

THE FULL-SCALE WIND TUNNEL

Early aeronautical researchers constructed wind tunnels to obtain data about the forces generated by air flowing over aircraft surfaces. They quickly discovered that at atmospheric pressure, all the aero-dynamic characteristics of a small model could not be directly correlated to the flight performance of a full-sized aircraft. Several critical research areas could only be explored with full-scale models or with the actual aircraft.

Under the direction of Smith J. DeFrance, the Langley Memorial Aeronautical Laboratory built a full-scale wind tunnel and placed it in operation in May of 1931. The tunnel's 30 x 60 foot, open-jet test section was 56 feet long and could easily accommodate the largest aircraft of the period. Until 1945 it was the world's largest wind tunnel.

A six component recording balance measured the forces acting on test aircraft. This instrumentation logged data on drag, lift and cross-wind forces and the commensurate pitching, yawing and rolling moments. Engineers also investigated aircraft engine cooling and cowling airflow problems under conditions approximating flight.

Downstream of the test aircraft, two four-bladed wooden propellers directly connected to 4000-horsepower induction motors circulated the air through the test

section. Motor control equipment regulated wind speed between 25 and 118 miles per hour. During operation the two motors used about 3 megawatts of electricity.

Airflow from the dual propellers was split into two streams which returned through air passages located between the test section and the building's outer walls. Guide vanes at the corners of the return passages directed the flow around the air circuit. The working components were protected by a steel framed, externally supported building sheathed in asbestos-cement sheet.

Early tests on aircraft indicated that surface roughness, external struts, landing gear and protruding rivets increased drag and imposed serious penalties on aircraft performance. Performance of most World War II military aircraft was significantly improved by "drag cleanup tests" run in the full-scale wind tunnel. The facility was used to test a variety of vehicles including military aircraft, dirigibles, submarines, the project Mercury space capsule and supersonic aircraft. In the 1960s and 1970s the tunnel was modified and equipped for dynamic free-flight model testing. When the facility was closed in September of 1995, it was NASA's oldest operating wind tunnel.

The success of the American aerospace industry is due in no small part to the aeronautical research performed in the full-scale tunnel.

For complete project information see the Historical Report.