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MAJOR CONTRIBUTIONS TO AVIATION ACHIEVED IN THE LANGLEY 8-FOOT HIGH-SPEED TUNNEL AND THE 8-FOOT TRANSONIC PRESSURE TUNNEL

Several important advances in aviation were developed in the Langley 8-Foot Transonic Pressure Tunnel and its predecessor, the Langley 8-Foot High-Speed/Transonic Tunnel. The 8-Foot High-Speed Tunnel was built in 1936. It was powered by an 8,000-horsepower electric motor, permitting testing at Mach 0.75. In 1945, the tunnel became known as the 8-Foot Transonic Tunnel when a 16,000-horsepower motor was installed which increased the testng capability to Mach 1.0. However, testing in solid-wall tunnels near Mach 1.0 was difficult for practical models because of wall interference. In 1946, Ray Wright first analyzed the potential of a partially open or slotted tunnel wall. His concept showed promise, and was further developed by John Stack and his associates. In 1950, the 8-Foot Transonic Tunnel became the world's first slotted transonic wind tunnel.

The advanced capability of the 8-Foot Transonic Tunnel was used in the discovery of a fundamental rule of aerodynamics. In 1952, tests of the new Convair YF-102 supersonic fighter prototype showed unexpected excessive shock-wave losses which threatened to prohibit the airplane from breaking the sound barrier. The problem was studied by Richard T. Whitcomb, and he discovered that it was not sufficient to streamline the wing and fuselage. Instead, the cross-sectional area of the airplane had to have a smooth distribution from nose to tail like that of an ideal streamlined body. Airplanes designed by Whitcomb's Area Rule had fuselages which were constricted in the area of the wing and were dubbed "flying coke bottles." The YF-102 prototype was redesigned using the Area Rule and in 1954, the YF-102A successfully pierced the sound barrier while climbing. Whitcomb's Area Rule is still being used for all supersonic airplane designs.

In 1953, the 8-Foot Transonic Pressure Tunnel became operational. The tunnel is powered by a 25,000-horsepower motor permitting testing over a Mach number range of 0.2 to 1.3. The new 8-foot tunnel retained the slotted-wall concept of its predecessor, but also could be run at pressures up to 2 atmospheres, which gave it a higher Reynolds number capability. In the mid-to-late 1960's, Richard T. Whitcomb turned his talents toward increasing the cruise speeds of commercial jet transports. In pursuit of this goal, Whitcomb developed a family of advanced technology airfoils. These "supercritical" airfoils are characterized by relatively blunt leading edges, flat upper and lower surfaces in the middle, and extensive camber in the aft end. Tests in the 8-Foot Transonic Pressure Tunnel suggested a possible 10-percent increase in speed over a conventional airfoil. In 1971, flight tests of a transport-type supercritical wing on a Vought F-8U fighter confirmed the wind-tunnel results. An important benefit of supercritical wings came to light during the fuel crisis of the early 1970's. Instead of flying faster than a conventional wing of the same thickness, a thicker supercritical wing could be built to fly at the same speed as a conventional wing. The thicker wing could be made stronger and lighter allowing more fuel capacity and longer range. Supercritical wings are now in use on most third-generation jet transports and some fighter airplanes.

Another way to reduce the fuel consumption of jet transports was developed by Whitcomb in the mid 1970's. For many years, aerodynamicists had been trying to reduce the induced drag of airplanes by using endplates on wings to reduce the strength of the tip vortices. However, the drag of the endplates themselves more than offset the reduction in induced drag. By properly shaping small vertical wings called "winglets" at the wingtips, Whitcomb was able to reduce the induced drag of several jet transport models by 4 to 8 percent. These results in the 8-Foot Transonic Pressure Tunnel were confirmed during flight tests of winglets on a KC-135 airplane in 1979. Several business jet and military aircraft currently use winglets to reduce fuel consumption and improve performance.