





Twenty-five years ago this month,
the F-16 began to transform USAF's fighter forces.

The Viper Revolution

By Peter Grier

IN THE beginning, critics complained that the airplane was too small and too slow and didn't have the two engines necessary for flight safety. Pilots would never like it, they said. The Air Force would never buy it, they said. Long-range air-to-air missiles would render its agility moot, they said. The era of dogfighters was definitely over.

"They" were wrong.

Twenty-five years ago, the first production F-16s began rolling into the Air Force inventory. Since then, the lightweight, multirole fighter has more than lived up to the prediction of its designers that it would prove to be a revolutionary weapons system.

Over the years, the F-16 has shown that cutting-edge technology does not always have to bring with it exorbitant cost, that bigger is not always better, and that a good basic design, with proper upgrades, can serve many roles. It has pioneered high G cockpits, fly-by-wire controls, "relaxed stability"

An F-16CJ from the 23rd Fighter Squadron, Spanghdaem AB, Germany, is outfitted to hunt surface-to-air missile sites.



The “fighter mafia” pushed for consideration of a small, lightweight fighter. A competition pitted the General Dynamics YF-16 prototype against Northrop’s YF-17. USAF selected the GD entry.

aerodynamics, and other features now common in newer aircraft models.

The F-16 has an official name—Fighting Falcon—that nobody uses. To those who fly, arm, or maintain it, it is “the Viper.” It has been the most popular fighter of its time, with some 4,100 F-16s delivered to more than 20 countries. It has flown more than 200,000 combat sorties. Its air combat record: 71-to-zero.

“We consider the F-16 to be the most versatile fighter in the world,” said John L. Bean, Lockheed Martin vice president in charge of F-16 operations.

For all that, the F-16’s original proponents were something of an underground cell. Their association dated from an evening in the mid-1960s when a General Dynamics engineer named Harry Hillaker was sitting in the Officers’ Club at Eglin AFB, Fla., having an after-dinner drink. Hillaker’s host introduced him to a tall, blustery pilot named John R. Boyd, who immediately launched a frontal attack on GD’s F-111 fighter. Hillaker was annoyed but bantered back.

A few days later, he received a call—Boyd had been impressed by Hillaker’s grasp of aircraft conceptual design and wanted to know if Hillaker was interested in more-organized meetings.

Thus was born a group that others in the Air Force later dubbed the “fighter mafia.” Their basic belief was that fighters did not need to

overwhelm opponents with speed and size. Experience in Vietnam against nimble Soviet-built MiGs had convinced them that technology had not yet completely turned air-to-air combat into a long-range shoot-out.

As a tactics instructor at Nellis AFB, Nev., Boyd had devoted much time to analyzing the relative positions and speed of aircraft in dogfights. He developed what he called a theory of energy maneuverability, which held that a pilot lost advantage in combat when he allowed his aircraft’s potential en-

ergy to decay to less than that of his opponent.

“Winning required the proper management of energy available at the conditions existing at any point during a combat engagement,” wrote Hillaker in 1997.

The fighter mafia’s premise was that an aircraft that was superior in acceleration and turning radius would also prove superior in combat. The theory was not popular with the rest of the Air Force. Other fighter theorists emphasized top speed and weapons capability. Many were also put off by Boyd’s personality, which was blunt to the point of brutal.

The Air Force had gone for decades without a new fighter, and top officials were solid in their support of development and production of the dual-engine F-15. Some perceived the underground push for a lightweight dogfighter to be a threat, according to Hillaker, who was later honored as the father of the F-16.

Critics viewed the notion of a lightweight fighter in the context of the Air Force’s experience with the F-104, a hot airplane that was popular with pilots but had little range and little capability. It was not bought in large quantities by the US Air Force.

The fighter mafia felt just as strongly that there were quantifiable advantages to their approach. A small aircraft would enjoy a high thrust-to-weight ratio. Small aircraft have less drag—the original F-16 design had about one-third the drag of an F-4 in



Among the many F-16 variants was the delta-wing F-16XL. Compared to the standard F-16, it could carry more fuel and ordnance, but USAF went with the F-15E Strike Eagle for the deep interdiction role.

level flight and one-fifteenth the drag of an F-4 at a high angle of attack.

Small aircraft might also be the way to break the ever-rising unit cost of fighters, thought Hillaker, Boyd, and a few others. They plotted flyaway costs of successive aircraft, beginning with the P-51, and discovered that cost-per-pound increased at the same rate as the overall cost. (This ended up being true for the F-16 as well—its cost-per-pound was significantly higher than previous models, but, since it was much smaller, overall cost was kept down.)

Eventually, the Air Force gave General Dynamics and Northrop small contracts to study the trade-offs inherent in maneuverable aircraft. GD's conclusion: It was possible to pro-



USAF photos



In January 1979, an F-16 of the 388th Fighter Wing, Hill AFB, Utah (at top) became the first operational F-16. Above, an F-16 demonstrates its remarkably tight turning radius against an F-4E.

duce a fighter that was twice as maneuverable as an F-4D and had twice its mission radius, yet weighed 17,000 pounds instead of the 29,000 pounds of the F-4D.

This caught the attention of Deputy Secretary of Defense David A. Packard, among others. Put off by the results of the procurement of the F-111, Packard wanted to experiment with a return to prototyping. A lightweight fighter technology program, he felt, might be a good way to start.

"The rest is history," said Hillaker.

The new lightweight fighter technology effort was formally launched in January 1972. Five firms responded with proposals. In April, the military

chose two to proceed: the General Dynamics YF-16 and Northrop's YF-17.

First rollout of the YF-16 came just 20 months later, on Dec. 13, 1973.

First flight took place at Edwards AFB, Calif., on Jan. 20, 1974—inadvertently. During high-speed taxi tests the aircraft became unstable—so much that its wingtips were hitting off the runway and throwing off sparks. General Dynamics test pilot Phil Oestricher decided that the safest thing to do was take to the air. He did one circuit and then landed.

The problem turned out to be the aircraft's electronic fly-by-wire con-

trol system, which was too sensitive to the pilot's touch. After re-tuning, the prototype made a straightforward formal first flight on Feb. 2.

In April 1974, the stakes of the competition were raised when Secretary of Defense James R. Schlesinger announced that the winner would go into full-scale development and production. This new "Air Combat Fighter" program was supposed to produce a no-frills daylight and good weather aircraft that could be purchased in large quantities to supplement smaller buys of the more expensive F-15.

Throughout 1974, the YF-16 and YF-17 went through batteries of tests and air combat trials against everything from F-106 Delta Darts and F-4 Phantoms to clandestinely obtained Soviet MiGs. In close air combat, the YF-16 appeared clearly superior. At one point, a YF-16 prototype took three straight engagements against an F-4, which then had to land to refuel. Still airborne, the YF-16 then bested a second Phantom sent up to resume the fight.

The YF-16 also had an advantage over the YF-17 in that the GD aircraft was powered by a single F100 engine—the main power plant for the F-15. USAF officials knew that, with two aircraft using the same type engine, unit costs might go down and logistics would be simplified.

The Winner

In January 1975, Air Force Secretary John L. McLucas formally declared the General Dynamics YF-16



Over the years, F-16 equipment and armament have changed to keep pace with the threat. This New York Air National Guard F-16 flying over Afghanistan has a targeting pod and 500-pound laser guided bombs.

the winner of the competition.

Initial plans called for a buy of 650 aircraft at a cost of \$4.35 billion. The fighter might well prove popular on the foreign market, Lucas suggested at the time. He predicted that it might eventually sell as many as 3,000 units.

GD delivered the first production F-16 to the Air Force on Aug. 18, 1978. The 388th Tactical Fighter Wing, Hill AFB, Utah, received the first operational F-16 on Jan. 6, 1979, 25 years ago this month.

Foreign sales of the new fighter began at almost at the same time, with the first going to the Belgian Air Force and others to the Royal Netherlands Air Force not long afterward.

The F-16's now-familiar, shark-like visage, with stubby cropped delta wings and large tail, is a highly integrated aerodynamic configuration. The wings and main fuselage are blended together in three dimensions, creating a shape that improves lift at high angles of attack.

The airframe is conventional, composed of 80 percent aluminum alloys, eight percent steel, and the rest composites and exotic metals. There are so many access panels—228 in the original design—that the aircraft looks unfinished when a large number are opened.

Fuel capacity is surprisingly large for a small aircraft, so much so that fuel accounts for about one-third of the aircraft's fully loaded weight.

With current power plants (either the Pratt and Whitney F100 or the General Electric F110), the aircraft can reach Mach 2 at high altitude. Its ceiling is above 50,000 feet, and its ferry range is more than 2,000 miles.

Standard armament includes an internally mounted 20 mm cannon with 500 rounds. Modern Block 50 versions can carry up to 22,000 pounds of weapons, electronic countermeasures, sensor pods, or fuel tanks on 11 external stations.

Pilots sit up high, in a 30-degree reclining seat whose position helps them pull up to nine Gs in a turn. The

frameless canopy provides excellent vision. Overall the impression is almost of riding outside the aircraft, rather than in it. It's like being in a glass bubble with a clear view in all directions.

A sidestick controller is mounted on the pilot's right. Originally the stick was simply pressure sensitive, not moveable like a joystick, but it was later modified to move slightly so as to improve pilot feel.

The "Electric Jet"

That the stick could be fixed was possible only because of one of the F-16's revolutionary advances: fly-by-wire technology. As the first Air Force fighter to completely replace mechanical controls with electronic ones, the airplane was sometimes called the "Electric Jet." That nickname faded away as fly-by-wire controls became more common.

In turn, fly-by-wire made possible another of the F-16's advances: relaxed stability. With a computer sensing directional deviations and helping control the airplane, the F-16 can safely fly with its center of gravity behind its center of pressure. This makes the aircraft inherently unstable—but also highly responsive.

Over the last quarter-century, the F-16 has proved to be a mainstay for more than just the US Air Force. It is the most international fighter in the world, serving currently in the air arms of some 20 countries. Four



Norway is one of more than 20 countries that fly the F-16. This Norwegian Viper is escorting US C-130s operating in Southwest Asia. The F-16 has amassed some 200,000 combat flying hours.

more—the United Arab Emirates, Chile, Oman, and Poland—will take delivery of F-16s over the next three years, pushing total airframe production over the 4,400 mark.

Unlike many sophisticated US weapons systems, the F-16 was available for foreign military sales from the beginning. Under an unusual agreement for the time, a consortium of four NATO nations—Belgium, Denmark, the Netherlands, and Norway—jointly produced F-16s with the US starting in 1979. The aircraft used components made in all five countries, with final assembly lines in Belgium and the Netherlands.

The benefits of this arrangement were mutual: The Europeans supported employment at home and got a relatively inexpensive upgrade in military capability; the US Air Force saved money via lower unit costs, while supporting allied interoperability.

The F-16 is also the primary strike aircraft of the Israeli Defense Force. Deliveries to Israel began in July 1980. The first 75 Israeli F-16s were Block 10/15 models originally ordered by the Shah of Iran. His overthrow put the airplanes back on the market.

Into Combat

The combat debut of the F-16 occurred on April 28, 1981, when Israeli Defense Force F-16s shot down two Syrian Mi-8 helicopters over Lebanon. Less than two weeks later, eight IDF F-16s destroyed Iraq's Osirak nuclear reactor during a famous and daring raid. Because of the high accuracy of the F-16's bombing computer, the Israelis were able to strike Osirak with conventional dumb bombs, instead of laser guided munitions.

Overall, the Israeli use of F-16s has been highly successful. During Israel's incursion into Lebanon in the early 1980s, IDF F-16s had a record of 44-to-zero in air battles with Syrian MiGs.

The second nation to use the F-16 in combat was Pakistan, which began taking delivery of A/B models in October 1982. During the chaos



Lockheed Martin photo by Nick Alvarado

This is the newest Viper—the Block 60 version. It was designated F-16E/F and was destined for the United Arab Emirates this year. The first combat use of an F-16 came in 1981 by a foreign air force, the Israeli Defense Force.

of the Soviet experience in neighboring Afghanistan, Pakistani F-16s tangled with Afghan Air Force intruders on a number of occasions. At least eight Afghan airplanes were shot down. During an encounter on April 29, 1987, a Pakistani F-16 was also shot down. Subsequent investigation revealed that that the airplane probably was a casualty of friendly fire from another F-16.

Other nations that have bought F-16s in quantity are Egypt, Turkey (which built its own final assembly line), Greece, and South Korea.

The basic F-16 airframe has been produced in a bewildering array of models, mods, and blocks during the last quarter-century. Lockheed Martin, which bought the former General Dynamics assembly line in 1992, now counts more than 110 different F-16 versions.

The exterior look of the aircraft may remain the same, but the interior has changed dramatically. There have been six major block changes, four generations of core avionics, five engine versions, five radar versions, five electronic warfare suites, and at least two versions of most other subsystems. The main F-16 computer of today has 2,000 times the memory of that in the 1978 F-16.

Though conceived as a simple dayfighter, the F-16 quickly became something more. Since November 1981, all delivered aircraft have had built-in wiring and structural provisions for precision strike, night attack, and beyond-visual-range interception missions.

And the dogfighting role envisioned by the fighter mafia 25 years ago did not play out in the combat debut of USAF's F-16. Instead, on Dec. 27, 1992, an F-16D faced down an Iraqi MiG-25 with a single AIM-120A Advanced Medium-Range Air-to-Air Missile fired at a range of about three miles. Two USAF F-16s were patrolling the no-fly zone over southern Iraq when they spotted the MiGs repeatedly breaching the zone. After ignoring warnings, one was shot down by the AMRAAM in the first USAF air-to-air kill credited to the F-16.

The F-16 constitutes more than 50 percent of USAF fighter strength through at least 2010, when its replacement, the F-35 Joint Strike Fighter, begins to enter the inventory. Current projections call for F-16s to remain in the US inventory for at least a decade after that and until at least 2030 for other nations.

"We expect the F-16 to remain a significant portion of our business for many years," said Dain M. Hancock, president of Lockheed Martin Aeronautics, in a statement issued to commemorate the 25th anniversary of global production. ■

Peter Grier, a Washington editor for the Christian Science Monitor, is a longtime defense correspondent and a contributing editor to Air Force Magazine. His most recent article, "Lighter Footprint, Longer Reach," appeared in the October 2003 issue.