
Sport Aviation®
EAA'S MONTHLY MEMBERSHIP MAGAZINE
FEBRUARY 1995
N91DR
BERKUT

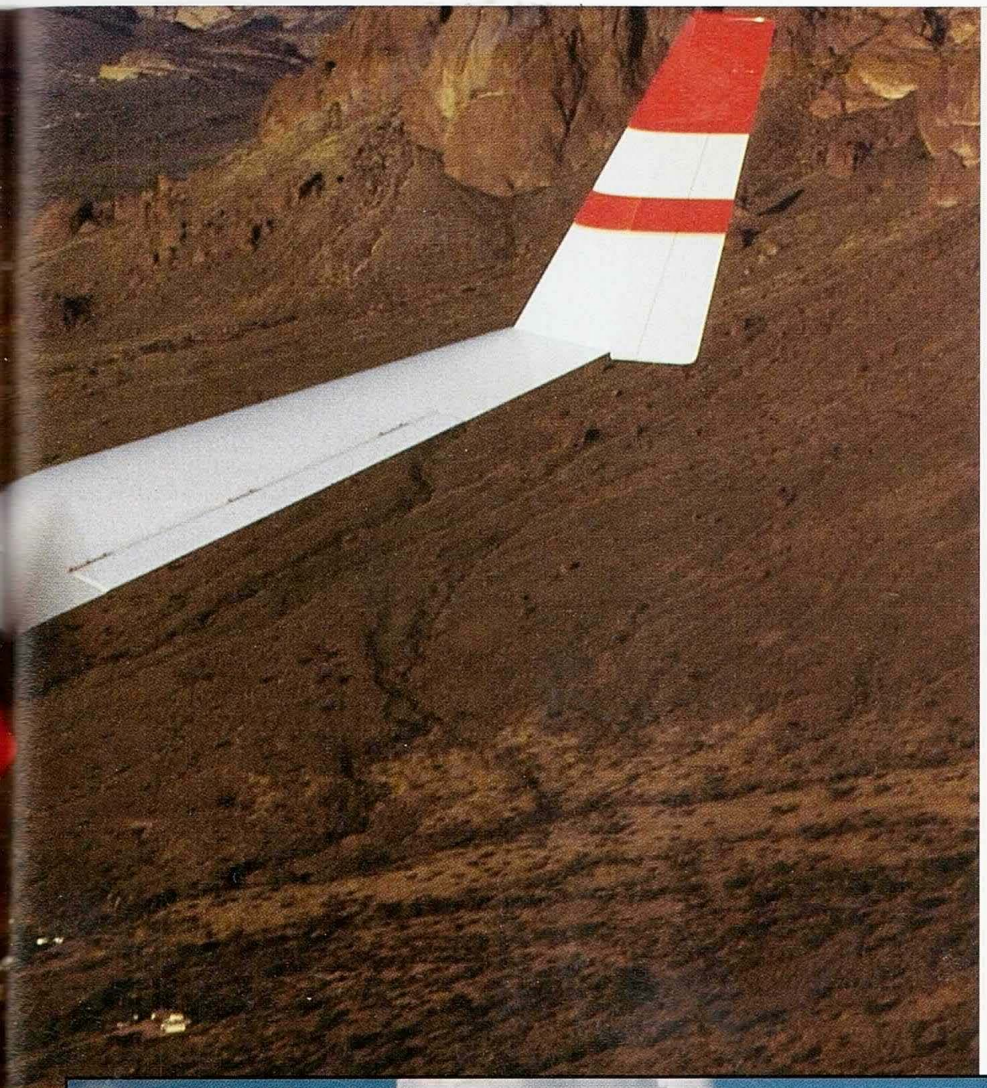
BERKUT

Carbon Fiber Wolf Hunter

Article and Photos by
Budd Davisson

The descendants of the Mongols of central Asia must have an intense feeling of pleasure knowing they've progressed to the point they can command the mighty golden eagle to do their wolf hunting for them. Their name for this ultimate bird of prey is Berkut.

Wonder how they'd feel seeing their



stately weapon swoop to the Earth backwards . . . its tail feathers in front.

Those of us belonging to the tribe EAA wouldn't bat an eye at seeing a Berkut swoop down to the numbers with its traditional beak and tail pointing the wrong direction. That's how far **we've** progressed.

Dave Ronnenberg and his company, Experimental Aviation (3025 Airport Ave., Santa Monica, CA 90405, 310/391-8645), have taken the basic concept of the VariEze/Long-EZ and carried it to the next level. A long-time builder of Long-EZs (eight to his credit), Ronnenberg didn't start out to have a career building backwards flying machines. He had been a serious model builder when, in his mid-twenties, the death of his brother set him on a new life-path.

After leaving the Voyager project he returned to the LA basin where he continued custom building and became involved with California Microwave modifying Long-EZs to use RPVs. At the same time, he was doing subcontract work for such companies as Yamaha, showing them how to use fiberglass for conceptual work, designing and building prototypes and anything else that came along. He even became involved in a three-wheel

vehicle prototype.

All the time he was doing this work he was working on a new airplane, a new evolutionary step away from the Long-EZ.

"Every Long-EZ I built was non-standard. They had different noses, different canopies, cowls, engines, exhaust systems, induction systems. I kept modifying and improving until by 1985 I had quite a wish list of things I wanted to incorporate into a single airplane. Molding the fuselage was high on that list along with a retractable landing gear and a larger engine.

"Even though I didn't know what gear I wanted to use, I knew I wanted to stay away from mounting it on the outboard end of the main spar. I talked to Shirl Dickey about his retract gear and saw that by lengthening the fuselage to both balance the engine and have a larger cockpit, it also gave me room to mount the gear in the belly. Today Dickey makes my gear legs.

"I wanted to move everything forward because of the Long-EZ's ability to have an aft CG accidentally built into it. Also, I wanted at least 360 cubic inches behind the firewall because I knew the Long-EZ's gross weight was primarily a factor of its ability to climb or perform at higher density altitudes. It all worked together to give more room and more power with a cleaner airframe."

While redesigning the fuselage he worked on another of his wish list items - a completely molded fuselage and wing strake package. To keep the weight down he has gone to carbon fiber in as many places as possible which he says also gives him parts that are totally stable once cured. He has taken advantage of the parts consistency by incorporating much of his jigging indices into the molds so the parts themselves incorporate the important match points. It's a high tech variation on the Tab-A-into-Tab-B concept.

The fuselage skins, for instance, have a waterline clearly molded into them along with positioning points for the strake skins. This eliminates the alignment difficulties often associated with attaching wing strakes to the fuselage so they are matched and have the proper angle.

In as many places as possible, similar match points are tooled in. They are often molded-in-place protrusions which provide self-alignment for another assembly. The landing gear assembly, for instance, is installed this way. Rich Riley, their writer/PR/Do-Everything guy has been quoted as saying they ought to carry the concept to the extreme and just print the plans on the parts.

The only parts of the airframe that still adhere to the original Rutan concept of moldless construction in which hot-wired cores are then covered in glass are the wing panels, winglets and canard. But even in those parts Dave applies a different building technique.

After laboriously correcting the problems endemic in hot-wiring (wire drag, undercutting, chatter, etc.) in the cores in his own projects, he searched for a way for the builder to produce cleaner, truer cores. If the core is perfect, the part will also be perfect and won't require extra weight in the form of fill.

The kit is supplied with hot-wired cores that are approximately 1/4" oversize. Aluminum airfoil templates

are also supplied which are used as sanding guides. The builder makes a long, true sanding block covered in 36 grit which he slides back and forth on the templates to rough the core to shape. Then finer sandpaper is used until the surface is smooth and straight. According to Ronnenberg, this system always yields a part that is die straight with a flawless surface.

Incidentally, the kit also includes plans for a vacuum pump to use in bagging the lay-ups that costs $20 to make utilizing an old refrigeration unit. One of their builders came up with it and calls it "The Cheap Little Sucker."

The power package is a Lycoming IO-360-B1B utilizing one mag and an electronic ignition unit from Klaus Savier's Light Speed Engineering company. During mag checks it was interesting to note the normal 50-75 rpm drop on the mag while the electronic ignition didn't drop a single rev. It acted as if the mag hadn't even been switched off.

The prop on the prototype at the time we caught up with it at Copperstate '94 was another Savier product. A black, evil looking, highly twisted thing, it was a maple/composite unit with specially shaped blades for their aerobatic demos but used the same dimensions as their normal cruise prop, 67" diameter and 91"(!) pitch.

Norm Howell, F-16 test pilot from Edwards and all-around homebuilt fanatic, was doing the honors when I got a chance to fly the airplane.

I was especially glad for Howell's restraint in not laughing when I did the Berkut Boogie in scrambling aboard. The accepted boarding method is to place one hand on the canard and another on the canopy rail. Then with a minimum of grunting you leap and turn at the same time, pirouetting around to hook part of your rear on the canopy rail. Fearful of looking like a wimp, I over did it and nearly launched myself tail first into the cockpit.

Now comes the obligatory prototype statement: The kits make provision for a step. And a step of some sort is sorely needed, especially if the pilot is even less athletic than I am (hard to believe) or has a few female friends/spouse who want a more dignified way of boarding.

Prototypes being what they are . . . prototypes . . . they always have a bunch of things that ". . . will be taken care of in the kits . . ." In the dozens of demonstrators we've flown, not one has been as kitted, so the Berkut is far from being alone in that respect.

A word about canard airplanes and especially those with a tandem configuration. Canards are different than other airplanes, both in the way they fit and in the way they fly. The differences aren't huge and are easily acclimated to by a pilot with some adaptability built into him. To a factory built driver who has limited homebuilt experience, however, just sliding down into the airplane will make him or her feel as if they are boarding an F-16. Or the space shuttle. And that's not far from being the truth. The environment alone is enough to get the juices flowing, both the good ones and the bad, which makes flying the airplane that much more of a challenge.

In the case of an airplane like the Berkut, almost every aspect of it has to

be looked at from two points of view: The first is how it would be viewed by someone with experience in canard aircraft. The second is how it would be looked at by the average pilot/builder (300-500 hours total time, 35-50 hours per year) with no tiny airplane or canard experience.

For instance, sliding down into the cockpit requires threading both legs through cutouts in the bottom edge of the panel and slinking down into a semi-supine seating position. To a Long-EZ driver the fit will feel almost luxurious in both elbow room and general accommodations. Everything fits the way a high-performance pilot sees it in his dreams. A Cessna 172 pilot, on the other hand, is going to feel as if he is being loaded into an artillery shell. Even though it's not even remotely tight (how much moving around do you actually do on a cross country?), it will be perceived that way by a big airplane pilot. To him or her, the smallish instrument panel is going to feel like a lap top computer is strapped across his legs. Once the pilot is accustomed to the environment, his biggest problem will be in staying awake because it is so comfortable.

As it happens, the rudder pedals were too far away for my what are apparently stubbier than average legs and we had to put a thick pack behind me. That, unfortunately, moved me so far forward it screwed up the ergonomics of the stick placement and the canopy curvature. It was nothing major, but noticeable.

Here it is again . . . kit built aircraft have the option of adjustable rudder pedals.

Norm went through the litany of avionics, switches, etc., and it was time to crank. The Lycoming lit off and I felt it, rather than heard it start barking. The airframe is so stiff there was no doubt when the air/fuel mixture was right for firing.

The brakes at first give the impression of being mushy, but we hadn't moved 20 feet when I began to like the way they were modulated. Some steer-by-brake systems are touchy, others not positive enough. This one had a nice soft feel that developed pressure just before actually getting braking so it was easy to steer.

A problem I always have with canards is keeping my feet off the pedals when they aren't needed. Since the rudders are independent, my usual technique of keeping pressure on both pedals always backfires because it deploys both rudders at the same time. Not critical but certainly strange looking to an observer.

The Berkut canopies probably add a lot of complexity and cost to the kit, but from my perspective they are worth every penny. The ability to taxi with one or both canopies open, á la F-4 Phantom, is worth its weight in AN hardware (or gold, whichever is higher). The usual canopy on a canard can't be opened during taxi which puts the occupants in a sweat box during the summer. Taxiing the Berkut like a convertible was nice. Then, just reach up and pull, remembering to get your hands out of the way when it starts down.

Once the canopy was down, I found my forward seating position put the forward canopy coaming in a position that blocked part of the top row of instruments, including the airspeed. Again, adjustable pedals will solve that.

As we lined up on the centerline of runay 12R at the big Williams Gateway airport, I was conscious of a lot of pressure on the side stick from the elevator trim springs. Norm had said it was trimmed okay for takeoff, but there was no trim indicator so that was an educated guess.

The plan was to accelerate to 90 mph, smoothly rotate and climb out. With that in mind, I eased the power in, remembering I might need some brake to steer. It took only one tiny poke with the brakes before the rudders took over. Then it was just a matter of waiting a few seconds until the needle started towards 90 mph. I gently increased back pressure on the stick and found I was still fighting a lot of trim pressure. Norm had said the elevator would blow up to neutral and lighten the trim load. Apparently it needed the trim rolled further back because it took a lot of muscle to get the nose up.

When the nose cleared the runway, the airplane started off the ground and I went to check the nose and to hold that exact attitude. When I did, the nose dropped far more than I wanted with the help of the trim springs and I skipped off the runway. Embarrassing! That was okay, though, because I'd embarrass myself much more later in the flight.

A quick fix for the trim problem would be a trim indicator, which could be nothing more than a paint stripe on the inboard end of a canard tip where the elevator mates.

Once off the ground I found holding the pitch attitude required some careful isometrics of me against the springs until I had enough sense to reach up

with a thumb and toggle the lollipop trim switch on top of the stick back a couple of times. Then life became much more livable.

The airplane was moving around a little because I hadn't yet learned to appreciate how rapidly the airplane responded to any kind of aileron pressure. Any kind!

Retracting the gear was strictly a matter of throwing the small switch between my legs up. If the lights hadn't winked I would have never known anything had gone on, since the airplane didn't do anything unusual.

Norm's patient, reassuring voice in the Bose noise-canceling headsets (which really worked and are a necessity) told me anything over 100 mph

was good for climb. I was doing a solid 110 before I pulled up into the climb and we started upstairs like a bullet. The literature says 2,000 fpm which looks about right, but the airplane felt much better the faster it went. The difference in actual climb rate between 110 mph and 140 mph wasn't enough to really notice, but the airplane seemed much happier and was much more stable at those speeds.

It is important that you picture what flying something like the Berkut looks and feels like from inside the Raybans. For one thing, compared to most airplanes, you're practically lying on your back, which is, of course, an illusion. It's supine, but not very. The instrument panel is just above your knees gently caressing your Levi's and your legs are straight out in front of you. All rudder work is strictly from the ankles down. The legs never move. Glass wraps from just above your elbows, over your head and sweeps down to the top of the panel, giving the feeling the airplane stops just in front of the panel since practically none of it can be seen. Although the canard is out there, it never occurs to you to look at it. It is mentally invisible.

The tiny throttle sticks up under your outstretched left arm and your right arm is slightly, only slightly, bent so your hand can wrap around the side stick. The trim switch is on top of the stick, but a small square box on the side of it has a bunch of push buttons that flip-flop the comm and nav and let you talk to the outside world.

The movements required to control the airplane aren't movements at all. Especially in roll. The old saying about the airplane reading your mind absolutely applies here. In normal maneuvering, the stick doesn't move at all. Just the gentlest of pressures is all that's required to whip one wing down. The pressures required are so slight, sometimes it's hard to tell whether you actually touched the stick or not.

The ailerons have absolutely no break-out forces. Nothing. None. They offer no resistance, so centering the stick is strictly a visual affair because there is no small notch between pressure build-ups letting you know

you've found center.

Furthering the feeling of mind-over-matter aviating is the tremendous roll response/acceleration right around neutral. Just the slightest pressure results in 5-10 degrees of bank instantly.

But, the illusion of whipping around the longitudinal axis is just that . . . an illusion. The actual roll rate isn't all that high and the aileron pressures required to get max rate are also far from being light, especially when measured against the response and pressures right around neutral. The pressures aren't linear.

This is just an analysis of the aileron feel, not a criticism. However, things happen very quickly right at neutral and it is no place for a ham handed pilot. The feel isn't that much different than a lot of canards, but the response is much higher, which is a welcome change.

The airplane also has yaw characteristics that are probably typical of highly swept wings. They give a huge amount of dihedral effect with yaw, so there is a definite coupling of roll with yaw. Swing the nose sideways with rudder and you get some definite roll with it.

The adverse yaw is also interesting. At cruise speeds adverse yaw is close to being non-existent. In fact, because of the roll-yaw couple, you're better off keeping your feet on the floor. Something I never did do very well.

At slow speeds, the airplane has a bunch of adverse yaw. Actually, at slow speeds it has what might be considered to be "normal" coordination requirements while at cruise speed it acts more like a jet.

Once trimmed out in level flight, the airplane just sits there requiring little or no input from the pilot. If upset by turbulence, however, the airplane takes a while to recover on its own. A few pitch stability tests showed the airplane to be statically positive, but not strongly so. Pulled 15 knots off cruise and released, it gently started back down and then surprised me by not overshooting the original speed by more than about 8 knots. It damped out completely with no long terms in two very leisurely cycles.

In setting up for cruise the aerobatic prop made itself known, however, the extreme effort for fuel efficiency also showed. At 2600 rpm, the electronic monitoring panel only showed 19.5 inches of manifold pressure! We were truing a shade under 180 knots (207 mph). Apparently Dave and his guys wind it up a lot faster, around 2800 rpm in cruise, but that seemed awfully fast to those of us used to normal looking numbers. With their earlier engine, which was slightly hot rodded, their speed tests showed 75% cruise to be about 208 knots true at 8,000 feet (1228 mile range, 10.3 gph) and the economy cruise was 187 knots (1514 mile range with 30 minute reserve, 7.7 gph). Race speeds which were officially recorded at various canard bashes ran between 240 mph and 248 mph. It would take a fast wolf to escape this Berkut.

The extreme stiffness of the airframe was very noticeable when cutting through turbulence. Since we were whistling along at over 200 mph and nothing in the airframe was flexing to absorb energy, even moderate chop hammered at us with sharp edges.

Wondering about how I embarrassed myself the second time? The belly board speed brake is a T-shaped handle on the left side of the throttle. The mixture is a much smaller, but still vaguely T-shaped handle on the right side. Guess which one I pulled during slow speed tests for gear and speed brake effects? Like I said, embarrassing.

The gear speed is 150 mph, so it can be used to slow you down, but it really doesn't add that much drag and there is very little pitch change. It doesn't require retrimming at all. The belly board does pitch the nose down and does a lot for increasing speed stability when slow. If the power is up when the board is down there's a lot of buffeting from the pro working in dirty air but that all disappears when the throttle comes back.

The airplane takes some planning in approach just to get rid of the speed. Then it needs careful attention to keep the speed down. Norm wanted 100 on downwind and 90 down close to ground effect to leave enough canard authority in the bank to flare comfortably. Keeping it at 100 mph was a chore in the beginning, since just the tiniest nose pitch change gave an extra 10 mph. Once it got down to 90, it was much easier to control and was close to being speed stable at 85. In this respect, it was very canard-like.

The visibility over the nose is awesome on short approach. Also, once the airplane is slow with the speed brake out, it actually comes down at a much steeper angle than you'd expect for such a clean bird. Many canards need a very flat approach angle. When the glide is broken it takes some concentration to keep from over-rotating because the nose is so low it is almost out of sight. In fact, an attitude that looks to be nearly level is actually a good landing attitude.

Norm was intoning height above the runway as I willed the airplane down the last 5 feet. It was an interesting balancing act between me, the trim springs and an airplane that I knew would dart at the runway if I released any back pressure but would be all too happy to balloon if I increased angle of attack a fraction of a degree. I just kept working at it until the mains thumped on. The nose stayed in the air until I tried to gently lower it, at which time it decided it had had enough and dropped to the ground as if relieved the flight was over.

Solid braking stopped us at the intersection and it showed no urge at all to do anything but roll straight ahead.

About that time I took my first breath since downwind.

Certainly one of the most asked questions about the Berkut is Ronnenberg's relationship with Burt Rutan.

Dave's response is, "When designing this airplane, there were several things I wanted to address and number one was I didn't want to anger Burt Rutan. He's a friend and we have conversations but we don't talk engineering; I don't ask for advice or help. He's keeping an arm's length relationship with me which I think is necessary.

"The airplane exists because of Burt, but only because he designed the airplane from which it evolved. But it evolved without his assistance. He was completely and totally separate. He had nothing to do with the program whatsoever and I think he'd like people to know that."

We didn't discuss the subject with Burt, but maybe we didn't have to. For one thing, the semi-finished Berkut in the Experimental Aviation booth at Oshkosh had the owner's name on it . . . Dick Rutan. Also, Ronnenberg recounted an incident at a past Rutan forum where Burt was saying he would never be involved in the sale of kits and plans again, saying something to the effect of ". . . but if you'd like to see something I like, go see the Berkut."

At this point in time there are nearly 50 kits in the field and Dave Ronnenberg expects at least three at Oshkosh '95. In the meantime, keep your wolves under cover. The Berkuts are coming. ◆