
636	resolution		
637	AC voltage source		
638	resolution		
639	DC current		
640	resolution		
641	AC current		
642	resolution		

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
643	resistance		
644	resolution		
645	current capacity		
646	**ATS CHARACTERISTICS**		
647	Special Design Equipment:	First MATE Tester	Personality Module Display Monitor
648	Transportibility:	UNK	Two Man Portable
649	Internal Cooling:	Lockheed LRM Liquid/Air Heat Exchanger	Internal, station controlled lower unit for UUT
650	Threat Simulators:		
651	type threats		
652	quantity		
653	output:		
654	voltage		
655	current		
656	bandwidth		
657	coded waveforms		
658	**DEPLOYMENT DATA**		
659	Size/Weight:	UNK	
660	number of 463L pallets (air transportable gear)	UNK	1
661	size/configuration (fixed gear)	UNK	

Table D-2. - Specification Summaries for CATS and METS (Continued)

	ATE SPECIFICATION ITEM	CATS (F22 FACTORY/DEPOT?)	METS (F15E)
662	weight (lbs)	UNK	2685
663	footprint	UNK	
664	**ENVIROMENTAL DATA**		
665	Ambient Temp (for operation)	UNK	0 to 55 deg Centigrade
666	Humidity		
667	external cooling source required	required for UUT	not required
668	heat generation		
669	Internal Refrigeration Unit:		
670	use		for UUT only
671	air temperature		
672	shock tested	UNK	20 G, 18 inch to 24 inch drop
673	vibration tested	UNK	5 Hz to 55Hz
674	water resistance tested	UNK	Y
675	Input Power Requirements:	UNK	
676	60 Hertz		
677	400 Hertz		
678	DC		
679	current load		

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
1	**STATION INFORMATION**			
2	Station Configurations:	Computer/Inertial Radio Frequency Display/Indicator Processor/Pneumatic	1 STATION CONFIGURATION with Computer/Radio Frequency/Display/Indicator and Processor Testing Capabilities	1 STATION CONFIGURATION with Computer/Radio Frequency/Display/Indicator/ Processor/Pneumatics andINS Testing
3	**SYSTEM CONTROL**			
4	OPERATING SYSTEM:	GDE SYSTEMS; designed	GDE SYSTEMS; designed	GDE SYSTEMS; designed
5	operating environment	Modified HP Operating System	Modified HP Operating System	Modified HP Operating System
6	TPS software environment:			
7	ATLAS	Y	Y	Y
8	ADA			
9	**COMPUTER**			
10	Computer Type:	HP 900 series	HP A990 (HP12990C processor)	HP A990 (HP12990C processor)
11	address/data bits	16	16	16
12	mips	3	15	15
13	clock speed (Mhz)	7.5 MHz	12.5 MHz	12.5 MHz
14	main memory - Mbytes	1.5	8	8
15	mass storage - Mbytes:			
16	permanent	40	0	0

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
17	transfer rate	4.4 Mbits/sec		
18	removable	(2)20 (Magnetic media)	(2) 594 formatted (Optical disks)	(2) 594 formatted (Optical disks)
19	transfer rate		>4.4 Mbits/sec	>4.4 Mbits/sec
20	punched tape reader	Y	N	Y
21	magnetic tape reader	Y	Y	Y
22	I/O ports:			
23	IEEE-802.3 Ethernet	N	N	Y
24	RS-232	Y(2)	Y (7 total) 4 accesible & 3 reserve	Y 29 total
25	IEEE-488	Y(2)	Y (2)	Y (5)
26	HP-IB (enhanced IEEE-488)	Y(2)	Y (2)	Y (5)
27	SCSI	N	Y	Y
28	RS-422	N	Y	Y
29	RS-423	N	N	Y
30	VME	N	N	Y
31	VXI	N	N	Y
32	Printer:	Y	Y	Y
33	characters/sec	>80 char/sec	>80 char/sec Port & Software for high speed printer	>80 char/sec Port & Software for high speed printer
34	**OPERATOR INTERFACE**			
35	CRT:			

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
36	screen size	15 inch	9 inch	9 inch
37	colors - number	monochrome	monochrome	monochrome
38	resolution	25 lines by 80 characters	640 by 400 resolution (25 lines by 80 characters)	640 by 400 resolution (25 lines by 80 characters)
39	type			
40	Input Devices:			
41	keyboard	Y	Y	Y
42	trackball	N	N (Capability for H/W exists - S/W required)	Y(S/W driver required)
43	mouse	N	N (Capability for H/W exists - S/W required)	Y(S/W driver required)
44	bar code reader	N	N (Capability for H/W exists - S/W required)	Y(S/W driver required)
45	touchscreen	N	Y (80 by 25 Touchpoints)	Y (80 by 25 Touchpoints)
46	hand-held terminal	N	Y (MIL-STD-810 compliant)	Y (MIL-STD-810 compliant)
47	**UUT/SYSTEM INTERFACE**			
48	I/O Pins:	Pin Interface	Densely-Packed Leaf Spring (pinless interface)	Densely-Packed Leaf Spring (pinless interface)
49	quantity	2500	2500	2500
50	volts/pin	up to 512 VDC	up to 500 VDC	up to 500 VDC
51	power paths	limited only by space for connectors on ITA	limited only by space for connectors on ITA	limited only by space for connectors on ITA

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
52	signal paths		Up to 100MHz sinewave	Up to 100MHz sinewave
53	Feedthroughs:			
54	low frequency:			
55	no. of pins	250	180	450
56	max current	5 amp (max), 1 amp (typ)	3 amp (max), 1 amp (typ)	3 amp (max), 1 amp (typ)
57	frequency range	>2 MHz squarewave	100 MHz	100 MHz
58	power:			
59	no. of pins		48 output pins, Input pwr pins from LRU limited only by the space on the ITA for connectors	48 output pins, Input pwr pins from LRU limited only by the space on the ITA for connectors
60	max current	35A	15A	15A
61	frequency range	800Hz	DC, 400 Hz, 800 Hz	DC, 400 HZ, 800 Hz &programmable AC fre to 8000Hz
62	coax (RF):			
63	no. of pins	Station dependent	8 type N	8 type N/ 36 to 108 pins
64	max current			
65	frequency range		DC to 18.5GHz	DC to 18.5GHz / DC to 1GHz
66	Digital Test Unit:			
67	no. of pins	208	697	961
68	no. of channels	40	192 single ended, 96 differential	Expandable to 288 single ended, 144 differential

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
69	data rate		10Hz to 16MHz and 40MHz	10Hz to 16MHz and 40MHz
70	logic levels	TTL differential	TTL single-ended/differential/ ECL/CMOS	TTL single-ended/differential/ ECL/CMOS
71	compatibility:	See busses	See busses	See busses
72	Switching:	90 form C relays		
73	low frequency switch:		180 relays	300 relays
74	no. of pins		258	498
75	max current	30 (5 A) and 60 (1 A)	60 (1 A)	150 (1 A)
76	relay matrices:	Y	Y (12)1 x 5 and (2) 2 x 8	Y (24)1 x 5 and (5) 2 x 8
77	frequency range		(160) restricted BW driver dependent, (80) DC-1MHz, (18) DC-10MHz	(499) restricted BW driver dependent, (200) DC-1MHz, (72) DC-10MHz
78	coax switch:			
79	no. of pins	32	None (pinless interface does not require coax)	None (pinless interface does not require coax)
80	relay matrices :	4 each 1X5 6 each 1X2		
81	frequency range			
82	power switch:			
83	no. of pins		60	150

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
84	relay matrices:	8 1X2 Form C Relays 6 1X2 15 Amp 30 1X2 5 Amp 60 1X2 power or signal	5 1X4 (high current @ 18.75 amps) 1 1X2 (high current @ 18.75 amps) 2 1X2 (ganged high current - 18.75 amps) 60 1x2 power or signal DC to 1 kHz	5 1X4 (high current @ 18.75 amps) 1 1X2 (high current @ 18.75 amps) 2 1X2 (ganged high current - 18.75 amps) 150 1x2 power or signal DC to 1 kHz
85	Universal I/O:			
86	number of pins		180	450
87	number of instrument ports		(2) IEEE-488/(7) RS232	(5) IEEE-488/(29) RS232/ (29) RS422/RS423
88	maximum current		3 amps	3 amps
89	frequency range		100MHz	100MHz
90	Extended Performance I/O:			
91	number of pins		300	Exensive capability using MMS, VXI, and VME
92	number of instrument ports		(2) IEEE-488/(7) RS232	(5) IEEE-488/(29) RS232/ (29) RS422/RS423
93	maximum current		3 amps	
94	frequency range		100MHz	
95	Digital/Analog Converters:			
96	quantity	UNK	(12) 2.5 mv step, (8) 10v or 100v 20ma max	(12) 2.5 mv step, (8) 10v or 100v 20ma max

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
97	voltage	+/- 10 V and +/- 100 V	+/- 10 V, +/-10V and +/- 100 V, int/ ext ref	+/- 10 V, +/-10V and +/- 100 V, int/ ext ref
98	max current		20 ma	20 ma
99	resolution	14 bits	12 Bits & 16 bits	12 Bits & 16 bits
100	sampling rate		DC - 5KHz	DC - 5KHz
101	synchro-resolver channel		3 channels (9 pins)	3 channels (9 pins)
102	**BUSSES**			
103	*Number of Channels*			
104	Protocols Available:		(Advanced Bus Emulator)	(Advanced Bus Emulator)
105	MIL-STD-1553 A/B	Y	Y	Y
106	MIL-STD-1773	Y with I/O translators	Y with I/O translators	Y with I/O translators
107	MIL-STD-1397A	Y	Y	Y
108	EIA RS-232-C	Y	Y	Y
109	EIA RS-422-A	Y	Y	Y
110	RS-485	Y	Y	Y
111	AR-57A			
112	IEEE-488	Y	Y	Y
113	IEEE-802.3 (ethernet)	N	N	Y
114	Arinc-429	Y	Y	Y
115	H009			

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
116	F-16 AIS (Manchester)	Y	Y	Y
117	PSP-RC	Y	Y	Y
118	1750A processor bus	Y 7MHz (Max)	Y	Y
119	8088 microprocessor bus	Y	Y	Y
120	80x86 microprocessor bus	Y 7MHz (Max)	Y	Y
121	UART			
122	AIM-9 interface			
123	HSDB (high speed data bus)	Y	Y	Y
124	FODB (fiber optic data bus)	Y with I/O translators	Y with I/O translators	Y with I/O translators
125	RTDB	Y	Y	Y
126	MWG	Y	Y	Y
127	EMC	Y	Y	Y
128	ASPJ jam bus	Y	Y	Y
129	ASPJ status bus	Y	Y	Y
130	MCAIR 3818A			
131	Frequency range	10Hz to 7MHz	10 Hz to 16 MHz AND 40MHZ	10 Hz to 16 MHz AND 40MHZ
132	**VIDEO**			
133	Video Signal Generation:			
134	horizontal timing	Per RS-170 and RS-343	Per RS-170 and RS-343	Per RS-170 and RS-343
135	horizontal resolution	Per RS-170 and RS-343	Per RS-170 and RS-343	Per RS-170 and RS-343

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
136	vertical timing	Per RS-170 and RS-343	Per RS-170 and RS-343	Per RS-170 and RS-343
137	vertical timing resolution	Per RS-170 and RS-343	Per RS-170 and RS-343	Per RS-170 and RS-343
138	synch format	Per RS-170 and RS-343	Per RS-170 and RS-343	Per RS-170 and RS-343
139	video data	6 shades of gray	8 shades of gray	8 shades of gray
140	video output modes:			
141	output 1	RS-170 (mod) (raster)	RS-170	RS-170)
142	output 2	RS-343 (raster)	RS-343	RS-343
143	output 3	HOBO	HOBO	HOBO
144	output 4	MAVERICK	MAVERICK	MAVERICK
145	output 5	symbology stimulus (cursive)	symbology stimulus (cursive)	symbology stimulus (cursive)
146	output 6	HUD display (special cursive)	HUD display (special cursive)	HUD display (special cursive)
147	output 7		Special Raster Video Stimuli	Special Raster Video Stimuli
148				
149	display measurement:			
150	placement	See F-16 EO Table	See F-16 EO Table	
151				
152	resolution	See F-16 EO Table	See F-16 EO Table	
153	intensity	See F-16 EO Table	See F-16 EO Table	
154	intensity variation	See F-16 EO Table	See F-16 EO Table	
155	field of view	See F-16 EO Table	See F-16 EO Table	

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
156	modulation transfer function	See F-16 EO Table	See F-16 EO Table	
157				
158	DIGITAL TESTING			
159	Pattern Rate - Patterns/Sec			
160	test rates:			
161	minimum	10 Hz	10 Hz	10 Hz
162	maximum	7 MHz	16 MHz TO 40MHZ	16 MHz TO 40MHZ
163	I/O pins	208	697	961
164	memory depth / pin	32 K	128 K X 16 bits OR 64 K X 32 bits	128 K X 16 bits OR 64 K X 32 bits
165	EEPROM programming pulse	Y	Y	Y
166	Digital Test Unit:			
167	Bit Rate	7 MHz	10Hz to 16MHz and 40MHz	10Hz to 16MHz and 40MHz
168	pin interface	Y	Y	Y
169	voltage ranges	TTL	TTL single-ended/differential/ ECL/CMOS	TTL single-ended/differential/ ECL/CMOS
170	clock speed	10 MHz	10Hz to 16MHz and 40MHz	10Hz to 16MHz and 40MHz
171	Diagnostic Probe: (digital)	None	None	None
172	voltage range			
173	input data rate (max)			
174	resolution			

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
175	compatibility			
176	propagation delay			
177	logic threshold			
178	pulse detection			
179	input impedance			
180	output impedance			
181	Timing Generation:			
182	frequency range	10 Hz to 10 MHz	10 Hz to 40 MHz	10 Hz to 40 MHz
183	pulse width range	50 nsec to 25 sec	50 nsec to 25 sec	50 nsec to 25 sec
184	Time Interval Measurement:			
185	period	40 nsec to 64 sec	40 nsec to 64 sec	40 nsec to 64 sec
186	pulse characteristics	5 nsec - 40 nsec resolution	5 nsec - 40 nsec resolution	5 nsec - 40 nsec resolution
187	range			
188	**ANALOG SWITCHING**			
189		16 HV 500V Max (DC-20KHz)	4 HV differential (DC-500 Hz)	10 HV differential (DC-500 Hz)
190	number signal paths	240 LV (DC-1MHz)	80 LV (DC-1MHz)	200 LV (DC-1MHz)
191	bandwidth at voltage	18 LV (0-32V)(DC-10MHz)	160 LV (Restricted BW) 4 HV (500 V max) DC-20KHz 18 LV (10-32V) (DC-10 MHz)	400 LV (Restricted BW) 10 HV (500 V max) DC-20KHz 72 LV (10-32V) (DC-10 MHz)
192	**LOADS**			
193	Programmable Loads:		N	Y

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
194	max power dissipation			4800 Watts
195	max voltage			200 V
196	max current			60 amps
197	ProgrammablePrecision Resistor:		N	Y
198	range	30 - 100 ohms		
199	accuracy	+/-0.050 ohms		
200	Fixed Resistance:			
201	quantity	5	50, (5) 93 and (3) 500 ohms loads	50, (11) 93 and (6) 500 ohms loads
202	values	5.6 Ohms; 14 Ohms; 28 Ohm; 56 Ohms; 140 Ohms	50, 93 and 500 ohms loads	50, 93 and 500 ohms loads
203	ANALOG STIMULI			
204	Arb Funct/Wave Gen:			
205	channels	6	2	5
206	amplitude	0 V to +/- 10 V	0 V to +/- 10 V	0 V to +/- 10 V
207	amplitude resolution	0 V to +/- 20 mV	0 V to +/- 20 mV	0 V to +/- 20 mV
208	sine waveform	Y	Y	Y
209	square waveform	Y	Y	Y
210	pulsed DC waveform	Y	Y	Y
211	ramp waveform	Y	Y	Y
212	arbitrary waveform	Y	Y	Y

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
213	DC level waveform	Y	Y	Y
214	triangle waveform	Y	Y	Y
215	haversine	Y	Y	Y
216	random noise	Y	Y	Y
217	(sin x)/x	Y	Y	Y
218	Frequency Ranges:			
219	pulsed DC and square wave	0.01 Hz to 2 MHz	0.01 Hz to 2 MHz	0.01 Hz to 2 MHz
220	sine wave	0.01 Hz to 2 MHz	0.01 Hz to 2 MHz	0.01 Hz to 2 MHz
221	triangle and sawtooth wave	0.01 Hz to 140 KHz	0.01 Hz to 140 KHz	0.01 Hz to 140 KHz
222	arbitrary wave	9 Hz to 16 MHz	0.01 Hz to 2 MHz	0.01 Hz to 2 MHz
223	Resolution:			
224	pulsed DC and square wave	0.05 percent	0.05 percent	0.05 percent
225	sine wave	0.05 %	0.05 %	0.05 %
226	ramp wave	0.05 %	0.05 %	0.05 %
227	arbitrary wave	0.05 %	0.05 %	0.05 %
228	point generation for arb wave	8 to 1024 points	8 to 1024 points	8 to 1024 points
229	max. point generation rate	16 MHz	16 MHz	16 MHz
230	available modes of operation	AM: 0 to 100% modulation	AM: 0 to 100% modulation	AM: 0 to 100% modulation
231	dual phase mode	YES - programmable thru 360 deg , up to 250KHz	YES - programmable thru 360 deg , up to 250KHz	YES - programmable thru 360 deg , up to 250KHz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
232	Discrete Generator:			
233	Pulse Generator:			
234	quantity	6	1	6
235	period range	250 nsec to 100 seconds	250 nsec to 100 seconds	250 nsec to 100 seconds
236	pulse width	200 nsec to 25 seconds	200 nsec to 25 seconds	200 nsec to 25 seconds
237	accuracy	1 msec	1 msec	1 msec
238	amplitude	+/- 0.15 V to 25 V (93 ohms)	+/- 0.15 V to 25 V (93 ohms)	+/- 0.15 V to 25 V (93 ohms)
239	delay	100 nsec to 25 seconds	100 nsec to 25 seconds	100 nsec to 25 seconds
240	double pulse	N	S/W Programmable	S/W Programmable
241	pulse burst count		1022	1022
242	Counter/Timer Stimulus:			
243	voltage levels	0 to 100 V	0 to 100 V	0 to 100 V
244	frequency range	DC to 10 MHz	DC to 10 MHz	DC to 10 MHz
245	duty cycle	0 to 99%	0 to 99%	0 to 99%
246	time delays		40 ns to 30 sec	40 ns to 30 sec
247	resolution of delay			
248	accuracy of delay			
249	pulse width		20ns min	20ns min
250	resolution of pulse width			
251	accuracy of pulse width			

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
252	digital to synchro generation	4	1	1
253	voltage level	11.8 Vrms	11.8 Vrms	11.8 Vrms
254	accuracy	Accuracy: 0.07 deg Resolution: 0.02 deg	Accuracy: 0.07 deg Resolution: 0.02 deg	Accuracy: 0.07 deg Resolution: 0.02 deg
255	power	1.25 VA (max)	1.0 VA	1.0 VA
256	Synchro Generation:			
257	quantity	4	1	10
258	angular range	0 to 360 deg	0 to 360 deg	0 to 360 deg
259	resolution	1.31 arc min.	1.31 arc min.	1.31 arc min.
260	angular rate	0 to 1080 degrees/sec	0 to 1080 degrees/sec	0 to 1080 degrees/sec
261	index ref position		0 deg	0 deg
262	reference voltage	26 Vac	26 Vac	26 Vac
263	voltage (synchro)	11.8 Vrms	11.8 Vrms	11.8 Vrms
264	reference frequency	400 Hz	400 Hz	400 Hz
265	frequency range	400 Hz	400 Hz	400 Hz
266	Function Generator:			
267	quantity	6	2	5
268	amplitude	0 to +/- 10 V	0 to +/- 10 V	0 to +/- 10 V
269	slew rate	500 V/usec	500 V/usec	500 V/usec
270	rise time	60 nsec	60 nsec	60 nsec

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
271	waveforms available:			
272	sine wave	Y	Y	Y
273	square wave	Y	Y	Y
274	ramp (sawtooth) wave	Y	Y	Y
275	triangle	Y	Y	Y
276	pulse	Y	Y	Y
277	frequency range	0.01 Hz to 2 MHz	0.01 Hz to 2 MHz	0.01 Hz to 2 MHz
278	arbitrary function	8 to 1024 points	8 to 1024 points	8 to 1024 points
279	special capabilities	dual phase mode		
280	Square Wave Output			
281	frequency range	See Pulse Generator Section	See Pulse Generator Section	See Pulse Generator Section
282	frequency accuracy	See Pulse Generator Section	See Pulse Generator Section	See Pulse Generator Section
283	frequency resolution	See Pulse Generator Section	See Pulse Generator Section	See Pulse Generator Section
284	phase shift range	See Pulse Generator Section	See Pulse Generator Section	See Pulse Generator Section
285	duty cycle	See Pulse Generator Section	See Pulse Generator Section	See Pulse Generator Section
286	amplitude	See Pulse Generator Section	See Pulse Generator Section	See Pulse Generator Section
287	AC Line of Sight Seeker (Loss)			
288	amplitude	50 mVrms to 4 Vrms	50 mVrms to 4 Vrms	50 mVrms to 4 Vrms
289	phase	-180 to +180 deg	-180 to +180 deg	-180 to +180 deg
290	frequency	50 Hz to 150 Hz	50 Hz to 150 Hz	50 Hz to 150 Hz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
291	**ANALOG MEASUREMENT**			
292	Digital Multi-Meter:			
293	DC range	0.0625 V to 512 V	+/- 0.0625 V to +/-500 V	+/- 0.0625 V to +/-500 V
294	DC resolution	+/- 0.05%	+/- 0.05%	+/- 0.05%
295	AC range	0.0625 V to 512 V	+/- 0.0625 V to +/-500 V	+/- 0.0625 V to +/-500 V
296	AC resolution	<=100 uv	<=100 uv	<=100 uv
297	current range		N	0 to 60 amp
298	current resolution		N	0.03% of FS
299	resistance range	0 to 10 Mohm	0 to 10 Mohm	0 to 10 Mohm
300	AC Voltage Ratio	1.5 to 6.0 percent	1.5 to 6.0 percent	1.5 to 6.0 percent
301	DC Voltage Ratio	to 1000:1	to 1000:1	to 1000:1
302	Frequency/Time Interval Counter:			
303	frequency range	2 Hz to 10 MHz	2 Hz to 10 MHz	2 Hz to 10 MHz
304	time interval range	up to 64 sec	50 nsec to 64 sec	50 nsec to 64 sec
305	input voltage range	up to 64 sec	50 nsec to 64 sec	50 nsec to 64 sec
306	count events			
307	Microwave Counter:	See RF Measurement	See RF Measurement	See RF Measurement
308	Frequency Response Analyzer	accomplished thru measurement system	accomplished thru measurement system	accomplished thru measurement system
309	Vector Voltmeter:		Y	Y

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
310	Sampling Signal Analyzer:			
311	resolution	15 bit	15 bit	15 bit
312	rate	to 200 KHz	to 200 KHz	to 200 KHz
313	resolution	5 usec	5 usec	5 usec
314	Waveform Digitizer:	accomplished thru measurement system	Y	Y
315	channels		2	2
316	input voltage range		+/- 500V	+/- 500V
317	frequency response		DC to 10MHz	DC to 10MHz
318	amplitude resolution		15 bits + sign bit	15 bits + sign bit
319	sampling interval		1usec to 68.7 secs	1usec to 68.7 secs
320	storage depth		1024	1024
321	sampling/conversion rate		1 GHz repetitive mode/330KHz single event	1 GHz repetitive mode/330KHz single event
322	Synchro-Resolver:			
323	angular range	0 to 360 deg	0 to 360 deg	0 to 360 deg
324	resolution	0.33 minute	0.33 minute	0.33 minute
325	angular rate (max)	0 to 360 deg/sec	0 to 360 deg/sec	0 to 360 deg/sec
326	reference voltage	26 Vrms +/- 5%	26 Vrms +/- 5%	26 Vrms +/- 5%
327	voltage (synchro)	11.8 Vrms	11.8 Vrms	11.8 Vrms
328	reference frequency	400 Hz	400 Hz	400 Hz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
329	accuracy	+/- 1.5 min	+/- 1.5 min	+/- 1.5 min
330	resolution		16 bits	16 bits
331	frequency range	400 Hz	400 Hz	400 Hz
332	index reference position		0 deg	0 deg
333	Oscilloscope:			
334	traces	2	See Video Section	See Video Section
335	bandwidth	DC to 25 MHz 4 wire bus	See Video Section 4 wire bus	See Video Section 4 wire bus
336	DC POWER			
337	PROGRAMMABLE:			
338	Low Voltage:			
339	quantity	7 supplies max complement depends on station	6 [(4) 40V 10 A, (2) 40V 15 A]	6 [(4) 40V 10 A, (2) 40V 15 A]
340	max. watts per supply	1225 Watts	(4) 400W, (2) 360 W	(4) 400W, (2) 360 W
341	max. voltage	Programmable to 35V	Programmable to 40 V	Programmable to 40 V
342	max. current	Programmable to 35 A	Programmable to 15 A	Programmable to 15 A
343	High Voltage:			
344	quantity	3	2 (150V 2A)	2 (150V 2A)
345	voltage range	90 V	programmable to 150 V	programmable to 150 V
346	max current	35 A	programmable to 2A	programmable to 2A
347	Current Source:		Y	Y

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
348	unit 1: amplitude	-300 uA to +300 uA	DC supplies are designed for Current source	DC supplies are designed for Current source
349	resolution	1 uA	capability using programmable	capability using programmable
350	unit 2-6: amplitude	-1 A to +1 A	constant current mode	constant current mode
351	resolution	32 uA		
352	FIXED:			
353	quantity	1 supply with 5 outputs	1 supply with 5 outputs	1 supply with 5 outputs
354	volts	+5, +15, -15, +120 ,-120 VDC	+5, +15, -15, +120 ,-120 VDC	+5, +15, -15, +120 ,-120 VDC
355	amperes	<1A	<1A	<1A
356	watts			
357	REFERENCE:			
358	quantity			
359	voltage range			
360	current			
361	AC POWER			
362	PROGRAMMABLE:			
363	number of phases	1 and 3	1 and 3	1 and 3, and varable up to 8 out-puts
364	frequency		400 and 800 Hz	progarammable eq (up to 8000Hz) & amps800 Hz
365	voltage	0-240 Vrms	5, (3ph.)115,@ 400Hz; (4 outputs) 26 @ 800Hz	5, (3ph.)115,@ 400Hz; (4 outputs) 26 @ 800Hz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
366	current		2A,15 A/Phase, and 2.125 A/ output	2A,15 A/Phase, and 2.125 A/ output
367	power		5432 Watts total power (including fixed 26V 400 Hz)	5432 Watts total power (including fixed 26V 400 Hz)
368	FIXED:			
369	Facility Power Feed-Through:	115/200 V, 400 Hz, 3 ph	None required 115 Vac 60 Hz or 230 Vac 50 Hz (facility pwr dpdnt)	None required 115 Vac 60 Hz or 230 Vac 50 Hz (facility pwr dpdnt)
370	Pulsed Signal:			
371	Stimulus Power for UUTs:	26 Vrms, 400 Hz, 1 phase 0-185 Vrms, 300-500 Hz, 4 VA, 3 ph. 0-144Vrms, 400Hz+/-20 300VA, 3 ph. 0-26Vrms, 400Hz+/-20, 1A, 1ph. 26 Vrms, 800 Hz, 1.5 VA 40-85 Vrms, 5600 Hz, 1 A 11.8 Vrms, 400 Hz, prog phase 11.8 Vrms, 400 Hz prog rate of ph. change	26 Vrms, 400 Hz, 1 phase,1 A 5 Vrms, 400 Hz, 1 phase, 2 A 115 Vrms, 400 Hz, Phase A, B, and C 15A/phase 26 Vrms, 800 Hz, (4 outputs) 1ph. 2.125A/output	26 Vrms, 400 Hz, 1 phase,1 A 5 Vrms, 400 Hz, 1 phase, 2 A 115 Vrms, 400 Hz, Phase A, B, and C 15A/phase 26 Vrms, 800 Hz, (4 outputs) 1ph. 2.125A/output varable voltage 0-115 VAC from 400-8000Hz
372	RF STIMULI			
373	SYNTHESIZERS:			
374	Synthesizer 1:		multiple ports	multiple ports
375	frequency range	10 MHz to 18 GHz	30 MHz to 18.5 GHz	30 MHz to 18.5 GHz
376	frequency resolution	10 Hz to 30 Hz	10 Hz to 30 Hz	10 Hz to 30 Hz
377	power range:			

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
378	w/o amplifier	+28.5 to -121 dBm (x-band for +28.5)	+5dBm 3GHz to 18.5GHz/ +16dBm .4GHz to 3GHz	+5dBm 3GHz to 18.5GHz/ +16dBm .4GHz to 3GHz
379	w/ amplifier			
380	PM:	Y (500 MHz to 18.5 GHz)	Y (500 MHz to 18.5 GHz)	Y (500 MHz to 18.5 GHz)
381	on/off ratio	60 dB (minimum)	60 dB (minimum)	60 dB (minimum)
382	rise/fall time	25 nsec (minimum)	25 nsec (minimum)	25 nsec (minimum)
383	min. pulse width	100 nsec	100 nsec	100 nsec
384	max. frequency	10 Hz to 1 MHz	10 Hz to 1 MHz	10 Hz to 1 MHz
385	pulse on pulse modulation	N	Y	Y
386	AM:	Y (30 MHz to 500 MHz)	Y (30 MHz to 500 MHz)	Y (30 MHz to 500 MHz)
387	frequency rate	10 Hz to 25 KHz	10 Hz to 25 KHz	10 Hz to 25 KHz
388	modulation depth	0 to 95 %	0 to 95 %	0 to 95 %
389	FM:	N	N	Y
390	frequency rate			200KHz
391	Phase Modulation:	N	N	Y
392	frequency rate			1 MHz
393	deviation			20 deg
394	IFF:	Y	Y	Y
395	frequency rate	1 GHz to 1.05 GHz	1 GHz to 1.05 GHz	1 GHz to 1.05 GHz
396	CW:			

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
397	Synthesizer 2:		Same characteristics as above this synethizer is located in MMU and is used as a reference	
398	frequency range			0.01 to 20GHz
399	power range:			
400	w/o amplifier			+10 to -90dBm
401	w/ amplifier			
402	PM:			
403	on/off ratio			>80 dB
404	rise/fall time			<10nsec
405	min. pulse width			25nsec min
406	max. frequency			
407	AM:			
408	frequency rate			10Hz to 100KHz
409	modulation depth			0-60 dB
410	FM:			
411	max rate			1 MHz
412	Fast Switching Synthesizer:		N	
413	frequency range			0.05GHz to 18GHz
414	power range			+10 to -107 dBm
415	frequency switching time			<100nsec

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
416	FM:			
417	rate			0.0625hz to 10 Mhz
418	deviation			0.125Hz to 20 MHz
419	AM:			
420	rate			0.0625Hz to 20 Mhz
421	depth			99.99%
422	Spread Spectrum Modulator/ Demodulator		N	
423	Modulation Signals:			
424	high accuracy AM			Y
425	(ILS and VOR)			Y
426	TACAN			Y
427	linear pulse			Y
428	FSK			Y
429	MSK			Y
430	BPSK			Y
431	QPSK			Y
432	OQPSK (GPS)			Y
433	Broadband Noise Source:		N	Y
434	frequency range			10MHz to 26.5GHz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
435	excess noise ratio			12-16 dB
436	Phase Noise:		N	Y
437	pulsed			x-Band
438	continuous wave (CW)			UHF, VHF, x-Band
439	bandwidth			100Khz
440	Stabilized Local Oscillator:	10 MHz	10 MHz	10 MHz
441	**RF MEASUREMENT**			
442	Spectrum Analyzer 1:		Limited capabilities accomplished via	Y
443	frequency range	10 MHz to 18.5 GHz	Microwave Measurement Unit	30Mhz to 18.5 GHz
444	with ext. mixers			
445	resolution bandwidth	10 Hz to 6 MHz		
446	video bandwidth			
447	input amplitude:			
448	log		-50dB (30Mhz - 2Ghz) -544dB (2Ghzhz - 12Ghz) -38dB (12Ghz - 18.5Ghz)	-50dB (30Mhz - 2Ghz) -544dB (2Ghzhz - 12Ghz) -38dB (12Ghz - 18.5Ghz)
449	linear			
450	Spectrum Analyzer 2:		N	Y
451	frequency range			
452	with ext. mixers			100Hz to 26.5 GHz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
453	resolution bandwidth			1Hz to 3Mhz
454	video bandwidth			-134 to +30 dBm
455	input amplitude:			
456	log			
457	linear			
458	Detection:			
459	Pulse	Y	Y	Y
460	AM	Y	Y	Y
461	FM	N	N	Y
462	Attenuation (dB)	Y (0-121dB)	Y (0-121dB)	Y (0-121dB)
463	Millivolt Meter:	Accomplished thru MMU and Measurement system	Accomplished thru MMU and Measurement system	Accomplished thru MMU and Measurement system
464	voltage range			
465	bandwidth			
466	Power bandwidth (MHZ):			
467	RF Power Meter:		dual channel	dual channel
468	power range	+30 to -70 dBm	+44 to -70 dBm	+44 to -70 dBm
469	frequency range	10 MHz to 18.5 GHz	100KHz to 18.5 GHz	100KHz to 18.5 GHz
470	CW Power Meter:			
471	power range	10 MHz to 18.5 GHz	10 MHz to 18.5 GHz	10 MHz to 18.5 GHz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
472	frequency range	+35 to -70 dBm	+44 to -70 dBm	+44 to -70 dBm
473	Noise Figure Meter:		N	Y
474	noise figure range			0 to 30dB
475	noise figure resolution			0.01 dB
476	frequency range			10 to 1600 MHz
477	frequency resolution			1 Mhz
478	Carrier Noise Tester:	Y (Phase noise)	N	Y
479	frequency range	x-band		UHF, VHF, x-Band
480	amplitude			
481	IF output bandwidth			10001zKhxz
482	IF output level			2V max
483	Sampling Signal Analyzer:	Y	Y	Y
484	SWR meas. range	Automatic 1.5:1 Semiautomatic 1.2:1	Automatic 1.5:1 Semiautomatic 1.2:1	Automatic 1.5:1 Semiautomatic 1.2:1
485	vector voltmeter:		N	Y
486	frequency range			100 KHz to 233 GHz
487	phase range			0 +/- 180 degrees
488	peak power meter:		N	Y
489	frequency range			50 MHz to 40 GHz
490	power range			-32 to + 20 dBm

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
491	Vector Network Analyzer:			
492	Network Analysis:		N	Y
493	frequency range			50 MHz to 20 GHz
494	time			
495	bandwdith			
496	max input			+20 dBm
497	noise level			-93 dBm
498	(complex/fundamental signal measurement)			
499	IF bandwidth			
500	sweep time			<5mSec/point (2 port)
501	Frequency Counter/Measurement:			
502	frequency counter:		Y	Y
503	frequency range	10 MHz to 18 GHz	30 MHz to 18.5 GHz	30 MHz to 18.5 GHz
504	accuracy	+/- 0.0001% +/- 10% @ 0.1 usec pulse +/- 0.1% @ 0.4 usec pulse +/- 0.01% @ 1 usec pulse +/- 0.01% @ 10 - 100 usec pulse	+/- 0.0001% +/- 10% @ 0.1 usec pulse +/- 0.1% @ 0.4 usec pulse +/- 0.01% @ 1 usec pulse +/- 0.01% @ 10 - 100 usec pulse	+/- 0.0001% +/- 10% @ 0.1 usec pulse +/- 0.1% @ 0.4 usec pulse +/- 0.01% @ 1 usec pulse +/- 0.01% @ 10 - 100 usec pulse
505	resolution	10 Hz (min)	10 Hz (min)	10 Hz (min)
506	RF pulse width	0.1 usec (min) to 100 msec	0.1 usec (min) to 100 msec	0.1 usec (min) to 100 msec
507	RF power level	-70 to +30 dBm	-20 to +33dBm	-20 to +33 dBm

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
508	sensitivity	-44 to 70 dBm (range dependent)	-20 dBm	-20 dBm
509	input power range	-20 to 33 dBm	-20 to 33 dBm	-20 to 33 dBm
510	Modulation Evaluation:			
511	*Pulse Modulation*			
512	frequency range	500 MHz to 18.5 GHz	500 MHz to 18.5 GHz	500 MHz to 18.5 GHz
513	pulse width	100 usec minimum	100 usec minimum	100 usec minimum
514	rise/fall time	10 nsec	10 nsec	10 nsec
515	dynamic range	60 dB	60 dB	60 dB
516	sensitivity	-20 dBm	-20 dBm	-20 dBm
517	PRF	200 Hz to 1 MHz	200 Hz to 1 MHz	200 Hz to 1 MHz
518	Amplitude Modulation			
519	frequency range	30 MHz to 500 MHz	30 MHz to 18.5GHz	30 MHz to 18.5GHz
520	modulation frequency	10 Hz to 25 KHz	10 Hz to 25 KHz	10 Hz to 25 KHz
521	sensitivity, valley	-40 dBm	-40 dBm	-40 dBm
522	accuracy	+/- 1 dB or 5%	+/- 1 dB or 5%	+/- 1 dB or 5%
523	Frequency Modulation	N	N	Y
524	frequency range			30Mhz to 18.5Ghz
525	modulation, frequency			
526	distortion			
527	spectrum			

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
528	RF Input Characteristics:			
529	frequency range	10 MHz to 18.5 GHz	10 MHz to 18.5 GHz	10 MHz to 18.5 GHz
530	input power	1-2 Watt average (100 peak {10 usec max})	1-2 Watt average (100 peak {10 usec max})	1-2 Watt average (100 peak {10 usec max})
531	impedance	50 ohms (nom.)	50 ohms (nom.)	50 ohms (nom.)
532	VSWR	1.35:1 to 1.7:1 (freq dependent)	1.35:1 to 1.7:1 (freq dependent)	1.35:1 to 1.7:1 (freq dependent)
533	**SPREAD SPECTRUM**			
534	Frequency range (Mhz)	N	N	N
535	Hop rate (hops/sec)	N	N	N
536	Code rate (chips/sec)	N	N	N
537	Modulation/Demodulation:			
538	amplitude modulation (AM)	Y	Y	Y
539	precision AM	Y	Y	Y
540	pulse modulation (PM)	Y	Y	Y
541	pulse on pulse modulation		Y	Y
542	frequency modulation (FM)	N	N	N
543	wideband FM			
544	narrowband FM			
545	frequency-shift keying (FSK)	N	N	N
546	binary phase shift keying (BPSK)	N	N	Y

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
547	continuous phase shift modulation (CPSM)	N	N	N
548	quadrature phase shift keying (QPSK)	N	N	N
549	offset quadrature phase shift keying (OQPSK)	N	N	N
550	Modulo-2	N	N	N
551	JTIDS:	N	N	N
552	TACAN		N	Y
553	VOR		N	Y
554	ILS	Y (not with JTIDS)	Y (not with JTIDS)	Y (not with JTIDS)
555	MSK			
556	GPS	N	N	Y
557	OPTICAL TESTING	See F-16 EO Table	See F-16 EO Table	See F-16 EO Table
558	LASER			
559	Transmitter:		N	Y
560	aperture			6" to 10" dia collimator
561	field of view			50 milleradians
562	Pulse Repetition Frequency (PRF)			5 to 25 Hz
563	Divergence			50 to 1000 microradianss
564	Range (kM)			+/- 5 meters

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
565	resolution (meters)			+/- 5 meters
566	energy input			3 to 300 millijoules
567	power density (measurement)			0.01 to 1.0 millijoules/sqr cm for 8" collimator
568	power density (stimulus)			10e-11 to 10e-12 joules/sqr cm
569	Wavelength			1.06 microns
570	Spectral Bandwidth			+/-0.01 microns
571	Angle of regard			90 to nadir
572	Polarization			no restriction
573	beam alignment range			+/- 2 deg of pointing direction
574	Receiver:		N	Y
575	sensitivity ranges			10e-17 to 10e-12 joules/sqr cm
576	range gate			0.5 to 10Kilometers
577	Field-Of-View (FOV):			20 to 500 milliradians
578	apertures			1" to 6" dia receiver aperature
579	FOV coincidence			FLIR/Laser 200 uradains, FLIR/ TV 20 uradians
580	coaxial			separate on FLIR and TV
581	wavelength			1.0 microns
582	acceptance PRF			5 to 25 Hz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
583	fiber optic types			50-100us dia core and cladding on plastic clad silica
584	separate aperture on coaxial			separate on FLIUR and TV
585	Tracker:		N	Y
586	sensitivity ranges			5.10-10 to 5.10-6 watts/sqr cm
587	range gate			0.5 to 10 kilometers
588	Field-Of-View (FOV):			30 deg circular
589	apertures			0.5 to 5.0 inches dia
590	coaxial			laser input
591	wavelength			1.06 microns
592	acceptance PRF			5 to 25 Hz
593	**INFRARED**		N	Y
594	Number of targets:			12
595	Range (degrees C)			10 deg C to 60 deg C
596	Resolution (degress C)			0.01 deg C
597	Aperture			6" to 10" dia collimator
598	Field of View (max)			3.4 deg
599	Field of View (min)			4 microns (40-60 urad), 10 microns (100-160 urad)
600	Source Spacial Freq.			3 to 14 microns

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
601	Spectral Bands			RS-170
602	Video Output			10 to 60 deg C
603	Source temperature			
604	VISUAL	See F-16 EO Table	See F-16 EO Table	Y
605	Number of targets			12
606	Size			1" dia typ
607	Spectral Band			0.4 to 1.1 micron
608	Video output			RS-170 typ
609	Effect. Source Lumin. @ TPS Entrance Aperture			0.1 to 10,000 footlamberts typ
610	INERTIAL TESTING			
611	Stimulus:		N	Y
612	static load	100 lbs		100 lbs
613	rate	0 to 300 deg/sec		0 to 300 deg/sec
614	acceleration	0-10 deg/sec		0-10 deg/sec
615	torque	3.6 ft-lbs		3.6 ft-lbs
616	positional accuracy	(+/- 30) sec of arc		(+/- 30) sec of arc
617	AUDIO TESTING			
618	Frequency Range	.01 Hz to 100 KHz	.01 Hz to 100 KHz	.01 Hz to 100 KHz
619	Resolution	.001 Hz	.001 Hz	.001 Hz

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
620	Display Range	Same as Frequency	Same as Frequency	Same as Frequency
621	Modes:	AFSK, FSK	AFSK, FSK	AFSK, FSK
622	**PRESSURE/PNEUMATICS**			
623	Stimulus:			
624	Pressure:			
625	static	0.5 to 34 in HG		0.5 to 34 in HG
626	total	0.5 to 99.99 in HG		0.5 to 99.99 in HG
627	differential	-30 to +30 in HG		-30 to +30 in HG
628	rate	0.1 to 40000ft/min		0.1 to 40000ft/min
629	**MAINTENANCE SOFTWARE**			
630	Built in test (BIT)	N	Y	Y
631	Confidence test(s)	Y	Y	Y
632	Self-calibration	Y - Via Calibration Cart	Y - On station via Cal Adapter	Y - On station via Cal Adapter
633	OAFI	Y	Y	Y
634	**CALIBRATION SIGNALS**			
635	DC voltage source:		+/- 2V, +/-10 V, =/-100 V	+/- 2V, +/-10 V, =/-100 V
636	resolution		+/-0.47uv, +/-2.4uv, +/-24.8uv	+/-0.47uv, +/-2.4uv, +/-24.8uv
637	AC voltage source:		32mVrms - 64 Vrms	32mVrms - 64 Vrms
638	resolution			
639	DC current:			

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
640	resolution			
641	AC current:		AC drives 10 kohms or greater impedance	AC drives 10 kohms or greater impedance
642	resolution			
643	resistance		100 ohm, 500, 5k, 50k, 500k, 5M ohms	100 ohm, 500, 5k, 50k, 500k, 5M ohms
644	resolution		accuracy = 0.01%	accuracy = 0.01%
645	current capacity			
646	ATS CHARACTERISTICS			
647	Special Design Equipment:		Interlock system in Interface, LRU DC & AC Power Supplies, & LRU cooling units to protect LRUs	Interlock system in Interface, LRU DC & AC Power Supplies, & LRU cooling units to protect LRUs
648	Transportibility:	Van Installation Available	Two Man Portable	Two Man Portable
649	Internal Cooling:		Internal, station controlled blower & refrigeration units for UUTs	Internal, station controlled blower & refrigeration units for UUTs
650	Threat Simulators:			
651	type threats	programmable	programmable	programmable
652	quantity	4	4	4
653	output:			
654	voltage	+/- 10 V	0 +/- 5 V	0 +/- 5 V
655	current	+/- 0.2 Amp/channel	+/- 0.1 A(max)/channel	+/- 0.1 A(max)/channel

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
656	bandwidth	0.01 Hz to 1 MHz	0.01 Hz to 1 MHz	0.01 Hz to 1 MHz
657	coded waveforms	multiple	multiple	multiple
658	DEPLOYMENT DATA			
659	Size/Weight:			
660	number of 463L pallets (air transportable gear)	8	1	1
661	size/configuration (fixed gear)	247 sq-ft per shipping configuration	66 sq-ft per shipping configuration	dependent on station config
662	weight (lbs)	5108 to 6707 lbs (config dependent)	approx 2700 lbs	dependent on station config
663	footprint	281 sq-ft (does not include operator areas)	279 sq-ft including operator & maintenance space	dependent on station config
664	ENVIROMENTAL DATA			
665	Ambient Temp (for operation)	10 to 35 deg Centigrade	Oper: 5-40 deg C, Tested -5-45 deg C, Storage -40 to +65 C	Oper: 5-40 deg C, Tested -5-45 deg C, Storage -40 to +65 C
666	Humidity	20 % to 65 %	Oper: 0 to 95% non-condensing (MIL-STD 210); Storage: 0 to 100%	Oper: 0 to 95% non-condensing (MIL-STD 210); Storage: 0 to 100%
667	external cooling source required	35 psig @ 50 scfm	None required	None required
668	heat generation	45,631 BTU/hr (max)		
669	Internal Refrigeration Unit:			
670	use	for UUT only	for UUT only	for UUT only

Table D-3. - Specification Summaries for F-16 ATE (AIS & IAIS) (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)	IAIS w//EXTENDED CAPABILITY
671	air temperature		27 deg C, +5 to -10 deg range	27 deg C, +5 to -10 deg range
672	shock tested	MIL-STD-810	Y	Y
673	vibration tested	*16PS003*, para 3.2.3.4	Y	Y
674	water resistance tested		Y	Y
675	Input Power Requirements:		Any one of the following options: 230V+/-15% 50Hz+/-3 or 208V+/-10% 60Hz+/-6 or 200V+/-10% 400+/-40Hz	Any one of the following options: 230V+/-15% 50Hz+/-3 or 208V+/-10% 60Hz+/-6 or 200V+/-10% 400+/-40Hz
676	60 Hertz	120/208V, +5%, -10%	60Hz is not required	60Hz is not required
677	400 Hertz	115/200V	400Hz is not required	400Hz is not required
678	DC	No DC is required	No DC is required	No DC is required
679	current load	22 KVA (max) 115/200V 400Hz, 7 KVA (max) 120/208V 60Hz	18 KVA (max)	18 KVA (max)

Table D-4. -Specification Summary F-16 Electro Optics (EO) Testing

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)
1	Special F16 AIS Capabilities		
2	Optical/Video Testing Capabilities		
3	Placement Accuracy		
4	Measuring Point Circle	Accuracy	Accuracy
5	0 degrees	+/- 1'	+/- 1'
6	4.5 degrees	+/- 1.5'	+/- 1.5'
7	10 degrees	+/- 3'	+/- 3'
8	14 degrees	+/- 4'	+/- 4'
9	Raster Brightness (day)		
10	Shades of Grey Verified	6	8
11	Contrast Ratio Peak White		
12	To 50 foot lamberts, (fL)	>8:1	>8.1
13	Raster Brightness (night)		
14	Shades of Grey Verified with Peak White adjusted to 0.5 fL +/- 0.1 fL	6	8
15	Raster Resolution (verified)	>=10%	>=10%
16	Symbol Line Brightness		
17	Average	>1600 fL	>1600 fL
18	Variation		

Table D-4. -Specification Summary F-16 Electro Optics (EO) Testing (Continued)

ROW #	ATE SPECIFICATION ITEM	F16 AIS	IAIS (F16 DOWNSIZE)
19	10 degree Circle	+/-20%	+/-20%
20	Total Field of View	+/-40%	+/-40%
21	Parallax		
22	Acceptable Range	0 to 20mv	0 to 20mv
23	Accuracy	Converging +/-0.1mv (+/-20arc sec)	Converging +/-0.1mv (+/-20arc sec)
24	Display Measurements		
25	Luminance	0.02 - 10,000 fL	0.02 - 10,000 fL
26	Range	+/-10%	+/-10%
27	Accuracy	+/- 7%	+/- 7%

APPENDIX E. ATS DATA SUMMARIES

Tables E-1, E-2, and E-3 provied detailed data summaries for the 15 Army, Navy, and Air Force selected weapon systems respectively. Table E-4 a listing of the escalative indices by fiscal year (FY) used throughout this study to convert all amounts to consistent FY 1993 dollars [Indices 1992].

Contents of Appendix E

Table E-1: Detailed ATS Data Summaries for Selected Army Weapon Systems.

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY*		QTY	Type	R & D	Production	R&D	Production
ABRAMS	AN/USM 410	2	D Level	34	LRU/SRU	0.652	3.199	6.785	1.378
	DSESTS	198	I, D Level	34	LRU/SRU	8.413	179.342	5.141	30.294
	DIT-MCO	1	D Level	92	Cables	0	0.176	0	0.230
	LASER RANGE TELESCPOPE	1	D Level						
	Cummulative	**202**		**160**		**9.065**	**182.717**	**11.926**	**31.902**
BRADLEY	AN/USM-410	3	D Level	46	LRU/SRU	0.978	4.800	9.180	2.800
	DSESTS	227	I, D Level	29	LRU/SRU	9.615	204.962	4.385	29.624
	Cummulative	**230**		**75**		**10.593**	**209.762**	**13.565**	**32.424**
APACHE	EETF	22	I, D, F Level	75	LRU/SRU	26.690	219.21	14.980	33.429
	Ditigial Signal	5	F Level				4.131		
	Low Power RF	5	F Level				4.131		
	Radar Systems	5	F Level				4.131		
	Processor Test Set	5	F Level				4.131		
	Assembly Test Set	5	F Level				4.131		
	Cummulative	**47**		**75**		**26.690**	**239.865**	**14.980**	**33.429**

Table E-1: Detailed ATS Data Summaries for Selected Army Weapon Systems. (Continued)

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY*		QTY	Type	R & D	Production	R&D	Production
MLRS	MSM-105	1.65	I Level	12	LRU	0.538	2.634	2.395	0.402
	AN/USM-410	0.15	D Level	25	LRU/SRU	0.049	0.239	4.989	0.076
	BSTF	9.4	I Level	10	LRU/SRU	2.540	20.680	2.582	4.700
	CEE	1	D, F Level	35	LRU/SRU	0.270	1.860	9.036	0.175
	DIT-MCO	2	D Level	16	Cables	0.000	0.352	0.000	0.080
	Cummulative	**14.2**		**98**		**3.397**	**25.764**	**19.002**	**5.433**
AVENGER	CEE	2	D, F Level	29	LRU/SRU	0.540	3.881	7.468	0.309
	BSTF	33	I Level	7	LRU/SRU	8.910	74.977	1.803	1.224
	EOB (BSTF)	13.2	I Level	0	LRU/SRU	7.792	29.99	0	0
	Cummulative	**48.2**		**36**		**17.242**	**108.848**	**9.271**	**1.533**

* A fractional quantity indicates that the identified ATS is used in support of another weapon system. The quantity stated reflects the service estimate of the prorated work load share assigned to the respective ATS.

Table E-2: Detailed ATS Data Summaries for Selected Navy Weapon Systems

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY*		QTY **	ITA/ID	R & D	Production	R&D	Production
A-12	AN/USM-636 CASS	62	I & D Level	80 M 435 C	40 87	24.771	155.210	59.581 123.725	95.098 1.371
	Cummulative	**62**		**515**	**127**	**24.771**	**155.210**	**183.576**	**96.469**
AMRAAM	AN/USM-636 CASS RF/ HYB	14	I & D Level	16 M 20 C		4.178	26.180	49.128	18.122
	AN/USM-636 CASS MTS	13	I & D Level	1 (Missile) 1 (Section)		6.140	32.189	13.646	
	Cummulative	**27**		**39**		**13,760**	**58.369**	**62.772**	**18.122**
F/A 18	AN/USM-470(V) 1 MV	58	I & D Level	43 M	27	39.296	290.757	25.768	21.852
	AN/USM-446 RSTS	55	I & D Level	6 M; 21 C	27	10.000	130.789	19.970	35.349
	AN/ASM-686 IATS	31	I & D Level	27 M	27	11.337	30.384	32.913	16.003
	AN/USM-629 EOTS	34	I & D Level	11 M	11	21.459	49.985	5.646	12.446
	AN/USM-392B DMTS	14.4	I & D Level	18 C	18	10.668	5.553	4.100	1.105
	AN/ASM-608V IMUTS II	49	I & D Level	3 M	3	4.020	22.759	5.000	3.986
	AN/USM-458C NEWTS	28.2	I & D Level	7 M	7	14.291	14.393	6.936	7.367
	AN/USM-484 HTS	88	I & D Level	1 M; 44 C	39	3.332	45.718	8.053	22.962
	AN/USM-636 CASS RF	31	I & D Level	16 M; 106 C	21	9.252	59.808	41.086	28.120
	Cummulative	**388.6**		**303**	**180**	**123.655**	**650.146**	**149.471**	**149.190**

Table E-2: Detailed ATS Data Summaries for Selected Navy Weapon Systems (Continued)

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY		QTY.	ITA/ID	R & D	Production	R&D	Production
F/A 18 OFFLOAD	AN/USM-470(V) 1 MV	31	I & D Level	15 M; 3 C	9	9.252	41.571	18.240	18.202
	AN/USM-446 RSTS	31	I & D Level	5 M; 21 C	8	9.252	63.953	16.851	14.365
	AN/USM-458C NEWTS	1	I & D Level	8 M	4	0.298	2.063	12.624	16.585
	AN/USM-392B DMTS	1	I & D Level	18 C	4	0.298	2.063	8.345	5.068
	Cummulative	**64**		**70**		**19.100**	**109.650**	**56.060**	**54.220**
MK 50	MK 664 System Test Set	10	I & D Level	30 M	12	17.350	19.661		
	Cummulative	**10**		**30**	**12**	**17.350**	**19.661**		
SQQ-89(V) ASW SYSTEM	Tektronics S3270 ATS	3	D Level, Factory	8 M 2 C	8 2		0.500	0.015 0.015	
	HP 3060 Board Test System		Factory						
	HP 3065 AT Board Test System		Factory						
	GENRAD 2272 Test Station		Factory						
	Teradyne L210 ATE		D Level Factory	14 M 19 C	14 19		1.000	0.015 0.015	
	Martin Marietta C902268 Telemetry Drive Module Tester		Factory						

Table E-2: Detailed ATS Data Summaries for Selected Navy Weapon Systems (Continued)

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
SQO-89(V) ASW SYSTEM (con't)	Martin Marietta C902188 Acoustic Module Computer Tester		Factory						
	Martin Marietta C902249 HDG Depth Temp Module Tester		Factory						
	RSSD TS 3042 Automated Analog Module Test Set		Factory						
	DIT-MCO 8213/9100		Factory						
	3H Ind PT 900 Power Supply Test Station		Factory						
	Loral 87003 Exciter Test Console		Factory						
	HP Model 80 Analog Tester	1	D Level	1 M 1 C	1 1			0.028 0.028	
	AN/USM192 TAT Transportable Analog Tester	6	D Level	6 M 4 C	6 4		0.185	0.012 0.012	
	AN/GOM-4	4	D Level	8 M	8			0.030	
	Cummulative	**14**		**63**	**18**		**1.685**	**0.170**	

* A fractional quantity indicates that the identified ATS is used in support of another weapon system. The quantity stated reflects the service estimate of the prorated workload share assigned to the respective ATS.

** C stands for cards or SRAs, M stands for modules or WRAs.

Table E-3: Detailed ATS Data Summaries for Selected Air Force Weapon Systems

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY *		QTY/ TYPE**	ITA/ID	R & D	Production	R&D	Production
ACM	GSM-348 Guided Missile Test Set	2	D Level	3 M 10 C	3 10	4.560	3.193	10.271	1. 141
ACM	System Acceptance Test Equipment (SATE	1	D Level	2 M	2	2.850	2.825	3.078	.342
ACM	Automatic Depot Inertial Navigatiion Test Station	2	D Level	1 M 1 C	1 1	3.534	4.674	8.209	.912
ACM	Electronic Systems Test Set (ESTS) AN/GSM-263F	6 5	D Level I Level	2 M 4 C	2 4	5.385	1.228	5.815	2.736
ACM	**Cummulative**	**16**		**23**	**23**	**16.330**	**11.921**	**27.373**	**5.132**
C17-A	Intermediate	6	I Level Training	38 M 9 M			50.111	18.423	3.402
C17-A	Depot	6	D Level	356 C				116.499	29.125
C17-A	**Cummulative**	**12**		**394**			**50.111**	**134.922**	**32.527**
F-15 A/B Depot ATS	ALM 205	3	D Level	39 C	39	17.014	15.058	16.307	4.892
F-15 A/B Depot ATS	ALM 206	2	D Level	21 C	21	5.671	4.014	6.380	2.634
F-15 A/B Depot ATS	ALM 205A	3	D Level	88 C	88	9.446	11.939	30.786	5.779
F-15 A/B Depot ATS	ALM 206A	2	D Level	49 C	49	3.149	3.439	12.034	3.218
F-15 A/B Depot ATS	MADTS	3	D Level	20 C	16	2.980	16.004	5.960	1.316
F-15 A/B Depot ATS	DADTS	3	D Level	57 C	46	3.725	15.337	17.363	2.454
F-15 A/B Depot ATS	AADTS	5	D Level	160 C	105	13.658	72.238	42.536	3.091
F-15 A/B Depot ATS	**Sub-totals**	**21**		**434**	**364**	**55.643**	**138.023**	**131.367**	**23.383**

Table E-3: Detailed ATS Data Summaries for Selected Air Force Weapon Systems (Continued)

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY *		QTY./ TYPE**	ITA/ID	R & D	Production	R&D	Production
F-15 C/D Depot ATS	ALM 205B	8	D Level	78 C	78	9.656	43.661	20.957	6.549
	ALM 206B	1	D Level	13 C	13	1.371	2.519	3.493	1.092
	CGDTS-70	5	D Level	48 C	40	4.044	41.360	9.191	1.168
	MADTS	3	D Level	20 C	16	0.000	0.000	0.000	0.000
	DADTS	3	D Level	57 C	46	0.000	0.000	0.000	0.000
	AADTS	5	D Level	330 C	105	0.000	0.000	30.906	3.270
	Memory Module Test Stations (L293-10)	3	D Level	26 C	21	1.419	30.869	8.271	1.167
	Depot Avionics Radar Test Stations (ASM-467)	3	D Level	21 C	8	15.967	37.256	22.599	2.456
	Sub-totals	**31**		**593**	**327**	**32.457**	**155.665**	**95.417**	**15.702**
F-15E Depot ATS	ALM 205B	8	D Level	92 C	92	0.000	0.000	3.179	1.915
	ALM 206B	1	D Level	13 C	13	0.000	0.000	0.000	0.000
	CGDTS-70	5	D Level	62 C	54	0.000	0.000	1.926	0.095
	MADTS	3	D Level	20 C	16	0.000	0.000	0.000	0.000
	DADTS	3	D Level	57 C	46	0.000	0.000	0.000	0.000
	AADTS	5	D Level	398 C	166	0.000	0.000	13.058	1.713
	Memory Module Test Station (L293-10)	3	D Level	63 C	55	0.000	0.000	10.880	1.793
	Depot Avionics Radar Test Stations (ASM-4)	3	D Level	21 C	8	0.000	0.000	0.000	0.000
	Sub-totals	**31**		**726**	**450**	**0.000**	**0.000**	**29.043**	**5.517**

Table E-3: Detailed ATS Data Summaries for Selected Air Force Weapon Systems (Continued)

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY *		QTY./ TYPE**	ITA/ID	R & D	Production	R&D	Production
F-15 A/B AIS	Atenna A&B (AN/GSM-228)	14	I Level	3 M	3	7.538	48.978	3.000	19.740
	CNI (Comm/NAV/IFF (AN/GSM-230)	19	I Level	15 M	15	6.154	44.338	5.700	17.100
	I&C (Indicators & Controls (AN/GSM-229)	21	I Level	20M	20	5.385	38.688	7.000	25.200
	Computer (AN/GSM-231)	26	I Level	24 M 5 C	24 5	3.846	89.413	19.108 3.981	10.672 1.038
	Display (AN/GSM-232)	25	I Level	14 M	14	10.577	95.185	86.154	17.850
	Microwave (AN/GSM-233)	18	I Level	5 M	5	3.846	48.637	14.000	12.060
	TISS (AN/ALM-246)	2	I Level	23 M	14	0.000	9.460	0.000	3.563
	TITE (AN/ALM-173)	16	I Level	9 M 13 C	9 9	14.231	110.769	107.308 31.154	12.295 5.538
	Sub-totals	**141**		**131**	**118**	**51.577**	**485.468**	**277.404**	**125.056**
F-15 C/D AIS	Antenna A&B (AN/GSM-228)	12	I Level	3 M	3	0.000	36.846	0.000	16.920
	Antenna A&B - Multi-stage Improvement Program	1	I Level	3 M	3	7.880	3.070	0.000	0.528
	CNI (COMM/NAV/IFF) (AN/GSM-230)	13	I Level	15 M	15	0.000	30.337	0.000	10.500
	I&C (Indicators & Controls (AN/GSM-229)	13	I Level	23 M	23	0.000	23.950	0.359	2.100
	Computer (AN/GSM-231)	15	I Level	24 M 5 C	24 5	0.000	51.584	0.000	6.157 1.283
	Display (AN/GSM-232)	15	I Level	20 M	20	0.000	57.111	12.608	15.300
	Microwave (AN/GSM-233)	15	I Level	7 M	7	0.000	40.531	0.683	17.100
	MTS (85 MSIP)	1	I Level	9 M	9	0.000	2.948	3.546	1.371
	TISS (AN/ALM-246)	14	I Level	23 M	14	12.087	66.219	70.133	24.944
	TITE (AN/ALM-173)	11	I Level	9 M 13 C	9 9	0.000	76.154	0.000	8.453 3.808
	Sub-totals	**110**		**154**	**141**	**19.967**	**388.750**	**87.329**	**108.463**

Table E-3: Detailed ATS Data Summaries for Selected Air Force Weapon Systems (Continued)

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY *		QTY./ TYPE**	ITA/ID	R & D	Production	R&D	Production
F-15 E AIS	Aircraft Radar Test Station	6	I Level	3 M	3	10.853	24.837	0.131	0.852
F-15 E AIS	Mobile Electronic Test Set (METS) (AN/USM-617)	12	I Level	22 M	12	0.409	10.039	0.600	13.204
F-15 E AIS	Display (AN/GSM-233)	12	I Level	14 M	14	0.000	32.424	0.000	8.040
F-15 E AIS	Microwave (AN/GSM-232)	12	I Level	5 M	5	0.000	45.689	0.000	8.568
F-15 E AIS	TISS - (AN/ALM-246)	7	I Level	23 M	14	0.000	33.110	0.000	12.472
F-15 E AIS	**Sub-totals**	49		67	48	11.262	146.099	0.731	43.136
F-15	Down Sized Tester (DST) - estimated	61	I-Level	97M	62	2.000	84.900	82.300	45.400
F-15	**CUMMULATIVE**	402				172.906	1,398.905	703.560	366.657
F-16 Depot ATS	TI Digitial Test Station	6	Factory, D Level	224 C	132	1.063	5.305	25.464	5.766
F-16 Depot ATS	Analog Test Station	13	Factory, D Level	218 C	125	17.147	2.862	33.165	5.574
F-16 Depot ATS	Micro Wave Test Station	11	Factory, D Level	42 C	27	6.657	21.499	12.099	3.018
F-16 Depot ATS	HI Digital Test Station	5	Factory, D Level	107 C	36	11.513	11.797	22.561	1.872
F-16 Depot ATS	FACT II	1	D Level	116 C	54	0.000	0.206	4.142	0.266
F-16 Depot ATS	DUST	8	D Level	46 C	46	0.120	2.154	0.710	1.248
F-16 Depot ATS	**Cummulative**	44		753	420	36.501	43.822	98.142	17.744

Table E-3: Detailed ATS Data Summaries for Selected Air Force Weapon Systems (Continued)

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
F-16 I-Level ATS	A/B AIS	104	Factory I Level D Level	52 M 40 M 52 M	42 33 42	146.929	267.477	71.229	56.962
	C/D AIS	72	Factory I Level D Level	69 M 58 M 69 M	52 43 52	129.693	235.923	20.423	61.770
	Advanced Computer	160	Factory I Level D Level	76 M 46 M 76 M	52 30 52	29.389	425.096	20.814	112.857
	• IAIS	64	Factory I Level D Level	22 M 22 M 22 M	18 18 18	89.371	102.365	41.300	27.533
	Cummulative	**400**		**219**	**164**	**395.383**	**1,030.860**	**153.767**	**259.122**
F-22 CATS EMD	Digital	50	DEV	75 M	75		33.099	12.078	
	PS/Analog	9	DEV	75 M	75		5.029	17.769	
	RF/Digital	42	DEV	36 M	36		33.711	11.484	
	RF/Microwave	27	DEV	47 M	47		31.253	10.990	
	EO	20	DEV	14 M	14		24.518	19.208	
	System	2	DEV	6 M	6		2.968	17.490	
	Sub Totals	**150**		**253**	**253**	**25.000**	**130.577**	**89.019**	**7.402**
F-22 FACTORY	Digital	50	F Level	75 M	75		4.965	6.643	
	PS/Analog	9	F Level	75 M	75		0.754	9.773	
	RF/Digital	42	F Level	36 M	36		5.057	6.316	
	RF/Microwave	27	F Level	47 M	47		4.688	6.044	
	EO	20	F Level	14 M	14		3.678	10.564	
	System	2	F Level	6 M	6		0.445	1.370 2.250	
	Sub Totals	**150**		**253**	**253**	**3.750**	**19.587**	**42.960**	**11.979**

Table E-3: Detailed ATS Data Summaries for Selected Air Force Weapon Systems (Continued)

	ATS		Application	TESTED ITEMS		ATE COSTS (FY93 $M)		TPS COSTS (FY93 $M)	
	NAME	QTY *		QTY./ TYPE**	ITA/ID	R & D	Production	R&D	Production
F-22	RF/Microwave								
	EO								
	Sub Totals	20		15	15	5.500	35.752	5.509	6.665
F-22 DEPOT	Digital	3	D Level	75 M	75		2.284	1.812	
	PS/Analog	3	D Level	75 M	75		1.928	2.665	
	RF/Digital	3	D Level	36 M	36		2.769	1.723	
	RF/Microwave	3	D Level	47 M	47		3.993	1.648	
	EO	3	D Level	14 M	14		4.229	2.881	
	System	3	D Level	6 M	6		5.120	0.374 2.250	
	Sub Totals	18		253	253	5.000	20.323	13.353	25.166
F-22	Cummulative	338		774	774	39.250	206.239	150.391	51.212

* C Stands for cards or SRU's, M Stands Modules or LRUs

Table E-4 : Fiscal Year (FY) - Escalation Indices used in All Analyses [Indices 1992]

FY	Escalation Indices
1969	3.970
1970	3.833
1971	3.61
1972	3.398
1973	3.126
1974	2.917
1975	2.682
1976	2.483
1977	2.223
1978	2.025
1979	1.838
1980	1.673
1981	1.549
1982	1.460
1983	1.399
1984	1.354
1985	1.313
1986	1.272
1987	1.228
1988	1.183
1989	1.140
1990	1.102
1991	1.066
1992	1.033
1993	1.000
1994	0.969
1995	0.938
1996	0.909
1997	0.881

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REFERENCES

[AF Depot] Air Force. Action Item Response. WR-ALC ATE (Partial Listing), McCranie, Rodney, 25 June 1992; OO-ALC Testers. Undated; and SM-ALC ATE equipment. Hanson, Jeff. Undated. Depot ATS at SM-ALC that is non-weapon Specific. Lawson, Dave.

[AMRAAM 1992] Simmons, Don. Air Force. Generic Factory STE Acquisition & Depot Planning. 20 April 1992.

[APACHE 1991] Cost/Benefit Analysis of the AH-64 Helicopter ATE. September 1991.

[Apache/F-16 AIS 1992] General Dynamics. F-16 AIS vs. Apache. 28 April 1992.

[Army Depot 1992] Army. HQ DESCOM TMDE/ATE Branch. Army Depot ATE and Utilization Data (-1 and-2). 23 March 1992.

[ATE 1976] ATE Ad Hoc Working Group. Report on Navy Issues Concerning Automatic Test Monitoring and Diagnosing System and Equipment. 13 February 1976.

[ATE History] General Dynamics. Briefing Charts AF ATE History. Submitted by AF, TIM. Undated.

[CAIG] OASD, CAIG. F-16 A/B Avionics Intermediate Shop Cost Analysis Study. Undated.

[CASS 1992] NAVAIR Briefing. ATE/CASS P^3I Planning. 25 March 1992.

[CATS 1992] Air Force. Tim Action Item Response. CATS Manufactures Equipment Listing. 9 June 1992.

[CECOM Dec 1983] Army TMDE. Army Digital Test Requirements Report. CECOM-80-0520-2. December 1983.

[CECOM Jul 1983] Army TMDE. Army Digital Test Requirements Analytic Report. CECOM-80-0520-1. July 1983.

[CIP] Navy. CASS Introduction Plan (CIP), Air 552. 30 April 1993.

[Evanovich] Evanovich, Peter J. Center of Naval Analysis. Avionics Support (Briefing). Undated.

[F/A-18 1992] Navy. Review of TRDS for the F/A-18 Radar Set. TIM Action Item Response. 5 May 1992.

[FAR 1992] Federal Acquisition Regulation Part 45 Definitions & Policy. 11 June 1992.

[Frost 1983] Frost & Sullivan, Inc. The Military Test Equipment Market in the U.S. A1213. August 1983.

[Frost 1990] Frost & Sullivan, Inc. The U.S. Market for Military Test Equipment, Winter 1990/1991. A2375. 1990.

[GFE ATE 1991] Army. Special Tools and Test Equipped AT Factories SSEDS MICOM, AVSCOM. MICOM, AV SCOM, TA COM, Factory Test Equipment, 4 June 1992.

[IFTE 1989] TRADOC. IFTE Cost and Operational Effectiveness Analysis. January 1989

[Indices 1992] OASD (PA&E). DoD Escalation Indices. 16 March 1992.

[JIAWG 1992] CASS Compatibility Analysis of JIAWG Components. Navy. 18 May 1992.

[Koto 1989] Lockheed Corp. F-22 Support Briefing by Tairo Koto, to R. Rolfe and C. Fisher, 1989.

[MATE 1990] ASD/Softech. MATE Effectiveness Evaluation Report. 90-1001-0630. 30 November 1990.

[McComb 1992] McComb, Donald. WP-ALC. Air Force. Background Paper on Air Force Depot Use of Factory Test Equipment (FTE).

[Merrill] Merrill Captain. CASS Program Office. CASS Briefing. Undated.

[Mosemann 1992] Mosemann, L.K. AF: Policy for Use of Ada & ATLAS for Automatic Test Systems. 18 February 1992.

[NAEC 1982] Naval Air Engineering Center, Lakehurst N.J. 1982, Test Requirement Analyses. NAEC-MICS-82-01-479.

[Najarian 1991] Najarian Captain. Driving Down the Cost of Support (Aviation Log Officer's Conference). 19 November 1991.

[Navy Report] Navy. Action Item Response. Percent Common Report ATE. Undated.

[STERN 1992] Private Communicate between Dr. R. Rolfe (IDA) and Mr. B. Stern (Hewlett Packard). October 1992.

[TADS/PNUS 1992] Air Force Tim Action Item Response. TADS/PNUS Targeting and Night-Vision System Test Requirement Review. 1 May 1992.

[TPS-DEVEL 1992] Navy, NAVAIR. TPS Development Cycle, Action Item. 13 March 1992.

[Vertical 1992} Navy. Factory Testing/Vertical Testability Navy Viewpoint. 10 April 1992.

[VXI 1992] Willis, Wayne. VXI Journal. Vol. 3. No. 3, Fall 1992, P.7 "VXI, 5 years Later".

BIBLIOGRAPHY

Air Force. Action Item Response. ACM Maintenance Concept (FAX) 9 April 1992.

Air Force. Action Item Response. Ada Based Environment for Test (ABET) (Briefing). 25 March 1992.

Air Force. Action Item Response. CATS-WA/ATIF (Briefing) 22 January 1992.

Air Force. Air Force Guide Specification, Integrated Diagnostics. AFBS-87256. 30 April 1991

Air Force. AFSC/AFLC Policy Memorandum. Policy on a Preferred Architecture for Automatic Test Equipment. 16 May 1990.

Air Force. AF/SA/ALC/LDAT ATS Baseline Survey Analysis (Interim Report). Project Status Briefing. September 1991.

Air Force AFSC/LDAT. Joint Command Commercial off-the-shelf (COTS) Supportability Working Group (CSGW) Final Report. 4 October 1991.

Air Force. Appleton, Gary. Minutes of Testability and Diagnostics Session #3 (Air Force Logistics Visions Workshop) 27 May 1992.

Air Force. ASD/AEG. Tompkins Colonial. JLC Automatic Testing Panel MATE/CSS/IFTE Analysis Presentation (Briefing). 9 April 1985.

Air Force. ASD/ALX Letter. F-15 E Nuclear Encoder/Decoder (E/D) and Power Supply (PS) Depot MATE Application Baseline Review (Letter). 21 July 1988.

Air Force. ASD Brief/ATS (CATS Program Requirements). 22 January 1992.

Air Force. ASD/ENE. Weapon System Maintenance Concept, Weapon System: C-17 (FAX). 2 April 1992.

Air Force. ASD/YPLS Action Item Response. Department of Defense ATS Investment Strategy Study F-16 Intermediate Level AIS. 2 April 1992.

Air Force. Automatic Test System (ATS) Acquisition - IDEFO Process. 6 March 1992

Air Force. Automatic Test Equipment Integrated Commodation Management Concept of Operations plan for the F-15 Downsized Tester Program (unsigned). December 1991

Air Force. ASD/AEG Letter. Waiver Request AN/ALQ-117/172 Depot Tester. 21 January 1986.

Air Force. ASD/ENEME Letter. Information Foreclosure of Action Item 1, Tim #$. 12 May 1992.

Air Force. ESD/EN Letter. Embedded Computer Resource Personnel Survey. 5 March 1992.

Air Force. ESB/EN Letter. Embedded Computer Resource Survey. 5 May 1992.

Air Force. F/A-18 Program Update for ILSMT. 7 April 1992.

Air Force. F-15 Avionics Intermediate shop Obsolete Component Analysis (C&CNI Test). Undated.

Air Force. F-16 AIS Support System Alterative Study Find Briefing. 31 May 1989.

Air Force. F-111 Digital Flight Control Computer (DFCC) Depot Automatic Test Equipment Selection and Cost Assessment Study. 6 July 1990.

Air Force. Integrated Weapon Systems Management Concept of Operations Plan for ATE. 27 January 1992.

Air Force. Kunay, Ed. F-22 Automatic Test Systems. 10 April 1992.

Air Force. Lambert SmSgt. Action Item Response. Air Force ATE Acquisition - Current Process.

Air Force. MATTOPPU, ASD/AEGB. TIM Presentation. Modular Automatic Test Equipment Program and Policies Briefing 13 March 1992.

'Air Force. McComb, Donald. WRALC/LNPC. Test Program Sets TPS Development Environment. 30 April 1992.

Air Force. Modular Automatic Test Equipment (MATE) Waiver for the Battle (BMS). 31 March 1987.

Air Force. Paper on Air Force Depot ATE Standardization Undated.

Air Force. Request for MATE Waiver for the Radar Module Test Station (RMTS). 3 June 1987.

Air Force. SAALC/MMTM Letter. SOF Common Intermediate Level Support Equipment. 21 March 1988

Air Force. SAF/AQ. Memorandum. Direction for the Development and Acquisition of Automatic Test Systems (ATS). 30 July 1992.

Air Force. Simmons, Don. Tim Action Item Response. AMRAAM Factory Test Equipment. 15 April 1992.

Air Force. SMALC/MAITD Letter. Update to ATE Survey of November 1986 for ESD/TCRL. 3 March 1988.

Air Force. Smith, O.T., McComb, Donald. Air Force Depot ATS Requirements & Strategies. Report LNPC 92-001. 20 April 1992.

Air Force. Smith, O.T. Depot View DOD ATS Investment Strategy Study (Briefing). 21 April 1992.

Air Force. SOF RF METS (Briefing). Undated.

Air Force. Statement of Operational Need (Son) Modular Automatic Test Equipment (MATE) II. AFLC 003-89. Undated.

Air Force. Talking Paper on the ATS Acquisition Process. 1 November 1989.

Air Force. Test program Sets TPS Development Environment. Report LNPC 92-004. 30 April 1992.

Air Force. Tim Action Item Response. AFMC(I)/EN Letter. Embedded Computer Resource. Personnel Survey. 18 February 1992.

Air Force. Tim Action Item Response. CATS Test Program Sets. 3 November 1991.

Air Force. Tim Action Item Response. CATS-WGAT IF (Briefing). 22 January 1992.

Air Force.Tim Action Item Response. Factory ATS Cost (CATS, CASS, EFTE Cost Assessment). Undated.

Air Force. Tim Action Item Response. F-16 Weapon System Profile.

Air Force. Tim Action Item Response. WR-ALC/CNT Letter. Embedded Computer Resource Personnel Survey. 31 March 1992.

Air Force. Topper Major. Memorandum for Record. F-22 Cost Data. 9 June 1992.

Air Force. USAF Early Risk Reduction Phase I CASS VS MATE Study Final Report. 86 PR 1254.

Air Force. USAF/LGXX Point Paper. Objective Wing/Composite Wing. 27 May 1992.

Air Force. USAF Scientific Advisory Board Final Report Briefings to Gen. McDonald. 22 October 1990.

Air Force. WRALC/LYPBC. Automatic Test Equipment Software Support Environment (ATESSE). Undated.

Air Force. WRALC/LNPCA. Test Program Set (TPS) Rehosting. Report LNPC 92-003. 30 April 1992.

Air Force. WR-ALC/LNPC. IFTE Upgrade to meet the GPS. Report IFTE-91-002. 12 December 1991.

Air Force. WRALC/LNPC. TPS Impact of DATSA Digital Upgrade (Briefing). Undated.

Air Force. WRALC/LNPC. TPS Impact Results from DATSA Digital Upgrade. 30 April 1992.

Air Force. WR ALC/MAITC. How to Buy a MATE Tester for Less Million Interservice. Report MAG 88-011-01. 17 April 1989.

ALC AFSC/AFLC 800-23. Policy for Modular Automatic Test Equipment. 25 January 1994.

Army. 1988 Go Forth and Develop an IFTE Battlefield Laydown (Briefing). Undated.

Army. Action Item Response. Army ATE Acquisition. Current Process. 11 May 1992.

Army. Action Item Response. Summary of Cost/Economic Analysis for Various Options for ASAS Maintenance 10 year life-cylce. Undated.

Army. Air-55212G. A-12 Weapon System Support Equipment Program Management Review (Briefing). 2 April 1990.

Army. AMC Automatic Test Equipment Policy. AMC-M750-1 6 August 1991.

Army. AMCPM. M1A2 DSESTS Waiver to the 1986 AMC ATE Policy. 9 May 1989

Army. AMCPM-TMDE Memorandum. ATE Programs of the Three Services. 4 November 1988.

Army. AMCPM-TMDE-T. Update TPS Semi-Annual Fielding and Availability Report. 23 January 1992.

Army. AMCPP-M Memorandum. Approved Acquisition Plans for the Integrated Family of Test Equipment IFTE. 19 December 1990.

Army. AMSMC-MAE-ET. Test Program Set (TPS) Fielding and Availability Report. 22 January 1992

Army. AMSMI-LC-ME-XP Memorandum. Information Relevant to Depot Level ATG Waiver for BFUS/TOW. 28 February 1989.

Army. AMSDS-EN-D, Point Paper. Competitiveness of Department of Defense (DOD) Service Depots. 17 April 1992.

Army. AMSDS-EN-DT. Point Paper - Automatic Test Equipment (ATE) Exemption from Federal Information Resource Management Regulation (FIRMR). 16 April 1992.

Army. AMSDS-EN-DT, Point Paper. Depot Level Comments on ATE Standard Language. 20 April 1992.

Army. AM XTM-RF-P Memorandum. Integrated Family of Test Equipment (IFTE) to CASS Conversion. 1 May 1992.

Army. Apache TRD for TADS Night Sensor Assembly. Drawing No. 13231181. 14 August 1989.

Army. Approved Acquisition Plans for the Integrated Family of Test Equipment IFTE. 19 December 1990.

Army. Army Test Program Set Procedures. Pamphlet 750-43. 28 February 1992.

Army. Army Test, Measurement, and Diagnostic Equipment Program. Army Regulation 750-43. 29 September 1989.

Army. ATCD-SL memorandum. DA Form 2028 Changes to the IFTE Required Operational Capability. 27 September 1990.

Army. Bosco Mr. Navy. NAEC 5232. A-12 All Weather Attack Aircraft Program Review Avionics Support
(Briefing). Undated.

Army. PM TMDE Quarterly Review Part I ATSS (Briefing). 19 May 1992.

Army. Testability Program for Systems and Equipment. MIL-STD 2165A. 26 January 1985

Army. Tim Action Item Response. Army Automated Test Equipment (ATE) Development, Acquisition, & support (point paper). Undated.

Army. Tim Action Item Response. Depot Test (Briefing). Undated.

Army. Tim Action Response. Technology Base Strategy (Briefing). 25 March 1992.

Army. Tim Action Response.The Electronics Maintenance Company Concept (Briefing). Undated.

Army. Tim Action Item Response. Translation Cost to HP 3070 (Briefing). Undated.

Army. Tim Presentation. TMDE Overview Briefing. 13 March 1992.

Army. Tim Presentation. Army ATE: Policies, Procedures and Organization Briefing. 13 March 1992

Army. The Key to Combat Readiness/IFTE Status Briefing. 23 March 1992.

Army. TMDE Acting. Optics Test (Bradley Tow / Tow 2) BSA Test station Approaches. 16 April 1992.

Army. TMDE. Electro-Optical Program Concept Formulation Package. 8 November 1990.

Army. TMDE. BSTF/BSTS Program, Revised Draft Baseline Cost Estimate (BCE). 10 June 1991.

Army. TMDE, Contact Test Set (CTS) Program Baseline Cost Estimate (BCE) (Volume1). 23 October 1991.

Army. TMDE. Contact Test Set (CTS) Program Baseline Cost Estimate (BCE) (Volume 2). 23 October 1991.

Army. TMDE. Contact Test Set (CTS) Program Baseline Cost Estimate (BCE) (Volume 3). 23 October 1991.

Army. TMDE. Electro-Optical Program (EOP) Baseline Cost Estimate (BCE) Executive Summary. 2 August 1990

Army. TMDE. TMDE Technology Base Program. TMDE. 1 May 1991.

Army. TMDE. PM-TMDE Quarterly Review PT1 ATSS. 25 February 1992.

Army. Tobyhanna Army Depot Test Program Sets Development Environments (Briefing). Undated.

Army. TRD for PNVS Night Sensor Assembly. Drawing No. 13083805.

Army. TRD for Day Sensor Assembly (LESS LRU's). Drawing No. 13231268. 6 June 1991.

Army. TRD for PNVS Electronic Unit Assembly. Drawing 13231198. 28 March 1991.

Army. Use of Commercial Test Capability (Briefing). 26 March 1992.

Army. Waggoner, Larry. In Process Review Cost/Benefit Analysis of AH-64 Apache Automated Test Equipment (Briefing). Undated.

ASD/AEGB. MATE Application Program Status System (MAPSS) (computer listing). 4 February 1991.

ASD/AEBG. MATE Payoffs-Backup Information (Briefing). Undated.

ASD/AEGG. MATE Development & Material Management (position paper). 26 February 1985.

A Team Corp. Test program Reusability Report. Contract F33657-88C-2159/60. 28 December 1990.

A Team Corp. Wilkinson, Kenneth. Letter with althoughts that Provides Summary of Historical Relationship for MATE/CASS/IFTE. 28 October 1988.

ATS Full Report. Approved MATE Baselines. 23 March 1992.

ATS Option Report MATE Report. 23 March 1992

Automatic TFS Subcommittee. Test Program Vertical Transportability. Task No. 90.3. Undated.

Boeing. CATS System Software Training. 16 April 1992.

Cassady, Patrick, Miller, Dennis. IFTE Electro-Optical Program Cost-Benefit Analysis TRAC-WSMR-CBA-90-040. December 1990.

Coulter, Bruce. USATA. DSESTS-IFTE Decision Briefing. Undated.

DASD (PR) Memorandum. AMRAAM ADM Action Item #3. Core Maintenance Requirements Economic Analysis. 10 February 1992.

Defense Analysis and Studies Office. Software Maintenance in DOD. 12 December 1988.

Defense Depot Maintenance Council Cost Comparability Committee cost Comparability Handbook. 23 January 1992.

Department of Defense Inspector General. DODIG Audit Report. #92-037. 23 January 1992

Department of Defense Inspector General. DODIG Audit Report. #92-022. 17 December 1991.

DoD. DoD Directive Maintenance of Military Materiel. DODD 4151.18. 12 August 1992.

General Dynamics. Automatic Test Systems Discussion Mr. Marty Meth. (Briefing). 31 March 1992.

General Dynamics Electronics Division. F-16 AIS Family of ATE and Derivative ATE Commonality Benefits. 15 April 92.

General Dynamics. F-16 AIS Family of ATE and Derivative ATE Commonality Benefits. 15 April 1992.

General Dynamics. F-16 AIS Support System Alternatives Study. F33657-84-C-0247- P00401 CDRL No. 3400. 31 May 1989.

General Dynamics. Letter to Mr. Meth. Dehost of the F-16 IAIS Support System Study. 8 April 1992.

General Dynamics. Open Discussions with Mr. Marty Meth (Briefing by General Dynamics). 31 March 1992.

General Dynamics. Testability/Built-in Test (BIT), Generic Integrated Maintenance Diagnostics (GIMDS) Final Tech Report. CDRL 1017. Control No. F33657-86C-0193. FZM-7545-3-8 TG3. 14 June 1991.

General Electric Company. CASS/ABET/XVI (Briefing). 6 February 1992.

General Electric. Aerospace. Consolidated Automated Support System (Briefing) JPCG. Depot Maintenance Executive Group Decision for Tactical Missiles. DoD Tactical Missile Study. 18 January 1991.

General Electric. High Level CASS Station Overview. July 1992.

General Electric. Neeb, Karl and Alexander, Marc. VXI/MMS Presentations. 10 November 1992.

Grumman. IFTE Mobility (Briefing). undated.

Grumman. IFTE Prime Item Product Fabrication Specification. IFTE89P200202-01. 14 October 1991.

Grumman. Intermediate Forward Test Equipment (IFTE) Commercial Equivalent Equipment CEE Handbook. IFTE85E03A1-00. 1 September 1987.

Hewlett Packard. Gattuse, Joe. R&D, Manufacturing and Diagnostic Support Equipment for Defense Electronics Programs. January 1992.

Hewlett Packard. Letter to Christine Fisher from Hewlett-Packard Company. 14 May 1992.

Hewlett Packard. VXI and MMS Slides Briefing.

Hewlett Packard. Why Multiple Platform (VXI & MMS Briefing). Undated.

Hurley. Marcus Major General. Objective Wing Conference (Briefing). september 1991.

ICAF. Nodine Colonial. Standardization in Department of Defense Acquisition Programs, from Principles to Prospects. 1991-1992 Research Paper.

IFTE (CEE) Test JIAWG. 5 May 1992

Integrated Weapon System Management (IWSM) CONOPS Plan for ATE. 18 March 1992.

Joint service Regulation. Logistics Depot Maintenance Interservicing. OPNAV INST 4790.14. 1 June 1988.

Lambert, SmSgt. AF-SA-ALC/LDA. Integrated Weapon System Management for Automatic Test Equipment (Briefing).

Martin Marietta. Apache (CMRS) Calibration Investment Requirements Summary. 31 January 1989.

MATE, CSS, IFTE, HITS and DFT Programs Analysis Report. 20 February 1985. Undated.

MATE Program Office. MATE Standard (Human Factors Standard). MATE-STD-HF. 1 August 1989.

MATE Program Office. MATE Standard (MATE Instrument on a Card). MTE-STD-IAC-A. 1 August 1989

MATE Program Office. MATE Standard (MATE Program Managers Handbook). MATEHDK-ACQ. 1 August 1989

MATE Program Office. MATE Standard (System Control Interface). MATE-STD-CIL. 1 August 1989.

MATE Program Office. MATE Applications Baseline Worksheet. 1 August 1990.

MATE Program Office. MATE Guidance for Down Sized Tester Acquisition. 9 October 1990.

MATE 1992 ATE Program Office. MATE Control and Support Software and MATE Products Distribution. 19 February 1992

McDonnell Aircraft Company. Factory Support Plan F/A-18E/F (Briefing). 7 April 1992.

Merrill, Captain. CASS Program Office. CASS Point Paper (CASS Performance Threshold Changes). 6 November 1991

Merrill, Captain. CASS Program Office. CASS EO - Briefing with Northrop. 13 February 1992.

Mills, Mick. MATE SCADC Briefing from (MATE Users Group). Undated.

Navy. Action Item Response. Candidates for Review for Potential Future CASS Support. 6 April 1992

Navy. AIR 41025B. Modeling Proof on Concept (IDSS Briefing). 22 April 1992.

Navy. AIR 5522. CASS TPS Planning & Acquisition (Briefing). 30 March 1992

Navy. AIR 55223. Study CASS Off-load Program. 5 May 1992.

Navy. ATI Automated Test International Limited Partnership (Commercial CASS-Briefing). 7 May 1992.

Naval Aviation Depot. Cost/Benefit Study. ATE Service Life Extension Program (SLEP) & Off-load to CASS TPS Support Alternatives. 15 September 1989

Naval Aviation Depot. Generating Test Development Data from Logistic Support Analysis Records Feasibility Report.

Navy. CNO. CASS Decision Memorandum. 15 March 1985

Navy. Consolidated Automated Support System. CASS.

Navy. Engineering and Manufacturing Development (EMD) of the Advanced Air-to-Air Missile. 16 December 1991.

Navy. F-14D. Alternatives to CASS Briefing and Script. 24 May 1990.

Navy. Integrated Diagnostics Support System (IDSS) (Briefing).

Navy. Life Cycle Management of Test Measurement and Diagnostic Equipment (TMDE). NAVSEA Instruction 9028. 12 September 1991.

Navy. Maintenance Concepts, Levels, and Types. OPNAV INST 4790.2E. 1 June 1990

Navy. Maintenance of Surface Ship Electronic Equipment. OPNAVINST 4790.13. 11 September 1987.

Navy. McGockin, Harry. Navy Test Development Environments (Briefing). Undated.

Navy. NADEP. Action Item Response. Depot Automatic Test Equipment (ATE). 4 March 1992.

Navy. NAVAIR. Desert Shield/Storm Briefing. 12 November 1991

Navy. NAVAIR. Introducing CAS to Naval Aviation Maintenance. NAVAIR INST 13630.2A. 22 March 1991

Navy. NAVAIR 5522. Naval Air Systems Command Support Equipment Selection Guide. 17 June 1981.

Navy. NAVAIR Policy Letter. Policy for Maintenance/Support of Commercial Test Equipment Embedded as a Unit of Longer Test/Support Equipment System. 16 January 1987.

Navy, NAVAIR. Utilization of the Consolidated Automated Support System as Factory Test Equipment. 12 November 1991.

Navy. Navy ATS Fielding Concepts (Briefing). 21 April 1992

Navy. Navy Policy and Responsibility for Test, Measurement, Diagnostic Equipment and Systems & Metrology & Calibration. SECNAVINST 3960.6. 12 October 1990

Navy. NAVSEA. CASS. Policy Paper 87-13. 26 May 1987.

Navy. NAVSEA-04DS Ketter, Nubuatyre.nucrinubuatyre (2M) Electronic Repair/Automatic Test Equipment. 4 May 1992.

Navy, NAVSEA. Test, Measurement, monitoring, Diagnostic Equipment and Systems and Metrology and Calibration (Policy Memorandum). 28 January 1991.

Navy. NAVSEA. Weapon & Combat Systems Maintenance. INST 4700.1. 26 May 1987.

Navy. NAWC-P2353 MTS Software Support Estimated (FAX). 1 Apr 1992.

Navy. MWSC. Miniature/Microminiature (2M) Workload & Cost Benefit Analysis (Draft). January 1992.

Navy. Pidgeon, Richard. DATA: Before, During & After TPS Development (Briefing). 5 May 1992.

Navy. Tim Action Item Response. F-16 SPO Sustaining and Service Reports.

Navy. Tim Action Item Response. OSS Costs for NON-CASS ATE. 30 June 1992.

Navy. Tim Action Response. TPS Cost Drivers. 13 March 1992.

Navy. Tim Action Response. Vertical Testability Objective (FAX). 9 April 1992.

Navy. Test and Monitoring Systems Program Office, SPAWAR Automatic Test Equipment Inventory Survey. 30 September 1985

Nessbaien, Sam, Podobinski, Hank, and Anderson, Greg. Reducing ATE Size through Effective RF Asset Utilization (Paper). Undated.

Northrop. Making Technology Work (Electro-Optics Briefing Slides).

Novta, F., Ward, K. Logistics Management Institute. Test Equipment Management. January 1985.

NSIA. National Security Industrial Association, ıatic Testing Committee Statement.

25 March 1992

OSD. Action Item Response. CAIG Cost Information (Summaries for Multiple System F-16, F-15, F-22, C-17). OASD (PA&E) provided by Gilmore. Undated.

Payne, David. Economic Analysis of the AH-64 (APACHE) Automated Test Equipment (Briefing). Undated.

PM-TRADE. Integrated Program Summary Milestone Decision Review IIb (IFTE-BSTF & CTS). 10 January 1992

Prime System Full Report. Prime System Report-Completed. 23 March 1992.

Prospective Computer Analysts (PCA) Inc. Cost Benefits Analysis (CBA) for the CASS and ATE Alternatives; Control No. N00140-86-C-9146. 31 August 1987

Prospective Computer Analysts (PCA) Inc. The Consolidate Automated Support System (CASS) and ATE Alternatives Assessment: Control No. N00140-86-C-9146. 31 August 1987.

Racal - Dana Instruments (Briefing presented to IDA). Undated.

Raytheon Company. Archambault, John. Automatic Test Equipment (ATE) for Hawk Missile System Factory Test (Briefing). 9 April 1992.

Ross, Bill. Navy. TIM Presentation. Navy ATS Policies and Processes Briefing. 13 March 1992.

SA/ALC. Notes From F-15 AIS Road Map Meeting. 1-2 March 1990.

SA-ALC/MMI. F/FB-111 Avionics Intermediate Shop Test Stations. 4 December 1979.

SA-ALC/MMT.F-15 M[illegible] Electronic Test Set (F-15A-D Rehost Study) (Briefing). Undated.

Softech and SEMCO. Final Report BIB Depot Test Station Supportability. Contract F33657-86 -D-0298/0006. February 1992.

TASC. A-7 Cast LCC Management Support Project Review. SP-5520-A-1. 11 May 1988.

TASC. A-7 CAST Supportability Analysis. TR-5522-3-1. 15 June 1990.

TASC. Life-Cycle Cost Based Methodology for ATE Procurement. SP-10147. 29 March 1989.

Tektronix. Hebert, Bob. Commercial Standards for Downsized Military ATE (Briefing).

Tektronix. Letter from Richard McBee of Tektronix to Dr. Rolfe of IDA. Charts and Annual Report. 17 May 1992.

Teradyne. Teradyne Assembly Test Group (Briefing). 10 November 1992.

Teradyne. Teradyne Dynamic Digital Test Systems (Briefing). 29 May 1992.

Term Technology, Inc. An Instrument Manufacture's Experience with the Modular Measurement (Briefing). 10 November 1992.

Trinkle, John. NAVAIR. ATS(V), BB Workload Factors FA-18 WRA, ATS only tested. 19 March 1992

Uliano, Colonel. IFTE Program Office. IFTE MSIIB (Production Decision) in Process Review - (Briefing). 12 February 1992

US Army TRADOC. IFTE Cost and Operational Effectiveness Analysis) COEA) Update (MSIIIB Report). January 1992

VXI Consortion. VXI (VXE Bus Extensions for Instrumentation) Briefing.

Wall, Craig. ASD/ENEM. F-22 Automatic Test System Study - Final Report Briefing.

Walsh, D.P. F-14D CASS Support Briefing. 16 May 1991

Westinghouse. Westinghouse Test Facilities (Briefing). 9 April 1992.

Westinghouse. Hilliod, Milton. Westinghouse Factory of the Future (Briefing

LIST OF ACRONYMS

A	Amps
ABBET	A Broad Based Environment for Test
AC	Alternating Current
ACBI	Advanced Communications Bus Interface
ACM	Advanced Cruise Missile
AF	Air Force
AFAE	Air Force Acquisition Executive
AFLC	Air Force Logistics Command
AFMC	Air Force Materiel Command
AFSC	Air Force Systems Command
AIS	Avionics Intermediate Shop
ALC	Air Logistics Center
AM	Amplitude Modulation
AMC	Army Materiel Command
AMRAAM	Advanced Medium Range Air-to-Air Missile
APM	Army Program Manager
ASD (P&L)	Assistant Secretary of Defense for Production and Logistics
ATE	Automatic Test Equipment
ATLAS	Abbreviated Test Language for All Systems
ATSE	Army Test Support Equipment
ATS	Automatic Test Systems
BIT	Built-In-Test
BSTF	IFTE) Base Shop Test Facility
CAE	Computer-Aided Engineering
CASS	Consolidated Automated Support System
CATS	Common Automatic Test System

CBA	Cost Benefit Analysis
CEE	Commercial Equivalent Equipment (for BSTF)
CIP	CASS Introduction Plan
CLIN	Contract Line Item Number
CNA	Center for Naval Analyses
CND	Cannot Duplicate
CNI	Communications, Navigation, Identification
COEA	Cost and Operational Effectiveness Analysis
COTS	Commercial off the Shelf
CSE	Common Support Equipment
CTS	Contact Test Set
DAC	Designated Acquisition Commander
DB	Decibel
DC	Direct Current
DST	Downsized Tester
DTU	Digital Test Unit
DoD	Department of Defense
EMC	Electro-Magnetic Compatibility
EMD	Engineering and Manufacturing Development
EO	Electro-Optical
EOA	Electro-Optical Assembly
ESG	Executive Steering Group
EW	Electronic Warfare
FAR	Federal Acquisition Regulation
FMECA	Failure Mode, Effects, and Criticality Analysis
FLIR	Forward-Looking Infrared Radar
FY	Fiscal Year
FYDP	Five Year Defense Plan
GAO	(U.S.) Government Accounting Office
GD	General Dynamics
GE	General Electric

GFE	Government-Furnished Equipment
GHZ	Giga Hertz
GPIB	General Purpose Instrument Bus
GPS	Global Positioning System
HAC	House Armed Services Committee
Hg	Mercury
HW	Hardware
HZ	Hertz (cycles per second)
I&C	Indicators and Controls
I/O	Input/Output
IAIS	Improved Avionics Intermediate Station
ID	Interface Device
IDA	Institute for Defense Analyses
IEEE	Institute for Electronics and Electronical Engineers
IFTE	Integrated Family of Test Equipment
IG	Inspector General
I-Level	Intermediate Level
ILS	Integrated Logistics Support
INS	Inertial Navigation System
IOC	Initial Operational Capability
IR	Infrared
ITA	Interface Test Adapter
IWSM	Integrated Weapon System Management
JIAWG	Joint Integrated Avionics Working Group
K	Thousand
LRM	Line Replaceable Module
LRU	Line Replaceable Unit
LSA	Logistics Support Analyses
LASAR	Digital circuit simulator used for test program generation
MAM	Maintenance Assist Module
MATE	Modular Automatic Test Equipment

METS	Mobile electronic Test Set
MHZ	Mega Hertz
MLRS	Multiple Launch Rocket System
MMS	Modular Measurement System
NAVAIR	Naval Air Systems Command
NATSF	Naval Aviation Technical Services Facility
NEOF	No Evidence of Failure
NTP	Navy Training Plan
O&S	Operations and Support
OASD(P&L)	Office of the Assistant Secretary of Defense for Production and Logistics
OSD	Office of the Secretary of Defense
PEO	Program Executive Office
PFG	Pneumatic Function Generator
PGM	Product Group Manager
PH	Phase
P^3I	Pre-Planned Product Improvement
PM	Program Manager
PMA	Program Management Activity
PMRT	Program Management Responsibility Transfer
PM TMDE	Program Manager, Test Measurement, and Diagnostic Equipment
PNVS	Pilot Night Vision System
POM	Program Objective Memorandum
PSE	Peculiar Support Equipment
QPL	Qualified Parts List
R&D	Research and Development
RF	Radio Frequency
RLA	Repair Level Analysis
RTOK	Review Test O.K
SR	Service Reports
SRA	Shop Replaceable Assembly

SRU	Ship Replaceable Unit
SPO	System Program Office
SOS	Support-of-Support
SPD	System Program Director
SSM	System Synthesis Model
STE	Special Test Equipment
SW	Software
TADS	Target Acquisition and Designation System
TCTO	Technical Change Technical Order
TIM	Technical Interchange Meeting
TISSS	Tester Independent Support Software System
TMDE	Test, Measurement, and Diagnostic Equipment
TPS	Test Program Set
TRADOC	Training and Doctrine Command
TRD	Test Requirements Document
TY	Then-Year
uM	Micro-Meter
uRAD	Micro-Radian
UUT	Unit Under Test
V	Volt
VAC	Volts AC
VAST	Versatile Avionics Shop Tester
VHDL	VHSIC Hardware Description Language
VHSIC	Very High Speed Integrated Circuits
VME	Versa Module European (or VMEbus)
VXI	VME Extended for Instruments
Vrms	Volts, root-mean-square
WAVES	Wave-form and Vector Exchange Specification
WCTV	Weapons Carrier/Tracked Vehicle
WRA	Weapon Replaceable Assembly
W	Watt