tional Business Aircraft Association conventions and later at an air show in San Diego. Prescott Aeronautical Corporation's marketing blitz, and the fact that the airplane appeared complete, down to a paint job that at least was different, tended to obscure the serious nature of the undertaking. Frequently more attention was paid to recently named chairman and principal investor Linden S. Blue, former Beech CEO and Gates Learjet executive vice president/general manager. Quite a few observers called it a paper airplane and dismissed it to the realm of exercises to test the potential market before committing to a real project. Even the configuration of the Pusher worked against it with those people to whom it was too reminiscent of the Bede BD-5.

Behind the sophisticated marketing is a solid, state-of-the-art approach to design, development and manufacturing. Even those to whom the design itself is unappealing have been impressed with the approach the company is taking.

The Prescott Pusher is a single-engine, four-place, low-wing, T-tail, tricycle-gear airplane with an aft-mounted engine driving a pusher propeller through a 12-inch propeller shaft extension. The prototype Pusher is equipped with a fixed-pitch wood propeller, although the plan is to offer a four-blade, variable-pitch, automatically controlled

PRESCOTT PUSHER

propeller with reversing capability.

Structure is a combination of tubular steel fuselage covered with a composite, non-structural shell. Aerodynamic surfaces are conventional aluminum-covered, built-up spar and rib construction. Flush riveting is used in all aluminum surfaces to minimize drag. The wing airfoil shape is an advanced natural laminar flow design. The wingtips are

The Pusher's behavior in ground effect and pitch characteristics become familiar with a little practice.

drooped and shaped to reduce induced drag. The wings are mildly swept, with the leading edge running from a point at the root that intersects at the middle of the cabin to slightly behind the aft bulkhead at the tip. The horizontal stabilizer is mounted at the top of the vertical tail and has a single, full-span elevator that incorporates a movable trim surface. The ailerons and flaps are designed to reflex—that is to be set at a negative angle of deflection above the chord line—in the cruise position.

The stated reasons for choosing a pusher configuration are better propulsion efficiency, improved forward visibility and lower vibration and noise than tractor propulsion arrangements. Cabin space and comfort were included in the design goals also. It was decided to offer both fixed- and retractable-gear models. Complete kits, which do not include avionics, instruments, interior, engine, engine mount or propeller, are priced at $29,500 and $36,500, respectively.

The overall objective was to develop a technically advanced, efficient, high-performance airplane. Design empty weight is 1,220 pounds, and gross, 2,250. With a 180-hp engine, initial performance specifications for the retractable version with a constant-speed propeller include an approach configuration stall speed of 57 knots, maximum speed of 160 knots and 75-percent cruise at

7,500 feet of 156. Sea level rate of climb objective is 980 fpm. If these performance goals can be attained, the Pusher will be very competitive with production four-place, retractable singles.

Performance objectives had to be balanced with another set of design goals directed at the construction of the airplane by amateur builders. The most critical, complicated tasks are performed by the factory. These include cutting, forming, welding and finishing the tubular fuselage, wing spar center sections and other critical parts, such as the main gear trunnions, forming the aluminum parts and molding the composite shell. One basic goal is to offer a kit that people with no specific building skills or experience can successfully build to design tolerances, yet satisfy the FAA requirement that the builder complete more than 50 percent of the work. The kits themselves, which will be covered in more detail in the May issue of *Pilot*, are well-organized. The building manuals are accompanied by a videotape to help the builder visualize the steps in the process. Prescott has announced plans to develop building centers in selected locations in the United States to assist customers. The company projection of time to complete is 1,500 hours—about a year of dedicated part-time work.

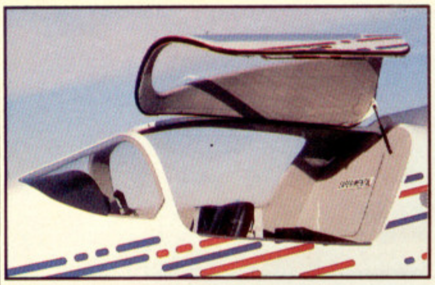
Computer-aided design and manufacturing (CAD/CAM) has been employed from the beginning of the project. The McDonnell Douglas system Prescott recently purchased has been used not only to save time at the drafting table, but also to design hard tooling such as the form blocks used to stretch form-radiused airfoil leading edges and to direct tube cutting for the fuselage. It also prints the drawings used in the manuals from the engineering data bank.

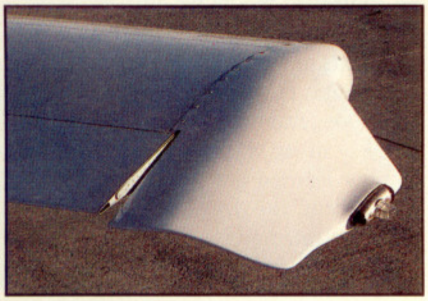
It took designer F. Thomas (Tom) Prescott 18 months to get from his preliminary design to a flying prototype. Prescott, by the way, has bachelor's and master's degrees in engineering and both academic and practical experience. He gained engineering and flight test experience with Gates Learjet, Piper (where he was chief of flight test on the 602P Aerostar) and Sikorsky.

Before construction of the prototype began, he tested a one-fifth scale model of the design in a wind tunnel, including tests of the airfoil's ability to maintain satisfactory flow and drag characteristics with foreign matter on it (some laminar flow designs experience significant degradation—flow separation—in precipitation or with bugs on the leading edge). Some aerodynamic refinements were made, based on the findings. Then he and his brother, Leo L. Prescott Jr.—experienced aeromodelers—built a radio-controlled model for further testing.

Both Prescotts are very active in the test flights of the prototype, as well. The information developed from wind tunnel, model and actual flight test has resulted in many changes to the airplane. Lessons learned are being applied. In other words, the development program is sophisticated and professional.

Before the first actual (as opposed to





"official") flight on May 13, 1985, non-destructive static load tests and preliminary ground vibration and flutter tests were conducted. Gear drop tests and initial destructive and non-destructive tests have been carried out on the trim tab, rudder, ailerons and flaps since then. An airframe is being rigged in a test bed to perform ultimate load evaluations on the entire aerodynamic structure. The company has stated that all elements will be tested before individual kits are shipped to customers.

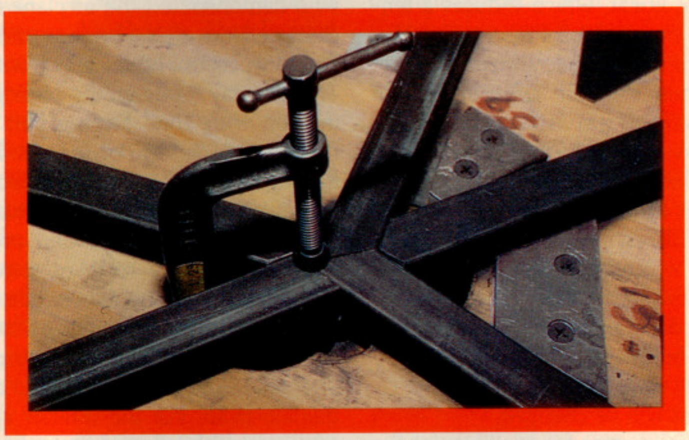
When *Pilot* Creative Director Art Davis and I visited the company in January for a briefing on the program and to fly and photograph the prototype, the first two kits (trim tab and rudder) were being shipped. Since then the flap and aileron kits have been signed off and shipments have begun. The vertical stabilizer and elevator kits were to be approved by early March; the fuselage frame kit should be ready in late March.

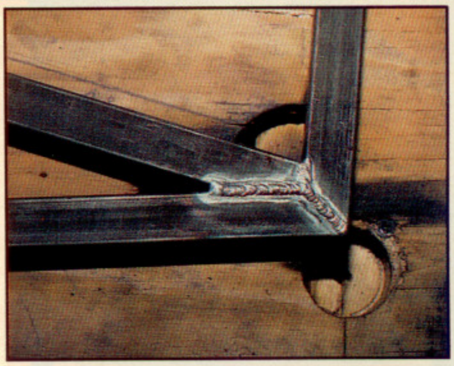
Tom Prescott told us that the development and proving program is following FAR Part 23, although because of time and expense there are no plans to seek Part 23 certification. If the AOPA/EAA-sponsored basic airplane proposal becomes a regulation (see "The Primary Aircraft Proposal," October 1984 *Pilot*, p. 48), the company does plan to seek manufacturing approval under it.

The prototype, N41PP, has already undergone some changes (some before construction was finished). For instance, gear and flap actuation was to have been all-electric. This was changed to an electrically controlled hydraulic system for weight and center of gravity reasons. Nose gear steering is also hydraulic, utilizing the same rocker-switch system used in the Aerostar (this might be changed to a mechanical system).

The first and second flights were hampered by unacceptably high oil temperatures (this is part of the reason why the July 9, 1985, flight has been dubbed "official"). The fix was to relocate the oil cooler from the engine bay to the nose bay. Throughout our four flights over two days, with ambient temperatures in the 50s, both oil and cylinder head temperatures were well within limits. The gear geometry was changed for better low-speed pitch control, especially during takeoff. Elevator trim tab area has been increased to improve effectiveness with full power application with the gear and flaps extended. The elevator's angle of incidence has been increased from -1.5 to -3.0 degrees to reduce drag

PRESCOTT PUSHER





The Pusher's smooth lines and precision fittings are due in large part to computer-aided design and manufacturing (CAD/CAM). Fuselage framework is cut to fit with the help of computer-programmed saws, then hand-welded. Main gear trunnions (bottom right) also come pre-built. Reflexed ailerons and flaps are shown in photos above and at bottom left. Future aircraft will have fuselage and wingtip fairings aligned with the reflexed control surfaces.

PRESCOTT PUSHER

Pusher configuration means better visibility and propulsion efficiency, quieter cabin.

in cruise. The aileron control geometry was changed to reduce sensitivity.

When I flew it, the prototype still had the fixed propeller installed. It had flown a total of 110 hours. The nose-mounted air data sensor boom had been removed, but gear doors had not been installed. Between the second and third flights, a spinner was installed that increased available propeller rpm by 500 and further improved engine cooling.

The elevator hinging and control geometry will be changed, and a new stabilizer will be installed to decrease the gap between it and the elevator. At low speed, particularly when in ground effect, pitch is quite sensitive and the feel is not linear, which induces a tendency to overcontrol. Prescott has also decided to reduce the number of structural elements in the tail assembly to reduce weight and construction complexity. Weight reduction should also improve loading flexibility.

There is no aerodynamic warning before the stall, and the company is experimenting with stall strips to generate buffet a few knots above stall speed.

The rudder pedal arrangement encourages brake dragging, particularly by tall pilots who have big feet. The arrangement will be changed.

The current seats are too high for the cabin. Lower ones will be designed to increase headroom. The windshield support structure is too large and interferes with forward visibility, particularly for tall pilots. It will be modified, also.

The fuel tank is mounted in the fuselage center section on the prototype. The second airplane, which is supposed to fly in early summer, will have wet wings in the wing leading edges. An optional fuselage auxiliary tank may be offered.

The changes will be made to and tested on 41PP (except for the wing fuel tanks) before the second airplane is completed.

The Prescott Pusher is very much an aircraft in development. The company is demonstrating the courage of its convictions by permitting outsiders to fly it before the design is frozen. Demonstration flights in the prototype have started.

My first flight was with Tom Prescott, who demonstrated the airplane and its characteristics after a briefing and a preflight inspection. I then flew it with Leo. The next day I rode on the photography mission with Tom. During part of the flight, I tried out the back seats. Later, I flew again with Leo as check pilot.

Preflight is pretty standard except for the aft-mounted engine and propeller (owners will have to learn some new cautions on the ramp to preclude people walking into the propeller). Access to the engine and accessories is excellent. The nose looks large enough to accommodate radar, but the interior space is taken up with oil coolers and the hydraulic power pack.

Entry to the cabin and cockpit is through the left side canopy, which is oversized. Reaching the right front seat is the most cumbersome, but really no more of a chore than rear seat access in the typical single-door general aviation single or light twin. The rear seats, which are mounted on the spar center section or carry-through structure, are higher than those in front. This improves forward visibility for the sightseers in back. Visibility to the sides from all seats is superb. There is a baggage bay behind the rear seats.

Instrument panel, controls and systems are arranged and configured in a way that is familiar to most pilots.

Visibility over the nose from the cockpit is good, except for the obstruction caused by the windshield/canopy juncture. The instrument panel is low in profile, and the nose—with no engine jutting out in front—slopes steeply.

For pilots not used to the steering arrangement, it takes a few tries to get used to but is positive and predictable. Pre-takeoff checks are standard. Acceleration is slow in the initial takeoff run with the fixed-pitch propeller, but directional stability is good. The acceleration was not helped by my difficulty in keeping my toes off the brakes. I had already been briefed that ground effect at flying speed creates a pitch-up tendency. This encourages overrotation at takeoff; there is no need to flare during landing because of the characteristic ("Fly it on with attitude, just like a Lear," Leo Prescott had told me).

During the takeoff run, the elevator force lightened and the airplane seemed to establish a slightly nose-light attitude by itself. As the weight on the nosewheel lightened, the right-turning tendency became more pronounced. At that point, the airplane felt ready to fly, but it was not flying. I added a bit of back pressure. No change. Then I added a bit more. There was a dead spot, but then the airplane told me I had overrotated, as it pitched up into the air. I put the same amount of nose-down command in, but it was too much. After that initial oscillation, we were off and flying, but I was cursing myself for being ham-handed. It took a few circuits to get the characteristics down to an acceptable performance.

The pitch characteristics and the behavior of the Pusher in ground effect are the only two handling areas that I observed that will take a bit of transition training. They are different from what most piston-power pilots are accustomed to and must be learned. Once learned, they are easy, and the airplane flares itself and flies onto the runway very nicely, once the proper attitude is established. Once the mains are on the runway, the nose falls through quickly, and attempts to hold it off only aggravate the inevitable bump as the nosewheel hits.

I spent a good bit of time in all configurations, mostly in slow flight and stalls. While there is no aerodynamic warning, stalls are mild (we did not try any highly aggravated or accelerated stalls). In each of the configurations I tried abrupt power changes to sample pitch changes. Behavior was quite predictable. Pilots making the transition to the Pusher should find no surprises. There is adverse yaw produced by uncoordinated turn entry, both with aileron first and rudder first. Properly coordinated turns take a bit of care at first. Spiral stability is better to the right than to the left, but in both directions will take a lot of neglect before winding up. Pitch damping is good, although bump-induced excursions take three to four oscillations before neutralizing.

All in all, the Pusher in its current state of development should present no handling challenges to pilots used to flying single-engine production airplanes, once briefed on the characteristics.

Prototype number one is expected to fly with a constant-speed propeller this spring. By the time the second prototype flies this summer, the design will be frozen, and the first development phase will be complete.

There are other developments in the works. Work is to begin this spring on a Mazda-based, dual-rotor, liquid-cooled engine rated at about 210 hp. The company has just announced a joint development project with Avia Products Company, a small propeller development firm, to test a four-blade, composite, variable-pitch propeller of advanced airfoil design. The prototype is being built to be installed on 41PP.

It is to Prescott's credit that the basic airplane is being developed using proven systems and components, applying state-of-the-art techniques to bring it to market. There are some exciting new ideas that will be explored, but prospective customers will not have to depend on yet undeveloped ideas to get an airplane into the sky.

There will be no one option among basic recreation/transportation general aviation aircraft. But if the people at and behind Prescott Aeronautical stick to their plan, the Pusher should prove to be one true alternative. □