AEROTECH NEWS and Review

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Edwards Air Force Base: Where history is made!

On June 5, 1948, Capt. Glen Edwards died when the YB-49 Flying Wing he was co-piloting crashed – killing all five on board. But the base that bears his name, Edwards Air Force Base in Southern California's High Desert, has a long history that predates Captain Edwards.

In this special issue, we take a look back at the history of the base from the earliest days of flight test, to modern times when the newest aircraft in the U.S. inventory continue to be tested.

Edwards: Base named for World War II veteran, test pilot

Capt. Glen Edwards, for whom Edwards Air Force Base is named, died 75 years ago on June 5, 1948, when the Northrop YB-49 Flying Wing he was co-piloting crashed – killing all five on board.

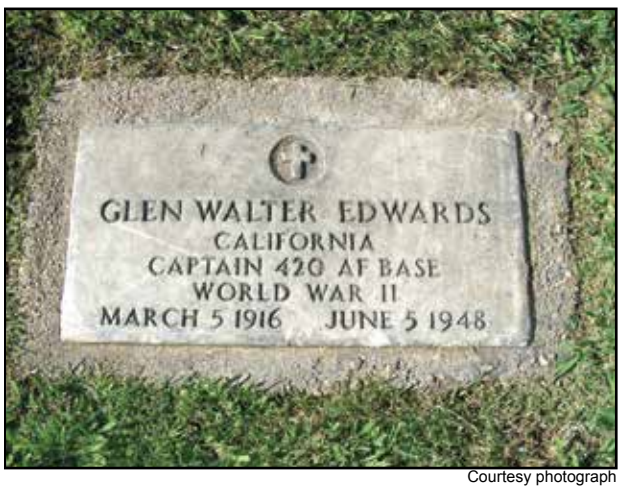
Edwards was born March 5, 1918, in Medicine Hat, Alberta, Canada, where in 1931, at age 13, his parents moved the family to Lincoln, Calif.

Although mostly known for his test pilot background and subsequent death, Edwards was a World War II veteran who served in North Africa and Italy.

After graduating with a Bachelor of Science degree in Chemical Engineering from the University of California, Berkeley, Edwards enlisted in the U.S. Army Air Forces on July 15, 1941, five months before Pearl Harbor.

Upon completion of flight training, he was commissioned as a second lieutenant at Luke Field, Ariz., in February 1942. Assigned to the 86th Light Bombardment Squadron of the 47th Bombardment Group, he departed for the North African Theater of Operations (Tunisia) as a flight commander in October 1942. There he led his flight of A-20s on extremely hazardous, low-level missions against German tanks, convoys, troop concentrations, bridges, airfields, and a variety of other tactical targets.

When the Germans broke through the Kasserine Pass in February 1943, his undermanned and undersupplied squadron flew 11 missions in a single day, repeatedly attacking advancing armored columns and blunting their thrust. On one of these missions, Edwards and his crew set a record by completing a combat mission — from takeoff to landing — in just 19 minutes. His squadron received a Distinguished Unit Citation for this action.



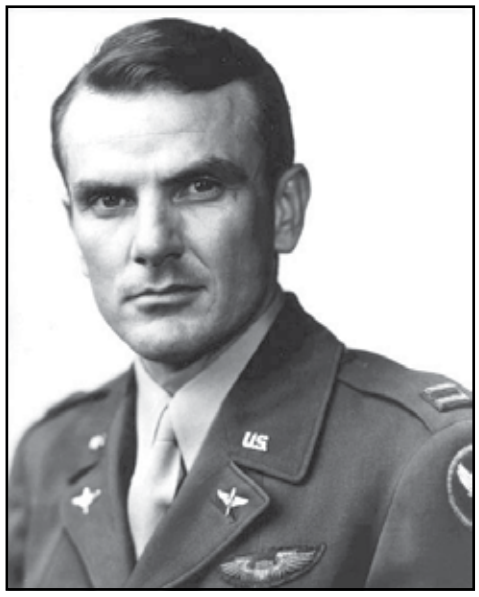
Courtesy photograph

During his tours in the North African campaign and the invasion of Sicily, Edwards completed 50 combat missions and was awarded four Distinguished Flying Crosses and six Air Medals.

Returning to the United States in December 1943, he was assigned to the Pilot Standardization Board at Florence Army Air Field, S.C., and then, in late 1944, to the Flight Test Division at Wright Field, Ohio. He graduated from the Flight Performance School (now known as the U.S. Air Force Test Pilot School) there in May 1945 and was assigned to the Bomber Test Operations Section.

Although assigned to Wright Field, he spent much of his time at Muroc Army Air Field, in California's High Desert, testing a wide variety of experimental prototypes such as Douglas' highly unconventional pusher-prop light bomber, the XB-42 Mixmaster.

In December 1945, he and Lt. Col. Henry E. Warden set a new transcontinental speed record when they flew this airplane from Long Beach, Calif., to Bolling Air Force Base, in Washington, D.C., in just five hours, 17 minutes.


Air Force photograph

Capt. Glen Edwards

In 1946, he was the principal project pilot for the jet-powered Convair XB-46 prototype bomber. It was also during this period that he acquired his first experience with a flying wing, as he familiarized himself with the flying qualities of the Northrop N-9M, a single-seat, one-third scale mock-up of the giant XB-35 prototype bomber. Living modestly on a captain's salary at the time, he also somehow managed to help put two of his nephews through college.

His skills as a pilot, engineer and officer were held in such high esteem that his immediate superior, Maj. Robert M. Cardenas, recommended him as project pilot for an unprecedented program — the first attempt to exceed the speed of sound in the Bell X-1. That assignment, however, went to Capt. Chuck Yeager.

Edwards was, instead, selected to be among the first to be sent to Princeton University for graduate study in the aeronautical sciences. The recent war had spawned truly revolutionary advances in aviation technology and it had become apparent to men such as Col. Albert Boyd, the chief of the Flight Test Division, that a new breed of military test pilot — one who combined the talents of a highly skilled pilot with the technical expertise of an engineer— would be required to effectively evaluate increasingly complex aircraft and onboard systems. Thus, when Glen Edwards graduated from Princeton with a Master of Science degree in Aeronautical Engineering in 1947, he represented one of the first of this new breed.

In May 1948, Edwards was selected to join the team of test pilots and engineers at Muroc who were then evaluating the Northrop YB-49, the all-jet version of the exotic flying wing bomber.

After his first few flights, he was not favorably impressed, confiding to his diary that it was "the darndest airplane I've ever tried to do anything with. Quite uncontrollable at times."

Then, on June 5, 1948, he was flying as co-pilot with Maj. Daniel Forbes when the airplane departed from controlled flight and broke apart in the sky northwest of the base. All five crew members were killed.

One of Boyd's first orders of business, when he assumed command of Muroc in late 1949, was to rename the base in honor of someone who had given his life to the cause of experimental flight research. By tradition, Air Force bases were named after distinguished individuals who were native sons of the state in which a base was located. Boyd could think of no one more deserving than the bright, young, Canadian-born Californian whose promising career had ended in the skies over the western Mojave.

On Dec. 8, 1949, Muroc Air Force Base was officially redesignated Edwards Air Force Base and, during ceremonies on Jan. 27, 1950, a plaque was unveiled that commemorates his achievements.

The tribute at its base reads: "A pioneer of the Flying Wing in the western skies, with courage and daring unrecognized by himself."

In 1995, Edwards was inducted into the Aerospace Walk of Honor in Lancaster, Calif.

In 2008, the family of Edwards donated his diaries to the Air Force Flight Test Museum. The diaries describe Edwards' experiences during World War II, from when he joined the Army Air Corps, up to a few days before he died.

There is a middle school in Lincoln, Calif., named after Edwards.


Air Force photograph

On June 5, 1948, Northrop's YB-49 No. 2, a prototype flying wing jet bomber, went out of control during its 25th test flight and crashed about 10 miles northwest of Muroc Air Force Base. Three officers and two civilian aircrew were killed. The pilot was Maj. Daniel Forbes, Jr. and the co-pilot was Capt. Glen Edwards. The aircraft was testing stall recovery performance when it suffered a catastrophic structural failure with the outer wing panels tearing off. In December 1949, Muroc was renamed Edwards Air Force Base in honor of Edwards.

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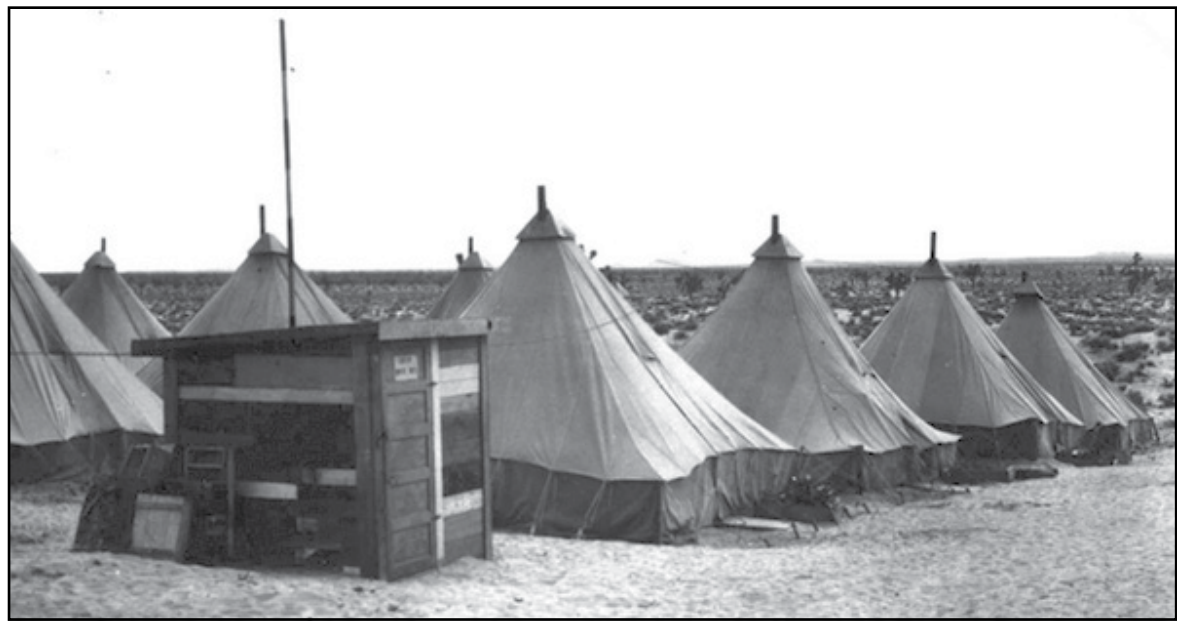

Air Force photograph

A row of tents sit at Camp Muroc in the early days.

The Natural Setting

A parched and forbidding wilderness to those who first see it, the northwestern Mojave Desert is a land of coyotes and jack rabbits, of ragged greasewood and, of course, Joshua trees.

It is a harsh land of sometimes stunning contrasts — a land of griddle-hot days and bone-chilling nights, of violent dust storms, bewildering mirages and mesmerizing sunsets.

Until the Southern Pacific Railroad arrived in 1876, the desert was populated mostly by occasional prospectors drifting endlessly in pursuit of elusive mineral wealth. In 1882, the Santa Fe Railroad ran a line westward out of Barstow toward Mojave and built a water stop at the edge of an immense dry lakebed, roughly 20 miles southeast of Mojave. The lonely water stop was known simply as "Rod," and the lakebed was then called Rodriguez Dry Lake.

By the early 1900s, "Rodriguez" had been anglicized into "Rodgers," which was then shortened to "Rogers." First formed in the Pleistocene Epoch and featuring an extremely flat, smooth and concrete-like surface, Rogers Dry Lakebed is a playa — or pluvial lake — that spreads out over 44 square miles, making it the largest such geological formation in the world.

Its parched clay and silt surface undergoes a timeless cycle of renewal each year, as water from winter rains is swept back and forth by desert winds, smoothing it out to an almost glass-like flatness.

Courtesy photograph

The Corum family, who settled near Rogers Dry Lake on May 18, 1916. Clifford Corum and his wife Effie are second and third from left, and Clifford's brother Ralph is on the right.

The homesteaders

In 1910, the Corum family settled at the edge of this lakebed. In addition to raising alfalfa and turkeys, they located other homesteaders in the area for a fee of $1 per acre. As those settlers moved in, the Corum brothers earned contracts for drilling water wells and clearing land. They also opened a general store and post office.

Their request to have the post office stop named "Corum" was disallowed because there was already a Coram, California. So they simply reversed the spelling of their name and named it "Muroc." Small, isolated homesteads dotted the land over the next 20 years.

The airmen arrive

The early homesteaders thought of Rogers Dry Lakebed as a wasteland. However, a visionary Airman commanding March Field, Lt. Col. H. H. "Hap" Arnold, saw it as a one-of-a-kind "natural aerodrome" — one that could be acquired at virtually no cost to the taxpayer.

Thus, in September 1933, the Muroc Bombing and Gunnery Range was established by Arnold. This remote training site, now a small enclave within present-day Edwards, served the Army Air Corps' bombers and fighters for several years.

With the arrival of World War II, a permanent base sprang up for the training of combat flight crews. In July 1942, it was activated as a separate post and designated Muroc Army Air Base.

Throughout the war years, B-24s thundered through the Muroc skies and P-38s strafed the targets on the range as bomber crews and fighter pilots prepared to do battle overseas.

Strange shapes in the sky

In the meantime, wartime development of military aviation overwhelmed Wright Field in Ohio with an immense volume of flight test work. It was necessary to find a remote location with good flying weather where a new top-secret airplane could safely undergo tests.

In the spring of 1942, a site was chosen alongside the north shore of Rogers Dry Lakebed, about six miles away from the training base at Muroc. A wooden hangar and rudimentary facilities sprang up and on Oct. 1, 1942, Bell test pilot Bob Stanley lifted the wheels of the Bell XP-59A Airacomet off the enormous, flat surface of the dry lakebed. The turbojet revolution had arrived. America's first jet plane was shortly joined by a second, the famed Lockheed XP-80 Shooting Star.

As revolutionary as these two experimental fighter planes were, the natural runways of the lakebed served them well. The first-generation turbojet engines had a nasty habit of flaming out, and the Airacomet required an extremely long takeoff roll.

During the postwar years, all of America's first generation of jets — both Air Force and Navy — underwent testing at Muroc, and the great lakebed served as a welcome haven to countless pilots in distress.

The success of these programs attracted a new type of research activity to the base in late 1946. The rocket-powered Bell X-1 was the first in a long series of experimental airplanes designed to prove or disprove aeronautical concepts — to probe the most challenging unknowns of flight and solve its mysteries.

On Oct. 14, 1947, Capt. Charles E. "Chuck" Yeager flew the small bullet-shaped airplane to become the first human to exceed the speed of sound. With the X-1, flight testing at Muroc began to assume two distinct identities. Highly experimental research programs — such as the X-3, X-4, X-5 and XF-92A — were typically flown in conjunction with the National Advisory Committee for Aeronautics, or NACA, and were conducted in a methodical fashion to answer largely theoretical questions. Then, as now, the great bulk of flight testing at Muroc focused on evaluations of the capabilities of aircraft and systems proposed for the operational inventory.

In December 1949, Muroc was renamed Edwards Air Force Base in honor of Capt. Glen W. Edwards, who was killed a year earlier in the crash of the YB-49 Flying Wing.

By that time, the base had already become the reigning center of American flight research and on June 25, 1951, this fact was finally officially recognized when its test community was designated the U.S. Air Force Flight Test Center, or AFFTC. That same year, the U.S. Air Force Test Pilot School moved to Edwards from Wright Field, Ohio.

Its curriculum focused on the traditional field of performance testing and the relatively new field of stability and control, which had suddenly assumed critical importance with the dramatic increases in speed offered by the new turbojets.

The Golden Age of flight test

The decade of the1950s was a remarkable period in the history of aviation, and there was no better evidence of this than what transpired at Edwards. If the concept seemed feasible — or even just desirable — it was evaluated in the skies above the sprawling 301,000-acre base.

The experimental rocket planes, for example, continued to expand the boundaries of the high-speed and stratospheric frontiers.

As the decade opened, the first-generation X-1 reached Mach 1.45 (957 mph) and a 71,902-foot altitude, representing the edge of the envelope. The D-558-II Douglas Skyrocket soon surpassed these marks. In 1951, Douglas test pilot Bill Bridgeman flew the skyrocket to a top speed of Mach 1.88 (1,180 mph) and a peak altitude of 74,494 feet. Then, in 1953, Marine test pilot Lt. Col. Marion Carl flew the same plane to an altitude of 83,235 feet.

On Nov. 20, 1951, the National Advisory Committee for Aeronautics's Scott Crossfield became the first man to reach Mach 2 as he piloted the Skyrocket to a speed of Mach 2.005 (1,291 mph). Less than a month later, Maj. Chuck Yeager topped this record as he piloted the second-generation Bell X-1A to a top speed of Mach 2.44 (1,650 mph) and, just nine months later, Maj. Arthur "Kit" Murray flew the same airplane to a new altitude record of 90,440 feet.

These records stood for less than three years. In September 1956, Capt. Iven Kincheloe became the first man to soar above 100,000 feet, as he piloted the Bell X-2 to a then-remarkable altitude of 126,200 feet. Flying the same airplane just weeks later on Sept. 27, Capt. Mel Apt became the first to exceed Mach 3, accelerating to a speed of Mach 3.2 (2,094 mph). His moment of glory was tragically brief, however. Just seconds after attaining top speed, the X-2 tumbled violently out of control and Apt was never able to recover.

With the loss of the X-2, the search for many of the answers to the riddles of high-Mach flight had to be postponed until the arrival of the most ambitious of the rocket planes — the North American X-15.

Meanwhile, the turbojet revolution had reached a high plateau at Edwards, as aircraft such as the famed "Century Series" of fighters — the F-100 Super Sabre, F-102 Delta Dagger, the Mach 2 F-104 Starfighter, F-105 Thunderchief and F-106 Delta Dart — made supersonic flight seem almost commonplace.

Incorporating many advances made possible by the experimental research programs, each of these aircraft was a technological achievement and, indeed, as a group, they defined the basic speed and altitude envelopes for fighters, which are still in effect to this day.

The Space Age

The 1960s ushered in a new emphasis on space flight. The Test Pilot School, for example, was re-designated the Aerospace Research Pilot School as it moved into the business of training future astronauts.

High above the flightline, the X-15 was beginning to explore hypersonic and exoatmospheric flight. Indeed, in July 1962, it became the first — and, so far, the only — airplane to fly in near space as it soared above 314,000 feet, winning astronaut wings for its pilot, Maj. Robert M. White. With Maj. William J. "Pete" Knight at the controls on Oct. 3, 1967, the highly modified X-15A-2 ultimately reached a top speed of Mach 6.72 (4,520 mph), which remains the highest speed ever attained by a manned airplane.

While space-related activities captured the public's imagination, test pilots at Edwards were also continuing to expand the frontiers of atmospheric flight in air-breathing, jet-powered aircraft such as the XB-70 Valkyrie and the YF-12 and SR-71 Blackbird. The 500,000-pound Valkyrie proved itself capable of sustained triple-sonic flight

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operations at altitudes above 70,000 feet.

In the meantime, the mysterious Blackbirds, now described as first-generation "stealth" aircraft, provided even more dazzling performances as they routinely cruised at speeds in excess of Mach 3 (about 2,250 mph) and at altitudes well above 80,000 feet.

With the decline of the military manned space mission in the early 1970s, the Aerospace Research Pilot School was once again re-designated the U.S. Air Force Test Pilot School. This change was more than symbolic. Based on a survey of graduates still active in the flight test business, the school completely revamped its curriculum to reflect major changes that had recently taken place in the aerospace world.

Experience had shown that the proliferation of increasingly sophisticated onboard avionics, sensor and fire-control systems would be a constant and that supervising modern test programs would increasingly require strong management skills. Thus, the school replaced its space-oriented phase of curriculum with a whole new battery of courses focusing on systems tests and test management.

Air Force photograph

On May 17, 1946, the highly innovative XB-43 Jetmaster made its first flight with Douglas test pilot Bob Brush at the controls. The XB-43 was the nation's first prototype jet bomber. Captured at a later date, this Edwards History Office file photo shows the XB-43 sharing the Edwards ramp with two Northrop flying wing bombers.

The modern skies

New aircraft types arrived in the 1970s: the F-15 Eagle with its advanced engine and fire-control system; the single-engine F-16 Falcon with its revolutionary, "fly-by-wire" flight control system; and the B-1 Lancer with its multitude of highly sophisticated offensive and defensive systems.

These planes more than bore out the prophecy concerning the ever-increasing importance of systems testing and integration. Moreover, another major new element of complexity was soon introduced into the flight test process.

At a remote location in 1978 and 1979, an AFFTC test pilot and a pair of flight test engineers were engaged in proof-of-concept testing with Lockheed's "low-observable" technology demonstrator, dubbed "Have Blue." The successful conduct of these tests led immediately to the development of a new subsonic attack aircraft that was designated the F-117A Nighthawk.

Another aerospace revolution — the stealth revolution — was underway.

The 1980s opened with one of the most dramatic episodes in all of Edwards' history.

At 10:20 a.m. on April 14, 1981, the wheels of the Space Shuttle Columbia touched down on Rogers Dry Lakebed. Astronauts John Young and Robert Crippen had successfully landed the first orbiting space vehicle ever to leave the Earth under rocket power and return on the wings of an aircraft. The era of reusable space vehicles had dawned.

In the meantime, flight testing itself had evolved into a remarkably complex process that led to a similar revolution in the Flight Test Center's ability to acquire and process flight data. In fact, the extraordinary number of costly flying hours required to test and integrate all of the new systems under the traditional "fly-fix-fly" method had forced the AFFTC to rethink its whole approach to the business of testing. Thus, the decade also saw the development of sophisticated new facilities at Edwards that met the challenges of the new technologies.

Air Force photograph

On Jan. 9, 1943, the first flight of the Lockheed XC-69 took place from Burbank, Calif., to Muroc Army Airfield. It was piloted by company test pilots Edmund Allen and Milo Burcham. The four-engine, propeller-driven aircraft was designed by Kelly Johnson and developed from the Lockheed L-049 Constellation airliner.

The Integration Facility for Avionic Systems Test, the Benefield Anechoic Facility and the Test and Evaluation, Modeling and Simulation Facility — all part of the Avionics Test and Integration Complex, permitted the testing and integration of new and complex software-intensive systems on the ground before they were taken into the air.

Spectacular events have become almost commonplace at Edwards over the years, but they have always represented only a small part of the Flight Test Center's workload. The primary job has always been to assure that American aircrews go into combat with the most effective and reliable operational aircraft in the world.

The capabilities of existing aircraft such as the F-15 and F-16

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have been continually refined and expanded, even as totally new aircraft and systems incorporating radical new technologies are developed for future operational use.

The dual-role F-15E, for example, was developed in the 1980s and went on to demonstrate truly remarkable combat effectiveness in the Persian Gulf conflict of the early 90s. The Low Altitude Navigation and Targeting Infrared for Night, or LANTIRN, system revolutionized air-to-ground combat operations during the same conflict by denying our adversary the once comforting sanctuary of night.

The late 1980s also witnessed the arrival of the first giant flying wing to soar over the base in nearly 40 years. The thin silhouette, compound curves and other low-observable characteristics of the B-2 Spirit bomber represented third-generation stealth technology, following the SR-71 and F-117.

The new bomber, by far the most sophisticated and complex airplane ever built, was soon followed in the early 1990s by the arrival of the YF-22A and the YF-23A, both of which would soon give a new definition to the term "air superiority."

The two prototype fighters were the first airplanes to blend stealth with agility and high-speed, supersonic cruise capability. The YF-22A was selected to become the Air Force's new advanced tactical fighter after a brief demonstration and validation risk reduction flight test program. Now named the Raptor, the F-22A continues to undergo test and evaluation at Edwards.

A new group of research projects came to Edwards in the 1990s. Global Hawk, an unmanned aerial vehicle that has been used extensively in Afghanistan as well as Iraq, made its first flight at Edwards in February 1998 and has gone on to fill a critical role in America's war on terrorism. The X-24, X-33, X-34 and X-38, a series of new lifting bodies, technology demonstrators and half-scale models that might make space flight, research and development safer and more economical, were tested here by NASA during the decade.

The new millennium brought new projects with worldwide impact. The X-35A and X-32A, competing models for the Joint Strike Fighter program, made their first flights in September and October 2000. The X-35A won the competition in 2001 and will eventually be built in various versions for America's flying armed services and for foreign air forces as well. Also new are the Airborne Laser Program and the Predator Unmanned Aerial Vehicle Programs.

Where we stand today

Flight testing at Edwards has come a long way since the first olive-drab XP-59A lifted off from the lakebed more than 60 years ago.

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Air Force photographs

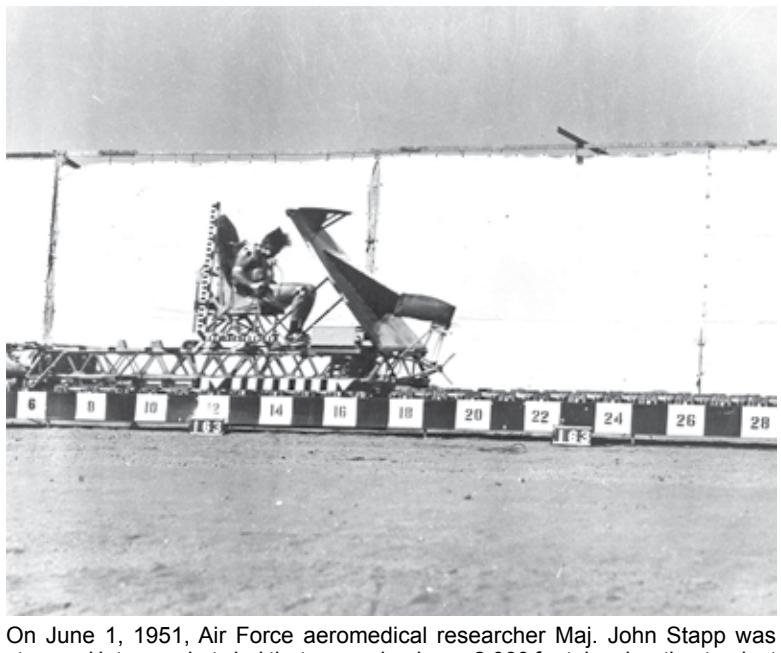
On Oct. 14, 1947, on his ninth powered flight in the airplane, Capt. Charles E. "Chuck" Yeager piloted the Bell X-1 "Glamorous Glennis," named after his wife, to a speed of 699.4 mph at 43,000 feet (Mach 1.06), and became the first to exceed the speed of sound. This X-1 flight established that aircraft could be designed to exceed the previously deemed "sound barrier."

The 1940s and 1950s

Air Force photographs

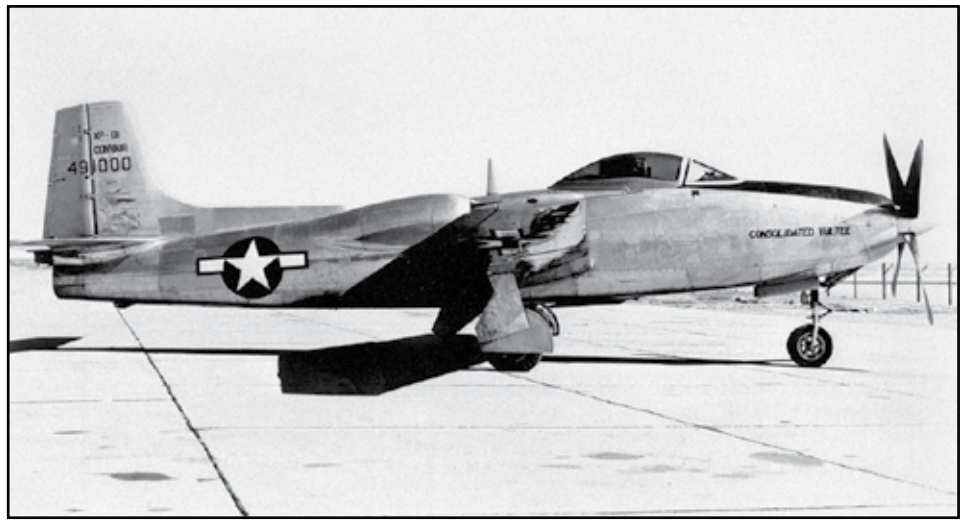
On Aug. 16, 1948, the XF-89 Scorpion made its first flight, flown by Northrop test pilot Fred C. Bretcher. The twin-jet night fighter was selected by the Air Force after a fly-off with the XF-87 and the Navy's Douglas XF3D-1 Skyknight because of its potential for development.

On March 23, 1948, the Douglas XF3D Skyknight made its first flight, with Douglas test pilot Russell Thaw at the controls. The F3D, a large twin-engine night fighter developed for the Navy, had been trucked in to Muroc Army Airfield from El Segundo, Calif., for its flight test program.



On June 1, 1951, Air Force aeromedical researcher Maj. John Stapp was strapped into a rocket sled that was poised on a 2,000 foot deceleration track at North Base. Moments later, 4,000 pounds of rocket thrust blasted him down the track and into the braking system (from 88.6 mph to a full stop in 18 feet). For a brief instant, he endured 48 g with a rate of onset of about 500 g per second. In other words, his body had absorbed an impact of more than four tons. Prior to Stapp's sled experiments, conventional medical wisdom had maintained that the human body could probably survive no more than 17-18 instantaneous g.

On April 5, 1947, the second prototype of the Hughes XF-11 twin-boom reconnaissance aircraft made its first complete flight (takeoff and safe landing), piloted by Howard Hughes.



On Feb. 11, 1945, the Consolidated Vultee Aircraft Corporation's XP-81 made its first flight at Muroc. It was piloted by Frank Davis.

On May 18, 1953, Jacqueline Cochran made two supersonic dives in a Canadian-built (Canadair) F-86E Sabre and became the first woman to exceed the speed of sound. Later that day she flew the same plane over Edwards AFB's low-level course, a 12-pylon, 100-kilometer track, to a new women's absolute speed record of 652.552 miles per hour. A chase plane flown by her friend, Maj. Charles "Chuck" Yeager, accompanied her.

On Feb. 15, 1958, the first Convair B-58 Hustler (55-665) arrived at the Air Force Flight Test Center for Phase IV testing, concluding a combined delivery and test flight. The four-engine delta winged aircraft was the world's first bomber designed to sustain supersonic speeds during its mission profile. This aircraft is part of the Air Force Flight Test Museum's collection and is currently in storage.

On Nov. 28, 1956, the Ryan X-13 Vertijet made the world's first jet vertical transition flight. Following a horizontal takeoff, test pilot Pete Girard put the test airplane into a vertical hover and then recovered flying speed for a conventional landing. This Edwards History Office file photo was captured at South Base on Oct. 24, 1956, during a vertical takeoff test.

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Over the years, the U.S. Air Force and the world of aerospace have continued to meet the future in the clear blue skies above the base. Every single aircraft to enter the Air Force's inventory — and a great many that failed to do so — has been put through its paces at Edwards. Some Navy and Army aircraft have been tested here as well.

Arguably, more major milestones in flight have occurred at this base than anywhere else in the world. The demands of the Global War on Terrorism and the ever-accelerating pace of technological change over the past half-century have been daunting, but the Edwards flight test community repeatedly demonstrates its ability to adapt to these changes and to master the many challenges they impose.

The turbojet revolution, the space revolution, the systems revolution and now the unmanned aircraft systems revolution have imposed seemingly insurmountable obstacles. Each barrier, however, has been overcome through a combination of technical aptitude, daring ingenuity and skillful management.

Indeed, the Center's unique blend of natural, technical and human resources has transformed it into something much more than a benefit to the Air Force; it is an irreplaceable national asset.

In July 2012, the Air Force Flight Test Center was redesignated the Air Force Test Center as part of a new five-center construct implemented by the Air Force Materiel Command. As part of the restructuring, AFTC assumed responsibility not only for flight test at Edwards (under the auspices of the 412th Test Wing), but also Eglin Air Force Base, Fla., (under the auspices of the 96th Test Wing, and the Arnold Engineering Development Complex at Arnold AFB, Tenn.

So what does the future hold for Edwards? Ongoing testing includes the F-35 Lightning II, the KC-46 Pegasus tanker, hypersonic missile testing, and more. In 2023, the F-22 Raptor Combined Test Force transitioned into the Air Dominance Combined Test Force and will be tasked with flight testing the Next Generation Air Dominance family of systems. And everyone is waiting for the first flight and flight testing of the U.S. Air Force's newest Bomber — the B-21 Raider.

Northrop Grumman photograph

The Future: The U.S. Air Force announced Sept. 12, 2023, that the B-21 Raider has commenced engine runs as part of its ground test program at Northrop Grumman's Palmdale, Calif., facility. Engine testing is an essential milestone for the program as the world's first sixth-generation aircraft continues on the path to flight test. The B-21's first flight will remain a data driven event that is monitored by Northrop Grumman and the United States Air Force. Developed with the next generation of stealth technology, advanced networking capabilities and open systems architecture, the B-21 Raider will serve as the backbone of America's bomber fleet. Following the B-21s first flight, testing will commence at Edwards Air Force Base, Calif.

Air Force photographs

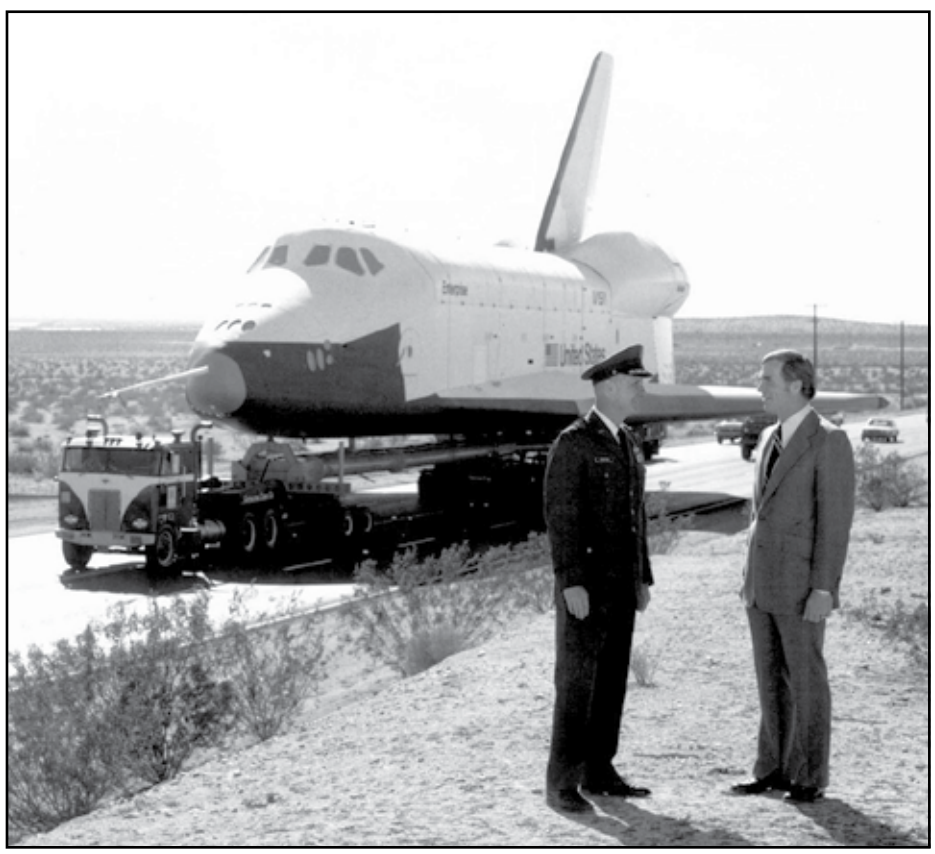
On Oct. 3, 1967, Maj. William J. "Pete" Knight flew the modified X-15A-2 to a speed of Mach 6.72. The flight marked the highest speed achieved in the X-15 program and remains the highest speed ever reached by a manned airplane.

On Sept. 21, 1964, North American Rockwell's XB-70 Valkyrie experimental aircraft made its first flight from Plant 42 in Palmdale, Calif., to Edwards. It was flown by North American test pilot Alvin S. White and Col. Joseph F. Cotton. Originally conceived as a strategic bomber with the ability to cruise at Mach 3 speeds, the two XB-70s completed were used as joint Air Force/NASA high-speed research vehicles only.

On May 10, 1972, Fairchild Republic's YA-10A Thunderbolt II made its first flight, flown by company chief test pilot Howard "Sam" Nelson. The twin-engine, twin-tailed ground attack aircraft was designed around the GAU-8 Avenger 30 mm rotary cannon.

On Aug. 26, 1975 the McDonnell Douglas YC-15 flew from Long Beach, Calif., to Edwards on its first flight. The high-wing, four-engine aircraft utilized an innovative externally blown flap, propulsive-lift concept. It was the McDonnell Douglas entry into the Air Force's Advanced Medium STOL Transport program to develop an aircraft capable of carrying troops and equipment into short, unimproved airfields in combat areas. Today this aircraft is on static display in the Century Circle outside the west gate entry point.

On Dec. 23, 1974, the Rockwell International B-1A Lancer made its first flight from Air Force Plant 42 in Palmdale, Calif., landing at Edwards AFB. The aircraft commander was Rockwell test pilot and retired Air Force Col. Charles Bock, Jr. He was accompanied by Air Force pilot and B-1 Joint Test Force director Col. Emil "Ted" Sturmthal, and flight test engineer Richard Abrams. The 70-minute, 250-mile flight path was within reach of the Rogers Dry Lake runways during which basic flight evaluation was conducted.



On March 8, 1979, Space Shuttle Columbia arrived at Edwards AFB on a trailer after a 38-mile journey from the Rockwell International plant in Palmdale, California. The trailer traveled through Lancaster, Calif., then to Edwards. The orbital vehicle was delivered to NASA's then Dryden Flight Research Center facility to be mated with its Boeing 747 carrier aircraft. Columbia was the first space-rated orbiter in NASA's Space Shuttle fleet. It launched for the first time on mission STS-1 on April 12, 1981, the first flight of the Space Shuttle program.

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Air Force photographs

On July 4, 1982, the Space Shuttle Orbiter Columbia landed on the main runway in front of President Ronald and Mrs. Nancy Reagan and some 500,000 visitors and guests. After the shuttle's fourth orbital flight was its first landing on a concrete runway and marked the end of its formal flight test program. The space vehicle was flown by Navy Capt. Thomas K. Mattingly II (U.S. Air Force Test Pilot School Class 65B) and Col. Henry W. Hartsfield (TPS Class 64C). On this flight (STS-4), the Columbia established a U.S. record altitude for spacecraft in a circular orbit.

July 20, 1982 - The first flight of the F-16XL took place. General Dynamics modified a FSD F-16 to answer a U.S. Air Force requirement for a dual-role, longer-range fighter to support future air combat requirements. The F-16XL featured a cambered, cranked-delta wing with a sharp leading-edge sweep with twice the area of the original wing.

NASA photograph

On Oct. 14, 1984, the Grumman X-29A made its first flight, piloted by company test pilot Charles A. Sewell. This was the first time in more than a decade that an X-series research plane got underway at Edwards.

On Oct. 30, 1991, a Lockheed YF-22A made the first flight in the initial Engineering & Manufacturing and Development (EMD) Phase test program, two weeks ahead of schedule.

On Nov. 2, 1990, the Vought YA-7F Strikefighter Combined Test Force completed its test program, flying the two prototype aircraft on 184 sorties totaling 315 flight hours. The program was cancelled with only two aircraft built.

The McDonnell Douglas C-17 Globemaster on its first flight heading from Long Beach, Calif., to Edwards Sept. 15, 1991.

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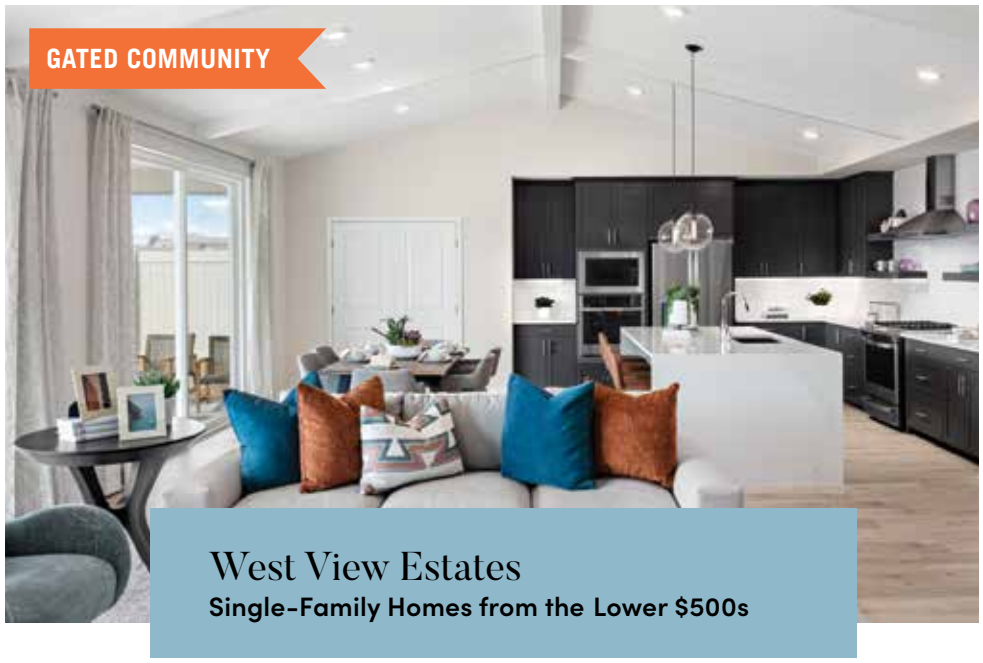

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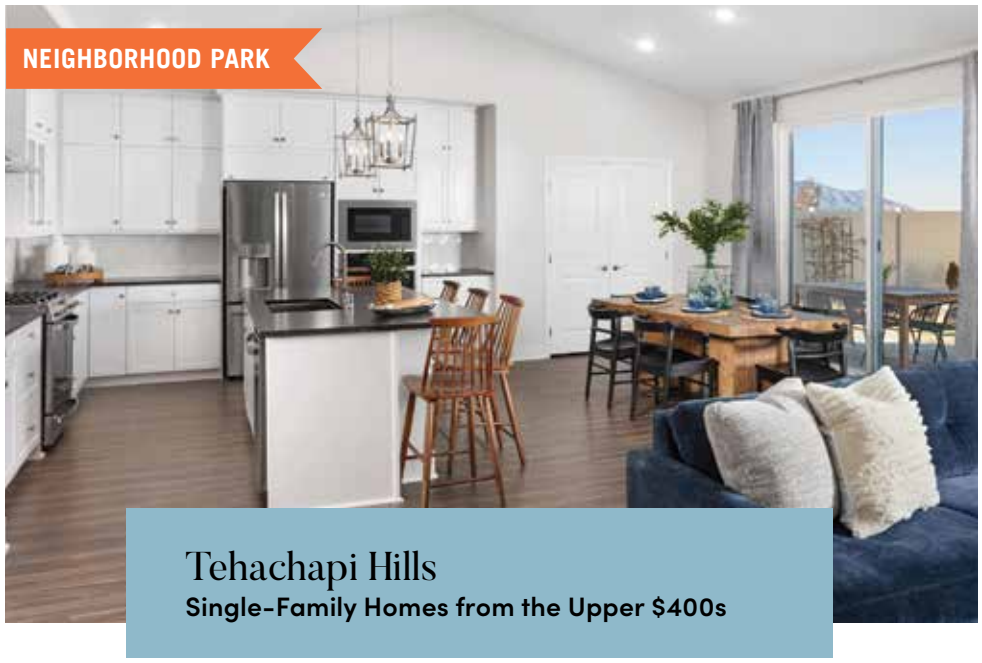

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Air Force photographs

On April 4, 2003, the CV-22 Osprey Test Team reached a milestone when the tilt-rotor aircraft successfully completed a terrain-following radar exercise. The event took place during the multi-mode radar test plan segment of the aircraft's test plan.

Boeing photograph by Paul Weatherman

A Boeing 787 Dreamliner takes off after a touch-and-go landing at Edwards AFB Aug. 14, 2017. Boeing has been conducting flight tests with its newest airliner at Edwards recently. Periodically, aviation industry companies are provided the opportunity to conduct flight tests at Edwards given the base's unique test assets such as multiple runways, a controlled airspace, large dry lakebeds and flying weather.

NASA photograph by Carla Thomas

Sierra Nevada Corp.'s Dream Chaser spacecraft underwent a successful free-flight test on Nov. 11, 2017, at NASA's Armstrong Flight Research Center, Edwards, Calif. The test verified and validated the performance of the Dream Chaser in the critical final approach and landing phase of flight, meeting expected models for a future return from the International Space Station.

Air Force photograph by Kyle Brasier

The X-62A Variable Stability In-Flight Simulator Test Aircraft, or VISTA, flies over Palmdale, Calif., Aug. 26, 2022.

Air Force photograph by Christopher Okula

A KC-46A Pegasus test aircraft touched down at Edwards May 23, 2018, for another round of testing. The new aerial refueling aircraft is intended to start replacing the Air Force's aging tanker fleet, which has been refueling aircraft for more than 50 years.

In July 2023, Edwards AFB hosted the Air Force Weapons School capstone. Dozens of combat aircraft assigned to the Weapons School at Nellis AFB, Nev., participated in the extensive training event. The Weapons School trains tactical experts and leaders to control and exploit air, space and cyber on behalf of the joint force.

An F-35A takes off from Edwards Air Force Base, Calif., on Jan. 6, 2023. A developmental test team from the 461st Flight Test Squadron conducted the first flight of an F-35 in the Technology Refresh 3 (TR-3) configuration at the base. The 50-minute flight, which took the jet to 35,000 feet at speeds just shy of the speed of sound above the Mojave Desert, marked the start of an extensive flight test campaign.

The B-21 Raider was unveiled to the public at a ceremony Dec. 2, 2022, in Palmdale, Calif. Designed to operate in tomorrow's high-end threat environment, the B-21 will play a critical role in ensuring America's enduring airpower capability. The Raider is currently undergoing engine testing at the Northrop Grumman facility in Palmdale, Calif. Following first flight, expected later in 2023, the aircraft will undergo flight testing at Edwards AFB, Calif.

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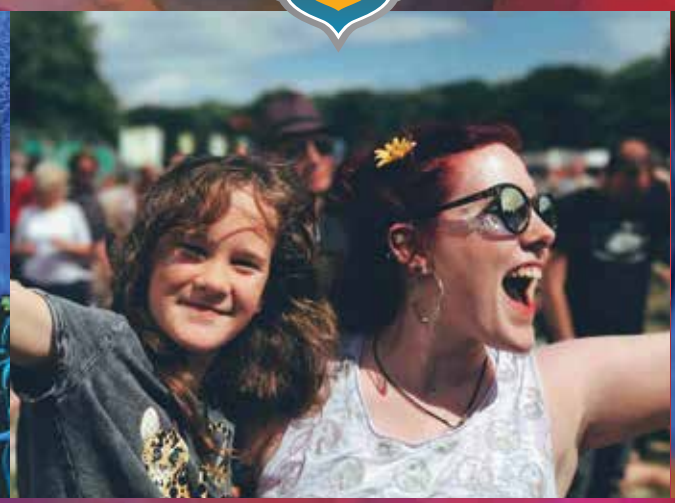

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Palmdale Amphitheater

NASA has long, storied history at Edwards AFB

by Jay Levine
NASA Armstrong

The National Advisory Committee for Aeronautics sent 13 engineers and support staff to California's Mojave Desert in September 1946 to assist in the quest for supersonic flight.

The X-1 aircraft represented the first U.S. Air Force designated "X" or experimental vehicle. It officially exceeded Mach 1 Oct. 14, 1947. Mach is measured from 650-750 mph depending on a number of factors such as atmospheric conditions and altitude. The NACA had its first supersonic flight, also on an X-1 aircraft, March 4, 1948.

The small contingent of NACA, which became NASA in 1958, staff were expected to complete the single project and wrap up operations at the desert outpost. Now 70 years later, the NASA Armstrong Flight Research Center in California continues to test the latest aviation marvels through flight.

A number of X-planes followed, designed to find answers related to speed, temperature, structure, control and human physiology, work that continued as the agency morphed from the NACA to NASA in 1958. One such aircraft was the X-15 rocket plane program that posted a then record 199 flights, including binders of research, and an official record of speed at Mach 6.7, or more than 4,500 mph, and an unofficial altitude record at the edge of space at 67 miles, or 354,200 feet.

The center's initial focus was aeronautics, but the X-15 bridged the worlds of high speed aircraft with the research needed to reach beyond Earth's atmosphere. The development of reaction control systems for the legendary X-15 was critical for spaceflight, as it provided a way to control a vehicle in the absence of dynamic pressure as is encountered in space.

NASA photographs

XS-1 was on the ramp with the B-29 mothership in 1949. This is the second XS-1 built and it later was converted into the X-1E. Unlike the XS-1-1, which was flown by the Air Force, the XS-1-2 was flown mostly by Bell and NACA pilots. It gathered much more research data than the more famous XS-1-1, known as "Glamorous Glennis."

The Lunar Landing Research Vehicle also was tested here. After the aircraft that simulated flight of the one-sixth gravity of Earth that astronauts would face on the moon. The research contributed to construction of the Lunar Landing Training Vehicles that were built and sent to NASA Johnson Space Center in Houston (then called the Manned Spaceflight Center). Apollo astronauts used the spindly aircraft to train for landing on the moon. The practice was helpful when Neil Armstrong piloted the Lunar Module manually to the lunar surface to take the first steps.

Lifting body aircraft were designed to validate the shape of a space return vehicle that could land like an aircraft instead of descending under a parachute and landing in the ocean. When the Sierra Nevada Corporation's Dream Chaser spacecraft returns for additional approach and landing tests at Armstrong in 2017, it will continue the center's historic role with lifting body shaped vehicles.

Space Shuttle Enterprise's approach and landing tests marked another contribution to space-related technology. A large steel gantry called the Mate Demate Device slowly lifted the shuttle onto the back of a specially modified NASA 747 Shuttle Carrier Aircraft. Enterprise was then launched from the back of the large aircraft to confirm shuttles could safely land unpowered.

The center retained a role with the space shuttles during the 30-year program, often hosting landings. Most early landings and first flights of new orbiters or return to flight operations

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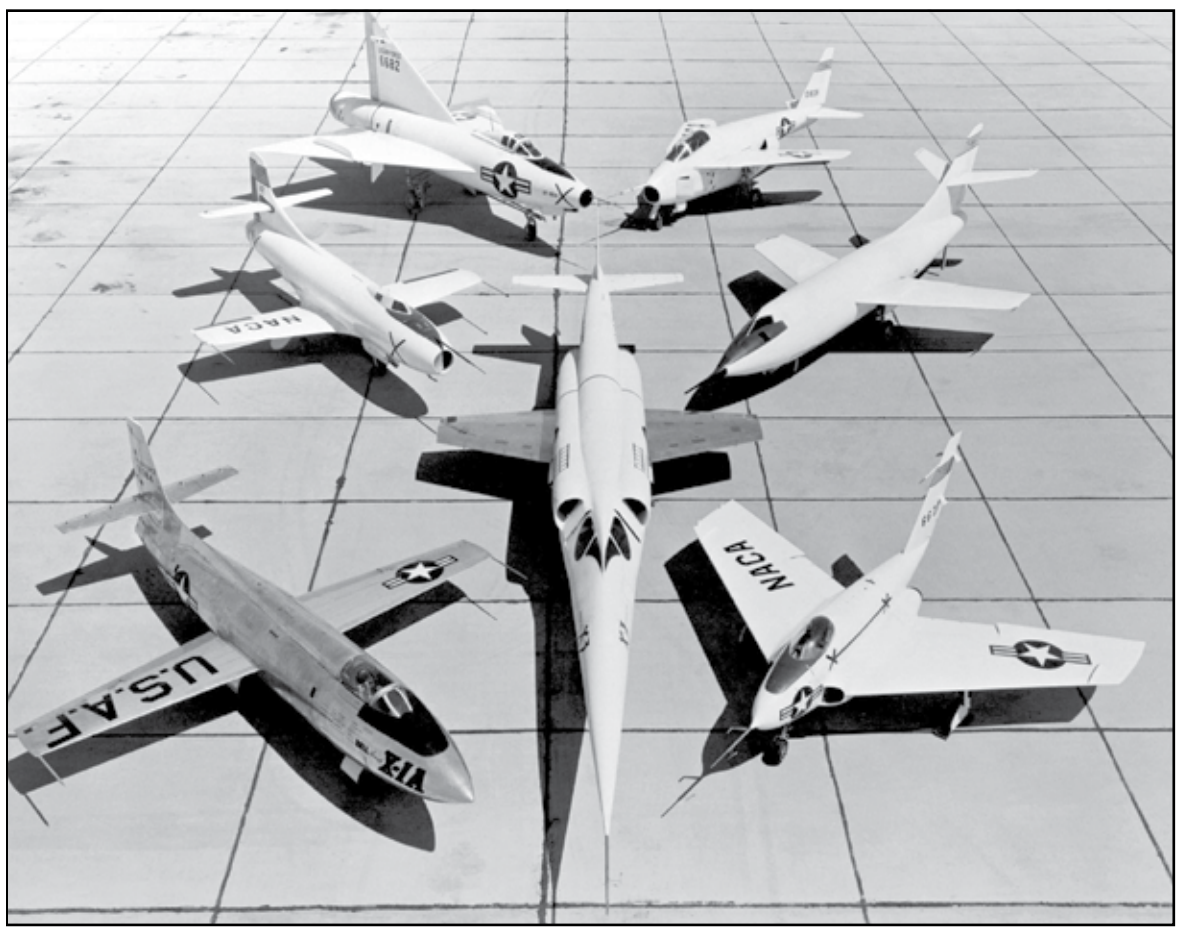
After an ablative coating to protect the craft from high-temperatures flight, the X-15 was then covered with a white sealant coat and mounted with additional external fuel tanks.

The X-15 No. 2 (56-6671) launches away from the B-52 mothership with its rocket engine ignited.



NASA photograph

This 1953 photo shows some of the research aircraft at the NACA High-Speed Flight Research Station (now known as NASA Armstrong Flight Research Center in California). The photo shows the X-3 (center) and clockwise from left the X-1A (Air Force No. 48-1384), the third D-558-1 (NACA No. 142), the XF-92A, the X-5, the D-558-2, and the X-4.

This 1964 photograph shows a ground engine test underway on the Lunar Landing Research Vehicle (LLRV) No. 1.

NASA, from 14

took place at the center. The shuttles concluded 54 space missions with a landing at Edwards and a return trip on the NASA 747 to Kennedy Space Center in Florida.

Also of consequence of the space program, Armstrong was involved in testing the pad launch abort test capsule for NASA's Orion spacecraft, which is intended to eventually take astronauts on a journey to Mars. The capsule's instrumentation and wiring took place at the center, as did its weight and balance, center of gravity and combined systems testing. The center also led the construction of the launch site at White Sands Missile Range in New Mexico where the capsule successfully launched May 6, 2010.

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LLRV flies with support chase Bell 47 helicopter. The helicopter was a second set of eyes for the research pilot, warning him of any problems. When test flights of the LLRV began in October 1964, the helicopter would hover close by, providing information such as altitude and descent rate. LLRV test operations were phased out in late 1966 and early 1967.

Left: The HL-10 was one of five heavyweight lifting-body designs flown at NASA's Flight Research Center (now NASA Armstrong), Edwards, Calif., from July 1966 to November 1975 to study and validate the concept of safely maneuvering and landing a low lift-over-drag vehicle designed for reentry from space. Northrop Corporation built the HL-10 and M2-F2, the first two of the fleet of "heavy" lifting bodies flown.

The wingless, lifting body aircraft were lined up on Rogers Dry Lake at what is now NASA's Armstrong Flight Research Center, Edwards, Calif. From left to right are the X-24A, M2-F3 and the HL-10. The lifting body aircraft studied the feasibility of maneuvering and landing an aerodynamic craft designed for reentry from space. These lifting bodies were air launched by a B-52 mother ship, then flew powered by their own rocket engines before making an unpowered approach and landing. They helped validate the concept that a space shuttle could make accurate landings without power.

Software for the agency's Space Launch System rocket, which will launch Orion into deep space, was tested onboard Armstrong's F-18 aircraft that flew nearly vertical to simulate a rocket flight path. An Armstrong F-18 was also used to test a radar system that helped land the Mars Curiosity rover on the surface of the planet in 2012.

In fact, Armstrong manages the Space Technology Mission Directorate's Flight Opportunities program, which seeks to mature space technology development through flights on commercial suborbital launch vehicles. The program funds the flights in space-like environments of new technologies of interest to NASA's space exploration goals. Among other successes, the program has matured a 3-D printer is now on the International Space Station that can print parts and tools.

Speed isn't only the regime of space vehicles. Armstrong researchers explored the realm of hypersonic speed with the first integrated hypersonic scramjet engine, the X-43. The air-breathing engines propelled the vehicle to speeds of Mach 7, about 4,500 mph, and nearly to Mach 10, or roughly 6,500 mph, during separate flights in 2004.

A defining feature of all supersonic aircraft is a loud sonic boom created when an aircraft exceeds the speed of sound. Over the years NASA researchers have worked to mitigate or soften these booms, modifying aircraft to test theories and new technologies.

Seven decades after helping to create the first sonic boom, NASA is designing a new X-plane to demonstrate quiet boom capabilities, which could lead to supersonic flight without startling people on the ground, a key hurdle to amending rules that currently prohibit overland supersonic operations. The preliminary design review for the Quiet Supersonic Transport human-piloted X-plane is currently underway.

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NASA photograph by Carla Thomas

NASA's historic B-52 mother ship carried the X-43A and its Pegasus booster rocket on a captive carry flight from Edwards Air Force Base Jan. 26, 2004. The X-43A and its booster remained mated to the B-52 throughout the two-hour flight, intended to check its readiness for launch. The hydrogen-fueled aircraft is autonomous and has a wingspan of approximately 5 feet, measures 12 feet long and weighs about 2,800 pounds.

Photograph by Nick Galante

The solar-electric Helios Prototype flying wing is shown near the Hawaiian Islands of Niihau and Lehua during its first test flight on solar power.

Blue Origin photograph

The New Shepard booster lands after the vehicle's flight on Dec. 11, 2019.

General Atomics Aeronautical Systems Inc. photograph

The Altus II aircraft was an early General Atomics Aeronautical Systems Inc. technology demonstrator. The company later developed aircraft such as the Ikhana (Predator B) and the SkyGuardian that NASA has used for flight research.

General Atomics Aeronautical Systems, Inc. photograph

General Atomics Aeronautical Systems, Inc. flew its SkyGuardian unmanned aircraft to conduct a NASA Systems Integration and Operationalization demonstration activity on April 3, 2020.

Unmanned Aircraft Systems, or UASs, are another major area that the center has researched with experimental vehicles since the 1960s. Engineers have continued to investigate this area of aeronautics including shapes and subsystems.

Armstrong and other NASA centers remain involved in the technology development of UAS to help in the eventual integration of Unmanned Aircraft Systems into the National Airspace System.

In the early 1990s Armstrong managed the Environmental Research Aircraft and Sensor Technology program with industry partners. The idea was to develop emerging environmentally friendly aircraft, sensors and technologies needed to fly the emerging class of aircraft safely and conduct science missions. The solar-powered Helios reached an altitude of 96,863 feet altitude during the program. Prototypes of the Predator-B aircraft later led to the NASA science platform named Ikhana, which is now used for science and aeronautical missions.

Sometimes technology advancements lead to revolutions in the way challenges are approached. For example, a specially-modified F-8 aircraft flown at Armstrong validated digital fly-by-wire control technology that replaced hydraulic systems. Military and commercial aviation companies subsequently integrated the systems into its aircraft. More recently, cars, motorcycles and boats are using systems with origins based in that research.

With an eye toward making aircraft technologies transferrable to commercial uses, the NASA Aeronautics Mission Directorate is planning to make it common for future aircraft to be more fuel efficient, quieter and produce fewer emissions.

An example was the all-electric X-57 Maxwell X-plane — intended to be high-efficiency, while reducing noise and emissions. NASA announced earlier in 2023 that the program would wind down later this year.

The center doesn't fly airplanes only for aeronautics research. Specially modified aircraft based at Armstrong support NASA's Airborne Science Program, flying scientists and specialized instruments around the world to study Earth and its changing environment. This includes a DC-8 flying laboratory, a C-20A aircraft, two ER-2 high-altitude aircraft and two Global Hawks.

For several years, Armstrong operated and maintained the Stratospheric Observatory for Infrared Astronomy, or SOFIA. Retired in 2022, the NASA a 747SP had the world's largest airborne infrared telescope. It flew above most of the atmosphere's water vapor, which limits Earth-bound telescope observations. The result was clearer images of the universe and the ability to use the latest science instruments to capture extraordinary astronomical data about the solar system and far beyond.

Following its retirement, the SOFIA aircraft relocated to Arizona where it is part of the Pima Air and Space Museum.

Currently, the center is working with Lockheed Martin on the X-59 Quiet SuperSonic Technology (Quesst) aircraft that is taking shape as it approaches construction completion, and should make its first flight soon. The X-59 will fly to validate the technology to make quiet supersonic flight a reality. The science includes the shape of the aircraft itself reducing the loudness of a sonic boom to a quiet thump.

Once NASA proves the aircraft is as quiet as it's designed to be, the X-59 will begin the third phase of its mission in 2024, where it will be flown above select U.S. communities to gather data from sensors and people on the ground to gauge public perception. That data will help regulators establish new rules that may enable commercial supersonic air travel over land, greatly reducing flight times.

Before the new supersonic experimental aircraft flies, Armstrong worked to assess how people currently perceive sonic booms. Flight series such as the Sonic Booms in Atmospheric Turbulence Flights at Kennedy Space Center in Florida and the Quiet Supersonic Flights in Galveston, Texas, have focused on that work. NASA Armstrong has even captured images of how shockwaves interact with each other and between supersonic aircraft using a process called Air-to-Air Background Oriented Schlieren Flights.

It's hard to predict how future aviation and space vehicles and their systems will evolve. However, it is certain that NASA Armstrong will build on its 75-plus years of success to validate the technologies that will drive exploration for a better tomorrow.

Editor's note: Leslie Williams, Christian Gelzer, Matt Kamlet and Mike Agnew contributed to this report.

NASA photograph by Jim Ross

The Space Shuttle Endeavour, mounted securely atop one of NASA's modified Boeing 747 Shuttle Carrier Aircraft, left NASA's Armstrong Flight Research Center at Edwards Air Force Base in Southern California at sunrise, nine days after concluding mission STS-111 to the International Space Station.

Lockheed Martin photograph

NASA's X-59 aircraft is parked near the runway at Lockheed Martin Skunk Works in Palmdale, Calif., on June 19, 2023. This is where the X-59 will be housed during ground and initial flight tests. The move from its construction site to the flight line is one of many milestones that prepare the X-59 for its first and subsequent flights. Next up, the team will conduct significant ground tests to ensure the aircraft is safe to fly. The X-59 aircraft—the centerpiece of NASA's Quesst mission—is designed to demonstrate the ability to fly supersonic, or faster than Mach 1, while reducing the loud sonic boom to a quiet sonic thump. NASA will then fly the X-59 over several communities to gather data on human responses to the sound generated during supersonic flight. NASA will deliver that data set to U.S. and international regulators to possibly enable commercial supersonic flight over land.

NASA photograph by Jim Ross

The X-56A flies over the desert near NASA Armstrong Flight Research Center, Edwards, Calif. NASA researchers are used the remotely piloted X-56A to explore the behavior of lightweight, flexible aircraft structures.

NASA photograph by Carla Thomas

NASA's Sustainable Flight Demonstrator project hit a new milestone Aug. 15, 2023, when Boeing flew an MD-90 airplane from Victorville, Calif., to its facility in Palmdale, Calif., where conversion to the X-66A experimental aircraft will begin. Key modifications by Boeing to the MD-90 will include replacing its wings with a new pair that will be thinner and extra-long, stabilized by diagonal struts. The design concept, known as the Transonic Truss-Braced Wing configuration, promises to be more fuel efficient than today's best-in-class commercial aircraft. The Sustainable Flight Demonstrator project seeks to inform a potential new generation of single-aisle aircraft. Boeing will work with NASA to build, test, and fly the X-66A, a full-scale test aircraft.

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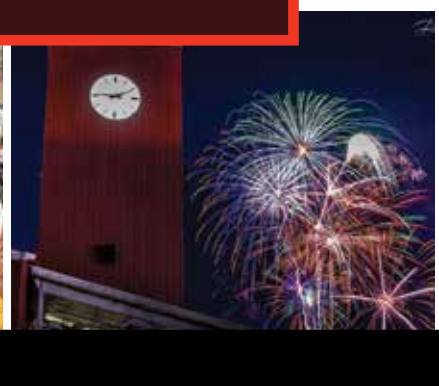

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Pancho Barnes

A splash of color in a dusty, desert outpost

by Bob Alvis
special to Aerotech News

Muroc/Edwards has a rich history, full of technological advancements and amazing personnel who have always kept it at the forefront of aviation innovation on a worldwide scale.

With all the whiz kids and brains needed to put that technology into a working aircraft, it stands to reason that there are times when some steam needs to be blown off, to keep the mind focused and not let the rigors of flight test — a very dangerous business — get the better of you.

Nowadays, the working squadrons have their own traditions and staff that help to keep the pressures in perspective. I admit, I've seen some pretty interesting traditions played out by some very creative personnel! But it wasn't always that way. When young men came to the desolate High Desert in the 1930s and 1940s, bar room activities and shenanigans were pretty much confined to tents and shacks with some pretty stiff company. What the region needed was a free soul who could take the boring and monotonous and inject it with the spirit of adventure — and a heavy dose of outrageous!

Enter one Pancho Barnes, whose colorful resume changed the High Desert landscape and turned the dusty airfields into places of camaraderie and legend while, in her own way, keeping the mission on track.

Pancho was the perfect mascot for the flyboys and personnel of that era, as her flamboyant personality and zest for life challenged the very extremes of their own forms of outrageousness — whether it be pushing the flight test envelope or blowing off steam after hours. "Florence Lowe Barnes" was not a name that summoned up images of crazy fun and shenanigans in a smoky bar room in the desert, but the name "Pancho" sure fit the bill for an adventure-seeking group of educated thrill seekers at our remote desert airfield!

Courtesy photograph

Pancho Barnes

Pancho's nickname came from a place that just added to her legend, from her days teamed up with a young man on a rusty banana boat who went by the name of Roger Chute — another free-spirit adventurer. Passing herself off as a man, Florence set out with Roger to explore Mexico, seeking adventure in a country where Mexican revolutionaries made being an American in Mexico a very dangerous undertaking. The day came when Florence and Roger had a conversation about names and Florence drew on a bit of literary history as inspiration for a name change. The revolutionaries had given Roger a magnificent white horse, while Florence ended up on a burro. Florence noted that Roger was reminiscent of Don Quixote and Roger said, "that would make you his trusty servant, Pancho!" Florence quickly pointed out the inaccuracy of the name Pancho, saying that the name of the servant was really Sancho! "Ah, what the hell, Pancho or Sancho, you fit the bill and from now on I'm calling you Pancho," Roger announced.

With a built-in taste for showmanship, she thought this was a great name: Pancho Barnes! Sort of a pleasant contradiction. She rolled the name around a bit and it came out tasting sweet. At that moment Roger had put forth the name that christened her for life — Pancho Barnes, a name that would fit her physically and spiritually for the rest of her days.

The stories of Edwards Air Force Base and Pancho Barnes will always be intertwined, for it was a location and a kindred soul that were custom-made for each other. The Happy Bottom Riding Club, and the pioneers and legends of flight test who sought escape within its boundaries, found their common denominator in this burro-riding, adventure seeking woman who looked at life not just as something to be lived, but to be experienced living on the very edge of the outrageous! Pancho and her ranch will forever be part of the history of Edwards. Many of us looking for the colorful in life are thankful that Florence turned her back on a structured society and gave us a reason to let loose and blow off steam without caring about how it looks to others. We can wish that our names carried the same aura of adventure as this free spirit, who bucked the system at every opportunity.

Until next time, Sancho/ Pancho/ Bob out!

Courtesy photograph

The sign welcoming guests to Pancho Barnes' Happy Bottom Riding Club.

Courtesy photograph

March 7, 1935, Florence "Pancho" Barnes, a well-known aviatrix, purchased the Ben Hannam ranch near Muroc. She announced her intention to construct a private landing field there.

The ruins of Pancho Barnes' Happy Bottom Riding Club at Edwards Air Force Base, Calif.

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