PARENTING A PULSAR

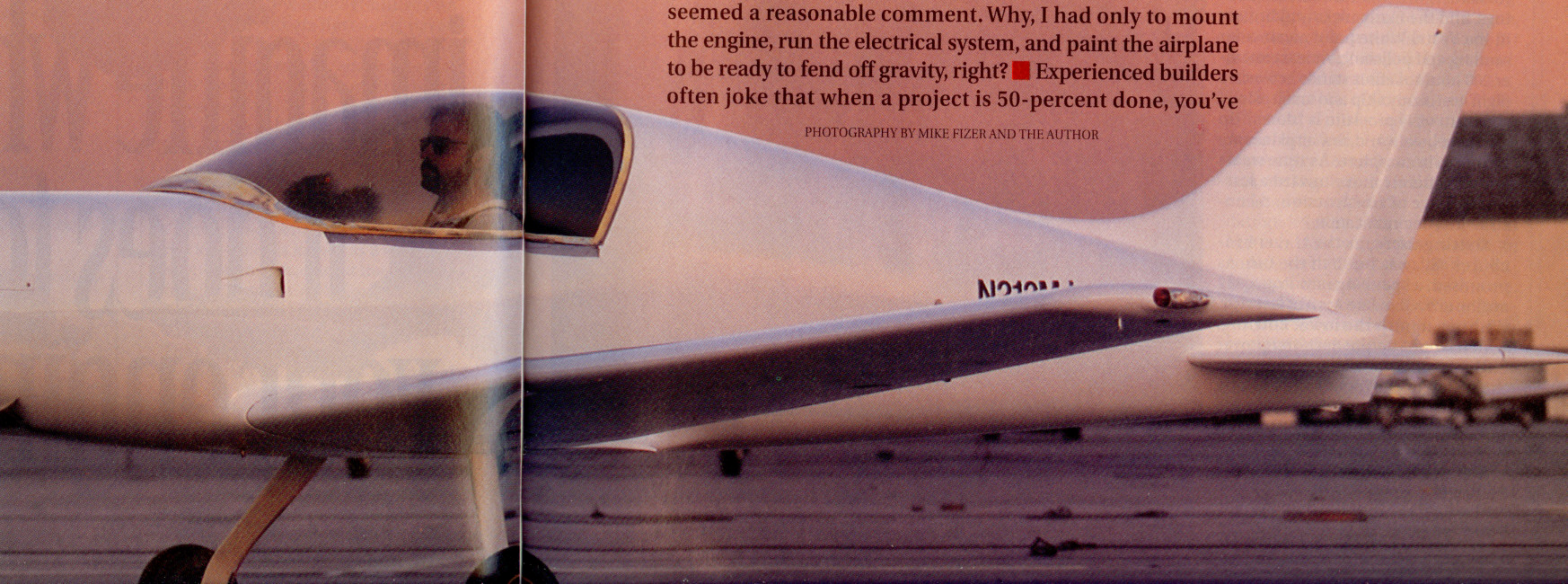
HOMEBUILDER'S HOME STRETCH

Racing for the finish line

BY MARC E. COOK

Children, newlyweds, and homebuilders say the damndest things. In the last installment of the Pulsar-building tale, I brashly stated that with 450 hours of labor in the books, I was beginning to see the culmination of my work ("Parenting a Pulsar: Building Experience," May 1994 *Pilot*). Given that the fuselage and wings were nearly whole and structurally complete and that the quick-build options should have brought the build time to 800 hours or so, it seemed a reasonable comment. Why, I had only to mount the engine, run the electrical system, and paint the airplane to be ready to fend off gravity, right? ■ Experienced builders often joke that when a project is 50-percent done, you've

PHOTOGRAPHY BY MIKE FIZER AND THE AUTHOR



only got 90 percent left to finish. (Put another way, the last 10 percent takes 90 percent of the effort.) Initially, I believed this to be the ramblings of builders who had spent too much time in the paint booth.

But prove them right I most certainly did.

From the comfortable perspective of owning a homebuilt airplane that possesses a special airworthiness certificate and is ready for flight test, it's easier now to look back on the final assembly process as more joy than pain, more triumph than despair. From within the belly of the beast, it's often a different view.

And the build time? Painted and ready to fly, this Pulsar took 991 hours to get from crate queen to the verge of flight. Nor is it over yet. At the opening of the flight test, there's no interior or baggage compartment in my Pulsar. Its wheels are unadorned with fairings, and the many nicks and bruises in the Vestal White paint await color sanding and polishing. At least another 200 hours of effort stands between a flight-test-ready ship and an airplane I can cautiously proclaim is "done." (In the homebuilt world, few airplanes are ever totally complete. As time wears on, they merely move toward a less-frantic pace of construction, reconstruction, or modification.)

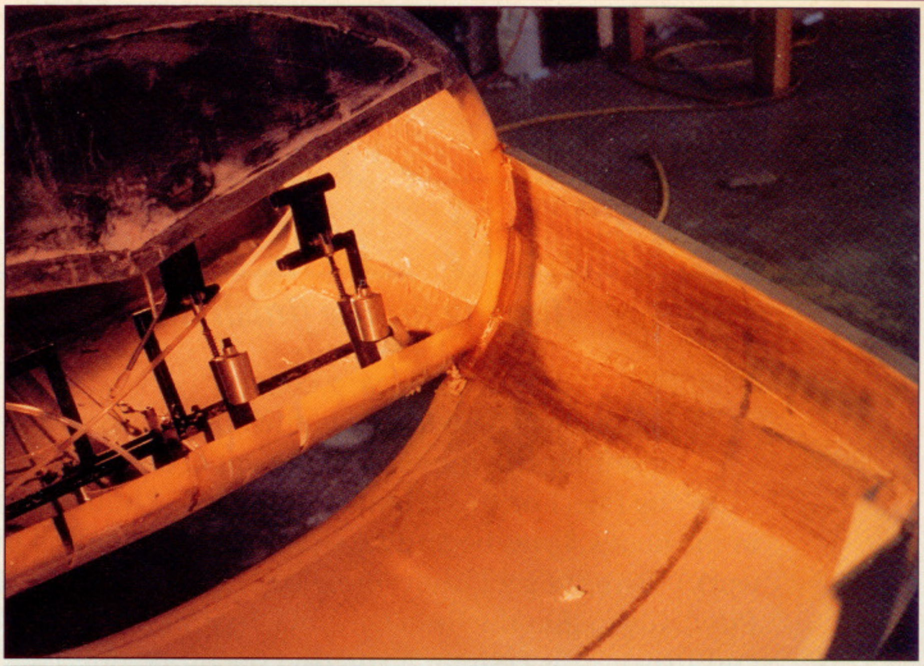
Getting there, as the travel brochures say, was but half the fun. As promised, a spanking new Rotax 912 engine arrived in late April of last year. Within a month the lower cowling, which would be the 80-horsepower engine's mount, had been bonded to the rest of the airframe. The Pulsar's design resembles that of the Bonanza, wherein the lower cowling is a structural member and the engine attaches to metal bed mounts that span hefty composite reinforcements. It's a strong and simple way to locate the prime mover, but it also makes access to the underside of the engine difficult. Engine installations, it seems, expand to fill all available space.

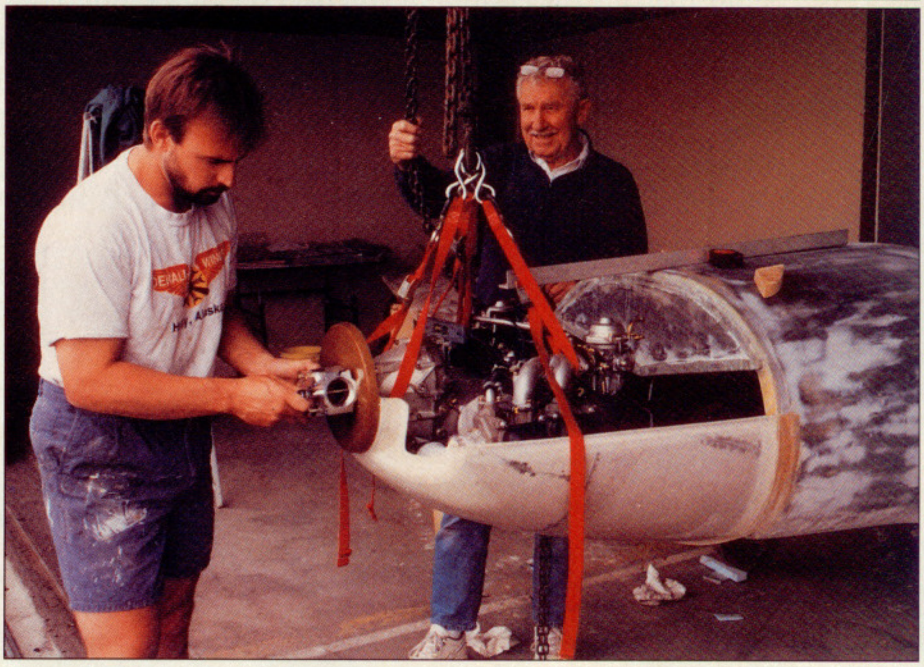
With the help of newly revised builders' manuals, the engine nestled itself onto the Pulsar's nose with few major troubles. (The manuals get better with every revision, as you would expect, thanks to substantial field input.) The first time the engine goes in, it does so only to locate the mounts in the lower cowling. Then the powerplant comes out and the steel and aluminum members are bonded into place. After another installation to check the accuracy of the mounts, the Rotax returns to its stand while the builder attaches the nosewheel structure, closes the firewall, and paints the interior of the engine compartment.

In truth, the engine sat in the crate for months after the mounts were finished, while the most time-consuming single task in building the airplane was undertaken: preparation for paint.

Well-versed composites toilers will tell you that the main advantages of fiberglass include overall workability and ease of making complex shapes. Opposing those traits is the tedious finishing process, which can take what seems like a millennium and more patience than many homebuilders can muster.

Fiberglass construction is simply glass-fiber cloth wetted with a resin. Like any cloth, a fiberglass structure will have voids—pinholes—in the weave. Depending upon the type of





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Thick belts of unidirectional fiberglass spread engine loads into fuselage sides (opposite, top). Eventually, the lucky builder gets to lower the engine carefully into place (opposite, bottom). But that's just the beginning of the fun, since pinhole filling (right) and various coats of primer (below, bottom) await application.

fiberglass used, these pinholes may be relatively few in number, or they could cover the surface like the pores of your skin. Pre-impregnated and oven-cured fiberglass, which the Pulsar uses, typically has more pinholing than wet-layup methods. That's in part because the pre-preg material optimizes the epoxy/cloth ratio for light weight, and the oven curing with the parts vacuum-bagged tends to pull excess resin from the skins. All of this is fine for weight and strength, but it leaves the builder with millions of tiny pinholes to fill.

During the pinhole-filling endeavor you must be careful to add as little dead weight as possible. Any medium used to fill these holes will not benefit structural integrity, just subtract from the useful load later on. For filler, some builders employ glass balloons (called micro) and epoxy, while others have tried various liquid primer/surfacers.

At the time I was starting the pinhole hunt in earnest, Poly Fiber (formerly Stits) came out with a revised filler, called Superlight. With the consistency of marshmallow creme and the toxic-yellow hue of nuclear waste, the Superlight filler had me raising my eyebrows. But it promised to be easy to work with and considerably lighter than the alternative.

A process I thought would take a month or so finally consumed nearly 240 hours. From the first application of weave filler to the final spray coat of PPG K36 primer, the journey expanded my spray-gun skills and severely tested my resolve. For the first time in the project, I thought I had bitten off more than I could chew.

At several points along the way I fought with the issue of who would apply the color coats. I tried my hand at a few panels and decided that my skills—still nearer along the spectrum to "hack" than "pro"—wouldn't cut it. And so, my helper since the beginning of the project, Jim Johnson (now my father-in-law), helped me load the Pulsar into a 24-foot-long moving van for a trip out to Chino, California, for the final paint. It was a great ego-booster to see the airplane loaded into the van, knowing that I would have very little more sanding, priming, sanding, and priming to do. (In truth, the canopy frame wasn't ready for primer at my self-imposed paint deadline; it would have to wait.)

Jim Hatfield, of Corona Aero Refinishers in Chino, had painted the American Yankee belonging to Bill Marvel (see "American Aviation AA1: Yankee Ingenue," April 1993 *Pilot*) and had earned Marvel's recommendation. (Having become friends with Marvel, I knew that this was not an endorsement to be taken lightly.) Hatfield spent five days with the airplane, applying four coats of DuPont Chroma One acrylic urethane. He delivered the finished product exactly on time and on budget. This would be the only time my Pulsar would earn that distinction.

Upon rolling the Pulsar back out of the moving van, great relief swept over Jim and me. The hardest, most demanding part of the project had been completed. The results were excellent. Somehow the Pulsar looked far more finished and ready to fly in its all-white base coat than it had in bleak gray primer.

Next on the list came the installation of the instruments and electrical system. This is one area in which homebuilts differ greatly. Some have pristine electrical systems that would look at home in a turboprop, while others contain wires strewn about the airframe, conduits seemingly woven by a drunken spider. Since there's so much deviation in design and equipment level, the kit makers seldom offer hard-and-fast wiring rules and schematics. For the most part, the homebuilder is cast adrift.

So I was lucky to happen upon Bob Nuckolls' *The AeroElectric Connection*. It's a hefty reference work overflowing with excellent wiring suggestions, electrical theory, and some forward thinking on airplane electrics. I found it a refreshing and thought-provoking guide, one that helped me make some crucial decisions about wiring and wire placement, sizing conductors, and myriad other small items that I already know have paid off. (Indeed, about the only system to be totally trouble-free up to the first flight has been the electrical.) *The AeroElectric Connection* costs $42 from Medicine River Press, 6936 Bainbridge Road, Wichita, Kansas 67226; telephone 316/685-8617. Homebuilders—and owners of production-line airplanes as well—ought to consider this an important part of the reference library.

Finally, with the electrical system in place and working, and the powerplant reinstalled and its systems connected, we were ready to start the engine. With the usual level of head-scratching and double-checking that accompanies such an event, Jim and I filled the fuel tanks and the oil reservoir, confirmed that the coolant system was full, and, on a bright, sunny afternoon, decided to give it a go.

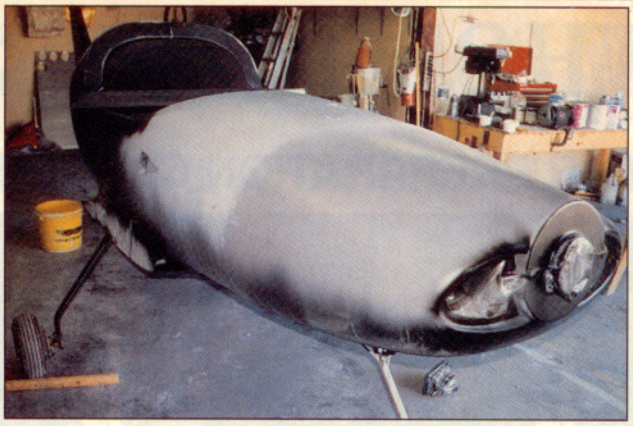
With little fanfare, the Rotax caught on the second blade and settled into a high, smooth idle. At first, however, the oil pressure was reluctant to come up, and I shut it down after only 20 seconds or so. We noticed that the oil reservoir had been depleted of its stock, so we added another quart and tried again. This time, the oil pressure came right up and the other vital fluids began to show a rise in temperature.

Over the course of an hour, we witnessed the oil level mysteriously falling, allowing the reservoir's suction tube to draw air. This results in a drop in oil pressure. Blindly, we kept adding oil, hoping that the lines were just getting wetted. But all the while, we wondered just how much oil this little 80-hp engine was going to consume. Finally we found out. Having run the engine up to about 3,000 rpm (that's below the runup speed for the 912) for a few minutes, we noticed the oil reservoir vent pumping great torrents of hot, foamy oil all over the ramp. Turns out the flexible return line under the engine had been kinked slightly, causing the oil to collect in the crankcase rather than being returned to the external reservoir. Without a scavenge pump, the 912 relies upon crankcase pressure to deliver the oil back to the firewall-mounted container. Apparently, enough oil had accumulated in the case and the pressure had risen sufficiently to break through the restriction. Then, of course, four quarts of oil tried to occupy a three-quart reservoir with predictable results.

The oil system finally debugged, we set about correcting the many small fluid leaks that seem inevitable in a new installation. Finally, with all the major pieces in place and tentatively proven—at least the rigging looked good and the engine wasn't leaking, spewing, or threatening to immolate any part of the airframe—it was time to begin taxi tests.

Choosing a flight-test program—yes, that includes the taxi portions—can be daunting. As a guide, all builders should read Advisory Circular 90-89, "Amateur-built Aircraft Flight Testing Handbook." It's an astonishingly useful text on flight testing, one that covers all the bases and does so in a concise and straightforward fashion. I'd probably read the AC a dozen times before the Pulsar ever rolled under its own power.

It's when the airplane is ready to taxi under its own thrust that you begin to feel



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Three different primers are represented (above) before the gray-all-over airplane gets loaded to go to the painter (below). Finally, the Pulsar returns home with several coats of base white (bottom).

the payback for years of effort. I started with low-speed work, meandering around the ramp, seating the brake pads and getting used to the toe brakes. (These were a real unknown at the outset of the project. I was pleased to learn that my self-designed toe-brake system worked better than I had hoped. Score one for the shade-tree engineer.)

Eventually, I graduated to the large Long Beach Airport taxiways and, ultimately, to one of the runways itself. (Here's a hint for those of you locked into a large airport for taxi tests: Pick a day with IFR weather. I had pretty much the run of the taxiways and one of Long Beach's runways while the field was below VFR minimums. At one point, it became clear that the tower personnel were happy to have something to do.) Without an airworthiness certificate, I didn't dare perform any ground hops, and so the high-speed taxi tests were done with great care not to reach or exceed rotation speed. During these tests, I found massive airspeed-indicator errors, later traced to static ports that were not properly flush with the fuselage skin. Also, I discovered that the brake pads, which had sat unused on the wheels for nearly two years, began chunking into little pieces. I was none too thrilled to have to reline the brakes after just a few hours' time in service.

A few weeks of chasing after small problems and unfinished items predating the paint job left the airplane ready for inspection. There is also the issue of paperwork, of course, but AC 20-27D "Certification and Operation of Amateur-build Aircraft" covers the topic in detail. Jim and I loaded the Pulsar into a moving van for one last ground-bound journey to Chino, my chosen airport for the flight test. Long Beach was out, thanks to FAA prohibitions on flight tests over densely populated areas. I occasionally grumbled about the odd MD-11 or C-17 making maiden flights out of the same airport, nonetheless.

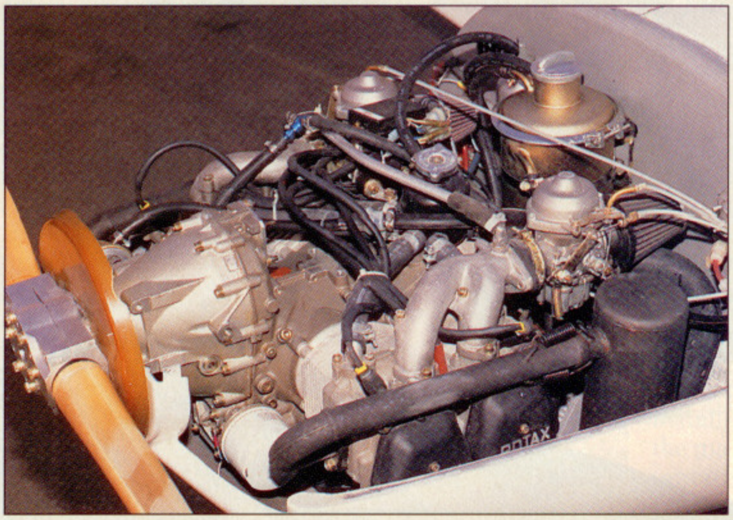
How refreshing it was then to meet with Chino Airport Manager Glen Porter, who openly welcomed an experimental airplane embarking upon its flight test. He opined that many of the experimentals on the field had come in for the flight test and their owners elected to keep them there afterward. I can see why. Chino is bristling with activity and carries an almost magical combination of vitality and relaxed, do-what-you-want atmosphere.

It's when the airplane is ready to taxi under its own thrust that you begin to feel the payback for years of effort.

Earlier in the project I called on Don Barber, an FAA designated airworthiness representative for the Riverside FSDO. He guided me through his expectations, both in what he wanted to see in the airplane and with regard to paperwork. We met in Chino; and after a fairly thorough inspection and a careful combing of the paperwork, he handed me a small pink card: the Special Airworthiness Certificate. With it came a two-page addendum outlining the flight-test area and duration (40 flight hours), as well as other operating limitations. With a warm handshake and kind words about the quality of the airplane, Barber left me to contemplate the next, biggest step in the whole project—first flight.

As has happened so many times in the construction of the Pulsar, I stood back and gazed over the graceful little airplane, my eyes following along its slender snout—dubbed a "dog nose" by my wife. Only this time—the first time—the Pulsar seemed to be imploring me to roll it out of the hangar and put it into the sky.

Soon enough, my friend. □



After final installation of the Rotax 912 comes the time to start it up and commence the ground tests.