The One and Only

FAIRCHILD VZ-SFA FLEDGLING

by Kent A. Mitchell

During the latter years of the 1950s, considerable attention and military fundings were directed toward experimental aircraft with short takeoff and landing (STOL) or vertical takeoff and landing (VTOL) capabilities. For the most part, these efforts were made possible by the availability of relatively low-weight, high-power turbine engines.

Several experimental approaches were considered in order to produce a practical STOL/VTOL aircraft. These were: 1. Boundary layer control. 2. Vectored slipstream. 3. Jet wing (blown flap). 4. Two-dimensional jet mixing.

Contracts were awarded to a spread of four aircraft manufacturers to develop experimental aircraft to explore each of these approaches. Fairchild Aircraft was chosen to research the vectored slipstream concept. In 1957, the U.S. Army Transportation Research and Engineering Command (TRECOM) awarded Fairchild a $1 million contract (No. DA44-177-TC-350) to produce one vehicle for testing.[1] Fairchild's design concept, designated as their Model M-224, was based on a National Advisory Committee for Aeronautics (NACA) model that used one engine driving four gear shaft driven wing mounted propellers.[2] From the outset, the design was labeled as a VTOL research aircraft. The first public appearance of the design concept was an artist's drawing in *Aviation Week* magazine.[3] Power for the aircraft was to be a single General Electric T58 turboshaft engine and the Army furnished two units to Fairchild to support the test program.[4]

Construction of the aircraft, now designated the VZ-5FA, was completed in June 1959. Systems checkout and instrumentation installation were accomplished during July.[5] Tethered ground tests were conducted at Fairchild's Hagerstown, Maryland plant during August and September 1959.[6]

As seen in the drawings and photographs, the experimental aircraft employed four large diameter propellers mounted on the high fixed wing with full-span, two-piece, sliding flaps. The use of four props allowed lower disc loading with moderate propeller diameter and the use of a higher aspect ratio wing to give more efficient cruise performance. The wing had an area of 191 square feet. The horizontal tail was a

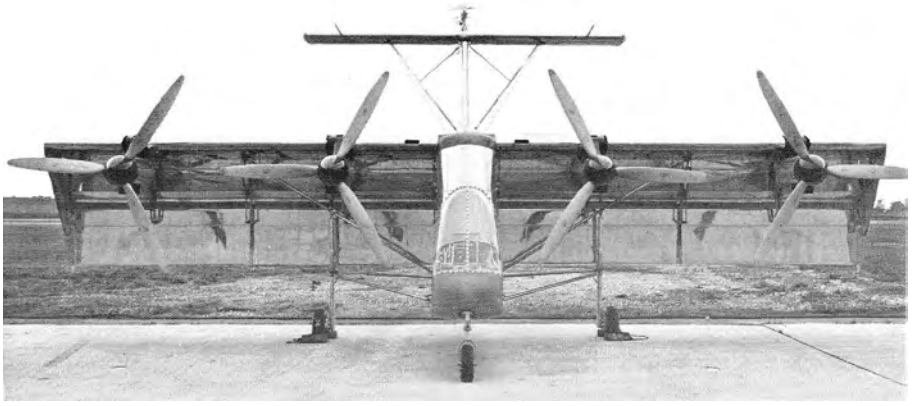
One wheel off! Fairchild test pilot "Russ" Howard at the controls. Note that the horizontal stabilizer is not installed during this test.
(Fairchild Aircraft Photo No. 36-268, Russell L. Howard Collection)

single "full flying" unit, i.e., there was no separate elevator, the entire stabilizer moved. This stabili2er arrangement permitted elimination of up-load due to ground effect. The incidence angle of the horizontal stabilizer was in proportion to the extension of the wing flaps.

The vertical stabilizer had a large conventional rudder. For pitch and yaw control at low airspeeds or during VTOL operations, two hydraulically driven fans were mounted aft of the horizontal tail. Roll control was effected by employing differential pitch of the outboard main propellers. The transition between this low-speed control system and normal flight controls occurred at 20 to 30 knots and was proportional to the position of the wing flaps. During conventional flight the outboard sections of the flaps functioned as ailerons.

The theory by which the VZ-5FA could effect a vertical takeoff and landing was that of a vectored, or deflected, slipstream. The air movement from the four relatively high thrust propellers was deflected downward by the large wing flaps. When the aircraft was rotated on its main landing gear to a 28-degree nose-up attitude, the resultant propeller thrust and the deflected slipstream forces on the wing produced a vertical force greater than the weight of the aircraft. On a Standard Day (sea level, 59°F), the General Electric T58 produced 1,100 shaft horsepower, which in turn produced 4,510 pounds of static lift from the propellers—enough lift to overcome the 3,777 pounds of aircraft gross weight by 19 percent.

Power was taken from the T58 via a gear box mounted at the rear of the engine. A shaft ran forward through the fuselage to a "T" gear box located near the wing center leading edge. From that



The Fairchild VZ-5FA, flaps fully extended.
(Fairchild Aircraft Photo No. 35-399, Harold G. Martin Collection)

Front quarter-view, clearly showing the four counter-rotating Hartzell propellers. The full span flaps are completely retracted.
(Fairchild Aircraft Photo No. 35-91, Russell L. Howard Collection)

VZ-5FA front view, flaps extended.
(Fairchild Aircraft Photo No. 35-90, Russell L. Howard Collection)

Altitude—18 inches! This is apparently the maximum height the VZ-5FA ever attained. (Fairchild Photo No. 36-296, Russell L. Howard Collection)

gear box, power was transferred laterally to a 3:1 reduction gear box at each of the four propellers. An 8-hp hydraulic pump was also driven by the tee-box, providing 3,000 psi power to operate the four wing flap actuators and a cooling fan for the engine lubrication system. A second hydraulic pump, which was mounted on the aft engine accessory gear box, powered the two hydraulic motor-operated tail fans.

The dual tail fans were identical, fixed-pitch, but variable-speed propellers mounted aft of the horizontal stabilizer. Hydraulic fluid to the two fan motors was routed from the variable-displacement pump through a diverter valve. The diverter valve was actuated by the pilot's control stick to increase the speed of one fan and reduce the speed of the other—which provided pitch control.

Movement of the rudder pedals tilted the entire dual fan assembly to produce the desired side force for yaw control. When both pitch and "rudder" control inputs were simultaneously commanded, a compensatory increase in vertical fan motor pressure was provided by a separate pedal displacement input to the variable-displacement hydraulic pump. This arrangement sounds complex, but blade speed-changing was considered by the designers to be less complicated than blade pitch-changing. The fans were inoperative during normal forward flight.[7]

One of the first phases of testing the VZ-5FA design was to measure the actual static lift generated by the engine and four propellers. To accomplish this, 90 pounds of test equipment were installed including an onboard recording oscillograph and strain gauges on tethering cables at the aircraft center-ofgtavity. The Fairchild test pilot for this program was Russell L. Howard. Besides flying for Fairchild, "Russ" also had a moonlighting crop-dusting business and spent many hours in an open cockpit behind the barking engine of a Stearman—in addition to flying many other aircraft types before and since. However, of his experience with the VZ-5FA, sitting in close proximity to the front of the turbine engine and four props, Howard says, "That was the noisiest thing I ever got ahold of. It's a wonder I'm not deaf!"

For another phase of the test program, the VZ-5FA was transported to the NASA Langley Research Center for wind tunnel testing.[8] These tests were to verify parameters such as horsepower required versus angle of attack—versus propeller blade angle—versus flap position, etc.

Returned to the Fairchild plant at Hagerstown, the aircraft was prepared for one more major ground test prior to a full flight test program—a "drop test," to verify the structural integrity of the landing gear. The VZ-5FA was hoisted 36 inches above the concrete hangar floor—and dropped. The landing gear passed the test. The rest of the airplane did not—it fell off. The airframe was repaired and the test repeated—with the same result. At this time, because the other three experimental STOL/VTOL aircraft had already been flying for several months—and because a significant amount of diverted slipstream test data had been recorded utilizing the Fairchild design, it was felt that it was not economically feasible to repair the airframe or continue testing the VZ-5FA and the contract was ended. •

REFERENCES

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2. "Fairchild to Begin VTOL Model Tests," *Aviation Week* magazine, September 9, 1957.

3. Artist's drawing caption, "Fairchild VTOL Design," *Aviation Week* magazine, January 27, 1958, p. 37.

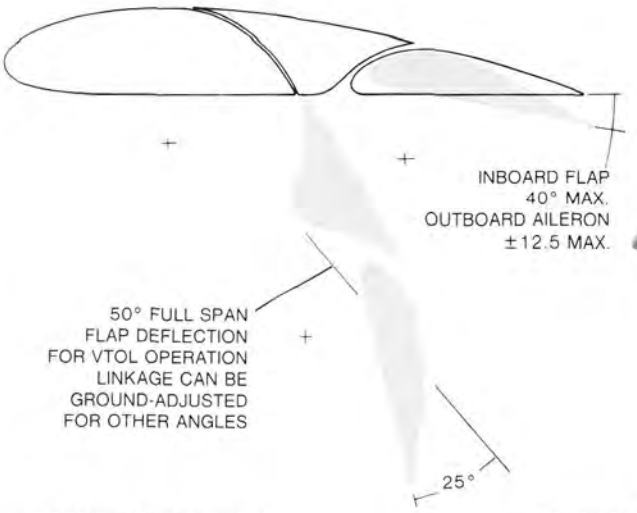
4. News Digest column, *Aviation Week* magazine, February 10, 1958.

5. News Digest column, *Aviation Week* magazine, July 27, 1959, p. 23.

6. Caption, "First Photo of Fairchild M-224 VTOL," *Aviation Week* magazine, October 5, 1959, p. 133.

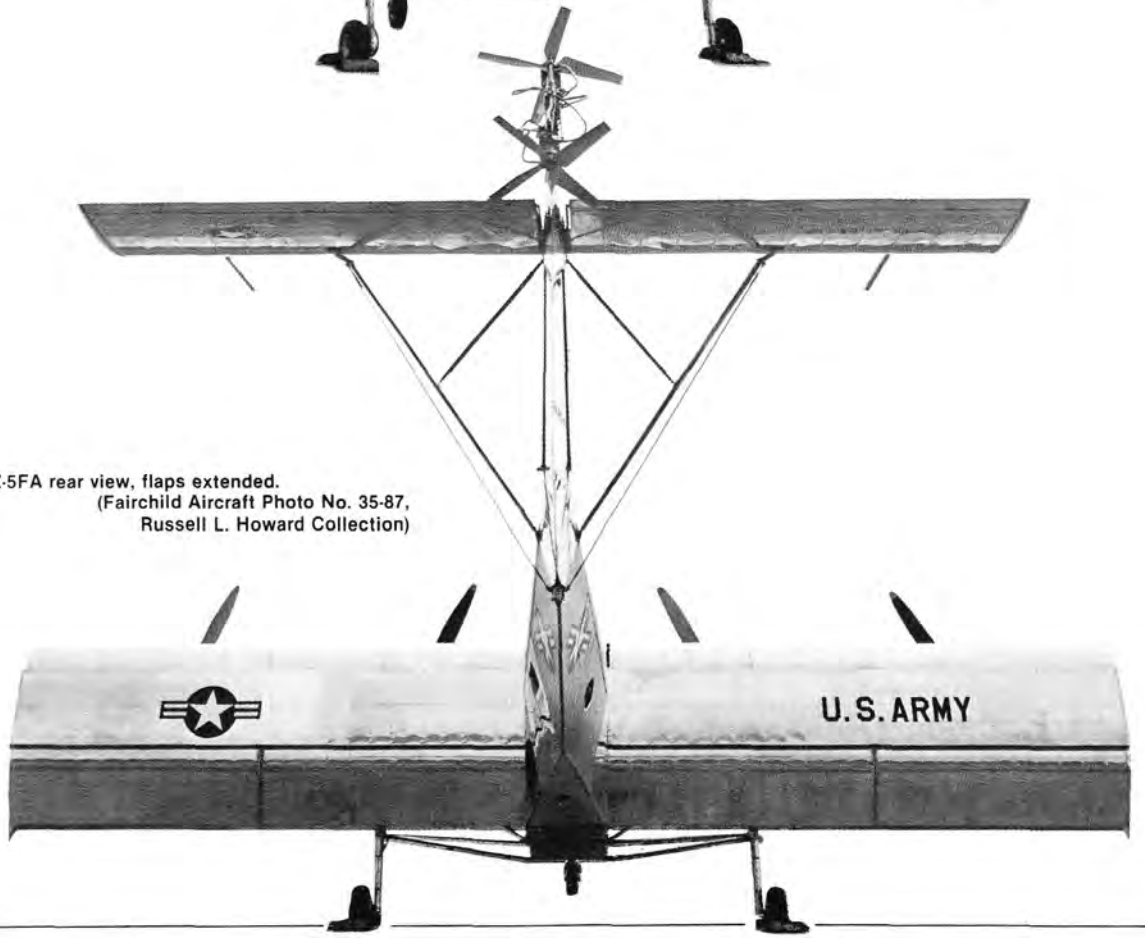
7. *Op. cit.* Company marketing brochure

8. News Digest column, *Aviation Week* magazine, April 10, 1961.



Flap operation geometry.[1] **(Author's Collection)**

Three-quarter rear view, showing the T58 engine exhaust outlet and the hydraulic motor-driven, tail-mounted, pitch and yaw control fans.
(Fairchild Aircraft Photo No. 35-88, Russell L. Howard Collection)



VZ-5FA rear view, flaps extended.
(Fairchild Aircraft Photo No. 35-87, Russell L. Howard Collection)