American Institute of
Aeronautics and Astronautics

Historic Aerospace Site

NASA Ames Research Center

Moffett Federal Airfield, California

NACA's 40 x 80 foot wind tunnel at Ames Aeronautical Laboratory. The model shown here is 50 feet long.

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Aeronautics and Astronautics

HISTORIC AEROSPACE SITE

NASA Ames Research Center

MOFFETT FEDERAL AIRFIELD, CALIFORNIA

AIAA

The World's Forum for Aerospace Leadership

Joseph Sweetman Ames (1864–1943)

Joseph Sweetman Ames was born July 3, 1864 in Manchester, Vermont, the only child of George L. and Elizabeth L. Bacon Ames. Ames attended the Shattuck School in Faribault, Minnesota from 1872 until 1883. He received a B.A. from The Johns Hopkins University in 1886 and soon after studied at the University of Berlin.

Ames returned to Hopkins in 1887 to do work in spectroscopy and received his Ph.D. in 1890. He became an associate professor at Hopkins in 1891 and full professor in 1899. He taught until becoming provost of the University in 1926, and served as its president from 1929 to 1935.

Ames was an original member of the National Advisory Committee for Aeronautics, starting in 1915, and served as its chair from 1919 until 1939.

Almost as soon as Wilbur Wright landed his plane at Kitty Hawk, and certainly as soon as the Wright Brothers and others had mastered the control of flight, the usefulness of airplanes, particularly for military purposes, became quite apparent to the U.S. government. In 1915, it established the National Advisory Committee for Aeronautics (NACA) to foster the development of aviation through scientific research. In 1917 NACA built the Langley Memorial Aeronautical Laboratory near Hampton, Virginia, a pioneer in advanced research facilities at the time.

By 1936, now chaired by Joseph Ames, NACA was becoming more aware of the military buildup and military aggression in other parts of the world. It took a little longer for the rest of the government to take notice, but by 1938 NACA had formed a Special Committee on the Relations of NACA to National Defense in Time of War. One of the suggestions of its chair, Major General Oscar Westover, was that the Committee make plans for an additional research center in the interior of the country or on the west coast. This suggestion was made to help relieve some of the "congested bottleneck" at Langley, the result of a small amount of space as well as a shortage of electrical power in the area to run NACA's new high-speed wind tunnels.

NACA formed another Special Committee, on Future Research Facilities, which made the recommendation for the establishment of a second major aeronautical research facility on an Army field near Mountain View, California. The estimated cost: $11 million. This recommendation was submitted by NACA to President Roosevelt and the Bureau of the Budget, and they quickly sent it to Congress. Congress initially rejected it, but a rising military threat in Europe, combined with the support of many sympathetic Congressmen and Senators, led to its approval, and the appropriation of $10 million for a new research facility, plus a smaller amount for expanding the Langley facilities.

The Army field where NACA planned to build its new facility was Moffett Field, named for Rear Admiral William Moffett, who helped establish the field and who had died in a dirigible crash in 1933. At that time, the dirigible airship showed promise for use in commercial and military operations, and a west coast base of operations was required, which led to the selection of the Sunnyvale site. Although the widespread use of dirigibles never materialized, the huge Hangar One at Sunnyvale still stands as a testament to their history.

Construction at Moffett Field began late in 1939 with a small administration building to house the even smaller staff, who arrived in January 1940. John Parsons, of Langley, headed the construction, and Smith DeFrance was the engineer-in-charge. The first order was business was to build a flight research facility, which began in February 1940, followed by a technical services building and shortly thereafter by three wind tunnels: a 16-foot tunnel, two 7- by 10-foot tunnels, and a 40- by 80-foot tunnel. Deemed a convenience rather than a necessity, an official administration building was not completed until October 1943. The research facility was officially named for Joseph Ames on April 18, 1940.

Ideas for research projects came from all over, but the first official research project focused on the problem of aircraft icing. Ice on the wings lessens or changes their aerodynamics; ice on the motor can, oddly, make it overheat; and the freezing of other parts of a plane significantly interrupts their functions and can place the craft in danger. Icing problems plagued the air transportation industry as well as the military, and research was needed to figure out the cause of the icing as well as how to remove it or prevent it. Lewis Rodert, one of the early Ames engineers, had already started this research at Langley, and he and his group needed an aircraft that could collect data in severe conditions.

An aerial view of the NACA Ames Aeronautical Laboratory and its wind tunnels.

A view of the huge dirigible hangar with doors open at both ends. The hangar was erected in 1931–33 and covers eight acres.

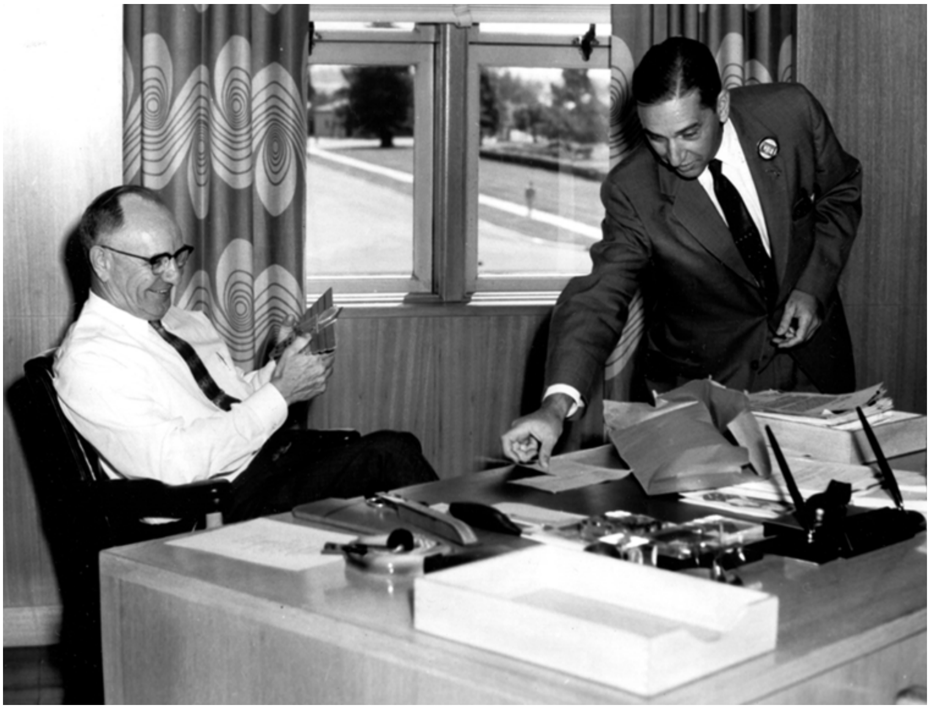
The 16-foot wind tunnel at NACA Ames Aeronautical Laboratory.

Test pilot Lawrence A. Clousing climbs into his Lockheed P-80 aircraft for a test flight at the Ames Aeronautical Laboratory.

Testing advanced designs for high-speed aircraft, an engineer makes final calibrations to a model mounted in the 6 x 6 Foot Supersonic Wind Tunnel.

They experimented with thermal deicing, by running hot exhaust gas through the wings of a Lockheed 12A, and discovered that this process worked well. Rodert's techniques for deicing were built into many WWII Allied aircraft, including the B-17 and the B-24. His work won him the prestigious Collier Trophy in 1947, the first of many Collier trophies won by work at Ames. Many other types of wartime aircraft were also examined and tested here. Work on the Lockheed P-38, for example, found the reasons why the plane would often go into a vertical dive during a high-speed descent, from which no pilot could recover. Use of the wind tunnel found problems with the wing design, which they ultimately could fix by installing a hinged flap under the wing so that the pilot could control the dive. These flaps were immediately built in the P-38 and were later added to the design of all new fighter aircraft.

As the war progressed, so too grew the need to provide ever more sophisticated research facilities. Engine developments, particularly the work in jet-assisted take-offs (JATO) meant that aircraft could fly at increasingly higher speeds, and researchers realized that there would soon be a need for supersonic wind tunnels, that could produce airflows faster than the speed of sound. One issue that made supersonic wind tunnels quite complex was



Smith DeFrance (seated), Director of Ames Aeronautical Laboratory, examines an award marking his 35 years of service with NACA, while Associate Director Jack Parsons looks on.

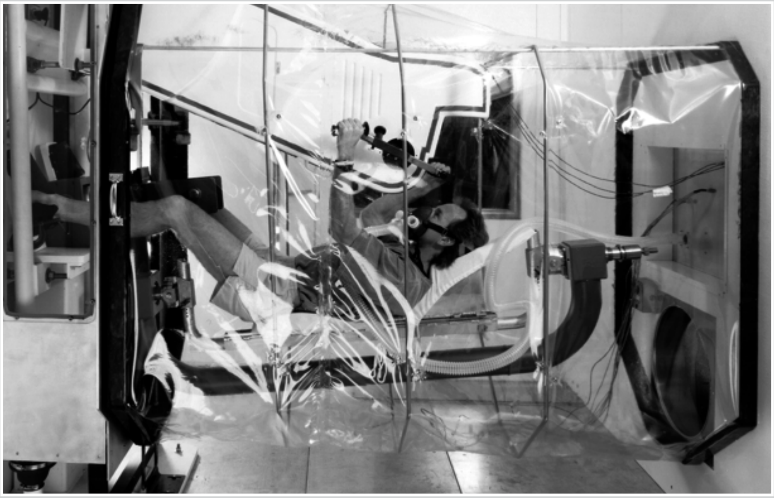
the need to vary the air flow speed, which in subsonic tunnels could be adjusted merely by changing the speed of the fan producing the flow. In a supersonic tunnel, however, the flow was adjusted by changing the geometry of various parts of the tunnel itself, which made their construction much more complex. Ames initially built a small 1-foot by 3-foot supersonic tunnel, and soon after was approached by the Navy to build a larger one, a 6- by 6-foot. This was the first of the large supersonic tunnels built by NACA.

The workforce at Ames had grown from 50 in 1940 to 1,000 by 1948. Smith DeFrance had become the laboratory's director, and John Parsons went from heading the initial construction to chief of the full scale and flight research division. He later became chief administrator of the laboratory. Two other men played an integral part in guiding the early efforts at Ames: Harry Goett, who took over from Parsons as the head of all full scale and flight research, until he left in 1959 to become founding director of the new Goddard Space Flight Center; and H. Julian Allan, a brilliant theoretician who served as chief of the high speed research division.

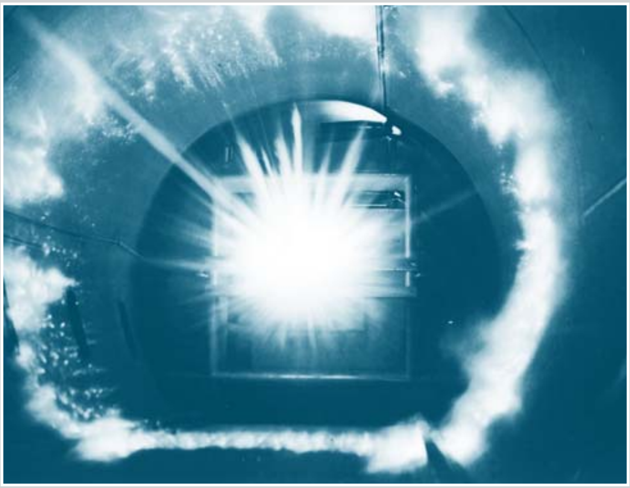
After the war, Ames continued its research on supersonic flight, a need that grew as jet propelled aircraft became more common. NACA and the military met in 1946 and agreed on a "unitary plan" for new facilities, which resulting in the building of the Unitary wind tunnel facility at Ames. This facility covered 11 acres and was composed of three large test sections. Each section could produce different, but overlapping, wind speeds, which allowed one model to be tested there over the entire range of speed from Mach 0.3 to 3.5.

From there the next step was the exploration of hypersonics. As early as the late 1940s Ames researchers were conducting hypersonic experiments, and this put them in an important position as the need for ever more sophisticated missiles grew in the 1950s. In 1955, President Eisenhower stated his priorities of intercontinental ballistic missile (ICBM) and intermediate-range ballistic missile (IRBM) projects, which led to the addition of the Lockheed Missiles and Space Company adjacent to Moffett Field. The need for high-speed missiles also meant increased work at Ames, but at the end of the 1950s Ames had to change its focus and adjust to a new era.

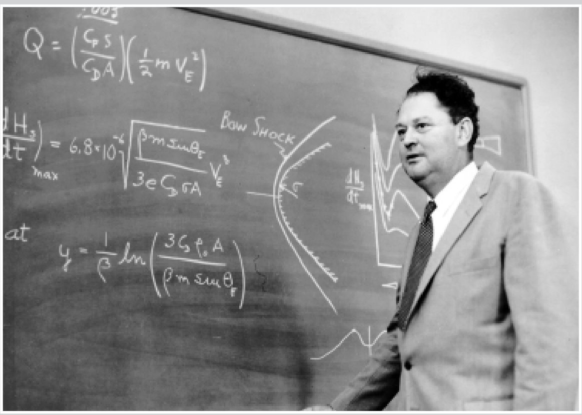
In 1958, NACA was disbanded and its facilities became part of the National Aeronautics and Space Administration (NASA). NASA's new goals were firmly space oriented, which meant that many of Ames' wind tunnels were mothballed, and although NASA received budget



The EVA (Extra Vehicular Activity) Exercise Device for evaluation of effects of weightlessness on astronauts during long duration spaceflights.



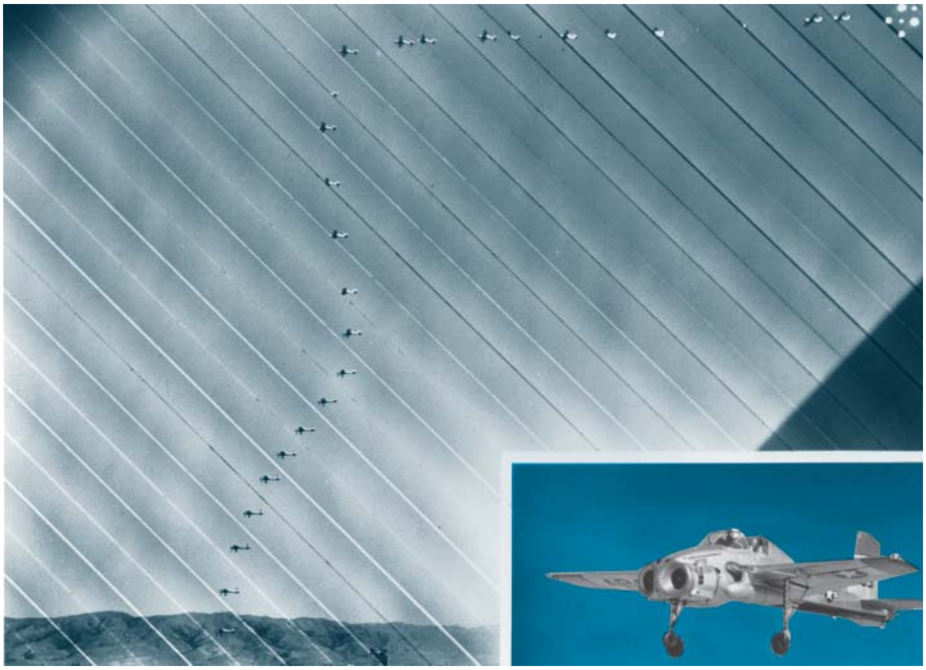
The photo shows the "energy flash" when a projectile launched at speeds up to 17,000 mph impacts a solid surface at the Hypervelocity Ballistic Range at NASA's Ames Research Center, Mountain View, California. This test is used to simulate what happens when a piece of orbital debris hits a spacecraft in orbit.



H. Julian Allen with his blunt body theory.

increases into the 1960s, not much of the money came to Ames. When the money did come, it had to be used so quickly that there was little time to train new workers; it became necessary to hire firms with the skills already in place and Ames personnel found themselves spending more time managing contractors than actually doing their own research.

As part of the increased focus on space, Ames started in new research areas. One area was that of life sciences, which was helped by having a well-established human factors group already established in the flight simulation branch. Ames also built and managed several of the Pioneer solar observatories. Another important area of Ames research was that of reentry into the earth's atmosphere. "Harvey" (H. Julian) Allen had proposed the theory, contradictory to everything known at the time, that a blunt body shape would actually be better than a pointy shape for getting an object back into Earth's atmosphere without it burning up. Allen's work led to the creation of arc jet facilities and ballistic ranges for entry heatshield testing and development. Extensive testing and new facilities at Ames proved this theory to be true and the result was the shape of the space capsules used by the Mercury, Gemini, and Apollo astronauts, as well as of other future vehicles.



A landing on the lunar surface is simulated by the NASA Ames Research Center's Bell X-14A Vertical Take-Off and Landing (VTOL) aircraft.

Ames continued working on high-speed aerodynamics, and used its facilities to aid in the design of commercial air vehicles such as jumbo jets and more effective military aircraft needed in Vietnam and beyond. Ames also became a leader in flight simulators.

As the Apollo era drew to a close, the aerospace industry as a whole took a beating, and the possibility of Ames' closing was rumored. Ames weathered the storm, and changed course once again, to flight research. Ames combined with the Dryden Flight Research Facility in 1981, where many of the early Ames fleet had been sent years before. This provided an excellent location and existing facilities for flight testing. One new technology pioneered at Ames and tested here was fly-by-wire technology, which replaced hydraulic systems in aircraft. Other types of experimental aircraft were also developed here, and Ames also did significant research in Vertical Takeoff and Landing (VTOL), on airplanes such as the Bell X-14 and XV-15, the V-22 Osprey, and the British Harrier.

In the 1970s Ames continued to find new and innovative uses for its wind tunnels, and starting upgrading their facilities. A long-term upgrade project led to the 1987 renaming of the full-scale tunnels as the National Full-Scale Aerodynamics Complex (NFAC) and included a new 80- by 120-foot tunnel that could accommodate the growing size of commercial and military aircraft. Ames also provided some support for the Space Shuttle program, most notably in the development of its heat shield.

In the 1990s, with the end of the Cold War, Ames had to reinvent itself once more to fit with the new NASA credo of "faster, better, cheaper." The Navy had been managing Moffett Field almost continuously since 1935; but with the end of the Cold War, the Navy no longer needed Moffett Field. NASA took over as the custodial agency in 1994. Also in 1994, the Dryden Research Center, which had been a part of Ames for twelve years, became an independent center. During this period, Ames lost many programs and faced the possibility of closure on at least one occasion.

Ames weathered the changes, however, and began a strong program of improvement and growth in the information technology arena. In 1996, NASA Administrator Dan Goldin named Ames a Center of Excellence for Information Technology. Ames created numerous teams that developed technologies in modeling, database management, smart sensors, human-computer interaction, supercomputing, and networking. Ames also produced major research in bioinformatics and is now a resource for investigators to apply computer technology to the study of biological systems. Research into nanotechnology has also led to significant opportunities in flight control and other areas.

An aerial view of NASA Ames Research Center.

NASA "Future Flight Central," the world's first full-scale virtual airport control tower at Ames. The facility is designed to test ways to solve potential air and ground traffic problems at commercial airports under realistic airport conditions and configurations.

Air traffic control and air traffic safety issues had been studied at Ames since the 1970s, but new software and equipment developed in the late 1990s provided state-of-the-art facilities for research. Other programs continued to grow at Ames in the areas of astrobiology, the seeking of life in the universe; experimental aircraft; and the Stratospheric Observatory for Infrared Astronomy (SOFIA), an airborne infrared observatory built into a 747. Flying at 41,000 feet allows it to rise above 99 percent of the Earth's obscuring water vapor and make observations impossible with even the most powerful telescopes on the ground.

Since 1939, the NASA Ames Research Center and its employees have demonstrated again and again the ability to adapt to new circumstances. From icing issues on airplanes to infrared telescopes, Ames has proven itself more than equal to any challenge, and it continues to support the U.S. government, its citizens, and the aerospace community worldwide.

All photographs courtesy of NASA.

FOR FURTHER INFORMATION:

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THE AIAA HISTORIC AEROSPACE SITES PROGRAM

For over 75 years, the American Institute of Aeronautics and Astronautics (AIAA) has served as the principal society of the aerospace engineer and scientist. Formed in 1963 through a merger of two earlier societies, the American Rocket Society (ARS) and the Institute of the Aerospace Sciences (IAS), the purpose was, and still is, "to advance the arts, sciences, and technology of aeronautics and astronautics, and to promote the professionalism of those engaged in these pursuits." Today, AIAA has more than 35,000 members, as well as 90 corporate members.

In addition, AIAA sponsors many technical conferences, seminars, and short courses per year, and publishes *Aerospace America,* and seven archival technical journals (including one online journal). The Institute also publishes conference papers and proceedings, technology assessments, position papers, audiovisual information packages, many books, and a variety of career-related educational materials. The Institute conducts a rigorous public policy program and works closely with other societies and governments in broad areas of mutual concern.

AIAA established the Historic Aerospace Sites Program in January 2000 to promote the preservation of, and the dissemination of information about, significant accomplishments made in the aerospace profession. In addition to NASA Ames Research Center, over 35 sites have been recognized, including the 1940 Air Terminal at William P. Hobby Airport, Houston, Texas; the Boeing Red Barn, Seattle, Washington; Kitty Hawk, North Carolina; the site of the first balloon launch, in Annonay, France; and Tranquility Base, on the moon.

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