

THE CANARD PUSHER

No. 77

Jan. 1994

Published quarterly (Jan., April, July, Oct.) by

RUTAN AIRCRAFT FACTORY, INC.

Building 13 - Airport

1654 Flight Line

Mojave, CA 93501

805-824-2645

U.S. & Canadian subscriptions	\$14.00
Back issues	\$ 3.50
Overseas (Airmail)	\$16.00
Back issues	\$ 4.00

If you are building a RAF design, you must have the following newsletters:

VariViggen (1st Edition), newsletters 1 to 77.

VariViggen (2nd Edition), newsletters 18 to 77.

VariEze (1st Edition), newsletters 10 thru 77.

VariEze (2nd Edition), newsletters 16 thru 77.

Long-EZ, newsletters 24 through 77.

Solitaire, newsletters 37 through 77.

Defiant, newsletters 41 through 77.

A current subscription for future issues is mandatory for builders -- as this is the only formal means to distribute mandatory changes. Reproduction and redistribution of this newsletter is approved and encouraged.

PLEASE NOTE: RUTAN AIRCRAFT IS OPEN TUESDAY ONLY FROM 8:00 TO 5:00. When you call on Tuesdays, please give your name, serial number, and nature of the problem. If you are not in an emergency situation, we ask that you write to Mike. However, if you require immediate assistance, Mike will make every effort to return your call between 2:30pm and 4:00pm (our time).

When writing to RAF, send along a stamped, self addressed envelope if you have builder's questions to be answered. Please put your name and address on the back of any photos you send.

WHAT EVER HAPPENED TO OCT. CP?

The October 1993 edition of the Canard Pusher did not make it to the printer. There were two reasons for this: We were very busy with a flight test program at Edwards Airforce Base and, we had very little material for CP 77 (Oct.). All subscribers will have their subscriptions extended so you will still receive the same number of CPs.

If you have any subject you feel would be of interest to other builders/flyers of RAF designs, or one of a safety nature, please send them in. This newsletter is your newsletter. In order to keep it alive, we need feedback!

FLASH!

Unofficial, 2000 kilometer, closed-course speed record set by Dick Rutan flying Burt's Catbird in the C1-B weight class (1000 kg/2204 lbs.) on December 20, 1993.

Dick took off from Mojave and completed a flight from the Lake Hughes VOR to the Boise, Idaho VOR and back, a distance of over 1087nm (2013.5km) in 5 hours and 6 minutes. Unofficially, and subject to ratification by the FAI, that is an average speed of roughly 245mph. The old record was held by Jeana Yeager flying Dick's Long-EZ at 204mph. Congratulations, Dick and the Catbird.

ANOTHER CLOSED COURSE WORLD RECORD

"Ontario Approach, this is VariEze N99VE, 25 miles east of Homeland VOR at 10,500 ft. Request transition to Homeland for a 180 turn."

"VariEze N99VE, Ontario Approach. We've been waiting for you. Approved as requested. Will call your turn."

Two hours down and 14 more to go, I thought. All of that planning over the past 3 months is paying off. Fuel consumption and time are better than planned, the air is smooth, no significant wind, and the moon is full. Couldn't ask for better conditions. Looks like a go for the record....

It was almost ten years ago on the weekend of July 14 and 15th, 1984 that Jeana Yeager set the same

closed course world's record for aircraft weighing between 661 and 1102 pounds in the same aircraft, N99VE. Jeana circled a course from Bakersfield, CA to Merced and back for a total of 8 laps and 2428 miles. Several hours later I followed up with a distance over a straight line departing Mojave, CA and flying non-stop to Martinsburg, WV just west of Washington, D.C. for a total of 2214 miles - two records in one weekend. Turning 50 this month, and needing a mid-life crisis thing to do, nothing seemed more appropriate than to test all the improvements I have made to the plane and getting both distance records in my name. In each of the old records, the plane had averaged about 150 mph and 50 miles per gallon. Since the fully loaded take off weight was right up against the maximum of 1102 pounds allowed for the class, my weight over Jeana's meant that I would be carrying about 10 gallons less. Aircraft improvements since that time had to make up for the difference.

Since 1983, I have been very active in the CAFE 400 events, taking my share of trophies like those shown in the October '93 *Sport Aviation* article. To be competitive with people like Klaus Savier in his very efficient and fast VariEze and Gene Sheehan with his highly refined Q200 prototype, took some dedicated effort to constantly modify and test, looking for every last knot of speed and efficiency. Major changes since the original records are the addition of custom designed high compression pistons for the Continental A65, lower drag wheel pants replacing the original "football" shaped pants, an Ellison throttle body injection carburetor, a modified oil tank and induction system to accommodate a low drag cowl, and an electronic ignition supplied by Light Speed Engineering with manifold pressure regulated spark advance.

Getting Ready

After I finish a typical modification, I try to gauge how much effort was expended for the speed gained; some mods are more successful than others. The wheel pants are perhaps the highest payoff of any mod to date adding about 5 knots to my top speed. The pants are carved from a single block of foam with a top planform using a 65-025 symmetrical airfoil. The side view is driven by the requirement for a constant pressure distribution at each station down the pant. To

achieve this, the angle that the top and the bottom of the pant make with the waterline is the same as the angle that the left and right side make with the line of flight. All of the flow lines appear laminar, traveling straight aft without curling back. A plug and female mold were made on which two layers of glass were laid up to give a weight of about 1 1/2 lbs. per pant.

The original A65 was designed with 6.5:1 compression in the days when fuel for general aviation over 80 octane wasn't readily available. It is well known that the thermodynamic efficiency of a piston engine increases as a function of compression ratio. After several iterations (some not so successful), I designed and had constructed by a custom automotive piston manufacturer, a set of forged pistons with a 9.0:1 compression ratio. Also, I installed a set of modern technology automotive rings with a 3-piece oil control ring and Total Seal gapless 2nd compression ring. As a result, I average about 25 hours per quart of oil and have a very low idle manifold vacuum reading of about 7 inches. Crankcase blow-by is almost nonexistent.

The Ellison throttle body injection unit has become a familiar piece of equipment in the homebuilding community. The ability to lean much beyond a conventional carburetor and still run smoothly gives nearly a 10% savings in fuel consumption. The Ellison is mounted horizontally in front of the oil tank to allow the installation of a low profile cowl. The induction tube passes through the tank and exits at the distribution spider. The induction air heating lowers volumetric efficiency somewhat (reduces maximum power) but provides a longer mixing length to give better fuel distribution prior to reaching the spider. Since efficiency is the primary goal, the trade off was worth it. Also an added benefit of oil cooling eliminates the need for an oil cooler.

Over the years, I have had three different engine cooling systems on the airplane. When originally built, being convinced that Burt's way was the only way, I installed a conventional EZ pitot cooling scoop. Since that time I have had the flush NACA scoop, and now the "arm pit" scoops. The arm pit scoops show a slight advantage over the flush scoops, but this is one of those modifications where the speed increase per hours spent is very poor. The place where this

modification is a real winner is in the way it looks and how it cools the engine. Head temperatures in cruise are in the 260-280F range. Many other aerodynamic cleanup changes can be classified as attention to detail; such as fairings and leak sealing, contribute to the overall efficiency.

The standard magneto is designed with fixed timing to give detonation-free operation during worst case operation (maximum power, hot day, sea level condition). At high altitude, where conditions are cool and power is reduced, the optimum ignition advance is considerably higher to account for a much slower flame travel within the combustion chamber. The light weight electronic ignition supplied by Light Speed Engineering replaces one of the magnetos with an electronic processor and a set of ignition coils. The system senses manifold vacuum and adjusts spark advance up to a maximum of 17 degrees above the nominal setting. The effect of this advance is dramatically illustrated at altitude by noting a 50 RPM drop switching from the full advanced setting of 43 degrees back to the nominal setting of 26 degrees.

All of these efforts to increase efficiency have also paid off in speed. When first constructed, the plane would not quite reach 180 mph. Recently, at an EZ racing event held at Wendover, NV over the Bonneville salt flats, the airplane turned 204 mph on a 125 mile triangular course. Not too bad for a two-place plane with 170 cubic inch displacement engine at 7000 ft. density altitude.

Flying The Record

I had not given much thought to going after a second record and was even unsure that the aircraft had the capability of breaking the existing record until I received encouragement from Dick Rutan at this past year's Oshkosh event. On the trip home, I started doing some serious data taking. Calculations confirmed that indeed the aircraft had the range necessary to beat the old record if the empty weight had not crept up over the years. To my surprise, my attention to weight additions had paid off. The empty weight with auxiliary fuel tank installed was about 10 lbs. more than at the time of the previous record attempt, more than accounting for

all those "essentials" such a LORAN and autopilot. I contacted Art Greenfield of the National Aeronautical Association (NAA) and received a package of all the forms necessary to sanction and certify a World's Record. Turnpoint verification can be accomplished by either a NAA certified observer or the FAA. I chose the FAA route and contacted the Approach Control people at both Phoenix and Ontario, CA. Both groups were delightful to work with and anxious to help in any way they could. I sent the forms for turn point verification that they were to fill out at each passage. The NAA, the United States certifying authority of the Federation Aeronautique Internationale (FAI), requires that an NAA observer must witness the aircraft weighing, barograph installation, gas tank sealing, takeoff, and landing. Klaus Savier, who is an NAA member and the present record holder for the 1000 and 2000 kilometer speed records in his VariEze, filled the requirements for a qualified observer.

Planning for the right time takes a little bit of common sense and a lot of luck. Since part of the flight occurs at night, I wanted the moon to be as full as possible in case an off-airport landing would be necessary. On the weekend of October 30/31, the moon was at its full brightness. The closed course turn points of Chandler, AZ and Homeland VOR on the eastern edge of the LA basin were chosen for the flat, low altitude terrain and the safety of paralleling Interstate 10 the entire route. As the time approached, the Santa Ana conditions that fanned the fires in the LA area were developing. The airplane gods were smiling, and what was supposed to be peak wind conditions all weekend actually turned out to be light and variable to 10 knots from the south at altitude.

Klaus flew to Phoenix in mid-afternoon on Saturday the 30th to help with final preparations of the airplane. We fueled up, less an anticipated 4 gallons and parked the plane. I went home to try to get some sleep. After a largely unsuccessful attempt to rest, I got dressed with borrowed ski pants, down booties and a warm coat. Leroy Castle, a local EAA member and keeper of the Arizona EAA Council platform scales, showed up at the airport at about 9 pm.

After rolling N99VE onto the scales, I climbed in with all the equipment that I would eventually

take off with. After adding the necessary fuel to bring the total weight up to the 1102 pound class limit, Klaus sealed the tanks. Total fuel on board was calculated to be 49.3 gallons. My conservative "how-goes-it" chart said that I would need 48 of those gallons to make it four times around the predetermined course for the record. At 10:50 pm, I departed into the night for Homeland VOR. The rest is history. The plan went off without a hitch. Fuel flows, engine temperatures and all the electronics worked flawlessly. At each turn point, I exceeded my anticipated times, speeds and fuel flows. Taking data with a calibrated fuel flow meter at each point, I generated the following summary: (See chart on last page)

After all the concern for adequate margin, I landed with almost 7 gallons of fuel on board or almost 400 additional miles possible. At this writing, all the paperwork has been submitted for final approval by the NAA and FAL.

Gary Hertzler"

ED. Congratulations, Gary, attention to detail is everthing! 58-1/2mpg at 157mph - WOW!

A DIFFERENT CONTOUR/FINISHING IDEA

This is presented as food for thought, not as the only way to do it. This idea was developed by Cory Bird, a very bright manufacturing engineer at Scaled. Cory is in the finishing stages of his exquisite original design and came up with this idea while working through the contouring stages on his airplane. I recently refinished my wood core/carbon composite prop and I used Cory's idea and I liked it! It worked great! Here it is.

The idea came when Cory compared the weight of a gallon of epoxy with a gallon of Featherfill. If you have not done this, do it, it will open your eyes! Even taking into account the evaporation of solvents in the Featherfill, there is a huge difference. Anyway, this is a process that starts when you have your airplane (or parts of airplane) structurally complete, in bare glass, and are ready to begin contouring. Sand the glass as usual, you are not looking for a structural bond such as you would need in a glass-to-glass bond, you just need to scratch the cured epoxy. Use at least 40 grit, 36 grit is better. Sand hard in one direction 10 strokes. Then sand hard at

90° to the first sanding in the same area, 10 strokes. This is not a hard and fast rule, it is just a rule of thumb so that you can begin to see the kind of surface preparation you need prior to applying dry micro.

Before applying the dry micro, paint the area with pure epoxy. Wipe as much of this epoxy off as you can with a clean paper towel. This is the "glue" that will bond the dry micro to the cured substrate (skin). A good idea here is to only try to do a small area at a time, say a square foot or two. Mix up a batch of dry micro - the consistency of cake icing works well. Some people try to mix it so dry that it is almost impossible to apply. I don't agree with that. The gram or two of weight you might save per 8 ounce cup is simply not worth the enormous effort. Spread the micro (just like peanut butter) using a squeegee. If it rolls up behind the squeegee, it is a little dry but you can fix that with peel ply. Squeegee through the peel ply to get the micro even and where you want it. Once the whole surface is micro'd, allow it to cure.

Contour sanding should be done using a long sanding block. In the case of a wing, 3 or even 4 feet is not too long. Glue 36 grit sandpaper to the sanding block using 3M 77 spray adhesive. Sand until you hit glass, then stop. If you still have low spots, rough them up, fill them with dry micro and repeat the above until you have the smooth contour you like. Leave it in 36 grit scratches. Do not go to a finer grit sandpaper.

Now, mix up a little pure epoxy and, using a 6" wide soft rubber squeegee, spread this pure epoxy (no micro) all over the surface. The idea is to fill all of the 36 grit scratches with pure epoxy. Carefully squeegee as much of this first coat of epoxy off as you possibly can. Use a lot of force on the squeegee and wipe the edge of the squeegee often with a paper towel. Allow to cure for two hours or so. The first coat should be gelling but not fully cured when the second coat of epoxy is applied in exactly the same way. Continue with this ritual until you have applied five separate coats. At two hours per coat, obviously you will need at least 10 hours at one stretch. Of course, this will depend on the ambient temperature and on what epoxy you are using. Here in Mojave in the summer, using Safety-Poxy or PTM&W epoxy, two hours between

coats is sufficient. Allow these five coats to cure for a full 48 hours.

At this point, you have filled all of the 36 grit scratches and you have a very thin film of cured epoxy over the entire surface. All that remains now is to final sand. You should not have any runs or thick lines of epoxy. Wet sand with 220 grit followed by 320 wet. You are now ready to paint! That's it, no Featherfill, no Morton's eliminator, nothing but epoxy all the way. This way, there are no pinholes, no voids, no place for a delamination to start, no place to trap moisture. All you need now is a quality paint. I would suggest at least a high quality urethane or epoxy paint. Keep in mind that your composite airplane is very flexible and will flex in turbulence and while taxiing over bumps. If you use a brittle paint such as enamel or lacquer, it will crack at all highly stressed areas.

For the toughest, most longlasting finish, you should use the same epoxy for the contouring method described here as you used to manufacture your airframe. However, this may be time consuming because sanding Safety-Poxy micro can be very hard work. The only way to speed this up, for those of us who are impatient, would be to use the fast West System (Gougeon Bros.) for the contour job. It will go much quicker, perhaps only one hour between coats, and it will sand much more easily - it will not be quite as tough, but it will certainly be adequate.

I would appreciate any feedback from anyone trying this system. - ED.

TIRE WEAR

Over the years, we have seen EZ's, Defiants and even Viggens with horrendous wear patterns on the tires. Regardless of the original main wheel alignment method used during construction, in the final analysis, the wear pattern on the tires tells it all.

Ideally, the main tires should wear evenly across each tire. They should not wear on the outside or inside shoulders. If your tires are wearing unevenly, fix the problem, don't just accept it as inevitable. If the rubber tread is wearing heavily on the outside shoulder, you have too much toe in. If the inside shoulders are wearing badly, you

have too much toe out. To correct both problems, install aluminum taper shims as required between the axle flanges and the main gear strut. These taper shims are available from several sources including Aircraft Spruce and usually come in 1/2°, 1° and 2° increments. These may be combined to give greater tapers if required. (They can be installed so as to remove excess camber as well, if required.)

We have found that it can take several iterations to finally achieve the even tread wear that is most desirable, but it can be done. Give it a try.

CAUTION: FOD TO PUSHER PROPS

Foreign object damage to your EZ prop, such as a nick or gouge that you might tend to believe was gravel thrown up by the tires, probably is not from the tires at all but most likely is caused by something that fell out of the cowling (off the engine!). My 2100 hours of Long-EZ flight and over 700 hours of VariViggen flight have proven to me that almost invariably a ding in the prop, especially if inboard of 10 inches from the tip, was caused by something coming out of the cowling. A clipped end of safety wire, a washer, a nut, even a bolt and once an exhaust stud, nut and washer! My experience has shown that gravel/sand particles thrown up by the nose tire does cause tiny chips in paint and wood predominantly near the tips of a prop (the outboard 10 inches or so). The main tires seldom, if ever, cause anything to be thrown into the prop arc.

The point I want to get across is this: Any damage to your prop, heavier than sand and light gravel chips and generally inboard of 10" from the tips, is almost certainly caused by something falling out of your cowling and possibly off your engine. Do not ignore this type of damage, even if the prop damage is minor. Ground the airplane - remove the cowl and use a good flashlight to carefully and methodically check for missing screws, nuts, bolts, etc. You will be amazed how often you will find something missing. Over time, you will learn to be more careful about casually clipping a piece of safety wire and having it lodge in a wiring bundle on the firewall. Same goes for a dropped washer, nut or bolt. If it does not fall all the way to the ground - know that it lodged somewhere and will go into the prop disc

sometime. With time, you will become an expert at finding lost washers in wing roots or in wiring bundles. Remember, the airplane will always try to warn you before it bites you! An unexplained ding in a prop blade is a warning! Pay attention - Fly safely. - ED.

EPOXY UPDATE

The dust is beginning to clear after the initial confusion caused by the State of California making the use of MDA illegal, at least, in the industrial environment. Since Scaled Composites does not subject its employees to MDA or styrene (contained in Safety-Poxy) RAF reasoned that homebuilders should have the same benefits. A lot of frantic testing was conducted and, as a result, PTM&W (PR2770/PH366C) was recommended. Many builders complained about the workability of this rather thick (viscous) epoxy system so the tests and evaluations continued. Today, we have an improved, thinner PTM&W (PR2032/PH3660) which has even better physical properties than the original PTM&W and we have Hexcel's 2427 system which has the advantage of using the Safety-Poxy ratio pump "as is", that is to say, the mix ratio is 44:100. The workability and "wet out" qualities of Hexcel 2427 are excellent and the physical properties are adequate.

Caution: Both of the above epoxy systems have higher exotherm problems than Safety-Poxy. The only place this can cause a problem is when you join foam blocks. This is very important. You cannot have a micro joint between two foam blocks any thicker than 1/8". You must be absolutely certain that your micro joint, or the space between the foam blocks, is less than 1/8" (1/16" is best). Any more than 1/8" will cause an exothermic reaction, due to the high insulating properties of the foam, and serious damage to the foam and loss of structural integrity of the foam joint will result.

This is not as good as Safety-Poxy (which allowed a safe foam block joint up to 1/4" thick), but both of these epoxy systems are completely free of MDA (a known carcinogen) and styrene (highly allergenic). Soooo..... you have your choice.

Please let us have your observations as feedback for the CP. We, and all of our readers, are

interested to hear about personal experiences, good and bad!

LETTERS

FROM CHARLIE PRECOURT, VARIEZE BUILDER/FLYER, ASTRONAUT.

"Dear RAF,

I've sent along some info I hope will make good inputs for the upcoming newsletter. You'll find a photo of my launch on the Columbia in April and a couple of other shots we took from orbit. The launch is an impressive ride to say the least! In the photo, the tail of the orbiter has just cleared the tower level (couple hundred feet) and our speed is already over 100 mph vertical. There are 7 million pounds of thrust and our liftoff weight is just under 5 million pounds! First stage is quite a rumble - about like a freight train - and the thrust gives you a relentless, increasingly hard push into the back of your seat - to just under three g's at booster burnout. That's not a lot of g but it's a long duration at that g level so you really get a strong sense of the rapid acceleration. After booster separation, the ride smooths out and the g level drops off until the fuel weight starts to decrease as the tank empties. We hit 3 g's again at about the 7 minute point in ascent and stay there until main engine cutoff at 8 1/2 minutes where we hit orbit at a speed of 17,500 mph (Mach 25). Zero g is immediate after the engines cutoff. Some folks may recall that our initial attempt at the launch resulted in a pad abort as our right main engine failed the start sequence due to a purge valve that failed to close. There were some tense moments sorting out the problem, but the safety system worked as designed and stopped a potential engine burn-through... Once on orbit though, the delays become insignificant. In the grand scheme of things a month delay for the engine changeout and retest was a small price to pay to ensure a safe and very productive mission.

We were a spacelab mission that conducted over 90 different experiments in medicine, biology, robotics, materials sciences, (crystal growth and metallurgy - using furnaces to melt and resolidify a variety of materials in the absence of gravity which enhances their properties -- I'd like to try a fiberglass layup in zero g

sometime!!). We had a laboratory setup that included some 8 furnaces, over a dozen laser devices, a medical diagnostic rack that had ultrasound, EKG and EEG devices - you name it. One experiment in fluid physics actually verified a process empirically that up 'til now had only been a theory in the textbooks. So all in all, we had a great flight in terms of scientific return. In the medical research area, a very promising research in cell fusion (genetic engineering) was also completed. In the absence of gravity, cells of different types can be fused using electric fields without damaging the cells (without gravity you have no perturbing forces that damage the cells during fusion like you have on earth). The result is the ability to produce hybrid cells with very high quality characteristics. One day this technique may allow us to design cancer killing cells or cures for other diseases.

The most rewarding aspect of space flight personally, though, was viewing the earth. It is nothing short of incredible. Those are some of the most precious moments of a lifetime and I wish I could have somehow had my family there with me to share it. When we travel to talk about our spaceflight experiences, we're often asked if the experience changed us in any way. Some have even called it a religious experience but I like to describe it more in terms of gaining a new perspective on our place in the universe. You witness first hand and on a grand scale the awesome power of nature. At any one moment you can view an area that is approximately 1000 miles across the face of the earth - further than that you lose detail at the horizon - and the speed of the orbiter is such that you see an entirely new 1000 mile area every three minutes and twenty seconds! When you take in the view of a sandstorm blowing out of Africa across the Atlantic that covers over a thousand miles across or watch lightning continually going off under you on the night side of the earth, you really get a new perspective of how powerful nature is. I used to think our machines were pretty powerful - I've flown my VariEze coast to coast several times and I've flown F-15's across the Atlantic on deployments and now I have ridden several million pounds of thrust to orbit. We speak in terms of big numbers when we talk about the power of our machines, but when you see how little you are from the perspective of viewing the earth from orbit, you realize how insignificant you are as an individual against the power of

nature. You also realize that your seven million pound thrust machine is nothing more than a speck of dust revolving around a planet that itself is just a speck of dust in the universe. So when you combine that with the view of an earth without visible borders or political boundaries, you see that it is only the teamwork of thousands of people that allows us to harness our little piece of nature! If only we could take the people fighting in Bosnia, Haiti or Somalia to orbit to see where they come from - I don't think there would be nearly as much conflict on earth.

Speaking of Somalia, I've also put in a photo of that country that shows the horn of Africa, the Gulf of Aden and off on the horizon Saudi Arabia. The colors are incredible and in person the view in 3D is mind boggling. You can't float by a window on orbit without being distracted by the view! Finally, I've included a slide showing yours truly floating in the lab module while I was working on an air sampling experiment (sorry I've run out of prints of interior shots for the moment). Nothing beats being able to float, although it makes working with multiple free pieces of equipment or parts kind of tough as they all want to float away. I remember at one point having a couple of items in each hand, something else between my knees and a pencil between my teeth while I was trying to record some data - and then Houston decided to call and I needed to key the mic to answer!

Reentry was a treat as well - we entered on the night side of the earth for an early morning landing at Edwards. As we hit the atmosphere at about 400,000 feet, the heat of reentry (about 2500 deg.) started an ionization of the atmosphere that we saw as an orange-pink glow out all the windows. We're at an angle of attack of about 40 degrees during the hot phase of entry and so out the overhead window you can see down the core of the vortex and plasma trailing behind us which appears as a brightly pulsating, red-orange tail. At about Mach 19, we came into sunrise on the eastern horizon in front of us so through the forward widows we began to see sunlight which was bright enough to overpower the red glow, while out the overhead and side windows we continued to see the glow until we fully slowed below the high heat velocities (down below about Mach 8). We hit the California coast doing Mach 5 and were finally starting to fly a little more like an airplane. In five more minutes

we were on final at 300 knots with a 19 degree dive for Rwy 22 breaking through a thin overcast at about 16,000 feet. It was like a homecoming to see the lakebed again, as I had spent 5 years there before joining the space program.

I'm looking forward now to my next flight opportunity as the pilot. This first mission, I was designated mission specialist number 2 (MS-2) who performs duties somewhat analogous to a flight engineer in an airline crew on ascent and entry but who also acts as pilot and shift commander on orbit. I was on opposite shifts from the mission commander on orbit and therefore flew all the orbital maneuvers required during my awake hours to point the science instruments in the payload bay at their intended targets (earth observation cameras, ultraviolet cameras for the study of the Milky Way and our communication antennas that needed to be pointed at satellites). I also had command of the overall operation while the mission commander's shift slept. With a crew arrangement like this, we can operate the experiments 24 hours a day and maximize the science return of the flight... In any event, I hope to fly again towards the end of '94 or early '95 as the pilot for my next crew. Until then, I'm supporting upcoming missions as CAPCOM - the person who communicates with the crew from the control center.

Our future with the shuttle program is now expanding to include the Russians. We have two cosmonauts here in Houston now training for a shuttle flight in January. We are also planning up to 10 MIR (Russian space station) rendezvous flights where we will use the shuttle to change out crewmembers on MIR. Some of our astronauts will begin training in Moscow to fly on MIR and we plan to conduct further research, expanding on what was done on my lab flight, aboard MIR. This is all leading up to our planned joint space station development with the Russians and our European, Japanese and Canadian partners. So, many of us are now also beginning Russian language training. Things have really changed for a guy who used to fly F-15's on the German border - now I walk down the hall in my office and hear Russian being spoken by visiting cadre from the Russian space agency! Let's hope it works!

Mike, I've also enclosed the info about deep stall that we discussed at Oshkosh. I have received

permission for public release of the video tape of an F-16 deep stall incident which gives a pilot's - eye view of a deep stall which almost doesn't recover. I've also attached a letter describing what the important learning points are from the video, especially as they apply to EZ pilots who are unfamiliar with deep stall. I've made arrangements with a local video service here to duplicate the tape for those who want a copy. I'll be happy to provide a copy of the tape along with a transcript of the audio portion (for clarity) and my writeup about the learning points to look for on the tape to anyone out there who'd like one. I'm able to do this at cost for \$13 a copy which includes the tape, the duping, printing and mailing. Folks can just mail me a note at my address: 7015 Little Redwood Dr., Pasadena, TX 77505 to get a copy.

Y'all take care, and fly safe!

Charlie Precourt"

ED NOTE: Many thanks, Charlie, for the fabulous description of what most of us can only imagine - what a trip! Also: See ad for tape in the FOR SALE section of this newsletter.

PLANS CHANGES AND OTHER IMPORTANT MAINTENANCE INFORMATION

ALL RAF DESIGNS - CAUTION: EXOTHERM PROBLEMS. SEE ARTICLE "EPOXY UPDATE" PAGE 6 THIS ISSUE.

Since RAF is no longer active in the development of homebuilts, we are not likely to discover many new errors or omissions in the plans. For this reason, we need your help. Please submit any significant plans changes that you may come across as you go through the building process.

RAF RECOMMENDED SUPPLIERS

Aircraft Spruce
PO Box 424
Fullerton, CA 92632
714-870-7551

Wicks Aircraft
410 Pine Street
Highland, IL 62249
618-654-7447

FeatherLite
PO Box 781
Boonville, CA 95415
707-895-2718

Brock Mfg.
11852 Western Ave.
Stanton, CA 90680
714-898-4366

These suppliers are still the only authorized RAF dealers for all your various aircraft materials and components.

RAF recommends the following prop manufacturers:

Bruce Tift
B&T Props
75872 Mosby Creek Rd.
Cottage Grove, OR 97424
503-942-7068

Ted Hendrickson
PO Box 824
Concrete, WA
98237
206-853-8947

SHOPPING

FLUSH, INTERNALLY MOUNTED ANTENNAS

A complete line of antennas, specifically designed for, and flight tested on, composite aircraft. The antennas are tuned for maximum performance and, in general those who have used them so far, report reception is doubled over standard external antennas.

VariEze builder/flyer, Bill Butters, has started a company to develop a full range of buried antennas. These are normally supplied with a BNC connector built into the actual antenna, but can be supplied without connectors to include enough length of co-ax cable to facilitate easy installation with minimum weight and bulk.
Contact: Bill Butters

Advanced Aircraft Electronics
PO Box 4111
Florissant, MO 63032
1-800-758-8632

CANARD PUSHER DIGEST, 2ND EDITION

Stet Elliott's "Canard Pusher Digest for the Long-EZ" is now in its 2nd Edition. (For a complete

description, see CP57). Includes all builder related information from CPs 24-75. The 2nd edition of the Digest has now grown to over 700 pages, and is professionally printed on double sided 8 1/2 x 11" paper from a laser printed master.

Quarterly updates to the Digest are also available. The updates provide additional information from newly published CPs to bring the Digest current. The updates are compatible with either Digest edition.

Note that the Digest is for builders and flyers of the Long-EZ only. It does not support other RAF designs.

CP Digest for the Long-EZ (2nd Edition)
\$75.00
(Overseas orders add \$20.00 for airmail)
Annual Update Subscription (4 updates)
\$25.00
(Overseas orders add \$5.00 for airmail)

CANARD PUSHER NEWSLETTERS "ON DISK"

Stet Elliott has also compiled the text of all the Canard Pusher newsletters in electronic format. The set includes all of the Canard Pusher Newsletters, from the very first one published in May of 1974, to the present. The set of CPs is provided in a text only format which should be 100% compatible with any computer word processor you presently use. It is available for either the IBM or Macintosh platforms. A hard disk is strongly recommended since the set contains over five megabytes of textual information!

This product is ideal for anyone interested in reading about the evolutionary development of RAF's canard designs through the years, or for those builders still plagued with the "I know I read it here somewhere!!" syndrome. With one of the inexpensive text search and retrieval programs, text string searches across the entire set of files are a snap.

CPs on disk costs \$65.00. Specify disk size, (3 1/2" or 5 1/4"), platform (IBM or Mac), and disk capacity.

For either the CP Digest for the Long-EZ, or the CPs on disk, contact:

Stet Elliott
5322 W. Melric Dr.
Santa Ana, CA 92704
(714) 839-8233

VARI-EZE INDEX

Lists all plans changes from CP10 through CP68 as well as all suggestions, problems, etc. For any VariEze builder, this is a must. Bill sells it a couple of different ways. You can buy just the printed book for \$20.00 or you can get the book plus a 5-1/4" IBM compatible floppy disc with a delimited ASCII listing of the data base (or optional PFS professional file data file) for \$24.00. Specify which you would want. This index will be updated annually.

Contact: Bill Greer
811 Cooper Square Cir. #240
Arlington, TX 76013

PLEASE NOTE: Those of you who have the first edition, Bill has improved the indexing of several topics and added more cross-indexing. You may find it helpful to get an up-grade.

DEFIANT FLYER

If you are building a Defiant and you are not currently receiving John Steichen's Defiant Flyer, you are missing a bet. This publication is exactly what is required by both builders and flyers. It contains all kinds of helpful information and great articles. Bayard DuPont's letter on his Ford-powered Defiant in the December issue is a case in point. See CP67, page 2 for information on subscribing to the Defiant Flyer.

Seen at Oshkosh. Beautiful leather seat cushions (also available in various fabrics) for Long-EZ, VariEze and Defiant.

Contact: Diana Davidson
Alexander Aeroplane Co.
900 S. Pine Hill Road
PO Box 909
Griffin, GA 30224
404-228-3901

LONG-EZ PARTS PRICE LIST FROM FEATHER LITE

Main gear strut	\$ 349.00
Nose gear strut	58.00
Engine cowls, pr. (glass)	329.00
Engine cowls, pr. (Kevlar)	480.00
Cowl inlet	48.00
Wheel pants (3.5x5)	150.00
Wheel pants (500x5)	180.00
Above item in Kevlar	215.00
NG 30 cover	21.00
Pre-cut canard cores	160.00
Pre-cut wing & winglets	1199.00
Leading edge fuel strakes w/bulkheads	524.00
Strut cover SC	19.50
Nose wheel cover NB	19.50
Sump blister	19.50
NACA inlet	47.00
3" extended nose gear	70.00

Feather Lite, Inc. is proud to announce another product to re-introduce to EZ builders: The original Space Saver Panel by the late Rusty Foster. This is a bare fiberglass panel with a molded recess for builder installation of an aluminum flat stock electrical panel. \$40.00
Contact Michael Dilley or Larry Lombard (both ex-RAF employees and EZ builders and flyers) at:

Feather Lite, Inc.
PO Box 781
Boonville, CA 95415
707-895-2718

RAF "GOODIES" AVAILABLE

NEW ITEM

VIDEOS AS MENTIONED IN CP76.

We now have available VHS tapes of two of Burt's talks at Oshkosh '93.

Tape #1 - Design College - Cockpit of the Future.
Tape #2 - RAF Builder's Support Forum.

Please send \$20.00 per tape to RAF at 1654 Flight Line, Mojave, CA 93501. We will pay the postage.

Charms-Long-EZ/VariEze (gold or silver)	6.50
Name patch	1.50
Silhouette patch (no Defiant or Long-EZ)	3.50
3-ship poster (17"x22")	3.75
2 Long-EZs in trail (11"x17")	3.00
Defiant on water (11"x17")	8.00
RAF Chronological poster	15.00
Long-EZ lithograph	10.00
Color photos (EZs, Solitaire, Defiant)	1.25
Night photo by Jim Sugar	5.00
Videos - Building the Rutan Composite	39.00
Go-A-Long-EZ	39.00

FOR SALE

F-16 DEEP STALL INCIDENT VIDEO

Gives a pilot's-eye view of a deep stall which almost doesn't recover. Includes a letter describing what the important learning points are from the video, especially as they apply to EZ pilots who are unfamiliar with deep stall, as well as a transcript of the audio portion (for clarity).
Price - \$13.00.

Contact: Charlie Precourt
7015 Little Redwood Dr.
Pasadena, TX 77505-4433

AIRCRAFT COVERS

Custom cover for you Long-EZ. This neat design completely covers your prop, canopy and nose and only uses two straps. Made from space-age Evolution 3 material. Reasonable price.

Contact: Tony Brazier
PO Box 6478
Ocala, FL 32678
904-237-1811

NOSE GEAR RATCHET

Dr. Curtis Smith's nose gear crank ratchet is still available at \$38.00 which includes postage and packaging. No need to call, just send check or money order. This little device should be considered a "must" by all Long-EZ and VariEze builder/flyers. Once you have flown with it you will wonder how you ever did without it.

Contact: Curtis Smith
1846 Sextant Dr.
Worden, IL 62097
618-656-5120

NEW PRICE

SIGHT GAUGES

New, improved fuel sight gauges. Use with auto fuel or Avgas. Clear bubble with white background. Retrofit for Long-EZ and VariEze. \$35.00 per set.

Contact: Vance Atkinson
3604 Willomet Court
Bedford, TX 76021-2431
817-354-8064

ORIGINAL REM 37 BY SPARK PLUGS. These are the short ones available up to mid 80's. New - \$17.00 ea.

They were the "thermos" expanding "o" ring-type. This type of fuel cap requires regular lubrication of the "O" rings at 25 hour intervals. If this is not done

Contact: Steve Franseen
303-987-1880 (leave message)

FOUR STACK STAINLESS EXHAUSTS

Further update on the all stainless steel 4-stack exhaust pipes. They are now available with springs and slip tubes at the flange or with ball joints, builder's choice, each still has the original slip tube support on each side to keep the pipes totally independent of each other. They have 1/4" type 321 stainless steel flanges and type 321 .035" stainless steel tubes. The tubes are "degreased" inside and out before they are purged or back-gassed with argon while being welded (others don't do these two very important steps). They fit Lyc. engines for any pusher aircraft, Ez's and Cozys, etc. - Cost - \$500.00 plus \$15.00 shipping and handling.

Also, if anyone would like to have ball joints fit and welded on their existing pipes, the cost is \$150.00.

The RAM AIRBOX is still available at \$325.00. Reuseable foam air filter - \$20.00 plus \$11.95 shipping and handling.

The increase of performance of both 4-stack exhaust pipes and airbox combination is very impressive, about 200 rpm on the average Long-EZ

installation. Builders can call or send SASE for a flyer. Both items come with an installation sheet.

Contact: Hal Hunt
6249 Longridge Ave.
Van Nuys, CA 91401-2528
818-989-5534

HARD TO FIND BELLCRANK BEARINGS

Bellcrank bearings for control systems are now in stock again. Due to a nation wide shortage, Wicks has contracted with a local manufacturer to provide as many as needed. They just received 5000 of the BC4W10 bellcrank bearings which are used on many experimental aircraft.

THE LATEST IN LAMINATING EPOXY

In stock - a large supply of the newest laminating epoxy available. PTM&W Industries 2032 Epoxy Resin and 3660 Hardener is designed for all types of structural applications and for all your laminating needs.

PTM&W Industries, working with respected aircraft designers, has developed this new epoxy laminating system to be the safest to use, and to have the best chemical adhesion on fiberglass, carbon fiber, Kevlar, etc.

Contact: Wicks Aircraft Supply Co
Bill Weder
618-654-7447 or
1-800-221-9425 for a free
catalog.

WANTED

Original (or later) Lexan or Plexiglas VariEze Landing Lite nose tip cover.

Contact: A. McPherson
PO Box 195
Stewarts Point, CA 95480-0195
707-785-2947

Plans for NACA inlet for Long-EZ. Will pay reasonable price plus shipping.

Contact: Klay E. Gilbert
PO Box 307
Lindsay, TX 76250-0307

DOES RAF HAVE A COZY RELATIONSHIP?

It has recently come to our attention that a statement printed on the cover of the COZY Mark IV plans is creating an impression that these plans or this aircraft may have been approved by Burt Rutan or by Rutan Aircraft Factory. The aircraft and the plans for the aircraft have NOT been approved by Burt Rutan nor have they been approved by Rutan Aircraft Factory.

The reason that there is any agreement at all with the CO-Z Development Corporation is because Nat Puffer (unlike others) came to RAF in the early 1980's and agreed to pay a royalty if we allowed him to copy and publish portions of the Long-EZ plans for developing his original Cozy design. At that time we considered that, at a future date, we might assist him by testing the Cozy and possibly testing his future designs. However, RAF decided it could not provide the same controls over the design, therefore, the same safety program we provide to Long-EZ builders/flyers would be unavailable. Consequently, RAF never evaluated nor approved the Cozy or any other Co-Z program.

This does not infer that there is anything wrong with the Cozy or with any of Nat's other designs, only that RAF has never tested them and, thus, cannot comment on their suitability or safety.

Any statement found on any document from CO-Z Development Corporation relative to RAF's agreement represents only that CO-Z Development has full permission to use structural and manufacturing technologies that were developed for the Long-EZ. There is no approval or implied approval by RAF regarding the suitability of CO-Z designs.

CP77 CHART

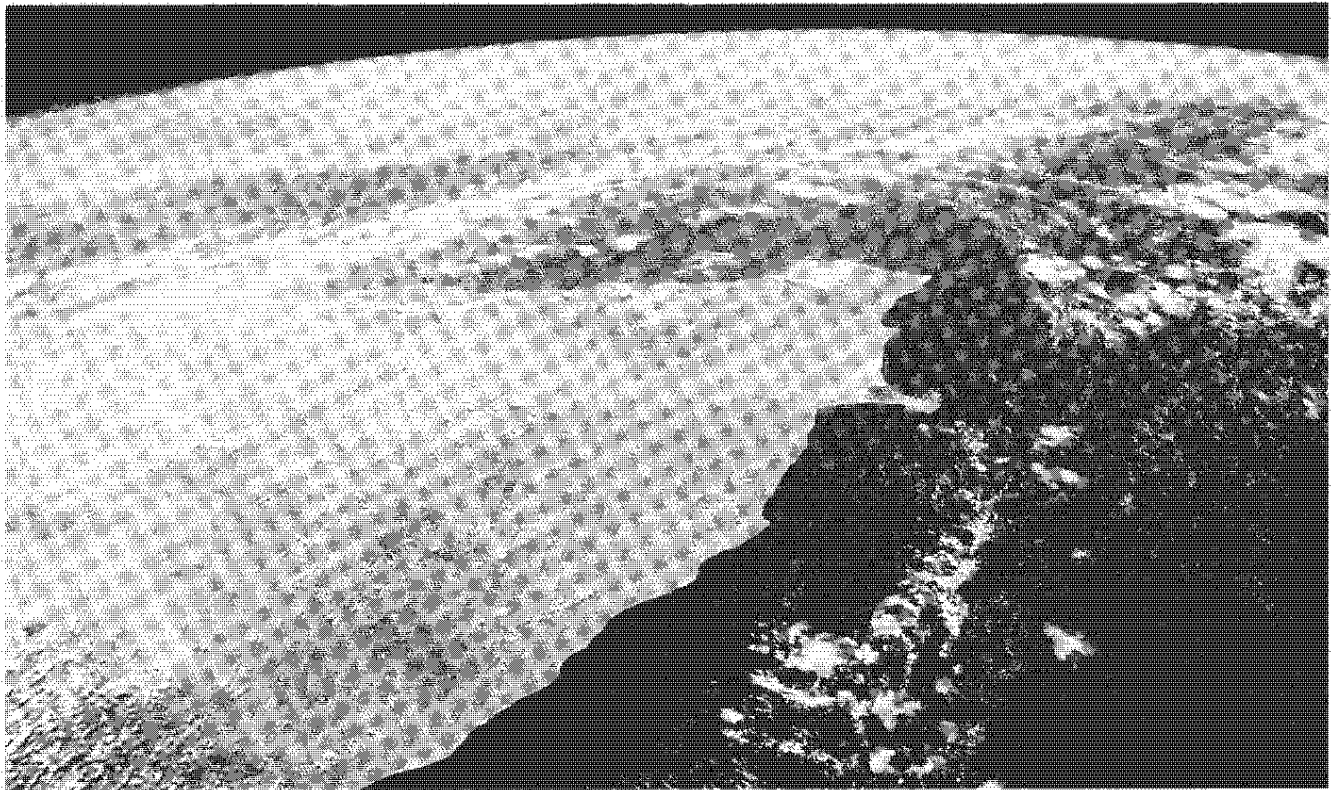
	A	B	C	D	E	F	G	H	I
1	TURN	ELAPSED	LEG	LEG	FUEL	LEGFUEL	LEGBURN	LEG	
2	POINT	TIME(HR)	TIME(HR)	MPH	BURN(GAL)	BURN(GAL)	RATE(GPH)	MPH	
3									
4	P10	1:57	1:57	159.5	6.30	6.30	3.23	49.38	
5	HDF	3:59	2:02	153	11.65	5.35	2.63	58.14	
6	P10	5:59	2:00	155.5	16.75	5.10	2.55	61.00	
7	HDF	7:58	1:59	156.8	21.87	5.12	2.58	60.76	
8	P10	9:58	2:00	155.5	27.12	5.25	2.63	59.25	
9	HDF	11:57	1:59	156.8	32.09	4.97	2.51	62.59	
10	P10	13:57	2:00	155.5	37.22	5.13	2.57	60.64	
11	HDF	15:50	1:53	165.2	42.49	5.27	2.80	59.03	
12	P10								
13									
14	SUMMARY:								
15									
16	ELAPSED TIME(HR):	15:50							
17	AVERAGE MPH:		157.1						
18	TOTAL FUEL		42.49						
19	BURN(GAL):								
20	AVERAGE GAL/HR		2.68						
21	AVERAGE MPG:		58.55						

P10=CHANDLER, AZ

HDF=HOMELAND VOR

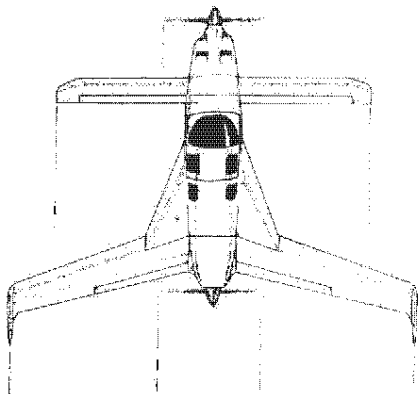
LEG LENGTH=311 STATUTE MILES

TOTAL LENGTH=2488 STATUTE MILES



Somalia on the Horn of Africa as seen by Astronaut Charlie Precourt, VariEze builder/flyer, from Spacecraft Columbia, April 1993. Photo by Charlie Precourt

RUTAN AIRCRAFT FACTORY
1654 Flight Line
Mojave, CA 93501



TO:

JAN: 94

The line which appears above your name lets you know through which *Cunard Pusher* you are paid. If your label says **LAST ISSUE CP77**, then this is your last issue, and you need to renew.

CP 77