

# Starting from Scratch

## Learning to Fly EAA's Wright *Flyer* Reproduction

BY ROBERT N. ROSSIER ■ PHOTOS BY JIM KOEPNICK

Checking out in a new aircraft is usually a two- or three-step process. The first step is ground school, where we pore over the approved flight manual and learn the aircraft's systems, operating limits, performance characteristics, and normal and emergency procedures. Next, if we're lucky, a simulator augments the process, allowing us to practice procedures and test the outer edges of the operating and performance envelope without risking life, limb, or bent aluminum.

Then comes the actual flight training, where under the tutelage of an experienced flight instructor, we put the book learning to practice. As part of the process, and before we go solo, we work through all the normal and emergency procedures, and become acquainted with the specific flight characteristics for





Above and previous spread, towed behind a vehicle at approximately 27 miles per hour, the 1902 Wright glider—with modified canards to give it some manners—gives EAA's Countdown to Kitty Hawk pilots a feel for what it will be like to fly the powered *Flyer* on December 17th in Kitty Hawk. Right, famed test pilot Scott Crossfield briefs pilot candidate Terry Queijo and back-up pilot Ken Hyde.

the various regimes of flight from slow flight, stalls, and steep turns to takeoff, cruise, and landing.

But what if you don't have that approved flight manual? What if there's no experienced instructor? Then what do you do? That's exactly the problem faced by the intrepid pilots who will re-enact the Wright brothers' first powered flight on December 17, 2003 at Kitty Hawk, North Carolina—the site of the first powered airplane flight a hundred years ago.

### Back in Time

When it comes to the training needed to "check out" in EAA's Wright *Flyer* reproduction, there's nobody around anymore who really qualifies as an instructor. Like Orville and Wilbur, they are starting from

scratch and learning as they go. But the team assembled to put the exclamation point on EAA's Countdown to Kitty Hawk celebration (presented by Ford Motor Company and supported by Eclipse Aviation, Microsoft Flight Simulator, and Northop Grumman) has a few aces up its sleeve. In charge of the training program is former NASA test pilot Scott Crossfield of X-15 program fame, whose vast experience in a broad spectrum of flight test and space programs is proving invaluable.

The four pilots selected for the program are also uniquely qualified to participate in the program. Retired airline pilot Ken Hyde is the founder of The Wright Experience, and has built and flown numerous Wright-era aircraft, including the

replica of the 1902 Wright glider as well as the 1903 Wright *Flyer* reproduction to be flown in December. Chris Johnson is an Air Force Reserve officer and airline pilot who owns and flies a Luscombe 8E and a Cessna 180, and co-owns a Grumman TBM-3E Avenger. Dr. Kevin Kochersberger is a professor of mechanical engineering at the Rochester Institute of Technology, and has extensive experience both as a sailplane pilot and as a hang glider pilot. Terry Queijo is an airline captain flying Boeing 757/767, a veteran skydiver, and light plane pilot. Even for such highly accomplished professionals, preparing to fly the Wright reproduction is a challenging prospect—and is unlike learning to fly virtually any other aircraft.

### Unlearning to Fly

Most of the time when we check out in a new airplane, a great deal of our experience readily transfers to that craft. After all, most airplanes have the same basic controls, and similar flight characteristics. Not so for the Wright *Flyer*. "It's completely different in every way as far as flight controls go," says Terry Queijo. "From altitude control to lateral control, the controls are completely unlike anything else."

Indeed, a quick look at the *Flyer* reveals what we now consider to be very unconventional controls. A hip cradle that moves side-to-side controls bank, and a horizontal bar that moves up and down controls pitch. Having such unconventional controls puts a trained and experienced pilot at a disadvantage. "Negative transfer is a real problem," explains Crossfield. "Things you would do intuitively as a pilot in any other airplane just don't work with this one."

In addition to the odd control system, the pilots must adapt to an aircraft with very limited maneuverability and control capabilities. "The airplane has no static stability," says Queijo, "so you have to constantly stay on top of it. It can suddenly go off in any direction as it responds to even the slightest breeze or thermal."

Turning the aircraft—or keeping it flying in a straight line—is no simple task. Rather than the modern-day system of ailerons and rudder, the Wrights' approach to roll control was wing warping, in which the camber of the wing is changed to increase or decrease lift, resulting in serious adverse yaw. "Wing warping is way overrated," notes Crossfield. "It gives the aircraft some very poor flight characteristics. The adverse yaw causes some strong over-controlling characteristics. The Wrights really weren't able to maneuver the '03 *Flyer*. They could pretty well keep it going straight, but they really didn't figure out the control problems until 1905."

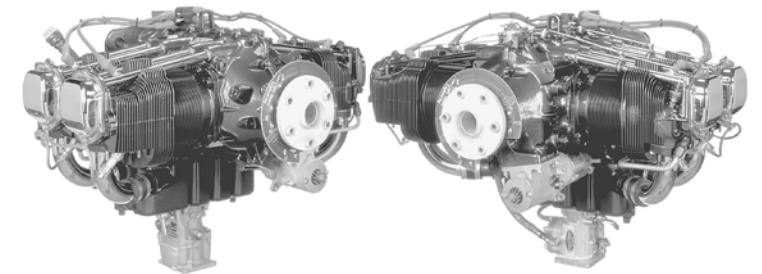


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Other control problems plague the flight team as well. As Crossfield notes, there's not enough elevator authority to flare the aircraft for landing, so the only way to do it is to glide downhill. Regardless of that simple fact, it's an uphill struggle.

#### Reverse Engineering

Despite the problems of negative transfer, one potential advantage today's pilots have over the Wrights is the knowledge available from reverse engineering. Earlier this year, wind tunnel testing of the Wright reproduction was conducted at the Langley Full Scale Tunnel (LFST) at NASA's Langley Research Facility in Norfolk, Virginia (see *EAA Sport Aviation*, July 2003, p. 74). One objective of the testing was to determine the flight and performance characteristics of the aircraft. Perhaps even more importantly, the data from these tests was intended to develop a high fidelity simulator, which could be used to train the pilots who would fly the aircraft on the centennial celebration.

According to Kochersberger, the '02 glider simulator was very helpful, and he anticipates the '03 simulator will enhance the training as well. The simulator has the same hip cradle and canard controls as the '03 *Flyer*, but with no motion. The device is wired to a display that provides visual feedback, much like any flight simulator operating on a personal computer.

"The wind tunnel data provides about 80 to 90 percent of what you need," says Kochersberger. "The other 10 to 20 percent is the dynam-



Scott Crossfield mans the tether attached to the 1902 glider.

ic data relating to the aircraft forces and loads as it maneuvers. Normally, after we fly, we take that data and go back to make corrections to the simulator. That's what we've done for the '02 glider, and the simulator for that now has extremely good fidelity."

Data from the wind tunnel testing is currently being integrated with the simulator software, although it isn't clear how accurately the simulator will reflect the characteristics of the actual '03 reproduction. Still, other training tactics may compensate for any shortcomings, and ultimately provide a highly realistic training environment.

#### Progressive Training

The best recipe for training the replica pilots, and the one that Crossfield and the pilots are banking on, is to follow essentially the same progression that led to the Wrights' success. "We're following pretty much the same path as the Wright brothers," explains Crossfield. "We begin by getting as much experience as we can

in the '02 glider before we move on to the *Flyer*."

The path to success isn't exactly smooth, and the process of training in the '02 glider has revealed yet another challenge to be overcome by the pilots: control coordination. "The airplane has very poor control harmony," notes Kochersberger. "It is 10 times as pitch sensitive as anything I've flown, and about a 10th as sensitive in roll."

Still, the '02 glider really is a good place to start. "It's lightweight, has relatively little inertia, and is pitch sensitive," says Kochersberger. "The only dramatic difference is that the '02 glider is not as pitch unstable as the '03 *Flyer*, so we'll have to prepare for that."

Pitch instability may be the crux of the training for the *Flyer*. To help make that transition, the second phase of the training was designed to take advantage of what had been learned about the flight characteristics of the '03 *Flyer*, and modify the '02 glider to match those characteristics as closely as possible. In partic-

ular, the canard configuration from the '03 *Flyer* has been adapted to the '02 glider to create a hybrid that should give the pilots a leg up when it comes to making the transition. The center of gravity has also been modified to more accurately reflect the '03 *Flyer*. In July, the pilots began training with the modified '02 glider, and so far the program is going well. "The goal is to make the transition to the reproduction as much like going from one model to another as possible," says Crossfield.

#### Stumbling Blocks

Despite the success of the training program to date, several stumbling blocks have been encountered. Although there is no aircraft flight manual per se, a great deal has been learned by scouring the data and poring over the many notes and documentation the Wrights produced throughout their dogged pursuit of powered flight. "Quite frankly," says Crossfield, "we've had all the same troubles the Wright brothers had." The team has had to sort out a multitude of problems, such as control rigging details and issues with the drive train, and resolve them using the same technology and materials available to the brothers a hundred years ago.

"The one thing the Wrights did have was lots of flying time in the '02 glider," says Kochersberger, and gaining that advantage has been a stumbling block as well. Wet and inclement weather this spring put the program on hold. Another glitch came when pilot Ken Hyde



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Pilot candidate Terry Queijo gets airborne.



Pilot candidate Kevin Kochersberger gets some sim time and some air time, below.



of The Wright Experience suffered a broken arm in an accident with a replica 1911 Wright Model B. The team is now pretty well back on track, and as of this writing, the pilots have completed about 150 flights and covered some 60 miles.

At EAA AirVenture Oshkosh this summer, the field of four pilots vying for the chance to make the historic flight was narrowed to two: Kochersberger and Queijo. But the concerns over the schedule and more potential stumbling blocks still linger, and despite the selection, all four pilots are continuing the training. "We have to be ready in case something unforeseen happens," says Crossfield.

#### *Final Preparations*

The team is now nearing the home

stretch, and is about to enter the final stage of training. So far, all the training has been done in a towing mode, with the glider towed behind a Ford Explorer traveling at about 27 miles per hour. "The next step," says Queijo, "is to transition to actual gliding flight. Once we've done that, I think we'll really be ready."



That phase is planned for a three-week period from late October through early November, and will be conducted somewhere on the Outer Banks, near where the Wrights flew. If all goes well, the pilots hope to have a chance to test the '03 reproduction before the re-enactment flight scheduled for December 17.

"We've been very lucky to have Crossfield's expertise at the helm," says Queijo. "He was really able to anticipate the problems and has made the training as safe as possible." Still, there are more hurdles to overcome. As the time for the flight of EAA's Wright *Flyer* reproduction nears, the biggest hurdle still appears to be the weather.

"The Wright brothers flew the aircraft at 30 mph into a 25 mph wind, so they only had a ground speed of 5 mph," explains Kochersberger. "We will likely be flying the aircraft with much less wind, and we may have a considerably higher ground speed, which makes it a little more risky." Not only is there a concern that someone could be injured, but any substantial damage to this one-of-a-kind aircraft could result in a missed opportunity, and serious disappointment for all those who have worked so long and diligently on the program.

Still, all the players express confidence that the training will be successful, and the flight will go as planned. "I'm confident that we'll do what we set out to do," says Crossfield, "and these four pilots are the ones to make it happen."