IN MEMORIUM
Judson Brohmer

"I absolutely love to fly. Nothing compares to the feeling of zooming along at forty or fifty thousand feet, skimming over wispy clouds, chasing the world’s most advanced fighter.”

Those words came from Judson Brohmer, one of the aviation photographers featured in our January 2000 photographer issue. Brohmer, a regular contributor to Code One, produced a gallery of aviation photos of the F-22 Raptor during its tenure at Edwards AFB, California. This gifted photographer lost his life during an F-16 photo chase mission from Edwards on July 17, 2001. Everyone associated with Judson will miss his contributions, his talent, and his enthusiasm.

JSF Glider Insert

This issue of Code One contains a fold-it-yourself version of the Lockheed Martin Joint Strike Fighter. Now you, too, can be an X-35 test pilot.

HAT TRICK PILOT

Capt. Joe “Hooch” Feheley, an instructor pilot of the 383rd FS from Homestead, Florida, flew in three different fighters in one day during a deployment to Leage AB, Germany. Feheley flew in an F-16 from his home unit and an F-4 and MIG-29 from 73rd FS at Leage. The three-aircraft hat trick is a first for any pilot, according to pilots at the German air base.

RLNIAF’s 311 Celebrates Fifty

The first of May 2001 was the fiftieth anniversary of the RNLIAF 311 Squadron, which has flown the F-84, F-84F, T-404, and F-16.

NEW PAINT SCHEME FOR INDONESIA

Indonesian F-16s now sport a new paint scheme. The aircraft reside in the 3rd Squadron located at Ishiuyahudji AB at Madura, Java.

AFTI-F-16 AT USAFM

The AFTI-F-16 landed for the last time at Wright-Patterson AFB, Ohio, where it joins the collection of historically significant USAF aircraft at the US Air Force Museum.

NORTH DAKOTA SETS SAFETY RECORD

The 119th FW of the North Dakota ANG has logged over 50,000 hours of accident-free flight time in the F-16, an accomplishment formally announced by North Dakota Governor John Hoeven.

ROKAF Sets Safety Records

The 161st and 162nd Squadrons of the Republic of Korea Air Force established flying safety records recently in the F-16 Block 32. The 161st Squadron, the oldest F-16 unit in the ROKAF, achieved 30,000 hours of accident-free flying in the Block 32 F-16 it has flown since 1986. The 162nd Squadron, also flying Block 32 aircraft, achieved 50,000 hours of accident-free flying.

ROKAF Displays New Demo Design

The Royal Netherlands Air Force F-16 solo display received a freshly painted jet in April for the 2001 and 2002 show season. The solo display team consists of several members of the 312th Squadron from Volkel AB. The team flies an F-16 Mid-Life Update. The paint scheme was designed by the company Base-Line.

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Pentagon Okays WCMD
The US Department of Defense gave the green light to begin full-rate production of the wind-corrected munitions dispenser at Eglin AFS, Florida. The WCMD, a tail kit installed on existing "dumb" munitions, transforms these munitions into "smart," accurate, adverse weather weapons. The tail kits will be used on the CBU-87 combined effects munitions, the CBU-89 Gator Mine System, and the CBU-97 sensor fused munition. The Air Force plans to buy 40,000 tail kits, with 30,000 slated for the CBU-87 and 5,000 each for the CBU-89 and CBU-97. These weapons will be integrated on the F-16 as well as on other current and future fighters and bombers. The tail units are scheduled for delivery by the summer of 2002.

Shaw Wins Maintenance Award
The 20th Component Repair Squadron at Shaw AFB, South Carolina, recently claimed a 2000 Maintenance Effectiveness Award as the best maintenance, component repair, or equipment maintenance squadron in the Air Force. The annual awards are given to those maintenance units with flight line or backshop maintenance capability that have best managed their resources. The 20th CRS is also one of four units going on to compete for the Secretary of Defense Maintenance Award (the Phoenix Trophy), which recognizes the best maintenance organization in the DoD.

F-16 Performs At LAD Expo
Capt. Randy Efferon wowed crowds with aerial demonstrations in the Glock 50 F-16 during the Latin American Defense Expo 2001 last April. The event, held in Rio de Janeiro, Brazil, drew a distinguished crowd, including visitors from several embassies and commanding officers from the armed services of Brazil. Efferon is the pilot for the Air Combat Command East Coast F-16 Demo Team from Shaw AFB, South Carolina.

F-16 Launches Live JASSM
An AGM-158 Joint Air-to-Surface Standoff Missile, or JASSM, launched from an F-16 successfully demonstrated end-to-end performance by destroying an air defense target in a flight test at White Sands Missile Range, New Mexico, in late April. The launch occurred at Mach 0.80 and at an altitude of 2,800 feet above the New Mexico desert. After weapon release, the missile, built by Lockheed Martin Missiles and Fire Control in Orlando, Florida, autonomously navigated and guided to the planned target. JASSM used anti-jam global positioning system guidance en route to the target area. In the terminal phase, JASSM used its imaging infrared seeker and target correlator algorithms to precisely locate the target. The live warhead detonated upon impact, destroying the air defense target.
Arnold Improves Engine Testing

Testing completed in March at the Air Force Arnold Engineering Development Center will help validate proposed improvements to the Pratt & Whitney F100-220 engine and prepare it for flight testing. During the eighteen-month AEDC test phase, technicians tested the increased blade stiffness, oil seals, and improved logic control systems of the engine. A laser beam trained on the engine compressor measured the amount of blade deflection or bending occurring when the engine operated at selected flight conditions. This new measurement system, which allows every blade to be measured at various angles, replaces the previous method of placing strain gauges randomly on a few of the blades.

Wolf Pack Celebrates Seventy

F-16 Fighting Falcons from the 8th FW, Kunsan AB, Republic of Korea, celebrated the seventeenth anniversary of the 8th Operations Group. The 8th OG enjoys a rich and distinguished history, having established itself as one of the most lethal and venerable units in the US Air Force.

Paris Air Show

Rainy skies over the northern Paris suburb of Le Bourget cleared to make way for the 44th Paris Air Show held 17 to 24 June. Billed as the world's largest air show, this year's salon showcased the latest in technology for both military and civil applications. A full-scale mockup of the Lockheed Martin entry into the Joint Strike Fighter competition made its debut at Paris. Complementing the F-16 flight display in the air, a representative Block 60 F-16 was on display in the static park. Lockheed Martin Aeronautics products and partnerships were also represented at the show by the C-130J, C-27J, and T-50 cockpit simulator.

ROCAF F-16 Fires Harpoon

The Republic of China Air Force successfully test-fired an antiship AGM-84 Harpoon missile from an F-16 last April. According to officials at ROCAF Headquarters, the ROCAF F-16 fired the Harpoon in an air force-navy combined drill during the Hankuang No. 17 military exercise in southern Taiwan. The missile hit the target, a decommissioned destroyer, off the Chiupeng bay in the southern Taiwan county of Pingtung.

BAF Demo Wins Best Of Show

Belgian Air Force solo demo pilot, Capt. Rudy “Chilo” Schoonbaert, won the Breitling Trophy for best solo demo in the Biggin Hill Air Show in the UK, flying his F-16 MLU with a 43JG-fighter. Schoonbaert, one of two BAF demo pilots, flew out of Florennes AB.
F-117 Celebrates Twenty
The F-117 Nighthawk stealth fighter made its maiden flight over the Nevada test ranges twenty years ago on 18 June. Ten years later, it proved its worth in Operation Desert Storm, flying almost 1,300 sorties and scoring direct hits on 1,600 high-value targets in Iraq. Not one F-117 sustained combat damage during that six-week air war. Of the fifty-nine production F-117s procured by the Air Force, fifty-two are still in service. All F-117s are now based at the 49th FW at Holloman AFB, New Mexico. The three squadrons comprising the 49th—the 7th, 8th, and 9th FS—trace their heritage to the 49th Pursuit Group of the Pacific Theater in World War II.

Israel Approves Follow-On F-16s
The Israeli government approved the purchase of fifty additional F-16s specially modified for the Israeli Air Force. A formal contract remains to be negotiated. Deliveries, which are expected to begin in 2006, will extend the life of the F-16 production line though the end of 2009 when deliveries conclude. This purchase, valued at $2 billion, follows an order for fifty aircraft placed in mid-1999. To date, Israel has placed six different orders for the F-16 for a total of 350 aircraft.

New Mexico ANG Deploys To Singapore
F-16 pilots from the New Mexico ANG completed more than one week of mock aerial combat over the South China Sea in May against jets from Australia and Singapore. The dogfights were part of Commando Sling, an exercise designed to sharpen the dissimilar air-to-air combat skills of participating airmen. Pilots from the 188th FS of the New Mexico ANG flew against Australian F/A-18s and Singaporean F-16, F-5, and A-4 jets. The Guardians competed against pilots from the two other nations on all seventy-three planned missions flown from Pya Lebar AB in Singapore. "That 100 percent rate was the best rate we've ever had for a Commando Sling," said Lt. Col. Billy Sonner, operations officer for the 497th Combat Training Squadron. The Singapore-based 497th CTS hosts up to six of the training exercises annually to provide fighter pilots the chance to fly against other types of aircraft.
The aircraft sits atop a thick metal grate that covers a large concrete pit. The hover pit, as it is called, is a scaled-up version of the one used for the very first vertical flights of the Harrier prototype, the Hawker P1127, performed in the fall of 1960 at Dursfold in England. The pit collects exhaust thrust and directs it away from the aircraft to create a less turbulent and more controlled environment.

"Harrier, everything looks good here," radios Paul Bloxham from the data trailer. "You are cleared for takeoff." The accent, again, is distinctly British as Bloxham, the flight test conductor, is another IAR employee recruited by the X-35 program for his Harrier experience.

"Power is coming up to eighty-five percent," Hargreaves announces. The increased power pivots the aircraft on its main gear, gently lifting the nosewheel of the X-35B off the grate of the hover pit. The aircraft has gone from a level attitude to a slightly higher one of three degrees nose high. One more scan of the engine instruments and Simon declares, "Powering up!" The Pratt & Whitney F119-1111 engine roars intensely as 20,000 horsepower transfers from the engine's core to the Rolls Royce lift fan just behind the cockpit. The aircraft rises gently in the air.

Maj. Art Tomassetti, a US Marine Corps test pilot stationed next to the pit, acts as a landing site supervisor, or LSS, for Hargreaves. When Tomassetti sees the main gear lift from the pit, he radios to the test team, "Lift Off!" Hargreaves eases the throttle back to idle. The main gear of the X-35B settle back onto the hover pit, followed by the nosewheel. The engine spools down to idle. This first unofficial flight of the X-35B attains a height of less than five feet. Though only a "hop," the first vertical takeoff represents a huge leap for the X-35 team.

"The first hop was over in a few seconds," notes Bloxham. "It was one of the shortest first flights in the history of aviation. Once we cleared the pilot to go, the test conductor in the trailer couldn't do much else. The flight was over as soon as it started."

"Everyone on the program breathed a sigh of relief after the first hop," Hargreaves explains. "We know in a heartbeat that the airplane and its flight control work. Everything else from that point on is clearly challenging and must be completed in a short timeframe. But the first jetborne flight was a huge achievement." Within a few days after Hargreaves' first hop, all three STOVL test pilots on the X-35 team hovered the aircraft. Tomassetti was the first military pilot to evaluate the X-35B in hover on 29 June. Squadron Leader Justin Paine, an experienced Harrier test pilot from the Royal Air Force, evaluated the X-35 for the UK military the next day. "The fact that other pilots hoversed the aircraft so quickly in the test program is a testament not only to their abilities as test pilots but also to the design of the X-35," Hargreaves says.

Converting From A To B

The X-35B airframe actually completed its first flight months earlier, on 24 October 2000 to be exact, as the X-35A, the conventional takeoff and landing, or CTOL, demonstrator. The X-35A went on to fly twenty-seven flights, expanding the flight envelope to 33,000 feet and supersonic speeds. It was then transformed into the X-35B STOVL demonstrator when a vertical lift system was installed in an empty circular bay behind the cockpit. (The upper and lower doors of this bay were fully operational during the X-35A flight tests.) The transformation continued when roll ducts and roll posts were installed in the wings, a straight duct was replaced with a three-bearing swivel duct on the aft end of the Pratt & Whitney F119-1111 (the same engine used for the other X-35

Ship 4002 Flies 200 Sorties

Raptor 4002 accomplished another significant program achievement in March when it became the first F-22 to fly 200 sorties. This achievement came as the program secured approximately $674.5 million to continue development, assembly, and testing through the end of fiscal year 2001. Five F-22s reside at Edwards, all involved in the flight test program. The remaining four Engineering and Manufacturing Development Raptors are scheduled to join the test fleet by the end of 2001.

Tyndall Billboard

Community interest in the Air Force's newest fighter soars high in the Florida panhandle where the 325th FW at Tyndall AFB is slated to be the schoolhouse for F-22 pilots and maintainers. Ed Bollor, who operates Lamar Advertising in Panama City, posted this billboard near the base as a public service. More than 75,000 people saw the message on their way to Tyndall's open house in late March.

F-22 NASCAR

This Wood Brothers Racing No. 21 Ford Taurus received a special F-22 paint scheme on Memorial Day for the Coca-Cola 600 NASCAR race at Lowe's Motor Speedway in Charlotte, North Carolina. The Air Force regularly advertises on No. 21. Motorcraft, the car's sponsor, chose this blue paint job to salute the men and women who serve and have served the US Air Force. Elliott Sadler, who drove the car, placed nineteenth. The race was won by Jeff Burton.
Ship 4006 Joins Fellow Raptors At Edwards

Raptor 4006 flew from Georgia to California in May, increasing the number of air dominance fighters at Edwards AFB to five. Raptor 4006's capabilities closely resemble those of Raptor 4008, which flew to Edwards in March. These latest two Raptors, the most complete versions of the aircraft, have essentially the same capabilities as the production fighter.

Raptors Surpass 1,000 Flight Test Hours

The F-22 Raptor flight test program surpassed 1,000 hours of flying on 18 April when Boeing test pilot Chuck Killberg guided Raptor 4003 over the test range at the Air Force Flight Test Center at Edwards AFB, California. This third F-22 delivered to the F-22 Combined Test Force at Edwards is dedicated to testing the Raptor's structural capability as part of the flight envelope expansion program.

"This significant achievement, and the many flight test hours to come, are a real indicator of just how thoroughly we are testing the Raptor—a direct result of the hard work, dedication, and professionalism of the integrated government and contractor team," said Col. Chris Seat, F-22 CTF director. Since 1998, flight test activity at the CTF has centered on flight sciences, such as flying qualities, structures, utilities and systems, propulsion, and performance. With this latest avionics and flight test aircraft, the avionics development testing will increase the pace of the CTF's flight test activity. (The F-22 program had accumulated over 1,200 hours by early July 2001.)

Ship 4001 Prepares For Live Fire Tests

The stripped-down airframe of Raptor 4001 was placed in the live fire test range at the 46th Test Wing aircraft survivability research facility at Wright-Patterson AFB, Ohio, where it will soon complete ballistic wing live fire testing. A .50-caliber high-explosive incendiary projectile, the type carried by MIG-29s and Su-27s, will be fired at the Raptor's wing root to assess the airframe's ability to withstand damage. The platform under the aircraft was built specifically for this test. Five J-79 jet engines (structure in front of the F-22) will generate a 4,000-lb thrust over the wing, while the airframe bears a three-g load to simulate forces encountered during a moderate climb.

in flight. We have not had a single problem. The system is mature, reliable, and ready for in-air conversions.

"Every step we take from the pit tests in the first months of 2001 to the ground runs in the spring have instilled more confidence in our system," adds Blossham. "The airplane hasnt missed a beat mechanically from the day we built it."

Blossham's confidence and the confidence of the entire X-35B flight test team was reinforced by the success of the ground test program of the vertical lift system. In these tests, the STOVL propulsion system was subjected to more than twice the operating time and more than twice the operating events expected during the X-35B STOVL Flight demonstration program. The system was put through about 250 total accumulated engine cycles in these accelerated mission tests, which also included more than 110 hours of total STOVL lift system operating time and 171 dynamic thrust engagements of the lift fan. The STOVL propulsion system was cycled through the equivalent of 132 flight test missions. The operations were identical to those expected during subsonic and supersonic flight testing, ground testing, and STOVL operations.

"These tests were crucial in establishing the reliability of our propulsion system," notes Kathy Zapka, the propulsion integrated product team lead for X-35. "Thrust is crucial to safety in STOVL modes since thrust acts as a control surface. Defining our expected performance is important because it relates to safety. Generally, thrust is not crucial to safety for VTOL aircraft. Thrust is more closely associated with maximum performance."
Vertical Lift Contributors

The counter-rotating blades of the lift fan provide about 18,000 pounds of lifting power at the front of the aircraft. Lift fan thrust is controlled by a combination of engine rpm and fan inlet guide vane angle. The thrust from the lift fan can be vectored from thirty-four to ninety-five degrees (as measured from the horizontal line from the nose to the end of the fuselage). Each roll past provides about 1,500 pounds of lifting thrust on each side of the aircraft. Adjusting the thrust split to the two posts provides lateral control. The engine, which provides about 28,400 pounds of nonafterburner thrust in CTOL mode, contributes about 18,000 pounds of downward thrust in STOVL mode. Nozzle exit area and engine rpm are used to control the thrust from the aft end of the aircraft. The engine angles downward thrust through a three-bearing duct that can swivel ninety-five degrees from the horizontal and sweep plus or minus twelve degrees from left and right.

The lift fan approach was chosen for its many attributes. It extracts power from the engine, thus reducing exhaust temperatures from the engine by about 200 degrees compared to exhaust temperatures of direct-lift systems. It significantly reduces exhaust velocity as well. Engine exhaust air combines with the low-temperature and low-velocity air from the lift fan to produce a more benign ground environment. Cool exhaust air from the fan prevents heat exhaustion from engine fire being reintroduced into the intakes. Hot gas reingestion, a common problem on legacy Harrier-type approaches, causes compressor stalls and other severe engine performance degradations. Most importantly, the lift fan system was chosen because it does not detract from the up-and-away performance of the JSF119-641 engine.

The ground environment and the growth potential convince me that this is the right concept,” Harragroves explains. “For example, the Harrier grew fifty pounds per year on average. No reason prevents this airplane from doing the same. The shaft-driven lift fans gives us huge amounts of available thrust in the ground environment with little to no weight penalty. A STOVL aircraft must be tolerant of weight growth. An augmented system lends itself to weight growth.”

UK Royal Air Force Pilot Flies X-35B

Squadron Leader Justin Paines became the first Royal Air Force pilot to evaluate the vertical takeoff, hover, and vertical landing performance of the X-35B on 30 June. Paines, a Harrier pilot selected to test the X-35 demonstrator aircraft for the UK, soared into the air in a series of three hover missions for a total of eight and one-half minutes at the Lockheed Martin plant in Palmadale, California. “It was awesome. The aircraft performed flawlessly,” Paines said after the flight. “The system produces an incredible amount of thrust, even here in the high desert in summer. Apart from having to adhere to the upcoming flight test phase, nothing would have stopped my accelerating away to supersonic speed with the same aircraft.”

X-35B Heads To Edwards

The X-35B flew from Palmadale, California, to nearby Edwards AFB on 5 July to continue its flight test program. The aircraft completed seventeen vertical takeoffs, hover, and level flight at the Edwards AFB range. All of the X-35B vertical takeoffs, hover, and level flight were accomplished at 2,500 feet elevation and temperatures up to ninety-four degrees Fahrenheit. Simon Harragroves flew the aircraft to Edwards to begin the in-flight STOVL and conventional flight testing series for the X-35B.

US Marine Pilot Flies X-35B

Maj. Art Tomassetti became the first Marine and the second pilot to fly the short-takeoff/vertical landing X-35B on 29 June. Tomassetti is the first pilot to have flown all three X-35 variants: the X-35A, X-35B, and X-35C. “On a hot day in the high desert, the X-35B demonstrated the kind of vertical performance that Harrier pilots dream about,” said Tomassetti, a Harrier pilot who also serves as an X-35 test pilot for the Marine Corps. “With three press-ups today, I am convinced that we are on the right track.”

Power-By-Wire Wins Industry Award

The test program for the JSF “power-by-wire” flight control system received the 2000 Aerospace Industry Award for engineering, maintenance, and modifications in ceremonies during the Paris Air Show in June. The program, led by Lockheed Martin Aeronautics, was part of the JSF “Integrated Subsystems” Technology program formed by the US government to reduce the risk of selected technology candidates for the JSF program. For the test, the Advanced Fighter Technology Integration ATFT/I-16 was modified to replace the existing integrated servos with electro-hydrostatic actuators to operate the variable, horizontal, vertical, and rudder. A new power generation and distribution system provided the electrical power for the new system. The electric actuators use power more efficiently, thereby increasing the potential benefits of the system. The modified I-16 was the first manned aircraft of any type to fly with a full electric actuation system and no hydraulic or mechanical backups.

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X-35B Takes Off, Vertically

The X-35B launched vertically, held its position, and landed vertically on 24 June, a first for a JSF demonstrator and a critical validation of the revolutionary shaft-driven lift fan propulsion system. "This was a stunning success. The lifting power is incredible and the handling is extremely precise," said Simon Hargreaves, the test pilot. "The flight occurred with minimal pilot input—I was essentially a passenger. This speaks volumes about the quality of the aircraft and the propulsion system."

Hargreaves held the X-35B in a stabilized position about twenty-five feet above the ground, for thirty-five seconds, checking to ensure the flight controls responded properly before returning the plane gently to the ground.

X-35B Goes Vertical And Supersonic

The X-35B engaged its short takeoff/vertical landing system and made a supersonic dash in the same flight on 9 July near Edwards AFB. Pilot Simon Hargreaves took off, climbed to 9,000 feet, and successfully engaged the shaft-driven lift fan propulsion system at 180 knots. He then accelerated to an indicated Mach 1.08, marking the first time a JSF demonstrator has achieved a STOVL mode conversion and sustained supersonic flight in a single sortie. The test marked the X-35B's first in-flight conversion to STOVL mode as well.

Flight Test Envelope

The flight test envelope for STOVL operations is divided into four basic sections—ground, jetborne, conversion, and semi-jetborne. Ground testing includes taxi tests and restrained tests. Jetborne testing covers vertical takeoffs, vertical landings, and hover operations at air speeds under forty knots (speeds at which the normal CTOL control surfaces are not involved and at which the aircraft mass is not supported by lift generated from the wing). Semi-jetborne testing includes STOVL flight at speeds greater than forty knots (speeds at which the wing is generating lift). Semi-jetborne encompasses flight at greater than forty knots in STOVL mode, including short takeoffs and short landings. Conversion testing covers the transition from CTOL to STOVL modes in flight.

Conversion and transition carry specific meanings in STOVL testing. Conversion refers to a mechanical process, the act of engaging the clutch to spin up the lift fan. Transition relates to a change in the aerodynamic state of the aircraft from solely wingborne or jetborne flight modes to a semi-jetborne flight mode. The aircraft has to be converted to start a transition. Conversion takes place from about 150 knots to 200 knots, speeds well above the stall speed of the aircraft. The minimum speed is dictated by the amount of aerodynamic tail plane power needed to control the pitch moment caused by the initial thrust of the lift fan. The maximum speed is determined by the aerodynamics of the lift fan intake.

"We have to use a different approach for expanding the flight envelope of STOVL than the approach for expanding the envelope of a conventional aircraft," Bloxham explains. "For example, we wouldn't consider testing at 100 feet off the ground as an envelope expansion point for a CTOL aircraft. While we use the same flight envelope graphics of altitude..."
plotted against speed for both CTOL and STOVL speeds over 250 knots are not meaningful to the STOVL environment. We concentrate on nozzle angle, power, and attitudes as a better description of the limits of the flight envelope.”

"The STOVL airplane can do everything the CTOL airplane can do when the STOVL airplane is in the CTOL mode," adds Tomassetti. "STOVL takes the aircraft into a realm of flight that involves more than just aerodynamic surfaces. The engine and the lift system fly the airplane. The transition from one type of flight to the other is a major portion of the testing. We also test the jetborne side of the equation, which is completely different from CTOL testing.”

**Ground Testing**

After the X-35A was fitted with the vertical lift system in January 2001 and transformed into the X-35B, it was fixed to the hover pit with a special landing gear that allowed local cells to measure STOVL lift forces and moments directly and that prevented the airplane from lifting into hover at higher power settings. More than 100 of these restrained tests were conducted with all control functions fully under pilot command. X-35B test pilots performed full rehearsals of vertical flight missions, including conversions from conventional takeoff and landing modes to vertical modes. These tests were conducted in several configurations, including open-gate conditions on the hover pit to represent out-of-ground-effect flight and closed-gate conditions to produce the ground effects encountered during vertical landings and takeoffs.

"Results from those tests were extremely positive," notes Zapka. "Our measurements showed no thermal distress from either hot-gas ingestion or flow-field effects on the aircraft surfaces. Also recorded favorable thermal conditions at ground level near the airplane.”

The ground tests included twenty-six CTOL to STOVL clutch engagements of the lift fan at high engine rpm. The X-35B was operated at maximum STOVL thrust levels for periods of up to ninety seconds. Individual test series were run with a full aircraft fuel load for as much as one hour. “All twenty-six of these conversions worked exactly as expected,” notes Hargreaves, who was in the cockpit for many of them. “Noise level and vibration in the cockpit were virtually unchanged at idle compared to CTOL levels. The propulsion system responded predictably to pilot inputs. Thrust and thrust-vector commands were crisp. Noise and vibration at full power with the thrust vector at the hover setting were comfortable.”

Before the X-35B flew, it was put through a series of taxi tests in STOVL mode. “The taxi tests determined how we slow the aircraft from higher taxi speeds,” Blancham explains. “To stop from a taxi speed of 100 knots, for example, we position the nozzle all the way down and forward a little bit and use the thrust of the propulsion system to slow down. We don’t use forward directed thrust all the way to a standstill because hot exhaust gas can be thrown forward of the airplane and reingested in the intakes, which is not good. We let the runway in these tests to determine visually at what speed the gases start moving forward. At that speed, the nozzle go back to about forty degrees and the airplane uses its brakes to come to a complete stop.”

**Jetborne Testing**

Before the first hop, the X-35B completed vertical takeoffs without leaving the ground in a test called a go-go VTO. “We overfilled the airplane with fuel so it was too heavy to hover,” Hargreaves explains. “That required full fuel, about 37,000 pounds full-up weight. As we pushed the power up, the landing gear extended. When the main gear got to within one inch of their total travel, the weight-on-gear switch told the airplane it was flying. That closed the loop on the flight control system, which meant that a lot of the clever STOVL functions came into play. The airplane automatically trimmed itself to a hover attitude, which is three degrees nose up, so the nosewheel came off the ground a couple of feet. We then went to full power. For all intents and purposes, we were flying. I made pitch inputs by moving the sidestick controller fore and aft. I made rudder inputs by moving the rudder peddles. I also made nozzle angle inputs to the thrust vector lever to move the aircraft forward and aft. We collected a lot of data during this test.”

After its first hop and one or two more hops at different fuel loads, the X-35B completed its "official" first flight—a sustained and controlled hover at about twenty feet above the ground on 24 June. “The flight was a stunning success,” recalls Hargreaves. “The aircraft was easy to control within the confines of the hover pit. Handling was extremely precise.”
Aéreo No. 14 guides students through an elementary flying course on the Beech VT-345 Mentor and the SAI Marchetti SF-260E, the latter being a replacement for the aging Mentors. Following this six-month course, students progress to the Tucanos of Grupo 14 for a six-month advanced flying training course.

Following their graduation, FAW pilots selected to go to fighters either advance to the NF/F-5s of Grupo Aéreo de Caza No.12 at Barquisimeto or continue on the Tucano for a fighter lead-in training course. On the F-5, pilots complete a similar fighter lead-in training as on the Tucano. Pilots are introduced to air-to-air and air-to-ground tactics and weapon employment before they can be deployed to the operational F-16 and Mirage squadrons. The tactical training on the Tucano serves as a stopgap measure following the deactivation of the Rockwell T-2D Buckeye jet trainers, previously operated by Grupo de Entrenamiento Aéreo No. 13 at Barcelona. Until their retirement in 1999, the venerable Buckeyes formed the tactical stepping stone to the operational fighter units for new FAW fighter pilots. This situation will change later this year when the FAW’s new jet trainers, the Alenia-Aermacchi Embraer AMX-I two-seat trainers, start arriving in Venezuela.

**Future Upgrades**

Apart from fleet rejuvenations and current upgrades, the FAW is about to embark on the most significant F-16 upgrade programs to date to provide a credible F-16 combat potential for the next twenty years. The improvements should enable night and adverse weather operations. "We are studying several options at this moment," explains Brig. Gen. Anselmi, FAW air operations commander. "On the one hand, we can choose the Mid-Life Update kit for a robust and proven set of sophisticated technical features. On the other hand, we can choose from a variety of attractive alternatives to the MLU package."

The FAW is assessing the Israeli F-16 Avionics Capability Enhancement upgrade kit as an alternative to MLU. The F-16 ACE, a joint project of Israeli defense industries led by Israel Aircraft Industries and Elbit Systems, upgrades the avionics and enhances the aircraft structure to extend aircraft service life.

Another MLU alternative is the Falcon One upgrade program offered by Singapore Technologies Aerospace. Similar to the F-16 ACE, Falcon One offers state-of-the-art avionics with a glass cockpit. Sophisticated in the Israeli and Singapore options might be, the MLU package is still considered an attractive choice, especially since the FAW is evaluating European partners to overhaul its F-16 fleet to bring it up to an MLU standard. SABCA in Belgium and Fokker in the Netherlands, which are upgrading the F-16s of their respective air forces, are being considered for the upgrades. No matter which option the FAW pursues, the ever-expanding capabilities of its F-16 fleet will expand even further.

*Eric Stigler is an aviation journalist based in the Netherlands.*
Volcan, the commander of Escuadrón 167. "Sending the engines all the way to Korea required some effort on our part to maintain aircraft availability, considering that the entire upgrade process, including shipment, takes about three months per engine," the maintenance chief continues. "The upgrade program is running smoothly. We have been installing the wire harnesses required to accommodate the 205Es and modifying the cockpit instrumentation ahead of schedule."

In a similar manner, Grupo 161 is currently fielding a night vision capability for its F-16s, which encompasses installing cockpit and external lighting that is fully compatible with night vision goggles. Aircraft modifications for both the NVG and engine upgrade programs concluded recently.

**New Roles And Relationships**

The Litigante and the NVG capability of the F-16s being called into night action recently to counter illegal border incursions and illegal incursions into Venezuelan air space. In the latter missions, the infrared capabilities of the Litigante, designed primarily for air-to-ground use, provided the F-16 with a useful instrument in the air-to-air regime as well because the system aids nighttime intercepts. For missions like these, for which Grupo 161 continuously pulls alert duties at El Libertador, the F-16 increasingly cooperates with other services of the Venezuelan military.

Such interoperability and service integration are key issues in the Venezuelan armed forces nowadays. As Brig. Gen. Adelmi notes: "We are moving toward a new military doctrine that focuses on a unified command structure that covers all branches of our armed forces. Although we are still several years away from fully implementing this doctrine, we are already addressing such interoperability issues as command and control. We have to deal with cultural differences within various branches of our military. These differences make the entire operation even more interesting."

**New Capabilities And F-16 Training**

The operation of the Litigante and the NVG system form part of the training syllabus of the Grupo 16 F-16 pilots. Once qualified on the F-16, pilots complete the twenty flights of NVG training. Capt. Juan "Judas" Pinto, an F-16 instructor pilot from Escuadrón 161 with almost 1,000 F-16 hours, is enthusiastic about the NVG capability. "NVG literally opens up a completely new world," he says. "At first it takes some adaptation to become accustomed to the imaging and coloring the NVGs generate. Once they reach a comfort level, pilots can take advantage of this wonderful asset."

F-16 pilots enroll in the NVG course before they are inserted in the Litigante training course, which includes another twenty flights. Further F-16 courses offered at the base include two- and four-ship flight lead courses, a functional check flight course, and an instructor pilot course.

The instructor pilots of the two escuadrones play a key role in training the pilots who eventually join Grupo 161. Basic qualification on the Fighting Falcon is taught in A, B, and C tracks. Experienced fighter pilots, shifting to F-16s or pilots regaining their F-16 currency complete the fifty missions in the A-track. Pilots joining Grupo 161 with less experience on jets, such as those coming from the F-86's OV-10 Bronco, complete the sixty flights in the B-track. New pilots coming out of pilot training complete the 120 flights in the C-track. This C-track course has been extended recently as graduates from the F-16 pilot training select for the F-16 in the immediate progress to the Fighting Falcon from the Embraer EMB-312 T-27 Tacano.

This relatively big step from "Tucano" to F-16 is the result of a recent revision of the FAW pilot training curriculum. In the FAW, pilot trainees start their career at the Escuela de Aviación Militar, the military flying school of the Venezuelan air force academy at Mariscal Sucre Air Base at Boca del Río just outside Maracaibo. Here, Grupo de Entrenamiento
The first STOVL takeoffs and landings were conducted at fixed nose angles of twenty-two degrees and then at thirty-four degrees. These initial flights were followed by takeoffs and landings at slower and slower speeds, down to minimum speed of about eighty knots. From here, semi-jetborne testing advanced toward jetborne conditions from slower and slower air speeds at 150 feet above the runway.

"The final decelerations to purely jetborne flight, around eighty knots or so, were the most challenging tests," Blossam says. "We knew we have a good end point, but we had to go through lots of unknowns to get there. The computer modeling looked good. But the jet effects and interactions make the region difficult to predict. The area is also unforgiving because the aircraft is so close to the ground." Tomassetti agrees with the assessment. "The first vertical landing in ground effect to a solid surface was the biggest challenge to this phase of the program," he says. "Andis Hargreaves. "When we started from 150 knots and built down in speed, we were going to a known and good endpoint. We didn't want to tip-toe into the unknown. That's why our first flight was a vertical takeoff. We removed a lot of risk by hovering before we decelerated into a hover condition."

**Mission X And Beyond**

Mission X, flown by Tomassetti on 20 July, provided a taste of the operational utility of the STOVL version of the JSF by combining all of the various aspects of STOVL flight into a single mission. The Marine Corps pilot performed a short takeoff, converted from STOVL to CTOL at 5,000 feet, climbed to 25,000 feet, accelerated to supersonic speeds, converted back to STOVL, decelerated to hover, and then performed a vertical landing in ground effect at Edwards.

The first vertical flight of the X-35 and its subsequent testing opens a new era for the US Marines and for the UK Royal Navy and Royal Air Force. "STOVL gives us capability we don't have with helicopters," explains Tomassetti, who has over 1,500 hours of Harrier flight experience in the US Marines as well as combat time in the Harrier in Desert Storm. "We deploy expeditionary units that fit onto amphibious ships that require STOVL-capable aircraft. Fixed-wing aircraft offer these units huge tactical advantages over helicopters. Fighters typically fly at least 600 knots faster than helicopters can fly. They give commanders an ability to project power much farther and faster than typical rotary wing aircraft. They give commanders a much larger sphere of influence for reconnaissance and attack."

"The JSF improves on the Harrier, our current STOVL fighter," Tomassetti continues. "The Harrier, with very little computer augmentation to reduce pilot workload, is difficult for pilots to learn to fly and to stay proficient. The JSF, with computers to reduce pilot workload, will be easier for pilots to learn how to fly and to stay proficient. In addition, the performance will be better than the Harrier, the range longer, the payload larger, and the shape much stealthier. I'm looking forward to getting this airplane into the fleet."

Eric Hefa is the editor of Code One. A special thanks to Jarrod Segmond for his assistance with the article.
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Nuego, which carries an F-16.
At El Libertador, F-16s operate along-
side Mirage 50E/50Vs of Grupo Aéreo
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final model of the Mirage III/M family,
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The Mirage 50 shares a few systems with
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radar and the Atar 9K-50 engine, and
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Mirage 50E/V and dual-seat Mirage
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Grupo 16 Falcons to fly missions and
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Among the other tenant units at El
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Lockheed Martin C-130H, Shorts 360,
and Alenia G.222 transports, Grupo 6
operates two Boeing 707s modified to
provide aerial refueling. These tankers
can refuel aircraft equipped with USAAF-
style refueling receptacles, like that of
the F-16, as well as aircraft fitted with
refueling probes, like that of the
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**Expanding Capabilities**

The F/AV is capitalizing on the F-16's
potential for expanding its capabilities
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Worth to prepare them for the arrival of the first aircraft in Venezuela. The first six F-16s touched down at El Libertador on 15 November 1983. Grupo 16 reached full strength on 20 November 1985 when the last of the twenty-four aircraft arrived from Fort Worth.

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Within Grupo 16, the aircraft are operated by two multirole flying squadrons designated Escuadrón de Caza 161 “Caribes,” named after a Venezuelan indigenous tribe, and Escuadrón de Caza 162 “Gavilanes,” or Sparrowhawks. Both squadrons are subdivided into three escuadrones or flights, identified as A, B, and C. A third squadron, designated Escuadrón de Mantenimiento 167, maintains the F-16s.

The Venezuelan government chose the FMS Track for the F-16 purchase. The program was designated Peace Delta and consisted of eighteen F-16A and six F-16B models, all Block 15 aircraft. Prior to the aircraft deliveries, a group of six pilots was dispatched to the US in 1983 to be converted to the F-16 at the 311th TFS at Luke AFB in Arizona. Among this first group of Venezuelan F-16 pilots was the current FAM air operations commander, Brig. Gen. Bérgulo Ansaldi Espin. "It was a great honor but also a great responsibility to be one of the first to convert to the F-16," Ansaldi recalls. Apart from this group of pilots, a group of fifty-four technicians received training on the Fighting Falcon at Luke and at Fort Worth for a total of 1,300 hours in the Fighting Falcon. Since its arrival, the F-16 has formed the backbone of our air defense; it is also regarded as the pinnacle of our nation's defense capability.

The importance of the F-16 for Venezuela stretches beyond its military, as D'Armas explains: "In Venezuelan society, the F-16 represents the nation's pride in our technological achievements. It symbolizes our sovereignty and
**Tutor et Ultor**—Protector and Avenger. This motto underscores the emblem of **Grupo Aéreo de Caza No. 16 Dragones de la Fuerza Aérea Venezolana** (Group 16 Dragons of the Venezuelan Air Force).

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Moody AFB in Georgia. Called “Panhandle Rescue 2001,” the exercise involved HC-130s, Joint Stars, and AWACS aircraft as well as four F-16s from Aviano.

"Ideally, we still have a complete package of command and control assets, including AWACS, Rivet Joint, Joint Stars, and Compass Call," says Maj. Mark Moore, an F-16 pilot with the 310th. "F-3 AWACS aircraft direct the entire operation. RC-135 Rivet Joint aircraft monitor electronic activities of potential threats. E-8C Joint Stars helps to track ground targets. EC-130H Compass Call aircraft provide electronic jamming support. That command and control package gives us a lot of situational awareness." Coordination with those other assets, unpredictable movements of potential ground and air threats, variations in terrain, time constraints, and weather and light conditions are a few of the many factors that make training for CSAR missions inherently complex. "To fly out, locate a survivor, build a game plan, bring the assets together, and extract the survivor can be a lengthy process," explains Schrader. "The mission can take anything from two to six hours, even longer depending on the scenario.

"The CSAR mission is also known as a "Sandy" mission from the call signs used for it during the Vietnam War," Schrader continues. "It normally involves a four-ship of F-16s. Sandy 1, the lead F-16, and Sandy 2 form the lead element. They find the survivor and suppress any threats in the immediate vicinity. Sandy 1 orchestrates the whole scenario. He positions the SEAD assets (suppression of enemy air defense), the electronic warfare assets; and the air-to-air assets. Sandy 2 helps out with communications and situational awareness."
Sandy 1 then devises a game plan for getting the aircraft out. Sandy 3 and Sandy 4 rendezvous with the helicopter and escort it to the rescue area. Their job is to sweep the route for surface threats, providing reconnaissance and suppressing ground threats. They also pass information to the lead element.

"The typical loading for the F-16 in the CSAR mission consists of four laser-guided 500-pound bombs, four air-to-air missiles, a LANTIRN targeting pod, an electronic countermeasure pod, and two wing tanks."

"The F-16 is well-suited for the mission," notes Moore. "It can get to the area fast and provide for its own self-defense. The radar can find helicopters and other assets involved in the mission. The LANTIRN pod, through its designation to deliver laser-guided bombs precisely to a target, allows us to locate the survivor and keep track of things on the ground and in the air. We use the targeting pod to lock onto the rescue helicopter and to keep track of it. Our night vision capability comes in handy." The avionics of the block 40 F-16 helped for the close air support role, work nicely for CSAR as well.

Aside from avionics, pilot proficiencies developed in close air support and forward air controller missions apply to the CSAR mission. "In CAS and FAC missions," Moore explains, "we use the targeting pod and our eyeballs to find targets. In many cases, we are relying on someone else to talk us into a target. We have to develop the ability to translate someone's visual description of an area from a ground perspective to the LANTIRN's infrared image of an area from an aerial perspective. That ability to shift perspectives is extremely valuable for the CSAR mission as well."

The 510th will soon put its experience and CSAR training to the test later this year when it deploys to Operation Northern Watch. "F-16 CSAR assets will be imbedded in ONW packages for the first time, and we will be the first F-16 unit to support the CSAR mission at ONW," Schrader proudly notes.

"CSAR is a gratifying mission," adds Capt. Curtis Pitts, another F-16 pilot in the 510th. "We're out there saving someone, most likely one of our fellow pilots. The role is very demanding. It's another hat for an F-16 pilot to wear, frankly it's a role most pilots hope they never have to perform. If I ever get shot down, heaven forbid, CsAR is the one mission I want the Air Force to perform at its best."
Joint Strike Fighter
Fold and Fly the Newest Fighter

Put the Future at your fingertips and send it sailing across the room with this precut easy-to-assemble model of the Joint Strike Fighter. This paper airplane represents the design developed by the Lockheed Martin JSF team, Lockheed Martin Aeronautics Company, Northrop Grumman, and BAE Systems.

Punch Out
Top Section

Tab Fold Line
Tab Fold Line

© 2006 Lockheed Martin Aeronautics Co.
Punch Out
Bottom Section

1. Fold flap over

2. Fold halves together along fuselage center line

3. a. Tuck quarter-round tab through slit
   b. Fold wings up approximately 90 deg

4. Fold halves together along fuselage center line

5. Fold tabs down approximately 90 deg at tab fold lines

6. a. Insert vertical tails fully into rear wing slits
   b. Hold wing steady and pull vertical tails toward the back to lock tails in place (see Rear View Detail)
   c. Slip long tabs through forward wing slits, then pull halves fully together
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Combat Search and Rescue (CSAR) missions usually fall under the control of an Air Force A-10 pilot, who communicates with the downed aircrrew and directs helicopters and other assets to the rescue site. F-16 pilots have been called on to perform CSAR missions, too, most recently during Operation Allied Force where circumstances pressed them into action on short notice. They were in the vicinity of the downed pilot, and they were armed with the weapons, communication, and navigation capabilities needed to deal with the situation.

The CSAR mission became a formal assignment for the F-16 earlier this year as a result of Aerospace Expeditionary Force rotations and the lack of dedicated search and rescue aircraft. Three USAF F-16 squadrons now perform CSAR as part of their regular AEF assignments—the 310th and 555th at Aviano Air Base in Italy and the 18th at Eielson AFB in Alaska.

"We started working the details for the mission last September," says Lt. Col. Steve Schrader, commander of Aviano's 310th Fighter Squadron. "We flew our first CSAR training missions with the 83rd Search and Rescue Squadron of the Italian Air Force in November and again in early February. The 83rd flies HH-3F helicopters from Rimini Air Base."

In March, members of the 510th deployed to Tyndall AFB in Florida to practice CSAR missions with HH-60G helicopters of the 41st Rescue Squadron "Jolly Greens" from

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History

Sixty years after its inception, Fuerza Aérea Venezolana, or FAV, began looking for a combat aircraft that would take over both the air defense and ground attack duties of its Mirage IIIs and Ys. Several options were explored and various aircraft evaluated, including the Mirage 2000, the Kfir C-7, and the F-16. Evaluation criteria included versatility, maneuverability, combat radius, maintainability, and supportability. Since the F-16 scored best in all of these categories, the US government was approached for the purchase of seventy-two Fighting Falcons. Like many other foreign F-16 prospective clients at that time, the FAV was initially offered the “no-frills” F-16J/79, which was turned down. In late 1982, however, the US government approved the sale of twenty-four F-16A/Bs to Venezuela.

The Venezuelan government chose the FMS track for the F-16 purchase. The program was designated Peace Delta and consisted of eighteen F-16A and six F-16B models, all Block 15 aircraft. Prior to the aircraft deliveries, a group of six pilots was dispatched to the US in 1983 to be converted to the F-16 at the 316th TFS at Luke AFB in Arizona. Among this first group of Venezuelan F-16 pilots was the current FAV air operations commander, Brig. Gen. Bécido Anselmi Espin. “It was a great honor but also a great responsibility to be one of the first to convert to the F-16,” Anselmi recalls. Apart from this group of pilots, a group of fifty-four technicians received training on the Fighting Falcon at Luke and at Fort Worth to prepare them for the arrival of the first aircraft in Venezuela. The first six F-16s touched down at El Libertador on 15 November 1983. Grupo 16 reached full strength on 20 November 1985 when the last of the twenty-four aircraft arrived from Fort Worth.

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US and allied pilots have flown thousands of combat missions over hostile territory since the Gulf War. The missions continue in Operations Northern Watch and Southern Watch over Iraq, where pilots face surface-to-air missiles and anti-aircraft artillery. They also deal with similar threats over the former Yugoslavia, though to a lesser degree. Despite these constant threats, aircraft losses to hostile fire in these operations can be counted on one hand, thanks to intricate planning, substantial experience, and advanced hardware. If the worst case happens, however, and an aircraft goes down, a combat search and rescue mission kicks into high gear to extract the aircrew from hostile territory quickly and safely.

Col. Héctor D’Armata, commander of FAV
Grupo 16

Col. Héctor D’Armata Dugarte, who has been involved with F-16s since January 1985, commands the F-16 Grupo. “The F-16 plays a predominant role in our air force,” says D’Armata, who has amassed over 1,300 hours in the Fighting Falcon. “Since its arrival, the F-16 has formed the backbone of our air defense; it is also regarded as the pinnacle of our nation’s defense capability.” The importance of the F-16 for Venezuela stretches beyond its military, as D’Armata explains: “In Venezuelan society, the F-16 represents the nation’s pride in our technological achievements. It symbolizes our sovereignty and...
out willingness to defend it.” This civic pride is illustrated in the city seal of Palo Nino, which carries an F-16.

At El Libertador, F-16s operate alongside Mirage 50EY/DVs of Grupo Aereo de Caza No. 11. The Mirage 50 is the final model of the Mirage III/V family, which is only operated by the air forces of Venezuela and Chile. The F/A-18 or Mirage 50 fleet consists of retrofitted Mirage 11s and 5Vs previously operated by the FAV as well as of newly built Mirage 5s. The Mirage 50 shares a few systems with the Mirage F1, such as the Cyrano IV radar and the Atar 9K-50 engine, and features a new avionics suite. Single-seat Mirage 50EY and dual-seat Mirage 50DV fighters often team with the Grupo 16 Falcons to fly missions and to practice air combat training.

Among the other tenant units at El Libertador is Grupo de Transporte No. 6. This unit performs a special support role for the FAV’s fighter force, like the F-16s from Grupo 16. Besides its Lockheed Martin C-130H, Shorts 360, and Antonov 225 transports, Grupo 6 operates two Boeing 707s modified to provide aerial refueling. These tankers can refuel aircraft equipped with USAF-style refueling receptacles, like that of the F-16, as well as aircraft fitted with refueling probes, like that of the Mirage 50.

**Expanding Capabilities**

The FAV is capitalizing on the F-16’s potential for expanding its capabilities with new upgrade programs. “The aircraft offers new things all the time and is challenging us constantly,” D’Armas points out. “The great team of technicians and pilots we have in Group 16 enables us to keep ahead. Most of these upgrades are carried out by the group’s own technicians of Escuadrón 167. In recent years, these upgrades involved replacing the Litton AN/ALR-69 radar warning receiver with an enhanced Elara SPS-2000 WVR from Israel as well as installing the Litton LN-93 ring laser gyro.

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Mission X, flown by Tomassetti on 20 July, provided a taste of the operational utility of the STOVL version of the JSF by combining all of the various aspects of STOVL flight into a single mission. The Marine Corps pilot performed a short takeoff, converted from STOVL to CTOL at 5,000 feet, climbed to 25,000 feet, accelerated to supersonic speeds, converted back to STOVL, accelerated to hover, and then performed a vertical landing in ground effect at Edwards.

The first vertical flight of the X-35 and its subsequent testing opens a new era for the US Marines and for the UK Royal Navy and Royal Air Force. "STOVL gives us capability we don't have with helicopters," explains Tomassetti, who has over 1,500 hours of Harrier flight experience in the US Marines as well as combat time in the Harrier in Desert Storm. "We deploy expeditionary units that fly onto amphibious ships that require STOVL-capable aircraft. Fixed-wing aircraft offer these units huge tactical advantages over helicopters. Fighters typically fly at least 600 knots faster than helicopters can fly. They give commanders an ability to project power much faster and further than typical rotary wing aircraft. They give commanders a much larger sphere of influence for reconnaissance and attack."

"The JSF supports our current STOVL fighters," Tomassetti continues. "The Harrier, with very little computer augmentation to reduce pilot workload, is difficult for pilots to learn to fly and to stay proficient. The JSF, with computers to reduce pilot workload, will be easier for pilots to learn how to fly and to stay proficient. In addition, the performance will be better than the Harrier, the range longer, the payload larger, and the shape much stealthier. I'm looking forward to getting this airplane into the fleet."

**Eric Hyls is the editor of Code One.**

*A special thanks to James Seguy for his assistance with the article.*
Other jetborne testing included vertical landings after completing transition from semi-jetborne to jetborne flight. Completing these tests is the high desert in California, about 2,500 feet above sea level during the first few months of the summer, highlights the thrust margin of the X-35 and its lift fan system. "A jet engine loses about one pound of thrust for every foot over sea level," Hargreaves explains. "With the presence of the air from conditions would give us the equivalent of 2,500 pounds of extra thrust. But thanks to the efficiency of our vertical lift system, we don't need it. We plan to complete all the required testing in the high desert."

Conversions

After the first official flight, the X-35B completed a functional check flight, which was essentially a CTOL flight. "This flight proved that the airplane has the same performance of the X-35A CTOL version," notes Blockham. "We flew a variety of points in the envelope and verified that it met the performance of the X-35A. We also opened the STOVL doors in flight for the first time, the first step in the conversion process from CTOL to STOVL. We observed loads and flying qualities as we cycled the doors."

The first conversion occurred about 10,000 feet and 150 knots. After the first conversion, the X-35B completed several more conversions and flew in STOVL mode at slower and slower speeds by vectoring the nozzles at greater downward angles. Subsequent conversions from CTOL to STOVL and back occur at a maximum altitude of 10,000 feet and a minimum altitude of 2,500 feet.

Semi-Jetborne Testing

The aircraft entered the semi-jetborne state in up-and-away flight the first time it was converted. "After the initial conversion, we continued to operate in STOVL mode and assessed the handling of the airplane," Blockham explains. "We work downward to the hover point we established on the first official flight over the pit. Eventually, we hover and land on a solid pad at Edwards AFB."

After the initial conversions at 10,000 feet, the aircraft performed conversions at similar speeds at 5,000 feet. In STOVL mode, the aircraft starts slowing down to speeds of about 100 knots. "We don't want to go any slower than 100 knots at 5,000 feet, because the slower the aircraft gets, the more ground references a pilot needs," Blockham says. After establishing 100 knots at 5,000 feet, we drop down to about 150 feet above the ground for slower speed testing.

The 150-foot maximum altitude for hovering is dictated by visual references. "We decelerate into a hover at about 150 feet above the runway," Hargreaves says. "This height provides visual references in terms of peripheral vision, sideway movement, and general awareness of the airplane without looking down at flight instruments. Hovering it like driving a car: With experience, drivers know how fast they are going without looking down at their speedometers."

Volcan, the commander of Escuadron 167, "Sending the engines all the way to the limit, we are required to put the aircraft on display and maintain aircraft availability, considering the entire upgrade process, including shipment, takes about three months per engine," maintenance chief continues. "The upgrade program is running smoothly. We have been installing the wire harnesses required to accommodate the 250Es and modifying the cockpit instrumentation ahead of schedule."

In a similar manner, Grupo 16 is currently fielding a night vision capability for its F-16s, which encompasses installing cockpit and external lighting that is fully compatible with night vision goggles. Aircraft modifications for both the NVG and engine upgrade programs concluded recently.

New Roles And Relationships

The Litening pod and the NVG capability of the F-16s being fielded into night action recently to counter illegal border incursions and illegal incursions into Venezuelan airspace. In the latter missions, the infrared capabilities of the Litening pod, designed primarily for air-to-ground use, provided the F-16 with a useful instrument in the air-to-air regime as well because the system aids nighttime intercepts for missions like these, for which Grupo 16 continuously pulls alert duties at EL Libertador, the F-16 increasingly cooperates with other services of the Venezuelan military.

Such interoperability and service integration is key in the Venezuelan armed forces nowadays. As Brig. Gen. Amstum notes: "We are moving toward a new military doctrine that focuses on a unified command structure that covers all branches of our armed forces. Although we are still several years away from fully implementing this doctrine, we are already addressing such interoperability issues as command and control. We have to deal with cultural differences within various branches of our military. These differences make the entire operation even more interesting."

New Capabilities And F-16 Training

The operation of the Litening pod and the NVG system form part of the training syllabus of the Grupo 16 F-16 pilots. Once qualified on the F-16, pilots complete the twenty flights of NVG training. Capt. Juan "José" Pinto, an F-16 instructor pilot from Escuadron 161 with almost 1,000 F-16 hours, is enthusiastic about the NVG capability. "NVG literally opens up a completely new world," he says. "At first it takes some adaptation to become accustomed to the imaging and coloring the NVGs generate. Once they reach a comfort level, pilots can take advantage of this wonderful asset."

F-16 pilots enroll in the NVG course before they are inserted in the Litening training course, which includes another twenty flights. Further F-16 courses offered at the base include two- and four-flight lead courses, a functional check flight course, and an instructor pilot course.

The instructor pilots of the two escuadrons play a key role in training the pilots who eventually join Grupo 16. Basic qualification on the F-16 is taught in A, B, and C tracks. Experienced fighter pilots shifting to F-16s or pilots regaining their F-16 currency complete the fifty missions in the A-track. Pilots joining Grupo 16 with less experience on jets, such as those coming from the F-5's OV-10 Bronco, complete the sixty flights in the B-track. New pilots coming out of pilot training complete the 120 flights in the C-track. This C-track course has been extended recently as graduates from the F-5 pilot training selected for the F-16 in the same way as the F-16s are selected for the F-16. The C-track will get the 120 flights in the C-track. This C-track course has been extended recently to include graduates from the F-16 pilot training.
Aéro No. 14 guides students through an elementary flying course on the Beech VT-34A Mentor and the SIAI Marchetti SF-260E, the latter being a replacement for the aging Mentors. Following this six-month course, students progress to the Tucanos of Grupo 14 for a six-month advanced flying training course.

Following their graduation, FAW pilots selected to go to fighters either advance to the NF/1-5s of Grupo Aéreo de Caza No.12 at Barquisimeto or continue on the Tucano for a fighter lead-in training course. On the F-5, pilots complete a similar fighter lead-in training as on the Tucano. Pilots are introduced to air-to-air and air-to-ground tactics and weapon employment before they can be deployed to the operational F-16 and Mirage squadrons. The tactical training on the Tucano serves as a stopgap measure following the deactivation of the Lockheed T-33D Buckeye jet trainers, previously operated by Grupo de Entrenamiento Aéreo No. 13 at Barcelona. Until their retirement in 1999, the venerable Buckeyes formed the tactical stepping stone to the operational fighter units for new FAW fighter pilots. This situation will be changing later this year when the FAW's new jet trainers, the Alenia-Aermacochi Embracer AMX-1 two-seat trainers, start arriving in Venezuela.

**Future Upgrades**

Apart from fleet reconfigurations and current upgrades, the FAW is about to embark on the most significant F-16 upgrade programs to date to provide a credible F-16 combat potential for the next twenty years. The improvements should enable night and adverse weather operations. "We are studying several options at this moment," explains Brig. Gen. Amsale, FAW air operations commander. "On the one hand, we can choose the Mid-Life Update kit for a robust and proven set of sophisticated technical features. On the other hand, we can choose from a variety of attractive alternatives to the MLU package." The FAW is assessing the Israeli F-16 Avionics Capability Enhancement upgrade kit as an alternative to MLU. The F-16 ACE, a joint project of Israeli defense industries led by Israel Aircraft Industries and Elbit Systems, upgrades the avionics and enhances the aircraft structure to extend aircraft service life.

Another MLU alternative is the Falcon One upgrade program offered by Singapore Technologies Aerospace. Similar to the F-16 ACE, Falcon One offers state-of-the-art avionics with a glass cockpit. Sophisticated in the Israeli and Singapore options might be, the MLU package is still considered an attractive choice, especially since the FAW is evaluating European partners to overhaul its F-16 fleet to bring it up to an MLU standard. SABCA in Belgium and Fokker in the Netherlands, which are upgrading the F-16s of their respective air forces, are being considered for the upgrades. No matter which option the FAW pursues, the ever-expanding capabilities of its F-16 fleet will expand even further.

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The aircraft from higher taxi speeds," Blossham explains. "To stop from a taxi speed of 100 knots, for example, we position the nozzle all the way down and forward a little bit and use the thrust of the propulsion system to slow down. We don't use forward directed thrust all the way to a standstill because hot exhaust gas can be thrown forward of the airplane and reingested in the intakes, which is not good. We vet the runway in these tests to determine visually at what speed the gas starts moving forward. At that speed, the nozzles go back to about forty degrees and the airplane uses its brakes to come to a complete stop."

**Jeborne Testing**

Before the first hop, the X-35B completed vertical takeoffs without leaving the ground in a test called a go-go VTO. "We overfilled the airplane with fuel so it was too heavy to hover," Hargreaves explains. "That required full fuel about 37,000 pounds full-up weight. As we pushed the power up, the landing gear extended. When the main gear got to within one inch of their total travel, the weight-on-gear switch told the airplane it was flying. That closed the loop on the flight control system, which meant that a lot of the clever STOL functionality came into play. The airplane automatically trimmed itself to a hover attitude, which is three degrees nose up, so the nosewheel came off the ground a couple of feet. We then went to full power. For all intents and purposes, we were flying. I made pitch inputs by moving the sidestick controller fore and aft, I made yaw inputs by moving the rudder pedals. I also made nozzle angle inputs to the thrust vector lever to move the aircraft forward and aft. We collected a lot of data during this test.

After its first hop and one or two more hops at different fuel loads, the X-35B completed its "official" first flight—a sustained and controlled hover at about twenty feet above the ground on 24 June. "The flight was a stunning success," recalls Hargreaves. "The aircraft was easy to control within the confines of the hover pit. Handling was extremely precise."

**Ground Testing**

After the X-35A was fitted with the vertical lift system in January 2001 and transformed into the X-35B, it was fixed to the hover pit with a special landing gear that allowed local cells to measure STOL lift forces and moments directly and that prevented the airplane from lifting into hover at higher power settings. More than 100 of these restrained tests were conducted with all control functions fully under pilot command. X-35B test pilots performed full rehearsals of vertical flight missions, including conversions from conventional takeoff and landing modes to vertical modes. These tests were conducted in several configurations, including open-gate conditions on the hover pit to represent out-of-ground-effect flight and closed-gate conditions to produce the ground effects encountered during vertical landings and takeoffs.

"Results from these tests were extremely positive," notes Zappia. Our measurements showed no thermal distress from either hot-gas reingestion or flow-field effects on the aircraft surfaces. We also recorded favorable thermal conditions at ground level near the airplane.

The ground tests included twenty-six CTOs to STOL, clutch engagements of the lift fan at high engine rpm. The X-35B operated at maximum STOL thrust levels for periods of up to ninety seconds. Individual test series were run with a full aircraft fuel load for as much as one hour. "All twenty-six of these conversions worked exactly as expected," notes Hargreaves, who was in the cockpit for many of them. "Noise level and vibration in the cockpit were virtually unchanged at idle compared to CTO levels. The propulsion system responded predictably to pilot inputs. Thrust and thrust-vector commands were crisp. Noise and vibration at full power with the thrust vector at the hover setting were comfortable."

Before the X-35B flew, it was put through a series of taxi tests in STOL mode. "The taxi tests determined how we slow
**X-35B Takes Off, Vertically**

The X-35B launched vertically, held its position, and landed vertically on 24 June, a first for a JSF demonstrator and a critical validation of the revolutionary shaft-driven lift fan propulsion system. "This was a stunning success. The lifting power is incredible and the handling is extremely precise," said Simon Hargreaves, the test pilot. "The flight occurred with minimal pilot input—I was essentially a passenger. This speaks volumes about the quality of the aircraft and the propulsion system." Hargreaves held the X-35B in a stabilized position about twenty-five feet above the ground for thirty-five seconds, checking to ensure the flight controls responded properly before returning the plane gently to the ground.

**X-35B Goes Vertical And Supersonic**

The X-35B engaged its short takeoff/vertical landing system and made a supersonic dash in the same flight on 9 July near Edwards AFB. Pilot Simon Hargreaves took off, climbed to 9,000 feet, and successfully engaged the shaft-driven lift fan propulsion system at 180 knots. He then accelerated to an indicated Mach 1.08, marking the first time a JSF demonstrator has achieved a STOVL mode conversion and sustained supersonic flight in a single sortie. The test marked the X-35B's first in-flight conversion to STOVL mode as well.

**Flight Test Envelope**

The flight test envelope for STOVL operations is divided into four basic sections—ground, jetborne, conversion, and short takeoffs and short landings. The flight test envelope includes STOVL flight at speeds greater than forty knots (speeds at which the normal CTOL control surfaces are not involved and at which the aircraft mass is not supported by lift generated from the wing). Semi-jetborne testing includes STOVL flight at speeds greater than forty knots (speeds at which the wing is generating lift). Semi-jetborne encompasses flight at greater than forty knots in STOVL mode, including short takeoffs and short landings. Conversion testing covers the transition from CTOL to STOVL modes in flight. Conversion and transition carry specific meanings in STOVL testing. Conversion refers to a mechanical process, the act of engaging the clutch to spin up the lift fan. Transition relates to the change in the aerodynamic state of the aircraft from a conventional takeoff or landing to the STOVL mode, including hovering and takeoff and landing.

"We have to use a different approach for expanding the flight envelope of STOVL than the approach for expanding the envelope of a conventional aircraft," Blohm explains. "For example, we wouldn't consider testing at 100 feet off the ground as an envelope expansion point for a CTOL aircraft. While we use the same flight envelope graphics of altitude
Vertical Lift Contributors

The counter-rotating blades of the lift fan provide about 18,000 pounds of lifting power at the front of the aircraft. Lift fan thrust is controlled by a combination of engine rpm and fan inlet guide vane angle. The thrust from the lift fan can be vectored from thirty-four to ninety-five degrees (as measured from the horizontal line from the nose to the end of the fuselage). Each roll port provides about 1,500 pounds of lifting thrust on each side of the aircraft. Adjusting the thrust split to the two ports provides lateral control. The engine, which provides about 26,000 pounds of nonafterburner thrust in STOVL mode, contributes about 18,000 pounds of downward thrust in STOVL mode. Nozzle exit area and engine rpm are used to control the thrust from the aft end of the aircraft. The engine angles downward through a three-bearing duct that can swivel ninety-five degrees from the horizontal and sweep plus or minus twelve degrees from left and right.

The lift fan approach was chosen for many attributes. It extracts power from the engine, thus reducing exhaust temperatures from the engine by about 200 degrees compared to exhaust temperatures of direct-lift systems. It significantly reduces exhaust velocity as well. Engine exhaust air combines with the low-temperature and low-velocity air from the lift fan to produce a more benign ground environment. Cool exhaust air from the fan prevents hotter exhaust from engine from being reingested into the intakes. Hot gas reingestion, a common problem on legacy Harrier-type approaches, causes compressor stalls and other severe engine performance degradations. Most importantly, the lift fan system was chosen because it does not detract from the up-and-away performance of the JSF F-35A engine.

The ground environment and the growth potential convince me that this is the right concept," Harroges explains. "From 1960, the Harrier grew fifty pounds per year on average. No reason prevents this airplane from doing the same. The shaft-driven lift fan gives us huge amounts of available thrust in the ground environment with little to no weight penalty. A STOVL aircraft must be tolerant of weight growth. An augmented system lends itself to weight growth."
Ship 4006 Joins Fellow Raptors At Edwards

Raptor 4006 flew from Georgia to California in May, increasing the number of air dominance fighters at Edwards AFB to five. Raptor 4006's capabilities closely resemble those of Raptor 6045, which flew to Edwards in March. These latest two Raptors, the most complete versions of the aircraft, have essentially the same capabilities as the production fighter.

Raptors Surpass 1,000 Flight Test Hours

The F-22 flight test program surpassed 1,000 hours of flying on 18 April when Boeing test pilot Chuck Kilberg guided Raptor 4003 over the test range at the Air Force Flight Test Center at Edwards AFB, California. This third F-22 delivered to the F-22 Combined Test Force at Edwards is dedicated to testing the Raptor's structural capability as part of the flight envelope expansion program.

"This significant achievement, and the many flight test hours to come, are a real indicator of just how thoroughly we are testing the Raptor—direct result of the hard work, dedication, and professionalism of the integrated government and contractor team," said Col. Chris Seat, F-22 CTF director. Since 1998, flight test activity at the CTF has centered on flight sciences, such as flying qualities, structures, utilities and systems, propulsion, and performance. With this latest avionics flight test aircraft, the avionics developmental testing will increase the pace of the CTF's flight test activity. (The F-22 program had accumulated over 1,200 hours by early July 2001.)

Ship 4001 Prepares For Live Fire Tests

The stripped-down airframe of Raptor 4001 was placed in the live fire test range at the 46th Test Wing aircraft survivability research facility at Wright-Patterson AFB, Ohio, where it will soon complete ballistic wing live fire testing. A 33mm high-explosive incendiary projectile, the type carried by MIG-29s and Su-27s, will be fired at the Raptor's wing root to assess the airframe's ability to withstand damage. The platform under the aircraft was built specifically for this test. Five FJ3 jet engines (structure in front of the F-22) will generate a 350-knot airflow over the wing while the airframe bears a three-g load to simulate forces encountered during a moderate climb.
The aircraft sits atop a thick metal grate that covers a large concrete pit. The hover pit, as it is called, is a scaled-up version of the one used for the very first vertical flights of the Harrier prototype, the Hawker P1127, performed in the fall of 1960 at Dunsfold in England. The pit collects exhaust thrust and directs it away from the aircraft to create a less turbulent and more controlled environment.

"Harrier X, everything looks good here," radios Paul Bloxham from the data trailer. "You are cleared for takeoff." The ascent, again, is distinctly British as Bloxham, the flight test conductor, is another IAR employee recruited by the X-35 program for his Harrier experience.

"Power is coming up to eighty-five percent," Hargreaves announces. The increased power pivots the aircraft on its main gear, gently lifting the nosewheel of the X-35B off the grate of the hover pit. The aircraft has gone from a level attitude to a slightly higher one of three degrees nose high. One more scan of the engine instruments and Simon declares, "Powering up!" The Pratt & Whitney JFS119-611 engine roars in 20,000 horsepower transfers from the engine's case to the Rolls Royce lift fan just behind the cockpit. The aircraft rises gently in the air.

Maj. Art Tomasetti, a US Marine Corps test pilot stationed next to the pit, acts as a landing site supervisor, or LSS, for Hargreaves. When Tomasetti sees the main gear lift from the pit, he radioed to the test team, "Lift Off!" Hargreaves eases the throttle back to idle. The main gear of the X-35B settle back onto the hover pit, followed by the nosewheel. The engine spools down to idle. This first unofficial flight of the X-35B attains a height of less than five feet. Though only a "hop," the first vertical takeoff represents a huge leap for the X-35 team.

"The first hop was over in a few seconds," notes Bloxham. "It was one of the shortest first flights in the history of aviation. Once we cleared the pilot to go, the test conductor in the trailer couldn't do much else. The flight was over as soon as it started."

"Everyone on the program breathed a sigh of relief after the first hop," Hargreaves explains. "We knew in a heartbeat that the airplane and its flight control work. Everything else from that point on is clearly challenging and must be completed in a short timeframe. But the first jetborne flight was a huge achievement."

Within a few days after Hargreaves'first hop, all three STOVL test pilots on the X-35 team hovered the aircraft. Tomasetti was the first military pilot to evaluate the X-35B in hover on 29 June. Squadron Leader Justin Paine, an experienced Harrier test pilot from the Royal Air Force, evaluated the X-35 for the UK military the next day.

"The fact that other pilots hovered the aircraft so quickly in the test program is a testament not only to their abilities as test pilots but also to the design of the X-35," Hargreaves says.

Converting From 8 To 8

The X-35B airframe actually completed its first flight months earlier, on 24 October 2000 to be exact, as the X-35A, the conventional takeoff and landing, or CTOL, demonstrator. The X-35A went on to fly twenty-seven flights, expanding the flight envelope to 34,000 feet and supersonic speeds. It was then transformed into the X-35B STOVL demonstrator when a vertical lift system was installed in an empty circular bay behind the cockpit. (The upper and lower doors of this bay were fully operational during the X-35A flight tests.) The transformation continued when roll ducts and roll posts were installed in the wings, a straight duct was replaced with a three-bearing swivel duct on the aft end of the Pratt & Whitney JFS119-611 (the same engine used for the other X-35

Ship 4002 Flies 200 Sorties

Raptor 4002 accomplished another significant program achievement in March when it became the first F-22 to fly 200 sorties. This achievement came as the program secured approximately $674.5 million to continue development, assembly, and testing through the end of fiscal year 2001. Five F-22s reside at Edwards, all involved in the flight test program. The remaining four Engineering and Manufacturing Development Raptors are scheduled to join the test fleet by the end of 2001.
F-117 Celebrates Twenty

The F-117 Nighthawk stealth fighter made its maiden flight over the Nevada test ranges twenty years ago on 18 June. Ten years later, it proved its worth in Operation Desert Storm, flying almost 1,300 sorties and scoring direct hits on 1,600 high-value targets in Iraq. Not one F-117 sustained combat damage during that six-week air war. Of the fifty-nine production F-117s procured by the Air Force, fifty-two are still in service. All F-117s are now based at the 49th FW at Holloman AFB, New Mexico. The three squadrons comprising the 49th—the 7th, 8th, and 9th FS—trace their heritage to the 49th Pursuit Group of the Pacific Theater in World War II.

Israel Approves Follow-On F-16s

The Israeli government approved the purchase of fifty additional F-16s specially modified for the Israeli Air Force. A formal contract is to be negotiated this year. Deliveries, which are expected to begin in 2006, will extend the life of the F-16 production line through 2009 when deliveries conclude. The purchase, valued at $2 billion, follows an order for fifty aircraft placed in mid-1999. To date, Israel has placed six different orders for the F-16 for a total of 350 aircraft.

New Mexico ANG Deploys To Singapore

F-16 pilots from the New Mexico ANG completed more than one week of mock aerial combat over the South China Sea in May against jets from Australia and Singapore. The dogfights were part of Commando Sling, an exercise designed to sharpen the dissimilar air-to-air combat skills of participating aces. Pilots from the 188th FS of the New Mexico ANG flew against Australian F/A-18s and Singaporean F-10, F-5, and A-4 jets. The guardsmen competed against pilots from the two other nations on all seventy-three planned missions flown from Paya Lebar AB in Singapore. "That 100 percent rate was the best rate we've ever had for a Commando Sling," said Lt. Col. Billy Songet, operations officer for the 49th Combat Training Squadron. The Singapore-based 497th CTs hosts up to six of the training exercises annually to provide fighter pilots the chance to fly against other types of aircraft.
"Hattrick* Control, Hattrick 3 is ready for takeoff."

These words, transmitted in full British accent from the cockpit of the X-35B signal the beginning of the final portion of the concept demonstration phase of the Joint Strike Fighter program for Lockheed Martin. The pilot, Simon Hargreaves, an experienced Harrier test pilot from BAE Systems in the UK, glances at a life-size windsock planted near the test ramp at Lockheed Martin facilities in Palmdale, California. He then scans the cockpit displays to check engine and aircraft systems. His voice is broadcast directly through a telemetry system to a data trailer where two dozen engineers scan detailed information on the X-35B and its unique vertical propulsion system.

* Hattrick refers to the third of three successful X-35 variants.
Pentagon Okays WCMD

The US Department of Defense gave the green light to begin full-rate production of the wind-corrected munitions dispenser at Eglin AFB, Florida. The WCMD, a tail kit installed on existing "dumb" munitions, transforms these munitions into "smart," accurate, adverse weather weapons. The tail kits will be used on the CBU-87 combined effects munitions, the CBU-89 Gator Mine System, and the CBU-97 sensor fused weapon. The Air Force plans to buy 40,000 tail kits, with 30,000 slated for the CBU-87 and 5,000 each for the CBU-89 and CBU-97. These weapons will be integrated on the F-16 as well as on other current and future fighters and bombers. The tail units are scheduled for delivery by the summer of 2002.

Shaw Wins Maintenance Award

The 20th Component Repair Squadron at Shaw AFB, South Carolina, recently claimed a 2000 Maintenance Effectiveness Award as the best maintenance, component repair, or equipment maintenance squadron in the Air Force. The annual awards are given to those maintenance units with flight line or backshop maintenance capability that have best managed their resources. The 20th CRS is also one of four units going on to compete for the Secretary of Defense Maintenance Award (the Phoenix Trophy), which recognizes the best maintenance organization in the DoD.

F-16 Performs At LAD Expo

Capt. Randy Efferson wowed crowds with aerial demonstrations in the Block 50 F-16 during the Latin American Defense Expo 2001 last April. The event, held in Rio de Janeiro, Brazil, drew a distinguished crowd, including visitors from several embassies and commanding officers from the armed services of Brazil. Efferson is the pilot for the Air Combat Command East Coast F-16 Demo Team from Shaw AFB, South Carolina.

F-16 Launches Live JASSM

An AGM-158 Joint Air-to-Surface Standoff Missile, or JASSM, launched from an F-16 successfully demonstrated end-to-end performance by destroying an air defense target in a flight test at White Sands Missile Range, New Mexico, in late April. The launch occurred at Mach 0.80 and at an altitude of 2,000 feet above the New Mexico desert. After weapon release, the missile, built by Lockheed Martin Missiles and Fire Control in Orlando, Florida, autonomously navigated and guided to the planned target. JASSM used anti-jam global positioning system guidance en route to the target area. In the terminal phase, JASSM used its imaging infrared seeker and target correlator algorithms to precisely locate the target. The live warhead detonated upon impact, destroying the air defense target.
In Memoriam
Judson Brohmer

"I absolutely love to fly. Nothing compares to the feeling of zooming along at forty or fifty thousand feet, skimming over wispy clouds, chasing the world's most advanced fighter."

Hat Trick Pilot

Capt. Joe "Hooter" Feheley, an instructor pilot of the 83rd FS from Homestead, Florida, flew in three different fighters in one day during a deployment to Leage AB, Germany. Feheley flew in an F-16 from his home unit and an F-4 and MiG-29 from 73rd FS at Leage. The three-aircraft hat trick is a first for any pilot, according to pilots at the German air base.

RNFLAF's 311 Celebrates Fifty

The first of May 2001 was the fiftieth anniversary of RNFLAF 311 Squadron, which has flown the F-84, F-84F, F-104, and F-16.

New Paint Scheme For Indonesia

Indonesian F-16s now sport a new paint scheme. The aircraft reside in the 3rd Squadron located at Istiwyahudi AB at Medan, Java.

AFTI/F-16 at USAFM

The AFTI-F-16 landed for the last time at Wright-Patterson AB, Ohio, where it joins the collection of historically significant USAF aircraft at the US Air Force Museum.

North Dakota Sets Safety Record

The 119th FW of the North Dakota ANG has logged over 50,000 hours of accident-free flight time in the F-16, an accomplishment formally announced by North Dakota Governor John Hoeven. The Fargo-based unit, better known as the Happy Hooligans, has flown the single-engine fighter aircraft since converting from the F-4 in March 1990. A flight of two F-16s topped the 50,000 mark in May during a basic fighter maneuver training flight in military air space over the Devils Lake region. North Dakota ANG pilots and aircraft maintenance crews have safely operated fighter aircraft for more than twenty-eight years, accumulating more than 122,000 total safe flying hours in fighter aircraft since 1973.

ROKAF Sets Safety Records

The 161st and 162nd Squadrons of the Republic of Korea Air Force established flying safety records recently in the F-16 Block 32. The 161st Squadron, the oldest F-16 unit in the ROKAF, achieved 30,000 hours of accident-free flying in the Block 32 F-16 it has flown since 1986. The 162nd Squadron, also flying Block 32 aircraft, achieved 50,000 hours of accident-free flying. Dr. Don Jones, vice president of F-16 programs for Lockheed Martin Aeronautics, and Paul Jones, director Korea F-16 programs, presented the ROKAF plaques commemorating the event.

RNFLAF Displays New Demo Design

The Royal Netherlands Air Force F-16 solo display received a freshly painted jet in April for the 2001 and 2002 show season. The solo display team consists of several members of the 312th Squadron from Volkel AB. The team flies an F-16 Mid-Life Update. The paint scheme was designed by the company Base-Line.

Code One Online Update

Check out codeonemagazine.com for video clips of the first X-38B flight—a vertical takeoff.