Defying Tradition

Rutan's Defiant twin is a big homebuilt capable of doing very big things.

BY DON DOWNIE

"My Vari-Eze is too small, my Grumman is too slow and the Defiant will be like having my own personal DC-3," says a builder from Illinois.

"A trip to England is in my future," reports another from California.

"We expect that we will never use the airlines again," says a pilot from Hawaii. "A trip to Europe is on the agenda."

"Anything's possible with this plane," says a builder from Kentucky.

More than 150 sets of plans for Burt Rutan's long-range, push-pull twin—the Defiant—have been delivered since the project was announced last August, and several of these builders are well on their way to completion. Fred Keller of Anchorage, Alaska, is handling builder support for the Rutan Aircraft Factory's project and says that at least one or two builders may have Defiants completed in time for Oshkosh '85. "I understand one builder has a couple of veteran EZ builders working full time on his project," says Keller. "It will be a thrill to see the Defiants start showing up at Oshkosh."

In 1977 and '78, Rutan designed and built the prototype Defiant in 7½ months with only 1½ to two people working on it; he estimated no more than 1800-1900 hours of work went into the prototype.

The twin-engine, centerline-thrust Defiant is the most impressive plans-built project ever begun. The resulting homebuilt is a big airplane (2950 pounds at gross weight) capable of doing very big things. The prototype has been flown to an altitude of 28,000 feet, has a standard-tank endurance of 15½ hours and will cruise 1200 miles at 213 mph with four people aboard, logging 13.9 mpg.

The first section of Defiant plans costs $490; the engine installation and owner's manual come later. Building time and expense is equal to two Long-EZs, according to Rutan, and the out-of-pocket cost is estimated at between $20,000 and $30,000 without avionics. However, some builders currently involved say that the project really isn't that big.

Many observers of the homebuilt scene shook their heads when Rutan announced that plans would be available; some of these same observers felt that the self-launched Solitaire sailplane was a much better candidate for success. But it is this kind of thinking that makes for horse races and dice games.

In late 1981, Rutan contracted with Fred Keller to build the No. 2 Defiant and complete documentation with updated drawings and photographs during construction. Keller's Defiant joined Rutan's on the flight line at Oshkosh '83. Keller was chosen for the Defiant project only after building a KR-1 and the Oshkosh '81 Grand Champion Vari-Eze. He's a full-time construction superintendent with the telephone company in Anchorage and builds airplanes as an avocation, aided by his wife, Sharon Kay. In fact, the first thing Keller did after being asked to build a Defiant was to check with his wife, who approved the project.

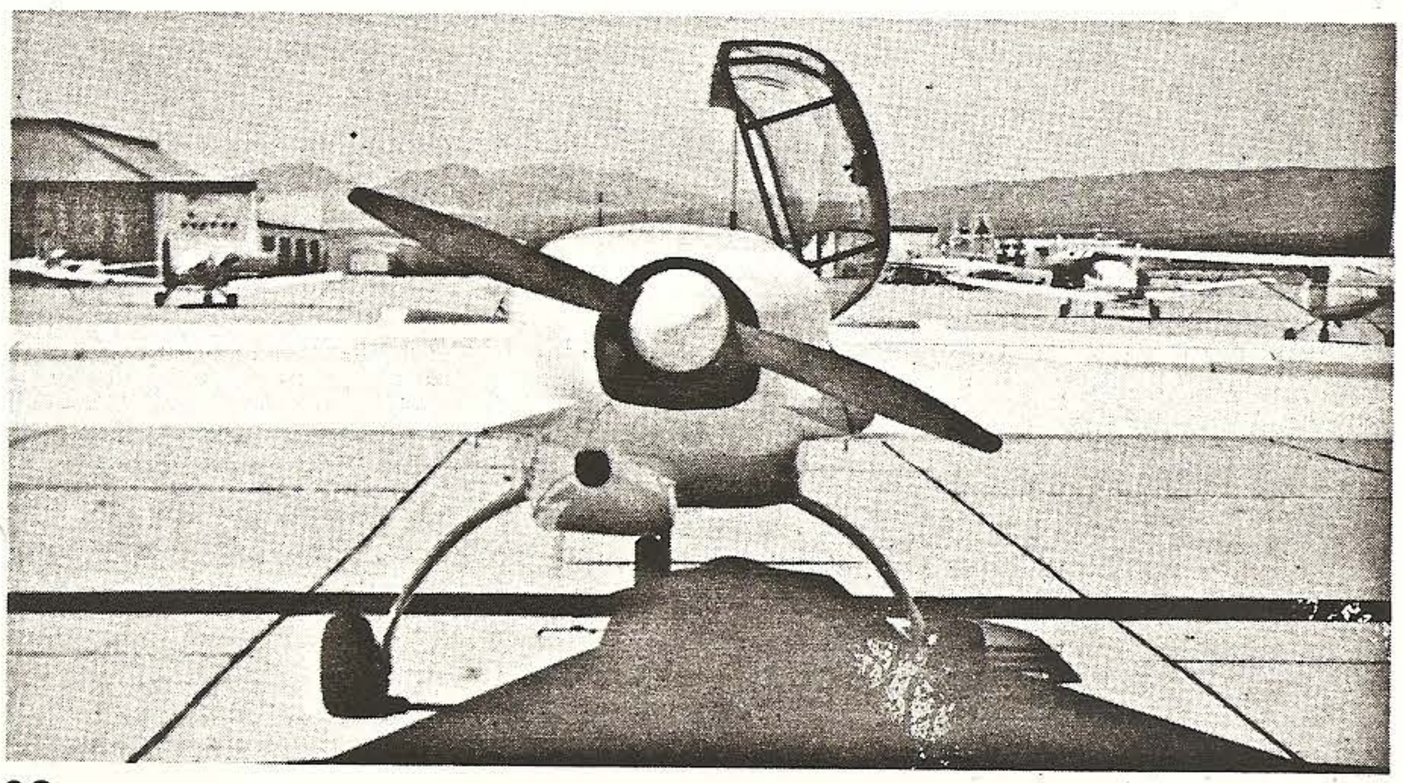
It was in August 1984 that Rutan and Keller announced that plans would be available soon but it was not until March of 1985 that the last of the engine-mount drawings were completed by Keller and the owner's manual completed by Rutan. From the beginning, the clamor for Defiant plans has been steady; but Rutan accepted neither advance reservation deposits nor checks until the major portion of the plans for the No. 2 aircraft were completed, printed and ready for mailing.

Newcomers to the scene of homebuilding and kitplanes may not be up-to-speed on what the Defiant is and what its unique capabilities are. Essentially, the Defiant is a four-place, canard-type twin with four-cylinder Lycoming engines of 150, 160 or 180 horsepower each. Rutan says its canard configuration provides several important benefits as compared to conventional twins:

"One, packaging is considerably more efficient—it has a standard-size cabin in an airframe whose wetted area is only 60% that of a conventional light twin.

"Two, the smaller airframe also has

The Defiant's rear-engine intake scoop is offset to avoid the oil and exhaust gasses from the front engine.



The twin-engine, centerline-thrust Defiant is a big homebuilt with big capabilities: 15½-hour endurance, 1200-mile range and 213-mph cruise speed.

Photos: Don Downie

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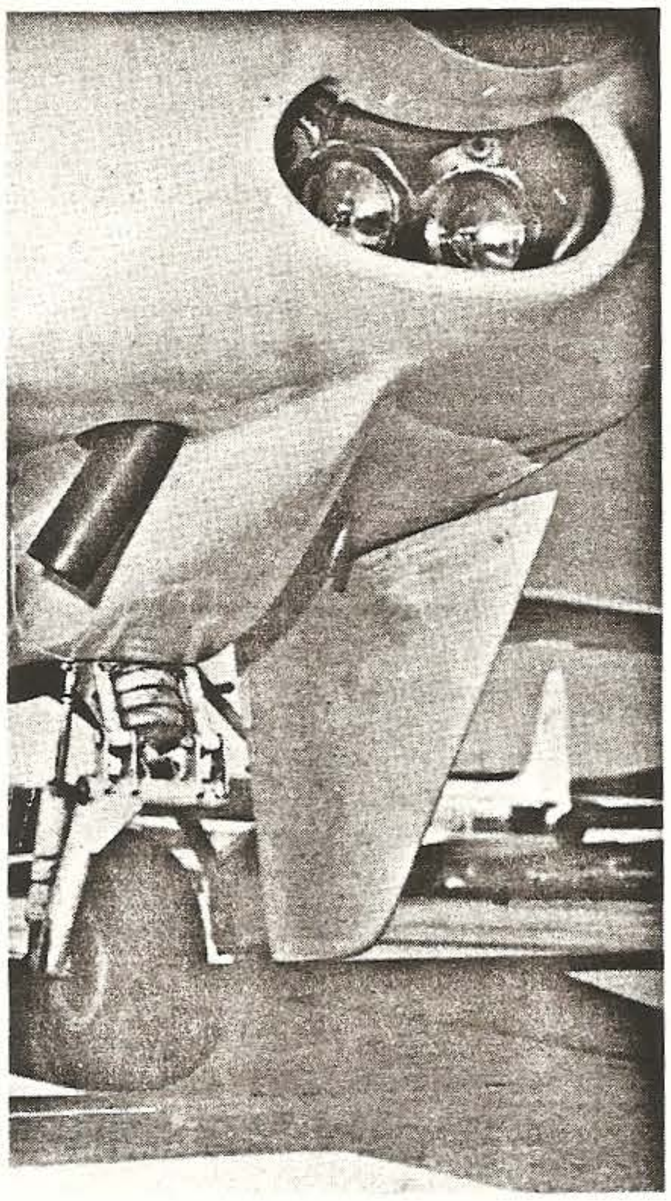

The standard Defiant "rhino" rudder is mounted on the fuselage belly, a mere foot from the rudder pedals; it's the simplest design, but many builders may opt for the more-aesthetic winglet rudders.

reduced structural-load paths, allowing a structure much lighter than a conventional twin while having better durability and a higher-G capability.

"Three, the tandem wings allow natural aerodynamic angle-of-attack limiting; thus, the airplane is stall resistant.

"Four, the tandem wings, using winglets for directional stability, provide a 30% reduction in induced drag compared to a conventional aircraft with the same span loading.

"Five, flight control systems are simpler and lighter. Elevators are only two feet from the control sticks, and provide a flap effect without separate flaps; thus, at low speed the canard has a deflected, full-span slotted flap, yet the pilot has no flap control to adjust.

"The rudder—only a foot away from the pilot's rudder pedals—is designed to provide control yet have no effect on stability," according to the designer. Ailerons on the aft wing are controlled from their inboard end such that the entire wing and vertical fin assembly is built without any moving parts.

"The small-chord elevators and ailerons allow control forces compatible with a side-arm control stick," says Rutan. "This allows more precise, less-fatiguing control and provides improved use of primary-instrument panel space.

"The fuel system consists of a 58-gallon tank with a large sump for each engine," Rutan continues. "The two systems are independent and require no pilot action for normal operations. Crossfeed is available. The sumps are accurately gauged and are equipped with low-level warnings, such that when 45 minutes of fuel remains, the pilot not only has a warning light but also has a gauge that moves full scale for the last 45 minutes of fuel. He can then intelligently plan his options when fuel is low, knowing quantity to within one-third gallon of fuel. The last one-half gallon of fuel can be used in all normal attitudes."

Flying qualities are conventional, according to Rutan, with the following exceptions: Spiral stability is positive and speed stability is high, such that the aircraft flies hands off indefinitely once trimmed—even in turbulence. Second, there are no pitch or roll trim changes due to configuration or power. Once trimmed at approach speed it will hold that speed hands-off during power changes and landing gear extension. "The Defiant is a very stable IFR platform with a very solid 'big airliner' feel," says Rutan. "It holds a desired approach speed with less attention than a conventional light twin."

The No. 2 aircraft differed from the prototype in some details. Span was increased by 27 inches on the main wing and by 24 inches on the canard. Aileron hinge points were modified for lighter stick forces. The back seat now folds forward for a 'station-wagon' concept with ample space for two people to sleep. The canopy opening was improved and the fuselage shape modified slightly for more headroom in the back seat.

Keller made a few minor changes on his own in building No. 2. He moved the step forward for easier cabin entry. The canopy opens wider than on the prototype and the headrests were moved from the back of the seats to the canopy frame. The rear-engine air scoop is offset to stay away from front-engine oil and exhaust gasses during cruise; the rear scoop also doubles as a pick-up for air for the cooler and for expelling the exhaust.

Keller feels that many builders may remove the rhino rudder that hangs down aft of the front engine and install tip rudders similar to the Long-EZ's. "The rhino looks like hell," he says, "but that is the simplest way to build the rudder system; it hooks directly to the rudder pedals."

The latest *Canard Pusher*, Rutan's quarterly builder newsletter, gave the following advice on propeller selection to Defiant builders nearing completion:

"Based on our considerable experience with wood props, we have designed a prop extension that Ken Brock will be manufacturing and selling to Defiant builders that is optimized to reduce or eliminate many of the problems associated with wood props. This extension is 8 inches long, a length required to fair the engine nicely. The flange that bolts to the engine is standard. The flange that the prop bolts to is 7 inches in diameter, 1 inch larger than standard. The crushplate also is 7 inches in diameter and 1/2-inch thick in order to be able to spread the local force exerted by the bolts. This additional inch of diameter gives us approximately 20 square inches more area to drive the prop. Also the threaded drive lugs are 3/4-inch diameter instead of 5/8-inch and are threaded for 1/2-inch x 20 bolts instead of 3/8-inch. This allows us to torque the bolts to 375-400 in./lb. (instead of 220 in./lb.) *without* crushing the wood. We have tested this system on the O-320 as well as the O-360 engines with excellent results.

"These prop extensions are the *only* RAF recommended prop extensions for Defiant. We have informed the prop manufacturers of this change which requires a larger prop hub and 3/4-inch countersunk holes. Of course, if you use constant-speed props, none of the above is applicable."

So, you can see that the RAF headquarters in Mojave is looking actively at the finishing touches for that long line of Defiants that are now on their way toward flight lines all over the country. □

***FOR MORE INFORMATION,** contact Rutan Aircraft Factory, Building 13, Airport KP, Mojave, CA 93501; 805/824-2645.*