PRESS RELEASES

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
AMES AERONAUTICAL LABORATORY
MOFFETT FIELD, CALIF.

What Ames Laboratory Is

Ames Aeronautical Laboratory is one of three major research establishments operated by the National Advisory Committee for Aeronautics. Founded in 1915, the NACA is an independent, civilian agency of the Federal Government, whose 17 members are appointed by the President of the United States and who serve without pay.

Most of NACA's research is of a fundamental nature: all of it is directed toward practical solution of the problems of flight, and much of it is focused upon scientific problems. In this manner, the frontiers of aeronautical knowledge are being broadened constantly. NACA does not design or build airplanes. However, the scientific information obtained by its engineers and technicians is gathered for the purpose of assisting the designers and builders of airplanes.

To obtain this knowledge, the Committee operates the Ames Laboratory, which was established at Moffett Field, near San Francisco, in 1940; the Langley Aeronautical Laboratory near Hampton, Virginia; and the Lewis Flight Propulsion Laboratory at Cleveland, Ohio. The NACA also has field stations at Wallops Island, Virginia, where rocket-propelled models are studied, and at Edwards Air Force Base, Edwards, California, where transonic and supersonic flight research is conducted with such special airplanes as the Bell X-1 and X-5, the Douglas Skystreak and Skyrocket, and the Northrop X-4.

What Ames Laboratory Does

The scientists and technicians of Ames Laboratory are engaged primarily in the field of supersonic aerodynamics - in other words, in a continuous search for the wings, bodies, controls, air inlets, and other components which will prove the safest and most efficient for airplanes flying at and beyond the speed of sound. (Research on the jet and rocket engines to power these airplanes of the future is carried on at the Lewis Flight Propulsion Laboratory. Work at the Langley Laboratory covers aerodynamics, hydrodynamics, structures, stresses, and allied fields.)

Many of the experiments under way at Ames Laboratory (and at the other NACA laboratories) are concerned with the varied problems encountered in the transonic speed range - in which the airplane may be said to be passing through the speed of sound (which varies from 760 miles per hour at standard sea-level temperatures to around 650 miles per hour at high altitudes where temperatures drop to 60° below zero).

It is in the transonic range that aircraft encounter many difficulties, including drastic increases in drag, buffeting of wing and tail surfaces, dangerous changes in control forces. In seeking solutions to these problems, Ames scientists are experimenting with many and varied types of wings and fuselages. Some of the wings, for example, are thin and swept back sharply from the fuselage - as are tail surfaces. Others are triangular in form.

While continuing to explore the transonic range, the NACA has also intensified scientific study of air-flow phenomena at high supersonic (or hypersonic) speeds. This speed range, in excess of five times the speed of sound, is of growing importance because of the need for more knowledge concerning conditions encountered by guided missiles.

Much of the work now under way at Ames Laboratory may be described as a long-range search for further knowledge of the laws governing transonic and supersonic flight - knowledge which will be applied to the airplanes of the future. The knowledge gained through this research is promptly made available to the military services and the aircraft industry in the form of technical reports.

The People of Ames Laboratory

Currently, there are more than 1250 persons - all Civil Service employees - working at Ames Laboratory. At their head is Director Smith J. DeFrance, who directs the activities of six major units; the Full-Scale and Flight Research, High-Speed Research, Theoretical and Applied Research, Research Instrumentation and Engineering Services, Technical Service, and Administrative divisions.

Many and varied professions and skills are required for aeronautical research. The Laboratory's staff includes research scientists, aeronautical engineers, physicists, test pilots, electrical and electronics engineers, machinists, photographers, wood workers, airplane mechanics, draftsmen, instrument makers, sheet metal workers, tool makers, artists, electricians, and clerical workers. The monthly payroll amounts to $500,000.

Tools of Research

Experiments at Ames Laboratory are carried on both in wind tunnels and in actual flight.

The 15 Ames wind tunnels are among the largest and fastest in the world. They include:

<u>40- by 80-foot wind tunnel</u>: (Note: Wind tunnels are measured by the size of the section in which the model is tested.) This is the world's largest, with a test section big enough to accommodate a full-scale airplane with a 70-foot wing span. The circuit of this tunnel is approximately half a mile in extent. Electric motors totaling 36,000 horsepower drive six 40-foot propellers. Maximum speed of the air stream is about 250 miles per hour.

<u>6- by 6-foot supersonic wind tunnel</u>: One of the largest, most modern supersonic wind tunnels in existence. The maximum speed is twice the speed of sound (equivalent to 1500 mph). The giant compressor which achieves these airspeeds is driven by two electric motors of 25,000 horsepower each.

<u>16-foot wind tunnel</u>: A large, high-speed wind tunnel particularly useful in studying flight problems with large models. Motors with a total of 27,000 horsepower permit airspeeds up to 680 miles per hour.

<u>12-foot pressure wind tunnel</u>: In a tunnel of this type, the scientist has at his command a special device to study the effects of model scale, or size, on air-flow behavior, as separate from the effects of speed. By varying the air density, while holding constant speeds, or the reverse, these effects can be isolated and defined. In the Ames 12-foot tunnel, full-scale flight conditions can be more nearly simulated than in any other wind tunnel in existence. Two 18-ton fans provide speeds up to about 700 miles per hour. Horsepower totals 11,000. Pressures from one-sixth to six times atmospheric can be achieved.

<u>1- by 3-foot supersonic wind tunnels</u>: Ames Laboratory has two of these tunnels. One, with compressors driven by 10,000-horsepower motors, achieves speeds 2.2 times the speed of sound. The other, operated intermittently with air released from the adjoining 12-foot low-turbulence pressure tunnel, registers as high as 3.4 times the speed of sound (equivalent to 2600 mph). In these and other supersonic tunnels, it is possible to observe and photograph shock waves forming around models through the use of an optical device known as the schlieren apparatus.

<u>Supersonic free-flight wind tunnel</u>: One of the latest research tools to be placed in operation at the Laboratory, this wind tunnel employs the technique of firing models from guns into air stream rushing in the opposite direction to the model's flight. Speeds eight times the speed of sound have already been achieved.

<u>10- by 14-inch supersonic wind tunnel</u>: Another valuable piece of equipment for exploring air-flow problems in the hypersonic range. This wind tunnel is capable of supplying aerodynamic data over the wide range of 2.75 to 7 times the speed of sound, equivalent to about 2,000 to 5,000 miles per hour at sea-level temperatures.

Currently under construction at the Laboratory is a new 8-foot supersonic wind tunnel which will be powered by electric drive motors totaling 180,000 horsepower.

Wind tunnels provide a controllable air stream and the means to measure reactions of a model airplane, wing, or other component to that air stream; but research in actual flight is equally important. The test pilots of Ames Laboratory fly a number of different types of airplanes, including jet fighters. These are usually used as flying laboratories for basic research, the results of which will be applicable to many types of high-speed aircraft.

Much of this research is concerned with stability and response to controls in flight. As the performance of aircraft increases, these problems become more and more serious, and the NACA program, which seeks methods for their alleviation, becomes more intensified.

Ames Aeronautical Laboratory was named in honor of Dr. Joseph Sweetman Ames (1864-1943) who for more than 20 years served as chairman of the National Advisory Committee for Aeronautics or NACA's Executive Committee. Doctor Ames was an eminent physicist and was president of the Johns Hopkins University from 1929-1935.

7/14/52

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NACA DISCLOSES DETAILS ABOUT NEW

SUPERSONIC WIND TUNNEL

ON WEST COAST

Moffett Field, California, July 14, 1952 - - The greatest power output ever harnessed to a single shaft - four electric motors totaling 180,000 hp. - will be required to operate the new supersonic wind tunnel at the NACA's Ames Aeronautical Laboratory, it was announced today. Construction of the new tunnel, considerably faster and larger than the 6- by 6-foot supersonic wind tunnel now being used intensively at Ames to develop new aerodynamic information for use in design of tomorrow's fighter airplanes and guided missiles, has been quietly under way for some time, it was disclosed.

Orders for four electric motors, each weighing more than 145 tons and rated at 45,000 hp, were placed with the General Electric Company of Schenectady, N. Y. If the need arises, these four motors, mounted in tandem to a single tunnel drive shaft, can be accelerated to produce a peak one-hour output of 216,000 hp. The motors are the largest of their kind ever constructed.

The new tunnel, which will require at least two years for completion, will have a test section eight feet across, permitting study of plane and missile models under large-scale conditions. Speeds several times that of sound can be reached in the test section.

In making the announcement, Dr. Smith J. DeFrance, director of the Ames Laboratory, said the drive system will be so arranged that it can be connected to either of two very large compressors, each of which will be used independently to operate the tunnel. The reason for the two compressors is that such an arrangement will permit its use over a broader speed range.

Construction of the two axial-flow compressors, which look like a giant tube 50 feet long and 24 feet in diameter studded with small blades, is being carried on by the Newport News Shipbuilding and Dry Dock Company of Virginia. The larger of these, with 11 stages, will weigh about 1,300 tons. The Newport News Company also is constructing two diversion valves for the tunnel. These are similar to huge plug valves, and they will be used to divert the air flow from one channel of the tunnel to another.

When the disk blanks of alloy steel for the larger of the two compressors were forged by the Bethlehem Steel Company, for shipment to Newport News for final machining, numerous special problems arose. The Bethlehem people started with a 92-inch ingot, weighing more than 48 tons. Due to the diameter of the forging and to the limited distance between press columns, position of the forging under the 7,500-ton press required partial forging of the two disks at the same time to avoid unequal loading of the press.

As each of the disks was processed through rough machining, it was mounted on a low-bed trailer truck - the disks are too unwieldy to be shipped by railroad freight car - and hauled under special police guard from Bethlehem to Philadelphia, for transshipment to Newport News by boat. After final finishing, they then will be shipped by water, through the Panama Canal, to the Ames Laboratory.

The Bethlehem Company, in discussing its part in this important project designed to help keep America ahead in the race for air supremacy, said the rotor disks were larger than the pole pieces that were forged at its plants for the Columbia University and University of Chicago cyclotrons.

The Chicago Bridge and Iron Company is building the tunnel structure.

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AERODYNAMIC HEATING

Moffett Field, California, July 14, 1952 -- Airplane and missile speeds so high that the metal structure, if it were built like 1952 equipment, would be heated to flabbiness, and the crew and equipment roasted, are possible in the future, scientists at the NACA's Ames Aeronautical Laboratory noted today at the Biennial Inspection being held at the federal aeronautical research establishment at Moffett Field. This newest roadblock to man's progress toward ever faster flight is called aerodynamic heating. It is already a problem demanding attention.

But just as the nation's research scientists refused to give up, five years ago, when the sky showed warning signs of a "supersonic barrier," today they reported a vigorous attack on this new "barrier" and were confident that ways and means of conquering, or avoiding the problem can be found.

Major contributions to knowledge about the problem are expected from the Bell X-2, the stainless steel research airplane designed to investigate high supersonic speeds where aerodynamic heating will be experienced. NACA tests with the X-2 will provide an accurate check on the theories and laboratory work done by the researchers.

Aerodynamic heating increases with speed and is directly related to the thin boundary layer of air surrounding the aircraft structure. At Mach number 3 (2,000 m.p.h. at altitude), for example, this boundary layer air may have a 600° F. temperature; at Mach number 5 (3,300 m.p.h. at altitude) it may reach 1,600° F. Skin friction occurring between the plane and the boundary layer air may also account for as much as half an aircraft's drag at Mach number 3 and can considerably reduce operating range.

Aerodynamic heating causes problems of construction, fuel supply, and design, the NACA scientists report. Sustained high speed flight at high altitudes and temperatures will mean fuel losses through evaporation and boiling. Special provisions to prevent this, however, raise structural weight.

High temperatures weaken aluminum structural parts, thus requiring heavier construction. Stainless steel used in the X-2 holds its strength better at high temperatures and is one means of combating structural weakening caused by aerodynamic heating. Titanium is another metal which may be used to lick the heating problem.

On very short flights at very high speeds, heat generated aerodynamically may not penetrate beyond the skin of the missile. This was why the German V-2 missile did not burn up at the speeds it reached near the ground.

Sustained flights at high speed, however, will need some system to remove heat generated by the boundary layer. For very short periods water cooling may be practicable. The heat would be allowed to vaporize water and the vapor then vented overboard. This would keep aircraft heat at the temperature of boiling water. The water supply would, of course, take up space and cut into fuel and payload. It was pointed out that cooling is necessary to protect the pilot and also any electronic equipment the aircraft may carry. Today's new fighter airplanes carry refrigeration for this purpose, and improved refrigeration systems may prove to be the answer to the aerodynamic heating problem.

Aeronautical scientists have long known that the boundary layer air flow can be either laminar (smooth) or turbulent, with a transition area between the two. The laminar flow of the boundary layer produces much less skin friction and aerodynamic heating than turbulent flow areas and researchers are working on ways to extend the areas of laminar flow at supersonic speeds.

More recently, it has been discovered that cooling is one way of increasing the areas of laminar flow and the question of the amount of cooling needed to insure laminar flow is one of the most important in this field of research.

Experiments on skin friction and heat transfer rates have been carried by the NACA scientists through speeds up to Mach number 3 (2,000 m.p.h. at altitude) for both laminar and turbulent flows. The NACA's work in this direction is continuing as newer and better research facilities become available, it was reported.

July 7, 1952

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BOUNDARY LAYER CONTROL READY
FOR TEST ON F-86 SABRE

Moffett Field, California, July 14, 1952 -- A promising method of boundary layer control by suction through porous leading edges of aircraft wings and flaps was demonstrated today to more than 500 visitors at the Biennial Inspection of the National Advisory Committee for Aeronautics' Ames Aeronautical Laboratory at Moffett Field, California.

The type of boundary layer control demonstrated at the Ames Inspection is aimed at achieving suitably low landing and take-off speeds in aircraft whose top speeds are transonic or supersonic. Landing lift has become a much more serious problem with the trend in aircraft design to higher speeds. Developments such as higher gross weights, wings of smaller area and aspect ratio, use of moderately or sharply swept back wings and unusual plan forms all help in reaching ever higher top speeds, but at the cost of higher landing speeds. This leads to serious problems of long runways.

The application shown in the Ames 40 x 80 foot wind tunnel, the world's largest, uses the swept wings on a North American F-86 U. S. Air Force jet fighter with a research installation consisting of porous material applied to the front portions of the flaps and wing leading edges. A suction pump system built into the test model draws air through the porous material.

Landing speed depends upon the amount of lift a plane's wings can produce at low speeds and research has shown that boundary layer control is one means of increasing this lift. Various types of boundary layer control are being studied to overcome this difficulty.

NACA research has shown that an important factor in the maximum lift of a particular wing or flap design is maintaining a smooth flow of air over the surfaces at high airplane angles of attack or large flap deflection angles. Laboratory tests indicate that this smooth flow of air sometimes breaks down because of a slow moving sheet of air next to the wing surface known as the boundary layer. Scientists have found that if this slow moving air can be controlled or removed, smoother flow and hence more lift can be obtained.

The Ames Laboratory demonstration showed that with boundary layer control, the test model could achieve greater landing lift by operating at a higher airplane angle of attack and a greater flap deflection angle than would be possible without boundary layer control. Ames scientists disclosed that porous area boundary layer control has been developed in the laboratory to such a degree that it now can be carried to flight testing using the F-86 as a flying laboratory equipped with the special wings to determine whether in actual use such a device is practical.

Other methods of boundary layer control to obtain high lift consist of removing the boundary layer through suction slots or porous surfaces or speeding it up by ejecting high speed air through slots along the wing and flap. Research on the suction slot on a 45° swept-back wing is going on at the NACA's Langley Aeronautical Laboratory at Hampton, Virginia. Ames has examined in detail the effectiveness of porous areas suction along the leading edge of a 63° swept wing as well as the installation shown at the Laboratory's Biennial Inspection.

More research is needed to find which kind of boundary layer control is best for a particular wing design. And the scientists cautioned that boundary layer control will not necessarily be used in all future aircraft designs since in some cases the added landing lift needed might be supplied by using other devices such as flaps. Boundary layer control of the type shown at Ames Laboratory will find its best uses in transonic and supersonic aircraft.

Visitors to the Laboratory also saw a section of the shops where the porous leading edges used in the tests were made. The material used is a very thin porous metal sheet. To hold it in place, thin ribs cut from brass sheet were silver soldered to the longitudinal spars of the test wing, making a rigid frame over which the porous sheet was stretched. It was not pre-formed, but was clamped in place along one side, then stretched to a smooth fit as it was being spot welded to the ribs. To obtain the right amount of air flow, porous felt was fastened to the inside surface of the leading edges. This felt was shaped under pressure in a metal mold and steam treated to fix the desired contour.

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