

# THE CANARD PUSHER

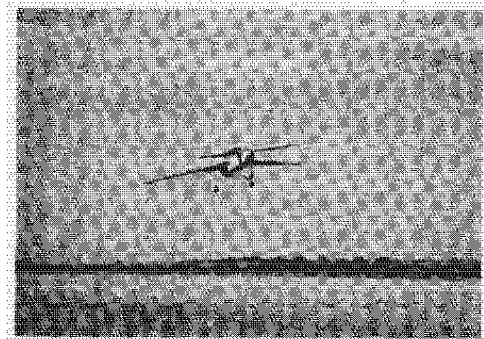
NO. 15

JANUARY 1978

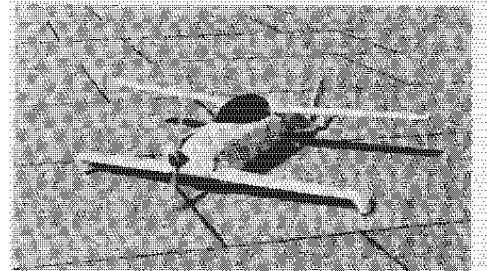
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If you are building a VariViggen you must have newsletter 1 through 15.  
If you are building a VariEze you must have newsletter 10 through 15.  
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CLEARANCE LANGSTON - FITZ  
EZ IN TEXAS (AUSTIN)



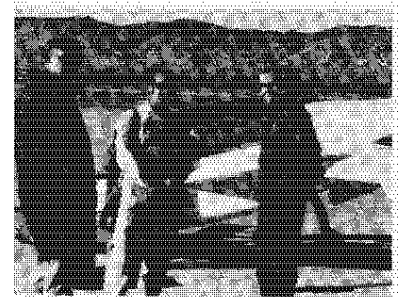
QUICKIE PROTOTYPE

RAF ACTIVITY since the October '77 "Canard Pusher" has involved work on two new prototypes, new flight tests with the VariEze prototype - N4EZ, work with NASA on their VariEze evaluation and on the skewing AD-1, further evaluation of our solar water heater, builder support, a construction workshop, and preparation of "Section IV" (2nd edition) and "Section IIC" (Lycoming).

Those of you who are EAA members have already seen the Quickie in the January '78 "Sport Aviation". It is being developed as a joint venture by Burt Rutan, Tom Jewett and Gene Sheehan. Due to the large amount of time involved in supporting the VariEze program, Burt does not plan to market any new homebuilts in the foreseeable future; thus, after design freeze on the Quickie this spring, Burt and RAF will become inactive on the Quickie. It will be marketed as a complete kit (with engine) this summer by Quickie Enterprises, a new company formed by Tom and Gene. If you desire Quickie information beyond that in this newsletter, contact them, NOT RAF. They will stuff your self-addressed, stamped envelope with a Quickie flyer, or will provide a complete info kit for \$6. (Quickie, Box 786, Mojave, Ca 93501.

The other project in our shop is still under construction and due to fly in April. It is RAF model 40, a light twin being developed for Pug Piper. He plans to certify and manufacture it within the next four years. Pug headed Piper Aircraft until 1974, then joined Beechcraft where he managed the group that developed the new Beech Model 77.

Our homebuilt solar water heating system has been in operation at RAF for about nine months now. When it has successfully demonstrated one year of operation we will be offering plans, and materials will be available at VariEze distributors. It is a very low-cost system using many of the techniques and materials used in the VariEze. It is designed to provide about 70% of the household water heating energy requirements at a cost of a small fraction of currently available units. Please do not inquire yet, but look for it to be available this spring or summer. Announcement will be made in the "Canard Pusher."



DON PHIL JIM  
HUGHES BROWN PATTON  
NASA EVAL OF N4EZ

AIRFORCE TO USE VARIEZE - Burt Rutan gave a series of canard design seminars to the Air Force Flight Dynamics Lab at Wright Patterson Air Force Base, Ohio. We just recently heard that they are now having a VariEze built to use as a flight test platform for some RPV avionics. It will have a pilot in the back seat and a lot of test gear in front.

CANADA VARIEZE APPROVAL - A seminar was held in Toronto, 1 December 77 to 3 December 77 for the purpose of evaluating inspection criteria for homebuilt composite aircraft. Attendees included Canadian D.O.T. management and inspectors from each of Canadas regional inspection offices. Presentations on composite structural design and inspection were given by Larry Haig (American Eaglet) and Burt Rutan (VariEze and VariViggen SP). Inspection discussion periods were held and workshops were given in which the inspectors were given a first-hand knowledge of what is a good and bad part. This is something we would like to see in other countries!

We were pleased to see NASA's general aviation research activity take an interest in the stall/spin characteristics of the VariEze. Last November NASA Langley, sent pilots Jim Patton and Phil Brown and engineer Don Hughes to RAF to do a flight test evaluation of N4EZ. Their debriefing was positive. We look forward to seeing their formal report. Since their evaluation, NASA is going ahead with very comprehensive research including building two VariEzes, one for full-scale wind-tunnel tests and one for flight tests. They also plan small scale, spin tunnel tests.

The workshop on 18 December '77 at RAF was well attended by approximately 110 VariEze builders and guests. VariEze construction methods were detailed, and the beautiful weather allowed flight demos by the VariEze and Quickie.

**VARIIZE CLUBS/SQUADRONS** - Now that 25<sup>+</sup>EZs are flying there is more interest in clubs. The following are new ones; see previous newsletters for others.

Omaha - Jud Bock, 11029 Franklin St., Omaha, Ne. 68154

Idaho - Kieth McIntyre, 923½ Kenneth, Moscow, Id. 83843 (208) 882-4070

Ohio, In, Mi, Il, Mo - Paul Sunday, 666 Tyler, Peru, In 46970 (317) 472-1521

New Jersey - Lee Herron, 1480 Pleasant Valley Way, #12, West Orange, NJ 07052 (now has helpful newsletter, plans an EZ flyin Jun 3-4, 78.)

Buffalo - Don White, 54 Columbia St., Hamburg, NY 14075 (716) 649-6137

**ENGINES** - "Section IIC," Lycoming O-235 installation for VariEze is now available. We were almost two months late on this due to late arrival of documentation from Air Sport and to some redesign being required.

N4EZ now has nearly 300 flight hours. Its O-200A has 1500 hours since major overhaul. It has required no maintenance besides oil changes since it was installed in N4EZ two years ago. It rarely requires more than two flips to start. Oil temperature runs at 170 deg F. Cylinder heads run 420 degrees in a long climb, 360 degrees at cruise, and do not exceed 300 degrees on a continuous hot-day ground run. It has never had a starter while on N4EZ and its alternator was removed a year ago. These two holes were covered with 3/16" aluminum plates. My logbook shows that the starter failed twice on the previous owner and the alternator once, costing him over \$400! As you know starters are not recommended on VariEzes. Only one has flown with a starter and that builder has since removed it. About 1/2 of the EZs to initially fly with alternators have removed them also, to reduce weight. We strongly recommend that you first fly without starter and without alternator. Add them later if you desire but do initial flying as light as possible. Do use a carb accelerator pump or primer for easy starting.

The following is a quote from Warren Curd, Raytown, Mo: "I originally had full electrical - the airplane flew well enough, but I had to carry weight in the nose, then when I started adding weight in the passenger seat I was less than satisfied. I finally took your advice and removed the starter, alternator, two solenoids, 22 ft of 1/0 cable and heavy battery - weight reduction 65 lb! The airplane now flies and handles so much better, I hardly can believe it. TO & Ldg speeds & dis-

tance are greatly reduced, climb improvement is amazing -- take it from me, save yourself alot of work later - don't install a starter or alternator in your Eze. Starting is easy and the trickle charger keeps the small battery sufficiently charged for radio needs."

One Eze flyer experienced sufficient clogging of his fuel filter at 35 hr to affect engine operation. The "Owners Manual" 1st edition recommended inspection at 50-hour intervals. We now recommend 25-hour inspections. In addition, check it after the first five hours for fuel tank contamination. If you are using the VA6 filter, replace, rather than clean, the element. One builder substituted a drain-equipped gascolator for the filter and drain, as he was concerned about the filter's ability to pass water. We know of no water related problems, but don't see anything wrong with his modification.

Some builders are reporting that their Westburg tachs don't function correctly - be sure you have the right model number - it should have an "M" on the end (for magneto). If yours doesn't operate I'm told you can send it with \$2 to Westburg for modification.

**WITH MUFFLERS**  
**MUFFLERS** - N4EZ has been flying since October. It has undergone modification to increase power, however net performance loss, due mostly to the aerodynamic drag of the large bumps on the cowling, is about four to five mph. The most disappointing news is that the net lowering of sound level is less than hoped for. The engine exhaust noise is reduced substantially, but the prop noise and canopy air leakage is still there, making the Eze still louder than the average lightplane. Measurements taken at the front seat are shown below; Back seat, is one to two db louder.

VariEze no mufflers	75% pwr	98.5 db
VariEze mufflers	75% pwr	96.5 db
VariEze no mufflers	50% pwr	95 db
VariEze mufflers	50% pwr	93.5 db
Cessna-150	75% pwr	93.5 db
Piper PA28-140	75% pwr	91 db

Based on this data we have not yet decided to pursue production of the mufflers - we would like to hear from you builders to see if you would be willing to pay the cost, weight and performance penalty for this much reduction in noise. Let us know.

**ROSENHAN WHEELS & BRAKES** - Good news - the modification designed by the manufacturer has been tested by Lee Herron on his VariEze and he reports the new brakes are excellent. They use the same piston size as the Cleavelands, do not require adjustment and are no longer "soft" as were the original ones. All brakes delivered after November '77 have the new direct-action calipers. If you want to update your original triangle-block type brakes, you can get a modification kit at VariEze distributors.

The previous Rosenhan brakes were supplied with neoprene O-rings which were supposed to be compatible with aircraft or automotive fluid. Fred Rosenhan has told us that some may swell with certain types of fluid. The new brake retrofit kit has aircraft type O-rings and extra ones to change your master cylinders. If you experience swelling with the old type write Fred Rosenhan, 810 E. 6400 S, Salt Lake City, Ut 84107 to get a replacement of aircraft type O-rings.

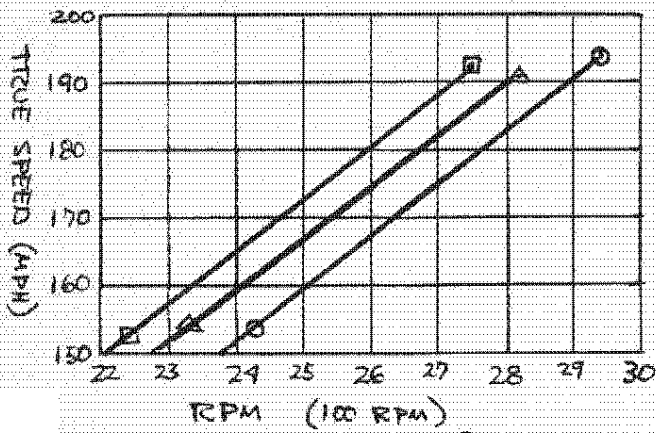
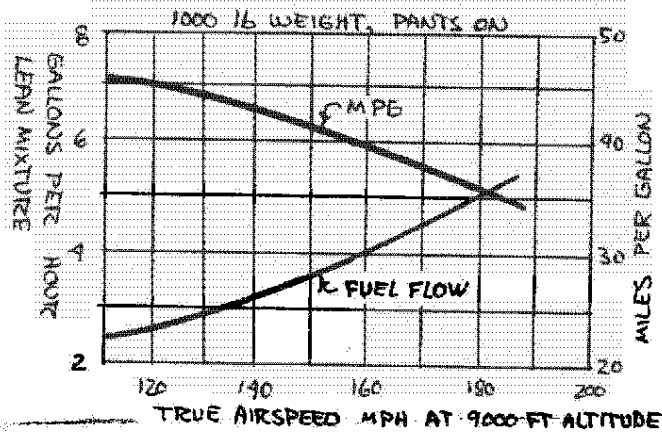
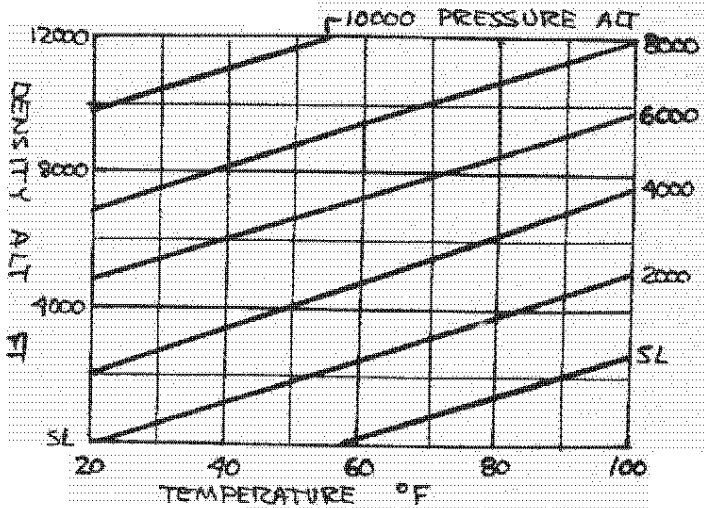
**STALL CHARACTERISTICS & CG** - Bill Rogers has reported less desirable stall characteristics than N4EZ's. Specifically, his airplane would depart into a snap roll if aggravated with rudder at full aft stick, and could enter a very high angle-of-attack deep stall. This stall was easily recovered with forward stick. He flew his airplane to RAF; we installed some nose weight and he repeated his tests. This time his Eze responded similar to N4EZ at aft cg. Until we confirm his cg by an accurate weighing (he did his on bathroom scales) we must assume that he was aft of the aft cg limit when he discovered the undesirable traits. We recommend that you avoid the last inch of the cg range until you are well familiar with the stall characteristics of your airplane and know that your weight and balance is accurate and current.

**VARIABLE PERFORMANCE** - In an earlier "CP" we told you the rpm data supplied was in error. We have calibrated a backup tach and remeasured this data. See below. Note that Cassidy has reduced the pitch on his VariEze prop to make it turn faster to help takeoff and climb.

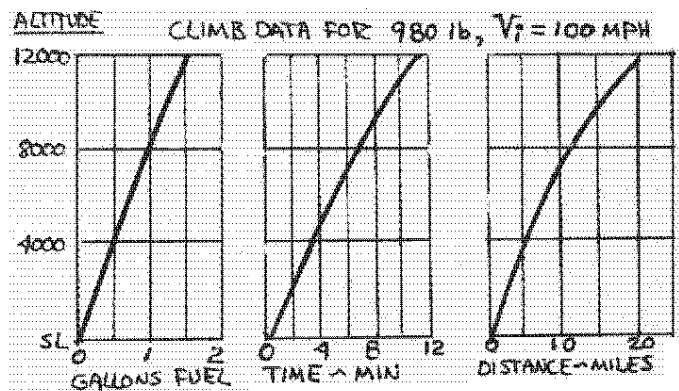
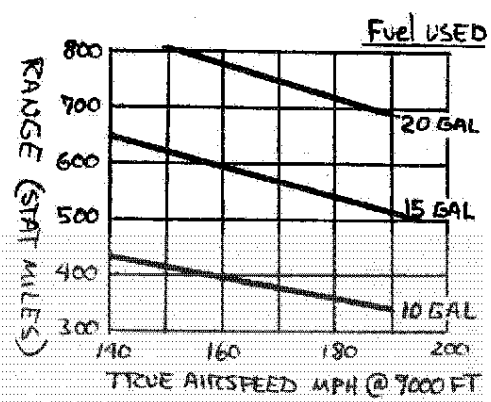
Seal cowling leaks around the fuselage, exhaust and aileron tubes. Air leaks here slow the airplane and reduce cooling. Canopy air leaks can also reduce performance.

Your owners manual shows most data vs. density altitude. Add the chart shown below to determine this. The new 2nd edition of the "owners Manual" has refined data based on N4EZ tests with wheel pants, and data supplied by homebuilders. In addition to cruise data it has full throttle speeds vs. altitude, allowing you to directly compare your Eze to N4EZ.

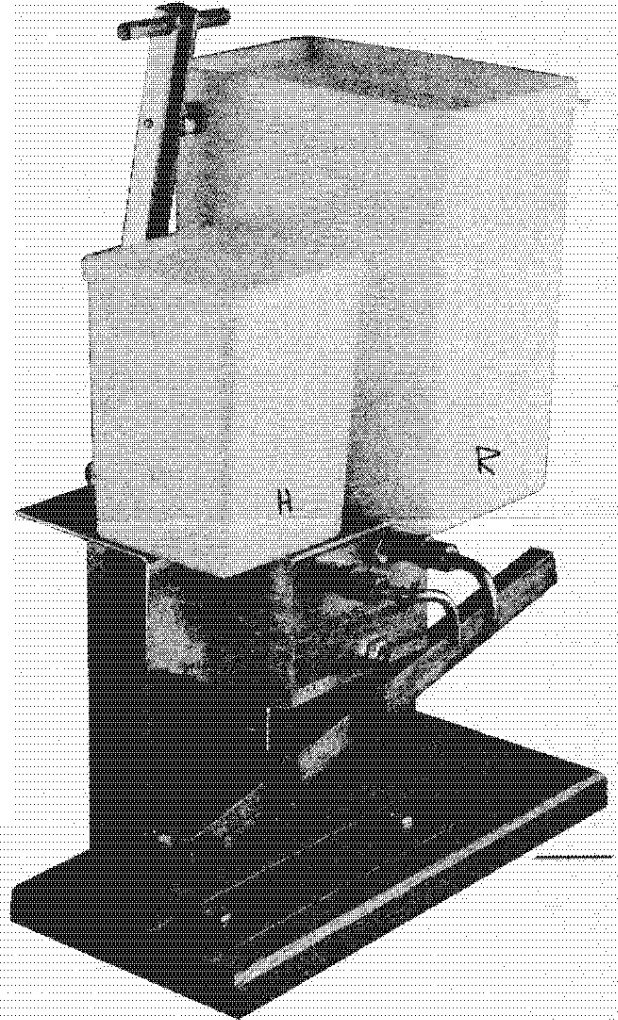
Recently we obtained an accurate fuel flow totalizer to better define actual inflight mileage. The results of these tests show that, due to the poor fuel specifics of the 0-200 at low power, the "Owners Manual" data is incorrect except at high speed. Cut out the graphs shown below and paste them in your owners manual to correct this (2nd edition has blank pages in back). The climb-fuel-used-chart is handy for flight planning. All cruise data are for lean mixture, 25° F on rich side of EGT peak. Our tests show that at 9000 ft, full rich mixture results in 21% decrease in range at 180 mph and 30% decrease at 110 mph! Even 25° F extra richness (0.1" motion of mixture knob) causes 5 to 6% reduction in range.



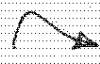
SYMBOL	PROP	8000 FT ALT. PANTS AND 10.3" SPINNER INSTALLED. LEVEL FLIGHT.
○	TEDS 56x70	TOP SYMBOLS DENOTE FULL THROTTLE.
□	CASSIDY 58x67	
△	CASSIDY 58x69	



CONTROL SYSTEM ROD ENDS - The HM3 rod ends used in the control system are susceptible to being damaged if you do not use care in installing them. When adjusting the pushrod under the front stick be sure the normal stops in roll are reached before a twisting load is applied to the rod end. Be careful to not bend the rod end threads. If an HM3 has been bent, twisted, damaged or overloaded in any way it must be discarded, or used in a noncritical area (landing brake for example). Check your rod ends, particularly in the pitch system where they are non-redundant - if they are marked HM3C return them to be replaced with HM3. The "C" is a commercial grade and is not as strong as the aircraft HM3.



THIS IS THE EPOXY PUMP DISCUSSED  
ON PAGE 9



This area intentionally left blank so you  
can cut out the performance charts and paste in  
your "Owners Manual."

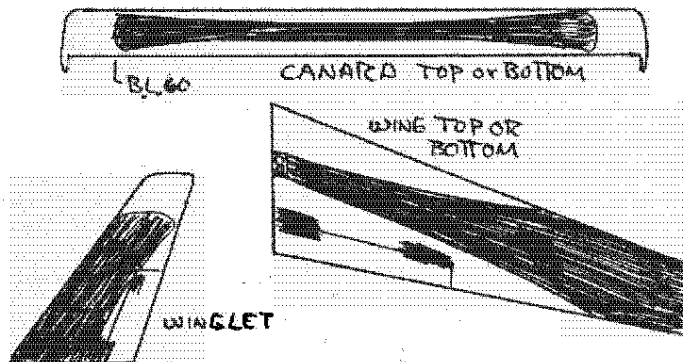
**COMPOSITE STRUCTURE** - It is evident from looking at some of the parts we've seen, that a few of you, including some inspectors, do not adequately understand the inspection criteria. We have even seen some parts that need repair to meet the criteria, yet they were passed by FAA. DO NOT assume that just because FAA signs it off, it is okay. DO assure yourself that you can judge a part to the criteria in "Section I," "Section V," and newsletter 10. Also, be familiar with the clarifications in the other newsletters. Some more follow:

**Bump/Joggle/Dip Criteria** - The best way to check this is to lay a 12-inch straightedge on the part spanwise. Move it all over the surface in the critical areas. If you can see 1/16" gap in any area, the part must be repaired. It is best to repair or beef up lumpy areas even if they meet this criteria. Better yet, do a good job in core preparation and use your squeegee well in the layup to avoid the lumps in the first place.

**Dryness Criteria** - Pick any 6"x6" square in the layup in the critical area. Assess carefully if any evidence of air in the layup is present (white fleck/bubbles, air at the foam face). If the dryness evidence is more than 10% of the area, the part MUST be rejected. Reject or repair any evidence of dryness or voids in the trailing edge or leading edge overlaps. Better yet, do an adequate inspection with good light before cure when it's easy to fix. If in doubt on overlaps be sure to stipple in enough epoxy.

The following is a listing of the "critical areas" - the portions of the VariEze that must meet all the inspection criteria:

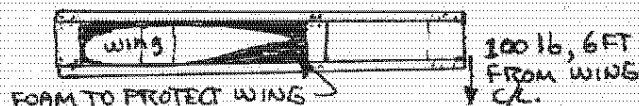
1. Center section spar - entire outside skin and spar caps.
2. All portions of the fuselage within 10" of the engine mounts and canard lift tab attachments.
3. All control surfaces.
4. All flying surfaces in the shaded areas shown plus all overlaps at L.E. & T.E.



Several builders have had flying surfaces warp or bend due to being poorly supported until fully cured. Do not hang or support them at each end for long periods as they may "creep" or slowly deform. Store them leading edge down with support in at least three places. Your surfaces can be better

protected against "creep" if you post-cure them. Sailplane manufacturers do this by putting the entire airplane in an oven at 160° F. You can do it as follows: After you have painted on the black primer put the wing/winglet or canard out in the sun - be sure it is well supported in at least three places along its span. At noon a black surface can reach 140 to 180° F, giving it a relatively good post-cure. After the post-cure the structure is more stable for warping or creep. If you have a wing or canard that is twisted wrong, apply a twisting force in the opposite direction before and during the post-cure (weights applied to boards Bonded or clamped to the surface can be used). Remove the force only after the surface has cooled. A 200-ft-lb torque (50-lb weight on a 4-ft arm) applied twice, once while the top surface is post-cured and once for the bottom surface, can twist your Eze wing or canard over one degree. The twist correction will be permanent and will stay as long as the surface remains cool (below the post-cure temperature). This is generally referred to as the heat deformation characteristic of the epoxy. If it is room-temperature cured only, it will soften above 140° F. But if post-cured it will not soften until over 160° F. Heat for post-curing or for intentional deforming can be applied by other means such as heat lamps, hair dryers or electric radiant heaters (household type), however this is generally not recommended, since it is too easy for the homebuilder to get the part too hot and ruin the part. The blue foam is damaged above 240° F. If you want to use these heat sources, do so by applying the heat very slowly and checking the temperature often by placing your hand on the surface. If you can hold your hand on the surface five seconds without pain, the temperature is okay - three seconds is too hot.

Most people think the relative incidence of the two wings, set in chapter 8 is permanent, with no adjustment. This is not true. Several builders, on our instruction, have used the heat deformation method to straighten wing incidence on a completed airplane as much as one degree to correct a poorly trimmed airplane. Do this as follows: Attach a board as shown to the wing to provide a 600-ft-lb torque in the direction desired. Cover the wing root

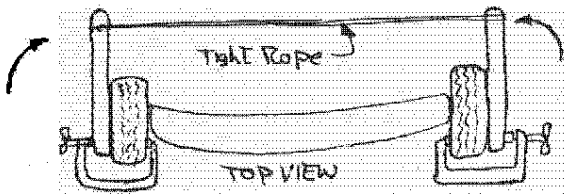


with corrugated cardboard to insulate it to protect the blue foam. Using hair dryers or radiant heaters\* slowly warm the center-section spar (three or four sides, depending on if fuel tank is on), continually checking the surface for correct temperature (at least five seconds to pain). Heat it uniformly from the wing fitting to the fuselage. Let the spar completely cool before removing the weights. Re-check incidence to see how much it changed - don't overdo it the first time, use only moderate heat until you see how much will be required.

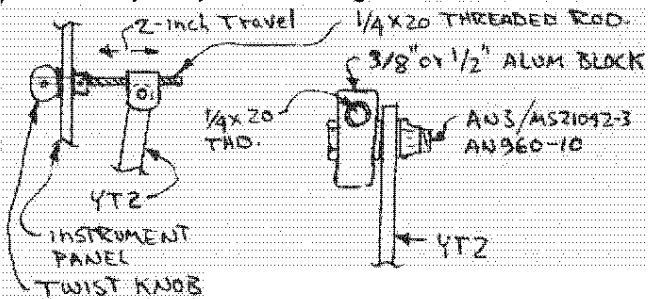
Creep is rare on the main gear since this part is post-cured. However, the main gear is subjected to a continuous high stress over long periods when the airplane is parked. This stress can be greatly relieved if you lift under one wing and allow the gear legs to spring together, then set the airplane back down when you park it. It is doubtful if gear creep will be a problem with the Eze, but if you do notice creep (gradual spreading of the gear) it can be reset by pulling the wheels tightly together with a rope (weight off the gear)

\* Do not use heat lamps- they can create hot spots.

heating then cooling the strut, then removing the rope. Another handy use of the heat deformation method is setting toe-in. If you need more toe-in, clamp boards on the wheels as shown, heat, then cool the strut, remove the boards and presto - toe-in that's easier than installing shim plates!

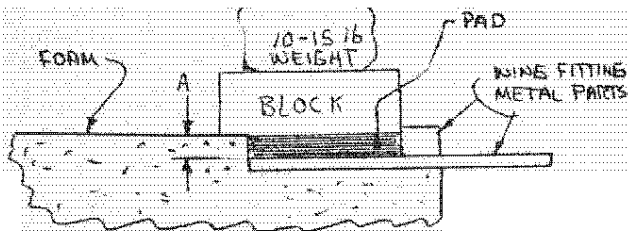


We have been flying a different yaw trim knob on M4EZ that provides a finer adjustment, but eliminates the parking brake feature. This is optional; use it if you wish. Unless you can find some left-hand thread rod, it works backwards, i.e., turn it right for left trim.



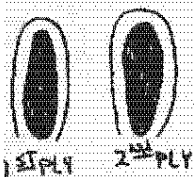
**VARIEZE BUILDING HINTS** - In order that you don't later overlook these, jot them down in the appropriate places in your "Section I." Same goes for building hints in other newsletters.

A builder has suggested a better method than the one shown in newsletter 13, pg 5, for building the eight glass pads in the wings and center section spar at the wing fittings. The following method gives a wet bond of the pad to the wing fitting, saves a separate cure, and allows you to trim and round the pads at the sides, in place on the fittings. First, measure dimension "A" to be sure it is .012" times the number of plies to be laid up in the pad. Dull the wing fitting, lay up the pads with excess hanging out the sides, no voids at front and back. Apply peel ply, then Saran Wrap (plastic release), then the block (overlapping the foam to assure a perfect transition from foam to pad), then the weight and let cure. Be sure to remove the peel ply and round the corners before the shear web is laid up.



Do not use a rod to align the CS2 brackets on the elevators. They can be as much as 0.1" off and a rod will still slip through and rotate freely. If you have done this, check by sighting or stringing a tight fine wire down the middle of the holes. The CS2 brackets must be repositioned if they do not meet the 1/16" alignment tolerance.

There has been some confusion on the sequence of applying the BID-wrap on the main gear. Lay the gear leg leading edge down on three blocks. Sand its surface and round the T.E.. Apply one ply BID at 45 degrees. Cure. Turn over and apply 1-ply BID at 45 degrees. Now mount the tabs (step 2 & 3) then the brakelines (step 4). When glassing over the brakeline fill the adjacent void with dry micro.



Peel PLY or SANDING IS NOT Needed IF 2<sup>nd</sup> PLY IS done WITHIN 24 hr of 1<sup>st</sup> PLY.

Many are still spending too much time in the layups. If a layup takes over twice the time shown in the plans YOU ARE DOING SOMETHING WRONG and are probably not doing a good layup. Try this - instead of bringing in small amounts of epoxy to stipple in with a brush, pour the epoxy on the surface and make MANY LIGHT PASSES with a light squeegee to move the epoxy into the cloth. The squeegee can be the thin plastic from a coffee can lid. You can cut two 4-inch squeegees from the plastic cover of a 3-lb coffee can. It is easy to tell if the layup is too wet - pass the squeegee across the part then stop and lift it. If the layup is too wet there will be a "lump" of epoxy where the squeegee stopped. Be sure resin is not colder than 75° F. Using this method of going too rich, then squeegeeing the excess out gives less chance of trapping air. You will find this method works so fast that it is paced by measuring and mixing epoxy, so be sure to have one person who only does the mixing. Do a thorough job of inspecting for dryness, bubbles, overlap, imperfections, etc., and have someone else check it, too, before you leave it to cure. It's a shame to have to reject a part that's dry when it could have been fixed before cure.

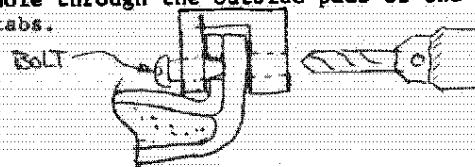
Before glassing canard or wing bottom put masking tape below the knife trim line on the leading edge. This keeps epoxy off the foam on the top surface. A few pieces of 2"-thick, 2 ft-square foam rubber are handy to support wings and foam cores so they can be handled and worked on, without damage. Sticking nails into the leading edge of the wing cores at the W.L. at tip, root and mid-span will help in eyeballing the leading edge straight. Thanks, Duane Solberg, for the above hints.

Nat Puffer discovered that the canard bolts can be reached through the nose access door without need to reverse the bolts. He also suggests routing pitot line around, rather than under, battery to eliminate moisture trap.

Bob Gentry suggests adding 2" to the height of all wing jig blocks to give room to reach under to clean off micro.

Jim Smith reports a Sears model 315.17381 router is handy for recess cuts, rounding longer on edges and, set at zero depth, it removes excess residual micro spots on foam and joints without cutting adjacent foam surfaces.

Make a drill jig as shown to accurately drill the hole through the outside pads of the main gear tabs.



**FLIGHT SAFETY** - Most operational problems occurring with VariEzes have been due to not following the information provided in the "Owners Manual." It is disappointing to see someone fail to succeed merely because he overlooked or elected not to follow "the book." We do get questions from those who want to modify or exceed the limitations in the "Owners Manual." Our recommendation is to first follow the book; then if you desire, expand your envelope professionally to suit your needs, but **DO NOT EXPECT SUCCESS**, unless you follow all "Owners Manual" recommendations. Be sure you have completely updated your manual and checklist to include all newsletter additions (fuel system, ailerons, etc.) or buy the 2nd edition. Carry the book in your airplane. USE your checklist.

**QUESTIONS** - When writing RAF with an individual question please remember we can answer only those accompanied with a self-addressed, stamped envelope. If you're outside the U.S. you can substitute an international postal coupon (available at your post office) for the stamp.

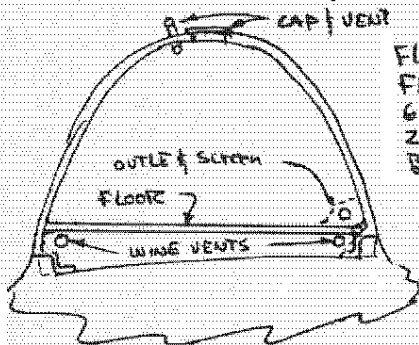
Q. Can I use Scotch Brite dish pads to dull the fiberglass for a future layup?  
 A. No, use only 36-grit or 60-grit sandpaper. Better yet, plan ahead and use peel ply. We've noticed that many builders are not using peel ply for winglet attachment. Be sure to peel ply the outboard 18" of the wing and the lower 14" of the winglet.

Q. After installing the optional landing brake my left suitcase doesn't fit - what now?  
 A. Trim the stiffener from the suitcase front and tuck its nose inward about 4".

Q. Can I hinge the instrument cover for access?  
 A. No, the piece behind F28 is structural and must be glassed in place as shown to aid fuselage stiffness.

Q. I hear different numbers - how much does it cost & how many man-hours to build an Eze?  
 A. This info is based on what we hear from builders. Those who buy all available prefab parts spend about \$4900 + engine and average 900 man-hr. Those who build most everything spend about \$3000 + engine and average 1400 man-hours. Minimums we've heard of are \$2400 + engine and 580 man-hours.

Q. Instead of the separate fuselage fuel tank can I make my aft fuselage compartment into a fuel tank?  
 A. Yes. Several have done this, saving work and weight. The inside of the compartment must be laid up wet, like the wing tanks. The cap, outlet, screen & vent are installed similar to the wing tanks. The tank must have a bottom as shown to allow wing tank vents to pass under & to avoid leaks at the center section spar bolts.



FLOOR AND FRONT FACE CAN BE 616 PVC WITH 1 OR 2 PLYS B10 ON BOTH SIDES.

**VARIIZE PLAN'S CHANGES** - Be sure to copy these in to your plans now.

**OWNERS MANUAL**  
 (1st edition only)  
 page 40

Change 50 hr to 25 hr. Add "replace element if VA6 filter is used."

**OWNERS MANUAL**  
 1st edition pg 20  
 2nd edition pg 19

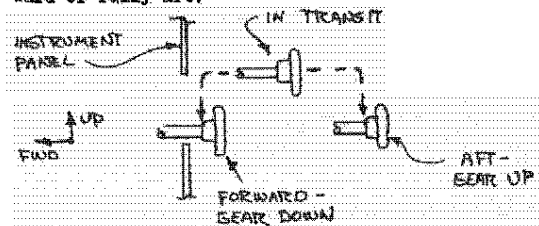
Add "stall characteristics have been found to vary from airplane to airplane, particularly at far aft cg. Avoid the last one inch of the cg range until you know the stall characteristics of your airplane and know your weight and balance is current and accurate. Recovery controls for any unusual characteristics at high angle-of-attack are stick forward and rudder against any rotation, (ailerons neutral)."

ALSO  
**VARIIZEAL MANUAL** Pg 16

**OWNERS MANUAL**  
 (1st edition only)  
 pg 4

Add the following:

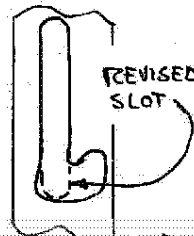
The diagram below shows the motion of the nose gear handle to extend or retract the gear. The handle is locked in the lowered position for gear up or down. Do not force the handle downward unless it is fully forward or fully aft.



If the handle is forced down repeatedly this can bend the tube with the result that the down lock "snub" is lost. Be sure to check that the required one-inch snub is available. (Pg 17-10 of "Section I").

**SECTION I**  
 Pg 17-10 &  
 pg A-1

Revise the slot for the nose gear as shown below (straight slot). Fabricate the parts shown below and install as outlined on page 7 of newsletter 14. This eliminates the sideways motion of NG10, allowing NG11 to remain firmly in the extreme locations of NG13 guides. If NG11 is not fully into the extreme travel of NG13's on both sides, the nose gear may come out of its lock during taxi.

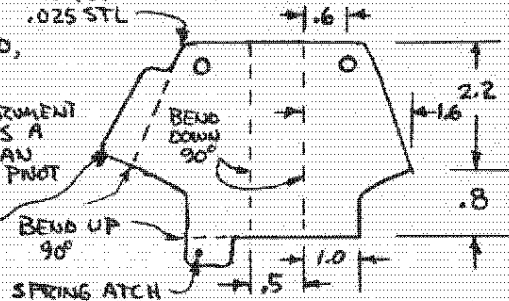


TAB, .032  
 ALUM OR  
 .025 STL



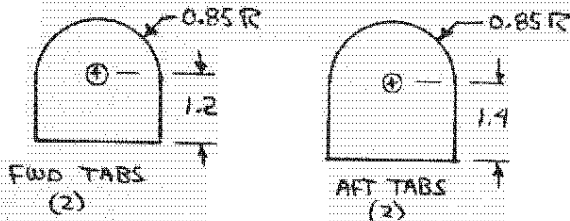
SPACER, 3/16 ID, 5/16 OD, 0.5L  
 ALUM OR STL  
 IS TO GO IN INSTRUMENT PANEL. THIS IS A BUSHING FOR AN AN3 BOLT TO PINOT TAB.

CP15 Pg 7



**SECTION I**  
Pg 18-1

Ignore dimensions on landing gear tabs. Substitute those shown below. If you have fabricated these check to be sure you are not short on the 0.85 dimension.



**SECTION I**  
Pg A-5 &  
pg 10-3

Beef up of landing gear attach tabs shown in newsletter 12 & 14 has required that some material be removed from the main gear strut to correctly fabricate the tabs. To avoid this, move both forward extrusions forward 0.2" and move both aft extrusions aft 0.2". Each extrusion set should be spaced 5/8" apart. (Initial fabrication only, retrofit is not required). Do not lay up pads on wax paper.

**AILERON ADDENDUM**  
page 5

Drawing on right side - 9-3/4 should be 9-1/4.

**AILERON ADDENDUM**  
page 9, Bill of materials

Add "6061-T6 can be substituted for 2024-T3 on the 3/4" tube.

**SECTION I**  
pg 15-1

3.7 should be 2.7

**SECTION I**  
pg 6-7

Section A-A trough should only be 8" long on bottom of wing. Use the full 10" for wing top. Use care to not undercut this area. On glass dimensions, increase the 58" dimension (UND spar cap) to 62" and increase the top UND spar cap from 62" to 66" (page 6-11). New construction ody, retrofit is not required.

**SECTION I**  
pg 4-2, 6-1,  
& 7-1

Add "Be sure to use the method shown at the top right of pg 7 of newsletter 12. This will assure a straight leading edge. HOT WIRE LE WIRE

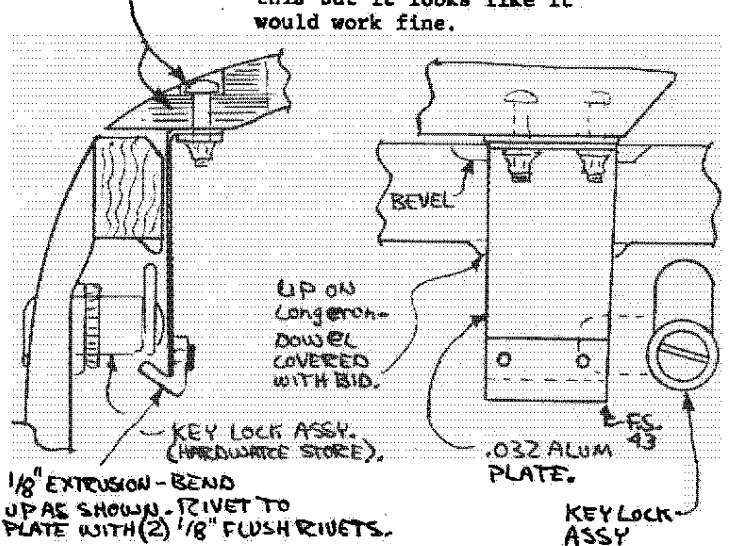
**SECTION IIA & IIC**

Add "mixture and throttle controls must operate smoothly without free play, lag or excess friction. They must snub against idle and full positions. Check this before running the engine."

**SECTION I**  
Pg 22-8 &

Reference the canopy opening occurrences described in newsletter 14. A builder has suggested a car-hood type secondary latch system that doubles as an engagement point for the canopy key lock. To open, use key to rotate lock arm vertical. Then raise canopy 1.5" and push in on the latch. I haven't installed this but it looks like it would work fine.

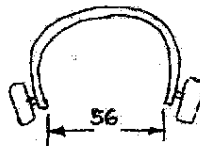
REINF AND BOLTS SAME AS FOR LATCHES



1/8" EXTRUSION - BEND UP AS SHOWN - RIVET TO PLATE WITH (2) 1/8" FLUSH RIVETS.

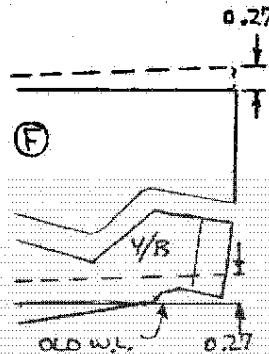
**OWNERS MANUAL**  
Pg 40

In annual maintenance section add "Jack or lift the weight off the wheels and measure the spread of the main gear. If it's more than 56 inches at insides of strut at axles, move it inward using the method in newsletter 15." (see page 5).



**SECTION I**  
Pg 6-14 & 6-15

DASHED LINES ARE CORRECTED W.L.



The waterline on template Y/B and the straightedge of jig block F are at an incorrect angle by about 0.7°. This error was noted in newsletter 11, and builders were told to shim F to get straight leading and trailing edges. Most builders have done this, taking the correct approach of making the root & tip waterlines parallel and shimming to get a straight L.E. & T.E., thus getting a straight wing with the correct twist. However, some did not notice the note in cp 11, and have questioned us on the jiggling method. To avoid confusion, correct the waterline on Y/B and F as shown, by raising them 0.27" at the trailing edge. They are correct at the leading edge. Now, if the jig blocks are mounted on a flat table, the L.E. & T.E. should be straight.



**SHOPPING** - Good news. Several of the items we have been trying to get on the market are now defined, tested and ordered by the distributors.

**EPOXY PUMP** - marketed by Aircraft Spruce & Wicks. This is the same pump we've been using at RAF for the last year. It dispenses the correct ratio of resin and hardener into a single cup. It is a well-built, industrial quality unit. It saves alot of epoxy since you can make small batches if desired (the balance scale is not accurate below one-two oz. It can save about 5-10% of the man-hours required for a lay-up. It should be durable enough to last for years of continuous use.

**SOLAR PANEL** - We have finally been able to get a manufacturer to build a solar charging panel for our application at a good cost. It is only 0.1" thick, weighs 0.6 lb, measures 9"x12", puts out 4 watts, and retails at Aircraft Spruce & Wicks for about \$119. This panel can be bent into a gentle curve for mounting on the Eze nose.

**PLACARDS** - Aircraft Spruce is developing a complete set of metal placards for your Eze cockpit. They have a special sponge-type adhesive that adheres well to a fiberglass surface.

**SPINNER** - Aircraft Spruce now has a spinner specifically designed for the VariEze. It has been in test on N4EZ for the last three months. Previous spinners have suffered cracks after a few hours. This one has two very stiff flanges that accurately fit the cone. It has a long, pleasing shape, is 10.3" diameter, and comes complete with forward airflow guide for best engine cooling and low drag. I had given up on spinners until this one worked out so well. Specify engine type and prop hub thickness - the flange is custom trimmed.

**MATERIALS SUBSTITUTION** - Those of you who receive "Sport Aviation" may have noticed an article in the January issue by Hans Neubert inferring that VariEzes could be built from commercial weave 181 and 143 fiberglass and any one of a number of commercial epoxy systems. Particularly disturbing was the author's inference that our distributors were merely pouring the low-cost, highly-toxic 815 resin into containers with a different lable. We are not concerned that VariEze builders are being misled, as they have been kept aware of the reasons we had to resort to special formulations and cloth weaves. "CP" 10 (Oct '76) describes the problems we encountered trying to use 181/143 cloth and attempting to use Shell 815 resin systems. It also describes our fight to reduce the materials' cost. As we discussed in "CP" 12, development of the resin/hardener system after the first vendor went out of business, was a difficult, time-consuming task. This required five months of testing over 20 different formulations from three different vendors to develop a system that would meet our requested specifications of (1) min SPI of 11, (2) heat distortion, (3) odor, (4) room temperature physicals, (5) fuel and foam compatibility (6) moisture absorption (7) cure time at 65° and 95° (8) exotherm with micro mix, in insulated foam core, (9) mix ratio, (10) viscosity, and (11) shelf life. It is of interest to note that one of the larger formulators in the Los Angeles area was unable to de-

**4-PLY TIRES** - Wicks and Aircraft Spruce are now stocking 4-ply main tires for the VariEze. They are lighter but stronger than the 2-ply slicks. They have a fine tread that will not pick up large rocks. They should be operated at 65 to 70 psi pressure. I am using these now on N4EZ.

**RUDDER & PITCH SPRINGS** - Aircraft Spruce is now stocking custom-made springs for VariEze pitch trim and for rudder return.

**PREFAB WINGS/CENTERSECTION SPAR** - Jiran is currently completing tooling to produce VariEze wings and C/S spars. The design is somewhat different than the plans, in that a long tongue with two pins is used in place of the current metal fitting. This allows incidence adjustment. The wings will have a sailplane-like finish. They will be flight tested on an airplane built by Jiran for that purpose. That airplane will be sold after tests are completed. Anyone interested in it should contact Jiran.

**"I FLY A VARIEZE" SIGN** - Cowleys is making a an attractive plastic magnetic sign - contact them if interested.

**FOR SALE** - A75-8,G. Layton (213) 894-3979.

**FOR SALE** - VariViggen wingfitting set, Lynn Pilkington, 140 S 1st W., Hyrum, Ut 84319, (801) 245-3805.

velop a system to simultaneously meet the requirements, and Applied Plastics required over a dozen different system variants to arrive at the solution. I have asked Applied Plastics, the RAE formulator, to respond to the Neubert article. Their comments follow:

"I believe it to be fairly well known that in early 77 the R A resin system was changed from the "Lambert Blend" to epoxy resin and hardeners manufactured by Applied Plastics Co. Inc, 612 E. Franklin, El Segundo, Calif. Applied Plastics is a resin manufacturer supplying the aircraft and aerospace industry world-wide and have been manufacturing chemical intermediates for more than twenty-five years. Explaining the varied technical capabilities, unique abilities of our chemists and our extensive quality control department would be time consuming and may indicate an attitude of DEFENSE while to the contrary we are offensively incensed by this article which in our opinion does not take sufficient regard for the personal safety of fellow EAA builders and of others who might follow these suggestions.

The statement that R A resins after March are the familiar Shell Epon 815, only further substantiates our feeling that substituting resin systems without laboratory evaluation by QUALIFIED INDIVIDUALS can be extremely dangerous. Our laboratory testing showed the use of B.G.E.

resins in this construction to cause extensive foam damage.

Let me state here that Applied Plastics does not now, and never has, supplied Shell 815 or Shell 828 as R A resin.

The cost comparison example which suggests you buy 828 by the drum is an extremely hazardous recommendation, in our opinion.

The pages that address themselves to epoxy hardener substitutions are equally as potentially hazardous.

The suggestion that would encourage a homebuilder to handle materials such as DETA and TETA are in our opinion reckless and unnecessary. The following hardeners were not useable because of the safety problems they represent; also our knowledge of working with these materials showed them to be too exothermic when used in foam cores with microballoons: AEP, TETA, SHELL U, SHELL T. Shell A was never considered as it is a system that requires heat curing and not too many have autoclaves or walk-in ovens, not to mention the added responsibilities heat-curing systems require to make good laminates. Shell T has been discontinued for well over a year.

The chart which showed the above curing agents along with Versamid 140, which is a high viscosity material, and then suggested that you thin with toluene or alcohol can again produce a hazardous situation, hazardous when working with them as well as hazardous from the standpoint that you change the physical properties of the hardeners when you cut them with solvents. When solvents are trapped in laminates you will also get long term degradation of the laminate, and foam core damage.

The development of the RAE slow hardener to meet the requirement of adequate cure and yet not result in exotherm damage deep in a foam core, required several months testing. More than a dozen different systems were tested, not merely to optimize the pot life but in fact to achieve a system that provided the homebuilder with a safe structure. Both the fast hardener and the slow hardener required numerous tests to meet the specifications. Often we would find material that would be excellent in all proper ties but then would fail to meet the all important heat resistance test. This requirement alone excluded most of the common base hardeners referred to in the article by Hans Neubert.

Let me add that Applied Plastics sells most of its materials in drum quantities and would be most pleased to pass on savings through the distributors to builders who have the resources and the equipment necessary to handle five-hundred-pound drums. Finally, let me reiterate that from the beginning our intention was to provide safety and safety at a moderate cost; in our opinion the R A resin systems are sold at a very low cost for formulated systems."

I have invited Mr. Neubert to our shop for a first-hand demonstration of what happens when the VariEze layups are attempted with 181 and 143 cloth. While they perform nicely when used in vacuum bag operations they present unacceptable problems when used in most of the Eze hand-layups. We made many measurements of this when we originally attempted to use them. They can more than double some layup times due to the frustration of chasing wrinkles and bubbles, they cannot be flagged for spar caps, they hide air making inspection more difficult and less reliable, they draw in air after a moderate pass with the squeegee, their ability to conform to compound curves is less than BID and UND, the difficulty in determining major fiber orientation leads to errors, and they require more resin to wet out for the inexperienced laminator, resulting in a weight increase.

Summarizing, we have spent a considerable amount of effort developing methods and materials to make it possible for the homebuilder to do what the aviation industry cannot yet do - that is, build a safe all-composite airplane. To allow the average individual to be capable of this task did require other than the commercially available materials. A VariEze with engine and radio will cost from \$5000 to \$10,000. Saving 3% of that by substituting unsafe structural materials is foolish.

VARIVIGGEN NEWS - (Be sure to note the "Owners Manual" addition shown on page 7 of this newsletter).

Another Vigen has taken to the air since "CP" 14. Here are details from Harold Reiss.

"1st. flight C.G. was set up at 122.9" with a 180 lb. pilot, 15 gallons of fuel in the main tank and an empty weight of 1130 lbs. I had to add 47½ lbs. of lead to the nose to get this C.G. location, so, other builders keep the tail end as light as you can without sacrificing strength, particularly if you locate the battery behind the front seat bulkhead, as I did.

Dec 27th runway taxi tests were somewhat limited. I had planned to do 4 or 5 runs down the runway to determine how it would handle, however the first nose wheel lift off at 47 indicated resulted in a somewhat mushy 1 to 2 ft. high flight. After putting it back on the runway, and while still rolling, I applied about 1/2 throttle to 52-54 indicated, retarded the throttle to idle to prevent further acceleration, raised the nose wheel and once again the mains followed and I found myself airborne at about 10 ft. Everything felt fine with the stick slightly aft of neutral and centered so I decided to go ahead. I applied about 1/2 throttle, climbed up to pattern altitude, left the gear down, and set up a normal approach. Had 20 degrees of crosswind at about 5 kts. and used diminishing power. The landing was a squeaker. There are no indications of any warps or twists in the flying surfaces so no trim tabs will be needed.

Thursday Dec. 29 - Actual planned first flight. Take off run was slightly long as I used only about 1/2-power and had about 18 kts wind at 190 degrees on runway 22 - crosswind control is excellent - flew the pattern with gear down and did a power approach landing which was again a squeaker and

slightly nose high. The nose fell through a lot slower than the first time and I taxied in to complete the T.V. coverage (six and 10 o'clock news) Then I decided another flight was the order of the day. I broke ground a lot quicker with full power at about 56 indicated and lowered the nose a bit. Speed build-up is very rapid in this airplane as it got to 120 ind. right now. Started up to pattern altitude, slowed to 80 - 95 and retracted the gear, nose wheel first, by using the panel breakers, and then the mains. The gear came up perfectly though I did notice a slight vibration after retraction. Got on downwind, slowed and selected gear down - there went the nose wheel down and locked, but alas no mains - shook the wings - still NO MAINS. I then cycled the circuit breaker for the mains and had NORMAL gear extension.

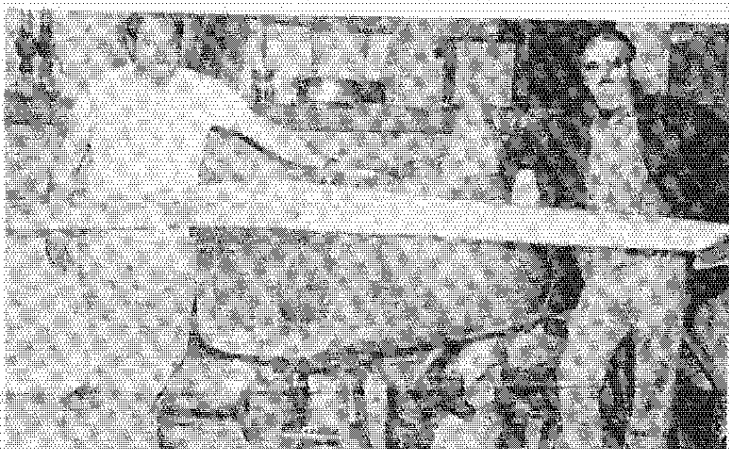
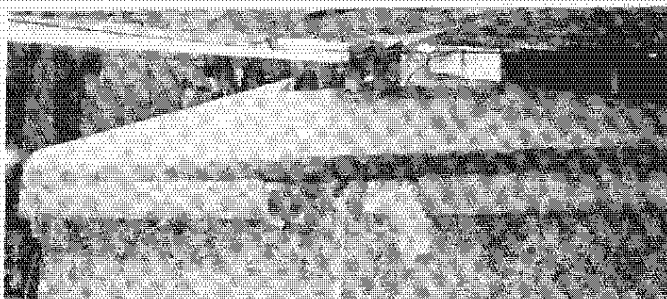
I suppose the breaker might have opened at a lower than 5 amp current draw during retraction and took that long to cool for reset, although I think everything was all the way up. During tests on the jacks I had checked the load electrically and found it to be 3.57 amps with no outboard load on the wheels. So far the airplane has about one hour of actual flight time on it and it feels really good. If we had some of your California weather instead of snow every day, the time on 29HR would build faster. I called Mike Melvill and we will get together for some photos when the weather is decent."

Mike has also had the main gear C/B pop. We are recommending that you change both main and nose breakers from 5 amp to 7 or 10 amp. Mike installed cabin heat per the instructions supplied with the cowl. He reports that it is very effective with more than enough heat. He has floor outlets in both cockpits and on the windshield.

Mike had a very harrowing experience with his Vigen at about 50 hr. Apparently due to a materials defect a 1 ft length of one exhaust pipe fell off and hit the prop causing 1/2 of one blade to separate. The resulting severe vibration made the wing tips invisible and set off the ELT. Mike shut down and made a forced landing in a field. No damage resulted except for prop and pipe. Mike was quite complimentary on the strength of his Vigen to hold up under this severe shaking. He replaced the defective part and installed a stainless "net" on the cowl outlet such that a recurrence would allow the tube to drop into the cowl rather than the prop. He also shortened his tubes to the same length as N27VV's. N27VV ran this exhaust system (in mild steel) over 500 hr with no indications of any type failure. Mike now has nearly 100 hr and plans to fly to the sun-n-fun flyin in Florida this month.

The accompanying photos show the progress of Dave Burdette's all composite canard for his Vigen. Also shown is Ken Guscott's winglet installation on a standard-shaped composite wing.

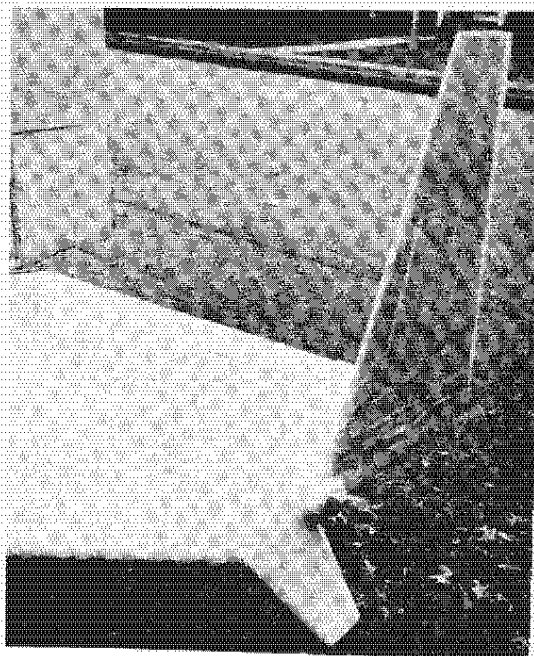
VARI-VIGEN GLASS CANARD IN J15.



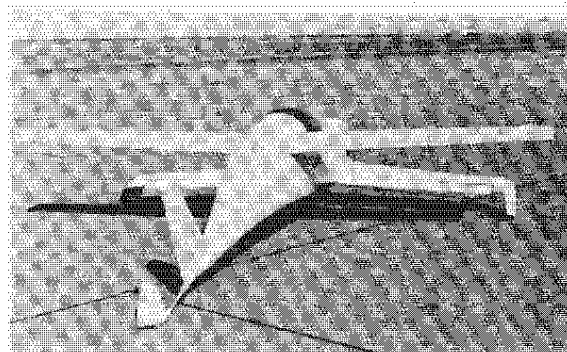
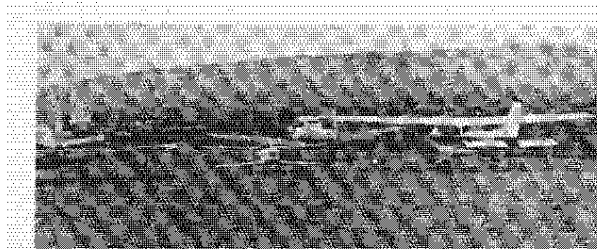
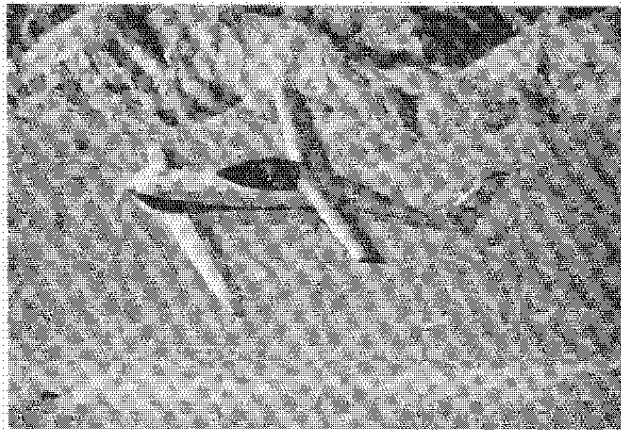
JIM SMITH

DAVE BURDETTE

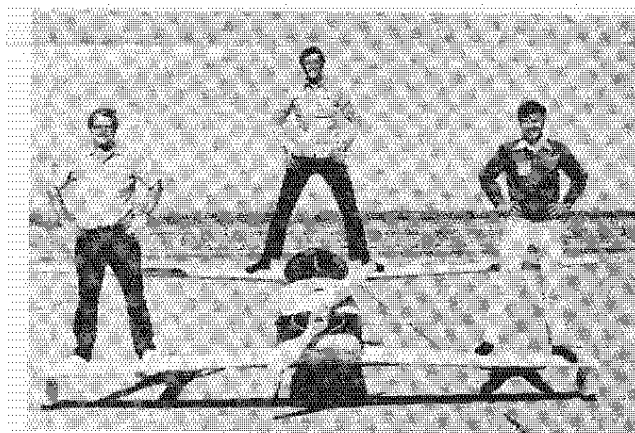
NO! THIS CANARD GOES ON THE VIGEN, NOT THE EZ!



**QUICKIE** - The photos give you a good idea of its configuration. You EZ builders will find its structure very familiar, except that it has no wing fittings - its canard & wing are made in one piece & built permanently on the fuselage. We use the term "2/3 EZ" a lot, since it has about 2/3 the glass and epoxy of an EZ and takes about 2/3 the man-hours and cost to build. Its empty weight is much less than 1/2 the EZ's and it has only 16 or 18 horsepower! It will cruise comfortably over 110 mph and has good range. Burt did the initial 3-view in May 77. Tom, Gene and Burt worked on drawings and engine development during June and July. Construction started in late August 77. It was kept a secret from all but those of us at RAF until its first flight in mid-November. The airplane is described in great detail in Quickie Enterprises "Info Kit." Please do not call or write RAF for info on the Quickie - as Tom and Gene will be doing all marketing and homebuilder support. Those of you who will build the Quickie are in for a real pleasant surprise - this is one, fun airplane to fly!

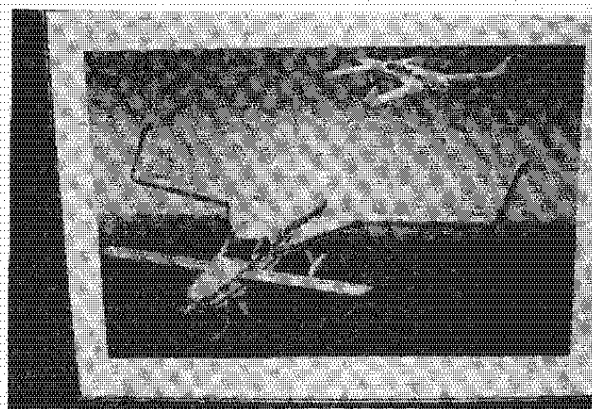


**NEW RAF LIGHT TWIN** - Shown in the adjacent artist's concept is our 4+2 twin under construction at RAF. It will be in a class by itself, in that it is a very basic airplane with few complex systems and is considerably lighter than the competition. Its 46-inch wide cabin is more comfortable and has 6" more leg room than current light twins, yet its overall size, gross weight, and wing area is much less. Its primary intended attribute is safety, in that it not only has no min-control speed, but will require no pilot action or configuration changes in order to climb when an engine fails. It is designed to even be able to climb at its minimum full-aft-stick speed, at gross, with one prop windmilling (not feathered) and with the gear down. A comparison follows. Note that the M40 has retractable nose gear only, no flaps and fixed props. Both airplanes have two 160-hp Lycomings.



GENE                      BURT                      TOM

	GRUMMAN COUGAR	RAF MODEL40
Seats	4	4+2
Span	36' 10"	28' 10"
Wing Area ft <sup>2</sup>	184	127.3
IFR Empty Weight - lb	2645	1525
Useful load - lb	1155	1375
Gross Weight - lb	3800	2900
Payload, Full Fuel - lb	459	835
Fuel, 4 Adults+80 lb Baggage - lb	375	540
Rate of Climb - fpm	1200	1600
Single Engine R/C - Gear Dn,		
Flaps Dn, Windmilling - fpm	Neg	280
Max Single Engine R/C - fpm	280	320
Cruise 55% - kt	149	181
Cruise 75% - kt	165	201
Range, 75%, Full Fuel, nm	1100	1045
Range, 4 Adults+80 lb Baggage - nm	593	1045
Stall, Ldg Config - kt	61	61



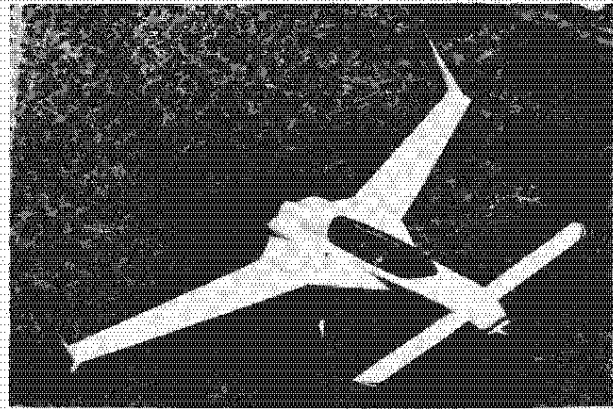
# VariEze

TODAY'S HOMEBUILT WITH TOMORROW'S TECHNOLOGY

**THE AIRPLANE** The VariEze is a small, high-performance home-built sportplane. It can be built from raw materials costing approximately \$2600 (less engine) in about 1000 man-hours, or from prefab parts and materials, costing approximately \$4000 in about 600 man-hours (about eight months spare time work). Its structure is a sandwich of high-strength fiberglass, using low-density, rigid foam as core material. The structure is fabricated directly over the shaped core, thus expensive tools and molds are not required. Composite-sandwich structure offers the following advantages over conventional wood or metal: less construction time requiring less skills, improved corrosion resistance, improved contour stability, better surface durability, dramatic reduction in hardware and number of parts, easier to inspect and repair. The VariEze uses the small four-cylinder Continental aircraft engines. The O-235 Lycoming, stripped of starter and alternator, is now being tested and should be available soon. The airplane has exceptional climb and cruise performance. It can carry two people 700 miles at 185 mph on less than 20 gallons of fuel. Frontseat passengers up to 6', 7"/250 lbs and backseat passengers up to 6', 5"/220 lbs can be accommodated plus a modest amount of baggage in two custom suitcases. The airplane does not have full dual controls, but does have a backseat control stick. Due to its small size (only 67-sq.ft. wing area) it is not the airplane for installing extra equipment for IFR, night flying, etc. It can handle a simple electrical system with a single NAV COM and gyro instrument. These can even be powered with a solar panel, thus eliminating the heavy alternator. The VariEze is recommended for day-VFR operation only. Due to its relatively high landing speed (60 kt/70 mph) and small tires, it is acceptable only for smooth, hard-surface runways. Its stability and overall flying qualities are superb. Once trimmed, it will hold attitude and level flight "hands-off" even in turbulence. Trim changes due to power, gear retraction, or landing brake are all very small. Its unique aerodynamic design allows it to be flown with full aft-stick, at less than 50 knots, without a stall departure or loss of control, and without altitude loss. The VariEze uses the latest aerodynamic features: NASA winglets, both wings cruise at best L/D, basic arrangement provides stall safety, stiff structure provides accurate contour maintenance, basic systems design eliminates or combines complex control systems, which saves weight, cost and building time while increasing reliability and lowering maintenance.

**THE TEST PROGRAM** The VariEze test program was probably the most extensive and successful ever conducted on a homebuilt. It included basic flight tests for flying qualities, performance and systems, spin and dive tests to FAR part 23 requirements, static load tests and landing gear drop tests exceeding part 23 criteria, environmental/thermal tests on structural materials/components, manufacturing methods testing, and many others.

**THE HOMEBUILDER SUPPORT** The manufacturing manual is a literal education in using the materials and is a detailed step-by-step guide to construction using an illustrated format not common in aircraft plans. The Rutan newsletter, "The Canard Pusher," published since mid 1974, updates plans, provides building hints, etc. Complete owners manual provides all necessary information for safe initial testing and for normal and emergency operations.



VARIEZE DOCUMENTATION is available in six sections.

**SECTION I - MANUFACTURING MANUAL** - This is the complete education manual for composite materials and methods, also, the complete plans and construction manual for the entire VariEze except engine installation. The manual consists of a 153-page, bound, 11"x17" book plus nine larger full size drawings. It includes 168 photos, over 800 drawings and illustrations, and over 65,000 words. The builder is led, step-by-step through the entire construction of the airplane. The manual identifies sources for all materials and all prefabricated components. **NASAD approved**

**SECTION II - ENGINE INSTALLATION** - This is a set of drawings and construction manual for the complete engine installation including mount, baffles, instrumentation, electricals, fuel, exhaust and induction systems, carb heat box and muff, cowling installation, prop and spinner.

**SECTION IIA - Continental A65, A75, C85, C90, O-300**  
**SECTION IIC - LYCOMING O-235 - No accessories.**

**SECTION III - ELECTRICAL** - This is an optional (not required) set of drawings and installation instructions for electrical system.

**SECTION IV - OWNERS MANUAL** - This is an operational handbook and checklists, including normal and emergency operation, detailed flying qualities and performance charts, maintenance, maiden flight procedure, pilot checkout, etc.

**SECTION V - FINISHING THE COMPOSITE AIRCRAFT** - Applies not only to a VariEze, but to other epoxy/composite aircraft. Includes filling/contouring/priming/U.V. barrier/color and trim.

**SECTION VI - LANDING BRAKE** - Complete full size drawings for an optional drag device. The brake dramatically increases the airplane's glide angle and deceleration in the flare. Without the brake the airplane is limited to runways at least 2400-ft long. With it, runways down to 1800-ft long can be used with appropriate pilot proficiency.

**SPECS & PERFORMANCE WITH 100-HP CONTINENTAL, FIXED-PITCH PROP @ GROSS WEIGHT:**

Take Off	900 ft	Range @ Max Cruise	700 mi
Climb	1600 fpm	Range @ Econ Cruise	850 mi
Max Cruise	195 mph	Min Speed (full aft stick)	55 mph
Econ Cruise	165 mph	Landing Distance	900 ft
Empty Weight	560 lb	Wing Span/Area	22,2' / 53.6ft <sup>2</sup>
Gross Weight	1050 lb	Canard Span/Area	12.5' / 13ft <sup>2</sup>

**SPECS & PERFORMANCE WITH 75-HP CONTINENTAL:**

Take Off	1050 ft	Econ Cruise	145 mph
Climb	900 fpm	Empty Weight	530 lb
Max Cruise	172 mph	Gross Weight	950 lb

THE FOLLOWING ARE RAF-AUTHORIZED DISTRIBUTORS OF VARIEZE MATERIALS AND COMPONENTS... CONTACT THE DISTRIBUTORS AT THE ADDRESSES SHOWN FOR THEIR CATALOGUES AND DESCRIPTION OF ITEMS.

**AIRCRAFT SPRUCE & SPECIALTY CO.**  
201 W. Truslow Ave, Bx 424,  
Fullerton, Ca. 92632  
(714) 870-7551

OR

**WICKS AIRCRAFT SUPPLY**  
1100 5th St.  
Highland, IL. 62249  
(618) 654-2191

All Raw Materials  
Catalog costs \$2.

**KEN BROCK MANUFACTURING**, 11852 Western Ave, Stanton, Ca. 90680  
(714) 898-4366.  
Prefabricated components: wing attach assembly, nosegear machined parts, control system components, fuel caps, engine mount, rudder pedals. Catalog costs \$2.

**FRED JIRAN GLIDER REPAIR**, Bldg 6, Mojave Airport, Mojave, Ca 93501  
(805) 824-4558.  
Prefabricated components: cowling, fuel tanks, wheel pants, main-gear and nosegear struts, strut cover and nosegear box.  
Send SASE with 3-oz postage for brochure.

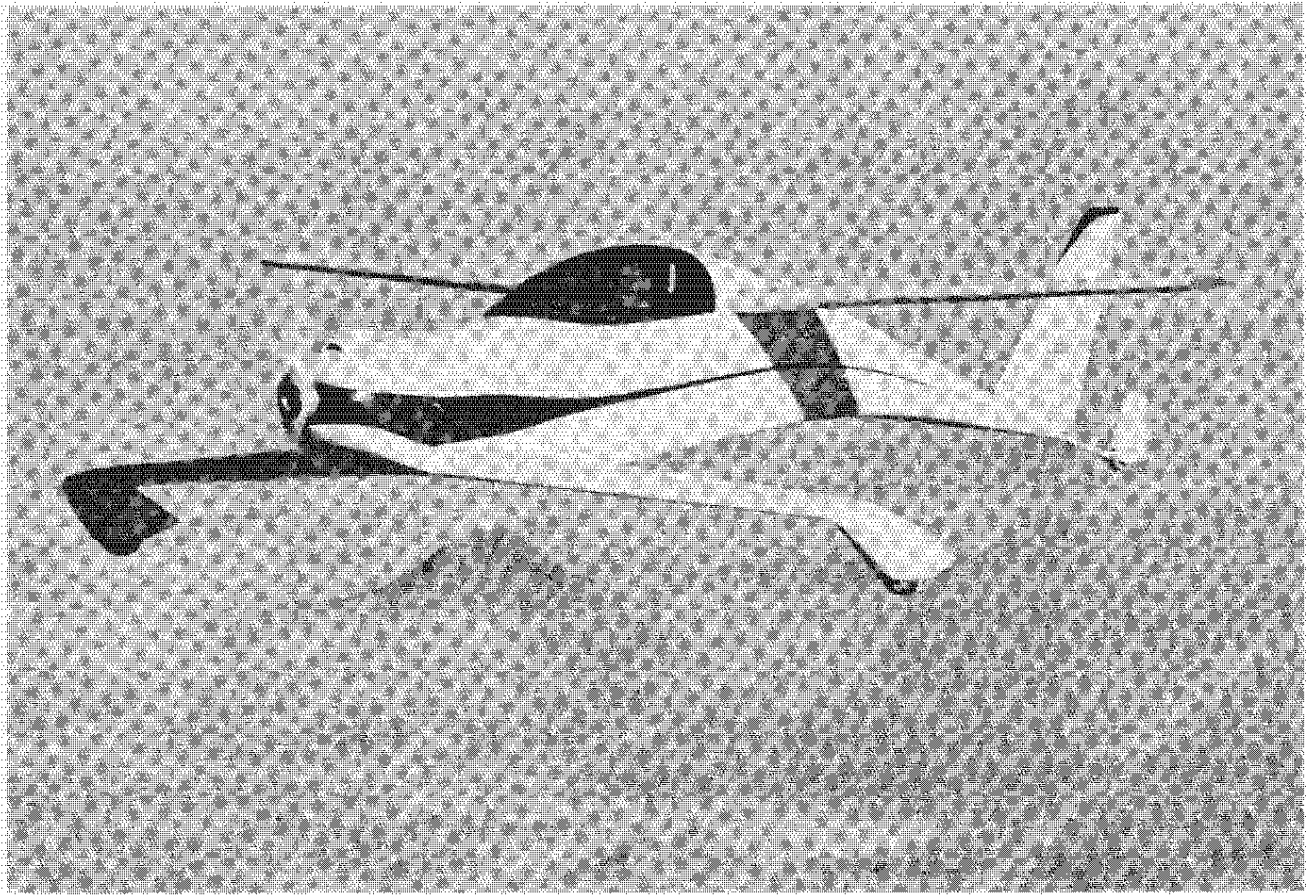
**COWLEY ENTERPRISES**, Building 170, Mojave Airport, Mojave, CA 93501  
(805) 824-2368. Plexiglass canopy.

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