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Special Study



# HISTORY OF AIR FORCE OPERATIONAL TEST AND EVALUATION (OT&E) MISSION, ORGANIZATION, AND POLICY

**An Introduction to the Air Force Operational Test & Evaluation Center (AFOTEC)**



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## AFOTEC'S EMBLEM

Shown on the front cover, AFOTEC's official emblem was designed in 1974 based upon the new Center's responsibilities and the roles and missions of the United States Air Force as outlined in the contemporary edition of AFM 1-1. The emblem's heraldry features four blue and gold "deltoids." They appear as a flight of delta wing aircraft leaving white contrails against a blue sky. Each of the deltoids has a symbolic meaning, representing four fundamental military objectives of the United States: to deter aggression, to resolve conflicts on favorable terms, to achieve national objectives, and to promote a secure international environment. The blue and gold deltoid color scheme subdivides these four fundamental objectives into eight of the specified missions and tasks of the United States Air Force: (1) strategic aerospace, (2) counterair, (3) air interdiction, (4) close air support, (5) aerospace defense, (6) reconnaissance, (7) electronic warfare, and (8) airlift. The white contrails signify the test and evaluation process, which follows the concept formulation, validation, and development of systems and equipment. The red scales in the foreground portray AFOTEC's impartial and independent assessment of system performance as weighed against the Air Force's tasks and missions.

To represent the 50 years of Air Force operational testing since the formation of AFOTEC's predecessor, the Air Proving Ground Command, the cover shows head-on drawings of two aircraft: the B-29, which was the most advanced bomber of World War II; and today's B-2, which will help give the Air Force global reach and global power into the 21st century.

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This report defines the various categories of Operational Test and Evaluation (OT&E) and related activities and explains how they support the defense acquisition process. It summarizes the historical evolution of operational testing by the Air Force since World War II and organizational responsibilities for OT&E within the Air Force, other armed services, and the Department of Defense. It discusses changing policies, basic procedures, and political influences. After mentioning the contribution of OT&E to Operation Desert Storm, the history concludes with details on the reorganization of Air Force OT&E during 1992.

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## PREFACE

This study is primarily intended as background information for people involved with operational test and evaluation (OT&E), especially as conducted by the Air Force. Presented from the perspective of the Air Force Operational Test and Evaluation Center, it expands on a previous publication titled "An Introduction to Operational Testing and AFOTEC" (last updated in July 1991), which recent events have rendered obsolete. As described herein, operational testing has been evolving since World War II. Understanding the policies and organizational features of today's OT&E requires some knowledge of this history.

The undersigned completed this publication on the eve of departing for a new assignment after six rewarding years at AFOTEC. This period, especially the last year, has been marked by fundamental changes in the Air Force's OT&E mission. Although a slower pace of change in the coming years may allow this study to remain useful for some time as a current reference as well as a historical document, a revision will eventually become necessary. With this in mind, please forward any corrections, suggestions, updates, or additional information to HQ AFOTEC/RS, 8500 Gibson Blvd SE, Kirtland AFB NM 87117-5578 (DSN 246-5341).

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## TABLE OF CONTENTS



### List of Illustrations

# HISTORY OF
# AIR FORCE OPERATIONAL TEST AND EVALUATION (OT&E): MISSION, ORGANIZATION, AND POLICY

The benefits of testing weapons under realistic conditions before using them in combat became apparent during World War II. But how and when these tests should be conducted and who should do them were questions that the Air Force answered in different ways over the next 50 years. The evolution of the Air Force Operational Test and Evaluation Center (AFOTEC) from a small management headquarters in 1974 to the Air Force's central operational test agency in 1992 represents the latest chapter in this quest. Before recounting the history of operational testing, however, an introduction to today's testing process and related activities as they are presently defined will help put past developments in a clearer perspective.

## The OT&E Process

### Definitions

Within the Department of Defense (DoD), test and evaluation (T&E) encompasses a wide range of activities, broadly categorized as development test and evaluation (DT&E) and operational test and evaluation (OT&E). Although either type of T&E may occur at any point in the life cycle of a system, DT&E usually begins first. It focuses on engineering analyses, design alternatives, performance measurements, and compliance with contract specifications in a controlled environment. DT&E includes both contractor and government-conducted projects, ranging from laboratory experimentation to flight testing. Contractor testing includes preproduction qualification testing (PPQT) and production qualification testing (PQT). OT&E traditionally starts later than DT&E and focuses on the overall performance of a system in its intended operational environment. In view of OT&E's role in the acquisition process, DoD and the services have assigned responsibility for it to independent operational test agencies (OTAs), such as AFOTEC.

**OT&E.** By law (Title 10 of the US Code) operational test and evaluation is defined as "the field test, under realistic combat conditions, of any item of (or key component of) weapons, equipment, or munitions for the purpose of determining the effectiveness and suitability [of these items] for use in combat by typical military users; and the evaluation of the results of such test."[1] Operational effectiveness primarily concerns how systems perform

when employed, while operational suitability involves how well they can be kept available for use (for example, reliability, maintainability, and supportability). Operational (or "user") requirements, drawn up by the operating commands, provide the main criteria against which to measure the system's performance. The findings of OT&E contribute to decisions on the acquisition of new systems, improvements to systems already being produced, modifications of systems deployed in the field, and other aspects of their operational capabilities. OT&E has several sub-categories and related activities based largely on the maturity of the system being examined.

**IOT&E.** Production or production-representative hardware funded by research, development, test and evaluation (RDT&E) appropriations receive initial OT&E (IOT&E). The most common purpose of IOT&E is to assist in making decisions in the acquisition process, especially for beyond low rate initial production (B-LRIP) or full rate production at Milestone III (see Figure 1). For low volume or one-of-a-kind systems, such as ships, satellites, simulators, and command centers, IOT&E is also used to support turnover decisions from the developing to the operating command. Within the Air Force, IOT&E has normally overlapped with DT&E, sharing many of the same resources.

**FOT&E.** After a system enters production, it may undergo follow-on OT&E (FOT&E). FOT&E refines IOT&E estimates, assessing the capability of the full system and any modifications, and reevaluates the system against changing operational needs. AFOTEC conducts some Air Force FOT&Es for high-cost, high-risk, or potentially controversial programs. The operating commands, which conduct most FOT&Es, are also responsible for tactics development and evaluation (TD&E), confirming training requirements, and refining doctrine for weapons employment.

**QOT&E.** Systems that do not require R&D funding receive qualification OT&E (QOT&E). These include existing systems given a new mission or modified to improve capabilities as well as contractor off-the-shelf (COTS) or nondevelopmental items (NDI). Procedures followed for QOT&E are similar to those used for IOT&E, and the actual testing may be combined with Qualification Test and Evaluation (QT&E), which resembles DT&E.

**OAs.** To help reduce risk in early acquisition decisions, DoD has called upon its operational test agencies to examine new systems before there is production-representative hardware to test. When this activity occurs during the demonstration and validation stage or before, it is known as an early operational assessment (EOA). When it supports another decision prior to production approval (Milestone III), it is called an operational assessment (OA). OAs may use technology demonstrators, prototypes, mockups, engineer-

ing development models, or simulations. The objectives of these assessments are to improve planning by highlighting program documentation status and the readiness of a system for IOT&E, examine the significance of programmatic voids and early testing trends, and conduct special field tests or simulations as directed. The four services defined the OA and EOA in 1989.

**Multiservice T&E/OT&E.** When two or more services or federal agencies test a system funded with RDT&E money, it is considered a multiservice test and evaluation. In these cases, DoD appoints a lead service, which conducts the test according to its regulations. For multiservice OT&E, the four OTAs follow procedures and arrangements outlined in an umbrella memorandum of agreement.

**JT&E.** Joint test and evaluation (JT&E) programs also involve two or more of the services, but as a rule are administered and largely funded by the Office of the Secretary of Defense (OSD) as a separate category of testing that does not represent acquisition efforts. Conducted by specially formed joint test forces, JT&E may be either developmental or operational in emphasis.[2] During the 1970s, many JT&E programs were chartered as large and "open-ended" efforts, but in 1986 OSD began limiting their scope and setting a goal of two or three years for their execution.[3]

***OUEs and Demonstrations.*** Although not formally defined, operational utility evaluations (OUEs) have been periodically conducted to meet a specific purpose directed by higher headquarters. They normally assess how well a future system would satisfy overall user requirements if it performs as advertised. Because of their early timing in the acquisition process, OUEs can rely heavily on modeling and simulation. On other occasions when hardware is available, operational test agencies may conduct restricted tests, characterized as demonstrations, to show how the existing equipment performs certain functions.[4]

## Program Milestones

Most of the activities defined above support defense acquisition decisions. The structure of the acquisition process, which has changed periodically over the years, underwent a major revision with the new DoD "5000" series publications signed on 23 February 1991. Figure 1 on the next page shows the phases and milestones (decision points) in the acquisition cycle, with accompanying T&E activities listed beneath.[5]

The Defense Acquisition Board (DAB) reviews major programs, i.e., Acquisition Category (ACAT) I and II, at each milestone. After being streamlined in 1990, members of the DAB included the Undersecretary of

Defense for Acquisition (USD(A)), Vice Chairman of the Joint Chiefs of Staff (JCS), OSD's Director of OT&E (DOT&E), Director of Defense Research and Engineering (DDR&E), Assistant Secretary for Program Analysis and Evaluation (PA&E), DoD Comptroller, and the three service acquisition executives (SAEs). Its supporting structure includes committees for conventional, strategic, and command, control, communications, and intelligence ($C^3I$) systems. Service bodies, such as the Air Force Systems Acquisition Review Council (AFSARC), follow milestones similar to the DAB for those programs over which they have authority. The services may further delegate decisions for smaller programs (ACAT III and IV) to subordinate commands. Today, OT&E is an integral part of the acquisition process. This was not always the case in the past.

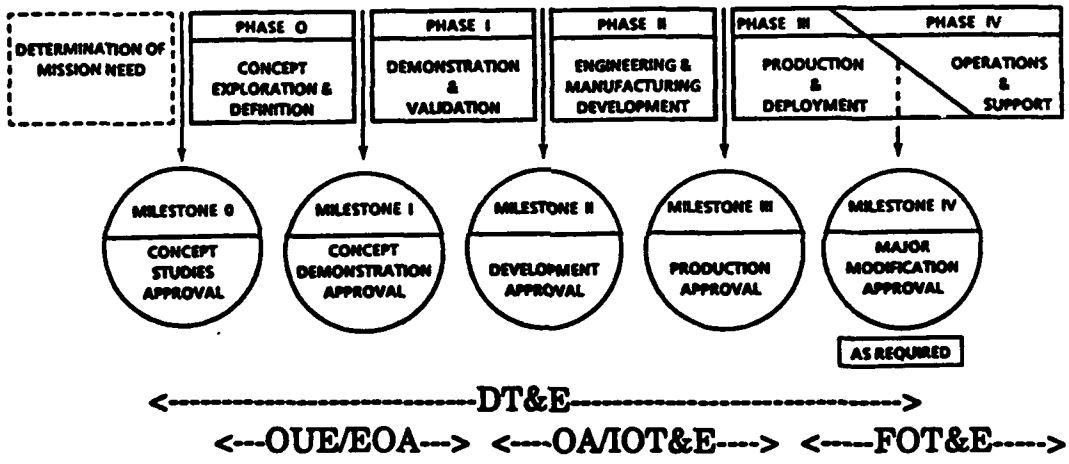


**Figure 1. Acquisition Milestones and OT&E Activities**

## Air Force OT&E Before AFOTEC

How did operational testing become an influential part of defense acquisition?[6] In essence, what is now Air Force T&E dates back to 1909, when the Chief of the Signal Corps issued the following "test directive" to 1Lt Benjamin Foulois after the Wright Brothers delivered an early flying machine to the Army. "Your orders are simple, lieutenant. You are to evaluate the airplane. Just take plenty of spare parts--and teach yourself to fly."[7] Foulois soon improved the operational effectiveness of the aircraft by adding a seat, safety belt, and landing gear.

## From World War I to World War II

By the time the United States entered World War I in 1917, the European powers--testing their aircraft over the trenches for almost three years--were far ahead in all aspects of military aviation. American airmen had to fly British and French planes into combat.

During the 1920s and 1930s, despite tight budgets, the Army Air Corps established and built up the Materiel Division, a centralized organization that combined RDT&E-type functions with logistics at Wright and Patterson Fields near Dayton, OH. Reflecting peacetime priorities and the revolutionary strides being made in aviation technology at the time, the Materiel Division's testing emphasized basic engineering, contract compliance, and flying characteristics rather than wartime operations.[8] With the coming of World War II in Europe, however, the gradually emerging concept of a proving ground to more realistically test air weapons became reality.

## Air Proving Ground, 1941-1957

Six months before Pearl Harbor, in May 1941, the Army Air Forces (AAF) created the Air Proving Ground at Eglin Field, FL. Upgraded to the Air Proving Ground Command (APGC) in April 1942, its mission rapidly expanded from "service tests" of ordnance and aviation equipment to testing new aircraft for operational fitness and tactical suitability. Brig Gen Grandison Gardner, a protege of AAF Commanding General Hap Arnold, served as the APGC's commander throughout the war. Like AFOTEC today, the Air Proving Ground Command was independent of developing and using commands and reported directly to General Arnold or his Army Air Forces Board. By war's end, the Command had conducted more than 2,800 tests on a wide variety of equipment, including almost all of the notable American fighters and bombers of World War II. In addition to perfecting the use of proximity fuzes, napalm, incendiary bombs, and fighter escorts, some credit it with originating the role of the fighter-bomber as a key element in tactical air power. The Proving Ground even ushered in the American employment of cruise missiles by testing and deploying an American copy of the German V-1.[9]

After a brief loss of status during the post-war demobilization, the APGC was recreated as one of the early major commands (MAJCOMs) of the new United States Air Force (USAF) in 1948. "In determining the operational suitability of materiel and equipment," explained its first post-war commander, "every effort is expended to simulate combat conditions."[10] The outbreak of the Korean War in 1950 reawakened interest in combat readiness throughout

the Air Force. A later article asserted that "APGC is a major command for one good reason--to assure its objectivity. Responsible to no one but the Air Force Chief of Staff, Proving Ground calls the results as it sees them."[11] At the end of the Korean War, the APGC commander explained his command's philosophy as follows. "We don't concern ourselves about the factors that went into design of the equipment, though we appreciate that they must be numerous and complex.... We try to find out only one thing--will it do the job?"[12]

During the 1950s, APGC grew to include 12,000 personnel and its own "Air Force in miniature" consisting of almost every aircraft and missile then in the inventory. Its primary mission was conducting "operational suitability tests," defined as "tests of tactically equipped aircraft materiel or equipment with their component systems and support items to determine their effectiveness in combat." These tests also were "designed to develop improved operational tactics and techniques....and refine support and training requirements." In addition to performing operational suitability tests, APGC tested new weapons under extreme climactic conditions and examined their reliability and producability. With all of its weapons and resources, APGC was also called upon to stage impressive firepower demonstrations as part of Air Force and DoD public relations programs.[13]

Priority given to nuclear capabilities after the Korean War led to deemphasis of conventional weapons and traditional combat roles. The Air Proving Ground Command, which was not universally popular with other elements of the Air Force, appeared to have grown too big and independent for its own good. Facing large budget cuts in conventional forces in 1957, the Air Force abolished APGC as a MAJCOM and merged what was left into a test center of the Air Research and Development Command (ARDC).[14]

Why did the Air Force do away with its first independent operational test agency? The official answer was "the changing technology of war"--with missiles replacing bullets--and the need for more timely production appeared to make operational testing obsolete. As explained by the APGC's last commander, "once production starts, it is costly to slow down or hold back."[15]

Part of the underlying reason for the demise of the Air Proving Ground Command may be found by looking at the multi-phase T&E process of the time.[16] The first six of these phases emphasized engineering factors, contract compliance, and the functioning of equipment. Not until operational suitability testing (Phase VII) did APGC get a chance to see how a weapon worked under operational conditions. In view of this, Gen Hoyt S. Vandenberg, Air Force Chief of Staff from 1948-1953, had ordered that early production schedules be slowed down to give APGC time to complete its testing and make recommendations for design changes before the need for costly retrofits.[17]

The growing Cold War technology race, however, put priority on getting complex new equipment into the field as soon as possible. This put more pressure on ARDC not to slow programs down. In 1956 the Air Force added Phase VIII, "unit operational employment testing," conducted by the using commands.[18] By the time APGC and the MAJCOMs had a chance to assess new systems, an increasing number were already in production. Although operational testing could still help in the system's employment and support as well as document requirements for future modifications, it seemed to contribute relatively little to the ever accelerating acquisition process.[19]

## Streamlined T&E, 1958-1964

To shorten the time needed to get ever more sophisticated equipment from design to deployment, the Air Research and Development Command had devised the concept of the "weapon-system." Initially applied to Intercontinental Ballistic Missiles (ICBMs), the resulting "total package procurement" policy included having the Air Force enter into a partnership relation with contractors to eliminate duplication. Reflecting this philosophy, ARDC was expanded to create Air Force Systems Command (AFSC) in 1961. For maximum efficiency, the new management approach featured a high degree of "concurrency" in development, testing, production, facilities construction, and other support preparations.[20] The condensed T&E schedule and the Air Force's growing emphasis on missiles and nuclear weapons, even in the tactical air forces, called into question the validity of traditional operational testing and its "fly-before-buy" philosophy.

In conjunction with APGC's demise, the Air Force streamlined the T&E process from the eight phases of testing to only three categories. Categories I and II, performed respectively by the contractor and AFSC's test centers, were equivalent to today's DT&E. Category III, performed by the MAJCOMs, was similar to today's FOT&E. Overall, Air Force T&E was the most formal and structured of the four services' programs, but there was no longer anything equivalent to today's IOT&E before production.

The Air Force OT&E function had also become procedural rather than organizational. Even the office on the Air Staff that had interfaced with APGC since 1948 was abolished, so there was no central operational testing advocate to maintain a corporate memory or to balance the interests of the developer and user. Within the scope of this decentralized system, the MAJCOMs did perform some highly professional OT&Es. These tests, however, still usually occurred far too late to affect equipment design. Instead, the implementation of OT&E findings often required costly retrofits, modifica-

tions, and various "workarounds" in the field. The high degree of concurrency--which had worked so well in the crash development of ICBMs--proved less successful when applied to systems with more flexible missions, such as aircraft.[21]

Growing concern with this situation led the Air Staff to form a Weapons Effectiveness Testing Task Force in December 1964. After highlighting the lack of valid data with which to evaluate weapons effectiveness, this interim body was replaced by a new deputy to the Deputy Chief of Staff (DCS) for Plans and Operations (AF/XOPW) in 1965. This Deputy Directorate for OT&E grew to over 75 people who monitored test programs, coordinated on sponsored test resources, and provided the Air Force with centralized operational testing guidance for the next decade.[22] Its Air Staff organizational symbol changed to AF/XOW in 1967 and AF/XOOW in 1970. After being headed by brigadier generals in 1965 and 1966, the directorate was thereafter run by colonels; however, in December 1970 the Deputy Director of Operations (normally a 2-star general) was assigned an additional duty as the DCS/Plans and Operation's Assistant for OT&E.[23]

## New Focus on Operational Testing, 1965-73

**Combat Evaluations.** The war in Vietnam presented American weapons with unexpected challenges, ranging from primitive anti-guerilla tactics to rapidly evolving electronic warfare capabilities. The hot and humid jungle environment also took its toll. Problems in employment and maintenance, which might have been corrected with earlier OT&E, had to be dealt with at great cost in the field. For air-to-air weapons, the Pacific Air Forces (PACAF) conducted "Combat Sage," as its contribution to the existing Weapon System Evaluation Program (WSEP).[24] Wartime requirements for new systems also led to new, high priority development and testing programs, such as those for fixed wing gunships and electronic countermeasures.[25] Combat evaluations, such as the highly publicized Combat Lancer deployment of F-111As to Thailand in 1968 (when three of six new aircraft were lost in the first five weeks), sometimes proved risky.[26]

**Southeast Asia Performance Deficiencies.** Problems affected all the armed services. In a sample of 22 weapon systems deployed to Southeast Asia from 1965-1970, Department of Defense studies found all but one had suffered major deficiencies in the field. Some placed blame on the fact that only three of these weapons had undergone OT&E prior to production decisions.[27] As the result of such findings and other embarrassing problems with performance and cost overruns on new systems, the potential benefits of OT&E

became the focus of much attention. The acquisition of fewer but more complex and expensive systems with longer service lives was allowing less room for mistakes than in the past.

**Ideas for Change.** Starting in 1969 with reports by task forces of the President's Science Advisory Committee and the Defense Science Board, DoD began looking at how OT&E could better contribute to procurement decisions--which now came under the purview of the Defense Systems Acquisition Review Council (DSARC)--forerunner of today's DAB. There was a growing perception within DoD and Congress that both the developing and operating commands had too much of a stake in the success of major acquisition programs to be trusted with doing all of the testing and subsequent evaluations.

**Calls for Independent OT&E.** The pressure on the services to reorganize their OT&E function gained momentum in the early 1970s. After a detailed study of operational testing, a Presidential Blue Ribbon Panel recommended on 1 July 1970 that there be an OT&E organization, independent of the developer and user, reporting directly to the chief of each service.[28] Deputy Secretary of Defense David Packard repeated this recommendation in a memorandum to the services on 11 February 1971, and on 21 April 1971, he introduced the definition of "initial operational test and evaluation" (IOT&E) of new systems to assist in acquisition decisions.[29] Some key members of Congress supported Packard's ideas on both the independence and timing of operational testing, and Public Law 92-156 of 17 November 1971 required submission of OT&E data before weapons procurement.[30] In December 1972 the Commission on Government Procurement recommended that OT&E start as early as possible in major system acquisitions and be conducted by an activity separate from developer and user organizations.[31] As described later (pages 23-25), the Army and Navy quickly complied by designating independent OTAs.

**Initial Air Force Response.** The Air Force did not respond promptly to these calls and create a separate operational test agency in the field. After the Bolender study (named for the brigadier general who headed it), which was completed in September 1970, the Air Force did initiate several management improvements.[32] These included designation of the 2-star position of Assistant for OT&E, who could report directly to the CSAF.[33] It also restructured T&E from the former system of category testing to the basic dichotomy of DT&E and OT&E still in effect today, with the using commands responsible for the latter.[34] The Air Staff did not concur with the Procurement Commission's recommendation to create an independent OTA, contending that existing checks and balances were sufficient to prevent bias in test

reporting. In May 1973 the Vice CSAF rejected a request from the Deputy Director of Defense Research and Engineering for Test and Evaluation (DDDR&E(T&E)) to reconsider the Air Force position.[35] Meanwhile, the Air Force's delay in establishing an operational test agency had been criticized by the General Accounting Office (GAO) in a statement by the Comptroller General on 26 March 1973.[36]

## Decision to Create AFTEC While Retaining MAJCOM OT&E

The growing pressures from OSD and Congress eventually overcame the Air Force's reluctance to comply with the Commission's recommendation. In late September Gen George S. Brown, CSAF (and former commander of AFSC) ordered the Air Staff to start planning for a new OTA, and one month later he advised DDDR&E(T&E) of this plan.[37] After staffing the proposal and formally notifying the MAJCOMs on 24 November,[38] Headquarters Air Force issued the official directive for the establishment of the Air Force Test and Evaluation Center (AFTEC) on 11 December.* To help assure "complete objectivity," AFTEC was to be "independent of those Air Force commands which develop, procure, and use Air Force weapons and subsystems."[39] In deference to the Air Force, Department of Defense Directive (DoDD) 5000.3, "Test and Evaluation," had allowed for a "limited number of...major field agencies" for OT&E when first published in January 1973, but a change in early 1974 struck out this exemption. The directive then read that "in each component there will be one major field agency separate and distinct from the developing/procuring command and from the using command which will be responsible for OT&E...."[40]

The Air Staff OT&E directorate (XOOW), which had 42 personnel in early 1974, was reduced in scope to become a 7-person division (AF/XOOFA, later XOORE and XOOST) responsible mainly for coordination.[41] The Air Force's major commands, however, continued to conduct most OT&E programs and many related activities, such as TD&E. As a result, many of the commands continued to operate their own test units as separate OTAs (see pages 20-21). This posed a potential inconsistency with DoD guidance that would be not be addressed for another 17 years.

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*To more clearly indicate its mission and avoid confusion with DT&E, the word "operational" was added to the Center's name in April 1983.

## Evolution of AFOTEC, 1974-1991

The Air Force Test and Evaluation Center was activated as a separate operating agency (SOA) on 1 January 1974 at Kirtland AFB, NM.[42] Kirtland was already site of the Air Force T&E Systems Program Office (TESPO), assigned to AFSC's Air Force Special Weapons Center, which was developing a vast Continental Operating Range (COR) in the Great Basin area, initially for the Tactical Air Command. AFTEC was slated eventually to operate the COR, which had evolved from the Have Edge concept of the late 1960s, but Congress did not fund the project in 1974, and the TESPO was soon disbanded.[43]

The people assigned to AFTEC in the next several months had to "hit the ground running." Maj Gen John M. Burns assumed command on 25 February. The Center achieved initial operational capability in April 1974, and became fully operational in October 1974. By year's end it was managing 32 OT&E programs, leading two DoD-sponsored JT&E programs, and monitoring 103 operational tests being conducted by the MAJCOMs.

### Organization

Unlike the large and cumbersome Air Proving Ground Command, AFTEC was designed as a small management headquarters that would borrow most of the equipment, personnel, and facilities needed for field testing from the developing and operating commands. With termination of the continental operating range project, AFOTEC remained dependent on DT&E facilities and training ranges belonging to other commands and services.

**Size.** As its workload of programs and other responsibilities grew during the next decade, AFOTEC expanded to over 600 personnel in the headquarters and field. This number remained fairly stable from 1984 through 1991. In addition to the people assigned to AFOTEC, the commander also exercised operational control over a comparable number attached to test teams and provided guidance to as many as 2,000 personnel involved in operational testing by the MAJCOMs.[44]

**Headquarters.** From 1974 until 1992, AFOTEC's headquarters organization followed a matrix structure in which each OT&E program drew upon a variety of personnel from functional areas in several directorates. These specialists formed test support groups (TSGs), headed by a test manager, to plan, coordinate, and support individual OT&E programs. Most test managers were assigned to one of several division in the Directorate of Test and Evaluation (TE). The director of TE also supervised detachments and

test teams in the field, which normally did the actual testing.* Figure 3 on page 31 shows the final version of this organizational structure in detail.

**Field Units.** Since most tests could not be conducted from Kirtland, AFOTEC formed test teams as geographically seperate operating locations (OLs) whenever and wherever needed. At several key locations (see map at Figure 2), AFOTEC established detachments (dets) to support test teams and administer field activities.

- Det 1, first located at Kapaun AS, Germany, was activated in June 1977 to provide liaison with United States Air Forces in Europe (USAFE) at nearby Ramstein Air Base and other European organizations. As a result of the post-Cold War drawdown and fewer tests being conducted in Europe, Det 1 was inactivated and replaced by OL-RC on 30 September 1991. Just nine months later, Det 1 was reactivated at Scott AFB, IL, as AFOTEC's major field unit for command, control, communications, and computer testing (see page 22).

- Det 2, at Eglin AFB, FL, was activated in August 1977. It worked closely with local AFSC and Tactical Air Command organizations at this major T&E complex, such as the Tactical Air Warfare Center (TAWC) and the former Armament Division. Det 2 supported numerous teams, most involved with munitions and electronic combat. In 1992 its mission and organization expanded as it absorbed much of the operational testing workload of the Air Combat Command's Air Warfare Center (AWC).

- Det 3, at Nellis AFB, NV, was activated in April 1978 to interface with the Tactical Fighter Weapons Center (TFWC) and other organizations at the Nellis range complex. It later shrank in size, largely as a result of TFWC's reduced OT&E mission, and was replaced by OL-TF on 30 September 1991.

- Det 4, which had been the designation of a classified unit working on mobile MX missile basing from August 1980 through December 1981 at Kirtland, was reactivated in Colorado Springs in February 1984 to support space-related test teams and serve as AFOTEC's liaison with US and Air Force Space Commands as well as the North American Air Defense Command (NORAD). Det 4 later moved on to Peterson AFB and, in 1992, took over much of the Space Command OT&E mission it had been monitoring.

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*For a summary of organization changes in the headquarters culminating with the complete reorganization in 1992, see pages 32-34.

- Det 5, at Edwards AFB, CA, was activated in July 1982. This was eight years after AFTEC first proposed a detachment there, an idea that was not supported by Systems Command at the time. Det 5's main mission was to serve as the parent organization for the numerous aircraft and missile test teams that had been working at the Air Force Flight Test Center (AFFTC) since AFOTEC's earliest days.[45]

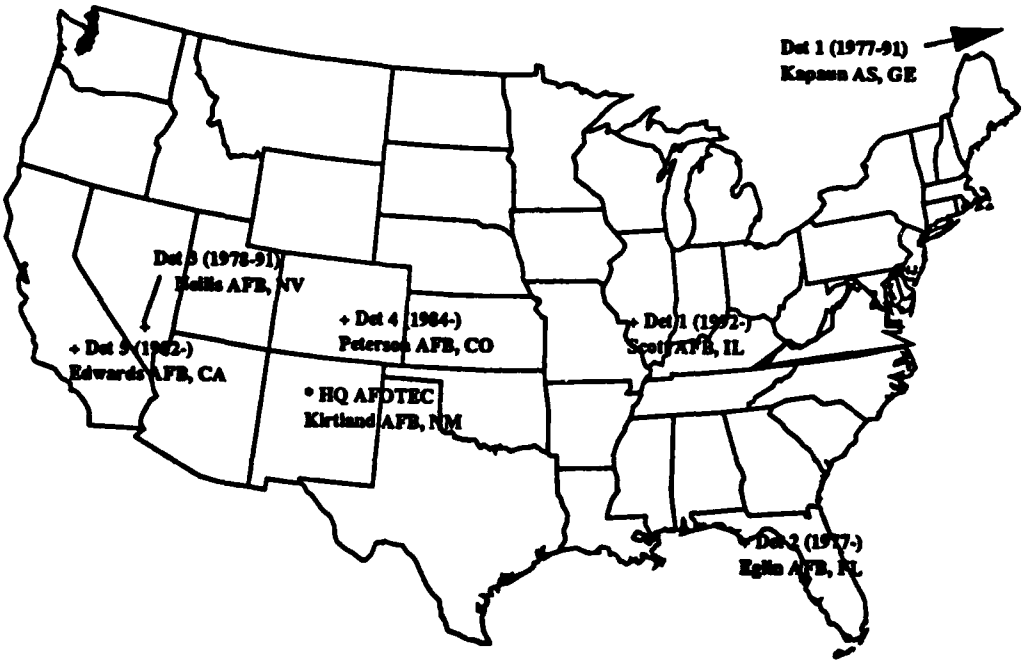


**Figure 2. Location of AFOTEC Detachments**

## OT&E Procedures

Although the detailed methods used for OT&E have continually evolved throughout AFOTEC's history, the following basic activities and their underlying policies and procedures have remained fairly consistent.[46]

**Planning.** A common theme during AFOTEC's history has been ever-earlier participation in acquisition programs and definition of the user requirements that normally generate new systems. After program definition, AFOTEC begins advance planning. This leads to development of a test concept, which through a test planning review (TPR) process, evolves during pre-test planning into a detailed OT&E plan. Throughout this process

AFOTEC also prepares the OT&E section of successive test and evaluation master plans (TEMPs), which also address DT&E. Based on basic program documentation,* AFOTEC's test plan identifies all the various elements to be evaluated, including critical operational issues (COIs), measures of effectiveness (MOEs), test objectives, measures of performance (MOPs), and evaluation criteria. The plan also covers all aspects of the coming OT&E effort, including resources and support needed (which other documents break out in detail), test scenarios, schedule, planning considerations, and limiting factors.

**Limitations.** Resource constraints (e.g., the infeasibility of replicating actual warfare) has limited the scope of almost all tests. Beyond these inherent limitations, AFOTEC has attempted to test as realistically as practical but historically faced other limiting factors. Some of the most common were inadequate threat systems, safety and airspace restrictions, less than optimal instrumentation, too few primary test articles, not enough support equipment, the system tested not being production-representative, use of immature software, insufficient maintenance data, and incomplete documentation.[47]

The insufficiency of existing ranges and test facilities has been a persistent problem. In 1984, several years after cancellation of the Continental Operating Range (see page 11), AFOTEC took the lead in trying to meet DoD's range and threat limitations by initiating a statement of operational need to establish an Electronic Combat Test Capability (ECTC) program. If the program had continued, ECTC would have upgraded the Utah Test and Training Range to provide an integrated air defense system. Cuts in the defense budget and other factors led to the cancellation of the ECTC program in 1990, but AFOTEC has continued to work actively for improved test capabilities and resources.[48]

**Test Execution.** At least nine months before a scheduled start date, the test director is normally assigned to the detachment or OL at the main test location and begins to build the test team to conduct the OT&E. In many IOT&Es, AFOTEC's teams have shared resources with a previously established DT&E team as part of a combined test force (CTF).[49] Led by the Responsible Test Organization (RTO), the CTF could also include representatives of the

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* These documents and their names changed over the years. For example, the statement of operational need (SON) and the systems operational requirements document (SORD) became the operational requirements document (ORD) in early 1991. Other key documents have included the program management directive (PMD), the system threat assessment report (STAR) and the recently emphasized cost and operational effectiveness analysis (COEA).

System Program Office (SPO) and contractors developing the system. In cases of multiservice OT&E, the participating services' OTAs establish a joint test organization under the designated lead service's test director. In any case, the OT&E team processes and interprets test data with complete independence from its DT&E counterparts.

In almost all cases, the MAJCOMs have loaned AFOTEC the bulk of the personnel and equipment needed to conduct its tests. To help determine operational suitability through use of a common data system, the CTF forms a Joint Reliability and Maintainability Evaluation Team (JRMET). Test teams also submit product quality deficiency reports (PQDRs--known also as "service reports" prior to 1991) to identify deficiencies discovered in testing and recommend enhancements, with the higher priority PQDRs implemented as soon as possible.[50] Many of the personnel who take part in the OT&E later become available to help the MAJCOM in the "beddown" and initial operational capability (IOC) of the system.

**Analysis.** The main focus of most test activities has been the generation of data (e.g., statistics, telemetry, visual documentation, and questionnaires). To find trends and draw valid conclusions requires data collection from as many sources or perspectives as practical, reduction of this data to a useable volume while reviewing for consistency and discrepancies (e.g., "outlying data"), and examination of the reduced data for specific objectives. For tests involving large volumes of data, team analysts and Headquarters AFOTEC--augmented by support contractors--use automated data reduction and analysis packages to help "crunch" the numbers.

| Effectiveness | Suitability |
|---|---|
| Security | Reliability |
| Vulnerability | Transportability |
| Susceptibility | Compatibility |
| Survivability | Maintainability |
| Interoperability | Supportability |
| Capability | Availability |

**Table 1. Some Attributes of Effectiveness and Suitability**

As shown in the table above, these analyses address the main characteristics of the system, with operations analysts trying to answer the

question "is it capable?" and logistics analysts, the question "will it be available?" In the increasingly important field of software suitability, AFOTEC has also developed considerable expertise.

**Modeling and Simulation.** Supported by an expanding Communications-Computer Systems Division (SC), AFOTEC's analysts built up considerable experience in modeling and simulation (both digital and hybrid or "man-in-the-loop") during the 1980s. AFOTEC developed its own computer models as well as using other DoD facilities and the expertise available through technical support contracts. The use of modeling and simulation could be especially valuable during EOAs and OUEs. Although noted for its expertise in this area, the Center consistently followed a firm policy that modeling and simulation can supplement but not substitute for actual testing.[51]

**Reporting.** AFOTEC's most important product has not necessarily been testing or analysis per se, but rather the information contained in briefings presented and reports published on the results. In addition to end-of-test briefings and detailed final reports, lengthy OT&E programs have often required interim summary reports as well as periodic briefings and other assessments. The briefings and reports go to a wide range of officials and organizations, such as SPOs, Program Executive Officers (PEOs), MAJCOMs, the Air Staff, other OTAs, and DOT&E. The briefings or portions thereof are also often presented to the AFSARC or DAB.

In its first few years, AFOTEC's reports were fairly unstructured in their approach and format. Starting in 1977, they became more compact and consistent, although continuing to present results in a variety of ways and often directly recommending whether to produce or not produce the system tested. After this practice ended in 1983, OT&E reports were assigned Inspector General-style rating terms, such as "outstanding," "satisfactory," "marginal, and "unsatisfactory." AFOTEC dropped use of these judgmental words in early 1988 and began stating its evaluation results strictly on whether systems met or did not meet user requirements or criteria in specific areas. In 1992, consistent with DOT&E's philosophy and the practices of the other service OTAs, AFOTEC began to use higher-level measures and draw overall conclusions about the system's effectiveness and suitability. Decision-makers, however, still must weigh the OT&E results with other factors, such as the system's potential for improvement, past contractor performance, budgetary constraints, current force structure needs, the latest threat projections, alternative solutions, and economic or political realities.[52]

After termination of an OT&E program, the final report and other key documents are preserved as a permanent historical record on the procedures and findings of the OT&E. Starting in the early 1980s, AFOTEC also

began to maintain an OT&E Lessons Learned database of suggestions submitted by test teams and personnel at the headquarters.[53]

## AFOTEC Commanders and Policies

Although the evolution of OT&E policy and procedures has been strongly influenced by outside factors, past commanders of AFOTEC have left their mark as well. They have also helped shape the Center's philosophy, mission, and mode of operation--as indicated in the brief chronology that follows.[54]

**Early Commanders, 1974-76.** With four commanders in the first three years (see Appendix B), AFTEC devoted most of its attention to starting and conducting tests--many of which had first been planned before its formation--and asserting its basic authority and independence in the face of reluctant acquisition and T&E communities.[55] Revisions of AFR 23-36 (AFTEC's mission regulation) and AFR 80-14 ("Test and Evaluation") in July 1976 helped give the new Center more clout while work began on a new Air Force OT&E directive.

**Maj Gen Howard W. Leaf, 1976-80.** General Leaf, whose T&E experience had begun as a test pilot at Eglin in 1955, commanded AFTEC during this crucial period when the Center almost doubled in size while continuing to assert its independence and build its credibility.[56] After a lengthy coordination process, the Air Force published AFM 55-43 on OT&E management in June 1979. Although not entirely mandatory, this AFTEC-originated manual provided detailed guidance to the MAJCOMs. A revised AFR 57-1 on operational requirements, also published in June 1979, formalized AFTEC's review of documentation on proposed new systems. AFTEC initiated a deficiency reporting process and formation of the Air Force OT&E Resources Management Assessment System (the ORMAS)--a corporate body for programming funds, ranges, personnel, test assets, and other support among the Air Staff and MAJCOMs. Internally, the Center established a senior advisory committee and began more systematic advance planning, threat realism, suitability analysis, software evaluation, and test reporting. It also conducted the first major OT&E based on a concept of models, simulation, and flight testing. In effect, AFTEC assumed the basic structure and established the procedures followed for the next dozen years.

**Maj Gen Wayne E. Whitlatch, 1980-82.** By the time General Whitlatch assumed command, AFTEC had reached the stage of maturity when it was appropriate to step back and do some in-depth self-examination. One year after his arrival General Whitlatch used the results of two major studies

of AFTEC's mission and organization to write a comprehensive mission statement compatible with the latest strategic planning concepts.

**Maj Gen Richard W. Phillips, 1982-85.** Under the command of General Phillips, AFOTEC replaced AFM 55-43 with a shorter AFR 55-43, published in June 1985. Although directive in nature, the regulation still allowed considerable leeway to the MAJCOMs in how to plan, conduct, and report OT&E. General Phillips implemented the IG-style rating system and an early type of system examination known as IOT&E Phase 1 to help meet the information needs of decision-makers prior to Milestone III of the acquisition cycle.

**Maj Gen Michael D. Hall, 1985-87.** During the tour of General Hall, who had once headed its AIM-9 Sidewinder test team, the Center updated the official mission statement in AFR 23-36, published in March 1986. The revised regulation spelled out several functions, such as the various elements that comprise operational suitability, not covered in the previous 1980 edition. In the continuing effort to find a way to provide earlier inputs to decision-makers, he redefined IOT&E(1) as the early operational assessment (EOA). As an overall theme during his command, General Hall emphasized making OT&E an "integral part of the acquisition process" and improving relations with developers. He also began holding offsite meetings to encourage fresh looks at the way the Center did business--one result of which was an in-depth organizational assessment by a team of outside consultants, published in September 1987.

**Maj Gen Cecil W. Powell, 1987-89.** General Powell, who came to AFOTEC in July 1987 with a broad range of T&E experience and strong backing from the CSAF, changed the Air Force's evaluation policy from assigning IG-style ratings to precise descriptions of test results based on meeting or not meeting specific user requirements. He led an effort to standardize OT&E procedures Air Force-wide--a goal largely met with a thorough revision of AFR 55-43 first issued in September 1989 and formally published in June 1990. General Powell also stressed early and disciplined planning (resulting in the Test Planning Review or TPR process), initiated the DoD-wide definition for operational assessments (OAs and EOAs), and helped reinforce AFOTEC's longstanding philosophy that modeling and simulation should supplement rather than substitute for test data. He took a special interest in improving the Air Force's requirements process and was a key contributor to the Air Force's first acquisition program corporate review (a B-1B "summit meeting") in recent history.

**Maj Gen Peter D. Robinson, 1990-91.** General Robinson's solid analytical background brought increased attention to the complex processes

underlying the measurements of effectiveness and suitability and the need to reduce "undetermined" ratings. He also institutionalized the concept of strategic planning and introduced the philosophy of total quality (TQ) to the way AFOTEC performed its staff work and served its suppliers and customers--who include both the users of the equipment tested and the decision-makers relying on the Center's reports. AFOTEC's independence was confirmed when, on 5 February 1991, it became a direct reporting unit (DRU) while most other SOAs became field operating agencies (FOAs).

**Maj Gen Marcus A. Anderson, 1991-.** As described in the final sections of this history (pages 28-34), Maj Gen Marcus A. Anderson led AFOTEC through the most significant period of change since the Center's establishment. He oversaw the implementation of TQ and, at a time when the entire Air Force was realigning and downsizing, he completely revamped the Center's organization and expanded its mission to encompass most of the OT&E traditionally performed by the major commands. Under his leadership, AFOTEC also raised the focus of its evaluations to mission level measures and higher level ratings and, in the face of post-Cold War budget cuts, began looking at ways to make OT&E as cost-effective as possible.

## OT&E and the Major Commands

Prior to the changes of 1992, the operational Major Commands--especially the Tactical Air Command (TAC), Strategic Air Command (SAC), Military Airlift Command (MAC)--had long conducted a wide variety of OT&E programs on new and modified systems in their inventories. Except for systems unique to their theaters, USAFE and Pacific Air Forces (PACAF) normally relied on TAC to perform operational testing for all the tactical air forces (TAF). This extensive OT&E program came under the purview of TAC's DCS for Requirements (TAC/DR), while that of SAC and MAC were managed by their DCSs for Plans and Requirements (XR).

The other commands also managed OT&E programs. Air Training Command (ATC) focused on training aircraft and related systems. Air Force Space Command (AFSPACECOM) began conducting OT&E of space systems in the mid-1980s, and the Air Force Special Operations Command (AFSOC) took over testing of its systems from MAC during the first part of 1991. The Electronic Security Command (ESC) at Kelly AFB, TX, which expanded to become the Air Force Intelligence Command (AFIC) on 1 October 1991, tested cryptographic systems and sensitive intelligence equipment. Air Force Communications Command (AFCC), which had conducted OT&E of communi-

cations, air traffic control, and computer equipment, transferred many of its field units to the MAJCOMs in October 1990 and was reduced to an FOA in July 1991. Besides T&E offices at their headquarters, several of the MAJCOMs had field units that performed OT&E.

## MAJCOM Field Units

TAC. Because the Tactical Air Command was responsible for the requirements, training, and employment of the vast majority of actual warfighting systems, it had the largest OT&E program of any of the major commands. It established the USAF Tactical Air Warfare Center (TAWC) in 1963 to carry on testing of Air Force versus Army concepts for close air support and tactical airlift. With expansion of the Vietnam War, TAWC's charter grew to include a wide range of development, testing, and tactics activities--with a special emphasis on electronic combat. In 1966 TAC created the Tactical Fighter Weapons Center (TFWC) at Nellis AFB, NV, and the Tactical Airlift Center at Pope AFB, NC, to share the increasing workload. It also assigned OT&E to a Tactical Air Reconnaissance Center and a Special Operations Force. In July 1971 TAC consolidated most OT&E at TAWC. MAC inherited the Airlift Center when it assumed the tactical airlift mission from TAC in 1974. Both TAWC and TFWC (which focused on TD&E), plus their subordinate wings, groups, and squadrons also became increasingly involved in extensive training programs, such as Blue Flag and Red Flag exercises.[57] On 1 October 1991 the word "tactical" was dropped from the names of the two centers, with TAWC becoming the Air Warfare Center and TFWC later becoming the Weapons and Tactics Center.

SAC. Within the Strategic Air Command, OT&E activities were divided among several squadrons. The 31st Test and Evaluation Squadron at Edwards AFB was activated on 1 July 1986 to assume the testing mission of the 4200d TES which had begun operations in the mid-1960s. It focused on testing SAC aircraft and related systems. The 49th Test Squadron (TESTS) at Barksdale AFB, LA, began in July 1972 as the 4201st TESTS at Pease AFB, NH. It moved to Barksdale in 1974 and was designated as the 49th TESTS in July 1986. The squadron focused on air-launched missile and munitions testing and certification. The 513 TESTS was activated in July 1986 at Offutt AFB, NE, where it concentrated on SAC's electronic warfare systems and software. The 576 TEST at Vandenberg AFB, CA, tested SAC's ballistic missiles. The 31st, 49th, and 513th squadrons reported directly to SAC's DCS for Requirements and Test (XR), while the 576th was part of the 1st Strategic Aerospace Division, which became 20th Air Force less than a year before SAC

was disestablished in June 1992.[58] Most of SAC's test units, including the 99th Test Group at Offutt AFB, NE, were integrated into the Air Combat Command and its two centers.

**MAC.** The USAF Airlift Center (ALCENT) at Pope AFB, NC, was transferred from TAC to MAC in 1974 with the transfer of the tactical airlift mission. It focused on the testing of equipment and systems related to air transport and worked closely with Army units at nearby Fort Bragg. The ALCENT was renamed the Air Mobility Center to reflect the formation of the Air Mobility Command in June 1992.

**AFSOC.** The Military Airlift Command created the Special Missions Operational Test and Evaluation Center (SMOTEC) at Hurlburt Field, FL, in October 1983. It was formed by consolidating the combat rescue test functions formerly performed by the 1550th Aircrew Training and Test Wing at Kirtland, and the special operations test functions of the 2nd Air Division and its 1st Special Operations Wing at Hurlburt. SMOTEC became a unit of the Air Force Special Operations Command when AFSOC was established in May 1990. In addition to testing systems used in special operations and low-intensity conflict, the Center was also involved in requirements and doctrine.[59]

**AFCC.** The Air Force Communications Service activated the 1815th Test Squadron at Richards Gebaur AFB, MO, in January 1973 to do operational testing of new communications and air traffic control equipment. In June 1981 the 1815th was moved to Wright-Patterson AFB, OH, and combined with personnel from the Creek Scope program, which was updating long-haul communications in Europe. The 1815th, which was renamed an OT&E Squadron in November 1985, became the Air Force Communications Command OT&E Center (AFCC OTEC) in April 1989. As the result of a Defense Management Report initiative, the OTEC was reorganized as the T&E Division of AFCC's new Technology Integration Center (TIC/TE) at Scott AFB, IL, in April 1991.[60] Here, on 1 June 1992, it became AFOTEC's new Det 1 (see page 13).

## Monitored Tests

Headquarters AFOTEC and its detachments monitored and advised on the OT&E programs conducted by MAJCOMs and their subordinate organizations. Monitored OT&Es were defined as USAF-directed tests involving high risk, high cost, and priority precedence systems. For internal management, AFOTEC designated them as Category 1 tests. On these AFOTEC coordinated on the TEMP, approved test plans, and commented on

final reports. For smaller and less critical programs, AFOTEC's role was advisory. These OT&Es included USAF-directed (Category 2) or command-initiated (Category 3) projects. At the end of 1991, AFOTEC's Test Resources and Information Management System (TRIMS) listed 106 Category 1, 227 Category 2, and 209 Category 3 tests being conducted by the MAJCOMs--a total of 542 (compared to 585 one year earlier). AFOTEC planners also used Categories 4, 5, and 6 for tracking conducted, monitored, and cognizance programs projected for the future.[61]

## Developers and Implementors

Air Force Systems, Communications, and Logistics Commands (AFSC, AFCC, and AFLC) had long been responsible for developing, acquiring, implementing, and supporting the new and modified systems tested by AFOTEC and the MAJCOMs. During AFOTEC's first decade, it often found itself in an adversarial relationship with AFSC and its SPOs. System Command's renunciation of its traditional role as the advocate of new programs in 1989 and its loss of major system responsibilities to the newly created program executive officers (PEOs) in early 1990 changed the context of AFOTEC's relationship with developers. The replacement of AFSC, AFLC, and much of AFCC by the new Air Force Materiel Command (AFMC) on 1 July 1992 then consolidated the command structure with which AFOTEC works.

## Informal Contacts

Many of AFOTEC's contributions to the other commands' OT&E programs as well as testing-related aspects of acquisition programs took place informally at the action officer level. The directors, chief scientist, vice commander, and commander also tried to resolve the more difficult issues through frequent personal meetings and phone conversations with other officials. Sometimes AFOTEC served as an intermediary between developers and users on various issues related to requirements and testing. Although usually undocumented, the Center's informal contacts represented an extensive and integral part of AFOTEC's management responsibilities.[62]

## OT&E Outside the Air Force

### Other Services

As with many other functions, each of the armed forces had developed its own approach to performing OT&E. They all, however, have operated under the principle that the uniformed services should be responsible for operationally testing the weapons that they will have to fight with in combat.[63]

Unlike the Air Force, which did away with its Air Proving Ground Command in 1957, the Navy has kept an operational testing organization intact since World War II.[64] This organization became the DoD's first independent operational test agency in 1971, one year before the Army established its counterpart. The Marine Corps activated its OTA in 1978.[65] To coordinate policies and discuss issues of common concern, the four OTAs periodically hold commanders' conferences.

**Army.** On 8 November 1990, the Army activated a new Operational Test and Evaluation Command (OPTEC) to replace and expand upon its Operational Test and Evaluation Agency (OTEA), which had served as the Army's OTA since being established at Fort Belvoir, VA, in September 1972.[66] Formation of OPTEC implemented a Defense Management Report decision of 20 November 1989 to consolidate Army OT&E activities under a single command. The realignment allowed the Army to reduce the number of personnel involved with OT&E from approximately 2,700 to 2,000 positions.[67]

In addition to its headquarters in Alexandria, VA, the new OPTEC encompassed several components: the Operational Evaluation Center (OEC), which included former OTEA functions at Alexandria; the OPTEC Threat Support Activity (OTSA), formerly the Army Development and Acquisition Threat Simulators Activity (ADATS-A), at Fort Bliss, TX; and the Test and Experimentation Command (TEXCOM), formerly a subcommand of the Training and Doctrine Command (TRADOC), headquartered at Fort Hood, TX. TEXCOM continued to operate its Experimental Center (the TEC) at Fort Hunter Ligget, CA, but OPTEC replaced TRADOC's traditional test boards with directorates and T&E Coordinating Offices (TECOs) responsible for various combined arms centers and branches: Infantry, Signal, Armor/Engineer, Aviation, Fire Support, Intelligence, and Communications/Electronics, Air Defense Artillery, and Airborne/Special Forces. Among the key positions in Army OT&E are the evaluators at OEC and the test officers and test directors at TEXCOM. For major tests, a senior officer from the participating field command serves as the test director, with a TEXCOM officer as the deputy.

Prior to the formation of OPTEC, the Army relied on a dual planning and reporting system in which OTEA published independent test design plans, independent evaluation plans, and independent evaluation reports, while TRADOC was responsible for the test plans and test reports. In line with the reorganization, OPTEC consolidated documentation of both tests and evaluations. In addition to formal OT&E, the Army under both OTEA and OPTEC has managed an open-ended strategy known as continuous comprehensive evaluation ($C^2E$).[68]

**Navy.** Until the formation of OPTEC, the US Navy's Operational Test and Evaluation Force (OPTEVFOR)--which traces its lineage back to 1945--was the largest of the OTAs in terms of assigned personnel and test resources. The commander (COMOPTEVFOR) historically managed all OT&E programs, both large and small, prepared related tactics guides (a MAJCOM responsibility in the Air Force), and performed numerous other Chief of Naval Operations (CNO) projects.[69] To perform these functions, OPTEVFOR (from the early 1970s through the early 1990s) had about 300 people in the Norfolk headquarters and a deputate in San Diego and over 1,000 personnel in the field, including three air test and evaluation squadrons (AIRTEVRONs): VX-1 with anti-submarine aircraft at Patuxent River, MD; VX-4 with fighters at Point Mugu, CA; and VX-5 with attack aircraft at China Lake, CA. OPTEVFOR has used operational test directors (OTDs) to perform the basic roles of both AFOTEC's test managers and test directors. For executing shipboard tests, the OTDs normally deploy to the fleet and use operational personnel.[70]

The Navy's IOT&E process traditionally has been divided into OT-I, conducted prior to Milestone II if test articles were available, and OT-II, conducted prior to Milestone III and culminated by the operational evaluation (OPEVAL). OPTEVFOR conducts the OPEVAL separate from and normally after the technical evaluation (TECHEVAL), which culminates DT&E. OT-III is FOT&E conducted after the OPEVAL, and OT-IV is FOT&E conducted later on production systems if necessary.[71] In addition to presenting results and overall conclusions, OPEVALs have normally addressed how the test resolved each of the COIs, if the results support limited production, and COMOPTEVFOR's recommendation as to whether or not the system tested is ready for full or partial fleet introduction.[72]

**Marines.** The Marine Corps Operational Test and Evaluation Activity (MCOTEA), a tenant organization with about 40 personnel at Quantico, VA, has conducted operational tests of Marine Corps systems and equipment since 1978. Fleet Marine Forces support MCOTEA in executing tests and providing the data used by MCOTEA to prepare independent evaluation reports (IERs) for the Commandant of the Marine Corps. Both MCOTEA and

OPTEVFOR also use Marine Helicopter Squadron One (HMX-1) at Quantico for tests involving rotary wing aircraft. (HMX-1, formed in 1947, is also the unit that flies government leaders in the Washington DC area.) Key Marine OT&E positions include operational test project officers (OTPOs) at MCOTEA (similar to AFOTEC's test managers) and test directors assigned to Fleet Marine Forces, who execute and report on the tests. Like AFOTEC in the past, MCOTEA also monitors smaller OT&E programs performed by operational organizations.[73]

**DoD Oversight**

Mainly because of dissatisfaction with operational testing's influence (or lack thereof) on weapons acquisition, Congress mandated the creation of the Director of Operational Test and Evaluation by Public Law 98-94 passed in September 1983. After being established as an OSD function in 1984[74] and having a permanent director appointed in 1985, DOT&E began to play an influential role in the formulation of OT&E policy. (The abbreviation DOT&E refers to the position but is also used for the organization.) The office grew to about 40 personnel organized into divisions for conventional systems, strategic, $C^3I$, and resources and administration. Because of its small size, DOT&E came to rely on the Institute for Defense Analyses (IDA) to perform much of its technical work. Under its first appointed director, Mr John E. (Jack) Krings, DOT&E received considerable attention from members of the Congressional Military Reform Caucus--especially for attempts to expand its role in managing T&E resources, which they considered beyond the office's statuatory responsibilities.

By law DOT&E is responsible for reporting directly to the Secretary of Defense and Congress on OT&E matters. As a member of the DAB, the Director also assures consideration of OT&E findings for milestone decisions. To do this, DOT&E exercise oversight responsibilities for major and selected non-major acquisition programs. Among other requirements, the services submit TEMPs for periodic review, and DOT&E approves the OTAs' test plans. DOT&E also reports to Congress on OT&E results for systems proceeding beyond low rate initial production (B-LRIP). Dr Robert C. Duncan, who was confirmed as Director in November 1989, emphasized the need for DOT&E to conduct independent analysis of test data and to meet past concerns about the quality and impartiality of OT&E.[75]

Reflecting the dichotomy between OT&E and DT&E, oversight of the latter and management of test resources belongs to the Under Secretary of Defense for Acquisition's Director of Test and Evaluation. Prior to 1992, the

Director of Defense Research and Engineering's Deputy Director for Test and Evaluation, abbreviated as DDDR&E(T&E), had performed these functions. Until DOT&E's creation, DDDR&E(T&E) and its predecessors had also been responsible for oversight of OT&E (except for a brief period from 1978 to 1979 when OT&E came under the Assistant Secretary for Program Analysis and Evaluation (PA&E).

## Congressional Influence

As previously indicated, congressional interest in OT&E helped lead to the establishment of independent OTAs in the early 1970s and compelled DoD to create DOT&E a decade later. Much of this interest is reflected in the numerous studies and investigations performed by the General Accounting Office (GAO) as well as frequent hearings and legislative actions.[76]

A general theme in statements by the Congress's Military Reform Caucus and reports by the GAO has been skepticism about the wisdom of concurrent development, production, and testing strategies. Believing strongly in the "fly before buy" approach, they have also reflected a philosophy that operational testing should have more of an adversarial relationship to the acquisition community and thereby help lead to cancellation of more programs. Some congressional staffers and OSD officials also thought operational testing should focus on demonstrations and force-on-force field exercises rather than sophisticated data gathering and analysis. The potential conflict of interest in using contractor support and data for OT&E has been a particular concern of Congress, which passed highly restrictive provisions against this practice in late 1986.[77]

Legislation passed in late 1989 expanded DOT&E's monitoring role by lowering the thresholds for certifying completion of OT&E to $75 million in RDT&E or $300 million in procurement, by requiring approval of test article quantities for major programs at Milestone II (thereby tightening control over LRIP quantities), and by extending DOT&E's annual report to include a comparison of the TEMP versus actual test activities.[78] The new legislation did not alleviate the restrictions against use of contractor personnel and data that has made combined DT&E/IOT&E increasingly difficult.

How to continue doing intensive, analytical, yet efficient tests and evaluations of the performance of increasingly complex systems, and at the same time satisfy the political goals of Congress and policy objectives of OSD, will undoubtedly pose a continuing challenge to AFOTEC and the Air Force.

## Desert Storm

The performance of many "high tech" weapons during January and February 1991 in Operation Desert Storm, although only one factor contributing to the coalition's decisive military victory, helped put DoD's acquisition and testing programs in a more favorable perspective. Much of the criticism and bad publicity about operational testing during the previous decade proved unfounded or exaggerated. "The effective use of high technology was a key reason for both the high level of performance of air and ground forces and the minimization of allied casualties," concluded Rep Les Aspin's House Committee on Armed Services, which also observed that "the decisive factor in the war with Iraq was the air campaign."[79] DoD's Gulf War report also noted the "extraordinary effectiveness of air power" while concluding that "a revolutionary new generation of high-technology weapons, combined with innovative and effective doctrine, gave our forces the edge."[80] Preliminary findings on the effectiveness of the weapons of Desert Storm contrasted sharply with the previously mentioned reports of the Vietnam era.

AFOTEC had tested at least 35 of the major systems used in Desert Storm, ranging from the A-10 Thunderbolt II to the Navstar Global Positioning System.* An AFOTEC study of the wartime performance of six recently tested systems showed significantly better operational effectiveness in Desert Storm than during OT&E--indicating both the rigor of the operational tests as well as improvements made as the systems matured. Although less progress was apparent in suitability factors (some of which AFOTEC had not been able to evaluate),[81] the Center's findings and similar data from the other OTAs confirmed DOT&E's preliminary assessement to Congress that "in general, the experience of combat was in keeping with the results of OT."[82]

## New Look for Air Force OT&E, 1991-1992

As described earlier, the creation of AFOTEC in the mid-1970s was a compromise between those who wanted a single Air Force operational test agency and those who wanted to keep a decentralized system. During the early 1990s, the Air Force began another look at its OT&E structure in the midst of other fundamental changes.

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*For a list of the major systems tested by AFOTEC from 1974-1991 indicating those that participated in Desert Storm, see Appendix C.

## Changes in the Air Force

**Redesignation of Separate Operating Agencies.** On 5 February 1991, the Air Force redesignated most of its Separate Operating Agencies (SOAs) and Direct Reporting Units (DRUs) as field operating agencies (FOAs) and assigned them to appropriate functional chiefs at Headquarters USAF. AFOTEC, which had been an SOA since its establishment, became one of only three remaining DRUs which, under a new definition, reported directly to the Chief of Staff of the Air Force (CSAF).[83] A factor that precluded AFOTEC from becoming an FOA was its Department of Defense-mandated status as one of the services' independent operational test agencies (OTAs).[84]

**MAJCOM Reorganizations.** In September 1991 the CSAF, Gen Merrill A. McPeak, and Secretary of the Air Force (SAF), Dr Donald B. Rice, announced a sweeping reorganization of the operational MAJCOMs. The most notable feature of this was replacement of the Strategic Air Command (SAC), Tactical Air Command (TAC), and Military Airlift Command (MAC) by new Air Combat and Air Mobility Commands.[85] This was in addition to the previously initiated replacement of Air Force Systems Command (AFSC) and Air Force Logistics Command (AFLC) by the Air Force Materiel Command (AFMC) and formation of a new Air Force Intelligence Command (AFIC).

**Creation of AF/TE.** In July 1991 the Secretary and the Chief also created a new office in the Air Staff, the Director of Test and Evaluation (AF/TE), to consolidate management over OT&E and DT&E.[86] AF/TE combined the functions previously performed by the Air Staff's OT&E Division (AF/XORT in its final configuration) and Secretariat's Directorate of T&E (SAF/AQV), which had been created in early 1988. Among other initiatives, the new office began a fresh look at how the Air Force should do OT&E. Appointment of Lt Gen Howard W. Leaf, USAF-Retired (former AFOTEC commander), as the director on 28 October 1991 accelerated this effort.

## Expansion of AFOTEC's Mission

**AF/TE's Initiative.** In the past decade, the decentralized Air Force OT&E structure had grown increasingly out of step with the rest of the Department of Defense--whose directives had long called for each of the military services to have a single operational test agency independent of developing and using commands.[87] As noted earlier, the Navy had chartered such an organization in 1971, and the Army fully centralized its operational testing and evaluation under a new command in 1990. General Leaf was not satisfied with the Air Force's existing OT&E structure, and with the support

of AFOTEC's Commander, Maj Gen Marcus A. Anderson, included a proposal to centralize responsibility for most tests as one of his most important initiatives to improve Air Force T&E.[88] In December 1991 General Leaf obtained approval from the SAF and CSAF for the expansion of AFOTEC's mission to include all of the initital and qualification testing that had been conducted by the MAJCOMs. The goals for this restructure included improved efficiency, impartiality, and credibility.[89]

**Implementing the Realignment.** A 26 December 1991 announcement by Gen Michael P.C. Carns, the Air Force Vice Chief of Staff, launched this most significant change in the Air Force's OT&E mission since the establishment of AFTEC in 1974. His message directed that AFOTEC assume responsibility for all initial and qualification OT&E plus selected FOT&E.[90]

For AFOTEC, the new year brought the abrupt challenge of planning, negotiating, programming and implementing this realignment by 1 June 1992--the same date that the new Air Mobility and Air Combat Commands would stand up. The Center assembled a transition team, which worked closely with representatives from the affected MAJCOMs to review each of several hundred existing test programs. After scrubbing this list, they determined which were appropriate for transfer to AFOTEC, which should be completed by existing test teams, and which were eligible for continued MAJCOM management.[91]

Once AFOTEC and the commands agreed on the status of test programs, they had to determine how much funding, how many positions, and which people would be transferred to the Center.[92] As in any major realignment, such actions were sometimes painful for the losing organizations. Yet a spirit of cooperation generally prevailed, and most of the details were worked out in a mere five months.

**Program Transfers.** On 4 May 1992, General Anderson briefed the Air Force Chief of Staff on the progress to date.[93] With the CSAF's approval, the transfers took place as scheduled. On 1 June the number of programs being conducted by AFOTEC increased from 41 to 186. These included those which had been the responsibility of AFCC's Technical Integration Center, whose entire OT&E Directorate (TIC/TE) was reborn as AFOTEC Det 1 on that date. Fifty-nine additional tests, already underway, were "grandfathered" for the MAJCOMs to finish.[94]

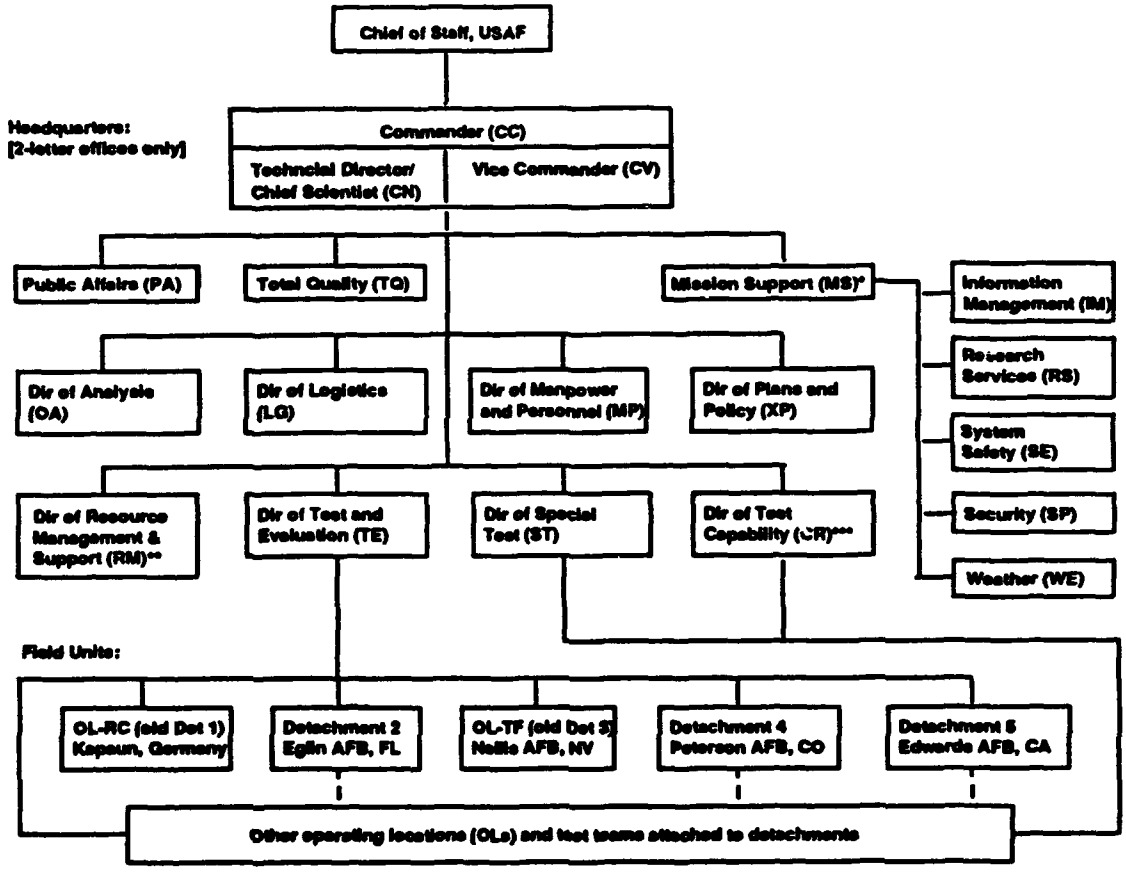
After meeting the June target date, AFOTEC and the MAJCOMs wrapped up most of the remaining details by 30 September 1992. Fifty additional MAJCOM test programs were identified during the summer for transfer to AFOTEC, bringing the total to 195 (with over a hundred more that might also require involvement by the Center in the future). To meet its increased workload, AFOTEC received more than 200 new positions, which

with previously programmed losses, brought its authorized strength to just over 800. The main challenge involved previously unidentified tests and funding requirements that forced AFOTEC to prioritize test programs to determine how best to apply the limited money available.[95] Obviously, many challenges lay ahead for AFOTEC in managing its expanded mission at a time of major fiscal pressures.

## Changes in AFOTEC's Organization

In harmony with the restructure of Air Force OT&E, AFOTEC simultaneously executed the most thorough reorganization in its history. Announced by General Anderson on 18 February 1992, it became effective on 18 May. The reorganization had several complementary objectives, all consistent with the principles of total quality management and its goals of empowering teams at the working level and meeting customer expectations for fast and efficient service.

**1974-1991.** Prior to 1992, AFOTEC's organization followed a matrix structure in which each OT&E program drew upon a variety of personnel from functional areas in other directorates. Most test managers, who had responsibility for planning and coordinating individual OT&E programs, were assigned to one of several divisions in the Directorate of Test and Evaluation (TE). The director of TE also supervised detachments and test teams in the field. Starting in 1977, the Directorate of Plans and Resources (XR) began to perform advance planning for many OT&E programs with its own test managers. In 1981, XR split into the Directorates of Plans and Policy (XP) and Resources and Support (RM). For technical and support expertise on their test support groups, TE's or XP's test managers relied on representatives from other directorates and offices. The TSGs included members from the Directorate of Analysis (OA), the Directorate of Logistics (LG), as well as RM and special staff or liaison offices for safety, security, weather, and intelligence expertise. AFOTEC managed joint tests in a Directorate of Special Test (JT), which because of a declining JT&E workload, became an XP division in 1987. Also in 1987, the Center's growing participation in highly classified programs with special access requirements led to formation of the Directorate of Special Test (ST). In 1990 a provisional organization under an assistant for range matters (formed in 1989) became the Directorate of Test Capability (CR) to provide expertise on threat capabilities, range resources, and related matters. Figure 3 shows the final version of AFOTEC's matrix organization prior to the reorganization of 1992.




ATTACHED TO HQS: Elements of the Air Force Intelligence Command, Air Force Logistics Command, and Tactical Air Command.

NOTES: *Dual-hatted as Headquarters Squadron Section Commander (CCQ)
**Includes Comptroller (AC), Engineering/Facilities (DE), and Communications/Computer Systems (SC) functions
***Includes Intelligence (IN) functions.

**Figure 3. Organization of AFOTEC, 1991**

The matrix-type organization, which was the subject of major studies published in 1981 and 1987, was an efficient and flexible way to use specialized personnel to support changing program workloads while keeping subject matter experts together. But this type of structure did not reflect the mission areas of the systems tested. It featured vertical divisions that split TSG members among different offices and, along with horizontal layering of directorates into divisions and branches, fostered a lengthy coordination process. It also gave the Director of TE, who was responsible for six large divisions as well as detachments in the field, a disproportionate span of

control.[96] As shown in Figure 4, there were some changes to the directorates over the years, but the fundamental structure of 1974 remained intact until 1992.

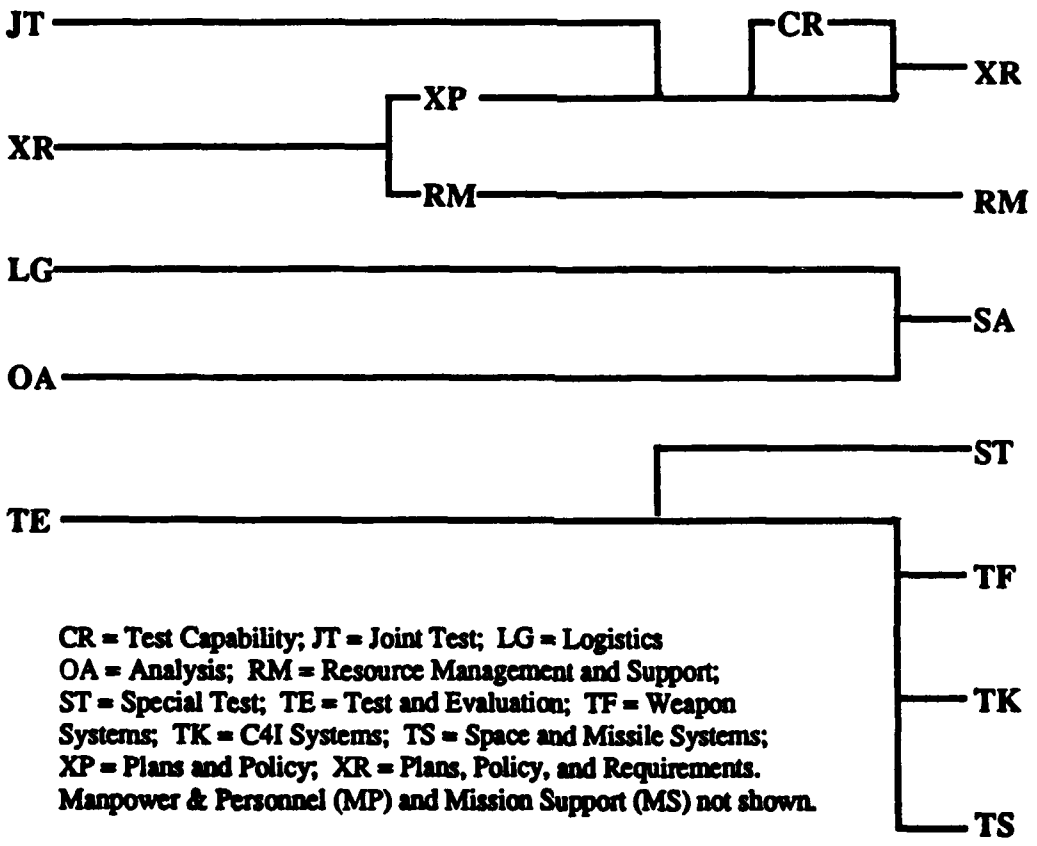



**Figure 4. Evolution of Major AFOTEC Directorates, 1974-1992**

**Reorganization of 1992.** The most visible feature of the reorganization in the headquarters was the realignment of major directorates. As shown in Figure 4, the Directorate of Test and Evaluation (TE), previously responsible for all but a small number of special programs, gave birth to three new "T" directorates organized by mission areas: Weapon Systems (TF), C$^4$I Systems (TK), and Space and Missile Systems (TS). As in the existing Directorate of Special Test (ST), each now included its own analysts. These were reassigned from the former Directorates of Analysis (OA) and Logistics (LG), whose remaining functions were consolidated into a new Directorate of

Systems Analysis (SA). Likewise, the Directorates of Plans and Policy (XP) and Test Capability (CR) were consolidated into the Directorate of Plans, Policy, and Requirements (XR). The other large directorate, Resource Management (RM), remained largely unaffected by the reorganization.[97] The organization chart below (Figure 5) depicts the major features of AFOTEC's structure after 18 May 1992.

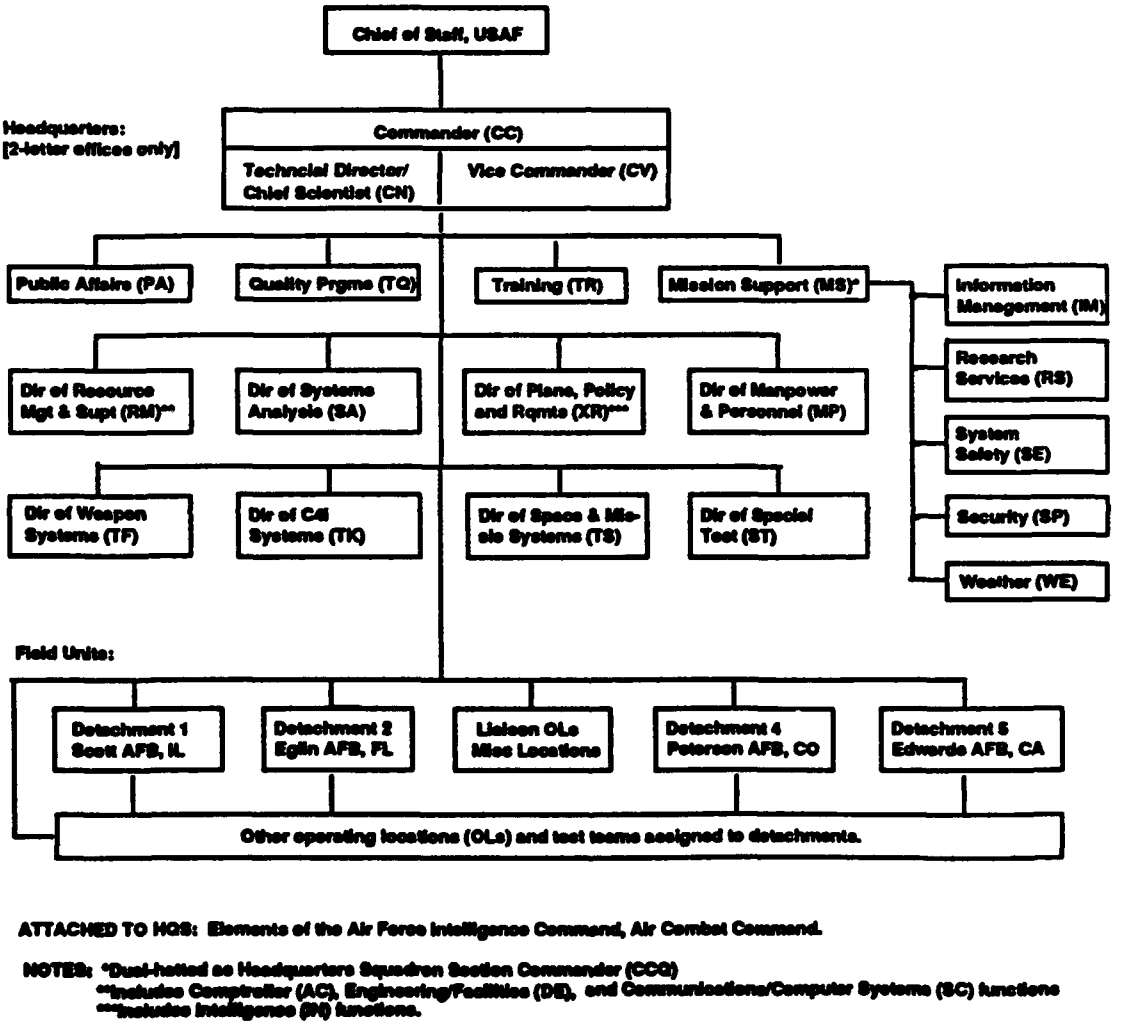



**Figure 5. Organization of AFOTEC, 1992**

In addition to realigning directorates, the reorganization eliminated an entire bureaucratic layer of middle management by blending what had been divisions and branches into teams. The new "flatter" structure improved communications flow and pushed authority down lower in the organization.

This reinforced the status of test managers and focused attention on their test support groups, which remained the key elements for planning, coordinating, and analyzing tests. Instead of being formed by specialists who were "matrixed" from various directorates, TSG members now came from the same closely-knit teams. To help build an initial test concept for many programs, XR formed a new test concept group (TCG) of highly experienced personnel.

The reorganization also strengthened the role of AFOTEC's detachments in the field, which were expanding in size and importance as they took over many of the former MAJCOM tests. Detachment commanders, who previously came under the TE Director, now reported directly to the AFOTEC Commander. The key role of test teams in executing tests was also enhanced. The Headquarters would continue to plan tests, while the dets and OLs would execute them, with the transfer of responsibility now occurring at test readiness briefings (approximately 30 days prior to testing).

The intent of the reorganization was improved planning and support for AFOTEC's test teams in the field--and better, more timely OT&E products.[98] As a result of the program transfers and AFOTEC reorganization, the Air Force now had a single, expanded operational test agency to assure independence and to help improve the credibility of its OT&E mission.

## Conclusion

After the restructure of Air Force OT&E and its internal reorganization, AFOTEC stood poised to take on the challenges of the post-Cold War era. Although the Air Force appeared certain to continue shrinking in size, and its budget to remain under severe pressures, there seemed to be a consensus on the need to maintain the technological advantages recently demonstrated in Desert Storm. Even with the cancellation of many acquisition programs, operational testing would be required on those new systems that remained under consideration for production. Tests and assessments would also be needed for modifications to existing equipment and prototypes of systems that--under DoD's new acquisition strategy--might be developed but not produced in quantity. AFOTEC's chief challenge would be to find innovative ways to test this wide range of systems at the best possible cost while continuing to assure their operational effectiveness and suitability.[99]

## ENDNOTES

The following sources include supporting documents (SDs) attached to annual histories of AFOTEC, a copy of which is on file at the Air Force Historical Research Agency (AFHRA), Maxwell AFB, AL, as well as AFOTEC/RS.

1. US Code, Title 10, Section 138(a)(2), 21 Feb 90. (Derived from Public Law 98-94 as amended).

2. AFR 55-43, "Mangement of Operational Test and Evaluation," 29 Jun 90, SD I-6 in Hist of AFOTEC 1990; AFOTECR 55-9, same subj, 1 Sep 92 and Ltr, AF/TE to Distribution, "Types of Test and Evaluation (T&E)," Policy Letter 92-T-002, 10 Sep 92 (to be SDs in Hist of AFOTEC 1992).

3. See Keith R. Newsom, Joint Test & Evaluation (JT&E) Library Catalog, AFOTEC/RS, Third Edition, May 91.

4. Staff Summary, AFOTEC/XPX, "Demonstrations - What are they and how should AFOTEC handle them?," 30 Jan 90, w/atch point paper, SD I-6 in Hist of AFOTEC, 1990.

5. Source for Fig 1: DoDI 5000.2, "Defense Acquisition Management Policies and Procedures," 23 Feb 91, p 2-1.

6. In addition to the specific sources listed below, this account of the evolution of OT&E is distilled from several dozen articles, reports, and papers collected by the author from the Air University Library, the AF Historical Research Agency, and the Defense Technical Information Center. The most comprehensive previous study was "The Evolution of Policy Affecting Air Force Operational Test and Evaluation, 1909-1981" by Terrence R. StLouis, AFOTEC Hist Ofc, Sep 83. See the bibliography at Appendix A for a partial list of OT&E studies.

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8. Maj Gen Leigh Wade (USAF-Ret.), "Testing the Early Planes," Air Force Magazine, Sep 74, pp 92-97. For detailed information on the Air Material Division and related organizations, see Bernard J. Termena et al, Logistics: An Illustrated History of AFLC and its Antecedents, 1921-1981 (AFLC Office of History, 1981), and Lois Walker and Shelby Wickam, From Hoffman Prairie to the Moon: The History of Wright-Patterson Air Force Base (2750 Air Base Wing History Office, 1986).

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1933-1940, Mar 89; Historical Outline 1933-1944, Nov 89; Robert F. Futrell, "Science and Air Warfare: Training and Testing at Eglin in World War II," in William S. Coker (ed.), The Military Presence on the Gulf Coast (Pensacola, FL, 1978).

10. Maj Gen W. E. Kepner, "The Air Proving Ground," Army-Navy Journal, 5 Nov 49 (Vol 87, No 10), p 257.

11. Allan R. Scholin, "The Air Proving Ground: How an airplane joins the Air Force," Air Force Magazine, Dec 54, pp 52-59.

12. Maj Gen Patrick W. Timberlake, as quoted in the above article.

13. Ibid.; Maj Gen Robert W. Burns, "A Major Air Command with a Management Mission," Armed Forces Management, Sep 55, pp 5, 34-36.

14. Martin P. Brown, "Testing our Air Weapons," Ordnance, Sep-Oct 62, pp 242-44.

15. Maj Gen Robert W. Burns, "Why the Air Proving Ground Center Is Changing Its Operation," Armed Forces Management, May 1958, pp 18-20.

16. AFR 80-14, "Test and Evaluation," 11 Sep 51. The evolution of testing policies may be traced in the numerous superseded revisions to AFR 80-14 on file in the Air University Library. The last edition of AFR 80-14, 3 Nov 86, will be replaced by AF Policy Directive 58-1 in late 1992.

17. Article by Scholin cited above.

18. AFR 80-14, 8 Jun 56.

19. Oral History Interview, L.R. Benson with Lt Gen Howard W. Leaf (USAF-Ret), HQ USAF Dir of T&E, 8 and 10 Sep 92. General Leaf began his long involvement with test and evaluation in 1955 as a test pilot with the APGC.

20. Michael H. Gorn, Vulcan's Forge: The Making of an Air Force Command for Weapons Acquisition, 1950-1986, (Andrews AFB, MD: HQ AFSC/HO, 1986), Vol I, pp 37-81.

21. Many of these points were made in the reports cited below in notes 27 and 28 and the bibliography at Appendix A.

22. AFR 55-31, "Operational Employment Testing and Evaluation," was first published 20 Dec 66.

23. Semiannual Histories of the Directorate of Operations, HQ USAF, Jun 65 - Jun 74, on file at AFHRA; OT&E Review (quarterly journal published by AF/XOOW), 1971-1974, on file in AFOTEC/RS.

24. Lt Col Peter J. Unitt (USAF, Ret), "Testing During Combat?," Friends Journal (USAF Museum), Vol 14, No 2&3 (Summer/Fall 91), pp 38-41. The 1st

Test Sq at Clark AFB was responsible for Combat Sage, which focused on the introduction of new model missiles and the collection of data from the war.

25. See J.S. Ballard, Development and Employment of Fixed Wing Gunships, 1962-1972, Office of Air Force History (Washington DC: GPO, 1982); Monograph (S/OADR), Bernard C. Nalty, Tactics and Techniques of Electronic Countermeasures in the War Against North Vietnam, 1965-1973, Office of Air Force History, Aug 77, no classified info used; August R. Seefluth, "Birth of the Pods," Air Force Magazine, Feb 92, pp 52-55.

26. See Historical Study (S-NF/OADR), T.L. Grandy, "F-111 Support," Sacramento Air Material Center History Office, Dec 69, on file at AFHRA.

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28. Gilbert W. Fitzhugh et al, Report to the President...by the Blue Ribbon Defense Panel, with Appendix F, "Staff Report on Operational Test and Evaluation" (Wash DC: GPO, 1 Jul 70).

29. Memo, Dep SecDef David Packard, "Conduct of Operational Test and Evaluation," 11 Feb 71, and Memo, Packard, "Test and Evaluation in System Acquisition Process," 3 Aug 71, SDs 4 and 8 in Hist of AFTEC, 1974-75.

30. 92nd Cong--1st Sess, Public Law 92-156 (85 Stat 423), 17 Nov 71, p 463.

31. Report of the Commission on Government Procurement cited above, Vol II, p 164.

32. St Louis, "Policy Affecting OT&E," pp 17-20.

33. Hist of the Dep Dir for OT&E (AF/XOOW), Jan-Jun 71.

34. AFR 80-14, "Test and Evaluation," 12 May 72.

35. Hist of AF/XOOW, Jan-Jun 73.

36. US General Accounting Office, "Statement of Elmer B. Staats, Comptroller General of the United States, before the Committee on Armed Services, House of Representatives, on Cost Growth in Major Weapons Systems," 26 Mar 73.

37. Hist of AF/XOOW, Jul-Dec 73.

38. Staff Summary Sheet (unsigned), Brig Gen Abbott C. Greenleaf, "Operational Test and Evaluation," 15 Nov 73, with atch ltr, Gen George S. Brown, CSAF, to Gen Robert J. Dixon, TAC/CC, et al, 24 Nov 73, SD 12 in Hist of AFTEC, 1974-75.

39. Ltr, AF DCS/Programs & Resources, "USAF Decision Number D-73-81, Air Force Test and Evaluation Center (AFTEC), 11 Dec 73, SD 14 in Hist of AFTEC, 1974-75.

40. DoDD 5000.3, "Test and Evaluation," 19 Jan 73, p 3, with changes through 20 May 75 incorporated.

41. Hist of AF/XOOW, Jan-Jun 74.

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43. AF/XOOW Histories, 1968-74, trace the progress of Have Edge and the COR. The basic concept is described in an article, "Integrated Offensive/-Defensive Test Environment," OT&E Review, Vol I, No 6 (15 Nov 71), pp 1-3, on file in AFOTEC/RS. Planning for the COR is summarized in AFOTEC/RS Special Study, "Development of the Electronic Combat Test Capability (ECTC) Program, 1984-1988," Jul 89, pp 1-2.

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45. AFOTECR 23-1, "...Mission and Organization," 1 Aug 89 w/c1, 12 Jan 90; Special Orders on file in AFOTEC Histories.

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47. See Study Report (S-NF/OADR), Benson et al, Test Limitations: The Experience of the Air Force Operational Test and Evaluation Center (AFOTEC), 1974-1990, SR-91-001 (AFOTEC/RS, May 1991), Part I (U), "Analysis," SD I-7 in Hist of AFOTEC, 1990.

48. See Special Study (FOUO), Benson, "Development of the Electronic Combat Test Capability (ECTC) Program, 1984-1989," (AFOTEC/RS, Jul 89) and Hist of AFOTEC, 1990, pp 54-57.

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57. "The New TAWC" (several articles), USAFTAWC Quarterly Report, Autumn 1971, pp 4-30; Capt Rich Reitan, "TAC OT&E," USAF Fighter Weapons Review, Summer 1977, pp 1-7; Extract from Chapter 1, "History of the USAF Tactical Air Warfare Center," 1984; TACR 23-43, "USAF Tactical Air Warfare Center," 9 Feb 84; TACR 23-56, "USAF Tactical Fighter Weapons Center," 3 Jan 89.

58. Pamphlet, 31TES/HO, "31 TES," nd; Handout, 49TEST, "49th Test Squadron - Rich in History and Excellence," ca Feb 92; Extract, AFHRA/RS, "Addendum to History of 513 Bombardment Sq," 5 Jun 86; Brfg slides, HQ SAC/XR, on SACs' OT&E function, Jan 92.

59. Handout, AFSOC, "History of the Special Missions Operational Test and Evaluation Center," nd.

60. Thomas E. Snyder (ed.), Air Force Communications Command: An Illustrated History, Third Edition, (Scott AFB, IL: HQ AFCC/HO, 1991), p 261; Fact Sheet, TIC/TE, 17 Apr 92.

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92. See HQ AFOTEC Programming Plan (PPlan) 92-1 (FOUO), "Transfer of Initial...Qualification Operational Test and Evaluation," 30 Apr 92, and HQ USAF Program Action Directive 92-09 (FOUO), "Transfer of Major Command Initial and Qualification Operational Test to [AFOTEC]," 15 May 92, for details (to be SDs in Hist of AFOTEC 1992).

93. Brfg, Maj Gen Marcus A. Anderson, AFOTEC/CC, and Col Clarke D. Hubbard, AFOTEC/CCS, to CSAF, "Realignment of Air Force Operational Test and Evaluation," 4 May 92 (to be SD in Hist of AFOTEC, 1992).

94. AFOTEC Blanket Work Directive 92-01, "Programs that have been transferred," 17 Jun 92 (to be SD in Hist of AFOTEC 1992).

95. Brfgs by AFOTEC/RM on funding from late Sep through mid-Nov 92; Ltr, AFOTEC/CCE to CV et al, "Offsite Minutes," 28 Oct 92; Brfg, "Implementation of OT&E Realignment," 2 Nov 92.

96. Col David T. Archino, later AFOTEC Chief of Staff, chaired the following two studies: Report on the AFOTEC Mission, May 81, and Review of the AFTEC Organization," Jun 81, SDs I-23 and I-28 in Hist of AFTEC 1981. A member of the USAF Academy's Dept of Behavioral Sciences and Leadership led a 3-person team of consultants that issued an Organizational Assessment of AFOTEC in Sep 87, SD I-99, Hist of AFOTEC 1987.

97. HQ AFOTEC PPlan (FOUO), "Internal Reorganization of AFOTEC," 22 May 92, no FOUO info used.

98. Maj Gen Marcus A. Anderson, "AFOTEC: Increased Responsibility and Organizational Improvement," TIG Brief, No. 5, Sep-Oct 92; Brfg, AFOTEC/-CC, "Internal AFOTEC Realignment," 2 Nov 92.

99. Videotape (FOUO) AFOTEC/RSV, Address to AFOTEC by Gen Michael P.C. Carns, Vice CSAF, 2 Nov 92, no FOUO info used.

## Appendix A

## SELECTED BIBLIOGRAPHY OF REPORTS AND STUDIES

The following includes papers prepared for the Air War College (AWC), Air Command and Staff College (ACSC), Defense Systems Management College (DSMC), and the National War College (NWC)--most of which are also available from the Defense Technical Information Center.

AFTEC/AFOTEC Histories, 1974-1992, with supporting documents

Benson, L.R., Cofer, R.J., and Lloyd, C.D., "An Illustrated History of AFOTEC," Preliminary Edition, AFOTEC/RS, Nov 89

Benson, L.R., Janson, C.R., and Saluda, S.A., "Test Limitations: Experience of the Air Force Operational Test and Evaluation Center, 1974-1990," AFOTEC/RS, Jun 91.

Bryden, William D. Jr, Maj, USAF, "The Test and Evaluation Evolution (Relative to the US Air Force)," DSMC Study Report PMC 74-1, May 74

Dolan, William G., Lt Col, USAF, "Operational Test and Evaluation: The Key to Credibility," AWC Research Report 4896, Apr 73

Everly, Keith W., Maj, USAF, "United States Air Force Policy for Operational Test and Evaluation," ACSC Student Report 87-0800, Apr 87

Fallon, Clifford B., Maj, USAF, "Operational Test and Evaluation Planning Procedures," ACSC Research Study 0930-74, May 74

Guild, Richard E., Col, USAF, "Implications of Legislation Regarding Operational Testing and Evaluation," NWC Strategic Study, May 84

Headquarters USAF, DCS/Plans and Operations, semiannual historical reports, 1964-1974

Hersman, Walter C., Maj, USAF, "Operational Test and Evaluation in the Acquisition of USAF Weapon-Systems," ACSC Rsch Study 1270-72, May 72

Hoblit, Jerry N., Lt Col, USAF, "Test and Evaluation: The Persistent Problem," AWC Research Report 372, Apr 78

Holmes, James L., Lt Col, USAF, "Problems and Recommendations Concerning Test and Evaluation Policy," AWC Research Report 376, Apr 78

Hoover, Ronald C., Maj, USAF, "Proposals for Improved Management of Air Force Test and Evaluation," ACSC Report 1095-80, May 80

Kessler, David C., Lt Col, USAF, "A Study of USAF Test and Evaluation Policy," DSMC Study Project Report PMC 77-2, Nov 77

Long, Christoper S., Maj, USAF, "Operational Test and Evaluation in the Weapon System Acquisition Process," ACSC Student Rpt 82-1550, Mar 82

Oertel, Robert E., Maj, USAF, "Operational Test and Evaluation: The Quest for Independence," Research Report AU ARI-85-8, Dec 85

Randolph, Bernard P., Lt Col, USAF, "Organizing for Operational Test and Evaluation," AWC Professional Study 5508, Apr 74

St Louis, Terrence R., AFOTEC/HO, "The Evolution of Policy Affecting Air Force Operational Test and Evaluation, 1909-1981," Sep 83

Van Pelt, Larry G., Col, USAF, "Flight Test Concept Evolution," AWC Research Report MS 120-81, Apr 81

## Appendix B

## COMMANDERS AND VICE COMMANDERS OF AFOTEC

Commanders:

| | |
|---|---|
| Maj Gen John J. Burns | 1 January - 25 August 1974 |
| Maj Gen Richard G. Cross, Jr. | 26 August 1974 - 31 August 1975 |
| Col Stephen E. Moore | 1 September 1975 - 9 November 1975 |
| Maj Gen Robert A. Rushworth | 10 November 1975 - 30 September 1976 |
| Maj Gen Howard W. Leaf | 1 October 1976 - 31 May 1980 |
| Maj Gen Wayne E. Whitlatch | 1 June 1980 - 26 May 1982 |
| Maj Gen Richard W. Phillips, Jr. | 27 May 1982 - 29 August 1985 |
| Maj Gen Michael D. Hall | 30 August 1985 - 30 June 1987 |
| Maj Gen Cecil W. Powell | 1 July 1987 - 18 January 1990 |
| Maj Gen Peter D. Robinson | 19 January 1990 - 18 July 1991 |
| Maj Gen Marcus A. Anderson | 19 July 1991 - |

Vice Commanders:

| | |
|---|---|
| Col Harold K. Wimberley | 5 July 1974 - 31 August 1975 |
| Col Stephen E. Moore | 10 November 1975 - 31 April 1977 |
| Col Hervey S. Stockman | 1 May 1977 - 28 August 1977 |
| Col Charles H. Hausenfleck | 29 August 1977 - 1 November 1982 |
| Col Paul N. Chase | 6 January 1983 - 19 June 1984 |
| Col Ralph F. Wetzl | 20 June 1984 - 3 July 1985 |
| Col Jon I. Lucas | 3 July 1985 - 14 October 1987 |
| Col Joseph E. Merrick | 15 October 1987 - 28 June 1989 |
| Col Robert A. Heston | 29 June 1989 - 31 August 1992 |
| Col John A. Judd | 1 September 1992 - |

## Appendix C

### SYSTEMS TESTED BY AFOTEC, 1974-1992

The following list shows various weapons and other systems tested and evaluated by AFOTEC prior to the program transfers of 1992 and the inclusive dates of testing. Many of the entries cover multiple OT&E programs, with various tests (e.g., IOT&Es, FOT&Es, OUEs) performed during the time-spans indicated. It does not include operational assessments (OAs or EOAs) of systems still in development. Systems used in or deployed to Operation Desert Storm are indicated by an asterisk (*).

A-10 Thunderbolt II, 1974-77*
A-10 LANTIRN, 1982-83
A-10 Operational Flight Trainer (OFT), 1980-82
Advanced Aerial Refueling Boom, 1977-78*
Advanced Airborne Command Post (E-4B), 1977-79
Advanced Medium Range Air-to-Air Missile (AMRAAM), 1981- *
Advanced Synthetic Aperture Radar System (ASARS-2), 1982*
AGM-65 Maverick (various models), 1974-85*
AGM-86B Air Launched Cruise Missile (ALCM), 1979-81*
AGM-88 High Speed Anti-Radiation Missile (HARM), 1979-87*
AGM-109 ALCM, 1979-80
AGM-122 SideARM, 1983-84
AGM-130, 1989-90
AIM-7F/M Sparrow, 1975-82*
AIM-9L/M Sidewinder, 1975-81*
AIM-120 - See AMRAAM*
Airborne Self Protection Jammer (ASPJ/ALQ-165), 1988-89
Airborne Warning and Control System (AWACS/E-3A), 1974-82*
Air Force Satellite Communications (AFSATCOM), 1975-82*
AN/ALR-56M Radar Warning Receiver, 1988
AN/ALR-74 Radar Warning Receiver, 1984-88
AN/APR-38 (F-4G), 1986
Anti-Satellite (ASAT) air-launched missile, 1983-88
AQM-81A Firebolt, 1984-85
Automated Data Processing System, 1979-83
Automated Remote Tracking System (ARTS), 1988-89*
Automated Technical Control Program (ATEC), 1977-78
B-1/B-1A, 1974-81
B-1B Lancer, 1984-91
B-1B Weapon System Trainer, 1991-
B-52 (various models and systems), 1977-86*
B-52 Weapon System Trainer (WST), 1981-84
BGM-109 Ground Launched Cruise Missile (GLCM), 1982-84
BQM-34F Target Drone, 1975
C-5A Galaxy, 1980-81*
C-141B/YC-141B Starlifter, 1977-80*
CBU-89/B Gator, 1980-82*
Cobra Dane, 1976-77
Common Strategic Rotary Launcher, 1985-86
Communications Data Link Jammer (CDLJ), 1982
Consolidated Space Operations Center (CSOC), 1989- *
Cruise Missile Defense, 1985-87
DSU-16/B Target Detector, 1976-77
Defense Support Program (various subsystems), 1978-86*
E-3A - See AWACS*
E-4B - See AACP

EF-111A Raven, 1977-82*
EF-111A OFT, 1985-87
F-4G Advanced Wild Weasel, 1975-78*
F-5E/F, 1975-76 (RSAF*)
F-15 Eagle, 1975-77*
F-15E Strike Eagle, 1988-90*
F-16/YF-16 Falcon, 1974-90*
F-16 OFT/WST, 1981-89
GBU-15 Glide Bomb, 1983-87*
GLCM - See BGM-109
Ground Wave Emergency Network (GWEN), 1984-88
HH-60 Combat Helicopter, 1984-86
Joint Tactical Fusion, 1984
Joint Tactical Information Distribution System (JTIDS), various components, 1978-89*
Joint Surveillance and Target Attack Radar System (JSTARS), 1990- *
KC-10 Tanker, 1980-81*
KC-135 WST, 1981
KC-135R, 1982-84*
Low Altitude Navigation and Targeting Infrared for Night (LANTIRN), 1982-87*
Low Level Laser Guided Bomb (GBU-22/23), 1982-85*
Milstar, 1984-
Modular Control Equipment (MCE), 1986-87*
NATO Airborne Early Warning Ground Environment Integration Segment (NAEGIS), 1982-83
Navstar Global Positioning System (Space, Control, and User Equipment Segments), 1980- *
Next Generation Weather Radar (NEXRAD), 1986-89
North Warning System, 1989
Over-the-Horizon Backscatter (OTH-B) Radar, 1981-1991
Pave Mover/Assault Breaker, 1981-82
Peacekeeper in Minuteman Silos, 1982-89
Piper Enforcer (PA-48), 1984
Precision Location Strike System (PLSS), 1986-87
Remote Controlled Tactical Airborne SIGINT System, 1983-84
Seek Comm, 1982
Seek Talk, 1981
Sensor Fuzed Weapon (SFW), 1990-91
Short-Range Attack Missile (SRAM) -II, 1990-91
Space Defense Operations Center (SPADOC), 1986-87
Space Transportation System (STS), various components, 1980-87
Strategic Air Command Digital Info Network (SACDIN), 1984-86
T-46A Next Generation Trainer, 1985-87
Tacit Rainbow (AGM-136), 1989-91
Tactical Ground Intercept Facility II, 1983-84
TR-1 Tactical Reconnaissance System, 1986*
TRI-TAC (numerous components), 1979-87*
YC-14 Transport, 1976-77
YC-15 Transport, 1975-77-
YF-17 Lightweight Fighter, 1974-75

*Used in Desert Storm

## GLOSSARY OF ABBREVIATIONS AND ACRONYMS

(Does not include weapon system designations identified in Appendix C)

| | |
|---|---|
| AAF | Army Air Forces |
| ACC | Air Combat Command |
| AF | Air Force |
| AFCC | AF Communications Command |
| AFIC | AF Intelligence Command |
| AFFTC | AF Flight Test Center |
| AFM | AF Manual |
| AFMC | AF Materiel Command |
| AFOTEC | AF Operational Test and Evaluation Center |
| AFOTECR | AFOTEC Regulation |
| AFPD | AF Policy Directive |
| AFR | AF Regulation |
| AFSARC | AF Systems Acquisition Review Council |
| AFSC | AF Systems Command |
| AFTEC | AF T&E Center |
| AFSPACECOM | AF Space Command |
| ALCENT | Airlift Center |
| AMC | Air Mobility Command |
| APGC | Air Proving Ground Command |
| AQV | Director for T&E, Assistant SAF for Acquisition |
| ARDC | Air Research and Development Command |
| ATC | Air Training Command |
| B-LRIP | Beyond LRIP |
| $C^2E$ | Continuous Comprehensive Evaluation |
| CNO | Chief of Naval Operations |
| COEA | Cost & Operational Effectiveness Analysis |
| COI | Critical Operational Issue |
| COR | Continental Operating Range |
| COTS | Contractor off-the-shelf |
| CTF | Combined Test Force |
| CR | Director of Test Capability |
| DAB | Defense Acquisition Board |
| DCS | Deputy Chief of Staff |
| DDR&E | Director Defense Research and Engineering |
| DDDR&E (T&E) | Deputy DDR&E for T&E |
| DEMVAL | Demonstration & Validation |
| Det | Detachment |
| DMR | Defense Management Report |
| DoD | Department of Defense |
| DOT&E | Director of Operational Test and Evaluation |
| DSARC | Defense System Acquisition Review Council |
| DT&E | Development Test and Evaluation |
| ECTC | Electronic Combat Test Capability |
| EOA | Early Operational Assessment |
| ESC | Electronic Security Command |
| FOA | Field Operating Agency |
| FOT&E | Follow-on Operational Test and Evaluation |
| FSD | Full Scale Development |
| GAO | General Accounting Office |
| ICBM | Intercontinental Ballistic Missile |
| IDA | Institute for Defense Analyses |
| IEP | Independent Evaluation Plan |
| IOC | Initial Operational Capability |
| IOT&E | Initial Operational Test and Evaluation |
| JRMET | Joint Reliability and Maintainability Evaluation Team |
| JCS | Joint Chiefs of Staff |
| JT&E | Joint Test and Evaluation |
| LFT | Live Fire Testing |
| LG | Director of Logistics |
| LRIP | Low Rate Initial Production |
| MAC | Military Airlift Command |
| MAJCOM | Major Command |
| MCOTEA | Marine Corps Operational Test and Evaluation Activity |
| MOA | Memorandum of Agreement |
| MOE | Measure of Effectiveness |
| MOT&E | Multiservice Operational Test & Evaluation |
| MST&E | Multiservice Test & Evaluation |
| NDI | Nondevelopmental Item |
| NORAD | North American Air Defense Command |
| OA | Director of Analysis |
| OA | Operational Assessment |

| | |
|---|---|
| OL | Operating Location |
| OPEVAL | Operational Evaluation |
| OPTEC | Operational Test and Evaluation Command |
| OPTEV-FOR | Operational Test and Evaluation Force |
| ORD | Operational Requirements Document |
| ORMAS | Operational Resources Management Assessment System |
| OSD | Office of the Secretary of Defense |
| OT | Operational Test |
| OTA | Operational Test Agency |
| OT&E | Operational Test and Evaluation |
| OTD | Operational Test Director |
| OTEA | Operational Test and Evaluation Agency |
| OTEC | OT&E Center (AFCC) |
| OTPO | Operational Test Project Officer |
| OTSA | OPTEC Threat Support Activity |
| OUE | Operational Utility Evaluation |
| PACAF | Pacific Air Forces |
| PEO | Program Executive Office |
| PMD | Program Management Directive |
| PPQT | Pre-Production Qualification Test |
| PQT | Production Qualification Test |
| PQDR | Product Quality Deficiency Report |
| QOT&E | Qualification Operational Test and Evaluation |
| QT&E | Qualification Test and Evaluation |
| RCM | Requirements Correlation Matrix |
| R&D | Research & Development |
| RDT&E | Research, Development, Test and Evaluation |
| RM | Director of Resource Management and Support |
| RTO | Responsible Test Organization |
| SA | Director of Systems Analysis |
| SAC | Strategic Air Command |
| SAE | Service Acquisition Executive |
| SAF | Secretary of the Air Force |
| SAR | Special Access Required |
| SMOTEC | Special Missions OT&E Center |
| SON | Statement of Operational Need |
| SPO | Systems Program Office |
| ST | Director of Special Test |
| TAC | Tactical Air Command |
| TAF | Tactical Air Forces |
| TAWC | Tactical Air Warfare Center |
| T&E | Test and Evaluation |
| TE | Director of Test & Evaluation |
| TECHEVAL | Technical Evaluation |
| TECO | Test & Evaluation Coordination Officer |
| TEC | TEXCOM Experimentation Center |
| TEMP | T&E Master Plan |
| TEXCOM | Test and Experimentation Command (OPTEC) |
| TF | Director of Weapon Systems |
| TFWC | Tactical Fighter Weapons Center |
| TIC | Technical Integration Center |
| TK | Director of C4I Systems |
| TPR | Test Planning Review |
| TRADOC | Training and Doctrine Command |
| TS | Director of Space & Missile Systems |
| TSG | Test Support Group |
| USAFE | United States Air Forces in Europe |
| USD(A) | Undersecretary of Defense (Acquisition) |
| WSEP | Weapon System Evaluation Program |
| XOORE | |
| XOOST | |
| XORT | OT&E Division (Air Staff) |
| XP | Dir/DCS of Plans and Policy |
| XR | Dir/DCS of Plans, Policy, and Requirements |