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THE PILOT'S GUIDE TO OWNING AND FLYING PRIVATE AIRCRAFT

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EVOLUTION OF THE NEW BERKUT

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Berkut:

EVOLUTION OF AN EAGLE

Getting closer to the dream.

By Richard Riley   Photos by Chuck Stewart

"I want to fly faster than a Mooney on less money than a Taylorcraft. I want a stable, comfortable, cross-country airplane that's good for ±10G."

THE DREAM IS ALWAYS THE SAME: I'm in a clearing with about a dozen people in pale blue robes. I see the Wright Brothers. Amelia Earhart. Charles Lindbergh and Wiley Post. And Captain Eddie Rickenbacker staring intently at a German pilot in a leather jacket with a Blue Max around his neck. There's also a seagull shifting from foot to foot on the back of a chair.

In the center of the clearing, a fire is burning under a pot that bubbles and steams as a gnome stirs it with a propeller blade. I approach him.

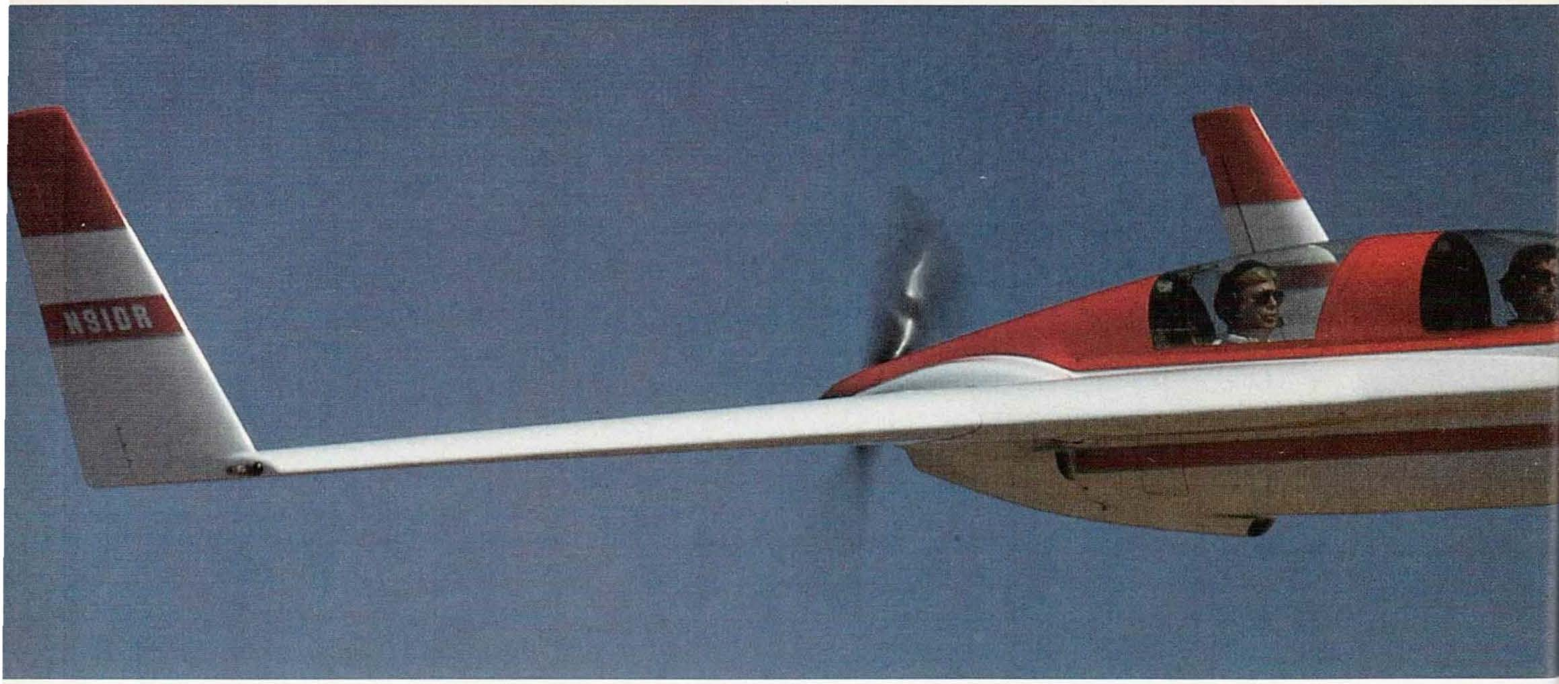
"What is your wish, my son?" he asks.

I take out my notebook and start reading.

"I want to fly faster than a Mooney on less money than a Taylorcraft. I want a stable, comfortable, cross-country airplane that's good for ±10G. I want to cruise at 207 knots, land at 60 without flaps and climb at 2000 fpm on a cruise prop. I want to carry two people and 300 pounds of baggage 1300 miles on 50 gallons of gas. I don't want to have to worry about things like stalling or spinning. I want the glide ratio of a Schweizer sailplane, but I want it to handle like an F-16 and look like the sexy airplanes I used to doodle in English class," I tell him.

Usually, he squints up at me and says, "Yeah, right. Come back when you have a sheep and a virgin." But this time, something strange happens. A blissful smile comes over his face, and he hands me a business card.

"Call Dave," he says. "Tell him I sent you."



Life was suddenly looking very, very good. Maybe this was the airplane of my dreams, after all.

DAVE TURNED OUT TO BE Dave Ronneberg, the designer and manufacturer of a remarkable new kitplane called Berkut. His voice on the telephone didn't sound otherworldly, so I made an appointment to look at his airplane. A few days later, I drove out to Santa Monica Airport, the field where Douglas built the venerable DC-3. In many ways, that's appropriate, because the Berkut is as much of a leap over a conventional Cessna as the DC-3 was over the Tri-Motor.

Before I go any farther, here's the story on the name Berkut, as explained by Ronneberg. "A berkut is a breed of eagle that lives in the Tiblisi Mountains of central Asia, in the republic of Kirgizia. They weigh about 12 pounds, are related to the Golden Eagle and are bred and trained by the native tribesmen to hunt and kill wolves."

Honest.

If you've ever seen one of the Rutan homebuilts, the Vari-Eze or the Long-EZ, you have a general idea of what the Berkut looks like. All-composite construction—in this case, a combination of carbon fiber cloth and fiberglass—makes for a structure that's round and smooth and free of rivets. With the engine in back, it has tremendous visibility. Its canard configuration puts a small wing with elevators in the front to provide a third of the lift for the Berkut. The ailerons are on the larger rear wing. A pair of winglets act as vertical stabilizers and, although you might not think so, act as lifting surfaces, improving span loading.

To some, the Berkut and its Rutan-designed predecessors look like flying pickle forks, but Rutan's basic canard design is a remarkably efficient arrangement. A Vari-Eze piloted by Klaus Savier won the Palm Springs-to-Chicago race a few months ago, flying nonstop on a Continental O-200 engine at better than 179 knots. I was so hooked on the design that I went out and bought myself a used Long-EZ. It easily does 156 knots on its 118-hp Lycoming 0-235. It regularly outruns business-class twins, and I get from Los Angeles to San Francisco in less than two hours for about $20.

Now think of a Long-EZ after massive doses of illegal steroids and about a year of heavy aerobics, and you get the general idea of what Berkut is like. Where the Long-EZ is a fairly cramped airplane on the inside, the Berkut is very comfortable. It has retractable gear, a 205-hp Lycoming IO-360-B1A engine and the performance of a flaming bat from hell.

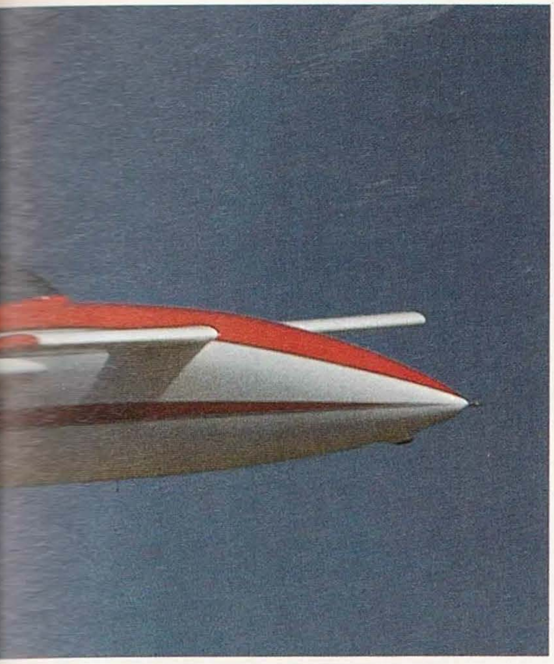
The airplane looks fast even sitting on the ground. The seats are tandem, like a fighter's, which keeps the frontal area small. As if the two canopies hinged at the rear and pivoting upward like an F-4 weren't enough, the red-and-white paint scheme catches more eyes than Madonna at a nude beach.

While I drooled on the high-aspect-ratio wing, Ronneberg filled me in on the background of the airplane. He had been a hired gun, helping owners with their homebuilts for several years, building a Mong Sport, a couple of Pitts Specials, a Lancair and seven Long-EZs when he first began to think about a new design. He realized that the Long-EZs were taking more than their share of time to build.

"The Long-EZ uses moldless construction, which makes it simple to come up with complex shapes, but it essentially requires you to originate a new pattern with every plane you build," he explained.

In 1985, he began making sketches of a new airplane, one that would keep the Long-EZ's flying characteristics while providing more room. He stretched the fuselage a foot forward of the firewall, increased the width by 3.5 inches and headroom by 4 inches.

Then he ran into Sam Kriedel, the head of Space Shuttle design for North American Rockwell. Kriedel liked the sketches and lofted them on a Cray super computer, giving Ronneberg



cross-sections and bulkhead shapes.

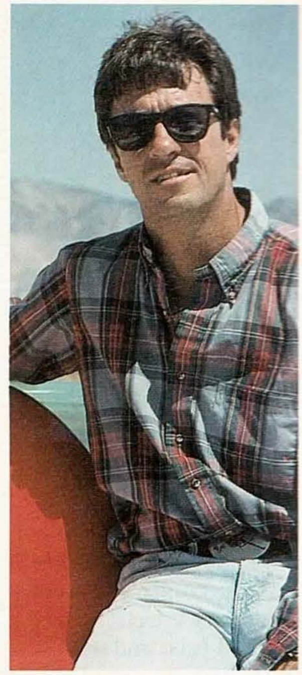
A couple of years later, a potential customer began talking with Ronneberg about what kind of modifications could be done to the Long-EZ to make it a better airplane, and Ronneberg pulled out the loftings. "We realized that if we were going to build this plane right, we should build a plug, take molds, then pull parts from the molds. It's more effort up front, but we quickly realized that there was a potential market out there for the kind of plane we were talking about. Molding would give the customer less construction time, more consistent, higher quality parts and a stronger, lighter airplane."

Without molding, one of the chief time-consumers was the finishing process. EZs demand a tremendous effort in repeated filling and sanding to convert the rough fiberglass exterior into something smooth enough to paint. With molding, most of the external surfaces require only minimal surface preparation before final painting.

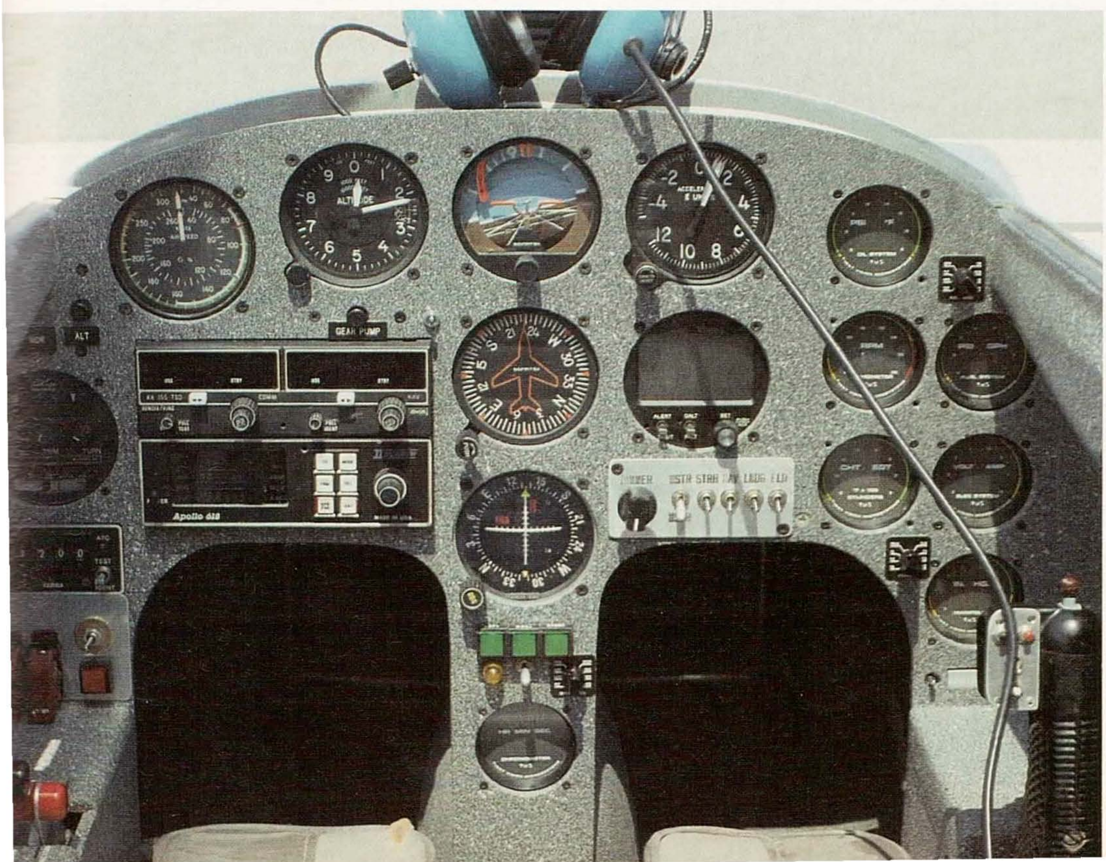
Work on the Berkut plug began in 1986 and was completed in short order. Then there was a hiatus of a couple of years while the financing was arranged. Construction of the tooling and then the prototype began in early 1989 and was completed 18 months later, in July, 1991. The airplane attended Oshkosh '91, still in primer, leaving Los Angeles for Wisconsin with 40.4 hours on the Hobbs meter.

The plane was an instant success, gathering crowds wherever it touched down. Potential customers tried to press money into Ronneberg's hand, but unlike many in the kit industry, he refused to take early deposits. "I just didn't want to do business that way," he explained. "Companies have been taking orders, then going bust and leaving customers high and dry for decades. I wasn't going to take an order until I knew that I could deliver."

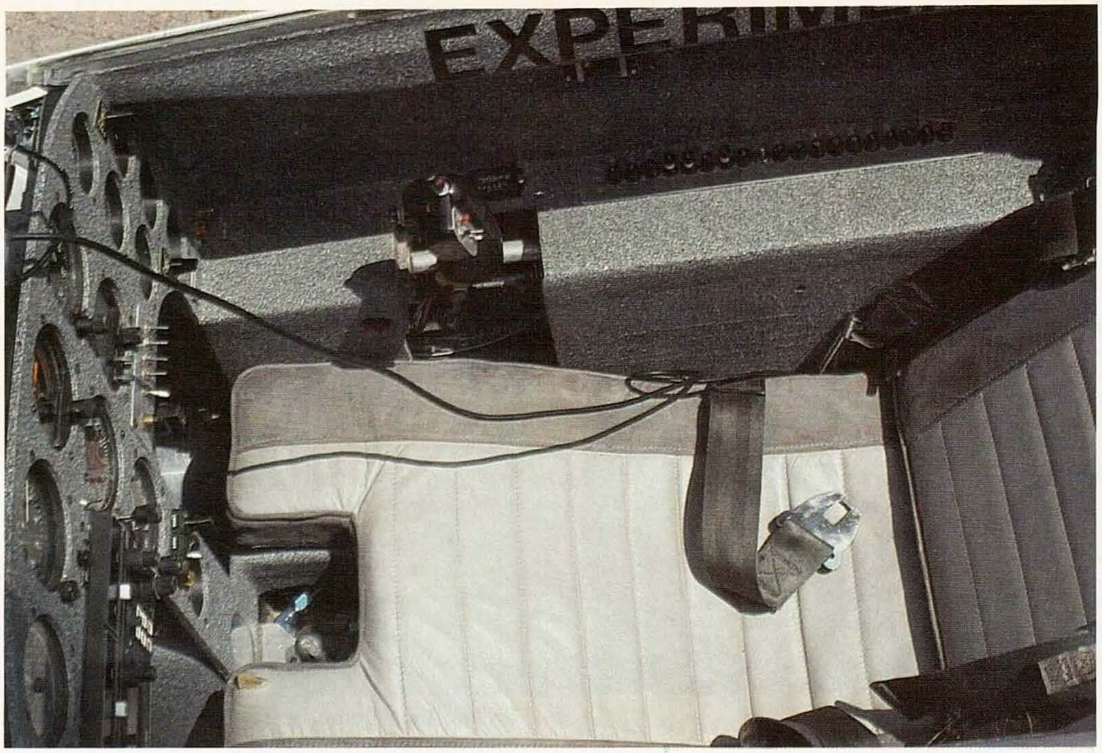
That day came last August, when Ronneberg began to take orders on the first day of Oshkosh '92. He left the show with half a dozen orders and immediately began to ready kits for shipment. By the time you read this, the first parts of the kits—wings, winglets and canards—will be on their way to those six builders. Six months later, these builders will receive fuselages, already primed and bonded. Six months after that, they'll receive the last parts of the airplane, including the landing gear. Splitting the kit into three parts simplifies the cash flow for the customer and keeps Ron-



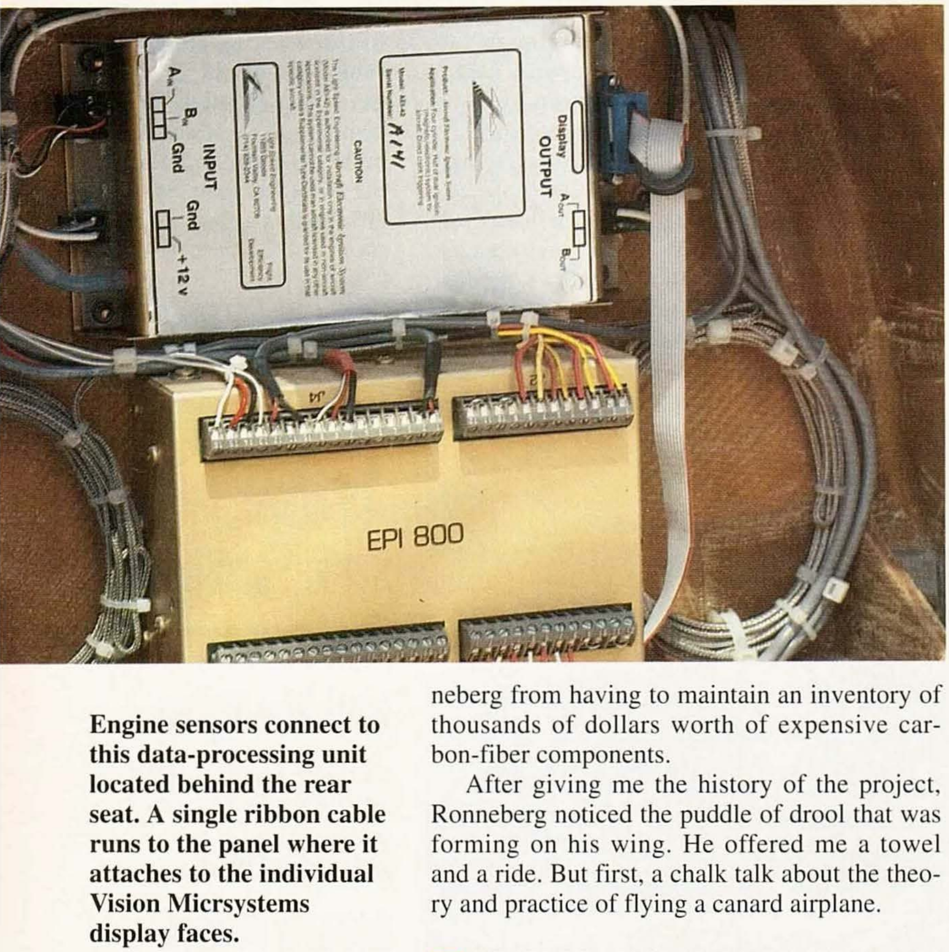
Building seven Long-EZs, plus a stint with Burt Rutan working on the round-the-world *Voyager*, gave Dave Ronneberg the inspiration to design and build the Berkut. Below, the Berkut's panel is efficiently packed with state-of-the-art avionics.



To some, the Berkut and its predecessors look like flying pickle forks, but Rutan's basic canard design is a remarkably efficient arrangement.



Berkut's front seat may seem a bit tight, but the pilot's legs stretch out comfortably in two cutouts in the panel. The sidestick (from an F-86 Sabre) has switches for trim control, navcom frequency selection and push-to-talk, and an autopilot.



Engine sensors connect to this data-processing unit located behind the rear seat. A single ribbon cable runs to the panel where it attaches to the individual Vision Micrsystems display faces.

neberg from having to maintain an inventory of thousands of dollars worth of expensive carbon-fiber components.

After giving me the history of the project, Ronneberg noticed the puddle of drool that was forming on his wing. He offered me a towel and a ride. But first, a chalk talk about the theory and practice of flying a canard airplane.

THE FIRST AIRPLANE DESIGNED to be unstallable, and thus unspinable, was the venerable Ercoupe. It used a simple device to achieve that noble end: a 10-cent stop on the elevator. A canard design uses an entirely different method to achieve the same end result: The elevator is in the front. As it pitches the nose upward and increases the angle of attack, the front wing eventually stalls because it has a higher loading than the main wing. At that point, the canard's angle of attack decreases, reattaching the flow without ever stalling the main wing. In Berkut, a 12-inch stretch in the fuselage makes it virtually impossible to create an aft c.g. condition, thus guaranteeing the stall characteristics as advertised.

The Berkut takes off and flies with perfect simplicity. The only transition a Cessna driver needs is for landing—there is no stall, so there is no real flare. Instead, the pilot flies the plane all the way to the runway, controlling speed and descent rate by increasing pitch. Without flaps, this is not a STOL airplane, but touchdown is around 60 knots, and an experienced pilot can put it down in less than 1000 feet.

I climbed into the cockpit and strapped the airplane on. The seat is considerably wider than I would have thought, given the tandem layout. For comparison, there is much more shoulder room than in a Cessna 152 with two small people on board. It's about the same as a Skyhawk or a Cherokee—there isn't enough room to do jumping jacks, but you can certainly squirm enough to keep your rear from falling asleep. The cushions are made of 3-inch-thick temperfoam and are covered with a lightweight, fireproof synthetic suede.

One of the nice things about homebuilt airplanes is that builders don't have to get stuck with cheesy factory-installed details because the company was building to meet a specified cost. In a homebuilt, if you want mohair upholstery, you use it. In this case, the cushions and the semireclined position reminded me of slipping into my dad's old Laz-Z-Boy—relaxing and comfortable. The seat angles were designed by NASA for extended use.

Baggage room in the airplane is less than in a Cessna, but it is possible to stuff a surprising amount of stuff into the available space. A

Long-EZ has about 10 cubic feet of baggage room; the Berkut about 12. There is room in the nose, in the wing roots/strakes, adjacent to the fuel tanks and in front of the passenger's legs. The secret is to pack small, soft bags that can be stuffed into extra corners. For those who need more space, under-wing luggage pods are available; they sacrifice about 6 knots at the top end but provide room enough for the kitchen sink. They look a lot like drop tanks and prompt a lot of questions from the unfamiliar.

The tandem cockpits limit panel space, but there is a surprising amount of equipment here. All the engine functions are displayed on Vision Microsystems ETI 800 gauges on the right. The equipment is unique in that all the engine sensors connect to a data-processing unit back near the engine. A single ribbon cable then runs to the panel (at the opposite end of the airplane in a pusher) and attaches to all the individual display faces. The displays are only about half an inch thick and are backlit for use at night. At $3200 per set of gauges, it may seem expensive, but it includes all the functions of a graphic engine analyzer and a fuel computer. Vision Microsystems introduced a new, square display panel, the ETI 1000, at Oshkosh this year. It combines all the displayed information on a single screen.

The panel is a solid if minimal IFR setup. On the left, an electronic turn coordinator from Navaid Devices serves as a wing leveler and as a single-axis autopilot. A single KX 155 with a DVOR card provides nav, com and glideslope, and an Apollo 618 loran aids in navigation. Conventional gyros, an airspeed indicator and a directional gyro sit in the middle of the panel.

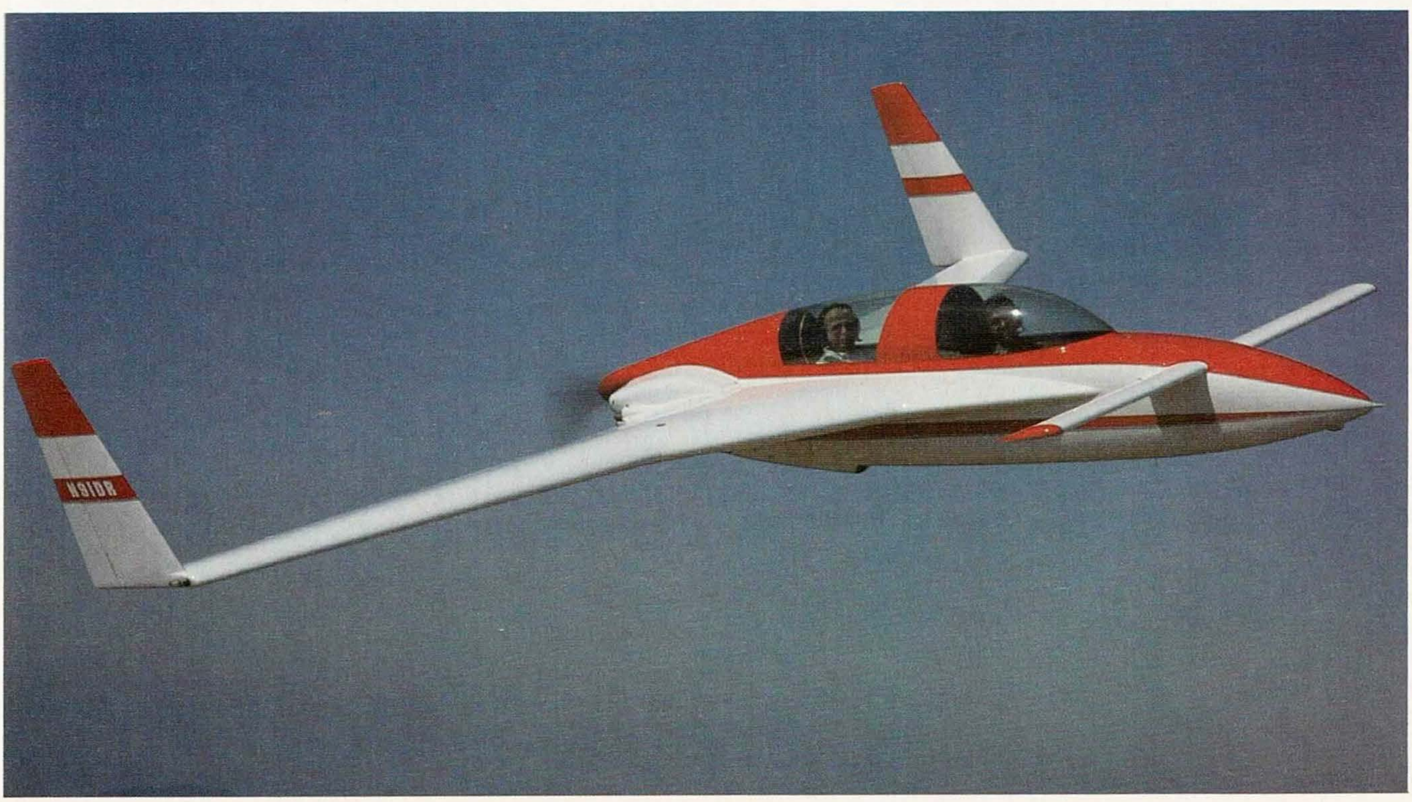
The most interesting instrument in the panel is the Rocky Mountain Instruments Micro-Encoder, an electronic pitot-static computer that's available either in kit form or ready to install. It mounts in a standard 3 1/8-inch hole and provides you with a blind encoder for your transponder, a vertical speed indicator, airspeed, true airspeed, altitude, pressure altitude, density altitude and outside air temperature. It will even interface with a loran or GPS to provide altitude information. RMI is now working on a model for certified IFR work.

Ronneberg has included some basic and very useful HOTAS (hands on throttle and stick) features into the Berkut. The tiny Terra transponder is just ahead of the throttle and mixture controls; you can change the squawk by feel without moving your hand from the throttle. The sidestick control grip came from an F-86 and includes electric trim control, push-button flip-flops for nav and com, push-to-talk button, autopilot on/off and a weapons release trigger (inactive).

With cockpit familiarization finished, we pushed back and went through the startup procedure. The engine is injected and uses one of Klaus Savier's electronic ignition systems, but starting was normal. Electric fuel pump on for a count of five, full rich, crack the throttle, switches on, crank until it catches, check the oil pressure. The ignition system comes into play even at idle—it throws such a large spark that you can lean the engine down much further than you would with mags. The same is true at altitude, and Ronneberg reports about a significant fuel savings during cruise at altitude. It also provides for a few extra horsepower above 6000 feet, as demonstrated by the race performance of Savier's Vari-Eze.

The engine on the Berkut is worth noting. It started life as a straight-valve Lycoming IO-360, normally producing 180 hp. Then Dick Demars rebuilt it, balancing, blueprinting and

All-composite construction makes for a structure that's round and smooth and free of rivets.



porting it. Then he shaved the cylinder bases .063 inch, bumping the compression and increasing the horsepower to 205. It is an incredibly smooth, strong-running powerplant, absolutely equal to the task Ronneberg has set for it. At this time, the Lycoming 360 and its variants are the only engines that Ronneberg is supporting. The 320 would fit nicely, but performance and c.g. would suffer, it wouldn't burn less fuel at the same speed and the cost of a rebuilt 320 is almost as much as a 360. Builder's choice; just a word to the wise.

When photographed over Santa Paula, California, in 1991, the Berkut was still in white primer. The red trim was added in early 1992 to make it stand out from the usually all-white composite crowd.

The Berkut Revolution: Canard Evolution

OUR COVER PHOTO is a little unusual this month. It's more than just an airplane picture, it's something of a family portrait. Take a quick glance—the resemblance is undeniable. Dave Ronneberg's Berkut is obviously evolved from the Burt Rutan-designed Vari-Eze and Long-EZ. It's something Ronneberg readily admits it, giving full credit where it's due.

After building the third of seven Long-EZs, he began thinking about changing the design, making it longer and wider and adding retractable gear. "It took me 15 years to get to the point where I felt confident enough to do a variation on Burt's original design," he explained. "I started with the basic lines of the Long-EZ and added all the changes I'd thought about over the years."

While the 1903 Wright *Flyer* might be considered the world's first powered canard design, Burt Rutan's first canard airplane was the two-place, tri-gear VariViggen, which debuted in February, 1972. Although it was a limited success and several are still flying today, the VariViggen was a boxy, aesthetically crude design that bears little resemblance to the sleek, sexy Berkut.

Rutan came a lot closer to realizing the dream in September, 1974, with something he called a speedwing version of the VariViggen: the Vari-Eze. Constructed using the then-unique fiberglass-over-foam-core construction method, the prototype Vari-Eze made its first flight on May 21, 1975. The Vari-Eze created quite a stir when it arrived at Oshkosh for the annual EAA fly-in and convention. It won the Outstanding New Design Award that year and remains popular with homebuilders to this day.

Never one to rest on his laurels, Rutan took the canard design a step further with his next project, the Long-EZ. The prototype was completed in just four months and made its first flight on June 13, 1979. There were some teething problems, but after numerous modifications, it went on to set numerous speed and distance records. Rutan sold plans and kits for a while, but gave up the kit manufacturing business to concentrate on *Voyager* and other aircraft. Although Long-EZ kits are no longer available, used plans and unfinished projects continue to be hot items in the homebuilding world—take a look at the Oshkosh ramp sometime.

But if you want to see Vari-Ezes and Long-EZs and it doesn't happen to be late July in Wisconsin, try a visit to Santa Monica Airport, south of Los Angeles. Santa Monica is the home of the Berkut and at least 15 Vari-Ezes and Long-EZs. That's where we went to find the airplanes to pose for the canard family portrait on our cover. The Vari-Eze was built and flown by Bram Arnold, the Long-EZ by Verne Simon. The Berkut was built and flown by Dave Ronneberg (up front) and Don Murphy.

—Chuck Stewart

Simon, Murphy, Ronneberg and Arnold pose with their mounts.

Ronneberg's Berkut is joined by Verne Simon's Long-EZ and Bram Arnold's Vari-Eze in a picture-perfect formation above the Mojave flats. Several months before, the Berkut won the air race for canard aircraft held annually at Wendover, Utah. Its record-setting time over the 126-mile course: 215.56 knots —nearly 250 mph.

Berkut

continued

Taxiing was uneventful. Steering is through differential braking and a castering nosewheel, but with tricycle gear and the engine in the rear, visibility is incredible. The rudders are independent and pivot only outward, so the brakes engage at the bottom of the rudder travel. As we lined up on the runway, Ronneberg warned me that the rudders wouldn't become effective until about 30 knots, so I'd be using the brakes until we reached that speed. That's because the rudders aren't in the propeller slipstream and become effective gradually as you accelerate.

Acceleration off the line isn't as spectacular as you might expect in a 2000-pound airplane powered by a 205-hp engine, but that's because of the propeller, another of Klaus Savier's clever little innovations. The Black Bart (as it is called) is composite—carbon fiber over a birch core—optimized for cruise. It has a 91-inch pitch, which limits static rpm to just over 2000. As we began rolling forward and airspeed increased, the engine develops more and more power. When we rotated about 1100 feet down the line and I was pressed firmly into the seat, I felt like I was in a small jet.

Two on board, 30 gallons of fuel, an almost standard day, climbing 2000 fpm at 100 knots on a cruise prop. Life was suddenly looking very, very good. Maybe this was the airplane of my dreams, after all.

AS WE CLIMBED, Ronneberg took over the controls. "Watch this," he said. He pulled the stick all the way back and held it there. My pucker factor went off the scale as I anticipated a departure stall. Wrong. The canard stalled out at just about 55 knots and, with the main wing still flying and full control available, we kept climbing at 1650 fpm, at a 25°angle.

A minute later, we leveled out and headed north to find empty sky where we could wring the airplane out. The slick design and minimal frontal area let the airplane keep accelerating in level flight for a long time. About three minutes later, we were up to a comfortable cruise of 207 knots. I suppressed the urge to drool again.

We reached an unpopulated area where we could put Berkut through its paces. First, Ronneberg demonstrated its excellent hands-off stability. Properly trimmed up, Berkut has no tendency to wander. A quick experiment with Dutch rolls proved utterly boring. There's no adverse yaw above 120 knots, so unless you want to slip the airplane, all flying is done without rudder pedals. Even alternating rudder to get the nose to swing out to the maximum yaw possible—while exciting—came nowhere close to stalling a vertical stabilizer; the yaw damped and came back to center in two oscillations.

Up to now, we'd been making gentle, standard-rate turns, but the plane felt nimble and responsive, even more so than my beloved Long-EZ. Ronneberg invited me to play with the roll rate. A flick of the wrist took the airplane to 60° about as fast as I could blink. Ronneberg suggested that we try an aileron roll. There was no need for the customary initial dive to gain speed—just lift the nose about 10° and give it full left stick. We rolled around smoothly in just under two seconds, according to my watch. It was a little slower than the F-16 that I'd specified, but more than adequate, and about twice the roll rate of my EZ.

The side-stick controller is a joy to use. The controls, even in a full-deflection roll, are crisp, light and precise. You just think about making a turn and it happens. In pitch, there's a nice relationship between stick forces and the onset of increasing G. As we tried a wind-up turn, we maxed out at 6.3 G; just about the time I was getting tunnel vision, I ran out of forearm strength to pull back on the stick.

A couple of loops demonstrated equally impressive performance—about 4 G coming through the backside, smooth and steady. The plane is stressed to better than ±10 G, but cannot be considered a fully aerobatic airplane because of the canard configuration. If it can't stall or spin, it also can't snap roll. And while the canard is a marvelously efficient device in upright flight, making it fly inverted is a complex job, and the prototype (at least for now) isn't set up to fly upside-down. For simple moves like aileron rolls, barrel rolls, inverted Cuban-8s and loops, though, it's as forgiving and responsive as anything I've ever flown.

Having wrung out both the airplane and myself, it was time to return to the Berkut's Santa Monica aerie, so I turned around and started a high-speed run. We leveled off at 4000 feet, left the throttle open and retrimmed. After everything had equaled out, we were sustaining 215 knots true.

As we entered the downwind at 170 knots and 1400 feet, I anticipated a long pattern. My Long-EZ, with its slippery shape and faired main gear, is tremendously difficult to get on the ground. If you are red over white on final, you'll miss the runway entirely, and I fly a lot slower than Berkut. Ronneberg told me to flip the gear-select toggle switch down. The V_{LE} is 165 knots, and dropping the gear slows the plane down in a hurry. At 104 knots, the drag break on the belly can be extended to steepen the descent angle even more, and cross-controlling can make Berkut drop like the ruble.

The plane has a tendency to float in ground effect, and I ended up touching down about 1000 feet down the runway at 70 knots. Keeping the nose in the air as long as possible saves the brakes, and we turned off the runway about 3000 feet down the runway.

With the gear and drag brake up, Berkut has a glide ratio of about 18:1, the same as the trainer I used when I got my sailplane rating. That means that if you lose power at 10,000 feet, you have 3600 square miles to find someplace to land, more if you find a thermal.

We opened the front canopy as soon as we got on the taxiway—the same canopies that give 320° visibility serve as terrific greenhouses when you're on the ground. After shutting down, we went over the specifications.

Ronneberg lists the gross at 2000 pounds. Empty weight of the prototype is 1126 pounds, but production planes are expected to weigh in at about 1050 pounds. Full tanks add 275 pounds, and two FAA-standard humans another

The Berkut

Price

Three-stage kit (excluding engine, etc.)	$26,890
Approximate cost to complete	$40,000-$45,000

Specifications

Wingspan	26.6 ft.
Wing area (includes canard)	110 sq. ft.
Length	18.5 ft.
Height	7.5 ft.
Landing gear type	retractable, tricycle
Seats	2, tandem

Weights and Loading

Maximum gross weight	2000 lb.
Empty weight	1126 lb.
Useful load	874 lb.
Wing loading	18.2 lb./sq ft.
Power loading	9.75 lb./hp
Fuel capacity	47 gal.

Engine

Lycoming IO-360-B1A, four-cylinder, horizontally opposed, normally aspirated, fuel-injected, 205 hp at 2700 rpm.

Propeller

Light Speed Engineering, two-blade, fixed-pitch, 91-inch diameter, carbon fiber over birch core.

Performance

Maximum speed	215 kt.
Cruise speed, 75% power	207 kt.
Range, 75% power, with reserve	1300 n.m.
Stall speed (no flaps)	54 kt.
Rate of climb, sea level	2000 fpm
Service ceiling	29,000 ft.
Takeoff ground roll	1000 ft.
Landing ground roll	1000-1500 ft.

360. That leaves 315 pounds for luggage, and unless you're carrying your rare birdshot collection, you won't ever reach gross. The same is true of c.g. As long as the pilot falls within some very broad weight limits, you can't get the airplane out of its c.g. envelope. The passenger sits ahead of c.g., as does all the baggage, and adding or losing fuel doesn't affect c.g. at all.

Like many kits, the Berkut is sold in three segments: first, the solid-core wings and canard, then the fuselage, and finally, the retractable-gear-related items. Total kit price is $26,890, excluding engine, propeller, avionics, wiring harness, paint and upholstery. The price of the kit is largely dependent on the price of carbon fiber, which makes up 60% of the airframe—spar caps and skins for the main wing and canard, for example, use more than $3000 worth of the stuff. It should take about the same amount of time to build as a Lancair or a Long-EZ—estimated at 2000 hours, but varying widely with the skill and experience of the builder. With a half run-out engine and a basic VFR instrument package, figure about $40,000 to get the plane up and flying. A sport model with less carbon fiber and fixed maingear will cut about $4000 off the price and about 500 hours off the building time. The end result will be a lighter airplane that is about 24 knots slower at the top end.

One of the questions Ronneberg gets all the time is why he doesn't build a molded wing. His response is straightforward: He doesn't have to. "In a conventionally configured airplane, the wings are hollow because you store fuel in them. In Berkut, the wings are almost entirely aft of c.g. The solid core structure is easier to build, stronger, stiffer, lighter and cheaper."

Like most kitplane companies, Ronneberg sells an information kit, with spec sheets, reprints, parts lists and a color photograph, for $20. A videotape was being produced while I was there and should be available around the first of the year. Rides are available for serious customers, but be warned. One ride and you'll probably be hooked for life. Not a problem, though—just see Dave.

***FOR MORE INFORMATION,** contact: Experimental Aviation, 3025 Airport Ave., Santa Monica, CA 90405; telephone 310/391-1943.*