

# F-16 Test Aircraft Completes Long Distinguished Career

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The following was released today by Lockheed Martin Aeronautics Company:

F-16 serial number 75-0750 has completed a distinguished career as an advanced technology test aircraft for more than 22 years. It is best known for its service as the Advanced Fighter Technology Integration (AFTI)/F-16 technology demonstrator since the early 1980s.

Aircraft 750 flew its final flight on Jan. 9, 2001 from its birthplace in Fort Worth, Texas, to Wright-Patterson Air Force Base in Dayton, Ohio. It is scheduled to be retired and inducted into the Air Force Museum there.

"The AFTI/F-16 has been an excellent platform because of the F-16's basic modern systems, the relative ease of incorporating advanced technologies and the F-16's low cost of operation and maintenance," said Don Swihart, AFTI Program Manager at the Air Force Research Laboratory in Dayton. "The AFTI/ F-16 has been a real workhorse in proving out advanced fighter technologies, and it is fitting that this aircraft have its final resting place in the Air Force Museum."

Aircraft 750 was originally built as an F-16A, the sixth A model and seventh of eight aircraft in the F-16 Full-Scale Development program. It first flew and was delivered to the U.S. Air Force in April 1978. Since then the aircraft has been modified extensively many times and participated in 10 flight test programs. (See attached history summary for listing of test programs and demonstrated technologies.)

The aircraft's last achievement was the very successful Joint Strike Fighter Integrated Subsystems Technology demonstration in Fort Worth during October-November 2000. The aircraft was modified with an all-electric flight control system with electrostatic actuators and a 270-VDC switched reluctance electric power system. It was the first aircraft to fly with an all-electric flight control system, adding to its many aviation firsts. Government studies show the combination of technologies will reduce weight, improve reliability and maintainability, increase survivability, and trim costs compared to traditional hydraulic actuator systems.

During its 22-plus year career, the aircraft accumulated 756 flights and 1,446 flight hours. Much of the time the aircraft was undergoing extensive modifications at the Fort Worth plant. This unique aircraft was flown by more than 23 test pilots from Lockheed Martin (and predecessors), U.S. Air Force, National Aeronautics and Space Administration, U.S. Marine Corps and the Swedish Air Force. Customers have included the U.S. Air Force (various agencies and commands), U.S. Navy, U.S. Army, NASA, Swedish Air Force and DoD's Joint Strike Fighter program.

"The AFTI/F-16 has been a great tool for early testing of high-payoff technologies and has enabled early introduction of valuable capabilities into F-16 production," said Gary Ervin, vice president of Advanced Development Programs at Lockheed Martin Aeronautics in Palmdale, Calif.

Technologies that have transitioned into F-16 production include: digital flight controls, multifunction displays, dual multiplex bus avionics architecture, wide-angle head-up display, up-front controls, single-switch mission reconfiguration, dorsal avionics compartment, digital data link, digital terrain system, automatic terrain following and system-wide integrity management, night vision system (night vision goggles and compatible cockpit lighting), improved takeoff and landing control laws, and voice annunciation. Items going into the F-16 in the near term include helmet-mounted cueing of weapons and sensors, digital color map display, internalized FLIR targeting system, and in-flight route planning.

Advanced technologies demonstrated that have promise for the next generation of fighters or future incorporation on current fighters include: voice interaction, auto ground collision avoidance, head-steered FLIR imaging, covert radar altimeter, electric flight control actuation, and cooperative engagement capability (separated target sensor and shooter).

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#### AFTI/F-16 History

The history of F-16 S/N 75-0750 is summarized by the following programs/projects it supported.

##### FSD

The aircraft began its service with the U.S. Air Force in the F-16 Full Scale Development (FSD) program. It had its first flight on April 19, 1978, in Fort Worth, Texas, was delivered to the Air Force on Apr. 21, and flown to Edwards AFB, Calif., on June 7. It was designated F-16A No. 6, one of eight aircraft in the FSD program flying at Edwards AFB. F-16A No. 6 was a full- systems F-16A and was used for avionics systems testing and reliability and maintainability testing in the F-16 FSD and FSD follow-on test programs.

The aircraft was returned to Fort Worth in January 1979 for extensive modifications, including instrumentation upgrades. From September 1979 to March 1980 the aircraft was used for electromagnetic hardness ground testing at Sandia Labs, Kirtland AFB, New Mexico.

##### DFCS

In the late 1970s, the USAF laboratories at Wright-Patterson AFB, Ohio, created the Advanced Fighter Technology Integration (AFTI) program office to perform flying demonstrations of advanced technology systems and capabilities for fighter aircraft. F-16A No. 6 was chosen to be the primary flying test bed for the program, and the aircraft was designated AFTI/F-16. An F-16 was chosen because of its modern features, its ease of integrating advanced systems, its low operations and maintenance costs, and the reduced risk of transitioning the technologies to the Air Force's large F-16 fleet.

The first project for AFTI/F-16 was the Digital Flight Control System (DFCS) project. A triple-redundant digital flight control system replaced the F-16's original analog electronic system. A distinctive feature during this stage were the two large chin canards located behind the engine inlet. These canted vertical canards were used for directional control, i.e., in the yaw axis. The main objective of this period was to evaluate task-tailored flight modes, where the aircraft had a certain degree of decoupling of aircraft attitude and flight path. The aircraft could change its nose position without changing its flight path, and conversely, perform translation maneuvers -- change flight path without changing aircraft attitude. It could also perform coordinated "flat turns" -- horizontal turns without banking or sideslip.

The aircraft received advanced avionics and cockpit modifications, which were forerunners of those systems in the F-16C/D first produced in 1984. (A list of AFTI technologies introduced on the production F-16s is presented at the end of this history.) A dorsal avionics compartment was added to house avionics systems to be tested and a large suite of flight test instrumentation and recording equipment. Also, provisions were incorporated for attaching a spin recovery chute system.

The aircraft inducted for modification at Fort Worth in March 1980 and had its first flight in the AFTI/F-16 configuration on July 10, 1982. The AFTI/F-16 conducted 108 DFCS flight tests at Edwards AFB from September 1982 through July 1983.

##### AMAS

The aircraft underwent a year of modifications in 1983-84 to install additional components for the Automated Maneuvering Attack System (AMAS). This was a follow-on to earlier USAF efforts at integrated fire and flight control, where the aircraft would be automatically positioned or pointed for weapons delivery with minimal involvement by the pilot. Precision electrical- optical tracking pods were installed in the wing root area on both sides of the aircraft. The system was used for automatic gun tracking of airborne targets and maneuvering bomb deliveries. The aircraft demonstrated the ability to accurately deliver unguided bombs using 5-g curvilinear toss delivery at 200 feet above the ground. This program also demonstrated an all-altitude automatic ground collision avoidance capability. Other innovative features were a voice recognition and command system (for interfacing with the avionics system), a helmet-mounted sight (for high-off- boresight target cueing, and a digital terrain system with color moving map.

First flight in the AMAS configuration was on July 31, 1984, and flight testing at Edwards began in September. Last flight in this program was in April 1997.

## CAS/Night Attack

The AFTI/F-16 underwent a series of three modifications and flight tests in the late 1980s and early 1990s to demonstrate emerging technologies associated with close air support (CAS) and night attack operations. Systems included a modem connecting the radios to the fire control system to serve as a data link for automatic target handoff. This allowed the aircraft to quickly and accurately communicate with forward air controllers on the ground and in the air. An advanced digital terrain system was added that provided accurate terrain-referenced navigation, terrain following, all-terrain obstacle avoidance, passive air-to-ground ranging, and color moving map. The latter supported a color tactical situation display (third cockpit display) with threat overlays and in-route planning for exceptional pilot situation awareness. A laser spot tracker was added to help detect and identify targets designated by forward air controllers.

Modifications were begun in mid 1987, and first flight in this phase was Dec. 14, 1988. In Dec. 1989, the AFTI/F-16 conducted cooperative engagement tactics with another specially-configured F-16 in ground support missions at Fort Hood, Texas.

In the early 1990s, the aircraft was reconfigured with a standard F-16 inlet (versus one with canard provisions) and upgraded with F-16C/D wings and horizontal tails. The aircraft's avionics system was completely upgraded to the F-16C/D Block 40 standard, including processors, displays, an APG-68 radar, and digital flight control system. The paint scheme was changed from the camouflage gray to one resembling the production F-16 gray scheme.

New AFTI-unique systems included a new data link and a more advanced digital terrain system with automatic terrain and threat avoidance capability. For night operations, several forward-looking infrared (FLIR) navigation and targeting systems were demonstrated, including a head-steered FLIR mounted on the nose and a helmet-mounted display. One was a single-turret navigation system called Falcon Eye and another was a two-turret nav/targeting system dubbed Falcon Knight. Also, several night vision goggles (NVGs) were investigated along with compatible cockpit lighting modifications.

The last flight in this phase was in January 1992.

## Talon Sword Bravo

In 1993-94 the AFTI/F-16 was used to demonstrate cooperative engagement techniques where the sensor and shooter are separated. Several exercises involved launch of AGM-88 High-speed Anti-Radiation Missiles (HARM) with targeting data linked from different external sources. One case involved the AFTI/F-16 launching a HARM over a mountain range at a threat radar site based solely on target data supplier by an external source.

## EGI

In 1994 the aircraft received an embedded Global Positioning System/ inertial navigation system (EGI), and testing was conducted in 1994-95. Test objectives included evaluation of GPS in jamming environments. Additional testing was conducted in 1997 to evaluate several EGI configurations for use in F-16 and F-15.

## AGCAS

In 1996 the AFTI/F-16 was used to evaluate algorithms and reaction times in an automatic ground collision avoidance system (AGCAS). This data were used in the successful AGCAS testing conducted in 1998 using another F-16. (AFTI/F-16 aircraft was not available due to modification incorporation.)

## J/IST

The aircraft began an extensive modification at Lockheed Martin in Fort Worth in late 1997. An all-electric flight control system was installed, which was a first in aviation history. The modifications included a power-on demand 270Vdc switched reluctance electrical power system and replacement of the standard integrated servo actuators with electrostatic actuators. The program was part of the Joint Strike Fighter Integrated Subsystem Technologies (J/IST). The aircraft successfully conducted flight testing during October and November 2000.

## Retirement

F-16 75-0750 flew its last flight on Jan. 9, 2001, a ferry flight from Fort Worth, Texas to Wright-Patterson AFB, Ohio. There it will be retired from service and inducted into the Air Force Museum. Before its retirement, it was the second oldest F-16 still flying, the other being another F-16 FSD aircraft, which was converted to a F-16XL prototype and is still flown occasionally by NASA as a research vehicle.

## Contribution to F-16 operational fleet

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architecture, wide-angle head-up display, multifunction displays, up-front controls, single-switch mission reconfiguration, dorsal avionics compartment, digital data link, digital terrain system, automatic terrain following and system-wide integrity management, night vision system (night vision goggles and compatible cockpit lighting), improved takeoff and landing control laws, and voice annunciation. Items going into the F-16 in the near term include helmet-mounted cueing of weapons and sensors, digital color map and tactical situation display, in-flight route planning, 3-display cockpit and internalized FLIR targeting system.

Advanced technologies demonstrated that have promise for the next generation of fighters or future incorporation on current fighters include: voice interaction, auto ground collision avoidance, head-steered FLIR imaging, covert radar altimeter, electric flight control actuation, and cooperative engagement capability.

Statistics

Number of flights: 756

Number of flight hours: 1,446

Number of pilots: this one-of-a-kind aircraft was flown by more than 23 test pilots from Lockheed Martin (and predecessors), U.S. Air Force, NASA, U.S. Marine Corps and the Swedish Air Force.

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