BERKUT PART 2:

Last month we learned how the Berkut was designed. Here's how it flies.

BY RICHARD RILEY

It was an extraordinarily clear day. What passes for rain in Southern California had washed the smog from the sky and left behind 50-mile visibility, calm winds, bright sunshine and mild temperatures. I pulled up to Experimental Aviation's hangar at Santa Monica Airport.

The Berkut was sporting a fresh coat of glossy white paint over the matte-white primer it had worn since its debut at Oshkosh three months earlier. Like most composite aircraft, the Berkut is painted white to keep skin temperatures below critical levels, above which the strength and fatigue resistance of the epoxies in the structure are reduced.

Dave Ronneberg, the Berkut's designer and builder, had just returned from the National Business Aircraft Association (NBAA) convention in Houston, Texas. The Berkut was the first experimental plane ever to be displayed there. Although rain and wind kept away a lot of the potential buyers Ronneberg had hoped to meet, the plane was clearly a hit. At the "Wings over Houston" airshow that proceeded NBAA, the crowd around the plane got so large the plane had to be roped off, and the show program featured Berkut on the cover under the headline "The Littlest Angel."

Just prior to NBAA, the Berkut scored another major coup: It won the annual canard race held at Wendover, Utah, in record time. Average speed over the 126-mile course was 248.35 mph, a good 2 minutes faster than the second-place finisher. The Berkut is obviously one seriously fast airplane.

The Berkut is a tandem two-seater with a stick and throttle, but no rudder pedals, brakes, instruments or radios in the rear seat. Although there is no rollover structure to block the back seater's view of the front instrument panel, the strakes and wings severely limit downward visibility, making it hard to see well enough to land from the back seat. But because the rear cockpit has 6 inches more leg room, 4 inches more head room and 3½ inches more shoulder room, it is at least more comfortable than the Long-EZ from which it evolved. Nonetheless, I'd already flown the Berkut from the rear seat, and I wanted to try it from the front.

As we appoached the plane to begin the preflight, I made sure my tape recorder was running so I would be able to catch everything without having to take notes. On its retractable gear, the Berkut sits a couple of inches higher than a standard Long-EZ, so getting into the back seat requires somewhat of an acrobatic maneuver.

Standing just ahead of the wing on the left side of the plane, you grab the rollover structure with your right hand and plant your left hand on the strake. Then you jump, simultaneously pulling yourself up via the rollover bar and pivoting counter-clockwise. If all goes right, you end up with your rear planted on the leading edge of the strake, ready to swing your legs around and lower youself into the cockpit.

As I prepared to begin "the Berkut hop," Ronneberg pointed at the front seat. "You've done enough time back there, why don't you try it up front?" Though I responded with a gracious and understated, "I suppose," inside, it was a victorious, "Yes!"

The Preflight

Despite Berkut's composite construction and canard design, the preflight was familiar enough for a former Cessna driver: Inspect all control surfaces for freedom and security, check the skin for deformations, and check the landing gear for brake and tire wear. Drain the fuel sumps and gascolator, check the oil, prop and lights, and check the canopy hinges and lock-down points, and the pitot/static system. Ensure that everything is attached securely—if it's not, it departs through the prop.

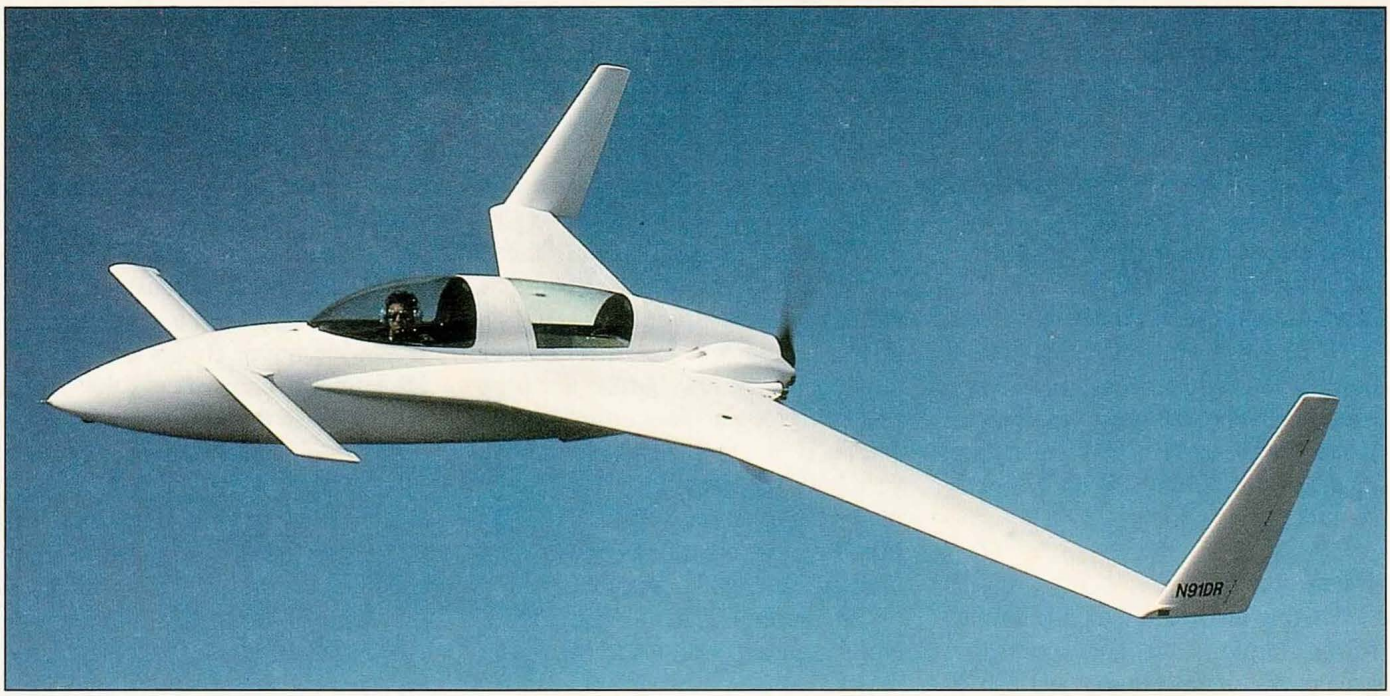
In the Cockpit

Using a modified Berkut hop (I recommended Ronneberg consider a kick-in step, since we're not all as tall and athletic as he is), I climbed into the front seat. I was struck by generous amount of elbow room. For me, getting into the four-point harness in a Long-EZ has always been like a straightjacket escape routine—if you try to hold the two parts of the buckle in your hands in front of your waist, your elbows run into the sides of the cockpit. In the Berkut, it's not a problem. The fit—close, but comfortable—is like a bucket seat in a sports car.

Ronneberg briefed me on the cockpit layout. Because of the tandem seating, the instrument panel is only about half as wide as that of a side-by-side plane, so it takes some real creativity to squeeze a fully redundant IFR package into it.

Vision Microsystems' ETI 800, an electronic engine monitoring system, takes up most of the right side. It con-

THE EAGLE FLIES



PHOTOS: CHUCK STEWART

Though it looks like a speed machine—which it is— the Berkut also has a roll rate of 270° per second and is capable of limited aerobatics.

sists of seven 2½-inch, round, backlit LCD modules that display tach and hours, oil temperature and pressure, cylinder head and exhaust gas temp, manifold pressure and fuel pressure/fuel flow. Information from the transducers in the engine compartment is gathered together in a single digital processing unit and sent to the panel by a ribbon cable equipped with 16 conductors. A matching multi-function electronic clock is also included in the package, but it is installed near the bottom of the panel, almost between the pilot's knees.

On the floor in a notch cut into the pilot's seat cushion is the fuel selector valve. Above it is a small plexiglass window used to visually check the position of the nosewheel (it's possible the free-castoring wheel could be turned to the side, keeping it from raising all the way into the well). The locking toggle switch that controls the gear, and three yellow in-transit and three green down-and-locked lights are located just above the clock. Above that is a CDI/glideslope head connected to the nav receiver.

The center of the panel is occupied by the primary flight instruments and communications equipment. Just right of center is a Rocky Mountain Instruments Micro Encoder, which serves primarily as a mode C encoder and VSI, but also continuously displays OAT, indicated airspeed, barometric pressure and the altitude being squawked. With the flip of a switch, it also provides density and pressure altitude and true airspeed. An RS-232 serial port on the back enables it to export data to other systems in the cockpit.

Also on the right is the panel for the main switch, strobes, landing and nav lights, and intercom. At the top is a hole currently occupied by a g meter, but reserved for a moving map and Stormscope display that will be installed sometime in the future.

Located at the top center of the panel is an attitude indicator, with a directional gyro just below. To the left is an airspeed indicator, a King navcom and a IIMorrow 618 loran. At far left is an electronic turn-and-bank/autopilot from Navaid Devices that is capable of following a loran or VOR bearing, and a Terra 250 transponder. The transponder is located only a couple of inches ahead of the throttle quadrant and can be easily operated with the left hand resting on the throttle. Below the transponder are two covered toggle switches that control the ignition systems.

The Berkut's engine, an I0-360-B1A, is equipped with both a conventional magneto and a computerized electronic ignition made by Klaus Savier's company, Light Speed Engineering. The electronic unit provides multiple spark discharges through the top set of plugs, plus a spark advance, which helps provide more power at altitude. The amount of spark advancement is indicated by a strip of yellow analog lights in the lower right corner of the panel; a toggle switch next to the indicator can be switched off to defeat the advance portion of the ignition's programming.

One of the neatest gadgets in the plane is the digital sound system. On the left wall of the cockpit above the throttle and mixture levers is a one-inch-thick Sony remote controller display. It looks a lot like a car radio with round knobs on either side and an LCD display in the middle, but it

only controls the functions of the units mounted elsewhere in the plane: a six-disc CD player mounted behind the pilot's seat and an ultra-thin cassette player located just above the left footwell.

The signal feeds into the intercom, which suppresses the music whenever an external radio signal or internal mike signal overcomes the squelch. Even though the intercom and Bose ANR headsets are mono, the sound quality is terrific. The "Top Gun" soundtrack is in the stack of CDs, but Ronneberg's current favorite flying music is the "Dances With Wolves" soundtrack.

Getting Started

Starting the injected engine cold is fairly simple. First, check that the gear pump circuit breaker just above the navcom is popped out in the off position and that the gear selector is switched to down (there aren't any squat switches to prevent raising the gear while on the ground.) Flip on the master switch. The master switch for the avionics is in the middle of the circuit breaker bank on the right armrest; verify it's off, then flip open the cover on the single magneto and switch it on.

Next, switch on the auxiliary fuel pump for a count of five, or until the fuel pressure reaches 24 pounds, then switch it back off. It's an injected engine, so the throttle is opened 1/2 inch and the mixture set to rich. Finally, press the starter button until the engine catches, turn on the alternator field, count five to eliminate the chance of voltage spikes, then switch on the electronic ignition and the avionics.

Runup is no different from any other plane; the only surprise is that the static engine speed at full throttle is only a hair above 2000 rpm. The Black Bart cruise prop has a 91-inch pitch to it, so the plane needs to be moving pretty fast before the prop will let the engine develop full power. There is no rpm drop when you switch off the left mag; the electronic ignition does such an efficient job that in most situations the magneto spark is an afterthought in the cylinder.

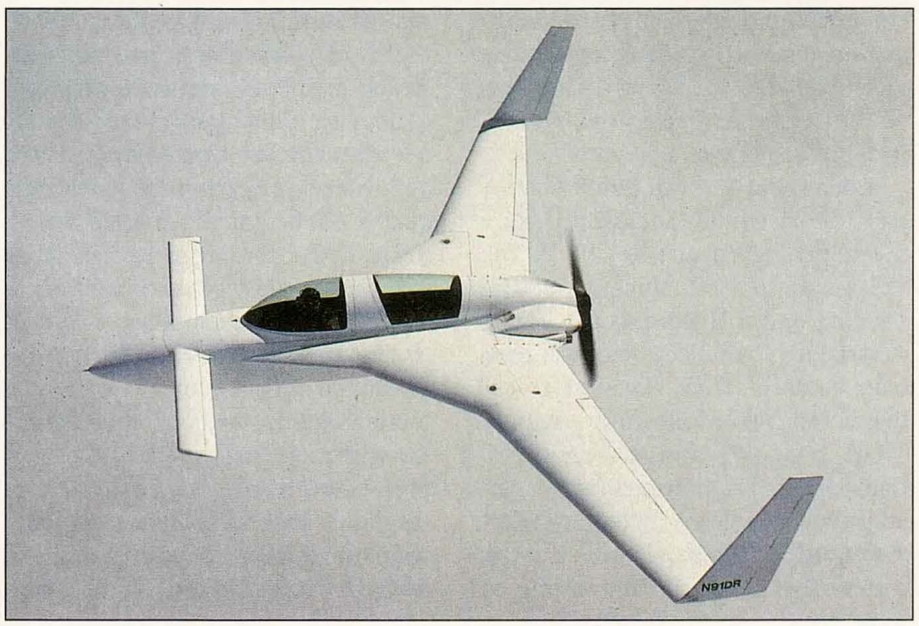
Taxi control is provided by differential braking, but S-turning is not required as there is excellent visibility over the nose. With a strong crosswind when we were taxiing out, I ended up tapping the left brake every few seconds to keep us turned into the wind. When Long-EZ designer Burt Rutan inspected the Berkut at Oshkosh '91, he said the only change he might make to the plane was to add a steerable nosewheel. After taxiing in a crosswind, I'm tempted to agree, but the brake system works perfectly well, and besides, a steerable nosewheel would increase complexity, building time, weight and opportunities for things to go wrong.

During the long roll down the taxiway to the active, I used the flip-flop com switch on the sidestick and found it to be quite comfortable and natural. It is part of the former F-86 stick and is located next to a flip-flop nav switch, a PTT button and an autopilot toggle switch. The close proximity of the switches requires a little concentration until you get used to it—I turned on the autopilot once when I was trying to transmit.

Initial takeoff roll is a little strange if you've never flown a Long-EZ. Directional control is via the brakes only because the rudders aren't in the propeller slipstream and have to reach 20-30 mph before they have any effect. Prior to that, any change in direction is accompanied by a slight deceleration that lengthens the takeoff. None of the Rutan canard family can be considered STOL performers—for one reason, there aren't any flaps—but Ronneberg says that with a light load of fuel and only one aboard, he can get off the ground in less than 1000 feet. In the meantime, Klaus Savier is working on another propeller for the Berkut that will increase low-end performance without sacrificing speed at the top.

With the fixed-pitch prop, the engine is producing only about 130 hp at the beginning of the takeoff roll, so acceleration off the line is not very quick. The canard is ready to fly at 66 mph, and the main wing is able to fly the moment the canard lifts the nose off the ground. We were well down the runway by then, but the faster we went, the faster we accelerated.

As soon as we passed the go-around point, Ronneberg signalled to raise the gear. I pressed in the gear circuit breaker, then pulled the locking toggle switch out and flipped it up. The hydraulic pump in the nose started and the gear transitioned up into the wells. As the gear doors closed, acceleration increased again —significantly. In no time, we picked



Wingspan is 26.6 feet of high-modulus carbon fiber that enables the Berkut to cut through turbulence with minimum loss of airspeed.

The Berkut's cockpit is considerably more roomy than a Long-EZ, but it takes some acrobatic skill to get in.

up 25 mph. After rotating, we were climbing at 110 mph at a rate of 2250 fpm. (With performance like that, who needs a constant-speed prop?)

Ronneberg hadn't established V_X, V_Y or best glide when this article was written (mid-November, 1991), but by the time you read this, Norm Howell, a Long-EZ owner and Air Force test pilot, will have taken the Berkut through a complete test sequence and established these numbers. (He is also planning an assault on the 33,731-foot altitude record for the C1B class.)

In the Air

As I already knew from earlier flights in the Berkut, pitch control was light and responsive. The electric trim, controlled by a small two-axis electronic joystick located atop the sidestick, was smooth and easy to use, but I could have used a visual indicator somewhere on the panel to show me the trim condition. The Berkut has both pitch and roll trim, both of which must be readjusted as airspeed changes.

After climbing to 1000 feet, I trimmed the nose slightly lower and watched the cruise speed climb as we headed out to the practice area. As we flew along the coast I had some trouble maintaining a fixed altitude. Some light, choppy turbulence made it difficult to trim the plane. The high-modulus of the carbon fiber wings allows the Berkut to punch through turbulence with minimal loss of airspeed, but the tradeoff is that more of the buffet is transferred to the cockpit.

Directional control is very similar to that of the Long-EZ. It is so quick and positive, it's almost as if you can make a turn just by thinking about it. Yaw stability is also excellent. With the gear up or down, the yaw deflection generated by applying full rudder and releasing it damps in less than five side-to-side oscillations.

A big treat, especially for someone who learned to fly in a Cessna 150, is the visibility—the only thing I can compare it to is a helicopter. There is about 320° of visibility horizontally, and more than 180° vertically.

Low-speed handling and safe stall/spin characteristics are one of the reasons canard designs are so popular. By producing lift to pitch the plane up into a higher angle of attack, the canard acts as the elevator. As angle of attack increases, the canard, which has a higher wing loading than the main wing, stalls and pitches the nose of the aircraft down well before the main wing has stalled. In a correctly loaded EZ, it is impossible to stall the main wing even if you start at a high airspeed, pull the nose rapidly to the vertical and wait for the airspeed to bleed off—the main wing's angle of attack never increases beyond the stall point.

The Berkut incorporates the same safe-stall canard philosphy as the Long-EZ. The extra length of the fuselage decreases the danger of an aft loading. In fact, some of the hydraulic systems currently installed in the nose could easily be relocated to the gear bay.

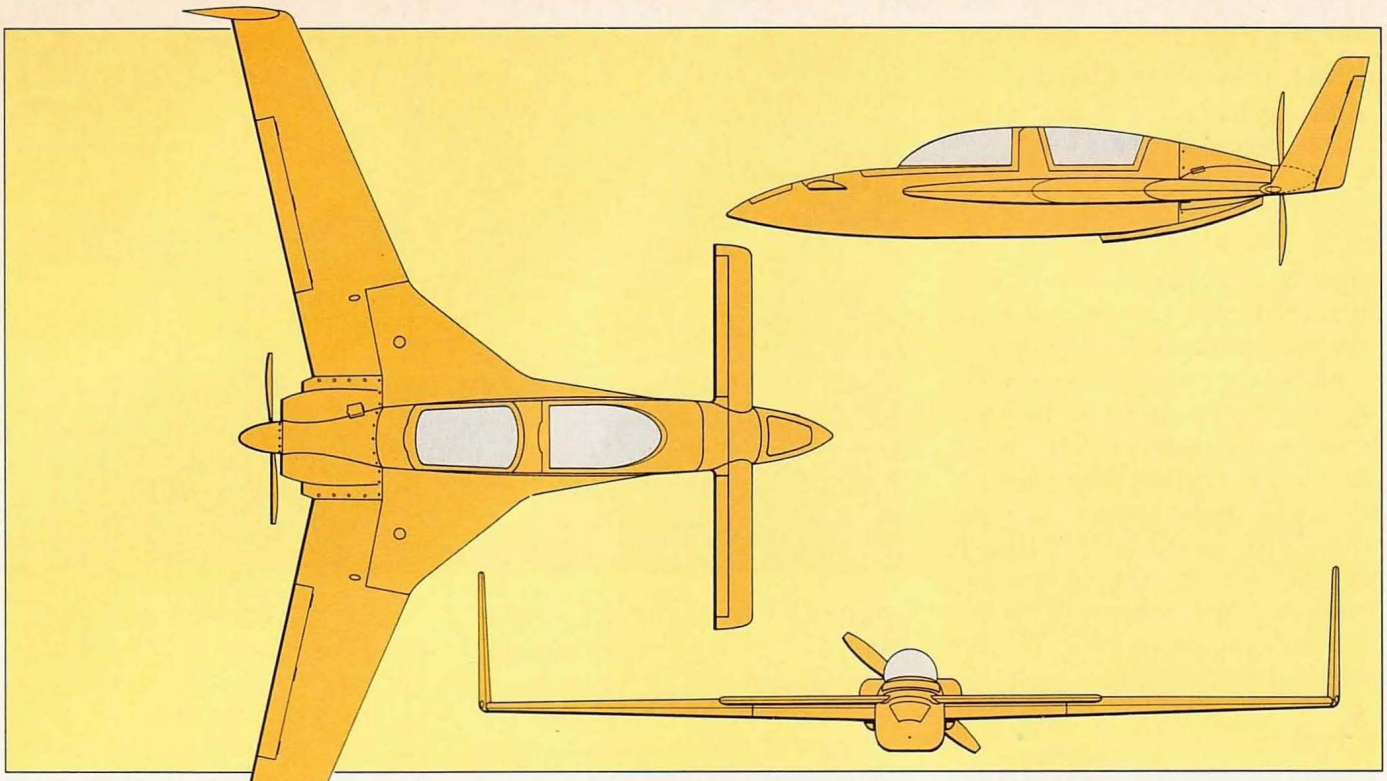
When airspeed drops below 66 mph, the canard simply stops flying and pitches the nose down suddenly, though not very far. If the c.g. were a bit more aft, the Berkut might well have the same gentle, mushy pitch changes that a correctly loaded EZ displays at slow speeds. The foward c.g. is also responsible for the higher stick forces in the pitch axis, which several Long-EZ owners have reported when comparing their aircraft to the Berkut.

After playing with slow flight, I tested the roll rate at full deflection. The absence of drag from the gear combines with the large ailerons to produce a sharp roll that pulls around quickly and smoothly. If my stopwatch was accurate, the roll is about 270° per second. The trim uses a rider on a motorized, threaded rod to change the balance point between two opposing springs that are attached to both the canard and the ailerons. Although these springs also increase the effort needed to effect control deflection, full deflection didn't require an inordinate amount of stick force.

A high-speed sequence was last on the agenda—I was glad I saved the best till last. We were level at 1500 feet with the throttle firewalled and a true airpseed of 252 mph. The reason the Berkut is able to achieve such speeds is not a massive powerplant, but rather the small frontal area, clean aerodynamics and light weight. As a result, the plane continues to accelerate for a long time, having to overcome compressability at the top of its current level flight regime.

Landing

After all too short a flight (1.1 hours on the Hobbs meter), we entered the pattern at Camarillo Airport to try a few touch-and-goes. This is where I discovered one of the problems inexperienced pilots have with EZs: It's such a clean design, it's hard to slow down. You can use the belly-board speed brake, a carryover from the original Long-EZ design, and it's



BERKUT

possible to slip the plane or use both rudders in opposition, but the most effective way to slow the Berkut is to put the gear down. The large, open gear wells in the bottom of the wing provide a lot of drag and allow for a very docile descent.

Ronneberg briefed me again on the landing technique as we flew the downwind. The Berkut has less of a tendency to float down the runway than it's predecessor, but you still have to fly it all the way to the ground, trying to run out of speed and altitude at the same time, and touching down on the mains at just over 70 mph. You have to keep flying the canard down the runway until the nose falls of its own accord at about 50 mph. I had to keep reminding myself that I couldn't flair the Berkut like a 172—you can't stall the wing!

As instructed, I crabbed to correct for the crosswind and was ready to tap the right rudder at the last minute to straighten out. About 10 feet above the runway, I suddenly found myself in trouble. Ronneberg is a good 7 inches taller than I am, most of it in the waist. With the main wing well into ground effect, our angle of attack was so high that I couldn't see the horizon, much less the runway. Ronneberg fed in some last minute corrections from the back seat, dropping the nose and setting down our mains well right of centerline. It wasn't pretty, but any landing you don't have to call the insurance company about...

We canceled the touch-and-go in favor of a full stop and parked under the tower to figure out a solution to the visibility problem. I expected I'd be banished to the rear seat, but instead, Ronneberg made the ultimate sacrifice—he gave me his seat cushion. Sitting on two cushions, I had the visibility I needed, but Ronneberg was left to suffer in the unyielding, non-contoured fiberglass seat in back.

We started the engine hot (no prime, mixture full lean, throttle full

THE BERKUT

Specifications

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

Weights and Loadings

Gross weight	2000 lb.
Empty weight	1035 lb.
Useful load	965 lb.
Wing loading	18.2 lb./sq. ft.
Power loading	9.75 lb./hp
Fuel capacity	47 U.S. gallons

Engine: Lycoming IO-360-B1A, 205 hp at 2700 rpm

Propeller: Light Speed Engineering's 67x91, wood "Black Bart."

Performance

Maximum speed (sea level)	248 mph
Cruise speed (75% power)	239 mph
Range	1314 s.m.
Rate of climb (sea level)	2000 fpm
Service ceiling	32,000 ft.
Stall speed (clean)	62 mph mph
Takeoff ground roll	1000 ft.
Landing ground roll	1500 ft.

Price: Still to be determined.

Manufacturer:
Experimental Aviation
3021 Airport Ave., Ste. 109
Santa Monica, CA 90405
phone 213/391-1943

Source of information:
Experimental Aviation

Other pertinent notes:
Kits and plans are not yet available.

open, crank until it catches, immediately reverse the throttle and prime and turn on the electronic ignition) and took off again. I made two more touch-and-goes at Camarillo, then headed back to Santa Monica, where the landing was better, though still not perfect.

When we topped off the tanks, we found we'd used only 11 gallons of fuel with all of our wide-open-throttle maneuvering. In his own tests, Ronneberg has found that the IO-360 is a surprisingly economical engine. Flying cross-country at the same speeds as a 320-powered Long-EZ, the 360-powered Berkut actually burned 10% less fuel.

Parking is another area where the Berkut is very different from its predecessor. While EZs park with their noses down in the grazing position, the Berkut maintains enough weight on its nose to sit smartly on all three gear. It's also light enough for one person to push around the hangar and small enough that it can easily share a Cessna-size parking space with another EZ.

What's Next?

As we pulled in we were met by Rick Fessindon, a recently retired Navy fighter pilot who is building a Long-EZ in the same hangar where the Berkut is kept. He'd flown the Berkut the day before and returned with a huge, Cheshire-cat grin, calling the Berkut was "the most fun plane I've flown since I left the Navy." He was talking about quickly finishing his Long-EZ so he could start on a Berkut, but Ronneberg slowed him down. "You already have most of what you need," Ronneberg said, "so why not just convert it to a Berkut?"

My antennae went up—my own Long-EZ project was at the same stage as Fessindon's: structurally complete but unfinished. Because the Berkut's canard, wing, strake and spar are the same as a Long-EZ's, it would be a relatively easy job to cut the strakes from the fuselage, cut out the main spar, and bond them in place in a molded Berkut fuselage. I wanted to re-do the stubby Long-EZ nose anyway, and since there was so little finish work to do on the molded fuselage, I could avoid a lot of sanding and be flight-ready several months sooner.

While I was thinking about it, Fessindon said yes to the idea. He will be the first to construct a fully retractable Long-EZ/Berkut. I have since taken the plunge as well, but I'm more interested in getting my Long-EZ flying with a minimum expenditure of time and money, so mine will be the first mutant conversion built with fixed gear. Ronneberg has given more than passing thought to the possibility of selling Berkut fuselages to people with flying EZs—he estimates the conversion would take about 500 hours, and result in a plane that is significantly more comfortable and 30-40 pounds lighter.

Ronneberg has maintained his policy of not taking orders before parts and plans can be shipped, so he will be personally supporting these early conversion projects as prototypes. But plans for creating a Berkut kit business are coming together. By the time you read this, Ronneberg expects to be accepting 25-50 $10,000-escrow deposits for the first Berkut kits. When enough customers have committed, he will order materials and start molding parts.

Some Final Thoughts

The Berkut is not the universal answer to every homebuilder's needs. For one thing, it's not the easiest airplane to get into. But like squeezing into a Ferrari, I think it's worth the effort. Ferraris are popular because of their performance and beauty. The same is true of the Berkut. Ronneberg has built an airplane that looks and flies great. Every time I've flown it, I've found it to be impressively fast, responsive, economical, stable and strong. What more could you ask for? ❑

FOR MORE INFORMATION on the Berkut, contact Experimental Aviation at 3021 Airport Avenue, Ste. 109, Santa Monica, CA 90405; phone 213/391-1943.