it.

4) **Window installation:** Tim Hedstrom says he has helped install windows on 13 Lancair IVs. What they do is fit the windows first, then drill holes very carefull for screws, then lube the screws with mold release wax, and lub some area washers the same way. Then get a few key screws, place a large wedge of flox in the joint, press the window in place, and while holding insert 4 key screws with area washers on both sides. After all are in place, tighten carefully. To get a nice exterior edge where the flox seeps out, before hand, use two layers of electrical tape where the window meets the frame. After tightening the screws, wipe away the excess flox. Then just pull up the 2nd layer of tape. Leave the first layer there for protection as you sand the lip later for paint.

5) **Rain:** Sooner or later, everyone will park outside in the rain. And no matter how well you are covered and sealed, a little water might leak in. Rather than have to open up the inspection cover in the nose to sop it out, the sneaky thing to do is to drill a couple of holes through the bottom at the low point so the water will drain out all by itself. Hmmmm!

FOR SALE

LONG EZ N84LZ

#15
$8.50

By: John Jamison
April, 1986

I. Problem Areas

A. Cabin Heat. The original cabin heater, called for in the plans, was not installed because of comments in CP-32 and CP-34 which stated that the 20 amp electric heater should be "more than adequate". I installed this heater and found it to be of marginal value. With the sun shining, and wearing two heavy pair of socks, long underwear, boots, and a light jacket an OAT of 40F is tolerable without cabin heat. With cabin heat on, an OAT of 30F is tolerable. When the sun goes down, or it is overcast, these minimum temperatures are raised by 5 degrees. Note that I have installed a canopy seal system of my own design that allows very little air leakage, and I have installed foam around the elevator tubes. Sealing all air leaks is not the complete solution, because some airflow is needed to prevent fogging of the canopy, especially in the back seat area. The best solution seems to be to seal the elevator tube/fuselage clearance hole with foam and return to an engine source heat system. I installed a heater system that uses hot engine oil that is run through 25 feet of 3/8 inch stainless steel braided flexible hose that is routed to the nose of the aircraft and back to the engine. A valve system of my own design allows the oil to flow to the engine oil cooler or to the hose in the cabin or any combination of the two. The oil can be completely shut off in the event of an oil line leak(if a check valve is installed in the return line). In this system the oil hose acts as the heat exchanger to warm the cabin similar to the way that hot water baseboard heat works in a house. The hot oil lines were isolated from structural areas and fuel lines by physical means or by insulation. The insulation must be able to withstand the high temperature of the oil line. Some foil-backed 1/8 inch foam tape I tried worked well and some hot water pipe foam insulation I tried melted from the heat. Allowing room for these hoses with insulation would have been much easier if done during construction. This system with the 20 amp electric heater on keeps me comfortable down to an OAT of +30F with no sun shinning while wearing normal clothing and a light jacket(no long johns). However, the canopy fogs up at this temperature if the sun is not shinning. Frost forms on the inside of the canopy below about +25F so some type of defroster is needed at these low temperatures. At low cruise power(110KIAS) the oil temp is 160F, the lower limit. It appears that not much more heat can be taken from the engine oil without cooling it below the normal operating range. The lower temperature limit for comfortable operation is +20F with both heaters on while wearing long johns and heavy boots. At this outside air temperature, the oil temperature stabilized at 170F at 125KIAS cruise speed.

B. Entry Door. The entry door leaks both air and water. Air comes in around the hinge and the hartwell latch. I was able to stop the hinge leak by putting a small bid layup over the hinge area on the inside that extended forward onto the fuselage wall. Before glassing I protected the hinge from epoxy with one layer of scotch tape. I have no fix for the hartwell latch, and may get one of the flush mounting air tight latches. To prevent water from coming into the airplane through this door, I dug out a trough at the bottom of the door opening (U-shaped cross section)

instead of the tapered treatment called for in the plans. This litt trough catches water, and a small hole at the front of the trough, through the outer fuselage wall, drains any accumulation.

C. Nose Wheel Bearing. The nose wheel turns on the spacer and bolt instead of the bearing. I have found wear on the bolt and spacer. The reason this occurs is the rubber bearing seals rub on the wheel hub tightly and the seal-to-hub joint has more friction than the spacer-to bearing or spacer-to-fork joints. To fix this problem, I glued the assembly with epoxy. I cleaned the hole in the inner race of the bearing with MEK. I also cleaned the spacer and fork. I then applied a light coating of thin flox on the spacer, bearing hole, and fork. I coated the axle bolt with paraffin as a release and assembled the nose wheel unit. Next time I may mill a slot in the inner fork surface below the axle hole and fit a pin in the spacer outer mating surface that would slip into the fork slot to keep it from turning. This would eliminate the need for epoxy between the spacer and fork and would ease disassembly. Or I may simply paint the mating surfaces of the spacer, bearing inner race, and fork with zinc chromate and assemble the parts wet.

D. Aft Canopy Joint Location. My aft canopy joint (cut per the plans) is about 1.5 inches forward of the main spar forward vertical face. This cut determines the location of the headrest. This cut location puts the headrest too far forward for passenger comfort. Extra thick seat back padding or a seat back insert board will be needed to solve the problem. The aft canopy joint needs to be slightly forward of the spar forward face to allow space for the fuel vent lines to pass (about .3 inch). If a lap joint is used for weather seal, the cut may possibly be made further aft because the forward edge of the inner lap will become the forward edge of the aft canopy joint.

E. Canopy Differential Expansion. The canopy assembly rises at the front and rear when cooled. I did final shaping using micro fill and sanding in a 70 degree environment. Because it was winter, when I came back to inspect my work in the morning the temperature was about 30 degrees. I found the front and rear edges of the canopy raised up 1/8 inch. In flight the same thing occurs with cooler temperatures at altitude. My fix was to install a more sophisticated weather seal that can handle these canopy gap changes. I describe it later.

II. Changes

A. Nose Gear Retract Assembly Chatter. My nose gear assembly chattered during extension with the airplane upright and during retraction with the plane turned over. I removed the retract assembly and discovered that there was some end play in the worm gear (NG-58) assembly. A washer was ground down to a snug fit to take up this end play. The washer was installed between NG-58 and NG-57 on the end with no washer and the chattering stopped. Another problem is that after six months of use the nose gear retract assembly loosened to the point that the gear would not remain in the retracted position. Installing a washer in the retract mechanism to bind it up slightly, along with a friction device on the crank rod, may solve the problem (as described in the CP).

B. Landing Light Well Cover. The landing light area will be a major air leak without a cover of some sort. I fabricated a bubble cover using urethane foam for a mold (another local builder used a balloon). A rubber boot around the actuating rod effectively seals the area. A

rubber boot on the landing brake actuating rod stops another air leak.

C. Mounting Canopy. I spread the aft portion of the canopy when initially mounting it to the fuselage. This gives more interior room and a smoother transition from the canopy to the aft cowl area.

D. Canopy. The driver here was my desire to have a good weather seal for air and water. I made numerous changes (in sequence):

1. When trimming the outer canopy layup, the plans call for trimming even with the longerons. I trimmed about .25 inch below the longeron thinking that this overlap would shed water better. I have found that it not only sheds water, but provides positive centering for the canopy. An extra 2 layers of duct tape applied to the longeron area before the layup provided clearance for the inside layup that will be glass-to-glass in the overlap area just outside of the longerons.

2. To positively insure that water would not enter the avionics area, I cut the canopy off 1 inch aft of the instrument panel instead of forward of the panel as called for in the plans. This was done to ease installation of an overlapping waterproof seal on both the front and rear canopy joints. The NACA air inlet on the canopy had to be downsized (2/3 size) to fit. The inlet works well, but does leak water when flying in moderate rain. A small tube from the inlet to the right side canopy frame outside the seal could dump this water overboard.

3. In order to use a nice thick weatherstrip, it was necessary to provide some space between the longeron and the canopy frame. I did this by using my Dremmel router to remove .1 inch of the urethane foam from the surface of the canopy frame that mates with the top of the longeron. This left a nice gap for the weatherstrip. After the canopy was installed on the airplane, several bumps of flox were put in this gap to provide a solid closed position for the canopy. One of these bumps was located adjacent to each of the canopy latches.

4. To provide an overlapping joint at the forward and aft canopy joints, I routed out the urethane to the outer skin .5 inch from the forward and aft canopy edges. After rounding the urethane edges and glassing with bid, this gives a glass-to-glass .5 inch smooth sealing surface. The other half of the lap joint was glassed on the forward and aft cowl edge after the cowls were permanently installed and glassed inside. This lap joint was made by bondoing formica to the inside of the cowls so that the formica makes a form upon which the lap joint is glassed. This layup went on the cowl edge (urethane) and made a 90 degree bend onto the formica form. Two plies of bid were used. After this layup cured, I removed the formica form, sanded, and applied an inside layup from .5 inch inside the cowl onto the entire inner surface of the previous layup. I trimmed the edge to give a .5 inch lap joint. The weatherstrip was mounted on the fuselage side of the joint for better water protection except on the left longeron. Here, I put it on the canopy frame so that it would not be torn when climbing in and out of the airplane. This upgraded canopy seal system provides a thick enough seal so that there is very little leakage. At cold temperatures differential expansion causes the front of the canopy to raise slightly. But after replacing the "P" strip weather seal with 1/4 by 3/8 foam in the forward canopy area there is no air leakage.

E. Canopy Vent. The vent was downsized because cutting off the canopy aft of the instrument panel left much less area on the canopy on which to install the vent. Extra layups were put on the forward canopy area for reinforcement. This smaller vent works very well. A short piece of aileron hinge material was used to fabricate a vent door. With the hinge in the 90 degree position (hinge bump inside), I taped the inside area of the hinge, then floxed all around the outflow opening and hinge mount area. The assembly was put in position and left to cure. This leaves a nice flat hinge mount area and a flat sealing surface for the door. After filing and sanding, rivet the door into place. A small drawer knob was installed in the center of the door. To provide friction, so the door would remain in any desired position, a small aluminum tab was fabricated about 1/2 by 1 inch. A hole was drilled near one end to mount it on the drawer knob screw head. It was bent into a curved shape so that it rubs on the canopy frame surface. It works fine.

F. Canopy Defroster. My defroster consists of a distribution duct that goes from the top center of the instrument panel to my electric heater. A two-way valve was mounted onto the front of the electric heater so that I can select either heat for my feet or defrost. Where the duct crosses the fuselage/canopy joint, the two ducts were matched end to end with no seal, and it works well. The defrost air exits through two 5 inch openings to either side of the fresh air inlet vent. A diffuser vane in each outlet spreads the air around nicely. The distribution duct was made using the pour-in-place urethane foam, shape-it glass-it system. The duct feeds through a 3/4 by 2 inch opening in the instrument panel that transitions into a 2 inch aluminum tube that was squashed on one end to match the rectangular opening. From the aluminum tube to the heater, scat flexible tubing was used. If I did not have an electric heater I would try to install an air vent so that fresh air could be directed onto the canopy to defog it. The rear canopy area especially tends to fog with a passenger in the rear seat.

G. Fuel Cap Seal/Tank Vent System. I had heard from other EZ fliers that the fuel caps and vent system were prone to leak fuel. So, a twin vent system was installed as recommended in CP-27. This is an additional vent at the far aft top of each fuel tank that is routed to the same outside location as the vent called for in the plans. This results in 4 vent tubes on top of the aft cowl. This system is working well. The reason for the twin vent is to allow the use of sealing fuel caps. The sealing caps in the catalogs are both heavy and expensive. What I did was modify the Brock caps that are called for in the plans. I determined that fuel might be leaking around the Dzus fastener. To seal it, a small hole was drilled through the Dzus fastener shaft without removing the Dzus fastener. Then, an "O" ring (or two) was installed followed by a thin washer. The whole thing is held on by a cotter pin through the hole drilled through the Dzus fastener. The "O" ring is a very snug fit on the Dzus shaft to provide a seal. The washer is also a snug fit against the "O" ring. Even with full tanks, I get very little fuel leakage.

H. Electrical Panel. At Oshkosh, I saw a compact electrical panel with switch circuit breakers that looked ideal. The panel was about five by seven inches and had seven switches. Half of the panel was filled with switches and the other half had a circuit board that contained wiring to drive an LED indicator for each switch. I removed the circuit panel and potted the limited amount of wiring in silicon rubber. If I were doing it again, I would remove the LED system entirely, because it is of little value. In the space where the circuit panel use to be, I

installed all of my circuit breakers and distribution buses. All of my switches and circuit breakers are on one panel that can be pulled out for inspection by removing four screws. The only problem with this panel is that the switch circuit breakers will move to the "off" position with very little pressure on the switch. So, I fabricated a guard from brass tubing that was mounted over the switches for protection. The 90 degree bends in the bar were reinforced with piano wire and the ends of the brass tubing were tapped and screwed to the switch panel. The switch panel was mounted in the forward portion of the right baggage strake. All wires for the panel were routed in two slots in the right fuselage wall that ran vertically down behind the right console. The wires exited the sidewall below the area where the flight controls pass. This panel was purchased from Ultimate Aerobatics Limited in Canada (Pitts people).

I. Baggage Opening Lips. Retaining lips were installed on the bottom edge of each baggage opening. They were made out of light density 1/4 inch white foam that was glassed on both sides after tacking in place with five minute epoxy. I was not very enthused about doing this, but the results were worth the effort. These lips are about 3/4 inch high.

J. Wing Joint System. The method for finishing the wing/spar joints in the plans was not going to give me a nice straight joint, so I modified the system slightly. First, the center of the joint was marked using a long straight edge. The marking was well away from the actual joint area. Any marks near the joint will be obliterated by sanding and glassing. Then, the joint was filled with scrap pieces of urethane foam that were tacked in place with five minute epoxy. When cured, the area was sanded smooth and glassed with two layers of bid, lapping 1/2 inch onto the spar and wing. After cure, I remarked the joint line and carefully sawed a nice straight joint. A hack saw was used and the resulting gap was a little too narrow. A gap of 3/32 to 1/8 inch would allow the wing incidence to be adjusted, if necessary. I then removed the wing, made a flox corner, and glassed the remaining exposed urethane area with one ply of bid.

K. Engine Cowling Extension. The six inch propeller extension was used. After some discussion with other builders who had used longer extensions and modified cowls, I decided to modify my "plans cowls" which were purchased from Wicks Aircraft. My builder discussions indicated that an air outlet area of about 50 square inches was needed. I installed the prop spinner on the extension and filled the area aft of the engine cowl with urethane foam. A 1/2 inch annular space was marked around the spinner (this was not enough space). The two side openings are 2 x 2.8 x 6 inches (opening narrows from the spinner outboard). This gives a total area of 46 square inches. The inlet area is 12.25 x 4 inches measured to the fuselage skin surface (12.25 x 3 inches inside the inlet). The foam was shaped to flow into the original cowl shape and was glassed with 3 plies of bid. After cure, the split line was cut (horizontal) and the cowls were removed. I cleaned out the urethane foam and glassed one ply bid on the inside. The bottom layup continues forward onto the reinforcing rib. The cowl attach flange was done just like the flange that is already installed. The cowl should not be closer than 1/2 inch to the prop or the top cowl will be difficult to remove due to interference with the prop.

Initial testing, with spinner installed, indicated high CHT on number 4 cylinder (425 - 450 degrees, leaned for cruise). Because of this condition, I removed the spinner and backing plate to give a larger air

outflow area. Engine CHT's dropped 35 degrees for climb conditions. I did some carefully controlled speed runs to see how much the spinner actually improved performance. These runs were done within two hours of each other, on the same day, and fuel was up-loaded to give the identical gross weight. The engine was leaned to the same EGT, and two runs were made in opposite directions. CHT was measured at the bottom sparkplug.

	Speed (KIAS) 8,500'/10,500'	#4 CHT 8,500'/10,500'	OAT 8,500'/10,500'
No Spinner	136 / 130.5	420 /410	47 / 43
With Spinner	136 / 130	425 / 420	48 / 43
	Climb Speed (KIAS) 8,500'/10,000'	**#4 CHT 8,500'/10,500'**	**OAT 8,500'/10,500'**
No spinner	110 / 110	425 / 415	57 / 48
With Spinner	110 / 110	418 / 440	58 / 49

My conclusion, based on this limited data, is that the spinner provides no measurable speed gain with my modified cowl. Secondly, the air outlet area on my cowl is too small and is restricting airflow which results in generally higher CHT's with spinner installed. Because the spinner assembly weighs around 6 pounds and provides no benefit other than appearance, I have removed the spinner permanently and replaced it with a small skull cap spinner. If I were to keep the spinner, I would provide more outflow area by enlarging the annular ring, because there was some rubbing of the spinner against the cowl in this area. A 1 inch ring area would probably do the trick. If I were doing it again, I would leave the spinner off and further reduce the engine outflow area as much as possible while maintaining a smooth airflow shape for the cowl. The outflow area could be as little as 60 square inches after subtracting the prop hub area. I installed the cowling air deflectors recommended in CP-42 (2 1/2 inches high) and they evened out my cylinder temperatures; in climb: 1-425, 2-400, 3-400, 4-425 Westach bottom plug; in cruise: 1-375, 2-375, 3-350, 4-375. Before the air deflectors were installed the cylinder temperatures, in climb on the bottom plugs using calibrated Westach instrument, were: 1-360, 2-400, 3-400, 4-450. In a stabilized condition, the Alcor bayonette CHT reads 30 degrees less than the bottom spark plug CHT using the Westach indicator (50 degrees less in climb).

Later, I installed an oil heat valve assembly to the left of the NACA inlet. In order to do this I had to cut away part of the left air deflector on the lower cowel. As a result of this valve installation, the #4 CHT started running hot again(450F in climb). Because #1 cylinder was running so cold I installed baffles similar to those shown in CP47-PG11. The inter-cylinder baffle is the same as the one on the top of the cylinders. The lower aft baffle is half of the inter-cylinder baffle that is riveted to the existing aft baffle. This lowered my CHT on #4 cylinder by 50F to 400F in a long climb measured at the bottom plugs.

L. Engine Breather System. The Gardner oil separator system recommended in CP-36 was installed. Oil did not vent, but the separator returned some water to the crankcase. I did not like water in the tubes being returned to the engine. The separator was removed, and a stretched coiled spring separator was added to the breather hose. This hose still

runs up hill forward through the forward engine baffle. Then, it runs directly to the anti-backfire valve at the exhaust pipe. There is less water in the hoses and I have no visible oil loss. Next time I might leave the anti-backfire valve off. The breather exit is within 4 inches of the end of the exhaust pipe and it is unlikely that the breather system would see any pressure from the exhaust. The stainless tube extends about 4 inches from the exhaust so that it is cool enough to not melt the breather hose. At 200 hours the weight of the anti-backfire valve on the end of the tube led to cracking where the tube enters the exhaust manifold. I removed this valve and have had no further problems.

M. Cowling Fasteners. Installing and removing cowling screws is a real pain. I should have put camlocs instead of screws on the wing/cowl joints. Note that the farthest aft wing/cowl fastener must be about 2 inches from the wing trailing edge or the top and bottom camloc receptacles may interfere with each other.

N. Engine Cowl Insulation. Exhaust heat will discolor or burn the engine cowls. To prevent this, I applied fiberfrax on the inner cowl as an insulator using silastic adhesive. To protect the fiberfrax from becoming oil soaked and as an additional heat reflector, I applied a layer of heavyduty aluminum foil on top of the fiberfrax with more silastic. I also wrapped my exhaust pipes with ceramic insulating tape from Sport Flight. I secured this tape with hose clamps - not safety wire and was careful to keep the material away from the carb heat inlet.

O. Wing Root Heat Shield. Instead of installing this by wrapping the aluminum over the cowling attach lips, I countersunk the shield inside of the wing root. Nutplates were installed on the heat shield flanges. Two countersunk screws through each cowling attach lip hold the shield in place.

III. Ideas That Did Not Work Well

A. Front Seat Shoulder Harness. I made my roll over structure wider so that the shoulder harness attach points could be closer together inside of the headrest. Having the shoulder straps closer together is nice, but the extra effort required to put the attach points inside the headrest is significant. Also, the wider headrest obstructs the view for the rear seat passenger. Next time, I would either build per the plans or maybe make the headrest a little narrower to move the shoulder harness attach points closer. This would make the shoulder harness more comfortable and improve rear seat visibility.

B. Pitot Heat. I installed it, have never had to use it and would not install next time. It takes too much power,and gets too little use.

C. Landing Gear Joint Fairing. I fabricated a fairing for my landing gear/fuselage junction. It looks nice, but was a lot of work and an article on aerodynamic drag that I read stated that fairings on junctures that are 90 degrees or more do not benefit from fairings. Next time, I would duct tape the gear and glass some bid onto the joint. After cure, I would cut a nice even clearance space between the gear and fuselage with the dremel tool.

D. Vari EZ Carb Heat Box. I purchased a Vari EZ carb heat box and planned to modify it for my Long EZ. This aluminum box supplies enough heat, but I could not keep it from coming loose from the exhaust pipe

(plans system). A Cessna heat muff I now have, that clamps onto the exhaust pipe, works as well and stays put. I bought this unit from Aircraft Spruce.

E. Prop Spinner. Careful test with and without the spinner showed no speed increase with the spinner. Because of its cost and weight, I would leave it off next time and install a small skull cap spinner.

F. Alternator. I used a full sized alternator due to the electric heater, pitot heat, and the other usual electrical equipment. Next time, I would leave these high current items off and use a small alternator and an engine heat source heater system. The large alternator requires that the lower cowl be modified so it will fit. Both the extra weight and size make this an undesirable unit.

G. Brakes. As normal brake wear occured, the rudders would deflect more and more with full brake application. Eventually, the rudder cable nicopress sleeve would hit the winglet and the brake master cylinders would have to be adjusted. The problem was that the master cylinder return spring was not strong enough to return the master cylinder to the point where it would be recharged with more hydraulic fluid. To fix this, a compression spring was purchased at a local hardware store that fits over the pushrod between the top of the master cylinder and the brake adjusting stopnut. Rudder deflection now remains constant.

IV. Things I Might Try Next Time

A. Chrome Brake Disks. The disks that came from the supplier were standard unchromed units. My disks are covered with surface rust after a week in my hangar. This hangar has a concrete pad under the airplane and earth floor everywhere else. The brakes work alright, but seem to be wearing fast from the rusty disks. I have found that the heavy duty pucks help (#66-56), but next time I will buy chrome.

B. Fuselage width at Firewall. Next time I would widen the fuselage at the firewall slightly (1/2" each side) to provide more space where the engine mount attaches to the firewall. Working in this area is very difficult; especially installing and removing engine mount bolts. This would require a slightly wider firewall and thicker spruce spacers for the engine mount extrusions. This would also provide more room for plumbing and wiring. I would be careful about making it too wide or the prefab engine cowl might not fit properly.

C. Move Battery. Next time I would section my NG-30 plans vertically just aft of the gear retract mechanism and add a 1" section. This would move the battery, nose, and nose gear forward 1", which would give slightly more nose room and improve the aft CG tendancy. Also, my nose wheel was very close to the instrument panel bulkhead and this would move it away a little.

D. Removable Consoles. Next time I would install the consoles so that they could be removed by glassing them into place with 3-ply bid tapes using duct tape for a release. Then, install nutplates to fasten them into place. This would greatly ease inspection and maintenance.

E. Landing Light. The landing light relects light into the cockpit that is very distracting at night. Also it is difficult to visually check the nose gear because the light blinds you. I think a better

location can be found for this light. I think that mounting it near the top of the nose gear strut, to either side, so that it retracts flush with the gear might work.

V. Avionics

The limiting factor for avionics is instrument panel space. The best way to gain panel space is to locate switches and less important instruments in the forward portion of each baggage strake opening. Also, the vertical location of the canopy, using the plans templates, was too low for me. I raised the canopy slightly which gave a higher instrument panel with more space. I was careful to not remove too much material from the instrument panel, because it is a structural bulkhead. I tied my instrument panel to the top forward cover to replace structure that was removed when cutting out large panel holes.

A. Engine Instruments. The most space efficient instrument cluster I have come up with stacks the following 2 1/4" gauges on the far right side of the panel: turn and slip, combination RPM/CHT, combination oil pressure/temperature, fuel pressure. The gauges are surface mounted in individual round holes to preserve as much panel structure as possible.

1. Oil pressure/temperature - the small Westach unit works fine.

2. RPM - Westach unit is not real accurate, but is adequate and cheap. I Shielded the leads.

3. CHT - the Westach unit with spark plug gasket thermocouples works okay. If only one cylinder is to be monitored it should be number 4, because it runs the hottest.

4. EGT - On my Lyc O-235 L2C this instrument is of little value because when leaning, the engine runs rough before peak EGT is reached. It may work OK with other engines or carbs.

5. Fuel pressure. The Westach fuel pressure sending unit, mounted per the plans, did not operate when the engine was above 2000 RPM due to engine vibration. Remounting the unit, similar to the oil pressure sending unit, solved the problem.

B. Flight Instruments. I installed a flight instrument panel that is unitized so that it can be removed intact from the cockpit side. I think the optimum arrangement is; top row: Airspeed, Horizon Gyro, Altimeter; bottom row: Navigation CDI, Heading Gyro, Vertical Speed.

C. Radios. I Stacked the radios on the left side of the panel, but far enough to the right that they do not interfere with the elevator trim springs or bellcrank. Slight angling of the radio stack is not offensive. I used 1/2 inch aluminum angle, installed vertically behind the instrument panel, to mount the radio stack. A rear hanging strap was also used. Some thoughts I have had on radio systems follows:

1. Low Bucks/Full Capability:

Apollo I Loran C
RST NAV/COM w/electronic CDI
Transponder
RST voice actuated intercom

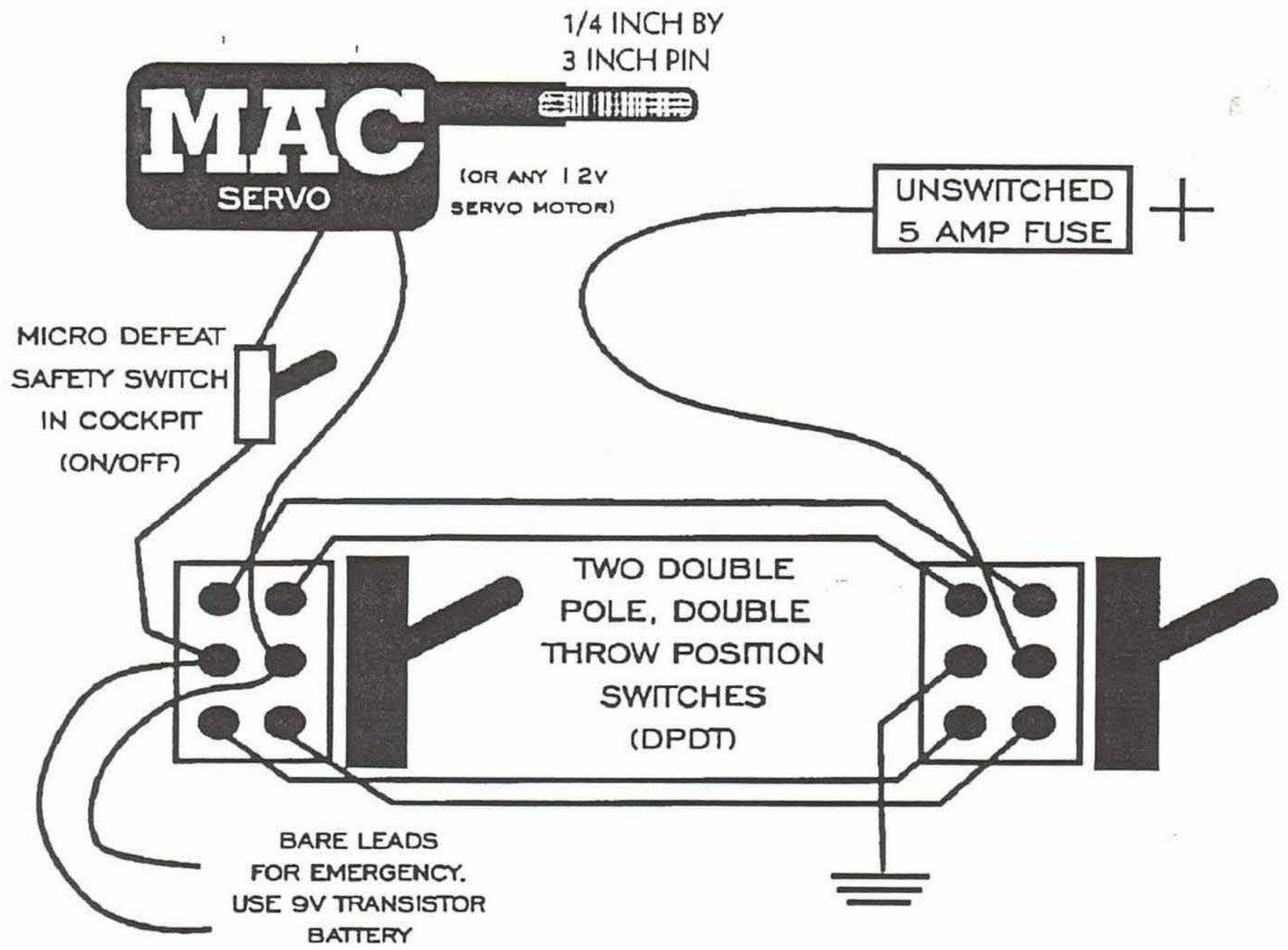
Electric Canopy Lock

Larry & Vickie Laughlin (CA) - I have always hated the method of locking the EZ. I got the following from Lan-air builder/pilot/friend, Wil Price.

He installed a MAC servo inside the fuselage to drive a small pin out through the fuselage door frame structure and into the canopy frame. Other servos from automotive electric mirrors, R/C models, etc. would also work. The servo is out of sight and is operated by a pair of hidden switches. A third switch, accessible from within the cockpit, defeats the servo so it can not lock while operating the airplane.

During aircraft battery failure the canopy can be unlocked by attaching a 9V battery to a hidden pair of leads.

It seems unlikely that just anyone could open the canopy as first one would have to be aware the system exists. Then this person would have to find the two, 3 position switches, then determine in what position combination they must be set to actuate the servo. The servo will not move without the correct switch setting, known only to the pilot/builder.



If the servo totally fails in the locked position the pilot can insert a hack-saw blade and cut the pin. In reality the "what-ifs" are pretty remote possibilities. Lets face facts, if someone wants to get into our airplanes, no lock is going to stop them, especially the toy cabinet lock we use.

I haven't installed the servo lock on my Long-EZ yet but can think of several areas where it will work. The best location being above the instrument panel driving the pin back toward the cockpit into the canopy frame. The switches could be placed in the nose wheel and cowl areas.

Spinner For Sale

I have the following Continental 0-200 parts with 80 hrs TT for sale. SAE#1 pattern for 3/8" bolts.

Spinner bulkhead plate- A/C Spruce part number 10102 $20
Spinner- A/C Spruce part number 10101 $35
Acorn fairing- A/C Spruce part number 10104 $15
All of the above $50

You do need the interior bulkhead (A/C Spruce part 10103) to complete the assembly.

Contact:
Kyle Howard
kyle@hnet.net
(414) 334-2624 eves
919-A Cedar Street
West Bend, WI 53095

Happy New Year

Pay Attention to Details

Carl Denk - (OH) After a recent flight, I moved the propeller to a horizontal position and heard a light swish of air, that wasn't usually there. I suspected a valve leak, and anticipated some future work to minimize damage. While trying to pinpoint what cylinder it was, I noticed air breezing across my finger as I moved the prop. It wasn't very long before I identified a crack on the head at the top of the cylinder, between fins. The crack was less than an inch long. If these cracks are left to continue, the cylinder head separates from the cylinder resulting many times in a engine fire.

The moral to the story: Pay attention to the smallest details. How many of you, EVERY time you walk up to you automobile, look for leaking liquids, low tires, or nails in the tires? How much force does it require to move your plane into its parking space (where the surface condition and slope is always the same)? If it is more than usual, maybe the tire pressure is low or you may be dragging brakes.

Canopy Gas Spring

Jim Voss - (Russia) If you are still holding your canopy open when you taxi on windy days or if you worry about your canopy coming open in flight, you need to install a gas spring to hold your canopy firmly open but also firmly closed. I installed my canopy gas spring when I built my Long-EZ but it would be an easy modification to a completed aircraft.

I purchased a Gas Spring Corporation unit, FEN-127-P1-45, from Aircraft Spruce. The geometry shown in the drawing is for this spring which has a fully extended length of 9-5/8 inches. This correct length spring holds the canopy firmly in the open position and pushes the canopy down, so it remains closed, when in the closed position. My gas spring is just over center when the canopy is almost closed so it pushes the canopy firmly closed, but doesn't slam shut.

If you use a different gas spring, you will have to figure out the geometry yourself. I did my sophisticated engineering design analysis by making a wooden mock-up of the gas spring out of two sticks held together by a bolt with wing nut. I cut a slot in one of the sticks so the total length was variable from the shortest that the gas spring could be to the longest that the gas spring could be. This allowed me to find the proper attach point for the spring on the roll over structure and on the aluminum angle canopy cross brace. The easiest thing would be to use the A/C Spruce gas spring so you can use my dimensions which have worked well for several years.

Fabricate the roll over structure's aluminum bracket attach point, the aluminum angle that replaces the arrow stock canopy stay and the aluminum bar that reinforces the attach point on the aluminum angle. The aluminum angle should be long enough to extend into the canopy rails about one inch on each side to assure secure anchoring. Make the attachment holes in the bracket and bar appropriate for the size of the bolts on the ends of the gas spring.

Cut out the fiberglass arrow stock canopy stay and replace it with the aluminum angle. Flox it into place. Be sure to get it oriented correctly and allow clearance for the roll over structure and seat back as shown in the drawing. Drill the gas spring attachment hole in the aluminum angle at the exact location shown in the drawing with respect to the canopy hinge (or per your geometry if you changed things).

Attach the aluminum reinforcing bar to the aluminum angle with two flush rivets so the attachment holes match. This strengthens the attachment point.

Install a hard point where the bracket goes on the roll over structure. Make it like the original plans hard point with a plywood insert and several layers of BID glass on top. Attach the bracket as shown in the original plans. If you use different parts or dimensions, this is where you will have to use the mock-up gas spring to get the geometry right before attaching the bracket permanently to the roll over structure. This might be worth doing in any case, just to be sure the geometry all is correct.

Then attach one end of the gas spring to the crossbar and attach the other end to the aluminum bracket that goes on the roll over structure.

The canopy should open to about 90 degrees and should close easily with the gas spring exerting a force downward to hold the canopy closed. The cross stay aluminum may flex a little as you open or close the canopy but it is strong enough.

So, there is no more need to taxi with your arm up on the canopy rail and no more worries about the canopy opening on takeoff.

ED: An other big advantage is all the standard canopy closing mechanism is moved out the way of the back seater's knees. Jim may have never ridden in back and ripped open a knee on that stock Brock part's sharp edge.

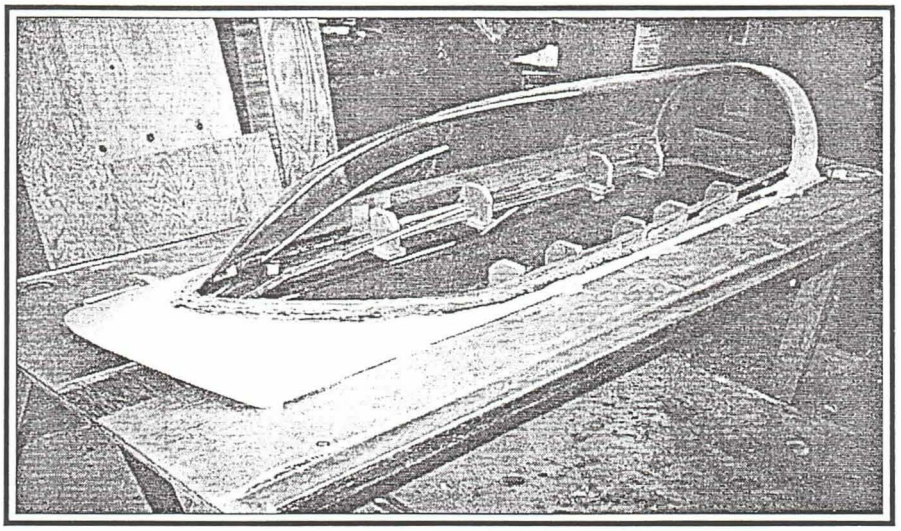
Canopy Replacement

Bill Oertel - (CA) While preparing for a Puerto Vallarta trip, in 1995, my hangar partner called and told he had accidentally broken my Vari-Eze's canopy. I thought it was a joke, but seeing the 4" hole right in front of the windscreen just above the canopy frame convinced me otherwise.

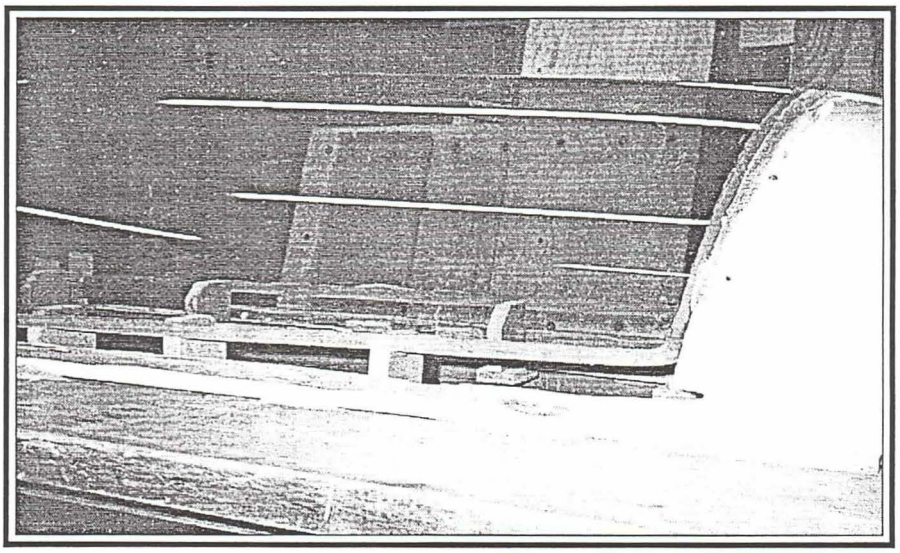
Canopies are now selling for between $400 and $500, but if you shop around you can find one at a reasonable price still in the box. A friend found mine on the Internet for $150. This one is green while the original was smoke gray, but the basic shape was the same. The new one was not as tall over the passenger's seat as the original but, as seen in the photos, we compensated for that.

While getting up the nerve to start, Jim Emonds, retired Rockwell skunk works engineer stopped by and volunteered his work shop, abundant experience and artistry at finding the easiest way to accomplish a task. I couldn't refuse.

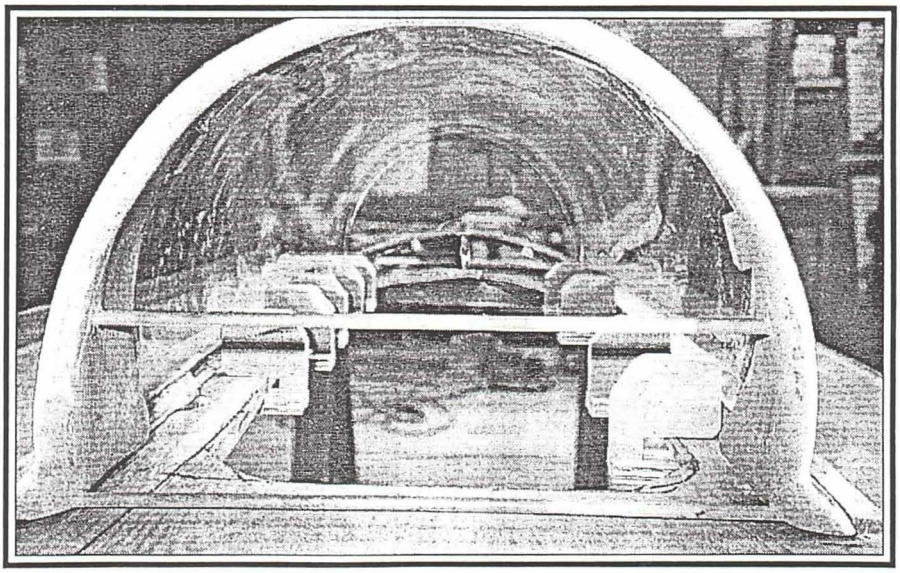
When I removed the canopy, I took measurements across the longerons at 6" intervals. The old canopy glass was removed through the inside of the frame by cutting through the fiberglass with a body grinder. This took about 15 minutes. We got a piece of ½" plywood and trued it up with straight wood runners screwed in place with drywall screws. The measurements taken from the longerons were then transferred to the plywood and the canopy frame was placed on the plywood between the marks and bondoed in place. Jim turned the assembly over on saw horses and cut out the plywood with circular saw inside the canopy frame. Wooden support blocks were then made and a new glass was supported in the frame in an upright attitude. At the rear of the frame the flange was removed from the glass on the lower sides and the rest was trimmed to fit the frame. This was quickly done with a body grinder sporting a coarse sandpaper disc. Small wood blocks were screwed through the frame with drywall screws to hold the glass firmly in



Frame bondoed to plywood with spacers holding new glass



New canopy is not as tall as the original. Gap must be filled.



View from aft shows cut out in plywood and spacer blocks used to position the new canopy

place front and rear.

The large voids between the frame and new glass were sealed with bending chip board (note pad backing material), Canned foam proved too hard to control and set up too slowly. All this was done in one evening.

On the second night, preparation of the frame and glass were accomplished to assure a good mechanical bond. Deformities were smoothed out inside and outside of the frame. Some dry micro was used to fill and level as necessary.

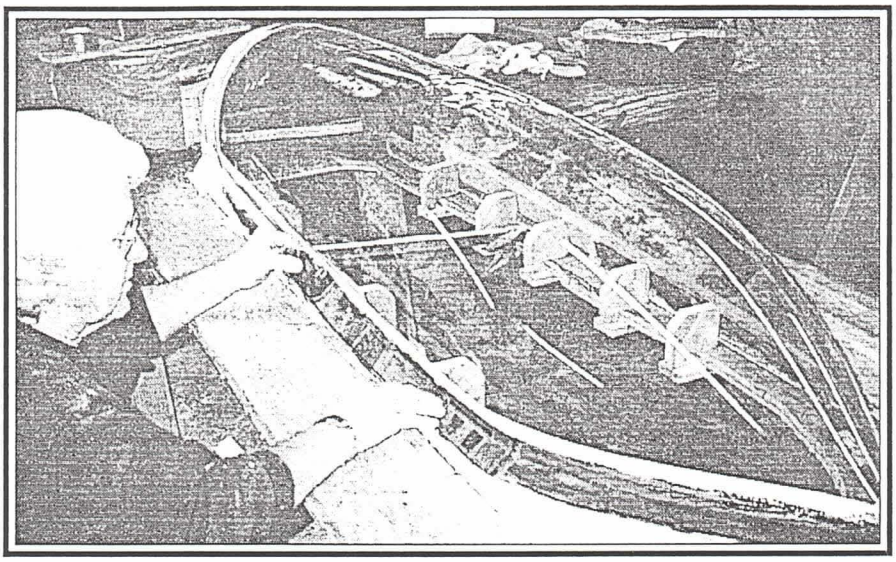
On the third night, we did the outside wet lay up by first painting the surfaces to be bonded and then we wet out BID on newspaper on a hard surface. The BID and paper were cut with shears. The BID was then transferred to the frame/glass structure and newspaper removed.

Note the masking tape on the glass to both protect and provide a trim line. Newspaper controls the wet fabric until it is applied. Some folks use aluminum foil or "Saran" for this purpose.

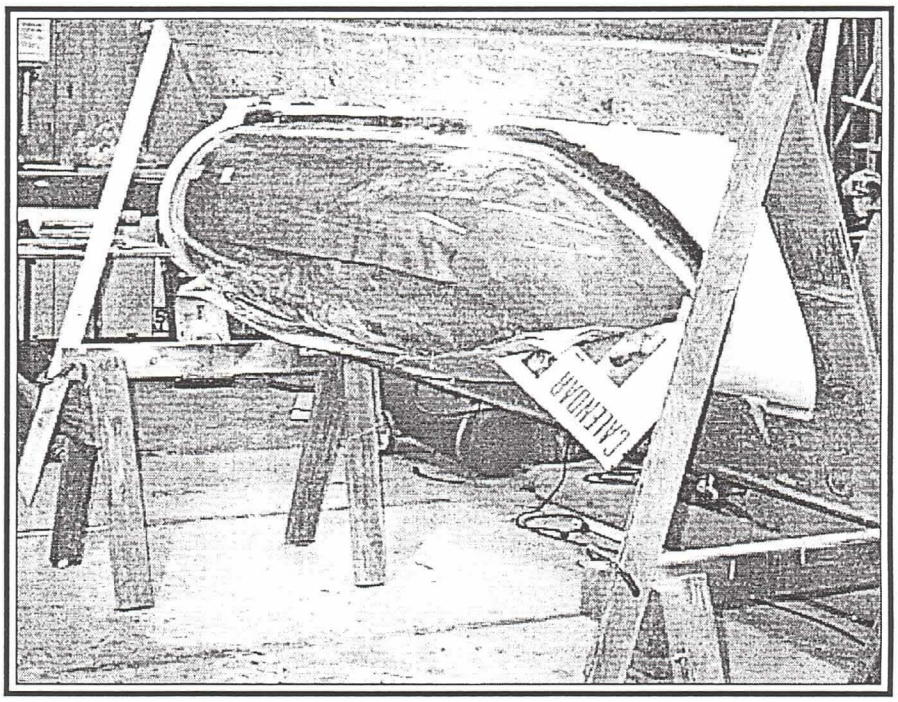
On the fourth night, the whole mass was supported on edge on the saw horses with supports screwed and clamped in place. The inside support blocks were then removed and the interior of the frame prepared for the glassing operation. The lay ups were done, one side at a time (the down side), and the assembly was reversed on the saw horses and the opposite side was done.

On the fifth night we trimmed the glass lay-ups and removed the frame from the plywood. I took it to the airport and checked the fit to the fuselage. It was PERFECT!!!

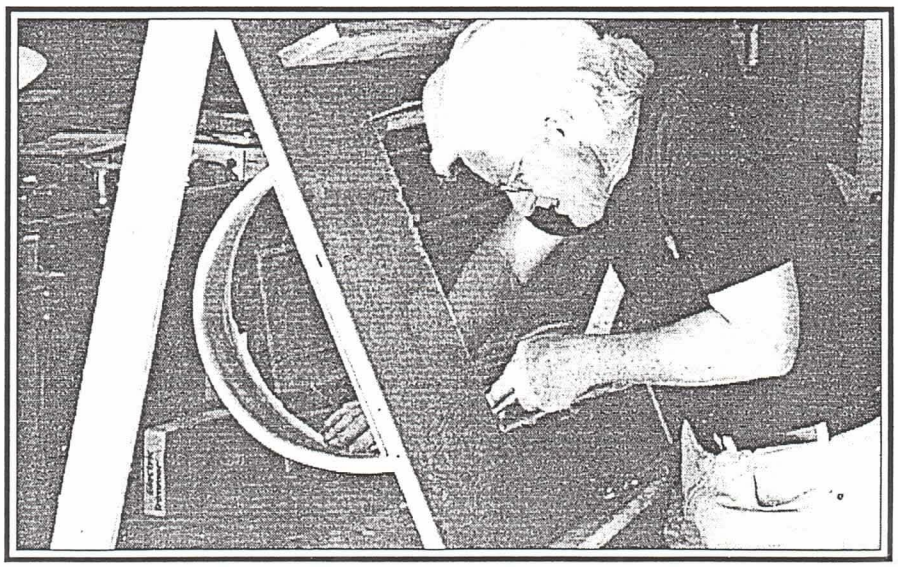
On the sixth and seventh days I applied primer and painted the final color. In one week the canopy was replaced and the aircraft ready for flight. It really was a piece of cake, especially with Jim's help!! In two years of flying there has been no problem with this canopy and I would not hesitate to use these methods again.



Wet out BID is supported by carrier paper before installation



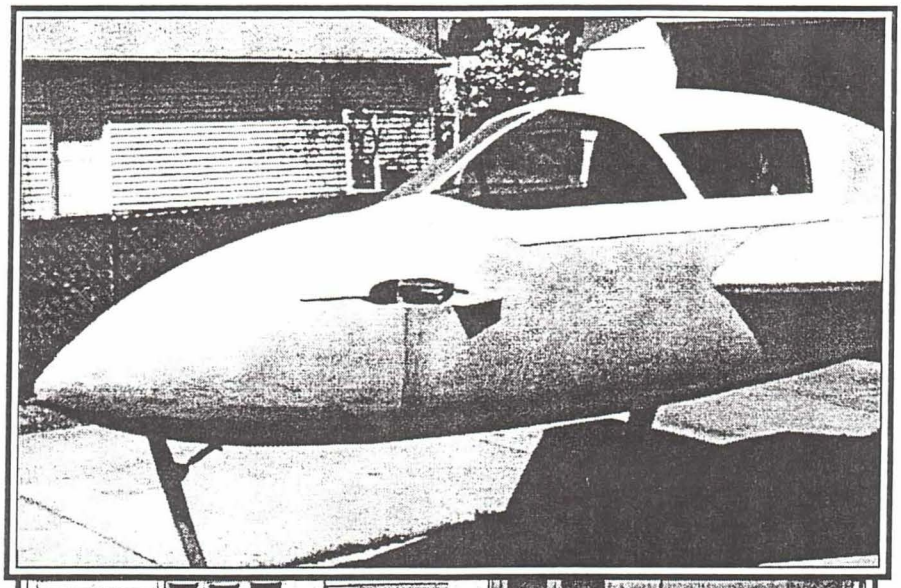
Interior tapes are more easily layed up in this tilted frame

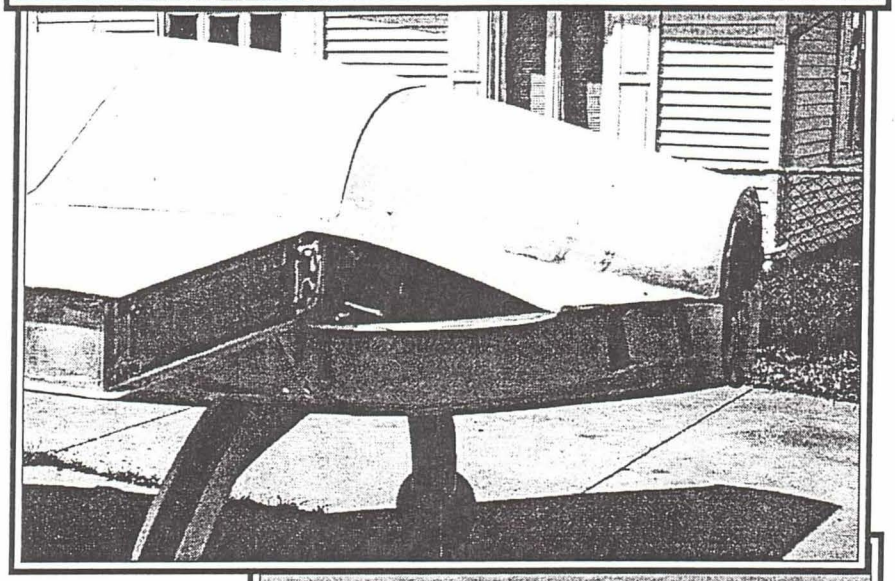


Back to Homebuilder Basics

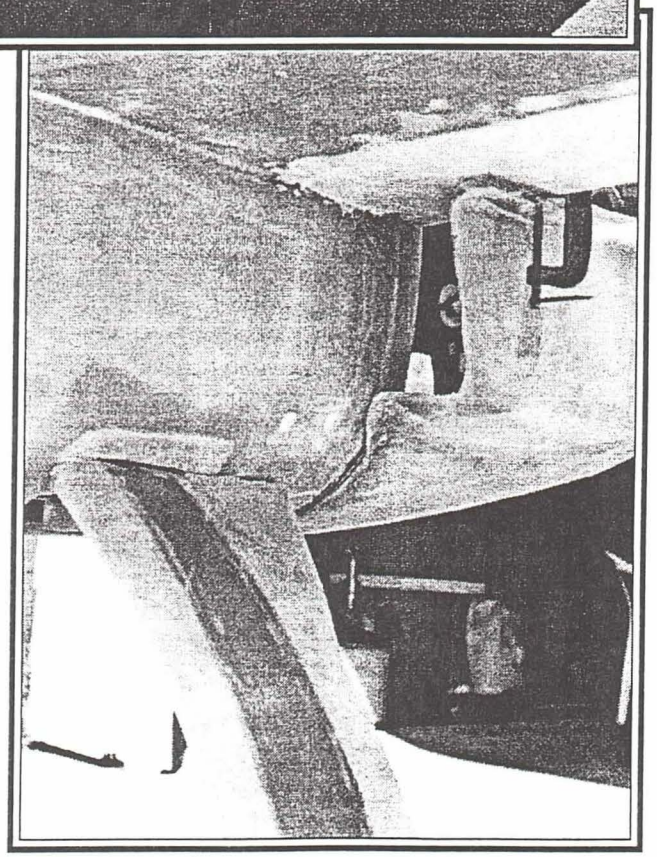
In the 70's, when Burt first brought the Vari-Eze to OSH, a revolution was started. The airplane's performance, appearance, relative ease of construction and affordability combined to cause a sensation.

The homebuilder could, indeed, have it all. Foam and glass were cheap and Rutan plans showed how to build nearly everything. As years passed more prefabricated parts and kits became available and prices increased dramatically! If you have mucho bucks there is little problem, but the average man's airplane has begun to look like a Peitenpol again.





I recently visited a fellow who demonstrates one can still build a modern airplane without knocking over a Brinks truck. George Graham is well along on what he calls a highly modified E-Racer. E-Racer purists may be repulsed because George's main gear is not retractable, however, this "mod" was an acceptable change to George due to the complexity, weight and cost reduction. All airplane designs are compromises. We all have different constraints and must adjust accordingly. George also **made** his own main gear strut to further save money and because no prefab strut was available for a fixed gear. He made a mold of the strut then wetted out the multitude of individual strands of glass and laid them into the mold. It was "just another 2 hour job" that took almost 24 hours of continuous lay up effort.



In the "good old days" one could get a prefab canopy for about $200. Now, they are around $800. George decided to make a different canopy, more fitting with his constraints. Flat Plexiglas sheets were heated, formed and placed in a sandwich composite frame to create a unique canopy that fairs well into the rest of the aircraft.

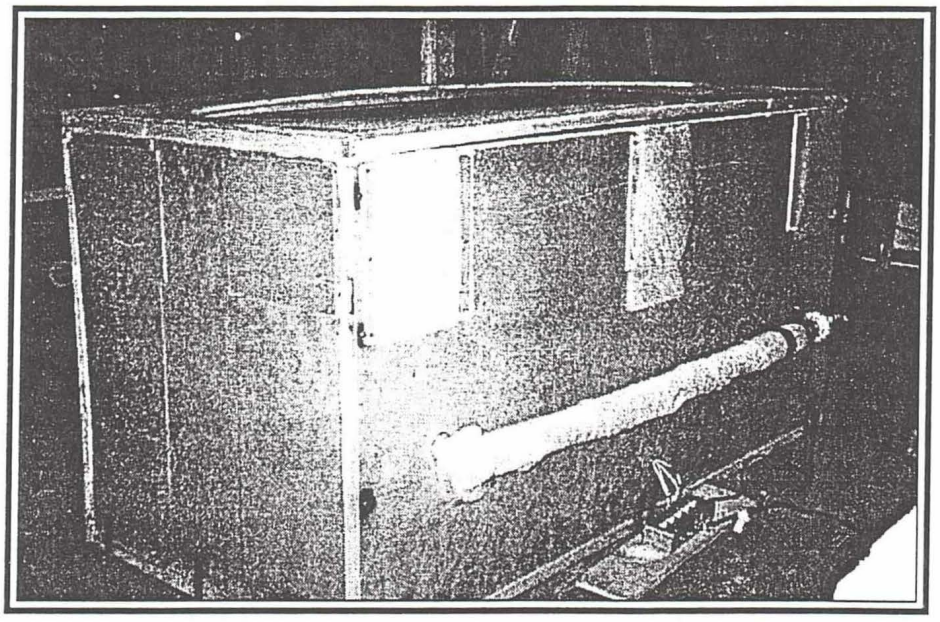
Another area of major expenditure is the powerplant. See page 12 for George's solution to propeller and PRSU (prop speed reduction unit). You may remember the January 98 issue having a view of his Mazda automotive conversion and ingenious way of mounting it for testing. How many other homebuilt engine/prop combinations do you know of that have over 15 hours logged before installation in the airframe? The cowl is of sandwich construction, also. My hat is off to anyone who demonstrates good old Yankee ingenuity and dedication to produce a modern composite design like George has done. It seems building from scratch is still alive and one can still build on a budget.

2816

Free Form Custom Canopy

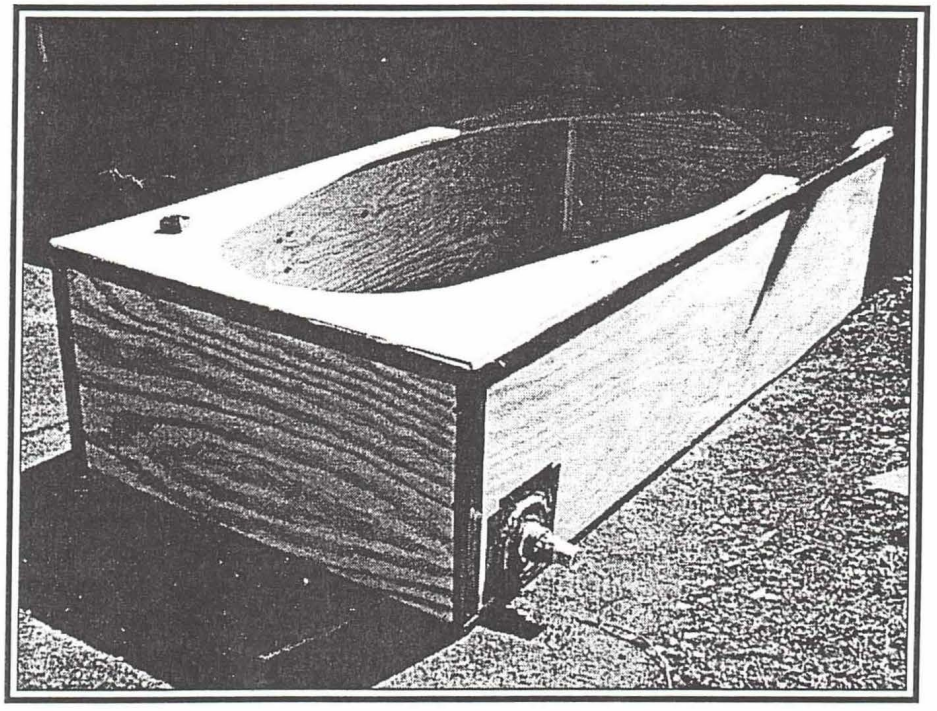
Alan Borman (MN) - Since necessity is the mother of invention, when I needed a canopy for my Cozy 3 I decide to make my own. I wanted a custom bubble so a standard Cozy canopy would not work. After several months of R & D, I had all the information I needed to attempt making my own canopy.

First, I constructed the oven box using 2 X 2s and Masonite panels on both sides with insulation between the walls. It was 4' x 4' x 8' with removable insulated cover. Tempered glass viewing windows were used to check on the Plexiglas and look for fires. (We had a fire because the metal heat shields were not high enough.) 4 oven burners from residential type electric stoves were used and controlled manually by switches. All heating elements combined used 46 amps so a 60 amp breaker was used. Galvanized heat shields were placed under the heat elements and up the side walls. A small blower motor circulated the air inside the box to prevent hot spots. The Plexiglas needed to be at a uniform temperature when formed.



4' x 4' x 8' insulated oven box

A separate box was formed as a vacuum chamber and the predetermined canopy shape was cut out of the top as a template. The shape determines the canopy height. The edge of the template was lined with closed cell rubber (pick up truck topper sealing foam) for a tight seal of the Plexiglas to the vacuum box lid. This box was placed on folding tables and a standard shop vac with a 2" ball valve was used to maintain and control a vacuum.



vacuum camber box with canopy shape cut out

The Plexiglas was screwed down to a 2 x 2 frame using long thin strips on top of the Plexiglas to keep it from pulling away from the frame during the vacuum process. We used metal rails like you find in kitchen cabinets that hold the little clips that the shelf rests on. It was formed like a channel and worked well. A cross member was used in the center of the frame to keep the sides from pulling in when the bubble got pulled down.

The Plexiglas with the frame was placed on top of the oven box lying horizontally and the lid was placed over the Plexiglas. Metal tape was used to seal the box and reduce heat loss. It removes easily and doesn't shrink like duct tape does when heated. The oven was slowly brought up to 325 degrees F. We measured temperatures with a digital thermometer and meat thermometers above and below the glass. The forming temperature was between 275 and 350 degrees F.

At that temperature, the Plexiglas sagged about 8-10". We let it cook about 20 minutes then came the moment of truth. Actually, it was the 5th moment of truth because we ruined the previous four moments of truth. We removed the tape, flipped off the lid, moved the frame off the oven box and on to the vacuum box, hit the vacuum and watched as the laws of physics did the rest. The Plexiglas was sucked down into the vacuum box within 20 seconds, to the amazement of all in attendance. The Plexiglas cools very quickly and you

have only about 90 seconds until it starts to get hard.

To check the depth of the plastic canopy we used a Q-tip, taped to string that was attached to a 2 x 2 and bridged over the canopy. The string was cut to a pre determined length before the process. The Plexiglas is very soft and a tape measure or other marking device will make marks. The vacuum was controlled by modulating the 2" ball valve and watching the Q-tip for depth indication until the Plexiglas cooled. We waited until it was warm to the touch and removed the screws to prevent any stress cracking that might result from the cooling of the Plexiglas.

The end result was a perfect custom bubble well worth the blood, sweat, tears and money spent. Several times during the process I wondered why I didn't take up stamp collecting.

The most important items are:

Make sure the Plexiglas is clean as any plastic or metal slivers will cause that area to heat unevenly and cause a small deformation.

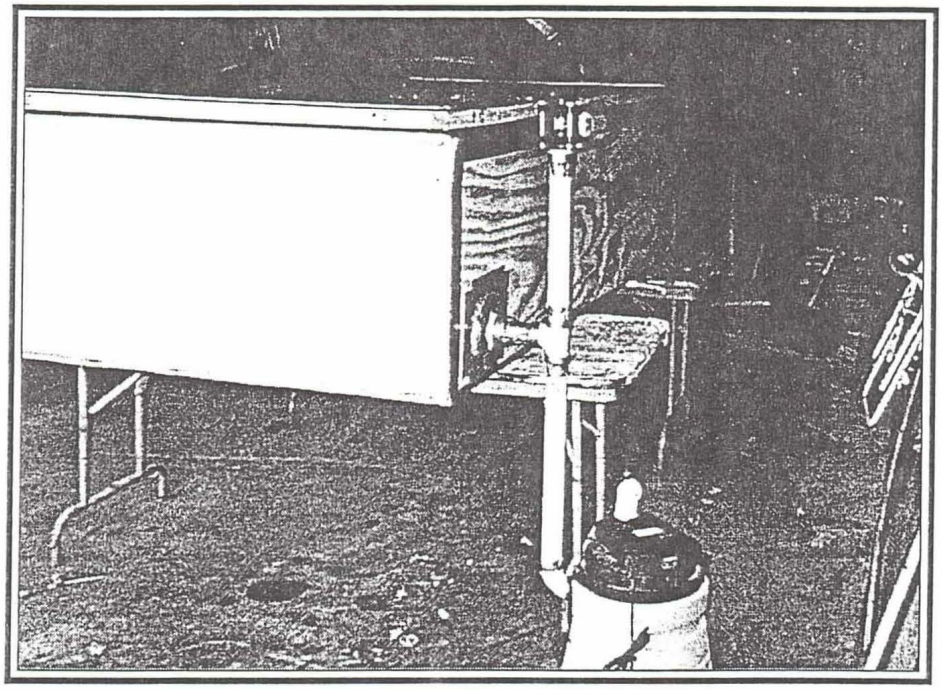
Screw the Plexiglas down every 4" using a wood or metal reinforcing bar. The edges of the Plexiglas will get soft, creep, curl and might pull away from the screws if they are not tight.

Do not get the Plexiglas too hot. It sags down too far and will not seal uniformly on the foam edges. If it is too cold it will only form down half-way.

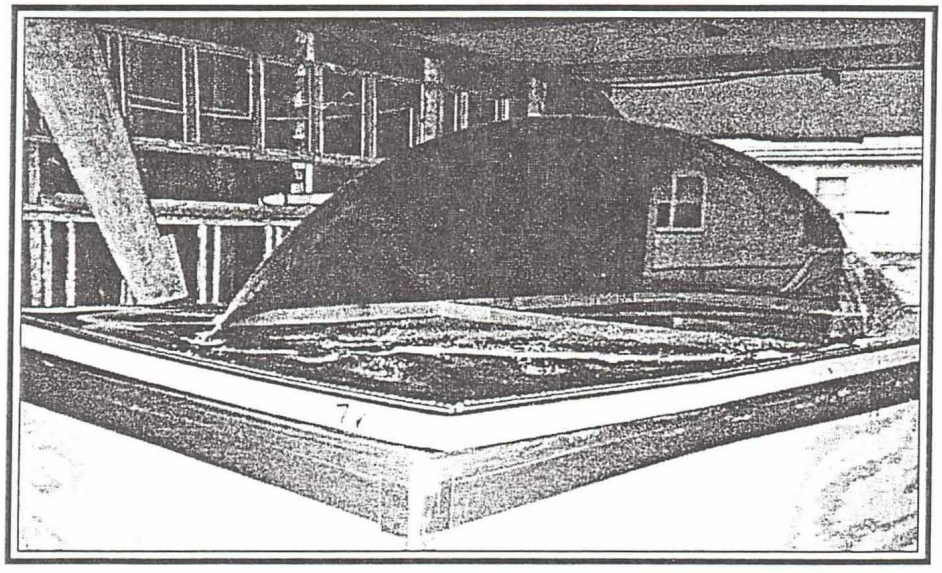
The vacuum box must be sturdy. We used ¼" plywood and it was bowing in on the sides and the bottom from vacuum pressure. Use at least ½" plywood and caulk all wood to the 2 x 2s before screwing. We used duct tape and it still leaked. Tape the seal of the shop vacuum lid to the container.

The learning curve goes straight up when you go into unknown territory, but the project was rewarding and can be done at home. I learned a lot along the way and now have the canopy I needed. If you have any questions feel free to give me a call.

612-455-5356.



Shop Vac creates vacuum which is controlled by a ball valve



The finished canopy is worth all the effort!

Wheel Vibration
<Canard.Com>

Solution to the on going wheel shimmy problem has been centered on wheel balance and brake disc alignment. Many builders have been frustrated when such attention did not fix the problem. The following seems worth checking out.

Greg Bordelon - I've built and worked on RV series aircraft. When we experienced wheel shimmy, Van recommended accurately balancing the wheels. If that did not cure the problem, you were instructed to balance the wheel pant on the axle axis. There may be too much weight in the trailing edge of the wheel pant. Don't laugh! Wheel pants are like a dart or elevators or ailerons. If there is too much weight behind the pivot point It will wobble or shimmy.

Balancing was accomplished by gluing lead shot inside the nose of the pant then laying two layers of cloth. This fixed the shimmy. The out of balance wheel pant changes the resonant frequency of the gear assembly.

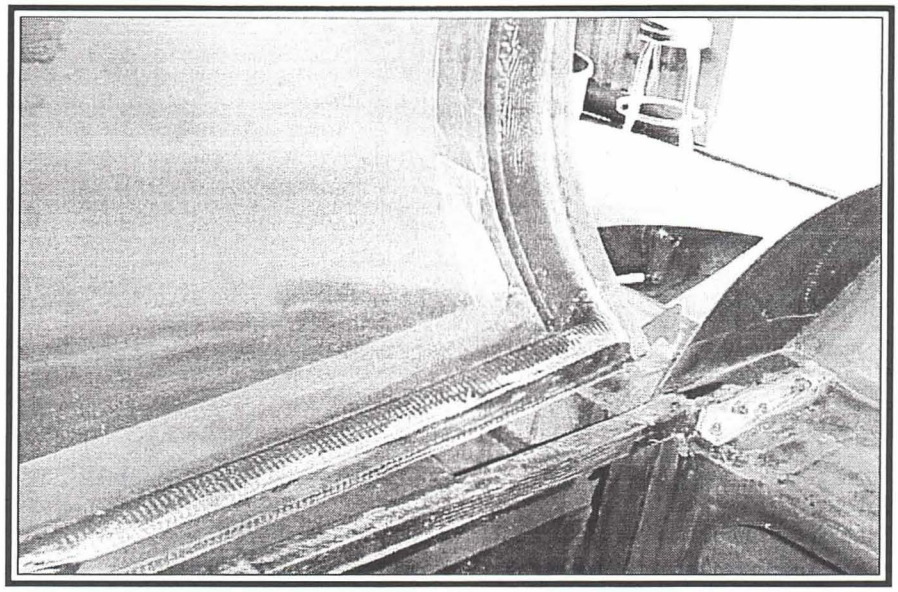
Volovsek Long-EZ

ED: - Periodically, I have the opportunity to visit projects under construction. A recent visit was to a beautiful Long-EZ being built by Steve Volovsek in Hampton Roads, VA.

He has the modern updates frequently found in recently started projects. One modification I had limited exposure to was his European canopy design. The first time I'd seen it was on a French Vari-Eze. Some folks have complained about lack of headroom in the Long-EZ and Francois Lederlin solved that by placing the Plexiglas canopy outside the canopy frame instead of inside it. You might find the following pictures of interest if you feel the need for more room. The increase in drag caused by greater cross section is probably minimal, as the canopy is no wider than the firewall. I assume there is a weight increase as Plexiglas is heavy.

The canopy latch mechanism is similar to the plans system, but the AN-525 screws, which are captured by the C-2L latches, are attached differently.

The nose access hatch is large enough to get at the battery conveniently and the brake master cylinders are up near the hatch edge for easy inspection and maintenance. Steve's hatch cover mount system uses few screws and its sandwich construction will prevent warpage found with the typical no-core glass skin.



Note the increased width in the aft canopy head area

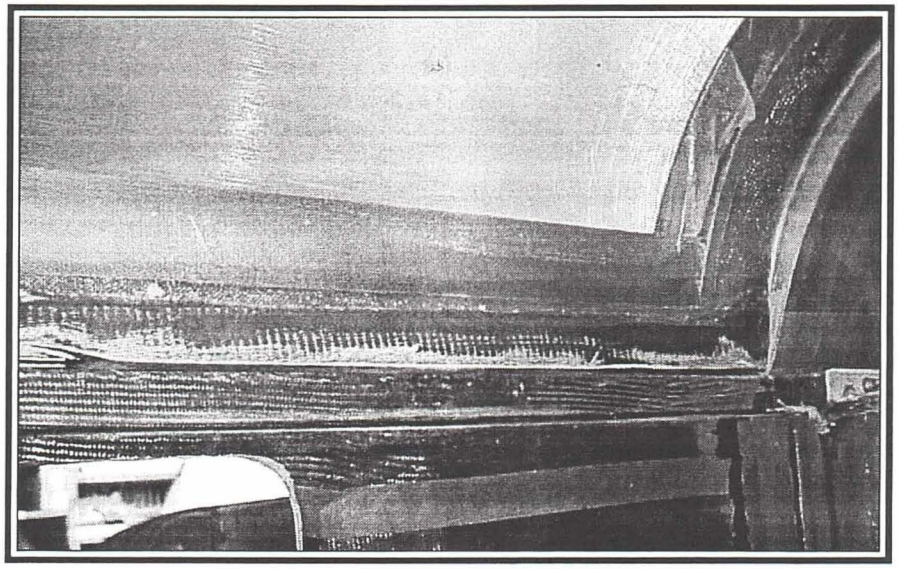
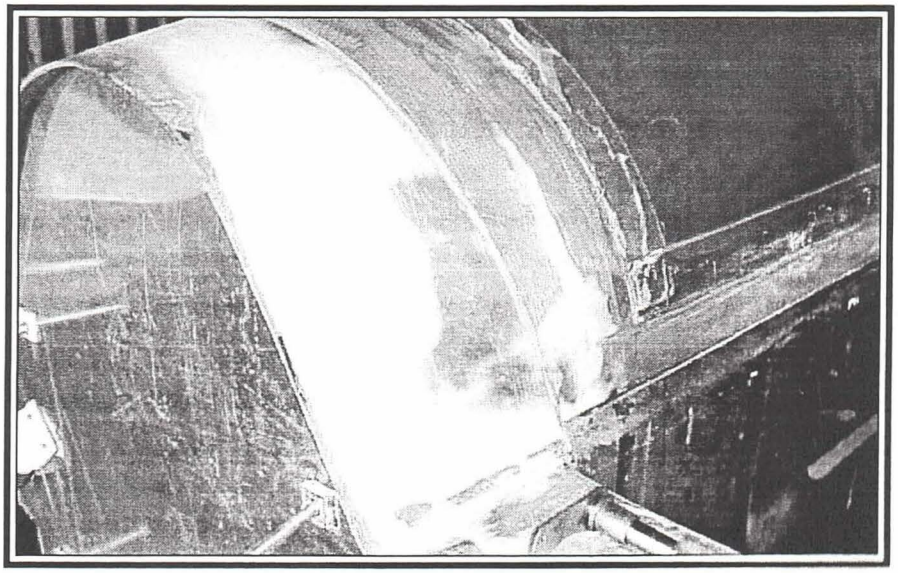


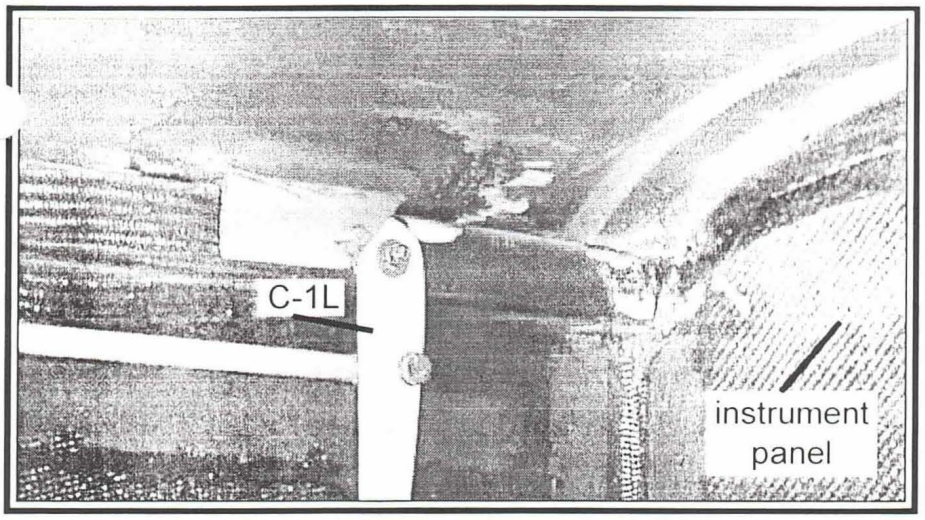
Photo shot inside passenger area. Extra width is apparent



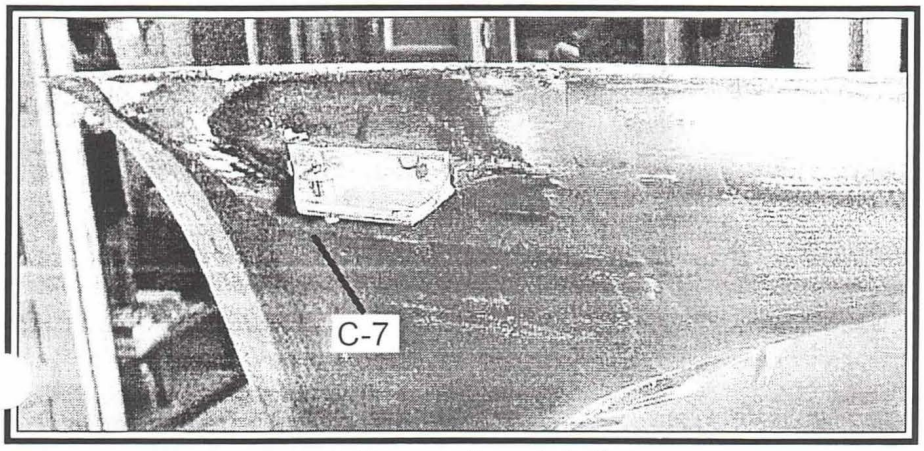
Exterior has no reduction in crossection area

History of the French Canopy

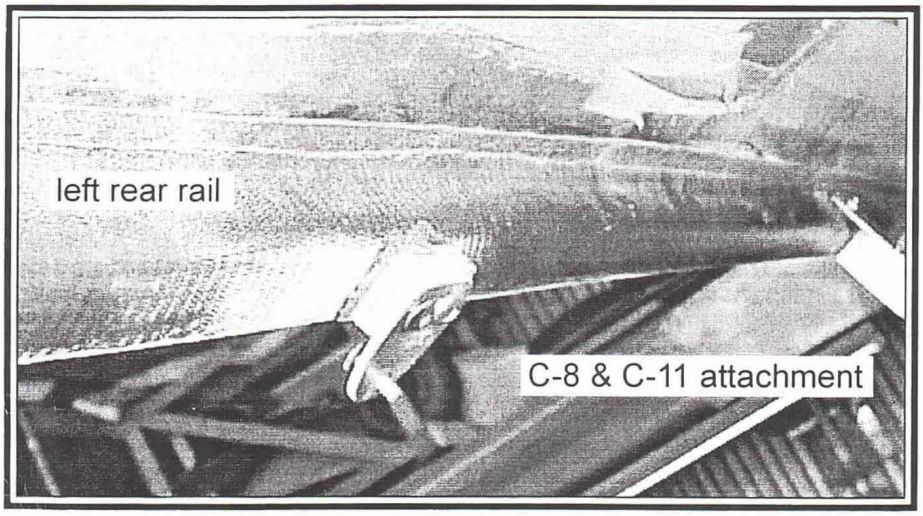
Ernest Magallon Graineau (France) - The man who started the idea of mounting the canopy outside the frame on the Vari-Eze is Francois Lederlin, an architect from Grenoble. The project started in late 1976 and a mold for the canopy was built and sent to Nuvile & Malinvaud, a manufacturer who used to fabricate replacement canopies for various types of helicopters and planes. The enlarged canopy required a new firewall but provided a much better downward view. When the fuselage tank became mandatory, the

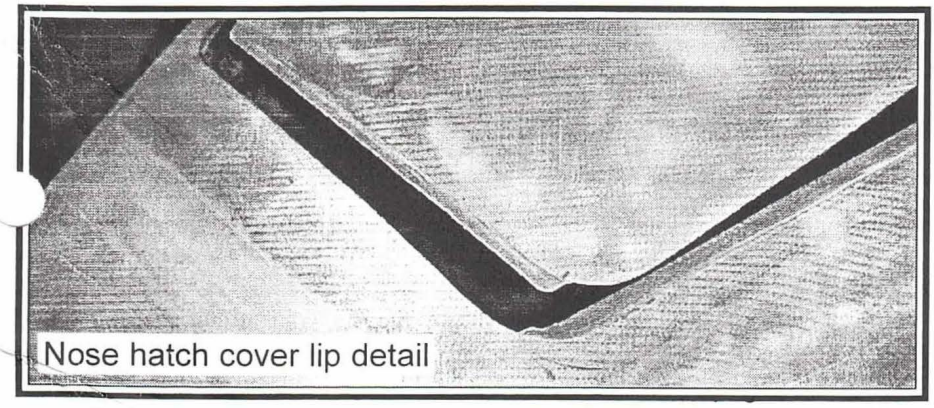


left side front seat photo taken inside closed canopy area



C-7 mounting detail





larger firewall shape offered a greater capacity for this tank (about 15 litters-16 quarts) and much more headspace.

Francois Lederlin does not fly anymore because he suffers from Parkinson disease. Among the staff who realized this job are: our friends Jacques Rubin, the late Laurent Morelle who designed the rounded fuselage, Bruno Guimbal, Claude Charnay, the late Jacques Leschaeve, Claude Petit and some others. The Vari-Eze built by Francois Lederlin was sold eight years ago to Yves Garcin and is currently parked in "Le Nid des Canards" at Montpellier.

In this hangar there is no assigned parking place. If one is known to be away for some time his plane is parked in the far end of the hangar if someone is going to fly the next day, the plane is parked near the door, but in the weekend we usually go flying together. Last weekend we were seven airplanes to fly to Millau, an airport forty miles from Montpellier, our home airport.

The French "School of Vari-Eze" has innovated a lot of modifications to the basic Vari-Eze, among them one-point refueling and different canopy latches. The Long-EZs built in France have the same type of canopy, with outside of the canopy frame. Nuvile & Malinvaud can still provide canopies for our canards.

Whelan Fixes Goof

Baine Whipkey (GA) - The white light bulb burned out in my Whelen A-600 wing tip light. When I got one from A/S it cost $22.85. Ouch! That was only the beginning of the problem. When I tried to install it, I broke the receptacle after many tries to get it to slide in even after loosening the screw that holds the two halves together.

I called Whelen in desperation; they confessed that some bulbs got out in the field that were the wrong size and would not go in. They agreed to send a new receptacle and bulb at no charge.

GIB View

Tom Staggs (WA) - Once upon a time, a long time ago, I got an airplane with tandem seats. I had also just gotten a girlfriend who sort of liked planes and really liked pilots, all of which was good. Unfortunately, she also got airsick.

As we found on trips, she would get quiet as she would feel ill, and I couldn't tell how she was doing because I couldn't see her.

Once when we were stuck in a Podunk town, I went to the local K-Mart to see what I could make that would allow me to see her beautiful face and better tell when it was time to land.

What resulted is known as "Kayvision". It is simply a convex mirror attached to a suction cup that is then placed in the pilot's field of view but also in line with the canard, so that it doesn't really block any view.

Below is a picture of the unit, as well as the passenger's view of the unit from their seat.

To make the unit, buy a 1-1/2" diameter suction cup, as are often found in the checkout stand at K-Mart or hardware stores. Then go to the section of the store that sells automotive trinkets and purchase one of the curved mirrors with double-stick tape on the back. Finally, obtain a small piece of brass sheet that you can find in the model section or at a model plane store.

Construction Steps:

Remove the wire hook from the suction cup. Straighten the hook on the suction cup so that it is straight except for about the last ¼", which is bent as shown to the right.

Solder a small piece of brass sheet the same size as the back of the mirror to the wire from the suction cup.

Attach the mirror to the piece of brass sheet stock.

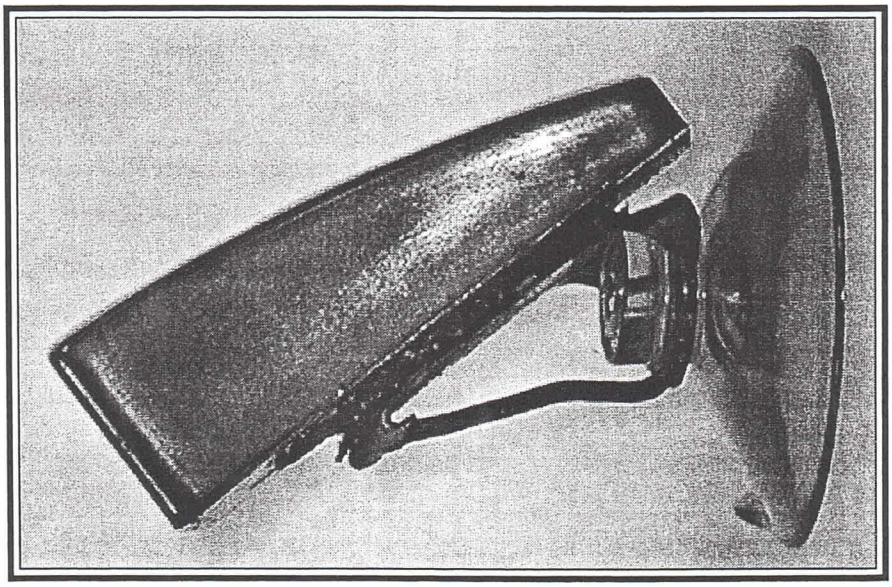
ED: An alternate mount might be made from glass and epoxy.

Attach the assembly to your canopy and move it around until you can see your passenger's smiling face.

Induction Air Web-site

Kurt Wegge (IL) - This is a good read. K & N's web page is full of good information on airflow for engines. http://www.knfilters.com/facts.htm

passenger's view of the mirror



side view of mount

Caution Canopy Safety Latch

Baine Whipkey: (GA) - I discovered my stainless steel canopy safety latch was broken more than 75% through and I caught it just in time. It felt peculiar when I pulled up on the canopy so I said "what is this"?

I for one would not fly without it working correctly. I can't say how many times I have cycled the canopy.

A friend of mine Nick Saliba was killed a couple of years ago. One of the things that happened that day was that his canopy was found NOT at the crash site.