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Information Summary

IS-2000-10-009-DFRC

Aerospace Careers: Aerodynamics Engineers

Aerodynamics engineers at the Dryden Flight Research Center are at the core of NASA's aeronautical research effort. They are involved in almost every project at the Center, from tests of small modifications on a flight control surface to studying new aircraft construction concepts at supersonic speeds.

Most aerodynamicists at Dryden are part of the Aerodynamics Branch, which is responsible for the design and implementation of flight research projects, and analysis and publication of the research results. They also support other projects at Dryden, joint and cooperative projects involving other NASA centers, other government agencies, and commercial aerospace firms.

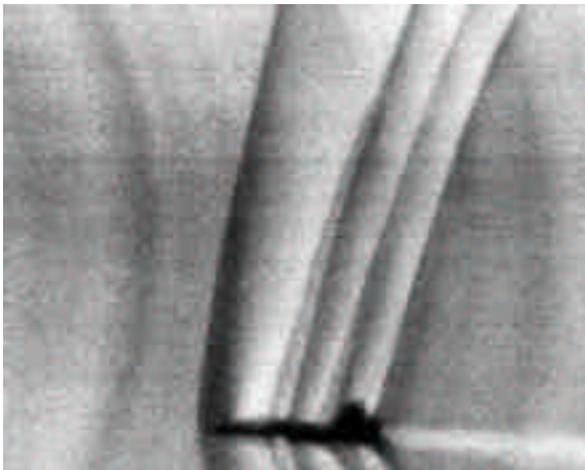


NASA F-15B Research Testbed is often used for in-flight tests of aerodynamic experiments.

What is Aerodynamics?

Aerodynamics is the study of air movement around an aircraft in flight; the study of the forces generated by the air that are felt by the aircraft and its components; and the study of aircraft components when they are subjected to forces produced by an air flow. Aerodynamic engineering principles must be considered in many aspects of the flight such as performance, stability, control, flight mechanics and dynamics.

Accurate predictions of aerodynamic characteristics are critical for the safe and efficient design of all types of aircraft. Although wind tunnels and analytical methods are available for this purpose, there are fundamental limitations to these techniques. The small scale of the test models, or the turbulence level (or noise) usually affects wind tunnel data in the tunnel environment. The aerodynamic forces and moments generated by the motions of an aircraft in free flight cannot be simulated in most wind tunnels. The theoretical approach to aerodynamic design is limited by the complicated nature of fluid dynamics. Even the most advanced super-computer-based analysis methods cannot fully simulate aerodynamic flows over arbitrary shapes. Because of these limitations, flight research is the ultimate means of determining the aerodynamic characteristics of full-scale aircraft.



Schlieren photograph of shockwaves produced by a T-38 while flying Mach 1.1 at 13,000 feet.

The Work of Aerodynamics Engineers

At NASA Dryden, aerodynamicists are typically involved in the study of vehicle aerodynamics, local aerodynamics, test technique development, meteorology and air data.

Vehicle aerodynamics refers to the understanding of the forces and moments that act on an airplane in flight. These forces (lift, drag and side force) and moments (pitch, roll and yaw) are dependent on numerous parameters including angle of attack and Mach number. In turn, these are critical to the flying qualities of the vehicle. Engineers at Dryden are responsible for modeling these characteristics for use in flight simulations and for control system design studies. In addition, aerodynamicists are responsible for determining the true vehicle aerodynamics from actual flight data obtained during test maneuvers.

Local aerodynamics research refers to the study of fluid flow phenomena that are present in a region of flow near an aircraft. Such phenomena include the thin layer of highly viscous flow near the surface (referred to as the boundary layer), vortex flows (small tornado-like flows which are generated near wing tips and sharp leading edges), and shock wave interactions. In-flight measurements are typically used to evaluate state-of-the-art theory and predictive methods.

Some of the most important work of the aerodynamics engineers at Dryden is focused on air data measurements, which are vital parameters obtained during flight. Air data measurements include speed, altitude, angle of attack (the nose-up angle of an aircraft in relation to its true flight path), and angle of sideslip (degrees of yaw in relation to the true flight path). Instruments to collect this information are mounted on each research aircraft and must be checked and calibrated to assure that accurate data are being received and recorded.

In-flight calibration of air data is required because the test aircraft itself disturbs the airflow about the instruments, and the effects must be quantified. Dryden engineers have been directly involved in the development of several advanced concepts for determining accurate air data on vehicles that operate in hostile environments (such as re-entry from space) or have other design constraints (such as stealth aircraft).

Tools of the Aerodynamics Engineer

The Aerodynamics Branch uses many tools and test techniques. Specialized maneuvers are designed and conducted to identify aerodynamic stability, control and performance characteristics. Local aerodynamics is studied using sensors to measure pressures and temperatures on the surface of the airplane and sometimes even at locations away from the surface. Microphones and other high-frequency devices are used to determine turbulence levels in regions of the flow.

Also, there are several methods to 'visualize' the pattern of flow about the airplane. These include using tufts of yarn attached to the surface and the insertion of smoke into the air stream.



Engineers at NASA Dryden Flight Research Center use this Flow Visualization Facility, or "water tunnel," to see the flow characteristics around aircraft models. These studies may be used to compliment in-flight aerodynamic data.

The People and the Projects

Typical days for aerodynamics engineers do not exist at Dryden because each day can bring new and exciting challenges and projects.

Branch engineers usually spend part of the day at their computers, analyzing flight data from current and past projects — looking for unusual data points that may signal problem areas, defining performance data, and predicting the outcome of future aerodynamics investigations.

They also attend meetings — team sessions with other branch engineers and meetings with people from other branches working on the same research project. On project flight days, aerodynamics engineers may also be at a console in a mission control room monitoring data being transmitted from a research aircraft.

Other activities may include a water tunnel test, traveling to other NASA centers to help with wind tunnel tests, or attending a cooperative project meeting at a distant military installation or at a commercial aerospace firm.

Aerodynamics engineers have been involved in nearly every aircraft research project at Dryden in the Center's 50-plus year history. The scope of projects at Dryden is varied. It has included airfoil investigations on a high-flying glider to assist in the design of future high-altitude, long-endurance environmental research aircraft; establishment of the aerodynamic research parameters on the X-33 Reusable Launch Vehicle (RLV) technologies; and basic aerodynamic research on skin friction, boundary layer, flow visualization, and surface pressures utilizing a special test fixture mounted on the belly of a modified F-15B research aircraft.

Education and Experience

Aerodynamics engineers at Dryden have varied educational backgrounds, but they all have one common attribute: they possess a bachelor of science degree and many have advanced degrees. The most common degrees are in aerospace, aeronautical or mechanical engineering, but also included are degrees in electrical engineering, mathematics and physics.

Individuals interested in pursuing a career in flight research aerodynamics should have a general understanding of aircraft, engineering computer skills, and an interest in many related fields such as aero-structures, control systems, and instrumentation. In particular, an aerodynamics researcher should be willing to participate in all aspects of the experimental process.

Many commercial aircraft manufacturers and major aircraft companies employ aerodynamics engineers. Within the federal government, aerodynamics engineers can be found in the Federal Aviation Administration and also in the Air Force and Navy, in addition to NASA.