A New Wren's Nest

Remember the Wren? If you were into the aviation scene in the mid-1960s you will recall the publicity that attended the debut of Jim Robertson's STOL modification of the Cessna 182 . . . and you'll never forget the then unusual appearance of its canard. Chances are you never actually saw a Wren because few were built, but if you did, you were immediately aware you were looking at an airplane that was very much out of the ordinary. And if you saw it land or take off . . . and if the pilot was really showing off . . . you **knew** it was something special!

The Wren had its beginning in the brilliant mind of James Robertson, who at one point in his career was an engineer for the Helio Aircraft Corporation, makers of the Otto Koppen designed Helio Courier series. In the early 1960s Robertson formed his own company, Skycraft, Inc. of Ft. Worth, and built a prototype STOL airplane initially called the Skylark, but later re-named the Skyshark. It incorporated the same basic device every STOL airplane had since the days of World War I when Handley-Page and others began experimenting with ways to dramatically increase lift - the slotted flap. On the Skyshark it was monstrous . . . extending full span, double slotted, 42% of chord and capable of being cranked down to an 80 degree angle! In that position - and, no doubt, with a whole lot of power to overcome the drag - the wing produced over three times as much lift as it did with the flap retracted. That in itself was not a significant advance; researchers had long known what had to be done to produce such lift. The trick was how to control it, how to counteract the immense pitch down force generated when a flap that size was lowered. Most of the designers who preceded Robertson simply put the tail on as long a lever as was practical to create the down force needed to overpower the wing's pitch down (that's why the Helio Courier and the Fieseler Storch have such long aft fuselages). The limitation of that solution is that dragging a heavily down loaded tail through the air creates just what the term implies - a lot of drag. It's this combined drag of the flaps and tail that makes it necessary for most STOL airplanes to have large engines - they need the power to literally plow their way through the air when in the STOL mode.

Where Robertson ventured off on his own was in his attempt to create some sort of counteracting force on the wing itself - **ahead** of the center of lift around which the flaps were pitching the wing down. He first tried a set of full span leading edge slats (he called them "shrouds") that deployed simultaneously with the flaps. They served, as all such Handley-Page type leading edge devices do, to allow the wing to fly at a higher angle of attack before stalling, but apparently were not of sufficient help in counteracting the flap's pitch down force.

This inadequacy led Robertson to his greatest innovation - what he named his "ULS" (for "ultra low speed") control system. It consisted of what we now recognize as a canard surface mounted just behind the propeller. To this horizontal surface were mounted small vertical surfaces, at about half span and well within the prop's slipstream. Both the horizontal and vertical fixed surfaces had trailing edge movable control surfaces - elevators and rudders. Being ahead of the aerodynamic pivot point of the airplane in flight, these surfaces worked in

Jo and Todd Peterson

conjunction with but, of course, in the opposite direction than the rudder and elevator mounted on the tail. The result was a combined rudder and elevator force more powerful than possibly any other airplane had ever possessed. And mounted as they were in the prop's slipstream, the canard/forward rudder surfaces made that control force available down to the forward speed at which the wing was no longer capable of lifting the airplane. One further benefit was the fact that the front mounted surfaces did their work by **lifting** . . . which meant the rear mounted tail did not have to create so much down force, or drag. The result was that the Skyshark could do its thing on less power than STOL aircraft with aft mounted tails only.

In U. S. Army tests at Fort Eustis, VA, it was shown that the ULS system increased the total control force by more than 250% at 40 mph and made possible a 50% reduction in safe minimum flying speed . . . which, in turn, reduced take-off and landing rolls by 50%. Significantly, stability and control were unaffected at higher, "normal" speeds. (Little useful would have been gained, of course, if all the newfound ultra low speed control force had made an unmanageable beast out of the airplane at cruise speed.)

Sad to say, on the heels of all this technical success came the more sordid machinations of the business world. In raising the money to form his company, Robertson had taken in partners who, as partners are often wont to do, had a variety of ideas about how his inventions should be utilized to produce returns on their investments. One of them was based on the undeniable fact that it would be much less expensive (read more profitable) to adapt Robertson's high lift and low speed control devices to an existing, currently produced airframe than it would to design and build their own. No doubt they pointed out to Robertson that no STOL airplane had ever been successful in the civilian market, mainly due to their costing two or three times that of conventional airplanes of comparable power and cruise performance.

The result of this corporate confrontation was the modification of a stock 1958 Cessna 182A into what we know today as the Wren (and a change in the name of the company to Wren Aircraft). It flew for the first time in January of 1963 and was certified by the FAA on June 30, 1964. Robertson had been assisted in the modification by A. E. "Doc" Morris, an aeronautical engineer with extensive bush flying experience in Paraguay. Shortly thereafter, the company's board of directors voted Robertson right out the door . . . proving once again that the invention of neat new things is not the purpose of a business concern, but, rather, as Calvin Coolidge once put it, "The business of business is business." Robertson went to work for Boeing in 1965, started another company the next year to modify stock airplanes to STOL configurations and, sadly, died in 1968. Ironically, that same year Doc Morris was killed in the crash of a Wren being developed for the military's quiet flight program.

Initially, the Wrens sold reasonably well for a STOL airplane - a little better than one a month through mid-1966, according to a contemporary report. Everyone who flew the airplane at the time was properly amazed by its performance . . . but to a man, they were as equally astounded by its price. At a time when a new 182 sold for a base price of around $15,000, the Wren's price was $31,875! The reason was largely parts count and labor. The 182's wing had to literally be dismantled, then remanufactured. All told, the Wren modification involved 1,064 parts and 2,114 nuts, bolts and bearings, each of which had to be installed by paid workers. Then there were the costs of doing business and the little matter of the profit the owners expected to make. An added cost factor was the fact that the Ft. Worth built Wrens began as brand new 182s, available through business arrangement with Cessna. Those airplanes were also equipped with special Hartzell props, modified to go into reverse pitch for **really** short landings . . . and backing into parking places to impress potential buyers!

Unfortunately, Wren Aircraft succumbed to the siren song of government contracts and as has happened to so many other firms over the years, went bankrupt in 1969 when the military rejected projects upon which management had literally bet the company. Galen Means of Wichita bought the supplemental type certificates when the company assets were sold and held them until 1977 when he, in turn, sold them to Todd Peterson of Thedford, Nebraska.

Peterson had been operating an aircraft repair business at Thedford for several years (and doing a little air show flying in an Akro Duster II, incidentally) when he bought the STCs. He spent nearly three more years in Thedford doing market research and building tooling before moving to a hangar at the Buckeye, Arizona airport (just west of Phoenix) to begin producing Wrens. His new company was named Advanced Lift Systems, Inc.

A lot of things had changed in the decade that stretched from 1967 to 1977. For one thing, the 182 had evolved into what was a very different airplane than the one that was modified into the Wren in 1964, and upon which the STCs were approved. Different versions of the Continental O-470 engine, a tubular main gear and other changes had come along, so in order to use the old STCs, Todd had to limit his modifications to the 182H through 182M models from the 1960s. Modifying used airplanes, in turn, meant he would also have to completely remanufacture the airframes in addition to installing the Wren STOL goodies. Fortunately, his previous experience in aircraft repair had provided him with the background for this aspect of the operation. Several new developments that had come along for the 182, like speed fairings and auto gas STCs, were options he could offer Wren buyers. One arbitrary deci-

sion he made was to eliminate the reversible prop - he simply did not think its benefits justified today's price for the propeller.

The first Advanced Lift System Wren emerged from the Buckeye facility late in 1983. The word was out that the Wren was back in production (and orders had come in sufficient numbers to justify building two a month). There were times over the next year, in fact, that the firm's production was sold for nearly 12 months into the future. The company was and is today one of the few in civil aviation that has been able to sell more airplanes than it can make.

Business was good, but Peterson was not entirely happy with his operation. The Wren modification of the 182 is very labor intensive and with all new employees at Buckeye that he had to train and supervise . . . in addition to his roles as the company president, chief test and demonstration pilot, locator and purchaser of used 182s, etc., etc. . . . it simply was not possible to maintain the high level of quality work he demanded. Everything that went out his door was airworthy and looked good, but there were always minor variations that he could not tolerate. Consequently, in 1985 he moved the company to a new building on the Eloy, Arizona airport and reopened his production line at a purposely slower rate - about one airplane every two months. Quality is now at the level Peterson wants it to be . . . and his order book is still filled for months ahead.

I happened to catch Todd Peterson and his wife, Jo, in the quiet lull the evening before the start of the Copperstate Fly-In at Eloy last October and was able to talk to them about the Wren. Todd told me he seeks out and carefully selects his own 182s for modification because he does not want any surprises when he starts rebuilding them. The first thing that is done is the modification of the wings. Essentially, everything aft of the rear spar is removed, the rear spar, itself, is replaced with a stronger one and a set of double slotted Fowler flaps is installed. As the accompanying photos show, that involves the installation of a number of very large external hinges and associated tracks so the flaps can move down (30 degrees) and aft, simultaneously, to increase both the chord and camber of the wing. The flaps are actually in two segments, the outer ones doubling as ailerons - or flaperons, as they are called.

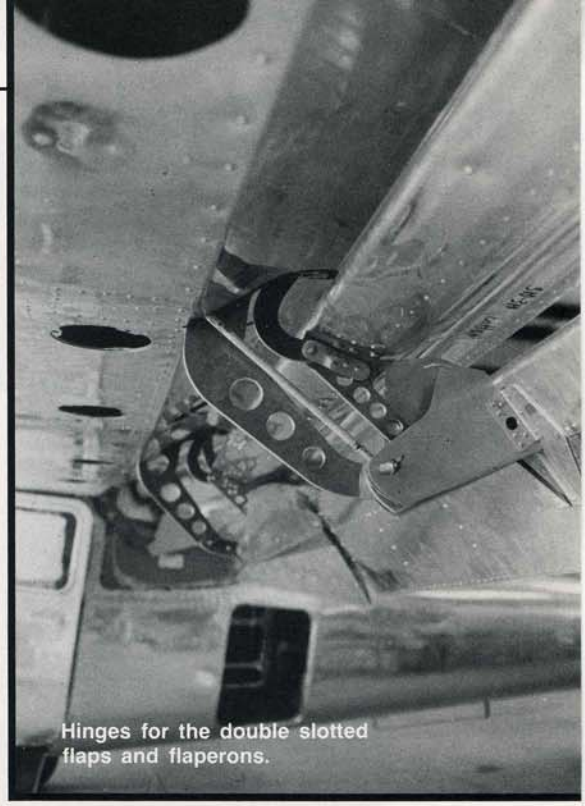
Instead of the Skyshark's leading edge "shrouds", Robertson found he could increase the stall angle of the 182's NACA 2412 airfoil from 16 to 20 degrees by simply riveting on a drooped leading edge cuff. This mod proved so effective that Cessna later added it to its production line, and it was the basis of Robertson's subsequent STOL kit business.

One of the most severe problems of STOL designs is adverse yaw. This is the drag caused by the "down" aileron on the high wing in a banked turn. It causes the nose of the airplane to want to go in the opposite direction of the turn. In STOL airplanes, adverse yaw is often the limiting factor in low speed control. To counteract this phenomenon, Jim Robertson devised a type of spoiler that came to be jokingly referred to as "Wren's teeth".

It consists of five teardrop shaped vanes mounted on top of each wing just ahead of each flaperon. Each vane is mounted atop a vertical shaft and can twist from the straight ahead, neutral position to 60 degrees broadside - toward the wingtip **only**. All five are interconnected by pushrods to the aileron bellcrank in such a manner that when the aileron behind them moves up, they pivot outboard, killing lift to help the aileron drop the wing **and** creating drag to counteract the drag . . . or adverse yaw. . . . of the "down" aileron on the opposite wing. It's a clever and mechanically simple solution to an age old problem.

When Robertson designed the Wren modifications, he apparently did not believe the vertical fins and rudders on the canard of the Skyshark were needed for the Cessna 182. Just the fixed canard and elevator are installed on the Wren, the latter hooked into the control linkage so that it moves in the opposite direction of the rear elevator.

The Wren modification also involves the change from a trim tab system on the rear elevator to a movable horizontal stabilizer like that on the Cessna 180. Run by a jackscrew, the system is interconnected with the flaps so as they split and extend, the horizontal stabilizer's leading edge is deployed downward to help counter the nose down pitch being produced by the wing.



Hinges for the double slotted flaps and flaperons.

A Wren 460P under construction at Eloy.

It is significant that all these devices, the Wren's teeth, the trimmable tail, the forward elevator, are tied into the conventional control system and do not require any additional handles, levers, knobs or whatnot. Without the handle to reverse the prop, the Peterson Wren, has the same wheel, rudder pedals, flap and engine controls a stock 182 has.

The total weight of the Wren modifications is 114 pounds and it takes about 1300 man-hours to install them. Once it has been done, Peterson and his work force begin remanufacturing the remainder of the airframe. The process involves the following:

- Exchange of engine and prop.
- Exchange of all accessories.
- Fabrication of a new instrument panel and the fitting of all new instruments and the avionics of the customer's choice.
- All new fuel cells.
- New windows and windshield.
- Overhaul and/or replacement of all control, hydraulic and electrical systems.
- The fitting of 8:00 x 6 wheels on the mains and a 6:00 x 6 wheel on the nose gear.
- Repositioning the pitot tube outboard (4 inches) and canting it downward (4 degrees) for more accurate low speed indications.
- New interior.
- The customer's choice of paint.

Options include 8:50 x 6 mains and 8:00 x 6 nosewheels, mainly for bush pilots, and an 88 inch propeller instead of the normal 82 inch McCauley, long range tanks, heated pitot, articulating seats, an external power plug, speed fairings and an auto fuel STC.

The older model Continental O-470R is no longer in production, but the factory still remanufactures them. Peterson buys his (and the props) through Van Dusen.

The bottom line of all this is interesting. It will cost you $81,009 to own a Wren with all the available options, less avionics. With fully equipped Skylanes selling for over $100,000 these days, the Wren is in a more competitive stance than it was in the 1960s when it cost twice as much as a stock 182.

So, what do you get for your 81 thousand? You get an airplane that, except for the canard and Wren's teeth, looks like a stock 182; an airplane that has 114 pounds less useful load and is about 5 or 6 mph slower than a stock 182 - unless you order the speed fairings, in which case it is a little faster. You get an airplane that has the room and big upright seat comfort for which the 182 has always been admired. And, in the cruise configuration, you get an airplane that handles and rides like any stock 182.

But what you also get that no owner of a stock 182 has is an airplane that can take off and land in standard conditions and zero wind in 300 feet . . . fully loaded . . . and do it in what is essentially a **level attitude**. Unlike most other STOL airplanes, the Wren's performance comes off the lift produced by the flap system in a level attitude, instead of at high angles of attack. When the airplane touches down, a button on the control wheel is pressed to dump the flaps. This puts the weight on the wheels and allows immediate hard braking, if needed. You have an ultra short field airplane that has a tricycle gear so you can realize the advantages of its crosswind take-off and landing capability and the added flotation on soft surfaces of a third wheel . . . **without** being concerned about damaging the nose gear on rough terrain. With the canard in the prop's slipstream, all the weight can be taken off the nose gear **standing still**.

You have an airplane that produces so much lift that you can make a go-around at half power and hardly any trim change . . . and an airplane that does not fly a lot differently when fully loaded than it does with just the pilot aboard. The rate of climb is less, of course, since only the lift is increased by the various devices - the power stays the same.

You have an airplane that can fly safely at such low power settings that the endurance can be stretched to 11 hours (but without a potty, who cares!).

You have an airplane with a stall speed . . . maybe that's a "mush" speed . . . of 30 mph and one that is fully controllable in all axes as long as it is still in the air. With all of 40 mph on the clock, you can wrest the Wren around at ridiculous angles of bank without fear of losing it. And the most practical use of this capability is being able to slow down in severe turbulence - **very** slow - and still maintain full controllability . . . and, of course, in effecting a forced landing at the lowest possible forward speed. And, if it is your bag, the Wren was certified in the 1960s for near zero-zero landings. With its level approach attitude, the airplane was simply flown down the glideslope at 50 to 60 mph until the wheels touched the ground.

However . . . after all the gee-whiz recounting of Wren capabilities, we must step back from the heat of enthusiasm and ask ourselves the hard question . . . who really needs all this? Bush pilots do, and, in fact, almost half Peterson's production goes to Alaska and Canada - 40% to Alaska alone. Fish spotters do. Radio and TV stations have found the Wren can do almost all they need done in traffic watch and aerial filming assignments a helicopter can do, at a fraction of the cost. Missionaries can use them to fly to remote areas where no real airports exist . . . and anyone who regularly flies in and out of high altitude strips would love the

Wren.

There's still another group that might have reason to own a Wren . . . something that was dreamed up back in the 1960s when the design was just going on the market, but is just as valid today. Flown more or less normally . . . that is not in the bush pilot, I've-gotta-get-it-stopped-on-that-sandbar-in-150 ft. mode . . . the Wren's low speed capabilities are largely in reserve for emergencies and/or as a safety cushion for those whose proficiency is slipping for one reason or another. The Wren brochure suggests that "aging or non-proficient pilots" could ". . . get a new lease on their flying life with the Wren." I don't think age alone is that much of a factor . . . I know some really sharp, really old pilots . . . but I **do** think a lack of proficiency is a **big** factor.

Non-professional pilots . . . those of us who pay for our flying out of the grocery money . . . don't fly enough. We all know that. EAA estimates the average sport pilot flies less than 50 hours a year and no one contests the figure. An airplane as forgiving as the Wren would cut down on the fairly high incidence of take-off and landing accidents this group experiences, which are largely the result of a lack of practice. The government is **not** going to dole out stipends to sport pilots so they can fly more . . . and pilots are **not** going to stop flying altogether, so a more forgiving airplane is, in my opinion, the one realistic means of improving the lightplane safety record.

Not everyone can afford an $81,000 Wren, of course, and Todd Peterson couldn't produce enough to make a dent in the accident figures anyway . . . but there should be something in all this that is food for thought for our homebuilt designers. Most homebuilders are non-professional pilots; most homebuilders fly less than 50 hours per year . . . so, what kind of airplane should you guys be designing for them? The Wren, after all, is simply a 3-surface airplane. We are seeing variations of that configuration regularly now. The Rutan/Amsoil racer, the Predator, the Grizzly, Q-2s with Garry LeGare's fin mounted trimmer, the newest versions of the King Air, the new Gates/Piaggio Avanti, Burt Rutan's proposals for Beech's next generation of singles and medium twins . . . all are examples of 3-surface airplanes. Fowler flaps are nothing new . . . and think how the parts count could be reduced in a composite airplane. Something to think about, eh?

And, finally, as I pointed out last year in my article on the Helioplane, eventually we are going to have to re-think the lightplane if we expect to use it in urban areas in the U.S.A. of tomorrow. Airports are going to have to get smaller if we are to be able to afford to build any more, and if we expect airplanes to ever be used by a significantly greater number of people than they are now, there will have to be more . . . and more conveniently located . . . airports. And as for the sequence . . . I don't think the new, smaller airports will be built until the airplanes to use them are already flying.

In the meantime, for those of you who can and want to get a jump on the future with a Wren, contact Todd Peterson at Advanced Lift Systems, Inc., Municipal Airport, Rt. 1, Box 1003, Eloy, AZ 85231 (phone 602/466-3122).

MARKET PLACE