The fastest kit airplane and the most expensive, the Swearingen SX300 can crack the $100,000 barrier in construction costs.

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KITS

SWEARINGEN SX300

Two seats and turboprop performance

It is, in certain respects, the ultimate kit-built airplane. The fastest, with a top speed of 239 knots. The most expensive, at $43,021 for a series of six construction kits (not including engine, propeller, avionics, instrumentation, upholstery and paint). And perhaps the most complex to build. For many pilots, the Swearingen SX300 may represent the ultimate personal airplane available from any source, whether it be a factory production line or a kit-maker's packing crate.

The SX300 is the invention of designer/entrepeneur Edward J. Swearingen Jr., who is best known for the line of aircraft that bears his name—the Swearingen Merlin and Metro turboprops. Swearingen sold the line to the Fairchild Aircraft Corporation 15 years ago, and updated versions of those aircraft now are marketed as the Fairchild 300, 400 and Metro. Among other projects, Swearingen also was involved in the development of the Twin Comanche, the Cheyenne and a prototype for a pre-Malibu pressurized single while working under contract to Piper Aircraft in the 1960s and early 1970s.

For Swearingen, speed always has been a high design priority. The keys to superior performance, in his view, are plenty of power, high wing loading, a conventional configuration and meticulous attention to drag reduction. That philosophy, and a dedication to the highest standards of construction, are reflected in every inch of the SX300.

The 300-horsepower Lycoming IO-540 that powers the SX300 is one of the largest horizontally opposed piston engines found on general aviation singles; it is bolted to one of the smallest airframes. Wingspan is 10 feet less than a Piper Tomahawk's, and length is one foot shorter. The SX300's power to weight ratio of eight pounds per horsepower places the airplane in a class with some turboprops, and so does its performance.

Best initial rate of climb is 2,400 feet per minute at 125 knots. A cruise climb speed of 160 knots yields about 1,000 fpm below 10,000 feet. Cruise speed at 65-percent power and 12,500 feet is 231 knots, and range is 980 nautical miles with a 45-minute reserve.

Maneuvering speed in the SX300 is a high 207 KIAS, which allows the pilot to descend without having to make substantial speed reductions. It also allows the pilot to maintain a relatively high speed in turbulence. The day I flew Swearingen's prototype, the tiny airplane was hardly budged by strong midday Texas thermals, a consequence of its high 33.6-pounds-per-square-foot wing loading.

Trade-offs for the SX300's impressive top-end performance figures come in the form of high (for a single) approach and stall speeds. Recommended final approach speed is 100

Swearingen, the designer and the design

knots, slowing to 80 over the threshold. Stall speed in the landing configuration is 70 knots at gross weight. With gear and flaps up, stall speed rises to 75 knots.

It might seem that combining a big engine with a small airframe would be a simple formula for high performance. The trick, of course, is to make the airplane an efficient, sturdy and stable machine. The engineering that has gone into the SX300 is more typical of the approach taken in designing a business jet than a general aviation single.

Wing and fuselage skins are heavy-gauge .040-inch-thick aluminum alloy. The skins account for much of the airframe's strength, reducing the need for complex and heavy internal structures. The wing has been static-load tested to six Gs. Stress analysis calculations indicate that the failure point is beyond nine Gs. Wing leading edges are fabricated as single U-shaped sections, spanning from wing root to wing tip and curving aft to the spar. The leading edge is stretch-formed, meaning that it is stretched into shape by pressing a mold into a sheet of aluminum. This technique enables the leading edge contours to be formed with a high degree of conformity to design specifications.

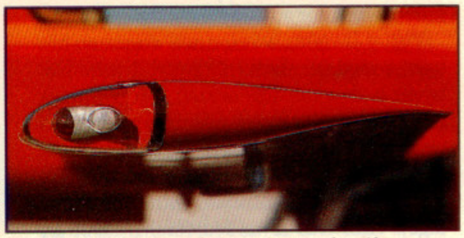
Rear wing skins join the leading edge in a joint that is recessed one tenth of an inch below the aerodynamic contour of the wing. This depression is filled in with a synthetic compound that is flexible when dried and will not crack, according to Swearingen. Carefully applied and sanded before painting, the filler is almost unnoticeable, even under close inspection, and the wing takes on a seamless look.

The wing section is a natural laminar flow (NLF) design, an NLF(1)-0416, to be precise. As the airfoil's designer, NASA engineer Dan M. Somers, explains it, NLF airfoils, designed with the aid of computers, offer the low drag factors of earlier laminar-flow designs combined with the high lift coefficients of turbulent-flow airfoils. Earlier laminar-flow designs could not match the high lift produced by non-laminar-flow airfoils. Because of the high-lift properties of the SX300's wing section, the wing is set at a slightly negative angle of incidence (minus one degree at the root, minus four degrees at the tip) in order to produce the least drag in cruise flight.

Flush rivets are used throughout the airframe. Communications and navigation antennas are buried in the fiberglass wing tips and in the tail. The gear is operated by means of an electrically actuated hydraulic system

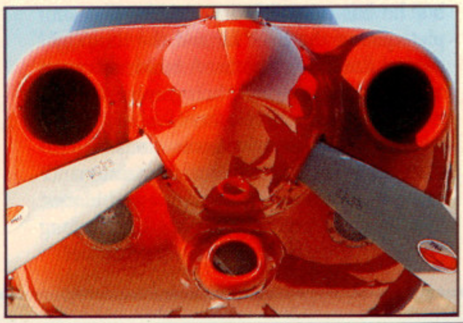
and is fully enclosed when retracted. The flaps are hydraulically actuated.

Minimizing cooling drag while providing even cooling to all cylinders was a significant design objective. At the SX300's cruise speeds, intake air can actually "dam up" at the cooling air inlets, adding substantial drag. The solution was to modify the prototype's original cowling by extending the cooling air inlets forward almost to the prop. The original nearly rectangular inlet shape was rejected in favor of a rounded inlet, and the inlet leading edges were molded in an airfoil shape. Felt seals surround the propeller shaft to prevent cooling air from reversing course and flowing back out the front of the cowl. The upper half of the powerplant is tightly baffled in order to direct cooling air down through the cylinder heads more efficiently.



ART DAVIS

Innovation and attention to detail are reflected in the distinctive shape of a natural laminar flow airfoil and the SX300's rounded, airfoil-shaped air inlets.



Several other modifications have been made to the SX300 since initial flight testing. The horizontal tail area was increased approximately 20 percent to improve low-speed pitch control. Rudder chord was increased two inches to provide more control in a full-power stall. Positive servo tabs were added to the ailerons to reduce roll forces, and an anti-servo tab was added to the elevator to increase pitch forces. Wing dihedral was increased from three to four degrees to improve roll stability.

Inside the cockpit, the prototype's soft leather upholstery adds an appropriate touch of luxury to such an exotic airplane. But the important inside story has to do with Swearingen's attempt to provide substantial system redundancy. The pilot's gyro instruments are electrically driven, while the copilot's gyros are air-driven. Neither an electrical failure nor a vacuum failure will leave the pilot without attitude and direction reference.

A split-bus electrical system allows the pilot to quickly shed electrical load while retaining essential items—the pilot's turn coordinator, one navcom, the fuel boost pump and a map light. The prototype also is equipped with a two-axis S-Tec autopilot specially programmed for the pitch and roll characteristics of the SX300.

Flying characteristics are sophisticated, also. Prospective pilots need training in truly high-performance aircraft; transition training tailored to the SX300 would be even better. It is not an aircraft that should be treated lightly in *any* aspect of its operation.

Even with the addition of the anti-servo tab, pitch forces are quite light in all phases of flight. Aileron and rudder forces are as nicely balanced as they are responsive. Roll rate is 140 degrees per second, and aileron rolls are nearly effortless.

The airplane's aerobatic capability will tempt pilots. But a high degree of aerobatic proficiency will be required to avoid excessive speed build-up or inadvertent spins. At the moment, the airplane's spin characteristics are unknown. Swearingen says spin tests will be conducted in the future, after the airplane has been rigged with a spin recovery parachute and a canopy jettison system.

The stall break may seem rather sharp to pilots accustomed to the stall characteristics of factory-built high-performance singles. Overzealous application of the SX300's sensitive controls could lead the pilot to exacerbate the stall. Again, pilot proficiency will be the key to safe stall recovery.

Swearingen Aircraft has shipped three of the aircraft's six subassembly kits to builders—those for the empennage, wings and fuselage. Shipments of the engine installation and landing gear kits are scheduled to commence in September 1986. The cockpit completion kit will be the last to be shipped. Kits have been shipped to 88 individuals, 69 of whom are actively building airplanes, according to Swearingen.

SX300 builders interviewed for this article praise the quality of materials and prefabricated parts. Drawings and assembly instructions for the airplane are first-rate, and technical support from Swearingen Aircraft has been good, they say. But some also say that the SX300 is as complex and demanding a building project as one is likely to find among kit aircraft.

Swearingen will not estimate building time for the SX300 because, he says, it will vary considerably with the experience of the builder. One spare-time builder, who expects to take at least five years to finish his airplane, quips that "The SX300 is for the buyer who wants a fast airplane, but doesn't need an airplane fast." Some purchasers have hired experienced aircraft mechanics or homebuilders to work full-time on the construction of their SX300s.

Building time may be reduced substantially, however, if Swearingen wins FAA approval for his plan to offer what he refers to as the SX300 "big chunk" kit. This kit would provide a fully assembled fuselage, completed wings, and an empennage complete except for the left-hand stabilizer—the only component that will have to be fashioned out of sheet metal. Rather than spending hundreds of hours drilling holes and driving rivets, the builder will bolt the airframe together and install the various aircraft systems.

The kit still will meet the amateur-built requirements, Swearingen says, because the homebuilder still puts in more than half the hours of labor necessary to complete the airplane, while learning just as much about aircraft construction as with the previous kit. (FAA regulations require that amateur-built airplanes be assembled solely for education or recreation.) A price has not yet been arrived at for the new kit, but it too will be a big chunk, says Swearingen. *—J. Jefferson Miller*