A COLLABORATIVE

KR COMMUNITY

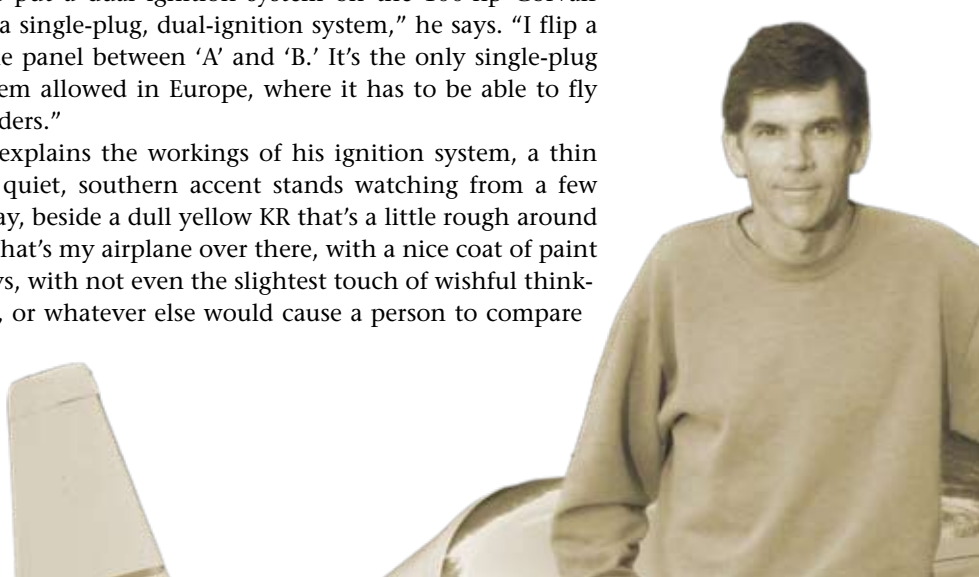
Mark Langford's diligence helps other builders fly

BY GREG LASLO | photos by Michael Steineke

A few people are still milling around the airplanes parked in the Hallmarks of Homebuilding area at EAA AirVenture Oshkosh 2006, though most are finding seats for the air show, which has started about 100 yards away. Already, some pilot or another is gunning the airspeed before pitching up for a loop or around for a snap roll.

Several of the lurkers have stopped about halfway down the row dedicated to Rand Robinson KRs, in front of a red-on-white KR-2S with half its shark-tooth cowl open. Bill Clapp's airplane would be a head-turner anyway, but presently, he's explaining—shouting—how he put a dual ignition system on the 100-hp Corvair engine. "It's a single-plug, dual-ignition system," he says. "I flip a switch on the panel between 'A' and 'B.' It's the only single-plug ignition system allowed in Europe, where it has to be able to fly on five cylinders."

As Clapp explains the workings of his ignition system, a thin man with a quiet, southern accent stands watching from a few airplanes away, beside a dull yellow KR that's a little rough around the edges. "That's my airplane over there, with a nice coat of paint on it," he says, with not even the slightest touch of wishful thinking, or irony, or whatever else would cause a person to compare the two.



Bill Clapp's red-on-white KR-2S hides a 100-hp Corvair engine under its shark-tooth cowl.

That's because when you take away a few personal touches and some new-and-improved tweaks, Clapp's aircraft—along with a couple of others parked nearby—are clear descendents of an airplane that this man, Mark Langford, has spent the last dozen years building and refining. And while these aircraft flew before his was even completed, Langford—and his builder websites—have become the go-to sources for builders of this type.

Truth be told, Langford's KR still isn't exactly done, which is why it looks, well, not done. Langford hasn't painted it beyond shooting a couple of coats of primer on the top and a protective paint layer across the bottom to keep the engine oil out of the fiberglass. It seems he's been busy, first, working with other builders documenting the entire building process for the world to read and, more recently, test-flying his KR to find out just what the little airplane can do. It's not a stretch to say, then, that part of the reason Clapp and others are finished and flying—including several on this row that arrived together in a group flight from KR pilot Mark Jones' place in Waukesha, Wisconsin—is exactly because Langford's not done yet.

"This is really about a community," Langford says. "It's an Internet collaboration of people who really know what they're doing and have resources to bear, people who have their own little area of expertise."

OVER AND OVER

Langford calls his nearly finished product the next-generation KR-2S. The KR-2S, of course, being the current derivative of the KR-2 originally designed in the 1970s by Ken Rand, which in turn grew out of the KR-1. That airplane is noteworthy for being the first to use fiberglass-over-urethane-foam construction, which is why it has its own section in the Hallmarks of Homebuilding parking area here.

So it's not something to be tinkered with lightly. In building his airplane, Langford left the basic fuselage shapes the same, but that's about it. He's using different flight controls, different airfoils for the flight surfaces, different flaps and ailerons, and an engine that's about twice the horsepower of what the aircraft was originally designed to carry.

To begin, as narrow as the KR-2S is—and it's without a doubt an intimate fit in that cockpit—widening the fuselage is a logical decision if one is looking to shake things up a bit. But at 2.5 inches wider than the stock plans, Langford's airplane obviously outgrew the stock canopy. Fortunately, another KR builder recommended a Dragonfly canopy, which fit perfectly. Instead of a fuel tank mounted in front of the cockpit, he installed wing tanks in the wings. That gave him longer range and a less sketchy weight and balance, since the fuel cells are nearly dead-on with the airplane's center of gravity.

At the other end of the fuselage, Langford built a horizontal stabilizer that's 6 inches longer than the plans, built it up with a different NACA airfoil, and changed the tail's angle of incidence, moving it up to negative 0.75 degrees, or almost parallel to the aircraft's longitudinal axis—if he had it to over again, by the way, he'd add balance horns to the elevator, at the recommendation of an aerodynamicist, which is one of the places Clapp deviated from the program, the benefit of coming second. While he was at it, Langford changed the angle of the wing, flattening it to 1 degree, which keeps the airplane from trimming nose-down at top speed flight. Clapp, after his first flight, reported the design to be dead-on right. This is his second KR, so he'd know.

"Mark's an engineer," Clapp says. "He's put out tons of information that he's learned."

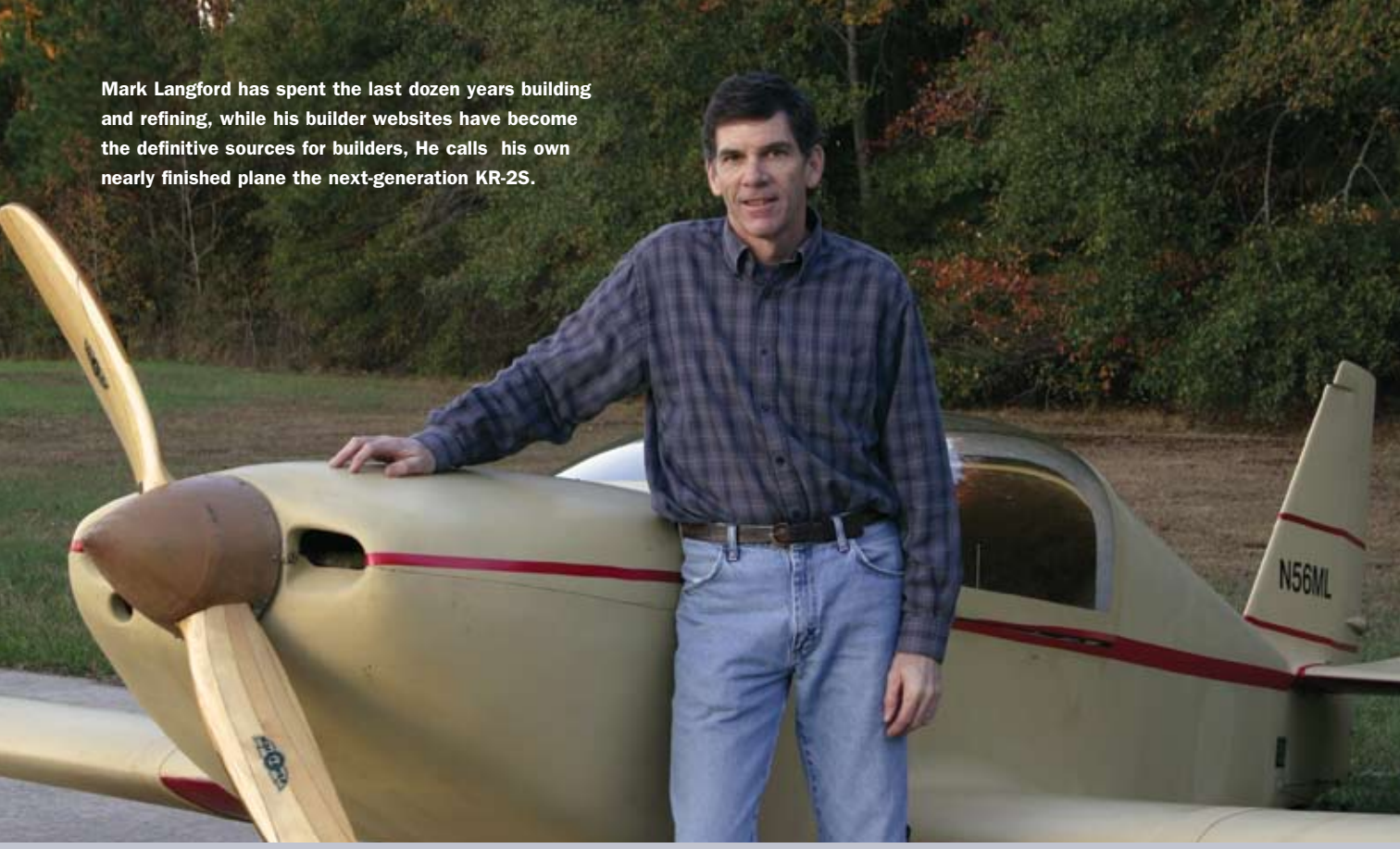
Clapp points out that the time Langford spent building his airplane saves every other builder time. By following Langford's lead Clapp built his aircraft up from the boat stage in only about 600 hours over two years.

And speaking of the wing, the original plans called for wings covered with fiberglass. While building his airplane, though, Langford went one further. He used the computer-aided design (CAD) drawing of the wing to create an offset, to allow him to cover the foam with fiberglass and then add two layers of carbon fiber. That gives him a nice, rigid surface for sanding. "Now it doesn't deflect out of the way when you go to sand it with the long board," he says. "Otherwise, you end up not having a true airfoil."

Hang a set of split flaps off that new wing, increase the depth of the ailerons to 20 percent of the total wing chord while reducing their overall length, and you've got a whole new airplane, especially if there's a bigger, better powerplant up front. Rand designed both the KR-1 and KR-2 to fly behind a Volkswagen engine, and that's originally what Langford intended to use. Once he'd spent some time with the Corvair engine and William Wynne at his Corvair College, he changed his mind, which, of course, meant he had to design his own engine cowling from the plug up—coincidentally, to the benefit of Clapp, who used the plug to shape his own cowling before switching last year to Wynne's "holey cowl."

And that's really touching on the point here. The spe-

Mark Langford has spent the last dozen years building and refining, while his builder websites have become the definitive sources for builders, He calls his own nearly finished plane the next-generation KR-2S.



cifics of Langford's airplane aren't as important as what other builders have done with his modifications. He's documented nearly every step of the process—the good, the bad, and the done-over—online for other KR builders to read, learn from, and comment on. "They tell me that if you print it out, it's this thick," he says, holding his fingers out wide enough to grasp a big-city phone book. "I've never done it."

ONLINE COLLABORATION

"I think the inspiration for my website was that I had to build things two or three times, and it was so frustrating that when I figured out how I did it, I wanted to save other people the trouble that I went through," Langford says. "People say, why do you spend so much time on that website; you could have been done years ago? It makes me feel better that I wasted all that time, because now I know how to do it, I can put it out there, and I can save 100 people five hours apiece, 100 hours apiece. It makes me feel that my time has been worthwhile, and that I have done something productive, rather than trying to build it the wrong way."

Langford has shared most of his modifications on his personal website, but his other website is of greater interest—and significance—to most KR builders. He's the administrator of the KRNet.org website, a clearinghouse of builder information from not only his aircraft, but also those of other builders.

The site acts as a forum for more than 650 builders—those who have flying aircraft, those who have existing airframes they're interested in modifying, and those who are just starting out. It's a place where they can share results to learn what really works, and what doesn't. The end result is that the collective knowledge of the group is making a good airplane even better, in essence, picking up where Rand Robinson Engineering left off.

"This is really about a community," Langford says. "It's an Internet collaboration of people who really know what they're doing and have resources to bear, people who have their own little area of expertise."

For many builders, that's priceless information—time is money, and, well, money is money. Unless the guy in the next hangar is building the same type of airplane as them, builders are often at a loss for how to proceed through a particularly confusing stage of building or if they're choosing between one of several construction options.

Even Langford—and, consequently, those who have followed his lead—has benefited from the online exchange.

The "new" wing used by his aircraft is the result of a member of the forum, Steve Eberhart, who worked with a professor and graduate student at the University of Illinois to design an airfoil and wing specifically for the KR-2S. The airfoil uses modern laminar-flow aerodynamics to achieve a greater efficiency than original KR builders could ever expect. "We took a wing that uses a 1920s airfoil, and now we're using state-of-the-art," Langford says. "That airfoil was designed for an airplane that could do 80 (mph). We started putting big Volkswagen turbo-powered engines in [KRs], and we could go 120. Now builders are putting O-200s in them, and we can go 200."

> Every time Langford flies, he carries a laptop, and the computer is hooked into the engine information system (EIS) to record airspeed, engine speed, and altitude. Every flight he takes, he logs data and then saves it at home.

The theoretical results the aeronautics experts predicted for the new wing, incidentally, were tested by another member of the group who was in the process of switching wings on his KR. Put into action, it proved a boost in speed against a known quantity—the same airplane with the stock wing.

That's become something of a hallmark of Langford's site. There are real people out there who have done the real deal and can share that knowledge. "If you've got a question, you can post it, and there are a bunch of people out there who have either built it or flown it or both," he says. "It's a really good community for facts, not just conjecture."

For most new projects—certainly those started in the last 10 years or so—Internet sites such as KRNet.org fill the role the original builder newsletters served, only a lot faster. Yet, for all of its usefulness as an information resource, the Internet can offer hit-or-miss information, often offered by less-than-expert sources. Too often, online discussions become hypothetical tit-for-tats between posters who spend more time e-mailing than building.

"The difference is, I've done it, and I'm proud of it," he says. "I've learned a lot doing this one, and now I know what I'm talking about. When I say something I can say, this is proven. I know it works. As I refine it, I'll know more about what does and what doesn't work."

What gets Langford excited about the collective contribution is that, taken together, they've made a good airplane into a very good airplane, moving on from where

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Clapp's Corvair power is driven by single plug, dual ignition system. It's the only single-plug ignition system allowed in Europe.

the designers left off. "The KRs have been refined by builders," he says, by members of forums like his.

BUILDING ON SUCCESS

Langford put more than a decade into building his airplane and actually got to fly Clapp's KR-2S before he even flew his own. That flight was a pretty important moment. It shifted his energy from building for the sake of building into building to fly.

Yet, the airplane is still in primer. Actually, he shot a new coat on it just prior to flying to AirVenture this year. He hasn't painted it yet because he's not done. Just as building took years—the process described on his websites—flight-testing it may take a long time, too, and for the same reasons. With a completed airframe, Langford defaulted to test pilot to find out what the airplane is capable of and to document what performance changes occur when the airframe is modified with different add-ons.

First and foremost, Langford's discovered the airplane that occupied his shop for so long is a lot of fun to fly. A lot. "This is a really inexpensive way to have a lot of fun," Langford says. "I don't know of anything else that gives you this much speed for the money."

During the first year he flew, he logged more than 280 hours, which in and of itself creates something of a problem. "If you're flying 280 hours a year, after a while you say, well, I've seen everything around here; today I'm going to see what speed I really fall out of the sky at a 45-degree bank," he says. "How slow can I really go?"

Every time he flies, he carries a laptop, and the computer is hooked into the engine information system (EIS) to record airspeed, engine speed, and altitude. Every flight he takes, he logs data and then saves it at home. "I can look at any slice of time," he says. "If anything ever happens, I can go back and look."

Those results also allow him to stop the at-large speculation by providing real data. In fact, when a list member offered to provide expected performance information for a spreadsheet that listed propeller and engine combinations and their performance, Langford politely suggested that real data—once the airplane was flying—would be more credible and therefore more useful.

On his own, he's gathered more specific performance measurements. He preemptively offers that he's doing these tests so that he can more effectively—and correctly—answer members' questions when they post them to the site. Who knows what someone might ask, and when they do, he wants to be prepared.

When a KRNet.org member asked about what altitude

he should land straight ahead in the event of an engine failure, and when he could turn back, Langford could answer because he had actually done that the day before. He was able to sort through hours of computer tracks to find the right one and say, more or less definitively, that above 500 feet the airplane will make the runway, provided it's powered by the same Corvair engine and has his split flaps to slow down in time to land, ambient weather conditions notwithstanding.

Prior to a prop change, he did some speed and climb tests so he could compare the old prop's efficiency to the new one once it was installed. He timed runs with a stopwatch, altimeter, EIS, and GPS on four different runs. The results were 157 mph for a 75 percent cruise with the Sterba, while a new Sensenich pulls him along at 170 mph; certainly toasty, considering how dirty the airplane is without wheelpants and gap seals.

With the throttle wide open, he's calculated fuel burn to be 5.1 gph. And, according to his numbers, a 2050 rpm power setting is the minimum the airplane will fly in level flight, and at that, the fuselage is at a 10-degree angle, up from the 8.1-degree angle it rides at while climbing out and the 9.2 degrees it peeks up when tied down. At engine idle, the fuselage is at a 6.8-degree angle with the flaps down and an 8.2-degree angle with the flaps up. At its full-bore speed, it's at a 0.5-degree nose-up attitude. Esoteric information, to be sure, unless you're the one who wants to know.

"What we're trying to do now is gather performance information, and then we'll know how much difference they make," Langford says. "It's neat to go back and look at the numbers and know that I'm not just whistling *Dixie*."

Eventually, he wants to test whether various accessory configurations help or hinder the cause. He's curious about the pros and cons of such add-ons as wheelpants and wingtips—and not just if they improve efficiency, but also by how much. With a methodical, change-one-part-at-a-time approach, he hopes to gather specific quantitative data on each, to see what effect each tweak has over the aircraft's previous performance. After all, if it makes the airplane better and helps other builders, it's worth doing.

"I just followed his lead," says Jones. "Mark is absolutely the best in KRs. There are only a handful of people who are keeping up." EAA

GO DIRECT

Http://KRNet.org — The website provides a wealth of Internet information about KRs as well as the mailing list devoted to helping KR builders and pilots construct and fly their KR aircraft more safely and efficiently.