

The

EZ



The business end of the EZ-Rocket is a LOX-alcohol 400 lb-thrust regeneratively cooled engine. XCOR uses an ignition interlock to guarantee the prevention of explosions and hard starts.

**No, really,
we're not kidding!**

BUDD DAVISSON



Rocket



DEKEVIN THORNTON

“So anyway, we thought we’d just put a couple of rocket motors on our Long-EZ. You know, just to prove the concept, and when we get funding, we’re putting together a thrill ride that will travel vertically at 3.5 Mach and take people into suborbital flight and ...”

It’s at about this point in a conversation that you normally tune someone out. Rocket motors? Yeah right! Didn’t I see you in an old aviation documentary riding a bicycle with a rocket on your back? And did your burned butt ever heal? Suborbital thrill ride? Give me a break!

Oh, wait a minute. You say you’re from Mojave, California. That’s different. All right, let’s hear the rest of the story.

That’s all it takes to elevate someone from “av-kook” status to credible aviation innovator: being from California helps, but being based on the Mojave airport says, at the very least, that you’ve chosen to associate with folks whom many in the world may *consider* to be kooks, but they are some of the most successful, innovative, and highly respected kooks in the world.

At Mojave, the uncommon is commonplace. That’s why seeing what appeared to be a normal Long-EZ blast off the runway, scribe in smoke a steep chandelle up to an impossibly high downwind, and then glide back to the runway barely raised any eyebrows. This was Southern California. This was the Mojave Airport. That

kind of thing is supposed to happen.

XCOR’s rocket-powered EZ is not, we repeat not, just a gee-whiz, let’s-see-if-we-can-do-it hot rod experiment. It has a definite purpose; it is designed to prove to a doubting public *and* a skeptical financial community that everything the general public knows about rockets—most of which is based on either World War II V-2 films or hearsay—is wrong.

Dan DeLong, XCOR’s chief engineer and owner of the EZ that became the EZ-Rocket that amazed the crowds at EAA AirVenture Oshkosh 2002, says, “Rockets can be made to be just as reliable and safe as any other form of propulsion, but what we’re really trying to prove is that we can produce that reliability and phenomenal power at a fraction of the cost normally associated with man-rated rockets.”

DeLong and XCOR are from the part of the population that many judge to have their heads in the clouds. That, too, is wrong. They don’t have their heads in the clouds; their heads are way, way above—in near space.

Bridge to Space

“Our goal, as a company, is to eventually provide a low cost link to space,” DeLong says. “More properly, we want to show that there are much less expensive ways to put a package into orbit than current methods allow. It now costs approximately \$13 million to put a thousand-pound object into orbit, and we feel we can do it at a fraction of the cost. But, we’re going to work up to

JIM KOERNICK



The EZ-Rocket takes off...

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that level a step at a time. The EZ is the first step.”

DeLong is not a dreamer. You’ll never hear him say, “Oh, you don’t have to be a rocket scientist to understand that,” because he and his XCOR cohorts are rocket scientists. Well, that’s not correct, either. “The whole rocket scientist thing is right up there with archeology,” DeLong says. “It’s old-fashioned.



...then, with ventral landing brake deployed, dead-sticks in for a landing.

It a rare homebuilt that has Helium and LOX gauges fitted to its instrument panel.

We're rocket engineers."

Most XCOR employees are out of the aerospace industry, and DeLong and a few others are veterans of another rocket startup company. When that company went nowhere, they felt so strongly about what they were doing that they decided to keep the process going and formed their own company.

"We went looking for work space, and since we didn't have a huge amount of funding, we were limited on what we could afford. Naturally, we liked the feel of Mojave, and when we went up there, the airport manager made us an offer on hangar space we couldn't pass up. Then we began building test engines."

XCOR first traveled to Oshkosh in 2001, bringing with them a rocket motor you could hold in one hand. It was basically a machined brass cylinder connected to fuel and an ignition source that you could turn on and off at will. It produced 15 pounds of thrust. They also had their EZ-Rocket there, but it didn't fly the AirVenture crowd like it did in 2002.

"The EZ-Rocket is sort of a funny story," DeLong says. "We went looking for a pilot and naturally thought of Dick Rutan. But we didn't know if he'd have any interest. At first he got real quiet, then said, 'An EZ with a rocket, huh?' Then, he said it again, 'An EZ with a rocket, huh!' The next day he called and said, 'Yeah, why not?'"

"We had a big motor running in the EZ before that first AirVenture, but we planned on putting the airplane on static display because we hadn't flown it. Then, just before the show, Dick was out taxi testing the airplane. We were watching him, and one of the guys said, 'He's sure letting that engine run a long time,' and about that time the airplane lifted off. We hadn't planned



JIM KOEPNICK

on flying the airplane because, among other things, it only had one engine. Still, there it was flying along over the runway. Then, he shut it down, and we drove out to retrieve him. When we caught up to Dick, he knew what we were thinking, and he said, 'I'm not going to be associated with a company at Oshkosh that brings an airplane that hasn't flown.'"

At the time of the first flight, the sun was already down, and there weren't any instrument lights, so Dick couldn't see the instruments, and the onboard camera wasn't even installed yet.

The flight capped a monumental drive to get ready for EAA AirVenture, and "We were all totally burned out, but we wanted to be at Oshkosh in the worst sort of way," DeLong says. "Within a few hours of the flight, we were designing fixtures to mount the EZ on a trailer. Then, three guys piled in a truck and drove straight through to Oshkosh—a 30-hour trip. We showed up a day and a half late and immediately held a press conference to let the world know we existed."

DeLong's background is not only varied, it may be exactly what's needed for this project because it seems to be formatted around the concept that "regardless of how high tech something looks, there's

always a cheaper way to do it and still maintain the level of quality."

When he came out of Cornell in 1974, DeLong worked for a number of engineering companies, one of which built a series of two-man, dry submarines. This company also had the contract to Lotus car that turned into a submarine for the James Bond movie, *The Spy Who Loved Me*, which really was a working submarine. Shortly thereafter DeLong began working for Perry Submarine.

"This was about the time the government was going full bore building deep submersibles that could be used, among other things, for rescuing submarines. They went to one of the leading companies in the field, and they did get their sub. The price tag was \$80 million. A few years later the British government came to us to design a sub that would perform exactly the same functions. They got their sub, too, and about the only difference between the two was that ours cost only \$750,000, plus it could be shipped by air. We think we can bring the same degree of savings to getting into orbit."

Certainly the majority of the population has had their mental image of rockets formed by the well-publicized explosions of rockets during ignition. Then there's the question of ignition itself: What if



EZ-Rocket pilot Dick Rutan.

ARNOLD GREENWELL

you get into orbit and can't relight your motor to come back to Earth? In that case, it's pretty certain no one is going to come up and tow you home.

"The explosion problem and the ignition reliability factors have always overlapped," DeLong explains. "Plus, there's a big difference in the fuel we're using. Older fuels were highly toxic and corrosive, as well as being prone to explosive behavior. Tales of fuel leaks melting the pilots didn't gain any friends for the rocket community either. We use isopropyl alcohol and liquid oxygen, LOX.

"Many of the earlier rocket explosions were caused by ignition problems where fuel would begin to flow but the igniters wouldn't work, allowing fuel to pool in the engine. Then the igniter would fire with the predictable result.

"We use a processor to control the starting sequence, but even so, we've developed a method for handling the fuel-pooling problem. Our igniter is mounted in a small chamber of its own—a tube, if you will—that is ported into the combustion chamber. At the top of the smaller chamber is a pressure switch along with the igniter and a small fuel inlet. In effect we have a separate, tiny rocket engine pointing into the main chamber, and we're using it as the firing mechanism. When we trigger the igniter, a small amount of fuel is metered into the tube, and when that fires, pressure closes the

switch, starting fuel flowing to the engine. In other words, if the ignition system isn't working, no fuel is flowing.

"We also flow the fuel through a jacket around the rocket which both warms the fuel and cools the rocket. In the past this type of technology was expensive and hard to do, but with computerized machining capabilities, that's no longer the case."

The bottom line of all of the experimentation and the EZ-Rocket is that XCOR has a solid handle on what it takes to design and build a cost-effective, reliable, and safe rocket, which is exactly what the pundits say is necessary to make space more accessible.

Space Thrill Ride

But that's only part of the story. The bridge between the EZ and XCOR's space shuttle is a little bird named Xerus. This is what promises to be the ultimate E-ticket ride. "We've been contracted by an adventure travel agency that was the pipeline for the recent sale of a seat aboard the Russian space shuttle and routinely puts civilians in MiG-25s. They have guaranteed us 600 sold seats for our Xerus program."

Xerus is an up-and-down vehicle that is part space shuttle and part roller coaster. It seats one passenger and the pilot and, with the aid of four larger XCOR rockets (currently under development), goes up with a vertical velocity of 3.5 Mach, achieves a suborbital altitude (high

enough to qualify the passenger for astronaut wings), and then glides back down to Earth. The entire experience takes about 40 minutes, and the quoted firm ticket price is \$98,000. Don't laugh. Remember this is the same adventure travel agency that got a rock singer a slot on a Russian space shuttle, and XCOR is flying a Long-EZ with custom-made rockets, so this may be a union made in...well...made in Mojave.

The Xerus will be state of the art, and because it doesn't need to return from orbit, it can be a little less robust than a space shuttle and a little more like an airplane. It'll lean heavily on carbon fiber and graphite for its structure.

"We already have a sizable amount of design work done, so it's well past the dream stage," DeLong says. "The engines and their propellant pumps are being developed under a military satellite launch contract. XCOR expects to have hot fire test starting within a year. The airframe design is lagging behind that schedule but making progress."

One of the most exciting things about watching Dick Rutan on his low passes while doing multiple rocket firings is that this isn't even the tip of the iceberg; there is so much more to come. XCOR has its eyes on the stars but its feet on the ground. The difference between it and so many other companies is that the ground on which it is standing, Mojave Airport, has been made hallowed by so many visionary designs and so many innovative aviation firsts.

If you're an innovator in a sea of conformity, which is usually the case, you fight an uphill battle. If you're an innovator amongst innovators, then you are bolstered and supported by the energy around you, and that often is the difference between success and failure.

Who knows, maybe there's a rocket in your future. You could even be the first on your block to qualify for astronaut wings. 