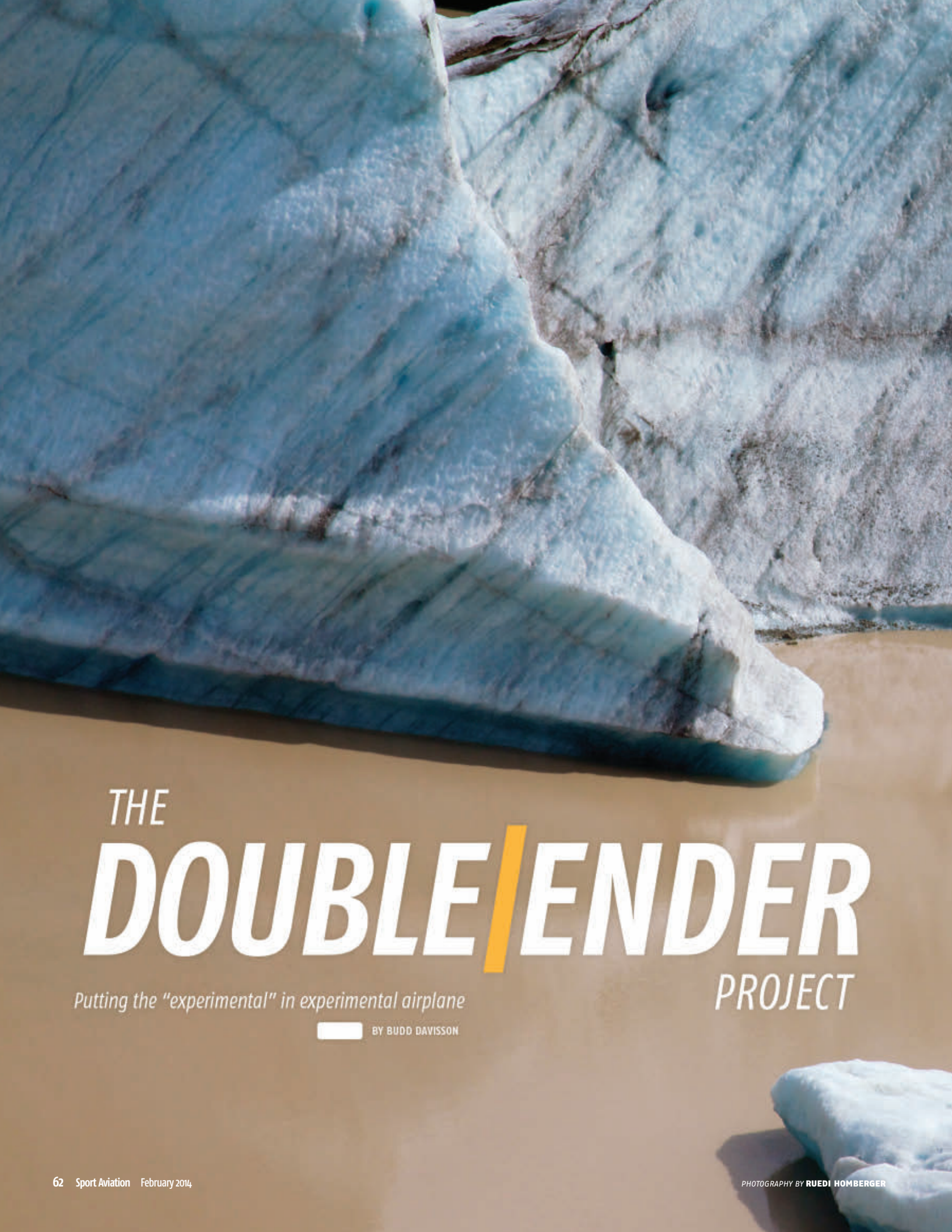

# THE DOUBLE/ENDER PROJECT

*Putting the "experimental" in experimental airplane*

BY BUDD DAVISSON



PHOTOGRAPHY BY **RUEDI HOMBERGER**

**THERE IS SOMETHING** addictive about the concept of landing an airplane in places where airplanes aren't supposed to be able to land. This coupled with an unexplainable urge to see seldom-visited parts of this planet has given rise to an explosion of aircraft designers and designs, all of which strive to capture the Super Cub's crown as king of the backcountry airplanes. Most of the new crop are some sort of Cub clone. However, Alec Wild and his team's DoubleEnder is definitely not a Cub clone. In fact, the DoubleEnder may well be the true definition of "experimental airplane." It is in a continual state of modification—experimentation, if you will—with the design and each change aimed at better accomplishing the short-field, bush-flying goal while, at the same time, increasing safety in an inherently dangerous environment.

Let's put the short-field, bush thing in perspective: A tennis court is 78 feet long. A city block, depending on the city, is about 300 feet. Lots of airplanes can take off and land in those distances. Look at the Valdez, Alaska, contest results, for instance: Frank Knapp's self-designed and homebuilt *Lil' Cub* (See the January issue of EAA's *Experimenter* digital magazine) won the experimental category with takeoff and landing distances of 58 and 54 feet, respectively. Of course, he had maybe 5 gallons of gas on board, was stripped of everything not necessary to make it fly, and was the airplane's sole occupant. These are not practical, real-world results. However, according to Alec, his DoubleEnder can easily land with zero wind and at gross weight (two FAA-sized people, full tanks, and a bunch of cargo: useful load is 1,000 pounds!) in 120 feet. Further, its landing gear and tires meet the critical bush requirement of being able to plop down on almost any reasonable surface. This is real-world, useful performance. Not contest numbers.

Oh, one other very unique claim the DoubleEnder can make is that it can have an engine failure on takeoff and just keep on flying. In the bush environment, that's a life-saving capability.

Right up front it should be made clear that the DoubleEnder project, as they call it, is a work in progress and nothing is currently for sale. Alec says, "At some point we will offer it as a kit. It is just a matter of time. Our issue is that our preference is to design new airplanes rather than work on the sales side of things. We'll do both, but our main goal remains to advance the concept of STOL through the design of truly modern bushplanes. At this stage we will not sell the plans. Right now we are concentrating on designing the side-by-side version of the DoubleEnder and the single-engine pusher version. Once they are done and tested we will hopefully offer kits for all three designs."

Incidentally, to answer the question some have asked, Alec says, "Yes, a multiengine rating is required to fly the airplane."

The goals of the rather unusual appearing design evolved out of Alec's personal experiences in the bush environment.

"I started flying in a Super Cub when I was about 16. My dad was a pilot, and my first experimental airplane was an experimental Super Cub that I purchased and flew around in Alaska, as well as doing a bunch of bush flying in Africa in support of wildlife programs. I still have my original Super Cub today."

Generations of bush pilots worldwide have put the Super Cub at the top of their list in terms of an airplane's ability to get them in and out of nearly inaccessible locations. But, as anyone in Alaska, Africa, or any other country with serious wilderness will tell you, the terrain and conditions often place


*The pilot is on short final to an even shorter sandbar, a common bush flying technique.*

limits on Piper's iconic bush baby, just as they do on any airplane.

Alec says, "As I was flying around, thoughts began to form in my mind beginning with the simple fact that the best tool presently available for bush flying was designed in the early 20th century. The basic design is 75 years old! We should be able to improve upon that with today's technology. There was no single moment that inspired me to design and build a second-generation bushplane. It came on me slowly through experience and seeing what several other airplanes incorporated into their design.

"As I thought about the Super Cub's limitations and what I would change, safety was always number one. Performance was essential, too. Then there was increased visibility both for the usefulness and the thrill. I also liked the idea of side-by-side so that a passenger can enjoy the same view as the pilot. We put the DoubleEnder team together in 2007 and got serious about designing what we thought of as a new-generation bush, or utility, airplane."

The DoubleEnder project team is small, but each brings definite expertise to the work at hand. Alec says, "Doug Keller is our structural engineer. His background includes doing work for Cub Crafters, Sherpa Aircraft, and others.

"Eric Lewis has been part of the team since the beginning, and he's our hands-on guy doing both building and maintenance. He did most of the work on the prototype airplane.

"Pete Anderson came on board in 2011 and works with Eric building stuff and doing modifications, which is an ongoing process."

Alec strives to emphasize that surrounding the core team is a lot of other people who were, and are, contractors for tooling, machining, aero design, CNC work, etc.

The final product (which isn't even close to being final) looks unique, to say the least, but every aspect of it contributes to an airplane that does the Super Cub one (or two) better. On the one hand, it appears as if someone who didn't know how to design an airplane designed one, but on closer inspection, you find it aggressively attacks some of the more common problems and concerns that bush pilots have, chief among them being safety.

Two things generally lead the safety list in a bush situation. First is dealing with the possibility of an engine quitting or refusing

*Alec Wild, founder of the DoubleEnder project, and structural engineer Doug Keller, aim to build a new-millennium bushplane.*

*The only thing in front of the pilot is Plexiglas and structure, which is designed to fail and absorb energy before it gets to the pilot.*

PHOTOGRAPHY BY **JEAN-MARIE URLACHER** AND **RUEDI HOMBERGER**

*One of many wing designs tried featured double-slotted Fowler flaps, but they were deemed too complex.*

*Flaps are now a double-slotted hinged design extended toward the tip with spoilers to help with low-speed roll control.*

to start and stranding you. Either way, you're in serious trouble. The obvious way around worrying about losing an engine is having two. That, however, introduces the concerns inherent with maintaining control with a conventional twin when an engine fails, hence the push-pull, centerline arrangement of the DoubleEnder. Losing an engine just means losing half of the 260 hp available, but doesn't mean losing the airplane.

Alec says, "One of our design goals was to have good single-engine performance up to 10,000 feet regardless of the load. To allow that while flying at max gross, including the 55-gallon (330-pound) belly tank, we incorporated the ability to dump the fuel out of the belly tank in just a few seconds. We also wanted it to be a benign airplane to handle on one engine, which is the nice thing about the centerline arrangement: The loss of an engine just means losing some performance. Control isn't affected at all."

Fuel is fed from a 24-gallon tank in each wing. Normally, the left tank operates the front engine, and the right tank operates the rear engine. But, they can cross feed, the engines can run on both tanks at the same time, or both engines can run on one tank at the same time. The belly tank uses a transfer pump to get fuel up to the wing tanks.

The powerplants are 130-hp Rotax 914s that in the process of experimentation have driven a wide variety of props including Warp Drive, Kiev, DUC, Airmaster, Catto, etc. Alec says that, "As of today our favorite prop is the Warp Drive three-blade, 72-inch diameter."

Even from a distance, the helicopter-like visibility of the nose is obvious, but as the fuselage is examined, it becomes even more obvious that a lot of thought has gone into the structure behind the omni-vision bubble.

"The ability to see the touchdown point throughout the landing is critical for short-field operations," Alec says. "As is being able to see rocks and holes in the touchdown area during landing roll-out. However, we wanted the pilot to be protected against impacts from several directions: vertical impact, frontal impact, or a nose-over. The front of the fuselage incorporates a crush cell that is designed to absorb the forces of an impact, which protects the rest of the fuselage and the pilot."

The heart of any airplane is its wings and the lift they produce. In the case of the

*Visibility was one of the primary design goals, along with twin-engine safety. The DoubleEnder can safely fly on only one of its 130-hp Rotax engines.*

PHOTOGRAPHY BY **JEAN-MARIE URLACHER** AND **ERIC LEWIS**

DoubleEnder, it can safely be said that they've built and flight-tested nearly every commonly known method for squeezing the most lift possible out of a wing at the slowest speed possible. This includes two different airfoils, three different flaps, and four different slats. The structure of the wings is fairly conventional fabric-covered aluminum with drag and anti-drag wires, although, in some areas, the wires have been replaced by tubes for structural reasons.

## SEE THE VALDEZ STOL AIRCRAFT FLY AT OSHKOSH

The amazing capabilities of the Valdez STOL aircraft will be on full display at EAA AirVenture Oshkosh 2014! These specially built and modified aircraft, originally created for Alaskan bush-pilot necessity but also the inspiration for one of the world's most unique aviation competitions, will be part of the "Valdez STOL" (short takeoff and landing) flying activities during the week at Oshkosh.

Demonstrations featuring the amazing airplanes that compete at the annual Valdez, Alaska, fly-in and air show in May each year will be held several days at Oshkosh. More than a dozen of these aircraft, including homebuilt and specially modified production airplanes, are built to provide supplies to the rugged and far-flung outposts throughout Alaska. The demanding terrain in that state requires that aircraft take off and land on rough runways often less than 500 feet long.

Along with flying demonstrations during AirVenture's daily afternoon air show on July 28-30, the Valdez STOL aircraft will stage a "fun flying" demonstration from the grass ultralight runway on Friday evening, August 1. In addition, the aircraft will be on display in special parking areas near the Vintage area and on the main showcase ramp at Oshkosh, with pilots and builders part of forums and evening programs throughout the week.

"Most people think of airport runways of concrete a mile or more in length, but these aircraft can land on almost any flat surface—sometimes in less than 100 feet," said Jim DiMatteo, EAA's vice president of AirVenture features and attractions. "The necessity of creating aircraft that can serve Alaska's remote population also inspired a competition that is nothing like you'll see in the Lower 48."

Further details and schedules of the Valdez STOL aircraft activities will be announced as they are finalized.

Alec says, "The double-slotted flap arrangement we currently use is a manual system that includes a dropped-hinge mechanism, while the first was an electric system that used tracks and offered a huge Fowler motion (about 14 inches of rearward travel). The Fowler motion and electric system offered better aerodynamics, but there is something to be said about the simplicity and reliability of a manual system. This is even more important given that this is a bushplane and the remote areas it is designed to fly in. Simple is better for many reasons, especially when it needs to be fixed or serviced in the middle of the bush. The deflection is about 50 degrees.

"At first we tried drooping the ailerons with the flaps for more lift but were dissatisfied with the roll authority when really slow, so we eliminated it. Now, instead of drooped ailerons, we have greatly increased the span of the flaps, and use roll control spoilers in addition to the ailerons that are placed ahead of the flap area and are linked with the ailerons to help the roll response at the slowest speed."

On the leading edge of the wing, one only has to view the details in the photos of the airplane at various stages of its development to see a wide variety of slat designs and operation.

Alec says, "We've had three different slat methods—all of them movable. They each had their pros and cons. The initial slats simply pivoted. While they offered great performance at slow flight, they gave us too much drag in cruise. We developed our second set, which was on rails (similar to the Handley Page slat). The downside to that system was weight. Our last version uses pivots and is a good compromise between weight and performance. They offer the same slow-flight performance and completely eliminate the cruise drag, while keeping the complexity and weight of the system to an acceptable level. All the slats we have experimented with are aerodynamically controlled. We did not want to increase the pilot workload by having a manual setup. The slats come out on their own when needed, and retract automatically when they are not necessary."

As for the covering and cosmetics of the airplane, it has been covered in Stits with PPG paint and the prepainted Oratex 6000 system from Germany that is gaining favor up north. Alec says the Oratex fabric allows a weight savings of about 25 pounds on the complete aircraft.

Being an experiment in process, the performance numbers are continually improving as they design, test, and modify the airplane. The version they were flight-testing at press time gave some impressive numbers.

"The landing approach speed (which really means the approach angle of attack) is 36 mph," Alec says. "That is quite a bit higher than the ultimate stall speed, which is under 30 mph, so there is positive control throughout and leaves a large safety margin. When light and the pilot is familiar with the airplane, the approach speed can be less than that."

Many of the specialized super-short-field airplanes, as seen at the Valdez competition, can take off and land terrifically short (when loaded light), but their cruise speed is greatly compromised, which limits their usefulness. Alec says the DoubleEnder will cruise at 112 mph even when wearing 35-inch (that's right, 35-inch) tires. So, when equipped for the roughest possible terrain, the airplane still has reasonable cruise speeds.

Regardless of what the DoubleEnder project mutates into, and whether plans or kits are available for it or not, their research and in-the-field experimentation is already yielding great dividends for STOL (short takeoff and landing) aviation. When they are finished, we are going to have empirical (as opposed to theoretical) answers as to what actually works in the STOL environment. Better than that, if they go into kit or plans production, we'll take a step over the threshold into STOL 2.0 with safer, albeit unique, answers to the age old question: How short is too short? EAA

**Budd Davisson** is an aeronautical engineer, has flown more than 300 different types, and has published four books and more than 4,000 articles. He is editor-in-chief of *Flight Journal* magazine and a flight instructor primarily in Pitts/tailwheel aircraft. Visit him on *www.AirBum.com*.