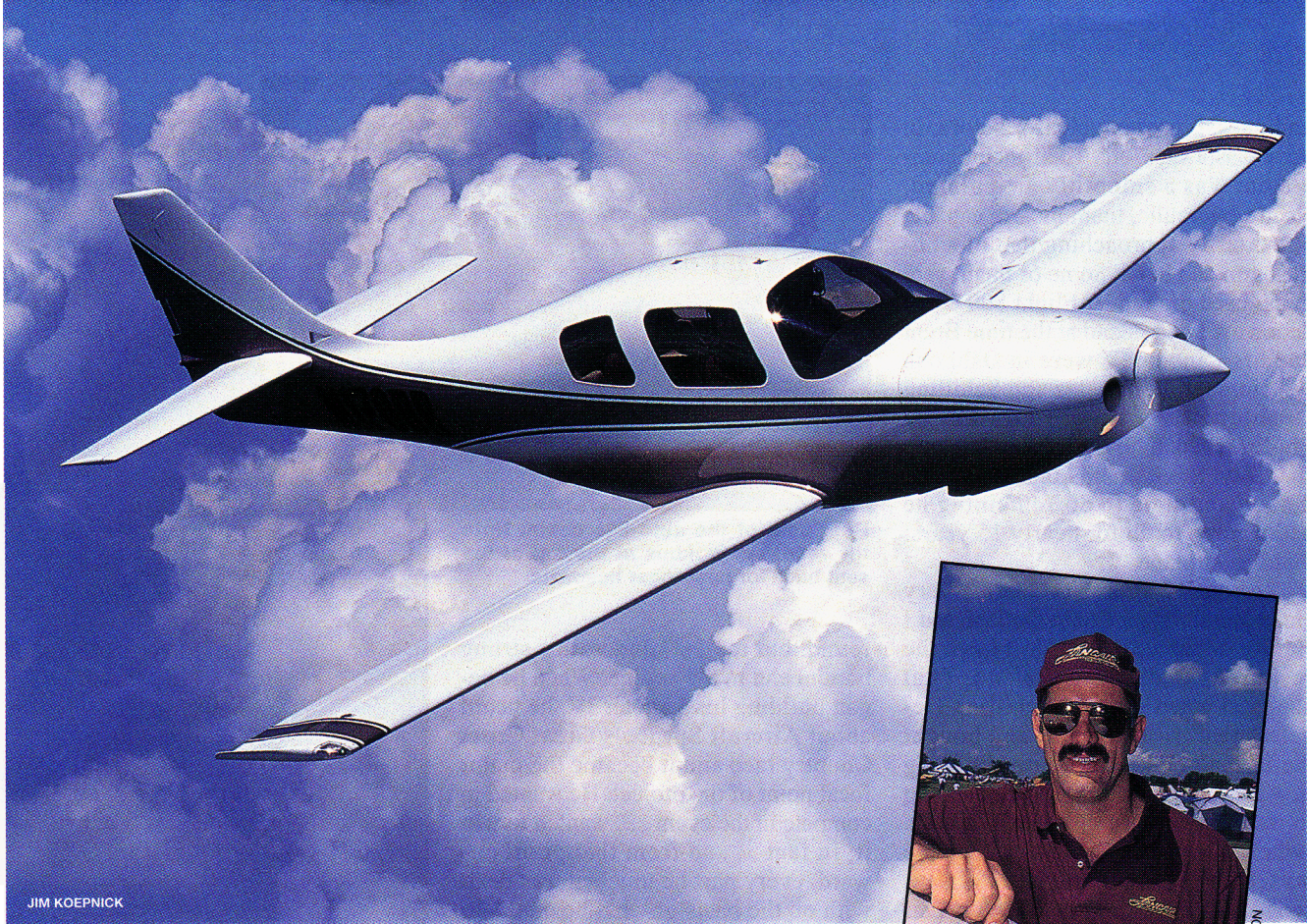
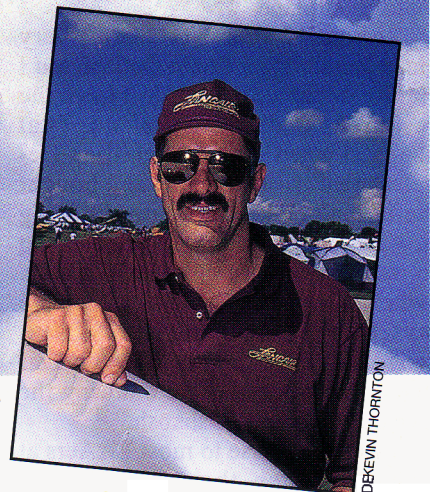




JIM KOEPNICK



DEKEVIN THORNTON

BRENT REGAN'S *Race Winning* LANCAIR IV-P

BY JACK COX

Brent Regan's Great Cross Country Race winner was much more than met the casual eye. It looked like just another beautifully built Lancair IV-P, but under its slick paint job lurked a host of innovations of interest to all homebuilders.

First, you need to know that Brent built all of the airplane himself, with the exception of the wiring of the radio stack, the installation of the leather interior and the application of the final coats of paint. That left him with major operations like substituting a Lycoming TIO-540 for the Lancair IV's standard Teledyne Continental TSIO-550, remaking a great number of the airframe's metal parts in 6A14V titanium and designing and building his

own moving map flight computer with color display and CD ROM/music player. Obviously, some special capabilities are necessary to accomplish such tasks, so you will be better served at this point by knowing a bit about Brent's background.

Brent was born in San Mateo, CA, which to those of us out in the hinterlands is just another city limits sign within the urban area we think of as "San Francisco." His father, Barry Regan, owned and operated the Dynatex Corporation, a highly specialized metal forming company that supplied the aerospace industry.

"He was a very inventive fellow who was able to make components and parts that nobody else could," Brent

says. "There are quite a few parts he made on the moon and in space today. I spent a lot of Saturdays and Sundays in the plant while I was growing up, sweeping floors and playing on the machine tools and learning all about that sort of thing. I guess you could say I had something of a mechanical engineering weaning right from birth."

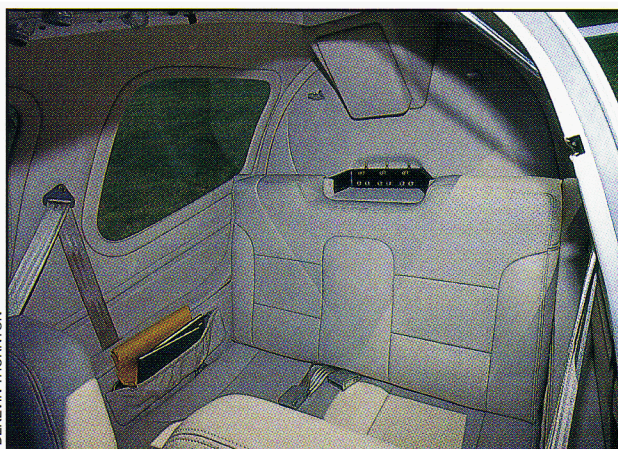
Brent spent two years in college studying electrical engineering, but left to start what would become a series of small businesses. None were very successful, he says, until about 12 years ago he and a partner co-founded a company in Davis, CA called Schilling Development. That firm specialized in the design and manufacturing of robots for use in extreme environments . . .

underseas, inside nuclear reactors, in toxic waste sites, etc. Their major component was a smoothly articulated, electro/hydraulic, titanium arm capable of dexterity approaching that of a human arm and hand. Some of them were being used to recover Flight 800 crash debris off Long Island at the time Brent and his Lancair IV were in Oshkosh last summer. Four years ago Schilling Development was sold to an English/French holding company and, suddenly, Brent found himself with the money and time to do something he had wanted to do for nearly 15 years: build an airplane.

"About 12 years ago I came very close to building a Rutan Defiant, but I finally decided I just didn't have the resources to see it to the end. That changed when we sold Schilling Development, so I went out and bought the Lancair IV kit and started building it. At the same time, I began learning to fly. I trained initially in a 172, then switched over to a Debonair to prepare myself for transitioning into the Lancair. I got my IFR ticket in the Lancair just a few weeks before entering the race and coming to Oshkosh."

It was a surprise to most EAAers at Oshkosh when they learned that Brent's Lancair was powered by a Lycoming engine. The airplane was designed around the Continental TSIO-550-B, which is a bed-mounted engine with the nose gear attachment and retraction mechanism incorporated in the mount. The Lycoming is a rear mounted (Dynafoal) engine, which is a world apart from the bed mount. Trying to rear mount the Lyc in the airframe would have meant designing and building an entirely new nose gear installation, so Brent went in the other direction and made the parts and pieces that allowed him to fit the Lycoming in the Lancair bed mount.

Why go to so much effort. . . some 700 hours of additional labor. . . when the Continental 550 and Lycoming 540 are so comparable in power? In a word, racing. Before he started Schilling Development, Brent was involved for a time in endurance auto racing. Among other venues, he ran Porsche 911s and Mazda RX-7s in the 24 hours of Daytona and the six hours at Riverside, and in the process learned a great deal about what works and what doesn't in extended runs at high power. There were a lot of factors involved, he



Rear seat of the auto-like cabin. Note the recessed jackbox at the top of the seat back for passenger headsets.

found, but it all started with a strong bottom end in the engine. When he began building his Lancair IV, he heard about Aircraft Spruce's Great Cross Country race and it became the major focal point of the project. He wanted to compete in the event . . . wanted to **win** it, in fact. . . so from that point onward, every part he touched was dealt with on the basis of what he could do to improve it so as to enhance his chances of ultimately winning the Great Cross Country race. That was the reason for remaking many of the steel parts in titanium, which saved about 45 pounds of weight. It was also the reason for the selection of the Lycoming engine, despite all the additional work that its use entailed.

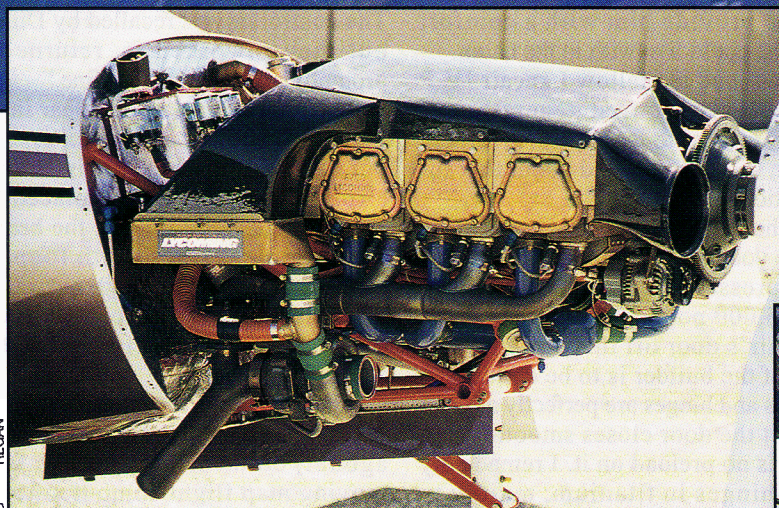
"I looked at both the Continental and Lycoming from the engineer's standpoint and the thing that really sold me on the Lycoming is that it had a larger diameter crankshaft. That is important when you are running engines at high power."

A change of this sort inevitably has a domino effect, and in this case it meant Brent had to design and build his own oil sump for the Lycoming with mounting lugs to allow it to attach to the stock Lancair bed mount (he made the pattern for the sand casting and later did the necessary machining), his own induction system and his own cooling system. Cooling was a very big part of the 700 hours that went into the development of the Lycoming installation. It began with a NASA report passed on to him by his friend and fellow Lancair IV builder, Fred Moreno, that indicated that conventional baffling systems on flat four, six and eight cylinder aircraft engines typically

leaked about 50% of the cooling air taken in through the inlets. Brent knew that a lot of the closely cowled, big engine homebuilts were power limited because of cooling, so he resolved to improve the situation in his Lancair IV. As can be seen in the accompanying photos, his solution was a carbon fiber plenum chamber over the top of each bank of cylinders, with extensions down each side to the intercoolers for the two Garrett turbochargers. Not visible are other ducts from the plenum to the oil cooler and the intercooler for the pressurization system. The plenum is as leakproof as Brent could make it, and allows him to run at very high power settings, essentially indefinitely. He has upped the compression ratio slightly to 8.5 to one and has limited his max manifold pressure to 35 inches, which, he says, is easier on the engine thermodynamically and provides a little better fuel economy.

Brent's engine started out as a

JIM KOEPNICK



Brent designed his own oil sump with lugs to allow attachment of the Lycoming TIO-540 engine in the stock Lancair bed mount, which was designed to accommodate the Continental TSIO-550. Here we see the carbon fiber plenum chambers over the engine, with extensions running down to the intercoolers for the Garrett turbochargers. There is a similar installation on the left side of the engine.



Brent's moving map flight computer is at the lower right of the instrument panel — tilted up 15° for ease of viewing.



core for a Lycoming IO-540K out of an Aerostar. He made a TIO out of it by installing the two Garrett turbochargers and two Stewart Warner intercoolers.

“The engine is now very similar to what is used in the Malibu Mirage. I hired a retired engineer from Garrett and had him assist me in selecting the turbochargers, waste gate controllers,

the blowoff valve, etc., because there is such a variety of them. He knew exactly what was needed and for my part, his fee was money well spent.”

Brent is using a four-blade MT pro-



DEKEVIN THORNTON PHOTOS

Landing gear detail. Brent used stainless brake lines with loops for added flexibility rather than the standard flexible lines.

pellor that actually looks rather small on the airplane. The small diameter is to keep the tips from going supersonic and reducing their propulsive efficiency.

Fuel consumption was much on Brent's mind during the construction of the Lancair. It's 785 nautical miles from the Jeffco Airport near Denver to Appleton, WI, which is the course for the Great Cross Country Race. To run

that distance at high power, Brent chose Lancair's 95 gallon wing tank option. At normal cruise power, that's good for 4.5 hours at 290 knots, or around 1,100 miles — which Brent says is nice to have, but is really longer than he can tolerate in the seat. Brent, incidentally, is 6 ft. 5 in. tall and had to make up a special carbon fiber seat pan that drops a little lower than the stock pan to provide him with a comfort zone he could live with in the cabin.

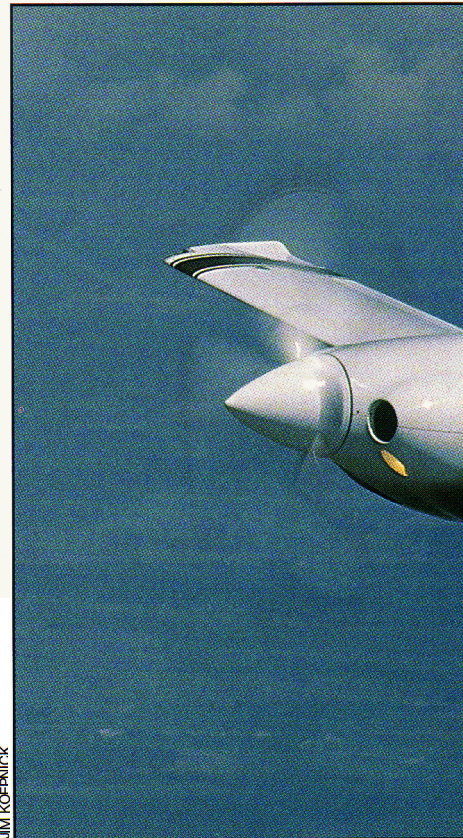
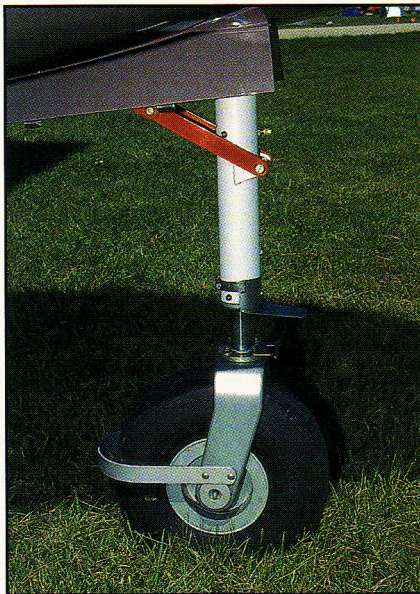
Brent and his fellow Lancair IV-P builders are the first generation of homebuilders to tackle a pressurized cabin, so he was asked about that installation.

"The biggest challenge is the door. When you have a five pound per square inch pressure differential, there are over 5,000 pounds trying to tear the Lancair's door off the airplane. The task of the builder is to be certain the latches and hinges are perfectly aligned so that the door closes smoothly and there is no preload on it. I remade my door hinges in titanium, mainly to make them follow the contour of the roof of the fuselage a little better. Lancair has done a wonderful job on the rest of the pressurization system, coming up with components that can withstand the stresses involved. When my plane was finished and still in primer, I buttoned it up, hooked up the air compressor and pumped it up to 7.5 psi, which is 50% over the max rated pressure. I thought if I am going to break something, I want to do it now.



DEKEVIN THORNTON

One of the biggest engineering challenges in any pressurized airplane is proper sealing of the cabin door. Note the number of sturdy hooks that are necessary to withstand some 5,000 pounds of pressure on the inside of the Lancair IV-P door.



JIM KOERNICK

There were a few creaks and moans, but nothing failed so I was happy with the pressurization system. I haven't had a bit of trouble with it in flight. The controller was recalled by Dukes, but they reworked it, returned it promptly and it's working fine."

The retractable landing gear in the Lancair IV is also a complex system, but has been trouble-free in Brent's airplane. He arbitrarily replaced the flexible hydraulic lines at the brakes with stainless lines (with loops in them for added flexibility), but, otherwise, he simply made sure every component was properly aligned during installation.

The instrument panel of Brent's N170BR is dominated by a 6.5 in. (diagonal) color display screen for a moving map flight computer he designed and built. He calls it the Aero/PC and describes it as "... a fully IBM PC compatible computer designed for use in the aircraft environment. The computer will boot without a keyboard connected so that only a Trackball or other PS/2 pointing device is needed to interface to the system. The system has been tested with Windows 3.1 and Mentor Flightstar/Flightmap connected to a King KLN90A GPS. It is configured to



launch Flightmap on startup and is typically ready for the GPS connection before the GPS has acquired a position fix." The unit weighs 8.7 pounds. The display swings 90° for access to the CD ROM and 3.5 in. floppy drive and is tilted 15° upward for best viewing. (For more information on Brad's Aero/PC contact him at 26180 Road 97, Davis, CA 95616.)

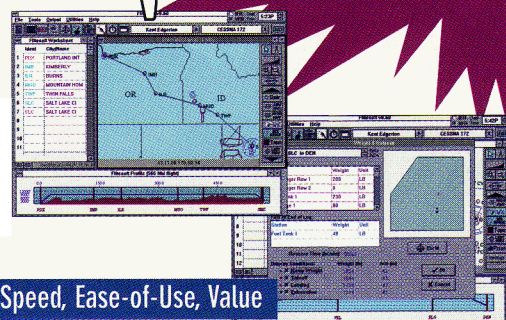
Some of the other features of N170BR include a triple redundant electrical system, ski rack in the baggage compartment and fluorescent cabin lighting. He also devised a way to actuate his rudder without having the cables run out of the aft end of the fuselage.

It took Brent 4,943 hours of construction time spread over a period of two and a half years to complete his Lancair IV-P. It was completed in September of 1995 and was flown for the first time by Lancair's Mike Dehate on the morning of September 28. Brent had completed Flightcraft's flight training course on the Lancair IV, so he made his first flight in his new toy that afternoon. By the day's end, he and Mike had combined to put 3.4 hours on the plane — with no squawks. According to Brent, N170BR was the 21st Lancair IV to fly and the

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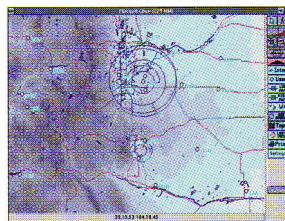


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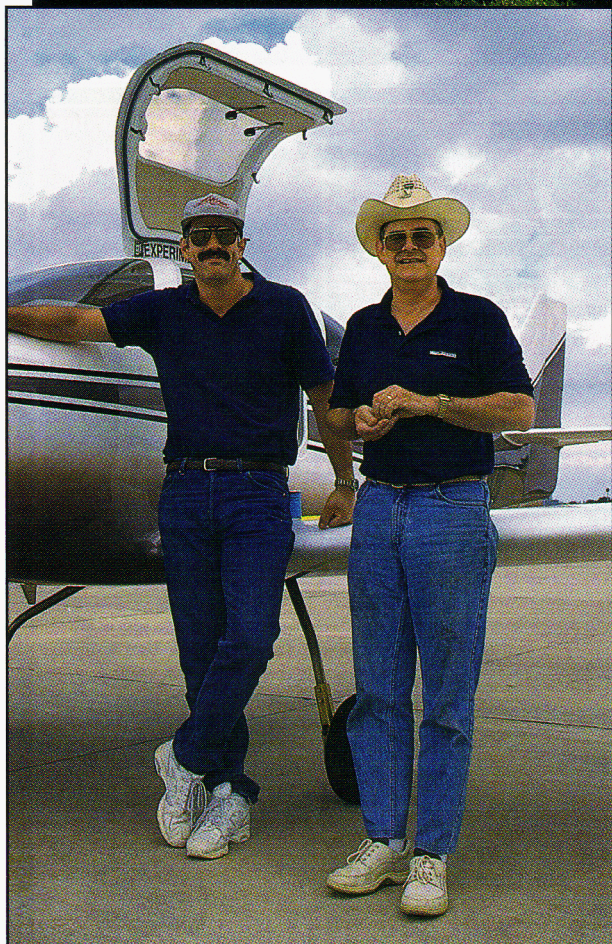
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Brent Regan, left, and Fred Moreno just after their arrival at Oshkosh '96. They were the first racers to arrive, and as they would later learn, the winners of the Unlimited class in the Great Cross Country Air Race.

15th to complete the 40 hour FAA required test program.

"One of the biggest contributors on this airplane never touched it," Brent says. "That was my wife, Moura. She was extremely supportive and understanding. I would try to come in and spend a couple of hours with the kids during dinner time and play with them for a while, but then I would leave and go back to work on the airplane. Moura indulged me during those long evenings in my shop and that helped me finish the airplane as much as anything did. She's the perfect woman for me to be married to.

"I fly the airplane every week, sometimes a couple of times a week. I use it on business trips and it takes me to Los Angeles in an hour and a quarter and to San Fran-

cisco in half an hour. It has opened up opportunities for me that I wouldn't otherwise have. I really enjoy flying it and it is one of the great joys of my life. I can't imagine not having built it, now that it is done. Of course, while I was building there were times when I was cursing myself, but that's all behind me now. I think my next project will involve more horsepower for the plane. I want to build some kind of different engine. I have been looking at Michael Zoche's diesel, but I'm also considering other options."

THE GREAT CROSS COUNTRY RACE

Brent was asked to relate his experiences in the Great Cross Country Race.

"That was really interesting. Fred Moreno and I took off from Jeffco and the weather was VFR, but shortly we were in marginal VFR conditions. Fortunately, the moving map display I built for the airplane was able to show us exactly where we were in relationship to the Denver Class B airspace so we could go right to the corner and turn and then follow the arc on out until we were on course. That saved a lot

of time. We got a clearance, but the controller wanted us to head 090° instead of the on course 055° we wanted. We headed out that way for a while and kept requesting course changes and higher altitudes, and by the time we reached 27,000 ft. we were on course for Wisconsin. Right about then we came out to this beautiful stratus layer and the sky was blue and the engine was running well — it was just perfect.

“Fred and I stayed busy the whole flight monitoring the engine system, calculating fuel flows and time enroute and looking at the winds aloft to see if there was a better altitude to fly. It really paid off to have Fred with me. I don’t think I could have won without him. I don’t think I could have stayed on top of things as well without him and would have lost more time. We had only a minute and 30 some odd seconds between us and Mike Dehate, so it would have been very easy to slip behind him.

“We had beautifully clear skies until we were about 100 miles out of Appleton. About the time we began our descent, we began running into the back side of the low that was centered over Wisconsin, so we had a broken cloud deck to penetrate. Our descent profile was based on the Mach limit of the airplane at various altitudes, so Fred kept reading them off to me as we descended. I left the autopilot locked on heading, so I was just flying the VSI. We started off with 1,000 fpm, then 1,100, 1,200, 1,300 until we ran the VSI off its stop. Then we had to fly off the airspeed indicator and that climbed from about 255 knots to 274, which was VNE. We held it there until we reached 10,000 ft. where we had to level off to the 250 knot speed limit.

“The cumulus clouds had nice big holes around them so instead of punching through them and taking a beating in the turbulence, we were able to kind of slalom through the holes. That was really spectacular and a lot of fun. We popped out underneath at about 2,200 ft., canceled IFR and headed straight in to the finish line at the Appleton Airport. We blasted over the airport, turned out over the lake and headed south toward Oshkosh. I slowly brought the power back and got the engine cooled off, then we landed at Wittman Airport. We were both still shaking pretty good — our adrenaline

was still running about 140% of max — as we taxied to the designated parking area on the West Ramp. To our surprise no one else was there, but it was all right when we were welcomed to Oshkosh and told we were the first to arrive. We would not know until later that evening that we had won, but at that moment I really didn’t care. We were there, we were alive, the airplane was still in one piece and it had really been great fun running the race.

“I’d like to emphasize the importance of having events like this for homebuilders. It was really one of the things that, you know, you are in the middle of this kit, you are looking at all those pieces and you think it is

never going to be done. Your skin itches, your eyes are watery and your fingers are all cut up from sanding... but then you have something like this race, something you really want to do, and you just keep on it. The race is a great motivator, a big help in getting through the building process.”

Brent and Fred Moreno set a new record in winning the Great Cross Country Flying Race with a speed of 299.9 knots . . . 345.34 mph . . . over the 785 nautical mile course. Who would have dreamed that sort of capability would ever be available to private individuals . . . to homebuilders? We are indeed living in exciting times! ♦

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DAVE GUSTAFSON

Unlimited Category winner Brent Regan, right, is congratulated by Jim Irwin, president of Aircraft Spruce & Specialty, sponsor of the Great Cross Country Flying Race

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