

NASA Facts

National Aeronautics and
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FS-2002-09-044 DFRC

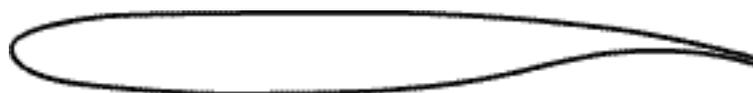
F-8 Supercritical Wing



F-8 Supercritical wing in flight. (NASA photo EC73-3468)

Background

In the early 1960s, Richard T. Whitcomb, chief of the Transonic Aerodynamics Branch, Langley Research Center, Hampton, Va., conducted exploratory research that led to the invention and patent of the NASA Supercritical Airfoil. Compared to a conventional wing, the supercritical wing (SCW) is flatter on the top and rounder on the bottom with a downward curve at the trailing edge (see illustration). The concept was first studied in the 8-foot transonic pressure tunnel and other wind tunnels at Langley and Ames Research Center, Moffett Field, Calif., before actual research with an aircraft began.



Supercritical wing diagram

A TF-8A Crusader, available from the U.S. Navy, was selected as the SCW testbed. With its easily removable wing, landing gear that retracted into the fuselage, and Mach 1.7 capability, it was a satisfactory choice as a testbed. The announcement that the SCW concept would be flight tested at the Dryden Flight Research Center (then the NASA Flight Research Center), Edwards, Calif., was made in February 1969.

Rockwell International's North American Aircraft Division was awarded the \$1.8 million contract to fabricate the supercritical wing. It was delivered to NASA in December 1969.

The supercritical wing was a new tailoring of an airfoil design that delayed the formation and reduced the strength of the shock wave over the wing just below and above the speed of sound. Delaying shock wave formation at these high speeds resulted in less drag. Results of NASA supercritical wing research showed that aircraft using the concept would have increased cruising speed, improved fuel efficiency, and greater flight range. Supercritical wings are now commonplace on virtually every modern subsonic commercial transport.

Flight Research

Dryden engineer John McTigue was the first SCW program manager, with Tom McMurtry as the lead project pilot. At Langley, Whitcomb took a personal interest in test results while Thomas Kelly acted as that Center's project engineer.

The first SCW flight took place on March 9, 1971, with McMurtry at the controls. On this first flight, McMurtry reached an altitude of 9,200 feet and a maximum speed of 260 miles per hour.

Pilot Tom McMurtry and Supercritical Wing

With the new wing, the F-8 landed at a high speed of 200 miles per hour. Without antiskid brakes or wing flaps, it was necessary to land the craft directly on Rogers Dry Lake. The 15,000-foot concrete runway at Edwards was used for most takeoffs but was too short to accommodate landings. The first flight of the supercritical wing at supersonic speeds was on May 26, 1971.



Pilot Tom McMurtry and the F-8 SCW. (NASA photo ECN-3442)

Studies of actual wing performance began in August 1971. Pressure sensors on the wing's upper surface measured shock wave formation. Performance largely substantiated data from the original wind tunnel tests performed at Langley. In May 1972, NASA added new instrumentation and installed new fuselage fairings, which were intended to reduce drag at speeds just below the speed of sound (Mach numbers between 0.95 and 1.0), thereby increasing speed. However, it turned out that the fairings actually produced somewhat higher drag at most speeds.

Research results showed the SCW had increased the transonic efficiency of the F-8 by as much as 15 percent and proved that passenger transports with supercritical wings could increase profits by 2.5 percent over aircraft with conventional wings. This equated to \$78 million per year (in 1974 dollars) for a 280-plane fleet of 200-passenger airliners.

The last flight of the NASA SCW F-8 was on May 23, 1973, with Ron Gerdes as pilot.

Specifications

This F-8 jet aircraft was originally built by LTV Aerospace, Dallas, Texas, for the U. S. Navy.

NASA 810: Navy Bureau # 141353.

Powerplant: Pratt & Whitney J57 turbojet.

Original wingspan: 35 feet 2 inches (350 square feet)

(Wingspan with the supercritical wing: 43 feet, 1 inch)

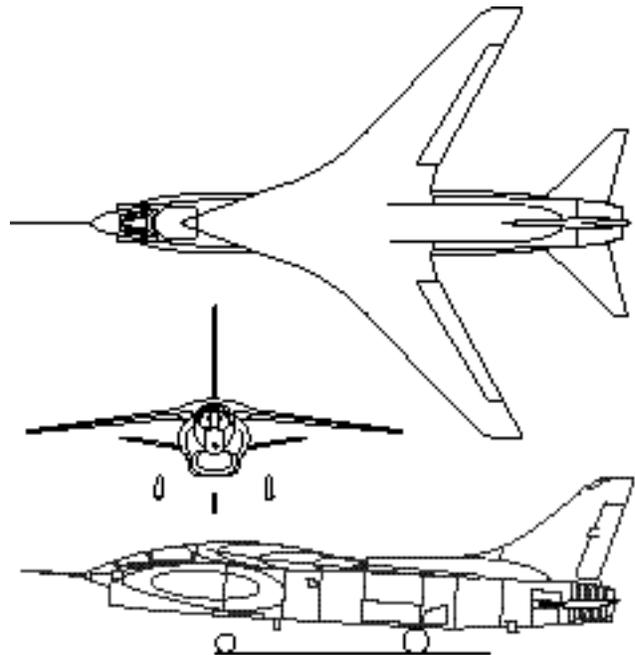
Overall length: 54 feet 6 inches

Height: 15 feet, 9 inches.

Flown as the SCW testbed by NASA from 1971 to 1973.

Fleet F-8s were the first carrier-based planes with speeds in excess of 1,000 mph. LTV won the Collier Trophy for its design and development. Total production was 1,261.

McMurtry reached an altitude of 9,200 feet and a maximum speed of 300 knots (260 mph).



Three view of F-8 SCW aircraft (above), supercritical airflow (below).

