JIM KOEPNICK

6.6 MILES UP IN MY Long-EZ

BY JIM PRICE

Setting a World Altitude Record is an outstanding opportunity to link with and learn from some of the best people in the world. A partial listing includes Burt Rutan, John Roncz, the University of Michigan Department of Aerospace Engineering, and the Carson City, NV EAA Chapter who were all wonderful to help with this project. My biggest surprise was finding nearly every time I asked for advice or help I was able to get it.

I always knew aviation people were special, but the responses I received were an affirmation of that fact. These folks are truly "World Class People."

My goal focused on setting an altitude record after deciding it would be challenging, yet possible. In my work at General Motors, we are often challenged to do more with less. One of my favorite managers terms this as "leveraging adversity." When I began this quest I didn't realize I would have to best a competitor with sponsorship, contacts and programs far surpassing anything that I had. What a great challenge!

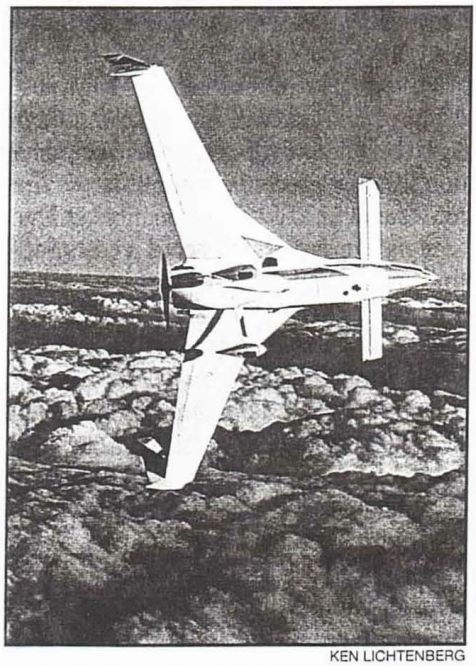
Initial study of FAI rules and records led me to believe I was best suited to go after the Altitude and Altitude in Horizontal Flight for C-1.a weight class (661 to 1102 pounds). A major concern was: could I get my Long-EZ, including myself and all required equipment, to the required takeoff weight of less than 1102 pounds? In the Long-EZ's eleven years and over 4,000 hour building process, I tried to keep weight to the minimum and still have a comfortable IFR equipped plane. As a testimony of how wonderful this plane is, I have already had it in all of the Continental United States (including Alaska), seven Provinces of Canada (including the North West Territories) and even to Mexico. All this in less than three years of flying. It's the best thing short of teleportation.

When completed (July 1994), its empty weight was 907 pounds, in the bottom 10 percentile of O-320 EZs. I still needed a lower empty weight so I began removing and weighing all non-essential items. I was able to get my airplane's empty weight down to 842 pounds. Nothing was overlooked; even the engine lifting eye was removed. I was sure this weight removal would permit me to make the C-1.a weight class. Weight removal brought about creative repositioning of equipment to keep the CG where I wanted it.

While working on airframe empty weight, I looked at myself and thought that I should kill some fat cells and shed some weight. I set a goal to loose 25 pounds and I was able to remove 30 with a self imposed exercise program and diet. After doing this weight review, I conducted a test flight to determine what my service ceiling would be. Examination of the rate of climb data to flight level 280 showed I could advance the existing record.

During the weight reduction process, I looked into what special equipment would be needed for the flight. Jeff Rose of **Electroair** offered a great enhancement for his dual electronic ignition system I had in my Long-EZ. The modification allowed me to exceed normal spark advance using a control inside the cockpit. The system worked wonderfully and allowed me to advance the spark timing much further than the normal system allowed.

All I had to do was to switch over to a



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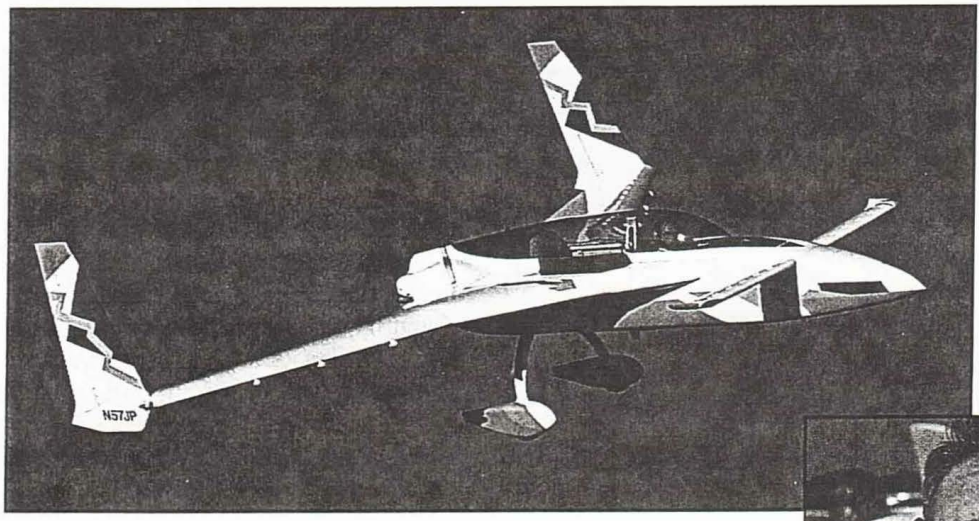

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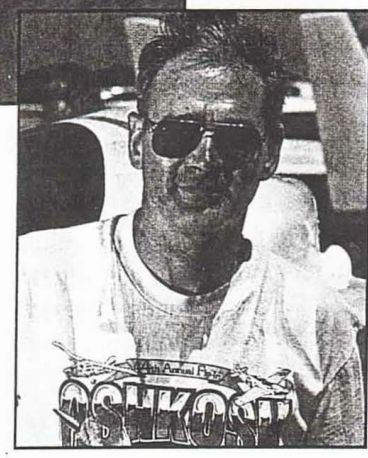
manual mode at about FL 180, advance timing until I saw an rpm drop, then retard timing slightly from that point. This was done much like the setting of fuel mixture. It operated like the early cars used to do with their manual spark controls!

Another weight reducing piece of special equipment was Bill Bainbridge's ultra light weight alternator. The 8 amp unit weighs just 3.7 pounds and mounts on the vacuum pump pad. Bill's alternator allowed removal of my heavier 40 amp alternator yet provided plenty of power for my electronic ignition, transponder/encoder, handheld radio and GPS.

I knew this activity can be dangerous, so after inquiries, I linked up with the Air Force Department of Aerospace Physiology at Brooks AFB. Lt. Col. Sam Holoviak saw my level of commitment and offered to help me prepare for the record attempt. Sam was outstanding to work with and helped me better understand what a hostile environment I would be going into. Sam had a special way of getting my attention with statements like, "This is essential for your survival! (Can I make this any clearer?)." The two largest physiologic areas of concern were: Decompression Sickness (DCS), i.e. the bends and loss of oxygen supply. Per his suggestion, I found an Air Force base near my record setting location with an altitude chamber to treat me in case I got the bends. He also suggested doing what U-2 and SR-71 drivers do, pre-breathing 100% oxygen for at least one hour to get as much nitrogen out of my system as possible. To assure proper oxygen delivery, I purchased a special Air Force style pressure oxygen regulator. Because of low ambient pressure at the altitudes I went to, oxygen cannot be absorbed normally into the blood stream. It must be forced in using a pressure system and special oxygen mask. Obviously this oxygen system was an essential tool. I also had an emergency back-up supply of pressurized oxygen in case the regulator failed. The back-up oxygen system was one of the very few extras to go on the flight with me.



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Lancair IV and Questair drivers need to be aware of some of the data Sam shared with me. Unpressurized flying above 21,000 feet will have a high DCS risk. Major variables are: altitude, exposure time, breathing gas, pre-breathing and exercise. At 28,000 feet, 50% of the tested subjects had DCS symptoms within 24 minutes. I took and highly recommend the Air Force physiology course offered through the FAA. It covers this information and other important physiological flight concerns.

During this preparation period, I flew to Minden, NV, to initiate local contacts. This trip with Jim Conners in a Prop Jet Bonanza was especially delightful. Jim knows the area very well and suggested I do my flight in Minden. Tony Sabino of Soar Minden, a local sailplane FBO, offered to help with some of the special flight equipment like the recording barometer and oxygen mask. Tony also steered me to local National Weather Office weather expert, Doug Armstrong, ATC personnel controlling this area.

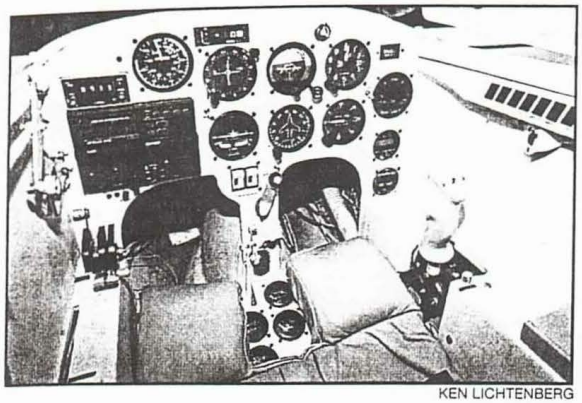
While in Nevada, I reviewed safety concerns which included selection of numerous emergency landing sites. These were selected because weather can change rapidly in this region and I wanted several options in case I got trapped on top of a cloud deck. One of the primary reasons I chose Minden was it is one of the few areas one can go up this high VFR in the special airspace called a wave window. I hoped I would be able to link to a mountain wave to assist my climb. . . unfortunately the wave I had hoped for never materialized in my two attempts.

After a review of the flight program status, an idea occurred to me. I decided to inquire at the University of Michigan Aerospace Engineering Department to see if they would conduct a critique of my progress to date. I hoped they could offer suggestions for improvements. Dr. Kauffman kindly scheduled a meeting for me. Four professors and 14 students were in attendance. They also found this record setting attempt to be an excellent opportunity to work on a challenging development program.

After a group review of the Army's Long-EZ flight test report, Professor Bill Ribbens noted the Long-EZ's minimum power speed was below the stall speed. Dr.Ribbens suggested a wind tunnel test to see if vortex generators (VGs) could lower the wing's stall speed and allow the Long-EZ to fly closer to the minimum power speed.

My timing was extremely lucky as a senior wind tunnel class was about to begin the next semester. Professor Dahm forwarded my test proposal to his students to see if any of them would be interested in taking on this project.

I was again fortunate as one of the stu-



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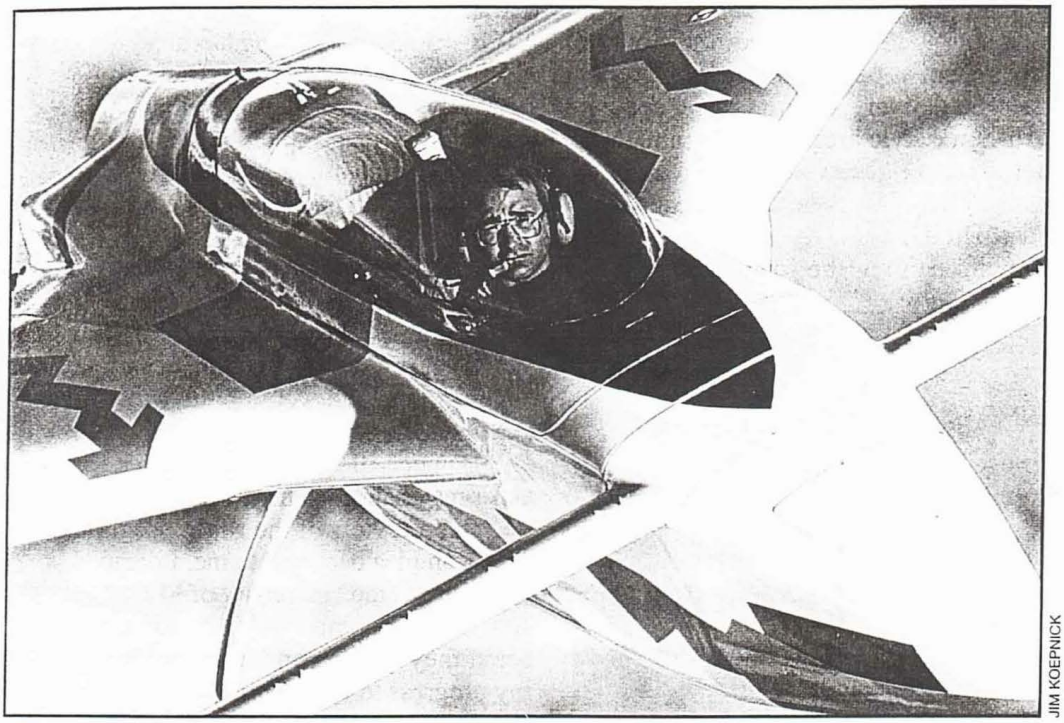

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dent teams was interested in taking on a study of effects of vortex generator effects. Our team started by building an omega span Roncz canard airfoil and a half scale main wing section. We had a few exceptional events. Most memorable was when I told the students epoxy would cure faster at 100° than at room temperature. One of them decided if a little heat was good, a lot more would be better yet!

Oh well, our first airfoils had the foam cores melted. Rebuilding both airfoils would have caused us to be too far behind our targeted time line so we chose to just make another canard and not test the main wing airfoil.

I gave Charles White (president of Micro AeroDynamics, Inc.) a call and he provided me information about a normal VG installation and materials for testing. I asked one of the test development experts at GM to look at my project and he determined a simplified testing method to obtain the optimum placement of the VGs on my airfoil with a minimum number of tests. We decided to test three variables: 1. Large and small VGs; 2. Fore/aft placement of VGs (what percent of chord); 3. How many VGs to install.

By running four tests we determined low speed lift could be significantly improved using VGs. The best tested placement of the VGs was at 20% of chord. The VG's size didn't much matter in lift but smaller ones provided less drag. VG pairs installed more closely together (every 4 inches) gave us the best lifting results. Students Brian Wiear, Eric Roth and Eric Wang were all great to work with. It was a dream come true to do wind tunnel testing with such a prestigious group.

I spoke with the NAA several times to obtain all requirements for the flight. It took me much longer than I imagined it would to get information on several issues. One example was: when the NAA told me I needed certified scales to weigh the plane prior to my flight, I inquired who was the proper authority to certify them. The NAA person that I spoke with didn't know. After a month of asking around it dawned on me to stop at a truck scale on the freeway. The officer was very helpful and I found certification is done by the Department of Agriculture.

Other questions remained. Would an extra horsepower producer like nitrous oxide be legal? The rules state auxiliary power is not allowed. Because of this I decided to not pursue nitrous injection during my development process. I personally would prefer to see nitrous not allowed because it is such a radical horsepower enhancement. Once it is approved to be used for competition it seems like everyone will have to adopt its use in order to be competitive.

A lot of people have inquired how much this process of record setting costs. It cost $39 to get your FAI sporting license, sanction fees for a record are $350 for the first record and $275 for additional ones. Then to register a successful record it costs $400 for the first and $325 for the second. The observer gets $275 a day plus expenses, like their airline ticket, hotel, rental car, food, etc. I was lucky to get an observer who truly enjoyed doing this activity and he would only accept a bit of gas money for his plane. Also, it takes a long time to go through the steps of having a record certified. After I returned home from my flight, Dr. Ribbens spent a couple of days going over my data using the FAI formulas to come up with the altitudes that I had attained. My record flight took about eight months to be certified by the NAA and then the FAI. Needless to say, one needs a lot of patience to go through this process.

By this time things were pretty well in order so I flew to Minden where friends helped me prepare my Long-EZ for our flight. Stan Gorman came in from Tucson and Dave Jones flew his Long-EZ in from Susanville, CA. To help out, Jeff Rose even dropped in to make sure his ignition was working out O.K. for me. Dave Timms was even kind enough to bring over his specially made propeller which he used for his World Record. At the time he loaned me his propeller he was still the official World Record Holder!

My first test flight was to evaluate Dave's propeller for this flight. I think it would have been ideal at altitude but I could overpower it at lower altitudes.

Trying to minimize consumables, fuel and oxygen, I decided to use a flight profile that would get me up high quickly. By reducing climb time the total amount of airframe drag overcome during the flight is reduced, therefore less fuel would be used. The bottom line is I used a propeller of the same pitch and diameter I use normally. That gives me a great climb up to FL 300. After that the prop is overpitched and rpm gradually falls off all the way to 2100, which is well below the engine's power band. The next flight test purpose was to validate the effect of vortex generators. I did this up high while wearing a parachute. The main wing was tufted to assure that the canard would stall, as required, before the main wing. I entered into this test very carefully as it could be catastrophic if the main wing stalled and the plane

went into a flat stall. The yarn tufts clearly indicated the canard was stalling before the main wing. It was fascinating to see airfoil sections behind vortex generators wouldn't stall but the area between them would.

On April 9, 1996, we had everything ready to go and I decided to go for an official record attempt. Tom Gribben, my official observer assigned by the NAA, came down from Reno. He checked things out and we were ready to go. Tom was a delight to work with and was very helpful in assuring that I complied with all the rules. I had a great run to 31,400 feet with good climb rate, even at that altitude, but I went down to the minimum fuel to meet the required FAA fuel reserves at landing so I aborted the run. I did have one wake up call. While at 31,000 feet I decided to change fuel tanks and found the fuel valve was frozen stuck. It wasn't a big problem as I had enough fuel on that tank to make it to the ground, but it was quite an exercise in such a cramped cockpit. As expected, the canopy frosted on the inside such that one couldn't see out.

Using a turn coordinator, airspeed and handheld GPS inside a frosted opaque canopy is quite a work out. Because of this, I was even more thankful I was in a canard design because of its docile stall characteristics. Everything worked very well and after computing and plotting the rate of climb every 1000 feet all the way up, I was sure I could do a lot better on a future run with just a bit more fuel. I knew of a few items I could remove to reduce weight — enough which would compensate for the additional fuel that I wanted for my next flight. With this testing done I found my scheduled vacation and good weather used up. I headed home on a commercial flight leaving the Long-EZ there prepared and ready to go.

I stayed in contact with Doug Armstrong, the weather expert, trying to find a good weather window in which to come out and accomplish my goal. On May 3 I got a call that things looked good and I flew to Reno the next day.

When I got out to Reno, John Grubb and his wife, Edie, took me under their wing and with the help of Dave Jones we quickly got everything ready to go. The winds weren't as good as I had hoped for, but I had no time to wait around so I decided to give it a go anyway. On May 5, 1996, we were ready to launch. We even went so far as to push the Long-EZ out to the runway to save fuel. Dave taped the entire front of the canopy down and John gave me one of his famous hand prop starts and off I went.

Later I looked at a tape of my launch and it was incredible to see the rate of sustained climb. Upon my first contact with controllers, I certainly enjoyed hearing, "Cleared to Flight Level 360!" There was a bit of mountain wave action north of my ATC authorized flight area, but I couldn't talk the controllers into letting me go over in that area. I had hoped by running a transponder the controllers would allow me more latitude in the flight area that I wanted to use. Unfortunately, it didn't work that way. I hope this doesn't sound negative, for I truly appreciate having this special area to fly in and realize that while the wave window is "hot," it requires special action on the air traffic controllers part.

This time I leaned the engine more judiciously to conserve fuel, the timing advance was working great and everything was going super until . . . At about fight level 310 I got a pop out of the airframe. On a pucker factor of one to ten, this hit a thirteen! My barometer recorder later showed that I leveled for four minutes while I evaluated what was going on. All flight controls and the powerplant were operating normally. I guess you'd have to be there to truly appreciate the scene. With the canopy frosted over I couldn't see if the wings were still on and it was already extremely cold at about -57° Fahrenheit. The culprit noise was caused by a very minor delamination of the canopy to its frame. The delamination was caused by the different material expansion/contraction rates between the canopy and the canopy frame which causes the canopy to twist. Since the canopy is right next to your ear I'm sure this sound seemed louder than it would have if it had been further away. The canopy is bonded to its frame in a way that it couldn't come off so after a careful evaluation of all systems I decided to go on.

As my climb progressed, stall and cruise speed slowly got closer and closer together and the plane felt like it was on a "bubble." Any control input made the plane feel like it would slide off the edge

of the top of the bubble it seemed to be perched on. Believe me, you won't need a cup of coffee to get yourself going when you do a flight like this!

The air traffic controller I was talking to was having a difficult time understanding me as I didn't have a microphone inside my oxygen mask. I thought that by pulling my mask off my chin and having the microphone in that area it would work O.K. (it had in previous flights). So much for that theory. My encoder blanks at 28,000 feet so the controller was asking me quite often what my altitude was. With the workload I had, this was quite awkward for me. I even had my mask come unsealed because of pulling it up. This caused one of the lenses in my glasses to have condensation on it. The lesson I learned was that next time I will go up with a microphone in my oxygen mask.

When I approached my perceived maximum, I leveled off to video tape the altimeter, airspeed indicator and a clock. That documentation proved airspeed was maintained during the horizontal portion of the flight attempt. An electronic barometer recorder collected the altitude every ten seconds. After flying the required period of time (90 seconds level for the altitude in horizontal), I decided I had had enough fun for one day, and extended the nose wheel to increase drag and pointed the nose downward.

The altitudes I attained were 35,027 feet for altitude and 34,926 for altitude in horizontal flight; enough for the two World Records for which I had hoped! I landed with seven gallons of fuel, which was more than required. Data evaluation of my climb rate just prior to my leveling for the altitude in horizontal portion of the flight, showed I was still climbing at 90 feet per minute. The plotted rate of climb data indicates I could have gained approximately another thousand feet. When one is used to a plane that climbs 2,000+ fpm, 90 fpm doesn't seem like much.

A few interesting statistics about the flight were: temperature got to -61° Fahrenheit, it took one hour and ten minutes to climb and another twenty-five minutes to descend, my spark advance got up to nearly 50°. I do not know the manifold pressure reading at altitude as I didn't have that or any extra gauges. It was gratifying to see that both the April 9 and May 5 flights had the same climb profile to each altitude within a few seconds of one another. I knew a layer of longjohns with down jacket and pants would still allow me to get cold and I did, but not to an unbearable or unsafe state.

What is next? The altitude I reached was greater than the existing C-1.b Altitude in Horizontal Flight record. This heavier class starts at 1102 pounds. All it would require is another gallon of gas and I would be up in that weight class.

In order to get a bit higher (2,273 feet) and capture the C-1.b Altitude Record, I believe I will need to come up with some more tricks. I am looking into nitrous oxide to boost the horsepower. I also plan to look into obtaining sponsorship to defray some of the expenses. The project was truly a grand opportunity for me. It took a year and a half to prepare for this record, and it was marvelous to have all the assistance that I had. My sincerest thanks to all of you who were involved, many of which were not acknowledged in this article.

Be well and fly safely!

(If additional information on Jim's record flight contact him at email: HiLong@aol.com) ◆