We've loaded cartons of content, amassed stacks of stats, and plotted a plethora of plans since launching the new Code One website last summer. Here's an overview.

**What's Popular**
- The cockpit photo collection has garnered the most hits since we went live with the new site.
- F-35 flight test updates and pieces on Skunk Works projects are always near the top of popular articles.
- News photos of first flights of the latest F-35 Lightning IIs attract a lot of attention as well.
- A photo of the XB-36 has the highest hit count for any image on the site.
- Footage of the first flight of the A-12 has created the most traffic.

**What's There But Not So Obvious**
- PDFs of almost every back issue of Code One are available in a drop-down menu. Click on the image of the latest cover to get to the menu.

**What's New**
- The home page has been tweaked to include rotating main images and alternating Most Popular tabs.
- We've uploaded a lot of archival content. The site now has more than 1,300 images in almost 100 galleries.
- We've posted about 400 news items covering everything from the latest C-130 delivery to recent F-16 exercises to obituaries on aviation luminaries.

**What's Coming**
- We plan to implement Facebook Like links across the site.
- We are creating an expanded program page for F-35 that includes the latest news, photos, videos, and articles on one screen. This may be applied to other programs later.
- New photo galleries that accommodate collections of images are in work (think a covey of cockpit photos or a passel of patches on a single page).
F-35 FLIGHT TEST UPDATE
Lightning II Testing Highlights Through June

UP SHIP
Hybrid Airships Could Revolutionize Cargo Transport

RESEARCH VIKING
Versatile S-3 Dons A Lab Coat For NASA

MASS APPEAL
Youngstown C-130 Unit’s Aerial Spray Mission

THROUGH THE CANOPY GLASS
This Laboratory Is A Required Stop For Every F-35 Canopy

ABSOLUTE BLACKBIRDS
Records Set By SR-71 Crews In 1976 Still Stand

CONVAIR FISH
A Look Back At Convair’s Design For A U-2 Successor

NEWS
The previous installment of the F-35 Flight Test Update wrapped up with the F-35 program reaching 1,000 cumulative flight hours during an AF-1 and AF-4 formation flight at the US Air Force Flight Test Center at Edwards AFB, California, on 8 March 2011. Since then, the program has completed more than 200 additional flights and, as of late June, had surpassed 1,400 flight hours and 1,000 total flights. Five F-35s have surpassed 100 total flights, and sixteen F-35s are flying at four locations, the newest of which is not a test facility, but is the 33rd Fighter Wing, the F-35 training center at Eglin AFB, Florida. A total of twenty-five pilots have flown the F-35, and twenty-one of them are currently flying the aircraft.

F-35A AF-1 expanded the flight envelope to Mach 1.53. F-35C CF-3 joined the test force at the Naval Air Warfare Center Aircraft Division at NAS Patuxent River, Maryland. CF-2 began jet blast deflector testing at Lakehurst, New Jersey, in preparation for carrier trials. By mid-2011, the F-35B short takeoff/vertical landing variant had logged ten times more vertical landings than in all of 2010. F-35B pilots have also performed more than 230 short takeoffs since arriving at NAS Patuxent River in late 2009.
15 March 2011
100th Short Takeoff
Lockheed Martin test pilot David Nelson was at the controls of F-35B BF-1 as the aircraft completed the 100th short takeoff for the F-35B fleet. The milestone occurred on Flight 102 for BF-1 from NAS Patuxent River, Maryland. The 1.3-hour flight included two short takeoffs, one slow landing, and one vertical landing.

Photo By Andy Wolfe

17 March 2011
100 Flights For AF-2
US Air Force test pilot Maj. Scott McLaren was at the controls for Flight 100 of F-35A AF-2. The 1.3-hour flight from Edwards AFB, California, included 360-degree loaded rolls and positive-g maneuvers.

Photo By Paul Weatherman

7 April 2011
First STOVL Mode For BF-4
US Marine Corps test pilot Lt. Col. Fred Schenk put F-35B BF-4 into STOVL mode for the first time on Flight 43. The flight took place at NAS Patuxent River, Maryland.

Photo By Andy Wolfe

21 April 2011
100 Flights For BF-3
Lockheed Martin test pilot David Nelson was at the controls for Flight 100 of F-35B BF-3. The flight originated from NAS Patuxent River, Maryland.

Photo By Michael Jackson

22 April 2011
Edwards Adds A Pilot
US Air Force Maj. Steven Speares became the twentieth pilot to fly the F-35 when he took off from Edwards AFB, California, in F-35A AF-1 for a 1.6-hour test mission. The mission was Flight 122 for AF-1.

Photo By Darin Russell
27 April 2011
BF-4 Completes First Vertical Landing
The fourth F-35B short takeoff/vertical landing jet, BF-4, descended to its first vertical landing at NAS Patuxent River, Maryland, with Marine pilot Lt. Col. Fred Schenk at the controls. This was Flight 47 for BF-4. Photo By Andy Wolfe

Pax Adds A Pilot
Marine Maj. Richard Rusnok became the twenty-first pilot to fly the F-35 when he took off in F-35C CF-1 from NAS Patuxent River, Maryland, for a 1.5-hour test mission. The mission was Flight 55 for CF-1. Photo By Phaedra Loftis

29 April 2011
CF-2 First Flight
Lockheed Martin test pilot Bill Gigliotti was at the controls for the first flight of F-35C CF-2 from NAS Fort Worth JRB, Texas. Photo By Randy Crites

BF-3 Completes First Vertical Landing
Lockheed Martin test pilot David Nelson was at the controls of BF-3 on Flight 102 as it became the fourth short takeoff/vertical landing F-35B to complete a vertical landing at NAS Patuxent River, Maryland. Photo By Andy Wolfe

6 May 2011
AF-8 First Flight
The third production model of the F-35 Lightning II, F-35A AF-8, completed its inaugural flight from NAS Fort Worth JRB, Texas, with Lockheed Martin test pilot Bill Gigliotti at the controls. Photo By Angel Delcueto

AF-7 Delivered To Edwards
Air Force Maj. Scott McLaren flew F-35A AF-7 on a three-hour ferry flight from NAS Fort Worth JRB, Texas, to Edwards AFB, California. The ferry marked Flight 7 for AF-7. Photo By Darin Russell

F-35 STOVL Mode Gear Up
Marine Lt. Col. Fred Schenk took the F-35B into STOVL mode with landing gear up for the first time. The test, which occurred on Flight 118 for the aircraft, was part of the envelope expansion for the F-35B. Photo By Andy Wolfe
10 May 2011

200th Short Takeoff
Lockheed Martin test pilot David Nelson was at the controls of F-35B BF-1 as the aircraft completed the 200th short takeoff for the F-35B fleet. The milestone occurred on Flight 121 for BF-1 from NAS Patuxent River, Maryland. The 1.2-hour flight included two short takeoffs, one slow landing, and one vertical landing.

Photo By Phaedra Loftis

12 May 2011

100th Vertical Landing
The F-35B fleet at NAS Patuxent River, Maryland, completed 100 vertical landings as BAE test pilot Peter Wilson touched down in F-35B BF-1 on Flight 123 for the aircraft.

Photo By Michael Jackson

13 May 2011

AF-6 To Edwards
Air Force Lt. Col. Hank Griffiths was at the controls of F-35A AF-6 for a successful 3.6-hour ferry flight to Edwards AFB, California. AF-6 is the first production F-35 Lightning II. Griffiths is the director of the F-35 Integrated Test Force at Edwards.

Photo By Paul Weatherman

AF-9 Makes First Flight
The fourth production model of the F-35 Lightning II, F-35A AF-9, completed its inaugural flight from NAS Fort Worth JRB, Texas, with Lockheed Martin test pilot Bill Gigliotti at the controls. AF-9 is one of the first two F-35A production aircraft that will be delivered later in 2011 to Eglin AFB, Florida, where it will be used for pilot and maintainer training.

Photo By Carl Richards

16 May 2011

CF-2 Delivered To Pax
Marine Lt. Col. Matt Taylor landed F-35C CF-2 at NAS Patuxent River, Maryland, for the first time. Taylor ferried the second F-35C on a 2.9-hour flight from Fort Worth, Texas. The ferry was Flight 6 for F-35C CF-2. The second F-35C joined five other F-35s operating at the test site.

Photo By David Drais
21 May 2011
First F-35 Airshow Appearance
F-35C CF-2 successfully completed the first F-35 public flyby at the Joint Base Andrews NAF Washington Joint Services Open House airshow in Suitland, Maryland, during the opening ceremony. The appearance was Flight 7 for CF-2, which was piloted by Navy Lt. Cdr. Eric Buus. 
Photo By Andy Wolfe

CF-3 First Flight
Lockheed Martin test pilot Dan Canin was at the controls for the first flight of F-35C CF-3. The flight, from NAS Fort Worth JRB, Texas, lasted 0.7 hours. It was cut short due to weather. 
Photo By Angel Delcueto

25 May 2011
Most Flights In One Day
The F-35 program completed the most flights in one day with a combined total of ten flights at all three flight test locations. 
Photo By Darin Russell

First Flight For Norman
Al Norman, the new F-35 chief test pilot, completed his first F-35 flight. Norman flew F-35A AF-4 on a one-hour mission from Edwards AFB, California. The mission was Flight 31 for AF-4. 
Photo By Angel Delcueto

31 May 2011
AF-1 Reaches Mach 1.53
Lockheed Martin test pilot Jeff Knowles flew F-35A AF-1 to Mach 1.53, the fastest speed to date for the F-35 fleet. The milestone was achieved during a flutter test flown by Knowles from Edwards AFB, California. 
Photo By Tom Reynolds
2 June 2011
Edwards Adds Another Pilot
Vince Caterina, a US government test pilot, became the twenty-third pilot to fly the F-35 when he took off from Edwards AFB, California, in F-35A AF-2 for a 1.6-hour test mission. The test mission was Flight 128 for AF-2.
Photo By Darin Russell

3 June 2011
CF-3 To Patuxent River
Lockheed Martin test pilot Dan Canin ferried F-35C CF-3 to NAS Patuxent River, Maryland, during a 2.9-hour flight from Fort Worth, Texas. The ferry was Flight 5 for CF-3. The aircraft joined six other F-35B/Cs being flown at the US Navy flight test center.
Photo By David Drais

13 June 2011
Pax Adds A Test Pilot
Navy Lt. Chris Tabert became the twenty-fourth pilot to fly the F-35 when he flew F-35B BF-3 on a 1.1-hour mission from NAS Patuxent River, Maryland. The mission was Flight 115 for BF-3.
Photo By Andy Wolfe

20 June 2011
1,000th F-35 Flight
Air Force Lt. Col. Leonard Kearl was at the controls for the 1,000th F-35 flight. The 1.8-hour flight, completed in F-35A AF-6, originated from Edwards AFB, California.
Photo By Paul Weatherman

25 June 2011
CF-2 To Lakehurst
Navy Lt. Cdr. Eric Buus ferried F-35C CF-2 to the Naval Air Engineering Station at Lakehurst, New Jersey, where the aircraft will undergo jet blast deflector ground testing. Jet blast deflector testing ensures the aircraft is compatible with jet blast deflectors installed on US aircraft carriers.
Photo by Michael Jackson
Less than a year later, the burned-out remains of the Hindenburg at NAF Lakehurst, New Jersey, signaled the end of the era of large, hydrogen-filled rigid airships. Today, the term airship usually refers to a 190-foot-long, helium-filled non-rigid blimp carrying TV cameras.

But in 2013, an idea once old will become new again when the captain of the first SkyTug issues the traditional command: “Up ship.” Then, this hybrid airship—a vehicle nearly the length of a football field that is part blimp, part aircraft and is capable of carrying twenty tons of cargo—will lift off for the first time. And by 2016, the captain of an even larger airship—one nearly the length of three football fields and capable of carrying one million pounds of cargo—could issue the same command before starting a trip across the Atlantic.

The revived interest in airships can be directly linked to global commerce. More than 36 billion tons of cargo—everything from flowers to food to Formula 1 race cars—are shipped around the world annually. But in the last twenty years, the military has also seen a need to quickly move large quantities of everything from relief supplies to tanks into areas that often don’t have adequate—if any—infrastructure.

“There is a big gap between using a ship and using an aircraft to haul cargo in both the commercial and the military worlds,” notes Dr. Bob Boyd, the hybrid airship program manager at the Lockheed Martin Skunk Works, the company’s advanced technology development organization in Palmdale, California.

“A ship can carry a lot and is inexpensive, but it’s also slow. It costs a commercial shipper between six and ten cents per ton mile—moving one ton of cargo one mile—to transport goods by ship. However, a ship takes two to three weeks to get from China to the United States,” observed Boyd. “A 747 air freighter can get cargo around the world in hours, but the cost is fifty or sixty cents per ton mile, and space is limited. With the hybrid airship, we’re looking at transporting a lot of goods in about three days for around twenty-five cents per ton mile. We’re trying to fill that middle niche.”
COMpletely new design

Development of new airship technologies started in 1990 when Skunk Works engineers looked at buoyant lift system vehicle concepts—that is, lifting by helium alone—for a commercial shipping company. In 1999, Skunk Works launched an internally funded effort to develop a revolutionary aeronautical concept called AeroCraft, a hybrid airship that not only gets lift from the nonflammable helium inside its envelope, but from its aerodynamic shape as well.

“A number of issues are associated with non-hybrid airships,” Boyd noted. “They’re very large, which makes them difficult to steer; they don’t land on runways; they’re difficult to land in a crosswind; and they always land with their nose into the wind. They usually need a large circle of concrete to land on with a mooring mast to tether them. Since the idea was to have only minimal crew for economic reasons, the vehicle has to operate with a low crew workload.”

The key to the control issue was found by using movable engines and propellers that not only provide propulsion but also act as control surfaces working in conjunction with the airship’s rudders. The engines have to be economical to operate—smaller and burn less fuel than the ones on current aircraft—for the entire airship concept to be viable.

The development work done on the AeroCraft program showed a three-lobed envelope design flies better than the cigar shape of historic airships or the roughly oval profile of blimps. “This design gets about eighty percent of its lift from buoyancy and the other twenty percent from aerodynamics,” Boyd noted.

“The airship needs to be going about twelve knots to get airborne. There has to be wind over the body.”

The critical element to making a practical airship was the development of an air cushion landing system, or ACLS. The ACLS allows the airship to operate like a hovercraft over unimproved ground or even over water.

The landing pads are two interlocked ovals. A fan inflates the outer ring, which provides a shape and a semi-solid surface to land on. When parked, the fan in the inner ring runs in the opposite direction and creates a low-pressure cushion, essentially becoming a suction cup that keeps the airship from being blown around by the wind. This system eliminates the need for a mooring mast or acres of concrete.

“All our development work showed the need to build a demonstrator,” said Boyd. “We had to prove a hybrid airship could be built. We had to show we could park it, and it wouldn’t blow away. We had to show the entire system would work.”

P-791

At the Skunk Works, projects are designated with randomly chosen numbers so its nature or sequence is not revealed. The hybrid airship demonstrator was given the identifier P-791. The company-funded demonstrator, which is 123 feet long, fifty-three feet wide, and thirty feet high, was built in 2005. First flight came on 31 January 2006.

“P-791 was designed using a Mr. Potato Head approach,” Boyd continued. “All of the major components—cockpit, engines, fuel lines, control surfaces, ACLS pads—are attached on the outside of the envelope.” The only structures inside the envelope are two nose-to-tail curtains that run down the seam lines of the envelope’s three lobes to provide shape and strength and two air bags, called ballonets, that expand and contract to equalize pressure as the helium expands and contracts with altitude.
The envelope is woven Vectran, a lightweight, high-strength material similar to Kevlar. It was assembled using heat seal bonding or chemical bonding on the seams. “Airships are very low pressure—about 1/10th of one psi,” Boyd noted. “The Goodyear blimps get shot at all the time by idiots trying to bring them down. But the gas flow is so slow that the crew can land and patch the leak. We weren’t shot at, but if we had been, the envelope could have been repaired using a contact patch that’s just peel and stick.”

The engines and propellers are mounted on aluminum rings that allow vectoring up and down and left and right for climbing, descending, and steering. The forward engine mounts are lashed to the envelope, while the two aft engines are attached with a composite, wishbone-shaped assembly that fits along the contours of the envelope. The engine/propeller/mount combinations, called thrusters, give P-791 a top speed of about thirty knots.

Company test pilot Eric Hansen made the first two flights and was followed by Bill Francis. The pilots sat side by side in an enclosed gondola with flight engineer Tim Blunck. “It is difficult to detect small changes in the wind in a vehicle this large,” Boyd noted. “We developed a closed-loop digital flight control system that uses an ultrasonic anemometer pressure sensor to gather data. This system allows the pilot to simply put a line on the moving map display showing where he wants to go, and the system reacts, adjusts to conditions, and takes care of everything else.”

A total of six flights, each about thirty minutes long, were carried out in the P-791 test program. The tests were mostly ground handling demonstrations. When out of ground effect, the airship crew remained in the traffic pattern at Palmdale, staying below 2,000 feet.

“Everything worked as planned,” Boyd recalled. “We conducted engine-out operations, and the ship responded well. We even accidentally tore one of the landing pads and were able to land without incident. We ended up with a very strong design. We then started putting a business plan together for larger airships.”

BIG, BIGGER, REALLY BIG

A year after going on contract, Aviation Capital Enterprises, based in Calgary, Alberta, Canada, announced on 17 March 2011 that it had teamed with the Skunk Works to develop, build, test, and certify to US Federal Aviation Administration standards a family of hybrid airships designed for heavy lift, economical cargo transport. Aviation Capital will market the hybrid airship to the commercial market, while Lockheed Martin retains rights to the military market.

The first variant, called SkyTug, will be like a super-sized helicopter, only at about one-tenth the cost. SkyTug will have a range of up to 1,000 nautical miles at a cruise speed of sixty knots. It will be used on four- to eight-hour missions to support remote drilling sites or mines where there is no infrastructure for aircraft. The 290-foot-long SkyTug is scheduled to be flown in early 2013. The two airships called for in the initial contract will be built in Palmdale, as will any additional SkyTugs in the future.

The second variant, called SkyFreighter, is a regional lifter capable of carrying seventy tons of cargo. “An airship this size could..."
be an enabler for countries to expand their economies,” Boyd noted. First flight of a 400-foot-long SkyFreighter is expected to come in 2014.

Both SkyTug and SkyFreighter will be powered by piston diesel engines that will only vector up and down, as it was determined from P-791 testing that rudder turns only were sufficient for steering, so side-to-side slewing of the engines wasn’t necessary. A market exists for as many as fifty of the smaller airships.

The third and largest variant is called SkyLiner. This behemoth, expected to be flown in 2016, will measure 800 feet long and be capable of lifting 500 tons of cargo. SkyLiner, which will be powered by six turboprop engines each turning a large-diameter propeller, will be used on international or transoceanic routes. The ACLS pads on SkyLiner, which will measure eighty feet long and thirteen feet tall, will retract to reduce drag.

“SkyLiner will be ideal for goods like electronics, vegetables, or sports cars that have a short time/value exchange and are heavy and expensive to put on an aircraft,” Boyd said. The projected market could support a fleet of several hundred SkyLiners.

All three variants will have long, rectangular cargo containers attached underneath the envelope. The flight deck is located in front. Each box will have a roll-on/roll-off capability and will accommodate containers or pallets. The SkyLiner cargo box is 300 feet long, fifty feet wide, and thirty feet tall with an upper and a lower deck.

“The flight deck on SkyLiner will look more like a ship’s bridge than a cockpit. The SkyLiner will have room for galleys, lavatories, and bunks,” noted Boyd. “Like on a container ship, the minimal crew is there to make sure everything is running. Honestly, there won’t be a whole lot for the airship crew to do. The airship is going to be traveling in a straight line at about 100 knots for several days, so we are looking at ways to stream ESPN or HBO to the crew.

“The airship’s big advantage is it gets away from an airport,” Boyd continues. “A hybrid airship that can land anywhere only needs a cleared field next to a trucking terminal. Cargo comes off the airship and is hauled away in waiting trucks without needing an intermediate stop. Airships represent the next stage in the consolidation of the global transportation system.”

The P-791 demonstrator, now inflated only with air, sits in a hangar at the Skunk Works. One day, it may be seen as the progenitor of a revolutionary new generation of airships that span the globe. If these airships prove to be a commercial, military, and humanitarian success, P-791 could one day find itself in another large hangar—at the National Air and Space Museum.

Jeff Rhodes is the associate editor of Code One.
The S-3 Viking was described as the Swiss Army Knife of Naval Aviation for good reason. Throughout its nearly four decades of frontline service with the US Navy, the S-3 took on many roles ranging from carrier-based anti-submarine and antisurface warfare; to carrier onboard delivery; to tanking; and, finally, to an intelligence, surveillance, and reconnaissance asset.

The S-3 also served as a test aircraft. Over its career, special projects with names like Outlaw Viking, Gray Wolf, Beartrap Viking, Orca Viking, and S-3B Surveillance System Upgrade were tested on the Viking.

The Navy retired the S-3 from fleet service in 2009, but a trio of the remaining Vikings has once again donned lab coats—only now the research takes place at the NASA Glenn Research Center in Cleveland, Ohio, which has been conducting all manner of aeronautical research since 1942.

Early last decade, the Navy decided to retire the S-3 and, accordingly, started to draw down the Viking fleet. Around 2006, officials at NASA Glenn recognized the Viking’s potential as a research platform and worked with the Navy to get three S-3Bs transferred to the center.

The first aircraft, Navy Bureau Number 160607, is the prime test aircraft at NASA Glenn. This aircraft, which rolled off the assembly line in 1978 as the last of the 187 S-3s built, is now known as NASA 601. Flight testing is not a new tasking for this particular Viking as it had been assigned to VX-20, the S-3 test squadron at

James Demers
NASA Research Pilot

Alan Mickiewright
NASA Chief S-3 pilot
NAS Patuxent River, Maryland, for much of its career. After undergoing full depot-level maintenance and extensive modification that took nearly two years at NAS Jacksonville, Florida, NASA 601 was flown to Cleveland in January 2008.

Much of the military-specific equipment on the Viking was removed to reduce weight and maintenance costs. Other equipment was removed simply because it was not needed. “We fly this aircraft to collect data for a researcher. We need to get airborne, get the data, and get back on the ground,” noted Demers. “And we have to do that safely and reliably.”

To prepare the S-3 for its new role, the aircraft underwent a significant interior change. “We have eight aircraft at this center, and they all have standardized cockpit instrumentation,” said Demers. “For instance, the center has a commercial GPS navigation system in our T-34s, our Learjet, the Twin Otter, and in the S-3. That system is very effective for the type of flying we do, typically operating from commercial or general aviation airports. The spare parts for our cockpit instrumentation are all interchangeable. Our two center avionics technicians don’t have to know how to maintain multiple systems. Pilots can easily go from one aircraft to another.”

Aircraft-specific equipment now only takes up about the first third of the S-3’s main avionics bay. The additional space provides room for a set of nineteen-inch wide avionics racks that can be fitted with test-specific gear, such as sensor controls and recording equipment. What had been the two crew stations in the aft cockpit now houses a computer keyboard with a connection that allows data from the aircraft’s two independent data systems to be loaded directly onto a researcher’s computer through a 1553B high-speed data bus.

Orange grab handles, Plexiglas covers over aircraft avionics and electrical systems, and new LED lighting were also installed in the avionics bay. “The center’s Safety Committee said we had to ‘baby proof’ the jet,” noted Demers. “Non-regular flyers, such as the researchers, may only make several flights over the course of their research project, but we have to be able to accommodate them.” Part of that accommodation involved deactivating the ejection seats.

Through early 2011, NASA 601 had accumulated about 100 test hours on aeronautical research and earth sciences projects. The Great Lakes Environmental Assessment Mission, or GLEAM, is a good example. “This project is designed to measure—from the air—algae growth found in the Great Lakes. We first tested the sensor on the T-34 and then took the sensor to altitude on the Learjet. Later this year, we’ll conduct an operational test with it on the S-3,” said Alan Micklewright, NASA’s chief S-3 pilot. “The S-3 will enable more data collection than from either of those other two aircraft.”

One of the other two NASA S-3Bs serves as a fit-and-function ground test vehicle. The role of the other Viking, now a spare, could soon grow. The Glenn Center has obtained several of the large underwing cargo pods used on the US-3A carrier onboard delivery aircraft in the 1970s. Rather than modifying the aircraft for a future test, the NASA team wants to modify the pods to carry sensor equipment that can easily be switched out for future tests.

Potential projects for the S-3 include next-generation airspace communications research, propulsion research, swept wing icing, and atmospheric science projects. The aircraft may also be used in the FAA-sponsored Unmanned Aerial Systems in the National Airspace System research. “The S-3 operates in a niche part of the flight envelope, and it’s very cost-effective for NASA to fly,” observed Micklewright. “But the reality is that this aircraft has to earn its keep. We’re always looking for new projects or to team with other agencies, like with the Air Force Research Lab, on their projects.”

“We don’t fly our S-3 from a carrier; we don’t have nugget pilots; and we don’t beat the aircraft up in daily shipboard operations. We do research flights under controlled conditions and then put the aircraft to bed in a hangar. We have experienced maintainers and a large supply of spare parts,” concluded Micklewright. “The S-3 is going to be a valuable research platform for the foreseeable future.”

Jeff Rhodes is the associate editor of Code One.
Assigned to Air Force Reserve Command's 910th Airlift Wing, the 757th AS is the only large-area, fixed-wing aerial spray unit in the US Department of Defense. Aircrews, maintainers, and a couple of the unit’s six entomologists—almost half of the insect specialists in the US Air Force—deploy more than twenty-five times a year for extended operations at locations ranging from southern Florida to Mountain Home AFB, Idaho, and from Parris Island, South Carolina, to Hill AFB, Utah.

Flying C-130Hs equipped with palletized Modular Aerial Spray System, or MASS, units, the 757th AS crews spray thousands of acres every spring, summer, and fall. “A C-130 can spray up to 150,000 acres per day,” noted Lt. Col. (Dr.) Mark Breidenbaugh, who heads the entomology department at Youngstown. “Some places, a spray-equipped Hercules is literally the only way to manage invasive plants or to apply pesticide.”

The mission of the 757th AS, known as the Blue Tigers, dates back to the Pacific theater in World War II. Eradicating disease-carrying insects, or vectors, from the air became a priority once the US military saw how many hundreds of thousands of Soldiers and Marines became incapacitated—and how many died—from malaria and other diseases. The Special Aerial Spray Flight was created soon after the Air Force became a separate service in 1947.

Air Force crews flew insect spray missions during the Korean War with T-6 and C-46 aircraft. During the Vietnam conflict, aircrews, primarily flying the UC-123 Provider transport, carried out 1,500 insect control missions in addition to the thousands of flights spraying the controversial defoliant Agent Orange.

“There is now an executive order preventing using herbicide in war,” noted Breidenbaugh. “And in this unit, we are stricter than the strictest state environmental laws and safety requirements when it comes to handling and applying pesticides and herbicides. We closely monitor the health of everyone involved. That all came about because of Agent Orange.”

On 1 April 1973, the active duty Air Force UC-123K spray aircraft and the service’s entomology staff were transferred to the Air Force Reserve. The aerial spray mission shifted from the 355th Tactical Airlift Squadron at Rickenbacker ANGB, Ohio, to the 757th AS at Youngstown in January 1992. At the same time, the spray...
aircraft changed from the C-130E to the C-130H.

TOOLS OF THE TRADE
A dedicated spray maintenance flight was also established in 1992 to take care of, load, and operate the MASS units. This group of twenty technicians, part of the wing’s 910th Maintenance Squadron, works out of its own garage at one end of the Youngstown flightline. “Many of us have been here for twenty years,” notes CMSgt. Ken Pauley, the aerial spray flight chief. “You have to be a bit of a zealot in this job.”

Conair Aviation, a Canadian aviation services company, delivered the first MASS unit in 1988. Each unit weighs 8,900 pounds empty and takes up three pallet positions in the C-130. The sixth and final unit arrived at Youngstown in 1992. “These spray systems are the only ones in the world like them,” Pauley noted.

Each MASS unit can carry 2,000 gallons of pesticide, herbicide, or dispersant, but only one type of agent is carried at a time. The system consists of two 500-gallon stainless steel tanks, two 500-gallon aluminum tanks, one 200-gallon aluminum flush tank, in addition to pumps, pipes, and a control station. The heavier stainless steel tanks are required for agents that are corrosive to aluminum, which limits overall capacity for missions requiring those agents. The four main tanks are tilted up toward the flight deck to use gravity to help them drain completely.

In the maintenance flight garage, the MASS units are stored on individual flatbed trailers. Each unit has a dedicated crew chief and assistant, who are allowed to personalize the systems with artwork on the control panel. The flatbeds allow for ease of transport and installation of the MASS units in one of the four 757th AS C-130s that have been modified for aerial spray. The units are transferred from the flatbed to a cargo loader and then rolled directly onto the aircraft. Installation takes about an hour.

The primary spray aircraft, all delivered in the late 1980s and early 1990s, feature upgraded electrical connections, paratroop doors with a sealable port that accommodates the four-inch diameter pipe for the spray nozzles, and internal plumbing for an inner and outer set of spray bars mounted under each wing. “The spray bars give us extra coverage per pass, but they are not used on most missions,” notes Townsend. “We mainly use the door nozzles.” The nozzles and spray bars are installed on the aircraft after arrival at a deployed location.

Two C-130s assigned to Youngstown’s second flying squadron, the 773rd AS, are partially modified for spray operations. “We only have manning authorization for the four primary aircraft,” said Townsend. “We’d only use the other aircraft in an emergency. Those C-130s are the ultimate spares.”

AIRBORNE EXTERMINATORS
“Flying at low altitudes and fairly high speeds in congested areas with towers isn’t for everyone,” observed Townsend. “This is a high-competency, high-visibility program. Experience and performance really matter. It may take five years for an experienced copilot to become a spray mission commander.” Qualification for spray navigators and flight engineers is much the same.

“Loadmasters have to have about 1,000 hours of flight time before we’ll consider them for the spray mission,” said Townsend. Two
loadmasters are carried on spray missions, one to operate the MASS control panel and the other to monitor the tanks, lines, and pumps and to ensure the agent is being dispensed. “There is, by necessity, a lot of coordination between the flight deck crew and the two spray operators in the back of the aircraft,” added Pauley.

Once trained, a MASS-qualified crewmember has to participate on two training or operational flights every six months and at least one actual spray mission every calendar year. The training missions can come at Youngstown or at the end of a deployment when one final mission is flown over the previously sprayed area to flush the large tanks with water or, for some agents, with mineral oil. One of the spray units, MASS 6, is only used for local training flights. It has never been filled with anything but water as both a safety and a liability concern.

“Spraying is not just quantity dumping,” stated Townsend. “We need to make sure the agent goes where we want it to and doesn’t drift onto a farmer’s field. We also have to put out the exact dosage per acre.” For instance, a shot glass of insecticide mixed with water is enough to kill mosquitoes over an entire acre. Breidenbaugh noted that the right size droplet to kill a flying mosquito is roughly twenty microns. “A fifty micron droplet will kill a mosquito simply on impact, but it wastes material and puts more chemicals in the environment than necessary.”

Although the 757th AS now has seven fully qualified spray crews, it is working to get all of its aircrew members qualified because business is booming. After Hurricanes Katrina and Rita in 2005, squadron crews treated nearly 2.9 million acres for mosquitoes and flies in Louisiana and Texas, the largest aerial spray mission ever conducted under AFRC. More than 771,000 acres were treated in Louisiana after Hurricane Gustav in 2008. More than 30,000 acres of open water in the Gulf of Mexico were treated with dispersant in the aftermath of the Deepwater Horizon oil rig disaster in 2010.

“We now regularly conduct mosquito abatement operations on federal installations in nine states,” noted Breidenbaugh. “We’ve been very successful at controlling the cheatgrass at Mountain Home, which allows native prairie grasses to reestablish, which reduces the potential for range fires. We’ve done research on droplet drift through foliage and validated computer models. We’ve got a lot going on.”

OUT IN THE FIELD

Since 1983, one of the regular stops for the 757th AS is Hill AFB, Utah. This spring, two aircrews and six spray maintenance flight technicians deployed to the base near Salt Lake City to treat the bombing ranges in the North Utah Test & Training Range, an isolated, desolate expanse of land west of the Great Salt Lake. The objective of the mission is to rid the ranges of Halogeton, an invasive, non-native succulent plant that grows fast and is toxic to animals. Killing this plant clears the range to allow weapons testers to see results immediately and explosive ordnance disposal technicians to disarm weapons unimpeded.

The herbicide used on the Hill ranges is called Krovar. Like all the agents used by the MASS crews, Krovar is delivered from local vendors—spray materials are never transported in raw form on the aircraft as a safety precaution. The load crews mix the Krovar with blue dye and water in specific amounts, an additive to keep the mix from foaming in the tanks, and an agent to increase the surface tension of each droplet to control drift. After the first batch of 1,800 gallons is loaded into the MASS unit, a second batch is prepared for the second aircraft. Crews apply about twenty-two gallons of mixture per acre.

The aircrews stagger their takeoffs, so while one crew is spraying, the second aircraft is being loaded. Each lift, as the crews call them at Hill, requires about twenty minutes of transit time, about thirty minutes to spray, and about twenty minutes back. Each crew
flew two lifts per day over the ten-day deployment.

A commercial agricultural spray GPS attached to the upper escape hatch provides an additional tool for the navigator on most missions. But at Hill, the spray crews take advantage of an old navigational tool—the human eye.

The Utah ranges are so wide open, a truck is parked at each end of the areas to be sprayed—which, in 2011, were the nearly 1,300 acres designated as Targets 21 and 24. The C-130 pilot lines up on the truck, and the navigator, taking winds into account for drift, calls “spray on” as the aircraft passes over the first vehicle. The loadmaster then opens the nozzles. The navigator calls “spray off” before the aircraft passes over the truck at the other end of the target. The aircrew repositions, and the drivers in the trucks move forward thirty-five feet to park in the middle of the next swath to be sprayed. Because of the dye, it appears the crew is using a roller to tint the desert blue as they fly back and forth.

As at all operating locations, the MASS unit tanks were flushed at Hill. But just like after every operation, the units were taken apart and thoroughly cleaned and reassembled once back at Youngstown. The biggest issue with the MASS units is their age, increasing the need for upkeep and maintenance, and their uniqueness. Because these systems were the only MASS units ever built, spare parts are becoming a serious issue. “We now make a lot of our own parts,” said Pauley. “One of our crew chiefs found some new and better pipe endcaps in a junkyard.”

“We continue to get calls from other Department of Defense installations as word gets out about what we can do,” concluded Townsend. “New missions for us are being discussed, such as supporting US Africa Command and fighting malaria there or providing a capability to remediate large chemical spills. We have a big job, and it’s getting bigger.”

Jeff Rhodes is the associate editor of Code One.
“Pilots never see the outside world through a canopy. They see an image of it.” Mike Jones, a Lockheed Martin Technical Fellow in optics, electro-optics, and directed energy, uses these lines to introduce visitors to the canopy mapping laboratory at the Lockheed Martin facility in Fort Worth, Texas. The laboratory, near the F-35 production line, is a required stop for every canopy before it is installed on a Lightning II.

“Every manufactured canopy optically distorts the view of the outside world in a unique way,” added Jones, who has been influential through the years in devising instruments to quantify these distortion differences for the F-16 and F-22. He is the inventor of the advanced canopy mapping system used for the F-35 canopy.

Mapping the optical properties of a canopy is akin to reverse engineering the optics of a pair of prescription glasses. However, these glasses don’t rest on noses—they surround the heads of fighter pilots. The mapping process is necessary because aerial and ground targets viewed through head-up and helmet-mounted displays are distorted by canopy thickness, curves, and material. Simply put, the canopy can have a direct effect on weapon accuracy.

Optical deviations vary widely for azimuth, which is defined by left and right head movement, and elevation, defined by up and down movement. Deviations also vary with eye position in the cockpit. That position changes with head movement and seat height.

The output of a canopy mapping system generates data that allows compensation for these optical deviations in the form of sets of numbers called look-up tables. These tables, which are associated with a specific canopy, interact with the avionics software to correct pilot displays. If a canopy is changed on a particular airframe, the look-up table must be reloaded as well.

The defined viewing area depends on the aircraft and the targeting system. For example, a more detailed map is required for an F-16 equipped with a joint helmet-mounted cueing system than for an F-16 without that system.

“The accuracy requirements and larger range of viewing angles for the helmet-mounted display system in the F-35 forced us to explore new technologies and approaches for compensating for canopy optics,” noted Jones. “Besides, the mapping systems we have for the F-16 and the F-22 could not physically accommodate the shape and structure of an F-35 canopy.”
Jones says the idea for the F-35 canopy mapper came to him from his background in directed energy, wavefront sensors, adaptive optics to correct for time-varying aero-optical and atmospheric turbulence, and even from his background in astronomy. The subject is as complicated as that last sentence reads.

Jones elaborated: “The key idea that occurred to me is that the F-35 canopy optically distorts and deviates the passage of light through it in a manner similar to aerodynamic flow fields and free-stream atmospheric turbulence, except that the optical deviation does not vary with time. Instead, optical deviation varies with where a pilot looks through the canopy. Once the canopy is manufactured, it does not change the way it deviates the outside world. So it acts as a frozen turbulence field. Deviation, which is not a trivial matter, is a function of where and from what direction an object is viewed through it.”

Previous canopy mappers use only one or two probe beams. The beam source is placed at specific locations inside the canopy and then projected through the canopy to a sensor. Deviation is measured as a difference in beam angle with and without the canopy. This process made measurement of canopy optical deviation over the total field of regard and for all head positions time consuming and tedious.

The older type canopy mappers are highly serial in nature. The measurements are taken sequentially for each azimuth and elevation angle one at a time at one eye position. Then the canopy has to be moved to the next eye position and the complete set of azimuth and elevation angle measurements must be repeated for each of several possible eye positions.

The F-35 advanced canopy mapper, or ACM, simultaneously measures optical deviations for the total region for a pilot’s head and eyes by using a large collimator and a laser to produce a large pattern of test beams into the wavefront sensors. This approach significantly reduces the time required to measure a canopy by eliminating the need to take measurements at different eye positions. “We still have to measure at different azimuth and elevation angles,” explains Jones, “but changes in optical deviation with head position are captured simultaneously in a single camera frame.”

Changes in azimuth angles are handled by rotating the canopy on a platform about the central test beam projector. Changes in elevation are handled by placing the wavefront sensors on a moveable arm. Canopy rotation motors and wavefront sensor cameras, as well as real-time data acquisition and storage, are fully under computer control. Canopies are lowered onto and removed from the fixture by the same overhead crane system that moves major assemblies on the F-35 production line.

The F-35 ACM has already demonstrated a significant savings in time and labor costs of at least forty times better than previous mapping technologies and equipment. Previous mappers would require more than one week of measurement time to fully measure the F-35 canopy to the same resolution and range of angles. The new mapper finishes its complete set of measurements in only about one hour after the canopy is loaded—a significant benefit over the thousands of canopies that will have to be measured during F-35 production.

The prototype ACM has been operational since 2008. It is the product of a creative and talented joint engineering team between the F-35 program, the Lockheed Martin ADP (Advanced Development Projects, the Skunk Works) Mission Systems and Avionics group, and LM Aero Electronic Laboratories and Ranges personnel. Two more advanced canopy mappers are in the works to handle the increased F-35 production rates.

Eric Hehs is the editor of Code One.
ABSOLUTE BLACKBIRDS

IN JULY 1976, THREE US AIR FORCE AIRCREWS, FLYING THE MACH 3+ SR-71 HIGH ALTITUDE RECONNAISSANCE AIRCRAFT, SET THREE ABSOLUTE WORLD AVIATION RECORDS—THE MAXIMUM PERFORMANCE BY ANY TYPE OF AIRCRAFT—IN TWO DAYS. THOSE MARKS STILL STAND IN 2011. ONE RECORD, ABSOLUTE SPEED, IS STILL OFFICIALLY RECOGNIZED AS THE FASTEST SPEED HUMANS HAVE EVER TRAVELED IN AN AIRCRAFT. BY JEFF RHODES

The keeping of aviation records goes back to October 1905 when representatives from eight countries, including the United States, met in Paris to form the Fédération Aéronautique Internationale, or FAI. The FAI became the world governing body for official aircraft—and later, spacecraft—records and to supervise sport aviation competitions. The National Aeronautic Association, or NAA, is the US representative to the FAI.

A year after the FAI was formed, the first officially recognized records were set. Brazilian Alberto Santos-Dumont flew his box kite-like aircraft, called 14-bis, over a really small closed course—a circle of 25.8 feet—in Bagatelle, France, on 14 September 1906. That November, Santos-Dumont increased the closed course distance record to 733 feet and set the first recognized speed record—25.6 mph.

Seventy years later, US Air Force officials wanted to make a special, notable flight with the SR-71 to celebrate the US Bicentennial. An around-the-world speed flight was considered first but rejected. “We then looked at what could be accomplished on a typical training sortie,” said Al Joersz, who, as an Air Force captain in 1976, was chief of SR-71 standardization/evaluation for the 9th Strategic Reconnaissance Wing at Beale AFB in northern California, where the now-retired SR-71s were based.

Looking through the record book, unit officials determined there were three existing absolute records that their aircraft, which never had an official nickname but was universally referred to as ‘Blackbird,’ could break—Speed Over A Closed Circuit, Altitude In Horizontal Flight, and Speed Over A 15/25 Kilometer Straight Course.

“Jim Sullivan, our squadron operations officer and the pilot who set the New York-to-London speed record in the SR-71 in 1974, came to me and told me I was going to set the absolute speed record,” noted Joersz. “We had several crews deployed, so the most experienced crews we had on hand were picked.” Because of the intense crew coordination required, SR-71s were always flown by dedicated two-man crews.

Beale’s wing mission planning organization coordinated the flights, working with both the FAA and NAA. “We flew the mission a couple of times in the simulator,” recalled Joersz. “That sim was all analog—our moving map consisted of a scrolling paper map—but it did prepare crews for flights.”

Approvals for the planned Fourth of July flight date were not granted in time, but all was ready by month’s end. The flights began and ended at Beale, but speed and altitude measurement took place on the instrumented ranges at the Air Force Flight Test Center at Edwards AFB in southern California.

Maj. Pat Bledsoe, the wing chief of standardization/evaluation (the wing then—as now—also operated the U-2 reconnaissance aircraft), and his reconnaissance systems officer, or RSO, Maj. John Fuller, were first up on 27 July, aiming to break the Speed Over A Closed Course record. Like for Santos-Dumont, a giant circle set the outer boundaries of the 1,000 km (621 mile) closed course. Bledsoe flew Blackbird 958, Air Force serial number 61-7958, on six straight-line paths, essentially circumscribing the inside of circle, entering and leaving the track at the same point. He completed the course at a speed of 2,092.29 mph, easily breaking the 1,852.61 mph record set by Mikhail Komarov in the E-266, a highly modified Soviet MiG-25, in 1967.

Unfortunately, scattered clouds over Edwards later that day negated both the Altitude In Horizontal Flight attempt...
by Capt. Bob Helt and his backseater, Capt. Larry Elliott, and the Absolute Speed record run by Joersz and his RSO, Maj. George Morgan. “For the Absolute Speed record, the rules say that the aircraft’s altitude can’t vary by more than 150 feet from the assigned altitude over the course,” noted Joersz. “Once the clouds came in, altitude couldn’t be measured accurately from the ground. So we flew again the next day.”

On 28 July, Helt and Elliott had a problem with their assigned aircraft, so they hopped into another SR-71, serial number 61-7963, to set the sustained altitude record. The key to setting this mark was quickly accelerating and holding the aircraft steady at altitude. Wilbur Wright had set the world’s first altitude record of eighty-two feet on 13 November 1908. The record Helt and Elliott set was more than an order of magnitude better—85,069 feet, easily beating the previous record of 80,257 feet set in May 1965 by US Air Force Col. R. L. Stevens in a YF-12, one of the SR-71’s predecessors.

To set the Absolute Speed record, Joersz and Morgan, flying in Blackbird 958, had to cross the electronic timing gate, travel the twenty-five meter course, cross a second timing gate, turn around, and repeat the course from the opposite end to negate the effect of winds. The crew had an unstart—Blackbird-speak for an engine shutdown—just after crossing the timing gate on the second leg while flying at a speed of Mach 3.3.

“On an unstart, the aircraft yaws and the nose pitches up,” Joersz noted. “There is a five-step checklist to get the engine relit. I knew I had to keep the nose down to stay in the 150-foot box, so that’s what I concentrated on. By the time we’d gone through the checklist, we’d already passed the second gate. Still, we exited the gate at Mach 3.2.”

The officially recorded average speed of the two legs was 2,193.16 mph, besting the previous mark of 2,070.101 mph also set by Stevens in the YF-12. While the SR-71 was operational, several pilots flew the Blackbird faster than the official record but not during sanctioned record attempts.

“The records weren’t a big deal at the time,” said Joersz. “I was just happy to fly the aircraft. I flew an instructional sortie the next day.”

In 2006, the FAI reduced the number of absolute records to the best-ever performance without qualification—speed, altitude, greatest payload, and distance. The records set by Bledsoe and Helt are now classified as Class C and C-1, Landplane records, meaning they still exist, but have been moved off the first page of the official record book.

“One of our maintainers came up to me after the record flight and said, ‘This is the flight people will remember. It’ll last a long time,’ ” recalled Joersz, who rose to the rank of major general and later had a twelve-year career with Lockheed Martin in advanced development before retiring in 2010. “After our flights, the emphasis in aerospace as a whole shifted from speed and altitude to maneuverability and stealth. The records we set have now stood for thirty-five years. It turned out that maintainer was right.”

Jeff Rhodes is the associate editor of Code One.
WE NOTED IN OUR LAST ISSUE THAT THE CONVAIR SUPER HUSTLER HAD TO BE SMALL BECAUSE IT WAS TO BE LAUNCHED FROM BELOW A B-58 HUSTLER. IT HAD TO BE FAST TO DELIVER ITS PAYLOAD WITHOUT BEING INTERCEPTED. AND IT HAD TO FLY HIGH TO REACH SUPersonic speeds AND TO AVOID DETECTION. SMALL, FAST, AND HIGH-FLYING WERE CHARACTERISTICS THAT ALSO MADE THE AIRCRAFT A LOGICAL CANDIDATE FOR A RECONNAISSANCE PLATFORM TO REPLACE THE LOCKHEED U-2.
The secretive U-2 took to the skies for the first time in the summer of 1955, flying at altitudes above 70,000 feet to avoid detection. Even at those heights, however, the U-2 was picked up and tracked by ground-based radars on its earliest operational mission over Eastern Europe in the spring of 1956. Nonetheless, the United States continued to use the aircraft through the late 1950s to collect valuable intelligence on the military capabilities of the Soviet Union, Warsaw Pact, and other countries. Since becoming operational, the U-2 aircraft has continued to function as the premier reconnaissance platform for the United States.

Lockheed, with the assistance of Lincoln Laboratory at the Massachusetts Institute of Technology, attempted to address the U-2’s susceptibility to radar detection with coatings and external structures in Project Rainbow initiated in August 1956. The project was unsuccessful and was cancelled in May 1958. Even before Project Rainbow, the US Air Force funded some U-2 successor studies as early as 1955. However, none of these studies showed promise.

The CIA, the original customer for the U-2, took up the challenge in the fall of 1957 when it initiated its own U-2 successor program. Richard Bissell, project manager for the U-2 at the CIA, led the effort. Lockheed and Convair were invited to participate in the classified program. Bissell enlisted the Land Panel to act as a scientific advisory board to help evaluate aircraft proposals. The panel was named after its chairman, Edwin Land, founder of the Polaroid Corporation.

Lockheed’s efforts led to a series of design configurations called Archangel. Convair’s efforts led to a design called FISH—short for First Invisible Super Hustler.

RECONNAISSANCE VERSION SUPER HUSTLER

While no design for a reconnaissance version of the Super Hustler was completely invisible, early versions were more visible to radars than later ones. FISH origins can be traced to a standard version of the Super Hustler with cameras and sensors added to the front section of the aircraft. The variant was presented to the Air Force in May 1958.

The equipment on the Super Hustler included an ultrahigh-resolution camera located just behind the nose wheel compartment that provided up to 5,500 nautical miles coverage. A high-resolution X-band radar located in the next compartment provided a range of fifty nautical miles and a resolution of 200 feet at twenty nautical miles. The compartment also contained a scanning radar with a range of 180 nautical miles. A data recorder, added to the compartment behind the cockpit, collected information from both radars as well as video from the television camera in the nose.

The range figures for the reconnaissance version were about 8,000 nautical miles for a composite aircraft, which consisted of a manned stage and a booster. The manned stage alone had a range of 5,400 nautical miles. Operating speeds and altitudes were the same as for the Super Hustler (Mach 4 and 80,000 feet). This reconnaissance version of the Super Hustler accounted for about five pages of a much larger report that addressed various uses and basing strategies for the Super Hustler.
SPECIAL PURPOSE SUPER HUSTLER

Reconnaissance soon became a primary focus for the Super Hustler. When it was formally presented as a preliminary study for the US Air Force—not the CIA—in September 1958, the aircraft was initially called the Special Purpose Super Hustler. This variant of the Super Hustler was a single-stage aircraft. That is, the design deleted the unmanned ramjet-powered booster stage that carried the nuclear payload planned for the standard Super Hustler.

Removing the booster stage allowed the manned stage to be stretched thirty-six inches. Not only did this additional space make room for more fuel in the main fuselage, but it also made room for either a photoreconnaissance package or a signals intelligence package in the nose. The Special Purpose Super Hustler featured an updated navigation system and larger ramjet engines. The design gave an option for replacing one member of the two-person crew with a large vertical camera.

The photoreconnaissance package offered two options. The first option consisted of one large panoramic camera with a twenty-four inch focal length. At the aircraft’s cruising altitude of 90,000 feet, the camera could cover an area of thirty miles by 1,500 miles while producing individual images measuring nine inches by thirty-eight inches. The second option, called a dual-purpose photoreconnaissance installation, consisted of three smaller 2.25-inch square format cameras (three-inch focal length) designed to locate targets and one larger 4.25-inch by eighteen-inch panoramic camera (twelve-inch focal length) designed to collect technical intelligence.

The signals intelligence package, called a ferret reconnaissance system, was designed to detect and locate radar and radio stations and to analyze signals produced by those stations to determine the order of battle intelligence—basically, how an adversary would respond electronically to an attack. The package had modular, removable units and flush-mounted antennas.

The initial design avoided detection from threat radars by operating at high speeds and high altitudes. Radar cross section was addressed by the aircraft’s small size and by its flat bottom (even though the inlet was on the lower fuselage). The presentation included a size comparison to the proposed B-70 and the existing B-52 to emphasize the advantage of the Special Purpose Super Hustler’s small size. Its small size and operational altitude also reduced sonic booms, which were predicted to be around 110 decibels at Mach 4 as measured at sea level.

The gross weight of the initial Special Purpose Super Hustler was 31,200 pounds, which included 18,750 pounds of fuel. By comparison, the gross weight for the manned stage of the two-stage Super Hustler was 20,190 pounds, which included 11,070 pounds of fuel. The Special Purpose Super Hustler had a cruise speed of Mach 4, a maximum altitude of 90,000 feet, and a range of 4,500 nautical miles.

CURVED EDGES

A month after the preliminary study was presented to the US Air Force, Convair was asked by Richard Bissell to exploit the reconnaissance capabilities of the Super Hustler concept. The request resulted in a Special Purpose Super Hustler Feasibility Study that was presented to the Land Panel for initial evaluation on 11 November 1958.

The study included two basic aircraft configurations. The first configuration, called a minimum change configuration, had a wing area similar to the previous special-purpose design. However, the wing’s leading edges were slightly curved outward to lower the radar cross section of the aircraft. Wing length was 28.1 feet; wingspan was 19.8 feet. The second configuration had much larger curved wings with wing length of 38.0 feet and wingspan of 34.2 feet. This second configuration became the recommended configuration.

The recommended configuration was refined and labeled Configuration 220. By December 1958, the design was 48.8 feet long and 8.7 feet tall. It had a gross weight of 35,000 pounds and an empty weight of 15,300 pounds.

Like the Super Hustler, this early version of FISH had a nose tip that hinged downward and tucked below the fuselage to deal with the space limitations of the B-58 carrier. (The nose could be swung up after the landing gear of the B-58 was retracted.) The aircraft was powered by two Marquardt MA24E ramjet engines with 41.5-inch diameter
variable-geometry exit nozzles. A Pratt & Whitney JT12 series turbojet engine was nestled between and just in front of the ramjets. A bifurcated intake on the lower side fed both ramjets and the turbojet.

Two landing vision arrangements were outlined in the study. The first had the same droop nose design used on the Super Hustler in which a hinge just behind the canopy tilted the forward section of the aircraft downward eleven degrees so the pilot could see over the nose of the aircraft for landings. In this configuration, the one-pilot crew sat thirteen inches to the left of the aircraft centerline to make room for a fuel tank on the pilot’s right. Insulated metal covers protected the flush-mounted canopy glass from the high surface temperatures produced by flight at Mach 4.

The second landing vision arrangement was more standard, with a protruding canopy structure allowing the pilot vision over the nose. In this configuration, the pilot sat on the centerline. The canopy glass consisted of three layers: the outer layer was a silica glass; the middle layer was a radiation shield; and the inner layer was a conventional laminate. This more standard arrangement was further refined in March 1959 as Configuration 226.

The mission profile for the initial versions of FISH involved launching the aircraft from the B-58 carrier at Mach 2.2. FISH would then climb and accelerate to Mach 4 in three minutes. In about another minute, the aircraft would reach its 90,000-foot cruising altitude where it would cruise at Mach 4 for about forty-nine minutes, turn 180 degrees in about nine minutes, and then cruise back to its home base for another forty-two minutes.

The descent took the aircraft from Mach 4 to Mach 0.4 in approximately twenty-two minutes. The 4,150 nautical mile range did not include 216 nautical miles of fuel reserve on the turbojet engine. High-energy fuel containing a boron compound added another 1,000 nautical miles to the range. Flight control was made possible by two elevons, two vertical fins, two rudders, and the nose tip that could be deflected for trim control.

At Mach 4 and 90,000 feet, the temperature prediction for the leading edges of the wings and engine inlets, the hottest external parts of the aircraft, was 915 degrees F. To deal with these temperatures, the wing leading edges were formed of triangular inserts made of pyroceram, a ceramic material developed by Corning that was impregnated with graphite to reduce radar reflections. The ceramic inserts were held in place with alternating triangles of Rene 41, a high-temperature nickel alloy. (René 41 was used for the outer shell of the Mercury space capsule.) The engine inlet was made of Inconel, a nickel-chromium alloy used for jet engine turbine blades. (Inconel was used for the skin of the X-15.)

Detection performance was presented in four sections—radar, infrared, contrails, and sonic booms. The radar cross section tests were the most extensive, involving sixty different models with variations in fuselage configurations, wing planforms, vertical fin configurations, notching techniques, and engine exhaust shields. These tests were done with 1/46-scale models.

Radar cross section tests were also done on full-scale models of the engine inlet with two different inlet screen types. Radar cross section results were presented as polar plots of radar cross section (radar return intensities measured on a complete 360-degree circle around the aircraft).

The program schedule called for twenty aircraft, with the first flight planned twenty-seven months after go-ahead. Five aircraft would be used for flight testing. The twentieth aircraft would be delivered in less than five years. Program cost was estimated to be $205 million in 1958 dollars. These costs did not include the dedicated B-58 aircraft needed for the program.
THE COMPETITION

The Lockheed A-3 was Convair’s competition for the U-2 replacement for the November 1958 Land Panel review. The A-3 was an unstaged (not a parasite) aircraft that cruised at Mach 3.2 at 95,000 feet. Two inboard JT12 turbojet engines took the A-3 to supersonic speed, at which point two forty-inch diameter ramjets at the wingtips accelerated it to cruising speed. The JT12s burned JP-150 fuel, while the ramjets burned boron-based high-energy fuel.

The A-3’s design length was 62.3 feet. Wingspan was 33.8 feet. Height was 14.6 feet. Gross weight at takeoff was about 30,000 pounds, which included 18,000 pounds of fuel and 250 pounds of payload in the nose. The operating radius was 2,000 nautical miles. The pilot flew in a full pressure suit in a cockpit pressurized with nitrogen.

The Land Panel favored the Convair design, which had a significantly smaller radar cross section than the Lockheed A-3. On 22 December 1958, Convair was given the green light to continue the development of FISH and to plan for a production program. A follow-up review was performed by the operations group of the Development Projects Division of the CIA in January. This review, which was based on a formal operational requirements document and specific selection criteria, came to the same conclusion as the Land Panel.

CONVAIR WORKS FISH

Convair spent the first five months of 1959 refining the FISH design. The changes were detailed in a FISH program status review presented to the Land Panel in early June. The revised aircraft had several significant design changes. As for the design choices mentioned earlier, the refined design settled with the larger wing and the protruding canopy. However, instead of locating the canopy on the centerline, Convair offset it to the left (as the flush-mounted canopy option had been) to conform with the clearances mandated by the B-58 carrier.

The single JT12 turbojet engine between the ramjets was replaced by two General Electric J85 turbojet engines located just behind the cockpit. The two engines were hinge-mounted so they could pop out of the fuselage to be used on landings. The vertical tails were relocated from the wings to the fuselage. The rear landing skids were replaced with wheels.

The changes increased the gross weight of the aircraft to 38,325 pounds—about 3,300 pounds more than the November 1958 design. Range was reduced from 4,150 to 3,900 nautical miles. The overall dimensions for the new design, however, were roughly the same (47.0 feet long, 10.1 feet high, and a wingspan of 37.0 feet).

In addition to refining the design, Convair conducted extensive tests for metal forming, machining, welding, brazing, heat-treating, and chemical etching on the more exotic airframe materials, including high-temperature alloys and ceramics for the wing leading edge. The company developed manufacturing processes for several full-scale airframe components—a wing box, wing leading edge, and self-sealing fuel box.

Contracts were awarded for a number of major subsystems, including the navigation system, flight controls, environmental control system, turbine drives, and generators. The production process was detailed on a map of the production hangar. Organization charts were populated, and employees were interviewed and screened to meet the high security requirements for program access.

More significantly, Convair conducted hundreds of hours of wind tunnel testing on various models of the aircraft, including on a 1/17-scale model of FISH, on the FISH/B-58 composite, and on a variety of inlet models. Several fundamental design problems then surfaced. The drag of the FISH/B-58 composite model was higher than expected. To get FISH to the necessary speed to start its ramjet engines, the B-58 carrier required more thrust than provided by its four J79-5 engines. The FISH/B-58 composite craft also had a balance problem. The center of gravity at low speeds was too far forward. FISH, when flying on its own, also had balance and stability issues. Finally, more fuel was needed to provide the required range.

The balance, drag, and fuel problems could be addressed by increasing the length of FISH by about 1.5 feet and the length of the B-58 carrier by five feet and by upgrading the B-58 to J79-9 engines. Convair proposed modifying two B-58s for the flight test phase of the program (which included three FISH aircraft). The aircraft would be created from B-58s already in the production schedule for the US Air Force.

Among many other changes, the modifications included adding a five-foot section to the forward fuselage. Two other B-58s would also be designated as development prototypes for a B-58B program being proposed to the US Air Force as a follow-on program to the B-58. Production B-58Bs would then become the primary carrier as FISH went operational. Subsequently, the success of FISH became dependent on selling the Air Force on the B-58B.
LOCKHEED TAKES A-4 TO A-11

While Convair prepared for production and struggled with aerodynamic issues, Lockheed pursued its own design efforts on a high-speed, high-altitude reconnaissance platform. During this period, the CIA also tasked Lockheed with designing its own B-58 parasite as a check on the performance predicted for FISH by Convair. Lockheed Skunk Works came up with two designs. One was called Arrow I; the other, B-58 Launched Vehicle. Both designs confirmed Convair’s performance figures.

Lockheed’s own designs evolved from A-4 through A-11. The first three configurations, A-4 through A-6, were smaller, self-launched aircraft with vertical surfaces hidden above the wing. They weighed up to 63,000 pounds with fuel and featured blended wing/fuselages. The aircraft employed a variety of propulsion schemes that included turbojets, ramjets, and rockets. None, however, met the required mission radius of 2,000 nautical miles, leading Lockheed to conclude that maximum performance and low radar cross section were mutually exclusive.

The next three configurations, A-7 through A-9, were smaller designs (44,000 pounds gross weight) that focused on performance at the expense of radar cross section. The designs had one J58 turbojet and two XPJ-59 ramjet engines. However, none of these designs could also meet the required range.

A-10 and A-11 configurations were larger aircraft that also focused on performance at the expense of radar cross section. The more refined A-11 was submitted by Lockheed at the next Land Panel review. It had a gross takeoff weight of more than 92,000 pounds, which included 55,330 pounds of fuel. It was powered by two J58 turbojets with afterburners, cruised at Mach 3.2, and provided a range of 4,000 nautical miles. The aircraft was 117 feet long, 21.0 feet tall, and had a wingspan of 57.0 feet.

BACK TO THE DRAWING BOARD

When Convair failed to sell the Air Force on the B-58B, the carrier aircraft for FISH was dead on the design table. FISH had other setbacks as well. While the Land Panel still favored its smaller size and lower radar cross section, the CIA was concerned about the operational complexity associated with a staged design. These concerns were reinforced by Lockheed’s independent parasite studies, which questioned the reliability of ramjet engines, the minimal clearances with the B-58 carrier, and the lack of means for the pilot to eject when the parasite was mated to the B-58.

Both companies were asked to submit new designs. For Lockheed, the challenge was to lower the radar cross section. For Convair, the challenge was to create an entirely new design—a self-launched aircraft that met the mission requirements. The redirection led to the Lockheed A-12 and to the Convair Kingfish.

Credits: Most information for this article was derived from several Convair presentations that were released and made public in the late 1980s to support the National Aerospace Plane project. Details on the Lockheed Archangel designs came from the CIA archives (online) and from a public presentation on the history of the Archangel program by John R. Whittenbury. Code One sends a special thanks to Paul Suhler, author of From Rainbow to Gusto: Stealth and the Design of the Lockheed Blackbird, for reviewing the article and for background information on the competition between Lockheed and Convair. Mr. Suhler’s book was published by AIAA in 2009 and is available on Amazon.com and AIAA.org.
Over The Top

A combined active duty and Air Force Reserve Command crew from Dover AFB, Delaware, teamed to fly a C-5M Super Galaxy on a fifteen-hour, nonstop mission direct from Dover to Bagram Airfield, Afghanistan, on 5–6 June 2011. The flight was the first time a US Air Force aircraft had been flown on a northern route over the Arctic Circle, over Russia, and over Kazakhstan to Afghanistan. US Transportation Command and Air Mobility Command officials at Scott AFB, Illinois, described the mission as a proof-of-concept flight to help establish future sustainment operations in Afghanistan. The C-5M, a C-5A converted as part of the Super Galaxy test fleet, was refueled by an Air National Guard KC-135R tanker crew over northern Canada.

Thunderbirds Fly On Alternative Fuel

The Thunderbirds, the US Air Force Air Demonstration Squadron, flew two shows 20–21 May 2011 using a camelina-based hydrotreated renewable jet fuel blend for the first time. The team performed at the Joint Services Open House at Joint Base Andrews NAF Washington, outside the nation’s capital. The Air Force is evaluating biomass fuels derived from seed oil from the camelina plant, beef tallow or animal fat, and various waste oils and greases. The Air Force has certified biofuel as a fifty-percent blend with jet fuel in several aircraft, including the F-16 and the F-22. Air Force fleetwide certification of the biofuel mix is scheduled for completion in 2013.

Purple Suit Maintenance

Seven US Airmen from the 33rd Fighter Wing at Eglin AFB, Florida, gained first-hand experience maintaining the US Marine Corps and US Navy variants of the F-35 Lightning II during a recent assignment at NAS Patuxent River, Maryland. During their stay, the 33rd FW maintainers are learning how each branch of the service conducts aircraft maintenance. While the three F-35 variants are significantly different from each other, the Air Force F-35A, Marine Corps F-35B, and Navy F-35C are similar enough that maintainers do benefit from performing basic maintenance on all variants. Joint F-35 pilot and maintainer training will be conducted at Eglin. The Airmen, the second cadre of Air Force maintainers to be trained, arrived at Pax River on 19 April. The training ran through July.

An Even Dozen

US Customs and Border Protection ordered its twelfth P-3 Mid Life Update, or MLU, kit on 26 May 2011. CBP has a fleet of sixteen P-3s based at Corpus Christi, Texas, and Jacksonville, Florida, that are flown on a variety of missions, but primarily on counternarcotics interdiction. Five P-3 operators—Norway, CBP, US Navy, Canada, and Taiwan—have a total of seventy-one sets of new wings on order. The MLU kit, which includes new wings as well as other structural components, gives Orion operators more than twenty years of additional service life.
**Second C-5M Delivered**

The second production C-5M Super Galaxy was redelivered to the US Air Force on 12 April 2011. The aircraft (Air Force serial number 85-0002) was flown from the Lockheed Martin facility in Marietta, Georgia, to Stewart ANGB, New York, where it will undergo internal paint restoration before being returned to Dover AFB, Delaware. This is the fifth C-5 to be brought up to the M-model standard. Other C-5Ms include three former test aircraft now in the operational fleet. Two other aircraft are currently in Marietta undergoing modernization as of June 2011. A total of fifty-two C-5s, consisting of forty-nine B-models, two C-models, and one A-model, will be modernized through the Reliability Enhancement and Re-engining Program, or RERP.

**MC-130J Combat Shadow II Airborne**

The first MC-130J Combat Shadow II for US Air Force Special Operations Command was flown for the first time on 20 April 2011 at the Lockheed Martin facility in Marietta, Georgia. The company flight crew consisted of Eric Thompson, Jeff Anderson, Lucky Madsen, David Files, and Tom Potteiger. The new special operations aircraft, based on the KC-130J tanker, has a boom refueling receptacle, more powerful electric generators, an electro-optical/infrared sensor, and a combat systems operator station on the flight deck. Fifteen MC-130Js are on order. This first Combat Shadow II will be delivered to Cannon AFB, New Mexico, in September. This photo was taken on the aircraft’s second flight on 22 April.

**Osprey Drag**

Two US Marine Corps KC-130J Super Hercules tanker crews refueled six MV-22 Osprey tiltrotor aircraft during a 2,800-mile flight from Camp Bastion, Afghanistan, to Souda Bay, Greece, on 8 April 2011. This was the longest Osprey transfer to date. The mission was conducted to return Marines, cargo, and the MV-22s from Afghanistan to the amphibious assault ship USS Kearsarge (LHD-3) and the 26th Marine Expeditionary Unit, which had been tasked to the Mediterranean region in support of operations in Libya. The KC-130J crews were from Marine Aerial Refueler Transport Squadron 252 (VMGR-252) at Cherry Point, North Carolina, deployed to the 2nd Marine Aircraft Wing (Forward) in theater.

**BEAR CLAW**

Students in the Test Management Program at the US Air Force Test Pilot School at Edwards AFB, California, completed a project in late March called BEAR CLAW, or Basic Envelope Air Refueling Control Laws, with the VISTA, or Variable In-Flight Stability Test Aircraft, NF-16. This project was designed to obtain preliminary data to ultimately lead to an unmanned aerial vehicle conducting air-to-air refueling with a tanker. A joint project between two Air Force Research Laboratory directorates, the BEAR CLAW test team used the VISTA NF-16 to simulate a UAV. Although the NF-16 can be remotely piloted, this phase of the testing required one of the project team members to pilot the aircraft so specific data could be collected.
Black Sheep Stand Down

The 8th Fighter Squadron, the active duty F-22 unit at Holloman AFB, New Mexico, was officially inactivated in ceremonies on 13 May 2011. The 8th FS, known as the Black Sheep, had been reactivated in September 2009 after being inactivated April 2008 following the retirement of the F-117 Nighthawk. The squadron will once again be placed in inactive status as a result of the changing of the flying mission at Holloman. The 8th FS inactivation will mark only the second time in the squadron’s sixty-one year history it has been inactive. The 8th FS Raptors will be absorbed into the 7th FS at Holloman and other F-22 squadrons at Nellis AFB, Nevada; Langley AFB, Virginia; and Joint Base Elmendorf-Richardson, Alaska.

Milestone Refueling

A KC-135 tanker crew from the 916th Air Refueling Wing at Seymour Johnson AFB, North Carolina, became the first in Air Force Reserve Command and Air Mobility Command to refuel the F-35 Lightning II during a mission on 30 March 2011. The crew, which was using a borrowed aircraft from McConnell AFB, Kansas, was on rotational assignment to the Air Force Flight Test Center at Edwards AFB, California, when Air Mobility Command headquarters authorized line tanker crews to refuel the new fighter. The 916th Air Refueling Wing was also the first operational tanker wing to refuel the F-22 several years ago.

Last Raptor Mid Body Completed

Production of the 195th and final F-22 Raptor mid body was completed at the Lockheed Martin facility in Fort Worth, Texas, on 12 May 2011. The fuselage section was loaded into its shipping container prior to an employee ceremony. The container was then shipped to Marietta, Georgia, for mating and final assembly. A bit of the Lone Star state traveled with this Raptor to the Peach State as employees placed a Texas flag in the container. The final F-22 Raptor, which is scheduled to roll off the Marietta assembly line in late 2011, with expected delivery to the US Air Force in early 2012. F-22 mid body production began on 5 June 1995. The total production number includes test and production Raptors.

Dolphin Lift

US Coast Guard personnel load an MH-65C Dolphin helicopter into a HC-130J prior to its transfer from CGAS Atlantic City, New Jersey, to CGAS Barbers Point, Honolulu, Hawaii, on 30 April 2011. The HC-130J is based at CGAS Elizabeth City, North Carolina.
Peacekeeper Delivery

The National Museum of Nuclear Science and History at Kirtland AFB, New Mexico, received a deactivated LGM-118 Peacekeeper intercontinental ballistic missile for display on 22 April 2011. The seventy-one foot tall, 195,000-pound, four-stage Peacekeeper missile, delivered by a C-5 crew from the 445th Airlift Wing, the Air Force Reserve Command unit at Wright-Patterson AFB, Ohio, arrived in sections and was immediately put on display. The ten-warhead Peacekeeper was the US’s most accurate and powerful ICBM from 1986 until 2005 when it was decommissioned. Fifty of the missiles were fielded. Some of the decommissioned missiles have since been used to launch satellites. The HTV-2 hypersonic research vehicle, developed by the Lockheed Martin Skunk Works, is also launched by a modified Peacekeeper.

Exercise Sea Breeze

US Sailors from Patrol Squadron 45 (VP-45), in conjunction with members of the Ukrainian military, held a joint press conference with Ukrainian media in Odessa, Ukraine, on 9 June 2011. Known as the Pelicans, VP-45 participated in Exercise Sea Breeze 2011, flying its P-3C Orion maritime patrol aircraft in the large-scale multinational maritime exercise on the Black Sea. During the exercise, the VP-45 crews flew with Ukrainian Ka-27 helicopters and Mi-14 patrol aircraft in antisubmarine warfare exercises. Air, land, and naval forces from Azerbaijan, Algeria, Belgium, Denmark, Georgia, Germany, Macedonia, Moldova, Sweden, Turkey, and the United Kingdom also participated in the exercise, which ran through 18 June. VP-45 is based at NAS Jacksonville, Florida.

Raptor Record

Pilots from the 525th Expeditionary Fighter Squadron flew thirty F-22 sorties in a single day during a scheduled deployment to Kadena AB, Japan, in April, setting a new Raptor squadron record. While on Okinawa, Airmen from the F-22 squadron worked with 18th Wing at Kadena and flew with crews and aircraft from the 961st Airborne Air Control Squadron, 909th Air Refueling Squadron, and 67th and 44th Fighter Squadrons, as well as with US Marine F/A-18s based on the island. The squadron, known as the Bulldogs, reverted to its normal 525th Fighter Squadron designation when the pilots and maintainers returned home to Joint Base Elmendorf-Richardson, Alaska, on 29 April 2011.

#3 And #4 To 5K

US Air Force Col. Robert McCutchen, Jr., the special assistant to the 56th Fighter Wing commander at Luke AFB, Arizona, became the third pilot to record 5,000 flight hours in the F-16 on 1 April 2011. McCutcheon has served as an associate instructor with the 56th FW, as well as with the 944th FW, the Air Force Reserve Command Associate unit at Luke, since 1997.

Col. Lenny Dick, vice commander of the Air National Guard-Air Force Reserve Command Test Center at Tucson International Airport, Arizona, became the fourth pilot to record 5,000 flight hours in the F-16 on 9 May 2011. His milestone mission was a test flight for new software designed to improve Guard and Reserve F-16 capabilities.

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US C-130 aircrew members from the 36th Airlift Squadron at Yokota AB, Japan, dropped seven Davis Drifter buoys on 29 April 2011 in a joint US-Japanese effort to track the movement of seawater along the northeastern coast of Honshu, Japan’s main island. The data collected from the buoys will aid scientists in developing more accurate models of ocean currents. The models will be used to help Japanese and US disaster response planners understand where water will flow should further radioactivity be released from the earthquake- and tsunami-damaged Fukushima Daiichi nuclear power plant. The models will also help determine the safest route for ships operating along the Japanese coastline. The mission was the first of its kind for 36th AS crews.

537th Airlift Squadron Flies Again
The 537th Airlift Squadron, which traces its lineage to the last days of World War II, was reactivated in ceremonies at Joint Base Elmendorf-Richardson, Alaska, on 6 May 2011. The 537th AS, an active duty Air Force unit, will be made up of approximately 100 personnel and will team up with the 144th AS, the Alaska Air National Guard C-130H squadron that recently relocated to Elmendorf. Airmen of the 537th AS will be using the Guard’s aircraft, and the crews will fly integrated flights with each other. The squadron was reactivated during the Vietnam War. While based at Phu Cat AB, South Vietnam, the unit, then known as the 537th Tactical Airlift Squadron, flew C-7 Caribou transports.

Tigers At Green Flag
Approximately 200 Airmen from the 79th Fighter Squadron at Shaw AFB, South Carolina, returned home on 29 April 2011 after participating in a Green Flag exercise at Nellis AFB, Nevada. Green Flag is an exercise designed to prepare both the US Army and US Air Force for upcoming deployments. The two and one-half week exercise, which stresses realistic combat training, replicates irregular warfare conditions found in current combat areas and gives pilots an unscripted battle exercise and training. F-16 pilots from the 79th FS, known as the Tigers, worked with Army forces to provide airborne sensor and employment support during the exercise. The actual flying took place in training airspace over the Army’s National Training Center at Fort Irwin, California.

Better Brakes
The 418th Flight Test Squadron at the Air Force Flight Test Center at Edwards AFB, California, recently tested the performance of carbon brakes and the new Mark IV digital antiskid control unit to replace the legacy brake system on the C-130. The testing involved max-effort braking where the pilot applies maximum pressure to the brakes to stop the aircraft at different cargo weights and on wet runways. The carbon brakes are designed to reduce the potential for brake fires and locking up. The brakes also reduce stopping distance. If the tests, which ran through July, are successful, then the brakes will be retrofitted to all US Air Force C-130E and H models.
Combat Talon Dedicated

A historic MC-130E Combat Talon I was dedicated as a static display at Hurlburt Field, Florida, in ceremonies on 6 May 2011. The aircraft, US Air Force serial number 64-0567, was flown during Operation Eagle Claw, the attempted rescue of Americans held hostage in Iran in 1980. It was also the aircraft used to fly Panamanian dictator Manuel Noriega to the United States to stand trial for drug trafficking after his capture in 1989 during Operation Just Cause. On 26 November 1979, a crew flying this aircraft conducted the first fixed-wing airland flight while using night-vision goggles. The MC-130E, nicknamed Wild Thing, was retired with 21,336.6 flight hours and is painted in the same scheme it wore during Operation Eagle Claw.

Actor Altitude

Actor Gary Sinise, a longtime supporter of the US military, flew back-seat in a TU-2S, the two-seat trainer version of the Dragon Lady high-altitude reconnaissance aircraft, at Beale AFB, California, on 8 June 2011. A film crew documented Sinise’s trip to Beale for an upcoming TV special that will highlight the U-2 story and the base’s mission. The show will include scenes of Sinise’s altitude chamber and egress training, as well as his flight above 70,000 feet altitude with a 1st Reconnaissance Squadron pilot. Sinise is best known for his role as Lt. Dan in the movie Forrest Gump and regularly performs with his rock music band for military audiences around the world.

In Memoriam – Bob Widmer

Robert H. Widmer, who created the design and engineering department at the then-Consolidated Aircraft Fort Worth Division in Texas, passed away 20 June 2011. His work resulted in production of the B-32, B-36, and B-58 bombers; F-111 and F-16 fighters; and RB-57 high-altitude reconnaissance aircraft. Widmer was the first engineering team leader to completely integrate airframe, propulsion, and avionics into a single weapon system for the supersonic B-58 Hustler. He received a number of honors and awards, including the 1980 Sylvanus A. Reed Aeronautics Award for lifetime achievement from the American Institute of Aeronautics and Astronautics. He retired as the General Dynamics corporate vice president for science and technology in 1981 after a forty-two year career.

V26N1 Corrections

On page 3 of the Volume 26, Number 1 issue of Code One, Lt. Col. Matt Kelly is a Marine F-35 test pilot, not a Naval Aviator. On page 36, the F-16s flown by VMFAT-501 at Eglin AFB, Florida, are on loan from the active duty 52nd Fighter Squadron at Luke AFB, Arizona, not the 419th Fighter Wing.