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Birth of a Kitplane: Dave Ronneberg's

BERKUT

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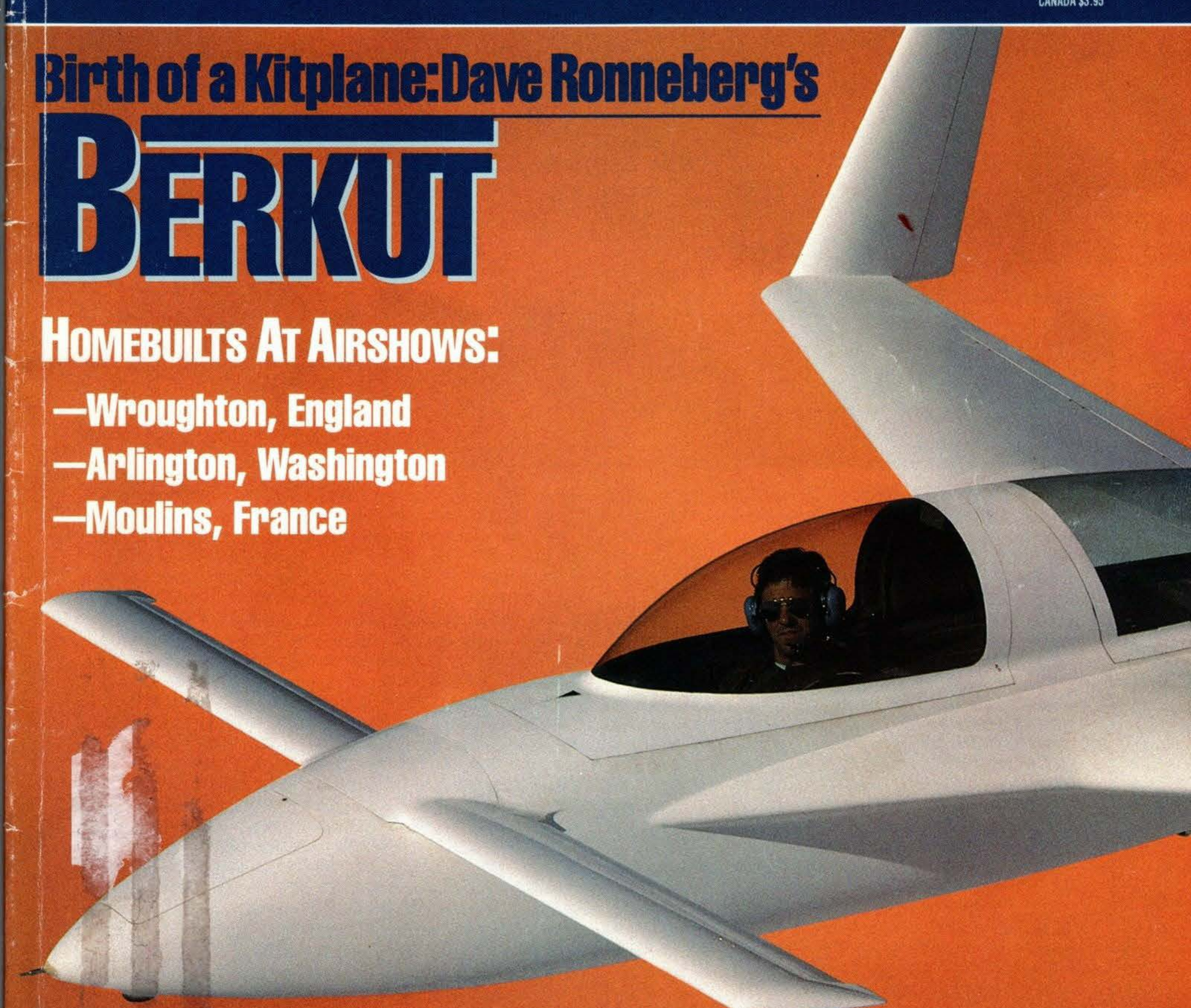

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PART 1

BIRTH OF AN EAGLE

At first glance it may look like a Long-EZ, but the canard Berkut is an all-new design.

BY RICHARD RILEY AND PAUL BARNES

Fifty feet off the wing of our Piper Archer, a pair of canard pushers fly in tight formation for a photo session. One is a garden variety Long-EZ; the other is a new plane, still in primer and minus upholstery. This plane, which bears more than a passing resemblance to the Long-EZ next to it, is the Berkut, designed and built by Dave Ronneberg of Santa Monica, California. Ronneberg is about to do something with the Berkut that will make Long-EZ pilots green with envy.

He calls "Gear up!" over the radio, then flips a switch on the panel. All three gear legs pivot smoothly and disappear into the fuselage. All of a sudden, the formation opens up. Without a change in power, the Berkut has picked up about 20 knots. The Long-EZ pilot shoves the throttle forward and pulls away from us at 190 mph. Ronneberg does the same in the Berkut, but he pulls away at 235 mph.

Before we go any further, here's the answer to the most-asked question about the plane: The name "Berkut" was inspired by a type of eagle that is bred and trained for hunting wolves by the nomadic Kirghizian horsemen of central Asia. "The berkut eagle weighs only 10 pounds," says Ronneberg, "but its claws have more than a ton of binding force—a blow from its wing can break a man's arm."

Built at Santa Monica's Clover Field (where the legendary Douglas DC-3 was born), the Berkut, says Ronneberg, "is as powerful and responsive as its namesake."

Hyperbole aside, the Berkut truly is an extraordinary plane. It is the prototype of what Ronneberg considers the logical next step in the evolution of Burt Rutan's classic Vari-Eze and Long-EZ canard designs. It's larger and faster than a Long-EZ, it has retractable gear, and it is constructed of pre-molded carbon-fiber components. If all goes as planned, Ronneberg and his company, Experimental Aviation, hope to begin producing Berkut kits sometime in 1992.

Improving a Good Idea

Berkut designer Dave Ronneberg is an experienced builder. By 1985, he had participated in building a Starduster II, several Pitts, a Mong Sport and a Stearman, and he had personally built a Lancair and seven Long-EZs. While working for Burt Rutan, he was also involved in constructing parts for the round-the-world *Voyager*.

"By the time I was on my third Long-EZ, I realized it was too small," Ronneberg says. "Furthermore, the construction technique required that I effectively originate a new pattern for every plane I built. I thought I should be able to do that just once on a plug that I could make molds from—then I wouldn't have to duplicate so much effort. I began to see that there was a lot of potential for change in the design. I thought about a larger canopy and a longer, wider fuselage with some elbow room."

At about that time, Los Angeles businessman/pilot Don Murphy approached Ronneberg about building an airplane. "As we talked," said Murphy, "all Dave's ideas for modifying the Long-EZ came pouring out. The first was a larger fuselage...for both aesthetic and practical reasons."

Murphy, you see, is not a small man and was uncomfortable in a standard Long-EZ, especially in the narrow back seat. So Ronneberg pulled out some preliminary sketches he had made of a plane that had an extra 12 inches between the firewall and the front seat, was 3.5 inches wider and had 4 inches more headroom. Ronneberg readily acknowledges the relationship of the Berkut to the Long-EZ. "I basically started with the vertical lines of the Long-EZ and added all the changes I'd thought about over the years," he says.

An engineer with a large southern California aerospace firm offered to loft the design (during down-time on the same super-computer that was used to loft the Space Shuttle) and produce full-size templates of the fuselage and bulkheads. "We used those to make a full-size mockup of the fuselage, which we stored for several years while we continued talking about design changes and

PHOTOS: DAVE RONNEBERG AND CHUCK STEWART

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building methods," Ronneberg said.

In the meantime, the idea of building a single airplane for Murphy evolved into the idea of producing kits. "Burt Rutan was out of the business of selling Long-EZ plans," Ronneberg explained, "but there was—and still is—a lot of interest in the design, with unused plans and unfinished projects being sold all the time."

Work on the Berkut began in earnest two years ago. Ronneberg bought a set of the retractable landing gear Shirl Dickey designed for his side-by-side E-Racer (in carbon fiber rather than the original fiberglass). He also negotiated a deal to use the gear for future Berkut kits. Although the gear retract mechanism took up 6 inches of the 1-foot fuselage stretch, it left enough space to make the rear seat quite comfortable.

After studying the drawings, Peter Nachowski of Hercules/Magnamite Corp. was so impressed that he arranged for his firm to donate the raw carbon fiber to build the spars, wings, gear, strakes, cowlings, air brake and doors. Susan McGrath of J.B. Martin and Company arranged for Nachowski's donation to be woven into a strong (almost twice the tensile strength of fiberglass), lightweight (4.5 ounces per square yard), unidirectional cloth at cost.

The rest of the design evolved as the plane was built, including the installation of a Lycoming IO-360-B1A rebuilt by Dick Demars, featuring an electronic ignition and multi-

The shape of the Berkut was transferred from paper to reality via this fuselage plug. Still unfinished, it was used as the form for making the female molds.

ple-spark discharge unit provided by Klaus Savier's Light Speed Engineering. Uprated to produce 205 hp at 2700 rpm, the engine drives an unusually short and thick laminated carbon prop also built by Savier.

A number of estimated project completion dates came and went (standard procedure on every home-building project), but finally, with the help of a band of dedicated volunteers, the plane was ready for its first taxi tests last July. In fact, at the peak of the July 11 solar eclipse, a high-speed taxi run at Camarillo Airport turned into the Berkut's first flight. On the "official" first flight later that same day, the gear was cycled, and a climb rate of 2000 fpm and a cruise speed of 230 mph were achieved.

Some Design Specifics

While it's obvious that the Berkut was inspired by the Long-EZ, there

Designer/builder Dave Ronneberg (right) and a helper show off the Berkut fuselage and main spar. Hanging from the ceiling behind them is the finished fuselage plug.

The 58-pound fuselage is constructed of fiberglass/balsa wood sandwich. The half-inch-thick balsa core is visible through the two-ply fiberglass skin, giving it a distinctive parquet look.

are dozens of large and small differences between the two planes. Nonetheless, Ronneberg gives credit where it's due: Burt Rutan. "It's taken me 15 years of building to get to the point where I can do variations on the theme that Burt was done with a decade ago."

In addition to the larger fuselage and retractable gear, one of the most noticeable differences is the canopy. Where the Long-EZ has a one-piece, side-hinged canopy, the Berkut has a separate, rear-hinged canopy over each seat, *a la* the F-4 Phantom. In a Long-EZ, roll-protection is provided by a triangular device located on the back of the pilot's seat; in the Berkut, it is provided by a round, foot-long, carbon fiber/balsa-sandwich structure that doesn't block the view of someone flying from the rear seat.

Because of its high modulus and low weight, molded carbon fiber was also used to construct the canopy frames, both of which are secured with two cam-roller latches that can be locked and unlocked from the front seat only. If the throttle is advanced and the canopies are not locked down, MicroSwitch sensors sound a warning horn. Similar switches in the landing gear sound a horn when the throttle is pulled back to idle without the gear in the down and locked position.

The seats in the Berkut's surprisingly roomy cockpit are angled back 45° and fitted with a four-point harness system that makes you feel like you're wearing the airplane rather than just sitting in it. Wrap-around canopies provide 300° visibility. Forward visibility from the rear seat is good enough to enable a passenger to land the plane—using the throttle and sidestick (there are no rudder pedals or instruments in back).

The sidestick is mounted at the forward end of the right armrest and is equipped with a two-axis electric trim control. Throttle, mixture control and air brakes are located on the left side of the cockpit. Ronneberg put a lot of

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work into creating his own version of the military HOTAS (hands on throttle and stick) control stick, with switches for navcom frequency selection, push-to-talk and autopilot an integral part of the stick. The transponder is conveniently located so that it can be operated without removing the left hand from the throttle.

The Berkut is equipped with a transponder, loran, autopilot/electronic turn and bank, a full-vacuum gyro system, an integrated pitot/static system display from Rocky Mountain Instruments and a full complement of engine monitors from Lance Turk's Vision Microsystems, making for a very efficient instrument panel. Though not installed on the prototype, there is enough room in the rear cockpit to add an optional instrument panel.

There are minor innovations throughout the Berkut. Cylinder-cooling air scoops shaped like the intakes on an Air Force F-111 fighter-bomber are located at the bottom corners of the cowling. They are separated from the cowling by airflow separators that remove the slower boundary layer air that adheres to the surfaces. A third scoop, located on the bottom of the fuselage, feeds air to the intake plenum and directs airflow through the oil cooler.

These scoops have proved so effective during flight testing (cylinder-head and oil temps have not exceeded 300° and 180°F respectively) that Ronneberg wants to reduce their size and drag.

The Berkut's fuel sumps, two blisters on the bottom of the strakes on the standard Long-EZ, are housed in

The wing spar is constructed of eight-ply carbon fiber and foam formed over a solid wood mold. After the carbon-fiber C-channel is cured, the wood mold is removed and the spar caps added.

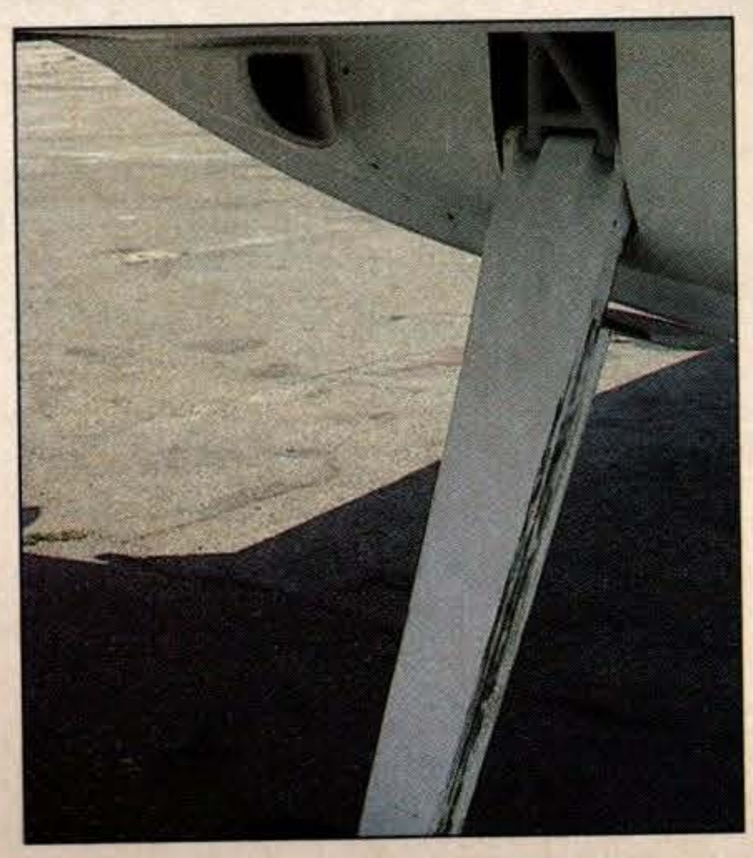
Ronneberg spent a lot of time rough-shaping the Berkut fuselage from inside the fiberglass female mold.

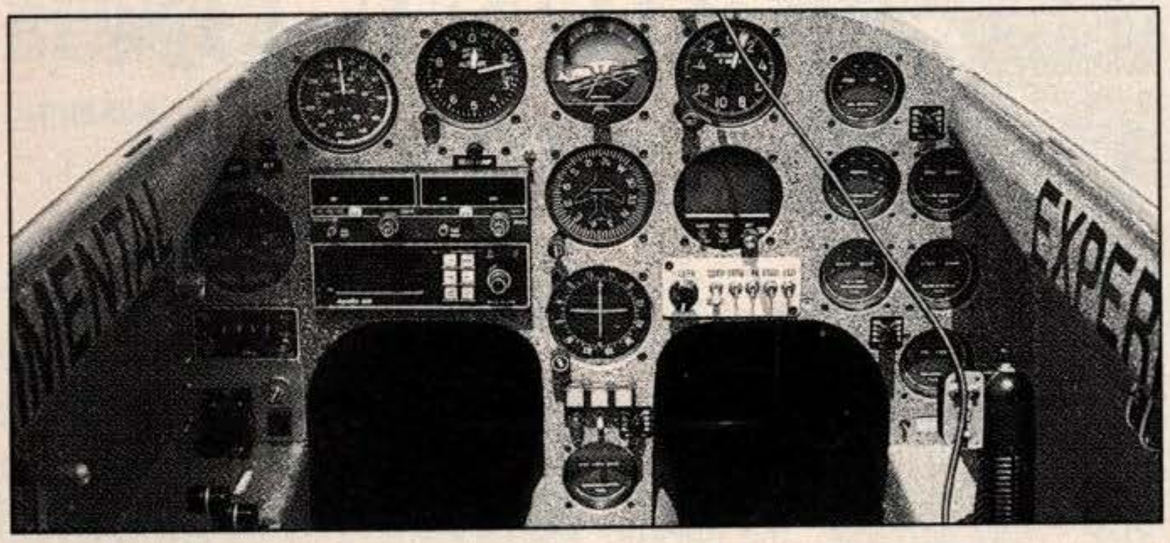
This photo was taken inside Ronneberg's Santa Monica hangar on May 5, 1991—the Berkut still looked like it had a long way to go. However, the plane was finished and made its first flight on July 11.

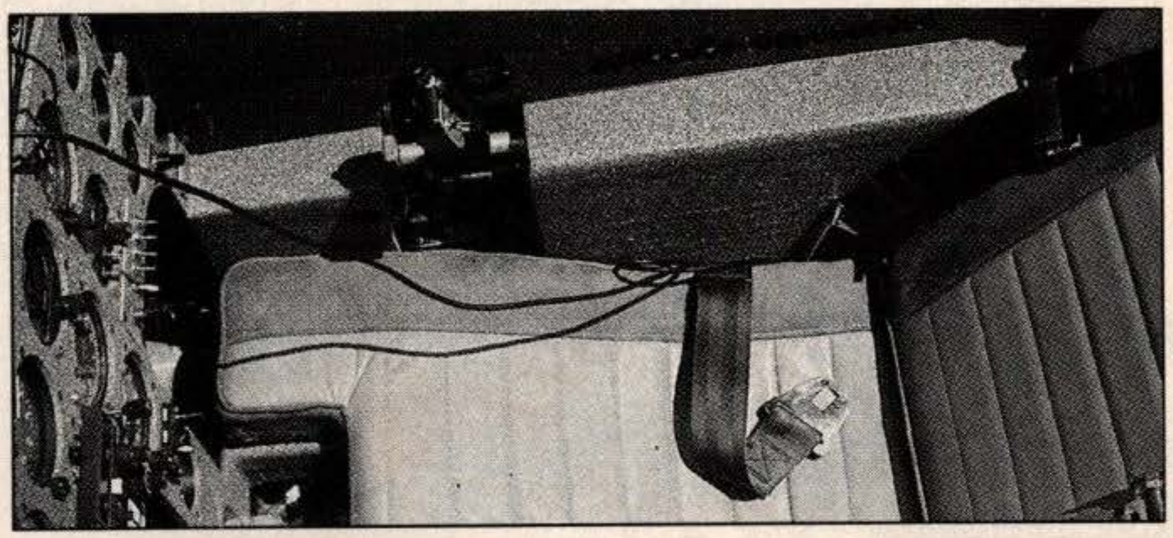
The Berkut's individual, rear-hinged canopies provide 300° visibility and are a major departure from the Rutan Long-EZ influence.

The Berkut's retractable main gear is built of carbon fiber and was purchased from Shirl Dickey, who designed the gear for his side-by-side E-Racer.

When retracted, the hydraulically activated main gear fits flush into the bottom of the wing/fuselage strake.







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the rear seat support. The sump uses a flop tube to allow for inverted flight (although the engine does not yet have an inverted oil system).

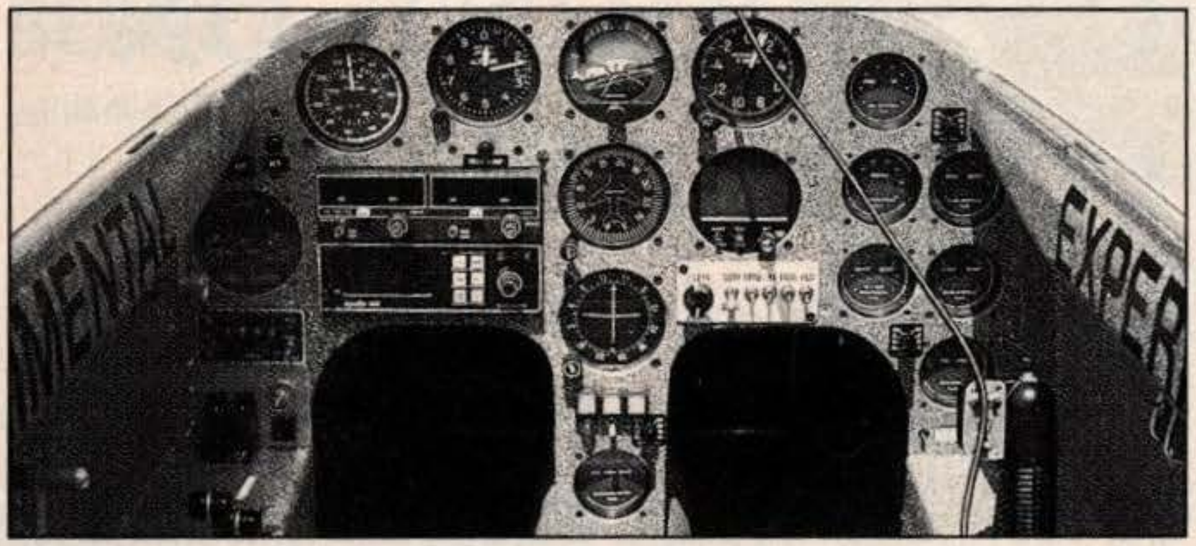
The Berkut's ailerons are 6 inches longer (at the outboard ends) and slightly wider in chord than the Long-EZ, giving it a roll rate of 190° per second, which is 55% faster than a standard EZ. The vertical winglets, which act as stabilizers and provide lift augmentation, are canted outward 4 inches at the top. They are fiberglass covered, allowing the loran and com antennas to be laminated into them. The lower winglets have been eliminated; likewise the external rudder horns. Instead, the horns and cables are built into the wing to reduce drag. This is a recent modification from Rutan that has only been used on a few Long-EZs.

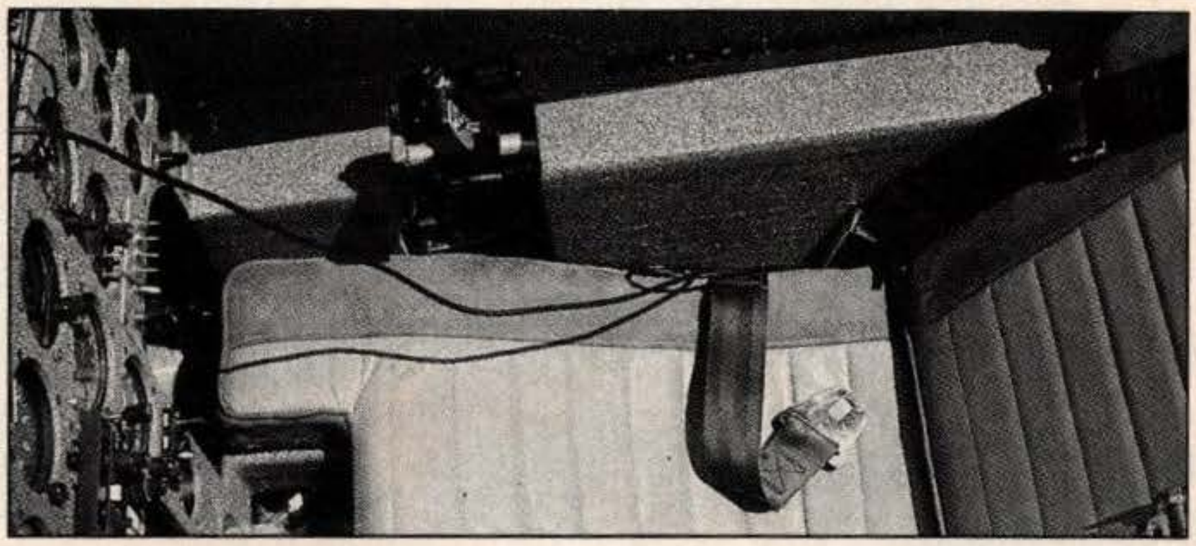
The strakes—the delta-shaped sections of the wing root where the fuel tanks and baggage storage space are—have a convex upper surface and, unlike flat Long-EZ strakes, provide extra lift. Although he is still waiting for wind tunnel test results to confirm it, Ronneberg suspects the Berkut's relatively low landing speed (several knots slower than a Long-EZ) is the result of lift created by the strakes.

The cockpit features a pitot/static system display from Rocky Mountain Instruments and engine monitors by Vision Microsystems. The sidestick has switches for trim control, navcom frequency selection and push-to-talk, and autopilot.

The Berkut fuselage is 12 inches longer, 3.5 inches wider and 4 inches higher than a Long-EZ, making it comfortable even for six-footers. Both seats are angled back 45° and fitted with four-point safety harnesses.

The canard is the same John Roncz-designed airfoil used on the Long-EZ, except that the lift tabs





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