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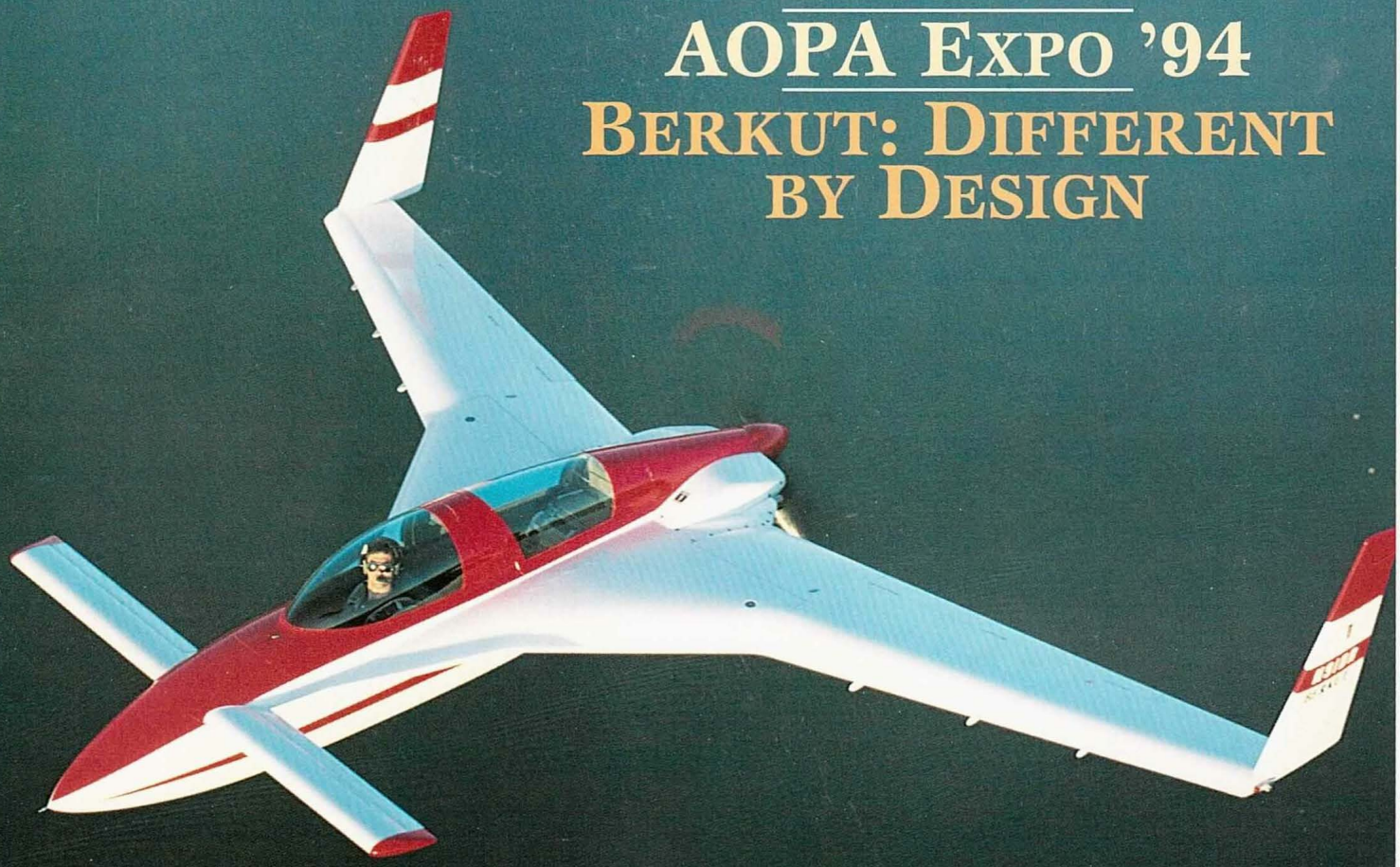
BERKUT: DIFFERENT BY DESIGN



EZ DOES IT

Rutan Long-EZ

BY MARC E. COOK

TO say that Burt Rutan has been influential in matters of aircraft design vastly understates the case. From reexamining the precepts of aeronautical design to blazing a new construction trail, Rutan has shifted the axis of the entire homebuilt universe. ■ His designs, including the Varieze and Long-EZ, have been among the most popular of all homebuilts. Among the myriad ways these designs depart the norm, two are perhaps the most significant: the canard and the method of moldless fiberglass construction. A canard airplane is designed to be unstallable, with the forward lifting surface intended to stall before the main wing does. In this sense, Rutan played on the virtues of safety, but there are other benefits. A conventional tail balances the airplane by opposing the wing's lift; in the canard, all surfaces combine to provide lift. This, together with light weight and the reduced frontal area of tandem seating, makes the Long-EZ quick for the power. ■ And by instigating new construction methods, Rutan forever broke the mold of the typical homebuilt being a tube-and-fabric or familiar aluminum construct. Acceptance of current composite airplanes is in some ways due to the strides made by Rutan and his far-flung band of builders. ■ Rutan, ever the prolific

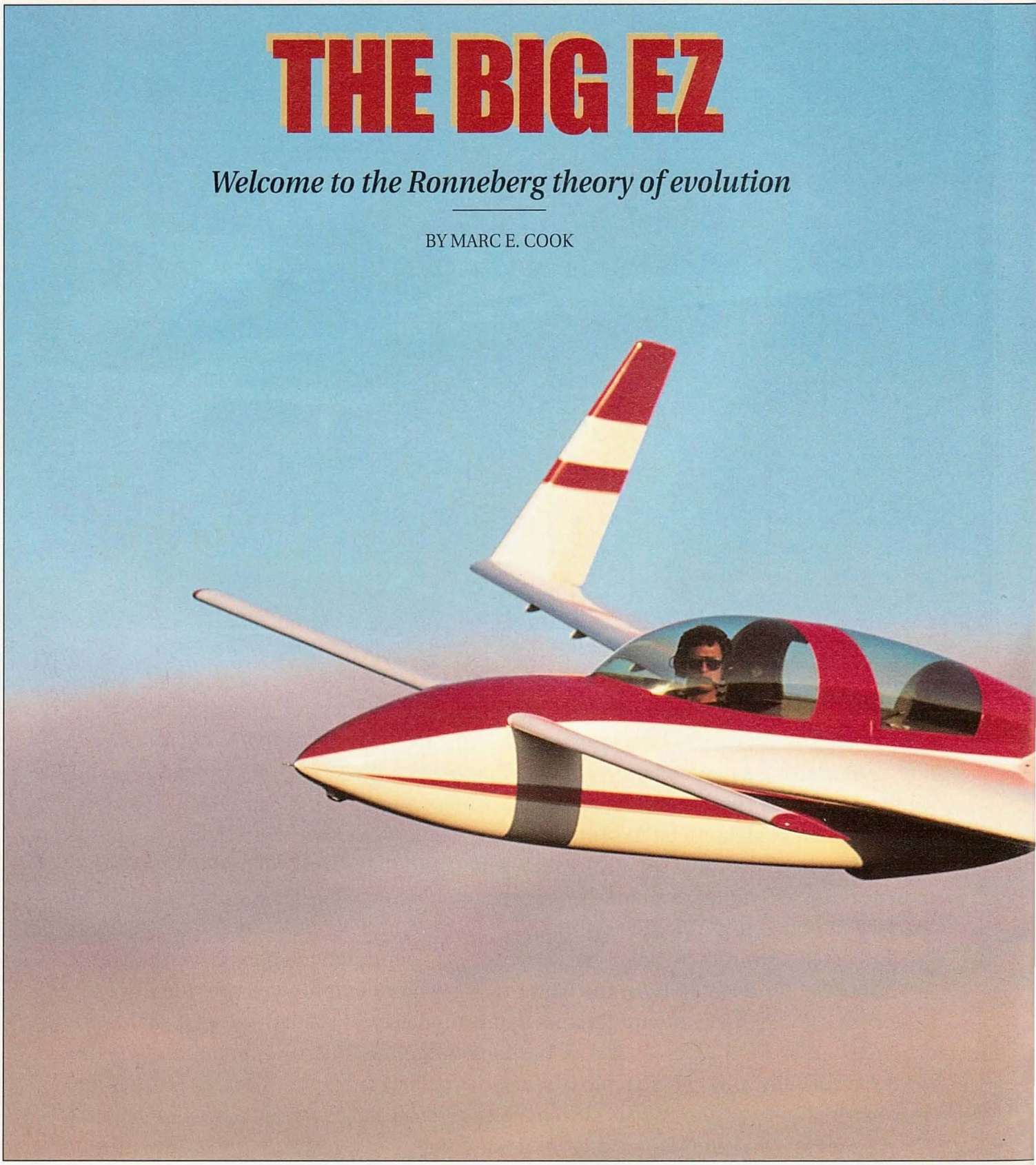
PHOTOGRAPH BY ART DAVIS

designer, has concocted other, more unusual steeds in recent years, from a cannon-wielding attack jet to bush models to corporate transports; one, the Beech Starship, even made it into series production. And that's to say nothing of the daring round-the-world *Voyager*. ■ But the world of the homebuilder has been without Rutan's direct influence for more than a decade, since the

THE BIG EZ

Welcome to the Ronneberg theory of evolution

BY MARC E. COOK



Rutan Aircraft Factory ceased selling plans. This, thanks to liability concerns and Rutan's desire to embark upon new projects. Into the void have stepped a number of new and derivative designs, some remaining quite true to the Long-EZ ideal with others landing far afield, in concept and execution. ■ If imitation is indeed the sincerest form of flattery, Rutan ought to be beaming.

Appearances, sometimes, are deceiving. Given its tandem seating and general Long-EZ-lookalike ramp presence, the Berkut is nonetheless a most radical departure from the Rutan mold. From the shape of the nose to the fully retractable, hydraulically operated gear, the Berkut departs from EZ convention at nearly every turn. Dave Ronneberg, constructor of eight Long-EZs and the Berkut's penman, likes to think of the Berkut as the kind of airplane Burt Rutan himself would have evolved from the long-lasting EZ. Ronneberg's company, Experimental Aviation, in Santa Monica, California, sells the kits.

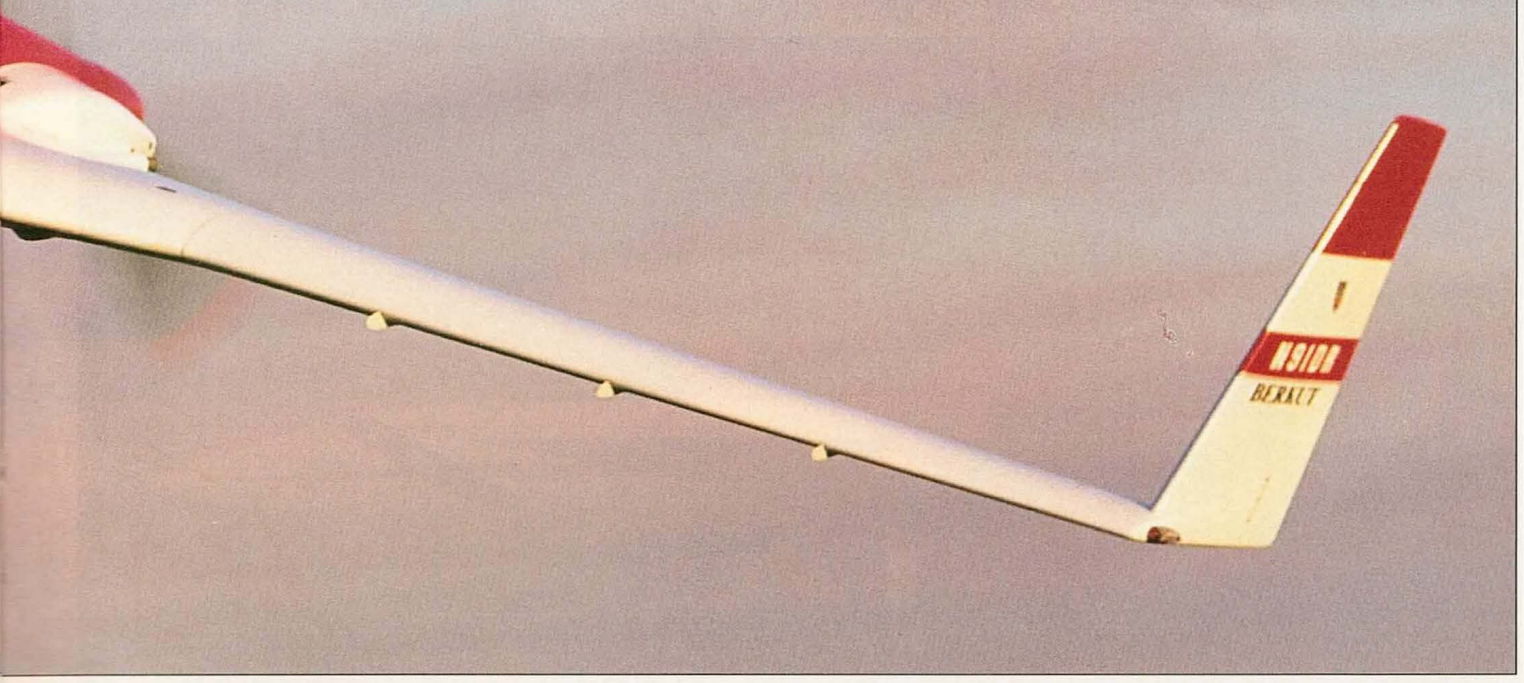
Ronneberg's changes touch virtually every part of the Berkut, so much so that there's hardly a piece that could fit on a plans-built EZ. Ronneberg stretched and widened the fuselage, giving the shape a new nose and radically altered canopy. Hinged at the rear like frontline jet fighters, the Berkut's twin canopies offer a fabulous view from the front, and an adequate one from behind. Moreover, the shape of the inboard strakes differs from EZ practice and you'll notice the Berkut's ailerons have greater span than a typical Long's. Finally, at the power end of the airplane, there's a tweaked, parallel-valve IO-360 Lycoming capable of 205 horsepower through a 9.7:1 compression ratio, electronic ignition (with a magneto backup), and a number of other speed tricks. That's a more stout powerplant than your typical EZ carries around.

That engine, along with the retractable gear, gives the Berkut excellent go potential. We noted a true airspeed of 207 knots at 2,840 engine rpm and 8,000 feet in slightly above-standard conditions. At a more sedate 2,700 rpm, the Berkut still turned in 195 knots, obtained at about a 2-inch reduction in available manifold pressure. All of which is kind of amazing considering that the Berkut's graphite-wrapped, wood-core fixed prop carries more pitch than a room full of salesmen.

Such a radically cruise-oriented prop doesn't hurt climb performance much, largely because at 2,000 pounds maximum gross weight, the airplane isn't carrying around much heft for the power. Initial rate of climb of better than 1,500 fpm is possible with two aboard and a higher-than-optimum airspeed. Solo, the Berkut can maintain about 2,000 fpm at nearly 120 knots indicated.

When it's time to come down, the Berkut obliges, with added drag from a belly speed brake and no-speed-limits gear activation. (Other kit manufacturers take note.) With a mild power reduction, the Berkut will head earthward

BERKUT PHOTOGRAPHY BY MIKE FIZER



with ear-popping swiftness.

In almost every respect the Berkut's handling is superb. Pitch forces are well moderated and the stick-force-per-G gradient is such that pulling hard enough on the airplane to break it would also likely result in pulled muscles. (To watch Rick Fessenden's lovely high-G aerobatic routine makes one think he's got a gorilla's forearms.) Yaw stability is excellent, with no perceptible adverse yaw.

Roll control is the big surprise. Normal Long-EZs have relatively conventional roll performance, with a fairly leisurely rate. Forget all that. In the Berkut, roll rate is fast and effort very low. In fact, for the first few minutes in the airplane, it's the average pilot's tendency to overcontrol, appearing at the helm more like Keenan Wynn than Chuck Yeager. After a time, the forces become familiar, but even so much as checking a chart enroute requires a substantial degree of effort to keep the wings level. A single-axis autopilot—which the factory Berkut has installed but was not working at the time of our flight—ought to be mandatory equipment for the cross-country traveler.

Indeed, handling the long haul proves one of the Berkut's finest traits. With a fairly roomy front cockpit and an adequately large rear station, two can make

vacation plans come true without having to leave *everything* behind. Unfortunately, baggage must be consigned to the cutouts in the strakes next to the backseater.

Limited baggage space hearkens to the Long-EZ roots, but not much else of the Berkut's construction does. In typical EZ fashion, the wings, canards, and vertical stabilizers are made up of foam-core composites. Still, the Berkut uses carbon skins on the wings and strakes, and carbon spar caps on the main wing and canard; the high-tech composite is also used in the cowling and canopy frames. One nice touch: The Berkut kit contains the foam cores cut to approximate shape, saving a great deal of time. The fuselage is also a radical change from the Rutan methods. It's molded in halves out of wet-layup fiberglass that's vacuum bagged and oven cured to, as one company wag says, a golden brown. All of the carbon fiber results in an amazingly stiff airplane, especially so in the wing structure. It's immediately evident upon encountering turbulence. Where most Long-EZs flex in the bumps, the tips of

the Berkut's wings hardly quiver.

That Ronneberg sweated the structural details is fine, but what probably pays the greatest dividends is his attention to style. From the armpit air intakes to the graceful nose, the Berkut seems to evoke a kind of slender menace that, to this eye, the basic Long-EZ lacks. Experimental sells the kit components for $29,490; you get to add an engine and propeller, paint, interior, and avionics. Estimated build time is 1,500 hours. □

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CANARD FOR FOUR

Four seats for the Rutan faithful

BY MARC E. COOK

In automobile restoration circles, there are two diverse character types. You'll find those who undertake refurbishing with an eye toward replacing the old with the new where it is not obvious, like hiding a CD changer in the trunk of a '38 Ford. And then there are erstwhile souls who will search hither and yon for the absolute, correct door handle. They'll scarcely stop short of carbon dating to determine the appropriateness of the piece.

So, too, does this dichotomy exist in kit aircraft. Despite evidence that suggests otherwise, Nat Puffer, head of Co-Z Development Corporation, fits firmly in the latter category. You see, though the Cozy Mark IV is quite obviously heftier—wider, especially—than a Long-EZ, it remains remarkably close in spirit and execution to the Rutan design. Ask Puffer about fully retractable gear or mega-horsepower engines for the Cozy, and he'll shake his head and say emphatically, "No way. That's just not part of the design. We'll never do that."

Puffer makes a big deal (and rightly so) about his licensing agreement with Rutan and the now-defunct Rutan Aircraft Factory, which discontinued selling plans for the Long-EZ in 1983. According to Puffer, he entered into the agreement after Rutan took on too many projects to be interested in selling plans for a side-by-side Long-EZ. Even though Rutan has tried to cancel the agreement, Puffer continues to send royalty checks for each set of plans sold. By January 1984, Puffer had completed the plans for the original Cozy, a three-place model. Further expansion of the fuselage—still mated to Long-EZ wings and canard—resulted in the Mark IV, which first flew in 1988.

When looking at the Cozy Mark IV today, the EZ heritage is plain to see. Fixed main gear remains, as does the hand-cranked retractable nose gear. Find one tied down for the night, and you'll witness the classic nose-down, "grazing" parking stance. Inside, the shoulder-to-shoulder seating gives up some squirm room over a standard Long-EZ. Even though the cabin width is listed as 42 inches, the three consoles (two for the sidesticks, and one in the center for engine controls) steal some hip room. In back, two full-size adults will find the IV, well, quite cozy. Better to call it a parents-and-kids conveyance, or a two-placer with generous baggage capacity.

Thanks to a 180-horsepower Lycoming

COZY PHOTOGRAPHY BY MIKE FIZER


N14CZ

churning away behind the back seats, the Cozy is a performer. Claimed maximum cruise nets 192 knots on about 10.5 gph; fuel capacity is 52 gallons, so endurance should be quite good. Listed max climb performance is 1,200 fpm at the maximum gross weight of 2,050 pounds; estimated empty weight is 1,050 pounds. Our time with the Cozy included some significantly bumpy air, so speed checks were not very reliable—but the airplane did acquit itself well on the climb out from a 1,300-foot-elevation airport, showing better than 1,500 fpm with about 330 pounds of humans in the cabin and brimming fuel tanks.

As is typical of the EZ, the Cozy's handling is a mix of the unusual and the benign. Control harmony is good, with pitch significantly heavier than roll or yaw. It's difficult to pull excessive G loads given the stick force gradient of the Cozy; lightning-strike concerns aside, it ought to make a fine instrument platform.

Stalls aren't, really; the nose bobs as the canard stalls and the airplane sinks moderately. Some canard designs have experienced difficulty in maintaining Rutan's rule of thumb that the canard stalls well before the main wing. An aft center of gravity can unload the canard to the point that the airplane may reach a sufficiently high angle of attack to stall the main wing. Concerned with this, Puffer cut up the interior of his lovely Cozy and fitted a movable ballast to simulate various loadings. After extensive flight testing, he decided to lop a total of 6 inches from the canard span, guaranteeing that under reasonable loadings the canard will stall first. On the down side, this adds slightly to takeoff and landing speeds.

Even so, the Cozy can be ridden down final at 80 knots without drama. With the belly mounted speed brake deployed, the glide angle is steep enough to make conventional approaches. Without it, only a very flat approach is possible.

Puffer sells plans only for the Cozy, for $500. He estimates that you can build the airframe for about $14,000 in parts and materials. If you shop carefully, the 2,500-hour project could set you back as little as $25,000. Which, these days, is probably cheaper than restoring a '38 Ford. The Cozy will fly better, too. □

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BUILT FOR SPEED

An EZ alternative for the powerplant tinkerer

BY MARC E. COOK

Aldous Huxley once opined that "Speed, it seems to me, provides the one genuinely modern pleasure." In that sense, and that sense alone, Huxley and E-Racer creator Shirl Dickey appear cut from the same cloth. At first glance, Dickey's Rutan-inspired two-seater seems little more than a side-by-side Long-EZ knockoff, an expedient way to design an airplane on someone else's homework.

But that's not the whole of the story. Instead, the E-Racer began with Dickey's quest for speed. He'd already built a Long EZ, but soon began to feel the need for additional alacrity. As a complication, there is a limit to the amount of extra thrust and weight that may be fitted to an EZ without clanging against airframe limitations.

Taking the situation into his own hands, Dickey crafted a new fuselage that mostly resembles the tandem-seat Long EZ, but which carries two abreast in a 42-inch-wide cabin. Placing both humans together freed up room behind, which Dickey promptly filled with a highly modified Buick V-8 engine. Turning a 1.75:1 gear reduction drive, the liquid-cooled, all-aluminum 298-cubic-inch engine makes an estimated 240 horsepower at 5,000 rpm. Dickey prefers to keep a conservative maximum of 4,000 rpm for cruise, yielding 191 knots true at optimum altitude on about 12 gallons per hour.

A conventional aircraft powerplant also may be fitted to the plans-built E-Racer. The MK-II model (the V-8 version is the MK-I) will house a Lycoming O-320 of 160 hp, although larger engines can be made to fit. One advantage of using a conventional flat engine is greatly improved baggage space. What's more, Dickey is willing to listen to builders who would like to try other aviation and auto-converted engines. That's an unusual stance for a plans producer, and it represents something of the E-Racer's niche—to be a willing partner to a trailblazing homebuilder's imagination.

Departing the EZ norm in other ways, the E-Racer employs fully retractable gear with main legs crafted from carbon fiber. In Dickey's airplane, they are lifted with a lever-operated hydraulic pump. E-Racer main spars have heftier caps and shear webbing, giving a claimed 25-percent increase in wing stiffness; the trailing edge, unlike that of the EZ, is straight from tip to cowling. In addition, the vertical stabilizers are flush with the leading edge of the main wing, not set back as they are on the Rutan birds. Otherwise, the main wing is identical to an EZ's, and the exposed area of the Roncz canard is likewise the same.

Even at the higher 1,800-pound maximum weight (the EZ was 1,325 pounds) the E-Racer is an energetic performer. As is typical of canard pushers with fixed-pitch props, the initial runway acceleration isn't neck-snapping (especially so at the 5,042-foot elevation of Prescott, Arizona's Love Field, where we flew the E). Once off and climbing at about 105 knots, the E-Racer begins to scoot, showing better than 1,500

fpm in admittedly choppy, uneven air. Claimed rate of ascent is 2,500 fpm.

Aside from the unusual movements required by the center-stick-shod, motorcycle-style throttle, the E-Racer feels much like a heavy Long EZ. Control harmony is good, being heavier in pitch than in roll, and the airplane shrugs off turbulence well.

Right now, the E-Racer plans cost $250. For the same price, there's also the King Racer version, which has a longer cabin and a 2-inch-wider fuselage. You can buy many of the components—from the landing gear legs to whole wing assemblies—prefabricated, from a booming EZ-support cottage industry. Estimated construction costs are hard to pin down, given the bewildering array of options; expected build time is pegged at 1,500 to 2,000 hours. Which is to say that the E-Racer is one genuinely modern pleasure in reach of the enterprising builder. □

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BIGGER CAN BE BETTER

Speed and luxury all in one

BY MARK R. TWOMBLY

The Velocity was born in the imagination of Dan Maher, a free-thinking Florida boat builder. Maher built a Rutan Long-EZ using many of his boat-building materials and construction techniques—wet-layup fiberglass skins wrapped around styrofoam cores. Not satisfied that a tandem-seat, plans-built design met every airplane builders' needs, he created lofted drawings of his EZ to use as a template for designing a larger, four-place version—the Velocity.

Maher first presented his creation in 1986 at Sun 'n Fun, and

VELOCITY PHOTOGRAPHY BY WINSTON LUZIER

The roomy interior provides lots of space for an uncluttered panel. This is a different aircraft than the one flown, but is typical.

it created a stir. The new design was notable not so much for its velocity as its felicity: It looked very cool. With its tadpole body, stylish windows, and unconventional aerodynamic configuration, it appeared to be a successful cross-pollenization of a late-1940s Hudson Hornet and a George Lucas space-movie speedster.

Nouveau appearance notwithstanding, the most appealing feature of the airplane is its interior. Those swept, dark-tinted windows admit subdued light into a classy, European-car-like cabin. The feeling is altogether different from a production aircraft.

Typical empty weight of a Velocity Model 173, the latest and most popular version to be offered, is 1,275 to 1,300 pounds. Gross weight is 2,400 pounds. Two 30-gallon wing tanks supply a 6-gallon header tank, which feeds the engine. Thus there are no Left or Right fuel selector positions.

Taxiing is a little different because of the castering nosewheel and an unusual braking system: You push on a rudder pedal to deflect the corresponding rudder, then push harder to brake.

In climb and cruise the Velocity performs well. With two aboard the company's 173 fixed-gear demonstrator and about 35 gallons of fuel, we climbed out at 1,000 to 1,200 fpm at 110 KIAS. Though originally designed for 180 hp, a 200-hp Lycoming now appears to be the standard. A cruise check at 6,500 feet msl yielded 150 KIAS at 2,650 rpm and 10.5 gph. Count on about 15 knots more if the gear retracts.

The airplane is surprisingly stable in pitch and roll, and is best flown with thumb and forefinger. Electric pitch trim moves a spring that biases the stick. The wingtip-mounted rudders deflect outward only, but it seems to make no difference in yaw control. In fact, the airplane will make coordinated turns without the use of rudders.

Landings are the biggest challenge. Deploying the electrically actuated speed brake, a flap on the airplane's belly, is the only effective way to slow the Velocity down. Approach speeds are relatively high—we used 100 knots on downwind, 90 on base, 80 on final, and looked for 70 at touchdown—and the attitude is increasingly nose high as speed decays. Full-stall landings are not recommended because the nose will plunk down first—and hard. Precise speed control is the name of the Velocity's landing game.

The Velocity has gone through some maturation. The additional weight in the rear, plus variations in building technique, led to a serious problem. It was discovered that the airplane could enter an unrecoverable flat-attitude descent following a deep stall. The problem was solved by increasing the wing chord and moving the aft center of gravity limit forward three-quarters of an inch. Also, the aft fuel baffle was moved forward two inches. The changes are incorporated in the Model 173.

The changes made for a heavier, slower Velocity, with 65 gallons of fuel capacity instead of the original 73, but it is now a more docile and thus safer airplane.

Also, Maher has sold the company to Duane and Scott Swing, a father and son team that built two Velocities and in the process designed a gear retraction mechanism that has become popular with builders.

The Swings are in full swing at Velocity's Sebastian, Florida, factory. At the time of our visit last spring more than 200 Velocity kits had been sold and some 40 builder airplanes were flying. Kits are priced at $21,000 for a standard fixed-gear model and $22,000 for the 173; add $4,000 for the retractable gear option. You can buy everything it takes to build a complete airplane, including engine, interior, instruments, and prop, for about $42,500 for the fixed-gear standard version or approximately $47,500 for a retractable 173. □

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