The U.S. Air Force Flight Test Center

Forging Aerospace Power for America

Air Force Flight Test Center History Office

Edwards AFB, CA

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When the Air Force Flight Test Center (AFFTC) was established on 25 June 1951, Edwards Air Force Base had already become well known as the place where "the rubber meets the ramp" and the *de facto* center of American flight research, development, test and evaluation.

The origins of the base dated back to 1933 when Lt. Col. Henry H. "Hap" Arnold was searching for a training range for his March Field squadrons. He journeyed northward one day to a remote location called "Muroc" on California's high desert and immediately saw that it was ideal for his purposes. What he saw was the vast, 44-square mile expanse of Rogers Dry Lake. Calling it a "natural aerodrome," he recognized that its extremely flat, concrete-like surface made it the world's most spacious natural landing field, one that could be put in service at virtually no cost to the taxpayers. This, combined with the utter isolation of the place and an arid climate that would permit year-round flight operations, prompted him to send a small contingent of troops to the site to lay out a remote bombing and gunnery range along the eastern shore of the lake bed. By the end of the 30s, what came to be known as the Muroc Bombing and Gunnery Range was hosting units from all across the Army Air Corps and it had served as the focal point for major wargame exercises.

When America entered the war, a much larger complex of facilities was already under construction across the lake bed and, on 23 July 1942, Muroc Army Air Base was activated as a separate post. Throughout the war years, its primary mission was to provide training for pilots and aircrew prior to overseas deployment.

By that time, however, another site along the north shore of the lake bed had been selected for a very different type of mission. Noting the same advantages cited by Hap Arnold, project officers for a top secret program had selected it as the location for testing a radically new type of aircraft. That airplane was the turbojet-powered Bell XP-59A and, when it lifted off from the lake bed on 1 October 1942, the United States officially entered the jet age. The site at Muroc proved to be an ideal location to wring out the new technology and thus it became the initial proving ground for the turbojet revolution in this country, as virtually all of America's first-generation jets were tested there along with a growing number of other types of experimental and prototype aircraft. Indeed, even before the end of the war, the decision to transform the entire base into a major test complex had already been made. In addition to the unique natural advantages offered by the location, proximity to the burgeoning aircraft industry in southern California was a major factor in this decision. By war's end, the majority of the Army Air Forces' prime aircraft contractors were concentrated in the region.

XP-59A

On 16 October 1945, the full-time mission at Muroc became flight test. And, although

the mission continued under the direction of the Flight Test Division at Wright Field, in Ohio, the locus of flight testing for the new U.S. Air Force would shift westward to the Mojave Desert before the end of the decade.

The success of the jet programs drew a new type of program to the base in late 1946 when a rocket-powered experimental airplane arrived to commence its powered flight test program. The bullet-shaped Bell X-1 was the first in a long series of research airplanes that were designed to probe the unknowns of flight and solve their mysteries. The X-1 was designed to explore the high-speed transonic region and determine if a piloted airplane could safely exceed the speed of sound. That question was answered on 14 October 1947 when, after launching from a B-29, 24-year old Capt. Charles E. "Chuck" Yeager climbed to 42,000 feet, leveled off and accelerated to a speed of Mach 1.06 (700 mph), thereby shattering the myth of a "sound barrier" forever.

Capt. Charles E. "Chuck" Yeager with the X-1

With the X-1, flight operations at Muroc began to fall into two categories. Highly experimental flight research programs were commonly flown in partnership with the contractors and the National Advisory Committee for Aeronautics (NACA—the forerunner of NASA) to explore new concepts and answer largely theoretical questions with airplanes such as the semi-tailless X-4 and delta-winged XF-92A. By far the bulk of the testing, however, continued to focus on highly accelerated Air Force and contractor evaluations of the capabilities of aircraft and systems proposed for the operational inventory such as the F-84, B-45, F-86 and F-94.

Northrop's giant YB-49 flying wing was one of many airplanes that failed to make it into the inventory. During a test on 5 June 1948, one of the prototype bombers departed controlled flight and broke apart in the sky northwest of the base. All five crewmembers were lost. One of them was Capt. Glen W. Edwards. On 8 December 1949, Muroc Air Force Base was renamed in his honor.

By the time the base was officially designated the Air Force Flight Test Center in June of 1951, more than 40 different types of aircraft had first taken flight at the base and the nation's first generation of jet-powered combat airplanes had already completed development. One of them, the North American F-86 Sabre, was dominating the skies over Korea. Thus, as the new AFFTC commenced operations, it already had a solid foundation on which to build.

YF-100

YB-52

The promise of the turbojet revolution and the supersonic breakthrough were realized in the 1950s, as the Center tested and developed the first generation of true supersonic fighters—the famed "Century Series" (F-100, F-101, F-102, F-104, F-105 and F-106)—and, in the process, defined the basic speed and altitude envelopes for fighter aircraft that still prevail to this day. The Center also played a pivotal

role in the development of systems that would provide the nation with true intercontinental power projection capabilities as it tested aircraft such as the B-52, C-133 and KC-135, as well as the YC-130 which served as the basis for a classic series of tactical transports that would continue in frontline service until well into the 21st century. It also supported the development of the extremely high-altitude and long-range U-2 and the dazzling ultra-performance capabilities of the B-58, the world's first Mach 2 bomber.

The Center also continued to explore new concepts with experimental aircraft such as the swing-wing X-5, the unmanned Mach 2 X-10 and the X-13 which proved the feasibility of employing jet thrust for vertical takeoffs and landings. And, of course, test pilots at Edwards continued to expand the edge of the envelope in rocketplanes such as the Douglas D-558-II Skyrocket, in which NACA research pilot A. Scott Crossfield became the first man to reach Mach 2 (1,291 mph) on 20 November 1953, and the Bell X-1A in which Maj. Chuck Yeager accelerated all the way out to Mach 2.44 (1,650 mph) less than a month later. Flying the Bell X-2, Capt. Iven C. Kincheloe became the first pilot to climb above 100,000 feet on 7 September 1956, as he claimed a peak altitude of 126,200 feet. Just three weeks later, on 27 September, Capt. Mel Apt became the first man to exceed Mach 3, as he piloted the airplane to a top speed of 2,094 mph (Mach 3.2). Tragically, the airplane tumbled violently out of control while it was still above Mach 3 and he was killed in the ensuing crash.

Capt. Iven C. Kincheloe with the X-2

Those records did not last long, as the AFFTC partnered with NASA's Flight Research Center at Edwards in the 1960s to explore the hypersonic and near-spaceflight regimes in the rocket-powered North American X-15. The program got underway in earnest in 1961 when Maj. Robert M. "Bob" White became the first man to exceed Mach 4, as he accelerated to 2,905 mph (Mach 4.43) on 7 March. He claimed Mach 5 just three months later when he pegged a speed of 3,603 mph (Mach 5.27) on 23 June and then, during the X-15's first full-powered flight on 9 November, he exceeded Mach 6, as he flew to a speed of 4,094 mph (Mach 6.04). Major White also became the first man to fly an airplane in space when he climbed to 314,750 feet on 17 July 1962. NASA's Joe Walker flew the airplane to its peak altitude of 354,200 feet (67 miles) on 22 August 1963 and Maj. William J. "Pete" Knight reached Mach 6.72 (4,520 mph) in the modified X-15A-2 on 3 October 1967, a speed that remains to this day the highest ever attained in an airplane.

X-15


Major Robert M. "Bob" White with the X-15

The USAF Test Pilot School (TPS) was renamed the USAF Aerospace Pilot School in 1962 and its curriculum was expanded to provide the first and only formal astronaut training program for U.S. military test pilots within the Department of Defense. By the time the training was terminated in 1972 (and the school once again became the USAF TPS), it had made a lasting

mark on the U.S. space program, as 37 of its graduates were selected for the U.S. space program and 26 earned astronaut's wings by flying in the X-15, Gemini, Apollo and Space Shuttle programs (and, over the years since, scores of TPS graduates have been selected for astronaut duties by NASA).

Meanwhile, high on Leuhman Ridge overlooking Rogers Dry Lake, the earth quaked as the USAF's Rocket Propulsion Laboratory (now the Propulsion Directorate of the USAF Research Laboratory which remains a major tenant unit at Edwards) was testing the engines that were thrusting the U.S. into the space age, including the giant Saturn rocket boosters that were destined to take it to the moon.

Finally, the AFFTC and NASA also teamed up to explore a new concept called "lifting reentry" with a series of wingless lifting body aircraft. These rocket powered-vehicles—the M2-F2, M2-F3, HL-10, X-24A and X-24B—paved the way for the Space Shuttle and future spaceplane designs when they demonstrated that they could make precision landings after high-speed gliding descents from high altitude.

While the X-15 and Lifting Body programs represented a high-water mark in flight research, the Center's primary job was to test and develop the systems that would expand the nation's airpower capabilities. The major aircraft systems that were tested and developed during the 1960s—the T-38, B-52H, F-4 and RF-4, F-111 and FB-111, C-141 and C-5—all became mainstays in the USAF operational inventory. And so did the still spectacular, triple-sonic SR-71 Blackbird which, for more than a quarter of a century, provided the United States with an unsurpassed global reconnaissance capability.

SR-71

The 1970s were dominated by a new—and still very much ongoing—development, as the focus began to shift toward integrating, developing and testing a proliferation of electronic and computer-driven systems. The Flight Test Center played a pivotal role, for example, in the successful development of a pair of new fighters. The F-15 Eagle featured a host of cutting-edge technologies, including a powerful, multi-mode, high-frequency pulse-Doppler fire-control radar system and a pair of afterburning 24,000-lb thrust turbofan engines. The lightweight F-16 Fighting Falcon was the first combat aircraft to incorporate fly-by-wire technology into its flight control system. The F-15 would remain the world's unrivaled air superiority fighter into the 21st century and, in addition to the USAF, the versatile F-16 became the multi-role fighter of choice among allied air forces around the globe.

F-15

The Center also explored a host of new technologies and concepts that would subsequently be incorporated into the designs of operational systems. It employed a highly modified YA-7D DIGITAC aircraft, for example,

to demonstrate the feasibility of using digital flight control computer technology to optimize an airplane's tracking and handling qualities for a full range of weapons delivery tasks. New propulsion lift concepts and flight control technologies demonstrated on the YC-15 were ultimately applied to the design of the C-17. The Center also played a key role in a highly classified demonstration program with even wider-ranging consequences, as it joined with a Lockheed Skunk Works team to evaluate the HAVE BLUE low-observable concept demonstrators in tests that validated the feasibility of incorporating radically new stealth technology into the design of an effective combat aircraft.

The AFFTC reentered the space arena in the late 70s and early 80s, as it teamed with NASA's Dryden Flight Research Center to plan and conduct the reentry-through-landing phases of the Space Shuttle orbital flight test program which commenced with the successful landing of the Shuttle Columbia at Edwards on 14 April 1981. Meanwhile, the Center continued to deliver systems providing truly impressive combat capabilities to the warfighting commands, among them the AGM-86B Air-Launched Cruise Missile (ALCM), F-117A "stealth fighter," F-15E Strike Eagle, B-1B bomber, and the Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) system. Systems such as these, matched with precision-guided conventional weapons, provided capabilities that were to redefine the whole concept of air-to-ground combat in Operations Desert Storm, Enduring Freedom and Iraqi Freedom.

Space Shuttle Columbia

The Center also continued to evaluate the potential of a wide range of cutting-edge technologies by employing a variety of concept demonstrator aircraft such as a highly modified F-15B that served as the test bed for an integrated flight and fire control (IFFC) system that promised to alter the nature of air combat when it successfully demonstrated the capability to fire effectively on hard-turning air-to-air targets from virtually any attack angle and on air-to-ground targets while in maneuvering flight. The Advanced Fighter Technology Integration (AFTI) F-16 explored the real-world feasibility of state-of-the-art integrated sensor, avionics and flight control technologies for possible incorporation into both new and existing fighter designs. Voice command and automated ground collision avoidance systems, an automated target handoff system and an all-terrain automated maneuvering attack system were just a few of the many advanced capabilities validated during a remarkably productive program that extended from the early 80s through the late 90s. Perhaps most spectacularly, a major technical achievement was accomplished on 13 September 1985, when Maj. Wilbert D. "Doug" Pearson became the world's first "space ace" as he launched a three-stage anti-satellite (ASAT) missile from his highly modified F-15A and scored a direct hit against a satellite orbiting 340 miles overhead—a stunning event that reportedly reverberated through the halls of the Kremlin.


F-15 ASAT

B-2

Over the past decade and a half, the Flight Test Center has been engaged in testing and developing systems—as well as integrating new capabilities into existing systems—that will enable the Air Force to achieve its vision of global vigilance, reach and power. First developed in the 1990s, the B-2 bomber combined third-generation stealth with long-range and a precision-guided weapons capability that continues to evolve. In September 2003, for example, an AFFTC test crew successfully released 80 independently targeted GBU-38 Joint Direct Attack Munitions (JDAM) against 80 different targets in a single pass and thereby achieved a truly impressive milestone in the development of the Air Force's precision strike capabilities. The C-17 was developed into the most flexible heavy-lift cargo aircraft ever to enter the Air Force inventory as has been amply demonstrated in recent operations in support of the Global War on Terror. Combining stealth, unmatched maneuverability, supercruise (Mach 1.5 without use of afterburners) with fully integrated systems, the F-22 has redefined the term "air dominance" and is currently undergoing tests that will also give it an awesome range of multi-mission capabilities.

F-22

RQ-4 Global Hawk

The AFFTC has also been engaged in testing the RQ-4 Global Hawk, a long-endurance, high-altitude unmanned aerial vehicle which, while still under development, has provided battlefield commanders in Afghanistan and Iraq with unprecedented near real-time, high-resolution, all-weather intelligence, surveillance and reconnaissance capabilities. The Center is nearing completion of the development test and evaluation of the CV-22, a tilt-rotor vertical takeoff and landing aircraft that will meet a long-standing USAF Special Operations Command requirement for a vehicle that can conduct long-range, high-speed, vertical lift operations in adverse weather and nighttime conditions. Tests of the multi-service (and multi-national) F-35 Joint Strike Fighter have recently gotten underway and the Center is now engaged in the test and development of a directed-energy system that promises to transform future combat. The airframe of the YAL-1A Airborne Laser is a highly-modified Boeing 747-400F that hosts an extremely complex array of systems that will feature two targeting lasers, deformable optics (beam-steering mirrors) and a megawatt-class chemical oxygen iodine laser designed to destroy hostile theater ballistic

YAL-1A Airborne Laser

missiles during the initial boost phase of their flights.

For more than six decades, the AFFTC and its antecedents at Edwards AFB have played a pre-eminent role in forging the future of the USAF and, indeed, the world of aerospace in general. During that period, the Center has tested and supported the development of virtually every aircraft system that has entered the USAF inventory and it has been involved in more major milestones in flight than any other comparable organization in the world. It has been on the cutting edge of every major development that has transformed the field of flight. The turbojet revolution, the supersonic and hypersonic breakthroughs, the space revolution, systems revolution and, more recently, the stealth revolution have each imposed seemingly insurmountable challenges that have been overcome through a combination of technical skill, daring ingenuity, and resourceful management. And, as the Center looks toward the future, yet another transformation is underway—a system-of-systems revolution that promises to provide the capability to find, fix, track, target, engage and assess any target on or above the face of the earth. It, too, poses truly daunting challenges. But the men and women who comprise the Air Force Flight Test Center have embraced them. "Ad Inexplorata," the Center's motto, is Latin for "Toward the Unexplored." At Edwards, it has always been much more than just a motto, for it conveys an *esprit de corps* that extends from the Center's past, through its present and into its future.

Dr. James O. Young, AFFTC/HO, April 2007

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