Editor, Code One Magazine  
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Dear Sir:

The Atlanta High School DECA Chapter is very appreciative of the help we received from your company, courtesy of Mr. Don Steger, Art Director, in the Bessie Coleman U.S. Postal Stamp Dedication.

It was from your magazine, Code One, October, 1990, Vol. 5, No. 3, we learned so much background information about Bessie Coleman. We were able to use this to publicize Atlanta, Texas as the birthplace of Bessie Coleman, the World's First Licensed Female African-American Aviatrix.

Mr. Don Steger, also a native of Atlanta, Texas, and your Art Director, helped design the display posters, which we used to publicize Bessie Coleman's birthplace and the stamp dedication, which took place May 23, 1995 downtown at our gazebo. Also, a commemorative plaque which Mr. Steger designed, was presented to Mr. Bill Moore, our Atlanta Postmaster, to hang permanently in the Atlanta, Texas Post Office. The writer of the article in your magazine was Mrs. Elaine Derouen, who is also a former resident of Atlanta, Texas.

We feel your company helped us, along with others, persuade the Postal Service in Washington, D.C. to include Bessie Coleman as one of theirs five to be issued in the Black Heritage Series issue, out of thousands nominated. We have found a very important piece of Atlanta, Texas' history which we can now preserve and be proud. Thank you so much!

Sincerely yours,

Atlanta DECA Chapter

Tommy Thomas, Chairperson
Leslie Lemoine, Co-chairperson
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Weapon Wizardry

*Code One* Profiles the 39th Flight Test Squadron at Eglin AFB, Florida

Anything that falls from or shoots off an F-16 probably encountered its maiden flight over sunny Florida from the 39th Flight Test Squadron at Eglin AFB. The squadron is test central for certifying weapons for the F-16 and for expanding the F-16's flight envelope for existing weapons. The 39th FTS also plays a key role in developing the latest generations of a wide range of air-to-target weaponry to be used on a variety of aircraft, from F-15E strike fighters to B-2 bombers. Everything from the latest precision-guided munitions and off-boresight missiles to improved bomb racks, radar pods, and cluster bombs loaded with heat-seeking submunitions are accumulating flight time under the wings of F-16s from the 39th.
This has become the place to test weapons," says Capt. Gregg Carswell, the squadron's engineering flight commander. "Cost is the main reason so many of these weapons are developed here. The F-16 is such an inexpensive aircraft to operate. Another reason is capability. The F-16's avionics can talk to the bombs. We can use the aircraft's global positioning system, or GPS, to guide them. We can transmit weapon-critical navigation data to the aircraft with the airplane's internal data modem. The F-15E can do all this, too, but we can do it at a much lower cost. Weight may be our only limitation with the F-16."

One look at a list of upcoming tests posted on the wall of Carswell's office, however, indicates that weight does not present much of a limitation. The list includes a load of four GBU-24 bombs scheduled for certification tests this summer. A GBU-24 is a laser-guided bomb in the 2,000-pound class. The massive Norden radar pod—a 600-gallon fuel tank filled with an AN/APG 74 radar—recently took its first flight under the wing of one of the F-16s from the 39th. The Norden pod is being used to demonstrate sensor technologies for detecting, tracking, and identifying mobile missile launchers. Interestingly, a much larger Lockheed aircraft, a modified Navy S-3 Viking, was the first to carry the system.

This wide variety of testing, though, boils down to one purpose—to increase the combat capability of the F-16. A large part of that job involves determining whether existing or new weapons, racks, tanks, and pods are compatible with the F-16. These compatibility tests take many forms. They may involve launching a new missile (or a missile new to the F-16) from different positions on the wing. They may involve dropping newly developed bombs. The squadron also tests new combinations of existing loadings on the F-16 to see if the airflow generated around one loading interferes with the safe release of another at prescribed speed and altitude points.

"A weapon is useless if it limits the aircraft to 300 knots," explains Maj. Gary Plumb, an F-16 test pilot and the unit's assistant operations officer. "Ideally, we want a weapon that will allow us to go as fast as we can and to pull maximum g's. But there are always limits. Part of our job is to determine those limits and to make the jet as safe as we can."

The people running around the flight operations building in a blur are probably test engineers.

Before any new loading leaves the ground, the aircraft with accompanying loadings goes through a series of ground tests. Detailed computer simulations and wind tunnel tests are conducted first to develop a basis of information. The loading is then put through fit checks. In these checks, the aircraft is placed on jacks and the gear doors and flaps are actuated to make sure these systems are not constricted. Mounting lugs on the loading are matched with those on the associated hardpoints or rails. Technicians check basic geometries to make sure nothing
Maj. Gary Plumb and other test pilots at the 39th fly a variety of F-16s, from Block 10 to Block 50.

scrapes the ground when the aircraft rotates for takeoff and lands. After these initial ground tests, the airplane is powered up with the test item attached to see if the avionic system recognizes it and, in some cases, can communicate with it.

"Most of the engineering is done before any hardware gets here," explains Plumb. "Normally, our first flight with a test item, a new munition for example, is what's called a compatibility flight profile. Our engineers clear the munition to certain points in the aircraft's envelope. We start at a slow speed in a safe regime to see if the airplane handles normally. We may configure the aircraft asymmetrically with the weapon to see if the airplane is controllable at slower speeds and on landings. We fly a series of maneuvers and make sure that the weapon doesn't affect handling. We stress the munition with positive and negative G forces. We execute maximum performance rolls under increasing G's up to some limit set by the engineers. All the while, we look for handling performance problems and weapon structural failure."

In the last part of a compatibility flight profile, test items are flown at high Q—low and fast. "We call it a speed soak," says Plumb. "We go down to 1,000 feet and fly at 0.9 Mach or at some other prescribed maximum speed for half an hour. We are assuming that, in a high-threat war, pilots may need that high-speed, low-altitude capability to get to and get away from a target."

According to Plumb, speed soaks can push a piece of hardware beyond its limits of durability. "At high Q, I've seen doors come off," Plumb says. "Strange things can happen at the edges of the envelope. Bombs have come back with cracked or missing fins and nose fuses that have unthreaded themselves. A chase plane follows us to make sure we're not losing parts of the jet or parts of the weapon. We make sure it can function and talk to the jet at these speeds. This work establishes an envelope."

After the compatibility flight profile, test items designed to fall from the aircraft are put through a series of drop tests. "We may be able to carry a weapon at high speeds and under high G forces, but the flight envelope in which it can be released may be smaller," Plumb explains. "To establish this envelope, we drop a weapon at its negative and positive G limits and at its fastest and slowest airspeeds. We concentrate on the areas we think represent the worst conditions. Turbulence can alter the ballistics of a weapon. Some have come off the airplane and knocked off ventral fins. A weapon may also affect the airflow around adjacent wing tanks, so we test drop tanks as well. Just going out to a certain point in the envelope with weapons may cause the wings to flutter. Engineers can predict these characteristics with computer models, and they can fly shapes in a wind tunnel. But the results are never quite the same as what we actually see on the airplane in flight."

High-speed separation cameras mounted in orange blisters on the aircraft record the immediate separation of a weapon from its carrier. It is up to a unique group of aerial photographers, however, to document what follows. "Those onboard separation cameras are important," explains TSgt. Ralph Hallmon. "But things usually don't get interesting until a bomb falls out of its frame. I've filmed bombs that separate cleanly and then come back and almost hit the aircraft."

Hallmon heads up a four-person aerial photographic group within the 39th FTS. The photographers also support other flight test functions at the base. "Our primary duty is data collection," says Hallmon, who has been an aerial photographer at Eglin for eight years. "Regular aerial photographers tend to fly straight and level to get public relations photos. They usually put the camera down when the flying gets tough. Here, we often have to capture coverage while maneuvering. We chase bombs 200 feet above the ground and in dives up to sixty degrees. We often shoot while our aircraft is inverted. Our most difficult task is recording a high-G launch. These high-speed cameras weigh sixteen pounds. I have filmed missile launches at up to 8.5 G's. What's really tough, though, is holding these cameras while going from eight G's to zero G in one second."

The high-speed cameras run at rates up to 500 frames per second. Engineers review the films frame by frame to
make sure that a bomb is doing what it is designed to do. "We also fly loads and flutter tests," says Hallmon. "Engineers have all the strain gauges and other sensors that quantify flutter characteristics. We show them exactly what the movements look like."

Test flights are scrutinized simultaneously on the ground by groups of engineers in sophisticated monitoring facilities. Depending on the test, these engineers may monitor hundreds of aircraft and weapon parameters during one flight. The aircraft flight path and the local weather patterns are shown on large screens above colorful consoles of computer monitors and strip charts that display and record signals transmitted from both the sensors in the test aircraft and the hardware being tested. Meanwhile, engineers wear headsets with microphones tied to everyone else in the room and to the test pilot.

"The people running around the flight operations building in a blur are probably test engineers," says Carswell, a test engineer himself. "The success of a test program lies squarely on the shoulder of the test engineer. He or she, simply by omission, can do a lot of harm by not collecting the right data, failing to collect it, or failing to say 'skip it' for a test point if something looks wrong. That doesn't happen here because we have a rigorous certification process for engineers. We try to have all the right people in the ground control facility for these tests."

A significant portion of the weapon development work being carried out by these engineers and test pilots involves increasing the lethality of existing bombs by improving their accuracy. "The United States has thousands of Mk 82 and Mk 84 bombs," says Plumb. "These bombs have about a five milliradian dispersion, which means if you drop two bombs from 10,000 feet under the exact same conditions, they may land fifty feet from each other because of tolerances allowed in the manufacturing process. If a bomb doesn't hit a tank right on, it will probably not destroy it. So we're taking those dumb bombs and making them smart."

These educated bombs are generally referred to as guided bomb units, or GBUs. The existing USAF arsenal contains about a dozen types of these weapons. The GBU-15, as one example, is a 2,000-pound Mk 84 bomb with a seeker head from a Maverick missile attached to the front end and large steerable fins affixed to the back. These bombs are released and guided for relatively long distances by laser or electro-optical (television) systems. The guidance systems themselves leave room for improvement—and testing.

"Laser systems require an airplane to stay around long enough to lase the target until impact, or they need someone on the ground and close enough to the target to lase it," explains Plumb. "And both laser and electro-optical systems are limited by weather. Many of these drawbacks can be overcome with guidance based on a global positioning system. The bomb, essentially, steers itself with position updates transmitted from a network of GPS satellites."

The 39th FTS has been demonstrating weapon guidance systems based on GPS. The program is called EDGE, which stands for exploitation of differential GPS for guidance enhancement. The EDGE guidance system, in simple terms, improves upon the accuracy of satellite-based guidance systems by supplementing them with information
from receivers at precisely surveyed locations on the ground. This ground-based refinement of space-based GPS information is called differential GPS. Lessons from the program will feed into the next generation of precision-guided munitions.

Gregg Costabile has been with the program for combining GPS with dumb bombs since its unheralded origins in 1991. "No one had done it before," says Costabile. "Our first drop, launched from over sixteen miles away, missed by six meters. That was with GPS only. EDGE, with differential GPS, improves upon that accuracy. Our first drop in May impacted within four meters of the target. The weapon was released at 30,000 feet at 0.9 Mach and over twelve miles and about 100 seconds from the target."

In the last drop test scheduled for late June, F-16s will drop two of these weapons ten seconds apart against one target. "We would like to see the second bomb fly through the hole made by the first," says Costabile.

Pinpoint accuracy at such long standoff ranges amounts to revolutionary destructiveness. Airplanes, it seems, are becoming platforms for unmanned airplanes.

"That's right," agrees Col. Harry Walker, the operations group commander for the 46th Test Wing at Eglin. "The smarter the bomb, the more it is like an airplane. We're producing bombs with sensors in a variety of spectrums—irradiate, millimeter wave, electro-optical. We have bombs with guidance control systems that are basically offshoots of digital flight control systems."

Walker is one of a handful of "double patch wearers"—pilots who have graduated from both the Air Force fighter weapons school and test pilot school. He was one of the USAF test pilots for the joint DARPA/NASA/Ar Force forward-swept-wing X-29 aircraft. His background and position as operations group commander at Eglin give him a broad perspective on the direction of weapon development.

"In general, we are trying to make weapons smarter, smaller, and more powerful," he says. "GPS and other sensor technologies make us smarter. We must have eyes to get to the target. GPS may be the right solution, but we need accurate coordinates for a target to begin with. That's another challenge. Long-range glide bombs, like today's AGM-130, will have to become more stealthy in themselves. Some day we will be building weapons with self-protection systems and bombs with their own active or passive countermeasures. Aircraft designed for low observability and internal carriage force us to think about making these weapons smaller—to use combinations of new chemical explosives and redesigned penetrators to produce bombs as or more powerful than current larger bombs. We are developing a new bomb, basically a GBU-28, that senses how many floors it has gone through as it goes through a building. The back part of the bomb can take out a given floor and the front part keeps going to the basement before blowing up. We have some very devious people putting this one together."

Permutations of the GBU-28 "bunker buster" bomb (a 5,000-pound bomb designed to penetrate twenty feet of concrete and originally dropped by an F-111) may fall just outside the F-16's payload capacity. The F-16, however, is the primary platform for developing a slew of new weapons. One of the more successful and evolutionary intriguing programs recently completed at the 39th FTS is an infrared air-to-air missile built by Raytheon.

The missile originated as a short-finned AIM-9 variant called the Stork, or Boxoffice I. It was designed to be carried in the F-22's internal weapon bay. Its significantly smaller tail fins (and lack of canards) produced several benefits. The compact control surfaces created a smaller radar signature and a greater range—almost double as a matter of fact. The aircraft could also carry more missiles in a given space. But these benefits came at a price—reduced control.

This drawback was addressed by a simple but highly effective thrust-vectoring system in a second design,
called Boxoffice II. The thrust-vectoring system produced turn radii of less than 1,000 feet, which created another problem, or, more accurately, another opportunity. Essentially, the missile could out turn its own sensor angle. So the engineers attached a bulbous wide-angle seeker head to the front end of the missile, which gave it a sensor angle of plus or minus ninety degrees from its nose. The aircraft’s radar sweep, though, is limited to about sixty degrees. So the engineers incorporated a helmet-mounted display designed by Honeywell for cueing the missile. It worked.

“We performed two guided shots with the missiles at QF-106 drones,” recounts Capt. Brian Simpson, one of two 39th FTS test pilots for the program. “I shot the first one in May 1994. We used a standard AIM-9M seeker head. The drone was 1,000 feet in front of me and twenty-five degrees to the left, flying in the same direction. I launched the missile as the drone began a four-g break away from my aircraft. The missile, without a warhead, impacted two seconds later and knocked the drone out of the sky.

“For the second launch last July,” Simpson continues, “we used the helmet-mounted display and the wide-angle seeker head. The drone and the F-16 approached head-on at 0.9 Mach each. They were separated by 2,000 feet vertically and 7,500 feet horizontally. The drone began a five-g maneuver into the F-16 when the test pilot fired the missile at a gimbal angle of fifty-six degrees. Six seconds later, the missile passed within fifteen inches of the drone.”

Requirements for highly maneuverable missiles and precision-guided bombs come from real-world threats and experience. Boxoffice II, for example, addresses known USAF deficiencies as compared with threat missiles, namely the Russian-built AA-11 Archer. Requirements for highly accurate GPS-based guidance systems can be traced to experiences in the Gulf War. Whatever the source of requirements, however, the advance of technology behind these weapons seems unrelenting.

“After I graduated from fighter weapons school and went on to become a test pilot,” says Col. Walker, “one of the test engineers asked me, ‘Why is it that whenever engineers develop something new, you operators always want us to do more?’ I replied that the engineers have yet to satisfy our requirements. Every fighter pilot wants four things: invulnerability, invisibility, omniscience, and home-on proplastm weapons. Until the engineers can give us those four things, we’ll always want more.”

_Eric Hehs_

**In The Pipeline**

Various personnel at the 39th Flight Test Squadron are working on this short list of programs.

*DWS-24*, an air-to-ground munitions dispenser, is made by a subdivision of Deutsche Aerospace. The unpowered dispenser is released during high-speed, low-level flight and flies autonomously to a target where it releases submunitions over an area up to 350 meters wide and 1,000 meters long. Several European countries are interested in the program. The 39th is currently evaluating a GPS guidance system and high-altitude launches for the weapon.

*ASRAAM*, the advanced short-range air-to-air missile, is being developed by British Aerospace. The infrared-guided off-boresight missile is a candidate for the next generation AIM-9.
**JDAM**, the joint direct attack munition, is being developed for the US Air Force and Navy. It will be a highly accurate, all-weather conventional bomb with its own inertial guidance system. The weapon will likely use technology demonstrated in the EDGE program, which is featured in the main article. JDAM is scheduled to be fielded in the 1997-1998 timeframe.

**JSOW**, joint standoff weapon, is a modular, low-cost glide weapon developed for the US Air Force and Navy. The weapon can carry several different submunitions, warheads, nonlethal payloads, and terminal sensors. It also allows for different modes of propulsion.

**HTS**, a targeting system for the high-speed antiradiation missile, is currently fielded by several units flying the Block 50 F-16. The system is a super-sensitive receiver that detects, classifies, and ranges threats and passes the information to the HARM missile and to displays in the cockpit. The 39th FTS is working on software updates for the system as well as on a modem for transferring information from HTS-equipped aircraft to non-HTS aircraft.

**PIDS 3**, the pylon integrated dispenser system, is a Danish weapons pylons similar to a MAU-12. The pylon has a blister on the back that contains compartments for chaff or flare dispensers. It is being tested for the Air National Guard.

**British Bomb Rack**, a dispenser for dropping BDU-33 practice bombs, is a replacement for the SUU-20. The new rack uses a compressed gas instead of pyrotechnic charges to eject bombs. The rack is finishing operational tests on the F-16 and has flown in compatibility tests on the F-15E and F-111.

**DSU-33**, an inexpensive radar-based bomb fuze, is designed to replace more expensive radar fuzes in the current inventory.

**ALR-56M**, a radar-warning receiver, evaluates threat radar and sends information to the ALE-47, which automatically dispenses flare and chaff accordingly.

**CBU-97**, also called the sensor-fuzed weapon, is a cluster munition that releases ten submunitions on parachutes at about 150 feet above the ground. Each submunition dispenses forty target-sensing projectiles over a large number of ground targets, like tanks and armored personnel carriers. The 39th FTS is performing lot acceptance tests on the initial production run.

**Wind-Corrected Munitions Dispenser**, a kit with an inertial guidance system and steerable fins, will be attached to current cluster munitions. The kit improves the standoff performance of the CBU by correcting for wind drift after drops from high altitudes. The kit is still in the early development stages.
Four Cyrillic letters adorn a toggle switch in the MiG-29 cockpit. The letters spell a word that sounds like *schlemm*. The switch activates a helmet-mounted sight system used to designate targets for one of the most formidable air-to-air missiles any USAF fighter pilot may ever face, and actually ever face—the AA-11 Archer. The system allows pilots of the MiG-29 to shoot the thrust-vectored Archer where their planes are not pointing. With a turn of the head, they can target opposing aircraft up to forty-five degrees off the nose of the MiG. When MiG-29 pilots of Germany’s Jagdgeschwader 73 (Fighter Wing 73) use the helmet-mounted sight system in simulated engagements, they call it a *schlemm shot.* (Not surprising, *schlemm* means grand slam in German.)

Only a handful of US Air Force fighter pilots have ever been schlemmed. Those who have, though, consider themselves lucky. They have experienced what others have only read about or encountered in simulations. With experience comes credibility. And as of last May, the most credible squadron when it comes to fighting the MiG-29 is the 510th Fighter Squadron from Aviano Air Base in northern Italy.
Most people associate Aviano with Deny Flight Operations over Bosnia. Many pilots of the 510th Squadron and its sister F-16 squadron, the 555th, have been flying over Bosnia from Aviano for almost three years without much attention. Until recently, that is. These days, the squadrons fly these missions for two-month shifts every six months. The units spend two of the remaining four months training at Aviano and two months deployed. On one such deployment last year to Decimomannu Air Base on the southern tip of Sardinia, Capt. Will Sparrow of the 510th learned about an upcoming German MiG-29 visit to the island. The Fulcrums, he heard, were looking for aerial adversaries. “We were on the phone about thirty seconds later getting our name on the books to come back down here,” Sparrow said.

A few months after that call, the 510th headed back to Sardinia with ten F-16s and an able support team for a four-week MiG-29 Fest. The JG-73 sent ten Fulcrums and fifteen air-to-air German F-4Fs. The pilots flew a variety of setups, from simple one F-16 flying basic fighter maneuvers against one MiG-29, to more complex encounters of four F-16s teamed against four MiG-29s. Two F-16s also flew against two MiG-29s and two F-4Fs. “We called that two v two-plus-two,” explained Sparrow. “The MiGs practice a lot of tactics with the F-4s to make use of the F-4’s radar.”

The more complex engagements were simultaneously monitored by ground controllers who used the air combat maneuvering instrumentation facilities at Decimomannu to guide the aerial combatants. The ACM facilities were also used by the aircrews to review the engagements. “Decimomannu is a fantastic place to train,” said Sparrow, who was in charge of the deployment for the 510th. “The base has an ACM that can’t
German F-4Fs line up at Decimomannu.

be beat for debriefing. And they have a bombing range nearby at Cappa Frasca.

"I hope this deployment receives a lot of attention because it deserves a lot," Sparrow continued. "Not because we're here, but because we're learning about aircraft very similar to the German MiGs, aircraft that could cause us a lot of problems. As for what we expected before coming down here, we would get ten different answers from ten different pilots. We've heard a lot of things about the MiG-29. We all read the same stuff and get the same information. But we never really know what to believe. We now know they are a great adversary. They were everything I expected and more. Nothing can substitute for training like this. We go out and fight ourselves a lot and we try to make those encounters as realistic as possible. But this is the real thing. And these MiG pilots are really well trained."

Germany's MiG-29 unit is based at Laage Air Base near Rostock on the Baltic coast. Before German reunification in 1990, the aircraft flew for the former East Germany and the Warsaw Pact. After reunification, the Fulcrums became a test wing for the German Air Force. In 1993, the unit became an operational wing. Its twenty-four Fulcrums and twenty-eight pilots officially became a combined wing with an F-4 unit from Pferdsfeld Air Base in 1994. The unit formally maintains an alert role and polices the air over the five republics that comprise the former East Germany. Many of Germany's MiG-29 pilots are former F-4 pilots who were trained in the United States. These pilots volunteered to convert to the Fulcrum, which currently represents the most advanced fighter in the German Luftwaffe.
The JG-73 has also retained a number of former East German MiG-29 pilots who have had to tailor their knowledge of the airplane to fit western-style tactics. Most of the Fulcrum pilots have less than 300 hours in the aircraft. Only a few have over 400 hours. No one in the unit, including former East German pilots, has over 500 hours in the MiG-29.

This was not the JG-73's first encounter with advanced western aircraft. The wing flew against Dutch F-16s at Decimomannu last year and against Spanish F-18s for two weeks in 1993. The Germans deploy to Sardinia because the ACMI facilities are there and because air-to-air combat training is restricted over the former East Germany, which covers Laage Air Base. The restriction, however, may be dropped later this year.

Most of Germany's MiG-29 maintenance personnel are from the former East German Air Force.

This deployment answered so many questions I had in my mind about the MiG-29. The experience confirmed what I knew about the MiG-29's ability to turn and to fight in the phonebooth. It is an awesome airplane in this regime.

Capt. Mike McCoy,
F-16 pilot with the 510th
“The highlight of this deployment for me has been the BFM [basic fighter maneuvering, i.e., modern dogfighting] against a clean F-16C,” explained Capt. Oliver Prunk, the operations officer for the JG-73. “The F-16C performs significantly better in terms of power when compared with the F-16A. I was also pleased with the proficiency of the American pilots. They take their jobs very seriously. We try to be the best adversary we can. I think they were surprised with the performance of the MiG-29 and with what we can do with it.”

The most impressive aspect of the Fulcrum’s performance for the American pilots was its low-speed maneuverability. “In a low-speed fight, fighting the Fulcrum is similar to fighting an F-18 Hornet,” explained Capt. Mike McCoy of the 510th. “But the Fulcrum has a thrust advantage over the Hornet. An F-18 can really crank its nose around if you get into a slow-speed fight, but it has to lose altitude to regain the energy, which allows us to get on top of them. The MiG has about the same nose authority at slow speeds, but it can regain energy much faster. Plus the MiG pilots have that forty-five-degree cone in front of them into which they can fire an Archer and eat you up.”

The off-boresight missile, as described in the opening scenario, proved to be a formidable threat, though not an insurmountable one. “Some of their capabilities were more wicked than we originally thought,” said McCoy. “We had to respect the helmet-mounted sight, which made our decisions to anchor more difficult. In other words, when I got close in, I had to consider that helmet-mounted sight. Every time I got near a Fulcrum’s nose, I was releasing flares to defeat an Archer coming off his rail.”

“Before coming here, some of our pilots may have thought of the MiG’s helmet-mounted sight as an end-all to a BFM fight,” explained Lt. Col. Gary West, commander of the 510th. “We have found that it is not as lethal as we had expected. We encountered some positions—particularly in an across-the-circle shot or a high-low shot and in a slow-speed fight—where a Fulcrum pilot can look up forty-five degrees and take a shot while his nose is still off. That capability has changed some of the pilots’ ideas on how they should approach a MiG-29 in a neutral fight. Below 200 knots, the MiG-29 has incredible nose-pointing capability down to below 100 knots. The F-16, however, enjoys an advantage in the 200-knot-plus regime. At higher speeds, we can power above them to go to the vertical. And our turn rate is significantly better. By being patient and by keeping airspeed up around 325 knots, an F-16 can bring the MiG-29 to its nose. But the pilot must still be careful of the across-the-circle shot with that helmet-mounted display.

“We have done very well on neutral BFM engagements,” continued West. “We have tried single- and two-circle fights, depending on how much lead turn we had at the merge. Without exception, we have been able to use finesse or power to an advantage after at least a couple of
turns. I don’t think any F-16 pilot has gotten defensive and stayed there. As always, and this applies to any airplane, success depends on who is flying.”

Three pilots from the 510th received backseat rides in one of the JG-73’s two-seat MiG-29 trainers. Capt. Sparrow was one of them. “The MiG is harder to fly than the F-16,” said Sparrow. “The Soviet airframe is great, but the avionics are not user friendly. After flying in the backseat of the Fulcrum, I got a feel for how spoiled we are in the F-16. I always felt good about the F-16, but I wouldn’t trade flying the F-16 for any other aircraft, foreign or domestic.

“The Fulcrum doesn’t have the crisp movements of an F-16,” Sparrow continued. “You need to be an octopus in the MiG-29 to work the avionics. Those German pilots have it tough. Just to get a simple lock on and fire a missile may take a half dozen hands-off switches or so. We can do the same with a flick of the thumb while we are looking at the HUD. F-16 pilots also have a significant sight advantage. A couple of hundred feet advantage can make a difference in air-to-air combat; the actual difference is more significant than that. MiG-29 pilots have a tough time checking their six o’clock. Their canopy rail is higher. They can lose sight of us even when flying BFM.”

“Their visibility is not that good,” agreed McCoy, one of the other two pilots who enjoyed a spin in the Fulcrum. “Their disadvantage is a real advantage for us. F-16 pilots sit high in the cockpit. All the MiG-29 pilots who sat in our cockpit wanted to look around with the canopy closed. They were impressed that they could turn around and look at the tail and even see the engine.”

“Besides visibility, I expected better turning performance,” McCoy continued. “The MiG-29 is not a continuous nine-g machine like the F-16. I tried to do some things I normally do in an F-16. For example, I tried a high-AoA guns jink. I got the Fulcrum down to about 180 knots and
pulled ninety degrees of bank and started pulling heavy g's. I then went to idle and added a little rudder to get the jet to roll with ailerons. The pilot took control away from me in the middle of these maneuvers because the airplane was about to snap. I use the F-16's quick roll rate like this all the time with no problem.

“I also tried to do a 250-knot loop,” McCoy recalled. “I went to mil power and stabilized. As I went nose high, I asked for afterburner. I had to hamfist the airplane a little as I approached the top of the loop. I was still in afterburner at about 15,000 feet and the jet lost control. The nose started slicing left and right. I let go of the stick and the airplane righted itself and went down. It couldn’t finish the loop. In the F-16, we can complete an entire loop at 250 knots.”

Like Sparrow, McCoy climbed out of the MiG-29 cockpit feeling better about the F-16, especially its automation. “The biggest instrument in the MiG-29 cockpit is the clock,” McCoy said. “It took me a while to understand this. But a large clock is needed to keep track of the time after launching a missile. When they launch a missile, they have to consider their shot range and the type of missile they are shooting and estimate how long it will take to impact before firing. When they take a five-mile Alamo shot, for example, they have to calculate mentally the time required for the missile to reach its target so their radar can illuminate it for the duration. They fire and watch until they know when they can turn away. That procedure is a real disadvantage if they’re flying against someone who shot a missile at them at about the same time.

“F-16 pilots don’t have to think about these things,” McCoy continued. “We have great automation. When we launch a missile, the airplane performs all the calculations and displays a countdown on the head-up display for us. When we’re within ten miles, we want our eyes out of the cockpit looking for flashes or smoke from an adversary. That’s why our head-up display is focused to infinity. We can view information without refocusing our eyes to scan the horizon. Inside of ten miles, Fulcrum pilots are moving their hands around flipping about six switches, some they have to look at. I am moving one, maybe two switches, without taking my hands off the throttle and stick.”

German Fulcrum pilots realize the limitations, and advantages, of their aircraft. “If you define an F-16 as a third-generation fighter, it is not fair to

Before coming here, some of our pilots may have thought of the MiG’s helmet-mounted sight as an end-all to a BFM fight. We have found that it is not as lethal as we had expected.

Lt. Col. Gary West, commander of the 510th
I hope this deployment receives a lot of attention because it deserves a lot. Not because we're here, but because we're learning about aircraft very similar to the German MiGs, aircraft that could cause us a lot of problems.

Capt. Will Sparrow

speak of the MiG-29 as a third-generation aircraft because of its avionics,” said Lt. Col. Manfred Skeries, the deputy commander of the JG-73. “Aerodynamics, now, are something different.” Skeries is the former commander of all East German fighter forces and the first German pilot to fly the MiG-29. His comments came after he received his first flight in the F-16.

“The MiG-29’s avionics are a shortcoming,” admitted Capt. Michael Raubbach, a Fulcrum pilot of the JG-73. “Its radar-warning and navigational equipment are not up to Western standards. The Russian idea of hands-on throttle and stick is not the same as it is in the West. It is true that we have to look in the cockpit a lot to flip switches. And the way information is provided and the accuracy with which it is provided—in the navigational equipment in particular—doesn’t allow full employment in the Western concept.

“Our visibility is not as good as an F-16 or even an F-15,” Raubbach continued. “We can’t see directly behind us. We have to look out the side slightly to see behind us, which doesn’t allow us to maintain a visual contact and an optimum lift vector at the same time. This shortcoming can be a real problem, especially when flying against an aircraft as small as the F-16. But as a German, I can’t complain about the MiG’s visibility. The aircraft offers the greatest visibility in our air force.”

Raubbach is one of many Western-trained pilots who volunteered for the first five MiG-29 slots that became available after Germany made the JG-73 an operational wing. He is now an instructor pilot for the unit. “The helmet-mounted sight is a real advantage when it comes to engagements requiring a visual identification,” Raubbach said. “It offers no advantage in a BVR engagement, however, unless you enter a short-range flight, which is not very likely against an AMRAAM-equipped opponent like we are facing here.”

The Westernization of an Eastern aircraft has presented its own problems. The MiG-29’s powerful Isotov RD-33 engines, designed as disposable commodities for a mass force, were designed to run about 400 hours before they had to be replaced. (By comparison, F-16 engines can run about 4,000 hours between overhauls.) The Germans have managed almost to double the RD-33’s lifespan by detuning the engines by ten percent. Besides lowering thrust, the cost-saving fix has reduced range and dirtied the exhaust at lower altitudes. The move from JP-4 to NATO’s standard fuel JP-8 has also hurt engine performance.

“The engines have been extremely reliable,” commented Raubbach. “It goes from afterburner to military power, without problems, at various speeds and under varying g conditions. I can feel the difference detuning makes only at higher speeds. We have many spare engines. We had a shortage at one time, but we now have a big supply. Engines do not represent a shortcoming for us.”

Though aerodynamically adept, the MiG-29’s performance is constrained by avionics conforming to Soviet tactical doctrine. The aircraft was designed to rely heavily on a centralized system of ground controllers, which could take control of the aircraft’s radar.
The system could also land the plane if necessary. "Warsaw Pact pilots were not taught to evaluate a situation as it occurs in the air," Prunk explained. "Pilots were used to a system that made many decisions for them. The aircraft's guidance system had room for only six preprogrammed steerpints, including three targets. The radio had twenty preselected channels at frequencies unknown to the pilot."

"The aircraft was not built for close-in dogfighting, though it is aerodynamically capable of it," Prunk continued. "The East Germans flew it as a point defense interceptor, like a MiG-21. They were not allowed to max perform the airplane, to explore its capabilities or their own capabilities. Sorties lasted about thirty minutes. The airplane was designed to scramble, jettison the tank, go supersonic, shoot its missiles, and go home." This relatively strict operational scenario presents its own limitations. Many of these involve the aircraft's centerline fuel tank. The MiG-29 cannot fly supersonic with the tank attached. Nor can pilots fire the aircraft's 30mm cannon (the tank blocks the shell discharge route) or use its speed brakes. The aircraft is limited to four g's when the tank has fuel remaining. The tank creates some drag and is also difficult to attach and remove. The MiG-29 can carry wing tanks that alleviate many of these shortcomings, but the Luftwaffe has no plans to purchase them from Russia.

Even given its drawbacks, the MiG-29 remains a formidable foe. "This deployment answered so many questions I had in my mind about the MiG-29," said McCoy, who flew in eight sorties against the Fulcrum and in one with it. "The experience confirmed what I knew about the MiG-29's ability to turn and to fight in the phonebooth. It is an awesome airplane in this regime. The awe, though, fades away after that first turn in. The biggest adrenaline rush was getting to that point. After that, I started evaluating it as a weapon. The German MiG-29 pilots represent a worst-case threat for us because their skills are so good."

"When Western pilots merge with a MiG for the first time, they tend to stare at it in awe," said West, who flew in three sorties against the Fulcrum. "Instead of flying their jets and fighting, they are enamored by this Soviet-built aircraft that they have spent their lives learning about. Pilots lose this sense of wonder after a first encounter. It is no longer a potential distraction. They are going to know what type of fight to fight and exactly where they may be in trouble. No one can learn these things by reading reports. Air-to-air fighting is a perishable skill. But the lessons we learned here won't be forgotten. These pilots will know at the merge exactly what they are up against. They will have more confidence. And they know they are flying an aircraft that is superior in maneuverability, power, and avionics."

"When our pilots first arrived here, they almost tripped over themselves because their eyes were glued to the ramp and those MiG-29s," West continued. "After a few days, though, those MiGs became just like any other aircraft. And that's the way it should be."

Eric Hehs
You can read all you want about pitchrocking out of a deep stall in the F-16, but nothing gets the point across better than actual experience. At least, that’s what pilots are saying after completing a departure resistance and deep stall recovery training program taught by test pilots at Edwards AFB, California.

Edwards is about the only place F-16 pilots can officially practice the recovery technique. The training program, taught by pilots from the F-16 Combined Test Force, began several years ago as familiarization instruction for Air National Guard pilots. Since then, it has gained in popularity. Over 450 F-16 pilots from Air Combat Command, Air Education and Training Command, as well as from foreign air forces have completed the course.

The program is designed to increase pilot awareness of the F-16’s flying qualities in low-speed and departure regimes. It begins by focusing on how to avoid departures. Operational pilots learn how to employ the F-16 effectively at the slow-speed edge of its flight envelope without departing from controlled flight. Instructors then review the F-16’s characteristics in a deep stall and explain how to recover—safely and confidently—before actually performing about ten recoveries from a variety of deep stall situations.

A solid understanding of how the F-16 limiters for angle of attack, roll rate, and yaw rate function is essential for recovering from deep stalls and for avoiding departures as well.

The AOA limiter allows the pilot to fly up to 25.5 degrees AOA with stores certified as Category I and up to about eighteen degrees AOA with Category III stores. Both analog and digital F-16s have similar capabilities with respect to the AOA limiter. These AOA limits, however, can be momentarily overshoot, up to thirty degrees AOA (Cat I), without the aircraft progressing into a departure. AOA overshoots typically occur when a pilot makes abrupt pitch inputs below 200 knots. If the aircraft gets any slower, smooth inputs are required to prevent a departure. The same lessons taught during the F-16 RTU horn awareness training apply here: When the horn comes on, smoothly roll to the nearest horizon, stop the roll (so you don’t assault two limiters), and then smoothly blend in aft stick to keep the nose moving toward the vertical.

The low-airspeed, smooth-input recovery is flown during the training profile to demonstrate to the pilot how to recover the aircraft during a nose-high, low-airspeed situation without departing from controlled flight. Starting from seventy degrees nose high and 140 knots, a properly executed recovery will keep the aircraft in controlled flight at speeds as slow as seventy knots. (Don’t try this at home—always recover on the horn.)

The roll rate limiter reduces the available roll rate authority to prevent roll-coupled departures. The limiter is apparent below 250 knots and above fifteen degrees AOA. The amount of rudder available to the pilot is also decreased as the AOA increases. Most F-16 pilots don’t
The F-16 CTF has familiarized over 450 pilots in high-AOA characteristics of the F-16. The training concludes with simulated flameout landings.

notice this relationship because they don't normally use the rudder during air combat. Using the rudder during high-g maneuvering increases departure susceptibility because the roll rate limiter can be exceeded. A yaw departure can also occur during asymmetric maneuvering. Yaw departures are best avoided by releasing the controls.

The yaw rate limiter functions only when the AOA exceeds twenty-nine degrees AOA. The limiter stops yaw rates by deflecting the rudder, flaperons, and stabilators. The pilot's stick inputs are cut out, but rudder inputs are available. However, letting the yaw rate limiter optimize the control surfaces to stop the yaw rate is the best approach. Some of the stabilator deflection is used to stop yaw rates, and the rest is used to pitch the nose toward the earth to self-recover the aircraft.

Because of this limiter mechanization, the F-16 self-recovers from departures about forty percent of the time (historically at Edwards). However, when the nose pitches back towards the sky and the AOA gauge stays pegged at thirty-two degrees, the aircraft is in a deep stall. The actual AOA in a deep stall is somewhere between sixty to eighty degrees during the majority of flight testing at Edwards. The aircraft may still self-recover after a cycle of pitch oscillations. Because of this tendency to self-recover, the flight manual recommends a "controls-neutral" for ten to twenty seconds—if altitude permits.

In the training, we perform a 360-degree, one-g AOA limiter roll and a 360-degree, maximum-g roll to demonstrate how the F-16 can be aggressively maneuvered by saturating one limiter (AOA) and assaulting another (roll). Later in the profile, we enter intentional roll-coupled departures by assaulting both limiters simultaneously. The center of gravity is maintained at the aft limit during the familiarization flight to demonstrate a worst-case scenario and to make intentional deep stalls easier to set up. The telltale sign of an aft center of gravity is a lot of red showing on the fuel gauge. The flight manual prohibits maximum command rolling maneuvers above fifteen degrees AOA with an aft center of gravity because of the aircraft's increased susceptibility to departure.

Deep stalls can be non-oscillatory or oscillatory. During a non-oscillatory deep stall, the nose wants to sit on the horizon with no noticeable pitch rate. To recover, the pilot must initiate a pitch rate using pitch inputs with the manual pitch override (MPO) switch engaged. In an oscillatory deep stall, the pilot adds to the momentum that's already present as the nose pitches up and down. The pilot must add to the pitch rate at the proper moment to rock the aircraft out of the deep stall. Recovery may be delayed if these inputs are not timed properly to coincide with the natural motion of the aircraft. When the AOA is reduced enough to recover the aircraft, a slight hesitation in the nose can be observed along with a minor shudder as the air once again flows smoothly over the wings. Needle movement on the AOA gauge provides another clue that the aircraft is about to recover.

Recovering from an inverted deep stall is easier in some ways because it is less oscillatory. However, it often creates some confusion about which rudder pedal to push to stop the yaw rate. The current production yaw rate limiter doesn't operate inverted, so the pilot must stop the yaw rate manually. By concentrating on which way the jet is rotating with respect to the horizon, the pilot steps on the opposite rudder to stop the yaw.

The most common error committed by pilots trying to recover from inverted deep stalls is failing to stop the nose down pitch rate and, thereby, transitioning to an upright deep stall. The transition can be avoided by neutralizing aft stick input (that is, pulling toward the ground) at thirty to forty degrees nose low and then reversing the input (pushing) near ninety degrees nose low to
stop the pitch rate and keep the jet heading ninety degrees nose low. A transition to an upright deep stall calls for continued pitch rocking, as described above.

For both upright and inverted deep stalls, the MPO switch can be released when the jet is recovered from the deep stall. Recovery is best determined when the AOA gauge is no longer pegged and the aircraft is pointing sixty to ninety degrees nose low. To minimize the altitude lost in the dive pullout, a limiter pull can be executed at 150 knots. The average altitude lost from departure to dive pullout is approximately 10,000 feet during the training rides, assuming good MPO phasing and a 150-knot pullout. Most Class A mishaps caused by departures began with departures just above 10,000 feet MSL, where the pilots didn’t have time to attempt recoveries.

The F-16’s departure and deep stall handling qualities are vastly different when external stores are carried. Aircraft configured with wing tanks are susceptible to roll coupling at or beyond 180 degrees of roll, which is a basic Cat III restriction when the loading originally couldn’t pass the Cat I “not to exceed 180 degrees of roll” criteria. Centerline stores have less directional stability and are more oscillatory in a deep stall than clean aircraft. Some configurations have been certified as a Restricted Cat I loading. Many times, the restriction is 180 degrees of roll because the test aircraft flying that configuration departed controlled flight after rolling past 180 degrees. A lot of the dirtier configurations develop sideslip during the roll, which translates into angle of attack as the roll progresses. The aircraft then proceeds to a departure. The same is true for flying a Cat III loading with the stores configuration switch in Cat I. If the configuration couldn’t be certified as Cat I, then all bets are off as you exceed the Cat III AOA restriction. The bottom line is to look up a specific configuration’s restrictions in the flight manual and honor them, unless you want to be surprised either at low altitude or with a bandit in the phonebooth.

Intentional departures allow the pilot to observe the post-stall characteristics and to practice recovering the aircraft to controlled flight. We fly a variety of setups during the training. The fifty-five-degree pitch attitude slow-speed departure allows the aircraft to run out of airspeed and typically settle into a non-oscillatory deep stall. The sixty-degree pitch attitude inverted departure settles into a non-oscillatory inverted deep stall. The pitch rate departure is set up as a split-s at 125 knots, which settles into an upright, slightly oscillatory deep stall. The tactical pitch rate departure simulates a BFM scenario in which the pilot thinks, “I can get it over the top.” It then settles into an oscillatory deep stall. The roll-coupled departure combines rolling and yawing left, followed by abruptly pulling the stick aft three-quarters of the way through the roll. These inputs produce a highly oscillatory departure that in most instances is close to what the pilot will see with a centerline tank. Since this departure is performed in a clean aircraft, the pilot typically recovers after one properly applied MPO cycle. After eight to ten departures, pilots have the confidence to handle the F-16 in any operational situation that requires flying near the edge of the envelope.

_Maj. Russ Prechtel is an experimental test pilot at the F-16 CTF and the program manager for high-AOA familiarization._

*The F-16’s departure and deep stall handling qualities are vastly different when external stores are carried.*
More than 1,600 companies exhibited their wares at this year's Paris Air Show, the world's largest air show. Lockheed Martin's Steve Barter and Bland Smith wowed the company representatives and visitors with daily aerial exhibitions in a Block 50 F-16 Fighting Falcon. Other aircraft flying in the show included the Russian Su-27 and MiG-29, the French Mirage and Rafale, and the only remaining DASA/Rockwell X-31. The Russian Su-35 and the Eurofighter 2000 were displayed at the show. Lockheed Martin was honored at the show by winning the prestigious Aerospace Industry Award from Flight International Magazine. The award was presented for the company's success in reducing the cost of the F-16 as production rates have declined.

His Royal Highness Prince Philip of Belgium completed his first aerial refueling mission in an F-16 last March. The prince flew in the back seat of an F-16 piloted by Capt. Pierre "Pepe" Paris of the Operation Conversion Unit Squadron of the 1st Wing at Beauvechain Air Base. The aircraft was refueled by a KC-135R of USAFE's 100th Air Refueling Wing from RAF Mildenhall in the United Kingdom. The prince, heir to the throne in Belgium, is a graduate BAF pilot, though not F-16 qualified.
Cmdts. Rudy Theys and Jean-Jacques DeWael are exhibiting their flying talents and the F-16's impressive maneuverability around Europe as demonstration pilots for the Belgium Air Force. Theys, the operations officer for the 23rd Squadron at Kleine Brogel Air Base, performed in twenty-five shows during his first year as a demo pilot in 1994. This year is the third year for DeWael, who is based at the 1st Squadron at Florennes AB. DeWael has been flying Fighting Falcons since 1989, when Florennes AB converted to the aircraft.
The 11th Multirole Squadron from Sarghoda took five of the seven annual awards presented by the Pakistan Air Force to PAF units. The 11th Squadron received the Inter-Squadron Armament Trophy, the Combat Flying Training, Maintenance Efficiency, Overall Best Combat-Ready Squadron, and the coveted Callaghan Inter-Squadron Maintenance Efficiency Award. The 9th Squadron, also an F-16 unit from Sarghoda, took the War Preparedness Trophy and was second overall in the competition. The 26th Squadron, an A-5 squadron from Peshawar, received the Flight Safety Trophy.

At Home

Name Changes; Quality Remains The Same

Lockheed Fort Worth Company formally became Lockheed Martin Tactical Aircraft Systems in May. The name change reflects the recent consolidation of Lockheed Corporation with Martin Marietta. “Losing Fort Worth from our name is somewhat disappointing, a little like turning loose of our security blanket,” said Dain Hancock, the president of the newly renamed company. “However, our new name will serve us well in establishing our future role very clearly, both for our worldwide customers as well as internally to our corporation.”
The 3,500 Fighting Falcon was delivered in ceremonies in Fort Worth in late April. The milestone aircraft was accepted by Col. Larry Cooper, the US Air Force’s F-16 system program director, and handed over to Lt. Col. Jeff Eberhart, commander of the 79th Fighter Squadron at Shaw AFB in South Carolina. Aircraft 3,500 is a single-seat Block 50D version of the F-16C, the newest fighter in the Air Force inventory. Production will continue for USAF at low monthly rates until early 1997. USAF officials recently expressed a need to order 120 more F-16s to forestall a shortfall in the service’s tactical aircraft fleet beginning around the year 2000.

The North Dakota Air National Guard’s 178th Fighter Squadron “Happy Hooligans” have been named the winner of the 1994 Hughes Trophy for being the most outstanding air-to-air unit in the US Air Force. The unit was ranked best of forty units in the National Guard, Air Combat Command, and USAFE that are eligible for the award. “This award even surpasses winning William Tell,” said Col. Michael Haugen, the commander of the 119th Fighter Group. “Winning William Tell was like winning the Superbowl or the World Series,” said Haugen. “But this is bigger. The award is based on performance over the entire year. It is another example of our men and women working as a team, day in and day out. A great many factors go into being selected.” The 178th has flown over 14,500 sorties and over 22,000 accident-free flight hours since converting from the F-4 to the F-16 in 1990. It was also the first ANG unit to launch the AIM-120 advanced medium-range air-to-air missile.
**FS-X Wingbox Delivered**

**Lockheed Martin** delivered the left-hand wingbox for an FS-X flight test aircraft in ceremonies in May. Lockheed Martin will deliver two additional wingboxes later this year. Mitsubishi Heavy Industries designed the lower wingbox structure, which includes the lower skin spars, ribs, and cap—all made from graphite-epoxy composite material and cocured together. The wing is fitted with mechanically attached titanium components in areas that will bear high stress loads. Fuji Heavy Industries of Japan designed the graphite-epoxy upper wing skin, which is mechanically attached to allow access to the wing interior. The FS-X program is notable as the first major military aircraft development program conducted jointly by the United States and Japan. The aircraft is designed to meet Japan's support fighter requirements and will be produced exclusively for use by the Japan Defense Agency. The initial flight of the FS-X prototype is scheduled for this summer.

**Reconnaissance Pod Demonstrated**

**Lockheed Martin** completed a quick-reaction integration project and launched an ANG F-16 on its first flight with an operating electro-optical reconnaissance pod in late April. The F-16 from the 193rd Fighter Group in Richmond, Virginia, collected ground imagery using a camera equipped with an electro-optical back in place of its usual film canister. The flight marks the first step in transitioning the manned tactical reconnaissance mission from the RF-4C to the F-16 for the US Air Force. The system on the F-16 is one of several affordable, off-the-shelf options that take advantage of F-16 reconnaissance development efforts dating back to the 1980s. Competitor McDonnell Douglas recently demonstrated a more costly reconnaissance system on an F-15.
An F-16A with advanced avionics designed for several European air forces flew for the first time last April. Officials of air forces from Belgium, Denmark, the Netherlands, Norway, and the United States celebrated the milestone in a traditional F-16 delivery ceremony in May. The flight represented a major milestone in the Mid-Life Update, or MLU, program for updating early model F-16s in the fleets of European air forces. MLU improvements include a modular mission computer, upgrades to the Westinghouse APG-66 radar, and cockpit enhancements. The modifications bring more advanced technology to the original F-16A/B configuration, improving its capabilities and increasing its reliability and maintainability. A total of 301 European F-16s will be modified in the production phase of the program, which begins in 1996.
Nominations are now being accepted for this year’s Semper Viper Award for Outstanding Airmanship. The award pays tribute to pilots demonstrating airmanship skills noteworthy of its namesake, the late Joe Bill Dryden. It is presented annually at the F-16 Viper Driver Reunion held in Phoenix, Arizona. A selection panel from Lockheed Martin Tactical Aircraft Systems will evaluate candidates who carry on Joe Bill’s tradition of excellence in airmanship and system knowledge. The winner of the 1994 award was Capt. Robert Wright of the 555th Fighter Squadron at Aviano Air Base, Italy. Candidate applications for the 1995 award should be mailed to the Code One editorial office (see page 1 for address). Applications should include complete information describing particular missions or outstanding aviation skills demonstrated by the nominee. Receipt of nominations will be acknowledged by the selection panel.

F-16 Designer Takes To The Skies

Harry Hillaker, who many regard as the “Father of the F-16,” flew in one of the latest descendants of his lightweight fighter design at Moody AFB in Valdosta, Georgia, on 31 May. Hillaker flew in the backseat of an F-16D Block 40 from the 68th Fighter Squadron with Capt. Al Woodcock piloting from the front seat. The one-hour, fifteen-minute ride began with a level takeoff followed by a three-g pullout to 16,500 feet. “The airplane got there right now,” said Hillaker after the flight. “I remember thinking, when climbing to altitude, ‘How sweet it is.’” The flight continued with several simulated bombing attacks using the aircraft’s LANTIRN navigation and targeting pods.

This was Hillaker’s second ride in an F-16. He flew in a preproduction F-16 with a J-79 engine in 1981. “This airplane had about 10,000 pounds more thrust than the F-16/79,” Hillaker said. “I was most impressed with its acceleration even though we were carrying a centerline fuel tank, two wing tanks, and both LANTIRN pods.

“My expectations were very high,” he said. “But the experience exceeded my expectations, particularly the airplane’s acceleration.” Hillaker, at seventy-six, is one of the oldest people to fly in the high-performance F-16. Top on his wish list is a ride in the F-16XL. “If I couldn’t get that,” he said, “I would love to fly in the latest Block 50 version of the F-16.”
New Orleans Launches Dino-Flight

Lt. Col. Thomas King, Col. Craig Mays, Col. Lee Brundage, Lt. Col. Greg Wilson (left to right) of the 926th FW of the USAF Reserve at New Orleans, Louisiana, put their 108 years of flying experience together in one flight last May. Their four F-16s were loaded with over 16,500 hours of flying time, more than 4,100 hours of combat time in over 2,100 combat missions, eleven combat tours, eighty-six air medals, twelve distinguished flying crosses, seventy-three Top Gun awards, and one silver star. The flight, touted as the “dino-flight,” was the last for Mays, who is retiring after twenty-six years of service. As Mays walked away from his airplane for the last time, he turned to a reporter and said, “I hope no one will ever have the opportunity to attain as many combat hours as we have because war is never a good thing. Yet, if any decides to challenge America’s strength, we are ready.”

One More USAF Pilot Hits 3,000-Hour Mark

Maj. Lance Undhjem reached a milestone last March that few F-16 pilots will ever see—3,000 hours in the F-16. Undhjem became the third Air Force pilot and fourth pilot in the world to reach the mark. After his flight, Undhjem joked about his achievement. “All it means,” he said, “is that I’m getting old.” Undhjem, who calls himself an “F-16 baby,” put the aircraft on his wish list while in pilot school. He got his wish and was part of the first class to have second lieutenants flying the F-16. Undhjem flies for the 944th Fighter Wing of the Air Force Reserve at Luke AFB in Arizona. His USAF active service included flying slot F-16 for the Thunderbirds demonstration team and instructing at the Fighter Weapons School. Undhjem, who now also flies for Delta Airlines, has been flying with the 944th for five years.
Winning For Generations

Thanks much for sending the copies of *Code One* featuring the 119th Fighter Group of Fargo, North Dakota. Except for one, I spread them out to retired buddies of mine. They are all old friends who, like me, flew in William Tell years ago. The 179th did a hell of a job in winning the thing, and the writeup in *Code One* was terrific, as was the photography. Your magazine is really a class publication. Congratulations to you and your crew for a great job.

The 119th also won the Hughes Trophy for 1994. Without doubt, your article and *Code One* contributed to their selection.

"Pee Wee" Edlund, Sr.
(former Lockheed F-104 driver)
Battle Lake, Minnesota

Wall Of Bushmaster

Beginning on 1 January 1995, the 78th Fighter Squadron began a 102-day deployment to Saudi Arabia in support of Operation Southern Watch. Flying the newest F-16s, the Block 50 mini-D, the "Bushmasters" of Shaw AFB put their Vipers to the test flying both SEAD [suppression of enemy air defense] and DCA [defensive counter air] sorties over southern Iraq. During this period, over 1,000 combat sorties were flown, resulting in over 3,000 combat hours. This is equivalent to nine months of training sorties completed in only three calendar months.

Squadron maintainers produced a phenomenal 22.3 UTE rate [utilization rate—flying hours per airframe per month] for eighteen airplanes with only a twelve PAA maintenance manning package [maintenance personnel for twelve aircraft]. They were also a part of the largest Joint Task Force-Southwest Asia combat surge, providing the most SEAD capability from the Block 50 ever! Under the leadership of Lt. Col. Tim Cantwell, the Bushmasters set the pace for defining the SEAD mission, the newest role for the F-16.

Enclosed is the "blast wall" mural created by Capt. Mat Mulligan and SSgt. Gary Temples that highlights the Bushmasters' continuing involvement in Operation Southern Watch.

The Bushmasters
20th Fighter Wing
Shaw AFB, South Carolina

Strike Up The Band

I've been a long-time admirer of our Air National Guard unit in Fargo, the Happy Hooligans. Working alongside them in the old Armory, I used to observe them out my window, taking off, turning, and landing. Now in the new Armed Forces Reserve Center, we hear them overhead almost daily.

I'm very proud of their achievement at William Tell. I just happened to run across a copy of the January *Code One* and I'd like a copy or two for my Army National Guard office. While the 188th is a National Guard band, I've had as many as three private pilots in the unit. Your photography, art, and articles all look first rate. I'll enjoy putting some copies on display.

Sgt. Bernard J. McKigney
188th Army Band, ARNG
Fargo, North Dakota

Appreciated By Many

I'm a fourteen-year-old girl wanting to be a fighter pilot in the US Air Force. I was wondering if you could do an article on women pilots in the Armed Forces. It would be appreciated by many women.

Kylee Wilson
Hudson, Illinois

What About The WASPs?

It was with a tinge of envy and a great deal of admiration that I read your excellent interview with Maj. Jackie Parker, female fighter pilot. What a gal. But, hey! You need to correct her statement that "the first year that women entered Air Force pilot training was 1976," How about the WASPs? The Women Airforce Service Pilots entered Air Force pilot training in 1943, during World War II.

True, we did not fly combat, but thirty-eight of us were killed in the line of duty. So it was serious piloting. By the end of September 1944, WASPs were delivering three-fifths of all fighter planes.

Besides ferrying, we towed targets and performed tracking and searchlight missions, radio control flying, weather hops, administrative and utility flying, simulated strafing, and test piloting.

Many gave instrument rides and refresher courses to instructors. We flew everything from primary trainers to the B-29 Superfortress, including Mustangs, Thunderbolts, B-17s, B-26s, and C-54s. Whatever they'd let us do, we did, understanding that we had to try harder and gripe less than the men we flew with. The fact that they made more money and had more perks than we did meant nothing to most of us. We thanked God for the chance to serve our country in a way that American women had not been allowed to before.

Incidentally, we had a record slightly better than the men for the same type of flying. Is it any wonder that we grandmas sigh deeply when we keep reading that women didn't fly military planes until the 1970s?

Marion Hodgson
Fort Worth, Texas

New And Unusual Experience

I read with interest the article about Maj. Jackie Parker, the first female F-16 combat pilot in the US Air Force. I was the operations officer of the 161st Fighter Squadron, Kansas ANG, when she was assigned here for F-16 training. For us old guys with an entire career in tactical aviation, her assignment promised to be a new and unusual experience. We never knew a female military pilot, let alone trained with one. What a relief it was when she arrived with the same ability, aggressive attitude, and commitment to country as the rest of her male classmates. She proved to be a capable aviator, receiving the same training and performing to the same standards as every other F-16 student in our seven-year tenure as the ANG F-16 schoolhouse.

With the obvious differences aside, Maj. Parker could have been any one of us. She possesses the unique drive and love of flying as every other pilot I have known.
The question to be asked is this: If there are a set of realistic standards for a job and a person has the physical and psychological ability to meet those standards along with the commitment to serve and possibly die for their country, is gender a barrier any less arbitrary than skin color or shoe size?

Lt. Col. Dave Stephan
McConnell AFB, Kansas

Tapping Wealth Of Talent

Thank you for forwarding the April issue of Code One Magazine. The article on my youngest sister, Jackie Parker, was educational as well as insightful. It shows how women can not only contribute in the safer military careers but also be an asset to the fighting force as well. Unfortunately, it will be a long time until women are fully accepted and welcomed by all aspects of the military. Articles such as this one will help to demonstrate the need to take advantage of the wealth of talent that is not being tapped.

Elizabeth Parker
Sherman Oaks, California

Big Fan

As an aviation enthusiast and big F-16 Fighting Falcon fan, I felt I should let you know how much I enjoy the informative articles in your magazine. Your photography and editorial illustrations are fantastic. But for me, it is more than a good magazine because I can learn a lot about your language and the technical aspects of the aircraft. It is obvious that you have a good team.

I also want to praise and thank Jimmy Hix, your chief of flight operations, and Bland Smith, a Lockheed Martin experimental test pilot, and the rest of their team at the Berlin Air Show. They made it possible for me to sit in an F-16C and to fly the F-16 flight simulator. They also gave me a copy of this marvelous magazine.

Christopher H. Puth
Pirmasens, Germany

Show Director

I am reading Code One with great interest. At the Berlin Air Show 1994, I had the pleasure to meet Jimmy Hix and your F-16 pilot Steven Barter. I was the flight director for the show.

In one of your last copies of Code One, you mentioned that Joe Bill Dryden's articles are compiled in one special edition called Semper Viper. Please let me know if the special edition is still available. I also want to take this opportunity to thank you for this excellent magazine, which keeps me in touch with my former task of test flying military jet airplanes for the Dornier aircraft company and for the German Air Force.

Dieter Thomas
Thomas Flight Test
Fürstenfeldbruck, Germany

Editor's note: Limited copies of Semper Viper are still available for $7.50, including domestic postage.

Another Scheme

First of all, allow me to congratulate you all on a truly fine publication. I am an avid scale modeler, specializing in military aircraft. One of my greatest interests is the fascinating paint schemes applied to the aircraft of aggressor squadrons. My personal model collection includes over twenty examples of adversary aircraft from the three major adversary-wing flying branches of our military services. My collection includes what I believed to be every paint scheme applied to the F-16s slated for air combat training. It was therefore with great interest that I saw on page 10 of your April issue a beautiful photo of an F-16C in what appears to be a close copy of the Soviet Flanker scheme. The instant I saw it, I knew I had to model it.

Andrew J. Desautels
Kuston, Louisiana

Four-Time Reader

I recently read your January 1995 issue at the 178th Fighter Group of the Ohio ANG in Springfield. I am a K-9 handler for the Ohio State Highway Patrol and a "friend of the Guard." I am also an avid modeler and a member of the IPMS (International Plastic Modelers Society). I really enjoyed the entire issue (I read it three or four times), especially the article "Modeling the F-16."

Tim Stockman
Bluffton, Ohio

The Biggest Fan

Being the biggest F-16 fan ever, I was delighted to see an issue of Code One. The magazine belonged to a friend of mine. It is really marvellous, with incredible photographs and very interesting articles. I am studying and training for a career as a pilot in the Belgian Air Force. Therefore, I am looking forward to seeing future issues.

Yves Lambrecht
Oostrozebeke, Belgium

General Dynamics?

Having worked for General Dynamics from 1941 to 1983 and being associated with the initial flights at Edwards AFB and at General Dynamics on the YF-16 and F-16XL, I am enjoying retirement and remembering many wonderful times during those test programs. Now, having a grandson in his third year at the Air Force Academy, I wish to send him your excellent magazine, Code One, for the outstanding information it contains and for his enjoyment.

Wilbur Pound
Fort Worth, Texas

Making Copies

May I please have permission to make about thirty copies of your article on "Building the Model F-16" for my History of Aviation students? I require them to build a model and some do not yet know one end of a model or an aircraft from the other.

Robin Higham
Professor of History
Kansas State University
Manhattan, Kansas

New Name, Same Suppliers

Please find attached a check to cover subscription cost for Code One Magazine. As a long-time supplier of General Dynamics, Lockheed, and now Lockheed Martin, I have enjoyed your magazine and look forward to each new issue. Keep up the good work.

Les Conner
Dealers Electrical Supply Company
Fort Worth, Texas

We'd like to hear from you. Send letters to: Editor, Code One Magazine Lockheed Martin TA5 PO Box 74B, Mail Zone 1793 Fort Worth, Texas 76101