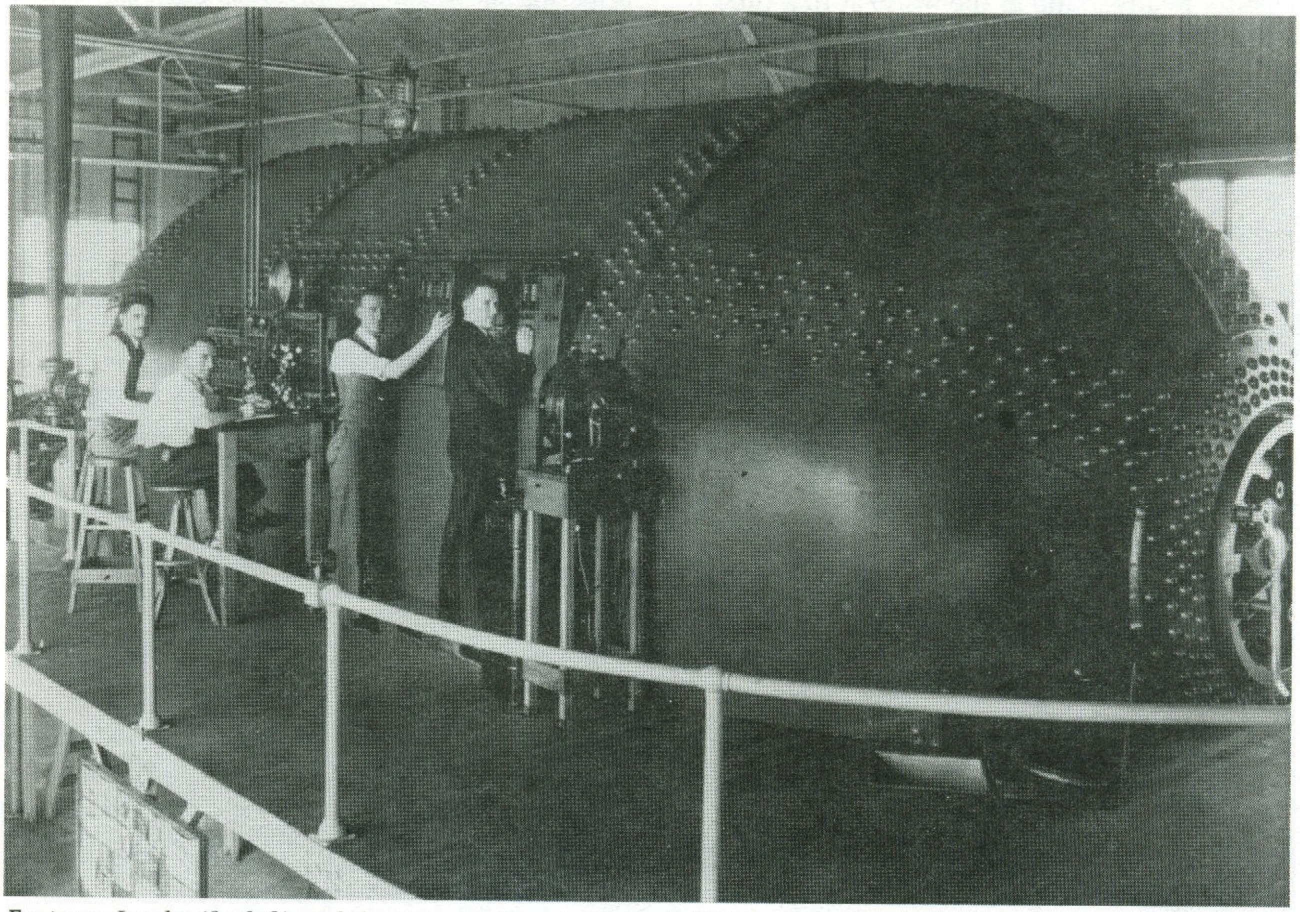
National Aeronautics and
Space Administration

Information Summaries

NF168 - May 1992

Langley Research Center
National Historic Landmarks



Eastman Jacobs (far left) and the Variable Density Tunnel (VDT) research team, March 1929. The VDT was a major contributor to the outstanding international reputation of American aeronautical research, as well as a major behind-the-scenes reason for the success of the American aircraft industry.

Few of us will ever forget where we were when Neil Armstrong first set foot on the lunar surface and made his now famous remark, "That's one small step for man; one giant leap for mankind."

It was a moment of immense pride for all Americans. And it was especially gratifying for the employees of NASA Langley Research Center, who had spent years developing and perfecting technology that helped make that first trip to the moon possible.

To honor NASA's and Langley's contribution, the United States Department of the Interior designated five Langley facilities National Historic Landmarks in 1985. They are among 26 sites nationwide so honored for inclusion in the Department's "Man in Space" project. "Man in Space" was conceived to preserve for posterity the NASA sites that most contributed to America's successful aeronautics and space programs between 1915-72, one of the most exciting periods in our nation's history.

The five Langley sites include three wind tunnels and two training facilities. The wind tunnels provided the technological base from which the early space program was initiated-they allowed us to develop the rockets necessary to take us to the moon and beyond. The training facilities were critical in preparing astronauts to actually operate in space and land on the moon.

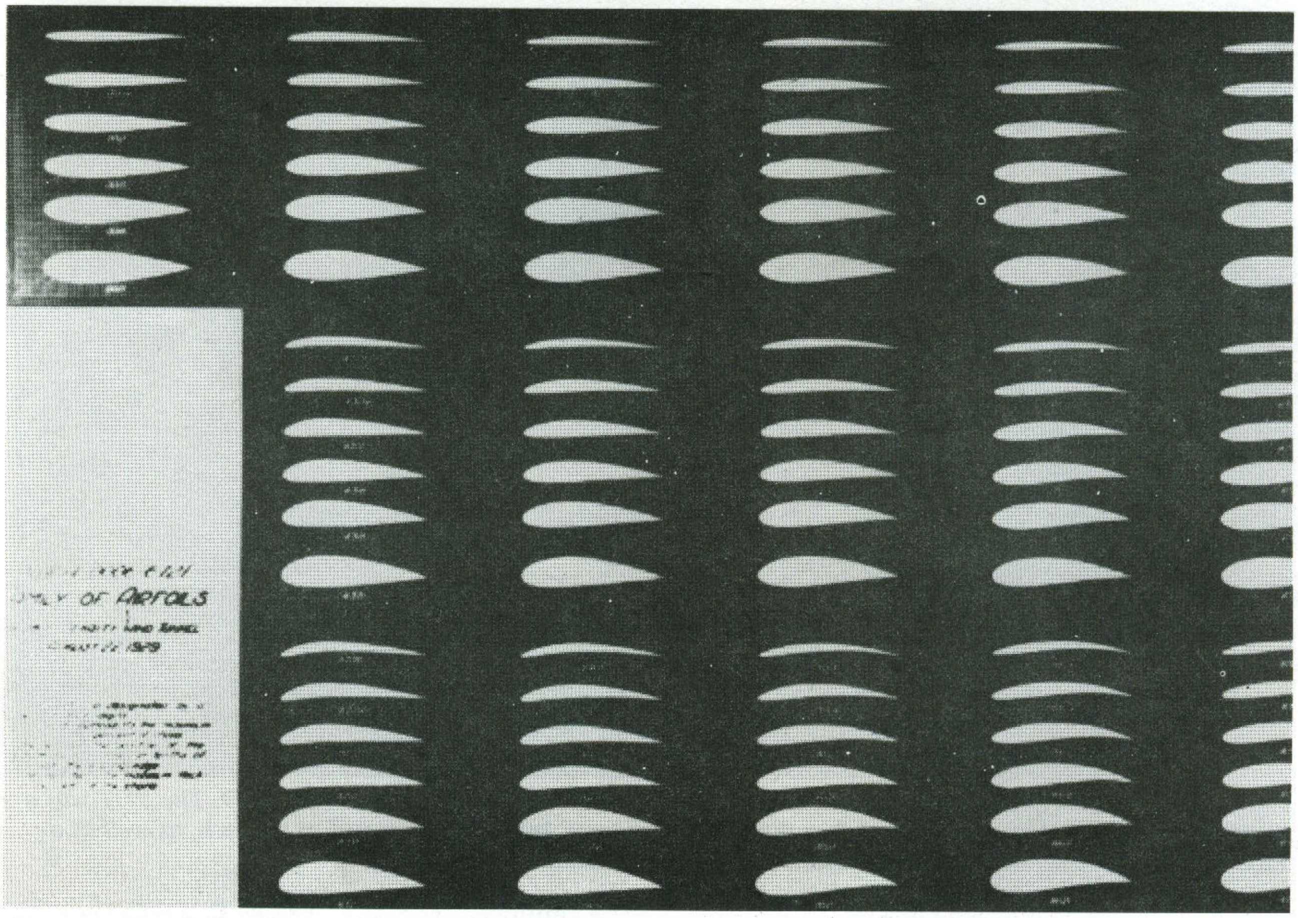
Langley's National Historic Landmarks

Variable Density Tunnel (VDT)

First operational at Langley in 1922, the VDT "put NACA on the map," according to Dick Layman, Langley's Historical Program Coordinator. The VDT was an aeronautical research tool superior to any found in the world at that time, and set an early standard for all variable density wind tunnels in use today.

Built from a design conceived by Dr. Max Munk, a German scientist familiar with European wind tunnel design, the VDT was the first pressurized wind tunnel in the world. This meant the VDT could achieve more realistic effects than any previous wind tunnel in predicting from models how actual aircraft would perform under flight conditions.

The VDT interior was destroyed by fire in 1927, but was rebuilt and placed back in service



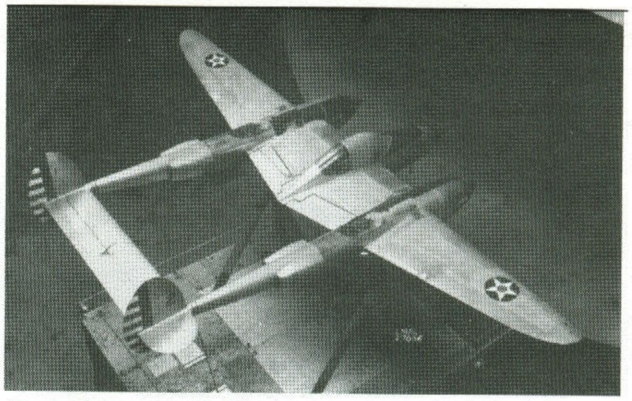
The VDT became the primary source of new aircraft wing research in the U.S. -- if not the world until the late 1930s. One of its most impressive products was a family of 78 fully tested airfoil shapes released to the aircraft industry in 1933. Many of these airfoils remain in use today. Details of this research can be found in the famous NACA technical report 460 of 1933.

in 1930. By the 1940s, however, it was obsolete and was removed from service as a wind tunnel, although its basic structure and mechanical systems remained intact.

Full-Scale Tunnel (FST)

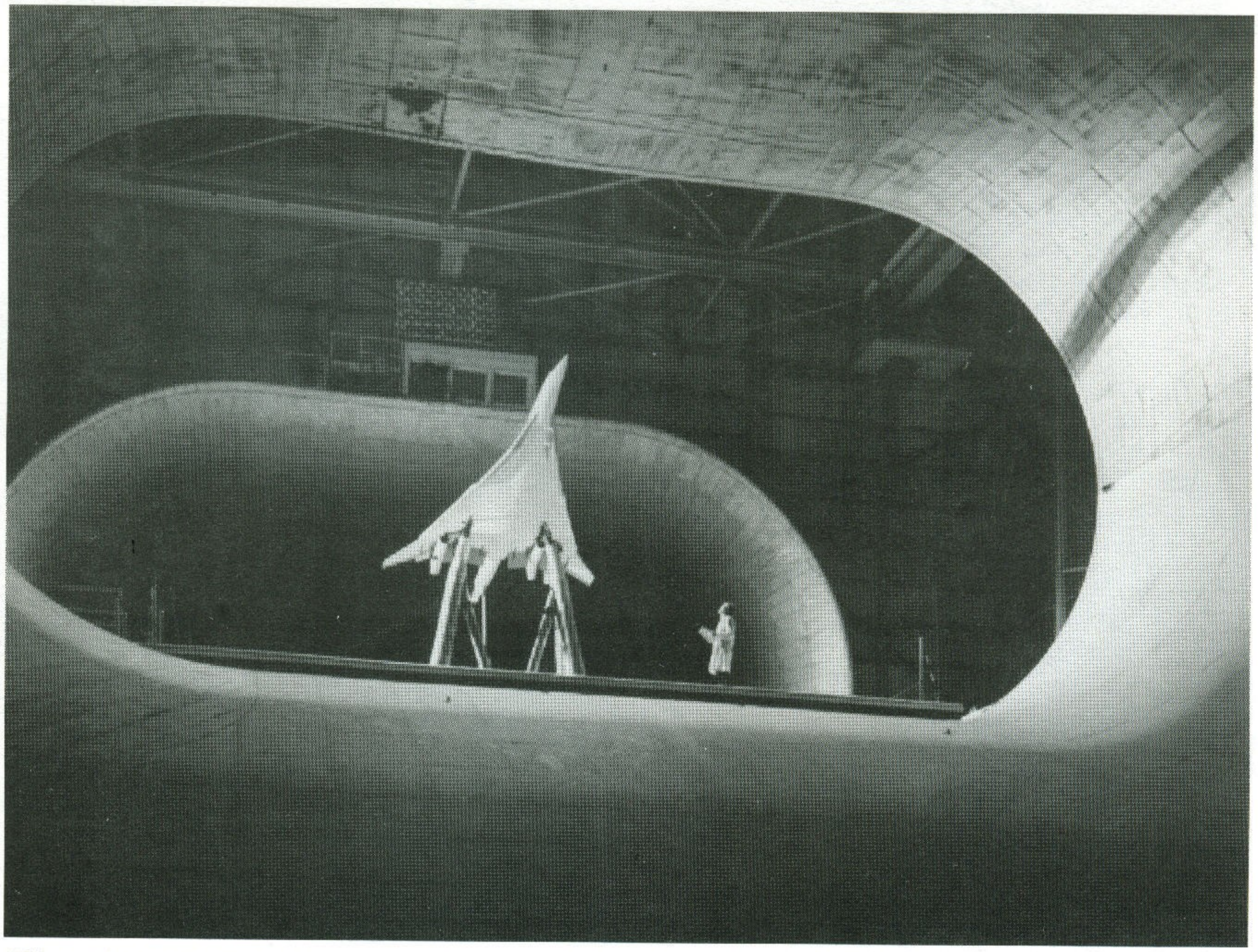
Although the VDT revolutionized wind tunnel testing concepts in the 1920s, NASA's forerunner, NACA, still needed a tunnel that could test full-scale models or actual aircraft.

In 1929 NACA began construction of the nation's--and the world's--first full-scale wind tunnel. The design team was led by Smith J. De France. The tunnel was completed in 1931. The FST was a double-return tunnel capable of moving air at speeds up to 118 miles an hour through its circuit. The tunnel was used to test virtually every high performance aircraft used by the United States in World War II. For much of the war, when it was operational 24 hours a day, seven days a week, the FST was the only tunnel in the free world large enough to perform these tests.



Drag cleanup tests were conducted on the Lockheed YP-38 Lightning in the Full-Scale Tunnel in December, 1944. Later models of the P-38 provided stellar service in World War II.

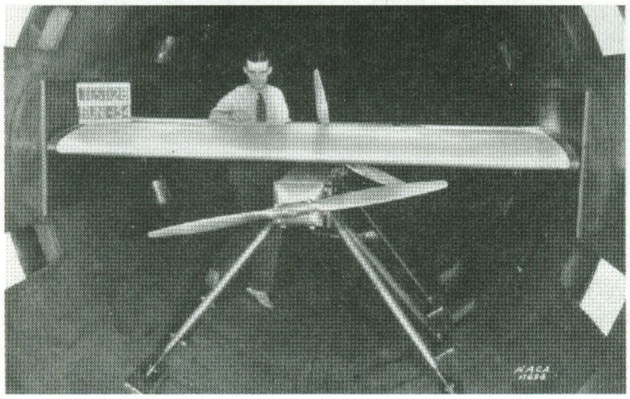
Since the war, many types of aircraft have been tested in the tunnel including the Harrier VTOL fighter, the F-16, the American supersonic transport, the Space Shuttle and Lunar Landing Test Vehicle. The tunnel is still in use today, modified to allow new testing procedures, such as free-flight and high angle of attack.



This model is one concept for a supersonic transport aircraft tested at the Full-Scale Tunnel in the early 1970s.

Eight-Foot High Speed Tunnel

This tunnel was a landmark in wind tunnel design when it was completed in 1936. It was the first continuous-flow high-speed tunnel. This meant it could operate almost indefinitely to produce a high-speed airstream approaching the speed of sound. And it was large enough to accommodate large scale models, and even actual aircraft sections.

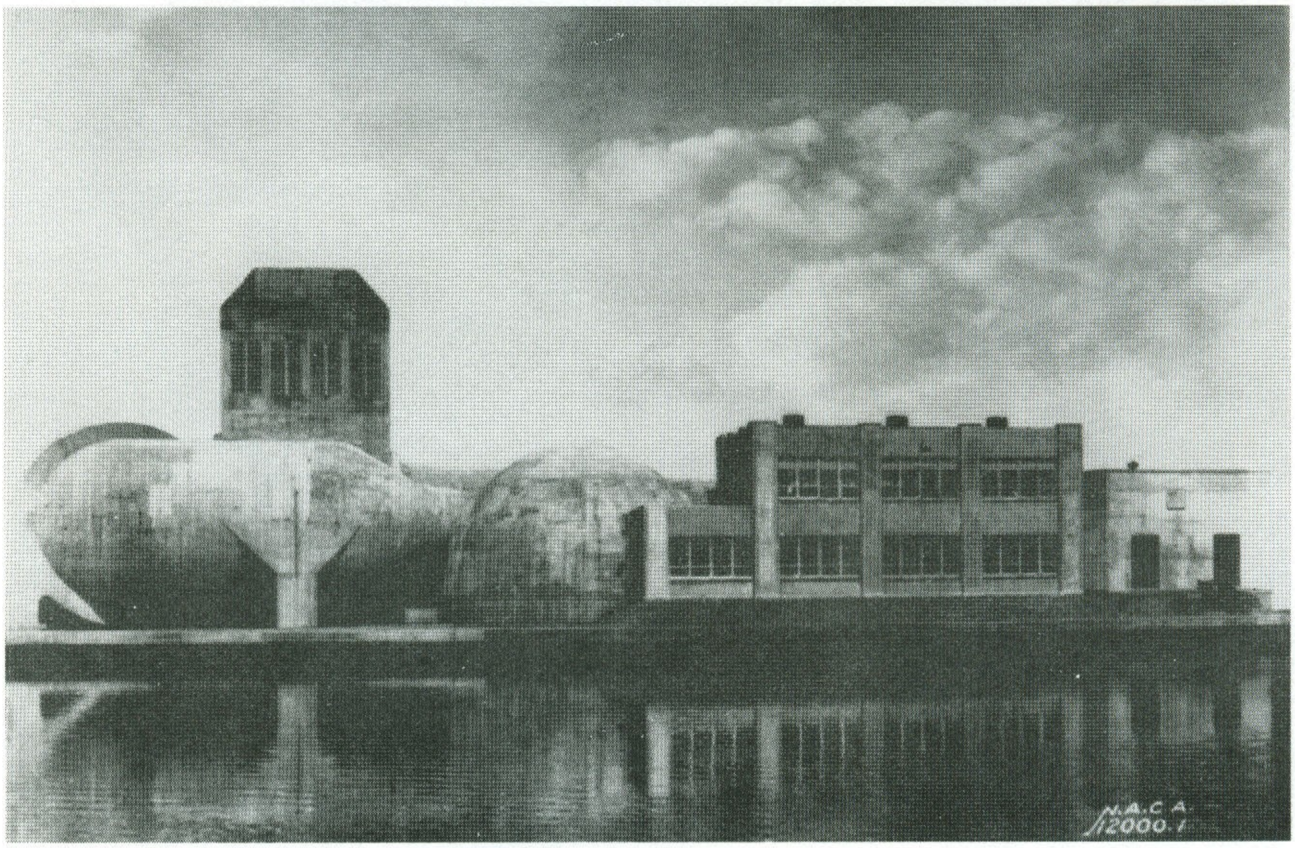


The windmill power of an experimental propeller is tested in the 8-Foot HST in May 1939. This tunnel produced the high-speed cowling shapes used in World War II aircraft, and a new family of efficient air inlets used in early jet aircraft. Its greatest achievement was the development and operational demonstration of the first transonic slotted throat wind tunnel.

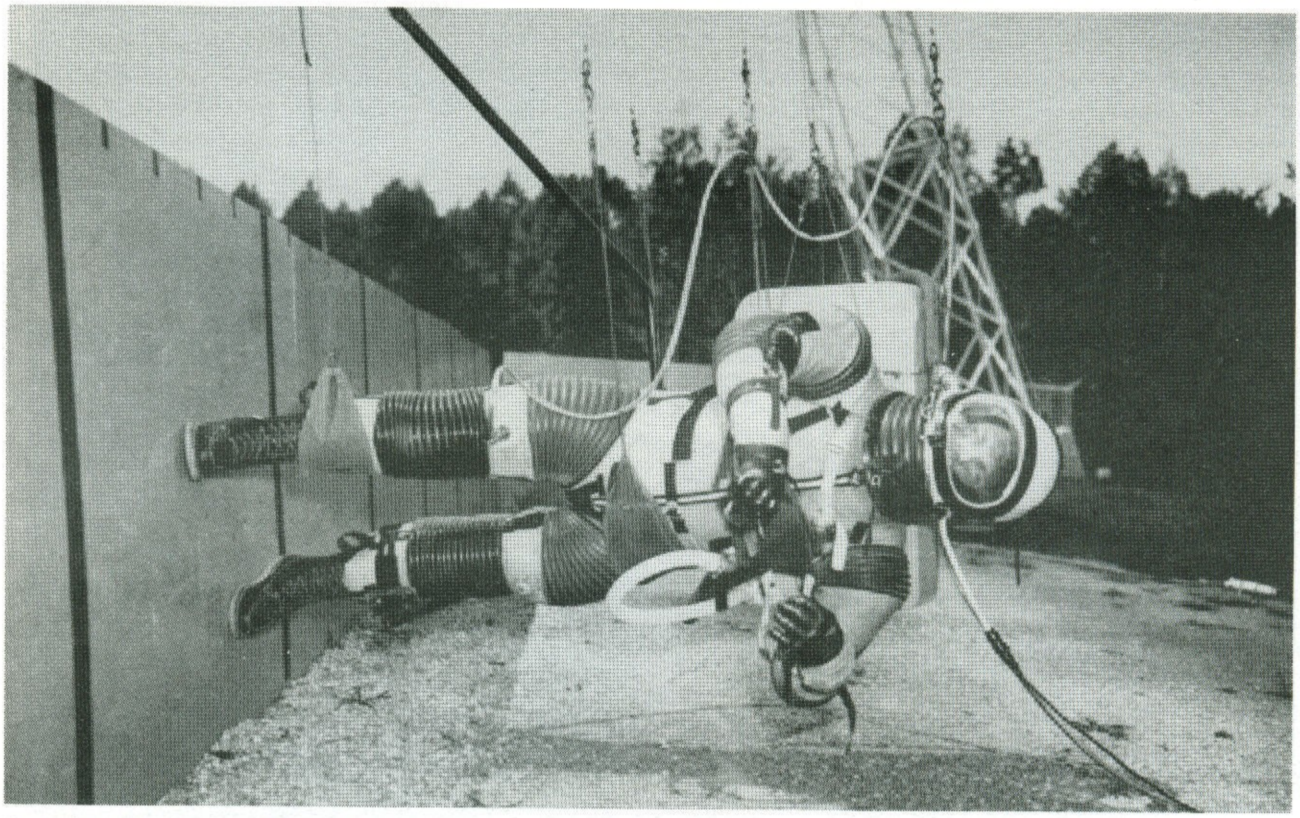
In 1950, the tunnel was the first in the world to be modified to incorporate a slotted throat design. This revolutionary design gave researchers their first accurate data on airframe performance in the transonic range. The tunnel was deactivated in 1956, when a new 8-foot pressure tunnel was built near it.

Lunar Landing Research Facility

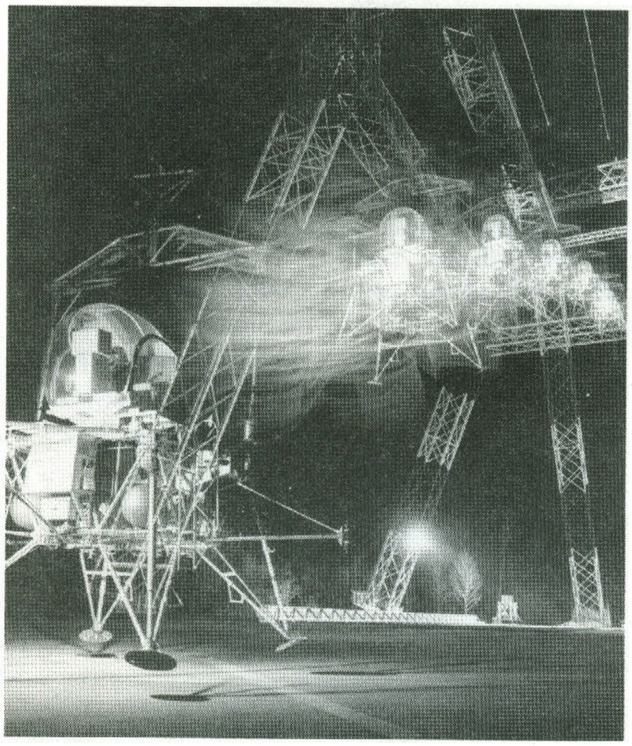
This essential facility allowed NASA to train Apollo astronauts to fly in a simulated lunar environment. Neil Armstrong, Edwin Aldrin and 22 other astronauts used the facility to practice piloting problems they would encounter in the last 150 feet of descent to the surface of the moon. It was built in 1965 and was basically an A-frame structure with a gantry used to manipulate a full-scale Lunar Excursion Module Simulator (LEMS).



The concrete walls of the igloo-like structure around the test section of the 8-Foot High Speed Tunnel were one foot thick. The tunnel was used to study models of aircraft and aircraft components in a high-speed airstream approaching the speed of sound.



Ingenious lunar-gravity simulator. A suited astronaut is cable-supported so that one-sixth of his weight is applied to an inclined wall to simulate walking on the surface of the moon.



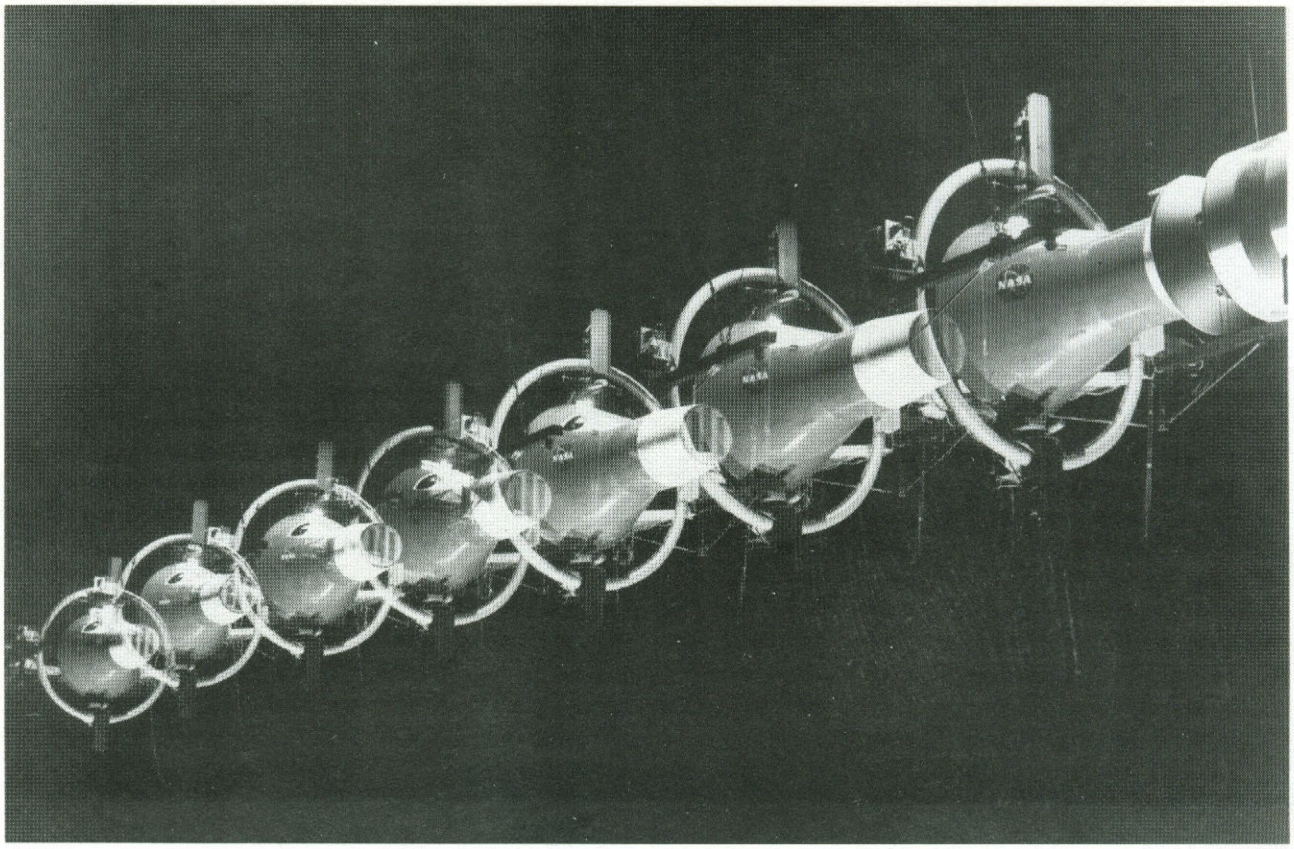
Multiple-exposure shows how most forward motion was cancelled during descent of Apollo's Lunar Excursion Module Simulator (LEMS). The vehicle was designed at Langley Research Center.

The astronauts were also able to practice walking on a simulated lunar surface, as the base of the Lunar Landing Research Facility was modeled with fill material to imitate the moon's surface. Suspended by slings and cables on their sides, the men experienced what it would be like to walk on the moon where gravity is only 1/6 of that on Earth.

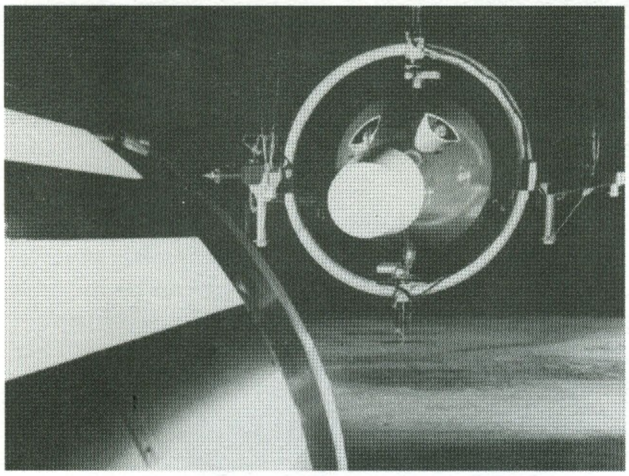
Today this facility is used for aircraft impact dynamics studies. The lunar landscape has been replaced by an impact runway that can be modified to simulate different crash environments. The LEMS has also been refurbished, and the names of many of the astronauts who trained at the Lunar Landing Research Facility are listed on its exterior. Today, the LEMS is on exhibit at the Virginia Air and Space Center in Hampton.

Rendezvous Docking Simulator

Built in 1963, this full-scale simulator was used by Gemini and Apollo astronauts to practice pilot-controlled rendezvous and docking techniques needed to link two vehicles in space. As man's first trip to the moon was accomplished using two spacecraft--a moon-landing vehicle that could boost itself back into lunar orbit to link up



What may appear to be a fleet of spacecraft flying in formation is actually a multiple exposure of the Rendezvous Docking Simulator with a Gemini spacecraft mockup attached at right.



Two research pilots simulate Earth orbit rendezvous and docking in a full-scale mockup of the Gemini spacecraft. The rendezvous docking simulator enabled researchers to determine an astronaut's ability to complete a rendezvous in either Earth or lunar orbit.

with the Command Module--this docking technique was critical to the success of the entire mission.

The simulator consists of an overhead carriage and cable-suspended gimbal system. Full-scale modules of both the Gemini and Apollo spacecraft could be hung from the simulator allowing pilots to "fly" the vehicle to practice docking with other spacecraft.

After the completion of the Apollo program, the simulator was modified for other purposes and its Apollo Command Module was replaced by an aircraft cockpit. It is no longer in use today.

Facts and Figures

Variable Density Tunnel

Operational:	*1922*
Initial Cost:	*$262,000*
Designer:	*Dr. Max Munk, a NACA scientist/engineer from Germany*
Circuit and Pressure:	*Continuous, annular return; 20 atmospheres*
Test Section:	*5′ diameter, closed throat*
Drive System:	*Fan; 250-HP electric motor*
Maximum Speed:	*51 MPH*
Status:	*Inactive*

Full-Scale Tunnel

Operational:	*1931*
Initial Cost:	*$900,000*
Designer:	*Smith J. De France*
Circuit and Pressure:	*Double return, atmospheric Test Section: 30′ by 60′, open throat (capable of testing aircraft with spans of 40 feet)*
Drive system:	*Two fans; two 4000-HP electric motors*
Maximum Speed:	*118 MPH*
Status:	*Still operational*

Lunar Landing Research Facility

Operational:	*1965*
Initial Cost:	*$3.5 million*
Structure:	*400′ x 230′ A-frame steel structure*
Status:	*Currently used to test structural design of aircraft to resist impact during crashes*

The Lunar Excursion Module Simulator was used for training in conjunction with the Lunar Landing Research Facility.

Weight:	*12,000 pounds*
Cab Size:	*Could accommodate two astronauts with a common instrument panel mounted between them*
Status:	*Inactive. Refurbished and on display at the Virginia Air and Space Center in Hampton*

Rendezvous Docking Simulator

Operational:	*1963*
Structure:	*Overhead carriage and cable-suspended gimbal system. Could accommodate full-scale models of the Gemini and Apollo spacecraft*
Status:	*Inactive*

Eight-Foot High-Speed Tunnel

Operational:	*1936*
Initial Cost:	*$266,000*
Circuit and Pressure:	*Single return, atmospheric*
Test Section:	*8′ diameter, closed throat*
Drive System:	*Fan; 8000-HP electric motor*
Maximum Speed:	*575 MPH (Mach 0.75)*
Major Modifications:	*Repowered to 16,000 HP (mach 1 capability) in 1945; Mach 1.2 contoured nozzle installed in 1947; slotted-throat test section installed in 1950.*
Status:	*Deactivated in 1956*

Langley Research Center National Historic Landmarks** was prepared by the NASA Langley Office of Public Affairs with the assistance of Dr. James R. Hansen. Dr. Hansen is the author of **Engineer in Charge: A History of the Langley Aeronautical Laboratory, 1917-1958.

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